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The Polymer Society of Korea

추계학술대회 연구논문 초록집

Annual Fall Meeting

50권 2호

부산컨벤션센터

2025. 9. 29[Mon] - 10.1[Wed]

The Polymer Society of Korea

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2025년도 추계 정기총회 및 학술대회 안내

○ 간친회

- 일정: 2025년 9월 29일(월) 17:30
- 장소: 부산컨벤션센터 간친회장

○ 총회

- 일정: 2025년 9월 30일(화) 10:30
- 장소: 부산컨벤션센터 기조강연장

○ 사전/현장등록

구분	연회비	사전등록		현장등록 ·25.9.13(토)~9.22(월): 온라인 결제만 가능 ·25.9.29(월)~10.1(수): 현장결제만 가능	
		사전등록A	사전등록B (1년연회비면제)	현장등록A	현장등록B (1년연회비면제)
종신회원	-	130,000원		150,000원	
정회원(일반)	50,000원	130,000원	180,000원	150,000원	200,000원
학생회원 (대학원생, 학부생)	30,000원	60,000원	90,000원	70,000원	100,000원
비회원	160,000원			180,000원	
원로회원	면제 (60세 이상, 20년 이상 회원자격 유지)				

- 사전등록 마감일: 2025년 9월 12일(금)
(단, 발표자는 초록접수 시 납부하셔야 초록을 제출하실 수 있사오니 이 점 유의하십시오.)
- 한국고분자학회 회원의 경우, 연회비 미납 시에는 사전등록을 하실 수 없습니다.
- 현장등록의 혼잡을 피하고 등록비의 절감을 위해 사전등록을 적극 권장합니다.
- 학술대회 종료 후에는 결제방법 변경 등의 재결제가 불가합니다.
- 증빙서류(거래명세서, 영수증)는 로그인 후 [Registration Check] 페이지에서 출력 가능합니다.

○ 환불규정

- 등록비 환불 마감일: **2025년 9월 22일(월)**
- 초록 수정(삭제) 기한까지 초록을 접수 취소(삭제)할 경우 연회비와 등록비를 환불해 드립니다.(주말및공휴일제외)
※ 초록 수정(삭제) 기한 종료 후에는 초록의 접수 취소(삭제)는 불가하며, 발표 취소로 처리됩니다.
- 발표자가 초록 수정(삭제) 기한 종료 후에 발표를 취소할 경우 연회비는 환불 불가하며,
등록비는 행사 일주일 전 까지만 요청에 의하여 환불해 드립니다.(주말 및 공휴일 제외)
- 연회비는 납부일로부터 한 달 이내인 경우 환불해 드립니다.(발표자 제외)(주말 및 공휴일 제외)
단, 8월 22일~9월 결제의 경우에는 등록비 환불 마감일까지만 연회비 환불이 가능합니다.

일정표

9월 29일(월)

시간	행사	장소
12:00-17:00	등 록	3층 로비
13:00-16:30	학문후속세대 연구발표	각 발표회장
13:00-17:00	대학원생 구두발표	
16:40-17:20	평의원 회의	간담회장
17:30-19:00	간담회	

9월 30일(화)

시간	행사	장소
08:00-17:00	등 록	3층 로비
09:00-10:30	포스터 발표(I) (게시: 9:00-12:00) (좌장: 박민주, 박정태) (1PS-1 ~ 1PS-278)	3층 전시장
10:30-11:20	[제99회 정기총회(추계)] 1. 개회 2. 2026년도 수석부회장 선거 결과 보고 3. 2025년도 추계 학회상 시상 4. 회무보고 5. 의안 심의 6. 기타토의 7. 폐회	기조강연장
11:20-12:00	[기조강연] PL-1 Next Generation Photovoltaics 이광희, 광주과학기술원 (좌장: 한미정)	
12:00-13:20	점 심	
13:20-14:00	[기조강연] PL-2 Exploring Effective Pathways to Tackle Plastic Waste Pollution Yu-Zhong Wang, Sichuan University (좌장: 김승현)	기조강연장
14:00-17:40	초청강연 및 연구논문 발표(II)	각 발표회장
17:00-18:30	포스터 발표(II) (게시: 15:30-18:30) (좌장: 구강희, 김종호) (2PS-1 ~ 2PS-278)	3층 전시장

10월 1일(수)

시간	행사	장소
08:00-16:00	등 록	3층 로비
08:30-10:00	포스터 발표(III) (게시: 8:30-11:30) (좌장: 안효성, 양상희) (3PS-1 ~ 3PS-278)	3층 전시장
10:10-10:50	[기조강연] PL-3 Polymers and Polymer Blends for New Opto- and Bio-electronic Devices Antonio Facchetti, Georgia Institute of Technology/Northwestern University (좌장: 김주현)	기조강연장
10:50-12:30	초청강연 및 연구논문 발표(II)	각 발표회장
12:30-14:00	점 심	
14:00-17:00	초청강연 및 연구논문 발표(II)	각 발표회장

각회장 발표일정

9월 29일(월)

각회장	1-1회장 (106)	1-2회장 (107)	2회장 (108)	3회장 (109)	4회장 (110)	5-1회장 (101)	5-2회장 (102)	6회장 (103)	7회장 (104)	8회장 (105)	9회장 (201)	10회장 (202)	12회장 (203)
	대학원생 구두발표 (I)	대학원생 구두발표 (II)	대학원생 구두발표 (III)	대학원생 구두발표 (IV)	대학원생 구두발표 (V)	대학원생 구두발표 (토론I)	대학원생 구두발표 (토론IV)	대학원생 구두발표 (토론V)	대학원생 구두발표 (코스맥스)	학운후속세대 연구발표	Graduate Student Oral Session (I) (English)	Graduate Student Oral Session (II) (English)	[MR 특별세션] 공액고분자 기반 광전자소자의 상용화를 위한 연구 혁신 동향
13:00	서명은, 오준균 O1-1	최영재, 최청룡 O1-17	김호범, 김명웅 O2-1	김 정, 여현우 O3-1	심지민, 이민재 O4-1	정승준, 최종민 OD1-1	전성권 OD4-1	김수찬, 권지연 OD5-1	김해민, 한구희 OC-1	공호열, 이준민 O8-1	고영운, 김세영 O9-1	노상철, 김대우 O10-1	손성윤, 이준우 L12-1
	O1-2	O1-18	O2-2	O3-2	O4-2	OD1-2	OD4-2	OD5-2	OC-2	김성훈	O9-2	O10-2	권영수
13:30	O1-3	O1-19	O2-3	O3-3	O4-3	OD1-4	OD4-4	OD5-4	OC-3	김태영	O9-3	O10-3	L12-2
	O1-4	O1-20	O2-4	O3-4	O4-4	OD1-5	OD4-5	OD5-5	OC-3	김태영	O9-3	O10-3	김민준
14:00	O1-5	O1-21	O2-4	O3-4	O4-4	OD1-6	OD5-6	OC-4	이재서	O9-4	O10-4	L12-3	
	O1-6	O1-22	O2-5	O3-5	O4-5	OD1-7	〈토론〉 지속가능한 고분자 소재를 위한 순환적 디자인	〈토론〉 지속가능한 차세대 에너지 소재 개발 및 응용	최준식, 박성민 OC-5	O8-4	O9-5	O10-5	김주현
14:30	O1-7	O1-23	O2-6	O3-6	O4-6	〈토론〉 차세대 분자전자소자를 위한 고분자기술	대학원생 구두발표(토론II)	대학원생 구두발표(토론III)	OC-6	정태훈	O9-6	O10-6	L12-4
	O1-8	O1-24	O2-7	O3-7	O4-7	대학원생 구두발표(토론II)	대학원생 구두발표(토론III)	양상희	OC-7	Break	O9-7	O10-7	이현정
15:00	성해경 O1-9	조우경 O1-25	O2-8	Break	Break	김수환, 박현지 OD2-1	OD3-1	OD3-2	안종복	O8-6	O9-8	O10-8	Break
	O1-10	O1-26	O2-9	박민주 O3-8	O4-8	OD2-2	OD3-3	OD3-4	O8-6	O9-9	안효성	이재준	최종민, 김진석
15:30	O1-11	O1-27	O2-10	O3-9	O4-9	OD2-3	OD3-3	OD3-4	전규진	O8-7	O9-10	O10-10	L12-5
	O1-12	O1-28	O2-11	O3-10	O4-10	OD2-4	OD3-4	OD3-4	한재규	O9-11	O10-11	O10-11	김경곤
16:00	O1-13	O1-29	O2-12	O3-11	O4-11	OD2-5	OD2-6	〈토론〉 플로이드 및 분자 자기조립의 원리와 응용		O9-12	O10-12	O10-12	L12-6
	O1-14	O1-30	O2-13	O3-12	O4-12	〈토론〉 침단 의료를 고분자 및 응용	〈토론〉 침단 의료를 고분자 및 응용	〈토론〉 플로이드 및 분자 자기조립의 원리와 응용		O9-13	O10-13	O10-13	우현영
16:30	O1-15	O1-31	O2-14	O3-13	O4-13					O9-14	O10-14	O10-14	L12-7
	O1-16	O1-32	O2-15	O3-14	O4-14								노용영
				O3-15	O4-15								L12-8
													차효정

우수논문발표상 응모

우수논문발표상 응모

9월 30일(화)

각회장	1회장 (106-7)	2회장 (108)	3회장 (109)	4회장 (110)	5회장 (101-2)	6회장 (103)	7회장 (104)	8회장 (105)	9회장 (201)	10회장 (202)	11회장 (205)	12회장 (203)	13회장 (204)
	의료용 고분자 부문위원회 I	콜로이드 및 분자조립 부문위원회 I	에너지 부문위원회 I	에코소재 부문위원회	[SK케미칼 특별세션] 플라스틱의 새로운 패러다임 Recycled, and Renewable	ACS 에디터에게 듣는 고분자 연구의 비전 (English)	[과기정보부 특별세션] 나노 및 소재 기술 R&D 정책 및 연구성과 교류	New Horizon in Materials and Photonics Research from Scientific Excellence to Industrial Impact	Korea-Taiwan Joint Symposium: Bridging Polymer Innovation (English)	탄소융복합소재 특별세션: 매트릭스 설계부터 부품까지	분자전자 부문위원회 I	폴리올레핀 기반 소재의 기술혁신과 지속가능성	Recent Trends of Molecular Engineering in Electronics and Energy Materials
14:00	곽민석 1L1-1	류 진 1L2-1	심지민 1L3-1	김 경 1L4-1	조현준 1L5-1	여현우 1L6-1	임종철 1L7-1	권지연 1L8-1	권지연 1L9-1	박태훈 1L10-1	나석인 1L11-1	김용석 1L12-1	김명길 1L13-1
14:25	Andreas Herrmann	박정준 1L2-2	Chulsung Bae	Rusli Daik	양남철 1L5-2	Key Lee	윤성철 1L7-2	김유수 1L8-2	Shih-Huang Tung	박영민 1L10-2	조진환 1L11-2	이분열 1L12-2	Hui Huang
14:50	허강무 1L1-2	강지형 1L2-3	김준영 1L3-2	현 규 1L4-2	이상열 1L5-3	김일두 1L6-2	손창윤 1L7-3	김경택 1L8-3	Ying-Nien Chou	김인호 1L10-3	김법준 1L11-3	홍성철 1L12-3	김충익
15:15	정지훈 1L1-3	김도준 1L2-4	조원철 1L3-3	구준모 1L4-3	강주식 1L5-4	Yongfeng Men	김형준 1L7-4	안진희 1L8-4	Chen-Tsyrr Lo	한문희 1L10-4	조신욱 1L11-4	남상훈 1L12-4	백강준
15:40	이동원 1L1-4	심용희 1L2-5	이장용 1L3-4	Lam Tan Hao	김지현 1L5-5	Mary B. Chan-Park	임종선 1L7-5	정현호 1L8-5	Che-Yi Chu	김동균 1L10-5	이승걸 1L11-5	고영수 1L12-5	김재현
16:00	1L1-5	김소연 1L2-6	이세찬 1L3-5	이동윤 1L4-5	김성기 1L5-6	윤동기 1L6-5	1L7-5	박정은 1L8-5	Jung-Yao Chen	정용재 1L10-5	남수지 1L11-5	홍성철 1L12-5	김재현
16:25	정영미 1L1-6	합종호 1L2-7	이정현 1L3-6	명재욱 1L4-6	신용준 1L5-7	박소정 1L6-6	정소희 1L7-6	이재영 1L8-6	Break	전승렬 1L10-6	정승준 1L11-6	채창근 1L12-6	Ming Shao
16:50	이수홍 1L1-7	임호선 1L2-8	이정수 1L3-7	1L4-7	유영만 1L5-8	Yoshiko Miura	손창윤 1L7-7	이은지 1L8-7	김진홍	정재우 1L10-7	Shihong Wang	서명운 1L12-7	홍석원
17:15	강길선 1L1-8	우상혁 1L2-9	103-1 두기수	1L4-8	1L5-9	김승현	과기부 특별세션 간담회	1L8-8	노주란	김민영	김태일	이원선 1L12-8	박상민
17:40	김수현 1L1-9	한대훈 1L2-10	103-2 채지연	서진영	문정미 1L5-10	정재일	패널토론	1L8-9	이승훈	박상윤	김자영	김용석 1L12-9	윤석민
18:05	김지현 1L2-11	김지현						최종민			1L11-9	정예환	

Keynote 특별발표(40분)

신진연구자 특별 심포지엄

각회장 발표일정

10월 1일(수)

각회장	1회장 (106-7)	2회장 (108)	3회장 (109)	4회장 (110)	5회장 (101-2)	6회장 (103)	7회장 (104)	8회장 (105)	9회장 (201)	10회장 (202)	11회장 (205)	12회장 (203)
	의료용 고분자 부문위원회 II	콜로이드 및 분자조립 부문위원회 II	에너지 부문위원회 II	기능성 고분자	글로벌 환경규제 대응을 위한 지속가능 기능성 고분자 및 복합소재	고분자가공/ 복합재료/재활용	고분자구조 및 물성	고분자 합성	단파 적외선 검출용 전자소자를 위한 고분자 및 나노결정 연구	한화고분자기술상 수상기념세션: 에너지-바이오 융복합 소재 및 소재 기술	분자전자 부문위원회 II	Soft Matter Systems: Materials, Mechanics, and Miniaturized Devices
10:50	이수홍 2L1-1 나 건	윤홍석 2L2-1 강준희	최우혁 2L3-1 이원호	서명은 2L4-1 구강희	김동균 2L5-1 이평찬	홍성우 2L6-1 이진우	박재홍 2L7-1 진형민	김명웅 2L8-1 신재만	강문성 2L9-1 김종현	임재훈, 황혜림 2L10-1 김동하	남수지 2L11-1 신원석	하민정 2L12-1 이영훈
11:15		2L2-2 허수미	2L3-2 황종국	2L4-2 김태형	2L5-2 김진철	2L6-2 장종태	2L7-2 김영삼	2L8-2 강성민	2L9-2 이정용	2L10-2 김세훈	2L11-2 송명훈	2L12-2 이원령
11:40	2L1-2 양성윤	2L2-3 이성민	2L3-3 채수종	2L4-3 김봉훈	2L5-3 정도연	2L6-3 남영우	2L7-3 배주혜	2L8-3 Andrew J. Boydston	2L9-3 장대성	2L10-3 박희준	2L11-3 나석인	2L12-3 Alex Abramson
12:05	2L1-3 한동욱	2L2-4 정대웅		2L4-4 Sheng Li	2L5-4 손은호	2L6-4 임기원	2L7-4 문희리	2L8-4 조상호	2L9-4 이지원	2L10-4 염지현		2L12-4 김지윤
12:30	2L1-4 김재윤											
	점 심											
14:00	박우람 2L1-5 황용성	유재범 2L2-5 조수연	김효원 2L3-4 김수찬	이상호 2L4-5 이형일	노상철 2L5-5 심봉섭	김진철 2L6-5 안석훈	이준민 2L7-5 김연수	고영운 2L8-5 김민수	왕동환 2L9-5 김영훈		김호범 2L11-4 노광동	허민정 2L12-5 김재환
14:25	2L1-6 송창식	2L2-6 김미소	2L3-5 구민수	2L4-6 박수진	2L5-6 김윤호	2L6-6 백승열	2L7-6 박주혁	2L8-6 황예진	2L9-6 이재원		2L11-5 임종철	2L12-6 고종국
14:50	2L1-7 황성연	2L2-7 김용구	2L3-6 류훈희	2L4-7 구병진	2L5-7 김제민	2L6-7 이창욱	2L7-7 장태후	2L8-7 하중운	2L9-7 백세웅		2L11-6 강홍기	2L12-7 위정재
15:15	2L1-8 한철수	2L2-8 정근홍	2L3-7 박슬기	2L4-8 김병수	2L5-8 박성민	2L6-8 남기호	2L7-8 류 진	2L8-8 임태환	2L9-8 최민재		2L11-7 박명수	
15:40	Break			2O4-1 이승엽			2L7-9 노형도	2L8-9 황윤호			Break	
16:00	2L1-9 박종찬					2L6-9 심지현					2L11-8 강홍기	
16:20	2L1-10 김하린					2L6-10 권준표					2L11-9 김승현	
16:40	2L1-11 김지혜										2L11-10 김선홍	
											2L11-11 남승민	
											2L11-12 김경남	

Keynote 특별발표 (40분)

학술상 특별발표 (40분)

신진연구자 특별 심포지엄

기조강연

부산컨벤션센터 기조강연장

2025년 9월 30일(화), 11:20 ~ 12:00

Next Generation Photovoltaics

이광희, 광주과학기술원

Kwanghee Lee, GIST

Abstract: To achieve zero-carbon or zero-energy buildings, buildings must generate energy from on-site renewable energy resources through the concept of building-integrated-photovoltaic (BIPV) systems, and also prevent energy loss to the surroundings through the use of high-performance thermal insulation materials. However, current BIPVs are not suitable for state-of-the-art modern buildings equipped with exterior window glasses on almost all of their surfaces. In this talk, I am going to address the current state of the arts of organic solar cells (OSCs) and perovskite solar cells (PSCs), which are introduced into film-type flexible and semi-transparent BIPV systems. Because organic semiconductors and perovskites are inherently semi-transparent in the visible region and mechanically flexible, in contrast to the opaque, brittle inorganic semiconductors used in conventional BIPVs, they are excellent candidate materials for such window-film-type BIPVs. I will also address the stability issues of both photovoltaics together with a capability to fabricate into large area modules and panels.



Prof. Kwanghee Lee

2006-현재	광주과학기술원 신소재공학과 교수
2007-현재	광주과학기술원 허거신소재연구센터 부센터장
2015-현재	광주과학기술원 GIST-ICL 국제공동연구 R&D 센터장
2015-현재	광주과학기술원 특훈교수
2020-현재	광주과학기술원 에너지밸리기술원 원장
2019-2023	광주과학기술원 차세대에너지연구소 소장
2023-2024	광주과학기술원 연구부총장
2024-현재	광주상공회의소 경제자문위원회 자문위원

Chair



한미정

한국화학연구원

기조강연

부산컨벤션센터 기조강연장

2025년 9월 30일(화), 13:20 ~ 14:00

Exploring Effective Pathways to Tackle Plastic Waste Pollution

Yu-Zhong Wang, Sichuan University

Abstract: To address environmental challenges posed by end-of-life plastics, novel upcycling strategies must be developed to convert bulk waste into value-added chemicals, monomers/oligomers, and high-performance materials. For instance: (1) Designing new catalysts or solvent systems to selectively degrade waste polymers can reduce the complexity of degraded products to some extent; (2) Developing new strategy for focusing on “reconstructing new products” at the basis of full use of the wastes is highly desired; (3) Synthesizing inherently recyclable polymers is essential to achieve closed-loop monomer-polymer cycling. Furthermore, the repeatably chemically-recyclable biodegradable polymers will be the optimal choice for producing single-use plastics. These avenues will be elucidated through the author’s recent research work.



Prof. Yu-Zhong Wang

1982	B.A., Qingdao University
1987	Master D., Sichuan University
1994	Ph.D., Sichuan University
1995-Present	Professor, Sichuan University
1999	Visiting Professor (DAAD), Plank Institute for Polymer Research
2002	Visiting Professor(UK Royal Society), The University of Nottingham
2009-Present	Director, National Engineering Laboratory of Eco-Friendly Polymeric Materials (Sichuan)
2024-Present	Director, State Key Laboratory of Advanced Polymer Materials

Chair



김승현
인하대학교

기조강연

부산컨벤션센터 기조강연장

2025년 10월 1일(수), 10:10 ~ 10:50

Polymers and Polymer Blends for New Opto- and Bio-electronic Devices

Antonio Facchetti, Georgia Institute of Technology/Northwestern University

Abstract: We investigated the phase behaviors of block copolymer blends composed of the polystyrene-*b*-poly(*n*-butyl methacrylate) (PS-*b*-PnBMA) and polystyrene-*b*-poly(*n*-hexyl methacrylate) (PS-*b*-PnHMA), using small-angle neutron scattering (SANS), small-angle X-ray scattering (SAXS), and depolarized light scattering (DPLS). A miscible phase between the PnBMA and PnHMA blocks in the BCP blends allows the various composition-dependent phase behaviors. Intriguingly, a closed-loop phase transition was found in nearly symmetric composition of the miscible PS-*b*-PnBMA/PS-*b*-PnHMA blends from lower disorder-to-order transition (LDOT) to order-to-disorder transition (ODT) behaviors with increasing amount of PS-*b*-PnHMA. In this presentation we report the development of novel polymeric materials for use as single components or in blends with small molecule or polymer for applications in three major areas. 1. Realization of new mechanically ductile and ultra-stretchable organic solar cells. Here, ductility of the photoactive blend is improved by the design of a family of molecular acceptors having a trialkylsilyls group. 2. New mixed ionic-electronic conductors particularly *n*-type based on naphthalene diimide (NDI) and diketopyrrolopyrrole (DPP) units. 3. We discuss recent implementation of a new *n*-type polymer for the realization of high-performance and balanced complementary electrochemical OECTs and inverters, which are then used to fabricate neuromorphic circuits capable of sensing, transducing and recording information.



Prof. Antonio Facchetti

1992	B.A., University of Milan
1997	Ph.D., University of Milan
1997	Post-Doc., U. California at Berkeley, USA
2002-Present	Research/Adjunct professor, Northwestern University
2005-Present	Chief Technology Officer, Flexterra Corp.
2023-Present	Hightower Chair Professor in MSE, Georgia Institute of technology

Chair



김주현
부경대학교

Keynote 발표: 분자전자 부문위원회

부산컨벤션센터 제11회장

2025년 9월 30일(화), 16:20 ~ 17:00

Biomimetic Designs for Semiconducting Polymers

Sihong Wang, The University of Chicago

Abstract: The vast amount of biological mysteries and biomedical challenges faced by humans provide a prominent drive for seamlessly merging electronics with biological living systems (e.g., human bodies) to achieve long-term stable functions. Towards this trend, one of the key requirements for electronics is to possess biomimetic form factors in various aspects for achieving diverse functions and long-term stability. To enable such paradigm-shifting requirements, polymer-based electronics are uniquely promising for combining advanced electronic functionalities with biomimetic properties. In this talk, I will introduce our design concepts for semiconducting polymers, which enable the incorporation of various biomimetic properties. First, I will introduce a new design strategy for introducing bioadhesive properties to redox-active semiconducting polymers, so as to enable intimate and stable interfacing of transistor-based biosensors with tissue surfaces. Second, to solve the issue of immune reactions and foreign-body responses to implantable bioelectronics, I will discuss our recent exploration of studying and developing immune-compatible and ultrasoft hydrogel designs for polymer semiconductors and conductors. Finally, I will show our design of stretchable light-emitting polymers with high quantum efficiency, which is enabled by the use of thermally activated delayed fluorescence. Collectively, our research is opening up a new generation of electronic materials that fundamentally change the way that humans interact with electronics.



Prof. Sihong Wang

2005-2009	B.S., Tsinghua University, China
2009-2014	Ph.D., Georgia Institute of Technology
2015-2018	Post-Doc., Stanford University
2018-2025	Assistant Professor, The University of Chicago
2025-Present	Associate Professor, The University of Chicago

Chair



정승준
고려대학교

Keynote 발표: 의료용 고분자 부문위원회

부산컨벤션센터 제1회장

2025년 9월 30일(화), 14:00 ~ 14:40

Polymer Mechanochemistry Enables the Activation of Drugs, Proteins and Genes by Biocompatible Ultrasound

Andreas Herrmann, DWI - Leibniz Institute for Interactive Materials/RWTH University

Abstract: The field of optogenetics has enabled the fundamental understanding of neural circuits and disorders. However, these techniques require invasive surgical procedures to deliver light to target cells due to the low penetration depth of light into tissue. Therefore, ultrasound (US) was used as alternative trigger since US can deeply penetrate tissue with high spatiotemporal control. Our group develops molecular technologies based on polymer mechanochemistry to control the activity of drugs, proteins and nucleic acids by US. While initial efforts relied on low frequency (20 kHz) US that is destructive to cells, our current efforts are dedicated to two technology platforms that allow the activation of bioactive compounds by biocompatible US, i.e. imaging US and low intensity focussed US. The first technology relies on high molecular weight polynucleic acids that are produced by rolling circle amplification or transcription and that encode multiple binding sites for drugs, proteins and nucleic acids. Once these loaded nucleic acid carriers are subjected to US, non-covalent bond cleavage occurs by collapse of US-induced cavitation bubbles leading to activation of the cargoes. In this way, gene knock-down in vitro was achieved by liberating siRNA and immunostimulation was successfully realized in vivo by activating CpG oligonucleotides. Similarly, protein activity can be switched on by US, involving the mechanochemical activation of a protease that subsequently triggers split intein function for controlling the activity of a broad scope of proteins. A second platform technology for low-intensity US activation is mechanophore-incorporated microbubbles that also allow the spatiotemporally controlled release of bioactives.



Prof. Andreas Herrmann

1997	Diploma in Chemistry, University of Mainz, Germany
2000	Ph.D., Planck-Institute for Polymer Research, Germany
2002	Post-Doc, Swiss Federal Institute of Technology, Switzerland
2004	Junior Research Group Leader at the Max-Planck-Institute for Polymer Research, Mainz, Germany
2007	Professor for Polymer Chemistry and Bioengineering at the Zernike Institute for Advanced Materials at the University of Groningen, Netherlands
2017-Present	Professor of Macromolecular Materials and Systems at RWTH Aachen University, Germany, and Scientific Board Member of the DWI - Leibniz-Institute
2017	Scientific Board Member of the DWI - Leibniz-Institute, Aachen, Germany
2018	Vice Director of the DWI - Leibniz Institute, Aachen, Germany
2023	Director of the DWI - Leibniz Institute, Aachen, Germany

Chair



곽민석
부경대학교

Keynote 발표: 에코소재 부문위원회

부산컨벤션센터 제4회장

2025년 9월 30일(화), 14:00 ~ 14:40

Aqueous Processing of Natural Rubber-Synthetic Polymer Nanocomposites

Rusli Daik, Universiti Kebangsaan Malaysia

Abstract: This research develops advanced nanocomposites from natural rubber (NR) and synthetic polymers to enhance mechanical, thermal, and electrical properties while promoting sustainability. Liquid natural rubber (LNR) emulsions (10,000 and 50,000 g/mol) were prepared using SDS; lower molecular weight LNR showed better stability with less emulsifier use. LDPE/LNR blends (100/0 to 40/60) achieved optimal stress-strain performance at 60/40 composition, with DSC confirming blend homogeneity. HDPE/LNR composites with organo-modified montmorillonite (OMMT) (3-15% LNR, 3-5% OMMT) showed improved tensile, impact, and thermal stability, with exfoliated or mixed structures confirmed by XRD and TEM. Nylon-6/LNR blends with 2-10% clay improved mechanical properties at 85/15 ratio. PC/LNR/OMMT nanocomposites (2-10% OMMT) displayed higher thermal degradation temperatures. NR/PS matrices with 11.91-36.25% polypyrrole nanoparticles achieved conductivities of 1.77×10^{-8} - 1.07×10^{-4} S/cm, alongside increased tensile strength and modulus. Overall, incorporating nanomaterials effectively tailors NR-based materials for diverse industrial applications aligned with sustainability objectives.



Prof. Rusli Daik

1993	B.Sc, Univ Kebangsaan Malaysia (UKM)
1997	Ph.D., Durham University, United Kingdom
1997-2003	Lecturer, Univ Kebangsaan Malaysia
2003-2013	Assoc. Professor, Univ Kebangsaan Malaysia
2013-Present	Professor, Univ Kebangsaan Malaysia

Chair



김 정
경희대학교

Keynote 발표: 에너지 부문위원회

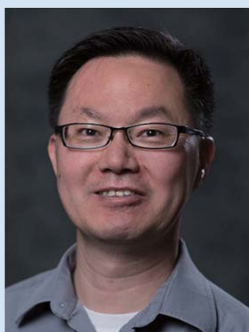
부산컨벤션센터 제3회장

2025년 9월 30일(화), 14:00 ~ 14:40

Molecular Engineering of Ion-Conducting Polymers for Clean Energy Technologies

Chulsung Bae, Rensselaer Polytechnic Institute

Abstract: Anion exchange membranes (AEMs) based on hydroxide-conducting polymers are a key component for anion-based electrochemical energy technology such as hydrogen fuel cells, electrolyzers for green hydrogen, and redox flow batteries. Although these alkaline electrochemical technologies offer a promising alternative to acidic proton exchange membrane electrochemical devices, the access to chemically stable, mechanically durable, high-performing polymer electrolyte materials has been bottleneck to advance electrochemical technologies for hydrogen and other green chemicals until now. Recent progress at the Bae group of Rensselaer Polytechnic Institute in the development of advanced hydroxide-conducting polymers and membranes for AEM technology applications will be presented.



Prof. Chulsung Bae

1991	B.S., Inha University
1994	M.S., POSTECH
1997	M.S., University of Massachusetts at Lowell
2002	Ph.D., University of Southern California (Advisors: G. K. Surya Prakash & George A. Olah)
2004	Post-Doc., Yale University (advisor: John F. Hartwig)
2004-2012	Assistant Professor & Associate Professor, University of Nevada Las Vegas
2012-Present	Ford Foundation Professor, Rensselaer Polytechnic Institute (RPI)

Chair



심 지 민
서울대학교

플라스틱의 새로운 패러다임: Recyclable, Recycled, and Renewable

플라스틱 폐기물과 생산과정에서의 CO₂ 발생을 해결하기 위한 Recyclable 제품의 설계 및 화학적 재활용, 그리고 Bioplastic 까지 포함된 완결적 자원순환&탄소 중립 체계를 구축을 위한 SK케미칼의 기술을 소개합니다.

부산컨벤션센터 제5회장

2025년 9월 30일(화), 14:00 ~ 18:05

14:00 플라스틱 재활용 관련 규제동향



양남철, SK케미칼
(Nam Choul Yang, SK Chemicals)

14:25 Glycolysis 기반 PET 재활용을 통한 BHET 생산



이상열, SK케미칼
(Sang Yeol Lee, SK Chemicals)

14:50 SK Chemicals' r-TPA Process



강주식, SK케미칼
(Ju Sik Kang, SK Chemicals)

15:15 T2T(Textile to Textile) Closed Loop Solution



김지현, SK케미칼
(JiHyun Kim, SK Chemicals)

15:40 Coffee break and social networking

16:00 SK Chemicals PET Recycle Solution: Circular Recycle



신용준, SK케미칼
(Yongjun Shin, SK Chemicals)

16:25 From Waste to Resource: The Commercialization of Chemically Recycled Polybutylene Terephthalate (CR-PBT)



유영만, SK케미칼
(Youngman Yoo, SK Chemicals)

16:50 화학적 재활용 기술을 활용한 Copolyester 소재 개발



이부연, SK케미칼
(BooYoun Lee, SK Chemicals)

17:15 ECOZEN : Sustainable Packaging Solution



문정미, SK케미칼
(Jung-Mi Moon, SK Chemicals)

17:40 PO3G: Bridging Sustainability and Performance in Polyurethane Chemistry



정재일, SK케미칼
(Jaeil Chung, SK Chemicals)

Organizer/Chair



김지승
SK케미칼



정현문
SK케미칼



구준모
충남대학교



전현열
한국화학연구원



조현준 Chair
SK케미칼



김성기 Chair
SK케미칼

Vision of Polymer Research from ACS Editors

This session features editors of leading ACS polymer journals who will share their perspectives on the future of polymer science. With a focus on emerging trends, key challenges, and editorial priorities, the session aims to provide valuable guidance for researchers contributing to the advancement of the field.

부산컨벤션센터 제6회장

2025년 9월 30일(화), 14:00 ~ 18:00

14:00 South Korea's 2024 Research Focus: Polymers, Chemistry, and Global Publishing Trends



Kee Hyuk Lee
ACS Publications

14:25 High-Throughput Catalyst Design Using Carbon Nanofibers



Il-Doo Kim
KAIST

14:50 Molecular Weight and Distribution Dependency of Crystallization and Mechanical Properties in Polypropylene



Yongfeng Men
CIAC, Chinese Academy of Science

15:15 Cationic Polymers as Antibacterial Agents and RNA Carriers



Mary B. Chan-Park
Nanyang Technological University

15:40 Coffee break and social networking

16:00 Dynamic Nanostructures through Self-Assembly of Functional Polymers and Nanoparticles



So-Jung Park
Ewha Womans University

16:25 Synthesis of Glycopolymers by the Controlled Polymerization and Design of Molecular Recognition



Yoshiko Miura
Kyushu University

16:50 Controlling the Structure of Thin Films via the Self-Assembly of Block Copolymers toward Versatile Applications



Seung Hyun Kim
Inha University

17:15 Panel Discussion (Meeting with ACS Editors)

Organizer/Chair



Dong Ki Yoon Chair
KAIST



Hyeonuk Yeo Chair
Kyungpook Nat'l Univ.

나노 및 소재 기술 R&D 정책 및 연구성과 교류

본 특별세션은 과기정통부 주최, 한국연구재단과 소재혁신선도본부(재료연)에서 주관하는 세션으로, 나노 및 소재 기술 분야 정부 R&D 추진방향을 소개하고, 나노 및 소재기술개발사업을 수행하는 연구자들의 주요 성과를 공유합니다. 이어지는 간담회를 통해, 정책 담당자와 연구자 간의 교류와 소통을 촉진하기 위한 장을 마련코자 합니다.

부산컨벤션센터 제7회장

2025년 9월 30일(화), 14:00 ~ 17:30

14:00 나노 및 소재분야 정부 R&D 추진방향

(Strategic Directions of Government R&D in Nanotechnology and Materials)



윤성철, 한국연구재단 나노·소재단
(Sung Cheol Yoon, NRF)

14:30 인공지능 및 분자 시뮬레이션 활용 수소센서/디스플레이 소재 개발

(AI/molecular Simulation-driven Development of Hydrogen Sensor and Display Materials)



손창윤, 서울대학교
(Chang Yun Son, Seoul Nat'l Univ.)

15:00 이오노머 이종접합 구조를 기반으로 한 저전압 전기접착 클러치 개발

(Electrostatic Clutches Based on Ionomer Heterojunctions for Low-Voltage Switching of Stiffness and Strength)



김형준, 서강대학교
(Hyeonjun Kim, Sogang Univ.)

15:30 반데르발스 층상 구조 기반 협대역폭·고이동도 반도체 구현을 위한 유기금속 화합물 전구체 개발

(Development of Organometallic Compound Precursors for Narrow-bandgap, High-mobility Semiconductors Based on Van der Waals Layered Materials)



임종선, 한국화학연구원
(Jong Sun Lim, KRICT)

16:00 머신러닝 기반 나노결정 형성 메커니즘 통찰

(From Data to Discovery: ML-Driven Insights into Nanocrystal Formation)



정소희, 성균관대학교
(Sohee Jeong, Sungkyunkwan Univ.)

16:30 과기부 특별세션 간담회

Organizer/Chair



고 서 진
대구경북과학기술원



임 종 철 Chair
충남대학교



손 창 윤 Chair
서울대학교

New Horizon in Materials and Photonics Research from Scientific Excellence to Industrial Impact

This special GIST session highlights frontier research in materials and photonics, bridging fundamental discoveries with industrial impact. Speakers will present advances ranging from atomic-scale spectroscopy and plasmonic nanostructures to sustainable energy and biomedical innovations. With the spirit of GIST UP, the session aims to inspire cross-disciplinary dialogue and open pathways for transformative technologies.

부산컨벤션센터 제8회장

2025년 9월 30일(화), 14:00 ~ 17:15

14:00 Visualizing and Controlling Molecular Function by
Atomic-Scale Spectroscopy: From Single-Molecule
Insight to Materials Innovation



김유수, 광주과학기술원
(Yousoo Kim, GIST)

14:25 Exploring Extreme Science with the CoReLS PW Laser



김경택, 광주과학기술원
(Kyung Taec Kim, GIST)

14:50 Research for "Rule Breaker" Drugs (High molecular
weight molecules including antibody drug conjugate)



안진희, 광주과학기술원
(Jin Hee Ahn, GIST)

15:15 Shape and Material-Engineered Plasmonic
Nanostructures



정현호, 광주과학기술원
(Hyeon-Ho Jeong, GIST)

15:40 Coffee break and social networking

16:00 Scale-up Science of Electrolytic Cells



이재영, 광주과학기술원
(Jaeyoung Lee, GIST)

16:25 GIST InnoCORE: AI-Nano Convergence Initiative in
NDDs



이은지, 광주과학기술원
(Eunji Lee, GIST)

16:50 Toward Sustainable Energy Conversion & Storage
Systems for the Future Mobility



엄광섭, 광주과학기술원
(KwangSup Eom, GIST)

Organizer/Chair



김호범 Chair
광주과학기술원



박정은 Chair
광주과학기술원



최영재
광주과학기술원

Korea-Taiwan Joint Symposium: Bridging Polymer Innovation

The Joint Workshop of the Korean and Taiwanese Polymer Societies will convene leading scientists and engineers from both nations to present and discuss their latest research achievements in polymer science. This collaborative event promotes scholarly exchange, encourages cross-border collaborations, and highlights innovative approaches to contemporary challenges in polymer materials. The scientific program will feature invited and contributed presentations covering various topics, including novel polymer synthesis, advanced characterization techniques, functional and sustainable materials, and emerging applications in diverse industrial and technological domains. By bringing together distinguished experts and early-career researchers, the workshop aims to foster a vibrant platform for dialogue, knowledge sharing, and the development of future joint research initiatives between the Korean and Taiwanese polymer communities.

부산컨벤션센터 제9회장

2025년 9월 30일(화), 14:00 ~ 18:00

14:00	Blends of PEO and Spider Silk Proteins for Applications in Solid-State Polymer Electrolytes and CO ₂ Separation		Shih-Huang Tung National Taiwan University
14:25	Surficial Bonding Zwitterionic Modification for Anti-biofouling Applications		Ying-Nien Chou National Chung Cheng University
14:50	Dual-Ion Functionalized Composite Polymer Electrolytes for Next-Gen Lithium Batteries		Chen-Tsyr Lo National Taiwan University of Science and Technology
15:15	Magnetic-Field-Directed Phase Transitions of Block Copolymers		Che-Yi Chu National Chung Hsing University
15:40	Photo-patternable Photomemory for Logic Gate Application		Jung-Yao Chen National Cheng Kung University
16:05	Coffee break and social networking		
16:20	Radiative Cooling based on Polymers		Jin Hong Kim KIST
16:45	Polymer Redox Booster Design for Intra - Intermolecular Charge Transfer in Electrochemical Energy Storage System		Juran Noh Sangmyung University
17:10	Selective Dispersion of Semiconducting SWNTs via Conjugated Polymers for Electronic Device Applications		Seung-Hoon Lee Kongju National University
17:35	Integration of Conductive Polymers in Quantum Dot and Perovskite Photovoltaics		Jongmin Choi DGIST

Organizer/Chair



Bong Hoon Kim
DGIST



Jun Kyun Oh
Dankook Univ.



Woo-Jin Song
Chungnam Nat'l Univ.



Ji Eon Kwon Chair
KIST



Wonho Lee Chair
Kumoh Nat'l Inst. Technol.

에너지-바이오 융복합 소재 및 소자 기술

최근의 유무기 소재 연구는 기존 물성의 한계를 극복하는 수준을 넘어, 서로 다른 소재 간의 융합을 통해 기존에는 구현되지 않았던 새로운 기능과 응용 분야를 확장하는 방향으로 나아가고 있습니다. 본 세션에서는 다양한 소재를 목적지향적으로 설계·합성하고, 이를 에너지, 바이오, 광전자 소자 등 첨단 분야에 적용하는 최신 연구를 조명하고자 합니다.

부산컨벤션센터 제10회장

2025년 10월 1일(수), 10:50 ~ 12:45

2025
Award

10:50 Chirality, Plasmonics and Supramolecular
Self-Assembly Converge: From Energy Conversion·Storage,
Optoelectronics to Theranostics



김동하, 이화여자대학교
(Dong Ha Kim, Ewha Womans Univ.)

11:30 Photonic Nanomaterials for Light-Activated
Theranostics



김세훈, 한국과학기술연구원
(Sehoon Kim, KIST)

11:55 Tin Halide Perovskite Materials and Devices



박희준, 한양대학교
(Hui Joon Park, Hanyang Univ.)

12:20 Chiral Materials for Energy and Bio



염지현, 한국과학기술원
(Jihyeon Yeom, KAIST)

Organizer/Chair



임재훈 Chair
성균관대학교



황혜림 Chair
이화여자대학교

탄소융복합소재: 매트릭스 설계부터 부품까지

고분자 복합소재는 물성강화를 위한 섬유와 형상을 지지하는 고분자 매트릭스의 결합으로 구성됩니다. 본 세션에서는 복합재 내부 구조에서 발생하는 결합 메커니즘 및 계면 특성에 대한 기초 연구부터 기능성 복합재료 개발에 이르기까지의 다양한 연구 주제를 논의하고자 합니다. 나아가 산업계에서 진행 중인 복합재의 자동화 제조 공정 개발 및 재활용 기술에 대한 논의까지 범위를 확장하고자 합니다. 이번 세션을 통해 탄소 기반 융복합 소재의 나노스케일 기초 연구에서부터 대형 부품의 산업적 적용까지의 연계성을 살펴보고, 향후 연구 개발의 방향성을 함께 모색하는 자리가 되기를 기대합니다.

부산컨벤션센터 제10회장

2025년 9월 30일(화), 14:00 ~ 17:40

14:00 Multi-Modal Tactile Sensors Based on Design-Optimized Carbon Nanocomposites



박영빈, 울산과학기술원
(Young-Bin Park, UNIST)

신진 14:25 Development of functional artificial muscle based on carbon composite structures



김인호, 성균관대학교
(Inho Kim, Sungkyunkwan Univ.)

14:45 탄소섬유 제조공정기술과 섬유-매트릭스 계면접착력 제어



한문희, 한국탄소산업진흥원
(Moon-Heui Han, kcarbon)

15:10 Closed-Loop 4D Printing of Multi-Functional Sulfur-Rich Polymer Composites for Modular Intelligent Soft Systems



김동균, 한국화학연구원
(Dong-Gyun Kim, KRICT)

15:35 Coffee break and social networking

16:00 Studies on Energy Dissipation Characteristics of Viscoelastic Materials for Impact Applications



전승렬, 한국과학기술연구원
(Seung-Yeol Jeon, KIST)

16:25 다중양자 핵자기공명을 이용한 탄성체 가교밀도 정량분석



정재우, 송실대학교
(Jae Woo Chung, Soongsil Univ.)

16:50 지속가능 풍력발전을 위한 복합재료용 에폭시 수지 재활용 플랫폼 기술개발



김민영, 국도화학(주)
(Minyoung Kim, KUKDO CHEMICAL)

17:15 자동차용 복합재료 자동적층 기술 소개 및 개발 전략



박상윤, 현대자동차
(Sang Yoon Park, Hyundai Motor Group)

Organizer/Chair



정용채 **Chair**
한국과학기술연구원



김성진
(주)란스에이앤씨



박태훈 **Chair**
한국재료연구원

폴리올레핀 기반 소재의 기술혁신과 지속가능성

고도화된 글로벌 시장에서 한국의 폴리올레핀 소재는 가격 경쟁력, 환경규제 대응, 제품 고부가가치 측면에서 기술적 한계에 직면했습니다. 이에 기존 범용 제품 중심 구조에서 탈피하여, 기능성·차세대 응용으로의 기술 전환이 요구되며, 본 세션에서는 학회에서 활발히 활동하는 석유화학기반 화학 소재 연구자 및 기업실무자의 성과를 공유할 예정입니다.

부산컨벤션센터 제12회장

2025년 9월 30일(화), 14:00 ~ 17:40

14:00 Synthesis of PS-PO-PS Triblock Copolymers



이분열, 아주대학교
(Bun Yeoul Lee, Ajou Univ.)

14:25 C-H Insertion Capability of Azides for Post-polymerization Functionalization of Polyolefins



홍성철, 세종대학교
(Sung Chul Hong, Sejong Univ.)

14:50 고분자 중합용 메탈로센 촉매 개발 동향



남상훈, (주)에스피씨아이
(Sanghun Nam, SPCI)

15:15 폴리올레핀 중합촉매/공정/응용 소재의 발전과 향후 전망



고영수, 공주대학교
(Young Soo Go, Kongju Nat'l Univ.)

15:40 Coffee break and social networking

16:00 Palladium(II)-Catalyzed Synthesis of Model Polynorbornenes with High Heat Resistance



채창근, 한국화학연구원
(Chang-Geun Chae, KRICT)

16:25 Synthesis of Functional Polyolefins via Postpolymerization Deoxygenation



서명은, 한국과학기술원
(Myungeun Seo, KAIST)

16:50 Molecular Dynamics Simulation of Metallocene Poly-alpha-olefins and Their Lubrication Property Modulation by Additives



이원선, 피이주식회사
(One-Sun Lee, Precious Energy, Co. Ltd.)

17:15 Synthesis of Randomly Carboxyl-Functionalized Vinyl-Addition Polynorbornene and Application



김용석, 세종대학교
(Yong Seok Kim, Sejong Univ.)

Organizer/Chair



김용석 Chair
세종대학교



홍성철 Chair
세종대학교



이민재
국립군산대학교

Recent Trends of Molecular Engineering in Electronics and Energy Materials

As the demand for high-performance materials in electronics and energy applications continues to rise, precise control at the molecular level has become essential to surpass the limitations of conventional materials. This session will explore recent advancements in organic, inorganic, and hybrid material systems for next-generation electronic and energy technologies.

부산컨벤션센터 제13회장

2025년 9월 30일(화), 14:00 ~ 17:40

14:00 The Precise and Scalable Synthesis of Conjugated Polymers



Hui Huang
Tianjin University

14:25 Advances in Radiation-Resistant Solution-Processed Metal-Oxide Thin-Film Transistors



김충익, 서강대학교
(Choongik Kim, Sogang Univ.)

14:50 Functional Nanocarbons for Ultraflexible, High-Energy-Density Li-S Batteries in Next-Generation Urban Air Vehicles



백강준, 부경대학교
(Kang-Jun Baeg, Pukyong Nat'l Univ.,

15:15 High-density vertical organic electrochemical transistor arrays and complementary circuits



김재현, 동국대학교
(Jaehyun Kim, Dongguk Univ.)

15:40 Coffee break and social networking

16:00 High-efficiency and Mechanically Robust Intrinsically Stretchable Organic Solar Cells for Wearable Electronics



Ming Shao
Huazhong University of Science and Technology

16:25 Etchant-Free Dry-Developable EUV Photoresists Materials Based on Small Organometallic Complexes



홍석원, GIST
(Sukwon Hong, GIST)

16:50 Harnessing Light-Induced Molecular Dynamics for Advanced Organic Electronics: From Color-Cognitive Memristors to Efficient Hole Transport in Perovskite Devices



박상혁, 공주대학교
(Sanghyuk Park, Kongju Nat'l Univ.)

17:15 Rhenium Unveiled: Advancing Hydrogen Production with High Efficiency



윤석민, 경상국립대학교
(Seok Min Yoon, Gyeongsang Nat'l Univ.)

Organizer/Chair



김명길 Chair
성균관대학교



하영근
경기대학교



김선주
중앙대학교



김재현 Chair
동국대학교

글로벌 환경규제 대응을 위한 지속가능 기능성 고분자 및 복합소재

전 세계적으로 강화되고 있는 탄소중립, 자원순환, 유해물질 저감 등 환경규제는 고분자 및 복합소재 산업 전반에 걸쳐 새로운 기술적 도전과 혁신을 요구하고 있습니다. 본 특별 세션은 글로벌 환경규제에 능동적으로 대응하기 위한 지속가능 고분자 및 복합소재 기술의 최신 연구 성과를 조망하고자 마련되었습니다. 다양한 관점에서의 접근을 통해, 환경과 산업, 학문의 조화를 이끄는 차세대 소재 개발 전략에 대해 심도 있는 논의의 장이 될 것입니다.

부산컨벤션센터 제5회장

2025년 10월 1일(수), 10:50 ~ 15:40

10:50 글로벌 환경규제 대응을 위한 자동차용 친환경 소재 기술 동향



이평찬, 한국자동차연구원
(Pyoung-Chan Lee, KATECH)

11:15 Sustainable Specialty Chemicals in the Era of
Environmental Regulation and Circular Economy



김진철, 한국화학연구원
(Jin Chul Kim, KRICT)

11:40 생활계 및 폐차 유래 소재 기반 복합소재의 자동차용 부품화
기술 연구



정도연, BGF에코머티리얼즈
(Doyeon Jeong, BGFecomaterials)

12:05 지속가능한 불소고분자 산업 전략



손은호, 한국화학연구원
(Eun-Ho Sohn, KRICT)

12:30 Lunch

14:00 엔지니어링 소재를 위한 생분해성 바이오복합재 개발



심봉섭, 인하대학교
(Bong Sup Shim, Inha Univ.)

14:25 Eco-Friendly Functional Composites Based on Water-
Borne Polyimides: From Molecular Design to
Advanced Applications



김윤호, 한국화학연구원
(Yun Ho Kim, KRICT)

14:50 Polarity-Switchable Maleic Anhydride-Containing
Copolymer for VOC-Free Polymer Coating
Applications



김채빈, 부산대학교
(Chae Bin Kim, Pusan Nat'l Univ.)

15:15 Polymers with Dynamic Covalent Bonds for
Addressing Global Environmental Regulations and
Enabling a Sustainable Future



박성민, 한국화학연구원
(Sungmin Park, KRICT)

Organizer/Chair



박성민
한국화학연구원



노상철 Chair
전남대학교



김채빈
부산대학교



김동균 Chair
한국화학연구원

단파 적외선 검출용 전자소자를 위한 고분자 및 나노결정 연구

본 세션은 최근 관심이 급증하고 있는 단파 적외선(shortwave infrared, SWIR) 감지 기술에 필요한 고분자 및 나노결정 소재의 개발과 이를 활용한 광검출 소자 연구의 최신 동향을 다룹니다. 다양한 소재 설계 전략과 소자 구조, 응용 가능성에 대한 논의를 통해 SWIR 감지 분야의 미래를 조망합니다.

부산컨벤션센터 제9회장

2025년 10월 1일(수), 10:50 ~ 15:40

10:50 Modification of Infrared-Responsive Wavelengths in Organic Photodetectors for Efficient Pulse Oximetry



김종현, 아주대학교
(Jong Hyun Kim, Ajou Univ.)

11:15 Colloidal Quantum Dot Infrared Avalanche Photodetectors



이정용, 한국과학기술원
(Jung-Yong Lee, KAIST)

11:40 Spin-on Integration of Visible-transparent Organic Photodiode onto Si-CMOS for VIS-SWIR Dual Image Sensor



정대성, 포항공과대학교
(Dae Sung Chung, POSTECH)

12:05 Enabling Image Sensor Design Using Thin-film Photodetection Technology



이지원, 포항공과대학교
(Jiwon Lee, POSTECH)

12:30 Lunch

14:00 Silver Chalcogenide Colloidal Semiconductor Nanocrystals for Shortwave Infrared Optoelectronic Applications



김영훈, 국민대학교
(Younghoon Kim, Kookmin Univ.)

14:25 Organic Semiconductors for SWIR Sensing: Critical Role of Molecular Design



이재원, 충남대학교
(Jaewon Lee, Chungnam Nat'l Univ.)

14:50 Field-modulated Quantum Dot Solids for Efficient Shortwave Infrared Photodetector



백세웅, 고려대학교
(Se-Woong Baek, Korea Univ.)

15:15 Silver Telluride Colloidal Quantum Dots for Shortwave Infrared Photodetectors



최민재, 동국대학교
(Minjae Choi, Dongguk Univ.)

Organizer/Chair



강문성 Chair
서강대학교



정소희
성균관대학교



왕동환 Chair
중앙대학교

Soft Matter Systems: Materials, Mechanics, and Miniaturized Devices

This session highlights recent advances in soft materials and architected metamaterials that respond dynamically to external stimuli, with a focus on their mechanical and physical properties. Key applications include wearable devices, soft actuators, and implantable microrobots.

부산컨벤션센터 제12회장

2025년 10월 1일(수), 10:50 ~ 15:15

10:50 Iontronics for Energy Harvesting and Sensing



이영훈, 경희대학교
(Younghoon Lee, Kyung Hee Univ.)

11:15 Biological Signal Sensing Platform Based on Polymer Electronic Circuits



이원령, 서울대학교
(Wonryung Lee, Seoul Nat'l Univ.)

11:40 An Artificial Nervous System for Communication between Wearable and Implantable Therapeutics



Alex Abramson
Georgia Institute of Technology/
Emory University School of Medicine

12:05 Digitizing Soft Machine: Programmable Materials, Structure and Devices



김지윤, 울산과학기술원
(Jiyun Kim, UNIST)

12:30 Lunch

14:00 Dynamic Characterization of 3D Soft Auxetic Metastructures



김재환, 금오공과대학교
(Jaehwan Kim, Kumoh Nat'l Inst. Technol.)

14:25 Electrified Hydrogels for Small-Scale Robotics



고종국, 가천대학교
(Jongkuk Ko, Gachon Univ.)

14:50 Engineering Complexity: Microstructured Surfaces and Magnetically Actuated Morphing Systems



위정재, 한양대학교
(Jeong Jae Wie, Hanyang Univ.)

Organizer/Chair



하민정 Chair
광주과학기술원



최영재
광주과학기술원

공액고분자 기반 광전자소자의 상용화를 위한 연구 혁신 동향

본 특별세션은 공액고분자를 기반으로 한 차세대 광전자소자의 상용화를 위한 연구 혁신 동향을 집중 조명합니다. 태양전지, 발광소자, 광감지기 등 다양한 응용 분야에서 요구되는 고효율성, 고안정성, 대면적 공정 가능성을 갖춘 소재 및 소자 개발에 대한 최신 연구 성과를 폭넓게 다룹니다. 또한 분자 설계, 정밀합성, 계면공학, 소자 구조 최적화 등의 다양한 기술적 접근을 통해 학문적 성과와 산업적 파급력 사이의 접점을 모색합니다.

부산컨벤션센터 제12회장

2025년 9월 29일(월), 13:00 ~ 16:40

13:00 A Pioneering Journey Toward Advanced Optoelectronics: From Molecular Insight to Device Innovation



권영수, 삼성디스플레이
(Youngsoo Kwon, Samsung Display)

13:25 From Disorder to Performance: A New Paradigm in Conducting Polymer Design



김민준, 경기대학교
(Minjun Kim, Kyonggi Univ.)

13:50 Self-Assembled Monolayers as Universal Hole Transport Layers for High-Efficiency and Stable Solar Cells



김주현, 부경대학교
(Joo Hyun Kim, Pukyong Nat'l Univ.)

14:15 Stretchable, Self-Healing Thermoelectric Devices Operable under Ambient Conditions



이현정, 국민대학교
(Hyunjung Lee, Kookmin Univ.)

14:40 Coffee break and social networking

15:00 Strategies for Improving Stability of Organic Solar Cell



김경곤, 이화여자대학교
(Kyungkon Kim, Ewha Womans Univ.)

15:25 Single-Component Organic Photocatalysts for Green Hydrogen Production



우한영, 고려대학교
(Han Young Woo, Korea Univ.)

15:50 Development of High-Performance p-type Semiconductors for Transistors



노용영, 포항공과대학교
(Yang-Young Noh, POSTECH)

16:15 Understanding Charge Carrier Dynamics in Organic Photocatalysts for Hydrogen Evolution



차효정, 경북대학교
(Hyojung Cha, Kyungpook Nat'l Univ.)

Organizer/Chair



임종철
충남대학교



손성윤 Chair
광운대학교



김민준
경기대학교



오승수
포항공과대학교



이준우 Chair
아주대학교



최종민 Chair
대구경북과학기술원



김진석 Chair
전북대학교

분자전자 부문위원회(I)

인공지능, 차세대 반도체, 유연 및 고해상도 디스플레이, 고성능 배터리, 바이오 전자소자 등 첨단 기술이 빠르게 발전함에 따라, 주요국 간 핵심 소재·부품·장비 확보를 위한 경쟁도 한층 치열해지고 있습니다. 특히, 친환경성과 고효율을 동시에 만족해야 하는 반도체 및 디스플레이 소재, 차세대 배터리, 자율주행 및 웨어러블 기기를 위한 전자소재 혁신은 국가 기술 경쟁력 확보를 위한 핵심 이슈로 부상하고 있습니다. 본 세션에서는 반도체, 디스플레이, 에너지, 바이오 전자소자의 융합적 연구 동향과 함께, 지속가능한 소재 플랫폼 개발을 위한 최신 성과를 공유합니다. 고기능성 분자전자소재의 설계부터 융합형 소자 구현, 실용화를 위한 연구전략까지 폭넓게 논의하며, 글로벌 기술 주도권 확보를 위한 분자전자 분야의 미래 비전을 함께 모색하고자 합니다.

부산컨벤션센터 제11회장

2025년 9월 30일(화), 14:00 ~ 18:15

14:00 Alkaline Water-Splitting Textile Electrodes Using Interfacial Interaction-Mediated Assembly



조진한, 고려대학교
(Jinhan Cho, Korea Univ.)

14:25 Design of Photoactive Materials for Intrinsically-Stretchable Polymer Solar Cells



김범준, 한국과학기술원
(Bumjoon Kim, KAIST)

14:50 Non-Volatile Solid Additives for High-Efficient Eco-Friendly Organic Photovoltaic Cells



조신욱, 울산대학교
(Shinuk Cho, University of Ulsan)

15:15 Ionomers in PEMFC Catalyst Layers: Molecular Dynamics Simulation Approaches



이승걸, 울산과학기술원
(Seung Geol Lee, UNIST)

15:40 Multifunctional Heterojunction Thin-Film Transistors Based on p-Te/n-Al:IZTO



남수지, 한국전자통신연구원
(Sooji Nam, ETRI)

16:05 Coffee break and social networking

Keynote

16:20 Biomimetic Designs for Semiconducting Polymers



Sihong Wang
The University of Chicago

17:00 Advanced Materials for Reduction of Motion Artifact in Bioelectronics



김태일, 성균관대학교
(Tae-il Kim, Sungkyunkwan Univ.)

17:25 Designing Electrochemical Biosensor Interfaces for Health Monitoring Applications



김자영, 연세대학교
(Jayoung Kim, Yonsei Univ.)

17:50 Strain-Invariant Stretchable Electronics Enabled by Tunable Dielectric Elastomers



정예환, 한양대학교
(Yei Hwan Jung, Hanyang Univ.)

Organizer/Chair



이보람
성균관대학교



정승준 Chair
고려대학교



나석인 Chair
전북대학교



김도환
한양대학교



윤진환
서울시립대학교

분자전자 부문위원회(II)

인공지능, 차세대 반도체, 유연 및 고해상도 디스플레이, 고성능 배터리, 바이오 전자소자 등 첨단 기술이 빠르게 발전함에 따라, 주요국 간 핵심 소재·부품·장비 확보를 위한 경쟁도 한층 치열해지고 있습니다. 특히, 친환경성과 고효율을 동시에 만족해야 하는 반도체 및 디스플레이 소재, 차세대 배터리, 자율주행 및 웨어러블 기기를 위한 전자소재 혁신은 국가 기술 경쟁력 확보를 위한 핵심 이슈로 부상하고 있습니다. 본 세션에서는 반도체, 디스플레이, 에너지, 바이오 전자소자의 융합적 연구 동향과 함께, 지속가능한 소재 플랫폼 개발을 위한 최신 성과를 공유합니다. 고기능성 분자전자소재의 설계부터 융합형 소자 구현, 실용화를 위한 연구전략까지 폭넓게 논의하며, 글로벌 기술 주도권 확보를 위한 분자전자 분야의 미래 비전을 함께 모색하고자 합니다.

부산컨벤션센터 제11회장

2025년 10월 1일(수), 10:50 ~ 17:30

10:50 Development of Organic Semiconductor Materials to Improve the Morphology of Active Layer and Stabilize the Organic Optoelectronic Devices



신원석, 한국화학연구원
(Won Suk Shin, KRICT)

11:15 Multi-Functional Additives for High Performance Perovskite Light-Emitting Diodes



송명훈, 울산과학기술원
(Myoung Hoon Song, UNIST)

11:40 Colloidal Ink Engineering for High-Performance Slot-Die Processed Perovskite Solar Cells



나석인, 전북대학교
(Seok-In Na, Jeonbuk Nat'l Univ.)

12:05 Lunch

14:00 Highly Efficient and Stable Lasing Emission from Metal Halide Perovskite Thin Films



노광동, 이화여자대학교
(Kwangdong Roh, Ewha Womans Univ.)

14:25 Elucidating the Stability of All Inorganic Perovskite Solar Cells



임종철, 충남대학교
(Jongchul Lim, Chungnam Nat'l Univ.)

14:50 Polymer Nucleation-inducing Seed Layer Based Multifunctional Transparent Ultrathin Gold Neural Interfaces



강홍기, 서울대학교
(Hongki Kang, Seoul Nat'l Univ.)

신진 15:15 Rational Design Strategies for Polymer and Hybrid Electrolytes for Safer and High-Performance Lithium- and Sodium-Ion Batteries



박명수, 한국화학연구원
(Myung-Soo Park, KRICT)

15:35 Coffee break and social networking

신진 15:50 Spin-Dependent Energy Conversion Process by CISS Effect



마선일, 성신여자대학교
(Sunil Ma, Sungshin Women's Univ.)

신진 16:10 Controlling the Size of Conjugated Polymer Nanoparticles for Efficient and Robust Visible-Light Photocatalysis



김승현, 대구경북과학기술원
(Seunghyeon Kim, DGIST)

신진 16:30 Soft Materials and System For Wireless Skin-interfaced electronics



김선홍, 서울시립대학교
(Sun Hong Kim, University of Seoul)

신진 16:50 Dynamic Structural Color Control Using Chiral Liquid Crystal Elastomers



남승민, 조선대학교
(Seungmin Nam, Chosun Univ.)

신진 17:10 Wearable Energy-Electronic Devices and Their Integration System Toward On-body Wearable Microgrids



김경남, 충남대학교
(Kyeong Nam Kim, Chungnam Nat'l Univ.)

Organizer/Chair



이보람
성균관대학교



정승준
고려대학교



남수지 **Chair**
한국전자통신연구원



김호범 **Chair**
광주과학기술원



강홍기 **Chair**
서울대학교



김도환
한양대학교



윤진환
서울시립대학교

의료용 고분자 부문위원회(I)

의료용 고분자 및 바이오소재 연구의 지평과 미래

본 세션에서는 지난 30여 년간의 의료용 고분자 및 생체재료 연구개발 성과를 바탕으로, 생체분해성 고분자의 의료 응용과 개발 동향을 살펴봅니다. 핵산-고분자 복합체 및 초고전하 폴리펩타이드를 활용한 생체활성물질 설계, 자극 응답성 하이드로젤 및 고분자 나노전달체 기반 약물전달시스템, 줄기세포 공학, 및 난용성 약물 가용화 기술 등의 최신 연구 동향을 다루며, 의료용 고분자 소재의 인공장기 및 재생의학 분야 응용 가능성을 모색하고자 합니다.

부산컨벤션센터 제1회장

2025년 9월 30일(화), 14:00 ~ 18:00

Keynote

14:00 Polymer Mechanochemistry Enables the Activation of Drugs, Proteins and Genes by Biocompatible Ultrasound



Andreas Herrmann
RWTH University

14:40 New Thermogelling Biomaterials and Their Biomedical Implications



허강무, 충남대학교
(Kang Moo Huh, Chungnam Nat'l Univ.)

15:05 Chemoimmunological Intervention of Crosstalk between Tumor Microenvironment and Draining Lymph Node for Improved Cancer Immunotherapy



정지훈, 성균관대학교
(Ji Hoon Jeong, Sungkyunkwan Univ.)

15:30 Rationally Designed Self-Immolative Polymeric Prodrug Nanoparticles for Therapeutic and Bioimaging Applications



이동원, 전북대학교
(Dongwon Lee, Jeonbuk Nat'l Univ.)

15:55 Advanced Biomaterials for Peripheral Nerve Regeneration



정영미, 한국과학기술연구원
(Youngmee Jung, KIST)

16:20 Coffee break and social networking

Keynote

16:40 지난 45년 동안의 교육자와 연구자로서의 회상



강길선, 전북대학교
(Gilson Khang, Jeonbuk Nat'l Univ.)

Keynote

17:20 소재의 꿈, 생명으로 피어나다: 생분해성 고분자에서 재생의학까지



김수현, 한국과학기술연구원
(Soo Hyun Kim, KIST)

Organizer/Chair



박우람
성균관대학교



진윤희
연세대학교



김기수
부산대학교



이수홍 Chair
동국대학교



곽민석 Chair
부경대학교

의료용 고분자 부문위원회(II)

바이오 고분자 혁신: 차세대 융합소재와 응용

본 세션에서는 기능성 나노입자를 활용한 줄기세포 치료 기술과 기능성 의료용 고분자 연구를 통해 난치성 질환 치료의 새로운 가능성을 모색합니다. 나노재료 기반 약물전달, 연역치료, 및 암 백신 개발 등 바이오메디컬 응용 연구와 생체모사 재료를 이용한 줄기세포 연구, 친환경 생분해성 소재 개발을 다루며, mRNA 전달 나노입자 제조 디바이스, 오가노이드 활용 신경과학 연구, 및 바이오센서 기반 디지털 재활 기술까지 첨단 바이오 및 생체재료 기술의 현재와 미래를 조망하고자 합니다.

부산컨벤션센터 제1회장

2025년 10월 1일(수), 10:50 ~ 17:00

Keynote

10:50 Bioactive Materials and Amphiphilic Polymer Conjugates in the Treatment of Various Diseases



나 건, 가톨릭대학교
(Kun Na, Catholic Univ.)

11:30 Exploring Various Polymer Hybrid Coatings To Control the Bio-interface Properties for Medical Implants



양성윤, 충남대학교
(Sung Yun Yang, Chungnam Nat'l Univ.)

11:55 Versatile and Instructive Potentials of MXene Nanomaterials for Tissue Engineering & Regeneration



한동욱, 부산대학교
(Dong-Wook Han, Pusan Nat'l Univ.)

12:20 Engineered Hydrogels with Tunable Mechanical Properties and Tissue Adhesiveness for Biomedical Applications



김재윤, 성균관대학교
(Jaeyun Kim, Sungkyunkwan Univ.)

12:45 Lunch

14:00 Understanding the Forces that Control Cell Fate and Disease Progression



황용성, 순천향대학교
(Yongsung Hwang, SoonChunHyang Univ.)

14:25 Biocompatible Tattoo Inks Based on Natural Dyes Encapsulated in Amphiphilic Polymers for Improved Safety and Stability



송창식, 성균관대학교
(Changsik Song, Sungkyunkwan Univ.)

14:50 Bio-Based Smart Polymers for the Future of Sustainable Medical Applications



황성연, 경희대학교
(SungYeon Hwang, Kyung Hee Univ.)

15:15 Medical Nanoparticle Manufacturing System Using Microfluidic Technology



한청수, (주)케이런
(Chungsoo Han, KRON co.,Ltd.)

15:40 Coffee break and social networking

신진

16:00 Patient-Specific Brain Organoids for Precision Neurotherapeutics



박종찬, 성균관대학교
(Jongchan Park, Sungkyunkwan Univ.)

신진

16:20 Exploring Ongoing Advances in Cancer Targeted Therapy and Biotherapeutics



김하린, 국민대학교
(Ha Rin Kim, Kookmin Univ.)

신진

16:40 Bioelectronics for Continuous Physiological Fluid Monitoring



김지혜, 아주대학교
(Jihye Kim, Ajou Univ.)

Organizer/Chair



박우람 Chair
성균관대학교



진윤희 Chair
연세대학교



김기수
부산대학교



이수홍 Chair
동국대학교

콜로이드 및 분자조립 부문위원회(I)

콜로이드 및 분자 조립 기반 스마트 연성소재

This session focuses on innovative soft materials developed through colloidal and molecular self-assembly. Topics include smart and responsive systems, hierarchical structures, and functional materials with tailored properties for advanced applications. Emphasis is placed on the interplay between molecular design, assembly behavior, and stimuli-responsiveness. Leading researchers in the field will share their recent breakthroughs, offering insights into future directions of smart soft material research.

부산컨벤션센터 제2회장

2025년 9월 30일(화), 14:00 ~ 18:20

14:00 Liquid Metal Particles-Incorporated Composites for Functional Materials and Soft Devices



박성준, 성균관대학교
(Sungjune Park, Sungkyunkwan Univ.)

14:25 Unlocking the Power of Supramolecular Chemistry in Soft Materials Design



강지형, 서울대학교
(Jiheong Kang, Seoul Nat'l Univ.)

14:50 Engineering Lipid Mesophases for Exosome Therapeutics



김호준, 한국과학기술연구원
(Hojun Kim, KIST)

15:15 Nanoparticle Aggregation-Driven Reversible Control of Rheological Properties in Microgel Composites



심윤희, 수원대학교
(Yul Hui Shim, The University of Suwon)

15:40 Coffee break and social networking

신진

16:00 Light Amplification in Solution-Phase Colloidal Quantum Dots



함동효, 한양대학교
(Donghyo Hahm, Hanyang Univ.)

16:20 In-Drop Capillary Spooling of Microfibers Made from Self-Healable Thermoplastic Polyurethane via Supramolecular Interactions



임호선, 숙명여자대학교
(Ho Sun Lim, Sookmyung Women's Univ.)

16:45 Particle Adhesion on Thin Liquid Layer



우상혁, 중앙대학교
(Sanghyuk Wooh, Chung-Ang Univ.)

17:10 3D/4D Printing of Smart Soft Materials for Bio-Inspired Functional Applications



한대훈, 전남대학교
(Daehoon Han, Chonnam Nat'l Univ.)

17:35 Self-Assembled Latticework Nanostructures for Flexible Antireflective Film



최유진, 한국화학연구원
(Yu-Jin Choi, KRICT)

신진

18:00 Wavelength-Selective 3D Printing for Mechanically Programmable Multimaterial Structures



김지원, 경북대학교
(Ji-Won Kim, Kyungpook Nat'l Univ.)

Organizer/Chair



류진 Chair
한국과학기술연구원



김소연 Chair
서울대학교

콜로이드 및 분자조립 부문위원회(II)

인공지능을 활용한 연성소재의 설계와 응용

머신러닝과 인공지능의 발전이 연성 소재와 분자 시스템의 설계·예측 방식을 혁신하고 있습니다. 본 세션은 멀티스케일 시뮬레이션과 생성 모델을 통한 구조 설계, 고분자·단백질 등 복잡 분자의 AI 기반 물성·기능 예측과 바이오센서 응용, 양자컴퓨팅을 포함한 차세대 계산 플랫폼의 활용을 중심으로, 데이터와 실험·이론의 융합이 만들어내는 새로운 연구 패러다임을 조망합니다. 이를 통해 연성소재 분야에서 AI가 열어갈 미래 방향을 제시합니다.

부산컨벤션센터 제2회장

2025년 10월 1일(수), 10:50 ~ 15:40

10:50 Multiscale Simulation of Soft Materials Using Machine Learning Potentials



강준희, 부산대학교
(Joonhee Kang, Pusan Nat'l Univ.)

11:15 When AI Learns the Context of Polymer Chemistry: The HAPPY Paradigm



허수미, 전남대학교
(Su-Mi Hur, Chonnam Nat'l Univ.)

11:40 De Novo Design of Protein Self-assembly Using Deep Generative Models



이상민, 포항공과대학교
(Sangmin Lee, POSTECH)

12:05 EXAONE Discovery: Toward Generalizable Molecular Property Prediction



정대웅, LG AI연구원
(Dae-Woong Jeong, LG AI Research)

12:30 Lunch

14:00 Corona Phase Engineering and AI-Driven Signal Analysis for Multidimensional Precision Chemical Information Transfer



조수연, 성균관대학교
(Sooyeon Cho, Sungkyunkwan Univ.)

14:25 Machine Learning-Guided Design of Gradient Soft Materials via Digital Light Processing



김미소, 한국과학기술원
(Miso Kim, KAIST)

14:50 Self-assembly of Bottlebrush Copolymers in Solution: from Molecular Dynamics Simulation to Machine Learning



김용주, 고려대학교
(Yongjoo Kim, Korea Univ.)

15:15 Quantum Advantage in Toxicity Prediction Models Using Quantum Machine Learning



정근홍, 육군사관학교
(Keunhong Jeong, Korea Military Academy)

Organizer/Chair



윤흥석 Chair
한양대학교



유재범 Chair
충남대학교

에코소재 부문위원회

맞춤형 분해 특성을 갖는 차세대 바이오폴리머 복합소재 기술동향

본 세션에서는 사용 목적과 환경에 따라 분해 속도 및 거동을 정밀하게 제어하는 '맞춤형 분해성' 차세대 바이오폴리머 복합소재의 최신 기술 동향을 소개하고자 합니다. 소재 설계부터 물성 제어, 최종 응용에 이르기까지 최신 연구 결과들을 공유하고, 관련 분야 전문가들과 함께 지속가능한 미래를 위한 발전 방향을 모색하는 교류의 장을 마련하고자 합니다.

부산컨벤션센터 제4회장

2025년 9월 30일(화), 14:00 ~ 17:50

Keynote

14:00 Aqueous Processing of Natural Rubber-Synthetic Polymer Nanocomposites



Rusli Daik
Universiti Kebangsaan Malaysia

14:40 The Linear and Nonlinear Rheological Properties of PLA/LDPE and PHA/LCB-PLA Blends



현 규, 부산대학교
(Kyu Hyun, Pusan Nat'l Univ.)

15:05 Eco-Designed Biodegradable Polyesters: Linking Sustainability to Performance



구준모, 충남대학교
(Jun Mo Koo, Chungnam Nat'l Univ.)

15:30 Hydrophobic Surface Modification of Nanocellulose in an All-Aqueous System



Lam Tan Hao, 한국화학연구원
(Lam Tan Hao, KRICT)

15:55 Coffee break and social networking

16:10 Functional Biodegradable Polymer Systems: From High-Barrier Packaging Coatings to Sustainable Organic Electronics



명재욱, 한국과학기술원
(Jaewook Myung, KAIST)

16:35 Seaweed-Based Hydrovoltaics for Sustainable Electricity Generation



안효성, 전남대학교
(Hyosung An, Chonnam Nat'l Univ.)

17:00 Sustainable Microbial Production of Biodegradable Polymer PHA from Renewable Sources



고자경, 한국과학기술연구원
(Ja Kyong Ko, KIST)

17:25 Starpolymer Catalysts for Room-temperature Activation of CO₂



서진영, 한국화학연구원
(Jin Young Seo, KRICT)

Organizer/Chair



김 정 Chair
경희대학교



이 동 윤 Chair
경북대학교

에너지 부문위원회(I)

차세대 지속가능 그린 에너지 구현을 위한 첨단 소재 및 융합 혁신 기술 I

본 세션에서는 차세대 지속가능한 그린 에너지 산업과 관련된 다양한 첨단 소재 및 융합 혁신 기술 연구 동향을 살펴보고, 고분자를 비롯한 다양한 소재들의 응용 가능성에 대해 함께 고찰하는 심도 있는 토론의 장을 마련하고자 합니다.

부산컨벤션센터 제3회장

2025년 9월 30일(화), 14:00 ~ 17:40

Keynote

14:00 Molecular Engineering of Ion-Conducting Polymers for Clean Energy Technologies



Chulsung Bae
Rensselaer Polytechnic Institute

14:40 Research & Development of MEA/PEM for H₂ Fuel Cell and Water Electrolysis



김준영, 코오롱인더스트리
(Jun Young Kim, Kolon Industries, Inc.)

15:05 Advanced Separators Breaking the Trade-off Between Conductivity and Strength for Alkaline Water Electrolysis



조원철, 서울과학기술대학교
(Wonchul Cho, Seoul Nat'l Univ. Sci. & Technol.)

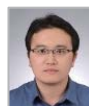
15:30 음이온교환막 수전해(AEMWE)용 고성능 고분자 전해질 소재 기술개발 동향



이장용, 건국대학교
(Jang Yong Lee, Konkuk Univ.)

15:55 Coffee break and social networking

16:10 Sol-gel Transition Assembly of Anion-exchange Membranes



이정현, 고려대학교
(Jung-Hyun Lee, Korea Univ.)

16:35 Understanding Ionomer Oxidation in Anion Exchange Membrane Water Electrolyzers and Their Actual Effects on Cell Durability



이성수, 한국과학기술연구원
(Albert Sung Soo Lee, KIST)

신진 17:00 Ionomer Induced Interfacial Electron Transport Problem at PEM Water Electrolyzer Anode



두기수, 한국에너지기술연구원
(Gisu Doo, KIER)

신진 17:20 High-Performance Direct Ammonia Fuel Cells Based on Anion Exchange Membranes



채지연, 한국기계연구원
(Ji Eon Chae, KIMM)

Organizer/Chair



심지민 Chair
서울대학교



김효원
한국에너지공과대학교



이세찬 Chair
국민대학교

에너지 부문위원회(II)

차세대 지속가능 그린 에너지 구현을 위한 첨단 소재 및 융합 혁신 기술 II

본 세션에서는 차세대 지속가능한 그린 에너지 산업과 관련된 다양한 첨단 소재 및 융합 혁신 기술 연구 동향을 살펴보고, 고분자를 비롯한 다양한 소재들의 응용 가능성에 대해 함께 고찰하는 심도 있는 토론의 장을 마련하고자 합니다.

부산컨벤션센터 제3회장

2025년 10월 1일(수), 10:50 ~ 15:35

10:50 High-stability n-type Conjugated Polymer Cathodes For Lithium-ion Batteries



이원호, 금오공과대학교
(Wonho Lee, Kumoh Nat'l Inst. Technol.)

11:15 Hierarchical Pore Design of Hard Carbon Anode Materials for High-Performance Potassium-Ion Storage



황종국, 아주대학교
(Jongkook Hwang, Ajou Univ.)

11:40 화학기상증착 기반의 고용량 실리콘 음극재 기술 개발 전략



채수중, 국립부경대학교
(Sujong Chae, Pukyong Nat'l Univ.)

12:05 Lunch

14:00 Strategies for Enhancing the Stability of Anode-Free Lithium Metal Batteries



김수찬, 성균관대학교
(Soochan Kim, Sungkyunkwan Univ.)

14:25 Polyelectrolyte Multilayers on Anodes for Aqueous Zinc-Ion Batteries



구민수, 동아대학교
(Minsu Gu, Dong-A Univ.)

14:50 Strain, Cracks, and Interfaces: Understanding the Degradation in Polycrystalline and Single-Crystal Cathodes for Lithium Batteries



류훈희, 충남대학교
(Hoon-Hee Ryu, Chungnam Nat'l Univ.)

신진 15:15 Electrode Modification Strategies for High-performance Batteries



박슬기, 전북대학교
(Sulki Park, Jeonbuk Nat'l Univ.)

Organizer/Chair



이민재
국립군산대학교



손창윤
서울대학교



유지영
경북대학교



최우혁 **Chair**
인하대학교



김효원 **Chair**
한국에너지공과대학교

고분자 합성: 정밀 제어 고분자 합성: 분자 수준에서 응용까지

본 세션은 정밀 고분자 합성을 기반으로 한 구조 제어와 기능 구현의 최신 연구를 소개한다. 생분해성 라디칼 고분자, 흐름 반응기를 활용한 공액 고분자 합성, 금속 촉매 없는 중합 등 혁신적 합성 전략과 더불어, 에너지 저장, 해양 방오, 유기 X선 센서 등 다양한 응용 사례를 다룬다. 분자 수준의 조작이 어떻게 전자소자, 에너지 소재, 기능성 표면 설계로 이어지는지를 조명한다. 정밀 합성의 진보가 실용적 기능으로 확장되는 흐름을 통찰하고자 한다.

부산컨벤션센터 제8회장

2025년 10월 1일(수), 10:50 ~ 16:00

10:50 Polymerization/Depolymerization-Driven Morphology Switching in Bottlebrush Copolymer Particles



신재만, 송실대학교
(Jaeman Shin, Soongsil Univ.)

11:15 Amphiphilic Copolymer Coatings for Marine Antifouling: Design Criteria for Copolymer Composition and Sequence



강성민, 충북대학교
(Sung Min Kang, Chungbuk Nat'l Univ.)

11:40 Metal-Free Ring-Opening Metathesis Polymerization



Andrew J. Boydston
University of Wisconsin, Madison

12:05 Synthesis and Application of Biodegradable Radical-containing Polymers for Transient Electronics and Energy Storage



조상호, 한국과학기술연구원
(Sangho Cho, KIST)

12:30 Lunch

14:00 Functional Dielectric Polymer with Improved Dielectric Polarization For High-performance Energy-harvesting Devices



김민수, 순천대학교
(Kim Min Soo, Suncheon Nat'l Univ.)

14:25 Achieving Reliable Synthesis of Conjugated Polymers Using a Continuous Flow Reactor



황예진, 인하대학교
(Ye-Jin Hwang, Inha Univ.)

14:50 Organic X-Ray Image Sensors Using a Medium Bandgap Polymer Donor with Low Dark Current



하중운, 경상국립대학교
(Jong Woon Ha, Gyeongsang Nat'l Univ.)

15:15 Liquid Metal Particles Enabled Template Polymerization for Thermal Interface Materials



임태환, 강원대학교
(Taehwan Lim, Gangwon Univ.)

신진 15:40 One-Step Synthesis of 3D-Mesoporous SiCN Monoliths via In-Situ Microphase Separated Organic-Inorganic Block Polymer



황윤호, 부경대학교
(Yoonho Hwang, Pukyong Nat'l Univ.)

Organizer/Chair



고영운 Chair
전남대학교



김명웅 Chair
인하대학교

기능성 고분자: 응용 맞춤형 기능성 소재 기술

본 세션은 바인더, 센서, 순환소재 등 미래 사회에 기여할 수 있는 응용소재개발을 목표로 블록 공중합체, 엔지니어링 플라스틱을 비롯해 다양한 고분자 소재를 연구 중인 연구자들을 초청하여 기능성 고분자 소재의 설계부터 합성 및 응용을 아우르는 전주기적 연구의 최신 동향에 대해 활발한 논의의 장을 마련하고자 합니다.

부산컨벤션센터 제4회장

2025년 10월 1일(수), 10:50 ~ 16:00

10:50 Block Copolymer Assembly in Emulsions for Tunable Photonic Pigments



구강희, 울산과학기술원
(Kang Hee Ku, UNIST)

신진 11:15 Synthesis and Thermo-Responsive Behavior of Well-Defined, Low-Molecular-Weight Polyethersulfone



김태형, 한국화학연구원
(Taehyoung Kim, KRICT)

11:35 Three-Dimensional Adaptive Energy Devices for Intelligent Energy Management



김봉훈, 대구경북과학기술원
(Bong Hoon Kim, DGIST)

12:00 Tailored Reactivity of Pentafluorophenyl Ester Based Copolymers for Coating and Bioimaging Applications



Sheng Li, 한국과학기술원
(Sheng Li, KAIST)

12:25 Lunch

14:00 Selective Polymeric Platforms for Gold Detection and Upcycling



이형일, 울산대학교
(Hyung Il Lee, University of Ulsan)

14:25 Strategies for Polymer-Based High-Energy-Density Batteries



박수진, 포항공과대학교
(Soojin Park, POSTECH)

14:50 Molecular Lithium Sensors Based on ^{19}F NMR Spectroscopy and Photophysical Changes



구병진, 단국대학교
(Byungjin Koo, Dankook Univ.)

15:15 Mechanochemistry for Circular Polymer Chemistry: From Laboratory Polymers to Industrial Plastics



김병수, 연세대학교
(Byeong-Su Kim, Yonsei Univ.)

15:40 Pseudo-DSMC Simulation of Gas-Surface Interactions on GNW-Deposited Polymer Substrates: Ergodicity and Trapping-Induced Reactivity

이승엽, 한국생산기술연구원
(Seungyeop Lee, KITECH)

Organizer/Chair



서명은 Chair
한국과학기술원



이상호 Chair
동국대학교

고분자가공/복합재료/재활용: 극한 환경 고분자 복합재료 및 공정

극한 환경 고분자 복합재료는 극한 조건에서도 우수한 물성 및 특성을 유지하는 특수기능성 소재로서, 우주항공, 자동차, 해양, 군사 등 다양한 산업에서 핵심 소재로 활용되고 있습니다. 본 세션에서는 이 분야의 국내 전문가들을 초청하여 최신 연구 동향을 공유하고, 기술적 도전과 미래 발전 방향에 대해 논의하고자 합니다.

부산컨벤션센터 제6회장

2025년 10월 1일(수), 10:50 ~ 16:25

10:50 극저온 및 초고온 우주환경 대응 탄소복합재 기술 개발



이진우, 한국재료연구원
(Jin Woo Yi, KIMS)

11:15 나노재료의 항공 우주 시스템 적용 연구 소개



장종태, 한국항공우주연구원
(Jong Tai Jang, KARI)

11:40 Sustainable Functional Space Composites Materials with Atomic Oxygen (AO) Protection for Very Low Earth Orbit (VLEO) Conditions



남영우, 한국항공대학교
(Youngwoo Nam, Korea Aerospace Univ.)

12:05 Development of Silica Network Structure in Tire Rubber Composites for Electric Vehicles using Telechelic Polybutadiene



임기원, 한국타이어
(Kiwon Lim, Hankook Tire)

12:30 Lunch

14:00 Neutron Shielding Composites for Space Applications



안석훈, 한국과학기술연구원
(Seokhoon Ahn, KIST)

14:25 Polyimide Materials Innovation for Thin and High-Integration Applications



백승열, 피아이첨단소재
(Sung Yul Back, PI Advanced Materials)

14:50 Additive Manufacturing with Silicone, Polydicyclopentadiene, and Composites via Heating at a Patterned Photothermal Interfaces (HAPPI)



이창욱, University of Wisconsin
(Chang-Uk Lee, University of Wisconsin)

15:15 Curing Kinetics, Processability, and Thermal Behavior of End-Capped Imide-Based Thermosets with Different Backbone Conformations



남기호, 경북대학교
(Ki-Ho Nam, Kyungpook Nat'l Univ.)

15:40 고신뢰성 CAE기반 극한환경 대응 복합소재의 성능 예측 시뮬레이션



심지현, 다이텍연구원
(Jeehyun Sim, DYETEC)

신진 16:05 Mechanically Robust and Flexible Polymers by Molecular Weaving



권준표, 아주대학교
(Junpyo Kwon, Ajou Univ.)

Organizer/Chair



홍성우 Chair
한국생산기술연구원



김진철 Chair
한국화학연구원

고분자구조 및 물성: 지속가능한 사회를 위한 소재 구조-물성 연구 최신 동향

본 세션은 고기능 고분자 소재의 구조-물성 상관관계를 중심으로, 환경, 에너지, 바이오 등 다양한 분야에서의 지속가능한 응용 가능성을 조망합니다. 최신 합성 기술과 정밀 분석을 바탕으로 한 구조 설계 전략부터 실제 적용 사례에 이르기까지, 차세대 고분자 기술의 융합적 발전 방향을 국내 주요 연구자들과 함께 논의합니다.

부산컨벤션센터 제7회장

2025년 10월 1일(수), 10:50 ~ 16:00

10:50 Rational Design of Block Copolymers for Tailoring Mesoporous Carbons toward Efficient Catalyst Support



진형민, 충남대학교
(Hyeon Min Jin, Chungnam Nat'l Univ.)

11:15 Application of 2D IR to Study the Structure and Dynamics of Perovskite Films and hAPP Peptides



김영삼, 울산과학기술원
(Yung Sam Kim, UNIST)

11:40 Process-structure-property Relationships of Responsive Hydrogels



배진혜, 중앙대학교
(Jinhye Bae, Chung-Ang Univ.)

12:05 Thermotropic Mesophases Enable Vitrification in Aliphatic Carboxylate Coordination Polymers



문회리, 이화여자대학교
(Hoi Ri Moon, Ewha Womans Univ.)

12:30 Lunch

14:00 Functional Hydrogel Formation via Room-Temperature Self-Polymerization of Zwitterionic Monomers



김연수, 포항공과대학교
(Youn Soo Kim, POSTECH)

14:25 Multiscale hydrogel engineering enables transparent, elastic, expandable human brain composites



박주혁, 서울대학교
(Juhyuk Park, Seoul Nat'l Univ.)

신진 14:50 Nanofibers to Textiles: Sustainable Engineering of Advanced Cellulose Materials



장태후, 인천대학교
(Taehoo Chang, Incheon Nat'l Univ.)

15:10 Functional Gel-like Coatings: Structure-Property Design for Biocompatible and Antifouling Surfaces



류진, 한국과학기술연구원
(Jin Yoo, KIST)

15:35 Multi-functional Structural Supercapacitor CFRP with NiCo_2O_4



노형도, 한양대학교
(Hyung Doh Roh, Hanyang Univ.)

Organizer/Chair



박재홍 Chair
이화여자대학교



이준민 Chair
포항공과대학교

Plenary Lecture **PL-1**

기조강연

2025.9.30(화), 11:20~12:00, 기조강연장(205호)

Chair: 한미정

Next Generation Photovoltaics

이광희[†]

광주과학기술원

To achieve zero-carbon or zero-energy buildings, buildings must generate energy from on-site renewable energy resources through the concept of building-integrated-photovoltaic (BIPV) systems, and also prevent energy loss to the surroundings through the use of high-performance thermal insulation materials. However, current BIPVs are not suitable for state-of-the-art modern buildings equipped with exterior window glasses on almost all of their surfaces. In this talk, I am going to address the current state of the arts of organic solar cells (OSCs) and perovskite solar cells (PSCs), which are introduced into film-type flexible and semi-transparent BIPV systems. Because organic semiconductors and perovskites are inherently semi-transparent in the visible region and mechanically flexible, in contrast to the opaque, brittle inorganic semiconductors used in conventional BIPVs, they are excellent candidate materials for such window-film-type BIPVs. I will also address the stability issues of both photovoltaics together with a capability to fabricate into large area modules and panels.



이광희(광주과학기술원)

광주과학기술원 신소재공학과 교수 (2006-현재)

광주과학기술원 히거신소재연구센터 부센터장 (2007-현재)

광주과학기술원 GIST-ICL 국제공동연구 R&D 센터장 (2015-현재)

광주과학기술원 특훈교수 (2015-현재)

광주과학기술원 에너지밸리기술원 원장 (2020-현재)

광주과학기술원 차세대에너지연구소 소장 (2019-2023)

광주과학기술원 연구부총장 (2023-2024)

광주상공회의소 경제자문위원회 자문위원 (2024-현재)

Plenary Lecture **PL-2**

기조강연

2025.9.30(화), 13:20~14:00, 기조강연장

Chair: 김승현

Exploring Effective Pathways to Tackle Plastic Waste Pollution

Yu-Zhong Wang[†]

Sichuan University

To address environmental challenges posed by end-of-life plastics, novel upcycling strategies must be developed to convert bulk waste into value-added chemicals, monomers/oligomers, and high-performance materials. For instance: (1) Designing new catalysts or solvent systems to selectively degrade waste polymers can reduce the complexity of degraded products to some extent; (2) Developing new strategy for focusing on “reconstructing new products” at the basis of full use of the wastes is highly desired; (3) Synthesizing inherently recyclable polymers is essential to achieve closed-loop monomer-polymer cycling. Furthermore, the repeatably chemically-recyclable biodegradable polymers will be the optimal choice for producing single-use plastics. These avenues will be elucidated through the author’s recent research work.



Yu-Zhong Wang(Sichuan University)

B.A., Qingdao University (1982)

Master D., Sichuan University (1987)

Ph.D., Sichuan University (1994)

Professor, Sichuan University (1995-Present)

Visiting Professor (DAAD), Plank Institute for Polymer Research (1999)

Visiting Professor(UK Royal Society), The University of Nottingham (2002)

Director, National Engineering Laboratory of Eco-Friendly Polymeric Materials (Sichuan) (2009-Present)

Director, State Key Laboratory of Advanced Polymer Materials (2024 -Present)

Plenary Lecture **PL-3**

기조강연

2025.10.1(수), 10:10~10:50, 기조강연장

Chair: 김주현

Polymers and Polymer Blends for New Opto- and Bio-electronic Devices

Antonio Facchetti[†]

Georgia Institute of Technology/Northwestern University

We investigated the phase behaviors of block copolymer blends composed of the polystyrene-*b*-poly(*n*-butyl methacrylate) (PS-*b*-PnBMA) and polystyrene-*b*-poly(*n*-hexyl methacrylate) (PS-*b*-PnHMA), using small-angle neutron scattering (SANS), small-angle X-ray scattering (SAXS), and depolarized light scattering (DPLS). A miscible phase between the PnBMA and PnHMA blocks in the BCP blends allows the various composition-dependent phase behaviors. Intriguingly, a closed-loop phase transition was found in nearly symmetric composition of the miscible PS-*b*-PnBMA/PS-*b*-PnHMA blends from lower disorder-to-order transition (LDOT) to order-to-disorder transition (ODT) behaviors with increasing amount of PS-*b*-PnHMA.

In this presentation we report the development of novel polymeric materials for use as single components or in blends with small molecule or polymer for applications in three major areas. 1. Realization of new mechanically ductile and ultra-stretchable organic solar cells. Here, ductility of the photoactive blend is improved by the design of a family of molecular acceptors having a trialkylsilyl group. 2. New mixed ionic-electronic conductors particularly *n*-type based on naphthalene diimide (NDI) and diketopyrrolopyrrole (DPP) units. 3. We discuss recent implementation of a new *n*-type polymer for the realization of high-performance and balanced complementary electrochemical OECTs and inverters, which are then used to fabricate neuromorphic circuits capable of sensing, transducing and recording information.



Antonio Facchetti(Georgia Institute of Technology/Northwestern University)

B.A., University of Milan (1992)

Ph.D., University of Milan (1997)

Post-Doc, U. California at Berkeley, USA (1997)

Research/Adjunct professor, Northwestern University (2002-Present)

Chief Technology Officer, Flexterra Corp. (2005-Present)

Hightower Chair Professor in MSE, Georgia Institute of technology (2023-Present)

Oral Presentation **O1-1**

대학원생 구두발표 (I)

2025.9.29(월), 13:00~13:15, 1-1회장

Chair: 서명은,오준균

Mechanistic study of polymerization-retarding impurities toward full circular economy of polystyrene

하유진, 김희중⁺

인하대학교

Polystyrene (PS) is a widely used plastic with low recycling rates, raising environmental concerns. Catalytic depolymerization of PS yields a styrenic liquid (SL), mainly styrene, offering a route to a circular economy. However, impurities in SL hinder repolymerization and lower molar mass. Here, we investigated structure–reactivity relationships in SL and identified benzyl-containing molecules and α -substituted styrenes that interfere with polymerization via chain transfer or thermodynamic effects. These impurities were removed by distillation, yielding distilled SL with ~92% styrene. Its polymerization gave high-molar-mass PS (up to 150kDa), with thermal and mechanical properties comparable to virgin PS. Furthermore, depolymerization of repolymerized PS showed consistent behavior, supporting the feasibility of a closed-loop PS recycling system. This work offers insights into impurity effects and proposes practical solutions for scalable and sustainable PS recycling.

Oral Presentation **O1-2**

대학원생 구두발표 (I)

2025.9.29(월), 13:15~13:30, 1-1회장

Chair: 서명은,오준균

Enhancement of Doping Efficiency of Conjugated Polymers via Backbone Torsion Strategy with Methyl Group Introduction for High-Performance Organic Thermoelectrics

장규진, 하종운¹, 한미정⁺, 강영훈, 박병욱

한국화학연구원

¹ 경상국립대학교

Chemical doping of conjugated polymers (CPs) enhances their electrical properties by increasing free carrier concentration, necessitating structural designs that facilitate efficient dopant incorporation into the polymer backbone. For large molecular dopants such as F4TCNQ, sufficient internal space within the polymer is necessary for effective diffusion of dopants. In this study, we synthesized a series of CPs (DPP-BT, DPP-MBT, MDPP-BT and MDPP-MBT) with different methylation patterns on the donor and acceptor units to induce backbone torsion and ensure effective access spaces for dopants. The position and number of the methyl groups affected both crystallinity and doping characteristics of the CPs. As a result, MDPP-MBT, which exhibited the highest backbone torsion, achieved a conductivity of 592 S cm^{-1} and a power factor of $1284 \mu\text{W m}^{-1} \text{ K}^{-2}$ upon doping with 0.1wt% of F4TCNQ, representing more than a twofold enhancement over the non-methylated DPP-BT.

Oral Presentation **01-3**

대학원생 구두발표 (I)

2025.9.29(월), 13:30~13:45, 1-1회장

Chair: 서명은, 오준균

Chalcogenophene-Driven Backbone Engineering for High Mixed Ionic-Electronic Conduction

**김태훈, 오신비¹, 김지환, 정다현¹, Alexander Tipan-Quishpe², 윤명한², 김범준¹,
강기훈[†]**

서울대학교

¹ 한국과학기술원

² 광주과학기술원

Organic electrochemical transistors (OECTs) rely on mixed ionic and electronic transport within OMIECs, where structural and transport properties are tightly coupled. Chalcogenophene substitution is an effective strategy to tune intra- and intermolecular interactions in conjugated polymers. Here, we investigate the effect of heteroatom substitution in a DPP-based donor-acceptor polymer for OECTs. Replacing thiophene with selenophene enhances device performance by increasing the quinoidal character and π -electron delocalization, resulting in a notable improvement in μC^* , primarily due to higher charge carrier mobility. In addition, the optimized materials exhibit low off-state current and a high on/off current ratio, making them promising candidates for unipolar inverter applications.

Oral Presentation **O1-4**

대학원생 구두발표 (I)

2025.9.29(월), 13:45~14:00, 1-1회장

Chair: 서명은,오준균

Preserved Elastic Modulus and Enhanced Adhesion in Long-Term and Thermally Stable Glycol Gels via Affine Shrinkage upon Water Evaporation

박소연, 정태훈, 최재원, 김연수[†]

포항공과대학교

Glycol-based polymer gels have gained attention as stable alternatives to hydrogels due to the ultra-low volatility and thermal stability of glycol solvents. However, achieving strong and durable adhesion in these gels remains challenging because of their low surface energy and limited exposure of adhesive functional groups. In this study, poly(2-hydroxyethyl acrylate) gels were synthesized in water-butylene glycol mixtures, and selective water evaporation was employed to address adhesion limitations by removing the volatile component in a controlled manner. Selective water evaporation enriches hydroxyl-functional groups at the gel surface, resulting in an over 6-fold enhancement in adhesion strength. This strategy preserves the elastic modulus via affine shrinkage without additional polymer chain entanglement. The resulting glycol gels exhibited exceptional stability in mechanical properties and interfacial adhesion over a wide temperature range (−20 °C to 120 °C).

Oral Presentation **01-5**

대학원생 구두발표 (I)

2025.9.29(월), 14:00~14:15, 1-1회장

Chair: 서명은,오준균

Water-Based Radiative Cooling Coating with Durability and LCA-Verified Emission Cuts

최민지, 유영재[†]

중앙대학교

Passive daytime radiative cooling (PDRC) is a sustainable method to reduce surface temperatures without energy input. Conventional TiO_2 -based coatings offer limited mid-infrared emissivity. We developed a scalable, water-based acrylic coating with glass bubbles and inverse opal photonic particles to enhance cooling performance. The coating achieved a solar reflectivity of 0.74 and an emissivity of 0.94, resulting in a subambient cooling effect of 5.6°C and net cooling power of 119.59 W/m^2 . Life cycle assessment (LCA) verified a 72.7% reduction in CO_2 emissions. Durability tests confirmed resistance to thermal aging and weathering, demonstrating practical applicability in sustainable architecture.

Oral Presentation **O1-6**

대학원생 구두발표 (I)

2025.9.29(월), 14:15~14:30, 1-1회장

Chair: 서명은,오준균

Direct Patterning of Sol-Gel Cu_xO /IGZO Heterojunctions for Multi-Valued Logic via Self-Assembled Monolayers

백석현, 박성준⁺

아주대학교

In this study, we introduce a ternary inverter based on a Cu_xO /IGZO heterojunction, fabricated via a photolithography-free, solution-based process combining sol-gel deposition with self-assembled monolayer (SAM) patterning. This approach not only preserves the electrical performance of the transistors but also offers scalability and cost-effectiveness. Structural analysis confirms the formation of a smooth, partially overlapped heterojunction interface.

Depth-resolved X-ray photoelectron spectroscopy (XPS) reveals a gradient in oxidation states within the Cu_xO layer, which facilitates enhanced hole injection at the IGZO interface. This promotes efficient hole transport and enables negative differential transconductance (NDT), a critical mechanism for MVL operation. These results underscore the potential of scalable, low-cost, solution-processable oxide semiconductors for next-generation MVL electronics.

Oral Presentation **01-7**

대학원생 구두발표 (I)

2025.9.29(월), 14:30~14:45, 1-1회장

Chair: 서명은,오준균

Bone-Targeted Regeneration Using Hybrid TUDCA-Functionalized MSC Nanovesicles in Osteoporosis Therapy

차경엽, 이수홍[†]

동국대학교

Nanotechnology shows strong potential in regenerative medicine, especially for tissue repair and targeted delivery. Mesenchymal stem cell-derived nanovesicles (MSC-CNVs) are biocompatible and bioactive but limited by low yield and poor targeting. To address this, we developed a hybrid system combining tauroursodeoxycholic acid (TUDCA) to enhance CNV production with bisphosphonate-conjugated lipid nanoparticles (BP-LNPs) for bone targeting. TUDCA-functionalized CNVs (TCNVs) improved yield and regenerative factor levels. BP-hybridized CNVs (BP-hCNVs) enhanced cell uptake and reduced clearance. Ex vivo imaging showed superior bone accumulation. BP-hTCNVs promoted osteogenic differentiation and significantly improved bone regeneration in an ovariectomy-induced osteoporosis mouse model. This hybrid system offers a promising nanoplatform with enhanced efficiency, targeting, and osteoregenerative function for osteoporosis therapy.

Oral Presentation **01-8**

대학원생 구두발표 (I)

2025.9.29(월), 14:45~15:00, 1-1회장

Chair: 서명은,오준균

Ice Recrystallization Inhibition via 2D Janus Peptide Nanosheets

김리서, 이은지[†]

광주과학기술원

Antifreeze proteins (AFPs) play a key role in the survival of polar organisms by selectively binding to specific ice crystal facets and regulating their growth. To mimic this mechanism, a series of amphiphilic peptides were developed incorporating aromatic residues, anionic groups, and hydrophobic tails. These peptides spontaneously self-assembled into two-dimensional Janus nanosheets. At the nanoscale peptide binds to ice crystal surfaces to block their growth, while at the macroscale hydrophobic face prevents water access to inhibit ice recrystallization. Cryo in-situ imaging revealed binding between the nanosheets and ice surfaces. These findings highlight the potential of amphiphilic peptide nanosheets as efficient cryoprotective agents for the preservation of sensitive biological materials such as sperm, oocytes, and stem cells.

Oral Presentation **O1-9**

대학원생 구두발표 (I)

2025.9.29(월), 15:00~15:15, 1-1회장

Chair: 서명은,오준균

Composition-Driven Design of Solid Polymer Electrolytes: Effects of Non-coordinating and Coordinating Polymers on Ionic Transport in PVDF-HFP/PEG Blends

윤승한, 황인수, 최장욱, 김소연⁺

서울대학교

This study explores how coordinating and non-coordinating polymers influence ionic transport in solid polymer blend electrolytes (SPBEs). SPBEs composed of PEG and PVDF-HFP showed ionic conductivity up to 2.21×10^{-4} S/cm at 298 K. Spectroscopy revealed that increasing PEG content shifts Li^+ coordination from solvent-based complexes to PEG ether groups, enabling ion hopping assisted by segmental motion. Ionic conductivity followed VTF behavior, with PEG-rich SPBEs showing lower activation energy and higher pre-exponential factors, indicating enhanced segmental mobility and overcoming the conventional compensation effect. Reduced conductivity analysis confirmed improved intrinsic transport with higher PEG content. Electrochemical tests demonstrated stable lithium plating and stripping with low overpotential in PEG-rich SPBEs. These results highlight that tuning the composition of SPBE offers a strategy for designing high-performance SPBEs for all solid-state lithium batteries.

Oral Presentation **O1-10**

대학원생 구두발표 (I)

2025.9.29(월), 15:15~15:30, 1-1회장

Chair: 서명은,오준균

Fabrication of Li-selective fully aromatic polyamide nanofiltration membranes via a combined loosening strategy

정찬희, 신승수, 김용현, 정지윤, 이정현⁺

고려대학교

There is a growing demand for separation technologies to recover lithium (Li) from industrial and natural resources. Among these, nanofiltration (NF) membranes have gained attention owing to their energy efficiency and ion selectivity. However, conventional Li-selective NF membranes based on semi-aromatic polyamide (PA) often suffer from poor acid resistance, while fully aromatic PA membranes offer stability but exhibit low performance and selectivity. This study presents a fully aromatic PA NF membrane fabricated by a combination of two PA-loosening strategies. The resultant membrane exhibited high Li selectivity and exceptional water permeance under both single- and mixed-salt conditions. Furthermore, it maintained excellent acid resistance and long-term stability. Our approach offers a simple yet powerful route to develop high-performance, acid-stable NF membranes applicable to Li recovery and other industrial separations.

Oral Presentation **01-11**

대학원생 구두발표 (I)

2025.9.29(월), 15:30~15:45, 1-1회장

Chair: 서명은,오준균

Dual-Mode Wearable Sensory Systems with Dynamic Operation Using Electrical-Ionic Bimodal Conductors

권진한, 문홍철[†]

한국과학기술원

In this work, we propose dynamically switchable dual-mode wearable sensory platforms based on electrical-ionic bimodal conductors that integrate both electrical and ionic conductive characteristics within a simple bilayer structure. The conductor design incorporates highly conductive, crack-forming electrical channel and elastic ionic channel. Each conduction layer serves as the primary sensing channel, depending on the strain range. The electrical channel demonstrates superior performance in detecting low strains, leveraging dramatic resistance changes caused by the disruption of the electrical conducting network under strains. In contrast, the ionic channel adjusts its resistance in response to geometric deformation upon stretching, enabling the detection across a broad strain range. The optimized sensory platform exhibits outstanding performance metrics, including high sensitivity, substantial deformability, and remarkable durability.

Oral Presentation **O1-12**

대학원생 구두발표 (I)

2025.9.29(월), 15:45~16:00, 1-1회장

Chair: 서명은,오준균

Mixed Ion-Electron Conductive Polymer Interlayers for Sustainable Lithium Batteries

최웅식, 심채영, 심근홍, 박문정⁺

포항공과대학교

Sulfur and redox-active organic compounds have been widely studied as cathode for lithium batteries due to low cost and sustainability. However, their application is limited by poor electronic conductivity, sluggish Li^+ transport and active material dissolution, leading to poor cycling stability. Although various interlayers have been introduced to enhance redox kinetics, progress has been slow. In this study, we developed mixed ion-electron conducting interlayers via an ice-templating method to simultaneously enhance electron and ion transport and suppress shuttle effects. This interlayer consists of highly ordered porous polyaniline nanosheets decorated with Li^+ conducting polyethylene glycol nanoparticles along the pore walls. The interlayer exhibited both high electrical (6.0 S cm^{-1}) and ionic (0.22 mS cm^{-1}) conductivity, while mitigating the shuttle effects by confining active materials within the porous structures. These led to enhanced battery performance of lithium batteries.

Oral Presentation **01-13**

대학원생 구두발표 (I)

2025.9.29(월), 16:00~16:15, 1-1회장

Chair: 서명은,오준균

Controlling Sequence and Composition in Polymer Binders for High Performance Silicon Anodes

이승우, 안석균[†]

부산대학교

Silicon has emerged as a next-generation anode material for lithium-ion batteries due to its high theoretical capacity and potential for fast charging. However, its practical application is limited by significant volume changes during charge–discharge cycles, which compromise long-term stability. In this study, we synthesize a series of polynorbornene-based copolymer binders incorporating ethylene glycol and carboxylic acid functionalities with varying compositions via ring-opening metathesis polymerization (ROMP). The living nature of ROMP allows rapid synthesis of polymers with precise control over molecular weight and sequence. Interestingly, variations in molecular sequence (i.e., block vs. random) and composition in binders significantly influence the mechanical integrity and electrochemical performance of the silicon anodes. Our study highlights the importance of sequence and composition control in designing high-performance binders for silicon anodes.

Oral Presentation **O1-14**

대학원생 구두발표 (I)

2025.9.29(월), 16:15~16:30, 1-1회장

Chair: 서명은,오준균

Tunable Adhesion Strength of Donor-Acceptor Stenhouse Adduct Embedded Polymer Matrix under Visible-Light Irradiation

권민경, 김시우, 서경원¹, 노우진¹, 안효성¹, 이재준⁺

부산대학교

¹ 전남대학교

Tunable adhesives hold great promises for advanced material applications requiring on-demand adhesion control. Photoswitches offer a compelling strategy to achieve such tunability, enabling responsiveness at the molecular level. Donor-acceptor Stenhouse adducts (DASAs) are particularly attractive due to their large volumetric transformation and reversible surface polarity changes upon visible light exposure. In this study, we synthesized a crosslinked network comprising polyethyleneimine (PEI) and bisphenol A diglycidyl ether, with covalently integrated DASA moieties. The photo-responsive adhesion of the DASA-functionalized films was quantified using probe tack tests and AFM-based force distance measurements before and after visible light irradiation. To optimize adhesion tunability, we systematically modulated both surface properties and bulk stiffness of the films. This switchable adhesive system presents a versatile platform for applications requiring dynamic, controllable adhesion.

Oral Presentation **01-15**

대학원생 구두발표 (I)

2025.9.29(월), 16:30~16:45, 1-1회장

Chair: 서명은,오준균

Programmable Separation of Pre-Assembled P3HT from Free P3HT for Selective Nanowire Blends Confirmed by Quantitative TEM Analysis

윤준연, 이은지[†]

광주과학기술원

Precise control over crystalline versus amorphous domains and molecular orientation in conjugated polymer (CP) thin films is vital for enhancing performance of soft electronics like field-effect transistors, LEDs, and solar cells. Here, we introduce a straightforward centrifugation-based purification method that isolates highly crystalline P3HT nanowires and their hybrids with CdSe quantum dots from non-assembled polymers prepared via the whisker method. This separation enriches structural coherence and molecular ordering, markedly boosting hole mobility. Conversely, films derived from the supernatant of non-crystalline chains exhibit superior stretchability, revealing a critical trade-off between electrical performance and mechanical flexibility. We establish a rational pathway to selectively engineer domain composition in CP films, enabling a tailored balance between high charge transport and mechanical compliance for next-generation flexible and wearable electronics.

Oral Presentation **O1-16**

대학원생 구두발표 (I)

2025.9.29(월), 16:45~17:00, 1-1회장

Chair: 서명은,오준균

Stretchable strain-insensitive capacitive pressure sensor

최건오, 정예환[†]

한양대학교

Stretchable pressure sensors are essential in applications such as stretchable displays and prosthetics. However, conventional stretchable pressure sensors struggle to distinguish between strain and pressure signals, requiring additional processing for data analysis. In this study, we report a strain-insensitive capacitive pressure sensor using a dielectric elastomer with a tunable dielectric constant. This innovation represents a significant advance in the development of stretchable capacitive pressure sensors. This study presents a potential solution for distinguishing between pressure and strain signals by overcoming the inherent challenges of pressure sensors and improving their practicality. This advancement paves the way for the integration of these sensors into next-generation stretchable devices, intelligent robotics, and other advanced applications.

Oral Presentation **01-17**

대학원생 구두발표 (II)

2025.9.29(월), 13:00~13:15, 1-2회장

Chair: 최영재, 최청룡

Integrating Redox Chemistry and Elasticity: Organodisulfide-Based Ionogels for High-Performance Stretchable Capacitors

김민수, 박동현, 유원철¹, 조경국^{1,2}, 이근형⁺

인하대학교

¹ 한양대학교

² 한국화학연구원

The development of stretchable energy storage devices with both high energy and power densities remains a major challenge for next-generation wearable and deformable electronics. We introduce redox-active ionogels (R-ionogels) incorporating organodisulfides as redox species for use in high-performance, stretchable solid-state electrochemical capacitors (R-SECs). The R-ionogels are formulated by combining tetraethylthiuram disulfide (TETDS), the ionic liquid [EMI][TFSI], and a physically crosslinked polymer network of P(VDF-HFP). Electrochemical characterization, including CV and GCD tests, confirms that the R-SECs exhibit both pseudocapacitive behavior from redox reactions and EDL capacitance. Notably, the device utilizing a 0.25 M TETDS R-ionogel achieves a high specific capacitance of 405 F/g, an energy density of 117 Wh/kg, a power density of 5.9 kW/kg, and retains 83% of its capacitance at high current densities with 80% cycling stability over 2000 cycles.

Oral Presentation **O1-18**

대학원생 구두발표 (II)

2025.9.29(월), 13:15~13:30, 1-2회장

Chair: 최영재, 최청룡

Discovery of Optimal Interplay between Grafting Ratio and Side-Chain Interval in Adhesive Polymer Binders for Lithium-Ion Batteries

원광빈, 심지민[†]

서울대학교

High-energy lithium-ion batteries (LIBs) require polymer binders that maintain mechanical integrity under high mass-loading. While polyvinylidene (PVDF) is electrochemically stable, its poor adhesion often leads to electrode delamination and capacity fading. Although modified PVDF binders have been explored, most lack systematic control over polymer structure. Here, we develop PVDF-g-polyacrylic acid (PAA) (PVDFA) binders with carboxylic acid functional groups to improve interfacial adhesion. By tuning side-chain length and spacing, we identify key structural parameters that govern adhesion and cycling durability. Enhanced bonding with electrode components is confirmed through electrochemical testing and post-mortem analysis. These results show that precise control of polymer architecture-particularly the interplay between side-chain length and interval-enables significant performance improvement, offering a rational strategy for designing durable, high-efficiency LIB binders.

Oral Presentation **O1-19**

대학원생 구두발표 (II)

2025.9.29(월), 13:30~13:45, 1-2회장

Chair: 최영재, 최청룡

Catalytic Decomposition of Polycarbonates in Aqueous Solution by End-Scission

박승주[†], 강영종^{†1}

한양대학교

¹ 한양대학교 화학과

Polycarbonate (PC) waste poses a significant environmental challenge due to its stability and resistance to hydrolysis under mild conditions. In this study, we developed an aqueous-phase catalytic system capable of decomposing PC via an end-scission pathway. The approach enables efficient depolymerization at ambient temperature, leading to high recovery of bisphenol A (BPA) with excellent selectivity. Structural analyses of the polymer fragments confirmed end-group scission as the dominant degradation pathway, while catalyst reuse tests demonstrated good stability over multiple cycles. This study provides a practical and sustainable method for polycarbonate recycling, highlighting the potential of aqueous-phase catalytic strategies for efficient polymer depolymerization.

Oral Presentation **O1-20**

대학원생 구두발표 (II)

2025.9.29(월), 13:45~14:00, 1-2회장

Chair: 최영재, 최청룡

Effect of Chlorine Substitution on the Isoindigo backbone on the Crystallinity and Thermoelectric Performance of Conjugated Polymers

배건택, 하종운¹, 박병욱, 한미정, 강영훈⁺

한국화학연구원

¹ 국립경상대학교

Chemical doping is widely employed to enhance the electrical and thermoelectric (TE) properties of conjugated polymers (CPs), but preserving crystallinity and morphological stability is essential to attain high performance of TE. In this study, we propose a molecular design strategy involving the incorporation of chlorine (Cl) atoms into the polymer backbone to enhance the crystallinity of the isoindigo-based CPs and simultaneously suppress structural disorder following chemical doping. Nanostructural and morphological analyses revealed that Cl-substitution improved molecular ordering in the pristine film and contributed to the preservation of the crystalline structure upon doping. As a result, the Cl-substituted CP exhibited a high electrical conductivity of 119 S cm^{-1} and a power factor of $93.2 \text{ } \mu\text{W m}^{-1} \text{ K}^{-2}$ by the structural stability in the doped state providing continuous charge transport pathways.

Oral Presentation **01-21**

대학원생 구두발표 (II)

2025.9.29(월), 14:00~14:15, 1-2회장

Chair: 최영재, 최청룡

Vertically Aligned Anhydrous Rochelle-Salt/PDMS Composite Films for Eco-Friendly High-Voltage Piezoelectric Energy Harvesting

김건우, 윤제문[†], 최재학¹

동의대학교

¹ 충남대학교

Rochelle salt is a non-toxic and eco-friendly piezoelectric material, notable for its excellent crystal growth and ease of processing. Although it shows a high piezoelectric coefficient and spontaneous polarization near room temperature, it suffers from fragility and reduced stability due to its sensitivity to environmental changes like temperature and humidity. For these reasons, ceramic and polymer materials have generally been preferred. In this study, RS was maintained in an anhydrous state, and a composite film was fabricated by applying an electric field to vertically align RS crystals within a PDMS matrix. This RS/PDMS film exhibited a maximum output voltage of about 8V, demonstrating high-performance piezoelectric response while retaining non-toxic and eco-friendly characteristics. These results suggest new possibilities for the development of eco-friendly, high-performance piezoelectric devices and energy harvesting technologies utilizing RS by overcoming issues of stability.

Oral Presentation **O1-22**

대학원생 구두발표 (II)

2025.9.29(월), 14:15~14:30, 1-2회장

Chair: 최영재, 최청룡

Mechanochromic Auxetic Photonic Pattern for Simultaneous Analysis of Deformation Direction and Strain

이환영, 김신현[†]

한국과학기술원

Elastic photonic crystals, composed of non-closed colloidal arrays embedded in elastic matrices, exhibit mechanochromism; however, the extent of colloidal deformation inherently limits their color-change sensitivity. Fractal cut patterns with regular cut structures expand under strain by twisting their skeletons, thereby amplifying local deformation within the cut regions. In this study, we constructed cut regions using elastic photonic crystals and skeleton regions using urethane, enabling large color changes with minimal deformation. As a result, the system achieved an ultrahigh sensitivity of up to 60 nm/%—approximately 20 times higher than that of bulk films. Furthermore, by analyzing colorimetric changes under multidirectional deformations, we established a platform capable of simultaneously determining both deformation magnitude and direction. This auxetic photonic pattern offers potential for applications in structural health monitoring and mechanochromic sensing.

Oral Presentation **O1-23**

대학원생 구두발표 (II)

2025.9.29(월), 14:30~14:45, 1-2회장

Chair: 최영재, 최청룡

Targeted Ferroptosis Modulation in Cancer Immunotherapy via Iron Oxide Nanoparticle-Encapsulated PD-L1 siRNA

류수현, 이강원[†]

서울대학교

We developed a tumor-targeted nanoplatform that induces ferroptosis and suppresses immune evasion. Iron oxide nanoparticles were coated with PEI to load PD-L1 siRNA and modified with hyaluronic acid for CD44-mediated targeting. This system selectively delivers therapeutics to cancer cells with minimal off-target effects. In vitro, treatment reduced cancer cell viability to 30% while sparing normal cells. Ferroptosis was confirmed by elevated ROS and lipid peroxidation. PD-L1 siRNA effectively silenced PD-L1 expression. In vivo, the nanoparticles inhibited tumor growth and accumulated in tumors, with low distribution to other organs. Immunohistochemistry showed decreased PD-L1 and increased CD8⁺ T cell infiltration. This nanoplatform integrates ferroptosis and immune checkpoint blockade for effective cancer therapy.

Oral Presentation **O1-24**

대학원생 구두발표 (II)

2025.9.29(월), 14:45~15:00, 1-2회장

Chair: 최영재, 최청룡

Decoupling Geometric Artifacts from Intrinsic Crystallographic Properties in Thin-Film X-ray Scattering for Optoelectronics

정세인, 김영용¹, 조길원⁺

POSTECH

¹ Pohang Accelerator Laboratory, PLS-II

Grazing-Incidence X-ray Scattering is indispensable for analyzing thin-film optoelectronic materials. However, its quantitative accuracy is often compromised by geometric artifacts, which are fundamentally linked to the Distorted Wave Born Approximation (DWBA). In this work, we systematically investigate a critical artifact arising from the X-ray beampath length, which significantly alters measured scattering intensities. Through model studies on well-known organic and inorganic thin films, we establish a clear correlation between beampath length and intensity distortions, differentiating this phenomenon from the conventional footprint effect. Crucially, we propose a practical extrapolation method to effectively correct for these beampath-dependent artifacts. This approach enables the extraction of intrinsic crystallographic parameters free from geometric distortions, paving the way for more reliable structure-property relationships and robust in-situ/operando characterization.

Oral Presentation **O1-25**

대학원생 구두발표 (II)

2025.9.29(월), 15:00~15:15, 1-2회장

Chair: 최영재, 최청룡

Uniform Synthesis of Lignin Nanoparticles and the Effects of its Content on Microstructure and Properties of Polymer Nanocomposites

이인준, 김소연[†]

서울대학교

Lignin, the second most abundant biopolymer after cellulose, is gaining attention in academia and industry as a promising material for eco-friendly process. Recent studies have focused on employing lignin in the form of lignin nanoparticles (LNPs) in polymer nanocomposites (PNCs) to enhance material properties.

In this study, LNPs (~tens of nm) were readily produced via anti-solvent precipitation. Polyvinyl alcohol (PVA) was used as the matrix polymer, and then PNCs were fabricated by solution casting method. We investigated the effects of LNP content and PVA molecular weight on PNC's microstructure and properties. Small-Angle X-ray Scattering (SAXS) and rheometer were employed to analyze LNP dispersion and microstructure. Structural variation in the solution state were found to influence crystallinity and properties of PNCs.

Through these findings, we aim to understand the role of LNPs and contribute to the growing knowledge of lignin-based nanocomposites and their potential applications in sustainable materials science.

Oral Presentation **O1-26**

대학원생 구두발표 (II)

2025.9.29(월), 15:15~15:30, 1-2회장

Chair: 최영재, 최청룡

Fiber-Integrated Organic Electrochemical Transistors for Real-Time Glucose Monitoring in Plants

원종현, 이인호, 박성준[†]

아주대학교

Organic electrochemical transistors (OECTs) combine high sensitivity, biocompatibility, and ion–electron coupling, making them ideal for biosensing. Yet, planar formats struggle with miniaturization for implantable use due to noise and mechanical mismatch.

In this study, we introduce fiber-integrated OECTs patterned onto 200 μm fibers via photolithography for minimally invasive glucose monitoring in plants. PEDOT:PSS channels enhanced redox sensitivity and reduced impedance, yielding high transconductance ($>19 \text{ mS}$) and excellent SNR.

This platform outperforms conventional sensors by offering superior spatial resolution, lower invasiveness, and improved integration with plant tissues, enabling real-time in vivo monitoring for plant research and smart agriculture.

Oral Presentation **O1-27**

대학원생 구두발표 (II)

2025.9.29(월), 15:30~15:45, 1-2회장

Chair: 최영재, 최청룡

Synthesis of Well-Defined Triphenylamine-Based HTL Polymers via Living Anionic Polymerization for Enhanced Perovskite LED Performance

김준모, 강범구[†], 양예은, 장이령

송실대학교

In this study, we carried out living anionic polymerization of **A** and **B** containing triphenylamine units with hole transport properties. The anionic polymerization of **A** and **B** was performed using sec-BuLi or K-Naph as initiator in THF at -78 °C and -30 °C. Well-defined poly(**A**) and poly(**B**) with controlled molecular weights and narrow molecular weight distributions were successfully synthesized at both temperatures without side reactions. Based on these results, well-defined block copolymers incorporating poly(**A**) or poly(**B**) segments were also synthesized through block copolymerization with styrene. Finally, we applied poly(**A**) and poly(**B**) as hole transport layers in perovskite LEDs (PeLEDs). The device fabricated with poly(**B**) demonstrated significantly improved performance in PeLEDs compared to the reference device fabricated with PVK. These results suggest that poly(**B**) can be a new option for HTL in PeLEDs.

Oral Presentation **O1-28**

대학원생 구두발표 (II)

2025.9.29(월), 15:45~16:00, 1-2회장

Chair: 최영재, 최청룡

Glycol Gel with Tunable T_g and Mechanical Properties for Patterning

정수민, 최재원, 김연수[†]

POSTECH

Glycol-based gels offer wide thermal operability, biocompatibility, and tunable mechanical properties, making them attractive for thermal-responsive applications. Using 1,3-butanediol (BG) as the solvent, we fabricated gels with an extended temperature range (freezing point: -57°C ; boiling point: 204°C), enabling introduction of controllable glass transition temperatures (T_g). By adjusting monomer composition and concentration, T_g values from below 0°C to over 100°C were achieved. Through spatial patterning, distinct T_g domains were created within a single gel. Upon heating to intermediate temperatures, only the low- T_g regions soften and deform, while high- T_g areas remain rigid. This configuration allows rigid domains to support electronic components stably, while soft domains enable mechanical deformation. Fine-scale photopatterning using a photomask further enhanced spatial control over properties.

Oral Presentation **O1-29**

대학원생 구두발표 (II)

2025.9.29(월), 16:00~16:15, 1-2회장

Chair: 최영재, 최청룡

Photoswitchable Dynamicity in Azobenzene-Based Elastomers while Maintaining Mechanical Robustness

이민우, 강지형¹

서울대학교 화학부

¹ 서울대학교

We introduce a physically crosslinked elastomer system (PolyAzo) featuring sterically hindered azobenzene molecules, capable of reversible photoswitching of dynamic mechanical properties while preserving mechanical robustness. Unlike conventional azobenzene-based materials that exhibit phase transitions such as solid-to-liquid transitions, PolyAzo leverages trans-to-cis isomerization within the solid state to modulate mechanical responses without disrupting the crosslinked domain. The photoisomerization process enhances molecular mobility within the physically crosslinked domains, resulting in increased stress relaxation and energy dissipation under mechanical force. This photoinduced dynamic crosslinked domain significantly improves the overall mechanical properties such as toughness upon UV irradiation. Notably, PolyAzo exhibits self-healing behavior with UV exposure, demonstrating its ability to dynamically repair mechanical damage while maintaining structural integrity.

Oral Presentation **O1-30**

대학원생 구두발표 (II)

2025.9.29(월), 16:15~16:30, 1-2회장

Chair: 최영재, 최청룡

이온 도핑된 π -공액 고분자 소자의 도핑 열화 메커니즘 분석

조선우, 곽정훈[†]

서울대학교

Nowadays, heavily doped π -conjugated polymers via ionic doping play a crucial role in devices such as organic electrochemical transistors(OECTs) and thermoelectric(TE) devices, where high on-current is required. However, the stability issues of ionic doping remain unsolved, since active layers in such wearable devices must be continuously exposed to electrolytes, which makes encapsulation infeasible. In our research, we fabricated poly[2,5-bis(3-tetradecylthiophen-2-yl)thieno[3,2-b]thiophene](PBTTT) films via ion-exchange doping. Their long-term conductivity under various stress conditions, including heat, water, ethanol, ambient, and inert atmosphere, was measured. The results were then analyzed from two aspects, doping stability and structural degradation. This work gives the key mechanisms underlying the conductivity decrease and guidance for designing robust polymer-based electronics.

Oral Presentation **01-31**

대학원생 구두발표 (II)

2025.9.29(월), 16:30~16:45, 1-2회장

Chair: 최영재, 최청룡

지속 가능한 건축물 냉각을 위한 생분해성 PLA-Pulp 복합소재

홍승혁, 유영재[†]

중앙대학교

본 연구에서는 폴리락트산(PLA)과 표백 펄프를 이용해 수동형 주간 복사 냉각(PDRC)을 위한 생분해성 복합소재를 개발하였습니다. 70 wt%의 펄프가 포함된 복합소재는 높은 장파 적외선 방사율(0.94)과 우수한 태양광 반사율을 나타내어, 주변 온도보다 11.1도 낮은 냉각 효과와 110.17 W/m²의 냉각 성능을 보였습니다. 해당 소재는 18일 이내에 완전히 생분해되는 것으로 확인되었으며, 이러한 결과는 PLA-Pulp 복합소재가 건축물 냉각을 위한 지속 가능하고 효율적인 친환경 소재로 활용될 수 있는 가능성을 보여줍니다.

Oral Presentation **O1-32**

대학원생 구두발표 (II)

2025.9.29(월), 16:45~17:00, 1-2회장

Chair: 최영재, 최청룡

Magnetically Aligned Anisotropic Hydrogel Scaffold for Skeletal Muscle Regeneration

배고은, 이현종⁺

가천대학교

Severe volumetric loss of skeletal muscle results in limited regeneration and incomplete functional recovery. To address this, we developed a scaffold mimicking the native muscle structure by integrating magnetically responsive polycaprolactone (PCL) fibrils into a gelatin methacrylate (GelMA) hydrogel. Electrospun PCL fibers containing iron oxide nanoparticles were aligned under an external magnetic field after embedded in the hydrogel, forming an anisotropic structure. We evaluated the effects of fiber concentration and alignment on mechanical properties, cell viability, and myogenic differentiation. Aligned fiber incorporation enhanced the hydrogel's mechanical strength and promoted cell elongation and orientation along the fiber direction. Additionally, increased MyoD expression indicate improved early myogenic differentiation. These findings demonstrate the potential of this magnetically guided anisotropic hydrogel as a scaffold for skeletal muscle regeneration.

Oral Presentation **O2-1**

대학원생 구두발표 (III)

2025.9.29(월), 13:00~13:15, 2회장

Chair: 김호범, 김명웅

Light-Triggered In-Operando Shape Fixation of Magneto-Responsive Microtextures with Covalent Adaptable Networks

문호준, 윤여명¹, 조웅비, 이동욱², 정소담², 김채빈¹, 위정재[†]

한양대학교

¹ 부산대학교

² 동의대학교

Magneto-responsive microtextures enable the formation of complex 3D microstructures via magnetic deformation, yet the deformed shapes typically revert to their original form once the magnetic field is removed. In this presentation, we introduce disulfide-based covalent adaptable networks (DS-CANs) as a matrix to enable shape fixation through dynamic covalent bonding. DS-CANs undergo UV-triggered bond exchange reactions at room temperature, allowing the magnetically deformed shapes to be fixed on demand. Magnetomechanical actuation of the DS-CAN-based microarrays is achieved by incorporating hard magnetic NdFeB particles into the composite. These DS-CAN/NdFeB microarrays demonstrate not only on-demand magnetic actuation but also reversible and patternable shape fixation via UV exposure under an external magnetic field. Furthermore, we fabricated complex 3D hierarchical and staggered-overlapped microstructures inspired by microdenticles through UV-assisted shape fixation.

Oral Presentation **O2-2**

대학원생 구두발표 (III)

2025.9.29(월), 13:15~13:30, 2회장

Chair: 김호범, 김명웅

Modulation of the Crosslinking Degree in Piperidinium-Based Anion Exchange Membranes for Efficient Water Electrolysis

장현지, 강범구[†], 박승일

승실대학교

A quaternization-based crosslinking strategy was employed using 4,4'-trimethylenebis(1-methylpiperidine), a stable crosslinker under alkaline conditions, to enhance the ion exchange capacity, suppress swelling, and improve alkaline stability. Polystyrene-*b*-poly(6-bromohexyl acrylate)-*b*-polystyrene block copolymers with polystyrene contents (30, 44, 50, and 60 wt%) were synthesized, and crosslinked membranes (CPSBHAS30, CPSBHAS44, CPSBHAS50, and CPSBHAS60) were prepared to investigate the correlation between crosslinking degree and membrane properties. CPSBHAS50 demonstrated the most balanced performance. CPSBHAS50 showed a low swelling ratio (22.6% at 80 °C), high tensile strength (17.6 MPa), and excellent alkaline stability, retaining 86.7% of its initial ionic conductivity after 720 h in 1 M KOH at 60 °C. Furthermore, it achieved a high current density of 0.926 A/cm² (1 M KOH, 60 °C, 2.0 V) and maintained stable voltage operation for 100 h at 0.2 A/cm².

Oral Presentation **O2-3**

대학원생 구두발표 (III)

2025.9.29(월), 13:30~13:45, 2회장

Chair: 김호범, 김명웅

Sorting-free Carbon Nanotube Channel for Synaptic Transistor with Facile and Rapid fabrication process

신동희, 정범진[†]

부산대학교

Carbon nanotubes (CNTs) are promising candidates for next-generation electronic materials due to their high charge mobility, chemical and thermal stability and mechanical flexibility. However, their metallic and semiconducting CNT mixture requires time and cost consuming sorting processes before device fabrication. In this study, we demonstrate a sorting-free CNT channel synaptic transistor using electrolyte-gated doping. An electrolyte composed of a ferroelectric polymer and ionic liquid induces p-type doping in the CNTs. We investigated the switching behavior of the CNT devices as a function of ionic concentration and doping state under applied bias. The devices exhibit stable conductance modulation, long-term potentiation/depression and short-term plasticity. Furthermore, we evaluated synaptic performance through pattern recognition simulations. These results suggest that our simple synaptic device fabrication process is a promising approach for neuromorphic computing applications.

Oral Presentation **O2-4**

대학원생 구두발표 (III)

2025.9.29(월), 13:45~14:00, 2회장

Chair: 김호범, 김명웅

Tailoring Interfacial Interactions and Dynamics of Polylactic-acid nanocomposites via PLA-Grafted-Cellulose Nanocrystals

정효진, 김지현¹, 박제영¹, 김소연⁺

서울대학교

¹ 서강대학교

Poly(lactic acid) (PLA) is a biodegradable polymer with excellent mechanical and thermal properties, whose performance can be enhanced by adding nanoparticles (NPs) to form polymer nanocomposites (PNCs). Among NPs, cellulose nanocrystal (CNC) is attractive based on its eco-friendly nature, but often poorly compatible with PLA due to its hydrophilicity. To overcome this, PLA chains can be grafted onto CNC (gCNC) to improve compatibility with matrix.

This study compared PLA/CNC and PLA/gCNC nanocomposites, focusing on physical adsorption vs. chemical grafting at the interface. The effects of interfacial chains on dynamics were quantified, and microstructures were examined. gCNCs not only enhanced compatibility with PLA but also accelerated chain mobility through the stretched conformations, leading to distinct polymer dynamics across time scales confirmed by BDS, QENS, and NMR. These findings highlight gCNC as a promising reinforcement inducing synergistic effects beyond conventional PNCs.

Oral Presentation **O2-5**

대학원생 구두발표 (III)

2025.9.29(월), 14:00~14:15, 2회장

Chair: 김호범, 김명웅

Designing a fully Bio-Based Copolyester from 2,5-Furandicarboxylic Acid: Linking Molecular Structure to Stiff but Elastic Properties

최세훈, 구준모[†]

충남대학교

Mechanical stiffness and elastic recovery are often difficult to achieve simultaneously due to conflicting structural requirements. Here, we present a fully bio-based copolyester, poly(propylene-co-cyclohexanedimethylene furanoate) (PPCF), that overcomes this challenge. Polar aromatic 2,5-furandicarboxylic acid units impart high rigidity, while the asymmetric molecular structure enables elastic potential. Consequently, PPCF exhibits a Young's modulus of 2785 MPa, tensile strength of 69.8 MPa, and notched impact strength of 142.7 J·m⁻¹, comparable to engineering plastics. Notably, PPCF recovers its shape at 65 °C, below its glass transition temperature, even after plastic deformation beyond the yield point. These findings highlight PPCF as a sustainable, high-performance polymer combining mechanical strength and recoverability for advanced applications.

Oral Presentation **O2-6**

대학원생 구두발표 (III)

2025.9.29(월), 14:15~14:30, 2회장

Chair: 김호범, 김명웅

Ion-Retentive Multi-Cross-Linked Membrane Ionogel Assembly for Sustainable Neurostimulation

김종휘, 김도환[†], 정재용¹, 박성민², 김지홍, 최원혁, 김준호², 임준우¹

한양대학교

¹ 숭실대학교

² 포항공과대학교

Neurostimulation is used for a variety of disease treatment, yet conventional metal and polymer based electrodes cause faradaic charge injection, leading to gas evolution, electrode degradation and ion exchange. These effects compromise long-term stability and biocompatibility of the device, limiting its clinical application.

Here, we present a multicross-linked membrane-ionogel assembly (McMiA) that enables a stable neural interface. The McMiA consists of a dopamine-cross-linked graphene oxide based membrane and a genipin-cross-linked biopolymeric ionogel, forming an anti-degradable network and ion diffusion layer that prevents synthetic-biological ion imbalance. Introducing of ionic liquid extends the electrochemical window beyond physiological limits, preventing undesired electrochemical reactions. This synergistic combination ensures improved long-term stability, highlighting McMiA's potential as a promising platform for advanced neural interface engineering.

Oral Presentation **O2-7**

대학원생 구두발표 (III)

2025.9.29(월), 14:30~14:45, 2회장

Chair: 김호범, 김명웅

Polyaniline-Modified Mo₂TiC₂ MXene Nanocomposites for Wearable Ammonia Sensors with Superior Sensitivity and Humidity Tolerance

이주연, 김선준[†]

한국과학기술연구원

Conductive polymers have attracted significant attention for gas sensing due to their tunable physicochemical properties, ease of functionalization, and compatibility with flexible substrates. In this study, we report a room-temperature NH₃ gas sensor based on polyaniline (PANI)-modified Mo₂TiC₂ MXene, where PANI serves not only as a selective NH₃ receptor but also as a stable conductive matrix. The synergy between PANI and MXene yields enhanced charge transport and gas adsorption, resulting in a 52-fold increase in NH₃ sensitivity over pristine MXene. The composite sensor exhibited a 57.8% response to 100ppm NH₃ under humid conditions. For wearable integration, we fabricated flexible electrodes via spray-coating Ti₃C₂ MXene followed by drop-casting the PANI-Mo₂TiC₂ composite layer. The device demonstrated high sensitivity and retained long-term stability for over 120 days, highlighting the potential of polymer-MXene hybrids for next-generation flexible gas sensing technologies.

Oral Presentation **02-8**

대학원생 구두발표 (III)

2025.9.29(월), 14:45~15:00, 2회장

Chair: 김호범, 김명웅

3D mesoporous MnO@C nanocomposite prepared by block copolymer self-assembly as cathodic materials for high-performance aqueous zinc-ion battery

박지성, 진형민[†]

충남대학교

This research investigates molecular self-assembly, a process in which molecules spontaneously arrange into ordered structures via intermolecular forces such as hydrogen bonding and van der Waals interactions. By adjusting the volume fractions and molecular weights of polymer blocks, it is possible to achieve nanoscale structures with diverse sizes and morphologies.

Here, we employed block copolymer self-assembly to produce three-dimensional mesoporous carbon composites containing manganese oxide. The method involved co-assembling amphiphilic PS-*b*-PEO with manganese and phenol-formaldehyde precursors to create cylindrical structures. Subsequent heat treatment transformed these structures into manganese oxide-doped mesoporous carbon composites. Structural analyses using SAXS, SEM, BET, and other techniques verified the formation of the nanostructures, confirming their effectiveness as cathode materials for aqueous zinc-ion batteries.

Oral Presentation **O2-9**

대학원생 구두발표 (III)

2025.9.29(월), 15:00~15:15, 2회장

Chair: 김호범, 김명웅

Conjugated Polymers capable of changing conductivity by aqueous solutions containing ions: Enhancing Ion–Polymer Interactions via Hydrophilic Side Chains

이효선, 김종호⁺¹

경북대학교 섬유시스템공학과

¹ 경북대학교

Organic mixed ionic–electronic conductors (OMIECs) are capable of transporting both ions and electrons, making them promising materials for aqueous sensing. We synthesized a series of naphthalene diimide (NDI)-based n-type conjugated polymers with ethylene glycol (EG) side chains of varying lengths. These hydrophilic side chains interact with ionic species in solution, affecting ion–polymer interactions and electrical properties. Electrical measurements in ion-containing aqueous environments showed side chain length-dependent changes in conductivity. In particular, the polymers with longer EG chains exhibited non-volatile conductivity behavior, maintaining conductive states after ion removal. These results demonstrate that side chain engineering can tailor ionic interactions and electronic responses in OMIECs, enabling application-specific functions—such as neuromorphic operation for non-volatile systems and organic electrochemical transistors (OECTs) for volatile.

Oral Presentation **O2-10**

대학원생 구두발표 (III)

2025.9.29(월), 15:15~15:30, 2회장

Chair: 김호범, 김명웅

Formation of Conductive Pathways to Improve Thermoelectric Performance in Doped Polymers

김병진, 조길원[†]

포항공과대학교

Chemical doping enhances the electrical performance of conjugated polymers (CPs), yet intrinsic disorder often restricts charge transport to a subpercolation regime due to disrupted connectivity between conducting domains. Here, we employ a simple molecular design strategy to overcome this limitation by inducing small π - π aggregates within amorphous regions. A random copolymer with 33 mol% unsubstituted thiophene units (RP33) achieves high conductivity ($>500 \text{ S cm}^{-1}$) and a power factor $>100 \text{ } \mu\text{W m}^{-1} \text{ K}^{-2}$ via ion exchange doping. Structure analyses and transport analyses reveal that these aggregates establish percolation pathways in the disordered matrix, enabling coherent charge transport. This work highlights aggregate-driven microstructural engineering as a promising route to boost charge transport in doped CPs.

Oral Presentation **02-11**

대학원생 구두발표 (III)

2025.9.29(월), 15:30~15:45, 2회장

Chair: 김호범, 김명웅

A Synthetic Method for Covalent Adaptable Network Formation from Thiol-Epoxy Click-derived Linear Polymers via Transesterification

이유섭, 김소희¹, 엄태준¹, 방준하⁺

고려대학교

¹ 국립금오공과대학교

Vitrimers, characterized by their covalent adaptable network (CAN) structures, are a class of polymer networks that combine mechanical robustness of thermosets with reprocessability of thermoplastics. Unlike conventional thermosets, vitrimers retain their network structure while allowing reversible bond rearrangement under external stimuli, enabling recyclability, self-healing, and stress relaxation. In this study, CAN was prepared without the use of external crosslinkers by thermally activating linear polymers, synthesized by thiol-epoxy 'click' reaction. Dynamic bond exchange was induced through transesterification, enabling the formation of adaptable network structures upon heating. Rheological analyses confirmed dynamic behavior and showed excellent reprocessability, retaining their mechanical and rheological properties after recycling. The mechanical properties of networks were tunable through monomer selection, enabling control over rigidity and flexibility.

Oral Presentation **02-12**

대학원생 구두발표 (III)

2025.9.29(월), 15:45~16:00, 2회장

Chair: 김호범, 김명웅

Microfluidic Droplet Device for Selective Extraction and Retrieval of Analytes from Solid-Containing Samples

최성욱, 김동현¹, 유재범², 김주현⁺, 정수환¹

한국화학연구원

¹ 경북대학교

² 충남대학교

Sample pretreatment, such as liquid-liquid extraction (LLE), is essential for analyzing complex samples containing interferences. However, LLE requires large amounts of organic solvents, causing environmental and health issues. Liquid-liquid microextraction (LLME) offers cost-effective and rapid enrichment due to low solvent use and high surface area-to-volume ratio. Nevertheless, LLME has drawbacks like analyte loss during extra removal steps when solid particles are present. To address this, we designed a microfluidic device enabling direct extraction and retrieval of analytes from slurry samples without further preparation. The extractant, 1-octanol, confined in a microchamber, contacts the flowing sample in the main channel and rapidly extracts model analytes—Nile Red (NR), carbamazepine (CBZ), and perfluorooctanoic acid (PFOA). This system enables selective analysis of various aquatic samples without conventional pretreatment.

Oral Presentation **O2-13**

대학원생 구두발표 (III)

2025.9.29(월), 16:00~16:15, 2회장

Chair: 김호범, 김명웅

Effect of network elasticity on the electric double layer of Ionoelastomers

신희윤, 김형준[†]

서강대학교

Ionoelastomers (IEs) are liquid-free single-ion conductors in which one ion is covalently tethered to an elastic polymer network. This study investigates how the elasticity of the network affects EDL capacitance as a function of applied voltage. The results show that elastic energy significantly influences ion distribution: in soft networks with low storage modulus, tethered ions can accumulate densely at interfaces, leading to a symmetric camel-shaped capacitance–voltage (C–V) profile. In contrast, stiff, highly crosslinked networks restrict this accumulation, resulting in an asymmetric C–V profile due to limited mobility of the tethered ions compared to their mobile counterions. Additionally, because polymer elasticity is temperature-dependent, lowering the temperature increases the modulus and enhances the asymmetry in EDL capacitance. These findings highlight the critical role of mechanical elasticity in controlling interfacial ion behavior and capacitance in IEs.

Oral Presentation **O2-14**

대학원생 구두발표 (III)

2025.9.29(월), 16:15~16:30, 2회장

Chair: 김호범, 김명웅

Thermal Aging-Induced Impact Degradation and Lifetime Modeling of PP Composites

권대율, 유영재[†]

중앙대학교

This study investigates the accelerated thermal degradation behavior of polypropylene (PP)-based composites for automotive applications and predicts their lifetime using theoretical modeling. Time-dependent variations in tensile and impact strength followed a temperature-dependent Weibull degradation trend, from which an Arrhenius–Weibull combined model was constructed. Statistical reliability analysis and lifetime distribution fitting were performed using Minitab software, and strong correlation between Accelerated Life Testing (ALT) and Accelerated Degradation Testing (ADT) validated the model's applicability. Thermal decomposition was identified as the primary degradation mechanism, and optimal accelerated conditions were established to shorten test duration. This work offers a valuable foundation for lifetime prediction and thermal reliability design of PP-based materials.

Oral Presentation **02-15**

대학원생 구두발표 (III)

2025.9.29(월), 16:30~16:45, 2회장

Chair: 김호범, 김명웅

A Surface Functionalization Approach Using Conductive Polymer Shells on Metal Oxide for Enhanced Electrorheological Properties

강다희, 제갈석, 임지수, 윤창민[†]

인하대학교

Hollow titania nanospheres (HTNS) functionalized with various conducting polymers (CPs) were synthesized as the dispersion materials for ER fluids. HTNS were fabricated by depositing titania shells onto silica core through sol-gel method, followed by removing the core using sonication-mediated etching with ammonia solution. Subsequently, various conducting polymers including polythiophene, polypyrrole, and polyaniline were coated onto HTNS by vapor deposition polymerization to attain HTNS-CPs. And then, various HTNS-CPs were dispersed in silicone oil (3.0 wt%) to formulate ER fluids. Among them, polythiophene-coated HTNS-based ER fluid showed the highest ER performance due to the enhanced polarizability induced by intrinsic electronic structure of polythiophene. Accordingly, additional charge carrier provided by CPs have significantly increased the polarizability of metal oxide employed in ER fluids.

- 본 연구는 2025년도 정부(교육부)의 재원으로 한국연구재단의 지원을 받아 수행된 기초연구사업임(RS-2022-NR070869).

Oral Presentation **O3-1**

대학원생 구두발표 (IV)

2025.9.29(월), 13:00~13:15, 3회장

Chair: 김 정,여현욱

Optical Detection of Light Wavelengths Using Diarylethene-Doped Liquid Crystals

박서연, 최대섭, 임준형, 백지혜, 김영기[†]

포항공과대학교

Diarylethene (DAE) is notable for its reversible photoisomerization between open and closed forms in response to specific wavelengths of light. Here, we demonstrate a DAE-doped liquid crystal (LC) system that exhibits clear, macroscopic optical changes for effective wavelength detection. Incorporation of DAE into the LC bulk enables light-induced isomerization of DAE, which drives LC reorientation observable by polarized optical microscopy. Specifically, when DAE is in its open form, the LC aligns planar at the water interface; upon UV irradiation, DAE switches to its closed form, inducing vertical reorientation of the LC and resulting in a distinct optical change. To elucidate the underlying mechanism, fluorescence confocal polarizing microscopy (FCPM) revealed that closed-form DAE molecules preferentially accumulate at the water interface under UV exposure.

This work was supported by the National Research Foundation of Korea (RS-2023-00212739, RS-2024-00411809, RS-2023-00302586).

Oral Presentation **O3-2**

대학원생 구두발표 (IV)

2025.9.29(월), 13:15~13:30, 3회장

Chair: 김 정,여현욱

Morphologically Engineered Cellulose Crystals for Eco-friendly Cloud Seeding

우흥균, 이동현, 이재준[†]

부산대학교

Cloud seeding, which induces precipitation by nucleating ice crystals, faces growing demand for materials that are both efficient and sustainable amid the climate crisis. Among potential candidates, cellulose emerges as a promising material due to its intrinsic crystallinity and eco-friendliness; however, its ice nucleation ability (INA) remains poorly understood. In this study, we investigate how the size, shape, and crystallinity of cellulose influence its INA. Cellulose crystals with controlled dimensions and morphologies, from spherical to rod-like, were prepared via acid hydrolysis. Crystallinity was tuned by varying hydrolysis conditions, enabling a systematic study of its role in INA. To evaluate INA, we used the droplet freezing method in a Peltier-type cooling chamber, recording the number of frozen droplets versus temperature under controlled conditions. Our results demonstrate cellulose's potential as a seeding material and provide a framework for lab-scale INA assessment.

Oral Presentation **03-3**

대학원생 구두발표 (IV)

2025.9.29(월), 13:30~13:45, 3회장

Chair: 김 정,여현욱

Improved Acidic Gas Adsorption in Organic Gas Sensors Using Base-Enhanced Zeolites via Metal Cation Exchange

구나현, 박영돈[†]

인천대학교

To realize high-performance organic gas sensors, enhancing both sensitivity and selectivity toward specific gases remains a critical challenge. Here, we report a strategy to improve gas adsorption by incorporating metal cation-exchanged zeolites into poly(3-hexylthiophene). 13X zeolites were ion-exchanged with Li^+ , Na^+ , K^+ , Rb^+ , Cs^+ , Mg^{2+} , enabling tunable surface basicity and charge density. These modifications affected chemical interactions with acidic gases. Larger ions such as Cs^+ and Rb^+ promoted acid-base interactions, enhancing adsorption and sensor responses. In contrast, small ions with high charge density, like Mg^{2+} and Li^+ , increased dipole interactions, enabling reversible and rapid sensing. Gas response varied with ion type, highlighting the role of ionic properties in surface reactivity. This study demonstrates the potential of ion-tuned zeolites-polymer hybrids for selective and stable gas sensing at room temperature.

Oral Presentation **O3-4**

대학원생 구두발표 (IV)

2025.9.29(월), 13:45~14:00, 3회장

Chair: 김 정,여현욱

고에너지밀도 LIB 건식 후막 양극을 위한 고분자 바인더 설계

윤주희, 최윤성, 진형준[†]

인하대학교

리튬 이온 배터리(LIB)에 대한 수요가 증가함에 따라, 에너지 밀도 향상을 위한 핵심 전략으로 두꺼운 전극 설계가 주목받고 있다. 기존의 슬러리 기반 습식 공정에 비해, 건식 공정은 용매가 필요 없고 공정이 단순하다는 점에서 장점이 있다. 그러나 건식 공정에서는 용매 없이 도전재와 바인더를 균일하게 분산시키기 어렵기 때문에, 전극 내 리튬 이온 수송 저하라는 문제점이 발생한다. 본 연구에서는 이러한 분산 문제를 해결하기 위해, 바인더와 도전재를 in-situ 혼합하여 균일한 분포의 두꺼운 전극을 제조하는 효과적인 방법을 제안하였다. 용액상 도전재를 환원시키는 과정에서 고분자 바인더를 함께 도입하여, 도전재와 바인더를 균일하게 혼합하였다. 이 접근 방식은 전극 구성 성분 간의 균일한 분포를 유도해, 두꺼운 전극에서도 안정적인 구조 형성과 우수한 이온 및 전자 전달 특성을 확보할 수 있다. 그 결과, 전기화학적 저항 증가 없이 NCM 기반 양극에서 높은 면적당 질량을 달성하는 건식 후막 전극을 구현하였다. 제안된 방법은 두꺼운 전극을 안정적이고 확장 가능하게 제조할 수 있는 공정으로, 기존 공정의 복잡성을 최소화하면서 고에너지 밀도의 LIB 구현 가능성을 제시한다.

Oral Presentation **O3-5**

대학원생 구두발표 (IV)

2025.9.29(월), 14:00~14:15, 3회장

Chair: 김 정,여현욱

Exchangeable Liquid Crystal Elastomers with Enhanced Reprocessability

최예빈, 안석균⁺

부산대학교

Exchangeable liquid crystal elastomers (xLCEs) incorporating dynamic covalent bonds offer significant advantages including reprocessing and reprogramming. However, conventional reprocessing for xLCEs are largely limited to hot pressing, which requires long processing times and restricts shape formation to simple 2D films. In this work, we synthesize a series of xLCEs that can undergo rapid bond exchange, thereby enhancing thermal processability. By systematically tailoring the network structure of xLCEs, we achieve a broad range of mechanical and rheological properties. Importantly, the optimized xLCEs exhibit liquid-like behavior at elevated temperatures, enabling versatile melt-processing into 1D fibers, 2D films, and complex 3D shapes. Our approach addresses key limitations of conventional xLCE processing and opens new opportunities for applications in soft actuators, active textiles, and reconfigurable surfaces.

Oral Presentation **O3-6**

대학원생 구두발표 (IV)

2025.9.29(월), 14:15~14:30, 3회장

Chair: 김 정,여현욱

Light-driven liquid crystal elastomer actuators operating at ultralow temperatures

김현성, 김대석¹, 이창연⁺

중앙대학교

¹ 국립부경대학교

Conventional thermo-responsive liquid crystal elastomers (LCEs), which are common actuators, are unable to function in freezing conditions because the phase transitions they rely on occur at elevated temperatures. Here, we present a new LCE actuator capable of operating in extreme cold. The key to this technology is to incorporate a high concentration of photothermal nanomaterials by using a mesogen-assisted exfoliation (MAE) method, which effectively exfoliate and disperse low-dimensional nanomaterials like molybdenum disulfide (MoS₂) within the LC matrix. Due to this high concentration, the resulting composite exhibits a remarkable photothermal effect, reaching a local temperature of over 700°C within 3 seconds. This allows the LCE to undergo the necessary phase transition and perform effective thermo-mechanical actuation even in extreme ambient temperatures of -80 °C. This strategy significantly lowers the temperature performance envelope of LCE-based soft actuators and is expected to contribute to the development of robotics for harsh environments.

Oral Presentation **O3-7**

대학원생 구두발표 (IV)

2025.9.29(월), 14:30~14:45, 3회장

Chair: 김 정,여현욱

Molecular-Level Design of Hole Transport Layer for Heat-Stable and Efficient Perovskite Solar Cells

이동균, 이태경[†]

경상국립대학교

Perovskite solar cells (PSCs) using 2,2',7,7'-tetrakis[N,N-di(4-methoxyphenyl)amino]-9,9-spirobifluorene (spiro-OMeTAD) have achieved power conversion efficiencies over 26%, but still suffer from thermal instability. Hole transport layer (HTL) is particularly vulnerable to thermal degradation, mainly due to the chemical nature and ratio of dopants. The typical 6:1 ratio of 4-tert-butylpyridine (tBP) to lithium bis(trifluoromethanesulfonyl)imide (LiTFSI) improves solubility but facilitates de-doping by reducing spiro-OMeTAD^{•+}TFSI⁻ radicals. Here, we performed molecular simulations to develop a molecular-level design strategy for heat-stable HTL. Our results revealed that a 1:1 ratio stabilizes Li⁺-tBP coordination, suppressing free tBP and mitigating de-doping. This improves doping stability, raises the glass transition temperature, and enhances thermal durability. These insights provide the molecular-level guideline for designing thermally stable PSCs.

Oral Presentation **O3-8**

대학원생 구두발표 (IV)

2025.9.29(월), 15:00~15:15, 3회장

Chair: 김 정,여현욱

Ring-opening polymerization kinetics and micellization of amphiphilic block copolymers bearing decalactone isomers

김상윤, 김세영[†]

단국대학교

In this research, poly(ethylene glycol) (PEG)-based amphiphilic copolymers were synthesized using two isomeric forms of decalactone, epsilon-decalactone (ϵ -DL) and delta-decalactone (δ -DL). Copolymerization was carried out under various conditions, with ring-opening of the decalactone monomers catalyzed by 1,5,7-triazabicyclo[4.4.0]dec-5-ene (TBD). The polymerization kinetics in each isomer was investigated considering both enthalpic and entropic factors related to the ring-opening of the monomer. We performed a comparative analysis of the resulting PEG-based copolymers using GPC and NMR to evaluate the efficiency of each isomer in the copolymerization process. Furthermore, to assess the potential of the amphiphilic copolymers as candidates for drug delivery systems (DDS), we micellized representative copolymers and analyzed them using DLS.

Oral Presentation **O3-9**

대학원생 구두발표 (IV)

2025.9.29(월), 15:15~15:30, 3회장

Chair: 김 정,여현욱

Solvent Vapor-Induced Rearrangement of Adsorbed Polymer Chains and its Effect on Interfacial Properties

배석영, 김소연[†]

서울대학교

The polymer adsorption layer is a thin layer of polymer chains directly adsorbed onto a substrate. These layers are known to govern the physical properties of polymer materials involving polymer–solid interfaces. Although polymer adsorption has been widely studied, the effect of solvent interactions on directly adsorbed chains has yet to be thoroughly explored.

In this study, we investigate the rearrangement of poly(2-vinylpyridine) (P2VP) chains adsorbed on solid substrates by exposing them to solvent vapor. We found that specific solvent vapors induce chain rearrangement, altering interactions between P2VP chains and the substrate. Notably, these structural changes result in a transition in the surface property of the adsorption layer, from hydrophilic to hydrophobic. Furthermore, we examine how these rearranged chains influence the dynamics of non-adsorbed chains in an additional polymer layer by analyzing the glass transition temperature of the entire polymer film.

Oral Presentation **O3-10**

대학원생 구두발표 (IV)

2025.9.29(월), 15:30~15:45, 3회장

Chair: 김 정,여현욱

Sterilizable vertical n-type organic electrochemical transistors for skin-conformal ECG monitoring

이인호, 박성준[†], 원종현

아주대학교

The development of reliable, high-performance skin-attachable biosignal sensors is critical for wearable healthcare applications. Here, we present a biosensor based on a 4-terminal vertical Corbino-type organic electrochemical transistor (OECT) using n-doped poly(benzodifurandione) (n-PBDF). This structure effectively reduces parasitic resistance, achieving high transconductance of 374 mS at low voltage and a record-high μC^* value of $1787 \text{ F cm}^{-1} \text{ V}^{-1} \text{ s}^{-1}$ among n-type OECTs. The device demonstrates excellent long-term stability and retains performance after UV and thermal sterilization. Its ultrathin form factor and the inherent flexibility of n-PBDF ensure mechanical adaptability for skin integration. Capable of detecting biosignals such as ECGs with high fidelity, this sensor offers strong potential for practical use in next-generation wearable healthcare systems.

Oral Presentation **03-11**

대학원생 구두발표 (IV)

2025.9.29(월), 15:45~16:00, 3회장

Chair: 김 정,여현욱

Structure–Property Relationships in Isocyanate-Terminated Prepolymers under Controlled Moisture-Curing Conditions

김성수, 문호준, 조용비, 위정재[†]

한양대학교

Moisture cure of isocyanate-terminated prepolymers has found broad application in the automotive, construction, and electronics industries due to excellent adhesion, high durability, and ease of use. This study evaluates the structure–property relationships of the cured polymer based on curing kinetics under various curing conditions. Based on the rate law, elevated humidity and temperature enhance the reaction rate, which modifies the resulting network structure, particularly the crosslink density. Curing behavior was assessed by infrared spectroscopy and dynamic mechanical analysis. The relationship between cure kinetics and thermo-mechanical property was clarified to establish a comprehensive framework for the structure–property relationship. The findings offer guidance for improving the industrial applicability of moisture-curable prepolymers.

Oral Presentation **03-12**

대학원생 구두발표 (IV)

2025.9.29(월), 16:00~16:15, 3회장

Chair: 김 정,여현욱

Self-propelling gel actuators driven by autonomous chemomechanical Marangoni propulsion

최재원, 정태훈, 김연수[†]

포항공과대학교

Autonomous propulsion without external energy input remains challenging in biomimetic soft robotics. Here, we report porous self-oscillating gels (PSGs) exhibiting rapid (~ 630 s) and large-amplitude ($>13\%$) deformation via an internal Belousov–Zhabotinsky reaction. The porous structure significantly enhances diffusivity, accelerating chemical wave propagation and enabling substantial volume changes. Consequently, internally generated formic acid is actively expelled, creating an asymmetrical surface tension gradient that drives continuous Marangoni propulsion. Unlike conventional actuators dependent on external stimuli or preloaded fuels, PSGs autonomously generate and spatiotemporally control chemical fuels. Furthermore, gel geometry can modulate locomotion modes, including linear, rotational, and combined trajectories. This bioinspired strategy offers a versatile platform for untethered soft actuators and autonomous microrobots.

Oral Presentation **03-13**

대학원생 구두발표 (IV)

2025.9.29(월), 16:15~16:30, 3회장

Chair: 김 정,여현욱

A simulation study on acrylic pressure sensitive adhesives: Effects of poly(n-alkyl acrylates) side chain on structural and mechanical properties

이재현, 성봉준^{†1}

서강대학교 화학과

¹ 서강대학교

Pressure-sensitive adhesives (PSAs) are materials that adhere when subjected to slight pressure. Among them, acrylic PSAs, composed of soft monomers, which possess a low glass transition temperature (T_g) and transparency, hard monomers, which improve the cohesive strength and functional monomers, which reinforce adhesion, are widely employed in the display industry. For n-alkyl acrylates (hydrocarbon-based soft monomers), whose microstructure changes with the number of alkyl carbons (N_a) and determines their viscoelastic behavior, but a molecular-level understanding is lacking. In this study, we investigate the effects of N_a on the polymers through molecular dynamics simulations, using random copolymer systems constructed from 90% n-alkyl acrylate monomers ($N_a = 4, 8, 12$) and 10% acrylic acid. We find that increasing N_a induces a plasticizing effect, which weakens interchain interactions, enhances chain mobility, and lowers T_g , directly leading to an increase in secondary creep rate under identical loading conditions.

Oral Presentation **O3-14**

대학원생 구두발표 (IV)

2025.9.29(월), 16:30~16:45, 3회장

Chair: 김 정,여현욱

Tuning Characteristics of Diblock Copolymer Micelles via Post-Micellization Modification

안재균, 김새로, 손병혁[†]

서울대학교

Diblock copolymer micelles can be modified by using copolymers with functional monomers in one of the blocks, which must be synthesized separately. In this presentation, we synthesized diblock copolymers with modifiable monomers in both blocks, and then altered these units to tune the micellar characteristics. Poly(4-vinylpyridine) was selected as the core block and was cross-linked via quaternization, providing micellar stability during solvent exchange. A copolymer of 2-vinylpyridine and cyclohexylmethacrylate was employed as the corona block, offering solubility contrast with the P4VP core and promoting the formation of spherical micelles. The reactivity difference between 4VP and 2VP toward quaternization allowed for sequential post-micellization modification of the core and corona. The degree of quaternization in each block was quantified by NMR and FT-IR. Morphological changes induced by solvent variation after post-micellization modification were mainly investigated using TEM.

Oral Presentation **O3-15**

대학원생 구두발표 (IV)

2025.9.29(월), 16:45~17:00, 3회장

Chair: 김 정,여현욱

Influence of Cargo Loading on Structure and Relaxation of Complex Coacervate Core Hydrogels

유문철, 최수형[†], Abotsi Djogbessi Kodjo Alphonse

홍익대학교

Complex coacervate core hydrogels (C3Hs), formed via electrostatic interactions between oppositely charged ABA-type triblock copolyelectrolytes and counter polyelectrolytes, are promising carriers for charged biomacromolecules such as DNA, mRNA, and proteins. Although various cargos have been successfully loaded into C3Hs, systematic studies on loading-dependent dynamics remain limited due to the high cost of biomacromolecules. In this study, we precisely controlled the amount of synthetic homopolyelectrolytes as model cargos to investigate how loading content affects C3H structure and relaxation behavior. As the loading increased, the core size expanded and chain relaxation became slower. These changes were analyzed in terms of structural variations, including inter-core distance, core radius, and chain release pathways. Our findings provide insight into how loading influences micellar dynamics and offer guidance for designing tunable coacervate-based delivery systems.

Oral Presentation **O4-1**

대학원생 구두발표 (V)

2025.9.29(월), 13:00~13:15, 4회장

Chair: 심지민, 이민재

Autonomous self-healing 3D micro-suction adhesives for multi-layered amphibious soft skin electronics

임도현, 정민우¹, 김다완², 오진영¹, 방창현⁺

성균관대학교

¹ 경희대학교

² 한국교통대학교

Soft electronics with high adhesion strength, self-healability and stretchability had highly demanded for intimate adhesion interfaces on wet/dry biosurfaces and device protection. However, previous self-healable adhesives may have problems such as chemical contamination, skin damage, and manifesting self-healing ability in harsh environments. Here, we report the self-healable bioinspired adhesive patch with stretchable, reusable interface for biosignal monitoring even in harsh environment. The patch has efficient self-healing and mechanical property, respectively and it performed faster healing rate than that of human's skin. Our patch also shows good normal adhesion in both dry and underwater conditions (max. 7.82 N/m² in dry conditions, and max. 4.44 N/m² in underwater conditions). Based on the robust adhesion property, we have successfully obtained reliable measurements of biosignals during body movement.

Oral Presentation **O4-2**

대학원생 구두발표 (V)

2025.9.29(월), 13:15~13:30, 4회장

Chair: 심지민, 이민재

Hydrocarbon-Based Proton Exchange Membranes for Fuel Cells via Controlled Radical Polymerization of Block Copolymer Precursors

양선우, 여원준, 서명은[†], 채일석¹

한국과학기술원

¹ 현대자동차

The demand for hydrocarbon-based proton exchange membranes (PEMs) is increasing due to the limitations of perfluoroalkyl sulfonic acid-based compounds, such as high cost and restrictions on perfluoroalkyl substances. Most hydrocarbon-based PEMs are based on condensation polymers, which exhibit high physical and thermal stability. However, chemical disorder of these polymers leads to less distinct interfaces, resulting in disordered proton channel. In contrast, block copolymers synthesized via controlled polymerization offer clear boundaries between blocks, enabling the formation of well-ordered microstructures.

In this work, reversible addition–fragmentation chain transfer (RAFT) polymerization was employed to control parameters such as microstructure, degree of sulfonation, and glass transition temperature. Through systematic optimization, the resulting membranes demonstrated excellent performance, comparable to that of commercially available Nafion.

Oral Presentation **O4-3**

대학원생 구두발표 (V)

2025.9.29(월), 13:30~13:45, 4회장

Chair: 심지민, 이민재

Design of Rigid Rod Bismaleimide Monomers for Thermally Stable and Reprocessable Polymer Networks

권우현, 구교선, 여현욱[†]

경북대학교

Bismaleimide (BMI) resins are addition-type polyimides known for excellent heat resistance and mechanical strength, while offering processability similar to epoxy resins. With these properties, BMIs are promising materials for aerospace and other high-performance applications. Maleimide groups contain reactive double bonds that undergo various addition reactions—such as free-radical reactions, Michael addition, Ene reactions, and Diels-Alder reactions—without forming by-products. These reactions lead to tightly crosslinked networks that are thermally stable and durable. In this work, new BMI monomers were designed with extended conjugated structures to enhance network performance. Ester groups were also introduced to enable reprocessability via dynamic covalent bonds. These monomer-based polymers showed excellent thermal stability. And reprocessability through transesterification was demonstrated, and the materials retained their properties after two reprocessing cycles.

Oral Presentation **O4-4**

대학원생 구두발표 (V)

2025.9.29(월), 13:45~14:00, 4회장

Chair: 심지민, 이민재

Wheat Gluten Film with Leather-Like Tactility and Superior Water Resistance via Protein Denaturation-Driven Cross-Linking

김소연, 오동엽[†]

인하대학교

Conventional leather production raises concerns regarding animal ethics and environmental pollution during both manufacturing and disposal processes. Similarly, petroleum-based synthetic leathers contribute to environmental degradation due to their production methods. As a result, plant-based leather alternatives have garnered increasing attention, but these alternatives often fall short of commercial leather in terms of mechanical properties and tactile qualities. Gluten, a natural plant-derived protein from wheat, contains 3% cysteine, which can form disulfide bonds upon oxidation, resulting in a highly elastic and strong three-dimensional network. In particular, thermal and UV treatments can induce oxidative cross-linking among amino acids such as cysteine and tyrosine, modifying molecular alignment and spacing. In this study, a leather-like material was fabricated through a three-step protein denaturation process using gluten, glycerol, and water. The resulting film was quantitatively compared to natural bovine leather and PU synthetic leather in terms of mechanical properties, water resistance, and tactile feel, demonstrating high similarity to natural leather. Surface treatment with heat and UV irradiation enhanced water resistance and hydrophobicity, and newly formed oxidative cross-linked compounds were confirmed through LC-MS/MS analysis. Furthermore, a life cycle assessment (LCA) revealed that the gluten-based leather reduced carbon dioxide emissions by more than 12 times compared to conventional bovine leather. This study highlights a sustainable strategy for overcoming the limitations of plant-based protein materials by inducing oxidative cross-linking through purely physical treatment.

Oral Presentation **O4-5**

대학원생 구두발표 (V)

2025.9.29(월), 14:00~14:15, 4회장

Chair: 심지민, 이민재

Low-Content Non-oxidized Graphene Flake (NOGF)/PDMS Composites for High-Performance Electromagnetic Interference Shielding

이자윤, 전윤석[†], 황인혁, 김선준¹

국립부경대학교

¹ 한국과학기술연구원

In this study, we report high-performance EMI shielding composites incorporating directionally aligned non-oxidized graphene flakes (NOGF) within a polydimethylsiloxane (PDMS) matrix. NOGF was obtained by exfoliating graphite intercalation compounds without oxidation, preserving its graphitic structure. Unidirectional freeze-casting method was used to form aligned NOGF aerogels, which were infiltrated with PDMS to create lightweight, flexible composites. The NOGF/PDMS composite achieved a maximum shielding effectiveness (SE) of 54.2 dB at 2.1 mm, surpassing reduced graphene oxide (rGO)/PDMS (31.4 dB at 2.5 mm). The SE was direction-dependent, with longitudinal samples performing better than transverse ones. The composites also showed improved tensile strength, Young's modulus and toughness due to efficient load transfer and enhanced filler-matrix interaction from the defect-suppressed NOGF. These results highlight the potential of low-content graphene composites for EMI shielding.

Oral Presentation **O4-6**

대학원생 구두발표 (V)

2025.9.29(월), 14:15~14:30, 4회장

Chair: 심지민, 이민재

Closed-loop recyclable biomass-based soft-electronics via one-pot chemical separation

이성민, 최청룡[†]

금오공과대학교

We present a closed-loop recycling strategy for soft electronics using a one-pot chemical separation process. Devices were built with biomass-derived materials—crosslinked poly(ethyl lipate) (c-P(EtLp)) and gelatin hydrogels—along with EGaIn and MXene. At end-of-life, immersion in a biphasic solvent and mild acid enabled clean separation of each component without degradation. Key raw materials were fully recovered and reused to fabricate supercapacitors, strain sensors, and EMG electrodes that maintained original performance. The process is scalable for unsorted device batches and avoids cross-contamination. This work offers a generalizable, energy-efficient route toward sustainable soft electronics with reduced environmental impact and improved circularity.

Oral Presentation **O4-7**

대학원생 구두발표 (V)

2025.9.29(월), 14:30~14:45, 4회장

Chair: 심지민, 이민재

Thermally Triggered On-Demand Fungal Biodegradation for Sustainable Electronic Devices

차석준, 정연식[†]

한국과학기술원

Transient electronics face a persistent trade-off between operational reliability and effective end-of-life degradation. Inspired by fungal spores, we developed a biologically integrated device for programmable, on-demand biodegradation. The system features dormant *Aspergillus niger* spores encapsulated in a nutrient-rich hydrogel, which is enclosed within a heat-responsive polycaprolactone (PCL) shell. Upon thermal activation, a structural transition in the PCL shell increases its water permeability, allowing moisture to reach and revive the spores. The activated spores then germinate and release enzymes to digest the surrounding polymer substrates. This approach maintains complete structural integrity until triggered, enabling mild, spatially controlled, and self-contained degradation, thus advancing a sustainable and programmable future for transient electronics.

Oral Presentation **O4-8**

대학원생 구두발표 (V)

2025.9.29(월), 15:00~15:15, 4회장

Chair: 심지민, 이민재

Long-term aging effect of MXene dispersions with PVA additives: Rheological and structural properties

조은호, 이준호¹, 한태희¹, 김소연⁺

서울대학교

¹ 한양대학교

MXene is widely used in polymer-based composites with polyvinyl alcohol (PVA) to enhance flexibility and mechanical strength due to its excellent thermal and electrochemical properties. However, its poor chemical stability causes structural changes over time, presenting challenges for MXene/PVA composites. Since interactions between MXene and PVA affect particle structure and rheological properties of the dispersion, understanding how this interaction influences the aging process is crucial.

In this study, we investigated the aging effects of MXene dispersions by varying PVA concentration. Small-angle X-ray scattering and rheological analysis showed that an optimal PVA content led to enhanced stability in nanostructure and rheological behavior. Moreover, structures formed in the dispersion influenced the properties of the final composite. These findings offer insights into controlling the long-term structure and stability of MXene-based composites through polymer incorporation.

Oral Presentation **O4-9**

대학원생 구두발표 (V)

2025.9.29(월), 15:15~15:30, 4회장

Chair: 심지민, 이민재

Solvation Structure Modulation in Aqueous Electrolytes : Facilitating Electrochemical Nitrate Reduction

서민영, 김용주[†]

고려대학교

the electrochemical nitrate reduction reaction (NO_3^- -RR) is significantly activated even in acidic lithium nitrate solutions at LiNO_3 concentrations exceeding 6 m on a Pt electrode (the highly effective catalyst for HER) by the formation of a "hydronium-in-salt" electrolyte (HISE), a new type of aqueous high concentration salt electrolyte. The observed enhancement of NO_3^- -RR while the suppression of HER-activity in the LiNO_3 based HISE was verified by MD simulations. The formation of a HISE in acidic LiNO_3 solutions contrasts with that of a "water-in-salt" electrolyte in LiTFSI with the same concentration. The mechanism of NO_3^- -RR activation in a HISE suggests facilitated proton-coupled electron transfers (PCETs) from H_3O^+ to NO_3^- and subsequent reactive intermediates owing to the proximity between the two ions induced by the unique solvation structure blended with all ions together ($\text{Li}^+ + \text{NO}_3^- + \text{H}_3\text{O}^+$).

Oral Presentation **O4-10**

대학원생 구두발표 (V)

2025.9.29(월), 15:30~15:45, 4회장

Chair: 심지민, 이민재

Vertically Stacked Skin-conformal Organic Photodetectors for Dual-Wavelength Detection in Motion-Robust SpO₂ monitoring

정재빈, 김재현, 박성준[†]

아주대학교

Accurate pulse oximetry in wearable healthcare remains challenging due to two key limitations of conventional organic photodiode (OPD) systems: spatial separation of detectors and limited spectral selectivity. Conventional devices detect red and near-infrared (NIR) signals at different skin sites, making them susceptible to motion artifacts and signal scattering. Moreover, Spectral overlap further causes crosstalk, hindering precise oxygen saturation (SpO₂) analysis. To address these issues, we propose a vertically stacked, skin-conformal OPDs capable of dual-wavelength detection at a single skin location with high spectral specificity. Charge injection narrowing (CIN) is employed in the NIR-selective OPD, which is located above a visible-light OPD, to suppress unwanted visible response to below 1% external quantum efficiency (EQE). The device shows stable performance under skin contact and motion, offering a compact, scalable solution for reliable wearable SpO₂ monitoring.

Oral Presentation **O4-11**

대학원생 구두발표 (V)

2025.9.29(월), 15:45~16:00, 4회장

Chair: 심지민, 이민재

폴리우레탄 분산 기반의 다양한 색상 구현이 가능한 건물 외부용 수동 주간 복사냉각 코팅 소재

유지훈, 유명재[†]

중앙대학교

주간 수동 복사 냉각 기술은 지속 가능한 건축에 중요한 기술입니다. 본 연구에서는 폴리우레탄 분산액(PUD)을 기반으로, 안료와 글라스 버블을 활용한 색상 구현 가능한 PDRC 페인트를 개발했습니다. 안료는 선명한 색을, 글라스 버블은 산란 효과를 통해 높은 태양 반사율을 제공합니다. 3D 프린팅 모형 주택 실험을 통해, 본 소재는 온도 저감과 색상 유지 모두에서 우수한 성능을 보여주었습니다.

Oral Presentation **O4-12**

대학원생 구두발표 (V)

2025.9.29(월), 16:00~16:15, 4회장

Chair: 심지민, 이민재

Development of Polymeric-Inorganic Hybrid Black Pigments with High NIR Reflectance and True Blackness for LiDAR Sensor Utilized in Autonomous Vehicle

사민기, 잠바가, 김지원, 윤창민[†]

인하대학교

Novel LiDAR-detectable hybrid black pigments combining near-infrared (NIR)-transmissive polymeric materials with NIR-reflective inorganic metal oxides are successfully developed as advanced coatings for autonomous vehicles. These pigments are designed to overcome the intrinsic limitations of individual polymeric and inorganic components, simultaneously achieving high NIR reflectance and true black appearance. Specifically, the polymer-based NIR-transmissive layer selectively absorbs visible light while allowing efficient transmission of NIR wavelengths, functioning as a tunable optical filter. Meanwhile, the embedded inorganic metal oxides enhance internal NIR scattering and back-reflection, thereby improving overall LiDAR signal detectability. The resulting hybrid pigment system exhibits superior NIR reflectance and visual blackness compared to conventional single-layer coatings. LiDAR sensor validation tests confirm that the hybrid-coated surfaces can be reliably detected, underscoring the role of functional polymers in enabling next-generation LiDAR-compatible black coatings for autonomous mobility systems.

- 본 연구는 2025년도 정부(교육부)의 재원으로 한국연구재단의 지원을 받아 수행된 기초연구사업임(RS-2022-NR070869).

Oral Presentation **O4-13**

대학원생 구두발표 (V)

2025.9.29(월), 16:15~16:30, 4회장

Chair: 심지민, 이민재

저전력 기반 광열전 시스템 개발을 위한 흑금 기반 광열전 기판

김정한, 편승범, 최민주, 황영지, 조은철⁺

한양대학교

일상 생활에서 조명에 사용되는 에너지는 전체 에너지 사용량의 약 4 %이며 (건물에 사용되는 에너지 중 약 10 %), 일상 생활에서 사용되는 LED와 같은 조명을 활용 가능한 에너지로 전환할 수 있는 기술 개발은 건물에 사용되는 에너지 재활용 관점에서 매우 중요함. 본 연구에서는 넓은 파장의 빛을 높은 흡수 효율로 흡수할 수 있는 흑금 나노입자를 활용하여 광열기판을 제조하고 이를 광열전 디바이스에 장착하여 태양광 및 일상 생활에서 사용되는 LED 빛을 광열전기로 전환하고자 하는 연구를 수행하였음. 광열기판은 흑금나노입자-천연고분자 수분산액을 구리 기판에 casting하여 제조하였고, 기판의 광학 및 광열 특성을 조사하여 광열전 기판으로 적합성을 평가하였음. 제조된 기판이 펠티어 열전 디바이스에 장착되어 나타나는 광열전 성능은 상용화된 광열전 필름과 비교하여 평가하였음. 광열전 기판은 LED를 광원으로 활용하였을 때 높은 광열전 전환 효율을 나타내는 것을 확인하였고, 이를 바탕으로 실용화된 전기를 생산하기 위한 방법을 연구하였다.

Oral Presentation **O4-14**

대학원생 구두발표 (V)

2025.9.29(월), 16:30~16:45, 4회장

Chair: 심지민, 이민재

Electron-Selective Self-Assembled Monolayers in Organic Photoelectrochemical Cells

이의민, 이동현, 조한희[†]

UNIST

Self-assembled monolayers (SAMs) have attracted considerable attention as charge-selective interfacial layers, offering alternatives to conventional metal oxide-based charge transporting layers (CTLs) in semiconductor optoelectronic devices such as photoelectrochemical cells and solar cells. While hole-selective SAMs have been extensively investigated, the development of electron-selective SAMs has seldom been demonstrated mainly due to the scarcity of suitable molecular backbones and the relatively moderate magnitude of dipole moments. Herein, we present a series of naphthalimide-based electron-selective SAMs for organic photoanodes. These SAMs exhibit large molecular dipole moments, which enables effective modulation of the FTO work function and facilitates electron extraction. Consequently, our SAM-based organic photoanodes demonstrate high performance and operational stability for solar water oxidation in the absence of any metal oxide CTLs.

Oral Presentation **O4-15**

대학원생 구두발표 (V)

2025.9.29(월), 16:45~17:00, 4회장

Chair: 심지민, 이민재

Metal-Metal Oxide Heterostructures from Monodisperse Nanodot Array via Block Copolymer Self-Assembly

임지수, 진형민¹

충남대학교

¹ 충남대학교 유기재료공학과

Conventional M-MO heterostructured catalysts synthesized via simple methods such as co-precipitation and sol-gel suffer from limited control over particle size and interparticle spacing, leading to non-uniform reaction kinetics and unstable catalytic performance. In this study, we introduce a novel infiltration synthesis strategy based on block copolymer (BCP) self-assembly to fabricate well-ordered M-MO nanoparticle arrays. This approach enables precise spatial control and structural uniformity for various metal-metal oxide combinations. In particular, this versatile strategy allows for the fabrication of diverse M-MO heterostructures, including Pt-, Pd-, Co-, Au-, and Ir-based systems with ZnO, thereby offering tunable functionalities toward desired applications. The resulting Pt-ZnO arrays exhibit enhanced thermal stability and catalytic activity for the hydrogen evolution reaction (HER), significantly outperforming conventional Pt arrays.

Oral Presentation **OD1-1**

대학원생 구두발표(토론): 차세대 분자전자소자를 위한 고분자 기술

2025.9.29(월), 13:00~13:10, 5-1회장

Chair: 정승준, 최종민

Chromatic refinement filtration of F8BT shell on copper doped zinc sulphide for high resolution mechanoluminescence haptic sensor

김남우, 최효성[†]

한양대학교

Mechanoluminescence materials have emerged as promising candidate for haptic interface sensors due to their mechanically driven luminescence property. However, the inherently broad emission spectra of most mechanoluminescence materials hinder sharp signal generation and high spectral resolution. Here, we suggest a chromatic filtration strategy employing a poly(9,9-dioctylfluorene-alt-benzothiadiazole) (F8BT) polymer shell on copper-doped zinc sulphide (ZnS:Cu) to achieve highly refined and intensified ML signal. By selectively suppressing spectral components below 490 nm, the F8BT shell effectively narrows the emission bandwidth, yielding a full width at half maximum (FWHM) of 55 nm during the ML behaviour. In particular, F8BT shell efficiently mitigates signal intensity loss, which can be ascribed to the colour filtration ability, through mechanoluminescence-induced photoluminescence performance. This dual functionality significantly reduces spectral noise in the blue region with high intensity, enhancing the resolution in actual ML-based haptic controllers. Our approach establishes a scalable framework for high-resolution ML platforms, providing a versatile pathway toward next-generation stress-sensing applications with unprecedented spectral precision and optical fidelity.

Oral Presentation **OD1-2**

대학원생 구두발표(토론): 차세대 분자전자소자를 위한 고분자 기술

2025.9.29(월), 13:10~13:20, 5-1회장

Chair: 정승준, 최종민

Ultra-Sensitive Short-Wave Infrared Organic Photodetectors Enabled by a Proquinoid Electron Acceptor

박세정, 고서진^{*1}, 최연수, 이보람^{*2}, 이승현

한국화학연구원

¹ DGIST

² 성균관대학교

Achieving high-performance organic SWIR photodetectors (SWIR OPDs) remains challenging due to intrinsically weak photoresponse and sensitivity. Herein, we report a novel proquinoid-type non-fullerene acceptor (NFA), denoted as TQC-4Cl, featuring an ultra-narrow band gap of 1.01 eV and a broad spectral response extending beyond 1200 nm, enabled via an aromatic-quinoid transformation strategy. Thermal annealing of the TQC-4Cl film significantly enhances its crystallinity and molecular ordering. Consequently, the optimized TQC-4Cl-based SWIR OPDs exhibit an exceptionally low dark current density (J_d) of $4.38 \times 10^{-8} \text{ A cm}^{-2}$ at -0.5 V bias and a high external quantum efficiency (EQE) of 13.66 % at 1200 nm, resulting in a shot-noise limited specific detectivity (D_{sh}^*) of 1.06×10^{12} Jones under the same bias condition.

Oral Presentation **OD1-3**

대학원생 구두발표(토론): 차세대 분자전자소자를 위한 고분자 기술

2025.9.29(월), 13:20~13:30, 5-1회장

Chair: 정승준, 최종민

Enhancing Operational Stability of Organic Electrochemical Transistors with Carboxylated Mixed Conductors

박은제, 강기훈⁺

서울대학교

Organic mixed ionic-electronic conductors (OMIECs) have emerged as key materials in organic electrochemical transistors (OECTs) for next-generation bioelectronics due to their ability to couple ionic and electronic signals. Conventional OMIEC designs feature conjugated backbones with ethylene glycol (EG) side chains, which facilitate electronic transport and ion uptake, respectively. However, EG chains present trade-offs between ionic transport, ionic-electronic coupling, and stability due to swelling. To overcome these limitations, we introduce OMIECs incorporating carboxylic acid functional groups via a side-chain thermocleavage method, which exhibit enhanced volumetric capacitance and a unique electrochemical doping mechanism. These materials yield OECTs with high transconductance and improved operational stability, offering insights into molecular design strategies for high-performance bioelectronic applications.

Oral Presentation **OD1-4**

대학원생 구두발표(토론): 차세대 분자전자소자를 위한 고분자 기술

2025.9.29(월), 13:30~13:40, 5-1회장

Chair: 정승준, 최종민

Simultaneous Enhancements of Power Conversion Efficiency and Thermal Stability in Organic Solar Cells by Self-doped Perylene Diimide-based Polymer

이영완, 이슬, 김봉수⁺

울산과학기술원

Organic solar cells (OSCs) have shown significant progress in recent decades, accompanied by improvements in electron transporting layers (ETLs). Among various ETL materials, PDINN demonstrates excellent electron transport in devices by controlling the work function of the electrodes due to its self-doping ability. However, the low glass transition temperature of PDINN causes inferior thermal stability in OSCs, despite achieving a high power conversion efficiency (PCE). Herein, we designed a series of perylene diimide-based polymers to suppress the thermal movement of the ETL molecules. The molecular weight was controlled in the medium (M) and high (H) batches to manipulate solubility. PPV-M, the ETL polymer which contains a vinyl linker group with a moderate molecular weight, demonstrated the highest PCE of 18.45% in OSC device applications, with enhanced thermal stability among the ETLs. In contrast, PDINN-based OSCs achieved a PCE of 17.79% and showed the lowest thermal stability.

Oral Presentation **OD1-5**

대학원생 구두발표(토론): 차세대 분자전자소자를 위한 고분자 기술

2025.9.29(월), 13:40~13:50, 5-1회장

Chair: 정승준, 최종민

Protic Stabilization and Morphology Control of Polyaniline Electrodes for High Energy Density, Stable and Electrochromic Energy Storage Devices

이은혜, 신찬호¹, 권현정, 김소현, 윤태광, Tse Nga Ng¹, 김종현⁺

아주대학교

¹ University of California San Diego

Polyaniline (PANI) suffers from limited redox stability due to degradation of the pernigraniline salt (PS) state, which restricts its practical capacity. Here, we introduce a protic additive, propylene glycol, into nonaqueous electrolytes to stabilize the PS state via hydrogen bonding. This approach enabled highly reversible redox behavior and an extended lifetime of 3,850-cycle in Zn-based supercapacitors. Furthermore, we developed electrochromic energy storage systems by tailoring PANI morphologies to enhance Zn^{2+} diffusion. Among them, porous PANI delivered 97.3% of capacity retention over 1,400 cycles. Notably, the porous PANI electrodes exhibited excellent electrochromic performance with coloration efficiency, indicating distinguishable charged and discharged states of the batteries. These findings demonstrate that chemical stabilization and morphological engineering is a promising strategy to boost electrochemical and electrochromic performance of PANI electrodes.

Oral Presentation **OD1-6**

대학원생 구두발표(토론): 차세대 분자전자소자를 위한 고분자 기술

2025.9.29(월), 13:50~14:00, 5-1회장

Chair: 정승준, 최종민

Transparent PEDOT:PSS/MXene Thin-Film Heater with Enhanced Conductivity by Trifluoroacetic Acid Treatment

주지환, 정범진[†]

부산대학교

MXene is a promising two-dimensional material for electronics and thermal applications such as heaters, owing to its excellent conductivity, mechanical strength, and surface chemistry. However, its flake-like morphology makes it difficult to form transparent and uniform thin films via simple methods like spin coating, and its conductivity significantly decreases as the film becomes thinner. Herein, we fabricated a transparent and uniform composite thin-film heater by blending MXene with PEDOT:PSS using a one-step spin-coating process. Post-treatment with trifluoroacetic acid enhanced the conductivity of the PEDOT component by doping. Furthermore, micropatterning the PEDOT:PSS/MXene film confined electron pathways, resulting in significantly improved Joule heating performance. This approach enables the development of high-performance transparent electrodes and broadens the application scope of MXene-based materials in advanced electronics and thermal management.

Oral Presentation **OD1-7**

대학원생 구두발표(토론): 차세대 분자전자소자를 위한 고분자 기술

2025.9.29(월), 14:00~14:10, 5-1회장

Chair: 정승준, 최종민

Monolithically Integrated Ionogel-Based Triboelectric Nanogenerators

한지혜, 문홍철[†]

한국과학기술원

Stretchable triboelectric nanogenerators (TENGs) have garnered significant attention in wearable electronics and self-powered sensors. However, achieving intrinsically stretchable TENGs with stable performance under mechanical deformation remains a major challenge, including inter-layer adhesion. Here, we present the intrinsically stretchable ionogel-based TENGs (S-iTENG). The optimized S-iTENG exhibits high stretchability and voltage output, maintaining stable operation even at 80% strain.

Oral Presentation **OD4-1**

대학원생 구두발표(토론IV): 지속가능한 고분자 소재를 위한 순환적 디자인

2025.9.29(월), 13:00~13:10, 5-2회장

Chair: 전성권

High-Performance Furandicarboxylate Polyesters with 1,3-Propanediol and Neopentyl Glycol: Understanding Structure–Property Relationships

이용재, 구준모[†]

충남대학교

Dimethyl furandicarboxylate (DMFD) is a biomass-derived monomer with a rigid aromatic ring structure similar to terephthalic acid, making it suitable for synthesizing polyesters and polyamides. Yet the effect of subtle diol variations on DMFD-based polymer properties is scarcely studied. In this study, two furanoate polyesters, poly(propylene furanoate) (PPF) and poly(neopentyl furanoate) (PNF), were synthesized to assess how differences between 1,3-propanediol and neopentyl glycol influence crystallinity and mechanical behavior. PPF and PNF showed Young's modulus values of 2.5 and 3.0 GPa and tensile strengths of 100.7 and 98.0 MPa. After optimized annealing, Young's modulus increased to 3.4 and 3.6 GPa and tensile strengths rose to 112.6 and 121.4 MPa. These findings demonstrate that even slight diol structural differences can strongly affect crystalline morphology and mechanical performance, offering valuable insights for designing high-performance bio-based polymers.

Oral Presentation **OD4-2**

대학원생 구두발표(토론IV): 지속가능한 고분자 소재를 위한 순환적 디자인

2025.9.29(월), 13:10~13:20, 5-2회장

Chair: 전성권

Energy-autonomous and skin-adaptive sensor patch with monolithically nano-interconnected interfaces for spatiotemporal teleoperation

전승환, 김현승¹, 박창현, 양태현², 정창규¹, 방창현⁺

성균관대학교

¹ 전북대학교

² 건국대학교

Here, we present a energy-autonomous and highly skin-adaptive sensor adhesive patch significantly advancing virtual reality based spatiotemporal teleoperation. Monolithic multilayers include deformable top and bottom wrinkled electrodes embedded with carbon nanotubes monolithically embedded in middle active layer, providing ~40% enhanced self-powered sensing and reverbility (<10,000 cycles). Additionally, a sensor integrated with a bio-inspired hierarchical octopus-beetle adhesive ensures robust and reversible adhesions in multi-directional skin adhesion under wet conditions while maintaining breathability and comfort for long-term wear. This design addresses the critical challenges of low power consumption for reliable signal transduction and mechanical mismatch limiting current skin-attached devices, enabling a human-friendly and durable device for immersive teleoperation technologies. This study was published in: Materials Science and Engineering: R: Reports, 165, 100995

Oral Presentation **OD4-3**

대학원생 구두발표(토론IV): 지속가능한 고분자 소재를 위한 순환적 디자인

2025.9.29(월), 13:20~13:30, 5-2회장

Chair: 전성권

Organic-Inorganic Hybrid PVA Hydrogel with Enhanced Amine Loading for High Capacity Indoor CO₂ Adsorption

정찬희, 이택승[†]

충남대학교

Elevated indoor CO₂ levels degrade air quality and impair human performance, underscoring the need for effective sorbents in confined spaces. Amine-based sorbents, particularly those containing poly(ethyleneimine) (PEI), are widely used for CO₂ capture but often suffer from amine loss and poor stability. We prepared hydrogels of poly(vinyl alcohol) (PVA), tetraethyl orthosilicate (TEOS), and PEI, combining the mechanical robustness of PVA-TEOS with the strong CO₂ affinity of PEI. Samples with varying PEI contents were synthesized to study how amine loading affects CO₂ uptake and material properties. Higher PEI content increased pore volume and changed viscoelastic behavior. The optimized hydrogel showed high CO₂ uptake, indicating that PVA-TEOS-PEI hydrogels can be tuned as effective sorbents for indoor CO₂ mitigation.

Oral Presentation **OD4-4**

대학원생 구두발표(토론IV): 지속가능한 고분자 소재를 위한 순환적 디자인

2025.9.29(월), 13:30~13:40, 5-2회장

Chair: 전성권

Intrinsically Reconfigurable Boroxine-Crosslinked Dynamic Thermosetting Polyimide Adhesives

조하영, 남기호^{*1}

경북대학교 섬유시스템공학과

¹ 경북대학교

High-temperature adhesives are essential in advanced industries such as aerospace, automotive, and electronics, where extreme thermomechanical stability is required. However, conventional adhesives based on irreversible thermosets have critical limitations in recyclability and sustainability. Herein, we present a sustainable and reusable high-temperature polyimide adhesive utilizing dynamic covalent chemistry (DCC). The adhesive features a polyimide backbone end-capped with phenylboronic acid, which undergoes dehydrative cyclization to form reversible boroxine bonds. This dynamic network imparts high thermal stability and enables reversible bond exchange under external stimuli. The thermomechanical properties and reversibility of the adhesive were thoroughly characterized, and its adhesive performance was systematically evaluated. The results demonstrate the potential of dynamic covalent polyimide adhesives as next-generation sustainable solutions for high-performance applications.

Oral Presentation **OD4-5**

대학원생 구두발표(토론IV): 지속가능한 고분자 소재를 위한 순환적 디자인

2025.9.29(월), 13:40~13:50, 5-2회장

Chair: 전성권

Diallylammonium-cyclopolymerized anion exchange membranes for high-performance water electrolysis with engineered ion-transport properties

최주연, 이명석, 조원희, 남유진, 최찬희, 이정현⁺

고려대학교

Anion exchange membrane (AEM)-based water electrolysis (AEMWE) is considered one of the most cost-efficient approaches for converting renewable energy into hydrogen. The hydroxide ion conductivity of AEMs is a critical factor for achieving high AEMWE performance. However, many AEMs exhibit unsatisfactory ion conductivity, and the factors governing their ion transport remain unclear. Herein, we propose a pyrrolidinium-containing diallylammonium-cyclopolymerized (PDT) membrane consisting of both linear and crosslinked monomers. The monomer composition was engineered to achieve high ion conductivity. The optimized PDT membrane exhibited higher AEMWE performance than commercial AEMs in both 1 M KOH(aq) and pure water. This study provides a high-performance AEM with engineered ion-transport properties.

Oral Presentation **OD2-1**

대학원생 구두발표(토론II): 첨단 의료용 고분자 및 응용

2025.9.29(월), 15:00~15:10, 5-2회장

Chair: 김수환, 박현지

pH-Responsive Hydrogel for Targeted Protocatechuic Acid Delivery in Hepatocellular Carcinoma

HAO WEIQIANG, 이규익[†]

경북대학교

Hepatocellular carcinoma (HCC) is a leading cause of cancer-related deaths worldwide. Plant-derived phenolic agents, such as protocatechuic acid (PCA), show promise in HCC treatment but are limited clinically by poor targeting and rapid metabolism. To address these challenges, this study introduces a pH-responsive hydrogel (PA-CB-PCA) for PCA loading, enhanced bioavailability, and targeted tumor delivery. Boronobenzoic acid was conjugated to weight chitosan (CB), with PCA loaded via reversible boronate ester bonds, and crosslinked with protocatechualdehyde (PA) through boronate ester and Schiff-base linkages to improve stability and enable pH-triggered release. In vitro, the hydrogel exhibited shear-thinning injectability, 73% PCA release at pH 6.5, HCC cell targeting, and reduced viability, migration, and proliferation. In vivo, it reduced tumor burden, liver injury markers, inflammation, and fibrosis. This platform offers a promising strategy for phenolic drug delivery and HCC treatment.

Oral Presentation **OD2-2**

대학원생 구두발표(토론II): 첨단 의료용 고분자 및 응용

2025.9.29(월), 15:10~15:20, 5-2회장

Chair: 김수환, 박현지

Synthesis of a Zwitterionic Chitosan and its Antifouling Coatings for Medical Devices

김나윤, 조우경¹

충남대학교 화학과

¹ 충남대학교

Peripherally inserted central catheters are widely used for prolonged intravascular therapies, including blood transfusion and drug delivery. However, extended use increases the risk of severe infections and thrombosis. Zwitterionic polymer coatings offer a promising strategy by forming a highly hydrated antifouling layer that provides antibacterial properties while reducing thrombosis risk. The hydration layer inhibits coagulation factor adhesion, and electrostatic repulsion further minimizes thrombogenesis. In this study, we synthesized a zwitterionic polymer by conjugating isonicotinic acid (INA) with 1,3-propanesultone to produce 3-(4-carboxypyridin-1-ium-1-yl)propane-1-sulfonate (SB-INA), which was then conjugated to chitosan. The resulting zwitterionic chitosan polymer was coated onto a medical titanium substrate, and its antifouling properties were evaluated. This presentation provides our strategy for designing a zwitterionic chitosan derivative and its biomedical applications.

Oral Presentation **OD2-3**

대학원생 구두발표(토론II): 첨단 의료용 고분자 및 응용

2025.9.29(월), 15:20~15:30, 5-2회장

Chair: 김수환, 박현지

Fabrication of Poly(2-oxazoline)-Based Amphiphilic Block Copolymer Micelles for Polymeric Surfactants and Comparative Study with PEG-Based micelles.

김신철, 김세영⁺

단국대학교

For diseases of ARDS, polymer-based pulmonary surfactants provide a promising solution. Previous studies have shown that PEG-PS-based polymeric surfactants can reduce surface tension. However, in real biological environments, PEG-PS-based polymeric surfactants have limitations. Therefore, this study aims to solve the low ESP (Equilibrium Spreading Pressure) of PEG segment in PEG-PS-based polymeric surfactants, synthesizing a new amphiphilic block copolymer in which the PEG segment is replaced with a poly(oxazoline)-based polymer. Furthermore, considering the effects of crystallization tendency and the effects caused by the thermoresponsive temperature. Additional modifications were made to the polymer. Finally, compared the performance differences between micelles formed by the two block copolymers and the interfacial properties at the air-liquid interface. These results were used to explore the potential of using these amphiphilic block copolymers as pulmonary surfactants.

Oral Presentation **OD2-4**

대학원생 구두발표(토론II): 첨단 의료용 고분자 및 응용

2025.9.29(월), 15:30~15:40, 5-2회장

Chair: 김수환, 박현지

Shape-Changing aptameric structure for sensing SARS-CoV-2 variants

김재영, 오승수[†]

포항공과대학교

Accurate, yet simple and fast diagnosis of severe acute respiratory syndrome coronavirus 2(SARS-CoV-2) has been crucial during the pandemic. However, viral mutation can increase its infectivity and reduce sensitivity of current methods. To date, existing detection methods must be frequently reassessed and even abandoned if they fail to meet the required standards whenever major mutations occur; in particular, antibody-based Rapid Antigen Tests are vulnerable to this limitation. Accordingly, sensors that are universally responsive to mutations would be highly effective for detecting continuously mutating viruses, including those that may emerge in the future. We propose an intuitive and simple method using structure-switching aptamers to detect SARS-CoV-2, regardless of mutations. The aptamer structure was developed based on an hACE2-mimicking biopolymer that universally binds to SARS-CoV-2 variants. Our results demonstrate successful SARS-CoV-2 variant detection in non-treated samples.

Oral Presentation **OD2-5**

대학원생 구두발표(토론II): 첨단 의료용 고분자 및 응용

2025.9.29(월), 15:40~15:50, 5-2회장

Chair: 김수환, 박현지

Personalized Stem Cell Membrane-Coated Curcumin-PLGA Nanoparticles for Osteoarthritis-Specific Drug Delivery

이선준, 이수홍[†]

동국대학교

Traditional drug delivery systems for osteoarthritis (OA) face challenges such as rapid joint clearance and limited biocompatibility. Inflammation accelerates cartilage and extracellular matrix degradation, impeding regeneration. To address these issues, we fabricated dCOL2-CM-Cur-PNPs as an OA-specific drug delivery system for anti-inflammation and regeneration. This system comprises curcumin-loaded PLGA nanoparticles (Cur-PNPs) coated with iPSC-derived mesenchymal stem cell membranes (iMSC-CMs) and functionalized with phospholipids targeting damaged type II collagen (dCOL2). The iMSC-CM coating enables sustained drug release and facilitates intracellular uptake by OA chondrocytes. It inhibits M1 macrophages and promotes M2 polarization. dCOL2 enables selective targeting to OA cartilage in vitro and in vivo. dCOL2-CM-Cur-PNPs exhibited significant anti-inflammation and cartilage regeneration in a DMM rat model, highlighting its potential as a next-generation drug delivery platform.

Oral Presentation **OD2-6**

대학원생 구두발표(토론II): 첨단 의료용 고분자 및 응용

2025.9.29(월), 15:50~16:00, 5-2회장

Chair: 김수환, 박현지

Pneumatic Valve-Based Microfluidic Device for the Detection of Exogenous Gene

한지훈, 윤혜원, 이창수[†]

충남대학교

Human erythropoietin (hEPO) enhances performance by increasing red blood cells and is banned by WADA due to its potential misuse for gene doping. DNA quantification is important for anti-doping test, but the conventional techniques rely on nucleic acid amplification which have inherent issues like and time-consuming and cross-contamination risk quantification bias. Here, we suggest a CRISPR-Cas12a based rapid detection technique for amplification-free and effective quantification of DNA at the amol level. To achieve this, we leveraged the fluid manipulation effect enabled by pneumatic valves to perform a Cas12a assay based on solution mixing within a loop reactor, which differs from conventional laminar-flow-based mixing strategies. This approach yielded excellent specificity and a rapid detection time of 30 minutes. Moreover, we demonstrated its versatility and quantification capability by directly detecting DNA from unpurified plasma samples using human pooled serum.

Oral Presentation **OD5-1**

대학원생 구두발표(토론V): 지속가능한 차세대 에너지 소재 개발 및 응용

2025.9.29(월), 13:00~13:10, 6회장

Chair: 김수찬, 권지연

Hierarchically Porous Metal/Carbon Catalysts Constructed via Block Copolymer Self-Assembly and VIPS for Enhanced Hydrogen Evolution Reaction

최보명, 진형민[†]

충남대학교

Platinum (Pt) is widely used for the hydrogen evolution reaction (HER) due to its high intrinsic activity. However, it suffers from high cost, limited availability, and poor long-term durability. To overcome these issues, we developed a vapor induced phase separation (VIPS)-assisted block copolymer (PAN-*b*-P4VP) strategy to construct hierarchically porous metal/carbon catalysts. The selective coordination ability and porogenic function of P4VP enabled Pt nanoparticles to be encapsulated within mesopores, resulting in uniform dispersion throughout the carbon matrix. Concurrently, VIPS produced a bicontinuous 3D porous network that enhanced mass transport, and the rough surface further suppressed bubble agglomeration and promoted rapid detachment. These features collectively contributed to excellent HER performance. The system also allowed selective loading of other metals, demonstrating broad applicability in electrocatalysis.

Oral Presentation **OD5-2**

대학원생 구두발표(토론V): 지속가능한 차세대 에너지 소재 개발 및 응용

2025.9.29(월), 13:10~13:20, 6회장

Chair: 김수찬, 권지연

Initiator-Free, Room-Temperature, Open-Air Compatible, In Situ Self-Polymerizing Gel Electrolytes for Sustainable Aqueous Zinc Metal Batteries

김세현, 한동엽, 이상엽, 손무근¹, 신성빈, 정태훈, 지형민, 강준희¹, 박수진, 김연수⁺

포항공과대학교

¹ 부산대학교

Aqueous zinc metal batteries (AZMBs) suffer from dendrite formation and side reactions at the Zn anode, limiting cycle life and stability. In situ gel polymer electrolytes (GPEs) can mitigate these issues by forming robust electrode–electrolyte interfaces, but conventional GPEs require initiators and crosslinkers that generate byproducts and hinder Zn²⁺ conduction. Here, an initiator- and crosslinker-free GPE is developed that spontaneously polymerizes at room temperature in air via a Zinc salt-induced mechanism. Simply mixing zwitterionic monomer with Zinc salt induces spontaneous gelation, forming a flexible polymer network with tight electrode contact and continuous Zn²⁺ conduction pathways. Zn cells exhibit over 4100 h of stable cycling and retain 95.6% capacity after 100 cycles in Zn||VO₂ full cells. This sustainable, scalable approach offers a practical solution to Zn-anode challenges and enables eco-friendly AZMBs for next-generation energy storage.

Oral Presentation **OD5-3**

대학원생 구두발표(토론V): 지속가능한 차세대 에너지 소재 개발 및 응용

2025.9.29(월), 13:20~13:30, 6회장

Chair: 김수찬, 권지연

Unveiling Interfacial Corrosion of Ga-Based Liquid Metal Alloys in Lithium Metal Batteries

백제준, 김수찬[†]

성균관대학교

Ga-based liquid metals (LMs) are promising interfacial materials for lithium metal batteries due to their conductivity, softness, self-healing, and low toxicity. They promote uniform, lithiophilic Li deposition and extend battery life. However, Ga's high reactivity with metal current collectors can cause alloying, corrosion, and interfacial degradation. In eutectic alloys like Galn and GalnSn, metal segregation further destabilizes the interface. Despite these issues, LM-induced corrosion has been largely overlooked. This study investigates the structural, chemical, and electrochemical impacts of Ga-based LMs on anode current collectors. We reveal that such corrosion critically shortens battery lifespan. These findings expose a key challenge in using Ga-based LMs and suggest design strategies for stable, durable interfaces in next-generation lithium metal batteries.

Oral Presentation **OD5-4**

대학원생 구두발표(토론V): 지속가능한 차세대 에너지 소재 개발 및 응용

2025.9.29(월), 13:30~13:40, 6회장

Chair: 김수찬, 권지연

Molecular Weight-Dependent Properties of PEO Interfaces in Anode-Free Lithium Metal Batteries

조재원, 김수찬[†]

성균관대학교

The development of anode-free lithium metal batteries (AFLMBs) holds great potential for next-generation energy storage due to their high theoretical energy density and simplified design. Yet, the absence of a host anode leads to unstable lithium deposition and poor interfacial reversibility. To address these challenges, we introduce polyethylene oxide (PEO) coatings with varying molecular weights as artificial interfacial layers on copper current collectors. This study focuses on how molecular weight influences the structural and electrochemical properties of the PEO layer, including polymer morphology, lithium ion transport, and solid electrolyte interphase (SEI) formation. Through a systematic comparison, we reveal how tuning polymer chain length can optimize interface stability and cycling performance in AFLMB systems, offering key insights into the structure-performance relationship of polymer-modified interfaces.

Oral Presentation **OD5-5**

대학원생 구두발표(토론V): 지속가능한 차세대 에너지 소재 개발 및 응용

2025.9.29(월), 13:40~13:50, 6회장

Chair: 김수찬, 권지연

Post-Treatment Strategy for High-Capacity NDI Polymer Cathodes in Li-Ion Batteries

이민희, 이원호[†]

금오공과대학교

Conjugated polymer cathodes are promising candidates for next-generation Li-ion batteries, but their capacity is limited by inactive alkyl side chains. We propose a simple heat-treatment strategy to remove the side chains of a naphthalenediimide (NDI)-based polymer P(NDI2OD-T2). This reduced inactive mass and nearly doubled the specific capacity from 56.3 to 117.0 mAh g⁻¹. It also created a porous structure that improved ion diffusion and capacitive storage. Electrochemical tests showed that the heat-treated electrode maintained stable performance at sub-zero temperatures due to better ion transport and surface storage. At room temperature its crystallinity decreased, lowering conductivity compared to the fresh electrode, but the capacity was still greatly enhanced. These results highlight post-treatment as an effective route to tune the structure–property relationship of conjugated polymer cathodes and enhance the capacity of organic electrodes.

Oral Presentation **OD5-6**

대학원생 구두발표(토론V): 지속가능한 차세대 에너지 소재 개발 및 응용

2025.9.29(월), 13:50~14:00, 6회장

Chair: 김수찬, 권지연

Binder Crystallinity Control in Dry-Coated Thick Cathodes for Improved Ionic Conductivity

김혜민, 허수민, 진형준[†]

인하대학교

To improve the energy density of lithium-ion batteries, the development of thick cathodes is essential. However, slurry-based fabrication processes often result in inhomogeneous particle distribution due to solvent evaporation. Additionally, insufficient ionic conductivity within the electrode can lead to performance degradation under high current densities. In this study, a solvent-free dry-coating process was employed to fabricate thick cathodes. To enhance lithium-ion mobility within the electrode, a strategy to reduce binder crystallinity was implemented. Quenched poly(vinylidene fluoride) (PVDF) was initially used as a binder, but this method required an additional quenching step in the process. To address this limitation, succinonitrile (SN), known for its high ionic conductivity, was introduced as an additive. SN not only improved ionic conductivity but also acted as a plasticizer. As a result, the SN-containing PVDF binder exhibited lower crystallinity than quenched PVDF, leading to enhanced lithium-ion transport.

Oral Presentation **OD3-1**

대학원생 구두발표(토론III): 콜로이드 및 분자 자기조립의 원리와 응용

2025.9.29(월), 15:00~15:10, 6회장

Chair: 양상희

Understanding the Wetting Behavior of Liquid Metals with Oxide Skins through Force Balance Analysis of Contact Angles

오형수, 손정곤[†]

KIST

Gallium-based liquid metals form oxide films a few nanometers thick in air, exhibiting interfacial behavior not fully explained by Young's equation. We propose a modified equation incorporating the interfacial energies of the liquid metal–oxide and oxide–air interfaces and the oxide film's mechanical tension. Each factor affecting the effective surface tension was separated and quantified using force balance and adhesion tests. By using a substrate of the same oxide film, the intrinsic interfacial energy and yield tension were measured independently for the first time. We show that the advancing contact angle of liquid metal on polymers is governed by the oxide film's yield tension rather than the substrate's surface energy, offering guidelines for liquid metal–polymer interface design. This analysis also provides a quantitative basis for why the advancing contact angle remains constant or dewetting occurs at these interfaces.

Oral Presentation **OD3-2**

대학원생 구두발표(토론III): 콜로이드 및 분자 자기조립의 원리와 응용

2025.9.29(월), 15:10~15:20, 6회장

Chair: 양상희

Mechanophysical Synthesis of Core/Shell Hybrid Supraparticles via Particles Collision

**이건호, 황정욱, 이성환¹, 김진수², 박진우, 최윤석³, 이진훈, 이진홍⁴, 최재령⁵,
양철민⁶, 김일진⁷, 박보인⁸, Shu Yang⁹, 전승렬⁶, 유승건¹, 이동욱[†]**

울산과학기술원

¹ 한국전기연구원

² 한국과학기술연구원, 한국재료연구원

³ 워싱턴 대학교 세인트루이스

⁴ 부산대학교

⁵ 한국재료연구원

⁶ 한국과학기술연구원

⁷ 한국소재융합연구원

⁸ 전북대학교

⁹ 펜실베이니아 대학교

Polymer microparticles (MPs) can be functionalized by decorating their surfaces with inorganic nanoparticles (NPs). However, this process requires multiple chemical modification steps because these particles are synthesized through 'wet chemistry'. We propose a dry, mechanophysical synthesis that forms core/shell hybrid supraparticles (HSPs) via particle-particle collisions, utilizing the modulus difference between MPs and NPs. NPs can be embedded stably onto the MPs surface through the interfacial energy and collision energy. HSPs can be synthesized from a diverse combination of MPs and NPs, regardless of their shapes and functionalities. Furthermore, a single MP can incorporate multiple types of NPs. For example, the HSPs composed of magnetic, photocatalytic, and ion-adsorptive NPs can not only remove toxic water pollutants, but also exhibit recyclability. The mechanophysical synthesis provides a route for sustainable and versatile self-assembly of heterogeneous MPs.

Oral Presentation **OD3-3**

대학원생 구두발표(토론III): 콜로이드 및 분자 자기조립의 원리와 응용

2025.9.29(월), 15:20~15:30, 6회장

Chair: 양상희

Enhancing Thermal Conductivity and Stability of Organic PCM Composites via Segregated Filler Network Formation

이동훈, 김채빈[†]

부산대학교

Phase change materials (PCMs) can absorb and release heat during phase transitions without a change in temperature, making them useful for thermal management. However, organic PCMs typically suffer from low thermal conductivity and leakage, limiting their practical use. In this work, we present a PCM composite incorporating a highly interconnected network of thermally conductive hexagonal boron nitride (h-BN) fillers to address these challenges. The composite is fabricated by blending h-BN with two immiscible organic PCMs in the molten state, forming a Pickering emulsion that solidifies upon cooling. This induces a 2D filler network that improves thermal conductivity (~ 20.2 W/m·K) and maintains structural stability above both PCMs' melting points. Compared to single-PCM composites, the material shows improved heat transfer and thermal stability. This strategy offers a promising pathway for advancing the performance and reliability of PCM-based thermal regulation systems.

Oral Presentation **OD3-4**

대학원생 구두발표(토론III): 콜로이드 및 분자 자기조립의 원리와 응용

2025.9.29(월), 15:30~15:40, 6회장

Chair: 양상희

From Order to Disorder: Quantitative Control of Nanopatterned Block Copolymer Arrays

태성관, Gabriella Pasya Irianti¹, 김예찬², 허수미⁺¹, 김소연⁺

서울대학교

¹ 전남대학교

² 삼성전자

Structural disorder could induce unique properties such as quasiparticle localization, potentially serving as functional design elements for wave-manipulating devices. Such intriguing phenomena have brought about much research interest in tailoring structural disorder; however, reproduction and quantitative analysis of disordered nanostructures still remain experimentally challenging, with the term "disorder" itself often suffering from definitional ambiguity.

Here, we employ block copolymers to alter and characterize structural disorder. Starting from a hexagonal array formed in sphere-forming block copolymer thin film, we deliberately introduced and fine-tuned the disorder by adjusting readily accessible parameters, including annealing temperatures, incorporation ratio of metal precursors, and blending ratio with homopolymers. This study potentially offers a platform for engineering disordered systems that could mediate phenomena related to quasiparticle localization.

Oral Presentation **OC-1**

대학원생 구두발표(코스맥스)

2025.9.29(월), 13:00~13:15, 7회장

Chair: 최준식, 김혜민, 한구희, 박성민

Antigen-Independent Tumor Tagging via Fc Display for Broad-Spectrum NK Cell Immunotherapy

강선우, 김원종[†]

포항공과대학교

Natural killer (NK) cells are key effectors in tumor immune surveillance, primarily eliminating cancer cells through antibody recognition. However, their therapeutic potential is hindered by heterogeneous tumor antigen expression. To address this, we developed a strategy to display Fc fragments directly on tumor cell surfaces using a synthetic fusion protein, Univody, composed of the human IgG1 Fc region fused to a transmembrane domain. The construct was delivered as plasmid DNA (pUnivody) via a phenylboronic acid (PBA)-functionalized lipopolyplex (LPP) system, facilitating targeted delivery while minimizing cytotoxicity. This approach enabled antigen-independent Fc display on tumor cells, leading to NK cell activation in vitro. In vivo, pUnivody@LPP-PBA significantly suppressed tumor growth in triple-negative breast cancer and melanoma models, demonstrating a versatile immunotherapy platform that circumvents tumor antigen dependence.

Oral Presentation **OC-2**

대학원생 구두발표(코스맥스)

2025.9.29(월), 13:15~13:30, 7회장

Chair: 최준식, 김혜민, 한구희, 박성민

Optically tunable catalytic cancer therapy using enzyme-like chiral plasmonic nanoparticles

강하은, 유수빈¹, 김령명², 김동하⁺

이화여자대학교

¹ Harvard Medical School

² 한국화학연구원

Cascade enzymatic reactions are key to complex biochemical processes but remain challenging to control in artificial systems. We report chiral plasmonic nanoparticles with glucose oxidase (GOD) and peroxidase (POD) activities for optically tunable catalytic cancer therapy. Using sequential circularly polarized light (RC then LC), we selectively activate GOD and POD, achieving 1.3× overall enhancement compared to uncontrolled cascades by optimizing the reaction environment. D-Au nanoparticles show 2× higher affinity for D-glucose due to chirality matching. In cell and mouse models, sequential irradiation yields the highest radical generation and best therapeutic efficacy. This platform offers strong potential for precision catalytic therapy.

Oral Presentation **OC-3**

대학원생 구두발표(코스맥스)

2025.9.29(월), 13:30~13:45, 7회장

Chair: 최준식, 김혜민, 한구희, 박성민

Respiratoid: A Photosynthetic Chloroplast–CTP–Alginate Macrosystem for 3D-Printed Oxygenation in Cell Transplantation

유채림, 이동윤[†]

한양대학교

Oxygen deprivation remains a major hurdle in cell transplantation, particularly in 3D constructs without vasculature. Here, we present a photosynthetically active hydrogel ("Respiratoid") that continuously supplies oxygen via stabilized chloroplasts. Chloroplasts were conjugated to alginate using a chloroplast-transit peptide (CTP), which anchors to the outer chloroplast membrane, enhancing structural integrity and oxygen-evolving protein expression. The resulting Respiratoid was 3D-printed into centimeter-scale cubes (ResCubes) and loaded with pancreatic islets. The oxygen-releasing performance and islet-supporting capacity of the ResCubes were experimentally validated in vitro and in vivo and further supported by oxygen diffusion simulations in silico. This nature-inspired platform overcomes burst-release and ROS-related toxicity common to conventional oxygen-releasing biomaterials, and enables scalable, long-term oxygenation for cell-based therapies.

Oral Presentation **OC-4**

대학원생 구두발표(코스맥스)

2025.9.29(월), 13:45~14:00, 7회장

Chair: 최준식, 김혜민, 한구희, 박성민

DNA-programmable microcapsules for stimuli-responsive artificial cell systems

배다인, 오승수[†]

포항공과대학교

Artificial cells are increasingly recognized as powerful tools for understanding biological complexity and building life-like systems. Among various platforms, proteinosomes, protein-polymer conjugate-based microcapsules, have attracted attention due to their self-assembly-driven formation, selective permeability and potential for enzymatic activity. However, achieving precise stimuli-responsive control remains a key challenge in efforts to mimic natural cell systems. Here, we introduce a new class of DNA-tethered proteinosomes that utilize DNA as dynamic linkers between building blocks. These microcapsules can be programmed to undergo structural changes in response to specific molecular cues. This strategy enables fine-tuned control over capsule integrity and presents a modular approach toward stimuli-responsive artificial cell systems. Our work highlights the potential of integrating DNA nanotechnology into soft matter-based synthetic cell platforms for programmable behavior.

Oral Presentation **OC-5**

대학원생 구두발표(코스맥스)

2025.9.29(월), 14:00~14:15, 7회장

Chair: 최준식, 김혜민, 한구희, 박성민

Effect of TiO_2 Particle Shape on the Structural and Rheological Properties of Water-in-Oil High Internal Phase Pickering Emulsions

김예린, 김규한[†]

서울과학기술대학교

Water-in-oil high internal phase Pickering emulsions (W/O HIPPEs) exhibit their polyhedral droplets and viscoelastic characteristics, resulting from their high volume fraction of the dispersed phase. These emulsions enable encapsulation of water-soluble substances while minimizing oil content, making them applicable to various applications. While most studies have focused on stabilizing oil-in-water (O/W) HIPPEs using amorphous TiO_2 particles, this study provides the first investigation into stabilizing W/O HIPPEs using TiO_2 particles of different shapes—spindle-shaped and amorphous—modified with stearic acid. We investigated the role of particle shape in determining the interfacial stability and mechanical properties of W/O HIPPEs through comprehensive analysis of droplet size distribution, interfacial particle behavior, and rheological properties. These findings contribute to the design of HIPPE systems with tunable characteristics, facilitating their application in diverse fields.

Oral Presentation **OC-6**

대학원생 구두발표(코스맥스)

2025.9.29(월), 14:15~14:30, 7회장

Chair: 최준식, 김혜민, 한구희, 박성민

Thermally Stable Nanostructured Patterns Achieved by Dehalogenation in Bottlebrush Block Copolymers

정재원, 오혜진, 방준하[†]

고려대학교

Compared to linear block copolymers (BCPs), bottlebrush block copolymers (BBCPs) exhibit superior properties such as higher entanglement molecular weight due to their unique architecture. However, thermal annealing of BBCP thin films often results in defects, mainly caused by side reactions involving terminal bromine (Br) groups. To enhance thermal stability and pattern fidelity, a dehalogenation reaction was employed to remove these terminal Br groups before annealing. This pre-treatment effectively suppressed defect formation and enabled the generation of well-ordered nanostructures solely through thermal annealing. The resulting morphologies, characterized by atomic force microscopy (AFM) and small-angle X-ray scattering (SAXS), showed high uniformity and order. These improved BBCPs demonstrate strong potential for directed self-assembly (DSA) applications, functioning not only in creating aligned nanoscale patterns but also in repairing defects in pre-patterned substrates.

Oral Presentation **OC-7**

대학원생 구두발표(코스맥스)

2025.9.29(월), 14:30~14:45, 7회장

Chair: 최준식, 김혜민, 한구희, 박성민

Polarity-Switchable Maleic Anhydride Copolymer Coatings for Enhanced Microplastic Capture in Water Filters

최윤영, 박준용¹, 전해리¹, 이상혁¹, 김채빈⁺

부산대학교

¹ 중앙대학교

Microplastics are widespread aquatic contaminants, yet conventional size-exclusion membrane filters show limited capture efficiency. Thin adhesive layers have been used to improve performance, but typically require toxic organic solvents. Here, we present a polarity-switchable adhesive copolymer containing maleic anhydride (MA). Upon base treatment, the copolymer becomes hydrophilic and water/ethanol-soluble; subsequent heat triggers ring closure, restoring hydrophobicity and forming a stable adhesive layer under aqueous conditions. This eco-friendly, solvent-free coating enhances microplastic capture and enables odorless, large-scale spray application. The reversible polarity-switching mechanism also offers a sustainable route for filter recycling.

Oral Presentation **O8-1**

학문후속세대 연구발표

2025.9.29(월), 13:00~13:20, 8회장

Chair: 공호열,이준민

Immune-modulative nano-gel-nano system for patient-favorable cancer therapy

김성훈, 김영민[†]

한국과학기술연구원

Current cancer immunotherapies often show limited efficacy due to suppressive tumor immune microenvironments (TIMEs). To overcome this, localized delivery of tumor antigens and immune stimulants is essential. However, repeated administrations can be inconvenient and lack precise immune control, increasing the risk of cytokine storms. Here, we present a patient-adaptable nano-gel-nano platform enabling sustained generation of tumor-associated antigens and release of adjuvants. This is achieved through the specific delivery of drugs to cancer cells and antigens/adjuvants to immune cells over the long term, maintaining proper concentrations within the tumor site with a single injection. This system maintains effective concentrations within the tumor via a single injection, supports tumor-specific immunity, enhances immune checkpoint blockade efficacy, and induces systemic memory T cell responses, while minimizing systemic toxicity.

Oral Presentation **O8-2**

학문후속세대 연구발표

2025.9.29(월), 13:20~13:40, 8회장

Chair: 공호열,이준민

Mechanotransducing Organic Electrochemical Diode for Crosstalk-inhibited Artificial Skin

김태영, 정운룡[†]

포항공과대학교

High-resolution deformable artificial skin emulating human tactility is essential for interactive robotics, prosthetics, and wearable electronics. Although recent developments in stretchable transistors and diodes have mitigated electrical crosstalk, persistent challenges remain to simultaneously satisfy large deformability, structural simplicity, and tactile signal fidelity. We unify the diode functionality and mechanotransduction into an organic electrochemical diode. The diode operates through ion-hole coupling in the organic semiconductor, while mechanical deformation is transduced into strain-dependent impedance changes. The diode exhibits a rectification ratio of 5×10^2 at 10^2 Hz—more than an order of magnitude higher than previously reported ionic diodes in rectification ratio and operating frequency. This unified approach enables the direct fabrication of crosstalk-resistant ion-electronic skin, achieving accurate strain/pressure mapping.

Oral Presentation **O8-3**

학문후속세대 연구발표

2025.9.29(월), 13:40~14:00, 8회장

Chair: 공호열,이준민

Engineered Hypoxic Niches and Cell-Tethering Colloidal Gels Enhance MSC Paracrine Productivity and Promote Vascular Regeneration

이재서[†], 이명철¹, 김성수¹, 신수련², 권일근

경희대학교

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Microporous hydrogels are widely used for therapeutic cell delivery but often suffer from harsh pathological environments and rapid cell escape. To overcome these issues, cell-tethering and hypoxic conditioning colloidal hydrogels encapsulating mesenchymal stem cells (MSCs) were developed. Tyramine-conjugated gelatin forms oxidative phenolic crosslinks on cell surfaces, preventing egression and providing mechanical cues via microporous networks. Oxygen-releasing microparticles embedded in the hydrogels continuously generated oxygen for two weeks, sustaining mild hypoxia even under oxygen-deprived conditions. This environment enhanced MSC viability and paracrine secretion of angiogenic factors. In vivo, the hydrogels reduced inflammation and apoptosis while promoting vascularization. In a mouse hindlimb ischemia model, the MSC-tethered hydrogels significantly improved blood flow recovery and muscle regeneration, demonstrating their potential for ischemic tissue repair.

Oral Presentation **O8-4**

학문후속세대 연구발표

2025.9.29(월), 14:00~14:20, 8회장

Chair: 공호열,이준민

Self-oscillating helix showing amplified winding and unwinding motions

정태훈, 최재원, 김혜인, 김영기, 김연수⁺

포항공과대학교

Self-oscillating gels have become a distinguished class of smart soft materials because they undergo spontaneous and cyclic swelling-deswelling changes without on-off switching of external stimuli. However, their practical applications of them are still limited due to a small change and non-directional actuation by isotropic deformation. Herein, to improve the degree of deformation, we report an unprecedented method to convert an isotropic deformation into anisotropic and unidirectional deformation of gel. As a result of introducing a three-dimensional periodic gradient structure by photopolymerization into the gel network, a helix gel could be synthesized. The helix gels exhibited amplified uniaxial winding and unwinding during the Belousov–Zhabotinsky (BZ) reaction. In addition, they showed a significant change in length compared to the conventional rod gel. This presentation will discuss synthetic strategy, structure analysis, and improved self-oscillation of helix gels.

Oral Presentation **O8-5**

학문후속세대 연구발표

2025.9.29(월), 14:40~15:00, 8회장

Chair: 공호열,이준민

Bio-Inspired Metal–Organic Framework-Modified Porous Structured Polymer-Based Separator for Advanced Li–S Batteries

안종복, 김수찬[†], 유필진[†]

성균관대학교

High-performance separators characterized by excellent thermal stability, electrolyte wettability, porosity, and Li⁺ selectivity are vital for the safety and energy density of LiSBs, especially for suppressing polysulfide (LiPS) shuttling, which compromises the capacity and cycling stability. This study presents a novel separator design that combines template sacrificial and in situ growth methods to prepare a cobalt-imidazole framework-modified poly(ether ether ketone) inverse opal structure (ZIF-IO) that effectively inhibit the LiPS shuttle effect. The ZIF-IO separator, which has abundant electroactive sites, such as negative imidazole sites, enhances Li⁺ mobility. Co²⁺ attracts S_x²⁻, aiding LiPS adsorption and decomposition, thereby reducing LiPS shuttle diffusion. Through the ZIF-IO separator, the synergy of the Lewis acid–base effect and physical inhibition markedly curtailed LiPS transfer and lithium dendrite formation in the LiSB.

Oral Presentation **O8-6**

학문후속세대 연구발표

2025.9.29(월), 15:00~15:20, 8회장

Chair: 공호열,이준민

필러 첨가에 따른 우레탄 접착제의 기밀 성능 및 전단 강도 변화에 관한 연구

전규진[†]

HD한국조선해양

본 연구는 LNG 선박의 2차 방벽에 적용되는 우레탄계 접착제를 대상으로, 탄산칼슘 필러 첨가에 따른 기밀 성능 및 전단 강도의 변화를 분석하였다. 단일형 가열경화성 우레탄 접착제를 사용하였으며, 필러의 함량을 변화시켜 접착제의 성능 변화를 평가하였다. 기밀 성능 및 전단 강도는 LNG 선박 2차 방벽에 적용되고 있는 규격에 따라 평가되었다. 시험 결과, 필러 함량이 감소할수록 기밀 성능은 향상되는 반면, 전단 강도는 필러 함량 증가에 따라 개선되는 경향을 보였다. 이러한 결과는 필러가 기재 간 충전 효과를 통해 기계적 강도를 증진시키는 반면, 과도한 필러는 기밀성을 저해할 수 있음을 시사한다. 두 성능 간 균형을 고려할 때, 소량의 필러 첨가가 가장 적절한 조성으로 판단되었다. 본 연구는 LNG 선박 건조에 필수적인 접착제의 성능 최적화를 통해 국내 조선 산업의 기술 경쟁력 제고에 기여할 수 있을 것으로 기대된다.

Oral Presentation **O8-7**

학문후속세대 연구발표

2025.9.29(월), 15:20~15:40, 8회장

Chair: 공호열,이준민

전력케이블용 반도체성 복합재료의 유변학적·열적 응답에 기반한 PTC 거동 모델 제안

한재균, 김동학^{*1}, 손영곤², 이재식¹

(주)디와이엠솔루션

¹ 순천향대학교

² 공주대학교

고전압 전력케이블(HV/EHV)용 반도체층은 전계 완화와 절연층 보호를 통해 케이블의 장기 수명 확보에 기여하며, 일반적으로 폴리에틸렌(PE) 수지에 카본블랙(CB)을 혼합한 복합재료로 구성된다. 본 연구는 온도 상승 시 체적저항이 증가하는 PTC(Positive Temperature Coefficient) 거동에 주목하여, CB 및 가교제(Dicumyl Peroxide, DCP) 함량을 변화시킨 시편들을 대상으로 체적저항과 저장탄성률(G') 간의 상관관계를 분석하였다. 연화점(T_s)을 기준으로 저온과 고온 영역을 나눈 경험적 모델(PTC-VR 모델)을 제안하였고, 각 영역에서 상수 γ 와 n 을 적용하여 체적저항의 크기와 PTC 민감도를 정량화하였다. 본 모델은 전도성 네트워크의 열적 안정성을 기계적 응답을 통해 설명할 수 있는 도구로, 고전압 케이블용 반도체 복합재 설계에 유용한 기초 자료를 제공한다.

Oral Presentation **O9-1**

Graduate Student Oral Session (I) (English)

2025.9.29(월), 13:00~13:15, 9회장

Chair: 고영운, 김세영

Structural Control of Chiral NFAs via Thermal Annealing and End-Group Engineering for g-Factor Modulation in Vertical OFETs

김광민, 안재용¹, 이상욱¹, 오준학¹, 김봉수⁺

울산과학기술원

¹ 서울대학교

Organic field-effect transistors (OFETs) for circularly polarized light (CPL) detection are gaining attention for chiroptoelectronic applications. We report a vertical-type OFET system based on non-fullerene acceptors (NFAs) with chiral alkyl side chains, designed to achieve both high g-factor and detectivity. We investigated the effect of thermal annealing and end-group variation on the chiroptical and electrical performance of the devices. IC2F-based devices showed enhanced g-factor (−0.1) and detectivity (4.9×10^{11} Jones) after annealing. In contrast, IC2Cl-based devices showed minimal change, indicating that end-group structure significantly affects molecular packing. These results highlight that combining end-group design, and thermal treatment is key to optimizing CPL-sensitive OFETs. This study offers a design strategy for CPL photodetectors based on chiral organic semiconductors and insight into how structural factors influence chiroptical performance.

Oral Presentation **O9-2**

Graduate Student Oral Session (I) (English)

2025.9.29(월), 13:15~13:30, 9회장

Chair: 고영운, 김세영

Defect-Free Block Copolymer-Based Distributed Bragg Reflector for Photon-Recycling

DING SHANGXIAN, 류두열⁺

연세대학교

We suggest a new and feasible approach for the photoelectrochemical (PEC) application of distributed Bragg reflector (DBR) films using lamella-forming PS-*b*-P2VP self-assembly. A weak hydroxy acid of lactic acid (LA) in a methanol solution was incorporated into the 2VP units to favourably swell and protonate the P2VP domains of the defect-free films, leading to the selective expansion of LA-incorporated P2VP domains. The reflected wavelengths of the BCP-based DBR films were cooperatively tuned by controlling the crosslinking density in the P2VP domains immediately before the LA incorporation. The reflected wavelength (λ_m) was effectively tuned by varying the weight fraction of 1,4-dibromobutane (W_{DBB}). These narrow-width, high-reflectance DBR films were integrated into the rear of photoanodes to scrutinize the optimal λ_m for the best PEC performance, where the photon-recycling process also allowed the reflected lights to illuminate the backside.

Oral Presentation **O9-3**

Graduate Student Oral Session (I) (English)

2025.9.29(월), 13:30~13:45, 9회장

Chair: 고영운, 김세영

Surface and bulk engineering for highly efficient and stable perovskite solar cells

김찬혁, 민한울[†]

고려대학교

Achieving high efficiency and long-term stability remains a key challenge in perovskite solar cells (PSCs). We present a dual strategy combining surface defect removal and orientation engineering. The top surface of perovskite films shows higher defect density than the bulk, causing bandgap blue-shift and non-radiative recombination. Selective trimming (~50 nm) using a solvent-anti-solvent mixture reduced surface defects while preserving morphology and absorption.

To further improve performance, we introduced 2D perovskite into the trimming solvent, simultaneously refining the surface and forming a favorable 2D/3D interface. Unlike conventional 2D/3D structures that hinder charge transport, the tilted 2D perovskite enhanced conductivity and passivated grain boundaries without affecting 3D crystallization. As a result, devices achieved a certified efficiency of 26.3% and retained ~90% of initial output after 1100 h under MPP tracking.

Oral Presentation **O9-4**

Graduate Student Oral Session (I) (English)

2025.9.29(월), 13:45~14:00, 9회장

Chair: 고영운, 김세영

cECM-incorporated Bioactive Hydrogels for Burn Wound Healing

김연정, 권재원¹, 안병하¹, 박귀덕¹, 박경민⁺

인천대학교

¹ 한국과학기술연구원

Burn wound healing continues to present a clinical challenge owing to extended inflammation and the lack of a conducive microenvironment. To address these limitations, various biomaterials have been developed. Among these, cell-derived extracellular matrix (cECM)-based hydrogels have demonstrated potential in modulating cellular behavior, directing macrophage polarization, and offering a bioactive microenvironment. Here, we develop cECM-incorporated bioactive hydrogels (Gel-cECM). Gel-cECM demonstrate adequate mechanical strength and preserve ECM components, providing structural support and supporting long-term cell-matrix interactions. In addition, Gel-cECM enhance host cell infiltration, M2 macrophage polarization, angiogenesis, and collagen deposition in vivo. Notably, they accelerate wound healing and the regeneration of skin appendages, including hair follicles, muscle fibers, and nerves. In sum, Gel-cECM offer significant potential for burn wound healing and tissue regeneration.

Oral Presentation **O9-5**

Graduate Student Oral Session (I) (English)

2025.9.29(월), 14:00~14:15, 9회장

Chair: 고영운, 김세영

Nanopattern-Assisted Reconfigurable Surface-Enhanced Raman Scattering (SERS) Film for Smart Chemical Monitoring

민고윤, 나진수, 황순형¹, 박주혁⁺

서울대학교

¹ 한국기계연구원

Flexible surface-enhanced Raman scattering (SERS) substrates enable direct molecular analysis on irregular surfaces, making them valuable for food safety and bio-signal detection. However, most conventional SERS substrates suffer from structural damage after repeated use and limiting their practical utility. This study introduces a reconfigurable composite film with uniformly dispersed nanoparticles in a shape-memory polymer matrix. A thin gold layer is deposited onto the nanopatterned surface and selectively transferred to the target during light-triggered shape recovery, forming dense hotspots. The template is cleanly detached and reused, while the sensing layer is restored by simple redeposition without lithography. Raman analysis confirmed strong signal enhancement and reliable detection of residual chemicals on curved surfaces, demonstrating the potential of this system as a high-performance, reusable SERS platform for smart chemical monitoring.

Oral Presentation **O9-6**

Graduate Student Oral Session (I) (English)

2025.9.29(월), 14:15~14:30, 9회장

Chair: 고영운, 김세영

Cationic Polymer-Grafted PVDF for High-Performance and Antibacterial Triboelectric Nanogenerators

우인선, 한동헌, 오승주, 윤재욱, 허웅, 최승은, 윤준모, 배진우[†]

한국기술교육대학교

The growing demand for wearable and portable electronics highlights the need for sustainable, self-powered systems with enhanced hygiene. However, conventional triboelectric nanogenerators (TENGs) often suffer from bacterial contamination. Herein, we report a dual-function antibacterial film-based TENG (AF-TENG) using quaternary ammonium-grafted PVDF (NH₄-PVDF) as a tribo-positive layer. Grafted cationic monomers enhance the dielectric constant, β -phase content, and tribo-positivity, thus enhancing the TENG performance. As a result, the 40 wt% NH₄-PVDF-based AF-TENG achieves a high-power density of 134 mW m⁻², 24.1 times higher than that of pristine PVDF-CTFE, and maintains stable output over 21,000 cycles. Additionally, it exhibits 99.99% antibacterial activity against *S. aureus* and *P. aeruginosa*. This work offers a scalable approach for fabricating multifunctional TENGs, addressing both performance and hygiene for next-generation self-powered wearable electronics.

Oral Presentation **O9-7**

Graduate Student Oral Session (I) (English)

2025.9.29(월), 14:30~14:45, 9회장

Chair: 고영운, 김세영

Salt-templated Porous Electrodes and Zwitterionic Electrolytes for All-Hydrogel Supercapacitors

엘레스타 프리스카 푸트리, Shakti Singh¹, 윤진환¹

부산대학교

¹ 서울시립대학교

Hydrogel-based supercapacitors are promising for next-generation soft and biointegrated energy storage, simultaneously achieving high electrochemical performance and biocompatibility remains challenging. Here, we develop a dual NaCl-based strategy combining porous electrodes fabricated via NaCl templating with zwitterionic hydrogel electrolytes containing biocompatible NaCl. Optimizing the electrode composition and structure leads to improved porosity, stability, and electrochemical performance, while using a zwitterionic hydrogel with non-toxic electrolyte enhances interfacial adhesion. This approach addresses the performance-biocompatibility trade-off in hydrogel supercapacitors, offering a viable pathway for safe, wearable energy storage applications.

Oral Presentation **O9-8**

Graduate Student Oral Session (I) (English)

2025.9.29(월), 14:45~15:00, 9회장

Chair: 고영운, 김세영

Glass Transition Temperature Effect on EUV Resist Pattern Quality

김현석, 안지훈, 허수미[†]

전남대학교

Extreme ultraviolet (EUV) lithography enables sub-10 nm patterning, but chemically amplified resists (CARs) face significant LER (line edge roughness) challenges. While polymer-based CARs offer processing advantages, their performance is heavily influenced by the glass transition temperature (T_g), a factor that remains inadequately understood. However, systematic investigation has been hindered by the difficulty of measuring T_g effects under thin-film processing conditions. Here, we employ a coarse-grained simulation framework to study the influence of T_g on CAR performance, considering molecular weight, acid diffusion, and interparticle interactions. Our results reveal that polymers with T_g below the post-exposure bake temperature show enhanced deprotection and sharper boundaries, leading to reduced LER. These insights establish design principles for developing high-performance polymer resists in EUV lithography.

Oral Presentation **O9-9**

Graduate Student Oral Session (I) (English)

2025.9.29(월), 15:00~15:15, 9회장

Chair: 고영운, 김세영

Tailor-Made Buffer Materials: Advancing Uniformity and Stability in Perovskite Solar Cells

Danh Nguyen[†]

Pusan national university

As p-i-n perovskite solar cells (PSCs) gain popularity, bathocuproine (BCP) plays an essential role as a buffer layer between the electron transport layer and electrode, reducing Schottky contact and improving performance. Yet, the roles of its functional groups remain unclear. This study modifies BCP by adding phenyl and p-tolyl groups at the 2,9-positions to improve molecular planarity and protect reactive nitrogen sites in the phenanthroline core. These changes enhance charge transport and stability. Techniques like electrostatic force microscopy, impedance spectroscopy, and photoluminescence show that modified BCP improves charge extraction, reduces recombination, and boosts structural stability. As a result, device lifetimes increase significantly. This work highlights the potential of engineered BCP derivatives for efficient and stable PSCs.

Oral Presentation **O9-10**

Graduate Student Oral Session (I) (English)

2025.9.29(월), 15:15~15:30, 9회장

Chair: 고영운, 김세영

Photoactivable surfactant design for in-situ stabilization of hydrogel bioelectronics

이승연, 이동균, 강지형[†]

서울대학교

Conductive hydrogels are considered as promising materials for soft and stretchable biointerfaces due to their tissue-like mechanical properties and water-rich nature. However, delamination of hydrogel electrodes from hydrophobic encapsulants, commonly used to prevent external mechanical or chemical damages, greatly limits device performance and stability. Herein, I present a photoactivable surfactant (PAS) design as a effective strategy to stabilize conductive hydrogel networks onto hydrophobic materials. PAS not only reduces interfacial surface energy but also effectively forms tough interface with high lap-shear strength and long-term wet stable electrochemical performance. By photo-activating anchor of our surfactant design, hydrogel devices can be patterned into various shapes and thicknesses, showing excellent stretchability and high conductivity.

Oral Presentation **09-11**

Graduate Student Oral Session (I) (English)

2025.9.29(월), 15:30~15:45, 9회장

Chair: 고영운, 김세영

High-speed skin-conformal organic photodetectors for near-infrared wireless communication

김재현, 박성준[†]

아주대학교

Near-infrared (NIR) communication is essential for wearable technologies, as it facilitates fast and dependable data transmission for real-time monitoring of physiological parameters and smooth interactions between humans and machines. In this study, we have created ultra-thin (3- μm) skin-conforming organic photodetectors (OPDs) that boast a cut-off frequency ($f_{-3\text{dB}}$) surpassing 3 MHz and an impressive specific detectivity (D^*) of 1.56×10^{14} Jones at 790 nm, while still maintaining an $f_{-3\text{dB}}$ above 1 MHz even when subjected to 66% compression. When placed on a fingertip, the OPDs provide stable NIR communication with a bit-error rate of 10^{-3} under different incident angles, showing their capability for high-speed, angle-free reception of audio signals from a distant light source over a distance exceeding 100 m. These OPDs effectively address the previous constraints faced by NIR-OPDs related to slow photo response and low detectivity when mechanically deformed.

Oral Presentation **09-12**

Graduate Student Oral Session (I) (English)

2025.9.29(월), 15:45~16:00, 9회장

Chair: 고영운, 김세영

High-Performance Acoustic Polyurethane Composite Foams with Eco-friendly Multidimensional Fillers

공은수, 나진수, 추상민, 선정윤, 유웅열, 박주혁[†]

서울대학교

Polyurethane foams (PUFs) are widely used in automotive industries for acoustic absorption due to their porous structure that dissipates sound via air friction and cell wall vibration. However, achieving strong sound absorption and mechanical stability at low density remains challenging. In this study, eco-friendly multidimensional fillers were incorporated into low-density PUFs to modulate cell openness. The cell openness varied with filler content, affecting airflow resistivity and tortuosity. Composites with optimized filler content showed enhanced broadband sound absorption along with improved thermal and mechanical stability. Rheological analysis assessed the viscoelasticity of polyol mixtures and curing behavior of polyurethane, which were used to control the stability of cell nucleation and growth during foaming. Therefore, this study presents a practical strategy to fabricate lightweight, high-performance foams by combining eco-friendly fillers with rheological control.

Oral Presentation **09-13**

Graduate Student Oral Session (I) (English)

2025.9.29(월), 16:00~16:15, 9회장

Chair: 고영운, 김세영

Improving PEC efficiency by enhancing light γ capture from laser patterning of Cu₂O film

최경천, 최규완¹, 서지연[†], 손민규¹

부산대학교

¹ 한국세라믹기술원

Cuprous oxide (Cu₂O) has gained attention as a photocathode material in photoelectrochemical (PEC) systems due to its favorable optoelectronic properties for water splitting. However, its practical performance is often limited by low light absorption. In this study, we introduce a laser-induced dot patterning method to improve light-harvesting efficiency and enhance the PEC performance of Cu₂O electrodes. UV-Vis and photoluminescence (PL/TRPL) analyses revealed that the patterned structure exhibits stronger light absorption and longer carrier lifetimes compared to unpatterned samples, indicating reduced recombination and improved charge separation. Consequently, the dot-patterned Cu₂O photocathode showed higher photocurrent density and enhanced hydrogen evolution performance. These findings demonstrate that laser patterning is a promising and straightforward approach to boost the efficiency of Cu₂O-based PEC devices without requiring complex fabrication steps.

Oral Presentation **O9-14**

Graduate Student Oral Session (I) (English)

2025.9.29(월), 16:15~16:30, 9회장

Chair: 고영운, 김세영

Molecular Simulation of Bottlebrush Nanocarriers: Architectural Tuning and Blending Strategies

이상엽, gabriella, Quoc Thang Phan¹, xavier banquy¹, 허수미[†]

전남대학교

¹ University of montreal

Effective drug delivery systems require high-payload capacity and long circulation times to maximize therapeutic efficacy while minimizing side effects. Bottlebrush polymers offer promising solutions through their tunable architecture—backbone length, grafting density, and side chain composition, enabling stable micelle formation. However, this architectural flexibility introduces complex structure-property relationships that are difficult to predict and optimize through experimental approaches alone. To address this challenge, we performed coarse-grained molecular dynamics simulations investigating how structural parameters affect micelle properties across varying concentrations. We systematically evaluated three systems: pure bottlebrush micelles, blends with amphiphilic linear block copolymers, and core-shell bottlebrushes incorporating the copolymer as side chains.

Oral Presentation **O10-1**

Graduate Student Oral Session (II) (English)

2025.9.29(월), 13:00~13:15, 10회장

Chair: 노상철, 김대우

Reconfiguring polymer network topology via photo-tunable crosslinkers

이시환, 선정윤[†]

서울대학교

The mechanical properties of network polymers, such as elastomers and gels, depend on their intrinsic polymer network topology, which is challenging to modify. To achieve on-demand control of their mechanical properties, we synthesized dynamic covalent crosslinkers that undergo photo-metathesis for reversible and gradual topological reconfiguration. The polymer network includes consistent main chains and crosslinkers that break under ultraviolet light and reform under visible light. This reconfiguration enables changes in the strength and stretchability of network polymers while maintaining their toughness and elasticity. These photo-tunable crosslinkers allow the creation of various photo-tunable elastomers and gels by integrating them with different polymer networks. Furthermore, light-induced network modulation facilitates localized mechanical property adjustments, generating transformable multi-material structures and enhancing fracture resistance.

Oral Presentation **O10-2**

Graduate Student Oral Session (II) (English)

2025.9.29(월), 13:15~13:30, 10회장

Chair: 노상철, 김대우

Metal Oxide-Embedded Carbon Nanofibers Coated with Polypyrrole for Asymmetric Supercapacitor Electrodes

제갈석, 박규식, 라운호, 윤창민[†]

인하대학교

Herein, we present the design and synthesis of novel asymmetric supercapacitor electrodes based on carbon nanofibers (CNFs) embedded with metal oxides (SnO_2 , Fe_2O_3) and further coated with polypyrrole (PPy) as protective and additional pseudocapacitive layer. Firstly, CNFs are fabricated by electrospinning polyacrylonitrile precursors followed by carbonization, and then metal oxides are embedded onto the surface by a hydrothermal treatment. Finally, uniform PPy layer is coated by the dispersion polymerization under static conditions. The resulting SnO_2 -CNF@PPy- and Fe_2O_3 -CNF@PPy-based electrodes showed outstanding capacitances of 506.7 and 425.9 F g^{-1} due to the synergistic effect of high electrical conductance, pseudo-capacitance and stable structural integrity provided from the hierarchical application of CNFs, metal oxides, and PPy. Two electrodes are assembled as an asymmetric supercapacitor device with excellent capacitance (100.7 F g^{-1}) and superior cycling stability.

- 본 연구는 2025년도 산업통상자원부 및 산업기술기획평가원(KEIT) 연구비 지원에 의한 연구임(RS-2022-00156073).

Oral Presentation **O10-3**

Graduate Student Oral Session (II) (English)

2025.9.29(월), 13:30~13:45, 10회장

Chair: 노상철, 김대우

ROS-Responsive Graphene–Hyaluronic Acid Nanomedicine for Targeted Therapy in Renal Ischemia/Reperfusion Injury

이승준, 이재영⁺

광주과학기술원

Acute kidney injury (AKI) often progresses to chronic kidney disease (CKD) due to complex pathophysiology involving reactive oxygen species (ROS) and renal fibrosis. We developed a multifunctional nanoplatform for kidney-specific targeting, ROS scavenging, and ROS-responsive anti-fibrotic drug release to prevent AKI-to-CKD transition. Hyaluronic acid (HA), targeting CD44 overexpressed in injured kidneys, was conjugated to reduced graphene oxide (rGO), an antioxidant and drug carrier, forming HA/rGO. Paricalcitol, an anti-fibrotic drug, was loaded onto HA/rGO and released under oxidative stress. HA/rGO showed strong antioxidant activity, protecting tubular cells from ROS-induced damage in vitro. In vivo, HA/rGO accumulated in ischemia/reperfusion (IR)-injured kidneys via HA-CD44 interaction, improved renal function, and reduced fibrosis in IR mouse models. This nanoplatform effectively mitigates AKI-to-CKD progression through targeted, ROS-responsive therapy.

Oral Presentation **O10-4**

Graduate Student Oral Session (II) (English)

2025.9.29(월), 13:45~14:00, 10회장

Chair: 노상철, 김대우

Unveiling the Role of Amorphous Phases in Mixed Ionic–Electronic Conduction using Conjugated Regioblock Copolymers for Organic Electrochemical Synaptic Transistors

최광훈, 임성일, 장호원¹, 최창순, 주현수, 임정아[†]

한국과학기술연구원

¹ 서울대학교

Organic electrochemical synaptic transistors (OECT-STrs) based on conjugated polymer mixed ionic–electronic conductors (CP-MIECs) are gaining attention for their unique microstructures. However, the distinct roles of crystalline and amorphous phases in electrochemical doping remain unclear. Here, we report OECT-STrs using regioblock P3HT copolymers with tunable crystallinity by varying the regiorandom fraction. With incorporating an amorphous phase in active channel of OECT-STrs, neuromorphic learning efficiency improved by enhancing the potentiation uniformity, resulting from sequential polaron formation in the amorphous phase and bipolaron formation in the crystalline phase during potentiation. Amorphous phases also enhance long-term retention at high potentiation states by promoting charge localization. Neural network simulations show devices with high amorphous content use only 18% of the power required by crystalline-rich devices due to fewer training cycles.

Oral Presentation **O10-5**

Graduate Student Oral Session (II) (English)

2025.9.29(월), 14:00~14:15, 10회장

Chair: 노상철, 김대우

Electrochromic Smart Glass-Based Uniaxial Orientation of Lyotropic Chromonic Liquid Crystal Reactive Mesogen

Pham Huu Huan, 정광운¹

Jeonbuk National University

¹ 전북대학교

To advance the development of an electrochromic (EC) smart glass, a π -extended viologen-based lyotropic chromonic liquid crystal (π V-LCLC) reactive mesogen (RM) is newly designed and successfully synthesized in this study. By extending the π -conjugation length of viologen, the π V-LCLC RM forms a stable LCLC phase at room temperature and retains its chemical integrity during the EC reactions, exhibiting reversible transitions across three redox states: dication (D), cation-radical (C), and neutral (N). A uniaxially oriented nanostructure is stably constructed on the macroscopic scale through shear-coating and photopolymerization. This newly developed π V-LCLC RM facilitates the fabrication of energy-efficient EC optical devices with tunable transmittance and multicolor modulation, and it is operable at a low voltage of 2.5 V. This work was supported by BK21 FOUR program and Basic Research Laboratory Program (RS-2023-00207836).

Oral Presentation **O10-6**

Graduate Student Oral Session (II) (English)

2025.9.29(월), 14:15~14:30, 10회장

Chair: 노상철, 김대우

Multimodal Physicochemical Health Monitoring via a Fully Printed Chip-less Wearable Neuromorphic Device

이상현, 최용석¹, 조정호⁺

연세대학교

¹ California institute of technology

We have developed a miniaturized, standalone, chip-less wearable neuromorphic system capable of simultaneously monitoring, processing, and analyzing multimodal physicochemical biomarker data (i.e., metabolites, cardiac activities, and core body temperature). By leveraging scalable printing technology, we fabricated artificial synapses that function as both sensors and analog processing units, integrating them alongside printed synaptic nodes into a compact wearable system embedded with a medical diagnostic algorithm for multimodal data processing and decision making. The feasibility of this flexible wearable neuromorphic system was demonstrated in sepsis diagnosis and patient data classification, highlighting the potential of this wearable technology for real-time medical diagnostics.

Oral Presentation **O10-7**

Graduate Student Oral Session (II) (English)

2025.9.29(월), 14:30~14:45, 10회장

Chair: 노상철, 김대우

A Silk-Based Balloon Catheter for Active and Controlled Drug Delivery

조희수, 홍진기[†]

연세대학교

Atherosclerosis, caused by the buildup of plaques, is one of the leading causes of death globally. Balloon catheters restore blood flow by compressing plaques through inflation. In addition, drug-coated balloons (DCBs) deliver drugs coated on the outer surface upon inflation. However, weakly bound drug matrices are prone to loss in blood flow and cause side-effects. Therefore, active drug release functionality is required for controlled delivery. Herein, we developed a silk-based active drug-releasing balloon (SB). We developed a silk packing inducer (SPI) that binds silk fibroin chains and induces hydrophobic interactions, resulting in a compact, condensed structure. Given its compact structure, SB exhibited balloon-feasible mechanical performance. Moreover, the compact hydrophobic silk fibroin structure binds hydrophobic drugs and enables their release upon inflation. Therefore, SB could actively release drugs upon inflation and transfer to the arterial wall.

Oral Presentation **O10-8**

Graduate Student Oral Session (II) (English)

2025.9.29(월), 14:45~15:00, 10회장

Chair: 노상철, 김대우

Processing of Smart Polyurethane Based on Biopolyols

이원진, 박주혁[†], 민고움, 추상민, 선정윤, 송영석¹, 이시현

서울대학교

¹ 단국대학교

With increasing awareness of environmental issues and tighter regulations, the importance of biodegradable plastics is growing. Polyurethane, known for its excellent processability and wide applicability, is also required to shift toward biodegradable alternatives. In this study, biodegradable polyurethane was fabricated via reaction injection molding and foaming. To optimize these processes, rheological properties and cure behavior of the raw materials and mixtures were carefully analyzed. Based on these results, suitable processing conditions were identified. Molded specimens were evaluated for mechanical properties and shape memory performance. For the foamed samples, internal cell morphology, shape recovery behavior, and sound absorption performance were comprehensively assessed. This study proposes optimized processing guidelines for each manufacturing route, offering a practical direction for the fabrication of high-performance biodegradable polyurethane materials.

Oral Presentation **O10-9**

Graduate Student Oral Session (II) (English)

2025.9.29(월), 15:00~15:15, 10회장

Chair: 노상철, 김대우

Multiscale Filler-Integrated Smart Composites for High-Performance Multifunctionality

나진수, 추상민¹, 이학준, 선정윤, 박주혁⁺

서울대학교

¹ 서울대학교

Shape memory polymers (SMPs) hold great potential for adaptive and responsive systems, including soft robotics, wearable technologies, and biomedical devices. However, traditional SMPs are limited by weak mechanical properties, inadequate thermal transport, and poor electrical conductivity. To overcome these challenges, we developed hybrid composites using both micro-and nanofillers, to improve interfacial bonding and hierarchical networks. By systematically varying the filler ratios and analyzing their rheological responses, we explored percolation behavior correlated with multifunctional improvements. Consequently, the final formulations exhibited significant improvements in mechanical strength, electrical conductivity, and thermal transport. This study presents a scalable design strategy that integrates hierarchical filler engineering and rheological optimization to enable reliable, multifunctional SMP composites with tunable properties for advanced adaptive systems.

Oral Presentation **O10-10**

Graduate Student Oral Session (II) (English)

2025.9.29(월), 15:15~15:30, 10회장

Chair: 노상철, 김대우

Colorimetric Synapses for Reconfigurable Broadband Photonic Integrated Circuits

김현우[†], 조새벽[†]

성균관대학교

To address the limitations of electrolyte-based neuromorphic devices, such as instability and fabrication incompatibility, we propose a fully solid-state photonic synapse utilizing AgBiS₂-based heterojunctions. By exploiting the intrinsic trap states and persistence photoconductive (PPC) properties of AgBiS₂, our device achieves long-term memory retention without the need for ion-gel or floating-gate structures. The incorporation of Y6 with distinct near-infrared absorption enables wavelength-selective trapping and detrapping, resulting in bidirectional and reconfigurable synaptic weight modulation. This behavior is further elucidated through a thermodynamic photo-generation trap model, offering fundamental insights into colorimetric synaptic switching under spectrally diverse stimuli. The simplified architecture and CMOS-compatible fabrication highlights its potential for scalable integration into neuromorphic photonic circuits.

Oral Presentation **O10-11**

Graduate Student Oral Session (II) (English)

2025.9.29(월), 15:30~15:45, 10회장

Chair: 노상철, 김대우

Stiffness-Patterned Light-Fueled Jumper for Symmetry Breaking and Efficient Snap-Through

함민정, 조용비, 전지수¹, 위정재[†]

한양대학교

¹ Georgia Institute of Technology

Living species use jumping to traverse complex terrains, inspiring soft robotic systems with embedded physical intelligence to mimic such motions. Among these, liquid crystalline polymers (LCPs) offer light-responsive, programmable deformation ideal for small-scale robotics. However, efficient energy release in snap-through motions is hindered by a trade-off between stiffness and initial curvature. Here, we spatially program mechanical stiffness of LCPs to overcome this limitation, achieving multi-modal photomechanical jumping under uniform light. Stiffness mismatch induces localized curvature, enhancing strain responsivity while preserving initial curvature. By controlling symmetry of adapted patterns, we demonstrate direction-selective jumping, corroborated by finite element simulations. Integrating stiffness variation with geometric asymmetry enables a dual-mode jumping, along with sequential and consecutive jumps, offering an adaptive strategy for high-performance soft actuators.

Oral Presentation **O10-12**

Graduate Student Oral Session (II) (English)

2025.9.29(월), 15:45~16:00, 10회장

Chair: 노상철, 김대우

Microfluidic Fabrication of Conductive Hydrogel Optical Fibers with Controlled Swelling for Enhanced Performance

싱 아르티, 윤진환¹

부산대학교

¹ 서울시립대학교

Hydrogel fibers combining optical transmission and ionic conductivity are crucial for bioelectronics, neural interfaces, and soft robotics. Here, we demonstrate conductive hydrogel optical fibers fabricated via continuous microfluidic coaxial extrusion with precise control over swelling ratio to optimize performance. The core-cladding architecture maintains high light transmission efficiency while achieving ionic conductivity of 26.6 S/cm after NaCl treatment. By controlling the crosslinking density and hydrogel composition, we tune the swelling ratio of the core and cladding to optimize the refractive index contrast, directly correlating with optical and electrical properties. The fibers retain stable light guiding under deformed states and repeated bending cycles.

Oral Presentation **O10-13**

Graduate Student Oral Session (II) (English)

2025.9.29(월), 16:00~16:15, 10회장

Chair: 노상철, 김대우

Hydroxyapatite-Reinforced GelMA Scaffolds Enhance Osteogenic Differentiation of SAOS-2 Spheroids

NARANTUNGALAG AMARBAYASGALAN, 이현종⁺¹

gachon university

¹ 가천대학교

Bone tissue engineering has emerged as a promising field aimed at developing biomimetic scaffolds that support bone regeneration by mimicking the structure, composition, and mechanical properties of native bone. Among various approaches, the use of three-dimensional (3D) cell culture models and biocompatible scaffolds has gained substantial attention due to their ability to provide physiologically relevant environments for osteogenesis. In this study, we investigate the effect of hydroxyapatite (HAp)-reinforced gelatin methacryloyl (GelMA) hydrogels on osteogenic differentiation in SAOS-2 cell spheroids. Our results indicate that the incorporation of HAp into GelMA scaffolds significantly enhances osteogenic potential through improved mineralization, cell-cell communication, and osteogenic marker expression. This study contributes to the growing body of research focused on engineering advanced scaffolds for bone tissue regeneration.

Oral Presentation **O10-14**

Graduate Student Oral Session (II) (English)

2025.9.29(월), 16:15~16:30, 10회장

Chair: 노상철, 김대우

Multimodal Double-Helix Fiber Sensor for Independent Pressure and Strain Detection in Wearable Sensory Applications

츠어베야르[†], 이화성[†]

한양대학교

Fiber sensors with engineered architecture offer a compelling platform for next-generation wearable electronics, owing to their inherent mechanical adaptability and compatibility with textile integration. In this study, a multimodal fiber sensor with a one-dimensional double-helix architecture is introduced, enabling the independent detection of pressure and strain stimuli within a single device. Strain sensing is realized via piezoresistive changes in a helical conductive fiber, while pressure is detected through piezocapacitive responses between two twisted fiber electrodes separated by a dielectric layer. This structural configuration ensures effective decoupling of signals, yielding reliable dual-mode operation without cross-interference. The strain-sensing component demonstrates a gauge factor of $0.03 \pm 0.001 \text{ \%}^{-1}$, high linearity (0.996–0.999), negligible hysteresis, and rapid response ($\sim 300 \text{ ms}$) and recovery ($\sim 350 \text{ ms}$) times over an extended strain range (0–300%). The pressure sensor exhibits a gauge factor of $0.001 \pm 2 \times 10^{-5} \text{ kPa}^{-1}$, excellent linearity (0.992), fast response ($\sim 150 \text{ ms}$), and mechanical durability over 2500 cycles. Practical demonstrations—including joint motion, respiration, tactile force, and airflow detection—validate the sensor's multimodal functionality. By integrating high fidelity, minimal signal interference, and robust structural performance, the proposed double-helix fiber sensor presents a versatile and scalable solution for wearable multimodal sensing applications.

Invited Lecture **L12-1**

[MR Special Session] Research Trends for the Commercialization of Conjugated Polymer-Based Optoelect

2025.9.29(월), 13:00~13:25, 12회장

Chair: 손성윤, 이준우, 최종민, 김진석

A Pioneering Journey Toward Advanced Optoelectronics: From Molecular Insight to Device Innovation

권영수[†]

삼성디스플레이

This talk presents a long-term research effort focused on improving the performance of organic electronic materials through new design approaches for molecular and device structures. Moving beyond the traditional crystallinity-centered paradigm, this work introduces molecular structures that allow effective charge transport in disordered systems and device strategies that enhance interfacial properties. Rather than isolated material or device development, the study investigates correlations among structure, properties, and function, offering insights into core device mechanisms. These materials and strategies have been applied to various organic and hybrid optoelectronic devices, including solar cells, transistors, and sensors, demonstrating high performance, mechanical flexibility, and green process compatibility. This work offers a new direction in function-driven material design and helps build the foundation for future optoelectronic technologies.



권영수(삼성디스플레이)

아주대학교 응용화학과 (학사) (2007)

POSTECH 화학공학과 (박사) (2014)

삼성디스플레이 책임연구원 (2014-2020)

삼성디스플레이 수석연구원 (2021-현재)

Invited Lecture **L12-2**

[MR Special Session] Research Trends for the Commercialization of Conjugated Polymer-Based Optoelect

2025.9.29(월), 13:25~13:50, 12회장

Chair: 손성윤, 이준우, 최종민, 김진석

From Disorder to Performance: A New Paradigm in Conducting Polymer Design

김민준⁺

경기대학교

This talk presents a long-term research effort focused on developing new design strategies for conducting polymers to realize high-performance organic optoelectronic devices. Departing from the conventional crystallinity-centered paradigm, this study introduces a molecular design based on low-crystallinity P3HT derivatives that enable efficient charge transport through localized aggregates in disordered structures. This approach not only achieved high charge carrier mobility but also ensured mechanical flexibility. Based on this concept, various donor-acceptor (D-A) polymers were synthesized and successfully applied to organic field-effect transistors (OFETs), organic photovoltaics (OPVs), and perovskite solar cells (PSCs), demonstrating excellent performance and compatibility with green processing. This work moves beyond conventional material synthesis, offering a new perspective in polymer design and laying a foundation for future organic optoelectronic technologies.



김민준(경기대학교)

부산대학교 독어독문/화학과 (학사) (2004-2013)

부산대학교 화학과 (석사) (2013-2015)

포항공과대학교 화학공학과 (박사) (2015-2019)

RIKEN CEMS (Post-Doc.) (2019-2022)

삼성디스플레이 (Staff Engineer) (2022-2024)

경기대학교 화학과 조교수 (2024-현재)

Invited Lecture **L12-3**

[MR Special Session] Research Trends for the Commercialization of Conjugated Polymer-Based Optoelect

2025.9.29(월), 13:50~14:15, 12회장

Chair: 손성윤, 이준우, 최종민, 김진석

Self-Assembled Monolayers as Universal Hole Transport Layers for High-Efficiency and Stable Solar Cells

김주현[†]

부경대학교

Interfacial engineering is essential for advancing both perovskite and organic solar cells (PSCs and OSCs), particularly in achieving high power conversion efficiency (PCE) and long-term operational stability. Recent efforts have focused on the development of self-assembled monolayers (SAMs) as multifunctional hole-transport layers (HTLs). Phenothiazine- and carbazole-based SAMs facilitate enhanced interfacial energetics, surface wettability, and defect passivation. These SAM HTLs result in significant improvements in film morphology, charge extraction, and stability of both PSC and OSC structures. Tailoring the chemical structure and functionality of SAMs further addresses interfacial challenges, enabling efficient and durable devices without reliance on conventional PEDOT:PSS. These findings establish SAMs as a robust platform for future interface design in solution-processed photovoltaic devices.



김주현(부경대학교)

서강대학교 화학과 이학사 (1986-1990)

서강대학교 화학과 이학석사 (1990-1992)

코오롱중앙연구소 (1992-1998)

서강대학교 화학과 이학박사 (1999-2002)

워싱턴주립대학교 박사후연구원 (2002-2004)

국립부경대학교 고분자공학과 교수 (2006-현재)

Invited Lecture **L12-4**

[MR Special Session] Research Trends for the Commercialization of Conjugated Polymer-Based Optoelect

2025.9.29(월), 14:15~14:40, 12회장

Chair: 손성윤, 이준우, 최종민, 김진석

Stretchable, Self-Healing Thermoelectric Devices Operable under Ambient Conditions

이현정[†]

국민대학교

In this study, a series of p- and n-type polymeric ionic gels (PIGs) with different ratios of ionic side chains are synthesized to allow only single-type ions to pass through them. The results demonstrate that the repeatedly stretchable PIGs are transparent, thermally robust up to 125°C, and self-healing. Among the series of PIGs, p- and n-type PIGs with 75% ion moieties (P75 and N75) exhibit the optimum ionic conductivity (4.1×10^{-4} and $2.7 \times 10^{-4} \text{ S cm}^{-1}$) and ionic Seebeck coefficients (S_i) (5.84, and -4.18 mV K^{-1}) under ambient conditions (25°C and relative humidity (RH) of 30%), resulting in ZT values of 1.87×10^{-3} and 1.18×10^{-3} . Accordingly, P([EMIM+][SPA])_{0.75-r-MA}_{0.25} (P75) and P([APTA][TFSI-])_{0.75-r-MA}_{0.25} (N75) are used to achieve stretchable ionic thermoelectric devices.



이현정(국민대학교)

포항공과대학교 화학과 (학사) (1991-1995)

포항공과대학교 화학과 (석사) (1995-1997)

포항공과대학교 화학과 (박사) (1997-2001)

UIUC 재료과(박사후연구원) (2001-2003)

MIT 재료과(박사후연구원) (2003-2004)

KIST (선/책임연구원) (2004-2010)

국민대학교 (조교수/부교수/교수) (2010-현재)

Invited Lecture **L12-5**

[MR Special Session] Research Trends for the Commercialization of Conjugated Polymer-Based Optoelect

2025.9.29(월), 15:00~15:25, 12회장

Chair: 손성윤, 이준우, 최종민, 김진석

Strategies for Improving stability of organic solar cell

김경곤⁺

이화여자대학교

The commercial viability of organic photovoltaics (OPVs) hinges on addressing the critical issue of stability, particularly the degradation of the photoactive layer under external stressors. In this talk, I will discuss the fundamental causes of instability in OPVs, including morphological changes, environmental factors, and material degradation. I will also discuss recent advances in materials design and device engineering strategies aimed at enhancing the long-term stability of OPVs. Based on our laboratory's research, I will share some of the approaches we have explored that show potential in addressing these stability challenges, contributing to the development of more durable and efficient organic solar cells.



김경곤(이화여자대학교)

고려대학교 화학과(학사) (1988-1992)

고려대학교 화학과(석사) (1992-1996)

고려대학교 화학과(박사) (1998-2003)

Wake Forest University, Yale University(박사후연구원) (2003-2006)

한국과학기술연구원 (2006-2012)

이화여자대학교 화학나노과학과 (2012-현재)

Invited Lecture **L12-6**

[MR Special Session] Research Trends for the Commercialization of Conjugated Polymer-Based Optoelect

2025.9.29(월), 15:25~15:50, 12회장

Chair: 손성윤, 이준우, 최종민, 김진석

Single-component organic photocatalysts for green hydrogen production

우한영⁺

고려대학교

Hydrogen is a promising clean energy carrier due to its high energy density and zero-carbon emissions. However, conventional gray H₂ production emits CO₂, prompting interest in solar-driven H₂ generation via photocatalyst (PC) systems. Early studies focused on inorganic photocatalysts like TiO₂, which have limited visible light absorption due to their wide bandgap. In contrast, organic semiconductors provide tunable energy levels and visible light absorption, making them attractive for photocatalysis. Binary donor/acceptor organic nanoparticles have achieved high hydrogen evolution rates, but their performance is highly sensitive to bulk heterojunction morphology, which is difficult to control. To address this, single-component photocatalysts (SCPCs) are being explored. In this contribution, a new design strategy for SCPCs and their photocatalytic properties for hydrogen generation in water will be discussed.



우한영(고려대학교)

한국과학기술원 화학과 (박사) (1996-1999)

UCSB 박사후연구원 (2003-2006)

부산대학교 나노융합공학과 교수 (2006-2015)

고려대학교 화학과 교수 (2015-현재)

Invited Lecture **L12-7**

[MR Special Session] Research Trends for the Commercialization of Conjugated Polymer-Based Optoelect

2025.9.29(월), 15:50~16:15, 12회장

Chair: 손성윤, 이준우, 최종민, 김진석

Development of High-performance p-type Semiconductors for Transistors

노용영[†]

포항공과대학교

Developing high-mobility p-type semiconductors that can be grown using silicon-compatible processes at low temperatures, has remained challenging in the electronics community to integrate complementary electronics with the well-developed n-type counterparts. This presentation will discuss our recent progress in developing high-performance p-type semiconductors as channel materials for thin film transistors. For the first part of my talk, I present an amorphous p-type oxide semiconductor composed of selenium-alloyed tellurium in a tellurium sub-oxide matrix, demonstrating its utility in high-performance, stable p-channel TFTs, and complementary circuits.¹ Theoretical analysis unveils a delocalized valence band from tellurium 5p bands with shallow acceptor states, enabling excess hole doping and transport. Selenium alloying suppresses hole concentrations and facilitates the p orbital connectivity, realizing high-performance p-channel TFTs with an average field-effect hole mobility of $\sim 15 \text{ cm}^2 \text{ V}^{-1} \text{ s}^{-1}$ and on/off current ratios of $10^6 \sim 10^7$, along with wafer-scale uniformity and long-term stabilities under bias stress and ambient aging.

Next, I will present high-performance tin (Sn^{2+}) halide perovskite based p-type transistors using cesium-tin-triiodide-based semiconducting layers.^{2,3} The optimized devices exhibit high field-effect hole mobilities of over $50 \text{ cm}^2 \text{ V}^{-1} \text{ s}^{-1}$, large current modulation greater than 10^8 , and high operational stability and reproducibility.⁴ In addition, we explore triple A-cations of caesium-formamidinium-phenethylammonium to create high-quality cascaded Sn perovskite channel films. As such, the optimized TFTs show record hole mobilities of over $70 \text{ cm}^2 \text{ V}^{-1} \text{ s}^{-1}$ and on/off current ratios of over 10^8 , comparable to the commercial low-temperature polysilicon technique level. In the final part, I would like to briefly introduce our recent halide perovskite transistors, fabricated by thermal evaporation.⁵

References: [1] A. Liu, Y.-Y. Noh et al, Nature, **629**, 798–802 (2024). [2] A. Liu, Y.-Y. Noh et al, Nature Electronics **5**, 78–83 (2022). [3] H. Zhu, Y.-Y. Noh et al, Nature Electronics **6**, 650–657 (2023). [4] A. Liu, Y.-Y. Noh et al, Nature Electronics **6**, 559–571 (2023). [5] Y. Reo, Y.-Y. Noh et al, Nature Electronics, **8**, 403–410 (2025).



노용영(포항공과대학교)

GIST 신소재공학과 (박사) (2005)

캠브리지 대학교 캐빈디쉬 연구소 (Post-Doc.) (2005–2007)

ETRI 선임연구원 (2008–2009)

한밭대학교 화학공학과 조교수 (2009–2013)

동국대학교 융합에너지신소재공학과 부교수 (2013–2019)

POSTECH 화학공학과 교수 (2019–현재)

Invited Lecture **L12-8**

[MR Special Session] Research Trends for the Commercialization of Conjugated Polymer-Based Optoelect

2025.9.29(월), 16:15~16:40, 12회장

Chair: 손성윤, 이준우, 최종민, 김진석

Understanding Charge Carrier Dynamics in Organic Photocatalysts for Hydrogen Evolution

차효정[†]

경북대학교

Photocatalytic hydrogen production using organic semiconductors offers advantages such as structural tunability, low cost, and stability. However, performance is limited by Frenkel excitons, energetic defects, and inefficient charge separation. To enhance performance, it is essential to understand the relationship between molecular design and charge carrier dynamics. Recent studies have focused on identifying limiting factors and exploring charge behaviors using time-resolved techniques. In this work, we investigate the charge carrier dynamics in organic photocatalytic nanoparticles for hydrogen evolution, including photoinduced charge generation, transport, and interfacial redox reactions. We employ time-resolved methods, such as transient spectroscopy, to explore how molecular structures affect these processes. This study aims to provide insights into the interplay between molecular design, charge carrier dynamics, and photocatalytic efficiency.



차효정(경북대학교)

경북대학교 고분자공학과 (학사) (2004-2009)

포항공과대학교 화학공학과 (박사) (2009-2014)

임페리얼컬리지런던 화학과 (Post-Doc) (2015-2020)

경북대학교 수소 및 신재생에너지학과 (조/부교수) (2020-2025)

경북대학교 에너지공학부 (부교수) (2025-현재)

Keynote Lecture **1L1-1**

의료용 고분자 부문위원회 I: 의료용 고분자 및 바이오소재 연구의 지평과 미래

2025.9.30(화), 14:00~14:40, 1회장

Chair: 곽민석, 이수홍

Polymer Mechanochemistry Enables the Activation of Drugs, Proteins and Genes by Biocompatible Ultrasound

Andreas Herrmann[†]

DWI – Leibniz Institute for Interactive Materials/RWTH University

The field of optogenetics has enabled the fundamental understanding of neural circuits and disorders. However, these techniques require invasive surgical procedures to deliver light to target cells due to the low penetration depth of light into tissue. Therefore, ultrasound (US) was used as alternative trigger since US can deeply penetrate tissue with high spatiotemporal control. Our group develops molecular technologies based on polymer mechanochemistry to control the activity of drugs, proteins and nucleic acids by US. While initial efforts relied on low frequency (20 kHz) US that is destructive to cells, our current efforts are dedicated to two technology platforms that allow the activation of bioactive compounds by biocompatible US, i.e. imaging US and low intensity focussed US. The first technology relies on high molecular weight polynucleic acids that are produced by rolling circle amplification or transcription and that encode multiple binding sites for drugs, proteins and nucleic acids. Once these loaded nucleic acid carriers are subjected to US, non-covalent bond cleavage occurs by collapse of US-induced cavitation bubbles leading to activation of the cargoes. In this way, gene knock-down in vitro was achieved by liberating siRNA and immunostimulation was successfully realized in vivo by activating CpG oligonucleotides. Similarly, protein activity can be switched on by US, involving the mechanochemical activation of a protease that subsequently triggers split intein function for controlling the activity of a broad scope of proteins. A second platform technology for low-intensity US activation is mechanophore-incorporated microbubbles that also allow the spatiotemporally controlled release of bioactives.



Andreas Herrmann(DWI – Leibniz Institute for Interactive Materials/RWTH University)

Diploma in Chemistry, University of Mainz, Germany (1997)

PhD (Dr. rer. nat.), Planck-Institute for Polymer Research, Mainz, Germany (2000)

Post-Doc, Swiss Federal Institute of Technology, Zurich, Switzerland (2002)

Junior Research Group Leader at the Max-Planck-Institute for Polymer Research, Mainz, Germany (2004)

Professor for Polymer Chemistry and Bioengineering at the Zernike Institute for Advanced Materials at the University of Groningen, Netherlands (2007)

Professor of Macromolecular Materials and Systems at RWTH Aachen University, Germany, and Scientific Board Member of the DWI – Leibniz-Institute (2017-Present)

Scientific Board Member of the DWI – Leibniz-Institute, Aachen, Germany (2017)

Vice Director of the DWI – Leibniz Institute, Aachen, Germany (2018)

Director of the DWI - Leibniz Institute, Aachen, Germany (2023)

Invited Lecture **1L1-2**

의료용 고분자 부문위원회 I: 의료용 고분자 및 바이오소재 연구의 지평과 미래

2025.9.30(화), 14:40~15:05, 1회장

Chair: 곽민석, 이수홍

New thermogelling biomaterials and their biomedical implications

허강무[†]

충남대학교

Thermogelling polymers that undergo reversible sol–gel transitions in aqueous media have gained considerable attention for biomedical applications such as injectable drug delivery and tissue engineering. However, conventional synthetic thermogels often suffer from poor biodegradability, limited biocompatibility, and insufficient mechanical stability, limiting their clinical potential. To overcome these drawbacks, we developed a novel class of thermogelling materials—acyl glycol chitosans (AGCs)—synthesized via N-acylation of glycol chitosan using various acyl groups. These polysaccharide-based thermogels exhibit excellent biocompatibility, tunable biodegradability, enhanced thermogelation, and superior physical robustness compared to synthetic systems. In this study, we introduce the physicochemical and biofunctional properties of AGCs and highlight their promising biomedical applications, including injectable delivery and 3D cell culture platforms.



허강무(충남대학교)

JAIST 재료공학과 (박사) (1998-2001)

KIST 의과학연구센터 (Post-Doc) (2001-2002)

퍼듀대학교 약학대학 (Post-Doc) (2002-2004)

충남대학교 유기재료공학과 교수 (2004-현재)

(주)랩투랩 CEO (2019-현재)

Invited Lecture **1L1-3**

의료용 고분자 부문위원회 I: 의료용 고분자 및 바이오소재 연구의 지평과 미래

2025.9.30(화), 15:05~15:30, 1회장

Chair: 곽민석, 이수홍

Chemoimmunological Intervention of Crosstalk between Tumor Microenvironment and Draining Lymph Node for Improved Cancer Immunotherapy

정지훈[†]

성균관대학교

The efficacy of cancer immunotherapy is often limited by immunosuppressive tumor microenvironment (TME) and insufficient immune activation in tumor-draining lymph nodes (TDLN). Since the TME and TDLN form a dynamic axis crucial for tumor metastasis and resistance to immune checkpoint blockade, strategies that effectively modulate both sites are critical. A newly identified dual-functional natural immune modulator, SKKU-06, induces cancer cell-autonomous secretion of IFN- β and immunogenic cancer cell death. Direct delivery of SKKU-06 to the TDLN using microneedles (MN) reshapes the local immune landscape to suppress cancer, while minimizing off-target toxicity and significantly improves tumor control, reduced lung metastases, and extended overall survival. This approach provides a minimally invasive and effective strategy for integrating natural product-based therapies with advanced drug delivery systems to target the TME-TDLN axis, thereby improving outcomes in metastatic cancer.



정지훈(성균관대학교)

한국과학기술원 생명과학과 (박사) (1999-2003)

미국 유타대학교 약학대학 (박사후연구원) (2004-2007)

성균관대학교 약학대학 (교수) (2007-현재)

Invited Lecture **1L1-4**

의료용 고분자 부문위원회 I: 의료용 고분자 및 바이오소재 연구의 지평과 미래

2025.9.30(화), 15:30~15:55, 1회장

Chair: 곽민석, 이수홍

Rationally Designed Self-Immolative Polymeric Prodrug Nanoparticles for Therapeutic and Bioimaging Applications

이동원[†]

전북대학교

Recent advance in nanotechnology, biology and chemistry have led to the development of various stimulus-responsive polymeric nanomaterials for biomedical applications such as drug delivery and bioimaging. When polymers are designed to respond specifically the pathological conditions, their medical performance could be further enhanced, enabling precise nanomedicines. Compared to normal cells and tissues, pathological conditions such as cancer and inflammation have altered redox balance and acidic pH. In our lab, we developed several polymers for therapeutic and imaging applications by exploiting simple chemistry to respond altered redox balance and acidic pH in various pathological conditions. I will discuss molecularly engineered biopolymer nanoparticles implicating that simple chemistry extends the medical applications of polymeric nanoparticles.



이동원(전북대학교)

영남대학교 (1990-1997)

University of Florida (박사) (2000-2004)

University of South Florida College of Medicine (PostDoc) (2004-2006)

Georgia Institute of Technology (Research Associate) (2006-2008)

전북대학교 고분자나노공학과 교수 (2008-현재)

Invited Lecture **1L1-5**

의료용 고분자 부문위원회 I: 의료용 고분자 및 바이오소재 연구의 지평과 미래

2025.9.30(화), 15:55~16:20, 1회장

Chair: 곽민석, 이수홍

Advanced Biomaterials for Peripheral Nerve Regeneration

정영미[†]

한국과학기술연구원

Peripheral nerve injuries cause motor and sensory deficits, increasing patient morbidity. While autologous nerve grafting is the current standard for nerve repair, it faces limitations such as donor site shortage and related complications. Tissue-engineered nerve grafts have thus emerged as promising alternatives. We developed a nerve conduit composed of an electrospun PLCL membrane and a visible light-crosslinked gelatin hydrogel. The nanoporous PLCL membrane served as a flexible, non-collapsible outer layer, mimicking the epineurium. Inner gelatin hydrogel paths, aligned via 3D printing and photocrosslinking, featured microgrooved surfaces that guided axonal growth and acted as reservoirs for bioactive molecules. In vivo tests confirmed that the conduit supported axonal regeneration, remyelination, and functional recovery. These results demonstrate that our conduit is a promising alternative to autologous nerve grafts for peripheral nerve repair.



정영미(한국과학기술연구원)

서울대학교 응용화학부 학사 (1997-2001)

서울대학교 협동과정 의용생체공학전공 석사 (2001-2003)

서울대학교 협동과정 의용생체공학전공 박사 (2005-2008)

한국과학기술연구원 선/책임연구원 (2010-현재)

연세대학교-KIST 융합연구원 (2019-현재)

Invited Lecture **1L1-6**

의료용 고분자 부문위원회 I: 의료용 고분자 및 바이오소재 연구의 지평과 미래

2025.9.30(화), 16:40~17:20, 1회장

Chair: 곽민석, 이수홍

지난 45년 동안의 교육자와 연구자로서의 회상

강길선[†]

전북대학교

우연한 기회로 시작된 고분자 연구가 45년이 흘렀다. 처음에는 연구자로 시작하여 교육자라고 하는 과분한 생활을 하였다. 선생으로서 28년간 265명의 석·박사 배출, 700여 편의 논문 등을 게재하여 제자 모두들 제약회사 계통에 취직하였다. 석사논문은 고분자용액물성이었다. 한국화학연구원에서 일회용 의료용구 연구로 시작되어 코로나/플라즈마방전 표면처리, Gradient Surface, 방사선멸균, 마이크로니들, 삼투정제제, PLGA제제, 제네릭/카피 제제, 생체이용률 개선, 재생의학을 이용한 연골·뼈·망막·디스크·각막·중추신경재생, 성체줄기세포, 새로운 생체재료 발굴, 오르가노이드에 이르기까지 많은 분야를 연구하였다. 어떻게 새로운 아이디어를 내고 어떠한 연구 결과들을 창출하였나, 이들을 회상하고자 한다.



강길선(전북대학교)

인하대학교 고분자공학과(학사) (1981)

인하대학교 고분자공학과(석사) (1985)

한국화학연구원(선임연구원) (1987-1998)

The University of Iowa (공학박사) (1991-1995)

전북대학교 고분자나노공학과 교수 (1998-현재)

Invited Lecture **1L1-7**

의료용 고분자 부문위원회 I: 의료용 고분자 및 바이오소재 연구의 지평과 미래

2025.9.30(화), 17:20~18:00, 1회장 (106-7호)

Chair: 곽민석, 이수홍

소재의 꿈, 생명으로 피어나다: 생분해성 고분자에서 재생의학까지

김수현[†]

한국과학기술연구원

For decades, my research on biodegradable polymers unlocked new possibilities in tissue engineering and regenerative medicine. This lecture will reflect on my journey, sharing the challenges and achievements in developing biomaterials for cartilage and blood vessel regeneration. Progress was made possible through the process of creating materials that mimic natural tissues, which fused knowledge and technology from diverse fields.

As I retire, I want to share two key visions. First, establishing a robust global research system is crucial for tackling complex challenges. Second, AI will revolutionize regenerative medicine. AI-driven design of novel materials and personalized treatments will accelerate the era of precision medicine.

This lecture is a farewell, but also a chance to inspire the next generation. I hope my experience becomes a seed for their future success, and I will conclude with a call to action for a brighter future in biomaterials and regenerative medicine



김수현(한국과학기술연구원)

서울대학교 섬유고분자공학과 (학사) (1978-1982)

서울대학교 섬유고분자공학과 (석사) (1982-1984)

서울대학교 섬유고분자공학과 (박사) (1988-1992)

KIST (영년직연구원) (1985-현재)

KU-KIST Graduate School 고려대학교 교수 (2012-현재)

한국 조직공학 재생의학회 회장 (2018-2019)

Invited Lecture **1L2-1**

콜로이드 및 분자조립 부문위원회 I: 콜로이드 및 분자 조립 기반 스마트 연성소재

2025.9.30(화), 14:00~14:25, 2회장

Chair: 류 진, 김소연

Liquid Metal Particles-Incorporated Composites for Functional Materials and Soft Devices

박성준[†]

성균관대학교

The gallium-based liquid metals are an appealing conductor for application in soft, stretchable and shape reconfigurable electronics due to metallic conductivity even while they are strained. The liquid metal spontaneously forms a passivating thin oxide layer (~3 nm) on its surface upon exposure to oxygen. This oxide layer can promote the adhesion of the liquid metal onto various substrates and helps the metal be patterned into the desired geometries through various conventional ways. Ultrasonication can break the liquid metal into micro- and nanosized small particles stabilized by the oxide. These particles are useful because they enable alternative ways to pattern, handle, and utilize liquid metal. In this presentation, we will discuss recent emerging applications of the liquid metal particles-based composites for functional materials and soft devices.



박성준(성균관대학교)

충남대학교 공업화학과 (학사, 석사) (2009)

독일 아헨공과대학교 화학과 (박사) (2013)

현대자동차 재료개발센터 (책임연구원) (2016)

NC State 대학교 화학공학과 (Post-Doc.) (2018)

전북대학교 고분자나노공학과 (조교수) (2023)

성균관대학교 화학공학부 (부교수) (2023-현재)

Invited Lecture **1L2-2**

콜로이드 및 분자조립 부문위원회 I: 콜로이드 및 분자 조립 기반 스마트 연성소재

2025.9.30(화), 14:25~14:50, 2회장

Chair: 류 진, 김소연

Unlocking the Power of Supramolecular Chemistry in Soft Materials Design

강지형[†]

서울대학교

Over the last two decades, supramolecular chemistry has seen remarkable advancements and has emerged as a powerful tool for designing dynamic materials. While its impact is well recognized in related research fields, its full potential in solid-state soft materials remains underexplored. Our group has been working to unlock the potential of supramolecular chemistry in soft materials. In this presentation, I will discuss our insights and approaches to developing mechanically robust polymer networks and polymer composites. In the first part, I will focus on the rational design principles of polymer networks crosslinked by supramolecular interactions to create high-performance elastomers with exceptional stretchability, toughness, and self-healing capabilities. Additionally, I will introduce a novel type of 3D printing photorein for additive manufacturing applications. In the second part, I will highlight new assembly methods for integrating nanomaterials into polymer matrices, a critical aspect of maximizing the properties of both components. Two examples will be presented: (1) the acoustic assembly of liquid metal droplets in a polymer matrix to achieve rubber-like elastic conductors, and (2) template-directed assembly of conductive polymers within hydrogel matrices to develop tissue-like bioelectrode materials. Throughout the presentation, I will discuss not only the design of these materials but also their unique applications, showcasing how supramolecular chemistry can drive innovation in soft materials.



강지형(서울대학교)

서울대학교 화학부 (학사) (2012)

동경대학교 화학생물공학과 (석사) (2014)

동경대학교 화학생물공학과 (박사) (2017)

스탠포드 대학교 화학공학과 (Post-Doc.) (2017-2019)

KAIST 신소재공학과 조/부교수 (2020-2024)

서울대학교 화학부 부교수 (2024-현재)

Invited Lecture **1L2-3**

콜로이드 및 분자조립 부문위원회 I: 콜로이드 및 분자 조립 기반 스마트 연성소재

2025.9.30(화), 14:50~15:15, 2회장

Chair: 류 진, 김소연

Engineering Lipid Mesophases for Exosome Therapeutics

김호준[†]

한국과학기술연구원

엑소좀 치료제는 매우 유망한 치료 플랫폼으로 주목받고 있지만, 임상에 쓰이기 위해선 여전히 해결해야 할 문제들이 남아 있습니다. 본 연구에서는 엑소좀의 불균질성 문제와 제한적인 약물로딩을 해결하기 위해 지질 막 공학을 통한 해결방안을 제안하고자 합니다. 첫 번째 챕터에서는 엑소좀의 조성 불균질성을 극복하기 위한, 엑소좀 모사체 기술을, 그리고 두 번째 챕터에서는 엑소좀에 거대분자를 원스텝으로 로딩하는 막 융합 기반의 혁신적인 기술을 소개하고자 합니다.



김호준(한국과학기술연구원)

KAIST 신소재공학과 (학사) (2010-2012)

UIUC 신소재공학과 (박사) (2012-2017)

KIST 위축연구원 (2018-2020)

KIST 선임연구원 (2020-현재)

Invited Lecture **1L2-4**

콜로이드 및 분자조립 부문위원회 I: 콜로이드 및 분자 조립 기반 스마트 연성소재

2025.9.30(화), 15:15~15:40, 2회장

Chair: 류 진, 김소연

Nanoparticle Aggregation-Driven Reversible Control of Rheological Properties in Microgel Composites

심윤희[†]

수원대학교

Microgels are soft materials with tunable rheology, suited for applications such as 3D printing, drug delivery, and coatings. However, balancing printability and structural stability remains a challenge. Here, we explore nanoparticle aggregation as a reversible physical cross-linking mechanism in silica-Carbopol microgel composites. Silica nanoparticles aggregate at low pH and disperse at high pH due to surface charge changes, enabling reversible control of elasticity and yield stress. Structural transitions are characterized using SAXS, NMR, and recovery rheology. We further show that aggregation kinetics can be tuned via particle size, temperature, and concentrations. Our approach provides a pathway to create microgel composites with reversible mechanical properties, opening new possibilities for advanced ink formulations and sustainable material applications.



심윤희(수원대학교)

울산과학기술원 나노화학과 (학사) (2010-2015)

울산과학기술원 화학공학과 (박사) (2015-2021)

서울대학교 코팅기반 화학공정 연구센터 (Post-Doc) (2021)

University of Illinois at Urbana-Champaign (Post Doc) (2021-2023)

서울대학교 화학공정기술연구소 (Post-Doc) (2023-2024)

수원대학교 신소재공학과 조교수 (2024-현재)

Invited Lecture **1L2-5**

콜로이드 및 분자조립 부문위원회 I: 콜로이드 및 분자 조립 기반 스마트 연성소재

2025.9.30(화), 16:00~16:20, 2회장

Chair: 류 진, 김소연

Light Amplification in Solution-Phase Colloidal Quantum Dots

함동효⁺

한양대학교

Colloidal quantum dots (QDs) represent a versatile class of solution-processable nanomaterials with tunable emission and high quantum yields. However, their practical application in light amplification has been limited by fast optical gain decay due to nonradiative Auger recombination, especially in dilute, solution-phase environments. Here, we introduce type-(I+II) QDs that create hybrid biexciton gain states composed of direct and indirect excitons. These trion-like states exhibit strongly suppressed Auger decay, resulting in extended optical gain lifetimes of several nanoseconds. When integrated into a Littrow cavity, static liquid solutions of these QDs exhibit stable, narrow-linewidth lasing (<0.4 meV) over a widely tunable spectral range. Beyond solution-phase operation, these colloidal QDs can be integrated into soft material platforms, expanding their applicability as tunable, flexible gain media and potential replacements for dye-based lasers.



함동효(한양대학교)

서울대학교 화학생물공학부 (학사) (2014)

서울대학교 화학생물공학부 (석박사) (2020)

성균 나노과학기술원 (박사후연구원) (2020-2022)

Los Alamos National Laboratory (박사후연구원) (2022-2025)

한양대학교 화학공학과 조교수 (2025-현재)

Invited Lecture **1L2-6**

콜로이드 및 분자조립 부문위원회 I: 콜로이드 및 분자 조립 기반 스마트 연성소재

2025.9.30(화), 16:20~16:45, 2회장

Chair: 류 진, 김소연

In-Drop Capillary Spooling of Microfibers Made from Self-Healable Thermoplastic Polyurethane via Supramolecular Interactions

임호선[†]

숙명여자대학교

Self-healing materials that can autonomously recover from any damage are gaining interest in their potential in adaptive and durable systems. In this study, we developed a thermoplastic polyurethane (TPU) with intrinsic self-healing properties, enabled by reversible supramolecular interactions and dynamic covalent bonding. Upon thermal activation, the TPU films can fully recover from damage such as scratches or cuts. It also exhibits a shape-memory effect, allowing controlled deformation and recovery. To explore functional applications, the TPU was processed into microfibers via wet-spinning. The material system exhibits in-drop capillary spooling, where the microfibers spontaneously coil inside a liquid droplet due to interfacial forces and internal stress recovery. This phenomenon highlights the interplay between material self-healing, shape memory, and capillary-driven motion, suggesting potential applications in soft actuators, bio-integrated systems, and smart fiber-based devices.



임호선(숙명여자대학교)

서울시립대학교 환경공학부(학사) (2002)

포항공과대학교 환경공학부(석사) (2004)

포항공과대학교 화학공학과(박사) (2008)

Massachusetts Institute of Technology, Materials Science and Engineering (Post-Doc)
(2009-2011)

한국전자기술연구원 융복합전자소재연구센터 선임연구원 (2011-2016)

숙명여자대학교 화공생명공학부 부교수 (2016-현재)

Invited Lecture **1L2-7**

콜로이드 및 분자조립 부문위원회 I: 콜로이드 및 분자 조립 기반 스마트 연성소재

2025.9.30(화), 16:45~17:10, 2회장

Chair: 류 진, 김소연

Particle Adhesion on Thin Liquid Layer

우상혁[†]

중앙대학교

Thin liquid film dust filters with small pores are widely used for air purification in daily life. Dust, or particulate matter (PM), is captured at the filter pores; thus, smaller pores enhance PM capture efficiency. However, smaller pores also reduce air permeability and increase pressure drop, creating a trade-off. This dilemma arises from weak adhesion between solid PMs and dry solid filter surfaces. Inspired by the human nose, which uses thin mucus on nasal hairs for filtration, we design a filter with a thin, non-volatile liquid coating at the pore surface. This liquid layer strongly adheres PMs, boosting capture efficiency without sacrificing airflow. The coated filter shows exceptional performance in high-speed filtration with no PM re-dispersion. Moreover, suppressed re-dispersion enables novel bi-directional filtration. This Particle Removing Oil-coated (PRO) filter presents a new dust filtration paradigm for fast, efficient air cleaning.



우상혁(중앙대학교)

서울대학교 화학생물공학부 (학사) (2006)

서울대학교 화학생물공학부 (박사) (2013)

Max Planck Institute for Polymer Research (Post-Doc.) (2014-2016)

Max Planck Institute for Polymer Research (Group Leader) (2017-2017)

중앙대학교 화학공학과 조교수 (2017-2021)

중앙대학교 화학공학과 부교수 (2021-현재)

Invited Lecture **1L2-8**

콜로이드 및 분자조립 부문위원회 I: 콜로이드 및 분자 조립 기반 스마트 연성소재

2025.9.30(화), 17:10~17:35, 2회장

Chair: 류 진, 김소연

3D/4D Printing of Smart Soft Materials for Bio-Inspired Functional Applications

한대훈[†], 남기영, 이호원¹

전남대학교

¹ 서울대학교

Shape memory polymers (SMPs) are smart soft materials capable of programmable deformation and shape recovery in response to stimuli such as temperature or light. This talk presents two applications using 3D/4D-printed SMP microstructures for adaptive surface and biomedical technology. The first case introduces a hook-and-loop fastener inspired by plant diaspores, featuring temperature-dependent bonding strength and on-demand detachment. The fastener, fabricated using P μ SL and molding, demonstrates robust adhesion at room temperature and low separation force above the glass transition temperature. The second case involves an octopus-inspired microneedle patch designed for safe drug delivery. The patch enables strong skin adhesion and easy, controlled detachment in response to thermal stimulation. These studies highlight the potential of SMP-based 4D printed systems in developing programmable and functional solutions to engineering problems in industrial and biomedical applications.



한대훈(전남대학교)

서울시립대학교 화학공학과 (학사) (2004-2012)

서울시립대학교 화학공학과 (석사) (2012-2014)

Rutgers, 뉴저지 주립대학교 기계공학과 (박사) (2014-2020)

미네소타대학교 기계공학과 (박사후연구원) (2019-2022)

전남대학교 화학공학부 조교수 (2022-현재)

Invited Lecture **1L2-9**

콜로이드 및 분자조립 부문위원회 I: 콜로이드 및 분자 조립 기반 스마트 연성소재

2025.9.30(화), 17:35~18:00, 2회장

Chair: 류 진, 김소연

Self-Assembled Latticework Nanostructures for Flexible Antireflective Film

최유진[†]

한국화학연구원

We report the design and fabrication of antireflective films composed of a linear polarizer and a quarter-wave plate for use in OLED devices, aiming to minimize light reflection from internal metal electrodes. To enable flexible OLEDs and 3D displays, we developed (1) imidazolium-functionalized amphiphiles forming lyotropic liquid crystal phases for solution-processable linear polarizers and (2) X-shaped guest molecules that assemble with reactive mesogens into latticework structures exhibiting negative birefringence dispersion. Both optical films were fabricated via bar-coating, and their polarization and dispersion-compensating properties were evaluated in relation to their molecular structures. Our results highlight the importance of molecular design in achieving macroscale optical performance for advanced electro-optic applications.



최유진(한국화학연구원)

전북대학교 고분자 나노공학과 (학사) (2009-2012)

전북대학교 고분자 나노공학과 (석사) (2013-2015)

전북대학교 고분자 나노공학과 (박사) (2015-2020)

Massachusetts Institute of Technology (박사후 연구원) (2020-2022)

University of California, Santa Barbara (박사후 연구원) (2022-2023)

한국화학연구원 선임연구원 (2023-현재)

Invited Lecture **1L2-10**

콜로이드 및 분자조립 부문위원회 I: 콜로이드 및 분자 조립 기반 스마트 연성소재

2025.9.30(화), 18:00~18:20, 2회장

Chair: 류 진, 김소연

Wavelength-Selective 3D Printing for Mechanically Programmable Multimaterial Structures

김지원[†]

경북대학교

Wavelength-selective digital light processing (DLP) 3D printing enables spatial control of mechanical properties within a single printed structure by modulating photopolymerization pathways. A dual-curable epoxy-acrylate resin system incorporating spectrally orthogonal photoinitiators allows selective activation of radical and cationic polymerizations under violet and UV light, respectively. This approach achieves voxel-level tuning of stiffness within each layer, facilitating the direct fabrication of multimaterial architectures without post-processing. Demonstrated structures include helically reinforced composites, compliant-to-rigid transitions, and bioinspired assemblies mimicking musculoskeletal interfaces. Additionally, selectively reinforced soft domains support the creation of durable stretchable electronics. This scalable and high-resolution printing platform offers new opportunities in soft robotics, wearable systems, and functional polymer materials.



김지원(경북대학교)

한국과학기술원 (KAIST) 생명화학공학과 학사 (2012-2016)

한국과학기술원 (KAIST) 생명화학공학과 석사 (2016-2017)

한국과학기술원 (KAIST) 생명화학공학과 박사 (2017-2022)

한국과학기술원 (KAIST) 박사후연구원 (2022-2022)

텍사스 오스틴 주립대학교 (The University of Texas at Austin) 박사후연구원 (2022-2025)

경북대학교 화학공학과 조교수 (2025-현재)

Keynote Lecture **1L3-1**

에너지 부문위원회 I: 차세대 지속가능 그린 에너지 구현을 위한 첨단 소재 및 융합 혁신 기술 I

2025.9.30(화), 14:00~14:40, 3회장

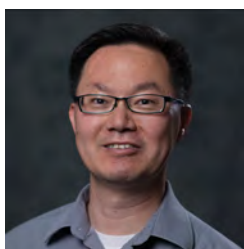
Chair: 심지민,이세찬

Molecular Engineering of Ion-Conducting Polymers for Clean Energy Technologies

Chulsung Bae[†]

Rensselaer Polytechnic Institute

Anion exchange membranes (AEMs) based on hydroxide-conducting polymers are a key component for anion-based electrochemical energy technology such as hydrogen fuel cells, electrolyzers for green hydrogen, and redox flow batteries. Although these alkaline electrochemical technologies offer a promising alternative to acidic proton exchange membrane electrochemical devices, the access to chemically stable, mechanically durable, high-performing polymer electrolyte materials has been bottleneck to advance electrochemical technologies for hydrogen and other green chemicals until now. Recent progress at the Bae group of Rensselaer Polytechnic Institute in the development of advanced hydroxide-conducting polymers and membranes for AEM technology applications will be presented.



Chulsung Bae(Rensselaer Polytechnic Institute)

B.S., Inha University (1992)

M.S., POSTECH (1994)

M.S., University of Massachusetts at Lowell (1997)

Ph.D., University of Southern California (Advisors: G. K. Surya Prakash & George A. Olah) (2002)

Post-Doc., Yale University (advisor: John F. Hartwig) (2004)

Assistant Professor & Associate Professor, University of Nevada Las Vegas (2004-2012)

Ford Foundation Professor, Rensselaer Polytechnic Institute (RPI) (2012-Present)

Invited Lecture **1L3-2**

에너지 부문위원회 I: 차세대 지속가능 그린 에너지 구현을 위한 첨단 소재 및 융합 혁신 기술 I

2025.9.30(화), 14:40~15:05, 3회장

Chair: 심지민,이세찬

Research & Development of MEA/PEM for H₂ Fuel Cell and Water Electrolysis

김준영⁺

코오롱인더스트리

A high level of activities in the fields from a polymer electrolyte membrane fuel cell (PEMFC) to a PEM water electrolysis (PEMWE) has been made to realize its commercialization and to develop sustainable energy technologies for achieving decarbonization targets. However, there are still technological hurdles including high cost, performance loss, and inferior durability with long-term cycle. Herein we present the R&D progress of the PEM and membrane-electrode assembly (MEA) for FC and WE applications. Future development in a broad range of hydrogen-related industry will be performed by balancing high performance against multiple functionalities and manufacturing cost.



김준영(코오롱인더스트리)

한양대학교 고분자공학 (박사) (2006)

삼성SDI 중앙연구소 책임연구원 (2006-2016)

MIT 재료공학/화학공학 (Post-Doc) (2007-2010)

코오롱인더스트리 연구개발본부 수소에너지연구팀장 (2016-현재)

Invited Lecture **1L3-3**

에너지 부문위원회 I: 차세대 지속가능 그린 에너지 구현을 위한 첨단 소재 및 융합 혁신 기술 I

2025.9.30(화), 15:05~15:30, 3회장

Chair: 심지민,이세찬

Advanced separators breaking the trade-off between conductivity and strength for alkaline water electrolysis

조원철⁺, 이동현, 김현진, 신지혜

서울과학기술대학교

Pressurized alkaline water electrolyzers (AWE) with thinner porous separators are considered an optimal design strategy, as they simultaneously enhance voltage efficiency and hydrogen storage density. However, the inherently high hydrogen permeability and low mechanical strength of state-of-art commercial separators such as Zirfon® 220 lead to hesitancy in applying the pressurized AWE system. In this study, we present a straightforward impregnation method reducing ohmic resistance and gas crossover. This innovative separator **effectively reduced gas crossover** by 40% without compromising overall cell performance and higher mechanical strength. Furthermore, extensive long-term experiments indicate no **discernible increase** in degradation rates compared to reference separators.



조원철(서울과학기술대학교)

고려대학교 응용생명환경화학과(학사) (2003)

포항공과대학교 환경공학과(석사) (2005)

한국과학기술대학교 생명화학공과(박사) (2014)

한국에너지기술연구원 수소연구단 (수소연구단장) (2005-2022)

서울과학기술대학교 미래에너지융합학과 부교수 (2022-현재)

Invited Lecture **1L3-4**

에너지 부문위원회 I: 차세대 지속가능 그린 에너지 구현을 위한 첨단 소재 및 융합 혁신 기술 I

2025.9.30(화), 15:30~15:55, 3회장

Chair: 심지민,이세찬

음이온교환막 수전해(AEMWE)용 고성능 고분자 전해질 소재 기술개발 동향

이장용[†]

건국대학교

음이온교환막은 전통적인 수처리분야 뿐 아니라 수전해, 연료전지, 레독스 플로우 배터리와 같은 에너지 변환 및 저장 시스템에서도 핵심 소재로 활용되고 있으며, 최근에는 eCO_2R 이나 전기화학적 암모니아의 합성 및 분해와 같은 분야에서도 널리 사용되고 있다. 이 중 수전해는 넓은 활용 범위와 높은 기술적 성숙도로 인해 상용 활용에 가장 가까운 분야로 평가받고 있어 그 중요도가 더욱 큰 분야이다. 최근 활발한 연구를 바탕으로 다양한 음이온교환소재가 개발되고 있으며, 이를 바탕으로 전체 시스템의 성능 및 내구성도 비약적으로 향상되고 있다. 그럼에도 불구하고 여전히 음이온교환소재는 전체 시스템의 성능 및 내구성을 제한하는 기술적 난제로 여겨지고 있다. 특히 연료전지 분야에서는 활용 환경이 가혹하여 더 큰 어려움이 있다. 이에 본 발표에서는 다양한 수전해용 음이온교환막 소재와 관련된 기술 동향에 대해 소개하고 이의 성능 및 내구성 향상 전략에 대해 논한다. 특히 전해질막과 이오노머 소재의 활용과 관련된 요구사항을 바탕으로 이를 구별하고 우수한 전해질막 및 이오노머 소재의 설계 방향에 대해 이야기한다.



이장용(건국대학교)

건국대학교 신소재공학과(학사) (1997-2005)

건국대학교 신소재공학과(석사) (2005-2007)

건국대학교 신소재공학과(박사) (2007-2011)

한국화학연구원 (책임연구원) (2011-2024)

건국대학교 화공학부 조교수 (2024-현재)

Invited Lecture **1L3-5**

에너지 부문위원회 I: 차세대 지속가능 그린 에너지 구현을 위한 첨단 소재 및 융합 혁신 기술 I

2025.9.30(화), 16:10~16:35, 3회장

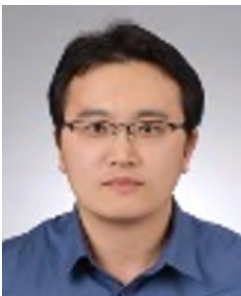
Chair: 심지민,이세찬

Sol-gel transition assembly of anion-exchange membranes

이정현[†]

고려대학교

최근 수전해를 통한 그린수소 생산 기술에 대한 관심이 증가함에 따라, 음이온교환막 기반 수전해 기술 개발 연구가 활발히 진행되고 있다. 수전해 공정에 있어서 음이온교환막은 형성되는 기체 간의 혼합을 방지하고, 음이온을 선택적으로 이동시켜 수소생산을 용이하게 하는 핵심적인 역할을 한다. 하지만, 현재 수전해 공정에 사용되는 음이온교환막은 거의 전량 해외 제품에 의존하고 있는 현실이다. 학계에서도 음이온교환막 개발을 위한 많은 연구가 이루어지고 있으나, 상용 음이온교환막 대비 성능 및 내구성이 낮거나, 대면적 생산이 용이하지 못한 단점을 가지고 있다. 본 연구에서는 기존 음이온교환막 제조기술과 차별화된 sol-gel transition assembly 기술을 활용하여, 상용 음이온교환막 보다 성능과 내구성이 우수하면서도 대면적 생산이 용이한 음이온교환막 제조기술에 대해 소개하고자 한다.



이정현(고려대학교)

고려대학교 화학공학과(학사) (1999)

고려대학교 화학공학과(석사) (2001)

Georgia Tech 화학공학과(박사) (2010)

미국국립표준과학연구원(NIST) (Post-Doc) (2010-2012)

한국과학기술연구원(KIST) 선임연구원 (2014-2014)

고려대학교 화공생명공학과 교수 (2014-현재)

Invited Lecture **1L3-6**

에너지 부문위원회 I: 차세대 지속가능 그린 에너지 구현을 위한 첨단 소재 및 융합 혁신 기술 I

2025.9.30(화), 16:35~17:00, 3회장

Chair: 심지민,이세찬

Understanding Ionomer Oxidation in Anion Exchange Membrane Water Electrolyzers and their Actual Effects on Cell Durability

이성수[†]

한국과학기술연구원

Anion exchange membrane water electrolyzers (AEMWEs) are a critical technology for sustainable hydrogen production, but long-term durability remains a critical challenge. To address this drawback, we investigate various approaches to mitigate ionomer oxidation in AEMWEs, focusing on how differences in ionomer structure affect ionomer-catalyst interactions. Most hydrocarbon ionomers and membranes contain phenyl groups, which are readily absorbed on the hydrogen evolution reaction (HER) oxygen evolution reaction (OER) surface, negatively affecting performance. Based on these findings, we observed that ionomers with lower adsorption energy exhibited better performance and durability. Post-operation analysis confirmed that these ionomers experienced less oxidation, which was conclusively shown in pure water feed operating conditions. This study provides valuable insights into the optimization of ionomer structure for enhancing AEMWEs performance and durability.



이성수(한국과학기술연구원)

UC Berkeley 화학과 학사 (2004-2008)

과학기술연합대학교 재료공학 박사 (2009-2014)

KIST (Post-doc) (2014-2017)

미국 Los Alamos National Lab (Post-Doc.) (2017-2019)

한국과학기술연구원 극한물성소재연구센터 선임연구원 (2019-현재)

Invited Lecture **1L3-7**

에너지 부문위원회 I: 차세대 지속가능 그린 에너지 구현을 위한 첨단 소재 및 융합 혁신 기술 I

2025.9.30(화), 17:00~17:20, 3회장

Chair: 심지민,이세찬

Ionomer Induced Interfacial Electron Transport Problem at PEM Water Electrolyzer Anode

두기수[†], 박현정, 이창수, 김상경

한국에너지기술연구원

Green hydrogen—central to deep decarbonization and long-duration storage—motivates PEM water electrolysis as a leading route with high current density and dynamic operation. Yet lowering Ir loading often produces anode losses not captured by bulk ohmics. Drawing on recent experiments and modeling, this talk isolates an ionomer-induced barrier to interfacial electron transport at the IrOx/TiOx/porous-Ti junction. Native n-type TiOx forms a Schottky-like barrier; when PFSA ionomer wets the PTL, mixed ionic/electronic contacts pinch off electron paths, increasing interfacial resistance. The barrier height scales with catalyst work function and ionomer–PTL contact area, so highly dispersed IrOx and dense layers aggravate losses at ultralow Ir. We propose design rules: restrict ionomer at the PTL, insert conductive or passivating interlayers, prefer lower-work-function IrOx facets, and tune particle size and porosity to preserve electronic percolation in low-PGM anodes.



두기수(한국에너지기술연구원)

KAIST 생명화학공학과 (학사) (2016)

KAIST 생명화학공학과 (석사) (2018)

KAIST 생명화학공학과 (박사) (2022)

KAIST 응용과학연구소 (Post-Doc) (2022-2022)

한국에너지기술연구원 선임연구원 (2022-현재)

Invited Lecture **1L3-8**

에너지 부문위원회 I: 차세대 지속가능 그린 에너지 구현을 위한 첨단 소재 및 융합 혁신 기술 I

2025.9.30(화), 17:20~17:40, 3회장

Chair: 심지민,이세찬

High-Performance Direct Ammonia Fuel Cells Based on Anion Exchange Membranes

채지연[†]

한국기계연구원

Ammonia is considered a promising carbon-free fuel due to its ease of liquefaction under mild conditions—at room temperature under moderate pressure (0.8 MPa) or at atmospheric pressure at $-33\text{ }^{\circ}\text{C}$ —as well as its compatibility with existing transport and storage infrastructure. Due to its high hydrogen content, ammonia can also serve as a hydrogen carrier; however, its decomposition and purification require substantial energy input. Consequently, the direct utilization of ammonia as a fuel has attracted considerable attention. In particular, direct ammonia fuel cells (DAFCs) based on anion exchange membranes offer advantages such as high energy density and simplified system architecture. This study presents a systematic investigation into the anode configuration and composition that influence the performance of DAFCs.



채지연(한국기계연구원)

경상국립대학교 고분자공학 (학사) (2011-2015)

과학기술연합대학원대학교 에너지공학 (석사) (2015-2017)

고려대학교 화공생명공학 (박사) (2018-2022)

한국에너지공과대학교 수소에너지연구소 (Post-Doc) (2022)

한국기계연구원 친환경모빌리티연구실 선임연구원 (2022-현재)

Keynote Lecture **1L4-1**

에코소재 부문위원회: 맞춤형 분해 특성을 갖는 차세대 바이오폴리머 복합소재 기술동향

2025.9.30(화), 14:00~14:40, 4회장

Chair: 김 정, 이동윤

Aqueous Processing of Natural Rubber-Synthetic Polymer Nanocomposites

Rusli Daik[†], Lee Ching Yee, Shahinas Bidol, Srihanum Adnan, Ahmad Adlie Shamsuri, Huzaifah Haritsah Abd Razak, Hassan Ghalib Abdullah, Ibrahim Abdullah, Mohammad Hafizuddin Jumali, Ishak Ahmad

Universiti Kebangsaan Malaysia

This research develops advanced nanocomposites from natural rubber (NR) and synthetic polymers to enhance mechanical, thermal, and electrical properties while promoting sustainability. Liquid natural rubber (LNR) emulsions (10,000 and 50,000 g/mol) were prepared using SDS; lower molecular weight LNR showed better stability with less emulsifier use. LDPE/LNR blends (100/0 to 40/60) achieved optimal stress-strain performance at 60/40 composition, with DSC confirming blend homogeneity. HDPE/LNR composites with organo-modified montmorillonite (OMMT) (3–15% LNR, 3–5% OMMT) showed improved tensile, impact, and thermal stability, with exfoliated or mixed structures confirmed by XRD and TEM. Nylon-6/LNR blends with 2–10% clay improved mechanical properties at 85/15 ratio. PC/LNR/OMMT nanocomposites (2–10% OMMT) displayed higher thermal degradation temperatures. NR/PS matrices with 11.91–36.25% polypyrrole nanoparticles achieved conductivities of 1.77×10^{-8} – 1.07×10^{-4} S/cm, alongside increased tensile strength and modulus. Overall, incorporating nanomaterials effectively tailors NR-based materials for diverse industrial applications aligned with sustainability objectives.



Rusli Daik(Universiti Kebangsaan Malaysia)

B.Sc, Univ Kebangsaan Malaysia (UKM) (1993)

Ph.D, Durham University, United Kingdom (1997)

Lecturer, Univ Kebangsaan Malaysia (1997-2003)

Assoc. Professor, Univ Kebangsaan Malaysia (2003-2013)

Professor, Univ Kebangsaan Malaysia (2013-Present)

Invited Lecture **1L4-2**

에코소재 부문위원회: 맞춤형 분해 특성을 갖는 차세대 바이오폴리머 복합소재 기술동향

2025.9.30(화), 14:40~15:05, 4회장

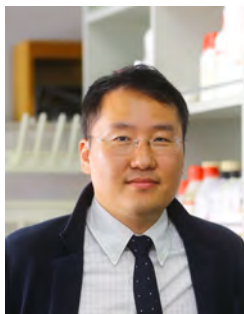
Chair: 김 정, 이동운

The linear and nonlinear rheological properties of PLA/LDPE and PHA/LCB-PLA blends

김민찬, 현규[†]

부산대학교

Our initial investigations focused on Polylactic acid (PLA)/low-density polyethylene (LDPE) blends. Due to the long-chain branches (LCB) of LDPE, PLA/LDPE blends exhibit strain hardening behavior under extensional flow at specific morphological conditions. This strain hardening is highly beneficial for processes like blow molding or foaming. This concept has also been applied to Polyhydroxyalkanoate (PHA)/LCB-PLA blends. This blend aims to enhance the mechanical properties and processability of PHA by utilizing the inherent stiffness and strain hardening effect of LCB-PLA, while maintaining PHA's biodegradability and introducing material properties suited for more demanding applications. In this research, PHA/LCB-PLA blends are assessed through linear and nonlinear rheological properties. Additionally, Scanning Electron Microscopy (SEM) is conducted to examine the blend morphology.



현규(부산대학교)

B.A., Seoul National Univ. (1998)

Ph.D., Seoul National Univ. (2005)

Post-Doc., Max-Planck Institute for Polymer, Mainz, Germany (2006)

Post-Doc., KIT (Karlsruhe Institute of Technology), Karlsruhe, Germany (2007)

Researcher, DESY (German Electron Synchrotron), Hamburg, Germany (2008)

Professor, Pusan National Univ. (2010-현재)

Invited Lecture **1L4-3**

에코소재 부문위원회: 맞춤형 분해 특성을 갖는 차세대 바이오폴리머 복합소재 기술동향

2025.9.30(화), 15:05~15:30, 4회장

Chair: 김 정, 이동윤

Eco-Designed Biodegradable Polyesters: Linking Sustainability to Performance

구준모[†]

충남대학교

The transition toward sustainable polymer materials requires innovative strategies that integrate eco-friendly design with high-performance functionality. Citric acid (CA), a renewable organic acid, offers unique opportunities in both catalysis and structural design of sustainable polyesters. A hybrid catalyst from CA enables water tolerant system that was highly disadvantageous in every polyester system, while the incorporation of citric acid into the polymer main chain enhances overall performance. Also, the multifunctional nature of citric acid facilitates the formation of three-dimensional polymer architectures, yielding unprecedented networked biodegradable polyesters with tunable degradation profiles. Our findings demonstrate that citric acid, when strategically employed as both a catalytic component and a structural element, can open new avenues for high-performance, sustainability-driven polyester materials.



구준모(충남대학교)

B.A., Hanyang Univ. (2012)

Ph.D., Hanyang Univ. (2018)

Post-Doc, KRICT (2018)

Post-Doc, KTH Royal Institute of Technology (Stockholm, Sweden) (2019)

Senior Researcher, KRICT (2019-2022)

Assistant Prof. Chungnam National Univ. (2022-현재)

Invited Lecture **1L4-4**

에코소재 부문위원회: 맞춤형 분해 특성을 갖는 차세대 바이오폴리머 복합소재 기술동향

2025.9.30(화), 15:30~15:55, 4회장

Chair: 김 정, 이동윤

Hydrophobic Surface Modification of Nanocellulose in an All-Aqueous System

Lam Tan Hao, 박슬아, 김효정^{*1}

한국화학연구원

¹ 한국화학연구

Nanocellulose, derived from the Earth's most abundant biopolymer, offers a sustainable alternative to petroleum-based materials. Its high strength, optical properties, high aspect ratio, and biodegradability make it attractive for diverse applications. However, nanocellulose's hydrophilicity limits its use in hydrophobic or high-ionic strength environments. Existing hydrophobization methods are complex, inefficient, or environmentally unfriendly. Here, leveraging nanocellulose's ability to stabilize oil-in-water emulsions, we introduce a green, scalable method to produce hydrophobic nanocellulose entirely in water using a surfactant-acid catalyst. This presentation describes the modification protocol and characterization of the resulting hydrophobic nanocellulose. We are conducting a life-cycle assessment to evaluate the environmental impact of this method. This work offers a sustainable route to tailor nanocellulose surfaces for application in nonaqueous systems.



Lam Tan Hao(한국화학연구원)

B.Sc., Biotechnology, Can Tho University (Vietnam) (2011-2016)

Ph.D. (Integrated Program), Chemical Engineering and Advanced Materials, Korea National University of Science and Technology (UST) (2018-2023)

Postdoctoral Researcher, Korea Research Institute of Chemical Technology (KRICT) (2023-Present)

Invited Lecture **1L4-5**

에코소재 부문위원회: 맞춤형 분해 특성을 갖는 차세대 바이오폴리머 복합소재 기술동향

2025.9.30(화), 16:10~16:35, 4회장

Chair: 김 정, 이동윤

Functional Biodegradable Polymer Systems: From High-Barrier Packaging Coatings to Sustainable Organic Electronics

최신형, 명재욱[†]

한국과학기술원

The accumulation of plastic and electronic waste demands sustainable polymer innovations that unite functionality with environmental responsibility. We present two advances in biodegradable materials. First, a boric acid-crosslinked poly(vinyl alcohol) coating on paper markedly improves mechanical strength, oxygen and water vapor barrier properties, and oil resistance, while retaining marine biodegradability and biocompatibility—offering a sustainable alternative to polyethylene-based coatings for packaging. Second, Sepia melanin-shellac films flexographically printed on paper show stable electrical conductivity under ambient and humid conditions and achieve nearly complete biodegradation under composting, with negligible ecotoxicity. Together, these studies illustrate bio-inspired polymer design strategies that address plastic pollution and electronic waste, paving the way for green functional polymers in packaging and organic electronics.



명재욱(한국과학기술원)

B.S., KAIST (2011)

M.S., Stanford University (2014)

Ph.D., Stanford University (2016)

Post-Doc., Pennsylvania State University (2016-2017)

Assistant Professor, Southern Methodist University (2017-2019)

Assistant Professor, KAIST (2019-2024)

Associate Professor, KAIST (2024-현재)

Invited Lecture **1L4-6**

에코소재 부문위원회: 맞춤형 분해 특성을 갖는 차세대 바이오폴리머 복합소재 기술동향

2025.9.30(화), 16:35~17:00, 4회장

Chair: 김 정, 이동윤

Seaweed-Based Hydrovoltaics for Sustainable Electricity Generation

안효성⁺

전남대학교

To address the escalating need for carbon-neutral technologies, we introduce a sustainable hydrovoltaic electricity generator that utilizes natural seaweed as the primary functional material. The device operates by converting water evaporation into electricity, driven by a humidity gradient between a copper plate (bottom electrode) and a copper mesh (top electrode). A compact unit (2 cm × 5 cm × 0.1 cm) achieves stable performance under 70% relative humidity, generating an open-circuit voltage of 0.35 V, a current density of 30 $\mu\text{A}/\text{cm}^2$, and a power density of 2.64 $\mu\text{W}/\text{cm}^2$. When multiple units are connected in series, the system produces sufficient output to drive practical devices such as light-emitting diodes or charge supercapacitors. These results highlight the potential of seaweed-based hydrovoltaics as a scalable, eco-friendly platform for low-power energy harvesting, with biodegradable components and a significantly reduced life-cycle carbon footprint.



안효성(전남대학교)

한양대학교 화학공학과 (학사) (2003-2010)

한양대학교 화학공학과 (석사) (2010-2012)

Texas A&M University 화학공학과 (박사) (2013-2018)

University of Illinois 재료공학과 (포닥) (2018-2021)

전남대학교 석유화학소재공학과 조교수 (2021-현재)

Invited Lecture **1L4-7**

에코소재 부문위원회: 맞춤형 분해 특성을 갖는 차세대 바이오폴리머 복합소재 기술동향

2025.9.30(화), 17:00~17:25, 4회장

Chair: 김 정, 이동윤

Sustainable microbial production of biodegradable polymer PHA from renewable sources

고자경[†]

한국과학기술연구원

Polyhydroxyalkanoates (PHAs) are emerging as promising eco-friendly alternatives to conventional plastics due to their biodegradability and biocompatibility. In this study, a sustainable microbial platform for PHA production was developed using *Cupriavidus necator* H16 to convert various renewable carbon sources including CO₂, polyethylene (PE) waste, and lignocellulosic biomass into PHA. Through the integration of solar-powered bioelectrochemical systems and biocompatible catalysts, efficient CO₂-to-PHA conversion was achieved. Notably, oxidized PE derivatives were directly utilized as feedstocks for PHA biosynthesis, enabling the upcycling of recalcitrant plastic waste into biodegradable polymer materials. This work demonstrates a scalable, carbon-neutral route for producing biodegradable polymers from waste carbon streams, offering new opportunities in sustainable polymer design and circular materials economy.



고자경(한국과학기술연구원)

고려대학교 식품공학과 학사 (2003-2007)

고려대학교 식품공학과 석사 (2007-2009)

퍼듀대학교 생물공학과 박사 (2010-2014)

한국과학기술연구원 박사후연구원 (2014-2018)

한국과학기술연구원 선임연구원 (2018-2025)

한국과학기술연구원 책임연구원 (2025-현재)

Invited Lecture **1L4-8**

에코소재 부문위원회: 맞춤형 분해 특성을 갖는 차세대 바이오폴리머 복합소재 기술동향

2025.9.30(화), 17:25~17:50, 4회장

Chair: 김 정, 이동윤

Starpolymer catalysts for room-temperature activation of CO₂

서진영[†]

한국화학연구원

The efficient utilization of CO₂ as a sustainable carbon feedstock is an important strategy for addressing climate change and developing value-added materials. Herein, we present novel starpolymer catalysts designed for the CO₂ cycloaddition reaction under ambient conditions. By tuning the density of nucleophilic units near the porphyrin core, we demonstrate how molecular architecture strongly influences catalytic activity. A porphyrin core surrounded by a high density of nucleophiles exhibits superior catalytic activity for cyclic carbonate production from CO₂, under ambient reaction conditions. In addition, the temperature-responsive phase transition of these starpolymers allows easy recovery by filtration. This study emphasizes the role of precise molecular design in polymer-based catalysis and provides insights into structure–activity relationships, offering a promising platform for next-generation catalysts and a sustainable green economy.



서진영(한국화학연구원)

B.A., Pusan National University (2017)

Ph.D., Korea University (2022)

Post-Doc, Korea Institute of Science and Technology (2022-2023)

Senior Researcher, KRICT, Center for Bio-based Chemistry (2024-현재)

Invited Lecture **1L5-1**

[SK케미칼 특별세션] 플라스틱의 새로운 패러다임: Recyclable, Recycled, and Renewable

2025.9.30(화), 14:00~14:25, 5회장

Chair: 조현준, 김성기

플라스틱 재활용 관련 규제동향

양남철[†], 김한석

SK케미칼

최근 많은 국가에서 플라스틱 오염의 사회적 이슈를 해소하기 위해 플라스틱 제품의 재활용/재사용 및 대체재(3R)를 요구하는 규정이 도래하고 또 그 요구사항이 강화되고 있다. 이러한 규정은 대부분 해당 제품을 제조/판매하는 기업에게 관련 의무를 부여하고 있어, 기존의 환경 마케팅적 접근에서 벗어나 재활용을 포함한 의무를 필수적으로 이행해야하는 상황으로 바뀌고 있다. 환경오염 문제의 심각성 측면에서 많이 지적되어온 포장재를 중심으로 하고 있으나, 최근 들어 자동차나 섬유 등으로 확대되는 움직임을 보이고 있다. 또한 관련 규제들은 중금속이나 PFAS와 같은 유해물질의 통제는 물론 특히 식품용도 포장재의 경우 매우 까다로운 수준의 안전성을 요구하고 있으므로 이를 준수하기 위해서는 높은 재활용 기술 수준이 요구된다. 본 발표에서는 이러한 플라스틱 재활용 관련한 각국의 규제 동향을 개략적으로 살펴보고자 한다.



양남철(SK케미칼)

한양대학교 공업화학과(학사) (1996)

한양대학교 공업화학과(석사) (1998)

한양대학교 공업화학과(박사) (2002)

삼성SDI 중앙연구소 (2002-2011)

SK케미칼 화학연구소 (2011-현재)

Invited Lecture **1L5-2**

[SK케미칼 특별세션] 플라스틱의 새로운 패러다임: Recyclable, Recycled, and Renewable

2025.9.30(화), 14:25~14:50, 5회장

Chair: 조현준, 김성기

Glycolysis 기반 PET 재활용을 통한 BHET 생산

이상열[†]

SK케미칼

전 세계 페PET 발생량은 연간 약 3천만 톤에 달하며, 재활용률은 9%에 불과하다. EU는 PET병에 2025년까지 재생원료 25% 사용을 의무화하고, 2030년까지 30%로 상향할 예정이다. 미국 캘리포니아주는 2025년 25%, 2030년 50% 이상을 요구하며, 한국은 2026년부터 최종제품 생산자에게 10% 사용을 의무화하고 2030년까지 30%로 확대할 계획이다. PET 재활용은 기계적·화학적 방식으로 나뉘며, 화학적 재활용은 다시 Glycolysis, Methanolysis, Hydrolysis등으로 나뉜다. 그 중 PET를 BHET 단량체로 제조하는 Glycolysis는 화학적 재활용의 주요 방식으로 주목받고 있다. 본 발표에서는 Glycolysis 기술의 최신 동향과 상업화 동향을 조망하고, 지속가능한 PET 처리 방안으로서의 잠재력을 논의한다.



이상열(SK케미칼)

한양대학교 화학공학과 (학사) (2002-2009)

고려대학교 화공생명공학과 (석사) (2018-2020)

SK케미칼 (2009-현재)

Invited Lecture **1L5-3**

[SK케미칼 특별세션] 플라스틱의 새로운 패러다임: Recyclable, Recycled, and Renewable

2025.9.30(화), 14:50~15:15, 5회장

Chair: 조현준, 김성기

SK Chemicals' r-TPA Process

강주식[†]

SK케미칼

Plastic recycling is a key strategy for carbon reduction and is receiving increasing attention. PET is a representative plastic material with systematic collecting and sorting systems worldwide. Chemical recycling can recover raw materials of PET such as r-BHET, r-DMT, and r-TPA. Among these, r-TPA is particularly promising due to its compatibility with existing PET polymerization processes, allowing direct input without changes to equipment or reaction conditions. However, commercialization has been delayed due to the high contamination level of waste feedstock and the inherent purification challenges of TPA. SK Chemicals' r-TPA process has been proven capable of converting highly contaminated textile waste into r-TPA of equivalent quality of virgin TPA through the production of CR-PET and Copolyesters. A pilot plant is currently being designed based on a continuous process suitable for commercialization.



강주식(SK케미칼)

경희대학교 섬유공학과 (학사) (1991-1998)

경희대학교 섬유공학과 (석사) (1998-2000)

고려대학교 화학과 (박사) (2013-2018)

SK케미칼 (2000-현재)

Invited Lecture **1L5-4**

[SK케미칼 특별세션] 플라스틱의 새로운 패러다임: Recyclable, Recycled, and Renewable

2025.9.30(화), 15:15~15:40, 5회장

Chair: 조현준, 김성기

T2T(Textile to Textile) Closed Loop Solution

김지현[†]

에스케이케미칼

우리가 흔히 PET병으로 잘 알고 있는 PET 소재는 실제 섬유 용도로 사용되는 양이 가장 많으며, 최근 fast fashion 트렌드로 인해 섬유 폐기물의 양은 날로 증가하고 있습니다. 패션업계는 전세계 탄소 배출량의 약 10%를 차지하며 2017년 기준 전세계 섬유폐기물의 양은 약 21억톤에 달하며 재활용을 위한 수거율은 14%에 불과합니다. Textile분야에서의 지속가능성을 위한 Closed Loop Solution에 대해 SK케미칼에서 개발하고 있는 전처리 및 해중합 기술에 대해 소개하고자 합니다.



김지현(에스케이케미칼)

서울대학교 화학교육과(학사) (1996-2000)

서울대학교 화학과(석사) (2000-2002)

서울대학교 재료공학부(박사) (2014-2018)

SK케미칼 화학연구소 (2002-현재)

Invited Lecture **1L5-5**

[SK케미칼 특별세션] 플라스틱의 새로운 패러다임: Recyclable, Recycled, and Renewable

2025.9.30(화), 16:00~16:25, 5회장

Chair: 조현준, 김성기

SK Chemicals PET recycle solution: Circular Recycle

신용준[†]

SK케미칼

고분자는 우수한 기계적 물성, 경량성, 가공 용이성 및 상대적으로 저렴한 가격 등 다양한 장점으로 현대 문명의 발전과 인류 생활의 윤택함에 많은 기여를 하고 있다. 하지만 분해 속도가 느린 고분자의 특성으로 인해 공해 및 microplastic에 대한 우려가 커지면서 고분자를 바라보는 시선과 사용 및 처리 방법에 대한 새로운 시도와 규제가 생겨나고 있다. PET는 투명한 특성을 갖는 것과 동시에 높은 기계적 강도, 내마모성, 가공 용이성을 갖으면서도 가격이 저렴한 engineering plastic이다. 이런 특성들로 인해 PET는 생수병, 음료병, film 및 의류 등 다양한 용도로 인류의 생활 곳곳에 사용되어 매년 1억톤 이상이 생산되고 있으며, 수거 체계가 비교적 잘 갖추어진 thermoplastic의 특징으로 고분자 중에서 가장 많은 양이 recycle 되는 친환경성이 장점이나, mechanical recycle은 용도 전개에 제약이 있는 등 한계가 있다. 본 발표에서는 glycolysis를 통한 SK케미칼의 PET recycle solution을 소개하고, SK케미칼에서 생산되는 SKYPET CR의 적용 예와 closed loop를 통한 친환경 solution을 제시하고자 한다.



신용준(SK케미칼)

연세대학교 화학과 (학사) (1995-1999)

포항공과대학 화학과 (석사) (2000-2002)

University of Akron, Polymer Science (Ph.D) (2016-2021)

SK Chemicals RnD Center (2002-현재)

Invited Lecture **1L5-6**

[SK케미칼 특별세션] 플라스틱의 새로운 패러다임: Recyclable, Recycled, and Renewable

2025.9.30(화), 16:25~16:50, 5회장

Chair: 조현준, 김성기

From Waste to Resource: The Commercialization of Chemically Recycled Polybutylene Terephthalate (CR-PBT)

유영만⁺, 한예지¹, 김성기¹

SK케미칼

¹ 화학연구소

The development of Chemically Recycled Polybutylene Terephthalate by SK Chemicals is driven by the automotive industry's need for environmentally friendly materials in compliance with End-of-Life Vehicle regulations. Utilizing glycolysis-based depolymerization technology, CR-PBT is synthesized from rDMT or rBHET derived from waste PET bottles and textiles. CR-PBT achieves mechanical and thermal properties comparable to virgin PBT. CR-PBT can serve as a 1:1 substitute for virgin PBT in various applications, including automotive headlamp bezels, mobile phone components, connectors, cosmetic packaging, sewing threads, ultra-fine bristles, and covered yarns. Unlike MR-PBT, which suffers from impurities and property degradation, CR-PBT exhibits lower foreign matters and more stable coloration. Notably, CR-PBT has successfully passed high-temperature and high-humidity hydrolysis evaluations for automotive motor housing applications, a feat unattainable with MR-PBT.



유영만(SK케미칼)

한양대학교 화학공학과(학사) (1994-2001)

한양대학교 화학공학과(석사) (2001-2003)

SK케미칼 화학연구소 (2003-현재)

Purdue University 재료공학(박사) (2013-2017)

Invited Lecture **1L5-7**

[SK케미칼 특별세션] 플라스틱의 새로운 패러다임: Recyclable, Recycled, and Renewable

2025.9.30(화), 16:50~17:15, 5회장

Chair: 조현준, 김성기

화학적 재활용 기술을 활용한 Copolyester 소재 개발

이부연[†]

SK 케미칼

SK케미칼은 플라스틱 순환 경제 구축을 위해 화학적 재활용 기술을 활용한 Copolyester 소재 개발에 집중하고 있습니다. 특히 PET를 해중합하여 원료 상태로 되돌리는 화학적 재활용 기술을 고도화하고 있으며, 이 기술은 물리적 재활용으로는 해결하기 어려운 오염된 폐플라스틱도 재활용할 수 있어 고품질의 재활용 소재 생산을 가능하게 합니다.

이러한 재활용 소재들은 뛰어난 투명성, 내화학적성, 내구성 등의 물성을 유지 가능하여 화장품 용기, 포장재, 가전제품 등 다양한 분야에 적용되어 플라스틱 폐기물 문제 해결에 기여하고 있습니다. SK케미칼은 앞으로도 재활용 소재 개발을 통해 지속 가능한 사회를 만드는데 앞장설 계획입니다.



이부연(SK 케미칼)

인하대학교 화공생명공학부 (학사) (1996-2004)

인하대학교 고분자공학과 (석사) (2004-2006)

효성 기술원 (2006-2013)

SK케미칼 (2013-현재)

Invited Lecture **1L5-8**

[SK케미칼 특별세션] 플라스틱의 새로운 패러다임: Recyclable, Recycled, and Renewable

2025.9.30(화), 17:15~17:40, 5회장

Chair: 조현준, 김성기

ECOZEN : Sustainable Packaging Solution

문정미[†]

SK케미칼

SK케미칼은 지속가능한 미래를 위한 소재 혁신 전략의 일환으로, 바이오 기반 고투명 폴리에스터 ECOZEN을 개발하고 상업화하고 있다. ECOZEN Claro는 PET 재활용 스트림에 적합한 구조를 갖추고 있으며, 바이오 원료 기반과 재활용 가능성을 동시에 만족시켜 친환경 고기능성 패키징 소재로 주목받고 있다. 특히, 고투명성과 내화학성을 갖추어 화장품 용기, 식품 포장재 등 고부가가치 시장에 적용되고 있으며, chemical recycle(CR) 원료의 적용 비율을 점진적으로 확대하는 방향으로 기술 개발이 진행 중이다. 본 발표에서는 ECOZEN Claro의 물성, 재활용 적합성, CR 함량 확대 전략 및 주요 적용 사례를 중심으로 SK케미칼의 지속가능 소재 개발 방향을 소개한다.



문정미(SK케미칼)

서울대학교 바이오소재공학 (2003-2008)

서울대학교 바이오소재공학 (2008-2010)

SK케미칼 (2010-현재)

Invited Lecture **1L5-9**

[SK케미칼 특별세션] 플라스틱의 새로운 패러다임: Recyclable, Recycled, and Renewable

2025.9.30(화), 17:40~18:05, 5회장

Chair: 조현준, 김성기

PO3G: Bridging Sustainability and Performance in Polyurethane Chemistry

정재일[†]

SK케미칼

Polyurethanes (PU) rank among the 6th most widely produced polymers globally, owing to their versatile properties and broad applicability across various industries. However, increasing concerns regarding their environmental impact and recyclability have prompted the development of strategies aimed at improving the sustainability of PU materials. Among these approaches, bio-based solutions derived from renewable feedstocks have gained attention as viable alternatives, offering significant reductions in greenhouse gas emissions and enhanced mechanical performance. This study aims to elucidate the unique physicochemical characteristics of the ether-based bio-polyol, polytrimethylene ether glycol (PO3G), and to evaluate its current commercialization status as a sustainable alternative within the polyurethane industry.



정재일(SK케미칼)

건국대학교 신소재공학과(학사) (1995-2003)

광주과학기술원 신소재공학과(석사) (2005-2007)

SK케미칼 화학연구소 (2007-현재)

Invited Lecture **1L6-1**

ACS 에디터에게 듣는 고분자 연구의 비전 (English)

2025.9.30(화), 14:00~14:25, 6회장

Chair: 여현옥,윤동기

South Korea's 2024 Research Focus: Polymers, Chemistry, and Global Publishing Trends

Kee Hyuk Lee[†]

ACS Publications

In 2024, global publication trends in chemistry, materials science, and energy research exhibited dynamic growth and increasing interdisciplinarity. This presentation explores South Korea's expanding role as a global research leader, with a particular emphasis on its contributions to polymer science and related fields. Based on data from ACS Publications and global research databases, South Korea ranks among the top contributors to high-impact publications, especially in catalysis, sustainable energy, and advanced materials. The top 20 chemistry topics from South Korea reveal a strategic shift toward applied research in electrochemistry, nanotechnology, and polymer-integrated materials. These insights provide a data-driven foundation for shaping national research funding strategies, aligning with global scientific priorities, and reinforcing Korea's leadership in polymer and materials innovation.



Kee Hyuk Lee(ACS Publications)

Asia Engineering Representative, Elsevier (2014)

Contents Development Editor, ACS Publications (2023-Present)

Invited Lecture **1L6-2**

ACS 에디터에게 듣는 고분자 연구의 비전 (English)

2025.9.30(화), 14:25~14:50, 6회장

Chair: 여현옥,윤동기

High-Throughput Catalyst Design Using Carbon Nanofibers

김일두[†]

KAIST

Electrospinning, a powerful technique for nanomaterial fabrication, plays a critical role in the advancement of next-generation materials and devices. Through precise nanomaterial engineering, we can significantly enhance performance, particularly in environments that demand exceptional mechanical stability and efficiency. Recent breakthroughs have centered on the creation of advanced composite materials, including high-entropy and multi-elemental nanoparticles, and the integration of stable single-atom catalysts onto robust nanostructured supports. These innovations are critical for a wide range of applications, from chemical sensing to energy storage and conversion technologies such as lithium-air batteries, water splitting, and CO₂ reduction. The design of highly efficient catalysts is pivotal to these advancements, requiring materials that resist agglomeration, maintain high thermal stability, and deliver superior performance with minimal catalyst loading. This invited presentation will delve into the diverse applications of nanostructured supports, including metal oxides and carbon fibers, optimized for the stable immobilization of catalysts. Additionally, the discussion will cover the journey from laboratory research to commercialization, highlighted by the development of custom electrospinning equipment and roll-to-roll manufacturing processes.



김일두(KAIST)

B.S., Hanyang University (1997)

Ph.D., KAIST (2002)

Post-Doc., MIT (2005)

Senior Research Scientist, KIST (2011)

Professor, KAIST (2011-Present)

Invited Lecture **1L6-3**

ACS 에디터에게 듣는 고분자 연구의 비전 (English)

2025.9.30(화), 14:50~15:15, 6회장

Chair: 여현옥,윤동기

Molecular Weight and Distribution Dependency of Crystallization and Mechanical Properties in Polypropylene

Ying Lu, Dong Lyu, Yongfeng Men[†]

Changchun Institute of Applied Chemistry (CIAC), Chinese Academy of Science

We investigated the crystallization kinetics and large strain network failure behavior in polypropylenes of different molecular weight and distribution. It turns out that the kinetics of the crystallization in polypropylene strongly rely on the number average molecular weight. The ratio between the radius of gyration of the molecular chain coil and the long spacing of the crystalline lamellae is found to be a key factor that determines the crystallization kinetics. Furthermore, the critical stress that initiates the failure of the oriented network during stretching to a large deformation beyond strain hardening was found to scale with the weight average molecular weight. The results thus provide promising possibilities to design polypropylene materials via tuning molecular weight and distribution.



Yongfeng Men(Changchun Institute of Applied Chemistry (CIAC), Chinese Academy of Science)

B.A., Southeast Uni. Nanjing, China (1995)

M.S., CIAC, China (1998)

Ph.D., Univ. of Freiburg, Germany (2001)

Post-Doc. & Physicist, BASF AG, Germany (2005)

Professor, CIAC, China (2005-Present)

Director, State Key Laboratory of Polymer Science and Technology, China (2025-Present)

Invited Lecture **1L6-4**

ACS 에디터에게 듣는 고분자 연구의 비전 (English)

2025.9.30(화), 15:15~15:40, 6회장

Chair: 여현옥,윤동기

Cationic Polymers as Antibacterial Agents and RNA Carriers

Mary B. Chan-Park[†]

Nanyang Technological University

Cationic Polymers can be dangerous but they are needed for various biomedical applications. Here we introduce a new kind of cationic polymers that form N-heterocyclic carbene that aids translocation across membranes. Unlike traditional antibiotics or AMPs, Oilgoimidazoliums (OIMs) do not cause membrane lysis. Using biochemical and biophysical assays, we demonstrate that carbene formation facilitates a hydrophobic shift in OIMs which are rather hydrophilic with multiple positive charges, enabling them to traverse bacterial membranes and target intracellular DNA. These findings underscore the importance of carbene-mediated internalization as a distinguishing feature of OIMs. We demonstrate the applicability a wide range of polyimidazoliums and OIMs as antibacterial agents.



Mary B. Chan-Park(Nanyang Technological University)

B.Eng., National University of Singapore (1986)

Ph.D., MIT (1993)

Post-Doc., MIT (1993)

Professor, NTU (2001-Present)

Invited Lecture **1L6-5**

ACS 에디터에게 듣는 고분자 연구의 비전 (English)

2025.9.30(화), 16:00~16:25, 6회장

Chair: 여현옥,윤동기

Dynamic Nanostructures through Self-Assembly of Functional Polymers and Nanoparticles

박소정[†]

이화여자대학교

The self-assembly of nanoscale building blocks into complex nanostructures with controlled structural anisotropy can open up new opportunities for realizing active nanomaterials exhibiting spatiotemporal structural transformations. Here, we adopt a combination of bottom-up DNA-directed self-assembly and top-down photothermal patterning to fabricate free-standing nanoparticle films with vertical and lateral heterogeneity. This approach involves the construction of multi-component plasmonic nanoparticle films by DNA-directed layer-by-layer (LbL) self-assembly, followed by on-demand lateral patterning by the direct photothermal writing method. The distinct plasmonic properties of metal nanoparticles constituting the multi-domain films enable photopatterning in a selective domain with precisely controlled vertical depths. The photopatterned films exhibit complex morphing actions instructed by the lateral and vertical patterns inscribed in the film as well as the information carried in DNA.



박소정(이화여자대학교)

B.S. Ewha Womans University, Korea (1994)

M.S. Ewha Womans University, Korea (1996)

Ph.D. Northwestern University, USA (2002)

Post-Doc. University of Texas at Austin, USA (2002-2005)

Assistant/Associate Professor, University of Pennsylvania, USA (2005-2013)

Professor, Ewha Womans University, Korea (2013-Present)

Invited Lecture **1L6-6**

ACS 에디터에게 듣는 고분자 연구의 비전 (English)

2025.9.30(화), 16:25~16:50, 6회장

Chair: 여현옥,윤동기

Synthesis of Glycopolymers by the Controlled Polymerization and Design of Molecular Recognition

Yoshiko Miura[†], Masanori Nagao

Kyushu University

Biopolymers such as proteins, nucleic acids, and polysaccharides have precise structures and exhibit diverse and excellent functions. A key function of a biopolymer is molecular recognition, which governs complex biological phenomena. Biomolecular recognition relies on the multivalent effect, in which multiple functional groups interact simultaneously. The interaction between physiologically active saccharides and sugar recognition proteins is known to significantly enhance the multivalent effect, and the molecular recognition ability of glyco-clusters, which aggregate glycans, strongly exhibits the multivalent effect. As one type of glycocluster, glycopolymers with saccharides attached to their side chains exhibit strong molecular recognition ability. We are investigating how to precisely control glycopolymers like biopolymers using controlled radical polymerization via the RDRP method. Polymer design through controlled polymerization can enable the control of molecular recognition with proteins and the development of molecular recognition devices.



Yoshiko Miura(Kyushu University)

B.A., Kyoto University (1995)

Ms of Eng, Kyoto University (1997)

Ph. D, Kyoto University (2000)

Post-Doc, V. Percec, University of Pennsylvania (2000)

Assistant Prof, Nagoya University (2001-2005)

Associate Prof, Japan Advanced Institute of Science and Technology (2005-2010)

Professor, Kyushu University (2010-Present)

Invited Lecture **1L6-7**

ACS 에디터에게 듣는 고분자 연구의 비전 (English)

2025.9.30(화), 16:50~17:15, 6회장

Chair: 여현옥, 윤동기

Controlling the structure of thin films via the self-assembly of block copolymers toward versatile applications

임민혁, 홍영민, 최현호, 김민재, 윤종인, 김승현⁺

인하대학교

Thin films are widely used in various industrial fields due to their tunable properties and ease of integration onto different substrates. Beyond their well-known role in semiconductor processes, thin films are also employed in areas such as optics, energy, surface protection, and biomedical technologies. Among various approaches, the self-assembly block copolymers offer a highly effective strategy for controlling the structure and surface properties of thin films. However, despite their great potential, block copolymer self-assembly also faces several challenges in practical applications. In this work, several strategies to overcome the limitations such as difficulties in controlling hierarchical structures and constraints associated with predominantly two-dimensional planar configurations, including the use of block copolymer blends and solvent orthogonality are introduced.



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B.S. Seoul National University, Korea (1992)

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Ph.D. Seoul National University, Korea (1998)

Post-Doc. U. Mass. Amherst, USA (2005)

Professor, Inha University, Korea (2005-Present)

Editor-in-Chief, Macromolecular Research (2025-Present)

Invited Lecture **1L7-1**

[과기정통부 특별세션] 나노 및 소재 기술 R&D 정책 및 연구성과 교류

2025.9.30(화), 14:00~14:30, 7회장 (104호)

Chair: 임종철, 손창윤

나노 및 소재분야 정부 R&D 추진방향

윤성철[†]

한국연구재단 나노·소재단

나노 및 소재 기술 분야 정부 R&D 추진방향을 소개합니다.



윤성철(한국연구재단 나노·소재단)

한양대학교 공업화학과(공학사) (1992)

서울대학교 화학과(이학석사) (1994)

서울대학교 화학과(이학박사) (1997)

삼성토탈 연구소(선임연구원) (1997-2001)

LG전자기술원(책임연구원) (2001-2004)

한국화학연구원 선임/책임연구원 (2004-현재)

한국화학연구원 화학소재연구본부장 (2019-2023)

한국연구재단 나노·소재단장 (2024-현재)

Invited Lecture **1L7-2**

[과기정통부 특별세션] 나노 및 소재 기술 R&D 정책 및 연구성과 교류

2025.9.30(화), 14:30~15:00, 7회장

Chair: 임종철, 손창윤

인공지능 및 분자 시뮬레이션 활용 수소센서/디스플레이 소재 개발

손창윤⁺

서울대학교

고분자 및 연성 소재를 기반으로 한 첨단 수소센서와 디스플레이 소재 연구는 국가 핵심 전략기술의 중요한 축으로, 미래 소재가 지녀야 할 우수한 물리·화학적 특성을 분자 수준에서 논리적으로 설계하고 이를 실험적으로 구현하는 융합적 연구가 필수적으로 요구된다. 특히, 인공지능과 분자 시뮬레이션의 결합을 통해 고도의 물성 예측 능력을 구현하고, 컴퓨터 비전 인공지능을 활용하여 실험 데이터를 신속하고 직관적으로 분석하는 체계는 산업 현장에 직접 적용 가능한 차세대 소재 디자인 및 분석 기술로 각광받고 있다.

본 발표에서는 이러한 맥락에서, 인공지능과 물리법칙을 결합한 분자 시뮬레이션을 통해 화학적 민감도를 극대화한 이온성 유기 액정 기반 센서 소재 개발과 더불어, 인공지능을 이용한 실험 영상의 자동 분석을 통해 현장의 이상 신호를 즉각적으로 탐지·알림할 수 있는 기술을 소개한다. 또한, 유연 디스플레이 소재 개발을 위한 고분자 계면 전기적 복잡성의 예측과 작용기 다양성 설계를 위한 생성형 AI, 나아가 시뮬레이션 궤적의 효과적 샘플링을 가능케 하는 디퓨전 모델 기반 생성형 AI와 자유에너지 계산의 결합을 통한 고분자 구조 변화 메커니즘 규명 사례를 제시한다. 이를 통해, 인공지능과 분자 시뮬레이션의 융합이 나노소재 개발 연구에서 어떻게 실질적 혁신을 견인할 수 있는지 조망하고자 한다.



손창윤(서울대학교)

서울대학교 화학부(학사) (2005)

서울대학교 화학부(석사) (2011)

Univ. of Wisconsin-Madison(박사) (2017)

Caltech (Post-doc) (2017-2019)

포스텍 화학과 조교수 (2020-2024)

서울대 화학부 조교수 (2024-현재)

Invited Lecture **1L7-3**

[과기정통부 특별세션] 나노 및 소재 기술 R&D 정책 및 연구성과 교류

2025.9.30(화), 15:00~15:30, 7회장

Chair: 임종철, 손창윤

Electrostatic Clutches Based on Ionomer Heterojunctions for Low-Voltage Switching of Stiffness and Strength

박세환, 최윤제, 김형준[†]

서강대학교

Electrostatic clutches offer electrically programmable control of system stiffness, providing significant advantages in various robotic and haptic applications. However, conventional dielectric-based electrostatic clutches require high operating voltages, often surpassing several kilovolts, while most low-voltage electro-adhesives are unsuitable for electrostatic clutches due to their intrinsic tackiness, resulting in a low switching ratio and reversibility. Here, an electrostatic clutch based on ionomer heterojunctions on rigid electrodes, encased within soft elastomers, capable of switching the system stiffness more than 530-fold at an operating voltage of just 1 V is presented. Under the reverse bias, the formation of an ionic double layer at the ionomer heterojunction interface enables strong electrostatic adhesion of stiff electrodes at low voltage, yet low tackiness of ionomers allows almost free sliding at the forward bias. The performance of these electrostatic clutches across various geometries and voltages based on the fracture mechanics model is explored. Within this framework, by adjusting the clutch compliance, a force capacity of 50 N cm⁻², powered by a 1.5 V battery with an on/off ratio over 250 is achieved, outperforming the latest electrostatic clutches in operating voltage and switching ratio.



김형준(서강대학교)

KAIST 생명화학공학과 학사 (2011)

KAIST 생명화학공학과 박사 (2017)

UMass Amherst Post-Doc. (2017-2021)

서강대학교 화공생명공학과 조교수 (2021-현재)

Invited Lecture **1L7-4**

[과기정통부 특별세션] 나노 및 소재 기술 R&D 정책 및 연구성과 교류

2025.9.30(화), 15:30~16:00, 7회장

Chair: 임종철, 손창윤

Development of organometallic compound precursors for narrow-bandgap, high-mobility semiconductors based on van der Waals layered materials

임종선⁺, 김창균, 정택모, 송우석, 송다솜

한국화학연구원

Two-dimensional van der Waals layered materials exhibit excellent mechanical and electrical properties. Due to these characteristics, van der Waals layered materials are emerging as key materials for flexible and stretchable semiconductors and displays, as well as flexible sensors that require flexibility and stretchability. However, the current process for growing transition metal chalcogenide thin films using transition metal precursors or chalcogen precursors or powders requires high-temperature processing at around 800 °C, making it difficult to directly process on flexible/stretchable substrates. The present study developed a precursor compound platform for van der Waals layered materials that can be processed at low temperatures to address these issues. We developed new precursors containing desired transition metals and chalcogen elements and conducted application studies on various high-mobility semiconductors and narrow bandgap photodetectors using these precursors.



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서강대학교 물리학과(박사) (2001)

(주)네오뷰코오롱 (2001-2001)

(주)삼성전자 LCD연구소 (2002-2005)

한국화학연구원 (2005-현재)

Invited Lecture **1L7-5**

[과기정통부 특별세션] 나노 및 소재 기술 R&D 정책 및 연구성과 교류

2025.9.30(화), 16:00~16:30, 7회장

Chair: 임종철, 손창윤

From Data to Discovery: ML-Driven Insights into Nanocrystal Formation

정소희[†]

성균관대학교

Unraveling nanocrystal formation is essential for advancing optoelectronic materials, yet reaction pathways remain obscured by transient intermediates and complex chemistry. We present a machine learning framework that integrates transformer-based spectral learning with topological manifold analysis (UMAP) to map reaction pathways directly from raw UV-vis data. Applied to InAs nanocrystals, this approach reveals four distinct growth routes, identifies hidden intermediates, and clarifies how additives dictate pathway selection—establishing direct links between reaction dynamics, nucleation density, and final material properties.

To translate these insights into synthesis, we employ Bayesian optimization to design experimental strategies that directly target high-performing material characteristics. This closed-loop, data-driven workflow moves beyond empirical trial-and-error, offering a scalable paradigm where ML not only uncovers hidden chemistry but also accelerates the rational discovery of advanced nanomaterials.



정소희(성균관대학교)

KAIST 화학과(학사) (1995)

KAIST 화학과(석사) (1997)

University of Michigan 화학과(박사) (2005)

Los Alamos National Lab (Post-Doc) (2005-2006)

한국기계연구원 연구원 (2007-2018)

성균관대학교 에너지학과 교수 (2019-현재)

Invited Lecture **1L8-1**

[GIST 특별세션] New Horizon in Materials and Photonics Research from Scientific Excellence to Industrial Impact

2025.9.30(화), 14:00~14:25, 8회장 (105호)

Chair: 김호범, 박정은

Visualizing and Controlling Molecular Function by Atomic-Scale Spectroscopy: From Single-Molecule Insight to Materials Innovation

김유수[†]

광주과학기술원

Understanding and controlling molecular structure–function relationships at the single-molecule level is essential for designing advanced functional materials. Nanospectroscopy based on the scanning tunneling microscope (STM) accesses electronic and vibrational states with atomic resolution, revealing the origins of optical and electronic functions. We developed an integrated approach combining STM with tip-enhanced Raman spectroscopy, single-molecule photoluminescence, and ultrafast THz-pulse-driven exciton dynamics. These methods allow precise spatial and temporal control of molecular charge and reactivity. Using this platform, we clarified mechanisms of on-surface synthesis, including selective bond formation, C–C coupling vs. C–H activation, and polymerization vs. cyclization. Reaction pathways were steered by chemisorption direction and oxygen species. Our methodologies offer a spectroscopic platform beyond conventional techniques, with implications for molecular photonics and polymer design.



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도쿄대학 응용화학과(박사) (1999)

Chief Scientist, RIKEN (2015-현재)

도쿄대학 응용화학과 교수 (2022-현재)

광주과학기술원 화학과 교수 (2024-현재)

IBS 단장, 양자변환연구단 (2024-현재)

Invited Lecture **1L8-2**

[GIST 특별세션] New Horizon in Materials and Photonics Research from Scientific Excellence to Industrial Impact
2025.9.30(화), 14:25~14:50, 8회장 (105호)

Chair: 김호범, 박정은

Exploring Extreme Science with the CoReLS PW Laser

김경택[†]

광주과학기술원

Modern physics has progressed through the pursuit of understanding extreme conditions—relativity for fast motion, quantum mechanics for small scales, and their unification in quantum electrodynamics (QED). Strong-field QED, which explores particle behavior in ultra-intense electromagnetic fields, remains a frontier in both theory and experiment. At the Center for Relativistic Laser Science (CoReLS), we develop petawatt-class lasers and perform laser-plasma experiments to study high-energy particles and radiation, aiming to probe strong-field QED effects. Despite technological challenges, this research holds promise for revealing new physical phenomena and deepening our understanding of matter and light under extreme electromagnetic conditions.



김경택(광주과학기술원)

가천대학교 물리학과(학사) (1994-2001)

한국과학기술원(KAIST) 물리학과(석사) (2001-2003)

한국과학기술원(KAIST) 물리학과(박사) (2003-2007)

한국과학기술원(KAIST) 물리학과 박사후연구원 (2007-2008)

광주과학기술원(GIST) 고등광기술연구소 선임연구원 (2008-2010)

캐나다 국립과학회 연구위원 (2010-2014)

광주과학기술원(GIST) 물리광학과 교수 (2014-현재)

IBS 상대론적레이저과학연구단 단장 연구단 (2024-현재)

Invited Lecture **1L8-3**

[GIST 특별세션] New Horizon in Materials and Photonics Research from Scientific Excellence to Industrial Impact

2025.9.30(화), 14:50~15:15, 8회장 (105호)

Chair: 김호범, 박정은

Research for "Rule Breaker" Drugs (High molecular weight molecules including antibody drug conjugate)

안진희[†]

광주과학기술원

Recently, there has been growing interest in large-molecule compounds like ADCs (Antibody-Drug Conjugates) in the development of new drugs. The advantage of ADCs lies in their ability to combine the targeting capability of antibodies with the potent cell-killing ability of chemotherapy, while minimizing damage to healthy tissues. This approach holds great promise, especially for cancers that are resistant to traditional treatments. Especially, Enhertu has demonstrated the potential of a new class of ADC drugs. ADCs consist of an antibody, a linker, and a payload. As polymeric substances, ADCs show strong anticancer effects, but improvements are still needed in terms of efficacy, toxicity, and physicochemical properties. This presentation aims to introduce current trends in ongoing research and the specific focus areas of our research group.



안진희(광주과학기술원)

서강대학교 화학과(학사) (1990)

서강대학교 화학과(석사) (1992)

서강대학교 화학과(박사) (1997)

University of California at Berkeley (Post-Doc) (1998-2000)

한국화학연구원 신약연구본부 선임, 책임연구원 (2000-2016)

광주과학기술원 화학과 교수 (2016-현재)

IRC 센터장, AI기반 중대분자 연구단 (2024-현재)

Invited Lecture **1L8-4**

[GIST 특별세션] New Horizon in Materials and Photonics Research from Scientific Excellence to Industrial Impact

2025.9.30(화), 15:15~15:40, 8회장 (105호)

Chair: 김호범, 박정은

Shape and Material-Engineered Plasmonic Nanostructures

정현호⁺

광주과학기술원

Plasmonic nanoparticles and nanostructures, engineered via precise control of material composition and geometry, offer unique optical properties with wide-ranging applications in sensing, imaging, and photonic devices. However, scalable and reliable fabrication remains a challenge for industrial integration. This talk presents two complementary, wafer-scale fabrication approaches: physical shadow growth and electrostatic nanoparticle coating. Shadow growth, a directional vacuum deposition method, enables the creation of diverse 3D nanostructures, from simple spheres to complex chiral and hybrid forms, by using nanoscale shadowing effects. Meanwhile, a proton-assisted electrostatic assembly technique allows rapid transfer of colloidal nanoparticles onto 2-inch wafers, achieving 40% monolayer coverage in just 10 seconds, nearly 100× faster than prior methods. These strategies offer scalable pathways for producing shape- and material-engineered nanostructures, with demonstrated applications in molecular sensing, cellular imaging, optical filtering, and photonic memory. The talk will highlight the fabrication principles and discuss their potential for enabling next-generation photonic systems.



정현호(광주과학기술원)

단국대학교 전자전기공학부 (학사) (2010)

단국대학교 전자전기공학부 (석사) (2011)

Max Planck Institute for Intelligent Systems (박사) (2017)

University of Cambridge, Cavendish Laboratory, 물리학과 (박사후연구원) (2018-2019)

GIST 전기전자컴퓨터공학부 조교수 (2020-2024)

GIST 전기전자컴퓨터공학과 부교수 (2024-현재)

Invited Lecture **1L8-5**

[GIST 특별세션] New Horizon in Materials and Photonics Research from Scientific Excellence to Industrial Impact
2025.9.30(화), 16:00~16:25, 8회장 (105호)

Chair: 김호범, 박정은

Scale-up Science of Electrolytic Cells

이재영[†]

광주과학기술원

At the beginning of the 21st century our world is facing serious problems with regards to environment, climate, energy, raw materials, water and food. All these global problems are seeking scientific solutions, especially from electrochemistry and chemical processes, and in this connection scale-up science of fundamental observations based on reasonable hypothesis is of tremendous importance. In this presentation I shall intend to introduce a number of our electrocatalytic approaches for less power consumption in electrochemical water splitting, carbon dioxide conversion/utilization(e-CCUs), and ammonia synthesis/decomposition applying anion exchange membrane.¹⁻⁵ Considering build-up of ideal interfacial structure to overcome mass-transfer limitation more energy production from alkaline fuel cells and Li-S battery together with AI machine learning will be explained.⁶

References: (1) M. Choi, S. Bae, J. Lee et al., Nat. Catal. 8, 476-486 (2025). (2) S. Bae, J. Lee et al., Chem. Eng. J. 479, 147522 (2024) (3) S. Kang, J. Lee et al., Chem. Eng. J. 499, 156469 (2024). (4) D. Yoon, J. Lee et al., J. Energ. Chem. 93, 352-360 (2024). (5) J. Lee, eSuS Co., Ltd., 2022, www.esus.co.kr. (6) J. Park and J. Lee, Trends Chem. 6, 302-313 (2024).



이재영(광주과학기술원)

인하대학교 화학공학과(학사) (1996)

인하대학교 화학공학과(석사) (1998)

FHI der MPG & FU Berlin 물리화학과(박사) (2001)

RIST/KIST 선임연구원 (2002-2007)

GIST 환경에너지공학과 교수 (2007-현재)

Humboldt Club Korea 회장 (2024-현재)

Invited Lecture **1L8-6**

[GIST 특별세션] New Horizon in Materials and Photonics Research from Scientific Excellence to Industrial Impact

2025.9.30(화), 16:25~16:50, 8회장 (105호)

Chair: 김호범, 박정은

GIST InnoCORE: AI-Nano Convergence Initiative in NDDs

이은지[†]

광주과학기술원

This presentation introduces the hierarchical self-assembly structures of disease-causing proteins and showcases the GIST-InnoCORE research program through peptide self-assembly applications. The AI-ACE team converges artificial intelligence with advanced biotechnology and nanophotonics, pursuing three transformative goals: real-time, high-sensitivity analysis of protein structural changes in neurodegenerative diseases; revolutionary early diagnostic accuracy for degenerative brain disorders; and cultivation of globally distinguished InnoCORE Fellows in AI+S&T convergence research. Our breakthrough "nanoinformatics" platform elegantly integrates artificial peptide polymeric assemblies, cutting-edge nanophotonic devices, and sophisticated AI algorithms to create a universal diagnostic and drug discovery system. By tracking protein conformational transitions from monomers to pathological aggregates, this approach enables non-invasive liquid biopsy diagnostics with profound industrial impact through strategic partnerships and technology transfer. Ultimately, this platform addresses critical societal challenges in our rapidly aging society, offering transformative solutions for healthcare cost reduction.



이은지(광주과학기술원)

연세대학교 화학과 학사 (2002)

연세대학교 화학과 석사 (2005)

연세대학교 화학과 박사 (2009)

서울대학교 화학부 박사후연구원(Post-Doc.) (2009-2010)

University of Massachusetts Amherst 고분자 공학과 박사후 연구원(Post-Doc.) (2010-2011)

충남대학교 분석과학기술대학원 부교수 (2011-2018)

광주과학기술원 신소재공학부 교수 (2018-현재)

광주과학기술원 신진특훈교수 (2024-현재)

이노코어 단장, 뇌질환 조기진단을 위한 AI+나노융합 연구단 (2025-현재)

Invited Lecture **1L8-7**

[GIST 특별세션] New Horizon in Materials and Photonics Research from Scientific Excellence to Industrial Impact
2025.9.30(화), 16:50~17:15, 8회장 (105호)

Chair: 김호범, 박정은

Toward Sustainable Energy Conversion & Storage Systems for the Future Mobility

엄광섭[†]

광주과학기술원

Current energy technologies for future vehicles primarily focus on the development of energy conversion and storage systems with higher power and energy densities, longer cycle lives, and more competitive costs. However, despite extensive efforts, there have been few significant scientific breakthroughs capable of replacing the far more economical fossil fuel engines. Enhancing durability and continuously exploring alternative materials are essential steps toward accelerating the commercialization of advanced energy systems for electric vehicles by extending their operational lifespans and reducing costs. Energy conversion and storage systems, such as batteries and fuel cells, operate based on electrochemical processes, and their degradation is largely attributed to electrochemically induced phenomena occurring during operation. Therefore, a clear and comprehensive understanding of the underlying electrochemical mechanisms is crucial for improving the stability of these systems. This understanding must inform the development of advanced materials and effective mitigation strategies. In this presentation, I will introduce the work conducted by my research group in the field of materials electrochemistry, with a particular emphasis on enhancing the stability and performance of next-generation battery and fuel cell systems for future electric vehicles and aeromobility applications.



엄광섭(광주과학기술원)

KAIST 신소재공학과 학사 (2005)

KAIST 신소재공학과 박사 (2010)

KIST, Fuel Cell Research Center, 박사후연구원 (2010-2012)

Georgia Tech, ChBE, 박사후연구원 (2012-2016)

GIST 신소재공학부 조교수, 부교수 (2016-2023)

GIST 신소재공학부 부학부장 (2021-2023)

GIST 신소재공학과 교수 (2023-현재)

GIST 신진특훈교수 (2024-현재)

Invited Lecture **1L9-1**

Korea-Taiwan Joint Symposium: Bridging Polymer Innovation (English)

2025.9.30(화), 14:00~14:25, 9회장

Chair: 권지언,이원호

Blends of PEO and Spider Silk Proteins for Applications in Solid-State Polymer Electrolytes and CO₂ Separation

Cheng-Hao Liao, Min-Jie Chang, Shih-Huang Tung[†]

National Taiwan University

Spider silk, renowned for its outstanding mechanical properties, is recognized as one of the strongest biomaterials in nature. This study examines the influence of spider silk proteins on the crystallinity, microstructure, and interfacial characteristics of polyethylene oxide (PEO). The findings indicate that these proteins effectively inhibit PEO crystallization, expanding the amorphous phase while significantly enhancing the mechanical properties of PEO. Consequently, PEO/spider silk protein blends emerge as promising candidates for applications such as solid-state polymer electrolytes and CO₂ separation membranes. When employed as solid electrolytes in lithium-metal batteries, the blends exhibit a 35-fold increase in ionic conductivity, a 10-fold improvement in toughness, and a 4-fold enhancement in interfacial adhesion compared to pure PEO-based electrolytes. These improvements result in effective suppression of lithium dendrite formation and yield superior cycling performance in LiFePO₄|Li cell tests at 25 °C. In CO₂ separation applications, the blend membranes demonstrate an increase in CO₂ permeability from 22.6 to 109.5 barrer and an enhancement in CO₂/N₂ selectivity from 45 to 64 relative to pure PEO membranes.



Shih-Huang Tung(National Taiwan University)

B.A., National Taiwan Univ. (1998)

M.A., National Taiwan Univ. (2000)

Ph.D., Univ. of Maryland, College Park, USA (2007)

Post-Doc., Univ. of California, Berkeley, USA (2007-2008)

Professor, National Taiwan Univ. (2008-Present)

Invited Lecture **1L9-2**

Korea-Taiwan Joint Symposium: Bridging Polymer Innovation (English)

2025.9.30(화), 14:25~14:50, 9회장

Chair: 권지언,이원호

Surficial Bonding Zwitterionic Modification for Anti-biofouling Applications

Ying-Nien Chou[†]

National Chung Cheng University

We developed functionalized zwitterionic copolymers with epoxy and aldehyde groups for stable covalent bonding on multiple material surfaces. Poly(GMA-co-SBMA) (PGSM) and poly(GMA-co-SBAA) (PGSA) were synthesized via free radical polymerization, enabling durable modification of chemically inert substrates such as nitrile butadiene rubber, polyamide (PA), polyurethane (PU), and biosensor platforms. To improve process efficiency, we introduced a one-step acid-catalyzed method that directly activates PA and PU surfaces, eliminating the need for conventional two-step pretreatment. This simplified process maintained excellent coating stability and antifouling performance, achieving up to 95% reduction in protein adsorption, substantial improvement in blood compatibility, and over 98% reduction in *E. coli* attachment. Applied to biosensors, PGSA coatings reduced nonspecific binding, enhancing stability and signal-to-noise ratio. The method offers an industrially viable strategy for engineering biocompatible, antifouling surfaces in textiles, medical devices, and biosensors.



Ying-Nien Chou(National Chung Cheng University)

Visiting scholar, University of Washington (2013)

Ph.D., National Cheng Kung University (2016)

Post-Doc., Center of Membrane Technology, CYCU (2017)

Researcher, Industry Technology Research Institute, ITRI (2019)

Assistant Professor, Southern Taiwan University of Science and Technology (2019-2024)

Assistant Professor, National Chung Cheng University (2024-Present)

Invited Lecture **1L9-3**

Korea-Taiwan Joint Symposium: Bridging Polymer Innovation (English)

2025.9.30(화), 14:50~15:15, 9회장

Chair: 권지연,이원호

Dual-Ion Functionalized Composite Polymer Electrolytes for Next-Gen Lithium Batteries

Chen-Tsyrr Lo[†]

National Taiwan University of Science and Technology

Composite polymer electrolytes (CPEs) are key to solid-state batteries. In this work, zwitterion and single-ion structures with varying ratios were incorporated into polymer electrolytes to study ion transport and battery performance. Copolymers with different zwitterion–single-ion contents were synthesized and characterized by ¹H NMR, GPC, EDS, and DSC. Blended with PVDF-HFP, they were electrospun into nanofiber membranes with tailored ion concentrations, analyzed by OM, SEM, TEM, and FTIR. PEO was then infiltrated to form CPEs. Electrochemical tests included ionic conductivity, lithium-ion transference number, Li plating/stripping stability, SEI analysis (SEM, XPS), LSV, and LFP half-cell rate and cycling tests. Results show that adjusting functional ion type and ratio significantly enhances lithium-ion transference and cycling stability, highlighting the potential of functional dual-ion design for next-generation lithium batteries.



Chen-Tsyrr Lo(National Taiwan University of Science and Technology)

B.S. and M.S., Dept. of Chemical and Materials Engineering, Chang Gung University (2011)

Dept. of Chemical Engineering, National Taiwan University (2016)

Assistant Professor, Innovative Flex Course for Frontier Organic Material Systems; Dept.

of Organic Materials Science, Yamagata University, Japan (2016-2018) Assistant

professor, Dept. of Chemical Engineering, Chung Yuan Christian University (2018-2019)

Assistant professor, Dept. of Mater. and Optoelectronic Science, National Sun Yat-Sen University (2019-2022)

Assistant professor, Dept. of Material Science and Engineering, National Taiwan University of Science and Technology (NTUST) (2022-Present)

Deputy chairman, Global Development Engineering Program, NTUST (2025-Present)

Invited Lecture **1L9-4**

Korea-Taiwan Joint Symposium: Bridging Polymer Innovation (English)

2025.9.30(화), 15:15~15:40, 9회장

Chair: 권지연,이원호

Magnetic-Field-Directed Phase Transitions of Block Copolymers

Che-Yi Chu[†], Tzu-Yun Lin, Wen-Sheng Chiu, Ya-Ting You, Chih-Chung Chen, Sheng-Jie Lin, Huang-Min Wang, Ying-Jie Wang, Chun-Jen Su¹, U-Ser Jeng¹

National Chung Hsing University

¹ National Synchrotron Radiation Research Center

We investigated the magnetic-field-directed phase transition to fabricate an oriented double gyroid structure and the relevant lattice distortion of block copolymer/magnetic nanoparticle nanocomposites formed by the polystyrene-b-poly(ethylene oxide) (PS-b-PEO) and magnetic nanoparticles (MNPs) using the small-angle X-ray scattering (SAXS). This transition was driven by sequential generation of 3-fold junctions via the fusion at curved faces of deformed cylindrical segments containing the magnetic-field-guided spatially assembled MNPs. Meanwhile, the occurrence of lattice distortions was deduced to be governed by the preferred growth direction of PEO crystallites, which promoted distortion of the double gyroid cubic lattice.



Che-Yi Chu(National Chung Hsing University)

Natl. Tsing Hua Univ, Taiwan (2011)

Post-Doc, Natl. Tsing Hua Univ, Taiwan (2011-2014)

Asst. Researcher, NSRRC, Taiwan; SANS Beamline Scientist, ANSTO, Australia (2014-2015)

Asst. Professor, Natl. Chung Hsing Univ, Taiwan (2017-2021)

President, Taiwan Neutron Science Society (2022-2024)

Assoc. Professor, Natl. Chung Hsing Univ, Taiwan (2021-Present)

Invited Lecture **1L9-5**

Korea-Taiwan Joint Symposium: Bridging Polymer Innovation (English)

2025.9.30(화), 15:40~16:05, 9회장

Chair: 권지언,이원호

Photo-patternable Photomemory for Logic Gate Application

Jung-Yao Chen[†]

National Cheng Kung University

Photonic integrated circuits (PICs), which integrate various photonic components, are promising for high-speed, high-capacity, and low-thermal-effect data communication systems. The exploration of photonic components such as LEDs, image sensors, opto-couplers, photodiodes, and non-volatile flash photomemory is critical, especially the latter, as it serves as a fundamental building block for modern big data storage. However, the mechanisms behind photo-recording remain underexplored, and there is little discussion on selecting photoactive materials for ultrafast photo-programming. This talk will address these challenges and discuss strategies for realizing ultrafast photo-programming in photomemory. Furthermore, as the importance of machine learning continues to grow, in-memory computation emerges as a promising approach, especially for data-intensive tasks like machine learning. Unlike the conventional von Neumann architecture, which separates processing and storage process, in-memory computation offers advantages by enhancing data access speed, reducing energy consumption, and improving overall efficiency. However, the development of organic photo-controllable logic-in-memory remains rare due to challenges such as solubility issues for film stacking and the immaturity of photo-recordable devices. In this talk, the strategies to realizing all solution-processable and photo-programmable inverter will be discussed as well.



Jung-Yao Chen(National Cheng Kung University)

Ph.D., National Taiwan University (2016)

Post-Doc., National Taiwan University (2016-2018)

Assistant Professor, National Chung Cheng University (2018-2021)

Assistant Professor, National Cheng Kung University, Taiwan (2021-2023)

Associate Professor, Department of Photonics, National Cheng Kung University (2023-Present)

Invited Lecture **1L9-6**

Korea-Taiwan Joint Symposium: Bridging Polymer Innovation (English)

2025.9.30(화), 16:20~16:45, 9회장

Chair: 권지언,이원호

Radiative Cooling based on Polymers

김진홍⁺

한국과학기술연구원

In response to growing concerns over global warming, there has been an increasing demand for new eco-friendly and sustainable cooling technologies that can reduce energy consumption and greenhouse gas emission associated with traditional active cooling technology. Passive daytime radiative cooling (PDRC) has emerged as a promising zero-energy cooling strategy that works by reflecting solar light (0.3-2.5 μm) and emitting infrared radiation to outer space through the atmospheric window (8-13 μm). In this presentation, I will suggest molecular design strategy for polymer based PDRC materials. After then, I will show the highly solar reflective PDRC paint based on dual-scatter perfluoropolymer nanocomposite.



김진홍(한국과학기술연구원)

서울대학교 재료공학부 (학사) (2011)

서울대학교 재료공학부 (석/박사) (2019)

서울대학교 재료공학부 (Post-Doc) (2019-2020)

튀르츠부르크대학교 (Post-Doc) (2020-2022)

한국과학기술연구원 선임연구원 (2022-현재)

Invited Lecture **1L9-7**

Korea-Taiwan Joint Symposium: Bridging Polymer Innovation (English)

2025.9.30(화), 16:45~17:10, 9회장

Chair: 권지언,이원호

Polymer Redox Booster Design for Intra –Intermolecular Charge Transfer in Electrochemical Energy Storage System.

노주란[†]

상명대학교

Li-S batteries offer high energy density in terms of both volume and cost. However, their practical application is still hindered by slow reaction kinetics during the liquid–solid conversion processes. Thus, electrocatalysts play a critical role by reducing the activation energy for electrochemical reactions. A design challenge for electrocatalysts is it must simultaneously possess ion-philic polarity to attract polysulfide and electron-philic conductivity to facilitate electron transfer. In this presentation, we propose a strategy to design redox-mediating polymers by leveraging materials informatics for screening reduction potentials, along with DFT-based structural analysis. In results, we developed anthracenequinone-based polymer redox mediators that significantly enhance the energy density of Li–S batteries. This work demonstrates a rational design strategy for polymeric redox boosters that efficiently mediate ion and electron transport.



노주란(상명대학교)

중앙대학교 화학신소재공학 학사 (2011-2015)

중앙대학교 화학신소재공학 석사 (2015-2017)

Texas A& M University PhD in MSEN (2018-2022)

Pacific Northwest National Lab. Postdoc. (2022-2023)

LG 에너지솔루션 책임연구원 (2023-2025)

상명대학교 화공신소재전공 조교수 (2025)

Invited Lecture **1L9-8**

Korea-Taiwan Joint Symposium: Bridging Polymer Innovation (English)

2025.9.30(화), 17:10~17:35, 9회장

Chair: 권지언,이원호

Selective Dispersion of Semiconducting SWNTs via Conjugated Polymers for Electronic Device Applications

이승훈[†]

공주대학교

This talk presents two studies utilizing conjugated polymers for organic and nanotube-based electronics. First, we achieved high-purity semiconducting SWNTs via selective dispersion using polyfluorene derivatives. Optimized processing enabled high-performance transistors with mobilities up to $43.6 \text{ cm}^2/\text{V}\cdot\text{s}$ and ON/OFF ratios over 10^4 .

Second, we investigated dark current suppression in organic photodetectors using fluorinated polymers. Analysis of energetic disorder and Urbach energy revealed that improved molecular ordering reduced trap-assisted recombination, enabling low dark current while maintaining high quantum efficiency.

These results demonstrate how conjugated polymers can be applied both in nanomaterial sorting and in improving device performance.



이승훈(공주대학교)

송실대학교 유기신소재파이버공학 (2003-2010)

광주과학기술원 광공학응용물리 (2010-2012)

광주과학기술원 나노바이오재료전자공 (2012-2016)

한국화학연구원 연구원 (2017-2023)

공주대학교 신소재공학부 부교수 (2023-현재)

Invited Lecture **1L9-9**

Korea-Taiwan Joint Symposium: Bridging Polymer Innovation (English)

2025.9.30(화), 17:35~18:00, 9회장

Chair: 권지언,이원호

Integration of Conductive Polymers in Quantum Dot and Perovskite Photovoltaics

최종민[†]

대구경북과학기술원

This presentation explores the integration of conductive polymers into quantum dot (QD) and metal-halide perovskite solar cells to address challenges in charge extraction, interfacial defects, and device instability. Conjugated polymers are introduced as effective hole transport materials (HTMs) and interfacial modifiers, offering advantages such as tunable energy level alignment, dopant chelation, and morphological compatibility. These features help suppress interfacial recombination and enhance charge selectivity. To illustrate these concepts, I will present examples of ambipolar conductive polymer-integrated perovskite solar cells and dopant-chelating conductive polymer-integrated QD solar cells, both of which demonstrate improved device performance and stability.



최종민(대구경북과학기술원)

포항공과대학교 화학공학과 (학사) (2010)

포항공과대학교 화학공학과 (박사) (2016)

University of Toronto 박사후연구원 (2016-2018)

대구경북과학기술원 부교수 (2018-현재)

가헌신도재단 특훈교수 (2024-현재)

Invited Lecture **1L10-1**

탄소융복합소재 특별세션: 매트릭스 설계부터 부품까지

2025.9.30(화), 14:00~14:25, 10회장

Chair: 박태훈, 정용채

Multi-Modal Tactile Sensors Based on Design-Optimized Carbon Nanocomposites

박영빈[†], 정창윤¹

울산과학기술원

¹ 영남대학교

Tactile sensors for wearable applications, e.g., electronic skins, robotic manipulators, etc., often require multi-modal sensing ability that enables combinations of pressure, shear, and bending stress/strain measurements. Carbon nanomaterials (CNMs) and CNM-derived polymer composites offer a high degree of freedom for sensor design and performance tunability. This paper presents recent studies on CNM-based, multi-modal tactile sensors, namely: (1) pressure-shear multi-modal sensor based on carbon nanocomposite pillar arrays; (2) multi-layered, micro-patterned nanocomposite pressure sensor with modulus gradient for wide-range sensitivity; and (3) bio-inspired, carbon nanotube(CNT)-coated hexagonal micro-columnar arrays with interlocking structure for pressure, shear and bending sensing.



박영빈(울산과학기술원)

서울대학교 기계설계학과(학사) (1995)

서울대학교 기계설계학과(석사) (1997)

Georgia Tech 기계공학과(박사) (2003)

Georgia Tech 섬유고분자공학과(Post-Doc.) (2003-2004)

Florida A&M University 산업공학과 조교수 (2004-2007)

UNIST 기계공학과 조교수, 부교수, 교수 (2009-현재)

UNIST 복합재료기술연구센터 센터장 (2016-현재)

Invited Lecture **1L10-2**

탄소융복합소재 특별세션: 매트릭스 설계부터 부품까지

2025.9.30(화), 14:25~14:45, 10회장

Chair: 박태훈, 정용채

Development of functional artificial muscle based on carbon composite structures

김인호⁺

성균관대학교

Artificial muscles are key to next-generation robotics that emulate the complex motions of living organisms. For real-world use, they must achieve a balance of high strain, stress, energy density, and mechanical durability. We present muscle-inspired actuator fibers and bundles that deliver strong, reversible contraction. These systems leverage exfoliated graphene fillers embedded in a uniaxially aligned liquid crystalline matrix to enable fast, photothermal actuation with high work capacity. Notably, thermally driven structural transitions induce reversible graphene percolation, allowing real-time electrical monitoring of actuation. This dynamic network also enhances mechanical strength, especially during contraction, supporting stable, muscle-like performance. The compliant fiber design allows easy bundling and integration into light-responsive soft robotic systems for high-power, wireless operation.



김인호(성균관대학교)

서강대학교 화학과, 바이오융합 (학사) (2010-2014)

서강대학교 화학과 (석사) (2014-2016)

한국과학기술원 신소재공학과 (박사) (2016-2020)

Caltech, Medical Engineering (Post-Doc.) (2021-2025)

성균관대학교 화학과 조교수 (2025-현재)

Invited Lecture **1L10-3**

탄소융복합소재 특별세션: 매트릭스 설계부터 부품까지

2025.9.30(화), 14:45~15:10, 10회장

Chair: 박태훈, 정용채

탄소섬유 제조공정기술과 섬유-매트릭스 계면접착력 제어

한문희[†]

한국탄소산업진흥원

탄소섬유는 우수한 기계적 강도와 낮은 밀도를 바탕으로 항공우주, 모빌리티, 에너지 등 다양한 분야에서 핵심 구조재로 활용되고 있다. 본 발표에서는 PAN계 탄소섬유를 중심으로 방사부터 안정화, 탄화 및 후공정에 이르는 제조 공정 전반을 소개하고, 각 공정 단계가 섬유의 물성에 미치는 영향을 살펴본다. 아울러 고분자 매트릭스 수지와와의 복합화에 있어서 중요한 계면접착력 향상을 위한 표면처리 기술 및 사이징 처리를 통한 화학적/물리적 결합력 제어 방안을 고찰한다. 본 발표는 탄소섬유 기반 복합재의 성능최적화를 위한 공정기술 및 계면설계의 방향성을 제시하고자 한다.



한문희(한국탄소산업진흥원)

서울대학교 재료공학부(학사) (2002)

서울대학교 재료공학부(박사 수료) (2005)

효성 (2005-2019)

한국탄소산업진흥원 수석연구원 (2020-현재)

Invited Lecture **1L10-4**

탄소융복합소재 특별세션: 매트릭스 설계부터 부품까지

2025.9.30(화), 15:10~15:35, 10회장

Chair: 박태훈, 정용채

Closed-Loop 4D Printing of Multi-Functional Sulfur-Rich Polymer Composites for Modular Intelligent Soft Systems

김동균[†]

한국화학연구원

As demand for multi-functionality and recyclability grows in advanced manufacturing and soft robotics, closed-loop 4D printable polymer systems are gaining attention. We present a sustainable 4D printing strategy using sulfur-rich composites derived from industrial waste sulfur. Tailored poly(phenylene polysulfide) networks (PSNs) and their magnetic composites with Fe_3O_4 or CrO_2 enable hot-melt extrusion through dynamic S-S bond exchange and shear-thinning behavior. The printed structures allow modular assembly, shape-morphing, and recyclability. Notably, PSN- CrO_2 composites exhibit light-tunable magnetic behavior via Curie transition-based demagnetization under NIR irradiation. Using these materials, we built autonomous soft robotic systems with light- and magnetically controlled locomotion, and an MPSN-based stirring bar for on-demand catalyst release. This work highlights the promise of sulfur-based composites for intelligent soft systems.



김동균(한국화학연구원)

서울대학교 화학생물공학부(학사) (2008)

서울대학교 화학생물공학부(박사) (2014)

Princeton University 화학생물공학과(Post-Doc) (2014-2015)

한국화학연구원 화학소재연구본부 선임연구원 (2015-2022)

과학기술연합대학원대학교 KRICT스쿨 부교수 (2021-현재)

한국화학연구원 화학소재연구본부 책임연구원 (2023-현재)

Invited Lecture **1L10-5**

탄소융복합소재 특별세션: 매트릭스 설계부터 부품까지

2025.9.30(화), 16:00~16:25, 10회장

Chair: 박태훈, 정용채

Studies on Energy Dissipation Characteristics of Viscoelastic Materials for Impact Applications

전승렬[†]

한국과학기술연구원

Phase transition-induced mechanical dissipation allows materials to absorb impact energy without permanent damage, based on their structural and mechanical properties. Specifically, viscoelastic materials with high loss factors are promising for applications like ballistic protection and crash absorbers. This presentation introduces three composite systems using such dissipation. First, a liquid crystal elastomer (LCE)-based fiber composite achieves a damping coefficient two orders of magnitude higher than typical composites, via the combined effects of LCE dissipation and composite damage. Second, strain rate-dependent stiffening in boric acid-based polymer gels is tuned through nanomaterial hybridization to meet low-velocity automotive impact demands. Lastly, a method is presented in which polymers, though not viscoelastic, generate hybrid supraparticles under high-speed nanoparticle impacts, enabled by and impact-induced phase transition from local thermal degradation.



전승렬(한국과학기술연구원)

서울대학교 재료공학부 (학사) (2004-2008)

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한국과학기술연구원 선임연구원 (2020-현재)

Invited Lecture **1L10-6**

탄소융복합소재 특별세션: 매트릭스 설계부터 부품까지

2025.9.30(화), 16:25~16:50, 10회장

Chair: 박태훈, 정용채

다중양자 핵자기공명을 이용한 탄성체 가교밀도 정량분석

정재우[†]

송실대학교

타이어는 차량의 주행, 출발, 제동 과정에서 연비에 큰 영향을 미치는 요소 중 하나이며, 타이어에 사용되는 엘라스토머는 부위별 요구 특성에 따라 서로 다른 물성을 가지도록 설계된다. 이들 물성에 가장 큰 영향을 미치는 요소는 가교밀도이며, 이는 가황 공정 배합비와 조건에 따라 결정된다. 따라서 타이어 각 부위의 요구 특성을 명확히 이해하고, 가황된 엘라스토머의 물성을 정밀하게 분석 및 제어하는 것은 연비 향상에 필수적이다.

기존 가교밀도 측정 방법 중에서는 팽윤법이 가장 간편하고 널리 사용되고 있으나, 분석에 시간이 오래 걸리고 오차가 크다는 단점이 있다. 본 연구에서는 엘라스토머의 가교밀도를 보다 신속하고 정량적으로 분석할 수 있는 다중양자 핵자기공명분광법(MQ-NMR)을 소개하고, 이 방법을 기존의 전통적인 가교밀도 분석법과 비교하고자 한다. 이를 통해 MQ-NMR의 정밀도 및 효율성을 검증하고, 향후 타이어 소재 설계에 있어 효과적인 가교밀도 제어 방안을 제시하고자 한다.



정재우(송실대학교)

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서울대학교 재료공학부 (박사) (2003-2008)

프린스턴대학교 화학생물공학부 (박사후연구원) (2009-2012)

KIST 탄소융합연구센터 (선임연구원) (2012-2013)

송실대학교 신소재공학과 (교수) (2013-현재)

Invited Lecture **1L10-7**

탄소융복합소재 특별세션: 매트릭스 설계부터 부품까지

2025.9.30(화), 16:50~17:15, 10회장

Chair: 박태훈, 정용채

지속가능 풍력발전을 위한 복합재료용 에폭시 수지 재활용 플랫폼 기술개발

김민영[†], 김원엽, 허진욱, 이권윤, 이가영, 김재원

(주)국도화학주식회사

풍력발전 블레이드는 대부분 에폭시 수지를 기지재로 사용하는 섬유강화복합재료 구성되어 있으며, 그 사용 수명 종료 후 처리 문제는 환경 및 자원 측면에서 심각한 도전 과제로 인식되고 있다. 본 연구는 사용 완료된 풍력 블레이드로부터 에폭시계 고분자를 화학적으로 분해하여 Bisphenol A 등 주요 단량체 수준으로 회수하고, 이의 순도 향상 및 재활용 가능성을 평가하고자 한다. 또한, 본 연구는 열경화성 수지의 구조적 한계를 극복하고 재가공성을 부여하기 위한 대안으로 비트리머(Vitrimer) 기반 신규 에폭시 수지 시스템을 설계하고자 한다. 이 수지는 동적 공유결합(Dynamic Covalent Bonding) 메커니즘을 기반으로 하여 높은 열적 안정성과 가공 중 재형성 능력을 동시에 가지며, 자원 순환 및 수지 재활용을 가능하게 할 것이다. 개발된 수지는 Pilot scale 수준에서 합성 및 가공 테스트가 수행할 예정이며, 기계적 물성, 유리전이온도, 점도 특성 등을 중심으로 기존 수지와 성능 비교 평가를 통해 풍력발전기 블레이드에서의 적용 가능성을 확인할 것이다.

본 연구는 에폭시계 복합재의 순환경제적 전환을 위한 기술적 기반을 제시함과 동시에, 대형 구조물 재활용을 위한 실질적 수지 시스템의 방향성을 제시할 것을 목표로 수행될 예정이다.

이 연구는 2025년도 산업통상자원부 및 산업기술기획평가원(KEIT) 연구비 지원에 의한 연구임(국가과제번호 RS-2025-25447226, '지속가능 풍력발전을 위한 복합재료용 에폭시 수지 재활용 플랫폼 기술 개발')



김민영(주)국도화학주식회사

부산대학교 화학공학과(학사) (1996)

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Invited Lecture **1L10-8**

탄소융복합소재 특별세션: 매트릭스 설계부터 부품까지

2025.9.30(화), 17:15~17:40, 10회장

Chair: 박태훈, 정용채

자동차용 복합재료 자동적층 기술 소개 및 개발 전략

박상윤[†], 이동욱, 황경정

현대자동차

자동차 산업에서 경량화 및 소재 고급화에 대한 기술 니즈가 증대됨에 따라 그 효과가 큰 차체 외판(루프, 후드 등) 및 샤시 부품에 복합재료 적용을 위한 연구가 완성차를 중심으로 활발히 진행되고 있다. 또한 Purpose Built Vehicle, Air Mobility 그리고 Robotics 등 다양한 미래 모빌리티 산업들이 출현함에 따라 소량·다품종 부품에 적합한 복합재료 설계/재료/해석 그리고 생산기술에 대한 기술 니즈가 증대되고 있다. 일반적으로 복합재료는 금속재료 대비 높은 소재 가격 및 낮은 생산성(Cycle-Time)으로 인한 "경제성 문제"와 "품질 안정화 문제" 등을 해결해야 한다. 이를 위해 최근 유럽 내 자동차 산/학/연을 중심으로 차세대 복합재료 제조 기술 경쟁력 확보를 위해 많은 연구가 진행되고 있으며, 최근 소량·다품종 생산에 적합한 자동적층(Automated Fiber Placement) 기술을 적용, 복합재료 생산 품목 다원화 및 확대를 위한 연구가 활발히 진행되고 있다. 이를 통해 기존 단일 품목, 대량 생산에 적합한 HP-RTM 전용 Preform 센터 대비 자동적층은 (1) 장비/시설 투자비 절감, (2) 데이터 기반 생산 공정 관리 그리고 (3) 적층 품질 개선 및 Cycle-Time 단축에도 유리한 것으로 알려져 있다. 이를 바탕으로 본 발표에서는 차량 및 미래 모빌리티용 복합재료 기술 대응을 위한 자동적층 기술 개발 사례 및 향후 계획에 대해 소개하고자 한다.



박상윤(현대자동차)

한국항공대학교 항공기계공학부 (학사) (2001)

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한국항공대학교 항공재료공학과 (박사) (2010)

대한항공 R&D Center (2011)

현대자동차 기초소재연구센터 (2014-현재)

Invited Lecture **1L11-1**

분자전자 부문위원회 I

2025.9.30(화), 14:00~14:25, 11회장

Chair: 나석인, 정승준

Alkaline water-splitting textile electrodes using interfacial interaction-mediated assembly

조진한⁺, 모정민¹, 김혜민¹

고려대학교

¹ 고려대학교 화공생명공학과

Growing concerns over global warming, pollution, and energy shortages have intensified the demand for clean, renewable energy sources to replace fossil fuels. Among them, hydrogen (H₂) from water electrolysis stands out due to its eco-friendliness and high energy density. However, its production is limited by the poor durability and low catalytic performance of HER and OER electrodes. In this study, we report high-performance HER and OER electrodes that exhibit low overpotentials and outstanding operational stability even at a high current density of 2,000 mA cm⁻². These electrodes are fabricated using interfacial interaction-mediated, nonnoble electrocatalytic components—without the need for noble metals or thermal treatments.



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POSTECH 화학공학과 (학사) (1991-1995)

POSTECH 화학공학과 (석사) (1995-1997)

서울대학교 화학공학과 (박사) (1997-2001)

막스플랑크 및 멜번대학교 (포닥) (2001-2003)

국민대학교 신소재공학부 (조교수) (2006-2010)

고려대학교 화공생명공학과 (교수) (2010-현재)

Invited Lecture **1L11-2**

분자전자 부문위원회 I

2025.9.30(화), 14:25~14:50, 11회장

Chair: 나석인, 정승준

Design of Photoactive Materials for Intrinsically-Stretchable Polymer Solar Cells

김범준[†]

한국과학기술원

Considering the technical standards (e.g., mechanical robustness) required for wearable electronics, which are promising application platforms for organic solar cells, the development of fully stretchable OSCs (f-SOSCs) should be accelerated. First, the mechanical requirements of f-SOSCs, in terms of tensile and cohesion/adhesion properties, are summarized along with the experimental methods to evaluate those properties. Second, important studies to make each layer of f-SOSCs stretchable and efficient are discussed, emphasizing strategies to simultaneously enhance the photovoltaic and mechanical properties of the active layer. For example, I present material design strategies to enhance the mechanical robustness of the PSCs; i) incorporating a high-molecular weight polymer acceptor as an electro-active additive into binary blends, ii) design of hydrogen-bonding incorporated polymers, and iii) design of block copolymerized electroactive polymers.



김범준(한국과학기술원)

UCSB 화학공학과(박사) (2006)

UC Berkeley (Post-Doc.) (2008)

KAIST 생명화학공학과 조교수, 부교수, 교수 (2008-현재)

KAIST지정 석좌교수 (2018)

Georgia Tech 방문교수 (2019)

KAIST 생명화학공학과 학과장 (2021-2025)

Invited Lecture **1L11-3**

분자전자 부문위원회 I

2025.9.30(화), 14:50~15:15, 11회장

Chair: 나석인, 정승준

Non-Volatile Solid Additives for High-Efficient Eco-Friendly Organic Photovoltaic Cells

조신욱[†]

울산대학교

While most eco-friendly OPV developments have focused on replacing solvents in the photoactive layer with benign alternatives, reliance on harmful additives for morphology modulation remains a major obstacle to achieving fully sustainable OPVs. This study presents the example of a fully eco-friendly OPV, achieved by incorporating novel, non-volatile, eco-friendly solid additives, 4,4'-dihydroxybiphenyl (DBP), in combination with the eco-friendly solvent o-xylene. DBP demonstrates the highest performance and long-term stability due to its superior miscibility and higher boiling point, achieving a PCE of 17.78%. Enhanced crystallinity and optimal phase separation morphology within the photoactive layer by DBP contribute to improvements in charge transfer, mobility, and device stability. This development marks a significant step toward the commercialization of sustainable OPVs, meeting the dual objectives of high efficiency and environmental compatibility.



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부산대학교 물리학과 (박사) (2001-2006)

Univ. of California at Santa Barbara (Post-Doc.) (2006-2010)

울산대학교 물리학과 교수 (2010-현재)

Invited Lecture **1L11-4**

분자전자 부문위원회 I

2025.9.30(화), 15:15~15:40, 11회장

Chair: 나석인, 정승준

Ionomers in PEMFC Catalyst Layers: Molecular Dynamics Simulation Approaches

이승걸[†]

울산과학기술원

This presentation introduces a study employing molecular dynamics (MD) simulations to investigate the design and key behaviors of ionomers in the catalyst layers of proton exchange membrane fuel cells (PEMFCs). Focusing on MD simulations and integrating various multiscale computational approaches, including density functional theory (DFT), we examined how factors such as ionomer molecular structure, solvent environment, and nanomaterials influence mass transport properties like proton conductivity and oxygen permeability. In addition, we present results on the oxygen permeability characteristics of high oxygen-permeable ionomers (HOPIs) with different molecular structures. These findings provide fundamental design principles for the development of high-performance and durable fuel cell materials, and are expected to contribute to advancements in next-generation mobility and hydrogen energy technologies.

Acknowledgement: This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (Ministry of Science and ICT, MSIT) (No. RS-2025-02315340).



이승걸(울산과학기술원)

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Caltech 화학·화공학부 (Post-Doc) (2011-2012)

국방과학연구소 선임연구원 (2012-2013)

부산대학교 유기신소재공학과 교수 (2013-2024)

울산과학기술원 신소재공학과 교수 (2024-현재)

울산과학기술원 반도체소재부품대학원 겸임교수 (2025-현재)

Invited Lecture **1L11-5**

분자전자 부문위원회 I

2025.9.30(화), 15:40~16:05, 11회장

Chair: 나석인, 정승준

Multifunctional Heterojunction Thin-Film Transistors Based on p-Te/n-Al:IZTO

남수지[†]

한국전자통신연구원

Heterojunctions play a pivotal role in enhancing the electrical characteristics and enabling multifunctional behaviors in thin-film transistors (TFTs). In this study, we report a novel heterojunction TFT integrating p-type tellurium (Te) and n-type aluminum-doped indium-zinc-tin oxide (Al:IZTO), which enables precise threshold voltage (V_T) modulation and supports advanced logic functionalities. The proposed architecture employs Te as an electron-blocking layer and Al:IZTO as a high-mobility charge transport layer, forming a well-defined heterointerface that facilitates controlled carrier injection. Beyond V_T modulation, the device demonstrates zero and negative differential resistance behavior, enabling the realization of low-power ternary inverters and NAND gates. These findings underscore the potential of horizontal heterojunction engineering for next-generation multifunctional and energy-efficient electronic systems.



남수지(한국전자통신연구원)

POSTECH 화학공학과 학사 (2002-2006)

POSTECH 화학공학과 박사 (2006-2012)

UIUC 재료공학과 Post Doc. (2012-2015)

ETRI 실감소자연구본부 책임연구원 (2015-현재)

UST 반도체소자공학 부교수 (2020-현재)

Keynote Lecture **1L11-6**

분자전자 부문위원회 I

2025.9.30(화), 16:20~17:00, 11회장

Chair: 나석인, 정승준

Biomimetic Designs for Semiconducting Polymers

Sihong Wang[†]

The University of Chicago

The vast amount of biological mysteries and biomedical challenges faced by humans provide a prominent drive for seamlessly merging electronics with biological living systems (e.g., human bodies) to achieve long-term stable functions. Towards this trend, one of the key requirements for electronics is to possess biomimetic form factors in various aspects for achieving diverse functions and long-term stability. To enable such paradigm-shifting requirements, polymer-based electronics are uniquely promising for combining advanced electronic functionalities with biomimetic properties. In this talk, I will introduce our design concepts for semiconducting polymers, which enable the incorporation of various biomimetic properties. First, I will introduce a new design strategy for introducing bioadhesive properties to redox-active semiconducting polymers, so as to enable intimate and stable interfacing of transistor-based biosensors with tissue surfaces. Second, to solve the issue of immune reactions and foreign-body responses to implantable bioelectronics, I will discuss our recent exploration of studying and developing immune-compatible and ultrasoft hydrogel designs for polymer semiconductors and conductors. Finally, I will show our design of stretchable light-emitting polymers with high quantum efficiency, which is enabled by the use of thermally activated delayed fluorescence. Collectively, our research is opening up a new generation of electronic materials that fundamentally change the way that humans interact with electronics.



Sihong Wang(The University of Chicago)

B.S., Tsinghua University, China (2005-2009)

Ph.D., Georgia Institute of Technology (2009-2014)

Postdoc, Stanford University (2015-2018)

Assistant Professor, The University of Chicago (2018-2025)

Associate Professor, The University of Chicago (2025-Present)

Invited Lecture **1L11-7**

분자전자 부문위원회 I

2025.9.30(화), 17:00~17:25, 11회장

Chair: 나석인, 정승준

Advanced Materials for Reduction of Motion Artifact in Bioelectronics

김태일[†]

성균관대학교

Electrophysiology, exploring vital electrical phenomena in living organisms, anticipates broader integration into daily life through wearable devices and epidermal electrodes. However, addressing the challenges of the electrode durability and motion artifacts is essential to enable continuous and long-term biopotential signal monitoring, presenting a hurdle for its seamless implementation in daily life. To address these challenges, an ultrathin polymeric conductive adhesive with stretchability, and skin conformability, is presented. The skin conformability and stability of electrodes is designed by theoretical criteria obtained by mechanical analysis. Throughout continuous 1-week-long electrocardiogram (ECG) monitoring in daily life, the system consistently preserves signal quality, underscoring the heightened durability and applicability of the PPd measurement system.



김태일(성균관대학교)

성균관대학교 화학공학부 (학사) (1997-2003)

서울대학교 화학생물공학부 (박사) (2003-2009)

University of Illinois at Urbana-Champaign (Post-Doc) (2009-2013)

성균관대학교 화학공학부 교수 (2013-현재)

Invited Lecture **1L11-8**

분자전자 부문위원회 I

2025.9.30(화), 17:25~17:50, 11회장

Chair: 나석인, 정승준

Designing Electrochemical Biosensor Interfaces for Health Monitoring Applications

김자영⁺

연세대학교

Wearable biosensors enable non-invasive, real-time monitoring of human physiology through dynamic sensing of (bio)chemical markers in sweat, saliva, tears, and interstitial fluid. These platforms offer molecular-level insights into health, stress, and performance in daily life, addressing limitations of traditional blood-based diagnostics. This talk will highlight recent developments in electrochemical wearable biosensors integrated into mouthguards, tattoo patches, and contact lenses, focusing on continuous metabolite monitoring for applications such as diabetes management. It will also introduce a personalization strategy for accurate blood glucose estimation using non-invasive biofluids. Lastly, recent efforts on detecting small molecules using quantum electrochemical sensing with nanoscale molecularly imprinted polymers will be discussed, underscoring the clinical and daily-life impact of wearable point-of-care technologies.



김자영(연세대학교)

연세대학교 화학과 학사 (2006-2010)

연세대학교 화학과 석사 (2010-2012)

UC San Diego 재료공학 박사 (2012-2018)

Stanford Uni. 화학공학과 (Post-Doc) (2018-2021)

연세대학교 의과대학 의학공학교실 조교수 (2021-현재)

Invited Lecture **1L11-9**

분자전자 부문위원회 I

2025.9.30(화), 17:50~18:15, 11회장

Chair: 나석인, 정승준

Strain-Invariant Stretchable Electronics Enabled by Tunable Dielectric Elastomers

정예환⁺

한양대학교

신축성 전자기기는 인장에 의해 발생하는 다양한 특성 변화에 따른 문제로 신뢰성 높은 기기 개발에 난항을 겪고 있음. 예를 들어, 신축성 배선의 전도도 감소, 반도체 장치의 전류-전압 및 전달 특성의 변화, 그리고 무선 주파수 소자에서의 주파수 변동 등이 이에 해당됨. 또한, 신축성 디스플레이는 인장에 의한 채우기 비율과 해상도의 변화로 인해 표시되는 이미지와 동영상에 왜곡되는 문제가 있음. 기존 신축성 터치 센서는 인장과 압력의 구분이 불가능하여 감지 정확도의 한계가 있음. 본 세미나에서는 특성이 변하지 않는 신축성 반도체 장치, 무선 주파수 회로, 디스플레이 및 터치 센서 등을 포함하여 변형-불변 신축성 전자기기 및 디스플레이를 구현하기 위한 첨단 기술을 소개함. 특히 각종 특성이 인장에 따라 변하지 않도록 새로운 소재의 개발과 이러한 변화를 방지하기 위한 설계 기법을 포함한 전략을 소개할 예정임. 마지막으로, 해결해야 할 남은 도전 과제들을 살펴보고 미래 연구 방향에 대해 함께 논의할 예정임.



정예환(한양대학교)

일리노이대학교 어버너-섀페인 캠퍼스 재료공학과 연구원 (2011-2012)

성균관대학교 화학공학부 박사후연구원 (2017-2019)

노스웨스턴대학교 생체통합기기연구소 박사후연구원 (2019-2021)

한양대학교 융합전자공학부 조교수 (2021-2025)

한양대학교 융합전자공학부 부교수 (2025-현재)

Invited Lecture **1L12-1**

폴리올레핀 기반 소재의 기술혁신과 지속가능성

2025.9.30(화), 14:00~14:25, 12회장

Chair: 김용석, 홍성철

Synthesis of PS-PO-PS triblock copolymers

이분열⁺

아주대학교

PS-block-poly(ethylene-co-1-butene)-block-PS (SEBS) is an attractive material, traditionally produced through the costly hydrogenation of PS-block-polybutadiene-block-PS. An innovative one-pot method for synthesizing SEBS-like triblock copolymers has been developed in our laboratory. In this method, a dialkylzinc compound containing styrene moieties ($((\text{CH}_2=\text{CHC}_6\text{H}_4\text{CH}_2\text{CH}_2\text{CH}_2)_2\text{Zn})$) was synthesized, which is then used to grow poly(ethylene-co-1-hexene) chains via CCTP, resulting in di-end functional PO chains that are functionalized with styrene and Zn moieties. Subsequently, PS chains are attached to both ends of these PO chains through anionic styrene polymerization, initiated by $\text{Me}_3\text{SiCH}_2\text{Li}(\text{pmdeta})$ initiator. Details on the concept, implementation, and scale-up process for commercialization will be presented.



이분열(아주대학교)

서울대학교 화학과 학사 (1986-1990)

서울대학교 화학과 박사 (1990-1995)

LG화학 (1995-1999)

UC Santa Barbara Post-doc (1999-2000)

아주대학교 분자과학기술과 교수 (2001-현재)

Invited Lecture **1L12-2**

폴리올레핀 기반 소재의 기술혁신과 지속가능성

2025.9.30(화), 14:25~14:50, 12회장

Chair: 김용석, 홍성철

C-H insertion capability of azides for post-polymerization functionalization of polyolefins

홍성철[†]

세종대학교

Despite wide commercial success, the applications of polyolefins (POs) are often limited by their lack of functionality, polarity, and structural diversity. In this presentation, a technology platform for the functionalization of POs through post-polymerization modification is introduced. The C–H insertion capability of nitrene intermediates has garnered significant interest due to its broad applicability to organic macromolecules containing C–H bonds. Sulfonyl azide- and azidoformate-containing reagents have been prepared to modify commercial-grade POs via a simple melt-processing method. Non-catalytic C–H insertion by nitrene intermediates is also employed to fabricate polymer–inorganic hybrid materials with enhanced elasticity and adhesion properties. This technology platform offers scalable and viable pathways to broaden the utility of industrially significant POs by leveraging readily available resources.



홍성철(세종대학교)

서울대학교 공업화학화 학사 (1987-1991)

서울대학교 공업화학화 석사 (1991-1993)

서울대학교 공업화학화 박사 (1993-1996)

일본 JAIST, 독일 BASF, 미국 CMU Postdoc. (1997-2001)

미국 Crompton사 선임연구원 (2002-2004)

세종대학교 나노신소재공학과 교수 (2004-현재)

Invited Lecture **1L12-3**

폴리올레핀 기반 소재의 기술혁신과 지속가능성

2025.9.30(화), 14:50~15:15, 12회장

Chair: 김용석, 홍성철

고분자 중합용 메탈로센 촉매 개발 동향

남상훈[†]

(주)에스피씨아이

Metallocene catalysts, featuring single-site active centers, offer exceptional capabilities in controlling polymer molecular weight distribution, stereoregularity, and comonomer incorporation. This precision enables the production of high-performance polyolefins applied across packaging, automotive, and medical material sectors. Recent research has focused on structurally diverse catalyst systems, including ansa-metallocenes, half-metallocenes, and post-metallocene variants, coupled with efforts to enhance sustainability and recyclability. In this presentation, we will review the latest developments in metallocene catalyst architectures, copolymer design strategies, and industrial implementation cases, and introduce SPCI's state-of-the-art metallocene catalyst facility, which is equipped to support advanced polymerization processes.



남상훈((주)에스피씨아이)

부산대학교 나노융합기술학과 유기합성전공 (2008-2010)

(주)에스피씨아이 상무 (2010-현재)

Invited Lecture **1L12-4**

폴리올레핀 기반 소재의 기술혁신과 지속가능성

2025.9.30(화), 15:15~15:40, 12회장

Chair: 김용석, 홍성철

폴리올레핀 중합촉매/공정/응용 소재의 발전과 향후 전망

고영수[†]

공주대학교

폴리올레핀은 지난 70년간 비약적인 성장을 통해 인류에게 매우 중요한 소재로 자리매김하였다. 그러나 최근 10년간 아시아, 특히 중국을 중심으로 한 급격한 생산량 증가와 경기 침체로 인해 국내외 석유화학 산업은 경제적 어려움에 직면하고 있으며, 이를 극복하기 위한 국내 기업과 정부의 다양한 노력이 지속되고 있다. 본 발표에서는 석유화학 산업의 핵심 분야인 폴리올레핀 기술의 수십 년간 발전 과정을 살펴보고, 향후 국내외 폴리올레핀 기술 및 산업의 전망에 대해 논의하고자 한다.



고영수(공주대학교)

KAIST 화학공학과 박사 (1993-1997)

캐나다 워털루대 Post-doc (1997-1999)

삼성토탈 선임연구원 (1999-2001)

보레알리스 연구팀장 (2002-2006)

공주대학교 화학공학부 교수 (2006-현재)

Invited Lecture **1L12-5**

폴리올레핀 기반 소재의 기술혁신과 지속가능성

2025.9.30(화), 16:00~16:25, 12회장

Chair: 김용석, 홍성철

Palladium(II)-Catalyzed Synthesis of Model Polynorbornenes with High Heat Resistance

채창근[†]

한국화학연구원

Model polynorbornenes with high heat resistance were synthesized via vinyl-addition polymerization of alkyl-substituted norbornenes using a palladium(II)-catalyzed system specifically designed to maintain homogeneous catalytic activation. A weakly solvating catalytic environment was established through the rational combination of a monodentate phosphine ligand and a weakly coordinating solvent, which effectively preserved the homogeneous nature of the catalyst throughout polymerization. This design enabled stable initiation and propagation of methyl-, ethyl-, and butyl-norbornene monomers, yielding polymers with narrow molecular weight distributions ($\text{Đ} < 1.10$) and high molecular weights (M_n up to 500 kDa). The resulting polymers exhibited high optical transmittance exceeding 90% at 400 nm and glass transition temperatures reaching 300 °C. Importantly, these findings suggest that living polymerization behavior can emerge through tuning of the catalytic environment.



채창근(한국화학연구원)

광주과학기술원 신소재공학부 (박사) (2013-2019)

The University of Chicago (박사후연구원) (2019-2021)

한국화학연구원 고기능고분자연구센터 (선임연구원) (2021-현재)

Invited Lecture **1L12-6**

폴리올레핀 기반 소재의 기술혁신과 지속가능성

2025.9.30(화), 16:25~16:50, 12회장

Chair: 김용석, 홍성철

Synthesis of functional polyolefins via postpolymerization deoxygenation

서명은[†]

KAIST

Introducing functional groups into commodity plastics, such as polyolefins, is a promising approach for producing higher-value functional materials. From the upcycling/recycling standpoint, functional polyolefins may be useful as (reactive) compatibilizers to increase miscibilities of nonpolar polyolefins with other polymers. However, direct copolymerization with functional comonomers and postpolymerization modification of relatively unreactive polyolefins are challenging. In this presentation, I will discuss a deoxygenation reaction as a synthetic route to functional polyolefins with different functionalities with controlled levels of functionalization. Synthesis of well-defined precursor polymers containing oxygen in the pendant and deriving hydrocarbon polymers via deoxygenation will be discussed in detail.



서명은(KAIST)

한국과학기술원 화학과 (학사) (1998-2002)

한국과학기술원 고분자화학 석사 (2002-2004)

한국과학기술원 고분자화학 박사 (2004-2008)

한국과학기술원 박사후연구원 (2008-2009)

University of Minnesota 박사후연구원 (2009-2013)

한국과학기술원 조교수, 부교수, 교수 (2013-현재)

Invited Lecture **1L12-7**

폴리올레핀 기반 소재의 기술혁신과 지속가능성

2025.9.30(화), 16:50~17:15, 12회장

Chair: 김용석, 홍성철

Molecular Dynamics Simulation of Metallocene Poly- α -olefins and Their Lubrication Property Modulation by Additives

이원선[†]

피이주식회사

Metallocene-catalyzed poly- α -olefins (mPAOs), synthesized from linear α -olefins, are attractive synthetic base oils due to their tunable viscosity, thermal stability, and low volatility. Here, we perform molecular dynamics simulations to investigate the physical properties of C8- and C10-based mPAOs, including shear viscosity, density, thermal conductivity, and diffusion coefficients over a wide temperature range. Simulations are conducted using all-atom force fields that have been validated for hydrocarbon systems. Temperature-dependent trends in transport properties are systematically examined to understand the microscopic origins of lubricant performance. The results offer detailed molecular-level insights into the relationship between polymer chain length, temperature, and bulk properties. This computational approach provides a foundation for the rational design of advanced lubricants with tailored thermophysical performance for energy-efficient applications.



이원선(피이주식회사)

서울대학교 화학과 (박사) (1997-2002)

University of Pennsylvania (포닥) (2002-2007)

Northwestern University (포닥) (2008-2013)

Qatar Foundation (Scientist) (2014-2021)

Northwestern University (visiting scholar) (2021-2022)

Safarik University (Scientist) (2023-2024)

Invited Lecture **1L12-8**

폴리올레핀 기반 소재의 기술혁신과 지속가능성

2025.9.30(화), 17:15~17:40, 12회장

Chair: 김용석, 홍성철

Synthesis of Randomly Carboxyl-Functionalized Vinyl-Addition Polynorbornene and Application

김용석[†], 정현민¹, 채창근²

세종대학교

¹ 금오공과대학교

² 한국화학연구원

A series of bis(β -ketoimino)nickel(II) complexes with p-substituted N-phenyl groups were synthesized, and their general coordination geometry was elucidated by single-crystal X-ray diffraction analysis. All the catalyst systems exhibited high catalytic activities at NBE feed contents of up to 50 mol %, resulting in the production of copolymers with high molecular weights. In addition, the content of polar ester groups was precisely controlled by the feed ratio of the monomers. Since the copolymerization behaviors were revealed to be independent of the electronegativity of p-substituent, all the catalyst systems were considered to serve the random copolymerization of NB and NBE. The resulting polynorbornene exhibited the dielectric and surface properties well tunable by compositional modulation.



김용석(세종대학교)

연세대학교 화학과 (학사) (1994)

POSTECH 신소재공학과(석사) (1996)

POSTECH 신소재공학과(박사) (2001)

한국화학연구원 책임연구원 (2002-2024)

세종대학교 화학과 교수 (2024-현재)

Annual Fall Meeting of the Polymer Society of Korea

September 29(Mon)~October 1(Wed), 2025, 부산컨벤션센터(BEXCO)

Invited Lecture **1L13-1**

Recent Trends of Molecular Engineering in Electronics and Energy Materials

2025.9.30(화), 14:00~14:25, 13회장

Chair: 김명길, 김재현

The Precise and Scalable Synthesis of Conjugated Polymers

Hui Huang[†]

Tianjin University

Conjugate polymers (CPs), especially the alternating CPs, have attracted much attention since they have applications in many fields, including energy, information, and biology. Currently, the synthesis of alternating CPs mainly depends on the transition metal-catalyzed cross coupling reactions. Due to the homocoupling side reactions, there are intrinsic structural defects in the backbones of the CPs, resulting in detrimental electronic properties, large batch-to-batch variation, and unclear structure-property relationship. Thus, it is important to develop new methods for precise and scalable synthesis of CPs.

In this talk, we will report several novel synthetic methods for precision synthesis of CPs including an original C-S bond activation based polymerization (CASP) method. We will discuss the catalytic systems, the structural defects and the catalytic mechanisms. Also, we will present the challenges and prospects of this field.



Hui Huang(Tianjin University)

B.A., Beijing Normal University (2000)

Ph.D., Dartmouth College (2008)

Post-Doc., Tobin J. Marks, Northwestern University, USA (2010)

Scientist, ConocoPhillips/Phillips 66 Company (2010-2013)

Professor, University of Chinese Academy of Sciences, P. R. China (2013-2025)

Professor, Tianjin University, P. R. China (2025-Present)

Invited Lecture **1L13-2**

Recent Trends of Molecular Engineering in Electronics and Energy Materials

2025.9.30(화), 14:25~14:50, 13회장

Chair: 김명길, 김재현

Advances in Radiation-Resistant Solution-Processed Metal-Oxide Thin-Film Transistors

김충익[†]

서강대학교 산학협력단

This study explores rad-hard amorphous metal-oxide thin-film transistors (TFTs) fabricated by solution processing, focusing on stability under high-energy irradiation. ZnO and IGZO TFTs show significant electrical degradation from proton-induced oxygen vacancies, while amorphous zinc tin oxide (a-ZTO) and zinc-indium-tin oxide (ZITO) with optimized compositions exhibit superior radiation resistance. ZITO with a 4:1:1 Zn:In:Sn ratio, combined with thin channels and organic passivation layers, demonstrates excellent in situ and ex situ stability with minimal threshold voltage shifts and high mobility under harsh radiation. Additionally, doping InZnO with group IV metals (Ti, Zr, Hf) strengthens oxygen bonding and widens the bandgap, significantly reducing radiation-induced defects. These findings highlight promising routes for developing large-area, rad-hard electronics for aerospace and nuclear applications.



김충익(서강대학교 산학협력단)

하버드대학교 박사후연구원 (2009-2010)

서강대학교 화공생명공학과 (2011-현재)

Invited Lecture **1L13-3**

Recent Trends of Molecular Engineering in Electronics and Energy Materials

2025.9.30(화), 14:50~15:15, 13회장

Chair: 김명길, 김재현

Functional Nanocarbons for Ultraflexible, High-Energy-Density Li-S Batteries in Next-Generation Urban Air Vehicles

백강준⁺

부경대학교

In response to the growing demand for sustainable energy technologies, Li-S batteries have emerged as a promising next-generation alternative to conventional LIBs. Li-S batteries offer significantly higher theoretical energy densities at a substantially lower cost, utilizing earth-abundant and environmentally friendly S. In this presentation, I will introduce key strategies based on nanocarbons designed to enhance the performance of Li-S batteries. First, I present a free-standing S cathode with high S loading, constructed using a functionalized SWCNT-based conductive fibrous network. This architecture enables efficient electron transport and accommodates high S content. Second, I demonstrate a commercial separator modified with a functional nanocarbon interlayer that employs a dual polysulfide-trapping mechanism. This approach effectively suppresses polysulfide shuttling by blocking their migration toward the Li anode, thereby enhancing cycle stability.



백강준(부경대학교)

고려대학교 재료공학부 학사 (2000-2005)

광주과학기술원 신소재공학과 박사 (2006-2010)

한국전자통신연구원 연구원 (2010-2011)

Northwestern Univ. 포스닥 연구원 (2012-2012)

한국전기연구원 선임연구원 (2013-2015)

국립부경대학교 차세대반도체공학전공 교수 (2015-현재)

Invited Lecture **1L13-4**

Recent Trends of Molecular Engineering in Electronics and Energy Materials

2025.9.30(화), 15:15~15:40, 13회장

Chair: 김명길, 김재현

High-density vertical organic electrochemical transistor arrays and complementary circuits

김재현[†]

동국대학교

We demonstrate high-resolution vertical organic electrochemical transistor (OECT) arrays with facile and general micropatterning approach for polymeric electronic channel materials using electron-beam lithography. The highly energetic electrons enable direct electronic conversion from semiconducting to insulating state through molecular disordering and bond dissociation. Thus, high-resolution vertical OECT active matrix arrays are successfully fabricated on a skin-like soft platform with excellent electronic characteristics such as high transconductances, fast transient times, and ultra-stable switching properties. Particularly, we present vertically stacked complementary logic circuits, which are essential components for digital processing and logic operations. Our new architecture offers broad applicability to multifunctional and multiplexed state-of-the-art electronics with high-density wearable device applications as well as human-oriented bioelectronics.



김재현(동국대학교)

중앙대학교 전자전기공학부 (학사) (2007-2013)

중앙대학교 전자전기공학부 (석사) (2013-2015)

중앙대학교 전자전기공학부 (박사) (2015-2020)

Northwestern University, Department of Chemistry and Materials Research Center (Post-Doc.) (2020-2023)

동국대학교 시스템반도체학부 조교수 (2023-현재)

Invited Lecture **1L13-5**

Recent Trends of Molecular Engineering in Electronics and Energy Materials

2025.9.30(화), 16:00~16:25, 13회장

Chair: 김명길, 김재현

High-efficiency and Mechanically Robust Intrinsically Stretchable Organic Solar Cells for Wearable Electronics

Ming Shao[†]

Huazhong University of Science and Technology

Intrinsically stretchable organic solar cells (is-OSCs) represent an ideal power source for next-generation wearable electronics. However, a longterm challenge lies in overcoming the trade-off between power conversion efficiency(PCE) and mechanical stretchability. To address this limitation, we report multiple strategies: (1) physical blending active materials with elastomers; (2) incorporation of chemical bonding to effectively dissipate internal stress; (3) new molecular design of a series of ductile polymer donors and non-fullerene acceptors exhibiting unique plasticizing effect. As a result, we achieved is-OSCs that simultaneously show the high efficiency (PCE>19%) and mechanical stretchability ($\epsilon_u > 90\%$). These robust and efficient stretchable active layers also offer great potential for broader wearable electronics applications, such as polarization-sensitive detection.



Ming Shao(Huazhong University of Science and Technology)

B.A., Huazhong Univ. Sci & Tech (2003)

Ph.D., Univ. of Tennessee, Knoxville, USA (2011)

Post-Doc, K. Xiao & D.B. Geohegan, Oak Ridge National Laboratory, USA (2013)

Device Scientist, A. Facchetti, Polyera Inc (2014)

Professor, Huazhong Univ. Sci & Tech (2017-Present)

Invited Lecture **1L13-6**

Recent Trends of Molecular Engineering in Electronics and Energy Materials

2025.9.30(화), 16:25~16:50, 13회장

Chair: 김명길, 김재현

Etchant-Free Dry-Developable EUV Photoresists Materials Based on Small Organometallic Complexes

홍석원[†]

GIST

Extreme ultraviolet (EUV) lithography requires innovative photoresist materials that enable high-resolution patterning without relying on wet development. This talk introduces two etchant-free, dry-developable EUV photoresist systems based on small organometallic molecules: $\text{Fe}(\text{styrene-acac})_3$ and N-heterocyclic carbene (NHC)–metal complexes. Both materials exhibit high EUV reactivity and enable pattern formation via straightforward thermal development under vacuum, eliminating the need for toxic solvents or corrosive etchants. The Fe-based system achieves 1 μm and sub-100 nm patterns, while NHC–Au and Ag complexes demonstrate 80 nm resolution with competitive line edge roughness and EUV sensitivity. Through EUV-photoelectron spectroscopy, NEXAFS, and DFT calculations, we elucidate their reaction mechanisms, highlighting secondary electron-driven polymerization. These findings offer promising routes toward sustainable and scalable EUV lithographic processes.



홍석원(GIST)

서울대학교 화학과 (학사) (1989-1995)

서울대학교 화학과 (석사) (1995-1997)

Northwestern Univ. 화학과 (박사) (1998-2003)

The Scripps Research Inst. (Post-doc) (2003-2005)

U of Florida 화학과 조교수 (2005-2012)

GIST 신소재공학부, 화학과 부교수, 교수 (2012-현재)

Invited Lecture **1L13-7**

Recent Trends of Molecular Engineering in Electronics and Energy Materials

2025.9.30(화), 16:50~17:15, 13회장

Chair: 김명길, 김재현

Harnessing Light-Induced Molecular Dynamics for Advanced Organic Electronics: From Color-Cognitive Memristors to Efficient Hole Transport in Perovskite Devices

박상혁[†]

공주대학교

We present an integrated molecular design strategy that harnesses light-induced excited-state dynamics of organic semiconductors to advance multifunctional optoelectronic devices. First, a color-cognitive memristor is developed by employing photoresponsive molecular layers exhibiting light-enhanced polarity. This enables wavelength-dependent conductance modulation, mimicking human visual perception and enabling multispectral memory for neuromorphic vision. Second, we demonstrate that excited-state properties synergize with proton transfer to improve hole mobility in heterocyclic ring-based organic semiconductors. When implemented in a NiOx-based hybrid hole-transport layer for perovskite solar cells, the result is enhanced charge extraction and improved device efficiency. These results underscore the potential of light-driven molecular engineering in unifying sensory, memory, and energy-harvesting functions within organic electronic platforms.



박상혁(공주대학교)

서울대학교 재료공학부(학사) (1998-2002)

서울대학교 재료공학부(박사) (2002-2008)

서울대학교 신소재공동연구소(선임연구원) (2008-2009)

Northwestern University(Postdoc) (2009-2011)

국립공주대학교 화학과(교수) (2011-현재)

Invited Lecture **1L13-8**

Recent Trends of Molecular Engineering in Electronics and Energy Materials

2025.9.30(화), 17:15~17:40, 13회장

Chair: 김명길, 김재현

Rhenium Unveiled: Advancing Hydrogen Production with High Efficiency

윤석민[†]

경상국립대학교

The development of sustainable hydrogen production technologies is vital for a low-carbon economy. Among these, the hydrogen evolution reaction (HER) in water electrolysis plays a key role in generating green hydrogen. While platinum-based catalysts are highly effective for HER, their high cost drives the search for alternatives. Rhenium has recently emerged as a promising, cost-effective candidate, offering electrocatalytic performance comparable to platinum group metals. In addition to its electrochemical potential, rhenium-based nanocatalysts demonstrate excellent thermal catalytic activity, particularly in the rapid and selective decomposition of nitrogen hydrides to produce pure H₂ and N₂.



윤석민(경상국립대학교)

충남대학교 화학과(학사) (2001-2004)

포항공과대학교 화학과 (박사) (2004-2009)

Northwestern University (postdoc) (2009-2014)

IBS (tenure-track researcher) (2015-2017)

원광대학교 화학과 부교수 (2018-2024)

경상국립대학교 화학과 부교수 (2024-현재)

Invited Lecture **2L1-1**

의료용 고분자 부문위원회 II: 바이오 고분자 혁신: 차세대 융합소재와 응용 (1)

2025.10.1(수), 10:50~11:30, 1회장

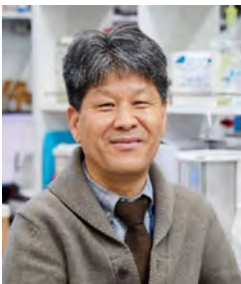
Chair: 이수홍

Bioactive materials and amphiphilic polymer conjugates in the treatment of various diseases

안민지, 노재원, 나 건⁺

가톨릭대학교

We evaluated the potential of an amphiphilic polymer (AP) to bioactive materials such as an antibody or PS. APP and antibody conjugates (APAC) had preserved specificity and structural integrity. APAC reduced aggregation and protected the antibody denaturation or fragmentation from heat and protease stress, subsequently improved binding kinetics and therapeutic efficiency. We then applied AP for the development of photosensitizer (PS) platforms for photodynamic therapy (PDT). AP was conjugated with a PS (APS) to enhance photostability and increases a singlet oxygen generation with targeting effect of PS. APS prevented the decrease in photoactivity of the PS caused by aggregation induced quenching, resulting in a increasing photophysical yield. APS showed superior PDT for treatment of glioblastoma (GBM) in in vivo test. In particular, as co-treated with a checkpoint blockade antibody, APS demonstrates the potential of the synergistic effect as a clinical solution in the treatment of GBM.



나 건(가톨릭대학교)

The University of Utah, Post-doc (2002-2004)

가톨릭대학교, 특훈교수 (2005)

세계생체재료연합회, 석학펠로우 (2020)

한국생체재료학회, 회장 (2024-2024)

Invited Lecture **2L1-2**

의료용 고분자 부문위원회 II: 바이오 고분자 혁신: 차세대 융합소재와 응용 (1)

2025.10.1(수), 11:30~11:55, 1회장

Chair: 이수홍

Exploring various polymer hybrid coatings to control the bio-interface properties for medical Implants

양성윤⁺

충남대학교

Polymers have been essential cues in biomedical applications yet optimizing their performance for in vivo implants remains challenging. Silicone and titanium implants, common in reconstructive surgery and orthopedics, exhibit bio-inert properties that hinder tissue integration, requiring surface modifications to improve biocompatibility. This study develops thin film coatings incorporating hydrogel nanofiber matrices that mimic native tissues and guide cellular behavior. Pseudo-3D structures from photo-curable resins are examined for effects on cell morphology and motility. Additionally, 3D hydrogel printing enhances interfacial adhesion between implants and tissues. Findings highlight the role of chemical and physical properties of polymeric and hybrid materials in modulating cellular responses, offering insights into advanced medical implants and diagnostic biochip technologies



양성윤(충남대학교)

이화여자대학교 화학과(석사) (1991-1993)

한국화학연구원(연구원) (1993-1994)

한국과학기술원(연구원) (1994-1995)

Polytechnic University(현. New York University) 화학화공과 (박사) (1996-2000)

Massachusetts Institute of Technology 재료공학과 Post Doc./ Senior Post Doc.(2000-2003)

Chungnam National University 고분자공학과/유기재료공학과 (교수) (2004-현재)

Invited Lecture **2L1-3**

의료용 고분자 부문위원회 II: 바이오 고분자 혁신: 차세대 융합소재와 응용 (1)

2025.10.1(수), 11:55~12:20, 1회장

Chair: 이수홍

Versatile and Instructive Potentials of MXene Nanomaterials for Tissue Engineering & Regeneration

한동욱[†]

부산대학교

We investigated the biological potentials of MXene nanomaterials (NMs) for tissue engineering and regeneration. MXene (transition metal carbides/nitrides) are accordion-like multilayered or monolayered two-dimensional (2D) nanosheets exhibiting excellent electrical, optical, and magnetic properties with biocompatibility. Interestingly, MXene NMs can interact with various biomolecules and proteins, and directly interact with cells to modulate cellular behaviors and differentiation. In light of this, we introduced three types of MXene-incorporated engineered scaffolds: Electrospun nanofiber matrices for bone regeneration; nanofiber matrices and three-dimensional (3D) bioprinted grafts for muscle regeneration. We also delved into the applications of various 2D NMs in tissue engineering, highlighting their unique advantages over conventional approaches and presenting them as emerging strategies in regenerative medicine.



한동욱(부산대학교)

연세대학교 생체재료학 (석사) (1998-2000)

연세대학교 생체재료학 (박사) (2000-2004)

교토대학 재생의과학연구소 (Postdoc) (2005-2008)

부산대학교 광메카트로닉스공학과 (2008-2025)

Invited Lecture **2L1-4**

의료용 고분자 부문위원회 II: 바이오 고분자 혁신: 차세대 융합소재와 응용 (1)

2025.10.1(수), 12:20~12:45, 1회장

Chair: 이수홍

Engineered Hydrogels with Tunable Mechanical Properties and Tissue Adhesiveness for Biomedical Applications

김재윤⁺

성균관대학교

Hydrogels have emerged as versatile materials for a wide range of biomedical applications, including tissue engineering, drug delivery, and wearable skin patches. However, conventional hydrogels often exhibit intrinsically low mechanical strength, and enhancing both mechanical robustness and tissue adhesiveness simultaneously remains a significant challenge. In this work, we present an approach to engineer hydrogel networks by finely tuning their mechanical and adhesive properties. Through precise reconstruction of the polymer architecture and introduction of additional crosslinking, we developed hydrogels with markedly improved tensile strength, toughness, and interfacial adhesion to biological tissues. These engineered hydrogels offer promising potential for biomedical applications that demand both mechanical durability and reliable integration with soft tissues.



김재윤(성균관대학교)

서울대학교 응용화학부 (학사) (1997-2001)

서울대학교 응용화학부 (석사) (2001-2003)

서울대학교 화학생물공학부 (박사) (2004-2007)

하버드대학교 (Postdoc) (2008-2012)

존스홉킨스대 연구원 (2008)

성균관대학교 화학공학부 교수 (2012-현재)

Invited Lecture **2L1-5**

의료용 고분자 부문위원회 II: 바이오 고분자 혁신: 차세대 융합소재와 응용 (2)

2025.10.1(수), 14:00~14:25, 1회장

Chair: 박우람, 진윤희

Understanding the forces that control cell fate and disease progression

황용성[†]

순천향대학교

Although the biomechanical properties of native extracellular matrix (ECM) and its contribution to the cell-cell and cell-matrix interactions play a critical role in maintaining tissue homeostasis and disease progression, an efficient method to understand these biological events during various fibrosis-associated disease progression is still a daunting task. Thus, in this talk, I will describe the dynamic role of cell-cell/cell-matrix interactions of various cells, which are cultured on biomaterials with varying matrix stiffnesses, in regulating disease progression by employing traction force microscopy, intracellular microscopy, and monolayer stress microscopy to understand the cell-generating forces and their subsequent contribution to the disease progression. Such a cell culture platform can offer novel strategies to understand the pathophysiology of various diseases.



황용성(순천향대학교)

성균관대학교 신소재공학 (학사) (1998-2006)

UC San Diego 재료과 (석사) (2006-2007)

UC San Diego 재료과 (박사) (2007-2011)

UC San Diego 의공학과 (포스닥) (2011-2014)

순천향대학교 교수 (2015-2025)

Invited Lecture **2L1-6**

의료용 고분자 부문위원회 II: 바이오 고분자 혁신: 차세대 융합소재와 응용 (2)

2025.10.1(수), 14:25~14:50, 1회장

Chair: 박우람, 진윤희

Biocompatible Tattoo Inks Based on Natural Dyes Encapsulated in Amphiphilic Polymers for Improved Safety and Stability

송창식[†]

성균관대학교

The growing demand for tattoos has raised concerns over the safety of conventional inks, which often contain toxic dyes and heavy metals. To address these risks, we developed a biocompatible tattoo ink using natural dyes encapsulated in water-soluble amphiphilic polymers. This formulation improves the dispersion of hydrophobic natural dyes in a safe, aqueous medium while eliminating harmful components. Systematic optimization led to a stable dye-polymer nanoparticle system. In vitro tests on human skin cells confirmed excellent biocompatibility with no cytotoxicity. The ink showed strong color retention and consistency, and professional tattoo artists reported superior handling and safety compared to traditional inks. This work demonstrates a safer alternative for tattoo applications through natural dye integration and advanced encapsulation.



송창식(성균관대학교)

한국과학기술원 화학과 학사 (1995-2001)

MIT 유기화학 박사 (2002-2007)

MIT 박사후 연구원 (2007-2011)

성균관대학교 조교수 (2011-2015)

성균관대학교 부교수 (2015-2021)

성균관대학교 교수 (2021-현재)

Invited Lecture **2L1-7**

의료용 고분자 부문위원회 II: 바이오 고분자 혁신: 차세대 융합소재와 응용 (2)

2025.10.1(수), 14:50~15:15, 1회장

Chair: 박우람, 진윤희

Bio-Based Smart Polymers for the Future of Sustainable Medical Applications

황성연[†]

경희대학교

Bio-based polymers are emerging as key materials for next-generation medical applications, offering both environmental sustainability and advanced functionality. Biodegradable adhesives provide strong bonding while being water-soluble and safe, making them ideal for temporary uses such as wound closure, surgical patches, and drug delivery systems. Shape memory polymers, capable of recovering their original form in response to stimuli like heat or moisture, enable the design of smart medical devices—such as self-expanding implants and responsive scaffolds—that adapt to dynamic biological environments. Together, these materials address the growing demand for safer, more adaptable, and environmentally responsible solutions in healthcare. As global efforts toward sustainable technologies continue, bio-based adhesives and shape memory polymers are expected to play a transformative role in the future of biomedical materials and medical device design.



황성연(경희대학교)

숭실대학교 섬유공학과 학사 (1996-2002)

한양대학교 섬유고분자공학과 석사 (2006-2008)

한양대학교 섬유고분자공학과 박사 (2008-2011)

SKC 첨단기술중앙연구소 선임연구원 (2011-2014)

KRICT 한국화학연구원 바이오화학연구센터 선임연구원 (2014-2018)

KRICT 한국화학연구원 바이오화학연구센터 센터장 (2018-2022)

경희대학교 식물환경신소재공학과 부교수 (2022-현재)

Invited Lecture **2L1-8**

의료용 고분자 부문위원회 II: 바이오 고분자 혁신: 차세대 융합소재와 응용 (2)

2025.10.1(수), 15:15~15:40, 1회장

Chair: 박우람,진윤희

Medical nanoparticle manufacturing system using microfluidic technology

한청수[†]

주식회사 케이런

The COVID-19 pandemic has demonstrated the potential of nanotechnology in medical polymers, particularly in gene delivery nanoparticles. The expansion of nanotechnology into the medical field demands precise quality control standards, necessitating a broad understanding of fluid synthesis and microfluidic-based convergence technologies.

This study established the foundation for the stable production of high-quality nanoparticles by applying Korea's world-class precision manufacturing technology, accumulated in semiconductor manufacturing, to the manufacturing of medical nanoparticles. Medical applications of nanoparticles require comprehensive consideration of various variables from the initial development stage, including quality characteristics, process conditions, and manufacturing protocols. Scale-up for clinical applications also requires consideration of factors such as raw material procurement, process reliability, and interim analysis.



한청수(주식회사 케이런)

인하대학교 자동화공학과(학사) (2002)

세디콘 연구소장 (2007-2013)

세디콘테크놀로지 대표이사 (2013-2015)

미콘 연구소장 (2015-2017)

케이런 대표이사 (2018-현재)

Invited Lecture **2L1-9**

의료용 고분자 부문위원회 II: 바이오 고분자 혁신: 차세대 융합소재와 응용 (2)

2025.10.1(수), 16:00~16:20, 1회장

Chair: 박우람, 진윤희

Patient-Specific Brain Organoids for Precision Neurotherapeutics

박종찬[†]

Sungkyunkwan University

iPSC-derived brain organoids offer a promising platform for modeling neurodegenerative diseases and evaluating drug responses in a patient-specific context. Our research involves CRISPR-Cas9 editing of genes such as ApoE and TREM2, as well as the use of patient-derived iPSCs carrying disease-associated mutations. These models support high-content imaging-based drug screening and tissue-clearing techniques for functional assessment. While rooted in neuroscience, this work has potential to benefit from integration with biomedical materials—such as biofunctional scaffolds or delivery systems. This talk aims to share our organoid-based precision medicine approach and explore future synergy with advanced medical materials.



박종찬(Sungkyunkwan University)

고려대학교 생명과학대학 생명과학부 이학사 (2008-2013)

서울대학교 의과대학 의과학과 의학박사 (2013-2019)

영국 유니버시티 런던 박사후연구원 (2020-2022)

성균관대학교 생명물리학과 조교수 (2023-2025)

성균관대학교 생명물리학과 부교수 (2025)

Invited Lecture **2L1-10**

의료용 고분자 부문위원회 II: 바이오 고분자 혁신: 차세대 융합소재와 응용 (2)

2025.10.1(수), 16:20~16:40, 1회장

Chair: 박우람, 진윤희

Exploring ongoing advances in cancer targeted therapy and biotherapeutics

김하린[†]

국민대학교

This presentation provides an overview of recent breakthroughs in targeted anticancer therapeutics. The presentation highlights the rational design and application of peptide-drug conjugates (PDCs) and peptide-based therapeutics as innovative strategies for selective drug delivery and tumor targeting. Key elements of biopharmaceutical development, including delivery system optimization and linker engineering, will also be discussed. Furthermore, the lecture introduces emerging modalities such as mRNA-based cancer vaccines and other next-generation immunotherapies shaping the future of precision oncology. Designed for graduate students, researchers, and faculty in biotechnology, pharmaceutical sciences, and related fields, the lecture offers both foundational insights and recent advances to inspire future directions in cancer biotherapeutics.



김하린(국민대학교)

서울대학교 약학과 (학사) (2011-2017)

서울대학교 약학과 (박사) (2017-2023)

스탠포드대학교 의과대학 (포닥) (2023-2024)

국민대학교 응용화학부 (조교수) (2024-현재)

Invited Lecture **2L1-11**

의료용 고분자 부문위원회 II: 바이오 고분자 혁신: 차세대 융합소재와 응용 (2)

2025.10.1(수), 16:40~17:00, 1회장

Chair: 박우람, 진윤희

Bioelectronics for Continuous Physiological Fluid Monitoring

김지혜[†]

아주대학교

Physiological fluid monitoring plays a critical role in enabling personalized healthcare, early diagnosis, and effective disease management. In this talk, I will present recent advances in wearable and implantable bioelectronics designed for real-time physiological fluid monitoring. First, I will introduce a wearable bioimpedance-based device developed for noninvasive, real-time monitoring of breast milk volume during lactation. This platform was validated through human clinical studies, demonstrating its potential to support infant health. Second, I will discuss a fully implantable bladder function monitoring system. This device was evaluated over an extended period in rodent and non-human primate models, offering a reliable tool for tracking post-surgical recovery in bladder cancer patients. Together, these innovations highlight the transformative potential of bio-integrated electronics to enable continuous, seamless, and patient-centered health monitoring.



김지혜(아주대학교)

성균관대학교 신소재공학과 (학사) (2011-2015)

성균관대학교 신소재공학부 (박사) (2015-2020)

노스웨스턴대학교 (박사후연구원) (2020-2025)

아주대학교 첨단바이오융합대학 조교수 (2025-현재)

Invited Lecture **2L2-1**

콜로이드 및 분자조립 부문위원회 II: 인공지능을 활용한 연성소재의 설계와 응용 (1)

2025.10.1(수), 10:50~11:15, 2회장

Chair: 윤홍석

Multiscale Simulation of Soft Materials Using Machine Learning Potentials

강준희[†]

부산대학교

Machine learning (ML) offers a powerful and efficient way to predict the physical and chemical properties of materials using large databases. While methods like density functional theory (DFT) provide accurate predictions, they are computationally expensive and limited in scope. To overcome this, we developed ML-based force fields (ML-FFs) that enable fast and accurate predictions of structural changes at the atomic scale. Our approach combines high-dimensional neural network potentials (HDNNPs), Gaussian process models, and a universal potential, trained on DFT and ab-initio molecular dynamics (AIMD) data. These ML-FFs are applied to both nanomaterials and soft materials, the latter requiring special consideration due to their flexible and dynamic structures. This framework supports efficient multiscale simulations, offering valuable insights for designing high-performance and functional materials.



강준희(부산대학교)

서울시립대학교 물리학과 (학사) (2010-2012)

DGIST 에너지시스템공학과 (박사) (2012-2016)

연세대학교 화공생명공학과 (박사후연구원) (2016-2018)

한국에너지기술연구원 (선임연구원) (2018-2022)

부산대학교 나노에너지공학과 부교수 (2022-현재)

Invited Lecture **2L2-2**

콜로이드 및 분자조립 부문위원회 II: 인공지능을 활용한 연성소재의 설계와 응용 (1)

2025.10.1(수), 11:15~11:40, 2회장

Chair: 윤홍석

When AI Learns the Context of Polymer Chemistry: The HAPPY Paradigm

허수미[†]

전남대학교

The intersection of artificial intelligence and polymer science represents one of the most promising frontiers in materials research, yet the complexity of polymer structures has historically posed significant challenges for computational approaches. Traditional molecular representations often struggle to capture the hierarchical nature and intricate connectivity patterns that define polymer behavior, limiting the effectiveness of machine learning models in understanding structure-property relationships. We introduce HAPPY (Hierarchically Abstracted rePeat unit of POLymers), a revolutionary paradigm that enables Transformer-based AI systems to comprehend the context of polymer chemistry. Our research explores how this paradigm shift enables both forward property prediction and inverse design challenges, opening new possibilities for accelerated polymer discovery.



허수미(전남대학교)

서울대학교 공과대학 응용화학부 (공학사) (1996-2000)

서울대학교 공과대학 응용화학부 (공학석사) (2000-2002)

University of California, Santa Barbara, Chemical Engineering (공학박사) (2006-2011)

University of Wisconsin, Madison, Chemical Engineering, Research Associate (2012)

University of Chicago, Institute for Molecular Engineering, Postdoctoral Scholar (2012-2014)

Argonne National Laboratory, Material Science Division, Postdoctoral Appointee (2014-2015)

전남대학교 고분자융합소재공학부 조교수, 부교수 (2015-2024)

전남대학교 고분자융합소재공학부 교수 (2024-현재)

Invited Lecture **2L2-3**

콜로이드 및 분자조립 부문위원회 II: 인공지능을 활용한 연성소재의 설계와 응용 (1)

2025.10.1(수), 11:40~12:05, 2회장

Chair: 윤홍석

De novo design of protein self-assembly using deep generative models

이상민[†]

포항공과대학교

단백질 4차구조는 여러 개의 단백질 subunit이 자기조립을 통해 형성하는 복합체로써, dimer, tetramer, 바이러스 캡시드, 헬리컬 번들 등 다양한 형태로 자연계에서 발견됩니다. 단백질 복합체의 경우 cooperativity, compartmentalization, multi-valency, multi-functionality 특성을 활용하여 모노머 형태에 비해 훨씬 다양하고 복잡한 기능들을 수행할 수 있습니다. 단백질 도킹과 같은 기존의 4차구조 설계방식은, subunit 단백질의 구조 변경이 어려워 설계할 수 있는 4차구조의 형태가 극히 제한적이었습니다. 하지만 최근 인공지능 기반의 단백질 구조 생성모델이 개발되면서, 기존의 단백질 subunit 구조에 제한 받지 않고 자유로운 4차구조 설계가 가능 해 졌습니다. 본 발표에서는 AI 기반의 단백질 구조설계 모델을 활용하여 기존에는 설계하기 어려웠던 복잡한 4차구조를 설계할 수 있는 방식에 대해 소개하고자 합니다. 또한, 단백질-단백질 상호작용 설계 뿐 아니라, 단백질-핵산 혹은 단백질-소분자 상호작용 설계를 통해 단백질 4차구조를 바이오 치료제로 활용할 수 있는 방향에 대해 소개하고자 합니다.



이상민(포항공과대학교)

한양대학교 화학공학과 (학사) (2007-2013)

한양대학교 화학공학과 (석사) (2013-2015)

University of Michigan 화학공학과 (박사) (2015-2021)

University of Washington 생화학과 (포닥) (2021-2023)

포항공과대학교 화학공학과 조교수 (2024-현재)

Invited Lecture **2L2-4**

콜로이드 및 분자조립 부문위원회 II: 인공지능을 활용한 연성소재의 설계와 응용 (1)

2025.10.1(수), 12:05~12:30, 2회장

Chair: 윤홍석

EXAONE Discovery: Toward Generalizable Molecular Property Prediction

정대웅[†]

LG AI연구원

Recent advances in artificial intelligence have accelerated research in AI-driven materials discovery. However, the development of generalized predictive models remains a major challenge in this domain due to the scarcity of property data and the heavy bias of existing datasets toward specific chemical spaces. To address these issues, we pretrain models on large-scale molecular structure data and implement techniques that enable effective information exchange across various property prediction tasks. Our approach facilitates the learning of broadly applicable representations, improving generalization to unseen chemical domains. The resulting model, EXAONE Discovery, serves as a foundation model for materials science, capable of supporting diverse material development tasks. By leveraging large-scale pretraining and cross-task learning strategies, EXAONE Discovery demonstrates strong potential for accelerating innovation across multiple material-related fields.



정대웅(LG AI연구원)

카이스트 바이오및뇌공학과(학사) (2012)

카이스트 바이오및뇌공학과(박사, 통합과정) (2017)

주식회사 노타 CEO (2017-2018)

카이스트 바이오및뇌공학과(Post-Doc) (2018-2020)

LG AI연구원 Research Scientist (2020-현재)

Invited Lecture **2L2-5**

콜로이드 및 분자조립 부문위원회 II: 인공지능을 활용한 연성소재의 설계와 응용 (2)

2025.10.1(수), 14:00~14:25, 2회장

Chair: 유재범

Corona Phase Engineering and AI-Driven Signal Analysis for Multidimensional Precision Chemical Information Transfer

조수연⁺

성균관대학교

Corona phases on single-walled carbon nanotubes generate rich near-infrared (nIR) fluorescence signals that encode molecular interactions. By tailoring these soft-matter interfaces, we produce multidimensional spectral and spatial responses beyond conventional receptor-based sensing. Recent advances in our group integrate artificial intelligence with the corona phase engineering, where machine learning decodes hidden multispectral features within nIR spectra to reveal subtle fingerprints that classical analysis cannot capture. In parallel, deep learning applied to nIR imaging performs pixel-level feature extraction and object detection, allowing high-throughput mapping of cellular heterogeneity and dynamic chemical process. In this talk, I will highlight how corona phase engineering, combined with AI-driven interpretation of nIR spectral and imaging data, opens a route to multidimensional precision chemical information transfer for diagnostics and process analytics.



조수연(성균관대학교)

KAIST 생명화학공학과 학사 (2009-2013)

KAIST 생명화학공학과 박사 (2013-2019)

MIT 화학공학과 박사후연구원 (2019-2022)

성균관대학교 화학공학부 조교수 (2022-2025)

성균관대학교 화학공학부 부교수 (2025-현재)

Invited Lecture **2L2-6**

콜로이드 및 분자조립 부문위원회 II: 인공지능을 활용한 연성소재의 설계와 응용 (2)

2025.10.1(수), 14:25~14:50, 2회장

Chair: 유재범

Machine Learning-Guided Design of Gradient Soft Materials via Digital Light Processing

김미소[†]

한국과학기술원

Grayscale digital light processing (g-DLP) enables control of light intensity to fabricate soft materials with spatially programmable mechanical properties. In this talk, we introduce a synergistic design platform that combines g-DLP with machine learning-guided multi-objective optimization and a custom-designed viscoelastic polyurethane acrylate resin system. The resin exhibits a record-wide tunable modulus range (8.3 MPa to 1.2 GPa) with excellent damping performance, while the AI framework uses Bézier-based optimization to generate optimal gradient distributions. Our structures achieve up to 83% reduction in strain concentration and significant improvements in fracture delay and fatigue durability in applications from artificial cartilage to automotive bumpers. This work pioneers a data-driven pathway for engineering next-generation soft materials through the integration of chemistry, photoprinting, and machine learning.



김미소(한국과학기술원)

서울대학교 재료공학부 (학사) (2000-2004)

MIT 재료공학부 (석사) (2004-2007)

MIT 재료공학부 (박사) (2007-2012)

한국표준과학연구원 선임연구원 (2012-2021)

성균관대학교 신소재공학부 조교수 (2021-2025)

KAIST 기계공학과 부교수 (2025-현재)

Invited Lecture **2L2-7**

콜로이드 및 분자조립 부문위원회 II: 인공지능을 활용한 연성소재의 설계와 응용 (2)

2025.10.1(수), 14:50~15:15, 2회장

Chair: 유재범

Self-assembly of bottlebrush copolymers in solution: From molecular dynamics simulation to machine learning

김용주[†]

고려대학교

In this study, we present extensive dissipative particle dynamics simulation studies of bottlebrush copolymers in solution having different grafting sequences: block and random. Distinct morphology of the grafting sequence-controlled bottlebrush copolymer micelles is investigated through backbone chain distribution along with the micelle structure. We further quantify the dependence of the micelles on the length scale of the backbone chain and side chain using the scaling relationship. Also, the experimental scaling of BBCP and BRCP micelles in water shows consistent results of the sequence-dependent scaling exponents calculated by simulation. This work reveals the scaling behavior of the sequence-controlled graft copolymer micelles which potentially guides how one can modify the solution self-assembled complex micelles by controlling architecture and structure parameters of the bottlebrush copolymer.



김용주(고려대학교)

POSTECH 신소재공학부 (학사) (2005-2008)

MIT 재료공학부 (박사) (2008-2013)

KAIST 나노융합연구소 (Post-Doc, 연구교수) (2013-2020)

국민대학교 신소재공학부 (조교수) (2020-2024)

고려대학교 신소재공학부 (조교수-부교수) (2024-현재)

Invited Lecture **2L2-8**

콜로이드 및 분자조립 부문위원회 II: 인공지능을 활용한 연성소재의 설계와 응용 (2)

2025.10.1(수), 15:15~15:40, 2회장

Chair: 유재범

Quantum advantage in toxicity prediction models using quantum machine learning

정근홍[†]

육군사관학교

In response to growing chemical terrorism threats and the emergence of unknown hazardous substances like structurally diverse Novichok agents, this study presents advanced computational approaches to enhance chemical safety. The diversity of these agents poses challenges for detection using conventional techniques.

To overcome this, we developed classical machine learning models to predict key properties such as vapor pressure and toxicity, enabling faster risk assessment. Additionally, we explored quantum machine learning (QML) methods, including techniques like Data Re-uploading and Identity Block structures. These QML models, especially when combined, showed superior performance over classical neural networks in toxicity classification tasks.

The results demonstrate the promise of quantum-enhanced models in accurately assessing the risks of novel chemical agents, contributing to improved preparedness against emerging threats.



정근홍(육군사관학교)

육군사관학교 화학과 (학사) (1999-2003)

서울대학교 화학과 (석사) (2005-2007)

UC Berkeley 화학과 (박사) (2012-2016)

콜로라도 주립대 Senior Scientist/Visiting Scholar (2020-2021)

육군사관학교 물리화학과 부교수, 교수 (2017-현재)

Invited Lecture **2L3-1**

에너지 부문위원회 II: 차세대 지속가능 그린 에너지 구현을 위한 첨단 소재 및 융합 혁신 기술 II (1)

2025.10.1(수), 10:50~11:15, 3회장

Chair: 최우혁

High-stability n-type conjugated polymer cathodes for lithium-ion batteries

이원호[†]

금오공과대학교

n-Type conjugated polymers are promising cathode materials for lithium-ion batteries (LIBs) due to their structural tunability, light-element composition, and potential for sustainable production. Unlike traditional inorganic cathodes, these polymers offer flexibility in molecular design and processing. However, issues such as low conductivity and poor cycling stability have limited their application. Here, we present high-stability n-type polymer cathodes designed by incorporating electron-deficient cores and optimizing side chains. The resulting polymers exhibit improved redox stability and long-term cycling performance. Structural and electrochemical analyses reveal key relationships that explain their enhanced stability. These findings highlight the potential of molecularly engineered n-type polymers as viable alternatives to inorganic cathodes for durable, high-performance LIBs.



이원호(금오공과대학교)

부산대학교 나노정보소재공학과(학사) (2003-2010)

부산대학교 나노융합기술학과(석사) (2010-2012)

한국과학기술원 생명화학공학과(박사) (2013-2017)

펜실베이니아 주립대학교(Postdoc.) (2017-2019)

국립금오공과대학교 고분자공학과 부교수 (2019-현재)

Invited Lecture **2L3-2**

에너지 부문위원회 II: 차세대 지속가능 그린 에너지 구현을 위한 첨단 소재 및 융합 혁신 기술 II (1)

2025.10.1(수), 11:15~11:40, 3회장

Chair: 최우혁

Hierarchical Pore Design of Hard Carbon Anode Materials for High-Performance Potassium-Ion Storage

황종국[†]

아주대학교

하드카본은 구조적 적합성과 낮은 제조비용으로 인해 차세대 나트륨 및 포타슘 이온 배터리의 유력한 음극재로 주목받고 있으나, 에너지 밀도와 출력 특성의 향상이 지속적으로 요구된다. 최근 기공 구조 제어가 이온 저장 전위를 낮추고 가역 용량을 향상시키는 효과적인 전략으로 부각되고 있지만, 기공의 크기와 개방도가 포타슘 이온 저장에 미치는 영향에 대한 기초적인 이해는 여전히 부족하다.

본 연구에서는 이러한 한계를 극복하기 위해, 외부 표면이 밀폐되고 내부에 ultramicropore와 mesopore가 계층적으로 연결된 폐쇄형 계층 다공성 구형 하드카본(closed hierarchically porous carbon spheres)을 설계하였다. 이 구조는 ultramicropore를 통한 이온 저장 활성점 농도 증가와 mesopore를 통한 신속한 고체상 이온 수송이라는 각 기공의 이점을 유지하면서, 외부 표면에서의 부반응을 억제하고 에너지 밀도를 효과적으로 향상시킨다.

이를 통해 본 연구는 초기 쿨롱 효율 저하와 과도한 전해질 소모 등 기존 open porous 구조의 근본적 한계를 극복하고, 고 ICE, 고 에너지 및 고 출력 특성을 동시에 달성할 수 있는 하드카본 설계 전략을 제시한다.



황종국(아주대학교)

POSTECH 화학공학과 (학사) (2006-2010)

POSTECH 화학공학과 (박사) (2010-2016)

Max Planck Institute of Colloids and Interfaces (PostDoc) (2016-2018)

Utrecht University, Inorganic Chemistry and Catalysis (PostDoc) (2018-2020)

아주대학교 화학공학과 조교수/부교수 (2020-현재)

Invited Lecture **2L3-3**

에너지 부문위원회 II: 차세대 지속가능 그린 에너지 구현을 위한 첨단 소재 및 융합 혁신 기술 II (1)

2025.10.1(수), 11:40~12:05, 3회장

Chair: 최우혁

화학기상증착 기반의 실리콘 음극재 기술 개발 전략

채수종[†]

부경대학교

Silicon is an attractive anode material for next-generation rechargeable batteries because of its exceptional theoretical capacity ($\sim 3,579 \text{ mAh g}^{-1}$). However, its practical implementation remains hindered by severe $\sim 300\%$ volume change during (de)lithiation, fracture-induced electrical isolation, and intrinsically low electronic conductivity. Rational nanostructuring has emerged as the most effective way of overcoming these obstacles. Among the various synthesis routes, chemical vapor deposition (CVD) stands out for its ability to deliver ultrahigh-quality silicon. This presentation reviews recent advancements in CVD-based Si anodes aimed at mitigating the fundamental limitation. Building on these advances, we will also highlight a new generation of CVD-derived Si anode for all-solid-state batteries. Finally, this presentation will highlight the potential of CVD technologies as a platform for next-generation chemistries, broadening its scope beyond conventional Li-ion batteries.



채수종(부경대학교)

울산과학기술원 신소재공학/에너지공학 학사 (2014)

울산과학기술원 에너지공학 박사 (2019)

퍼시픽 노스웨스트 국립연구소 (Post-Doc) (2019-2021)

국립부경대학교 에너지화학소재공학전공 부교수 (2021-현재)

Invited Lecture **2L3-4**

에너지 부문위원회 II: 차세대 지속가능 그린 에너지 구현을 위한 첨단 소재 및 융합 혁신 기술 II (2)

2025.10.1(수), 14:00~14:25, 3회장

Chair: 김효원

Strategies for Enhancing the Stability of Anode-Free Lithium Metal Batteries

김수찬[†]

성균관대학교

Anode-free lithium metal batteries (AFLMBs) are promising candidates for achieving ultra-high energy densities. However, their practical application is critically limited by the instability of lithium deposition onto the current collector during the initial formation step, as well as the morphological and chemical degradation of lithium metal during cycling. Here, we systematically investigate strategies to enhance the cycling stability of AFLMBs, with a particular focus on their effects on initial lithium nucleation and long-term cycling behavior. These strategies include the design of novel current collectors, the introduction of artificial interphases, electrolyte optimization, and specially tailored cell formation protocols. Our results provide new insights into the interfacial and structural evolution of lithium metal and offer design guidelines for the development of stable AFLMB systems.



김수찬(성균관대학교)

123123 (123123-123123)

성균관대학교 화학공학부 (학사) (2009-2015)

성균관대학교 화학공학과 (석사) (2015-2017)

성균관대학교 화학공학과 (박사) (2018-2021)

University of Oxford (Post-Doc.) (2021-2023)

University of Cambridge (Postdoctoral Research Fellow) (2023-2024)

성균관대학교 화학공학부 (조교수) (2024-현재)

Invited Lecture **2L3-5**

에너지 부문위원회 II: 차세대 지속가능 그린 에너지 구현을 위한 첨단 소재 및 융합 혁신 기술 II (2)

2025.10.1(수), 14:25~14:50, 3회장

Chair: 김효원

Polyelectrolyte Multilayers on Anodes for Aqueous Zinc-Ion Batteries

구민수[†]

동아대학교

Aqueous zinc-ion batteries (AZIBs) are promising candidates for next-generation energy storage systems due to the abundance of zinc and the inherent safety of aqueous electrolytes. However, direct contact between the Zn anode and electrolyte often leads to dendritic growth and parasitic reactions, ultimately limiting cycle life. In this study, we report a strategy to stabilize the Zn anode via the application of polyelectrolyte multilayer coatings using a layer-by-layer (LbL) assembly technique. The LbL coatings facilitate Zn^{2+} ion diffusion and significantly lower the nucleation overpotential, thereby effectively suppressing dendrite formation. Furthermore, the coatings provide both ionic and electronic conductivity, contributing to enhanced electrochemical performance. This eco-friendly and scalable approach offers a viable route to improving the energy density and cycling stability of AZIBs, advancing their potential for industrial deployment.



구민수(동아대학교)

UNIST 나노생명화학공학부 (학사) (2009-2013)

UNIST 에너지공학과 (박사) (2013-2018)

연세대학교 화학과 (Post-Doc.) (2018-2019)

University of Texas at Austin 화학과(Post-Doc.) (2019-2021)

동아대학교 화학공학과 (조교수) (2021-현재)

Invited Lecture **2L3-6**

에너지 부문위원회 II: 차세대 지속가능 그린 에너지 구현을 위한 첨단 소재 및 융합 혁신 기술 II (2)

2025.10.1(수), 14:50~15:15, 3회장

Chair: 김효원

Strain, Cracks, and Interfaces: Understanding the Degradation in Polycrystalline and Single-Crystal Cathodes for Lithium Batteries

류훈희[†]

충남대학교

$\text{Li}[\text{Ni}_{1-x-y}\text{Co}_x(\text{Mn and/or Al})_y]\text{O}_2$ cathodes have become the dominant choice for rechargeable battery applications. Conventional cathode development has largely focused on increasing nickel content to boost energy density. However, cathodes with ultra-high Ni content face significant chemical and mechanical instability. One such strategy involves adopting single-crystal cathodes to eliminate interparticle grain boundaries, thereby reducing the formation of microcracks and enhancing thermal and cycling stability by minimizing surface degradation. Despite these advantages, single-crystal cathodes still face specific degradation challenges. This presentation provides a detailed comparative study of single-crystal and polycrystalline cathodes across a range of Ni-rich compositions. Structural evolution and electrochemical behavior are examined to elucidate the dominant capacity fading mechanisms in single-crystal systems compared to that in polycrystalline cathode.



류훈희(충남대학교)

한양대학교 에너지공학과 (학사) (2016)

한양대학교 에너지공학과 (박사) (2022)

한양대학교 에너지공학과 (Post-Doc) (2022-2023)

Lawrence Berkeley National Lab. (USA, Post-Doc) (2023-2024)

충남대학교 응용화학공학과 조교수 (2024-현재)

Invited Lecture **2L3-7**

에너지 부문위원회 II: 차세대 지속가능 그린 에너지 구현을 위한 첨단 소재 및 융합 혁신 기술 II (2)

2025.10.1(수), 15:15~15:35, 3회장

Chair: 김효원

Electrode modification strategies for high-performance batteries

박슬기[†]

School of Chemical Engineering

Lithium-ion (Li-ion) batteries (LIBs) and next-generation battery technology have both gained significant attention due to increasing demands for sustainable and high-performance energy storage. These technologies are being explored in electric vehicles (EVs), aviation, and energy storage systems (ESS).

The practical applicability of a battery is influenced by factors such as energy density, rate capability, lifespan, cost and eco-friendliness. Special attention is given to how electrode material design influences these metrics, to align research efforts with the requirements of practical battery application.

This work shows several approaches, including electrode surface modification, formation of composite architectures, conductive network design, and interface engineering to bring advanced materials closer to the conditions and constraints of practical battery applications.



박슬기(School of Chemical Engineering)

경희대학교 화학공학과 (학사) (2009-2013)

성균관대학교 화학공학과 (석박사) (2013-2019)

영국 캠브리지 대학교 (Post-Doc) (2019-2023)

스웨덴 노스볼트 (R&D 엔지니어) (2023-2025)

전북대학교 화학공학과 조교수 (2025-현재)

Invited Lecture **2L4-1**

기능성 고분자: 응용 맞춤형 기능성 소재 기술 (1)

2025.10.1(수), 10:50~11:15, 4회장

Chair: 서명은

Block Copolymer Assembly in Emulsions for Tunable Photonic Pigments

구강희[†]

UNIST

Block copolymer-based photonic colloids offer a sustainable and tunable platform for structural coloration, yet challenges remain in achieving diverse morphologies, dynamic responsiveness, and scalable fabrication. This talk introduces a unified strategy to construct three-dimensional photonic microparticles using linear amphiphilic block copolymers through emulsion-driven self-assembly. By tuning interfacial conditions, solvent evaporation, and molecular composition, we realize both disordered porous structures for angle-independent color and highly ordered lamellar architectures for directional optical responses. Incorporation of stimuli-responsive elements further enables reversible color modulation under external triggers such as pH. These approaches provide a versatile route to photonic pigments with programmable structure-color relationships for applications in sensing, smart coatings, and optical devices.



구강희(UNIST)

KAIST 생명화학공학과 (학사) (2008-2012)

KAIST 생명화학공학과 (석사) (2012-2014)

KAIST 생명화학공학과 (박사) (2014-2018)

MIT 화학과 (박사후연구원) (2019-2020)

충남대학교 응용화학공학과 (조교수) (2020-2022)

UNIST 에너지화학공학과 (조교수) (2022-현재)

Invited Lecture **2L4-2**

기능성 고분자: 응용 맞춤형 기능성 소재 기술 (1)

2025.10.1(수), 11:15~11:35, 4회장

Chair: 서명은

Synthesis and Thermo-Responsive Behavior of Well-Defined, Low-Molecular-Weight Polyethersulfone

김태형[†]

한국화학연구원

Thermo-responsive polymers attract interest as smart materials that undergo physical or chemical changes with temperature. While their aqueous behavior is well studied, responses in organic solvents are less explored. This study examines the thermo-responsive behavior of poly(ether sulfone) (PES) in organic media. End-group modification and molecular weight control via chain-growth condensation polymerization enabled precise tuning of the cloud point temperature, especially in low-molecular-weight PES due to free volume effects. Solvent affinity was also evaluated by varying non-solvent species and concentrations. The system responded to the hydrogenation state of benzene derivatives with similar ring structures but different aromaticity. An electrochemical method was developed to monitor phase transitions, showing that redox species diffusion is hindered. These findings suggest the potential of thermo-responsive PES for applications in electrochemical systems using organic solvents.



김태형(한국화학연구원)

성균관대학교 화학과 (학사) (2012-2016)

한국과학기술원 (KAIST) 화학과(박사) (2016-2022)

한국과학기술원 (KAIST) 자연과학연구소 (Post-Doc.) (2022-2023)

University of Minnesota (Post-Doc.) (2023-2025)

한국화학연구원 고기능고분자연구센터 (선임연구원) (2025-현재)

Invited Lecture **2L4-3**

기능성 고분자: 응용 맞춤형 기능성 소재 기술 (1)

2025.10.1(수), 11:35~12:00, 4회장

Chair: 서명은

Three-Dimensional Adaptive Energy Devices for Intelligent Energy Management

김봉훈[†], 이수연, 진호준

DGIST

Solar heating and radiative cooling can reduce energy use by utilizing the Sun (~5800 K) and outer space (~3 K) as natural heat sources and sinks, but single-mode operation limits their adaptability. This study introduces reversible thermal devices using 3D structures assembled via mechanical guidance. These devices enable: i) dual-mode switching via uniaxial strain, ii) integration of rigid/soft materials through optimized design, and iii) thermal control on macro- and microscales. Using black paint-coated PI for heating and PDMS/silver/PI multilayers for cooling, they reach 59.5 °C and -11.9 °C. Mode changes by 3D angle and performance on various substrates are also demonstrated.



김봉훈(DGIST)

고려대학교 신소재공학과 학사 졸업 (1998-2005)

KAIST 신소재공학과 석사 졸업 (2005-2007)

KAIST 신소재공학과 박사 졸업 (2007-2012)

KAIST / UIUC / Northwestern University 신소재공학과 박사후 연구원 (2012-2019)

숭실대학교 유기신소재파이버공학과 조교수 (2019-2022)

DGIST 로봇및기계전자공학과 부교수 (2022-현재)

Invited Lecture **2L4-4**

기능성 고분자: 응용 맞춤형 기능성 소재 기술 (1)

2025.10.1(수), 12:00~12:25, 4회장

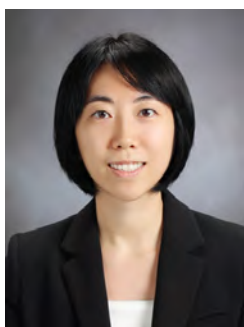
Chair: 서명은

Tailored reactivity of pentafluorophenyl ester based copolymers for coating and bioimaging applications

Sheng Li[†]

KAIST

We synthesize pentafluorophenyl (PFP) ester based polymers as reactive precursors and use them to prepare copolymers for applications as antifouling coatings and fluorescent polymers for bioimaging. In the first example, we prepare copolymers with both fouling-resistant and fouling-release properties by grafting poly(ethylene glycol) (PEG) and poly(dimethylsiloxane) (PDMS) onto a poly(pentafluorophenyl acrylate) (PPFPA) precursor. By tuning the side-chain composition, the antifouling performance of the coating can be optimized to target foulants of different sizes. In the second example, PPFPA is used to create fluorescent polymers by grafting NIR dye molecules. At an optimized dye loading, spherical nanoparticles with enhanced fluorescent properties are achieved. Improved fluorescence signal detection following cellular internalization is demonstrated through in vitro imaging.



Sheng Li(KAIST)

B.S. MIT (2002)

M.S. MIT (2003)

Ph.D Princeton University (2013)

Post-Doc. Seoul National University (2013-2014)

Research Investigator, Central R&D, Dupont (2014-2015)

Assistant Professor, Dept. of Chemical and Biomolecular Engineering, KAIST (2016-2021)

Associate Professor, Dept. of Chemical and Biomolecular Engineering, KAIST (2021-Present)

Invited Lecture **2L4-5**

기능성 고분자: 응용 맞춤형 기능성 소재 기술 (2)

2025.10.1(수), 14:00~14:25, 4회장

Chair: 이상호

Selective Polymeric Platforms for gold detection and upcycling

이형일[†]

울산대학교

In this presentation, the selective detection and separation of gold by polymeric materials from electronic wastes will be discussed. To the best of our knowledge, the current work presented in talk is the first example of the gold recovery from electronic wastes at ultra-high purity. The general strategy presented herein can potentially be used for the separation of precious metals and hazardous metals using polymeric platforms capable of the selective detection of various kinds of water-soluble analytes.



이형일(울산대학교)

한양대학교 공업화학과 (학사) (1998)

한양대학교 공업화학과 (석사) (2000)

Carnegie Mellon 대학교 화학과 (박사) (2007)

MIT 화학공학과 (Post-Doc) (2007-2009)

울산대학교 에너지화학공학부 교수 (2009-현재)

Invited Lecture **2L4-6**

기능성 고분자: 응용 맞춤형 기능성 소재 기술 (2)

2025.10.1(수), 14:25~14:50, 4회장

Chair: 이상호

Strategies for Polymer-Based High-Energy-Density Batteries

박수진[†]

포항공과대학교

There are various strategies to increase the energy density of rechargeable batteries including the fabrication of high-area-capacity electrode and Li metal batteries. First, I introduce a covalently interconnected system employing silicon microparticles and a highly elastic gel polymer electrolyte. Through the cost-effective but practical approach of electron beam technology, the resulting pouch cell showed exceptional stability and high gravimetric energy densities of 413 Wh/kg. As the second topic, Li metal anode emerges as a promising candidate for Li-based chemistry with high-energy-density. I introduce an innovative Li metal anode model deploying a hyperporous conductive architecture on CNT film, fabricated through a nonsolvent induced phase separation process. This design integrates ionic polymers with conductive carbon, offering a substantial improvement over traditional current collectors by reducing the weight of Li metal anode.



박수진(포항공과대학교)

경희대학교 화학과 (학사) (1992-1996)

포항공과대학교 화학과 (석사) (1996-1998)

포항공과대학교 화학과 (박사) (2000-2003)

Univ. of Massachusetts at Amherst (Post-Doc.) (2006-2008)

울산과학기술원 에너지화학공학부 조/부/교수 (2009-2018)

포항공과대학교 화학과 교수 (2018-현재)

Invited Lecture **2L4-7**

기능성 고분자: 응용 맞춤형 기능성 소재 기술 (2)

2025.10.1(수), 14:50~15:15, 4회장

Chair: 이상호

Molecular Lithium Sensors Based on ^{19}F NMR Spectroscopy and Photophysical Changes

구병진[†]

단국대학교

With the advancement of lithium-related technologies, detecting lithium through various methods has become increasingly important for future applications. In this seminar, I will present our laboratory's recent efforts in developing molecular lithium sensors. First, we have developed ^{19}F NMR-based lithium detection. By utilizing crown ethers capable of binding lithium and fluorine reporters, we can detect lithium by monitoring electronic changes around the fluorine atoms, which leads to a change in the ^{19}F NMR chemical shift. Second, we have explored naphthoxazoline derivatives as lithium-responsive materials. They exhibit photophysical changes upon lithium binding through the modulation of conjugation, enabling lithium detection without the use of crown ethers. This approach is more economical and potentially scalable for large-scale production. We currently aim to polymerize these sensing units to fabricate colorimetric functional polymer films that detect lithium.



구병진(단국대학교)

서울대학교 재료공학부 (학사) (2005-2012)

MIT 재료공학과 (박사) (2017)

UC Berkeley 화학과 (Post-Doc) (2017-2020)

단국대학교 고분자시스템공학부 조교수 (2020-현재)

Invited Lecture **2L4-8**

기능성 고분자: 응용 맞춤형 기능성 소재 기술 (2)

2025.10.1(수), 15:15~15:40, 4회장

Chair: 이상호

Mechanochemistry for Circular Polymer Chemistry: From Laboratory Polymers to Industrial Plastics

김병수[†]

연세대학교

Mechanochemistry has emerged as a solvent-free platform in polymer chemistry, offering sustainable routes for polymer synthesis and degradation. This presentation outlines mechanochemical strategies for circular polymer chemistry, spanning from laboratory-scale synthesis to real-world plastic recycling. Polyethers and poly(methyl methacrylate) derivatives were synthesized via solid-state polymerizations using various monomers. Building on these insights, mechanochemical degradation strategies were applied to poly(vinyl chloride) (PVC) and poly(ethylene terephthalate) (PET). Through sequential dehydrochlorination and epoxidation, oxirane mechanophores were incorporated into PVC, enabling force-induced degradation into water-soluble fragments. PET was depolymerized into terephthalic acid under basic conditions. Selective depolymerization was achieved even in PVC/PET mixtures. This presentation highlights the potential of mechanochemistry in advancing circular polymer technologies.



김병수(연세대학교)

서울대학교 화학과 (학사) (1994-1999)

서울대학교 화학과 (석사) (1999-2001)

University of Minnesota, Twin Cities (Ph.D.) (2001-2007)

MIT (Postdoctoral Research Associate) (2007-2009)

울산과학기술원 (조교수, 부교수) (2009-2018)

연세대학교 화학과 (언더우드 특훈교수) (2018-현재)

Oral Presentation **204-1**

기능성 고분자: 응용 맞춤형 기능성 소재 기술 (2)

2025.10.1(수), 15:40~16:00, 4회장

Chair: 이상호

Pseudo-DSMC Simulation of Gas-Surface Interactions on GNW-Deposited Polymer Substrates: Ergodicity and Trapping-Induced Reactivity

이승엽[†], 최혁주¹

한국생산기술연구원

¹ 대구경북과학기술원

Gas-surface interactions on graphene nanowall (GNW) structures deposited on flexible polyimide (PI) substrates were investigated using a pseudo-direct simulation Monte Carlo (pseudo-DSMC) method. Realistic GNW deposition patterns were extracted from SEM images and applied to trajectory-resolved particle simulations to evaluate gas accessibility and contact behavior on complex interfaces. Spatial contact histograms revealed that certain morphologies promote localized molecular trapping and enhanced residence times, indicating that surface reactivity can be modulated by geometric confinement alone. These results suggest that controlling GNW deposition geometry provides an effective strategy for improving the functional performance of polymer-based surfaces in applications such as gas capture, sensing, or catalysis.

Invited Lecture **2L5-1**

글로벌 환경규제 대응을 위한 지속가능 기능성 고분자 및 복합소재 (1)

2025.10.1(수), 10:50~11:15, 5회장

Chair: 김동균

글로벌 환경규제 대응을 위한 자동차용 친환경 소재 기술 동향

이평찬[†]

한국자동차연구원

전 세계적인 지속성장 가능한 사회 실현을 위한 환경 규제 강화는 소재 혁신과 기술 개발의 압력으로 작용하고 있다. 유럽과 미국은 생산자 책임 재활용 제도를 시행하고 있으며 생산자에게 재활용이 가능한 폐기물 일정량을 재활용하도록 의무화 하고 있으며, 생산단계에서부터 재활용이 가능하게끔 설계를 의무화하도록 규제하고 있다. 자동차 산업에 있어서도 EU 집행위원회에서 차량 폐기물 관리 및 순환성 요건 강화를 위해 EU 폐차처리 지침 개정안을 공개하였다. 신차 함유 재활용 플라스틱 비율과 폐차 재활용 시 플라스틱 재활용 비율 규정을 강화하여 산업적인 대응이 필요한 상황이다. 이 뿐 아니라 주요국들은 환경인체유해성이 입증된 소재에 대한 사용규제를 시행 중이며 이에 따른 소재 및 부품화 기술개발이 요구되고 있다. 이에 따라, 국내외 산업환경에 적극적으로 대응할 수 있는 자동차용 친환경 소재 기술을 혁신하여 미래 모빌리티 소재부품 신시장을 선점할 필요가 있다.



이평찬(한국자동차연구원)

성균관대학교 고분자공학과(학사) (2000-2005)

성균관대학교 고분자공학과(석사) (2005-2007)

성균관대학교 고분자공학과(박사) (2007-2012)

한국자동차연구원 (2009-현재)

Invited Lecture **2L5-2**

글로벌 환경규제 대응을 위한 지속가능 기능성 고분자 및 복합소재 (1)

2025.10.1(수), 11:15~11:40, 5회장

Chair: 김동균

Sustainable Specialty Chemicals in the Era of Environmental Regulation and Circular Economy

김진철[†]

한국화학연구원

Stricter global regulations, such as CMR substance restrictions and ELV directives, are accelerating the transition toward sustainable specialty polymers. This study presents the development of CMR-free, environmentally compliant polymer systems utilizing dynamic polymer networks (DPNs) based on covalent adaptive chemistry. These materials exhibit thermal reprocessability, self-healing, and closed-loop recyclability, making them suitable for applications in foams, films, and structural sheets. By enabling depolymerization and selective additive removal, these systems support circular economy goals without compromising performance. The approach offers a versatile platform for designing next-generation specialty materials for automotive, electronics, and packaging sectors, aligning functionality with regulatory and environmental demands



김진철(한국화학연구원)

경북대학교 고분자공학과(학사) (2000-2005)

POSTECH 신소재공학과(석사) (2005-2007)

POSTECH 화학과(박사) (2007-2012)

미네소타대학교 화학과(Posdoc) (2012-2013)

한국화학연구원 선임연구원 (2013-2021)

한국화학연구원 책임연구원 (2021-현재)

Invited Lecture **2L5-3**

글로벌 환경규제 대응을 위한 지속가능 기능성 고분자 및 복합소재 (1)

2025.10.1(수), 11:40~12:05, 5회장

Chair: 김동균

생활계 및 폐차 유래 소재 기반 복합소재의 자동차용 부품화 기술 연구

정도연[†]

BGF에코머티리얼즈

자동차산업은 탄소 감축의무가 있는 타산업과 마찬가지로 순환경제 이행방안을 채택하여 생활계 재활용 소재를 비롯한 차량 순환성을 높이기 위하여 ELV(End of Life Vehicle) 폐차 부품 재사용, 재활용을 높이기 위하여 재생소재 사용을 촉진하기 위해 순환성을 높이는 설계를 강제화 하고 있다. 이를 통해 폐차되는 차량이 순환자원으로 관리 될 수 있도록 하여, 신차 제조시 재활용 소재가 많이 활용되고, 관련된 밸류체인 구축을 촉진하도록 설계되고 있는 실정이다.

국내에는 폐차유래 폴리프로필렌 외장류 등 부품 자원화 등으로 이미 상업화가 진행중에 있으나 해체가 어려운 내장류는 ARA(Auto Recycle Agency)를 통해서 폐소스 수거가 24년 초부터 가능한 실정이다. 이전까지는 비유가성으로 인하여 자원화가 이루어 지고 있다가 EU-ELV 정책에 대응하고자 현대기아에서 생산자책임재활용으로 시행해 오던 기관을 활용하여 첫발을 내딛었다.

본 연구에서는 생활계 유래 폴리올레핀계 소재 와 폐차유래 내장류의 폴리프로필렌 소재를 비롯, 엔진룸에서의 수거된 폴리아마이드 소스를 활용하고자 연구개발을 하였다.



정도연(BGF에코머티리얼즈)

코원이노텍 (책임) (2005-2014)

BGF에코머티리얼즈 (수석) (2014-현재)

Invited Lecture **2L5-4**

글로벌 환경규제 대응을 위한 지속가능 기능성 고분자 및 복합소재 (1)

2025.10.1(수), 12:05~12:30, 5회장

Chair: 김동균

지속가능한 불소고분자 산업 전략

손은호⁺

한국화학연구원

불소고분자 재료는 낮은 표면에너지, 탁월한 오염 방지 및 내열성, 뛰어난 화학적 안정성과 내약품성을 지니고 있다. 이러한 특성 덕분에 불소고분자는 전기전자, 반도체, 디스플레이, 자동차 등 핵심 기간 산업에서 제품의 고기능화, 고성능화, 고부가가치화를 실현하는 데 필수적인 핵심 소재로 폭넓게 활용되어 왔다.

그러나 2023년 유럽연합의 전방위적인 과불화화합물(PFAS) 규제안 발표는 국내외 관련 산업에 상당한 혼란과 불확실성을 야기했다. 당시 명확한 대안이나 구체적인 미래 전략 없이 갑작스럽게 발표된 규제안으로 인해 많은 기업들이 어려움을 겪었으나, 그동안 관련 업계 종사자들의 심도 깊은 논의와 고민을 통해 향후 나아가야 할 방향에 대한 공감대와 아이디어들을 도출해왔다.

본 발표에서는 이러한 변화의 흐름 속에서 지속가능한 불소고분자 산업을 구축하기 위해 우리가 어떠한 전략을 수립하고 실행해야 할지에 대해 함께 모색하는 시간을 갖고자 한다.



손은호(한국화학연구원)

인하대학교 화공고분자생물공학부 (학사) (1998-2002)

서울대학교 화학생물공학부 (석사/박사) (2003-2010)

경희대학교 공과대학 박사후연구원 (2010-2011)

임페리얼컬리지런던 화학과 박사후연구원 (2011-2012)

한국화학연구원 선임/책임연구원 (2012-현재)

한국화학연구원 계면재료화학공정연구센터 센터장 (2019-현재)

Invited Lecture **2L5-5**

글로벌 환경규제 대응을 위한 지속가능 기능성 고분자 및 복합소재 (2)

2025.10.1(수), 14:00~14:25, 5회장

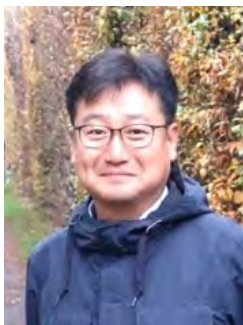
Chair: 노상철

엔지니어링 소재를 위한 생분해성 바이오복합재 개발

심봉섭[†]

인하대학교

엔지니어링 및 전자 플라스틱은 비분해성으로 인해 심각한 환경 문제를 야기합니다. 본 연구에서는 미생물 분해 기술과 바이오 복합재를 결합한 새로운 통합 전략을 제안합니다. 슈퍼웜의 장내 미생물 군집이 플라스틱을 탄소원으로 사용하여 엔지니어링 플라스틱을 분해할 수 있는 효소 능력을 갖추고 있음을 규명했습니다. 분광학적 분석을 통해 고분자 사슬의 분해를 확인하였습니다. 보강재 역할을 하는 셀룰로오스 나노섬유, 생체모방 접착제이자 전도성 물질인 폴리도파민, 구조적 완결성을 높이는 층상 규산염 점토를 포함하는 새로운 바이오 복합재를 설계 및 제작했습니다.



심봉섭(인하대학교)

고려대학교 화학공학과 (학사) (1993-1999)

University of Michigan, 화학공학과 (박사) (2002-2009)

University of Delaware, 포스닥 (2009-2011)

인하대학교 화학공학과 교수 (2011-현재)

Invited Lecture **2L5-6**

글로벌 환경규제 대응을 위한 지속가능 기능성 고분자 및 복합소재 (2)

2025.10.1(수), 14:25~14:50, 5회장

Chair: 노상철

Eco-Friendly Functional Composites Based on Water-Borne Polyimides: From Molecular Design to Advanced Applications

김윤호[†]

한국화학연구원

The demand for sustainable and high-performance materials has increased interest in water-borne polyimide (W-PI) systems. Unlike conventional polyimides made with toxic solvents, W-PIs use poly(amic acid) salt (PAAS) chemistry in water, enabling green and energy-efficient processing. This study presents a platform for functional W-PI composites, from surfactant-assisted polymerization of aromatic monomers to eco-friendly nanocomposite fabrication. By tuning molecular structures and interfaces, W-PIs show excellent compatibility with fillers such as porous silica, graphene nanoribbons, and 2D siloxene, leading to low-dielectric insulators, conductive films, and lithium-ion battery binders. W-PI films with high dielectric strength also show potential in electronics. The resulting materials match or exceed the performance of solvent-based systems while reducing environmental impact.



김윤호(한국화학연구원)

KAIST 생명화학공학과 (학사) (2003)

KAIST 생명화학공학과 (석사) (2006)

KAIST 생명화학공학과 (박사) (2006-2010)

Washington Univ. in St. Louis (Post-Doc) (2010-2011)

한국화학연구원 선임/책임연구원 (2011-현재)

Invited Lecture **2L5-7**

글로벌 환경규제 대응을 위한 지속가능 기능성 고분자 및 복합소재 (2)

2025.10.1(수), 14:50~15:15, 5회장

Chair: 노상철

Polarity-Switchable Maleic Anhydride-Containing Copolymer for VOC-Free Polymer Coating Applications

김채빈⁺

부산대학교

Global environmental concerns are driving efforts to reduce the use of toxic and volatile organic compounds (VOCs) in polymer coatings. While water and/or ethanol are considered eco-friendly alternatives, they are primarily used with hydrophilic polymers, which often lack durability in humid environments. To address this limitation, a polarity-switchable copolymer containing maleic anhydride (MA) was developed. Base-induced ring opening renders the copolymer hydrophilic and water-soluble, enabling the formulation of water-based coatings. Subsequent heat treatment restores its hydrophobicity, ensuring robust performance. Various MA-containing copolymers have been developed for applications including anti-icing coatings and pressure-sensitive adhesives aimed at removing microplastics from water. These polymers completely eliminate the need for organic solvents, offering an eco-friendly solution and enabling large-scale spray applications without odor.



김채빈(부산대학교)

University of Minnesota Twin Cities, 화학공학과 (학사) (2009-2011)

University of Texas at Austin 화학공학과 (박사) (2012-2016)

한국과학기술연구원(KIST) 위촉연구원 (2016-2019)

부산대학교 고분자공학과 부교수 (2019-현재)

Invited Lecture **2L5-8**

글로벌 환경규제 대응을 위한 지속가능 기능성 고분자 및 복합소재 (2)

2025.10.1(수), 15:15~15:40, 5회장

Chair: 노상철

Polymers with Dynamic Covalent Bonds for Addressing Global Environmental Regulations and Enabling a Sustainable Future

박성민[†]

한국화학연구원

The increasing stringency of global environmental regulations including carbon neutrality targets, and directives for circular resource use, demands materials that combine high performance with sustainability. Dynamic covalent bond (DCB)-based polymers have emerged as promising candidates to address these challenges by integrating the robustness with the reprocessability. In this presentation, polymer structure design strategies that govern the dynamic behavior of DCB polymers will be discussed, with a focus on how these features can be tailored to meet the stringent requirements of relevant applications. Furthermore, recent progress in developing closed-loop recycling pathways will be highlighted as a key enabler of sustainable material solutions. By bridging fundamental understanding with practical applications, this work aims to illustrate how DCB polymers can drive environmentally compliant technologies and support the transition to a sustainable future.



박성민(한국화학연구원)

연세대학교 화학공학과 (학사) (2011)

연세대학교 화공생명공학과 (박사) (2017)

Rensselaer Polytechnic Institute 화공과/화학과 (Post-doc) (2017-2019)

한국화학연구원 선임/책임연구원 (2019-현재)

Invited Lecture **2L6-1**

고분자가공/복합재료/재활용: 극한 환경 고분자 복합재료 및 공정 (1)

2025.10.1(수), 10:50~11:15, 6회장

Chair: 홍성우

극저온 및 초고온 우주환경 대응 탄소복합재 기술 개발

이진우[†], 김상우, 고민정, 김윤상, 엄문광, 오영석, 신재성¹

한국재료연구원

¹ 한국항공우주연구원

탄소복합재는 낮은 밀도와 우수한 기계적 특성으로 인해 자동차, 항공/우주, 풍력발전, 조선/해양, 스포츠/레저 분야 등 다양한 산업에 걸쳐 사용되고 있다. 탄소복합재를 우주 분야에서 적용할 때 극저온에서 초고온 까지 극한의 환경에 대응할 수 있는 성능이 추가적으로 요구된다. 예를 들어, 우주 발사체의 추진제를 보관하는 탱크의 경우, 액체 산소의 극저온에도 인성을 유지할 수 있는 탄소복합재가 요구된다. 위성체의 구조부품에 사용되는 탄소복합재는 지구궤도의 넓은 온도 변화에도 내열성과 치수안정성을 유지할 수 있어야 한다. 또한 지구 재진입 비행체는 공력가열에 의한 3000도 이상의 온도 상승에 대응할 수 있는 경량 열보호시스템 소재가 필요하다. 그러나 이러한 극한환경은 기존 고분자 기지 및 섬유 보강제로는 한계를 가지기 때문에 새로운 탄소복합재용 소재 개발이 필요하다. 본 연구에서는 우주환경에 대응할 수 있는 탄소복합재를 위한 소재 및 공정기술을 개발하고 극한환경에서 그 성능을 평가하였다. 이를 통해 국내 개발 탄소복합재의 우주 분야에서의 적용 가능성과 활용성을 제고하고자 한다.



이진우(한국재료연구원)

한양대학교 공업화학과 (학사) (1999)

광주과학기술원 신소재공학과 (석사) (2001)

한국과학기술원 생명화학공학과 (박사) (2014)

LG화학 연구소 (2001-2005)

한국재료연구원 복합재료연구본부 책임연구원 (2006-현재)

Invited Lecture **2L6-2**

고분자가공/복합재료/재활용: 극한 환경 고분자 복합재료 및 공정 (1)

2025.10.1(수), 11:15~11:40, 6회장

Chair: 홍성우

나노 재료의 항공 우주 시스템 적용 연구 소개

장종태[†], 심규진, 김진원

한국항공우주연구원

맥신이나 그래핀 등의 최신 나노 재료가 개발되어 여러 산업에서 적용되고 있으며 항공우주 분야에도 그 적용이 시도되고 있다. 본 논문에서는 나노 재료를 항공우주 시스템에 적용하고 있는 연구 과제의 사례를 소개하며, 또한 나노 재료가 특히 진공과 극한의 온도를 가진 우주에서 사용되기 위해 고려해야 하는 우주 환경에 대한 기본적인 이해를 추가적으로 소개하고자 한다.



장종태(한국항공우주연구원)

충남대학교 전자공학과 (학사) (1997)

충남대학교 전자공학과 (석사) (1999)

(주)대화산기 기술연구소 주임연구원 (1999-2004)

충남대학교 전자공학과 (박사) (2017)

미국 NASA JPL 방문연구원 (2018)

한국항공우주연구원 우주탐사연구센터 책임연구원 (2004-현재)

Invited Lecture **2L6-3**

고분자가공/복합재료/재활용: 극한 환경 고분자 복합재료 및 공정 (1)

2025.10.1(수), 11:40~12:05, 6회장

Chair: 홍성우

Sustainable Functional Space Composites Materials with Atomic Oxygen (AO) Protection for Very Low Earth Orbit (VLEO) Conditions

남영우[†]

한국항공대학교

This study evaluates the potential application of oxide/oxide ceramic matrix composites for stealth satellites operating in the Very Low Earth Orbit (VLEO) environment below 450 km above the Earth's surface. VLEO offers advantages such as reduced communication latency and high-resolution, real-time data transmission due to its proximity to Earth. However, the harsh conditions in VLEO, including high atmospheric drag, extreme thermal cycles (-150 to 150 °C), intense ultraviolet (UV) radiation (100 ~ 400 nm), and material degradation from atomic oxygen (AO flux: 10^{14} ~ 10^{16} atoms/cm²s, kinetic energy 5.3 eV) pose significant challenges for satellite materials. A simulated VLEO environment test was conducted using a facility capable of generating ultra-high vacuum ($\sim 10^{-6}$ Torr), AO flux (1.35×10^{17} atoms/cm²s), thermal cycling (-80 to 150 °C), UV radiation (280~420 nm), thermal cycling (-80 to 150 °C).



남영우(한국항공대학교)

한국항공대학교 항공우주공학과 (학사) (2012)

KAIST 항공우주공학과 (석사) (2014)

KAIST 항공우주공학과 (박사) (2018)

KAIST 기계기술연구소 (Post-Doc) (2018)

경상국립대학교 기계항공공학부 조교수/부교수 (2018-2021)

한국항공대학교 스마트드론공학과/항공우주 및 기계공학과 일반대학원 부교수 (2023-현재)

Invited Lecture **2L6-4**

고분자가공/복합재료/재활용: 극한 환경 고분자 복합재료 및 공정 (1)

2025.10.1(수), 12:05~12:30, 6회장

Chair: 홍성우

Development of Silica Network Structure in Tire Rubber Composites for Electric Vehicles using Telechelic Polybutadiene

임기원[†]

한국타이어

운송 부문은 지구 온난화의 주요 원인인 온실가스의 가장 큰 배출원 중 하나로서 내연기관에서 전기차로의 전환은 필수입니다. 하지만, 타이어 산업 측면에는 전기차의 독특한 설계 및 작동 요소로 인해 속성 간의 트레이드-오프 관계인 내마모성과 구름 저항을 동시에 개선하면서도 그립 성능을 유지해야하는 상당한 도전 과제를 제시하고 있습니다. 본 연구에서는 타이어용 고무 복합체에 실란-중결된 텔레켈릭 폴리부타디엔과 실란 커플링제를 결합하여 새로운 개방형 구조 실리카 네트워크를 형성함으로써 실리카 네트워크의 미세 분산이 현저히 개선시키고 폴리머-필러 상호작용을 크게 증대시켰습니다. 또한, 제안된 복합체는 젖은 노면 접지력을 유지하면서 기계적 강성, 내마모성 및 구름 저항 측면에서 상당한 성능 향상을 나타내었습니다. 이를 통해 EV의 특수한 요구 조건을 충족하면서도 환경 친화적이고 고성능의 타이어 솔루션에 이바지 할 것으로 기대됩니다.



임기원(한국타이어)

충남대학교 정밀공업화학과 (학사) (1995-2002)

충남대학교 공업화학과 (석사) (2002-2004)

고려대학교 화공생명공학과 (박사) (2020-2025)

한국타이어 중앙연구소 프로젝트 리더 (수석연구원) (2003-현재)

Invited Lecture **2L6-5**

고분자가공/복합재료/재활용: 극한 환경 고분자 복합재료 및 공정 (2)

2025.10.1(수), 14:00~14:25, 6회장

Chair: 김진철

Neutron shielding composites for space applications

안석훈[†]

KIST

Boron Nitride Nanotubes (BNNTs) have emerged as a material of significant interest for aerospace applications due to their exceptional thermal stability, mechanical strength, and unique ability to shield against radiation. These properties make BNNT composites particularly suitable for the harsh conditions encountered in space. By integrating BNNTs into polymer matrices, we achieved composites that exhibit enhanced thermal conductivity and neutron shielding properties, crucial for maintaining structural integrity in extreme temperatures and shielding against cosmic radiation. Our research demonstrates that BNNT composites can significantly improve the lifespan and reliability, offering a promising solution for next-generation space missions. Furthermore, the high aspect ratio and lightweight nature of BNNTs contribute to the overall efficiency and performance of aerospace vehicles, highlighting their potential to revolutionize the field of space engineering.



안석훈(KIST)

한양대학교 화학과 (학사) (1998)

한양대학교 화학과 (석사) (2000)

미시건대학교 화학과 (박사) (2011)

콜럼비아대학교 화학과 (Post Doc) (2011-2012)

한국과학기술연구원 책임연구원 (2013-현재)

KIST 기능성복합소재연구센터 센터장 (2025-현재)

Invited Lecture **2L6-6**

고분자가공/복합재료/재활용: 극한 환경 고분자 복합재료 및 공정 (2)

2025.10.1(수), 14:25~14:50, 6회장

Chair: 김진철

Polyimide Materials Innovation for Thin and High-Integration Applications

백승열⁺

피아이첨단소재

모바일 및 전자기기의 소형화·초박형화, 고집적·고성능화가 가속화됨에 따라 고기능성 폴리이미드 소재의 수요가 증가하고 있다. 폴리이미드는 우수한 치수 안정성, 내열성, 낮은 열팽창계수 등의 특성을 바탕으로 다양한 첨단 응용 분야에서 핵심 소재로 활용되고 있다. 본 발표에서는 고유전율, 저유전손실 등 물성 향상을 위한 분자 설계 및 공정 기술의 최신 동향을 소개하고, 차세대 모바일 및 고집적 시스템 구현을 위한 폴리이미드 소재의 역할과 기술적 과제를 제시한다.



백승열(피아이첨단소재)

한양대학교 분자시스템공학(학사) (1999-2009)

한양대학교 유기나노공학과(석사) (2010-2012)

피아이첨단소재 IT개발1팀 팀장 (2012-현재)

Invited Lecture **2L6-7**

고분자가공/복합재료/재활용: 극한 환경 고분자 복합재료 및 공정 (2)

2025.10.1(수), 14:50~15:15, 6회장

Chair: 김진철

Additive Manufacturing with Silicone, Polydicyclopentadiene, and Composites via Heating at a Patterned Photothermal Interfaces (HAPPI)

이창욱, Kyle C. H. Chin, Samuel Leguizamon¹, Brad H. Jones¹, Oleg Davydovich¹, David Hayne², Margaret E. Tetzloff, Daria Rudykh, Luke Henderson², Andrew J. Boydston[†]

University of Wisconsin-Madison

¹ Sandia National Laboratories, Albuquerque

² Deakin University

We report a new technology, heating at a patterned photothermal interface (HAPPI), which achieves additive manufacturing (AM) of thermoset resins. In HAPPI AM, the patterned light dictates the pattern of heat on the bottom of the vat, which is translated into a thermally cured resin layer. We describe the HAPPI printing using a commercial Sylgard 184 polydimethylsiloxane resin. We further discuss commercialization of HAPPI technology with medical grade silicone to prosthetic and orthotic markets. Additionally, we report AM of polydicyclopentadiene (pDCPD) and pDCPD-carbon fiber composites using encapsulated Grubbs-type catalyst particles. Incorporating carbon fibers in the pDCPD matrices enhanced Young's modulus and ultimate strength in HAPPI samples, with maximum observed increases of 220% and 170%, respectively. We envision HAPPI AM to enable pathways to create 3D composite structures of other thermosets, such as urethanes, thiol-ene networks, and thiol-epoxide materials.



이창욱(University of Wisconsin-Madison)

부산대학교 고분자가공학과 (학사) (2004)

University of Tennessee 재료과(석사) (2006)

Louisiana State University 화학과(박사) (2013)

University of Kentucky, Center for Applied Energy Research (Post-Doc.) (2013-2014)

University of Washington 화학과 (Research Scientist) (2014-2018)

University of Wisconsin-Madison 화학과 Scientist II (2018-현재)

Invited Lecture **2L6-8**

고분자가공/복합재료/재활용: 극한 환경 고분자 복합재료 및 공정 (2)

2025.10.1(수), 15:15~15:40, 6회장

Chair: 김진철

Curing Kinetics, Processability, and Thermal Behavior of End-Capped Imide-Based Thermosets with Different Backbone Conformations

남기호[†]

경북대학교

Phenylethynyl-terminated imide (PETI) oligomers are high-performance thermosetting materials widely applied in films, adhesives, moldings, and composite matrices. Their tunable molecular weights and melt viscosities allow precise control of processing and end-use properties. Upon thermal curing, PETIs form ultra-rigid crosslinked networks, imparting exceptional thermal stability, solvent resistance, and mechanical performance. This presentation highlights recent advances in ultra-high-temperature PETI systems, emphasizing structure–property–processing relationships. It begins with a brief historical overview and key physicochemical attributes of PETIs, followed by a focused discussion on molecular design strategies employing noncoplanar monomers (e.g., kinked and cardo structures), fluorinated groups, flexible linkers, and liquid crystalline mesogens. The talk concludes with current challenges and prospective research directions for next-generation PETI-based materials.



남기호(경북대학교)

연세대학교 응용과학부 (학사) (2008-2012)

연세대학교 화공생명공학과 (박사) (2012-2020)

한국과학기술연구원 (연구원) (2015-2018)

University of Pittsburgh (박사후연구원) (2020-2021)

경북대학교 섬유시스템공학과 조교수 (2021-현재)

Invited Lecture **2L6-9**

고분자가공/복합재료/재활용: 극한 환경 고분자 복합재료 및 공정 (2)

2025.10.1(수), 15:40~16:05, 6회장

Chair: 김진철

고신뢰성 CAE기반 극한환경 대응 복합소재의 성능 예측 시뮬레이션

심지현[†]

DYETEC연구원

극한환경에 적용되는 복합재료 압력탱크는 필라멘트 와인딩 공정에서 발생하는 보이드(Void)로 인해 구조적 신뢰성 확보에 어려움이 있다. 따라서 결함이 성능에 미치는 영향을 정밀하게 예측하고, 이를 고려하여 설계 변수를 최적화하는 것은 고신뢰성 부품 개발에 있어 필수적이다.

이에 본 연구는 고신뢰성 CAE 기법과 인공지능을 융합한 통합 프레임워크를 제시한다. 우선 다상(multi-phase) 유한요소해석(FEA)을 통해 보이드의 체적, 위치, 분포가 기계적 물성 저하에 미치는 메커니즘을 정량적으로 규명하였다.

이를 바탕으로, FEA 데이터를 학습시킨 딥러닝(Deep Learning) 모델을 구축하여 필라멘트 와인딩의 핵심 변수인 섬유 배향 각도에 따른 내압 성능을 신속하게 예측하고, 내구성과 파열 압력을 최대화하는 최적의 각도 조합을 도출하였다. 본 연구는 물리 기반 시뮬레이션과 데이터 기반 최적화를 연계한 고도화된 방법론으로, 향후 고압 수소 저장 용기 등의 안전성과 신뢰성 향상에 기여할 것으로 기대된다.



심지현(DYETEC연구원)

충남대학교 유기소재 섬유시스템공학과(학사) (2008)

충남대학교 유기소재 섬유시스템공학과(석사) (2010)

한국건자재시험연구원(KCL) 연구원 (2010)

KS Q ISO/IEC 17025 측정불확도(시험분야) (2010)

경북대학교 섬유시스템공학과(박사) (2025)

다이텍연구원 디지털산업본부 본부장 (2025-현재)

Invited Lecture **2L6-10**

고분자가공/복합재료/재활용: 극한 환경 고분자 복합재료 및 공정 (2)

2025.10.1(수), 16:05~16:25, 6회장

Chair: 김진철

Mechanically Robust and Flexible Polymers by Molecular Weaving

권준표[†]

아주대학교

Polymer chain entanglements help determine the mechanical characteristics of polymeric materials. Here, the study of 3D molecularly woven covalent organic frameworks (COFs) to induce polymer chain threading is introduced. When incorporated into a polyimide matrix, COF nanocrystals can template its chain conformation and modulate the range of intermolecular interactions by forming polymer-COF junctions. The large pore sizes and high degrees of freedom achieved through molecular weaving allow for the spatial arrangement of polymer strands. This offers a programmable pathway for unthreading polymer chains under stress, resulting in the enhancement of the strength, ductility, and toughness of the composites.



권준표(아주대학교)

고려대학교 기계공학부(학사) (2013)

고려대학교 기계공학과(석사) (2016)

UC Berkeley 기계공학과(박사) (2022)

막스플랑크연구소 생체재료(Post-Doc.) (2022-2025)

아주대학교 기계공학과 조교수 (2025-현재)

Invited Lecture **2L7-1**

고분자구조 및 물성: 고기능 소재의 구조-물성 상관관계 및 지속가능 응용 (1)

2025.10.1(수), 10:50~11:15, 7회장

Chair: 박재홍

Rational Design of Block Copolymers for Tailoring Mesoporous Carbons toward Efficient Catalyst Support

진형민[†]

충남대학교

Block copolymers (BCPs) offer a versatile platform for designing mesoporous carbon materials as efficient catalyst supports. As a first step, we designed and synthesized a porogen-containing BCP, which enabled mesoporous carbon formation via simple pyrolysis. Homopolymer blending further induced bimodal phase separation, yielding hierarchical pore structures. To further enable direct and uniform metallic catalyst incorporation, pyridine-functionalized BCPs were rationally designed and synthesized to introduce coordinating ligand sites for selective metal ion binding. Upon vapor-induced phase separation (VIPS) and pyrolysis, well-organized hierarchical porous architectures with uniformly dispersed Pt nanoparticles were obtained. Finally, electrospun nanofibers derived from the same BCP enabled the fabrication of nitrogen-doped carbon supports with confined, catalytically active metal nanoparticles.



진형민(충남대학교)

연세대학교 금속시스템공학과 (학사) (2011)

KAIST 신소재공학과 (석사) (2013)

KAIST 신소재공학과 (박사) (2017)

KAIST 응용과학연구소 박사후연구원 (2017-2018)

시카고대학교 박사후연구원 (2018-2018)

한국원자력연구원 선임연구원 (2019-2022)

충남대학교 유기재료공학과 조교수 (2022-현재)

Invited Lecture **2L7-2**

고분자구조 및 물성: 고기능 소재의 구조-물성 상관관계 및 지속가능 응용 (1)

2025.10.1(수), 11:15~11:40, 7회장

Chair: 박재홍

Application of 2D IR to Study the Structure and Dynamics of Perovskite Films and hIAPP Peptides

김영삼[†]

울산과학기술원

Two-dimensional infrared (2D IR) spectroscopy has made tremendous progress since its pioneering work by Prof. Robin Hochstrasser in 1998. In the introductory part, a brief overview of 2D IR spectroscopy, covering its principle, history, and experimental methods, will be presented. Recent applications of 2D IR to small molecules and large molecular complexes will follow. For acetic acid dissolved in acetonitrile, 2D IR reveals the presence of two isomeric forms of acetic acid: the syn- and anti-isomers. Besides, it uncovers Fermi resonance within each isomer. In another application, 2D IR studies of perovskite films reveal two distinctive absorption peaks in the C=O stretch region, where the two peaks have not reported before. Moreover, 2D IR studies of the aggregation of human islet amyloid polypeptide (h-IAPP) mutants associated with type-II diabetes show that S20G forms relatively shorter oligomers in the early aggregation phase than wild-type hIAPP, where S20G is known to be more cytotoxic than wild-type hIAPP.



김영삼(울산과학기술원)

서울대학교 화학과(학사) (1998)

서울대학교 화학과(석사) (2000)

펜실베니아대학교(Univ. of Penn.) 화학과(박사) (2005)

펜실베니아대학교(Univ. of Penn.) 화학과(Post-Doc.) (2006-2010)

울산과학기술원 화학과 부교수 (2010-현재)

Invited Lecture **2L7-3**

고분자구조 및 물성: 고기능 소재의 구조-물성 상관관계 및 지속가능 응용 (1)

2025.10.1(수), 11:40~12:05, 7회장

Chair: 박재홍

Process-structure-property relationships of responsive hydrogels

배진혜[†]

중앙대

The design and fabrication of responsive hydrogels with reversible shape morphing and tunable actuation speed have been of great interest. In this talk, I will discuss our recent progress in approaches to integrate functional materials into stimuli-responsive hydrogels. These approaches provide insights into how the presence of functional additives and physical interactions between the additives and hydrogel networks can lead to different internal structures, and thus mechanical properties. Next, I will describe how we have leveraged these insights to precisely program the 3D shapes and control the swelling-deswelling kinetics by external stimuli, and tune the mechanical properties. Such stimuli-responsive shape morphing systems of hydrogels will allow us to understand their structure-property relationships and utilize these systems for applications ranging from soft robotics to biomedical devices.



배진혜(중앙대)

서울대학교 화학생물공학부 (석사) (2007)

University of Massachusetts Amherst, Polymer Science and Engineering (박사)
(2009-2015)

Harvard University, School of Engineering and Applied Sciences (포스닥) (2015-
2018)

University of California San Diego, Chemical and Nano Engineering (조교수) (2018-
2024)

University of California San Diego, Chemical and Nano Engineering (부교수) (2024-
2024)

중앙대학교 화학공학과(부교수) (2025-현재)

Invited Lecture **2L7-4**

고분자구조 및 물성: 고기능 소재의 구조-물성 상관관계 및 지속가능 응용 (1)

2025.10.1(수), 12:05~12:30, 7회장

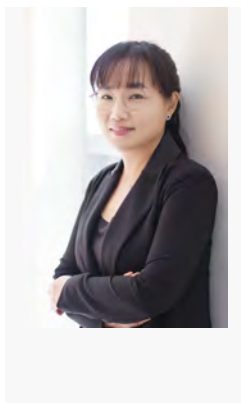
Chair: 박재홍

Thermotropic Mesophases Enable Vitrification in Aliphatic Carboxylate Coordination Polymers

문화리[†]

이화여자대학교

Vitrification of coordination polymers (CPs), particularly those based on carboxylate networks, remains rare despite their potential for creating functional hybrid glasses. Here, we report mesophase-driven vitrification in a family of carboxylate CPs, C-MgCnDC ($n = 2-7$, C stands for crystalline), based on aliphatic dicarboxylate linkers. Thermal dehydration triggers a conformational disorder in the aliphatic linkers and changes in carboxylate binding modes without cleavage of metal-ligand bonds, yielding a semicrystalline mesophase (desC-MgCnDC) of extended coordination networks. Continued heating induces a direct glass transition, producing mesophase-derived glasses. Notably, only the $n = 7$ derivative undergoes conventional melting, highlighting distinct mechanisms between mesophase- and melt-driven vitrification. The mechanical robustness of mesophase-derived glasses, attributed to chain entanglement, is contrasted with the softer nature of melt-quenched glass, in which the Mg-O backbone is partially dissociated. Our results demonstrate that ligand chain flexibility governs vitrification and cold crystallization pathways, establishing a mechanistic link to organic polymers. This mesophase-based strategy not only offers new design principles for fabricating hybrid glasses but also significantly broadens the chemical space of vitrifiable coordination networks beyond melt-processable materials.



문화리(이화여자대학교)

이화여자대학교 화학과(학사) (2001)

서울대학교 화학부(석사) (2003)

서울대학교 화학부(박사) (2007)

로렌스버클리국립연구소(Post-Doc) (2008-2010)

UNIST 화학과 조교수, 부교수, 정교수 (2010-2023)

이화여자대학교 화학나노과학과, 정교수 (2023-현재)

Invited Lecture **2L7-5**

고분자구조 및 물성: 고기능 소재의 구조-물성 상관관계 및 지속가능 응용 (2)

2025.10.1(수), 14:00~14:25, 7회장

Chair: 이준민

Functional Hydrogel Formation via Room-Temperature Self-Polymerization of Zwitterionic Monomers

김연수[†], 김세현

포항공과대학교

Zinc dendrites and side reactions limit the cycle life of aqueous Zn-metal batteries (AZMBs). In situ gel polymer electrolytes (GPEs) can mitigate these issues by forming robust interfaces, but conventional GPEs require initiators, crosslinkers, and harsh conditions, often yielding poor Zn^{2+} transport. Here, we report an initiator- and crosslinker-free in situ GPE that spontaneously forms at room temperature in air. Mixing zwitterionic monomers with Zn salt induces self-polymerization, resulting in a flexible, physically crosslinked network. This electrolyte ensures intimate interfacial contact and continuous Zn^{2+} ion conduction. Symmetric Zn cells show excellent cycling (>4100 h) and stable operation at -10°C , outperforming conventional GPEs. $\text{Zn}||\text{VO}_2$ full cells retain 95.6% capacity after 100 cycles. This sustainable, cost-effective strategy effectively addresses key AZMB challenges.



김연수(포항공과대학교)

이화여자대학교 화학나노과학과 (학사) (2009)

이화여자대학교 화학나노과학과 (석사) (2011)

동경대학교 화학생명공학과 (박사) (2015)

동경대학교 재료공학과 (Post-Doc.) (2015-2017)

포항공과대학교 신소재공학과 조교수 (2017-2023)

포항공과대학교 신소재공학과 부교수 (2023-현재)

Invited Lecture **2L7-6**

고분자구조 및 물성: 고기능 소재의 구조-물성 상관관계 및 지속가능 응용 (2)

2025.10.1(수), 14:25~14:50, 7회장

Chair: 이준민

Multiscale hydrogel engineering enables transparent, elastic, expandable human brain composites

박주혁[†]

서울대학교

To develop treatments for incurable diseases, understanding complex human biological systems is essential. Yet, the size and fragility of human organs hinder such studies, limiting research to small tissue samples. This talk introduces mELAST (magnifiable entangled link-augmented stretchable tissue-hydrogel), a platform that transforms human brain tissue into an elastic, transparent, and expandable hydrogel composite. mELAST forms superhydrophilic, entangled polymer networks in situ within native nanoporous structures, integrating with endogenous biomolecules. We compare the physicochemical properties of mELAST and conventional hydrogels, including rheology, tensile strength, porous structures, and permeability. These features enable large-scale tissue processing, multiplexed immunostaining, and repeatable expansion for multiscale 3D imaging. mELAST demonstrates how engineered polymer structure–property relationships can advance human organ analysis and therapeutic discovery.



박주혁(서울대학교)

서강대학교 화학과 (학사) (2009-2013)

서울대학교 재료공학부 (박사) (2013-2018)

MIT 의공학연구소 (박사후연구원) (2019-2024)

서울대학교 재료공학부 (조교수) (2024-현재)

Invited Lecture **2L7-7**

고분자구조 및 물성: 고기능 소재의 구조-물성 상관관계 및 지속가능 응용 (2)

2025.10.1(수), 14:50~15:10, 7회장

Chair: 이준민

Nanofibers to Textiles: Sustainable Engineering of Advanced Cellulose Materials

장태후⁺

인천대학교

Cellulose, Earth's most abundant biopolymer, offers a sustainable platform for functional materials. This study proposes a unified strategy to create superhydrophobic (SHP) and antibacterial cellulose-based materials, from nanofiber coatings to textiles. Lyophilized cellulose nanofibers (CNFs) undergo green mechanochemical esterification with fatty acids, enhancing reactivity without toxic solvents. Oleic acid-modified CNFs yield SHP coatings with exfoliation-based renewability, suitable for moisture barriers and water harvesting. Scaling up, cotton textiles are esterified and impregnated with copper ions, producing fluorine-free, particle-free SHP-antibacterial fabrics. These maintain SHP after washing and show >99% bacterial reduction, demonstrating sustainable, scalable potential for real-world use.



장태후(인천대학교)

연세대학교 금속시스템공학과(학사) (2012)

연세대학교 신소재공학과(석사) (2014)

Purdue University Materials Engineering (박사) (2023)

Intel Corporation (Engineer) (2023-2025)

인천대학교 신소재공학과 조교수 (2025-현재)

Invited Lecture **2L7-8**

고분자구조 및 물성: 고기능 소재의 구조-물성 상관관계 및 지속가능 응용 (2)

2025.10.1(수), 15:10~15:35, 7회장

Chair: 이준민

Functional Gel-like Coatings: Structure-Property Design for Biocompatible and Antifouling Surfaces

류진[†]

한국과학기술연구원

Implantable medical devices are essential in healthcare but often face biofouling issues that impair function and threaten patient safety. To address this, antifouling polymeric gel-like coatings have emerged as an effective solution to improve device biocompatibility and durability. This talk introduces fabrication and functionalization strategies of coatings aimed at reducing biofouling and thrombogenesis. Key advances include tuning surface properties—such as roughness, hydrophilicity, and mechanical modulus—to enhance performance. In vitro tests demonstrated significant inhibition of protein adsorption, cell adhesion, and bacterial colonization, as well as bactericidal activity. These findings highlight the potential of gel-based coatings to provide multifunctional antifouling and antithrombotic protection, paving the way for safer and longer-lasting implants.



류진(한국과학기술연구원)

서울대학교 화학생물공학부 (학사) (2013)

서울대학교 화학생물공학부 (박사) (2018)

한국과학기술연구원 생체재료연구센터 (Post-Doc) (2020)

Purdue University 화학공학과 (Post-Doc) (2021)

한국과학기술연구원 생체재료연구센터 선임연구원 (2021-현재)

Invited Lecture **2L7-9**

고분자구조 및 물성: 고기능 소재의 구조-물성 상관관계 및 지속가능 응용 (2)

2025.10.1(수), 15:35~16:00, 7회장

Chair: 이준민

Multi-functional Structural Supercapacitor CFRP with NiCo2O4

노형도[†]

한양대학교

The multifunctional composite as both a structural supercapacitor and a self-sensing sensor was devised in this study. NiCo2O4 nanowires was integrated on the carbon fiber fabric to boost electrochemical performance and sensing, with an ionic liquid as the electrolyte. This design enables simultaneous energy storage and real-time structural integrity monitoring. The NiCo2O4 nanowires provide high surface area and excellent electrical conductivity, crucial for efficient charge storage and sensitive strain detection. The ionic liquid ensures stable electrochemical cycling and contributes to the composite's mechanical properties. This research demonstrates the successful integration of energy storage and sensing functionalities within a single material. This novel approach offers significant potential for lightweight, high-performance applications in aerospace, automotive, and wearable electronics, where space and weight are critical.



노형도(한양대학교)

울산과학기술원 기계신소재공학부 (학부) (2010-2014)

울산과학기술원 기계공학과 (박사) (2014-2020)

울산과학기술원 기계공학과 (박사후) (2020-2021)

한국재료연구원 탄소복합재료연구실 (선임연구원) (2021-2023)

한양대학교 ERICA 기계공학과 (조교수) (2023-현재)

Invited Lecture **2L8-1**

고분자 합성: 정밀 제어 고분자 합성: 분자 수준에서 응용까지 (1)

2025.10.1(수), 10:50~11:15, 8회장

Chair: 김명웅

Polymerization/Depolymerization-Driven Morphology Switching in Bottlebrush Copolymer Particles

신재만⁺

승실대학교

Structure-shifting polymer particles offer promise for smart soft materials. This study introduces nanostructured colloids formed by confined assembly of bottlebrush random copolymers with a polydisulfide backbone. Unlike compartmentalized colloids from PS/PDMS blends, these particles exhibit inner nanostructures such as lamellae, cylinders, and spheres. Depolymerization of the dynamic backbone induces a morphology shift to compartmentalized structures, with reversible switching achieved through polymerization-depolymerization-repolymerization cycles. Incorporating aggregation-induced emission luminogens (AIEgens) reveals morphology-dependent photoluminescence, driven by domain size and AIEgen aggregation state.



신재만(승실대학교)

한국과학기술원 생명화학공학과 (학사) (2009-2013)

한국과학기술원 생명화학공학과 (석/박사) (2013-2019)

UC Santa Barbara, Materials Research Lab (Post-Doc.) (2019-2021)

승실대학교 신소재공학과 조교수 (2021-현재)

Invited Lecture **2L8-2**

고분자 합성: 정밀 제어 고분자 합성: 분자 수준에서 응용까지 (1)

2025.10.1(수), 11:15~11:40, 8회장

Chair: 김명웅

Amphiphilic Copolymer Coatings for Marine Antifouling: Design Criteria for Copolymer Composition and Sequence

강성민⁺

충북대학교

Marine fouling presents a significant challenge, increasing operational costs and raising environmental concerns. Effective control of marine fouling requires not only preventing the adhesion of marine organisms but also minimizing the adsorption of marine sediments. While hydrophilic polymers help prevent the adhesion of marine organisms, hydrophobic polymers are effective in reducing the adsorption of marine sediments. Consequently, there is a growing need for amphiphilic copolymers that integrate these opposing properties. This presentation will highlight the critical importance of achieving an optimal balance between hydrophilicity and hydrophobicity, as well as the beneficial role of random copolymer sequences in enhancing antifouling properties. Additionally, ethylene glycol dicyclopentenyl ether acrylate is proposed as a promising hydrophobic monomer, capable of exhibiting a partial negative surface charge upon coating, thereby contributing to improved antifouling efficacy.



강성민(충북대학교)

KAIST 화학과(학사) (2000-2004)

KAIST 화학과(박사) (2004-2009)

KAIST 화학과(Post-Doc, 연구조교수) (2009-2012)

부경대학교 해양바이오신소재학과(조교수) (2012-2016)

충북대학교 화학과(교수) (2016-현재)

Invited Lecture **2L8-3**

고분자 합성: 정밀 제어 고분자 합성: 분자 수준에서 응용까지 (1)

2025.10.1(수), 11:40~12:05, 8회장

Chair: 김명웅

Metal-Free Ring-Opening Metathesis Polymerization

Brittany K. Trinh, Andrew J. Boydston[†]

University of Wisconsin, Madison

Our group integrates fundamental and applied research within the scope of soft materials. In this seminar, we will discuss a new mechanism for ring-opening metathesis polymerization that is now a centerpiece of our program. The approach leverages visible light photoredox catalysis to allow for the use of organic initiators, in contrast to widely used metal-alkylidene initiators. Studies on our mechanistic hypothesis have yielded an exciting interplay of challenges and opportunities, often with one disguised as the other. We will share our findings that include methods for stereocontrol, chain transfer, and functional group compatibility, as well as our adventures into the applied and commercial sectors.



Andrew J. Boydston(University of Wisconsin, Madison)

B.S., Univ. of Oregon (2001)

M.S., Univ. of Oregon (2002)

Ph.D., Univ. of Texas (2007)

Post-Doc., R. H. Grubbs, Caltech (2007-2010)

Professor, University of Washington (2010-2018)

Professor, University of Wisconsin (2018-Present)

Invited Lecture **2L8-4**

고분자 합성: 정밀 제어 고분자 합성: 분자 수준에서 응용까지 (1)

2025.10.1(수), 12:05~12:30, 8회장

Chair: 김명웅

Synthesis and application of biodegradable radical-containing polymers for transient electronics and energy storage

조상호[†]

한국과학기술연구원

Biodegradable radical-containing polymers offer unique redox properties and sustainability, making them promising candidates for advanced electronics and energy storage. We present recent synthetic strategies for polycaprolactone (PCL)-based radical polymers functionalized with TEMPO radicals, highlighting their tunable biodegradability and redox functionality. These polymers serve as environmentally friendly cathodes in lithium-ion batteries, delivering excellent electrochemical performance and efficient degradation into benign, water-soluble byproducts. Additionally, their intrinsic memristive characteristics enable applications in physically transient electronics, combining high performance, flexibility, and complete aqueous dissolution. This work establishes a versatile platform for next-generation eco-friendly wearable and implantable technologies.



조상호(한국과학기술연구원)

한양대학교 화학과 (학사) (2007)

한양대학교 화학과 (석사) (2010)

Texas A&M 대학교 화학과 (박사) (2015)

토론토대학교 화학과 (Post-Doc) (2015-2017)

한국과학기술연구원 극한물성소재연구센터 선임연구원 (2017-현재)

Invited Lecture **2L8-5**

고분자 합성: 정밀 제어 고분자 합성: 분자 수준에서 응용까지 (2)

2025.10.1(수), 14:00~14:25, 8회장

Chair: 고영운

Functional dielectric polymer with improved dielectric polarization for high-performance energy-harvesting devices

김민수[†]

순천대학교

Polymer dielectric composites have been utilized to fabricate triboelectric nanogenerators, which have recently found application in haptic devices. Based on the triboelectric effect and electrostatic induction, nanogenerators composed of polymer dielectric composites have been developed; however, their output performance remains poor due to the low dielectric constants of conventional polymers. Engineering dielectric nanostructures enhances dielectric polarization, improving device performance and increasing sensitivity to external stimuli. Here, we present a rational design of polymer nanostructured dielectric composites to boost the output of self-powered, multifunctional triboelectric nanogenerators. This polymer-engineering approach establishes a versatile platform for next-generation multifunctional TENGs in tactile sensing and energy harvesting.



김민수(순천대학교)

중앙대학교 화학공학과 (석사) (2008)

한국과학기술원 생명화학공학과 (박사) (2014)

성균관대학교 진단/치료용 고분자소재연구센터 (Post-Doc) (2014-2015)

New York University, Molecular Design Institute (Post-Doc) (2015-2016)

울산과학기술원 에너지화학공학과 연구교수 (2016-2023)

국립순천대학교 화학공학과 조교수 (2023-현재)

Invited Lecture **2L8-6**

고분자 합성: 정밀 제어 고분자 합성: 분자 수준에서 응용까지 (2)

2025.10.1(수), 14:25~14:50, 8회장

Chair: 고영운

Achieving Reliable Synthesis of Conjugated Polymers Using a Continuous Flow Reactor

황예진[†]

인하대학교

Donor–acceptor (D–A) conjugated polymers offer excellent electronic and photonic properties, yet their synthesis remains a barrier to commercialization. Continuous flow synthesis is a promising scalable alternative, but its application has been limited. Here, we report the flow synthesis of six D–A polymers using a continuous reactor. By varying reaction parameters, we examined effects on polymerization and quality. p-type, n-type, and ambipolar polymers were synthesized under unified conditions, with only reaction time requiring adjustment. Compared to batch synthesis, the flow method gave similar or higher degree of polymerization, higher yields, and much shorter reaction times. The polymers showed high quality in both material properties and transistor performance. These results highlight flow synthesis as an efficient route for producing D–A conjugated polymers.



황예진(인하대학교)

인하대학교 화학공학과 (학사) (2008)

Univ. of Washington 화학공학과 (석사) (2012)

Univ. of Washington 화학공학과 (박사) (2015)

MIT 화학공학과 (Post-Doc) (2015-2017)

인하대학교 화학공학과 조교수 (2017-2023)

인하대학교 화학공학과 부교수 (2023-현재)

Invited Lecture **2L8-7**

고분자 합성: 정밀 제어 고분자 합성: 분자 수준에서 응용까지 (2)

2025.10.1(수), 14:50~15:15, 8회장

Chair: 고영운

Organic X-Ray Image Sensors using a Medium Bandgap Polymer Donor with Low Dark Current

하종운[†]

경상국립대학교

The development of portable X-ray detectors is necessary for diagnosing fractures in unconscious patients in emergency situations. However, this is quite challenging because of the heavy weight of the scintillator and silicon photodetectors. This study presents a novel biTPD-based polymer donor (PBDT-biTPD) that exhibits excellent photodetection properties even in a thick photoactive layer, owing to the symmetric backbone and highly soluble molecular structure of biTPD. The ability of PBDT-biTPD to strongly suppress the dark current density ($\sim 10^{-10}$ A/cm²) at a negative bias (-2.0 V) while maintaining high responsivity (0.29 A/W) even at a thickness of 700 nm results in a maximum shot-noise-limited specific detectivity of $D_{sh}^* = 2.18 \times 10^{13}$ Jones in the OPDs. Printed OPDs are developed by slot-die coating for use in X-ray detectors, which exhibit $D_{sh}^* = 2.73 \times 10^{12}$ Jones with clear rising (0.26 s) and falling (0.29 s) response times upon X-ray irradiation.



하종운(경상국립대학교)

부산대학교 화학과 박사 (2013-2019)

부산대학교 박사후연구원 (2019-2020)

한국화학연구원 박사후연구원 (2020-2023)

한국화학연구원 선임연구원 (2023-2025)

UST-과학기술연합대학원대학교 조교수 (2024-2025)

경상국립대학교 나노신소재융합공학과 조교수 (2025-현재)

Invited Lecture **2L8-8**

고분자 합성: 정밀 제어 고분자 합성: 분자 수준에서 응용까지 (2)

2025.10.1(수), 15:15~15:40, 8회장

Chair: 고영운

Liquid metal particles enabled template polymerization for thermal interface materials

임태환⁺

강원대학교

Since the AI biochip packs more power into a tiny patch of silicon, engineering designers must add a thermal interface material (TIM) to pull heat away fast enough to keep nearby tissue safely. Yet, their practical potential as TIM for implantable biochips is restricted by three intrinsic drawbacks: limited biocompatibility, high stiffness, and only modest through-plane thermal conductivity. Here, we present an epoxy growth mechanism on the surface of conductive fillers and correspondingly propose a strategy for developing a biocompatible, tissue-like soft, and highly thermally conductive TIM. We employ submicron-scale Ga-based liquid metal particles(LMPs) as soft, conductive fillers. The LMPs surface rapidly oxidize when exposed to trace levels of oxygen (even below 2 ppm), forming a stable oxide shell. We encapsulated the LMs with polydopamine(PDA), which is a representative biocomponent, via solution polymerization.



임태환(강원대학교)

한양대학교, 유기나노공학과, 학사 (2005-2010)

한양대학교, 유기나노공학과, 석사 (2010-2012)

University of Utah, 화학공학과, 박사 (2017-2021)

한국생산기술연구원 산업융합유무분, 박사후연구원 (2021-2023)

강원대학교 화학공학전공, 조교수 (2023-현재)

Invited Lecture **2L8-9**

고분자 합성: 정밀 제어 고분자 합성: 분자 수준에서 응용까지 (2)

2025.10.1(수), 15:40~16:00, 8회장

Chair: 고영운

One-Step Synthesis of 3D-Mesoporous SiCN Monoliths via In-Situ Microphase Separated Organic-Inorganic Block Polymer

황윤호[†]

부경대학교

본 연구에서 제안한 유기-무기 하이브리드 중합 유도 미세상 분리(organic-inorganic hybrid polymerization induced microphase separation, H-PIMS) 공정은 PEO-b-P(mVSZ-co-DVB)를 합성하여 가공성이 우수한 SiC 기반 메조다공성 세라믹 전구체를 제조할 수 있게 한다. 본 연구에서는 블록 공중합체 템플릿이나 어닐링 공정 없이 단일단계로 합성하는 방법을 제시한다. 이 합성법을 활용하여 다양한 형상의 monoliths를 가공할 수 있으며, 이를 열분해(pyrolysis)함으로써 높은 열적 안정성을 지닌 메조다공성 질화규소(SiC_xN_y)로 전환할 수 있다. 이러한 재료는 우수한 열 안정성, 화학적 저항성, 그리고 형태 조절 가능성을 나타낸다. 본 연구는 에너지, 화학, 환경 분야에서 다기능 세라믹 플랫폼 개발을 위한 고분자-세라믹 전환 전략의 잠재력을 제시한다.



황윤호(부경대학교)

충남대학교 화학공학과(학사) (2007-2013)

포항공과대학교 화학공과(석/박사) (2013-2019)

포항공과대학교 화학공학과(Post-Doc) (2019-2022)

펜실베이니아대학교 생명화학공학과(Post-Doc) (2022-2024)

국립부경대학교 고분자공학전공 조교수 (2024-현재)

Invited Lecture **2L9-1**

단파 적외선 검출용 전자소자를 위한 고분자 및 나노결정 연구 (1)

2025.10.1(수), 10:50~11:15, 9회장

Chair: 강문성

Modification of Infrared-Responsive Wavelengths in Organic Photodetectors for Efficient Pulse Oximetry

김종현⁺

아주대학교

Infrared organic photodetectors (OPDs) have emerged as promising candidate for next-generation infrared signal detection. Unlike traditional inorganic detectors, organic semiconductors enable low-cost fabrication on lightweight and flexible substrates. These advantages open new opportunities for wearable electronics, biomedical sensing, and large-area infrared imaging. In this presentation, simple method for modifying infrared-responsive wavelengths in OPDs will be introduced. Furthermore, the application of the suggested strategy to the efficient pulse oximetry will be presented.



김종현(아주대학교)

아주대학교 응용화학과 (학사) (2001-2005)

서울대학교 응용화학부 (석사) (2005-2007)

서울대학교 재료공학부 (박사) (2007-2011)

워싱턴 주립대 재료공학과 (Post-Doc.) (2012-2014)

충남대학교 화학공학교육과 조교수 (2015-2016)

아주대학교 응용화학생명공학과 조교수/부교수/정교수 (2016-현재)

Invited Lecture **2L9-2**

단파 적외선 검출용 전자소자를 위한 고분자 및 나노결정 연구 (1)

2025.10.1(수), 11:15~11:40, 9회장

Chair: 강문성

Colloidal Quantum Dot Infrared Avalanche Photodetectors

이정용[†]

한국과학기술원

Colloidal quantum dots (CQDs) have emerged as promising materials for infrared photodetectors (IRPDs), offering high specific detectivity (D^*) and compatibility with low-cost solution processing. While CQDs can support photo-induced charge multiplication, their performance in IR detection is often limited by thermal noise inherent to low-bandgap materials. Here, we report a pioneering device architecture that enables kinetically pumped avalanche multiplication in CQD-based IRPDs. By applying a strong electric field across a thick CQD layer (>540 nm), photogenerated electrons acquire sufficient kinetic energy to exceed the bandgap, thereby triggering avalanche multiplication. Tuning the dot-to-dot distance to approximately 4.1 nm optimizes the balance between impact ionization and electron hopping, enhancing charge transport and multiplication efficiency. As a result, our optimized CQD-based IRPD achieves a maximum multiplication gain of 85 and a peak detectivity of 1.4×10^{14} Jones at 940 nm. This work establishes a new platform for CQD-based photodetectors with potential for single-photon detection and ultra-high-sensitivity applications.

[†]Lee et al. Nature Nanotechnology 20, 237 (2024)



이정용(한국과학기술원)

서울대학교 전기공학부 (학사) (2000)

서울대학교 전기공학부 (석사) (2002)

Stanford University (Ph.D) (2010)

Stanford University (Post-Doc) (2010)

한국과학기술원 교수 (2010-현재)

한국과학기술원 지정 석좌교수 (2023)

Invited Lecture **2L9-3**

단파 적외선 검출용 전자소자를 위한 고분자 및 나노결정 연구 (1)

2025.10.1(수), 11:40~12:05, 9회장

Chair: 강문성

Spin-on integration of visible-transparent organic photodiode onto Si-CMOS for VIS–SWIR Dual Image Sensor

정대성[†]

포항공과대학교 (POSTECH)

Vertically stacked image sensors that detect both visible (VIS) and shortwave-infrared (SWIR) light are important for compact multi-spectral imaging. However, current designs often trade off resolution or SWIR sensitivity due to the limits of silicon. Here, we demonstrate a visibly transparent SWIR organic photodiode (OPD) stacked directly on a silicon photodiode for pixel-aligned VIS–SWIR imaging. The OPD uses a new donor polymer, P(BDT-TQ), with strong SWIR absorption and a deep HOMO level, and is optimized with PMMA to improve visible transmittance and reduce traps. The device shows high visible transparency, strong SWIR responsivity, and low dark current. Fully fabricated via low-temperature spin-coating, it is integrated with a 120×64 silicon pixel array using a dual-tap architecture for low-crosstalk dual-wavelength imaging. This scalable, CMOS-compatible design enables compact, high-performance multi-spectral vision systems.



정대성(포항공과대학교 (POSTECH))

포항공과대학교 화학공학과 (학사) (2005)

포항공과대학교 화학공학과 (박사) (2010)

시카고대학교 화학과 (Post-Doc) (2010-2012)

중앙대학교 화학신소재공학부 조교수 (2012-2017)

DGIST 에너지시스템공학부 부교수 (2017-2020)

포항공과대학교 화학공학과 부교수, 교수 (2020-현재)

Invited Lecture **2L9-4**

단파 적외선 검출용 전자소자를 위한 고분자 및 나노결정 연구 (1)

2025.10.1(수), 12:05~12:30, 9회장

Chair: 강문성

Enabling Image Sensor Design Using Thin-film Photodetection Technology

이지원[†]

POSTECH

Short wave infrared (SWIR) image sensing is attracting lots of interests from industrial, automotive and even consumer application with advantages of eye-safety, material differentiation, less interference from ambient light etc. Currently, mainstream SWIR image sensors are based on InGaAs and Ge photodiode. However, these technologies are suffering from high production cost and high dark current respectively. Meanwhile, considerable research has been conducted on colloidal quantum dot (CQD) based SWIR image sensing to enable low cost, high performance imaging.

This presentation introduces recent advances in thin-film CQD photodiode-based image sensor technologies. The current main stream SWIR technologies will be introduced briefly with their advantages and limitations. Then, the fundamentals of thin-film CQD photodiode based SWIR imaging will be discussed, with an emphasis on image sensor design and fabrication. Furthermore, current limitations of CQD thin-film photodiode-based technologies will be addressed, along with emerging approaches to overcome these challenges.



이지원(POSTECH)

KAIST 전자공학과 석/박사 (2006-2013)

삼성전자 S.LSI 책임연구원 (2013-2018)

IMEC (벨기에), Team leader, Principal Scientist (2018-2022)

한양대학교 ERICA 나노광전자학과 부교수 (2022-2023)

IMEC (벨기에), Guest Professor (2022-현재)

포항공과대학교 반도체 공학과 조교수 (2024-현재)

Invited Lecture **2L9-5**

단파 적외선 검출용 전자소자를 위한 고분자 및 나노결정 연구 (2)

2025.10.1(수), 14:00~14:25, 9회장

Chair: 왕동환

Silver Chalcogenide Colloidal Semiconductor Nanocrystals for Shortwave Infrared Optoelectronic Applications

김영훈⁺

국민대학교

Ag₂Te colloidal quantum dots (CQDs) are of great interest in shortwave infrared (SWIR) optoelectronic applications owing to their size-tunable bandgaps with high optical properties. We present a synthesis method for Ag₂Te CQDs that controls their crystal size and bandgap through chemical reactivity. This involves controlling the concentration and type of ligands, as well as the precursor ratio. The rapid termination of the reaction in this method prevents Ag₂Te CQD decomposition, yielding monodisperse CQDs with absorption and emission in the 1100–1600 nm range. We also present core/shell-type Ag₂Te/Ag₂S CQDs, which improve their chemical stability and optical properties including photoluminescence (PL) intensity. Consequently, the Ag₂Te/Ag₂S CQD-based SWIR photodetector exhibits a high external quantum efficiency of 8.4% and a specific detectivity of 1.1×10^{11} Jones at 1550 nm, with a fast response time of 38 ns.



김영훈(국민대학교)

국민대학교 신소재공학과(석사) (2010)

고려대학교 화공생명공학과(박사) (2014)

고려대학교 화공생명공학과(Post-Doc) (2014-2015)

토론토대학교 전기전자컴퓨터공학과(Post-Doc) (2015-2017)

DGIST 에너지융합연구부(선임연구원) (2017-2021)

국민대학교 화학과 부교수 (2021-현재)

Invited Lecture **2L9-6**

단파 적외선 검출용 전자소자를 위한 고분자 및 나노결정 연구 (2)

2025.10.1(수), 14:25~14:50, 9회장

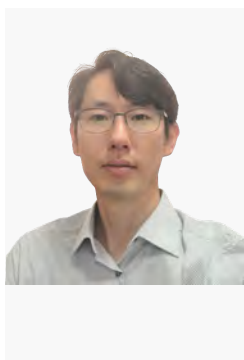
Chair: 왕동환

Organic Semiconductors for SWIR Sensing: Critical Role of Molecular Design

이재원[†]

충남대학교

Organic semiconductors capable of short-wavelength infrared (SWIR) detection are emerging as promising materials for flexible, lightweight, and cost-effective optoelectronic applications. This presentation highlights our recent efforts in the molecular design and synthesis of nonfullerene small molecule acceptors (NFAs) optimized for SWIR sensing. We demonstrate that precise tuning of molecular architecture enables significant red-shifting of absorption spectra beyond 1300 nm. By integrating these NFAs into organic photodetector (OPD) devices, we achieve enhanced photoresponse and detectivity in the SWIR range, along with exploring potential applications in low-light optical communication. Our findings underscore the critical role of molecular engineering in unlocking the potential of organic semiconductors for SWIR optoelectronics.



이재원(충남대학교)

충남대학교 화학공학과 (학사) (2001-2008)

광주과학기술원 신소재공학부 (석사) (2008-2010)

포항공과대학교 화학공학과 (박사) (2010-2014)

UCSB 화학과 (Post-Doc.) (2017-2020)

충남대학교 응용화학공학과 (부교수) (2020-현재)

Invited Lecture **2L9-7**

단파 적외선 검출용 전자소자를 위한 고분자 및 나노결정 연구 (2)

2025.10.1(수), 14:50~15:15, 9회장

Chair: 왕동환

Field-modulated Quantum Dot solids for Efficient Shortwave Infrared Photodetector

백세웅[†]

고려대학교

Solution-processed shortwave infrared (SWIR) photodetectors have emerged as essential components for diverse applications, ranging from autonomous platforms to quantum information systems. For these technologies, achieving simultaneously high gain and broad bandwidth at the telecommunications wavelength of 1550 nm—comparable to state-of-the-art commercial InGaAs devices—remains a critical challenge. In this work, we introduce a generalized approach to boost gain in photodiode architectures through carrier multiplication. Our method leverages heterogeneous colloidal quantum dot (CQD) solids, processed from solution, to engineer the spatial distribution of the internal electric field within the active layer. By exploiting quantum confinement effects, we realize a localized field enhancement that promotes efficient carrier multiplication. The resulting CQD-based photodetectors deliver an exceptional gain-bandwidth product, representing the highest value reported to date for solution-processed infrared photodetectors.



백세웅(고려대학교)

KAIST 생명화학공학과(학사) (2011)

KAIST EEWS 대학원(박사) (2017)

토론토대학교 ECS 박사후연구원 (2020)

고려대학교 화공생명공학과 부교수 (2020-현재)

Invited Lecture **2L9-8**

단파 적외선 검출용 전자소자를 위한 고분자 및 나노결정 연구 (2)

2025.10.1(수), 15:15~15:40, 9회장

Chair: 왕동환

Silver Telluride Colloidal Quantum Dots for Shortwave Infrared Photodetectors

최민재[†]

동국대학교

Colloidal quantum dots (CQDs) offer unique advantages for optoelectronic applications due to their bandgap tunability, solution processability, and environmental stability. Particularly, their capability to absorb and emit in the infrared region makes them ideal for applications such as optical communication, night vision, and SWIR photovoltaics. While III-V semiconductors have been widely used for such purposes, their integration is limited by high-temperature processing and complex fabrication. In this work, we present silver telluride CQDs as a viable alternative, exhibiting size-controlled synthesis and bandgap tunability in the SWIR range, optimized for 1,550 nm photodetector applications. We also explore ligand exchange strategies to enhance device performance, highlighting the potential of Ag₂Te CQDs for next-generation infrared technologies.



최민재(동국대학교)

KAIST 신소재공학과 (학사) (2007-2011)

KAIST 신소재공학과 (석사) (2011-2013)

KAIST 신소재공학과 (박사) (2013-2017)

University of Toronto 전기전자컴퓨터공학과 (Post-Doc.) (2017-2020)

동국대학교 화공생물공학과 부교수 (2020-현재)

Invited Lecture **2L10-1**

한화고분자학술상 수상기념세션: 에너지-바이오 융복합 소재 및 소자 기술

2025.10.1(수), 10:50~11:30, 10회장

Chair: 임재훈, 황혜림

Chirality, Plasmonics and Supramolecular Self-Assembly Converge: From Energy Conversion·Storage, Optoelectronics to Theranostics

김동하[†]

이화여자대학교

The chirality of nanostructured systems has gained growing attention in catalysis, biotechnology, optoelectronics, spintronics, etc., owing to their exotic enantio-/spin-selective interactions and intriguing chiroptical features. However, large-scale fabrication of chiral inorganic nanostructures still remains a challenge. Herein, we report precision engineering and supramolecular self-assembly based nanofabrication of hybrid chiral nanostructures and exploit their unprecedented applications. We demonstrate chiro-optical, magneto-optical, catalytic energy conversion and circularized light emission properties from libraries of chiral inorganic nanostructures. Our design concept pinpoints the steps required to construct an extended library of viable chiral nanostructures, and will aid in the development of artificial chiral materials.



김동하(이화여자대학교)

서울대학교 섬유공학과 (학사) (1987-1991)

서울대학교 섬유고분자공학과 (석사) (1992-1996)

서울대학교 섬유고분자공학과 (박사) (1996-2000)

매사추세츠주립대학교 고분자공학과(Post-Doc) (2000-2003)

막스플랑크고분자연구소(Post-Doc) (2003-2005)

이화여자대학교 화학나노과학과 교수 (2006-현재)

Invited Lecture **2L10-2**

한화고분자학술상 수상기념세션: 에너지-바이오 융복합 소재 및 소자 기술

2025.10.1(수), 11:30~11:55, 10회장

Chair: 임재훈, 황혜림

Photonic Nanomaterials for Light-Activated Theranostics

김세훈[†]

한국과학기술연구원

Light-activated phototherapy is a noninvasive and selective treatment modality for cancer and other diseases. Inorganic and organic-inorganic hybrid nanomaterials capable of converting photon energy into therapeutic effects often potentiate proper delivery of photomedicine to the target tissues/cells, as well as another intriguing effect on the photophysical properties; i.e., smart control of the light-matter interactions in the assembly can switch the phototherapeutic activity on demand, enabling safer and more precise phototherapy. In this presentation, our recent results on multi-component and hierarchically assembled photomedicine approaches at the nanoscale will be introduced, including plasmonic and photon-upconverting hybrid nanomaterials with versatile photonic attributes, such as photothermal, photocatalytic, photoechogetic effects, potentiating effective and sophisticated theranostic applications.



김세훈(한국과학기술연구원)

서울대학교 섬유고분자공학과(학사) (1996)

서울대학교 섬유고분자공학과(석사) (1998)

서울대학교 재료공학부(박사) (2002)

서울대학교 재료공학부(박사) (2002-2007)

한국과학기술연구원(KIST) 선택임연구원 (2008)

한국과학기술연구원(KIST) 선택임연구원 (2008-현재)

고려대학교 KU-KIST 융합대학원 교수 (2017-현재)

Invited Lecture **2L10-3**

한화고분자학술상 수상기념세션: 에너지-바이오 융복합 소재 및 소자 기술

2025.10.1(수), 11:55~12:20, 10회장

Chair: 임재훈, 황혜림

Tin Halide Perovskite Materials and Devices

박희준[†]

한양대학교

Tin (Sn) halide perovskites have emerged as compelling alternatives to their lead-based analogues, offering substantially lower environmental risk. Their inherently low bandgap makes them ideal for low-bandgap subcells—achieved by alloying with lead—in all-perovskite tandem solar cells, thereby complementing high-bandgap front cells. I will first describe our strategy to eliminate vertical lattice inhomogeneity in solution-processed films, which has enabled tandem devices to approach 28 % power conversion efficiency. Next, I will present our breakthroughs in harnessing Sn perovskites for near-infrared photodetectors at 940 nm. Finally, I will discuss our recent achievement of record-performance Sn perovskite thin-film transistors, with mobilities exceeding $80 \text{ cm}^2\text{V}^{-1}\text{s}^{-1}$ and on/off ratios above 3×10^9 , which pave the way for energy efficient complementary logic circuits.



박희준(한양대학교)

서울대학교 재료공학부 (학사) (1998-2002)

서울대학교 재료공학부 (석사) (2002-2004)

University of Michigan-Ann Arbor (2007-2012)

Intel Corporation, Senior researcher (2012-2014)

아주대학교 전자공학과, 조교수/부교수 (2014-2019)

한양대학교 유기나노공학과, 부교수/교수 (2019-현재)

Invited Lecture **2L10-4**

한화고분자학술상 수상기념세션: 에너지-바이오 융복합 소재 및 소자 기술

2025.10.1(수), 12:20~12:45, 10회장

Chair: 임재훈, 황혜림

Chiral Materials for Energy and Bio

염지현[†]

카이스트

Chirality has emerged as a unifying concept across materials science, enabling breakthroughs in both energy-efficient electronic systems and precision biomedical platforms. In this seminar, we highlight recent advances in chiral optoelectronic materials and their dual roles in reducing energy consumption and enhancing biofunctionality. Chiral selenium nanorod lattices demonstrate broadband circularly polarized light detection with remarkable stability, providing a foundation for low-power optical sensing. Meanwhile, chiroferromagnetic quantum dots offer enhanced g-factors and optical synaptic behaviors, making them ideal candidates for neuromorphic AI processors that operate on polarization-encoded signals. On the biomedical front, a universal chiral nanopaint strategy has been developed to impart chiroptical functionality to a range of metal oxide nanoparticles, enabling enantioselective interactions critical for targeted drug delivery. Together, these advances suggest a paradigm in which chirality is not merely a structural attribute, but a powerful design tool for integrated systems that span energy and bio. The seminar will discuss how such chiral architectures can be engineered, implemented, and scaled to develop multifunctional devices that bridge the demands of next-generation AI and medicine.



염지현(카이스트)

KAIST 신소재공학과(학사) (2009)

미시간대학교 고분자공학과(박사) (2017)

MIT 화학공학과(Post-Doc) (2018-2020)

KAIST 신소재공학과 조교수 (2020-현재)

NYU 겸임교수 (2025-현재)

Invited Lecture **2L11-1**

분자전자 부문위원회 II (1)

2025.10.1(수), 10:50~11:15, 11회장

Chair: 남수지

Development of organic semiconductor materials to improve the morphology of active layer and stabilize the organic optoelectronic devices

신원석[†]

한국화학연구원

Once the photoactive layer material for organic optoelectronic devices has been determined, controlling the optimal morphology is a crucial means of improving performance, and the most common method is to adjust the solvent and additives. Additionally, although organic optoelectronic devices have many advantages over inorganic devices, their stability has not yet been fully verified in most cases. One of the reasons for the low stability of organic optoelectronic devices is the inability to maintain the morphology of the photoactive layer itself, and another is the stability of each layer and between layers of organic optoelectronic devices composed of multiple layers. In this presentation, research results conducted recently by the Korean Research Institute of Chemical Technology (KRICT) to optimize the morphology of the photoactive layer of organic optoelectronic devices and to improve the stability of the devices will be presented.



신원석(한국화학연구원)

연세대학교 화학과(학사) (1986-1990)

한국과학기술원 화학과(석사/박사) (1990-1995)

삼성종합화학 선임연구원 (1995-1999)

Univ. of Arizona(Post-Doc) (1999-2002)

Northwestern Univ.(Post-Doc) (2002-2003)

한국화학연구원 선임/책임연구원 (2007-현재)

Invited Lecture **2L11-2**

분자전자 부문위원회 II (1)

2025.10.1(수), 11:15~11:40, 11회장

Chair: 남수지

Multi-Functional Additives for High Performance Perovskite Light-Emitting Diodes

송명훈[†]

울산과학기술원

Molecular additives have been introduced to reduce crystal size and suppress grain boundary defects for efficient perovskite light-emitting diodes (PeLEDs). In addition, circularly polarized light-emitting diodes (CP-LEDs) based on quasi-2D halide perovskites incorporating chiral additives have been demonstrated.

Here, we present several types of multifunctional additives in minimal quantities for highly efficient or CP PeLEDs. In particular, R-/S-methylbenzylammonium iodide (MBAI) and R-/S-1,1'-binaphthyl-2,2'-diyl hydrogen phosphate (BHP) are incorporated to enhance chiral distortion and perform high circular polarization of PeLEDs. Interestingly, we observed that when the two chiral components had the same handedness, the chiral signals were amplified, whereas opposite handedness led to mutual cancellation.



송명훈(울산과학기술원)

한양대학교 화학공학과 (학사) (1993-2000)

한국과학기술원 생명화학공학과 (석사) (2000-2002)

동경공업대학 유기고분자물질전공 (박사) (2002-2005)

한국과학기술원 생명화학공학과 (Post-Doc) (2005-2006)

캠브리지대학교 카벤디쉬연구소 (Post-Doc) (2007-2009)

울산과학기술원 신소재공학과 교수 (2009-현재)

Invited Lecture **2L11-3**

분자전자 부문위원회 II (1)

2025.10.1(수), 11:40~12:05, 11회장

Chair: 남수지

Colloidal Ink Engineering for High-Performance Slot-Die Processed Perovskite Solar Cells

나석인[†]

전북대학교

In this study, we introduce a new method for fabricating high-performance perovskite solar cells using a Slot-Die process with colloidal inks (CI). By incorporating toluene and chlorobenzene as antisolvents to DMSO, we developed CI with improved rheological properties over conventional inks. This modification enhances wettability, promotes heterogeneous nucleation, and lowers crystallization activation energy, leading to high-quality perovskite films. We thoroughly examined how ink composition, rheology, and crystallization affect device performance. The optimized CI achieved up to 21.32% efficiency, excellent long-term stability, and high scalability, with 20.26% and 19.15% efficiencies for 2.7cm² and 8.64cm² minimodules, respectively. These results will provide valuable insights into fundamental aspects of CI for high-quality perovskite film formation and also suggest a promising approach for the commercialization of high-performance perovskite solar cells and modules.



나석인(전북대학교)

전북대학교 신소재공학부 (학사) (2003)

광주과학기술원 신소재공학과 (석사) (2005)

광주과학기술원 신소재공학과 (박사) (2010)

한국과학기술연구원 (연구원/선임연구원) (2009-2012)

CSIRO Visiting Scientist (해외우수방문연구원) (2017)

전북대학교 유연인쇄전자전문대학원 교수 (2012-현재)

Invited Lecture **2L11-4**

분자전자 부문위원회 II (2)

2025.10.1(수), 14:00~14:25, 11회장

Chair: 김호범, 강흥기

Highly Efficient and Stable Lasing Emission from Metal Halide Perovskite Thin Films

노광동⁺

이화여자대학교

Metal halide perovskites are promising for next-generation light-emitting devices due to their excellent optical and electrical properties. Beyond achieving >20% external quantum efficiency in LEDs, they exhibit strong optical gain, enabling potential laser applications. Combining perovskites with optical feedback structures has advanced this field, but practical use requires low lasing threshold and high stability. We demonstrate efficient and stable lasing from perovskite thin films through mixed-cation design, additive incorporation, and dimensional control. These methods reduce amplified spontaneous emission thresholds, enhance optical output under strong excitation, and mitigate photo-induced degradation. Lasing under optical pumping in LED device architectures also indicates a feasible pathway toward electrically injected perovskite lasers.



노광동(이화여자대학교)

서울대학교 물리교육과 (학사) (2009)

Brown University, Department of Physics (박사) (2015)

Princeton University, EE Department (Post-Doc) (2015-2022)

이화여자대학교 물리학과 조교수 (2022-2024)

이화여자대학교 물리학과 부교수 (2025-현재)

Invited Lecture **2L11-5**

분자전자 부문위원회 II (2)

2025.10.1(수), 14:25~14:50, 11회장

Chair: 김호범, 강흥기

ELUCIDATING THE STABILITY OF ALL INORGANIC PEROVSKITE SOLAR CELLS

임종철⁺

충남대학교

To overcome the stability issue, many studies are reported with all inorganic materials in the perovskite solar cells. However, Cs (for the A cation) based metal halide perovskite shows an unstable character at the room humidity. The instability of Cs based metal halide perovskite is commonly known to be related to the degradation of perovskite structure, i.e. decomposition of perovskite. Here, we elucidate the mechanism of degradation process of Cs based metal halide perovskite light harvester. The degradation process is strongly related to the bonding interaction at the interface between perovskite and the substrate. Various bonding interactions are included at the interfaces, in this case, weak bonding propagates the decomposition of perovskite crystals. To deeply understand the insights on the mechanism, we introduced the interlayer at the interface, so the interlayer improves the strengths of bonding interactions and inhibit the propagation of decomposition process.



임종철(충남대학교)

충남대학교 나노소재공학/고분자공학(공학사) (2002-2009)

포항공과대학교 화학공학과(공학박사) (2009-2015)

포항공과대학교 고분자연구소(Post-Doc) (2015-2015)

영국 옥스퍼드대학교 물리과(Post-Doc) (2015-2020)

충남대학교 에너지과학기술대학원 조교수 (2020-2023)

충남대학교 에너지공학과 부교수 (2024-현재)

Invited Lecture **2L11-6**

분자전자 부문위원회 II (2)

2025.10.1(수), 14:50~15:15, 11회장

Chair: 김호범, 강흥기

Polymer nucleation-inducing seed layer based multifunctional transparent ultrathin gold neural interfaces

강흥기[†]

서울대학교

Neural interface technologies are evolving rapidly to better understand brain function and treat neurological diseases. Recent efforts focus on (1) minimally invasive approaches and (2) integrating additional functions such as optical interfacing. While novel materials have potential, clinical use requires extensive validation. This talk introduces a method for creating transparent, flexible neural electrodes using conventional gold, enabled by polymer-metal atomic interaction. By thinning gold electrodes below 10 nm while maintaining electrical continuity, we achieved high transparency. Applications in biomedical fields will also be discussed.



강흥기(서울대학교)

KAIST 전자전산학과 (학사) (2004-2008)

UC Berkeley Electrical Engineering and Computer Sciences (석사) (2008-2010)

UC Berkeley Electrical Engineering and Computer Sciences (박사) (2008-2013)

Columbia University/KAIST (Postdoc) (2014-2019)

DGIST 전기전자컴퓨터공학과 (조교수/부교수) (2019-2024)

서울대학교 의과대학 의공학교실 (부교수) (2024-현재)

Invited Lecture **2L11-7**

분자전자 부문위원회 II (2)

2025.10.1(수), 15:15~15:35, 11회장

Chair: 김호범, 강흥기

Rational Design Strategies for Polymer and Hybrid Electrolytes for Safer and High-Performance Lithium- and Sodium-Ion Batteries

박명수[†]

한국화학연구원

Lithium-ion (LIB) and sodium-ion batteries (SIB) are widely used energy storage systems, offering high energy density and cyclability (LIBs), and cost-effectiveness and sustainability (SIBs). However, flammable liquid electrolytes pose safety risks, limiting large-scale use. Although flame-retardant additives have been explored, they often reduce performance. To address this, we propose rational design strategies for polymer and composite electrolytes to improve both safety and performance. First, a polymer electrolyte with optimized solvent and cation-coordinating matrix enhanced ion dissociation and conductivity. Second, a nonflammable polymer electrolyte with ion-conductive networks and a flame-retardant phosphate solvent suppressed decomposition and enabled efficient ion transport. Lastly, hybrid electrolytes combining polymers and ion-conductive oxides improved thermal and mechanical stability. Continuous oxide frameworks provided structural integrity and fast ion pathways.



박명수(한국화학연구원)

한양대학교 화학공학과 (학사) (2015)

한양대학교 화학공학과 (박사) (2021)

한양대학교 한양배터리센터 (Post-Doc.) (2021)

SK이노베이션 차세대배터리센터 (PM) (2021-2022)

SK온 차세대배터리센터 (PM) (2022-2024)

한국화학연구원 이차전지연구센터 (선임) (2025-현재)

Invited Lecture **2L11-8**

분자전자 부문위원회 II (2)

2025.10.1(수), 15:50~16:10, 11회장

Chair: 김호범, 강흥기

Spin-Dependent Energy Conversion Process by CISS Effect

마선일[†]

성신여자대학교

Recently, it has been demonstrated that when the charge carrier propagates through the chiral materials, its spin state can be controlled by the inherent helical field in chiral materials, which is called chirality-induced spin selectivity (CISS effect). Due to the intrinsic spin control capability of chiral materials, the formation of intermediate chemical species from the spin-unparalleled intermediate radical can be effectively suppressed during the energy conversion process without an external magnetic field.

Herein, based on the in-depth understanding of chirality transfer phenomena in a new type of chiral perovskites, we successfully demonstrated spin-controlled chemical energy conversion devices. The first experimental demonstration of a chiral perovskite as a spin-controlled layer in an oxygen evolution device with a sandwich configuration allows us to fully exploit the potential of chiral materials in water-splitting applications.



마선일(성신여자대학교)

연세대학교 신소재공학과 (학사) (2009-2016)

연세대학교 신소재공학과 (박사) (2016-2022)

University of Michigan (Post Doc) (2022-2024)

성신여자대학교 화학에너지융합학부 조교수 (2024-현재)

Invited Lecture **2L11-9**

분자전자 부문위원회 II (2)

2025.10.1(수), 16:10~16:30, 11회장

Chair: 김호범, 강흥기

Controlling the Size of Conjugated Polymer Nanoparticles for Efficient and Robust Visible-Light Photocatalysis

김승현[†]

대구경북과학기술원

Conjugated polymer-based photocatalysts offer promising opportunities for sustainable chemical transformations under visible light. However, their efficiency is hampered by limited exciton utilization and instability. In this talk, we demonstrate size reduction in the polymer photocatalysts serves as a unified strategy to enhance both reactivity and stability across two distinct systems: conjugated microporous polymers (CMPs) and vinylenelinked covalent organic frameworks (COFs). In CMPs, dispersion polymerization enabled size-controlled synthesis of well-dispersed nanoparticles (15–180 nm), leading to over 10-fold improvement in photocatalytic reactivity. In vinylenelinked COFs, we suppressed photo-induced degradation pathway by reducing nanoparticle size, achieving a 5-fold increase in operational stability. These studies highlight how precise control over nanoparticle size can unlock new regimes of performance in polymer photocatalysts.



김승현(대구경북과학기술원)

서울대학교 화학생물공학부 (학사) (2016)

MIT 화학공학과 (박사) (2021)

막스플랑크 고분자연구소 (Post-Doc) (2021-2024)

DGIST 에너지공학과 조교수 (2025-현재)

Invited Lecture **2L11-10**
분자전자 부문위원회 II (2)
2025.10.1(수), 16:30~16:50, 11회장
Chair: 김호범, 강흥기

Soft materials and system for wireless skin-interfaced electronics

김선희[†]

서울시립대학교

Skin-interfaced electronics have drawn significant attention over the past decade due to their unparalleled potential in healthcare applications, offering intimate integration with the human body. Soft materials composed of elastic polymer matrices embedded with functional nanoparticles, termed "soft nanocomposite", have emerged as a promising strategy to achieve soft platform. Through structural engineering of these soft materials, strain-invariant wireless skin-interfaced systems have been realized, laying the groundwork for practical operation in real-world, dynamically changing environments. To highlight the potential applications in digital healthcare, system-level integration of soft bioelectronic platforms, including a bionic band capable of real-time physiological signal monitoring with long-range wireless communication, as well as a more advanced, high-performance multimodal sensor system were designed for practical medical applications.



김선희(서울시립대학교)

서강대학교 화공생명공학과 (학사) (2009-2013)

서울대학교 화학생물공학부 (석사) (2013-2015)

서울대학교 전기정보공학부 (박사) (2018-2022)

한양대학교 융합전자공학부 (박사후 연구원) (2022-2023)

노스웨스턴 대학교 (박사후연구원) (2023-2025)

서울시립대학교 화학공학부 (조교수) (2025-현재)

Invited Lecture **2L11-11**

분자전자 부문위원회 II (2)

2025.10.1(수), 16:50~17:10, 11회장

Chair: 김호범, 강흥기

Dynamic Structural Color Control Using Chiral Liquid Crystal Elastomers

남승민[†]

조선대학교

Structural color, originating from photonic bandgaps in periodically arranged nanostructures, has attracted growing interest as a platform for tunable photonic systems. Among various candidates, chiral liquid crystal elastomers (CLCEs) stand out for their vivid reflection, dynamic wavelength tunability, and mechanical flexibility, enabled by the self-assembled helical alignment of liquid crystal molecules within an elastic network. Here, recent advances in dynamic structural color control using CLCEs are presented, with a focus on real-time and reversible wavelength tuning. Key strategies include the integration of electroactive actuators, multimodal deformation schemes, and heterogeneous material configurations for simultaneous multi-color tuning. These developments enhance the functionality of CLCEs and position them as promising materials for next-generation applications such as adaptive displays, wearable sensors, and reconfigurable photonic surfaces.



남승민(조선대학교)

부산대학교 전자공학과 (학사) (2013-2018)

부산대학교 전자전기컴퓨터공학과 (석사) (2018-2020)

POSTECH 전자전기공학과 (박사) (2021-2024)

POSTECH 전자전기공학과 (Post-Doc) (2024-2025)

조선대학교 전자공학과 조교수 (2025-현재)

Invited Lecture **2L11-12**
분자전자 부문위원회 II (2)
2025.10.1(수), 17:10~17:30, 11회장
Chair: 김호범, 강흥기

Wearable Energy-Electronic Devices and Their Integration System Toward On-body Wearable Microgrids

김경남[†]

충남대학교

The rapid advancement of wearable sensing and interfacing electronics brings growing challenges in achieving sustainability and energy autonomy. The long-term and reliable operation of these autonomous systems depends on the smart integration of energy harvesting and storage modules, along with their control and regulation circuits. However, current self-powered wearable systems often lack system-level energy management strategies, which limits their efficiency, reliability, and practicality. Reframing these technologies through the lens of wearable microgrids offers a new perspective for developing reliable, energy-efficient systems. By strategically integrating distributed on-body energy harvesters with energy storage components and decentralized hierarchical control, continuous and sustainable device operation becomes feasible. This work presents a vision for wearable microgrids based on application-specific, performance-matched combinations of harvesters and storage elements.



김경남(충남대학교)

UNIST 신소재공학과 (박사) (2015-2018)

UC San Diego 박사후연구원 (2018-2020)

한국화학연구원 박사후연구원 (2020-2022)

DGIST 에너지환경연구부 선임연구원 (2022-2025)

충남대학교 에너지과학기술대학원, 조교수 (2025-현재)

Invited Lecture **2L12-1**

Soft Matter Systems: Materials, Mechanics, and Miniaturized Devices (1)

2025.10.1(수), 10:50~11:15, 12회장

Chair: 하민정

Iontronics for energy harvesting and sensing

이영훈⁺

경희대학교

In this talk, I will discuss that hydrogels can be promising materials to be introduced into the field of tribotronics, resulting in maximizing the potential of TENGs and broadening the range of its applications. Feasibility and advantages of applying hydrogels as conducting layer in TENGs will be investigated. Three sections of ionic devices based on tribotronics will be explored; (1) design of soft ionic materials for tribotronics, (2) triboelectric energy harvesting based on ionic materials, and (3) broadening the research field of tribotronics based on ionic materials: self-powered touch sensors, touch position sensors, proximity sensors, and versatile soft robots. Fundamental insights into the underlying working principle of ionic material-based TENG may help to open new avenues for further innovation in the field of soft devices.



이영훈(경희대학교)

경희대학교 기계공학과 (학사) (2009-2014)

경희대학교 기계공학과 (석사) (2014-2016)

서울대학교 재료공학부 (박사) (2016-2021)

MIT RLE (Postdoctoral Fellow) (2021-2023)

가천대학교 기계공학과 조교수 (2023-2025)

경희대학교 기계공학과 조교수 (2025-현재)

Invited Lecture **2L12-2**

Soft Matter Systems: Materials, Mechanics, and Miniaturized Devices (1)

2025.10.1(수), 11:15~11:40, 12회장

Chair: 하민정

Biological Signal Sensing Platform Based on Polymer Electronic Circuits

이원령⁺

서울대학교

Signaling of biochemical and bioelectrical information on the biological surface is important to get accurate, continuous bio-information. Recently, flexible invasive medical devices have been well developed with their mechanical stability for attaching sensors to complex body internal surfaces. Especially, they are attracting attention as implantable devices due to their conformability. In this study, we aimed to demonstrate various bio applications by realizing conformable electronics using polymer electronic components. The conformability of device platform was realized the two ways; one is the making ultra-thinness, the other is the adapting low Young's modulus materials. We specifically demonstrate measurement in mapping bio-electrical signals on muscles, brains, and hearts and measurement in bio-chemical concentrations on the sweat, interstitial fluidic. Furthermore, we minimized the sensor elements by taking unique circuit schematic such as inductive coupling, self-powering, optical-information-transporting.



이원령(서울대학교)

B.A., Nagoya University, Japan (2009-2013)

M.S., The University of Tokyo, Japan (2013-2015)

Ph.D., The University of Tokyo, Japan (2015-2018)

Post-Doc, KAIST (2018-2020)

Senior Researcher, KIST (2020-2025)

Associate Professor, Seoul National University (2025-현재)

Invited Lecture **2L12-3**

Soft Matter Systems: Materials, Mechanics, and Miniaturized Devices (1)

2025.10.1(수), 11:40~12:05, 12회장

Chair: 하민정

An Artificial Nnervous System for Communication between Wearable and Implantable Therapeutics

Alex Abramson[†]

Georgia Institute of Technology/Emory University School of Medicine

Bioelectronics have transformed our capacity to monitor and treat diseases; however, a lack of micrometer-scale, energy efficient communication options limit these devices from forming integrated networks that enable full-body, sensor driven, physiological control. Inspired by our nervous system's ability to transmit information via ionic conduction, we engineered a Smart Wireless Artificial Nervous System (SWANS) that utilizes the body's own tissue to transmit signals between wearables and implantables. SWANS' implantable communication components maintain syringe-injectable footprints and >15x greater power efficiencies than Bluetooth and Near Field Communication. In vivo studies in rats demonstrate SWANS' ability to wirelessly regulate dual hind leg motor control by connecting electronic-skin sensors to implantable neural interfaces via ionic signaling as well as coordinate bioelectronics throughout the epidermal, subcutaneous, intraperitoneal, and gastrointestinal spaces.



Alex Abramson(Georgia Institute of Technology/Emory University School of Medicine)

B.S. Johns Hopkins University (2015)

Ph.D. MIT (2019)

Post-Doc., Stanford University (2022)

Assistant Professor, Georgia Tech (2022-Present)

Invited Lecture **2L12-4**

Soft Matter Systems: Materials, Mechanics, and Miniaturized Devices (1)

2025.10.1(수), 12:05~12:30, 12회장

Chair: 하민정

Digitizing Soft Machine: Programmable Materials, Structure and Devices

김지윤⁺

울산과학기술원

Recent advances in virtual intelligence have reached or surpassed human-level cognitive capabilities, while physical machines still lag in intelligent adaptability despite mimicking biological forms like humans or octopuses. To address this, our research group aims to develop an integrated robotic platform capable of programming its morphology, physical properties, interfaces, and functions. Achieving this requires innovation across materials, components, system architectures, manufacturing, and operation. In this talk, I will introduce key research directions and outcomes from our group, including programmable robotic components using smart materials, structural architectures based on tensegrity and folding mechanisms, and AI-based methods for robot design and operation. These efforts aim to bridge the virtual and physical worlds, reshaping our interaction with the environment.



김지윤(울산과학기술원)

서울대학교 전기공학부(학사) (2010)

서울대학교 전기공학부(박사) (2013)

미국립보건원(NIH) 암연구센터 (Post-Doc.) (2014-2016)

울산과학기술원 신소재공학과 부교수 (2016-현재)

Invited Lecture **2L12-5**

Soft Matter Systems: Materials, Mechanics, and Miniaturized Devices (2)

2025.10.1(수), 14:00~14:25, 12회장

Chair: 하민정

Dynamic Characterization of 3D Soft Auxetic Metastructures

김재환[†]

국립금오공과대학교

Recent advances in soft mechanical metatmaterials has highlighted the potential of 3D soft auxetic metastructures, however, accurate prediction of their dynamic properties remains challenging. In this work, two complementary approaches are presented to address this gap. First, a wave propagation-based theoretical-experimental method was developed to evaluate the dynamic properties of re-entrant honeycomb auxetic structures fabricated from viscoelastic polymers. Second, a vibrational physics-guided neural network (VPGNN) was proposed to directly estimate natural frequency and damping ratio from impulse responses by embedding analytical impulse response functions and physical metadata into the learning process. These strategy bridges experimental data, physical modeling and deep learning, enabling accurate, interpretable and scalable dynamic characterization of soft auxetic metastructures, thereby expanding their potential in engineering applications.



김재환(국립금오공과대학교)

한국과학기술원 기계공학과 (학사) (2008-2012)

한국과학기술원 해양시스템공학과 (석사) (2012-2014)

한국과학기술원 기계공학과(박사) (2019)

삼성전자, DA (Staff Engineer) (2019-2020)

국립금오공과대학교 기계공학부 조교수 (2020-2025)

국립금오공과대학교 기계공학부 부교수 (2025-현재)

Invited Lecture **2L12-6**

Soft Matter Systems: Materials, Mechanics, and Miniaturized Devices (2)

2025.10.1(수), 14:25~14:50, 12회장

Chair: 하민정

Electrified Hydrogels for Small-Scale Robotics

고종국[†]

가천대학교

Electroactive soft actuators, inspired by biological organisms, hold a significant promise for revolutionizing robotics by replacing conventional motors. However, their practical application has been typically restricted by a critical trade-off: limited performance and strict operating conditions have prevented the development of small, lightweight, and truly portable robots. This talk introduces a new class of electrified hydrogel actuator that overcomes these limitations. A hydrogel-layered electroosmosis actuator capable of unprecedented performance at low voltage and power is presented. This breakthrough is enabled by the capillary-assisted in situ assembly of metal nanoparticles, forming an ultrathin, porous metallic layer on the hydrogel surface. By integrating these actuators with a microcontroller and a small battery, we demonstrate the small and fast untethered aquatic soft robots that can pave the way for a new generation of autonomous soft robotics.



고종국(가천대학교)

서울대학교 화학생물공학부 (학사) (2008-2012)

서울대학교 화학생물공학부 (석박사통합) (2012-2018)

고려대학교 화공생명공학과 (연구교수) (2018-2021)

Max Planck Institute for Intelligent Systems (박사후연구원) (2021-2023)

가천대학교 화공생명배터리공학부 (2023-현재)

Invited Lecture **2L12-7**

Soft Matter Systems: Materials, Mechanics, and Miniaturized Devices (2)

2025.10.1(수), 14:50~15:15, 12회장

Chair: 하민정

Engineering Complexity: Microstructured Surfaces and Magnetically Actuated Morphing Systems

위정재[†]

한양대학교

Magneto-responsive soft materials offer new opportunities in programmable surface engineering and microscale actuation. This study presents three strategies for controlling and fixing microscale architectures. Inspired by sharkskin, 3D microdenticle arrays are formed via magneto-mechanical actuation, enabling tunable anisotropic drag and friction through structural interlocking. A light-activated covalent adaptable network allows reversible, binder-free fixation using UV-induced disulfide exchange under ambient conditions. Magnetically actuated micropillar arrays exhibit multimodal, high-frequency oscillations, with motion controlled by magnetic alignment and geometry. These approaches enable dynamic reconfiguration of soft robotic and fluidic systems, offering spatiotemporal control of functional microactuators. The combined strategies form a versatile platform that connects biomimetic design with material programmability.



위정재(한양대학교)

델라웨어대학교 화학공학과 박사 (2008-2013)

미공군연구소 박사후연구과정 (2012-2014)

MIT 기계공학과 박사후연구과정 (2014-2015)

인하대학교 고분자공학과 조교수, 부교수 (2015-2022)

한양대학교 유기나노공학과 부교수 (2022-현재)

뉴욕주립대 ESF 화학공학과 (겸임연구교수) (2023-현재)

Poster Presentation **1PS-001**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Screening Dopants for Developing a Fluorine-Free Conductive Polymer Adhesive for Electrical Applications

황인서, 선충민, 김기훈, 남호성, 윤현석[†]

전남대학교

Conventional polymer binders such as PVDF, which are electrically insulating, hinder charge transport within electrodes and necessitate the use of additional conductive additives. A fluorine-free, intrinsically conductive polymer adhesive (CPA) was synthesized by ternary doping of polyaniline (PANI) with camphorsulfonic acid (CSA), dodecylbenzenesulfonic acid (DBSA), and glycidyl trimethylammonium chloride (GCT) via solution processing. The doped structure exhibits improved redox activity, polymer chain ordering, and interfacial interactions, resulting in high electrical conductivity and strong adhesion without the need for conductive agents or thermal treatment. Compared to PVDF, CPA delivers higher specific capacitance, reduced internal resistance, and enhanced compatibility with diverse electrode materials. These results underscore the potential of CPA as a multifunctional and environmentally benign binder for advanced electrochemical energy storage applications.

Poster Presentation **1PS-002**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

In-situ Polymerized Fluorinated Gel Polymer Electrolytes Enabled by High-Energy Electron Beam Irradiation for Lithium-ion Batteries

채욱일, 엄태식[†]

홍익대학교

Solid-state electrolytes (SSEs) have gained much attention, which shows high-energy density and safety. However, SSEs possess problems applying commercial lithium-ion batteries (LIBs). Gel polymer electrolytes (GPEs) are promising electrolytes for practical LIBs due to high ionic conductivity, chemical stability, and processability. Here, we developed in-situ polymerized GPEs using high-energy electron beam (E-beam) irradiation. GPEs were fabricated in 4.4 seconds of E-beam irradiation without the use of an initiator. Fluorinated monomer was introduced into the polymer matrix, resulting in enhanced electrochemical performance. Fluorinated GPE (FPE) exhibited high ionic conductivity of 1.53 mS cm^{-1} at 25°C , a lithium transference number of 0.53, and good electrochemical stability of 5.1 V. In addition, FPE demonstrated an high initial discharge capacity of 197 mAh g^{-1} at 0.1 C in NCM 811/FPE/Li configuration and a capacity retention of 83% after 100 cycles at 0.5 C.

Poster Presentation **1PS-003**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Engineering Functionalized Cellulose for Solid Electrolytes: Impact of Chemical Modification and Morphology on Ion Transport

진우석, 정재한[†]

서울과학기술대학교

Cellulose-based solid polymer electrolytes (CSE) have emerged as promising materials for cost-effective all-solid-state batteries due to their mechanical robustness, thermal resistance, and inherent polar functionalities. However, its dense hydrogen-bonding network restricts intermolecular spacing and limits Li^+ transport, requiring molecular-level structural engineering.

To address this limitation, we functionalized cellulose with citric acid to simultaneously disrupt hydrogen bonding and introduce a high density of carboxyl groups capable of coordinating with Li^+ . This molecular design allows investigation into how polar group density and intermolecular chain spacing influence Li^+ hopping transport. By varying the degree of esterification, we modulate the number of active coordination sites and analyze their effect on ionic conductivity and Li^+ transference. Our results reveal a correlation between carboxyl group density and formation of efficient Li^+ transport channels in CSE

Poster Presentation **1PS-004**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Investigation of Mechanisms of Molecularly Functionalized Separator for High Performance Lithium Metal Batteries via Molecular Simulations

조유빈, 이지윤, 이태경[†]

경상국립대학교

High-energy-density lithium metal batteries (LMBs) are promising strategy for advanced energy storage systems. However, these batteries are constrained by electrolyte-electrode interphase degradation, impairing electrode stability and performance. To stabilize the interfaces of electrodes, we introduce a molecularly functionalized separator (MFS) and investigate its role using density functional theory calculations. The MFS shows stronger binding energy with Li metal surface compared to electrolytes, enhancing LiF formation. The PF₅ bound to MFS is thermodynamically unfavorable than hydrolysis reactions of free PF₅, thereby inhibiting PF₅ hydrolysis. The MFS exhibits low binding energies with transition metal (TM) ions, indicating spontaneous chelation of dissolved TM ions from cathode. According to thermodynamic analysis, HF is spontaneously captured by C-F bonds in the MFS, suggesting its serve as HF scavenger. These findings highlight the potential of MFS to stabilize interfaces and improve the performance of LMBs.

Poster Presentation **1PS-005**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

A Multifunctional Polymer Brush Network Binder for High-Nickel Cathodes: Architecture-Driven Elastic Recovery, Adhesion, and Li⁺ Transport

조민서, 심지민[†]

서울대학교

Fabricating thick, high-loading electrodes using nickel-rich layered oxides such as $\text{LiNi}_x\text{Co}_y\text{Mn}_z\text{O}_2$ (NCM) is essential for maximizing energy density of lithium-ion batteries, but it also intensifies mechanical and interfacial stresses that compromise cycling stability. Herein, a multifunctional polymer brush network (PBN) binder is synthesized by cross-linking poly(vinylidene fluoride)-graft-poly(acrylic acid) with polyethylene glycol diglycidyl ether (PEGDGE). This design provides elastic recovery, strong hydrogen-bond adhesion, and improved Li⁺ transport via PEG domains. PBN reduces PVDF brittleness, improving toughness, elasticity, and stress recovery for stable cycling under high-loading and low binder content. Electrochemical and theoretical results confirm better Li⁺ mobility and binder interactions. Post-mortem analysis shows PBN preserves electrode integrity and stabilizes the cathode electrolyte interphase (CEI), demonstrating the importance of multifunctional binder architecture.

Poster Presentation **1PS-006**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Ion–Dipole Induced Polymer Electrolytes for Enhanced Ion Transport and Dendrite Suppression in LMBs

정희주, 최우혁[†]

인하대학교

To address key challenges in lithium-metal batteries (LMBs), such as dendrite growth and interfacial instability, we developed a composite elastomer electrolyte (CEE) via one-step UV polymerization with a multiple-bridge design. The CEE consists of a nitrile monomer (FN), a hydrogen-bonding monomer (BACOEa), a deep-eutectic solvent (SN/LiTFSI), and Al₂O₃ nanowires. Ion–dipole interactions between Li⁺ and –CN groups, along with hydrogen bonding to TFSI[–], enhance selective Li⁺ transport, yielding a high lithium-ion transference number ($t_{\text{Li}^+} = 0.72$) and ionic conductivity ($1.7 \times 10^{-3} \text{ S cm}^{-1}$). The nanowire-reinforced matrix improves mechanical strength, contributing to dendrite suppression. Furthermore, using the CEE as both electrolyte and binder, composite elastomer cathodes (CECs) were fabricated, exhibiting improved interfacial contact and stable cycling in Li||LFP full cells. This strategy offers a promising direction for enhancing safety and performance in next-generation LMBs.

Poster Presentation **1PS-007**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Tailoring GNP/Super P Hybrid Networks for High-Performance NCM811 Dry Electrodes

정현지[†], 유영재[†]

중앙대학교

To improve the performance of NCM811-based dry electrodes, we fabricated 150 μm -thick electrodes using composite conductive agents composed of 0D Super P and 2D GNPs. By varying the Super P content (25–100 wt%), we investigated the impact of conductive agent morphology on electrode performance. Among all compositions, the SuperP75 electrode (75% Super P, 25% GNP) exhibited the highest specific capacity ($\sim 208 \text{ mAh g}^{-1}$ at 0.1C) and excellent rate capability. While CV tests showed minimal differences in current density or peak area, the composite-based electrodes demonstrated electrochemically stable structures. Furthermore, the SuperP75 electrode maintained stable capacity over cycling and recovered its initial capacity after returning to 0.1C. These results highlight the role of optimized Super P/GNP ratios in enhancing conductivity and lithium-ion transport in thick dry electrodes, offering a scalable path for high-energy-density lithium-ion batteries.

Poster Presentation **1PS-008**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

A Water-resistant Artificial Solid Electrolyte Interphase (SEI) for Lithium Metal Anodes: Enabling Dry Room-Free Processing and Dendrite Suppression

정영훈, 심지민[†]

서울대학교

Lithium (Li) metal is considered a promising anode material for next-generation rechargeable batteries. However, challenges such as uneven Li electrodeposition and unstable solid electrolyte interphase (SEI) formation during cycling lead to premature cell failure and safety risks. In this study, we introduce an artificial SEI based on fluorinated polyethyleneimine (PEIF), featuring a super-hydrophobic yet lithiophilic protective layer. The nitrogen-rich PEI backbone facilitates uniform Li⁺ flux, while fluorinated side chains block moisture and solvent penetration, enabling dry room-free processability. Structural optimization of PEIF effectively suppresses electrolyte decomposition and Li dendrite growth, enhancing battery safety and lifespan. This approach provides a practical and scalable route toward stable Li metal batteries that are compatible with ambient manufacturing environments

Poster Presentation **1PS-009**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Tunable sulfur-doped carbon coatings for conductivity bridging and mechanical protection in silicon anodes

전희지, 김정훈[†], 정민석

연세대학교

Most of the reported S-doped Si/C composites exhibit sulfur doping that is unevenly distributed on the amorphous carbon layer surface or to have a thin carbon layer formed only on the particle surface, resulting in structural instability. To obtain composites with a uniformly S-doped carbon coating layer enveloping the entire particle, we designed a new synthesis route using spray drying with polystyrene sulfonic acid (PSS), a water-soluble polymer, as the precursor. Through spray drying followed by carbonization, S-doped carbon-coated silicon composites (Si/S-C) were synthesized. During carbonization, a polymer-derived carbon layer forms while sulfur atoms simultaneously doped, resulting in a structure with enhanced electrical conductivity and mechanical stability.

Poster Presentation **1PS-010**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Advanced Functional Separators for Long-Life, Self-Recovering Thin Lithium Metal Batteries

장은빈, 박상현, 유지영[†]

경북대학교

With the growth of the EV market, thin Li metal anodes are explored for high energy density but suffer from limited Li sources and unstable SEI, causing capacity fade. To address this, LiFSI salt was coated on commercial separators, creating a localized high-concentration environment at the electrode interface. The coating dissolves during cycling, replenishing Li ions, reducing free solvent, and forming a stable LiF-rich SEI, enhancing mechanical and electrochemical stability. In Li||Li symmetric cells with 1M LiFSI/DME electrolyte, the salt-coated separator (SDL) showed lower polarization and improved cycle life compared to PE separators. SDL reduced nucleation overpotential and increased exchange current density improving interfacial kinetics. High-rate tests confirmed better capacity at 5C. SEM revealed dense Li deposition without dendrites in SDL. Thin Li metal half-cells with SDL maintained stable cycling over 250 cycles.

Poster Presentation **1PS-011**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Highly efficient ion extraction with phosphorylated micro-sized hydrogels

장영빈, 오승수¹

포항공과대학교

¹ POSTECH

The urgent need for battery material recycling stems from rising energy demands and stricter environmental regulations. Recovering metals like lithium, cobalt, and nickel is vital for economic and environmental sustainability. Liquid-Liquid Extraction (LLE), a traditional method for ion recovery, uses a two-phase system with water and an organic solvent, but requires toxic solvents and complex separation, limiting scalability and raising environmental concerns. To overcome these challenges, we propose a polyacrylamide-based microgel that extracts metal ions only in water without the necessity of organic solvents. By incorporating excess phosphate groups, the micro-sized hydrogel can capture metal ions within its structure, achieving a recovery rate greater than 95 % after extraction. This approach maintains high efficiency, simplifies operation, and enables selective metal recovery. Our findings present a potential scalable, environmentally sustainable solution for battery recycling.

Poster Presentation **1PS-012**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Synergistic Reinforcement and Dispersion Behavior of CNF/Silica Co-Fillers in SOL SBR Rubber Composites

장백균, 이동윤[†]

경북대학교

Cellulose nanofibers (CNFs) are eco-friendly fillers gaining attention as alternatives to silica and carbon black in rubber composites. However, their hydrophilic nature causes aggregation, limiting dispersion and reinforcement efficiency. This study explores synergistic effects of CNFs combined with silica as co-fillers in rubber matrices. The dual fillers are expected to form networks enhancing mechanical properties beyond single fillers. Tensile strength, elastic modulus, and thermal stability were measured. Scanning electron microscopy (SEM) examined filler dispersion. Dynamic mechanical analysis (DMA) and rheometry assessed storage modulus, loss modulus, and $\tan \delta$. The Payne effect was analyzed to understand filler interactions, providing insight into reinforcement mechanisms. Results suggest CNF/silica co-fillers have potential for sustainable, high-performance rubber composites.

Poster Presentation **1PS-013**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

A Nanoseeding Approach for the Controlled Growth of Perovskite Nanocrystals on Carbon Nanotubes

이하늬, 윤현석[†]

전남대학교

Multiwalled carbon nanotubes (MCNTs) were a structural platform for the controlled growth of CsPbBr₃ perovskite nanocrystals (PNCs) via a nanoseeding-mediated approach. Lead-based nuclei initially formed on the nanotube surface, followed by introduction of a cesium precursor to support PNC growth. The reaction temperature affected the morphology and optoelectronic properties of the resulting nanohybrids (PNTs). Notably, the presence of MCNTs promoted the formation of larger PNCs with enhanced green photoluminescence and reduced bandgap energy, thereby modulating electronic structure. PNTs exhibited a strong photogating effect and selective photocurrent activation under high-energy ultraviolet exposure, underscoring their potential as optoelectronic transducers. Additionally, the luminescent properties were leveraged for anti-counterfeiting. PNTs were used as black ink to create luminescent QR codes with forgery-resistant pixels, providing a robust strategy for secure authentication.

Poster Presentation **1PS-014**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

PVA-based Semi-IPN Polymer Electrolyte with UV-Initiated PEG-PVEC for Enhanced Ionic Conductivity and Mechanical Strength for Solid-state Lithium-ion Battery

이지연, 김덕준[†]

성균관대학교

Lithium metal batteries (LMBs) are considered promising candidates for next-generation energy storage devices due to their high energy density for various applications. However, challenges such as dendrite formation and instability of the electrolyte need to be addressed. In this study, a semi-interpenetrating polymer network (semi-IPN) structure was introduced, incorporating a polyvinyl alcohol (PVA) matrix with UV-initiated polyethylene glycol monomethyl ether methacrylate (PEGMA), polyethylene glycol dimethacrylate (PEGDA), and vinyl ethylene carbonate (VEC). The resulting electrolyte demonstrates an ionic conductivity of $1.36 \times 10^{-3} \text{ S cm}^{-1}$ and a tensile strength of 5.49 MPa, highlighting its potential for use in LMBs. These results show that UV-initiated semi-IPN-based polymer electrolyte enhances LMB performance by improving ionic conductivity and mechanical stability. In addition, the electrochemical stability window was measured by linear sweep voltammetry, and the interfacial compatibility with lithium metal was evaluated through lithium plating/stripping tests using lithium symmetric cells. This system offers a promising solution to safer and more efficient energy storage applications.

Poster Presentation **1PS-015**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Dual-Anion Regulated SEI Formation Enabling Stable and Thin Interphases for Lithium-Metal Anodes

이제민, 유지영[†]

경북대학교

A dual-anion locally concentrated ionic liquid electrolyte (D-LCILE), using LiFSI and LiTFSI salts, forms a thin, uniform, and LiF-rich solid electrolyte interphase (SEI) for stable lithium-metal batteries. Raman spectroscopy and molecular dynamics simulations show that dual-anion chemistry promotes aggregate (AGG)-rich Li^+ solvation, enhancing anion co-migration during charging. This allows FSI^- to reach the anode and decompose into LiF, a chemically and mechanically stable SEI component. AIMD simulations reveal fast F dissociation from FSI^- , while TFSI^- supports Li^+ transport and wettability via weak coordination. ToF-SIMS and XPS depth profiling verify high fluorine content in the SEI interior. SEM shows denser, thinner Li deposits with D-LCILE. Full-cell tests exhibit 99.93% capacity retention over 200 cycles. This dual-anion strategy offers a unified route to optimize solvation structure, SEI composition, and interfacial stability in high-energy lithium-metal batteries.

Poster Presentation **1PS-016**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Development of hydrocarbon-based proton exchange membranes with high ionic conductivity and dimensional stability

이예림, 이소영[†]

한국과학기술연구원

Proton exchange membranes (PEMs) play a vital role in electrochemical energy systems, including fuel cells and water electrolyzers. While perfluorosulfonic acid (PFSA)-based membranes are widely used, their high cost and limited stability under low humidity or high temperature have prompted interest in hydrocarbon-based alternatives. However, achieving both high proton conductivity and dimensional stability in hydrocarbon PEMs remains a critical challenge.

In this study, hydrocarbon-based PEMs were designed by incorporating hydrophilic functional groups into the polymer structure to facilitate efficient water-mediated proton conduction. Backbone rigidity and controlled microphase separation were also introduced to suppress membrane swelling and enhance mechanical integrity. The resulting membranes exhibit improved conductivity and dimensional stability, demonstrating their potential for next-generation electrochemical applications.

Poster Presentation **1PS-017**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

브롬산 계면 반응을 활용한 CsPbBr₃ 페로브스카이트 나노결정의 표면 제어 및 광촉매 기반 이산화탄소 환원 성능 향상

이경호, 장재영[†]

한양대학교

CsPbBr₃ 페로브스카이트 나노결정은 우수한 흡광 및 광전 특성으로 인해 차세대 광촉매 소재로 각광받고 있다. 특히 광촉매 기반 이산화탄소 환원 반응은 촉매의 표면에서 일어나기 때문에, 반응에 적합한 표면 환경을 조성하는 것이 중요하다. 예를 들어, 반응에 필요한 양성자의 효율적인 공급이 가능하거나, 활성점으로 작용할 수 있는 할라이드 이온이 풍부한 표면 조건이 있다. 본 연구에서는 유기-수계 계면에서의 화학 반응을 통해 CsPbBr₃ 나노결정 표면에 브로마이드 이온과 양성자를 동시에 도입할 수 있는 간단하면서도 효과적인 전략을 제안하였다. 수계에 존재하는 브롬산의 유기상으로의 확산을 정밀하게 제어함으로써, 단일 공정 내에서 결함 패시베이션, 할라이드 활성점 형성, 양성자 공급이 동시에 이루어지는 계면 반응 시스템을 구현하였다. 그 결과 CsPbBr₃ 나노결정의 광발광 양자효율이 향상되었으며, 가시광 조건 하에서의 CO₂ 환원 반응에서도 우수한 촉매 활성이 확인되었다. 본 발표에서는 제안한 계면 반응 기반 표면 제어 전략의 원리와 구현 방식, 그리고 이를 통한 광학 및 촉매 성능 향상에 대해 소개하고자 한다.

Poster Presentation **1PS-018**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Pyrolysis-Free Synthesis of PtO₄ Single Atom Catalysts for Interfacial Synergistic Hydrogen Evolution

윤여훈, 김상욱[†]

카이스트

Various types of atomic catalysts based on pyrolysis methodologies have been explored thus far, aiming at superior electrocatalytic performance with high cost-efficiency. However, such performance enhancements are predominantly ascribed to the augmented electrical conductivity at the carbonized framework rather than the intrinsic activity of catalytic sites. In this work, we introduce a pyrolysis-free strategy by utilizing dopamine monomers as adhesive modules to anchor PtO₄ catalytic sites on various 2D substrates. Taking advantage of these distinctive features, we experimentally verified the substrate-dependent noticeable variation in the characteristics of PtO₄ sites, attributed to the electron redistribution driven by hetero-interfacial synergistic effects. Notably, the mass activity of PtO₄ sites was enhanced by up to 63-fold through the judicious pairing with Ti₃C₂T_x MXene, highlighting the critical role of non-covalent interfacial engineering in catalytic performance.

Poster Presentation **1PS-019**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Interfacial Engineering of Lithium Metal Batteries Using Phase-Separated and Semi-interpenetrating Network Electrolytes via In-Situ Dual Curing Process

오수연, 최우혁[†]

인하대학교

Gel polymer electrolytes (GPEs) in lithium metal batteries (LMBs) encounter critical challenges of conductivity–strength trade-offs and interfacial instability. Here, we present an in-situ dual curable GPE that overcomes both via polymerization induced phase separation (PIPS) and a semi-interpenetrating network (semi-IPN). During 1st UV curing, BPAEDA polymerizes and induces phase separation with the liquid electrolyte, forming continuous ion-conduction pathways. This structure yields high ionic conductivity of 2.0×10^{-3} S/cm. VEC remains unpolymerized and enhances interfacial wetting after cell assembly. In the 2nd thermal curing VEC is polymerized in situ, forming a semi-IPN matrix with high strength ($G' = 1.36 \times 10^5$ Pa) and good electrode adhesion. This design lowers interfacial resistance (473Ω), suppresses dendrites, and enables stable lithium cycling for over 2000 hours, highlighting its potential for high performance LMBs.

Poster Presentation **1PS-020**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Anode Materials derived from Cattle Manure for High-Performance Li-ion Batteries

양채원, 엄태식[†]

홍익대학교

Cattle manure, a widely available agricultural waste, is a sustainable and low-cost precursor for hard carbon due to its high carbon and lignocellulosic content. Biomass-derived hard carbon is a promising anode material for lithium-ion batteries (LIBs) owing to its porous structure and enhanced Li^+ diffusion. In this study, porous hard carbon was synthesized from cattle manure via a simple ZnCl_2 -assisted activation and pyrolysis process. This method addresses the limitations of graphite anodes, such as low capacity and slow charging, by introducing a porous structure with large surface area. The activated and carbonized manure-derived anode (APCM) delivers a higher initial capacity than graphite and shows excellent cycling stability, retaining 364.09 mAh/g after 500 cycles at 0.1 A/g. It also demonstrates outstanding rate capability up to 5 A/g. These results show that ZnCl_2 -activated cattle manure is a promising and sustainable material for next-generation LIB anodes.

Poster Presentation **1PS-021**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Advanced lithium metal batteries via localized high concentration polymer electrolyte

안시연, 최우혁[†]

인하대학교

Lithium metal batteries (LMBs) are promising energy storage system due to their high energy density, but their practical application is hindered by lithium dendrite growth and safety concerns. Gel polymer electrolyte (GPEs) offer a alternative solution by mechanically suppressing dendrites, yet often exhibit low ionic conductivity and high interfacial resistance due to strong Li^+ solvation and sluggish ion transport. In liquid systems, F-containing diluent with low dielectric constants have been explored to mitigate this issue. Herein, we address the challenges of conventional GPEs by covalently incorporating an F-diluent into the polymer matrix. This reduces Li^+ solvation strength and promotes faster ion hopping, while the fluorinated environment induces an anion-rich solvation structure that facilitates the formation of a robust, LiF -rich SEI layer. This SEI layer stabilizes Li^+ flux and effectively suppresses dendrite growth. Moreover, the high oxidative stability of the F containing polymer enables reliable battery operation. This molecular-level GPE design can enhance ionic conductivity and electrochemical stability in LMB.

Poster Presentation **1PS-022**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Functional Polymer Thin Films for Enhancing Electrode Interfaces in Sulfide-Based All-Solid-State Batteries

조성진, 송영진, 박수진[†]

포항공과대학교

The demand for high-energy-density and safe energy storage has accelerated the development of all-solid-state batteries (ASSBs). To address interfacial instability in ASSBs with sulfide solid electrolytes (SSEs), we propose a strategy using submicron-thick functional polymer films deposited via initiated chemical vapor deposition. Eight polymers were evaluated, and poly(acrylic acid) (pAA) and poly((perfluorohexyl)ethyl acrylate) (pC6FA) significantly improved coulombic efficiency (CE) and cycling stability. These coatings protect anodes from direct SSE contact and enable tailored solid-electrolyte interphase (SEI) formation. In@pAA and In@pC6FA achieved CE >98.8% with favorable SEIs— $\text{Li}_2\text{CO}_3/\text{COO}^-\text{Li}$ for pAA and LiF/LixPOyFz for pC6FA—confirmed by XPS and TOF-SIMS, while others led to Li_2S formation and poor CE. Our findings offer insight into previously underexplored polymer–SSE interactions and provide a platform for interfacial design in high-performance ASSBs.

Poster Presentation **1PS-023**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Organic-Inorganic Hybrid Separators with Flame-Retardant Functionality for Lithium-Ion Batteries

서신영, 심지민[†]

서울대학교

Battery thermal runaway causes fire and explosion risks, emphasizing the need for flame-retardant strategies. Adding flame-retardant additives to electrolyte is common, but it raises viscosity and lowers ionic conductivity. Herein, an organic-inorganic hybrid flame-retardant separator was developed by coating both sides of a polyethylene (PE) separator with 9,10-dihydro-9-oxa-10-phosphaphenanthrene 10-oxide (DOPO)-containing cross-linked polymer and Boehmite ceramic particles, inspired by conventional ceramic-coated separators. The DOPO moieties provide radical scavenging and char-forming effects, while Boehmite contributes an endothermic effect through water release upon heating. The cross-linked polymer matrix effectively encapsulates the ceramic particles, mitigating interfacial resistance caused by direct contact between ceramic particles and the electrode. Furthermore, the organic-inorganic material hybridization yields a porous structure that ensures favorable ionic conductivity.

Poster Presentation **1PS-024**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Durability Improvement of PEMFC Membranes Using Cerium-Based Radical Scavenger Layer

김윤아, 이소영[†]

한국과학기술연구원

Perfluorosulfonic acid (PFSA) membranes used in PEMFCs suffer from radical-induced chemical degradation, especially under low humidity. To improve durability, a Ce-based radical scavenger(Ce-RS) was incorporated into the multilayer membrane. This Ce-RS layer effectively mitigates chemical degradation by intercepting reactive radicals such as $\bullet\text{OH}$ and $\bullet\text{H}$.

This multilayer membrane enhanced water uptake, improved thermal properties, and approximately threefold higher durability, maintaining stable operation for over 2000 hours under low-humidity OCV conditions. This strategy offers a promising approach for extending PEMFC membrane durability, and provides valuable insights for the design of membranes suitable for harsh operating environments.

Poster Presentation **1PS-025**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Architecture-tunable Bottlebrush Polymers as Artificial Solid Electrolyte Interphases for Lithium Metal Batteries

김승현, 심지민[†]

서울대학교

Lithium (Li) metal offers the highest theoretical capacity and lowest electrochemical potential among anode materials, but practical use is hindered by unstable interfacial chemistry causing dendrite formation and capacity loss. We introduce fully grafted bottlebrush polymers (BBPs) with polynorbornene backbones and lithiophilic polyethylene glycol side chains as artificial solid electrolyte interphases (SEIs). By varying backbone and side-chain lengths, we elucidated how molecular entanglement governs mechanical resilience and ion coordination of polymer interphases. The optimized BBP forms an entangled network that resists electrolyte swelling and promotes uniform Li deposition. Comprehensive analyses confirm the essential role of architecture-driven entanglement in establishing stable SEIs. This work establishes a molecular design strategy leveraging polymer entanglement to achieve durable, high-efficiency Li metal anodes.

Poster Presentation **1PS-026**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Inhibition of Structural Degradation in Silicon Anodes of Lithium-Ion Batteries Using a Supramolecular Self-Healing Binders based on a Host-Guest System

김서현, 이은지[†]

광주과학기술원

Silicon (Si) is a promising anode material for lithium-ion batteries (LIBs) due to its high theoretical capacity. However, it suffers from severe volume expansion during cycling, leading to particle pulverization and unstable solid electrolyte interphase (SEI), which result in rapid capacity fading. Conventional binders such as PVDF and PAA have weak interactions with Si and cannot effectively suppress such degradation. In this study, we propose a novel self-healing polymeric binder based on supramolecular host-guest interactions to address this issue. The dynamic reversible bonds allow the binder to dissipate mechanical stress and autonomously heal cracks formed during cycling. As a result, the Si electrode maintains its structural integrity and electrochemical performance over extended cycles. Our findings demonstrate that supramolecular self-healing binders are a promising strategy for enhancing the durability of Si anodes and advancing high-capacity next-generation LIBs.

Poster Presentation **1PS-027**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Covalent Adaptable Network Polymers as Electrolytes and Binders for Reprocessable Lithium Metal Batteries

김상원, 최우혁[†]

인하대학교

Covalent adaptable network (CAN)-based polymer electrolytes exhibit thermal reversibility, enabling unique functionalities such as self-healing and lithium salt recyclability. In this study, we synthesized a polymer electrolyte based on the Diels-Alder reaction and demonstrated its self-healing capability and lithium salt reuse, while maintaining comparable ionic conductivity and mechanical properties after electrolyte reprocessing. Furthermore, we integrated the electrolyte as a binder in the cathode to fabricate a composite cathode material. The self-healing behavior at the interface between the cathode and the polymer electrolyte significantly improved interfacial resistance, highlighting the potential of this approach for advanced lithium metal batteries (LMBs). These findings underscore the versatility and practical applicability of Diels-Alder-driven CAN-based polymer electrolytes for next-generation energy storage systems.

Poster Presentation **1PS-028**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Rational design of conducting polymer-modified 2D heterostructured lithium electrodes for enhanced energy storage performance

김상민, 김하진, 강성진, 김수원, 윤현석⁺

전남대학교

We propose a spatial engineering strategy to improve lithium-ion hybrid capacitor (LHC) performance by integrating the conducting polymer PEDOT into graphene-MoS₂ (GM) heterostructured electrodes. PEDOT was incorporated in two forms: a 3D embedded network (N-PGM) via vapor-phase polymerization and a 2D surface coating (L-PGM) applied at the final step. These configurations modulated surface capacitive effects and MoS₂ redox behavior. L-PGM exhibited the highest capacity and cycling stability (95.3% after 2000 cycles), while N-PGM showed better rate capability due to enhanced ion transport. Molecular dynamics simulations revealed that PEDOT reduced Li⁺ binding energy and improved ion mobility. PEDOT positioning affected ion transport, with surface coating enhancing diffusion and embedding balancing accessibility. These findings highlight polymer configuration as a key factor in optimizing charge storage and transport in nanostructured electrodes.

Poster Presentation **1PS-029**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

ROP-Derived Dual-Network Gel Polymer Electrolytes with Elastomeric Acrylate for Highly Stable Lithium Metal Batteries

김민중, 엄태식[†]

홍익대학교

Lithium metal batteries (LMBs) are considered next-generation energy storage systems due to their high energy density. However, the growth of lithium dendrites necessitates the use of solid-state electrolytes such as polymer electrolytes. 1,3-Dioxolane (DOL) has gained considerable attention for its compatibility with LMBs and its ability to undergo ring-opening polymerization (ROP). Nevertheless, ROP-derived polyDOL has a linear structure that results in low mechanical strength. To address this limitation, we developed a dual-network gel polymer electrolytes (DNGPEs) by incorporating elastomeric acrylate monomers into the ROP system. This structure significantly improved the mechanical integrity and electrochemical stability. As a result, the electrolytes exhibited stable cycling in lithium symmetric cell tests and high capacity retention in NCM811 half-cell evaluations. In conclusion, this DNGPEs system shows strong potential for enabling stable and high-performance LMBs.

Poster Presentation **1PS-030**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Ionic Liquid@MOF Composite Electrolytes for Enhanced Lithium-Ion Battery Performance at Low Temperatures

김동영, 이은지[†]

광주과학기술원

Low-temperature operation of lithium-ion batteries is limited by reduced ionic conductivity and unstable interfacial behavior. This study introduces a composite electrolyte that embeds ionic liquids (IL) into a metal-organic framework (MOF) to ensure stable performance at subzero temperatures. ZIF-8 serves as the MOF host, whose nanoporous structure confines the IL, effectively suppressing freezing and guiding lithium-ion transport. As a result, the composite maintains high ionic conductivity and enhanced electrochemical stability in cold environments. Cryogenic transmission electron microscopy (Cryo-TEM) confirms the formation of a uniform and stable solid electrolyte interphase (SEI) at the electrode interface. These findings suggest that IL@MOF composite electrolytes are a promising solution for reliable lithium-ion battery operation in extreme conditions, offering improved performance through controlled ion pathways and stabilized interfaces.

Poster Presentation **1PS-031**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Study on Molecular Behavior of PAA Binder Induced by Li precursors via Molecular Simulation

김규리, 손준수, 이태경[†]

경상국립대학교

Silicon anodes suffer from electrode detachment due to volume expansion during charge-discharge cycles. To improve adhesion, PAA binders with COOH groups are employed, as they can form strong hydrogen bonds with silicon. PAA tends to aggregate due to intra-hydrogen bonding between its COOH groups. This reduces interfacial contact, leading to decreased battery performance. In this study, molecular dynamics simulations were conducted to investigate the structural behavior of PAA depending on the anions of lithium precursors and to examine its interactions with Li⁺. The radius of gyration analysis revealed that the LiOH-PAA system has high flexibility. Furthermore, the radial distribution function confirmed strong interactions between Li⁺ and COO⁻ groups in the LiOH-PAA system, suggesting their contribution to pre-lithiation in silicon anodes. This study provides insights into the design of polymer binders based on anion-specific effects for achieving high-performance silicon anodes.

Poster Presentation **1PS-032**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Humidity-Tolerant Moisture Generator Based on MXene Bilayer Structure

권민지, Zhao Kaiying¹, 하제봉, 김지원, 신정원, 전찬영, 박철민⁺

연세대학교

¹ Stony Brook University

We report a humidity-tolerant moisture-driven energy generator based on an ion-selective bilayer structure composed of a porous MXene ($\text{Ti}_3\text{C}_2\text{T}_x$) aerogel and ionic hydrogel. The negatively charged MXene aerogel facilitates preferential cation transport from the hydrogel, forming an internal moisture gradient independent of ambient humidity. The device exhibits a high open-circuit voltage (~ 600 mV), short-circuit current density ($\sim 1160 \mu\text{A cm}^{-2}$), and power density ($\sim 25 \mu\text{W cm}^{-2}$) over a wide humidity range. DFT calculations confirm the role of MXene pore defects in enhancing directional ion diffusion. The device also demonstrates mechanical flexibility, enabling integration into wearable sensors for motion and expression detection. This work provides a design platform for stable and self-powered nanogenerators in diverse environments.

Poster Presentation **1PS-033**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Vitrimer with Dynamic imine bond based Self-healing Solid Polymer Electrolyte for dendrite-free Lithium metal batteries

강혜리, 이은지[†]

광주과학기술원

All-solid-state lithium (Li) metal batteries have garnered candidates as advanced electric vehicles and energy storage systems due to their high energy density and theoretical capacity (3680 mAh g^{-1}). However, Li metal anodes suffer from uncontrolled dendrite growth during the charge-discharge process, and electrolyte decomposition because large volume changes generate unstable electrode|electrolyte interfaces. As a result, the consumption of electrolytes would increase the fracture between electrolytes and active materials, which causes solid-state electrolyte cracking. Vitrimers possess dynamic covalent adaptable networks (CANs), which can reform their bond under external stimuli. Consequently, the crosslink density of materials is constant when the temperature sharply increases, and their self-healing properties enhance stable interface contact. Herein, we present self-healing vitrimer solid polymer electrolytes (SPEs) with dynamic imine bonds via catechol imine ligand.

Poster Presentation **1PS-034**

에너지 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Better Together: Integrating Adhesion and Ion Conductivity in Composite Binders for High-Performance Silicon Anodes

ANJALI NAGAPADI PREMAN, 안석균[†], 백현종¹

PUSAN NATIONAL UNIVERSITY

¹ 부산대학교

The choice of binder plays a critical role in mitigating the severe volume changes of silicon (Si) anodes. Poly(acrylic acid) (PAA) is widely used for its strong adhesion with the Si surface, yet its brittle and non-conductive nature often leads to performance decline over prolonged cycling. In this study, we developed a composite binder integrating PAA with a tailored terpolymer comprising (1) Li-ion conducting groups, (2) hydrogen bonding motifs, and (3) covalent crosslinking sites. This combination yields synergistic improvements in electrochemical performance and mechanical integrity of Si anodes, resulting in a high specific capacity of 2026 mAh g⁻¹ and a capacity retention of 71% over 300 cycles, surpassing PAA-based counterparts. The integrated binder system effectively enhances adhesion, mechanical durability, ion-conductivity and electrode morphology, offering a promising strategy for stable and high-capacity Si anodes.

Poster Presentation **1PS-035**

에코소재 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Bio-based and biodegradable non-tackifier pressure sensitive adhesives

허서정, 최권용¹, 김희중⁺

인하대학교

¹ 현대자동차

Pressure sensitive adhesives (PSAs) are used in a variety of applications such as tapes, sticky notes, and labels. However, conventional commercial PSA materials are petroleum-based and non-degradable, resulting in substantial environmental challenges. Therefore, sustainable PSA alternatives with comparable adhesion performance are urgently needed. In this study, we developed polyurethane PSAs derived from a cardanol, a non-food chain byproduct of cashew nut shells that achieved strong adhesion without tackifiers or plasticizers. This performance was attributed to the bulky side chain moiety of cardanol combined with hydrogen bonding urethane linkages. Additionally, these adhesives showed rapid biodegradation under mild conditions, addressing adhesive residue issues in pulping and recycling operations. Overall, this study suggests that cardanol-based PU PSAs are a promising sustainable alternative to traditional petroleum-based PSAs.

Poster Presentation **1PS-036**

에코소재 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Sustainable Thermoset Networks from Citric Acid for Enhanced Strength, Transparency, and Barrier Performance

조은정, 이동익, 노경목, 구준모[†], 황동기

충남대학교

Conventional thermosets are known for their durability and chemical resistance but suffer from environmental drawbacks due to their irreversible crosslinked networks. To overcome these limitations, we synthesized a bio-based thermosetting polymer using citric acid (CA), 1,4-cyclohexanedicarboxylic acid (CHDA), and 1,4-cyclohexanedimethanol (CHDM). The resulting polyester network exhibits high tensile strength, excellent optical clarity, and superior gas barrier properties. Notably, the material retains the performance advantages of conventional thermosets while enabling both recyclability and complete biodegradation under composting conditions. This work presents a sustainable alternative that integrates high performance with end-of-life degradability, offering potential for use in automotive, electronics, and packaging applications.

Poster Presentation **1PS-037**

에코소재 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

UV-Responsive Sustainable Adhesive Based on Polystyrene-block-Poly(Ethyl Lipoate) Copolymer

전여진, 최청룡[†]

금오공과대학교

Block copolymers (BCPs) are widely used in adhesives due to their self-assembling ability and tunable properties. However, conventional BCP-based adhesives are fossil-fuel-derived, non-degradable, and have fixed adhesion strength. To address these issues, we developed a novel BCP composed of polystyrene (PS) as a hard segment and bio-based poly(ethyl lipoate) (PEtLp) as a soft segment from α -lipoic acid. PS-b-PEtLp was synthesized via base-catalyzed ring-opening polymerization from thiol-terminated PS. Adhesion tests showed higher strength in cylindrical nanostructures than lamellar ones. Notably, disulfide bonds in PEtLp enable reversible, UV-responsive adhesion. Under UV, adhesion decreases by ~50%, allowing easy detachment. Selective depolymerization of the PEtLp block allows full recovery of both EtLp monomer and thiol-terminated PS. This study presents a renewable, degradable, and recyclable adhesive system as a sustainable alternative to petroleum-based adhesives.

Poster Presentation **1PS-038**

에코소재 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Synthesis and property analysis of PNF-based thermoplastic poly(ether-ester) elastomer according to changes in soft segment content

전소영, 구준모[†]

충남대학교

Thermoplastic poly(ether-ester) elastomer(TPEE) is widely used in automotive and electronic applications due to its excellent flexibility and mechanical strength. With EU Ecolabel regulations increasing the required biomass content in plastics from 20% to over 40%, demand is rising for high-performance elastomers derived from renewable resources.

In this study, a bio-based TPEE was synthesized using poly(neopentyl glycol 2,5-furandicarboxylate)(PNF), obtained from the bio-based monomer 2,5-furandicarboxylic acid(FDCA) and neopentyl glycol. PNF was used as the hard segment, and poly(trimethylene ether) glycol(PO3G) as the soft segment, with PO3G contents of 3, 5, and 10 mol%. Mechanical testing confirmed high Young's modulus and excellent elongation at break. These results suggest the potential of a high-performance TPEE that simultaneously achieves stiffness and flexibility, unlike conventional elastomers that typically trade off one for the other.

Poster Presentation **1PS-039**

에코소재 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Eco-friendly photodegradation of polybutylene adipate terephthalate mulching films with eggshell catalyst

장희주, 강동구[†]

인천대학교

Plastics significantly contribute to environmental pollution and carbon emissions. Biodegradable plastics have emerged as sustainable alternatives, but limited physicochemical stability hinders their widespread use. Thus, there is growing demand for functional biodegradable materials with adjustable mechanical properties and controllable degradability. In this study, UV-responsive biodegradable PBAT films were developed by incorporating Ca(OH)_2 nanoparticles derived from waste eggshells. PBAT films containing Ca(OH)_2 exhibited improved mechanical properties. Under UV light, the films degraded more effectively, with higher porosity, 10.62% thickness loss, and a carbonyl index of 5.94%. This study demonstrates the potential of the developed material for various plastic products, including mulching films, bags, food packaging, and shipping foams. It shows stability during use and efficient UV-triggered degradation, offering advantages in plastic recycling and sustainable applications.

Poster Presentation **1PS-040**

에코소재 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

A New Spin on Tradition: Spiroglycol-based Structural Modification of Poly(butylene terephthalate)

이진영, 구준모[†], 유경철

충남대학교

Poly (butylene terephthalate) is widely used across industries due to its excellent mechanical strength, but its recyclability is limited by filler compounding. In addition, its rapid crystallization rate makes it difficult to achieve the desired performance, leading to an underestimation of its material potential. In this study, spiroglycol (SPG) was selected as a comonomer to tune these properties. SPG monomers (≤ 40 mol%) were randomly introduced into the PBT chain through esterification and polycondensation, thereby synthesizing poly(butylene-co-spirocyclic terephthalate) (PBST). SPG's two spiro rings and methyl groups make it bulky. It reduces crystallinity and allows control over the crystallization rate of PBT. It also offers advantages such as increased glass transition temperature (T_g), transparency, and enhanced processability. Furthermore, the acetal bonds in SPG are cleavable under mild acidic conditions, enabling control over the decomposition rate.

Poster Presentation **1PS-041**

에코소재 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Entropy-Driven Depolymerization of Trithiocarbonate Terminated PMMA Assisted by Fluoroalcohols as Hydrogen-Bonding Catalyst

이재원, 곽영제[†]

승실대학교

Depolymerization of vinyl polymers typically requires harsh conditions and high energy input. Therefore, developing depolymerization methods under mild and environmentally friendly conditions has become a key research direction toward sustainable plastic utilization. From a thermodynamic perspective, polymers with bulky substituents are often in a more strained and less stable state due to steric hindrance, which can promote depolymerization. Building upon this concept, we investigate the use of fluoroalcohols that form strong hydrogen bonds with the carbonyl groups of PMMA repeating units. By mimicking bulky substituents through these interactions, we increase the entropic contribution to depolymerization, thereby enhancing its thermodynamic favorability and lowering the ceiling temperature. Furthermore, NMR analysis was employed to investigate the hydrogen bonding interactions between fluoroalcohols and PMMA or MMA, revealing structure-dependent binding affinities.

Poster Presentation **1PS-042**

에코소재 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Toxicological Assessment of Additives in Commercial Biodegradable Plastics: Impacts on Environment and Human Health

안소연, 강동구[†]

인천대학교

Polylactic acid (PLA) and polybutylene adipate terephthalate (PBAT)-based biodegradable plastics have emerged as promising eco-friendly alternatives to conventional fossil-based polymers. However, various chemical additives are commonly incorporated to enhance their mechanical strength and barrier properties, some of which may exhibit toxicity and environmental persistence. In this study, microbial toxicity was assessed using *Bacillus subtilis*, while environmental toxicity was evaluated with *Raphanus sativus* seeds and the marine copepod *Tigriopus japonicus*. Cytotoxicity was further tested in human keratinocytes (HaCaT) and hepatocytes (HepG2), revealing clear toxic effects in several samples. Although biodegradable plastics offer environmental advantages, the findings indicate that certain additives may pose biological risks. These findings highlight the need for systematic toxicity assessment of plastic additives and the establishment of stricter regulatory standards.

Poster Presentation **1PS-043**

에코소재 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Closed-Loop Chemical Recycling System for Bio-based Polyurethane Foam

신지인, 진선민, 김혜인, 최권용¹, 김희중[†]

인하대학교

¹ 현대자동차

Polyurethanes (PUs) have been widely used in various industrial applications. However, like most commodity polymers, their fossil fuel origin, essential non-degradability, and non-reprocessability raise significant environmental concerns. While there have been efforts to develop sustainable PUs and PU foams addressing such issues, most studies remain at the proof-of-concept stage, limiting their real-world viability. Here, we synthesized chemically recyclable polyol, poly(dihydrofuran) (PDHF), via ring-opening metathesis polymerization (ROMP), and subsequently used it in the foaming process with isocyanates. The resulting PU foam exhibited properties comparable to conventional PU foams. More importantly, the monomer could be efficiently recovered through a simple depolymerization–distillation process, achieving high yield and purity.

Poster Presentation **1PS-044**

에코소재 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Fabrication of Alternative Li-ion Battery Separators from Waste Polystyrene via Harnessing Inherent Impurities as Porogens

신동건, 하유진, 김희중[†]

인하대학교

Chemical recycling of polystyrene (PS), which recovers styrene monomers from waste PS, has been extensively explored as a route toward a closed-loop PS life cycle. However, the depolymerization process typically yields a mixture of styrene and styrene-like impurities due to limited selectivity, which interferes with efficient repolymerization into high-molecular-weight PS. To address this challenge, we introduced a multifunctional crosslinker capable of inducing extremely high molecular weights. Interestingly, instead of suppressing the impurities, we utilized them as porogens through exchange with a non-solvent, inducing a phase separation. The resulting network was applied as a Li-ion battery separator, and it showed comparable electrochemical performance with a commercial separator.

Poster Presentation **1PS-045**
에코소재 부문위원회(I)
2025.9.30(화), 09:00~10:30, 포스터장
Chair: 박민주, 박정태

Enhancing mechanical performance of recycled PET/PBT/TPU blends via a tailored compatibilizer

박진영, 오동엽⁺, 박제영⁺¹, 신미라¹

인하대학교

¹ 서강대학교

Increased use of Polyethylene terephthalate (PET), Polybutylene terephthalate (PBT), and Thermoplastic Polyurethane (TPU) creates significant plastic waste. This study upcycles these materials into a high-value polymer blend via mechanical recycling. A key challenge is the poor compatibility between polymers, which causes phase separation and degrades mechanical properties. To address this, we developed a novel compatibilizer—a random block copolymer synthesized via transesterification of PET, PBT, and Polytetramethylene ether glycol (PTMEG). Its structure promotes adhesion within the blend (PET:PBT:TPU at a 2:2:1 ratio, with 10 wt% compatibilizer). Adding the compatibilizer increased the blend's crystallization rate by over 1.5 times and improved tensile toughness by over 20%. This confirms that a tailored compatibilizer can significantly enhance the value of recycled polymer blends. Future work will focus on mixed waste streams and industrial scaling.

Poster Presentation **1PS-046**

에코소재 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Enhancing the Material Properties of Portland Limestone Cement Through the Co-utilization of Anionic Polymers Derived from Seaweed and Oyster Shell Waste

박재영, 오동엽⁺

인하대학교

Cement production, reliant on limestone for calcium oxide, emits significant carbon dioxide. Portland limestone cement (PLC), substituting calcium oxide with calcium carbonate, can be a CO₂ reduction strategy, though it often shows inferior properties to Ordinary Portland Cement (OPC). This study explores waste oyster shells as a sustainable limestone alternative in PLC. To address property limitations, anionic polymers (carrageenan, alginic acid) extracted from seaweed were incorporated. PLC samples with these polymers exhibited a 10-20% increase in compressive strength. This enhancement is attributed to the polymers' gelation behavior, suppressed water evaporation, and reduced porosity within the cement matrix due to decreased C-S-H particle aspect ratio. This research demonstrates the potential of valorizing discarded oyster shells and selectively using anionic polymers for a more sustainable cement industry.

Poster Presentation **1PS-047**

에코소재 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Paper-Based Earthworm-Assisted Biodegradable Organic Electrochemical Transistors

나현준, 홍영범¹, 심봉섭¹, 윤명한⁺

광주과학기술원

¹ 인하대학교

We developed paper-based organic electrochemical transistors (OECTs) with (PEDOT:PSS)/montmorillonite (MMT) active material that can be edible by the earthworm. The PVA-PAA-coated paper, combined with a post-hydrophobic treatment, enhances the water stability and mechanical strength of the substrate, as confirmed by universal testing machine (UTM) and water contact angle measurements. This eco-friendly OECT device was consumed by the superworm after operation, demonstrating its eco-degradability and disposability, as verified by further FT-IR and SEM analyses.

Poster Presentation **1PS-048**

에코소재 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Improving the Processability of Biodegradable Poly(pentylene adipate-co-terephthalate) via Molecular Engineering using Long-Chain Diacids

김유경, 이진홍¹, 전현열⁺, 서진영⁺

한국화학연구원

¹ 부산대학교

Poly(pentylene adipate-co-terephthalate) (PPeAT) is a biodegradable aliphatic-aromatic polyester with promising potential for sustainable material applications. However, its inherently low crystallinity limits chain ordering and processing performance. Herein, we try to enhance crystallinity of PPeAT using long-chain aliphatic dicarboxylic acid. These extended alkylene segments promote enhanced molecular packing and crystallization through improved chain alignment and intermolecular interactions. The resulting copolyesters were synthesized via melt polycondensation following an initial esterification step, achieving high weight-average molecular weights. Differential scanning calorimetry (DSC) analysis confirmed a significant increase in crystallinity. These results demonstrate that structural modification using long-chain dicarboxylic acids offers a viable strategy to tune and enhance the crystallinity of PPeAT-based biodegradable polymers.

Poster Presentation **1PS-049**

에코소재 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Spandex-Grade Polyurethane Elastomer with Reversible Covalent Adaptable Network for Green Solvent Processing and Fiber Formation

김민정, 오동엽[†]

인하대학교

Conventional spandex, composed of segmented polyurethanes with partially crosslinked structures, relies on toxic dipolar aprotic solvents (DMF, DMAc, NMP), causing environmental issues and limited recyclability. Herein, we developed polyurethane elastomers based on PTMEG and MDI and incorporated isophorone diisocyanate (IPDI) to introduce kinked hard segments that disrupt crystallinity, enhancing solubility without compromising mechanical properties. Bis(4-hydroxyphenyl) disulfide (BHPS), a dynamic chain extender, formed covalent adaptable networks (CANs) via disulfide metathesis, enabling reversible bond rearrangement and selective dissolution under mild conditions ($\leq 80^{\circ}\text{C}$) in green solvents such as diethyl carbonate (DEC) and tetrahydrofuran (THF). The resulting elastomers exhibited high elasticity, mechanical robustness, and were successfully processed into continuous fibers via wet-spinning, offering a sustainable and recyclable alternative to conventional fiber materials.

Poster Presentation **1PS-050**

에코소재 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Facile Synthesis of Fluorine-Doped TiO₂ via PVDF Pyrolysis for Efficient Photocatalytic Degradation of PFOA

김덕훈, 김주현^{*1}, 강홍석[†]

인하대학교

¹ 한국화학연구원

Per- and polyfluoroalkyl substances (PFAS), particularly perfluorooctanoic acid (PFOA), are highly persistent pollutants that pose serious environmental and health risks. In this study, surface-fluorine-doped TiO₂ (F-TiO₂) was synthesized through simple thermal decomposition of polyvinylidene fluoride (PVDF) to enhance photocatalytic degradation. Fluorine doping improved the hydrophobic interaction with PFOA and suppressed electron-hole recombination, resulting in higher activity than pristine TiO₂. Photocatalytic tests revealed that F-TiO₂ achieved approximately 40% higher PFOA removal after 6 hours compared to pristine TiO₂. Enhanced UV absorption was confirmed, demonstrating the potential of F-TiO₂ as a cost-effective and scalable photocatalyst for PFAS-contaminated water treatment.

Poster Presentation **1PS-051**
에코소재 부문위원회(I)
2025.9.30(화), 09:00~10:30, 포스터장
Chair: 박민주, 박정태

Sustainable Polymer Design Using Rigid Cyclic Bio-based Monomers

고희정, 서진영[†], 안석균^{†1}

한국화학연구원

¹ 부산대학교

The development of bio-based diols has garnered increasing attention as sustainable alternatives to fossil-based monomers to control carbon dioxide (CO₂) emissions. However, most commercial bio-based alcohols have been limited to soft segments of polymers, restricting their broader application in engineering materials. In this study, we report a novel strategy to overcome this limitation by synthesizing a bio-based monomer featuring a cyclic acetal functional group. This monomer was derived from renewable resources and designed to exhibit potential biodegradability and chemical recyclability. A series of polymerization reactions was conducted to incorporate the monomer into various polymer backbones, to explore its structure–property relationships and application feasibility. This work proposes a new approach to utilizing bio-based monomers by integrating functionality and sustainability, offering promising directions for next-generation eco-friendly polymer materials.

Poster Presentation **1PS-052**

에코소재 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Sustainable Design of Thermally Conductive EMC Fillers Using Semiconductor Waste

강다희, 사민기, 라윤호, 윤창민¹

인하대학교

¹ 인하대학교 고분자공학과

Sludge wastes mainly consisted of silicon (Si) generated from the semiconductor manufacturing processes are recycled as a highly thermal conductive fillers for epoxy molding compound (EMC). Initially, Si sludge underwent hydrochloric acid (HCl) treatment to remove metallic impurities, followed by hydroxylation using ammonia solution to enhance surface compatibility. Subsequently, silica is deposited onto the treated sludge via a sol-gel method, forming silica-coated semiconductor sludge (SCSS). The morphology of SCSS were successfully confirmed by various analysis. Finally, SCSS was homogeneously mixed with epoxy resin, curing agent, and carbon black, then subjected sequential processes of molding, degassing, and curing to acquire SCSS-filled EMC (SCSS-EMC). The resulting SCSS-EMC and commercial EMC-containing silica filler were compared for a thermal analysis. As a result, SCSS-EMC manifested 5 °C higher surface temperature under same heating condition. These finding successfully confirmed and suggested the recycling method of semiconductor sludge as a highly thermal conductive fillers for semiconductor packaging EMC application.

- 본 연구는 2025년도 정부(교육부)의 재원으로 한국연구재단의 지원을 받아 수행된 기초연구사업임(RS-2022-NR070869).

Poster Presentation **1PS-053**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Programmable Soft Actuator with Hybrid Responsiveness Based on Conductive MOF-Liquid Crystal Polymer Composite

홍태균, 윤동기[†]

KAIST

Soft robotics offers flexible solutions to challenges like aging populations and workforce decline, especially in medical and healthcare settings. A key component is the soft actuator, enabling movement through compliant materials. Liquid crystals (LCs) are promising due to their large, reversible deformation under stimuli. Here, we present an LC-based soft actuator integrated with a photothermally active metal-organic framework (MOF), $\text{Cu}_3(\text{HHTP})_2$. This MOF exhibits strong UV absorption via π - π^* transitions, enabling rapid actuation. Using an electric field, $\text{Cu}_3(\text{HHTP})_2$ was aligned within the LC matrix, allowing for controlled bilayer formation and reversible on/off actuation. Bending motion arises from anisotropic LC contraction and thermal expansion mismatch. The actuation behavior varied with UV irradiation angle and MOF alignment. Additionally, mechanical and bending performance were tunable by controlling MOF orientation.

Poster Presentation **1PS-054**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Effect of PEG-Lipid Type and Content on the Structural Characteristics of DNA-Loaded Lipid Nanoparticles Formulated via Ring Mixer

최지우, 정해교, 정선엽, 김세영⁺

단국대

mRNA vaccines induce immune responses by directing intracellular synthesis of antigen proteins and have demonstrated efficacy against SARS-CoV-2. However, mRNA is rapidly degraded in vivo, requiring lipid nanoparticle (LNP) encapsulation for stable delivery. In this study, we used a toroidal microfluidic ring mixer to formulate LNPs by mixing Salmon sperm DNA, an ionizable lipid, a helper lipid, cholesterol, and a PEGylated phospholipid (PEG-lipid; mPEG(2K)-DMPE or mPEG(2K)-DSPE) in ethanol and aqueous streams. The type and content of PEG lipid were varied, and particle size and polydispersity were measured by dynamic light scattering, and its morphology was examined by cryo-transmission electron microscopy. We observed that increasing PEG-lipid content led to smaller, more uniform particles. These results underscore the critical role of PEG-lipid ratio in tuning LNP physicochemical characteristics and provide design guidelines for next-generation mRNA vaccine delivery systems.

Poster Presentation **1PS-055**
콜로이드 및 분자조립 부문위원회(I)
2025.9.30(화), 09:00~10:30, 포스터장
Chair: 박민주, 박정태

Stimuli-Driven Reconfiguration of Colloidal Assemblies in Liquid Crystal Defects

최대섭, 임준형, 조은수, 김장민, 백지혜, 곽진석¹, 김영기[†]

포항공과대학교

¹ 영남대학교

Liquid crystal (LC) disclination lines are topological singularities which are promising templates for programmable colloidal assembly. However, previous techniques have been limited in achieving rapid and precise control over assembled structures. Here, we demonstrate modulation of disclination, enabling dynamic repositioning of colloidal chains. By applying electric fields combined with thermal ramps, we actively modulate LC disclination lines, transporting tethered colloids along predetermined trajectories. This approach provides reversible colloidal assemblies without repatterning of surface, which can be achieved by leveraging electric field interactions and temperature-induced elasticity changes. These dynamically tunable assemblies hold significant promise for applications in reconfigurable soft photonics, programmable micro actuation, and stimuli-responsive adaptive metamaterials. This work was supported by the NRF (RS-2023-00212739, RS-2024-00411809 and RS-2023-00302586).

Poster Presentation **1PS-057**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Multi-Level Photopatternable Photochromic Organogels for Programmable Optical Information Encryption

전현준, 류민, 이효민⁺

포항공과대학교

Optical information encryption technologies that respond to external stimuli such as moisture, light or chemical triggers are essential for advanced applications, including smart windows and color displays. While UV-responsive encryption methods have attracted increasing attention due to their intuitiveness and broad applicability, existing systems based on molybdate and tungstate suffer from slow response, which constrain their suitability for information display.

In this study, we introduce spiropyran-based photochromic organogels that exhibit rapid color fading and reversible responsiveness to external stimuli. Multi-level photopatterning was also achieved via photolithography. Additionally, the organogel surfaces exhibit water contact angle hysteresis below 5°, indicating high slipperiness. We envision that the multi-level photopatterned slippery organogel films presented in this work hold great potential in physically unclonable functions and advanced information encryption.

Poster Presentation **1PS-058**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Electrically Response Full-color Display using Core-Shell Nanoparticles in Non-polar Medium

임혜정, 이원목[†]

세종대학교

A photonic crystal (PC) features a photonic bandgap that precisely controls light, enabling high color saturation through refractive index contrast. In this study, we present electrically responsive photonic crystal displays (EPDs) designed for high color saturation and low power consumption. EPDs use monodisperse colloidal particles in a medium, achieving tunable reflection based on Bragg's equation as the particle lattice changes with applied voltage. We investigated high-index core-shell particles, known for strong reflective colors in non-polar EPDs. Our research explored methods to enhance EPD performance and stabilize these particles in low-dielectric media. The results confirm that integrating these specialized particles into EPDs enables full visible-spectrum tunability, significantly improving color contrast, expanding the color gamut, and maintaining long-term stability under DC electric fields.

Poster Presentation **1PS-059**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Compositional Effects of Monoacrylate Mesogens in Highly Stretchable Cholesteric Liquid Crystal Elastomers

이혜주, 최수비¹, 안석균¹, 김대석⁺

국립부경대학교

¹ 부산대학교

Cholesteric liquid crystal elastomers (CLCEs) exhibit structural color through Bragg reflection, arising from their helical molecular alignment. The structure of liquid crystal mesogens plays a key role in tuning both the mechanical and optical properties of CLCEs. We investigated the effect of incorporating RM105, a monofunctional mesogen with a single vinyl group, into CLCE films. Unlike RM82, which has two acrylate groups for dense crosslinking, RM105 forms bonds at only one end, reducing the crosslinking density and increasing network flexibility. As RM105 content increases, the elastic modulus of the CLCE decreases, allowing for larger wavelength shifts under deformation. These findings suggest that adjusting monoacrylate mesogen ratios provides an effective strategy to control both the softness and mechanochromic response of CLCEs, enabling the development of flexible optical materials for adaptive optics, strain sensors, and stretchable displays

Poster Presentation **1PS-060**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Microfluidic Synthesis of Photo-Responsive Polymersomes with Tunable Molecular Permeability

이현수, 채민지¹, 서한진¹, 이효민^{*1}

포항공과대학교

¹ POSTECH

Polymersomes are synthetic vesicles with bilayer membranes made of amphiphilic block copolymers, and serve as representative artificial cell models for applications such as drug delivery, biosensing, and bioreactors. Among the block copolymers used to prepare polymersomes, Polybutadiene-*b*-Polyethylene oxide (PB-PEO) is non-toxic and highly stability. Despite these advantages, PB-PEO polymersomes have been reported to exhibit limited responsiveness to external stimuli. Herein, we propose photo-responsive changes in the molecular permeability of polymersomes by exploiting photoisomeric analogs of PB-PEO block copolymers containing azobenzene. The resulting polymersomes can precisely regulate molecular transport of molecules or ions through photoisomerization under UV irradiation. We anticipate that this will enable selective molecular transfer, which is essential for artificial cell models, and allow active control of inter-/intra biochemical reactions in response to external stimuli.

Poster Presentation **1PS-061**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Spontaneous Wax Shielding for Enhancing Water-Sensitive Dynamic Imine Bond Stability

이지민, 박준용, 이상혁[†]

중앙대학교

Polymers based on dynamic imine bonds, which are typically formed via dehydration condensation reactions, are highly susceptible to hydrolysis. To address this issue, we introduce hydrocarbon wax into PDMS network to protect the imine bonds from water exposure. The incorporated wax, possessing inherently low surface energy, spontaneously migrates to the surface of the PDMS matrix, forming a hydrophobic layer that effectively suppresses water penetration. Due to the spatial confinement within the crosslinked PDMS, the wax exists in an amorphous state, allowing for flexible mobility. As a result, even after surface wax removal, internal wax can migrate to the surface, enabling dynamic and sustainable protection. This water-resistant, self-healing polymer matrix demonstrates stable crosslinking behavior and self-healing performance over repeated cycles, making it suitable for use in environments where moisture stability is required.

Poster Presentation **1PS-062**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Structurally tunable All-aqueous gels via photopolymerization of water-in-water emulsions

이은석, 김규한[†]

서울과학기술대학교

Water-in-water (W/W) emulsions are attractive for their biocompatibility and selective molecular partitioning, but their instability and limited structural control hinder practical applications. Here, we report a strategy to fabricate structurally tunable all-aqueous gels by stabilizing high-internal-phase W/W emulsions (HIPEs) and photopolymerizing their continuous phase. By addressing depletion-induced particle aggregation using polymer-grafted colloids, we achieve stable HIPEs with >95% internal phase volume. These enable in situ gelation with controllable interconnectivity by tuning particle type and concentration. Systems stabilized with PEG-grafted silica particles form interconnected networks, while polystyrene-based systems yield closed morphologies, affecting molecular diffusion. The resulting gels exhibit tunable viscoelasticity, spreading behavior, and molecular transport properties, and are compatible with diverse monomers and crosslinkers.

Poster Presentation **1PS-063**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Tailoring Ionic Affinity and Alignment with Ether functionalized Liquid Crystal Polymer Separators for Lithium Metal Batteries

이근중, 윤동기[†]

한국과학기술원

Lithium metal batteries are widely used in portable electronics and electric vehicles for their high energy density and stable cycling. The separator prevents electrode contact and enables lithium-ion transport. However, commercial polyolefin separators like polypropylene and polyethylene have low electrolyte wettability and Li-ion affinity. To overcome this, ether-functionalized liquid crystalline (LC) monomers were synthesized via Aza-Michael addition and incorporated into LC polymer films. Surface treatments induced LC alignment, allowing investigation of how molecular orientation affects ion transport. LC alignment was confirmed by polarized optical microscopy, and ether group orientation by polarized FTIR. This approach clarifies the link between molecular alignment and ion conductivity, offering a strategy to improve separator performance for next-generation lithium batteries.

Poster Presentation **1PS-064**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Investigating the Role of Anion- π Interactions in the Cohesion of Peptidomimetic Polyether

이승현, 신아람¹, 박진우, 윤소원¹, 김민성¹, 김병수¹, 이동욱[†]

울산과학기술원

¹ 연세대학교

Anion- π interactions play a crucial role in biological processes, including ion transport and enzyme catalysis. Despite their importance, these interactions have been rarely investigated in synthetic polymer systems. This study explores anion- π interactions with chemically well-defined peptidomimetics, inspired by the molecular composition of mussel foot proteins. Two functional epoxide monomers—catechol acetone glycidyl ether and 4,4-dimethyl-2-oxazoline glycidyl ether—were employed to construct polyether-based polymers mimicking two crucial amino acids 3,4-dihydroxyphenylalanine and aspartic acid, respectively. The anion- π interactions between the polymers were analyzed using a surface forces apparatus with attention to the effects of pH and relative monomer composition. At an equimolar monomer ratio and neutral pH 7, the maximum cohesion energy of 15.0 mJ/m² was observed. These findings highlight the potential of anion- π interactions to enhance the cohesive properties of synthetic polymers.

Poster Presentation **1PS-065**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Elongational deformation of droplet via worm-like liquid marble

이세연, 김현진¹, Syuji Fujii², 안효성³, 우상혁⁺

중앙대학교

¹ National Institute of Advanced Industrial Science and Technology

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Controlling the liquid droplet shape is challenging due to its surface tension. Although numerous deformation methods have been developed, most require continuous stimuli or chemical reactions to maintain deformed shapes. In this study, we present a simple method utilizing a liquid marble, which is a droplet covered with hydrophobic particles, as a platform. Through partial evaporation followed by mechanical shaking, we induce the surface area mismatch between the droplet and encapsulating particles and resolve the mismatch by rearranging its particles, forming stable elongated worm-like liquid marble (W-LM) even after removal of mechanical force. Moreover, W-LMs can be freely designed or programmed into various shapes and can be coalesced into long, wire-like channels. Owing to this simple method, the properties of the internal liquid can be preserved. We anticipate that this method shows potential for application in hydrogel templating, speed control microreactors, and microrobotics.

Poster Presentation **1PS-066**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Surface-Bound Parabens on UV-Blocking Nanoparticles to Minimize Human Absorption

이양우, 김지원¹, 최종훈¹, 구형준⁺

서울과학기술대학교

¹ 중앙대학교

Parabens are commonly used as preservatives in cosmetics, but concerns remain about their possible health effects. To reduce direct exposure while keeping their antibacterial function, we attached parabens to titanium dioxide (TiO₂) nanoparticles, which are often used in sunscreens. Linker molecules were used to help bind parabens to the TiO₂ surface. This surface treatment was confirmed using TGA, FT-IR, and zeta potential tests. HPLC results showed that the treated TiO₂ had better paraben adsorption. Cell tests showed over 80% survival, suggesting good biocompatibility. The modified TiO₂ also showed stronger antibacterial effects against *Staphylococcus aureus*, supporting its use as a safer and more effective cosmetic ingredient.

Poster Presentation **1PS-067**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Confinement-induced Inhibition of Azobenzene Photoisomerization

이건우, 이진훈, 박진우, 박진태, 이동욱[†]

울산과학기술원

Supramolecular chemistry enables the design of functional materials via non-covalent interactions. Among them, cyclodextrins (CDs) have been widely studied as host molecules due to their size-selective inclusion ability. Azobenzene (Azo) is a photo-responsive guest that forms complexes with α -CD and undergoes UV-responsive complexation. However, Azo photo-isomerization under confined status is poorly understood. In this study, we investigate the light-responsive dynamics of Azo while maintaining host-guest complexation with various sizes of CDs. Under confinement within complexation, α - and β -CD seems to inhibit the photo-isomerization of Azo, but γ -CD permits the isomerization due to a larger cavity size. This indicates that confinement by host molecules affect stimuli-responses of guest molecules. Our findings expand the understanding of supramolecular interactions beyond bulk systems and provide insights to design stimuli-responsive materials with confined-space effects.

Poster Presentation **1PS-068**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Hierarchical Porous Formation in Wet Spun P(VDF-TrFE) Fibers with Emulsion Templating Process for Enhanced Piezoelectric Sensitivity

유영호, 노정원, 황유민, 김미소¹, 박주현⁺

중앙대학교 서울캠퍼스

¹ 한국과학기술원

Polymer-based piezoelectric materials are highly valued for their flexibility and durability. However, their inherent piezoelectric performance is substantially lower than that of ceramic-based inorganic piezoelectric materials. In this study, we investigate the fabrication of hierarchical porous formation in P(VDF-TrFE) fibers with emulsion templating process using amphiphilic poly(acrylic acid) copolymer. We particularly focus on enhancing the piezoelectric response via the stress concentration and decrease of dielectric constant.

This approach not only enables significant improvement in the piezoelectric effect by promoting condensation of stress but also emphasizes the simplicity and cost-effectiveness of producing non-aqueous mini emulsions without resorting to the complex synthesis of block copolymers. The results suggest that the optimized porous fiber design holds promise for a wide range of advanced applications.

Poster Presentation **1PS-069**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Anti-Reflective Robust Nanostructures by Blockcopolymer Self-Assembly Patterns for Future Flexible Display Applications

유동원, 김장환¹, 김상욱⁺

한국과학기술원

¹ 아주대학교

Next-generation display technologies require precise and durable optical interfaces, especially in complex, curved designs. This study presents a novel anti-reflective strategy that combines high optical performance with mechanical robustness. Inspired by biological structures, nanohole arrays were embedded into a transparent polymer using block copolymer self-assembly. These nanostructures achieved over 70% reflection reduction through gradual refractive index transition, minimizing optical impedance mismatch, as confirmed by simulations. The embedded design also improved mechanical stability by effectively dissipating external stress, maintaining performance under repeated deformation. Additionally, the film demonstrated strong environmental adaptability in curved optical devices and exhibited self-cleaning properties due to its hydrophobic surface. This multifunctional approach offers a promising solution for advanced optical and display systems.

Poster Presentation **1PS-070**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

3D printable and Biocompatible PEDOT:PSS-Ionic Liquid Colloids for Rapid On-demand Fabrication of 3D Bioelectronics

오병국, 스티브 박*

한국과학기술원

3D printing enables rapid prototyping of complex structures, and PEDOT:PSS has emerged as a promising material for bioelectronics due to its tissue-like mechanical and electrical properties. However, existing PEDOT:PSS inks suffer from long post-treatment, low conductivity, and poor printability for high-aspect ratio structures. We present a one-shot strategy for the fabrication of PEDOT:PSS ink that achieves high biocompatibility, structural stability for tall 3D structures, and high conductivity. Using ionic liquid-assisted colloidal stacking via centrifugation, we developed a viscoplastic PEDOT:PSS-ionic liquid colloidal (PILC) ink with high-resolution printability (50 μm) and high conductivity (286 S/cm). We demonstrated the on-demand and versatile applicability of PILC inks through 3D circuit boards, on-skin e-tattoos for physiological monitoring, and implantable devices for opto-electrocorticography, sciatic nerve stimulation, and deep-brain recordings.

Poster Presentation **1PS-071**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Numerical evaluation of mixing performance in microfluidic systems for lipid-based nanocarrier production

야성현, 한정연[†]

가천대학교

Microfluidic mixing plays a key role in liposome and lipid nanoparticle (LNP) synthesis, where solvent exchange drives self-assembly. While various mixer designs enable size control, the relationship between mixing behavior and nanocarrier formation remains unclear. In this study, we numerically evaluate three microfluidic mixers—Hydrodynamic Flow Focusing (HFF), Toroidal Mixer, and Microfluidic Vortex Focusing (MVF)—by quantifying the degree of mixing based on solute concentration profiles. Simulation results are correlated with experimental liposome synthesis to identify mixing characteristics that promote uniform, controllable nanocarrier formation. Based on these findings, we propose and demonstrate optimized microfluidic mixer design through liposomes and LNPs synthesis under defined flow conditions. This work offers a practical framework that links numerical analysis with experimental outcomes in the development of microfluidic platforms for lipid-based nanocarrier production.

Poster Presentation **1PS-072**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Dual-Amplified Patch with Hierarchical Suction Cup and Short Microneedles for Uniform, Accelerated, and Pain-Free Transdermal Delivery of Extracellular Vesicles

송민우, 김민진, 황귀원, 김용대, 하민지, 신솔, 박재형, 방창현[†]

성균관대학교

Microneedles (MNs) are a key technology for transdermal delivery of biomolecules. However, conventional MNs often require long needles ($>600\text{ }\mu\text{m}$) to achieve sufficient penetration, causing pain or irritation. Also, chemical adhesives used to fix MNs on curved skin can harm tissue. Here, we developed a dual-amplified patch (MN@EV/SC) combining short MNs ($<300\text{ }\mu\text{m}$) with a suction cup (SC) inspired by octopus suckers. This structure provides skin adhesion and improves extracellular vesicle (EV) delivery. Short MNs reduce stress while maintaining delivery efficiency. The SC induces nanoscale deformation of the stratum corneum, facilitating EV diffusion into deeper dermal layers. Furthermore, suction-based adhesion lessens skin damage and improves contact on irregular surfaces. In vivo tests in aged mice showed that MN@EV/SC activates fibroblasts and promotes collagen synthesis, supporting its potential as a pain-free and effective transdermal platform for skin rejuvenation.

Poster Presentation **1PS-073**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Fluorescent Janus Particles for pH-Responsive Detection

방용빈, 김수환, 윤석민, 이성재[†]

수원대학교

Organic fluorescent dyes are widely used in various fields such as life science. Since they are not suitable for high-sensitivity detection and real-time monitoring, strategies for doping organic dyes into inorganic materials are being actively studied. Silica nanoparticles (SNPs) are promising for fluorescent doping due to their high chemical stability, biocompatibility, and ease of surface modification. In this study, we developed an amphiphilic fluorescent probe based on SNPs by the following procedure. Silica-wax colloidosomes were prepared by forming a Pickering emulsion of water, wax, and SNPs, and the exposed surface was selectively modified through a silane coupling reaction using APTES. After removing the wax, the bare side was modified with GPTMS. The APTES-modified Janus particles were stained with FITC, and the GPTMS-modified surface was stained with rhodamine B hydrazide. This fluorescent probe exhibited different colors of fluorescence in basic and acidic environments.

Poster Presentation **1PS-074**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Quad-band Short-wave Infrared Detection Using Bandgap-controlled Ag₂Te Quantum Dots via Direct Photolithography

박세영, Shlok Joseph Paul¹, Ayaskanta Sahu¹, 강문성[†]

서강대학교

¹ New York University

Multispectral short-wave infrared (SWIR) photodetection is highly desirable for applications like night vision and quality inspection. Colloidal quantum dots (QDs) are a promising, low-cost alternative to conventional semiconductors due to their size-tunable properties. We demonstrate a multispectral SWIR photodetector using four sizes of heavy-metal-free Ag₂Te QDs, patterned side-by-side via a direct photopatterning process. The resulting pixels show distinct responsivities at distinct wavelengths of 1150, 1350, 1550, and 1800 nm. By leveraging the unique photoresponse of each of the four QD channels, our device can identify SWIR wavelengths without a spectrometer—a capability not possible with single-size QD devices. This approach enables the creation of monolithically integrated, planar photodetector arrays where pixels for different wavebands are precisely patterned and independently addressable on a single chip.

Poster Presentation **1PS-075**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Surface Passivation via Pb–S Coordination Using (3-Mercaptopropyl)methyldimethoxysilane for Perovskite CsPbBr₃ Nanocrystals All-Around Stability

김진영, 왕동환[†]

중앙대학교

Perovskite nanocrystals (NCs) are attractive materials for optoelectronic applications, but their long-term stability remains a significant limitation. In this work, we explore a surface passivation approach using a sulfur-functionalized silane ligand, 3-mercaptopropylmethyldimethoxysilane (MPMDMS), to improve the environmental durability of CsPbBr₃ NCs. Through ligand exchange, MPMDMS forms strong interactions with surface Pb²⁺, leading to enhanced photoluminescence (PL) and improved resistance against moisture and heat. The treated NCs exhibit preserved optical performance along with superior stability in polar and thermal conditions. This study highlights a facile surface modification strategy for enhancing the robustness of perovskite nanomaterials.

Poster Presentation **1PS-076**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Synthesis of Pt-Coated Black Double-Shell Hollow TiO₂ Nanoparticles Via One-Step Reduction Methods

김지원, 사민기, 임지수, 윤창민[†]

인하대학교

In this study, Pt-coated black double-shell hollow TiO₂ nanoparticles (Pt/BDS-HNPs) are synthesized via a novel one-step co-reduction process of TiO₂ and Pt precursors. In specific, double-shell hollow TiO₂ nanoparticles (DS-HNPs) are synthesized by sequential methods of sol-gel assisted by the polyvinylpyrrolidone (PVP) surface modification and ammonia etching. Subsequently, DS-HNPs are mixed with sodium borohydride and platinum(II) acetylacetonate as reducing agent and Pt precursor, and placed in the tube furnace for thermal treatment. This novel one-step reduction method successfully converted white TiO₂ into black TiO₂ while simultaneously depositing a Pt coating. Finally, Pt/BDS-HNPs demonstrated excellent photocatalytic activity toward various organic dyes, owing to their enlarged specific surface area from the double-shell morphology and enhanced charge separation by Pt decoration.

- 본 연구는 2025년 정부(방위사업청)의 재원으로 국방과학연구소의 지원을 받아 수행된 미래도전국방기술 연구개발사업임(No.915066201).

Poster Presentation **1PS-077**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Thermo-Adaptive Photonic Skin for Neuro-Actuation Using Ion-Gel Transistor with Block Copolymer

김지원, 김관호, 이석영, 하제봉, 김수한, 권민지, 신정원, 전찬영, 박철민⁺

연세대학교

We report a photonic neuro-actuating synaptic skin that enables thermoresponsive signal transmission, dynamic color modulation, and mechanical actuation. The device consists of a 3-terminal ion-gel transistor incorporating a semiconducting channel of poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) blended with 2D titanium carbide ($\text{Ti}_3\text{C}_2\text{T}_x$) MXene, and a thermo-adaptive one-dimensional block copolymer photonic crystal as the gate insulator. The transistor exhibits temperature-dependent synaptic behavior accompanied by vivid, reversible structural color shifts, giving rise to a thermo-adaptive display synapse. Moreover, the synaptic output current is successfully converted into an amplified voltage signal, enabling temperature-dependent actuation of a connected soft actuator. This integrated system represents a new class of thermo-adaptive photonic neural skin, capable of visualizing synaptic activity and mimicking muscle-coupled neuronal responses in human skin.

Poster Presentation **1PS-078**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Transfer printing of thermal deposited nano island

김유리, 구윤정, 황혜선, 우상혁[†]

중앙대학교

Nano islands are of interest in sensing and catalysis due to their excellent optical properties, high surface area, and chemical stability. However, conventional deposition methods have limitations in forming uniform nano island structures on curved or irregular surfaces.

To overcome this, we propose a transfer method in which a metal thin film is deposited onto PDMS (polydimethylsiloxane) and then transferred to target substrates. Plasma treatment is applied to modulate the interfacial work of adhesion between the metal-deposited PDMS and the substrate, enabling reliable and efficient transfer.

This method allows metal films to be transferred onto various substrates such as glass, PET, and PDMS, as well as curved or non-planar surfaces where direct deposition is challenging. It is effective regardless of the metal type (e.g., Au, Ag, Cu) or film thickness. The resulting nano island structures retain their morphology and can be stacked in multiple layers to increase surface area. These features enable potential applications in areas such as catalysis and surface-enhanced Raman scattering (SERS).

Poster Presentation **1PS-079**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Asynchronous Optical Modulation of Fluorescence and Structural Color for Multimodal Sensing and Secure Encryption

김수한, 이선주, 김지원, 권민지, 신정원, 전찬영, 하제봉, 박철민⁺

연세대학교

Asynchronous optical control provides a powerful means to reduce signal interference in multimodal sensing. We report a self-assembled photonic material based on block copolymer (BCP) photonic crystals doped with aggregation-induced emission luminogens (AIEgens), which enables decoupled fluorescence (FL) and structural color (SC) responses. In the dry state, the material shows bright FL without SC, while solvent-induced swelling quenches FL and reveals vivid SC. This reversible switching allows for selective detection: FL for sensing temperature and nitroaromatic compounds, and SC for monitoring pH. The independent modulation of optical signals enhances reliability in multisignal detection. Furthermore, the orthogonal behavior enables a three-level optical encryption platform, encoding quaternary information via SC, FL, and pH-responsive SC. This system offers a robust, write-once-read-many strategy for secure data storage and anti-counterfeiting technologies.

Poster Presentation **1PS-080**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Diazonium-Functionalized High-Crystalline Ti₃C₂ MXenes for Environmentally Stable, Selective Gas Sensing at Room Temperature

김석현, 김선준[†]

한국과학기술연구원

Gas sensors play a vital role in managing environmental pollution, early disease detection and safety. With the advancements of the Internet of Things, wearable sensors are increasingly demanded where sensing materials with room-temperature (RT) operability and solvent processability are highly desired. In particular, MXenes have emerged as highly promising candidates as RT gas sensors due to their large specific surface area, and tunable chemical properties. However, achieving selective gas sensing and stability are still critical issues that need to be overcome. In this study, we try to address these issues by synthesizing high crystalline Ti₃C₂T_x MXene where the surface is modified with diazonium salts. We show that surface-modified MXenes exhibit exceptional selectivity toward gases such as acetone or ammonia while demonstrating improved long-term stability. These findings will help the fabrication of high-performance sensor for next-generation industrial applications.

Poster Presentation **1PS-081**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Octopus-Inspired Skin-Adaptive Nanofiber Patches for Robust and Precise Transdermal Delivery

김민진, 송민우, 황귀원, 강균로, 김용대, 방창현⁺

성균관대학교

Conventional skin electronic platforms depend on rigid substrates and cost-prohibitive fabrication techniques, limiting their mechanical adaptability. In this study, we report a cellulose nanofiber (CNF)-based adhesive electronic system, integrating a three-dimensional octopus-inspired architecture (OIA) and a conductive layer. The OIA directly imprinted onto the CNF, improves interfacial adhesion through mechanical suction and remains structurally stable even upon absorption of active ingredients. The optimized CNFs-OIA retains its architecture, enabling suction-based adhesion to improve skin attachment. A conductive layer was incorporated into the CNF-OIA, enabling the generation of microcurrents. These microcurrents reduce the electrical resistance of the stratum corneum and promote the delivery of active ingredients. This integrated approach offers a scalable solution for next-generation drug delivery. This study was published in: npj Flexible Electronics, 9, 1, 54 (2025)

Poster Presentation **1PS-082**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Cation effect on cohesion of phosphorylated cellulose nanofibers in extremely low salt concentrations

김동현, 이진훈, 이동욱[†]

울산과학기술원

Phosphorylated cellulose nanofibers (PCNFs) possess distinctive properties such as flame retardancy, low-toxicity synthesis, and ionic conductivity, which have high potential for sustainable applications such as energy storage and metal ion adsorption. To design elaborate and high-performance of functional systems, a fundamental understanding of ion-mediated interactions between PCNFs is crucial. Herein, we investigate the interaction forces between PCNF surfaces in aqueous solutions containing Na^+ , Mg^{2+} , and Ca^{2+} cations measured by a surface forces apparatus (SFA). Notably, significant increases in interaction forces were observed under highly diluted conditions (~ 1 nM), regardless of ion valency. Additionally, as the ion concentration increased, the interaction forces initially rose but then sharply decreased beyond a critical ion concentration for each ion species. These findings provide constructive insights as to tailoring PCNFs in aqueous environments.

Poster Presentation **1PS-083**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Understanding the molecular mechanism of chitosan in aqueous solution

권하은, 최지은, 임찬웅, 김준성¹, Asila Osman², 조용석¹, 황동수², 이동욱[†]

울산과학기술원

¹ 경상국립대학교

² 포항공과대학교

Chitosan is an abundant, biodegradable polysaccharide widely used in pharmaceutical and environmental applications. To better understand its interactions in aqueous systems, we investigated the adhesion of high molecular weight chitosan (>150 kDa) to four types of functionalized self-assembled monolayers (SAMs) at pH 3.0, 6.5, and 8.5 using a surface forces apparatus (SFA). High molecular weight chitosan exhibited the strongest adhesion to methyl-terminated SAMs (CH₃-SAMs) under all pH conditions, suggesting a potential for strong hydrophobic interactions with materials containing hydrophobic moieties. Although hydrogen bonding is typically regarded as the dominant interaction mechanism of chitosan, our findings provide new insights that may broaden its applicability in designing eco-friendly, chitosan-based functional materials.

Poster Presentation **1PS-084**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Magnetically Guided Amine-Functionalized Hydrogel Beads for Targeted Delivery of Doxorubicin in Transarterial Cancer Chemoembolization

고지원, 이원목[†]

세종대학교

Gelatin methacryloyl (GelMA), synthesized via methacrylation of gelatin with methacrylic anhydride (MA), offers outstanding biocompatibility and biodegradability for biomedical applications. By employing water-in-oil emulsion polymerization, GelMA was copolymerized with 3-sulfopropyl methacrylate (SPMA) to generate drug-eluting GelMA-SPMA hydrogel beads. In transarterial chemoembolization (TACE) for hepatocellular carcinoma, electrostatic attraction between doxorubicin and the sulfonate groups of SPMA resulted in markedly enhanced drug loading in the beads. To enable magnetic targeting and precise intravascular positioning, superparamagnetic iron oxide nanoparticles (SPIONs) were incorporated into the beads. Amine-functionalized SPIONs demonstrated superior magnetic responsiveness compared to pristine SPIONs.

Poster Presentation **1PS-085**

콜로이드 및 분자조립 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Amine-Zinc-GQD Functionalized PCNF Emulsion as a Luminescent Platform for Vitamin C Detection

LAKSHMISHRI PRABAKARAN[†], 양종렬, 김진웅[†]

Sungkyunkwan University

A luminescent oil-in-water emulsion was prepared using cyclohexane with cellulose nanofibrils (PCNF) and the interface was functionalized with amine (triethylenetetramine)-zinc graphene quantum dot (GQD) complexes. The GQD layer exhibits strong photoluminescence at an excitation wavelength of 312 nm. The photoluminescence of the emulsion is enhanced by the interaction with vitamin C (Vit. C - ascorbic acid) due to the passivation of surface traps and stabilization of Zn-TETA coordination. Similarly, upon UV excitation, Vit. C interacts with the GQD-Zn complex via its enediol groups, reducing surface defects and suppressing non-radiative pathways to enhance visible luminescence. Overall, photoluminescence at 312 nm excitation and 365 nm wavelength results in increased intensity, sensitive and selective detection of vitamin C from 10 μ M. The PCNF-GQD-Zn-Amine platform offers a robust, environmentally friendly and cost-effective detection strategy.

Poster Presentation **1PS-086**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Development of Versatile Initiator Films by Synthesizing Tyrosine-Conjugated Initiator Derivatives

황윤, 홍대화[†]

부산대학교

In this study, we developed substrate-independent initiator films that can be formed on a wide range of substrates. Our approach is based on the synthesis of tyrosine-conjugated initiator derivatives, in which the tyrosine moiety serves as a latent coating precursor. Upon enzymatic oxidation by tyrosinase, these precursors form thin films that simultaneously function as initiator layers for surface-initiated polymerization (SIP) of antifouling monomers. Specifically, two types of initiator molecules were designed, differing in the number of tyrosine units, to investigate the effect on film stability and to control the grafting density of polymer brushes. The resulting platform enables both tunable antifouling performance and broad substrate applicability, offering potential utility in biosensors, medical devices, and marine antifouling coatings.

Poster Presentation **1PS-087**
의료용 고분자 부문위원회(I)
2025.9.30(화), 09:00~10:30, 포스터장
Chair: 박민주, 박정태

Nanosheet-Engineered Tumor Spheroids for Enhanced Simulation of the Tumor Microenvironment

홍동용, 박우람*

성균관대학교

Conventional cancer models often fail to replicate the complex tumor microenvironment (TME), limiting nanotherapeutic evaluation. This study introduces a nanosheet-based tumor spheroid platform that better recapitulates in vivo tumor characteristics. Nanosheets enable uniform 3D spheroid formation with enhanced intercellular adhesion and structure. These spheroids demonstrate concentration-dependent increases in hypoxia and in reinforced cell-extracellular matrix (ECM) interactions. Notably, fibronectin expression is upregulated, promoting ECM remodeling and TME architecture. This enhanced microenvironmental simulation enables more accurate evaluation of nanoparticle-based therapeutics. Recapitulating key pathophysiological features of solid tumors, this nanosheet-integrated spheroid system provides a robust platform for preclinical screening of nanomedicines. This approach demonstrates significant promise to advance precision cancer therapeutics and translational outcomes.

Poster Presentation **1PS-088**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Instantaneous, adhesive arterial pressure sensor for wireless continuous post-operative hemodynamic monitoring and diagnosis

주재원, 신미경⁺

성균관대학교

Accurate blood flow monitoring is essential for recovery after complex cardiothoracic surgery, enabling real-time assessment of the surgical site. Yet, precise arterial flow monitoring using implantable wireless devices remains challenging. We present a soft adhesive vascular sensor that integrates a pressure sensor for high-resolution flow monitoring. Composed of viscoelastic, self-healing, energy-dissipative layers and an instant adhesive hydrogel, it ensures conformal contact with soft tissues. Its adaptive interface allows high-fidelity detection of micro-deformations from arterial pulsation and respiration. In a rat model, a wireless implant enabled continuous postoperative hemodynamic monitoring, providing precise, high-quality flow data for real-time evaluation of recovery.

Poster Presentation **1PS-089**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Hyperbranched Polyglycerol-Coated Mesoporous Organosilica Nanoparticles: Enhancing Anti-Biofouling and Pharmacokinetics for Targeted Drug Delivery

양경석, 조은빈, 유자형[†]

UNIST

Upon exposure to biological environments, nanoparticles form a protein corona, causing opsonization and rapid clearance by the mononuclear phagocyte system, reducing therapeutic efficacy. Although polyethylene glycol (PEG) reduces protein adsorption, it cannot fully prevent immune recognition and may induce anti-PEG antibodies. To address this, we developed mesoporous organosilica nanoparticles (MONs) coated with hyperbranched polyglycerol (HPG), a hydrophilic, non-immunogenic polymer. The dense, branched HPG inhibits protein corona formation, confirmed by protein assays and SDS-PAGE. HPG-MONs showed reduced macrophage uptake and excellent colloidal stability with high drug loading. They exhibited redox-responsive degradation in glutathione-rich conditions, suggesting efficient clearance and low accumulation. Overall, HPG-coated MONs offer a promising platform for improved drug delivery and immune evasion.

Poster Presentation **1PS-090**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Mechanical Quenching and Mechanoluminescence of Afterglow Luminescent Particles for Wearable and Rewritable Photonic Skins

조경주, 김성종, 한세광[†]

POSTECH

The optical properties of mechanical quenching (MQ) and mechanoluminescence (ML) offer promising potential for advanced photonic applications. We designed MQ particles (MQPs) and developed a wearable, rewritable photonic film as a communication platform for dark or underwater environments. The films displayed strong MQ along handwritten patterns under mechanical pressure, which could be erased by short ultraviolet irradiation, ensuring reusability. Reproducible MQ and ML responses revealed their correlation and provided insights into underlying mechanisms. The films showed high humidity resistance and retained rewritable capability underwater for extended periods. Furthermore, we demonstrated on-skin applicability by writing and erasing on a human hand, validating their potential as wearable photonic skins. This study highlights mechano-optical conversion as a strategy for developing innovative photonic materials with versatile applications.

Poster Presentation **1PS-091**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Unraveling the mechanism of nitric oxide release for prolonged sustained release in PLGA-mediated delivery

정윤서, 정성원¹, 홍진기[†]

연세대학교

¹ 국립한밭대학교

Diabetic foot ulcers (DFUs), a major diabetes complication, involved poor angiogenesis and tissue necrosis, often leading to amputation. Current self-care based therapies are burdensome and poorly support regeneration. Nitric oxide (NO) promotes wound healing through immune modulation, angiogenesis, and antimicrobial activity. However, Its clinical use is restricted by limited stability, demanding a modulate release approach.

In this study, we developed PLGA shell-based NO delivery system designed to sustain NO release, therebt facilitating early-stage healing in DFUs. S-nitrosoglutathione (GSNO) was covalently linked to PLGA and embedded in a hydrophilic core to mitigate initial burst release. Modulating the molecular weight of PLGA established a tunable diffusion barrier, enabling consistent and localized release of nitric oxide at therapeutically relevant levels. The system shows therapeutic promise for early diabetic wound treatment via targeted and prolonged nitric oxide release.

Poster Presentation **1PS-092**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Near-Infrared (NIR)-Emissive Bioluminescent Polymersomes for Stimulating Collagen Synthesis and Cell Migration in Wound Healing

정승오, 김혜민[†]

건국대학교

Photobiomodulation (PBM) is a therapeutic approach that uses light to stimulate cellular activity and regulate biological responses. While conventional PBM relies on external light sources with precise control over intensity and wavelength, these systems are often expensive and limited to surface-level applications. In this study, we present near-infrared (NIR)-emissive bioluminescent polymersomes as a self-contained PBM platform independent of external light sources. Luciferase enzymes and carbon dots (CDs) are co-encapsulated within self-assembled polymersomes, which protect the functional components and facilitate sustained bioluminescence. NIR emission is achieved via bioluminescence resonance energy transfer (BRET) between luciferase and CDs, promoting wound healing by enhancing collagen synthesis and cell migration. This system offers a promising strategy for non-invasive PBM therapy with potential applications in deep tissue regeneration.

Poster Presentation **1PS-093**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Fluorinated Polymer-Assisted Hydrophobic Surface Functionalization for Anti-Fouling Enhancement in Biosensing

이효준, 이규의[†]

경북대학교

Nonspecific protein adsorption decreases biosensor accuracy. Hydrophilic or zwitterionic surface modifications can reduce fouling, but their instability and complex synthesis limit use. Here, we present a simpler yet effective alternative: a fluorinated polymer-based hydrophobic coating. A copolymer was synthesized from 2,2,2-trifluoroethyl methacrylate (TFEMA) for low surface energy and hydrophobicity, and n-butyl acrylate (BA) for flexibility and strong adhesion. The copolymer can be applied to diverse substrates via a simple one-step spin-coating process. The coating showed excellent antifouling against proteins and cells, with thickness precisely controlled by polymer concentration to optimize performance. This coating can be stably and reproducibly applied to various substrates regardless of material type. Our work offers a robust, facile, and versatile surface modification strategy with strong potential for antifouling applications in biosensing platforms.

Poster Presentation **1PS-094**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Tumor-Selective De-Masking of Checkpoint Antibodies to Mitigate irAEs and Sustain Anti-Tumor Immunotherapy

이창현, 송석호, Torsha Ghosh, 박재형[†]

성균관대학교

Immune checkpoint blockade (ICB) antibodies offer durable responses, but their clinical use is often limited by immune-related adverse events (irAEs) from off-tumor immune activation. To overcome this limitation, we developed a generalized masking strategy utilizing polyethylene glycol (PEG) conjugation through CDM linkers. This design suppresses antibody-immune cell interactions under physiological pH, thereby reducing systemic immune activation and mitigating irAEs. In mildly acidic tumor microenvironments (TME), PEG is hydrolyzed, reactivating antibody function. In vitro assays confirmed restoration of antigen binding and phagocytic activity. In vivo, this strategy alleviated aCD47-induced anemia and reduced colitis associated with dual ICB therapy. De-masking restored antitumor efficacy and extended survival in syngeneic tumor models. These results highlight the potential of pH-responsive PEGylation as a broadly applicable platform for safer and tumor-selective immunotherapy.

Poster Presentation **1PS-095**
의료용 고분자 부문위원회(I)
2025.9.30(화), 09:00~10:30, 포스터장
Chair: 박민주, 박정태

Injectable Rod-like Delivery System for Enhanced Cancer Immunotherapy via Immune-Activating Complexes

이준섭, 박우람[†]

성균관대학교

The therapeutic efficacy of cancer immunotherapies is significantly constrained by immunosuppressive tumor microenvironments and immune tolerance mechanisms. This study developed an injectable rod-like delivery system incorporating immune-activating complexes for enhanced immune modulatory capabilities. Biomaterial-based rod-like structures were fabricated and functionalized with polymeric coatings to enable efficient loading of immune-activating complexes. Microscopic examination confirmed successful complex immobilization on structural surfaces. Biocompatibility was established through cytotoxicity assessment, and significantly increased pro-inflammatory cytokines and immune activation biomarkers were detected in immune cells after 24-hour exposure. The delivery platform exhibited robust immune stimulation with minimal cytotoxicity, demonstrating strong potential as a therapeutic vehicle for cancer immunotherapy and offering a promising strategy to address current limitations.

Poster Presentation **1PS-096**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Chondrogenic regulation through stem cell spheroids-laden semi-interpenetrating polymer network (semi-IPN) hydrogels mimicking cartilage microarchitecture

이은진, 신흥수[†]

한양대학교

Cartilage plays a vital role in joint function by providing chondrocytes within a dense extracellular matrix, allowing for smooth and durable movement. To replicate the complex properties of cartilage and properly regulate cell behavior, it is essential to engineer tissue constructs with precise design. In recent research, approaches using cell spheroids and hydrogel matrices have advanced cartilage tissue engineering, with particular attention on mesenchymal stem cell condensation and the local microenvironment during chondrogenesis. Here, semi-interpenetrating hydrogel consisting of hexanoyl glycol chitosan and gelatin methacryloyl with embedding stem cell spheroids was fabricated to recapitulate mesenchymal condensation process during cartilage development and cartilage microenvironment. The hydrogel provided an environment that prevented excessive spheroid sprouting while enhancing chondrogenesis and inhibiting hypertrophy, which is ideal for in vitro engineered 3D cartilage.

Poster Presentation **1PS-097**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Engineering a Photosensitizer for Precision Modulation of Biopolymer Condensates

이유진, 박민규, 권태혁[†]

Ulsan National Institute of Science and Technology

Recent studies show that specific biomolecular condensates are crucial in cancer initiation and progression and are linked to drug resistance, making them increasingly important therapeutic targets. In this study, we designed and synthesized an iridium-based photosensitizer capable of targeting biomolecular condensates. Furthermore, this neutral iridium-based molecule as a biocompatible photosensitizer with low dark toxicity offers the advantage of minimizing side effects. The photosensitizer enables the spatiotemporal generation of reactive oxygen species (ROS) upon light irradiation. By controlling light intensity, the oxidative stress induced by these ROS can be regulated, allowing for diverse condensate transformations in a precise manner. This system presents a novel approach to modulating condensate dynamics. In conclusion, this study investigates cancer cell changes induced by condensate modifications, potentially broadening its application as a novel therapeutic strategy.

Poster Presentation **1PS-098**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Targeted Degradation of NRF2 Transcription Factor by dNRF2 Oligonucleotide PROTAC Enhances Sensitivity of Cancer Redox Stress

이예진, 이강원[†]

서울대학교

Nuclear factor erythroid-2-related factor 2 (NRF2) is a master regulator of redox homeostasis, activating antioxidant and cytoprotective genes. However, its aberrant activation drives chemoresistance and tumor progression, while direct inhibition remains challenging due to its non-enzymatic, non-ligandable nature. Here, we introduce an oligonucleotide-based proteolysis targeting chimera (Oligo-PROTAC) platform for selective NRF2 degradation. These constructs utilize double-stranded oligonucleotides to bind NRF2 and induce ubiquitin-proteasome-mediated degradation. NRF2-targeting Oligo-PROTACs effectively reduced NRF2 levels, suppressed downstream gene expression, elevated intracellular ROS, and inhibited proliferation in NRF2-hyperactive cancer cells. Notably, co-treatment with doxorubicin or erastin produced synergistic cytotoxicity, lowering IC50 values by ~50%, especially in drug-resistant lines. These findings support oligonucleotide-based targeted protein degradation as a viable therapeutic strategy for addressing otherwise undruggable oncogenic regulators.

Poster Presentation **1PS-099**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Versatile π - π Interactive Hydrogel System for Conformable and Sustained Delivery of Aromatic Ring-Containing Therapeutics

이예성, 신미경^{*1}

성균관대학교 (자연과학캠퍼스)

¹ 성균관대학교

Sustained and localized delivery of aromatic drugs remains a challenge in biomaterial design. We developed a hydrogel (CHI-TA) via Schiff-base crosslinking between chitosan and terephthalaldehyde (TA). Aromatic rings of TA enable π - π stacking with conjugated drugs, supporting extended release without added processing. In a curcumin-loaded model, the hydrogel reduced burst release and retained drug locally. It forms within 20 s at body temperature and adheres to wet tissue, with adhesion >5.5 kPa, stiffness >40 kPa, and stability over 30 compressions. The gel remains intact in physiological conditions and shows better cytocompatibility and tissue integration than glutaraldehyde-based gels. In rat bleeding models, CHI-TA achieved hemostasis in under one minute and reduced blood loss by over 65%. These findings highlight its potential for delivering π -conjugated drugs in biomedical settings requiring tissue adherence and mechanical resilience.

Poster Presentation **1PS-100**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Adiponectin-Derived Peptide-Conjugated Heparin/Chitosan Hydrogel for Keloid Scar Treatment

이승찬, 김혜민[†]

건국대학교

Keloid scars are characterized by excessive fibroblast activity during the wound healing process, leading to overproduction of collagen. While various strategies have been employed to treat keloid scars, they are often associated with pain and undesirable side effects. In this study, we developed a biocompatible hydrogel physically crosslinked with heparin and chitosan, incorporating the adiponectin-derived peptide ADP355, for keloid therapy. ADP355, known for potential therapeutic effects in liver fibrosis and systemic sclerosis, activates AMPK and subsequently inhibits TGF- β 1 signaling, showing promising antifibrotic effects in keloids. To enhance its bioavailability and therapeutic efficacy, ADP355 was conjugated with heparin and subsequently embedded in a heparin/chitosan hydrogel matrix. This hydrogel-based approach offers a promising, minimally invasive alternative for the effective treatment of keloid scars, with reduced pain and side effects.

Poster Presentation **1PS-101**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Cationic Copolymer Interfaces on Nanoneedles via Initiated Chemical Vapor Deposition for Intracellular Gene Delivery

이소원, 장예림¹, 조영학, 성혜정⁺

한국과학기술연구원

¹ KAIST

High-aspect-ratio nanoneedles enable direct intracellular delivery of therapeutic biomolecules by physically penetrating the cell membrane. To achieve high delivery efficiency, the surface properties and biocompatibility of nanoneedles must be carefully tuned. In this study, we employed initiated chemical vapor deposition (iCVD) to functionalize silicon nanoneedles with a copolymer of glycidyl methacrylate (GMA) and dimethylaminoethyl methacrylate (DMAEMA). This solvent-free, low-temperature process preserves nanoneedle structure while allowing precise surface functionalization. Quaternary ammonium groups from DMAEMA promote electrostatic binding with negatively charged biomolecules, and epoxy groups from GMA enhance hydrophilicity and cell adhesion. The polymer-coated nanoneedles improved cell adhesion and viability while enabling efficient intracellular delivery. Our iCVD-based copolymer functionalization strategy demonstrates improved performance for nanoneedle-mediated delivery.

Poster Presentation **1PS-102**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Three-dimensional hyaluronic acid hydrogel with low-intensity ultrasound stimulation accelerates cellular reprogramming efficiency into induced pluripotent stem cells

이민주, 이수홍[†]

동국대학교

Induced pluripotent stem cells (iPS) present significant potential for tissue regeneration due to pluripotency, but traditional methods have low efficiency. Previous study showed that hyaluronic acid (HA) hydrogel enhances iPS generation. In this subsequent study, we explored whether low-intensity ultrasound stimulation (LIUS) improves iPS generation in HA hydrogel. Notably, we observed a time-dependent enhancement in iPS generation following LIUS, validated through OCT4-GFP intensity, colony formation, and pluripotency markers. LIUS also increased CD44 expression and membrane fluidity while collapsing cytoskeletal structures. LIUS also promoted epigenetic modifications, as evidenced by elevated levels of Acetyl H3, H3K4me2, and H3K4me3 markers. Importantly, 3D HA-LIUS system also achieved successful iPS generation in vivo. To summarize, LIUS as a 3D external stimulus would be a useful platform technique for achieving massive production of iPS by fostering cellular reprogramming.

Poster Presentation **1PS-103**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Long-Term Stabilization of Nucleic Acids Using Ionic Liquids

오화진, 오승수[†], 정설영

포항공과대학교

Among various types of nucleic acids, mRNA has emerged as a leading next-generation vaccine material, particularly highlighted during the COVID-19 pandemic. Despite its potential, mRNA is inherently unstable in aqueous environments due to hydrolysis. Accordingly, mRNA vaccines can only be stored for about 12 hours at room temperature and up to 6 months at cryogenic temperatures due to their limited stability. Furthermore, repeated freeze-thaw cycles can compromise nucleic acid stability. In this study, we introduce a novel stabilization strategy utilizing an ionic liquid. High-concentration cations in the ionic liquid interacts with the phosphate backbone of nucleic acids at hydrolysis-prone sites, thereby protecting them from structural degradation. This approach holds promise for enabling the long-term preservation of nucleic acids at ambient temperatures while maintaining their structural integrity and biological activity.

Poster Presentation **1PS-104**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Epigallocatechin Gallate-incorporated Carboxylated Poly-L-lysine Solution for Cryopreservation of Stem Cell Spheroids

엘리프, 강문성, 기동우, 장희정, 현승휴¹, 현우기¹, 한동욱⁺

부산대학교

¹ BMG Incorporated

Despite the therapeutic potential of stem cell spheroids, their distinct structural characteristics require optimized cryopreservation strategies, and conventional protocols often fail to maintain high post-thaw viability and integrity. To address this, we developed a cryopreservation solution incorporating epigallocatechin gallate (EGCG), a natural antioxidant extracted from green tea leaves, into carboxylated poly-L-lysine (COOH-PLL) to create an EGCG-loaded COOH-PLL (E-CPLL) system. The physicochemical properties of E-CPLL were analyzed according to the variation in functional groups. Human mesenchymal stem cell (MSC) spheroids preserved with E-CPLL exhibited significantly improved post-thaw viability, antioxidant activity, and structural stability compared to those treated with conventional cryoprotectants such as dimethyl sulfoxide (DMSO). These findings suggest that E-CPLL is a promising candidate for spheroid cryopreservation, minimizing cell death through synergistic chemical and biological protection.

Poster Presentation **1PS-105**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Development of a 3D In Vitro Bilayer Hydrogel Platform for Inducing Cancer-Associated Fibroblasts(CAFs) from Normal Fibroblasts

염은지, 고원건[†]

연세대학교

The tumor microenvironment (TME) critically influences cancer progression via interactions between cancer cells and stromal components. Cancer-associated fibroblasts (CAFs) contribute to tumor growth, invasion, and resistance, but conventional 2D cultures fail to mimic complex in vivo interactions.

We developed a 3D in vitro model using a bilayer hydrogel platform: cancer cells in alginate and 3T3 fibroblasts in collagen, allowing physiologically relevant CAF induction. Radiation and drug response tests demonstrated increased resistance of cancer cells in this model, highlighting the role of CAFs in therapy resistance.

To improve CAF induction, we are incorporating cancer spheroids that better mimic TME, using composite nanofiber-PEG hydrogels and micropatterned agarose scaffolds. The incorporation of this advanced scaffold is expected to offer deeper insights into TME dynamics and aid the development of more effective targeted therapies.

Poster Presentation **1PS-106**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Synthesis of N-oxide Series Polymer Brushes with Superior Hydrophilicity and Antifouling Properties

오정빈, 조우경[†]

충남대학교

Surfaces that resist nonspecific protein and cell adhesion are crucial for biomedical devices and implants. Trimethylamine N-oxide (TMAO), a natural osmolyte found in marine organisms, exhibits remarkable hydration capability due to its zwitterionic structure, characterized closely spaced positive and negative charges without a hydrocarbon spacer. Inspired by TMAO's hydration behavior, we developed N-oxide-based polymer brushes as antifouling coatings. In this study, we synthesized four TMAO-inspired N-oxide monomers and fabricated polymer brush coatings via surface-initiated ARGET ATRP (activator regenerated by electron transfer atom transfer radical polymerization). Antifouling performance was evaluated via antibacterial assays against *S. aureus* and *E. coli*. The resulting N-oxide polymer brushes demonstrated exceptional hydration and resistance to biofouling, highlighting their potential as next-generation antifouling coatings for biomedical applications.

Poster Presentation **1PS-107**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Substrate-Independent Bioinspired Antifouling Films Derived from Tyrosine-Conjugated Trimethylamine N-oxide (Tyr-TMAO)

양재식, 홍대화^{†1}

부산대학교

^{†1} 부산대학교

We present an antifouling coating inspired by trimethylamine N-oxide (TMAO), a natural zwitterionic osmolyte found in marine organisms. TMAO features a positively charged nitrogen directly bonded to a negatively charged oxygen, resulting in strong hydration and excellent antifouling properties. DOPA-based coatings have been widely used for substrate-independent applications, but they suffer from limitations such as auto-oxidation and the requirement for alkaline conditions to initiate coating. To address these issues, we adopted a tyrosine-based strategy inspired by melanogenesis. In the presence of tyrosinase, the phenol group of tyrosine is enzymatically oxidized, leading to film formation under neutral conditions. Based on this approach, we synthesized a tyrosine-conjugated TMAO derivative (Tyr-TMAO) and formed thin films via tyrosinase-mediated oxidation. The resulting Tyr-TMAO films exhibited superhydrophilicity and robust antifouling performance across a range of substrates.

Poster Presentation **1PS-108**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Urease-powered nanomotor containing STING agonist for bladder cancer immunotherapy

서예원, 최현식, 한세광[†]

포항공과대학교

Most non-muscle invasive bladder cancers have been treated by transurethral resection and following intravesical injection of immunotherapeutic agents. However, the delivery efficiency of therapeutic agents into bladder wall is low due to frequent urination, which leads to the failure of treatment with side effects. Here, we report a urease-powered nanomotor containing the agonist of stimulator of interferon genes (STING) for the efficient activation of immune cells in the bladder wall. After characterization, we perform in vitro motion analysis and assess in vivo swarming behaviors of nanomotors. The intravesical instillation results in the effective penetration and retention of nanomotors in the bladder. In addition, we confirm the anti-tumor effect of nanomotor containing the STING agonist (94.2% of inhibition), with recruitment of CD8⁺ T cells (11.2-fold compared with PBS) and enhanced anti-tumor immune responses in bladder cancer model in female mice. Furthermore, we demonstrate the better anti-tumor effect of nanomotor containing the STING agonist than those of the gold standard Bacille Calmette-Guerin therapy and the anti-PD-1 inhibitor pembrolizumab in bladder cancer model. Taken together, the urease-powered nanomotor would provide a paradigm as a next-generation platform for bladder cancer immunotherapy.

Poster Presentation **1PS-109**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Development of PEGylated Albumin-Based Nanoparticles for Cancer Therapy and Theranostic Applications

박효진, 임수연, 김병덕, 유빈, 김강민, 정지훈⁺

성균관대학교

Paclitaxel (PTX) is a potent chemotherapeutic commonly employed in managing recurrent and metastatic breast cancer. Nevertheless, its low water solubility requires formulation with oil- or surfactant-based vehicles, which can induce hypersensitivity reactions and hinder effective drug delivery to tumor tissues. To address these limitations, the present study introduces a solvent-free method to formulate PTX-loaded nanoparticles using PEG-conjugated human serum albumin (HSA-PEG). The nanoparticles were fabricated through a simple film-casting followed by hydration, yielding stable PTX-loaded particles. These nanoparticles showed efficient intracellular delivery and potent cytotoxic effects across several breast cancer cell lines. In a breast cancer xenograft mouse model, intravenous administration of HSA-PEG/PTX nanoparticles achieved prolonged systemic circulation and enhanced tumor targeting, ultimately leading to improved therapeutic outcomes and extended survival.

Poster Presentation **1PS-110**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Surface-Modified Biochips by Polymeric Thin Film for Multiplexed and Flexible Biosensing

박한균[†], 이정오¹, 양성윤^{†2}

충남대학교

¹ 한국화학연구원연구원

² 충남대학교

In this study, we aimed to construct a versatile biosensing platform using surface modification strategies. Previously the optical detection in biosensor modification exhibited limitations due to its sensitivity to chip thickness, transparency and geometry, restricting the platform's structural flexibility. To overcome these constraints, we introduced both organic and inorganic materials to functionalize surfaces capable of selective biomolecules such as nucleic acid, protein or carbohydrate capture. For the enhanced RNA detection, we modified the chip surface as a positively charged polymer coating, and we developed polymer capping layers on a copper electrode biochip to enhanced stability and sensitivity of a non-enzymatic glucose sensor. These approaches demonstrate that nanoscale blended polymer thin films can support both optical and electrochemical biosensing in multiplexed biomarker detection, POCT (Point-of-Care Testing), and wearable diagnostics.

Poster Presentation **1PS-111**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Bioinspired N-Oxide Surface Coatings for Antifouling and Antibacterial Protection of Medical Devices

박종석, 조우경[†]

충남대학교

Catheters and other indwelling medical devices are major contributors to hospital-acquired infections, primarily due to biofilm formation, underscoring the need for effective antifouling strategies. N-oxide compounds, forming stable hydration layers via dipole interactions, offer strong resistance to non-specific protein adsorption and bacterial adhesion. Amine-terminated N-oxide compounds were synthesized through amine oxidation and protecting group steps and characterized by ^1H NMR spectroscopy. A two-step surface functionalization was developed: first, a eumelanin-inspired coating was applied to diverse substrates; then, N-oxide compounds were grafted via Michael addition and Schiff base reactions. The antibacterial efficacy of the resulting surfaces was tested against *E. coli* and *S. aureus*, showing significant inhibition of bacterial adhesion. This work presents a bioinspired coating integrating melanin chemistry and N-oxide antifouling functionality, offering a promising strategy.

Poster Presentation **1PS-112**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Mesoporous SiO₂/N-doped TiO₂/Metal Phenolic Networks Heterostructure for UV-to-High Energy Visible Light Protecting Sunscreen

김희원, 최새한¹, 남윤성¹

한국과학기술원

¹ 생명과학과

Titanium dioxide (TiO₂, bandgap ~3.2 eV) is extensively used as a UV-blocking agent in sunscreens but suffers from a narrow spectral coverage (~3.2 eV bandgap) and high photochemical reactivity, resulting in undesired reactive oxygen species (ROS). Here, we developed a heterostructure composed of mesoporous SiO₂, N-doped TiO₂, and metal-phenolic networks (MPNs) to achieve comprehensive protection from ultraviolet (UV) to high-energy visible (HEV) light (400–500 nm). Nitrogen doping significantly extended the absorption range into the HEV range while simultaneously serving as recombination sites for photogenerated charges, effectively reducing ROS formation. Furthermore, the incorporation of MPN coatings improved UV-to-HEV protection via ligand-to-metal charge transfer mechanisms and demonstrated intrinsic antioxidant properties, suppressing ROS generation by up to 99%. This multifunctional inorganic-organic heterostructure addresses critical limitations of conventional inorganic UV filters, providing enhanced photoprotection and reduced phototoxicity for advanced sunscreen applications. This research was funded by the Korea Technology and Information Promotion Agency for SMEs (TIPA) (Grant RS-2025-02306912).

Poster Presentation **1PS-113**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

A VEGF-mimetic peptide facilitates the cost-effective differentiation of induced pluripotent stem cells into endothelial cells targeting ischemic diseases

김영진, 이수홍[†]

동국대학교

Ischemic diseases, caused by oxygen deficiency, often lead to irreversible tissue damage and organ failure. Cardiovascular diseases, causing about 17.9 million deaths annually, are mostly ischemic, highlighting the need for effective therapies. Endothelial cell (EC) transplantation can help restore blood flow, but adult-derived ECs have limited availability and function. iPSC-derived ECs offer a promising alternative, typically using vascular endothelial growth factor (VEGF), which is costly and may cause side effects. VEGF-mimetic peptides like QK are cheaper, more stable, and specific. This study showed that QK effectively induced EC differentiation from iPSCs and enhanced angiogenesis in HUVECs, with results comparable to VEGF. Both VEGF- and QK-induced iECs expressed endothelial markers and showed similar tube formation and regenerative ability in vivo. These findings support QK as a cost-effective VEGF substitute for generating iECs to treat ischemic diseases.

Poster Presentation **1PS-114**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Establishment of vascularized pancreatic cancer organoid culture platform and development of metastatic model

김수진, 김환⁺¹

한국교통대학교

¹ 한국교통대학교, (현) 서울과학기술대학교

Pancreatic ductal adenocarcinoma (PDAC) exhibits a profoundly unfavorable prognosis among solid malignancies. The retroperitoneal localization of the pancreas, coupled with the tumor's propensity for vascular invasion and encasement, impedes early detection and complicates surgical intervention. Furthermore, the aggressive metastatic dissemination and inherent chemoresistance of PDAC underscore the imperative for a comprehensive understanding of its pathogenesis and associated etiological factors. This study describes the development of vascularized PDAC organoid culture platform, engineered to recapitulate the in vivo tumor microenvironment. A functional vascular network was created by co-culture of PDAC organoids and vascular endothelial cells within a 3D-printed culture well. This platform demonstrates significant utility for investigating PDAC pathobiology, modeling tumor metastasis, and facilitating high-throughput pharmacological screening.

Poster Presentation **1PS-115**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Split Aptamer-Gold Nanoparticle loaded Hydrogel for ROS-Responsive Postoperative Tumor Microenvironment Modulation

김성민, 김원종⁺

포항공과대학교

Surgical resection is the primary treatment for breast cancer, but tumor recurrence due to residual cells and a postoperative microenvironment remains a critical challenge. We present a multifunctional therapeutic hydrogel (Apt-Au@Gel) integrating ROS scavenging, VEGF capture, and photothermal therapy (PTT) to suppress postsurgical tumor recurrence. Apt-Au@Gel consists of a crosslinked polymeric phenylboronic acid (pPBA) and polyvinyl alcohol (PVA) loading VEGF split aptamer-gold nanoparticles (Apt-AuNPs). Upon exposure to elevated ROS, released Apt-AuNPs aggregate to enable VEGF capture and enhance photothermal effects. Apt-Au@Gel implantation at the surgical site significantly inhibited tumor recurrence without systemic toxicity. These results suggest that Apt-Au@Gel offers a synergistic strategy for effective postsurgical cancer therapy by modulating the postoperative tumor microenvironment and eliminating residual tumor cells.

Poster Presentation **1PS-116**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Antigen Presenting Cell Mimetic Lipid Nanoparticles Loaded with mTOR siRNA for Regulatory T cell Induction

김보원, 이수홍[†]

동국대학교

Regulatory T cells (Tregs) are immunomodulators that reduce inflammation and promote tissue regeneration. Recently, inducing Tregs has emerged as a promising strategy for tissue regeneration. This process requires initial activation of naïve T cells by co-stimulation of CD3 and CD28. Also, the downregulation of the mammalian target of rapamycin (mTOR) pathway has been implicated in promoting Tregs induction. In this study, we developed lipid nanoparticles (LNPs) conjugated with CD3e and CD28 antibodies and loaded with mTOR-siRNA (Ab-LNPs). We assessed the activation efficiency of Ab-LNPs by measuring the enhanced expression of CD25, a key marker of T cell activation. Moreover, the Ab-LNPs exhibited higher siRNA delivery efficiency compared to control LNPs. These findings suggest that the Ab-LNPs effectively promote the activation and induction of Tregs from naïve T cells, offering a potential therapeutic strategy for tissue regeneration.

Poster Presentation **1PS-117**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Thermoresponsive and ROS-activated Prodrug Hydrogel for Controlled Drug Release Applications

고명서, Le thi phuc, 허강무[†]

충남대학교

Thermogels undergo reversible sol–gel transitions near physiological temperatures, making them ideal for injectable and localized drug delivery. In this study, we developed a novel ROS-responsive thermogel by covalently conjugating the anticancer drug doxorubicin (DOX) onto octanoyl glycol chitosan (OGC), a thermo-responsive polymer, using a thioketal (TK) linker—referred to as OGC-TK-DOX. This prodrug system addresses the limitations of physical drug loading, such as burst release and non-specific distribution. The chemical structure was confirmed by ¹H-NMR and FT-IR, and drug content was quantified using UV–vis spectroscopy. OGC-TK-DOX exhibited a sol–gel transition near body temperature, and its gelation behavior was tunable by the degree of substitution of octanoyl and DOX-TK groups. In summary, the OGC-TK-DOX thermogel system shows strong potential as a candidate for precise and sustained anticancer drug release at targeted sites, holding promise for effective cancer therapy.

Poster Presentation **1PS-118**

의료용 고분자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Surface Charge-Dependent Uptake of Pluronic Nanoparticles by HeLa Cells

강지오, 황주영¹, 오누리², 곽민석⁺

부경대학교

¹ 아주대학교

² 한국과학영재학교

Surface charge is a key factor influencing nanoparticle (NP) interactions in biological systems. To investigate its role in cellular uptake, we synthesized Pluronic block copolymer F127-based NPs functionalized with phosphate (PP) to impart negative charge and trimethylammonium bromide (AB) to confer positive charge. By varying the ratios of PP-F127 and AB-F127, we prepared self-assembled NPs with tunable surface charge densities and a semi-interpenetrating core structure. These NPs were characterized and evaluated for cellular uptake in HeLa cells. The results demonstrated that positively charged AB-NPs exhibited significantly enhanced cellular internalization compared to negatively charged PP-NPs, underscoring the critical role of surface charge in NP-cell interactions. These findings provide valuable insights into the design of NP-based drug delivery systems by highlighting the influence of surface charge on cellular uptake

Poster Presentation **1PS-119**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Development of Materials and Processes for Fine Metal Mask-Free Patterning of Emissive Layers in Full-Color OLED microdisplays

함효빈, 이승한¹, 강문성¹, 김봉수⁺

울산과학기술원

¹ 서강대학교

Organic light-emitting diodes (OLEDs) used in virtual and augmented reality displays require micrometer-scale red–green–blue (RGB) pixel patterns in the emissive layer (EML). Conventional patterning methods based on evaporation and shadow masks are limited to pattern sizes larger than tens of micrometers due to geometric constraints of the mask. Here, we propose an indirect photopatterning method for solution-processed OLED EMLs, which uses crosslinkable materials and enables micrometer-scale RGB pixel patterning without direct UV exposure or harsh etching processes. By repeating the indirect photopatterning process, RGB EML patterns can be formed, with a sacrificial photoresist (PR) layer protecting the underlying EMLs from solution exposure during subsequent steps. Using a conventional photolithography setup, RGB EML patterns exceeding 3,000 pixels per inch were achieved, demonstrating the method's industrial potential.

Poster Presentation **1PS-120**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Donor Polymer-Dependent Charge Generation and Morphology Control in High-Performance Non-Fullerene Organic Photovoltaics

함가영, 이다민, 박창우, 김명진, 차효정⁺

경북대학교

The molecular design of polymer donors plays a crucial role in determining the performance of bulk heterojunction (BHJ) organic photovoltaics (OPVs), in non-fullerene acceptor (NFA)-based systems. In this study, we investigated the effect of three representative donor polymers, PM6, PTQ10 and D18, on charge generation dynamics and device efficiency of BHJ OPVs incorporating BTP-eC9 as the NFA. Nanosecond transient absorption spectroscopy (ns-TAS) was employed to monitor the charge separation and transport. In parallel, complementary morphological characterization using grazing incidence wide-angle X-ray scattering (GIWAXS) was conducted to elucidate the phase separation and molecular packing in BHJ. This results reveal a strong correlation between donor polymer structure, nanoscale morphology, and photophysical behavior, demonstrating the rational donor polymer design is essential for optimizing charge generation and achieving high power conversion efficiency (PCE) in NFA-based OPVs.

Poster Presentation **1PS-121**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Co-adsorbed Monolayers Enabling Uniform Coverage for Enhanced Hole Extraction in Perovskite Photoelectronics

하두헌, 왕동환[†]

중앙대학교

This study investigates co-adsorbed self-assembled monolayers (CA-SAMs) for improving interfacial properties in perovskite optoelectronic devices. CA-SAMs induced a more negative surface potential and enhanced work function alignment, facilitating efficient hole extraction. AFM and SEM confirmed smoother morphology and larger grains, indicating improved crystallinity. Photoluminescence and electrical analyses showed reduced trap density and enhanced charge transport. XPS verified strong molecular adsorption and mixed monolayer formation. Compared to pristine SAMs, CA-SAMs suppressed molecular aggregation and voids, resulting in more uniform coverage and better energy alignment. These effects led to reduced dark current and improved device performance. The findings support CA-SAM processing as an effective strategy for interfacial engineering in perovskite photoelectronics, contributing to stable and efficient charge extraction.

Poster Presentation **1PS-122**
분자전자 부문위원회(I)
2025.9.30(화), 09:00~10:30, 포스터장
Chair: 박민주, 박정태

Maximizing Light Absorption in Ultrathin Tin Halide Perovskites via Fabry-Perot Optical Resonances

최지아, 임동규¹, 이규태¹, 박희준⁺

한양대학교

¹ 인하대학교

Tin (Sn) halide perovskites have emerged as promising alternatives to toxic lead (Pb) halide perovskites for optoelectronic applications. However, Sn²⁺ is easily oxidized and crystallizes rapidly, leading to poor film uniformity. It is particularly difficult to fabricate thick films that absorb enough light while maintaining film quality.^[1,2] In this study, we enhance light absorption in ultra-thin Sn halide perovskite films by employing Fabry-Perot (FP) resonances in a planar p-i-n architecture. By aligning the FP resonance condition with the intrinsic absorption peak of the perovskite layer, we induce constructive interference, enabling improved optical confinement. As a result, a 50 nm-thick Sn halide perovskite film with reduced defect density achieves relatively high photocurrent despite its minimal thickness. This approach demonstrates the potential of integrating optical engineering with material optimization to realize efficient photodetectors with enhanced performance.

Poster Presentation **1PS-123**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Template-Directed Self-Assembly of Semiconducting Polymers via Crystallizable Solvent-Induced Nanoconfinement

최소현, 육지호, 양희창[†]

인하대학교

We investigate the solution crystallization behavior of semiconducting polymers in nanoconfinement generated by 1,3,5-trichlorobenzene (sym-TCB), a solvent additive that crystallizes at room-temperature. Polymer solutions of diketopyrrolopyrrole-bithiophene copolymer (pDPPBT) and poly(3-hexylthiophene)(P3HT) were prepared in chloroform with varying concentrations of sym-TCB. Upon film casting, sym-TCB crystals directed the growth of polymer domains, resulting in spherulitic morphologies replicated from the solvent crystals. pDPPBT films exhibited predominantly edge-on chain orientation at the dielectric interface, whereas P3HT showed bimodal orientation: face-on alignment near the top surface via epitaxial crystallization and edge-on alignment at the bottom interface. This crystallization behavior was also observed in other conjugated polymer systems.

Poster Presentation **1PS-124**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Dual-Functional Strategy via Ethylenediamine and γ -ray-irradiated NiO_x for Highly Sensitive Perovskite Photoelectronic Devices

채가윤, 김병기, 김진영, 임지현, 하두헌, 왕동환⁺

중앙대학교

This study investigates the synergistic effect of combining ethylenediamine (EDA) treatment and γ -ray irradiation on NiO_x sol-gel, which dramatically improves its performance as a hole-transport layer in perovskite optoelectronic devices. EDA treatment stabilizes the film morphology and partially oxidizes Ni²⁺ to Ni³⁺, after which subsequent γ -ray irradiation further increases the Ni³⁺ fraction. The elevated Ni³⁺ content activates the Ni²⁺ ↔ Ni³⁺ hole-hopping pathway, substantially improving electrical conductivity. Consequently, the power conversion efficiency of the perovskite solar cell increases to 24%, and photodetector dark current is suppressed by 9.87-folds. These results demonstrate that a dual-treatment strategy combining EDA treatment and γ -ray irradiation can effectively improve the properties of NiO_x HTLs, making it a useful strategy for the development of high-performance perovskite optoelectronic devices.

Poster Presentation **1PS-125**
분자전자 부문위원회(I)
2025.9.30(화), 09:00~10:30, 포스터장
Chair: 박민주, 박정태

The Role of Interface Engineering in Efficient and Stable Back-Contact Perovskite Solar Cells

진해담, 김민[†]

서울시립대학교

Back-contact perovskite solar cells (BC-PSCs) maximize photon absorption and charge collection. Efficient charge extraction, however, requires sophisticated interface engineering. We developed a novel electron transport layer (ETL) via a simple spin-coating process, combining nanoparticle SnO_2 with a sol-gel SnO_2 solution. This significantly enhances interfacial contact, reduces trap-assisted recombination, and improves energy-level alignment.

Through advanced microscopy, we demonstrated that the BC-PSC achieves a 4.52% power conversion efficiency, attributed to superior charge collection. The back-contact configuration also enables direct analysis of interfacial charge dynamics, providing crucial insights into carrier transport.

These results highlight interface-engineered BC-PSCs as a scalable, high-performance platform for next-generation photovoltaics

Poster Presentation **1PS-126**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Charge Transport Modulation in n-Type Polymers via Isomerization for Thermoelectric Enhancement

지호준, 이정계, 김대건¹, 조길원⁺

포항공과대학교

¹ 가천대학교

The advancement of flexible thermoelectric (TE) materials relies on the development of efficient n-type conjugated polymers; however, progress in this area remains relatively limited. In this study, we explore a molecular engineering approach to enhance the charge transport characteristics of an n-type polymer system, poly(benzodifurandione) (PBFDO). By inducing a controlled isomerization of specific backbone segments through hydrothermal treatment, we achieve notable changes in structural order and transport behavior. These modifications promote a shift in the dominant charge transport mechanism and enable an improved thermoelectric response through an energy-filtering effect. The treated polymer films exhibit promising electrical and thermoelectric performance, offering new insights into structure-property relationships in conjugated TE materials. This work highlights the potential of isomeric design strategies for advancing next-generation polymer-based TE devices.

Poster Presentation **1PS-127**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

3D-Printable Ionic Hydrogel Electrodes and Electroluminescent Elastomers for Flexible Optoelectronic Devices

정은지, 윤진환[†], 박정빈¹

서울시립대학교

¹ 부산대학교

Flexible electroluminescent devices are essential for wearable electronics and soft robotics, but conventional fabrication limits design complexity and customization. We demonstrate direct ink writing (DIW) 3D printing of stretchable EL devices using three co-printable functional inks. Our ionic hydrogel electrode, crosslinked with Pluronic F-127 dimethacrylate (FDMA), offers high ionic conductivity, transparency, and stretchability. The electroluminescent ink, based on a UV-curable silicone matrix with embedded phosphors, provides stable brightness at low voltages. Fully 3D-printed devices retain consistent luminance under deformation and show reliable operation through repeated stretch-release cycles. This method enables rapid prototyping of complex 3D geometries, including curved displays and embedded lighting patterns hard to achieve with conventional methods. The platform supports customizable manufacturing for next-generation wearable optoelectronics and human-machine interfaces.

Poster Presentation **1PS-128**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Interface Engineering of Organic Photoanodes for Solar-Driven Value-Added Chemical Production

전은송, 조한희[†]

울산과학기술원

Organic semiconductors (OS) hold great potential for improving both the efficiency and the design flexibility of photoelectrochemical (PEC) devices due to their tunable energy levels, strong light absorption, and solution processability. Despite these advantages, their practical application in PEC systems remains limited, primarily because short exciton diffusion lengths and inefficient charge extraction often result in unfavorable charge recombination. To overcome these limitations, we engineered the semiconductor/charge transporting layer interface using nanostructured SnO_2 . This nanostructure facilitates efficient charge separation and suppresses charge accumulation at the interface. As a result, the optimized SnO_2 /OS photoanodes demonstrated hour-scale operational stability for various oxidation reactions such as sulfite and iodide oxidation. These findings highlight a pathway toward the practical solar-driven value-added chemical production through interfacial engineering.

Poster Presentation **1PS-129**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Improving Nonvolatile via Nanoweb Structuring of Organic Artificial Synapses

장효익, 이은호[†]

서울과학기술대학교

Organic electrochemical transistors (OECTs) are suitable for use as artificial synapses to mimic various neural functions. However, to improve the nonvolatile properties required for functional mimicry, it is important to enhance the interaction between the channel and ions. Various approaches have been attempted, but most rely on specific molecular structures or dopant chemistries, necessitating more universal and scalable method. Here, we precisely controlled ion interactions and doping efficiency in artificial synapses by modulating surface morphology via foaming-assisted nanoweb structuring. The nanoweb-structured channels induced rapid ion penetration and effectively suppressed back-diffusion. These allowed us to maintain more nonvolatile current and enable linear conductance modulation. These findings highlight the impact of channel morphology modulation on synaptic properties and provide an optimized design strategy for artificial synapses.

Poster Presentation **1PS-130**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Neuromorphic Artificial Synapses Enabled by Glycol-Modified through Copolymerization

장유현, 성준호, 이은호[†]

서울과학기술대학교

Electrolyte-gated organic synaptic transistor (EGOST) uses polymers as channel layers, so it is important to control the properties of the polymers. However, polymers with alkyl chains have low ionic reactivity, limiting their ability to implement synaptic plasticity. Therefore, glycol groups are being studied widely with polarity and strong ion interactions enable them to achieve non-volatile properties. Despite this, systematic studies on the effects of glycol group copolymerizing has not been lacking. In this study, we propose a strategy to enhance synaptic properties by introducing glycolated monomers into alkyl-based polymers via copolymerization. The results showed that synaptic properties could be achieved by enhanced doping to the channel through copolymerization. Based on LTP/D properties, high accuracy was achieved in ANN-based recognition. This study provides a new way for neuromorphic computing by implementing synaptic device with glycol introduction via copolymerization.

Poster Presentation **1PS-131**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Stretchable ferroelectric capacitors enhanced by amine-functionalized graphene oxide additive

장성보, 정범진[†]

부산대학교

Ferroelectric polymers such as PVDF-TrFE, PVDF-HFP, and PVDF-CFE are promising candidates for stretchable capacitors and memory devices owing to their mechanical deformability and electroactive properties. Nonetheless, their inherently low remanent polarization (P_r) and the considerable challenge of inducing the polar β -phase remain critical limitations to ferroelectric performance. To address these issues, a bilayer structure was designed with a top layer comprising a P(VDF-TrFE)/PEG diamine blend to preserve elasticity, while the bottom layer of amine-functionalized graphene oxide (AGO) facilitated dipole alignment and epitaxial crystallization through strong interfacial coupling. This bilayer configuration significantly enhanced P_r via improved β -phase orientation and domain alignment driven by AGO-induced epitaxy. This strategy may be applicable to the development of high-performance flexible ferroelectrics and wearable electronics.

Poster Presentation **1PS-132**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Synergistic Approach of Polymer Blend Systems for Improvement of Thermoelectric Power Factor via Optimization of Seebeck and Conductivity

장석환, 최원석, 배건탁, 장규진, 강영훈, 한미정, 박병욱⁺

한국화학연구원

Conjugated polymers have attracted attention as key materials for advanced thermoelectric (TE) devices, owing to their lightweight and flexibility. As one of the performance parameters of TE materials, power factor (PF) is defined by $PF=S^2\sigma$ (S and σ are Seebeck coefficient and electrical conductivity). However, single conjugated polymers generally face a limitation in terms of high PF, since the S - σ trade-off relationship make difficult to achieve the simultaneous enhancement in both of S and σ .

In this study, two polymers with relatively high S and σ , respectively, were blended to achieve the concurrent enhancement in both of S and σ . To obtain insight into the polymer blends, not only the TE performance, but also the optical, morphological, and structural properties of polymer blend films with various blend ratio was investigated. As a result, through efficient charge transport channels, the polymer blend exhibited ~100% enhanced PF compared to single polymer

Poster Presentation **1PS-133**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Hierarchical Double-Shell Black Nanoparticles Prepared by PVP-Assisted Coating as LiDAR-Detectable Pigments for Autonomous Vehicle Applications

임지수, 김지원, 강다희, 윤창민[†]

인하대학교

In this study, hierarchical black double-shell nanoparticles (HBDS NPs) with superb near-infrared (NIR) reflectance are synthesized to improve LiDAR sensor recognition in autonomous driving systems. The HBDS NPs are fabricated through sequential processes involving titanium tetrakisopropoxide (TTIP) sol-gel synthesis, sodium borohydride (NaBH_4) reduction, and ammonia (NH_4OH) etching. Polyvinylpyrrolidone (PVP) is employed as an interfacial agent to ensure robust adhesion between the titania shells and silica cores, creating stable double-shell architectures. And then, HBDS NPs are integrated into hydrophilic varnish and spray-coated onto various substrates. As a result, the HBDS NP-based coatings applied objects exhibit outstanding NIR reflectance (~40.6 R%) while maintaining excellent black coloration, verified by colorimeter. Importantly, practical LiDAR detection performance of objects coated with HBDS NPs are significantly enhanced, comparable to the white objects. These results suggest that HBDS NP coatings represent a viable solution for advanced, safety-focused coatings in autonomous vehicles.

- 본 연구는 2025년 정부(방위사업청)의 재원으로 국방과학연구소의 지원을 받아 수행된 미래도전국방기술 연구개발사업임(No.915066201).

Poster Presentation **1PS-134**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

All-Elastomeric Organic Schottky Diodes with Tunable Interfaces for Wearable Bioelectronics

이희정, 심현석[†]

부산대학교

Achieving precise energy level alignment at the electrode–semiconductor interface is crucial for high-performance organic Schottky diodes, especially in soft, stretchable electronics. Here, we present a fully elastomeric Schottky diode where all components—cathode, anode, and semiconductor—are intrinsically stretchable. Electrical performance is optimized by tuning the work function of PEDOT:PSS electrodes via a simple PSS doping process, enabling controlled ohmic contacts with the semiconductor PTB7-th. The device exhibits excellent mechanical durability along with a high rectification ratio and low leakage current. Key parameters, such as ideality factor and schottky barrier height, match theoretical values, validating our interface design. The diode is also integrated into a EMG-sensing circuit to demonstrate practical utility in energy-efficient soft electronics. These results highlight the potential of our elastomeric diode as a mechanically robust and electrically optimized platform for next-generation wearable and bio-integrated systems.

Poster Presentation **1PS-135**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Self-Assembled Monolayer Post-treatment of Transfer-Laminated PEDOT:PSS for Efficient Charge Transport in Organic Electronics

이희성, 왕동환⁺, 김민수, 장웅식

중앙대학교

This study introduces a novel strategy for optimizing hole transporting layer (HTL) via self-assembled monolayer (SAM) post-treatment for the transfer-laminated PEDOT:PSS to fabricate high performance organic photovoltaics (OPVs) and photodetectors (OPDs). The post-treatment of transfer-laminated PEDOT:PSS with SAMs not only effectively removed the insulating PSS chains, but also established robust interfacial linkage between the ITO substrate and the active layer. The chemical and morphological enhancement led to improved charge transport and reduced leakage current of fabricated OPVs and OPDs, achieving power conversion efficiency of 15.22% and specific detectivity of 1.33×10^{13} Jones. Comprehensive electrical analyses further demonstrate significant enhancements in resistance values of the devices, supporting the origin of the improvements. These findings provide valuable guidance for the development of next-generation organic semiconductor-based photoelectronic devices.

Poster Presentation **1PS-136**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Enhancing Thermoelectric and Electrical Properties of n-type Conjugated Polymer via Ion-Exchange Doping Strategy

이정계, 지호준, 김대건¹, 조길원⁺

포항공과대학교

¹ 가천대학교

The development of high-performance n-type organic thermoelectric materials remains a significant challenge for the realization of wearable electronic devices. Here, we introduce an ion-exchange doping strategy to markedly enhance the electrical and thermoelectric properties of poly(benzodifurandione) (PBFD), a promising n-type conjugated polymer. The ion-exchange process involves the replacement of protons (H^+) in the $[(PBFD)^-mH^+]$ system with external cations (X^+), enabling improvements in both electrical conductivity and Seebeck coefficient. As a result, the optimized PBFD systems exhibited the highest performance among reported n-type conjugated polymers to date. These findings highlight the potential of ion-exchanged PBFD not only as a high-conductivity electrode material, but also as an efficient thermoelectric material, thereby expanding its applicability in organic electronic and energy-harvesting devices

Poster Presentation **1PS-137**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Steric Effect-controlled Atomic Passivation of Colloidal InAs Quantum Dots for Infrared Photodetectors

이인서, 백세웅[†], 조가은, 김한슬¹

고려대학교

¹ 충북대학교

Infrared colloidal quantum dots (CQDs) are promising materials for next-generation optoelectronics. Among them, indium arsenide (InAs) CQDs have drawn attention for their suitability in emerging applications such as wearable devices. However, achieving efficient surface passivation remains a critical challenge for high-performance InAs CQD-based infrared photodetectors. In this study, we combine a sequential ligand adsorption model based on density functional theory calculations, together with systematic experiments to investigate atomic-scale ligand adsorption on InAs CQDs. The results indicate that passivation efficiency is determined by steric hindrance from halide ion size and surface electrostatic interactions. Smaller halide ligands allow for denser surface coverage, leading to enhanced charge transport. As a result, an optimized InAs CQD photodiode exhibits a specific detectivity of 3.2×10^{12} Jones at 980 nm.

Poster Presentation **1PS-138**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Chemically inert interface via perylene diimide transfer process for enhanced stability in perovskite optoelectronics

이유민, 임지현, 김병기, 채가윤, 왕동환⁺

중앙대학교

In this study, n-type perylene diimide (NPDI) was introduced into the transfer process to form an interfacial passivation layer, thereby contributing to the suppression of interface defects in perovskite optoelectronic devices and the formation of a complete interface with the electrode, thereby improving device performance and stability. The conventional solvent spin-coating method used for introducing the electron transport layer inevitably results in interfacial penetration, leading to defect formation caused by solvent residues. This limits the long-term stability of perovskite optoelectronic devices. To overcome these limitations, a transfer process was employed to eliminate direct contact with the underlying layer and solvent, enabling the formation of a hydrophobic and chemically stable interface. Therefore, NPDI transfer-based devices are optimized to enhance the stability and durability of perovskite optoelectronic devices through controlled interface engineering

Poster Presentation **1PS-139**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Molecularly Engineered Single-Component Exciplex Host for Stable and Efficient TADF OLEDs

이예서, 권수빈, 김신영, 조민주, 최동훈[†]

고려대학교

While exciplex hosts enhance charge balance and reduce driving voltage in OLEDs, most reported systems rely on vacuum deposition and complex multi-layer structures including HTLs. In solution-processed devices, binary exciplex hosts often suffer from phase separation and poor film morphology, limiting device performance. In this study, we designed a single-molecule exciplex host integrating donor and acceptor moieties via a flexible linker. This "Two-in-one" architecture improves solubility and film uniformity while enabling efficient exciplex formation. Applied in an HTL-free solution-processed TADF OLED, the device achieved superior efficiency and operational stability compared to conventional binary exciplex host systems. The simplified device structure also reduces fabrication complexity, highlighting the potential of single-molecule exciplex hosts for scalable, high-performance OLED applications.

Poster Presentation **1PS-140**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Theoretical Study on Enhancing the Stability of Two-Dimensional Nanomaterials through Aqueous Processing

이성원, 이동규, 이태경[†]

경상국립대학교

MXenes have emerged as promising 2D nanomaterials for energy storage and related applications. However, their expanded utilization is still limited by challenges in developing environmentally sustainable synthesis methods. In this study, we investigated an aqueous method that enabled efficient delamination of layered nanosheets while enhancing their structural integrity. This process replaced conventional intercalants and produced uniform and thin flakes with well-preserved morphology. To understand the role of water in structural and chemical stability, we performed density functional theory calculations. Our results showed that water molecules promoted interlayer stabilization through favorable surface interactions and hydrogen bonding. In addition, surface reactions associated with oxidative degradation were thermodynamically less favorable under aqueous conditions. Our study provides theoretical insights into stabilizing strategies for the scalable processing of 2D nanomaterials.

Poster Presentation **1PS-141**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Impact of Configurational Isomerism on Nanostructure and Hydrogen Evolution in Y6-Based Photocatalysts

이병휘, 우한영[†], 이순용

고려대학교

We synthesized two geometrically distinct but chemically identical single-molecule photocatalysts, cis-YCO and trans-YCO, based on a Y6 core with a carbonyl bridge. This subtle configurational difference significantly affects their nanoparticle morphology, optical properties, and hydrogen evolution performance. While both show similar absorption in solution and film, trans-YCO exhibits a red-shifted absorption in nanoparticle form, indicating different nanoscale organization. These results emphasize the importance of molecular-level design in tuning self-assembled structures and optimizing photocatalytic activity. This work offers a strategy for designing next-generation single-molecule organic photocatalysts with controlled morphology and high solar-to-hydrogen conversion efficiency, and it underscores the need for further studies on structure–property relationships in photocatalytic systems.

Poster Presentation **1PS-142**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Ultrathin Transformable Nanomembranes for Imperceptible and High-Performance Bioelectronics

이대연, 정현진¹, 손동희^{†1}, 김봉수[†]

울산과학기술원

¹ 성균관대학교

Next-generation bioelectronics require ultrathin, soft, and high-performance materials for seamless interfacing with dynamic tissues. We present a Transformable, imperceptible Hydrogel-elastomer adhesive bilayer based on Ionic-electronic conductive Nanomembranes (THIN, total thickness = 350 nm). THIN combines a hydrophilic, adhesive hydrogel (Alg-CA) with a hydrophobic semiconductor (P(g2T2-Se)) in an amphiphilic heterostructure. Selenophene substitution enhances backbone planarity and interchain interactions, enabling superior ionic-electronic conduction ($\mu C^* = 1034 \text{ F cm}^{-1} \text{ V}^{-1} \text{ s}^{-1}$) and strain-insensitive performance. Upon hydration, THIN softens (hardness: 1.35 to 0.035 GPa; stiffness: 0.16 to $9.11 \times 10^{-5} \text{ GPa } \mu\text{m}^4$), ensuring dry-state handling and conformal contact. In vivo application to rat sciatic nerve and heart demonstrates stable signal acquisition and long-term biocompatibility, establishing THIN as a promising platform for soft bioelectronics.

Poster Presentation **1PS-143**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

AgBiS₂ Nanocrystal Photoanodes for Visible-Light-Driven and Sustainable Photoelectrochemical Water Splitting

윤수진, 박진영, 최종민[†]

대구경북과학기술원

The transition to sustainable energy has become essential due to the rapid depletion of fossil fuels. Among various approaches, photoelectrochemical water splitting is gaining attention as a viable method for solar hydrogen production. This study presents a new strategy for designing a visible-light-responsive photoanode based on AgBiS₂ nanocrystals, which are free of toxic heavy metals and offer a more environmentally benign alternative to conventional materials. The AgBiS₂ NC photoanode, capped with halide-thiol ligands, shows significantly enhanced photocurrent density (J_{ph}) under both 1 sun and visible light, surpassing TiO₂ and Bi₂S₃ photoanodes. This improvement is attributed to more efficient electron extraction and reduced interfacial charge transfer resistance. Notably, 91% of the J_{ph} originates from the visible to near-infrared region, underscoring the strong potential of AgBiS₂ NCs as eco-conscious and high-performing photoabsorbers for next-generation PEC water splitting.

Poster Presentation **1PS-144**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Low-Temperature Pd/Ag-Catalyzed Polymerization Strategy for Defect-Free Conjugated Polymers

유현진, 김황석¹, 김홍식¹, 박준모¹, 최태림¹, 이병훈⁺

이화여자대학교

¹ 취리히 연방 공과대학교

A low temperature direct arylation polymerization (DArP) strategy enabled by Pd/Ag dual catalysis was proposed to prepare defect-free conjugated polymers with improved charge transport characteristics. Unlike conventional DArP, which employs single catalysis, Pd/Ag dual-catalytic DArP facilitates the efficient synthesis of defect-free D-A CPs—yielding approximately 20 CPs—under mild conditions. The resulting CPs exhibit high structural regularity and crystallinity, leading to improved hole and electron mobilities of 0.20 and 0.80 cm²V⁻¹s⁻¹, respectively, in organic field-effect transistors. Moreover, complementary metal-oxide semiconductor (CMOS) inverters demonstrate hysteresis-free transfer characteristics with a gain exceeding 100, surpassing those obtained from CPs synthesized via conventional DArP and Stille polymerization. These findings provide a novel strategy for developing high-performance CPs for electronics applications.

Poster Presentation **1PS-145**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Performance Enhancement of OECTs through Back-bone Glycolization

오혜란, 장효익, 이은호[†]

서울과학기술대학교

Organic electrochemical transistors (OECTs) are important for maintaining ion trapping states within the channel layer by controlling channel/ion interactions for use as artificial synapses. To this end, research is actively underway to enhance ion interactions through the introduction of glycol groups. However, most studies have focused on side chains, with little attention paid to the glycolization of the back-bone. The back-bone has a high packing density, so glycolization can maximize the effects of ion movement and path improvement. In this study, we modulated the ion doping and dedoping mechanisms through back-bone glycolization and demonstrated that it can meet the various performance requirements needed for OECT and artificial synapse operation. This proves the high potential of back-bone glycolization and suggests a design strategy for next-generation OECT implementation.

Poster Presentation **1PS-146**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Multifunctional COE Surfactants as Interfacial Conductors in Organic Photocatalysis

오승원, 우한영[†], 이순용

고려대학교

Growing need for renewable energy highlights solar-driven photocatalytic hydrogen evolution as a promising alternative. Organic nanoparticles, with tunable absorption and energy levels, allow broader solar spectrum use than inorganics. However, inefficient charge separation, limited transport, and poor aqueous stability remain. Conventional surfactants like SDS and TEBS stabilize nanoparticles but form insulating layer that hinder charge transfer and promote recombination. Here, we introduce conductive surfactants based on conjugated oligoelectrolytes (COEs) with cationic side chains and iodide counterions. COEs stabilize nanoparticles in water, provide charge pathways, and enhance cocatalyst adhesion. Even at low loadings, they yield small, stable particles. Ionic groups interact with Pt cocatalysts, enabling reduction and in situ deposition without external reductants. As surfactants and interfacial conductors, COEs offer a promising way to enhanced photocatalytic hydrogen evolution.

Poster Presentation **1PS-147**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

High-speed Extended Shortwave Infrared Photodetection Using Silver Telluride Colloidal Quantum Dots

안용남, 백세웅[†]

고려대학교

Extended shortwave infrared (eSWIR) photodetectors are vital for applications such as LiDAR, night vision, and gas sensing. Colloidal quantum dots (CQDs) offer a promising platform due to their solution processability and tunable bandgaps. However, most eSWIR CQDs contain toxic elements like Hg or Pb, violating RoHS standards. They also often require cryogenic cooling and exhibit slow response. Here, we report a fast, room-temperature-operable eSWIR photodetectors using RoHS-compliant silver telluride (Ag_2Te) CQDs. The low effective mass of Ag_2Te enables rapid carrier transport, while a thiol-based ligand exchange reduces surface traps and enhances mobility. Efficient charge extraction is further achieved by integrating the CQDs into a vertically structured photodiode with optimized energy level alignment. The resulting device exhibits a fall time of 72 ns at 298 K, representing the fastest response among CQD-based eSWIR photodetectors, including those containing restricted elements.

Poster Presentation **1PS-148**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Backbone Control for Non-Volatile Synaptic Device

안명진, 이은호¹

국립금오공과대학교

¹ 서울과학기술대학교

Organic electrochemical transistors (OECTs) have emerged as artificial synaptic devices that can realize biological synapses through the polymer channels that can transport both ions and charges. Most studies have focused on conjugated polymers as suitable channel materials due to their ability to control ion transport. In particular, the incorporation of glycol-based side chains can improve both packing efficiency and ionic accessibility, enhancing the non-volatile properties of neuromorphic devices. However, conjugated backbone modulation, which plays a crucial role in both charge transport and ion doping, has not been systematically addressed. In this work, we present a strategy to control both ion transport and doping properties via conjugated polymer backbone modulation. This approach suggests potential for the development of non-volatile artificial synapses in OECTs.

Poster Presentation **1PS-149**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Recyclable all-soft pressure sensor enabled by environmentally benign solvents

신동형, 심교승[†]

울산과학기술원

Soft pressure sensors are in high demand due to their mechanical deformability, but their growing production inevitably contributes to increased waste. However, conventional soft pressure sensors often overlook environmental impacts, both during fabrication and disposal. Here, we present a fully recyclable all-soft capacitive pressure sensor. The device consists of porous SEBS active layer and Ni@Ag/SEBS electrode. The porous SEBS film is fabricated using green solvents 2-MeTHF and IPA. 2-MeTHF acts as a good solvent that readily dissolves SEBS, while IPA serves as a poor solvent that induces phase separation. The selective evaporation of 2-MeTHF, owing to its lower boiling point than IPA, induces phase separation and results in the porous structure. Similarly, 2-MeTHF dissolves SEBS to embed Ni@Ag flakes and form a soft electrode. Remarkably, the device can be readily recycled by immersing it in 2-MeTHF, which dissolves SEBS matrix and enables magnetic recovery of Ni@Ag flakes.

Poster Presentation **1PS-150**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Perovskite quantum dots enhance organic solar cell efficiency by simultaneously improving light absorption, exciton transport, and interfacial dipole alignment

손동환, qurrotun ayuni khoirun nisa, rahmatia fitri binti nasrun, 김주현⁺

부경대학교

Organic solar cell (OSC) employing a FAPbI₃ perovskite quantum dot (PQD)-based electron transport layer (ETL) exhibits enhanced power conversion efficiency (PCE) and stability. The PQD ETL broadens absorption from UV to NIR, complementing the PM6:Y6BO active layer. Förster Resonance Energy Transfer (FRET) from PQDs improves exciton generation and photocurrent. The dipole moment of PQDs aligns energy levels and facilitates charge transport, thereby boosting the PCE from 15.4% to 18.0% and the J_{sc} from 25.4 to 28.9 mA cm⁻². External quantum efficiency reaches 88% at 570 nm, with improved charge dissociation probability (99.0%) and reduced recombination. The PQD-based OSC retains 95% of initial PCE after one week and 85% after 16 days, outperforming the reference. These results highlight PQDs as multifunctional ETL materials that improve light absorption, charge dynamics, and stability.

Poster Presentation **1PS-151**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Control of Zeolite Cation Amount for Improved Sensitivity of Acidic Molecular Gas Sensing

손다은, 박영돈[†]

인천대학교

High-performance portable real-time gas sensors are essential for environmental monitoring and detecting hazardous gases in industry. This study presents an organic thin-film transistor (OFET) gas sensor enhanced by incorporating a porous, high-surface-area FAU zeolite into the active layer of poly(3-hexylthiophene) (P3HT). By tuning the Si/Al ratio of the zeolite, the density of framework negative charges and coordinated Na⁺ cations was controlled, leading to the formation of basic surfaces. These surfaces promoted stronger interactions with acidic polar gases such as NO₂, SO₂, and CO₂, resulting in about 4.5 times higher sensitivity and selectivity than pristine P3HT films. Additionally, the porous zeolite structure improved air stability and recovery, enabling the composite films to maintain electrical performance under humidity and light exposure. This work demonstrates that optimizing the ionic composition of zeolites is a promising approach to improving gas sensor performance.

Poster Presentation **1PS-152**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Discussion on realization of Shortwave infrared organic photodiode

소찬, 정대성⁺

포항공과대학교

Short-wave infrared (SWIR, 1.0–2.5 μm) imaging is relevant to autonomous systems, machine vision, and low-light biomedicine where deeper penetration, material contrast, and eye-safe illumination are required. Organic photodetectors (OPDs) are promising because they are solution-processed at low temperature and their bandgap can be tuned molecularly. Recent donor–acceptor designs extend optical response to SWIR region. The main challenge is not reaching SWIR absorption, but converting those photons efficiently: maintaining charge collection at low photon energies while suppressing leakage remains difficult. This poster reviews the current SWIR-capable OPD landscape and focuses on practical levers—stabilizing closed-shell ground states, removing unintentional doping, implementing and selective blocking contacts—to activate long-wavelength absorption into real EQE and to outline a path toward reproducible, scalable SWIR OPDs.

Poster Presentation **1PS-153**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Morphological Modulation and Recombination Control through Strategic Ternary Additive Integration in Layer-by-Layer Organic Photovoltaics

박창우, 함가영, 이다민, 차효정⁺

경북대학교

The integration of a third component in layer-by-layer (LbL) organic photovoltaics (OPVs) effectively modulates the morphology and optoelectronic properties of the photoactive layer. In this study, we demonstrate that the targeted incorporation of IT-Th into both the donor (PM6) and acceptor (eC9) layers markedly enhances device performance. The presence of IT-Th promotes increased crystallinity in the donor material while concurrently mitigating excessive aggregation of the acceptor. The increased open-circuit voltage and short-circuit current density are attributed to energy level alignment and improved vertical phase separation, leading to increased device performance. Transient photovoltage investigations indicate that the morphological features reduce tail states, facilitate the formation of delocalized charges carriers. These findings underscore the critical role of interfacial and structural engineering in advancing the performance of LbL process ternary OPVs.

Poster Presentation **1PS-154**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Photo-patternable Liquid Metal-based Electric Heater

박찬우, 정범진[†]

부산대학교

Patterning of Ga-based liquid metals (LM) is promising candidates for soft circuits owing to their superior conductivity and exceptional stretchability. However, LMs have difficulties in patterning process such as direct printing or laser ablation due to their high surface tension and fluidity. These limitations lead to leakage of LM traces and poor pattern resolution. To overcome the issue, we introduced photopolymerizable conductive ink with LM microparticles (LMPs). The patterns were rapidly fabricated within 10 seconds under 365 nm UV light using a photomask and could be easily activated by pressing or rubbing. The sintered LMP-rich and polymer-rich phases showed no cracking or delamination under repetitive mechanical deformation. The LMP photo-pattern exhibited high resolution and excellent electrical conductivity with stable joule heating performance. We believe our method may provide a new pathway to design deformable electric heaters for wearable electronics.

Poster Presentation **1PS-155**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Defect Modulation via Interfacial Engineering in Halide Perovskite Memristors

박상증, 김호범[†]

광주과학기술원

Halide perovskites (HPs) have become one of the most important semiconducting materials for next-generation memristors, owing to their low halide vacancy formation energy and facile ion migration. However, uncontrolled defect density in HP memristors can lead to stochastic resistive switching, or in severe cases, completely inhibit resistive switching, undermining their reliability.

In this study, we develop HP memristors by modifying the interface between perovskite layer of α -formamidinium lead triiodide (FAPbI₃) and the electrode. The interfacial engineering effectively modulates defect states, enabling the devices to exhibit low operating voltage and stable memristive behavior. Furthermore, we develop a crossbar array based on multi-level resistance state memristors, demonstrating a high on/off ratio, device yield and operational stability.

Poster Presentation **1PS-156**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Photoinduced Reconfigurable Binary-Synaptic Transistor for in-Memory and Logic Operations

박상우, 김선권, 조정호[†]

연세대학교

Reconfigurable field-effect transistors (RFETs) are a promising research area for future electronics and computing. Here, a photoinduced reconfigurable transistor (PIRT) is introduced, which changes its transport characteristics under visible light using a TiAP/indium–gallium–zinc-oxide heterojunction. Photoionization of oxygen vacancies in the TiAP layer generates carriers that enable reversible switching between binary and synaptic transistor modes. Based on this, reconfigurable logic gates operate as both digital NOT gates and synaptic comparators depending on light exposure, and a PIRT-based in-memory array performs multiply–accumulate operations, showing potential for efficient, high-density computing.

Poster Presentation **1PS-157**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Synthesis of A Highly Thermal Conductive One-dimensional SiO₂-Embedded Carbon Composites as EMC Additives

라윤호, 윤창민[†]

인하대학교

In this study, silica-loaded carbon nanofibers (SiO₂/CNFs) with a high amount of silica is synthesized using the syringeless electrospinning method for epoxy molding compound (EMC) application. Polyacrylonitrile (PAN)-based nanofibers containing 20 wt% of uniformly dispersed 500 nm SiO₂ nanoparticles are successfully synthesized, exhibiting a significantly higher loading level compared to conventional syringe-type electrospinning methods. The resulting nanofibers are carbonized to attain SiO₂/CNFs and applied as additives for EMC. With the addition of SiO₂/CNFs, the thermal conductivity of EMC is effectively enhanced due to the creation of 1D heat pathway. Also, we have investigated that the high loading amount of SiO₂ improved the thermal conductivity by matching the packing factor. This SiO₂/CNFs can be used as 2nd generation filler materials for next-generation EMC.

- 본 연구는 2025년도 정부(교육부)의 재원으로 한국연구재단의 지원을 받아 수행된 기초연구사업임(RS-2022-NR070869).

Poster Presentation **1PS-158**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Gate-Dependent Mobility Measurements in Organic Electrochemical Transistors

남유현, 강기훈[†], 박은제, 김태훈, 김연주, 김지환¹

서울대학교

¹ University of Cambridge Cavendish Laboratory

Reliable measurement of gate-dependent mobility profile is essential for understanding charge transport in organic mixed ionic–electronic conductors (OMIEC), yet current methodologies remains poorly standardised. Here, we propose two complementary methods — gate-dependent impedance matching and gate-dependent time-of-flight for extracting gate-dependent mobility profiles — and their comprehensive analysis in organic electrochemical transistors. We demonstrate that the techniques are reliable mobility extraction methods across the entire device operation range for multiple prototype OMIECs, in addition to establishing key criteria for providing standardised practical guidelines that can be adopted as a robust, material-independent experimental approach for mobility extraction of a diverse material systems available.

Poster Presentation **1PS-159**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Facet–Growth Correlation Bypass Enables Dimensional Tuning in Blue-Emissive Perovskite Quantum Dots

김희은, 김지건¹, 김영훈⁺

국민대학교

¹ DGIST

Perovskite quantum dot (PQD) synthesis often relies on anisotropic growth directed by oleylammonium (OLAM⁺) ions that selectively bind to specific crystal facets. This facet-specific interaction induces a strong correlation between surface chemistry and growth direction, limiting shape control. Lattice incorporation of OLAM⁺ further reinforces this correlation, restricting morphological freedom. We present a nucleophilic strategy that enables early halide release via SN₂ reaction at lower activation energy than oleylamine, promoting isotropic nucleation before OLAM⁺-driven anisotropy. This temporal separation between nucleation and passivation relaxes facet-dependent growth, enabling dimensional control. OLAM⁺ then acts as a passive stabilizer, maintaining colloidal integrity without directing shape. This approach provides a general route to morphology-controlled PQDs and achieves stable blue emission through shape-regulated quantum dot formation.

Poster Presentation **1PS-160**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Stretchable Reconfigurable OECTs for Wearable Adaptive Logic Bioelectronics

김희나, 김태헌, 심현석[†]

부산대학교

Reconfigurable soft electronic devices capable of altering functionalities under mechanical deformation are critical for adaptive bioelectronics. We present a scalable, ionically reconfigurable platform based on intrinsically stretchable organic electrochemical transistors (OECTs) that operate as digital logic or analog synaptic devices within a unified architecture. Reversible switching is achieved by tuning the ionic environment of the gate electrolyte. Using a dual-doping strategy with a polar solvent and nonionic surfactant, the conducting polymer films show enhanced mechanical compliance and stable electrical performance, even after repeated deformation. We demonstrate reconfiguration between logic gates (inverter, NAND, NOR) and synaptic transistors with robust long-term memory. Integrated into an adaptive bioelectronic system, our devices interpret physiological signals, highlighting their potential in autonomous health monitoring and compression-regulating wearable platforms.

Poster Presentation **1PS-161**
분자전자 부문위원회(I)
2025.9.30(화), 09:00~10:30, 포스터장
Chair: 박민주, 박정태

The Effect of Energy Level Alignment in Organic Photocathodes

김훈, 조경욱¹, 고두현¹, 조한희⁺

울산과학기술원

¹ 성균관대학교

Organic semiconductor bulk heterojunction (OS BHJ)-based photoelectrochemical (PEC) cells offer a promising route for green hydrogen (H₂) production on a global scale. While energy level alignment governs charge generation within OS BHJ layers, its impact on the performance and operational stability of OS PEC cells remains poorly understood. Herein, we systematically investigated the effect of energy levels on the overall performance of OS-based photocathodes by employing a widely used non-fullerene acceptor, Y6, and a polymerized small molecule acceptor, PYIT, which have different energy levels despite their chemical similarities. Interestingly, PYIT-based photocathodes exhibited improved stability for solar-driven water reduction in neutral pH conditions due to their favorable energy level alignment for efficient charge transfer whereas Y6-based photocathodes showed inferior stability. This finding highlights the importance of energy level alignment in designing OS-based PEC cells.

Poster Presentation **1PS-162**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Stretchable and Biocompatible Electrode Array Integrated with Bio-Interface Chip for Real-Time Hand Gesture Classification

김태권, 심현석[†]

부산대학교

Conventional human-machine interfaces (HMI) relying on physical contact-such as keyboards and touchscreens-pose significant limitations in hands-free applications and for individuals with physical impairments. To overcome these constraints, we present an integrated bio-interface system that enables real-time hand gesture recognition through electromyography (EMG) signals acquired from the user's forearm. The system integrates a stretchable, biocompatible electrode array with a custom-designed bio-interface chip to enable the classification of multi-class hand gestures with 94.4% accuracy and demonstrates its practical utility through a real-time calculator application operated entirely by sequential gesture input. This work highlights not only the advances in integrated bioelectronic systems for bioelectrical signal processing and pattern recognition, but also the potential of next-generation HMI for intuitive, accessible, and practically deployable human-machine interaction.

Poster Presentation **1PS-163**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Zwitterionic Block Engineering Enables Ionogels to Overcome the Strength–Healing Trade-Off for Sustainable Electronics

김지홍, 공진연, 김종휘, 김도환⁺

한양대학교

Sustainable flexible electronic skins require materials that integrate ionic conductivity, mechanical strength, and self-healing. Ionogels are promising candidates, but achieving both toughness and reparability remains challenging due to trade-offs between mechanical reinforcement and polymer chain mobility. Polyurethanes (PUs) offer phase-separated structures suitable for balancing these properties, yet ionic liquids often disrupt this morphology.

Here, a zwitterionic polyurethane-based ionogel is developed through side-chain engineering. Incorporating hydrophilic zwitterionic groups into the hard segments preserves phase separation and promotes dynamic electrostatic and ion–dipole interactions, enabling self-healing and efficient ion transport. The resulting ionogel demonstrates high ionic conductivity, mechanical robustness, environmental stability, and strain sensitivity, making it ideal for next-generation soft electronics.

Poster Presentation **1PS-164**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Remarkable Thermoelectric Performance in a Mixed Ionic-Electronic Conducting Film via Lewis Acid-driven Hydroxo Complexes

김지현, 조강현, 김병관[†]

충남대학교

Mixed ionic-electronic conductors have garnered significant attention due to their potential to enhance thermoelectric (TE) performance by combining outstanding thermovoltage through ion diffusion with high electrical conductivity via electron transport. Herein, ion transport pathways enabling rapid cation (H^+ and Sn^{4+}) conduction are formed through the binding of Sn^{4+} Lewis acids and PEDOT:PSS. Hydroxo complexes formed by Sn^{4+} ion not only serve as highly concentrated source of protons but also enable dynamic proton conduction via super-acidic sites. TE performance were optimized by precisely controlling the relative humidity and the aggregation behavior, achieving remarkable Seebeck coefficient of 23.6 mV K^{-1} and power factor of $18.2 \text{ mW m}^{-1}\text{K}^{-2}$ at 90% RH. Leveraging high TE performance and voltage stability, PEDOT— $[Sn(OH)_n]^{(4-n)+}$ —based ionic–electronic conductors represent a promising platform for efficient TE harvesting, even under low-grade thermal gradients.

Poster Presentation **1PS-165**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

A polyimide-based ionogel with enhanced thermal robustness and self-healing properties for strain sensors

김재윤, 이근형⁺¹, 조경국⁺

한국화학연구원

¹ 인하대학교

The growing demand for wearable healthcare devices highlights the advantages of ionogel E-skin, particularly their skin-like mechanical properties, ionic conductivities, non-volatility. However, conventional polymer ionogels have a limited temperature range due to the restricted thermal stability of the polymer matrix. In this study, we designed a novel ionogel synthesized from thermostable polyimide backbone composed of 4,4'-(hexafluoroisopropylidene)diphthalic anhydride (6FDA), 2,2'-bis(trifluoromethyl)benzidine (TFMB) and 1-ethyl-3-methylimidazolium bis(trifluoromethyl sulfonyl)imide ([EMI][TFSI]). The resulting ionogel exhibits thermal stability over a wide temperature range. In addition, the ion-dipole interactions between the trifluoromethyl groups and the imidazolium cation impart skin-like self-healing functionality. A flexible strain sensor fabricated with this ionogel demonstrates accurate and reliable sensing performance under extreme temperature conditions.

Poster Presentation **1PS-166**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Oleylamine-Driven Phase Transition for the Synthesis of High Color Purity and High Stability CsPbBr₃/Cs₄PbBr₆ Core/Shell Nanostructured Perovskite Nanocrystals

김재우, 김지건¹, 김영훈⁺

국민대학교

¹ DGIST

Lead halide perovskite nanocrystals (PNCs) have garnered significant attention as next-generation photoactive materials due to their excellent optical properties such as high color purity with narrow emission and high photoluminescence quantum yield (PLQY). However, their poor chemical and environmental stability, due to their ionic nature and low formation energy, remains a major challenge. In this study, we synthesized green-emitting core/shell PNCs by coating a Cs₄PbBr₆ shell onto a CsPbBr₃ PNC core through precursor ratio and temperature control in a Cs-Pb-Br system. A surface-triggered phase transition via oleylamine (OLA) converted the CsPbBr₃ surface into Cs₄PbBr₆, enabling epitaxial shell growth. Moreover, surface passivation with organic ligands further improved their colloidal stability, enabling good dispersibility in nonpolar solvents. As a result, these core/shell PNCs showed highly bright green emission while exhibiting significantly enhanced chemical stability.

Poster Presentation **1PS-167**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Mechanically Robust Neuromorphic Computing Enabled by Stretchable Adhesive Ion-Gels

김윤수, 심현석[†]

부산대학교

Neuromorphic computing leveraging flexible electronic devices has emerged as a pivotal technology for next-generation wearable computing and soft robotics. In this work, we present a stretchable synaptic transistor utilizing a newly engineered ion-gel dielectric, enabling stable PPF performance under 50% tensile strain. In conventional ion-gel based synaptic transistors, the PPF index decreased from 1.5 to 1.1 under 50% tensile strain. In contrast, the proposed synaptic transistor retained a PPF index of 1.38, decreasing only slightly from 1.52 under the same condition. Based on this mechanical stability, MNIST digit classification using an artificial neural network (ANN) yielded an accuracy of 91.8% under 50% tensile strain. In addition, object classification using the CIFAR-10 dataset and convolutional neural network (CNN) achieved an accuracy of 85.6% under 50% tensile strain. The proposed device paves the way for next-generation wearable AI applications.

Poster Presentation **1PS-168**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Molecular Weight Engineering of Host Materials for Overall Device Performance in Multi-resonance TADF OLEDs

김신영, 박채영, 김하연, 곽하은, 권수빈, 이예서, 박성남, 조민주, 최동훈[†]

고려대학교

In this study, we investigated the effect of host materials with different molecular weights (MWs) on OLED performance, using a fixed conjugated core unit, CzCzPh. Three hosts were synthesized: CzCzPh-mAd (low-MW), Cy-2(Ph-mCzCz) (medium-MW), and P(Ph-mCzCz) (high-MW). Despite similar energy levels, high triplet energies across all hosts, device performance varied significantly. We also synthesized a solution-processable blue multi-resonance (MR) emitter, 4FIDABNA, with narrow-band emission and high solubility. To assess host universality, a device using the sky-blue emitter 5TCzBN was also fabricated. OLEDs with low- and medium-MW hosts outperformed those with the high-MW polymer host. Notably, Cy-2(Ph-mCzCz) demonstrated stable performance even under high-temperature drying, indicating that the medium-MW host offers an optimal balance of molecular stability, film morphology, and efficiency. These findings highlight its potential as a universal host.

Poster Presentation **1PS-169**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Fine Control of Electron Trapping via Insulating Property Modulation for Enhanced Photomultiplication in Organic Photodetectors

김서진, 우한영[†], 지민훈

고려대학교

Photomultiplication-type organic photodetectors (PM-OPDs) achieve EQE >100% via efficient electron trapping. Here, we introduce a strategy to fine-tune trapping by increasing the insulating character of nonfullerene acceptors (NFAs), rather than tuning energy levels. A series of BTP-based NFAs with varied alkyl chains and asymmetry were designed to modulate the insulation/conjugation ratio. Greater insulation led to longer trap lifetimes (up to 581 ms) and higher trap densities ($\sim 1.3 \times 10^{18} \text{ cm}^{-3}$), enhancing band bending, reducing depletion width ($\sim 8 \text{ nm}$), and lowering Schottky barrier height (to 0.23 eV). As a result, A-BTP-DT showed a high EQE of 7520% and detectivity of $2.7 \times 10^{13} \text{ Jones}$ at -10 V . This work offers a new approach for enhancing PM-OPD performance by structural control of electron trapping without altering LUMO levels.

Poster Presentation **1PS-170**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Interfacial Engineering for Efficient and Stable Blue Perovskite Light-Emitting Devices via Triplet Confinement and Defect Passivation

김민석, 황은혜¹, 권태혁⁺

UNIST

¹ University of Cambridge

This study aims to enhance perovskite led (PeLED) stability and efficiency by employing a triplet confinement strategy to prevent exciton leakage from the emitting layer to the hole transport layer (HTL). To achieve this, we develop an electron blocking layer (EBL) material with a high triplet state energy by designing a highly twisted molecular structure. Additionally, we screen functional groups to achieve an energy level alignment and surface passivation. By introducing functional groups to the EBL molecule, we modulate its energy level to enhance hole transport ability through energy level alignment. Moreover, we expect that introducing these functional groups will improve the interaction between the perovskite emission layer and the interfacial layer, leading to better surface passivation. In this presentation, we demonstrate the effectiveness of this strategy and explore how functional group tuning influences photophysical properties.

Poster Presentation **1PS-171**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Ultrasonication-Induced Ambient Synthesis of Perovskite Nanowires with Block Copolymer for Photodetector Applications

김도연, 김민[†]

서울시립대학교

Metal halide perovskite nanowires have emerged as promising candidates for optoelectronic materials because of their exceptional properties, such as large absorption coefficients and high charge carrier mobility. Conventional methods for synthesizing perovskite nanowires require high temperatures and vacuum conditions. However, we successfully synthesized CsPbBr₃ perovskite nanowires under ambient conditions facilitated by ultrasonication. It is especially notable that the incorporation of polystyrene-*b*-poly(2-vinyl pyridine) (PS-*b*-P2VP) block copolymers enhanced the solubility of the precursors and effectively suppressed the formation of Cs₄PbBr₆ intermediate phase, enabling the synthesis of high-purity CsPbBr₃ phase nanowires. Moreover, device performance analysis revealed a significant increase in photocurrent under light irradiation in photodetectors. This work highlights the promising potential of perovskite nanowires for next generation optoelectronic applications.

Poster Presentation **1PS-172**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Interface Engineering and Visualization of Phenothiazine-Derived SAMs for High-Efficiency and Stable Perovskite Solar Cells

Qurrotun Ayuni Khoirun Nisa, 손동환, Rahmatia Fitri Binti Nasrun, 김주현[†]

부경대학교

Self-assembled monolayers (SAMs) offer effective interfacial engineering by enabling defect passivation and energy level alignment in perovskite solar cells (PSCs). However, scalable deposition and uniform film formation are hindered by their thin and hydrophobic nature. In this work, we present a phenothiazine-based SAM (PTZ-PA) constructed via synergistic co-adsorption with a hydrophilic phosphonic acid, functioning as a hole transport layer in p-i-n PSCs. PTZ-PA promotes the formation of perovskite films with improved morphology and crystallinity, and facilitates favorable energy level alignment for efficient hole extraction. The phosphonic acid moiety coordinates strongly with Pb^{2+} in the perovskite, improving electronic coupling and mechanical anchoring. Consequently, the devices reach a power conversion efficiency above 23.2% and exhibit long-term stability over 500 hours under continuous illumination.

Poster Presentation **1PS-173**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Molecular Interlayers for Interfacial Dipole Modulation in Tin Halide Perovskite Thin Film Transistors

Juan Anthony Prayogo, 김학준¹, 정범호¹, 이유경², 이수연², Annisa Nurul Syabila², 박희준¹, 장재원^{1,2}

Pukyong National University

¹ 한양대학교

² 부경대학교

Effective defect passivation and energy level alignment are critical for enhancing the performance of tin (Sn) halide perovskite in thin-film transistors (TFTs). Herein, a series of quinoxaline-based interlayer molecules functionalized with phosphine oxide group and designed with varying dipole moments were developed. These molecular interlayers simultaneously reduce interfacial defects and modulate the energy barrier at the perovskite/metal interface. Notably, fluorinated derivatives exhibit superior interfacial dipole effects, leading to improved passivation and favorable energy level alignment. As a result, the modified TFTs demonstrate enhanced field-effect mobility, higher on/off current ratios, and improved operational stability.

Poster Presentation **1PS-174**

분자전자 부문위원회(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Unlocking the Properties of ALD-Grown Thin NiO_x Layer for Efficient, Stable Inverted Perovskite Solar Cells

강재욱[†], Asmaa Mohamed¹

전북대학교

¹ Jeonbuk National University

Nickel oxide (NiO_x) is an effective hole transport layer (HTL) in inverted perovskite solar cells (IPSC) due to its good energy alignment, transparency, and stability. While atomic layer deposition (ALD) enables precise NiO_x growth, conventional approaches using plasma or ozone co-reactants pose safety and complexity challenges. Herein, we studied the temperature-dependent growth (150°C to 300°C) of NiO_x films using H₂O-based ALD as a safer and scalable alternative, examining film growth rate, crystallinity, morphology, and optical properties. Results show that H₂O-based ALD produces high-quality NiO_x films with excellent uniformity, pinhole-free and ultra-smooth surfaces (RMS≤1 nm), critical for minimizing charge recombination. IPSCs with the optimized NiO_x HTL achieved a champion efficiency (~17.4%), exhibiting a 53% higher efficiency than other temperatures. This plasma/ozone-free method is ideal and easiest, ensuring potential for scaling up.

Poster Presentation **1PS-175**
고분자구조 및 물성(I)
2025.9.30(화), 09:00~10:30, 포스터장
Chair: 박민주, 박정태

Annealing Driven Polymer Chain Exchange Dynamics in Polymer Nanocomposites

최은진, 공태연, 김소연[†]

서울대학교

Polymer nanocomposites (PNCs) exhibit enhanced mechanical, thermal and electrical properties for broad applications. PNCs performance strongly depends on polymer-nanoparticle interfacial characteristics. Increasing annealing temperature and time enhances polymer adsorption, influencing desorption and swelling kinetics governed by chain conformations (train, loop, tail) in the interfacial layer.

Here, we introduced preferentially adsorbing polymer chains into pre-formed PNCs to induce chain exchange dynamics. Broadband dielectric spectroscopy revealed that differences in initial interfacial adsorption induce distinct dynamics. Rheological tests and Small-angle X-ray scattering confirmed physical evolution during chain exchange. Activation energy for chain exchange was identified to elucidate mechanisms driving these dynamics. This study highlights the key role of interfacial properties in governing polymer chain exchange, enabling more systematic interfacial engineering in PNC systems.

Poster Presentation **1PS-176**

고분자구조 및 물성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Photo-Crosslinkable Polysaccharide-Based Antifogging Films for Durable Micropatterned Surfaces

진혜인, 류민, 이효민⁺

포항공과대학교

Hydrophilic antifogging coatings ensure maintaining optical transparency under humid conditions by promoting filmwise condensation of water vapor to minimize scattering. However, there remains an unmet need for chemically and mechanically durable and spatially controllable antifogging coatings. In this work, we report multilayered hydrophilic polysaccharide-based thin films composed of methacrylated chitosan (CHI-MA) and methacrylated carboxymethyl cellulose (CMC-MA), fabricated via Layer-by-Layer (LbL) assembly. These LbL films exhibit UV-induced photo-crosslinkability, enhancing both the chemical and mechanical stability of the films. Furthermore, spatially selective UV exposure enables high-resolution micropatterning, facilitating the realization of humidity-responsive displays. These durable, photo-patternable antifogging films offer significant potential in applications ranging from smart coatings, sensors, to advanced optical displays.

Poster Presentation **1PS-177**

고분자구조 및 물성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Enhancing the Mechanical Properties of Biodegradable PLA/PCL Blends Using Bottlebrush Copolymers as a Compatibilizer

주진혁, 방준하[†], 최기홍, 이상엽¹

고려대학교

¹ 전남대학교

With the global push for sustainability, efforts have accelerated in developing polymer composites using biodegradable PLA. Despite its eco-friendliness, PLA's brittleness limits industrial applications, prompting research into enhancing its mechanical strength. This study investigates the use of Bottlebrush copolymers as compatibilizers to improve the performance of PLA/PCL blends. Owing to their dense side chains and tunable structures, Bottlebrush copolymers were synthesized to promote better interfacial dispersion and reduce phase separation between PLA and PCL. We systematically varied the degree of polymerization, side-chain length, and molecular architecture to examine their influence on mechanical properties. Improvements in miscibility and ductility were evaluated using universal testing machines, IZOD impact tests, and transmission electron microscopy, demonstrating the potential of Bottlebrush structures in overcoming the brittleness of PLA-based composites.

Poster Presentation **1PS-178**

고분자구조 및 물성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Predictive Design for Chiral Self-Assembly of Cellulose Nanocrystals

조은수, 백지혜, 임준형, 최대섭, 김장민, 김영기[†]

포항공과대학교

Cellulose nanocrystals (CNCs) are bio-derived materials that exhibit chiral self-assembly and consequent Bragg reflection at wavelengths set by the helical pitch P ; however, a quantitative framework linking P to controllable design remains elusive. Here, an Oseen–Frank model incorporating Straley’s chiral torque reduces pitch control to a single metric—the elasticity-to-torque ratio K_2/K_T . Guided by this metric, we program P across the entire visible spectrum using three design strategies: (i) length fractionation, (ii) ionic-strength (HCl/NaCl) screening, and (iii) chiral-dopant addition. The model quantitatively predicts reflection wavelengths of CNC films under systematic variations in polydispersity, ionic strength, and dopant concentration. The resulting design map enables scalable, eco-friendly, wavelength-selective reflectors such as security photonics, cosmetics, and optical coatings. Supported by the NRF (RS-2023 00212739, RS-2024-00411809, RS-2023-00302586).

Poster Presentation **1PS-179**

고분자구조 및 물성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Rheological and Mechanical Behavior of Catalyst-Free PET Vitrimers and Silica-Based Nanocomposites for Upcycling

정지석, 현규[†]

부산대학교

Polyethylene terephthalate (PET) is a widely used thermoplastic, but its low recycling rate and property degradation limit long-term use. To address this, we enhanced the processability, viscoelasticity, and mechanical properties of degraded PET by introducing dynamic network bonding. Using an eco-friendly, catalyst-free method, PET was upcycled into a vitrimer via torque rheometer with a tertiary amine and diepoxy. Rheological tests analyzed viscoelastic and thermal properties depending on crosslinking content. To further improve performance, we examined the effects of hydrophilic (silica 90) and hydrophobic (silica R202) fillers. While fillers enhance material properties, they may restrict chain mobility and hinder bond exchange. We evaluated the rheological, mechanical, thermal, and self-healing properties of vitrimer composites to understand filler influence. The results provide insights for designing high-performance PET vitrimers and advancing sustainable recycling strategies.

Poster Presentation **1PS-180**

고분자구조 및 물성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Intrinsically Low-Dielectric Polyimides Enabled by Mesogenic and Bulky Segment Engineering for High-Frequency Communication

장세은, 남기호[†], 김지영

경북대학교

The advancement of ultra-high-speed communication technologies demands the development of insulating materials with low dielectric properties (low- D_k , low- D_f) for miniaturization and high-density integration of electronic devices. Aromatic polyimides (PIs), known for their excellent thermal and mechanical stability, and intrinsic insulating properties, are promising for aerospace and microelectronic applications. However, the polar imide rings in PIs lead to high dielectric properties. Herein, novel PI systems were designed by incorporating rigid ester-based mesogenic units and bulky moieties into the polymer backbone. Ester-containing mesogenic structures enhance torsional rigidity and promote molecular orientation. In addition, the introduction of bulky structures increases the interchain free volume. These strategies result in the development of PI-based materials exhibiting low dielectric properties, making them attractive for high-frequency microelectronic applications.

Poster Presentation **1PS-181**

고분자구조 및 물성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Swimming Locomotion of Polymer Monolith in Fluids under Continuous Light Irradiation

이재경, 함민정, 조용비, 위정재[†]

한양대학교

Liquid crystalline networks (LCNs) with various topological defects have attracted significant attention due to their ability to undergo systematic and programmable locomotion based on designed molecular alignments. However, most of the previous demonstrations of locomotion under continuous light irradiation exhibited only unimodal behavior. In addition, locomotion in fluid environments was limited to simple movements, serving primarily as a demonstration rather than functional actuation. In this study, we introduce spiral aligned LCNs capable of continuous locomotion under continuous light irradiation. An automated rotational rubbing system was employed to efficiently fabricate spiral alignment. The LCN films were subsequently patterned into circular and double-arc geometries to enable continuous rotation and flip-wave locomotion under continuous light irradiation. We systematically investigated the locomotion behavior by varying key parameters that influence actuation performance. Furthermore, the photo-responsive LCN swimmers demonstrated effective motion in fluid environments, highlighting their potential for soft robotic applications in fluid or terrestrial environments.

Poster Presentation **1PS-182**

고분자구조 및 물성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Molecular Dynamics Simulation of Phase Separation in Aromatic Polymers for Bipolar Membranes

이윤구, 김용주^{*1}

서강대학교

¹ 고려대학교

Bipolar membranes (BPMs) demand both chemical stability and efficient ion transport under harsh electrochemical conditions. To overcome the limitations of conventional aliphatic polymer-based membranes—such as PFAS-related environmental concerns, ether bond hydrolysis, and poor mechanical strength—we introduce aromatic rings into hydrocarbon polymer backbones. This enhances both mechanical rigidity and chemical durability while maintaining environmental compatibility. Using all-atom molecular dynamics (MD) simulations, we systematically investigate how the incorporation of aromatic structures and hydrophobic monomer segments influences nanoscale morphology. The simulations reveal that increasing the hydrophobicity contrast between monomers induces spontaneous phase separation, forming continuous water channels embedded in robust hydrophobic frameworks. This study establishes a simulation-driven design framework for BPM materials, paving the way for durable, high-performance membranes tailored for next-generation electrochemical systems.

Poster Presentation **1PS-183**

고분자구조 및 물성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Rheological and Thermal Analysis of PDMS-PC Block Copolymers for Improved FDM 3D Printing Performance

신지윤, 김민찬, 정소담¹, 현규⁺

부산대학교

¹ 동의대학교

Polycarbonate (PC) is extensively employed in fused deposition modeling (FDM) due to its excellent mechanical properties; however, poor interlayer adhesion and significant mechanical anisotropy remain persistent challenges. This study investigates PDMS-PC block copolymers, in which polydimethylsiloxane (PDMS)—a polymer possessing a low glass transition temperature—is incorporated into PC to enhance printing performance. Samples with varying PDMS contents (6%, 9%, and 20%) were evaluated alongside neat PC. Rheological properties were characterized through small amplitude oscillatory shear (SAOS), steady shear, high-strain time sweep, and elongational viscosity (EVF) tests to explore structural behavior under conditions relevant to FDM processing. Morphological features of the materials were preliminarily examined to establish structure-property correlations. Additionally, thermal properties were characterized using differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA) to determine suitable printing parameters.

Poster Presentation **1PS-184**

고분자구조 및 물성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Drug-Polymer Dispersions through Freeze Drying for Dissolution Improvement

서경용, 홍서현, 김다혜, 김일원[†]

송실대학교

무정형 고체 분산체는 난용성 약물의 용해도 및 생체이용률을 향상시키는 효과적인 제형화 전략으로, 결정성 약물을 무정형으로 전환하여 높은 에너지 상태에서의 빠른 용출을 유도할 수 있다. 본 연구에서는 지용성이며 용해도가 낮은 fenofibrate를 모델 약물로 선정하고 동결건조를 활용한 무정형 고체 분산체를 제조하였다. Poly(vinylpyrrolidone), poly(vinylpyrrolidone-co-vinyl acetate), poly(ethylene glycol)을 고분자 매트릭스로 사용하여 무정형 유도의 효과를 시험하였으며, XRD, DSC, IR, SEM을 통해 구조적 변화를 확인하였다. 고분자 첨가로 무정형 분산체가 형성되었을 때 초기 용출 속도가 향상되었으며, 이러한 결과를 고분자가 약물의 결정화 속도에 미치는 영향과 상관지어 설명하였다.

Poster Presentation **1PS-185**

고분자구조 및 물성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Study on Polyurethane-Based Composites for Enhanced Functionality

조성훈[†], 백건희

영남대학교

In this presentation, we report a series of functional polyurethane-based materials developed in our laboratory. Conductive resin solutions were prepared using ABS-like and soft polyurethanes as 3D printing media, yielding composites with enhanced electrical and mechanical properties and excellent printability. In addition, a fabrication technique for nanoporous polyurethane foams was developed using eco-friendly blowing agents to enhance their utility as thermoplastic elastomers. These polyurethane-based materials are expected to contribute to the advancement of high-performance materials applicable to various fields, including lightweight components, thermal interface materials (TIMs), electromagnetic interference (EMI) shielding, thermal insulation, and sound absorption.

Poster Presentation **1PS-186**

고분자구조 및 물성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Structural Characterization of Linear Poly(glycerol) as a Poly(ethylene glycol) Substitute for Bioapplications

배정아, 김재엽, 김우규, 최수형[†]

홍익대학교

The accelerated blood clearance (ABC) effect associated with PEG-containing mRNA vaccines has highlighted the need for alternative hydrophilic polymers. Poly(glycerol) (PG) has emerged as a promising candidate due to its excellent biocompatibility and lack of ABC induction. To assess the potential of PG as a PEG alternative, we synthesized linear PG via ring-opening anionic polymerization and investigated the chain conformation and aqueous solubility of PG and PEG using small-angle neutron scattering (SANS). SANS analysis revealed that PG exhibited a smaller radius of gyration (R_g) than PEG, indicating a more compact polymer conformation. Both polymers showed positive second virial coefficients (A_2), confirming good solubility in water. Notably, PG exhibited a larger A_2 value, suggesting superior aqueous solubility compared to PEG. These findings offer valuable structural insights supporting the potential use of PG as a hydrophilic alternative to PEG in biomedical applications.

Poster Presentation **1PS-187**

고분자구조 및 물성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

고분자 네트워크에서의 힘 전달 경로 규명: 스피로피란 힘 센싱 분자를 통한 backbone과 crosslinker의 비교

김지원, 조준용, 장한결, 구종민¹, 이도창², 김재우⁺

한국과학기술연구원

¹ 성균관대학교

² KAIST

고분자 네트워크 내에서 기계적 힘이 전달되는 경로를 이해하는 것은 고분자의 기계적 강인성 향상과 기능성 구현에 핵심적입니다. 본 연구에서는 분자 수준의 힘 센서로 스피로피란을 활용해, 외부에서 가해진 기계적 힘이 고분자 네트워크를 통해 어떻게 전달되는지를 최초로 실험적으로 규명하였습니다. 구조는 동일하되 스피로피란의 위치만 다른 두 고분자(backbone vs. crosslinker)를 원자 이동 라디칼 중합으로 각각 합성하고 일축 인장과 동시에 형광을 측정했습니다. 이를 통해 초기에는 주쇄와 가교제 사이에 균일한 힘 분포가 관찰되지만, 신율 증가에 따라 사슬 정렬과 함께 strain hardening이 시작되며 점차적으로 주쇄에 힘이 집중되는 현상을 관찰했습니다. 본 결과는 거시적인 기계적 거동과 분자 수준의 힘 전달 경로 사이의 근본적인 연관성을 밝히며, 차세대 적응형·응답형 고분자 설계를 위한 원리를 제시합니다.

Poster Presentation **1PS-188**

고분자구조 및 물성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Synthesis of Tough Glycol Gel via Copolymerization of Glassy and Entangled Network Phases

곽지혁, 최재원, 정수민, 김연수[†]

포항공과대학교

Hydrogels are essential in biomedical and wearable technologies, but conventional water-based systems suffer from limited thermal stability, high vapor pressure, and brittleness. This study aims to develop tough glycol-based gels using 1,3-butanediol—a biocompatible solvent with low freezing point and high boiling point. Initial tests with 6 M acrylamide gels yielded brittle materials, as the polymer chains interact more strongly with each other than with the glycol solvent, resulting in high glass transition temperature ($\sim 120^{\circ}\text{C}$) and limited flexibility. To address this, dimethylacrylamide was introduced as a comonomer. The monomer ratio was optimized at constant total concentration, followed by variations in overall monomer and crosslinker content. Mechanical and thermal properties were evaluated using tensile testing and differential scanning calorimetry (DSC), offering insights into the design of durable glycol gels for advanced biomedical and structural application.

Poster Presentation **1PS-189**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Thermally Surface-Modified MXene/PDMS Composites with Low Filler Loading for Enhanced EMI Shielding

황인혁, 유성일, 전윤석[†]

국립부경대학교

$\text{Ti}_3\text{C}_2\text{T}_x$ MXene has gained increasing attention for EMI shielding applications due to its high electrical conductivity and layered structure. However, its oxidation sensitivity significantly limits standalone use, necessitating incorporation into polymer matrices for improved thermal stability and processability. In addition, the strong hydrophilicity of MXene causes poor compatibility with hydrophobic polymers such as PDMS, thereby hindering effective composite formation. To overcome these issues, an aligned MXene foam was prepared via freeze casting and thermally treated to enhance surface hydrophobicity, enabling efficient PDMS infiltration and composite fabrication. The resulting MXene/PDMS composite exhibited excellent EMI shielding effectiveness exceeding 45 dB at a low filler loading (~3 wt%), attributed to the synergistic effects of filler alignment and interfacial bonding. This approach provides a simple and scalable strategy for developing polymer composites utilizing MXene.

Poster Presentation **1PS-190**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Ionic liquid-assisted impregnation process with electrical field application for the fabrication of CNT films-based composites

허수민, 성동기[†], 김태겸

부산대학교

Carbon nanotube (CNT) films serve as macroscopic structures that retain excellent properties of individual CNTs, offering high potential for application as multifunctional composites. Although impregnating polymer into CNT films is essential for the fabrication of high-performance lightweight structural materials, the densely networked structure of CNT films hinders resin impregnation, posing a major challenge in composite fabrication. To overcome the limitation, an ionic liquid and an electrical system were introduced to enlarge internal space of the CNT film during a process and enhance its impregnation ability. In this process, the ionic liquid simultaneously served as electrolyte, curing agent of epoxy resin, and swelling agent, which enables uniform impregnation into CNT films under optimized electrical field condition. The effects of ionic liquid and electrical system on CNT film were investigated by characterizing mechanical properties and morphology of the resulting composites.

Poster Presentation **1PS-191**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Absorption-Dominant EMI Shielding Materials Based on Aluminum Foil-Supported Thermotropic Liquid Crystalline Polyester/Carbonyl Iron Powder Composites

최형호, 정영규⁺

충남대학교 유기응용재료공학과

This study shows a hybrid electromagnetic interference (EMI) shielding material composed of aluminum (Al) foil and a thermotropic liquid crystalline polyester/carbonyl iron powder (TLCP/CIP) composite. Pure Al foil shows ~80% reflection, 20% absorption, and total shielding effectiveness (SE_T) of ~40 dB in the X-band. Adding a 960 μm -thick TLCP/CIP layer lowers reflection to 25%, increases absorption to 75%, and SE_T to ~50 dB. These enhancements arise from dielectric-magnetic synergy and destructive interference at the air-TLCP/CIP and TLCP/CIP-Al foil interfaces. The TLCP/CIP layer causes multiple internal reflections, enabling coherent cancellation and energy conversion to heat. This asymmetric design reduces secondary electromagnetic pollution and achieves absorption-dominant shielding, increasing SE_T by ~25% over pure Al foil. Experimental results align with theory, showing thickness engineering converts metal shields into high-performance X-band EMI absorbers.

Poster Presentation **1PS-192**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Rheo-Mechanics and Applications of Nanomaterial and Polymer Dispersions

최경민, 이현상[†]

동아대학교

The colloidal and thermodynamic stability, and rheological properties of carbon based nanomaterials such as carbon nanotubes (1D) and graphene oxide (2D) play critical roles in fiber spinning, printing, and electrode coating processes. Due to their large size and anisotropy, colloidal stability was evaluated using a modified DLVO model that considers excluded volume effects. At equilibrium, thermodynamic stability was investigated based on morphological changes and variations in orientation factor observed in the 3D confocal microscopy images of the dispersion. Phase transition was explained using number density, and the self-consistent orientational distribution from the Onsager model. Under flow, microstructural evolution was investigated by measuring shear viscosity and applying theoretical models. Extensional rheology was evaluated using the Hyper-Spin-Line (HSL) model to analyze the influence of CNT waviness during the process of liquid crystalline wet-spun fibers.

Poster Presentation **1PS-193**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Modulation of Carbon Nanotube-Solvent Interfaces via Hydrogen Peroxide-Mediated Plasma Treatments

천수민, 허유정, 이기라, 강병우, 오승수[†]

포항공과대학교

For solvation of Carbon nanotubes (CNTs) in various solvents, CNT surface modification is important with modulation of CNT-liquid interfaces. Here, we present a simple and rapid surface modification process with no structural damage and defect formation, mediated by microwave treatments with combinatorial solvents. When CNTs are mixed with solvent mixtures, short microwave irradiation leads to hotspot-mediated production of various radicals. Along with hydrogen peroxides to catalyze radical formation, immediate radical chemisorption is followed. In this manner, uniform CNT dispersions with no CNT aggregation can be fabricated due to the strong charge attraction between electron donating groups and electron withdrawing groups in CNTs and solvents.

Poster Presentation **1PS-194**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Enhanced Mechanical Strength and Low-k Performance of Electrospun Polyimide Webs for Flexible Printed Circuit Board Materials

채승훈, 정영규[†]

충남대학교 유기응용재료공학과

Electrospun polyimide (PI) nonwovens, characterized by high porosity, are promising materials for flexible printed circuit boards (FPCBs) due to their low dielectric constants. However, their limited mechanical strength hinders broader practical applications. In this study, PI nanofiber webs were fabricated via electrospinning and subjected to thermal compression using a hot press to control internal porosity. Poly(amic acid) precursors, synthesized from 4,4'-oxydiphthalic anhydride and 4,4'-oxydianiline, were electrospun, imidized, and compressed under various conditions. The structural, mechanical, and dielectric properties were evaluated using SEM, porosity measurement, tensile testing, and LCR analysis. Thermal compression effectively reduced excess porosity, resulting in enhanced tensile strength while retaining low dielectric constants due to the presence of residual air voids. This method offers low-k PI substrates with improved mechanical strength for FPCBs.

Poster Presentation **1PS-195**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Robust and Multifunctional CFRPs Fabricated with Sulfur-Rich Terpolymers via Powder Processing

주준태, 이우화, 김동균⁺, 서지훈^{†1}

한국화학연구원

¹ 고려대학교

Carbon fiber-reinforced plastics (CFRPs) are lightweight and robust composites that are increasingly being used as an alternative to metal. However, conventional thermoset-based CFRPs are difficult to recycle due to their irreversibly crosslinked matrix, which hinders carbon fiber recovery and leads to waste accumulation. To address this issue, we developed a matrix using a sulfur-rich polymer (SRP) synthesized via inverse vulcanization, a strategy known for its dynamic covalent bonds. In this study, we synthesized a sulfur-rich terpolymer with two crosslinkers and fabricated CFRP composites using a powder-processing method. The resulting SRP CFRPs demonstrated not only excellent mechanical properties but also exhibited multifunctionality, including shape memory, self-healing and recyclability. This study offers a promising pathway for sustainable and functional CFRP applications.

Poster Presentation **1PS-196**
고분자가공/복합재료/재활용(I)
2025.9.30(화), 09:00~10:30, 포스터장
Chair: 박민주, 박정태

폐 PET의 해중합 반응 최적화 및 EDTA, MCDI 기술을 활용한 촉매 비활성화·정제 공정 개발

조원석[†]

시온텍

본 연구에서는 폐 PET 병을 아세트산 아연을 촉매로 사용하는 트랜스 에스테르화 반응을 통해 화학적으로 해중합하였습니다. ^1H NMR 분석을 통해 oligomer integration을 비교하여 최적의 PET:EG 몰비를 도출한 결과, 1:12 조건에서 가장 고효율로 BHET를 수득할 수 있었습니다.

반응 직후 EDTA를 투입하여 잔류 촉매와 Zn-EDTA complex를 형성함으로써, 이후 EG 회수 공정에서의 재중합을 효과적으로 억제하였습니다. 생성된 Zn-EDTA complex를 제거하기 위해 전기막 용량 탈이온화(MCDI) 장치를 적용하였으며, 이를 통해 90% 이상의 제거 효율을 달성하였습니다. 그 결과, MCDI 처리를 거친 rBHET을 재중합 하였을 때는 무색 투명한 칩이 형성된 반면, 처리를 거치지 않은 경우에는 적갈색을 띠는 칩이 생성되었습니다. 이와 같이 촉매 비활성화와 전기화학적 정제 공정을 결합한 본 기술은 폐 PET의 품질 및 재활용 가능성을 효과적으로 향상시킬 수 있음을 확인하였습니다.

Poster Presentation **1PS-197**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Replication-Barrier multilayer PUFs Enabled by Block Copolymer Self-Assembly and rGO Interlayers

조규희, 진형민¹

충남대학교

¹ 충남대학교

The rapid growth of the Internet of Things (IoT) has increased demand for secure device authentication, driving interest toward hardware cryptography using physical unclonable functions (PUFs) rather than software keys vulnerable to hacking. Block copolymer (BCP) self-assembly is ideal for PUF fabrication, as its thermally driven microphase separation generates unique nanopatterns. Here, we present a multilayer PUF wherein two Pt lamellae are electrically connected and cloning prevented by a rGO "replication-barrier" interlayer. A metal pattern fabricated from a BCP template was coated with rGO, and capped with a second Pt lamella to form a final structure. Electrical measurements verified interlayer conduction with distinct PUF-specific resistances. The rGO layer blocked imprinting and etching-based replication attacks, including resistance shifts for protection. This PUF significantly enhances anti-cloning security, highlighting potential for next-generation nano-security.

Poster Presentation **1PS-198**
고분자가공/복합재료/재활용(I)
2025.9.30(화), 09:00~10:30, 포스터장
Chair: 박민주, 박정태

Influence of Particle Morphology on the Rheology of Composite Polymer Suspensions

정유진, 이현상[†]

동아대학교

High-solids suspensions such as lithium-ion battery slurries, are polymer-based systems composed of active materials, conductive additives, and binders. Their rheological properties critically influence electrode manufacturing and battery performance. In non-Brownian suspensions, Discontinuous Shear Thickening (DST) occurs when the volume fraction exceeds a critical jamming threshold (ϕ_j), typically explained by mechanisms such as friction, lubrication, and stress release. However, existing models assume ideal spherical particles, limiting their applicability to real systems with irregular or anisotropic particles. To address this, we introduce the concept of fractal dimension to account for the structural complexity of non-spherical particles. This provides an extended theoretical framework for understanding rheological transitions and jamming behavior in high-solid-content polymer suspensions.

Poster Presentation **1PS-199**
고분자가공/복합재료/재활용(I)
2025.9.30(화), 09:00~10:30, 포스터장
Chair: 박민주, 박정태

Ultra-Conformable and Bioresorbable Nanomesh-Based Supercapacitor for Biomedical Application

장문종, 최혁주, 석예준, 이예준, 이성원[†]

대구경북과학기술원

Implantable devices are essential components in modern biomedical applications, such as continuous monitoring to infection treatment. However, conventional batteries suffer from limitations in size, rigidity, and inflammation. To address these challenges, bioresorbable supercapacitors have emerged as a promising alternative for transient energy storage in next-generation implantable devices.

This study presents fabrication of a polycaprolactone nanomesh-based bioresorbable supercapacitor using a molybdenum exhibiting excellent bioresorbability as the electrode and polyvinyl alcohol/chitosan as the electrolyte. The supercapacitor performance was evaluated through electrochemical methods, and its bioresorbability was demonstrated by gradual decomposition under physiological conditions.

Furthermore, the successful integration of this supercapacitor into an implantable device is anticipated to open new avenues for innovative applications in the healthcare and biomedical fields.

Poster Presentation **1PS-200**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Mechanically Strong Epoxy-Based Covalent Adaptable Networks with Dual Dynamic Bonds for Shape-Programmable Electronic Substrates

이재혁, 노지훈¹, 윤여명, 최경환, 강보석¹, 김채빈⁺

부산대학교

¹ 성균관대학교

Strong epoxy resin is a key material for PCB substrates due to its excellent strength, thermal stability, and electrical insulation. However, unlike thermoplastics, epoxy (or a thermoset) cannot be recycled because it lacks melt-processability. To overcome this, a new epoxy-based covalent adaptable network (CAN), crosslinked by dual-dynamic networks, has been developed. By adjusting monomer ratios, both dynamic and permanent crosslinking densities can be tailored, yielding heat-reprocessable CANs with high mechanical strength and thermal stability comparable to conventional bisphenol A epoxy. Additionally, the CAN can be depolymerized via base-catalyzed chemical recycling in heated water. Through its dual transition temperatures (T_g and T_v), CAN can be readily programmed to exhibit shape memory via T_g or shape fixation through dynamic bond exchange at T_v . This CAN matrix shows great potential as a recyclable composite matrix and a shape-reconfigurable PCB substrate for electronics.

Poster Presentation **1PS-201**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Improved electromagnetic wave absorption at the high-frequency 5G band in $\text{Ga}_x\text{Fe}_{2-x}\text{O}_3@\text{Ti}_3\text{C}_2\text{T}_x$ MXene-TPU composites

양현성, 김선준[†]

한국과학기술연구원

With the advancement in future mobility, the utilization of 5G communication technology is ever increasing. Here, it is important to ensure reliable communication without electromagnetic interference (EMI), where malfunction can lead to serious consequences. Thus, there is a need to develop EM wave absorbers in the 5G band for safe operation. In this study, we developed a 5G band EM wave absorber based on a polymer composite embedded with magnetic material/MXene hybrids. Specifically, Ga-doped epsilon iron oxide nanoparticles were functionalized on the surface of $\text{Ti}_3\text{C}_2\text{T}_x$ MXene, subsequently mixed with thermoplastic polyurethane (TPU). Synergetic effects caused by magnetic and dielectric loss in the composite improve EM wave absorption at 77 GHz, while the flexibility and lightweight of polymeric composites offer additional benefits. This approach provides a promising strategy for developing EM wave absorber tailored for next-generation radar in autonomous vehicles.

Poster Presentation **1PS-202**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Polarity-Switchable Maleic Anhydride Copolymer Coatings for Eco-Friendly and Durable Anti-Icing Applications

안세희, 김채빈¹, 이지민², 우상혁²

부산대학교

¹ 부산대

² 중앙대

Global environmental concerns have driven efforts to reduce the use of toxic and volatile organic solvents in polymer coatings. While water is an eco-friendly alternative, it mainly works with hydrophilic polymers, which often lack durability in humid environments. To address this, a polarity-switchable copolymer containing maleic anhydride (MA) was developed. Base-induced ring opening of MA introduces hydrophilicity for waterborne coating formulation, followed by thermal ring closure that restores hydrophobicity for long-term stability. When applied to rough surfaces, the coating adopts a Cassie-Baxter wetting state, enhancing superhydrophobicity and reducing ice adhesion. Incorporating graphene oxide improves hardness, thermal stability, and photothermal properties, enabling faster ice removal under sunlight. This multifunctional and sustainable polymer coating offers a promising solution for passive anti-icing applications on large-scale outdoor surfaces.

Poster Presentation **1PS-203**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Fabrication Strategy to Improve Thermal Stability of Polyimide-Based CFRP through Nanoconfinement Effects using CNT Networks

신주은, 김송희, 김다영, 성동기[†]

부산대학교

Carbon fiber reinforced plastics (CFRPs) are utilized in aerospace applications owing to their excellent mechanical properties and lightweight. However, their use in high-temperature environments is limited due to low thermal stability of conventional polymer matrix. In this study, Polyimide (PI) resin, one of representative polymers with outstanding thermal resistance, was introduced as a matrix to address this limitation. In addition, a carbon nanotube (CNT) network was incorporated as a functional nanostructure that improves thermal resistance. Polymer chains infiltrate the CNT network, and their mobility is restricted by its porous structure, which results in a nanoconfinement effect. The optimal CNT content that maximizes the nanoconfinement effect was identified based on structural observations and thermal analysis. The corresponding thermal properties were evaluated to confirm enhanced heat resistance.

Poster Presentation **1PS-204**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Melt-Processability and Thermal Behaviors of Phenylethynyl-Terminated Oligoimides Containing a Sterically Hindered Multicyclic Moiety

배정민, 남기호[†]

경북대학교

Polyimides are high-performance polymers widely employed in aerospace and electronics due to their excellent thermal and mechanical properties. Phenylethynyl end-capped polyimides (PETIs) were developed to improve processability by controlling molecular weight, yet their rigid backbones and strong interchain interactions still limit melt-processability. To address this, structural modifications using bulky moieties have been investigated. In this study, phenylethynyl end-capped oligoimides were synthesized by varying the molar ratios of cage-structured adamantane-1,3-diamine and 3,4'-oxydianiline. The incorporation of adamantane units disrupted chain packing, increased free volume, and enhanced melt flow behavior. The thermal and rheological properties of the resulting oligoimides were systematically compared, demonstrating that backbone engineering using sterically hindered diamines offers a promising route to improve processability of high-performance thermosetting polyimides.

Poster Presentation **1PS-205**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Electrochemical Properties of Heteroatom-Doped PolyHIPE-Based Hierarchical Porous Carbons for Supercapacitor Electrodes

류인재, 김경엽, 전형준, 이성재[†]

수원대학교

In supercapacitor electrodes, carbon-based materials with hierarchical porous structures have high specific capacitance. In this study, hierarchical porous carbons (HPCs) were fabricated through the following process. First, a W/O type polyHIPE was fabricated by polymerizing a high internal phase emulsion of a divinylbenzene phase and a TiO₂-dispersed aqueous phase. Then, the polyHIPE was sulfonated to maintain the pore structure during the high-temperature process. Finally, the foam was carbonized after urea treatment and KOH activation to enhance the electrical conductivity through heteroatom doping and form micropores and mesopores. HPCs have excellent power density and energy density due to the rapid movement of electrolyte ions and high specific surface area. After fabricating a supercapacitor electrode using a slurry composed of HPC, a conductive agent, and a binder, various electrochemical performances such as CV, GCD, and EIS were evaluated through three-electrode tests.

Poster Presentation **1PS-206**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Improvement of Bonding Strength Between Polyphenylene Sulfide/Glass Fiber Composites and Epoxy via Atmospheric-Pressure Plasma Jet

도환기, 조범곤[†]

국립금오공과대학교

Polyphenylene sulfide (PPS) composite reinforced with glass fiber (GF) offers excellent dimensional stability, chemical resistance, and mechanical strength, making it suitable for electric vehicle capacitor housings. The fabrication of capacitor housings requires epoxy molding, where the bonding strength between the capacitor housing and the epoxy is a crucial factor influencing the final product's performance. In this study, we enhanced the bonding strength between PPS/GF composites and epoxy by introducing functional groups and increasing surface roughness through atmospheric-pressure plasma. The introduction of functional groups was confirmed through XPS and FT-IR. The improvement of wettability was confirmed by calculating the surface energy through contact angle measurement. The changes in surface roughness were observed using AFM and SEM. The bonding strength of the plasma-treated sample increased significantly, reaching up to 24.8% compared to the untreated sample.

Poster Presentation **1PS-207**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Application of the Wet Capillary Thinning Method to Blood Viscosity Measurement and Study on Its Generalizability

김현수, 이현상[†]

동아대학교

The Wet Capillary Thinning method is a microfluidics-based technique capable of measuring rheological properties. Conventional methods for measuring blood viscosity include the rotational method, CaBER and the scanning capillary tube method. However, these methods require large sample volumes and most technique can cause evaporation and sample degeneration of sample. To overcome these limitations, the WCT method is applied to blood viscosity measurement. By using microchannels, the WCT method significantly reduces the required sample volume. Moreover, because the experiment is conducted in the liquid phase, it prevents evaporation and degeneration of sample. Blood and a miscible fluid are co-injected to suppress diffusion and form a blood filament. In this study, the repeatability and reproducibility of the WCT method in measuring blood viscosity are evaluated. Furthermore, experiments are conducted with various non-blood fluids to demonstrate the generalizability of the method.

Poster Presentation **1PS-208**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

A Study of Hydrogel Film Decontaminants for Physical Decontamination and Diffusion Barriers Performance

김진우, 장차현, 김대홍, 방진아¹, 변상문¹, 이상면¹, 정희수¹, 이규철⁺

동의대학교

¹ 국방과학연구소 제3기술연구원 5부

Chemical Warfare agents (CWAs), Which pollute complex environments such as large cities or indoor facilities, can cause casualties and secondary exposure. To defend against this, decontamination agents for CWAs are utilized and basically liquid-type are preferred. However, in the case of the liquid type, it is difficult to follow up treatment after use and shows limitations in blocking the diffusion of CWAs.

In this study, a film-type decontamination agent was produced for this investigation in order to get over these restrictions, and CWAs diffusion barriers performance and physical decontamination rate were carried out.

Poster Presentation **1PS-209**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Improvement of Mechanical Performance of Electron Beam-Cured SBR Nanocomposites by Introduction of Aramid Nanofibers and Glycidyl Methacrylate

김인희, 정영규[†]

충남대학교 유기응용재료공학과

This study aims to enhance the mechanical performance of styrene-butadiene rubber (SBR) nanocomposites by improving interfacial adhesion between aramid nanofibers (ANFs) and the rubber matrix using glycidyl methacrylate (GMA). GMA is a bifunctional monomer with epoxy and methacrylate groups; the epoxy reacts with amine groups on ANFs, while the methacrylate participates in crosslinking with SBR chains, promoting better filler dispersion and interfacial bonding. Composites containing varying ANF contents (0.5, 1, 2, 3 phr) were crosslinked via electron beam (EB) irradiation. FT-IR analysis confirmed chemical interactions among SBR, ANFs, and GMA. Tensile testing showed enhanced mechanical properties in GMA-containing composites, and SEM analysis of fracture surfaces revealed improved adhesion between fiber and rubber. These findings demonstrate that this interfacial control strategy effectively improves the performance of rubber nanocomposites.

Poster Presentation **1PS-210**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

반응성 희석제에 의한 trade-off 효과: 다층 GFRP에서 수지 유동성과 휘발성 사이의 상호작용 규명

김민규, 김재후¹, 조준용¹, 장한결¹, 김관훈², 한태희³, 김재우^{1*}

한국과학기술연구원/한양대학교

¹ 한국과학기술연구원

² 연세대학교

³ 한양대학교

반응성 희석제의 첨가는 유리섬유 강화 복합재(GFRP)의 가공성과 기계적 성능을 향상시키는 데 매우 중요한 역할을 한다. 본 연구에서는 진공 수지 주입 공정(VARTM)을 활용하여 제조된 GFRP의 구조적·기계적 특성에 대해 반응성 희석제인 스타이렌의 함량 변화(0, 20, 40, 60 wt%)가 미치는 영향을 체계적으로 분석하였다. 그 결과, 20 wt% 첨가 시 수지 점도가 낮아지며 섬유 함침성이 향상되어 충격강도와 층간 전단강도가 가장 높았고, 기공률은 가장 낮게 나타났다. 하지만 40~60 wt% 수준에서는 스타이렌의 휘발성 증가로 인해 기공이 많이 발생하였고, 이로 인해 기계적 특성이 저하되었다. 미세구조 분석(FE-SEM, micro-CT, burn-off, 아르키메데스 밀도 측정)을 통해 기공률과 성능 저하 간의 상관관계를 명확히 확인할 수 있었다. 본 연구는 반응성 희석제의 최적 함량 설정이 고성능 GFRP 개발에 있어 핵심임을 시사한다.

Poster Presentation **1PS-211**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Enhancement of Thermal Insulation and Flame Retardancy in GFRP via Layer-by-Layer Assembly of HGM/PEI Multilayers

김다영, 조다희, 허수민, 윤정욱, 성동기[†]

부산대학교

Glass fiber reinforced polymer (GFRP) is recognized for its potential as a lightweight structural materials with thermal insulation owing to its low thermal conductivity. Previous researches to improve the thermal insulation and flame retardancy of GFRP involve incorporating hollow glass microspheres (HGM) into the polymer. However, this method results in fiber filtration effect and increased resin viscosity, impeding resin impregnation during vacuum-assisted resin transfer molding and limiting the fabrication of high-quality composites. In this study, a layer-by-layer assembly method was proposed to overcome these limitations by pre-coating the glass fiber (GF) with HGM. To induce the electrostatic deposition, polyethyleneimine was used to impart a positive charge to the GF, facilitating the uniform and controllable coating of negatively charged, surface-modified HGM. The uniform deposition of HGM contributes to enhanced thermal insulation and flame retardancy of the resulting GFRP.

Poster Presentation **1PS-212**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

UV-Triggered Phase Transition of Azobenzene Polymers Enables Light-Driven Electrode Fabrication

강유진, 이창연⁺

중앙대학교

Azobenzene-containing polymers exhibit light-responsive properties through reversible trans-cis isomerization. Here, we present a UV-triggered phase-transitionable azobenzene polymer that undergoes photoliquefaction, enabling a solvent-free and light-driven electrode fabrication process. Upon UV irradiation, the polymer melts and acts as a temporary medium for slurry-free electrode casting. Once the light is removed, it re-solidifies, functioning as a binder. This reversible solid-liquid behavior allows uniform coating on the current collector without organic solvents or thermal curing. Electrodes fabricated via this method demonstrate stable adhesion and electrochemical performance comparable to those prepared by conventional slurry casting. Our approach highlights a novel use of azobenzene polymers as functional materials that integrate photochemical responsiveness and binder capability, offering a sustainable route for next-generation lithium-ion battery electrode processing.

Poster Presentation **1PS-213**

고분자가공/복합재료/재활용(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Crosslinked CNT/Conjugated Polymer Composite Films for Enhanced Mechanical and Electromagnetic Interference Shielding Performance

강유림, 김봉기[†]

건국대학교

Carbon nanotubes (CNTs) are widely utilized in electromagnetic interference (EMI) shielding materials due to their excellent electrical conductivity and lightweight nature. In this study, we propose a composite film for EMI shielding by wrapping CNTs with a conjugated polymer and introducing an azide-functionalized crosslinker (4Bx). The crosslinker was thermally activated to form a covalently crosslinked network, which enhanced the mechanical properties of the film, including tensile strength and modulus. To further improve the electrical conductivity and EMI shielding effectiveness (EMI SE), molecular dopants such as F4TCNQ and AuCl₃ were applied. Notably, the film maintained stable conductivity even after crosslinking, indicating that mechanical reinforcement was achieved without compromising electrical performance. This strategy enables the development of lightweight, mechanically robust, and high-performance composite films for practical EMI shielding applications.

Poster Presentation **1PS-214**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Structurally Crosslinked Polyurethane Network with Tri-Disulfide junctions to Achieve Mechanical Robustness, Transparency, and Self-Healing for Optical Coatings

홍성호, 유자형[†]

울산과학기술원

Optical coatings are vulnerable to external damage, and conventional self-healing polymers often lack mechanical strength due to their linear architecture.

Here, we report a self-healing polyurethane incorporating a tri-functional disulfide crosslinker (Tri-HEDS) with three $-S-S-$ units. This crosslinker forms a 3D network that enhances both mechanical properties and healing performance. Disulfide groups also interfere with chain packing, maintaining amorphousness and high transparency.

The material showed a tenfold increase in Young's modulus over linear PU and over 90% scratch healing within 2 h at 60 °C. It also achieved 100% transmittance in the visible range.

These results demonstrate that disulfide-based multi-functional crosslinkers can simultaneously realize mechanical robustness, transparency, and autonomous healing in optical polymer systems.

Poster Presentation **1PS-215**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Dual-functional silica particle platform with immobilized enzyme and conjugated polymer for detecting biomarkers

홍규원, 이동훈, 이택승[†]

충남대학교

Diagnosing diseases by detecting biomarkers in body fluids provides advantages compared to conventional disease diagnostic systems in terms of time and cost. Fluorescence-based biomarker detection using enzymatic reactions offers selectivity and rapid response. However, this method involves complex procedures and has low reproducibility due to many components such as enzymes and fluorophores. In this study, we developed a silica particle platform (SPP) that incorporates both enzymes and conjugated polymers (CP) to simplify the analysis. The SPP surface was modified with amine and aldehyde functional groups. The enzyme was immobilized via Schiff base chemistry. The CP was processed into nanoparticles and introduced through electrostatic interactions. Upon the enzymatic reaction of the biomarker, the reduced form of nicotinamide adenine dinucleotide (NADH) was generated, increasing blue fluorescence and decreasing the red fluorescence of the CP.

Poster Presentation **1PS-216**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Stretchable Heat Transfer Eco-Materials: Mesogen Grafted NR-Based Nanocomposites with High Thermal Conductivity

형재석, 정광운[†]

전북대학교

To develop stretchable heat transfer materials, thermally conductive natural rubber (TCNR) was newly designed and synthesized by utilizing inherent elastic properties of natural rubber (NR) and introducing thermally conductive monomer (TCM) to NR. Owing to phonon transfer assistance of TCM, TCNR film exhibited around 120% higher thermal conductivity (0.38 W/m·K) compared to the NR film (0.17 W/m·K). When the same hexagonal boron nitride (h-BN) content was incorporated, TCNR composites showed higher enhancement in thermal conductivity, and the TCNR composite film fabricated with h-BN of 15 wt% showed the thermal conductivity of 0.87 W/m·K. Due to the inherent elastic properties of NR, the TCNR composite film fabricated with h-BN of 15 wt% exhibited 140% stretchability. It was demonstrated that the TCNR composites can be utilized as a thermal management material for wearable devices. This work was supported by the BK 21 FOUR Program and Mid-Career Researcher Program (RS-2021-NR059321).

Poster Presentation **1PS-217**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Fabrication of MOFs-based hierarchical porous carbon nanofibers using laser carbonization

허인범, 진형민[†]

충남대학교

Recently, research on designing nanostructures of metal-organic framework (MOF)-based carbon materials has attracted much attention due to their versatility in various energy and environmental applications. In particular, their large specific surface area and pore structure have attracted interest as high-performance supercapacitors. However, conventional thermal processing using furnaces has suffered from long process times that cause aggregation of metal atoms. In this study, we report a novel laser process to generate metal-organic framework-based carbon nanofibers. The laser process can have a higher surface area and porosity than conventional thermal carbonization due to its fast processing time within a few seconds, and can distribute metal nanoparticles more uniformly. The fibers thus prepared have excellent performance as supercapacitors and are expected to show promise in electrochemical applications.

Poster Presentation **1PS-218**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Surface Modification of ePTFE Reinforcement via Ar/O₂ Plasma Treatment for Proton Exchange Membrane Fuel Cell

허웅, 한동헌¹, 오승주¹, 윤재욱¹, 우인선¹, 최승은¹, 윤준모¹, 배진우[†]

한국기술교육대학교

¹ 한국기술교육대학교 다기능성유기고분자 연구실

Proton exchange membrane fuel cells (PEMFCs) with reinforced composite membranes (RCMs) exhibit enhanced dimensional stability under humidity variations compared to conventional membranes. However, poor interfacial compatibility between hydrophobic expanded polytetrafluoroethylene (ePTFE) and hydrophilic ionomer limits performance. This study applies Ar/O₂ plasma treatment to modify ePTFE surface properties from hydrophobic to hydrophilic, enabling complete ionomer impregnation. Plasma-treated ePTFE-based RCMs demonstrated improved proton conductivity, reduced hydrogen crossover, and superior single-cell performance compared to untreated systems. These findings confirm plasma surface modification as an effective approach for optimizing RCM fabrication and enhancing overall PEMFC efficiency.

Poster Presentation **1PS-219**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

A facile strategy for synthesizing alginate capsules with controllable size, shell thickness, and functionality

한승희, 최원산[†]

한밭대학교

Alginate, a natural polymer extracted from brown seaweed, exhibits excellent biocompatibility, biodegradability, and porous structure, which have attracted considerable attention. These properties render it a promising material for diverse applications across environmental, pharmaceutical, and food-related sectors. However, conventional encapsulation methods often involve harsh conditions and complex equipment, limiting control over capsule size and shell thickness. This study introduces a novel fabrication strategy enabling the precise incorporation of organic and inorganic nanomaterials into alginate capsules. The method enhances structural stability, allows multi-capsule integration, and supports controlled release, protection, and reactive functionalities. The developed platform demonstrates high versatility and scalability, providing a flexible foundation for a broad range of applications that demand advanced capsule engineering and sophisticated functional composite design.

Poster Presentation **1PS-220**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Stretchable and Transparent PVC-gel Dielectric Heaters with High Dissipation Factor for Wearable Thermotherapy and Thermal Sensing

최승은, 오승주, 한동현, 윤재욱¹, 우인선, 허웅², 윤준모, 배진우⁺

한국기술교육대학교

¹ 한국

² 한국기술교육대

Multifunctional wearable heaters are essential for smart healthcare and soft electronics, requiring high transparency, stretchability, and low-voltage operation. This study introduces a dual-plasticizer strategy using dibutyl adipate (DBA) as the primary plasticizer and propylene carbonate (PC) with ethylene carbonate (EC) as high-dielectric secondary plasticizers in polyvinyl chloride (PVC). The resulting PVC-gel achieves a high dielectric loss ($>3 \times 10^3$) and dissipation factor (~ 295), enabling efficient dielectric heating. The heater shows excellent stretchability (300%) and optical transparency ($>90\%$), reaching 60°C at 350 V with a fast heating rate ($0.76^\circ\text{C s}^{-1}$) and high power efficiency (1.015 W cm^{-2}). It offers uniform, stable heating for 20,000 s, even under strain, supporting therapeutic use and thermal sensing. A gesture-recognition system is also demonstrated, highlighting its potential for next-generation wearable electronics.

Poster Presentation **1PS-221**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Self-assembled High Tin-containing Block Copolymer Patterns for Enhancing Ultra-thin EUV Photoresists

최수빈, 정연식[†]

카이스트

In EUV lithography for advanced semiconductor patterning, resist sensitivity and etch resistance are key performance metrics. Tin-based metal oxide resists (MORs) have emerged as promising candidates, but the ultra-thin films required for hyper-NA processes cause pattern loss and etching issues. In this study, poly(trimethyltin acrylate)-b-poly(methyl methacrylate) was synthesized via RAFT polymerization and post-polymerization modification to evaluate the application potential of self-assembled patterns. Gradient and triblock copolymers were also designed to achieve vertical alignment without neutral brushes. The polymers were characterized by NMR and GPC, and tin content was analyzed using ICP-OES and TGA. Vertical alignment was achieved by annealing with a neutral brush, followed by RIE etching, and pattern ordering was confirmed by SEM.

Poster Presentation **1PS-222**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Design and Functional Evaluation of UCST-type Ionic Liquids as Thermoresponsive Draw Solutes for Forward Osmosis

최광호, 조연수¹, 강효^{†1}

동아대

¹ 동아대학교

Eight ionic liquids were synthesized by combining dodecyltrimethylammonium or octyltrimethylammonium cations with four fluorinated anions. Among them, $[N_{11112}][OTf]$, $[N_{11112}][BF_4]$, and $[N_{1118}][BF_4]$ exhibited UCST behavior in water at 20 wt%, with transition temperatures of 35, 45, and 39 °C, and conductivities of 9.22, 19.01, and 32.13 mS/cm. In forward osmosis using deionized water, water fluxes were 18.75, 27.87, and 34.59 LMH in the AL-FS mode and 20.34, 36.09, and 37.53 LMH in the AL-DS mode. With brackish water fluxes were 12.39, 22.80, and 31.56 LMH in the AL-Fs mode and 15.39, 29.94, and 33.15 LMH in the AL-DS mode. Recycling of $[N_{1118}][BF_4]$ showed flux decline from 37.53 to 12.18 LMH over four thermal cycles. Antibacterial testing showed over 99% inhibition against E. coli and S. aureus. These results demonstrate the potential of UCST-type ionic liquids as thermoresponsive and antibacterial draw solutes for forward osmosis.

Poster Presentation **1PS-223**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Autonomous self-healing 3D micro-suction adhesives for multi-layered amphibious soft skin electronics

천현서, 임도현¹, 정민우², 오진영², 방창현^{†3}

성균관대학교

¹ 성균관대학교 화학공학과, ² 성균관대학교 화학공학과

² 경희대학교 화학공학과

³ 성균관대학교 화학공학과

Soft electronics with high adhesion strength, self-healability and stretchability had highly demanded for intimate adhesion interfaces on wet/dry biosurfaces and device protection. However, previous self-healable adhesives may have problems such as chemical contamination, skin damage, and manifesting self-healing ability in harsh environments. Here, we report the self-healable bioinspired adhesive patch with stretchable, reusable interface for biosignal monitoring even in harsh environment. The patch has efficient self-healing and mechanical property, respectively and it performed faster healing rate than that of human's skin. Our patch also shows good normal adhesion in both dry and underwater conditions (max. 7.82 N/m² in dry conditions, and max. 4.44 N/m² in underwater conditions). Based on the robust adhesion property, we have successfully obtained reliable measurements of biosignals during body movement.

Poster Presentation **1PS-224**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Tunable Mechanical Properties in Dynamic Liquid Crystal Elastomers

천세나, 최준명¹, 김현^{1,2}

성균관대학교, 한국화학연구원

¹ 성균관대학교

² 한국화학연구원

Liquid crystal elastomers (LCEs) are stimuli-responsive materials that combine the elasticity of rubber with the anisotropic properties of liquid crystals, enabling reversible and programmable shape changes in response to external stimuli. These features have attracted increasing interest for applications in soft robotics, actuators, and adaptive devices. However, conventional LCEs suffer from limited reprocessability after curing. To overcome this limitation, we introduce dynamic covalent bonds into LCE networks to enable reprogrammability with tunable mechanical properties by a systematic formulation. This study demonstrates dynamic LCEs can be used in next-generation smart systems.

Poster Presentation **1PS-225**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Fabrication of Long-Lasting Superhydrophilic Anti-Fogging Film Via Rapid and Simple UV Process

정재환, 최청룡[†]

금오공과대학교

Surface fogging is a common issue that reduces visibility, light transmission, and image clarity. While hydrophilic and hydrophobic coatings are used to mitigate fog, conventional ones often lack durability and require frequent reapplication. To address this, a robust anti-fog film has been developed that remains effective for over five weeks in humid conditions while maintaining high transparency (>60%). This is achieved by synthesizing a random copolymer containing superhydrophilic and photo-reactive segments, which can be UV-cured and covalently bonded to various substrates. The strong chemical anchoring enhances durability, resistance to physical stress, and environmental stability. The film is compatible with surfaces such as automotive glass, polymer films, and aluminum foil. This simple and fast process enables long-lasting anti-fog performance, offering broad applicability in fields like automotive, optics, and construction.

Poster Presentation **1PS-226**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

A Fast-Responding Thermally Activated Shape Memory Polymer Composites with Embedded 3D Interconnected Hexagonal Boron Nitride

정세윤, 남기호[†]

경북대학교

Thermally responsive shape-memory polymers (SMPs) are attractive for aerospace deployable structures in harsh environments. Fully aromatic polybenzimidazoles (PBIs) provide excellent thermal stability but lack shape-memory behavior due to rigid backbones. Here, flexible aliphatic segments were introduced into PBIs to enable reversible transitions via hydrogen-bonded crosslinks. To improve thermal responsiveness, boron nitride (BN) was added as a conductive filler, and its noncovalent functionalization suppressed agglomeration, ensuring uniform dispersion and forming efficient thermal pathways. π - π stacking and hydrogen bonding with imidazole groups enhanced polymer-filler interactions, facilitating heat transfer and faster actuation. The resulting nanocomposites showed high shape fixity, rapid recovery, and retained strong thermal and mechanical stability, demonstrating an effective strategy for high-performance SMPs in next-generation aerospace applications.

Poster Presentation **1PS-227**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Rewritable Triple-mode Light-emitting Encryption Display

전찬영, 이석영¹, 박종웅¹, 김지원¹, 김수한¹, 신정원¹, 하제봉¹, 권민지¹, 박철민¹

연세대학교 신소재공학과

¹ 연세대학교

Despite major progress in optical encryption using light-emitting materials, rewritable displays with mode-selective emissions remain rare. We present a rewritable triple-mode light-emitting encryption display utilizing stimuli-responsive fluorescence (FL), room-temperature phosphorescence (RTP), and electroluminescence (EL). The display includes coplanar electrodes with a gap, an FL phosphor-polymer composite (EL/FL layer), and a solvent-responsive RTP additive-polymer composite (RTP layer). Upon 254 nm UV exposure, dual FL and RTP emissions are triggered. Applying a polar solvent (excluding water) and an AC field activates EL, enabling triple-mode emission. Water deactivates RTP, switching the display to dual-mode (FL and EL). Emission modes are rewritable by solvent evaporation. The display enables secure full-color encryption, with information revealed only when the emission modes are correctly aligned, meeting the need for multi-mode light-emitting security displays.

Poster Presentation **1PS-228**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Surface-Modified Silicon-based Anodes via Ionic Interaction with Adhesive Bottlebrush Polymer Binder

장순호, 허윤, 조성재, 방준하[†]

고려대학교

Silicon is a promising anode material for next-generation lithium-ion batteries due to its high capacity (~4200 mAh/g), but its volume change during cycling causes mechanical failure and unstable SEI formation. To address this, we developed a binder based on ionic interactions between amine-modified silicon and bottlebrush poly(acrylic acid) (BBP-PAA). BBP-PAA was synthesized via grafting-through polymerization using ATRP and ROMP of poly(*tert*-butyl acrylate) macromonomers, followed by deprotection. This architecture improves processability and exposes dense carboxylic acid groups. Amine groups were introduced on silicon via silanization with (3-aminopropyl)trimethoxysilane, confirmed by FT-IR and TGA. Electrochemical tests showed that modified silicon electrodes had enhanced capacity retention and stability. These results suggest that ionic interactions between NH_3^+ and COO^- enhance adhesion and enable self-healing behavior of the binder.

Poster Presentation **1PS-229**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

High-Performance, Transparent, Stretchable Triboelectric Nanogenerator and Triboresistive Position Sensor: Tailoring PVC Gel Properties via Plasticizer Modulation

이태민, 우인선, 오승주, 윤재욱, 배진우[†]

한국기술교육대학교

The rapid growth of IoT and human-machine interfaces demands flexible, self-powered inputs. Rigid touch sensors that rely on stiff electrodes and external power limit usability. Triboelectric nanogenerators (TENGs) generate electricity from mechanical stimuli but must still deliver high output while remaining stretchable. Polyvinyl chloride (PVC) gels, whose electrical and mechanical properties are tunable through plasticizer type and content, meet this requirement. We compared three plasticizers—butyl benzoate (BB), dibutyl phthalate (DBP), and tributyl trimellitate (TBT)—in PVC TENGs and triboresistive position sensors (TPSs). Fewer aliphatic carbonyl groups enhanced deformability, dielectric constant, and triboelectric negativity. BB-plasticized PVC produced the highest power density, and TPSs fabricated from it preserved precise sensing at 50 % strain. These findings underscore the promise of PVC-gel devices for transparent, stretchable wearable electronics.

Poster Presentation **1PS-230**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Photo-Crosslinkable Hyaluronic Acid/Anthocyanin Hydrogels for real-time Wound Healing Monitoring

이초록, 윤영일¹, 박원호⁺

충남대학교

¹ 한국폴리텍대학

의학이 발달됨에 따라 상처 치유 과정을 지연시키는 세균 감염을 치료하기 위한 다양한 치료요법이 사용되고 있다. 하지만 과도한 치료제의 사용은 내성균의 발생을 야기함으로 이를 대체하기 위한 치료 방안이 요구된다. 본 연구에서는 세포 외 조직의 주요성분으로 우수한 생체적합성을 가지는 히알루론산에 메타크릴산 무수물을 도입한 메타크릴레이트 히알루론산을 제조하여 상처 드레싱용 광가교형 하이드로겔을 제조하였다. 광가교 시스템을 통해 빠른 겔화가 가능하였으며, 형태 안전성과 기계적 특성을 개선할 수 있었다. 또한 pH 반응성 천연 활성 성분인 안토시아닌을 도입하여 안토시아닌 함량에 따른 유변학적 특성을 분석하였으며, 안토시아닌이 첨가됨에 따라 항산화성, 항균성, pH 반응성이 증가함을 확인하였다. 최종적으로, 쥐에 대한 상처 치유 실험을 통해 형성된 하이드로겔이 상처 회복을 촉진시키고 상처 치유 과정 중 상처 미세 환경에서의 pH 변화에 따른 비색 변화를 모니터링 할 수 있음을 확인하였다.

Poster Presentation **1PS-231**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

All printed Programmable Electrically Driven Actuator-based Artificial muscle with proprioception

이윤선, 스티브 박[†]

한국과학기술원

We present an all-printed, programmable, electrically driven artificial muscle actuator with proprioception capability for soft robotics. The actuator is based on a CNT-SIS-GLCE composite, where Joule heating from applied voltage induces contraction of the LCE matrix. The CNT network ensures both electrical conductivity and mechanical resilience, enabling repeated actuation. Importantly, the actuator's resistance changes with deformation and temperature due to bolometric, dimensional, and percolation effects, allowing integrated self-sensing. This work demonstrates a scalable and flexible artificial muscle platform with built-in feedback, offering potential for wearable devices, human-machine interfaces, and biomedical robotics.

Poster Presentation **1PS-232**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Scutellarein Attenuates Inflammatory Cytokine-Induced Atrophy in hiPSC-Derived Skeletal Muscle Cells by Preserving Myotube Structure and Myogenic Identity

이시은, 박리주, 진윤희[†]

연세대학교 의과대학

Cancer cachexia is a severe metabolic syndrome involving systemic inflammation and irreversible muscle wasting. We developed a human in vitro model using skeletal muscle cells derived from human induced pluripotent stem cells (hiPSCs) and tested scutellarein, a natural JAK2/STAT3 inhibitor, for therapeutic potential. hiPSCs were differentiated into mature myotubes over 46 days, providing a human-specific platform for disease modeling. Inflammatory atrophy was induced by TNF- α and IFN- γ , with scutellarein pre-treatment. Treated groups showed preserved myotube diameter, increased matured expression, and improved sarcomeric integrity in a dose-dependent manner. These findings suggest scutellarein protects against inflammatory muscle atrophy and supports its potential as a cachexia therapy. The use of hiPSC-derived muscle cells offers a translationally relevant model for drug evaluation in human muscle disorders.

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (NRF-2021R1C1C2009131).

Poster Presentation **1PS-233**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Autonomous closure with shape memory vascular wall plug by dual hemostatic action

이상민, 조성우, 하현수, 이강석¹, 주현철, 성학준[†]

연세대학교

¹ 티엠디랩

Hemostasis of arterial punctures created by catheters in cardiovascular interventions have been performed conventional methods such as manual compression, surgical sutures or vascular closure devices (VCDs). While these methods support the reducing time to hemostasis, they still depend heavily on operator skill and lead to complications such as bleeding or pseudoaneurysm. Here, we propose a vascular wall plug (VWP) utilizing the shape memory effect to achieve rapid puncture closure independent of operator skill. VWP consists of three components: Body, Ring, and Wing. Body and Ring facilitate tight plugging like bolt-and-nut, while Wing regulates blood flow to promote primary hemostasis. Additionally, we evaluated the functional role of VWP's each component and demonstrated their synergistic hemostasis performance and vascular remodeling levels to conventional sutures, while minimizing operator skill dependency.

Poster Presentation **1PS-234**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Surface-engineered PP Separators for Optimized Electrochemical Stability and Performance

이민정, 권영제¹, 정호진¹, KAIYUN ZHANG¹, 박장우¹, 조계용^{1*}

부경대학교 공업화학과

¹ 부경대학교

Lithium-ion batteries (LIBs) are widely used in portable electronics or electric vehicles due to their high energy density and long cycle life. Polyolefin-based separators, particularly polypropylene (PP), are commonly utilized because of their low cost and moderate mechanical properties. However, their inherent limitations—such as poor thermal dimensional stability, insufficient electrolyte wettability, and limited mechanical robustness—remain significant challenges for advanced battery applications. In this study, we propose a surface-engineering approach based on tailored coating layers to improve the mechanical robustness and thermal resistance of PP-based separators while enhancing electrochemical performances. By systematically optimizing the coating thickness while selecting functionalized polymers, this study aims to establish a design framework for achieving well-balanced separator performance without compromising negative effects due to overcoating.

Poster Presentation **1PS-235**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Reverse piloti-structured evaporator with integrated light and salt rejection for solar desalination

이동건, 최원산[†]

한밭대학교

Engineered evaporator architectures with multifunctional layers are vital for advancing high-efficiency solar water purification. Here, we present a novel reverse piloti-inspired evaporator integrating optimized optical, thermal, and mass transport functionalities within a vertically stacked architecture. The system comprises a glass fiber scattering layer for multidirectional light harvesting, a broadband photothermal carbon soot (CS) coating, and a biodegradable PVA–konjac glucomannan KGM hydrogel. This hydrogel manages salt diffusion and prevents crystallization by gradually dissolving during operation, enabling long-term functionality even in high-salinity (20 wt%) brine. The device achieves a high evaporation rate of $1.95 \text{ kg m}^{-2} \text{ h}^{-1}$ and 96.4% solar-to-vapor efficiency under one sun. This work demonstrates the integration of emerging materials into scalable architectures for sustainable energy conversion and water purification in extreme environments.

Poster Presentation **1PS-236**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

MXene/Zwitterionic Hydrogels with High Filler Content Enabled by Temporary Hofmeister Ion Treatment

이다현, 최재원, 정태훈, 김연수⁺

포항공과대학교

Conductive hydrogels have garnered increasing attention in bioelectronics due to their unique combination of electrical conductivity and mechanical compliance. MXene, a 2D nanomaterial, stands out for its high conductivity, excellent aqueous dispersibility, and abundant surface functional groups. However, incorporating high loadings of MXene into hydrogels remains challenging, as it can significantly inhibit polymerization, hindering the formation of polymer networks at an early stage. Here, we present a Hofmeister ion-assisted strategy to fabricate MXene-loaded physical hydrogels with uniform dispersion and high filler content. This approach enables the formation of a homogeneous polymer matrix that accommodates elevated MXene concentrations. The resulting MXene/Poly(SBVI) zwitterionic hydrogels exhibit high electrical conductivity and viscoelastic mechanical properties resembling those of biological tissues, offering strong potential for implantable bioelectronic applications.

Poster Presentation **1PS-237**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

GelMA-Based Electronic Plant Arrows for Natural and Long-Term Physiological Monitoring of Plant Organs

이건호, 이준민[†]

포항공과대학교

Precise long-term monitoring of plant physiology is essential in smart agriculture for optimizing plant health and predicting yields. However, conventional rigid sensors can disturb plant structure and function, limiting their use to short-term or species-specific applications. To address this, we present an electronic plant arrow (EPA)—a substrate-free, injectable electrode made from photo-crosslinked gelatin methacryloyl (GelMA). GelMA provides biocompatibility, tunable stiffness, and low impedance. The EPA is stiff when dry for insertion but softens upon absorbing moisture, reducing tissue damage and improving contact stability. Its arrowhead shape ensures firm attachment, while the substrate-free design minimizes interference with growth. This system allows continuous, organ-specific physiological monitoring, supporting precision agriculture and real-time crop management.

Poster Presentation **1PS-238**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Fabrication of nanoporous polymer membrane with tunable 10-nm pore sizes for long-cycling lithium metal batteries

오태석, 최락현, 변혜령, 서명은⁺

한국과학기술원

Lithium (Li)-metal batteries (LMBs) are considered a great candidate to enhance energy density by utilizing metallic Li electrodes. On the other hand, the irregular Li^+ transport and subsequent dendrite formation must be resolved. The regulating Li^+ flux by pore size control was only observed in the <5 nm or >20 nm region, thus limiting the exploration of critical Li^+ transport phenomena and their impact on improving cell performance. Here, we propose a 3D continuous, functional mesoporous polymer membrane with controllable pore size, synthesized by polymerization-induced microphase separation. Introducing a negatively charged sulfonate group to the pore surface, the Li^+ conductivity can be increased, and side reactions on the surface of the lithium electrode through negative ions can be suppressed. This separator enhances Li^+ mobility compared to the counteranion, reducing interfacial resistance and promoting uniform Li deposition, resulting in long cyclability.

Poster Presentation **1PS-239**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Functional Siloxane-Coated Porous Membranes with Wettability Engineering for Selective Liquid Separation and Chemical Durability

오연수, 장봉준, 조진한¹, 유영민[†], 오명석[†]

한국화학연구원

¹ 고려대학교

Porous membrane-based liquid separation requires chemical resistance and selective permeability, making it essential in semiconductor, pharmaceutical, and fine chemical industries. However, conventional polymer membranes lack precise control over surface wettability, limiting separation performance. This study presents a strategy to regulate wettability by coating a nano-scaled organic siloxane polymer thin film. Poly(2,4,6,8-tetravinyl-2,4,6,8-tetramethylcyclotetrasiloxane) (pV4D4), was successfully deposited to nano-scaled thin film via initiated chemical vapor deposition (iCVD). The coating enabled separation of mixtures with small surface tension differences by modulating surface energy and enhanced the chemical resistance of polyethersulfone membranes, maintaining stability after 24-hour solvent exposure. This approach offers a cost-effective and selective methodology to ceramic membranes for liquid separation and addresses instability in conventional polymer membrane permeability.

Poster Presentation **1PS-240**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Textile-Based Stretchable Electroluminescent Display for Visual–Auditory Interaction

오승주, 최승은, 우인선, 허웅, 윤준모, 배진우⁺

한국기술교육대학교

We present a stretchable electroluminescent (EL) sound display that simultaneously delivers multicolor light emission and sound generation, designed for next-generation interactive textile platforms. To overcome the conventional trade-offs between mechanical stretchability and optical performance, we employ transparent ionogel-based electrodes and a high-permittivity composite layer comprising Ecoflex, Triton X, and inorganic phosphors. This material combination enables the device to maintain high brightness and clear acoustic output under various mechanical deformations. Moreover, we demonstrate a pixelated textile display capable of visualizing letters and patterns in diverse colors while emitting sound in sync. This multifunctional system represents a new direction in wearable human–machine interfaces by seamlessly integrating light, sound, and flexibility into a single textile-based platform.

Poster Presentation **1PS-241**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

MXene-based Hydrogel with Superior Oxidation Stability for Wearable Electronics

어진, 김하늘, 신채린, 하지석, 박영호, Jeevan Kumar Reddy Modigunta, G. Murali, 이승준, 인인식[†]

국립한국교통대학교

MXene-based hydrogels combine high electrical conductivity with exceptional mechanical flexibility, making them ideal for wearable strain sensor applications. However, their performance and long-term durability are hindered by the inevitable oxidation of MXene in water-rich hydrogel environments. To address this issue, catechol-functionalized poly(vinyl alcohol) (PVA-CA) is used as the polymer matrix instead of the conventional PVA. The catechol groups in PVA-CA form strong hydrogen bonds with MXene surface, effectively reducing oxidation-prone sites and significantly enhancing the oxidation resistance of the hydrogel. The resulting PVA-CA-MXene hydrogel demonstrates excellent self-healing properties alongside robust strain sensing capabilities, enabling accurate detection of subtle motions and handwriting. Additionally, signals from the hydrogel strain sensor are analyzed using deep learning models for precise activity classification. **This was supported by Korea National University of Transportation in 2025.

Poster Presentation **1PS-242**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Enhancing thermal and dielectric performance of PI-PDMS composites using silane-grafted AlN and KNN fillers

정현민[†], 양시윤, 박진홍, 김지훈, 박건교, 민선경¹, 김주현², 김민수²

국립금오공과대학교

¹ 국립금오공과대학교

² 중앙대학교

Enhancing both thermal conductivity and dielectric properties of polymer composites is important for advanced electronic applications. In this study, a polyimide (PI)-polydimethylsiloxane (PDMS) matrix was reinforced with aluminum nitride (AlN) and potassium sodium niobate (KNN) fillers. Surface-treated AlN improved thermal conductivity up to 3.34 W/m·K, while KNN increased the dielectric constant to 300, though with slight thermal degradation. By optimizing the filler ratio, the PI-PDMS/(90AlN-GPTMS/10KNN) composite achieved 2.7 W/m·K in thermal conductivity and 30.1 in dielectric constant at 10 kHz. These results show that surface modification and filler composition control enable simultaneous improvement of thermal and dielectric performance. This work offers a practical strategy for developing PI-based composites with balanced properties suitable for electronic and thermal management applications.

Poster Presentation **1PS-243**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Sustainable Polymer Coatings with Antibacterial and Antifouling Properties Derived from Capsaicin-Based Compounds

배인희, 조연수, 강효⁺

동아대학교

This study presents a fluorine-free hydrophobic polymer coating incorporating capsaicin-inspired moieties covalently bonded to the polymer backbone to prevent leaching. Poly(4-chloromethylstyrene) (PCMS) was synthesized by free radical polymerization and modified via nucleophilic substitution with N-vanillylnonanamide (CAP) to form PCAP# (# = 20, 40, 60, 80, and 100 mol%). Polymer films were fabricated on glass and cellulose through spin and dip coating, showing high transparency and moisture barrier properties. As CAP content increased, surface hydrophobicity improved and bacterial adhesion of *E. coli* and *S. aureus* was significantly reduced. Antifouling tests using dyes and stains showed decreased fouling at higher CAP substitutions. PCAP100 remained stable under saline and extreme pH, indicating strong durability. This coating system offers sustainable antibacterial and antifouling performance without using fluorinated compounds.

Poster Presentation **1PS-244**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

A Colorimetric Ammonia Sensor Using Cytosine-Functionalized Polydiacetylene

박수민, Mohammed Iqbal Khazi, 김종만[†]

한양대학교

Ammonia (NH₃) is widely used in industrial and agricultural fields, but it is considered a hazardous substance due to its toxicity. According to the Occupational Safety and Health Administration (OSHA), exposure exceeding 25 ppm over 8 hours or 35 ppm over 15 minutes is unsafe. NH₃, a major contributor to environmental pollution, is also generated during food spoilage and can serve as a useful indicator for monitoring meat freshness. In this study, a cytosine-functionalized diacetylene monomer (CyDA) was synthesized, which formed a self-assembled structure through hemi-protonation and was polymerized into blue-phase polydiacetylene (CyPDA-H) upon UV irradiation. Using this material, a 3D nanofiber structure was fabricated via electrospinning. The resulting structure exhibited high sensitivity to ammonia gas with a detection limit of 17 ppm, showing a distinct blue-to-red color change. When tested with fresh chicken at 25 °C, a clear color shift was observed over time, demonstrating its potential as a food freshness indicator for smart packaging applications.

Poster Presentation **1PS-245**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Thiol-ene Functionalization of PS-b-PI-b-PS Triblock Copolymer toward Solid Electrolyte Binder Applications.

류현근, 진형민¹

충남대학교

¹ 충남대학교 신소재공학과

All-solid-state batteries resolve the safety issues of flammable liquid electrolytes while providing high energy density. Sulfide-based solid electrolytes, offering liquid-like ionic conductivity even at room temperature, are among the most actively applied. Solution-based electrode fabrication is compatible with existing lithium-ion processes, where the solvent disperses the electrolyte and the binder ensures interfacial adhesion. However, sulfide electrolytes are vulnerable to structural damage in polar solvents, leading to performance degradation. This can be mitigated using low-polarity solvent-binder systems, though poor binder adhesion remains a challenge. To address this, we aimed to optimize binder structure through '-ene' functionalization. Specifically, we performed thiol-ene reactions to partially graft polar thiol groups onto the double bonds of a PS-PI-PS (SIS) triblock copolymer, focusing on controlling the reaction conversion and improving selectivity.

Poster Presentation **1PS-246**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Strain-sensitive Whitening and Reversibility Control for Reconfigurable Encryption System

노윤성, 정성원¹, 홍진기[†]

연세대학교

¹ 국립한밭대학교

Encryption and decryption systems based on multi-stimuli responsiveness (e.g. temperature, pH, mechanical force) have received significant attention for secure information storage. Despite these important contributions, most research has focused on multi-stimuli platforms, and fundamental understanding of parameters governing single-stimulus responsiveness-especially the critical control of reversibility-remains limited. Herein, we present a dual-polymer composite that exhibits reversible, strain-dependent transparency modulation. By systemically investigating the parameters governing both the optical response and reversibility, we developed a reconfigurable encryption platform that provides deeper insight for practical applications. Precise modulation of these trade-off parameters enables the implementation of an encryption system with tailored mechanical responsiveness and enhanced information security.

Poster Presentation **1PS-247**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Dynamic Liquid Crystal Elastomers with Enhanced Mechanical Properties: Systematic Analysis through Network Structure Modification

노경민, 김현¹, 심봉섭²

한국화학연구원 / 인하대학교

¹ 한국화학연구원

² 인하대학교

Liquid crystal elastomers (LCEs) are promising smart materials that can generate large strokes in response to external stimuli for applications such as soft robotics, artificial muscles, and biomimetic devices. However, conventional LCEs often suffer from limited mechanical strength and fixed cross-linked structures, restricting their practical use in engineering applications. In this study, we designed a novel class of LCEs incorporating dynamic covalent bonds. We precisely controlled the thermal, mechanical, dynamic properties of LCEs by adjusting the formulation. These results highlight the potential of the developed LCE materials as a part of next-generation smart engineering systems.

Poster Presentation **1PS-248**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Shape-Memory Polymers with Crystalline Properties for Medical Applications: Reducing Biofilm Formation through Surface Crystal Characteristics

김현재, 김요한¹, 김주은¹, 조성우¹, 김대현², 성학준¹, 이강석³

연세대학교

¹ 연세대학교

² 충남대학교

³ 티엠디랩

Polymer-based implantable medical devices are widely utilized due to their excellent mechanical properties and ease of fabrication. However, long-term use often results in biofilm formation caused by bacterial adhesion, leading to reduced device performance and severe health complications. In this study, we synthesized biocompatible polycaprolactone-based shape-memory polymers (SMPs) and investigated their properties to mitigate biofilm formation. The results revealed that the crystalline phase, characterized by densely packed polymer chains, reduces bacterial adhesion and biofilm formation due to its resistance to water penetration and protein adsorption. . In-vitro and in-vivo experiments demonstrated a significant reduction in biofilm formation on SMP surfaces compared to conventional materials. These findings highlight the potential of semi-crystalline SMPs as a transformative solution for next-generation biomedical applications

Poster Presentation **1PS-249**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Photocatalytic TiO₂-Incorporated Amidoxime Nanofibers for Efficient and Selective Recovery of Metal Ions from Seawater

김현석, 김영웅, 김태현, 이근우, 이택승⁺

충남대학교

In seawater, precious metal ions are present at extremely low concentrations, and various competing metal ions coexist, making it challenging to develop adsorbents with high selectivity and high adsorption capacity. Amidoxime groups exhibit high selectivity and adsorption capacity for specific metal ions. TiO₂ nanoparticles enhance ion accessibility by imparting hydrophilicity and improve surface reactivity under UV irradiation through their photocatalytic activity. In this study, nanofibers incorporating TiO₂ nanoparticles were fabricated using a syringeless electrospinning, and their cyano groups were converted to amidoxime by reacting with hydroxylamine. Adsorption behavior was confirmed by adsorption isotherms and kinetic model. Under UV irradiation, the adsorbents exhibited a rapid adsorption rate and enhanced adsorption capacity. The high selectivity for specific metal ions was confirmed even under seawater conditions in the presence of various competing ions.

Poster Presentation **1PS-250**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Heterogeneous Mechanical Property Design in Semi-Interpenetrating Polymer Networks: Toward Advanced Flexible Smart Materials

김지오, 조규형¹, 김영인¹, 구강희^{1*}

UNIST

¹ 울산과학기술원

Semi-interpenetrating polymer network (sIPN) glycol gels offer an exceptional balance between flexibility and mechanical integrity, making them ideal candidates for advanced flexible substrates. We demonstrate a spatially controlled thermal imidization strategy that enables selective mechanical reinforcement within uniform sIPN matrices. Through high-intensity UV irradiation via masking, localized heating drives imidization reaction in designated regions, resulting in enhanced stiffness, tensile strength, and chemical resistance, creating thermally-responsive flexibility gradients across the material. This programmable patterning approach facilitates complex deformation control, targeted reinforcement, and impact chemical resistance. This methodology expands the utility of sIPN Glycol gels for next-generation flexible displays, wearable electronics, and customizable biomedical devices, providing a versatile platform for spatially engineered smart materials.

Poster Presentation **1PS-251**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Highly Conductive and Washable E-Textiles Using Surface Functionalized MXene Ink

김재영, 김주향, 김선재, 윤이진, 박영호, Jeevan Kumar Reddy Modigunta, G.Murali, 이승준, 인인식[†]

국립한국교통대학교

$\text{Ti}_3\text{C}_2\text{T}_x$ MXene nanosheets hold significant promise to create electronic textiles (e-textiles) due to their excellent electrical conductivity, reactive surfaces, and facile solution processability. However, their poor oxidation stability and weak adhesion to textile fibers remain key challenges for achieving highly conductive and stable e-textiles. Additionally, the oxidative degradation of MXenes in the presence of NO_2 gas limits their utility in effective NO_2 detection. To address these challenges, we functionalize MXene surface with dopamine-conjugated carboxymethyl cellulose (CMC-DA). CMC-DA ligands enhance oxidation stability, promote strong adhesion to textile fibers, increase MXene loading, and enable selective interactions with NO_2 and humidity via their catechol head and CMC tail, respectively. Pad-dried cotton e-textiles are used to demonstrate Joule heating and strain sensing capabilities, while dip-coated hemp e-textiles are employed to demonstrate gas and humidity sensing. **This was supported by Korea National University of Transportation in 2025.

Poster Presentation **1PS-252**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

High-performance oil/water separation filters with partially soluble superhydrophilic interfaces and enhanced reusability

김은진, 최원산[†]

한밭대학교

Superhydrophilic and underwater superoleophobic surfaces, which form a stable hydration layer that permits water passage while repelling oil, show great potential for environmental remediation applications such as self-cleaning, wastewater treatment, and oil/water separation. However, their high surface energy makes them susceptible to fouling during prolonged use, leading to a loss of anti-oil-fouling (AOF) ability that's challenging to restore once compromised. Here, we present the development and testing of a novel underwater AOF filter designed for the cleanup and separation of various oil/water mixtures. This filter features a partially dissoluble surface, achieved through the stepwise coating of calcium carbonate (CaCO_3) nanoparticles and a biodegradable hydrogel blend of polyvinyl alcohol-Konjac glucomannan (PVA/KGM) or sodium alginate (SA) onto different fabric substrates. This design offers a promising solution for robust and long-lasting oil/water separation.

Poster Presentation **1PS-254**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Poly(vinyl alcohol)-based Polymeric Coacervates for Enhanced Hemostatic Performance

김성민, 김민희^{*1}, 박원호[†]

충남대학교

¹ 경북대학교

수술이나 외상으로 발생하는 급성 출혈은 체내 항상성을 무너뜨려 저혈압, 저체온증, 장기 기능 손상 등을 유발하며, 신속한 지혈이 이루어지지 않으면 생명을 위협할 수 있다. 기존의 거즈, 붕대 등의 물리적 방법의 지혈제는 넓은 부위의 출혈이나 심부 조직의 지혈에는 효과가 제한적이며, 제거 시 주변 조직 손상이나 추가적인 감염을 유발할 수 있다. 따라서, 본 연구에서는 상온 보관이 용이하고 응급 상황에서 빠르게 사용할 수 있는 poly(vinyl alcohol) (PVA) 기반의 분말형 지혈제를 개발하였다. 생체적합성이 우수한 PVA에 항산화-항균 기능이 우수한 폴리페놀 화합물인 tannic acid (TA), 양전하 고분자인 poly(allylamine hydrochloride) (PAH)를 조합해 제조된 지혈제는 체액과 접촉 시 점착성 coacervate로 전환되며, 출혈 부위에 밀착하여 효과적인 지혈과 감염 억제를 유도할 수 있다.

Poster Presentation **1PS-255**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

High-Sn containing block copolymers for advanced etch-mask materials in EUV lithography

김백진, 정연식[†]

한국과학기술원

EUV lithography, a key technology for sub-10 nm patterning that faces significant challenges, including insufficient etch resistance and poor pattern quality. DSA of BCP has emerged as a promising complementary strategy to complement EUV lithography by enabling high aspect ratios and reduced defectivity. In this study, high-Sn BCPs were developed to address two primary issues: enhancing etch contrast by incorporating inorganic Sn content, and vertical lamellar alignment without neutral layers. Monodisperse reactive polymers were synthesized via RAFT polymerization, followed by post-polymerization modification to introduce organostannyl moieties. The opposite block was designed as a gradient block to modulate surface energy across the interface, thereby promoting vertical lamellar self-assembly. The resulting BCP exhibited well-ordered pattern with process simplicity. These results highlight their potential as promising candidates for advanced nanopatterning applications.

Poster Presentation **1PS-256**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Fully Edible, Antioxidant-Loaded Microcarriers for Sustainable Cultivated Meat Production

김민호, 오승수[†]

포항공과대학교

For cultivated meat, large-scale animal cell expansion is necessary on scaffolds that ensure firm attachment, fast proliferation, and easy downstream processing. High surface-area microcarriers would be useful to spread oxygen and nutrients evenly in stirred bioreactors. However, most microcarriers are inedible, and otherwise, they rely on costly peptides or animal proteins. Here, we introduce low-cost, fully edible alginate microcarriers that avoid animal inputs and pricey motifs, while mitigating culture-induced oxidative stress via controlled release of encapsulated antioxidants. Tailored surface amination imparts a gentle positive charge that helps early fibroblast attachment and survival, enabling extracellular matrix deposition that allows subsequent muscle cell cultivation. Our results demonstrate favorable charge, stable antioxidant retention, and steady ECM buildup, holding the potential for the microcarriers to serve as a sustainable and scalable platform for cultivated meat production.

Poster Presentation **1PS-257**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Crystallization-Driven Self Assembly of Thermoresponsive Conjugated Block Copolymers into Multifunctional Nanowire Networks

김관윤, 이은지[†]

광주과학기술원

Thermo-responsive block copolymers enable precise structural control via self-assembly, which is vital for advanced material development. In this study, I synthesized conjugated thermo-responsive block copolymers designed to form aligned nanowire arrays through crystallization-driven self-assembly.

To enhance mechanical strength and electrical continuity, ABA-type triblock copolymers were introduced as physical cross-linkers. Tailored design of conjugated and LCST segments allowed reversible nanowire rearrangement under temperature changes. Moreover, NPs-containing polymers were employed, and in situ liquid-cell TEM was used to directly visualize thermally induced nano structural transitions in real time, confirming morphological changes.

This work presents a novel strategy to fabricate multifunctional nanowire networks integrating conductivity, thermo-responsiveness, and durability, with promising potential in stretchable electronics, thermal sensors, and smart nanodevices.

Poster Presentation **1PS-258**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Manganese nanoparticles embedded phenolic resol based laser-induced graphene for supercapacitor electrode fabrication

김경준, 진형민¹

충남대학교 공과대학

¹ 충남대학교 유기재료공학과

The porous carbon materials make it highly useful across various fields, because of excellent electrical conductivity and high specific surface area. Unlike traditional graphene fabrication methods such as mechanical or chemical exfoliation and chemical vapor deposition. Laser-induced graphene (LIG) uses the thermal or optical effects of laser to directly convert carbon-containing precursors into 3D porous graphene by laser direct writing technology. LIG offers a more efficient process with a highly 3D porous structure and reduced time and cost.

In this study, manganese precursor included phenolic resol solution were spin-coated to form a thin film, which was then laser carbonized to produce manganese embedded LIG interdigital electrode. The 3D porous carbon structure of LIG electrode was analyzed using SEM, XRD, etc and evaluate its potential as a supercapacitors.

Poster Presentation **1PS-259**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Robustly Repeatable, Permeable, and Omnidirectionally Stretchable, Adhesive Bioelectronics with Super-adaptive Conductive Suction Cups for Dynamic Biosurfaces

강균로, 황귀원, 임도현, 전승환, 송민우, 방창현⁺

성균관대학교

Skin-integrated wearable bioelectronics hold significant promise for continuous health monitoring and personalized therapy. However, achieving robust, repeatable, and permeable adhesive interfaces with omnidirectional stretchability remains challenging due to issues such as delamination, interfacial voids, and signal degradation under continuous skin deformation. Here, we present a highly adaptable skin-adhesive bioelectronic interface that integrates a conductive softened double-layered octopus-inspired adhesive nanocomposite with a kirigami-based metastructure (cs-OIA_k). This structure offers stable electrical performance ($\Delta R/R_0 < 10$ over 10,000 cycles), skin-like mechanical compliance, omnidirectional stretchability (up to 200%), and robust, repeatable adhesion (>10,000 cycles). The device enables reliable acquisition of ECG and EMG signals on dynamically deforming skin (−30% to 100%).

This study was published in: Advanced Science, 12, 25, 2570189 (2025)

Poster Presentation **1PS-260**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Tunable Synaptic Plasticity in Vertical Organic Electrochemical Diodes via Dopant Ion Size Modulation

Alexander Mauricio Tipan Quishpe, 윤명한¹

Gwangju Institute of Science and Technology

¹ 광주과학기술원

Organic mixed ionic-electronic conductors (OMIECs) are key materials in organic electrochemical transistors (OECTs) and neuromorphic devices due to their dual ion-electron transport capabilities. While OECTs have been widely studied for emulating synaptic behavior, organic electrochemical diodes (OECDs) offer a promising alternative architecture for neuromorphic computing. In this study, we present the impact of a vertical OECD structure on synaptic plasticity. By applying tailored input signals and stimulation protocols, we demonstrate fundamental neuromorphic functions. Both liquid and solid-state electrolytes were evaluated, revealing that ionic size significantly influences long-term potentiation/depression and retention behavior. This highlights the tunability of synaptic responses through ionic control. These vertical OECDs exhibit promising synaptic properties and provide a scalable path forward for polymer-based neuromorphic computing platforms.

Poster Presentation **1PS-261**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Preparation of reprocessable polycaprolactone (PCL) vitrimer with light-induced shape memory effects

황주희, 장영욱[†]

한양대학교

Vitrimers have emerged as a new class of thermoset material that possess thermoplastic-like reprocessability through dynamic covalent bond exchange within the network. This work demonstrated that PCL vitrimers featuring dynamic disulfide bonds can be prepared by chemical crosslinking a mixture of hydroxy-terminated PCL-g-polydopamine(PDA), synthesized by in-situ ROP of caprolactone in the presence of PDA, and a proper amount of hydroxyethyl disulfide (HEDS) using a diisocyanate as a crosslinker. The resulting PCL vitrimer showed excellent reprocessability owing to disulfide exchange reaction throughout the network under thermal activation. Photothermal effect of the PDA domain in the vitrimer enabled the material to exhibit shape memory effect under near IR irradiation. Such biobased PCL vitrimers with light-triggered shape memory effects are expected to have potential biomedical applications.

Poster Presentation **1PS-262**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Multipixelated Bioinspired Electroactive Adhesive Patch for Tactile VR and Multimodal Robotic Interfaces

황귀원, 전승환, 양태현¹, 방창현^{1,2}

성균관대학교

¹ 건국대학교

² 성균관대학교 화학공학과

Inspired by nature's use of surface-transmitted vibrations, we developed a soft electroactive patch that actively modulates adhesion through vibrations precisely tuned to control interfacial interactions. Incorporating a multiarray of microhairs with concave cavities, the patch enables lightweight, reversible, and spatially selective adhesion. The electrically activated soft material acts as a vibration-responsive adhesive switch that enables independent manipulation of multiple objects. Beyond adhesion control, the device serves as a skin-conformal, breathable haptic interface that delivers vibrotactile, enabling the perception of fine surface textures in virtual environments. By harnessing vibration-mediated modulation of adhesion, this platform connects object manipulation with human-machine interfaces, offering wide applicability in soft robotics, wearable technologies, and immersive systems. This study was published in: *Advanced Functional Materials*, 34(6), 2308747.

Poster Presentation **1PS-263**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

High-performance Nanofiltration Membranes Manufactured by Co-Deposition of Metal-Organic Framework and Polydopamine onto m-Aramid Hollow Fibers

황경익, 정영규¹

충남대학교

¹ 충남대학교 유기응용재료공학과

This study develops a nanofiltration membrane based on poly(m-phenylene isophthalamide) (PMIA) hollow fibers using a co-deposition method involving metal-organic framework (MOF) nanoparticles and polydopamine (PDA). ZIF-8, a microporous MOF, provides high porosity, surface area, and chemical stability, while PDA facilitates strong adhesion to polymeric surfaces through self-polymerization. The co-deposition process aims to form a stable composite selective layer on the PMIA hollow fiber membrane, enhancing dye rejection and water permeability. Membrane morphology and surface chemistry are characterized by SEM, FTIR, and XPS. Permeability and dye separation performance are assessed through standard filtration tests using Congo red dye solutions. This approach aims to improve both the separation efficiency and durability of PMIA-based nanofiltration membranes, highlighting the potential of MOF-polymer hybrid interfaces in water treatment applications.

Poster Presentation **1PS-264**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Electrochemical Detection of Redox-Active Analytes Using Functionalized Gold Arrays on ITO

홍영민[†], 윤종인, 양서진, 김승현[†]

인하대학교

Electrochemical nanosensors provide high sensitivity and rapid response via efficient charge transfer at active sites. Their performance depends on the electroactive surface area and surface groups involved in analyte interaction. Block copolymers allow nanoscale patterning, enabling precise control over these active regions. In this study, we fabricated a gold nanoparticle (AuNP)-based sensing platform using self-assembled PS-*b*-P4VP thin films as templates. We controlled the AuNP size and compared sensor performance according to particle size on indium tin oxide (ITO) substrates. The AuNPs were then functionalized for target detection. Electrochemical properties were evaluated using cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). Sensor performance was assessed using differential pulse voltammetry (DPV) for the detection of various electroactive substances including dopamine (DA), ascorbic acid (AA), uric acid (UA), and other redox-active analytes.

Poster Presentation **1PS-265**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Ultrathin and highly Permeable Anti-Swelling and Non-Drying Hydrogel-Based Body-Temperature Phase-Transmittable Electrode for Stretchable Bioelectronics

홍석현, 조재원, 스티브 박⁺

한국과학기술원

Aging increases degenerative diseases, creating major healthcare and socioeconomic challenges. Continuous health monitoring is essential for early diagnosis and treatment. Conventional systems are often rigid, leading to poor compatibility with soft tissues, unstable interfaces, and infection risks. Hydrogels are promising materials due to their water content and tissue-like softness, but they swell in moist environments, dry in air, and ultrathin forms ($\sim 30\mu\text{m}$) are prone to buckling and damage.

We present an ultrathin, highly permeable hydrogel-based bioelectronic system that resists swelling and drying. It integrates a body-temperature-softening liquid metal ink that supports the hydrogel and acts as a stretchable electrode. Before application, it maintains shape and stiffness for easy handling. Once on skin, it softens to match tissue mechanics, enabling reliable, long-term monitoring in dynamic conditions.

Poster Presentation **1PS-266**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Chain alignment engineering in double network ionogels via pre-stretching

한주환, 스티브 박*

한국과학기술원

Hydrogels with aligned polymer chains are promising for soft electronics, sensors, and tissue-mimicking materials due to their anisotropic mechanical and electrical properties. However, achieving stable and controllable alignment remains challenging, as current methods often involve complex processing or limited material choices. To address this, we propose a simple strategy based on sequential double network formation. The first network is pre-stretched, and a second network is formed within it to lock in the aligned polymer conformation. By tuning the composition and structure of each network, anisotropy and directional conductivity can be precisely controlled. Polarized optical and scanning electron microscopy confirmed successful alignment, showing distinct birefringence and oriented microstructures. This method offers a robust and scalable platform for fabricating anisotropically conductive hydrogels suitable for next-generation wearable electronics and soft sensors.

Poster Presentation **1PS-267**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Suspension Technology for Solid Wax Capsules in a Zero-Viscosity Skin Formula

하동완[†]

아모레퍼시픽

최근 뷰티 시장에서는 외관상 시각적 매력을 강조한 제형에 대한 수요가 증가하고 있으며, 특히 투명한 베이스에 캡슐이 떠 있는 형태의 제형이 주목받고 있다. 하지만 이러한 캡슐 제형은 점도 있는 크림이나 세럼에 한정되어 왔다. 본 연구에서는 점증제를 사용하지 않고도 고형 왁스 캡슐을 안정적으로 서스펜딩할 수 있는 무점도 스킨 제형 기술을 개발하고자 하였다.

캡슐로는 왁스 기반 캡슐을 활용하였으며, gellan gum, Cellulose 조합을 통해, 점도 없이도 서스펜딩이 가능한 스킨 제형을 구현하였다. 초기 실험에서는 젤란검 단독 사용 시 불안정한 서스펜딩 현상이 있었으나, Cellulose 조합과의 복합 적용을 통해 장기 안정성이 확보된 처방을 도출하였다.

또한, 제조 공정 중 냉각 단계에서의 Shear 조건 제어가 캡슐 분산 안정성에 중요한 요소임을 확인하였고, 최적화된 냉각 및 혼합 공정을 통해 랩파일럿 및 파일럿 단계에서의 일관성 있는 서스펜딩 안정성을 확보하였다. 본 연구 결과는 점도 없이 다양한 캡슐을 안정적으로 띄울 수 있는 플랫폼 제형 기술로서 활용 가능성이 높다.

Poster Presentation **1PS-268**

기능성 고분자(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Synthesis of Polyaniline-Based Nanocomposites and Their Gas-Sensor Applications

표기현, 김진열⁺

국민대학교

Polyaniline(PANi) is one of the most promising π -conjugated conductive polymers because of its remarkable attributes, such as enhanced conductivity, robust environmental stability, ease of doping, and conductivity control, and a wide array of color changes corresponding to various oxidation levels.

In this study, we synthesized various morphologies of PANi-based nanocomposites, using surfactants and substrates. In particular, we synthesized core-shell spherical nanoparticles and rod-shaped nanotube as sensing elements for acetone gas and gaseous H₂O (water vapor). These designed nanostructures improved sensitivity, selectivity, and stability in gas sensing applications. Notably, the CSA-capped Poly(aniline-co-aniline-2-sulfonic acid) spherical nanoparticles were able to reliably detect acetone gas and H₂O vapor at concentrations of 1 ppm and 1% relative humidity(RH), respectively, at room temperature.

Poster Presentation **1PS-269**

고분자 합성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Skeletal Editing for Post-Polymerization Modification

추민재, 임지우[†]

경희대학교

Skeletal editing has emerged as a powerful strategy for constructing new molecular frameworks via controlled bond rearrangements, but its application has remained largely confined to small molecules and has remained almost entirely unexplored in macromolecular systems. Herein, we report a photochemical post-polymerization modification of poly(2-vinylpyridine) (P2VP) through skeletal editing. By adapting a previously reported small-molecule methodology to a polymeric scaffold, we optimized the reaction conditions to enable efficient transformation and tunable degrees of functionalization (DOF). Notably, this strategy proceeds without the need for new monomer synthesis and allows a single starting polymer to yield diverse materials with tunable properties. Our findings constitute the first report on the application of skeletal editing in macromolecules.

Poster Presentation **1PS-270**

고분자 합성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Molecular Design of Ureidopyrimidinone End-Capped Oligoimide for Enhanced Mechanical and Electrical Properties

윤소미, 위정재^{*1}, 정용채^{*2}

한양대학교, 한국과학기술연구원

¹ 한양대학교

² 한국과학기술연구원

Polyimide (PI) is a high-performance polymer valued for its high thermal stability, mechanical strength, and chemical resistance, making it suitable for various electronic and energy applications. Although various monomer combinations have been used to tailor the desired properties of PIs, achieving high molecular weight often compromises solubility and processability. To address this issue, a low-molecular-weight oligoimide (OI) was synthesized and end-capped with Ureidopyrimidinone (UPy), enabling processability while maintaining key polymer properties.

Building on this strategy, the molecular structures of both the OI backbone and the UPy end-groups were further tuned to enhance charge separation during triboelectric interactions. By incorporating electron-withdrawing groups, hydrogen bonding, and extended aromatic systems, we investigate how these structural features influence triboelectric nanogenerator (TENG) performance, with particular focus on LUMO energy level modulation.

Poster Presentation **1PS-271**

고분자 합성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Topology-controlled platform: from synthesis to applications

위준의, 이상호[†]

동국대학교

Controlling polymer topology is a key factor in determining the physical properties and functionalities of polymers in both bulk and solution states. In this study, we synthesized polyglycidols with precisely controlled topologies (branched cyclic, hyperbranched, and linear) and systematically compared their structural and functional characteristics. We successfully synthesized each topological variant of polyglycidol, and evaluated their mechanical properties using rheometry, dynamic mechanical analysis (DMA), and nanoindentation. The self-healing performance of each topology was assessed through scratch tests and tensile testing. Furthermore, to evaluate adhesive properties, we synthesized topology-controlled poly(glycidoxycarbonyl benzoic acid)s (PGCs) and investigated differences in intra- and intermolecular hydrogen bonding interactions. These investigations revealed distinct differences in physical properties depending on polymer topology, highlighting the critical importance of precise topology control in the design of advanced polymeric materials.

Poster Presentation **1PS-272**

고분자 합성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Living chains separation of ATRP-prepared Poly(benzyl acrylate-b-styrene)

백현종[†], 배유진, 최수빈¹

부산대학교

¹ 카이스트

In reversible deactivation radical polymerization, block extension increases the fraction of terminated chains, significantly reducing the proportion of living species. Living chains molecular weight distribution follow a Poisson distribution, making their isolation essential for enabling high-performance multiblock and functional materials. Here, we report the first separation of living chains from poly(benzyl acrylate-block-styrene) (PBzA-b-PS) block copolymers synthesized via activators regenerated by electron transfer atom transfer radical polymerization (ARGET ATRP). Based on our earlier work with poly(benzyl acrylate) homopolymers, we used high-performance liquid chromatography (HPLC) to separate the living fraction. Bromine termini were converted to azides and subsequently functionalized with polar alkynes via copper-catalyzed azide-alkyne cycloaddition (CuAAC), enhancing polarity contrast between living and terminated chains. HPLC enabled successful isolation of the living chains, with size-exclusion chromatography confirming a narrow dispersity of $\bar{M}_w/\bar{M}_n \approx 1.017$. Preliminary matrix-assisted laser desorption/ionization mass spectrometry (MALDI-MS) revealed a near-Poisson distribution. This approach demonstrates the feasibility of chain-end-defined purification in complex block copolymer systems and expands the applicability of living chain separation beyond homopolymers.

Poster Presentation **1PS-273**

고분자 합성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

CO₂-Derived Thermoplastic Polyurethanes with Tailored Properties

박소윤, Anjali Nagapadi Preman, 김일, 안석균[†]

부산대학교

While thermoplastic polyurethanes (TPUs) are becoming increasingly important due to their unique combination of flexibility, durability, and recyclability, traditional TPUs are often synthesized from fossil-based raw materials. In this work, we present a series of TPUs synthesized using CO₂-derived polycarbonate polyols comprising allyl functional groups. The presence of reactive allyl groups in the polyols not only enables tuning of the thermal and mechanical properties of the resulting TPUs, but also provides opportunities for post-polymerization modification, such as thiol-ene click reactions. By carefully adjusting the allyl content in the polyols and converting them into carboxylic groups through post-polymerization modification, we achieved a broad range of thermal, mechanical, and adhesive properties of the resulting TPUs. Our approach offers the preparation of environmentally friendly TPUs with tailored functionalities.

Poster Presentation **1PS-274**

고분자 합성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Precise Synthesis of Copolymers Containing Poly(4-Hydroxystyrene) Segment via Living Anionic Polymerization and Selective Deprotection

김승기, 강범구[†], 장우재, 안준태

송실대학교

The anionic polymerization of hydroxyl-protected styrene derivatives, 4-(tert-butyldimethylsiloxy)styrene (A), 4-tert-butoxystyrene (B), 4-(2-tetrahydropyranyloxy)styrene (C) and 4-(1-ethoxyethoxy)styrene (D) was performed using sec-butyllithium in THF at -30°C. Well-defined poly(A), poly(B), poly(C) and poly(D) with controlled molecular weights and narrow molecular weight distributions were synthesized within 10 min without any side reactions. Based on these results, well-controlled poly(A-co-B), poly(A-co-C) and poly(A-co-D) copolymers were initially prepared through the anionic copolymerizations of A and B, A and C, A and D. Subsequently, poly(4-hydroxystyrene)-co-poly(B), poly(4-hydroxystyrene)-co-poly(C) and poly(4-hydroxystyrene)-co-poly(D) were obtained through a selective deprotection reaction.

Poster Presentation **1PS-275**

고분자 합성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Synthesis and Characterization of Poly(vinylidene fluoride-co-tetrafluoroethylene) for Anti-Corrosion Coating Applications

김민석, 백지훈[†]

한국화학연구원

Poly(vinylidene fluoride) (PVDF) has been extensively utilized as an anti-corrosion coating material owing to its outstanding chemical resistance, mechanical strength, hydrophobicity, and excellent processability. To further improve these properties, copolymerization with tetrafluoroethylene (TFE) has been explored. In this study, poly(vinylidene fluoride-co-tetrafluoroethylene) [P(VDF-co-TFE)] copolymers were synthesized with varying TFE feed ratios. The resulting copolymers were systematically characterized in terms of their chemical structure and mechanical properties. Furthermore, their wear resistance and chemical durability were evaluated to assess their suitability for anti-corrosion coating applications.

Poster Presentation **1PS-276**

고분자 합성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

One Pot: A Streamlined Strategy for Recycling Poly(butylene terephthalate)

권제훈, 윤지연, 박태경, 유경철, 황동기, 구준모[†]

충남대학교

Chemical recycling of plastic waste enables recovery of monomers for reuse, supporting a circular carbon economy. Among terephthalic acid (TPA)-based polyesters, poly(butylene terephthalate) (PBT) is a promising candidate for closed-loop recycling. However, conventional methods often involve high catalyst loadings and complex purification steps, limiting efficiency. This study presents a one-pot strategy that integrates depolymerization and repolymerization into a single process. Depolymerized intermediates are reused in situ without purification, reducing energy and material input. The effects of depolymerization time, 1,4-butanediol stoichiometry, and catalyst presence were systematically investigated. Emphasis was placed on how intermediate composition influences polymer conversion, molecular weight, and the thermal and mechanical properties of recycled PBT (rPBT). The results identify key parameters for producing high-quality rPBT through a simplified, sustainable process.

Poster Presentation **1PS-278**

고분자 합성(I)

2025.9.30(화), 09:00~10:30, 포스터장

Chair: 박민주, 박정태

Engineering fibronectin components in extracellular vesicles from mesenchymal stem cells boosts uptake efficiency and facilitates differentiation of iPSCs.

Alvin Bello, 김지성, 김시연, Nityanand Prakash, 김민선, 강민우¹, 이수홍⁺

Dongguk University

¹ 동국대학교

Extracellular vesicles have gained significant attention in cell therapy and regenerative medicine for their biocompatibility and ability to transfer therapeutic cargos, including growth factors, nucleic acid, cytokines, and miRNAs, which regulate cellular behavior, and essential biological processes such as cell regeneration and differentiation. Although EVs have been effectively utilized to enhance myogenic, chondrogenic, and osteogenic differentiation of mesenchymal stem cells (MSCs), their potential to directly influence the differentiation of pluripotent stem cells (PSCs) for therapeutic applications remains underexplored. PSCs, characterized by their high proliferation rates, often exhibit inefficient uptake of foreign materials, including EVs. In this study, we present a novel strategy to enhance EV uptake in PSCs by overexpressing a fusion protein comprising fibronectin's RGD and HepII fragments along with LAMP2B to promote FN display on EV surfaces.

Poster Presentation **2PS-001**

에너지 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Quinoxaline-Based Interfacial Engineering for Enhanced Wide-Bandgap Perovskite Solar Cell Performance

홍지희, 이유경¹, 박희준[†], 장재원¹

한양대학교

¹ 부경대학교

Wide-bandgap perovskite solar cells (PSCs) are essential for tandem photovoltaics that surpass single-junction efficiency limits. However, their performance remains limited by non-radiative recombination at the buried interface between hole transport layer and perovskite in p-i-n architectures. We introduce a quinoxaline-based donor-acceptor organic interlayer (QxNN) for the NiO_x /wide-bandgap perovskite interface. The interlayer effectively passivates interfacial defects through Lewis adduct formation, leading to improved charge extraction and reduced non-radiative recombination. QxNN's high dipole moment increases built-in potential. PSCs incorporating QxNN exhibited efficiency increase from 17.5 % to 20.0 %, representing one of the highest reported values. The devices demonstrated exceptional stability, maintaining 95 % of initial performance over 500 hours. These results highlight quinoxaline-based interfacial engineering for high-performance wide-bandgap PSCs.

Poster Presentation **2PS-002**

에너지 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Architecting Stable Percolated Spiro-OMeTAD Networks via Mutualistic Radical-Dopant Synergy

홍승빈, 손창윤[†]

서울대학교

Doping spiro-OMeTAD has significantly contributed to enhancing the power conversion efficiency (PCE) of perovskite solar cells (PSCs). Nevertheless, the individual roles of radicals and dopants, as well as their influence on hole transport, remain poorly understood. In this study, we elucidate the distinct contributions of radicals and dopants in doped spiro-OMeTAD films through molecular dynamics simulations. To investigate the role of dopants, we analyzed the local environment of spiro-OMeTAD radicals by evaluating the coordination number and binding energy of surrounding counterions, aiming to understand how additives stabilize hole carriers. We further examined the dynamic behavior of ionic species, which materials mediate charge transport within the system. Finally, we reveal a mutualistic interaction between radicals and dopants, resulting in the formation of a percolated network in the hole transport layer, which plays a pivotal role in enabling efficient hole conduction.

Poster Presentation **2PS-003**

에너지 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Weakly coordinating cationic polymer electrolytes for fast-charging solid-state lithium-metal batteries

오경석, 한혜정, 이상영[†]

연세대학교

Despite the growing interest in fast-charging solid-state lithium (Li)-metal batteries (SSLMBs), their practical implementation has yet to be achieved, primarily due to an incomplete understanding of the disparate and often conflicting requirements of the bulk electrolyte and the electrode-electrolyte interphase. Here, we present a weakly coordinating cationic polymer electrolyte (WCPE) specifically designed to regulate the Li⁺ coordination structure, thereby enabling fast-charging SSLMBs. The WCPE comprises an imidazolium-based polycationic matrix combined with a succinonitrile (SN)-based high-concentration electrolyte. Unlike conventional neutral polymer matrices, the polycationic matrix in the WCPE competes with Li⁺ for interactions with SN, weakening the original coordination between SN and Li⁺. This modulation of SN-Li⁺ interaction improves both Li⁺ conductivity of the WCPE and redox kinetics at the electrode-electrolyte interphase.

Poster Presentation **2PS-004**

에너지 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Integrated Moisture–Triboelectric Hybrid Generator Based on MXene/Hydrogel Foam for Autonomous Emergency Signaling

김관호, 하제봉¹, 박철민⁺

연세대학교 산학협력단

¹ 연세대학교 신소재공학과

We report a single-cell hybrid energy harvester that combines a moisture-enabled generator (MEG) with a triboelectric nanogenerator (TENG) for dual-mode power generation. The device is based on a 3D melamine foam uniformly coated with conductive MXene ($\text{Ti}_3\text{C}_2\text{Tx}$) nanosheets. A localized coating of organo-ionic hydrogel induces asymmetric ion migration, enabling moisture-induced electricity across various humidity and deformation conditions. The MXene/hydrogel foam also tolerates repeated mechanical contact, functioning as a robust TENG layer. This compact generator achieves up to 55 V, 102 μA , and 83 $\mu\text{W}\cdot\text{cm}^{-2}$, with ~30% stretchability and 2.1 MPa compressive strength. We further demonstrate an emergency alarm system where the MEG powers a steady signal, while the TENG amplifies output upon human motion. This synergy enables reliable self-powered operation for safety-critical environments.

Poster Presentation **2PS-005**

에너지 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Novel Electrolyte Design for High Performance WO₃ Based Electrochromic Devices: A Comparative Study with Ionic Liquids

하늘검, 문홍철[†]

한국과학기술원

Electrochromic(EC) devices offer low energy consumption, high optical modulation and simple structure, making them attractive for applications ranging from smart windows and displays to energy storage. Among these, WO₃-based EC systems are widely used thanks to their excellent electrochemical properties, high optical modulation and superior coloration efficiency. WO₃ undergoes redox reactions via Li⁺ intercalation/deintercalation, so selecting a suitable electrolyte is critical. Although ionic-liquid-based electrolytes—valued for their non-volatility and high ionic conductivity—are commonly employed, their multicationic nature makes them less ideal for WO₃ systems. Here, we introduce a novel electrolyte and perform a comprehensive comparative analysis against conventional ionic liquids, ultimately developing a high-performance WO₃-based EC device. This work provides valuable guidance for the design of advanced electrolytes in future EC platforms.

Poster Presentation **2PS-006**

에너지 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Unveiling the Role of Ethanol as a Green Solvent in Constructing 2D Catalytic Heterostructure

주민성, 윤현석[†]

전남대학교

An environmentally mild method was developed for tuning the structural phase of MoS₂ in 2D nanomaterials using ethanol and poly(N-vinyl-2-pyrrolidone), followed by solvent-free drying and annealing. This process yielded heterolayered 2D nanohybrids incorporating binary metal oxide nanoparticles. Ethanol effectively exfoliated MoS₂ and graphene nanosheets, while the incorporation of NiFe₂O₄ nanoparticles and functional groups on graphene enhanced electron donation to Mo 4d orbitals, converting MoS₂ from a semiconductor into a metallic phase. The synthesized nanohybrids exhibited superior electrocatalytic activity for hydrogen and oxygen evolution reactions via component synergy. Density functional theory and Tafel slope analysis confirmed reduced activation energies during key catalytic steps. Moreover, these nanohybrids maintained stability in eco-friendly hydrogel cells after repeated deswelling–swelling, demonstrating potential for sustainable water splitting.

Poster Presentation **2PS-007**

에너지 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Dual band Electrochromic Window with Anti-Glare and Thermal Control for Energy-Efficient Buildings

조희정, 문홍철¹

서울시립대학교

¹ 카이스트

As energy efficiency becomes a growing priority in building design, the need for smart window technologies that can dynamically manage solar radiation is more critical than ever. This study presents a voltage-tunable electrochromic window system that combines reversible metal electrodeposition and complementary chromophores to control visible and infrared light transmission. The resulting electrochromic devices (ECDs) in this work operates in three distinct optical states to adaptively regulate indoor light and heat. Experimental validation in a model house confirms its superior thermal insulation and dynamic light management. Overall, this work suggests a promising advancement in smart window technologies for sustainable urban environments.

Poster Presentation **2PS-008**

에너지 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Silicon Anode based Stretchable Battery Enabled by PVDF-OH Binder

조영광, 손정곤⁺

한국과학기술연구원

To develop stretchable batteries for wearable electronics, we synthesized PVDF-OH by introducing hydroxyl groups into PVDF via Fenton reaction. Silicon anodes offer high capacity but suffer from volume expansion, causing mechanical failure. Conventional PVDF binders lack elasticity and adhesion to accommodate this stress. The hydroxyl groups in PVDF-OH introduce hydrogen bonds with silanol groups on silicon, enhancing interfacial stability. Additionally, reversible hydrogen bonding between PVDF-OH chains contributes to the stretchability.

Electrodes made with PVDF-OH binder and silicon nanoparticles retained over 80% of capacity after more than 50 cycles. The binder maintained structural integrity under repeated cycles, showing promise for stretchable battery applications. This study demonstrates that introducing hydrogen-bonding functionality into polymer binders can improve both electrochemical performance and mechanical durability in silicon-based stretchable batteries.

Poster Presentation **2PS-009**

에너지 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Engineering Carbon-Doped Hollow Black TiO₂ through PVP-Assisted Morphology Tuning for Long-Life Lithium-Ion Battery Anodes

제갈석, 김지원, 라윤호, 윤창민[†]

인하대학교

Herein, we report a PVP-assisted synthesis of carbon-doped double-shell hollow black TiO₂ (c-HB-TiO₂) for durable and high-rate lithium-ion battery (LIB) anodes. Polyvinylpyrrolidone (PVP) supports the hierarchical morphology and promotes uniform carbon doping during thermal treatment. This design strategy enhances lithium-ion transport via engineered oxygen vacancies, shortened diffusion paths, and interconnected porosity. Electrochemical characterization reveals that the c-HB-TiO₂-based anode achieves a high reversible capacity of 177.7 mAh g⁻¹ at 1 C and 94.5% retention over 300 cycles. Additionally, the anode showed reduced charge-transfer resistance and a high diffusion coefficient of 1.69×10^{-10} cm² s⁻¹. These findings demonstrate the effectiveness of PVP-assisted morphology engineering in developing advanced dblack TiO₂ anodes for next-generation LIBs.

- 본 연구는 2025년도 산업통상자원부 및 산업기술기획평가원(KEIT) 연구비 지원에 의한 연구임(RS-2022-00156073).

Poster Presentation **2PS-010**

에너지 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Mechanical Shutdown in Silicon Anode Batteries Separator

장건순, 서지영, 이상영[†], 배원준

연세대학교

The pulverization of Si anode materials is recognized as a major cause of their poor cycling performance, yet a mechanistic understanding of this degradation from a full cell perspective remains elusive. Here, we identify an overlooked contributor to Si anode failure: mechanical shutdown of separators. Through mechano-structural characterization of Si full cells, combined with digital-twin simulation, we demonstrate that the volume expansion of Si exerts localized compressive stress on commercial PE separators, leading to pore collapse. This structural disruption impairs ion transport across the separator, exacerbating redox nonuniformity and Si pulverization. Compression simulation reveals that a Young's modulus greater than 1 GPa is required for separators to withstand the volume expansion of Si. To fulfill this requirement, we design a high modulus separator, enabling a high-areal-capacity pouch-type Si full cell to retain 88% capacity after 400 cycles at a fast charge rate.

Poster Presentation **2PS-011**

에너지 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Multi-Silane Functionalization of Energetic Materials for Next-Generation Hypersonic Fuel Systems

잠바가, 윤창민¹

Inha University

¹ 인하대학교

Novel silane-coated boron nanoparticles (BNs) with controlled polymeric networks are developed as energetic nanoadditives for scramjet engines. A dropwise silylation method facilitates uniform, dense polymeric silane networks through precise hydrolysis and condensation reactions, whereas rapid injection yields irregular, low-density coatings. Optimized dropwise-coated reduced boron nanoparticles (DrBNOs) exhibit significantly enhanced dispersion stability in hydrocarbon-based nanofluids, demonstrating excellent compatibility with hydrocarbon fuels. The optimized silane coatings improve oxidation resistance, facilitating rapid ignition, complete combustion, and increased combustion efficiency. Bomb calorimetry and droplet combustion analyses confirm high calorific values and minimal soot formation, highlighting precise spatial control as essential for advanced scramjet fuel additives.

- 본 연구는 2025년 정부(방위사업청)의 재원으로 국방과학연구소의 지원을 받아 수행된 미래도전국방기술 연구개발사업임(No.915066201).

Poster Presentation **2PS-012**

에너지 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

A Zwitterionic Double-Network Hydrogel Electrolyte Enabling High Ionic Conductivity and Cycle Stability for Flexible Zinc-Ion Batteries

이지섭, 박광열, 김성운, 김준혁, 유지영⁺¹

경북대학교

¹ 경북대학교

Aqueous Zinc-ion batteries (ZIBs) have attracted increasing attention as next-generation energy storage devices due to their inherent safety, low cost, and environmental friendliness. However, practical applications are still limited by several challenges, including zinc dendrite formation, electrode corrosion, and poor electrochemical stability caused by the presence of free water in aqueous electrolytes. In this study, a double-network hydrogel electrolyte including a zwitterionic monomer was developed to suppress free water through sulfonate groups, thereby enhancing ion dissociation and electrolyte stability. The hydrogel electrolyte is designed based on a double 3D network structure formed by copolymerizing three key components. Double 3D network structure can retain water molecules and thus provide high ionic conductivity. Additionally, hydrogel exhibits excellent adhesion and superior cycle stability, thereby satisfying the requirements for flexible devices.

Poster Presentation **2PS-013**

에너지 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

High Conductivity and Durable Fibrous PEDOT:PSS Sponge for Organic Redox Diffusion Battery

이종원, 윤명한[†]

광주과학기술원

In this research, we developed the high conductive and durable fibrous PEDOT:PSS sponge for organic redox diffusion battery using bottom-up approach. PEDOT:PSS microfiber were used as a building block and self-fused for fabrication of fibrous PEDOT:PSS sponge. The fabricated fibrous PEDOT:PSS sponge has large pores (~200 μ m), allowing smooth electrolyte diffusion and can be stretched by up to 40%. The fibrous PEDOT:PSS sponge demonstrates superior battery characteristics, demonstrating superior capacity compared to two-dimensional electrodes (film and mesh) when indigo carmine is used as the active material.

Poster Presentation **2PS-014**

에너지 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Synthesis and Characterization of Fluorinated Phenazine-Based Conjugated Polymers for Polymer Solar Cell Applications

이재훈, PUSPITA SARI, 김민섭, 진영읍⁺

국립부경대학교

Fluorinated phenazine-based conjugated polymers were synthesized as donor-acceptor materials for polymer solar cells. Four polymers were prepared: PBDT-DT-DoDFPz and PBDTT-DT-DoDFPz with linear alkyl side chains, and PBDT-DT-DHDFPz and PBDTT-DT-DHDFPz with branched side chains. BDTT-containing polymers exhibited deeper HOMO levels than their BDT analogues, while branched phenazine units further lowered HOMO levels, contributing to higher open-circuit voltages. AFM imaging showed that linear side chain polymers formed finer domains when processed with DCB, whereas branched side chain polymers achieved improved morphology with a 3% DIO additive. Optimized devices achieved a J_{sc} of 9.36 mA cm^{-2} , a V_{oc} of 0.66 V , and a fill factor of 0.55, leading to a maximum power conversion efficiency of 3.41%. These results highlight how side chain structure and phenazine design significantly influence electronic properties and device performance in polymer solar cells.

Poster Presentation **2PS-015**

에너지 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

A Strategy for Incorporating a Chemical Lithium Receptor into a Polymer Nanofiber Membrane

윤현승, 김진호, 박수호, 주민성, 윤현석[†]

전남대학교

The rising demand for lithium-ion batteries necessitates selective lithium recovery from aqueous sources such as seawater, geothermal brine, and spent electrolytes. Herein, we report an electrospun nanofiber membrane comprising 12-crown-4 (a Li⁺-selective ligand) and graphene nanosheets embedded in a polyethersulfone matrix. Graphene enabled homogeneous dispersion and immobilization of the ligand, while improving membrane stability, porosity, and hydrophilicity. DFT calculations confirmed the higher binding affinity of 12-crown-4 for Li⁺ over Na⁺ and K⁺. Noncovalent interactions between graphene and the ligand suppressed leaching. In a flow system, the membrane achieved a maximum Li⁺ adsorption capacity of 86.3 mg g⁻¹ and retained over 93% performance after 10 regeneration cycles. This work demonstrates a scalable, regenerable membrane for lithium-selective separation based on molecular recognition and nanostructural design.

Poster Presentation **2PS-016**

에너지 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

High-Capacity Lithium-Ion Battery Anodes Derived from Recycled Waste Photovoltaic panels

유은서, 예서희, 엄태식[†]

홍익대학교

Photovoltaic panels have been widely deployed as a clean energy source, contributing to greenhouse gas reduction. However, with many panels installed since the mid-2000s reaching the end of their 20-year lifespan, large volume of waste panels is expected, raising the need for efficient silicon recovery and value-added reuse. In this study, silicon recovered from end-of-life PV panels was refined using nitric acid-based chemical treatment and processed via high-energy ball milling for use as an anode material in lithium-ion batteries. A composite anode with 5 wt% PV panel-derived silicon mixed with graphite exhibited higher charge capacity than conventional graphite and maintained excellent cycling stability over 100 charge–discharge cycles. These results demonstrate the potential of recycled silicon from waste PV panels for lithium-ion battery anodes, contributing to resource circularity and the sustainability of next-generation energy storage technologies.

Poster Presentation **2PS-017**

에너지 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Design Principles for Side-Chain Architecture in Polymer Binders for Lithium-Ion Batteries

원광빈, 심지민[†]

서울대학교

High-energy lithium-ion batteries (LIBs) require polymer binders that maintain mechanical integrity under high mass-loading. While polyvinylidene (PVDF) is electrochemically stable, its poor adhesion often leads to electrode delamination and capacity fading. Although modified PVDF binders have been explored, most lack systematic control over polymer structure. Here, we develop PVDF-g-polyacrylic acid (PAA) (PVDFA) binders with carboxylic acid functional groups to improve interfacial adhesion. By tuning side-chain length and spacing, we identify key structural parameters that govern adhesion and cycling durability. Enhanced bonding with electrode components is confirmed through electrochemical testing and post-mortem analysis. These results show that precise control of polymer architecture-particularly the interplay between side-chain length and interval-enables significant performance improvement, offering a rational strategy for designing durable, high-efficiency LIB binders.

Poster Presentation **2PS-018**

에너지 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Study on Bio-Derived Polymer Candidates for Sustainable Binder Systems in Lithium–Sulfur Batteries

여상구, 황성준¹, 김수찬⁺

성균관대학교

¹ 성균관대학교 화학공학과

Binders are essential in lithium–sulfur batteries (LSBs), acting as both mechanical stabilizers and electrochemical mediators to suppress the polysulfide shuttle effect. Conventional PVDF binders suffer from low affinity to lithium polysulfides (LiPS) and require toxic solvents, limiting their use in Li-S systems. In this study, we investigate eco-friendly, water-processable, bio-derived polymer binders for sulfur cathodes. Xanthan gum (XG), carboxymethyl cellulose, λ -carrageenan (CRGN), chitosan, and alginate contain abundant polar groups that enable LiPS adsorption, suppress shuttle effects, and enhance electrode stability. Among them, XG and CRGN showed superior cycling performance due to strong LiPS affinity, facile Li-ion transport, and good slurry processability. Furthermore, we propose a dual-binder system combining XG and CRGN to exploit their synergy and develop a high-performance, fully water-processable LSB with improved cycling stability and sustainability.

Poster Presentation **2PS-019**

에너지 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

수열합성을 통한 Cu-HTCC 복합체 제조 및 이를 활용한 태양광 기반 열전 발전 및 물 증발 효율 향상

안태균[†]

한국교통대학교

이 연구는 Cu 나노입자를 포함하는 탄소 기반 하이브리드 소재(Cu-HTCC)를 합성하는 방법을 제시한다. 생성된 Cu-HTCC는 Cu 나노입자의 국소 표면 플라즈몬 공명과 HTCC 매트릭스의 독특한 전자 구조 때문에 빛 흡수가 향상된다. 유연한 2D 및 3D 형태의 Cu-HTCC/PDMS 나노복합체를 제작하였으며, 광열 기반 물 증발(최대 1.47 kg/m²·h) 및 열전 발전(최대 32.1 mV) 성능을 보여주었다. (본 연구는 2025년 국립한국교통대학교 지원을 받아 수행하였음)

Poster Presentation **2PS-020**

에코소재 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Alkaline Hydrogel as a Novel Platform for Marine CO₂ Capture via Calcium Carbonate Mineralization

황은석, 이기라[†]

포항공과대학교

Direct Air Capture (DAC) has received attention as a climate change solution, but it requires high energy for air processing and CO₂ desorption, with additional treatment needed for captured CO₂. This study proposes an alternative using amine-based basic hydrogels introduced into seawater. The hydrogels, with their crosslinked structure, locally elevate pH, shifting the carbonate equilibrium to favor carbonate ion formation. These ions react with calcium to precipitate calcium carbonate, removing CO₂ from seawater and drawing atmospheric CO₂ into the ocean. pH-responsive fluorophores were used to visualize the pH impact zone. The decrease in calcium ion concentration, measured by ICP-OES, served as an indicator of CO₂ removal. A life cycle assessment (LCA) confirmed the hydrogel system's net carbon removal effect. This approach provides an energy-efficient, ocean-based method for atmospheric CO₂ capture using passive chemistry driven by the hydrogel's local pH modulation.

Poster Presentation **2PS-021**
에코소재 부문위원회(II)
2025.9.30(화), 17:00~18:30, 포스터장
Chair: 구강희, 김종호

Chitosan-Based Superabsorbent Polymer for Enhanced Water Retention in Drought-Stressed Soils

주성빈, 오동엽¹, 박제영², 김효정^{1,3}

KRICT

¹ 인하대학교

² 서강대학교

³ 한국화학연구원

As droughts become more frequent with climate change, there is growing demand for environmentally friendly superabsorbent polymers (SAPs) that can help improve water retention in soils. In this study, we developed a biodegradable SAP based on chitosan grafted with poly(acrylic acid). By controlling the spacing and network, the water absorption performance was significantly improved, and the water absorption capacity of up to 305 g/g was achieved. This SAP is easily degraded by chitinase, and when added to the soil in small amounts (less than 1%), it more than doubled the water retention time of sandy soil. In addition, the germination rate and growth of corn and kidney beans were improved under limited moisture conditions. This study demonstrates the potential of chitosan-based SAPs to be applied as a sustainable water management strategy in agricultural fields.

Poster Presentation **2PS-022**

에코소재 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Multiscale Fiber-reinforced Biodegradable Composites with Enhanced Mechanical Properties

조고은, 한경임, 방준하^{*1}, 홍성우^{*2}

한국생산기술연구원

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We developed multiscale fiber-reinforced biodegradable composites by integrating cotton woven fabric (CWF) and sustainable cellulose nanofibers (CNFs) into a polyhydroxyalkanoate (PHA) matrix. CWF served as a structural scaffold, while CNFs acted as nanobridges to improve matrix-fiber adhesion. To facilitate CNF dispersion and interfacial bonding, a compatibilizer containing heterocyclic moieties and polylactide blocks (CHL) was synthesized. This hierarchical architecture enabled efficient stress transfer across the matrix and both micro- and nanoscale fibers. CHL-modified CNFs significantly enhanced the mechanical properties of the matrix, and the best performance was achieved with the combined reinforcement of CNFs and CWF. These findings highlight the importance of multiscale fiber design and compatibilizer-assisted interface control in developing robust, eco-friendly composites for sustainable material applications.

Poster Presentation **2PS-023**

에코소재 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Effect of Inorganic Fillers on the Breathability and Properties of TPEE Films

정예원, 이동윤[†]

경북대학교

Thermoplastic polyester elastomer(TPEE) is a high performance material with excellent mechanical properties and environmental resistance, used in various industrial applications such as functional films. In this study, inorganic fillers such as talc, calcium carbonate(CaCO_3) and silica(SiO_2) were incorporated into TPEE at different loadings to improve the breathability of the resulting films. After the stretching process, morphological analysis was conducted to investigate the influence of each filler on pinhole formation. The number and distribution of pinholes were found to vary depending on the type and content of the filler. In addition, the mechanical and thermal properties of the composites were evaluated to assess the effect filler incorporation on overall material performance. These findings are expected to provide fundamental insights for the development of high-performance, breathable TPEE-based film materials.

Poster Presentation **2PS-024**

에코소재 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Brønsted Base Mediated Electrochemical Depolymerization of Polyethylene Terephthalate

이동준, 김형준[†]

서강대학교

Chemical recycling is considered one of the few viable methods to achieve closed-loop recycling. However, PET(polyethylene terephthalate), one of the most widely used plastics, is chemically recycled under high temperature and pressure conditions, which is not energy-efficient due to its high chemical resistance.

Here we demonstrate transesterification of methyl benzoate, a model compound for PET, using an electrochemical method with Brønsted base mediators under mild conditions. We induce the formation of alkoxide through a proton-coupled electron transfer(PCET) process between the mediator and alcohol, followed by transesterification induced by the interaction between the alkoxide and methyl benzoate.

Through this process, we aim to depolymerize PET to regenerate BHET(Bis(2-Hydroxyethyl) terephthalate), the monomer of PET.

Poster Presentation **2PS-025**

에코소재 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Understanding oxidation mechanisms in polyethylene and the role of antioxidants: insights from density functional theory

안윤호, 박재홍[†]

이화여자대학교

Polyethylene (PE) is a widely used polymer, and understanding its atomic-scale oxidation mechanisms under thermal or irradiation conditions is essential for long-term performance and plastic decomposition studies. We focus on reactions involving alkoxy radicals, key intermediates in PE degradation. Using density functional theory (DFT), we determine reaction enthalpies and energy barriers via the nudged elastic band (NEB) method with a crystalline lamella model representing crystalline–amorphous interfaces. Our results show that certain pathways bypass hydroperoxides through alkoxy radical formation, enabling barrierless ketone formation. Ab initio molecular dynamics (AIMD) reveals their evolution toward carbonyl defects and chain scissions, impacting carbonyl index and molecular weight. We also assessed the radical scavenging ability of butylated hydroxytoluene (BHT), finding it easily deactivates alkoxy radicals and suppresses oxidation initiation.

Poster Presentation **2PS-026**
에코소재 부문위원회(II)
2025.9.30(화), 17:00~18:30, 포스터장
Chair: 구강희, 김종호

CNF Dispersion and Compatibility Enhancement in SBR Matrix

신일섭, 장백균, 이동윤[†]

경북대학교

Styrene-butadiene rubber (SBR) is crucial for high-performance tires, known for its excellent abrasion resistance and wet traction. While traditional fillers like silica and carbon black are common, growing environmental concerns highlight the need for eco-friendly alternatives.

Cellulose nanofibers (CNFs), derived from renewable sources, are highly promising. They offer superior tensile strength and stiffness, making them ideal for reinforcing SBR composites. However, CNF's hydrophilic nature often leads to poor dispersion within the SBR matrix.

This study incorporated surface-treated CNFs into SBR. We evaluated the composites' mechanical strength, abrasion resistance, and thermal properties, and used SEM to analyze CNF dispersion. Based on our findings, we propose optimized strategies to improve CNF dispersion and compatibility with SBR. This research contributes to developing greener, high-performance tire materials.

Poster Presentation **2PS-027**

에코소재 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Formation and Suppression of Photoresist-Derived Polymer Sludge in Packaging Process

박규식, 제갈석, 강다희, 윤창민[†]

인하대학교

In this study, we investigated the formation mechanism of polymer-based sludge arising from photoresist (PR) reactions in packaging processes and proposed a surfactant-based suppression strategy. Reproducible experiments using semiconductor-relevant chemicals confirmed that the sludge originates from hydrolysis and condensation of hexamethyldisilazane and DI water, which subsequently interacts with PR and developer to generate polymeric aggregates. These aggregates are stabilized through hydrophobic interactions and inter-polymer entanglement. Various ionic and nonionic surfactants were evaluated to suppress this formation. Our experimental results show that surfactants with long hydrocarbon chains effectively prevented aggregation between sludge seeds and polymeric residues. This work highlights a polymer science-based strategy to control undesired sludge formation in semiconductor packaging industry.

- 본 연구는 2025년도 정부(교육부)의 재원으로 한국연구재단의 지원을 받아 수행된 기초연구사업임(RS-2022-NR070869).

Poster Presentation **2PS-028**

에코소재 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Property Improvement of TPEE Composites with CNF and Biosilica

김효윤, 이동윤[†]

경북대학교

Thermoplastic polyester elastomer(TPEE) is a high-performance material with excellent mechanical properties and environmental resistance, widely used in various applications such as automotive, electronics and industrial components. In this study, TPEE was reinforced with eco-friendly fillers, cellulose nanofiber(CNF) and biosilica to enhance its physical properties. However, due to the hydrophilic nature of CNF and biosilica, achieving uniform dispersion within the hydrophobic TPEE matrix was challenging, which limited the performance of the resulting composites. To overcome this issue, TPEE was chemically modified to improve its compatibility with the hydrophobic fillers, leading to enhanced dispersion. The modified TPEE composites exhibited property variations depending on the filler content. Mechanical property evaluation and morphological analysis confirmed that the chemical modification had a positive effect on both filler dispersion and composite performance.

Poster Presentation **2PS-029**

에코소재 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Selective Chemical Recycling of Fiber-Reinforced Plastics Using Recyclable Polymeric Bead Catalysts

김용수, 김형준[†], 이동준

서강대학교

Fiber-reinforced plastics (FRPs) have been widely used as engineering plastics in various fields such as aerospace, drone, and automotive industries due to their lightweight nature combined with mechanical strength comparable to that of steel. However, the composite nature of FRPs—comprising carbon or glass fibers embedded in plastic resins along with other additives—significantly complicates recycling processes and hinders mechanical recycling approaches. In this study, we demonstrate a chemical recycling strategy using recoverable polymer bead catalysts that selectively depolymerize only the plastic resin into monomers. Simultaneously, the catalysts can be selectively separated and reused from the reinforcing fibers and other additives. This approach enables the complete recovery of all components in engineering plastics and offers a promising route to establish a circular economy for mixed plastic waste.

Poster Presentation **2PS-030**

에코소재 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

A Study on the Potential Cosmetic Applications of Asan Hot Spring Water

김영희, 정다운, 유근형[†]

(재)헬스케어스파산업진흥원

This study aimed to examine the specific components of hot spring water in the Asan region to explore their potential use in manufacturing cosmetic materials. The Asan area is home to five hot spring districts; however, this study focused specifically on the Onyang, Dogo, and Asan hot spring districts, as they are considered the most representative of the region. The research collected samples from 14 Onyang Hot Springs, 5 Dogo Hot Springs, and 2 Asan Hot Springs for a detailed analysis using ion chromatography (IC) and inductively coupled plasma spectroscopy (ICP-OES). Additionally, concentrated hot spring water underwent microscopic examinations.

The findings revealed distinct ingredient profiles across different hot spring districts as well as unique visual characteristics in the concentrated water samples. These results lay the groundwork for further exploration of hot spring-derived materials in the development of advanced skincare solutions.

Poster Presentation **2PS-031**

에코소재 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Design and Preparation of Crosslinker-Free Vitrimer Adhesive Materials

김소희, 이유섭¹, 방준하¹, 엄태준⁺

금오공과대학교

¹ 고려대학교

Vitrimers are a class of polymeric materials that combine the mechanical strength and thermal stability of thermosets with the reprocessability of thermoplastics. These dual characteristics make them attractive for structure adhesives requiring both strong bonding and recyclability.

In this presentation, a vitrimer adhesive was developed without external chemical crosslinkers, relying on transesterification-based dynamic covalent bonding. Hydroxyl groups generated during epoxy ring-opening enabled self-catalyzed transesterification and spontaneous network formation. Lap shear adhesion tests were performed on aluminum, copper, and polycarbonate substrates, among which polycarbonate showed the highest bonding strength. This work presents a crosslinker-free strategy for designing vitrimer adhesives with tunable properties and excellent adhesion to specific substrates.

Poster Presentation **2PS-032**

에코소재 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Easily Recoverable Star Polymer Catalysts with LCST Behavior for CO₂ Cycloaddition under Ambient Conditions

김성환, 나종범[†], 봉기완¹, 서진영²

한국과학기술연구원

¹ 고려대학교

² 한국화학연구원

Carbon dioxide (CO₂) continues to accumulate in the atmosphere, posing significant environmental challenges. To mitigate CO₂ emissions, the efficient conversion of CO₂ into value-added products is essential. Among the CO₂ valorization strategies, the cycloaddition reaction between CO₂ and epoxides is widely recognized; however, it generally relies on harsh reaction conditions with a suitable catalyst. In this study, we strategically designed star polymer-based catalysts promoting the reaction under room temperature and atmospheric pressure. Notably, the polymer exhibits lower critical solution temperature behavior, enabling facile separation via a simple temperature-induced phase transition and filtration. Furthermore, the synergistic incorporation of nucleophilic sites into the star polymer significantly enhances CO₂ conversion efficiency. This work offers insights into the design of thermoresponsive and recyclable catalytic systems for the CO₂ utilization under mild conditions

Poster Presentation **2PS-033**

에코소재 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Strategic Phase Separation via SAMs Engineering for Eco-Friendly and Stable High-Performance Gas Sensors

김성진, 박영돈[†]

인천대학교

Organic electronic devices offer advantages such as flexibility, light weight, and low cost, but their poor air stability and the resulting waste raise environmental concerns. This study presents an ecofriendly organic gas sensor based on blended films of poly(3-hexylthiophene) (P3HT) and polybutylene succinate (PBS). Vertical phase separation was controlled by tuning the substrate's surface energy using self-assembled monolayers (SAMs) of Hexamethyldisilazane (HMDS). This treatment directed PBS to the top of the active layer and P3HT to the bottom. The PBS layer suppressed P3HT oxidation, thereby improving air stability. Furthermore, increasing PBS content reduced the required amount of conductive polymer while enhancing sensing performance. These findings demonstrate that the sensor simultaneously achieves improved sensitivity and environmental sustainability through the use of a biodegradable polymer.

Poster Presentation **2PS-034**

에코소재 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Synthesis and Characterization Bio-based Aromatic polyacetal of poly(Divanillyl spiro-acetal)

김무현, 권용구[†]

인하대학교

The vanillin is a strong candidate for bio-based monomer which can have high thermal stability due to its rigid aromatic structure derived from lignin. The divanillin as an aromatic monomer was synthesized from vanillin through oxidative coupling with Iron sulfate. The divanillin was polymerized with pentaerythritol under acidic condition to generate amorphous poly (spiro-acetal) structure. The chemical structure of poly(divanillyl spiro-acetal) (PDVSA) was confirmed by ¹H-NMR and FTIR. The thermal properties were investigated by DSC and TGA. The data shows no melting temperature and glass transition temperature of PDVSA and T_{d5%} was 220 °C and 380 °C respectively.

Poster Presentation **2PS-036**

에코소재 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Micellization and Surfactant Ability of Amphiphilic Diblock Copolymers

NUTCHA NONGYAI, 권용구⁺¹

Inha University

¹ 인하대학교

The amphiphilic diblock copolymers, poly(γ -phenyl- ϵ -caprolactone)-block-methoxy poly(ethylene glycol) (PPhCL-b-mPEG), were synthesized via cationic ring-opening polymerization with varied hydrophobic block lengths. Phenyl substituents slowed polymerization rate and reduced crystallinity compared to PCL-b-PEG. Despite greater hydrophobicity, PPhCL-b-mPEG showed higher critical micelle concentrations (CMC) due to steric hindrance. These copolymers effectively stabilized high internal phase emulsions (HIPEs), offering enhanced long-term stability over PCL-b-PEG. The PPhCL-b-mPEG were successfully employed as emulsifiers for HIPE polymerization, resulting in the formation of highly porous materials. The observed decrease in pore size with increasing PPhCL chain length demonstrated the improved surfactant capability of PPhCL-b-mPEG in the formation of polyHIPE foams.

Poster Presentation **2PS-037**

에코소재 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Biodegradable and Structurally Tunable Poly(VL/LLA)HIPEs: Toward Eco-Friendly Porous Materials with Controlled Degradability

Jakkree Intranuwong, 권용구¹, 김아린²

Inha University

¹ 인하대

² 솔루스

Biodegradable porous polymers have emerged for environmental and biomedical applications due to their tunable properties and degradability. Here, the poly(VL/LLA)HIPEs were successfully prepared using high internal phase emulsion (HIPE) with various macroinitiator architectures to tailor controllable degradation behavior. The linear and star architecture of chemical structures influenced the morphology and degradation behavior of poly(VL/LLA)HIPEs were investigated. Under physiological hydrolytic conditions (PBS solution, pH 7.4, 37 °C), distinct differences in degradation profiles were observed. FTIR results revealed that gradual chain scission at ester linkages, indicated by changes in carbonyl and aliphatic stretching regions, as well as an increase in hydroxyl groups over time. The results highlight the importance of polymer architecture in tailoring degradation rates and open opportunities for the design of advanced porous systems for targeted applications.

Poster Presentation **2PS-038**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Nitroreductase and Reduction Responsive Ion Pair Self-Assembled Nanocarriers Based on Poly(diallyldimethylammonium chloride) and 5,5'-Dithiobis(2-nitrobenzoic acid)

황정선, 김진철[†]

강원대학교

An ion pair self-assembled micellar (IPSAM) nanocarrier was developed using poly(diallyldimethylammonium chloride)(PDADMAC) and 5,5'-dithiobis(2-nitrobenzoic acid) (DTNB). These two compounds formed electrostatic ion pairs via interactions between amino and carboxyl groups, resulting in amphiphilic complexes that spontaneously self-assembled in water. IPSAMs at molar ratios of 5/5, 6/4, and 7/3 (amine/carboxyl) formed stable white suspensions. Ion-pair formation was supported by characteristic FT-IR and NMR shifts. TEM confirmed micellar morphology, and hydrodynamic diameter, zeta potential, and CMC were measured. Upon DTT treatment, the UCST decreased with increasing dithiothreitol(DTT) concentration, showing redox responsiveness. Nitroreductases(NTR) treatment did not alter UCST but increased transmittance. Both stimuli enhanced the release of Nile red, indicating the system's reduction and nitroreductase responsiveness.

Poster Presentation **2PS-039**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Core/Shell Silver Chalcogenide Quantum Dots for SWIR Detection Applications

홍은수, 박세영, 강문성[†]

서강대학교

Silver chalcogenide quantum dots (QDs) have tunable band structures and size-dependent short-wave infrared (SWIR) absorption and emission. Their solution-processability enables easy integration into low-cost infrared sensing devices. In this study, we synthesized core/shell-structured silver chalcogenide QDs and characterized their structure and optical behavior using transmission electron microscopy (TEM), X-ray diffraction (XRD), and photoluminescence (PL) spectroscopy. Shell formation effectively suppressed surface trap states, resulting in enhanced PL intensity and improved spectral stability. Device-level measurements confirmed their ability to respond to infrared signals, validating their potential use in photodetector architectures. These findings demonstrate that surface-engineered silver chalcogenide QDs can serve as viable active materials for next-generation SWIR detection technologies.

Poster Presentation **2PS-040**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Silica Nanoparticles Functionalized with Oxidation Promoters for SiO₂ CMP

홍경오, 박소이, 김정우, 황현지, 김태동⁺

한남대학교

To develop a surface-modified colloidal silica abrasive with high SiO₂ film removal rates, we designed and synthesized a novel silane coupler, different from conventional surface modifiers used in CMP slurries. In this study, we introduced picolinic acid and nicotinoyl chloride as oxidation accelerators and silane linkers into the surface to perform chemical polishing on the surface of the silica polisher. This modification was aimed at enhancing the chemical interaction between the wafer and the abrasive during the CMP process, thereby improving polishing efficiency and selectivity. The morphology and particle size distribution of the surface-modified silica polisher were analyzed using scanning electron microscopy (SEM) and dynamic light scattering (DLS). In addition, the chemical structures of the synthesized oxidant-based silane coupler and the modified nanoparticles were confirmed by bio-nuclear magnetic resonance (¹H NMR) and infrared spectroscopy(IR).

Poster Presentation **2PS-041**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Surfactant-Mediated Photoinitiator Stabilization for Rapid 3D Photopolymerization of DN Hydrogels

허재현, 전석진[†]

국립금오공과대학교

Double network (DN) hydrogels are polymeric materials that combine mechanical strength with flexibility. They consist of two interpenetrating networks, one rigid and tightly crosslinked, the other flexible and loosely connected, resulting in excellent toughness and energy dissipation. These features make DN hydrogels attractive for biomedical implants, soft robotics, and wearable devices. Their use in high-precision 3D printing is also gaining interest for advanced medical and microstructured materials. However, challenges such as expensive photoinitiators and complex resin synthesis hinder progress. In this study, we present a simplified method to prepare water-dispersible photoinitiator particles suitable for low-cost DLP 3D printers. By optimizing the co-initiator and surfactant ratio, crystal growth was suppressed, enabling rapid photopolymerization of acrylate groups with high conversion efficiency.

Poster Presentation **2PS-042**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Photothermally Driven Infrared-Responsive Actuator Fibers via Polydopamine Coating

하연경, 김대석¹

부경대학교

¹ 국립부경대학교

Liquid crystal elastomers (LCEs) are crosslinked polymers that respond to external stimuli, making them attractive for actuators, sensors, and soft robotics. In this study, near-infrared (NIR)-responsive LCE fibers were developed through precursor injection, uniaxial stretching, UV curing, and polydopamine (PDA) coating. The precursor was injected into a PTFE tube, followed by solvent evaporation, stretching for mesogen alignment, and UV crosslinking. The aligned fibers showed reversible contraction of ~30% during phase transitions. PDA was coated by immersion in a dopamine-tris buffer, imparting photothermal properties. Under NIR light, the fibers contracted rapidly, enabling wireless actuation. Temperature changes were monitored using an IR camera. The fibers exhibited fast response, high power density, and large strain, demonstrating potential for light-driven soft actuator applications.

Poster Presentation **2PS-043**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Triboelectric Nanogenerators Based on Hierarchical Self-Assembly of PNB-g-PVDF Bottlebrush Polymers into Crystalline Core-Shell Nanospheres

최진우, 홍승재¹, 방준하¹, 강영종⁺

한양대학교

¹ 고려대학교

We present a solution-processed bottlebrush polymer, PNB-g-PVDF, that self-assembles into hierarchical core-shell nanospheres and delivers outstanding triboelectric performance. A thermally decomposable molecular splint, butadiene sulfone (BDS), drives the PVDF side chains to crystallize almost exclusively in the β phase, while TEM, SAED and depth-profile XPS identify a fluorine-rich, highly polar shell wrapped around a PNB-rich core. The curved shell concentrates the local electric field, and the mixed core provides deep traps that suppress charge leakage, jointly creating an intrinsic charge-trapping layer. When paired with nylon-6,6, the film produces 188 V, 18.8 μ A and 0.255 mW cm⁻², about triple the output of β -phase linear PVDF, and directly powers 27 LEDs. These results establish bottlebrush polymers as a tunable platform for high-efficiency, flexible TENGs suitable for wearable or implantable energy harvesting.

Poster Presentation **2PS-044**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Zwitterionic Ligand-Directed Surface Engineering of Perovskite Quantum Dots through Dual-Ionic Coordination

최준호, 김진영, 박정완, 왕동환⁺

중앙대학교

Perovskite quantum dots (PQDs) are promising for next-generation optoelectronic applications due to their outstanding optical properties. However, their instability, caused by surface defects and weakly bound hydrophobic ligands, hinders practical usage. These ligands are easily detached during purification or storage, resulting in optical degradation and particle aggregation. To overcome this issue, we propose a ligand engineering strategy using taurine, a zwitterionic ligand possessing both ammonium ($-NH_3^+$) and sulfonate ($-SO_3^-$) groups. Taurine enables dual-site surface passivation by simultaneously coordinating with surface-exposed Pb^{2+} and halide ions, improving surface stability. This strategy provides better ligand retention under water and moisture exposure, enhancing both structural and optical durability. Our findings suggest that zwitterionic ligand-based passivation is a promising approach for improving PQD stability in optoelectronic devices.

Poster Presentation **2PS-045**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

재활용 플라스틱을 포함하여 제작된 장치를 활용한 생분해성 입자 제조 및 특성

최재현, 조성규, 조은철[†]

한양대학교

일상/산업에서 널리 사용되지만 분해가 어려운 범용 고분자를 대체할 수 있는 생분해 가능한 고분자에 대한 연구는 환경 및 자원순환 관점에서 매우 중요함. 본 연구에서는 polycaprolactone (PCL)-poly(butylene adipate terephthalate) (PBAT) 고분자 기반 입자를 재활용 플라스틱 음료병을 포함하여 제작된 입자 제조 장치를 활용하여 제조하고 PCL 및 PBAT의 조성에 따른 입자의 특성에 관한 기초연구를 수행하였음. 유기용매에 용해된 PCL-PBAT가 포함된 syringe를 재활용 플라스틱 병에 고정시킨 후 중력을 이용하여 PCL-PBAT 용액을 수용액 상에 전달하면 oil 에멀전 droplet이 수용액 상에 형성되고, 이후 건조과정을 통해 입자를 제조하였음. 입자 내 포함된 PCL 및 PBAT의 조성에 따른 입자의 특성을 조사하였고, 염료를 포함한 입자를 제조하여 물에서 고분자의 조성에 따른 염료 방출 거동에 대해 조사하였다. 이 성과는 정부(환경부)의 재원으로 한국환경산업기술원의 탈 플라스틱 특성화 대학원 사업의 지원을 받아 수행된 연구임.

Poster Presentation **2PS-046**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Hyaluronic Acid-Coated Liposomes for Improved Ocular Drug Delivery through a Microfluidic Approach

최유리, 한정연⁺

가천대학교

Liposomes are biocompatible nanocarriers that encapsulate hydrophobic drugs within their lipid bilayer. They are advantageous for ocular drug delivery due to localized administration and minimal systemic absorption. However, limited mucoadhesion and rapid clearance from the ocular surface hinder their therapeutic efficacy. To enhance retention and stability, we coated the liposomes with hyaluronic acid (HA), a natural anionic polymer known for strong mucoadhesion and receptor interaction. To address the limitations of conventional liposomal systems, we adopted a microfluidic synthesis method. We investigated how lipid composition, stock solution concentration, and flow rate ratio affect colloidal stability and surface properties of HA-coated liposomes. The coating process involved dropwise addition of HA solution into the liposome suspension under stirring, enabling electrostatic adsorption. Size, PDI, and zeta potential were analyzed by DLS and ELS.

Poster Presentation **2PS-047**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

colourimetric detection of Pd(II) and Pt(II) ions in water using silver nanoprism-based probes and reusability of bimetallic nanostructures

최송희, 김문호[†]

부경대학교

Sensitive and selective methods for detecting Pd(II) and Pt(II) ions in water are crucial for environmental monitoring. Although traditional methods are accurate and sensitive, they face challenges due to high cost, specialised equipment, and limited field use. In this study, we introduce a colourimetric sensing probe designed to detect Pd(II) and Pt(II) ions in water. The probe uses enhanced chemical stability of silver nanoprisms achieved through Pd or Pt deposition. Our method shows low detection limits of 2.6 nM for Pd(II) and 0.3 nM for Pt(II), indicating high sensitivity. In addition, the probe is simple, low-cost, and works with both the naked eye and UV-Vis spectrophotometry, making it suitable for point-of-care use. Beyond detection, this method allows on-demand synthesis of bimetallic catalysts. The resulting Ag/Pd and Ag/Pt nanoprisms show potential for environmental remediation, offering a way to recycle and reuse Pd(II) and Pt(II) ions in catalytic applications.

Poster Presentation **2PS-048**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Comprehensive Analysis of Colloidal Behavior at the Water–Water Interface: From Assembly to Detachment

최서영, 김규한[†]

서울과학기술대학교

Aqueous two-phase systems (ATPS), formed by immiscible polymer-polymer or polymer-salt mixtures in water, have gained attention for their eco-friendly and biocompatible nature. This study investigates the dynamic behaviors of colloidal particles located at water–water interfaces, focusing on their clustering, structural evolution, and detachment under variable concentrations. By systematically analyzing the interplay of key forces—namely depletion attractions, capillary effects, van der Waals interactions, and electrostatic double-layer forces—we reveal how each contributes to particle assembly and detachment. Moreover, by tracking aggregate size evolution preceding detachment events, we introduce an image-based methodology for the indirect estimation of interfacial tension, and this approach accommodates diverse particle types. These findings deepen our understanding of interfacial colloidal dynamics and offer methodological tools applicable to soft matter research.

Poster Presentation **2PS-049**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Equilibrium clustering of non-ideal colloidal particles

주연서, 황혜림[†]

이화여자대학교

Colloidal cluster formation has predominantly been studied using uniform, spherical particles, yielding highly symmetric structures such as icosahedral or shell-like clusters. However, real-world colloids often exhibit heterogeneity in size and shape, and the influence of this non-uniformity on cluster formation remains poorly understood. In this work, we investigate the equilibrium assembly of clusters formed from polydisperse, morphologically irregular silica particles. By tracking the structural evolution of individual clusters over time, we reveal how local packing constraints and geometric frustration guide their formation. Despite the absence of symmetry, the resulting clusters exhibit reproducible structural motifs, suggesting robust organizing principles even in heterogeneous systems. These results suggest generalized mechanisms for structural organization in polydisperse systems and inform strategies for bottom-up design using realistic colloidal components.

Poster Presentation **2PS-050**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Self-Healing of Defects in Uniaxially Aligned Semiconducting Polymer Crystals via Molecular Doping: Insights into Crystallization from Transient vs. Settled Amorphous Phases

정호경, 강영종[†]

한양대학교

We present the self-healing of defects and enhanced crystallinity in uniaxially aligned poly(3-hexylthiophene) (P3HT) crystal via molecular doping with F4TCNQ. Using eutectic friction transfer (EFT), highly aligned P3HT films (P3HT_EFT) were fabricated, exhibiting superior alignment and planarity compared to spin-cast P3HT (P3HT_SC). Upon doping, the self-healing of defects in P3HT_EFT films led to a significant increase in the charged-ordered phase, transforming transient amorphous phases into well-ordered crystalline domains. In contrast, the conventional P3HT_SC films formed settled amorphous phases and exhibited no self-healing behavior.

Poster Presentation **2PS-051**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Improved photodetector performance enabled by the InAs core/thin-shell quantum dot structure

정현준, 정소희[†]

성균관대학교

Colloidal quantum dots (QDs), with size-tunable bandgaps enabled by quantum confinement and low-cost, flexible fabrication through solution-processability, are promising for infrared applications such as LiDAR and interactive displays. In particular, InAs QDs are actively explored as RoHS-compliant materials in response to environmental concerns. However, they suffer from abundant trap states due to fractional dangling bonds and limited surface binding sites. To address this, various ligand-based passivation strategies have been studied. In this work, we adopt a core/shell approach for trap passivation in InAs QDs. While thick shells or long-chain ligands hinder charge transport by increasing inter-dot spacing, our thin-shell structure passivates traps while maintaining efficient charge transport. Using these InAs core/thin-shell QDs, we fabricated infrared photodetectors with significantly suppressed dark current and enhanced performance.

Poster Presentation **2PS-052**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Design of Amphiphilic Polyhydroxyalkanoates (PHAs) for Biodegradable Surfactant Applications

정윤희, 송건호, 이기라, 황동수⁺

포항공과대학교

Polyhydroxyalkanoates (PHAs) are biodegradable, biocompatible polymers with strong potential for sustainable material systems. In this work, PHAs were modified via transesterification to introduce hydrophilic units—polyethylene glycol, polyglycerol, and carbohydrates—onto the hydrophobic backbone. NMR confirmed successful conjugation, and surface tension measurements indicated reduced surface energy compared with unmodified PHA. To assess surfactant functionality, emulsions were prepared using the modified PHAs via bulk mixing, followed by nanoparticle formation through microfluidization without additional surfactants. Dynamic light scattering revealed nanoparticles with narrow, uniform size distributions. These results highlight amphiphilic PHA surfactants as efficient emulsion stabilizers and promising candidates for biodegradable and biocompatible systems in biomedical and cosmetic applications.

Poster Presentation **2PS-053**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Computational Study on Sequence-Controlled Thermoresponsive Behavior of PLGA-PEG-PLGA Hydrogels

전병준, 서범준[†]

서울과학기술대학교

Hydrogels are promising materials for biomedical applications like drug delivery and tissue engineering. This study utilized Dissipative Particle Dynamics (DPD) simulations to investigate how the distribution of PLGA monomers impacts the thermoresponsive properties of PLGA-PEG-PLGA hydrogels, focusing on sol-gel transition and micelle formation behaviors. Simulations revealed that both block and random PLGA sequence types formed 3D networks from dispersed micelles as polymer concentration increased. However, the random sequence exhibited a higher sol-gel transition concentration. This was attributed to its less efficient micelle formation and aggregation. Furthermore, block sequences formed well-defined micelles, whereas random ones displayed structures with energetically unfavorable crowding. These findings highlight the critical role of PLGA monomer arrangement in hydrogel physicochemical properties, offering insights for precise biomaterial design.

Poster Presentation **2PS-054**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

콜로이드 양자점 다이오드에서 암전류 제어를 통한 SWIR 광 검출능 향상

장은지, 정소희[†]

성균관대학교

본 연구에서는 콜로이드 양자점 기반 다이오드에 전자 주입 차단층(MoO_x)을 도입하여 역전압 조건에서 암전류를 효과적으로 억제하였다. 금속-반도체 접합에서의 전하 거동을 설명하는 Simmons 모델을 기반으로 다이오드의 암전류-전압(J - V) 특성을 분석하였으며, 이를 통해 높은 역전압 조건에서의 전류 거동이 주로 터널링 전류 역학에 기인함을 확인하였다. 차단층 도입 결과 -1V에서 기존보다 16배 감소된 암전류 밀도 $4.4 \times 10^{-3} \text{ mA/cm}^2$ 와 EQE 84 %, SWIR 검출능 $8.6 \times 10^{11} \text{ Jones}$ 를 달성하였다.

Poster Presentation **2PS-055**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Molecular Dynamics Simulation Study on the LCST Behavior of PNVCL with Different Molecular Weights in Aqueous Solution

장신위에, 자오밍거, 조준한[†]

단국대학교

Temperature-responsive polymers are smart materials that reversibly change with temperature. Poly(N-vinylcaprolactam) (PNVCL) has attracted interest for its biocompatibility and coil-to-globule transition near body temperature, known as the lower critical solution temperature (LCST). This behavior is essential to its applications. According to Flory–Huggins Type I theory, PNVCL's phase behavior depends on chain length and molecular weight. However, controlling chain length remains challenging, emphasizing the need for molecular-level study. In this work, molecular dynamics (MD) simulations using the OPLS5 force field were performed to examine the LCST behavior of PNVCL with different molecular weights in water. Structural features—radius of gyration, hydrogen bonds, and radial distribution function (RDF)—were analyzed to show how molecular weight affects conformational transitions, providing theoretical insights for designing responsive polymers.

Poster Presentation **2PS-056**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Molecular dynamics study of conformational transitions and interactions in PVP/[C_nMIM][BF₄] mixtures

자오밍거, 장신위에¹, 조준한¹

단국대학교 고분자공학과

¹ 단국대학교

The alkyl chain length of imidazolium-based ionic liquids (ILs) influences polymer-solvent interactions and the resulting conformational and phase behavior. To uncover the underlying molecular mechanisms, molecular dynamics simulations were performed on polyvinylpyrrolidone (PVP) in four IL systems: 1-butyl-, 1-hexyl-, 1-octyl-, and 1-decyl-3-methylimidazolium tetrafluoroborate ([BMIM][BF₄], [HMIM][BF₄], [OMIM][BF₄], and [DMIM][BF₄]). Temperature-dependent changes in the radius of gyration (R_g) revealed similar conformational trends across the systems. Cluster analysis visualized a thermal transition from extended chains to compact aggregates, followed by re-extension at higher temperatures. Radial distribution function (RDF) analysis was employed to characterize the molecular interactions between PVP and the ILs. These findings highlight the tunability of polymer/IL systems and their potential for smart material applications.

Poster Presentation **2PS-057**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Dual-drug loading β -cyclodextrin pocket surfactants for enhanced pharmaceutical delivery

임은정, 양종렬, 김진웅[†]

성균관대학교

β -Cyclodextrin (β -CD) possesses a toroidal hydrophobic cavity that favors hydrophobic drug inclusion complexation. We rationally designed amphiphilic β -CD derivatives as "pocket surfactants" exploiting dual encapsulation mechanisms: molecular inclusion within the native cavity and supramolecular assembly through micelle formation. Schiff base conjugation introduces alkyl chains with predetermined lengths, modulating hydrophilic-lipophilic balance. This structural modification dictates self-assembly thermodynamics, yielding alkyl chain length-dependent critical micelle concentrations and micelle size distributions. UV-vis spectroscopy enables quantitative drug loading stoichiometry determination, while in vitro dissolution studies reveal sustained release profiles governed by diffusion and desorption mechanisms. The convergence of molecular recognition and colloidal self-assembly establishes our pocket surfactants as versatile nanocarrier platforms for dual-drug delivery applications.

Poster Presentation **2PS-058**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

The Complex Coacervation Phase Behavior of Polyampholytes

임규민, 신조원, 김형준[†]

서강대학교

Complex coacervation is a phenomenon in which phase separation occurs when two oppositely charged polyelectrolyte solutions are mixed, resulting in a mixed polymer dense phase and a dilute phase. The applications of coacervate widely ranges in various realms of science, while the molecular understanding of coacervates has rather fallen behind. Here in, tuning the ratio of charged monomers is considered a key parameter for controlling phase behavior. For effective charge control, our system utilizes polyampholytes—polymers that incorporate both cationic and anionic monomer units—as a versatile platform for exploring charge-driven phase separation. Through this study, we expect to see the influence of charge balance upon salt resistance and find out the dominant interaction of phase separation.

Poster Presentation **2PS-059**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Cs₃Cu₂I₅ Nanowires Grown via Solvent-Polarity Control: Mechanistic Investigations and Lyotropic Self-Assembly

이현민, 강영종[†]

한양대학교

Perovskite nanowires are expected to serve as building blocks for polarized light emission and detection due to their outstanding photophysical properties and anisotropic nature. Although there has been significant progress in the synthesis and applications of lead halide perovskite nanowires, their use is significantly limited by poor stability and toxicity. Here, high-aspect ratio Cs₃Cu₂I₅ nanowires are synthesized using a facile solution-phase method by controlling surface energy differences with a weakly polar solvent. Changing solvents enables manipulation of nucleation and growth kinetics, allowing the size and anisotropy to be adjusted over a wide range. Benefiting from the processability, lyotropic self-assembly of Cs₃Cu₂I₅ nanowires has been achieved in the styrene monomer, which then subsequently be aligned and polymerized. The aligned nanowire-polymer composite film exhibits enhanced stability and strong photoluminescence, with a polarization ratio of 0.31.

Poster Presentation **2PS-060**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Material-Specific Hue Mapping for Optical Strain Quantification in Stretchable Colloidal Films

이유진, 황혜림[†]

이화여자대학교

Colloidal photonic crystals (CPCs) embedded in soft, stretchable films offer a powerful platform for real-time optical strain sensing. We present an image-based quantification method that maps RGB data to HSV space, isolating hue as a precise, scalable indicator of mechanical deformation. As hue corresponds to the dominant Bragg-diffracted wavelength, its shift reflects nanoscale lattice changes under strain. Importantly, the hue-wavelength relationship is material-specific due to variations in refractive index, offering a unique optical fingerprint for each CPC film. Across three materials, we observe highly linear and consistent hue-strain trends. Statistical filtering and brightness normalization further ensure robustness under real-world imaging. This low-cost, non-contact approach establishes hue as a tunable mechanochromic signal, enabling next-generation applications in wearable electronics, soft robotics, and structural diagnostics.

Poster Presentation **2PS-061**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Ag₂Te Quantum Dot Short-Wave Infrared Phototransistor

이나경, 강문성[†]

서강대학교

Ag₂Te quantum dots (QDs) offer eco-friendly short-wave infrared (SWIR, 1.0–2.5 μm) photodetection with solution processability and spectral tunability, avoiding toxic Pb/Hg. However, energy level misalignment with transport layers and parasitic current leakage limit performance.

We developed dual optimization: (1) ligand engineering adjusts QD energy levels to match MOS electron transport layers, improving charge injection and reducing surface defects; (2) selective QD photopatterning via UV-induced crosslinking confines QDs to channel regions, suppressing dark current from source-drain bridging.

The resulting Ag₂Te QD-MOS hybrid phototransistors achieve suppressed dark current, effective SWIR photoresponse, and excellent stability. This scalable approach enables high-performance, environmentally friendly SWIR optoelectronics for next-generation imaging and sensing applications.

Poster Presentation **2PS-062**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Programmable colloidal self-assembly on patterned polymer substrates via DNA hybridization

이건우, 이기라[†]

포항공과대학교

DNA-mediated colloidal self-assembly has attracted significant interest due to its precise programmability. Building on previous work involving polymer substrates patterned by capillary force lithography, we now demonstrate DNA-modified polymer substrates and controlled assembly of complementary DNA-coated colloidal particles into well-defined monolayers with complex geometries. Using hexagonally patterned substrates, we successfully fabricated particle monolayers exhibiting a honeycomb structure. In contrast, square-patterned substrates enabled the formation of particle monolayers with a cubic arrangement. The particle monolayers, assembled via DNA hybridization with the substrates, exhibit enhanced stability and maintain structural integrity. These results highlight the versatility of DNA-mediated interactions in guiding colloidal assembly on customized patterned surfaces, advancing the design of colloidal superstructures with tailored architectures.

Poster Presentation **2PS-063**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Asymmetric Colloidal Multilayers via Domain-Selective Subduction at the Air–Water Interface

윤호준, 김규한[†]

서울과학기술대학교

We report an interfacial strategy to fabricate asymmetric multilayered colloidal films by compressing laterally segregated PS and SiO₂ microdomains at the air–water interface. Differences in hydrophilicity drive domain-selective subduction: silica domains preferentially sink beneath PS domains upon compression, forming vertical asymmetry. This stratification is tunable by compression distance and depletant concentration. At lower polymer levels, enhanced desorption leads to broader subduction and stronger asymmetry. Remarkably, when PS is functionalized with sulfonic acid to reverse wettability, PS domains subduct beneath silica, forming inverted structures. These findings reveal that interfacial energetics, not fixed surface properties, govern assembly. Our approach offers a versatile route to design asymmetric colloidal films for optical, catalytic, or separation uses.

Poster Presentation **2PS-065**

콜로이드 및 분자조립 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Liquid-Liquid Phase Separation of Peptide-Inspired Sticker-Spacer Polymers

오승환, 신혜주, 이현진, 최수형⁺

홍익대학교

Recently, the stickers-and-spacers framework has been adopted to describe liquid-liquid phase separation (LLPS) of biopolymers such as proteins and nucleic acids. In this work, we introduce peptide-inspired sticker-spacer polymers consisting of arginine-like guanidinium (G) stickers and lysine-like ammonium (A) spacers. When electrostatic repulsion is attenuated under high ionic strength, the sticker-spacer polymer undergoes LLPS in aqueous solutions, driven by attractive pi-pi interactions between G stickers. This LLPS behavior exhibits an upper critical solution temperature (UCST) and is highly programmable by varying salt concentration and sticker fraction. These results indicate that the sticker-sticker interactions of G-containing polymers are readily tunable by adjusting ionic strength and sticker valence, suggesting that associative polymers with G stickers are promising building blocks for designing stimuli-responsive polymeric materials in complex aqueous fluids.

Poster Presentation **2PS-066**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Oxygen- and calcium ion-releasing gelatin cryogels for enhanced hemostasis and skin wound healing

허광렬, 강전일, 박경민[†]

인천대학교

Conventional hemostatic materials, such as gauze and bandages, are associated with delayed hemostasis and necessitate removal. To address these limitations, cryogels have garnered attention as hemostatic dressings due to their water absorption capacity and extended storage stability. Herein, we develop oxygen (O₂)-generating cryogels (Oxycryogels) for use as hemostatic dressings via calcium peroxide (CaO₂)-mediated disulfide bond formation and lyophilization. The Oxycryogels demonstrate improved mechanical properties and highly interconnected macroporous structures. They facilitate blood absorption and hemostasis by releasing Ca²⁺ from CaO₂, both in vitro and in vivo. Moreover, O₂-releasing kinetics are modulated via catalase treatment. Our Oxycryogels promote wound healing and angiogenesis by their porosity and oxygen release capabilities in vivo. Consequently, Oxycryogels represent a promising candidate for hemostat dressings, owing to their hemostatic and angiogenic effects.

Poster Presentation **2PS-067**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Synthesis and characterization of L-tyrosine polyester(LPE) for biocompatible drug delivery vehicle

한서영, 최지운, 정일두[†]

부산대학교

L-Tyrosine, a naturally occurring amino acid containing both amino and carboxylic functional groups, is a promising candidate for biomedical materials due to its high biocompatibility and functionality. In this study, a novel L-tyrosine-based polyester (LPE) was synthesized to serve as a biodegradable carrier for therapeutic agents. The polyester backbone was constructed via esterification between desaminotyrosyl tyrosine hexyl ester (DTH), as a diol which was pre-synthesized from L-tyrosine and 1-hexanol, and succinic acid, as a biocompatible dicarboxylic acid. All the synthetic processes were confirmed by $^1\text{H-NMR}$, $^{13}\text{C-NMR}$ and FT-IR spectroscopies, and the molecular weight of the polyester was characterized by GPC. In the future, we plan to use water-in-oil-in-water double emulsion technology to fabricate nanoparticles having drugs or genes.

Poster Presentation **2PS-068**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Thermogelling Octanoyl Glycol Chitosan/Dialdehyde-terminated PEG Hydrogels with Enhanced Mechanical Properties Via Dynamic Schiff-Base Crosslinking

팜황민, 조민희, 허강무[†]

충남대학교

Designing injectable hydrogels that combine shear-thinning, rapid recovery, and tunable mechanical properties is vital for biomedical use, yet maintaining both fast gelation and long-term stability in dynamic systems remains a key challenge. In this work, we report a hybrid hydrogel formed by integrating thermogelling octanoyl glycol chitosan (OGC) with dialdehyde-terminated poly(ethylene glycol) (DP), yielding dual functionalities of thermal responsiveness and reversible covalent crosslinking. The resulting hydrogel showed excellent injectability, rapid gelation, self-healing capacity, and mechanically tunable behavior, primarily governed by dynamic Schiff-base bonding and physical interactions. Fine-tuning of the DP composition enabled precise control over the hydrogel properties. These features support its promising role in drug delivery systems and tissue engineering scaffolds.

Poster Presentation **2PS-069**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Self-assembling Polypeptide Cubicles

최지원, 정단비, 김혜, 정병문[†]

이화여자대학교

We report self-assembling polymer cubicles prepared by poly(e-L-lysine) conjugated to lactobionic acid and pentanoic anhydride (PKLC5). The lactobionyl and pentanoyl groups provide hydrophilic and hydrophobic properties, respectively, while the amine group unreacted provide pH-sensitivity to the polymer. As the pH decreased from 10 to 6, the aqueous polymer solution exhibited transparent-turbid-transparent transition. Scanning electron microscopy revealed that the polymer became turbid and form cubic nano-micro particles at pH=8. We hypothesize that the hydrophobic pentanoyl groups drive the aggregation, and optimal hydrogen bonding of the functional groups in a specific direction at pH=8 leads to cubicle formation. To identify the cubicle formation at pH=8, X-ray diffraction, dynamic light scattering, zeta potential, 2D-NMR, FTIR, and CD spectroscopies of the aqueous polymer solutions were studied.

Poster Presentation **2PS-070**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Biocompatible and Biodegradable L-Lysine Polyurethane (LPU) Nanoparticles for Drug Delivery Applications

최지윤, 정일두[†]

부산대학교

To obtain biodegradable biomaterial for matrix of drug delivery, L-lysine polyurethane (LPU) was designed using PLA-PEG-PLA triblock oligomer as a soft segment, 1,6-hexamethylene diisocyanate (HMDI) as a hard segment and L-lysine ethyl ester (LEE) as a chain extender. PLA-PEG-PLA was synthesized by ring opening polymerization (ROP) of lactide monomer onto poly(ethylene glycol) core and stannous octoate as a catalyst. LEE was synthesized by esterification of L-lysine with ethanol using thionyl chloride as a catalyst. LPU nanoparticles were fabricated by using water-in-oil-in-water double emulsion technique for encapsulating anticancer drugs such as 5-fluorouracil (5-FU). The structure and composition were confirmed by ^1H -NMR, ^{13}C -NMR, and FT-IR; molecular weights measured by GPC; nanoparticle morphology analyzed via DLS, FE-SEM, and TEM; drug encapsulation visualized by confocal microscopy; loading efficiencies evaluated by UV/Vis spectroscopy.

Poster Presentation **2PS-071**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Synthesis and Characterization of Crosslinked Hyaluronic Acid Using Polymerizable Polyrotaxane

최지윤, 정일두[†]

부산대학교

Hyaluronic acid (HA) has attracted considerable attention as a wound healing material due to its excellent biocompatibility and moisturizing properties. However, its application is often limited by insufficient mechanical strength and rapid degradation in vivo. To address these issues, we developed a HA-based hydrogel utilizing polymerizable polyrotaxane (PRMA) as a multifunctional crosslinker. Polyrotaxane was synthesized by threading β -cyclodextrin onto poly(propylene glycol) (PPG, MW = 4000), followed by end-capping with N-(triphenylmethyl)-glycine (Trt-Gly-OH) using DMT-MM as a catalyst. Methacryloyl chloride was subsequently grafted onto the threaded β -cyclodextrin to introduce polymerizable groups. Characterization by NMR, FT-IR, DSC and TGA confirmed the chemical structure and properties of the synthesized materials.

Poster Presentation **2PS-072**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Multi-shell structure upconversion nanoparticles-based multifunctional nanocarrier for combination cancer therapy

최종선, 김소연[†]

충남대학교

Photodynamic therapy (PDT) is a minimally invasive approach for cancer treatment that relies on the generation of reactive oxygen species (ROS) through light-induced activation of photosensitizers in the presence of oxygen. However, its clinical efficacy is often hindered by limited tissue penetration of light, insufficient endogenous oxygen, and the modest therapeutic effect of monotherapy. To overcome these limitations, combination cancer therapies integrating multiple therapeutic mechanisms have gained significant attention. In this study, we developed multifunctional nanocarriers based on multi-shell structured upconversion nanoparticles (MUCs) for synergistic cancer therapy with PDT, chemodynamic therapy (CDT), and starvation therapy. The synergistic antitumor efficacy of the MUC nanocarriers was systematically evaluated in HeLa and A549 cancer cell lines, demonstrating enhanced therapeutic outcomes compared to individual treatment modalities.

Poster Presentation **2PS-073**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Near-Infrared mediated mesoporous silica-decorated upconversion nanoparticles for enhanced photodynamic and gas therapy

최종선, 김소연[†]

충남대학교

Mesoporous silica nanoparticles (MSNs) offer a versatile nanoplatform for the sustained release and encapsulation of various therapeutic agents, including photosensitizers (PS), anticancer drugs, and anti-inflammatory compounds. Due to their large specific surface area, high loading capacity, tunable pore size, and excellent biocompatibility, MSNs have been widely explored as potential nanocarriers in the biomedical field. Lanthanide-doped upconversion nanoparticles (UCNPs), which can absorb low-energy photons and emit high-energy photons, have emerged as a new class of fluorophores with advantages such as high photostability, narrow emission bands, low biotoxicity, and resistance to photobleaching. In this study, we developed mesoporous silica-coated multi-shell structured UCNPs (MUmS) co-loaded with a PS and a manganese carbonyl (MnCO) derivative for combined photodynamic and gas therapy under near-infrared (NIR) irradiation.

Poster Presentation **2PS-074**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Upconversion Nanoparticles Loaded Photonic Contact Lens for Transepithelial Corneal Cross-Linking Using Hyaluronate - Riboflavin Conjugate

최인후, 이기범, 한세광[†]

포항공과대학교

Corneal cross-linking (CXL) has caused huge impact on keratoconus treatment, but the standard Dresden protocol requires painful epithelial removal and prolonged UV exposure. Here, we develop upconversion nanoparticles (UCNPs)-loaded contact lenses (UCLs) with 88.7% visible light transparency for minimally invasive transepithelial CXL using hyaluronate-riboflavin (HA-RF) conjugates. The core-shell structured UCNPs of NaYF₄:Yb,Tm@NaYF₄:Nd (~32 nm) were synthesized and embedded into medical-grade polydimethylsiloxane (PDMS) contact lenses. HA-RF conjugates enabled 4-fold enhanced transepithelial RF delivery compared to the conventional RF standard solution. The biomechanical strength of treated eyes was comparable to that with conventional epithelial-removal treatment with remarkable biocompatibility and no adverse effects. This innovative UCL treatment with HA-RF conjugates and NIR light would pave a big avenue for keratoconus treatment with greatly improved patient compliance.

Poster Presentation **2PS-075**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

ZnO-Triggered Assembly of Metal-Phenolic Networks for Broad-Spectrum Sunscreen Application

최새한, 김정아, 라피아, 남윤성[†]

한국과학기술원

Zinc oxide (ZnO) nanoparticles are widely used as inorganic UV filters for their excellent UV-blocking ability. However, their efficacy is limited by narrow spectral coverage and the generation of reactive oxygen species under UV exposure. Here, we present a scalable strategy to fabricate broad-spectrum UV filters via in situ formation and browning of a metal-phenolic network (MPN) on ZnO surface. The spontaneous release of Zn^{2+} from ZnO initiates complexation with tannic acid (TA), forming an MPN coating without external metal ions. The ZnO-mediated oxidation and dimerization of TA further induce a browning reaction, enhancing π - π conjugation and thereby extending the optical absorption range into the high energy visible light region. The proposed strategy enables the development of eco-friendly sunscreen agents with tunable optical and safety profiles. This research was supported by the Korea Health Industry Development Institute (KHIDI) (grant number: RS-2024-00340429) and the Korea Technology and Information Promotion Agency for SMEs (TIPA) (grant number: RS-2025-02306912).

Poster Presentation **2PS-076**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Stimuli-Responsive Cinnamaldehyde-Based Polymeric Micelles for ROS-Mediated Cancer Therapy

조상민, 이동원[†]

전북대학교

Cancer cells produce high levels of reactive oxygen species (ROS) and depend on glutathione (GSH) to maintain redox balance. Disrupting this system is a promising anticancer strategy. We developed GLOXmp, a nanotherapeutic that induces ROS and depletes GSH, amplifying oxidative stress in tumors. This stress upregulates γ -glutamyl transferase (GGT), which promotes nanoparticle uptake.

A self-amplifying mechanism is established, where increased GGT expression enhances GLOXmp internalization, further boosting ROS and therapeutic efficacy. GLOXmp forms micelles from cinnamaldehyde-based polymers, co-loaded with GSH-depleting agents and modified with tumor-targeting ligands.

In xenograft models, GLOXmp led to sustained oxidative stress, high tumor accumulation, and complete tumor regression without-systemic toxicity. This redox-driven tumor reprogramming offers a dynamic and selective strategy for precision nanomedicine.

Poster Presentation **2PS-077**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Zinc Ion-Releasing Bioactive Polymeric Adhesives for Improved Wound Healing

정재성, 김성은, 김연정, 박경민⁺

인천대학교

Tissue adhesives are gaining worldwide attention for wound management. Traditional wound dressings (e.g., gauze and films) have limitations such as poor adhesion and incomplete hemostasis. To overcome these, bioactive adhesive hydrogels have emerged as promising alternatives. Among various strategies, incorporating zinc ions (Zn^{2+}) is notable for promoting hemostasis, immune modulation, angiogenesis, and tissue remodeling. Herein, we developed bioactive hydrogel adhesives via a zinc peroxide (ZnO_2)-mediated disulfide bond and thiol-ene crosslinking. Our hydrogel showed tunable mechanical properties depending on ZnO_2 content. Our adhesive hydrogels sustainably release Zn^{2+} and H_2O_2 for up to 3 weeks with strong tissue adhesiveness. In vivo, our bioactive adhesives enhanced wound healing, such as hemostasis, immunomodulation, angiogenesis, and tissue remodeling. Overall, our Zn^{2+} -releasing bioactive hydrogel adhesives have considerable potential as advanced wound management adhesives.

Poster Presentation **2PS-078**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Preparation and Characterization of Cartilage Acellular Matrix based Hydrogels by Tissue Engineering

정성린[†], 박종석, 임윤묵

한국원자력연구원

본 연구는 방사선을 이용하여 Cartilage Acellular Matrix (CAM)과 Carboxymethyl cellulose (CMC) 가교된 수화겔을 제조하였다. CAM은 무혈관 및 무신경 조직으로 제2형 교원질(collagen)과 30%의 단백당(proteoglycans)으로 구성 되어 세포외기질(extracellular matrix, ECM)에는 세포의 부착을 방지하는 Lubricin, Biglycan, Decorin 등과 항혈관 효과가 있는 Chondromodulin-1, Encostatin, Thrombospondin-1 등을 함유 하고 있다고 알려져 있다. CMC는 방사선 이온화에너지에 의해 고분자 사슬의 불안정한 하이드록실 라디칼(hydroxyl radical), 수소 라디칼 (Hydrogen radical), 수화 전자(hydrated electrons) 등의 라디칼 형성으로 인해 가교되어 삼차원적 망상구조의 수화겔이 합성 된다. 방사선으로 가교된 CAM/CMC 수화겔에서 CAM 비율이 증가 할수록 겔화율과 겔강도는 감소하였고 팽윤도는 증가하였다. 또한, CAM/CMC 수화겔에서 세포의 부착도와 증식도가 CMC 수화겔에 비해 낮음을 확인하였다. 결론적으로, 본 연구에서는 방사선으로 가교된 CAM/CMC 수화겔은 관절염 치료제, 유착방지제 및 재생의학용 지지체로서 응용이 기대된다.

Poster Presentation **2PS-079**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Bioinspired Gradient Hydrogel Scaffold for Accelerated Skin Wound Healing

정도영, 권미나, 김기수[†]

부산대학교

Hydrogel scaffolds are widely utilized in tissue engineering however replicating the complex microenvironment of native tissue remains challenging. In this study a gradient hydrogel incorporating L929 mouse fibroblast spheroids was developed to better mimic the mechanical properties of skin and enhance wound healing. The gradient was achieved by modulating the concentration of methacrylated hyaluronic acid (HA-MA) via a dual-syringe pump system. The resulting hydrogel facilitated organized cell behavior and significantly promoted full-thickness skin regeneration. In vivo studies demonstrated that treated wounds exhibited a 1.53-fold increase in healing rate compared to untreated controls. These findings highlight the potential of the gradient hydrogel as a biomimetic scaffold for advanced wound healing and tissue engineering applications.

Poster Presentation **2PS-080**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Antioxidation-functionalized Hyaluronic Acid Conjugates for Oxidative Stress-Mitigating Cancer Therapy

임정민, 서성백[†]

부산대학교

Hyaluronic acid (HA) is a biocompatible and biodegradable glycosaminoglycan widely used in medical applications. It is especially studied in cancer-targeting therapies due to its ability to bind to CD44 receptors, which are overexpressed in various tumors. Elevated levels of reactive oxygen species (ROS) are commonly observed in tumor environments, contributing to various aspects of cancer development and progression. Polyphenols, plant-derived antioxidants with multiple phenolic groups, have been widely studied for their biological activities. Among them, Tannic acid (TA), which contains ~25 phenolic hydroxyl groups, is known for its strong antioxidant, antibacterial, and anti-inflammatory properties. In this study, we synthesized HA-TA conjugates by chemically linking TA to HA using epichlorohydrin. The conjugates showed concentration-dependent free radical scavenging ability, unlike native HA, indicating its potential as an antioxidant material for tumor-targeted applications.

Poster Presentation **2PS-081**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Microneedle-assisted lymphatic delivery of a natural immune modulator for enhanced cancer immunotherapy

임수연, 김병덕, 유빈, 김강민, 정지훈[†]

성균관대학교

Cancer immunotherapy can boost the immune system's fight against cancer, but it faces challenges like diverse tumors and side effects. Microneedles are a non-invasive way to deliver drugs, vaccines, and therapies directly to the skin, offering targeted delivery. Our study developed dissolving microneedles(dMN) made from a biocompatible tri-block copolymer that forms nano-micelles with drugs when applied to the skin. We used the dMN technology to formulate SKKU-06, a hydrophobic natural immune modulator derived from fungi, which exhibits anti-cancer and immunomodulatory properties in melanoma (SSKU-06@dMN). This process was even more effective when combined with anti-PD-1 treatment, reducing tumor growth and enhancing survival. The dMN-guided lymphatic delivery of SKKU-06 demonstrates the potential for treating metastatic tumors and improving cancer immunotherapy efficacy by modulating the tumor microenvironment.

Poster Presentation **2PS-082**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

3D printable hybrid resins using poly(ether ketone ketone) for dental application

이정민, 김수진, 정일두[†]

부산대학교

Poly aryl ether ketones (PAEKs) has now gradually become the leading polymer material in the fields of biomedical polymer, due to its good biocompatibility and high thermal, mechanical properties. Among PAEKs, PEKK has advantages such as higher thermal stability, better mechanical properties, versatile chemistry due to two ketone bonds compared to other PAEKs. We focused on poly(ether ketone ketone) based oligomer to improve the mechanical properties of dental resin. In this study, HEMA-terminated poly(ether ketone ketone) oligomer (CAEKK-HEMA) was synthesized using carboxylic acid-terminated poly(ether ketone ketone) oligomer(CA-EKK) and 2-Hydroxyethyl methacrylate(HEMA) and characterized by FT-IR, ¹H-NMR, and GPC. To investigate mechanical properties, the mixture of CAEKK-HEMA and ethoxylated bis-GMA(EBPDMA) with various ratios were photopolymerized by DLP 3D printer and their mechanical properties such as compressive and flexural strength were measured.

Poster Presentation **2PS-083**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Synthesis and characterization of 3D printable PEKK-based resins with multifunctional groups for high-performance dental applications

이정민, 김수진, 정일두[†]

부산대학교

Poly(ether ketone ketone) (PEKK) is notable for its excellent thermal stability, mechanical strength, and versatile chemistry due to two ketone groups. In this study, a GDMA end-capped PEKK oligomer (CAEKK-GDMA) was synthesized by reacting carboxylic acid-terminated PEKK oligomer (CAEKK) with glycerol dimethacrylate (GDMA). The tetra-functionality of GDMA increases enhancing the mechanical properties cross-linking density, of the resulting polymer network. The structure of CAEKK-GDMA was confirmed by FT-IR, ¹H-NMR, and GPC analyses. Various blends of CAEKK-GDMA and Bisphenol A ethoxylate dimethacrylate (EBPDMA) were photopolymerized using a DLP 3D printer. Mechanical testing demonstrated improved compressive and flexural strengths compared to neat resins. These results suggest that incorporating GDMA's four functional groups facilitates a tightly cross-linked network, significantly improving the mechanical performance of 3D-printed dental resins.

Poster Presentation **2PS-084**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Designing Oxygen-Supplying Containers to Create Hyperoxic Hydrogels for Facilitating Wound Healing

이유림, 강전일, 박경민[†]

인천대학교

Chronic wounds remain challenging to manage due to their prolonged inflammation and complications. To address this, bioactive hydrogels have emerged as promising platforms for immune modulation by delivering bioactive molecules to the wound. Among them, oxygen (O_2) plays a pivotal role in wound healing through immune modulation and tissue maturation. However, current O_2 -releasing hydrogels face critical limitations, including the cytotoxicity of O_2 -generating agents and their byproducts. Herein, we develop an O_2 -supplying container (Oxygener) using dopamine-mediated catalase immobilization to produce O_2 -enriched medium. By immersing hydrogels in this medium, we fabricate hyperoxic hydrogels capable of delivering O_2 without any supplementary agents. Our hydrogels support tissue remodeling and promote the transition from pro- to anti-inflammatory phases in vivo. The Oxygener demonstrates great potential as a platform for advanced O_2 -delivering systems to facilitate wound healing.

Poster Presentation **2PS-085**

의료용 고분자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Optimized Injectable Methacryl Glycol Chitosan Hydrogels for Sol–Gel Transition and 3D Spheroid Encapsulation in Chondrogenic Tissue Engineering

이영주, 이유빈¹, 강선웅¹, 허강무⁺

충남대학교

¹ 국가독성과학연구소

Methacryl glycol chitosan (MGC) is a thermo-responsive hydrogel that reversibly transitions from sol to gel with temperature and can be permanently stabilized by gentle UV-induced photo-crosslinking, minimizing phototoxicity while mimicking the extracellular matrix (ECM) for chondrocytes. Exploiting these features, we assessed MGC thermogels as a scaffold for three-dimensional chondrocyte spheroid culture, using conventional single-cell culture as the control. Chondrocytes organized into spheroids within MGC displayed markedly enhanced viability, proliferation, and cartilage-specific matrix synthesis compared with single-cell cultures. These results demonstrate that MGC thermogels furnish an optimal microenvironment for chondrocyte spheroid formation and underscore their promise as a biomaterial for cartilage tissue engineering.

Poster Presentation **2PS-086**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Large-scale thermo- and mechanosalient martensitic actuation through cooperative twist elasticity in a dense crystal lattice

황경태, Indranil Bhattacharjee¹, 라수연, 장민우, 장진혁, 황동렬², 문도현³,
Johannes Gierschner¹, 박형범⁴, 박상규[†]

한국과학기술연구원

¹ IMDEA Nanoscience

² 한남대학교

³ 포항가속기연구소

⁴ 인천대학교

Martensitic molecular crystals have attracted considerable attention for smart devices such as soft robotics, and MEMS, due to their ultrafast and reversible structural transformations triggered by heat or mechanical force. Nevertheless, the underlying mechanisms and design principles remain insufficiently understood. Here, we present the first example of solid-state twist elasticity in a DDDCS [(2Z,2'Z)-2,2'-(1,4-phenylene)bis(3-(4-(dodecyloxy)phenyl)acrylonitrile)]. DDDCS features three polymorphs (B, Y, and C-phases) that undergo reversible transitions upon thermal and mechanical stimulation. In particular, the Y→B transformation involves a cooperative twist of molecules and a packing motif shift from π -stacking to μ -herringbone, resulting in a 29% crystal elongation. The large deformation is enabled by the flexibility and dipolar interactions of the molecule. This insight suggests a new design principle for high-strain responsive molecular crystal.

Poster Presentation **2PS-087**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Liquid Metal-Vitrimer Conductive Composite for Recyclable and Resilient Electronics

호동해[†], Meng Jiang¹, Ravi Tutika¹, Joshua C. Worch¹, Michael D. Bartlett¹

DGIST

¹ Virginia Tech

Here, recyclable and healable electronics are reported through a vitrimer-liquid metal (LM) microdroplet composite. These electrically conductive, yet plastic-like composites display mechanical qualities of rigid thermosets and recyclability through a dynamic covalent polymer network. The composite exhibits a high glass transition temperature, good solvent resistance, high electrical conductivity, and recyclability. The vitrimer synthesis proceeds without the need for a catalyst or a high curing temperature, which enables facile fabrication of the composite materials. The as-synthesized vitrimer exhibits a fast relaxation time with reconfigurability and shape memory. The electrically conductive composite exhibits high electrical conductivity with LM volume loading as low as 5 vol.%. This enables the fabrication of fully vitrimer-based circuit boards consisting of sensors and indicator LEDs integrated with LM-vitrimer conductive wiring.

Poster Presentation **2PS-088**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Donor–Acceptor Positional Effects on Emission Performance and Roll-Off in Solution-Processed TADF OLEDs

현예지, 김윤희[†]

경상국립대학교

TADF materials boost OLED efficiency by converting triplet excitons into singlet excitons, reducing quenching losses. We designed two donor–acceptor molecules, SiPhCzTrz and SiTrzPhCz, by altering the positions of donor (PhCz) and acceptor (Trz) units. Both include a tetraphenylsilyl (TPS) group to enhance solution-processability. SiTrzPhCz showed stronger TADF and higher efficiency but suffered from roll-off due to longer exciton lifetimes. Its twisted structure helped suppress aggregation-caused quenching (ACQ). SiPhCzTrz had weaker TADF but showed more stable efficiency and longer device lifetime. As sensitizers in phosphorescent OLEDs, they achieved efficiencies of 19.3 and 20 cd/A, respectively. Notably, SiPhCzTrz allowed a simplified two-component emitting layer, improving cost-effectiveness and durability. These results highlight the role of molecular design in optimizing TADF materials for stable OLED performance.

Poster Presentation **2PS-089**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

The Effect of Molybdenum Oxide Interlayer Thickness on the Performance of Inverted Organic Photovoltaic Cells

한채연, 유창우, 이승훈[†]

공주대학교

Polymer solar cells (PSCs) are promising photovoltaic technology due to their flexibility, light weight, and low-cost manufacturability. A fundamental approach to enhancing device efficiency involves the optimization of interlayers, which significantly influence charge transport and interfacial characteristics. This study systematically investigates the effect of molybdenum oxide (MoO₃) interlayer thickness on the performance of inverted organic solar cells, where the interlayer is positioned between the PM6:Y6 active layer and the Ag top electrode. For this purpose, the thickness of the MoO₃ layer is precisely controlled to gain deeper insights into the resulting variations in the device's photovoltaic characteristics. This work demonstrates the critical role of precise interlayer control in the development of high-performance organic solar cells, ultimately aiming to identify the optimal film thickness for enhanced photovoltaic conversion efficiency.

Poster Presentation **2PS-090**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Rational Molecular Design of π -Extended Thiazolothiazole for High-Performance UV-OPDs Seamlessly Integrated with CMOS

표원준, 정대성[†]

포항공과대학교

Vacuum-deposited organic photodiodes (OPDs) offer unique advantages but achieving ultraviolet (UV) selectivity in such devices remains a key challenge. This is due to the need to reconcile two competing design requirements: (1) strong π - π stacking for efficient charge transport, and (2) limited π -conjugation to retain a wide bandgap suitable for UV absorption and vacuum deposition. Here, we report a molecular design strategy for UV-selective OPDs based on thiazolothiazole (Tz)-based small molecules with tailored backbone planarity and conjugation length. The optimized devices achieve outstanding UV selectivity, high specific detectivity, and fast dynamic response—representing the highest performance reported to date. Furthermore, we demonstrate the seamless integration of these semi-transparent OPDs with CMOS image sensors, underscoring their potential for multifunctional imaging applications.

Poster Presentation **2PS-091**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Enhancing thermoelectric performance via a new strategy that is pendant-side conjugated chains doping.

표승욱, 권민재, 정인환[†]

한양대학교

The device performance of organic thermoelectric (OTE) materials is generally evaluated by the power factor ($PF = S^2 \cdot \sigma$). However, a significant trade-off exists between the Seebeck coefficient (S) and electrical conductivity (σ), as these parameters are inversely dependent on the carrier concentration. Therefore, optimization of both S and σ is critical for enhancing thermoelectric performance.

In this work, we report a novel organic thermoelectric polymer, PTMN 1–3, featuring strong electron-withdrawing groups in the side chain. These groups exhibit strong interaction with $FeCl_3$ molecule, enabling pendant-type doping. This doping strategy allows selective trapping of dopants, leading to improved electrical conductivity while mitigating the reduction of the Seebeck coefficient. As a result, the polymer exhibits a consistently high power factor exceeding $10 \mu W m^{-1} K^{-2}$ over a broad doping concentration range (16–32 mM)

Poster Presentation **2PS-092**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Transfer Coated Al₂O₃ Layer for Composite Quasi-Solid Polymer Electrolyte in Lithium-Ion Battery

추슬기, 박명수, 송승완¹, 강영구⁺

한국화학연구원

¹ 충남대학교

Conventional LiBs use liquid electrolytes containing highly volatile and flammable organic solvents, thereby posing safety concerns. To address these issues, research has focused on quasi-solid-state polymer electrolytes. Among them, composite polymer electrolytes have attracted attention as they combine the flexibility of polymer electrolytes with the mechanical stability of inorganic particles. In this study, we developed a composite polymer electrolyte containing a high content of polydopamine-coated Al₂O₃, applied to the graphite anode by means of a transfer coating process. A thin, uniform composite film with an average thickness of less than 15 μm was prepared, which not only enhances energy density but also reduces interfacial resistance. The quasi-solid polymer electrolyte was prepared by means of in-situ thermal crosslinking of a precursor solution containing crosslinker and liquid electrolyte, injected into the transferred composite film.

Poster Presentation **2PS-093**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Self-Healing Thermoelectric Applications Based on Conductive Polymers and Organic-Inorganic Composites

최현수[†], 김병관[†]

충남대학교

Electronically conductive polymers are attractive for thermoelectric applications due to their easy processability, tunable electrical properties, and mechanical flexibility. Incorporating self-healing mechanisms further allows these materials to maintain their intrinsic electrical and mechanical performance over time, contributing to enhanced durability and sustainability. Such self-healing thermoelectric polymers are particularly promising for wearable devices, which are often subjected to harsh conditions and mechanical damage that degrade thermoelectric efficiency. By enabling recovery from these damages, self-healing polymers can prolong device performance. We review recent advances in self-healing organic and organic-inorganic composite thermoelectric materials, highlighting current research trends, limitations, and future challenges.

Poster Presentation **2PS-094**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Chiral perovskite layer for circularly polarized light emission from polymer light emitting diode

최원빈, 박종현, 오준학[†]

서울대학교

Chiral perovskite-based spin light-emitting diodes (spin-LEDs) have recently attracted significant attention as promising platforms for spintronic optoelectronics. In this study, we demonstrate circularly polarized light emission from a polymeric F8BT layer enabled by a chiral two-dimensional perovskite incorporating newly synthesized halogenated thiophene ligands as a spin-selective transporting layer. Systematic variation of the halogen atom size in the thiophene ligand revealed a pronounced enhancement in chiroptical activity, including circular dichroism (CD), circularly polarized luminescence (CPL), and spin-selective charge transport. Structural analysis showed that larger halogen atoms induce more pronounced asymmetric internetworks within the 2D perovskite lattice, while optical analysis indicated a concurrent increase in the magnetic transition dipole moment. These synergistic effects are responsible for the observed enhancement in spin selectivity. The structure–property relationship elucidated here offers a valuable design principle for future ligand engineering and device-level integration in chiral spintronic systems.

Poster Presentation **2PS-095**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Enhanced Gas Sensing Performance of Polythiophene Film with Ligand-Modified MOF-303

최슬기, 박영돈[†]

인천대학교

Organic gas sensors have attracted attention as next-generation sensing platforms due to their low-cost fabrication and potential for solution processing. However, sensors based on organic semiconductors like poly(3-hexylthiophene) (P3HT) exhibit poor sensitivity and selectivity toward gas analytes, limiting practical use. To address this, we developed a hybrid organic gas sensor by blending P3HT with porous metal-organic framework (MOF) MOF-303, whose organic ligands were chemically modified to enhance interactions with target gas molecules. This ligand modification, combined with MOF-303's high surface area and strong affinity for polar gases, promotes gas diffusion and adsorption at the sensing interface, improving sensitivity and response speed. As a result, the hybrid device exhibited significantly improved responsiveness and selectivity to target gases. These findings highlight the great potential of ligand-modified MOF/organic semiconductor hybrids as next-generation platforms for high-performance gas sensors in wearable and environmental monitoring applications.

Poster Presentation **2PS-096**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Ambipolar Charge Carrier Transport of Organic Semiconductor-Based Heterojunction Bilayers

최소현, 이강돈¹, 양희창⁺

인하대학교

¹ 노바텍아이엔티

This study evaluates ambipolar organic thin film transistors (OTFTs) and complementary-like inverters using PTCDI-C₁₃ and pentacene bilayers deposited sequentially on a polymer-grafted SiO₂ dielectric. As the underlying layers in semiconductor heterojunction bilayers (HJBs), PTCDI-C₁₃ crystallites with a nominal thickness of 4 monolayers (ML) were deposited and reorganized thermally. Finally, the crystal growth of pentacene was intermediated on the PTCDI-C₁₃ crystallites. Semiconductor HJBs clearly exhibited ambipolar charge-carrier transport, and the ambipolar OTFTs exhibited various hole (m_h) and electron (m_e) mobilities of 0.10-0.75 and 0.013-0.55 cm² V⁻¹ s⁻¹, respectively, depending on the p-conjugated structures of the semiconductors. The terrace-like crystal growth of pentacene could be intermediated on the smooth layered crystallites of PTCDI-C₁₃. Complementary-like inverters using two ambipolar OTFTs yielded a high voltage gain of up to 80.

Poster Presentation **2PS-097**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Regioregular Donor-Acceptor Copolymer with Highly Face-on Orientation Enabling a High Gain-Bandwidth Product of Photomultiplication-Type Organic Photodetector

최건업, 정대성[†]

포항공과대학교

Photomultiplication-type organic photodetectors (PM-OPDs) are promising for high-sensitivity detection due to their trap-assisted charge amplification. However, the unbalanced donor-to-acceptor (D:A) ratios required for PM operation typically induce a trade-off between gain and bandwidth. To address this, we developed a regioregular donor-acceptor copolymer comprising PDBD and FBT moieties. The polymer exhibited highly oriented face-on stacking and reduced trap density due to its regioregularity, enabling a gain-bandwidth product exceeding 4×10^5 Hz and specific detectivity (D^*) over 10^{12} Jones under reverse bias. These results demonstrate that polymer regioregularity is a key design parameter to overcome the gain-bandwidth trade-off in PM-OPDs.

Poster Presentation **2PS-098**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Stretchable Mxene/Silver Nanowire (MXAg) Electrodes for Biophotonic Applications of Stretchable Light-Emitting Diodes

조종형, 한세광[†], 박광현

포항공과대학교

Stretchable light-emitting diodes (LEDs) represent a promising platform for biophotonic technologies, including wearable phototherapy and optogenetic modulation. However, the advancement of such devices is constrained by the absence of electrodes that simultaneously provide high electrical conductivity, mechanical robustness, and long-term reliability. Silver nanowires (AgNWs) offer excellent conductivity but exhibit limited structural stability under strain. Here, we demonstrate MXene/silver nanowire (MXAg) hybrid electrodes that synergistically integrate the superior conductivity of AgNWs with the intrinsic flexibility and robustness of two-dimensional MXenes. The MXene framework facilitates uniform stress distribution, mitigating nanowire fracture and delamination. When incorporated into stretchable LEDs, MXAg electrodes enable stable and reproducible emission under deformation, underscoring their potential as a reliable solution for next-generation biophotonic applications.

Poster Presentation **2PS-099**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Multilayered Crystalline/Amorphous Electrodes with Enhanced Mechanical Stability for Strain Sensor Applications

조재상, 장웅식, 박금환¹, 왕동환⁺

중앙대학교

¹ 한국전자기술연구원

Metallic glass, an amorphous metal alloy with a disordered atomic structure, offers high strength and corrosion resistance but suffers from brittleness under mechanical stress. We developed a multilayer electrode by alternately depositing aluminum (Al) and metallic glass thin films via sputtering. This structure distributes strain across multiple interfaces, enhancing mechanical flexibility and durability. The strain sensor based on this structure exhibited excellent linearity, attributed to the multilayer design that allows Al-metallic glass films to better withstand strain, and enhance the overall working range of strain sensor device. Additionally, suppressed interfacial reactions enhanced chemical resistance and biocompatibility. Furthermore, this research demonstrates that the proposed electrode is applicable not only to strain sensors but also to organic photovoltaic devices, offering enhanced mechanical stability and durability.

Poster Presentation **2PS-100**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

High-Precision Printable Self-Powered NH₃ Sensor Enabled by 0D/1D Synergistic Black-TiO₂/MWCNT Heterostructure: Mass-Produced, Health Monitoring

조은호, 김세현[†]

건국대학교

Wearable NH₃ sensors are vital for early detection of toxic NH₃ exposure and noninvasive breath-based diagnosis of kidney disease. However, most are limited by rigidity and power dependence. Here, we present a fully printed, miniaturized, low-cost, self-powered flexible patch using black titanium oxide (B-TiO₂) nanoparticles and multi-walled carbon nanotubes (MWCNTs) via dispensing printing. MWCNTs offer a robust conductive scaffold, while oxygen-deficient B-TiO₂ provides abundant redox sites for charge storage. The resulting asymmetric microsupercapacitor (MSC) delivers a high areal capacitance of 16.3 mF cm⁻². The narrow bandgap of B-TiO₂, combined with internal n-n⁺ junctions and external n-p junctions with MWCNTs, boosts interfacial charge transport. This multidimensional synergy enables efficient, room-temperature NH₃ sensing. The integrated design supports scalable fabrication of robust, wearable, self-powered NH₃ sensors.

Poster Presentation **2PS-101**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Enhancing Charge Transport in Polymer Solar Cells via Semiconducting Single-Walled Carbon Nanotube Additives

조경호, 이승훈[†]

공주대학교

Polymer solar cells (PSCs) are promising candidates for next-generation photovoltaics due to their flexibility and low production costs. However, their limited charge carrier mobility often necessitates thin active layers (~100 nm), restricting light absorption and overall efficiency. In this study, we introduce semiconducting single-walled carbon nanotubes (s-SWNTs) as additives to enhance charge transport in PSCs. The incorporation of s-SWNTs effectively suppresses carrier recombination and improves mobility, enabling the fabrication of efficient PSCs with thicker active layers. This simple yet effective strategy offers a potential pathway to improve photovoltaic performance and may contribute to the development of scalable, high-efficiency polymer solar cells for future commercialization.

Poster Presentation **2PS-102**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Controlled Doping of Carbon Nanotube Sheets for Large Area Organic Thermoelectric Materials

김병관⁺, 김지현, 조강현

충남대학교

Flexible thermoelectric generators (f-TEGs) are a promising technology that can effectively power wearable devices by utilizing waste heat generated from the human body. Operating f-TEGs requires robust mechanical flexibility and high thermoelectric (TE) performance. Carbon nanotubes (CNTs) are ideal for this application due to their high electrical conductivity ($>1,000 \text{ S cm}^{-1}$) and flexibility. However, due to their insufficient p- and n-type TE performance and low solution dispersion, uniform large-area coating is difficult. In this study, we developed a simple three-step process using large area CNT sheets with improved dispersibility in aqueous solutions through oxidation. In particular, CNT/PET film ensure improved mechanical flexibility, and molecular doping through drop casting techniques is effective in ensuring convenient and stable TE performance. This study shows a method advantageous for large-area processing and suggests new possibilities for the development of f-TEGs.

Poster Presentation **2PS-103**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Exciton and Charge Dynamics in a Y6 Derivative Controlled by Molecular Symmetry

조가영, 박재홍¹

이화여자대학교

¹ 이화여자대학교교

Ultrafast laser spectroscopy was employed to investigate the excited-state dynamics of symmetric and asymmetric Y6 derivatives in solution. Systematic studies involving solvent polarity and excitation wavelength dependence revealed distinct photophysical behaviors arising from molecular symmetry control.

Notably, the asymmetric derivative exhibited additional spectral features, including a CT-like state with strong solvent dependence and distinct fluorescence emission separate from the localized excited state. The formation of this emissive CT-like state is closely associated with geometry redistribution, as evidenced by its excitation wavelength sensitivity.

These findings demonstrate that tuning molecular symmetry and structure offers an effective strategy for controlling excited-state pathways in π -conjugated systems, providing insight into rational design of next-generation optoelectronic materials.

Poster Presentation **2PS-104**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Star-shaped PEDOT:PSS-T photothermal membrane for solar desalination

정지수, 김태동⁺, 황현지, 오정은, 박민종

한남대학교

The importance and value of water have become more pronounced in recent years. This is due to the desertification and rapid expansion of dry areas from global warming and industrialization. As a result, regions with limited freshwater resources have relied on building desalination plants as a means of solving these problems. One of the freshwater production methods is the solar vapor generator system (SVG), which involves the processes of solar absorption, thermal conversion and local heating to induce seawater vaporization. In this work, we have successfully fabricated desalination membranes for SVG using PEC-T hydrogel materials prepared by combining cationic and anionic polymers. This material was blended with conducting polymer, PEDOT, to induce photothermal effects. The PEDOT:PSS-T composites were characterized by ¹H NMR and UV/vis spectroscopy, SEM, DLS, UTM, and photothermal test.

Poster Presentation **2PS-105**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Universal Interfacial Layer via Sulfoxide-Modulated Zinc Oxide Nanocrystal for Enhanced Photocurrent and Durability in Organic Photoelectronic Devices

정재현, 김병기, 임지현, 김민수, 왕동환⁺

중앙대학교

Organic photoelectronic devices including organic photovoltaics (OPVs) and organic photodetectors (OPDs) require electron transporting interlayer (ETL) for suitable photocurrent transport and external hole blocking. This study employs zinc oxide nanocrystals (ZnO NCs) coordinated with sulfoxide-based L-type ligands as an ETL, resulting in enhanced photocurrent generation. The energy level and interlayer morphology are optimized for device integrity, which makes it suitable for photocurrent flow and minimizing dark current. Enhanced electron mobility and trap density allows efficient charge transport and photo-response enhancement. Minimized leakage current flow of the proposed device enables higher light signal detectivity with reduced shot noise. Moreover, stability enhancement adopting L-type protector assisted ZnO NCs as an ETL is demonstrated, underscoring their applicability to next-generation organic photoelectronic devices.

Poster Presentation **2PS-106**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Randomness-Enhanced Organic PUF Devices via Phase-Separated Microporous Films

정민주, 이은광^{†1}

국립부경대학교

^{†1} 부경대학교

Hardware-based security systems have become increasingly vulnerable to hacking due to the advancement of artificial intelligence (AI). As a result, Physical Unclonable Function (PUF) devices, which generate unique and unclonable identifiers, have emerged as promising next-generation security technologies. In this study, a two-phase system with a microporous structure was designed to maximize the randomness and uniqueness of organic semiconductor-based security devices.

A thin film was fabricated by blending the organic semiconductor poly(3-hexylthiophene) (P3HT), the biodegradable polymer poly(1,4-butylene adipate) (PBA), and the surfactant Triton X-100. A selective removal process was then employed to induce a phase-separated microporous structure. As a result, the device spontaneously formed unique and unpredictable micro-patterns, demonstrating a high degree of randomness and validating its potential for implementation as a PUF device.

Poster Presentation **2PS-107**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Infrared-Sensing Organic Phototransistors Based on the Concept of Gate Sensing Layer

전연우, 이철연¹, 김화정, 김영규[†]

경북대학교

¹ 경북대학교 유기나노전자연구실

Sensing infrared (IR) light has become a key technology in various applications such as biomedical systems, autonomous cars, military devices, etc. Currently, such systems are composed of inorganic IR detectors, which have the demerit of being rigid and heavyweight. On this account, organic IR detectors with flexibility and lightweight features have attracted keen interest. However, owing to the intrinsically narrow energy level (gap) in the IR range, semiconducting and/or conducting polymers with an optical absorption in the IR range could not properly work as an active layer in the two-terminal or three-terminal devices. To overcome this fundamental issue, we have proposed a concept of gate-sensing layer (GSL) that plays a role in sensing IR, which is placed in the part of gate-insulating layers. This presentation demonstrates the fundamental aspects of GSL-based organic phototransistors and discusses recent experimental results including new materials and device structures.

Poster Presentation **2PS-108**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Optimization of organic gas sensor performance through sensing area control

전승현, 박영돈[†]

인천대학교

Organic-based gas sensors face critical challenges, including low sensitivity, poor selectivity, and limited atmospheric stability compared to inorganic counterparts. While many studies address these issues through chemical modification, structural engineering, and incorporation of porous materials, we demonstrate that simple geometric tuning—specifically adjusting channel length and contact geometry in poly(3-hexylthiophene) (P3HT)-based field-effect transistors—can significantly improve gas sensing performance without any chemical or physical modification. Although shorter channels enhance transistor characteristics, they reduce the effective gas adsorption area, thereby compromising sensing capability. Our findings emphasize the importance of structural design and suggest that geometry optimization alone can serve as a practical, scalable strategy to boost sensor performance and provide a platform for future integration with advanced materials.

Poster Presentation **2PS-109**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Organic Bimorph Actuator Film Enabled by Colossal Thermal Expansion Crystals

장민우, 장진혁, 라수연, 연한울¹, 박형범², 황경태, 박상규⁺

한국과학기술연구원

¹ 광주과학기술원

² 인천대학교

Dynamic crystals exhibiting colossal thermal expansion (TE) are promising candidates for next-generation smart actuators—including artificial muscles, origami systems, and soft robotics—due to their large, continuous volumetric change and linear thermal responsiveness. However, practical implementation is hindered by difficulties in processing and scaling the materials while preserving their single-crystallinity. Here, we present a thermally responsive bimorph actuator composed of an active 6,13-bis(triisopropylsilylethynyl) pentacene (TIPS-P) crystalline film integrated with a passive SU-8 layer. A meniscus-guided printing technique enables intrinsic crystallographic alignment of the TIPS-P film. The resulting actuator demonstrates rapid actuation and high curvature ($6.7\text{--}10.8\text{ cm}^{-1}$), attributed to the colossal TE coefficient (488 MK^{-1}) of TIPS-P. Furthermore, the actuator delivers measurable mechanical work ranging from 3.27 to $5.6 \times 10^{-7}\text{ J}$.

Poster Presentation **2PS-110**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Optimizing MDD-Fabricated Gold Nanostructures using Functional Polymer : Serum Albumin and M13 Bacteriophage

장민수, 한승욱¹, 박선우, 유상호, 정태영, 오진우[†]

부산대학교

¹ 휴머노이드 후각 디스플레이센터

Surface-enhanced Raman scattering (SERS) is a non-destructive technique that provides molecular vibrational information without sample pretreatment. SERS arises from enhanced electric fields ("hot spots") generated by localized surface plasmon resonance at metal nanoparticle interfaces, particularly within gaps of 2–10 nm. Achieving uniform nanostructures with dense hot spots is critical. Here, gold nanoparticle films were fabricated using serum albumin (SA) and M13 bacteriophage scaffolds via meniscus dragging deposition (MDD). We optimized incubation conditions and coating parameters, evaluating performance using rhodamine 6G (R6G). The optimized films demonstrated significant potential for metabolite analysis in biological samples.

Poster Presentation **2PS-111**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Steady-State Stability of High Reverse Bias with Dark Current Suppression via Molecular Alignment of BTP-eC9-based Ternary Optoelectronics

임지현, 장웅식¹, 김민수, 정재현, 왕동환⁺

중앙대학교

¹ UC Santa Barbara

In this study, the non-fullerene acceptor BTP-eC9 based on a ternary bulk heterojunction (BHJ) was utilized to achieve stable molecular arrangement, effectively suppressing dark current and ensuring stability under high reverse bias conditions. Organic materials based on a binary BHJ are widely used for efficiency, but they have limitations in terms of stable operation at high reverse bias. Therefore, by forming a PM6:BTP-eC9:Y12 ternary BHJ, the molecular arrangement and energy levels were aligned, enhancing stable dark current suppression and achieving stable light responsivity and detectivity under high reverse bias conditions. Additionally, the steady-state stability of dark current was investigated in real time, observing changes in dark current as high reverse bias. More stable dark current and noise suppression were observed in the ternary-based organic photodetector. Notably, clear signals were sustained at bias variations (at -3V) when driving a photoplethysmography sensor.

Poster Presentation **2PS-112**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Unraveling the Underlying Mechanism of Polymer Swelling for Fluoride-Assisted Etching of Silicone Residues in Wafer-Level Packaging

임지수, 잠바가, 박규식, 윤창민[†]

인하대학교

In wafer-level packaging (WLP), the effective removal of residual polydimethylsiloxane (PDMS) or silicone-based polymers after the temporary debonding process is critical for ensuring process reliability. This study presents a novel silicone etchant that operates through a polymer swelling-assisted mechanism. Five linear alkanes (pentane, hexane, heptane and octane) are selected as swelling solvents based on their close solubility parameter to PDMS. These solvents are systematically combined with tetrabutylammonium fluoride (TBAF) and a polar co-solvent (NOP), and the TBAF concentration is optimized in the range of 1.0–5.0 wt%. An optimized formulation composed of 3.0 wt% TBAF, 70.0 wt% pentane, and 27.0 wt% NOP achieves an etching rate of 96.4 $\mu\text{m}/\text{min}$, which is more than 12 times faster than that of a commercial silicone etchant. The enhanced etching efficiency is attributed to the swelling of the silicone matrix, which facilitates the diffusion of fluorine into the polymer network. Furthermore, material compatibility tests confirm that the etchant does not damage sensitive polymers such as PSPI and PSR used in pattern wafers and PCB substrates. This approach provides a highly selective, efficient, and polymer-safe solution for silicone residue removal in advanced semiconductor packaging applications.

- 본 연구는 2025년도 정부(교육부)의 재원으로 한국연구재단의 지원을 받아 수행된 기초연구사업임(RS-2022-NR070869).

Poster Presentation **2PS-113**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

A Hydrogen-Bonding Strategy for Enhanced Perovskite Precursor Stability and Solar Cell Performance

임수환, 용태영, 최종민[†]

대구경북과학기술원

In many works, the phase stability of formadinium (FA⁺) based perovskites has been enhanced by mixing additives containing methylammonium (MA⁺). However, a significant problem can be raised as the MA⁺ is readily deprotonated to MA⁰ because of its low pKa and the generated MA⁰ irreversibly reacts with FA⁺. This irreversible reaction triggers large organic carions as impurities hindering perovskite composition and crystallinity. This study shows that when 3-MBA is added to the perovskite precursor as an additive, the strong hydrogen bonding between FA⁺ and carboxylate group of deprotonated 3-MBA significantly improved the thermal stability of both the precursor and the perovskite film. Inverted perovskite solar cells with 3-MBA showed a high power conversion efficiency of 24.3%. Even after 1,740 hours at a high temperature of 85°C, they retained 98% of their initial performance, proving their remarkable thermal stability. The addition of 3-MBA improved solution stability, maintaining over 96% of their initial efficiency even after 140 days.

Poster Presentation **2PS-114**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Light Outcoupling Efficiency Improvement using Self-Wrinkled PDMS/Parylene Films

임선혁, 김차연¹, 이형석¹, 정성준[†], 박현진^{†2}

포항공과대학교

¹ 플렉서블 배리어 테크놀로지

² 한국화학연구원

Polymer-based optical films with surface microstructures have attracted considerable attention for improving the light outcoupling efficiency in optoelectronic devices. Conventional methods for inducing wrinkle patterns in polymer-based optical films require high annealing temperatures, plasma treatment, photolithography, or UV-ozone exposure. However, these methods increase process complexity and restrict substrate options. In this study, we proposed a simple fabrication process for self-wrinkled PDMS/Parylene films to improve light outcoupling efficiency in optoelectronic devices. During the deposition process, the self-wrinkled pattern was generated due to the mechanical stress differential resulting from Parylene infiltration into the PDMS. The optical performance of self-wrinkled PDMS/Parylene films was systematically evaluated by measuring the transmittance, haze, and luminance. As a result, the self-wrinkled PDMS/Parylene films significantly improved the light outcoupling efficiency.

Poster Presentation **2PS-115**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Suspended Wrinkled Organic Semiconductor Films: A New Platform for Flexible and Stable OECTs

이창민, 이은광[†], 송정혜, 정민주, 이승민, 문부현¹

부경대학교

¹ 유니스

In organic electrochemical transistors (OECTs), conventional planar structures typically use only one side of the active layer, limiting gate modulation and overall performance. Traditional bottom-up methods require sequential layering on a single substrate, restricting process flexibility and architectural innovation. To address these issues, we adopted a water-assisted transfer printing technique to fabricate a suspended organic semiconductor (OSC) film independently and transfer it onto various substrates. Capillary forces during transfer induce controlled wrinkling in the OSC film, enhancing mechanical strength and flexibility without compromising electrical performance. This suspended, wrinkled morphology improves gate control and device stability. Our approach offers a simple, adaptable platform for fabricating synaptic transistors, advancing neuromorphic and wearable bioelectronics.

Poster Presentation **2PS-116**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Enhancing the Sensitivity of Electrolyte-Gated FET Biosensors via AC Voltage System to Overcome Debye Screening Effect

이주혁, 하영근¹

경기대학교 화학과

¹ 경기대

Electrolyte-gated field-effect transistor (EGFET) biosensors offer high sensitivity in biomolecule detection, but their performance degrades in high-ionic-strength environments due to Debye screening. This study introduces an AC voltage modulation strategy to suppress ionic shielding by disrupting electrical double layer (EDL) formation. The biosensor was fabricated using an amorphous indium–gallium oxide (IGO) channel and functionalized with a tau-targeting aptamer via APTES and glutaraldehyde. Upon applying AC voltage together with a DC bias, EDL formation was weakened, thereby extending the effective charge detection range. Compared to DC-only sensing, the AC-assisted approach achieved stronger signal responses under identical ionic conditions. This work provides a promising strategy to overcome limitations in FET biosensor sensitivity under physiological environments and demonstrates its potential for reliable biomarker detection.

Poster Presentation **2PS-117**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

On-Chip Hebbian Learning via Integrated Neuromorphic Circuits

이정화, 김선권¹, 곽인철, 조정호⁺

연세대학교

¹ 연세대학교 화공생명공학과

To address the von Neumann bottleneck and the demand for energy-efficient learning, we propose an integrated neuromorphic platform that implements Hebbian learning directly on hardware. The system incorporates three synergistic elements: presynaptic transistors for input modulation, threshold-switching memristor-based neurons for spiking output, and feedback synaptic transistors for adaptive weight update. Without relying on complex external circuitry, our architecture enables real-time weight modulation based on input-output correlation. A 6×6 array-level integration confirms reliable signal propagation, local learning, and reduced power consumption. This work demonstrates a practical route toward scalable, CMOS-free neuromorphic computing with embedded learning capabilities.

Poster Presentation **2PS-118**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Humanlike Robotic Finger Motion Enabled by Spatial Synaptic Signal Routing

이윤찬, 조정호[†], 노동규

연세대학교

The complexity of coordinating humanlike finger movements in robotic systems remains a challenge due to inherent limitations of conventional binary logic control architectures and signal bottlenecks. This study presents an innovative robotic control approach employing an ion-gel-based synaptic transistor array capable of spatial multiplexing of spike signals. Leveraging parallel processing and ionic modulation, this system substantially reduces control complexity, enabling simultaneous and coordinated multi-actuator control. Integrated with robotic fingers driven by shape memory alloys, the proposed platform successfully demonstrates precise and humanlike finger movements with significantly lowered computational requirements. The elimination of digital-to-analog converters simplifies the overall circuitry, offering a promising solution for future advancements in efficient robotic control systems.

Poster Presentation **2PS-119**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Realization of High-Efficiency and Stable Perovskite Solar Cells via Defect Passivation and Gradual Energy Band Tuning

이유민, 김수관, 최종민¹

dgist
¹ dgist

Passivation engineering is essential for enhancing the efficiency and stability of perovskite solar cells (PSCs). Grain boundaries (GBs) in perovskite films contain defects that cause non-radiative recombination and allow moisture, oxygen, and lithium ions to penetrate, accelerating degradation. Lewis base-containing polymers can passivate these defects by forming Lewis adducts with uncoordinated Pb^{2+} ions. Conventional polymer passivation faces trade-offs: high concentrations offer full coverage but increase resistance, while low concentrations reduce resistance but leave GBs exposed. To address this, we developed a multifunctional polymer enabling dual passivation in both the perovskite and hole transport layers (HTL). This strategy reduces band offset, blocks lithium-ion migration, and suppresses pinhole and void formation. As a result, our PSCs achieved 24.0% power conversion efficiency and retained 92% of initial performance after 2000 hours in ambient conditions.

Poster Presentation **2PS-120**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Fabry–Perot Interferometer-Based Organic Photodiodes for High-Performance Optical Wireless Communication

이영경, 정대성[†]

포항공과대학교

This study introduces a high-performance optical wireless communication system using organic photodiodes (OPDs) with panchromatic active layers. Instead of relying on wavelength-selective organic materials, we adopt a Fabry–Perot interferometer structure as an optical filter integrated into the OPD. This structure enables narrowband detection by selectively enhancing specific wavelengths through constructive interference, which is essential for multi-channel visible light communication (VLC).

By combining a broadband-absorbing active layer with an interference-based filtering structure, this approach achieves precise spectral selectivity without the need for specially designed light-absorbing materials. This strategy allows for the development of flexible OPD arrays with tunable color responses and narrow detection bands, offering a scalable and practical solution for next-generation optoelectronic systems.

Poster Presentation **2PS-121**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Effect of Interfacial Complexation of Two Oppositely Charged Polyelectrolytes for Low-Voltage Reversible Electroadhesion

이승주, 김형준[†]

서강대학교

Electro-adhesion's reversible and programmable nature enables various robotic applications. In particular, the junction between two polyelectrolytes offers a promising approach to reversibly modulate adhesion at remarkably low voltages under 10 V - significantly lower than the kV-range voltages typically needed for conventional dielectric electroadhesives. The core mechanisms governing this system involve electrostatic interactions among ionic polymer chains and the formation of molecular-level complexes at the interface. However, these forces are difficult to isolate, as adhesion behavior is also influenced by the viscoelastic nature of the material. Furthermore, existing theoretical models fall short of fully explaining how these interfacial complexes contribute to adhesion. To address this gap, this study investigates the energetic contribution of such complexes to electro-adhesion, specifically by using contact adhesion test designed to minimize the effects of viscoelasticity.

Poster Presentation **2PS-122**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Development of Conjugated Polymers from Pharmaceutical Intermediates for High-Performance Panchromatic Organic Photodetectors and Fingerprint Image Sensors

이수민, 문예원, 정인환[†]

한양대학교

To be utilized in fingerprint-on-display (FoD) sensors, conjugated polymers for organic photodetectors (OPDs) should fulfill the requirements for both large-scale synthesis and high device performance. In this study, novel conjugated polymers synthesized from a pharmaceutical intermediate are developed as active layers for high-performance OPDs and FoD sensors. Through alkyl chain tuning, the highest photocurrent density and the lowest dark current density values were achieved. This resulted in the best OPD performance with a responsivity of 0.42 A/W and specific detectivity of 2.6×10^{13} Jones at -2 V under near-infrared irradiation, yielding a rising response time of 3–4 μ s, falling response time of 6–11 μ s, and -3 dB cut-off frequency of 80–100 kHz. Finally, the OPD is integrated into an organic thin-film transistor array of FoD sensor, resulting in the successful acquisition of a digital fingerprint image.

Poster Presentation **2PS-123**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Photovoltaic Properties of Hydroxy Minerals in Polymer Electrolytes on Dye-Sensitized Solar Cells

이성준, 김민규, 김미라[†]

동의대학교

The integration of additives such as inorganic fillers into polymer materials has garnered considerable attention for the development of advanced electrolyte materials, particularly in dye-sensitized solar cells (DSSCs). This study focuses on developing a preparation method for a hydroxy mineral as an inorganic filler, investigating its effects on the properties of polymer electrolytes, and evaluating the performance of the resulting electrolyte in DSSCs. Among various potential fillers, a hydroxy mineral such as zinc hydroxide chloride emerged as a promising inorganic filler owing to its unique structural and electrochemical properties.

Poster Presentation **2PS-124**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Achieving Shortwave Infrared Sensitivity in Organic Photodiodes via Polaron Engineering

이상준, 정대성[†]

포항공과대학교

We introduce a new method for developing shortwave infrared (SWIR) organic photodiodes (OPDs) using doped polymers. By engineering the doping process to enhance bound polaron formation and their conversion to free polarons under illumination, we establish a new photodetection mechanism in the SWIR range. Controlled dopant diffusion into polymer crystalline domains maximized the bound-to-free polaron ratio, directly improving device performance. The optimized OPD achieved an external quantum efficiency of 77,100% and a detectivity of 1.11×10^{11} Jones, demonstrating the potential of polarons as effective alternatives to Frenkel excitons in SWIR detection.

Poster Presentation **2PS-125**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Hierarchical Helical Morphologies as a Strategy for Dissymmetry Factor Amplification

이상욱, 오준학[†]

서울대학교

. Supramolecular chirality has emerged as a promising strategy for enhancing the chiroptical properties of optoelectronic materials. In this study, we present a method to effectively amplify molecular chirality by precisely controlling the self-assembly of perylene diimide (PDI) derivatives with chiral side chains. By finely tuning the solvent-assisted self-assembly conditions, we achieved a variety of supramolecular architectures, including unique helical structures that exhibited significantly enhanced dissymmetry factors in both circularly polarized light (CPL) absorption and photoluminescence. The close correlation between supramolecular structure and chiroptical activity was elucidated through detailed structural analysis. Furthermore, the chiral nanostructures were successfully applied as active layers in optoelectronic devices, demonstrating their potential as CPL detectors. This study highlights the underlying mechanisms of chirality induction and amplification via supramolecular engineering and provides a viable approach for the development of next-generation chiral optoelectronic materials and CPL-responsive devices.

Poster Presentation **2PS-126**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Backbone Modulation Strategy for Nonvolatile Artificial Synapse

이동화, 이은호[†]

서울과학기술대학교

Organic electrochemical transistors (OECTs) have emerged as promising candidates for neuromorphic devices capable of exhibiting synaptic properties such as long-term retention. While previous studies have primarily focused on improving synaptic behavior through morphological optimization at the electrolyte/semiconductor interface, systematic investigations into the correlation between charge carrier mobility in the conjugated backbone and synaptic performance remain limited. Here, we propose an effective molecular design strategy that enhances both charge transport and synaptic retention characteristics by modulating the conjugated backbone. This approach provides new insights into structure–transport–function coupling in organic synaptic devices and offers a viable path toward the development of robust, nonvolatile neuromorphic components.

Poster Presentation **2PS-127**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

A Deep Learning Approach to Surface Passivation Material Design for High-Efficiency Perovskite Light-Emitting Diodes

이동빈, 김호범[†]

광주과학기술원

Surface passivation is a key strategy to improve the external quantum efficiency (EQE) of perovskite light-emitting diodes (PeLEDs) by mitigating non-radiative recombination and stabilizing perovskite interfaces. However, the vast chemical space and the complex relationship between molecular structures and passivation performance present significant challenges in the rational design of effective surface passivators. Herein, we present a deep reinforcement learning (DRL) framework combined with a pre-trained deep neural network (DNN) utilizing KRFP fingerprints and high-importance chemical descriptors. The DNN model, acting as a reward function in the DRL environment, enables the autonomous exploration and optimization of novel surface passivation molecules. Our approach establishes a robust and data-driven strategy for accelerating the discovery of high-efficiency passivation molecules, paving the way for next-generation, high-performance PeLEDs

Poster Presentation **2PS-128**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Trap State Suppression Enabled by Modulated Donor Crystallization in Non-Halogenated Organic Photovoltaics

이다민, 함가영, 박창우, 차효정[†]

경북대학교

This study investigates tail states as key contributors to recombination-induced voltage loss through enhanced bimolecular recombination in organic photovoltaics (OPVs) processed with non-halogenated solvents. Grazing incidence wide-angle X-ray scattering (GIWAXS) reveals that the incorporation of PM6 promotes a more ordered face-on molecular orientation within the D18 donor layer. This improved molecular ordering suppresses carrier trapping associated with tail-state-induced energetic disorder—one of the primary causes of bimolecular recombination and voltage loss. Transient photovoltage and photocurrent measurements further confirm that the reduction in tail-state energy levels limits charge recombination and prolongs carrier lifetimes, ultimately leading to enhanced device efficiency. Collectively, these findings highlight the critical role of donor molecular orientation in regulating energetic disorder in LbL-processed OPVs.

Poster Presentation **2PS-129**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Surface-Brominated CsPbI₃ Nanocrystals Enabling High-Performance Red Electroluminescence for Wearable Display Applications

이경훈, 김윤호¹, 최문기¹, 양지웅⁺

대구경북과학기술원

¹ 울산과학기술원

All-inorganic halide perovskites are promising emitters for next-generation displays due to their tunable emission, narrow spectra, and high radiative efficiency. Among them, achieving pure red emission from ~10 nm CsPbI₃ nanocrystals remains challenging. Here, we report a mild post-synthetic halide exchange that incorporates bromide into CsPbI₃ nanocrystals (CsPbI₃:Br) without altering their core crystal structure. These modified nanocrystals exhibit enhanced red luminescence and improved charge transport. Red-emitting PeLEDs fabricated with CsPbI₃:Br achieve an EQE of 19.8%, comparable to leading devices. Furthermore, we demonstrate their integration into thin, flexible platforms capable of withstanding bending and deformation, enabling conformal attachment to curved surfaces. This approach offers a simple yet effective route to color-pure red-emitting perovskite nanocrystals and highlights their applicability in future flexible and wearable optoelectronic systems.

Poster Presentation **2PS-130**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Nanoimprint-Engineered Sensing Surface for Enhanced-Sensitivity in Extended-Gate Field-Effect Transistor Biosensors

이경민, 하영근[†]

경기대학교

Extended-gate field-effect transistor (EGFET) biosensors are promising tools for point-of-care diagnostics (POCD) due to their high sensitivity and label-free detection. However, electrolytes in this system lead to the formation of an electrical double layer (EDL), causing Debye screening that interferes with surface potential changes, significantly reducing sensor sensitivity. In this study, we use nanoimprint lithography (NIL) to modify the sensing surface of the extended gate. Patterns from optical discs were simply transferred onto the sensing surface using a PDMS mold to form concave surface structures. These features help suppress EDL formation in concave regions, thereby mitigating the Debye screening effect. Additionally, the extended-gate design allows the sensing part to be easily replaced, making the sensor reusable. This reusability, combined with straightforward patterning, makes the approach highly suitable for practical point-of-care applications.

Poster Presentation **2PS-131**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Optimization of Separation Process for High-Purity Semiconducting Carbon Nanotubes using Polyfluorene-Based Conjugated Polymers and Its Application to High-Performance Field-Effect Transistors

유태우, 이승훈¹

공주대학교 천안공과대학 신소재공학과

¹ 공주대학교

This investigation optimized the separation of intrinsic semiconductor/metallic mixtures of single-walled carbon nanotubes (SWNTs) using polyfluorene-based polymers for small-diameter (HiPco) and large-diameter (plasma torch) tubes. By precisely controlling polymer concentration, sonication time, and temperature, the critical trade-offs between yield-purity and dispersion-damage were balanced to establish optimal conditions for each system. The optimized process yielded >99% pure s-SWNTs, enabling high-performance field-effect transistors (FETs). FETs from large-diameter SWNTs achieved a high electron mobility of $43.6 \text{ cm}^2\text{V}^{-1}\text{s}^{-1}$, while those from small-diameter SWNTs showed an excellent ON/OFF ratio of 10^6 . This work proves that a tailored strategy, matching the polymer-SWNT system and process to the target device characteristics, is essential for developing next-generation electronics.

Poster Presentation **2PS-132**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Solid-State Homojunction Organic Electrochemical Transistors with Doped Polymer Electrodes

원동연, 조정호[†]

연세대학교

Organic electrochemical transistors (OECTs) have made strong interest in bioelectronics because of their distinctive capability to couple ionic and electronic transport. This feature makes them highly attractive for neuromorphic computing, biosensing, and wearable interfaces. Nevertheless, conventional OECTs rely on rigid metallic electrodes and liquid electrolytes, which restrict their integration into flexible, solid-state devices. To address this limitation, we demonstrate a solid-state homojunction OECT comprising a pristine polymer semiconductor channel, doped polymer semiconductor electrodes, and a solid electrolyte. The entire device stack is fabricated using photo-crosslinking, and the electrodes are formed by selective doping of the same polymer semiconductor. Three Lewis acids—gold(III) chloride (AuCl_3), iron(III) chloride (FeCl_3), and copper(II) chloride (CuCl_2)—are employed as molecular dopants, with AuCl_3 -doped polymers showing metallic conductivity ($\sim 100 \text{ S cm}^{-1}$). Using these materials, we obtain source, drain, and gate electrodes that enable a device mobility of $3.4 \text{ cm}^2 \text{ V}^{-1} \text{ s}^{-1}$ and excellent flexibility, with negligible degradation even after 5000 folding cycles at a bending radius of 0.1 mm. Furthermore, by integrating these homojunction OECTs, we successfully implement logic functions including NOT, NAND, and NOR gates.

Poster Presentation **2PS-133**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Chiropto-neuromorphic Operation Using Chiroptical Photocatalyst

원유상, 이정우, 김서영, 우승준, Pongphak Chidchob¹, 오준학[†]

서울대학교

¹ Chulalongkorn University

Organic electrochemical transistors (OECTs) are promising neuromorphic platforms due to their ionic–electronic coupling and memory characteristics. Light-driven synaptic devices using optical stimuli have gained attention for enabling low-power, non-invasive operation. While most studies rely on photoactive semiconducting layers, we present an alternative strategy by introducing a photocatalyst into the electrolyte with PBTTT-C12 as the semiconductor. This enables photoreactive OECT behavior with reliable synaptic plasticity under illumination. By incorporating chirality into the light-responsive photocatalyst, the system exhibits handedness-dependent photocurrent under circularly polarized light, allowing chirality-resolved neuromorphic operation. These results demonstrate its potential in chiroptical neuromorphic computing. This study offers a new route to integrate molecular chirality into advanced neuromorphic systems with directional optical selectivity.

Poster Presentation **2PS-134**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Supramolecular Engineering of Terahertz Wave Generators with Polar Substituents

오중권, 김채윤¹, 윤호섭, Mojca Jazbinsek², Fabian Rotermond¹, 권오필[†]

아주대학교

¹ Korea Advanced Institute of Science and Technology

² Zurich University of Applied Science

본 연구에서는 230×10^{-30} esu의 매우 높은 제 1차 초분극도를 갖는 2-(4-(4-(hydroxymethyl)piperidin-1-yl)styryl)-1-methylquinolinium (PMQ) 양이온 발색단을 기반으로 새로운 유기 비선형 광학 결정을 설계하고 합성했다. Benzenesulfonate 음이온에 할로젠과 같은 극성 치환기를 도입한 결과 기존의 비극성 치환기를 가진 음이온으로 구성된 결정과는 달리 대각 분자 배열 지수의 최대값을 달성하였다. 극성 치환기는 결정 내에서 비극성 치환기와는 달리 추가적인 이차 결합을 형성함으로써 새로운 초분자 상호작용을 유도하며, 이들의 더 큰 van der Waals 부피는 더 밀집된 공간 채움 특성을 가능하게 해 포논 진동을 효과적으로 억제할 수 있다. 이러한 구조적 특성은 테라헤르츠 (THz) 파의 자기-흡수를 줄여 효율적인 THz 파 광원으로의 응용 가능성을 시사한다. 실제 THz 발생 실험에서 해당 결정은 2-3 THz 주파수 영역에서 낮은 흡수를 나타냈고, 기준 무기 반도체인 ZnTe에 비해 약 7배 높은 THz 전기장을 생성했다.

Poster Presentation **2PS-135**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Dual-layered percolative networks of photoactive materials and elastomers for highly-stretchable, efficient organic photovoltaics

오종민, 김범준[†]

한국과학기술원

High PCE and stretchability are prerequisites for wearable applications of organic solar cells (OSCs). However most high-performance OSCs suffer from insufficient mechanical properties due to the brittleness of their photoactive layers. In this study, we develop OSCs with both high efficiency (PCE >15%) and exceptional mechanical robustness (COS >100%) by employing planar heterojunction (PHJ)-type photoactive layers consisting of a donor (D18) blended with an elastomer (SEBS) in the bottom layer and a blend of another donor with a small-molecule acceptor in the top layer. In the bottom layer, the incorporation of SEBS with D18 results in a bi-continuous network, which facilitates fast hole transport and effective mechanical stress dissipation. Simultaneously the top layer forms interconnected donor and acceptor domains, expanding donor/acceptor interface and promoting charge transport. These findings highlight the potential of the PHJ structure to develop OSCs for wearable uses.

Poster Presentation **2PS-136**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Hybrid 2D Nanostructure Films of Copper and Silver for Enhanced Electromagnetic Interference Shielding

오상현, 김태욱[†]

전북대학교

Two-dimensional (2D) copper nanosheets have emerged as promising conductive fillers for high-performance EMI shielding films. However, their practical use is limited by the need for high-temperature annealing to establish electrical percolation, which restricts compatibility with low-temperature substrates. To overcome this limitation, hybrid films composed of 2D Cu and Ag nanosheets (Ag NSs) were developed. Ag NSs provide superior conductivity and sinterability at lower temperatures, enabling robust conductive networks.

In this study, we systematically investigated the effects of Cu/Ag composition on film morphology, electrical conductivity, and EMI shielding effectiveness. By varying the mixing ratio and annealing temperature, key relationships between internal microstructure and performance were revealed. The optimized Cu/Ag film exhibited excellent EMI shielding under low-temperature conditions, showing strong potential for flexible and high-frequency electronic applications.

Poster Presentation **2PS-137**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Development of π -extended chiral ligands for circularly polarized light detection in 2D chiral perovskites

여도영, 정인환[†]

한양대학교

Chiral perovskites are promising materials for circularly polarized light (CPL) photodetectors due to their low trap densities, long carrier diffusion lengths and diverse crystal structures. Generally, chiral organic ligands are used to induce the chirality in perovskites. However, Various studies on chiral perovskites have been reported using the simple phenyl-based organic ligands such as methylbenzylamine and their derivatives. In this study, We introduce biphenyl-based chiral ligands, (R/S)-BPEAs, which enable the successful synthesis of chiral perovskites with larger-sized ligands. These new materials exhibit enhanced circular dichroism and improved CPL detection performance, expanding the possibilities for CPL photodetectors.

Poster Presentation **2PS-138**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Temperature-Responsive Ionic Conductors for Energy Systems

양현우, 문홍철[†]

한국과학기술원

As the need for advanced energy storage solutions grows, the development of materials that can self-regulate under varying environmental conditions has become increasingly important. This study focuses on the use of temperature-sensitive ionogels, which exhibit unique ionic conductivity behaviors in response to temperature changes. The ionogels undergo a reversible phase change that alters their ionic conductivity, providing an efficient mechanism for regulating performance in electrochemical applications. This temperature sensitivity makes the ionogels ideal candidates for energy storage platforms, where they can help improve the stability and safety of devices operating under fluctuating thermal conditions. By integrating these materials into energy storage systems, we can enhance performance while ensuring reliable operation across a wide range of temperatures.

Poster Presentation **2PS-139**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Asymmetric Interactions from Symmetric Molecular Structure Lead to Efficient and Diurnally Stable Semitransparent Organic Solar Modules

양상진, 서주호, 김서윤, 김우진, 양창덕⁺

울산과학기술원

Although symmetry-breaking designs in nonfullerene acceptors (NFAs) can enhance semitransparent organic solar cell (ST-OSC) performance, asymmetric interactions from symmetric structures remain unexplored. Here, we show that symmetric 4FY, with 2D fluorophenyl outer groups, enables dipole-driven self-assembly via asymmetric interactions, resulting in tighter packing than Y6. This leads to efficient layer-by-layer OSCs with reduced energy/recombination losses and improved charge transport. ST-OSCs based on PCE10-2F/4FY reach 10.81% PCE, 45.43% AVT, and 4.91% LUE. Notably, the device shows excellent diurnal cycling stability with a T80 of 134 h—about 17× that of PCE10-2F/Y6. Large-area (18 cm²) modules based on PCE10-2F/4FY deliver 6.78% PCE and record-high 3.10% LUE among narrow-bandgap ST-OSCs. This work introduces a design strategy where symmetric NFAs induce beneficial asymmetric interactions for scalable, stable, and high-efficiency ST-OSCs.

Poster Presentation **2PS-140**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Stable and Flexible Field-effect Transistors based on Semiconducting Single-walled Carbon Nanotubes

양동성[†], 이창기

한국생산기술연구원

Wearable and convenient electronic devices have emerged as essential components for next-generation electronics and intelligent systems. As the AI era unfolds, research into physical AI- embedded by interactive, sensor integrated devices and robotics-is rapidly expanding. In this context, developing user-friendly electronic devices that can physically interface with AI systems has become increasingly important. Such devices fundamentally require flexible and even stretchable physical characteristics. Semiconducting materials for these electronic components should exhibit not only superior mechanical properties but also high charge carrier mobility and density. From this perspective, semiconducting single-walled carbon nanotubes (s-SWNTs) represent promising materials. In this study, stable and flexible field-effect transistors (FETs) were fabricated using s-SWNTs as an active layer. Additionally, systematic methods to enhance device performance were introduced.

Poster Presentation **2PS-141**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Integrating Donor-Optimization Strategies via Two-Step Polymerization for Hydrogen Evolution in Visible-Light Photocatalysts

정우택, 안상혁, 함가영¹, 이소연², 양지웅², 정대성⁺, 차효정¹

포항공과대학교

¹ 경북대학교

² DGIST

To develop efficient polymer photocatalysts for visible-light-driven hydrogen evolution, we synthesized BT-based conjugated polymers with varying amounts of BDT as a strong donor and fabricated them into polymer dots (Pdots) via nanoprecipitation. The optimized polymer, PBF8BT-2, achieved a hydrogen evolution rate of 22,134 $\mu\text{mol g}^{-1} \text{h}^{-1}$ under $\lambda > 420 \text{ nm}$ with 8 wt% Pt, nearly twice the performance of F8BT. Photophysical analyses and DFT calculations showed that BDT incorporation enhanced charge separation, prolonged carrier lifetimes, and improved π - π stacking. This work offers a scalable design framework bridging organic photovoltaic and photocatalyst strategies.

Poster Presentation **2PS-142**

분자전자 부문위원회(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Injection Layer Formation via Reactive Ion Etching for Reducing the Contact Resistance in Organic Schottky Barrier Transistors

심혜륜, 정대성[†]

포항공과대학교

Organic Schottky barrier transistors (OSBTs), defined by short channel lengths based on the thickness of the active layer, utilize a Schottky barrier to determine the off-state, which removes the need for an insulating layer within the semiconductor and allows for an uncomplicated, scalable production process. However, the Schottky barrier creates significant contact resistance, a primary limitation impacting the device's overall electrical performance. While adding a charge injection layer can mitigate contact resistance, installing it beneath randomly formed source electrodes is challenging. In this research, we utilized oxygen-based reactive ion etching to place a charge injection layer under the source electrode, which increased the on-current and enhanced charge injection capabilities. This approach enabled the achievement of the highest on/off ratio of 3.38×10^7 in the OSBT and ensured high stability by employing a non-doped semiconductor as the active layer.

Poster Presentation **2PS-143**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Structural and Rheological Characterization of Triblock Copolymer-Based Hydrogels During Hydrolysis

황선혜, 김상윤, 김신철, 김다혜, 최지우, 오혜진, 김세영[†], 정선엽

단국대학교

Poly(D,L-lactide) (PLA) is an FDA-approved polymer for drug delivery systems, and with a combination of hydrophilic polyethylene oxide (PEO), PLA-b-PEO-b-PLA triblock copolymers offer excellent biodegradability and biocompatibility. In this study, we synthesized a PLA-b-PEO-b-PLA triblock copolymer and evaluated the structural and rheological properties of hydrogel made from simple aqueous self-assembly of the polymer. The copolymers were synthesized via ring-opening polymerization with Tin(II) 2-ethylhexanoate(Sn(Oct)₂) as catalyst.

The degradation behavior of the hydrogels was monitored over time under physiological temperature 37°C.

The hydrogels exhibited time-dependent degradation with observable changes in structural and viscoelastic properties (e.g., PLA domain size, dynamic moduli). These results suggest the potential of PLA-b-PEO-b-PLA based hydrogels as stimuli responsive plat forms for controlled drug delivery applications.

Poster Presentation **2PS-144**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Neglecting Polarizability in Polyethylene Oxide Accelerates Lithium Ion Transport

홍예성, 성봉준[†]

서강대학교

MD simulations are a powerful tool for investigating Li⁺ ion transport at the molecular scale, most studies neglect polarizability due to its high computational cost. However, we find that polarizability plays a critical role in accurately modeling Li⁺ ion transport. In this study, we perform all-atom MD simulations of LiPF₆ in PEO system to see the effect of polarizability. We selectively activate and deactivate polarizability using the force field to observe the structural and dynamical changes in the PEO-Li⁺ system. The first peak of the Li-O RDF decreases in order PM > NP > IP, whereas the O-O RDF remains nearly unchanged regardless of polarizability. Additionally, the MSD of PEO does not change significantly with polarizability, while the MSD of Li⁺ ion shows considerable variation. These structural and dynamical observations show that polarizability increases the binding between Li⁺ ion and oxygen atoms in PEO chains, which slows down inter-chain hopping of Li⁺ ion.

Poster Presentation **2PS-145**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Microstructure Evolution of Vitrimers under Strain and Temperatures and its effect on the Properties

현지은, 김소연[†]

서울대학교

Vitrimers are polymeric materials featuring cross-linked networks formed via dynamic covalent bonds. The processability and recyclability of vitrimers are enabled by its ability to undergo topological changes in response to external stimuli, such as heat and stress.

As the application of tensile force induces chain alignment along the direction of deformation, polymers with dynamic bonds experiences the stress relaxation via network rearrangement. Consequently, difference in kinetics between the rates of tensile deformation and the bond-exchange reaction is expected to lead to distinct structural changes and mechanical responses.

In this study, we investigate the evolution of microstructure and properties of vitrimers under tensile deformation at various strain rates. The stress relaxation tests were conducted to characterize the relaxation behavior. SAXS experiments were performed with tensile deformation to simultaneously investigate the microstructural changes.

Poster Presentation **2PS-146**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Plasmonic Mid-IR Sensing via Graphene Nanoribbons Fabricated Using Block Copolymer Patterns Aligned by Shear-Rolling process

허정, 손정곤¹

한국과학기술연구원

¹ 한국과학기술연구원

The mid-infrared region enables identification of various biomolecular vibrations. However, its long wavelength results in low sensitivity when detecting single molecules. To overcome these limitations, plasmon-enhanced mid-IR sensing techniques have been developed. One promising approach for plasmonic mid-IR sensing is the use of graphene nanoribbons. Owing to their atomically thin structure, graphene nanoribbons confine the electric field effectively and their low carrier density allows tunability of the plasmonic frequency via external gating. A conventional method for fabricating graphene nanoribbons is e-beam lithography, which suffers from high cost and low throughput. In this study, we propose a scalable method to fabricate graphene nanoribbons using unidirectionally aligned block copolymer patterns. Especially, our shear-rolling process enables rapid, large-area, and highly oriented alignment of block copolymer patterns on graphene directly.

Poster Presentation **2PS-147**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Control of Copolymer Content of PDD and That's Effect on EW and Yield in HOPIs

한훈희, 곽영제[†]

승실대학교

High oxygen permeability ionomer (HOPIs) are used in proton exchange membrane fuel cells to enhance efficiency. To develop HOPIs with tunable ion conductivity, controlling the copolymer content is crucial, which can be achieved by adjusting the initial feed ratio of comonomers. Accurate control over this composition requires knowledge of the copolymer reactivity ratios. In this study, we experimentally determined the reactivity ratio using the Fineman-Ross method. The obtained reactivity ratios were then used to predict the copolymer composition, which was compared to the values determined by ^{19}F -NMR. Additionally, we investigated the effect of copolymer content on the polymerization yield and the equivalent weight of the synthesized HOPIs.

Poster Presentation **2PS-148**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Non-selective polymer crosslinkers for commercial elastomer

한동현, 강지형⁺

서울대학교

A large volume of polymers is produced in modern society, but significant issues remain regarding their disposal and recycling. Recent research has focused on upcycling and post-modification strategies to impart new functions to commercial polymers. In this study, we investigate how the physical properties and crosslinking density of commercial elastomers (e.g., SEBS, PU) are affected by post-modification with various crosslinkers. The crosslinkers have PEG, PDMS, or alkyl chains as backbones, and we examine how their molecular weights and feed ratios influence the material properties. For covalent attachment, tetrafluorobenzene azide or benzophenone groups were introduced at the chain end of the crosslinkers, enabling nonselective photo-crosslinking to the C–H bonds of the base elastomers. Additionally, hydrogen bonding moieties were incorporated into the crosslinker backbone to examine their effect on network properties.

Poster Presentation **2PS-149**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Controlling the Non-Conventional Self-Assembly of Charged Block Copolymer Thin Films

최상현, 김소연[†]

서울대학교

The self-assembly of block copolymer in thin films has attracted great attention as a potential platform for nanopatterning. To advance future applications of BCP nanopatterning, it is essential to develop nanostructures that go beyond the conventional morphologies of BCPs. To achieve this, previous studies have employed diverse strategies such as blending, templating, and external fields.

In this study, we further expand the nanopattern library of BCPs by selective charging. Aligned BCP cylinders are charged by immersing in anionic metal complex solutions, followed by thermal annealing to induce transition into unique non-conventional morphologies. Image analysis show that the resulting morphology is determined by the defectivity of the initial aligned cylinders. Furthermore, the formation mechanism of the unique structures is revealed by structure analysis. This approach offers a facile and cheap platform for fabricating nanopatterns inaccessible with conventional BCP self-assembly.

Poster Presentation **2PS-150**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Reproducing All-Atom Mechanical Properties in Coarse-Grained Models

최동근, 박형식, 성봉준[†]

서강대학교

Accurately reproducing the mechanical properties of an all-atom (AA) model within a coarse-grained (CG) model requires the appropriate time scaling factor and level of coarse-graining. Since CG models have smoother potential energy surfaces, they exhibit faster dynamics than AA models. Although the Mean Square Displacement (MSD) trends were consistent across models, a significant discrepancy emerged after applying time scaling to construct stress curves. All CG models consistently underestimated the stress compared to the AA model, failing to accurately reproduce the mechanical behavior. This discrepancy arises because the energy dissipation mechanisms differ. In AA models, the dominant mechanism transitions from inter-chain non-bonded interactions to intra-chain dihedral motion during deformation. The simplification of such intramolecular interactions in CG models fundamentally alters this energy pathway, leading to the inaccurate prediction of mechanical properties.

Poster Presentation **2PS-151**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Comparative Studies on Rheological Properties of Cellulose Nanofiber (CNF)-reinforced Natural Polymers

이기훈[†], 최가람

서울대학교

Cellulose nanofiber (CNF) was employed as a reinforcing agent to enhance the rheological and mechanical properties of biopolymer systems. Natural polymers such as carboxymethyl cellulose, alginate, pectin, and gelatin were reinforced with CNF at varying concentrations to obtain tailored viscoelastic characteristics. Due to its nanoscale network structure and high elastic modulus, CNF significantly improved the durability, structural integrity, and shear-responsive behavior of the formulations. Rheological properties were assessed through modulus measurements and shear-thinning analysis. In addition, tensile strength, water uptake, and swelling behavior were also evaluated to investigate mechanical robustness and moisture retention performance. These findings provide the understanding of designing polymer structure-property relationships in CNF-reinforced hydrogels and development of natural polymer composites for potential biomedical applications.

Poster Presentation **2PS-152**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Prediction of low deformation rate creep behavior of polyethylene via molecular dynamics simulation

지창환, 박형식, 성봉준[†]

서강대학교

Creep is a method to measure mechanical properties by deforming under constant stress. Creep behavior shows three stages: primary creep, initial extension occurs rapidly; secondary creep, creep strain shows linear response; and tertiary creep, strain increases rapidly after high amount of deformation. Primary and secondary creep can be described by the Burger model which implies that they are related to Young's modulus and viscosity, respectively. However, analyzing creep via molecular dynamics (MD) simulation is still insufficient because of the rapid deformation rate, which makes it difficult to reproduce real experiments. To overcome these limitations, we employed the Ree-Eyring theory, which describes the relation between strain rate and viscosity. In this work, we present a method for predicting creep properties. Applying this methodology, we predicted viscosity in the experimental regime using MD simulation in good agreement with the experimental range.

Poster Presentation **2PS-153**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Suppression of Initial Solvent-Driven Non-Equilibrium Effect on Polymer Nanocomposites with Physically Adsorbed Bimodal Polymers

조성민, 공태연, 김소연[†]

서울대학교

In polymer nanocomposites (PNCs), polymers are adsorbed on the surface of nanoparticles, and adsorbed polymers contribute to determining the physical properties of PNCs. Many studies have first changed the intrinsic parameters such as size/shape/chemistry of particles/polymer to control adsorbed polymer. However, recent studies have shown that the final states of PNCs have path dependency induced by the non-equilibrium state of adsorbed polymers.

In this work, we investigate how the initial solvent-driven non-equilibrium effect on PNC changes when the conformation of adsorbed polymers is intentionally modified. To tune the chain conformation, we employ PNCs with a bimodal molecular weight distribution, in which unique chain conformations are formed via competitive adsorption between long and short chains. We found that the non-equilibrium effect in PNCs was suppressed in bimodal PNCs. This study will offer an insight into strategies for tuning the properties of PNCs.

Poster Presentation **2PS-154**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Molecular Design of Ionogel for Enhanced Ionic Conductivity at Low Temperature

조상현, 문홍철[†]

KAIST

As research in space and polar regions continues to expand, the demand for stable power supply under extreme environmental conditions has become increasingly critical. However, a significant decrease in conductivity is observed in ionogel-based electrolytes at low temperatures due to the reduced mobility of polymer chains, limited ion-ion dissociation, and low polymer flexibility. Here, we demonstrate a design strategy for ionogel electrolytes that maintain ionic conductivity at low temperatures through controlled molecular interactions. Two synergistic design strategies were employed: increasing polymer flexibility to enhance ion mobility, and improving the ionicity of the ionic liquid through interactions with fluorinated side chains. This ionogel overcomes the low-temperature limitations of existing materials and shows potential for practical applications in thermally demanding environments.

Poster Presentation **2PS-155**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Study on life prediction of plastic (PE, PVC) buried pipes in Seoul using TGA

정유석[†], 허상훈, 장동혁, 최재호¹, 변승헌¹, 안재찬¹

한국환경공단

¹ 서울물연구원

도시 인프라의 핵심 구성 요소 중 하나인 상수도에는 플라스틱 관(PE, PVC)이 매설되어 있다. 이러한 관들은 지하에 장기간 매설된 채 외부 노출이 어렵기 때문에, 실제 사용 환경에서의 열화 상태나 잔존 수명을 판단하는 데 한계가 있다. 특히 서울시와 같은 대도시에서는 관의 노후화로 인한 누수, 침하, 단선 등의 문제가 반복되고 있으며, 이에 따라 과학적이고 정량적인 수명예측 기법의 필요성이 대두되고 있다.

본 연구는 서울시 내 매설된 PE 및 PVC 플라스틱 관의 수명 예측을 위해 열중량 분석(Thermogravimetric Analysis, TGA)을 활용한 비교 분석을 수행하였다. 각 관의 매설 연도와 재질(PE 및 PVC)에 따라 수거된 샘플을 대상으로 비등온 TGA 시험을 실시하였으며, 이를 통해 재료의 열적 열화 특성과 분해 시작 온도를 파악하였다. Flynn-Wall-Ozawa 방법을 통해 전환율별 활성화 에너지를 계산하였고, 이를 바탕으로 Toop 해석법을 적용하여 수명을 예측 비교하였다. 본 연구는 도시 인프라의 플라스틱 관 노후화 평가 및 유지보수 계획 수립에 실질적인 기초 자료로 제공될 수 있다.

Poster Presentation **2PS-156**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Confinement of metal salts in self-assembled block copolymers

정승환, 박문정[†]

포항공과대학교

Functional organic-inorganic hybrid materials have attracted ceaseless interest over the past decades owing to their unique optical and absorption properties, making them promising candidates for applications in optical devices and solar cells. However, integrating inorganic components, primarily metals, into organic frameworks have faced challenges, as the tendency of metals to aggregate uncontrollably hinders the formation of high-fidelity structures and limits scalable, reproducible fabrication of hybrid structures with controlled spatial distribution of each component. Here, we present a strategy to localize metal salts within the subdomains of self-assembled polymer structures by incorporating functional end-groups, which strongly coordinate with metal ions. By varying the type and loading levels of metal salts, we investigated the resulting morphology, optical, and mechanical properties of the hybrid materials to explore their potential for use in advanced optical systems.

Poster Presentation **2PS-157**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Effect of End Groups on Supramolecular Polymer Network Properties

장건호, 강지형⁺

서울대학교

Supramolecular polymers have been widely studied to understand how network components affect their outstanding mechanical properties. To maximize these advantages, most current studies have focused on modifying the polymer backbone, while the effect of end groups has received limited attention despite their high mobility. Here, we studied how high mobility of end groups affects the supramolecular polymer network. Three different types of end group – a control group, a structure-modifying group, a crosslinking-weakening group, were introduced to the common polymer backbone. Compared to the control group, the structure-modifying group induces microstructural changes in polymer network. With the crosslinking-weakening group, the mechanical properties have been changed. De-crosslinking effect enhances the chain mobility and self-healing performance. This work proposes a new strategy for supramolecular polymers, by controlling dynamicity without modification of the main chain.

Poster Presentation **2PS-158**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Stabilization of superlattices and Frank-Kasper phases in block copolymers through zwitterionic interactions

민재민, 이호준, 박문정[†]

포항공과대학교

Superlattices provide unprecedented mechanical, electronic, and dielectric properties. However, developing such structures via bottom-up method remains rare, as it requires precise control over interfacial curvature. This becomes more challenging with the incorporation of ionic components. Here, we present a strategy for stabilizing superlattices, utilizing charged block copolymers and zwitterions as interfacial stabilizing agents. By systematically tuning the interaction strength of zwitterions, we show that zwitterions with weakly interacting cations preferentially localize at the interfacial sublayers between ionophilic and ionophobic domains. With increasing zwitterion concentration, the enhancement of ion-dipole interactions drives curvature modulation, facilitating phase transitions from superlattices to Frank-Kasper phases. These materials exhibit excellent dielectric properties and mechanical robustness, potentially enabling next-generation flexible electronic systems.

Poster Presentation **2PS-159**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Toughening Polymer Networks via Self-assembled Elastic Supramolecular Sponges

이해승, 김지윤, 강지형[†]

서울대학교

Polymer networks contain distribution in chain lengths. Upon stretch, the shortest polymer chains break earlier than others, resulting in poor fracture properties. To overcome this weakness, previous studies have focused on introducing sacrificial bonds. However, due to the mechanism based on irreversible bond scission, most systems suffer losses in elasticity and exhibits low fatigue resistance.

In this session, I will introduce supramolecular self-assembly as the key to overcome this tradeoff. Specifically, we use our designed oligomer that enables multivalent supramolecular interaction, which self-assembles to elastic supramolecular sponges (ESS) within various polymer networks. When ESSs are interlinked to the polymer network, they elastically deform to synchronize the tension applied to each polymer chain. This results in significant improvement in fracture properties including strength, fracture toughness, and fatigue threshold, without loss in elasticity.

Poster Presentation **2PS-160**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Enhancing Structural Stability in CO₂ Cycloaddition: Hierarchical MOF-808@Aerogel Composites with Tunable – OH Groups

이채연, 심상은[†]

인하대학교

In response to global warming caused by rising CO₂ emissions, among various approaches, the cycloaddition of CO₂ to epoxides using MOFs as catalysts is promising; however, most MOFs are microporous and tend to aggregate, limiting mass transfer and reducing yields with bulky epoxides. To address these issues, we fabricated MOF-808@aerogel composites resulting in a hierarchical structure. This structure improves MOF dispersion and mass transfer in cycloaddition reactions.

MOF-808, a 6-connected Zr-based MOF, has a loose framework and low structural stability. To overcome this, we synthesized aerogels using precursors with different numbers of –OH groups (VDMMS, VDMMS-co-VMDMS (1:1), VMDMS, VMDMS-co-VTMS (1:1), VTMS) and incorporated MOF-808 within these. The –OH groups on the aerogel chemically bond with the Zr, yielding composites with enhanced structural robustness. Our results show that this strategy provides superior durability compared to pristine MOF-808.

Poster Presentation **2PS-161**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Study on Surface Grafting of Polyethylene via Electron Beam Irradiation

이중남, 이건영, 정진혁¹, 김경민, 임정혁⁺

국립한국교통대학교

¹ 국립한국교통대학교

This study aims to modify the surface of polyethylene (PE) films by generating free radicals through electron beam (EB) irradiation and subsequently introducing functional molecules. EB irradiation was carried out under both air and nitrogen atmospheres. In the air atmosphere, functional monolayers were formed via silanization using (3-glycidyloxypropyl)trimethoxysilane (GPTMS) and (3-mercaptopropyl)trimethoxysilane (MPTMS). Under the nitrogen atmosphere, free radicals were generated on the PE surface, allowing for surface modification through grafting of glycidyl methacrylate (GMA). The chemical and physical characteristics of the modified surface were analyzed using contact angle measurements, Fourier-transform infrared spectroscopy, atomic force microscopy, and scanning electron microscopy.

Poster Presentation **2PS-162**

고분자구조 및 물성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Efficient Adipic Acid Synthesis from Bio-Based Glucaric Acid Salts

이지원, 이주홍, 김이천, 박현태, 이근호, 임원빈, 민진규, 이재룡, 봉하송, 정경주,
배지홍, 허필호[†]

부산대학교

Potassium glucarate, derived from renewable glucose, serves as a promising bio-based intermediate for sustainable adipic acid synthesis. In this study, adipic acid was produced via a one-pot reaction involving deoxydehydration (DODH) and hydrogenation using a Pd-ReOx/AC catalyst. The reaction was carried out under 110~150 °C and 2~30 bar H₂ in alcohol as solvent. The DODH reaction selectively removed hydroxyl groups of side chain from glucarate, forming an unsaturated intermediate, which was subsequently hydrogenated to adipate ester. As a result, solution was concentrated and converted to adipic acid through hydrolysis. Yield and purity of product were confirmed using FT-IR, ¹H, and GC/LC-MS. This study suggests that biomass can be used as an efficient and selective method for converting glucarate to adipic acid

Poster Presentation **2PS-163**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Hydrogel-Based Battery Operated by the Thermally Regenerative Electrochemical Cycle (TREC) Principle

황소정, 원종빈, 김동혁, 구형준⁺

서울과학기술대학교

A large portion of the energy consumed by humans is dissipated as low-grade waste heat. To harvest this thermal energy, batteries based on thermally regenerative electrochemical cycle (TREC) principles have been explored. However, conventional TREC systems typically rely on rigid electrode materials and are implemented in bulky, beaker-type configurations. Herein, we introduce a hydrogel-based battery system that operates on the TREC principle. The device adopts a three-electrode configuration comprising PBA as the working electrode, PEDOT:PSS as the counter electrode, and Ag/AgCl as the reference electrode. Electrochemical performance was evaluated using CV and GCD measurements. The system's thermal energy conversion capability was assessed through temperature coefficient analysis and voltage-specific capacity profiling. This hydrogel-based TREC platform offers promising potential for integration into next-generation wearable thermal energy harvesting systems.

Poster Presentation **2PS-164**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Enhanced Interfacial Adhesion and Thermal Stability of Epoxy Composites Reinforced with Surface-reactive Silica Nanoparticles

황민영, 정영규[†]

충남대학교 유기재료공학과

Epoxy composites are commonly used as epoxy molding compounds (EMCs) to protect integrated circuits (ICs) from external environments. However, the significant mismatch in the coefficient of thermal expansion (CTE) between the epoxy matrix and fillers induces thermal stress, which degrades mechanical properties, causes warpage, and leads to interfacial cracking of ICs, limiting their industrial applicability. This study introduces a novel epoxy composite system that incorporates silica nanoparticles modified with 3-glycidyloxypropyltrimethoxysilane (GPTMS) as a silane coupling agent. The inclusion of GPTMS-modified silica enhances interfacial adhesion and effectively reduces thermal expansion. Consequently, the developed composites exhibit improved mechanical strength, enhanced thermal stability, and excellent compatibility with various functional fillers. This work presents a promising approach for the development of high-performance epoxy composites for next-generation applications.

Poster Presentation **2PS-165**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Enhanced Dielectric Properties of PVDF-TrFE Composites via Self-Assembled BaTiO₃ Nanoparticle Networks and Polymer Infiltration

한준호, 구강희[†]

울산과학기술원

Achieving high dielectric performance in polymer composites is essential for advanced energy storage and electronic devices. We propose a strategy to enhance the dielectric constant of polymer-ceramic composites by combining a self-assembled BaTiO₃ (BTO) nanoparticle network with polymer infiltration using poly(vinylidene fluoride-trifluoroethylene) (PVDF-TrFE). BTO nanoparticles were self-assembled into a uniform network at the water-air interface and transferred onto a substrate. PVDF-TrFE was then spin-coated to enable polymer infiltration into the ceramic layer.

This mild and scalable process avoids high-temperature or high-pressure treatments, offering simplicity and broad applicability. It is also compatible with various polymer matrices, enabling composite design tailored to electrical or mechanical needs. This strategy offers a promising route to fabricate high-performance dielectric materials for diverse applications.

Poster Presentation **2PS-167**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Preparation Reduced Graphene Oxide Aerogel and Its Application as a Pressure Sensor

최현호, 임민혁¹, 김승현¹

인하대학교 화학공학과

¹ 인하대학교

The practical application of graphene aerogels in pressure sensors has been limited by their inherent brittleness, despite their low density, high porosity, and excellent electrical properties. To address this issue and improve mechanical performance, we prepared a three-dimensional porous aerogel by reducing graphene oxide (GO) with L-ascorbic acid (L-AA) as a green reducing agent and incorporating polydopamine (PDA) during synthesis. In this study, introducing polydopamine effectively suppressed volume shrinkage during aerogel formation, thereby enhancing the mechanical properties of the resulting aerogel. The structural, mechanical, and electrical properties of the reduced graphene oxide-polydopamine aerogel were characterized using scanning electron microscopy (SEM), a universal testing machine (UTM), and a multimeter. The sensor performance was evaluated, confirming its potential as a flexible and sensitive material for pressure sensing applications

Poster Presentation **2PS-168**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Tetrazolium-Polymer Composite Electrolyte for Lithium Metal Batteries

최소연, 이기라[†]

포항공과대학교

Lithium metal batteries (LMBs) are characterised by their high theoretical capacity (3860 mAh/g) and low redox potential (-3.045V vs. SHE). However, dendrite formation and interfacial instability hinder practical use.

In this work, we propose a polymer composite electrolyte based on polyacrylonitrile (PAN) and azide-functionalised mesoporous silica nanoparticles (MSNs), chemically crosslinked via tetrazole ring formation through cycloaddition. The cationic-tetrazolium ring facilitates lithium-ion transport by affecting anion mobility, similar to single-ion conductors.

The tetrazolium electrolyte exhibits a high lithium-ion transference number ($t_{Li^+} = 0.91$) and ionic conductivity (2.7 mS/cm at 80°C). In LiFePO₄ half-cell tests, it demonstrates long-term cycling stability (140.4 mAh/g over 290 cycles at 1C). This work demonstrates an approach in composite electrolytes to enhance ionic transport and stable electrochemical performance of LMBs.

Poster Presentation **2PS-169**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Preparation of Mechanically Flexible and Thermally Stable Polyimide Foams

최성훈, 박사랑, 박노균, 조경국, 김윤호, 원종찬⁺

한국화학연구원

Polyimide foam (PIF) has excellent mechanical flexibility, thermal/chemical stability, radiation resistance, and flame retardancy providing essential properties for advanced applications in extreme or multifunctional environments, including wearable electronics, aerospace cushioning, soft robotics, and thermally resilient impact-absorbing systems. In this study, functional PIFs were developed using poly(ether amide acid salt) (PEAS) powder as a precursor via a powder-based foaming process. Through systematic modification of the polymer backbone and optimization of the foaming conditions, we successfully obtained low-density foams with uniform pore sizes on the order of several hundred micrometers. In particular, PIFs exhibited not only mechanical compliance but also outstanding thermal stability. This study highlights the need for thermally stable yet mechanically flexible foam, and the potential of soft PIFs to expand the scope of high-performance polymer applications.

Poster Presentation **2PS-170**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Thermal Interface Composites with Vertically Aligned Liquid Metal-Coated Copper Fillers

최민영, 김현중, 경한빛, 김성수, 정여진, 구형준⁺

서울과학기술대학교

This study presents a novel thermal interface material (TIM) composed of Cu and gallium-based liquid metal (LM). Due to its high thermal conductivity (401 W/m·K), Cu is widely used in thermal management composites. LM remains liquid at room temperature, offers moderate thermal conductivity (26.6 W/m·K), and readily forms alloys with Cu, enhancing interconnectivity and heat transport. To explore this effect, Cu particles coated with LM (LM@Cu) were used as fillers in PDMS matrix, and thermal conductivity was evaluated. To improve heat transport, dielectrophoresis (DEP) was applied to vertically align the LM@Cu particles. Cross-sectional SEM imaging confirmed filler alignment. A comparison between samples with and without DEP revealed that DEP improved thermal conductivity. Finally, thermal performance was validated using an operating LED setup, where the TIM with LM@Cu fillers showed the most efficient heat dissipation, evidenced by the lowest temperature rise.

Poster Presentation **2PS-171**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Textile-based Capacitive VOC Sensor for Selective Toluene Detection at Room-Temperature

최민영, 배지인, 소주희¹, 구형준[†]

서울과학기술대학교

¹ 한국생산기술연구원

The monitoring of volatile organic compounds (VOCs) is becoming increasingly critical in various fields, including air quality management, and health and safety. Among VOCs, toluene induces neurotoxic effects upon prolonged exposure, even at low concentrations. Herein, we present a flexible capacitive toluene sensor based on conductive textile electrodes and a polydimethylsiloxane (PDMS) dielectric layer. Capacitance changes are sensitively governed by swelling behavior and dielectric constant variations of the PDMS layer upon VOC absorption. Theoretical predictions based on the Bruggeman theory showed good agreement with experimental results. The sensor exhibited excellent selectivity to toluene across a wide concentration range, with a fast response time and high durability, maintaining performance over 10000 bending cycles. This study demonstrates the potential of textile-based sensors for real-time, low-cost, and energy-efficient toluene monitoring in wearable applications.

Poster Presentation **2PS-172**
고분자가공/복합재료/재활용(II)
2025.9.30(화), 17:00~18:30, 포스터장
Chair: 구강희, 김종호

A Study on the Sound Absorption Performance by Developing Engine Room Sound-absorbing Materials with Low-Density Semi-rigid Recycled Polyurethane Foam

최경민[†], 최준원

대한솔루션

최근 자동차의 고급화 및 전기 자동차 확대에 의한 주행거리 증대를 위한 연비효율 개선과 환경문제로 인한 재활용을 향상에 대한 중요성이 증가하여 자동차 엔진룸의 후드 및 대쉬 판넬에 일반적으로 사용되는 흡음재인 GLASS WOOL 소재를 40% 경량화 가능한 저밀도 폴리우레탄 폼으로 대체 되고있습니다.

PU 폼은 중량 대비 우수한 흡음 성능을 가져 엔진룸 흡음재의 장점을 극대화할 수 있지만 열경화성 소재로 재활용을 향상에는 어려움이 있다. 또한, 엔진룸 흡음재에는 외관 품질과 강성을 보완하기 위해 아크릴 바인더 함침 PET 부직포가 적용되고 있습니다. 본 연구에서는 재활용 1~2데니어 PET와 해중합되어 6% 재활용을 PU 폼을 적용한 엔진룸 흡음재의 흡음 성능과 물리적 성질을 시험하였다.

Poster Presentation **2PS-173**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

다양한 폐차 유래 Polyamide 복합소재(ELV)의 물리적 특성

차승환⁺, 정도연, 이종수

BGFecomaterials

2023년도에 제안된 신 EU ELV Directive의 규제는 2031년부터 자동차 유럽 수출에 적용받기 때문에 차량 수출을 위한 소재·부품의 공급망 확보를 위한 재활용 플라스틱 소재 및 이를 적용한 부품 개발 규제이며, 각국의 탄소중립 정책에 의거, 의무 사용 및 수요급증이 예상되는 자동차용 재활용 엔지니어링 플라스틱 소재의 수급 및 성능 향상이 앞으로의 과제라 할 수 있다.

국내에서 폐차유래 폴리프로필렌 등은 이미 상업화가 진행중에 있으나 해체가 어렵거나 기준이 없는 나일론 소재는 ARA를 통해서 폐소스 수거가 24년 초부터 가능한 실정이다. 이전까지는 비유가성으로 인하여 자원화로 이루어 지지 않고 있다가 EU-ELV 정책에 대응하고자 현대기아에서 생산자책임재활용으로 시행해오던 기관을 활용하여 첫발을 내딛었다.

본 연구에서는 다양한 부품의 폐차유래 소재 폐소스를 (주)도원으로부터 받아 자동차용 부품에 활용할 수 있을지에 대한 DB를 구성 하였다. 본연구에서 폐차 유래 소재의 물성 한계를 극복하고 보다 넓은 영역의 사업군으로 더 많은 재활용률을 제고 할 수 있을 것이라 기대 해 본다.

Poster Presentation **2PS-174**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

폐차 유래 재활용 소재를 활용한 자동차용 Cylinder head cover 부품 적용

차승환⁺, 정도연, 이종수

BGFecomaterials

2023년도에 제안된 신 EU ELV Directive의 규제는 2031년부터 자동차 유럽 수출에 적용받기 때문에 차량 수출을 위한 소재·부품의 공급망 확보를 위한 재활용 플라스틱 소재 및 이를 적용한 부품 개발 규제이며, 각국의 탄소중립 정책에 의거, 의무 사용 및 수요급증이 예상되는 자동차용 재활용 엔지니어링 플라스틱 소재의 수급 및 성능 향상이 앞으로의 과제라 할 수 있다.

기존의 폐차기반 나일론 소재의 경우 해체작업의 메뉴얼 부재 및 비유가성으로 자원화로 이루어 지지 않고 있다가 EU-ELV 정책에 대응하고자 현대기아에서 생산자책임재활용으로 시행해오던 기관을 활용하여 첫발을 내딛었다.

본 연구에서는 폐차 기반 RD Tank나 엔진룸 커버 등 유리섬유 강화 PA66 소재를 활용하여 Cylinder Head Cover 부품을 제작하였으며, 신재 기반의 소재와 비교 평가하여 실 적용 가능 여부에 대해 조사하였다.

Poster Presentation **2PS-175**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Identification of Critical Factors for Fracture Behavior and Reliability Analysis in Carbon Fiber Reinforced Polymers

지형진, 이동현, 권동준[†]

경상국립대학교

Carbon Fiber Reinforced Polymer (CFRP) faces limited industrial application due to their complex fracture behavior, complicated reliability and product life prediction, despite excellent properties. This study aimed to understand CFRP fracture mechanisms and identify critical factors. Constituent component properties were evaluated, and reliability was analyzed using Weibull distribution and detailed fracture surface analysis. The interface exhibited the lowest reliability, proving the most critical factor in CFRP fracture. These findings provide crucial data for CFRP fracture prediction and contribute to future reliability and lifespan prediction research. This research was supported by the National Research Foundation of Korea grant funded by the Ministry of Science and ICT (RS-2023-00211944) and the Ministry of Education (RS-2020-NR049575) and Korea Institute for Advancement of Technology the Korea Government (P002809, "Semiconductor"-Specialized University)

Poster Presentation **2PS-176**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

폐자원을 적용한 폴리프로필렌 압출시트 제조 및 기계적 특성에 관한 연구

지상균[†]

대한솔루션

전 세계적으로 환경문제에 관한 인식이 증가되고 그에 따른 규제가 증가함에 따라서 자동차 산업에서도 이산화탄소 배출 절감을 위한 경량화 소재와 바이오 및 재활용소재에 관한 연구개발이 활발하게 진행되고 있다. 최근 유럽의 자동차 형식승인 ELV(End of Life Vehicle) 개정안에서는 신차에 재활용 소재를 반드시 사용하고 그 중에 일부분은 폐차에서 수거된 것이어야 하는 법규도 발효예정이다. 본 연구에서는 폐차에서 유래한 재활용 소재를 적용해야 하는 유럽 ELV 규제 대응을 용이하게 하기 위해서 폐차부품과 유사한 수준의 폐자원을 활용하여 복합 폴리프로필렌 압출시트를 제조하고 기계적특성을 평가 하였다. 또한 자동차 트렁크 트림 부품을 성형하고 신뢰성을 검증하였다.

Poster Presentation **2PS-177**
고분자가공/복합재료/재활용(II)
2025.9.30(화), 17:00~18:30, 포스터장
Chair: 구강희, 김종호

자동차 내장부품용 셀룰로스 섬유 복합소재의 성형 최적화 방안 연구

조현빈[†], 이동주, 이재현, 이재용, 김병진

디와이덕양

완성차 수요 증대 및 ELV 규제에 대응하기 위해 최근 자동차 인테리어 부품에서 바이오 소재 함량 증대 및 경량화에 대한 요구가 증가하고 있다. 이에 냄새, 경량성 등에서 한계를 보이는 천연소재 대신 물성, 기능성, 생산성을 개선한 셀룰로스 함유 복합재를 자동차 부품에 사용하기 위해 해당 기술의 확보가 필요하며, 용융성 및 결합성이 최적화된 마스터배치 개발이 병행되어야 한다.

본 연구에서는 셀룰로스 섬유 복합소재의 성형성 평가를 진행하였으며 유동 사출 패턴 분석을 통해 바이오매스 섬유와 다른 고분자 재료 간의 계면 접착력에 대한 상관관계를 분석하였다. 또한 실린더 및 금형 온도와 시간에 따른 최적 사출 조건을 도출하였으며, 향후에는 최적화된 설계를 바탕으로 시제품을 제작하여 내구 평가를 진행하고, 결과에 따른 기계적 특성을 검토할 예정이다.

사의 : 본 연구는 산업통상자원부에서 공고한 소재부품기술개발사업(과제번호: RS-2024-00433508)의 연구 수행으로 인한 결과물임을 밝힙니다.

Poster Presentation **2PS-178**
고분자가공/복합재료/재활용(II)
2025.9.30(화), 17:00~18:30, 포스터장
Chair: 구강희, 김종호

바이오 소재 적용 도어트림 성형성 및 성능 평가

조현빈[†], 이동주, 이재현, 이재용

디와이덕양

최근 소비자의 자동차 구매 기준은 제품의 기능 위주에서 디자인을 통한 감성적 측면으로 옮겨가고 있는 추세이다. 전과정평가(LCA) 등 글로벌 환경 규제를 고려한 친환경 인테리어 디자인 설계는 자동차 부품 제조 기업의 경쟁력에 있어 필수 요소가 되었으며 특히 도어트림은 차량 인테리어의 핵심이 되는 부품이다. 이에 도어트림 제품에 적용할 친환경성과 기계적 강성을 동시에 만족하는 바이오 소재의 개발 및 적용이 필요하다.

본 연구에서는 도어트림 시제품 제작을 위해 바이오 소재가 보강된 개발 컴파운드의 사출 성형성을 검증하고 성능을 분석하고자 한다. 스킨층 및 코어층에 재활용 소재를 혼합하고 사출 조건을 정립 및 개선하였으며, 장기 노화에 의한 기계적 특성 변화 및 노화시간에 따른 열화 평가를 통한 신뢰성 검증을 수행하였다.

사의 : 본 연구는 산업통상자원부에서 지원하는 디자인산업기술개발사업(과제번호: 20018397)의 연구 수행으로 인한 결과물임을 밝힙니다.

Poster Presentation **2PS-179**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Flexible Ionic Liquid–Functionalized Composite Film with Superior EMI Shielding, Thermal Conductivity and Mechanical Performance

Ain Rimsha, Tahreem Zahra, Muhammad Yasir, 강가연¹, 김성룡¹

Korea National University of Transportation

¹ 한국교통대학교

The growing integration of compact electronics increases the demand for lightweight, thermally conductive, and flexible electromagnetic interference (EMI) shielding materials. We developed composite films by non-covalently functionalizing reduced graphene oxide with hydrophilic ionic liquid 1-butyl-3-methylimidazolium bromide [BMIM][Br] and incorporating it into an aramid nanofiber (ANF) matrix via vacuum-assisted filtration. Ionic liquid enhanced dispersion and interfacial compatibility, promoting the formation of well-aligned, densely packed conductive networks. The resulting composite film exhibited improved EMI shielding, high thermal conductivity, excellent mechanical performance, and long-term stability under harsh environment, demonstrating their potential for high-performance flexible electronic applications. *This research was supported by a grant from the Academic Research Program of Korea National University of Transportation in 2025.

Poster Presentation **2PS-180**
고분자가공/복합재료/재활용(II)
2025.9.30(화), 17:00~18:30, 포스터장
Chair: 구강희, 김종호

Isocyanate-Derived Polyimide Foams for Lightweight Thermal Insulation

박성혁, 박사랑, 최성훈, 박노균, 김윤호, 원종찬[†], 조경국[†]

한국화학연구원

Polyimide foams (PIFs) are widely utilized as thermal insulators in aerospace, marine, and high-temperature systems due to their outstanding thermal stability, flame resistance, and low density. In this work, we introduce a simple and cost-effective fabrication strategy for PIFs based on an isocyanate-anhydride system. This approach eliminates the need for high-cost diamine monomers and enables scalable processing without external blowing agents. The resulting foams exhibit a homogeneous porous structure with tunable density and mechanical properties governed by the chemical structure and crosslinking degree of the polyimide network, confirming the formation of stable imide linkages and open-cell morphologies. These PIFs can maintain insulation performance at elevated temperatures, suggesting their potential for use as lightweight, high-performance thermal barrier materials in extreme environments.

Poster Presentation **2PS-181**
고분자가공/복합재료/재활용(II)
2025.9.30(화), 17:00~18:30, 포스터장
Chair: 구강희, 김종호

Nanoparticle-Induced Modulation of Degradation Pathways in Polylactic Acid Nanocomposites

정효진, 김소연[†]

서울대학교

The rapid increase in plastic usage has intensified plastic waste issues, emphasizing the need for biodegradable polymers. These can be used as composites incorporating nanoparticles (NPs) to improve performance, yet studies on degradation of polymer nanocomposites (PNCs) remain limited. Although degradation starts at the microscopic chain level, the effect of NP-chain interactions is poorly understood.

In this study, polylactic acid (PLA)/silica nanocomposites were prepared as model biodegradable PNCs, and NP effect on degradation was examined microscopically by analyzing various properties, microstructure, and polymer dynamics during enzymatic degradation. PNCs showed a distinct pathway: random chain scission dominated in neat PLA, while chain-end scission was favored in PNCs. This suggests the interfacial layer formed by NPs critically governs degradation. This study reveals NP incorporation can modulate degradation mechanism, providing insight for designing biodegradable materials.

Poster Presentation **2PS-182**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Thermoplastic Processing of Elastomeric Conductors with Slippery Interfaces

정현석, 강지형[†]

서울대학교

Liquid metal polymer composites (LMPC) are gaining attention in soft robotics, skin electronics, and implantable devices due to their excellent conductivity and stretchability, making them ideal for stretchable conductors. However, composite inks based on liquid monomers or polymer solutions present challenges for 3D printing due to their fluidity. Additionally, in fused deposition modeling (FDM) 3D printing, the high stress during extrusion can damage the LMP's oxide shell, leading to leakage, process contamination, and potential electrical shorts. Here, I present a leakage-free additive manufacturing process for liquid metal polymer composites, enabling the customized 3D printing of elastic conductors. We introduced slippery interfaces between all components of LMPC, enhancing LMPC dynamicity. This new strategy facilitated the direct printing of 3D circuits within multi-material objects, selectively imparting electrical conductivity and enhancing design flexibility.

Poster Presentation **2PS-183**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

나노복합필름 기반 경량 복합소재의 전자파 차폐 특성 연구

정재훈, 이지현, 박경환¹, 최병건¹, 염정현⁺

경북대학교

¹ 한국전자통신연구원

최근 5G 통신 기술의 상용화와 IoT 기기의 급속한 보급으로 전자기기 간 전자파 간섭 문제가 심화되고 있어, 차세대 유연 전자소자의 발전과 함께 기존 금속 기반 차폐재가 갖는 무게와 경직성의 한계를 극복할 수 있는 새로운 차폐 소재 개발이 시급한 실정이다. 고분자/ 무기입자 복합필름은 고분자 매트릭스와 무기입자 간의 계면 특성 차이로 인해 두 상 사이의 접착력이 상대적으로 약하게 형성되고, 연신에 의해 계면 탈리(interfacial debonding) 현상이 유발되어 구조체 내 미세다공성 구조 형성을 가능하게 한다. 형성된 미세다공성 구조는 전자파의 다중 산란 및 반사를 유도하여 적은 함량의 전도성 충전재로도 우수한 차폐 성능을 구현할 수 있다. 본 연구에서는 미세다공성 구조 도입을 통해 전자파 차폐 효율을 향상시키는 동시에 경량성과 유연성을 확보할 수 있는 새로운 복합필름 제조 기술을 개발하였다. 다양한 무기입자를 함유한 복합필름을 제조한 후 형성된 기공 구조 및 분포를 분석하였으며, 무기입자의 종류 및 함량에 따른 전자파 차폐 효율을 평가하였다. 본 연구는 과학기술정보통신부의 재원으로 과학기술사업화진흥원의 지원을 받아 수행된 연구임('학연협력플랫폼구축 시범사업' RS-2023-00304695, RS-2023-00304776).

Poster Presentation **2PS-184**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

탄소부직포/올레핀계 고분자/무기입자 복합소재의 제조 및 특성 연구

정재훈, 박경환¹, 최병건¹, 염정현⁺

경북대학교

¹ 한국전자통신연구원

전자기기의 고집적화 및 고주파수화로 인한 전자파 간섭(EMI) 문제가 증가함에 따라 경량 고성능 전자파 차폐 소재 개발이 시급한 과제로 대두되고 있다. 기존 금속 기반 차폐재는 우수한 성능에도 불구하고 높은 밀도, 부식 가능성, 제한적 가공성 등의 한계를 지닌다. 이에 대한 대안으로 탄소부직포는 저렴한 가격, 높은 전기전도성 및 화학적 안정성, 가공 유연성을 제공하여 주목받고 있다. 본 연구에서는 탄소부직포를 강화재로, 폴리프로필렌(PP)과 폴리에틸렌(PE)을 매트릭스 수지로 활용한 복합소재를 개발하였다. 전자파 흡수 및 반사 특성 제어를 위해 무기입자를 첨가하고 압축 성형 공정으로 복합소재를 제조하였으며, 구성 성분의 함량 변화에 따른 물리적 특성을 분석하였다. 이를 통해, 가공성과 경량성을 겸비한 고효율 전자파 차폐용 복합소재의 제조 가능성을 제시하고자 한다. 본 연구는 과학기술정보통신부의 재원으로 과학기술사업화진흥원의 지원을 받아 수행된 연구임 ('학연협력플랫폼구축 시범사업' RS-2023-00304695, RS-2023-00304776).

Poster Presentation **2PS-185**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Dynamic β -Amino Sulfone in Epoxy Networks for High-Performance and Sustainable Carbon Fiber-Reinforced Polymers

정용석, 한정우, 이수영, 김경수, 송창식[†]

성균관대학교

Covalent adaptable networks (CANs) are promising alternatives to conventional polymer matrices for extending the service life of carbon fiber-reinforced polymers (CFRPs). However, their application has been limited by insufficient thermal and mechanical performance. In this study, we developed a high-performance CAN matrix by incorporating divinyl sulfone (DVS) into an epoxy resin. The resulting β -amino sulfone-based CAN (BAS) forms a rigid yet dynamic network due to the high polarity of DVS and the stiffness of the epoxy backbone. The BAS-based CFRP (BAS-CP) exhibited a high glass transition temperature of 170.9°C and a tensile strength of 876.9 MPa, outperforming most vitrimer-based CFRPs. In addition, the dynamic bond exchange enables crack self-healing, reshaping of laminates and prolonged shelf life of prepregs. These combined properties—along with low-cost monomers and one-pot synthesis—make BAS a strong candidate for recyclable, and high-performance CFRPs.

Poster Presentation **2PS-186**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Chiral Plasmonic Supramolecular Hierarchical Architectures via Star-Like Block Copolymers

정서현, 김민주¹, 김동하[†]

이화여자대학교

¹ National University of Singapore

As photonic technologies advance toward multi-dimensional information processing, chiral optics offers new capabilities for displays, sensing, encryption, and neuromorphic devices. This work develops chiral plasmonic hybrid materials via co-assembly of star-like block copolymers, chiral additives, and gold nanoparticles. During solvent annealing, supramolecular chiral organization induces strong circular dichroism in the LSPR region. Solvent vapor pressure controls morphology and optical response: low-pressure DMF yields thermodynamically stable fibers, while high-pressure toluene forms kinetically trapped rods. Rod-like assemblies show g-factors up to 0.2—the highest for polymer-templated chiral plasmonic gold nanostructures—demonstrating the role of polymer architecture and processing in tuning chiroptical properties.

Poster Presentation **2PS-187**
고분자가공/복합재료/재활용(II)
2025.9.30(화), 17:00~18:30, 포스터장
Chair: 구강희, 김종호

폐차 유래 폴리카보네이트 소재 기초 연구

정도연⁺

BGF에코머티리얼즈

자동차산업은 탄소 감축 의무가 있는 타산업과 마찬가지로 순환경제 이행방안을 채택하여 생활계 재활용 소재를 비롯한 차량 순환성을 높이기 위하여 ELV(End of Life Vehicle) 폐차 부품 재사용, 재활용을 높이기 위하여 재생소재 사용을 촉진하기 위해 순환성을 높이는 설계를 강제화 하고있다. 이를 통해 폐차되는 차량이 순환자원으로 관리 될 수 있도록하여, 신차 제조시 재활용 소재가 많이 활용되고, 관련된 벨류체인 구축을 촉진하도록 설계되고 있는 실정이다.

국내에는 외장류 등 부품 자원화 등으로 이미 상업화가 진행중인 부분도 있으나. 해체가 어렵고, 외부코팅을 제거하여야 재활용 소재로 사용할 수 있는 헤드라이드 커버류에 사용되는 폴리카보네이트는 자원화가 이루어지지 않고 있다가 EU ELV 정책에 대응하고자 현대기아에서 생산자책임재활용으로 시행해 오던 기관을 통해 연구개발의 첫발을 내딛었다.

본 연구에서는 폐차유래 폴리카보네이트 소재 와 산업용 폴리카보네이트 소재를 비롯하여 기초 연구개발을 통해 다양한 재활용 소재를 확보의 발판이 되고자 한다.

Poster Presentation **2PS-188**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Exploring the Feasibility and Traceability of Fluorescent Materials as Optical Markers in Polymer

정규리, 주준태, 김태형⁺, 김동균⁺, 채창근⁺

한국화학연구원

Growing global concern over plastic waste has led to increasing legislation, requiring a certain percentage of recycled plastic (r-plastic) to be contained in products. It is driving the need for certification system that verifies the contents of r-plastic. Fluorescent material is regarded as a promising marker for detecting the contents of recycled plastics in products, due to its non-destructive qualitative and quantitative analysis. Fluorescent marker, when designed to have high fluorescence, durability, and compatibility with matrix polymer, can enable the construction of a reliable certification system. In this study, various fluorescent materials were screened to identify key structural factors for a high-performance marker. Their optical and thermal stability was characterized. In addition, markers were embedded in polymer matrices to evaluate their compatibility and applicability. These findings provide insight into the molecular design for high-performance marker.

Poster Presentation **2PS-189**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Development of LWIR transparent plastic optics via inverse vulcanization of elemental sulfur for automobile night vision system

전유빈[†]

현대자동차

Midwave and longwave infrared optical systems are essential for high-resolution thermal imaging in low-light conditions. While traditionally used in defense applications, its adoption in automotive night vision systems is anticipated to increase, highlighting the need for affordable vehicular thermal cameras lens materials. This perspective highlights recent advances in using synthetic organic and hybrid polymers as emerging IR-transmissive materials.

In this research, we developed novel LWIR transparent polymers from elemental sulfur and organic comonomer via inverse vulcanization. Given its favorable infrared transmittance and processibility, it presents a promising alternative for future integration into automotive camera lenses in night vision systems.

Poster Presentation **2PS-190**
고분자가공/복합재료/재활용(II)
2025.9.30(화), 17:00~18:30, 포스터장
Chair: 구강희, 김종호

Development of a Non-Conductive Adhesive Film with Enhanced Thermal Dissipation and Reduced Thermal Expansion

전민욱, 최용원¹, 강운병¹, 안철희⁺

서울대학교

¹ 삼성전자

As semiconductor devices continue to shrink, the limits of miniaturization are being reached, increasing demand for highly integrated systems. IC packaging, which protects and connects chips after front-end processing, has evolved from basic interconnects to advanced technologies that enhance functionality and competitiveness. In stacked semiconductor structures, epoxy-based non-conductive films (NCFs) are commonly used for chip bonding. However, higher stacking levels generate excessive heat, requiring materials with excellent thermal dissipation. In addition, the high thermal expansion of polymers induces interfacial stress, causing warpage. Other key concerns include controlling adhesion, viscosity, and optical transmittance. To address these issues, our team is developing NCFs with improved thermal conductivity and reduced expansion by optimizing filler shape, using hybrid fillers, and constructing thermally conductive networks within the polymer matrix.

Poster Presentation **2PS-191**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Preparation of Urea Network Nanogels for Conformal Coating via Sol–Gel Polymerization

장대현, 박지웅[†]

광주과학기술원

Urea network (UN) nanogels, synthesized via sol–gel polymerization of multi-functional amines and isocyanates, can be polymerized at room temperature and exist as stable colloidal sols in solution. This allows for uniform surface coating during post-processing with various materials such as graphene oxide or TiO₂. Upon heat treatment, the nanogels undergo structural rearrangement, forming a thermally stable and mechanically robust network. Additionally, carbonization enables electrical conductivity. Based on these properties, this study explores the potential of UN nanogels as a surface-coating layer that can function similarly to polymeric binders, aiming to improve interfacial stability and overall electrode performance.

Poster Presentation **2PS-192**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Surface Modification and Composites of Hollow Silica and Glass Fibers for High-Performance Vacuum Insulation Panels

장기철, 백정주, 김영훈, 신교직[†]

한국생산기술연구원

Vacuum insulation panels(VIPs) are widely used due to their excellent thermal insulation performance. However, key performance such as thermal conductivity and durability are dependent heavily on the design of the core material, there is a constant demand for performance enhancement. In this study, to improve mechanical support and interfacial bonding, hollow silica particles(HSPs) and glass fibers(GFs) were surface-modified using silane coupling agents such as APTES and GPTMS, respectively. The composites were fabricated by synthesis, electrospinning, and spray processes, and their chemical structures and bonding morphologies were confirmed by FT-IR and SEM analysis. Through this, it was confirmed that the composite between the surface-modified hollow silica particles and glass fibers was successfully achieved.

Poster Presentation **2PS-193**
고분자가공/복합재료/재활용(II)
2025.9.30(화), 17:00~18:30, 포스터장
Chair: 구강희, 김종호

PCLD as a Viscosity Modifier for Highly Filled Epoxy Composites

임유민, 심상은[†]

인하대학교

This study explores the use of polycaprolactone diol (PCLD) as a polymeric viscosity modifier in epoxy composites containing high loadings of thermally conductive fillers. Unlike conventional diluents, PCLD offers structural flexibility and good miscibility with epoxy, enabling effective viscosity reduction without sacrificing compatibility.

Epoxy composites were prepared by blending YD-128 resin with 0–10 wt% PCLD and adding 1 μm alumina fillers in the range of 0–50 vol%. Further analysis of viscosity, thermal conductivity, and thermal stability (TGA) is underway.

PCLD is expected to improve flow behavior and filler dispersion by reducing chain entanglement, thereby enhancing the processability of highly filled epoxy systems. This approach suggests a polymer-based strategy for developing thermal interface materials without relying on low-molecular-weight additives.

Poster Presentation **2PS-194**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Hybrid Artificial Olfaction: Integrating Human Receptors with Organic Synapses

임예지, 송현우, 원유상, 오준학[†]

서울대학교

Neuromorphic sensors aim to mimic biological sensory processing for rapid, energy-efficient data analysis. However, selectively identifying analytes within chemically similar mixtures remains a challenge. Here, we present an artificial olfactory system (AOS) that combines human olfactory receptors (hORs) with organic synaptic devices. The system integrates an hOR-functionalized extended gate with an organic neuromorphic component to generate distinct signal patterns in response to individual odorants and their mixtures, even at the molecular chain length level. These unique response profiles result from specific hOR-odorant interactions and enable precise classification through training and inference. This research showcases a new approach for developing high-performance olfactory platforms, with strong potential for future wearable and implantable neuromorphic applications.

Poster Presentation **2PS-195**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Preparation of Core–Shell MWCNT Fillers Using Ceramic Coating for Epoxy Composite Systems

임민혁, 김민재, 최현호, 김승현⁺

인하대학교

As advanced semiconductors like high-bandwidth memory (HBM) and IoT devices become more compact, thermal management is critical for reliability. The thermal conductivity of packaging materials affects semiconductor lifespan, increasing demand for better heat dissipation. Epoxy resin, commonly used in packaging, has low thermal conductivity (~ 0.22 W/m·K), so ceramic, metal, and carbon-based fillers are added.

Multiwalled carbon nanotubes (MWCNTs) are promising due to high thermal conductivity and efficiency at low content. However, their electrical conductivity and poor dispersion limit use in insulating applications.

To address this, MWCNTs were coated with ceramic materials such as Al_2O_3 , SiO_2 , and TiO_2 , forming core–shell structures that improve insulation while retaining thermal performance. The coated MWCNTs were analyzed by SEM and TEM, and their thermal and electrical properties were evaluated.

Poster Presentation **2PS-196**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Thermal Performance Limits of Polyimide for Aerospace-Grade Property Design

이현준, 김성호, 엄영호[†], 박준현

한양대학교

Polyimide (PI) films are known for excellent thermal stability, making them suitable for aerospace use under extreme temperatures. In such applications, long-term thermal and mechanical stability is essential. This study investigates high-temperature degradation of PI films to define their thermal performance limits for aerospace-grade applications. Heat treatment was performed above 300 °C, and changes in structure and properties were analyzed using FT-IR and SEM. Results showed notable mechanical strength loss as degradation progressed. Based on these findings, a safe operational temperature range was proposed to ensure material stability. These results can help evaluate the reliability of PI-based aerospace materials.

Poster Presentation **2PS-197**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Energy Dissipation and Recovery Behavior of Liquid Crystal Elastomer Foams with Crystalline RM44 Crosslinker

이지원, 김대석[†]

국립부경대학교

In this study, we investigate the influence of a crystalline crosslinker, RM44, which features terminal acrylate groups connected through rigid aromatic segments and flexible ether-alkyl spacers, on the energy dissipation and recovery performance of liquid crystal elastomer (LCE)-based foams. LCE foams inherently dissipate energy through soft elasticity, originating from the reorientation of liquid crystal domains under mechanical load. When RM44 is incorporated into a porous foam structure, its crystalline domains serve as physical crosslinking points that promote network restoration after deformation, thereby enhancing structural recovery. To evaluate these combined effects, we analyzed the storage modulus, loss factor ($\tan \delta$), and cyclic recovery behavior of RM44-containing LCE foams, providing insights into how the interplay between liquid crystal domain dynamics and crystalline crosslinkers governs both dissipation and resilience in energy-dissipative LCE materials.

Poster Presentation **2PS-198**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Fluorinated Boron Nitride Nanosheet-Reinforced TLCP Composites with High Thermal Conductivity and Low Dielectric Constant for Advanced PCB Applications

이준협, 정영규¹

충남대학교

¹ 충남대학교 유기응용재료공학과

As microelectronic devices evolve, PCB materials with both high thermal conductivity and low dielectric constant are increasingly needed. Conventional use of porous fillers to lower dielectric constant often compromises thermal conductivity. This study addresses the trade-off by using boron nitride nanosheets (BNNSs), known for high thermal conductivity. BNNSs were exfoliated via ultrasonication and ball milling, then fluorinated with CF₄ plasma to form fluorinated BNNSs (F-BNNSs). F-BNNSs were incorporated into thermotropic liquid crystalline polyester (TLCP), a polymer with excellent mechanical strength, thermal stability, and low moisture absorption. The resulting F-BNNS/TLCP composites exhibited both enhanced thermal conductivity and low dielectric constant while retaining TLCP's intrinsic properties. This approach effectively overcomes the traditional conflict between thermal and dielectric performance, offering strong potential for advanced electronic applications.

Poster Presentation **2PS-199**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Fabrication and Characterization of Carbon Nonwoven/PP Film Composites

이정언, 김늘새롬¹, 정길재¹, 강경모¹, 염정현⁺

경북대학교

¹ (주)라지

Carbon nonwovens, consisting of carbon fibers in a nonwoven sheet, exhibit excellent thermal and chemical resistance, maintaining structural stability at elevated temperatures. Compared with woven carbon-fabric composites, carbon-nonwoven-based composites generally show lower mechanical strength but offer greater structural flexibility, high compressibility, and a porous architecture that enhances interfacial adhesion with polypropylene (PP) and facilitates dispersion of functional fillers. These attributes promote uniform microstructure formation and improved functionality in the composite. In this study, PP and carbon nonwoven were laminated by hot pressing to fabricate composites, and a range of properties—including heat resistance—were evaluated to assess their application potential. This study was conducted with support from the Ministry of Science and ICT (KOITA20250002).

Poster Presentation **2PS-200**
고분자가공/복합재료/재활용(II)
2025.9.30(화), 17:00~18:30, 포스터장
Chair: 구강희, 김종호

Effect of Strain Rate on the Properties of Polypropylene/Inorganic-Particle Composite Films

이정언, 임춘삼¹, 임종제¹, 염정현⁺

경북대학교

¹ (주)경성화인켐

Cell pouch films, which serve as the exterior of pouch-type secondary batteries, generally adopt a multilayer outer/barrier/sealant structure; the sealant layer is typically polypropylene (PP). During manufacturing, the films are shaped by deep drawing, and the attainable drawing depth is critical for high-capacity designs. Anisotropy between the machine direction (MD) and transverse direction (TD) of the sealant layer is one factor that influences drawing depth. In this study, we quantify the strain-rate-dependent tensile properties of PP composite films containing inorganic particles and compare MD–TD disparities. Based on these measurements, we evaluate their applicability to deep drawing and the potential for mitigating directional property differences. This study was conducted with support from the Ministry of Science and ICT (RS-2024-00419614 & 2025 KNU RC-UniLab Project).

Poster Presentation **2PS-201**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Rewritable Direct Ink Writing Using Hydroxypropyl Cellulose Inks with Tunable Colors Enabled by Hydrogen-Bonded Guest Molecules

이상혁, 구강희[†], 오형석, 이주영, 김경진, 김지현¹, 채창주¹, 이수연¹

울산과학기술원

¹ 한국화학연구원

Hydroxypropyl cellulose (HPC) is a cellulose derivative exhibiting cholesteric liquid crystalline phases capable of reflecting visible light through hydrogen bonding with water. Recent studies have investigated tuning structural coloration of HPC for sensor applications and its potential as ink for direct ink writing (DIW), though practical use remains limited by mechanical performance.

This study introduces poly(vinyl alcohol) (PVA) as a guest material to overcome this limitation. Adjusting the molecular weight and hydrolysis degree of PVA enabled full-spectrum color tuning and improved rheological properties for DIW. Additionally, kinetic trapping was employed to prevent color fading from water evaporation, effectively stabilizing structural colors. This research leverages the unique properties of PVA to significantly enhance the practicality and applicability of HPC-based structural coloration systems.

Poster Presentation **2PS-202**

고분자가공/복합재료/재활용(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Analysis of fiber/matrix interfaces by fragmentation test based on AE

이동현, 지형진¹, 김종현¹, 양성백¹, 권동준¹

경상국립대학교

¹ 경상국립대

Interfacial property is a critical aspect of composite materials. Conventional fragmentation tests rely on optical observation, which imposes certain limitations. In this study, acoustic emission (AE) monitoring was employed to evaluate interfacial properties through fragmentation tests. AE signals enabled reliable detection of fiber fracture events, allowing the calculation of interfacial shear strength (IFSS). Furthermore, the use of fiber tows in fragmentation tests facilitated direct comparative analysis of interfacial performance. This research was supported by the National Research Foundation of Korea(NRF) funded by the Ministry of Science and ICT, the Ministry of Education and the Ministry of Trade, Industry and Energy (RS-2023-00211944, RS-2020-NR049575, RS-2023-0026563).

Poster Presentation **2PS-203**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Silicon Anode Binder based on Crosslinked Polyurethane with Different Crosslinking Densities

최재민, 황주원, 조남주[†]

부산대학교

Li-ion batteries have emerged as the most important energy supply devices. However, graphite electrodes do not satisfy the performance demands of modern high-performance batteries, because graphite suffers from low capacity, high cost and limited power output. To address these demands, many studies on silicon anode are being conducted. In order to commercialize a silicon anode, it is important to suppress the drastic volume expansion of silicon anode.

In this study, polyurethane (PU) binders with different crosslinking densities were synthesized for the silicon anode. The urethane group of polyurethane forms a hydrogen bond with the silanol group on the silicon outside, enabling strong interaction. The electrochemical performance of the battery was evaluated according to the crosslinking density of PU. High crosslinking density effectively suppressed the extreme volume expansion of silicon particle, lowered interfacial resistance, and showed high-capacity retention rate.

Poster Presentation **2PS-204**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

MOF-in-COF Structures as Composite Quasi-Solid Electrolytes Achieving Ultra High Ionic Conductivity and Lithium Transference Number

최은지, 유필진[†]

성균관대학교

Covalent organic frameworks (COFs) are promising solid-state electrolytes (SSEs) due to their ordered 1D channels that facilitate ion transport. However, the presence of C=N groups can hinder performance by enabling lithium ion storage within the framework. To overcome this limitation, we introduce metal-organic frameworks (MOFs) into COFs to form a MOF-in-COF (MC) hybrid structure. This integration optimizes pore environments and enhances compatibility with ionic liquid (IL), creating efficient lithium-ion pathways. The resulting IL-incorporated MC (IL@MC) electrolyte exhibits a high ionic conductivity of $1.5 \times 10^{-3} \text{ S cm}^{-1}$ at room temperature and a lithium-ion transference number of 0.26 at 60 °C. The improvement arises from MOF functionalization, which acts as selective gates for cation transport within the COF matrix.

Poster Presentation **2PS-205**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Gap-Independent Redox Behavior of an Ethyl Viologen in Planar Interdigitated Micro-Supercapacitors

최유정, 양찬우[†]

한국생산기술연구원

Planar interdigitated micro-supercapacitors (MSCs) are attracting attention as energy storage platforms that are compatible with compact, integratable electronics. This study investigates the redox behavior of 1,1'-bis(4-vinylbenzyl)-4,4'-bipyridinium dihexafluorophosphate (EV(PF₆)₂), also known as an ethyl viologen, in laser-patterned planar MSCs with controlled electrode spacing. Due to its bulky structure and strong affinity for electrode surfaces, EV(PF₆)₂ may exhibit stable and localized redox activity relatively unaffected by the electric field effects often encountered in devices with closely spaced electrodes. This surface-oriented reaction pathway likely reduces ion diffusion constraints and mitigates field-induced interference. These results suggest that EV(PF₆)₂ is well-suited for the design of structurally stable and electrochemically reliable MSCs, offering a viable strategy for miniaturized energy storage systems

Poster Presentation **2PS-206**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Autonomous Interlocking of Magnetic Robots with Reversible, On-Demand Decoupling

진수현, 양기준, 원수경¹, 위정재[†]

한양대학교

¹ California Institute of Technology

Miniaturized magnetic robots have been developed to accomplish complex tasks via collective behavior. However, inter-robot communication in magnetic system relies only on magnetic attraction, which is susceptible to disassembly in rough terrains or obstacle environments. Here, we present magnetic Linkbots with hook structures that autonomously form physical interlocking via magnetic actuations. Through the interlocked structures, the Linkbots achieve higher inter-robot assembly force than magnetically assembled robots. Also, the interlocking allows on-demand reversible decoupling, enhancing environmental adaptability. The interlocked Linkbots maintain their structure in fluidic environments and enable obstacle climbing. In-operando interlocking strategy provides a new paradigm for constructing highly reliable magnetic robotic systems.

Poster Presentation **2PS-207**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Gel Polymer Electrolyte Based on Sulfur and epoxy with Lithium bis(fluorosulfonyl)imide (LiFSI) for Lithium-ion Batteries

주기종, 배완수, 송수빈, 나혜원, 강동훈, 이도율, 장호현[†]

건국대학교

Although liquid electrolytes offer high ionic conductivity, safety concerns have prompted the development of alternative materials. Polymer and solid-state electrolytes provide enhanced thermal and electrochemical stability, despite lower conductivity. Poly(ethylene oxide) (PEO), a common polymer electrolyte, exhibits high crystallinity and strong lithium–oxygen interactions, limiting lithium-ion mobility. In this study, we synthesized sulfur-containing polymer electrolytes using episulfide-based monomers to improve flexibility and reduce crystallinity. The larger atomic radius of sulfur is expected to alleviate structural constraints and enhance redox reversibility. The materials were characterized by ^1H NMR and FT-IR spectroscopy, and their electrochemical performance was assessed using electrochemical impedance spectroscopy and charge–discharge cycling.

Poster Presentation **2PS-208**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Electric Vehicle Motor Core Adhesive Breakthrough: Exceptional Adhesion and Oil Resistance in Laminated Electrical Steels

조현정[†]

삼양사

In this study, we developed an adhesive specifically designed for laminated electrical steels used in dot-bonded motor cores for electric vehicles. This adhesive demonstrates exceptional adhesion performance and oil resistance, attributed to the incorporation of an isosorbide-based core structure, which provides both strong hydrophilicity and a rigid molecular framework. The adhesive's bonding performance was assessed through lap shear strength measurements on laminated electrical steel, along with peel strength evaluations on dot-bonded motor cores. These properties were compared with those of a reference adhesive formulated using a petroleum-derived alicyclic polyol. The isosorbide derivative was introduced into an acrylate-modified polyurethane matrix as a polyol component, enhancing compatibility with other formulation constituents and facilitating a rapid curing process.

Poster Presentation **2PS-209**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Fabrication of electrodes for photocatalysis using conjugated polymers synthesized with donor-acceptor structures

조윤서, 정찬희, 김영웅, 이택승⁺

충남대학교

Conjugated polymers (CPs) have been studied in the field of sensors and OLEDs due to their superior electron transport and thin film processability. However, CPs suffer from low conductivity and weak adhesion to substrate electrodes. In this study, the bandgap was controlled by introducing a donor-acceptor structure, and the problem was overcome by controlling the spin coating speed and baking temperature. The monomers were synthesized: one based on benzothiazole and the other on hydroquinone. These were polymerized via Suzuki-Miyaura cross-coupling and the resulting polymers were coated on electrodes. The synthesized monomers were confirmed by FT-IR and ¹H NMR spectroscopy, and the polymers were further analyzed by GPC and elemental analysis to show that they were polymerized. Electrodes were made from the polymer and followed by photoelectrochemical analysis to identify the band structure and to show its potential as a photocatalyst.

Poster Presentation **2PS-210**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Fabrication of porous amidoxime-based nanofibers for enhancement of adsorption performance

정택영, 이택승[†], 정찬희, 김영웅

충남대학교

Specific metal ions that can be utilized as energy resources are dissolved in seawater, interest in adsorbents for their extraction is increasing. Among various adsorbents, amidoxime-based nanofibers are considered as the most promising adsorbents because of their robust selectivity, specific surface area, and low cost. This study aims to introduce porosity on the surface of nanofibers. High specific surface area increases the contact of the nanofibers with seawater and mesopore facilitate ion diffusion. Porous nanofibers were fabricated via electrospinning of poly(acrylonitrile-co-methyl acrylate) with a sacrificial agent, followed by the removal of sacrificial phase. Then, reacted with a hydroxylamine solution to convert the cyano group to amidoxime group. The adsorption performance of the porous nanofibers was investigated as initial concentration, adsorption time, and pH. In addition, the adsorption mechanism was investigated by fitting to kinetics and isotherm models.

Poster Presentation **2PS-211**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Bottlebrush Polymers with Spatially Ordered Ion-Coordinating Domains for Li-Metal Interphase Stabilization

장진하, 강지형[†]

서울대학교

The transition to high-energy storage technologies has spotlighted lithium (Li)-metal batteries for their transformative potential in next-generation energy systems. However, their application remains premature for practical deployment due to dendritic Li growth and unstable electrode–electrolyte interfaces. To bridge this gap, polymer coatings represent a viable strategy as they induce uniform Li deposition through nanoscale morphology. Here, I report a novel bottlebrush block copolymer coating composed of polyethylene glycol (PEG) and polystyrene (PS) side chains for Li-metal stabilization. Our design leverages a gyroid-like microphase morphology that enables uniform ion transport pathways. In this architecture, the PEG matrix serves as a lithiophilic coordination domain, while the PS-rich regions promote Li⁺ dissociation via cation– π interactions. This synergistic configuration enhances Li⁺ mobility and facilitates spatially uniform Li plating.

Poster Presentation **2PS-212**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Construction of Hierarchical Chemosensing Films via Cyanostilbene Based AIEgens.

장준화, 정광운[†]

전북대학교

To develop organic fluorescent sensors responsive to acid vapors, a novel cyanostilbene-based reactive monomer containing a pyridine unit (PCRM) was rationally designed and synthesized. The resulting PCRM exhibited aggregation-induced emission (AIE) behavior and showed reversible fluorescence changes upon exposure to acidic and basic environments. Utilizing the optimized PCRM-8OB mixture, two-dimensional (2D) hierarchical nanostructured films were fabricated via a sequential process of self-assembly, photopolymerization, and selective etching. Remarkably, the fabricated films displayed anisotropic sensitivity toward acid vapors, depending on the molecular orientation within the film. This study presents a novel optical sensing platform capable of visually indicating the risk level based on varying concentrations of airborne acid vapor. This work was supported by BK21 FOUR Program and Research Laboratory Program (RS-2023-00207836).

Poster Presentation **2PS-213**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Post-modification of TPU into a covalent adaptable network by a one-step dynamic crosslinking

장유진, 최한빈, 장영욱[†]

한양대학교

Thermoplastic polyurethanes(TPUs), one of the important thermoplastic elastomers, are widely utilized across various industries due to their high elasticity and abrasion resistance, and excellent processability. However, increasing demands for sustainability and enhanced material properties have driven efforts to develop more advanced TPU materials. In this study, we present a one-step dynamic crosslinking strategy to convert commercially available TPU into a covalent adaptable network (CAN) featuring dynamic covalent bonds. This transformation was achieved by crosslinking the TPU using a dithiol containing boronic ester bonds in the presence of a small amount of DCP in an internal mixer. The resulting modified TPUs were characterized by FTIR, solubility test, DMA, DSC, tensile testing, and rheological analysis. The results demonstrate that the dynamically crosslinked TPUs exhibit enhanced mechanical properties and excellent recyclability compared to the unmodified material.

Poster Presentation **2PS-214**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Stretchable High-k Metal Oxide Transistors via Azide-Functionalized Ligand Patterning and Laser Lift-Off Transfer

장수련, Syed Zahid HASSAN, 권지은, 정대성[†]

포항공과대학교

Here, we employ a ligand exchange strategy for direct photopatterning of sol-gel oxide thin films, which is combined with a laser lift-off process using a sacrificial PZT layer. Azide-terminated bidentate ligands with ethylene glycol spacers are applied to zirconium dioxide (ZrO_2), indium oxide (In_2O_3), and zinc oxide (ZnO) films, enabling UV-induced crosslinking and patterning.

A PZT layer is deposited on a sapphire substrate as a sacrificial layer. After sequential spin-coating and photopatterning of ZrO_2 , In_2O_3 , and ZnO layers, a PDMS film is laminated on top. XeCl excimer laser irradiation from the sapphire backside sublimates the PZT, enabling transfer of the oxide stack onto the flexible PDMS substrate. This method enables high-resolution fabrication of oxide TFTs on rigid substrates and their release onto stretchable supports. The devices are compatible with solution-based processing, supporting their potential for next-generation flexible electronics.

Poster Presentation **2PS-215**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

High-efficiency, stretchable organic solar cells with enhanced substrate-electrode adhesion

임윤수, 이정용[†], 최재영

한국과학기술원

Intrinsically stretchable organic solar cells (IS-OSCs) have attracted significant attention as self-powered energy sources for wearable electronics, owing to their superior stretchability, seamless integration onto diverse surfaces, and facile fabrication. For mechanical robustness under tensile strain, the transparent electrode is crucial, since strong adhesion at the substrate/transparent electrode interface prevents device failure. Despite its importance, the development of stretchable electrodes for IS-OSCs remains relatively underexplored. To enhance adhesion between the substrate and the bottom electrode, we incorporated GOPS into PH1000 to enable cross-linking with the TPU substrate. As a result, the cross-linked PH1000 electrode enabled IS-OSCs to achieve a high power conversion efficiency (PCE) of 14.59% and to retain 71% of their initial PCE under 40% strain.

Poster Presentation **2PS-216**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Development of intumescent flame-retardant coatings based on PDMS incorporating APP and Melamine

임세라, 김경민, 박예린, 이준영, 황기섭⁺

한국생산기술연구원

In this study, a flame-retardant and intumescent coating was developed using polydimethylsiloxane (PDMS) as the binder, incorporating ammonium polyphosphate (APP), melamine, and a phytic acid-copper (PA-Cu) complex as key additives. PDMS was chosen for its thermal stability and flexibility. PA-Cu contributed to flame retardancy via phosphorus content and offered potential antimicrobial and thermal stabilization effects through copper ions. The coating was prepared by dispersing PA-Cu in water, blending with PDMS and curing agent, followed by addition of APP, melamine, and surfactants to improve foam stability. Homogenization was used to generate a foamed coating, which was applied to steel substrates and thermally cured. This work demonstrates that combining PDMS with APP, melamine, and PA-Cu provides a promising halogen-free strategy for developing high-performance flame-retardant coatings suitable for industrial and construction applications.

Poster Presentation **2PS-217**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Selective Detection of Bovine Serum Albumin Using a BiVO₄-based Photoelectrochemical Sensor with a Molecularly Imprinted Polymeric Film

임석진, 이유진, 박진영[†]

경북대학교

Photoelectrochemical (PEC) sensing is an analytical technique that detects specific analytes by monitoring changes in photocurrent resulting from light-induced separation of electron-hole pairs on photoactive materials. This technique is particularly attractive due to its high sensitivity, low background noise, and rapid response, which are essential for practical sensing applications. However, conventional PEC sensors suffer from limited selectivity and poor reusability, especially when nonspecific interactions occur in the detection of complex biological or chemical analytes. To address these limitations, this study aims to improve both selectivity and reusability by forming a molecularly imprinted polymer (MIP) on the PEC electrode, which enables specific recognition of target analytes. Specifically, to achieve selective PEC-based detection of bovine serum albumin (BSA), a BSA-imprinted MIP was fabricated on a BiVO₄ photoactive layer formed on an FTO/SnO₂ electrode.

Poster Presentation **2PS-218**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Study of the Integration of Cellulose Nanocrystal-Based Nanocomposites with SnSe for Broadband Circular Polarized Light Detection

임백현, 강세원[†]

한국화학연구원

Detecting circularly polarized light (CPL) plays a crucial role in emerging technologies such as advanced display systems, autonomous sensing, secure optical communication, and quantum information processing. However, current CPL detectors often require bulky optical components and have limited spectral ranges, limiting integration and sensitivity. In this study, we present a flexible broad-spectrum CPL sensor by integrating with a SnSe thin film onto a chiral nematic cellulose nanocrystal (CNC) film substrate. The CNC film has a tunable helical pitch that selectively reflects CPL in the visible to near-infrared range via Bragg reflection, enabling direct discrimination of polarization handedness. Our device exhibits clear photocurrent responses across both visible and near-infrared wavelengths with distinct sensitivity to the handedness of CPL. This approach provides the development of chiral photodetectors, enabling compact, high-performance, and flexible CPL detection systems for next-generation optoelectronic applications.

Poster Presentation **2PS-219**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Molecular Interface Engineering with TRM for Enhanced Thermal Conductivity in Polymer Composites

임민우, 정광운[†]

전북대학교

Enhancing thermal conductivity in polymer composites requires more than just adding conductive fillers, and interfacial compatibility plays a crucial role. We introduce a newly designed tetrathiafulvalene-based reactive mesogen (TRM) that features an electron-rich aromatic structure, promoting strong molecular-level interactions with hexagonal boron nitride (BN) and expanded graphite (EG). These interactions effectively bridge the thermal gap between filler and matrix, facilitating phonon transport. Comprehensive characterization demonstrates that TRM incorporation leads to a significant increase in thermal conductivity. This result highlights the potential of molecularly engineered additives in overcoming interfacial limitations and provides a promising pathway toward high-performance, thermally conductive polymer systems for advanced thermal management applications. This work was supported by Mid-Career Researcher Program (RS-2021-NR059321) and BK21 FOUR program.

Poster Presentation **2PS-220**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Development of an Acid Vapor Detection Film Based on a Triphenylamine Gelator

이혜림, 정광운[†]

전북대학교

To fabricate a litmus film capable of detecting acid vapor leakage, a newly designed triphenylamine (TPA)-based gelator (abbreviated TPA-MA) is newly synthesized. TPA-MA exhibits aggregation-induced emission (AIE) properties when it forms an ordered packing structure by intermolecular interactions. The organogel based on the TPA-MA undergoes gel-sol transition induced by temperature and pH changes, modifying its self-assembled structure, accompanied by changes in fluorescent behavior. Using a monomeric solvent, photopolymerization of the TPA-MA gel enables the production of a mechanically stable litmus film exhibiting switchable luminescence characteristics. The synthesized film exhibits a reversible color change with a fast response time and high mechanical stability. This film can be utilized to intuitively show the leakage of toxic chemical vapors, for human health and safety. This work was supported by the Basic Research Laboratory Program (RS-2023-00207836) and BK 21 FOUR Program.

Poster Presentation **2PS-221**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Development of Polypropylene for Automotive Exterior Applications with Enhanced Transparency and Mechanical Performance

이춘호[†]

현대자동차

Polypropylene resin is widely utilized in various applications, including automotive interior and exterior parts, electrical and electronic products, and building materials, due to its excellent economic viability, mechanical properties, moldability, and chemical resistance.

Polypropylene resin can be classified into homopolypropylene (homo PP), block polypropylene (block PP), and random polypropylene (random PP) based on the type of monomer and the manufacturing method.

There is a demand for the development of polypropylene resin compositions that maintain the rigidity of homo PP and the impact resistance of block PP while exhibiting the high transparency characteristic of random PP to elevate the quality of automotive exterior components.

In this study, we developed a novel polypropylene resin composition that achieves excellent mechanical properties, including high transparency, rigidity, and impact resistance, making it suitable for automotive exterior applications.

Poster Presentation **2PS-222**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Intrinsic Stretchable Optical Physical Unclonable Functions for Multi-level Challenge-Response Pairs and Mechanical Deformation Stability

이지예, 최지훈, 이신형¹, 박혜림⁺

서울과학기술대학교

¹ 서울시립대학교

As hacking and counterfeiting advance, the limits of traditional cryptographic methods are becoming evident. Physical Unclonable Functions (PUFs), which use physical randomness to generate unique device responses, offer a promising alternative. Optical PUFs provide high entropy and low replicability, making them suitable for secure applications. However, conventional optical PUFs rely on static structures, producing only one fixed response. This limits encoding capacity and reduces consistency under mechanical deformation.

We present a Si-polymer-based optical PUF that generates varied responses via wrinkle-crack patterns formed under tensile strain. A SiO_x layer created by ultraviolet ozone treatment induces random wrinkles due to elastic mismatch. These structures produce direction and strength-dependent patterns and maintain high reproducibility after repeated deformation. This approach offers a flexible and reliable platform for future hardware security systems.

Poster Presentation **2PS-223**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

High efficiency Gel-Polymer-Electrolyte containing epoxy groups through In-situ polymerization using Lithium bis(fluorosulfonyl) imide (LiFSI)

이지예, 배완수, 송수빈, 주기종, 나혜원, 강동훈, 이도율, 장호현[†]

건국대학교

Currently, liquid electrolytes, which are the most widely used electrolytes in lithium secondary batteries, have low interfacial resistance and high ionic conductivity, but they have many problems in terms of stability. As a result, research is being conducted on solid electrolytes, which are more stable than liquid electrolytes, but the problem is that they have low ionic conductivity at room temperature.

In this study, we synthesize monomers containing an epoxy group, which facilitates polymerization, and a carbonate group, which can form weak coordination bonds with lithium ions to enhance ionic conductivity. Based on these monomers, we investigate polymer electrolytes. Subsequently, polymer electrolytes are prepared via in-situ polymerization of the synthesized monomers with LiFSI.

The synthesized monomers were analyzed using FT-IR, and the electrochemical properties of the polymer electrolyte were analyzed using EIS, LSV, CV, t_{Li+} , and charge-discharge tests.

Poster Presentation **2PS-224**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Development of SWIR-Responsive Non-Fullerene Acceptors for Organic Photodetectors

이준환, 정민영¹, 조길원¹, 이재원⁺

충남대학교

¹ 포항공과대학교

SWIR organic photodetectors (OPDs) have emerged as a key research focus in various technological fields, including image sensing, medical imaging, and optical communications. As their absorption spectrum extends further into the long-wavelength region, these devices continue to reveal new application potentials. However, there remains a limited availability of non-fullerene acceptors (NFAs) exhibiting photoresponsive properties beyond 1000 nm.

To enhance molecular charge transfer dynamics, we have designed a series of materials based on an acceptor–donor–acceptor–donor–acceptor (A–D–A–D–A) framework. This approach involves functional group modification on the central acceptor unit, resulting in materials with bandgaps (E_g) below 1.0 eV, which have been successfully applied in optical communication applications.

Poster Presentation **2PS-225**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Direct Ink Printed Stretchable Conductive Hydrogels for High-Aspect-Ratio In Vivo Bioelectronic Applications

이준민, 이윤선, 스티브 박⁺

한국과학기술원

In this study, we present a direct ink printable stretchable conductive hydrogel designed for high-aspect-ratio bioelectronics. The ink is composed of monomer, gelation agent, protein, and conductive polymer, with ionic liquid and nano clay added to enhance electrical conductivity and mechanical compliance. Laponite is incorporated as a rheological modifier, enabling the ink to maintain shape fidelity prior to UV-induced crosslinking. The printed hydrogel structures demonstrate an aspect ratio of 10:1, stretchability up to 420%, and stable conductivity of 7.44 S/m under hydrated conditions. This enabled vertical stacking with fine resolution, essential for compact and multilayered bioelectronic systems. The succeeded in printing microneedle and mechanical softness suggest strong potential for integration with biological tissue. This work highlights a promising route toward the fabrication of conformal, high-resolution, and mechanically robust bioelectronics via direct ink printing.

Poster Presentation **2PS-226**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Crosslinkable Conjugated Copolymers Exhibiting Color-Tunable Fluorescence

이재용, 남재두, 김성현, 김종호[†]

경북대학교

Organic fluorescent materials have attracted attention in sensing applications due to their tunability and biocompatibility. Among various sensing mechanisms, color change is widely used owing to its easy visual recognition. In this study, we synthesized a series of D-A type copolymers by incorporating small amounts of fluorescent acceptor units with different emission colors into a conjugated polymer backbone with inherent fluorescence. To preserve morphological stability, crosslinkable monomers were included in all copolymers.

The photophysical properties of copolymers were evaluated by UV-Vis, PL, and fluorescence lifetime measurements. Each copolymer emitted short-wavelength emission in the swollen state and long-wavelength emission in the collapsed state, enabling solvent sensing based on this fluorescence behavior. Furthermore, crosslinking enabled spatial fixation and patterning of emissive regions, making them suitable for sensing and smart patterning applications.

Poster Presentation **2PS-227**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Electrochemical Sensor Based on Imprinted Polymer onto a Gold Electrode for Determination of Creatinine

이유진, 임석진¹, 박진영¹

경북대학교

¹ 경북대학교

Creatinine is a metabolic waste product from muscle activity, excreted by the kidneys, and a key biomarker for assessing renal function. Accurate monitoring of creatinine is essential for early detection of kidney dysfunction. However, conventional methods, such as enzyme-based biosensors, suffer from drawbacks including low stability, poor reproducibility, and susceptibility to interference in complex biological environments. To overcome these limitations, molecularly imprinted polymers (MIPs) have attracted interest. In particular, these synthetic receptors provide high selectivity and resist degradation and environmental interference, making them well-suited for creatinine sensing. In this study, an electrochemical sensor was developed by photopolymerizing an MIP layer on a gold substrate. This sensor, which operates based on creatinine levels in the blood, electrically measures minute changes in impedance caused by repetitive adsorption and desorption of creatinine molecules onto molecularly imprinted sites of polymer matrix.

Poster Presentation **2PS-228**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Engineering Intramolecular Voids in Polysilsesquioxane Films for Enhanced Thermal Insulation

이예지, 박우솔, 정민철, 임정혁, 김경민⁺

한국교통대학교

Controlling intramolecular voids in polysilsesquioxane (PSQ) networks is an effective route to improve thermal insulation in hybrid polymer. In this study, oligomethylsilsesquioxane (MSQ-OH) was synthesized via a sol-gel reaction of triethoxymethylsilane and subsequently cross-linked with diglycidyl ether type cross-linkers to tune the size of intramolecular voids. Two cross-linkers with different molecular lengths, neopentyl glycol diglycidyl ether (NPGDGE) and poly(ethylene glycol) diglycidyl ether (PEGDGE), were used to prepare NPGDGE-BPS and PEGDGE-BPS films, respectively. From two PSQ films, the effect of intramolecular void size on the thermal conductivity was investigated. The structural and thermal characteristics of the resulting polysilsesquioxane films were analyzed by the spectroscopic and thermal techniques. This was supported by Korea National University of Transportation in 2025.

Poster Presentation **2PS-229**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

pH-Sensitive PEG-P(Asp-Hyd-AMK) Nanomicelles Enable Targeted Delivery of Melatonin Metabolite AMK for Attenuation of Oxidative Stress in Alzheimer's Disease

이영현, 이강원[†]

서울대학교

Alzheimer's disease (AD) is characterized by chronic neuroinflammation and oxidative stress, where excessive reactive oxygen species (ROS) activate microglia and amplify inflammatory responses. AMK (N1-Acetyl-5-methoxykynuramine), a melatonin metabolite, retains strong antioxidant and neuroprotective properties, but its delivery to the brain is limited by the blood-brain barrier (BBB). In this study, we developed pH sensitive PEG-P(Asp-Hyd-AMK) nanomicelles, where AMK is conjugated via hydrazone bonds. These nanomicelles protect AMK in circulation and release it under acidic conditions typical of AD-affected brain regions. With excellent permeability and targeted delivery, this platform shows potential as a novel antioxidant nanotherapeutic for AD treatment.

Poster Presentation **2PS-230**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Spatiotemporal molecular tracing of nanoliter-scale biofluids via a soft skin-adaptive optical monolithic patch sensor

이연수, 방창현[†]

성균관대학교

Precisely tracking small volumes of biofluids is essential for diagnostics, yet integrating optical nanosensors into a simple platform usable on rough, dynamic biosurfaces remains difficult. Here, we introduce a bioinspired 3D microstructured patch for real-time molecular tracing of nanoliter-scale fluids. Inspired by tree frog toe pads, the patch features soft, hexagonally arranged pillars and microchannels for conformal adhesion and fluid control. Near-infrared fluorescent SWCNT nanosensors were embedded in a hydrogel and anchored within elastomer microchannels for simultaneous fluid capture and sensing. We demonstrated real-time sweat analysis without exercise or iontophoresis, achieving fast capture (45 s) and detection from ≥ 75 nL. This study was published in: Nature Communications 16, 3272 (2025).

Poster Presentation **2PS-231**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Multifunctional Conductive Fibers with Tunable Performance for Washable Sensing and Interconnects

이연서, 김희숙[†], 강병철

한국과학기술연구원

Fiber-shaped wearable electronics enable continuous monitoring by integrating electronic functions into textiles. For real-world use, these fibers must be conductive, stretchable, durable, multifunctional, and washable. However, complex fabrication and limited waterproofing hinder commercialization. Here, we present a simple method using common materials to create stretchable, conductive, and tunable fibers (SCFTFs) that function as both strain sensors and conductive threads, without chemical modifications or adhesives. SCFTFs achieve conductivities up to 10^3 S/cm, retain performance under 100% strain with waterproof coating, and remain stable after washing. By adjusting the coating, the gauge factor can be tuned for use in wearable sensors and e-textiles. This approach offers a practical solution for developing multifunctional, washable conductive fibers.

Poster Presentation **2PS-232**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Improvement in Curing Reaction and Physical Properties of Butyl Rubber Composites using Polydopamine-Coated Carbon Nanotubes

이신우, 정영규[†]

충남대학교 유기응용재료공학과

Butyl rubber (IIR) is extensively used in applications such as tire liners, inner tubes, and flexible electronics due to its superior gas barrier and vibration-damping properties. Polydopamine (PDA), known for its unique adhesiveness, biocompatibility, and organic solvent-free synthesis, was employed to enhance the dispersion and interfacial adhesion of carbon nanotubes (CNTs) in IIR. A self-polymerization method was used to coat the CNTs with a layer of PDA. The vulcanization process was analyzed through FT-IR spectroscopy, while microstructural and rheological properties were investigated using electron microscopy and rotational rheometry. Tensile properties, damping behavior, and electrical conductivity of the composites were evaluated. The improved dispersion of PDA-CNT, attributed to both covalent and non-covalent interactions with the matrix, resulted in enhanced curing efficiency, mechanical performance, and conductivity of the IIR composites.

Poster Presentation **2PS-233**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Tissue-Specific ECM-Based Platform for Enhanced Colorectal Cancer Organoids and Xenograft Models

이시은, 남예나, 진윤희[†]

연세대학교 의과대학

Organoids are three-dimensional mini-organ structures that serve as powerful tools for investigating tissue development, disease mechanisms, and drug responses. In cancer research, faithfully replicating patient-specific tumor characteristics is critical for developing clinically relevant models. Matrigel, the most commonly used scaffold for organoid culture, provides an ECM-like environment but lacks tissue specificity, which can limit physiological accuracy and translational value. In this study, we explore the use of decellularized extracellular matrix derived from intestinal tissue (Intestine ECM) as a tissue-specific scaffold for culturing colorectal cancer organoids and establishing cell-derived xenograft (CDX) models. By mimicking the native tumor microenvironment more effectively than Matrigel, Intestine ECM may enhance model reproducibility and better reflect in vivo tumor behavior, offering improved platforms for mechanistic studies and therapeutic screening in CRC research.

Poster Presentation **2PS-234**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Effect of Aliphatic Diisocyanate Ratios on Two-Way Shape Memory Behavior in Polyurethane Networks

이수영, 정용석, 김경수, 송창식[†]

성균관대학교

Two-way shape memory polymers (2W-SMPs) can reversibly change their shape in response to thermal stimuli and are widely studied for applications in soft actuators and smart devices. In this study, crosslinked polyurethane networks were synthesized using poly(ϵ -caprolactone) (PCL), polybutadiene (PB) as soft segments and glycerol as a chain extender. The networks were prepared by varying the ratio of two aliphatic diisocyanates: hexamethylene diisocyanate (HDI) and isophorone diisocyanate (IPDI). We observed that the shape memory characteristics, including shape fixity and recovery, were influenced by changes in the HDI/IPDI ratio. This study demonstrates that the HDI/IPDI composition is a key factor in controlling the properties and performance of polyurethane-based 2W-SMPs, offering a strategy for composition optimization. These findings provide valuable insights into the design of 2W-SMPs with tailored performance for soft actuators and adaptive materials.

Poster Presentation **2PS-235**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Reduction of biofilm formation through surface segregation of semi-crystalline shape memory polymers in the binary polymer blend

이상민, 이정진, 조성우, 김요한, 김성진¹, 김미영¹, 김대현², 성학준[†], 이강석^{†1}

연세대학교

¹ 티엠디랩

² 충남대학교

Various polymer-based implantable medical devices have contributed to improving the quality of life. However, conventional medical grade polymers were formed biofilm by bacterial adhesion in the body, leading to reduced device performance and severe health complications. In order to secure biofilm-reducing properties, medical grade thermoplastic polyurethane (TPU) and biocompatible polycaprolactone based shape memory copolymer (PCL-SMP) were blended. Surface characterization using FT-IR, XPS, and contact angle measurements revealed that PCL-SMP preferentially segregated to the surface of the blend. In-vitro experiments showed that biofilm formation was reduced by approximately 45% compared to conventional TPU. For In-vivo study, we fabricated TPU/PCL-SMP tubular type samples and biocompatible tube inserted into the bile duct of a pig model to confirm patency.

Poster Presentation **2PS-236**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Shear-Rheological-Assisted Dispersion of Surface-Modified MXene in Epoxy Resin for Improved Electromagnetic Shielding

이병완, 허소현, 김영석[†]

한국전자기술연구원

MXene, a two-dimensional material with high electrical conductivity and large surface area, has emerged as a promising candidate for electromagnetic absorption applications. However, its abundant polar functional groups result in poor dispersion within non-polar matrices, limiting its use in non-polar polymer-based composites. In this study, surface-modified MXene was incorporated into an epoxy matrix, and its dispersion behavior was systematically evaluated using shear rheology. Additionally, various nanoparticles (e.g., Fe₃O₄) were uniformly distributed within the MXene nanosheets to further enhance the dispersion and electromagnetic performance of the composites. The resulting shear-rheology-assisted dispersion strategy enables the formation of homogeneous MXene-based epoxy composites with industrially significant electromagnetic absorption properties. This approach provides valuable insights for the design and development of advanced MXene-based electromagnetic absorbing materials.

Poster Presentation **2PS-237**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Low-Bandgap Acceptor Design with π -Bridge Insertion for High-Responsivity NIR Organic Photodiodes

이맹강, 정민영¹, 조길원¹, 이재원⁺

충남대학교

¹ Pohang University of Science and Technology

We developed π -bridge engineered nonfullerene acceptors (NFAs) for high-specific-detectivity organic photodiodes (OPDs) working beyond 1200 nm in the near-infrared (NIR) range. Prior studies rarely explored how π -bridge design affects NFA-based OPDs. We systematically studied how π -bridge substitution impacts intramolecular charge transfer (ICT), energy levels, and aggregation. Three NFAs were synthesized, tuning the bandgap from 1.12 eV to 1.05 eV and broadening NIR absorption. Suppressing aggregation improved exciton dissociation and reduced nonradiative recombination. The optimized OPD shows a detectivity of 3.43×10^{11} Jones and a -3 dB cutoff frequency of 58.6 kHz at 1050 nm under -2 V. Finally, the device was applied in photoplethysmography (PPG) and optical wireless communication, showing strong potential for biosignal monitoring and transmission.

Poster Presentation **2PS-238**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Study on Oleic Acid-Based Eco-Friendly Polymer Electrolytes for Lithium-Ion Batteries

이도율[†], 배완수¹, 주기종¹, 송수빈¹, 나혜원¹, 이지예¹, 장호현^{†1}

건국대학교

¹ 건국대학교 글로벌캠퍼스 유기합성실험실

This study presents the development of a bio-based polymer electrolyte utilizing oleic acid, a natural fatty acid, for pursuing sustainable and eco-friendly energy storage solutions. Oleic acid, a renewable and biodegradable resource, was developed considering its eco-friendly advantages as an electrolyte and the stability of the polymer electrolyte. Lithium epoxidized fluorosulfonylamide oleic acid (LiEFSOA) was synthesized by functionalizing lithiated oleic acid with fluorosulfonyl isocyanate and then epoxidizing it. The solid polymer electrolyte with improved interfacial compatibility and ionic conductivity was obtained through in situ thermal polymerization. The structural, thermal, and electrical properties of the resulting material were characterized by FT-IR spectroscopy, thermogravimetric analysis (TGA), and electrochemical impedance spectroscopy (EIS). This eco-friendly approach demonstrates the potential of utilizing eco-friendly materials in lithium battery technology.

Poster Presentation 2PS-239

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Fluorescence Spectroscopy-Based Surface Characterization of Polypropylene for Molecular Bonding

이대준, 김연준, 박소민, 박주영, 김용석⁺

세종대학교

폴리프로필렌(Polypropylene, PP)은 낮은 표면 에너지와 화학적 비활성성으로 인해 금속과의 접착이 어렵고, 이로 인해 분자 접합 기술 적용 시 표면 전처리 및 계면 분석이 핵심 단계로 요구된다. 본 연구에서는 형광 분광법을 적용하여, PP 표면의 화학적 특성과 미세 구조 변화를 비파괴적으로 분석하였다. PP 시료의 전처리 조건 및 염색 조건에 따라 형광 스펙트럼의 변화 양상을 측정하고, 이때 변수로서 형광 파장의 이동 및 세기 분포는 표면 환경의 극성 변화, 에너지 상태 등을 반영하였다. 측정된 형광 스펙트럼을 계면의 균일성 및 반응성 평가에 적용하여 PP 표면의 분자 접합 가능성을 사전에 예측하고 조절할 수 있는 기반 자료를 확보하였다. 본 연구는 추후 금속과 고분자 간 직접 접합을 위한 계면 설계 및 최적화에 유용한 표면 분석 방법론으로 활용될 수 있을 것으로 기대된다.

Poster Presentation **2PS-240**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Branched anion exchange membrane based on poly(arylene piperidinium): Effect of branching moiety on polymer structure

이규하, 주지영[†]

전북대학교

Anion exchange membrane-based AEMFC, water electrolysis, and CCU have high potential as next-generation alternative energy generators, but they are facing difficulties in commercialization due to unstable chemical stability and low ionic conductivity of the membrane. In this study, we aim to overcome the limitations by developing a novel branched polymer structure using N-methyl-4-piperidone, p-terphenyl, dibenzothiophene, and branched monomers. First, the chemical structure was confirmed through FT-IR and NMR. Additionally, the morphology with nanophase separation was confirmed using AFM, and the surface of membrane was confirmed without any defect and high density through FE-SEM. These branched structure-based polymer backbone provide a strategy for the development of high-performance AEMs with superior properties.

Poster Presentation **2PS-241**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Design of Functional Binders for Interfacial Stabilization in High-Voltage High-Nickel Lithium-Ion Batteries

이경록, 문홍철¹

서울시립대학교

¹ kaist

As the demand for high-performance lithium-ion batteries increases, various strategies have been proposed to enhance device performance. Among them, increasing the operating voltage has gained attention as an effective approach to improve the specific capacity of batteries. However, high-voltage operation imposes significant challenges on electrode stability, necessitating the development of advanced polymer binders. Here, we design a novel polymer binder and comprehensively compare its effects with those of a conventional PVDF binder. The newly designed binder exhibits stronger adhesion to electrode components and higher electrolyte affinity, leading to enhanced interfacial stability. As a result, a uniform and robust cathode electrolyte interface layer is formed, improving capacity retention, cycling stability, and overall electrode performance. These findings provide useful guidelines for the development of high-performance polymer binders for next-generation lithium-ion batteries.

Poster Presentation **2PS-242**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Optical Coating and Characteristics of Polymer Lens Materials via Electron Beam Irradiation

이건영, 김민재, 정진혁, 옥도광, 이한진, 김경민, 임정혁⁺

한국교통대학교

Electron beam (EB) irradiation is a powerful processing technology capable of precisely controlling the chemical and physical properties of materials. In this study, EB irradiation was applied directly to polymer-based lens materials to investigate the resulting changes in surface structure and optical properties. Representative commercial lens substrates—CR-39, MR-8 and polycarbonate (PC)—were selected as targets, and each specimen was irradiated at doses ranging from 25 to 200 kGy. After irradiation, changes in absorbance as well as surface morphology were analyzed. These findings demonstrate the potential of electron beam irradiation as a means of inducing selective surface modification and imparting functionality to polymer materials. Optical and surface properties were analyzed using UV-vis spectrophotometry, contact angle goniometer, and FT-IR. (This was supported 2025 URP and Ulab at Korea National University of Transportation)

Poster Presentation **2PS-243**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Electrochromic and Polarization-Dependent Information Encryption Using Triphenylamine-Based Smart Films

유동민, 정광운[†]

전북대학교

A newly designed asymmetric triphenylamine (TPA)-based monomer (TPA-AM) is synthesized for high-security information encryption. The introduction of a methyl group induces steric hindrance, enabling TPA-AM to self-assemble into a lamello-columnar structure. This structure allows uniaxial alignment through a simple shear-coating process. The resulting thin films exhibit polarization-dependent photoluminescence (PL), electrofluorochromic (EFC), and redox-responsive electrochromic (EC) properties. Selective photopolymerization of these films enables dual-mode encryption, where encrypted information is revealed only under specific voltages or light polarization. Incorporation onto flexible indium tin oxide (ITO)-coated PET substrates demonstrates the system's potential for application in wearable optoelectronic security devices. This work was supported by the Basic Research Laboratory Program (RS-2023-00207836) and BK 21 FOUR Program.

Poster Presentation **2PS-244**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Zwitterion-Driven Anisotropic Photo-Responsive Films for Advanced Optical Modulation

위영재, 정광운[†]

전북대학교

A diarylethene-based zwitterionic molecule (DZM) was developed and incorporated into photochromic films exhibiting tunable optical and ionic conductive behaviors. The zwitterionic moiety, in conjunction with dendritic alkyl chains, drives hierarchical self-assembly, forming nanostructured domains that are directionally aligned via shear-coating processes. This molecular ordering imparts anisotropic photochromic characteristics and polarization-selective optical effects. Structural investigations reveal that the zwitterionic interlocking mechanism plays a role in generating aligned nanocolumns, which underlie the polarization-sensitive color changes. Under alternating UV and visible light irradiation, the films display reversible color transitions alongside modulated ionic conductivity, highlighting their promise for use in anti-counterfeiting applications. The research received substantial support from the BK Four Program and Basic Research Laboratory Program (RS-2023-00207836).

Poster Presentation **2PS-245**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Soft template synthesis and electrorheological characteristics of polypyrrole nanotubes

왕시조, Qi Lu, 최형진, 권용구[†]

인하대학교

Conducting polypyrrole (PPy) nanotubes were synthesized using methyl orange as a soft template. Then, their morphology, chemical and crystal structures, and thermal properties were studied. The PPy nanotubes were dispersed in silicone oil at a concentration of 5 vol% to examine their electrorheological (ER) properties. Testing results from controlled shear rate and controlled shear stress modes show that the flow curve can be fitted by the CCJ model. The dynamic and static yield stresses were 209.4 and 233.7 Pa, respectively, when an electric field strength of 3 kV/mm was applied. The yield stress versus electric field strength relationship exhibited a power-law relationship with a slope of 2.0. The dielectric properties of the ER fluid were studied and were shown to exhibit a good polarization response, resulting in a perfect ER response.

Poster Presentation **2PS-246**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Smart Ionic Skins and Actuators with Ionic Azobenzene-Based LCEs: Heat, Light, and Strain-Induced Ionic Conductivity Switching and Actuations

오민택, 정광운[†]

전북대학교

We report the design of a novel ionic azobenzene-based monomer (i-AAM) and its successful polymerization into liquid crystal elastomers (LCEs) that exhibit uniaxially orientation and switchable ionic conductivity. The i-AAM LCEs can form either monodomain or polydomain states, acting as actuators and ionic skins, respectively. In the monodomain state, the LCE contracts above T_{NI} and bends upon UV exposure. In the polydomain state, its ionic conductivity can be reversibly modulated by heat, light, and mechanical stimuli. By combining the distinct actuation and sensing capabilities of each state, we developed a soft gripper that not only deforms in response to various external stimuli but also detects their intensity. The LCE-based actuators and smart skins offer a versatile platform for developing next-generation soft robotic systems with integrated multi-functional responsiveness. This work was supported by Basic Research Laboratory Program (RS-2023-00207836), BK21 FOUR Program.

Poster Presentation **2PS-247**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Autonomous self-healable iontronic skin with mechano-sensitive ion dynamics for touch modulation

엘비스, 판보해¹, 권혁민², 김주성, 최한빈, 공진연, 영우빈³, 이경진¹, 김도환⁺

한양대학교

¹ 충남대학교

² 한양대학

³ KAIST

The self-healing properties and mechanosensing capabilities of the human skin have inspired the design of stretchable iontronic sensors. However, existing mechanasensitive designs can hardly achieve autonomously superior self-healing properties and effective control of ion dynamics in a homogeneous system simultaneously. Herein, we report a Cl-functionalized iontronic pressure sensitive material via the introduction of Cl-functionalized groups into a polyurethane matrix, which realizes an ultrafast, autonomous self-healing speed (4.3 $\mu\text{m}/\text{min}$), high self-healing efficiency (91% within 60 min), and mechanosensitive piezo-ionic dynamics. This strategy promotes effective control of ion dynamics via ion-dipole interactions, resulting in excellent pressure sensitivity (7.36 kPa^{-1}) for tactile sensors. The skin-like sensor responds to pressure variations, demonstrating its potential for touch modulation in future wearable soft electronics and human-machine interfaces.

Poster Presentation **2PS-248**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Flexible Transparent Heaters Based on Au/GaOx for High-Temperature Applications

엄기혁, 정운룡[†]

POSTECH

Flexible transparent heaters are promising for de-icing in vehicles and use in wearable or foldable devices. For operation in extreme environments, such as in the aerospace industry, higher-temperature heating performance is required. Our transparent heater was fabricated by printing gallium oxide (GaOx) on a polyimide (PI) substrate via ambient liquid Ga printing, followed by thermal evaporation of gold (Au) to form a Ga-Au alloy. Optical transmittance, sheet resistance, and heating performance were evaluated with varying Au thickness. A 6 nm Au layer showed 86% transmittance and a sheet resistance of 16 Ω/sq , while a 14 nm layer had 69% and 6 Ω/sq . Under 20 V, the 14 nm sample reached a peak temperature of 521 °C and maintained over 500 °C for 6 hours. The Au/GaOx heater also endured 8,000 bending cycles (2.5 mm radius) with <0.1% resistance change. These findings highlight the potential of Au/GaOx-based heaters de-icing, foldables, and extreme environments.

Poster Presentation **2PS-249**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Synthesis of Photo-Curable Adhesives with Thermally Switchable Behavior via UV-triggered Aza-Michael Reaction

Perumal Sathiyachandran, 양유진, 송창식[†]

성균관대학교

Adhesives are essential across diverse industries, with growing interest in high-performance and adjustable adhesives. In this study, we developed photo-curable adhesives with thermal reversibility via UV-triggered aza-Michael reaction. Photo-reactive monomers (HDI-IHTet and HDI-IDTet) with o-nitrobenzyl groups released amines under UV light. Monomers underwent photo-deprotection within 5 minutes, confirmed by UV-vis spectroscopy. Strong adhesion formed within 2 hours of UV irradiation through the reaction between diacrylates (BPAGDA and BDDA) with amines. In the lap shear test, HDI-IHTet system and HDI-IDTet system exhibited maximum shear strengths of 16.3 MPa/17.7 MPa and 28 MPa/32 MPa, respectively. To assess thermal reversibility, the adhesive layer was heated and cooled to room temperature. The adhesion strength of HDI-IHTet-BDDA recovered to 15.4 MPa, restoring 87%. These dual-responsive adhesives with high adhesion strengths open up a variety of potential applications.

Poster Presentation **2PS-250**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Fully Recyclable and Highly Adhesive Poly(β -Amino Ester) Covalent Adaptable Networks-based Solid Polymer Electrolytes for Lithium Metal Batteries

양미옥, 전용하¹, 최우혁¹, 김채빈⁺

부산대학교

¹ 인하대학교

Despite the widespread adoption of lithium metal batteries, safety and sustainability remain major challenges. Solid polymer electrolytes (SPEs) offer a safer and more durable alternative, with advantages such as flexibility, thin-film processability, and mechanical stability. Crosslinked rubbery polymers with low glass transition temperatures are typically used to ensure high lithium-ion conductivity, strong interfacial adhesion, and mechanical integrity. However, their permanent crosslinks hinder recyclability. To address this, poly(β -amino ester) (PBAE)-based covalent adaptable networks (CANs) were developed as fully recyclable, catalyst-free, and highly adhesive SPEs. Their lithium-ion conductivity, dynamic bond exchange behavior, and adhesion were systematically investigated across different crosslinking densities. Additionally, the reprocessability of the electrolytes was demonstrated, and lithium salts within the network were recovered with high purity.

Poster Presentation **2PS-251**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

A Ionic Liquids Enhanced Poly(γ -glutamic acid) Hydrogels for Flexible Strain Sensor

양규성, 강혜인¹, 윤영일², 박원호⁺

충남대학교

¹ 충남대학교 공과대학 유기재료공학과

² 한국폴리텍대학 바이오캠퍼스 바이오품질관리과

현대 사회에서 건강한 삶에 대한 관심이 높아짐에 따라, 의료 및 헬스케어 분야의 발전을 위한 웨어러블 디바이스 연구가 활발히 진행되고 있다. 그러나 기존의 금속 및 전도성 재료 기반 스트레인 센서는 유연성이 부족하여 설계에 제약이 있으며, 인체와 같이 굴곡이 많은 표면에서 변형을 정밀하게 감지하기 어려워 동작 및 변형 모니터링에 한계가 있다. 본 연구에서는 우수한 생체적합성을 지닌 poly(γ -glutamic acid)를 기반으로, 이온성 액체를 도입하여 고분자 수화젤 기반 스트레인 센서를 제작하였다. 개발된 수화젤 센서는 변형 감지 성능을 저하시키지 않으면서도 신장과 수축이 자유로운 높은 유연성을 가지며, 다량의 수분 함유로 인해 이온전도성이 향상되었다. 이를 통해 인체 동작 모니터링 응용 가능성을 검증하였으며, 피부와 유사한 기계적 특성으로 사용자 착용 편의성을 제공한다. 본 연구 결과는 재활 및 헬스케어 분야에서 수화젤 기반 스트레인 센서의 높은 잠재력을 제시한다.

Poster Presentation **2PS-252**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Highly Transparent Self-Healing Elastomers based on Localized Hydrogen Bonding with Outstanding Folding and Rolling Reliability

신혜원, 최기원¹, 고민재¹, 임상혁², 홍성우³

한국생산기술연구원

¹ 한양대학교

² 고려대학교

³ 한국생산기술연구원/한국과학기술연구원

Developing transparent polymers with both mechanical robustness and self-healing capability is a critical challenge for next-generation flexible displays and electronics. In this study, we report a crosslinked elastomer incorporating a sustainable isosorbide oligomer (HO) that forms strong, localized hydrogen-bonding networks. The resulting elastomer (HELI) exhibited excellent optical and mechanical properties, including 91.7% transmittance, 0.5% haze value at 550 nm, and 3H surface hardness. It also endured 100,000 folding and 10,000 rolling cycles without optical or structural degradation. Notably, HELI autonomously recovered 95 % of its tensile strength within 10 min at 80 °C, enabled by dynamic HO-mediated reversible hydrogen bonds that dissipate stress and repair damage at the molecular level. These results demonstrate a promising approach toward durable, transparent, and healable coatings for next-generation flexible displays and electronics.

Poster Presentation **2PS-253**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Artificially Intelligent Ferroelectric e-Skin for Tactile Learning

신정원, 이규호¹, 권민지¹, 김지원¹, 하제봉¹, 김수한¹, 전찬영¹, 박철민¹

연세대학교 산학협력단

¹ 연세대학교

Lightweight, adaptable tactile learning machines are capable of simultaneous sensing, storing, and learning from physical stimuli detected through the skin. These technologies are gaining significant attention for their applications in next-generation wearable and human-interactive neuromorphic electronics. This study presents an integrated AI-powered tactile learning electronic skin, constructed from an array of FeFETs equipped with dome-shaped tactile top gate. When pressure is applied to the gate, the device records changes in ferroelectric remnant polarization within the gate insulator. This leads to analog conductance modulation that varies with both the intensity and frequency of the pressure pulses, effectively emulating various stimuli. The device demonstrates outstanding stability during long-term potentiation and depression cycles, maintaining performance over 10,000 consecutive pulses. Also, low variability of 3.18% ensures consistent and reliable performance.

Poster Presentation **2PS-254**

기능성 고분자(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Controlled Phase Separation-Induced Microporous Polymer Networks for Breathable and Sensitive Wearable Sensors

김민성, 신다빈, 김호리, 안재용, 오준학⁺

서울대학교

Microporous polymer networks with bicontinuous morphology offer excellent potential for breathable and stretchable wearable sensors. However, scalable fabrication with uniform pores and stable mechanical properties remains a challenge. Here, we present a facile strategy using polymerization-induced phase separation (PIPS), where precise control of solvent ratios enables the formation of interconnected micropores. The resulting elastomeric films show high porosity, mechanical stability, and enhanced dielectric performance. When applied as the dielectric layer in capacitive pressure sensors, the material exhibited ~725% higher pressure sensitivity than conventional dense films. Furthermore, the porous architecture allows consistent physiological signal monitoring even under high humidity. This study highlights the potential of phase-separated polymer networks as next-generation materials for e-skin and wearable electronics.

Poster Presentation **2PS-255**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Development and Characterization of High Heat-Resistant Epoxy Prepreg for Semiconductor PCB Substrates

홍진건, 유수영, 김철용, 박명철[†]

씨엔에이텍(주)

A glass fiber-based prepreg is widely employed in semiconductor printed circuit board (PCB) substrates due to their superior insulating properties and cost-effectiveness. The thermal stability of the prepregs is a critical parameter, as it directly influences dimensional stability, interlaminar adhesion, and mechanical durability under high temperature processing conditions.

In this study, a high heat resistant epoxy resin system was developed to fabricate prepregs optimized for semiconductor PCB applications. Various resin formulations were systematically investigated to enhance not only thermal resistance but also key properties such as low dielectric constant and high adhesion strength. The resulting epoxy based prepregs exhibited excellent thermal and mechanical performance, demonstrating strong potential for application in high reliability semiconductor PCBs as well as in broader electronic and industrial composite material fields.

Poster Presentation **2PS-256**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Sustainable Thermoplastic Polyether Ester Elastomer Based on Chemically Recycled and Bio-Based Monomers

홍은지[†]

삼양사

In response to increasing demands for sustainability and reduced reliance on fossil resources, this study reports the development of an eco-friendly thermoplastic polyether ester elastomer synthesized from chemically recycled and bio-based monomers. The hard segments consist of recycled aromatic dicarboxylic acid esters and bio-based aliphatic diols, while the soft segments incorporate polytrimethylene ether glycol and isosorbide-alkylene glycol derivatives. This design enables control over melting temperatures, supporting various molding processes. The resulting TPEE exhibits stable tensile strength and elongation, ensuring consistent mechanical performance. The synthesis is compatible with conventional melt polycondensation, allowing integration into existing production lines. These results demonstrate the potential of this TPEE as a sustainable alternative to conventional plastics, offering both excellent processability and suitability for industrial applications.

Poster Presentation **2PS-257**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Polymerization-retarding impurities in the chemical recycling of polystyrene: mechanistic identification and control

하유진, 김희중[†]

인하대학교

Polystyrene (PS) is a common plastic, but its low recycling rate raises environmental concerns. Catalytic depolymerization of PS produces a styrenic liquid (SL), composed of its monomeric form, enabling a circular economy. However, impurities in SL disturb efficient repolymerization, preventing high molar mass formation. We systematically identified key structures in SL—such as benzyl-containing molecules and α -substituted styrenes—which hinder polymerization by acting as chain transfer agents or through thermodynamic effects. These impurities were removed by distillation, yielding distilled SL with ~92% styrene. Its polymerization gave high-molar-mass PS (up to 150kDa), with thermal and mechanical properties comparable to virgin PS. The repolymerized PS also depolymerized consistently, supporting the feasibility of a closed-loop recycling system. This study highlights the role of impurities and suggests a practical approach to scalable and sustainable PS recycling.

Poster Presentation **2PS-258**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Nitrile- and Ether-Enriched COF as a Functional Filler for Enhancing Proton Conductivity and Durability of SPEEK-Based PEMs

최지용, 이종찬[†]

서울대학교

A nitrile- and ether-rich covalent organic framework (COF-EN) was synthesized via nucleophilic substitution and used as a nanofiller to enhance the performance of sulfonated poly(ether ether ketone) (SPEEK)-based proton exchange membranes (PEMs). Incorporation of COF-EN improved thermal, oxidative, and dimensional stability through hydrogen bonding, dipole–dipole, and π – π interactions with the SPEEK matrix. The polar groups in COF-EN also facilitated water uptake and proton conduction. Among the composites, SPEEK/COF-EN_3 showed the best balance of mechanical and electrochemical properties, achieving a 2.3-fold increase in fuel cell power density compared to pristine SPEEK. This study highlights COF-EN as an effective filler for next-generation PEMs.

Poster Presentation **2PS-259**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Designing Supramolecular Polymerization and Emulsion Stabilization of Multicompartmentalized Nanoobjects

조수찬, 서명은[†]

KAIST

Miktoarm core-crosslinked star (CCS) polymers synthesized via polymerization-induced self-assembly (PISA) enable a spontaneous supramolecular polymerization. Here, we investigated how polymerization parameters affect these supramolecular polymerization. We demonstrated that increasing core size of miktoarm CCS polymers induced multicompartment structures and triggered a morphological transition from one-dimensional elongation to higher-order superstructures. Highly solvophobic arms promoted earlier and stronger interparticle association, whereas less solvophobic arms delayed or suppressed supramolecular polymerization. In addition, these multicompartment CCS nanoparticles served as efficient emulsion stabilizers, producing stable high internal phase emulsions (HIPE).

Poster Presentation **2PS-260**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Synthesis of a Polyelectrolytic Polyacetylene with Pyrene Substituents via the Quaternization Polymerization of 2-Ethynylpyridine

김태형, 박종욱¹, 진성호², 심상연³, 제갈영준^{†4}

한국화학연구원

¹ 경희대학교

² 부산대학교

³ 강릉원주대학교

⁴ 경일대학교

The quaternization polymerization of pyridylacetylenes using appropriate reactants is a versatile platform for the synthesis of ionically functionalized polyacetylenes. A polyelectrolytic polyacetylene derivative with pyrene substituents was synthesized via *In-situ* quaternization polymerization of 2-ethynylpyridine using 1-(bromoacetyl)pyrene. The monomeric N-(2-oxo-2-((pyrene)ethyl)-2-ethynylpyridinium bromide firstly formed from the reaction of 2-ethynylpyridine and 1-(bromoacetyl)pyrene was spontaneously polymerized without any additional catalyst systems to give the ionic polyacetylene in high yield (85%). The analysis results on the polymer structure using instrumental methods such as IR, NMR, and UV-visible spectroscopies showed that the polymer has the conjugated backbone system with the designed pyrene moieties. This polymer dissolves well in organic solvents such as DMSO, DMF, DMAc, etc.

Poster Presentation **2PS-261**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Enhanced C₃H₆/C₃H₈ Separation via Polymer-Coordinated Heterogeneous ZIF-8 Structures

정호진, 조계용[†]

부경대학교

In this study, we present a novel polymer-coordinated metal–organic framework, heterogeneous ZIF-8 (hZIF-8), engineered for high-performance C₃H₆/C₃H₈ molecular sieving. The hZIF-8 is synthesized via a Lewis acid-catalyzed cationic ring-opening polymerization of tetrahydrofuran (THF), yielding polytetramethylene ether glycol (PTMEG) chains that coordinate with Zn²⁺ ions during ZIF-8 crystallization. This in situ coordination leads to a hybrid architecture comprising nanocrystalline ZIF-8 domains embedded within an amorphous polymer matrix. The incorporation of PTMEG effectively restricts the dynamic linker swing motion inherent to ZIF-8, thereby reducing the aperture size and enhancing molecular sieving selectivity. Mixed-matrix membranes (MMMs) fabricated with hZIF-8 exhibit significantly enhanced C₃H₆/C₃H₈ separation performance, achieving a selectivity of 75.5 and a permeability of 17.4 Barrer at 30 wt% filler loading—representing improvements of 468% and 135%, respectively, compared to conventional ZIF-8-based MMMs. The intrinsic selectivity of hZIF-8 was extrapolated to be approximately 3,700, nearly an order of magnitude greater than that of pristine ZIF-8. These results highlight polymer coordination as a powerful strategy for tuning molecular sieving behavior in MOFs, offering promising avenues for advancing membrane-based hydrocarbon separations.

Poster Presentation **2PS-262**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

PFAS-Free Fabric Coating Using Slippery Covalently-Attached Liquid Surfaces (SCALS)

정현정, 양주호¹, 진영재^{*1}

한국화학연구원/울산과학기술원

¹ 한국화학연구원

Per- and polyfluoroalkyl substances (PFAS) offered exceptional water repellency, self-cleaning, and anti-fouling properties, but faced strict regulations due to bioaccumulation and toxicity. In this study, we developed a PFAS-free coating strategy based on polydimethylsiloxane (PDMS), by constructing a slippery covalently-attached liquid surface (SCALS) on textile substrates. A reactive triethoxysilane monomer bearing a functional group and a mono-terminated PDMS with a complementary moiety were co-dissolved in an organic solvent and uniformly spray-coated onto fabric. During subsequent thermal curing, an interfacial reaction occurred between the two components, resulting in the covalent anchoring of the liquid PDMS layer onto the fiber surface. ¹H NMR and FT-IR spectroscopy confirmed the formation of chemical bonds, and SEM/EDS analyses demonstrated uniform PDMS coverage on the textile surface. The resulting coated fabric exhibited a low water sliding angle and significantly reduced surface energy, highlighting the potential of this method as a fluorine-free, water-repellent, textile coating

Poster Presentation **2PS-263**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Synthesis of Eco-Friendly Non-fluorinated Water Repellent Using Long Chain Alkyl Acrylate

정명우, 정일두[†]

부산대학교

Although widely used fluorine-based water repellents, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS), have the advantages of excellent in water repellency, chemical stability, and maintenance of the original properties of fibers, their use are limited due to non-biodegradation and toxicity to human body. In this study, a non-fluorine repellent was synthesized through an emulsion polymerization process using nonionic and cationic emulsifiers, and stearyl acrylate, as a long-chain alkyl acrylate, in the presence of alkylsiloxane resin in order to maximize water repellent effect. The synthesized water repellent was applied to a fiber substrate, dried and coated to evaluate the water repellency and surface properties through the contact angle measurement and AATCC 22 water repellency test.

Poster Presentation **2PS-264**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Bio-based nylon synthesized under moderate conditions for sustainable applications

장선진, 임지호, 윤수민, 박재형⁺

경북대학교

Amid growing environmental concerns, there is increasing interest in the development of biopolymers derived from renewable bio-based monomers. These materials are attractive alternatives to conventional fossil fuel-based polymers, as they offer comparable performance with reduced ecological impact. Nylon, as one of the three most widely used synthetic fibers, is known for its superior resistance to heat, chemicals, and abrasion, making it an important target for sustainable innovation. In particular, long-chain nylon exhibits lower moisture absorption, and improved dimensional stability compared to short-chain nylon, making them suitable for various engineering and coating applications. In this work, bio-based long chain nylon was synthesized and characterized through structural, thermal, and mechanical analyses. Nylon was synthesized under mild conditions without high pressure, which simplifies the reaction process and reduces energy consumption for eco-friendly production.

Poster Presentation **2PS-265**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Impact of Carbonate Content in CO₂-Based Polyols on the Properties of Thermoplastic Polyurethanes

이한수, 김일⁺, 안석균⁺

부산대학교

Carbon dioxide (CO₂) is attractive feedstock for polymer synthesis because it is inexpensive, non-flammable and non-toxic gas. CO₂ can be copolymerized with various epoxides to produce polyols using a double metal cyanide (DMC) catalyst. In this study, CO₂-based polyols with varying carbonate contents (0–50 wt%) were synthesized and employed as precursors for the preparation of thermoplastic polyurethanes (TPUs). The mechanical, thermal, and water absorption properties of the resulting TPUs were systematically investigated. As the carbonate content in the polyols increased, both viscosity and glass transition temperature (T_g) also increased. Notably, the TPU derived from the polyol with 50 wt% carbonate content exhibited the highest tensile strength (9.6 MPa) and superior water resistance. These results demonstrate that tuning the carbonate content in CO₂-based polyols offers an effective strategy for tailoring the thermal, mechanical, and water-resistance properties of TPUs

Poster Presentation **2PS-266**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Nitroxide-Mediated Polymerization and Deprotection for the Synthesis of Poly(4-vinylphenol)

이진석, 김태형[†], 채창근[†]

한국화학연구원

Poly(4-vinylphenol) (P4VPh) is a key precursor for KrF photoresist resins, where minimizing line edge roughness in photolithography depends on achieving narrow molecular weight distributions. To achieve this, we synthesized well-defined P4VPh via nitroxide-mediated polymerization followed by acid-catalyzed deprotection. First, homopolymerizations of 4-acetoxystyrene and 4-tert-butoxystyrene were carried out. GPC confirmed predictable molecular weights based on monomer-to-initiator feed ratios, and low Đ (<1.20) was obtained across various ratios. Through the optimization of reaction parameters, we established polymerization conditions that promoted controlled radical propagation and minimized undesired pathways. Subsequent hydrolysis under optimized conditions was monitored by NMR, confirming deprotection to yield P4VPh. Moreover, undesired side reactions during deprotection were minimized, preserving both the molecular weight and Đ of the pristine polymer

Poster Presentation **2PS-267**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Synthesis and Surface Property Enhancement of UV-Curable Biodegradable Resins via Polymer Composition Control

류상욱[†], 이시윤

충북대학교

Biodegradable polymers are considered sustainable alternatives to conventional plastics but often face limited functionality that restricts broader use. This study synthesized a UV-curable biodegradable resin with improved surface properties by controlling polymer composition. Copolymers were prepared via ring-opening polymerization of L-lactide and ϵ -caprolactone, with methacrylate groups introduced at both chain ends to enable UV curing. To enhance surface hydrophobicity, alkyl methacrylate was incorporated, and surface properties were assessed by contact angle measurements after curing. Results showed that increasing alkyl methacrylate content effectively improved the hydrophobicity of the cured resin surface. These findings demonstrate the potential to tailor surface properties of biodegradable resins through monomer design and UV curing, suggesting their applicability in eco-friendly fields requiring both biodegradability and performance.

Poster Presentation **2PS-268**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Ion-Conductive Polyphosphazenes with Cross-Linking Functionality[†] for Solid Polymer Electrolytes in Lithium Batteries

이승윤, 한예은, 이종찬[†]

서울대학교

In this study, the synthesis and comprehensive characterization of ion-conductive, cross-linkable polyphosphazenes designed as primary polymer matrices for solid polymer electrolytes (SPEs) in lithium secondary batteries are reported. Through a simple and efficient chemical modification strategy, functional groups were introduced onto the polyphosphazene backbone to enhance both ionic transport and mechanical integrity. The synthesized materials were processed into fully solid, self-supporting electrolyte films. These thermally stable films exhibited a notable ionic conductivity of $\sim 3.78 \times 10^{-5} \text{ S cm}^{-1}$ at 25 °C, a performance attributed to the flexible –P=N– main chain and ion-conductive pendant groups. The findings highlight the promise of polyphosphazene-based SPEs in improving the safety and electrochemical performance of lithium secondary batteries, offering a valuable platform for next-generation energy storage systems.

Poster Presentation **2PS-269**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Synthesis and Development of an NDI-Based Polymer Acceptor with Selenopheno-Thiophene Backbone

이선정, 김윤희[†]

경상국립대학교

All-polymer organic photovoltaics (OPVs) are highly promising for indoor light energy harvesting due to their tunable optoelectronic properties and compatibility with large-area solution processing. In this study, we synthesized a novel NDI-based polymer acceptor, **P(NDI2OD-Se-Th 0.8)**, incorporating a selenopheno[3,2-b]thiophene backbone via Stille polymerization. The resulting polymer exhibits a medium optical bandgap and was blended with a commercial donor polymer, PBDB-T, to form a bulk heterojunction (BHJ) structure. By adjusting the Se-Th content to 80%, the acceptor achieved favorable absorption characteristics under indoor light, stable film morphology, and good phase separation.

Poster Presentation **2PS-270**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Effect of Catalyst and Deep Eutectic Solvent on the Polymerization of Polyamide 66 under Vacuum and High-Pressure Conditions

이근호, 이주홍, 박현태, 임원빈, 민진규, 이재룡, 이지원, 이승현, 변상욱, 김성호,
배지홍, 허필호[†]

부산대학교

The polymerization of polyamide 66 (PA66) was conducted at 250°C for 4 hours under both vacuum and high-pressure conditions, using a phosphoric acid catalyst (0.1–0.3 mol%) and a deep eutectic solvent (DES, 1–3 wt%). Under vacuum, the catalyst effectively promoted amide bond formation and confirmed using FT-IR, GPC, and GC-MS. The addition of DES improved viscosity control and increased uniformity, resulting in higher molecular weight. Due to the accumulation of amount of water generated during the polycondensation process, it is hard to form high-molecular-weight PA66 under high-pressure conditions. These results indicate that DES enhances PA66 polymerization degree efficiency under vacuum while it is difficult to achieve high molecular weight conversion under high pressure. As a result, it was confirmed that the use of DES enables synthesis of higher molecular weight PA66 under vacuum conditions, which is expected to have versatile applications in industrial settings.

Poster Presentation **2PS-271**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Formation of Nanostructured and Porous PDCPD via Ring-Opening Metathesis Polymerization

유창수, 서명은[†]

한국과학기술원

Poly(dicyclopentadiene) (PDCPD) exhibits robust mechanical strength and high thermal and chemical stability. The robust framework of PDCPD enables the formation of porous PDCPD with a wide range of pore sizes. Previous approaches to preparing mesoporous PDCPD have relied on block copolymer pre-polymers as templates, followed by polymerization of PDCPD to achieve nanostructured PDCPD. However, to control the pore size, the synthesis of various pre-polymers was required. Here, we report an efficient one-pot strategy for preparing nanostructured PDCPD via ring-opening metathesis polymerization-induced microphase separation. This method allows tuning of morphology, domain size, and degradability. Nanostructured PDCPDs were synthesized in a stepwise fashion involving the polymerization of macromonomer as a first block, followed by sequential polymerization of DCPD. We will discuss an investigation of the microphase separation behavior and porosity of PDCPD in detail.

Poster Presentation **2PS-272**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Synthesis of Hydroxyl Functionalized Poly(enol ether)s via ROMP

유서진, 김희중[†]

인하대학교

Polymer end groups are important chemical functionalities that can tune the polymer properties as well as diversify polymer structures through end-group modification or subsequent polymerization. Ring-opening metathesis polymerization (ROMP) is a versatile method for the polymerization of cyclic compounds containing C=C double bonds. In ROMP, various approaches such as the use of chain transfer agent (CTA) have been demonstrated to control end group functionalities. Although the hydroxyl end group is one of the most useful end groups, its incorporation in ROMP is often limited, as CTA containing hydroxyl groups are either difficult to use directly or require complex synthetic processes. Here, we employed ethylene glycol mono vinyl ether (EGVE) as a CTA in the ROMP of dihydrofuran (DHF) to tailor polymer chain end. By directly using this hydroxyl-CTA, we successfully functionalized the chain end with a hydroxyl group and controlled the molar mass of the resultant polymer.

Poster Presentation **2PS-273**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Degradable Superabsorbent Polymers Synthesized via Cyclic Ketene Acetal Copolymerization

오진영, 서명은[†]

한국과학기술원

Superabsorbent polymers (SAPs) are functional hydrogels that can absorb water up to 100–1000 times their weight while maintaining their structural integrity. Due to their exceptional absorption capacity, SAPs are widely used in hygiene products, food packaging, and ice packs. SAPs are typically composed of hydrophilic polymers such as poly(acrylic acid). However, their non-cleavable hydrocarbon backbones pose environmental concerns. To address this issue, we synthesized degradable SAPs via copolymerization of acrylic acid (AA) with a cyclic ketene acetal (CKA), introducing hydrolysable ester bonds into the backbone. The radical-mediated copolymerization of CKA and AA follows pseudo-first-order kinetics. The resulting SAPs exhibit high and tunable water absorption (up to 1290 g/g) and degrade over several months under normal swelling conditions, with rapid degradation occurring within a day under accelerated conditions.

Poster Presentation **2PS-274**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Precise Synthesis of Thermally Crosslinkable Hole-Transporting Homopolymers with Triphenylamine and Benzocyclobutene via Living Anionic Polymerization

양예은, 강범구[†], 장이령

송실대학교

In solution-processed OLEDs, the underlying layers must possess sufficient solvent resistance to withstand the solvents used for the deposition of upper layers. In this study, a novel monomer containing both a hole-transporting triphenylamine(TPA) group and a thermally crosslinkable benzocyclobutene(BCB) group was designed and precisely synthesized via living anionic polymerization. The resulting homopolymer enables both functionalities, efficient charge transport and thermal insolubilization, within a single polymer backbone. The anionic polymerization of N-(4-Ethenylphenyl)-N-phenylbicyclo[4.2.0]octa-1,3,5-trien-3-amine (BTPA) was carried out using potassium naphthalenide (K-Naph) as an initiator in THF at -30 °C for 10 min. The resulting (poly(BTPA)) exhibited well-controlled molecular weight and narrow molecular weight distribution, confirming the living nature of the polymerization. The synthetic results and characterizations of poly(BTPA) will be discussed in detail.

Poster Presentation **2PS-275**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Precision synthesis of fluorine- and poly(4-hydroxystyrene)-containing linear and star copolymers via living anionic polymerization and selective deprotection

안준태, 김승기, 강범구[†]

송실대학교

In this research, we synthesized three types of well-defined copolymers containing poly(4-hydroxystyrene) (PHS) segments via living anionic polymerization in tetrahydrofuran (THF) at -30°C for 10 minutes, using sec-butyllithium (sec-BuLi) as the initiator. Also, selective deprotection of the copolymers was subsequently carried out using tetra-n-butylammonium fluoride (TBAF) in THF at room temperature. The first polymer is a linear copolymer synthesized from protected 4-hydroxystyrene monomers. Based on this approach, the second polymer was further modified at the chain end-functionalized with a chlorosilane containing fluorine groups, which are known for their high EUV absorbance. The third polymer is a well-defined 3-arm star copolymer formed by coupling linear arms synthesized as in the first polymer with a fluorinated trichlorosilane coupling chemistry. These materials were designed for potential use in extreme ultraviolet (EUV) photoresist applications.

Poster Presentation **2PS-276**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Crown Ether-Integrated 2D Covalent Frameworks for Tunable Chemical Functionality

서동주, 이종찬[†]

서울대학교

We report a novel 2D covalent crystalline framework, **C2O**, composed of carbon and oxygen in a 2:1 molar ratio with embedded crown ether-like cavities. **C2O** is synthesized on a gram scale and shows excellent stability in acidic, basic, and organic solvent conditions.

The framework strongly coordinates with K⁺ from KI, enhancing I⁻ nucleophilicity and dramatically improving catalytic activity for CO₂ cycloaddition with epoxides. With KI, **C2O** boosts CO₂ conversion from 5.7% to 99.9% (epichlorohydrin) and from 2.9% to 74.2% (allyl glycidyl ether, AGE).

Moreover, C2O possesses both electrophilic and nucleophilic edge sites, allowing for post-synthetic modification. Reactions with AGE or ethoxyethylamine yield **C2O-AGE** and **C2O-EEA**, achieving even higher CO₂ conversion (97.2% and 99.9%, respectively).

This chemically stable, scalable, and functionally tunable crown ether-based framework offers a promising platform for advanced catalytic applications.

Poster Presentation **2PS-277**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Multifunctional MXene–Polyurethane Films for EMI Shielding and Joule Heating

유재혁, 정승환, 정성민, 구종민[†]

성균관대학교

In this study, we report multifunctional, flexible, lightweight, robust, and durable $\text{Ti}_3\text{C}_2\text{T}_x$ MXene–water-dispersible polyurethane composite thin films exhibiting outstanding EMI shielding and Joule heating performance. The combination of water-dispersible polyurethane dispersions (average particle size ~ 70 nm) and high-crystalline $\text{Ti}_3\text{C}_2\text{T}_x$ MXene (defect density < 0.2 at.%) results in a partially segregated yet highly aligned and compact MXene laminate structure. This architecture significantly enhances mechanical strength, glass transition temperature, and thermal stability, while achieving excellent electrical conductivity and low percolation threshold. The films demonstrate exceptional EMI shielding in X-band and remarkable Joule heating characteristics, including high saturation temperatures, ultrafast heating rates, and long-term operational durability. This work provides important insights into the structure–property relationships of MXene–polymer composites and offers a practical strategy to address challenges in flexibility, lightweight design, mechanical robustness, and durability for multifunctional applications.

Poster Presentation **2PS-278**

고분자 합성(II)

2025.9.30(화), 17:00~18:30, 포스터장

Chair: 구강희, 김종호

Development and Characterization of Low-Temperature Fast-Curing Polymer Curing Agents

정영훈, 정성민, 구종민[†]

성균관대학교

With the increasing demand for low-temperature processing in electronic devices, the development of polymer curing agents capable of rapid curing at low temperatures has become essential. In this study, we synthesized a novel low-temperature fast-curing agent by utilizing polymer phase transitions and dynamic disulfide ($-S-S-$) bonds to overcome the limitation of conventional Diels-Alder-based agents, which require curing temperatures above 140 °C. The curing agent was prepared in microparticle form via an oil-in-water emulsion method, and differential scanning calorimetry (DSC) confirmed curing initiation at 100–130 °C. Furthermore, the introduction of thiol and imidazole functionalities enhanced reactivity. This work demonstrates the potential of a new class of polymer curing agents applicable to low-temperature bonding processes.

Poster Presentation **3PS-001**

에너지 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

개환중합 기반 겔 고분자 전해질을 활용한 리튬이온 이차전지 연구

손태경, 엄태식[†]

홍익대학교

상용 리튬이온전지에 사용되는 액체 전해질은 화재 및 폭발 위험, 낮은 기계적 강도 등으로 인해 안전성에 한계가 있다. 이러한 문제를 해결하기 위해 최근 고체형 전해질에 대한 연구가 활발히 진행되고 있으며, 그 중에서도 겔 고분자 전해질(Gel Polymer Electrolyte, GPE)은 무기물 기반 전해질에 비해 높은 이온전도도와 우수한 계면특성을 지닌다는 점에서 주목받고 있다. 본 연구에서는 기존 GPE 대비 더 높은 성능과 안전성을 확보하기 위해 중합 가능한 고분자 단량체(DOL)와 가교제를 개환중합(Ring-Opening Polymerization, ROP)을 사용하여 새로운 겔 고분자 전해질을 얻고자 하였다. ROP 방식은 양이온 개시제인 전해질에 포함된 리튬염을 개시제로 활용함으로써 별도 개시제 없이도 공정 구현이 가능하며, 추가적인 가교 단량체를 도입하여 3차원 네트워크를 형성함으로써, DOL 단독 단량체를 사용할 경우에 비해 개선된 배터리 성능을 보여주었다.

Poster Presentation **3PS-002**

에너지 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Boosting Ion Conduction and Stability through Filler Surface Modification in CSEs

서하림, 유지영[†]

경북대학교

Composite solid electrolytes (CSEs) hold significant potential for solid-state lithium batteries, yet the role of filler–polymer interfacial chemistry in ion transport remains insufficiently clarified. Here, this study presents a ternary CSE system comprising an ionic liquid, polymer, and LLZTO, with tailored surface properties via ultraviolet ozone (UVO) treatment, which reduces oxygen vacancies. EIS and DRT analysis showed that the modified electrolyte (LEP/UV) displayed higher ionic conductivity and lower interfacial resistance than the pristine electrolyte (LEP). Furthermore, XPS profiling and LIBS mapping demonstrated thinner, more uniform SEI layers on Li metal. Consequently, LEP/UV full cells retained 92.47% capacity after 300 cycles at 0.2 C, outperforming the untreated system. This work highlights surface engineering of ceramic fillers as an effective method for boosting interfacial ion transport and cycling stability in solid-state electrolytes.

Poster Presentation **3PS-003**

에너지 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Polymer-Like Interfacial Engineering and Ignition Promotion in Boron-Titanium Nanocomposites for Scramjet Fuel Applications

사민기, 잠바가, 제갈석, 윤창민[†]

인하대학교

This study presents a dual strategy combining oxide-layer reduction and ignition promoter integration to enhance the performance of boron-based nanoadditives for scramjet fuels. Boron nanoparticles are functionalized with silane to form polymer-like interfacial networks, significantly improving dispersion stability in hydrocarbon fuels. Titanium nanoparticles (TNs) are physically mixed with silane-coated reduced boron nanoparticles (SRBNs), enabling rapid ignition without compromising particle integrity. The resulting SRBN-TN composites exhibits significantly improved combustion characteristics including high calorific value, reduced ignition delays, and more micro-explosions verified by the various analysis. Moreover, high-speed imaging camera validate that the synergistic effects of silane-based interfacial structuring and TN-induced ignition facilitated faster and cleaner combustion. This approach provides a scalable pathway for developing advanced energetic additives suitable for hypersonic fuel systems.

- 본 연구는 2025년 정부(방위사업청)의 재원으로 국방과학연구소의 지원을 받아 수행된 미래도전국방기술 연구개발사업임(No.915066201).

Poster Presentation **3PS-004**

에너지 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

All-Material Crosslinked Solid Polymer Electrolytes for High-Performance Lithium Metal Battery

배성연, 손정곤[†]

한국과학기술연구원

With the growing demand for energy storage devices, the development of high-energy-density batteries has become essential. However, current battery systems face critical limitations such as the low theoretical capacity of conventional anodes and the fire hazards associated with liquid electrolytes. To overcome these challenges, lithium metal is considered a promising anode due to its high theoretical capacity, and solid-state electrolytes are being actively investigated for improved safety and stability.

In our study, we aimed to enhance the mechanical strength, ionic conductivity, and interfacial adhesion of polymer-based solid electrolytes by introducing diazide crosslinking and a direct solution-coating process. A diazide crosslinker was used to simultaneously cure both PVDF-HFP and the plasticizer via C-H insertion, which reduced crystallinity and increased the amorphous phase, thereby improving ion transport. Coating the electrolyte in its solution state also enhanced interfacial contact with both the lithium metal anode and the cathode.

Poster Presentation **3PS-005**
에너지 부문위원회(III)
2025.10.1(수), 08:30~10:00, 포스터장
Chair: 안효성, 양상희

Polyampholyte Ionomers for Tailoring Product Selectivity in Electrochemical CO₂ Reduction

박상준, 김찬솔¹, 김형준⁺

서강대학교

¹ 한국과학기술연구원

Electrochemical CO₂ reduction (CO₂R) is a promising strategy for producing value-added chemicals from renewable energy. While ionomers have traditionally served as binder components for catalysts, recent studies reveal their critical role in modulating product selectivity by altering the electrode microenvironment. However, the structural diversity of commercial ionomers, in terms of backbone and functional groups, hampers a clear understanding of structure–selectivity relationships. This study uses a polyampholyte ionomer to investigate such structure-driven selectivity variations. The cationic component was designed to promote C₂⁺ product formation in CO₂R, and the anionic counterpart incorporated a functional group to tune hydrophobicity. By varying the monomer ratio, the overall ionic charge of the ionomer was systematically controlled, and the corresponding impact on product selectivity was evaluated.

Poster Presentation **3PS-006**

에너지 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Synthesis of zeolitic imidazolate framework (ZIF) nanoplates on cotton fabric for application as flexible supercapacitors in wearable electronic

박계리, 조시 바바나, 박미라^{*1}

우석대학교 산학협력단

¹ 우석대학교

Flexible and lightweight supercapacitors for wearable electronics is a focus of ongoing research that utilizes cotton fabric(CF) made of cellulose, which is treated with 2-methylimidazole (2MI) to facilitate the growth of Zn-zeolitic imidazolate framework (ZIF) nanoplates. The growth durations are varied at 3, 6, and 12 hours to promote the formation of two-dimensional nanoplates over the surface of the CF by adjusting Zn -to-2MI ratio. Subsequently, the carbonization of Zn-ZIF-decorated CF at 750 °C in an argon atmosphere resulted in a ZnO-wrapped carbon matrix. The electrochemical performance of optimized 6 hours sample exhibits a capacitance of 801 mF cm⁻² at a current density of 1 mA cm⁻², along with an energy density of 111.3 μWh cm⁻² at a power density of 2 mW cm⁻². Long-term testing shows a capacitance retention of 91% after 10,000 charge-discharge cycles, depicting potential energy storage device.

Poster Presentation **3PS-007**

에너지 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Development of Piezoelectric Nanogenerators Based on Silk Fibroin

김희진, 이기훈[†]

서울대학교

The recent increase in demand for wearable devices has prompted a growing need for sustainable power supply systems. Piezoelectric nanogenerators (PENGs), such as those activated by pressure or bending, have attracted attention. However, most PENGs currently rely on synthetic or inorganic materials that lack biocompatibility. This study used silk fibroin (SF), a natural protein, to address this issue.

SF is renowned for its excellent mechanical strength, biodegradability, and biocompatibility, and SF has a non-centrosymmetric molecular structure, making it suitable for piezoelectric applications. The piezoelectric performance was enhanced by controlling crystallinity and molecular orientation through variations in concentration, temperature, processing, and post-treatment. These adjustments could maximise sensitivity and output. The resulting system demonstrated improved performance and potential as a sustainable power solution for wearable electronics.

Poster Presentation **3PS-008**

에너지 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Facile Fabrication of High-Performance Separators via Polymerization-Induced Phase Separation for Lithium Metal Batteries

김호리, 오준학[†]

서울대학교

To leverage the advantages of lithium metal batteries, separator properties such as wettability and thermal stability are critical. Here, a porous separator was fabricated via a simple polymerization-induced phase separation (PIPS) method. The PIPS separator showed improved cycling stability over commercial PE, maintaining performance under 2C cycling at 3.0–4.3 V in Li/NCM811 cells and 0.5 mA cm^{-2} , 0.5 mAh cm^{-2} in symmetric Li/Li cells. This was attributed to enhanced electrolyte uptake and wettability. It also mitigated capacity fading under 1C cycling at 60 °C, demonstrating thermal durability. Structural and compositional analyses—including SEM, CLSM, XPS, TOF-SIMS, and BET—were conducted with electrochemical tests. These results demonstrate that the PIPS-based separator offers a simple, scalable, and effective approach to improving the safety and performance of lithium metal batteries.

Poster Presentation **3PS-009**

에너지 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Dendrite-Free, Conformal Deposition of Lithium Metal on Electroactive Organic Materials

김형철, 이상영⁺

연세대학교

Despite the enormous efforts to control the growth behavior of Li, achieving a dendrite-free Li deposition and high-energy-density have remained an inevitable challenge of Li metal batteries. Here, the conformal deposition of Li metal is reported on electroactive organic materials to achieve a high-energy-density and electrochemical longevity. To this end, Li₂C₈H₄O₄ (Li₂TP), which can act as both the electrode material and Li host, is used as the model electroactive organic material. The Li₂TP host exhibits reversible sequential lithiation/delithiation and Li deposition/stripping reactions. Consequently, a Li-free full cell constructed by the Li₂TP host (without pre-charging) and a LiFePO₄ cathode delivered a high areal capacity, exceptional rate performance, and superior cyclability (80% capacity retention after 100 cycles). This electroactive organic material-based Li host strategy can provide a new perspective for the development of practical Li metal batteries.

Poster Presentation **3PS-010**

에너지 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Intrinsically Stretchable All-Solid-State Lithium-Ion Battery Fabricated by Sequential Screen Printing

김현수, 손정곤[†]

한국과학기술연구원

The demand for wearable electronics has increased the need for deformable energy storage systems. However, conventional batteries with rigid metal-foil current collectors and active materials face limitations in such applications. Additionally, electrolyte leakage and structural degradation limit their use.

We developed a stretchable electrode using a PVDF-based binder with an azide-based crosslinker, enhancing elasticity and interfacial adhesion. Applying the same binder to the current collector improved interfacial compatibility and mechanical cohesion under strain. Additionally, a UV-crosslinkable solid polymer electrolyte was introduced, offering high elasticity, ionic conductivity, and strong adhesion. The entire cell was fabricated via sequential screen printing using orthogonal solvent systems and carefully tuned solubility parameters. This multilayer assembly ensured mechanical robustness and chemical compatibility, effectively preventing delamination.

Poster Presentation **3PS-011**

에너지 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Bidirectional Wastewater Treatment via Plasmonic Ammonia Electrooxidation and $2e^-$ Oxygen Reduction in a Zn–O₂ battery

김정현, 김정원, 김동하[†]

이화여자대학교

Zinc–air batteries (ZABs) offer high theoretical energy density (1218 Wh kg^{-1}) and low-cost zinc, but their efficiency is limited by the high overpotential of the oxygen evolution reaction (OER) during charging, whose onset potential is close to carbon corrosion, causing electrode degradation. Here, the OER is replaced with plasmon-enhanced ammonia oxidation (AOR) to lower charging voltage and avoid carbon corrosion. A Au NP/Pt/Ti felt anode generates hot carriers under 532 nm light, accelerating AOR and reducing charging voltage by $\sim 1.16 \text{ V}$ (vs. Zn) while oxidizing NH_3 to N_2 . During discharge, a two-electron oxygen reduction reaction ($2e^-$ ORR) catalyzed by graphitic ordered mesoporous carbon (GOMC) selectively produces H_2O_2 for additional ammonia degradation. A bipolar membrane separates the electrodes, enabling high voltage efficiency, NH_3 removal, H_2O_2 generation, and carbon corrosion suppression, demonstrating a multifunctional, sustainable ZAB platform.

Poster Presentation **3PS-012**

에너지 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Tuning structure–property relationships in N-type polymers for stable, high-capacity organic cathodes

김소영, 이원호[†]

금오공과대학교

P(NDI2OD-T2), a conjugated polymer with excellent electrochemical properties, has been applied in organic solar cells and transistors. Due to the redox-active carbonyl groups in its NDI core, it can store Li ions and serve as a cathode in Li-ion batteries. It also allows fluorine-free solution processing without PVDF binder. Notably, it retains over 95% of capacity after 2000 cycles at 10C, showing excellent stability. However, its capacity is limited to 52.4 mAh/g due to many inactive sites. To address this, we modified its structure to reduce inactive regions, achieving 85.4 mAh/g. Yet, increased solubility caused self-discharge. To mitigate the trade-off between capacity and stability, we aim to further tune the polymer structure and introduce additives. This strategy is expected to improve the electrochemical performance of organic cathodes while maintaining long-term stability, contributing to the development of advanced organic battery materials.

Poster Presentation **3PS-013**

에너지 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

FeP nanoparticles and Fe single atoms on N, P co-doped carbon for boosting redox kinetics in Li-S batteries

김대겸, 유영재[†]

중앙대학교

Rational design of sulfur host materials to suppress the dissolution of lithium polysulfides (LiPSs) is of great significance to accomplish efficient sulfur chemistry for high-performance lithium sulfur batteries (LSBs). Herein, FeP nanoparticles and Fe single atoms decorated in the N, P co-doped porous carbon prepared by an in-situ self-assembled method followed by pyrolysis process. In addition, multi-walled carbon nanotubes (MWCNTs) were also incorporated to enhance electrode conductivity. The hierarchical porous structures provide abundant active interfaces for LiPSs conversion as well as rapid Li-ion transfer kinetics. Moreover, by adjusting the Fe precursor ratio, a synergistic coexistence of FeP nanoparticles and Fe single atoms significantly enhanced polysulfide conversion kinetics and suppressed the shuttle effect. The electrochemical performances were conducted using Galvanostatic charging/discharging, cycle voltammetry, and long-term cycle stability.

Poster Presentation **3PS-014**

에너지 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Promoting Granular Lithium Sulfide Growth by Soft Acidic–Hard Basic Ionomer Binder for Lithium–Sulfur Batteries

이상영[†], 김다운, 최재훈

연세대학교

Electrode passivation limits the reversibility of Li–S batteries. Pivoting from the prevailing approaches that focus on electrode active materials and electrolytes, herein, we introduce a class of S electrode binders based on soft acidic–hard basic (SAHB) ionomers. The SAHB binder contains a soft cation (tetraallyl ammonium ion, TA^+) paired with a hard counter anion (nitrate, NO_3^-), allowing matched interactions with Li polysulfides via soft acid–soft base ($TA^+ - S_x^{2-}$) and hard base–hard acid ($NO_3^- - Li^+$) pairings. This intermolecular coupling retards LiPS diffusion, promoting three-dimensional granular Li sulfide growth, guided by a high Damköhler number. Consequently, the SAHB binder enables a Li–S cell to achieve a high specific capacity of $1545 \text{ mAh g}_{\text{sulfur}}^{-1}$ and stable capacity retention (71.5% after 300 cycles at a current density of 1 C), outperforming previously reported S electrode binders.

Poster Presentation **3PS-015**

에너지 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Engineering High-Performance Silicon Anodes through Spontaneous N-Doped Graphitic Encapsulation

강보경, 김상욱[†], 이원준¹

한국과학기술원

¹ 단국대학교

Silicon (Si) anodes are promising for next-generation lithium-ion batteries (LIBs) but face challenges from significant volume changes. This study introduces an innovative self-encapsulation strategy for Si particles using N-doped carbon nanomaterials. We developed a novel, room-temperature method where N-doped carbon nanotubes (CNTs) and graphene spontaneously encapsulate Si particles via pH control and electrostatic interactions, avoiding complex high-temperature processing. The optimized Si@N-CNT electrode showed outstanding electrochemical performance: 79.4% capacity retention after 200 cycles and 914 mAh g⁻¹ at 10C. This superior performance results from the N-doped carbon layer buffering volume changes, forming a stable SEI, and enhancing charge transfer. This technology offers a promising solution for Si anodes and other alloy-based electrode materials.

Poster Presentation **3PS-016**

에너지 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Design of ether-free poly(biphenyl alkylene piperidinium) anion exchange membrane with alkyl spacer for efficient water electrolysis

TO THI CAM THACH, 김덕준^{*1}

Sungkyunkwan University

¹ 성균관대학교

A series of ether-free anion exchange membranes (PBAPip-n-OH) was synthesized by quaternizing poly(biphenyl alkylene) backbones with piperidinium groups tethered via linear alkyl spacers. The flexible spacers promote nanoscale phase separation, forming continuous ion transport pathways within a mechanically stable hydrophobic matrix. Localized mobility of piperidinium end groups enhances hydroxide conductivity while suppressing chemical degradation. Among them, PBAPip-6-OH showed the best performance, with 65.14 mS cm⁻¹ conductivity and 67.6 MPa tensile strength at 30 °C. The membrane retained over 95% of its weight after 720 h in 1 M KOH. In water electrolysis, it reached 2.8 A cm⁻² at 2.0 V and 60 °C. These results demonstrate that side-chain engineering on ether-free backbones is a promising strategy for durable and high-performance AEMs in electrochemical applications.

Poster Presentation **3PS-017**

에너지 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Tuning Difluorobenzotriazole-Based Polymers through Substituent Engineering for Enhanced Solar Energy Conversion

Puspita sari, 이재훈, 진영읍[†]

Pukyong National University

A series of difluorobenzotriazole-based conjugated polymers P(BDTTH-TfFPzT), P(BDTTCl-TfFPzT), P(BDTTF-TfFPzT), and P(BDTTS-TfFPzT) were synthesized using Stille coupling to systematically examine the impact of substituent modification on material properties. Incorporation of hydrogen, chlorine, fluorine, or sulfur groups on the benzodithiophene (BDT) unit led to broad UV-Vis absorption (300–800 nm) and narrow optical bandgaps (1.75–1.80 eV). Variations in substituents strongly influenced molecular packing, charge transfer efficiency, and photovoltaic behavior. The fluorinated polymer delivered the highest power conversion efficiency (7.79%) due to enhanced charge mobility and improved morphology, whereas the unsubstituted variant recorded the lowest efficiency (3.85%). These results highlight the pivotal role of substituent engineering in tailoring polymer performance for next-generation organic photovoltaic applications.

Poster Presentation **3PS-018**

에너지 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Polymer-Based Hybrid Dry Electrode Strategy for High-Performance Lithium-Ion Battery Anodes

Chi Nguyen Thi Linh, 김덕준¹

Chemical Engineering- Sungkyunkwan University

¹ 성균관대학교

To address the electrochemical limitations of PTFE in dry-processed graphite anodes, we propose a hybrid binder system incorporating carboxymethyl cellulose (CMC) as a polymer co-binder. Ethanol-assisted dry mixing enables homogeneous dispersion of CMC within the composite without solvent recovery or thermal drying. Systematic variation of CMC content reveals that 1 wt% CMC (HGE-1) optimizes the trade-off between mechanical integrity and ionic transport. The hybrid electrode exhibits higher initial Coulombic efficiency, improved rate capability, and superior cycling stability compared to PTFE-only systems. These enhancements stem from the polymeric characteristics of CMC, which facilitate Li⁺ diffusion, enhance interfacial adhesion, and suppress PTFE-graphite aggregation.

Poster Presentation **3PS-019**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Tuning Monomer-to-Crosslinker Ratio for Enhanced Performance in WO₃/NiO Electrochromic Devices

오서영, 전석진[†]

국립금오공과대학교

This work explores the fabrication of electrochromic devices incorporating WO₃ and NiO layers, utilizing gel polymer electrolytes formed directly within the device through UV curing. The electrolyte system is composed of poly(ethylene glycol) methyl ether methacrylate (PEGMEMA) as the monomer and poly(ethylene glycol) dimethacrylate (PEGDMA) as the crosslinker. By systematically varying the monomer-to-crosslinker proportions, their influence on device performance metrics-including optical contrast, switching speed, and ionic conductivity-was evaluated. Optimal results were achieved at a 10:1 ratio, balancing the polymer network's density to maximize ion transport without compromising structural stability. These findings emphasize the necessity of fine-tuning crosslinker concentration to produce efficient and durable gel polymer electrolytes suitable for applications like smart eyewear electrochromic devices.

Poster Presentation **3PS-020**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Molecular Engineering of Hyaluronic Acid Enables Advanced Transdermal Emulsion Technologies

양종렬, 허윤희¹, 홍인기¹, 김진웅⁺

성균관대학교

¹ 한국콜마

We developed a hydrophobically modified hyaluronic acid (HA_{diC18}) through covalent octadecane (C18) grafting via Schiff base chemistry, creating an amphiphilic macromolecule capable of stabilizing oil-in-water emulsions. The hyaluronic acid backbone length emerges as a critical parameter controlling both polymer hydrophobicity and interfacial tension reduction. Interfacial assembly mechanisms at oil-water boundaries follow DLVO theoretical predictions, where electrostatic and van der Waals interactions determine HA_{diC18} adsorption behavior. Dermatological evaluation reveals that HA_{diC18} treatment markedly inhibits transepidermal water loss while facilitating enhanced skin penetration, yielding innate water retention capacity and biocompatibility. The convergence of these physicochemical and biological properties positions HA_{diC18} surfactants as promising candidates for emulsion-based transdermal delivery platforms, bridging fundamental colloid science with therapeutic applications.

Poster Presentation **3PS-021**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Surface chemistry-dependent lipid adsorption variations across diverse silica nanoparticle coating platform

양예지, 이보령, 김진웅[†]

성균관대학교

Lipid coating enhances nanoparticle stability, skin permeation, and cellular targeting through surface modulation. Surface properties govern lipid–nanoparticle interactions, yet adsorption mechanisms remain poorly understood. We demonstrate lipid-coated hybrid nanoparticles via co-extrusion of lipids with functionalized silica nanoparticle. DLS reveals systematic changes in size and surface charge between lipid-coated hybrids, uncoated silica nanoparticles, and bare liposomes. Lipid film formation occurs across all surface chemistries, whereas TGA and DSC demonstrate surface chemistry-dependent lipid adsorption variations, attributed to curvature effects and hydration shell dynamics. NBD-labeled silica nanoparticles enable quantitative assessment of full-coating ratios. This framework guides epigallocatechin gallate (EGCG) encapsulation for targeted antioxidant delivery. These findings establish designs for surface-tailored lipid-coated nanoparticles in biomedical systems.

Poster Presentation **3PS-022**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Pure Blue Emitting ZnSe/ZnMgSe Quantum Dots without Tellurium for QLED Applications

안소정, 정재한[†]

서울과학기술대학교

ZnSeTe has garnered great attention as a Cd- and Pb-free quantum dots emitting pure blue region ($\lambda_{em} \sim 450$ nm). However, the unavoidable use of Te, which is potentially toxic to the human liver and kidneys, remains a challenge. In this study, we developed ZnSe/ZnMgSe core/shell QDs using a compositionally graded ZnMgSe shell to achieve pure blue emission without the need for Te. The gradient shell design effectively passivated the core/shell interface, leading to reduction in interfacial defects, thus reducing the non-radiative decay as confirmed by time-resolved photoluminescence measurements. The correlation between the ZnMgSe composition and the optical properties of the QDs was studied. As a proof of concept, QLEDs were fabricated employing the ZnSe/ZnMgSe QDs. The influence of gradient shell composition on device performance was studied. This study suggests the potential of Te-free ZnSe-based QDs as environmentally and efficient emitters for blue QLED applications.

Poster Presentation **3PS-023**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

High-Loading Polyhydroxyalkanoate (PHA) Nanocarriers for Enhanced Skin Delivery

송건호, 정윤희, 황동수, 이기라*

포항공과대학교

Polyhydroxyalkanoates (PHAs) are biopolyesters produced by microorganisms such as bacteria and algae. Their biodegradability and biocompatibility have driven growing interest in PHA-based nanomaterials for biomedical applications, particularly as bio-adhesives [1]. In this work, we developed PHA nanoparticles as versatile carriers for skin-targeted delivery systems, designed to transport active compounds such as ceramide and niacinamide. Using multiple emulsification methods in both hydrophilic and hydrophobic solvent systems, we obtained nanoparticles with precisely controlled sizes of 10–300 nm and narrow distributions. These particles achieved high encapsulation efficiencies for both lipophilic and hydrophilic active ingredients, enhancing their stability and bioavailability. Furthermore, the synergistic bioactive effects of PHAs and encapsulated active ingredients offer intrinsic skin benefits, distinguishing them from conventional delivery systems and underscoring their potential for cosmetic and biomedical applications.

References

- [1] Jang, S. K., Song, G., Osman, A., Park, S. H., Lin, E., Lee, E., Sim, E. J., Yoon, K., Lee, S. J., Hwang, D. S., & Yi, G.-R. (2024). Monodisperse polyhydroxyalkanoate nanoparticles as self-sticky and bio-resorbable tissue adhesives. *Journal of Colloid and Interface Science*, 673, 647–656.

Poster Presentation **3PS-024**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Visualizing Ice-Binding Specificity of Designed Peptides via Fluorescence-Based Ice Plane Affinity (FIPA) for Cryopreservation Applications

손민영, 이은지[†]

광주과학기술원

Cryopreservation requires inhibition of ice growth and recrystallization, where antifreeze proteins (AFPs) and peptides play crucial roles. To investigate how these molecules interact with ice, we employed Fluorescence-based Ice Plane Affinity (FIPA), enabling real-time visualization of peptide binding on crystallographic ice planes. We designed Fmoc-WW-based amphiphilic peptides with varying stereochemistry to modulate ice-binding specificity. FIPA analysis using single crystal ice aligned along a- and c-axes revealed that peptide chirality affects preferential binding to basal or prism planes. Peptide self-assembly morphology was characterized via TEM and Cryo-TEM to support structural understanding. These results suggest that chirality and sequence-controlled peptides can directionally regulate ice growth, providing a strategy to develop efficient, low-toxicity cryoprotectants that mimic or outperform natural AFPs.

Poster Presentation **3PS-025**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Microfluidic Synthesis of Ethosomes with Paclitaxel and Quercetin for Transdermal Delivery Targeting Melanoma

변선영, 한정연[†]

가천대학교

Transdermal delivery offers a non-invasive alternative to systemic chemotherapy, particularly for anticancer drugs with poor solubility and limited patient compliance. To address these challenges, we developed ethosomes incorporating paclitaxel and quercetin, two lipophilic agents known for their synergistic anticancer effects. Ethosomes, composed of ethanol-enriched phospholipid bilayers, exhibit excellent deformability and enhanced skin permeability, making them suitable carriers for hydrophobic drugs.

To control the physicochemical properties of the ethosomes, we employed a microfluidic mixer for precise and reproducible synthesis. Transdermal drug permeation was quantified using a Franz diffusion cell to evaluate delivery performance based on vesicle size and composition, followed by in vitro studies to assess therapeutic efficacy. This platform may provide a promising strategy for localized melanoma therapy with improved therapeutic outcomes and reduced systemic toxicity.

Poster Presentation **3PS-026**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Ionic Conduction Disparity for Solid-State Ion Rectification

백상은, 강영종¹

한양대학교

¹ 한양대학교 화학과

Halide perovskites offer exceptional optoelectronic properties, but ionic migration challenges device stability. Recently, ion transport has been reinterpreted as a functional mechanism in iontronic devices. Here, we used Cs_4PbBr_6 single crystals as a 0D perovskite platform and locally converted their surfaces to 3D CsPbBr_3 via Prussian blue-mediated CsBr extraction. The resulting heterostructures showed a strong ionic mobility contrast. Time-dependent current under bias revealed negligible decay in Cs_4PbBr_6 but strong, thermally activated decay in CsPbBr_3 . Activation energies differed greatly—~2.5 eV for Cs_4PbBr_6 vs. 0.65 eV for CsPbBr_3 —enabling polarity-dependent current responses and solid-state ionic rectification.

Poster Presentation **3PS-027**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Mesoporous Water Trapping Strategy for Enhancing Stability and Luminescence via Sn^{2+} Oxidation Suppression under Ambient-Condition Synthesis of $\text{CsSn}_{1-x}\text{Pb}_x\text{Br}_3$ Quantum Dots

박정완, 김진영, 최준호, 왕동환⁺

중앙대학교

Perovskite quantum dots (PQDs) are mostly lead-based, but their toxicity limits practical applications. B-site mixing, such as partial substitution of Pb^{2+} by Sn^{2+} in $\text{CsSn}_{1-x}\text{Pb}_x\text{Br}_3$, enables lead reduction and optoelectronic tunability. However, Sn^{2+} oxidation by moisture, which causes lattice degradation, remains a major challenge to the structural and optical stability of tin-based PQDs. In this study, we propose a synthesis method for dehydrated and stable $\text{CsSn}_{1-x}\text{Pb}_x\text{Br}_3$ quantum dots via a mesoporous water trapping strategy. Molecular sieves with a pore size of 3 Å are employed to selectively adsorb and block water molecules based on molecular size. The addition of sieves to the polar solvent effectively removes residual H_2O , resulting in the formation of dehydrated QDs. The dehydrated $\text{CsSn}_{1-x}\text{Pb}_x\text{Br}_3$ PQDs exhibit improved photoluminescence and enhanced structural stability, demonstrating superior performance under ambient conditions compared to pristine PQDs.

Poster Presentation **3PS-028**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

High-Performance Infrared Photodetectors Based on Pb-Free III-V Colloidal Quantum Dots

박영상, 정소희[†]

성균관대학교

Colloidal quantum dots (CQDs) based on Pb-free III-V semiconductors have emerged as promising materials for short-wave infrared photodetectors (PDs), combining spectral tunability, low toxicity, and solution processability. However, achieving both low noise and high-speed operation, particularly beyond 1500 nm, remains challenging due to intrinsic material and device-level limitations. In this work, we introduce a novel device architecture that addresses these constraints through energy band engineering and optimized carrier transport. The resulting photodetector achieves a significantly reduced dark current density of 9.7×10^{-4} mA/cm² at -0.2V, over three orders of magnitude lower than conventional CQD-based PDs. Furthermore, the device exhibits a fast photoresponse time of 24ns and high operational stability under ambient conditions.

Poster Presentation **3PS-029**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Full Color Electrophoretic Photonic Display with Enhanced Color Tunability using Phenylethylamine

박가경, 이윤상, 이원목[†]

세종대학교

Electrophoretic Photonic Crystal Displays (EPDs) are reflective display technologies capable of tunable color modulation under applied electric fields. However, their practical application is limited by electrochemical instability. Here, we introduce phenylethylamine (PEA) as a promising alternative to conventional materials. PEA offers similar Lewis basicity to aniline but with lower toxicity, improved electrochemical stability, and reduced cost. Its favorable physical properties—including low viscosity, low melting point, and high boiling point—further enhance thermal and chemical stability. We develop a PEA-based color ink by dispersing low-refractive-index particles in a high-refractive-index medium, achieving enhanced color performance and low-voltage operation. This study demonstrates PEA's potential as a next-generation material for energy-efficient reflective displays.

Poster Presentation **3PS-030**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Morphological and Compositional Engineering of Donor-Acceptor Nanoparticles for Enhanced Photodynamic Performance in the Hypoxic Tumor Microenvironment

민경선, 최현석, 홍선주, 박주현[†]

중앙대학교

Conjugated polymer-based nanohybrids are promising phototherapeutic agents due to their tunable optoelectronic properties. In this study, nanoparticles were prepared using a modified phase separation method with D8PE-Ac and D8PE-PEG phospholipids, incorporating PCPDTBT as an electron-donating core material. Two structures were designed to examine the effect of acceptor location: (1) both PCPDTBT and Y6 distributed in the core, and (2) PCPDTBT in the core with Rose Bengal (RB) localized on the surface. Under 808-nm laser irradiation, reactive oxygen species (ROS) generation was analyzed to evaluate how acceptor positioning influences photodynamic efficiency. The results demonstrate that internal versus surface localization of acceptors critically affects ROS production. This study underscores the importance of molecular distribution within nanohybrids and offers insights for designing more effective nanostructures for cancer phototherapy.

Poster Presentation **3PS-031**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Evaluation of Local Anaesthetic Release from Biodegradable GelMA Beads for Embolization

띠루모르간 카비타, 이원목¹

Sejong university

¹ 세종대학교

Gelatin methacryloyl (GelMA) hydrogels have gained significant attention in biomedical applications due to their biodegradability, cytocompatibility, and customizable network structure. In pain management, local anaesthetics such as Ropivacaine (ROP) and Lidocaine (LID) are frequently administered; however, their rapid clearance limits their therapeutic window. A promising strategy to address this involves harnessing pH-responsive electrostatic interactions between drug molecules and hydrogel functional groups. Specifically, the protonated amine group ($-NH_3^+$) of anaesthetics exhibits enhanced affinity toward sulfonate groups ($-SO_3^-$) under acidic conditions, promoting drug entrapment and sustained release. We investigated and compared the encapsulation efficiency and release behaviour of ROP and LID across different pH environments.

Poster Presentation **3PS-032**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Continuous Flow System for Cr(VI) Reduction Using Pickering polyMIPE Hydrogels Embedded with Pd Nanocatalysts

김현정, 김문호[†]

부경대학교

The development of eco-friendly catalytic systems for environmental remediation has become increasingly important. In this study, we tuned the catalytic properties by controlling the shape of palladium nanoparticles (Pd NPs) and applied them to the reduction of Cr(VI) for water purification. The synthesized catalysts exhibited high Cr(VI) removal efficiency, and their performance was found to depend on the shape of the catalyst particles. Furthermore, a porous hydrogel was fabricated using a solid particle-stabilized emulsion system, into which the catalyst particles were embedded. This approach enabled the reusability of costly noble metal catalysts. Our findings demonstrate the potential of sustainable, bio-based catalytic platforms for efficient and eco-friendly water treatment technologies.

Poster Presentation **3PS-033**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Surface modification of quantum dots with dithiolated PEG for improved feasibility in bio-environment.

김주성, 김대윤¹, 정병국¹, 김세영⁺

단국대학교

¹ 부산대학교

Quantum dots (QDs) have optical properties such as high quantum efficiency and good photostability. Research is ongoing to utilize these properties in the field of biosensors. Most quantum dots have hydrophobic surfaces, which limit their dispersion and functionality in the bioenvironment. In this work, we designed water-dispersible QDs by exchanging the surface ligands (Oleic acid) of hydrophobic (CdSe/Cd_{0.5}Zn_{0.5}S) QDs with a hydrophilic ligand, dihydrolipoic acid functionalized poly(ethylene glycol) (PEG-DHLA), and characterized the dispersibility and optical properties of these QDs in an environment mimicking physiological condition. Dynamic light scattering (DLS) and spectroscopic analysis confirmed that the modified QDs were uniformly dispersed in saline and albumin buffers while retaining their optical properties. These findings demonstrate that quantum dots are promising nanomaterials with stability and optical properties for biosensors applications.

Poster Presentation **3PS-034**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Superhydrophobic Surfaces on 3D-Printed Patterns for Morphology Control of Supraparticles

김영준, 차찬욱, 한구희[†]

경북대학교

Supraparticles (SPs) are assemblies of nanoparticles (NPs), that retain NP properties while exhibiting macroscale behavior. SP formation is typically directed by evaporation-driven self-assembly of NPs inside a droplet on a superhydrophobic surface. However, conventional methods often rely on plain hydrophobic surfaces, which limit control over SP morphology. In this study, we investigated SP formation on 3D-printed micro-pillared substrates with superhydrophobic surfaces. After 3D printing, the micro-pillars were chemically treated to render them superhydrophobic. The geometry of 3D-printed features, such as pillar thickness and arrangement, dictates the final SP morphologies. The proposed approach simplifies the fabrication of superhydrophobic surfaces by minimizing processing time and complexity, offering a facile strategy for controlling SP morphologies.

Poster Presentation **3PS-035**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Development of Continuous Processing Technology for Mechano-Responsive Photonic Crystal Films

김영석[†], 문지윤, 허동민¹, 정재일¹, 강광중¹, 최병기¹

한국전자기술연구원

¹ (주)씨큐브

Mechano-responsive visualization materials possess significant application potential not only in stress sensing but also in self-reporting of material damage. Unlike conventional phosphorescent or fluorescent technologies, stimuli-responsive materials are gaining attention as active materials that can predict performance degradation and induce performance improvements. In particular, when applied to buildings and transportation systems, it is expected to play a significant role in preventing major disasters by enabling real-time detection of structural damage and failure without the need for external equipment.

In this study, we developed a continuous process for fabricating mechano-responsive photonic crystal visualization materials into films, and analyzed the optical properties of the resulting films. Photonic crystal materials with elastic and plastic characteristics were developed, and for mass production, synthesis equipment and process technology were established to stably produce approximately 4 liters per batch, equivalent to over 800 grams of dried material. Furthermore, a roll-to-roll continuous process system with crystallization control via a multi melt-shear process was constructed for film formation. The developed material was stably extruded at temperatures between 100–130°C, forming uniform films with a width greater than 100mm. It was confirmed that with repeated melt-shear processing, the intensity of the reflection peak increased and the color became more vivid.

Poster Presentation **3PS-036**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

MXene Electrodes Patterning for Supercapacitors via Meniscus Dragging Deposition

김승연, 이용희, 한구희[†]

경북대학교

MXenes have emerged as promising materials for energy storage devices due to their outstanding electrical and hydrophilic properties. However, patterning of MXene films remains a challenge for realizing energy storage devices such as supercapacitors. We report a simple method to fabricate patterned MXene-based supercapacitors by combining meniscus dragging deposition (MDD) and a laser-cut silicone rubber mask. An interdigitated MXene pattern can be easily produced by dragging the deposition plate back and forth over the mask-attached substrate. For the device manufacturing, a polyvinyl alcohol-NaCl gel electrolyte and gold current collectors were used. To characterize electrochemical performance, cyclic voltammetry and galvanostatic charge-discharge measurements were performed. The convective flow-based MDD process is applicable to various materials, offering a scalable strategy for energy storage device fabrication.

Poster Presentation **3PS-037**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Triple-Ligand Stabilized CsPbBr₃ Perovskite Nanocrystals for Efficient Light-Emitting Applications

김민지, 강영종⁺

한양대학교

Lead halide perovskite nanocrystals (NCs) have emerged as highly promising candidates for next-generation optoelectronic devices due to their excellent optical and electronic properties.

In this work, we report a facile ambient-air synthesis of hybrid organic–inorganic perovskite NCs using a triple-ligand system. This approach enhances ink stability and photoluminescence through ligand-assisted surface passivation.

Partial substitution of cations resulted in increased PL intensity. The emission color was tunable via halide composition.

The fabricated perovskite films exhibited uniform morphology and bright green photoluminescence. When applied to light-emitting diode (LED) devices, the FA-doped CsPbBr₃ films demonstrated superior luminance compared to pristine CsPbBr₃. These results suggest that solution-processed, ligand-engineered perovskite NCs hold strong potential for high-definition display and solid-state lighting applications.

Poster Presentation **3PS-038**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

3D Printed Self-Propelling Marangoni Surfers with Programmed Motion

김동형, 김영준, 한구희[†]

경북대학교

Self-propelling particles move autonomously by creating local gradients. A classic example is the camphor boat, or Marangoni surfer, which leverages the Marangoni effect for propulsion. The driving force is a surface tension gradient near the surfer, formed by releasing a substance that locally lowers the surface tension. A major challenge for Marangoni surfers is to miniaturize them while precisely controlling their direction of motion. Here, we use 3D-printing to design miniaturized surfers with programmed motion. A 3D-printed hole functions as a micro-engine, providing a fuel outlet to induce Marangoni propulsion. By strategically positioning these outlets, we demonstrate a variety of controlled motions, including linear, rotational, and precessional. Such self-propelling Marangoni surfers with controlled motions may hold promise for eco-friendly functions, such as microplastic capture.

Poster Presentation **3PS-039**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Lipid-PLGA Hybrid Nanoparticles for Enhanced Drug Delivery in Solid Tumors

김누리한, 한정연¹

Delft University of Technology

¹ 가천대학교

Drug delivery to solid tumors is challenged by hypoxia, acidic pH, and high interstitial pressure, which hinder drug penetration and therapeutic efficacy. This study investigates lipid-PLGA hybrid nanoparticles as a strategy to overcome these barriers. PLGA offers biocompatibility and controlled drug release, while the lipid layer enhances membrane interaction and cellular uptake, improving drug stability and intracellular retention.

Synthesized lipid-PLGA nanoparticles will be characterized for their physicochemical properties. To evaluate functional performance, a fluorescent model drug will be encapsulated to quantify drug loading efficiency and cellular uptake, comparing coated and uncoated PLGA nanoparticles. In addition, Gemcitabine, a chemotherapeutic agent, will be employed to assess therapeutic efficacy under tumor-mimicking conditions. This platform holds potential for future integration with diverse functional modules to address key delivery challenges in solid tumors.

Poster Presentation **3PS-040**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Enhanced Electrochromic Performance of WO_3 via Ag Nanowire Integration

금연희, 전석진[†]

국립금오공과대학교

Tungsten oxide (WO_3) is a leading electrochromic material, yet further improvements in coloration efficiency and device durability are critical for commercial use. In this study, high-aspect-ratio silver nanowires (AgNWs) were integrated into WO_3 nanoparticles using a doctor blade coating method to create nanocomposite electrochromic layers suitable for large-area fabrication. Devices using neat WO_3 , AgNW- WO_3 nanocomposites, and AgNW/ WO_3 bilayers were systematically characterized. Incorporation of AgNWs notably increased surface roughness and improved ion and electron transport, as demonstrated by optical, morphological, and electrochemical analyses. The AgNW- WO_3 structure achieved a threefold enhancement in coloration efficiency (15.2 to 46.5 cm^2/C) and maintained over 45% of initial optical modulation after 100 cycles. These findings offer a scalable approach to high-performance, durable electrochromic devices for applications such as smart windows.

Poster Presentation **3PS-041**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Synthesis of Chiral AuNBPs and Controllable Palladium Deposition depending on Surfactant

권미진, 김동하[†]

이화여자대학교

Chirality is crucial for understanding biological structure and function, influencing selectivity and specificity in biological processes. Chiral inorganic particles hold promise as artificial biomaterials that mimic natural chirality. Here, we present a controlled synthesis of chiral bimetallic nanoparticles, where Pd is deposited on chiral Au nanobipyramids (AuNBPs) to form chiral plasmonic nanozymes. By tuning Pd growth with stabilizers (CTAC, CTAB), we reveal how Pd crystalline morphology impacts chiroptical properties. This approach provides a simple, efficient route to chiral AuNBPs@Pd with high g-factors, stability, and peroxidase-like activity. These findings offer a versatile strategy for creating biomimetic chiral nanomaterials with broad applications.

Poster Presentation **3PS-042**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Snowman-shaped Janus particles with site-selective DNA Functionalization

공보현, 이기라[†]

포항공과대학교

Colloidal particles with asymmetric geometry and surface chemistry have attracted significant attention for their unique properties in directional self-assembly, targeted delivery, and emulsion stabilization ^[1]. Among them, snowman-shaped Janus particles which are composed of two partially fused spherical lobes with distinct physical or chemical properties represent a promising platform for multifunctional colloidal systems. Here we present one effective method for fabricating such particles and functionalizing DNA selectively. Polystyrene (PS) spheres are used as cores for growing 3-(trimethoxysilyl)propyl methacrylate (TPM) droplet on their surfaces under aqueous conditions ^[2]. Typically, the morphology of TPM lobe can be finely controlled by precisely tuning parameters such as TPM volume fraction and surfactant concentration. And DNA can be selectively functionalized by exploiting the difference in swelling behavior between the two spherical lobes.

Poster Presentation **3PS-043**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Thermally Decomposable Molecular Splint for High β -Phase Poly(vinylidene fluoride) Films

고은서, 최진우, 강영종[†]

한양대학교

A thermally decomposable additive, 1,4-butadiene sulfone (BDS), is used to fabricate high β -phase poly(vinylidene fluoride) (PVDF) films. During the in situ thermal retro-Diels-Alder reaction, BDS decomposes to generate H₂SO₃, which selectively interacts with the all-trans PVDF configuration via non-covalent interactions. This promotes spontaneous β -phase formation without mechanical drawing or thermal annealing. PVDF/BDS/water solutions yield 95% β -phase fraction with only 1.0 wt% BDS, confirmed through POM, SEM, FT-IR, DSC, and 2D-GIWAXS. The high β -phase PVDF exhibits superior ferroelectric and piezoelectric properties, with $E_c = 50$ MV/m, $P_r = 5$ μ C/cm², and $d_{33} \approx -25$ pm/V. A triboelectric nanogenerator (TENG) using this PVDF film delivers 2.5 times higher output charge density than neat PVDF, enabling efficient electronic device operation.

Poster Presentation **3PS-044**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Chain Stretching toward Crystallization of atactic-Polystyrene by Rapid Thermal Quenching Method with Entropy Diluents

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Hanyang University

¹ 한양대학교

While isotactic-polystyrene and syndiotactic-polystyrene (i-PS and s-PS) are well-known semicrystalline and highly crystalline polymers with corresponded chain conformation, atactic-polystyrene (a-PS) is considered uncrystallizable. In recent years, our group developed a rapid thermal quenching method with entropy diluents, which generated stress and squeezing to stretch and crystallize amorphous PMMA to the 1-D hypo-crystal structure, in which the chain exhibited 90 % of stretched-favored trans-gauche conformation to extend up to 60 % of the contour length. In this research, we applied the same process for a-PS and obtained the highly stretched zig-zag morphology consistent with 70 % of trans conformation in the backbone chain. The crystals exhibited X-ray diffraction peak, melting peak at 250 °C and dramatical enhancement of mechanical properties.

Poster Presentation **3PS-045**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Chitosan-based Hydrogels Embedded with Metal Nanocrystals for Catalytic Applications

Prayoga Muhamad Akbar, 김문호[†]

부경대학교

Porous chitosan-based hydrogels were successfully fabricated via low-thermally induced phase separation using alcohol as non-solvent resulting nanofibrous structure. The incorporation of chitosan-based hydrogels with photothermal materials enhanced the hydrogel's adsorption and thermal properties, it provided more functional groups for in-situ reduction of nanoparticles (NPs) and uniform NPs distribution facilitated effective contact to reduce pollutants rapidly. This green and reuseable catalytic platform shows promising performance for aqueous-phase catalytic applications, offering advantages in ease of recovery and environmentally friendly synthesis.

Poster Presentation **3PS-046**

콜로이드 및 분자조립 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Cellulose-Based Composite Monoliths for Efficient Continuous-Flow Water Remediation

Pradyasti Astrini, 김문호[†]

부경대학교

Hexavalent chromium (Cr(VI)) is a hazardous pollutant that must be reduced to the less toxic Cr(III) for effective water treatment. In this study, a cellulose-based composite monolith was developed as a sustainable 3D support for catalytic applications. The monolith was fabricated via phase separation of cellulose acetate in DMF using hexanol as a non-solvent, followed by deacetylation with NaOH. Abundant hydroxyl groups in the cellulose enabled in-situ reduction of metal nanoparticles, while embedded metal nanowires improved mechanical stability and facilitated galvanic replacement reactions. The resulting monolith efficiently reduced Cr(VI) to Cr(III) in a continuous-flow system within 3 hours. Additionally, the composite exhibited iodine adsorption capability, highlighting its multifunctional performance. This eco-friendly and scalable material offers strong potential for practical application in advanced wastewater remediation.

Poster Presentation **3PS-047**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Synthesis and Characterization of 3D Printable Dental Resin based on Photocurable Poly(Phenyl Sulfone)

이수정, 정일두[†], 이정민

부산대학교

Poly(phenyl sulfone) (PPSU), composed of repeating aryl ether (Ar-O-Ar) and sulfone ($-SO_2-$) units, exhibits excellent thermal stability and mechanical strength, attributed to the high polarity of the sulfone groups, as well as strong resistance to chemicals, UV radiation, and hydrolysis. These characteristics allow the PPSU to withstand high-temperature and high-pressure environments. In this study, photocurable methacrylate-terminated poly(phenyl sulfone) (MAPPSU) was synthesized via etherification of dichlorodiphenyl sulfone (DCDPS) and 4,4-dihydroxybiphenyl (DHBP) using potassium carbonate as the catalyst, followed by the reaction with methacryloyl chloride (MAC) using triethylamine (TEA) as an esterification catalyst to introduce methacrylate end groups. The formation of MAPPSU was confirmed through FT-IR, ^1H -NMR, GPC, TGA and DSC analyses, and used to formulate dental resin via DLP 3D printer to evaluate its mechanical properties much as compressive and flexural strengths.

Poster Presentation **3PS-048**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Polymeric Nanoparticles Containing Lumogen® Dyes for Cellular Detection and Imaging

이수빈, 곽민석[†], 진준오¹, 정수진

국립부경대학교

¹ 영남대학교

Lumogen fluorescent dyes have great light stability as well as high fluorescence quantum yields. Despite the excellent photophysical properties of dyes, the highly hydrophobic structure in common makes the compounds difficult to function as biological fluorescence probes. To generally utilize a family of organic fluorescent dyes such as Lumogen Red, Orange, Yellow, and Violet, as a biomarker for cellular imaging in flow cytometry and fluorescence microscopy, we used an encapsulation method using amphiphilic block copolymer namely Pluronic F127. The photostability of Lumogen nanoparticles were compared with commercial dye, Alexa488 and DAPI, used primarily bioimaging. Cell uptake of the probe nanoparticles by HeLa cells was analyzed by flow cytometry and confocal laser scanning microscopy. Also, we observed to confirm the position of the Lumogen nanoparticles in the HeLa cells using a high voltage electron microscope.

Poster Presentation **3PS-049**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Nucleic acid-based micelle incorporated with USE1-silencing siRNA for lung cancer therapy

이소윤, 김해주¹, 이창환², 조찬미³, 곽민석^{†3}

국립 부경대학교

¹ 부산대학교

² 울산의대

³ 국립부경대학교

UBA6-specific E2 conjugation enzyme 1 (USE1) is frequently overexpressed in lung cancer and has been implicated in tumor progression. To develop a targeted RNA interference (RNAi)-based therapeutic, we introduce U4T, a lipid-modified DNA carrier composed of four consecutive dodec-1-ynyluracil residues. U4T self-assembles into micelles and forms a soft spherical nucleic acid aggregate (siSNA) through simple hybridization with siRNA targeting USE1. The resulting siSNA demonstrates efficient cellular uptake without the need for cationic transfection agents and exerts potent anti-tumor effects. Specifically, siSNA significantly inhibits cell proliferation, migration, and invasion, induces G1 phase cell cycle arrest, and promotes apoptosis in lung cancer cells. In vivo studies further confirm its ability to suppress tumor growth. These results highlight siSNA as a promising and clinically applicable RNAi-based nanotherapeutic for lung cancer treatment.

Poster Presentation **3PS-050**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Neutrophil Targeting Lipid Nanoparticle Alleviates SARS-CoV-2-Induced Pulmonary Injury and Inflammation

이석희, 박우람[†]

성균관대학교

Excessive neutrophil activation, including neutrophil extracellular trap (NET) formation, is associated with severe COVID-19 and long-term sequelae, yet clinical applications of neutrophil-targeting therapies are limited by their short half-life and insufficient cell-type specificity. This study developed a lipid nanoparticle (LNP) platform designated DPN-LNPs, that co-encapsulates two NET inhibitors, DNase I and sivelestat, for specific delivery to lung neutrophils. In vitro and in vivo studies demonstrate that DPN-LNPs preferentially accumulate in lung neutrophils and degrade NETs as efficiently as free DNase I and sivelestat. Notably, DPN-LNP treatment administered only during the symptomatic phase of infection significantly improved SARS-CoV-2 outcomes. These findings provide proof-of-concept for adapting the LNP platform to deliver multiple immunomodulatory drugs in a cell-type specific manner to manage NET-associated complications in COVID-19 and other lung diseases.

Poster Presentation **3PS-051**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Ultrathin iCVD-Based Bioadhesive Coatings for Stable Electrode–Tissue Interfaces

윤형준, 최윤영, 문태진, 성혜정⁺

한국과학기술연구원

Reliable electrode-tissue adhesion is critical for accurate electrophysiological recordings during surgical, but signal quality deteriorates when electrodes detach. Conventional hydrogel-based bioadhesives, while providing tissue adhesion, create impedance barriers due to their thickness, compromising signal acquisition and electrode sensitivity. Here, an ultrathin bioadhesive coating achieving strong tissue adhesion while not damaging electrode impedance was developed via initiated chemical vapor deposition (iCVD). A poly(pentafluorophenyl methacrylate) (pPFMA) film reacts with amine groups of extracellular matrix proteins at body temperature. Adhesion tests in phosphate-buffered saline using flexible parylene substrates and porcine tissue verified that carbonyl groups in pPFMA provide strong adhesion and high hydrolytic stability. The ultrathin layer yielded a low impedance, supporting its suitability for electrodes intended for reliable electrophysiological signal acquisition.

Poster Presentation **3PS-052**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Development of Carboxymethylated Silk Fibroin Microgels with Anisotropic Structures for 3D Printable Cell Guidance Scaffolds

유연우, 최가람, 류여일, 김희진, 이기훈⁺

서울대학교

Microgel assemblies have high porosity and a reversible frictional force, making them a promising form for 3D printing in the biomedical field. Because most microgels are isotropic and spherical, which have limitations in guiding cell alignment, recent studies have focused on developing anisotropic microgels for cell alignment. Silk fibroin, a natural fibrous protein, has excellent biocompatibility and high mechanical strength, making it an attractive candidate for 3D printing inks.

In this study, we fabricate anisotropic silk fibroin microgels through carboxymethylation. Silk fibroin directly modified to keep anisotropic structures. Carboxymethylated silk fibroin (CMSF) was 3D printable, and aligned along the printing direction. To stabilize the printed structure, they were frozen and immersed in an acidic solution, maintaining their shape in the liquid phase. In this result, CMSF inks are expected to be used as a 3D printable cell guidance scaffold.

Poster Presentation **3PS-053**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Enhanced Cancer Immunotherapy via In Situ Nanomicelle-Forming Dissolving Microneedles

유빈, 임수연¹, 김병덕¹, 박효진¹, 김강민¹, 정지훈¹

성균관대학교 약학대학원

¹ 성균관대학교

Efficient co-delivery of tumor antigens and immunostimulatory adjuvants to lymph nodes is key to inducing robust anti-tumor immunity. We developed a dissolving microneedle (MN) system using an amphiphilic triblock copolymer that forms nanomicelles (NMCs) in situ upon skin application. These NMCs co-encapsulate hydrophobic TLR7/8 agonist (R848) and hydrophilic antigens (OVA), enabling effective lymphatic delivery and enhanced uptake by antigen-presenting cells. The MNs rapidly dissolve to release 30–40 nm NMCs optimized for lymph node targeting, minimizing systemic exposure and maximizing immune activation. In EG7-OVA tumor-bearing mice, transdermal delivery of R848/OVA-loaded MNs elicited strong antigen-specific humoral and cellular immune responses, resulting in potent therapeutic and prophylactic anti-tumor effects. This needle-free MN platform offers a promising strategy for safe and effective cancer vaccination with improved patient compliance.

Poster Presentation **3PS-054**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Nonleaching Diblock Polymer Brushes for Antibacterial and Antifouling Surfaces via Surface-Segregating Initiator

양승원, 정윤기[†]

한국과학기술연구원

Thrombosis, biofilm formation, and poor biocompatibility remain key obstacles in the development of implantable biomedical devices. Surface modification using polymer brushes is a promising strategy to address these challenges. Zwitterionic polymer brushes offer antifouling properties by forming a hydration layer, but their long-term use is limited by insufficient antibacterial activity and potential leaching. To overcome this, we developed a dual-functional polymer brush with antifouling, antibacterial, and nonleaching properties. The brushes were grafted onto polyurethane via surface-initiated atom transfer radical polymerization (SI-ATRP) using a surface-segregating initiator (SSI). Modified surfaces were analyzed by XPS, WCA, and AFM, and biological properties, including platelet adhesion, antibacterial effect, and cytotoxicity, were evaluated. This approach presents a promising surface engineering strategy to enhance the safety and durability of implantable biomedical devices.

Poster Presentation **3PS-055**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Advanced Osmium Redox Polymer Biosensors with Improved Enzyme Stability and Electron Transfer

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서울대학교 공과대학 재료공학부

¹ 엠팩스메디칼

² 서울대학교

Self-monitoring of blood glucose (SMBG) via finger-prick sampling causes discomfort and offers only momentary glucose values. To overcome this, continuous glucose monitoring (CGM) biosensors have been developed, with enzyme-based systems offering high selectivity and sensitivity. While mediators like osmium (Os) complexes improve electrode stability, CGM still faces challenges in accuracy and long-term enzyme stability. To address this, we enhanced biosensor performance through Os complex modification and linker integration. Among tested complexes, the one with dmbpy ligands showed the lowest redox potential, improving electron transfer. Increasing the coordination number from four to five improved water solubility by preventing cross-linking. Ethylamine was introduced as a linker to covalently bind the polymer to the enzyme, strengthening interactions and enhancing current stability.

Poster Presentation **3PS-056**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Development of Senescent Cell-Targeted Nanovesicle Delivery System via Cell Surface Vimentin Recognition

송예은, 이건우, 김덕일, 이민주, 이수홍[†], 이선준

동국대학교

Senescence-associated skin diseases are increasing with aged people. Aged skin exhibits impaired regeneration and own function. To treat such diseases, targeted removal or rejuvenation of senescent cells—the main drivers of these conditions—has emerged as a novel therapeutic strategy. Therefore, a delivery system targeting cell surface vimentin (CSV), a biomarker of senescent human dermal fibroblasts (HDFs), was developed by incorporating CSV-targeting peptide into HDF-derived nanovesicles with known anti-aging effects. The vimentin-targeting cell-derived nanovesicles (Vim-CNVs) were verified by ¹H NMR and DLS/TEM. Senescent fibroblasts treated with Vim-CNVs showed increased proliferation markers, reduced SA-β-gal activity, and enhanced wound healing. Enhanced wound healing was also observed in aged mouse models treated with Vim-CNVs. In conclusion, this study presents a promising approach for targeted drug delivery to treat age-related skin disorders.

Poster Presentation **3PS-057**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Synthesis of Fluorinated and Iodinated Cyanoacrylates and Their Application to Novel Liquid Embolic Composition

박현재, 전성익, 허세범¹, 제환준¹, 안철희⁺

서울대학교

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Liquid embolic agents are increasingly used in endovascular procedures due to their permanence, injectability, and high filling efficiency. However, Histoacryl® has limitations such as poor radiopacity and strong microcatheter adhesion. To overcome this, a new embolic composition combining iodinated (IECA) and fluorinated (PFPCA) cyanoacrylates was developed. IECA offers high radiopacity (1,100 mgI/mL), while PFPCA provides fast polymerization ($15.77 \pm 1.96 \mu\text{L/s}$) and low catheter adhesion ($8.65 \pm 0.79 \text{ N}$), improving usability. In rabbit renal artery embolization, the mixture with ethyl oleate achieved complete vessel occlusion and durable embolic effect, demonstrating its clinical potential.

Poster Presentation **3PS-058**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Hyaluronated Lipid Nanoparticles for Enhanced mRNA Vaccine Delivery

박보람, 김문구[†]

포항공과대학교

Lipid Nano Particle (LNP) has become an important platform for the development of mRNA vaccines. However, the current clinical use of LNPs, which employ poly(ethylene glycol) for mRNA vaccines and may undergo rapid degradation, has been known to cause side effects in a few patients. In this study, we developed a hyaluronate (HA) conjugated LNP for mRNA vaccine delivery. Several cationic lipids were conjugated to HA, and the resulting HA-LNP conjugates were used to form a complex with eGFP-expressing mRNA as a model vaccine. In vitro experiments showed that the HA-LNP/eGFP complex exhibited high expression of eGFP through HA receptor-mediated endocytosis. Additionally, we developed an HA-mRNA conjugate to form a complex with LNP for mRNA vaccines.

Poster Presentation **3PS-059**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Viscoelastic GelMA/Nanofiber Hybrid Hydrogel via Interfacial Dynamic Crosslinking

박민하, 이채원, 김민희[†]

경북대학교

세포 외 기질(ECM)은 주로 섬유상 단백질과 다당류로 구성되어 세포의 구조적 지지와 생화학적 신호 제어에 관여하며, ECM의 점탄성 특성은 세포의 부착, 이동, 분화 등에 중요한 영향을 미친다. GelMA는 생체적합성과 광가교 특성을 갖춘 수화젤 소재로 널리 사용되지만, 고정된 기계적 특성으로 인해 실제 조직의 점탄성 특성을 재현하는 데 한계가 있다. 본 연구에서는 GelMA 수화젤의 점탄성 특성을 향상시키기 위해 GelMA 측쇄에 boronic acid(BA)를 도입하였다. 동적 Borate-ester 결합을 형성하기 위해 PVA 나노섬유를 전기방사를 통해 제조하고 GelMA BA 수화젤과 복합화함으로써 점탄성을 조절하였다. 도입된 BA 함량과 나노섬유의 비율을 조절함으로써 수화젤의 물리화학적 특성뿐 아니라 점탄성 특성을 조절할 수 있었다. 궁극적으로 3차원 세포배양을 통해 수화젤의 점탄성 특성에 따른 in vitro 생물학적 특성 변화를 분석하였다.

Poster Presentation **3PS-060**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Ultrahigh-Stretchable Perovskite Quantum Dot LEDs for Conformal Biophotonic Devices

박광현, 한세광^{*1}

포항공과대학교

¹ 포항공대

Perovskite quantum dots are promising for next-generation lighting due to their superior color purity and emission tunability. However, their limited mechanical stretchability restricts their use in stretchable optoelectronics, especially wearable displays and biophotonic healthcare devices. We report the first intrinsically stretchable light-emitting diodes made by embedding bright perovskite quantum dots within a soft semiconducting matrix through advanced heterostructure engineering. Transmission electron microscopy, X-ray photoelectron spectroscopy, and photophysical analyses confirm strong structural, chemical, and electronic coupling between the quantum dots and matrix. These LEDs maintain stable, spectrally pure electroluminescence (FWHM: 19 nm) even under strains up to 125%, enabling seamless operation on bent surfaces such as the human wrist. This approach opens new opportunities for stretchable perovskite quantum dot LEDs in wearable biophotonic applications.

Poster Presentation **3PS-061**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Development of a Multifunctional Therapeutic System for Effective Treatment of Diabetic Foot Ulcers

김호용, 이보람, 김민지, 오세행[†]

단국대학교

Diabetic foot ulcers (DFUs) are a prevalent and serious complication in diabetic patients, with about 20% of individuals affected during their lifetime. Unlike typical wounds, DFUs are difficult to heal due to complex pathophysiology, including chronic inflammation, elevated reactive oxygen species (ROS), poor vascularization, and impaired epithelial regeneration. Conventional treatments, such as wound dressings, surgical debridement, and oxygen therapy, often have uncertain therapeutic outcomes due to limited efficacy, high cost, and potential side effects. To address these challenges, we developed a multifunctional therapeutic system that simultaneously offers: (i) sustained release of growth factors to promote epithelial repair, (ii) ROS scavenging to reduce oxidative stress, and (iii) immunomodulatory effects to control inflammation-induced tissue damage. The morphology, H₂O₂ scavenging, growth factor delivery, and cellular ROS scavenging of the complex system were investigated.

Poster Presentation **3PS-062**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Enhanced Angiogenic Potential of Cell Spheroids under Simulated Microgravity based on Neutral Buoyancy

김호용, 오세행[†]

단국대학교

The development of three-dimensional (3D) artificial tissues/organs using tissue engineering is a very promising technology. However, the dimension of artificial tissue is often constrained to sub-millimeter scales due to limited vascularization. Co-culturing mesenchymal stem cells (MSCs) with endothelial cells (ECs) has shown promise in promoting vascular development, yet achieving rapid and sufficient angiogenesis remains a challenge. Interestingly, studies have demonstrated that microgravity (μg) environments can stimulate angiogenic processes via cytoskeletal reorganization. In this study, we developed MSC/EC spheroids using a simulated microgravity platform based on neutral buoyancy to enhance angiogenic activity. We investigated various cell ratios to identify optimal conditions for angiogenesis under simulated μg . Angiogenic gene expression and marker levels under simulated μg were compared with the 1g environment through qRT-PCR and immunofluorescence staining.

Poster Presentation **3PS-063**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Preparation of antifouling coating on the surface of intraocular lens using SBMA to reduce posterior capsular opacification

김태형, 정윤기^{†1}

한국과학기술연구원

¹ 한국과학기술연구원

Cataract-induced opaque eyes are still treated with physical surgery, such as the implantation of Intraocular lens (IOL). After surgery, Lens epithelial cells (LECs) remaining within the lens capsule proliferate and differentiate along the IOL surface, causing Posterior capsule opacification (PCO). PCO is a common condition, with an incidence of up to 50% within five years. To prevent this problem, early inhibition of LECs adhesion is crucial.

To reduce LECs adhesion, we performed surface modification of hydrophobic IOL material using the SBMA, one of the zwitterionic polymers, via photo-polymerization. The IOL surface with SBMA exhibited excellent hydrophilicity and suppress adhesion of protein and LECs.

Poster Presentation **3PS-064**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Development of a PHB/PEO-Based Electrospun Fiber Sheet to Prevent Lung Air Leakage.

김은영, 권오형[†]

금오공과대학교

Pulmonary air leaks after lung resection can cause infection and cardiopulmonary complications. To address this, an ultrafine fiber sheet composed of poly(3-hydroxybutyrate) (PHB) and polyethylene oxide (PEO) was developed. Mimicking the extracellular matrix, the sheet offers high surface area and porosity, enhancing biocompatibility. Although PHB is biodegradable and biocompatible, its low crystallinity can lead to fiber fusion during electrospinning. Incorporating PEO improved fiber uniformity and crystallinity, as confirmed by FT-IR and DSC. Water contact angle analysis showed increased hydrophilicity with higher PEO content. Tissue adhesion, measured by rheometer also increased with PEO concentration. Burst pressure tests demonstrated effective air sealing. The PHB/PEO (7:3) sheet showed rapid degradation and excellent cytocompatibility in vitro. Histological analysis revealed superior skin regeneration compared to gauze and NEOVEIL™. These findings suggest that PHB/PEO sheets are promising candidates for sealing pulmonary air leaks.

Poster Presentation **3PS-065**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Polymeric Flake Hemostat Comprising Calcium Alginate, Starch, and Ionic Copolymer Networks for Enhanced Tissue Adhesion and Rapid Hemostasis

김유정, 권오형[†]

금오공과대학교

Flake-type bioresorbable hemostats are promising for controlling bleeding in narrow or irregular wounds due to their conformability and ease of use. Here, we developed adhesive hemostatic flakes composed of calcium alginate, starch, and interpenetrating ionic networks of polyacrylamide and poly(acrylic acid). Unlike conventional powders that detach easily under blood flow, this flake structure enhances wound adhesion and hemostatic function. We evaluated morphology, chemical properties, fluid uptake, coagulation ability, adhesion force, cytocompatibility, and in vivo bioresorption. The flakes exhibited higher tissue adhesion (-0.67 ± 0.06 N) and faster hemostasis (36 ± 5 s) than a commercial powder (Arista™ AH) in a rat liver hemorrhage model. These results demonstrate that this polymer-based flake system provides an effective and biocompatible solution for rapid hemostasis, suggesting strong potential for clinical use.

Poster Presentation **3PS-066**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Exploration of Emerging Trends in Microneedle-Based Hydrogel as a Wound Healing Patch

김영희[†]

(재)헬스케어스파산업진흥원

Microneedle-based hydrogels offer notable advantages due to their biocompatibility, ability to maintain a moist environment, and capacity for sustained drug release. Compared to needle-based drug injections, they minimize pain and scarring, making them a focal point for researchers in the areas of transdermal drug delivery system(TDS) and diagnostics. Particularly, these hydrogels have demonstrated impressive results in addressing chronic wounds.

This study aims to provide an overview of the latest advancements in technology and materials associated with hydrogel microneedle for wound healing. The discussion encompasses the process, the current state of hydrogel microneedle patches, TDS, and methods for analyzing physical properties. The study concludes by highlighting potential directions for future research and identifying key challenges in the development of hydrogel microneedle technologies.

Poster Presentation **3PS-067**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Progression of immunotherapeutic approaches via combined induction of ferroptosis using biodegradable Nano-Sized Metal-Organic Framework

김영준, 유자형¹

울산과학기술원

¹ UNIST

In the field of advancing cancer nanomedicine, various treatments encounter challenges attributed to tumor resistance. The resistance of tumor cells to apoptosis and immune responses has instigated an exploration into the immunogenicity of apoptosis, traditionally regarded as low compared to necrosis. Consequently, this study introduces iron oxide with PCN-224, highly crystal inorganic-organic networks between zirconium metal cluster and TCPP organic ligands, thereby inducing ferroptosis and augmenting cancer cell death. Immunogenic cell death (ICD) triggers a sustained anti-cancer immune response, amplifying the effectiveness of conventional anticancer treatments. Furthermore, the nanocomplex, coated with an anti-PD-L1 antibody, presents a multifaceted strategy with significant potential for cancer immunotherapy. Additionally, mild hyperthermia induced by the iron oxide photothermal effect enhances immune responses, synergizing effectively with ICIs in "cold" tumors.

Poster Presentation **3PS-068**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Controlling Injectable Adhesive Systems Using Bio-Inspired Nanoparticles for Enhanced Wound Closure

김여진, 서성백[†]

부산대학교

Traditional wound closure methods like sutures, staples, and tape can cause infections and complications. Tissue adhesives offer speed and ease but set within 10 seconds, limiting precise application control. This study mimics sandcastle worms' adhesive mechanism, where protein glue stored in granules bursts when exposed to seawater electrolytes, activating adhesion. Researchers developed nano-sized particles using alginate (anionic polymer) and Dermabond (cyanoacrylate adhesive). Cationic polymers including polyethyleneimine, chitosan, and PDADMAC serve as triggers to activate adhesive properties. This nanoparticle platform enables precise tissue adhesive control through low viscosity for accurate application and timed activation. The system offers broad application potential for various wounds, including ocular and abdominal cavities, overcoming rapid-setting limitations of conventional adhesives.

Poster Presentation **3PS-069**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Fabrication and Evaluation of an Oxidized Starch-Based Powder-Type Anti-Adhesion Agent with Improved Tissue Adhesiveness

김병주, 권오형[†]

금오공과대학교

Adhesions, often occurring after surgery due to excessive fibrous tissue formation between organs or tissues, can lead to various complications, necessitating effective anti-adhesion strategies. In this study, a powder-type anti-adhesion agent was fabricated using dialdehyde starch (DAS), synthesized via oxidative modification, and polyvinylpyrrolidone (PVP). DAS and PVP were used to improve adhesive properties. DAS was cross-linked using glyoxal. The tissue adhesion property was influenced by the ratio of DAS to PVP, the concentration of cross-linking agent, and the reaction duration. As a result, the x-DAS/PVP (7:3) powder formulation exhibited the highest adhesive performance. From the in vitro test, the powder was biocompatible and degraded within 7 days. In vivo animal studies confirmed effective reduction of tissue adhesion. x-DAS/PVP powder-type anti-adhesion agent is suitable for both laparoscopic and open surgery.

Poster Presentation **3PS-070**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Needle-Free Intranasal Nanovaccine with TLR7/8 Agonist for Immunotherapy of Metastatic Cancer

김병덕, 임수연, 유빈, 박효진, 김강민, 정지훈⁺

성균관대학교

Recent outbreaks and the global spread of infectious diseases have highlighted the need for mucosal vaccines, which can induce both antigen-specific humoral and cellular immune responses. Since systemic vaccines are generally ineffective at generating mucosal immunity, needle-free mucosal vaccines are important for disease prevention and mass immunization. However, low antigen stability at mucosal sites remains a challenge. In this study, we developed a cationic polymeric nanoparticle (DA3) platform that co-delivers the TLR7/8 agonist resiquimod (R848) and anionic ovalbumin (OVA) to enhance antigen stability and immune responses. The DA3/R848/OVA nanovaccine demonstrated superior dendritic cell activation, suppressed tumor growth in a B16-OVA melanoma model, induced immunological memory, and improved antitumor effects and survival following intranasal delivery, supporting its potential as a needle-free mucosal vaccine.

Poster Presentation **3PS-071**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Type I antifreeze protein-DNA hybrid nanostructures for ice recrystallization inhibition

김도현, 곽민석[†]

Pukyong National University

Antifreeze proteins (AFPs) protect organisms that inhabit a sub-zero environment from freezing. The type I AFP, isolated from the fish species, contains high alanine content and adopts an α -helical structure with cap at the carboxy termini. Here, we report the peptide-DNA hybrid structure(PDH) in which DNA tethered to the end of type I AFP. We designed a peptide nucleic acid(PNA) of 6 bases for connecting DNA and peptide. The PDH structures were compared to AFP activity by their inhibition of ice recrystallization(RI). We calculated the α -helical formation rate of the PDH structures and the molecular modeling of 1WFA conformational changes depending on the PNA binding site.

Poster Presentation **3PS-072**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Control of Marine Harmful Algal Blooms Using Photothermal Polymer Nanoparticles

구민정, 곽민석¹, Naz Fathma Tumpa¹, 김선주¹

국립부경대

¹ 부경대학교

Climate change has intensified the occurrence of harmful algal blooms in marine environments, leading to severe ecological and economic impacts through their production of toxins and water quality deterioration. To address this growing concern, we developed polymeric nanoparticles incorporating two distinct fluorescent dyes stabilized through a semi-interpenetrating network (sIPN) structure. The effectiveness of these engineered nanoparticles was evaluated against two red-tide causing species, *Akashiwo sanguinea* and *Alexandrium pacificum*. The nanoparticles demonstrated dual functionality: cellular visualization through UV-excited fluorescence using Lumogen® Violet(LV), and photothermal treatment capability using near-infrared (NIR) responsive Lumogen® IR788. When *Akashiwo sanguinea* cells treated with IR788-sIPN nanoparticles were exposed to NIR laser irradiation, significant reduction in cell viability was observed due to the photothermal effect.

Poster Presentation **3PS-073**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Lithographically Patterned Collagen–Polymer Interfaces for Spatial Control of Cell Adhesion

강민석, 김기수[†]

부산대학교

Molecular recognition between cells and the extracellular matrix plays a fundamental role in tissue development, repair, and regeneration. Engineering biomimetic surfaces that guide these interactions offers promising strategies in regenerative medicine. We develop lithographically patterned collagen-interpenetrated polymer (CIP) films to mimic native matrix architecture and modulate cell adhesion. The CIP films are fabricated via soft lithography using a PDMS mold and UV-initiated polymerization, resulting in well-defined microstripe patterns. Surface characterization using AFM, SEM, and FT-IR confirms successful pattern formation and collagen integration. Collagen adsorption and NIH/3T3 fibroblast assays show preferential adhesion and guided migration along CIP domains. This platform serves as a tunable wound healing interface that promotes accelerated tissue repair by spatially directing cell–material interactions.

Poster Presentation **3PS-074**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Personalized 3D-Bioprinted Skin Constructs Based on Patient-Derived Decellularized ECM for Improved Wound Healing and Tissue Regeneration

강래희, 이준민[†]

포항공과대학교

The skin, the body's largest organ, is vital for protection and homeostasis, making it a focus of regenerative medicine. Yet, most models lack patient specificity and fail to reflect the native extracellular matrix (ECM). Here, we introduce a three-dimensional (3D) bioprinted skin model using patient-derived decellularized ECM (pddECM) and keratin–alginate (KA) bioinks. The pddECM enhanced dermal fibroblast viability and collagen I expression, while KA supported keratinocyte activation. The model improved cell migration and angiogenesis under reduced hypoxia. Cytokine profiling showed increased intercellular adhesion molecule-1 (ICAM-1) and complement C5, with reduced interleukin-4 (IL-4) and interleukin-8 (IL-8). In vivo, gelatin methacryloyl (GelMA) with or without pddECM accelerated wound closure and preserved dermal tissue. This patient-specific platform holds promise for regenerative wound care and drug testing.

Poster Presentation **3PS-075**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Nanocomposite hydrogels based on partially reduced graphene oxide and silver nanowires for high-performance strain sensors

SAW HTET THURA LIN, 김소연⁺

충남대학교

In recent years, flexible and soft strain sensors that convert mechanical deformation into electrical or optical signals have attracted great attention for use in wearable electronics and smart systems. These sensors show strong potential in areas such as human motion tracking, electronic skin, medical diagnostics, energy devices, and soft robotics. Partially reduced graphene oxide (PRGO) is a promising material due to its electrical conductivity, water dispersibility, and flexibility. Silver nanowires (AgNWs) also offer high conductivity, attributed to their high aspect ratio and interconnection. In this study, a nanocomposite hydrogel was developed by embedding PRGO and AgNWs into a hydrogel matrix for human motion sensing. Its key physical and functional characteristics, such as water content, gel fraction, strength, adhesion properties, and electrochemical behavior were tested to evaluate its potential in flexible sensing applications.

Poster Presentation **3PS-076**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Cold-Responsive Hyaluronated Upconversion Nanoplatfom for Transdermal Cryo-Photodynamic Cancer Therapy

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Pusan National University

¹ 부산대학교

Upconversion photodynamic therapy (UPDT) has emerged as a novel localized therapeutic modality for treating various cancers through remote deep tissue photoactivation of ultraviolet and visible emissions of upconversion nanoparticles (UCNPs). However, further advances in UPDT are still restricted by the poor brightness of UCNPs to achieve sufficient therapeutic outcomes under skin-safe NIR laser power irradiation. Recently, it has been reported that the luminescence of UCNPs is greatly enhanced at cryogenic temperatures by suppressing thermal quenching. Therefore, in our study, we prepared 808-nm excitable UCNPs using a facile and accelerated synthetic protocol, which have been proven to exhibit a 2.5-fold photoluminescence intensity enhancement after exposure to low temperature conditions. Therefore, a new approach to combine cryotherapy and upconversion photodynamic therapy (Cryo-UPDT) is proposed in this study. We designed a therapeutic nanoplatfom that integrates porous silica-coated UCNPs, chlorin e6 photosensitizer, and hyaluronic acid (UCNPs@SiO₂-Ce6-HA), to treat skin cancer with exogenous 808 nm NIR laser excitation. An ex vivo study showed that a cryo-driven boost of upconversion brightness led to a 3.15-times increase of the cytotoxic 1O₂ generation by photosensitized Ce6 in the nanoplatfom. In vitro studies validated the biosafety, cancer targeting, and NIR-assisted cancer-cell killing properties of the UCNPs@SiO₂-Ce6-HA nanoplatfom. Moreover, excellent transdermal delivery capabilities were confirmed using porcine skin models. Thus, the developed nanoplatfom can effectively penetrate deep into the cancerous tissue and produce a synergistic tumoricidal effect under consecutive freezing and NIR laser irradiation. As a result, the proposed Cryo-UPDT treatment demonstrated an impressive 1.44 times higher tumor eradication in melanoma-bearing mice than PDT treatment alone. In summary, this study proves that Cryo-UPDT represents a novel and valid therapeutic strategy.

Poster Presentation **3PS-077**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Toward High-Performance mRNA-LNPs through Structural Optimization of Ionizable Lipids

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Lipid nanoparticle (LNP)-mediated mRNA delivery has revolutionized vaccination and disease treatment, with the chemical structure of ionizable lipids (ILs) dramatically influencing both efficacy and safety. Here, we report a versatile strategy to enhance protein expression from mRNA delivered by LNPs through structural modifications of ILs, specifically by tuning their head, linker, and tail regions. A library of ILs with systematic variations was synthesized—e.g., incorporating different 5-membered heterocycles in the head group, varying linker functionalities and lengths, and employing either linear or branched tails. LNPs containing each IL variant were evaluated through formulation optimization by measuring their physicochemical properties (e.g., size, PDI, surface charge, and mRNA encapsulation efficiency) and in vivo efficacy screening. Our results clearly demonstrate that the head group structure, linker length, and tail branching significantly affect protein expression levels.

Poster Presentation **3PS-078**

의료용 고분자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

DNAOD: A Predictive Tool for DNA Absorption Spectra Using a Three-Base Nearest-Neighbor Model

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Quantification of DNA is a very important aspect in biological and chemical field of research. One common DNA quantification method involves leveraging the extinction coefficient and absorbance parameters obtained from the absorption spectrum of a certain DNA sequence. Here, we introduce an absorption spectra prediction tool for single-stranded DNA based on its extinction coefficient employing a three-sequence nearest-neighbor model, which extends the conventional nearest-neighbor approach by considering three sequence bases instead of two. Our proposed model demonstrated high prediction accuracy when compared with both experimental data and predicted data using established models. We also provide a simple, user-friendly Python code for facile implementation of this model. Our findings would serve as a framework for further advances in DNA quantification, offering a valuable tool for diverse applications in molecular and polymer biology.

Poster Presentation **3PS-079**

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Chair: 안효성, 양상희

Upconversion Nanoplatfom co-doped with Gd and Fe for multimodal theranostic applications

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Multimodal cancer theranostics, integrating therapy and diagnosis in a single system, has attracted significant attention. Photodynamic (PDT) and photothermal therapy (PTT) are non-invasive treatments where a photosensitizer, upon light excitation, induces cancer cell death via reactive oxygen species or localized hyperthermia, respectively. Magnetic resonance imaging (MRI) provides accurate tumor visualization using contrast agents. However, conventional organic agents often suffer from poor stability and long-term toxicity. To address this, we propose an upconversion nanoparticle (UCNP) system with optimized gadolinium (Gd) and iron (Fe) content in the core and shell to enhance PDT and PTT effects. The Gd and Fe also enable dual-mode T₁/T₂ MRI imaging. This multifunctional UCNP platform presents a promising strategy for integrated cancer diagnosis and treatment.

Poster Presentation **3PS-080**

분자전자 부문위원회(III)

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Chair: 안효성, 양상희

Synthesis of Novel Polymer Donors for PM-Type OPDs: A Crystallinity Enhancement Strategy

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한양대학교

Photomultiplication-type organic photodetectors (PM-type OPDs) have attracted attention due to their ultrasensitive detection capabilities attributed to high external quantum efficiency (EQE) and responsivity (R). However, novel polymer donors for PM-type OPDs have been rarely developed except for P3HT. In this study, we report benzobisoxazole-based polymer donors with π -spacers to investigate their effects on OPD performance. Compared to the control polymer without a π -spacer (PBB), both polymers with a π -spacer (PTBB) and an extended π -spacer (PUTTB) exhibited enhanced crystallinity. Notably, the extended π -spacer not only suppressed dark current density due to its alkyl chain but also increased the absorption coefficient, leading to superior specific detectivity (D^*). As a result, PUTTB-based devices achieved exceptional performance with EQE of 27,280%, R of 117 A/W, and D^* of 3.86×10^{13} Jones at a bias of -30 V.

Poster Presentation **3PS-081**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Molecular Design for large-scale Wavelength-selective Organic Photodiodes

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한양대학교

Wavelength-selective organic photodiodes (OPDs) enable full-color imaging. However, polymer-based solution processes face challenges in large-scale fabrication. Therefore, research on vacuum deposition-based OPDs compatible for large-scale is becoming more important, especially focusing on enhancing their narrowband detection performance. In this study, four various electron-withdrawing groups were introduced into the electron-rich cyclopentadithiophene core. The optical properties changed due to intramolecular charge transfer interactions, enabling R-G-B selectivity with minimal structural changes. As a result, the deeper HOMO energy level reduces the dark current, achieving a high external quantum efficiency of approximately 70% and a high specific detectivity of about 2.0×10^{12} Jones. Furthermore, an organic X-ray sensor with imaging performance comparable to commercial alternatives was successfully fabricated by integrating vacuum-deposited OPDs.

Poster Presentation **3PS-082**

분자전자 부문위원회(III)

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Chair: 안효성, 양상희

Ion selective membrane through specific ion interaction effects on polyelectrolyte coacervates

신조원, 김형준[†]

서강대학교

Coacervation refers to the phase separation of protein or polyelectrolyte solutions into polymer-rich and polymer-dilute phases due to attractive interactions between polymer species. Specifically, simple coacervation involves a single polymer species, whereas complex coacervation occurs between oppositely charged polyelectrolytes. In simple coacervation, salt addition can either increase (salting-in) or decrease (salting-out) polymer solubility depending on the salt type. In complex coacervation, on the other hand, salt screens electrostatic interactions and can lead to the dissociation of polyelectrolyte complexes. Moreover, salt ions can either decrease or increase salt resistance of complexes by acting as preferential counterions or co-ions. In this study, we explore the potential of polyelectrolyte coacervate membranes for selective ion separation by utilizing the ion-specific phase behavior of coacervates. This approach is distinct from conventional ion separation mechanism such as Donnan exclusion, size exclusion, or dielectric exclusion. Our findings will enhance the understanding of the ion-specific effects on coacervation and can hold promise for advancing ion separation technologies.

Poster Presentation **3PS-083**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Mitigating Defects and Enhancing Performance in 2D Sn Halide Perovskite FETs via Alkali Halide Additive Engineering

신승윤, 박희준[†]

한양대학교

Sn-based 2D metal halide perovskites (MHPs) have emerged as promising channel materials for high-performance p-channel field-effect transistors (FETs), owing to their low hole effective mass and high mobility in the lateral direction.[1,2] However, the practical application of Sn-based 2D metal halide perovskites (MHPs) is hindered by poor film quality induced by fast crystallization, which arises from defects at both interfaces and the bulk of the perovskite film and intrinsic instability against oxidation.[1,3] In this work, to overcome the film quality limitations of Sn-based 2D MHPs, we incorporated KI and RbI into the perovskite precursor solution. This additive effectively mitigated defect formation and promoted uniform morphology with enlarged grain sizes. These improvements resulted in field-effect mobility of $1.35 \text{ cm}^2 \text{ V}^{-1} \text{ s}^{-1}$ and an on/off current ratio exceeding 1.0×10^6 , accompanied by remarkable operational stability and reproducibility.

Poster Presentation **3PS-084**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Antisolvent engineering of FAPbI₃ for NIR perovskite LEDs

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광주과학기술원

Formamidinium lead iodide (FAPbI₃) is widely studied for near-infrared perovskite light-emitting diodes (NIR PeLEDs) owing to its narrow optical bandgap. However, FAPbI₃ exhibits a low exciton binding energy and a high defect density, which lead to exciton dissociation and non-radiative recombination. To address these issues, we employ a series of antisolvent engineering strategies by controlling the crystallinity, grain size, and surface coverage of FAPbI₃ films, thereby enhancing exciton confinement and promoting radiative recombination. Additionally, small-molecule additives are introduced into the antisolvent for defect passivation. This study demonstrates that antisolvent and additive-assisted processing of FAPbI₃ can effectively enhance the efficiency and stability of NIR PeLEDs.

Poster Presentation **3PS-085**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Kinked Linear Side Chains via Oleyl Groups for Enhanced Face-On Orientation and Improved Power Conversion Efficiency in Organic Solar Cells

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울산과학기술원

The unique packing structure and solubility of Y-series nonfullerene acceptors (NFAs) are effectively controlled by inner side chain engineering. In general, the branched side chains (e.g., 2-ethylhexyl, 2-butyloctyl, etc.) are precisely engineered in NFAs to effectively enhance solubility, maintaining the helical packing structure. However, the development of Y-series NFAs with linear inner side chains has been rarely reported, as their very low solubility makes unfavorable film formation. Herein, we introduce oleyl inner side chains of Y-series NFA, which contain a cis-configured double bond, leading to improved solubility induced by the kinked conformation of the inner chains. This unique modification strategy strengthens face-on molecular packing compared to other Y-series NFAs with linear inner side chains, resulting in a promising power conversion efficiency of up to 14%.

Poster Presentation **3PS-086**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Design Strategies for High Performance in 3D-Printed Micro-Supercapacitors

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전북대학교

The advancement of wearable electronics demands energy storage devices with high power density and long cycle stability. Micro-supercapacitors are promising candidates due to their excellent rate capability and long cycle life. However, conventional photolithography-based fabrication limits scalability and structural flexibility. Herein, we fabricated micro-supercapacitors via DIW 3D printing of three-layered carbon black electrodes, allowing precise integration of electrode architectures with tunable geometries. we systematically varied the inter-line gap and active area. The device with a 0.3 mm gap and 0.5 cm² area exhibited the highest areal capacitance, reaching 0.62 mF/cm² during cyclic voltammetry at a scan rate of 100 mV/s. These results highlight the potential of 3D printing-based patterning as a scalable and flexible fabrication platform for next-generation microscale energy storage devices.

Poster Presentation **3PS-087**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Solvents Effects on the High Yield of Semiconducting Single-Walled Carbon Nanotubes

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공주대학교

The semiconducting single-walled carbon nanotubes(s-SWNTs) have potential for a wide range of applications in diverse fields. But the separation s-SWNTs from raw large-diameter single-walled carbon nanotubes(SWNTs) remains a challenge and the dispersion of SWNTs using conjugated polymer and solvent(toluene) has proven to be an effective method. But either purity or yield of the obtained fractions remains unsatisfactory. In this study, various solvents(tetralin, decalin, mesitylene, m-xylene, p-xylene, cumene, chlorobenzene, THF) are selected to optimize both purity and yield. In polarity solvents(chlorobenzene, THF) have led to presence of metallic SWNTs. But in non polarity solvents, an increasing trend in yield is observed with the increase in viscosity and high-purity s-SWNTs(>99%). Especially, high-viscosity solvent(tetralin, decalin) show a significantly higher yield than toluene, and these solvents are either aliphatic or partially aromatic in nature.

Poster Presentation **3PS-088**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Engineering Strategies for Next-Generation QD-based Flexible Displays

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대구경북과학기술원

¹ 울산과학기술원

Flexible light-emitting components are crucial for wearable electronics. This overview outlines material and structural strategies for developing quantum dot (QD)-based light sources with mechanical adaptability. An ultra-thin layer design is introduced to reduce bending stress, enhancing flexibility. By applying ~1.0 μm thick parylene and epoxy coatings, we fabricate QLEDs that endure repeated deformation and conform to skin. This approach is compatible with various emitters, including CdSe and perovskite QDs. We also present a stretchable emissive platform composed of colloidal QDs, an elastic matrix, and a conductive polymer. This composite maintains luminescence under 50% strain, showing strong potential for soft displays and wearable optoelectronics.

Poster Presentation **3PS-089**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Dual-Percolative Planar-Heterojunction Photoactive System for High-Performance Stretchable Organic Photovoltaics

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한국과학기술원

Intrinsically stretchable organic solar cells are promising candidates for wearable power sources due to their ability to deform in multiple directions. We present a new dual percolative planar-heterojunction (DP-PHJ) photoactive architecture, where the bottom and top layers comprise polymer donors (D18) and small-molecule acceptors (L8-BO), respectively, each at its percolation threshold relative to the other component. The interconnected D18 and L8-BO networks in both layers promote extensive donor-acceptor interfaces and efficient charge transport pathways. Simultaneously, robust D18 networks in the bottom layer dissipate mechanical stress, while percolated D18 in the top layer alleviates brittleness of L8-BO. Consequently, DP-PHJ-based OSCs exhibit superior PCE (19%) and mechanical robustness (4.4 MJ m^{-3}) compared to bulk-heterojunction (BHJ, PCE = 18% and toughness = 1.6 MJ m^{-3}) and conventional PHJ (PCE = 17% and toughness = 3.1 MJ m^{-3}) systems.

Poster Presentation **3PS-090**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Cation-Capped SnO₂ for Efficient and Stable Perovskite Solar Cells

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고려대학교

In conventional n-i-p perovskite solar cells, a thin (~30 nm) SnO₂ electron-transport layer is commonly used. Adding a fine, uniform, nanoscale surface-modification layer onto this delicate SnO₂ optimizes interfacial energy alignment, suppresses backward carrier recombination, and relieves strain within the perovskite. In this work, lanthanum (La) capping introduced onto SnO₂ by chemical bath deposition generates a conduction-band spike at the interface and reduces strain in the perovskite layer. This approach suppresses the formation of the undesired δ -phase of formamidinium lead triiodide (FAPbI₃) at the buried interface, enhances electron transport, and substantially improves device performance, and it also demonstrates strong operational stability under continuous illumination.

Poster Presentation **3PS-091**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Engineering Space-Confining Layers for Synthesis of Single-Crystalline Perovskite Thin Films

박준모, 김호범[†], 손연지, 유병준, 박상증

광주과학기술원

Polycrystalline (PC) perovskites have been widely investigated for optoelectronic applications owing to their facile fabrication process and excellent properties, including defect tolerance, tunable bandgaps, and high absorption coefficients. However, defects in PC perovskites induce trap states that promote non-radiative recombination and ion migration, thereby degrading device performance and structural stability. To address these issues, single-crystalline (SC) perovskites with intrinsically low trap densities have been explored, but their excessive thickness and limited size still hinder efficient charge transport and practical device integration. Herein, we demonstrate large-area, thin SC perovskite films by employing hydrophobic space-confining layers and polymer additives. Hydrophobic space-confining layers and polymer additives induced lateral crystal growth, enabling synthesis of large-scale and reduced thickness single-crystal thin films.

Poster Presentation **3PS-092**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Helical Electron Density and Enhanced Chiroptical Response in 1D Dion–Jacobson Chiral Perovskite Nanowires

박종현, 최원빈, 오준학[†]

서울대학교

Chiral hybrid organic–inorganic perovskites (HOIPs) have attracted significant attention for their potential in spin resolved optoelectronic applications. Despite growing interest, most chiral HOIPs remain limited to Ruddlesden–Popper (RP) phase structures due to synthetic challenges associated with achieving chirality transfer to the perovskite framework. In this study, we introduce a novel 1D Dion–Jacobson (DJ) phase chiral perovskite using a biphenyl-based chiral diammonium ligand, (R/S)-BPBEA (1,1'-([1,1'-biphenyl]-4,4'-diyl)bis(ethan-1-aminium) iodide). The incorporation of this chiral ligand leads to the formation of a helical arrangement in the $[\text{PbI}_6]^{4-}$ octahedral chains, forming highly ordered 1D nanowires. Importantly, the helical distortion of the Pb–I framework results in a spatially helical distribution of electron density along the nanowire axis. This structural feature enables efficient chirality transfer from the organic ligand to the inorganic backbone, significantly enhancing the chiroptical response, including circular dichroism. Compared to benzylamine-based chiral perovskites, the resulting DJ-phase system exhibits approximately 10 times stronger CD signals. Furthermore, the corresponding circularly polarized light photodetectors demonstrate high photocurrent dissymmetry factors (g_{ph}) up to ~ 0.74 , highlighting the potential of this design strategy for advanced chiral optoelectronic devices.

Poster Presentation **3PS-093**

분자전자 부문위원회(III)

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Chair: 안효성, 양상희

Enhancement of Gas Adsorption ability in Porous P3HT Films via Non-solvent Immersion

박세진, 박영돈[†]

인천대학교

This study enhances organic field-effect transistor (OFET) gas sensor performance by introducing porosity into poly(3-hexylthiophene) (P3HT) thin films (< 10nm) via non-solvent immersion. We correlated film morphology and electrical properties to gas sensing performance using various non-solvents. Hexane created wide, deep 3D pores, maximizing the specific surface area. This resulted in a 357% sensitivity enhancement (1.37 %/ppm) to NO₂ over pristine films and a 0.002 ppm limit of detection (LOD). Conversely, H₂O formed shallow pores with limited sensitivity but uniquely improved charge carrier mobility by 2.4% via polymer chain rearrangement. Our work proves that non-solvent immersion is an effective strategy to selectively control the porous structure and microscopic crystallinity of the active layer, offering a key strategy for designing high-performance organic gas sensors.

Poster Presentation **3PS-094**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Controlling Gold Nanoparticle Gaps with Genetically engineered M13 Bacteriophage for Advanced SERS Sensors

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Nanogap size plays a key role in enhancing SERS signals. Narrow gaps (1–10 nm) between metal nanostructures amplify electromagnetic fields via localized surface plasmon resonance (LSPR). Polymers help stabilize nanoparticles and improve reproducibility, though some may interfere through Raman signals or nonspecific interactions. We used M13 bacteriophage (~880 nm long, 6.6 nm wide) as a functional polymeric material. Genetic modification of its major coat protein p8 enabled display of gold-binding peptides for specific interaction with Au surfaces. By tuning the ratio of M13 phage to gold nanoparticles, we controlled nanogap sizes and achieved enhanced SERS performance. Among 20 peptide variants, those with high gold affinity showed superior signal enhancement. This strategy enables highly sensitive and selective SERS-based biosensing, offering a promising platform for future research on polymer–nanomaterial hybrids.

Poster Presentation **3PS-095**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Highly Deformable Regiorandom Semiconductors for Stretchable Electronics

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인하대학교

¹ 한국화학연구원

Regiorandom semiconductors, known for their straightforward synthesis and processing, have traditionally suffered from low hole mobility compared to their regioregular counterparts, limiting their practical use. In this study, we demonstrate that regiorandom organic semiconductors can deliver high drain current and hole mobility when employed in electrolyte-gated transistors, positioning them as viable candidates for stretchable electronics. The high capacitance of the electrolyte mitigates carrier trapping, resulting in enhanced charge transport and a high ON/OFF current ratio of approximately 10⁴. Furthermore, we investigated how variations in side-chains influence both electrical and mechanical properties. The optimized devices exhibited stable operation under 200% strain and maintained performance over 1,000 stretching cycles. These findings highlight the potential of regiorandom semiconductors as high-performance, stretchable materials for next-generation wearable technologies.

Poster Presentation **3PS-096**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Epoxy-based Reaction Driven Low-temperature Hybrid Bonding for Next-generation HBM and 3D packaging

박규식, 잠바가, 임지수, 윤창민[†]

인하대학교

In this study, low-temperature Cu/SiO₂ hybrid bonding is achieved through a synergistic combination of an epoxy-based reaction and electroless deposition (ELD). To enable this, the SiO₂ dielectric surface is functionalized with two different silanes of GPTMS and APTES, which can promote the epoxy ring-opening reactions and selective Au ELD on Cu pads. After sequential surface modification and ELD, the chips were bonded via thermocompression. As a result, complete Cu/SiO₂ hybrid bonding was realized at a low temperature of 250 °C without interfacial delamination or voids. Low-temperature hybrid bonding is achieved through the strong covalent bonding induced by epoxy ring-opening reaction, which enhances adhesion strength and enables bonding at reduced temperatures. This scalable combined method of epoxy polymerization and ELD can be a promising approach for next-generation HBM and 3D packaging technologies.

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Poster Presentation **3PS-097**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

LiA-TBA : A Single-Ion Conducting Binder with High Ionic Conductivity and Electrochemical Stability for Dual-Ion Batteries

문세정, 박민우, 김형준[†]

서강대학교

High-energy lithium-ion (LIBs) and dual-ion batteries (DIBs) require improved binders for better performance and stability. Conventional binders like PVDF and PAA face challenges with silicon anodes and high-voltage cathodes. We developed LiA-TBA, a single-ion conducting polymer binder from Li[ATFSI], a lithium sulfonylimide salt, and tert-butyl acrylate (TBA). SuFEx synthesis enables large-scale, pure Li[ATFSI] monomer production. LiA-TBA can be thermally converted to LiA-PAA, avoiding side reactions in direct LiA-PAA synthesis. Among samples with varying Li[ATFSI] content (0, 0.2, 0.5, 0.8), LiA-TBA 0.2 showed best results. In dual-ion batteries with natural graphite cathodes and lithium anodes, LiA-TBA 0.2 outperformed commercial PVDF binders in capacity, coulombic efficiency, and rate capability. Its flexibility and ionic conductivity make it promising for high-voltage, rate batteries. Future work will explore other monomers via SuFEx, LIB uses, and sodium substitution for Na-DIBs.

Poster Presentation **3PS-098**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Ultrashort Photonic Annealing as a Strategy to Suppress Surface Defects in PbS Quantum Dot Solar Cells

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대구경북과학기술원

This study presents ultrafast flashlight annealing (FLA) as an effective alternative to conventional thermal annealing (TA) for improving colloidal quantum dot (CQD) solar cells. TA enhances conductivity and nanocrystal packing but causes surface oxidation and hydroxylation, generating trap states that reduce device efficiency. FLA dramatically reduces annealing time to milliseconds, limiting thermal damage and preventing unwanted reactions. As a result, FLA-treated CQD films show lower trap densities, improved charge transport, and better photovoltaic performance. Devices using FLA achieve a higher open-circuit voltage (0.66 V) and power conversion efficiency (13.5%) than those with TA (0.63 V, 12.71%). Moreover, FLA preserves film morphology and enhances device stability. These findings demonstrate that FLA not only boosts performance but also extends durability, making it a highly promising technique for future CQD optoelectronic devices.

Poster Presentation **3PS-099**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Selective Etching of SiGe via Surface Passivation Using Self-Assembled Monolayers of Organic Molecules

남건희, 정대성[†]

포항공과대학교

We demonstrate a method for the selective etching of silicon-germanium (SiGe) by employing surface passivation with self-assembled monolayers (SAMs) of organic molecules. These SAMs form a densely packed, covalently bonded layer on the SiGe surface, effectively suppressing etching reactions in protected areas. This enables spatial control over etch rates, which is essential for advanced semiconductor device fabrication requiring nanoscale precision. By tuning the terminal groups and chemical affinity of the SAMs, surface reactivity can be selectively modified at the molecular level. The technique is compatible with standard lithography and etching processes, offering a promising route for integrating SiGe heterostructures into next-generation transistors and quantum devices.

Poster Presentation **3PS-100**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Sensitivity Enhancement of Extended-Gate Field-Effect Transistors via Dual-Gate Operation

김혜선, 하영근[†]

경기대학교

Extended-gate field-effect transistors (EGFETs) are promising for real-time chemical and biosensing due to their high sensitivity and flexibility. However, their performance is often limited by the Nernst response and affected by ion screening in complex fluids. Here, we present a dual-gate (DG) EGFET platform to overcome these issues. The back-gate voltage enables capacitive coupling with the electrolyte gate, allowing precise modulation of the channel potential and amplifying the sensor's response to surface potential changes. To ensure stability in liquid environments such as phosphate-buffered saline (PBS), we apply a self-assembled multilayer (SAML) as a passivation layer to prevent leakage current. This approach significantly improves both sensitivity and stability, demonstrating the potential of DG-EGFETs in advanced biosensing applications.

Poster Presentation **3PS-101**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Fabrication of CNT Nanostructures via Droplet-Based 3D Nanoprinting for Multifunctional Sensing Applications

김형집, 노찬호, 안지훈, 김원근⁺

국립금오공과대학교

Carbon nanotubes (CNTs) possess excellent electrical, mechanical, thermal, and chemical properties, which are further enhanced in nanostructured forms. In this study, we employed meniscus-based 3D nanoprinting to fabricate freestanding CNT-based 3D architectures. Proposed fabrication method provides various advantages such as design flexibility, cost-efficiency and nanoscale resolution.

We successfully printed CNT nanostructures—such as pillars and bridges—and applied to the inter-electrode connections for fabrication of chemical sensor devices. The CNT-based sensors demonstrated high sensitivity toward various volatile organic compounds (VOCs), confirming their potential as multifunctional chemical sensors.

Our results indicate that droplet-based 3D nanoprinting is a promising and scalable strategy for fabricating CNT-based devices and sensors, offering great potential for future nanoelectronic and sensing applications.

Poster Presentation **3PS-102**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Anion Engineering for Organic Nonlinear Optical Quinolinium Crystals with Various Electron Donors

김하늘, 김동주, 김채윤¹, 윤호섭, Mojca Jazbinsek², Fabian Rotermond¹, 권오필⁺

아주대학교

¹ Korea Advanced Institute of Science and Technology

² Zurich University of Applied Science

본 연구에서는 페놀릭 퀴놀리니움 (phenolic quinolinium) 기반의 1-methylquinolinium 양이온에 다양한 치환체를 도입하여 새로운 전자 주개 그룹을 설계하였다. 설계된 양이온은 130×10^{-30} esu 이상의 높은 제 1차 초분극도를 나타내었으며, 도입된 치환체는 양이온 간 머리-꼬리 상호작용 외에도 다양한 상호작용을 유도하여 분자 배열에 영향을 주었다. 이러한 구조적 변화는 비선형광학 특성의 향상으로 이어졌다. 또한 다양한 치환기를 도입한 음이온과의 조합을 통해 새로운 결정 소재를 설계하였고, 정성 이차 조화파 (quantitative second harmonic generation) 측정을 통해 비선형성을 확인하였다. 이러한 분자를 결정으로 성장시켜 물리적, 광학적 특성에 대한 다양한 분석을 진행하였다.

Poster Presentation **3PS-103**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Structure–Reactivity Correlation of Donor–Acceptor Conjugated Polymer Nanoparticles for Enhanced Photocatalytic Hydrogen Evolution

김택민, 정원조¹, 안상혁, 김준호¹, 함가영², 차효정², 정인환¹, 정대성⁺

포항공과대학교

¹ 한양대학교

² 경북대학교

To expand the material library of donor–acceptor conjugated polymers for photocatalysis, we synthesized two polymers containing bithiazole as the acceptor and fluorene as the donor. Incorporating a thiophene spacer between bithiazole units in PFOTzT led to enhanced molecular ordering and stronger interchain interactions compared to PFOTz. UV–vis and cyclic voltammetry confirmed red-shifted absorption and improved packing in PFOTzT. Nanoparticles were prepared using mini-emulsion and nanoprecipitation methods with various surfactants. PFOTzT–TEBS nanoparticles exhibited the highest hydrogen evolution activity under visible light, attributed to efficient exciton dissociation and suppressed charge recombination, as revealed by time-resolved photoluminescence and transient absorption spectroscopy. These results highlight bithiazole as a promising motif and underscore the importance of nanoscale morphology in designing efficient organic photocatalysts.

Poster Presentation **3PS-104**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Kinetically Induced Ionic Diode based on Phase Transition of Plastic Crystals

김찬규, 신조원, 김형준[†]

서강대학교

Ionic diodes function by directing ion flow and rectifying ionic currents have diverse applications in iontronic domains. While classic heterojunction diodes are commonly interpreted via equilibrium-based thermodynamic models, the actual behavior may be better captured by focusing on the dynamics at the interface. Here, we present a tri-layer structure ionic diode that operates kinetically by inducing a phase transition through the application of the external voltage. By electrically modulating ion transport, we induce a phase transition in ion-sensitive layers—polyelectrolyte complex and plastic crystal—leading to kinetic and electrical property changes. This transition dictates that both heterojunction and tri-layer structures share the same fundamental mechanism. Our results highlight that kinetic control of ion-sensitive materials can serve as a universal design principle for next-generation ionic devices.

Poster Presentation **3PS-105**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Nanoarchitectonics of Nanoporous Metal Film with Functional Polymers to Optimize Methanol Electrooxidation Activity

김진보⁺, 김정훈⁺¹

연세대학교 화공생명공학과

¹ 연세대학교 화공생명공학과

Mesoporous gold (Au) films with tunable pores are expected to provide fascinating optical properties stimulated by the mesospaces, but they have not been realized yet because of the difficulty of controlling the Au crystal growth. Here, we report a reliable soft-templating method to fabricate mesoporous Au films using stable micelles of polymers, with electrochemical deposition advantageous for precise control of Au crystal growth. Strong field enhancement takes place around the center of the uniform mesopores as well as on the walls between the pores. Furthermore, the crystal structure of the nanoporous noble metal films has been controlled by the construction of secondary nanostructures by the pulsed electrodeposition method. By employing secondary deposition techniques, the nanoporous structure was preserved, while the crystal structure was adjusted to optimize electrochemical performance.

Poster Presentation **3PS-106**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Enhanced Ion Trapping in Organic Synaptic Transistor Using Zwitterionic Crosslinkers

김준서, 정대성[†]

포항공과대학교

Organic synaptic transistors provide a promising platform for advanced electronics by integrating memory and computation, making them ideal for artificial neural networks. In this study, we introduce zwitterionic chains as a novel strategy to enhance ion trapping. By incorporating these chains into polymer semiconductors via a photochemical crosslinker, we achieve significant improvements in ion trapping. When applied to organic synaptic transistors, these materials exhibit non-volatile characteristics, as well as reversible and continuous conductance tuning, along with extended retention time. The devices demonstrate an enhanced memory window of 8 V with pronounced hysteresis due to effective ion trapping, enabling highly stable and reconfigurable conductance states. These results suggest that our approach could contribute to the development of energy-efficient neuromorphic devices while also fostering more reliable, adaptable electronics for future bio-inspired systems.

Poster Presentation **3PS-107**
분자전자 부문위원회(III)
2025.10.1(수), 08:30~10:00, 포스터장
Chair: 안효성, 양상희

Collective Behavior of Bacteria Confined in Anisotropic Fluid

김장민, 임준형, 조은수, 최대섭, 김영기[†]

포항공과대학교

Suspension of swimming bacteria, a prototypical example of active matter system, exhibits complex collective behaviors such as bacterial turbulence and swarming. While recent studies have extensively examined the geometric effects of surrounding on bacterial dynamics, the interplay between bacteria and anisotropic fluid remains underexplored. Here, we investigate how the anisotropy of thermotropic liquid crystal (LC) affects the self-organized motion of bacteria under the confinement. By constructing flattened aqueous droplets in the LC matrix, we observed bacteria spontaneously form ordered flow patterns. Furthermore, these flow patterns can be controlled by LC surroundings during phase transition. Our findings underscore the controllability of LC on bacterial motion, paving the way for further exploration of collective behavior in structured fluids. This work was supported by the National Research Foundation of Korea (RS-2023-00212739, RS-2023-00302586, RS-2024-00411809).

Poster Presentation **3PS-108**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Ultraviolet-Responsive Graphene Quantum Dots-Based Flexible Photonic Synaptic Transistors for Artificial Vision Systems

김윤성, 정범호, 박희준[†]

한양대학교

To address the growing demand for efficient edge computing in the era of the Internet of Things and artificial intelligence,^[1,2] we report a flexible optoelectronic synaptic transistor that integrates sensing, memory, and processing within a single device. The device employs graphene quantum dots (GQDs), synthesized from functionalized hexa-peri-hexabenzocoronene (HBC-PF6) and dispersed in a polymer matrix, as a charge-trapping floating gate. Upon UV exposure, photogenerated holes migrate to the channel while electrons are trapped in the floating gate, inducing a non-volatile threshold voltage shift that mimics synaptic potentiation. The device demonstrates robust mechanical flexibility (bending radius ± 1 mm) and shows key synaptic functions such as EPSC, PPF, short- to long-term plasticity transitions, and long-term potentiation/depression. Moreover, a device array integrated into a simple artificial neural network achieved over 91% accuracy in handwritten digit recognition.

Poster Presentation **3PS-109**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Enhanced Mobility and Low-Voltage Operation in Organic Source-Gated Transistors Through Electrode Structure Modification

김용희, 이은광[†]

부경대학교

Organic source-gated transistors (OSGTs) represent a device architecture for low-power applications, including wearable circuits, amplifiers, and LED backplanes. While OSGTs exhibit a low saturation drain voltage ($V_{DS,sat}$) for rapid saturation operation, they suffer from reduced mobility due to the low current from the Schottky barrier. This study addresses the limitations using patterned source electrodes of ohmic contact with partial Schottky contact electrodes, giving the minimum required Schottky barrier. The modified OSGT showed a significantly reduced $V_{DS,sat}$ compared to organic field-effect transistors (OFETs). Remarkably, the device demonstrated a mobility comparable to OFET and showed a ten-fold improvement over conventional OSGT. The high-mobility and low-voltage OSGTs can overcome traditional trade-offs between low-voltage operation and high mobility in organic transistors.

Poster Presentation **3PS-110**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Radiation Tolerance of Perovskite Solar Cells for Space Application

김영민, 민한울[†]

고려대학교

차세대 박막 태양전지 중, III-V 반도체 태양전지는 높은 방사선 내성 및 고효율을 통해 우주 응용 분야의 산업 표준으로 자리잡았으나, 공정 상으로 제조 비용이 높고 확장성이 제한되어, 대량 생산이 어렵다. 반면, 페로브스카이트 태양전지(PSC)는 저렴하고, 가벼우며, 전력 변환 효율(PCE)이 단일 접합 소자에서 현재 27.0%에 달해 III-V 반도체 태양전지의 대체재가 될 수 있다. 그러나 우주 환경에서의 양성자 방사선은 페로브스카이트 격자 내에 변위 공극으로 인한 결함을 유발하여 소자 성능을 저하시킬 수 있다.

이에 따라, 본 연구에서는 FAPbI₃ 기반 페로브스카이트의 A-site에 세슘 양이온을 첨가하여 양성자 조사 하에서 PSC의 내방사선성 및 자가치유 특성에 미치는 영향을 체계적으로 조사하였다. 해당 연구를 통해 극한 환경에서 페로브스카이트 안정성에 대한 심도 있는 이해를 제공하고, 우주 응용 분야를 위한 방사선 내성 PSC 설계에 중요한 정보를 제공한다.

Poster Presentation **3PS-111**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Comparative Study of Charge Extraction in Halide Perovskite Films with Electron Transport Layers of Fullerene and Non-Fullerene Acceptors

박재홍[†], 윤진경¹, 김시은¹

이화여자대학교화

¹ 이화여자대학교

To investigate the effect of electron transport layers (ETLs) on the charge carrier dynamics of halide perovskite materials, we studied the mixed halide perovskites ($A_m A'_{1-m} PbX_n X'_{3-n}$) with fullerene and non-fullerene based ETLs. The charge carrier dynamics were probed using flash-photolysis time-resolved microwave conductivity (FP-TRMC), a non-contact spectroscopic technique to probe photogenerated charge carrier mobility and lifetime on a nanosecond timescale without electrodes. Our result shows that both samples with ETL exhibit efficient charge extraction. We observed distinct charge extraction tendencies between the PVK/C₆₀ and PVK/CN₃ samples. To further analyze the transient behavior, we employed kinetic models to fit the transient TRMC signals and determine charge kinetic rate constants. This comparative analysis reveals distinct carrier kinetics depending on the ETL, thereby informing future strategies for interface engineering in perovskite solar cells.

Poster Presentation **3PS-112**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

New Organic Nonlinear Optical Salt Crystals with Space-Filling Groups for THz Wave Generation

김승민, 윤호섭, Mojca Jazbinsek¹, 권오필⁺

아주대학교

¹ Zurich University of Applied Science

본 연구에서는 강한 전자 받개인 퀴놀리니움에 플루오린을 도입한 6-fluoro-2-(4-hydroxy-3-methoxystyryl)-1-methylquinolinium (HM6FQ) 양이온과, 다양한 치환기를 도입한 benzenesulfonate 음이온을 결합하여 새로운 유기 비선형 광학 결정들을 설계하고 합성했다. 치환된 음이온들은 뚜렷한 반데르발스 부피 차이를 보이나, 기준이 되는 4-methylbenzenesulfonate (T) 기반 결정과 isomorphic한 결정 구조를 유지하며 결정화된다. 이는 기존 결정 내 존재하던 공극이 부피가 큰 치환기에 의해 효과적으로 채워짐에도, 전체적인 분자 배열이 유지된 결과이다. 아울러, 치환기의 종류에 따라 추가적인 이차 결합이 추가적으로 형성되어 국소적인 초분자 배열이 조정되었으며, 이는 포논 진동 흡수 억제에 기여한다. 이러한 결정 구조 유지와 초분자 조절 전략은 테라헤르츠파 생성용 유기 비선형 광학 결정의 설계 기반을 제공한다.

Poster Presentation **3PS-113**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Dual-Retention Synaptic Logic for Parallel Analog Computation with Reconfigurable Modes

조정호[†], 노동규, 김수현

연세대학교

We report a reconfigurable synaptic logic circuit that performs analog logic computation and parallel signal integration at the device level. By engineering the side chains of organic polymers, two synaptic transistors with distinct retention properties are designed: a long-term retention device for logic mode selection, and a short-term retention device for multi-input processing. These are integrated into a compact, dual-synapse logic gate capable of performing both AND and OR operations within a single structure. Demonstrated in a personalized disease risk assessment system, this architecture enables adaptive logic thresholds based on individual health conditions, offering efficient and low-power evaluation of biometric signals without complex circuitry.

Poster Presentation **3PS-114**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Boosting Hydrogen Evolution Rate by Spiro-Engineered Conjugated Polymer Photocatalysts with Tunable Electronic Properties

김소원, 박혜림¹, 함가영, 이지훈¹, 차효정⁺

경북대학교

¹ 국립한국교통대학교

The incorporation of spiro units into conjugated polymer backbones disrupts dense packing, creating permanent porosity that improves dispersion in aqueous media and facilitates water uptake without compromising backbone planarity. These features promote efficient charge separation and enhance photocatalytic hydrogen evolution. In this study, spiro-containing polymers were synthesized by integrating spiro moieties into a dibenzo[b,d]thiophene sulfone-based backbone. To explore electronic effects, both electron-donating and electron-withdrawing substituents were introduced onto the spiro unit. All polymers showed improved hydrogen evolution rates (HER), with the electron-withdrawing group exhibiting the highest activity due to enhanced electron extraction. These results demonstrate the synergistic role of spiro-induced porosity and tunable electronic properties in boosting the photocatalytic efficiency of conjugated polymers for solar-driven hydrogen production.

Poster Presentation **3PS-115**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

고성능 유기 열전소자 구현을 위한 루이스 쌍 도펀트의 형성 및 도핑 메커니즘 분석

김상범, 서의현, 장재영[†]

한양대학교

루이스 산과 시아노기 결합 기반의 루이스 쌍 도펀트는 우수한 산화력과 도핑 안정성을 제공한다. 그러나 반응성이 강해 도핑 제어가 어렵고, 루이스 쌍 도펀트 형성에 사용되는 무극성 용매는 유기반도체 박막을 손상시킨다. 본 연구에서 용매 극성에 따라 루이스 쌍 도펀트 형성과 반응성을 제어했다. 극성 용매는 루이스 산-용매 결합으로 도펀트 형성을 억제하지만, 용매 극성이 감소하며 루이스 쌍 도펀트가 효율적으로 형성된다. 결과적으로, 도핑 반응을 정밀하게 조절함과 동시에 우수한 도핑 안정성과 열전성능을 달성했다.

Poster Presentation **3PS-116**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Material Strategy for Sensitivity Control in the Detection of Reactive Oxygen Species Using Organic Transistors

김봉모, 김영규[†], 이철연¹, 김화정

경북대학교

¹ 삼성전자

Organic field-effect transistor (OFET)-based sensors have been recognized as a promising platform for biomedical applications due to various choices of organic materials, easy fabrication processes at room temperature, high design freedom for device shape, etc. Of various biomedical sensing applications, less attention has been paid to the detection of reactive oxygen species (ROS), even though ROS is one of the critical causes leading to various diseases (cancer, Alzheimer's, and diabetes) and ageing in human body. Hence, accurate and early detection of ROS is vital to prevent oxidative stress-induced cellular damage. In this regard, recently, our group attempted to develop ROS sensors based on OFETs in order to make a miniaturized sensing platform for fast and mobile applications. In this presentation, we demonstrate a design strategy of materials to diversely control the sensitivity of ROS detection, down to the sub-nano molar levels, on the basis of OFET geometry.

Poster Presentation **3PS-117**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Improving Stability and Sensing Performance of Organic Gas Sensor with Antioxidant Additives

김범준, 박영돈[†]

인천대학교

Organic semiconductors are susceptible to oxidation, leading to low air stability that hinders their commercialization in devices like sensors. In this study, we addressed this critical limitation by fabricating organic gas sensors with primary or secondary antioxidants added to the poly(3-hexylthiophene)(P3HT) active layer. The addition of these antioxidants significantly enhanced stability, effectively extending the device lifespan. In a 14 days stability test under extreme humidity, devices mixed with primary antioxidants showed a maximum on/off ratio retention about 6.2 times higher than the pristine devices, demonstrating excellent performance in delaying initial oxidation. Devices mixed with a secondary antioxidant proved to have long-term oxidation retardation. The antioxidant-added sensors also improved upon the low sensitivity and selectivity of conventional organic gas sensors. This is due to the functional groups of the antioxidants interacting with NO₂ molecules.

Poster Presentation **3PS-118**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Environmentally Friendly AgBiS₂-Based Solar Cells via Homogeneously Blended Donor–Acceptor Inks for Enhanced Charge Transport

김민영, 김해정, 최종민[†]

대구경북과학기술원

Colloidal nanocrystals (NCs) are promising materials for next-generation photovoltaics. Silver bismuth sulfide (AgBiS₂) NCs offer low toxicity, strong absorption, and solution processability. Yet, device efficiency is limited by surface trap states that cause non-radiative losses. We present a donor–acceptor (D/A) strategy using AgBiS₂ NCs with tailored surface ligands. By aligning energy levels and ensuring ink miscibility, we fabricated uniform bulk heterojunction films. This structure enhances charge separation, improves carrier transport, and supports thicker absorber layers. As a result, D/A-based AgBiS₂ solar cells reached 8.26% power conversion efficiency. This approach highlights the potential of molecularly engineered NC inks for eco-friendly, high-performance solar technologies.

Poster Presentation **3PS-119**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Work Function Controlled Polyelectrolyte based on Copper-Ion Doping for Precise Light Signal Detection in Organic Photodiodes

김민수, 왕동환^{*1}, 장웅식¹

중앙대학교

¹ 중앙대

A copper-ion-doped water-soluble polyelectrolyte with a deep work function (WF) of -4.95 eV is designed to improve the energy harvesting and light detection performances. The enhancement of photo- and mitigated dark-currents are observed by introducing the Cu:PSS added PEDOT:PSS in organic solar cells (OSCs) and organic photodetectors (OPDs), respectively. By incorporating the Cu:PSS into PEDOT:PSS, the optimal condition results in an improved photo-currents (J_{SC} of 27.74 mA cm^{-2}) and a suppressed dark-currents ($1.97 \times 10^{-9} \text{ A cm}^{-2}$). Further, the optimized condition demonstrated favorable surface morphology which contributed to the enhancement of device performance. Therefore, this study highlights the potential of Cu:PSS doping effect providing an promising strategy to achieve efficient light energy harvesting and signal detection.

Poster Presentation **3PS-120**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Improving water stability of organic solar cells by crosslinking the hole transport layer

김명진, 이다민, 함가영, 박창우, 차효정⁺

경북대학교

Poly(3,4-ethylenedioxythiophene):polystyrene sulfonate (PEDOT:PSS) is one of the most widely used conductive polymer for the hole transport layer (HTL) in organic solar cells (OSCs), due to its excellent water processability, high optical transparency, and low cost. However, the hygroscopic nature of the PSS component can lead to the absorption of moisture, resulting in the formation of pinholes and charge recombination sites at the interface, which deteriorate device performance and stability. In this study, we introduce a crosslinking strategy to improve the water stability of PEDOT:PSS-based HTLs. By simply incorporating a crosslinking agent into the PEDOT:PSS layer, the modified HTL maintain comparable photovoltaic performance to conventional PEDOT:PSS-based devices, while exhibiting significantly enhanced water resistance, operational stability, and mechanical robustness. This approach offers a facile and effective route toward high-efficiency, long-lifetime OSCs.

Poster Presentation **3PS-121**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Fiber-Based Hierarchical Porous Copper Nanosheet Triboelectric Nanogenerators for Self-Powered Sensor Applications

김대홍, 이승기¹, 김태욱[†]

전북대학교

¹ 부산대학교

Flexible and wearable electronics can directly interact with the human body and environment. Fiber-based electronics offer breathability, comfort, flexibility, and light weight, but face challenges in reliable power supply. Triboelectric nanogenerators (TENGs) address this by harvesting mechanical energy with high output density. In this study, a single-electrode TENG (SE-TENG) was fabricated on a fiber substrate using spray-coated copper nanosheet (Cu NS) film as the electrode and PDMS as the dielectric via capillary tube assisted coating (CTAC). The dielectric infiltrated the Cu NS film's voids, increasing interfacial area and charge induction. By controlling Cu NS thickness, the structure was optimized, enhancing output, flexibility, and stability. This method can be extended to fiber-based self-powered sensors for tactile and environmental detection, while the hierarchical porous Cu NS film also offers EMI shielding and thermal management potential.

Poster Presentation **3PS-122**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Digitally Controlled On-Demand Drug Delivery via MXene-Coated Microneedles

권혁진[†]

부경대학교

On-demand drug delivery enables precise therapeutic control with reduced side effects, but current systems often involve complex fabrication and limited scalability. Here, we introduce a bioelectronic drug delivery platform based on MXene-coated microneedles (MNs). MXenes, with their excellent conductivity, biocompatibility, and solution processability, allow for low-cost and scalable manufacturing. Upon electrical stimulation in an electrolytic environment, the MXene layer undergoes redox-driven oxidation and detachment, triggering controlled drug release. This system offers high biocompatibility, operational stability, and potential for localized, programmable, and multidrug delivery. Our approach provides a versatile and sustainable strategy for next-generation bioelectronic therapeutics.

Poster Presentation **3PS-123**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Visible-Light-Driven Photoprogrammable Organic Transistors Enabled by Triplet-Sensitized Diarylethene Blends

권지은, 정대성^{*1}, Syed Zahid Hassan¹

포항공과대학교

¹ POSTECH

Photoprogrammable organic field-effect transistors (OFETs) have garnered significant attention as optoelectronic platforms capable of light-induced current modulation. However, all previously reported photoprogrammable OFETs employing diarylethene (DAE) derivatives rely on ultraviolet (UV) light to induce the photocyclization (open-to-closed isomerization) process, limiting device stability and safety due to UV-induced degradation and biological hazards. To overcome this issue, we demonstrate, for the first time, a visible-light-driven photoprogrammable OFET based on a ternary blend comprising a polymer semiconductor (DPP-DTT), a DAE photoswitch, and a triplet sensitizer with a narrow singlet-triplet energy gap (ΔE_{ST}). Our system enables efficient photocyclization at 450 nm and photocycloreversion at 520 nm, exhibiting high photoprogrammable I_D switching ratio exceeding 10^3 and excellent fatigue resistance over more than 100 switching cycles.

Poster Presentation **3PS-124**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Sustainable Design of Polymer Exciplex Hosts for High-Efficiency TADF OLEDs via Halogen-Free Solution Processing

권수빈, 이예서, 김신영, 조민주, 최동훈⁺

고려대학교

Exciplex-type host systems are a promising approach to improve OLED performance. We developed solution-processable exciplex hosts by synthesizing three p-type polymers with varying alkylene spacer lengths. Longer spacers enhanced solubility, allowing the use of non-halogenated solvents. When combined with the n-type host tPDBA, stable exciplexes formed, enabling green TADF-OLED fabrication. Devices using non-halogenated solvents showed comparable efficiencies to those using halogenated ones. In particular, by employing a polymer host with high solvent selectivity that is soluble in the non-halogenated aliphatic solvent 2-MeTHF, systematic optimization of the emissive layer thickness was achieved, leading to a significant enhancement in OLED performance. These results present an effective molecular design strategy for polymer structure engineering toward sustainable, halogen-free solution processing of OLEDs.

Poster Presentation **3PS-125**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Orthogonal photopatterning of two-dimensional percolated network films for wafer-scale heterostructures

곽인철, 김지현, 강주훈, 조정호⁺

연세대학교

Molecular intercalation-based electrochemical exfoliation of two-dimensional (2D) materials can be used to create van der Waals heterostructures. We show that patterned van der Waals heterostructures can be fabricated from electrochemically exfoliated 2D flakes using a photoreactive crosslinker. When a 2D van der Waals percolated network with the crosslinker is exposed to ultraviolet light, the network junctions form covalent bonds. Our approach can be used to create wafer-scale arrays of photopatterned field-effect transistors based on different 2D materials. The field-effect transistors exhibit high spatial uniformity and can be used to create logic gates, namely NOT, NAND and NOR gates.

Poster Presentation **3PS-126**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Customizable 3D Nanoprinting for Advanced Plasmonic Nanostructures

곽성현, 정세훈, 최재영, 김원근⁺

국립금오공과대학교

Metallic nanoparticles are essential in nanophotonics for manipulating electromagnetic fields at subwavelength scales, enabled by localized surface plasmon resonance (LSPR). The plasmonic responses are highly dependent on the geometry and composition of each nanostructure, making precise structural control crucial. To address this, various fabrication techniques have been explored. In this work, we introduce a meniscus-guided 3D nanoprinting technique for fabricating freestanding plasmonic nanostructures, overcoming the main drawbacks of traditional nanolithography, such as limited throughput, high cost, and confinement to planar shapes. The resulting nanostructures offer robust performance in applications like metamolecules, biosensors, and photothermal systems. We expect this strategy will act as a versatile platform for customizing the fabrication of plasmonic nanostructures and flexibly tuning their optical functionalities as needed.

Poster Presentation **3PS-127**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Highly Selective Organic Gas Sensor via Surface-Functionalized MXene-Gas Interactions

고인화, 박영돈[†]

인천대학교

Organic gas sensors are gaining attention for use in environmental monitoring and industrial safety due to their flexibility, light weight, and low-cost processing. However, their limited sensitivity has driven efforts to develop hybrid systems with functional materials to improve performance. MXene has emerged as a promising gas-active material due to its excellent conductivity and high surface functionalization potential. In this study, we enhanced the performance of organic gas sensors by blending surface-modified MXene with poly(3-hexylthiophene) (P3HT). MXene was functionalized with amine and thiol groups using a simple silanization method. N-MXene exhibited the highest response to nitrogen dioxide (NO₂), while S-MXene responded most strongly to sulfur dioxide (SO₂). Additionally, air stability tests showed that surface-functionalized MXene effectively suppressed charge trapping and oxidative reaction of the polymer film, significantly improving long-term air stability.

Poster Presentation **3PS-128**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

High Performance of Organic Gas Sensors Blended with Biomass-Derived Activated Carbon

강신혁, 박영돈[†]

인천대학교

As industrialization progresses, the concentration of harmful gases in the atmosphere continues to increase. These toxic gases can cause serious damage to both human health and the environment, making the development of real-time gas detection technologies essential. In this study, we fabricated organic gas sensors by blending poly(3-hexylthiophene) (P3HT) with activated carbon, which has strong gas adsorption capability. Activated carbons with different surface areas were prepared by controlling the carbonization time and were blended with P3HT to form sensing layers. Compared to pristine P3HT sensors, the activated carbon/P3HT hybrid sensors exhibited higher responsivity and sensitivity to NO₂ gas. Notably, the sensor performance improved with increasing surface area of the blended activated carbon. These results demonstrate that biomass-derived activated carbon effectively enhances the gas sensing performance of organic sensors.

Poster Presentation **3PS-129**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Linking Mechanical Properties of Polymer Electrolytes to Cycling Stability

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국립금오공과대학교

¹ 한국과학기술원

The mechanical properties of solid electrolytes are critical for the stable operation of lithium metal batteries (LMBs). However, in typical polymer electrolytes, tuning mechanical properties, such as adjusting crosslinking density, often affects ionic conductivity. Because of this, it is difficult to clarify the specific role of mechanical properties in battery performance.

In this study, we developed an elastomeric electrolyte composed of separate ion-conducting and mechanical-supporting phases, enabling independent control over ionic conductivity and mechanical properties. This design enables tuning of the electrolyte's toughness, resilience, and adhesion energy by varying the crosslinking density in the mechanical-supporting phase without significantly affecting ionic conductivity. We evaluated mechanical properties and cell performance under room and low-temperature conditions using this system to offer guidelines for designing solid electrolytes for stable solid-state LMBs.

Poster Presentation **3PS-130**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Enhancing Colloidal Quantum Dot Photovoltaics through Organic-Soluble MXene Integration

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대구경북과학기술원

While colloidal quantum dot (CQD) photovoltaics have seen significant progress, several challenges still prevent further performance gains. A key issue is the Fermi level mismatch between the photoactive and hole-transporting layers, which hinders efficient charge collection. Furthermore, surface cracks in the hole-transporting layer can lead to direct contact between the active material and the metal electrode, compromising both device efficiency and stability.

To tackle these problems, we developed a polycatechol-functionalized MXene (PCA-MXene) that acts as both a dopant and an interlayer for CQD solar cells.

By uniformly dispersing PCA-MXene and CQDs in a butylamine solvent, we successfully tuned the work function and energy band alignment of the CQDs, which dramatically improved hole extraction. Moreover, the PCA-MXene interlayer effectively seals the tiny cracks in the hole-transporting layer, preventing metal electrode penetration and moisture intrusion.

Poster Presentation **3PS-131**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Bifunctional Ligand-Driven Transition Dipole Moment Alignment for Enhanced Light Outcoupling in Perovskite Quantum Dot Light-Emitting Diodes

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전북대학교

¹ 유연인쇄전자전문대학원

As the internal quantum efficiency of the state-of-the-art perovskite quantum dot light-emitting diodes (PeQLEDs) losses approaches unity, enhancing photon extraction becomes critical due to severe optical. The orientation of transition dipole moments (TDMs) plays a key role in determining the light outcoupling efficiency (η_{out}). Herein, we investigated the influence of nanocrystal (NC) shape and stacking behavior on the alignment of TDMs in the emissive layer. To modulate the TDMs, we proposed a facile ligand exchange strategy with bifunctional 1,5-naphthalenedisulfonic acid, which increased the proportion of horizontally oriented TDMs in the film from 60% to 70% by enhancing the long-range stacking order of NCs. This improved orientation was instrumental in η_{out} from 16.15% to 20.09%. As a result, devices with NDSA modified exhibit a peak external quantum efficiency of 22.63% at 5,127 cd/m² and a maximum luminance of 13,950 cd/m².

Poster Presentation **3PS-132**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Electrocatalytic Oxygen reduction properties of a trinuclear Cobalt complex with a Pyridine-based pincer ligand: Synthesis, structural characterization, and mechanistic insights

Sujoy Bandyopadhyay[†]

HANYANG UNIVERSITY

Clean energy systems like fuel cells and metal–air batteries require efficient, earth-abundant oxygen reduction reaction (ORR) catalysts. This work examines the trinuclear coordination complex $[\text{Co}_3(\text{L})_2(\text{CH}_3\text{CN})_5] \cdot 2\text{ClO}_4$ (1) was described by single crystal X-ray diffraction, revealing a monoclinic system and deformed trigonal bipyramidal geometry around cobalt(II) centers. Complex 1 has strong electrocatalytic activity for ORR, with an onset potential of 0.52 V and a Tafel slope of 136 mV dec⁻¹. This electrocatalytic process was explained using density functional theory (DFT) calculations, which showed a multi-step reaction pathway begun by oxygen adsorption. The results show that electrical and geometric parameters improve catalytic efficiency, providing essential insights for developing improved materials for electrochemical applications.

Poster Presentation **3PS-133**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Comprehensive Study of Charge Recombination and Photodegradation in Self-Assembled Monolayers of Carbazole Functionalized with tert-Butyl Groups for Enhanced Organic Solar Cells

**RAHMATIA FITRI BINTI NASRUN, 손동환, Qurrotun Ayuni Khoirun Nisa,
김주현[†]**

부경대학교

Self-assembled monolayers (SAMs) are promising hole-selective layers in organic solar cells (OSCs), but their role in device stability is not fully understood. While SAMs can increase the work function (WF) of indium tin oxide (ITO), they do not always form uniform layers that optimize both performance and stability. To address this, two carbazole-based SAMs, named CBZC4 and CBZC2, were developed by adding tert-butyl groups at the 3,6-positions of the carbazole core. This improves energy-level alignment and film uniformity. Light-soaking and aging tests reveal SAM degradation due to reactions with oxygen and moisture. CBZC2 showed excellent stability, maintaining over 99% of its power conversion efficiency (PCE) after UV exposure, outperforming PEDOT:PSS and MeO-2PACz. The high efficiency and long-term stability are linked to lower interfacial resistance and longer charge lifetimes, making CBZC2 a strong alternative to hygroscopic PEDOT:PSS.

Poster Presentation **3PS-134**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Advanced Coaxial Fiber Shaped Supercapacitors Tailored for Wearable Electronics

DANYA SRINIVASAN, 강재욱¹, 고금진¹

JEONBUK NATIONAL UNIVERSITY

¹ 전북대학교

Smart wearable need thin, flexible energy storage devices. Here, we fabricated coaxial fiber supercapacitors (FSCs) of various lengths, using horizontal meniscus coating (HMC) on nylon fibers. This method gives uniform coating of silver nanowires as the current collector and a composite of MXene+PEDOT:PSS as the active electrode. To prevent degradation of the Ag NWs during electrochemical processes, a protective intermediate layer of polyethylenimine ethoxylated (PEIE) was incorporated. Combines the electrochemical stability of MXene & the high capacitance and mechanical flexibility of PEDOT:PSS, the FSCs exhibits high areal capacitances of 620mF/cm² & 430mF/cm² for 1cm & 5cm long Ag NWs/PEIE/MP devices, at a current density of 28 μ A/cm². Reflects a ~40% enhancement over Ag NWs/MP FSCs without the PEIE layer. Additionally, 5 cm FSCs maintained 92% of capacitance after 10,000 GCD cycles, confirms their potential for integration into wearable electronics

Poster Presentation **3PS-135**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Suppressing phase segregation in mixed halide CsPbI₃-xBr_x perovskites by dual passivation using sodium dodecyl sulphate

Akhil Sreevalsan[†]

Hanyang University

The remarkable rise of metal halide perovskites (MHP) over the past decade has positioned them as promising candidates for next-generation optoelectronic applications. However, MHP are often plagued by intrinsic defects that facilitate halide migration and phase segregation, ultimately reducing charge carrier lifetimes and device stability. In this study, we introduce a straightforward defect passivation strategy using sodium dodecyl sulfate (SDS), which significantly enhances both photostability and photoluminescence efficiency. The dual functionality of SDS where its anionic and cationic components consistently passivate uncoordinated lead/halide sites and Schottky-type cation vacancies suppresses halide migration and mitigates compositional instability. The passivated films exhibit extended carrier lifetime of up to ~65 ns and maintain a long-lived photograph (~56 ns) even under prolonged illumination, in contrast to the rapid degradation observed in untreated sample

Poster Presentation **3PS-136**

분자전자 부문위원회(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Ambiently Processed Perovskites for High Performance Solar Module

강재욱[†], Abrar Karim¹

전북대학교

¹ Jeonbuk National University

Numerous methodologies for scaling up the perovskite photovoltaics is prevalent within the research community. A primary challenge has been to commercialize the system that is simple, scalable and environmentally sustainable. Herein, scalable n-i-p architecture has been devised to achieve a printable perovskite thin-film-based solar module with environmental adaptability and articulated through a straightforward, anti-solvent free growth process at ambient. To obtain high-quality printed perovskite film, the perovskite ink were engineered by adjusting its viscosity. The perovskite solar module exhibits the highest performance with a power conversion efficiency (PCE) of approximately 16.3% (area 12.9 cm²), underscoring the potential of these ambient printing techniques. This strategy utilizes a minimal amount of inks and offers the advantage of large-area fabrication in perovskite solar technologies at ambient.

Poster Presentation **3PS-137**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Design of Spiro-Structured Polyimides via Backbone Modification for Low Dielectric Constant

이주현, 강경윤, 이승우[†]

영남대학교

As device integration density increases and feature sizes shrink, issues such as capacitive coupling (cross-talk), RC delay, and power dissipation become more pronounced, emphasizing the need for insulating materials with low dielectric constants. Polyimide (PI) is a promising candidate due to its excellent thermal and mechanical stability; however, conventional PI often exhibits a relatively high dielectric constant. In this study, we designed and synthesized four types of PI-based polymers by structurally modifying the polymer backbone to lower the dielectric constant. Structural modifications were achieved by incorporating rigid and low-polarity units, including spiro-type structures, which effectively suppress dipolar polarization and increase free volume. The synthesized polymers were characterized using NMR and FT-IR for structural analysis, DSC and TGA for thermal properties, GPC for molecular weight distribution, and dielectric constant measurements.

Poster Presentation **3PS-138**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Enhanced electro-optical stability of polymer stabilized liquid crystals via two-step thiol-acrylate polymerization

이선재, 김지환, 김세움[†], 고지훈, 김도윤

서울과학기술대학교

Polymer-stabilized liquid crystals (PSLCs) reversibly switch between transparent and scattering states, enabling use in displays, smart windows.

Incorporation of thiol-terminated non-mesogenic monomers reduces the driving voltage. However, incomplete polymerization during a single-step photopolymerization process often causes image retention and hysteresis.

In this study, we present a two-step polymerization strategy to enhance the electro-optical stability of PSLCs. The first step involves a base-catalyzed Michael addition reaction, followed by UV-induced photopolymerization. This sequential process allows the complete consumption of thiol groups, effectively suppressing image sticking and hysteresis. The effects of component concentrations and polymerization parameters were systematically investigated to optimize device performance. The proposed approach offers a practical and scalable solution for fabricating highly stable PSLCs for advanced display and photonic applications.

Poster Presentation **3PS-139**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Crosslinked Sulfonated Poly(ether ether ketone) and Cellulose Acetate Membranes with Sulfosuccinic acid for mechanical stability in PEMFCs.

이동준, 노은진, 배인성[†]

한남대학교

Hydrocarbon-based proton exchange membranes (PEMs) are susceptible to mechanical degradation caused by water-induced swelling during fuel cell operation, which can lead to performance deterioration. Therefore, controlling excessive swelling is a critical focus in the development of hydrocarbon-based PEMs. In this study, membranes were fabricated by blending sulfonated poly(ether ether ketone) (SPEEK) with cellulose acetate and crosslinking with sulfosuccinic acid, resulting in improved dimensional stability and mechanical integrity. Additionally, the sulfonic acid groups in sulfosuccinic acid are expected to enhance proton conductivity across a wide range of humidity conditions.

Poster Presentation **3PS-140**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

The self-assembly structure of QDs-composite study by SANS and SAXS method

윤대희, 윤영진, 김태환[†]

전북대학교

It has been reported that the physical properties of Nanoparticles, including their optical, electrical, and thermal characteristics, can be modulated by the nanostructures that emerge from aggregate formations [1]. In this study, we utilize Quantum Dots (QDs) as nanostructures in conjunction with non-ionic surfactant Brij58(C16EO20). The induction of structure melting of Brij58 in water is achieved by mixing it with QDs, and this is subsequently emulsified using ultrasonication. The initial step involves the evaporation of the organic solvent, followed by the evaporation of water to achieve a 35 wt % (w/w) Brij58-water mixture. The analysis of QDs and QD-composites involves the use of Small Angle X-ray, Neutron Scattering (SAXS). The SAS experiment was conducted within the temperature range of 25 °C to 80 °C.

[1] Chen, O., Riedemann, L., Etoc, F. *et al.* Magneto-fluorescent core-shell supernanoparticles. *Nat Commun* 5, 5093 (2014).

Poster Presentation **3PS-141**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Electrochromic devices with intensity-tunable color reflection enabled by chiral liquid crystal films

오효석, 나애빈, 김세움⁺, 주도현, 김선재, 서강민, 선태민

서울과학기술대학교

We demonstrate an intensity-tunable color reflective display based on electrochromic devices (ECDs) incorporating a patterned color reflector. The reflector is fabricated by spin-coating a chiral reactive mesogenic mixture onto the bottom substrate of the ECD, followed by photolithographic patterning. An indium-tin-oxide (ITO) anode is subsequently deposited on the reflector. The ECDs are further integrated with a tungsten oxide/ITO cathode and an electrolyte containing propylene carbonate, lithium perchlorate, and ferrocene. The device exhibits structural colors originating from the reflector, with high reflectivity exceeding 40% in the pristine state, and continuous tuning of color depth is achieved upon voltage application. Our approach of integrating color reflectors into ECDs is suitable for applications in color reflective displays, digital signage, and smart windows.

Poster Presentation **3PS-142**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Structure–Property Relationships in Fluorinated and Non-Fluorinated Polyimide Films for Flexible Displays and Electronics

한경임, 신혜원, 배승환, 임상혁¹, 홍성우²

한국생산기술연구원

¹ 고려대학교

² 한국생산기술연구원/한국과학기술연구원

We investigated the structure–property relationships of fluorinated and non-fluorinated polyimide (PI) films. A non-fluorinated PI synthesized from an alicyclic dianhydride and an aromatic diamine exhibited high transmittance (>88%), low yellowness index (YI < 1.3), and low haze (<0.3%). It also showed good mechanical properties (Young's modulus of 5.2 GPa, tensile strength of 166 MPa) and excellent folding durability, withstanding over 1,000,000 folding cycles at a 1.5 mm bending radius. In contrast, the fluorinated PI containing CF₃-Substituted aromatics demonstrated a higher modulus (>8 GPa) but reduced optical quality (YI > 2.5) and lower folding reliability (<500,000 cycles). Dynamic mechanical analysis showed that the enhanced folding reliability of the non-fluorinated PI is due to higher energy dissipation, indicated by elevated loss modulus. These results underscore the potential of alicyclic-based non-fluorinated PIs for next-generation flexible displays and electronics.

Poster Presentation **3PS-143**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Simulation Studies on the Linear Mechanical Responses of Thermoplastic Elastomers: Effect of Chain Architectures

박형식, 성봉준[†]

서강대학교

Thermoplastic elastomers (TPEs) are block copolymers with network structures formed by physical crosslinkers—crystalline hard domains. Although the network morphology determines the mechanical properties of TPEs, the relation between chain architectures and network structures remains elusive. Here, we investigate the role of chain architectures on the crystallinity, conformations and mechanical properties of TPEs. We prepare linear, ring, and brush topologies with varying number of blocks (N_{blk}). Note that we fixed the hard composition and the molecular weight. We applied the sinusoidal strain to obtain storage and loss modulus (E' and E''). We find that E' is mainly determined by N_{blk} regardless of the topology. However, E'' highly depends on topologies. Linear ones have higher E'' compared to rings and brushes. We infer that linear ones have lower crystallinity and higher R_g , which promotes stress dissipations.

Poster Presentation **3PS-144**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Synthesis and Analysis of PDMS-PI with High Tensile Strength through Crosslinking

박장환, 박수빈, 이승우[†]

영남대학교

Currently, aromatic polyimide (PI) is in increasing demand in various industries such as semiconductor devices and automobiles due to its high tensile strength and excellent thermal stability. However, aromatic PI suffers from low tensile strain. To overcome this limitation, many studies have attempted to enhance the tensile strain by incorporating highly flexible polydimethylsiloxane (PDMS) into the polymer. While PDMS improves flexibility, it also reduces tensile strength due to weakened intermolecular interactions. To address this issue, a crosslinking strategy was adopted in this study. Various polyimide films were prepared by adjusting the molar equivalence of the crosslinking agent. The chemical structure of the synthesized PI was analyzed using H-NMR and FT-IR spectroscopy, and the thermal and mechanical properties of the films were evaluated using TGA, DSC, and UTM.

Poster Presentation **3PS-145**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Kinetic Engineering of Particle Size to Accelerate Vacuum-Assisted Thermal Treatment of Sulfur-Rich Polymers for Glassy Long-Wave Infrared Plastic Optics

박승빈, 조용비, 이미연¹, 배경연, 김성수, 유남호¹, 위정재[†]

한양대학교

¹ 한국과학기술연구원

Sulfur-rich polymers (SRPs) synthesized from elemental sulfur, a byproduct of petroleum refining, are promising candidates for next-generation long-wave infrared transmissive optical plastics due to their unique properties. However, their practical application is limited by a fundamental trade-off between thermomechanical robustness and optical performance. Herein, we present a kinetically engineered vacuum-assisted thermal treatment strategy, accelerated via particle size reduction, to overcome this limitation and improve the processing efficiency of SRPs.

Poster Presentation **3PS-146**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Synthesis and Properties of Polyimides Using Diamines with Asymmetric Functional Groups

박수빈, 이승우[†], 박장환

영남대학교

Polyimide is a high-performance polymer material that is widely used in various industrial fields due to its excellent chemical resistance, heat resistance, and electrical insulation properties. In this study, diamines containing asymmetric functional groups were synthesized, and polyimide films were fabricated using (4,4'-(hexafluoroisopropylidene)diphthalic anhydride (6FDA), 3,3,4,4-diphenylsulfonetetracarboxylic dianhydride (DSDA), 4,4'-(4,4'-Isopropylidenediphenoxy)diphthalic Anhydride (BPADA). The chemical structures of the diamine monomers and polyimides were confirmed by Fourier transform nuclear magnetic resonance (FT-NMR) and Fourier transform infrared spectroscopy (FT-IR), and the thermo-mechanical properties of the polyimide films were investigated using thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), and universal tension measurement (UTM).

Poster Presentation **3PS-147**
고분자구조 및 물성(III)
2025.10.1(수), 08:30~10:00, 포스터장
Chair: 안효성, 양상희

Development of Crosslinked Zwitterionic PEMs for High-Performance Fuel Cells

박범서, 신지연, 배인성[†]

한남대학교

Zwitterion-based proton exchange membranes (PEMs) are attracting attention as next-generation materials due to their excellent water retention and high proton conductivity. In this study, PEMs were fabricated via solution casting, with precise control over composition and crosslinking density to optimize water uptake and swelling ratio. The strong hydrophilicity of the zwitterionic groups enhanced moisture retention and stabilized the proton conduction network. Processing parameters such as temperature, relative humidity, and thermal treatment were tuned to adjust the physical and electrochemical properties of the membranes, resulting in structures well-suited for fuel cell applications. The fabricated membranes are currently being evaluated for proton conductivity and electrochemical stability using electrochemical impedance spectroscopy (EIS) and linear sweep voltammetry (LSV), with the goal of assessing their potential as high-performance PEMs.

Poster Presentation **3PS-148**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Fabrication of PbS QD-mediated Organic-Inorganic Hybrid SWIR OPDs using FPA-S Photo-crosslinker

정대성[†], 박교빈

포항공과대학교

Short-wave infrared (SWIR) photodiodes are widely studied for applications in medical, defense, and industrial imaging. Conventional InGaAs-based devices are expensive and incompatible with CMOS due to lattice mismatch. Quantum dots (QDs) offer a low-cost, CMOS-compatible alternative with tunable bandgaps, but long-wavelength QDs tend to be unstable due to their large particle sizes. To improve film quality and stability, we blend QDs with organic polymers. However, simple blending often leads to poor miscibility and phase separation due to interfacial energy mismatch. To overcome this, we introduce an azide-functional ligand (FPA-S) that binds to QDs and photo-crosslinks with polymers, thereby suppressing phase separation. Devices fabricated using this method achieve external quantum efficiency over 80% at 1600 nm, a dark current of 20 nA/cm² at -0.5 V, and breakdown voltages exceeding -20 V.

Poster Presentation **3PS-149**
고분자구조 및 물성(III)
2025.10.1(수), 08:30~10:00, 포스터장
Chair: 안효성, 양상희

Effect of Crystallization Structure Control of Polyethylene Sheath Materials for Power Cable on Long-Term Durability

문정미[†]

대한전선(주)

The sheath of power cables protects internal insulation and conductors from environmental stressors such as impact, moisture, chemicals, and UV radiation. As a key structural layer, it plays a crucial role in ensuring long-term reliability and service life. Polyethylene is widely used as a sheath material, with its crystalline structure and mechanical properties affected by cooling conditions during processing. These variations can influence crack resistance and durability. In this study, polyethylene specimens were compression-molded under quenching and slow-cooling conditions to control crystallinity. To assess the effect of crystalline structure on cracking resistance, specimens were thermally aged at elevated temperature under mechanical stress. The results reveal how cooling history impacts crystallinity and long-term performance, offering useful data for sheath design and lifetime prediction in power cable applications.

Poster Presentation **3PS-150**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Effect of Crosslink Density on the Lifetime Prediction of Ethylene-Propylene Diene Monomer (EPDM) Rubber for HVDC Cable Accessories

류수연[†]

대한전선

This study investigates the effect of crosslink density on lifetime prediction of EPDM rubber used in HVDC cable accessories. EPDM specimens with controlled crosslink densities were prepared via peroxide vulcanization and characterized through thermal and mechanical analyses. Additionally, compression set tests were performed to evaluate the influence of crosslink density on elastic recovery and mechanical durability. Accelerated aging experiments simulated thermo-electrical stresses typical of service conditions. The Arrhenius-Weibull model was applied to develop accelerated lifetime prediction models incorporating crosslink density. The results demonstrate a significant correlation between crosslink density and aging behavior, with optimal crosslink density ranges exhibiting markedly enhanced resistance to thermo-electrical degradation, as well as reduced compression set values indicating superior elastic durability.

Poster Presentation **3PS-151**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Molecular Dynamics Study of Terminal Chain Length Effects on Phase Structure of Bent-Core Liquid Crystals in the B4 Phase

김현준, 박혜원¹, 윤동기¹, 김용주⁺

고려대학교

¹ 카이스트

The molecular structure of liquid crystals affect formation of mesophases and supramolecular self-assembled structures. Bent-core liquid crystal molecules can form B4 phases, and recent studies found tubular nanostructures such as heliconical-layered nanocylinder(HLNC), besides classical helical nanofilament(HNF) depending on molecular structure. Diverse morphologies vary with molecular packing modes and interlayer interactions, influenced by terminal alkyl chain length, substitution pattern, and core rigidity. In this study, we investigated structure of azobenzene-containing dimeric liquid crystals using molecular dynamics simulation. Longer chains weaken π - π stacking between benzene, strengthen chain interaction, and increase flexibility by reducing relative end-to-end distance. These results provide molecular-level understanding of how terminal chain length governs the structural evolution and phase behavior of bent-core liquid crystals in the B4 phase.

Poster Presentation **3PS-152**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Light-Responsive Block Copolymer Particles with Long-Term Shape Memory and Programmable Reconfiguration

김진우, 김범준¹

KAIST

¹ kaist

In this study, we developed a BCP particle system capable of reversible and programmable shape transformation by incorporating hydrazone-based additives (Hyd) into the PS-*b*-P2VP. The Hyd undergoes reversible (E)/(Z) isomerization under alternating 410 and 365 nm light, which in turn controls its light-triggered quaternization with P2VP domains. This enables the generation of three distinct particle morphologies: a default ellipsoid in the dark, a larva-like shape under 410 nm light, and a stacked-disc structure under 365 nm light. These photoinduced morphologies are reversibly switchable during solvent vapor annealing and show excellent fatigue resistance. Importantly, the programmed shapes are stable for over 30 days in the absence of light, demonstrating structural memory for long-term information storage. Additionally, when domain-selective dyes are incorporated, the particle morphology alters FRET emission, offering both structural and functional programmability.

Poster Presentation **3PS-153**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Structure–Property–Biodegradability Correlation of Cellulose Derivatives for Eco-friendly Bioplastic

김영훈, 윤제문[†], 최재학¹

동의대학교

¹ 충남대학교

This study analysed the quantitative correlation between chemical structure, surface properties and biodegradability of five cellulose derivatives. FT-IR analysis confirmed the unique chemical structure of each substituent and contact angle measurements showed that CAB (60.1°) was the lowest and CAP (79.3°) was the highest. CA showed the highest water absorption of 16%, while CAP showed the lowest of 6%. The starting pyrolysis temperature of the samples was around 280-300°C, with EC (279.4°C) being the lowest and CA (304.8°C) being the highest. In the biodegradability test based on ISO-14855, CAP showed the maximum weight change and property change after 5 weeks, and EC showed the minimum reduction of 7%, suggesting that the microstructure of the substituent groups can have a significant effect on the degradation rate. The results can be used for the design of cellulose-based bioplastics.

Poster Presentation **3PS-154**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

원자력발전소 안전관련 펌프, 밸브 및 스너버의 비금속부품에 대한 내환경검증 방법에 대한 고찰

조성윤⁺

한국수력원자력 중앙연구원

원자력발전소 내 안전등급 기기의 신뢰성 확보를 위해 환경검증(Environmental Qualification, EQ)은 필수적이며, 특히 펌프, 밸브 및 스너버 내 비금속부품(nonmetallic parts)의 기능 유지 여부는 설계기준사고(Design Basis Accident, DBA) 조건 하에서 결정적인 영향을 미친다. 본 연구는 ASME QME-1-2022의 Appendix QR-B "Qualification Requirements for Nonmetallic Parts"의 규정을 기반으로, 원자력발전소 안전관련 펌프, 밸브 및 스너버의 비금속부품에 대한 체계적인 환경검증 방법과 절차를 제시한다.

제안된 절차는 ① 설계 및 서비스 조건 분석, ② 온도, 압력, 방사선, 습도 등 환경인자의 정량적 정의, ③ 대표 시편 또는 실물 부품을 활용한 가속노화 및 시험 수행, ④ 기기 단위의 기능검증, ⑤ 수명 평가 및 추정 등으로 구성된다. 특히 방사선 조사량과 고온 습열 조건 하에서의 재료 열화 특성을 기반으로 한 수명 추정 기법은 실증적 데이터를 기반으로 한 검증 신뢰도를 높이는 데 기여한다.

본 논문에서는 KINS의 안전관련 펌프, 밸브 및 스너버의 비금속부품 환경검증 관련 규제 본격화에 대비하고자 실제 원전 적용사례를 통해 검증되었으며, 펌프 씰, 밸브 디스크 패킹, 스너버 내 폴리머 제진소자 등 다양한 비금속부품에 대한 EQ 수행 사례를 포함한다. 본 연구는 향후 국내외 안전관련 펌프, 밸브 및 스너버의 비금속부품 환경검증 전략으로 참고될 수 있을 것이다.

Poster Presentation **3PS-155**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Self-Assembly of End-functionalized Amphiphilic Block Copolymers

김남준, 박문정[†]

포항공과대학교

Phase behavior of end-functionalized block copolymers has attracted considerable interest. In particular, ion-dipole electrostatic interactions at polymer chain ends markedly modifies conventional phase diagrams, enabling various strategies to stabilize unconventional morphologies with and without additives. Most studies have focused on attaching functional moieties to ionophilic block ends, resulting in diverse network structures. However, under salt-rich conditions, such ionic interactions diffuse non-selectively throughout the ionophilic matrix, diminishing the specificity and directionality of chain end interactions. Here, we investigate amphiphilic block copolymers with end-group modifications at the ends of ionophobic blocks. Their self-assembled morphologies, investigated in the presence and absence of additives, reveal that localizing polar groups within ionophobic subdomains plays a key role in modulating the interfacial curvature during block copolymer self-assembly.

Poster Presentation **3PS-156**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Fabric-Embedded Adhesive Hydrogel with Selective Double Network Reinforcement for Enhanced Adhesion and Mechanical Toughness

김경섭, 박규순, 스티브 박[†]

KAIST

Recent research on hydrogel adhesives has shifted from focusing only on adhesion strength to reinforcing mechanical integrity. Poor cohesion limits adhesive performance, especially on mechanically demanding substrates. However, improving toughness often compromises adhesion due to competition for covalent bonding. To address this, we developed a fabric-embedded adhesive hydrogel that separates mechanical reinforcement from surface adhesion. A reinforcing fabric was embedded within the hydrogel, and an ionic crosslinker solution was selectively infused through it, inducing localized double-network formation. This formed a tough core while preserving a soft, adhesive surface. The hydrogel is composed of polyvinyl alcohol, sodium alginate, and polyacrylamide, with calcium chloride enabling ionic crosslinking. As a result, our adhesive achieved 43% higher adhesion strength and a 2300% increase in toughness compared to conventional hydrogels with the same composition.

Poster Presentation **3PS-157**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Structurally Optimized Alternating PEAT for Enhanced Performance

권영제, 조계용[†]

부경대학교

The growing plastic waste problem demands effective solutions to lessen environmental harm. One approach uses biodegradable polymers like Polybutylene Adipate Terephthalate (PBAT) and Polylactic Acid (PLA), but these materials lack strength and heat resistance compared to commercial polymers. Efforts to improve their performance, including copolymerization and blending, have been tried, yet these mixed polymers form immiscible blend interfaces, reducing properties and raising costs. This study introduces a new strategy by developing an alternating copolymer, Polyethylene Adipate Terephthalate (PEAT), using BHET (Bis(2-hydroxyethyl) terephthalate). By recycling BHET obtainable from PET and other sources, the synthesis enhances strength and heat resistance while preserving biodegradability. The resulting PEAT structure overcomes traditional biodegradable polymer limitations. This method supports scalable solutions, aligning with sustainability goals.

Poster Presentation **3PS-158**

고분자구조 및 물성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Micropattern Diversity from a Single-Structure Mold in Organic Single-Crystal Printing

권세은, 김민석, 배인성[†]

한남대학교

C8-BTBT, an organic semiconductor known for its high mobility and excellent crystallinity, was used to grow single crystals by precisely controlling the solvent evaporation rate. Micro-patterns were created using the Selective Contact Evaporation Printing (SCEP) technique, where a prism-shaped PDMS mold selectively absorbed and diffused C8-BTBT molecules to induce aligned crystal structures. By adjusting parameters such as pressure, temperature, and annealing time, patterns with various widths and depths were achieved. Moreover, repeated use of the same PDMS mold enabled the formation of multi-patterned structures without performance loss. This high-resolution, low-cost, and low-temperature patterning method offers great potential for producing high-density organic transistor devices. The approach is not only scalable and reusable but also compatible with flexible electronics, demonstrating its value in next-generation organic semiconductor processing technologies

Poster Presentation **3PS-160**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

고성능 케나프 섬유 강화 생분해성 플라스틱의 제조를 위한 과당 가교 젤라틴 바인더

윤선영, 백지윤, 임지민, 진형준⁺

인하대학교

폐플라스틱 문제와 지속가능한 소재 개발에 대한 관심이 높아짐에 따라 천연 섬유 강화 플라스틱(NFRP) 복합재에 대한 연구가 주목받고 있다. 그러나 보강재로 사용되는 천연 섬유는 친수성을 띠기 때문에 폴리머와의 계면 접합력이 낮아, 공극이 형성되고 내구성이 저하되는 문제가 발생한다. 이를 개선하기 위해 화학적 표면 개질 기법이 적용되어 왔지만, 유해한 부산물의 발생과 섬유의 친환경성 저해로 인해 NFRP의 지속가능성 측면에서 한계가 존재한다. 본 연구에서는 이러한 문제를 해결하고자 과당을 활용한 마이야르 반응을 통해 형성된 젤라틴 기반 가교망을 친환경 바인더로 적용한 케나프 섬유 강화 복합재를 제안한다. 젤라틴 가교망은 섬유 표면을 코팅하고 공극을 충전함으로써 내수성과 기계적 물성을 개선하였다. 이후 생분해성 고분자와의 열압축 공정을 통해 폴리머 매트릭스와의 계면 접합력이 향상된 적층 구조의 NFRP를 제작하였다.

Poster Presentation **3PS-161**
고분자가공/복합재료/재활용(III)
2025.10.1(수), 08:30~10:00, 포스터장
Chair: 안효성, 양상희

재활용 Polyethylene을 적용한 TPE Sheet 개발

유나경, 최경민^{*1}

(주)대한솔루션

¹ 대한솔루션

전 세계적으로 환경문제에 대한 관심 증가와 인식 개선이 되면서 그에 따른 규제가 증가하게 되어 자동차 산업에서도 이산화탄소 배출 절감과 재활용 소재 등에 관한 연구개발이 활발하게 진행되고 있다. 최근 유럽의 자동차 법규(EU-ELV)의 지침 강화로 자동차 산업 전반에 재활용 소재 적용이 요구되고 있다. 본 연구에서는 재활용 폴리에틸렌(recycle Polyethylene)을 활용하여 자동차 내장재에 사용되고 있는 TPE(Thermoplastic elastomer) Sheet에 적용하여 재활용성을 향상시켰으며, 기존 Sheet와 재활용 Sheet의 기계적 물성과 열적 특성을 평가하였다.

Poster Presentation **3PS-162**
고분자가공/복합재료/재활용(III)
2025.10.1(수), 08:30~10:00, 포스터장
Chair: 안효성, 양상희

EPDM 고무 폼에 카본블랙과 분쇄 폐 PU 폼을 적용한 복합소재의 물성 평가 및 재활용 효과 연구

안준모, 정일두¹

한국소재융합연구원

¹ 부산대학교

본 연구는 EPDM(Ethylene Propylene Diene Monomer) 고무 폼의 물성 개선과 폐기물 재활용을 동시에 달성하기 위해 카본블랙과 분쇄 폐 PU(Polyurethane) 폼을 복합 필러로 적용한 친환경 복합소재 개발에 관한 것이다.

Poster Presentation **3PS-163**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Study on the Property Changes of Coffee Grounds– Styrofoam Composites According to Heat-Treatment Temperature

심동준, 윤제문[†], 최재학¹

동의대학교

¹ 충남대학교

This study investigated the changes in material properties of composites made from coffee grounds and Styrofoam according to heat-treatment temperature. Coffee grounds, as a natural organic material, have attracted attention as a recyclable and environmentally friendly resource, while Styrofoam is widely used in various industrial fields due to its light weight and insulating properties. However, Styrofoam has been pointed out as one of the major contributors to environmental issues, and research is being conducted on methods to recycle it.

In this experiment, coffee grounds were mixed with Styrofoam, and the composites were subjected to heat treatment at various temperatures to analyze the resulting physical and chemical changes.

Poster Presentation **3PS-164**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Enhanced Mechanical and Abrasion Resistance Properties of Silica-Reinforced SBR Composites using Urushiol as a Sustainable Bio-Based Interfacial Modifier

신예린, 정영규¹

충남대학교 유기응용재료공학과

¹ 유기재료공학과

This study investigates urushiol, a catechol derivative with a C15–C17 alkyl chain, as a sustainable bio-based interfacial modifier for silica-filled styrene-butadiene rubber (SBR) composites. The formation of covalent Si-O-C bonds between the hydroxyl groups of urushiol and the silanol groups on silica was confirmed through FT-IR spectroscopy and XPS analysis, demonstrating strong interfacial bonding. The hydrophobic long alkyl chain and unsaturated structure of urushiol enhance filler dispersion and facilitate secondary interactions with the rubber matrix. Universal testing machine results showed improved tensile properties, while abrasion resistance was significantly enhanced compared to composites with unmodified silica. These findings suggest that urushiol can act as a sustainable alternative to conventional silane coupling agents, providing a promising strategy for the development of eco-friendly rubber composites beyond tire applications.

Poster Presentation **3PS-165**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Effect of crosslinking in stability and barrier performance of cellulose nanocrystal and polyvinyl alcohol composite films

신누리, 김상윤, 김신철, 김세영⁺

단국대학교

This study presents the development of a biodegradable high-barrier coating film based on polyvinyl alcohol (PVA) and cellulose nanocrystals (CNC), aiming to improve moisture and oil resistance while maintaining structural stability. To overcome the water sensitivity and poor oil resistance of PVA, a base coating solution was formulated with ethylene acrylic acid copolymer (EAA) as a crosslinker. The composite films were then produced by bar coating. FT-IR analysis confirmed esterification-based crosslinking between functional groups of PVA and CNC. The resulting chemical network enhanced film stability during water-borne coating, preventing cracks after the full process including hydrophobic top coating. Barrier property tests demonstrated reduced oxygen transmission rate (OTR) and water vapor transmission rate (WVTR), along with improved oil resistance. The film shows potential as a biodegradable barrier coating for sustainable packaging.

Poster Presentation **3PS-166**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Suction-forced triboelectricity escalation by incorporating biomimetic 3-dimensional surface architectures

손지훈, 황귀원, 송민우, 김진형, 방창현⁺

성균관대학교

Triboelectric nanogenerators (TENGs), based on electrostatic induction and triboelectrification, offer promising energy harvesting solutions. This study introduces a hierarchical bio-inspired architecture with a 3D micro-architecture modeled after the male diving beetle to enhance the triboelectric effect. This architecture increases the contact area and compressibility, enabling conformal contact with the electrode surface in both dry and wet conditions. It boosts van der Waals and physical adhesion forces, significantly enhancing charge transfer. In dry conditions with 16 N of force, this beetle-inspired design outperforms flat and other 3D bio-inspired surfaces, generating the highest voltage (~42 V) and current (~1008 nA). This demonstrates that strategic physically adhesive structures can efficiently generate triboelectricity, a notable advance over traditional TENGs that depend on structureless or chemically adhesive designs.

Poster Presentation **3PS-167**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Aligning graphene sheets in aerogel-based composites for enhanced electromagnetic interference absorption

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부경대학교

¹ 한국과학기술연구원

This study investigates graphene aerogel-based polydimethylsiloxane (PDMS) composites designed to improve electromagnetic interference (EMI) absorption. These composites are fabricated by infiltrating PDMS into graphene aerogel produced by uni-directional freezing and thermal reduction. The composites in longitudinal directions exhibit a shielding effectiveness by absorption (SEA) of 8.6 dB/mm and a shielding effectiveness by total (SET) of 11.5 dB/mm in 8.2–12.4 (X-band) frequency range. On the other hand, the transverse direction shows a lower EMI shielding capability with a SEA of 4.5 dB/mm and a SET of 6.7 dB/mm. These are attributed to the fact that the aligned orientation of the fillers increased the internal multiple scattering of incident electromagnetic wave, which increases the propagation path and energy attenuation. These results demonstrate that controlling the filler orientation can significantly increase the EMI performances of graphene/PDMS composites.

Poster Presentation **3PS-168**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Improved X-ray shielding efficiency of PE/BNNs/BiI₃ composite film with surfactant modification

산무감마하링감, LI SHISEN, Nazmul Hossain, 김정환[†]

부경대학교

Exposure to neutron and X-ray radiation presents significant challenges in space travel and X-ray diagnostics. This study introduces a novel polyethylene-boron nitride-bismuth iodide (PE/BNNs/BiI₃) composite film, fabricated via hot pressing. designed for efficient X-ray shielding in medical, aviation, and nuclear applications. We demonstrate that the incorporation of a surfactant facilitates uniform dispersion of BiI₃ nanoparticles within the PE-BNNs matrix, significantly enhancing shielding performance. The surfactant-assisted film achieved 82.13% X-ray shielding efficiency, a substantial improvement over the 65.74% of the film without surfactant. We quantified its linear attenuation coefficient (LAC), mass attenuation coefficient (MAC), mean free path (MFP), half value layer (HVL), and tenth value layer (TVL) at 60 kV. These findings highlight the potential of this flexible, lead-free, and lightweight material to advance high-efficiency X-ray shielding technology.

Poster Presentation **3PS-169**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Property Evaluation of Asphalt Sheets Modified with Liquid Epoxidized Natural Rubber

배인희, 이관희, 문지현, 안희정¹, 강효[†]

동아대학교

¹ 에너지얼

This study explores the use of liquid epoxidized natural rubber (LENR) as a sustainable asphalt modifier to improve process efficiency and performance at lower temperatures. Asphalt provides excellent waterproofing and adhesion but loses its properties under cold conditions. Traditional modifiers such as styrene-butadiene-styrene (SBS) copolymers and natural rubber (NR) require high processing temperatures (170–200 °C), increasing energy use. LENR, synthesized via epoxidation and depolymerization of NR, was blended with asphalt below 160 °C. The LENR-modified asphalt sheets exhibited enhanced tensile strength, adhesion, and wet adhesion. A clear relationship was observed between LENR content and mechanical performance. These results demonstrate that LENR effectively enhances asphalt properties while allowing energy-efficient processing, showing promise as an eco-friendly alternative.

Poster Presentation **3PS-170**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Enhancing Glycolysis Efficiency and Suppressing Side Reactions via Morphological Transformation of Waste PET

정현민[†], 박창준, 전종훈

국립금오공과대학교

Pretreating waste PET using dimethyl sulfoxide (DMSO) led to controlled morphological changes and enhanced surface area. These changes dramatically accelerated the glycolysis reaction with ethylene glycol (EG), achieving 100% PET conversion at 180 °C. Compared to untreated flakes, the pretreated PET powders reacted up to five times faster under identical conditions. Additionally, the formation of DCTC, a typical side product from EG dehydration, was completely avoided. The BHET monomer obtained was highly pure, as confirmed by ¹H-NMR, FT-IR, and DSC analyses. Two pretreatment methods—single-solvent and co-solvent recrystallization—were systematically compared for performance. PET-DE powders with porous morphology showed the fastest conversion and highest BHET yield (83.9%). This morphology-engineered strategy provides a scalable, energy-efficient, and selective approach to PET chemical recycling.

Poster Presentation **3PS-171**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Solvent-free preparation of 2D crown ether-based covalent frameworks and their use in antibacterial polylactic acid nanocomposites

박진욱, 이종찬[†]

서울대학교

This study reports the first solvent-free synthesis of a novel covalent-frameworked 2D crown ether (C2O), composed of carbon and oxygen in a 2:1 mol ratio. The synthesized C2O contains abundant phenolic groups, similar to phlorotannins, offering strong antibacterial activity through contact-based mechanisms and excellent biocompatibility. The inherent crown ether structure of C2O facilitates efficient metal adsorption, enabling easy preparation of copper-embedded C2O (Cu@C2O). Cu@C2O exhibits significantly enhanced antibacterial effects at lower concentrations compared to pristine C2O. Polylactic acid (PLA) nanocomposites incorporating 0.1 wt% C2O show 99.99% antibacterial efficacy, which improves further by reducing filler content to 0.03 wt% when using Cu@C2O. Due to their durable antibacterial performance and biocompatibility, these materials are promising for biomedical, packaging, and antifouling applications.

Poster Presentation **3PS-172**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Ultrasound-Accelerated Alkaline Hydrolysis of PET at Ambient Temperature: A High-Speed Approach to Chemical Recycling

박진[†], 김도완, 문혜지, 이성권, 이성언, 조주현

테라클

The depolymerization of polyethylene terephthalate (PET) via hydrolysis usually requires long reaction times and harsh conditions, hindering large-scale application. Although photocatalysis, microwave irradiation, and enzymatic depolymerization have been studied, most still demand high energy input and cost. In this study, we successfully established an ultrasound-assisted hydrolytic depolymerization process that dramatically accelerates PET breakdown under mild conditions. Ultrasound generates cavitation, creating localized microenvironments of high temperature and pressure that promote polymer chain scission. A toluene–ethanol co-solvent system with sodium hydroxide as a catalyst was used to enhance reactivity. Results showed that the reaction time decreased from 2 hours without ultrasound to 10 minutes with ultrasound at 60 °C and atmospheric pressure. Catalyst and solvent reusability were confirmed, indicating improved energy efficiency and potential economic benefits.

Poster Presentation **3PS-173**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Directed Assembly of Metal Fillers for Anisotropic Heat Transfer in Thermal Interface Materials through Dielectrophoresis

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서울과학기술대학교

¹ 한국생산기술연구원

The growing demand for thermal interface material (TIM) composites with improved elasticity and thermal conductivity has been driven by the need for cost-effective thermal management solutions in next-generation flexible electronic devices, which inherently pose significant heat dissipation challenges. In this study, we employed dielectrophoresis (DEP) to induce anisometric alignment of metallic filler particles within a polymer matrix. This alignment strategy led to a marked enhancement in anisotropic thermal conductivity, reaching up to 0.6 W/m·K at a filler volume fraction of $\phi = 20\%$. In addition, mechanical testing revealed that the resulting TIM composites exhibited excellent elasticity and flexibility, making them well-suited for use in flexible and deformable electronic systems.

Poster Presentation **3PS-174**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Effects of Thickness and Nanoparticle Content on the Anti-icing Properties of Polyurethane Topcoats

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경상국립대학교

¹ 경상국립대학교 나노신소재융합공학과

² 경상국립대학교 나노신소재공학부 고분자공학전공

Polyurethane (PU) topcoats are primarily used as protective coatings for substrates in extreme environments, such as aircraft and wind turbines, owing to their excellent thermal insulation and mechanical strength. Recently, research has focused on enhancing anti-icing performance. This study investigated the anti-icing performance by controlling topcoat thickness and incorporating nanoparticles into the polyurethane resin, evaluating its dependency on both thickness and nanoparticle content. Based on the measured results, optimal conditions were determined to satisfy both mechanical and thermal insulation properties. This research was supported by the National Research Foundation of Korea(NRF) founded by the Ministry of Science and ICT(RS-2023-00211944), the Ministry of education(RS-2020-NR049575) and the Ministry of Trade, Industry and Energy(RS-2023-0026563).

Poster Presentation **3PS-175**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Developing High-Thermal-Conductivity Epoxy Composites: Using Hybrid Fillers of Silica Nanowires and Core-Shell Nanoparticles

박민아, 심상은^{*1}

인하대학교

¹ 인하대학교

As electronic devices become more integrated, thermal management is essential for reliability. However, epoxy resins have low thermal conductivity, limiting use in high-power systems. Silica is a good filler for its insulation and stability, but its poor thermal conductivity is a drawback. To address this, silica nanoparticles were coated with alumina via a sol-gel process to form core-shell structures, enhancing interfacial heat transfer. These were combined with silica nanowires to create a hybrid filler system. This design forms multidimensional thermal pathways in the epoxy matrix, improving heat conduction while retaining insulation. Future work includes optimizing filler ratios and applying alumina coatings to nanowires. The approach holds promise for electronic packaging and thermal interface materials.

Poster Presentation **3PS-176**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Green Photocatalysis: Dialdehyde Cellulose–TiO₂ Aerogel for CO₂ Cycloaddition

명현아, 심상은[†]

인하대학교

In this study, we introduce a green sol–gel route to synthesize a porous TiO₂ aerogel using TEMPO-oxidized dialdehyde cellulose (DAC). DAC reacts with a titanium alkoxide precursor to form a wet gel, which transforms into an aerogel via supercritical CO₂ drying and calcination. Aldehyde groups on DAC partially reduce Ti⁴⁺, creating abundant oxygen vacancies. In CO₂ cycloaddition tests, the DAC-templated aerogel outperformed TiO₂ nanoparticles made by precipitation. XRD, SEM, BET, and XPS confirmed its high porosity, large surface area, and vacancy-rich structure, demonstrating the promise of renewable polymer templates for advanced photocatalysts.

Poster Presentation **3PS-177**
고분자가공/복합재료/재활용(III)
2025.10.1(수), 08:30~10:00, 포스터장
Chair: 안효성, 양상희

Thermoelectric Devices Based on Porosity-Controlled Stainless Steel 304 and Polymer Composite

류희진, 양찬우[†], 주병권

한국생산기술연구원

Bi₂Te₃-based thermoelectric devices have been demonstrated to exhibit high thermoelectric performance. However, the high cost and material scarcity of these devices have hindered large-scale production and commercialization. To address these limitations, this study explores the development of thermoelectric devices utilizing SUS304 stainless steel, which offers relatively low thermal conductivity among metals along with superior mechanical strength, durability, cost efficiency, and environmental stability. The fabrication of porous structures was achieved through a process of sintering, wherein the amount and size of the particles of poly(methyl methacrylate) (PMMA) were meticulously controlled. The present study investigated the correlation between PMMA content and porosity, as well as its effect on thermoelectric performance. The integration of porous structures within the device design resulted in a reduction in thermal conductivity, thereby enhancing the performance of the thermoelectric devices. This study demonstrates the feasibility of SUS304-based thermoelectric devices as an alternative to conventional Bi₂Te₃-based systems.

Poster Presentation **3PS-178**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Photocurable Fe-doped TiO₂ nanocomposites for 3D patterning

류태경, 정재한⁺

서울과학기술대학교

3D printing with photo-curable resin has recently attracted attention due to its simplicity and ease of fabrication compared to conventional approaches. Titanium dioxide(TiO₂), known for its high refractive index and excellent transmittance, is widely incorporated into photo-curable resins for optical applications. However, the presence of photocurable molecules inevitably reduces the overall refractive index.

To address this limitation, we doped the TiO₂ with Fe, inducing a reduction in grain size and enhanced light-electron interactions, thereby increasing the refractive index. In addition, the surface of Fe-doped TiO₂ nanoparticles was functionalized with photocurable ligands, while excess resin was removed to further improve the refractive index.

As a proof of concept, Fe-doped TiO₂ photocurable nanocomposites were employed to fabricate patterned films, demonstrating a promising approach for high-performance metasurface fabrication.

Poster Presentation **3PS-179**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Continuous Atmospheric-Pressure Plasma Treatment for Enhanced Interfacial Properties in Sheet Molding Compound Composites

도환기, 조범곤[†], 김선종, 김민서, 신재광

국립금오공과대학교

Unlike other thermoset-based composite manufacturing processes, sheet molding compound (SMC) offers advantages for the mass production of carbon fiber (CF) composites. However, SMC has limitations in high-strength applications due to weak interfacial bonding between the fibers and resin. In this study, continuous atmospheric-pressure plasma treatment was applied to CF to introduce functional groups and increase surface roughness, thereby enhancing interfacial adhesion and improving the overall strength of the composites. The introduction of functional groups was analyzed using XPS and FT-IR. The surface energy was calculated from contact angle measurements. The changes in surface roughness were observed using AFM and SEM. The mechanical properties of the composite were evaluated using a UTM and DMA. The results showed that plasma-treated CF significantly improved the mechanical strength of SMC composites, increased treatment time leading to further enhancement.

Poster Presentation **3PS-180**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Functional Graphene Nanofiller-Modified Reactive Polymer Sizing Agent for High-Performance Carbon Fiber-Epoxy Composites

노유진, 정영규[†]

충남대학교 유기응용재료공학과

Enhancing both interfacial strength and electrical conductivity in carbon fiber (CF)-reinforced epoxy composites remains challenging. Here, poly(acrylonitrile-co-glycidyl methacrylate) (PAG) was synthesized as a reactive sizing agent, confirmed by ^1H -NMR and FT-IR. To impart electrical functionality, reduced graphene oxide (rGO) and azide-functionalized rGO (rGO- N_3) were incorporated into PAG; azide groups were verified via XPS and EDS. Electrical properties of the PAG-based hybrid films were evaluated, and the optimal formulation was applied to CFs to assess conductivity at the fiber level. SEM and EDS revealed surface morphology changes. Single-fiber microcomposites were fabricated by embedding fibers in epoxy droplets, followed by tensile testing and fracture surface analysis to assess interfacial behavior. This strategy combining a reactive polymer and functional nanofillers offers a versatile route for high-performance CF composites.

Poster Presentation **3PS-181**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Investigation of Mechanical Property Enhancement of 3D-Printed PA/Carbon Fiber Composites via Microwave Post-Treatment

남호근, 고종완[†]

한국생산기술연구원

Material extrusion (ME) is a widely used 3D printing method that forms parts by extruding thermoplastic materials through a heated nozzle. It offers advantages such as design flexibility and mold-free fabrication of complex structures. Polyamide (PA), known for its excellent wear and heat resistance, is widely used in ME due to its good processability. However, PA parts produced by ME exhibit weak interlayer bonding due to the layer-by-layer deposition process, resulting in poor mechanical performance. Conventionally molded PA exhibits a tensile strength of approximately 100 MPa, whereas ME-fabricated PA parts typically exhibit lower values, thereby limiting their industrial applicability. This study proposes a facile microwave post-treatment method to enhance the interlayer adhesion and mechanical properties of 3D-printed polymer composites. By optimizing microwave power (W) and exposure time (s), a 14.27% increase in strength was achieved without any noticeable geometric deformation.

Poster Presentation **3PS-182**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Engineered mycelium sheets for next-generation vegan leather

**김효정, 최혜서, 정윤희, 김기수, 고재왕¹, 김일진¹, 조경일¹, 정유진¹, 강경일²,
강동희², 엄영호[†]**

한양대학교

¹ 소재융합연구원

² CJ제일제당

Mycelium with a fungal network has garnered significant attention as a sustainable alternative to petroleum-based plastics owing to its robust fibrous structure, cost-effectiveness, and sustainability. However, its flexible use in advanced materials typically requires processing methods that may compromise its sustainability. Herein, we introduce controlled disentanglement method that enables the engineering of mycelium fibers into a processable and viscoelastic suspension. To enhance the viscoelasticity of the suspension during sheet casting, a minimal content (5 w/w%) of marine-derived binders is incorporated. The spreadability and structural recovery of this viscoelastic mycelium suspension were evaluated by three interval thixotropy tests, confirming its stable thixotropic behavior under high stress. The reassembled mycelium-based sheets exhibit remarkable enhancements in tensile modulus, strength, and stretchability, by 147%, 374%, and 292%, compared to neat mycelium sheet.

Poster Presentation **3PS-183**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Liquid crystal elastomer with 3-types of graphene

김현지, 김대석[†], 전윤석, 이자윤

국립부경대학교

Photothermal actuators have emerged as attractive candidates for soft robotics and smart material systems because they can deliver rapid, remote, and reversible actuation. Incorporating graphene and its derivatives into polymer matrices is a promising strategy to enhance photothermal conversion and mechanical performance, but uniform dispersion remains a significant challenge.

In this work, we fabricated ho liquid crystal elastomer (LCE) composites using three types of graphene: graphene oxide (GO), reduced graphene oxide (rGO), and non-oxidized graphene flake (NOGF). SEM and UTM data confirmed homogeneous dispersion in the LCE matrix. When irradiated with near-infrared light, the rGO-LCE composites displayed the highest photothermal actuation efficiency, attributable to their optimal balance of light absorption and interfacial compatibility. Our findings provide valuable guidance for designing advanced photothermal soft actuators.

Poster Presentation **3PS-184**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Evaluation of OBC/Elastomer Blend Compositions on Insulation Properties of Block-PP Cable Insulators

김창근⁺

대한전선

Polypropylene (PP) is a promising insulating material for power cables due to its superior performance. Block PP, offering greater flexibility than homo PP, is investigated for insulation applications. However, stress whitening-induced degradation remains a concern. In this study, PP-based composites were prepared with a fixed total fraction of elastomer and Olefin Block Copolymer (OBC), while varying the OBC content to assess effects on electrical and mechanical properties. Increasing OBC content improved breakdown strength but also raised flexural modulus. Controlling flexural modulus is essential to prevent whitening because excessive modulus hinders cable winding. Currently, quantitative standards for the flexural modulus of PP-based cable insulators are insufficient in existing power cable specifications. Therefore, these results provide valuable direction for future material design and standardization efforts in the cable insulation field.

Poster Presentation **3PS-185**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Synthesis of ZnO nanoparticles using Aloe Vera bio-template for photocatalytic and antibacterial applications

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우석대학교

¹ 우석대학교 산학협력단

The wide band gap energy of ZnO is beneficial for dye degradation applications owing to ultraviolet light absorbing capability, photocatalytic and antibacterial effects. The synthesis of ZnO using Aloe Vera is an eco-friendly approach to obtain uniform nanoparticles. The synthesis process involves a low-temperature (70 °C) reaction of zinc nitrate in the presence of Aloe Vera extract, with a pH of 12 controlled by adding aqueous NaOH dropwise. Subsequently, the synthesis eliminates the requirement for harmful chemicals, while delivering a fine-tuned ZnO nanoparticles having a range of 14-20 nm. The synthesized ZnO nanoparticles exhibit a band gap energy of 3.18 eV, which is suitable for degrading methylene blue dye by 82.43% in 210 minutes under 365 nm ultraviolet light. Moreover, the Aloe Vera-mediated ZnO nanoparticles indicated moderate antibacterial and strong antioxidant properties, making this green synthesis a sustainable solution for producing ZnO nanoparticles.

Poster Presentation **3PS-186**
고분자가공/복합재료/재활용(III)
2025.10.1(수), 08:30~10:00, 포스터장
Chair: 안효성, 양상희

Effect of Monomer Composition on the Performance of Waterborne Acrylic Emulsions for Paper Coating

김재희, 김상윤, 신누리, 김세영[†]

단국대학교

To improve the water resistance of paper-based packaging materials, a high-performance emulsion coating applicable to such substrates was developed. In this study, an acrylic waterborne emulsion was synthesized and evaluated. The monomers used included 2-ethylhexyl acrylate, methyl methacrylate, n-butyl acrylate, and acrylic acid, with sodium dodecyl sulfate as the emulsifier and ammonium persulfate as the initiator. Following emulsion polymerization, the resultant emulsion was neutralized and treated with tert-butyl hydroperoxide to remove unreacted monomers. The glass transition temperatures and coating performance on paper substrates were evaluated for emulsions with varying monomer compositions and synthesis procedures. Formulations with well-controlled thermal properties and excellent adhesion were identified, confirming their potential for water-resistant paper-based packaging. This advancement is expected to promote the adoption of eco-friendly coating materials.

Poster Presentation **3PS-187**
고분자가공/복합재료/재활용(III)
2025.10.1(수), 08:30~10:00, 포스터장
Chair: 안효성, 양상희

동물성 바이오차를 이용한 기계적 재활용 플라스틱의 VOCs 저감 기술 개발

김재홍[†]

지에스칼텍스

본 연구는 기계적 재활용(Mechanical Recycling, MR) 공정을 통해 생산된 재활용 플라스틱에서 발생하는 휘발성유기화합물(VOCs)의 효과적인 저감을 목적으로, 동물성 바이오차를 활용한 흡착 기반의 소취 기술을 개발하였다. VOCs는 재활용 플라스틱의 사용 저하와 소비자 기피의 주요 원인 중 하나로, 이를 개선하기 위한 친환경적이고 경제적인 접근이 요구된다.

본 연구에서는 육류 가공 부산물로부터 제조된 동물성 바이오차를 활용하였는데 폴리올레핀계 재활용 플라스틱에 혼합할 경우, 톨루엔, 스티렌, 에틸벤젠 등 주요 VOCs의 방출 농도가 현저히 감소하였다. 열탈착-기체크로마토그래피(TD-GC/MS) 분석을 통해 바이오차의 소취 성능을 정량적으로 확인하였으며, 그 효과는 고비용의 제올라이트계 소취제와 유사하거나 일부 조건에서는 이를 능가하였다. 이는 동물성 바이오차의 다공성 구조와 다양한 표면 관능기가 VOCs 흡착에 효과적이기 때문으로 예상된다. 동물성 바이오차는 저렴한 원료로부터 제조 가능하여 MR 플라스틱 복합소재의 원가 절감에도 기여할 수 있어, 산업적 활용 가치가 높다.

Poster Presentation **3PS-188**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Characterization and Washing of End-of-Life Vehicle-Derived Polyamide 6 Composites for Recycling Applications

김은지, 전윤석[†]

부경대학교

As recycling plays a crucial role in environmental sustainability, we investigated the properties of polyamide 6 composites derived from end-of-life vehicles and evaluated the effects of various cleaning agents and conditions. Prior to washing, the chemical composition and surface contaminants of the recycled composites were characterized using a range of analytical techniques. Following the cleaning process, total organic carbon content was measured, and gas chromatography–mass spectrometry (GC–MS) was employed to assess the removal efficiency of volatile organic compounds under different cleaning conditions. The results indicate that cleaning with cetyltrimethylammonium bromide at 70 °C under sonication is the most effective method. Furthermore, GC–MS analysis revealed a significant reduction in the concentrations of benzene, toluene, ethylbenzene, and xylene after washing. These findings suggest that appropriate cleaning treatments enhance material purity and contribute to improved recycling efficiency.

Poster Presentation **3PS-189**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Enhancement of Oil Resistance in Polyurethane Sealants through Surface Modification of Hydrophilic and Hydrophobic Silica Nanoparticles

김윤지, 이동현, 권동준[†]

경상국립대학교

Polysulfide sealants have been widely employed to prevent fuel leakage in aircraft components, owing to their excellent chemical resistance. They exhibit deficient mechanical properties and slow curing rate. These limitations were addressed by enhancing the oil resistance of polyurethane sealants through the addition of surface-treated SiO₂. The oil resistance of polyurethane sealants was evaluated by the addition of SiO₂. The addition of surface-treated silica to polyurethane sealant improved oil resistance and mechanical properties. These results suggest the development of optimal polyurethane sealant formulations with high strength and enhanced oil resistance for sealing aircraft fuel tank and other demanding applications. This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Ministry of Science and ICT (RS-2023-00211944), KIAT, the MOTIE (RS-2024-00419236) and the Ministry of Education (RS-2020-NR049575).

Poster Presentation **3PS-190**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

High-Dielectric BaTiO₃/PDMS Composites Using Pickering Emulsion with Interfacial Particle Assembly

김유진, 구강희[†]

울산과학기술원

Barium titanate (BaTiO₃, BTO) has been recognized as a highly promising material for enhancing the electrical performance of composites due to its high dielectric constant. However, aggregation and non-uniform dispersion of BTO nanoparticles with high surface energy limit the electrical performance and mechanical stability of the composites. To overcome these challenges, this study designs BTO/PDMS composites by inducing the self-assembly of BTO nanoparticles at the liquid-liquid interface, thereby achieving stable and uniform particle dispersion along with the formation of internal polymer network structure. Additionally, surface modification of BTO particles enhances interfacial compatibility between the particles and polymer matrix, effectively suppressing particle aggregation. The resulting BTO/PDMS composites exhibit excellent dielectric properties, suggesting practical potential for next generation electromagnetic applications.

Poster Presentation **3PS-191**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Preparation and Characterization of Polyolefin-Based Composite Films Incorporating Recycled Aramid Nanofibers

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경북대학교

¹ 한국전자통신연구원

High-strength materials like para-aramid are generally difficult to recycle and, at the end of their useful life, remain as waste, causing serious environmental pollution. However, recent research has revealed a method for separating aramid microfibers, making recycling possible. Breathable films are mass-produced by adding inorganic fillers like CaCO_3 to polyolefin and inducing interfacial separation through a stretching process, facilitating the formation of micropores. In this study, PE/ CaCO_3 composite films used as breathable films were acid-treated to remove CaCO_3 and expand the pores within the films. These films were then immersed and coated in an recycled aramid nanofibers (ANF) suspension dispersed in ethanol to produce olefin-based composite films containing recycled ANF, and their properties were evaluated. This study was conducted with support from the Ministry of Science and ICT (RS-2024-00419614 & 2025 KNU RC-UniLab Project).

Poster Presentation **3PS-192**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Enhancement of Interlayer Adhesion in FDM-Printed PA6/CF composite via Post-annealing

김시우, 고종완[†]

한국생산기술연구원

Among various 3D printing technologies, Fused Deposition Modeling(FDM) is widely used for processing engineering plastics due to its advantages such as rapid fabrication and the ability to create complex geometries. However, FDM parts often suffer from weak interlayer adhesion along the build Z-direction, resulting in poor mechanical properties and limiting their industrial and structural applications. In this study, instead of modifying printing parameters or adopting alternative technologies, we propose a facile post-annealing method to enhance interlayer bonding of FDM parts. By post-annealing, improved interfacial fusion was achieved while maintaining the original 3D geometry. Dramatic improvement in bonding quality, accompanied by increased mechanical properties, was confirmed by interfacial imaging performed before and after post-annealing. These findings demonstrate that the proposed post-annealing approach effectively overcomes a critical limitation of the FDM process.

Poster Presentation **3PS-193**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Effect of Reinforcing Additives on the Mechanical Properties of Recycled Polypropylene

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현대자동차

¹ HDC현대EP

In response to growing environment concerns and EU regulations, the use of recycled plastics in automotive has significantly expanded. However, recycled polymer often exhibits inferior mechanical properties compared to virgin materials.

This study investigates the degradation of mechanical properties and the manifestation of odor-related challenges arising from the incorporation of post-consumer recycled (PCR) and end-of-life vehicle (ELV) polypropylene (PP). To address these challenges, we evaluate the influence of stiffness-enhancing and impact-modifying additives on the performance characteristics of recycled PP compounds. In addition, the effects of additive particle size and thermal behavior on the composite performance was analyzed. The results provide practical insights into material design strategies to improve the stiffness, impact strength, and odor performance of recycled PP, facilitating its broader adoption in automotive interior applications.

Poster Presentation **3PS-194**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Electrospun Sandwich-Structured PVDF-HFP Composite Membranes for Enhanced Radiative Cooling with EMI Shielding Functionality

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충남대학교 유기재료공학과

¹ 충남대학교

Energy efficiency and environmental sustainability are critical objectives in modern technology. Developing cooling solutions that minimize energy use is essential to tackle overheating in electronics and reduce building cooling demands. In this study, a multifunctional nanofibrous membrane with a sandwich structure was fabricated for passive radiative cooling and electromagnetic interference (EMI) shielding. PVDF-HFP was blended with silica nanoparticles (SiO_2) or multi-walled carbon nanotubes (MWCNTs) and electrospun into two mats: PVDF-HFP/ SiO_2 (A) and PVDF-HFP/MWCNT (B). These mats were laminated into an A-B-A structure. The membranes were characterized by SEM, EDS, and FTIR, and cooling performance was evaluated using infrared thermal imaging. Reflectance and EMI shielding efficiency were measured via UV-vis-NIR spectroscopy and shielding tests. This design integrates thermal and electrical functionalities, offering a sustainable solution for energy-efficient applications.

Poster Presentation **3PS-195**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Fabrication of a Gradient Bimetallic Nanoparticles Platform on a Single Substrate via Block Copolymer Self-Assembly

권홍구, 김현수, 최홍균[†]

공주대학교

Block copolymer (BCP) self-assembly provides a simple and cost-effective strategy for fabricating well-ordered metallic nanopatterns over large areas. Bimetallic nanoparticles exhibit unique physical and chemical synergies that cannot be achieved with monometallic nanoparticles, due to the combination of two different metals. In this study, we developed a high-throughput compositional screening platform capable of generating continuous gradients of bimetallic nanoparticles on a single substrate via BCP nanopatterns. Co-Ni bimetallic nanoparticles with a compositional gradient ranging from $\text{Co}_{10}\text{Ni}_{90}$ to $\text{Co}_{90}\text{Ni}_{10}$ were fabricated on a single substrate by adjusting the substitution times of cobalt and nickel precursors along the substrate distance using a stage controller. Conventional methods require repetitive synthesis and analysis of individual samples to identify the optimal bimetallic composition, which is time- and resource-intensive. Our platform enables the formation and analysis of gradient compositions on a single substrate, significantly reducing experimental cost and time. Accordingly, the platform serves as a powerful tool for the identification of optimal compositions in catalysis, sensing, and biomedical applications.

Poster Presentation **3PS-196**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Enhancement of Mechanical and Thermal Properties of TPU/PBT Blends via Chain Extender Addition

권도현, 곽정현, 정정설[†]

(재)한국화학융합시험연구원

Thermoplastic polyurethane(TPU) exhibits low thermal stability limits its applicability in harsh environments such as those required for cable applications. To address this issue, this study aimed to enhance the thermal and mechanical properties of TPU by blending with polybutylene terephthalate(PBT). When PBT was blended into the TPU matrix in the range of 5 to 35 wt%, the blend with 30 wt% PBT showed the most favorable properties. Subsequently, epoxy-based chain extender was added to the 30 wt% PBT composition at 0.4, 0.6, 0.8 phr, and the blend containing 0.6 phr exhibited the most enhancement. In particular, a notable increase in the Vicat temperature was observed, and surface analysis by SEM confirmed that the polymer phases were most uniformly dispersed under the 0.6 phr condition. Optimizing the blend and chain extender content in TPU/PBT blends is effective in improving material performance and suggests potential for future application in high-performance cable materials.

Poster Presentation **3PS-197**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Structure-Property Correlation in Camphor and Tartaric acid-Derived Polyesters

강주희[†]

한국생산기술연구원

We present a novel copolyester composed of camphor- and tartaric acid-derived poly(ethylene terephthalate camphor dimethyl tartrate). The presence of a crosslinked bicyclic structure and spiro-ring imparts relatively high rigidity and thermal stability to the polyesters, and the acetal group contributes to their hydrolytic properties. The thermal stability of the polyesters was demonstrated up to 381°C, and the glass transition temperature matched or exceeded that of their homopolyester when up to 10-20 mol% of the novel diester was introduced. The hydrolytic sensitivity of polyester was shown to depend on the ratio of the Ct diester. The diester significantly influenced the degradation behaviors of polyesters under acidic buffer conditions.

Poster Presentation **3PS-198**
고분자가공/복합재료/재활용(III)
2025.10.1(수), 08:30~10:00, 포스터장
Chair: 안효성, 양상희

Development of Novel Biphenyl Structures to Improve Heat Conductivity

강주희[†]

한국생산기술연구원

Overheating is a key cause of failure in electronic systems. To overcome this problem, current studies are being conducted on polymer matrices that are economical, reduced weight, low dielectric constants, and excellent thermal conductivity. While processable polymers are easy for manufacturing, their thermal conductivity remains low ($0.1\text{-}0.5\text{ Wm}^{-1}\text{K}^{-1}$), indicating restricted applicability in thermal management uses. This study investigated the thermal response of epoxy/hexagonal boron nitride systems before and after introducing biphenyl amines. To enhance thermal conductivity and facilitate phonon movement, this study aimed to increase the crystallinity of the polymer matrix. Introducing biphenyl structures into the polymer matrix resulted in a thermal conductivity enhancement of about 1.8 times, according to the experimental results. The outcomes of this study are projected to advance the heat management performance of electronics, thus improving their stable operation and long-term reliability.

Poster Presentation **3PS-199**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Coordination Interaction of Gd Metal–Organic Frameworks and Bismuth Halides for Efficient X-ray Shielding

Nazmul Hossain[†], LI SHISEN, 산무감마하링감, 김정환[†]

부경대학교

X-ray radiation is essential in medical, industrial, military, and space applications. While lead (Pb) is commonly used for shielding, its toxicity and weight are major drawbacks. To provide a safer alternative, we developed a lightweight composite using gadolinium-based metal-organic frameworks (Gd-MOF) and bismuth halides. Gd-MOF enhances chemical bonding and absorption of bismuth halides into a sponge matrix, improving shielding performance. The optimized material absorbed 1.34 g of bismuth halide and achieved high shielding efficiency—94% at 60 kV and 78% at 100 kV—at a low density of 1.21 g/cm³.

Poster Presentation **3PS-200**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Phase-separated aerogel with photon cage structure enables efficient and complementary X-ray absorption

LI SHISEN, Nazmul Hossain, 산무감마하링감, 김정환[†]

부경대학교

To promote the safer and more efficient use of X-rays, the development of high-performance, lead-free shielding materials is essential. In this study, gadolinium (Gd) was strategically incorporated into an aerogel using a phase separation strategy to create a unique "photon cage" structure. This structure effectively prolonged the residence time of photons and enhanced multiple internal scattering events. As a result, the fabricated aerogels exhibited excellent X-ray shielding efficiencies, ranging from 76.4% to 97.2% within the 40-120 keV energy range. These findings present a promising pathway toward the development of flexible, high-efficiency, lead-free X-ray shielding materials.

Poster Presentation **3PS-201**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Multifunctional Imidazole-Functionalized Polyaspartamide/TiO₂ Composites for UV Screening, Heavy Metal Removal, and Suppressed Photocatalytic Activity

HEND, 문휘현, Sathiyachandran Perumal, Mohamed R. Elmasry, 박지유, 김윤철,
송창식[†]

성균관대학교

With global warming accelerating and the ozone layer depleting, increased UV exposure raises skin-related health concerns. Titanium dioxide (TiO₂)-based inorganic sunscreens are widely used but suffer from visible white turbidity and photocatalytic skin oxidation. In this study, TiO₂/polyaspartamide composites (T-PH and T-PA), functionalized with histamine and aminopropyl imidazole, were synthesized. The imidazole-bearing polymers were covalently grafted onto TiO₂, improving nanoparticle dispersion and enabling heavy metal adsorption via metal–ligand coordination. Compared to unmodified TiO₂, the composites showed a 33% reduction in whiteness index and suppressed methylene blue degradation (from 100% to 16–30%). They also displayed enhanced Cu²⁺ and Ni²⁺ ion adsorption. These multifunctional hybrids are promising for next-generation sunscreens, combining UV protection, high transparency, and environmental remediation.

Poster Presentation **3PS-202**

고분자가공/복합재료/재활용(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

A Flexible Electric–Magnetic Bilayer Composite Film for Absorption-dominant Electromagnetic Interference Shielding

김민선, 조고은, 김봉기^{*1}, 홍성우^{*2}

한국생산기술연구원

¹ 건국대학교

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The increasing demand for high-frequency 5G electronics necessitates flexible electromagnetic interference (EMI) shielding materials that exhibit high absorption and durability. In this study, we developed a bilayer composite film combining a thermoplastic polyurethane (TPU)/Carbonyl Iron Powder (CIP) absorption layer with a carbon nanotubes (CNTs)/PBTTT conductive layer. This structure integrates magnetic and dielectric losses with controlled conductivity to achieve absorption-dominant shielding. The film exhibited a high absorption shielding effectiveness (SEA) of 55 dB with a low reflection shielding effectiveness (SER) of 3 dB. It maintained over 95% of its total shielding effectiveness (SET) and reflectance below 0.5 after 10,000 folding cycles, confirming excellent folding reliability. A thermal stability test at 150 °C for 1 h demonstrated over 90% SET retention. These results highlight the potential of this bilayer system for next-generation EMI shielding in 5G-related devices.

Poster Presentation **3PS-203**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Enhanced Photoalignment via Methacrylate-Enabled Crosslinking with Biphenyl LC242

송효진, 장기철, 백정주, 김영훈, 김명길¹, 신교직⁺

한국생산기술연구원

¹ 성균관대학교

LC242, which contains a biphenyl group, possesses a strong π -conjugated core that promotes molecular alignment. To improve the alignment performance of the photoalignment polymer, methacrylate (MA) was incorporated into its structure. The introduced MA enabled crosslinking with LC242 via a radical reaction initiated by a photoinitiator, resulting in enhanced molecular ordering. Experimental analyses, including order parameter and angular absorbance measurements, confirmed improved alignment upon MA incorporation. Additionally, UV-Vis spectroscopy indicated a more stabilized π - π^* transition of the chalcone moiety in the MA-containing system. These results highlight an effective molecular design strategy that leverages the structural characteristics of LC242 and the reactivity of MA to enhance both alignment and optical stability.

Poster Presentation **3PS-204**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Stabilizing Li Metal Interfaces with Bottle Brush Polymer Additives

송여령, 강지형[†]

서울대학교

Lithium metal anodes are considered key components for next-generation batteries due to their high theoretical capacity. However, their practical application is hindered by issues such as dendrite formation and unstable interfacial chemistry, which lead to reduced efficiency and safety concerns. To address these challenges, it is essential to develop advanced electrolytes that can enhance lithium-ion conductivity and promote the formation of a stable interface. In this work, we present a novel electrolyte additive based on bottlebrush polymers bearing polyethylene glycol (PEG) side chains. We further investigate how the unique architectural features of the bottlebrush polymers affect the solvation structure of lithium ions at the anode interface. This study provides valuable insight into the role of polymer architecture in controlling ion transport and interfacial behavior, and offers a promising strategy for improving electrolyte performance in lithium metal batteries.

Poster Presentation **3PS-205**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Synthesis and Characterization of Poly(N-vinylcaprolactam) Hydrogels via Electron Beam Irradiation

손수호, 김민재, 김소희, 정진혁, 김경민, 임정혁⁺

국립한국교통대학교

Hydrogels possess a three-dimensional network structure, which imparts high water retention capacity and excellent biocompatibility. Among them, poly(N-vinylcaprolactam) (PNVCL) hydrogels have drawn significant attention due to their ability to shrink within the physiological temperature range and enable controlled drug release. In this study, PNVCL/PVP hydrogels were prepared by electron beam (EB) irradiation of a mixture consisting of N-vinylcaprolactam (NVCL) monomer and polyvinylpyrrolidone. The NVCL content was varied from 0.5 to 20 wt%, and EB irradiation was carried out at doses ranging from 10 to 50 kGy. The structure and physical properties of the resulting hydrogels were characterized using Fourier-transform infrared spectroscopy, UV-visible spectroscopy, dynamic light scattering, gel permeation chromatography, and differential scanning calorimetry. (This was supported by Korea National University of Transportation in 2025)

Poster Presentation **3PS-206**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Thiophene Based Biaxial Thin Films: Negative Dispersion Retarders with Broadband and Angle-Independent Antireflection

성창현, 정광운[†]

전북대학교

A thiophene based trialkyl benzamide (TTBA) consisting of thiophene based conjugated core and flexible alkyl dendrons is newly designed and synthesized. TTBA forms self-assembled nanocolumns of hexagonal columnar phase via hydrogen-bonded discotic aromatic cores and π - π stacking. Due to the high mobility of the nanocolumns, a two-layered thin film was fabricated by shearing TTBA onto uniaxially aligned rod-like nematic reactive mesogens. Optical analyses confirm that the axis of nanocolumns is perpendicular to the maximum refractive axis, indicating that the shear direction corresponds to the ordinary axis. These films exhibit not only high transmittance and colorlessness but also negative dispersion retardation by the orthogonal orientation between two layers. Consequently, the fabricated film can act as a biaxial quarter-wave plate for antireflective thin films. This work is supported by BK21 Four and the Mid-Career Researcher Program (RS-2021-NR059321).

Poster Presentation **3PS-207**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Polarization-Dependent Electrochromic Smart Windows Based-on Polymer-Stabilized Viologen

서성민, 정광운[†]

전북대학교

We newly synthesized a viologen-based reactive mesogen (ViRM) to develop polarization-dependent and electrochromic smart window. The uniaxially oriented and polymer-stabilized ViRM film was fabricated by shear-coating, self-assembly and photopolymerization. The ViRM film undergoes a color change through a reversible redox reaction of viologen by applying voltage. In addition, the ViRM film exhibits polarization-dependent transmittance because of the hierarchical lattice structure oriented along the shear direction (SD). This enables tunable transmittance by rotating the angle between the polarizing axis (PA) and SD using a linear polarizer. The developed ViRM film shows great possibilities not only in the field of smart windows but also multi-information encryption. This work was supported by BK21 FOUR program and Basic Research Laboratory Program (RS-2023-00207836).

Poster Presentation **3PS-208**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Two-Component TPU Solution-Cast Films for Secondary Battery Sealing Tapes: Mechanical Properties and Swelling Ratio Evaluation

백정주, 장기철, 김영훈, 신교직[†]

한국생산기술연구원

Two-component thermoplastic polyurethane (TPU) films were prepared via solution casting using a resin–hardener system for application in secondary battery sealing tapes. Mechanical performance was evaluated by measuring tensile strength, and elongation at break, while swelling ratio (SR) tests in electrolyte solvents assessed dimensional stability and solvent resistance. FTIR analysis confirmed curing efficiency and residual isocyanate groups, and SEM observations revealed the film morphology. Results showed that optimized resin–hardener ratios provided TPU films with balanced tensile properties and controlled swelling behavior, demonstrating their suitability for sealing tape applications in lithium-ion batteries. This work highlights the structure–property relationships of solution-processed TPU films and their potential as reliable sealing materials for energy storage devices.

Poster Presentation **3PS-209**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Molecularly Imprinted Sensors Based on Pyrrole and Pyrrole–Aniline Derivatives for Electrochemical Impedimetric Detection of 5-Fluorouracil

배정연, 우주성¹, 박진영¹

경북대학교 고분자공학과

¹ 경북대학교

5-Fluorouracil (5-FU) is an uracil-derived antitumor agent, and its overdose can lead to toxic metabolite accumulation and neurotoxicity. Therefore, sensitive and selective quantification of 5-FU is essential. To meet this analytical requirement, molecularly imprinted polymers (MIPs) have been studied as synthetic receptors for their selectivity, stability, and ease of preparation. Pyrrole is widely used as a functional monomer for electropolymerized MIP films due to its high conductivity, electroactivity, and processability. However, its limited functional groups restrict formation of specific interactions with target molecules. Therefore, in this study, 4-(1H-pyrrol-1-yl)aniline was introduced into the MIP matrix to enhance specific interactions with 5-FU by providing additional functional groups. To evaluate sensing performance of imprinted films, electrochemical impedance spectroscopy (EIS) was employed to measure changes in charge transfer resistance (R_{ct}) upon 5-FU binding.

Poster Presentation **3PS-210**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Free-Standing Infrared Fresnel Lens Based on Sulfur-Rich Polymer via Thermal Imprinting

배경연, 조웅비, 위정재[†]

한양대학교

For Infra-red (IR) lenses, chalcogenides and ceramics have been typically employed due to their high IR transmittance. However, thick, and thus heavy lenses are required to achieve high magnification as well as reduction in color distortion. Fresnel lenses, unlike traditional ones, have engraved grooves on a flat surface, allowing for shorter focal lengths and reduced weight, ideal for miniaturization. Traditional IR Fresnel lens fabrication is costly due to the use of ultra-precision cutting machines and expensive IR-transparent materials. In this presentation, we introduce an effective strategy to fabricate low cost yet sustainable IR Fresnel lenses with sulfur-rich polymers (SRPs). SRPs, produced from elemental sulfur via inverse vulcanization, are polymers due to their exceptionally high inorganic content. In addition, SRPs are thermally processable, allowing thermal imprinting.

Poster Presentation **3PS-211**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Highly Deformable Triboelectric Nanogenerator Achieved by Double-Network Ionic Hydrogels

남지현, Nabilah Anindita Febriola¹, 윤진환⁺

서울시립대학교

¹ Pusan National University

Soft triboelectric nanogenerators (TENGs) offer promising solutions for powering wearable devices through mechanical energy harvesting, but achieving both high stretchability and stable electrical output remains challenging. This work presents a highly deformable TENG incorporating double-network ionic hydrogels as stretchable electrodes and Ecoflex embedded with high-dielectric nanoparticles as the triboelectric layer. The double-network design provides exceptional mechanical robustness while maintaining ionic conductivity. The device demonstrates remarkable stretchability up to 400% strain while maintaining functionality, generating approximately 100 V output voltage at 100% strain and achieving 2.15 W/m² power density. The TENG successfully detects human motion, demonstrating potential for self-powered healthcare monitoring and wearable electronics applications.

Poster Presentation **3PS-212**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Red-Emitting Conjugated Polymer Dots for Fluorescence-Based Applications

이택승[†], 정찬희, 김영웅, 박채완

충남대학교

Fluorescent polymers have attracted attention due to their applications in bioimaging, sensing, and optoelectronics. Quantum dots and small-molecule dyes are commonly used, but they often suffer from cytotoxicity, low photostability, and limited fluorescence intensity. To address these issues, we synthesized a red-emitting conjugated polymer with an extended π -conjugated backbone and applied it to the fabrication of semiconducting polymer dots (Pdots) with enhanced optical stability. The polymer exhibited absorption and emission peaks at 506 nm and 624 nm, respectively. Pdots were prepared via nanoprecipitation, forming uniform and colloiddally stable nanoparticles. These Pdots showed strong fluorescence, high photostability, and responsiveness to environmental changes. Overall, the synthesized polymer-based Pdots demonstrate practical potential in fluorescence-based technologies such as imaging, sensing, and optoelectronics.

Poster Presentation **3PS-213**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Synthesis of Temperature-Responsive Ion Conducting Poly(urethane-urea) for Cold Chain Monitoring

박지윤, 송창식[†], 홍옥비

성균관대학교

The cold chain is defined as a distribution system that maintains temperature-sensitive products at low temperatures throughout the entire supply process. Exposure to ambient temperatures can lead to quality degradation. In this study, we developed a temperature-responsive polymer. The ion-conductive SPEs based on poly(urethane-urea) was optimized in terms of PTMEG polyol molecular weight, diamine content, Li salt concentration and degree of crosslinking. Under cold storage conditions, the crystallization of polymer chains suppressed Li⁺ mobility and reduced conductivity. In contrast, exposure to increased temperatures induced morphological changes in the polymer, leading to increased Li⁺ mobility and enhanced conductivity. Upon re-cooling, irreversible changes in ionic conductivity enabled traceable thermal history detection. This system demonstrates the potential of a polymer-based sensor platform for cold chain product quality management.

Poster Presentation **3PS-214**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Fluorescence Spectroscopic Analysis of Polycarbonate Films with Tunable Dye Compositions

박주영, 이대준, 김연준, 박소민, 김용석[†]

세종대학교

폴리카보네이트(PC)는 우수한 물성과 가공성으로 다양한 산업 분야에 활용되며, 형광 기능성 소재와의 융합을 통해 고기능성 소재로의 확장이 가능하다. 본 연구에서는 Fluorescein 및 Anthracenylmethyl 계의 형광염료를 다양한 조성으로 도입한 PC 필름을 제조하고, 형광 분광 분석을 통해 조성 변화에 따른 스펙트럼 특성을 평가하였다. 형광 강도 및 방출 파장의 정량적 분석을 통해 조성 분석 및 정량화 가능성을 검토하였으며, 본 연구는 향후 고분자 기반 형광 분석 기술 개발에 기초자료로 활용될 수 있을 것으로 기대된다.

Poster Presentation **3PS-215**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Smart Tendon-Inspired Motion Sensor Using Anisotropic Multiple-Crosslinked PVA Hydrogel

박연우, 김민희^{*1}, 박원호⁺

충남대학교

¹ 경북대학교

힘줄 조직은 혈류 공급이 제한되어 재생 능력이 낮으며, 손상이 진행될 경우 만성 파열이나 광범위 결손으로 자가 봉합이 불가능한 경우가 많다. 이를 대체하기 위한 다양한 연구가 진행되고 있으나, 대부분 기계적 물성 확보에 중점을 두고 있어 실제 조직 재생 유도 및 상태 모니터링 기능은 부족한 실정이다. 본 연구에서는 힘줄 재생을 유도하기 위해 돼지 유래 탈세포화 세포외기질(dECM)을 활용한 PVA 기반 이방성 수화젤을 개발하여 기계적 강도, 조직 재할 촉진, 실시간 센싱 기능을 통합한 인공 전자힘줄을 구현하고자 하였다. 돼지 힘줄로부터 추출한 dECM의 collagen과 GAG 함량은 탈세포 전과 유사하였으며 탈세포공정 이후 잔존 DNA 함량은 면역반응을 유발할 하지 않을 정도로 제거된 것을 확인하였다. 수화젤은 추가적인 가교공정을 통해 힘줄과 유사한 이방성 구조 및 기계적 특성을 향상시켰으며, 재생의학과 웨어러블 센서 기술을 융합한 차세대 치료 및 진단 통합 플랫폼으로의 활용 가능성을 제시하고자 한다.

Poster Presentation **3PS-216**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Surface Functionalization of PET with Sulfonamide Monomers through UV-Induced Grafting for Antimicrobial Efficacy

박수빈, 전민욱, 김무송¹, 안철희⁺

서울대학교

¹ 효성기술원

Polyethylene terephthalate (PET) is widely used in packaging, textiles, and medical devices. To address concerns about disease transmission, we developed an antimicrobial PET by covalently bonding sulfonamide-based compounds onto its surface. Unlike traditional PET modified with physically blended metals, which suffer from poor washing durability, our method ensures strong interfacial stability. Sulfonamide-derived monomers were synthesized in a single step and grafted onto PET using a photo-induced process. First, tertiary amines were introduced onto PET via aminolysis to act as type II photoinitiators. UV irradiation with benzophenone then enabled grafting of the monomers. FT-IR confirmed sulfonamide incorporation, and the resulting homopolymer showed 99% antibacterial activity.

Poster Presentation **3PS-217**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Thermal and Electrochemical Properties of Alicyclic Polyimide based Solid Polymer Electrolyte

박수빈, 서하늬, 조남주[†]

부산대학교

Research on all-solid-state batteries that substitute liquid electrolytes with solid electrolytes is being actively conducted to achieve high energy density and high capacity of lithium secondary battery. However, solid polymer electrolytes should not only improve ionic conductivity, but also be stable at high temperature and high voltage, and have mechanical stability capable of withstanding external forces. Therefore, in this study, polyimide with excellent thermal stability and mechanical durability was introduced as a matrix for solid polymer electrolyte. At this time, in order to alleviate the strong inter-chain interaction of polyimide, alicyclic polyimide with alicyclic ring was synthesized to compare the thermal property and mechanical stability with aromatic polyimide. The thermal stability and ionic conductivity of the alicyclic polyimide were evaluated.

Poster Presentation **3PS-218**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Critical Role of Thermomechanical Properties of Sulfur-Rich Polymers in Triboelectric Nanogenerators

박민지, 조용비, 김성수¹, 위정재[†]

한양대학교

¹ 한양대학

Elemental sulfur, a byproduct of petroleum refining, generates an annual surplus of 7 million tons. Its upcycling has attracted attention due to economic feasibility, thermal processability, and high electron affinity (-200 kJ mol^{-1}). Sulfur-rich polymers (SRP) with fluoropolymers have been used as negatively chargeable contact layer in triboelectric nanogenerators (TENG). However, fluoropolymer-based SRP contains toxic per- and polyfluorinated substances (PFAS), posing environmental concerns. In this study, we enhanced TENG performance exclusively by controlling sulfur content and film thickness. Increasing sulfur content alters the thermomechanical properties of SRP, affecting electron transfer and surface charge density. A thinner contact layer improves performance by increasing charge generation through electrostatic induction. Optimizing composition and film thickness yielded a 436 V open-circuit voltage, highlighting its potential for sustainable energy harvesting.

Poster Presentation **3PS-219**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Lithium Salts with Disulfide Dynamic Bonds for Enhanced Ion Transport in Polymer Electrolytes

박민우, 김형준[†]

서강대학교

Polymer electrolytes are promising candidates for solid-state ion conductors due to their flexibility and ease of processing. However, their ionic conductivity strongly depends on salt concentration, leading to a trade-off: increasing salt content improves ion transport but compromises mechanical strength, whereas reducing salt content maintains robustness but limits conductivity. Overcoming this trade-off remains a central challenge in electrolyte design.

In this study, we report the synthesis of a disulfide-containing lithium salt and its incorporation into thermoplastic polyurethane (TPU)-based polymer electrolytes. The disulfide moiety enables dynamic covalent exchange with the polymer matrix, promoting effective integration of the salt into the polymer phase. This salt-centered approach offers a strategy to enhance ion transport while preserving mechanical integrity in solid polymer electrolytes.

Poster Presentation **3PS-220**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Preparation of Hybrid Epoxy Composite Incorporating Silica-Microencapsulated Intumescent Flame Retardant

문형민, 임정혁, 김경민[†]

한국교통대학교

Although epoxy resins exhibit excellent mechanical strength, adhesion, and thermal stability, their inherent flammability restricts use at elevated temperature. Here, we mitigate this limitation by embedding silica-microencapsulated intumescent flame-retardant (MCIFR) particles in a diglycidyl ether of bisphenol A (DGEBA) and diaminodiphenylmethane (DDM) epoxy matrix. Pentaerythritol (PER) and ammonium polyphosphate (APP), key intumescent components, were individually microencapsulated through a TEOS sol-gel route and subsequently functionalized with APTES to enhance interfacial compatibility. During combustion, the MCIFR generated an expanded silica-reinforced char that impedes heat and oxygen transfer, thereby improving flame retardancy. The hybrid composites were evaluated for the structure, thermal properties, and flame retardancy using various analytical methods.

Poster Presentation **3PS-221**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Optimized Porous Hollow Carbon Nanofibers and Organic Electrolytes for High-Performance Supercapacitors

문종호, 정영규¹

충남대학교

¹ 충남대학교 유기응용재료공학과

In this study, porous hollow-structured carbon nanofiber (CNF) electrodes were fabricated using a coaxial electrospinning, with poly(azomethine ether) (PAME) as the primary polymer matrix. The fabricated CNFs were assembled into CR2032-type coin cells to assess their electrochemical performance with different electrolyte systems. Two types of electrolytes were evaluated: an aqueous electrolyte and organic solvent-based electrolytes. All coin cells showed typical EDLC behavior, confirming the physical charge storage mechanism of the electrodes. Notably, coin cells with organic electrolytes exhibited 3-4 times wider electrochemical potential windows compared to those using the KOH electrolyte. This expanded voltage range led to a significant improvement in energy density. These findings suggest that the combination of coaxially electrospun PAME-based hollow CNFs and optimized organic electrolytes presents a promising approach for the development of high-performance supercapacitors.

Poster Presentation **3PS-222**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Catalytic Colorimetric Bead Sensor for Detection of Hydroxylamine in Water

명화인, 서성백[†]

부산대학교

Hydroxylamine (HA), a toxic compound in industrial effluents, poses serious environmental risks. While electrochemical sensors offer high sensitivity, their poor reusability limits field use. Here, we present a colorimetric hydrogel sensor composed of polydiacetylene-benzaldehyde (PDA-BA) liposome-loaded alginate beads for point-of-care HA detection. The PDA-BA liposomes exhibit a blue-to-red color shift via oxime formation within 5 minutes of HA exposure. To improve sensitivity, 2-amino-5-methoxybenzoic acid (5-MA) was co-loaded into the alginate matrix without disrupting liposome function. RGB analysis using ImageJ showed a concentration-dependent colorimetric response (CR%), enabling semi-quantitative detection. The sensor allows naked-eye observation and smartphone-based analysis without specialized equipment. With its simplicity, portability, and catalytic enhancement, this PDA-based bead system offers a cost-effective solution for on-site monitoring of hazardous amines in water.

Poster Presentation **3PS-223**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Tuning Mesogenic Polymer Structures with Chiral Epoxide Dopants

레밍황, 구교선, 여현욱[†]

경북대학교

The study of chiral polymer compounds aims to mimic the functions of natural macromolecules. In this work, we synthesized basic and advanced chiral mesogenic diepoxide compounds using simple methods. Optical measurements confirmed their twisted helical structures. When used as dopants, these compounds improved the liquid crystal behavior of common epoxide monomers and polymer networks, resulting in cholesteric materials. Aromatic anhydride was used for bulk polymerization. The resulting materials were analyzed to evaluate the effectiveness of the modifications.

Poster Presentation **3PS-224**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Development of Functional Epoxy Monomers for Packaging Applications with Low Thermal Expansion and High Heat Resistance

노혜경, Hend, 송창식⁺, 김윤철

성균관대학교

With rising demand for high-performance electronic devices, semiconductor packaging is evolving toward finer, thinner, and more integrated structures. However, combining polymers with inorganic or metallic materials causes interfacial stress and warpage due to mismatches in the coefficient of thermal expansion (CTE). Conventional epoxy resins show high CTE, which remains a challenge. To address this, multifunctional epoxy monomers based on novolac and dicyclopentadiene (DCPD) novolac were synthesized. A Design of Experiments (DoE) method was used to optimize conditions for low CTE and high thermal stability by controlling repeating unit number and number-average molecular weight. Additionally, a resin with a rigid cardo-type fluorene structure was developed. This structure enhances thermal resistance, lowers CTE, and improves chemical, moisture, and dielectric performance. These epoxy systems provide a promising solution to ensure reliability in next-generation semiconductor packaging.

Poster Presentation **3PS-226**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Disodium Phosphate-Induced Li_3PO_4 SEI for Enhanced Li^+ De-solvation and High-Rate Capability in High-Loading Electrodes

김혜선, 유필진[†]

성균관대학교

Achieving both fast charging and high energy density is essential for commercializing electric vehicles and portable electronics. However, increasing active material content and adopting a high loading level to enhance energy density conflicts with achieving fast charging capability. In this study, disodium phosphate (Na_2HPO_4) is introduced as a novel additive to accelerate Li^+ lithiation/delithiation kinetics by forming a Li_3PO_4 -based solid electrolyte interphase (SEI) layer. The Li_3PO_4 SEI layer accelerates the Li^+ de-solvation process, improving high C-rate performance, with a 55% increase in high-rate charging capacity at 2C compared to the reference. Furthermore, accelerated lifetime degradation testing of a full cell (13 μL electrolyte) demonstrated superior capacity retention of 84.62% and 77.41% after 100 and 200 cycles, respectively, compared to 79.84% and 62.32% for the reference.

Poster Presentation **3PS-227**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Development of Shape Memory Polymer-based Microneedle Patch for Interstitial Fluid Extraction

김현재, 이상민¹, 장우진², 박주영³, 조성우¹, 한민지³, 성학준^{*1}, 이강석^{*3}

연세대학교

¹ 연세대학교

² 티엠디랩

³ 티엠디랩

Recently, interstitial fluid (ISF) has attracted attention in healthcare, medical and biomedical applications because it exists in the extracellular space and diffuses in the blood vessels, and ISF has a composition like that of blood. Due to various biomarkers in ISF, if we can extract ISF and use of them such as a biosensor to provide bio-information, we can provide useful health information to both clinicians and patients.

For effective ISF extraction, we developed a microneedle structure and used shape memory microneedle technology (INNOSELF-MN). We first designed a novel microneedle design including a hollow type of microneedle structure and a filled microneedle structure. Then, we set up a manufacturing process for microneedles with two shapes such as cone shape and x-shape using shape memory programming process and established a protocol for fluid extraction. Based on this study, we developed a shape memory microneedle capable of ISF extraction.

Poster Presentation **3PS-228**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Photocurable Hybrid Dental Composites for 3D Printing Based on Acrylic Polymer Containing Catechol Monomer

김현석, 정일두[†], 전채영

부산대학교

Mussel-inspired catechol polymers attract attention with strong interfacial interactions via hydrogen bonding, enabling diverse applications, including the biomedical industry. 3,4-dihydroxyphenylalanine (DOPA) with catechol moieties was reacted with methacrylic anhydride to synthesize a polymerizable monomer. Dopamine methylacrylamide (DMA) was characterized using FT-IR, ¹H-NMR, and ¹³C-NMR spectroscopies. It was mixed with ethoxylated bis-GMA (EBPDMA) in various compositions to 3D print using the DLP technique. The synthesized DMA was copolymerized with MMA (methyl methacrylate) to be applied to bone cement. It was copolymerized with acrylic acid and 2-HEMA (2-hydroxyethyl methacrylate) to formulate glass ionomer cement for dental restorative applications, and characterized through GPC, FT-IR, and ¹H-NMR spectroscopies. The specimens with various ratios were used to measure mechanical properties such as compressive strength and flexural strength.

Poster Presentation **3PS-229**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Cleavable and Eco-Friendly UV-Curable Acrylic Adhesives Using Lipoic Acid-Based Crosslinkers

김현석, 정일두[†], Rudru gangaratnamma

부산대학교

Polymers containing lipoic acid (LA), a 1,2-dithiolane ring, have gained attention for applications in self-healing coatings, sustainable adhesives, and dynamic polymer networks. LA polymerizes via disulfide ring opening, enabling reversible bonding through disulfide exchange. In this study, BDLA, synthesized by esterifying LA with 1,4-butanediol (BDO), was used as a ring opening at both ends photocrosslinker for acrylic prepolymers, enabling reversible polymerization and degradation. Disulfide bond cleavage was performed by both reductive cleavage using a reducing agent and thermal cleavage by heating in DMF. GPC was used to analyze the evaluation of molecular weight changes after disulfide bond cleavage. Mechanical properties such as peel strength, strain-stress curve were measured using a universal testing machine (UTM). Thermal stability and transitions were assessed through TGA, DSC, and DMA to evaluate the performance of LA-based dynamic adhesive materials.

Poster Presentation **3PS-230**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Quinoidal-Character Extension in Non-Fullerene Acceptors for Short-Wave Infrared Organic Photodetectors

김하정, 이재원[†], 정민영¹, 조길원¹

충남대학교

¹ 포항공과대학교

Photodetectors convert light to electrical signals for applications in medical imaging, environmental monitoring, and imaging systems. Inorganic active layers remain constrained by cost, weight, and dark current, motivating organic semiconductors as alternatives. This synthesis-driven study develops non-fullerene acceptors (NFAs) tailored for organic photodetectors. Guided by an A–D–A'–D–A (ADADA) architecture and a quinoidal-character-extension strategy, we tune donor–acceptor interactions to broaden absorption, and films show absorption onsets >1400 nm.

Poster Presentation **3PS-231**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Skin-attached haptic interface platform with bioinspired architectures capable of resisting sweat and vibration

김진형, 황귀원, 송민우, 임도현, 이연수, 김다완¹, 양태현², 방창현⁺

성균관대학교

¹ 국립한국교통대학교

² 건국대학교

A stable conformal interface technology for rough and sweaty complex skin is essential for a haptic interface capable of delivering sophisticated mechanical stimuli. However, conventional adhesives cannot maintain adequate adhesion at the haptic interface due to repetitive vibrations or sweaty skin. This study reports a reversible, versatile skin-attached haptic interface platform, which embeds the hybrid architecture of a water-drainable hexagonal array of frog toe pads and the energy-dissipation matrix of snail pedal muscles with interconnected structures. This adhesive patch exhibits remarkable adhesion in pulling and shear directions under both dry and sweaty conditions, also, resulting in vibration-resistant characteristics. The bioinspired skin-attached haptic interface demonstrates versatility by being reversibly applicable to various skin surfaces such as fingers, arms, and legs in virtual reality. This study was published in *Advanced Functional Materials* 34, 2311167 (2024)

Poster Presentation **3PS-232**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

면상 발열체-하이드로겔 복합 시트를 이용한 PNIPAM 기반 수분 탈착 제어

김태동[†], 장상현¹, 홍경오, 김유준

한남대학교

¹ 히시스

Poly(N-isopropylacrylamide)(PNIPAM)은 온도 변화에 따라 부피가 변하며 공기 중 수분을 흡·탈착할 수 있는 기능성 고분자이다. 그러나 PNIPAM 기반 하이드로겔은 탈착 속도가 느리고 내부 열전달 효율이 낮아 재사용 시 효율 저하 문제가 발생한다. 이러한 문제를 해결하고자, 면상 발열체와 결합된 하이드로겔 시스템을 설계하여 하이드로겔 내부까지 직접적으로 열을 전달함으로써 수분 탈착 반응 속도와 반복 사용 성능을 향상시키고자 하였다. 100 μ m 두께의 탄소 발열 필름과 중합 지지체 역할을 하는 나일론 테이프 위에 하이드로겔을 형성하여 복합 시트를 제작하였다. DC 전원 장치를 사용해 일정한 전압을 인가한 후, 열화상 카메라로 표면 온도를 측정하였다. 하이드로겔의 표면 미세구조는 주사전자현미경(SEM)으로 관찰하였고, 화학 구조는 적외선 분광기(FT-IR)를 통해 분석하였다. 제작된 복합 시트는 다양한 습도, 온도, 전압 조건에서 수분 탈착 거동을 평가하였다.

Poster Presentation **3PS-233**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Fluorescence Mapping of Functional Dye/Polycarbonate Hybrid Films for Composition Monitoring and Traceability

김연준, 이대준, 박소민, 박주영, 김용석[†]

세종대학교

폴리카보네이트(Polycarbonate, PC)는 우수한 기계적 강도, 내열성, 광투과성을 바탕으로 다양한 산업 분야에서 널리 활용되고 있다. 한편, 형광 분석은 높은 민감도와 선택성, 비파괴·비침습적 측정이 가능하다는 장점 덕분에 고분자 내부의 미세 환경 변화를 실시간으로 모니터링할 수 있는 유효한 분석 도구로 주목받고 있다. 본 연구에서는 메틸렌클로라이드(MC)를 용매로 하여 폴리카보네이트 용액을 제조하고, 여기에 기능성 형광염료를 다양한 조성으로 도입한 후, 솔루션 캐스팅(Solution Casting) 공정을 통해 필름을 제작하였다. 형광 분광법을 이용하여 스펙트럼을 측정하고, 다양한 분석 파라미터를 적용하여 염료 간 상호작용 및 정량 분석 효율을 비교하였다. 수집된 데이터는 체계적으로 데이터베이스화고, 형광 응답 특성을 기반으로 조성 추론 및 정량화 가능성을 평가하였다. 본 연구는 향후 고분자 기반 소재의 조성 분석 및 이력 추적 기술 개발에 활용 가능한 기초자료를 제공할 수 있을 것으로 기대된다.

Poster Presentation **3PS-234**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Patternable Slippery Oil-Infused porous Surfaces for Programmable and Mass-Sensitive Droplet Routing

김언지, 이왕은[†], 김희상, 양진철

한국화학연구원

We present heterogeneous oil-infused porous surfaces (HOIPSs) for programmable and precise directional control of water droplets. By selectively infusing two immiscible lubricants into chemically patterned nanopores, HOIPSs create surface hydrophobic gradients that repel droplets toward less hydrophobic regions, enabling uphill transport by balancing gravity and interfacial forces. The system allows tunable droplet motion by varying lubricant viscosity, tilt angle, and track geometry. This design can be extended to function as a mass-recognizing, logic-gated droplet router, enabling selective control based on droplet size or weight. HOIPSs further support controlled droplet merging, splitting, and guided movement, even on flexible or curved substrates. This approach offers a robust and scalable platform for programmable liquid manipulation, with potential applications in water harvesting and microfluidics.

Poster Presentation **3PS-235**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Advanced Thermal Management through Integration of Thermally Conductive and Phase-Change Heat-Storage Mesogens

김승훈, 정광운[†]

전북대학교

Heat storage systems using phase-change materials (PCM) are gaining attention for thermal energy harvesting. In this study, we synthesized thermally conductive reactive mesogens (TCRM) and heat storage mesogens (HSM) with high latent heat. To fabricate smart heat-managing TCRM-HSM polymer alloys, the composition and polymerization temperature were optimized using phase diagram analysis and thermal performance data. Phase-separated HSM domains within the TCRM network enable passive thermal energy storage. Through morphological and thermal analysis, it was confirmed that the heat storage capacity of the polymer alloys is related to the size of the phase-separated HSM domain. This polymer alloy exhibits high thermal conductivity (1.38 W/mK), enhanced latent heat (62.8 J/g). This work was supported by Mid-Career Researcher Program (RS-2021-NR059321) and BK 21 FOUR Program of the Korea government.

Poster Presentation **3PS-236**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Redox-Responsive and Uniaxially Oriented LCLC Film for Smart Glass Applications

김송은, 정광운[†]

전북대학교

To develop smart glass technology with electrochromic devices, we newly synthesized lyotropic chromonic liquid crystal (LCLC) thin films with perylene-diimide reactive mesogen (PDI-M). The PDI-M undergoes a reversible redox transition between its neutral and dianion states, resulting in color shift from red to dark purple. The PDI-M exhibit uniaxial alignment and LCLC network films show enhanced structural stability and physical properties than the monomer state after photopolymerization. Also, the fabricated film enables selective polarization due to uniaxial alignment and high dichroic ratio. These characteristics allow for the application of smart glass devices, including smart windows, and polarization-dependent displays for anti-counterfeiting. This work was supported by the BK 21 FOUR Program and Mid-Career Researcher Program (RS-2021-NR059321).

Poster Presentation **3PS-237**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Development of High-Stability Lithium Metal Battery via Bimetal UiO-66-NH₂ Layer

유필진[†], 김성현

성균관대학교

Lithium metal is considered an ideal anode material due to its exceptionally high theoretical capacity, low electrode potential, and rapid charging rate. However, uncontrolled lithium dendrite growth remains a critical obstacle to its practical application. In this study, bimetallic metal-organic framework nanoparticles are developed as artificial passivation solid electrolyte interphase (SEI) layer for high stability lithium metal batteries. This artificial layer utilizes lewis acid sites and lithophilic ligands to promote efficient lithium-ion desolvation, resulting in an enriched lithium-ion concentration at the electrode surface. Furthermore, the artificial passivation layer effectively prevents electrolyte decomposition and enables uniform lithium-ion flux, leading to a homogeneous inorganic SEI layer. Overall, these effects contribute to the effective inhibition of dendrite growth, presenting a promising strategy for developing next-generation lithium metal batteries.

Poster Presentation **3PS-238**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Enhancing Oxygen Permeability and Mechanical Properties of HEMA-NVP Hydrogels via POSS Cross-linking

김민석, 노현호¹, 이준서¹, 진예민¹, 임정혁¹, 김경민¹

한국교통대학교

¹ 국립한국교통대학교

Hydrogels offer advantages such as high water content and inherent hydrophilicity, making them suitable for various biomedical uses, including contact lenses and drug delivery system (DDS) without additional surface modification. Yet, their low mechanical strength and oxygen permeability limit long-term use. To address these limitations, we introduce polyhedral oligomeric silsesquioxane (POSS), a hybrid organic-inorganic material, as a cross-linker in a 2-hydroxyethyl methacrylate (HEMA) and N-vinylpyrrolidone (NVP) matrix. Electron beam (e-beam) irradiation is used to initiate cross-linking without chemical initiators, thereby eliminating residual toxicity concerns while providing in-situ sterilization. The rigid Si-O-Si framework and nanoporosity of POSS are expected to enhance both the mechanical strength and oxygen permeability of the resulting hydrogels. The resulting hydrogels are characterized in terms of their structural properties, oxygen transmission, and biocompatibility.

Poster Presentation **3PS-239**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Micro-Patterning of Quantum Dot Films via Indirect Photolithography for Display Applications

김문근[†], 김혁준¹, 금진호¹, 강문성¹, 방준하[†]

고려대학교

¹ 서강대학교

Precise spatial patterning of quantum dot (QD) layers at the sub-micrometer scale is essential for integrating colloidal nanomaterials into emerging microdisplay technologies. Here, we present an indirect photolithographic strategy to fabricate microstructured QD films with excellent resolution and pattern fidelity. Surface engineering of QDs with polymeric ligands enables uniform and robust emission layers while preserving nanoscale structural integrity. This lift-off-based approach yields solvent-resistant QD micropatterns with defined geometry and compatibility with advanced color conversion architectures. Our results establish a versatile and scalable pathway for integrating QDs into high-resolution AR/VR microdisplays and next-generation optoelectronic systems.

Poster Presentation **3PS-240**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

High-Performance Ether-Free Solid Polymer Electrolyte via a Synergistic Integration of Crosslinking and Polymer-in-Salt Strategies

김동우, 유필진[†]

성균관대학교

Recently, lithium metal batteries have emerged as promising next-generation energy storage systems; however, due to safety concerns associated with flammable organic solvents, there is growing interest in replacing them with solid-state electrolytes. In particular, polymer-based solid electrolytes have attracted considerable attention owing to their high stability and interfacial compatibility. Among various polymer candidates, poly(vinylidene fluoride)(PVDF) offers excellent mechanical strength and electrochemical stability, but its intrinsically low ionic conductivity makes it unsuitable as a standalone electrolyte. In this study, we propose an integrated crosslinking and polymer-in-salt strategy that effectively overcomes the conventional trade-off challenges. In addition, the adoption of an ether-free structure using the novel crosslinker N,N'-Bis(vinylsulfonylacetyl)ethylenediamine contributed to wide electrochemical stability, resulting in high overall performance.

Poster Presentation **3PS-241**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Tunable Fluorescent Polymer Sensors through SuFEx-Mediated Side-Chain Modification

이선부, 허재영, 노승현, 안태은, 김경수¹, 이강민, 김태연, 배한용, 송창식[†]

성균관대학교

¹ 성균관대학교 화학과 고분자합성연구실

The rapid and reliable detection of explosives is essential for public safety. Here, we report a series of pentiptycene polymers synthesized via SuFEx click chemistry, incorporating organosulfur side chains to modulate the electronic environment. This side-chain engineering strategy enhances photoinduced electron transfer (PET) and optimizes fluorescence quenching dynamics, leading to improved performance. Among the series, SP-7 exhibits a quantum yield of 74% and achieves >94% fluorescence quenching within 60 s toward DNT vapor—significantly outperforming the polymer P-1 (61%). Mechanistic studies using time-resolved photoluminescence and transient absorption spectroscopy confirm that both static and dynamic quenching processes are accelerated in SP-7, driven by favorable energy alignment. These results show that precise control over polymer side-chain structure via SuFEx chemistry offers a powerful route to tunable, high-performance sensors for explosive detection.

Poster Presentation **3PS-242**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Antimicrobial and Self-Healing Properties of Vinylidene Fluoride-Based Elastomers

권태형, 손은호[†]

한국화학연구원

Fluoroelastomers have attracted significant attention due to their excellent physical properties, such as low surface energy and high biocompatibility, especially in the medical and healthcare fields. However, their hydrophobic nature may promote bacterial growth and biofilm formation. To address this issue, we developed antibacterial fluoroelastomers by introducing quaternary ammonium groups into VDF-based copolymers through a simple chemical modification. The resulting polymers were fabricated into films under varying drying temperatures. Their mechanical and dielectric properties were analyzed using UTM and dielectric spectroscopy. Furthermore, self-healing and antimicrobial activity tests were conducted to evaluate their functional performance. These antibacterial fluoroelastomers offer promising potential for future biomaterial applications.

Poster Presentation **3PS-243**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Recyclable Low-k Polymers with High Thermal Conductivity for High-Frequency Electronics

고혜윤, 정광운[†]

전북대학교

Recyclable low dielectric polymers (LDPs) exhibiting high thermal conductivity are newly developed for next-generation high-frequency electronic applications. By integrating fused aromatic mesogens and siloxane linkers with octavinylsilsesquioxane, the LDPs achieve ultralow dielectric permittivity ($D_k = 1.79$), low dielectric loss ($D_f = 0.004$), and high thermal conductivity ($\lambda = 0.89 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$) at high frequencies (1 to 10 GHz). Additionally, cold crystallization is strategically employed to control the molecular organization and chain alignment, allowing for the investigation of their effects on the thermal conduction and dielectric properties. The LDPs also demonstrate reprocessability and recyclability without performance degradation. These multifunctional materials offer promising potential for eco-friendly electronic packaging and signal transmission in high-frequency circuits. This work was supported by Basic Research Laboratory Program (RS-2023-00207836) and BK21 FOUR Program.

Poster Presentation **3PS-244**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Colorimetric and Fluorometric Ammonia Sensors Based on Pyridinium Ion-Containing Polydiacetylenes

고세종, 김종만[†]

한양대학교

Owing to the stimulus-induced colorimetric and fluorometric changes, polydiacetylenes (PDAs) have been extensively investigated as sensor materials. PDA can be readily prepared by photopolymerization of self-assembled diacetylene (DA) monomers. This study focused on the development of colorimetric and fluorometric ammonia sensor using pyridinium ion-functionalized PDAs. The effect of nitrogen atom position (ortho, meta and para) on the sensing performance was also evaluated. Exposure to ammonia afforded both color and fluorescence changes of the polymers and the para-substituted pyridinium ion-containing PDA displayed the highest sensitivity against ammonia. Thus, a brilliant blue-to-red color transition and a red fluorescence generation was observed upon exposure to ammonia gas. The potential of the PDA sensor as a colorimetric indicator for monitoring of food spoilage was proved by observing a time-dependent blue-to-red color change with a meat sample.

Poster Presentation **3PS-245**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Macrophage Modulation and Tubular Repair in Acute Kidney Injury via PEG–Hyaluronic Acid-Engineered Extracellular Vesicles

강희건, 박재형[†]

성균관대학교

Acute kidney injury (AKI) is characterized by the damage to tubular epithelial cells (TECs), resulting in the rapid deterioration of the kidneys. Furthermore, pro-inflammatory macrophages (M1) near AKI impede regeneration and hinder therapeutic interventions. Therefore, we developed extracellular vesicles (EVs) derived from polyethylene glycol (PEG) conjugated hyaluronic acid (PHA) coated mesenchymal stem cells. Hyaluronic acid (HA) conjugated EV functions as a Toll-like receptor 4 (TLR4) antagonist, which inhibits the polarization of macrophages towards the M1 phenotype. In addition, HA targets CD44, which is overexpressed on injured TECs, enabling the selective delivery of PHA-EVs and promoting tissue reparation. The therapeutic efficacy of PHA-EVs was verified in vitro and in vivo by confirming suppression of M1 polarization and enhancement of TEC recovery. Consequently, this study demonstrates an innovative approach with potential for clinical translation in AKI therapy.

Poster Presentation **3PS-246**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Photo-Crosslinkable PVAMA Hydrogel Microneedles for Enhanced Transdermal Delivery

강영민, 김민희^{*1}, 박원호⁺

충남대학교

¹ 경북대학교

Microneedle은 기존의 주사 방식과 달리 미세 구조를 통해 피부 장벽을 선택적으로 관통함으로써 통증을 최소화하면서도 효율적인 약물 전달이 가능하다. 본 연구에서는 methacrylated poly(vinyl alcohol) (PVAMA)와 poly(ethylene glycol) diacrylate (PEGDA)를 혼합하여 구조적 안정성이 향상된 microneedle을 제조하였다. 천연 항균 물질인 curcumin을 가용화하기 위해 β -cyclodextrin (β -CD)를 이용해 복합체를 제조하였고, UV 조사를 통해 microneedle을 가교시켰다. 낮은 수용성의 curcumin과 달리 β -CD와의 복합체 형성을 통해 수분 기반의 환경에서도 우수한 분산성과 안정성을 나타내었으며, 약물의 방출 효율과 생체 이용률이 크게 향상되었다. 최종적으로, β -CD-curcumin이 봉입된 microneedle은 항균 활성과 지속적인 약물 방출을 통해 여드름 치료용 경피 약물 전달 시스템으로서의 적용 가능성을 확인하였다.

Poster Presentation **3PS-247**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Adhesive Conductive Additive-Enabled Ultra-High Active Material Loading Electrodes with Reduced Binder Content for Enhanced Rate Capability

강민기, 유필진[†]

성균관대학교

Fast-charging kinetics in Li-ion batteries, essential for high-power applications like electric vehicles, require high-loading level (HLL) electrodes with minimized inactive materials for superior energy density and cycle life. Traditional conductive additives like carbon black induce electrolyte impregnation issues and electrode degradation, while carbon nanotubes (CNTs) improve conductivity and mechanical strength but face dispersion challenges. Here, we introduce carboxymethyl cellulose-functionalized CNTs (CMC-CNTs) as adhesive conductive additives, significantly improving dispersion stability, mechanical strength, and conductive networks in HLL electrodes. Utilizing CMC-CNT enables binder reduction to ~1.6 wt%, enhances rate capability by 33%, and reduces ion resistance by 14% compared to commercial electrodes (~2 wt% binder). Our results demonstrate CMC-CNT's strong potential to improve the mechanical robustness and fast-charging performance of commercial Li-ion batteries.

Poster Presentation **3PS-248**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Synthesis and characterization of gel polymer electrolyte based on episulfide group via In-situ thermal polymerization for high-performance lithium ion batteries

강동훈, 배완수, 송수빈, 주기종, 나혜원, 이지예, 이도율, 장호현⁺

건국대학교

Solid polymer electrolytes (SPEs) based on poly(ethylene oxide) (PEO) are promising for lithium-ion batteries due to their chemical stability and good interfacial compatibility. However, their high crystallinity leads to low ionic conductivity and a narrow electrochemical stability window. In this work, a new SPE was developed using allyloxy methyl thiirane (AMT), a sulfur and oxygen containing monomer, via in-situ thermal polymerization initiated by lithium bis(fluorosulfonyl)imide (LiFSI). Ethylene carbonate (EC) and diethyl carbonate (DEC) were added to form GPE-2, which created uniform coatings on electrodes and enhanced cycling performance. The polymer structure was characterized by FT-IR and ^1H NMR, and electrochemical properties were evaluated using electrochemical impedance spectroscopy (EIS), linear sweep voltammetry (LSV), battery charge-discharge cycle testing, and lithium-ion transference number (t^+) measurements.

Poster Presentation **3PS-249**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Synthesis and Characterization of Highly Flexible Polyurethane Crosslinked with Slide-ring Polyrotaxane Composed of Poly(propylene glycol)-methyl- β -cyclodextrin

Rudru gangaratnamma, 정일두[†], 이지현

부산대학교

In this study, highly stretchable low covered movable slide-ring polymer gel was synthesized by crosslinking with diisocyanate and poly (propylene glycol)-methyl- β -cyclodextrin polyrotaxane. Low covered polyrotaxane was synthesized from methyl- β -cyclodextrin (Me- β -CD) and poly (propylene glycol) (PPG) with a molecular weight of 1000 and expected to have higher elongation properties than full covered polyrotaxane because of easier movement of ring structure along the main chain. The slide ring movement of crosslinked Me- β -CD on polyurethane backbone allows it to stretch without deformation. These unique properties of the resulting gels potentially act as flexible materials and create new opportunities for biomedical applications. The low covered polyrotaxane and polyurethane were characterized by FT-IR, ¹H-NMR and UV-vis spectroscopies. In addition, the elongation of polyurethane according to the content of polyrotaxane was shown through tensile strength measurement.

Poster Presentation **3PS-250**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Pressure Sensitive Adhesives from Supramolecular Movable Cross-linkers

Rudru gangaratnamma, 정일두[†]

부산대학교

Pressure-sensitive adhesives (PSAs) form bonds with various surfaces under light pressure due to their inherent tackiness at ambient conditions. They are widely used in applications ranging from packaging to electronics and medical devices. Incorporating movable cross-links into PSAs enables stress relaxation and improved adhesion without compromising cohesive strength. In this study, we explore the effect of mobile cross-links on the performance of a bio-friendly PSA formulated from cyclodextrin-based macromolecular composites. Polyrotaxane was functionalized with lipoic acid and 2-isocyanatoethyl methacrylate to introduce dynamic bonding. The resulting adhesives were characterized using FTIR, DSC, TGA, and mechanical tests. By systematically tuning the formulations and analyzing their mechanical and adhesive behaviors, we established structure–property relationships that support the development of sustainable, high-performance pressure-sensitive adhesives.

Poster Presentation **3PS-251**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Synthesis of Covalent Framework Membrane with beta-Cyclodextrin-incorporated Continuous 3D Nanopores

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Gwangju Institute of Science and Technology

¹ 광주과학기술원

² 충남대학교

We fabricated a three-dimensional continuous membrane with decorated beta-cyclodextrin (β -CD) on its nanopores. The membrane was synthesized using a facile organic sol-gel method with phase separation engineering. In this method, urea-bonded (UN) sols were formed by the polymerization of tetrakis(4-aminophenyl)methane (TAPM) and hexamethylene diisocyanate (HDI). These UN sols were then sequentially mixed with β -CD and poly(methyl methacrylate). Upon the extraction of PMMA, a 3D continuous nanoporous membrane incorporated with β -CD was formed, as evidenced by Fourier transform infrared (FTIR) spectroscopy and scanning electron microscope (SEM) imaging. With its nanoporous structure and functions, the developed material possesses diverse applications, including chirality-driven molecular separation and catalysis.

Poster Presentation **3PS-252**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Tunable Porous Polyurea Membranes with Embedded Metal Nanoparticles for Sustainable Catalysis

Elsayed Mostafa, 박지웅¹

GIST

¹ 광주과학기술원

In this study, we present the fabrication and characterization of a porous membrane based on a polyurea network synthesized via sol-gel polymerization, employing polyethylene glycol (PEG) as a porogen. Then, Pd nanoparticles were loaded through wet impregnation and in situ reduction techniques. This approach enables control over pore size and distribution, which is critical for subsequent catalytic applications.

The metal-loaded membranes will be utilized for catalytic applications, particularly in selective hydrogenation reactions such as the phenol-to-cyclohexanone reaction. Future work will focus on evaluating performance, with an emphasis on activity, selectivity, and reusability in both batch and flow-through modes.

This work demonstrates a versatile platform for the design of functional porous membranes with embedded catalytic sites, which can be tailored for advanced applications in green chemistry and energy-related processes.

Poster Presentation **3PS-253**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Red Sea Star-Inspired Polyurethane with Rapid Underwater Self-Healing via Dual Hydrophobic Units and Tandem Dynamic Bonds

Deng Limin[†], 이정용^{*1}, 영우빈^{*1}

카이스트

¹ KAIST

Inspired by the red sea star's fibrinolytic healing, we developed a polyurethane (DSFPU-3) with rapid underwater self-healing at ambient conditions. It integrates dual hydrophobic units—fluorinated hard segments and alkyl-chain soft segments—to repel water and protect dynamic bonding sites. Tandem dynamic covalent bonds (disulfide and imine) enable fast bond exchange and healing. DSFPU-3 shows excellent mechanical properties (tensile strength 4.2 MPa, toughness 17.9 MJ·m⁻³) and retains integrity after 4 days underwater. Optical and 3D microscopy confirm surface scratches heal fully within 12 hours at room temperature, with 98% mechanical recovery and a healing rate over 33.33 μm/h. Rheology and scratch-depth decay analysis support the self-healing mechanism. This approach offers a pathway to design high-performance underwater self-healing polymers for bioelectronics, soft robotics, and implants.

Poster Presentation **3PS-254**

기능성 고분자(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

A Photonic Polymeric Sensor Based on the Intertwined Cholesteric Liquid Crystal Structure for Humidity Monitoring

**BILAL UD DIN KHAN, Hafiz Saad Khaliq¹, Young-Min Cho¹, Min-Seok Kim¹,
Jae-Won Lee¹, 김학린⁺**

경북대학교

¹ Kyungpook National University

Detecting humidity is crucial in many fields, but most sensors need power, react slowly, or are made using costly and complicated processes. In this study, an optical sensor is constructed by integrating a cholesteric liquid crystal (CLC) structure with a hydrophilic polymer. Successful fabrication and subsequent extraction of the non-reactive mesogenic moiety from the CLC_{solid} film made it porous for monomer infiltration and subsequent cross-linked hydrophilic polymer network formation. The prepared film in exposure to change in %RH underwent redshift in a short time and returned to its original state accordingly. The color change was visible to the naked eye, so no complex equipment was needed. The sensor worked well over many cycles and keeps its optical appearance and performance. This simple and low-cost method could be useful for making other sensors that respond to changes in the environment.

Poster Presentation **3PS-255**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Synthesis and characterization of Hydroxyl-functionalized Polyimide for Gas separation membrane

박혜린, 백정주, 장기철, 김영훈, 고원건¹, 신교직⁺

한국생산기술연구원

¹ 연세대학교

Polyimides are high-performance polymers with excellent thermal and chemical stability, making them suitable for membrane-based gas separation. Incorporating polar groups into the backbone enhances interchain interactions and packing density, improving gas selectivity. In particular, hydroxyl groups facilitate hydrogen bonding and charge transfer complex (CTC) formation, increasing packing density. In this study, a hydroxyl-functionalized dianhydride and diamine were synthesized and polymerized via polycondensation to prepare a novel polyimide membrane. The chemical structures of the monomers and resulting polyimide were confirmed by NMR and FT-IR spectroscopy. Thermal stability of the polyimide was evaluated by DSC and TGA analysis. Chain packing characteristics were investigated through free volume and porosity analysis. In this regard, we observed the potential for enhanced hydrogen separation performance and applicability in next-generation hydrogen separation membranes.

Poster Presentation **3PS-256**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Synthesis of N-Alkylamide-Functionalized Vinyl-Addition Polynorbornenes by Post-Polymerization Modification for Enhanced Physical Properties

박준우, 채창근[†]

한국화학연구원

N-Alkylamide-functionalized vinyl-addition polynorbornenes were synthesized via post-polymerization modification to enhance physical properties through interchain hydrogen bonding interactions. Ester-functionalized polynorbornenes were prepared as precursor polymers with varying ester contents via Pd(II)-catalyzed vinyl-addition copolymerization. The gradient monomer sequence was confirmed by determining the reactivity ratios. Precursor polymers were employed in organobase catalyzed amidation with alkylamines. The amidation efficiencies ranged from 70% to 90%. At low amide contents of approximately 10 mol%, tensile strength increased by 10 MPa due to interchain hydrogen bonding, while T_g was reduced by only about 20 °C. Moreover, in the case of polymers functionalized with dodecyl amide, tensile toughness was improved by up to 2 times due to stress relaxation during tensile deformation and the reversible hydrogen bonding.

Poster Presentation **3PS-257**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Thermal Properties Control via Mesogenic Tail Engineering in Self-Assembled PEG-Based Liquid Crystal Polymers

박소정, 구교선, 여현욱[†]

경북대학교

Polyethylene glycol (PEG) is an attractive polymer applied in various fields based on its versatility including thermal stability, flexibility, and eco-friendliness. Meanwhile, liquid crystal polymers (LCP) have the potential as various functional materials based on self-assembly properties based on intermolecular interactions. In this study, PEG based LCP was synthesized by anionic ring opening polymerization of epoxide. In particular, the effect of alkyl-tail was investigated on the molecular orientation and physical properties by adjusting the length of the alkyl-tail length. The orientation properties were investigated by POM and XRD, and thermal properties were investigated by DSC, TGA and thermal conductivity measurements. The results demonstrate that the control of the mesogenic architecture can effectively guide the design of self-assembled polymer systems for improved thermal properties.

Poster Presentation **3PS-258**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Tailoring Self-Assembly and Thermal Conductivity via Aliphatic Spacer Design in PEG-Based Side-Chain LCPs

남은서, 여현욱[†], 구교선

경북대학교

Liquid crystal polymers (LCPs) are high-performance materials which have high thermomechanical properties, and molecular alignment-induced thermal conductivity. Due to these outstanding properties, LCPs have attracted considerable attention in the electronics, automotive, and aerospace industries. In this study, we report the novel side-chain LCPs based on biphenyl mesogenic units with varying aliphatic spacers. A series of epoxide monomers were designed and synthesized, and the corresponding polymers were obtained via anionic ring-opening polymerization containing well-defined PEG-based main chains. Phase transitions and liquid crystalline behavior were investigated using DSC and POM. Thermal characteristics were evaluated via DSC, TGA, DMA, and thermal conductivity measurements. The molecular alignment were examined through SAXS and WAXS. The liquid crystalline behavior varied with alkyl spacer length, and the polymers showed enhanced properties over conventional PEG.

Poster Presentation **3PS-259**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Reprogramming silica formation with dual-function alkylamines for rapid and tunable synthesis

황혜림[†], 김은성¹

이화여자대학교

¹ 이화여자대학교

Tunable silica particles are essential building blocks across fields such as catalysis, drug delivery, and photonic materials, yet current synthetic approaches remain limited in speed and versatility. The conventional Stober method offers monodispersity but suffers from long reaction times and poor tunability. This study presents an improved strategy by introducing alkylamines as both catalysts and surfactants, accelerating synthesis while preserving spherical monodispersity. Systematic variation of alkylamine type and concentration enabled precise control over reaction kinetics, particle morphology, and dispersion stability. The mechanism of surfactant-mediated particle formation was investigated by analyzing TEOS-micelle interactions and the role of alkylamine-solvent affinity in nucleation and growth dynamics. These findings expand the parameter space of the Stober method and establish a versatile platform for rapid synthesis of functional mesoporous silica particles.

Poster Presentation **3PS-260**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Synthesis and characterization of water-soluble organic polymers for biosensor applications

김영훈, 정찬희, 김영웅, 이택승⁺

충남대학교

Fluorescent polymer-based biosensors have emerged as a promising platform for the sensitive detection of microorganisms. Conjugated polymers (CPs) are attractive materials due to their distinct optical properties, which enable rapid and sensitive detection of bacteria. However, their use is limited by their poor solubility, aggregation, and low biocompatibility. To overcome these issues, we introduced water-soluble groups into the backbone of a CP. Donor monomers with sulfonate groups and acceptor monomers with a benzothiadiazole structure were synthesized and polymerized to obtain a water-soluble CP with enhanced fluorescence. The key reactions included aromatic bromination, Suzuki-Miyaura cross coupling, and Stille coupling. The structure of the CPs was confirmed using FT-IR and ¹H NMR spectroscopy, and their optical properties were analyzed by UV-Vis and photoluminescence spectroscopy. The resulting polymer demonstrated good solubility and strong fluorescence in water.

Poster Presentation **3PS-261**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Post-Functionalization of Polyethers via Light-Induced C–H Amidation

김영호, 서명은[†]

한국과학기술원

Direct functionalization of polymer C–H bonds offers a way to enhance polymers by adding new groups, but preserving chain integrity is difficult. We report a metal-free method for modifying polyethers via light-induced α -C–H amidation. This enables the synthesis of α -amino-functionalized polyethers with unique properties. The reaction follows a polar-radical relay mechanism, allowing selective C–N bond formation at ether α -positions. It minimizes backbone damage and cross-linking under mild conditions. The method shows high selectivity and potential for broader use, including controlled degradation of polyethers and modification of PEG-based materials.

Poster Presentation **3PS-262**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Semi-Interpenetrating Polyimide-Acrylamide Glycol Gel with Tunable Thermomechanical Properties for Shape-Deformable Display Substrates

김영인, 구강희[†]

울산과학기술원

This study presents a semi-interpenetrating network (Semi-IPN) glycol gel by incorporating polyimide into an acrylamide-based matrix. While polyimide is widely used as a display substrate for its excellent thermal and chemical stability, its rigidity limits its application in next-generation displays that require stretchability and freeform deformation. To overcome this limitation, the Semi-IPN structure combines the flexibility of acrylamide gel with the mechanical strength of polyimide, improving mechanical durability and enabling precise tuning of thermomechanical properties, including the glass transition temperature (T_g). By optimizing polyamic acid (PAA) concentration and UV curing conditions, tunable transparency, stretchability, and T_g in the range of 150–200°C are achieved. The developed Semi-IPN glycol gel shows promising potential as a flexible and reliable substrate for next-generation shape-deformable displays.

Poster Presentation **3PS-263**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Optimization of Silver Nanowire Growth via FeCl_3 Concentration and Reaction Temperature

김순호, 윤제문[†], 최재학¹

동의대학교

¹ 충남대학교

Silver nanowires (AgNWs) have emerged as strong candidates to replace indium tin oxide (ITO) in transparent electrode applications due to their superior conductivity, transparency, and mechanical flexibility. In this study, we systematically investigated how variations in FeCl_3 concentration and synthesis temperature affect the morphological evolution of AgNWs. Experimental results revealed that both parameters significantly influenced the length and diameter of the nanowires, which are directly linked to their optical and electrical properties. AgNWs synthesized under specific conditions exhibited uniform structure and high aspect ratios, indicating their suitability for high-performance transparent electrodes. These findings provide useful insights into the optimization of AgNW growth and offer a foundation for the development of next-generation flexible and transparent electronic devices.

Poster Presentation **3PS-264**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Synthesis of a Thermoresponsive Hydrogel Based on Amphiphilic Copolymer Bearing Polyoxazoline End-Blocks

김다혜, 김세영[†], 김신철

단국대학교

In this study, a thermoresponsive hydrogel with decent biocompatibility was developed based on a triblock copolymer, poly(2-isopropyl-2-oxazoline)-b-poly(ethylene oxide)-b-poly(2-isopropyl-2-oxazoline) (PiPOx-PEO-PiPOx). Both the central PEO block and the terminal PiPOx blocks are water-soluble at room temperature. However, above 40 °C, the PiPOx segments undergo a Lower critical solution temperature (LCST) transition, increasing hydrophobicity and promoting hydrophobic association. This thermoresponsive phase transition creates a network of nanosized physical crosslinks made from the PiPOx terminal block, leading to a well-defined sol-gel transition. Such behavior makes this hydrogel a promising potential for biomedical applications, including injection-based administration, controlled drug release, and static tissue engineering.

Poster Presentation **3PS-265**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Side Chain-Directed Control of Chiral Amplification in Self-Assembled Systems

김강석, 서명은[†]

한국과학기술원

Amino acids and proteins have inherent chirality and directional preferences, essential to their biological roles. These biomolecules show superior organization and efficiency compared to synthetic polymers. A central topic in supramolecular chemistry is the origin and amplification of homochirality through assemblies that respond to stimuli. These dynamic systems allow efficient chirality transfer via cooperative non-covalent interactions, often reflected in enhanced circular dichroism (CD) signals. The "sergeant-and-soldier" principle, where a few chiral sergeants guide achiral soldiers to form chiral assemblies, is a key strategy. Recent studies show that triarylamine derivatives can form co-assemblies with higher chiroptical activity than systems made of only chiral units. This study explores how side chain structures affect chiral amplification and aims to determine optimal molecular conditions to maximize chiral induction and transfer in supramolecular assemblies.

Poster Presentation **3PS-266**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Microspheres for Sustained Release of Anti-VEGF Drugs in Treating Subfoveal Choroidal Neovascularization

김강민, 임수연, 김병덕, 유빈, 이지현, 박효진, 정지훈[†]

성균관대학교

Age-related macular degeneration (AMD) is a leading cause of vision loss, primarily driven by pathological neovascularization mediated by the vascular endothelial growth factor (VEGF) pathway. This study investigates the therapeutic potential of sustained-release microspheres formulated with poly(lactic-co-glycolic acid) (PLGA) for controlled delivery of the anti-VEGF drug, Rivoceranib. Rivoceranib was encapsulated using an oil-in-water (o/w) single emulsion method followed by solvent evaporation. In vivo experiments utilizing a laser-induced choroidal neovascularization (CNV) mouse model demonstrated that Rivoceranib-loaded PLGA microspheres significantly suppressed neovascularization. These findings suggest that sustained-release PLGA microspheres containing Rivoceranib could serve as an innovative strategy for treating wet AMD through drug repositioning, offering prolonged efficacy and reduced administration frequency.

Poster Presentation **3PS-267**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Compositionally Tuned Methacrylate–Polysiloxane Systems for Transparent Thin Films

류상욱[†], 구윤기

충북대학교

Polysiloxanes containing methacrylate and various organic substituents can remain in a resin state at room temperature and form transparent, hard, glassy thin films through UV curing. In this study, a new ternary synthesis system was proposed by introducing trimethoxymethylsilane into the previous binary system composed of 3-trimethoxysilylpropyl methacrylate and dimethoxysilane. The incorporation of a non-bulky molecule promoted the formation of a more compact network structure, leading to enhanced thermal stability and hardness in the resulting glassy thin films.

These results demonstrate that the mechanical and optical properties of polysiloxane films can be effectively tuned through compositional control, suggesting a meaningful design strategy for the development of high-performance silicone-based thin film materials.

Poster Presentation **3PS-268**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Topochemical Polymerization of Peptide Monomers via Azide–Alkyne Cycloaddition

구성모, 이희승[†]

한국과학기술원

Proteins in nature perform diverse functions based on their well-defined structures. Although extensive efforts have been made to mimic their structure and function, achieving precise control over higher-order architectures remains challenging, requiring the development of new efficient covalent linking strategies. In this study, we explore an alternative approach to polypeptide synthesis using topochemical azide–alkyne cycloaddition(TAAC), a powerful strategy for constructing well-ordered polymers with high regioselectivity in a catalyst-free and solvent-free manner. Short peptide monomers bearing azide and alkyne groups were synthesized, and single-crystal X-ray diffraction (SCXRD) confirmed the spatial alignment of reactive groups in the crystalline state. The TAAC reaction was triggered in the solid state, and structural analysis revealed the formation of a polymer-incorporated crystal structure. These findings provide valuable insights for the design of biomimetic materials.

Poster Presentation **3PS-269**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Molecular Alignment-Driven Thermal Transport Properties in Liquid Crystalline Epoxy Resin Prepared by Anionic Ring-Opening Polymerization

구교선, 여현욱[†]

경북대학교

In this study, a series of liquid crystal epoxy resins (LCEs) were synthesized via anionic ring-opening polymerization using mesogenic bifunctional epoxy monomers. The molecular design incorporated a rigid biphenyl-based core and flexible alkyl spacers, which facilitated mesophase formation and enhanced molecular orientation. The formation of liquid crystalline alignments during polymerization was confirmed by polarization optical microscopy (POM). Furthermore, the molecular alignment of cured resins was investigated using small- and wide-angle X-ray scattering (SAXS and WAXS). In particular, correlation was observed between the mesophase alignment and the thermal conductivity of the polymer network through systematic changes in the molecular structure. This study highlights the crucial role of molecular structure and mesogenic order in regulating the thermal performance of epoxy-base thermoset.

Poster Presentation **3PS-270**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Thermal and Environmental Degradability of Camphor-Incorporated Poly(Hexylene Terephthalate) Copolymers

강주희[†]

한국생산기술연구원

Research on bio-based alternatives to plastics has improved due to their detrimental effects on the environment. The environmental drawbacks of traditional plastics have prompted increased focus on researching bio-based alternatives. As a bicyclic monomer, camphor-incorporated diester is introduced in the synthesis of bio-based polyesters. We report a two-step melt polymerization method for aliphatic polyester, using a novel designed diester monomer to produce poly(hexylene terephthalate camphor dimethyl tartrate). The structure of the copolymer was validated using nuclear magnetic resonance (NMR) and Fourier transform-infrared (FT-IR), successful synthesis. The estimation of molecular weight and their distribution was conducted through high-temperature gel permeation chromatography (HT-GPC). To evaluate thermal performance, differential scanning calorimetry (DSC) was employed to analyze the thermal behavior of the novel copolymers, offering valuable information on their thermal stability and degradation behavior.

Poster Presentation **3PS-271**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Synthesis of Organic Semiconductor Polymers with Donor–Acceptor Structures.

이택승[†], 정찬희, 김영웅, 강민경¹

충남대학교

¹ 충남대학교

Conventional conjugated polymers, which have a uniform and repeating electronic structure, have limited bandgap tunability and low charge mobility. This challenge precise control of their electrical and optical properties. In contrast, organic semiconductor polymers have a donor-acceptor based repeating structure, resulting in a narrower bandgap and conductivity. In this study, we synthesized donor-acceptor structure-based conjugated polymers to overcome the limitations of conventional materials. The process involves the synthesis of two monomers followed by polymerization. A conjugated polymer was polymerized using a donor moiety based on an alkoxy-substituted benzene ring and an acceptor moiety consisting of a benzothiadiazole core linked to thiophene units. Each synthetic step was confirmed by FT-IR and ¹H NMR spectroscopy. In addition, UV-Vis spectroscopy analysis exhibited fluorescence emission, indicating the presence of a conjugated structure

Poster Presentation **3PS-272**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Synthesis and Characterization of High-Strain Polyimides from Urethane-Based Diamines

강경윤, 이주현, 이승우[†]

영남대학교

Polyimide (PI) is a high-performance polymer with excellent thermal stability, mechanical strength, and chemical resistance due to its rigid aromatic structure. Polyurethane offers high tensile strength, toughness, and flexibility. To develop a PI with high tensile strain, we synthesized novel diamine monomers containing both ethylene and urethane groups. Three monomers with three, four, and five ethylene units were prepared and polymerized with 6FDA. Monomer structures were confirmed by FT-NMR, and the resulting polyimides were characterized by FT-NMR and FT-IR spectroscopy. Thermal properties were evaluated by thermogravimetric analysis (TGA), and mechanical properties were measured using a universal testing machine (UTM). The synthesized polyimides showed tensile strains up to 15%, demonstrating enhanced flexibility while maintaining thermal stability.

Poster Presentation **3PS-273**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Reprocessable Diallyl-based Liquid Crystal Elastomers with Highly Ordered Microstructure

Thu Loan Dang, 구교선¹, 여현욱^{1,2}

Kyungpook National University

¹ 경북대학교 물산업융합연구소

² 경북대학교

This study presents a solvent-free thiol-ene polymerization strategy conducted under thermal conditions with a radical initiator. A series of liquid crystalline diallyl monomers featuring twin biphenyl mesogens were synthesized and systematically evaluated. Among them, the optimal monomer was identified and copolymerized with a multifunctional thiol, yielding a liquid crystal elastomer (LCE) with a highly ordered microstructure. The resulting LCE exhibits effective reprocessability and retains its mesophase characteristics after thermal reprocessing, contributing to sustainable material development. Small- and wide-angle X-ray scattering (SAXS and WAXS) confirmed the presence of smectic phases in both the pristine and reprocessed networks. The elastomers also demonstrate enhanced thermal conductivity ($0.4 \text{ W m}^{-1} \text{ K}^{-1}$), approximately twice that of conventional thermoset polymers.

Poster Presentation **3PS-274**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Design and Synthesis of Natural Molecules-Based Liquid Crystalline Epoxy Resins

Linh Pham, 구교선¹, 여현욱^{*1}

Institute for Advanced Fiber Convergence Materials, KNU

¹ 경북대학교

Biomass-derived materials have gained attention in recent years due to their diverse raw material sources and potential to reduce environmental impact. However, a drawback is the lack of fundamental properties, which we aim to improve by utilizing the self-assembling characteristics of liquid crystals. In this study, natural molecules-based liquid crystalline epoxy resin (N-LCERs) are designed and synthesized. Featuring a conjugated aromatic ester structure and a flexible spacer, N-LCERs contribute to the formation of an oriented crystalline network in the cured epoxy via π - π stacking, enhancing intrinsic physical/chemical properties. The presentation will cover the liquid crystalline properties of the developed N-LCER monomers and the fundamental properties of the cured N-LCERs.

Poster Presentation **3PS-275**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Improving ion uptake in artificial synapses through facilitated diffusion mechanisms

LANDEP AYUNINGTIAS, 김윤희¹

Gyeongsang National University

¹ 경상대학교

The attachment of glycol side chains can remarkably enhance the ion transport to improve nonvolatile properties via polar groups; however, a comprehensive and methodical evaluation of this phenomenon has yet to be conducted. In this study, we observed the reactivity toward ions and the doping mechanism that changes by glycol group substitution to the side chains of DPP polymers. The analysis revealed that in the presence of glycol chains, the doping mechanism changes to diffusion-dominated, which allows ions to penetrate the channel and interact with it more intensely, thereby enhancing synaptic performance. The fabricated devices successfully mimicked the behavior of biological synapses, such as good long-term synaptic plasticity (LTP), paired-pulse facilitation (PPF), and long-term potentiation/depression (LTP/D).

Poster Presentation **3PS-276**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Side chain effect of benzodithiophene on the diketopyrrolopyrrole-based copolymer for the optoelectronic properties

Karina Ayu Larasati, 김윤희[†]

Gyeongsang National University

This study explores the synthesis and properties of two DPP-based copolymers, PBDTTT-DPP-C12 and PBDTTT-DPP-C17, differing in alkyl side chains. Both were synthesized via alkylation, lithiation, bromination, and Stille coupling. Structures were confirmed by ^1H NMR. Thermal analysis showed high stability with decomposition temperatures of 377 °C and 367 °C, respectively. UV-Vis spectra showed dual-band absorption with λ_{max} at 669 nm (C12) and 700 nm (C17), slightly red-shifted in film. Electrochemical studies via CV showed similar HOMO levels (−5.22 eV and −5.23 eV) and LUMO levels (1.47 eV and 1.49 eV). GIWAXS and AFM revealed PBDTTT-DPP-C12 had more edge-on orientation. In OPV devices, PBDTTT-DPP-C17 achieved higher PCE (2.8%) than C12 (1.8%). These results highlight how side-chain engineering impacts morphology, crystallinity, and solar cell efficiency in DPP polymers.

Poster Presentation **3PS-277**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Solution-Processed Di-Alkylphosphonic Acid Modified MXenes: Stable Dispersion, Oxidation Resistance, and EMI Shielding at Reduced Thickness

Ujala Zafar, 구종민¹

Sungkyunkwan University

¹ 성균관대학교

MXenes are promising conductive 2D materials, but their hydrophilic nature and poor compatibility with non-polar environments hinder their processing and coating applications. Here, we report a simple solution-phase approach for covalent surface modification of $\text{Ti}_3\text{C}_2\text{T}_x$ MXene using di-alkylphosphonic acid molecules, which attach in a face-on configuration without the need for catalysts or linking agents. The functionalized MXenes become hydrophobic and show stable dispersibility in a wide range of organic solvents, while retaining high electrical conductivity. Importantly, the modified MXenes exhibit exceptional stability against oxidation, with no significant oxide formation observed even after 30 days. Owing to the strong ligand attachment, these MXenes can be uniformly coated onto diverse substrates—including Cu, Al foil, PET, Ni foam, and even Teflon—where pristine MXene typically fails to adhere. Films fabricated from the dispersions deliver comparable electromagnetic interference (EMI) shielding efficiency to pristine $\text{Ti}_3\text{C}_2\text{T}_x$, but at reduced thicknesses. This facile and scalable modification strategy demonstrates a powerful route to produce long-term stable, processable, and conductive MXenes for advanced EMI shielding, flexible coatings, and printable electronic applications.

Poster Presentation **3PS-278**

고분자 합성(III)

2025.10.1(수), 08:30~10:00, 포스터장

Chair: 안효성, 양상희

Selective Bilayer-Al Removal in MoAlB Enables High-Yield Mo₂B₂ MBene with Enhanced Microwave Absorption Behavior

공상몽, 구종민[†]

성균관대학교

Two-dimensional transition-metal borides (MBenes) have recently emerged as MXene-analogous materials, yet their synthesis remains challenging, particularly from MoAlB, whose characteristic Al–Al bilayer stacking hinders A-site removal. Here we report a concept-level, chemoselective route that extracts Al while preserving the in-plane Mo–B and B–B networks, yielding high-yield few-layer Mo₂B₂ MBene. The resulting 2D material exhibits strong microwave attenuation: at a total absorber thickness of 4.6 mm, the minimum reflection loss reaches –50.6 dB in the low-frequency regime. Structure–property analysis indicates that retention of B–B covalency and the Mo–B framework underpins effective dielectric loss and impedance matching. Beyond this specific system, the demonstrated selective removal of a double Al layer establishes a viable pathway toward broader MBene chemistries derived from Al-rich MAB phases..



Advanced Polymer Testing

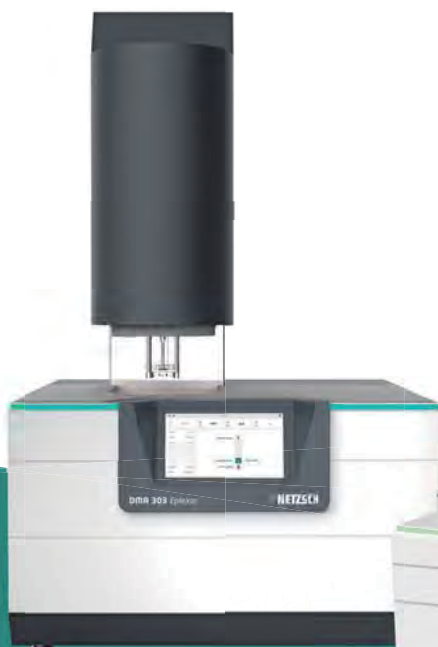
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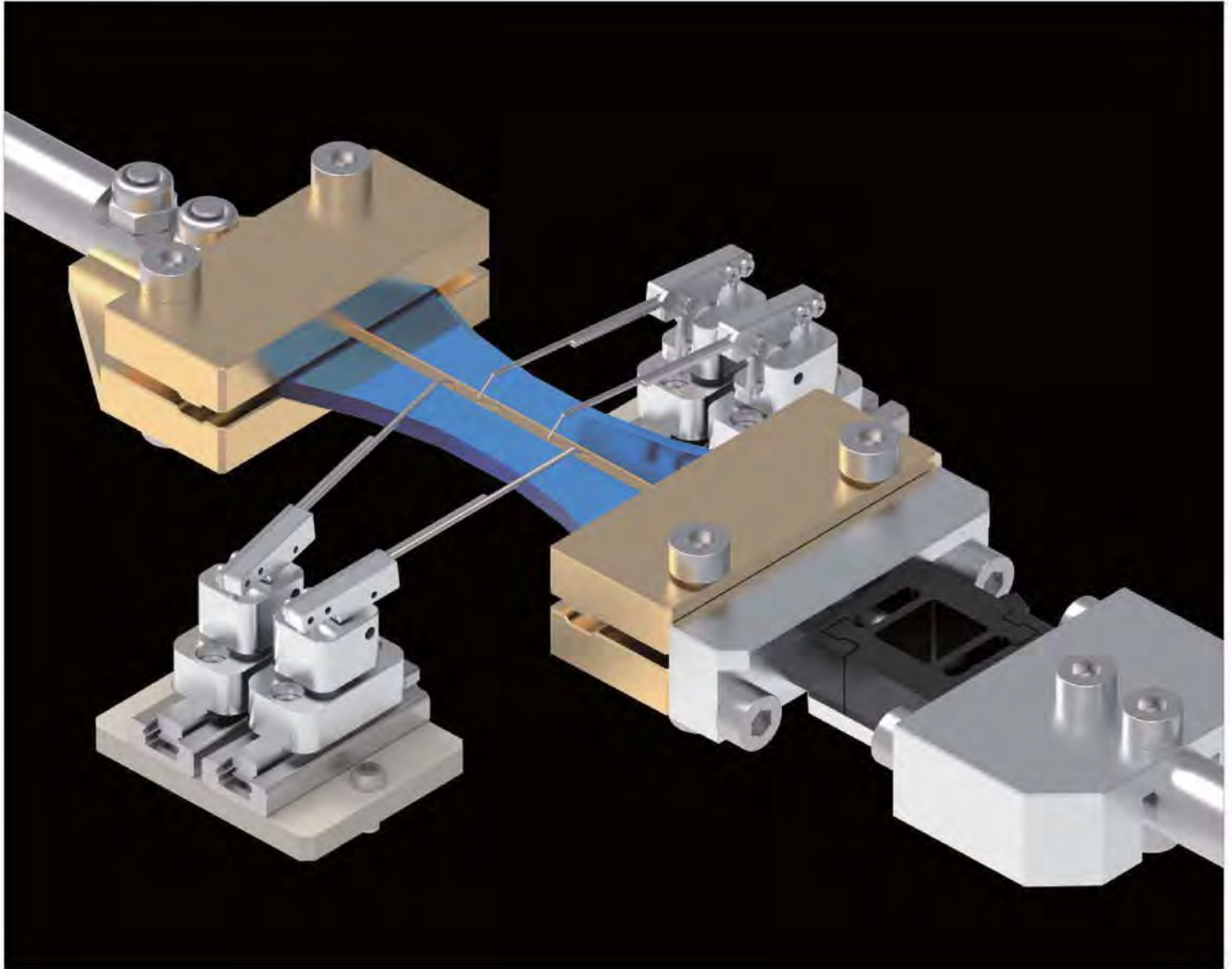
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9/22(MON) ~ 10/12(SUN)

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접수 기간 및 방법

[접수 기간] 9/22(월) ~ 10/12(일)

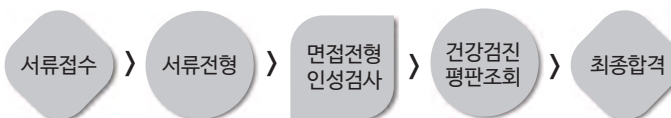
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[신입 박사] '26.1월 이내 입사 가능한 박사 학위 취득자
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전형 단계



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- 롯데그룹 채용 홈페이지 Q&A
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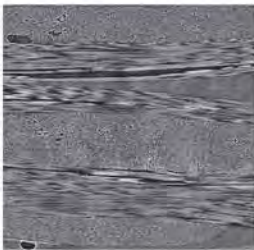
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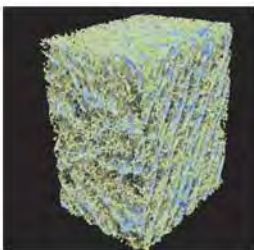
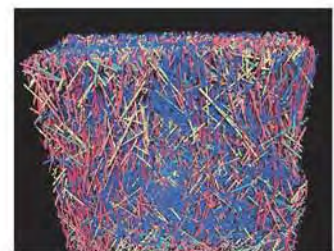


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- 높은 재현성: 시험자와 관계없이 동일한 결과 확보
- Strain Sweep Control: 물성 미지의 재료도 안정적으로 시험 가능 (토크·변형률 자동 조절)
- 측정 효율성: 최대 5개 시편 연속 자동 측정으로 작업 부담 및 시간 절감
- 확장 기능: 고온(350°C) 조건에서 High torque까지 측정 가능
- 대표 응용 분야
 - 프리프레그(Pregreg): 경화 과정 및 Tg 측정 (예: 177 °C 경화 후 Tg 약 120 °C)
 - 수지(Resin): 에폭시, 열경화성·열가소성 수지
 - 고무(Rubber): 스트레스 제어 기반의 배합물 특성 평가
 - 폴리프로필렌(PP)·폴리스타이렌(PS): 온도 변화에 따른 용점 및 점탄성 분석

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Materials

Analytical Reagents



TCI-SEJIN CI



Brochure

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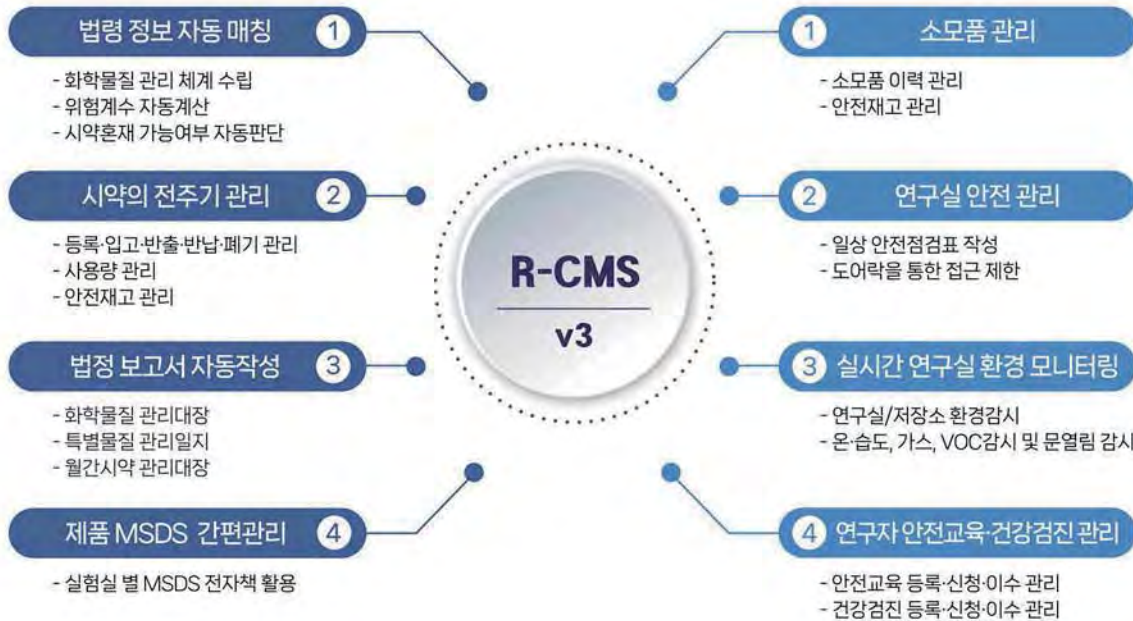
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- Wavelength (184 & 254nm or 254nm)
- High Intensity



AC-3 (COVER TYPE)



GPC (SEALING TYPE)



AC-6 (DRAWER TYPE)

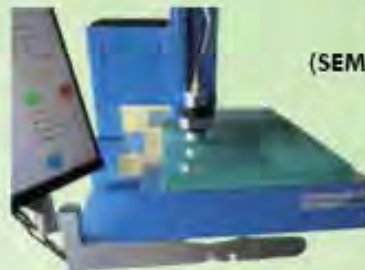
비저촉며저하초저장비 비저촉며저하초저장비

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ANOTHER PRODUCT



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계측기기 전문기업 및 국제공인교정기관

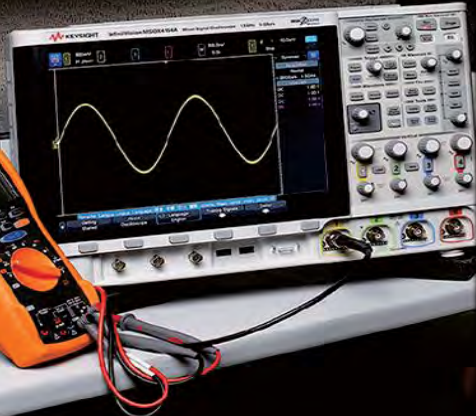
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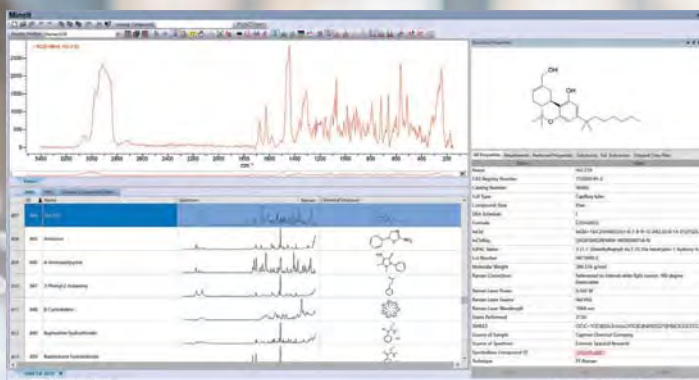
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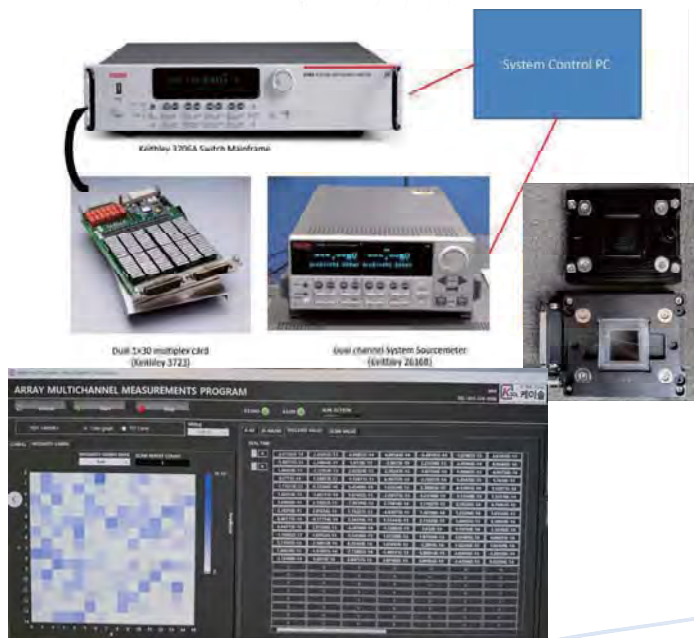


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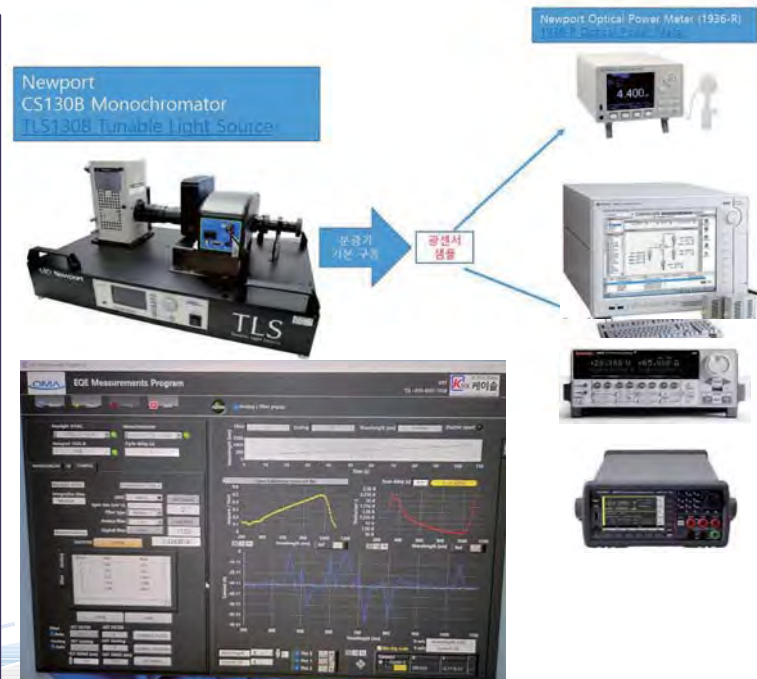
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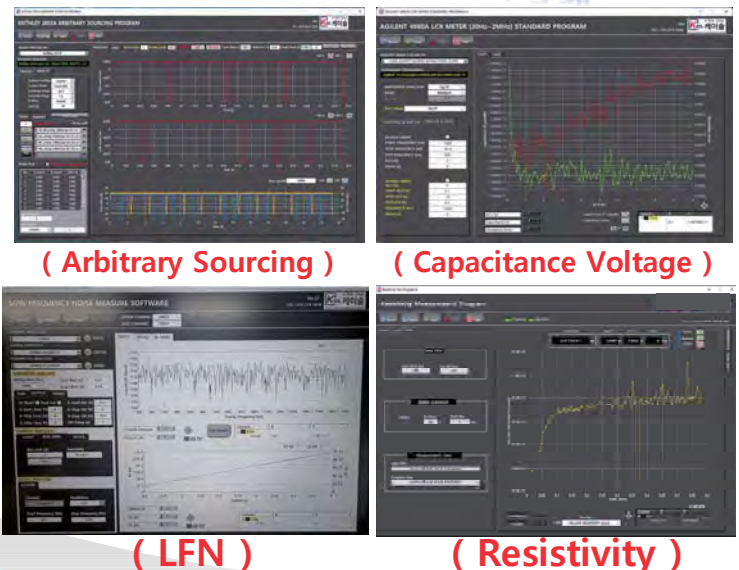
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만드는 기술

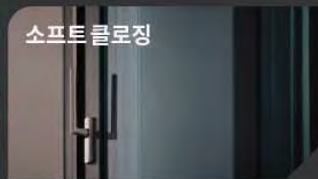
기술에 아름다움을
더하는 감각

그 전부를 창호에 담아
클렌제가 되다

4중 유리 단창



소프트 클로징



4면 밀착 시스템



소비자행동 환경만족지수
2025년 창호제 부문 1위



한국품질만족지수
2024년 창호 부문 1위

HIGHEND WINDOW

*상기 이미지는 연출된 이미지입니다. 4중 유리 단창 적용 모델: Klenze M700 / 소프트 클로징 적용 모델: Klenze M700, M500 / 4면 밀착 시스템 적용 모델: Klenze M700, M500



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문의

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2025년 12월 31일 까지

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