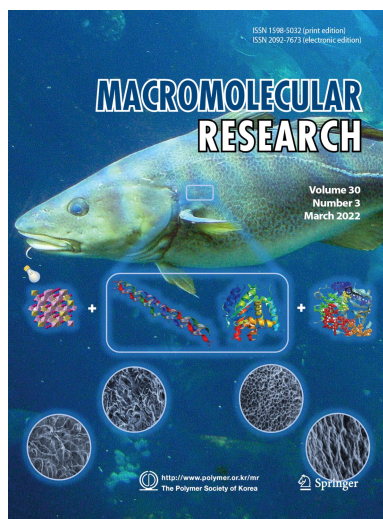


## COVER PAPER

### Cod Gelatin as an Alternative to Cod Collagen in Hybrid Materials for Regenerative Medicine

Victoria Chasova\*, Ludmila Semenycheva, Marfa Egorikhina, Irina Charykova, Daria Linkova, Yulia Rubtsova, Diana Fukina, Andrey Koryagin, Natalia Valetova, and Evgeny Suleimanov

Vol. 30, No. 3, pp 212–221 (2022) | MAR 25, 2022 | DOI 10.1007/s13233-022-0017-9



The chemical properties of collagen and gelatin are studied by the example of catalytic processes: enzymatic hydrolysis and its functional properties in hybrid hydrogel scaffolds in a composition with fibrinogen (Fn), as well as photocatalytic synthesis and the properties of their graft copolymers with polymethyl methacrylate (PMMA). Proteolysis of proteins in an aqueous solution leads to the destruction of peptides mainly with Mn~10%. Unlike collagen, in the case of gelatin, part of the initial highmolecular macromolecules is not destroyed. In hybrid hydrogel scaffolds in the composition with fibrinogen, cod collagen (CC) is more promising, showing less cytotoxicity in comparison with gelatin. Photocatalytic grafting of methyl methacrylate (MMA) on cod collagen and gelatin (CG) (~13–15%) with the formation of a graft copolymer PMMA–CG is more effective with collagen.

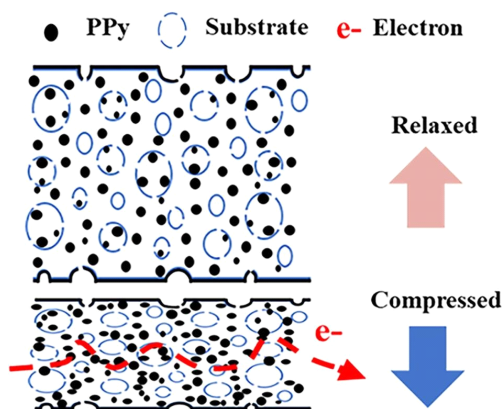
## REVIEW

### Pyrrole Coating with *In Situ* Polymerization for Piezoresistive Sensor Development – A Review

Dilini Srinika Wijerathne Gunasekara, Xin Niu, Waqar Lqbal, Yin He, and Hao Liu\*

*Macromol. Res.*, **30**, 153 (2022)

Poly-pyrrole (PPy) is highly practicing conductive polymers with potentiality to modify conductivity, sensitivity, and applicability to blend or coated over different materials to offer wide range of properties, especially for piezoresistive sensors that highly demand in smart electronics.



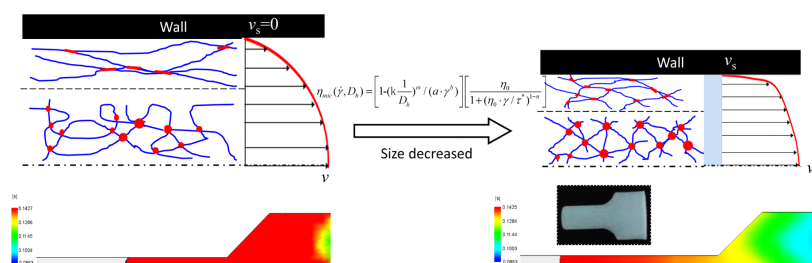
## ARTICLES

### Effect of Scale-Dependent Viscosity and Transesterification on Filling Behavior of Polycarbonate/Poly(ethylene terephthalate) Blends in Micro-Injection Molding

Bozhi Cai, Jing Jiang\*, Yongjun Cao, Junwei Sun, Ning Zhang, and Qian Li

*Macromol. Res.*, **30**, 163 (2022)

This study introduces a new scale-dependent viscosity model, in which transesterification reaction of polycarbonate/poly(ethylene terephthalate) (PC/PET) blends with various phase morphologies and micro-scale effects have been taken into account. The proposed viscosity model based on the Cross equation can describe the variation of shear viscosity for PC/PET blends under both macro- and micro-scale conditions. The average relative error under the micro-scale condition was  $4.5 \pm 1.1\%$ , which is much smaller than that of the average relative error under the macro-scale condition.

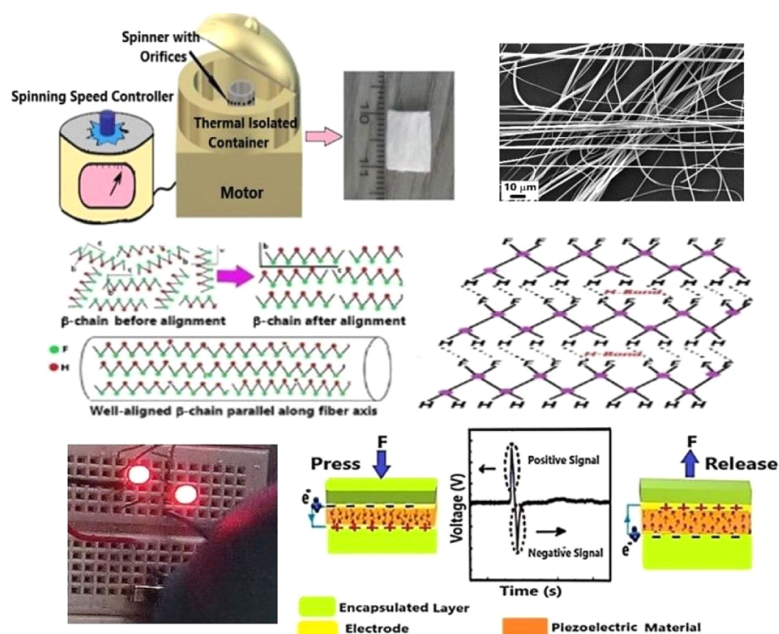


### Effect of $\beta$ -Chain Alignment Degree on the Performance of Piezoelectric Nanogenerator Based on Poly(Vinylidene Fluoride) Nanofiber

Khatatbeh Ibteha\*, Mohammad Hafizuddin Hj. Jumali\*, Sameer Al-Bati, Poh Choon Ooi, Bandar Ali Al-Asbahi, and Abdullah Ahmed Ali Ahmed

*Macromol. Res.*, **30**, 172 (2022)

This work demonstrated the effect of the  $\beta$ -chain alignment degree on piezoelectric nanogenerator (PNG) performance. A simple, safe and low-cost fast-centrifugal spinning technique was used to produce self-poled poly(Vinylidene Fluoride) (PVDF) nanofiber. PNG based on acetone-prepared PVDF fibers, with high  $\beta$ -chain alignment, generated output open-circuit voltage ( $V_{OC}$ ) and short-circuit current ( $I_{SC}$ ) five times higher than the film counterpart. In addition, the fibers showed a remarkable increase in  $\beta$ -chain alignment degree as the ratio of N,N-dimethylformamide (DMF) solvent increased. The optimum nanofiber with the highest  $\beta$ -chain alignment degree,  $\beta$ -fraction and piezoelectric charge coefficient of 0.93, 91.8% and  $-120 \text{ pC.N}^{-1}$  was obtained, respectively. PNG based on the optimum fiber displayed the highest  $V_{OC}$ ,  $I_{SC}$  and power density of 14 V, 1.4  $\mu\text{A}$  and  $6.7 \mu\text{Wcm}^{-2}$ , respectively. This performance is greater than any PNG made from electrospun PVDF fiber. The excellent performance of the fabricated PNGs was strongly related to the high alignment degree of  $\beta$ -chains parallel along the fiber axis. In addition, due to low Young's modulus (1.63 MPa) of the optimum fibers, the related lead-free PNG is sensitive to small movements and can be used in wearable and implanted medical devices.

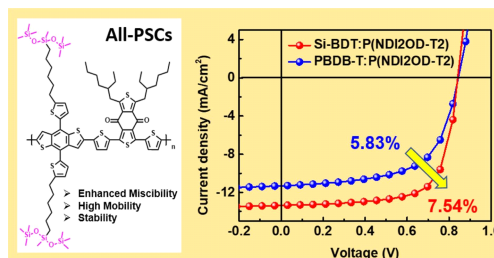


### Significance of Siloxane Functionalized Side-Chain $\pi$ -Conjugated Polymer Donor: Optimization of Active Layer Morphology Toward the Stable All-Polymer Solar Cells

Yeongju Do, Hyungjin Park,  
Thavamani Gokulnath,  
Kyungmin Sung, Ho-Yeol Park,  
and Sung-Ho Jin\*

*Macromol. Res.*, **30**, 183 (2022)

A wide bandgap  $\pi$ -conjugated polymer donor with a siloxane-functionalized side chain is developed and utilized in all-polymer solar cells processed from a halogenated solvent, which exhibited power conversion efficiency of 7.54% without any additives. Notably, these devices significantly enhanced short-circuit current density and fill factor in addition to their enhanced stability.

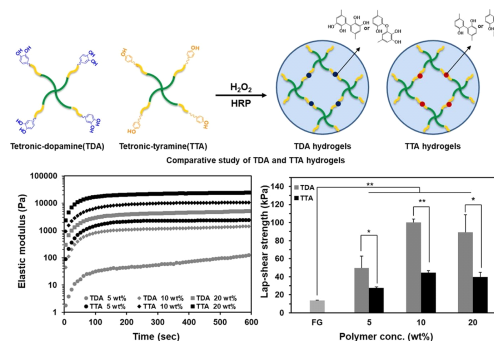


### A Comparative Study of Enzyme-Mediated Crosslinking of Catechol- and Phenol-Functionalized Tetronic Hydrogels

Dong Hwan Oh, Phuong Le Thi,  
and Ki Dong Park\*

*Macromol. Res.*, **30**, 190 (2022)

Enzymatically crosslinked tetronic-dopamine and tetronic-tyramine hydrogels were prepared, and their gelation properties were systematically compared. The difference in the number of hydroxyl groups at the polymer end group led to different gelation properties. The results showed that tetronic-dopamine hydrogels have slower gelation rate and lower gel stiffness, but superior adhesiveness than tetronic-tyramine hydrogels. Both hydrogels showed excellent biocompatibility.

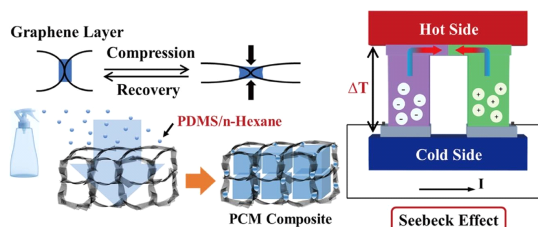


### Modification of Graphene Aerogel Embedded Form-Stable Phase Change Materials for High Energy Harvesting Efficiency

Chengbin Yu and Young Seok Song\*

*Macromol. Res.*, **30**, 198 (2022)

While porous graphene aerogel can hold plenty of pure phase change material (PCM) in the internal space, its volume shrinkage is a serious problem to decrease the weight of working material. Since the thermal energy storage (TES) capacity of PCM composite, however, depends on the mass ratio of pure PCM during the phase transition process, graphene aerogel filled PCM composite is an appropriate material for high latent heat thermal energy storage (LHTES). In this work, polydimethylsiloxane (PDMS) is embedded into the graphene aerogel by using a spraying method. The PDMS-embedded graphene aerogel exhibits higher mechanical property and flexibility than pristine aerogel. It reduces the volume shrinkage effectively and sustains the initial 3D porous structure to infiltrate pure PCM into the internal space, which can lead to an increase in the efficiency of thermo-electric energy harvesting due to the increase of PCM weight. A PN junction of thermo-electric power generator (PN TEG) is connected to the modified PCM composites, and a temperature difference between two sides of device occurs under the change of external conditions. The modified PCM composites constructed PN TEG generates stable and continuous thermo-electric energy during heating and cooling processes. In addition, finite element method (FEM) is employed to verify the experimental measurement.

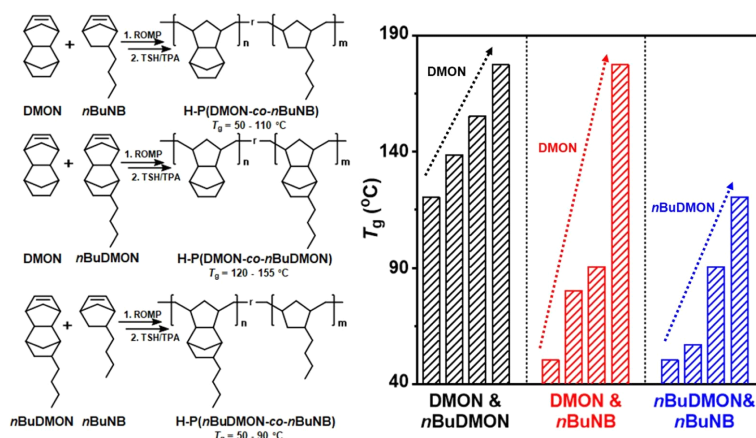


# Synthesis of Thermo-Controlled Cyclic Olefin Polymers *via* Ring Opening Metathesis Polymerization: Effect of Copolymerization with Flexible Modifier

Jin Young Seo, Seung Hyun Kang,  
Mi Ryu Lee, Chul-Hwan Choi,  
Sang-Ho Lee, Sangho Cho,  
Jung-Hyun Lee\*,  
and Kyung-Youl Baek\*

Macromol. Res., 30, 205 (2022)

Cyclic olefin polymers with flexible modifier were polymerized by sequential ring opening metathesis polymerization and hydrogenation. The *n*butylnorbornene (*n*BuNB) and *n*butyl-tetracyclododec-4-ene (*n*BuDMON) was utilized as flexible modifier and copolymerized with highly rigid DMON. The representative hydrogenated P(DMON0.7-co-*n*BuDMON0.3) exhibited 155 °C of *T*<sub>g</sub> and 402 °C of *T*<sub>d,5%</sub> as well as excellent optical transmittance (> 91%) in the visible range. These polymers were anticipated as future engineering plastic with optical transparency and high thermal stability.



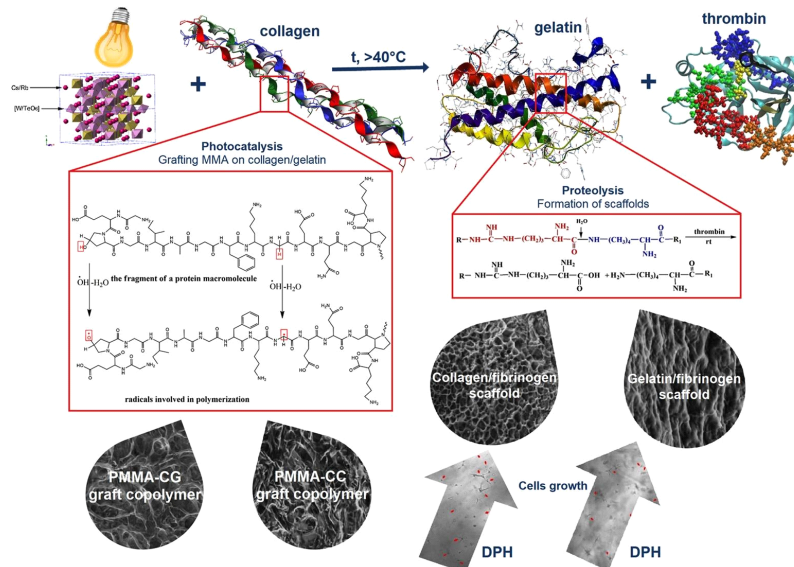
# Cod Gelatin as an Alternative to Cod Collagen in Hybrid Materials for Regenerative Medicine

Victoria Chasova\*,  
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Macromol. Res., 30, 212 (2022)

Cover Paper

The chemical properties of collagen and gelatin are studied by the example of catalytic processes: enzymatic hydrolysis and its functional properties in hybrid hydrogel scaffolds in a composition with fibrinogen (Fn), as well as photocatalytic synthesis and the properties of their graft copolymers with polymethyl methacrylate (PMMA). Proteolysis of proteins in an aqueous solution leads to the destruction of peptides mainly with Mn~10%. Unlike collagen, in the case of gelatin, part of the initial highmolecular macromolecules is not destroyed. In hybrid hydrogel scaffolds in the composition with fibrinogen, cod collagen (CC) is more promising, showing less cytotoxicity in comparison with gelatin. Photocatalytic grafting of methyl methacrylate (MMA) on cod collagen and gelatin (CG) (~13–15%) with the formation of a graft copolymer PMMA–CG is more effective with collagen.





## COVER PAPER

### Fabrication of a Strong Artificial Nacre Based on Tannic Acid-Functionalized Graphene Oxide and Poly(vinyl alcohol) Through Their Multidentate Hydrogen Bonding

Yoo-Bin Kwon, Sang-Ryong Lee\*, Tae Hoon Seo\*, and Young-Kwan Kim\*

Vol. 30, No. 4, pp 279–284 (2022) | APR 25, 2022 | DOI 10.1007/s13233-022-0031-y



Tannic acid-functionalized graphene oxide (TA-GO) exhibits considerably higher mechanical reinforcement than graphene oxide (GO) when they are laminated with poly(vinyl alcohol) (PVA), respectively. This distinct behavior originates from the formation of multidentate interfacial hydrogen bonding between galloyl moieties of TA and hydroxyl groups of PVA and indicates the importance of rational design of interfaces in polymeric composite materials.

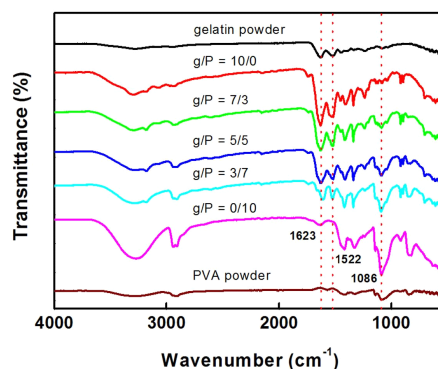
## ARTICLES

### Mechanical and Cell-Adhesive Properties of Gelatin/Polyvinyl Alcohol Hydrogels and Their Application in Wound Dressing

Heeseok Jeong, Deuk Yong Lee\*, Dae Hyeok Yang, and Yo-Seung Song

*Macromol. Res.*, **30**, 223 (2022)

Gelatin/polyvinyl alcohol (PVA) (g/P) porous hydrogels containing different g/P ratios are prepared by chemical crosslinking, followed by physical crosslinking. The peaks at  $1623\text{ cm}^{-1}$  and  $1522\text{ cm}^{-1}$  corresponded to the formation of imine ( $\text{C}=\text{N}$ ), which came from the interaction between the amine groups of gelatin and the aldehyde groups of GA. The peak at  $1086\text{ cm}^{-1}$  was attributed to the reaction of the aldehyde groups of GA with the hydroxyl groups of PVA, forming acetal groups. The co-existence of the acetal and imine peaks in the hydrogels indicated the presence of a gelatin-GA-PVA bond. FT-IR results suggested that the g/P hydrogels prepared at different g/P ratios were successfully crosslinked chemically and physically.

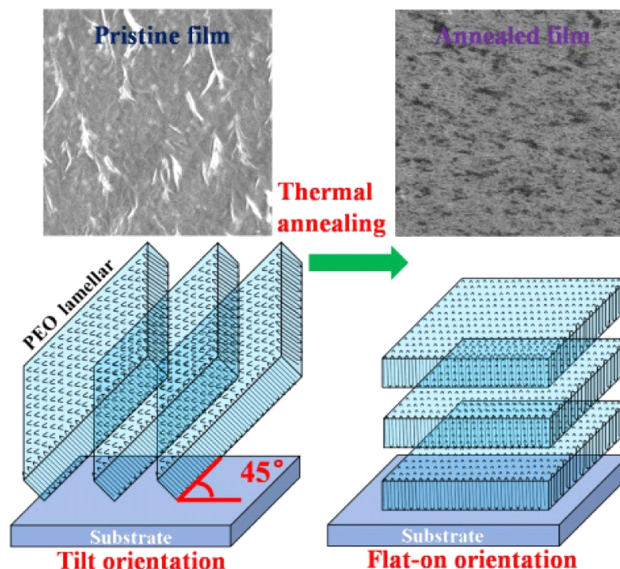


### The Transition of Molecular Alignment of Poly(ethylene oxide) Film *via* Thermal Annealing

Hangyu Zhang, Guangzhu Ding\*,  
Kun Wu, Chenguang Cai,  
and Jieping Liu

*Macromol. Res.*, **30**, 230 (2022)

The molecular alignment of polymer film, a complicated processing affected by processed conditions and dominating polymer application, has been attracted more attentions. In this paper, the annealing process can not only lead to the sheaf-like surface morphology completely but also is induced the formation of highly oriented flat-on lamellar structure for the PEO thin film.

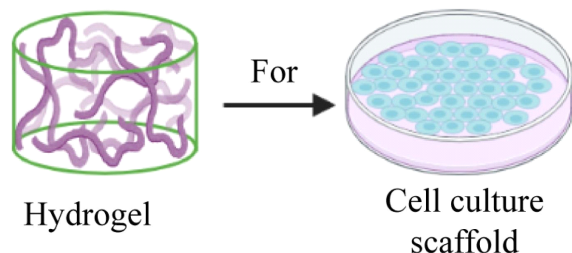


### Oxidized Alginate Hydrogel-Based Derivatives with Optimized Features for Cell Culture Scaffold

Etienne Twizeyimana, Shuang Zhang,  
Jean Felix Mukerabigwi\*,  
and Zhishen Ge

*Macromol. Res.*, **30**, 238 (2022)

To exploit the benefits of the natural polymer derived hydrogels for cell support; we herein demonstrate the novel design and development of hydrogel with the optimized features from chemically modified sodium alginate combined with carboxymethyl chitosan and gelatin for cell culture scaffold.

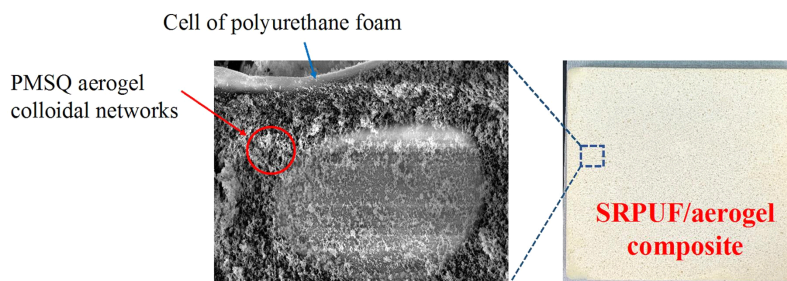


### Semi-Rigid Polyurethane Foam and Polymethylsilsesquioxane Aerogel Composite for Thermal Insulation and Sound Absorption

Byeong Seok Kim, Jinkyu Choi,  
Ye Seo Park, Yingjie Qian,  
and Sang Eun Shim\*

*Macromol. Res.*, **30**, 245 (2022)

Semi-rigid polyurethane foams (SRPUF)/polymethylsilsesquioxane (PMSQ) aerogel composites were prepared using a simple sol-gel process. The fabricated SRPUF/PMSQ aerogel composite with 63 phr (parts per hundred resin) of PMSQ aerogel exhibits decline in the thermal conductivity from 41.0 to 36.0 mW/m·K and the fabricated SRPUF/PMSQ aerogel composite with 45 phr of PMSQ aerogel showed an improvement in the average sound absorption coefficient from 0.57 to 0.67 at higher frequency range.

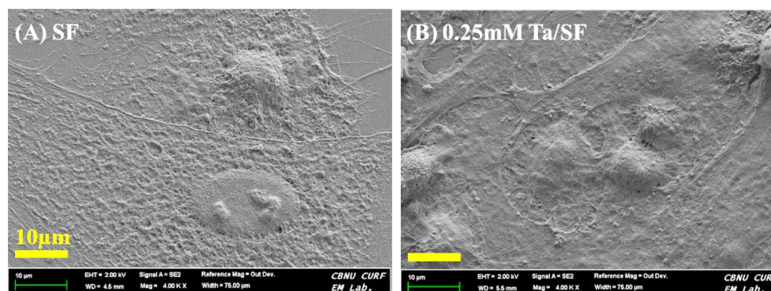


### Characterization of Taurine/Silk Fibroin Blend Film for Application as a Carrier for Corneal Endothelial Cell Transplantation

Jeong Eun Song, Ha Yan Jeon,  
Joo Hee Choi, Dae Hoon Lee,  
and Gilson Khang\*

*Macromol. Res.*, **30**, 254 (2022)

In this study, a film was prepared from silk fibroin (SF) and taurine (Ta) as a carrier for the regeneration of corneal endothelial cells (CEnCs). Ta/SF films were prepared by mixing Ta at various concentrations (0, 0.25, 0.5, 1, and 2 mM) in a 7% silk fibroin solution to determine the effects of Ta concentrations on cornea regeneration. We observed that the 0.25 mM Ta/SF film produced the highest number of viable cells and cellular proliferation. Ta/SF film was also found to maintain cell morphology and cell functionality. Therefore, Ta/SF film may be useful as a new treatment modality and a carrier for CEnCs in cornea tissue regeneration.

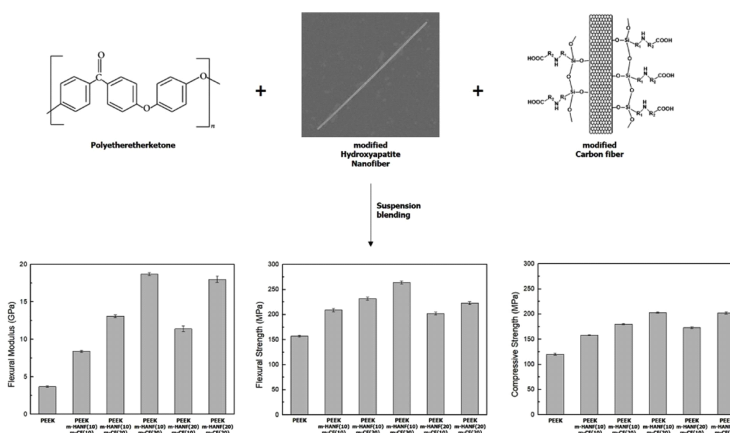


### Mechanical Properties of Polyetheretherketone Composites with Surface-Modified Hydroxyapatite Nanofibers and Carbon Fibers

Sangwoon Lee, In Sung Jeon,  
and Jae Young Jho\*

*Macromol. Res.*, **30**, 261 (2022)

Polyetheretherketone composites with modified hydroxyapatite nanofiber and modified carbon fiber were developed. Hydroxyapatite was added in fiber form, and the fillers were modified with silane coupling agent. Hydroxyapatite nanofiber improved the mechanical properties. Modification of fillers improved the interfacial adhesion between the matrix and fillers. As a result, polyetheretherketone composites with comparable mechanical properties to those of the cortical bone were earned.

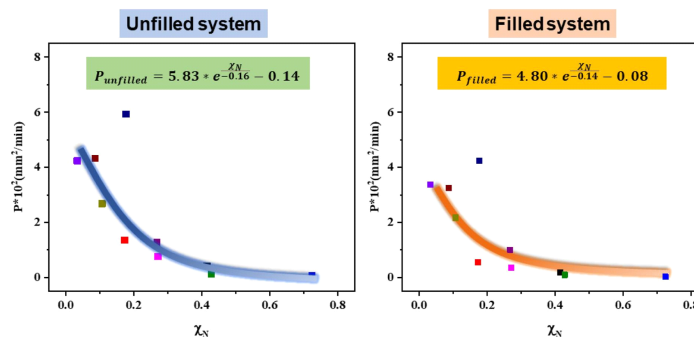


### Application of Three-Dimensional Solubility Parameter in Diffusion Behavior of Rubber-Solvent System and Its Predictive Power in Calculating the Key Parameters

Xingwang Jiang, Yupeng Hao,  
Huiyu Wang, Jieyun Tu,  
and Guangyong Liu\*

*Macromol. Res.*, **30**, 271 (2022)

There are strong exponential relationships between permeation coefficient ( $P$ ) and new Flory-Huggins interaction parameter ( $\chi_N$ ) obtained from three-dimensional Hansen solubility parameter (HSP) for both unfilled and filled rubber-solvent systems, which shows the predicting power of HSP in calculating the key parameters of solvents transporting in rubber.



# **Fabrication of a Strong Artificial Nacre Based on Tannic Acid-Functionalized Graphene Oxide and Poly(vinyl alcohol) Through Their Multidentate Hydrogen Bonding**

Yoo-Bin Kwon, Sang-Ryong Lee\*,  
Tae Hoon Seo\*,  
and Young-Kwan Kim\*

*Macromol. Res.*, **30**, 279 (2022)

Cover Paper

Graphene oxide (GO) is simultaneously reduced and functionalized with tannic acid (TA). The resulting TA-reduced GO (TA-RGO) sheets are incorporated with poly(vinyl alcohol) (PVA) and then assembled into an artificial nacre-like structure by vacuum-assisted filtration to induce formation of multidentate hydrogen bonding, the resulting TA-RGO/PVA composite film presented an overall and efficient reinforcement of tensile strength ( $186.1 \pm 12.8$  MPa), modulus ( $15.2 \pm 1.2$  GPa), and toughness ( $1546 \pm 248$  kJ/m<sup>3</sup>) compared to those of GO ( $83.3 \pm 5.4$  MPa,  $8.9 \pm 0.4$  GPa and  $1434 \pm 152$  kJ/m<sup>3</sup>) and TA-RGO ( $87.6 \pm 10.6$  MPa,  $13.8 \pm 1.4$  GPa and  $306 \pm 51$  kJ/m<sup>3</sup>), respectively.

