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# BIO-INSPIRED ENGINEERING OF MICROCHANNELS IN POLYMERS BY CRYSTALLIZATION OF SOLVENT

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**For millions of years, nature utilizes microporous polymeric materials of well-controlled structures of skeletal walls and pores for their functions. The structures of synthetic microporous polymers are commonly limited to architectures of isolated pores, although their preparation methods have been developed for the critical roles in various applications. The directional melt crystallization of solvent, a relatively new versatile preparation method to produce aligned pores in the forms of 3D patterns, has produced porous structures of Voronoi and honeycomb-like architecture morphology. By developing adequate conditions for different polymers, we have produced various materials having ordered microchannels. The important parameters, crystallization rate and direction were controlled by temperature gradient control in 3D space using a home-made apparatus to prepare defect-free materials having well-ordered through-thickness microchannels. As crystals nucleate and grow, solutes form cryoconcentrate phases, which become skeletal portions, and crystallized solvents become pores after sublimation. The defect-free films and cylinders of through-thickness porosity could be prepared. With the support of nanotemplates, nanospheres, nanorods, and nanomembranes could be prepared too. This directional crystallization method controlling pore morphology offers a versatile route to prepare unique porous polymers and composites for future environmental, biomedical, and electronics applications.**

## Recent Publications:

1. **Junseok Kim, Yunho Cho, Soyun Kim, and Jonghwi Lee, 2017, 3D Cocontinuous Composites of Hydrophilic and Hydrophobic Soft Materials: High Modulus and Fast Actuation Time, ACS Macro Letters, 6(10), p1119.**
2. **Byoung Soo Kim, Kangsuk Lee, Soyeon Lee, Jun Beom Pyo, Kwang-Hoon Lee, In Suk Choi, Kookheon Char, Jong Hyuk Park, Sang-Soo Lee, Jonghwi Lee*, Jeong Gon Son*, 2017, 2D reentrant auxetic structures of graphene/CNT networks for omnidirectionally stretchable supercapacitors', Nanoscale, 9, p13272.**
3. **A.T. Ezhil Vilian, Suyeong An, Sang Rak Choe, Cheol Hwan Kwak, Yun Suk Huh*, Jonghwi Lee*, and Young-Kyu Han*, 2017, Fabrication of 3D honeycomb-like porous polyurethane-functionalized reduced graphene oxide for detection of dopamine, Biosensors and Bioelectronics, 86, p1222.**
4. **Byoung Soo Kim and Jonghwi Lee, 2016, Macroporous PVDF/$TiO_2$ membranes with three-dimensionally interconnected structures produced by directional crystallization, Chemical Engineering Journal, 301, p158.**
5. **Suyeong An, Byoung Soo Kim and Jonghwi Lee, 2016, Porous Polyurethane Films Having Biomimetic Ordered Open Pores: Indentation Properties, Journal of Industrial and Engineering Chemistry, 33, p362.**

## Biography

Jonghwi Lee got his PhD from the University of Michigan, Ann Arbor and worked for Merck Research Laboratories as a Senior Researcher after his Post-doctoral training at the University of Minnesota. He won prizes from The Polymer Society of Korea (Best Paper Award), Korean Society of Industrial Engineering Chemistry (Contribution Recognition Award, Best Paper Award, Best Industry Collaboration Award), and Chung-Ang University (Excellence in Achievement Award, Bae Young Soo Award). He has published more than 150 research papers, and currently a Vice Editor of Journal of *Industrial* and *Engineering Chemistry and Macromolecular Research*. His research interests are biomedical polymers, polymer composites, porous polymers and crystallization.

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