Dr. Jin Kon Kim
Professor, Dept. of Chemical Engineering
Pohang University of Science and Technology

Dr. Kim is professor in the Department of Chemical Engineering of Pohang University, the Center for Block Copolymer Self-Assembly, and the Future IT Innovation Laboratory. He is the Director of Center for Smart Block Copolymers, National Creativity Research Initiative Program. He graduated from Seoul National University with a B.S. in chemical engineering, from Korea Advanced Institute of Science and Technology with a M.S. in chemical engineering, and from Polytechnic University, Brooklyn, New York, with a Ph.D. in chemical engineering. His current interests include: (1) phase behavior and phase transition of block copolymers with both lower critical disordered-to-order transition and upper critical ordered-to-disordered transition by SAXS, SANS, rheology, and Fourier transformed Infrared Spectroscopy, and (2) DSA based on block copolymer. He is author of over 200 international journal papers, has presented over 300 talks, and attended over 500 conference proceedings. Dr. Kim has been the recipient of numerous awards, including the POSTECH Fellow, Fellow: American Physical Society, Golden Award of Invention, Postechian Prize, and the Samsung Polymer Prize.

“Functional Nanomaterials Based Block Copolymer Self-Assembly”

We prepared nanoporous templates by using thin films of mixtures of polystyrene-block-poly(methyl methacrylate) (PS-b-PMMA) and PMMA homopolymers. These templates have cylindrical nanoholes spanning the entire thickness of the film. The nanoporous films were found to be very effective for the filtration of human Rhinovirus type 14 (HRV 14), major pathogen of a common cold in humans, from the buffer solution. We found that when the pore size was effectively controlled down to 6 nm, single file diffusion, namely, the constant drug release with time, was observed up to 2 months. When we fabricated functionalized nanochannels by using carboxylic acid terminated PS-b-PMMA, the nanochannel wall could be effectively used for immobilization site for molecular recognition agents (MRAs). By using overhanging single-stranded DNA as MRAs, the DNA-functionalized nanochannels showed high resolution to detect a single-base mismatch as well as to discriminate single-mismatched sequence at various locations by hybridization preference with MRAs.

I will also introduce a conceptually new and versatile approach to produce highly asymmetric lamellar morphologies by the use of binary blends of block copolymers [polystyrene-b-poly(2-vinyl pyridine) copolymer (PS-b-P2VP) and PS-b-poly(4-hydroxystyrene) copolymer (PS-b-PHS)] where P2VP and PHS are capable of the hydrogen bonding. We obtained the asymmetric lamellar microdomains having lamellar width ratio of 4:1. This ratio was increased up to 6:1 with increasing the degree of hydrogen bonding.

Finally, a novel self-neutralization concept will be introduced by using star-shaped 18 arm poly(methyl methacrylate)-block-polystyrene copolymers (PMMA-b-PS) 18 exhibiting lamellar and PMMA cylindrical nanodomains. When a thin film was spin-coated on a substrate, vertically aligned lamellar and cylindrical nanodomains were obtained without any pre- or post-treatment, although thermal annealing for a short time (less than 30 min) was required to improve the spatial array of vertically aligned nanodomains. Moreover, vertical orientations are observed on versatile substrates, for instance, semiconductor (Si, SiOx), metal (Au), PS or PMMA-brushed substrate, and a flexible polymer sheet of polyethylene naphthalate (PEN).

References