Department of Chemical Engineering
Distinguished Seminar Speaker

Richard Register
Professor and Chair
Chemical and Biological Engineering
Princeton University

Host: Hicham Fenniri
h.fenniri@neu.edu

Block Copolymer Thin Films: Structure, Shear Alignment, & Applications in Nanofabrication

Wed, March 18
312 Ell Hall
11:45am – 1:00pm

Refreshments will be served

ABSTRACT Block copolymers have been extensively studied for their ability to self-assemble into microdomain morphologies such as spheres, cylinders, and lamellae, with typical periodicities of 20-60 nm. Similar structures form when block copolymers are deposited as thin films on substrates; these films can serve as excellent templates for nanofabrication, where the block copolymer's nanodomain structure is faithfully reproduced in an inorganic material—but the final array of inorganic objects is, at best, only as good as the structure of the film from which it was derived. Consequently, we have worked intensively to develop methods to manipulate the structure of the films. For example, the polygrain structure normally formed by these nanodomains can be transformed to a single-crystal texture, over macroscopic areas, by a simple shearing process. Shear can also realign the domain orientation locally in films with an otherwise macroscopic orientation; create complex orientation patterns on the millimeter scale; and even transform spheres into cylinders. We have employed these thin, substrate-supported block copolymer films to fabricate dense arrays of 20-40 nm metal or semiconductor particles: dots (from sphere-forming block copolymers) or lines (wires, from cylinder-formers), all with a size and spacing set through block copolymer molecular weight. Such shear-aligned thin-film templates can also be stacked to produce square, rectangular, or rhombic grids. As a particular example, we have used this approach on shear-aligned films containing in-plane cylinders to fabricate centimeter-scale arrays of parallel nanowires; due to their fine pitch, such wire grids can polarize an exceptionally broad range of wavelengths extending down into the deep ultraviolet (for 193 nm photolithography), with 90% or better efficiency.

BIOGRAPHY Richard A. Register is Eugene Higgins Professor and Chair of the Department of Chemical and Biological Engineering at Princeton University, where he previously served as Director of the Princeton Center for Complex Materials, a broad-based Materials Research Science and Engineering Center funded by the National Science Foundation. His research interests revolve around micro- and nanostructured polymers, such as block copolymers, polymer blends, semicrystalline polymers, and ionomers, ranging across their physics, synthesis, characterization, and applications. He was named a Fellow of the American Physical Society in 2001; received the Charles M.A. Stine Award from the American Institute of Chemical Engineers in 2002; was honored with the Graduate Mentoring Award from Princeton University in 2008; and was named a Fellow of the American Chemical Society in 2012.

For more information visit: che.neu.edu