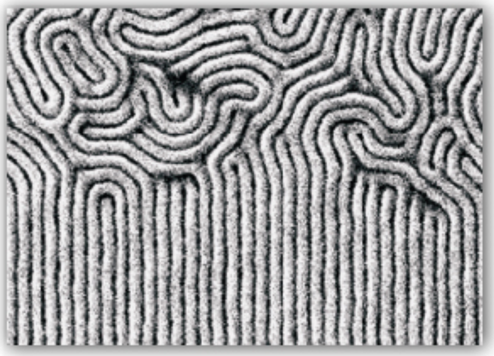
Paul F. Nealey

Directed Self-Assembly of Block Copolymers: A Platform for Nanomanufacturing



The use of block copolymers in the lithographic process is an attractive strategy to augment and enhance the capabilities of current tools in nanomanufacturing. We employ electron beam and 193-nm immersion lithography to fabricate chemically patterned surfaces. Block copolymer films are deposited on the surfaces and annealed. By judicious choice of the chemistry and geometry of the patterned regions, the domain structure of block copolymer film may be directed to assembly into desirable architectures for applications such as bit-patterned media or integrated circuits. Challenges that remain in materials and process development include delineation of the degree of perfection that can be obtained, and fabrication of sub-10-nm features in manufacturing-relevant processes. Here we report the relationships between attributes of the chemical pattern and process parameters on the degree of perfection of the assembled block copolymer films, two approaches to processing films on chemical patterns to enable assembly of high resolution copolymers with differing block surface energies, and design principles for the synthesis of new block copolymers for directed self-assembly with sub-10-nm features. Quantitative three-dimensional characterization of nanostructures derived from directed self-assembly (DSA) also remains a key roadblock to widespread implementation of DSA in nanomanufacturing. The last part of the presentation will address our research in this area using key resources at Argonne National Laboratory.

Paul F. Nealey is currently the Brady W. Dougan Family Professor in Molecular Engineering at the new Institute for Molecular Engineering of the University of Chicago, and a Senior Scientist at Argonne National laboratory. His research interests include nanofabrication techniques based on advanced lithography and directed self-assembly, dimension-dependent material properties of nanoscopic macromolecular systems, and quantitative three-dimensional characterization of the structure of soft materials. He is a fellow of the American Physical Society, and has received the National Science Foundation Career Award, the Camille Dreyfus Teacher-Scholar Award, the University of Wisconsin Romnes Fellowship, the Nanoscale Science and Engineering Forum Award from the American Institute of Chemical Engineers, and the Arthur K. Doolittle Award from the American Chemical Society. He was also the Founding Director of the National Science Foundation-funded Nanoscale Science and Engineering Center in Templated Synthesis and Assembly at the Nanoscale.

Wednesday, August 6, 2014 | 3:00 p.m.

Bldg. 402 | APS Auditorium
Argonne National Laboratory

APS COLLOQUIUM