Nanomanufacturing with block copolymers

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The research program at the University of Wisconsin Nanoscale Science and Engineering Center (UW-NSEC) aims to integrate self-assembling block copolymers into the lithographic process. The fundamental concepts of the UW approach are that 1) the most advanced production-oriented exposure tools (e.g. 193 nm, EUV, or electron beam lithography) and resist materials are used to create patterns of differing chemical functionality on the substrate, and 2) films of block copolymers can be directed to assemble in the presence of the chemical pattern into predictable and desirable morphologies, thereby augmenting and enhancing the lithographic process. In comparing the chemical pre-pattern to the pattern of domains induced to assemble in the block copolymer film, directed assembly has been demonstrated to achieve high degrees of pattern perfection, placement of features at the precision of the lithographic tool used to make the chemical pattern, improved dimensional control of features, improved line edge and line width roughness, and resolution enhancement by factors of two to four. In addition, the UW-NSEC approach has been demonstrated to robustly achieve non-regular device-oriented geometries with resolution enhancement by multiplication of feature density by interpolation on low duty cycle chemical patterns. Implementation of nanomanufacturing using block copolymers will be highlighted in the context of patterned media and integrated circuits.