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Rational design of block copolymer morphologies via control of the film thickness and substrate patterning: A self consistent field study
XIANGGUI YE, BRIAN J. EDWARDS, BAMIN KHOMAMI, Materials Research and Innovative Laboratory (MRAIL), Department of Chemical and Biomolecular Engineering, University of Tennessee, Knoxville — Chemically patterned substrates can direct the assembly of adsorbed layers or thin films of block copolymers. In this study we have examined the self-assembly of a lamella-forming diblock copolymer on periodically stripe-patterned substrates, and a cylinder-forming diblock copolymer on periodically doted-patterned substrates for various film thicknesses. In general, we have shown that for thin films the morphology of the block copolymer follows the chemical pattern at the substrate; however, with an increase degree of mismatch between the spacing of the pattern and the natural spacing of bulk block copolymer, a host of novel morphologies can been created, which have not to date been experimentally realized. Our studies clearly demonstrate that the film thickness and the pattern of substrate can be judiciously manipulated to rationally design morphologies for various applications such as filtration, conduction, and high-surface area membranes. Overall, these results demonstrate a promising strategy for fabrication of complex interfacial nanostructures from chemically patterned templates.

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