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Three Dimensional Morphology of Lamellae-forming Block Copolymer Thin Films between Two Chemically Nanopatterned Surfaces
GUOLIANG LIU, ABELARDO RAMIREZ-HERNANDEZ, PAUL F. NEALEY, JUAN J. DE PABLO, Department of Chemical and Biological Engineering, University of Wisconsin-Madison, Madison, Wisconsin 53706, USA — Previous work has demonstrated the directed assembly of block copolymers on one chemically patterned surface into desired two dimensional and three dimensional structures. Here, we report on the structures formed by block copolymer thin film equilibrated between two chemically patterned surfaces with orthogonal stripes. The patterned stripes have a width of $L_0/2$ and a period of L_0, where L_0 is the natural period of the block copolymer. Our experiments and simulations reveal that the block copolymer domains are continuous through the film and the interface between domains resembles the Scherk's first minimal surface. Different from that in the bulk, the interface between the domains is at equilibrium in the presence of the defined boundary conditions, and has a remarkable level of perfection over the patterned areas in centimeter scale. The impact of chemical patterns on block copolymer morphologies and the underlying physics gives insight into the nanofabrication of complex nanostructures with directed self-assembly using two engineered boundary conditions, as opposed to only one.

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