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Mixed Lamellae in Symmetric Diblock Copolymer Thin Films
DONG MENG, QIANG WANG, Colorado State University — For symmetric diblock copolymers confined between two flat and homogeneous surfaces, three morphologies (parallel, perpendicular, and mixed lamellae) have been obtained in experiments. While the effects of surface preference (for one of the two blocks) and film thickness on the thin-film morphology are well understood, less studied is the influence of a hard (impenetrable) surface on the copolymer chain conformations, referred to as the "hard-surface effect". It is this effect that favors the perpendicular lamellae between two neutral surfaces over parallel lamellae, at all film thicknesses. It also leads to the formation of mixed lamellae between asymmetric surfaces. Here we use the self-consistent field (SCF) theory in continuum to study the morphology of mixed lamellae. The SCF equations are solved in real space with high accuracy. Results under different boundary conditions (zero-density vs. non-flux) are compared to examine their effects on the copolymer chain conformations near the surface. We also study in detail the chain conformations at the T-junction in the mixed lamellae. Conditions under which the mixed lamellae are a stable phase (over parallel and perpendicular lamellae) are determined, and compared with experiments and Monte Carlo simulations.

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