Stacking faults of close-packed lattices in block copolymer/selective solvent mixture

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Abstract

Block copolymers (BCPs) with high compositional asymmetry self-assemble into spherical micelles organized in periodic lattices, where body-centered cubic (BCC) lattice was the predominantly observed packing symmetry. In this study, we mixed a symmetric poly(ethylene oxide)-*block*-polybutadiene (PEO-*b*-PB) with dodecylbenzene (DB), which was selectively miscible with PB block, to yield the micelle composed of PEO core domain and the corona containing PB blocks swollen by DB. The micelles were found to pack in the close-packed lattices, including both face-centered cubic (FCC) and hexagonal close-packed (HCP) lattice, depending on the composition as revealed by the small angle X-ray scattering (SAXS) profiles collected at TLS 23A1. The close-packed lattices were found to contain stacking fault. Interestingly, the concentration of the stacking fault varied with temperature in a reversible manner, where decreasing temperature tended to increase the probability of fault. The results suggested that there existed an equilibrium degree of stacking fault at a given temperature for block copolymer micelles, which was in clear contrast to the kinetic nature of stacking faults in metals and hard colloids.

Keywords – close-packed lattice, block copolymer, selective solvent, stacking fault