Morphological Transition of Bottlebrush Block Copolymer Particles Depending on the Molecular Weight

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The molecular weights and chain-rigidities of block copolymers can strongly influence their self-assembly behavior, particularly when the block copolymers are under confinement. We investigate the self-assembly of bottlebrush block copolymers (BBCPs) confined in evaporative emulsions; a series of symmetric BBCPs were used, where polystyrene (PS) and polylactide (PLA) side-chains are grafted onto the polynorbornene (PNB) backbone, are synthesized with different degrees of polymerization of the PNB (N_{PNB}). Morphological transitions from onion-like particles into ellipsoids occur as the N_{PNB} of the BBCP increases, which is also predicted from simulations of BBCP droplets by an implicit solvent model. Furthermore, we investigated the morphological evolutions of BBCP particles. Compared to onion-like particles, ellipsoids exhibit the unique axial development of ring-like lamellae domains on the particle surface, followed by the radial propagation into the particle center. Finally, the shape-anisotropies of the ellipsoidal BBCP particles are analyzed as a function of particle size.