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Phase Behavior of Binary Blends of AB+AC Block Copolymers with compatible B and C blocks

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Recently the experimental studies of phase behavior of binary blends of PS-b-P2VP and PS-b-PHS demonstrated an interesting effect: blends of symmetric PS-b-P2VP and shorter symmetric (PS-b-PHS) formed cylindrical HEX and spherical BCC phases, while each pure component formed lamellas. The miscibility of P2VP and PHS is caused by the hydrogen bonding between P2VP and PHS, which can be described as a negative Flory χ -parameter between P2VP and PHS. We developed a theory of the microphase segregation of AB+AC blends of diblock copolymers based on strong stretching theory. The main result of our theory is that in the copolymer brush-like layer formed by longer B chain and shorter C chains, the attraction between B and shorter C chains causes relative stretching of short C chains and compression of longer B chains. The latter manifests in an excessive bending force towards the grafting surface (BC|AA interface). Such bending force causes a transition from a symmetric lamella phase to a HEX cylinder or BCC spherical phases with the BC phase being a “matrix” component. In a blend of asymmetric BCC sphere forming copolymers (where B and C segments are the minor components), such bending force may unfold BCC spherical phase to a HEX cylinder phase, or even highly uneven lamella phases.

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