Phase Behavior of Poly(styrene-b-isoprene) Diblock Copolymers Loaded with γ-Fe_2O_3 Nanoparticles

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We investigate the effect of hard additives, i.e., magnetic nanoparticles, on the phase behavior of polystyrene-block-polyisoprene (PS-b-PI) diblock copolymers by varing the size of nanoparticles (6 nm and 14 nm). For the design of multicomponent materials with spatially defined order of different components, two PS-b-PI diblock copolymers showing lamellar (SI1) and cylindrical (SI2) morphologies are used as structure-directing matrices for the nanoparticle arrangement. Fine maghemite (γ-Fe_2O_3) particles with surfaces modified by oleic acid have been synthesized not only for greater solubility but also to prevent particle aggregation. Two different solvents, hexane and toluene, were used to prepare film specimens by static casting. Notably, the nanoparticles were selectively incorporated into the PI domains under hexane condition, while they were preferentially aggregated when toluene is used. Particularly, in the toluene condition, we observed the well-defined body centered cubic structure for SI2 as well as the undulating lamellar morphology for SI1. The structural information obtained from X-ray scattering is in good agreement with the TEM images.