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### **Phase Behavior of Block Copolymer/Inorganic Nanoparticle Composites**

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Block copolymers offer as versatile platforms for the fabrication of hybrid nanocomposites with ordered phases useful for various nanotechnology applications. Although the phase behavior of block copolymers is well established the effects of inorganic nanoparticle loading on their phase behavior are not well understood. We carried out a systematic study on the phase behavior of block copolymers with well dispersed nanoparticles. To achieve excellent dispersion of nanoparticles in the polymer phase we used grafted nanoparticles with small polymer chains compatible to a preferred domain of the block copolymer. The nanoparticles sequestered in a preferred domain have profound effects on the thermodynamically induced microphase separation of the block copolymers. To characterize the phase behavior of these systems in a selective solvent we used small angle neutron scattering and that in their bulk and thin film architectures was studied using synchrotron based small angle x-ray scattering and grazing incidence small angle scattering techniques. A number of molecular properties such as the molecular weight of the polymer, segment volume fraction, Flory-Huggins  $\chi$  parameter and the nanoparticle concentration influence the state of dispersion of nanoparticles and the nanocomposite morphology in bulk and thin film architectures. The addition of homopolymers provides as yet another variable to alter the interfacial tension and to slow the order-disorder transition. We also probed the nanoscale dynamics at the polymer/nanoparticle interfaces in these systems by using x-ray photon correlation spectroscopy. The dynamics of nanoparticles in the composites is strongly dependent on the dimensionality of the morphology of the block copolymer. Furthermore, the interfacial interaction at the polymer/particle interface plays significant role in the stress relaxation in the composites.

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