559b Patterning Nanoparticles in Structured Block Copolymer Thin Films

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Amphiphilic block copolymers are often utilized as useful templates for the fabrication of nanostructured materials. In particular, nanoparticle-copolymer hybrids combine the unique magnetic, electronic, catalytic and spectroscopic features of semiconductor or metallic colloids with the flexibility, solubility, and processibility of polymers, promising for the development of the next generation of catalysts, membranes, and optoelectrical devices. The preparation of these hybrid materials with tailored properties, such as superparamagnetism, UV-cut-off, or catalytic activities, requires a good understanding of the chemical nature and the topology of the amphiphilic blocks as well as the solvent-mediated interactions with the embedded nanoparticles. To minimize experimental effort for exploring the enormous parameter space, we have developed a polymer density functional theory for binary mixtures of copolymers and nanoparticles. It predicts various well-organized structures of nanoparticles in a thin film of amphiphilic copolymers that can be effectively controlled by adjusting the polymer-particle interactions. This generic theory is able to account for the microscopic characteristics of both nanoparticles and polymers and thus may offer valuable assistance for the fabrication of nanostructured hybrid materials by design.