Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Nanoparticle-Regulated Phase Behavior and Morphological Development in an Ordered Block Copolymer MICHELLE BOWMAN, North Carolina State University, STEVEN SMITH, Procter & Gamble Co., JON SAMSETH, SINTEF Materials & Chemistry, MICHAEL BOCKSTALLER, Carnegie Mellon University, RUSSELL THOMPSON, University of Waterloo, KIM RASMUSSEN, Los Alamos National Laboratory, RICHARD SPONTAK, North Carolina State University — Although microphase-ordered block copolymer motifs are employed to template inorganic nanoparticles, only recently has the effect of nanoparticles on copolymer self-assembly been explored. In this work, we examine the influence of nanoparticles on the copolymer order-disorder transition (ODT) temperature. Theoretical results from a hybrid self-consistent field/density functional theory – supported by experimental observations of a model copolymer/nanoparticle system – confirm that judicious selection of nanoparticle size and selectivity can be used to increase the ODT temperature at constant concentration. For a given nanoparticle size and selectivity, we show that there likewise exists a critical nanoparticle concentration beyond which the ODT temperature decreases. The ability of nanoparticles to increase the ODT temperature is a unique consequence of their size and is not expected for small-molecule additives. At high concentrations, the nanoparticles form percolated colloidal networks that represent highly confined environments for the copolymer molecules.

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Date submitted: 29 Nov 2007 Electronic form version 1.4