Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Self-assembled nanostructures in a cross-linkable block copolymer

CHUNLIN HE, Department of Chemical & Biochemical Engineering, University of Colorado at Boulder, IAN CAMPBELL, University of Colorado at Boulder, MARK STOYKOVICH, Department of Chemical & Biochemical Engineering, University of Colorado at Boulder — The self-assembly of block copolymers in films 50$\sim$100 nm thick provides an attractive approach to patterning nanoscale features. Chemical and thermal stability of the morphology in thin films is critical for the generation of robust templates for subsequent fabrication processes, and can be improved by cross-linking the copolymer domains. Atom transfer radical polymerization was used to synthesize PS/PMMA block copolymers with cross-linkable units capable of reacting through an acid-catalyzed mechanism or by photoinitiation with UV exposure. The self-assembly behavior of lamellar-forming block copolymers with or without cross-linkable units were compared in thin films through top-down characterization. We have developed approaches to decouple the self-assembly process from the cross-linking process, and characterized the cross-linking density and reaction rates within the nanostructured domains. The cross-linked nanostructures exhibit enhanced solvent and thermal stability, and have been demonstrated for the fabrication of three-dimensional block copolymer nanostructures in thick films using a layer-by-layer approach.

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Date submitted: 21 Nov 2011 Electronic form version 1.4