Phase Behavior of Ternary Block Copolymer Homopolymer Blends in Thin Films on Chemically Nanopatterned Surfaces

MARK P. STOYKOVICH, University of Wisconsin - Madison, HARUN H. SOLAK, Paul Scherrer Institute, PAUL F. NEALEY, University of Wisconsin - Madison — Ternary blends of lamellar-forming block copolymers and homopolymers exhibit a complex phase behavior in the bulk with ordered lamellar, two-phase, and disordered morphologies coexisting at a Lifshitz multicritical point. The onset of the unbinding transition and the associated bicontinuous microemulsion phase is predicted to be a function of $\alpha$, the ratio of the degree of polymerization of the homopolymer to the block copolymer. Here we investigate the phase behavior of ternary blends with varying $\alpha$ and lamellar periods, $L_b$, in thin films on chemically striped surfaces with period $L_s$. Our findings indicate that: 1) in contrast to model predictions for bulk systems, the unbinding transition is not strongly dependent on $\alpha$, 2) a blend in the microemulsion phase forms lamellar structures on patterned surfaces, 3) chemical surface patterns can induce phase separation of the ternary blend, and 4) the homopolymer components can distribute themselves in such a way as to form adjacent lamellar domains with different $L_b$. The technological importance of these findings is the ability of ternary blend systems to epitaxially self-assemble into imaging materials for sub-30 nm lithography.