Effect of Solvent Removal Rate on the Morphology of Solvent Vapor Annealed ABA Triblock Copolymer Thin Films

JULIE N. L. ALBERT, WEN-SHIEUE YOUNG, RONALD L. LEWIS, III, TIMOTHY D. BOGART, JASMINE R. SMITH, THOMAS H. EPPS, III, University of Delaware — Solvent vapor annealing (SVA) treatments can be used to kinetically trap unique self-assembled nanostructures in block copolymer thin films that are not achievable by traditional thermal annealing methods. In this work, we kinetically trapped the thin film morphologies of a cylinder-forming ABA triblock copolymer at key points during the solvent removal process following SVA in order to gain insight into the re-ordering mechanisms associated with solvent removal. Specifically, we identified morphology transformations as a function of solvent removal rate, showed that the mechanism for cylinder reorientation involved the propagation of changes at the free surface through the film as a front, and validated a film etching scheme to image the through-film morphology using successive ultra-violet ozone (UVO) etching steps followed by atomic force microscopy (AFM). This facile real-space analysis of the thin film internal structure is more easily implemented in comparison to cross-sectional imaging. The results and methodology of our work are significant not only for improving our understanding of block copolymer thin film self-assembly, but also for tailoring solution processing methods to fabricate nanostructured materials (e.g., for nanotemplate and membrane applications) in general.

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