Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Factors Influencing Shear Alignment of Cylinder-Forming Block Copolymer Thin Films RALEIGH DAVIS, RICHARD REGISTER, Princeton University, PAUL CHAIKIN, New York University — Application of shear stress to block copolymers is known to preferentially orient the microdomains in the direction of applied shear. While this phenomenon has been well studied for bulk block copolymer systems, the use of shear stress to align microdomains in block copolymer thin films (typically one to several microdomain layers) is still an active area of research. Numerous experimental factors influence the ease with which orientation is achieved as well as the ultimate quality of alignment observed. The present work investigates several of these factors using a series of cylinder-forming poly(styrene)-poly(hexylmethacrylate) copolymers. Parameters studied include film thickness, block copolymer molecular weight and composition, substrate wetting conditions (controlled via grafted polymer brush layers of either polystyrene or polyhexylmethacrylate), and applied shear stress. Quality of alignment is assessed via atomic force microscopy and subsequent computation of an orientational order parameter and the density of defects in the microdomain lattice. The results are compared to a melting-recrystallization model, thus providing greater insight into the fundamental mechanisms and key parameters which control how microdomains order in response to shear. In general monolayers are observed to align more poorly than thicker films, though the influence of film thickness on orientation depends strongly on polymer composition. Alignment quality is ultimately limited by inherent fluctuations in the cylinder trajectories as well as the presence of isolated dislocations.

Raleigh Davis
Princeton University

Date submitted: 14 Nov 2013 Electronic form version 1.4