MAR08-2007-005926
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Abstract for an Invited Paper
for the MAR08 Meeting of
the American Physical Society

Templated Self Assembly of Block Copolymer Thin Films

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A primary limitation of block copolymer films as templates for next generation electronic or data storage devices is the prohibitively long times required for thermally driven self-assembly and defect annihilation and long range order development. We demonstrate a high-throughput approach involving temporal zone (cold-hot-cold) annealing of block copolymer films well below their order-disorder transition temperature (T: HOT << T: ODT) that produces low defect concentrations, large grain size and a preferential alignment of the block microphase relatively rapidly. Promising results have been obtained by combining zone annealing with directed assembly on topographically patterned substrates. This combination results in the rapid development of long-range order which persists over the entire patterned area. The evolution of order in these templates is quantified using neutron reflection in conjunction with tomographic small angle scattering, and compared to scattering from model simulations to obtain a 3-D description of ordering within channel templates. The ability to rapidly achieve quantifiable long-range order in block copolymers (with inaccessible order-disorder transition temperatures) using non-destructive methods within templates suggests zone annealing as a robust nanomanufacturing method for guided self-assembly.

[1]Invited Talk