Effect of Homopolymer Additive Molecular Weight on the Patterning Behavior of Directed Self-Assembly of Block Copolymer-Homopolymer Blends

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Block copolymers (BCPs) are an attractive material to the microelectronics industry due to their ability to microphase separate into morphologies with pitches ranging from 5 -100nm. Directed self-assembly (DSA) is the process by which the feature's direction are oriented and controlled. One method of accomplishing this via chemoepitaxy which uses the energetic contrast in patterned regions of a substrate to direct thin film BCP morphologies during phase separation. Chemoepitaxial underlayers are composed of a highly block-preferential pinning stripe and a background region that may be slightly preferential to the unpinned block. The number of full pitch features that can form between any two pinning stripes is known as the density multiplication.

The pitch, individual domain sizes, and domain morphologies formed in a DSA process utilizing pure block copolymers are dictated by the molecular weights of the various blocks of the copolymer. Addition of homopolymer is one possible method for achieving pitch modulation, domain size modulation, and even morphological modulation from a given block copolymer. Such tuning of a block copolymer DSA process through additives may provide a means to extend the utility of single well controlled block copolymer to a wider range of applications. It is also be possible to achieve geometries that would be otherwise impossible with the block copolymer alone. In this work, coarse grained molecular dynamics simulations have been used to probe the effect of homopolymer additive molecular weight on the DSA patterning characteristics of block copolymer-homopolymer blends including pattern line edge roughness and line width roughness.