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Out-of-plane Block Copolymer Microdomains in High Aspect-Ratio Templates KARIM GADELRAB, WUBIN BAI, ALFREDO ALEXANDER-KATZ, CAROLINE ROSS, Massachusetts Inst of Tech-MIT — Directed self-assembly DSA of block copolymers BCP proved to be a power approach for nanoscale fabrication. In addition, BCP with highly incompatible blocks (high Flory-Huggins interaction parameter (χ)) offer improvement in resolution of the BCP patterns. Unfortunately, high-χ BCPs usually exhibit large differences in surface affinity between the two blocks, forming a surface layer of the lower surface energy block and favoring in-plane orientation of lamellae or cylindrical microdomains. Here, we explore the conditions under which a high χ BCP creates an out-of-plane lamellar structure using high aspect ratio trenches with preferential walls. We employ self-consistent field theory SCFT and single mode expansion of Ginzburg-Landau free energy expression in the weak segregation limit to analytically construct a phase diagram of the in- and out-of-plane lamellae as a function of aspect ratio and surface affinity. It is found that achieving an out of plane lamellar structure necessitates a coupling between aspect ratio and surface functionality. In particular, strong side wall attraction results in out-of-plane lamellae when the trench aspect ratio is greater than unity. The results are validated for a polystyrene-block-polydimethylsiloxane (PS-b-PDMS) system within trenches made using interference lithography.

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