

Wide Neutrality Window for Block Copolymer Vertical Orientation Using Incongruent Homopolymer Blended Brushes

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Abstract: Substrate neutrality is essential for achieving vertical orientation of block copolymers (BCPs) in directed self-assembly. We report incongruent homopolymer blended polymer brushes as a simple and robust platform for expanding the neutrality window. By blending hydroxyl-terminated polymers with mismatched chain lengths (e.g., PS-PMMA 6:10), we obtain a wide composition range that supports vertical lamellar and cylindrical morphologies without strict compositional tuning. The enhanced neutrality is attributed to a proposed canopy effect, where longer chains reorganize above shorter, densely grafted chains to minimize interfacial energy. Extending this strategy to high- χ systems such as PS-*b*-P2VP, we employ electro spray deposition as a high-throughput approach to rapidly screen processing conditions and enable controlled self-assembly. This combined brush electro spray platform offers a scalable pathway for nanoscale patterning and advanced nanomanufacturing applications.

