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Large Volume Self-Organization of Polymer/Nanoparticle Hybrids with Millimeter Scale Grain Sizes using Brush Block Copolymers
DONGPO SONG, JAMES WATKINS, Department of Polymer Science and Engineering, University of Massachusetts Amherst — The lack of sufficient long-range order in self-assembled nanostructures is a bottleneck for many nanotechnology applications. In this work, we report that exceptionally large volume of highly ordered arrays (single grains) on the order of millimeters in scale can be rapidly created through a unique innate guiding mechanism of brush block copolymers (BBCPs). The grain volume is over 1 billion times larger relative to that of typical self-assembled linear BCPs (LBCPs). The use of strong interactions between nanoparticles (NPs) and BBCPs enables the high loadings of functional materials, up to 76 wt% (46 vol%) in the target domain, while maintaining excellent long-range order. Overall this work provides a simple route to precisely control the spatial orientation of functionalities at nanometer length scales over macroscopic volumes, thereby enabling the production of hybrid materials for many important applications.

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