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Author: Biswajit Sarkar Paschalis Alexandridis

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# Block Copolymer-Nanoparticle Composites: Structure, Functional Properties, and Processing

Biswajit Sarkar and Paschalis Alexandridis\*

Department of Chemical & Biological Engineering  
University at Buffalo, The State University of New York (SUNY)  
Buffalo, New York 14260-4200

## Abstract

The incorporation of nanoscopic particles into ordered nanostructures afforded by block copolymers can provide control over particle distribution and orientation. This could enable the development of engineered nanomaterials that have enhanced properties such as mechanical, optical, electrical, or barrier. Deployment of large scale processing methods is necessary for the successful technological exploitation of the functional properties of nanoparticle-containing block copolymer hybrids. To this end, fundamental knowledge of the local structure, hierarchical morphology, structure-property relations, and influence of processing on all these is essential. This review addresses these issues. The successful localization of nanoparticles in ordered block copolymer matrices as well as the overall properties of the block copolymer-nanoparticle composites depend on the features of nanoparticles and of block copolymers, and can be modulated by the addition of small molecules. Incorporation of nanoparticles in block copolymers can be achieved by melt-mixing, solvent-based processing, or a combination of these two. Subsequent application of external fields such as shear, thermal, electrical, or magnetic can further improve the long-range internal structure and the functional properties of block copolymer-nanoparticle composites.

**Keywords:** block copolymer, nanoparticle, nano-composite, self-assembly, nano-hybrid

\*To whom correspondence should be addressed. E-mail: [palexand@buffalo.edu](mailto:palexand@buffalo.edu).

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