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Nanoparticle-directed self-assembly of amphiphilic block-copolymers[1]

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The self-assembly of nanoparticles and amphiphilic polymers provides a powerful tool for the fabrication of functional composite materials for a range of applications spanning from nanofabrication to medicine. Here, we present how the incorporation of nanoparticles affects the self-assembly behavior of amphiphilic block-copolymers and how to control the morphology of nanoparticle-encapsulating polymer assemblies. Based on the approach, we have prepared various types of well-defined nanoparticle-encapsulating polymeric nanostructures, including polymersomes packed with magnetic nanoparticles and unique cavity-like quantum dot assembles. We found that the incorporation of nanoparticles drastically affects the self-assembly structure of block-copolymers by modifying the relative volume ratio between the hydrophobic block and the hydrophilic block. In addition, the nanoparticle-polymer and nanoparticle-solvent interactions impact the arrangement and the hybridization of nanoparticles in polymer matrix. These findings should form the basis for the design rules of the self-assembly of nanoparticles and polymer amphiphiles, which will allow one to create new hybrid structures with predesigned morphology and properties. Furthermore, we demonstrated that the morphology of nanoparticle-encapsulating polymer assemblies significantly affects their properties such as magnetic relaxation properties, underscoring the importance of the overall self-assembly structure and the nanoparticle arrangement in polymer matrixes.

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