Nanoparticle-directed self-assembly of amphiphilic block-copolymers

SO-JUNG PARK, University of Pennsylvania

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 assemblies. 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.

This work was supported by the NSF career award, the ARO young investigator award, and the MRSEC seed award (University of Pennsylvania).