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Exotic nanoparticles with block copolymer design and solution construction with kinetic control

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Kinetic pathways and long temporal stabilities of different block copolymer micelles and nanoscale aggregates have been used to construct exotic nanoparticles in solution. Due to low chain exchange dynamics between block copolymeric micelles and solvent, global thermodynamic equilibrium is extremely difficult, if not impossible, to achieve in block copolymer assembly. However, by taking advantage of this slow kinetic behavior of polymeric micelles in solution, one can purposely produce multicompartment nanoparticles and mulitgeometry nanoparticles by forcing different block copolymers to reside in the same nanoscale structure through kinetic processing. While kinetically trapped in common nanostructures, local phase separation can occur producing compartments and surface patches uniquely displayed from the surface of the nanoparticle. This compartmentalization can be used within common micelle geometries to make complex spheres and cylinders or can be used to make new nanostructures such as multigeometry aggregates such hybrid cylinder-sphere aggregates, disk-cylinder nanoparticles, and hybrid inorganic-block copolymer nanoparticles. Additional results producing nanoparticles with blends of three or more different block copolymers and block copolymer-polypeptide hybrid particles will be discussed.