

Forming Kinetically-trapped Liquid Crystalline Spherical Nanoparticles during Polymerization-induced Self-assembly

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Liquid crystalline nanoparticles (LC NPs) have attracted considerable attention due to their anisotropic structures. However, the fabrication of LC NPs has typically been constrained by challenges in mass production and precise morphology and size distribution controls. Polymerization-induced self-assembly (PISA), a scalable and efficient technique, enables nanoparticle synthesis with diverse morphologies at high solids. Although the kinetic trapping associated with PISA typically limits morphological transitions of nanoparticles, it can be utilized to fabricate specific nano-objects. Herein, kinetically-trapped poly(2-(dimethylamino)ethyl methacrylate) –poly(6-((4-cyano-4'-biphenyl)oxy)hexyl methacrylate) (PDMA-PMA6CB) diblock copolymer LC NPs were synthesized using the LC polymer PMA6CB as the core-forming block. Small-angle X-ray scattering (SAXS) verified the straight PMA6CB main-chain conformation in PDMA–PMA6CB spherical micelles, exhibiting birefringence as lyotropic liquid crystal behavior in spherical particle formation under polarized optical microscopy (POM). To adjust birefringence, benzyl methacrylate (BzMA) was introduced to produce PDMA-PMA6CB-PBzMA triblock copolymer nanoparticles. The resulting nanoparticles exhibited reduced or absent birefringence, likely resulting from disrupted PMA6CB block radial orientation in spherical micelle cores, evidenced by SAXS. Further investigation of the morphological transitions of PDMA-P(MA6CB-co-BzMA) statistical copolymer nanoparticles elucidated kinetic trapping effects during nanoparticle formation. This study presents an efficient method to prepare LC NPs, offering valuable insights into the core-forming block control.

Keywords:

Polymerization-induced self-assembly; Liquid crystalline nanoparticles; Kinetic trapping; Small-angle X-ray scattering

References:

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