

Functional Nanoparticles via “Living” Crystallization-Driven Self-Assembly

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Abstract

Molecular, and more recently, macromolecular synthesis has evolved to an advanced state allowing the creation of remarkably complex organic molecules and well-defined polymers with typical dimensions from 0.5 nm - 10 nm. In contrast, the ability to prepare materials in the 10 nm – 100 micron size regime with controlled shape, dimensions, and structural hierarchy is still in its relative infancy and currently remains the virtually exclusive domain of biology. In this talk recent developments concerning a promising “seeded growth” route to well-defined 1D and 2D nano- and microparticles termed “living” crystallization-driven self-assembly (CDSA), will be described. Living CDSA can be regarded as a type of “living supramolecular polymerization” that is analogous to living covalent polymerizations of molecular monomers but on a much longer length scale (typically, 10 nm – 5 microns). Living CDSA also shows analogies to biological “nucleation-elongation” processes such as amyloid fiber growth. The building blocks or “monomers” used for living CDSA consist of a rapidly expanding range of crystallizable amphiphiles such as block copolymers, homopolymers with charged termini, or planar π -stacking molecules with a wide variety of chemistries. The seeds used as “initiators” for living CDSA are usually prepared from preformed polydisperse 1D or 2D micelles by sonication. Recent results indicate that living CDSA is scalable, which will help enable applications in areas such as optoelectronics, catalysis, and biomedicine, and recent examples of work by our group and our collaborators in these areas will be discussed.1-4.

References

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