Shape-Directed Nanocrystal Self-Assemblies: From Quasicrystalline to In-Transition Architectures

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Abstract: Uniform nanocrystals can spontaneously self-assemble into highly-ordered superstructures, serving as advanced nanomaterials that combine intrinsic nanocrystal properties with architecture-driven functionalities. Among the key parameters, the shape of the nanocrystal building blocks plays a primary role in dictating self-assembly. By finely tuning particle shape, entirely new superlattice paradigms can emerge. In this talk, I will present two examples: tetrahedral quantum dots and mecon-shaped silver nanocrystals. These systems give rise to unusual superlattices, including single component quasicrystals, cluster-based assemblies, and in-transition structures reminiscent of martensitic transformations. I will discuss design strategies to control interparticle interactions, demonstrate self-assemblies once thought impossible, and explore potential applications of these nanocrystal superlattices.

Short Bio: Yasutaka Nagaoka is a Research Professor in the Department of Chemistry at Brown University. He received his Ph.D. in Chemistry from the University of Florida in 2013 under Prof. Charles Cao, and holds M.S. and B.S. degrees from Keio University in Japan. His research focuses on nanocrystal synthesis and self-assembly, high pressure chemistry, and emergent properties of plasmonic nanomaterials.