Abstract
The controlled synthesis of colloidal nanocrystals with precise sizes, shapes and compositions is crucial for the creation of novel assemblies and functional devices constructed from these building blocks. In the first portion of this talk, I will share recently developed methods for the preparation of monodisperse optically-active nanocrystals. Examples include metal and metal-oxide particles exhibiting tunable plasmonic resonances, and lanthanide-doped nanocrystals displaying unique luminescent properties. Next, I will discuss the fundamental principles governing the self-assembly of nanocrystals into long-range ordered superlattices, and highlight examples of multicomponent nanocrystal superlattices in which the spatial arrangement and coupling between constituent nanocrystals dictate their collective physical properties. I will also share recent results on quasicrystalline assemblies and particle brush solids. In the second portion of this talk, I will show direct single-particle imaging of nanocrystal-based chemical reactions using in-situ graphene liquid cell TEM. By monitoring the shape evolution of anisotropic metal nanocrystals as they are oxidatively sculpted, images of a variety of short-lived, reactive intermediates can be captured and structurally analyzed. Understanding these reaction trajectories and their transient intermediates reveal important mechanistic insight into anisotropic nanocrystal reactivity and demonstrate the importance of developing tools capable of probing short-lived nanoscale species.