Mastering Nanoparticle Size and Shape Control Through Chemical Synthesis

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The ability to precisely control nanoparticle shape, size, and composition is useful in many fields, including catalysis and plasmonics. Seed-mediated strategies have proven effective for preparing a wide variety of structures, but the understanding of how to selectively grow corners, edges, and facets has limited the development of a general strategy to control structure evolution. We have developed a synthetic strategy for directing the site-specific growth of anisotropic seeds to prepare a library of designer nanostructures. This strategy leverages nucleation energy barrier profiles and the chemical potential of the growth solution to control the site-specific growth of nanoparticles into exotic shapes and compositions. This strategy can be used to not only control where growth occurs on anisotropic seeds but also control the exposed facets of the newly grown regions. The observation that one can control the microscopic shape of single crystals based upon control of particle building block and crystal symmetry has important fundamental and technological implications for this novel class of colloidal matter.