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Engineered Self-Assembly of Plasmonic Nanomaterials

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A critical need in nanotechnology is the development of new tools and methods to organize, connect, and integrate solid-state nanocomponents. Self-assembly – where components spontaneously organize themselves – can be carried out on a massively parallel scale to construct large-scale architectures using solid-state nanocrystal building blocks. I will present our recent work on the synthesis and self-assembly of nanocrystals for plasmonics, where light is propagated, manipulated, and confined by solid-state components that are smaller than the wavelength of light itself. We show the organization of polymer-grafted metal nanocrystals into hierarchical nanojunction arrays that possess intense "hot spots" due to electromagnetic field localization. We also show that doped semiconductor nanocrystals can serve as a new class of plasmonic building blocks, where shape and carrier density can be actively tuned to engineer plasmon resonances. These examples demonstrate that nanocrystals possess unique electromagnetic properties that rival top-down structures, and the potential of self-assembly for fabricating designer plasmonic materials.