Nanoparticle Synthesis and Self-Assembly for Metasurfaces and Beyond

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Many optical spectroscopy and imaging techniques are limited by the ability to fabricate nanoscale probes that are robust, reproducible, and support high quality optical resonances. I will describe how colloidal plasmonic nanoparticles overcome these obstacles and serve as enabling materials for spectroscopy and imaging. First, I will present our recent work on the synthesis and self-assembly of colloidal nanoparticles for the fabrication of resonant optical nanojunctions. Previously, we demonstrated that shaped colloidal nanoparticles can be organized into nanojunctions that possess intense “hot spots” due to electromagnetic field localization. Here, I will describe how colloidal nanoparticles can be assembled and used as metasurfaces for second harmonic light generations and near-perfect light absorbers. Second, I will present new syntheses and spectroscopic data for plasmonic nanodisks that are capable of upconverting near-infrared (NIR) light. We demonstrate that control of particle shape can be gained by utilizing a single-source, supramolecular precursor that adopts liquid crystalline order. This synthetic control results in the generation of two-photon absorbing (TPA) inorganic nanoparticles that support plasmon resonances in the NIR to mid-infrared wavelengths, which have the potential to exhibit extraordinary two-photon action cross-sections.