Probing Interparticle Interaction and Doping in Nanomaterials

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Understanding the fundamental interaction between nanoparticles that is critical to assembly of nanomaterials into superlattice structure for device applications. We have used strongly interacting Au nanoparticle aggregates as a model system for probing interparticle interaction. The structure of aggregates have been carefully characterized. We observed, for the first time, coherent vibrational oscillations of such nanoparticle aggregates based fs laser spectroscopy. The oscillations observed, in conjunction with hole burning experiment, suggests that the extended plasmon band is inhomogeneously broadened by different sized/structured aggregates. In a separate effort to understand how to achieve uniform doping of semiconductor nanoparticles, we used a molecular cluster “seed” approach for growing larger nanoparticles with Mn-doped ZnSe as an illustration. ZnSe:Mn nanoparticles were synthesized from cluster precursors and characterized. Two Mn sites have been identified with one on the surface, which quenches ZnSe emission but gives no Mn emission, and the other one in the interior, which has characteristic 580 nm emission.