Control of Gold Nanoparticle Aggregates by Manipulation of Interparticle Interaction

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Gold nanoparticles have attracted much attention in the past decade due to their stability, uniformity, and optical properties. For chemically reduced gold nanoparticles, the particle size can be varied by the amount of reducing agents. We control the size and stability of gold nanoparticle aggregates in aqueous solution by manipulating the inter-particle interaction. To control the interparticle interaction of gold nanoparticles, we utilize the competitive adsorption of organic adsorbates on the particle surface. Various experimental techniques such as quasi-elastic light scattering (QELS), UV-vis absorption spectroscopy, and surface-enhanced Raman scattering (SERS) are used to characterize the nanoparticle aggregates. For theological analysis, we simulate the aggregation of nanoparticle by the use of Monte Carlo simulation. Our findings suggest that replacing the trivalent citrate ions adsorbed on the particle surface with monovalent mercaptan ions destabilizes the particles, causing aggregation and the increase in final size. This is successfully explained by the classical DLVO (Derjaguin-Landa-Vervey-Overbeek) theory that describes the interparticle interactions and colloidal stability in solution.