

Electron Transfer Dynamics and Spectroelectrochemistry of Gold Nanoparticles

Dongil Lee  
Western Michigan University  
Nanotechnology Research and Computation Center  
Kalamazoo, MI 49008, USA  
Email: dongil.lee@wmich.edu

Gold nanoparticles can be synthesized with dense monolayer coatings of thiolate ligands. We have developed procedures for analytical characterization of the nanoparticles and their monolayers that permit expressing the nanoparticle composition as an average molecular formula, for example (I)  $\text{Au}_{140}(\text{C6})_{53}$  or (II)  $\text{Au}_{38}(\text{PhC2})_{24}$  where C6 is hexanethiolate and PhC2 is phenylethylthiolate. These nanoparticles are referred to as monolayer protected clusters (MPCs). When the metal MPC core is sufficiently monodisperse, single-electron changes in the electronic charge on the core can be voltammetrically discerned in the electrochemical charging of solutions of the MPCs. The single electron charging energetics, together with synthetic and spectral observations represent the bulk-to-molecule transition region where electronic band energetics yield to quantum confinement effects and discrete electronic states emerge. The ability to treat single electron charging as a pseudo-redox phenomenon facilitates design of experiments that probe the dynamics of electron transfers between nanoparticles, such as a) within solid state samples of nanoparticles as bimolecular events, and b) as electron diffusion-transport within films of nanoparticles on electrodes contacted by electrolyte solutions. The basic methodologies of solid state electron transfer experiments will be presented along with current results on the rate constants.