Abs. 1, 206th Meeting, © 2004 The Electrochemical Society, Inc.

Double Layer Charging and Ligand Chemistry of Monolayer-protected Gold Clusters

Rui Guo, Robert L. Donkers, Jennifer L. Brennan, Stephen W. Feldberg, Royce W. Murray*

Department of Chemistry, C-345 Kenan Laboratories of Chemistry, Univ. of North Carolina, Chapel Hill, NC 27599-3290

Gold nanoparticles containing less than 200 atoms have been of recent interest because they represent the bulk-to-molecule transition region. We have studied in particular $Au_{140}(SC6)_{53}$ and $Au_{38}(SC2Ph)_{24}$, whose voltammetry shows, respectively, quantized double layer charging capacitance (QDL) and a molecule-like band gap. The effects of supporting electrolyte concentration, temperature and solvent on QDL behavior of the hexanethiolate-protected gold cluster $Au_{140}(SC6)_{53}$ have been analyzed with double layer theory including diffuse layer effects. Phenylethylthiolate coated gold cluster $Au_{38}(SC2Ph)_{24}$ shows a doublet of oxidation waves in addition to the electrochemical band gap in square wave voltammetry. The spacing between the doublet peaks is affected by the electrolyte medium in a manner similar to that for $Au_{140}(SC6)_{53}$. Meanwhile, the ligand exchange kinetics of the $Au_{38}(SC2Ph)_{24}$ nanoparticles have been examined in comparison to that known for $Au_{140}(SC6)_{53}$, as a study of the effect of nanoparticle size on chemical reactivity. Finally, the diffusion coefficient of $Au_{38}(SC2Ph)_{24}$ in dichloromethane was also measured.

Acknowledgement of support from: ONR and NSF.

*rwm@email.unc.edu