STRUCTURE AND ELECTRICAL PROPERTIES OF AN ASSEMBLY OF GOLD NANOCLUSTERS

G. Muralidharan, L. Maya and T. Thundat
Oak Ridge National Laboratory
Oak Ridge, TN-37831-6123

ABSTRACT

The phenomenon of Coulomb-blockade has been observed in charge transport through metal or semiconductor islands separated by a tunneling barrier. While Coulomb-blockade has been studied extensively at low temperatures, there is increasing interest in conducting such studies at room temperatures. In the past, various fabrication methodologies have been adopted to prepare an assembly of metal clusters coupled by an insulating barrier. In the present study, we focus our effort on studying the electrical properties of metallic clusters assembled through chemical interactions.

It has been shown recently that free-standing, space-filling films, essentially one monolayer thick, can be assembled using gold clusters functionalized with carboxylic acid moieties. Such assembly is mediated by the presence of low molecular weight polymers containing amine functionalities. Assembly is generally promoted through the formation of peptide bonds in the presence of a carbodiimide while in the absence of the carbodiimide, assembly occurs through ion pairing. It has also been found that the spatial distribution of the gold clusters within the films is sensitive to the nature of the acid coating on the clusters. A systematic study of the structure of these films has been carried out using transmission electron microscopy and scanning probe microscopy. Since such films provide an excellent experimental framework for understanding coulomb blockade effects, electrical properties of the films have been measured at room temperature. This work will present some of the observed characteristics in the structure of the films. In addition, the electrical properties of the films will be presented with special reference to coulomb blockade effects in nanoscale metallic clusters at room temperature.

Oak Ridge National Laboratory
UT-Battelle, LLC
for the
U.S. Department of Energy
under contract number DE-AC05-0096OR22725.