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Charge Retention by Monodisperse Gold Clusters on Surfaces Prepared Using Soft Landing of Mass Selected Ions
GRANT JOHNSON, Pacific Northwest National Laboratory, THOMAS PRIEST, University of Louisville, JULIA LASKIN, Pacific Northwest National Laboratory — Monodisperse gold clusters have been prepared on surfaces in different charge states through soft landing of mass-selected ions. Gold clusters were synthesized in methanol solution by reduction of a gold precursor with a weak reducing agent in the presence of a diphosphine capping ligand. Electrospray ionization was used to introduce the clusters into the gas-phase and mass-selection was employed to isolate a single ionic cluster species which was delivered to surfaces at well controlled kinetic energies. Using in-situ time of flight secondary ion mass spectrometry (SIMS) it is demonstrated that the cluster retains its 3+ charge state when soft landed onto the surface of a fluorinated self assembled monolayer on gold. In contrast, when deposited onto carboxylic acid terminated and conventional alkyl thiol surfaces on gold the clusters exhibit larger relative abundances of the 2+ and 1+ charge states, respectively. The kinetics of charge reduction on the surface have been investigated using in-situ Fourier Transform Ion Cyclotron Resonance SIMS. It is shown that an extremely slow interfacial charge reduction occurs on the fluorinated monolayer surface while an almost instantaneous neutralization takes place on the surface of the alkyl thiol monolayer. Our results demonstrate that the size and charge state of small gold clusters on surfaces, both of which exert a dramatic influence on their chemical and physical properties, may be tuned through soft landing of mass-selected ions onto selected substrates.

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