MAR06-2005-020001

Abstract for an Invited Paper
for the MAR06 Meeting of
the American Physical Society

Chemical Functionalities in the non-scalable size-regime

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The reactivity and optical properties of nanoscale systems are mainly dominated by quantum-size effects that govern the electronic spectra of clusters, by the structural dynamical fluxionality of clusters, as well as by impurity-doping effects. In this talk these fundamental and unique cluster properties will be illustrated by specific examples obtained from molecular beam experiments in the gas phase and experiments on size-selected clusters on surfaces. Where possible, concepts for their understanding are given. Specifically, in the first part of the talk new results on the optical properties of small gold clusters on amorphous silica will be presented, where Cavity Ringdown Spectroscopy is used to measure optical transitions of clusters at surfaces with extremely high sensitivity. In the second part of the talk a new approach for obtaining thermodynamic properties of chemical reactions by using micromechanical devices is introduced and an overview of results on the catalysis of gold clusters is presented. By combining these experimental data with ab-initio calculations, a picture of the peculiar catalytic behavior of gold is now emerging.