

O 50: Particles and Clusters II

Time: Thursday 11:15–12:45

Location: H38

O 50.1 Thu 11:15 H38

In-plane optical anisotropy of metal clusters studied by reflectance-difference spectroscopy — ●JOSÉ MANUEL FLORES-CAMACHO, LI DONG SUN, NADIA SAUCEDO-ZENI, GÜNTHER WEIDLINGER, MICHAEL HOHAGE, and PETER ZEPPENFELD — Institut für Experimentalphysik, Johannes Kepler Universität Linz, A-4040, Linz, Austria

Reflectance-difference spectra of Ag clusters supported on an insulating, uniaxial substrate for Ag coverages in the 0.1 – 4.0 nm nominal thickness range are presented. The observed in-plane optical anisotropy is explained in terms of the splitting of the degeneracy of in-plane polarizations due to the presence of the non-equivalent dipole images in the substrate in quasi-electrostatic approximation. Geometrical sources of anisotropy might be excluded in a first approach since scanning electron and atomic force microscopy images reveal randomly arranged oblate spheroidal particles with in-plane rotational symmetry.

Although the presence of at least one source of in-plane anisotropy is necessary, be it cluster or substrate related, we show that reflectance-difference spectroscopy (RDS/RAS) is very sensitive to a number of particle-plasmon resonance related phenomena such as the cluster geometry, the randomness of the system, shape/size distributions, higher-than-dipole interactions between particles, percolation threshold, and the presence of a dielectric shell. From this we propose RDS/RAS as a reliable tool for the monitoring of cluster growth.

O 50.2 Thu 11:30 H38

Properties of mass selected Ag clusters in comparison to Ag island growth studied by low-temperature STM and STS — ●STEFANIE DUFFE¹, THOMAS IRAWAN¹, MARKUS BIELETZKI¹, TORSTEN RICHTER¹, BENEDIKT SIEBEN¹, HEINZ HÖVEL¹, CHUNRONG YIN², and BERND VON ISSENDORFF² — ¹Universität Dortmund, Experimentelle Physik I, 44221 Dortmund, Germany — ²Universität Freiburg, Fakultät für Physik, 79104 Freiburg, Germany

We deposit mass selected Ag clusters on a C₆₀ functionalized Au(111) surface at room temperature with a cluster machine consisting of a magnetron sputter gas aggregation source, a differential pumping stage with a cryo pump and a high transmission infinite range mass selector. We especially focus on clusters with closed geometric shells. At room temperature the C₆₀ molecules rotate on the surface [1], which may explain the observed mobility of the deposited clusters on the C₆₀ surface. For the deposition of Ag clusters with 55, 147 and 309 atoms at room temperature we observed extremely narrow height distributions with a cluster height of 1.7 nm and similar STS spectra for each cluster size. For Ag clusters with 561 and 923 atoms also larger heights were observed. To study the temperature dependent mobility we grew Ag islands on C₆₀/Au(111) by the deposition of Ag atoms at low temperatures.

[1] E.I. Altman, R.J. Colton, Surf. Sci. 295, 13 (1993)

O 50.3 Thu 11:45 H38

Arbitrary-order sum frequency generation scattering from spherical particles — ●SYLVIE ROKE — Max-Planck-Institut für Metallforschung, Heisenbergstrasse 3, 70569 Stuttgart

Nonlinear optical processes have been widely applied to study materials. The most commonly used techniques rely on second-order processes, such as second harmonic (SHG) and sum frequency generation (SFG). Consequently, SHG, SFG and some higher order techniques (like THG and CARS) have been developed into well-established spectroscopic and microscopic techniques that probe the optical interface- and bulk properties of materials. SHG, SFG and THG have recently been performed in a scattering geometry, in which the interfaces (and bulk) of (nano) particles in solution or embedded in composites can be probed in-situ. This enables one to combine the fields of soft matter and surface science.

To better understand these new developments, we have calculated the expressions for arbitrary-order sum frequency scattering from small

particles. We calculate the full 3-dimensional scattering pattern for the case of second-order scattering and specify the selection rules and relations that relate the molecular structure to the scattering process. From these expressions, we can derive useful insights into how molecular order, orientation, and chirality appear in the scattering pattern.

O 50.4 Thu 12:00 H38

Oxidation / reduction cycles of metal nanoparticles — ●A. STIERLE, N. KASPER, P. NOLTE, N. Y. JIN-PHILLIPP, and H. DOSCH — Max Planck Institut für Metallforschung, Heisenbergstr. 3, D-70569 Stuttgart, Germany

During catalytic reactions, oxide supported transition metal nanoparticles undergo continuously oxidation / reduction cycles. We have performed in-situ x-ray diffraction studies at the MPI-MF beamline at the Ångström Quelle Karlsruhe (ANKA) and at beamline BM32 at the European Synchrotron Radiation Facility (ESRF) during the oxidation and reduction of different epitaxial nanoparticle / oxide support systems (Rh, Pd/MgO(100), Rh,Pd/Al₂O₃(0001), Pd/ZnO(0001), particle size 5-10 nm), thereby closing the pressure gap from near-UHV to atmospheric pressures. The oxidation properties of nanoparticles is expected to depend on the support, their orientation and their size and shape. We observe that the particles undergo at 500 K reversible shape changes when changing from reducing to oxidizing conditions and back. Under oxidizing conditions the formation of new facets is observed and in the case of Rh/MgO(100) the evolution of a surface reconstruction. The shape of the nanoparticles is additionally characterized by ex-situ high resolution transmission electron microscopy.

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O 50.5 Thu 12:15 H38

Photochromic silver nanoparticles embedded in transition-metal oxides — ●ALEXANDER SPRAFKE, FLORIAN HALLERMANN, CHRISTOPH STRAKA, CHRISTIAN DAHMEN, MATTHIAS WUTTIG, and GERO VON PLESSEN — I. Institute of Physics (IA), RWTH Aachen University, 52056 Aachen, Germany

Photochromic materials change their color when irradiated with light. We have recently reported on the photochromic transformation of silver nanoparticles embedded in titania. This transformation shows itself in a bleaching of the nanocomposite films at the wavelength of irradiation, and is probably caused by a plasmon-assisted photoemission of electrons from the resonantly excited Ag particles. In the present work, we investigate whether a photochromic effect can also be found in Ag nanoparticles embedded in other transition-metal oxides, such as ZrO₂ and HfO₂. We examine the changes of the optical spectra of the films during laser irradiation, and compare them to the findings of our previous studies on the Ag/TiO₂ system. We discuss to what extent our model of the photochromic transformation can be applied to the Ag/ZrO₂ and Ag/HfO₂ films.

O 50.6 Thu 12:30 H38

Cluster surface interaction probed by resonance photoemission — MARKUS HESSLER and ●KAI FAUTH — MPI für Metallforschung, Heisenbergstr. 3, 70569 Stuttgart, Germany

Clusters of the late transition metals may experience strong modifications of their magnetic moments when exposed to the interaction with surfaces. In particular, the interaction with graphite nearly suppresses the intrinsic magnetism of small Fe, Co and Ni clusters. The present contribution discusses the use of resonance photoemission at the Ni 2*p* and 3*p* edges to elucidate details of the cluster substrate interaction. It is found that a gapless electronic structure with low density of states at the Fermi level forms at the cluster substrate interface by hybridization. Loss of magnetization can then be understood as a consequence of the Stoner criterion not being fulfilled. Ni 2*p* and 3*p* resonance photoelectron data yield complementary information about cluster surface interaction.