O 56: Nanostructures: Dots, Particles and Clusters

Time: Wednesday 10:30–12:30 Location: H4

O 56.1 Wed 10:30 H4

Coherent X-ray Diffraction of Single Epitaxial Nano-Objects — •Thomas F. Keller[1,2], Roman Shayduk[1], Vedran Vonk[1], Arti Dangwal Pandey[1], Claudia Neisser[3], Irene Fernandez-Cuesta[2], Alexey Zozulya[1], Michael Sprung[1], and Andreas Stierle[1,2] — [1]Deutsches Elektronen Synchrotron (DESY), Hamburg, Germany — [2]Institute for Nanostructure and Solid State Physics, University of Hamburg, Germany — [3]Institute for Ion Beam Physics, Helmholtz Center Dresden-Rossendorf, Germany

Controlled nanocatalysis requires novel approaches to understand the size-dependence of catalytic processes. We report on a one-to-one structure analysis of a single platinum (Pt) nanodot-array supported by a strontium titanate STO(100) single crystal by real-space imaging in a scanning electron microscope and in reciprocal space using coherent Bragg diffraction from a focused X-ray beam at PETRA III at DESY.

The Pt nanodot-array was created using a combined lift-off and etching process based on e-beam lithography. Utilizing a transfer and repositioning protocol using the Pt X-ray fluorescence we localized the 2x2 mu^2 array with a center-center distance of 150 nm between single Pt nanodots. The Pt(111) Bragg peak position indicates a preferential Pt(111)/STO(100) orientation. The interference fringes of this peak are typical for coherent diffraction and allow extracting particle shape, size and interparticle distance to compare with the real space imaging.

We propose the use of such nanodot-arrays for future experiments on in-situ oxidation or catalysis as well as for coherent X-ray diffraction of single nano-assemblies under reaction conditions.

O 56.2 Wed 10:45 H4

Cluster mobility of supported size-selected clusters — •Amelie Porzelt, Fabian Knoller, Michael König, Yves Fukamori, Friedrich Esch, and Ueli Heiz — Technische Universität München, Chair of Physical Chemistry, Lichtenbergstr. 4, 85748 Garching, Germany

We present our studies on the ripening dynamics of individual size-selected clusters on a periodically wettable Moiré-graphene film on Rh(111). By imaging the cluster dispersion and by tracking the cluster diffusion, insight into the fundamental processes that govern the cluster diffusion can be gained - how do clusters start their diffusive motion, which path do they follow, how do they stop, and how does this behavior depend on their specific size? We present data on the diffusion of bare clusters and investigate changes induced by adsorbates such as CO, hydrogen or oxygen.

O 56.3 Wed 11:00 H4

Mass selected copper clusters on thin oxide films investigated with STM — •Dominik Wolter[1], Raphael Floegel[1], Matthias Bohlen[1,2], Christoph Schröder[1], Conrad Becker[3], and Heinz Hövel[1] — [1]Fakultät Physik / DELTA, Technische Universität Dortmund, 44221 Dortmund, Germany — [2]Now at: Physikalisches Institut, Universität Freiburg, 79104 Freiburg, Germany — [3]Aix-Marseille Université, CNRS, CINaM UMR 7325, 13288 Marseille, France

Oxide layers are commonly used for industrial purposes (e.g. microelectronics) but also a topic of current research. It was shown previously, that an Al_2O_3 film on a clean $Ni_3Al(111)$ surface can provide a template for palladium cluster array growth [1]. The quality of the oxidized surface was investigated with **L**ow-**E**nergy **E**lectron **D**iffraction and **S**canning **T**unneling **M**icroscopy. These oxide films are suitable for the deposition and investigation of mass selected clusters, because the layers are thick enough to minimize cluster-surface interaction but simultaneously thin enough to keep characterization with STM feasible. We evaluate the apparent height of deposited copper clusters as well as the next-neighbor distances in order to investigate their arrangement on the oxidized surface. Furthermore the mobility of the clusters is analyzed by incremental heating procedures. The next-neighbor distances can then be compared to Monte Carlo simulation data for various lattices to check whether the clusters attach to the template structure given by the oxide film or not. [1] S. Degen, C. Becker and K. Wandelt, Faraday Discuss., **125**, 343-356 (2004).

O 56.4 Wed 11:15 H4

Towards the geometrical structure of small, deposited Au nanoclusters using grazing incidence X-ray scattering — •Deniza Chekrygina[1], Matthias Schwartzkopf[2], Bjoern Beyersdorff[2], André Rothkirch[2], Ivan Baev[1], Torben Beeck[1], Fridtjof Kielgast[1], Stephan Klumpp[1], Jan-Hendrik Ruescher[1], Stephan Roth[2], Wilfried Wurth[1,2], and Michael Martins[1] — [1]Physik Department, Universität Hamburg — [2]DESY Photon Science, Hamburg

Mass-selected gold clusters deposited on a surface consisting of only a few atoms are of great interest due to their quantum size effects [J.Phys.Chem A, 103,9573 (1999)]. The geometrical structure of these objects is still not determined for most cases and the existing theoretical models are contradictory [Phys.Rev.B 67,085404(2003);Str.Chem., V16,N4(2005)]. In our work we investigate the geometrical structure of size-selected Au9 clusters deposited on a silicon substrate prepared under different soft-landing conditions. The clusters were capped with a thin Al film to suppress oxidation. Due to the very small size of our clusters we follow a new path for structural analysis. We compare differently prepared samples and present first results obtained using a combination of several complimentary methods performed in parallel: Grazing-incidence small- and wide-angle X-ray scattering (GISAXS and GIWAXS) and X-ray fluorescence (XRF).

O 56.5 Wed 11:30 H4

Vortex Assisted Growth of Metallic Nanowires in Superfluid Helium Droplets — •Alexander Volk[1], Philipp Thaler[1], Andreas W. Hauser[1], Daniel Knez[2], Werner Grogger[2], Ferdinand Hofer[2], and Wolfgang E. Ernst[1] — [1]Institute of Experimental Physics, TU Graz, Petersgasse 16, 8010 Graz, Austria — [2]Institute for Electron Microscopy and Nanoanalysis, TU Graz, Steyrergasse 17, 8010 Graz, Austria

Helium droplets provide an ideal matrix for the aggregation of tailored metallic nanoclusters and nanowires. The vortex guided growth process of the wires in the superfluid helium environment has not been fully understood yet. Silver represents a special case among the metals studied so far since no continuous wires were detected after surface deposition, which was attributed to some unexplained barrier formation by the helium. We have explored the growth process of silver nanowires in detail and show by high resolution transmission electron microscopy in combination with computer simulations under which conditions continuous nanowires are obtained. These insights enable us to deduce a model for the growth process of these wires inside the helium droplets from comparison of silver and gold nanowire morphologies. It shows further, that the morphologies of the nanowires can be controlled *via* the doping rates with which the metal atoms are added to the droplets during the synthesis process.

O 56.6 Wed 11:45 H4

Formation of Ag-Au core-shell clusters in superfluid helium nanodroplets studied by atomic resolution electron tomography — Philipp Thaler[1], Georg Haberfehlner[2], Alexander Volk[1], Gerald Kothleitner[2], and •Wolfgang E. Ernst[1] — [1]Institute of Experimental Physics, TU Graz, Petersgasse 16, 8010 Graz, Austria — [2]Institute for Electron Microscopy and Nanoanalysis, TU Graz, Steyrergasse 17, 8010 Graz, Austria

Metallic nanoparticles consisting of a few thousand atoms are of large interest for potential applications in different fields such as optics, catalysis or magnetism. Structure, shape and composition are the basic parameters responsible for properties of such nanoscale materials. We report on the formation of metallic core-shell nanostructures in superfluid helium nanodroplets (He_N) and their subsequent surface deposition under soft landing conditions. Using atomic resolution electron tomography, we can clarify the structure and composition of our particles on an atomic level. This detailed analysis shines light on the growth process of the nanoparticles and will allow deliberate tuning between single core and multi-core structures in future experiments.

O 56.7 Wed 12:00 H4

Silver clusters in room temperature ionic liquids: supersonic nozzle expansion deposition — •Stefanie Roese, David Engemann, Andreas Gruhn, and Heinz Hövel — Fakultät Physik / DELTA, TU Dortmund, Otto-Hahn-Str. 4, 44221 Dortmund, Germany

Promising stabilizers for nanoparticles are room temperature ionic liquids (RTIL), which are salts of weakly coordinating cations and anions being liquid at room temperature [1]. They consist of a large organic cation and a small inorganic anion. The different charges of the molecules cause a strong attractive interaction, while the large difference of size of the molecules prevents condensation at room temperature [2]. Due to their low vapor pressure RTIL can be used under vacuum conditions. BMIM PF6 is one of the most widely studied ionic liquids [3] and is here used for the generation and stabilization of silver nanoparticles.

The investigated silver nanoparticles are formed in a supersonic nozzle expansion [4] and deposited into the RTIL using a rotating cylinder for mixing. The cluster properties are investigated afterwards with UV/Vis absorption measurements, XANES and SAXS. The formation of a cation layer at the cluster surface could be observed.

[1] J. Dupont, J. D. Scholten, Chem. Soc. Rev. 39, 1780 (2010). [2] J. Dupont, Accounts of chemical research 44, 11 (2011). [3] P. Dash and R. W. J. Scott, Chem. Commun. 2009, 812. [4] H. Hövel, et al., Z. Phys. D 42, 203 (1997).

O 56.8 Wed 12:15 H4

The effect of different gas admixtures on nanoparticles formation in a gas aggregation source and their treatment by hollow cathode plasma — •Oleksandr Polonskyi, Amir Mohammad Ahadi, Thomas Strunskus, and Franz Faupel — Chair for Multicomponent Materials, Faculty of Engineering, Christian-Albrechts University at Kiel, Germany

Metal nanoparticles (NPs) have been of high scientific interest in the last decades as they have unique chemical, physical, electrical, magnetic and optical properties, which are particularly explored in combination with host matrix. Among the number of PVD methods for nanoparticles generation, the gas aggregation method has lately received an increased attention due to simplicity of NPs deposition and variety of parameters to control their properties (size, rate). The present talk is concerned with a such called Gas Aggregation cluster Source (GAS) for metal and metal oxide nanoparticles generation. New results of the influence of nanoparticles generation by admixing different gases into the GAS volume for noble metals (Ag, Cu) will be presented. The effect of helium/oxygen admixture on cluster formation is studied in detail. In addition we report on the combination of the established process of NPs generation by GAS with a hollow cathode (HC) plasma source for novel nanostructure formation. Here, an Ag nanoparticle beam has been treated by a HC plasma at different operation parameters.