O 56: Poster Session - Nanostructures at Surfaces: Dots, Particles, Clusters

Time: Tuesday 18:15–20:00 Location: P2/2OG

O 56.1 Tue 18:15 P2/2OG

UV-light printing on APTES functionalized SiO2 surfaces: New approach for nanoparticle assembly — •Sergii Snegir[1], Olivier Pluchery[2], Thomas Huhn[1], and Elke Scheer[1] — [1]University of Konstanz, Konstanz, Deutschland — [2]Institut des Nano-Sciences de Paris (INSP), Sorbonne Universités, CNRS, Paris, France

The (3-Aminopropyl)trimethoxysilane (APTES) terminated SiO2 surface allows creating self-assembled monolayers (SAMs) of gold nanoparticles (AuNPs) if they are stabilized with trisodium citrate molecules. However, further functionalization of AuNPs with thiol-containing molecules leads to their strong aggregation on the surface due to the appearance of uncompensated dipole moments on the AuNP. Therefore, we developed a UV-light fixation method, which anchors AuNPs on their initial positions on the APTES surface prior to the process of AuNP functionalization. Herein, we present detailed studies of the passivation efficiency as the function of UV light wavelength, time of exposure, concentration of O2, N2, O3 gases. We have found that the combination of O3 and UV light under ambient atmospheric conditions leads to complete passivation of APTES terminated glass already after 2 min of UV exposure (26.1 mW/cm2). We have tested also the possibility to use the UV-light passivation for printing on APTES terminated surfaces by using different chromium masks. With this method, we can create SAMs of AuNP with different geometry and size (current resolution limit is several um) on a SiO2 surface (glass/quartz/silicon).

O 56.2 Tue 18:15 P2/2OG

Annealing behavior of FeNi alloy nanoparticles deposited on a W(110) surface: influence of the Stoichiometry — •Dennis Jagenburg, Mahboobeh Ravankhah, and Mathias Getzlaff — Institute of Applied Physics University Düsseldorf

Properties of metallic nanoparticles significantly differ from that of the corresponding bulk material. This has led to an increasing importance of investigating nanometer-sized metallic particles. From a technological point of view it is necessary to study the nanoparticles at higher temperatures due to heating and altering of structural components in devices during fabrication; thus, the functional performance may change. Therefore, the goal of this study is to analyze the influence of the stoichiometry and annealing temperature on the shape and structure of alloy nanoparticles.

Different sized-selected iron-nickel alloy nanoparticles are produced by a Magnetron-Based Nanocluster Source under UHV conditions and are deposited on a W(110) surface. Scanning Tunneling Microscopy (STM) is used to determine the behavior of $Fe_{0.25}Ni_{0.75}$ and $Fe_{0.75}Ni_{0.25}$ nanoparticles after deposition and subsequent tempering.

O 56.3 Tue 18:15 P2/2OG

Irradiation of Au-nano-islands with slow highly charged ions and characterization with AFM and SEM — •Gabriel L. Szabo[1], Janas Arkadiusz[3], Benedykt R. Jany[3], Franciszek Krok[3], and Richard A. Wilhelm[1,2] — [1]Institute of Applied Physics, TU Wien, 1040 Vienna, Austria — [2]Institute of Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden, Germany — [3]Institute of Physics, Jagiellonski University, 30-348 Kraków, Poland

Impacts of slow highly charged ions (HCIs) onto a target surface can lead to a change of the material's structure, such as e.g. phase transitions and nano-structures. Responsible for this transformation is the excitation of electrons of the target material due to the neutralization of the ion in the area of the ion impact and subsequent lattice heating mediated by electron-phonon coupling. So far, potential energy effects have not been observed on metallic target materials. This is due to the high electronic conductivity of conductors, which results in a fast dissipation of the electrical excitations induced by the potential energy of the impinging HCI. For a better understanding of this processes, single metallic nano-islands were irradiated. Special emphasize is put on the lateral size of those structures below which the electronic excitation cannot dissipate fast enough and stays confined for a longer period of time. In case of an existing size threshold, nano-structuring due to potential energy effects can be expected. In this work, Au-nano-islands were irradiated by 180 keV Xe^{40+} ions. The samples were measured on the same spot with AFM and SEM, before and after irradiation.

O 56.4 Tue 18:15 P2/2OG

Electronic structure of a carbon dot monolayer on TiO2(110) — •Jan Beckord[1], Matthias Hengsberger[1], Andrea Cannizzo[2], and Jürg Osterwalder[1] — [1]Department of Physics, University of Zurich, CH-8057 Zürich — [2]Institute of Applied Physics, University of Bern, CH-3012 Bern

Carbon dots are nanometer-sized particles with a carbon core and a functionalized organic shell. Our research focuses on their observed photocatalytic properties: for example, they significantly improve the oxygen evolution reaction at titanium dioxide surfaces under visible light irradiation. To elucidate the electronic structure of this system, we adsorbed a single layer of carbon dots with an average size of 4 nm on a clean rutile TiO2(110) surface from aqueous solution in vacuo. We will present the full characterization of these surfaces using XPS, UPS and 2PPE. Our measurements revealed an increased upward band bending of the n-doped substrate and a lowered work function. A continuum of additional occupied states is found at binding energies between 6 eV and 11 eV due to the various molecular orbitals on the carbon dots, and some more occupied states are observed very close to the Fermi level at binding energies between 1 eV and 3 eV. 2PPE measurements revealed a continuum of unoccupied states as well, which pushes the band gap below 2 eV. These continua of electronic states therefore facilitate exciton generation from visible light, explaining the function of carbon dots as effective photosensitizers. Additionally, we found excellent long-term stability even in ambient air and under strong light, making this system suitable for applications under ambient conditions.

O 56.5 Tue 18:15 P2/2OG

Fullerene arrangement by vapor deposition on a well-ordered thin Al_2O_3 film grown on Ni_3Al (111) crystal — •Alexander Kononov and Heinz Hövel — Fakultät Physik / DELTA, Technische Universität Dortmund, 44227 Dortmund, Germany

A thin (∼0.5nm) Al_2O_3 film on a $Ni_3Al(111)$ surface that shows an well-ordered network structure in STM at a tunneling voltage of 3.2V presents a corresponding dot structure formation at 2.0V. The dot structure acts as nucleation pattern when metal islands are grown by atom deposition [1]. For mass-selected Cu clusters it provides thermal stabilization and a specific arrangement of the clusters with respect to the dot structure [2]. This initial situation offers a huge potential for film oxide functionalization with different mass-selected clusters. Due to its easy fabrication, fullerenes (C_{60}) with their properties represent a model system for the metal clusters (e.g. Pb-Clusters), which are planned to be used for future experiments in our surface science facility. We present experimental UPS and STM results for vapor-deposited submonolayers of C_{60} on the surface of well-ordered $Al_2O_3/Ni_3Al(111)$, which show different behavior (e.g. shift in UPS spectrum, island growth in STM images) for different surface temperatures during vapor deposition.

[1] S. Degen, C. Becker, K. Wandelt, Thin alumina films on Ni3Al(111): A template for nanostructured Pd cluster growth, Faraday Discuss. 125, 343 (2004). [2] D. Wolter, Mass selected copper clusters on well-ordered aluminum oxide layers, PhD thesis, TU Dortmund (2018).