O 39: Nanostructures at Surfaces IV (Dots, Particles, Clusters, Arrays)

Time: Wednesday 15:45–17:45 Location: H36

O 39.1 Wed 15:45 H36

Investigation of the scattering form factor and surface plasmon resonances of metallic nanoparticles by Bragg diffraction — •Manuel Gonçalves, André Siegel, Ralf Ameling, and Othmar Marti — University of Ulm, Inst. Experimental Physics, Albert-Einstein-Allee 11, D-89069 Ulm, Germany

Plasmon resonances in particles of triangular shape on surfaces were investigated by experimental far-field methods and by numerical simulations. The spectral location of these resonances and the associated near-field enhancements are of high relevance for applications like surface enhanced Raman scattering (SERS) and other nonlinear effects. However, these resonances depend on many parameters, like size and shape of the particles, material and illumination conditions. On the other hand, the surface plasmon resonances influence directly the scattering of light, which can be measured in far-field.

The light scattering form factor of particles of different shapes was investigated by measuring the Bragg diffraction patterns of arrays of identical nanoparticles. The relative intensity of the Bragg diffraction orders is very sensitive to the shape and material of the particles. Thus, theoretical models of the scattering form factors of the particles can be checked by simulation of the Bragg patterns and comparison with the experimental data. This method relies on the averaged form factor of the particles and is not sensitive to particular features of single particles.

O 39.2 Wed 16:00 H36

Collective optical properties of silver nanocrystal arrays — •Herbert Wormeester[1], Stefan Kooij[1], Anne-Isabelle Henry[2], Marie-Paule Pileni[2], and Bene Poelsema[1] — [1]Solid State Physics, MESA+ Institute for Nanotechnology, University of Twente, Netherlands — [2]LM2N, Université Pierre et Marie Curie, Paris, France

Silver nanocrystal arrays of 5 nm diameter Ag nanoparticles surrounded by a shell of dodecanethiol are formed by drop-casting. This gives an ordered system of close-packed spherical nanocrystals that enables a thorough analysis of the electromagnetic inter-particle interactions. The position of the two plasmon resonances observed in these nanocrystals is the result of their collective interaction. This collective interaction leads to a low and a high energy plasmon resonance, excited by the electric field components parallel and perpendicular to the interface, respectively. The magnitude of the plasmon resonance splitting previously observed using a variety of different techniques is also found in ellipsometry spectra. We analyzed that the peak separation in the silver nanocrystal arrays is comparable to the optical response of isolated, non-interacting oblate nanocrystals. The optical deformation of the spherical particles as a result of the interaction can be compared with oblate particles that have a depolarization factor of 0.25 parallel to the interface. The ellipsometry measurement shows a better resemblance between calculation and measurement as compared to polarized reflection measurements. Most likely, this is due to the sensitivity for diffuse scattering of the latter technique.

O 39.3 Wed 16:15 H36

Shaping of Triangular Gold Nanoparticles in Periodic Arrays by Nanosecond Laser Pulses — •Rodica Morarescu, Frank Hubenthal, and Frank Träger — Institut für Physik and Center for Interdisciplinary Nanostructure Science and Technology - CINSaT, Universität Kassel, Heinrich-Plett-Sraße 40, D-34132, Germany

In this contribution we present recent results on selective and precise tailoring of triangular gold nanoparticles using ns-pulsed laser light. The reshaping has been investigated as a function of laser fluence and wavelength. In brief, monolayers of triangular gold nanoparticles in a periodic array were prepared by nanosphere lithography. For this purpose, gold atoms were deposited through the nanosphere mask. Subsequently, the mask was removed by sonicating the sample in a solvent, leaving behind periodic arrays of triangular gold nanoparticles.The particles have been reshaped using ns-pulsed laser light with different fluences and wavelengths. The morphological and the accompanying optical changes were investigated by scanning force microscopy and extinction spectroscopy. We demonstrate that laser irradiation is an ideal tool to precisely control the shape of the metal nanoparticles and thus, their optical properties. For example, the position of the surface plasmon resonance of the particles as prepared can be tuned from 732 nm to 532 nm,depending on the applied fluence. The main advantage of laser irradiation in comparisons to, e.g., thermal annealing is that nanoparticles in a well-defined area of the sample can be addressed. Possible applications of such laser tailored nanoparticles, e.g. as anchor points for functional molecular wires, will be discussed.

O 39.4 Wed 16:30 H36

Optical transmission through hexagonal sub-wavelength hole arrays in thin metal films — •Georgios Ctistis, Piotr Patoka, and Michael Giersig — Center of Advanced European Studies and Research (caesar), Ludwig-Erhard-Allee 2, 53175 Bonn, Germany

Nanostructured surfaces exhibit extraordinary optical properties as plasmon assisted transmission through sub-wavelength hole arrays. In this study we present near-field optical results of the light transmission through a nano-hole array in a metal film (gold and aluminium) produced by means of nanosphere lithography. The film thickness varied between 20 and 120 nm while the hole diameter and the inter-hole distance were kept constant at approx. 270 and 500 nm, respectively. Dependent on the thickness, a change in the transmission mechanism could be observed.

O 39.5 Wed 16:45 H36

Ar ion sputtering induced nanostructure on the Ag(110) — •Günther Weidlinger, Lidong Sun, José Manuel Flores-Camacho, Michael Hohage, and Peter Zeppenfeld — Institut für Experimentalphysik, Johannes Kepler Universität Linz, Linz, Austria

The Ag(110) surface was exposed to Ar ion bombardment and its effects on the surface morphology and optical anisotropic response were monitored by means of Atomic Force Microscopy (AFM) and Reflectance Difference Spectroscopy (RDS), respectively. The AFM studies show the formation of well ordered ripple structures. Depending on the sputtering condition either 1D or 2D ripple structures could be created. Especially the 2D ripple structure is quite stable both in Ultra High Vacuum (UHV) and in air at room temperature. The corresponding RD spectra exhibit single (double) pronounced peak for the 1D (2D) ripple structures, which is associated to the coupling of photons with surface plasmon mediated by the diffraction of the ripple structures. The direction and period of the ripple structure determined by the sign and the peak positions of RD spectrum agrees well with what is found from AFM demonstrating that RDS is a powerful tool for the characterization of nanostructured surfaces.

O 39.6 Wed 17:00 H36

An Addressable Supramolecular Rotary Switch Featuring Distinguishable Positions Embedded In A Two-Dimensional Porphyrin-Based Porous Network — •Nikolai Wintjes[1], Hannes Spillmann[1], Andreas Kiebele[1], Meike Stöhr[1], Thomas Jung[2], Davide Bonifazi[3], Fuyong Cheng[3], and François Diederich[3] — [1]Department of Physics, University of Basel, CH-4056 Basel — [2]Paul Scherrer Institute, CH-5232 Villigen PSI — [3]Laboratory for Organic Chemistry, ETH-Zürich, CH-8093 Zürich

In recent years, the attempts to build artificial functional devices from single molecules by the "bottom-up" approach were strongly in the focus of surface nanoscience. First experiments with molecules manually arranged by the STM tip gave first hints on the powerful possibilities of such a device. Nevertheless, a simple way to produce supramolecular devices parallel in vast amounts has never been shown before.

Herein we report on a highly complex supramolecular device that reminds of a mechanical rotary switch fabricated on a Cu(111) surface following the "bottom-up" approach. Self-assembly of a specially designed porphyrin molecule leads to the formation of porous networks featuring chiral cavities which serve as molecular stators for multistate molecular rotors. These can rotate between six stable positions of which three are distinguishable using Scanning Tunneling Microscopy (STM) (see figure 1). The rotation can be induced either thermally or by the STM tip. The energy barrier for rotation was estimated to be 0.28 eV.

O 39.7 Wed 17:15 H36

Creation of open networks from perylene derivatives — •Serpil Boz[1], Manfred Matena[1], Markus Wahl[1], Thomas A.

Jung[2], Lutz H. Gade[3], and Meike Stöhr[1] — [1]Institute of Physics, University of Basel, Switzerland — [2]Paul-Scherrer-Institute, Switzerland — [3]Institute of Inorganic Chemistry, University of Heidelberg, Germany

Self-assembly of molecules on surfaces directed by supramolecular interactions has been widely explored. The perylene derivative (DPDI) we analyzed [1] is modified on the surface in order to achieve self-assemblies. This modification is temperature-induced, thus providing an additional feature to the control of self-assemblies in contrast to usual approaches that make use of molecular properties already inherent to the molecules. Thin films of DPDI were prepared on Cu(111) and investigated with STM. Depending on the coverage before annealing, three different H-bond assemblies are generated, since in a thermally induced reaction the end groups of the molecule are modified and it can then act as both a H-bond donor and acceptor. For a similar perylene derivative (TAPP), an open quadratic assembly is found on Cu(111), which is not based on temperature-induced modification. If both molecules are present on the surface and the sample is annealed, a separation into two porous networks is observed.

[1] M. Stöhr et al., Angew. Chem. Int. Ed., 2005, 44, 7394

O 39.8 Wed 17:30 H36

Self-Assembly of Metal-Organic Coordination Networks at Surfaces with Scalable Nanocavity Size and Aspect Ratio — •Alexander Langner[1], Steven L. Tait[1], Chandrasekar Rajadurai[2], Nian Lin[1], Mario Ruben[2], and Klaus Kern[1] — [1]Max-Planck-Institut für Festkörperforschung, Stuttgart — [2]Institut für Nanotechnologie, Forschungszentrum Karlsruhe

We report on the rational use of two-dimensional supramolecular self-assembly as efficient bottom-up method for nanoscale patterning of metal surfaces. The controlled self-organization of multi-ligand systems by metal-organic coordination is investigated on Cu(100) under ultra high vacuum (UHV) conditions with scanning tunneling microscopy (STM). Mixtures of dicarboxyl and bipyridyl molecules with vapor deposited iron atoms assemble into arrays of coordination nodes, each consisting of 2 molecules of each functional group termination, coordinated in a cross geometry to a di-iron center. This directional and selective coordination produces ordered rectangular networks in which the size and the aspect ratio of the cavities can be scaled by varying the backbone length of the different linker molecules independently. Investigation of these model systems also gives insight into fundamental properties of self-assembly such as self-recognition or error correction.