O 18 Nanostructures II

Time: Tuesday 11:15–13:00 Room: PHY C213

O 18.1 Tue 11:15 PHY C213

Surface Plasmon Polariton Excitation on Tuneable Nanostructured Surfaces — •Dominic Zerulla[1], Stephanie Rehwald[1,2], Brian Ashall[1], Gillian Doyle[1], Michelle Galvin[1], Michael Berndt[1,2], and Klaus Schierbaum[2] — [1]UCD Dublin, School of Physics, Dublin 4, Ireland — [2]Heinrich-Heine-University Düsseldorf, Materialwissenschaft, 40225 Düsseldorf, Germany

Surface Plasmon Polaritons (SPPs) allow for extremely surface sensitive spectroscopic methods like Surface Plasmon Resonance (SPR) or Surface Enhanced Raman Scattering (SERS) which, play a fast-growing role in the Life Sciences.
The conditions for their excitation by photons are quite restrictive. On smooth metal surfaces a Kretschmann or Otto-type attenuated total reflection (ATR) setup is needed to generate an SPP. Using periodically nano- or mesostructured surfaces liberates from the ATR-restrictions, but a rigid nanostructure only allows for the excitation of SPPs for a single, fixed wavelength at a given angle of incidence. In order to gain more flexibility, e.g. in the light of tuneable laser sources, we are the first to design tuneable nanostructured surface on which a plasmon excitation is possible over a broad wavelength region. The nanostructures consist of a polymer base upon which the periodic structure is generated. Subsequently, the system is coated with a suitable metal (e.g. silver, gold, or aluminium) but is still tuneable with respect to changes in the excitation wavelength. The effect is proved by showing the full, experimentally derived dispersion relation of the SPP in comparison to theoretical predictions.

O 18.2 Tue 11:30 PHY C213

Electron confinement in nm-size vacancy islands — •Guillemin Rodaray[1], Haifeng Ding[1,2], Dirk Sander[1], and Jürgen Kirschner[1] — [1]Max-Planck-Institutfür Mikrostrukturphysik, Weinberg 2, D-06120 Halle — [2]Department of Physics, Nanjing University, Nanjing,China

We have studied the electron confinement in hexagonal vacancy islands on Cu(111) by low temperature scanning tunneling microscopy (STM). Hexagonal vacancy islands on Cu(111) are formed upon deposition of sub-monolayer amounts of Co at 320 K [1]. The vacancy islands are one atomic layer deep (0.2 nm), and are surrounded by straight step edges, which form hexagons with sizes in the nm range. Surface state electrons of Cu(111) are scattered at the vacancy hole edge. This gives rise to characteristic electron standing wave patterns inside the vacancy hole and on the terraces surrounding the hole. These electron standing waves are imaged and analyzed by scanning tunneling spectroscopy (STS) at 7 K. The dispersion relation of the confined electrons is derived for different vacancy hole diameters ranging from 5–15 nm and compared to those measured at straight terrace step edges. The origin of the standing wave pattern in the hole is discussed in view of the quantum corral model [2].
[1] J. de la Figuera, J. E. Prieto, C. Ocal, R. Miranda, Phys. Rev. B **47**(1993)13043; M. Klaua, H. Höche, H. Jenniches, J. Barthel, J. Kirschner, Surf. Sci. **381**(1993)106.
[2] H. C. Manoharan, C. P. Lutz, D. M. Eigler, Nature **403** (2000) 512; V.S. Stepanyuk, L. Niebergall, W. Hergert, P. Bruno, Phys. Rev. Lett. **94**(2005)187201.

O 18.3 Tue 11:45 PHY C213

Controllable molecular Ag contacts on Si(100) and Si(111) via electromigration — •Gernot Gardinowski, Jedrzej Schmeidel, Christoph Tegenkamp, and Herbert Pfnür — Institut für Festkörperphysik, Universität Hannover, Appelstrasse 2, 30167 Hannover, Germany

In order to characterize single molecules and nanostructures electrically, contacts with a well-defined geometry and size are essential. We present a electromigration method, that leads to thin vertical and small lateral contacts of high yield, which are particularly interesting for STM/AFM investigations. In a first step, we are using electron beam lithography on a two-resist combination (PMMA/LOR3B) on Si(100) and Si(111). We demonstrate, that it is possible to create nanobridges due to underetching. The latter can be used for a three dimensional stairs-like growth by evaporating of Ag at different angles. Film-thicknesses down to ≈ 4nm and lateral dimensions below 100 nm has been realised so far. This is important for heat dissipation during the planar breakjunction process and also for thin contacts for further investigations via STM/AFM. Contactpads have been tested by SEM/AFM/AES. In a second step, we are using a computer-based controlled electromigration method at ≈ 80 K. First measurements indicates gaps around 1 nm, which has been characterized electrically.

O 18.4 Tue 12:00 PHY C213

In-situ Monitoring of Particle Plasmon Excitation in Ag-nanostructures — •Liviu I. Chelaru, Dagmar Thien, Michael Horn-von Hoegen, and Frank Meyer zu Heringdorf — Institut für Experimentelle Physik, Universität Duisburg-Essen, Duisburg, Germnany

Although the Mie-Plasmon in Ag islands and particles is well known, it is still a challenge to analyze the plasmonic behaviour of single Ag particles and nanowires on surfaces. Photoemission Microscopy offers a way to directly observe particle plasmons by means of two photon photoemission. Here, the plasmon as an intermediate state completely dominates the photoemission signal; a first photon is used to excite a particle plasmon before a second photon triggers the plasmon-assisted photoemission. We will show, that the particle plasmon evolves during growth of Ag islands and wires on 4 degree vicinal Si(001) and demonstrate that depending on the size of the particle only distinct plasmon modes can be excited. The strong nonlinear nature of the two-photon photoemission process allows to image the fringe field pattern around the particle on the surface and to directly correlate the particle plasmon excitation with the lateral dimensions of the particle.

O 18.5 Tue 12:15 PHY C213

Surface plasmon on sputtered Ag(110) measured by reflectance difference spectroscopy — •L.D. Sun, J.M. Flores-Camacho, M. Hohage, and P. Zeppenfeld — Institut of Experimental Physics, Johannes Kepler University Linz, Altenberger str. 69, A4040 Linz, Austria

The surface plasmon resonance on sputtered Ag(110) has been investigated by Reflectance Difference Spectroscopy (RDS). The Ag(110) clean surface was exposed to Ar ion bombardment and its effects on the optical anisotropic response were monitored by means of RDS. The spectra exhibit a pronounced peak around the established surface plasmon resonance at about 3.66 eV. We believe that this feature is induced by the well known rippled pattern formed by the Ar ion sputtering on the clean Ag(110)[1], whose periodicity along the [001] direction allows for the coupling of the dispersion relations of surface plasmon and light in an excitation grating mode. The effects of annealing at room temperature and sputtering with other ions (Ne, He) will be discussed as well.
[1] S. Rusponi, C. Boragno and U. Valbusa, Phys. Rev. Lett. 78, 2795 (1997).

O 18.6 Tue 12:30 PHY C213

Excitation of surface plasmon polaritons at surface grooves in bulk metals and thin film metal waveguides — •J. Renger[1], S. Grafström[1], J. Seidel[1], P. Olk[1], L.-M. Eng[1], C. Akhmadaliev[2], L. Bischoff[2], B. Schmidt[2], D. Taverna[3], and J.-C. Weeber[3] — [1]Institute for Applied Photophysics, University of Technology Dresden, D-01062 Dresden, Germany — [2]Forschungszentrum Rossendorf, Institute of Ion Beam Physics and Materials Research, D-01314 Dresden, Germany — [3]Laboratoire de Physique de l'Université de Bourgogne, UMR CNRS 5027, F-21078 Dijon, France

We explore different approaches to excite surface plasmon polaritons (SPPs), aiming at strong enhancement and localization of the electromagnetic field. The SPP is excited by focussing laser light onto a small single groove or a grating having a finite number of periods. Such grooves cancel the requirement of momentum conservation, and makes the excitation of surface waves possible. The metallic structures were fabricated by high resolution focused ion beam milling (25 keV Ga+, IMSA-Orsay Physics FIB) into photolithographic pre-patterned 60 nm thick aluminium thin-film metallic waveguides. Our multiple multipole calculations show a characteristic dependence on both the width and the depth of the grooves, as well as a strong impact of the angle of incident laser light. Hence, this allows the selective excitation of SPP modes propagating at the air/metal or metal/glass interface. Experimental observation of SPPs was performed using scanning near-field optical microscopy with uncoated etched fiber probes. These results confirm the excitation of SPP modes at grooves.

O 18.7 Tue 12:45 PHY C213

Nanostructuring of NiMnSb(110): influences on surface magnetic properties — •Christian Eickhoff[1,2], Hristo Kolev[1], Georgi Rangelov[1], Lifeng Chi[1], and Markus Donath[1] — [1]Physikalisches Institut, Westfälische Wilhelms-Universität Münster, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany — [2]now at: Max-Born-Institut, Max-Born-Str. 2a, 12489 Berlin, Germany

The magnetic and electronic properties, crystal structure and surface morphology at the (110) surface of the ferromagnetic half-Heusler alloy NiMnSb have been investigated by means of magneto-optical Kerr effect, appearance potential spectroscopy, low-energy electron diffraction and atomic-force microscopy.

A standard sputter-anneal preparation procedure leads to a stoichiometric surface which is predicted to show a high spin polarisation at the Fermi level. We observed, in contrast, a reduced surface magnetic signal. Atomic-force microscopy reveals a nanostructuring of the NiMnSb surface which proceeds with the number of preparations. The changed morphology of the NiMnSb surface is made responsible for the observed reduced surface magnetization [1].

[1] H. Kolev, G. Rangelov, J. Braun, and M. Donath: *Reduced surface magnetization of NiMnSb(001)*, Phys. Rev. B 72, 104415 (2005)