O 44: Nanostructures at surfaces: Dots, particles, clusters, arrays III

Time: Wednesday 11:15–13:15 Location: WIL C107

O 44.1 Wed 11:15 WIL C107

Ultra-high dense array of magnetic quantum dots on a $GdAu_2$ template — •Laura Fernandez[1], Alberto Cavallin[2], Frederik Schiller[3], Stefano Rusponi[2], Martina Corso[1], Maider Ormaza[4], Harald Brune[2], and Enrique Ortega[1,3,4] — [1]DIPC, San Sebastián, Spain — [2]EPFL, Lausanne, Switzerland — [3]CFM-CSIC, San Sebastián, Spain — [4]UPV, San Sebastián, Spain

The growth of magnetic nanoparticles on surfaces by auto-organization processes represents a flexible and powerful alternative to obtain high-density, patterned magnetic storage media. Here, we report on the growth of a dense array of magnetic Co dots on a $GdAu_2$ surface alloy. We show that this $GdAu_2$ surface alloy behaves as an excellent template to achieve dot arrays with very high areal densities up to 54 Teradots/inch^2. Magnetic properties were analyzed by UHV-MOKE and XMCD revealing in-plane remanent magnetization.

O 44.2 Wed 11:30 WIL C107

Atomically flat single-crystalline gold nanostructures for plasmonic nanocircuitry — J.-S. Huang[1], P. Geisler[1], C. Brüning[1], J. Kern[1], J.C. Prangsma[1], X. Wu[1], •Thorsten Feichtner[1], J. Ziegler[1], P. Weinmann[1], M. Kamp[1], A. Forchel[1], P. Biagioni[2], and B. Hecht[1] — [1]Wilhelm-Conrad-Röntgen-Center for Complex Material Systems, University of Würzburg, Germany — [2]CNISM - Dipartimento di Fisica, Politecnico di Milano, Italy

Deep subwavelength integration of high-definition plasmonic nanostructures is of key importance for the development of future optical nanocircuitry. So far the experimental realization of proposed extended plasmonic networks remains challenging, mainly due to the multi-crystallinity of commonly used thermally evaporated gold layers. Resulting structural imperfections in individual circuit elements drastically reduce the yield of functional integrated nanocircuits. Here we demonstrate the use of very large but thin chemically grown single-crystalline gold flakes. After immobilization on any arbitrary surface, they serve as an ideal basis for focused-ion beam milling. We present high-definition ultra-smooth gold nanostructures with reproducible nanosized features over micrometer lengthscales. By comparing multi- and single-crystalline optical antennas we prove that the latter have superior optical properties which are in good agreement with numerical simulations.

O 44.3 Wed 11:45 WIL C107

Fabrication and Characterization of Well-Aligned Zinc Oxide Nanowire Arrays and their realizations in Schottky-Device Applications — •Kin Mun Wong[1], Liaoyong Wen[2], Yaoguo Fang[2], Fabian Grote[1], Hui Sun[1], and Yong Lei[1] — [1]Institute of Materials Physics and Center for Nanotechnology, University of Muenster — [2]Institute of Nanochemistry and Nanobiology, Shanghai University, Shanghai 201800, China

Highly ordered arrays of vertical zinc oxide (ZnO) nanowires (NWs) or nanopores were fabricated in our group by first thermal evaporating a thin film of gold on the ultrathin alumina membrane (UTAM). The UTAM was then utilized as a substrate for the growth of the ordered arrays using a chemical vapour deposition (CVD) process. Alternatively, a modified CVD process was also used to fabricate ultra-long ZnO NWs with the length of the nanowire exceeding 100 micrometres. Subsequently, densely packed arrays of ZnO NWs Schottky diodes were synthesized by transferring the long NWs on a substrate using a dry contact printing method and the electrical contacts were made on the NWs with a photolithographic process. The interesting electrical properties of the ZnO NWs, diodes or other metal oxide NWs such as the field emission, electron transport and piezoelectric properties were characterized by current-voltage or by other appropriate measurements.

1. L. Y. Wen, Z. Z. Shao, Y. G. Fang, K. M. Wong, Y. Lei, L. F. Bian, and G. Wilde, Appl. Phys. Lett. 97, 053106 (2010).

O 44.4 Wed 12:00 WIL C107

Surface Nano-Patterning in Realizing Large-Scale Ordered Arrays of Metallic Nanoshells with Controllable Structures and Properties — •Shikuan Yang[1,2], Feng Xu[1,2], Nina Winkler[1,2], Huaping Zhao[1,2], and Yong Lei[1,2] — [1]Institute of Materials Physics, University of Muenster — [2]Center for Nanotechnology

Surface patterns of metallic nanostructure arrays play an important role in many application areas such as surface-enhanced Raman scattering sensors, lithium-ion batteries, solar cells, and optical devices. Here we present an innovative surface nano-patterning technique in our group for realizing large-scale ordered arrays of metallic spherical nanoshells with well-defined structures. Sliver nanoshell arrays are synthesized using polystyrene sphere templates by an electrophoretic process. The fabricated Ag nanoshell arrays have a high controllability of the structural parameters, including the diameter, the surface roughness, and the inter-shell spacing. And the properties of the synthesized nanoshell arrays can be controlled based on the adjustment of the structural parameters. As an example, tunable surface-enhanced Raman scattering and localized surface plasmon resonance of the nanoshell arrays are demonstrated by controlling the structural parameters. The presented surface nano-patterning technique is a general fabrication process in achieving not only metallic nanoshell arrays, but also nanoshell arrays of other materials, such as semiconductors and metallic oxides.

O 44.5 Wed 12:15 WIL C107

Electrochemical formation of Self-Organized Superlattice Nanotube Arrays - Embedding Heterojunctions into Nanotubes Walls — •Wei Wei[1], Himendra Jha[1], Guang Yang[2], Erdmann Spiecker[2], and Patrik Schmuki[1] — [1]Department of Materials Science WW-4 (LKO), University of Erlangen-Nuremberg, Erlangen, Germany — [2]Center for Nanoanalysis and Electron Microscopy, University of Erlangen-Nuremberg, Erlangen, Germany

In recent years, a simple and convenient approach to form ordered transition metal oxide nanotubes arrays, i.e. self-organized electrochemical growth method, has attracted wide interests.In present work, we demonstrate how this simple anodization technique can be used to produce highly defined superlattice oxide nanotube arrays on metallic substrates. Under optimized growth conditions, a self-organization process occurs that yields 3D ordered nanotube arrays with regular nm-spaced modulations in the tube wall composition.An example will be shown where we prepared TiO2/Ta2O5 confined heterojunction nanotubes arrays, each of which contains approx. 100 periods of modulated pairs. The electronic properties in the tube wall alternate with a sub-20nm precision, which yields a significant phonon confinement effect. These structures are also expected to drastically enhance efficiencies in charge transfer devices. The process, however, is versatile (transferrable to a broad range of metal oxide junctions), allows tuning of the tube and superlattice geometry, neither requires UHV conditions, nor expensive equipment, and due to its parallel processing nature, it can easily be scaled up.

O 44.6 Wed 12:30 WIL C107

Surface Patterning Technique using Polystyrene Sphere Templates for Fabricating Diverse Nanostructures and Broad Applications — •Feng Xu, Shikuan Yang, Fabian Grote, Huaping Zhao, and Yong Lei — Institute of Materials Physics and Center for Nanotechnology, University of Muenster

Surface nano-patterning is a necessary step in many real device applications ranging from electronics to optics, data storage, sensing and display areas. Various protocols are adopted to synthesize surface nano-patterns, such as electron beam lithography, optical lithography, focused ion beam etching and so on. Template-based methods can be utilized for parallel surface nano-patterning with advantages such as high through-put and low-cost of surface nanostructures. Among them, monolayer polystyrene (PS) sphere template is powerful in preparing various surface nano-patterns with different topologies and composed of different building blocks. In our group, through heating Au-coated PS sphere arrays in a very controllable way, nanodot arrays can be acquired. These fabricated surface nano-patterns show intriguing optical properties, which include multiple surface plasmon resonance (SPR) bands and strong infrared absorption. These unique optical properties are very important in biological related application areas. Moreover, the full structural controllability of the surface nano-patterns supplies a possible way to investigate the relation of the sensing and surface-enhanced Raman scattering (SERS) performances to

the structural parameters. This is important in the exploration of the fabrication of SERS and SPR-based sensing substrates with ultra-high sensitivities.

O 44.7 Wed 12:45 WIL C107

Surface nano-structuring utilizing porous anodic alumina membranes; to the limits and beyond — •Stefan Ostendorp, Yong Lei, and Gerhard Wilde — Institute of Materials Physics and Center for Nanotechnology, University of Münster, 48149 Münster, Germany

Porous anodic alumina membranes (PAAMs) have been intensively investigated for more than two decades, especially for their applications as masks or templates for fabricating various nano-structures of regular hexagonal arrays of wires and tubes. In addition ultra-thin alumina membranes (UTAMs) are used as deposition masks for nano particles. The spacing of the hexagonal structure of PAAMs and UTAMs can be modified within certain limitations, that had been reported in the literature. So far there were only several *allowed* combinations of parameter values reported that lead to highly regular porous structures during the anodization process of the underlying aluminum foil. Here we present our latest results concerning the extension of these limits to larger interpore distances and pore sizes and concerning the ability to create structures with desired spacing. For this purpose, we combined two well known methods during the anodization process, which now allows adjusting the structural parameters beyond the previous known limitations, what is of great importance to device applications based on PAAM- and UTAM- prepared functional nanostructures.

O 44.8 Wed 13:00 WIL C107

Environment Controlled De-wetting Kinetics of Rh-Pd Bilayer Thin Films — •Gintautas Abrasonis[1], Sebastian Wintz[1], Maciej Oscar Liedke[1], Funda Aksoy[2], Zhi Liu[2], Karsten Kuepper[3], Matthias Krause[1,4], and Sibylle Gemming[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden, Germany — [2]Advanced Light Source, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA. — [3]Institut für Festkörperphysik, Universität Ulm, D-89069 Ulm, Germany — [4]Institut für Festkörperphysik, Technische Universität Dresden, 01062 Dresden, Germany

The control of morphology and surface composition of nanoalloys is the key factor in order to tune or to extend the range of their optical, magnetic and chemical properties. Therefore it is one of the major tasks in nanoalloy materials science. The de-wetting dynamics and kinetics dependence of a Rh-Pd bilayer/alloy thin film model system on chemical environment (CO and NO) is investigated in-situ by means of high pressure x-ray photoelectron spectroscopy. Independently of the initial state, the film surface shows an enrichment of Pd upon heating in vacuum. De-wetting caused by heating in NO or CO shows significant differences in the surface chemical composition evolution and, consequently, in the de-wetting onset temperature. Alternating exposure to NO or CO results in the surface enrichment with either Rh or Pd, respectively, and subsequent film rupture. The results are discussed on the basis of the interplay between thermodynamic and kinetic factors. The study demonstrates the effect of the chemical environment on the morphology as well as on the composition of supported nanostructures.