O 33: Nanostructures at surfaces: arrays

Time: Tuesday 15:00–16:30 Location: H31

O 33.1 Tue 15:00 H31

Fabrication of protein patterns by electron-beam writing in a protein-repelling matrix — Nirmalya Ballav[1], Heidi Thomas[2], Tobias Winkler[2], Andreas Terfort[2], and •Michael Zharnikov[1] — [1]Angewandte Physikalische Chemie, Universität Heidelberg, 69120 Heidelberg, Germany — [2]Institut für Anorganische und Analytische Chemie, Goethe-Universität Frankfurt, 60438 Frankfurt, Germany

One of the challenges of nanotechnology is the development of reliable, efficient, and flexible methods for the fabrication of protein patterns. An essential element of almost all available approaches is a protein-repelling "background" matrix, surrounding the active protein-adsorbing areas - the matrix prevents adsorption of proteins beyond these areas. Such a matrix is usually comprised of oligo- or poly(ethylene glycol)-based materials and is generally prepared by a backfilling procedure after the fabrication of the protein-attracting patterns. We present an alternative approach, showing that the protein-repelling matrix, both SAM- and polymer-like, can be used as a primary template for direct electron-beam writing of both non-specific and specific protein patterns of any desirable shape, including gradient ones, on a flexible length scale. The above factors make the approach quite versatile, which is additionally strengthened by intrinsic flexibility of electron-beam lithography, a wide range of suitable electron energies, broad availability of commercial oligoethylene glycol compounds, variable substrate material, and flexible choice of the target proteins. Complex gradient patterns fabricated by the approach can become an important tool for mimicking natural biological interfaces.

O 33.2 Tue 15:15 H31

UTAM Surface Nano-Patterning in Fabricating Quantum-Sized Nanodots — •Yong Lei, Stefan Ostendorp, Stefan Bartels, and Gerhard Wilde — Institute of Materials Physics and Center for Nanotechnology, University of Muenster, Wilhelm-Klemm-Str. 10, D-48149 Muenster, Germany

Two challenging technical points prevent the UTAM (ultra-thin alumina mask) surface patterning technique to synthesize surface structures within the quantum-sized range: (1) the arrangement regularity and monodispersity of UTAM pores are poor when the pore diameter is smaller than 20-25 nm; (2) it is difficult to obtain small-pore UTAMs that are suitable for the surface patterning. This prevents the fabrication of quantum-sized surface structures using the UTAM technique, thus an attractive feature of nanomaterials - the quantum confinement effect - is missing in the UTAM technique. Recently, we found a new route to prepare UTAMs with pores in the quantum-sized range and consequently to synthesize ordered arrays of quantum-dots. First, a modulated anodization process largely decreased the growth rate of UTAMs, and thus results in UTAMs with a thickness of about 80 nm. Regular arrays of nanodots with diameters of about 20 nm were fabricated using the UTAMs. Moreover, we proposed a pore-opening process of UTAMs that can well-control the pore-size of UTAMs in the range of 5 to 27 nm. Ordered arrays of surface nanodots within the similar size range can be fabricated. This is the first time in realizing regularly arrayed surface nanostructures in the quantum-sized range using the UTAM surface nano-patterning technique.

O 33.3 Tue 15:30 H31

ArF excimer laser irradiation of metallic nanoparticles on Silicon — Martin Kunz, •Alfred Plettl, and Paul Ziemann — Institut für Festkörperphysik, Universität Ulm, D-89069 Ulm

Distinct methods like a micellar technique [1], miniemulsion / emulsion techniques [2,3] or extended Polysterene (PS) colloid lithography [4] were developed for the preparation of self-assembled arrays of metal (Au, Pt) or polymer (PS, PMMA) nanoparticles (NPs). A short introduction into the various preparation routes, with emphasis on the progress of the micellar technique, will be given.

Studies on the effect of ArF-laser irradiation of extended metal NP arrays with diameters of about 10 or 30 nm respectively, deposited on Si- and SiO_2-substrates, are reviewed. The optical and thermal properties of different sample arrangements are analysed, the experimental set-up is presented and some observations at different laser energy densities are reported and discussed. Various phenomena can clearly be identified: small NPs show particle melting and shape rounding at low fluences or complete removal. Under special conditions also sinking of Pt-NPs into Si-oxide was observed. Large Au-particles behave different, e.g. are resulting in fragmentation. If fluences locally higher than the ablation threshold of the Si are reached on the substrate, additional phenomena become visible.

[1] G.Kästle, et al., Adv. Funct. Mat. 13, 853 (2003).
[2] A. Manzke, et al., Adv. Mater. 19, 1337 (2007).
[3] E.Schreiber, et al., Chem. Mater. 21, 1750 (2009).
[4] A. Plettl, et al., Adv. Funct. Mat. 19, 3279 (2009).

O 33.4 Tue 15:45 H31

Photochemical deposition of gold on ordered FePt nanoparticle arrays — •Thomas Härtling[1], Tino Uhlig[1], Axel Seidenstücker[2], Ulf Wiedwald[2], Alfred Plettl[2], Paul Ziemann[2], Lukas M. Eng[1], and Phillip Olk[1] — [1]TU Dresden, Institut für Angewandte Photophysik, 01062 Dresden (Germany) — [2]Universität Ulm, Institut für Festkörperphysik, 89069 Ulm (Germany)

Gold-coated magnetic nanoparticles are interesting candidates for biomedical, magneto-optical, or data storage applications. The gold coating of the particles improves their stability as well as biocompatability, and broadens the possibilities for surface functionalization. Here we use a photochemical approach to deposit an ultrathin gold shell around FePt nanoparticles arranged in a two-dimensional, hexagonally ordered array. We investigate the deposition process, the qualitiy of the gold coating, and the magnetic properties of the core-shell particles obtained with our technique. First results indicate an improved long-term stability of the magnetization.

O 33.5 Tue 16:00 H31

Optical properties of nanopore arrays based on porous alumina — •Hongdan Yan[1,2], Dirk Wulferding[1,2], Peter Lemmens[1,2], Jianmin Shi[3], Klaus-Dieter Becker[3], Frank Ludwig[4,2], and Meinhard Schilling[4,2] — [1]IPKM, TU-BS, Braunschweig — [2]IGSM, TU-BS, Braunschweig — [3]IPTC, TU-BS, Braunschweig — [4]EMG, TU-BS, Braunschweig

Anodic alumina templates with nanopores show photoluminescence peaks and optical absorption that can be divided into three Gaussian bands. Two kinds of oxygen vacancy centers are responsible for these processes. The defects can be tuned using thermal annealing. Work supported by DFG and B-IGSM.

O 33.6 Tue 16:15 H31

Terrace-Width Distributions (TWDs) of Touching Steps: Modification of the Fermion Analogy, with Implications for Measuring Step-Step Interactions on Vicinal Surfaces* — •Theodore L. Einstein[1], Rajesh Sathiyanarayanan[1,2], Ajmi BH. Hamouda[1,3], and Kwangmoo Kim[1] — [1]U. Maryland, College Park, USA — [2]Pennsylvania State U., USA — [3]Monastir U., Tunisia

Using Monte Carlo simulations, we compute[1] the TWDs of surfaces in which steps can touch each other, forming multiple-atomic height steps, but cannot cross (no overhangs), and so inconsistent with the standard mapping to spinless fermions. Our numerical results show that the generalized Wigner distribution, with minor modifications at small step separations, gives a very good fit for TWDs of touching steps. (We also generate analytic results by generalizing results for extended fermions.[2]) The interaction strength derived from the fit parameter ϱ indicates an effective attraction between steps, weakening the overall repulsion. The strength of this effective attraction decreases for larger mean-step separations and decreasing step-touching energies; describable via finite-size scaling. Hence, accurate extraction of the true repulsion strength requires multiple vicinalities.

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[1]RS, ABH, and TLE, Phys. Rev. B 80 (2009) 153415.
[2]Siew-Ann Cheong and C.L. Henley, arXiv:0907.4228v1.