# DS 4: Nanoengineered Thin Films

Time: Monday 11:15–12:45 Location: H34

DS 4.1 Mon 11:15 H34

**Dewetting of Ni thin films and formation of nanorods on ripple patterned substrates** — •Jan Petersen und S. G. Mayr — I. Physikalisches Institut, University of Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany

Self-organisation processes are currently of particular interest due to the need of higher structure densities to increase the performance of electronic devices. They might also replace expensive and time consuming lithography processes. We investigated the dewetting process of thin Ni films during thermal annealing on smooth and ripple patterned silicon dioxide. The ripple pattern was created by ion etching under oblique incidence and has a corrugation wavelength of about 50nm. Scanning electron microscopy images show a faster decrease of Ni surface coverage on the ripple pattern with increasing temperature indicating an additional driving force of curvature induced diffusion. The ridges act as diffusion barriers trapping Ni in the valleys. Finding the adequate film thickness and annealing temperature this leads to the formation of nanorods or nanowires. Electrical resistance was measured to analyze the dynamics of the dewetting process.

Financial support by the DFG - SFB 602, TP B3 is acknowledged.

DS 4.2 Mon 11:30 H34

**Tuning the structure of electrodeposited ZnO** — •Thomas Loewenstein[1], Christian Neumann[2], Joachim Sann[2], Bruno K. Meyer[2], and Derck Schlettwein[1] — [1]Institut für Angewandte Physik, Justus-Liebig-Universität Gießen, 35392 Gießen, Germany — [2]I. Physikalisches Institut, Justus-Liebig-Universität Gießen, 35392 Gießen, Germany

Zinc oxide thin films were electrodeposited on (0001) GaN and (0001) ZnO from aqueous electrolytes. Electrochemical deposition of compound semiconductors is attractive because of a widely tuneable nanostructure, especially if molecular adsorbates serve as structure directing agents as shown in this study for ZnO/Eosin Y hybrid materials. Scanning electron microscopy (SEM) revealed the formation of domains with different crystal sizes pointing at a varying density of nucleation sites on the substrate. Crystalline ZnO was deposited as proven by X-ray diffraction (XRD). The intensity pattern showed the expected preferential orientation with the c- plane of ZnO parallel to GaN (0001). XRD rocking curves with $\mathrm{FWHM} = 0.25°$ indicated a surprisingly high level of in-plane orientation of the grown ZnO crystalline domains. The peak position of (0002) ZnO was shifted by $2\Theta = 1.3°$. This difference and the corresponding simultaneous shift of (0004) ZnO were explained by a lattice expansion by 3.6 % in the c-direction. This clearly indicated the strong influence of the Eosin Y molecules adsorbed during the growth of ZnO and implications for the use of electrodeposited ZnO in practical devices are discussed.

DS 4.3 Mon 11:45 H34

**Template-Directed Growth – When Control is Lost** — •Felix Kalischewski[1], Jia Zhu[2], and Andreas Heuer[1] — [1]Institut für Physikalische Chemie, Universität Münster, 48149 Münster — [2]Physikalisches Institut, Universität Münster, 48149 Münster

Template-directed aggregation/crystallization is widely used to build architectures of functional materials. In this technique, substrate surfaces are pre-patterned to define the places of aggregation for the functional material, which is then added to the substrate e.g. by molecular beam deposition. Ideally, the deposited material will diffuse along the surface until a pattern site is met and it is immobilized. If, however, the distance between the pattern sites is too large or the deposition flux is too high, it becomes likely that a critical number of molecules aggregates and a stable 2d-nucleus is formed on an off-pattern position. At this point the intended nucleation control is lost and structural errors occur.

We focus on the behavior of this transition point. Intuitively, one would expect the transition when the area-density of the pattern is equal to the saturated density of the 2d-nuclei on an un-patterned substrate. This is not exact however, because the maximum concentration of adsorbed molecules, which is responsible for the formation of new nuclei, strongly depends on the specific pattern. We model the resulting concentration field by a set of differential equations which are solved numerically as well as analytically. In addition, we apply off-lattice Monte-Carlo simulations and compare the results to experimental data.

DS 4.4 Mon 12:00 H34

**Multi-Component Langmuir-Blodgett Transfers for Chemical and Structural Surface Patterning** — •Michael Hirtz[1], Xiaodong Chen[1], Marion Brinks[2], Armido Studer[2], Harald Fuchs[1], and Lifeng Chi[1] — [1]Physikalisches Institut, Westfälische Wilhelms-Universität, Wilhelm-Klemm-Straße 10, 48149 Münster, Germany — [2]Organisch-Chemisches Institut, Westfälische Wilhelms-Universität, Corrensstraße 40, 48149 Münster, Germany

Self-assembly and self-organization are of great interest for the creation of micro- and nanostructured patterned surfaces by bottom-up approaches. By transferring mixed Langmuir monolayers of a phospholipid (DPPC) with small ad-mixings of other components onto solid substrates large area chemical patterns structured in the meso- up to the nanoscale can be created. These patterns can provide the basis for further chemical modification to form topographical or more complex chemical structures. We present the transfer of DPPC mixed with different dyes yielding luminescent stripe patterns as a proof of concept. Furthermore, transferred patterns composed of DPPC and alkoxyamines followed by polymerization of the pattern yield structured polymer brushes. The concept should be expandable to various other substances opening a wide field of possible applications in biological science and surface modification.

DS 4.5 Mon 12:15 H34

**Organophosphonate Functionalized Silicon Nanowires for DNA Hybridization Studies** — •Daniel Pedone[1], Anna Cattani Scholz[1], Stefan Birner[1], Manish Dubey[2], Jeffrey Schwartz[2], Marc Tornow[3], and Gerhard Abstreiter[1] — [1]WSI, TU München — [2]Princeton University, USA — [3]IHT, TU Braunschweig

Semiconductor nanowire field effect devices have great appeal for label-free sensing applications due to their sensitivity to surface potential changes that may originate from charged adsorbates. In addition to requiring high sensitivity, suitable passivation and functionalization of the semiconductor surface is obligatory. We have fabricated both freely suspended and oxide-supported silicon nanowires from Silicon-on-Insulator substrates using standard nanopatterning methods (EBL, RIE) and sacrificial oxide layer etching. Subsequent to nanofabrication, the devices were first coated with an hydroxyalkylphosphonate monolayer and then bound via bifunctional linker groups to single stranded DNA or PNA oligonucleotides, respectively. We investigated DNA hybridization on such functionalized nanowires using a difference resistance setup, where subtracting the reference signal from a second wire could be used to exclude most non-specific effects. A net change in surface potential on the order of a few mV could be detected upon addition of the complementary DNA strand. This surface potential change corresponds to the hybridization of about $10^{10}\mathrm{cm}^{-2}$ probe strands according to our model calculations that takes into account the entire hybrid system in electrolyte solution.

DS 4.6 Mon 12:30 H34

**Nanopatterning by Phase Mask Projection Laser Ablation** — •Marisa Mäder, Thomas Höche, Jürgen Gerlach, and Rico Böhme — Leibniz Institute of Surface Modification, Permoserstrasse 15, 04318 Leipzig, Germany

Nanostructures attached to a substrate promise optical and electronic applications like LEDs or diodes. Moreover, for Nanodots applications in various probing techniques (including Surface Enhanced Raman Spectroscopy) are also aspired. So far, however, the fabrication process of most nanostructures is still very complex and often too costly for industrial use. An alternative, versatile, fast, and relatively easy process is the technique of laser ablation using phase-mask projection. Pulsed laser light with the wavelength of 248 nm is sent through a phase mask. The phase mask modulates the phase of the incident beam at defined positions. Using a Schwarzschild reflection objective, the resulting interference pattern is demagnified and projected onto a thin film. At positions where the intensity exceeds the ablation threshold of the film but not the substrate, material is ablated from the substrate. Different shapes of nanostructures can be fabricated this way, depending on the pattern of the phase mask. GaN nanowires were produced with a striped mask while Au nanodots were fabricated using a checkerboard mask. In principle, every combination of thin film and substrate material is possible, as long as the ablation thresholds are matching, respectively.