

## CPP 17 Thin Films and Surfaces II

Time: Wednesday 15:45–17:30

Room: ZEU Lich

CPP 17.1 Wed 15:45 ZEU Lich

**Self assembly of diblock copolymers on patterned substrates: A Single Chain in Mean Field simulation study** — ●KOSTAS DAOULAS<sup>1</sup>, MARCUS MUELLER<sup>1</sup>, MARK STOYKOVICH<sup>2</sup>, SANG-MIN PARK<sup>2</sup>, YIORYOS PAKONSTANTOPOULOS<sup>2</sup>, JUAN DE PABLO<sup>2</sup>, and PAUL NEALEY<sup>2</sup> — <sup>1</sup>Institut fuer Theoretische Physik, Georg August Universitaet, D37077 Goettingen — <sup>2</sup>Department of Chemical and Biological Engineering, University of Wisconsin, Madison, WI 53706-1691

The implementation of a recently developed Single Chain in Mean Field (SCMF) method is presented, to study the self assembly of a lamella-forming ternary blend of a diblock-copolymer with its respective homopolymers on periodically patterned substrates. The pattern consists of square arrays of spots preferentially attracting one component and the structure of the assembled blend is investigated as a function of pattern dimensions and film thickness. The SCFM simulations show that the blend morphology closely follows the pattern at the substrate forming a quadratically perforated lamella (QPL). Depending on the pattern dimensions, the QPL is connected to the film free surface either through cylindrical-like necks or lamellae-like domains, resulting in a bicontinuous morphology. The theoretical predictions concerning the structure observed on the free surface of the film are in accordance with experimental data obtained for the same systems.

CPP 17.2 Wed 16:00 ZEU Lich

**Nanoaggregates on surfaces structured by nanolithography** — ●MAIK VIELUF, HARALD GRAAF, and CHRISTIAN VON BORCZYNSKI — Optische Spektroskopie und Molekülphysik, Institut für Physik, Technische Universität Chemnitz, 09107 Chemnitz

For detailed investigations of single nanoaggregates a suppression of the interaction among the aggregates is necessary. Such suppression can be reached by fixing the aggregates to a structured surface with a certain distance between the structures. We report on a structuring on nanometer scale by local anodic oxidation of self-assembled monolayers by atomic force microscopy (AFM). The oxide structures are selectively chemically modified to achieve functionalized nanostructures. These functionalized nanostructures are used to bind semiconductor or metal nanoparticles or supramolecular structures. Such structures are investigated by confocal microscopy to evaluate the optical properties.

CPP 17.3 Wed 16:15 ZEU Lich

**A combinatorial study on gradient noble metal / polymer blend multilayers** — ●STEPHAN V. ROTH<sup>1</sup>, HARALD WALTER<sup>2</sup>, RALPH DOMNICK<sup>3</sup>, CHRISTIAN SCHROER<sup>1</sup>, MARION KUHLMANN<sup>1</sup>, RAINER GEHRKE<sup>1</sup>, and PETER MÜLLER-BUSCHBAUM<sup>4</sup> — <sup>1</sup>HASYLAB at DESY, Notkestr. 85, D-22603 Hamburg — <sup>2</sup>CSEM SA, Badenerstrasse 569, CH-8048 Zürich, Switzerland — <sup>3</sup>identif GmbH, Ulrich-Schalk-Str. 3 D-91056 Erlangen — <sup>4</sup>TU München Physik Department LS E13, James-Franck-Str. 1, D-85748 Garching

Nanostructuring of thin noble metal films is of utmost importance for many technological and biophysical areas, e.g. anti-counterfeiting and DNA scanning [1]. Usually a multilayer geometry is chosen consisting of noble metal layer / polymer / substrate. The optical properties of such multilayer systems depend crucially on the structure and morphology of the noble metal layer. It is determined by key parameters like deposition method or noble metal-polymer interaction affecting the self-assembly of the metal atoms. We advanced two-fold: Firstly, as polymer layer we chose a blend of deuterated polystyrene (dPS) and polyisoprene (PI). Secondly we installed a gradient in mass thickness of the noble metal layer during evaporation. To obtain information for combinatorial libraries microbeam grazing incidence small-angle x-ray scattering ( $\mu$ GISAXS) allowing to scan such gradients is excellently suited [2]. We present a combinatorial study on a gold and copper gradient multilayers.

[1] G. Bauer et al., *Nanotechnology* **14**, 1289 (2003)[2] S.V. Roth et al., *Appl. Phys. Lett.* **82**, 1935 (2003)

CPP 17.4 Wed 16:30 ZEU Lich

**Electrical Detection and Characterization of Self-Assembled Polyelectrolyte Multilayers by a Silicon-on-Insulator based Thin Film Resistor** — ●PETRA A. NEFF<sup>1</sup>, ALI NAJI<sup>2</sup>, REGINE VON KLITZING<sup>3</sup>, and ANDREAS R. BAUSCH<sup>1</sup> — <sup>1</sup>Lehrstuhl für Biophysik - E22, Technische Universität München, Germany — <sup>2</sup>Physik Department - T37, Technische Universität München, Germany — <sup>3</sup>Institut für Physikalische Chemie, Christian-Albrechts-Universität Kiel, Germany

The build up of polyelectrolyte multilayers (PEMs) was observed by a silicon-on-insulator (SOI) based thin film resistor. Although the structural properties of polyelectrolyte multilayers have been extensively studied, a detailed understanding is still lacking. The layer-by-layer deposition of the polycation poly(allylamine hydrochloride) (PAH) and the polyanion poly(styrene sulfonate) (PSS) results in defined potential shifts, which decrease with the number of layers deposited. We model the response of the device assuming electrostatic screening of polyelectrolyte charges by mobile ions within the PEMs. The screening length  $\kappa^{-1}$  inside the PEMs was found to be increased compared to the value corresponding to the bulk solution. Furthermore the partitioning of mobile ions between the bulk phase and the polyelectrolyte film was employed to calculate the dielectric constant of the PEMs and the concentration of mobile charges.

CPP 17.5 Wed 16:45 ZEU Lich

**Modulation of physico-chemical surface properties of binary polyelectrolyte brushes and its influence on protein adsorption** — ●PETRA UHLMANN, NIKOLAY HOUBENOV, NINA BRENNER, and MANFRED STAMM — Leibniz Institute of Polymer Research, Hohe Strasse 6, D-01069 Dresden

Binary brushes constituted from two incompatible polymers can be used in the form of ultrathin polymeric layers as a versatile tool for surface engineering to tune physico-chemical surface characteristics as wettability, surface charge, chemical composition or morphology, and furthermore to create responsive surface properties. Mixed brushes of oppositely charged polyelectrolytes are representing a special case of responding surfaces which are sensitive to changes of the pH value in aqueous environment. The polyelectrolyte brushes used were composed of the two oppositely charged polyelectrolytes poly(2-vinylpyridine) (P2VP) and polyacrylic acid (PAA) and the in-situ properties and surface characteristics, as surface charge, surface tension, extent of swelling of these brush layers are described. To test the behaviour of the polyelectrolyte brushes when coming into contact with biosystems, protein adsorption experiments with globular model proteins were performed at different pH values and salt concentrations of the buffer solutions. The influence of the pH value and the buffer salt concentration on the adsorbed amount, the structure of the protein layers and the interfacial tension during protein adsorption as well as the protein adsorption mechanism in reference to recently developed theories about protein adsorption on polyelectrolyte brushes will be discussed.

CPP 17.6 Wed 17:00 ZEU Lich

**Experimental determination of the coverage-height dependence of self-assembled monolayers during film formation** — ●AHMED ABD EL MONEM<sup>1</sup>, JANA WEHRMEISTER<sup>2</sup>, MARK HELM<sup>2</sup>, and MICHAEL HIMMELHAUS<sup>1</sup> — <sup>1</sup>Angewandte Physikalische Chemie, Universität Heidelberg, Im Neuenheimer Feld 253, 69120 Heidelberg — <sup>2</sup>Institut für Pharmazie und molekulare Biotechnologie, Universität Heidelberg, Im Neuenheimer Feld 364, 69120 Heidelberg

So far, the adsorption kinetics of Self Assembled Monolayers (SAM) of alkanethiols on the coinage metals has been extensively studied. A lot of theoretical and experimental work has been done to evaluate the adsorption rate and layer thickness. However, measurements of the adsorption kinetics have been found to depend strongly on the method applied according to the physical transducer mechanism used to trace surface adsorption, such as the change in the dielectric properties of the interface or the alteration of surface state density. In this work, we present a novel approach, which combines linear and nonlinear optical techniques, i.e. spectral ellipsometry and optical second harmonic generation, to acquire such different information during the adsorption process of alkanethiols on gold independently. Accordingly, by observing the adsorption of different alkanethiols (C4, C12, C18) in-situ the differences between the two methods could be clarified. Preliminary experiments carried out on

the adsorption of alkanethiol-terminated polyethylene glycol demonstrate the potential of the method for the determination of the coverage-height dependence of surface-grafted polymer brushes, which is particularly important for direct comparison with theoretical predictions.

CPP 17.7 Wed 17:15 ZEU Lich

**Irreversible adsorption of tethered chains at substrates. Monte Carlo Study.** — ●RADU DESCAS<sup>1,2</sup>, JENS-UWE SOMMER<sup>2</sup>, and ALEXANDER BLUMEN<sup>1</sup> — <sup>1</sup>Theoretische Polymerphysik, Universität Freiburg, Hermann-Herder-Strasse 3, D-79104 Freiburg, Germany — <sup>2</sup>Institut de Chimie des Surfaces et Interfaces, 15, rue Jean Starcky, F-68057 Mulhouse Cedex, France

We study using the bond fluctuation model the irreversible adsorption of single chains grafted with one end to the surface [1]. While the reversible adsorption involves equilibrium states [2,3], the irreversible adsorption implies non-equilibrium ones. We find that the adsorbate's growth is dominated by the zipping of monomers according to their order along the chain. The time of adsorption  $t(M)$  as a function of the number  $M$  of adsorbed monomers follows a power law;  $M^\alpha$  with  $\alpha > 1$ . We introduce a two-phase model, in which the chain is described by an adsorbate portion and a corona. According to our model the adsorption can be viewed as consisting in a main stage, during which single monomers attach to the surface through zipping, and a late stage, in which the corona collapses on the surface. We find that  $\alpha$  is given by  $\alpha = 1 + \nu$ , where  $\nu$  is the Flory exponent, and study the time evolution of various density profiles.

[1] R Descas, J. -U. Sommer and A. Blumen, submitted.

[2] R Descas, J. -U. Sommer and A. Blumen, J. Chem. Phys. 120, 8831, (2004).

[3] R Descas, J. -U. Sommer and A. Blumen, J. Chem. Phys. 122, 134903, (2005).