

## CPP 9: Poster: Interfaces and Thin Films (joint session with DECHEMA and VDI)

Time: Monday 17:30–19:30

Location: Poster C

CPP 9.1 Mon 17:30 Poster C

**Fabrication of nanostructured titania thin films for application in hybrid photovoltaics** — ●WEIGUO LU, MARTIN A. NIEDERMEIER, GREGORY TAINTER, and PETER MÜLLER BUSCHBAUM — TU München, Physik-Department, Lehrstuhl für Funktionelle Materialien, James-Franck-Str. 1, 85748 Garching, Germany

Nanostructuring of titanium dioxide thin films has been the subject of numerous studies over the last years due to their important role in various optoelectronic applications, e.g. photovoltaics. These thin films need to meet certain requirements. Exhibiting a high effective surface area and a decent degree of crystallinity is crucial for the functionality and performance. Using block-copolymer templates in combination with a sol-gel synthesis approach to produce metal oxide thin films gives a high control over the morphology and is a promising way to meet those requirements. In this study, nanostructured titania thin films are fabricated with a bi-continuous foam-like structure. The diblock-copolymer poly(styrene-block-ethylene oxide) is used as the templating agent in a sol-gel process to fabricate hybrid thin films, which are subsequently transferred to anatase titania films via a high-temperature calcination step. Due to the hybrid nature of the thin films after the sol-gel preparation route, our films are even suitable for super-structuring. The morphology is investigated with imaging techniques like atomic force microscopy or scanning electron microscopy. The optical properties are probed with UV/Vis spectroscopy and white light interferometry.

CPP 9.2 Mon 17:30 Poster C

**Microfabrication and characterization of stress-reduced YSZ membranes** — ●FLORIAN KUHL<sup>1</sup>, MARKUS PIECHOTKA<sup>1</sup>, DANIEL REPPIN<sup>1</sup>, TORSTEN HENNING<sup>1</sup>, JÜRGEN JANEK<sup>2</sup>, and PETER J. KLAR<sup>1</sup> — <sup>1</sup>I. Physikalisches Institut, Justus Liebig University, Heinrich-Buff-Ring 16, DE-35392 Giessen, Germany — <sup>2</sup>Physikalisch-Chemisches Institut, Justus Liebig University, Heinrich-Buff-Ring 58, DE-35392 Giessen, Germany

The oxygen conductor YSZ (yttria-stabilized-zirconia) is a material often used as the electrolyte in solid oxide fuel cells. To achieve a lower operation temperature and to maximize the currents it is necessary to miniaturize the fuel cell components, especially to reduce the thickness of the solid electrolyte. Another application of very thin YSZ films may be their utilization as an ion source. We fabricated free-standing YSZ membranes by partially removing a Si substrate by anisotropic wet-chemical etching. We characterized the resulting inhomogeneous strain distribution and found a correlation between the size of the membranes and the strain induced pattern. Arrays of free-standing stress-reduced membranes with a high packing density were prepared by using cross-like masking patterns. Deposition of a porous Pt electrode onto the YSZ membranes allows the measurement of their ionic conductivities.

CPP 9.3 Mon 17:30 Poster C

**Order and phase behavior of thin film of diblock copolymer-selective nanoparticle mixtures: A molecular dynamics simulation study** — ●LENIN S. SHAGOLSEM<sup>1,2</sup> and JENS-UWE SOMMER<sup>1,2</sup> — <sup>1</sup>Leibniz-Institut für Polymerforschung Dresden — <sup>2</sup>Technische Universität Dresden

We study a coarse grained model of AB diblock-copolymer and nanoparticle mixtures confined between two identical walls in slit geometry. The nanoparticles are selective with respect to the A-block of the copolymer, while the walls are repulsive and non-selective with respect to both the copolymers and nanoparticles. We systematically explore the various equilibrium morphologies formed by the copolymer nanocomposites in this confined geometry, and construct the corresponding phase diagram in diblock composition and nanoparticle concentration space. We observe both vertically and horizontally oriented lamellar structures. The vertically oriented lamellae is formed by symmetric and slightly asymmetric diblock-copolymers at low nanoparticle concentrations and it has a very limited region of stability in the phase space, whereas the horizontal lamellae can be realized up to highly asymmetric diblock-copolymers and at high nanoparticle concentrations. The formation of horizontally oriented lamellae is driven by the chains (mainly nanoparticle repulsive B-blocks) to relax stretching near the confining surfaces. By considering the horizontal lamellae, we

also investigate the effect of nanoparticle concentration on the lamellar layer thickness.

CPP 9.4 Mon 17:30 Poster C

**Investigation of critical parameters of polymer adsorption for chains with different architecture** — ●OLGA MIRONOVA<sup>1,2</sup> and JENS-UWE SOMMER<sup>1,2</sup> — <sup>1</sup>Leibniz-Institut für Polymerforschung Dresden e.V., Dresden, Germany — <sup>2</sup>TUD, Dresden, Germany

In order to understand the role of polymer chain architecture on adsorption properties, we used scaling arguments to analyze polymer systems. We suggest that molecules with the same molecular weight but with different structure can have different adsorption properties, such as critical energy of adsorption and crossover exponent. For such polymers this difference can be applied as basis in separation technique like Liquid Chromatography at Critical Condition. For computer simulation of polymer systems we used the Bond-Fluctuation Model (BFM). End-grafted polymers at an adsorbing surface are considered under good solvent conditions. We compared three types of polymer architecture: linear, star-shaped and hyper-branched. It was found that critical parameters for 4-arm star-shaped and linear polymers are very close to each other. We also studied competitive adsorption from a dilute solution containing a mixture of stars and linear polymers. For hyper-branched polymers we realized essential ensemble averages over many realizations of branching topology.

CPP 9.5 Mon 17:30 Poster C

**Static and dynamic properties of cross-linked and non cross-linked polymer brushes.** — MICHAEL LANG<sup>1</sup>, MAX HOFFMANN<sup>2</sup>, ●MARCO WERNER<sup>1,3</sup>, and JENS-UWE SOMMER<sup>1,3</sup> — <sup>1</sup>Leibniz-Institut für Polymerforschung Dresden, Germany — <sup>2</sup>Universität Heidelberg, Germany — <sup>3</sup>Technische Universität Dresden, Germany

We compare dense layers of surface-grafted polymer chains (polymer brushes) with and without additional random cross-links between the chains using the bond fluctuation model. In non cross-linked brushes with intermediate and low grafting densities, chain conformations can be described by random walks in a parabolic potential. Cross-linking leads to a reduction of brush height, whereby a large fraction of this reduction stems from cross-links between monomers of the same chains. Most cross-links between different chains do not contribute to a significant collapse of the brush, because they are established between monomers of similar contour distance to the grafting points, where the balance of stretching forces and chain elasticity stays almost unmodified by a cross-link. Chain dynamics of non cross-linked brushes is dominated by arm retraction processes suggesting an exponential increase of relaxation time as function of chain length. The largely confined motion of non cross-linked grafted chains inside a cross-linked brush highlights the recently discovered critical behavior [D. Romeis, H. Merlitz and J.-U. Sommer, J. Chem. Phys. 136 (2012) 044903] of monodisperse brushes as well as the dominance of arm retraction processes for the ultimate relaxation of the chains.

CPP 9.6 Mon 17:30 Poster C

**Slippage of polymers: Influence of the chemical structure** — ●MISCHA KLOS<sup>1</sup>, SEBASTIAN BACKES<sup>1</sup>, MATTHIAS LESSEL<sup>1</sup>, OLIVER BÄUMCHEN<sup>2</sup>, and KARIN JACOBS<sup>1</sup> — <sup>1</sup>Saarland University, Experimental Physics, 66041 Saarbruecken, Germany — <sup>2</sup>Dept. of Physics & Astronomy McMaster University, Hamilton, ON, Canada

The continuing miniaturization of microfluidic devices causes a growing importance of the solid/liquid interface for the flow dynamics. Our experiments probe slippage using the dewetting process of thin polymer films on hydrophobic substrates [1]. As hydrophobic coatings, we use amorphous polymers (AF1600, AF2400) and different types of highly ordered self-assembled silane monolayers on top of ultraflat silicon substrates. On silane surfaces, polystyrene (PS) of low molecular weight exhibits slip lengths of several hundreds of nanometers up to even micrometers [2]. On AF1600, no significant slip is observable. Recent studies using scattering techniques showed an ordering effect of PS at the solid/liquid interface depending on the structure of the substrate [3]. Will the situation change if, instead of PS, other polymers like PMMA or PVP are used? In contrast to PS, PMMA has no phenyl rings. Moreover, we probe how the crystallinity of the substrate influences slippage: We show results of dewetting experiments

supplemented with X-ray scattering methods to analyze the slippage mechanism at the solid/liquid interface. [1]O. Bäumchen et. al., *J Phys Condens Matter*, vol. 24, no. 32, pp. 325102, 2012 [2]R. Fetzer et, al., *Europhys Lett*, vol. 75, no. 4, pp. 638, 2006 [3]P. Gutfreund et al., *arXiv.org*, vol. cond-mat.soft. 2011

CPP 9.7 Mon 17:30 Poster C

**Preparation conditions influence dewetting behavior of thin polymer films** — ●MISCHA KLOS, MATTHIAS LESSEL, and KARIN JACOBS — Saarland University, Experimental Physics, 66041 Saarbruecken, Germany

Dewetting of thin polymer films on smooth substrates like silicon wafers can be influenced by many factors such as intrinsic material and surface parameters, the film itself and even the quality of the substrate. So the sample preparation is a crucial step in the entire experiment. Reliable results are only achieved by fully characterized systems, which implicates perfect cleaning. Silicon wafers are common substrates to study the flow dynamics of polymer film. Since they feature a very high surface energy, also dust, dirt, impurities or differences in the preparation procedure have an influence on the quality of the surfaces. Dust for example can act as a nucleation core on the one hand and on the other hand, depending on the density, it can stabilize the film due to pinning. We show a comparison of different preparation and cleaning methods for silicon surfaces and their impact on the stability of thin polystyrene films.

CPP 9.8 Mon 17:30 Poster C

**Synthesis and ARXPS Investigations of Nitrile-Functionalized Ionic Liquid Systems** — ●SANDRA KRICK CALDERÓN<sup>1</sup>, INGA NIEDERMAIER<sup>1</sup>, NICOLA TACCARDI<sup>2</sup>, FLORIAN MAIER<sup>1</sup>, PETER WASSERSCHIED<sup>2</sup>, PETER LICENCE<sup>3</sup>, and HANS-PETER STEINRÜCK<sup>1</sup> — <sup>1</sup>Physikalische Chemie II — <sup>2</sup>Chemische Reaktionstechnik, Egerlandstr. 3, 91058 Erlangen — <sup>3</sup>School of Chemistry, Nottingham NG7 2RD

Due to their outstanding physicochemical properties, ionic liquids (ILs) are promising candidates for many catalytic applications. One remaining challenge is the dissolution of transition metal complex (TMC) catalysts in ILs. Groups such as nitriles facilitate the interaction between IL and TMC up to direct IL-TMC complex formation. Two new nitrile-functionalized ILs ( $[(C_4CN)MIM][OTf]$  and  $[(C_4CN)_2IM][OTf]$ ) were successfully synthesized. Additionally, two palladium-based nitrile-coordinated complexes ( $[(C_4CN)MIM_2PdCl_2][OTf]_2$  and  $[-(C_4CN)-IM(C_4CN)-PdCl_2-x][OTf]_x$ ) were prepared from these ILs. Angle-resolved X-ray photoelectron spectroscopy (ARXPS) revealed a sandwich-like structure for  $[(C_4CN)MIM][OTf]$  at the IL/vacuum interface, with the anion enriched in the outermost layer and the cation located below. Contrary,  $[(C_4CN)_2IM][OTf]$  shows a uniform distribution at the surface. In both cases, the  $CF_3$  moiety of the  $[OTf]^-$  anion is pointing towards vacuum. Quantitative analysis of the XPS data of both metal-IL-complexes show a loss in anion which leads to the assumption that a carbene complex is formed. Supported by the DFG through SPP 1191 and by the EAM Cluster of Excellence.

CPP 9.9 Mon 17:30 Poster C

**Unusual water uptake in ultrathin polyvinyl acetate films** — ●HEIKO HUTH and CHRISTOPH SCHICK — Universität Rostock, Institut für Physik, Wismarsche Str. 43-45, 18051 Rostock, Germany

The water sorption of polyvinyl acetate (PVAc) at different relative humidity for bulk like and ultra-thin films was studied by AC chip calorimetry. For a micrometer sized sample of about 200 ng the plasticizing effect of water vapor is the same as in conventional differential scanning calorimetry (DSC) employing mg samples with closed volume and well defined water content of the mg scale samples is found. With decreasing film thickness the water sorption behavior becomes more complex and an increasing amount of adsorpt excess water is observed. The effect can be discussed as a water layer on top and below the polymeric film dependent on the surface properties of the underlying sensor surface. For the experiments a new setup to measure heat capacity of thin film samples under controlled humidity was developed. The AC chip calorimeter uses a self-made humidity generator applying mass flow controllers. A quartz crystal microbalance (QCM) allows checking the mass change during water uptake. The technical details of the device and the extensions for humidity control are discussed too.

CPP 9.10 Mon 17:30 Poster C

**Characterization and investigation of the diffusion of silver**

**nanoparticles using single molecule fluorescence spectroscopy** — ●MARTIN HARTMANN, STEFAN KRAUSE, THOMAS BAUMGÄRTEL, and CHRISTIAN VON BORCZYKOWSKI — Optical Spectroscopy and Molecular Physics Group, Chemnitz University of Technology, 09126 Chemnitz, Germany

Optical properties like the absorption or emission behavior of silver nanoparticles as a function of the particle size have been extensively studied in the past. Furthermore the catalytic and optical surface enhanced properties are of special interest.

In our experiments small silver nanoparticles with a diameter below 1 nm showed surprisingly diffusion phenomena on a pure silicon dioxide surface. The aim of this work is to characterize those nanoparticles, to find a reason why they are diffusing and to investigate their diffusion. Experiments were performed by means of optical microscopy and atomic force microscopy. We are able to show, that the investigated particles consist of less than 22 silver atoms. The reason for the diffusion seems to be a small water film on the silicon dioxide surface. Diffusion measurements for different humidities of the surrounding atmosphere have been carried out. It turned out that three main diffusion coefficients exist and two of them depend on the air humidity.

CPP 9.11 Mon 17:30 Poster C

**Adsorption Behavior of Catanionic Surfactant Mixtures at the air/liquid interface** — ●MARTIN UHLIG, HEIKO FAUSER, and REGINE V. KLITZING — Stranski-Laboratorium, Department of Chemistry, TU Berlin, Straße des 17. Juni 124 D-10623 Berlin, Germany

The strong synergism of catanionic surfactant mixtures is known for a long time. The synergism allows to reduce the expended amount of surfactant, thus making catanionic surfactant mixtures eco-friendly. Therefore, these mixtures are of great interest for a broad field of applications. However, only very recently basic research was performed about the stability of foams formed with these mixtures. It was shown that the formation of surface active complexes and aggregates strongly enhances the adsorption at liquid-air interfaces and thus the foamstability [1].

Literature also shows that mixtures of surfactants with unequal chain length differ in surface properties in comparison to mixtures with equal chain length [2]. Hence, the focus of our work is on the influence of the surfactant alkyl chain length on the foam properties. We investigate catanionic mixtures from two common surfactant types, sodium alkyl sulfates and quaternary alkylammonium bromides. Both surface tension and the surface elasticity of mixtures with both matching chain length and mismatching chain length are investigated. Studies about the correlation between adsorbed amount of surfactants, interactions in thin foam films, foamability and foam stability are in progress.

[1] Varade, D. et.al.; *Soft Matter*, 2011, 7, 6557-6570

[2] Patist, A. et.al.; *Langmuir*, 1997, 13, 432-434

CPP 9.12 Mon 17:30 Poster C

**Controlling probe dynamics by modification of adsorption site density in confined liquids** — DANIELA TÄUBER, ●FABIAN MEIER, and CHRISTIAN VON BORCZYKOWSKI — nanoMA, TU-Chemnitz, Institut für Physik

The mobility of probe molecules in confined liquids is influenced by short adsorption events at the interface. Here we report about the modification of the surface silanol density at silica substrates and its effect on single dye dynamics in ultrathin liquid films. In contrast to ensemble methods, single molecule microscopy provides information on a local scale with sub-micron resolution. Thereby, probability distributions of diffusivities (scaled square displacements at fixed time lags) yield additional details to the conventional analysis of particle tracking via calculation of mean square displacements along detected trajectories. The probe diffusion in ultrathin liquid films can be modeled by a two layer system, consisting of a heterogeneous near surface layer with slowed diffusion on silanol patches and a homogeneous upper layer[1]. Single molecule tracking experiments on substrates with modified surface silanol density are compared to simulations. High adsorption site density combined with two-dimensional confinement in mesopores allows us to use adsorbed dye molecules as probes for the dynamics of the liquid in such pores.

[1] D. Täuber, Dissertation, TU Chemnitz, 2011.

CPP 9.13 Mon 17:30 Poster C

**Mechanism analysis of symmetric adhesion of water-swelling**

**polymer films** — ●RINA IKUBO, MARKUS SCHINDLER, and PETER MÜLLER-BUSCHBAUM — TU München, Physik Department, LS Funktionelle Materialien, James-Frank-Str.1, 85748 Garching, Germany

Commonly symmetric adhesion between polymer films is studied in case of hydrophobic polymers. The symmetric adhesion of polymer films which swell in water, which ubiquitously exist around our atmosphere, is less investigated despite its technological importance and scientific interest. Previous studies on our model system consisting of the statistical copolymer poly(ethylhexylacrylate-stat-methylmethacrylate) have shown that the two components of the polymer establish an enrichment layer of methylmethacrylate(MMA) at the top surface, and the MMA content changes depending on the relative humidity. PMMA is also studied as the polymer film which swells in water. We present a study on the influence of water on the internal reorganization of adhesive films that include PMMA as one component, its behavior on symmetric adhesion and discuss the effect of hydration on the surface composition and entanglement of surface molecules.

CPP 9.14 Mon 17:30 Poster C

**Combination of grafted and adsorbed polymer chains on solid surface for the creation of multicompartamental responsive coatings** — ●SAMANTHA MICCIULLA and REGINE VON KLITZING — Stranski-Lab für Physikalische u. Teoretische Chemie, Technische Universität Berlin, Germany

Responsive coatings are of interest for a large number of researchers due to their applicability as highly tunable release systems. Functionality and structural properties allow for the creation of systems which respond to many different stimuli, like pH, temperature, ionic strength and light. The combination of grafted and physisorbed blocks in a unique matrix has been object of studies in the last few years. The design of such coatings arises fundamental questions, for instance which materials and geometries can be successfully combined, which properties are induced from the complex assembly and how the responsiveness is consequently affected. Task of our study is to clarify the mentioned aspects. The system under investigation is prepared by grafting thermoresponsive polymers on silica surface, which is used as macroinitiator for the growth of a strong polyelectrolyte block, onto which polyelectrolyte multilayers are adsorbed. The "grafting from" performed by Surface Initiated Atom Transfer Radical Polymerization allows for controlled chain growth and low polydispersity. The adsorption is performed by dipping the substrate in oppositely charged polyelectrolyte solutions. Sample characterization is carried out by combining Ellipsometry, Atomic Force Microscopy, Contact angle and X-Rays Reflectometry, while responsive properties are monitored by Ellipsometry.

CPP 9.15 Mon 17:30 Poster C

**Improvement of the lamellar structure in block copolymer thin films by solvent vapor treatment** — ALESSANDRO SEPE<sup>1</sup>, DORTHE POSSELT<sup>2</sup>, KASPER SWIATEK<sup>2</sup>, JIANQI ZHANG<sup>1</sup>, SEBASTIAN JAKSCH<sup>1</sup>, RICHARD STEINACHER<sup>1</sup>, JAN PERLICH<sup>3</sup>, DETLEF-M. SMILGIES<sup>4</sup>, and ●CHRISTINE M. PAPADAKIS<sup>1</sup> — <sup>1</sup>TU München, Physik-Department, Physik weicher Materie, Garching — <sup>2</sup>IMFUFU, Department of Science, Systems and Models, Roskilde University, Denmark — <sup>3</sup>HASYLAB at DESY, Hamburg — <sup>4</sup>Cornell High Energy Synchrotron Source, Cornell University, Ithaca NY, USA

Defects in nanostructured block copolymer thin films are often annealed by solvent vapor treatment. We have studied the structural ordering in lamellar poly(styrene-*b*-butadiene) thin films during exposure to cyclohexane vapour and subsequent drying using X-ray reflectometry and in-situ, real-time grazing-incidence small-angle X-ray scattering [1]. The films had initially the parallel lamellar orientation and were subject to two swelling/drying cycles. We found that the lamellar order after this treatment is best when (i) a well-correlated parallel lamellar orientation is obtained during the first swelling cycle and (ii) when the film is dried at a sufficiently slow rate.

1. Z. Di, D. Posselt, D.-M. Smilgies, C.M. Papadakis, *Macromolecules* **43**, 418 (2010).
2. Z. Di, D. Posselt, D.-M. Smilgies, C.M. Papadakis et al., *Macromolecules* **45**, 5185 (2012).

CPP 9.16 Mon 17:30 Poster C

**Molecular motions of confined ultra-thin polystyrene films studied by REDLS** — FAN-YEN LIN, TASSILO KAULE, RÜDIGER BERGER, HANS-JÜRGEN BUTT, and ●WERNER STEFFEN — Max Planck Institute for Polymer Research, P.O. Box 3148, 55128 Mainz, Germany

Resonance Enhancement Dynamic Light Scattering, REDLS\*, is used to probe the surface and interface dynamics of (immiscible) polymers in double-layers. A low T<sub>g</sub> (53°C) Polystyrene (PS) is supported by a gold layer and covered by a solid, transparent, high T<sub>g</sub> (> 200°C) Polynorbornene (PN) layer polymerized onto the PS layer directly. We observe two Arrhenius-like processes above and below the bulk T<sub>g</sub>. The degree of confinement is influenced partly by the thickness of the capping layer. The surface dynamics going from a free PS surface to confined is strongly changed.

\*Plum M. A., Menges B., Fytas G., Butt H. J., Steffen W., *Rev. Sci. Inst.* 2011, 82, (1), 15102

CPP 9.17 Mon 17:30 Poster C

**Interaction of Ta and Nb based salts with ionic liquids** — STEFAN KRISCHOK<sup>1</sup>, ADRIANA ISPAS<sup>1</sup>, ●ANDRÉ ZÜHLSDORFF<sup>1</sup>, ANGELA ULBRICH<sup>1</sup>, ANDREAS BUND<sup>1</sup>, and FRANK ENDRES<sup>2</sup> — <sup>1</sup>Technische Universität Ilmenau, Institut für Mikro- und Nanotechnologien, 98693 Ilmenau, Germany — <sup>2</sup>Clausthal University of Technology, Institute of Electrochemistry, 38678 Clausthal-Zellerfeld, Germany

We have analyzed the changes of the surface properties of the ionic liquids (ILs) 1-butyl 1-methyl-pyrrolidinium bis(trifluoromethylsulfonyl)amide ([BMP][TFSA]) and 1-methyl-3-propyl imidazolium bis(trifluoromethylsulfonyl)amide ([PMIm][TFSA]) with and without dissolved NbF<sub>5</sub> and TaF<sub>5</sub> by X-ray photoelectron spectroscopy (XPS). The relative intensities of core level emission agree very well with the expected stoichiometry. Moreover, the observed chemical shifts are in agreement with the chemical structure. Upon solution of the salts the situation changes drastically. In particular a strong modification of the cation/anion ratio is observed. With increasing amounts of TaF<sub>5</sub> and NbF<sub>5</sub> both, the Ta or Nb concentration and the cation anion ratio increases in the near surface region. Additionally a new salt induced F component appears in the XPS spectra. The detected TaF<sub>5</sub> (NbF<sub>5</sub>) concentration in comparison to the nominal volume concentration and the correlation with the observed [TFSA] depletion in the surface region will be discussed in more detail. Finally, results on more complex metal salts will be presented. A fundamental understanding of the investigated interaction processes provides the basis for future studies on electrochemical processes in these systems.

CPP 9.18 Mon 17:30 Poster C

**Influence of the Air/Water Interface on the Monolayer of Block Copolymers** — ●CHRISTIAN APPEL, MARTIN KRASKA, and BERND STÜHN — Experimental Condensed Matters Physics, TU Darmstadt, Germany

Monolayers of special amphiphilic polymers are investigated in terms of compression behaviour and structure of the air/water (a/w) interface. We compare \*bad/good\* solvent conditions for two different polymer systems and study the morphology at the interface in dependency on the ruling surface pressure. In one of the polymer systems a hydrophobic polymer (polybutylacrylate) is anchored to the interface by a hydrophilic oligomer (polyethylenglycol). We compare this system with the complementary situation, where a hydrophilic polymer (poly-2-vinylpyridine) is anchored by a hydrophobic oligomer (polyvinylferrocene).

We recorded compression isotherms and studied the structure of the monolayers by X-Ray reflectometry in situ at the a/w interface an exitu by the preparation of LB-films. These experiments lead to detailed structural pictures of the monolayers. We observed in situ the forming of a two-layer system in dependency of the surface pressure. In the semi-dilute regime we treat the monolayer systems as quasi 2D and quantify the influence of the water surface in terms of 2D power laws, e.g. the interface acts as a \*bad/good\* solvent for the monolayers, respectively.

CPP 9.19 Mon 17:30 Poster C

**Auxetic behaviour of  $\alpha$ -polypropylene with crosshatch structure** — ●MARTIN NEUMANN and ROBERT MAGERLE — Chemische Physik, TU Chemnitz, D-09107 Chemnitz

Auxetic materials expand laterally when stretched. We have discovered this unusual behaviour in thin films of elastomeric polypropylene (ePP), a semi crystalline polymer with a low degree of crystallinity. The crystalline lamella are orientated perpendicular to the film plane and branch into daughter lamellae with branching angles of 80° forming a crosshatch structure. With a microtensile testing setup that allows for simultaneous imaging with atomic force microscopy (AFM) we measured series of AFM images during uniaxial elongation of a 1.75  $\mu$ m thick film. Approximately 10  $\mu$ m large patches of the crosshatch

structure expand perpendicular to the stretching direction. This corresponds to a negative Poisson ratio of -0.2. AFM images taken after stepwise relaxation show, that the auxetic deformation is almost completely reversible. Our results show, that auxetic behaviour is an intrinsic property of  $\alpha$ -polypropylene with crosshatch structure. The auxetic behaviour is explained with a model based on elongating lamella branches with fixed branching angles, fixed lamella width, and a conservation of crystalline volume.

CPP 9.20 Mon 17:30 Poster C

**Ordering effects in thin xenon films studied with NMR** — ●ALEXANDER POTZUWEIT, HAGEN ALLMRODT, LARS KRAFT, ANUSCHKA SCHAFFNER, and HEINZ JÄNSCH — Fachbereich Physik, Philipps-Universität Marburg, D-35032 Marburg

We employ NMR of hyperpolarized  $^{129}\text{Xe}$  to investigate ordering phenomena and diffusion in thin Xe films. To increase the sensitivity towards structurally caused inhomogeneities a small line width is favorable. In solid Xe the line width is dominated by dipolar interaction with neighboring nuclear spins. This can be substantially reduced by diluting the NMR-active isotope  $^{129}\text{Xe}$  in the NMR-inactive isotope  $^{132}\text{Xe}$ . Thus we are able to investigate ordering effects like annealing. Using different pulse sequences makes it possible to distinguish local and global effects. Here we present the technical development of the apparatus and discuss first results.

CPP 9.21 Mon 17:30 Poster C

**Influence of strain and slip on the dewetting of thin films** — ANDREAS REINDL<sup>1,2</sup> and ●MARKUS RAUSCHER<sup>1,2</sup> — <sup>1</sup>Max-Planck-Institut für Intelligente Systeme, Stuttgart — <sup>2</sup>Institut für Theoretische Physik IV, Universität Stuttgart

Thin polymer films produced by spin coating techniques often exhibit residual strain. We investigate the influence of this strain on the stability for the case of weak hydrodynamic slip at the substrate surface and for the case of strong slip (plug flow limit), i.e., we address the question whether a film dewets or not. The linear stability analysis of the corresponding thin film equations shows that for weak slip, residual strain does not destabilize the film. In the case of strong slip, however, sufficiently large residual strain can lead to dewetting of the film.

CPP 9.22 Mon 17:30 Poster C

**Real-time studies on annealing of Tetratetracontane (TTC) by X-Ray diffraction** — ●LINUS PITHAN<sup>1</sup>, ANDREAS OPITZ<sup>1</sup>, ALEXANDER HINDERHOFER<sup>2</sup>, EDUARD MEISTER<sup>3</sup>, CHRISTIAN FRANK<sup>2</sup>, MICHAEL KRAUS<sup>3</sup>, WOLFGANG BRÜTTING<sup>3</sup>, FRANK SCHREIBER<sup>2</sup>, and STEFAN KOWARIK<sup>1</sup> — <sup>1</sup>Humboldt Universität Berlin — <sup>2</sup>Universität Tübingen — <sup>3</sup>Universität Augsburg

TTC ( $C_{44}H_{90}$ ) is e.g. used as dielectric interlayer in organic field-effect transistors [1]. For such devices large molecular grains with smooth surfaces are crucial. Here we report real time grazing incidence X-Ray diffraction (GIXD) measurements monitoring the annealing process of TTC thin films on silicon dioxide previously deposited by vapor deposition. Furthermore atomic force microscopy (AFM) and X-Ray reflectivity (XRR) results are presented. We find that randomly oriented and lying molecules on the surface rearrange into standing up molecules and fill subjacent layers [2]. By AFM measurements it can be shown that islands of molecules form large terraces in the annealing process.

[1] Kraus et al.; Organic Electronics, 12, 5, May 2011, 731-735, DOI:10.1016/j.orgel.2011.02.001

[2] Weber et al.; J. Chem. Phys. 136, 204709 (2012), DOI:10.1063/1.4719530

CPP 9.23 Mon 17:30 Poster C

**The effect of salt ions on the protein adsorption at lipid membranes** — ●HOLGER GÖHRING, MICHAEL PAULUS, and METIN TOLAN — Fakultät Physik/DELTA, Technische Universität Dortmund, D-44221 Dortmund

Lipid membranes serve in biological cells as boundaries between the intracellular and extracellular region. Many biological transport processes taking place at membranes are associated with the adsorption of proteins. Here the investigation of protein - membrane interactions is crucial for a deeper understanding of such processes. In the case of electrostatic interaction the screening effect of salt ions can be used to control the adsorption. The presented study investigates the protein adsorption to Langmuir films under the presence of different concentrations of salt ions. Langmuir films prepared on a liquid subphase are

an ideal model for cell membranes. By varying the salt concentrations the electrostatic interaction between the films and proteins is altered. However, also the accumulation of ions at the Langmuir films has to be taken into account just as the different impact of the salts on the stability of the proteins. To regard those effects different salt ions are used during this study. The adsorption process is investigated by x-ray reflectivity (XRR) measurements, which allow the determination of the electron densities of thin layers at the liquid surface.

CPP 9.24 Mon 17:30 Poster C

**Effects of Reactive Oxygen Species on Phosphatidylglycerol Monolayer with Adsorbed Polyethylenimine** — ●ANDREAS GRÖNING<sup>1</sup>, HEIKO AHRENS<sup>1</sup>, FRANK LAWRENZ<sup>1</sup>, THOMAS ORTMANN<sup>1</sup>, FRITZ SCHOLZ<sup>2</sup>, and CHRISTIANE A. HELM<sup>1</sup> — <sup>1</sup>Inst. für Physik, Uni Greifswald, Felix-Hausdorff-Str. 6, D-17487 Greifswald — <sup>2</sup>Inst. für Biochemie, Uni Greifswald, D-17487 Greifswald

Polymer adsorption is widely used to modify surfaces. To investigate the protective effect against free oxygen radicals polyethylenimine (PEI) is adsorbed onto oppositely charged DMPG lipid monolayers at the air/water interface. The structure of the lipid-polyelectrolyte system is investigated with X-ray reflectivity and grazing incidence diffraction. At different pH-values and mixed with a variety of salts PEI adsorbs flatly (2.8 nm). But in the presence of Fe(II)SO<sub>4</sub> and EDTA in the solution a 15nm thick PEI layer is formed due to incorporation of Fe<sup>2+</sup> EDTA complexes. Radical oxygen species are produced via the Fenton's reaction. The reaction is started by H<sub>2</sub>O<sub>2</sub> injection. If a highly compressed monolayer is attacked, the lateral pressure is reduced by 10mN/m within 30min for thin and 3h for thick adsorbed PEI layers. With X-ray reflectivity it is observed that the PEI layer shrinks and eventually disappears. Simultaneously, Fe<sup>2+</sup> binds to the lipid monolayer and the solid lipid phase changes from NN-tilted to hexagonal.

CPP 9.25 Mon 17:30 Poster C

**Fabrication of carbon nanomembranes by helium ion beam lithography** — ●XIANGHUI ZHANG, HENNING VIEKER, ANDRÉ BEYER, and ARMIN GÖLZHÄUSER — Fakultät für Physik, Universität Bielefeld, Postfach 10 01 31, 33501 Bielefeld, Germany

The scanning helium ion microscope (HIM) has been recently employed as an imaging and metrology tool for nanotechnology. In addition, the helium ion beam is capable of creating nano-sized patterns and performing nanofabrication as commonly done in a focused ion beam (FIB) system. It is known that aromatic self-assembled monolayers (SAMs) can be cross-linked due to electron irradiation and form mechanically stable carbon nanomembranes (CNMs). Here we use a helium ion beam as direct writing tool to cross-link 4'-nitro-1,1'-biphenyl-4-thiol (NBPT) SAMs with arbitrary patterns. The cross-linked SAMs were transferred to either silicon substrates with an oxide layer or transmission electron microscopy (TEM) grids for further characterizations or applications. After being transferred, the evolution of SAM's crosslinking process could be investigated by the HIM imaging. Formation of wormlike morphology with preferential directions indicates that the crosslinking starts from the energetically favorable sites, such as molecular domains with certain crystalline orientation. Furthermore, we also use the ion beam to form nanopores in the CNM with an attainable feature size of 5 nm.

CPP 9.26 Mon 17:30 Poster C

**Interdiffusion within polyelectrolyte multilayers: influence of kind and weight of polycation and the design of diffusion barriers** — ●MALTE PASSVOGEL<sup>1</sup>, PETER NESTLER<sup>1</sup>, RALF KÖHLER<sup>2</sup>, and CHRISTIANE A. HELM<sup>1</sup> — <sup>1</sup>Inst. für Physik, Uni Greifswald, D-17487 Greifswald — <sup>2</sup>Helmholtz-Zentrum für Materialien und Energien, D-14109 Berlin

With neutron reflectivity the position and width of the internal interface between protonated and deuterated blocks of polyelectrolyte multilayers is determined. First, a standard system formed from PDADMA and PSS (protonated or deuterated) in 0.1M NaCl solution is investigated. Immersion in a concentrated salt solution (1M NaCl) for different annealing times shows interdiffusion. The diffusion constant depends non-linearly on the PDADMA molecular weight. This finding suggests that the diffusing entities are polycation/polyanion complexes. For large PDADMA molecular weight (>150 kDa) no diffusion inside the PEM is found. To explore the influence of the polycations, films made with the branched Polyethylenimine (PEI) and PSS are investigated. These films show a strongly non-linear film growth and very broad internal interfaces. No interdiffusion occurs when these

films are immersed in 1 M NaCl. To test the idea that PEI might serve as a diffusion barrier, a PEI layer is placed between a protonated and deuterated PDADMA/PSS block. Immersion of these multilayers in 1M NaCl solution for different times shows that the presence of PEI leads to a broadening of the interface which increases linearly with immersion time suggesting movement of PSS with constant slow speed.

CPP 9.27 Mon 17:30 Poster C

**Influence of polymer molecular weight on the parabolic and linear growth of PDADMAC/PSS multilayers** — ●PETER NESTLER and CHRISTIANE A. HELM — Inst. für Physik, Uni Greifswald, D-17487 Greifswald

The buildup of polyelectrolyte multilayers (PEMs) is investigated under in-situ conditions using multiple angle null ellipsometry. Polyanion PSS and polycation PDADMAC are adsorbed from 0.1 M NaCl solution. First the PEMs grow parabolically with the number of deposited layer pairs. This behaviour is attributed solely to the PDADMAC adsorption, while each PSS adsorption step leads to a constant thickness increase. After  $N_{trans}$  layer pairs a sharp transition from a parabolic to a linear growth occurs. Depending on the molecular weight of the polyelectrolytes, three different regimes of  $N_{trans}$  are found: For PDADMAC polymer weight above 100 kDa and PSS polymer weight above 30 kDa, the transition occurs constantly after 15 adsorbed layer pairs. In the case of lower molecular weights both polyelectrolytes show an opposite influence on  $N_{trans}$ . A lower PDADMAC polymer weight leads to a decrease (down to 8 layer pairs), and a lower PSS polymer weight to an increase of  $N_{trans}$  (up to 36 layer pairs), respectively. Interestingly, for each combination of molecular weight the value  $N_{trans}$  is roughly proportional to the thickness increase per deposited layer pair in the linear growth mode (between 4 nm and 23 nm).

CPP 9.28 Mon 17:30 Poster C

**NREX polarized neutron/x-ray contrast reflectometer** — ●OLAF SOLTWEDEL, YURY N. KHAYDUKOV, THOMAS KELLER, FRANZ TRALMER, MANFRED OHL, and BERNHARD KEIMER — Max-Planck-Institut für Festkörperforschung, Stuttgart, Germany

NREX is a classical angle dispersive, fixed wavelength neutron reflectometer at the cold neutron source of the FRM II in Garching/Munich. The instrument provides grazing incidence small angle scattering (GISANS), specular and off-specular reflectometry all in polarized and nonpolarized modes. These techniques are well suited to determine structural properties such as chemical aggregation, polymer and surfactant adsorption, interdigitation in low dimensions (surfaces, interfaces and thin film systems) at solid/liquid and solid/air interfaces. With a conventional x-ray add on ( $\text{CuK}\alpha$ ), the instrument offers the unique possibility to combine x-ray- and neutron reflectometry in-situ. Recent developments, exemplary measurements and future perspectives of NREX will be presented.

CPP 9.29 Mon 17:30 Poster C

**Hindered Domain Formation of Lipid Monolayers with Adsorbed Macromolecules** — ●THOMAS ORTMANN, HEIKO AHRENS, and CHRISTIANE A. HELM — Inst. für Physik, Uni Greifswald, D-17487 Greifswald

Polyelectrolytes adsorb onto oppositely charged lipid monolayers either in a flatly disordered or a two-dimensional lamellar phase as known from Grazing Incidence Diffraction. With a Brewster angle microscope, nucleation and growth of lipid domains in the condensed phase are observed with short polyelectrolytes. These polyelectrolytes adsorb in a disordered phase when the lipids are in the fluid phase but order in the two-dimensional lamellar phase when the lipids are in the condensed phase. Long polyelectrolytes adsorb always in the two-dimensional lamellar phase beneath both lipid phases. Then, domain nucleation and growth is never observed. We suggest that the lipid rearrangement occurring on domain formation is not possible when too many lipids are electrostatically bound to one macromolecule.

CPP 9.30 Mon 17:30 Poster C

**Imaging chemically patterned self-assembled monolayers with helium-ion microscopy** — ●DANIEL EMMRICH, HENNING VIEKER, ANDRÉ BEYER, and ARMIN GÖLZHÄUSER — Physics of Supramolecular Systems, University of Bielefeld, 33615 Bielefeld, Germany

Chemical patterning of certain self-assembled monolayers (SAMs) is possible by local exposure with electrons. In this way, for example, nitro groups of SAMs of NBPT (4'-nitro-1,1'-biphenyl-4-thiol) molecules

convert into amino groups. This is accompanied by the formation of cross-links between molecules in the exposed monolayer. In this contribution the capability of helium-ion microscopy (HIM) for imaging chemical patterns in SAMs is discussed. To this end, SAMs of NBPT and BPT (1,1'-biphenyl-4-thiol) molecules are locally exposed by employing a stencil mask and an electron flood gun. HIM images of these samples at identical settings show a significant drop in the secondary-electron signal for the nitro-terminated areas in comparison to all other monolayer regions in this set of samples, i.e. the amino-terminated areas, the exposed as well as pristine SAMs from BPT molecules. This behaviour can be understood by considering the scattering of secondary electrons in the monolayer during the HIM imaging process. Imaging of fully cross-linked and chemically patterned SAMs as well as electron exposure dose sample series will be presented as well.

CPP 9.31 Mon 17:30 Poster C

**Brushes of weak Polyelectrolytes (PE): Complex interactions with Solvent and Gold Nanoparticles** — ●ZULEYHA YENICE<sup>1</sup>, JAN GENZER<sup>2</sup>, RALF KÖHLER<sup>1,3</sup>, and REGINE V. KLITZING<sup>1</sup> — <sup>1</sup>Stranski Lab, Inst. of Chemistry, TU Berlin, Germany — <sup>2</sup>Dept. of Chemical & Biomolecular Engineering, NCSU, Raleigh, USA — <sup>3</sup>Inst. of Soft Matter and Functional Materials, HZB, Berlin, Germany

PE-brushes represent a new class of thin film materials with tunable surface parameters and interactions, allowing functionalisation, or incorporation and exchange of solvents or particles. The swelling behaviour of PDMAEMA-brushes\* was investigated by means of different solvents as ethanol and water of varying pH, and different water vapours. This ellipsometric study revealed a complex picture of the internal interactions of PE-brushes. Neutron reflectometry (NR) was used to determine, first, the structure of these films, either collapsed in dry state, or fully extended when swollen in buffer, secondly, the distribution and penetration depth of gold nanoparticles (Au-NP) in these brushes, after the exposure to suspensions of Au-NP with ca 5 or 15nm diameter. The study showed a comparatively homogeneous distribution of the brush length for our preparation technique. It proved that nanoparticles were incorporated into the PE-brushes irrespective from the size of the Au-NP and the length of the brush. But due to the complexity of the system it was not possible to determine a profile or horizon of deposition for the gold particles up to now. PE-brushes open a wide field for applications, and manifold of interesting, fundamental questions as well. \*poly[2-(dimethylamino) ethyl methacrylate]

CPP 9.32 Mon 17:30 Poster C

**Diffusion and demixing dynamics of water and ethanol in a self-adjusting molecularly thin slit-pore** — ●NIKOLAI SEVERIN, IGOR M. SOKOLOV, and JÜRGEN P. RABE — Department of Physics, Humboldt-Universität zu Berlin Newtonstr. 15, 12489 Berlin, Germany

The behaviour of multicomponent liquids in confining geometries is a fundamental physical problem, which plays a central role in fields such as nano-fluidics, molecular biophysics, single molecule spectroscopy, and nano-chemistry, e.g. for molecular transport through channels of biological membranes, analyte recognition in molecular assays, and molecular synthesis. We followed with nanometer-scale lateral resolution the in-situ dynamics within mixed monomolecular water-ethanol films in a slit pore between mica and graphene, employing scanning force microscopy to image the graphene topography conforming to the film. Water and ethanol, highly miscible in three dimensions are shown to nano-phase separate in monolayers within the pore, consisting of a hydrophilic atomically flat mica surface and a more hydrophobic graphene layer. Graphene conforms to the liquid film, bending at the boundaries between the domains of water and ethanol to accommodate their different thicknesses of  $80 \pm 20$  pm. The growth dynamics of the domains allows to determine a lower bound for the two-dimensional diffusion constant of ethanol in water of  $D \geq 2 \times 10^{-14} \text{ ms}^{-2} \text{ s}^{-1}$ .

CPP 9.33 Mon 17:30 Poster C

**Untersuchungen zur Bildung von Membranen auf Basis von Cellulosederivaten** — ●MICHAEL METZE<sup>1</sup>, ANNETTE REICHE<sup>2</sup>, STEPHAN BARBE<sup>2</sup> und DIETER MELZNER<sup>2</sup> — <sup>1</sup>Institut für Technische Chemie, Leibniz Universität Hannover, Deutschland — <sup>2</sup>Sartorius Ste-dim Biotech GmbH, Göttingen, Deutschland

Poröse Polymermembranen auf Basis von Cellulosederivaten werden industriell häufig durch das Verdunstungsverfahren hergestellt. Dabei durchläuft ein Gieklösungsfilm eine Phasenseparation, welche durch

kontrollierten Entzug von Lösungsmitteln ausgelöst wird und bei weiterer Trocknung zur Bildung poröser Strukturen führt.

Das Verfahren wird großtechnisch zur Herstellung von Celluloseacetat- und Cellulosenitratmembranen mit Porengrößen im Bereich von  $0,1 \cdot 10^3 \mu\text{m}$  eingesetzt, welche z. B. Grundlage von Filterprodukten und diagnostischen Produkten für die Biotechnologie sind.

Grenzflächeneffekte sollten eine entscheidende Rolle bei der Membranbildung spielen. Allerdings ist ihr Beitrag nicht bekannt da die Energiebilanz des Verfahrens durch die Verdunstung der Lösungsmittel dominiert wird und die Flory-Huggins Thermodynamik zur Beschreibung der Polymerlösung keinen Ansatz zur Berücksichtigung von Grenzflächenphänomenen bietet.

Die Erfahrung zeigt, dass Tenside Einfluss auf den Membranherstellungsprozess haben. Im Rahmen des Vortrags soll, ausgehend von einem quaternären Modellsystem mit bekanntem Phasendiagramm, der Einfluss verschiedener Tenside auf das Entmischungsverhalten der Gießlösung durch Trübungstitration, gezeigt werden.

CPP 9.34 Mon 17:30 Poster C

**Hydrodynamic description of free surface films of nematic liquid crystals: weak anchoring model** — ●TE-SHENG LIN and UWE THIELE — Department of Mathematical Sciences, Loughborough University, Loughborough, Leicestershire LE11 3TU, UK

We propose a long-wave model that describes the dynamics of a free surface thin film of nematic liquid crystals on a solid substrate under weak anchoring conditions at the free surface. The model recovers two regimes reported in the literatures: (i) For thick films the surface anchoring energy dominates. The molecules in the bulk have to bend across the film (HAN state) and lead to strong 'elastic diffusion' of the free surface height; (ii) For thin films the bulk elastic energy dominates. The orientation of the molecules is homogeneous in the bulk (P state) and has no influence on the stability of the free surface. Furthermore, it is found that there exists an intermediate film thickness range for which the free surface is linearly unstable. Finally, we show that the P state, even though neutrally stable, is actually nonlinearly unstable.

CPP 9.35 Mon 17:30 Poster C

**Morphology of ultrathin gallium oxide layers** — ●FRANK LAWRENZ<sup>1</sup>, NIKOLAI SEVERIN<sup>2</sup>, JÜRGEN P. RABE<sup>2</sup>, CHRISTIANE A. HELM<sup>1</sup>, and STEPHAN BLOCK<sup>3</sup> — <sup>1</sup>Institut für Physik, Ernst-Moritz-Arndt Universität, Felix-Hausdorff-Str. 6, D-17487 Greifswald, Germany — <sup>2</sup>Department of Physics, Humboldt-Universität zu Berlin, Newtonstr. 15, 12489 Berlin, Germany — <sup>3</sup>ZIK HIKE, Fleischmannstr. 42 - 44, D-17475 Greifswald, Germany

Liquid gallium is applied onto mica, silicon and silica surfaces. AFM tapping mode imaging shows micrometer sized gallium drops accompanied by extended, ultrathin layers, which we attribute to gallium oxide (GaOx) films passivating the surface of liquid gallium under ambient conditions. On all surfaces investigated, the GaOx layers exhibit a thickness of about 3 nm and a roughness similar to the underlying substrate. Although they replicate patterns of the substrate topography, they also exhibit high mechanical stability, as normal forces on the order of 1  $\mu\text{N}$  (for tip radii of some 10 nm) have to be applied to abrade the layer. We discuss different methods of liquid gallium application onto the surfaces which lead to ultrathin GaOx layers of different quality with respect to layer homogeneity and coated area.

CPP 9.36 Mon 17:30 Poster C

**Asymptotics of the Capillary-Driven Thin Film Equation** — ●THOMAS SALEZ<sup>1</sup>, MICHAEL BENZAQUEN<sup>1</sup>, JOSHUA D. MCGRAW<sup>2</sup>, OLIVER BÄUMCHEN<sup>2</sup>, KARI DALNOKI-VERESS<sup>2</sup>, and ELIE RAPHAËL<sup>1</sup> — <sup>1</sup>Gulliver, ESPCI, Paris, France — <sup>2</sup>McMaster University, Hamilton, Canada

The study of polymer nanofilms is of tremendous importance in a variety of scientific fields, such as polymer physics, physiology, biophysics, micro-electronics, surface chemistry, and applied mathematics. In the lubrication approximation for viscous flows, the evolution of the free surface of such a film is governed by the capillary-driven thin film equation. We hereby present analytical [1] and numerical [2] treatments of this partial differential equation for a stepped initial profile, and compare the results to experiments on polystyrene [3]. Then, we derive the Green's function of the linearized problem and therefore obtain the solution for any summable initial perturbation. In particular, we show that this solution uniformly converges in time towards a unique self-similar attractor that is precisely the Green's function multiplied by the algebraic volume of the perturbation [4]. Finally, a numerical scheme enables us to conjecture the extension of this result to the non-

linear case, where the universal attractor appears to be identical to the one obtained in the linear case.

[1] Salez et al. *PoF* 24 102111 (2012), [2] Salez et al. *EPJE* 35 114 (2012), [3] McGraw et al. *PRL* 109 128303 (2012), [4] Benzaquen et al. submitted to *SIAM* (2012)

CPP 9.37 Mon 17:30 Poster C

**Growth kinetics of metal films sputtered on adhesive polymer films followed with in-situ GISAXS** — ●MARKUS SCHINDLER<sup>1</sup>, EZZELDIN METWALLI<sup>1</sup>, GÖKHAN GÜMÜSSOY<sup>1</sup>, PETER MÜLLER-BUSCHBAUM<sup>1</sup>, and STEPHAN V. ROTH<sup>2</sup> — <sup>1</sup>TU München, Physik-Department, Lehrstuhl für Funktionelle Materialien, James-Frank-Str.1, 85748 Garching, Germany — <sup>2</sup>HASYLAB at DESY, 22603 Hamburg, Germany

Pressure sensitive adhesives (PSAs) are widely used in everyday applications, industries and medicine. Individually tailored compounds exist for many fields of application. Among these is the establishment of strong but reversible adhesive bonds between metal surfaces. The interactions between a metal adherent and the polymeric adhesive govern the performance of any metal-adhesive joint and are therefore important to understand. We present an in-situ grazing incidence small angle X-ray scattering (GISAXS) study on the growth of metal films sputtered on a model PSA as well as on its homopolymer components. Different growth kinetics reveal insights into the metal-polymer interactions and isolate the influence of atomic and molecular forces due to the absence of usual adherent surface properties like its roughness or preceding surface treatments, e.g. cleaning. GISAXS provides means to follow the metal film formation during sputtering in-situ, revealing structural information with a very high time resolution.

CPP 9.38 Mon 17:30 Poster C

**Non-equilibrium dynamics of a bilayer system of confined colloidal particles in a planar shear flow** — ●TARLAN A. VEZIROV and SABINE H. L. KLAPP — Institut für Theoretische Physik, Technische Universität Berlin, Hardenbergstraße 36, 10623 Berlin, Germany

We perform computer simulations of a confined bilayer system of charged colloidal particles interacting via a combined soft-sphere- and Yukawa-potential. The system is driven from equilibrium by a planar shear flow. The model parameters are adjusted according to ludox silica particles, which we have previously studied under equilibrium conditions [1,2]. As a framework for solving the equation of motion, we employ overdamped Brownian dynamics simulations. We investigate the impact of the shear flow and confinement on structure formation and focus on statistical properties such as e.g. translational symmetry orderparameter and pair distribution functions. Furthermore we are interested in the emergence of the zigzag motion observed in experiments [3] and characterized by the spatial oscillations of layers. We hope that our results can be used as predictions for future experimental work.

[1] S. Grandner and S.H.L. Klapp, *J. Chem. Phys.* **129**, 244703 (2008). [2] S. H. L. Klapp, Y. Zeng, D. Qu and R. v. Klitzing, *Phys. Rev. Lett.* **100**, 118303 (2008). [3] D. Derks, Y.L. Wu, A.v. Blaaderen and A. Imhof, *Soft Matter* **5**, 1060 (2009).

CPP 9.39 Mon 17:30 Poster C

**Effect of patterning on film morphology and device performance of BHJ organic solar cells** — ●DANIEL MOSEGUÍ GONZÁLEZ<sup>1</sup>, CLAUDIA M. PALUMBINY<sup>1</sup>, JAN PERLICH<sup>2</sup>, STEPHAN V. ROTH<sup>2</sup>, and PETER MÜLLER-BUSCHBAUM<sup>1</sup> — <sup>1</sup>TU München, Physik-Department E13, Lehrstuhl für Funktionelle Materialien, James-Frank-Str.1, 85747 Garching (Germany) — <sup>2</sup>HASYLAB at DESY, Notkestr. 85, 22603 Hamburg (Germany)

Controlling morphology within polymer films for solar cells through imprinting procedures has been found to be a promising pathway to achieve high efficiency devices. These structured devices are expected to present improved performance due to light scattering and reflection effects, which lead to enhanced absorption without increasing film thickness. Furthermore, in the case of poly(3-hexylthiophene) a change in the crystalline orientation was observed, leading to higher conductivities and better device performance. So far limited work has been carried out investigating the inner morphological changes of imprinted blend devices. In this work, the effects of structuring BHJ poly(3-hexylthiophene): phenyl-C61-butyric acid methyl ester (P3HT:PC60BM) films are investigated. Imprinted surfaces are characterized with AFM. Moreover, crystallinity and internal film morphology is characterized using grazing incidence wide/small angle x-ray scattering (GIWAXS/GISAXS), respectively. In addition, x-ray reflec-

tivity measurements provide supporting information for depth profiles. Finally, the characteristics of the device performance will be discussed and compared to the observed morphological changes.

CPP 9.40 Mon 17:30 Poster C

**Nanostructured Organic Solar Cells** — •THOMAS PFADLER, RICKY DUNBAR, and LUKAS SCHMIDT-MENDE — Dept. of Physics, University of Konstanz, 78457 Konstanz, Germany

Organic solar cells have the potential to become an important low-cost alternative to conventional solar cells. However, before this can happen, the energy harvesting potential of organic solar cells must become more comparable with that of the pervading technology. This research is focusing on nanoimprint lithography (NIL), a low-cost lithographic method for high-throughput patterning applicable to organic semiconductors. This technique can be used to tailor an organic solar cells active material on a nanometer scale.

One possible application is the implementation of a plasmonic light-trapping geometry by structuring the organic semiconductor metal interface e.g. the back-electrode of a bulk heterojunction device. Another promising application of NIL aims to control the nanostructure of a donor-acceptor interface in organic devices. One organic layer e.g. the hole accepting layer is structured before the electron acceptor is subsequently deposited. Target of this approach is to enhance the overall efficiency by enhancing the interfacial area increasing the exciton separation yield and ensuring direct pathways to the electrodes minimizing charge recombination.

CPP 9.41 Mon 17:30 Poster C

**Coat Thickness Dependent Adsorption of Hydrophobic Molecules at Polymer Brushes** — •JENS SMIAŁEK<sup>1</sup>, HENDRIK WAGNER<sup>2</sup>, CARSTEN HENTSCHEL<sup>3</sup>, LIFENG CHI<sup>3</sup>, ARMIDO STUDER<sup>2</sup>, and ANDREAS HEUER<sup>4</sup> — <sup>1</sup>Institut für Computerphysik, Universität Stuttgart, Germany — <sup>2</sup>Institut für Organische Chemie, WWU Münster, Germany — <sup>3</sup>Physikalisches Institut, WWU Münster, Germany — <sup>4</sup>Institut für Physikalische Chemie, WWU Münster, Germany

We study the adsorption properties of hydrophobic test particles at polymer brushes with different coat thicknesses via mesoscopic Dissipative Particle Dynamics simulations. Our findings indicate stronger adsorption energies at thin polymer brushes. The reason for this difference is mainly given by entropic contributions due to different elastic deformations of the coatings. The numerical findings are supported by analytical calculations and are in good agreement to experimental fluorescence intensity results.

CPP 9.42 Mon 17:30 Poster C

**Distribution of Gold Nanoparticles within patterns of Polymer Brushes using UV lithography** — •STEPHANIE CHRISTAU, JIANLI ZHAO, and REGINE VON KLITZING — Stranski-Laboratorium für Physikalische und Theoretische Chemie, Institute for Chemistry, Technical University Berlin, Straße des 17. Juni 124, 10623 Berlin, Germany

The distribution of Gold Nanoparticles (AuNPs) in polymer brushes which are grafted from planar silicon surfaces is of big interest in the last few years. The reason is that polymer brushes are promising candidates for the ordering of particles and AuNPs will induce interesting optical properties.

Polymer brushes of (N,N-dimethylamino)ethyl methacrylate (DMAEMA) and N-isopropylacrylamide (NIPAM) are grown from a 2-bromo-2-methyl-3-(triethoxysilyl)propyl propanamide (BTPAm)-covered silicon surface via surface-initiated atom transfer radical polymerization (SI-ATRP). For the synthesis of both initiator-covered self-assembled monolayer (SAM) and polymer brushes a new type of sealed reactor is used that provides a constant nitrogen flux. The grafted chains are investigated using ellipsometry, atomic force microscopy (AFM), X-ray reflectometry, scanning electron microscopy (SEM) and gel permeation chromatography (GPC).

To study the influence of the polymer's chemical composition, the brush thicknesses and the conformation on the particle distribution, grid-like patterns of polymer brushes are formed using UV lithography. Different approaches for patterning are addressed.