

Symposium Self-organizing Surfaces and Interfaces (SYSO)

jointly organized by
Biological Physics (BP),
Chemical and Polymer Physics (CPP), and
Dynamics and Statistical Physics (BP)

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Overview of Invited Talks and Sessions

(lecture room BAR SCHÖ and GÖR 226; Poster P3)

Invited Talks

SYSO 1.1	Wed	14:00–14:30	BAR SCHÖ	Pattern formation in epitaxial growth and ion beam erosion — •THOMAS MICHELY
SYSO 1.2	Wed	14:30–15:00	BAR SCHÖ	Patterns and Pathways in Far-from-equilibrium Nanoparticle Assemblies — •PHILIP MORIARTY, ANDREW STANNARD, EMANUELLE PAULIAC-VAUJOUR, MATTHEW BLUNT, CHRIS MARTIN, IOAN VANCEA, UWE THIELE
SYSO 1.3	Wed	15:00–15:30	BAR SCHÖ	Block-Copolymer Derived Inorganic Functional Materials — •ULLRICH STEINER
SYSO 2.1	Wed	15:45–16:15	BAR SCHÖ	Crystallisation of polymers at surfaces and in thin films — •GÜNTER REITER
SYSO 2.2	Wed	16:15–16:45	BAR SCHÖ	Active Organisation of Cell Surface Molecules by Cortical Actin — KRIPA GOWRISHANKAR, DEBANJAN GOSWAMI, SUBHASRI GHOSH, ABHISHEK CHAUDHURI, BHASWATI BHATTACHARYA, SATYAJIT MAYOR, •MADAN RAO
SYSO 2.3	Wed	16:45–17:15	BAR SCHÖ	Phase Behaviour and Dynamics in Lipid Mixtures — •PETER OLMSTED

Sessions

SYSO 1.1–1.3	Wed	14:00–15:30	BAR SCHÖ	Self-Organizing Surfaces and Interfaces I
SYSO 2.1–2.3	Wed	15:45–17:15	BAR SCHÖ	Self-Organizing Surfaces and Interfaces II
SYSO 3.1–3.26	Wed	17:30–19:30	P3	Self-Organizing Surfaces and Interfaces - Posters
SYSO 4.1–4.5	Thu	9:30–10:45	GÖR 226	Self-Organizing Surfaces and Interfaces III
SYSO 5.1–5.6	Thu	11:00–12:30	GÖR 226	Self-Organizing Surfaces and Interfaces IV
SYSO 6.1–6.6	Thu	14:00–15:30	GÖR 226	Self-Organizing Surfaces and Interfaces V
SYSO 7.1–7.5	Thu	15:45–17:00	GÖR 226	Self-Organizing Surfaces and Interfaces VI

SYSO 1: Self-Organizing Surfaces and Interfaces I

Time: Wednesday 14:00–15:30

Location: BAR SCHÖ

Invited Talk SYSO 1.1 Wed 14:00 BAR SCHÖ
Pattern formation in epitaxial growth and ion beam erosion — ●THOMAS MICHELY — II. Physikalisches Institut, Universität zu Köln, Germany

In this talk I will discuss three examples for self organisation on solid surfaces under conditions far from thermodynamic equilibrium. The first example relates to cluster lattice formation on a graphene moiré, a situation where adding under non equilibrium conditions the same particles as those forming one system phase causes a dramatic amplification of a spatial inhomogeneity in the second system phase which in turn gives rise to a highly ordered and spontaneous arrangement of the added particles. The second example relates to crystal growth. The competition of random deposition and specific diffusion mechanisms leads to a self organized morphology of mounds. The characteristic length scales displayed allow one to read the fundamental atomistic parameters of diffusion from the pattern. At proper growth conditions a growth bifurcation takes place, where depending on whether a specific feedback mechanism was turned on or not the system displays patches of qualitatively different structure. Finally we briefly address the topic of self organisation of ion beam eroded surfaces, which for crystalline substrate may be considered as the inverse process of crystal growth.

Invited Talk SYSO 1.2 Wed 14:30 BAR SCHÖ
Patterns and Pathways in Far-from-equilibrium Nanoparticle Assemblies — ●PHILIP MORIARTY¹, ANDREW STANNARD¹, EMANUELLE PAULIAC-VAUJOUR¹, MATTHEW BLUNT¹, CHRIS MARTIN¹, IOAN VANCEA², and UWE THIELE² — ¹School of Physics and Astronomy, University of Nottingham, Nottingham NG7 2RD, UK — ²Department of Mathematical Sciences, Loughborough University, Loughborough, Leicestershire, LE11 3TU, UK

Nanoparticle-solvent films deposited on solid substrates are associated with a rich dynamic behaviour which gives rise to a wide variety of striking self-organised patterns [1-4]. Although close-to-equilibrium self-assembly of nanoparticle arrays has been studied in some depth, there has been rather less work on solvent-nanoparticle systems driven far from equilibrium. In the far-from-equilibrium regime, a remarkably broad array of intricate, spatially correlated patterns form including

“foam-like” cellular networks, labyrinthine structures similar to those formed in spinodal decomposition of binary fluids, and well-defined fractal morphologies. I shall focus on our recent results in two areas: (i) “coerced coarsening” of nanoparticle arrays where the system is mechanically driven towards equilibrium [3], and (ii) the use of scanning probe-defined silicon oxide patterns to direct solvent dewetting and thus control pattern formation in drying nanofluids [4].

1. G. Ge and L. Brus, *J. Phys. Chem. B* 104 9573 (2000) 2. E. Rabani et al., *Nature* 426 271 (2003); T. Bigioni et al., *Nature Materials* 5 265 (2006) 3. MO Blunt et al., *Nature Nanotech.* 2, 167 (2007) 4. CP. Martin et al., *Phys. Rev. Lett.* 99, 116103 (2007)

Invited Talk SYSO 1.3 Wed 15:00 BAR SCHÖ
Block-Copolymer Derived Inorganic Functional Materials — ●ULLRICH STEINER — Cavendish Laboratory, Department of Physics, University of Cambridge

Block-copolymer self assembly gives rise to highly organised structures on the 10-nm length scale. While this is well documented, the use of these self-assembled structures for the manufacture of functional materials that make use of their high degree of symmetry is rare. This is mainly due to the fact that text-book self assembly is limited to simple coil-coil copolymers, preventing the use of technologically more relevant materials.

A promising alternative to the direct manufacture is the use of generic, well studied copolymers as template for materials synthesis. Three separate approaches will be discussed. (1) Well defined interpenetrating porous networks arising from partial degradation can be replicated by electroplating or atomic layer deposition to yield an organic-inorganic composite material. (2) The incorporation of a suitable precursor molecules into one of the block-copolymer phases followed by a condensation reaction compartmentalises sol-gel chemistries to a 10-nm confinement, replicating the microphase morphology of the block copolymer. (3) The growth of a single crystal in the vicinity of a porous copolymer phase results in the formation of a highly structured single-crystalline material.

My talk will introduce these three strategies for the manufacture of nanomaterials and demonstrate their usefulness in the manufacture of dye-sensitised solar cells.

SYSO 2: Self-Organizing Surfaces and Interfaces II

Time: Wednesday 15:45–17:15

Location: BAR SCHÖ

Invited Talk SYSO 2.1 Wed 15:45 BAR SCHÖ
Crystallisation of polymers at surfaces and in thin films — ●GÜNTER REITER — Physikalisches Institut, Universität Freiburg, Deutschland

Crystallisation is one of the most impressive ways of generating order in molecular systems. However, the morphology of crystals can undergo various transitions, driven by different types of instabilities, yielding diverse patterns at hierarchical length-scales. Here, we focus on morphological transitions for polymer single crystals by studying their growth in quasi 2 dimensions, i.e. in thin films with thicknesses in the range of a single crystalline lamella. Our results are compared with theoretical concepts describing morphological instabilities of single crystals which were originally not developed for polymeric systems. Based on these results, we demonstrate that polymer thin films provide valuable model systems for studying general concepts of crystallization. We identify at which point the connectivity of the crystallizing units within chain-like molecules starts to play a measurable role. For example, in contrast to crystals of small molecules, polymer crystals typically have a wide range of melting temperatures, allowing for paradoxical phenomena like the coexistence of melting and crystallisation. Derived from this fact, we demonstrate that a self-seeding technique enables to generate arrays of correlated polymer crystals of uniform size and shape with their orientation inherited from an initial single crystal. We attribute this unique behaviour of polymers to the coexistence of variable fold lengths in meta-stable crystalline lamellae, typical for ordering of complex chain-like molecules.

Invited Talk SYSO 2.2 Wed 16:15 BAR SCHÖ
Active Organisation of Cell Surface Molecules by Cortical Actin — KRIPA GOWRISHANKAR¹, DEBANJAN GOSWAMI², SUBHASRI GHOSH², ABHISHEK CHAUDHURI¹, BHASWATI BHATTACHARYA³, SATYAJIT MAYOR², and ●MADAN RAO^{1,2} — ¹Theoretical Physics, Raman Research Institute, Bangalore, India — ²National Centre for Biological Sciences, Bangalore, India — ³Theoretical Science Unit, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, India

The local organization of cell surface molecules is thought to be determined by thermodynamic forces. In particular, interactions with specific lipids are expected to result in protein complexes enriched in lipid-phases called ‘rafts’. I will briefly discuss our experimental work on the spatial distribution and steady state dynamics of a putative raft component, the GPI-anchored proteins, using high spatial and temporal resolution FRET microscopy. I will provide evidence that the spatial distribution and dynamics of reorganization of GPI-anchored proteins is regulated by the underlying cortical actin activity. I will next discuss a coarse-grained theoretical approach involving the dynamical interplay between membrane composition and cortical actin activity, based on the framework of active hydrodynamics. Apart from successfully capturing all features of our experimental results, we make testable predictions regarding the nature of fluctuations of cell surface GPI-anchored proteins. Finally, I will discuss consequences of such an active organisation on chemical reaction kinetics and spatial patterning in cell surface signaling.

Invited Talk SYSO 2.3 Wed 16:45 BAR SCHÖ

Phase Behaviour and Dynamics in Lipid Mixtures — ●PETER OLMSTED — School of Physics & Astronomy, University of Leeds, Leeds, UK

Lipid bilayer membranes are ubiquitous in biology, and perform a variety of functions, including protection, regulation of chemical gradients,

transport, and catalysis. It is apparent that the lipid composition plays an important role in these functions. In this talk I will speak about recent advances (embracing theory, simulation, and experiment) in our group in studying the phase behaviour and mechanics of lipid bilayer membranes of different compositions.

SYSO 3: Self-Organizing Surfaces and Interfaces - Posters

Time: Wednesday 17:30–19:30

Location: P3

SYSO 3.1 Wed 17:30 P3

Controlling Structural Properties of Self-Assembled Oligonucleotide - Mercaptohexanol Monolayers — ●KURT KUMMER¹, ALFRED KICK², MARTIN BÖNSCH², DENIS VYALIKH¹, MICHAEL MERTIG², and SERGUEI MOLODTSOV¹ — ¹Institute of Solid State Physics, Dresden University of Technology, D-01062 Dresden, Germany — ²BioNanotechnology and Structure Formation Group, Max Bergmann Center of Biomaterials and Institute of Materials Science, Technische Universität Dresden, D-01062 Dresden, Germany

We present results of our recent investigations on the chemical conditions for the formation of mixed self-assembled monolayers of thiol-modified oligonucleotides and mercaptohexanol deposited onto gold surfaces. Using high-resolution X-ray photoemission spectroscopy we found that the spatial density of DNA strands can be varied in a controlled manner within a wide range by the concentration of MgCl₂ in the immobilization buffer. We were also able to illuminate the question how the DNA probes affect the quality of the mercaptohexanol SAM more deeply. In particular, the use of aqueous instead of ethanolic mercaptohexanol solutions with a more moderate mercaptohexanol concentration is demonstrated to be favorable for the formation of high-quality mixed monolayers.

SYSO 3.2 Wed 17:30 P3

Chemical reactivity at surfaces induced by self organisation in ultrathin PEO films — ●EVELYN MEYER and BRAUN HANS-GEORG — Leibniz Institute of Polymer Research Dresden - Max Bergmann Center of Biomaterials, Dresden, Germany

The self organisation process that will be addressed is related to the crystallisation of Polyethyleneoxide (PEO) from amorphous ultrathin (3nm) PEO films. During crystallisation dendritic shaped lamellae crystals of PEO develop. Using appropriate short chain molecules (molecular weights in between 2000 and 6000) unfolded, or just 2 to 3 times folded lamella appear. During this process the surface chemistry of the material changes while the hidden endgroups of the amorphous state become enriched at the new created lamella surfaces. Using electron beam lithography we could attach the water soluble PEO lamellae to the surface. Using aminoendendgroups and fluorescence labelling we could demonstrate the strong increase in these endgroups as a consequence of the crystallisation process.

SYSO 3.3 Wed 17:30 P3

Self-organisation and orientation of 1-Palmitoyl-2-Oleoyl-sn-Glycero-3-Phosphocholin (POPC) at the surface of hydroxypropionitrile — ●HARTWIG POHL¹, THOMAS KREBS², STEFAN KREYSLER¹, and HARALD MORGNER¹ — ¹Leipzig University, Wilhelm-Ostwald-Institute for Physical and Theoretical Chemistry, Linnéstr. 2, D-04103 Leipzig — ²University of Wisconsin, Chemistry Department, 1101 University Ave, Madison, WI 53706

The understanding of the self-organisation of lipids at the surface of polar liquids is of great interest in biochemical as well as in technical topics. In order to gain information about the surface structure of POPC in hydroxypropionitrile, we have performed investigations using various particle spectroscopies, including metastable induced electron spectroscopy [H Morgner 2000 Adv. At. Mol. Opt. Physics 42B 387-488], XPS and ISS. Recent ARXPS-data suggest that at low concentrations the polar head groups are located at the surface, rather than the hydrophobic chains [F Knoll 2001 PhD-thesis University Witten-Herdecke]. This is supported by investigations with NICISS [T Krebs 2006 PhD-thesis Leipzig University]. With increasing surface excess the relative position between both elements approaches the expected order. In order to gain additional information on the surface structure, we have employed the perfectly surface sensitive electron spectroscopy MIES that characterizes exclusively the topmost layer of the liquid. As we suspect the asymmetric structure of POPC to play an impor-

tant role, the behaviour of the analogues DPPC and DOPC in HPN is investigated by MIES as well.

SYSO 3.4 Wed 17:30 P3

Dynamics of a drop on oscillated substrate: the role of contact line hysteresis — ●IRINA S. FAYZRACHMANOVA¹ and ARTHUR V. STRAUBE² — ¹Department of Theoretical Physics, Perm State University, Bukirev 15, 614990 Perm, Russia — ²Department of Theoretical Physics, TU Berlin, Hardenbergstr. 36, 10623 Berlin, Germany

The dynamics of a drop sitting on the transversally oscillated substrate is under theoretical consideration. We aim at understanding the impact of the contact angle hysteresis, which is described by means of the dynamic boundary condition suggested by Hocking [1]: the contact line starts to move only when the deviation of the contact angle exceeds a certain critical value. As a result, the system is able to demonstrate stick-slip motion. Because of the dissipation at the contact line, the regime with steady nonlinear oscillations with the frequency of external driving (or in other words the limit cycle) is reached. By comparing the results with the non-hysteretic situation, we figure out how the hysteresis affects the dynamics. Particularly, we analyze the amplitude dependencies on governing parameters and obtain resonance conditions.

[1] L.M. Hocking, Waves produced by a vertically oscillating plate, *J. Fluid Mech.* **179**, 267 (1987).

SYSO 3.5 Wed 17:30 P3

Observation of prewetting transitions at surfactant-laden liquid-crystal/water interfaces — ●CHRISTIAN BAHR — MPI for Dynamics and Self-Organization, Bunsenstr. 10, D-37073 Göttingen

Fundamental arguments [1,2] predict for systems possessing a first-order wetting transition at coexistence, that first-order surface transitions should exist also off coexistence. These prewetting transitions are characterized by a discontinuous finite change of the thickness of the wetting film.

We have recently studied [3,4] the wetting behavior of thermotropic liquid crystals at surfactant-laden interfaces to aqueous phases. The wetting film at the interface consists in this case of a thin ordered (nematic or smectic) film which exists at temperatures where the bulk phase is in the disordered (isotropic) state. A significant advantage of the liquid-crystal/water systems is, that the strength of the ordering surface field can be controlled via the concentration of the surfactant. Careful tuning of the surfactant concentration should enable the experimental realization of prewetting transitions. In this study, we report first measurements confirming the existence of prewetting transitions in a nematic wetting film at such interfaces.

[1] J. W. Cahn, *J. Chem. Phys.* **66**, 3667 (1977).

[2] H. Nakanishi and M. E. Fisher, *Phys. Rev. Lett.* **49**, 1565 (1982).

[3] Ch. Bahr, *Phys. Rev. Lett.* **99**, 057801 (2007).

[4] E. Kadivar, Ch. Bahr, and H. Stark, *Phys. Rev. E* **75**, 061711 (2007).

SYSO 3.6 Wed 17:30 P3

Dewetting of colloidal solutions: Kinetic Monte Carlo model vs. Dynamical Density Functional Theory — IOAN VANCEA¹, MARK ROBBINS¹, ANDREW ARCHER¹, ●UWE THIELE¹, ANDREW STANNARD², EMMANUELLE PAULIAC-VAUJOUR², CHRISTOPHER MARTIN², MATTHEW BLUNT², and PHILIP MORIARTY² — ¹Department of Mathematical Sciences, Loughborough University, UK — ²The School of Physics and Astronomy, University of Nottingham, UK

We employ a kinetic Monte Carlo (KMC) model [1-3] and a Dynamical Density Functional Theory (DDFT) [4] to model the evaporative dewetting of a nanoscopic precursor film of nanoparticle solution that stays behind a mesoscopic convective dewetting front [2,5]. With the KMC model we study the influence of the particles on (i) spinodal

dewetting and nucleation processes, and (ii) the transverse instability of the dewetting front. The DDFT describes the dynamics of both -nanoparticle and liquid - densities. As compared to the purely 2d KMC it allows to model the evaporation/condensation of the solvent and its transport within the layer. The theories are compared in the spinodal and metastable parameter region as well as for unstable dewetting fronts.

- [1] E. Rabani et al, Nature 426, 271 (2003)
- [2] C. P. Martin et al, Phys. Rev. Lett., 99 116103 (2007)
- [3] I. Vancea et al, Phys. Rev. E, 78 041601(2008)
- [4] A.J. Archer, M. J. Robbins and U. Thiele, in preparation
- [5] E. Pauliac-Vaujour et al, Phys. Rev. Lett., 100 176102 (2008)

SYSO 3.7 Wed 17:30 P3

Thin Film Model for Evaporating Colloidal Suspensions — ●LUBOR FRASTIA, ANDREW J. ARCHER, and UWE THIELE — Department of Mathematical Sciences, Loughborough University, Loughborough, Leicestershire, LE11 3TU, UK

Based on long-wave approximation [1,2], we introduce a model for an evaporating film or drop of a colloidal suspension. Some basic assumptions regarding the various transport processes that are involved (convection, diffusion, evaporation) are used as well. We use the resulting system of coupled evolution equations to study the evaporation of drops on a solid substrate. Finally, we discuss the conditions for the self-pinning of the receding contact line that may result in the deposition of a dried-in ring of particles.

- [1] S.Kalliadasis, U.Thiele, Thin films of Soft Matter, Springer Wien, p.25-94 (2007)
- [2] A.V.Lyushnin, A.A.Golovin, L.M.Pismen, Phys. Rev. E 65, 021602, (2002)

SYSO 3.8 Wed 17:30 P3

Polymer brushes as self-organized surfaces — ●JENS-UWE SOMMER¹, HOLGER MERLITZ^{1,2}, and GUI-LI HE³ — ¹Leibniz Institute of Polymer Research, Hohe Strasse 6, D-01069 Dresden, Germany — ²Department of Physics and ITPA, Xiamen University, Xiamen 361005, P.R. China — ³Institut für Theoretische Physik II, Heinrich-Heine-Universität Düsseldorf, 40225 Düsseldorf, Germany

We propose a novel principle to build reversibly switchable polymer brushes based on molecular dynamics simulations. Here we use the interplay between the sharp concentration profile of densely grafted brushes and the effect of modified end-groups. We show that bulky end-groups display a strong tendency to localize on top of the polymer brush ("active" state of the coating). When the environment is changing to disfavor the end-groups (exposed to poor solvent), however, they retreat into the brush layer which turns the coating into a "passive" state. At high grafting densities the chains are highly stretched and the entropic difference between the active (stretched) and the passive (coiled) state is large leading to a sharp transition by changing the parameters of the environment (temperature, solvent quality) thus leading to an efficient switching behavior.

SYSO 3.9 Wed 17:30 P3

Viscosity and density at the polymer-solid interface — ●E.TILO HOPPE, ALEXANDRA MÜNZER, and CHRISTINE M. PAPADAKIS — TU München, Physikdepartment E13, Garching

Close to the interface between a polymer film and a solid the polymer properties deviate from the bulk. This change in physical behaviour is of importance for the adhesion of polymer coatings to solids, e.g. in medical implants or in paints.

The goal of the project is the investigation of the influence of the polymer-solid interaction on the physical properties of the polymers near the interface. Special interest is dedicated to the correlation in change of density and viscosity of the polymer near the interface. Low molecular weight polybutadiene melt on silicon oxide is studied as a model system. The changes in density and viscosity are investigated by neutron reflectometry and fluorescence correlation spectroscopy. To tune interface interactions between substrate and polymer melt, different substrate surface modifications have been applied and their surface tension components were determined with contact angle measurements.

SYSO 3.10 Wed 17:30 P3

Multiscale study of crystallization in diblock copolymer thin films at different supercooling — ●CHRISTINE M. PAPADAKIS¹, CHARLES DARKO¹, EZZ METWALLI¹, IOAN BOTIZ², GÜNTER REITER², DAG W. BREIBY³, JENS W. ANDREASEN⁴, STEPHAN V. ROTH⁵, and

DETLEF-M. SMILGIES⁶ — ¹TU München, Physikdepartment E13, Garching — ²Institut de Chimie de Surfaces et Interfaces, CNRS, Mulhouse, France — ³Department of Physics, Norwegian University of Science and Technology, Trondheim — ⁴Risø National Laboratory, Roskilde, Denmark — ⁵HASYLAB at DESY, Hamburg — ⁶CHESS, Cornell University, Ithaca NY, USA

In block copolymers with a crystalline block, the orientation of the crystalline chain stems with respect to the internal interfaces depends on the degree of supercooling. The thin film geometry offers the possibility to create oriented mesostructures and to gain detailed knowledge on the crystalline orientation. We have studied thin films of polystyrene-*b*-poly(ethylene oxide), PS-*b*-PEO, diblock copolymers in dependence on the degree of supercooling. AFM showed that the crystalline domains (lamellae) consist of grains, which are macroscopic at a low degree of supercooling, but of submicrometer size for strong supercooling. Using grazing-incidence wide-angle X-ray scattering, we could determine the grain orientation distribution function which shows that the chain stems are perpendicular to the lamellae at low supercooling, but tilted at strong supercooling. These results suggest that, at strong supercooling, the crystalline PEO lamellae do not grow homogeneously, but by the formation of small crystallites at the growth front.

SYSO 3.11 Wed 17:30 P3

Breakout crystallization in cylinder-forming diblock copolymer thin films — ●CHRISTINE M. PAPADAKIS¹, CHARLES DARKO¹, KORDELIA TROLL¹, ZHENYU DI¹, STEPHAN FÖRSTER², DETLEF-M. SMILGIES³, and ANDREAS TIMMANN⁴ — ¹TU München, Physikdepartment E13, Garching — ²Universität Hamburg, Department Chemie — ³CHESS, Cornell University, Ithaca NY, USA — ⁴HASYLAB at DESY, Hamburg

In thin polymer films, crystallization often leads to fascinating surface structures. We have investigated the long-term behavior of the crystallization in thin films of cylinder-forming poly(isoprene-*b*-ethyleneoxide), PI-*b*-PEO. Using optical microscopy, AFM, X-ray reflectometry and grazing-incidence wide- and small-angle X-ray scattering, we have observed breakout crystallization of the PEO. The crystallization of the film was complete only after 150 days. The original hexagonal morphology was destroyed by crystalline lamellae lying in the film plane. The PEO chain stems were perpendicular to the film plane.

SYSO 3.12 Wed 17:30 P3

Formation of lateral structures in thin diblock copolymer films by vapor treatment — ●CHRISTINE M. PAPADAKIS¹, PETER ČERNOCH², PETR ŠTĚPÁNEK², DETLEF-M. SMILGIES³, and STEPHAN V. ROTH⁴ — ¹TU München, Physikdepartment E13, Garching — ²Inst. Macromolecular Chemistry, Prague, Czech Republic — ³CHESS, Cornell University, Ithaca NY, USA — ⁴HASYLAB at DESY, Hamburg

Exposure of block copolymer thin films to solvent vapor allows to control the orientation of the mesostructure with respect to the film surface. Using grazing-incidence small-angle X-ray scattering (GISAXS), we have investigated the structural changes in thin films of lamellae-forming poly(4-octylstyrene-*b*-butylmethacrylate) [1] before and after exposure to solvents of different qualities and selectivities and have found that the treatment with the strongly selective solvent acetone results in the parallel orientation, whereas the weakly selective solvent cyclohexane (CHX) leads to the formation of perpendicular lamellae, thus a laterally structured film. In-situ, real-time GISAXS during swelling with saturated CHX vapor revealed that the lamellar reorientation takes place within the first 15 min of the swelling. The film thickness nearly doubles. Upon drying, the lateral structure is preserved, i.e. treatment with this solvent constitutes an attractive opportunity to induce lateral structures in thin block copolymer films.

1. P. Černoch, P. Štěpánek et al., Eur. Polym. J. 43, 1144 (2007).

SYSO 3.13 Wed 17:30 P3

Influence of Polymers on polarizability and structure of microemulsion droplets — ●ROBERT WIPF, SEBASTIAN JAKSCH, BERND STÜHN, and BJÖRN KUTTICH — TU Darmstadt, Experimentelle Physik kondensierter Materie, 64289 Darmstadt, Germany

Water-in-oil microemulsions are thermodynamically stable mixtures of water droplets in a continuous oil phase. The droplets are stabilized by a monomolecular layer of amphiphilic surfactant molecules. The investigated microemulsion consists of water and decane with sodium bis(2-ethylhexyl)sulfosuccinate (AOT) as ionic surfactant. We determine the structure of this system by SAXS showing spherical struc-

ture. The conductivity of such systems exhibits a steep increase when volume fraction or temperature increase above a critical value. This behavior can be understood as dynamic percolation. In the dielectric spectrum of a microemulsion, as a heterogeneous system, an interfacial polarization, known as Maxwell-Wagner-Sillars effect, was observed. In the high frequency regime a further relaxation occurs, which can be attributed to the sodium and AOT moiety ions. This relaxation depends strongly on the water content of the droplets as well as their interaction. Adding PEO to the water core leads to an extra polymer shell on the inner side of the droplet interface. Its influence on percolation temperature and structure can be observed by dielectric spectroscopy and SAXS. Adding the amphiphilic triblock copolymer PEO-PI-PEO at low droplet volume fraction decorates the droplets. This decreases attractive interaction among the droplets as we observe in dielectric and SAXS measurements.

SYSO 3.14 Wed 17:30 P3

STM STUDY OF SELF-ASSEMBLY AT THE SOLID-LIQUID INTERFACE CONTROLLED BY THE CONCENTRATION OF SOLVED MOLECULES — •THI NGOC HA NGUYEN — Reichenhainer Strasse 70 Physik-Neubau 09126 Chemnitz

Trimesic acid (TMA) is known to assemble in diverse supramolecular structures due to the three fold - symmetric carboxylic acid functionality for the formation of hydrogen-bond networks since they can act as both H-bond donor and acceptor at the same time, and therefore can bind to themselves in any conformation. The solvent chosen in this experiment is octanoic acid. According to (1), TMA in this solvent can only form chicken-wire structure. But, we found that, depending on concentration of TMA in octanoic acid, that there are also other structures. We made different solutions with the same amount of solute (TMA) and solvent (octanoic acid) but different concentration of solved TMA by different sonication time

SYSO 3.15 Wed 17:30 P3

Probing electronic states of double layered molecules in a STM junction — •FRANCESCA MATINO¹, GUILLAUME SCHULL¹, MARCO KNUTZEN¹, SANDRO GABUTTI², MARKUS NEUBURGER², MARCEL MAYOR², and RICHARD BERNDT¹ — ¹IEAP-Universität Kiel, Kiel, Germany — ²University of Basel, Basel, Switzerland

In recent years, electron transport through single molecules has become a key issue for molecular electronics. It is known that the electronic coupling between molecules and metallic electrode can affect the transport behaviour, so thin insulating layers are often used to decouple molecules and keep their properties unaltered. A promising alternative are cyclophanes, upright 3D-structures consisting of layered π -systems bridged with aliphatic chains, where the upper π -system is far away from the surface. We have used a UHV low temperature-STM to study the electronic properties of double layered conjugated molecule on metal surface. We report on the organisation and molecular properties of a single and a double layered naphthalenediimide on Au (111) surface. We focus on the influence of metal surface on the electronic states of both molecules as well as the interaction between the separate π -layer, in order to validate the electronic decoupling capability of cyclophanes on surface.

SYSO 3.16 Wed 17:30 P3

Growth kinetics of oligo-ethylene glycol thiols on Au-surfaces - Real-time IR studies under aqueous conditions — •STEFAN ZORN¹, NATHAN MARTIN², ALEXANDER GERLACH¹, and FRANK SCHREIBER¹ — ¹Institut für Angewandte Physik, Universität Tübingen, Tübingen, Germany — ²Montana State University, Bozeman, MT, USA

Oligo-ethylene glycols (OEGs) are an important model system for biotechnological applications. In particular OEG SAMs are able to form protein resistant surfaces. The underlying mechanism of this property is not fully understood until now. However, recent investigations indicate that solvent interaction with the OEG layer plays an important role in the capacity to withstand protein adsorption [1].

While n-alkane SAM growth has been intensively studied [2], only little is known about OEG SAM growth kinetics, although the structure of the OEGs including their conformation and defects is crucial for their performance in protein resistance. Using a polarisation modulation infrared reflection absorption spectroscopy (PMIRRAS) setup with a home made liquid cell we were able to monitor the different stages of growth and identify the different conformations of the OEG SAM dependent on the surface coverage. By comparing the absorption bands in the region of the strong C-O-C stretching mode we were

also able to describe the underlying growth kinetics and to model the changing ratio of all-trans and helical conformation during growth.

[1] M.W.A. Skoda et al., Langmuir 23 (2007) 970.

[2] F. Schreiber, Prog. Surf. Sci. 65 (2000) 151.

SYSO 3.17 Wed 17:30 P3

Nano-Diamantdrähte: Fabrikation und Charakterisierung für Anwendungen in der Elektrochemie — •WALDEMAR SMIRNOV, ARMIN KRIELE, MARCO WOLFER und CHRISTOPH E. NEBEL — Fraunhofer-Institut Angewandte Festkörperphysik, Tullastrasse 72, Freiburg 79108, Deutschland

Chemische und biochemische Sensoren der nächsten Generation erfordern signifikante Verbesserungen in Sensitivität, chemischer Stabilität und Bio-Kompatibilität, um zukünftige Bedürfnisse in diversen Anwendungen zu erfüllen. Seit einiger Zeit stehen vertikal ausgerichtete Nano-Drähte aus Diamant zur Verfügung. Diese sollten herausragende chemische Beständigkeit und elektrochemische Eigenschaften aufweisen, die bisher jedoch noch nicht charakterisiert wurden.

In diesem Vortrag wird die Herstellung von vertikal ausgerichteten Nano-Diamantdrähten aus Bor- und undotiertem Diamant vorgestellt. Die Drähte werden mittels eines ICP-Trockenätzverfahrens hergestellt, unter Verwendung von selbstorganisierten Nickelpunkt-Ätzmasken. Diese werden durch Aufdampfen einer dünnen Nickelschicht (ca. 1 nm) realisiert, die bei 700°C getempert wird. Durch Stranski-Krastanov Wachstum kommt es dabei zur Ausbildung von Nickelseln mit ca. 17 nm Durchmesser, die sich homogen verteilt auf der Oberfläche anordnen. Diese wirken als Ätzmaste im anschließenden Plasmaätzschritt (ICP). Die entstehenden Diamantdrähte weisen ein Aspektverhältnis von 18 auf. Die Eigenschaften der Drähte werden durch SEM, STM, AFM, IU und Mikro-Raman Experimente analysiert und in diesem Vortrag vorgestellt.

SYSO 3.18 Wed 17:30 P3

Probing the elastic properties of individual nanostructures by combining in-situ AFM and micro X-ray Diffraction —

•TILL H. METZGER¹, THOMAS SCHELER¹, THOMAS CORNELIUS¹, ROGERIO PANIAGO¹, MARIO RODRIGUES², CRISTIAN MOCUTA¹, ANGELO MALACHIAS¹, JOEL CHEVRIER², and FABIO COMIN¹ — ¹European Synchrotron Radiation Facility (ESRF), B.P. 220, 38043 Grenoble Cedex, France — ²Institut Néel, CNRS-UJF, B.P. 166, 38042 Grenoble Cedex 9, France

Atomic Force Microscopy (AFM) and micro X-ray Diffraction (micro-XRD) are combined to investigate nanostructures during in-situ indentation. This technique allows the determination of elastic properties of individual nanoscale objects, particularly here SiGe/Si(001) self-assembled islands. Using this novel technique it was possible to select a specific island, align it in the microfocused beam and apply a pressure onto it, using the AFM tip. Simultaneously, the X-ray diffuse scattering map from the island and the surrounding substrate was recorded in order to probe the lattice parameter change during indentation. An elastic reduction of the island lattice parameter of up to 0.6% was achieved.

SYSO 3.19 Wed 17:30 P3

Influence of molecule adsorption on the surface electric fields of GaAs(001)c(4x4) and (2x4) — •T. BRUHN^{1,2}, R. PASSMANN^{1,2}, B.O. FIMLAND³, M. KNEISSEL¹, N. ESSER^{1,2}, and P. VOGT¹ — ¹TU Berlin, Institut für Festkörperphysik, Hardenbergstr.36, 10623 Berlin, Germany — ²ISAS Berlin, Albert-Einstein-Str.9, 12489 Berlin, Germany — ³NUST, NO-7491 Trondheim, Norway

Organic/inorganic interfaces have been attracting a growing interest over the last years. Particularly the affection of surface electric fields due to molecular adsorption could open up perspectives for novel sensor concepts. For these purposes a profound understanding of the atomic and electronic properties of the interface formation is required.

In our experiments we have been investigating the interface between different the GaAs(001)c(4x4) and (2x4) surface reconstructions and self-assembled monolayers of small organic ring molecules (Cyclopentene (C₅H₈) and 1,4-Cyclohexadiene (C₆H₈)). The samples were prepared in UHV and investigated with reflectance anisotropy spectroscopy (RAS) and soft x-ray photoelectron spectroscopy (SXPS).

After the chemisorption of the molecules a significant influence on the linear electro-optic effect (LEO) could be observed. This influence could be shown to also depend on the substrate doping level. On both substrate surface reconstructions photoemission spectra of the Ga 3d and As 3d core levels exhibit a different influence on the surface band bending. These results can be explained by an affection of reconstruc-

tion induced piezo-electric fields due to the molecule adsorption.

SYSO 3.20 Wed 17:30 P3

Molecular arrangement of self-assembled Metal-Phthalocyanine on GaAs(001) — ●L. RIELE¹, R. PASSMANN^{1,2}, V. RACKWITZ¹, T. BRUHN^{1,2}, B.-O. FIMLAND³, M. KNEISSL¹, N. ESSER^{1,2}, and P. VOGT¹ — ¹TU Berlin, Institut für Festkörperphysik, Hardenbergstr.36, 10623 Berlin, Germany — ²ISAS Berlin, Albert-Einstein-Str.9, 12489 Berlin, Germany — ³NUST, NO-7491 Trondheim, Norway

Phthalocyanines have proved to be important materials for sensing applications such as chemical sensors. Therefore it is the major interest to profoundly understand the structural and electrical properties of such organic/inorganic hybrid systems.

Here we report on non-planar lead phthalocyanine (PbPc) deposited on the three main GaAs(001) reconstructions, i.e. c(4x4), (2x4) and (4x2). The samples were prepared under UHV conditions and investigated in terms of their interfacial atomic optical and chemical structure.

Our previous results showed an anisotropic molecular arrangement within 20nm thick PbPc films depending on the initial GaAs(001) substrate surface reconstruction. By using scanning tunneling microscopy (STM) the initial deposition steps and molecular arrangement are here investigated on self-assembled submonolayer coverages of PbPc on GaAs(001). These results help to elucidate how the arrangement of the adsorbed PbPc molecules within the first monolayer is influenced by the atomic configuration of the GaAs substrate.

SYSO 3.21 Wed 17:30 P3

Infrared studies of Pb nanowires on silicon vicinal surfaces — ●CHUNG HOANG, ROBERT LOVRINCIC, MARKUS KLEVENZ, FRANK NEUBRECH, and ANNEMARIE PUCCI — Kirchhoff-Institut für Physik der Universität Heidelberg, Im Neuenheimer Feld 227, 69120 Heidelberg

By means of polarized infrared (IR) spectroscopy we investigate the optical response of self-assembled lead nanowires growing on silicon vicinal surfaces. Under IR excitation polarized parallel to the long wire axis we see a shift of a resonance frequency to lower wave numbers when the nanowires are growing in length, meanwhile there is no significant change observed with perpendicular excitation. The different behaviour of the nanowires under polarized IR electrical field reveals surface plasmon excitation and resonant enhancement of the local field. This field enhancement is known to be localized at the tip-ends of the nanowires and it can be exploited, for example, via an optical nanoantenna concept. As the formation of lead nanowires is defined from the very beginning stage of the nucleation process and is related to the anisotropy of terrace and corner-rounding diffusion, we use Si(335) and Si(557) vicinal substrates with and without gold decoration as one-dimensional templates for producing various arrays of parallel nanowires for comparison. Our result demonstrates that the stability of the vicinal surfaces and also corner-rounding diffusion play key roles in the formation of the nanowires. The influence of the substrate temperature on the development and resonance frequencies of the nanowires is also studied.

SYSO 3.22 Wed 17:30 P3

Towards a molecularly thin Ferroelectric-OFET: surface modification of ferroelectric PZT films mediated through functionalized thiophene derivatives — ●KINGA HAUBNER^{1,2}, PETER MILDE¹, EVELIN JAEHNE², DENNY KOEHLER¹, ULRICH ZERWECK¹, and LUKAS ENG¹ — ¹Institute of Applied Photophysics, Technische Universität Dresden, 01062 Dresden, Germany — ²Institute of Macromolecular Chemistry, Technische Universität Dresden, 01062 Dresden, Germany

Lead zirconate titanate (PZT) has been used as the substrate material of choice for designing an ultrathin ferroelectric gate electrode in an organic field-effect transistor (Ferro-OFET). The focus of the present work is on the film formation process of the molecularly thin organic conduction layer based on α,ω -dicyano- β,β^* -dibutylquaterthiophene (DCNDBQT). Film formation is effectively promoted through specifically designed, bifunctional self-assembling molecules which act as a template layer. We report on nanoscale investigations of the film structure using a combination of X-ray photoelectron spectroscopy (XPS), ellipsometry and non-contact atomic force microscopy (nc-AFM) in combination with Kelvin probe force microscopy (KPFM). Excellent properties were found for those films prepared through in-situ UHV sublimation and analysis. Our measurements indicate that the DCND-

BQT molecules form a well-ordered closed packed, dense, and terraced molecular layer exhibiting step heights in the range of approximately 2.0 nm. Therefore, such organic monolayers are well suited as the conduction layer in ultrathin ferroelectric OFET-structures.

SYSO 3.23 Wed 17:30 P3

Sputter Deposition of Aluminium on Colloidal Polymer Templates — ●RAINER GEHRKE¹, GERD HERZOG^{1,2}, ADELIN BUFFET¹, SEBASTIEN COUET¹, KAI SCHLAGE¹, GUNAR KAUNE³, VOLKER KÖRSTGENS³, ROBERT MEIER³, EZZELDIN METWALLI³, STEPHAN V. ROTH¹, RALF RÖHLSBERGER¹, WILFRIED WURTH², and PETER MÜLLER-BUSCHBAUM³ — ¹HASYLAB at DESY, Notkestr. 85, D-22607 Hamburg, Germany — ²Inst. f. Exp. Phys., Univ. Hamburg, Luruper Chaussee 149, D-22761 Hamburg, Germany — ³TU München, Physik-Department, James-Frank-Str. 1, D-85747 Garching, Germany

This work addresses an approach to the formation of metal nanowire meshes on surfaces. Colloidal dispersions of 100 nm polystyrene spheres were spincoated on silicon. Islands of packed layers of spheres were formed which served as template for sputter deposition of aluminium. Structure formation was investigated with grazing incidence small angle X-ray scattering at beamline BW4 at HASYLAB/DESY using an in-situ sputtering chamber, thus scattering could be observed during metal deposition. The measurements indicate, that at the beginning of the deposition the metal atoms assemble in the indentations between the spheres, only after longer sputtering times the surface becomes completely covered with aluminium. If an unsputtered sample was heated beyond the glass transition temperature the lateral ordering vanished, if sputtering was stopped before complete metal coverage ordering remained upon heating. This indicates that the metal forms a stable structure separating the polymer spheres from each other.

SYSO 3.24 Wed 17:30 P3

DFT-study of the adsorption of organic molecules on low-index titanium dioxide surfaces — REGINA LUSCHTINETZ¹, ANDREY N. ENYASHIN^{1,2}, THEODOR MILEK¹, JOHANNES FRENZEL^{1,3}, ●SIBYLLE GEMMING³, and GOTTHARD SEIFERT¹ — ¹Theoretische Chemie, TU Dresden, D-01062 Dresden, Germany — ²Institute of Solid State Chemistry, 620041, GSP-145, Ekaterinburg, Russia — ³Forschungszentrum Rossendorf, P.O. 51 01 19, 01314, Dresden, Germany

The adsorption of small (bio-)organic molecules on clean, low-index TiO₂ surfaces has been investigated by density-functional based tight-binding calculations with the goal to rationalise the propensity of such molecules to self-assemble into row-like structures or two-dimensionally ordered patches. The systems studied range from phosphonic acids to the nucleotide cytidin monophosphate adsorbed on TiO₂ anatase(101) and rutile(110) surfaces. We studied the geometries and adsorption energies of several adsorption models and obtain several possible adsorption structures that can be present on the specific TiO₂ surfaces with comparable probability. For the pure phosphonic acids the preferable coordination is exclusively bidentate with similar adsorption energies but several different geometries. Monodentate and tridentate arrangements have significantly smaller adsorption energies and tend to relax towards the bidentate coordination. Despite the different steric situation, cytidin monophosphate exhibits exactly the same trends as phosphonic acids with bidentate coordination via a combination of oxo, alkoxy and hydroxyl groups.

SYSO 3.25 Wed 17:30 P3

Feedback effect on the self-organized structures formation upon femtosecond laser ablation — ●OLGA VARLAMOVA and JUERGEN REIF — LS Experimentalphysik II, Brandenburg University of Technology Cottbus and IHP/BTU JointLab Cottbus, Konrad-Wachsmann-Allee 1, 03046 Cottbus, Germany

Self-organized structures upon multi-pulse femtosecond laser ablation at intensities below the ablation threshold for a single pulse for CaF₂ and around the ablation threshold for Si are observed at the crater bottom. Numerous experimental data exhibit a positive feedback in the self-organization process. To investigate an influence of this effect on the formation of surface structures ablation experiments with variable pulse separation time have been performed on semiconductor (Si) and dielectric (CaF₂). By reducing laser repetition rate from 1000 Hz to 1 Hz we observe an exponential decrease of the ablated area on both samples. The results for Si show also an essential reduction of the pattern complicity as well as of their size in the centre of the ablation spot. We show that feedback becomes weaker with increasing

time intervals between successive pulses. The nature of the feedback mechanisms will be discussed.

SYSO 3.26 Wed 17:30 P3

Systematical Structural Investigation of Self-Assembled Monolayers formed from Dithiolanes on Gold (111) — •XIA STAMMER, ASIF BASHIR, CHRISTIAN HÜLSBUSCH, MARTIN KIND, and CHRISTOF WÖLL — Lehrstuhl für Physikalische Chemie 1, Ruhr-Universität Bochum, Universitätsstraße 150, D-44801 Bochum, Germany

Self-assembled monolayers (SAMs) have attracted considerable interest since they offer a huge potential for various applications including corrosion protection, nanoelectronics, biological compatibility of metal implants and other surface modifications. The most common self-assembling molecules used for self-assembly on gold are thiols and

disulfides, which have been extensively investigated in recent years. In order to improve the stability of thiol-based SAMs, we have investigated a new class of molecule, which contain two S-atoms per molecule. The formation and the structure of self-assembled monolayers of 4-alkane-1,2-dithiolane with different alkane chain length and Phenyl-dithiol on gold were explored. We have characterized these SAMs by contact angle goniometry (CA), infrared reflection absorption spectroscopy (IRRAS), scanning tunneling microscopy (STM) and X-ray photoelectron spectroscopy (XPS). IR-spectra of the isolated dithiolanes have been calculated using DFT. Overall, the 4-alkane-1,2-dithiolanes form a less crystalline film than alkanethiols of comparable chain lengths. However, the STM results of the phenyl-dithiol support well ordered and densely packed chelating molecules on the gold surface.

SYSO 4: Self-Organizing Surfaces and Interfaces III

Time: Thursday 9:30–10:45

Location: GÖR 226

SYSO 4.1 Thu 9:30 GÖR 226

Self organisation in ultrathin PEO films — •HANS-GEORG BRAUN and EVELYN MEYER — Leibniz Institute of Polymer Research Dresden - Max Bergmann Center of Biomaterials, Dresden, Germany
Ultrathin Polyethyleneoxide films show a variety of morphological features that can be related to dewetting scenario as well as to crystallisation processes. Dewetting on microheterogeneous surfaces allows the preparation of metastable non crystalline domains. Nucleation of these films which grow as highly branched dendritic structures is triggered by surface defects, contact by AFM tip or dewetting structures such as rims. The observations obtained on patterned surfaces are compared to the complex morphological features which can be observed for thin PEO films on homogeneous surfaces.

SYSO 4.2 Thu 9:45 GÖR 226

Competition between adsorption and desorption regulates deposition of weak polyelectrolyte multilayers — •MARTIN MÜLLER, WUYE OUYANG, SEBASTIAN PAULIK, and BERND KESSLER — Leibniz-Institute of Polymer Research Dresden e.V.

This paper addresses growth, molecular composition and morphology of consecutively adsorbed polyelectrolyte (PEL) multilayers (PEM) of branched poly(ethyleneimine) (PEI)/poly(acrylic acid) (PAC). in-situ ATR-FTIR spectroscopy and SFM were used in this study.

At first, exponential growth and highest PEM deposition was obtained for the pH combination 10/4 (PEI/PAC), where both PELs are nearly neutral reacting by acid/base interactions. Secondly, significant modulation features of PEI and PAC amount in dependence of z were found by ATR-FTIR, from which a competition between PEL adsorption and desorption, whenever the oppositely charged PEL contacts the actual PEM, is concluded. Thirdly, the thickness of these PEM was sensitively dependent on the parameters adsorption time, pH, concentration (cPEL) and molecular weight, which directly influence the adsorption/desorption competition. As a consequence of that a deposition maximum for medium cPEL was obtained. Finally, interesting defined surface segregated nanostructures and roughnesses could be created in dependence of these parameters also reflecting the adsorption/desorption competition. Such self regulated nanostructured PEM films with graded thickness and roughness are interesting concerning attraction/repulsion of metal ions, drugs, proteins and cells for biomedical coating, sensor or separation applications.

SYSO 4.3 Thu 10:00 GÖR 226

Structural changes in thin block copolymer films during vapor treatment — •ZHENYU DI¹, CHRISTINE M. PAPADAKIS¹, DORTHE POSSELT², RUIPENG LI³, and DETLEF-M. SMILGIES³ — ¹TU München, Physikdepartment E13, Garching — ²Roskilde University, Denmark — ³Cornell University, USA

Vapor treatment is a powerful alternative to thermal annealing of block copolymer thin films. The processes going on during structural rearrangements are complex. Solvent not only swells the polymers, but also increases the chain mobility and reduces the effective Flory-Huggins interaction parameter between the blocks [1].

We have investigated a thin film of lamellar poly(styrene-*b*-butadiene) which was vapor treated with toluene, a good and non-

selective solvent [2] or with cyclohexane, a slightly selective solvent, both in saturated and in non-saturated vapor. Grazing-incidence small-angle x-ray scattering with a time resolution of a few sec enable us to follow the changes of the inner film structure in-situ. In all cases, an overshoot of the lamellar thickness and a subsequent decrease are observed which we attribute to non-equilibrium swelling and the tendency to more coiled block conformations in the solvent. Also, the transient state is characterized by improved long-range order. We assign this behavior to the interplay of the rapid increase in chain mobility and the (slower) decrease of the interaction parameter.

[1] J. Noolandi, K.-M. Hong, *Ferroelectrics* 1980, 30, 117

[2] C. M. Papadakis, Z. Di, D. Posselt, D.-M. Smilgies, *Langmuir* 2008, ASAP

SYSO 4.4 Thu 10:15 GÖR 226

GISAXS and AFM investigation of Cobalt sputtering onto a polymer template — •ADELINE BUFFET¹, GERD HERZOG^{1,2}, SEBASTIEN COUET¹, RAINER GEHRKE¹, RALF ROEHLISBERGER¹, ANDRE ROTHKIRCH¹, KAI SCHLAGE¹, WILFRIED WURTH², GUNAR KAUNE³, VOLKER KOERSTGENS³, ROBERT MEIER³, EZZELDIN METWALLI³, PETER MUELLER-BUSCHBAUM³, and STEPHAN V. ROTH¹ — ¹HASYLAB at DESY, Hamburg, Germany — ²Inst. f. Exp.Phys., Univ. Hamburg, Hamburg, Germany — ³TU Muenchen, Physik-Department Lehrstuhl E13, Garching, Germany

Polymeric nanocomposite materials are outstanding materials for basic research and technological applications such as optical coating, solar cell technology and magnetic recording. Comprehension of their growth process is mandatory to improve the tailoring of the material final properties. Stop-sputter [1] experiments (Cobalt (Co) onto a polystyrene nanoparticle spin coated Si substrate) were performed at the beamline BW4 of the DORIS III storage ring at HASYLAB (DESY, Hamburg). The growth process was investigated using grazing incidence small-angle X-ray scattering (GISAXS [2]). The surface topography of the sputtered samples was then investigated by atomic force microscopy (AFM). We present the GISAXS and AFM measurements, which highlight a two-step growth process. In the initial stages, Co grows on polystyrene colloids. Afterwards, a percolated Co layer is formed, which replicates the full substrate morphology. [1] A. Metwalli et al., *Langmuir* 24, 4265-4272 (2008) [2] P. Mueller-Buschbaum, *Anal. Bioanal. Chem.* 376, 3-10 (2003)

SYSO 4.5 Thu 10:30 GÖR 226

Sensitive Tethered Membranes — •MARCO WERNER^{1,2} and JENS-UWE SOMMER^{1,2} — ¹Leibniz Institute of Polymer Research Dresden, Germany — ²Technische Universität Dresden - Institute for Theoretical Physics

We study static and dynamical properties of tethered structures such as membranes and fractal polymer objects embedded in three-dimensional space using the Bond-Fluctuation-Model. Tethered structures can be distinguished by their internal connectivity characterized by their spectral dimension. For two-dimensional structures (perfect membranes) we can confirm the theory of excluded volume induced stiffness which leads to flat membranes on larger scales [Kantor and Kremer, 1993, *Phys. Rev. E*, 48(4):2490]. By contrast, for fractal ob-

jects such as Sierpinski gaskets we obtain crumpled structures with a fractal dimension in good agreement with mean-field arguments [Kantor et al., 1986, Phys. Rev. Lett., 57(7):791].

Furthermore, we have investigated tethered membranes where one side is grafted with linear chains under variation of grafting density, chain-length and solvent-quality. We demonstrate switching between

convex and concave spontaneous bending by changing the solvent quality of the linear chains. In athermal solvent, the crossover between spontaneous bended state and flat state of the decorated membrane is controlled by the overlap density of the chains indicating that the self-organized bending stiffness of the tethered membranes is of the order of kT .

SYSO 5: Self-Organizing Surfaces and Interfaces IV

Time: Thursday 11:00–12:30

Location: GÖR 226

SYSO 5.1 Thu 11:00 GÖR 226

Establishment and Maintenance of Compartment Boundaries in Growing Tissues — ●JONAS RANFT¹, REZA FARHADIFAR¹, KATHARINA LANDSBERG², THOMAS BITTIG¹, CHRISTIAN DAHMANN², and FRANK JÜLICHER¹ — ¹Max Planck Institute for the Physics of Complex Systems, Nöthnitzer Straße 38, 01187 Dresden, Germany — ²Max Planck Institute of Molecular Cell Biology and Genetics, Pfotenhauerstraße 108, 01307 Dresden, Germany

In many developing epithelia, which are essentially two-dimensional tissues, distinct cellular compartments emerge. Cells within a given compartment show a characteristic signature of gene expression. Boundaries between compartments are typically sharp and often straight. Furthermore, these boundaries are lineage boundaries, i.e., the progeny of a cell lies in the same compartment. Such compartment boundaries can be considered as interfaces in the tissue. We discuss the role of cell division and cell mechanics for the morphology of compartment boundaries between two cell populations. Using a vertex model which can describe cell packing geometries, we study the conditions which give rise to stable and straight compartment boundaries during growth. We find that increased cell boundary tension at the interface between two cell populations can prevent the mixing of cells and leads to sharp boundaries. In order to quantify the morphology of these interfaces, we study the scaling behavior of interface fluctuations. We quantitatively compare our simulation results with experimental observations of the anteroposterior compartment boundary in the developing wing of the fruit fly *Drosophila*.

SYSO 5.2 Thu 11:15 GÖR 226

DNA interaction with freestanding cationic lipid bilayers — ●CHRISTOPH HEROLD, EUGENE P. PETROV, and PETRA SCHWILLE — Biophysics, BIOTEC, TU Dresden, Tatzberg 47-51, 01307 Dresden

We study interaction of DNA molecules of different lengths ($\sim 10\text{--}50$ kbp) with freestanding (giant unilamellar vesicles) and supported cationic lipid bilayers. Upon adsorption on supported cationic bilayers DNA molecules behave as 2D random self-avoiding coils, in agreement with observations previously reported in the literature. A completely different picture is observed when DNA molecules adsorb on freestanding cationic bilayers: In this case, shortly after adsorption, the adsorbed DNA molecules collapse from the coil conformation (gyration radius of ca. $2\ \mu\text{m}$) into a globule with a size below the optical resolution limit (gyration radius of ca. $0.3\ \mu\text{m}$). The DNA globules stay attached to the bilayer and exhibit translational Brownian motion on the membrane with a diffusion coefficient of $\sim 0.6\ \mu\text{m}^2/\text{s}$ corresponding to the size of ~ 100 nm, in agreement with the dimensions expected for globules produced upon DNA condensation. We present results of a systematic study of this phenomenon as a function of the DNA fragment length and cationic lipid membrane composition using fluorescence video microscopy with single particle tracking, transmission electron microscopy, and atomic force microscopy.

SYSO 5.3 Thu 11:30 GÖR 226

Translational diffusion in lipid membranes with phase separation: A Monte Carlo study — JENS EHRIG, ●EUGENE P. PETROV, and PETRA SCHWILLE — Biophysics, BIOTEC, TU Dresden, Tatzberg 47-51, 01307 Dresden

The intriguing phenomenon of subdiffusion frequently observed in cell membranes in SPT, FCS, and FRAP experiments is usually ascribed to the presence of membrane heterogeneities with dimensions below the optical resolution limit. In order to understand how the submicrometer-scale phase separation in the cell membrane can affect the lipid diffusion and manifest itself experimentally, we carry out dynamic Monte Carlo simulations of a two-lipid membrane (DMPC/DSPC) with the size on the micrometer scale over time in-

tervals of order of a second. To be able to do that with reasonable computational efforts, we simplify the traditional lattice model of a membrane – coupled lipid chains on a triangular lattice – and represent the membrane as a square lattice of lipid molecules. By comparing our simulation results with differential scanning calorimetry data for DMPC/DSPC membranes, we demonstrate that, with a proper choice of the lipid interaction parameters, our model correctly reproduces the thermodynamic properties, as well as the phase diagram of the lipid mixture. For certain ranges of the membrane compositions and temperatures we find that the Brownian motion of lipid molecules shows strong deviations from the normal diffusion law. Possible effects of the dynamic phase separation in SPT, FCS, and FRET experiments will be discussed.

SYSO 5.4 Thu 11:45 GÖR 226

Min proteins make waves: Self-organization of bacterial cell division proteins in vitro — ●MARTIN LOOSE^{1,2}, ELISABETH FISCHER-FRIEDRICH³, CHRISTOPH HEROLD¹, KARSTEN KRUSE⁴, and PETRA SCHWILLE^{1,2} — ¹Biophysics, Biotec, TU Dresden, Dresden, Germany — ²Max-Planck-Institute for Molecular Cell Biology and Genetics, Dresden, Germany — ³Max-Planck-Institute for Physics of Complex Systems, Dresden, Germany — ⁴Theoretische Physik, Universität des Saarlandes, Saarbrücken, Germany.

In the bacterium *Escherichia coli*, the Min proteins oscillate between the cell poles to select the cell center as division site. This dynamic pattern has been proposed to arise by self-organization of these proteins, and several models have suggested a reaction-diffusion type mechanism. We found that the Min proteins spontaneously formed planar surface waves on a flat supported membrane in vitro. We developed TIRF based single-molecule imaging experiments that revealed the dynamics of individual proteins during wave propagation.

SYSO 5.5 Thu 12:00 GÖR 226

Lamella and Cylinder Morphologies in Confined Copolymer-Homopolymer Mixtures — ●KOSTAS DAOULAS and MARCUS MÜLLER — Institut für Theoretische Physik, Georg-August-Universität, Göttingen

The Self Consistent Field Theory (SCFT) is a powerful method for predicting the morphologies in dense, self-organizing, polymeric systems. Usually within SCFT the chain architecture is captured via a Gaussian chain model, while non-bonded interactions are considered within a Flory-Huggins approach under the assumption of total or finite incompressibility of the liquid. In the later case, the spatial density variations are commonly described within the Helfand's quadratic potential. Here we present an alternative approach, using a more elaborated representation of the non-bonded interactions in spirit of a third order virial expansion with respect to the densities of the system components. The approach allows the description of the coexistence of the polymer liquid with its vapor; an important issue when modeling thin polymer films and topographical properties (e.g. terrace formation) of the free polymer surface. The approach is illustrated considering thin films formed by blends of PEO-b-PS (polyethylene oxide, polystyrene) copolymers with PAA (polystyrene-co-acrylic acid) homopolymers. We discuss how the parameters of the model should be selected such that a specific polymeric system (here, the PEO-b-PS/PAA blends) is represented. The morphologies are studied as a function of the PAA molecular weight and concentration in the mixture, showing that they change from cylinders to lamellae upon increasing the PAA content.

SYSO 5.6 Thu 12:15 GÖR 226

Packing Frustration of bicontinuous and multicontinuous cubic Gyroid mesophases — ●GERD E. SCHRÖDER-TURK¹, KARSTEN

GROSSE-BRAUCKMANN², and STEPHEN T HYDE³ — ¹Theoretische Physik, Universität Erlangen-Nürnberg, Staudtstr. 7, D-91058 Erlangen — ²Fachbereich Mathematik, Technische Universität Darmstadt, Schlossgartenstr. 7, D-64289 Darmstadt — ³Applied Maths, Research School of Physical Sciences, Australian National University, 0200 ACT, Australia

For the self-assembly of copolymers and lipids into cubic bicontinuous triply-periodic interfaces, domain thickness variations relate to packing frustration and affect phase stability. Domain thickness variations can be analysed by a medial surface approach [1]. We study triply-periodic space-partitions with interfaces modelled by constant mean curvature (cmc) representations of three-coordinated srs networks. These include

the $Ia\bar{3}d$ double-Gyroid geometry found in AB diblock copolymers. We find that the volume fraction of the minority (network) component at which the $Ia\bar{3}d$ Gyroid is typically stable in AB diblocks ($\approx 38\%$) corresponds to the case where the relative domain thickness variations (or packing frustration) of minority and matrix component are approximately equal. We discuss multi-continuous geometries based on three or more entangled cmc srs-network domains with relatively low packing frustration, possibly relevant for novel lipid mesophases [2].

[1] G.E. Schröder, S.J. Ramsden, A.G. Christy, S.T. Hyde, Eur. Phys. J. B **35**, 551-564 (2003) [2] S.T. Hyde, G.E Schröder, Curr. Op. in Coll. and Interface Sc. **8**, 5-14 (2003)

SYSO 6: Self-Organizing Surfaces and Interfaces V

Time: Thursday 14:00–15:30

Location: GÖR 226

SYSO 6.1 Thu 14:00 GÖR 226

Morphometric Multi-scale Surface Science — ●STEPHEN WATSON — University of Glasgow

The characterization of self-assembled faceted surfaces is a central theoretical challenge in surface science, since the ensuing morphological statistics (morphometrics) impact applications in diverse areas. I'll discuss the morphometrics emerging from the attachment kinetics limited coarsening of a thermodynamically unstable crystalline surface. One commonly used model is a dissipative ("steepest descent") singularly perturbed fourth-order partial differential equation. We first show that its singular limit is naturally characterized through the asymptotic expansion of an Onsager-Raleigh-type Principle of Maximal Dissipation (PMD) [1]. The resulting limiting faceted surface is then characterized by an intrinsic dynamical system. The properties of the resulting Piecewise-Affine Dynamic Surface (PADS) predict the scaling law for the growth in time of a characteristic morphological length scale. We then introduce a novel computational geometry tool which directly simulates the coarsening dynamics of million-facet PADS. We conclude by presenting data consistent with the dynamic scaling hypothesis, and report a variety of associated morphometric scaling-functions.

[1] S.J. Watson & S.A. Norris, Scaling theory and morphometrics for a coarsening multiscale surface, via a principle of maximal dissipation, Physical Review Letters 96(17), Art. No. 176103 (2006).

SYSO 6.2 Thu 14:15 GÖR 226

Anti-coarsening and complex dynamics of step bunches on vicinal surfaces — ●MARIAN IVANOV¹, VLADISLAV POPKOV², and JOACHIM KRUG¹ — ¹Institut für Theoretische Physik, Universität zu Köln, Zùlpicher Str.77, 50937 Köln, Germany — ²Dipartimento di Fisica Teorica "E. R. Caianiello", Università degli Studi di Salerno, Via Ponte Don Melillo, 84084 Fisciano (SA), Italy

Using morphological instabilities one can produce templates for nanoscale technology. One example of such an instability is step bunching, which splits a regular vicinal surface into regions of low and high density of monoatomic steps. The dynamics of the surface is described by the Burton-Cabrera-Frank model with boundary conditions provided by mass conservation at the steps. We consider a one-dimensional step train evolving in the presence of sublimation, electromigration, step-step interactions and an Ehrlich-Schwoebel effect. We show that the interplay of sublimation and step-step interactions removes the conservation law for the crystal volume in the co-moving frame, which has been assumed in previous work [1,2]. As a consequence large step bunches are found to break up into smaller bunches of a characteristic size, and the monotonic coarsening dynamics of the volume-conserving model is replaced by a complex quasiperiodic pattern. A preliminary dynamic phase diagram summarizing the different behaviors as a function of the model parameters will be presented.

[1] V. Popkov, J. Krug, Europhys. Lett. **72**, 1025 (2005), [2] V. Popkov, J. Krug, Phys. Rev. B **73**, 235430 (2006)

SYSO 6.3 Thu 14:30 GÖR 226

Self-assembled growth of magnetic antidot arrays — ●KAI SCHLAGE¹, SEBASTIEN COUET¹, STEPHAN V. ROTH¹, ULLA VAINIO¹, MOTTAKIN ABUL KASHEM², PETER MÜLLER-BUSCHBAUM², RUDOLF RÜFFER³, and RALF RÖHLSBERGER¹ — ¹HASYLAB at DESY, Notkestr. 85, D-22607 Hamburg, Germany — ²TU München, Physik-Department, Lehrstuhl E13, James-Frank-Str. 1, D-85747 Garching,

Germany — ³ESRF, BP 220, 38043 Grenoble, France

The self-assembled growth of magnetic nanostructures onto highly ordered (polymer) templates offers an elegant way to create magnetic nanostructures with a small variation in size and hence with well defined magnetic properties. Unfortunately, experimental methods are rare which allow to correlate the growth dynamics of the self-assembled nanostructures in-situ with its chemical and magnetic properties. In this contribution we present for the first time a combined grazing incidence small angle scattering (GISAXS) and nuclear forward scattering (NFS) study which offers the structural, chemical and magnetic sensitivity during such an in-situ deposition experiment. Iron is sputter deposited onto a diblock copolymer template which exhibits a surface morphology consisting of an ordered array of deep holes to create a magnetic antidot array. The experimental techniques combined here reveal the process of self-assembly of the deposited iron atoms with highest resolution in space, their chemical interaction with the polymer template (formation of oxide) and a remarkable onset of magnetic ordering compared to the growth of compact magnetic iron thin films.

SYSO 6.4 Thu 14:45 GÖR 226

STM investigations on Cyclopentene terminated GaAs(001)-surfaces — ●M. EWALD^{1,2}, R. PASSMANN^{1,2}, T. BRUHN^{1,2}, B.O. FIMLAND³, M. KNESSL¹, N. ESSER^{1,2}, and P. VOGT¹ — ¹TU Berlin, Institut f. Festkoerperphysik, Hardenbergstr.36, 10623 Berlin, Germany — ²ISAS Berlin, Albert-Einstein-Str.9, 12489 Berlin, Germany — ³NUST, NO-7491 Trondheim, Norway

The functionalisation of semiconductor surfaces with organic molecules is crucial for the development of new devices. Particularly in biosensoric and medical applications exists a wide field of applications. The first aim of our investigation was, to analyse the binding configuration and binding structure of small cycloalkenes, like cyclopentene, and their influence on the different GaAs(001) surface reconstructions. It was possible to develop a first structure model for the binding of cyclopentene on the GaAs(001) c(4x4) and (2x4) surface. Our STM measurements show, that the atomic structure of the GaAs surface influences the arrangement of the cyclopentene molecules. While cyclopentene molecules on the c(4x4) reconstruction show no long range order, the molecules on the (2x4) surface arrange on top of the dimer rows along the [110] direction. The different interface arrangements for the adsorption of cyclopentene on GaAs c(4x4) and (2x4) can be explained by the suggested structure models. Furthermore, in the case of cyclopentene on GaAs(001) c(4x4) surface, there is a local order that can be attributed to the binding of three molecules to one unit cell.

SYSO 6.5 Thu 15:00 GÖR 226

DFT-study of Pt induced Nanowires on Ge(001) — ●DANNY VANPOUCKE and GEERT BROCKS — University of Twente, Enschede, The Netherlands

The deposition of Pt on a Ge(001) surface gives rise to the spontaneous formation of nanowire (NW) arrays. These one atom thick NWs are defect and kink free with a length only limited by the underlying β -terrace. We present an *ab-initio* density functional theory (DFT) study of the underlying β -terrace and the NWs. For over 100 geometries the total energies were calculated and a comparison was made between their simulated scanning tunneling microscope (STM) images and the experimental STM images of this system. From this we identified the

geometry of the β -terrace and present a formation path for the NWs as function of increasing local Pt density. Our results show the β -terrace has a structure similar to the clean Ge(001) surface, but with one in four Ge surface atoms replaced by a Pt atom giving rise to a checkerboard pattern of Pt-Ge and Ge-Ge surface dimers. Furthermore we show that solitary NWs have a slightly different structure than NWs in NW arrays, and connect the difference in geometry to the difference in observed experimental STM images. Most remarkably, we show by direct comparison to experimental STM images that the experimentally observed "platinum" NWs[1], in fact, consist of *germanium* atoms located in Pt lined troughs[2].

[1] O. Gurlu et al., Appl. Phys. Lett. 83, 4610 (2003)

[2] D. E. P. Vanpoucke and G. Brocks, Phys. Rev. B 77, 241308(R) (2008)

SYSO 6.6 Thu 15:15 GÖR 226

Fabrication of Functional Hybrid Nanostructured Materials Based on Self-Assembled Dendrimers Templating Metallic Nanoparticles — ●AMIR FAHMI, TORSTEN PIETSCH, and NABIL GINDY — Department of Mechanical, Materials and Manufacturing Engineering, Faculty of Engineering, University of Nottingham, UK

Dendrimer-stabilized nanoparticles are promising candidates for the application of functional nanoparticles in bio- and physiological environments. Herein, different types of dendrimers are used to template colloidal nanoparticles, e.g. metals or semiconductors, in aqueous medium at room temperature. The dendrimers acts as a nano-reactor and simultaneously serves as effective reducing- and stabilizing agent. Due to their unique molecular architecture and monodispersity in terms of molecular weight, dendrimers provide excellent control over the particle size and size distribution. Indeed, significantly contribute to direct the structures formation in thin film. Our results indicate that depending on the types and generation of the dendrimers a variety of hybrid nanostructured materials are fabricated. It was also found that the nanoparticles growing within the dendritic matrix is governed by different templating mechanism. One of the main characteristics is their ability to guide the optical properties as a function of the nanoparticle size and their surface composition. The morphology and optical properties of dendrimer-stabilized metal- and semiconductor nanoparticles are investigated with respect to the dendrimer's generation for a variety of applications such as nanoelectronics, bio-molecular technology and catalysis.

SYSO 7: Self-Organizing Surfaces and Interfaces VI

Time: Thursday 15:45–17:00

Location: GÖR 226

SYSO 7.1 Thu 15:45 GÖR 226

Modulation of the free surface of smectic liquid crystals by focal conic domains — ●CHRISTIAN BAHR, WEI GUO, and STEPHAN HERMINGHAUS — MPI for Dynamics and Self-Organization, Bunsenstr. 10, D-37073 Göttingen

If μ -thick films of smectic liquid crystals (LCs) on a solid substrate are subjected to antagonistic molecular anchoring conditions at the film/air and film/substrate interfaces, focal conic domains (FCDs) are generated in which the smectic layers are wrapped around two singular lines (a circle on the substrate surface and a straight line running from the circle center to the air interface).

FCDs often self-organize in regular two-dimensional arrays. They provide the LC film with a superstructure made up by a regular arrangement of defect lines and curved layers, and result in a deformation or modulation of the film/air interface: The curved arrangement of the smectic layers leads to a depression in the film/air interface above each FCD. The depth of these depressions amounts usually to a value between 50 nm and 2 μ m and can be measured by AFM [1,2].

We report studies of several different LC/substrate systems and show, how the size and arrangement of FCDs—and thus the shape of the LC/air interface—can be controlled via the anchoring conditions on the substrate and the type of the smectic LC phase.

[1] V. Designolle, S. Herminghaus, T. Pfohl, and Ch. Bahr, Langmuir 22, 363 (2006).

[2] W. Guo, S. Herminghaus, and Ch. Bahr, Langmuir 24, 8174 (2008).

SYSO 7.2 Thu 16:00 GÖR 226

Depinning of three-dimensional drops from wettability defects — ●PHILIPPE BELTRAME¹, PETER HÄNGGI¹, and UWE THIELE² — ¹Institut für Physik, Universität Augsburg, D-86135 Augsburg, Germany — ²Department of Mathematical Sciences, Loughborough University, Loughborough, Leicestershire, LE11 3TU, UK

Substrate defects crucially influence the onset of sliding drop motion under lateral driving. A finite force is necessary to overcome the pinning influence even of microscale heterogeneities [1]. The depinning dynamics of three-dimensional drops is studied for hydrophilic and hydrophobic wettability defects using a long-wave evolution equation for the film thickness profile. It is found that the nature of the depinning transition explains the experimentally observed stick-slip motion [2].

[1] Thiele and Knobloch, New J. of Phys. 8 (2006) 313

[2] Beltrame, Hänggi and Thiele, submitted to EPL, (2008), arXiv:0811.2918v1

SYSO 7.3 Thu 16:15 GÖR 226

The dynamics of reaction fronts under different level of gravitational acceleration — ●KERSTIN ECKERT¹, ARMIN HEINZE¹, LAURENCE RONGY², ANNE DE WIT², and STEFAN ODENBACH¹ — ¹Institute for Fluid Dynamics, Chair of Magnetofluidynamics, Technische Uni-

versität Dresden, D-01062 Dresden — ²Nonlinear Physical Chemistry Unit, CP 231, Faculté des Sciences, Université Libre de Bruxelles, 1050 Bruxelles, Belgium

When two separate solutions of chemicals A and B, reacting according to the simple kinetic scheme A+B gives C, are brought into contact, the reaction takes place in a localized region, the reaction front. The propagation of such fronts was studied intensively in the past (e.g. Gálfí and Rácz, Phys. Rev. E 38, 3151, 1988) due to their relevance for biological or other physical systems, too. It was indicated recently (Shi & Eckert, Chem. Eng. Sci. 61, 5523, 2006 and Rongy et al. Phys. Rev. Lett. 101, 084503, 2008) that the propagation of these fronts is affected by gravity which leads to a faster motion as predicted by Gálfí and Rácz. We present an experimental study of an immiscible solvent combination placed in horizontal Hele-Shaw cell. A, B and C refer here to acid, base and salt, respectively. We analyse the dynamics of the resulting neutralization front by means of shadowgraph visualization and differential interferometry. The detailed comparison of ground-based and microgravity experiments strongly supports the idea that the reaction front propagation is caused by the interaction between reaction and diffusion with a pair of buoyancy-driven roll cells.

SYSO 7.4 Thu 16:30 GÖR 226

STM bias dependent imaging of molecular double layer — ●CHRISTIAN SEIFERT¹, NIKOLAI SEVERIN¹, DARIA SKURIDINA¹, XI DOU², KLAUS MÜLLEN² und JÜRGEN P. RABE¹ — ¹Department of Physics, Humboldt University Berlin, 12489 Berlin — ²Max-Planck-Institute for Polymer Research, 55128 Mainz

While Aviram and Ratner had proposed a molecular rectifier based on tunneling through donor and acceptor moieties linked by a spacer, it has been argued later that rectification may be also achieved with a single physisorbed donor or acceptor molecule located asymmetrically between two electrodes. The latter was attributed to the dependence of the potential at the position of the molecular orbitals in the tunneling gap on their relative position within the gap. However, it has been also claimed that the potential of a molecular adsorbate is not dependent on the tip-sample distance but rather equal to the substrate potential. Here we report in-situ scanning tunneling microscopy bias dependent imaging of bilayers of conjugated molecules self-assembled at the interface between an organic solution and the basal plane of graphite. The imaging revealed a dependence of the layers visibility on the applied bias as predicted by the model, which confirms that the electron potential drops gradually across the molecular adsorbate. The results indicate that resonance enhanced tunneling through physisorbed molecules between two biased metallic electrodes depends sensitively on the gap width and the relative position of the electronic orbitals within the gap, thereby providing a means to precisely control current-voltage characteristics through the geometry of the gap.

SYSO 7.5 Thu 16:45 GÖR 226

Structure Formation Kinetics in Evaporating Droplets of Diblock-Copolymer Solutions — •SILKE RATHGEBER^{1,2}, DIOGO BASTOS DE TOLEDO¹, ANDREAS TIMMANN³, and STEPHAN ROTH³ — ¹Max Planck-Institute for Polymer Research, 55128 Mainz, Germany. — ²Johannes Gutenberg-University, 55099 Mainz, Germany. — ³HASYLAB at DESY, 22603 Hamburg, Germany.

We followed the structure formation kinetics in droplets of diblock-copolymer solutions during the evaporation process using grazing incidence small-angle x-ray scattering. Aim of our investigation was to get insight which impact the confining interfaces, film-air and film-substrate, have on the structure formation in the droplets during the

later stages of the evaporation process. As model system we have chosen poly(styrene)-b-poly(isoprene) (PS-PI) diblock-copolymers solved in anisole, a low-vapor-pressure solvent with sufficient slow evaporation rate. We investigated symmetric as well as asymmetric PS-PI diblock copolymers which form lamellar and hexagonal bulk phases. The particular setup of our experiment allowed us to follow the structural changes occurring at the film-air interface as well as close to the substrate-film interface simultaneously. Ordering starts at the substrate. Skin layer formation at the film-air interface is not observed. The talk will discuss the drying scenarios in detail. This includes the appearance of interface mediated structures.