

CPP 20: POSTER: Biological Systems + New Materials

Time: Wednesday 16:00–18:30

Location: Poster B

CPP 20.1 Wed 16:00 Poster B

High Frequency Quartz Crystal Microbalance Flow Cell with Enhanced Accuracy for Liquid and Biochemical Sensing —

•PAULA SAGMEISTER, INGRID GRAZ, and REINHARD SCHWÖDIAUER — Soft Matter Physics, J. Kepler Universität, Altenbergerstraße 69, 4040 Linz, Österreich

Throughout the last twenty years, acoustic wave sensors have been proven as extremely sensitive and accurate devices for a wide variety of physical, chemical and biochemical sensing applications. Systems based on thickness shear mode (TSM) quartz resonators, working in a liquid environment with resonance frequencies between 5 and 15 MHz, are already established (and commercially available) for real-time measurements of biochemical interactions. The utilisation of high frequency fundamental (HFF) quartz resonators, with resonance frequencies up to 150 MHz (and beyond), could further improve the sensitivity of such systems by orders of magnitude. We present a fully biocompatible flow cell, designed for HFF quartz resonators which, in spite of their small size, can be removed and exchanged quickly and with ease. The system performance is evaluated and quantified by a number of experiments including various viscosity measurement of diluted sugar solutions, the detection of a bovine serum albumin (BSA) monolayer and other biochemical reactions. We further address some specific problems especially related to reusability and cleaning procedures.

CPP 20.2 Wed 16:00 Poster B

Kinetics, intermediates, and mechanisms of the aggregation of amyloid protein systems —•GUDRUN LOTZE¹, ANDREAS BÖGEHOLD², BERND ABEL², and HAUKE SCHOLLMMEYER¹ — ¹Georg-August Universität Göttingen, Institut für Röntgenphysik, Friedrich-Hund-Platz 1, 37077 Göttingen — ²Georg-August Universität Göttingen, Institut für Physikalische Chemie, Tammannstraße 6, 37077 Göttingen

Neurodegenerative diseases such as Alzheimer's, Parkinson's and the transmissible spongiform encephalopathies are characterized by abnormal protein aggregates, often in form of highly symmetric amyloid fibrils. Amyloid fibrils are polypeptide aggregates in which the polypeptide backbone is arranged in a specific cross- β sheet quaternary structure. However, the molecular mechanisms and timescales of the formation of intermediates and fibrils are still not fully understood and currently subject of intense research.

Insulin is a well suited model system to analyze the kinetics of fibril formation. We use x-ray scattering and transmission x-ray microscopy to investigate different states (intermediates and fully grown fibrils) of molecular structure and topology of the model system insulin.

CPP 20.3 Wed 16:00 Poster B

Protein Dynamics in the Light of Single-Molecule Spectroscopy —•JÜRGEN BAIER¹, MARTIN RICHTER¹, SILKE OELLERICH¹, RICHARD COGDELL², and JÜRGEN KÖHLER¹ — ¹Experimental Physics IV and BIMF, University of Bayreuth — ²Division of Biochemistry and Molecular Biology, University of Glasgow, United Kingdom

Proteins are supramolecular machines that perform a variety of tasks in living organisms. However, a protein is not a rigid structure and due to the relatively weak interactions that stabilise its 3-dimensional structure the lowest energy state of a protein is not unique. The potential energy hypersurface features a multitude of barriers and is commonly described by a rugged energy landscape where each minimum represents a different conformational substate. Since conformational fluctuations of the protein are equivalent to rearrangements of its atoms, chromophores embedded in the protein experience those changes as fluctuations in the local interactions. As a consequence the pigments react on conformational changes of the protein with changes of their electronic transition energies. Here we focus on the B800 BChl *a* molecules of the peripheral light-harvesting complex (LH2) from photosynthetic purple bacteria as local probes to study the conformational dynamics. We have recorded long sequences of fluorescence-excitation spectra from individual LH2 complexes and performed a statistical analysis of the spectral fluctuations of the B800 absorptions. The results are compared with predictions of the standard TLS model for spectral diffusion in glasses. We find a fundamental difference between the relaxation behaviour of our test protein and glasses.

CPP 20.4 Wed 16:00 Poster B

The electronic structure of core complexes from *Rps. palustris* —•THOMAS PREM¹, MARTIN RICHTER¹, JÜRGEN BAIER¹, SILKE OELLERICH¹, FRANCESCO FRANCIA^{2,3}, GIOVANNI VENTUROLI², DIETER OESTERHELT³, JUNE SOUTHALL⁴, RICHARD COGDELL⁴, and JÜRGEN KÖHLER¹ — ¹Experimental Physics IV and BIMF, University of Bayreuth — ²Department of Biology, University of Bologna and INFN, Italy — ³Department for Membrane Biochemistry, MPI for Biochemistry, Martinsried — ⁴Division of Biochemistry and Molecular Biology, University of Glasgow, United Kingdom

The primary reactions of purple bacterial photosynthesis occur within two pigment-protein complexes, the core RC-LH1 complex and the peripheral LH2 complexes. In the RC the reduction of a ubiquinone (UQ) to ubiquinol (UQH₂) takes place. In order to make contact with the cytochrome b/c1 complex as part of the cyclic electron pathway, the UQH₂ has to leave the RC. Hence, either the LH1 ring is not complete, i.e. there is a gap, or the LH1 structure is inherently flexible enough to allow UQH₂ to diffuse through it. A recent rather low resolution X-ray crystal structure of the RC-LH1 core complex from *Rps. palustris* showed the presence of a gap in the LH1 ring. This presence, though functionally critical, has become very controversial. We recorded single-molecule fluorescence-excitation spectra for individual RC-LH1 complexes of *Rps. palustris* and describe how the presence of a narrow spectral feature at the low-energy end of the spectrum unequivocally establishes the presence of a gap in the electronic structure consistent with the presence of the physical gap.

CPP 20.5 Wed 16:00 Poster B

Adhesion and wetting: from monolayer to capillary bridges

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Nanomechanical AFM measurements of adhesion forces revealed a strong dependence on humidity for Geckos spatula on various hydrophobic substrates [G. Huber et al, PNAS 102, 16293 (2005)]. Whereas capillary condensed water bridges are unlikely to form between hydrophobic substrates, adsorbed particles may build molecular bridges which seems to be sufficient to explain the increase of adhesion with humidity - even at sub-monolayer coverage. Adsorption isotherms as well as adhesion forces changes qualitatively at the crossover from nanometer thickness of liquid films to monolayers where the details of the substrate potential are relevant. Most density functionals use a hard sphere fluid as a reference system for an expansion of the attractive dispersion forces and model substrates by plane walls. However, close to a solid substrate the entropy of a fluid is dominated by the occupation probability of discrete adsorption sites formed by the corrugated substrate surface. We propose a density functional which captures accurately the monolayer adsorption properties but covers also the growth of mesoscopic films and capillary condensation at hydrophilic conditions. We discuss the dependence of wetting and adhesion on humidity and substrate strength, in particular at the crossover from single particle to capillary condensed bridges.

CPP 20.6 Wed 16:00 Poster B

Biological Calcium Carbonate Precipitation —

•SIGRID HENNING, CHRISTIAN SOOR, SABINE HILD, and ANDREAS ZIEGLER — Central Facility for Electron Microscopy; University of Ulm, Albert-Einstein-Allee 11, 89069 Ulm

Biomaterials have unique structures and morphologies, which acquire much better performance than geological minerals. Calcium carbonate is the most common mineral found in living organisms occurring as calcite, aragonite, and, to a lesser extent, vaterite and hydroxy calcite. Interestingly many organisms form amorphous calcium carbonate (ACC) that would be unstable in-vitro. ACC is thought to be a precursor phase for crystalline modifications and, because of its high solubility, occurs in transient calcium carbonate reservoirs. The terrestrial crustacean Porcellio scaber develops large ACC reservoirs that are used for the mineralization of the new cuticle synthesized before the old cuticle is shed in a process called moulting. In order to investigate the formation and stabilization of biogenic ACC under physiological conditions we analysed the cation composition in the region of ACC formation, isolated the proteins of the organic matrix

and tested their effects on mineral precipitation. We show that under these conditions the physiological Mg concentration (13 mM, Ca:Mg about 1:1) has a large effect on crystal morphology. Matrix proteins prevent crystal precipitation and lead to formation of 50 nm large colloidal particles. Depending on matrix concentration these particles are arranged in hollow sphere super structures resembling ACC spherules in *P. scaber* during natural degradation.

CPP 20.7 Wed 16:00 Poster B

Stimuli-responsive networks containing superparamagnetic nano-particles — XUENA ZOU¹, ●SILKE RATHGEBER¹, and PATRICK THEATO² — ¹Max-Planck Institute for Polymer Research, Polymer Physics, D-55128 Mainz — ²Johannes Gutenberg-University, Institute of Organic Chemistry, D-55099 Mainz

We report the synthesis and characterization of poly(N-isopropylacrylamide) (PNiPAM) hydrogels containing superparamagnetic nano-particles which are i.a. chemically bonded to the network. Changing magnetization by swelling (humidity), pH, temperature and stress will lead to new stable stimuli-responsive materials for sensor applications but also to materials which show, in response to an external magnetic field gradient, actuatoric properties. The synthesis of the PNiPAM gel is performed via a reactive poly(pentafluorophenylacrylate) (PPFPA) precursor gel. The advantage of the presented synthesis lies in the fact that the properties, e.g. the lower critical solution temperature, of the final hydrogels can be tuned by the degree of conversion from PPFPA to PNiPAM and/or incorporation of various functional groups, e.g. pH-dependent groups. Beside standard physicochemical characterization methods we report results from cryo-transmission electron microscopy to characterize the magnetic nano-particles and their distribution in the gels. Magnetic properties of the magnetic nano-particles and the loaded hydrogels were studied using a superconducting quantum interference device. The density of the magnetic nano-particles in the hydrogels was calculated according to the response of the gels to the external field.

CPP 20.8 Wed 16:00 Poster B

Thin polymer blend films of conducting homopolymers — ●M. RUDERER, J.-F. MOULIN, and P. MÜLLER-BUSCHBAUM — TU München, Physik-Department E13, James-Franck-Str. 1, D-85747 Garching, Germany

Two conduction homopolymers, MEH-PPV Poly(1-methoxy-4-(2-ethylhexyloxy)-p-phenylenevinylene) and P3BT (poly(3-butylthiophene-2,5-diyl)), are blended with different ratios. Thin films are prepared via spin-coating on glass slides. The resulting surface structures are characterized by optical microscopy and atomic force microscopy (AFM). With optical spectroscopy (UV/Vis) in reflection and transmission geometry the absorbed part of the optical spectrum is detected. The resulting parameters are correlated with the bulk phase diagram of the components.

CPP 20.9 Wed 16:00 Poster B

Azo-dye/ polymer composite - a novel class of materials for optical coatings — SVEN MACKO, ●RAFAEL MEINHARDT, ANSGAR DRAUDE, and HILMAR FRANKE — Department of applied physics, university of Duisburg-Essen, Lotharstr.1, 47057 Duisburg, Germany

Polymer films of dipolar and nondipolar materials with a thickness up to 1-2 microns have been prepared on glass substrates. Vapor deposition of azo-dyes (< 500 nm) and subsequent annealing leads to composite layers which are different from usual solution prepared guest-host systems. These composite layers can be prepared with high dye concentrations. Absorption spectra and metal film enhanced leaky mode spectroscopy have been applied prior and after the deposition of the dye layers. A strong interdiffusion has been observed. The obtained composite material is quite different from the well known guest-host systems.

Regarding their optical properties the composites behave more like organic glasses than guest-host systems. In comparison with the pure polycrystalline layers the scattering can be reduced with the composites and smooth surfaces may be obtained. Stable and efficient holographic gratings could be recorded in these layers.

CPP 20.10 Wed 16:00 Poster B

Structure of polymer coatings established for advanced quantum efficiency of photomultiplier tubes — ●V. KÖRSTGENS¹, C.-C. HSU², D. PANEQUE³, E. LORENZ², and P. MÜLLER-BUSCHBAUM¹ — ¹TU München, Physikdepartment E13, James-Franck-Str. 1, D-85748

Garching — ²Max-Planck-Institut für Physik, Föhringer Ring 6, D-80508 München — ³Stanford Linear Accelerator Center, Menlo Park, CA

Coatings consisting of a polyacrylate and para-terphenyl as wavelength shifter are established from solutions in chlorinated organic solvents via a spin-coating process. The coatings are milky in appearance and the coated photomultiplier tubes show an advanced quantum efficiency. Preparation conditions were varied with controlled humidity and the exposition of the sample to a flow of humid nitrogen while spin-coating and evaporation of the solvent. Optical microscopy revealed structures originated from crystallization of para-terphenyl and a superposed porous structure of the polymer matrix. Surface structures established on flat substrates under same conditions were also investigated by atomic force microscopy (AFM). The origin of the obtained structures is discussed in context to well-known structures referred to as breath figures. The relation between the surface structures of the polymer coating and the observed advanced quantum efficiency of photomultiplier tubes is addressed.

CPP 20.11 Wed 16:00 Poster B

IR to VIS ellipsometric studies of self assembled monolayers on metal and metal oxide surfaces — P. ANGELOVA¹, ●K. HINRICH², E. JÄHNE³, M. GNAUCK³, K.-J. EICHHORN⁴, K. KOSTOVA¹, and D. TSANKOV^{1,2} — ¹Institute of Organic Chemistry, Bulgarian Academy of Sciences, 1113 Sofia, Bulgaria — ²ISAS, Institute for Analytical Sciences, Department Berlin, 12489 Berlin, Germany — ³Institute of Macromolecular Chemistry, Dresden University of Technology, 01062 Dresden — ⁴Institute of Polymer Research, 01062 Dresden, Germany

Self assembled monolayers (SAM) were formed from terminally aryl-functionalized alkanethiols on Ag and Au surfaces and from long-chain alkylphosphonic acids and alkylphosphoric acid esters on aluminium oxide. The thiol compounds were synthesized from para-substituted benzyl esters of 16-mercaptohexadecanoic acid containing Cl, NO₂, CN and OCH₃ as substituents. The monolayers were characterized by IR and VIS ellipsometry, X-ray photoelectron spectroscopy and contact angle measurements. The different properties of the end groups affected the organizational order within the monolayer yielding different degree of orientation and tilt angles. For the bidentate or tridentate chemisorbed monolayers on the aluminum oxide surface formed from alkylphosphonic acid and alkylphosphoric acid ester a high degree of conformational order is found.

CPP 20.12 Wed 16:00 Poster B

Rigid amorphous fraction in polymer nano-composites — ●ALBERT SARGSYAN^{1,2}, ANAHIT TONAYAN², SEVAN DAVTYAN², and CHRISTOPH SCHICK¹ — ¹Institute of Physics, University of Rostock, Germany — ²State Engineering University of Armenia, Yerevan, Armenia

It is frequently reported that semicrystalline polymers show significantly smaller relaxation strength at glass transition than expected from the non-crystalline fraction. This observation could be explained by the introduction of a rigid amorphous fraction (RAF) which contributes neither to the heat of fusion or X-ray crystallinity nor to the relaxation strength at glass transition, see [1] for a review. The RAF is assumed to be in a glassy state above the common glass transition temperature. From heat capacity the temperature and time dependence of the RAF can be obtained. Polymer nano-composites can be used as such a model structure if they exhibit a RAF. If the polymer nano-particle interaction is strong enough there may be a significant RAF because of the large surface area of the nano-particles. The main advantage lies in the fact that the part causing the immobilization of the polymer molecules, i.e. the nano-additive, does not melt or crystallize in the relevant temperature range. So the essential disturbing factor for a direct observation of the devitrification is excluded. This may allow determining the devitrification of the RAF in polymer nano-composites by using calorimetric methods. The most recent data on this work is presented

CPP 20.13 Wed 16:00 Poster B

Nanoconfinement - A new strategy to manipulate the crystalline state of pharmaceuticals — ●G.T. RENGARAJAN, S. PANKAJ, D. ENKE, and M. BEINER — Martin-Luther-Universität Halle-Wittenberg, Naturwissenschaftliche Fakultät II, D-06099 Halle (Saale), Germany

The manipulation of the crystalline state of substances existing in dif-

ferent polymorphic forms is an important issue in many fields of application. In case of pharmaceuticals the stabilization of unstable forms is interesting since solubility and bioavailability are usually improved. We will show that it is possible to manipulate the crystallization behavior of pharmaceuticals and to stabilize unstable crystalline forms by confining the substance in pores with diameters in the range 20–400 nanometers [G.T. Rengarajan et al., *J. Am. Chem. Soc.*, to be published.]. The crystallization behavior of a pharmaceutical model system in two different types of nanostructured inorganic host systems is studied by DSC and x-ray scattering. The results clearly show that the most unstable crystalline form of this pharmaceutical melts and is stable for long times under confinement which was never observed for bulk samples. This allows to extract the thermodynamic parameters of this crystalline form which have not been reported so far and shows that this is an interesting field of application for nanostructured host-guest systems. The influences of pore geometry and surface interaction are studied and possible explanations for the differences between the crystallization behavior in the bulk and under confinement are discussed.

CPP 20.14 Wed 16:00 Poster B

Towards multifunctional composites: preparation and characterization of polymer-dispersed liquid crystals — ●LAKSHMI MEENA GANESAN, AXEL MELLINGER, MICHAEL WEGENER, WERNER WIRGES, and REIMUND GERHARD — Universität Potsdam, Institut für Physik, 14469 Potsdam, Germany

Micrometer-sized liquid-crystal droplets embedded in a polymer matrix induce optical switching behavior in the composite film through the alignment of the director along an external electric field. When a ferroelectric polymer is used as matrix material, the electric field generated by the piezo- or pyro-electric effect of the matrix material could potentially be used to switch the director of the LC. Employing a solvent-induced phase separation (SIPS) method, polymer-dispersed liquid crystal (PDLC) films were prepared from poly(vinylidene fluoride - trifluoroethylene) and a nematic liquid crystal. The films were sandwiched between two glass plates coated with transparent indium tin oxide (ITO) electrodes, and the field-dependent optical transmission of the charged PDLC films was measured. The phase-transition behavior of the liquid crystal was studied by means of infrared spectroscopy.

CPP 20.15 Wed 16:00 Poster B

Optimization of Alginate-Based Isocapillary Matrices for their Application in Biomedicine — ●MATTHIAS KELLERMEIER, RAINER MÜLLER, and WERNER KUNZ — Institut für Physikalische und Theoretische Chemie, Universität Regensburg, 93040 Regensburg

Unidirectional diffusion of divalent cations such as Cu^{2+} or Ca^{2+} into sols of sodium alginate provokes the formation of a hydrogel pervaded by capillaries which are aligned parallel to the direction of the cation flow showing hexagonal arrangement in cross-section. Gelation occurs due to the complexation and dehydration of the polysaccharide chains by the cations, leading to the release of water into the free lumen of the forming capillaries and the fixation of the polymer in the walls around them. Typical pore diameters vary in the range of 5–100 μm . The formation of highly ordered capillaries in alginate gels can be interpreted as a dissipative process similar to Rayleigh-Bénard convection, resulting from opposing diffusion gradients and friction. With respect to biomedical applications, these isocapillary gels can be modified either by incorporating inorganic particles into the gel matrix followed by densification and ceramization, or by stabilization of the alginate framework via covalent cross-linking of the chains, resulting in scaffolds useable as bone implants and for the regeneration of nerves. The aim of the present study is to optimize the pore structure of alginate gels in view of these applications. We focus on the effect of a series of additives in the sol, such as salts, sugars and surfactants. Furthermore, we have studied the variability of the pore structure of alginate gels by employing both different cations and counter-ions.

CPP 20.16 Wed 16:00 Poster B

In-situ measurement of the inverse piezoelectric coefficient in ferroelectrets — ●XUNLIN QIU, AXEL MELLINGER, MICHAEL WEGENER, WERNER WIRGES, GUGGI KOFOD, and REIMUND GERHARD — Universität Potsdam, Institut für Physik, 14469 Potsdam, Germany

A number of cellular polymer-ferroelectret materials were discovered to exhibit a strong piezoelectric response after proper charging [1]. The effective polarization (i.e., the density of macroscopic dipoles) in ferroelectrets originates from barrier discharges within the voids which

are initiated when the charging voltage exceeds a threshold value. In the present work, the build-up of the effective polarization of ferroelectrets under suitable voltage waveforms was studied by acoustic measurements of the inverse piezoelectric effect. The radiated sound signal has a contribution not only from the effective charge density, but also from the Maxwell stress. Therefore, a “butterfly” curve for the sound signal was obtained during charging under linearly increasing or decreasing voltages. The absolute piezoelectric d_{33} coefficients were determined by dielectric resonance spectroscopy immediately after charging. By comparing these d_{33} values with the zero-field sound signals, all other sound-signal measurements were converted to piezoelectric coefficients. A polarization-voltage (P-V) hysteresis loop was obtained by analyzing the data in light of an existing model for the piezoelectric d_{33} coefficient of ferroelectrets [2].

[1] S. Bauer, R. Gerhard-Multhaupt, G. M. Sessler, *Phys. Today* **57**, 37 (2004).

[2] M. Paaanen, J. Lekkala, H. Välimäki, *IEEE-TDEI* **8**, 629 (2001).

CPP 20.17 Wed 16:00 Poster B

Surface science investigations of cellulose, lignin and polymer compounds based on them for applications in fuel cells — STEFAN KRISCHOK¹, SYED IMAD-UDDIN AHMED¹, ●ANDREAS COMOUTH¹, MARCEL HIMMERLICH¹, ROSINA STANEVA¹, AXEL KAUFFMANN², JÜRGEN PFITZER³, M. HUBER⁴, WOLFGANG BENGEL⁵, and JUERGEN A. SCHAEFER¹ — ¹Institute für Physik und Institut für Mikro- und Nanotechnologien, Technische Universität Ilmenau, P.O. Box 100565, 98684 Ilmenau, Germany — ²Fraunhofer Institut für Chemische Technologie (ICT), Joseph-von-Fraunhofer-Straße 7, 76327 Pfinztal, Germany — ³TECNARO GmbH, Burgweg 5, 74360 Ilsfeld-Auenstein, Germany — ⁴SFC Smart Fuel Cell AG, Eugen-Sänger-Ring 4, 85649 Brunnthal-Nord, Germany — ⁵Biomasseprojekt GmbH, Fritz-Reichle-Ring 4, 78351 Radolfzell, Germany

Research in fuel cells has intensified due to their potential in various fields. One of the main fuel cell components - the bipolar plate, is currently based on metals or graphite. A pyrolyzed cellulose- and lignin-based polymer compound shows excellent potential. However, various critical issues still need to be addressed, such as impurity poisoning in Direct Methanol Fuel Cells (DMFC). In this context, X-ray photoelectron spectroscopy (XPS), X-ray Diffraction (XRD) and thermal desorption provide important indications about the presence of impurities, degree of pyrolysis and desorption processes occurring during pyrolysis. Such knowledge enables an optimization of the material composition and pyrolysis parameters, thus making it suitable for fuel cell applications.

CPP 20.18 Wed 16:00 Poster B

AFM Studies of Defect-induced Surface Modulations in Smectic Liquid Crystals — ●WEI GUO and CHRISTIAN BAHR — Max Planck Institute for Dynamics and Self-Organization, D-37073 Göttingen

Smectic-A liquid crystals show a common defect structure, focal conic defects, which consist of a complex arrangement of curved equidistant molecular smectic layers. In thin smectic films between a substrate and an air interface, focal conics cause depressions at the air interface which can be imaged by AFM microscopy [1].

We present here an AFM study of the defect-induced surface modulations in smectic films on various substrates and at various phase transitions. Whereas substrates causing a random planar alignment (the liquid-crystal director is oriented parallel to the substrate surface but there is no preferred in-plane orientation) lead to a pattern of circular surface depressions, we observe for substrates with an unidirectional planar alignment (the director possesses one or more preferred in-plane orientations) linear groove-like surface modulations of the air interface. In thicker films on these substrates, a complex structure is observed, in which the grooves seem to be decorated by rows of interdigitating circular focal conics.

We study also the behavior of the surface modulations at different liquid-crystal phase transitions like smectic-A – nematic, smectic-A – isotropic, or smectic-A – smectic-C.

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

CPP 20.19 Wed 16:00 Poster B

DC Electrical Transport through Metallic Nanostructures — ●RADIM KRĚNEK¹, VĚRA CIMROVÁ², and MANFRED STAMM¹ — ¹Leibniz Institute of Polymer Research Dresden, Germany — ²Institute of Macromolecular Chemistry AS CR, Prague, Czech Re-

public

Diblock copolymer nanotemplates provide a prospective way for development of ordered patterns of nanoobjects with e.g. magnetic (hard disks) or optoelectronic (LEDs, photovoltaic cells) functionality. Thin films of diblock copolymer enriched by a low molar mass additive are casted on conductive surfaces in order to ensure good electrical contact for electroplating of magnetic materials or optoelectronic devices. Extraction of the additive results in a porous nanostructure, but quality (depth) of the pores is very sensitive to the substrate roughness. As well, appearance of the top electrode depends on the applied material, technique and ambient conditions. We demonstrate various electrical transport regimes in relation with the roughness of the bottom electrode and the cluster size, loading rate, etc. of the sputtered metal applied for the top electrode. These transport regimes (injection limited currents, space charge limited currents, tunneling) are discussed regarding vertical profiles of the films.

CPP 20.20 Wed 16:00 Poster B

Spontaneous onion formation from planar lamellar nuclei — ●YASUTAKA IWASHITA¹ and HAJIME TANAKA² — ¹Max Planck Institute for Dynamics and Self-Organization, Göttingen, Germany — ²Institute of Industrial Science, University of Tokyo, Tokyo, Japan

Onion phase, which is composed of multilamellar vesicle (MLV, or onion) structures in lyotropic liquid crystals, has been studied in its formation under shear flow since the discovery by Roux *et al.* in 1993. However it has been also reported that onion phase can be formed spontaneously via sponge (isotropic)-to-lamellar phase transition without shear when lamellar phase nucleates as onions. In this study we report a new interesting step of the lamellar ordering (nucleation) from the sponge phase observed directly with optical microscopy: Initially lens-shaped nuclei (planar lamella) nucleate, and then they spontaneously transform into onion nuclei. We also reveal that the origin of this shape transformation is the competition between curvature elastic and interfacial energy. This means a remarkable fact that the initial most stable bulk structure (planar lamella) spontaneously changes into the metastable higher-energy bulk structure (onion). Finally we mention the aspect as a novel ordering step peculiar to a system of low-dimensional internal order (layered structure): The fate of nuclei can be seriously affected by the competition between interfacial and elastic deformation energy in general.

CPP 20.21 Wed 16:00 Poster B

Self organization and light induced patterning of azo-dye layers — RAFAEL MEINHARDT, VLADIMIR MURADOV, ●ANSGAR DRAUDE, and HILMAR FRANKE — Department of applied physics, university of Duisburg-Essen, Lotharstr.1, 47057 Duisburg, Germany

Thin layers of azo-dyes have been prepared from the vapour phase on pure glass, metal/ glass and ITO/ glass substrates. The films have been patterned using light or electrostatic charging of the substrate. As characterization methods plasmon spectroscopy, AFM investigations, X-ray scattering and holographic recording have been used.

A strong tendency for the formation of crystals is found especially in the range of 20-70 nm thick depositions. The crystallization depends on the roughness of the substrate and the presence of deposited electrostatic charges. Oriented transparent regions may be prepared as well as scattering unoriented areas. Both types of layers are sensitive for an optical reorientation via the Cis-Trans isomerization.

CPP 20.22 Wed 16:00 Poster B

Self-assembled treelike patterns from an evaporating binary solution — ●LEONID GOVOR, GOTTFRIED BAUER, and JÜRGEN PARISI — Institute of Physics, University of Oldenburg, Carl-von-Ossietzky Str. 9-11, D-26129 Oldenburg, Germany

Spontaneous formation of treelike patterns which developed during evaporation of the solvent from a phase-separated bilayer resulting from a binary polymer solution spin-coated onto a solid substrate has been studied. The initial bilayer consists of a poly(isobutyl methacrylate) (BMA) layer on top of a nitrocellulose (NC) solution layer. During evaporation, the top BMA layer becomes unstable and transforms into short ridges. Finally, the inhomogeneous evaporation of the solvent from the NC solution layer connects the BMA ridges to treelike patterns. To support our model, we present results of a complementary experiment based on casting of the BMA solution on an inclined glass substrate.

CPP 20.23 Wed 16:00 Poster B

Anregungstransfer in molekularen Aggregaten — ●GEORG SCHULZ, JAN RODEN, ALEXANDER EIFELD und JOHN S. BRIGGS — Physikalisches Institut, Albert-Ludwigs-Universität Freiburg, Hermann-Herder-Str. 3, D-79104 Freiburg

Molekulare Aggregate, die aus Dipol-Dipol-gekoppelten Farbstoffmolekülen bestehen, sind nach wie vor reger Gegenstand der Forschung. Bei der Aggregation bilden sich delokalisierte Zustände, die sowohl eine (oft) drastische Änderung des Aggregatabsorptionsspektrums bewirken und auch für effizienten Energietransfer entlang des Aggregats sorgen. Beispiele solcher Aggregate sind J-Aggregate, bei denen ein sehr schmales, rotverschobenes Absorptionsband entsteht, oder die Lichtsammelheiten bei der Photosynthese. Ein Problem bei der Beschreibung molekularer Aggregate ist die Berücksichtigung intramolekularer Vibrationen. Mit Hilfe der CES-Näherung konnten wir die Absorptionsspektren und optische Rotation solcher Quantenaggregate unter Einbeziehung ihrer Vibrationen [1] und Unordnung [2] hervorragend beschreiben. Wir betrachten nun den Energietransfer im Rahmen der CES-Näherung.

[1] A. Einfeld, J. S. Briggs, Chem. Phys. 281, 61, Chem. Phys. 324, 376

[2] A. Einfeld, J. S. Briggs, Phys. Rev. Lett. 96, 113003

CPP 20.24 Wed 16:00 Poster B

Growth of metal nanoparticles on tubular J-aggregates by photo-induced electron transfer processes — DÖRTHE MELITTA EISELE¹, ●OMAR AL-KHATIB¹, ANNA BURMISTROVA¹, HANS VON BERLEPSCH², CHRISTOPH BÖTTCHER², and STEFAN KIRSTEIN¹ — ¹Humboldt-Universität zu Berlin — ²Freie Universität Berlin

In this contribution it is shown that an electron transfer reaction from cyanine dyes to noble metal ions can be utilized to grow metallic nanoparticles at the surface of respective molecular aggregates. Therefore tubular J-aggregates with typical diameters of 20 nm and length exceeding 10 μm are formed in aqueous solutions using amphiphilic tetrachloro-benzimidazole carbocyanine dyes. The aggregates are characterized by means of cryogenic electron transmission microscopy (cryo-TEM) and by scanning force microscopy (AFM). Upon addition of noble metal salts (Na_2PdCl_4 or AgNO_3) to the aggregate solution metallic nanoparticles that are rather uniform in size with a mean diameter of a few nanometers are growing on the surface of the aggregates as observed by cryo-TEM. In case of Pd salt the aggregates are destroyed upon particle formation, while in case of Ag salt the aggregates are unaffected by the formation of silver particles. The growth of the metal nanoparticles is explained by a photoexcited electron transfer process from the J-aggregates to the metal ions. A systematic study of optical spectra with varying silver ion concentration allows to investigate the influence of the particle growth on aggregate structure and morphology.

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Nanotemplates from monolayers of electron donors and acceptors self-assembled at solid-liquid interfaces — ●MIN AI¹, FRANK JÄCKEL^{1,2}, XINLIANG FENG³, WEI ZHUANG¹, KLAUS MÜLLEN³, and JÜRGEN RABE¹ — ¹Humboldt University Berlin, Department of Physics, Newtonstr. 15, 12489 Berlin, Germany — ²present address: Stanford University, Department of Chemistry, 333 Campus Drive, CA 94305-5080, Stanford, USA — ³Max Planck Institute for Polymer Research, Ackermannweg 10, 55128 Mainz, Germany

We studied a potential nanotemplate for molecular and organic electronics consisting of an electron-withdrawing acceptor, an alkylated coronenebis(dicarboximide) derivative, and an electron-pushing donor, benzo[*o*]bistriphenylene[2,1,12,11-efghi:2*,1*,12*,11*-uvabc] ovalene. Self-assembled monolayers of the neat donor and acceptor and their mixture respectively were investigated by scanning tunneling microscopy (STM) at the interface between an organic solution and highly oriented pyrolytic graphite (HOPG). The pure electron acceptor forms two highly ordered crystalline phases with either one molecule ("oblique cell") or four molecules ("zigzag cell") per unit cell respectively. The neat electron donors could not be visualized. In the electron donor/acceptor mixtures, two distinct types of crystal structures are revealed, one with four donors and one acceptor, and the other with two donors and two acceptors in the unit cell. Molecular packing models are presented according to the STM images. The packing is attributed to the interactions between the molecules and between molecules and HOPG.

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Nanostructuring and nanoaggregates on functionalized sur-

faces — •THOMAS BAUMGÄRTEL, HARALD GRAAF, MAIK VIELUF, and CHRISTIAN VON BORCZYKOWSKI — Centre for nanostructured materials and analytics, TU Chemnitz, 09107 Chemnitz

We investigated the nano-structuring of silicon covered with an alkene monolayer. This was achieved by local anodic oxidation by an atomic force microscope (AFM). The monolayers are formed by a self assembling process through a heat induced chemical reaction. The molecules of these monolayers are highly ordered featuring relative physical and chemical stability. Thus they represent a way to passivate the surface. Furthermore the surface properties could be tuned easily by variation of the head groups of the alkenes.

Local anodic oxidation degrades the monolayer partially and the underneath silicon surface is oxidized resulting in a silicon oxide nanostructure. The organic monolayer influences the oxidation process naturally. A clear dependence of the oxidation time on the strength of the electric field was found.

The nanometer-sized siliconoxide structures were used for selective binding of optical active materials. Non-covalent interactions (e.g. ionic and hydrophobic) proved to be an elegant way for a selective modification of the structures as well as the surrounding surface. The in this manner modified surfaces have been examined both by atomic force microscopy and optical widefield microscopy.

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Tuning surface chemistry of thin PEO films by control of morphology — •EVELYN MEYER and HANS-GEORG BRAUN — Leibniz Institut für Polymerforschung Dresden, Max Bergmann Center of Biomaterials, D-01069 Dresden, Hohe Strasse 6

Ultrathin polyethyleneoxide (PEO) layers are of great importance as protein resistant coatings to avoid nonspecific protein adsorption. The controlled introduction of chemical groups (NH_2) into PEO layers allows a specific immobilization of proteins. Depending on the solution concentration PEO films, prepared by dip-coating, crystallize in unilamella or multilamellae morphologies. Chain length of PEO molecules and interaction of the amino-terminated PEO with the surface influence growth morphologies and distribution of amino groups on the lamella surface and consequently the grafting density of biomolecules attached to the lamella surface. The water soluble morphological PEO units can be immobilized at the surface by electron beam lithography. The arrangement of reactive amino groups within the morphological entities can be checked by selective fluorescence staining and fluorescence microscopy.

CPP 20.28 Wed 16:00 Poster B

Aligned Polyelectrolyte Chains Adsorbed onto an Oppositely Charged Lipid Monolayer — •JENS-UWE GÜNTHER, OLAF SOLTWEDEL, HEIKO AHRENS, and CHRISTIANE A. HELM — Institut für Physik, Ernst-Moritz-Arndt Universität, F.-L.-Jahn-Str. 16, D-17487 Greifswald, Germany

The negatively charged polyelectrolyte PSS (Poly styrene sulfonate) is adsorbed onto positively charged TAP or DOAB monolayers (1,2-Dipalmitoyl-3-Trimethylammonium-Propane, dioctadecylammonium bromide, respectively) at the water surface. The structure of the supramolecular complex is investigated with synchrotron grazing incidence diffraction. In-plane diffraction peaks at small angles measure the separation of the aligned polyelectrolyte chains, while those at large angles measure the quasi-crystalline structure of the alkyl chains within the lipid monolayer. Depending on the polyelectrolyte concentration in solution, the lipid charge is partially neutralized by the PSS and partially by anions, or complete charge compensation occurs. The influence of the ion concentration in the aqueous polyelectrolyte solution is discussed. The two peaks of the rod-scan at small angles indicate that the lipid monolayer buckles directly above the aligned PSS chains.

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Lattice dynamics of a two-dimensional colloidal crystal subjected to a substrate potential — •MARIA ZVYAGOLSKAYA¹, JÖRG BAUMGARTL¹, HANS HENNING VON GRÜNBERG², and CLEMENS BECHINGER¹ — ¹Universität Stuttgart, 2.Physikalisches Institut, Pfaffenwaldring 57, D-70569 Stuttgart, Germany — ²Karl-Franzens-Universität, Institut für Chemie, Heinrichstrasse 28, A-8010 Graz, Austria

In the presence of a substrate potential the phonon band-structure of a two-dimensional (2D) crystal can be tuned by varying the strength or the shape of the substrate potential. Here we study this idea by sub-

jecting a 2D colloidal crystal to a commensurate one-dimensional (1D) substrate potential with sinusoidal modulations in one or two spatial directions. Experimental realization of such potentials is achieved by interfering laser beams. We record the trajectories of colloidal particles by means of video-microscopy and then calculate the 1D and 2D phonon band-structure and the phonon spectrum. The 1D band-structure and the phonon spectrum allow for studying how the shape of the band structure is altered by the substrate potential. The 2D band structure displays the breaking of the 6-fold symmetry of the intrinsic colloidal crystal down to a 2-fold symmetry caused by the substrate potential.

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Temperature-Dependent Holographic Studies of Azobenzene-Containing Diblock Copolymers — •HUBERT AUDORFF¹, LOTHAR KADOR¹, CARSTEN FRENZ², and HANS-WERNER SCHMIDT² — ¹Universität Bayreuth, Physikalisches Institut und Bayreuther Institut für Makromolekülforschung (BIMF), 95440 Bayreuth — ²Universität Bayreuth, Makromolekulare Chemie I, 95440 Bayreuth

The light-induced reorientation of azobenzene and mesogenic side groups in the minority phase of diblock copolymers has been investigated with holographic methods at different temperatures. The materials consist of a matrix of polystyrene and minority phases which contain chromophores and mesogens in different ratios. Plane gratings were inscribed at temperatures between 20 °C and 90 °C. The influence of the temperature on the achievable refractive-index modulation, writing time, sensitivity, short-term relaxation, and long-term stability of the gratings was measured. With increasing temperature, the achievable refractive-index modulation becomes smaller, whereas the sensitivity is roughly constant. The stability drops strongly, when the glass transition temperature is approached.

CPP 20.31 Wed 16:00 Poster B

Single-laser-pulse-induced switching of molecular spin states — •SÉBASTIEN BONHOMMEAU¹, NIKO PONTIUS¹, HERMANN DÜRR¹, WOLFGANG EBERHARDT¹, SAIOA COBO², GABOR MOLNÁR², and AZZEDINE BOUSSEKOU² — ¹Berliner Elektronenspeicherring-Gesellschaft für Synchrotronstrahlung m.b.H (BESSY), Albert-Einstein-Straße 15, 12489 Berlin, Germany — ²Laboratoire de Chimie de Coordination, CNRS UPR-8241, Route de Narbonne 205, 31077 Toulouse, France

Light-induced phenomena in spin crossover complexes have aroused a lot of interest since the discovery of the LIESST (Light-Induced Excited Spin State Trapping) effect in solid state. Here, we demonstrate by means of Raman spectroscopy that a bi-directional spin transition can be obtained at room temperature when applying a nanosecond laser pulse in the hysteresis loop of the spin crossover complex Fe(pyrazine)[Pt(CN)₄]. This phenomenon is interpreted as a photo-induced phase transition exhibiting a threshold energy density. In order to provide a deeper insight on the electronic properties of such polymeric materials, X-ray photoemission and absorption experiments have also been performed on a multilayer assembly of thin films of Fe(azopyridine)[Pt(CN)₄] that display spin crossover. This information is of paramount importance to shed new light on the photo-induced dynamics, in the subpicosecond time scale, which will be investigated using the femtoslicing facility now available at BESSY GmbH.

CPP 20.32 Wed 16:00 Poster B

Simultaneous scanning tunneling and atomic force microscopy at ambient conditions using quartz tuning fork sensors — •STEFAN STRÖMSDÖRFER, VIATCHESLAV DREMOV, IRINA LAZAREVA, YURI KOVAL, and PAUL MÜLLER — Physikalisches Institut 3, Universität Erlangen-Nürnberg, Germany

We demonstrate the operation of a tuning fork based AFM in non-contact mode with simultaneous acquisition of both the tunneling current and the frequency shift of a vibrating conducting cantilever.

We were able to show atomic resolution of the graphite lattice of HOPG at ambient conditions. Whereas STM shows the well known mapping of every second carbon atom, in AFM the complementary subset of carbon atoms was visualized. These results agree qualitatively with previous measurements performed in UHV.

As the frequency shift, i.e. the force gradient determines the control, there is no restriction on the conductivity of the samples. The technique enables measurements of the tunneling current even if the sample surface contains insulating regions. We applied this method in the measurement of the conductivity along nanowires deposited onto an insulating substrate.