

## CPP 8: Interfaces and Thin Films (joint session CPP/DY)

Time: Monday 15:00–17:15

Location: H14

CPP 8.1 Mon 15:00 H14

**In situ GISAXS Investigations of Multi-responsive Block Copolymer Thin Films during Solvent Vapor Annealing** — ●FLORIAN JUNG<sup>1</sup>, PANAYIOTA A. PANTELI<sup>2</sup>, DETLEF-M. SMILGIES<sup>3</sup>, DORTHE POSSELT<sup>4</sup>, CONSTANTINOS TSITSILIANIS<sup>5</sup>, COSTAS S. PATRICKIOS<sup>2</sup>, and CHRISTINE M. PAPADAKIS<sup>1</sup> — <sup>1</sup>Physics Department, Soft Matter Group, Technical University of Munich, Garching, Germany — <sup>2</sup>Department of Chemistry, University of Cyprus, Nicosia, Cyprus — <sup>3</sup>Wilson Laboratory, Cornell University, Ithaca, USA — <sup>4</sup>Department of Science and Environment, Roskilde University, Roskilde, Denmark — <sup>5</sup>Department of Chemical Engineering, University of Patras, Patras, Greece

In the present work, we investigate the structure of a pH and temperature responsive, CBABC type pentablock terpolymer in thin films during solvent vapor annealing (SVA) using grazing-incidence small-angle X-ray scattering. The C end blocks are statistical copolymers of the hydrophobic n-BuMA and the thermoresponsive TEGMA, the B blocks are the weak cationic polyelectrolyte PDMAEMA and the A block is the hydrophilic PEG. Films were prepared by spin coating from aqueous solutions of different pH values. SVA experiments were carried out using both water and toluene as solvents. Films prepared at low pH feature a spherical morphology, and swell strongly in water, but only weakly in toluene vapor. At high pH, no structural features are observed, indicating the importance of ionization for microphase separation. During swelling in toluene, a morphology of small spheres is observed in the swollen state, while water has no noticeable effect.

CPP 8.2 Mon 15:15 H14

**Competition of structural and electrostatic forces in colloidal dispersions confined between of two charged surfaces** — ●MICHAEL LUDWIG and REGINE VON KLITZING — Soft Matter at Interfaces, Department of Physics, Technische Universität Darmstadt

Structural forces can be observed when pure solvents and ionic liquids, as well as dispersions containing nanoparticles, micelles, polymers or polyelectrolytes are confined between two smooth surfaces into a thin liquid film. Upon surface-approach, liquid matter has to be depleted from the vicinity of the surfaces, altering the interactions between the surfaces.

The present study addresses structural forces across thin films of suspensions of nanoparticles (NP) confined between two charged surfaces measured with a colloidal-probe atomic force microscope (CP-AFM). Special attention is drawn to the transition from diluted to concentrated NP-packing and to the effect of the outer surface charge. An extended fitting procedure was introduced to accurately fit experimental data. The need of an additional repulsive contribution to the fitting formula will be discussed in terms of the DLVO-framework.

CPP 8.3 Mon 15:30 H14

**Growth Kinetics and Molecular Mobility of Irreversibly Adsorbed Layers in Thin Films of P2VP and PVME** — ●MARCEL GAWEK, SHERIF MADKOUR, ANDREAS HERTWIG, and ANDREAS SCHÖNHALS — Bundesanstalt für Materialforschung und -prüfung, Unter den Eichen 87, 12205 Berlin

In well-annealed thin polymer films, with non-repulsive polymer/substrate interactions, an irreversibly adsorbed layer is formed. These adsorbed layers have shown enormous potential for technological applications. Due to the hard accessibility of these layers, their growth kinetics and molecular dynamics are still not fully understood. Here, the irreversibly adsorbed layers of Poly(2-vinylpyridine) (P2VP) and Poly(vinyl methyl ether) (PVME) thin films are revealed by solvent-leaching experiments. The growth kinetics of these layers is investigated as a function of original film thickness and annealing times. The thickness, topography and quality of the adsorbed layer is determined with Atomic Force Microscopy (AFM) and spectroscopic ellipsometry. Additionally, the molecular mobility of the adsorbed layer is investigated with Broadband Dielectric Spectroscopy (BDS). A recently developed nanostructured capacitor (NSC) is employed to measure the adsorbed layers with a free surface layer depending on annealing and solvent-leaching time. The results are quantitatively compared and discussed with respect to recently published work.

CPP 8.4 Mon 15:45 H14

**Enhanced protein adsorption near a phase transition** — ●MADELEINE R. FRIES<sup>1</sup>, DANIEL STOPPER<sup>1</sup>, FAJUN ZHANG<sup>1</sup>, ROBERT M. J. JACOBS<sup>2</sup>, MAXIMILIAN W. A. SKODA<sup>3</sup>, ROLAND ROTH<sup>1</sup>, and FRANK SCHREIBER<sup>1</sup> — <sup>1</sup>University of Tübingen, Germany — <sup>2</sup>University of Oxford, UK — <sup>3</sup>ISIS Facility, Didcot, UK

Protein adsorption at the solid-liquid interface is an important phenomenon that often can be observed as a first step in biomedicine. In particular, globular proteins tuned by multivalent ions give rise to a rich phase behavior including reentrant condensation and liquid-liquid phase separation (LLPS) through ion-bridges connecting individual proteins [1, 2]. Multivalent ions can be used not only to modify the bulk behaviour, but also the adsorption behaviour of proteins at the solid-liquid interface [3]. Here, we demonstrate experimentally that protein adsorption at attractive substrates can be enhanced significantly by approaching the LLPS regime through an increase in temperature or protein concentration, pointing towards the ability to control protein adsorption by means of suitably tailoring thermodynamic conditions. This is supported by theoretical calculations treating proteins as limited-valence (patchy) particles. These results could enable better biocompatibility in implants through guided protein-substrate interactions. [1] Zhang et al, PRL (2008); [2] Roosen-Runge et al, Sci. Rep. (2014); [3] Fries et al, PRL (2017)

15 min. break

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**Templated electrodeposition of nanoscale semiconductors** — ●LI SHAO<sup>1</sup>, ANDREW HECTOR<sup>1</sup>, PHILIP BARTLETT<sup>1</sup>, FRANCIS SWEENEY<sup>2</sup>, SAMANTHA SOULE<sup>1</sup>, RICHARD BEANLAND<sup>2</sup>, and GILLES MOEHL<sup>1</sup> — <sup>1</sup>Chemistry, Southampton University, University Rd, SO17 1BJ, United Kingdom — <sup>2</sup>Department of Physics, University of Warwick, Coventry CV4 7AL

The Advanced Devices by ElectroPlating (ADEPT) project, an interdisciplinary research project funded by the EPSRC (EP/N035437/1), aims to develop new techniques and materials for thermoelectric devices, infrared detection, and phase change memory, by using electrodeposition methods. In previous work, Sn nanowires were deposited into mesoporous silica templates with pores of 1.5nm diameter. In this work, well-ordered mesoporous silica films with 3D pore structures were prepared by the evaporation-induced self-assembly (EISA) method. Using these silica films as templates, tellurium was deposited into the 3D pores. Grazing incidence small-angle X-ray scattering (GISAXS), scanning electron microscopy (SEM) and transmission electron microscopy (TEM) were used to characterize film nanostructures before and after electrodeposition. Programmes based on the distorted wave Born approximation (DWBA) were used for analysis and simulation of the 2D diffraction patterns from GISAXS. The patterns show that silica films with different structures including cubic, hexagonal and orthorhombic were synthesized. 1.\*Philip N. Bartlett et al, Nano Lett. 2018, 18, 941\*947. Type: Talk Topic: Thin films division Email: L.Shao@soton.ac.uk

CPP 8.6 Mon 16:30 H14

**In-situ GISAXS during sputter deposition of metal nanolayers on functional polymer thin films for lithium-ion batteries** — ●SIMON J. SCHAPER<sup>1</sup>, VOLKER KÖRSTGENS<sup>1</sup>, MATTHIAS SCHWARTZKOPF<sup>2</sup>, PALLAVI PANDIT<sup>2</sup>, ALEXANDER HINZ<sup>3</sup>, OLEKSANDR POLONSKYI<sup>3</sup>, THOMAS STRUNSKUS<sup>3</sup>, FRANZ FAUPEL<sup>3</sup>, STEPHAN V. ROTH<sup>4</sup>, and PETER MÜLLER-BUSCHBAUM<sup>1</sup> — <sup>1</sup>TU München, Physik-Department, LS Funktionelle Materialien, 85748 Garching — <sup>2</sup>DESY, 22607 Hamburg — <sup>3</sup>CAU zu Kiel, Institut für Materialwissenschaft, LS Materialverbunde, 24143 Kiel — <sup>4</sup>KTH, Department of Fibre and Polymer Technology, SE-100 44 Stockholm, Sweden

Understanding the interface between metals, commonly used as current collectors, and ion-conducting polymers used in polymer lithium-ion batteries (LIBs) is crucial to develop highly reproducible, low-cost and reliable devices. To address these issues, sputter deposition is the technique of choice to fabricate scalable, reproducible and controllable nanometer and sub-nanometer metal layers on polymer thin films. The sputter deposition process, being well understood and controlled, offers advantages over chemical methods to tailor metal thin-film morphologies on the nanoscale and offers a superior adhesion of the deposited

material. We use in-situ grazing incidence small angle X-ray scattering (GISAXS) to investigate the formation, growth and, self-assembled structuring on polymer thin films and composites used in LIBs. Different polymer films are compared with respect to the metal layer growth.

CPP 8.7 Mon 16:45 H14

**Using GISAXS to reveal spatial correlations in the electrochemical nucleation of gold particles** — ●GILLES MOEHL, PHILIP BARTLETT, and ANDREW HECTOR — Chemistry, Southampton University, University Rd, SO17 1BJ, United Kingdom

Gilles E. Moehl, Philip N. Bartlett and Andrew L. Hector Chemistry, University of Southampton, Southampton, SO17 1BJ, UK. Developing the next generation of electronic devices requires the deposition of high-quality functional materials in a controlled fashion in complex structures in order to unleash the true potential of devices such as thermoelectrics, phase change memory (PCM) and infra-red detectors. Within EPSRC programme grant ADEPT \*Advanced Devices by ElectroPlating\* (EP/N035437/1), new techniques and materials are to be developed for that matter. Electrochemical nucleation was generally described theoretically many years ago as a random process, which mainly depends on the deposition rate applied through the set current or potential, resulting in either instantaneous or progressive nucleation. Further development of theory and experiments

has shown that the underlying process is just random, but that every newborn nucleus has the potential to influence the evolution of further nucleation steps. In this work, we show how grazing incidence small angle scattering can reveal spatial correlations in seemingly randomly arranged gold particles from electrolytic metal deposition.

CPP 8.8 Mon 17:00 H14

**An Extended Transfer Matrix Approach to Calculate the Scattering of Light in an Interface Profile** — ●REINHARD SIGEL — 83301 Traunreut

The transfer matrix method is a reliable work horse for the calculation of the reflection at an interface profile. In this contribution, the approach is extended by additional fluctuations  $\Delta\varepsilon$  of the relative permittivity  $\varepsilon$  within the profile, which cause light scattering. For small amplitudes, such fluctuations can be treated within the first Born approximation. The incident light as well as the exit of the scattered light through the layered profile are handled by the transfer matrix method. Based on a model which yields the interface profile and the fluctuation amplitudes, the intensity and the polarization properties of the light scattered in any solid angle are predicted. Applications to grazing incidence small angle X-ray scattering (GISAXS), evanescent wave dynamic light scattering (EWDLS) and scattering ellipsometry are discussed.