

CPP 26: Poster: New Perspectives of Scattering at Soft Matter

Time: Wednesday 11:00–13:00

Location: Poster A

CPP 26.1 Wed 11:00 Poster A

Structural evolution in diblock copolymer thin films with perpendicular lamellar structure during solvent vapor treatment— •JIANQI ZHANG¹, ALESSANDRO SEPE¹, RICHARD STEINACHER¹, JAN PERLICH², DORTHE POSSELT³, and CHRISTINE PAPADAKIS¹ — ¹TU München, Physikdepartment, Physik weicher Materie, Garching, Germany — ²HASYLAB at DESY, Hamburg, Germany — ³Roskilde University, IMFUFA, Denmark

Well-ordered structures formed by self-assembly of diblock copolymer have attracted increasing interest due to the potential applications. However, the usual preparation methods often result in defects which hamper the application. Vapor treatment with solvents is a commonly used technique to anneal defects in thin films. We have investigated the structural changes of lamellae-forming P(S-b-B) diblock copolymer thin films with perpendicular lamellar structure using in-situ, real-time grazing-incidence small-angle X-ray scattering with a time resolution of 30 s. Cyclohexane and ethyl acetate were used for vapor treatment, which are selective for PB and PS, respectively. We have found that new narrow Bragg rods appear before the diffuse Bragg rods bend in the vapor. These findings point to an initial formation of a thin near-surface layer having the perpendicular orientation and a later destabilization of the perpendicular orientation. The main reason is the change of chain conformations, i.e. a tendency to coiling of the initially stretched copolymers upon solvent uptake.

CPP 26.2 Wed 11:00 Poster A

Diffusion of proteins in a bicontinuous microemulsions: A combined fluorescence correlation spectroscopy and neutron spin echo study — •RALPH NEUBAUER, SEBASTIAN HÖHN, CHRISTOPH SCHULREICH, and THOMAS HELLWEG — Phys. und Biophys. Chemie (PC III), Universität Bielefeld, Universitätsstr. 25, 33615 Bielefeld, Germany

In bicontinuous microemulsions (ME) the oil and water components form sponge-like domains which are separated by a surfactant/co-surfactant film. This structure shows two dynamics: Bulk diffusion (water and oil domain) and film diffusion (surfactant), which can be observed by dynamic light scattering (DLS), neutron spin echo (NSE) and fluorescence correlation spectroscopy (FCS).

For FCS the label determines the type of diffusion which will be observed. Using an amphiphilic fluorescent molecule the diffusion of the surfactant film can be measured. By choosing a fluorescent apolar protein the movement of this particle in the water domain is detected and the confinement effect can be identified. In NSE experiments the deuteration decides about what is measured. If one component in the ME is protonated and the remaining components are matched out by deuteration, only the diffusion of the protonated component is analyzed. When all four components are deuterated and a protein (is inserted in the water phase, the diffusion of the protein will be obtained, also leading to a independent information about the confinement effect in a ME.

CPP 26.3 Wed 11:00 Poster A

A SANS study of ‘patchy’ worm-like surface compartmentalized nanostructures — •FRANK LÜDEL¹, SABINE ROSENFELDT², JOACHIM SCHMELZ³, LUDGER HARNAU⁴, THOMAS HELLWEG¹, and HOLGER SCHMALZ³ — ¹Physical and Biophysical Chemistry III, University of Bielefeld, Germany — ²Physical Chemistry I, University of Bayreuth, Germany — ³Macromolecular Chemistry II, University of Bayreuth, Germany — ⁴MPI for Intelligent Systems, Stuttgart, Germany

A very promising way towards hierarchically self-organized nanostructures is provided by the crystallization-induced self-assembly of polymers [1-3]. Currently, there is only a partial understanding of a few structures with patch-like surfaces having different compartments. Worm-like micelles with a core-corona structure from a semi-crystalline triblock terpolymer (SEM) in organic media were prepared [1]. Its soluble corona exhibits a patchy structure of microphase-separated polystyrene (S) and poly(methyl methacrylate) (M) enclosing a crystalline polyethylene (E) core. The structure formation is triggered by crystallization during cooling. SANS measurements with contrast variation were performed on a SEM with deuterated S-blocks (dSEM) for studying the structure in solution. Results thereof confirm a compart-

mentalized structure and are presented in this contribution.

- [1] Schmalz, H.; Schmelz, J.; et. al. *Macromolecules*, 2008, 41, 3235.
- [2] Schmelz, J.; et al. *ACS Nano*, 2011, in print; DOI:10.1021/nn202638t
- [3] Tang, Z.; Kotov, N. A. *Adv. Mater.*, 2005, 17, 951.

CPP 26.4 Wed 11:00 Poster A

Subsurface influence on the structure of protein adsorbates revealed by *in situ* X-ray reflectivity — •HENDRIK HÄHL¹, FLORIAN EVERS², SAMUEL GRANDTHYLL¹, PETER LOSKILL¹, and KARIN JACOBS¹ — ¹Saarland University, Experimental Physics, D-66041 Saarbrücken — ²Condensed Matter Physics Laboratory, Heinrich Heine University Düsseldorf, D-40225 Düsseldorf

The adsorption process of proteins to surfaces is governed by the mutual interactions between proteins, solution and substrate. Interactions arising from the substrate are usually attributed to the uppermost atomic layer. This “actual surface” defines the surface chemistry and hence steric and electrostatic interactions. For a comprehensive understanding, however, also the interactions arising from the bulk material have to be considered.

High energy X-ray reflectivity measurements enable the *in situ* determination of the density profile of the formed protein film. The results of these experiments clearly reveal the influence of the subsurface material on the adsorbing proteins via van der Waals forces. Thereby, the used set of functionalized silicon wafers enables a distinction between effects of the surface chemistry and the subsurface composition of the substrate: Whereas the surface chemistry controls whether or not the individual proteins are denatured, the strength of the van der Waals forces affects the final layer density and hence the adsorbed amount of proteins. The results imply that van der Waals forces mainly influence surface processes, which govern the structure formation of the protein adsorbates, such as surface diffusion or spreading.

CPP 26.5 Wed 11:00 Poster A

The P03/MiNaXS beamline at PETRA III: new opportunities for advanced SAXS/WAXS microbeam in-situ experiments using synchrotron radiation — •STEPHAN V. ROTH¹, ADELINE BUFFET¹, RALPH DOEHRMANN¹, SEBASTIAN GOGOLIN¹, MOTTAKIN ABUL KASHEM¹, GERD HERZOG¹, JAN PERLICH¹, MATTHIAS SCHWARTZKOPF¹, and GUNTARD BENECKE^{1,2} — ¹DESY, Notkestr. 85, D-22607 Hamburg, Germany — ²MPIKG Golm, Abt. Biomater., Wissenschaftspark Potsdam-Golm, D-14424 Potsdam, Germany

The novel beamline P03 (Micro- and Nanofocus X-ray Scattering, MiNaXS) at PETRA III serves a nano- and microfocus end station for performing small- and wide-angle x-ray scattering (SAXS/WAXS) experiments. With its microfocus end station being now in full user operation, its versatility allows for incorporating advanced complementary methods, such as fluidics and imaging ellipsometry [1]. To highlight the unique research capabilities at MiNaXS in terms of microfocused x-ray beams, low divergence and time-resolution, we present the results of in-situ spray and high-rate sputter deposition. The combination of high local and temporal resolution enables the in-situ observation of the fast deposition and nanostructure build-up in combination with microbeam grazing incidence small-angle x-ray scattering (μ GISAXS): The nanostructure build-up is locally analyzed from the initial deposition stages to the late vertical nanostructure and domain build-up with ms time resolution.

- [1] S.V. Roth et al., *J. Phys. Cond. Matter* 23, 254208 (2011)

CPP 26.6 Wed 11:00 Poster A

A 2D waveguide beam for X-ray nanodiffraction — •CHRISTINA KRYWKA¹, HENRIKE NEUBAUER², MARIUS PRIEBE², TIM SALDITT², JOZEF KECKES³, STJEPAN HRKAC¹, ADELINE BUFFET⁴, STEPHAN ROTH⁴, RALPH DOEHRMANN⁴, and MARTIN MÜLLER⁵ — ¹Christian-Albrechts-Universität zu Kiel, Institut für Experimentelle und Angewandte Physik, Leibnizstr. 19, D-24098 Kiel — ²Georg-August-Universität Göttingen, Institut für Röntgenphysik, Friedrich-Hund-Platz 1, D-37077 Göttingen — ³Montanuniversität Leoben, Department Materialphysik, Jahnstr. 12/I, A-8700 Leoben — ⁴DESY, Notkestr. 85, D-22603 Hamburg — ⁵Helmholtz Zentrum Geesthacht,

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The applicability of an X-ray nanobeam generated using a 2-dimensionally confining waveguide is demonstrated for nanodiffraction purposes. The experiments were performed at the Nanofocus extension of MINAXS Beamline at PETRA III. The Nanofocus extension of MINAXS is designed to routinely provide a nanofocused X-ray beam for diffraction experiments and is operated by the University of Kiel. Next to an extensive characterization of the waveguide beam, first high resolution nanodiffraction experiments were performed, e.g. on nanocrystalline TiN hard coatings on WC-Co and on ZnO-microrods with a microscopic metallic coating. Using the high spatial resolution of the waveguide beam interfacial residual stress was revealed in both sample systems. Finally, this contribution presents the current status and future extensions of the Nanofocus endstation.

CPP 26.7 Wed 11:00 Poster A

Easy use and low cost fibre based two color dynamic light scattering — ACHIM LEDERER and •HANS JOACHIM SCHÖPE — Johannes Gutenberg-Universität Mainz, Institut für Physik, Staudinger Weg 7, 55099 Mainz, Deutschland

Light scattering (LS) is one of the most powerful tools in soft matter physics to study the single particle properties as well as the structure, kinetics and dynamics of the system of interest. Unfortunately multiple scattering often complicates the data evaluation. A classy way to circumvent multiple scattering effects in LS data is provided by cross-correlation techniques [1]. Here two identical but distinguishable dynamic light scattering experiments are performed simultaneously on the same scattering volume, which is a major challenge to the mechanical and optical design of the setup. We present a new designed small and compact two color cross correlation light scattering setup to study the structure and dynamics of colloidal suspensions in the

regime of considerable turbidity. Using a home-made concentric four arm goniometer, combined with fiber optical illumination and detection devices allows an easy and long time stable alignment - even under temperature variation of $\sim 5^\circ\text{C}$. Tests with a nearly multiple scattering free suspension of small Rayleigh scatterers show intercepts in cross correlation near 0.4 over a wide range of scattering angles from 20° to 150° . Measuring slightly turbid samples in cross correlation mode multiple scattering is sufficiently suppressed allowing the determination of multiple scattering free dynamic structure factors as well as particle form factors.[1] K. Schätzl, Journal of Modern Optics 38, 1849 (1991)

CPP 26.8 Wed 11:00 Poster A

Conceptual design for a small angle neutron scattering instrument at a long pulse source — •DAMIAN MARTIN RODRIGUEZ¹, HENRICH FRIELINGHAUS², and DIETER RICHTER¹ — ¹ICS and JCNS, Forschungszentrum Juelich GmbH, 52425 Juelich, Germany — ²JCNS outstation FRM2, Forschungszentrum Juelich GmbH, Lichtenbergstr. 1, 85747 Garching, Germany

Within the European Spallation Source (ESS) Design Update Programme we are studying several concepts for a time of flight small angle neutron scattering (TOF-SANS) instrument for a long pulse source, i.e. the ESS in Lund. The favourite concept aims at samples of $1 \times 1 \text{ cm}^2$ area, which is directly connected with a $10 + 10 \text{ m}$. long SANS instrument or even longer. For a large spanned Q range we propose the use of at least two detectors at different distances. So for one-shot kinetic experiments the classical SANS Q-range can be covered. These initial considerations lead to a simple instrument with little compromises. Extensions for this basic set-up are considered as add-ons, like focussing optics, size changing slits or polarising elements.

The overall design will serve nearly all possible topics for the future research need for the SANS users around Europe.