

CPP 27: Interfaces and Thin Films II (joint session CPP, DS)

Time: Tuesday 14:00–16:00

Location: C 243

Invited Talk

CPP 27.1 Tue 14:00 C 243

Structure formation at interfaces: breath figures and beyond — ●MASOUD AMIRKHANI — Institut für Experimentelle Physik Universität Ulm Albert-Einstein-Allee 11 89081 Ulm, Germany

The interaction of two (or more) different materials in contact is crucial for basic science as well as for practical purposes. At the micro and nano regime, the number of molecules at the interface is comparable to that of bulk molecules so the interaction at the interface governs the overall structure and functionality of the system. The interface interaction is particularly crucial for the formation of emulsions, microemulsions and surface micelles. Additionally, the existence of a large interface does directly affect the adsorption of polymer on the surface and the performance of many systems such as ionic polymer metal composites (IPMC). One should note that the interface interaction can be altered using various physical and chemical stimuli. For example amphiphilic and amphiphilic-like molecules are able to modify surfaces and interface properties and also form self-assembled structures. In this talk, we present the investigation of the size and structure of surface emulsion and microemulsions under the influence of different additives. Additionally, the conformation and configuration of diblock copolymer on the substrate under the influence of solvent vapor annealing and electric field will be discussed.

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Simulations of solvent vapor annealing of cylinder-forming blockcopolymer thin films — ●ANATOLY V. BEREZKIN¹, IGOR I. POTEKIN², and CHRISTINE M. PAPADAKIS¹ — ¹Technische Universität München, Physik Department, München, Germany — ²Lomonosov Moscow State University, Physics Department, Moscow, Russian Federation

Ordered block copolymer films are promising as functional templates for lithography, molecular biology, colloid science etc. Using dissipative particle dynamics, we simulated the solvent vapor annealing (SVA) that is used to relax morphological defects, and control domain orientation in these films. The drying of films was considered in case of intermediate A/B block segregation and fast solvent evaporation. Under these conditions, the SVA transforms equilibrium morphology of lying cylinders to hexagonally ordered perpendicular cylinders in the wide parameter range. The best conditions for this were a moderate initial solvent concentration in the film, and a selectivity of the solvent to the major block. This is probably necessary to compensate entropy-driven adsorption of the short blocks at the film surfaces, revealed in other works. Too weak or too strong block segregation, or solvent selectivity result in disordered morphologies. First disordered microdomains are formed, and than after evaporation of the half of the solvent, the domains reorient along the gradient of solvent concentration. This may be explained by the Gibbs-Marangoni effect. Such mechanism of microdomain ordering notably distinguishes from those observed in other recent simulations.

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Instabilities in PS-PVP polymer blends thin films driven by surface tension and temperature effects — ●MARLENA FILIMON¹, JEAN-NICOLAS AUDINOT², PATRICK GRYSAN², JÖRG BALLER¹, and ROLAND SANCTUARY¹ — ¹Laboratory for the Physics of Advanced Materials, University of Luxembourg, Luxembourg — ²Department of Science and Analysis of Materials, Centre de Recherche Public-Gabriel Lippmann, Belvaux, Luxembourg

In thin supported films of polymer blends, in addition to composition and molecular weight of components, the structure is dependent on the surface energies of the components and on geometrical constraints induced by confinement in a thin film. Two-dimensional patterns attributed to the Marangoni instability and dependence of the Gibbs free energy of mixing components were observed for an interesting polymer blend (polystyrene/poly(vinylpyrrolidone) (PS-PVP)) thin films. As tools for investigating the nano-size domains structures of thin polymer blends (~150 nm), we exploited Tapping-Mode Atomic Force Microscopy (TM-AFM) and Nano-dynamic Secondary Ion Mass Spectrometry technique (Nano-SIMS 50). Additionally, wetting properties of the substrate and influences of these instabilities are studied using wetting measurements - contact angle. We propose a possible formation mechanism for presented patterns and show that the mechanism

is relevant to the Marangoni instability. The relevant variables which can affect the morphological evolution such as surface enrichment and temperature dependence were also discussed.

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Morphological Changes of Surface Immobilized Responsive Micelles — ●INNA DEWALD¹, JULIA GENSEL¹, JOHANN ERATH¹, EVA BETTHAUSEN², AXEL H. E. MÜLLER^{2,3}, and ANDREAS FERY¹ — ¹University of Bayreuth, Physical Chemistry II — ²University of Bayreuth, Macromolecular Chemistry II — ³Johannes Gutenberg University Mainz, Institute of Organic Chemistry

In recent years, formation of a multitude of smart coatings made from macromolecular building blocks has been demonstrated. Typical examples are brush type architectures or films formed by layer-by-layer self assembly (LbL-SA). In our work, we investigate multicompartment micelles formed from amphiphilic ABC triblock terpolymers as building blocks for responsive coatings. The application of such colloidal units for thin films has several advantages from a material-science perspective, e.g. stimulus-responsivity and multi-functionality on a single particle level and simple preparation of coatings by physisorption. Besides, using LbL-SA allows forming hierarchically structured coatings with novel properties and collective stimulus response of the integrated nanostructures.[1] Here, we investigate the effects of pH and salt on properties of these films [2] and explore the accompanying morphological changes of the surface immobilized micelles as a function of their composition, i.e. properties of each block and the succession they are connected to each other. 1.Gensel J., Dewald I., Erath J., Betthausen E., Müller A. H. E., Fery A., Chem. Sci., 2013, 4, 325. 2.Gensel J., Betthausen E., Hasenöhl C., Trenkenschuh K., Hund M., Boulmedais F., Schaaf P., Müller A. H. E. and Fery A., Soft Matter, 2011, 7, 11144.

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Polymer-solid interphases and glass transition probed by positron annihilation lifetime spectroscopy — CHRISTIAN OHRT, TÖNJES KOSCHINE, ●KLAUS RÄTZKE, and FRANZ FAUPEL — University of Kiel, Chair for Multicomponent Materials, D-24143 Kiel, Germany

The properties of materials involving polymer-solid interfaces are not only determined by the constituents but also by the interfacial region of the polymer near the solid, the so-called interphase. This interphase is particularly important in polymer-based nanocomposites. Here we report on positron annihilation lifetime spectroscopy (PALS) measurements of the free volume near the interface with a moderated positron beam. First investigations from the polymer side indicated a reduced free volume in Teflon AF / Si samples [1] but no quantitative information. Analysis from substrate side with a focused beam through a hole showed a significant average density increase in an interphase region with a width of about 10 nm. Additionally, the glass transition temperature as a probe for chain dynamics was determined as function of distance to the interface in a Teflon AF / SiN sample with depth resolved PALS. Within error margins, no change in the glass transition temperature could be detected in the interfacial region.

[1] S. Harms, K. Rätzke, V. Zaporozhchenko, F. Faupel W. Egger, L. Ravelli, Polymer, 52 (2011) 505

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Conjugated diblock copolymer/fullerene bulk heterojunction system in organic photovoltaic application — ●RUI WANG¹, ZHENYU DI¹, HENRICH FRIELINGHAUS¹, PETER MÜLLER-BUSCHBAUM², and DIETER RICHTER¹ — ¹Jülich Center for Neutron Science, outstation at FRM II, Lichtenbergstr. 1, 85747 Garching — ²TU München, Physik-Department, LS Funktionelle Materialien, James-Franck-Str. 1, 85748 Garching

In order to achieve an optimum energy conversion efficiency for polymer based organic solar cells an interpenetrating bulk heterojunction (BHJ) network is needed, which has a nanoscale morphology on the order of the exciton diffusion length. The interpenetrating network provides larger interface area for exciton dissociation as well. Diblock copolymers are very promising for achieving well controlled nanoscale morphologies. In the present work, we blend the conjugated diblock copolymer P3HT-b-PS with the fullerene derivative PCBM. By applying grazing incidence small angle neutron scattering (GISANS) we

investigate the active layer, GISANS had proven to give good contrast conditions for polymer:PCBM films in previous investigations. We present the determined structures in terms of phase information, size of structural length scales and molecular miscibility between the components.

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Controlling Nanostructures by Templated Templates: Inheriting Molecular Orientation in Binary Heterostructures —
•TOBIAS BREUER and GREGOR WITTE — AG Molekulare Festkörperphysik, Philipps-Universität Marburg, Deutschland

Precise preparation strategies are required to fabricate nanostructures of specific arrangement. In bottom-up approaches, where nanostructures are gradually formed by piecing together individual parts to

the final structure, the self-ordering mechanisms of the involved structures are utilized. In order to achieve the desired structures regarding morphology, grain size and orientation of the individual moieties, templates can be applied, which influence the formation process of subsequent structures. However, this strategy is of limited use for complex architectures, as the templates only influence the structure formation at the interface between the template and the first compound. Here, we discuss the implementation of so-called templated templates and analyze, in which extent orientations of initial layers are inherited in top layers of another compound to enable structural control in binary heterostructures. To that purpose we have prepared crystalline templates of the organic semiconductors pentacene and perfluoropentacene in different exclusive orientations. We observe that for templates of both individual materials the molecular orientation is inherited in the top layers of the respective counterpart.