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 microheterogenous 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 Di[1], Christine M. Papadakis[1], Dorthe Posselt[2], Ruipeng Li[3], and Detlef-M. Smilgies[3] — [1]TU München, Physikdepartment E13, Garching — [2]Roskilde University, Denmark — [3]Cornell 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 Buffet[1], Gerd Herzog[1,2], Sebastien Couet[1], Rainer Gehrke[1], Ralf Roehlsberger[1], Andre Rothkirch[1], Kai Schlage[1], Wilfried Wurth[2], Gunar Kaune[3], Volker Koerstgens[3], Robert Meier[3], Ezzeldin Metwalli[3], Peter Mueller-Buschbaum[3], and Stephan V. Roth[1] — [1]HASYLAB at DESY, Hamburg, Germany — [2]Inst. f. Exp.Phys., Univ. Hamburg, Hamburg, Germany — [3]TU 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] — [1]Leibniz Institute of Polymer Research Dresden, Germany — [2]Technische 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 objects 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 thethered membranes is of the order of kT.