CPP 23 Polymer films I

Zeit: Dienstag 14:00–15:00 Raum: TU C130

CPP 23.1 Di 14:00 TU C130

Interactions between polyelectrolytes and monovalent ions in adsorbed nanofilms — •Regine v. Klitzing[1,2] and John Erik Wong[3] — [1]MPI f. Kolloid- und Grenzflächenforschung, Potsdam — [2]Institut f. Physikalische Chemie, CAU Kiel — [3]Stranski-Laboratorium, TU Berlin

The polymer films presented in this study were made by alternate adsorption of polyanions and polycations from aqueous solution onto solid substrates (Silicon, glass) using the layer-by-layer method developed in the early 1990s by Decher et al.[1]. It is assumed that complexes between polyanions and polycations are formed by an exchange of small counterions. In the present work it is shown that not only the ionic strength [2, 3] but also the type of low molecular salt has a pronounced effect on the formation and destruction of the polyelectrolyte multilayers. The different ions lead to a systematic change in film properties according to the Hofmeister Series. This means that specific interactions due to the polarizibility and the related hydration shell of the ions are important for the multilayer structure. The multilayers are characterized by ellipsometry, X-ray reflectometry and AFM.

[1] G. Decher, J.D. Hong, J. Schmitt (1992) Thin Solid Films 210/211, 831.

[2] R. Steitz, W. Jaeger, R. v. Klitzing (2001) Langmuir 17, 4471.

[3] U. Voigt, W. Jaeger, G. H. Findenegg, R.v.Klitzing (2003) J. Phys. Chem. B., 107, 5273.

CPP 23.2 Di 14:15 TU C130

Shape of Dewetting Fronts: Impact of Slippage — •Renate Konrad[1], Barbara Wagner[2], Andreas Münch[3], and Karin Jacobs[1] — [1]FR 7.2 Experimental Physics - Soft Matter, Saarland University, D-66123 Saarbrücken — [2]WIAS, Mohrenstr. 39, D-10117 Berlin — [3]Institute of Mathematics, Humboldt University Berlin, D-10099 Berlin

A liquid film that retracts from a non-wettable solid surface exhibits a peculiar profile that depends on parameters like the contact angle, the effective interface potential and the viscous and/or viscoelastic behavior of the liquid. We show that under certain conditions the profile also reacts to a change in the solid/liquid boundary condition, i.e. the sliding friction at the interface, which can be retraced to a change in the slip length. The profiles are determined by scanning force microscopy.

A thin macromolecular film (polystyrene of low molecular weight) is prepared on a smooth, hydrophobized Si wafer. Hydrophobicity was achieved by preparing two different types of self-assembled monolayers of silanes on the surface, octadecyl- (OTS) and dodecyltrichlorosilane (DTS), respectively. We discuss the influence of the two monolayers on surfaces roughness and on contact angle as well as on the dewetting velocity of the polystyrene film. New theoretical studies can explain the difference in front profile by assuming a change in slip length. Since slippage can enhance the flow rate also on a macro-scale, slippage is an important issue in the design of microfluidic devices such as mixers etc. The vision is thus to be capable to tailor surfaces in their ability to enhance slippage.

CPP 23.3 Di 14:30 TU C130

Investigation of the dynamics of a Nanoparticle in a Polymer Film — •Juan G. Diaz-Ochoa, Wolfgang Paul, Kurt Binder, and Martin Aichele — Institut fuer Physik, Johannes Gutenberg Universitaet , Staudinger Weg 7, D-55099 Mainz

The dynamics of a nanoparticle on a polymer film is investigated via Molecular Dynamics (MD) techniques. The interaction between particle and the monomers of the melt is modeled with a modified Lennard-Jones potential; we consider that the particle has a perfect smooth surface and spherical shape, ignoring its atomistic structure. The system is micro canonical and the simulations are performed for melt temperatures between the glass transition Tc and the film dewetting temperature. We show that the motion of a particle three to four times bigger and twenty five times more massive than the monomers of polymer-chains (at this scale the gravitational force is too weak and will be not considered) is sensitive to the change of temperature of the melt.

For temperatures near Tc the mean square displacement shows for short times a transition from a ballistic into a sub diffusive regime; this effect is related to a ‘caging effect’ of the particle in the melt; for long times the subdiffusive regime evolves into a diffusive one. We show more over that the Dynamics of the particle depends of its size and is affected by the number of monomers in each polymer chain . For temperatures T¿¿Tc the behavior of the particle is similar to a conventional Brownian particle

CPP 23.4 Di 14:45 TU C130

Is fluid dynamics of thin polymer films dominated by thermal noise? — •Klaus Mecke[1,2], Renate Konrad[3], and Markus Rauscher[2] — [1]Institut für theoretische Physik, Universität Erlangen-Nürnberg, Staudtstrasse 7, D-91058 Erlangen — [2]MPI für Metallforschung, Stuttgart — [3]Experimentalphysik, Universität Saarbrücken

In bulk fluids hydrodynamic Navier-Stokes equations are proven to be valid down to nanometer scales. However, during dewetting processes of thin liquid films of nanometer thickness the interplay of substrate potential and thermal noise can lead to qualitative different behavior on laterally much larger scales up to microns. By deriving a stochastic thin film equation with a conserved noise term we show that, e.g. the spectrum of capillary waves change due to thermal fluctuations from an exponential decay to a power law for large wavevectors. Also the time evolution of film roughness $\sigma(t)$ and of the typical wavelength $\lambda(t)$ of unstable perturbations change qualitatively. Whereas a deterministic Navier-Stokes equation in lubrication approximation predicts in the linear regime a constant $\lambda(t)$ and even an initial decay of $\sigma(t)$, thermal noise leads to a much faster increase of roughness and $\lambda(t)$, i.e. to coarsening. These findings are robust, i.e., the predicted breakdown of the deterministic hydrodynamic description of thin liquid films on a nanometer scale occurs for small thermal noise amplitudes and for a large class of substrate interactions. The theoretical predictions seem to be confirmed in recent AFM measurements of dewetting of thin polymer films.