Experiments with single molecules of polyelectrolytes at surfaces.

**MANIPULATION OF SINGLE POLYMER MOLECULES ON SOLID SUBSTANCES**

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Single molecules of linear polyelectrolytes (such as poly(2-vinylpyridine) or polystyrene sulfonic acid) and star-shaped block copolymers (polystyrene-poly(2-vinylpyridine)) were imaged being deposited onto an atomically flat mica with the aid of atomic force microscopy. Their diffusion coefficient and the distribution of the polymer molecules adsorbed on the ‘nano-structured’ surface relief grating. Besides a characterization of the surface with AFM studies on nanostructure of sol-gel materials doped with photosensitive compounds.

**MANIPULATION OF SINGLE MOLECULES OF POLYMERES ON SOLID SUBSTANCES**

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We report on the manipulation of single macromolecules on solid surfaces. The macromolecule–surface interaction was tuned with alkylated amphiphile molecules, which self-assemble on crystalline substrates like the basal plane of graphite into monolayers with head groups and alkyl tails phase separated into lamellae. These lamellae can serve as soft nanoscopic ‘rails’ along which the polymer orients. ds-DNA molecules with contour lengths of up to 2 micrometers have been moved as a whole in a simple manipulation step on a layer of dodecyleamide (1). The length distribution of the polymer molecules adsorbed on the ‘nano-structured’ surface is considerably different from the length distribution in solution, which we attribute to the entropy loss of the molecules stretched on the ‘nano-rails’. We visualize the col-glue localization of poly(sodium 4-styrenesulfonate) by trapping the over-all conformation in solution on the surface.


**Ultra-small angle X-ray scattering at colloidal crystals on prepatterned support**

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Crystalline ordering of monodisperse colloidal spheres is of great interest for many technical applications. The aim we pursue is to build up ordered structures (2D and 3D) on patterned substrates. The aim we pursue is to build up ordered structures (2D and 3D) on patterned substrates. Therefore 400 - 1000 nm sized Polystyrene particles were deposited by Gravity Sedimentation onto a substrate that is pre-structured by a surface relief grating. Besides a characterization of the surface with AFM the structure can only be investigated by Ultra Small Angle X-Ray Scattering at the ID2 beamline of ESRF, Grenoble. Actually we received information-rich scattering images of samples measured in reflection and transmission geometry. From these data we could deduce 2D ordering of the colloids. For the first time we performed time-resolved measurements; in particular we measured the scattering signal of colloidal solution in-situ after deposition onto the substrate. While the whole process of drying takes up to 5 hours essential changes appeared within a time window of 5 to 15 minutes. We found that the degree of ordering was higher in the liquid phase right before complete evaporation of solvent compared with the ordering in solid phase.

**Modification and imaging of surface charges on polymers using atomic force microscopy**

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The atomic force microscope (AFM) is widely used to investigate and modify mechanical properties of thin polymer films. Different static and dynamic modes like force curve measurements, Pulsed Force Mode or intermittent contact techniques apply certain amounts of normal and lateral forces to the sample. This implies the possibility to create surface charges, similar to the macroscopic contact electrification of insulators. These charges can be imaged in the ‘Surface Potential’ or ‘Kelvin Probe Force’ mode of the AFM. The quantity of charge depends on parameters like contact time, force or velocity. By an additional tip voltage during contact, the amount and polarity of the surface charges can be influenced.

The long-term stability of these charges, measured on different polymers, will be also shown in this work.

**AFM studies on nanostructure of sol-gel materials doped with photosensitive compounds**

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Silica sol-gels are porous bodies made from liquids. It is possible to entrap various compounds in the porous sol-gel network. The aim of this work is to examine the structural properties of sol-gel matrices doped with photosensitive dyes. Our idea is to construct a special light applicator which can act simultaneously as carrier for photosensitive dye for PDT. Two photosensitizers were examined: natural porphyrine Protoporphyrine IX and chlorophyll based Photoolon. The sol-gel films were prepared from silicate precursor TEOS mixed with ethanol in acid catalyzed hydrolysis, with different ratios R (20, 32, 40) denoting the number of alcohol moles to the number of TEOS moles. Pure and doped films were studied by means of AFM. It was stated that nanostructure of sol-gels depends on R ratio. It was proved that there are open pores enabling the contact of photosensitizers with external environment and the immobilization in sol-gels do not alter the structure of photosensitive dyes.