CPP 35 Single molecules I

Zeit: Mittwoch 09:45–11:00 Raum: TU C243

CPP 35.1 Mi 09:45 TU C243

AFM-based single molecule force spectroscopy of surface-grafted polymer monolayers — •Lars Sonnenberg[1], Julien Parvole[2], Laurent Billon[2], Oleg Borisov[2], Markus Seitz[1], and Hermann E. Gaub[1] — [1]Lehrstuhl für Angewandte Physik, Ludwig-Maximilians-Universität München, Amalienstr. 54, 80799 München — [2]Laboratoire de Physico-Chimie des Polymères, Hélioparc Pau-Pyrénées, 2 Av P Angot, 64053 Pau Cedex 09, France

Surface-grafted polymer layers created by the so-called "grafting-from" technique on the basis of nitroxide-mediated polymerization (NMP) feature controlled monolayer thickness and polymer dimensions. Therefore, they offer a broad range of applications, whenever specific properties of the interfaces are tuned by proper surface modification. For a better understanding of the structure-property relationships in these polymer layers, which is necessary for the tuning of the materials properties, there is need for characterization at the molecular level.

Here, we present our results of desorption experiments of the interfacial polymer chains as obtained by AFM. The measured force curves reflect number, lengths and desorption forces of the substrate-bound polymer chains from an opposing silica surface. Most importantly, the lengths of the adsorbed polymer chains determined with force spectroscopy are in good agreement with previous molecular weight determination obtained by GPC. Thus, our results promise the implementation of the AFM method as an analytical tool for the analysis of chain length distribution and grafting density in surface-grafted polymer layers.

CPP 35.2 Mi 10:00 TU C243

A single molecule study of intramolecular energy transfer in endcapped polyfluorenes — •K. Becker[1], J. M. Lupton[1], J. Feldmann[1], A. C. Grimsdale[2], and K. Müllen[2] — [1]Photonics and Optoelectr. Group, Physics and CeNS, LMU München — [2]MPI für Polymerforschung, Mainz

Endcapped semiconducting polymers are not only promising materials for high-efficiency organic LEDs, but are also excellently suited for studies concerning the understanding of energy transfer in conjugated polymers. We present results on single molecule spectroscopy on a polyfluorene with perylene endcaps, which allow insight into the nature of inter- and intramolecular energy transfer. It is shown that the intramolecular energy transfer of the excitation from the polymer backbone to the perylene observed in single, isolated molecules is far less efficient and thus slower compared to the intermolecular energy transfer dominating in bulk films. The inefficiency of intramolecular energy transfer arises primarily due to the considerable inhomogeneous broadening of the polyfluorene. The efficiency can be increased by raising the temperature and increasing the linewidth [1]. Polarisation sensitive single molecule experiments give insight into the structural properties of the polymer chains by analysing the spectrally resolved photoluminescence of both the polyfluorene and the perylene endcaps.

[1] J. G. Müller et al., Phys. Rev. Lett. 91, 267403 (2003)

CPP 35.3 Mi 10:15 TU C243

Fluorescence Correlation Spectroscopy Investigations of Water-soluble Polymers — •T. Bonne[1], K. Lüdtke[2], R. Jordan[2], P. Stepanek[3], R. Ivanova[1], and C. M. Papadakis[1] — [1]Physik Department E13, TU München, Germany — [2]Chemie Department, TU München, Germany — [3]Inst. Macromol. Chem., Prague

The diffusional behavior of 2-alkyl-2-oxazoline based on homo- and block copolymers in aqueous solution is studied using fluorescence correlation spectroscopy (FCS). The hydrophobicity can be varied continuously by changing the length of the alkyl side chain, and fluorescence groups can be attached. The chain length dependence of the diffusion coefficient of a series of low molar mass poly(2-methyl-2-oxazoline)s is in good agreement with a model based on rod-like particles. Furthermore, FCS allowed us to determine the very low critical micelle concentration (CMC) of amphiphilic poly[(2-methyl-2-oxazoline)-b-(2-nonyl-2-oxazoline)] diblock copolymers in aqueous solution ($< 10^{-5}$ M). With dynamic light scattering we were able to determine the same micellar hydrodynamic radius as with FCS, but the CMC was below the detection limit [1].

[1] T. B. Bonné et. al (2004), Coll. Polym. Sci. 282: 833.

CPP 35.4 Mi 10:30 TU C243

Molecular motion in thin liquid films near surface steps — •Arne Schob and Frank Cichos — Photonics and optical materials, Institute of physics, TU Chemnitz, 09107 Chemnitz

Solid surfaces strongly influence structure and dynamics of liquids close to them. These solid-liquid-interactions lead for example to a layering of the liquid near the interface which results in anisotropic diffusion of molecules. This anistropy is difficult to uncover in common ensemble experiments, while single molecule tracking experiments however are able to reveal such effects. While typically single molecule diffusion is recorded viewing normal to the surface, we present for the first time experiments on single molecule diffusion observing along the surface with the help of a surface step. Our experiments on rhodamine doped thin liquid films on a cleaved mica surface reveal an enhanced probability to find single molecules close to the surface step. Further the single molecule diffusion is found to be strongly anisotropic at the step with a diffusion constant being three times larger along the step than perpendicular to it. The anisotropic diffusion is a clear sign that the molecules are trapped in a potential near the surface. From our experimental data we estimate this potential to be deeper than 60 meV.

CPP 35.5 Mi 10:45 TU C243

Electrothermal manipulation of single chromophores in PI-conjugated polymers — •Florian Schindler[1], John M. Lupton[1], Jochen Feldmann[1], and Ullrich Scherf[2] — [1]Photonics and Optoelectronics Group, Department of Physics, LMU Munich — [2]FB Chemie, University of Wuppertal

Single molecule spectroscopy and imaging is an excellent tool for studying optoelectronics on a molecular scale. With this technique we are able to identify single chromophores on an electroluminescent ladder-type poly(para-phenylene) molecule at low temperatures [1] and observe random changes of the emission frequency of single chromophores due to spectral diffusion [2]. By exposing single molecules placed on top of tiny conducting strip lines to short electrically generated heat pulses we initiate an abrupt increase of the linewidth during the pulse followed by a subsequent reduction. Furthermore, we observe a random jump of the emission frequency. These spectral jumps span over almost the entire range of the inhomogeneously broadened ensemble spectra indicating changes in the chromophore surrounding and its position within the polymer backbone. Depending on the polymer chain length, we can also identify an off/on switching of the fluorescence following the heat pulse. This is due to efficient energy transfer to trap sites [1].

[1] Müller et al., PRL 91, 267403 (2003)

[2] Schindler et al., PNAS 101, 14695 (2004)