

CPP 35: Interfaces

Time: Friday 10:30–12:30

Location: C 130

Prize Talk

CPP 35.1 Fri 10:30 C 130

Nonlinear light scattering: Bridging the gap between surface science & soft matter — ●SYLVIE ROKE — Max-Planck Institute for Metals Research, Heisenbergstrasse 3, 70569 Stuttgart — Trägerin des Herta-Sponer-Preises

Interfaces are important locations for an enormous variety of physical, chemical and biological processes. Although surface science studies are usually performed on flat interfaces under controlled environments, in reality most interfaces are part of complex (soft matter) systems, such as cell membranes, emulsions or grains in solid materials. In the last decades it has become possible to address structural and dynamical questions relating to flat interfaces under ambient conditions, by probing them with nonlinear optical techniques. If one combines light scattering with nonlinear optical processes it is now becoming possible to go one step further: Interfaces of dispersed particles can be investigated in situ[1].

In this presentation I will introduce nonlinear optical scattering, highlight new possibilities that are becoming available and show some of the latest developments. These include: the possibility of investigating molecular surface effects in colloidal phase transitions[2], how to extract molecular properties[3] and the possibility of observing embedded structures in (polymer) materials.

[1] - S. Roke, W. G. Roeterdink, J. E. G. J. Wijnhoven, A. V. Petukhov, A. W. Kleyn and M. Bonn, Phys. Rev. Lett., 91 (2003), 258302-1. [2] - S. Roke, J. Buitenhuis, M. Bonn and A. Van Blaaderen, J. Phys.: Condens. Matter., 17 (2005), S3469-S3475; S. Roke, J. Buitenhuis, A. van Blaaderen and M. Bonn, PNAS, 103 (2006), 13310-13314. [3] - A. G. F. de Beer and S. Roke, Phys. Rev. B, 75 (2007), 245438-1-8.

CPP 35.2 Fri 11:00 C 130

MD simulations of sheared brush-like systems — ●LEONID SPIRIN¹, TORSTEN KREER², and KURT BINDER¹ — ¹Johannes Gutenberg-Universität Mainz, Institut fuer Physik, Staudinger Weg 7, 55099 Mainz, Germany — ²Institut Charles Sadron, 6 Rue Boussingault, 67083 Strasbourg, France

Friction forces between two solid surfaces bearing polymer brushes play a key role in many applications. However, systems with soft colloids between polymer brushes have not been investigated yet. Star polymers can be taken as a model of hairy micelles or soft colloids. We perform Molecular Dynamics simulations of such systems under shear. Static and dynamical properties are investigated. In particular, we focus on the response to non-stationary external stimuli.

CPP 35.3 Fri 11:15 C 130

Reversible activation of a polyelectrolyte brush — V. PAPAETHIMIOU¹, J.-U. GÜNTHER², C. A. HELM², S. FÖRSTER³, G. H. FINDENEK¹, and ●R. STEITZ⁴ — ¹Technische Universität Berlin — ²Ernst-Moritz-Arndt-Universität Greifswald — ³Universität Hamburg — ⁴Hahn-Meitner-Institut Berlin

Polyelectrolytes anchored on surfaces are important in various applications and are also a challenging topic for fundamental studies. In this work, a monolayer of the PEE114PSS83 [(poly(ethyl ethylene)114 poly(styrene sulfonic acid)83) diblock copolymer was transferred from the air/water interface to a deuterated polystyrene coated silicon (dPS/Si) surface, for evaluation as a tunable polyelectrolyte-brush containing system. The grafting density of the polymer film was controlled by changing the lateral pressure during the depositions. X-Ray Reflectivity and AFM measurements showed that a homogeneous layer of the block copolymer was formed, whose thickness (maximum 8 nm) increased with increasing grafting density. Neutron reflectivity studies against aqueous solutions revealed a hydrophobic PEE layer attached on the dPS/Si surface, and a carpet/brush polystyrene sulfonate (PSS) double layer in water. The effect of salt concentration on the brush nanostructure was investigated in aqueous solutions containing 0-1 M NaCl. It was found that the brush thickness decreases for salt concentrations above 0.1 M. In addition, reversible activation of the brush by changing the ionic strength of the subphase was demonstrated. These results confirm a potential use as a stimuli-responsive polymer for both fundamental studies and biological applications.

CPP 35.4 Fri 11:30 C 130

Polarisation modulation IR studies on silica surfaces functionalised with protein resistant coatings — ●STEFAN ZORN¹, IAIN DUNLOP², ALEXANDER GERLACH¹, and FRANK SCHREIBER¹ — ¹Institut für Angewandte Physik, Universität Tübingen, Germany — ²Max Planck Institut für Metallforschung, Stuttgart, Germany

We performed polarisation modulation infrared reflection absorption spectroscopy (PM-IRRAS) studies of organic silane coatings on silica surfaces and their protein resistance. PM-IRRAS measurements require conducting surfaces to get a signal and to benefit from the surface selection rules. In the case of silane chemistry an important tool to functionalise silicon and glass surfaces this is hardly possible. We developed a multilayer, consisting of a titanium layer and a sputtered silica layer on top which is easy to produce and enables us to perform PM-IRRAS measurements on silanised surfaces. We studied biotinylated PEG2000 layers, a widely used system for sensor surfaces, and their ability to resist unspecific protein binding and enables specifically streptavidin binding. We were able to demonstrate PEG adsorption on the substrates and the specific binding of streptavidin with characteristic absorption modes. We also discuss theoretical aspects of the signal on different layer systems with the help of simulations based on the Fresnel equations.

CPP 35.5 Fri 11:45 C 130

Unspecific adsorption of protein films: dynamics and morphology — ●YVONNE SCHMITT, HENDRIK HÄHL, HUBERT MANTZ, and KARIN JACOBS — Saarland University - Department of experimental physics, 66123 Saarbrücken, Germany

Protein adsorption takes place whenever a surface is in contact with a protein solution and can for example lead to fouling. The control of adsorption therefore is of crucial importance for many biological and biomedical applications like dentistry and the design of implants. By performing in-situ AFM scans in a liquid environment it is possible to gain insight in the complex process of unsecific protein adsorption. The dynamics was monitored via a series of AFM images. The characterization of the spatial protein distribution is done by means of integral geometric methods (Minkowski-functionals) that allow to distinguish between random sequential adsorption and guided adsorption and gives an objective description of the morphology of the protein film. The experimental results will be compared with recent simulations in order to develop a comprehensive description of the the adsorption process which could possibly allow to predict the next adsorption sites for a given protein arrangement.

CPP 35.6 Fri 12:00 C 130

Activity and Conformation of Lysozyme Adsorbed on Surfaces of Nanodiamond/-silica — ●VICTOR WEI-KEH WU — Department of Chemical and Materials Engineering, National Kaohsiung University of Applied Sciences, 80782 Kaohsiung, Taiwan — Victor Basic Research Laboratory e. V. Gadderbaumer-Str. 22, 33602 Bielefeld, Germany, Email:victorbres3tw@yahoo.com.tw, Tel:+886-919-300-525.

Coverages and adsorption constants via fluorescence of free lysozyme before and after adsorption on the surfaces of nanodiamond/-silica of diameter 100 nm with their suspension solutions prepared with concentration of 25 mg in 10 mL PPBS of 7 mM at pH=11 have been obtained. 55 and 15 nm²/g BET surfaces of nanodiamond/-silica after adsorptive-dose rate-static-volumetric method were obtained. 12 and 4 nm² as available surfaces for each lysozyme at saturation threshold 190 and 175 nM for lysozyme and nanodiamond/-silica, respectively, can be derived. Coverages 10~65 % after adsorption on nanodiamond correspond 10~75 % of the original lysozyme activity, if effects upon helicity for both at pH=5 and 11 were similar. Lysozyme can possibly keep its helicity well and show its optimal activity, even as surface on nanodiamond is covered nearly 100 % at 700 nM. On the contrary, it on surface of nanosilica can still keep its helicity well, only if its concentration is lower than 100 nM. It might be deformed or changed with its folding structure much in the region of 100-1000 nM. Nanosilica is rather incompetent in the sense of adsorption of lysozyme. Ref. 1. V. W.-K. Wu, CL. 35, 1380 (2006), 2. T.-T. Bao Nguyen, H.-C. Chang, and V. W.-K. Wu, Diamond and Related Materials, 16, 872 (2007).

CPP 35.7 Fri 12:15 C 130

Specific Ion Adsorption at Solid Surfaces — ●DOMINIK HORINEK,

DOUWE BONTHUIS, and ROLAND R. NETZ — Physik Department, Technische Universität München, 85748 Garching, Germany

Ion specific effects at solid surfaces are of fundamental importance in biology, physics, and chemistry. Contrary to electrostatic forces, which are well-described by analytical theories, there is no satisfying theory for all solvent-induced forces. We present molecular dynamics simula-

tions for the calculation of potentials of mean force for ion adsorption at hydrophobic and hydrophilic surfaces. We discuss ion specific effects at infinite dilution as well as their implications for the surface tension and surface potential at finite salt concentrations based on an extended Poisson-Boltzmann modeling where we include the potentials of mean force from simulation. We obtain qualitative agreement with experiments.