CPP 16: Focused Session: Confinement of Polymers in Nanoscopic Layers - How Much do Properties Change? II

Time: Tuesday 14:00–15:30 Location: ZEU 160

Invited Talk CPP 16.1 Tue 14:00 ZEU 160

Glass Transition Dynamics of Polymer Films — •Ophelia K. C. Tsui — Department of Physics, Boston University, Boston, MA 02215

Most polymers solidify into a glassy amorphous state, accompanied by a rapid increase in the viscosity when cooled below the glass transition temperature (Tg). There has been an ongoing debate on whether the Tg changes with decreasing polymer film thickness and the origin of the changes. We measured the viscosity of unentangled, short-chain polystyrene (Mw = 2.4 kg/mol) films on silicon at different temperatures and found that the transition temperature for the viscosity decreases with decreasing films thickness, in agreement with the changes in the Tg of the films observed by thermal expansion measurements. By applying the hydrodynamics equations to the films, we are able to explain the data fully by assuming that a highly mobile layer is present within the top 2.3 nm thick region of the films and follows an Arrhenius dynamics while the remaining of the films is bulk-like.

Invited Talk CPP 16.2 Tue 14:30 ZEU 160

Conformational properties of polymer melts in spatial confinement — Hendrik Meyer, Albert Johner, Joachim Wittmer, Julia Zabel, Jean Farago, and •Jörg Baschnagel — Institut Charles Sadron, Strasbourg, France

Over the last years several groups discussed deviations from chain ideality in homopolymer melts and dense solutions. These deviations result from the interplay between melt incompressibilty and chain connectivity; the strength of the effect depends on the dimensionality of space. After an introduction to the behavior in the bulk we focus on polymer melts confined to thin films and capillaries. We find that deviations from chain ideality are stronger in thin films than in bulk and even stronger in thin capillaries. These theoretical predictions will be illustrated by results from molecular simulations of simple (coarse-grained) polymer models.

CPP 16.3 Tue 15:00 ZEU 160

Substrate influence on the structure and properties of polyelectrolyte multilayers — •Chloe Chevigny, Maximilian Zerball, and Regine von Klitzing — Stranski Lab., TU Berlin, Institut für Chemie, Sekr. TC 9, 10623 Berlin

Polyelectrolyte Multilayers (PEM), made by the Layer-by-Layer (LbL) deposition technique, are a very versatile and interesting tool for many technical applications. Since their development 20 years ago, there has been an exponential increase of works in this topic, allowing a better comprehension of their structures and properties, but also more applied studies, resulting in many applications such as sensor coatings or drug delivery systems. However, in order to better understand the functionalities of these systems and find new applications, fundamental studies are always needed. We focus on the properties profile across the film and on the effect of the solid substrate: over which length scale the substrate affects the film properties, and from which distance does the film reach bulk properties? For this project several surfaces types are studied: Silicon and Gold (resp. negatively and positively charged), with or without a first protective layer of PolyEthyleneImine PEI. The structure, as well as the swelling and dynamical properties of the multilayers, are determined via a combination of ellipsometry, X-rays and neutron reflectivity, QCM-D and FRAP measurements. The substrate is found to have an important influence, both on internal structure (layers inter-diffusion increases linearly from top to bottom) and properties (changing the substrate changes both diffusion and swelling features) of the multilayers.

CPP 16.4 Tue 15:15 ZEU 160

Density in polymer films and at the polymer-solid interface — •Eicke Tilo Hoppe[1], Boyuan Wang[1], Martin Haese-Seiller[2], Jean-Francois Moulin[2], Max Port[3], Bernhard Menges[3], and Christine M. Papadakis[1] — [1]TU München, Physik-Department, Fachgebiet der weichen Materie, Garching, Germany — [2]GKSS-Forschungszentrum Geesthacht, Geesthacht, Germany — [3]MPI for Polymer Research, Material Science Group, Mainz, Germany

The change in physical behaviour of polymers at interfaces is of importance for the adhesion of polymer coatings to solids, e.g. in medical implants and in nanocomposites. The aim of the project is the investigation of the influence of the polymer-solid interaction on the physical properties of the polymers near the interface.

We focus on the correlation between the changes of density, viscosity and chain orientation of the polymer melt near the interface. Polybutadiene melts from toluene solutions on silicon oxide are studied as a model system. To tune the interface interactions between substrate and polymer melt, the substrate surface is modified chemically and by silanization. The density profile near the solid interface is investigated by time-of-flight neutron reflectometry (TOF-NR) at REFSANS. The films have a lower density than the bulk value expected from literature and density deviations at the interface. The optical properties of polybutadiene are investigated in the bulk using optical waveguide spectroscopy, whereas the interphase is characterized by monitoring the surface plasmon. The refractive index in the interphase close to the gold-coated glass is lower compared to the bulk.