SFB TRR 102

Polymers under Multiple Constraints

Polymer and Soft Matter Seminar

Tuesday,

25th February 2014

at: **2.15 pm**

VDP3 1.04,
Von-Danckelmann-Platz 3,
06120 Halle

Dr. Nikolai Severin

Department of Physics, Humboldt-Universität zu Berlin

"Dynamics and structure of mono-molecularly thick water-ethanol layers confined between graphene and mica"

The behaviour of multicomponent liquids in confining geometries is a fundamental physical problem, which plays a central role in fields such as nano-fluidics, molecular biophysics, single molecule spectroscopy, and nano-chemistry, e.g. for molecular transport through channels of biological membranes analyte recognition in molecular assays and molecular synthesis. We followed in-situ the dynamics within mixed monomolecular water-ethanol films in a slit pore between a hydrophilic atomically flat mica surface and a more hydrophobic graphene layer, using scanning force microscopy. Graphene is the thinnest membrane known, and combines high flexibility[1] with impermeability even for small molecules. Water and ethanol, highly miscible in three dimensions are shown to nano-phase separate in monolayers within the pore. Graphene conforms to the liquid film, bending at the boundaries between the domains of water and ethanol to accommodate their different thicknesses of an angstrom. The growth dynamics of the domains allows to determine a lower bound for the two-dimensional diffusion constant of ethanol in water of $D \geq 2 \times 10\text{-}14\ m^2s^{-1}$. The lateral size of molecular domains becomes larger with the graphene thickness, which we attribute to the graphene bending energy. Ethanol and water molecules have been demonstrated to dope graphene negatively and positively, respectively. Consequently, we account for stabilization of the heterogeneity by the counteraction of electrostatic repulsion of the doped charges and line tension controlled by the bending energy of the graphene layers.

1. Severin, N., et al., Replication of Single Macromolecules with Graphene. Nano letters, 2011. 11(6): p. 2436-2439