CPP 36: Microfluidics III: Soft Objects in Flow

Time: Thursday 15:45–17:00 Location: ZEU 160

Topical Talk CPP 36.1 Thu 15:45 ZEU 160

Modifying Single Particle Diffusion by Chemical Surface Patterning — Martin Pumpa and •Frank Cichos — Molecular Nanophotonics Group, University Leipzig

Molecular dynamics at solid/liquid interfaces is among other effects defined by the strength of the interaction of the liquid with the solid surface. The hydrodynamic boundary conditions define the hydrodynamic friction a particle or molecule experiences close to this interface. Thus control of the surface properties of a solid substrate provides a route to control the interfacial molecular dynamics in liquid films. Within this contribution, we present first experimental results on a controlled manipulation of single molecule diffusion by chemically patterning glass surfaces. Using micro-contact printing, we prepare a hydrophilic/hydrophobic pattern on the surface. Typical dimensions of the structure of this pattern are on the order of a few micrometers. These surfaces are mounted in a surface forces apparatus, where the liquid covering the pattern is confined down to a film thickness of a few 100 nanometers. To study molecular dynamics, we employ single molecule tracking of labeled colloids dispersed in the liquid. A new correlation analysis of particle mobility and particle position reveals a clear spatial correlation between chemical surface preparation and particle diffusion.

CPP 36.2 Thu 16:15 ZEU 160

Dynamics of suspended particles diffusing through small walls — •Laura Almenar[1,2] and Markus Rauscher[1,2] — [1]Max-Planck-Institut für Metallforschung, Stuttgart, Germany — [2]ITAP, Universität Stuttgart, Stuttgart, Germany

We study the dynamics of suspended particles in small channels in the presence of flow (in particular Poisseuille flow). We describe the transport taking into account the interactions among the particles as well as with the walls. We extend our study to include the effect of hydrodynamic interactions between particlesand walls. With hydrodynamic chromatography as an application in mind we aim for a better understanding of these transport processes.

We focus first on steady state situtations and we calculate the size-dependent throughput of the particles using a finite element method. It will be compared with the case of non-interacting particles. The throughput is enhanced or decreased as compared to the non-interacting case depending on the size ratio of the particles and the interaction radius.

CPP 36.3 Thu 16:30 ZEU 160

Self Assembled Supramolecular Structures using Microfluidic Gel Emulsions: Applications in Molecular Electronic Circuits — •Shashi Thutupalli[1], Shuang Hou[1], Ralf Seemann[1,2], Marcel Mayor[3], and Stephan Herminghaus[1] — [1]Max Planck Institute for Dynamics and Self-Organization, Göttingen, Germany — [2]Experimental Physics, Saarland University, Saarbrücken, Germany — [3]Department of Chemistry, University of Basel, Switzerland

Hierarchical supramolecular structures in nature are seamlessly linked over several length scales. Synthetic systems with similar integration have been built using two approaches - top down and bottom up. We employ a combination of both, using droplet microfluidics and molecular design, to demonstrate the possibility of self assembled molecular circuits. Using microfluidic gel emulsions, we generate 100's of lipid bilayers that can hold self inserting (amphiphilic) conducting molecules that span the bilayer. Aqueous compartments on either side of the bilayers are then used as electrical contacts establishing self assembled nanogaps for molecular electronics. Further, the droplets in the microfluidic channel assemble into precise arrangements, forming well controlled circuits of conducting molecular rods. Special integrated microelectrodes are used as electrical probes. In such a setup, we show insertion of an electrochromic dye, Di-4-ANEPPS into bilayers of monoolein and record its fluorescence intensity variation with an applied voltage. As a first step to building functional circuits, we also present preliminary results with synthetic conducting molecules.

CPP 36.4 Thu 16:45 ZEU 160

Development and validation of a simplified particulate model for the simulation of blood flow in arbitrary geometries — •Florian Janoschek and Jens Harting — Institute for Computational Physics, Pfaffenwaldring 27, D-70569 Stuttgart, Germany

Simulation of human blood flow is a demanding task both in terms of the complexity of applicable models as well as the computational effort. One reason is the particulate nature of blood which in first approximation may be treated as a suspension of red blood cells (RBC) in blood plasma. A second reason is that in realistic geometries typical length scales vary over several orders of magnitude.

By coupling a simple molecular dynamics algorithm for modeling the RBC to the lattice Boltzmann method we obtain an efficient and versatile parallel code that keeps the particulate nature of the RBC and takes full hydrodynamic interactions into account. Different from other lattice Boltzmann-based approaches we do not model the deformability of the RBC itself but instead cover it by soft anisotropic potentials between each two particles as well as between each particle and the confining geometry.

Due to this simplifications our model is computationally efficient enough to simulate the high numbers of RBC that occur in vessels of intermediate size. To validate our model we compare our numerical results to experimental data obtained from the literature.