CPP 22: POSTERS Micro- and Nanofluidics

Time: Wednesday 16:00–18:30 Location: Poster A

CPP 22.1 Wed 16:00 Poster A

Kinetic Monte Carlo modeling of the fingering instability of dewetting fronts in nanoparticle suspensions — •Ioan Vancea[1], Christopher Martin[2], Matthew Blunt[2], Emmanuelle Pauliac-Vaujour[2], Philip Moriarty[2], and Uwe Thiele[1,3] — [1]Max-Planck-Institut fur Physik komplexer Systeme, Noethnitzer Str. 38, D-01187, Germany — [2]School of Physics & Astronomy, The University of Nottingham, University Park, Nottingham, NG7 2RD, UK — [3]School of Mathematics, Loughborough University, Loughborough, Leicestershire, LE11 3TU, UK

We use a kinetic Monte Carlo simulation of a 2D Lattice Gas Model to show that for a nanoparticle solution that dewets by evaporation the particles induce a strong fingering instability of the dewetting fronts. We analyze the influence of parameters, such as nanoparticle concentration, mobility, chemical potential on the characteristics of the fingering.

Furthermore we discus in detail the role played by nanopaticle-nanoparticle and liquid-nanoparticle interaction strength and distinguish parameter regions where hydrodynamic processes and liquid-particle demixing processes dominate the structure formation.

We acknowledge support by the European Union via the FP6 Marie Curie scheme [Grant MRTN-CT-2004005728 (PATTERNS)].

CPP 22.2 Wed 16:00 Poster A

Vibration dynamics of a bubble in contact with solid surface — Sergey V. Shklyaev[1] and •Arthur V. Straube[2] — [1]Theoretical Physics Department, Perm State University, Bukirev 15, 614990 Perm, Russia — [2]Department of Physics, University of Potsdam, Am Neuen Palais 10, PF 601553, D-14415 Potsdam, Germany

The linear natural and forced oscillations of a bubble in a liquid ambient in contact with a solid surface are studied [1]. We consider a class of boundary conditions allowing for different behavior at the contact line, where the three phases touch. The contact line dynamics is taken into consideration with the Hocking condition, which is shown to lead to interaction of the shape and volume oscillations even within the linear theory. Resonant phenomena, mostly pronounced for the bubble with the fixed contact line or with the fixed contact angle, are found out. The limiting case of weakly compressible bubble is analyzed. The general criterion identifying whether the compressibility of a bubble can be neglected is obtained.

[1] S.V. Shklyaev, A.V. Straube, Linear oscillations of a hemispherical bubble on a solid substrate, submitted to Phys. Fluids (arXiv:0710.0212)

CPP 22.3 Wed 16:00 Poster A

Mixing on the micron-scale with rotating colloidal clusters — •Sabri Rahmouni[1], Tobias Sawetzki[1], David Marr[2], and Clemens Bechinger[1] — [1]2. Physikalisches Institut, Universität Stuttgart — [2]Chemical Engineering Department, Colorado School of Mines

Recently, the fabrication of "lab on a chip" devices has attracted considerable attention amongst physicists and chemists. In the meantime many different approaches and solutions to operate such devices have been suggested. One of the main problems is the mixing of fluid components on the micron scale, i.e. at low Reynolds numbers where no turbulence exists. We demonstrate a novel approach to overcome this problem by subjecting paramagnetic colloidal particles to magnetic fields which rotate in the sample plane. As a result, an external torque is exerted on the colloidal particles which then act as micro mixers. When analyzing the output flow of a mixing chamber, we observe that such mixers strongly enhance the mixing of the two inlets, one of them containing small, nonmagnetic tracer particles.

CPP 22.4 Wed 16:00 Poster A

Molecular Electronics using Gel-Emulsions — •Shashi Thutupalli[1], Venkatachalam Chokkalingam[1], Marcel Mayor[3], Stephan Herminghaus[1], and Ralf Seemann[1,2] — [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

We use 'gel emulsions' (emulsion with a very small continuous phase volume fraction) that arrange into a foam like topology for well defined assembly of molecules across the droplet lamellae. For certain water in oil emulsions including suitable surfactants, the lamella separating the droplets can be collapsed to form a double-layer membrane by controlling the volume fraction of the continuous phase. A hydrophobic conducting molecule might then insert into the membrane with its hydrophilic head groups immersed into the droplets while the orientation of the molecule is well known. The water droplets sandwiching these molecules can then serve as electrodes to apply a voltage across the membrane via the molecules. When the gel-emulsion flows along a network of microfluidic channels we can induce precise rearrangements of the foam like droplet topology. Thus, we expect to build various electronic circuits. As a first approach towards this, water droplets in dodecane, with monoolein as surfactant, are produced. A voltage sensitive fluorescent dye (eg. Di-4-Anepps) is inserted in the membrane and switching of the fluorescent peak is demonstrated.

CPP 22.5 Wed 16:00 Poster A

Topology transitions of monodisperse emulsions in microchannels — •Enkhtuul Surenjav[1], Martin Brinkmann[1], Craig Priest[1], Stephan Herminghaus[1], and Ralf Seemann[1,2] — [1]MPIDS, D-37073, Göttingen, Germany — [2]Saarland University, D-66041, Saarbrücken, Germany

In the confinement of a micro-channel, foam-like emulsions appear in a variety of periodic patterns, we call topologies. Transitions between certain topologies in a flowing emulsion can be induced through variations of the channel geometry. Such a 'passive' manipulation of the droplets by means of the confinement allows to position, sort, exchange, compile and redistribute droplets. These rearrangements are studied for various geometries as a function of volume fraction and droplet size. Based on numerical and analytical result we predict mechanical instabilities in straight channels and present a phase diagram for the different droplet topologies. Furthermore, we quantify the impact of a bend in the channel on the exchange of droplet positions. In combination with a technique to coalesce targeted pairs of droplets, a controlled interchange of neighboring droplets can be used to perform multi-step reactions. The transition between a bamboo and a zigzag structure demonstrates that topology transitions are inherently hysteretic at large volume fractions of the dispersed phase. 'Passive' reorganizations based on fixed channel geometries can be supplemented by 'active' manipulation of an incorporated ferrofluid phase. A ferromagnetic continuous phase facilitates reorganization of liquid compartments on demand using an electromagnetic trigger.

CPP 22.6 Wed 16:00 Poster A

Separation of Model Emulsions on Chemically Patterned Surfaces: Confinement, Hysteresis & Droplet Coalescence — •Pagra Truman, Petra Uhlmann, and Manfred Stamm — Leibniz-Institut für Polymerforschung, Hohe Str. 6, 01069 Dresden, Germany

Chemically patterned surfaces can be used to drive liquid flow along surfaces in microfluidic systems. In this work we investigate the separation of model emulsions consisting of an aqueous and a non-polar component on step gradient surfaces with one hydrophilic and one hydrophobic side. The separation is driven by the strong affinity of the aqueous component to the hydrophilic side.

Analysing the separation process in detail we identify droplet coalescence as a key phenomena during separation. Thus droplet coalescence in the presence of hydrophobic and hydrophilic surfaces in confinement and on open systems is studied. Surprisingly we find that the impact of surface wettability on droplet coalescence in confinement is opposite to the case of an open system. Introducing a simple theoretical model taking into account surface energy hysteresis we are able to explain such behaviour.

CPP 22.7 Wed 16:00 Poster A

Two-dimensional gas-liquid two-phase flow in a microfluidic device — •Yasutaka Iwashita[1], Ralf Seemann[1,2], Christian Bahr[1], and Stephan Herminghaus[1] — [1]MPI for Dynamics and Self-Organization, 37073 Göttingen, Germany — [2]Experimental Physics, Saarland University, 66041 Saarbrücken, Germany

Monodisperse emulsions with a high volume fraction of the dispersed phase can be produced using step emulsification [1]: A quasi 2D-liquid stream of a dispersed phase surrounded by a continuous phase in a shallow channel is transformed into droplets at a topographic step by

a Rayleigh-Plateau-type instability.

Here we replace the dispersed liquid by gas and study the gas-liquid two-phase flow in a similar microfluidic device. Due to the compressibility and lower viscosity of gas (more than 100 times smaller than liquid) the dynamics of the quasi 2D, two-phase flow is different from that of liquids. By observing the flow we found three characteristic flow structures: (i) gas-liquid co-flow at high pressure (or large flow rate) of gas, (ii) bubble generation at the T-junction of the shallow channel and (iii) liquid one-phase flow when the gas pressure is lower than the liquid pressure at the T-junction. We will show how these flow structures depend on the conditions (height of the shallow channel, interfacial tension, etc.), and explain the findings with a "simple" theoretical analysis.

[1] C. Priest, S. Herminghaus and R. Seemann, Appl. Phys. Lett. 88, 024106 (2006)

CPP 22.8 Wed 16:00 Poster A

Recirculation flows and friction in confined gel emulsions — •Audrey Steinberger[1], Shashi Thutupalli[1], Ralf Seemann[1,2], and Stephan Herminghaus[1] — [1]MPI for Dynamics and Self-organization, D-37073 Göttingen — [2]Experimental Physics, Saarland University, D-66041 Saarbrücken

Emulsions with a high dispersed phase volume fraction, the so-called gel-emulsions, are not only a promising tool for handling liquids in microfluidic processes but also a convenient model system to study friction between membranes, as the arrangement of monodisperse droplets is defined and can be manipulated by the geometry of the microchannel in which they are flowing. Recirculation flows -controlling the mixing- inside the droplets are induced by the friction at the interfaces. We study experimentally those recirculation flows, using microparticle image velocimetry (μ-PIV), as a function of the arrangement of the droplets and the dispersed phase volume fraction, in order to investigate the friction properties of emulsions in the limit where the thickness of the continuous phase lamellas becomes very small, and possibly reduces to a surfactant bilayer.

CPP 22.9 Wed 16:00 Poster A

Thin dewetting polymer films: Fingering and the effect of interfaces — •Ludovic Marquant, Frank Müller, Julia Mainka, Oliver Bäumchen, and Karin Jacobs — Saarland University, Experimental Physics, D-66041 Saarbrücken, Germany

The dynamics of supported polymer thin films is studied along two aspects, which are the behaviour of films in bulk conditions (h> 100 nm) and the deviation from the bulk behaviour for smaller film thicknesses. First, we investigate the dynamics of the last stage of dewetting of a polymer melt from a hydrophobized substrate, where fingers are initiated by amplified fluctuations created by the growth of the rim (liquid moving front), analogue to the Rayleigh-Plateau-Instability. Film thickness and slippage influence the occurrence of the fingers structure. We demonstrate, backed by theoretical support, that slippage acts on the geometry of bulges, which become more asymmetric as the slip length increases. The system we use is a 100 nm polystyrene film prepared on top of differently hydrophobized Si wafer. Furthermore, we investigate the dynamics of the polymer at interfaces regarding the change of the glass transition temperature as we depart from bulk conditions. For molecules smaller than 300 kg/mol, it has been shown that the shift of Tg is not due to the geometrical finite size effect because the shift is independent of molecular weight. This phenomenon, studied by NMR, is explained by an enhanced molecular mobility at the free polymer interface. As NMR takes place in liquids and therefore affects the surface tension of polystyrene, we investigate in situ ellipsometry measurements of Tg with various liquids surrounding the film.

CPP 22.10 Wed 16:00 Poster A

Probing slippage of thin polymer films on smooth hydrophobic surfaces — •Oliver Bäumchen, Renate Fetzer, and Karin Jacobs — Saarland University, Experimental Physics, D-66123 Saarbrücken, Germany

We study the boundary conditions at the solid/liquid interface of thin film flow of highly viscous Newtonian liquids. To induce flow, we make use of the dewetting process. In our system, polystyrene melts below the entanglement length dewet after annealing above their glass transition temperature from smooth hydrophobic substrates, silicon wafers covered by octadecyltrichlorosilane (OTS), dodecyltrichlorosilane (DTS) brushes, and thin teflon (AF1600) films. By investigating the radii of the growing holes, we find that the dewetting velocity at a certain temperature strongly depends on the type of substrate. Identifying viscous flow and slippage contribution allows us to extract the slip length. The numbers for the slip length are consistent with results obtained from atomic force microscopy analysis of the shape of the rims that surround each hole. They exhibit either an oscillatory or a monotonically decaying rim profile. A recently developed Stokes model for a thin liquid film dewetting from a solid substrate [1], which is not restricted to a certain range of slip lengths, is used to determine slip length as well as the viscosity of the polymer melt. The slip length on the silane brushes is found to be about one order of magnitude larger on DTS than on OTS and decreases with increasing temperature, whereas on AF1600 we find a nearly vanishing contribution of slippage. [1] R. Fetzer et al., Langmuir 23 (2007) 10559.

CPP 22.11 Wed 16:00 Poster A

Lattice Boltzman and DPD Electrohydrodyamics simulations — Jens Smiatek[1], Friederike Schmid[1], •Marcello Sega[2], and Christian Holm[2] — [1]Fakultät für Physik, Universität Bielefeld, Universitätsstraße 25, D-33615 Bielefeld, Germany — [2]Frankfurt Institute for Advanced Studies, Ruth-Moufang Str. 1, D-60438 Frankfurt am Main, Germany

In the framework of the solution of coupled Navier-Stokes / Molecular Dynamics simulations of Electrohydrodynamic systems, we present the results of a comparison between Lattice Boltzmann and Dissipative Particle Dynamics.

The two methods, respectively based on the solution of the Boltzmann equation on a lattice, and on a momentum-conserving Galilean-invariant particle based thermostat, have been recently implemented into the ESPResSo simulation package. Convergence of physical observables and relative limits and strengths of the two approaches are evaluated, as well as their computational efficiency.

The benchmark system is that of an electroosmotic flow in a slit pore, where explicit ions are taken into account, with full periodic electrostatic treatment and hydrodynamic interactions.

CPP 22.12 Wed 16:00 Poster A

Water structure and slippage at hydrophobic and hydrophilic surfaces — •Christian Sendner[1], Jiri Janecek[2], and Roland Netz[1] — [1]Physik Department, Technische Universität München — [2]Institute of Physical and Applied Chemistry, Brno University of Technology, Czech Republic

Via Monte Carlo and Molecular Dynamics simulations, we probe the structure and slippage of water films at hydrophobic and hydrophilic surfaces. At nonpolar, hydrophobic surfaces, a depletion of the water density is observed which is set in relation to the wetting properties. At hydrophilic surfaces, achieved with polar hydroxyl groups on top, we examine the interfacial water structure dependent on the density, spatial distribution and angular orientation of the polar groups. In non-equilibrium simulations the slip length of sheared water layers between two hydrophobic surfaces is examined as well as the structural changes of interfacial water at hydrophilic surfaces under the influence of shearing.

CPP 22.13 Wed 16:00 Poster A

Quasistationary dynamics of droplets on chemically structured substrates — Fabian Dörfler[1,2], •Markus Rauscher[1,2], and Siegfried Dietrich[1,2] — [1]Max-Planck-Institut für Metallforschung, Stuttgart, Germany — [2]ITAP, Universität Stuttgart, Stuttgart, Germany

With open microfluidic systems in mind, we study the dynamics of droplets on chemical channels (i.e., hydrophilic stripes on otherwise hydrophobic substrates) in the quasistatic limit using the software Surface Evolver. In particular, we investigate the free energy landscape of droplets on symmetric Y-junctions in the capillary model. We find an energetic minimum right at the junction. There is a maximum in the energy landscape between two branches but no local minimum which might indicate the splitting of droplets. In addition, we find, that moving a droplet into a junction and back into a channel can result in a metastable elongated droplet shape.

We also investigate methods to include the substrate potential (i.e., the effect of long-ranged intermolecular interactions) into the Surface Evolver in order to apply this software to nanoscale droplets.

CPP 22.14 Wed 16:00 Poster A

Optical diffraction reveals microscopic properties of the superhydrophobic state. — •Helmut Rathgen and Frieder Mugele — Physics of Complex Fluids, University of Twente, The

Netherlands

We study the microscopic liquid–gas menisci formed at the texture of a superhydrophobic surface, making use of the inherent optical diffraction of the material. By measuring the angle dependence of the diffracted intensity, and comparing the experimental data to theoretical optics calculations with varying curvature of the menisci, we effectively solve the inverse diffraction problem and are able to measure the shape of the menisci with nanometer resolution. We study the shape of the menisci as a function of hydrostatic pressure. Next, driving the menisci in an ultrasound field, and measuring time–resolved diffraction intensities, we observe their nanometer scale oscillations. By comparing to unsteady Stokes flow theory, we find that the frequency response of the collectively oscillating menisci is governed by strong hydrodynamic interaction.

CPP 22.15 Wed 16:00 Poster A

Single Molecule Diffusion on Chemically patterned Substrates — •Martin Pumpa and Frank Cichos — Molecular Nanophotonics Group, University Leipzig

Molecular dynamics at solid/liquid interfaces is defined by the strength of the interaction of the liquid with the solid surface. This interfacial region extendes serveral 10 nm into the liquid, where modified structure and dynamics appear i.e. in the form of liquid layering. 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 either covered by an ultrathin liquid film or mounted in a surface forces apparatus, where the liquid covering the pattern is confined down to a film thickness of a few 10 nanometers. To study molecular dynamics, we employ single molecule tracking of dye molecules dissolved in the liquid. The diffusion of these dye molecules is observed by fluorescence wide field microscopy. First indications of anisotropic diffusion due to the pattern structure are reported.

CPP 22.16 Wed 16:00 Poster A

Colloids dragged through a polymer solution — •Christof Gutsche[1], Friedrich Kremer[1], Matthias Krüger[2], Markus Rauscher[2], Rudolf Weeber[3], and Jens Harting[3] — [1]Institut für Experimentalphysik I, Universität Leipzig — [2]Max-Planck-Institut für Metallforschung, Stuttgart and Institut für Theoretische und Angewandte Physik, Universität Stuttgart — [3]Institut für Computerphysik, Universität Stuttgart

We present micro-rheological measurements of the drag force on colloids pulled through a solution of lambda-DNA [1] (used here as a monodisperse model polymer) with an optical tweezer [2,3]. The experiments show a drag force which is larger than expected from the Stokes formula and the independently measured viscosity of the DNA solution. We attribute this to the accumulation of DNA in front of the colloid and the reduced DNA density behind the colloid. This hypothesis is corroborated by a simple drift-diffusion model for the DNA molecules, which reproduces the experimental data surprisingly well, as well as by corresponding Brownian dynamics simulations.

[1] Gutsche C, Kremer F, Krüger M, Rauscher M, Weeber R, Harting J, arXiv:0709.4142 [2] Gutsche C, Keyser UF, Kegler K, et al. Phys. Rev. E 76 (3): 031403 (2007) [3] Gutsche C, Salomo M, Kim YW, et al. MICROFLUIDICS AND NANOFLUIDICS 2 (5): 381-386 (2006)

CPP 22.17 Wed 16:00 Poster A

On particle based velocimetry: Brownian particle near walls — •Laura Almenar[1,2] and Markus Rauscher[1,2] — [1]Max-Planck-Institut für Metallforschung, Stuttgart, Germany — [2]ITAP, Universität Stuttgart, Stuttgart, Germany

Motivated by particle based velocimetry techniques, in particular by double focus correlation spectroscopy experiments, we study the dynamics of Brownian particles in shear flow in the vicinity of planar walls. The experiments are designed to measure hydrodynamic slip in polar liquids. However, wall effects such as the fact that the particles cannot penetrate into the wall, the electrostatic double layer force, and the reduced particle mobility in the vicinity of the wall have to be taken into account in the data analysis in order to avoid spurious slip. We model the dynamics of the Brownian particles by a drift-diffusion equation taking into account the impermeability of the wall, the electrostatic double layer force, and the reduced mobility of the particles in the vicinity of the wall. The latter turns out to be irrelevant for the experimental system.

We use analytical as well as numerical tools to simulate the experiments and to quantify the spurious slip that one would measure if the data was analyzed in a naive way. Here, we find qualitative agreement with the experiment. It turns out that for a more careful analysis of experimental data one needs more detailed information on the electrostatic particle-wall interaction.

CPP 22.18 Wed 16:00 Poster A

Thermal fluctuation of single DNA-molecules and their dynamic in shear flow — Katrin Günther, •Kristin Laube, and Michael Mertig — Max-Bergmann-Zentrum für Biomaterialien, Budapester Str. 27, D-01069 Dresden, Germany

We investigate thermal fluctuations and dynamic behaviour of single λ-DNA-molecules tethered in a microfluidic cell in the dependence of cation concentration and shear rate. By the use of endspecifically attached fluorescent quantum dots instead of fluorescent dyes we do not change natural mechanical properties of the DNA and we are able to track a particular segment of the molecule. From thermal fluctuations we determine persistence lengths and therewith the 3D distribution of end-to-end-distance by simulations that take the tethering surface into account. In shear flow with different $\dot{\gamma}$ we specify fractional extensions and the amplitude of fluctuations indicating changes in the molecule's morphology. For smaller shear rates we verify theoretically predicted cyclic motion of the free end of the DNA-molecule.

CPP 22.19 Wed 16:00 Poster A

Native UV laser induced fluorescence detection for single cell analysis in a hybrid PDMS-Quartz microfluidic chip — •Dominik Greif, Alexandra Ros, and Dario Anselmetti — Experimental Biophysics & Applied Nanoscience, Bielefeld University, Universitaetsstr. 25, 33615 Bielefeld, Germany

Single cell analysis promises individual expression studies, which are not limited by ensemble averaging effects. Label free detectors based on UV laser induced autofluorescence (UV-LIF) of aromatic amino acids are a valuable extension of the single cell approach.

Here, we present an extension of our previous studies on single cell analysis with native label-free UV-LIF detection [2], in order to improve separation efficiency and detection sensitivity. We reduced the background fluorescence by the fabrication of new PDMS-Quartz-Window-chips (PQW-chips) by at least 75 percent. These PQW-chips integrate fused silica windows in the PDMS-microdevice at the point of detection. Furthermore, the fluorescence intensity of Trp was investigated for different pH values of the separation buffer. Based on these improvements we exemplarily present single cell protein electropherograms from spodoptera frugiperda (Sf9) cells.

[1] W. Hellmich, D. Greif, C. Pelargus, D. Anselmetti, A. Ros, J. Chromatogr. A 1130 (2006) 195. [2] W. Hellmich, C. Pelargus, K. Leffhalm, A. Ros, D. Anselmetti, Electrophoresis 26 (2005) 3689.

CPP 22.20 Wed 16:00 Poster A

Dynamics of nano-droplets on structured surfaces — •Ali Moosavi[1,2], Markus Rauscher[1,2], and Siegfried Dietrich[1,2] — [1]Max-Planck-Institut für Metallforschung, Stuttgart, Germany — [2]ITAP, Universität Stuttgart, Germany

Nanodroplets residing near topographical or chemical steps on solid substrates exhibit a disjoining pressure induced dynamics. Our nanoscale hydrodynamic calculations reveal that non-volatile droplets are attracted or repelled from steps depending mainly on the long-ranged component of the intermolecular interactions. Since the equilibrium contact angle depends on the balance between both long- and short-ranged interactions, in some cases droplets are attracted by the less wettable part of the substrate. This can also lead to energetic barriers for droplets crossing chemical steps from the less wettable side to the more wettable side.

CPP 22.21 Wed 16:00 Poster A

Lattice Boltzmann simulation of non ideal fluids — •Bin Wu, Fathollah Varnik, and Dierk Raabe — Max-Planck Institut für Eisenforschung, Max-Planck Straβe 1,40237 Düsseldorf, Germany

The basic idea of the Lattice Boltzmann(LB) Method is that the liquid approaches *local* equilibrium on each lattice site via collisions.The lattice Boltzmann dynamics is given by$f_{\sigma i}\left(x+\epsilon e_{i\alpha}, t+\epsilon\right)-f_{\sigma i}\left(x,t\right)=-\frac{1}{\tau}\left[f_{\sigma i}\left(x,t\right)-f_{\sigma i}^{eq}\left(x,t\right)\right]$ with $\sum f_i e_{i\alpha} e_{i\beta}=P_{\alpha\beta}+nu_\alpha u_\beta$.

For a liquid-gas system,the equilibrium properties can be described by the free energy, $\Psi = \int_V (\psi_b(n) + \frac{\kappa}{2}(\partial_\alpha n)^2)dV + \int_S \psi_c(n)dS$.Minimizing the free energy gives $P_{\alpha\beta} = \kappa\partial_\alpha n\partial_\beta n + [n\partial_n\psi_b(n) - \psi_b(n) - \frac{\kappa}{2}(\partial_\alpha n)^2 - \kappa n \triangle n]\delta_{\alpha\beta}$.

The free energy enters the LB algorithm via the pressure tensor, $P_{\alpha\beta}$, which is so called free energy LB approach.

The free energy LB method can deal with Navier-Stokes level hydrodynamics at low Mach numbers. We simulate a droplet's motion on a step-gradient substrate.Owing to different Laplace pressure, the droplet is driven to move on the substrate.Simulation of the droplets' coalescence on substrates is also done by us and we fit the function between the width of bridge-neck and time.We find liquid droplet instability (evaporation) depends on the size of system.

CPP 22.22 Wed 16:00 Poster A

Thermally Excited Capillary Waves on n-Alkanes: Photon Correlation Spectroscopy Studies — •Matthias Wolff and Patrick Huber — Saarland University, Saarbruecken, Germany

Quasi-elastic light scattering from thermally excited capillary waves is a powerful method to study the surface hydrodynamics of liquids. We have designed a photon correlation spectroscopy setup in order to investigate this scattering and to relate it to the fundamental structural and thermodynamical properties of liquid surfaces. First measurements on the surface freezing effect in n-alkanes (n-eicosane, n-tetracosane) and how it affects the surface rheology are presented.

CPP 22.23 Wed 16:00 Poster A

Capillary Rise and Flow of Complex Liquids in Nanopores — •Simon Grüner and Patrick Huber — Saarland University

We present measurements on the capillary rise (spontaneous imbibition) and pressure driven flow (forced imbibition) of liquids into silica monoliths (namely porous Vycor) permeated by tortuous pores with radii of 5nm. The flow properties are studied as a function of the complexity of the building blocks of the liquids (water, n-alkanes and liquid crystals), as a function of shear rate and as a function of temperature in the case of the liquid crystal. This work has been supported within the DFG priority program 1164, Nano- & Microfluidics (Grant No. Hu 850/2).

CPP 22.24 Wed 16:00 Poster A

Surface scattering characterization of the fluid/substrate interface in a fluidic experiment — •J.-F. Moulin and P. Mueller-Buschbaum — TU Muenchen, Physik-Department, LS E13, James-Franck-Str.1, 85747 Garching (Germany)

We will present the results of Grazing Incidence X-Ray Scattering (GISAXS) performed on fluidic channels. Scattering methods such as Grazing incidence x-ray scattering (GISAXS) provide a wealth of information about the interfacial structure: with such an experimental technique both the in-plane ordering and the out of plane correlations are detected and quantitatively characterized in a non invasive/non destructive manner. Up to now this technique has never been used to characterize samples under flow. We have thus designed a new setup to perform GISAXS during a fluidic experiment where a solution is run over a substrate [1]. Together with state of the art GISAXS synchrotron beamlines such as BW4 at Hasylab (Hamburg, Germany) this setup makes it possible to map the structure of the liquid/solid interface of a fluidic channel at spots separated by c.a. 50 microns along the flow direction.

We will here present results obtained on detection of gold nanoparticles at the fluid/substrate interface as well as on the way these particles form a thin film under flow and how the structure of this film evolves with time.

[1]Flow at interfaces: a new device for x-ray surface scattering investigations, J-.F. Moulin, S .V. Roth, P. Müller-Buschbaum accepted for publication in Review of Scientific Instruments (2007)