CPP 34: Poster: Wetting, Micro and Nano Fluidics

Time: Wednesday 16:30–18:30 Location: Poster C

CPP 34.1 Wed 16:30 Poster C

3D-Velocimetry by Photonic Rutherford Scattering — •Markus Selmke and Frank Cichos — Universität Leipzig, molecular nanophotonics

We propose of a new kind of 3D-velocimetry using absorbing nanoparticles and a variant of photothermal single particle microscopy. Using a Quadrant photodiode detector we reveal that photons are deflected by a photonic potential which is created by a local refractive index change around a laser-heated absorbing nanoparticle. The deflection experienced is shown to be the analog to the deflection of a massive particle wave-packet in unscreened (spin-less) Coulomb scattering, i.e. the quantum mechanical analog to Rutherford Scattering. The experimentally found focal detection geometry reveals an adjustable lateral split sub-volume feature which allows new (cross-) correlation-based 3D-velocimetry experiments of absorbing particles with ultra-high sensitivity.

CPP 34.2 Wed 16:30 Poster C

Genie in a Channel — •Stefan Reutter — TU Darmstadt

When high-energy heavy ions are shot at a thin sample (< 100 μm), they leave a large number of parallel ion tracks. These can be etched to obtain mesoscopic cylinders with a narrow diameter distribution whose mean can be varied between 30 nm and 1 μm.

These channels can then be filled with a liquid to investigate properties such as diffusion and phase behaviour when trapped in a volume small enough that confinement effects become significant, but at the same time large enough that surface effects do not have a dominating influence on liquid dynamics.

I will present the results of diffusometry measurements on simple liquids and binary liquid systems in ion track channels obtained by Static Field Gradient Echo NMR experiments.

CPP 34.3 Wed 16:30 Poster C

Faster than spinodal dewetting: Ultra-thin liquid polystyrene films on silanized Si wafers — •Matthias Lessel[1], Oliver Bäumchen[2], Markus Rauscher[3], and Karin Jacobs[1] — [1]Department of Experimental Physics, Saarland University, D-66041 Saarbrücken, Germany — [2]Department of Physics and Astronomy, McMaster University, Hamilton, ON, Canada L8S 4M1 — [3]Max Planck Institute for Intelligent Systems, Heisenbergstr. 3, D-70569 Stuttgart, Germany

In recent years, many studies showed that a thin liquid film on a solid surface in air bears more complexity than expected from a simple three-layer-system: e.g. a highly mobile surface layer in case the liquid is an unentangled polystyrene (PS) melt (Yang et al., Science 2010; Seemann et al., J. of Polym. Sci. 2006) or a nearly full slip boundary condition for the PS melt on a solid substrate (Bäumchen et al., PRL 2009). Our study focuses on such phenomena and explores their influence on dewetting. We use hydrophilic and -phobic Si wafers, either covered by a highly ordered silane self-assembeld monolayer or by a thin layer of an amorphous fluoropolymer. On each of the substrates, one expects for a certain set of parameters spinodal dewetting for the PS melt (Seemann et al., PRL 2001). However, contrary to expectations, we observed a thermally activated nucleation process of hole formation instead of spinodal dewetting. The observed behavior is similar to results on free standing polymer films (Croll et al., Macromolecules 2012). A theory based on the capillary model of Croll et al. taking the effective interface potential into account will be presented to describe the results.

CPP 34.4 Wed 16:30 Poster C

Advanced in situ GISAXS investigations of drying and adsorption kinetics — •Berit Heidmann[1,2], Matthias Schwartzkopf[1], Gonzalo Santoro[1], Shun Yu[1], Gerd Herzog[1,2], Roman Mannweiler[1], Johannes F.H. Risch[1], Wilfried Wurth[2], and Stephan V. Roth[1] — [1]Deutsches Elektronen-Synchrotron (DESY), Notkestr. 85, D-22607 Hamburg, Germany — [2]Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg, Germany

Tailored gold nanoparticle assemblies play an important role for technological applications like solar cells, nanocatalysts and bioelectronics [1]. Solution casting is a promising process that enables low-cost fabrication of such devices. Grazing incidence small-angle X-ray scattering (GISAXS) is a powerful tool for in situ investigations of fast surface processes on nanoscale [2]. We have combined GISAXS and a contact angle apparatus to perform drop drying kinetic measurements with improved accuracy and flexibility. Using advanced drop casting deposition technique, we investigated in situ the drying kinetics during self-assembly of gold nanoparticles and the influence of different functionalized silicon surfaces on the process. In order to investigate the effect of the X-ray beam on sample surfaces, we compared in situ and ex situ drop drying experiments. Furthermore, the setup allows for investigation of different wetting behaviors as a function of X-ray radiation dose. [1] Bauer at al., Nanotechnology, 14, 1289-1311 (2003) [2] Roth et al., J. Phys.: Condens. Matter , 23, 254208 (2011)

CPP 34.5 Wed 16:30 Poster C

Forced Displacement Experiments in quasi 2D Porous Media. — •Michael Jung[1,2], Marta Sanchez de la Lama[2], Daniel Herde[2], Stephan Herminghaus[2], Martin Brinkmann[1,2], and Ralf Seemann[1,2] — [1]Universität des Saarlandes, Saarbrücken, Germany — [2]Max Planck-Institute for Dynamics and Self-Organization, Göttingen, Germany

As a model for a forced liquid displacement process into porous media, we study two-dimensional flow experiments in microfluidic devices. The devices and the porous structures are fabricated from oil-resistant UV-curable glue using soft-lithography. The devices were first saturated with oil (silicon oils, fluorinated oils or alkanes) and subsequently the oil was displaced by either a volume or pressure controlled water flush. We observe the global and local dynamic behavior of the advancing liquid fronts and the residual oil distribution using high speed microscopy as function of wettability, viscosity, flow velocity, and geometry of the pore space. On the length scale of individual pores we also investigate the influence of pressure fluctuations, which occur when a liquid front invades a throat. These experimental results are compared to numerical simulations based on multiple particle collisions for analogous pore geometry and wetting conditions.

CPP 34.6 Wed 16:30 Poster C

A new approach to measure the Depth of Correlation in micro-PIV — •Michael Hein[1], Bernhard Wieneke[2], and Ralf Seemann[1,3] — [1]Department of Experimental Physics, Saarland University, Saarbrücken, Germany — [2]LaVision GmbH Göttingen, Germany — [3]MPI for Dynamics and Self-Organization, 37073 Göttingen, Germany

In recent years micro-particle image velocimetry (micro-PIV) has become the most frequently used tool to measure flow profiles in microfluidics. Micro-PIV uses volume-illumination and imaging of fluorescent tracer particles through a microscope objective. The velocity-vectors are obtained by correlating two images captured shortly after each other. Thus the obtained velocity field depends on all imaged particles within an interrogation window, even on the defocused particles. Accordingly, the system dependent knowledge of the height extension of the measured plane (Depth of Correlation, DOC) is crucial when considering three dimensional flow profiles. We present a novel approach to determine the DOC based on artificial volume data derived with the same optical setup as used for the experiments. Using this method we examine the DOC in dependence of out-of-plane velocity gradients for commonly used microscope objectives.

CPP 34.7 Wed 16:30 Poster C

X-ray photon correlation spectroscopy (XPCS) study of nanospheres in parabolic microflow — •Raphael Urbani[1], Fabian Westermeier[2], Bernd Struth[2], and Thomas Pfohl[1] — [1]Chemistry Department, University of Basel, 4056 Basel, Switzerland — [2]Hasylab, Deutsches Elektronen-Synchrotron, 22607 Hamburg, Germany

The combination of state-of-the-art microfluidics with small angle X-ray scattering (SAXS) and X-ray photon correlation spectroscopy (XPCS) has been successfully used for dynamic investigations of colloidal particles in microflow with different geometric constraints.

Using a coherent X-ray beam of small size (about 10 μm x 10 μm) allows us to measure static and dynamic properties at different spatial positions within in the microfluidic channel system. We are able to

measure autocorrelation functions at fixed q-positons in the range of 10^{-6} - 10^{-1} s with an APD-detector and simultaniously at a wide q-range in a temporal range of 4 x 10^{-3} - 10^{2} s using a 2D fast readout detector. Analyzing the autocorrelation functions, we obtain detailed information about advective and diffusive transport within the microfluidic flow of different velocities and in different channel geometries such as curvatures and constrictions.

By means of the combination of XPCS with microfluidcs we probe spatially dependent the influence of microfluidic velocity fields, shear stress, hydrodynamic (wall) interactions and inertia effects on the transport behavior of the nanoparticles.

CPP 34.8 Wed 16:30 Poster C

Microfluidic Platform for Membrane Fusion Studies — •Nabor Vargas[1], Jean-Baptiste Fleury[1], and Ralf Seemann[1,2] — [1]Experimental Physics, Saarland University, D-66041 Saarbrücken — [2]MPI for Dynamics and Self-Organization, D-37073 Göttingen

Membrane fusion is essential for the life of eukaryotic cells, it is known as the process whereby two separate lipid bilayers merge to become one by means of a family of fusogenic proteins. Research on membrane fusion has been intense along past decades, but we are still far from unveiling the whole phenomena. We are exploring a new microfluidic approach to study single membrane fusion events in a controllable geometry. This experimental setup shall allow for the production of stable lipid bilayers, easy variation of the lipid membrane composition like the insertion of proteins, and superior control of the fusion process by e.g. by optical and electrical access. Lipid bilayers created inside the microfluidic chip can be moved and manipulated making them interact with each other resembling cell membrane fusion.

CPP 34.9 Wed 16:30 Poster C

Gold nanostructure assisted thermophoretic trapping of single nano-objects — •Marco Braun and Frank Cichos — Institute for Experimental Physics I, University of Leipzig, Linnéstraße 5, D - 04103 Leipzig

The manipulation and trapping of nano-objects that undergo Brownian motion are of great interest in soft-matter sciences. Optical tweezing is the most common technique for the trapping of individual particles in solution and is based on the optical gradient force. Hence, a sufficiently high polarizability of the particle in the solution is required. While it is thus easy to trap single dielectric particles larger than 100 nm, a trapping of smaller objects such as single molecules by means of optical tweezers can hardly be realized. Molecular trapping can be achieved by a technique called Anti-Brownian Electrokinetic trap (ABEL trap), which exploits the feedback controlled electric field of four electrodes. Hence, the latter technique requires electrical contacts, which introduce difficulties when fabricating multiple traps. Here, we present an all-optical technique which replaces the electric fields by highly localized thermal fields. The so-called thermophoretic trap exploits thermophoretic forces that act on a particle placed in a temperature gradient, which e.g. locally distorts the screening of the surface charges and by that induce a particle drift. In our approach the temperature field is generated by an optically heated Au nanostructures. Due to the small dimensions of the heat sources, even a small temperature increase introduces large temperature gradients causing a strong thermophoretic drift by which the motion of a diffusing particle can by manipulated.

CPP 34.10 Wed 16:30 Poster C

Imaging of drops on superhydrophobic surfaces in the Cassie and Wenzel states — •Periklis Papadopoulos, Lena Mammen, Xu Deng, Doris Vollmer, and Hans-Jürgen Butt — Max Planck Institute for Polymer Research, Mainz, Germany

A droplet deposited or impacting on a superhydrophobic surface rolls off easily, leaving the surface dry and clean. This remarkable property is due to a surface structure which favors the entrainment of air cushions beneath the drop, leading to the so called Cassie state. The Cassie state competes with the Wenzel (impaled) state, where the liquid fully wets the substrate. To utilize superhydrophobicity, impalement of the drop into the surface structure needs to be prevented. Recently, we demonstrated the capability of laser scanning confocal microscopy (LSCM) to image water drops on an array of micropillars [1]. While the drop evaporates from a pillar array, its rim recedes via step-wise depinning from the edge of the pillars. Once the pressure becomes too high, or the drop too small, the drop slowly impales the texture. The thickness of the air cushion decreases gradually. As soon as the water-air interface touches the substrate, complete wetting proceeds within milliseconds. LSCM opens a novel approach to study wetting dynamics, which is of high scientific and technological interest.

[1] P. Papadopoulos *et al.*, Langmuir **2012**, *28*, 8392-8398

CPP 34.11 Wed 16:30 Poster C

Effect of Wettability on Water-Oil Front Progression in Porous Media — •Alen Kabdenov[1,2], Hagen Scholl[1], Kamaljit Singh[2,3], Marco di Michiel[3], Mario Scheel[3], Stephan Herminghaus[2], and Ralf Seemann[1,2] — [1]Saarland University, Experimental Physics, D-66041 Saarbrücken, Germany — [2]Max Planck Institute for Dynamics and Self-Organization, D-37073 Göttingen, Germany — [3]European Synchrotron Radiation Facility, BP 220, F-38043 Grenoble, France

The effect of wettability on the three dimensional water-oil front progression in an initially oil filled porous medium during a water flood is observed in situ using ultrafast synchrotron X-ray tomography. The wettability of the porous media was controlled by using different cleaning and coating procedures, using different bead material or by using a variety of combinations of experimental fluids. It is shown that for smaller contact angles, the front progresses in a compact shape without any oil trapping and a single pore-volume of water flood is sufficient to reach the final state. By contrast, the front roughens in the case of larger contact angles, and forms several enlarged fingers due to front stopping at smaller throats. These fingers bypass several oil filled pore-pockets leading towards significant oil trapping and water flooding of more than three pore-volumes is required to achieve the final oil distribution. The trapped oil ganglia remain in place due to strong interfacial forces which is difficult to overcome in the tested regime of small capillary numbers.

CPP 34.12 Wed 16:30 Poster C

Laser interferometric observations of capillary rise in arrays of silicon nanochannels — •Mark Busch, Felix Koch, and Patrick Huber — Hamburg University of Technology, Hamburg, Germany

We present measurements on the capillary filling of nanochannels in mesoporous silicon films with organic solvents, polymers and epoxy resins. The time-dependent rise level of the liquids within the channels has been determined with laser interferometry [1]. This allows us to analyze the filling process with a high temporal (milliseconds) and spatial (micrometer) resolution. We found distinct changes in the imbibition dynamics as a function of the filling direction, from the top to the bottom or from the bottom to the top of the film. These peculiarities will be discussed with respect to a gradient in the porosity and/or a monotonic variation in the mean channel diameter as a function of channel length.

[1] L. Acquaroli et al.: Capillary Filling in Nanostructured Porous Silicon, Langmuir **27** (2011), No. 5, p. 2069-2072

CPP 34.13 Wed 16:30 Poster C

Structure and Dynamics in Hydrophilic Confinement from First Principles — •Christoph Allolio, Tobias Watermann, and Daniel Sebastiani — Institute of Chemistry, Martin Luther University Halle-Wittenberg, Von-Danckelmann-Platz 4, 06120 Halle (Saale)

Geometric confinement has a strong effect on water, making it quite different from the bulk.[1] To understand e.g. protein agglomeration, and folding, it is necessary to develop a better understanding of water under confinement.

We investigate the anomalous behavior and hydrogen bond network of water molecules confined at various interfaces using ab-initio molecular dynamics and spectroscopy. In addition to structural data, we use proton NMR chemical shifts as a measure for the strength of the hydrogen-bonding network. Our calculations illustrate the modifications of the ^1H NMR chemical shifts of confined water with respect to bulk water.[2] In the vicinity of silanols, weakly hydrogen bonded liquid water is observed, while at greater distances the hydrogen bonding network is enhanced with respect to bulk water. In addition we analyze the dynamics, finding e.g. a considerable slowing down of water diffusion at a water silica interface.

[1] N. Giovambattista, P. J. Rossky, P. G. Debenedetti, Annu. Rev. Phys. Chem. **63** (2012), 179.
[2] X. Y. Guo, T. Watermann, S. Keane, C. Allolio, D. Sebastiani, Z. Phys. Chem. **226** (2012), 1415.

CPP 34.14 Wed 16:30 Poster C

Fouling layer removal investigations under cross-flow conditions — •Gerd Herzog[1,2], Adeline Buffet[1], Matthias Schwartzkopf[1], Gunthard Benecke[1,3], Frans J. de Jong[4], Volker Körstgens[5], Kuhu Sarkar[5], Peter Müller-Buschbaum[5], Wilfried Wurth[2], and Stephan V. Roth[1] — [1]HASYLAB at DESY, Notkestr. 85, D-22607 Hamburg — [2]Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, D-22761 Hamburg — [3]MPI of Colloids and Interfaces, Department of Biomaterials, Am Mühlenberg 1, D-14476 Potsdam-Golm — [4]TU Hamburg-Harburg, Institut für Mehrphasenströmungen (V-5), Eißendorfer Straße 38, 21073 Hamburg — [5]TU München, Physik-Department E13, James-Franck-Str. 1, 85748 Garching

The process of scaling and fouling under cross-flow conditions as well as the removal of deposit layers is important for many technical applications like membranes, heat exchangers and ship hull coatings.

We used grazing incidence small-angle X-ray scattering (GISAXS) and a microfluidic cell for an in-situ investigation of the removal of an annealed polystyrene colloid layer on a glass substrate under a flow of deionized water. The sample was scanned several times in horizontal direction and the obtained data show the continuous transition from a polymer-covered to a pure glass substrate.

CPP 34.15 Wed 16:30 Poster C

Study of the interface of droplets using pH change — •Birte Riechers, Quentin Brosseau, Florine Maes, and Jean-Christophe Baret — Max Planck Institute for Dynamics and Self-Organization, Göttingen, Germany

Interfaces are prevalent in many systems such as emulsions and foams. They can be stabilized using surfactant molecules. Amphiphilic molecules influence the properties of the interface (e.g. surface tension, interfacial rheology) as well as the bulk properties of the two phases (e.g. pH). The understanding of these properties is fundamental for the control of emulsion encapsulation for biological compartimentalization [Baret, Lab Chip 12 (2012), 422; Baret et al., Langmuir 25 (2009), 6088].

In our study, the effect of surfactants on the pH inside the droplets of emulsions is investigated. We combined a microfluidic fluorescence setup with a pH sensitive dye to monitor pH changes with time. Ionic surfactant molecules are dissolved in the continuous phase and upon adsorption to the interface release protons into the dispersed phase. Our results regarding the change of pH inside the droplets will bring quantitative information on interfacial surfactant coverage and thus allowing to conclude the stability of the interface for microencapsulation.

CPP 34.16 Wed 16:30 Poster C

Acoustic Sorting of Drops and Cells — •Lothar Schmid[1] and Thomas Franke[1,2] — [1]Universität Augsburg, Experimentalphysik I, Soft Matter Group, Augsburg, Germany — [2]Department of Physics and School of Engineering and Applied Science, Harvard University, Cambridge, USA

We use a surface acoustic wave (SAW) device for manipulating fluids, droplets and cells in microfluidic channels.

The acoustic wave is coupled into the channel at specific regions, generating pressure gradients or microvortices. Electric control of the wave generator allows for precise regulation and fast switching times.

We show an application of the technique by demonstrating a microfluidic fluorescence-activated sorter for cells and droplets at high rates. Our acoustic sorter combines the advantages of traditional fluorescence-activated cell sorting (FACS) and droplet sorting (FADS) and is applicable to a multitude of objects. We can sort aqueous droplets at rates as high as several kHz into two or more outlet channels. We demonstrate cell sorting in one-phase flow using fibroblasts cells without prior encapsulation into drops directly from the bulk phosphate buffered saline media. Our acoustic micro-FACS meets conventional laboratory practice but at the same time allows for modular integration into more complex microfluidic setups.

CPP 34.17 Wed 16:30 Poster C

Nonlinear chemical reactions in a droplet — •Maria Schwarzl, Robert Niedl, Igal Berenstein, and Carsten Beta — Institute of Physics and Astronomy, University of Potsdam, Germany

Over the last decade, microfluidic systems with water in oil droplets have developed into a widely used design principle for chemical and biological applications. In particular, the use of droplets as small micro-reactors has stimulated enormous research activities. Among other aspects, the mixing behavior inside such droplets has been a topic of wide interest. It was observed that inside a droplet, aqueous solutions with different viscosities may exhibit faster mixing as compared to components with equal viscosity. Related to this observation, we have found that a nonlinear clock reaction, when operated in a linear microfluidic channel, can be accelerated by using fluids of different viscosities. To further characterize the effects that are responsible for these observations, we compare measurements of enzymatic and inorganic autocatalytic reactions in linear microchannels with those measured in a droplet system.

CPP 34.18 Wed 16:30 Poster C

Hydrogel driven microfluidics in structured paper substrates — •Robert Niedl and Carsten Beta — Institute of Physics and Astronomy, University of Potsdam, Germany

Many clinical tests require a purified analyte in combination with freshly prepared biological solutions. Under working conditions far away from standard clinical laboratories, e.g. in developing countries, such prerequisites are often difficult to establish. Here, we present a system that offers a solution to such problems. We extend the recently developed concept of paper-based microfluidics by incorporating a hydrogel into the paper device. The swollen hydrogel stores a defined volume of fluid on the sensor substrate. Through a thermally driven collaps of the hydrogel, the liquid is released to drive the fluidic system without any pumps or other sophisticated equipment. Sensitive chemicals deposed in initially dry sections of the paper substrate can be dissolved and transported across fluidic channels imprinted in the paper substrate. In this way, different chemicals can be supplied in a well-controlled and timely fashion to a reaction area, in which a specific assay may be performed. We demonstrate this concept by implementing a standard glucose test in this type of hydrogel-driven paper-fluidic device.

CPP 34.19 Wed 16:30 Poster C

The interplay of capillary rise and vapour phase adsorption in nanoporous Vycor glass — •Sebastian Kiepsch, Nico Bohr, and Rolf Pelster — FR 7.2, Experimentalphysik, Universität des Saarlandes, Campus E2.6, D-66123 Saarbrücken, Germany

The spontaneous imbibition of polar organic liquids, primarily n-decanol ($C_{10}H_{21}OH$), has been studied for nanoporous Vycor glass by means of dielectric spectroscopy. Vycor glass is an interconnected pore network with pore diameters $d_p \approx 7.5\,\mathrm{nm}$ and volume porosity $\Phi \approx 35\%$. For large times t, the imbibition dynamics can be described by the Lucas-Washburn law, $h(t) = c_h\sqrt{t}$. Here, h denotes the capillary height and the prefactor c_h depends on fluid parameters (viscosity, surface tension) and matrix parameters (porosity, radius ...). However, during the initial phase of the process, a systematic deviation from the square root behaviour occurs. We address the question whether the imbibition dynamics are a simple superposition of capillary rise and concurrent vapour phase adsorption. The time dependence of the latter process is measured in a controlled environment using the same technique.

CPP 34.20 Wed 16:30 Poster C

Capillary Levelling of Stepped Polymer Films - A Nanofluidic Probe of the Slip Boundary Condition — •Oliver Bäumchen[1], Thomas Salez[2], Joshua D. McGraw[1], Michael Benzaquen[2], Paul Fowler[1], Elie Raphaël[2], and Kari Dalnoki-Veress[1] — [1]Department of Physics & Astronomy and the Brockhouse Institute for Materials Research, McMaster University, Hamilton, ON, Canada, L8S 4M1 — [2]Laboratoire de Physico-Chimie Theorique, UMR CNRS Gulliver 7083, ESPCI, Paris, France

For flows on small length scales, the hydrodynamic boundary condition of a liquid at a solid surface plays an enormous role. In recent years much has been learned about this slip boundary condition from flows that are driven by internal, capillary, forces such as dewetting of thin liquid films. For the case of dewetting, holes in the film grow, driven by exposing the underlying substrate. Here, we present the opposite approach: We show that the capillary levelling of initially curved surfaces, in our case stepped polymer films, is sensitive to the nano-rheological properties of the liquid [1] and the slip boundary condition at the buried liquid/substrate interface. A thin film model which includes the hydrodynamic boundary condition enables us to quantify slip at the buried interface and to extract its dependence on the molecular weight of the polymer.

[1] J.D. McGraw, T. Salez, O. Bäumchen, E. Raphaël, and K. Dalnoki-Veress, Physical Review Letters 109, 128303 (2012).

CPP 34.21 Wed 16:30 Poster C

Theory of water and charged liquid bridges — •Klaus Morawetz — Münster University of Applied Sciences,Stegerwaldstrasse 39, 48565 Steinfurt, Germany — International Institute of Physics (IIP)Av. Odilon Gomes de Lima 1722, 59078-400 Natal, Brazil — Max-Planck-Institute for the Physics of Complex Systems, 01187 Dresden, Germany

The phenomena of liquid bridge formation due to an applied electric field is investigated. The effect of electromagnetic fields on a charged catenary is described by a new solution which allows to determine the static and dynamical stability conditions where charged liquid bridges are possible. The creeping height, the bridge radius and length as well as the shape of the bridge is calculated showing an asymmetric profile in agreement with observations. The flow profile is calculated from the Navier Stokes equation leading to a mean velocity which combines charge transport with neutral mass flow and which describes recent experiments on water bridges.
AIP Advances 2 (2012) 022146, Phys. Rev. E 86 (2012) 026302

CPP 34.22 Wed 16:30 Poster C

Early stages of nanoparticle attachment to polyelectrolyte layers - in-situ GISAXS investigations with microfluidics and dipcoating — •Volker Körstgens[1], David Magerl[1], Neelima Paul[1], Martine Philipp[1], Jan Perlich[2], Stephan V. Roth[2], and Peter Müller-Buschbaum[1] — [1]TU München, Physik Department, LS Funktionelle Materialien, James-Franck-Str. 1, 85748 Garching, Germany — [2]HASYLAB at DESY, 22603 Hamburg, Germany

In an application of the combination of microfluidics with in-situ GISAXS (grazing incidence small angle x-ray scattering) we investigate the early stages of the attachment of gold nanoparticles to polyelectrolyte layers. The study clearly shows the differing kinetics of the surface coverage of slightly negativly charged nanoparticles onto negatively charged layers of polystyrene sulfonate (PSS) and positively charged polyallylamine hydrochloride (PAH), respectively. With the microfocussed beam of a highly brillant x-ray third generation synchrotron a high time resolution is achieved. The microfluidic investigation with a special designed cell [1] is accompanied by GISAXS dip coating experiments [2] also performed in-situ.

[1] J.-F. Moulin et al., Rev. Sci. Instrum. 79, 015109 (2008).
[2] J. Perlich et al., Phys. Status Solidi RRL 6, 253 (2012).

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CPP 34.23 Wed 16:30 Poster C

Oscillations and Avalanches in Two-Dimensional Flowing Crystals — •Jean-Baptiste Fleury[1], Ohle Caussen[2], Stephan Herminghaus[2], Martin Brinkmann[2], and Ralf Seemann[1,2] — [1]Experimental Physics, University of Saarland, Saarbrücken, Germany — [2]Max-Planck Institute for Dynamics and Self-Organization, Göttingen, Germany

We study the mechanical response and the stability of monodisperse droplet packings in quasi 2d micro-channels under longitudinal compression. Depending on the exact choice of parameter a static droplet arrangement can be mechanically unstable and segregate into domains of higher and lower packing fraction. When these droplet arrangements with negative compressibility slowly flow along a microfluidic channel periodic density oscillations between the stable droplet packings can be found. For increasing flow velocity the sections of larger and lower packing fraction increase, finally leading to complex non-equilibrium droplet re-arrangements similar to avalanches. We will experimentally and theoretically discuss the mechanisms of the dynamical droplet rearrangements in an out-of-equilibrium microfluidic system.