CPP 21: Poster: Wetting, Micro and nanofluidics

Time: Wednesday 11:00–13:00 Location: Poster A

CPP 21.1 Wed 11:00 Poster A

Forced Displacement Experiments in quasi 2D Porous Media — •Michael Jung[1,2], Marta Sanchez de la Lama[2], Stephan Herminghaus[2], Martin Brinkmann[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 simple model for a forced liquid displacement process into porous media, we study two-dimensional flow experiments in microfluidic devices. The devices and the porous structure are fabricated from oil-resistant UV-curable glue using a soft-lithography technique. These devices were first saturated with oil of different viscosities and densities (silicon oils or alkanes). The oil was then displaced by flushing water of ether different flow rates or at an adjustable constant pressure. To precisely distinguish between the oily and the aqueous phase we add a dye to the aqueous phase. We observe the global and local dynamic behavior of liquid front using high speed microscopy. The effect of various additional parameters, such as wettability and the size and geometry of the pore space on the position and the roughening of the liquid front as well as the remaining fraction of trapped oil was investigated in detail. Parallel to the experiments we are studying numerically the effect of porosity and wetting conditions on two dimensional two phase flows in porous media. To this end we employ a multiple particle collision method for immiscible liquids that allows to vary the wettability of the pore walls.

CPP 21.2 Wed 11:00 Poster A

Liquid Morphologies in granulates with various wettability — •Marc Schaber[1], Mario Scheel[3], Martin Brinkmann[2], Marco Di Michiel[3], and Ralf Seemann[1,2] — [1]Experimental Physics, Saarland University, D-66041 Saarbrücken — [2]MPI for Dynamics and Self-Organization, D-37073 Göttingen — [3]European Synchrotron Radiation Facility, F-38000 Grenoble

When adding liquid to dry granulates, the liquid forms a network of capillary bridges and complex liquid structures. Depending on wettability of the granules and geometry of the granular pile different liquid structures are formed. By means of X-ray micro-tomography we explore the liquid equilibrium distribution emerging within granular packs. Monodisperse and polydisperse glass and basalt microspheres are used as granules having small and large contact angle, respectively. By fluidizing the granulate the packing geometry of the granules is changed and the liquid equilibrium structures are destroyed. Using ultra-fast X-ray tomography we explore how the liquid is re-distributed and how the liquid morphologies are re-formed in a new equilibrium situation.

CPP 21.3 Wed 11:00 Poster A

Wetting of grooved elastic substrates — •Carsten Herrmann[1], Dominik Michler[2], Martin Brinkmann[2], and Ralf Seemann[1,2] — [1]Experimental Physics, Saarland University, D-66041 Saarbrücken — [2]MPI for Dynamics and Self-Organization, D-37073 Göttingen

Wetting morphologies on grooved elastic substrates are considered experimentally. The substrates are fabricated from polydimethylsiloxane (PDMS) rubber and consist of straight parallel grooves having a rectangular shaped cross section. The wetting morphologies are generated by gas phase deposition and observed in-situ by optical microscopy. We explore the lateral order of the emerging wetting morphologies caused by the virtue of capillary forces and the shape of the liquid morphologies as function of wettability and geometry. Depending on geometry and wettability of the substrate an attractive or repulsive force between neighboring grooves respectively neighboring ridges emerge. This leads to different wetting scenarios and a particular lateral ordering of the wetting morphologies. We try to understand the mechanism causing the lateral ordering which are either a result of an energetic minimum or due to a frustration process.

CPP 21.4 Wed 11:00 Poster A

Microparticle Separation in Droplet Based Microfluidics — •Michael Hein[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

To compartment extremely small liquid volumes into droplets and manipulate them in droplet based microfluidic systems offers the benefit of inhibiting dispersion and cross contamination of analytes. For many applications like cytometry, hemotology or immunoassays molecules are attached to microbeads and subsequently dispersed in various liquids to achieve and probe certain reactions. To include those type of reactions into microfluidics devices we explore particle separation in droplets flowing in straight microfluidic channels. Particle separation might occur inside a droplet and leads to a concentration of dispersed particles at either the front or the rear end of a droplet after a short travel distance. We explore the particle separation for several parameters like density difference of the particles and the dispersed phase, particle size, viscosities of the liquids, droplet size, channel geometry, and flow velocity. After concentrating the particles, the droplet can be split into fractions containing excess dispersed phase and a large concentration of particles, which then can be used for further microfluidic processing or analyses.

CPP 21.5 Wed 11:00 Poster A

Microfluidic Platform for Membrane Fusion Studies — •J. 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 21.6 Wed 11:00 Poster A

Simulation of droplet traffic in asymmetric microfluidic loop — •Erfan Kadivar, Stephan Herminghaus, and Martin Brinkmann — Max Planck Institute for Dynamics and Self-Organization, Fassberg 17, D-37077, Göttingen, Germany

As observed in the recent experiments, the repartition of droplets at the inlet of an asymmetric microfluidic loop depends on the droplet size and distance of consecutive droplets [1-2]. In this work we present a numerical study of the droplet traffic at microfluidic channel with an asymmetric loop. As we assume the flat channel, we consider the flow in the Hele-Shaw limit, where the dynamics of two phases can be described by an effectively two dimensional Darcy flow. The continuity equation in combination with Darcy's law provides a self-consistent integral representation of the pressure on the boundary of the droplets and the side walls of the channels which is solved using standard boundary element methods. In addition to the Laplace pressure, we consider a disjoining pressure acting on the interface touching the interface of another droplet or the side wall. Finally we calculate the fraction of droplets flowing through in each arm of the loop as function of droplet size, arm length ratio, and distance between two consecutive droplets.

[1] M. Belloul, and et al, Soft Matter 7, 9453 (2011).
[2] W. Choi, and et al, Lip on a Chip 11, 3970 (2011).

CPP 21.7 Wed 11:00 Poster A

Microfluidic investigation of the electric-field-induced Frederiks transition in nematic liquid crystals in conjunction with a flow field — •Pramoda Kumar, Anupam Sengupta, and Christian Bahr — Max-Planck-Institute for Dynamics and Self-Organization, Göttingen, Germany

Microfluidic studies of nematic liquid crystals (LCs) offer interesting insights into hydrodynamics of anisotropic fluids, dynamics of topological defects and effects of confinement and surface anchoring of LC molecules on experimental outcomes [1,2,3]. In the present study, we use microfluidics to investigate the effect of flow on the electric-field-induced Frederiks transition in nematic liquid crystals. Depending on the direction of the applied electric field with respect to the equilibrium orientation of the LC molecules in flow, the orientational effects of the electric field can be either enhanced or reduced by varying the flow velocity. Effectively, we demonstrate the competing effects between flow and electric field induced orientation of the LC molecules. By tuning the flow velocity, the threshold voltage of the Frederiks transition can be adjusted. This phenomenon can be potentially utilized in display industry where there is an ever growing need for low energy consumption coupled with low response times.

[1] C. J. Holmes, S. L. Cornford and J. R. Sambles, Phys. Rev. Lett. **104**, 248301 (2010).
[2] A. Sengupta, S. Herminghaus and Ch. Bahr, Mol. Cryst. Liq. Cryst. **547**, 203 (2011).
[3] A. Sengupta, U. Tkalec and Ch. Bahr, Soft Matter **7** 6542 (2011).

CPP 21.8 Wed 11:00 Poster A

Dynamics of liquid-liquid dewetting — •Stefan Bommer[1], Sebastian Jachalski[2], Dirk Peschka[2], Barbara Wagner[2], and Ralf Seemann[1] — [1]Saarland University,Saarbrücken — [2]Weierstrass Institute, Berlin

We investigate the dewetting behavior of liquid polystyrene films (PS) from an underlying liquid poly(methyl)acrylate (PMMA) substrate. To understand the dynamics and the characteristics of liquid-liquid dewetting we explore the entire dewetting process from film rupture to the final droplet shape by in-situ scanning force microscopy (AFM). The nanometric polymer films are prepared in an non-equilibrium, glassy state and the dewetting process is started by heating the polymer films above their respective glass transition temperatures. The system is solidified by a fast reduction of temperature and the solidified liquid-liquid interface can be imaged by AFM after removing the upper PS structures using a selective solvent. Correlating both interfaces the 3d-shape of the dewetting structures can be determined. From the equilibrium droplet shapes and the resulting contact angles we can e.g. determine the ratio of the interfacial energies. The thus determined parameters are used as input parameter for numerically simulated dewetting processes which are compared to experimental results.

CPP 21.9 Wed 11:00 Poster A

Forced wetting of simple and complex fluids in horizontal capillaries — •Manos Anyfantakis[1], Günter K. Auernhammer[1], Daniela Fell[1,2], Mohammad A. Dadfar[1], and Hans-Jürgen Butt[1,2] — [1]Max Planck Institute for Polymer Research — [2]Center of Smart Interfaces, Technical University of Darmstadt

Investigation of the physics governing the dynamic wetting of various liquids in cylindrical capillaries is of profound interest in numerous practical applications, such as microfluidic devices, oil extraction, and printing technologies as well as various medical applications. Additionally to spontaneous wetting of microchannels, forced capillary wetting could provide a straightforward way to systematically address questions in dynamic wetting of simple and complex fluids. Here, we describe a simple method, which allows for the simultaneous measurement of both the advancing and the receding contact angles of moving liquid slugs.

The experimental setup consists of three main parts: the liquid reservoir, the glass capillary and a microscope equipped with a fast camera, which is used to image the moving liquid slugs. The driving force for liquid motion is the gravity induced pressure difference between the reservoir and the microscope stage. The advancing/receding contact angles are determined either by placing the local tangent to the triple line-liquid-gas interface or by fitting the meniscus shape. Experimental results regarding dynamic wetting/dewetting of surfactant solutions in capillaries of different wettabilities, in a broad speed range, are as well as challenges and further possibilities of the method are discussed.

CPP 21.10 Wed 11:00 Poster A

Gas flow measurements in nanopores: The influence of pore wall roughness on gas dynamics — •Sebastian Kiepsch[1], Simon Gruener[1,3], and Patrick Huber[1,2] — [1]Universität des Saarlandes, Experimentalphysik, Saarbrücken, Germany — [2]Pontificia Universidad Católica de Chile, Facultad de Física, Santiago, Chile — [3]BASF SE, Ludwigshafen, Germany

We have measured the flow of rarefied helium gas through various nanoporous membranes within a broad temperature range (30−300K). The materials used for these experiments (anodized aluminium oxide and Vycor glass) featured typical pore diameters in the range from 13−50 nm. The results were found to be in accordance with numerical calculations, based on a Knudsen diffusion model for cylindrical cross-sections. For Vycor glass, a tortuosity factor of $\tau = 3.6 \pm 0.05$ of the pore-network could be measured. In order to determine the influence of wall roughness on gas dynamics, the samples were reversibly modified by means of low-temperature argon vapour condensation. In this way we were able to add a monolayer of argon to the pore walls. Subsequent flow measurements with helium gave hints of higher diffusion coefficients. This effect may be related to pore wall smoothing upon argon adsorption.

CPP 21.11 Wed 11:00 Poster A

Pore Scale Investigations Of Forced-Imbibition In Porous Media — •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]MPI for Dynamics and Self-Organization, D-37073 Göttingen, Germany — [3]ESRF, BP 220, F-38043 Grenoble, France

We investigate static and quasi-static liquid morphologies of immiscible-liquid (water-oil) fronts in an initially oil saturated bead matrix flooded by water using ultra-fast X-ray micro-tomography at the European Synchrotron Radiation Facility (ESRF, ID15). The data were analysed for change in residual oil morphologies, the shape of liquid front with time during continuous water flooding and various factors affecting its behaviour, such as wettability (glass/basalt beads), flow rates, pore geometry and the influence of gravity. Our results show that the water-oil front is more compact in basalt beads, whereas the front in glass beads progresses in elongated fingers. The fingering in the porous medium results in a higher final residual oil saturation for glass beads, after a complete water flood due to bypassing of several oil-filled pore pockets. Preliminary results indicate a crucial importance of the wettability and that the front behaviour seems to be dominated by capillary forces, whereas the flow rate doesn't play a major role.

CPP 21.12 Wed 11:00 Poster A

Nanoscale pumping of water by AC electric fields — •Klaus Rinne[1], Stephan Gekle[2], Douwe Jan Bonthuis[2], and Roland Netz[1] — [1]Fachbereich Physik, Freie Universität Berlin, 14195 Berlin, Germany — [2]Technische Universität München, 85748 Garching, Germany

Using molecular dynamics simulations we present a novel mechanism for pumping of water through a carbon nanotube by time-dependent electric fields. The fields are generated by electrodes with oscillating charges in a broad GHz frequency range which are attached laterally to the tube. The key ingredient is a phase shift between the electrodes to break the spatio-temporal symmetry. A microscopic theory based on a polarization-dragging mechanism accounts quantitatively for our numerical findings.

CPP 21.13 Wed 11:00 Poster A

Measuring Flow Properties in Porous Media With Micron-sized Colloidal Tracers — •Christian Scholz[1], Frank Wirner[1,2], and Clemens Bechinger[1,2] — [1]2.Physikalisches Institut, Universität Stuttgart, Pfaffenwaldring 57, 70569 Stuttgart, Germany — [2]Max-Planck-Institut für Intelligente Systeme, Heisenbergstraße 3, 70569 Stuttgart, Germany

The understanding of transport and flow phenomena in porous media is important for many problems which arise in various fields of science and engineering, ranging from agricultural, biomedical, chemical and petroleum engineering to soil sciences. Although the literature on porous media has been growing rapidly over the last decades it is still unclear, how transport properties of liquids through porous materials can be related to their structure. We use finite-sized colloidal tracers to study flow and transport properties in random quasi-2D microfluidic porous media and study the effects of the tracer size on the mean and local tracer velocity within such structures. Significant differences in the mean velocities of different-sized tracers are found even for very low Stokes numbers, due to differing particle height distributions. We discuss the implications of these deviations for permeability measurements from particle tracking velocimetry. By applying an exponentially decreasing pressure drop we overcome the size dependence and measure the permeability of porous structures independently of tracer-size effects in the structure.

CPP 21.14 Wed 11:00 Poster A

Flow induced surface attachment of gold nanorods as probed with microfluidics and in-situ GISAXS — •Volker Körstgens[1], Kuhu Sarkar[1], Gerd Herzog[2], Matthias Schwartzkopf[2], Adeline Buffet[2], Frans J. de Jong[3], Stephan V. Roth[2], Michael Schlüter[3], 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 — [3]TU Hamburg-Harburg, IMS, 21073, Hamburg, Germany

The attachment of nanoparticles to a surface can be followed in-situ with GISAXS (grazing incidence small angle x-ray scattering) with a special designed microfluidic flow cell [1]. In this study the attachment of different gold nanoparticles including high aspect ratio gold nanorods to surfaces of insoluble calcium-alginate films is investigated. A scan along the microfluidic channel is carried out, collecting scattering data at different positions. With the brillant x-ray source available at the beamline MiNaXS of the PETRA III synchrotron source this procedure offers a time resolved as well as a position resolved GISAXS investigation of the attachment of nanoparticles. Information about the flow induced orientation of the attached high aspect ratio nanoparticles can be deduced from the GISAXS experiments.

This work has been financially supported by the BMBF (grant number 05K10WOA).

[1] J.-F. Moulin et al., Rev. Sci. Instrum. 79, 015109 (2008).

CPP 21.15 Wed 11:00 Poster A

Electrowetting on 3-dimensional structures: A method to control the transport of liquid plugs through hydrophobic sieves — •Markus Wink[1,2], Thomas Palberg[1], Karin Potje-Kamloth[2], and Michael Bassler[2] — [1]Johannes Gutenberg University Mainz, Germany — [2]Institut für Mikrotechnik Mainz, Germany

In the last two decades electrowetting has made its way into new applications, e. g., "lab-on-a-chip" systems, display technologies and microlenses. Recently, Lifton et al. have shown the use of electrowetting in microbatteries by introducing a micropourous structure, which is actively switched to the wetting state [1]. Here, we apply electrowetting to a microfluidic system and show tunable wetting and subsequent dewetting of a sieve representing a fundamental 3-dimensional structure. The pressure curve for transport of a liquid plug through a sieve is analytically described for a square mesh. The liquid entry pressure (LEP), which is the pressure required to fully wet the pores, depends on the size and shape of the pores, the interfacial tension of the liquid and the contact angle of the liquid on the solid surface. To enable electrowetting the square mesh is coated with a dielectric layer for electrical isolation and the surface is functionalized with a hydrophobic layer. The apparent contact angle of droplets on the sieve is investigated as a function of voltage. In addition, the LEP as a function of voltage is determined to test our hypothesis of a reduced LEP under electrowetting conditions.

[1] V.A. Lifton et al., Appl. Phys. Lett. 93, Issue 4 (2008) 043112

CPP 21.16 Wed 11:00 Poster A

Three-dimensional imaging of water drops on hydrophobic surfaces by confocal microscopy — •Periklis Papadopoulos, Hans-Jürgen Butt, and Doris Vollmer — Max Planck Institut for Polymer Research, Mainz, Germany

The microscopic description of wetting of a rough or structured solid surface by a liquid is still a challenge. Nano- and micrometer-sized inhomogeneities cause pinning of the three-phase contact line, preventing drops to reach their global equilibrium. To investigate the relation between the local, microscopic and the macroscopic contact angle, we image water drops on microstructured surfaces by laser scanning confocal microscopy (LSCM). The microstructures consist of cylindrical pillars arranged in a square lattice. Both the substrate and water are fluorescently labeled, allowing for accurate imaging of all interfaces and the three-phase contact line. Contact angles can be measure with accuracy of 1° and spatial resolution of a few μm. The "microscopic" contact angle close to the substrate varies by up to 30° along the wetting line, depending on the precise position. This variation, along with the contact line profile, causes deviations of the drop shape that persist at heights more than one magnitude larger than the size of the microstructures. This detailed information will allow us to tune the wetting properties of rough and patterned surfaces.

CPP 21.17 Wed 11:00 Poster A

Microfluidic systems for surface tension measurement — •Quentin Brosseau and Jean-Christophe Baret — Max Planck Institut for Dynamics & Self-organization, Göttingen, Germany

With the increasing number of microfluidics droplet-based methods developed, understanding surfactant adsorption at droplet interfaces, as main stabilizing process of emulsions, has become a major concern. Although such processes are well described in the diffusional case, models does not apply on chip where convective circulation is present. Our project aims at developing a series of microfluidic tools providing insights into the dynamics of surfactant adsorption, down to the millisecond-scale, for a dynamic determination of droplets surface tension. We for example exert a localized hydrodynamic stress transversal to the flow direction on the droplet. The droplet response – in deformation and relaxation – is measured and studied. The measured droplet deformation profiles reveal the characteristic time for surfactant adsorption at the interface, and the adsorption-desorption equilibrium. The influence of surfactant concentration, both above and below the CMC, and of the liquid flow rate are measured and additional 2D numerical simulation of the droplet deformation profile, provide tools to link deformations to effective interfacial tension.

CPP 21.18 Wed 11:00 Poster A

Importance of Mechanical Properties 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 microchannels under longitudinal compression. Depending on the exact choice of parameter a considered static droplet arrangement can be mechanically unstable and segregates into domains of higher and lower packing fraction. This is of fundamental importance also for corresponding flowing systems as it is not possible to generate mechanically stable droplet trains in this fairly large region of accessible volume fraction (around 15%) [1]. As a consequence flowing droplet arrangements present complex non-equilibrium droplet rearrangements, in these parameter regions, arising from the coupling of interfacial instabilities and dissipative friction. We will experimentally and theoretically discuss these mechanisms of dynamical rearrangements in an out-of-equilibrium microfluidic system.

[1] J-B. Fleury, O. Caussen, S. Herminghaus, M. Brinkmann and R. Seemann, Appl. Phys. Lett. (to be published, 2011)

CPP 21.19 Wed 11:00 Poster A

Influence of surface modification on sputter deposition — •Berit Heidmann[1,2], Matthias Schwartzkopf[1], Mottakin M. Abul-Kashem[1], Gunthard Benecke[1,3], Adeline Buffet[1], Denise Erb[1], Gerd Herzog[1,2], Ezzeldin Metwalli[4], Jan Perlich[1], Andre Rothkirch[1], Kai Schlage[1], Peter Müller-Buschbaum[4], Ralf Röhlsberger[1], Wilfried Wurth[2], and Stephan V. Roth[1] — [1]Deutsches Elektronen-Synchritron (DESY), Notkestr. 85, D-22607 Hamburg — [2]Univ. Hamburg, Inst. für Exp., Luruper Chaussee 149, 22761 Hamburg — [3]MPIKG, Dep. of Biomat., Am Mühlenberg 1, 14424 Potsdam-Golm — [4]TU München, Physik Department E13, James-Franck-Str. 1, 85748 Garching

Polymer-metal-nanocomposites are important for technical applications,e.g solar cells [1]. Metal sputter deposition on polymer templates represents one of the most efficient processes to obtain nanostructured composites. The crucial interaction is that of the metal atom with the polymeric material. We investigated in-situ the growth of gold cluster on top of these functionalized silanized silicon surfaces during sputter deposition under conditions similar to industrial processing. Using in-situ grazing incidence small-angle X-ray scattering, we show that due to different reaction mechanisms (chemisorption and physisorption) between the individual gold atom and the functional group yield different cluster growth kinetics, which in th case of thiol groups leads to the fast deposition of uniform gold layers.However, this is not the case in presence of phenyl groups due to their ability to repel gold atoms. [1] Kaune et al., ACS Apl. Mater. & Interfaces, 1, 353 (2009)

CPP 21.20 Wed 11:00 Poster A

Flow-stream-assisted deposition of gold nanoparticles — •Gerd Herzog[1,2], Mottakin M. Abul Kashem[1], Gunthard Benecke[1,3], Sebastian Bommel[1,4], Adeline Buffet[1], Frans J. de Jong[5], Volker Körstgens[6], Roman Mannweiler[1], Peter Müller-Buschbaum[6], Jan Perlich[1], Johannes F. H. Risch[1], Kuhu Sarkar[6], Matthias Schwartzkopf[1], Wilfried Wurth[2], and Stephan V. Roth[1] — [1]DESY, Notkestr. 85, D-22607 Hamburg — [2]Uni Hamburg, Inst. Exp.-P., Luruper Chaussee 149, D-22761 Hamburg — [3]MPI Coll. Int., Dep. Biomat., Am Mühlenberg 1, D-14476 Potsdam-Golm — [4]Humboldt-Uni Berlin, Institut für Physik, Newtonstr. 15, D-12489 Berlin — [5]TU Hamburg-Harburg, IMS, Eißendorfer Straße 38, 21073 Hamburg — [6]TU München, Physik-

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Production of nanowires by deposition of gold nanoparticles via flow-stream technique onto a nanostructured polymer-coated substrate might offer a cheap and fast solution for industrial application [1]. We investigate the deposition of gold nanoparticles on colloidal polymeric samples with and without artificially induced μm-sized channels. Using a microfluidic cell in combination with in-situ GISAXS (beamline P03, Hamburg) we follow the gold deposition during the solution flow. First results indicate a different temporal nanoparticle layer growth compared to the three stages deposition on flat templates [2].

[1] Metwalli et al., Langmuir 2009, 25(19), 11815

[2] Roth et al., 1st Int. Symp. on Multiscale Multiphase Process Eng., Kanazawa (2011)(MMPE)

CPP 21.21 Wed 11:00 Poster A

Influence of solute–dependent wettability on the stability of films of mixtures and suspensions — •Desislava V. Todorova and Uwe Thiele — Department of Mathematical Sciences, Loughborough University, Loughborough, Leicestershire, LE11 3TU, UK

We discuss the behaviour of thin films of non-volatile liquid mixtures, colloidal suspensions and polymer solutions on a solid substrate. First, we reformulate the coupled long-wave time evolution equations for the film height and mean solute concentration for a 'passive' solute in gradient dynamics. This form can then be extended to incorporate additional effects [1]. In particular, we focus on a concentration-dependent wettability. It is determined employing homogenisation techniques to obtain effective optical characteristics [2]. Combining this with classical theory of effective molecular interactions between the film surface and the substrate, we arrive at a Derjaguin (or disjoining) pressure that depends on film height and concentration.

We use the derived model to study the linear stability of flat homogeneous films. In particular, we investigate how the stability thresholds are influenced by the incorporation of the additional degree of freedom related to the concentration field. As an outlook we also analyse nonlinear thickness and concentration profiles for steady droplets.

[1] U. Thiele, Eur. Phys. J. Special Topics 197, 213-220 (2011).

[2] G. A. Niklasson, C. G. Granqvist, O. Hunderi, Appl. Optics 20, 26-30 (1981); D. Todorova et al., J. Optoelectron. Adv. Mater. 11, 1296-1299 (2009).

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CPP 21.22 Wed 11:00 Poster A

Influence of the wettability of the wall on capillary flow — Stefan Fogel, Ute Böhme, and •Ulrich Scheler — Leibniz-Institut für Polymerforschung Dresden e.V., Dresden, Germany

A Newtonian liquid in a capillary usually exhibits a parabolic flow profile resulting from the sticking at the wall. The situation is different in a capillary with a non-wetable wall. A significantly flattened profile is observed. Capillary flow is conveniently studied without any disturbance by flow NMR imaging. For each point in space velocity is determined in three directions. The focus has been on the transition between the two scenarios. Because a non-compressible liquid has been used, continuity requires transverse flow for the transition between the two flow profiles, which has been observed. Transition between the two types of flow profiles takes places over several millimeters and starts long before the change of the wall properties.

CPP 21.23 Wed 11:00 Poster A

Dynamic Contact Angles on Heterogeneous Substrates — •Daniel Herde, Stephan Herminghaus, and Martin Brinkmann — MPI for Dynamics and Self-Organisation, Goettingen, Germany

We study the influence of heterogeneities in the substrate wetting energy on the dynamical contact angle for a driven contact line. To this end, we model a 2-dimensional droplet sheared between two substrates in the Steady Stokes limit using boundary element methods.

Different definitions of the dynamic contact angle are compared. The constitutive velocity-contact angle relations for the case of driving with constant force and driving with constant velocity are discussed. Together with the information about the energy input in the system and the energy stored in the configuration of the free interface, we can characterise the influence of the heterogeneity on the energy dissipation in the system.