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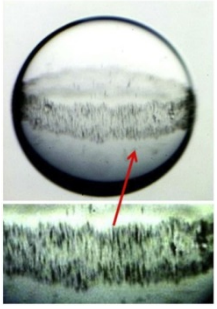


Nordic Workshop on
Soft Matter Physics

Norwegian Academy of Science and Letters

Drammensvegen 78, Oslo, Norway, September 29-30, 2014

The scope of the workshop:
Physics and chemistry of soft matter and related phenomena.
From basic science and natural phenomena to applications and technology.

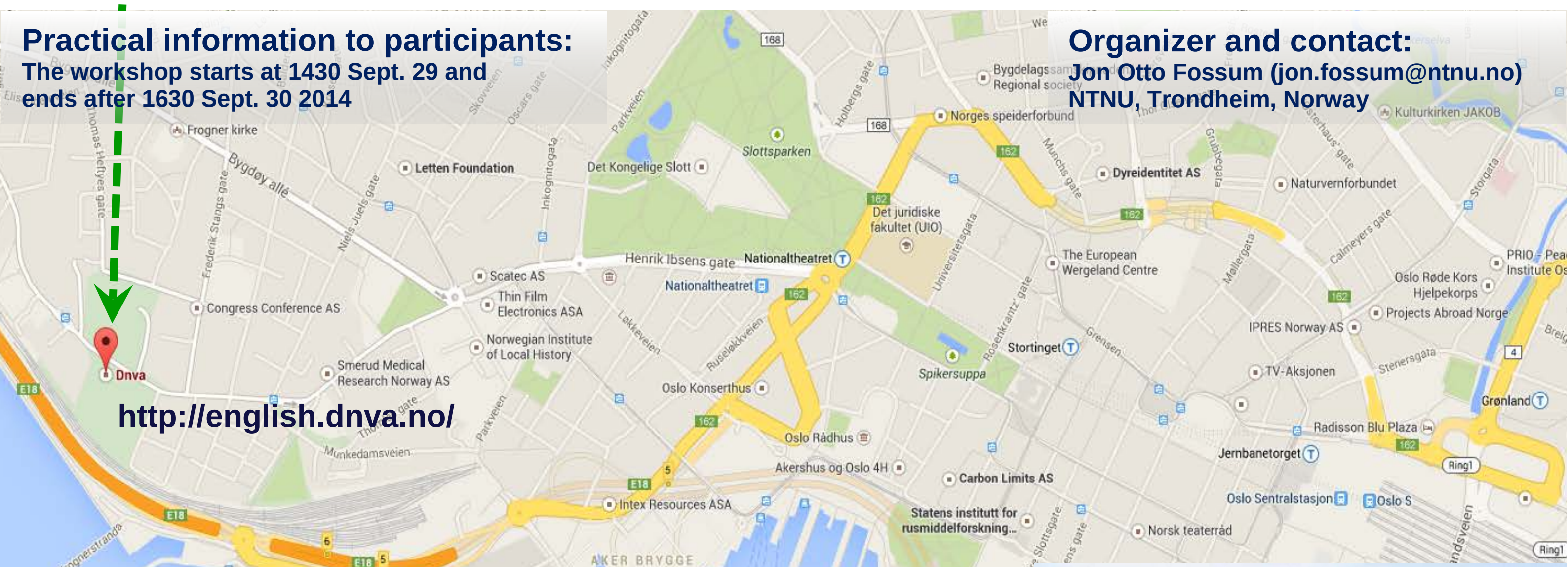
Confirmed Invited Speakers:
- Ernesto Altshuler (Univ. Havana, Cuba)
- Francoise Brochard (Inst. Curie, Paris, France)
- Paul Dommersnes (NTNU, Norway)
- Irep Gozen (Harvard Univ., USA)
- Finn Knut Hansen (Univ. Oslo, Norway)
- Tom Henning Johansen (Univ. Oslo, Norway)
- Yves Meheust (Univ. Rennes 1, France)
- Dorthe Posselt (Roskilde Univ., Denmark)
- Adrian Rennie (Uppsala Univ. Sweden)
- Noushine Shahidzadeh (Univ. Amsterdam, Netherlands)
- Arne Skjeltorp (Giamag Technologies and Inst. for Energy Tech. (IFE), Norway)
- Niclas Solin (Linköping Univ., Sweden)
- Ole Torsæter (NTNU, Norway)

Practical information to participants:

The workshop starts at 1430 Sept. 29 and ends after 1630 Sept. 30 2014

Organizer and contact:

Jon Otto Fossum (jon.fossum@ntnu.no)
NTNU, Trondheim, Norway



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This is the last in a series of Nordic Workshops in Soft Matter Physics funded by a Nordforsk grant (2010-14), and coordinated by Prof. J.O. Fossum, NTNU, Trondheim.
Previous workshops in the series:
2011: Kick-off Workshop for Nordforsk Soft Matter Physics network, at University of Århus, Denmark, June 28 - July 1. 2011.
2012: International Workshop on Soft Matter Physics & Complex Flows in Svolvær, Lofoten, Norway, May 22nd - 24th 2012.
2013: International Workshop on Soft Matter Physics and Biomembranes at University of Iceland in Reykjavik, May 21-24, 2013.

Book of abstracts

Nordic Workshop on Soft Matter Physics

Norwegian Academy of Science and Letters, Oslo, Norway

September 29-30, 2014

Program Summary: Nordic Workshop on Soft Matter Physics
Norwegian Academy of Science and Letters, Oslo, Norway, September 29-30, 2014

Time	**Monday September 29**	**Tuesday September 30**	**Time**
	Norwegian Academy of Science and Letters **Drammensvegen 78 Oslo** 	**Ole Torsæter**	**0900 - 0930**
		Yves Meheust	**0930 - 1000**
		Break/Discussions	**1000 - 1015**
		Dorthe Posselt	**1015 - 1045**
		Niclas Solin	**1045 - 1115**
		Finn Knut Hansen	**1115 - 1145**
		Workshop Lunch	**1145 - 1330**
		Alexander Mikkelsen	**1330 - 1345**
		Tomáš Plachý	**1345 - 1400**
1400 - 1445	Registration	Maja Hellsing	**1400 - 1415**
		Max Wolff	**1415 - 1430**
		Franz Adlmann	**1430 - 1445**
1445 -1500	Opening	Matti Knappila	**1445 - 1500**
1500 -1530	**Francoise Brochard**	Tatsiana Lobovkina	**1500 - 1515**
		Erica Zeglio	**1515 - 1530**
1530 - 1600	**Ernesto Altshuler**	Ilja Czolkos	**1530 - 1545**
		Leander Michels	**1545 - 1600**
1600 - 1615	Break/Discussions	Closing remarks followed by discussions	**1600 - 1800**
1615 - 1645	**Tom Henning Johansen**		
1645 - 1715	**Arne Skjeltorp**		
1715 - 1745	**Paul Dommersnes**		
1745 - 1800	Break/Discussions		
1800 - 1830	**Adrian Rennie**		
1830 - 1900	**Noushine Shahidzadeh**		
1900 - 1930	**Irep Gozen**		
1930 - 1945	Gavin Jeffries		
1945 -	Workshop Dinner		

Program Monday September 29:

1400 – 1445 *Registration*

1445 – 1500 *Opening*

1500 - 1600 Session I, Chair: Jon Otto Fossum, NTNU

1500 – 1530 Françoise Brochard-Wyart, G. Beaune, D. Cuvelier, S. Douezan, S. Dufour, J. Dumond, D. Gonzalez, K. Guevorkian and T.V. Stirbat
Institut Curie-PCC Curie-UMR 168_ Paris France, Université Pierre et Marie Curie, France
Soft Matter models of tissue "wetting of living drops". Spreading and motility of cellular aggregates

1530 - 1600 **Ernesto Altshuler**
Superconductivity Laboratory and "Henri Poincaré" Group of Complex Systems, Physics Faculty, University of Havana, Cuba
Active Matter in Microfluidic Funnels

1600 - 1615 *Break/Discussions*

1615 - 1745 Session II, Chair: Geir Helgesen, IFE

1615-1645 **Tom Henning Johansen**
Dept. of Physics, Univ. of Oslo, Norway
Colloidal transport on magnetic garnet chips

1645 – 1715 **Arne T. Skjeltorp**[1,2]
[1]Institute for Energy Technology, Kjeller, Norway, [2]Giamag Technologies (www.giamag.com)
Manipulation and applications of mesoscopic magnetic particles

1715 – 1745 **Paul Dommersnes**
Dept.of Physics, Norwegian University of Science and Technology – NTNU, Trondheim, Norway
Electric-field structuring of complex fluid drops

1745 - 1800 *Break/Discussions*

1800 - 1930 Session III, Chair: Kenneth D. Knudsen, IFE

1800 – 1830 **Adrian Rennie**
Materials Physics, Uppsala University, Sweden
Interaction of Particles, Proteins and Surfactants - Colloid Physics of Water Purification

1830 – 1900 **Noushine Shahidzadeh**
Institute of Physics, soft matter group, University of Amsterdam, Netherlands
Science for Art: soft matter systems for the preservation of our cultural heritage

1900 – 1930 **Irep Gozen**
Harvard University School of Engineering and Applied Sciences, Cambridge, MA 02138, USA
Thermomigration of molecular lipid films

1930 – 1945 **Gavin D. M. Jeffries**
Dept. of Chemical and Biological Engineering, Chalmers Univ. of Technology, Göteborg, Sweden
Manipulating Membranes with Microfluidics: From creation to cellular applications.

1945 – 2200 *Workshop Dinner*

Program Tuesday September 30:

0900 - 1000 Session IV, Chair: Paul Dommersnes, NTNU

0900 – 0930 **Ole Torsæter,**
Department of Petroleum Engineering and Applied Geophysics, Norwegian University of Science and Technology – NTNU, Trondheim, Norway
Enhanced Oil Recovery (EOR). Some experimental results on microbial methods and nanofluids for EOR.

0930 – 1000 Régis Turuban, Joaquin Jimenez, Pietro de Anna, Tanguy Le Borgne, **Yves Méheust,**
Géosciences Rennes, Université Rennes 1, Rennes, France
Mixing and reaction kinetics in porous media: an experimental pore scale quantification

1000 – 1015 Break/Discussions

1015 - 1145 Session V, Chair: Adrian Rennie, Uppsala University

1015 – 1045 **Dorthe Posselt[1]**, Jianqi Zhang[2], Detlef-M. Smilgies[3], and Christine M. Papadakis[2],
[1]IMFUFA, NSM, Roskilde University, Denmark;
[2]TU München, Physik-Department, Garching, Germany; [3]Cornell University, Ithaca, NY, USA
Restructuring of lamellar diblock copolymer thin films during solvent vapor treatment investigated by GISAXS

1045-1115 **Niclas Solin**, Fredrik Bäcklund, Patrik Johansson, David Jullesson, Olle Inganäs,
Linköping University, Department of Physics, Chemistry, and Biology, Linköping, Sweden
Functionalization and application of biomolecular self-assembled structures

1115 – 1145 **Finn Knut Hansen**
Department of Chemistry, University of Oslo, Norway
Surface dilatational elasticity by oscillation and relaxation measurements of sessile bubbles.

1145 – 1330 Workshop Lunch

1330 – 1600 Session VI, Chairs: Yves Meheust, Univ. Rennes 1, Irep Gozen, Harvard University

1330 – 1345 **Alexander Mikkelsen**, Paul Dommersnes and Jon Otto Fossum,
Department of Physics, Norwegian University of Science and Technology, Trondheim, Norway
Swimming motion of electro-rotating drops; Quincke rotation, electrorotation, passive rotors, collective dynamics

1345 – 1400 **Tomas Plachy**, Michal Sedlacik, Vladimir Pavlinek
Centre of Polymer Systems, University Institute, Tomas Bata University in Zlin, Czech Republic
Influence of temperature on the electrorheological effect

1400 – 1415 **Maja S. Hellsing**[a], Fredrik Höök[b] and Adrian R. Rennie[a],
a) Department of Physics & Astronomy, Ångström Laboratory, Uppsala University, Uppsala, Sweden
b) Department of Applied Physics, Chalmers, 412 96 Gothenburg, Sweden.
Polystyrene nanoparticles at a solid/liquid interface

1415 – 1430 H. Carstensen, V. Kapaklis, **M. Wolff**
Department of Physics and Astronomy, Uppsala University, Sweden
Phase formation in colloidal systems with tunable interaction

1430 – 1445 **F. A. Adlmann**[1], P. Gutfreund[2], A. Dennison[1,2],J. Ankner[3], J. Browning[3], A. Parizzi[3], B. Vacaliuc[3], C. E. Halbert[3], J. P. Rich[3], and M. Wolff[1],
[1]Materials Physics, Uppsala Universitet, Sweden [2]Large Scale Structures, Institut Laue-Langevin, France [3]Spallation Neutron Source, Oak Ridge National Laboratory, USA
Towards surface sensitive neutron scattering experiments with sub-microsecond resolution

1445 – 1500 **Matti Knaapila,** *Institute for Energy Technology, Kjeller Norway*
Measuring structural inhomogeneity of conjugated polymer at high pressures up to 30 GPa

1500 – 1515 **Tatsiana Lobovkina**
Dept. Chemical and Biological Engineering, Chalmers University of Technology, Göteborg, Sweden
Soft-matter biomimetic cell models for studying cell migration and in-cell transport of membrane compounds.

1515 – 1530 **Erica Zeglio**, Fatima Nadia Ajjan, Roger Karlsson, Niclas Solin,a Olle Inganäs
Biomolecular and Organic Electronics, IFM, Linköping University, Sweden
Conjugated Polyelectrolyte Complexes: A quest for multicolor electrochromic devices.

1530 – 1545 **Ilja Czolkos**
Dept. of Micro- and Nanotechnology, The Technical University of Denmark, Lyngby, Denmark
Confinement Strategies and Partial Melting of Long DNA Molecules

1545 – 1600 **Leander Michels**[1], Jon Otto Fossum[1], Henrik Hemmen[1], Karin Rustenberg[1], Zbigniew Rozynek[1], Pawel A. Sobas[2], Georgios N. Kalantzopoulos[2], Geir Helgesen[2], Kenneth D. Knudsen[2,1], Marian Janek[3], Tomás S. Plivelic[4], Geraldo José da Silva[5],
[1]Department of Physics, Norwegian University of Science and Technology NTNU, Trondheim, Norway, [2]Physics Department, Institute for Energy Technology – IFE, Kjeller, Norway, [3]Department of Physical and Theoretical Chemistry, Comenius University, Bratislava, Slovak Republic, [4]MAX IV Laboratory, Lund University, Lund, Sweden, [5]Instituto de Física, Universidade de Brasília, Brasília, Brazil,
Intercalation and Retention of Carbon Dioxide in a Smectite Clay promoted by Interlayer Cations

1600 - 1800 Closing remarks followed by discussions

Monday September 29

1500 - 1530

Françoise Brochard-Wyart, G. Beaune, D. Cuvelier, S. Douezan, S. Dufour, J. Dumond, D. Gonzalez, K. Guevorkian and T.V. Stirbat
Institut Curie-PCC Curie-UMR 168_ Paris France, Université Pierre et Marie Curie

Soft Matter models of tissue "wetting of living drops"- Spreading and motility of cellular aggregates

We first introduce the field of "Active Matter". Active processes in both living and non-living matter create a novel class of nonequilibrium materials composed of many interacting units that individually consume energy and collectively generate motion or mechanical stresses. Active systems span an enormous range of length scales, from the cytoskeleton of individual living cells, to tissues and organisms, to animal groups such as bird flocks, fish schools and insect swarms. We will show strong similarities between aggregates of ants and cells!

We then describe the biomechanics of multicellular aggregates, a model system for tissues. We characterize the tissue mechanical properties (surface tension, elasticity, viscosity) by a new pipette aspiration technique. The aggregate exhibits a viscoelastic response but, unlike an inert fluid, we observe aggregate reinforcement with pressure, which for a narrow range of pressures results in pulsed contractions or "shivering". We interpret this reinforcement as a mechanosensitive active response of the acto-myosin cortex.

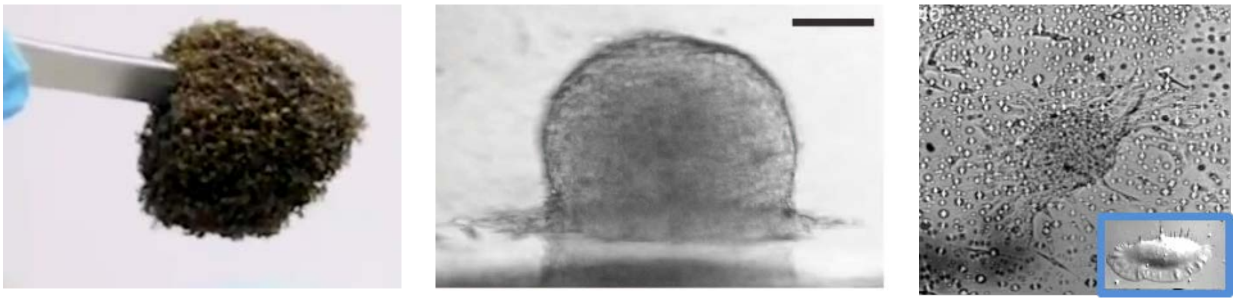


Figure 1: a) Aggregate of Ants, b) Aggregate of cells spreading, and c) migrating

We then describe the spreading of aggregates on rigid and soft substrates, varying both intercellular and substrate adhesion. We find both partial and complete wetting regimes. For the dynamics, we find a universal spreading law at short time, analogous to that of a viscoelastic drop. At long time, we observe a precursor film spreading around the aggregate. Depending on aggregate cohesion, this precursor film can be a dense cellular monolayer or consist of individual cells escaping from the aggregate The dynamics of spreading results from a balance between active cellular driving forces and permeation of cells to enter into the film.

Finally we describe the motility of aggregates induced by chemical or rigidity gradients, or spontaneous: on soft substrate, the precursor film is unstable, leading to a symmetry breaking and a global motion of the aggregate, as a giant keratocyte (Figure 1 c).

References:

- David Gonzalez-Rodriguez et al. (2012) Soft Matter Models of developing Tissues and Tumors. Science 338, 910; 1226418
- S. Douezan and F. Brochard-Wyart (2012) Dewetting of cellular monolayers. EPJE, 35: 34, 201
- David Gonzalez-Rodriguez et al. (2012) Opening of Macro apertures in Endothelial Cells. Phys. Rev. Lett. (108) 218105
- Douezan S et al. (2012) Wetting transition of living drops induced by substrate rigidity. Soft Matter, 8: 4578-4583
- Douezan S et al. (2011) Spreading dynamics and wetting of cellular aggregates. Proc. Nat. Acad. Sci (USA), 108: 7315
- Guevorkian K et al. (2011) Shivering of model tissues under controlled aspiration. Proc. Nat. Acad. Sci (USA), 108: 1338
- Guevorkian K et al. (2010) Aspiration of Biological Viscoelastic Drops. Phys. Rev. Lett. 104, 218101

Monday September 29

1530 - 1600

Ernesto Altshuler
Superconductivity Laboratory and "Henri Poincaré" Group of Complex Systems, Physics Faculty, University of Havana, Cuba

Active Matter in Microfluidic Funnels

Dispersion and migration of bacteria under flow in tortuous and confined structures such as porous or fractured materials is related to a large spectrum of practical interest, but is still poorly understood. Here, we address the question of transport and dispersion of an E. coli suspension flowing through a micro-fluidic channel with a funnel-like constriction in its center. We show a counter-intuitive symmetry breaking of the bacterial concentration, which increases significantly past the funnel. This concentration enhancement persists over large distances from the funnel and disappears at large flow rate values. We map our results onto a one dimensional convection-diffusion equation predicting quantitatively the experimental results, without free parameters, when a conservative non-local source term is introduced. This last term, measured experimentally, represents a long range memory effect due to the unbalance of wall adsorption and desorption processes past the constriction. Our model experiment points out the generic importance of considering such constriction effects in the description of transport properties of active matter in porous media. It also opens the possibility to control the concentration of bacterial suspensions in micro-fluidic channels by simply tuning the flow intensity or direction.

1615-1645

Tom Henning Johansen
Dept. of Physics, Univ. of Oslo, Norway

Colloidal transport on magnetic garnet chips

This talk reports on recent work exploring the potential of using magnetic garnet films to actively control the motion of paramagnetic colloids (Ugelstad spheres) in a planar lab-on-a-chip configuration. The active part of the garnet chip is a uniaxial ferromagnetic layer where magnetic domains can form patterns consisting of stripes or bubbles, which generate strong field gradients, and thereby also forces acting on paramagnetic particles. It is shown that by applying time-varying external uniform magnetic field, which dynamically displaces the domain boundaries, one may control the motion of the colloidal particles in a number of ways. Many examples of different modes of manipulation will be presented.

1645 - 1715

Arne T. Skjeltorp[1,2]
[1]*Institute for Energy Technology, Kjeller, Norway*
[2]*Giamag Technologies (www.giamag.com)*

Manipulation and applications of mesoscopic magnetic particles

Mesoscale (nanometers to microns) magnetic particles are becoming increasingly important in fields like biomedical applications, environmental nanoremediation of pollutants and toxic waste. A review will be given of magnetic field-directed self-assembly and manipulation of mesoscale magnetic particles as well as various applications.

Monday September 29

1715 - 1745

Paul Dommersnes
Dept.of Physics, Norwegian University of Science and Technology – NTNU, Trondheim, Norway

Electric-field structuring of complex fluid drops

Externally applied electric fields can induce remarkable changes in complex fluids. In colloidal suspensions, both the fluid viscosity and electric conductivity can increase with many orders of magnitude due to formation of induced dipole chains [1]. In liquid emulsions, induced dipoles on droplets lead to dipole-dipole attraction, droplet coalescence, and eventually emulsion breaking. These are but two classic and well-known examples. Today electric field control of complex fluids and soft matter is an active field which spans a wide range of applications, including optical devices, colloidal templating, targeted drug-delivery, microfluidics, smart materials, and robotics.

Over the last decade there has been considerable effort in better understanding and controlling colloidal particle adsorption and assembly at fluid drop interfaces, mainly triggered by the interest for particle-stabilized emulsions (surfactant free emulsions) [2], and also largely by the invention of colloidosome capsules [3].

Here we show that electric fields can induce a rich variety of phenomena on particle assemblies at liquid drop interfaces, including convective assembly of jammed colloidal 'ribbons', electro-rheological colloidal chains confined to a two-dimensional surface, spinning colloidal surface domains , and controllable 'pupil'-like openings in colloidal shells [4]. We further show how some of these effects can be used to build self-assembled structures with relatively simple means: The synergetic action of electro-hydrodynamic flow structuring and drop electro-coalescence spontaneously assemble capsules of controlled heterogeneity, including Janus and patchy capsules [5]

References:

[1] Electrorheological suspensions of laponite in oil: Rheometry studies, Kanak Parmar, Yves Méheust, Børge Schjelderupsen and Jon Otto Fossum. Langmuir 24, 1814 (2008)

[2] Emulsions stabilised solely by colloidal particles (Review), R. Aveyard, B.P. Binks, J.H. Clint, Advances in Colloid and Interface Science, 100–102, 503–546 (2003)

[3] Colloidosomes: selectively permeable capsules composed of colloidal particles, Dinsmore AD, Hsu MF, Nikolaides MG, Marquez M, Bausch AR, Weitz DA, Science 298(5595):1006-9. (2002)

[4] Active Structuring of Colloidal Armour on Liquid Drops, P. Dommersnes, Z. Rozynek, A. Mikkelsen , R. Castberg, K. Kjerstad, K. Hersvik, J.O. Fossum, Nature Communications 4, 2066 (2013)

[5]Electroformation of Janus and Patchy Capsules, Z. Rozynek, A. Mikkelsen, P. Dommersnes, J. O. Fossum,, Nature Communications 5, 3945 (2014)

1800 - 1830

Adrian Rennie
Materials Physics, Uppsala University, Sweden

Interaction of Particles, Proteins and Surfactants - Colloid Physics of Water Purification

Provision of clean water for drinking and washing and the treatment of waste water after industrial processes or from domestic use is crucial for good health and a clean environment. Many impurities are particulate and can be considered as colloidal dispersions. The process of purification usually consists of destabilizing the particles so that they can be removed as flocs. Our recent study has focussed on using sustainable materials from plants to replace conventional water treatment chemicals. Moringa seed proteins offer promising ways to treat water and have been shown to be as effective as other chemicals. Studies using reflection and scattering reveal interesting aspects of floc structure and suggest means to make adsorption specific to particular materials. Results suggest that hydrodynamics and concentration are very important in the practical aspects of flocculation and that structure and composition of aggregates could be controlled in a number of subtle ways. The molecular understanding of a traditional natural product thus suggests means to develop new processes that could be valuable in many countries and industries.

Monday September 29

1830 - 1900

Noushine Shahidzadeh
Institute of Physics, soft matter group, University of Amsterdam, Netherlands

Science for Art: soft matter systems for the preservation of our cultural heritage

Works of art and historical buildings are irremediably exposed to degradation by various ageing processes, pollution effects and physical erosion, e.g., frost and salt damage. In recent years, traditional conservation approaches used by art historians and museum conservators have been enriched by new insights from the exact sciences regarding for instance the cleaning of works of art or the prevention and repair of erosion damage. In general, due to environmental fluctuations such as temperature and relative humidity degradation occurs; a first necessary step is to identify the underlying causes. In my talk, I will give some examples of novel and promising techniques, focusing on salt weathering of stones. One of the most serious problems in conservation science today is the deterioration of stone-based porous materials (lime-based wall paintings, calcareous stones). I will first discuss the origins of the damage due to salt crystallization, and how the latter can be affected by the presence of surfactants that are usually employed as cleaning agents. In order to reduce such damage, different types of water-repellent treatments are used. I will show however that these treatments may even lead to an aggravation of the problem. As a remedy, I will give an overview of novel approaches for the sustainable consolidation of weakened stones using soft matter science. One of these is the development of nanostructured repair materials with physicochemical properties similar to that of the stone. Such composite systems are based on a self-assembled surfactant template and offer the additional advantage of reducing the amount of organic solvents and consequently the environmental impact of the treatments. By taking advantage of the unique opportunities offered by soft nanoscience, an appropriate treatment can be developed that, once applied, adheres strongly to the grains, and that makes the stone mechanically as strong as it was originally, while retaining its physicochemical characteristics and at the same time making it resistant to further decay.

1900 – 1930

Irep Gozen
Harvard University School of Engineering and Applied Sciences, Cambridge, MA 02138, USA

Thermomigration of molecular lipid films

Living cells continuously probe their close-range environment and move accordingly in order to adjust to physical or chemical stimuli. Examples of such stimuli are a chemical concentration, temperature, or adhesion strength gradient. Movement in these gradients, referred to as chemotaxis, thermotaxis or haptotaxis, respectively, benefits the cells in a particular way, for example by improving access to nutrients, creating connectivity or evading undesirable environmental conditions. Cell migration is a key mechanism in the function of immune system cells, sperm cells, wound healing and cancer cell metastasis.

The molecular machinery behind cell movement is complex. It involves a cascade of signaling events, structural elements, i.e., cytoskeleton filaments and motor proteins, as well as coordination of the extreme shape dynamics of the cell. There is a variety of experimental studies which, under laboratory conditions, focus on mimicking cell motility by exploiting a particular feature or component of the cellular machinery.

In the present study, we induce themigration of flat giant unilamellar vesicles (FGUVs), a variant of surface-supported lipid bilayer membranes, by generating a temperature gradient over a selected region on the membrane. Such gradient with a range of 20 μm has been achieved using a focused IR-B laser. The temperature gradient generated a surface adhesion gradient, along which FGUVs spontaneously relocated. We report on suitable lipid–substrate combinations, highlighting the critical importance of the electrostatic interactions between the engineered substrate and the membrane for reversible migration of intact vesicles. This is the first report on thermomigration of a supramolecular architecture. We also make use of the phenomenon to fabricate lipid nanotube networks in an entirely contactless manner.

Monday September 29

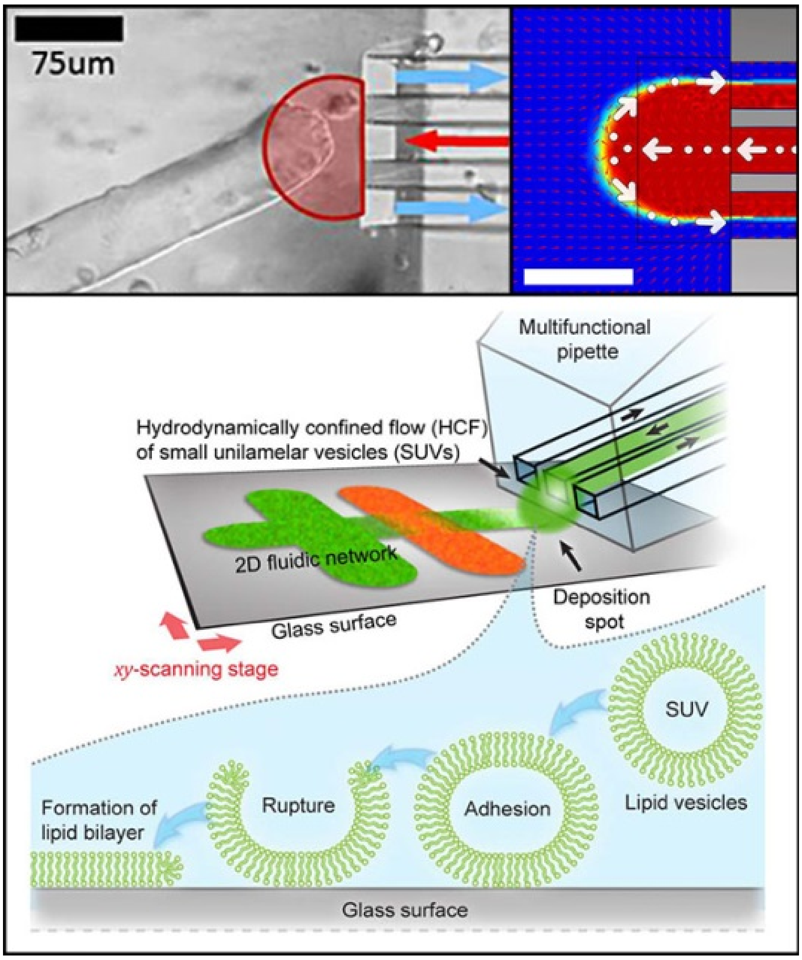
1930 – 1945

Gavin D. M. Jeffries
Department of Chemical and Biological Engineering, Chalmers University of Technology, Göteborg, Sweden

Manipulating Membranes with Microfluidics: From creation to cellular applications.

Biomembranes, a fundamental component of all cells, have long been investigated as a potential target to interrogate cellular activity and signaling. Composing practical models of these membranes has seen vesicles emerge as a model construct, with increasing interest in the formation of flattened vesicles or supported bilayers. Our recent investigations into using hydrodynamically confined flow technology to pattern and structure these supported lipid bilayers will be discussed.

These bilayer constructs, being 2D fluidic structures, are an ideal platform for studying local chemical effects and elucidating key interactions between agonists and biomembranes. This has particular importance in discerning complex relationships for identifying new drug targets and studying intracellular communication. The application of the hydrodynamically confined flow technology for delivering agonist, in a highly localized region, across cellular membranes of intact muscle fibers will also be presented; showing the utility of the developed microfluidic flow technology for not only establishing model systems but also for interrogating the membranes of living cells.



Tuesday September 30

0900 - 0930

Ole Torsæter
Department of Petroleum Engineering and Applied Geophysics, Norwegian University of Science and Technology – NTNU, Trondheim, Norway

Enhanced Oil Recovery (EOR) - Some experimental results on microbial methods and nanofluids for EOR.

Enhanced oil recovery (EOR) is the final stage in the recovery of crude oil from reservoirs. Often less than 50% of the total amount of the crude oil has been recovered prior to this stage. This means that implementation of EOR processes are required in order to prolong the life time of oil fields and to avoid extreme waste of valuable natural resources by leaving large amounts of oil in the reservoirs upon shut-in. Development, implementation and optimisation of efficient EOR techniques involves technical as well as scientific challenges. Consequently, research and development directed towards EOR processes has high priority.

The presentation gives a brief overview of the present EOR methods and discusses somewhat more in detail the microbial enhanced oil recovery (MEOR) technique and the use of nanofluids for EOR. Results from laboratory experiments using reservoir rock core samples and glass micromodels are presented and possible mechanisms for enhanced oil recovery are suggested.

0930 - 1000

Régis Turuban, Joaquin Jimenez, Pietro de Anna, Tanguy Le Borgne, **Yves Méheust**
Géosciences Rennes (UMR 6118), Université Rennes 1, Rennes, France

Mixing and reaction kinetics in porous media: An experimental pore scale quantification

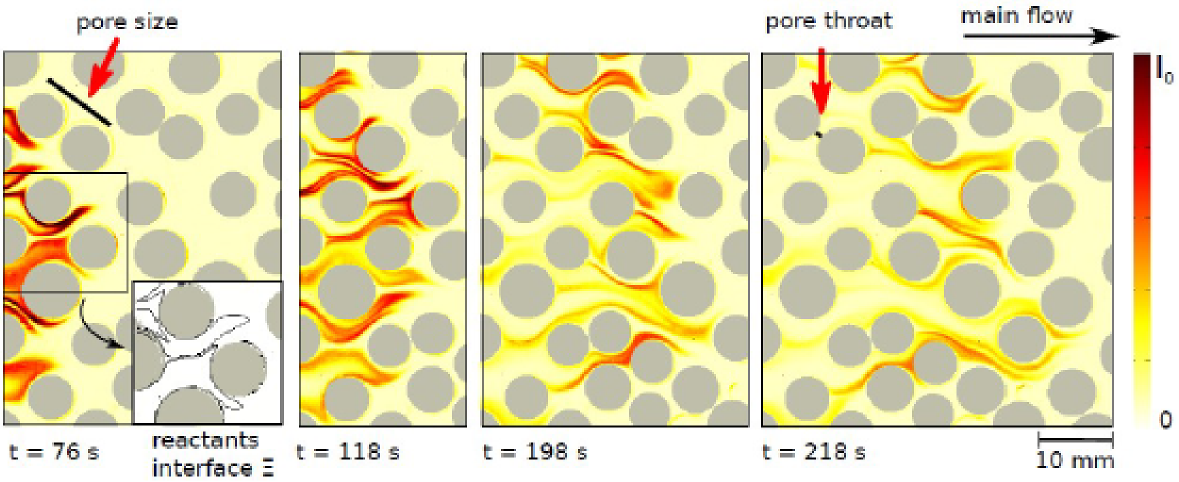
The mixing of chemical elements and nutrients is a primary controlling process for reactive transport in the subsurface, and consequently for biogeochemical cycles and contaminant transport in subsurface environments. Mixing and reactive transport in such natural porous media are primarily controlled by the interplay between diffusion, advection and reaction at the pore scale. Reaction kinetics measured in well-mixed laboratory reactors are never encountered on the field, and standard models based on Fickian transport/mixing often cannot explain field measurements. This is attributed to the heterogeneity of the pore scale velocity field in those systems. Yet, how this heterogeneity impacts mixing and (reactive) transport processes is still an open question, which we address using a quasi two-dimensional (2D) millifluidic setup.

The porous medium is built using soft lithography, and consists of a Hele-Shaw cell that contains a single layer of cylindrical solid grains. The setup allows for full characterization of the flow and transport/mixing; from the intra-pore measurement (i) of the velocity field by particle tracking, and (ii) of the concentration field over 3 orders of magnitude using a fluorescent tracer. The measured velocities show the existence of a network of preferential flow paths in channels with high velocities, as well as very low velocities in stagnation zones, with a non Gaussian probability density function of the velocities. Lagrangian velocities are long range correlated in time, which implies a non-fickian scaling of the longitudinal variance of particle positions. The analysis of Lagrangian velocities can be used to upscale both dispersion and mixing, and obtain predictions that are rather consistent with conservative tracer tests performed in the same porous medium.

The invading solute is organized into stretched lamellae. When a solution, A, displaces another solution, B, with which it reacts according to the simple bimolecular reaction $A + B \rightarrow C$, the reaction kinetics is tightly linked to the mixing dynamics through the deformation and coalescence of lamellae. We investigate this relation using a chemiluminescent reaction, for which the production of each molecule of C also produces one photon, providing us with a spatially-revolved measurement of the rate of formation of C (see the figure below). The setup allows investigating a wide range of Péclet and Damköhler numbers by varying the flow rate within the cell and the local reaction rate. While the classic advection-dispersion theory predicts a scaling of the cumulative product mass of C as time to the power 1/2, we observe two distinct, faster than Fickian, kinetic regimes, both controlled by the geometry of the mixing interface between the reactants. Initially, the invading solute is organized in stretched lamellae and the reaction is limited by mass transfer across the lamella boundaries. At longer times the front evolves into a second regime where lamellae coalesce and form a mixing zone whose temporal evolution controls the rate of product formation. In this second regime, the produced mass of C is directly proportional to the volume of the mixing zone defined from conservative species. A theoretical model accounting for the stretching and coalescence of the invading lamellae confirms this interpretation.

In the subsurface, many (reactive) transport processes of interest, such as the transport of pollutants from the Earth surface to aquifers, or that of amendments by fluids injected for the remediation of polluted soils, occur in the vadose zone (or unsaturated zone). This region of the subsurface extends between the surface and the water table, and is in effect a partially-saturated porous medium. In the last part of the presentation I shall address mixing under unsaturated conditions. The complex spatial distribution of the wetting phase (water) with respect to the non-wetting phase (air) under these conditions causes liquid flows to be focused onto narrower and more complex flow paths than under saturated conditions. The resulting velocity distribution is wider than that of the corresponding saturated flow. As saturation decreases, regions of very low liquid velocity expand to entire clusters of trapped wetting fluid; they coexist with liquid regions of high velocities in the narrow preferential channels constrained by the air phase. As a consequence, the mixing of solute elements is strongly impacted by the saturation degree. We have studied how, using our setup. Desaturation induces an anomalous non-Fickian temporal scaling of the global mixing. In this regime, the temporal scaling of the scalar dissipation rate (a measure of the global mixing rate) depends on the complex spatial distribution of the concentration field, which controls transverse mixing.

Figure:



Caption of the figure:

Spatially-resolved rate of formation of the product C of the reaction $A+B \rightarrow C$, measured during the displacement of solution B by solution A in a 2D porous medium.

Tuesday September 30

1015 – 1045

Dorthe Posselt[1], Jianqi Zhang[2], Detlef-M. Smilgies[3], and Christine M. Papadakis[2]
[1]IMFUFA, NSM, Roskilde University, Denmark; [2]TU München, Physik-Department, Garching, Germany; [3]Cornell University, Ithaca, NY, USA

Restructuring of lamellar diblock copolymer thin films during solvent vapor treatment investigated by GISAXS

Many applications of nanostructured thin block copolymer films are hampered by the presence of defects. Solvent annealing is a promising method for removing defects and in addition exercising some degree of control over the nano-patterning of the film. It is thus important to understand the rearrangement processes during solvent vapor treatment. We have investigated the structural evolution in lamellae-forming poly(styrene-b-butadiene) (P(S-*b*-B)) diblock copolymer thin films when treated with solvents of different selectivity towards the two blocks. The changes during solvent vapor treatment are studied in-situ using time-resolved grazing-incidence small-angle x-ray scattering (GISAXS) [1-3]. The results are discussed and compared to computer simulations [4].

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1045-1115

Niclas Solin, Fredrik Bäcklund, Patrik Johansson, David Jullesson, Olle Inganäs
Linköping University, Department of Physics, Chemistry, and Biology, Linköping, Sweden

Functionalization and application of biomolecular self-assembled structures

When exposed to acid and heat, many proteins readily form amyloid fibrils. Amyloid fibrils have very attractive mechanical properties and are thus investigated for various applications.1 Such fibrils can be used as templates in materials science applications. We have developed methods that allow us to functionalize such protein fibrils with various luminescent molecules as well as magnetic nanoparticles.2-4 Amyloid fibrils can form lyotropic liquid crystalline phases and this can be exploited in order to organize macroscopic samples of luminescent materials.4 We can successfully fabricate white OLEDs incorporating these materials.5 We can thus prepare biomolecule-based materials with different functionalities and morphologies and we are investigating various applications for such structures. An additional topic is the functionalization of lipid structures. We are investigating ways of preparing lipid structures functionalized with self-doped conducting polyelectrolytes. By employing a polyelectrolyte-ammonium salt complex, membranes consisting of phospholipids can be functionalized and exhibit conductivity. We are currently investigating the applications of this methodology in combination with biological membrane structures.

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Tuesday September 30

1115 – 1145

Finn Knut Hansen
Department of Chemistry, University of Oslo, Norway

Surface dilatational elasticity by oscillation and relaxation measurements of sessile bubbles.

Surface dilatational elasticity and viscosity can be measured by means of the axisymmetric drop/bubble shape method. Two different techniques using sinusoidal oscillations and step relaxations are used and the results from the relaxation measurements are treated by means of the bulk/surface diffusional exchange model. Different surfactants have been used, both anionic, cationic and polymers/biomacromolacules. Step relaxation and oscillation give mostly the same limiting surface dilatational elasticity, but step relaxation is a more model dependent method. In the cases that the bulk/surface diffusion model is correct, the two methods give the same results, but else step relaxation gives average values of the limiting elasticity E0 and the typical relaxation frequency w0. Limiting elasticity up to above 100 mN m-1 have been found. The surface/bulk diffusion model describes quite well relatively hydrophilic substances, especially at low concentrations, but less so the more hydrophobic ones. The surface dilatational elasticity as a function of the surface pressure of surface active polymers can go through both maxima and minima as a result of surface conformational changes.

Tuesday September 30

1330 - 1345

Alexander Mikkelsen, Paul Dommersnes and Jon Otto Fossum
Department of Physics, Norwegian University of Science and Technology-NTNU, Trondheim, Norway

Swimming motion of electro-rotating drops - Quincke rotation, electrorotation, passive rotors, collective dynamics

The spinning of a rigid sphere in a uniform E-field has been known since Quincke[1] first developed the theory in 1896; if the induced dipole moment of a sphere is oriented opposite to the direction of the applied electric field, the unstable configuration becomes unstable above a critical E-field strength and a small perturbation is enough to displace the dipole and make the E-field rotate the sphere.

Adding another Quincke rotating sphere to the system greatly complicates the dynamics and physics as complex hydrodynamic and electrostatic (dipole-dipole) interactions are included. The dynamics of two Quincke rotating particles have previously been described theoretically and simulated[2]; depending on the initial alignment and separation distance between the particles, Quincke rotating particles can attract each other, counterrotate and swim in a self-propelled motion as a pair at a constant velocity once steady state has been reached[2,3].

We have studied how silicone oil drops covered with jammed micron sized PE particles and suspended in castor oil Quincke rotate compared to silicone oil drops without surface particles. Our experiments show that the critical electric field strength Ec for the Pickering drop to Quincke rotate (250 V/mm) is remarkably lower than Ec for pure silicone oil drops (750-800 V/mm). In addition, we have looked at the interaction between two suspended Quincke rotating Pickering drops and how their interactions may lead to a cooperative self-propulsion (swimming) or orbiting motion.

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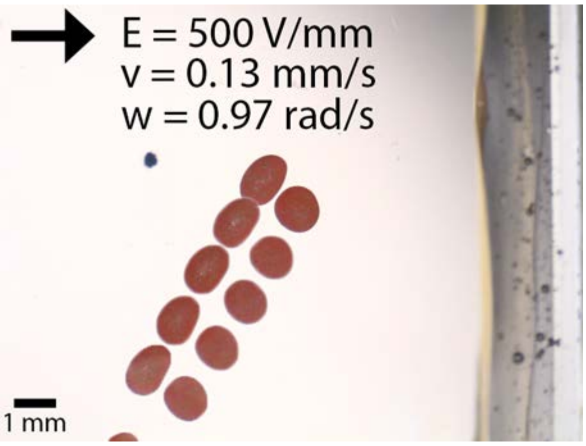

Two Quincke rotating Pickering drops made out of silicone oil and 50 micron PE particles. At the application of a strong E-field, the Pickering drops are counter rotating and their mass centers translate in a straight line perpendicular to the contact line. 6 pictures are edited together to illustrate the trajectory of the self-propelled Quincke swimmer. The E-field direction is indicated by the arrow.

Tuesday September 30

1345 - 1400

Tomas Plachy, Michal Sedlacik, Vladimir Pavlinek
Centre of Polymer Systems, University Institute, Tomas Bata University in Zlin, Czech Republic

Influence of temperature on the electrorheological effect

The electrorheological (ER) fluids are suspensions that can alter their rheological parameters by means of external electric field strength variation. They undergo a transition from liquid-like to solid-like state, which is represented by a steep increase in viscosity. It is assumed that the major phenomena responsible for this behavior are conductivity of the particles, and dielectric relaxation strength [1] of the ER fluid representing the difference between relative permittivity at „zero“ and „infinite“ frequencies. In this study, the temperature dependent rheological behavior of prepared ER fluids based on carbonized aniline oligomers particles dispersed in silicone oil in the absence and in the presence of external electric field was examined. Impedance spectroscopy was used as an evaluative tool of the ER effect, and the Cole-Cole model was applied in order to obtain the values of dielectric parameters [2]. It was found that with increasing temperature, the relaxation times of prepared ER fluids are shifted to the higher frequencies; thus, the relaxation times became shorter, which led to increase of the ER effect [3]. The ER effect increased also despite of the drop in the dielectric relaxation strength of the prepared ER fluid. The results show that the formation of chain-like structures within the ER fluids is a complex phenomenon which is affected by many factors. Thus, the enhanced ER effect at elevated temperatures can then be explained as the possible consequence of the shift of relaxation times to higher frequencies, and the decrease in viscosity of liquid medium, as the liquid medium hinders the particles in the proper movement and their connection into chain-like structures.

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1400 - 1415

Maja S. Hellsing[a], Fredrik Höök[b] and Adrian R. Rennie[a]
a) Department of Physics & Astronomy, Ångström Laboratory, Uppsala University, Sweden, b) Department of Applied Physics, Chalmers, Gothenburg, Sweden.

Polystyrene nanoparticles at a solid/liquid interface

Charge stabilised polystyrene nanoparticles dispersed in pure water form large crystals near flat interfaces and smaller crystallites in the bulk [1]. The polystyrene nanoparticles described here have previously been measured with neutron scattering in both transmission and reflection geometry, and were found to have an fcc structure [2]. Probing this system with quartz crystal microbalance with dissipation (QCM-D) indicates that the particles are not situated directly adsorbed at the interface. Their position is rather some distance away from the interface, separated by a layer of solvent. Changing ionic strength and particle concentration changes the separation distance of the particles from the interface. The high frequency rheology of the dispersion can also be determined. The structural and mechanical model can explain the anomalous increase observed in the resonant frequency.

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Tuesday September 30

1415 - 1430

H. Carstensen, V. Kapaklis, **M. Wolff**
Department of Physics and Astronomy, Uppsala University, Sweden

Phase formation in colloidal systems with tunable interaction

Self assembly is one of the most fascinating phenomena in nature and one key component in the formation of hirarchic structures forming the basis for living organisms. The formation of structure depends critically on the interaction between the different constituents.

Self assembly describes the formation of ordered structures on all length scales and is one of the most fascinating phenomena in nature. The formation of hadrons from elementary particles as well as the formation of galaxies could be understood as a process of self assembly. The only difference between these two systems is the driving force acting on totally different length scales. In the case of elementary particles and galaxies this is the strong and gravitation force, respectively.

In material science interactions on intermediate length scales are relevant. The most simple model are hard spheres, repulsing each other only in direct contact. This interaction will not result in self assembly without an external force, reduction in volume, since no long-range force component bringing and holding the particles together is present. The Lennard-Jones-potential describes the interaction between atoms or molecules with a short range repulsion but long range attraction. Other forces relevant in condensed mater physics are for example: surfactant, entropic, electric charge, magnetic or electric dipolar force. All these can drive self assembly.

Colloidal systems can self assemble in a wide range of structures and manipulating these has very interesting applications. One example is the use of branching-chains in magnetorheological fluid to tune the viscosity in a liquid for specific applications as adaptable dampers or loud speakers. The self assembly on length scales meeting optical wave length is interesting for plasmonic arrays and photonic crystals as well as for lasers with tunable wavelength.

Interestingly, the interaction between magnetic colloidal particles in a liquid can be tuned by adding different amounts of magnetic nano-particles, resulting in a changing effective magnetic susceptibility of the liquid matrix. With such an approach it has been shown that interesting self assembled structures can form.

We present a study of the self assembly in a two dimensional system where the interaction is tuned continuously. Two types of polystyrene beads with distinct magnetic susceptibilities are solved in a ferrofluid, a suspension of magnetic nano particles in water.

By changing the susceptibility of the ferrofluid the effective interaction between the colloidal particles is manipulated. We show that for an in-plane magnetic field polystyrene spheres undergo a phase transition from hexagonal to cubic ordering, when changing the effective interaction between the particles. We quantitatively characterize the phase transition by introducing an order parameter and explain the experimental results by the changing dipolar particle interaction.

Tuesday September 30

1430 - 1445

F. A. Adlmann[1], P. Gutfreund[2], A. Dennison[1,2],J. Ankner[3], J. Browning[3], A. Parizzi[3], B. Vacaliuc[3], C. E. Halbert[3], J. P. Rich[3], and M. Wolff[1]
1Materials Physics, Uppsala Universitet, Sweden 2Large Scale Structures, Institut Laue-Langevin, France 3Spallation Neutron Source, Oak Ridge National Laboratory, USA

Towards surface sensitive neutron scattering experiments with sub-microsecond resolution

Lubrication is of vital importance in technology. Therefor a good understanding of the interface layer in liquids under shear is in high need. Combining surface sensitive neutron with rheology offers unique possibilities to explore the interfacial behavior of liquids under mechanical load.
Recently, it was shown that SANS measurements with a sub-ms time resolution can be achieved with continuous beam for periodic excitations [1]. Taking this idea one step further and exploiting the possibilities of data taken in neutron event mode combined with time-of-flight neutron scattering techniques give rise to completely new opportunities for stroboscopic experiments. By linking the neutron detection time to specific times during the periodic excitation the challenge of low neutron flux is overcome.
We have implemented and tested this promising approach by using the rheometer setup [2] (see Figure 1) at the Liquids Reflectometer located at SNS, Oak Ridge, TN (USA).
All neutron events as well as the oscillatory shear have been acquired with a "Global Positioning System (GPS)" time stamp and are synchronized via fiber optics. To fully link the neutron events to the complementary shear load over the detector distance, a wavelength dependent correction has been applied compensating for the chromatic velocity deviation.
To visualize significant effects we have chosen an aqueous solution of Pluronic F127 as a model system, since this material offers a rich scattering behaviour and shows large sensitivity to deformation, including the formation of stress plateaus, which indicates the presence of complex regimes corresponding to a state of higher order up to layering in the flow directions [3,4].
We will discuss experimental results and the capabilities and limitations of this new technique.

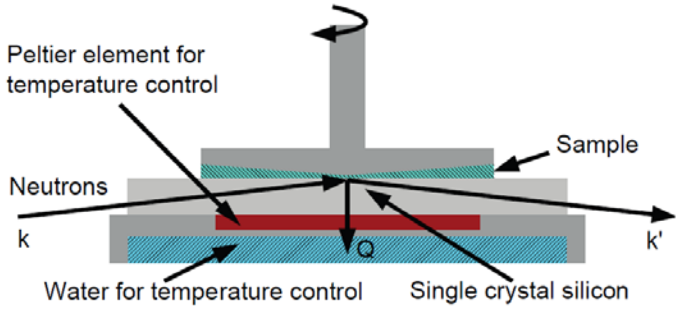

Figure 1: Schematics of the experimental set-up [2]. The neutron beam impinges on the liquid sample by traversing a single crystalline block of silicon.

References

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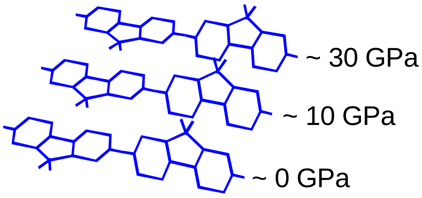
Tuesday September 30

1445 - 1500

Matti Knaapila
Institute for Energy Technology, Kjeller Norway

Measuring structural inhomogeneity of conjugated polymer at high pressures up to 30 GPa

We present X-ray scattering data from helical poly[9,9-bis(2-ethylhexyl)fluorene-2,7-diyl] collected in neon as pressure transmitting medium by mapping the sample with 10 µm spatial resolution at pressures up to 31 GPa. Reduction of torsion angle between adjunct repeats is observed during compression and found to be reversible upon decompression. Chain conformation does not depend on lateral position of sample in the pressure range from 1 to 7 GPa but changes significantly when pressure is increased from 7 to 31 GPa. Crystallite orientation does not depend on pressure or lateral position. The radiation damage is studied optically *ex situ* and proved to be insignificant.



1500 - 1515

Tatsiana Lobovkina
Department of Chemical and Biological Engineering, Chalmers University of Technology, Göteborg, Sweden

Soft-matter biomimetic cell models for studying cell migration and in-cell transport of membrane compounds.

Cell migration and in-cell transport play the key role in organ development, spreading of cancer cells, and immune system response to infection. Despite extensive research, some core aspects of the subject remain poorly understood and are in need of comprehensive quantitative explanation. Better understanding of cell migration and in-cell transport phenomena will be a breakthrough in dealing with cancer metastasis, chronic inflammatory diseases, and in developing new drugs for these disorders.

We develop biomimetic cell model consisting of lipid vesicles and nanotubes for the purpose of explaining the role of lipid membrane in the process of cell migration in response to chemical cues. In particular, we study directed movement of lipid molecules in membrane in response to small changes of calcium ion concentration. We demonstrate that the flow of lipids in the membrane can be controlled by the chemical gradient applied along the lipid bilayer.

Tuesday September 30

1515 - 1530

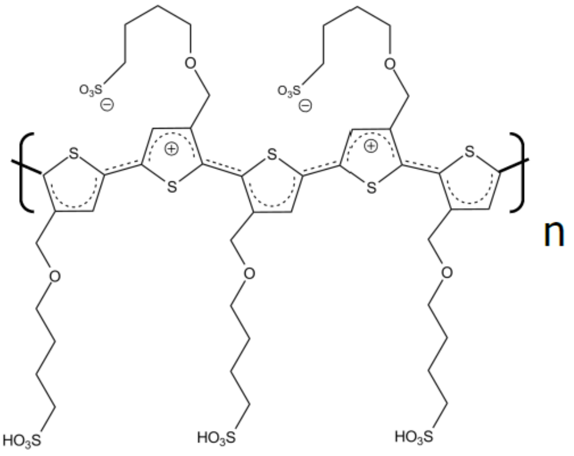
Erica Zeglio (§), Fatima Nadia Ajjan (§), Roger Karlsson, Niclas Solin,a Olle Inganäs
Biomolecular and Organic Electronics, IFM, Linköping University, Sweden.
(§): Both authors contributed equally to this work.

Conjugated Polyelectrolyte Complexes: A quest for multicolor electrochromic devices.

Conductive polymers have proved to be suitable materials for electronic applications. These compounds can provide new properties (flexibility, processability, etc.), that can be of great interest in the development of the new generation of devices, but some intrinsic limitations did not allow overcoming the use of inorganic materials. One of the limiting factors is their poor solubility, which renders device manufacturing demanding. One way to overcome those limitations is to provide them with polar groups, producing the so called polyelectrolytes, which are highly water soluble.

Our focus is on the use self-doped water soluble conducting polyelectrolytes in order to prepare blends in solution as well as in the solid state. The aim of this study is to understand how variations in solution properties effect the supramolecular organization of the polyelectrolytes in the solid state. The obtained materials will then be used to produce devices with novel properties and higher performance.

Some of the used polyelectrolytes:



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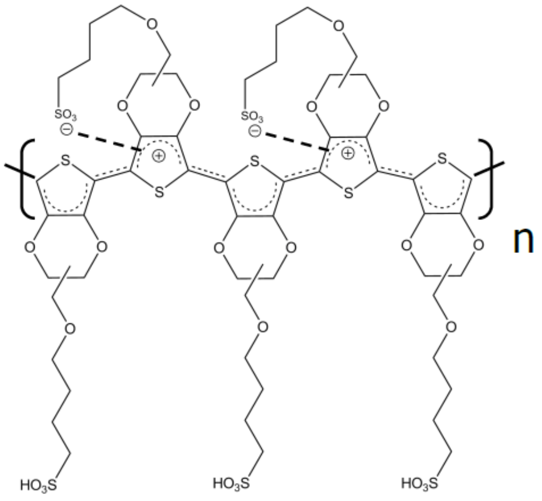

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Tuesday September 30

1530 - 1545

Ilja Czolkos
Dept. of Micro- and Nanotechnology, the Technical University of Denmark, Lyngby, Denmark

Confinement Strategies and Partial Melting of Long DNA Molecules

The linear DNA molecule is the universal carrier of all organims' genetic information. The molecule is therefore of pivotal interest in screening for diseases with a genomic background such as cancer. While genomic sequencing is an expensive and time-consuming process, lab-on-a-chip-based methods aim for cheap and fast screening of the DNA. Very importantly, they additionally aim to screen DNA of single cells to overcome ensemble averaging.

Partial melting mapping is a technique where DNA is stretched and a barcode-like melting pattern is recorded, and can be compared to a theoretically-derived melting map. In order to successfully achieve partial melting, one needs to keep an eye on factors such as staining, ionic conditions, and the presence of other components that influence the melting temperature.

In order to optically access the DNA molecule along its length and to observe the barcode-like melting pattern, it needs to be stretched out of its random coil configuration. This is usually realized by confining DNA molecules which are hundreds of micrometers long in a controlled way. This however presents a challenge from an engineering and experimental point of view.

In this talk, I will give a brief overview on the principles behind melting mapping and of the most recent strategies to confine DNA in practice.

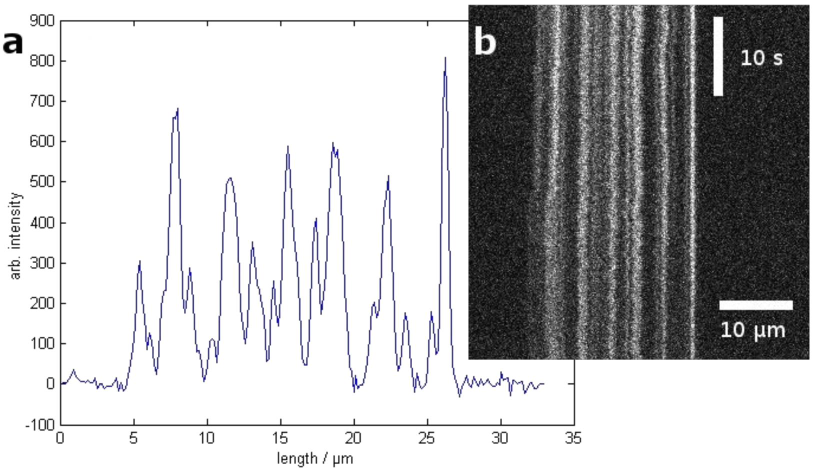

Figure 1: ***a.*** *A fluorescence intensity profile of a partially melted DNA molecule, derived from* ***b.*** *a time trace of a DNA molecule of Staphylococcus aureus stretched in a 120 × 120 nm channel. The intensity profile can be mapped to a theoretical melting map, i.e. it will be positioned along the genome.*

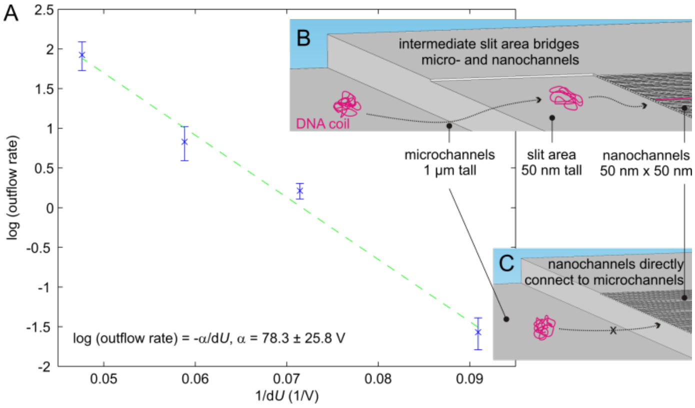

Figure 2: ***A.*** *Arrhenius plot of the rate of DNA molecules passing through nanochannels versus the applied potential in a fluidic device with an entry structure as shown in B. Devices where nano- and microchannels are interfacing directly (C) allow few or no DNA molecules to pass.* ***B.*** *Fluidic device with intermediate slit area which serves as an energetic stepping stone where the DNA coil is forced into a flat confirmation before it is stretched out.* ***C.*** *Fluidic device without slit area. The single energetic barrier is too high for the DNA coil to enter the nano-channels.*

Tuesday September 30

1545-1600

Leander Michels[1], Jon Otto Fossum[1], Zbigniew Rozynek[1], Henrik Hemmen[1], Karin Rustenberg[1], Pawel A. Sobas[2], Georgios N. Kalantzopoulos[2], Geir Helgesen[2], Kenneth D. Knudsen[2,1], Marian Janek[3], Tomás S. Plivelic[4], Geraldo José da Silva[5].
[1]*Department of Physics, Norwegian University of Science and Technology NTNU, Trondheim, Norway*
[2]*Physics Department, Institute for Energy Technology – IFE, Kjeller, Norway.*
[3]*Department of Physical and Theoretical Chemistry, Comenius University, Bratislava, Slovak Republic*
[4]*MAX IV Laboratory, Lund University, Lund, Sweden,*
[5]*Instituto de Física, Universidade de Brasília, Brasília, Brazil*

Intercalation and Retention of Carbon Dioxide in a Smectite Clay promoted by Interlayer Cations

A good material for CO2 sorption should possess some main properties: (i) a large effective surface area with good sorption capacity, (ii) selectivity for CO2, (iii) regeneration capacity with minimum energy input, allowing reutilization of the material, and (iv) low cost and environmental friendliness. Smectite clays are layered nanoporous materials that may be good candidate in this context. Here we report experiments which show that gaseous CO2 intercalates into the interlayer space of a smectite clay (synthetic fluorohectorite) at conditions close to ambient. The rate of intercalation, as well as the retention ability, of CO2 is found to be strongly dependent on the types of interlayer cations, which in the present case are Li+, Na+ and Ni2+. Remarkably we observe that the smectite Li-fluorohectorite is able to retain CO2 up to 35 °C at ambient pressure, and that the captured CO2 can be released by heating above this temperature. In conclusion our experiments indicate that smectite, with a large effective surface area, can contribute for CO2 capture, whereas charge compensating cations are main ingredients enabling temperature- and pressure- controlled capture and release from such smectite clay minerals.

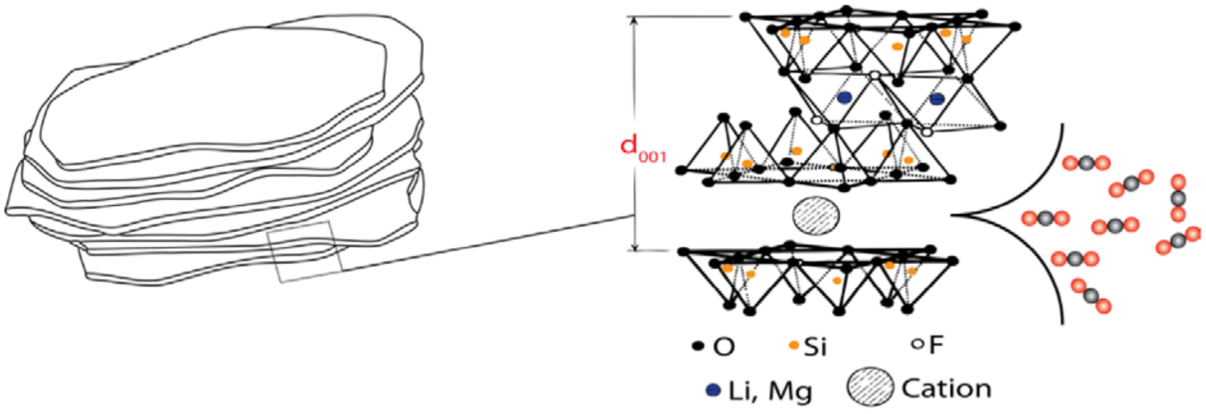

Figure 1: Graphical Abstract, smectite clay particle (left) and its structure showing the interlayer space (right) where the CO_2 intercalates.

List of participants

Name	Institution
Franz Adlmann	Uppsala University, Sweden
Ernesto Altshuler	University of Havana, Cuba
Mario Altoe	Norwegian University of Science and Technology, Trondheim, Norway /University of Brasilia, Brazil
Francoise Brochard	Institute Curie, Paris, France
Paul Dommersnes	Norwegian University of Science and Technology, Trondheim, Norway
Ilja Czolkos	Technical University of Denmark, Lyngby, Denmark
Jon Otto Fossum	Norwegian University of Science and Technology, Trondheim, Norway
Irep Gozen	Harvard University, USA
Giovanni Grassi	Norwegian University of Science and Technology, Trondheim, Norway /University of Brasilia, Brazil
Finn Knut Hansen	University of Oslo, Norway
Elisabeth Lindbo Hansen	Norwegian Radiation Protection Authority, Oslo, Norway
Geir Helgesen	IFE. Kjeller, Norway
Henrik Høyer	Giamag Technologies, Norway
Gavin Jeffries	Chalmers University of Technology, Sweden
Aldo Jesorka	Chalmers University of Technology, Sweden
Tom Henning Johansen	University of Oslo, Norway
Maja Hellsing	Uppsala University, Sweden
Kenneth D. Knudsen	IFE, Kjeller, Norway
Matti Knaapila	IFE, Kjeller, Norway
Gerbrand Koster	University of Oslo, Norway
Tatsiana Lobovkina	Chalmers University of Technology, Sweden
Yves Meheust	University of Rennes 1, France
Alexander Mikkelsen	Norwegian University of Science and Technology, Trondheim, Norway
Leander Michels	Norwegian University of Science and Technology, Trondheim, Norway
Shirin Nouhi	Uppsala University, Sweden
Tomáš Plachý	Norwegian University of Science and Technology, Trondheim, Norway /Tomas Bata University, Zlin, Czech Republic
Dorthe Posselt	Roskilde University, Denmark
Adrian Rennie	Uppsala University, Sweden
Everton Santos	Norwegian University of Science and Technology, Trondheim, Norway
Noushine Shahidzadeh	University of Amsterdam, Netherlands
Arne Skjeltorp	IFE, Kjeller/Giamag Technologies, Norway
Niclas Solin	Linköping University, Sweden
Terje Strand	Research Council of Norway
Ole Torsæter	Norwegian University of Science and Technology, Trondheim, Norway
Max Wolff	Uppsala University, Sweden
Erica Zeglio	Linköping University, Sweden