NTNU
Norwegian University of Science and Technology

Institute for Energy Technology

3rd Annual International Workshop on
Soft & Complex Matter

Themes: Self-assembled and photonic mesostructures

Norwegian Academy of Science and Letters
Drammensvegen 78, Oslo, Norway, October 6-7, 2016

Confirmed invited speakers:

Francoise Brochard-Wyart (Inst. Curie, Paris, France)
Hrvoje Buljan (Univ. Zagreb, Croatia)
Andreas Carlson (Univ. Oslo, Norway)
Paul Dommersnes (NTNU, Trondheim, Norway)
Maria Helena Godinho (New Univ. Lisboa, Portugal)
Geir Helgesen (IFE, Norway)
Mile Ivanda (Ruder Boskovic Institute, Zagreb, Croatia)
Tatsiana Lobovkina (Chalmers Univ., Sweden)
Aldo Jesorka (Chalmers Univ., Sweden)
Gerbrand Koster (Inven2 AS, Oslo, Norway)
Adrian Rennie (Uppsala Univ., Sweden)
Frank Scheffold (Univ. Fribourg, Switzerland)
Arne Skjeltorp (Giamag Technologies/IFE, Norway)
Jaakko Timonen (Aalto Univ., Finland)
Silvia Vignolini (Univ. Cambridge, UK)
Julia Yeomans (Univ. Oxford, UK)

Practical information to participants:
The workshop starts after 1600 Oct. 6, and ends before 1600 Oct. 7, 2016

http://english.dnva.no/

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Jon Otto Fossum
(jon.fossum@ntnu.no)
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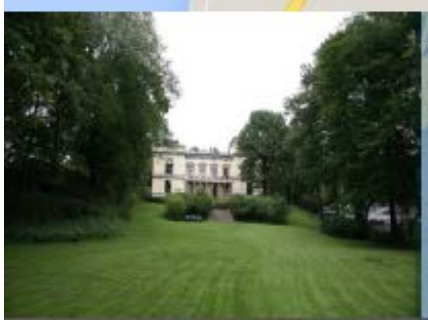


The Research Council of Norway

Program and Book of Abstracts

3rd Annual International Workshop

Soft & Complex Matter

Norwegian Academy of Science and Letters, Oslo, Norway

October 6-7, 2016

Program Summary:

Time	Thursday October 6	Friday October 7	Time
	Norwegian Academy of Science and Letters **Drammensvegen 78 Oslo** 	**Silvia Vignolini:** Cellulose bio-inspired hierarchical structures	**0900 - 0920**
		Frank Scheffold: Hyperuniform disordered photonic materials	**0920 - 0940**
		Maria Helena Godinho: New Photonic Structures from Iridescent Cellulose nanocrystal films	**0940 - 1000**
		Arne Skjeltorp: Tendril perversion and other topological oddities	**1000 - 1020**
		Gerbrand Koster: Optical micromanipulation of nanoparticles and cells inside living zebrafish	**1020 - 1040**
		Discussions	**1040 - 1100**
		Hvroje Buljan: Controlled guiding and topologically protected rotational dynamics of Janus particles in light fields	**1100 - 1120**
1600 - 1730	**Registration**	**Geir Helgesen**: Control and propulsion of magnetic microparticles using oscillating magnetic fields	**1120 - 1140**
1730 - 1740	**Jon Otto Fossum:** Introduction	**Jaakko Timonen**: Magnetic Self-Assembly of Droplets and Colloids	**1140 - 1200**
1740 - 1800	**Francoise Brochard-Wyart:** Nanostickers for cells: a model study using cell-nanoparticles aggregates	**Paul Dommersnes:** Electric field induced self-assembly of structured matter	**1200 - 1220**
1800 - 1820	**Andreas Carlson:** Self-organization of proteins in immune cell adhesion	**Adrian Rennie:** Self-Assembly of Cationic Amphiphiles - Crystals, Micelles and Adsorbed Layers	**1220 - 1240**
1820 - 1840	**Aldo Jesorka:** Biofunctionalization of Nanopatterned Teflon AF	**Workshop Lunch followed by discussions**	**1240 - 1400**
1840 - 1900	**Discussions**	**Departure**	**1400 -**
1900 - 1920	**Tatsiana Lobovkina**: Self-assembled biodegradable nanoparticles for nucleic acid drug therapy		
1920 - 1940	**Mile Ivanda:** Development and Applications of Silicon Nanostructuring		
1940 - 2000	**Julia Yeomans:** Confining active turbulence		
2000 - 2300	**Workshop Dinner followed by discussions**		

Thursday October 6:

1600 - 1730 ***Registration***

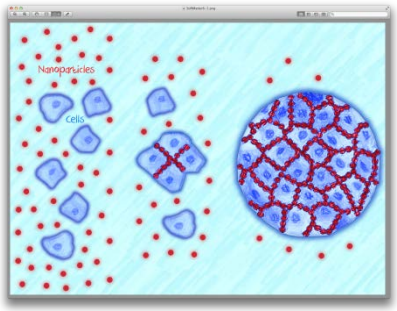
1730 -1740 ***Jon Otto Fossum, NTNU, Trondheim, Norway***

Introduction

1740 -1800 ***Françoise Brochard-Wyart, G. Beaune, S. Dufour, B.Brunel and F.Winnik***

Institut Curie-PCC Curie-UMR 168_ Paris France
Université Pierre et Marie Curie

Nanostickers for cells: a model study using cell-nanoparticles aggregates



We present direct evidence that nanoparticles (NPs) can stick together cells inherently non-adhesive. Using cadherin-depleted S180 murine cells lines, which exhibit very low cell-cell adhesion, we show that NPs can assemble dispersed single cells into large cohesive aggregates. The dynamics of aggregation ruled by diffusion and collision can be described as a second order kinetic characterized by a rate of collision that depends upon the size, the concentration and the surface chemistry of the NPs. We model the cell-cell adhesion induced by the "nanostickers" using a three-state dynamical model, where the NPs are free, adsorbed on the cell membrane or internalized by the cells. We define a "sticking efficiency parameter" to compare NPs and look for the most efficient type of NPs. We find that 20-nm carboxylated polystyrene NPs are more efficient nanostickers than 20-nm silica NPs which were reported to induce fast wound healing and to glue soft tissues (1),(2).. Nanostickers, by increasing the cohesion of tissues and tumors may have important applications for tissue engineering and cancer treatment.

1) X. Wang et al J. Mater. Chem. B, 2016, 4, 779–784.
2) S. Rose, A. Prevoteau, P. Elzière, D. Hourdet, A. Marcellan and L. Leibler, Nature, 2014, 505, 382–5.

1800 - 1820 ***Andreas Carlson[1], L. Mahadevan[2]***

[1]University of Oslo, Norway, [2Harvard] University, USA

Self-organization of proteins in immune cell adhesion

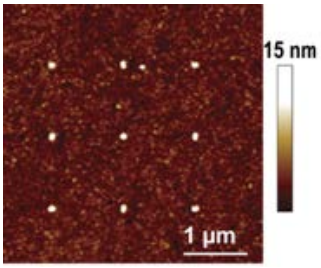
The cellular basis for the adaptive immune response during antigen recognition relies on a specialized protein interface known as the immunological synapse. We propose a minimal mathematical model for the dynamics of the immunological synapse that encompass membrane mechanics, hydrodynamics and protein kinetics. Simple scaling laws describe the time and length scales of the self-organizing protein clusters as a function of membrane stiffness, rigidity of the adhesive proteins, and the fluid flow in the synaptic cleft. Numerical simulations complement these scaling laws and quantify the nucleation, growth and stabilization of the large scale protein pattern. These results suggest that self-generated fluid flow from membrane deformation can be one of the players that help regulate protein sorting at short times, while active processes appears to regulate the long time dynamics of the immunological synapse.

1820 - 1840 Aldo Jesorka

Department of Chemistry and Chemical Engineering/Physical Chemistry, Chalmers University of Technology,41296, Gothenburg, Sweden

Biofunctionalization of Nanopatterned Teflon AF

I report on the use of arrays of Teflon Amorphous Fluoropolymer (AF) nanopillars for directing the assembly of single rectangular DNA origami scaffolds, functionalized with covalently linked fluorophore molecules, in defined positions on patterned surfaces. Teflon AF is utilized for surface patterning as a non-amplified negative e-beam resist, which is exposed and chemically developed to generate arrays of hydrophobic nanopillars with a minimum feature size 40 nm. Binding of engineered DNA origami with >80% coverage of the available sites to the pillars is facilitated by hydrophobic moieties that act as molecular anchors. This combination of top-down lithography and bottom-up self-assembly is an efficient means of fabricating hierarchically structured bio-nanointerfaces in which the positioning of functional units is precisely controlled on the molecular scale inside the DNA assembly, and on the nanoscale at pre-designed locations on the substrate.



1840 - 1900 Discussions

1900 – 1920 Tatsiana Lobovkina

***Department of Chemistry and Chemical Engineering,
Chalmers University of Technology, Gothenburg, Sweden***

In recent years, a considerable amount of research has been devoted to development of various types of self-assembled and biodegradable nanoparticles for drug delivery applications. The nanoparticle approach allows to acquire suitable biological tolerance, protection of the drug from degradation and prolonged drug release. In the diversity of the nanoparticle formulations, self-assembled lipid particles are of particular importance due to their minimal toxicity and ability to carry rather large drug payload.
Nucleic acids (NAs), such as small interfering RNA (siRNA) and messenger RNA (mRNA) are highly potent drugs for directing protein expression in biological cells. These molecules are valuable drug candidates in such areas as regenerative medicine, anti-cancer and anti-infection immunotherapy, as well as treatment of neurological disorders. However, incorporating of hydrophilic NA molecules, into the hydrophobic core of a nanoparticle remains a significant challenge.
In this talk, a hydrophobic ion pairing (HIP) approach for encapsulating NA in lipid nanoparticles will be discussed. The HIP consists of NA molecule (siRNA or mRNA), and a cationic surfactant tightly coupled by electrostatic interaction. The HIP approach allows for incorporating NA in the hydrophobic core of a nanoparticle and provide prolonged drug release, both in-vitro and in-vivo.

1920 - 1940 ***Mile Ivanda[1]*, Vedran Đerek[1], Lara Mikac[1], Hrvoje Gebavi[1], Marijan Marciuš[1], Mira Ristić[1], Eric Daniel Głowacki[2], Serdar Niyazi Sariciftci[2]***

[1]Center of Excellence for Advanced Materials and Sensing Devices, Ruđer Bošković Institute, Bijenička c. 54, 10000 Zagreb, Croatia, *: ivanda@irb.hr
[2]Johannes Kepler University Linz, Linz Institute for Organic Solar Cells (LIOS) / Institute of Physical Chemistry, Altenbergerstraße 69, 4040 Linz, Austria

Development and Applications of Silicon Nanostructuring

Silicon nanomaterials, known as one of the most important types of nanomaterials, feature a number of unique merits, such as excellent electronic/mechanical/optical properties, huge surface-to-volume ratios, and facile surface modification [1]. Fast development of silicon nanomaterials with well-defined structures and required functionalities has vastly promoted the advancement of silicon nanotechnology. Structuring surface and bulk of (poly)crystalline silicon on different length scales can significantly alter its properties and improve the performance of opto-electronic devices and sensors based on silicon. Different dominant feature scales are responsible for modification of some of electronic and optical properties of silicon. We present several chemical methods for easy structuring of silicon on nano and micro-scales, based on both electroless and anodic etching of silicon in hydrofluoric acid based etchants, and chemical anisotropic etching of silicon in basic environments. We show how successive micro and nano structuring creates hierarchical silicon surfaces, which can be used to simultaneously exploit the advantages of both structuring feature length scales. We present some final results of application of silicon nano structuring in development of SERS substrates [2] and silicon/organic heterojunctions for IR light sensing [3].

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1940 - 2000 ***Julia M Yeomans***

The Rudolf Peierls Centre for Theoretical Physics
1 Keble Road, Oxford, OX1 3NP, UK

Confining active turbulence

Dense active matter, from bacterial suspensions and microtubule bundles driven by motor proteins to cellular monolayers and synthetic Janus particles, is characterised by mesoscale turbulence, the emergence of chaotic flow structures. We discuss how a regular lattice of flow vortices can be stabilised by confinement of an active material in a channel, and show that the transition from the vortex lattice to active turbulence lies in the directed percolation universality class [1]. Considering confinement within an array of rotating discs we discuss possible ways of exploiting active matter to create namomachines [2].

[1] Onset of meso-scale turbulence in living fluids, A. Doostmohammadi, T.N. Shendruk, K. Thijssen and J.M. Yeomans , arXiv:1607.01376
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2000 - ***Workshop Dinner***

Friday October 7:

0900 - 0920 Silvia Vignolini

Department of Chemistry, University of Cambridg, Lensfield Road, Cambridge CB2 1EW, UK

Cellulose bio-inspired hierarchical structures

Nature's most vivid colours rely on the ability to produce complex and hierarchical photonic structures with lattice constants on the order of the wavelength of visible radiation [1]. A recurring strategy design that is found both in the animal and plant kingdoms for producing such effects is the helicoidal multilayers [2,3]. In such structures, a series of individual nano-fibers (made of natural polymers as cellulose and chitin) are arranged parallel to each other in stacked planes. When distance between such planes is comparable to the wavelength of light, a strong polarised, colour selective response can be obtained [4]. These helicoidal multilayers are generally structured on the micro-scale and macroscopic scale giving rise to complex hierarchical structures.
Biomimetic with cellulose-based architectures enables us to fabricate novel photonic structures using low cost materials in ambient conditions [5-7]. Importantly, it also allows us to understand the biological processes at work during the growth of these structures in plants.
In this talk the route for the fabrication of complex bio-mimetic cellulose-based photonic structures will be presented and the optical properties of artificial structures will be analyzed and compared with the natural ones.

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[6] Parker R. et al. (2016). Hierarchical Self-Assembly of Cellulose Nanocrystals in a Confined Geometry ACS Nano, 2016, 10 (9), 8443–8449
[7] Kamita G. et al. (2016). Biocompatible and Sustainable Optical Strain Sensors for Large-Area Applications Adv. Opt. Mat. DOI: 10.1002/adom.201600451

0920 - 0940 ***Nicolas Muller[1], Jakub Haberko[1], Catherine Marichy[1], Luis Froufe-Pérez[1], Pablo F. Damasceno[2], Michael Engel[2], Sharon C. Glotzer[2] and Frank Scheffold[1]***

[1]Department of Physics and Fribourg Center for Nanomaterials, University of Fribourg, Chémin du Musée 3, 1700 Fribourg, Switzerland
[2]Department of Chemical Engineering, University of Michigan, Ann Arbor, Michigan 48109, USA

Hyperuniform disordered photonic materials

Structured dielectric materials in three dimensions can exhibit photonic properties that allow control of the propagation of light. For crystalline structures, a complete or incomplete photonic band gap emerges and the propagation of light is hindered or even completely suppressed over a certain range of wavelengths. Full photonic band gaps open up for dielectric materials with a sufficiently high refractive index contrast. The change in transport properties is accompanied by a reduction in the local density of states, which results in increased lifetimes for embedded light emitters such as fluorescent molecules. Interestingly, it appears that many of these unique properties are not tied exclusively to crystalline structures. In a recent numerical study Florescu et al. demonstrated that particular designer disordered materials could display large, complete photonic band gaps in two dimensions [1]. Mapping hyperuniform point patterns with short-range geometric order into tessellations allows the design of interconnected networks that give rise to enhanced photonic properties [2].
Here we report on the fabrication and characterization of such photonic network structures in three dimensions [3] and for optical wavelengths in the shortwave infrared [4,5,6]. We first discuss the fabrication of polymer templates of the network structures using direct laser writing (DLW) lithography [4,5]. Next the mesoscopic polymer networks are converted into silicon by a two-step process where the intermediate stage is stabilized by coating with a thin layer of titanium dioxide. The resulting hyperuniform material consists to more than 75% of silicon and displays a pronounced photonic gap in the optical transmittance at λ=2.5μm [6,7]. To obtain a better understanding of the physical parameters dictating the properties of amorphous photonic materials we also report on results from numerical calculations in two and three dimensions [3,8].

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[8] L. S. Froufe-Pérez, M. Engel, P. F. Damasceno, N. Muller, J. Haberko, S. C. Glotzer, and F. Scheffold, Phys. Rev. Lett. 117, 053902 (2016)

0940 - 1000

Susete N. Fernandes[1], Nuno Monge[1,2], Pedro L. Almeida[1,3] Pawel Pieranski[3] & Maria H. Godinho[1]

[1] I3N/CENIMAT, Department of Materials Science, Faculty of Science and Technology, Universidade NOVA de Lisboa, Campus de Caparica, 2829-516 Caparica, Portugal.
[2,3]Área Departamental de Física, Instituto Superior de Engenharia de Lisboa, Instituto Politécnico de Lisboa, 1959-007 Lisbon, Portugal.
[4] Laboratoire de Physique des Solides, UMR 8502, Université Paris-Sud, Bât. 510, 91405 Orsay, France.

New Photonic Structures from Iridescent Cellulose nanocrystal films

Iridescent solid films with periodic helicoidal structures that reflect only left circularly polarized light, can result from drying liquid crystalline suspensions of cellulose nanocrystals in water [1-4]. Here we report the use of solid cellulose nanocrystals iridescent films to produce a new photonic structure, which reflects both right and left circular polarizations [5]. The effect originates from the infiltration of a nematic liquid crystal layer in micrometric sized planar gaps separating left-handed cholesteric domains with different pitches. The anisotropic layer acts as a half-wave phase retarder. Furthermore, we reversibly tune the photonic properties of cellulose nano composites by application of an electric field or by temperature variations, which are changing the birefringence of the nematic layer. This work paves the way to the use of cellulose nanorods iridescent films to new photonic applications as for example tunable reversible reflective displays.

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[4] T. D. Nguyen, W. Y. Hamad, M. J. MacLachlan, Chem Commun (Camb) 2013, 49, 11296
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1000 - 1020

Tendril perversion and other topological oddities

Arne T. Skjeltorp[1,2]

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[2]Institute for Energy Technology, NO-2007, Kjeller, Norway

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Abstract

Tendril perversion is a geometric phenomenon found in helical structures such as plant tendrils, Fig. 1, in which a helical structure forms that is divided into two sections of opposite chirality, with a transition between the two in the middle [1]. The phenomenon was known to Charles Darwin, who wrote in 1865 [2],

"A tendril ... invariably becomes twisted in one part in one direction, and in another part in the opposite direction... ".

An interesting example of helical shape and perversion can be found in cellulose fibers [3].

Fig. 1. Tendrils of the wild cucumber (*Echinocystis lobata*). On the left, a tendril that did notc find a suitable support to catch—it coiled into a single-sense spiral. On the right, a endril that caught a support—it coiled into a spiral whose one part turns in a direction opposite to the direction of turns of the other part. The number of turns in

Other topological oddities that will be presented are "rainbow", self-assembled and self-organized colloidal systems [4].

Acknowledgments

The project has been funded in part by the Research Council of Norway and the Institute for Energy Technology.

References

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[2] Charles Darwin, "On the movements and habits of climbing plants", Journal of the Linnean Society (1865).

[3] João P. Canejo and Maria H. Godinho, Materials 2013, 6, 1377-1390 João P. Canejo and Maria H. Godinho, Materials, 6, 1377-1390 (2013)

[4] A.T. Skjeltorp (unpublished).

1020 - 1040 ***Patrick Lie Johansen, Federico Fenaroli, Lasse Evensen, Gareth Griffiths & Gerbrand Koster****
Department of Molecular Biosciences, University of Oslo, Blindernveien 31, 0371, Oslo
****Present address: Inven2 AS, Forskningsparken, Gaustadalléen 21, 0349 Oslo, Norway***

Optical micromanipulation of nanoparticles and cells inside living zebrafish

Regulation of biological processes is often based on physical interactions between cells and their microenvironment. To unravel how and where interactions occur, micromanipulation methods can be used that offer high-precision control over the duration, position and magnitude of interactions. However, lacking an in vivo system, micromanipulation has generally been done with cells in vitro, which may not reflect the complex in vivo situation inside multicellular organisms. Here using optical tweezers we demonstrate micromanipulation throughout the transparent zebrafish embryo. We show that different cells, as well as injected nanoparticles and bacteria can be trapped and that adhesion properties and membrane deformation of endothelium and macrophages can be analysed. This non-invasive micromanipulation inside a whole-organism gives direct insights into cell interactions that are not accessible using existing approaches. Potential applications include screening of nanoparticle-cell interactions for cancer therapy or tissue invasion studies in cancer and infection biology.

1040 - 1100 ***Discussions***

1100 - 1120 ***Ognjen Ilic[1,2], Ido Kaminer[1], Bo Zhen[2,3], Owen Miller[4], Yoav Lahini[1], Hrvoje Buljan[5], Marin Soljačić[1,2]***

[1]Department of Physics, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139
[2]Research Laboratory of Electronics, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139
[3]Physics Department and Solid State Institute, Technion, Haifa 32000, Israel
[4]Department of Applied Physics and Energy Sciences Institute, Yale University, New Haven, Connecticut 06520
[5]Department of Physics, University of Zagreb, Bijenička c. 32, 10000 Zagreb, Croatia

Controlled guiding and topologically protected rotational dynamics of Janus particles in light fields

Light is a powerful tool to manipulate matter on the nanoscale. Applications, such as optical trapping and optical transport, demand focusing and shaping of the light beam. Accordingly, it is commonly assumed that in order to spin an object in a steady state, a beam of light should be shaped or polarized to carry non-zero angular momentum. We point out that optically asymmetric particles can become stable nanoscale motors even in a linearly polarized plane light wave by simulating the dynamics of spherical Janus particles in a light field [1]. In a broad regime of parameters we find stable steady state precessing states for Janus particles. Such precessing steady states arise from topologically-protected anti-crossing behavior of the vortices of the optical torque vector field. These results show that asymmetry can be a powerful degree of freedom in designing nanoparticles for optimal external manipulation in a range of nano-optomechanical applications [1]. Moreover, we show that, by introducing tailored optical asymmetry in the particle, we can realize a novel guiding method that is controllable by the frequency of light, without regard to the direction or the shape of the light beam [2]. With detailed stochastic simulations, we demonstrate guiding of a two-faced nanoparticle where the optically induced thermophoretic drift serves as the propulsion mechanism [2].

[1] O. Ilic, I. Kaminer, B. Zhen, O. Miller, H. Buljan, M. Soljačić, in preparation
[2] O. Ilic, I. Kaminer, Y. Lahini, H. Buljan, M. Soljačić, Exploiting Optical Asymmetry for Controlled Guiding of Particles with Light, ACS Photonics 3, 197 (2016).

1120 - 1140 Geir Helgesen

Physics Department, Institute for Energy Technology, Kjeller, Norway

Magnetic control of microparticles and propulsion induced by oscillating magnetic fields

Magnetic micro- and nanoparticles can be collected and controlled by use of external magnetic fields from current carrying coils or permanent magnets. Use of constant magnetic fields will induce a dipole-dipole aggregation of particles, which gives limited possibility for control of their motions. By applying a constant magnetic field gradient, magnetic particles are forced to move in an externally controlled direction at a fixed speed as determined by their particle size, susceptibility, the liquid viscosity and field strength and gradient. However, this is of limited usefulness for many applications since the direction and speed of motion are difficult to control using permanent magnets. This challenge can be bypassed by using tri-axial, oscillating magnetic fields, which can propel microspheres in arbitrary directions at controlled velocities. Examples of these techniques will be presented.

1140 - 1200 Jaakko Timonen

Department of Applied Physics, Aalto University School of Science, Finland

I will discuss two recent advances in magnetic self-assembly of droplets and colloids. The first one concerns local magnetic tweezing of non-magnetic colloids into colloidal crystals with microscopic magnetic field gradients.[1] Other colloidal phases (such as colloidal liquids) and structures (such as clusters) can be also created. In the second example, I will discuss self-assembly of ferrofluid droplets on superhydrophobic surfaces into clusters and crystals.[2] These ”equilibrium” structures can be driven out of equilibrium by applying dynamic magnetic field gradients, leading to restructuring of the self-assembled structures. In the end, I will discuss the possibility of utilizing these two self-assembly schemes for realizing dynamic photonic materials.

[1] J. V. I. Timonen, A. F. Demirörs, and B. A. Grzybowski, Magnetofluidic Tweezing of Nonmagnetic Colloids, Advanced Materials 28, 3453-3459 (2016)
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1200 – 1220 Paul Dommersnes

Laboratory for Soft and Complex Matter Studies,
Department of Physics, Norwegian University of Science and Technology - NTNU, Trondheim, Norway

Electric field induced self-assembly of structured matter

Dynamic self-assembly of materials require energy input, for example by externally applied physical forces or internal chemical reactions. Applying electric fields to a suspension of particles or droplets can induce self-assembly phenomena due to both dipole-dipole interactions and electro-hydrodynamic flows. Here we will present some of the activities at NTNU on electric field driven self-assembly routes.

1220 - 1240

Self-Assembly of Cationic Amphiphiles - Crystals, Micelles and Adsorbed Layers

Adrian R. Rennie[1], Jeremy Karl Cockcroft[2] and Andre Shamsabadi[2]

Uppsala University, Uppsala, Sweden[1] and University College London, U.K.[2]

The self-assembly of amphiphiles is often described in terms of simple pictures of the size and shape of the molecules and in particular the volume and length of the hydrophobic chain and the cross-sectional area of hydrophilic moieties. However there are some surprising observations as regards the thickness of adsorbed layers and the size of micelles of some surfactants such as n-alkyltrimethylammonium bromides. The relationship between the organisation of surfactants in the crystalline solid phases, packing in micelles, and assembly at interfaces will be discussed. The arrangement of interdigitated alkyl chains (see Figure 1) has important consequences for many properties. New studies of the effects of varying chain length show the importance of the high mobility of the alkyl chains and of the co-ordination of ionic groups. Understanding the self-assembly of simple molecular materials can guide the use of interfacial modification to drive the formation of interesting and useful structures of particles.

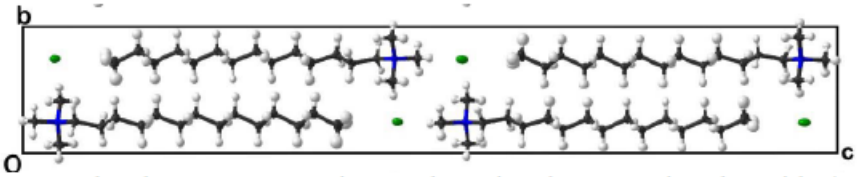

Figure 1. Molecular arrangement in tetradecytrimethyammonium bromide (C_{14}TAB) crystals at low temperatures.

1240 - 1400 ***Workshop Lunch***

1400 - ***Departure***