# CONTENTS

Cover. Neutron reflectivity measurements are able to characterize temperature-responsive polymer brushes, now evaluated by a novel method involving polymer brush theory. Courtesy of Dr. Hill and Mr. Zhang. (See also Zhang, J.; Nylander, T.; Campbell, R.; Rennie, A.; Zauscher, S.; Linse, P.; Soft Matter, 2008, 4, 500-509.)

Paula Leckius, Media-Tryck is gratefully acknowledged for the cover design.

# NEUTRON REFLECTIONS

In February 2007 the Swedish government decided to support the location of the European Spallation Source (ESS) in the northern part of Lund, Sweden. The government also offered to cover 30% of the investment (out of about 13 billion SEK) and about 10% of the operating costs (out of about 1.2 billion SEK). Just recently the Danish government announced that they actively support ESS in Lund and will start concrete negotiation with the Swedish government on their involvement. The other sites competing for the ESS are in Spain and Hungary. At the moment we do not know where ESS will be located and there is of course a political element in the quest for ESS that is as predictable as the spring weather in Lund. I'm sure if you have followed the debate from a Swedish perspective or have come as a visitor to our department after a 45 minutes train ride right from exiting from Copenhagen airport you have noticed how convenient the location of ESS to Lund would be. Actually the suggested location is only 1-2 km from our department. Equally important is that there are two major universities nearby, Lund University and Copenhagen University, which will provide the proper scientific environment. These universities already work close together both in teaching, research and on another existing facility, namely Max-lab, the synchrotron located only 10 minutes walk from our department. There are also advanced plans to build a Max IV, the next generation Swedish synchrotron radiation facility, at the site of ESS. The government is expected to give the green light to build this facility this autumn. Co-localizing ESS and Max IV would be further boost for the Lund case.

It came as a surprise for many not at least ourselves when we learned that our department is one of the largest Swedish users of neutrons. In a way this shows also how the majority researchers are using neutrons as one really excellent technique in order to get deeper insight after learning about the system with other more accessible experimental techniques. Therefore the major part of the neutron experiment is done already at the own laboratory or at the neutron facility off the beam. One example of the latter is The Deuteration Laboratory at ILL in Grenoble, which we have used to produce deuterated DNA for our DNA-compaction studies using SANS. ESS or any neutron facility is much more than the lamp generating neutrons. In fact a majority of the users, present or future, are not very interested in the source it self as long as the neutrons are safely produce, reliable and come at high flux. Most of us are more concerned about the instruments, sample environment, laboratory facilities and easy handling of the instruments. It is always a challenge when building large-scale facilities like ESS to get the balance between design of the source and what it is going to be used for. The source it-self is much more visible and large, maybe too large for some, while the real impact for our Øresund region and whole Europe is the research that is going to be carried out there. Here neutron can generate knowledge that is not accessible with any other technique. However, as for science in general the secretes of life is not only revealed by one set of looking glasses, but requires neutron glasses, X-ray glasses and ordinary looking glasses. Our department has engaged itself in several activities connected to ESS from a science and user perspective, both within our university and in scientific advisory committee for the Scandinavian ESS initiative. I should also say that one of our former PostDocs, Dr. Richard Campbell, is now co-responsible for the new horizontal neutron reflectometer, FIGARO, at ILL in Grenoble. This shows that our competence in the area of applying neutron scattering and reflectivity to soft matter does matter already today.

In June 2007 we organized the 4th European Conference on Neutron Scattering (ECNS2007) together with our Swedish, Danish and Norwegian colleagues. During almost a week we had 700 participants from many countries and disciplines with neutrons as the common denominator. The meeting meant a lot of work for us all, but our reward is that meeting was a large success. Still when we travel to neutron facilities we can see people carrying the ECNS 2007 rucksack with the Lund University seal, which together with positive comments about the atmosphere and organization of the meeting makes us happy and grateful. It is great to get so many new friends in such a short time! One person who deserves special credit for the meeting is Prof. Adrian R. Rennie from Uppsala University who chaired the meeting and also made sure that scientific program contained the proper balance to represent the diversity of neutron users. Many of us have worked together with Adrian also scientifically so we regard him as a member of the family.

On a personal note I can say that I never anticipated, when I did my PhD 20 years ago, that I will spend almost a month every year on neutron facilities in Europe and in US. The first neutron reflectivity experiment I did was with Fredrik Tiberg (now CEO of Camurus AB in Lund) on the interfacial structures of an amphiphilic protein from milk,  -casein, was a large success. In fact all the experiments we did with this protein has been very successful, partly because we had the knowledgebase of the behaviour of the protein from ellipsometry, and it also made us realize the possibilities that neutron reflectivity offers. Since then we have successfully worked with other far more complicated systems using both neutron reflectivity and neutron scattering. Regarding neutron scattering, Ulf Olsson, has been one of the pioneers already when the neutron facility at Risø was in operation, working with shear induced structural changes of surfactant phases. Recently Per Linse has joined the neutron club, even though he has never done an experiment. His contribution has been to develop brush models for the fitting of the data on thermo-responsive polymer brushes. This points on the fact that modeling is an important part of a successful neutron experiment. In all about 10 researchers, Postdocs and PhD students are using neutron for there research. With great excitement we are ready face the challenges ahead, whether ESS is localized to Lund or not!

Tommy Nylander

# RESEARCH PROJECTS

Within the broad arena of modern colloid and surface chemistry, research is largely concentrated into four loosely-bound areas: (1) Molecular assembly; (2) Adsorption and interfaces; (3) Colloidal biology; (4) Theory and modelling.

Many projects involve two or more of these subjects and some projects have aspects that fall outside all four of these themes.

## Molecular assembly

**Cross-linked DNA gels.** DNA molecules, both single- and double-stranded, have been covalently cross-linked to form chemical gels. Addition of electrolytes causes a deswelling of the gels. From the volume changes the association of oppositely charged cosolutes with DNA can be monitored. For cationic surfactants a dramatic compaction is noted as well as the formation of different ordered microstructures. An extensive comparative study of the deswelling of both ss- and ds-DNA gels on addition of several cosolutes- metal ions of different valency, proteins, polyamines and other polycations and cationic surfactants- have been performed. Both thermodynamic and kinetic aspects, as well as reversibility of volume changes, have been considered. The release of DNA and incorporated proteins are investigated, in particular related to triggering release. (D. Costa, M. Miguel (Coimbra), B. Lindman).

**Molecular dynamics and nanoscale organization in molecular matter.** Several types of intermolecular interactions, e.g., steric, electrostatic, and hydrophobic, affect the dynamic behavior of large molecules in crowded system. NMR offers a unique possibility of resolving different molecules and molecular sites even in rather complex mixtures. For colloidal and biological systems with reduced molecular mobility and sample heterogeneity on the nano- to micrometer scale, solid-state NMR methods with magic-angle spinning are necessary in order to extract high-resolution spectroscopic information. Dynamic and site-resolved information can be correlated in multidimensional experiments. In this project we apply modern multidimensional solid-state NMR techniques for the study of molecular dynamics and organization in a series of colloidal systems, such as DNA-lipid assemblies, lyotropic liquid crystals, and block copolymers within mesoporous silica. (P. Nunes, T. Ferreira, S. Küster, M. Miguel, V. Alfredsson, L. Piculell, D. Topgaard).

**NMR self-diffusion experiments.** In this project we study fundamental aspects of the pulsed gradient spin echo (PGSE) NMR technique applied to fluid motion in porous systems. With the method one can estimate molecular displacements over a wide range of time scales (from ms to several seconds). The data convey information about the pore morphology and dynamic features related to the long-range fluid diffusivity, the local molecular self-diffusion, and the characteristic time for exchange between various compartments.. (D. Topgaard, A. Nowacka I. Åslund, G. Rata, O. Söderman).

**Diffusion NMR studies of human brain microstructure.** Diffusion-weighted magnetic resonance imaging is a diagnostic tool for ischemic stroke, demyelinization, and tumor detection. In this project excised brain tissue is studied by means of state-of-the-art spectroscopic diffusion NMR equipment in order to elucidate the relation between brain microstructure, water diffusion, and signal response in the clinical imaging system. (D. Topgaard, I. Åslund, O. Söderman, J. Lätt (Radiation Physics), S. Brockstedt (Radiation Physics), F. Ståhlberg (Radiation Physics), E. Englund

(Pathology), M. Sjöbeck (Pathology)).

**Electrostatics and deformations during DNA-amphiphile swelling.** The swelling behavior with respect to maximal water content and characteristic distances of the unit cell dimension of a stoichiometric DNA:amphiphile complex is studied under the influence of added salt. The aim is to obtain qualitative and quantitative information on the contribution of attractive electrostatic forces and repulsive deformation forces upon DNA:amphiphile swelling. (C. Leal, E. Mori, L. Pegado and H. Wennerström). (Project completed)

**Block copolymer-surfactant interactions.** Interaction between triblock copolymers of poly(ethylene oxide) (PEO) and poly(propylene oxide) (PPO) (PEO-PPO-PEO) and nonionic surfactants (of the type CiEOj) in dilute aqueous solution are studied using dynamic and static light scattering in combination with differential scanning and isothermal titration calorimetry. Small-angle X-ray scattering and depolarized dynamic light scattering are also employed for structural analysis of the mixed micelles. The aim is to study the block copolymer-surfactant interaction, the mixed micelles formed as well as the retarded kinetics of the shape transition of the mixed micelles. (D. Löf, K. Schillén, G. Olofsson, A. Niemiec, W. Loh (UNICAMP, Brazil), O. Glatter (University of Graz, Austria)).

**Polymers labeled with fluorescent chromophores.** Water-soluble polymers covalently labeled with fluorescent hydrophobic dyes have been synthesized and their solution properties are now investigated. The polymer is a polyelectrolyte, poly(acrylic acid) (PAA), and the chromophores are either pyrene or naphthalene, which are randomly attached onto the polymer. The aim is to achieve molecular understanding of the association processes in hydrophobically-modified polymer systems by using dye-labeled polymers. Fluorescence measurements (steady-state and time-resolved) report on the self-association of the polymers in aqueous solution and also on their interaction with surfactants, other polymers or other additives. The time-resolved fluorescence investigations provide detailed information on the dye excimer/dimer formation in these systems. The solution behavior of pyrene-labeled PAA and the effects induced by PEO-PPO-PEO triblock copolymers in water are also studied using dynamic light scattering. (J. S. Seixas de Melo, T. Costa and M. G. Miguel (University of Coimbra, Portugal), K. Schillén, B. Lindman).

**Extensional rheology, shear rheometry and dynamic light scattering measurements on systems of cylindrical surfactant micelles and block copolymer-nonionic surfactant mixed micelles.** In the elongational flow technique the extensional viscosity is measured by using an uniaxial elongational flow field. An increase in the extensional viscosity, i. e. elongational thickening, may be observed in systems that are shear thinning. An example where this can occur is in systems of linear polymers, where thickening may be exhibited due to uncoiling of the polymer chain to an aligned and extended conformation, cylindrical micelles of amphiphiles, et.c. In this project we explore a variety of different systems by using shear rheometry, extensional rheology and dynamic light scattering in combination. The rheological properties (and growth) of cationic cylindrical surfactant micelles in aqueous solution are studied under three different flow fields: simple shear, opposed-jets flow (which approximates uniaxial extension) and porous media flow (which includes simultaneously shear and elongational components of the flow). The retarded kinetics of the sphere-to-rod transition of mixed micelles of PEO-PPO-PEO triblock copolymer and nonionic CiEOj surfactants is also being investigated. By using zero-shear rheology as a function of time and temperature the time-dependence of the transition is followed and the results are in good agreement with those obtained from time-resolved static and dynamic light scattering measurements. (D. Löf, K. Schillén, M. Torres and A. J. Müller (Universidad Simón Bolívar, Venezuela)).

**Supramolecular aggregates of amphiphilic gadolinium complexes as contrast agents for magnetic resonance imaging applications.** Magnetic resonance imaging (MRI) is an imaging technique with cellular resolution that is widely used as a diagnostic tool in clinical practice. In this project, new potential blood pool contrast agents based on amphiphilic gadolinium complexes and amphilphiles that contain a bioactive peptide with target specificity are being developed. The structures of the self-assembled aggregates (lamellar aggregates, vesicles and micelles) in aqueous solution are characterized by means of dynamic light scattering, cryo-TEM and small-angle neutron scattering. (M. Vaccaro, L. Paduano, G. Mangiapia, G. Morelli, A. Accardo and D. Tesauro (University of Naples, Italy), E. Gianolio and S. Aime (University of Turin, Italy), D. Löf, K. Schillén, O. Söderman).

**Phase behaviour of aqueous "complex salts" of oppositely charged polymer and surfactant.** We use a simplified approach to study structures and water uptake of oppositely charged polymers and surfactants. The essence is to use the minimum number of components to map out the generic features, and to make contact between polymer/surfactant systems and conventional surfactant systems. To this end, we first synthesize the pure "complex salt" (polyion + surfactant ion) and use it as our point of departure. Binary mixtures of complex salt and water are studied, and also truly ternary mixtures involving one of the following additional components: The conventional surfactant (surfactant ion + simple monovalent counterion), the conventional polyelectrolyte (polyion + simple counterion), the corresponding polyacid (protonated polyion), or a non-polar "oil". These complex salt mixtures represent excellent model systems of minimum complexity to test fundamental problems in colloid science. Most experiments so far refer to alkyltrimethylammonium (CnTA+) surfactant ions with polyacrylate (PA-) counterions. If the charge density of the polyion is decreased, either by mixing in polyacrylic acid or making copolymers of sodium polyacrylate with a neutral comonomer, the curvature of the aggregates increases. This results first in a destabilization of the hexagonal phase relative to the micellar cubic phase. Moreover, the micellar aggregation number decreases, even for spherical micelles. The miscibility of the complex salt with water increases with an increasing fraction of neutral comonomers in the polyion; however, an opposing effect is found if the hydrophobicity of the neutral comonomer is increased. Most recently, we have performed a series of experiments using "oligomeric", rather than polymeric, polycarboxylate ions (oxalate, succinate, citrate and butyl tetracarboxylate) to probe how the interactions between surfactant aggregates of different geometries change when the degree of polymerization of the counterion is gradually increased. For systems containing spherical micellar aggregates, full miscibility with water was obtained with the dicarboxylate counterions, whereas micellar solutions with tricarboxylate counterions phase separated into one dilute and one concentrated micellar phase. Micellar systems with tetracarboxylate counterions behaved similarly to those with polycarboxylate counterions: they phase separated into a very dilute aqueous solution in equilibrium with a micellar cubic phase. For lamellar systems, divalent counterions were enough to prevent swelling of the lamellae in water; the maximum degree of swelling in excess water varied very little with the degree of polymerization of the counterions. (J. Norrman, L. Piculell and I. Lynch; W. Loh and J. Bernardes (UNICAMP, Brazil)).

**Ionic surfactants with polymerizable counterions.** The results of the preceding project include phase diagrams of mixtures of complex salts (surfactant ions with polymeric counterions) with conventional ionic surfactants (with monomeric counterions). Such phase diagrams actually predict the outcomes of polymerization processes, where the monomeric counterions of a surfactant ion are gradually polymerized into polymeric counterions. In a newly started project, we test these predictions by using ionic surfactants with polymerizable counterions. Indeed, the polymerization of acrylate counterions of alkyltrimethylammonium surfactants yields phases in accordance with the equilibrium phase diagrams determined previously. These polymerization processes are of fundamental and practical interest. For instance, they are closely analogous to processes where highly ordered mesoporous silica materials are produced by the polymerization of silicates in the presence of surfactants. (S. Santos, L. Piculell, O. Karlsson, M. Miguel (Coimbra University)).

**Phase diagram and Thermodynamics of Surfactants at low Water Contents.** The uptake of water in surfactants is investigated by means of a sorption calorimeter. The device simultaneously measures the water activity as a function of water content and the partial molar enthalpy of mixing water with the surfactant. From the data, accurate water/surfactant compositions vs. temperature phase diagrams are obtained. In addition, using the thermodynamic properties of the phases and phase transitions, phase boundaries are constructed on the basis of thermodynamic modeling. By combining the sorption calorimetric measurements with accurate DCS measurements, a phase diagram for the dimethylamine oxide water systems has been determined. (V. Kocherbitov (Malmö University), O. Söderman).

**Interaction between cyclodextrin and surfactants. Cyclodextrin forms inclusion complexes with surfactants.** In this project we examine the stoichiometry, strength and structure of such complexes formed between α, β and γ-cyclodextrin and cationic gemini and bola surfactants. The main methods used are NMR diffusometry, NMR multi-dimensional techniques (mainly ROESY) and isothermal calorimetry. Also conductivity measurements are used. (M. Nilsson, O. Söderman, G. Olofsson, A. Valente (Coimbra))

**Physico-chemical characterisation of micellar properties of PEG 12-acyloxy-stearates.** Recent work with PEG 12-acyloxy-stearates (PEG-12-AS) has revealed remarkable properties of these amphiphilic compounds with regard to cell damage effects. For PEG1500 12-acyloxy-stearates with acyloxy groups of 14 to 18 carbon atoms no effects on red blood cells or intestinal cells were observed. The same behaviour was found for methyl-PEG2000 12-acyloxy-stearates. The mechanism behind these very unusual properties is still unknown. To shed some light on the mechanisms, we perform adsorption studied of different PEG-12-AS on lipid bilayers. The adsorption isotherms are determined by in situ ellipsometry. In addition, methods to determine the very low cmc values of PEG-12-AS are developed. (M. Vaccaro, O. Söderman, C. v Corswandt (Astra-Zeneca, Mölndal)).

**Emulsions.** NMR techniques are used to study oil- in- water and water- in- oil type emulsions with varying volume fractions. Self-diffusion data show that molecules of the dispersed phase undergo restricted self- diffusion whereas unbounded diffusion is the rule for the dispersion medium. The self- diffusion data can be used to determine emulsion characteristics such as droplet size, size distribution and interdroplet interactions. In a related project new methods that allow the study of high internal phase ratio emulsions (concentrated emulsions) by means of the NMR self- diffusion approach have been developed. Here we focus on methods to investigate short- and long-time diffusion of the dispersed phase. In addition, the diffusional transport of active substances solubilized in the emulsions is investigated. Concentrated emulsions are also being used as model systems in developing methods to study porous media by means of pulsed field gradient NMR. In particular the new method of modulated field gradients is being used in the study of such emulsions. (C. Malmborg, D. Topgaard, O. Söderman).

**Transport properties of colloidal sized aggregates in complex polymer systems – stability, retention, and deposition.** In this project we study the fate of hydrophilic drug carriers in contact with the mucus layer in the gastrointestinal tract. The mucus layer is a complex mixture, containing among other things mucin (a negatively charged polyelectrolyte contributing to the gel like properties of the mucus layer) and lipid depots. We have chosen to investigate mixtures of mucin and a model drug carrier – a mixed micelle of a non-ionic and a cationic surfactant, the latter providing functionality and retentive properties towards the mucin matrix. Depending on composition phase separation and precipitation can take place. The structural properties of the precipitate are studied by means of SAXS and the water rich phases are investigated by a combination of different optical and analytical methods, such as PGSE-NMR, HPLC, and Cryo-TEM. (G. Lafitte, K. Thuresson (Camurus AB, Lund), O. Söderman).

**Long chain surfactants.** Double chain cationic surfactants may form vesicles above the chain melting temperature, Tc. In a vortexed dispersion all chains freeze when the dispersion is cooled below Tc. However, in a sonicated dispersion it was found from NMR experiments that approximately 50 % of the chains remain in a fluid state even far (20-30 °C) below Tc. The reason for the stability of this supercooled state, and how frozen and fluid domains are distributed is still unclear. Work is extended to other lipid surfactants and lipids where similar observations have been made. In a more detailed DSC study of the chain melting/freezing process two separate steps involving similar enthalpy changes were observed. One of the processes showed slow kinetics in the freezing direction,, and has therefore not always been recognized. In another project, the self-assembly of log chain fatty alcohol/surfactant mixtures are studied when cooled below the chain melting temperature. (P. Saveyn (Univ. of Gent), P. van der Meeren (Univ. of Gent), G. Olofsson, T. Drakenberg, U. Olsson)

**Asymmetric catanionic surfactants.** Catanionic surfactants are complex salts of surfactant cations and surfactant anions (e.g. dodecyl tetra methyl ammonium dodecyl sulphonate) in the absence of additional simple salts (e.g. NaCl). Symmetric (equal alky chain lengths) catanionics form essentially stable water insoluble crystals at room temperature. In asymmetric catanionics the surfactant film may carry a net charge in mixtures with water because of a mismatch in the aqueous solubility of the two surfactant ions. The chain length mismatch also reduces the Krafft temperature significantly resulting in that these materials are water soluble already at room temperature. If the solubility difference is not too large, these surfactants form a lamellar phase in water which can swell to very high water contents due to the net bilayer charge. However a very interesting aspect is the presence of an unusual miscibility gap within the lamellar phase, which has previously been observed only in a few particular systems. With the addition of an alkane, the lamellar phase is transformed into a water-in-oil droplet microemulsion with spherical, weakly charged droplets of low polydispersity. Using small angle neutron scattering we study the long range droplet-droplet interactions which depend on the concentration dependent effective droplet charge (B. Silva (Porto), E. Marques (Porto), U. Olsson).

**Living polymers and living networks.** Some surfactants form giant micelles in solution that can be longer than several micrometers. These solutions have properties similar to polymer solutions, however with some significant differences. The size distribution is not fixed but varies with concentration and temperature. Moreover, micelles may break and reform which influences the dynamics. For these reasons the are often referred to as "living polymers". Furthermore, there are also systems where the micelles form connected (branched) network, similar to a bicontinuous microemulsion. Here the morphology resembles that of polymer gels and one may refer to a "living network". In this project we compare phase behavior of living polymer and living network systems and we have studied the effect of shear flow on the liquid structure and in particular the shear induced formation of a nematic phase of wormlike micelles. The structural transformation may be followed by small angle neutron scattering (rheo-SANS) or by NMR measurements (rheo-NMR). The growth of "living polymers" with increasing concentration is an unresolved problem. Simple mean field models predict that the number averaged contour lengths varies approximately as the square root concentration while one in the analysis of recent experiments have found a much higher exponent. An important complication in the analysis of experimental data is the interactions and how they influence e.g. the osmotic compressibility. Here we are combining static and dynamic light scattering, and NMR self-diffusion experiments, to investigate the growth law in dilute solutions. The diffusion of surfactant molecules is restricted to the self-assembly aggregates which may form a random coil or be an infinite connected network. Both super and sub diffusion may be observed which can be described within the same formalism in terms of a generalized diffusion equation with fractional derivatives. (S. Bulut, J. Hamit, U. Olsson, T. Kato (Tokyo), R. Angelico, L. Ambrosone and A. Ceglie (Campobasso), G. Palazzo (Bari), K. Mortensen (Risø, Denmark).

**Bilayer membrane kinetics, including vesicle fusion.** The phase lamellar-to-"sponge" phase transition involves a topological transformation of a bilayer membrane. In the lamellar phase the bilayer has a planar topology while it is multiply connected in the so-called "sponge" or L3 phase. Topology transformations are believed to involve the fusion or fission of membranes. With nonionic surfactants the phase transformation can occur by a minor change in temperature. Using deuterium as "phase-detection" the transition has been investigated in both directions. The sponge-to-lamellar transition appears to occur via a nucleation and growth process while the opposite transition rather involves a random fusion of adjacent bilayer membranes. To investigate the bilayer structure in more detail, The transitions are also studied by small angle neutron scattering experiments. Nonionic vesicles spontaneously fuse at elevated temperatures. Here, vesicle fusion kinetics is tudied using time-resolved static and dynamic light scattering and small angle neutron scattering. (S. Bulut, M. Zackrisson, U. Olsson, H. Wennerström; M. Gotter (Köln), R. Strey (Köln)).

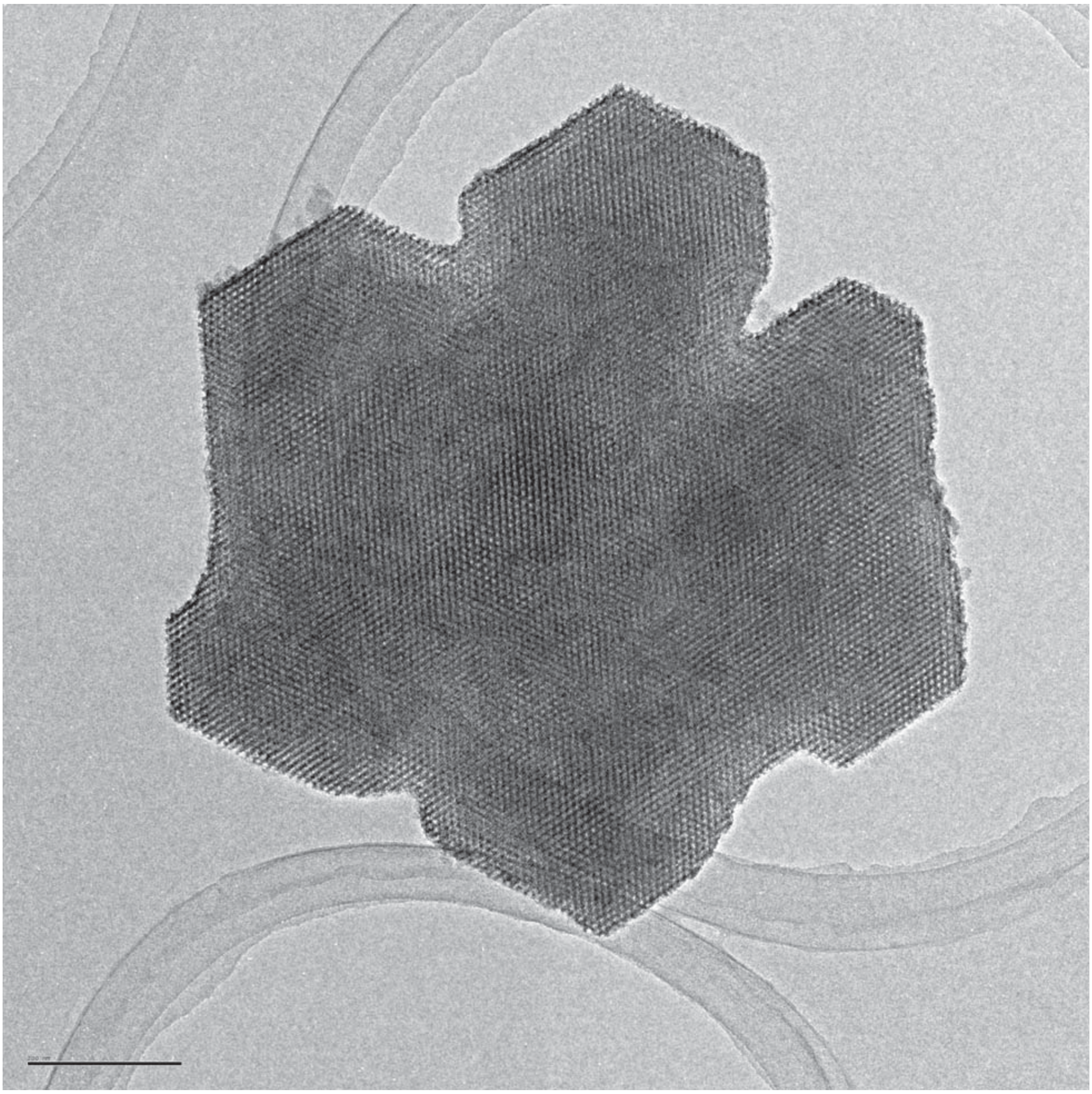
**Lamellar phase rheology and shear-induced formation of multi-lamellar vesicles.** The equilibrium structure and phase equilibria of the lamellar phase are sometimes complicated as noted in already early studies by Ekwall and Fontell. This complication appears to be due to the formation of multi-lamellar vesicles ("onions") under shear, which can originate simply by shaking the sample. A systematic study is performed on nonionic surfactant- water systems where the structure of the lamellar phase under shear is investigated using small angle neutron and light scattering. Depending on the temperature, that governs the monolayer spontaneous curvature, we can identify two distinct regions corresponding to "onions" (lower temperature) and planar bilayers (classical lamellar phase, higher temperature). The equilibrium structure at zero shear, however, appears to be the classical lamellar structure. The onion size varies with the applied shear rate or shear stress. In systematic experiments, it was found that the onion states obtained at large strain values are reversible and correspond to true steady states. Oriented ("single crystal") lamellar phases still contain equilibrium defects that give them a relatively high shear viscosity and in addition make them viscoelastic. (U. Olsson, B. Medronho (Coimbra), M. Miguel (Coimbra), C. Schmidt (Paderborn), M. Imai (Tokyo), Y. Suganuma (Tokyo).

**Thermodynamics of microemulsions.** The common behavior of many microemulsion system with, e.g. the so-called Winsor I, II and III equilibria and the formation of lamellar phases at higher surfactant concentrations is qualitatively rather well understood. Here, the interfacial description, based on the curvature elasticity of the surfactant film, is a useful approach to understand the thermodynamics (structure and phase equilibria) of microemulsions and related phases. The key ingredients in this description are the spontaneous curvature of the surfactant film and two elastic modulii, the bending rigidity, which is a stiffness parameter and the saddle splay modulus which tells about the preferred topology of the surfactant film. Many efforts have been made to measure these quantities but it is difficult and different approaches or methods often give significantly different results. Particularly difficult it is to measure the saddle splay modulus. In this project we investigate a number of microemulsion systems with nonionic surfactants, varying the chain length of the oil. Depending on the oil chain length, and hence the degree of "oil penetration" (short oils penetrate or solvate the surfactant alkyl chains better) the microemulsion phase behavior is quantitatively and well as in some parts qualitatively different. It appears that oil penetration affects not only the spontaneous curvature but also the elastic modulii. (J. Balogh, H. Kaper, U. Olsson, H. Wennerström, J. Skov Pedersen (Aarhus), Project completed.

**Drug nanoparticles.** A significant proportion of drugs on the market are poorly soluble in water and it is expected that this will be even more pronounced in the future. Formulations of poorly water-soluble compounds offers a challenge to the formulation scientist, from the early discovery phase through the development to the launch of the pharmaceutical product. A potentially interesting way of formulating such compounds is as aqueous nanosuspensions with typical particle sizes of the order of 100 nm. The particles may be amorphous or crystalline, and in the development of such formulations one comes across a number of classical colloid and surface science problems such as nucleation and growth, Ostwald ripening and particle characterization. (U. Olsson, Lennart Lindfors (AstraZeneca)).

**Mesoporous inorganic materials.** Inorganic material with pores in the meso range can be synthesised with surfactant aggregates acting as structure directing agents. We are studying the formation of such systems. Our attention is mainly focused on silica systems formed with non-ionic block copolymers, in particular Pluronics. The structures formed are highly dependent on the length of the polymer blocks as well as on the temperature of the synthesis, and range from lamellar via hexagonal to micellar cubic. Also, addition of inorganic salts has a strong influence on the outcome of the synthesis. Characterization is performed with SAXS, , USAXS, SANS, TEM and nitrogen adsorption measurements. Time resolved mechanistic studies are done with in-situ SAXS/USAXS (synchrotron light), in-situ SANS and TEM. (P. Linton, V. Alfredsson and H. Wennerström).

**(Cryo-)Transmission electron microscopy.** TEM enables the direct imaging of both solid-state systems, such as mesoporous silica, but also of liquid samples. The liquid samples are frozen and transported to the microscope and subsequently studied in the microscope under cryogenic conditions. Cryo-TEM is used for direct imaging of labile systems containing biological and synthetic amphiphiles, naturally occurring polymers (polysaccharides, proteins, etc.) or synthetic polymers, liquid crystals and gels. This technique allows for direct imaging and detection of different entities found in, for example, very dilute amphiphilic systems. It is consequently possible to identify e.g. vesicles, micelles and cubosomes. The energy filtering-option on this microscope (Philips CM 120 bio-twin) can be used to improve the contrast, permit the observation of thicker specimens and also allow for elemental analysis. (V. Alfredsson, A. Carnerup, A. Alfredo Gonzalez-Perez, P. Linton, P. Vandoolaeghe).



Electron micrograph of mesoporous SBA-15. The particles grow via an unusual mechanism including an oriented aggregation of smaller particles into larger single mesoscopic crystals as seen in the image.

**Cryo-Fracture TEM.** Conventional Cryo-TEM experiments requires very thin samples in order to have sufficient transmission. This is difficult to achieve with viscous samples. In this project we have developed a slightly modified specimen preparation protocol, where a (too) thick vitrified specimen is punched with a sharp object in a number of different spots. In the resulting fractures one frequently find edges that are thin enough image in transmission. Lamellar phases, including a lamellar mesh phase, hexagonal and cubic phases have been successfully imaged using this protocol. (A Gonzalez-Péréz, S. Bulut, U. Olsson)

**DNA membranes.** Mixed membranes of DNA and poly(vinyl alcohol) are prepared by a freeze-thawing process. The membranes are characterized with respect to their internal structure and transport properties. Single-stranded DNA are found to form more homogeneous membranes than double-stranded. (A. Valente, M. Miguel (Coimbra), B. Lindman.

**DNA particles.** Through an interfacial diffusion mechanism DNA particles were prepared and studied with respect to internal structure and DNA release. A large difference in internal structure between different DNA conformations for surfactant systems point to the role of hydrophobic interactions. (M. C. Morán, M. Miguel (Coimbra), B. Lindman)

**Solubilization of conjugated anionic copolymers by nonionic surfactants in aqueous solution.** Interaction between the conjugated polyelectrolyte, anionic poly{1,4-phenylene-[9,9-bis(4-phenoxy- butylsulfonate)]fluorene-2,7-diyl} (PBS-PFP), and the non-ionic alkyloxyethylene surfactant n-dodecylpentaoxyethylene glycol ether (C12E5) in water is investigated. Using UV/visible and fluorescence spectroscopy, dynamic light scattering and electrical conductivity, a coherent model for this polymer-surfactant interaction is formulated, which is based on the of break-up of the PBS-PFP clusters through polymer-surfactant association and formation of cylindrical micelles containing isolated polymer chains. This process involves a careful balance between electrostatic, hydrophilic and hydrophobic interactions. Strong support for this comes from molecular dynamics simulations, which indicate stable polymer-surfactant structures and also provide support for the tendency of C12E5 to break up polymer aggregates. (H. D. Burrows, S. M. Fonseca, C. L. Silva, A. A.C.C. Pais and A. J.M. Valente (University of Coimbra, Portugal), M. José Tapia (Univeridad de Brugos, Spain), S. Pradhan and U. Scherf (Bergische Universität Wuppertal, Germany), K. Schillén)

**Complex salts in reverse micelles.** The complex salt cetyltetramethylammonium polyacrylate is well soluble in short-chain alcohols, such as butanol, where a large L2 phase is formed. The phase diagram is weakly dependent on the degree of polymerization of the polacrylate, but the rheology of the L2 phase differs dramatically between PAs of 30 and 6000 repeating units. The experimental results seem consistent with a structure of extended inverse micelles (polyion cores surrounded by surfactant counterions), where the length of the polymeric micelle increases with the length of the polyion. The system is investigated by a range of methods including rheology, moleular self diffusion, and cryo-transmission electron microscopy. (L. Piculell; J. Bernardes and W. Loh (UNICAMP, Brazil))

**Nonionic associating polymer-surfactant mixtures.** Not only oppositely charged mixtures, but also certain nonionic polymer-surfactant mixtures phase separate associatively in water. A well-known case of association involves mixtures of a poly(carboxylic acid) with polyethylene oxide. We have investigated the phase diagrams of mixtures where poly(acrylic acid), of two degrees of polymerization, has been added to aqueous mixtures of the common triblock copolymer EO27PO61EO27 (“Pluronic P104”). At low overall polymer contents, an associative phase separation was observed. At high concentrations of the triblock copolymer, the gradual replacement of water with poly(acrylic acid) made the liquid crystalline phases disappear. A possible explanation of this phenomenon is that polyacrylic acid interacts less selectively than water with the PEO and PPO blocks. (B. Luigjes, S. Santos, L. Piculell)

## Adsorption and Interfaces

**Effects of polymers on adhesion formation in surgery.** Adhesion formation is a well-known complication of abdominal and pelvic surgery. Together with Stig Bengmark and Kåre Larsson (Ideon Research Center) and Roland Andersson and coworkers (Department of Surgery, Lund University) we investigate the effect of water-soluble polymers and find very significant effects with certain hydrophobically modified polymers as well as synergistic behavior between oppositely charged polyelectrolytes. Mixed polymer systems, both nonionic and ionic, have been extensively tested in animal experiments in the Department of Surgery, Lund University. Major reductions in adhesion formation have been obtained, much above products used in clinics. Studies based on the systems we have designed have formed the basis of two doctoral thesis in surgery. (B. Lindman).

**Interaction between functionalised soft polymer particles and inorganic surfaces.** When water evaporates from a dispersion of polymer particles, the particles are forced together developing a coherent film. Therefore soft polymer particles are widely used as binders in a range of applications, including water based paints, glue, and paper coatings. It is generally found that chemically modified particles have superior properties in films that include inorganic pigment particles, resulting in improved mechanical properties and water resistance of the film. In this project, the effect of the functionalisation of the polymer particles on their film formation and interactions with inorganic surfaces is studied, primarily by atomic force microscopy. (J.K. Dreyer, T. Nylander, L. Piculell).

**Stimulus-responsive polymer brushes on surfaces.** Patterned polymer brushes constitute one approach to fabricate functionalized surfaces. Our aim is to in more depth characterized such brushes manufactured at Purdue University by, in particular, QCM, ellipsometry, and neutron reflectivity as well as with simulation methods. (S. Zauscher (Duke University), A. Rennie (Uppsala University), F. Höök (Solid State Physics), R. Campbell, T. Nylander, M. Patra, and P. Linse).

**Phase separation, adsorption behavior and delivery capacity of polyelectrolytes and oppositely charged surfactants at hydrophilic surfaces.** The concentrated phase formed in dilute mixtures of polyelectrolytes and oppositely charged surfactants can be a precipitate (solid) or a coacervate (liquid) depending on parameters such as the molecular weight and charge density of the polymer, the self-assembly of the surfactant and the charge ratio of polymer vs. surfactant in the mixtures. The phase separation is of practical use in products where it is desired to obtain a deposition on a surface. The polymer-surfactant complexation can also be used as a delivery tool for an additional substance to the surface. The aim of the present project is to link the adsorption behavior of a polyelectrolyte-surfactant mixture with the characteristics of the phase separation in the bulk solution. Based on these results, an investigation regarding the delivery of an oil-in-water emulsion to a hydrophilic surface is made. A combination of different techniques is used: in-situ ellipsometry to investigate the adsorption behavior, phase studies and turbidity measurements to look into the bulk properties, dynamic light scattering to determine the size of soluble aggregates and gel swelling experiments to investigate the polymer-surfactant binding. (A. Svensson, O. Santos, T. Nylander, L. Piculell, B. Lindman in collaboration with E. Johnson and R. Panandiker, Procter & Gamble, Cincinnati).

**DNA compaction in solution and at particle solution interfaces.** The DNA macromolecule undergoes a transition from a semiflexible coil to a more compact globule in solution as a consequence of cationic surfactant binding. DNA compaction is also observed on different types of polystyrene particles in the presence of surfactant. DNA adsorption has also large implications for the fabrication of nano-structures using e.g. gold nanoparticles. Gold nanoparticles modified by thiol-derivatized singlestranded (ss)DNA (thiol-ssDNA) are promising building blocks for nanoscale materials and are used in various applications in bioanalysis. The contribution of nonspecific interactions to the overall interactions of thiol-ssDNA and dsDNA macromolecules with gold nanoparticles is here very important. Dynamic light scattering, cryogenic transmission electron microscopy and SANS is used to get an insight in the structure of the complexes formed. (M. Cárdenas (Malmö University), C. Dreiss, D. Pebalk (Moscow State University, Russia), J. Jansson, K. Schillén, J. Barauskas, J. L. Brennan and M. Brust (University of Liverpool, UK), T. Cosgrove (Bristol University), T. Nylander, B. Lindman).

**The effect of the antimicrobial agents on the enzymatic degradation of the model cellulose film.** Controlling the fabric degradation and protecting them against microbes are important issues in the textile industry. In this project we investigate the enzymatic activity of two cellulases at the solid-liquid interface. Our attention is mainly focused on the degradation of the model cellulose film treated by antimicrobial agent. The kinetics of the cellulose film in terms of the time-evolution of the mass and thickness of the cellulose film were followed by in situ ellipsometry. It was demonstrated for the first time that the antimicrobial agent inhibited the enzymatic activity at the solid-liquid interface. (D. Jausovec (Univ of Maribor), B. Voncina (Univ of Maribor), T. Nylander, D. Angelescu, B. Lindman).

## Colloidal Biology

**Controlling DNA compaction by surfactant mixtures.** Cationic surfactants can be used to compact and precipitate DNA. Using fluorescence microscopy it is possible to follow DNA single molecule compaction. DNA conformational changes are strongly cooperative involving a coexistence of extended and globular species. The dissociation of DNA-cationic surfactants can be achieved by the addition of anionic surfactants, non-ionic surfactants and cyclodextrins. Contrarily to what happens with the surfactant mixtures, when cyclodextrins are used the coexistence of coils and globules is not observed. Cationic surfactants provide protection to the DNA towards DNase digestion and inhibit its transcription. When non-ionic surfactant is added the production of RNA is resumed. (R. Dias, J. Carlstedt, A. González-Pérez, M.-L. Örberg, T. Nylander, B. Lindman)

**Diffusion NMR studies of human brain microstructure.** Diffusion-weighted magnetic resonance imaging is a diagnostic tool for ischemic stroke, demyelinization, and tumor detection. In this project excised brain tissue is studied by means of state-of-the-art spectroscopic diffusion NMR equipment in order to elucidate the relation between brain microstructure, water diffusion, and signal response in the clinical imaging system. (D. Topgaard, I. Åslund, O. Söderman, J. Lätt (Radiation Physics), S. Brockstedt (Radiation Physics), F. Ståhlberg (Radiation Physics), E. Englund (Pathology), M. Sjöbeck (Pathology)).

**Hydration of extracted skin lipids and model lipids.** We aim at the characterization of the lipid component of the stratum corneum (the upper layer of the skin) at different degrees of hydration, using NMR. The project aim at the understanding how diffusive transport and molecular organization occurs through the skin and how it can be affected. Hydration of model lipid membranes is also investigated, focusing on how small water-soluble solutes, like urea and glycerol, can protect the membrane system against osmotic stress. Here, we put a special emphasis on applications of urea and glycerol in skin care products. (F. Costa-Balogh, C. Silva (Coimbra University), D. Topgaard, H. Wennerström, A. A. C. C. Pais (Coimbra University), E. Sparr).

**Amyloid formation and protein-lipid co-aggregation.** Many human disorders belong to a family of amyloid diseases, characterized by abnormal folding of proteins into aggregates with a fibrillar structure. We have shown on the formation of protein-lipid aggregates when the protein aggregation is taking place in the presence of lipid membranes. The aim the project is to investigate the basic principles for such protein-lipid co-aggregation. We study the interactions between the Aβ protein, involved in Alzheimer's disease with model lipid membranes of different composition. The lipid-protein interaction is investigated by means of flouresnce spectroscopuy and in monolayers studies (E. Hellstrand (Biophysical Chemistry, Lund University), E, Sparr, S. Linse (Biophysical Chemistry, Lund University)).

**Lung surfactants.** The alveolar surface is lined by film of submicron thickness between the epithelial cells and the alveolar lumen with the main function to lower the surface tension. The aqueous bulk structure of this layer consists of lipid bilayers forming lamellar bodies (LB:s) and tubular myelin (TM), and two hydrophilic proteins in the outside water ; SP-A and SP-D. We are studying the structure of and phase transitions in this layer with cryo-TEM and SAXD. Another aspect of the project is the diffusion in through the interfacial lipid membrane with complex structure that implies a diffusional permeability that is different for hydrophilic and hydrophobic substances. The transport processes is theoretically analyzed considering the dynamic conditions. (M. Larsson (Lund University Hospital), T. Nylander, K. Larsson, C. Åberg, E. Sparr, H. Wennerström).

**The ejection of genome from viruses.** In this work light scattering is used as the main technique in order to study the ejection process of natural DNA from λ-bacteriophage. Measurements are carried out under different physical conditions and the ejection process is also studied with different DNA binding proteins added to the investigated solutions. (D. Löf, K. Schillén, A. Evilevitch (Biochemistry, Lund University), B. Jönsson (Biophysical Chemistry, Lund University). Project completed.

**Studies of fluid flow in cartilage.** Articulate cartilage covers the surfaces of joints. Its function is to take up load and allowing the bones to slide over one another by reducing the friction. Cartilage does this very well; it can support pressures of up to 200 atm and cartilage surfaces can slide over each other with very low friction coefficients. Yet the mechanism under which cartilage operates are poorly understood. In this project we study in vitro fluid flow and compression under varying loads in cartilage from pig joints. NMR diffusometry and imaging techniques are used. (G. Rata, D. Topggard, O. Söderman, W. Greene (UC Santa Barbara), B. Zhao (UC Santa Barbara), J. Israelachvili (UC Santa Barbara)).

**Lipid-lipase structure function relationship.** The aim is to better understand the small-scale structure of lipid aggregates, which are of important substrates for lipolytic enzymes. The aggregate structure and composition have a determining influence on the activity of the lipase. Furthermore, the aggregate structures are largely influenced by the formed catalytic products. Therefore a large part of the project is devoted to study the phase behavior and phase structure of selected mixtures of triglyceride, diglyceride, monoglyceride, fatty acids, soap, glycerol and aqueous solution, using NMR, small angle x-ray scattering and microscopy techniques. (T. Nylander, J. Barauskas, F. Tiberg, A. Svendsen (Novoozymes)).

**Lipid nanostructures as matrices for biologically active molecules.** The use of cubic-lipid phases (e.g. in the monoolein- aqueous system) as matrices to study immobilize enzymes and redoxactive molecules, both natural (e.g. ubiquinone, vitamin K1) is studied. Of particular interest is to study how and why the structure of the lipid aggregate changes when lipophilic compounds (e.g. membrane bound cofactors for enzymes) solubilised in the lipid matrix. The project involves both studies of the phase behavior of the lipid-lipophilic compound and/or enzyme-aqueous system as well as the activity of the enzymes and redox active compounds. (T. Nylander, V. Razumas (Lithuania), K. Larsson, F. Tiberg (Camurus AB, Lund), M. Monduzzi (Italy)).

**Lipid-peptide interactions.** The potential of using self-associated nano-structured lipid aqueous based nanoparticles as carrier for peptide drugs is exploited. An important aspect is the study of how these liquid crystalline particles, cubic phase nanoparticles CPNP, interacts with surface as well as with models of biological membrane. The project also involves fundamental investigations of peptide-lipid interactions as well as effects of enzymatic degradation and permeation of biomembranes. The aim is to increase the understanding of the physicochemical factors that control the uptake of the peptides from the gastro-intestinal tract. The project involves biophysical and surface chemical studies of interactions in model systems, using ellipsometry, neutron reflectivity and SAX. (P. Vandoolaeghe, T. Nylander, F. Tiberg, Adrian Rennie (Uppsala University) and H. Wennerström).

**Interaction between poly nucleic acids, surfactants and phospholipids.** In the living system, DNA and RNA are present in an environment that contains many other substances, e.g. lipids in cell membranes and in the cell nuclei, which may influence its structure and function. RNA occurs more often than DNA in the single-stranded form, where the apolar parts of the bases are obvious targets for hydrophobic interaction with other species. We aim at revealing the basic features of DNA-phospholipid and RNA–phospholipid interactions. We study double stranded DNA, single stranded DNA and RNA, and the model lipid membrane systems are chosen to mimic cell membranes and the lipids within cell nuclei, in order to better understand the functions of intra nuclear lipids. One important aspect is to understand the factors determining DNA compaction due to interaction at an interfaces such as a membrane, therefore our interfacial studies also involve the interactionwith cationic surfactants or polymers. These systems are studied with several techniques, including dynamic light scattering, cryo-TEM, differential scanning calorimetry, isothermal titration calorimetry, ellipsometry, neutron reflectivity, quartz crystal microbalance (QCM-D), NMR, monolayer techniques, fluorescence microscopy and fluorescence spectroscopy. (M-L. Örberg, A. Zettergren, T. Nylander, E. Sparr, V. Alfredsson, F. Höök (Solid State Physics, Lund University), M. Cárdenas (Malmö University), B. Lindman).

**Interactions between DNA and cationic dendrimers.** Dynamic light scattering and steady-state fluorescence spectroscopy are utilized to investigate the interaction between poly(amido amine) (PAMAM) dendrimers and double stranded (ds) DNA. The aim is to study the formation process of dsDNA-dendrimer aggregates and their internal structure. (M.-L. Örberg, K. Schillén, T. Nylander).

**Morphologies and structures of aqueous dispersions of brain lipids.** The self-assembly of lipids, with high degree of unsaturation, from e.g. brain and other tissues is not yet fully understood. The morphologies and structure formed by different type of brain lipids in aqueous dispersion and how the formed structures dependent on cholesterol content, buffer composition and temperature are investigated by cryo-TEM, SAXD and WAXD. (V. Alfredsson, T. Nylander; K. Larsson (Camurus Lipid Research); P. Lo Nostro and B. Ninham (University of Florence).

**Free-solution electrophoresis of DNA and DNA-surfactant mixtures.** Free-solution electrophoretic properties of DNA and DNA-surfactant mixtures in the dilute regime are investigated employing an in-house electrophoresis cell with fluorescence microscopy detection on the single molecule level. At sufficient concentrations, the presence of the cationic surfactant induces a coil-to-globule transition of the long DNA chains, and for an intermediate range of surfactant concentrations, a coexistence of DNA coils and globules is present. It is found that the electrophoretic mobility of the coils is marginally higher than that of the globules. (J. Carlstedt, R. Dias, B. Lindman)

**Adsorption of macromolecules to responsive membranes.** The interaction of negatively charged polyions and macroions with a coarse-grained membrane is looked upon. The membrane consists of sets of negative and positive "lipids" which are allowed to move in the xy plane, simulating the lateral diffusion of lipids in membranes, and also to protrude individually into the "solution". It is shown that the adsorption behaviour is determined by the length and stiffness of the polyelectrolyte, overall charge of the membrane, and mobility of charges in a nontrivial manner. The adsorption of the polyelectrolyte is clearly improved when the lipids are allowed to diffuse. Also, when individual protrusions are considered the adsorption of the polyelectrolyte is further enhanced. The surface response to the adsorbing macromolecule is two-fold: (i) the displacement of the surface particles out of the surface plane and towards the macromolecule and (ii) the polarization of the surface with the concentration of positive charges near the oppositely charged molecule. (R. Dias, A. A. C. C. Pais, (University of Coimbra), and P. Linse).

**Transport in responding lipid membranes.** In a simplified description of diffusive transport one considers a membrane barrier and a concentration gradient of the diffusing species. Within a more dynamic approach, the barrier is also allowed to respond by changes along the concentration gradient, which motivates the name "responding membrane". The aim of the present research project is i) to reveal the basic mechanisms for molecular transport in responding membranes and ii) to apply the concepts of responding membranes to the skin barrier. Permeation of small molecules in skin and in model lipid membranes is investigated in a diffusion cell system, and the studies are combined with theoretical modelling and structural characterization of the same systems. For the transport studies in model lipid membranes, we recently devolved a system of so-called double-porous membranes where the lipid lyotropic phases are confined and aligned inside the pores of a synthetic polymer membrane. (C- Åberg, F. Costa-Balogh, S. Björklund, J. Engblom (Malmö University), K Thuresson (Camurus AB), V. Burnier (L'ORÉAL, Paris), B. Cabane (ESPCI, Paris), H. Wennerström, E. Sparr)

## Theory of Colloids

**Diffusive transport in responding membranes.** We aim at the mechanisms for diffusive transport in responding lipid membranes in the presence of several gradients. We study how an external gradient that induce structural transformations and domain formation in the membrane can be used as a regulating mechanism to control the barrier properties and introduce non-linear transport behavior. Beside the basic scientific interest in these mechanisms, several applications in biology and technology can be seen in, for example, the barrier properties of stratum corneum (the upper layer of the skin). The skin is exposed very different environments, thus exposed to several gradients. We particularly investigate how an osmotic gradient and a gradient in CO2 affect the barrier properties and the observed pH gradient over the skin. (C. Åberg, H. Wennerström, E. Sparr).

**Fundamental issues concerning surface forces.** We study a number of problems concerning basic questions in the area of surface forces. This include the molecular interpretation of the van der Waals interaction as expressed in the Lifshitz theory and its consequences for dynamic systems, the role of dissolved gas in the hydrophobic interaction, capillary induced phase separation as a mechanism for long range attractive interactions and the validity of the Derjaguin approximation. (H. Wennerström).

**The dielectric approximation.** In the theoretical description of surface forces an aqueous medium is typically described as a dielectric continuum. This often leads to quantitatively accurate descriptions. However, the continuum description of the solvent breaks down at short separations and one must turn to a molecular picture. Through computer simulations we study the relation between the continuum and the fully molecular description of charged surfaces interacting at short range in a dipolar solvent. (L. Pegado, B. Jönsson, G. Karlström, H. Wennerström).

**Dynamics of polymer adsorption.** The dynamics of adsorption and desorption of uncharged homopolymers have been investigated using a coarse-grained model comprised of a bead-spring chain and a planar surface. Brownian dynamics simulation has been used to examine the adsorption process for polymers released near the surface and with bulk properties, and Monte Carlo simulations to explore equilibrium adsorption structures of the polymer. Systems with varying polymer contour length, polymer stiffness, and polymer-surface interaction potential, have been considered. Investigations have been made on polymer extensions perpendicular and parallel to the surface and also characterized the adsorbed state in terms of loops, tails, and trains. After the diffusion of the polymer to the vicinity of the surface, three succeeding phases were identified: distortion, attachment, and relaxation phase. In the distortion phase, the polymer starts to experience the potential of the surface and becomes elongated perpendicular to the surface. In the attachment phase, the polymer makes direct contact with the surface and becomes contracted perpendicular to the surface. Finally, in the extended relaxation phase, the chain polymer spreads on the surface. Currently, we are performing similar investigations to examine the polymer adsorption from solutions of polymers with different chain length and concentration. (N. Källrot and P. Linse).

**Polyelectrolyte gels.** Volumes and other structural properties of polyelectrolyte gels in equilibrium with pure water have been determined by Monte Carlo simulations. The role of chain length polydispersity and topological network defects of four different networks with varying crosslinking density, monomer charge, and chain stiffness have been investigated. Generally, a chain length polydispersity reduced the gel volume, whereas the presence of chains with one end detached from the crosslinker (severed chains) led to an increased gel volume. Polyelectrolyte networks displayed the largest and uncharged polymer the smallest dependence on chain length polydispersity. The effect of severed chains was strongest for flexible polyelectrolyte gels and weakest for uncharged networks and stiff polyelectrolyte gels. Mechanical properties of uncharged and charged polymer gels were also investigated through uniaxially stretching and compared with theory. Furthermore, the swelling and mechanical properties of various interpenetrating polymer networks (IPN) have also been studied. Six networks made from permuations of a moderately crosslinked polyelectrolyte network, a moderately crosslinked neutral polymer network, and a highly crosslined polyelectrolyte network were first swollen in water and structural properties such as end-to-end chain lengths and radial distributions functions were compared with the component networks' equilibrium properties. The swelling of composite IPNs was discussed in terms of a balance between the osmotic pressure due to mobile counterions and the restoring force of the network chains, which act in parallel to counteract the osmotic swelling. The equilibrium volume decreased upon uniaxial extension and the elastic modulii of IPNs have been determined. (S. Edgecombe and P. Linse).

**Structures of charged block copolymers.** The structure of spherical brushes formed by symmetric diblock polyampholytes end-grafted onto small spherical particles in aqueous solution is examined within the framework of the so-called primitive model using Monte Carlo simulations. The properties of the two blocks are identical except for the sign of their charges. Three different chain flexibilities corresponding to flexible, semiflexible, and stiff blocks, are considered at various polyampholyte linear charge densities and grafting densities. The link between the two blocks is flexible at all conditions, and the grafted segments are laterally mobile. Radial and lateral spatial distribution functions of different types and single-chain properties are analyzed. The brush structure strongly depends on the chain flexibility. With flexible chains, a disordered polyelectrolyte complex is formed at the surface of the particle, the complex becoming more compact at increasing linear charge density. With stiff blocks, the inner blocks are radially oriented. At low linear charged density, the outer blocks are orientationally disordered, whereas at increasing electrostatic interaction the two blocks of a polyampholyte are parallel and close to each other, leading to an ordered structure referred to as a polyampholyte star. As the grafting density is increased, the brush thickness responded differently for flexible and nonflexible chains, depending on a different balance between electrostatic interactions and excluded volume effects. In addition, the interaction between such composite colloidal particles composed of a spherical core and grafted AB-diblock polyampholytes are investigated. The B-block is end-grafted onto the core of the colloid and its linear charge density is varied, whereas the linear charge density of the A-block is fixed. Brush structure of a single colloid, the mean force between two colloids, and the structure of solutions of such colloids have been determined for different linear charge densities of the B-blocks and block lengths. Many features of the present system are controlled by the charge of the B-blocks. In the limit of uncharged B-blocks, (i) the grafted chains are stretched and form an extended polyelectrolyte brush, (ii) a strong repulsive force is operating between two colloids, (iii) and the solution is thermodynamic stable and displays strong spatial correlation among the colloids. In the limit where the charges of the two types of blocks exactly compensate each other, (i) the chains are collapsed and form a polyelectrolyte complex surrounding the cores, (ii) an attractive force appears between two colloids, and (iii) strong colloid clustering appears in the solution. These features become more pronounced as the length of the polymer blocks is increased, and a phase instability occurs at sufficiently long chains. A comparison with properties for other related colloidal particles is also provided. (A. Akinchina and P. Linse). Project completed.

**Nanopatterned polymer brushes.** Structural properties of polymer brushes on nanopatterned surfaces in good solvent have been examined by AFM experiments. Experimentally determined brush heights obtained for different foot-print sizes, polymer molecular weights, and surface grafting densities have been analyzed using scaling relations obtained from simulations. We found good agreement between the experimental data and the theoretical predictions. Our results thus indicate that the scaling predictions provide a useful tool for the design and fabrication with polymeric and biomacromolecular nanostructures on surfaces. (M. Patra, W.-K. Lee (Duke University), S. Zauscher (Duke University), and P. Linse).

**Novel evaluation method of neutron reflectivity data.** Neutron reflectivity (NR) measurements have been performed on stimulus-responsive polymer brushes containing N-isopropylacrylamide (NIPAAM) at different temperatures and contrasts using two different brush samples of roughly the same grafting density and layer thickness. The NR data were analyzed using a novel method employing polymer density profiles predicted from lattice mean-field theory augmented with a polymer model to describe polymer solubility that decreases with increasing temperature. The predicted density profiles at the different temperatures were self-consistent with the experimentally observed profiles; hence the experimental data lends credibility to the theory. We found that the brush thickness decreased from 220 to 160 nm and the polymer volume fraction increased from 55 to 75% when increasing temperature from 293 to 328 K. The new evaluation approach involved significantly fewer independent fitting parameters than methods involving layers of uniform densities. Furthermore, the approach can straightforwardly be extended to analyze neutron reflectivity data of grafted, weakly charged polymers that display pH-sensitive behaviour and also to block copolymers and to surfaces with adsorbed polymers. We propose that such accurate model calculations provide a tool to interpret results from NR experiments more effectively and design neutron reflectivity experiments for optimal outcome. (J. Zhang (Duke University), S. Zauscher (Duke University), A. Rennie (Uppsala University),T. Nylander, R. Campbell, and P. Linse).

**Virus modeling.** Structural properties of encapsidated flexible polyelectrolytes in viral capsids with dodechaedral charge distribution have been investigated by Monte Carlo simulations using a coarse-grained model. Several capsid charge distributions ranging from a homogeneous surface charge distribution ($\lambda = 0$) to a complete dodecahedral distribution ($\lambda = 1$) at constant total capsid charge and fixed radial location of the capsid charges have been considered. The radial and lateral organizations of the polyelectrolyte have been examined as a function of the polyelectrolyte length and capsid charge distribution. With short polyelectrolytes a single polyelectrolyte layer was formed at the inner capsid surface, whereas at increasing polyelectrolyte length also a uniform polyelectrolyte density inside the surface layer was established. At low $\lambda$, the polyelectrolyte layer was laterally isotropic, but at $\lambda \geq 0.05$ a dodecahedral structure started to appear. At $\lambda = 1$, the polyelectrolyte followed essentially a path along the edges of a dodecahedron. With sufficiently long chains, all edges were decorated with polyelectrolyte, facilitated by loop formation. Second, the effect of salt on the location and structure of a flexible polyelectrolyte confined inside a viral capsid and the Donnan equilibrium of the salt across the capsid have been examined also using a coarse-grained model solved by Monte Carlo simulations. At low salt concentration the polyelectrolyte was strongly adsorbed onto the inner capsid surface, whereas at high salt concentration it was located preferentially in the central part of the capsid. Under the condition of equal Debye screening length, the electrostatic screening increased as the valence of the polyelectrolyte counterion was increased. The distribution of the small cations and anions was unequal across the capsid, an excess of polyelectrolyte counterions occurred inside the capsid, the excess increasing with the salt concentration. A simplified representation of the small ions through the use of the screened Coulomb potential provided only a qualitatively correct picture; the electrostatic screening originating from the small ions was exaggerated. Moreover, conformations and structural transitions of polyelectrolytes strictly confined onto a spherical 2D surface have been investigated by scaling descriptions based on physical arguments concerning polyelectrolyte adsorption onto planar surface and liquid crystals as well as by Monte Carlo simulations using a bead-spring model with short-range and electrostatic repulsions. In case of the electrostatic screened regime, a disordered-ordered (spiral) transition at increasing persistence length of the chain was found. It was predicted that the transition occurred when the persistence length is comparable with the mean spacing between adjacent strands of the ordered chain. The presence of a non-screened electrostatic repulsion led to a more complex behavior with (i) a reentrant order-disorder transition and (ii) a tennis ball texture as an additional smectic/nematic structure. The various competing structures given by the theory were recovered by the Monte Carlo simulations, which also indicated that the tennis ball texture was favored over the spiral structure by the long-range interactions for semi-flexible chains. Currently, numerical calculations are performed to determine the structure of the genom inside virial capsids at different genome length, genome flexibility, and capsid size. Finally, two literature reviews on modeling of spherical-like viruses focusing on the electrostatic interation in viruses as well as on viral self-assembly and viral genom packaging have been produced. (D. Angelescu, J. Stenhammar, T. T. Nguyen (University of California Los Angeles), R. Bruinsma (University of California Los Angeles), N. Oskolkov, and P. Linse).

**Forces between charged colloids.** Forces between single pairs of negatively charged micrometer-sized colloids in aqueous solutions of monovalent, divalent, or trivalent counterions at varying concentrations have been measured by employing optical tweezers. The experimental data have been analyzed by using the Derjaguin-Landau-Verwey-Overbeek (DLVO) theory and a numerical solution of the Poisson-Boltzmann (PB) equation. With monovalent counterions, the data are well described by the DLVO and PB theories, suggesting that the DLVO theory is adequate to describe the colloidal forces at these conditions. At higher counterion valence, the approximations within the theories become evident. (C. Gutsche (Leipzig University), U. F. Keyser (Leipzig University), K. Kegler (Leipzig University), F. Kremer (Leipzig University), and P.Linse). Project completed.

**Colloid Adsorption onto Responsive Membranes.** The adsorption of colloids with varying sizes and charges onto a surface carrying both negative and positive charges representing a membrane has been investigated by using a simple model employing Monte Carlo simulations. The membrane is made of positive and negative charges (headgroups) that are allowed to move along the membrane, simulating the translational diffusion of the lipids, and are also allowed to protrude into the solution, giving rise to a fluid and soft membrane. When an uncharged colloid is placed in the vicinity of the membrane, a short-ranged repulsion between the colloid and the membrane is observed and the membrane will deflect to avoid coming into contact with the colloid. When the colloid is charged, the membrane response is two-fold: the headgroups of the membrane move towards the colloid as to partly embrace it, and the positive headgroups of the membrane approach the oppositely charged colloid, inducing the demixing of the membrane lipids (polarization). The presence of protrusions enhances the polarization of the membrane. Potential of mean force calculations show that protrusions give rise to a more long-ranged attractive colloid-membrane potential which has a smaller magnitude at short separations. (R. Dias and P. Linse).

**Electrostatics in the presence of spherical dielectric discontinuities.** A united description of the electrostatics of an arbitrary number of electrostatic multipoles, each localized in a spherical dielectric cavity, in a dielectric medium is presented. The permanent charges as well as the polarization surface charges are described by multipole expansions in standard format. Expressions of the polarization surface charge density, the electrostatic potential energy, and the electrostatic interaction including the contribution from the polarization surface charge densities are given. Simplified expressions applied to monopoles and/or two dielectric cavities are also provided. As an application of this method, the potential of mean force between two spherical and like-charged macroions in a salt-free aqueous solution has been determined using canonical Monte Carlo simulations. The systems considered covered the range from a purely repulsive to a purely attractive potential of mean force as the electrostatic coupling was increased. The macroions were modeled as spheical dielectric cavities, and the polarization surface charge densities occurring at the dielectric discontinuities were expanded in spherical harmonics. The surface polarization gave rise to (i) an attenuation of the counterion accumulation at the macroion surfaces at all cases considered, (ii) an enhanced repulsive potential of mean force in the weak to intermediate electrostatic coupling regime, and (iii) a less attractive at short separation and an enhanced attractive potential of mean force at longer macroion–macroion separation in the strong electrostatic coupling regime. (P. Linse and J. Rescic (University of Ljubljana)).

**Ferroelectric domains in polar liquids.** Model systems of dipolar fluids with particles possessing a dipole moment corresponding to water have been investigated by molecular dynamics simulation. Using model systems containing up to 30 000 particles, we found domains extending up to 30 Å with ferroelectric ordering with a life time longer than the rotational correlation time of the individual particles, in qualitative agreement with recent experimental findings. Current simulations on water models display similar findings. (G. Karlström (Theoretical Chemistry, Lund University), J. Stenhammar, and P. Linse).

**Statistical-mechanical programs.** During 2007, the web-based portal for running statistical-mechanical computer programs was extended with one new program and involves today DIELEC, MOLSIM, OZ, PB, PGESE, and POLYMER. This portal was used in advanced undergraduate courses in physical chemistry and as convenient tool for guest scientists during their visits at Lund and at their home institutes. (P. Linse).

# INSTRUMENTS AVAILABLE AT THE DEPARTMENT

**NMR.** (contact person: Daniel Topgaard). The department has Bruker AV-200 and AV-500 NMR spectrometers, both being equipped for high-performance diffusion studies. The AV-500 in addition has microimaging as well as solid-state and high-resolution magic-angle spinning capabilities. (Sponsored by VR/KFI).

**Dynamic and static light scattering.** (contact person: Karin Schillén).

**A)** A laser light scattering goniometer system from ALV Gmbh, Langen, Germany, for simultaneous angular dependent determination of dynamic light scattering (DLS) and static light scattering (SLS). The goniometer system is suitable for DLS experiments, such as determination of diffusion coefficients and size distributions in polymer solutions and surfactant micellar solutions, studies on polymer gels and glasses. In addition, depolarized DLS measurements for studies on optical asymmetric systems and determination of rotation diffusion coefficients can be performed. The system is also utilized for SLS experiments, i.e. determination of molecular weight, radius of gyration, and second virial coefficients in macromolecular solutions. The system includes a diode-pumped solid-state laser from Coherent (532 nm, 400mW), laser beam focusing optics including a laser beam attenuator, a goniometer with a rotary table of an angular range of 12° to 155°, a cell housing with an index matching quartz vat, a fiber optical near-monomodal detection system, a detection unit comprised of 2 matched photomulipliers in a pseudo-cross correlation arrangement. For the DLS measurements using photon correlation spectroscopy, two multiple tau digital correlators (with a total of 320 exponentially spaced channels) are utilized to obtain an initial real time sampling time of 12.5 ns. The lag time range extends from 12.5 ns up to >105 s, which makes it possible to detect particle sizes from 1 nm up to 5000 nm in radius. The temperature range of the DLS/SLS goniometer system is –12°C to +140°C. In addition, a differential refractometer from ALV for the determination of refractive index increments necessary for the SLS experiments is incorporated in the overall set-up with an optical fiber. (Sponsored by the former Swedish Natural Science Research Council (NFR).)

**B)** For the characterization of molecular weight and studies of conformation changes or association processes in macromolecular systems, a multi-angle desktop instrument for SLS measurements is available. The instrument is a Dawn DSP-F MALLS photometer (Wyatt Technology Corp., Santa Barbara, California) equipped with a 5 mW He-Ne laser (633 nm). The intensity of the scattered light is measured using photodiodes at 18 different angles simultaneously. The instrument is connected to a gel permeation chromatography system for on-line molecular weight determinations in aqueous solvents but batch analysis may also be performed. (Sponsored by FRN.)

**Surface force apparatus.** (contact person: Tommy Nylander). The Surface Force Apparatus allows the direct measurement of the interaction between two molecularly smooth surfaces (usually mica) in a crossed cylinders geometry. The separation between surfaces is measured interferometrically up to 0.1 nm resolution. The force is calculated from deflection of a double cantilever spring with an accuracy of ca 10-8 N. The SFA is being successfully used to identify and quantify most of the fundamental interactions occurring between surfaces, namely van der Waals, electrostatic double-layer, hydration, hydrophobic and steric forces, in different colloidal systems. (Sponsored by FRN).

**Surface film balance.** (contact person: Tommy Nylander). A Nima technology 611 Langmuir trough with a surface film balance (Wilhelmy plate) was acquired during 1997. The instrument is equipped with a dipper to prepare Langmuir-Blodgett films.

It can also be used for dynamic contact angle measurements, while simultaneously recording the surface film pressure. In addition a KSV minitrough was acquired 2000 and used together with the Optrel Multiskop ellipsometer. Both surface film balances are equipped to measure the surface potential (Sponsored by Crafoord Foundation).

**Ellipsometry.** (contact person: Tommy Nylander). The development of a high precision ellipsometer for time-resolved studies of thin adsorbed films has been successful and of great importance to several specific projects. The instrument allows precise and rapid measurements of the ellipsometric angles y and D, thus, allowing unique studies of the evolution of both the thickness and density (refractive index) of adsorbed surfactant and polymer layers with time. The possibility of working at different wavelengths provides an additional source of information on complex systems as well as flexibility to optimize the optical contrast of the systems studied. Continued efforts are invested in upgrading this instrument to improve its potential for studies of fast interfacial processes occurring on the nanometer scale. During 1998 we acquired an additional ellipsometer, an Optrel Multiskop (Optrel, Berlin Germany). This instrument has been fitted with sample cells to measure at the solid-liquid, liquid-liquid and liquid-air interfaces. Apart from doing null-ellipsometry we can also do imaging ellipsometry, Brewster Angle Microscopy, Surface plasmons as well as operate it in waveguide mode. (Sponsored by FRN).

**Transmission electron microscopy with cryo facilities.** (contact person: Viveka Alfredsson). At the national Centre for High Resolution Electron Microscopy (nCHREM) three electron microscopes are available. Two of the microscopes are operated at an accelerating voltage of 300kV and use a field emission gun as electron source: the JEOL3000F has many analytical possibilities, such as EDAX and EELS and the JEOL3000SFF is dedicated for protein crystallography and is equipped with a He-cooled stage. The third microscope is a Philips CM 120 bio-twin, dedicated for cryo-imaging. There are a number of different sample preparation equipments available at nCHREM. For more information, check out http://www.materialkemi.lth.se/nchrem/. (Sponsored by NFR, Crafoord Foundation and Knut and Alice Wallenberg foundation).

**Multimode scanning probe microscope.** (contact person: Tommy Nylander). A Multimode Scanning Probe Microscopy (Nanoscope-III) was purchased jointly by Physical Chemistry 1 and the Department of Food Technology from Digital Instruments Inc. in April 96. The instrument can be operated as both a scanning tunneling microscope (STM) and an atomic force microscope (AFM). With its many configurations the instrument can scan and image a wide variety of samples with scan sizes from atomic level up to 125 by 125 microns. As an AFM, traditional contact mode experiments in air and liquid and TappingMode experiments in air have been available for many years. More recent equipment purchases allow users to image surfaces with TappingMode in fluid environments, perform lateral force microscopy (LFM) measurements of topography and friction, and make force measurements using a colloidal probe. In the latter mode, a spherical particle is adhered to an AFM cantilever and colloidal forces between the probe and surface in a fluid environment can be studied. Other force measurements are also possible using standard cantilevers or chemically modified cantilevers. (Sponsored by FRN).

**SAXS.** (contact person: Ulf Olsson). The instrument is a Kratky compact camera equipped with a linear position sensitive detector (MBraun, Graz), and a Seifert ID 3000 (3.5 kW) generator. Equipped with two separate detectors, the instrument may record, simultaneously, the scattered intensity at both 'low' and 'wide' angles. The wide-angle (q-range 1.3--1.8 1/Å) scattering reports on short-range correlations and is helpful for example in discriminating between fluid and frozen surfactant chains. (Sponsored by FRN).

**Optical microscopy.** (contact person: Ulf Olsson). The Department has a Zeiss Axioplan Universal microscope equipped with differential interference contrast and a 35 mm photo camera MC 100 as well as with a 100W mercury short-arc lamp and a system of filters to allow the fluorescence microscopy observations. The microscope is further equipped with a high-sensitivity SIT video camera and an image processor, Argus 20, (Hamamtsu Photonics, Japan) together with the Macintosh-based image analysis software. (Sponsored by FRN & Crafoord Foundation).

**Calorimeters.** (contact person: Gerd Olofsson). A double twin isothermal microcalorimeter for the simultaneous determination of sorption isotherms and differential sorption enthalpies of vapors on solids. Isothermal titration microcalorimeter 2277 TAM Thermal Activity Monitor System.

**Rheometers.** (contact person: Ulf Olsson). A Carri-med controlled stress rheometer CSL 100 temperature controlled by a Peltier system. Measuring systems; cone and plate (solvent trap) in acrylic (4 cm, 1° and 6 cm, 1°) and stainless steel (4 cm, 1° and 6 cm, 1°). (Sponsored by Nils and Dorthi Troëdsson Research Foundation). A Physica UDS 200 controlled stress rheometer. Measuring systems temperature controlled by a Peltier system; cone and plate in acrylic (2.5 cm, 1°, 5 cm, 1°, 7.5 cm, 1°), cone and plate in stainless steel (2.5 cm, 1°, 5 cm, 1°, 7.5 cm, 1°), plate and plate in stainless steel (2.5 cm and 5 cm). Measuring systems temperature controlled by a cylindrical temperature system and an external water bath; cup and bob (2.5 cm) and a double gap measuring device, both in stainless steel.

### SAXS at MAX

The Physical Chemistry department, in particular through Malin Zackrisson and Ulf Olsson continue to work with Yngve Cerenius concerning the devlopment of the beam line I711 at Max-lab and the possbilities there for small angle scattering experiments (SAXS). The beamline is now fully operational on SAXS but e.g. sample environment is continuously upgraded, with the aim to develop it into a first class SAXS instrument. For further details on the SAXS instrument see the I711 home page at http://maxsun5.maxlab.lu.se/beamlines/bli711/ .

## COLLABORATIVE RESEARCH PROGRAMS

### Colloidal Structures from Self-association, COLINTECH.

Colloidal Structures from Self-association, COLINTECH, is a five-year research programme funded by the Swedish Foundation for Strategic Research, SSF. It started January 1, 2003 and finished by the end of 2007. Research groups at the Chalmers University of Technology, Institute for Surface Chemistry (YKI)/Royal Institute of Technology and Lund University, i.e. our department, are active in the programme. The research topics include the preparation of hard and soft nanoparticles through dynamic self-assembly, dynamics of non-equlibrium self-assembly dispersions, and structuring complex systems at interfaces. Members of the board of the Research Programme: Jan Svärd (chairman; Eka Chemicals), Krister Holmberg (Chalmers University of Technology), Björn Lindman (Lund University) and Bruce Lyne (Institute for Surface Chemistry).

## CIPSNAC

EU research training network "CIPSNAC: Colloidal and interfacial properties of synthetic nucleic acid complexes-assembly of nanostructured DNA particles and surfaces (EU-MRTN-CT-2003-504932). The Research Training Network (RTN), started in 2002, focus upon DNA nanoparticles and surfaces. In this specific field, a relationship between the structure, thermodynamic stability, enzymatic accessibility and gene transfer or detection efficiency has not been established so far. To date, physico-chemical characterization has only been carried out sporadically on isolated gene transfer systems. The establishment of phase diagrams as well as gene transfer efficiencies as a function of a large range of variables is time consuming. Therefore, this RTN project will bring about a concerted action of expert groups to address these problems. The fascinating frontier is to study the assembly of DNA surfactant complexes at the molecular level. The RTN will define model systems and key parameters such that a systematic theoretical approach becomes feasible. The partners are from Lund, Coimbra, Munich, Dublin and Paris. (T. Nylander, B. Lindman, responsible for Lund group)

## ELAPNET

The purpose of this Programme ALFA II - project is to build up collaboration between universities that are conducting teaching and research activities at undergraduate and graduate and graduate levels in areas related to synthesis and characterisation of polymeric materials by promoting exchange of undergraduate, graduate students and staff. This will help to reinforce the quality of education in those institutions and to increase the diffusion these activities in other universities. Latin American partners are from Argentina, Chile and Venezuela. (B. Lindman).

## POLYSURF

This is a Transfer of Knowledge (TOK) Development Scheme (DEV) funded within the Marie Curie Program of the European Union. The overall objective of the project is to increase the knowledge and research level of the host organisation, Institute of Textiles at the University of Maribor, on the creation of tailored and/or smart fibre forming polymers and materials that would be able to control the release of various active compounds or to create new tailored fibre surface properties for different end-applications in the area of technical textiles, such as medical, therapeutic, hygienic and protective textiles. The project will transfer knowledge of innovative fibre surface modification technologies based on (WP2) colloidal micro-hydro-gelation, (WP3) nano-micro-(en)capsulation and (WP4) polymer surface coating. Additionally, (WP1) innovative biotechnological, green-chemistry, chemical and physical catalysis tools, or their combination will be applied to activate and/or modify polymer surfaces and/or colloidal particles/layers created using ecologically and toxicologically suitable processes. According to the diversity of the knowledge and expertise that shall be transferred, the project will build a highly multidisciplinary scientific group, cutting across different established research areas, i.e. textile chemists, physical chemists, biological catalysts and colloidal engineers, that will be able to prepare colloidal particles, coatings and multi-layers, and subsequently apply them to different suitably eco-pre-activated and/or modified natural and synthetic polymer surfaces. The new fibre materials with upgraded properties can be exploited either to enhance the bulk properties of existing products for better performance, or to create new value-added products with smart and/or tailored surface characteristics based on the multi-functionality. The project objective will be realised through training, module-based courses and several research activities by outgoing seconded and incoming recruited more experienced (MER) and experienced (ER) researchers that will be able to provide the necessary inputs in these areas. (B. Lindman)

## Biopolymers based surfactants - Stabilization and functionalization of particles and surfaces

The COST-project "Biopolymers based surfactants - Stabilization and functionalization of particles and surfaces" aims at increasing the knowledge of processes at surfaces and interfaces and factors tuning them at the molecular scale. An interdisciplinary effort to study the interaction of surfactants, derived from high and low molecular biological sources, with different kinds of substrates, as soft and hard particles and structured polymer surfaces, is envisioned. This activity will focus on the stabilization of the systems and the functionalisation of different surfaces. This has extended social and industrial interest as these results will provide advanced hygienic and technical materials as well as new insight into critical medical field, as for example the biocompatibility of implants. This requires a multidisciplinary approach i.e. synthesis and activation of materials, characterization and understanding of surface properties and processes at the molecular and supramolecular level. A theoretical description of these systems will allow to predict the properties of final products based on their chemical composition and the structure of the surface active compounds and substrates. Modification of these surfactants as well as the dispersed and macroscopic substrates will change their interaction abilities and functionalities. The results will enable us to understand, and ultimately control, the structure-property relationship and create new materials with excellent surface specificity. (B. Lindman)

## The Division of Surface Chemistry of the Swedish Chemical Society.

The Division of Surface Chemistry of the Swedish Chemical Society was founded in 2001 to promote contacts between chemists interested in surface and colloid chemistry. In 2007, Lennart Piculell was elected chairman of the board. The main activity of the Division is to organize the Annual Surface and Colloid Symposium in Lund. The seventh symposium, held in November 2007, had as its the theme "Nanostructures from self-assembly - in solution, at interfaces and as a synthetic tool", with Björn Lindman on the scientific committee. Jonas Carlstedt, Niklas Källrot, Agnes Zettergren, Christoffer Åberg, Ingrid Åslund and Lennart Piculell constituted the local organizing committee.

## New strategies for oral delivery of drug peptides and peptidomimetics

A 3 year collaborative project involving Camurus AB and Physical Chemistry 1 was granted 2003 by VINNOVA (Swedish Agency for Innovation Systems) and SSF (Swedish Foundation for Strategic Research) within the so-called VINST program dedicated to support SME. The aim of the project is to develop more effective peptide carriers and during this process also increase the understanding of the physicochemical and biological problems involved in oral bioavailability of peptides and proteins. Oral administration of peptide and protein drugs has so far been hampered by low bioavailability, due to the presence of effective permeation barriers and lack of peptide stability in the gastro-intestinal tract. The project involves extensive interdisciplinary activities and cross-fertilization of projects. The basic approach will be to use self-associated nano-structured lipid carrier and exploit special properties, which can provide protection against enzymatic degradation and enhanced permeation of biomembranes. Scientifically the project will span biophysical studies of lipids and peptides to in vivo studies of uptake mechanism for peptides and proteins. (T. Nylander, H. Wennerström; F. Tiberg and K. Larsson Camurus AB)

## NEONUCLEI

The department was granted a 4 year EU-FP6 STREP in the NEST PATHFINDER project within Synhetic Biology, entitled "Self-assembly of synthetic nuclei: key modules for semibiotic chemosynthetic systems" (Acronyme NEONUCLEI and Contract no.12967) and coordinated by Prof. George Attard, University of Southampton, UK. NEONUCLEI will develop transcription-competent synthetic analogues of cell nuclei. These particles, termed neonuclei, will be obtained through self-assembly/organisation in mixtures of DNA, macromolecules (or nanoparticles), and lipids. The composition of the neonuclei will be chosen to produce particles with internal nano-architectures capable of sustaining gene transcription upon the addition of transcription factors. The DNA of the neonuclei will contain a gene cluster (or tandem repeats of the same gene). The genes will be separated by sequences designed to induce DNA compaction in response to specific chemical or physical stimuli. This will be exploited to establish non-biological control over the transcription of parts, or all, of the DNA. These control sequences offer the opportunity for multiple transcription control strategies and provide the capability of implementing temporally co-ordinated synthesis of multiple gene products. Neonuclei represent a key enabling step in the realisation of semi-biotic systems: these are systems and devices that combine synthetic non-natural functional systems with systems of biological origin. The neonuclei will be integrated with biological systems, or with isolated components, to produce novel semi-biotic devices capable of the controlled in situ synthesis of complex bio-molecules on demand. Physical chemistry 1 mainly contributes in providing understanding formation, morphology and structure of relevant self-assembly structures, DNA-surfactant/particle interaction, DNA compaction, morphology and structure of formed entities (T. Nylander, V. Alfredsson, B. Lindman, U. Olsson, H. Wennerström).

## BIOSCOPE

The department was granted a 3 year EU-FP6 STREP in the Nanoscience and technology area entitled "Self-reporting biological nanosystems to study and control bio-molecular mechanisms on the single molecule level" (Acronyme BIOSCOPE and Contract no. NMP4-CT-2003-505211, www.BIOSCOPE.fkem1.lu.se) and coordinated by Tommy Nylander at the department. BIOSCOPE will develop new nano-scale tools allowing unprecedented insight into bio-molecular mechanisms at biological interfaces on the scale of single molecules. The key element in the BIOSCOPE strategy is to involve the bimolecular system itself as part of the nanoscopic instrument which in various ways reports to the out-side world about its current local state. The objectives of BIOSCOPE are 1.) To develop instrumentation and methods for manipulation of enzymes and enzyme activity at the nano-scale providing insight into the bimolecular mechanisms on a single molecule level. 2.) To develop novel forms of integration, at the nano-level, of enzymes and non-biological systems such as nanoparticles, artificial membranes, electrical field or force field traps. 3.) To confine several enzymes to surfaces of nanoparticles or membranes on a less than 10 nm scale in order to achieve a self-organized assembly with concerted as well as controllable bioaction superior to the simple sum of the same individual enzymes. Apart from co-ordinating the project, Physical chemistry 1 mainly contributes in providing understanding formation, morphology and structure of self-assembly structures on the nanoscopic scale The project ended in the beginning of February 2007. (T. Nylander, V. Alfredsson, J. Barauskas, H. Wennerström).

## BIOCONTROL

EU Marie Curie research training network "BIOCONTROL" aims at controlling biological functions at, respectively on, bio-interfaces. It is based on the recent recognition of the importance of structure and properties of bio-interfaces, e.g. biological membranes, for a multitude of life processes. We now know that the evolution of atherosclerosis, cancer, immunity and viral infections, neurodegenerative disorders (Alzheimer, Prion diseases, etc.) and aging depend on perturbations of such interfaces. However, we need to improve our knowledge of the underlying molecular mechanisms in order to design efficient drugs and to meet the challenges in regenerative medicine and tissue engineering. This requires a deeper understanding of processes and interactions at bio-interfaces in terms of biology, biochemistry, biophysics and structure. The two major scientific objectives of BIOCONTROL are to: Provide fundamental knowledge of the forces and molecular mechanisms that regulate the interactions and biological processes taking place in and around biological membranes. Construct bio-mimetic surfaces and self-assembled structures that enable external control of biological and biotechnological processes, such as, cell adhesion and cell cycle regulation. Real progress in the field can only be achieved by breaking traditional academic borders. This requires the education of new researchers that are trained in cross-disciplinary and collaborative work. Therefore the major educational objective of BIOCONTROL is to train of a new category of 'life science' experts who can work across disciplines. This will be achieved by an unprecedented interdisciplinary training programme comprising (bio)physicists, biologists, (bio)chemists, surface chemists and computational biologists. (T. Nylander, V. Alfredsson). ( http://biocontrol.tau.ac.il/)

## SOCON

EU Marie Curie research training network "SOCON" focus on aqueous films, which are either confined between two solid surfaces or by air (foam film) or oil (emulsion film), respectively. SOCON put emphasis on complex self-organising systems of environmentally friendly components, such as sugar-based surfactants and polymeric carbohydrate derivatives, but we will also use traditional surfactants and polymers. The interest in the former class of surfactants and polymers is motivated by the fact that they can be made from renewable materials and that they have favourable properties with respect to applications in various fields. Most applications explore surfactant mixtures as well as surfactant-polymer mixtures. Hence, to advance the increased use of more environmentally friendly components synergistic and antagonistic effects in multicomponent systems have to be understood. In fact, this is one essential element of the joint network research. The wide range of systems which will be examined have in common self-assembly and strong surface activity. The four main objectives of the network are to: determine the relation between self-assembled structures in bulk solution, at one interface, and confined between two interfaces. SOCON will advance the understanding of the relations between changes in self-organised structures due to confinement and surface forces. This includes how the nature of the interface influences self-assembled surface structures and thus surface interactions. The emphasis will be on multicomponent systems. understand, predict, and control trapped non-equilibrium structures at interfaces and the corresponding surface forces. establish the correlation between properties of single films and complex colloidal systems. This includes macroscopic foams, emulsions and dispersions. promote the use of new environmentally friendly compounds in products and processes based on complex colloidal systems. For this purpose novel composite polymers and surfactants will be synthesized from natural building blocks. (P. Linse, T. Nylander). ( http://www.mcrtn-socon.org/)

### NANOGROWTH

This EPSRC (UK) founded project studies the fundamental aspects of crystal growth in nanoporous materials. It involves the application of a powerful set of complementary techniques to the study of crystal growth of open-framework materials comprising: atomic force microscopy, high resolution transmission and scanning electron microscopies, in-situ NMR with enhanced data processing, X-ray diffraction and mass spectrometry. A substantially better understanding of the synthesis process is likely to yield important economic benefits, for example, better process control, increased efficiency in reagent usage, improved reproducibility and the capacity to modify or tailor products for specific applications. (V. Alfredsson) (http://www.ucl.ac.uk/nanogrowth/index.htm)

## CONFERENCES, TRAVELS AND SEMINARS

Björn Lindman gave plenary lectures at the 56th SPSJ Annual Meeting in Kyoto, Japan, and on a workshop on Molecular Structure-Performance Relationships at the Surface of Functional Materials, Helsinki, Finland and an invited lecture at the 7th Annual Surface and Colloid Symposium in Lund. He also attended the 21st Conference of the European Colloid and Interface Society (ECIS), Geneva, a workshop on Polysaccharides in Iasi, Romania, Neonuclei Workshops, in Göteborg, Sweden and Southampton, UK, and COST Workshops in Maratea, Italy and Coimbra, Portugal. Björn Lindman organized and chaired an international DNA workshop in Goa, India. Björn Lindman was also honoured by Portuguese and Spanish colleagues by a special symposium in conjunction with the 2nd Iberian Colloid and Interface Conference in Coimbra, Portugal. During the year, Björn Lindman visited a number of universities and other research centers and in most cases he presented a lecture. The institutions visited included: Université Paul Sabatier, Toulouse, Chalmers Technical University, Göteborg, Uppsala University, Nanjing University of Science and Technology, Pontifica Universidad Católica, Santiago de Chile, Ecole des Mines de Paris, Sophia Antipolis, France, Greenwich University, UK, Helsinki University of Technology, Finland, Yangzhou University, China, Kyoto University, Japan, Kyushu University, Japan, University of Maribor, Slovenia, Trondheim University of Technology, Norway, "Petru Poni" Institute of Macromolecular Chemistry, Iasi, Romania. Björn Lindman also was engaged for evaluations by the European Commission and national research councils, and in consulting and training for industries in Japan, Germany, France, Norway, Sweden, Denmark, UK and United States. Björn Lindman was visiting professor at the Department of Chemistry, Coimbra University, Portugal, Nanjing University of Science and Technology, and Pontifica Universidad Católica, Santiago de Chile.

Olle Söderman took part in third COST D36/0008/06 working group meeting in Acquafredda di Maratea, Italy. Olle spent three weeks as a guest teacher in Department of Chemistry Università di Napoli "Federico II", Naples, Italy. He gave a Master course in surface and colloid science.

Lennart Piculell gave a invited plenary lecture at ARCHIPOL IVth Argentine-Chilean Polymer conference, Viña del Mar, Chile and invited lectures at Ian Wark Research Institute, University of South Australia, Borregaard company, Sarpsborg, Norway, and at IIª Reunião Ibérica de Coloides e Interfaces conference (RICI2), Coimbra, Portugal. He also gave a oral presentation at Australian Colloid and Interface Symposium 2007, Sydney, and presented a poster at ECIS 2007, Geneva, Switzerland. Lennart visited Department of Applied Mathematics, Australian National University, and BASF, Ludwigshafen, Germany

Per Linse gave invited lectures at SOCOBIM International Conference on Soft, Complex, and Biological Matter, Terrasini, Cicily, Italy and at IUTAM symposium on Swelling and Shrinking of Porous Materials: From Colloid Science to Poro-Mechanics, Petrópolis, Brazil. He gave oral presentations at the 4th Scandinavian Workshop on Scattering from Soft Matter Lund, Sweden and at 1st annual symposium of the Division of Theoretical Chemistry, Swedish Chemical Society, Örebro, Sweden and presented a poster at the 4th European Conference on Neutron Scattering, Lund, Sweden. Per also gave a seminar at University of Geneva.

Tommy Nylander gave invited talks at Physical and Chemical Aspects of Molecular Biology - An International Workshop on Current Problems in Complex Fluids, Hotel Camino Real, Puebla, México; DNA workshop, Devaaja Resort - Goa, India; Surfactant Self Assembly Symposium American Chemical Society Meeting in Boston, Massachusetts, USA; Symposium on Neutron Scattering at the AVS 54th International Symposium & Exhibition, Seattle WA, USA.

Karin Schillén delivered an oral presentation at II2 Reuniao Ibérica de Colóides e Interfaces, Coimbra, Portugal and presented posters at 9th Functional Genomics: Synthetic Biology, Gothenburg, Sweden and at International Soft Matter Conference, Aachen, Germany

Viveka Alfredsson gave invited lectures at 7th Annual Surface and Colloid Symposium, Lund, Sweden and, at the Inauguration of the EM centre, Stockholm University, Sweden. She also gave a seminar at Biocontrol Workshop in Stockholm, Sweden and presented a poster at Turning Points in Solid-State, Materials and Surface Science, Cambridge, UK.

Emma Sparr gave an invited lecture at the Wenner-Green symposia: The human skin barrier as a biomembrane model in Stockholm, and at the KILU department day. She also gave invited seminars at MEMPHYS (SDU, Odense) and at Malmö University

Daniel Topgaard gave oral presentations at the Symposium on Cellulose-Water Interactions arranged by Södra Cell, Varberg, Sweden, at Structure Dynamics in Soft Condensed Matter arranged by EUCHEM, Fiskebäckskil, Sweden and on a seminar at Nestlé, Lausanne, Switzerland.

Rita Dias presented a poster in the Biophysical Society conference in Baltimore and gave an oral presentation in the “Molecular organization in polymer-containing liquids” symposium.

Richard Campbell presented a poster at the 4th Scandinavian Workshop on Scattering from Soft Matter Lund, Sweden

Alfredo González-Pérez delivered oral presentations at 4th Periodic CIPSNAC Meeting, Lund, Sweden and at Final Periodic CIPSNAC Meeting Munich, Germany. He also presented posters at International Symposium in Biomolecular Nanoscale Assemblies Copenhagen, Denmark, at II reunião Iberica de Coloides e Interfaces –

RICI2, Coimbra, Portugal, 21st Conference of the European Colloid and Interface Society, Geneva, Switzerland, 9th Conference on Colloid Chemistry, Siófok, Hungary, and at 7th Annual Surface and Colloid Symposium, Lund Sweden.

Daniel Angelescu presented a poster at the 7th Surface and Colloid Symposium in Lund, Sweden.

Marie-Louise Örberg gave oral presentations at the workshop "Cationic Amphiphiles-DNA Systems: Basics to Technology", Goa, India and at the NEONUCLEI meetings in Southampton, UK and Gottskär, Sweden. Marie-Louise also presented posters at the Biophysical Society conference in Baltimore, USA, at the Synthetic Biology Conference in Gothenburg, Sweden, at the 4th European Conference on Neutron Scattering in Lund and at the 7th Annual Surface and Colloid Symposium in Lund.

Ingrid Åslund presented posters at Structure Dynamics in Soft Condensed Matter in Fiskebäckskil, Swedish NMR Meeting in Gothenburg and at the 7th Surface and Colloid Symposium in Lund.

David Löf presented posters at International Soft Matter Conference, Aachen, Germany and at the 7th Surface and Colloid Symposium in Lund.

Pauline Vandoolaeghe delivered oral presentations at European Conference on Neutron Scattering, Lund, Sweden and at International Soft Matter Conference, Aachen, Germany. She also presented posters at Bioscope meeting, Copenhagen, Denmark and at Biological surfaces and interfaces, San Feliu de Guixols, Spain. Pauline spent 3 months at LMU, Munich at the department of Biophysics in the framework of the European project CIPSNAC with work on neutron reflectivity to improve the sample environment of the REFSANS reflectometer at FRMII, Garching, Germany.

Jonas Carlstedt gave a oral presentation at CIPSNAC meeting in Lund and presented posters at European student colloid conference in Ven, and at 7th Surface and Colloid Symposium in Lund, Sweden.

Samuel Edgecombe presented a poster at the 7th Surface and Colloid Symposium in Lund, Sweden.

Niklas Källrot presented a poster at the 7th Surface and Colloid Symposium in Lund, Sweden.

Joakim Stenhammar presented a poster at the 7th Surface and Colloid Symposium in Lund, Sweden.

Salomé dos Santos presented posters at the European Student Conference in Ven, Sweden, at 21st ECIS, Geneva, Switzerland, and at 7th Surface and Colloid Symposium in Lund, Sweden.

Christoffer Åberg gave an oral presentation at "Interdisciplinary Transport Phenomena V: Fluid, Thermal, Biological, Materials and Space Sciences" in Bansko, Bulgaria and presented a poster at 7th Surface and Colloid Symposium in Lund, Sweden.

Luis Pegado gave an oral presentation at the European Student Conference in Ven, Sweden

## 4th European Conference on Neutron Scattering

The 4th European Conference on Neutron Scattering was held in Lund, Sweden from 25 to 29 June 2007 and locally organized by Physical Chemistry 1. About 700 participants participated in the Conference. There were 8 plenary lectures and two European prizes were awarded and the winners presented lectures in a further pleanry session. 120 talks were presented in four parallel sessions. The range of science covered was broad. Applications of neutron scattering in fields from chemistry, physics, biology, medicine, heritage studies, environmental science and engineering demonstrated the growing scope of the subject. Presentations on new instrumentation and sources highlighted the potential for further new work. As the major Conference in this field during 2007, participants were drawn from most European countries and from America, Japan, China, Australia and other countries.

## International Symposium on Biomolecular Nanoscale Assemblies

Most natural and artificial biological systems can change their structure, physical chemical state and properties as a reaction to the local nanoscopic environment. Recent advances in nanotechnology have made it possible to exploit these phenomena and develop new nano-scale tools which provide unprecedented insight into bio-molecular mechanisms at biological interfaces on the scale of single molecules. January 24-26, 2007, Physical Chemistry 1 organized an International Symposium on Biomolecular Nanoscale Assemblies at Nano-Science Center University of Copenhagen Denmark in Copenhagen to discuss these new possibilities together with leading experts in the field. The symposium that attracted over 100 participants the final meeting of BIOSCOPE - a research project (NMP4-CT-2003-505211) on “Self-reporting biological nanosystems to study and control bio-molecular mechanisms on the single molecule level”, funded by the European Commission under the Framework Programme 6. The invited speakers included :

C. Dekker (University of Delft, The Netherlands)
I. Willner (Hebrew University, Jerusalem, Israel)
D. Weitz (University of Harvard, MA, USA)
A. van Oijen (University of Harvard, MA, USA)
L. Jaeger (UCSB, CA, USA)
B. Lounis (CNRS, Bordeaux, France)
E. Delamarch (IBM, Zürich, Switzerland)
H. Gaub (LMU, Munich, Germany)
J. Hofkens (Katholieke Univeristeit Leuven, Belgium)
A. Rowan (Radboud University Nijmegen, The Netherlands)
D. Stamou (University of Copenhagen, Denmark)
M. Brust (University of Liverpool, UK)

# EXTERNAL PROFESSIONAL ACTIVITIES

Björn Lindman was on the Advisory or Editorial Boards of Advances in Colloid and Interface Science, Current Opinion in Colloid & Interface Science, Fine Chemicals, Colloid&Polymer Science, The Open Physical Chemistry Journal, and Journal of Dispersion Science and Technology. He is a fellow of The Royal Swedish Academy of Engineering Sciences, of The Royal Swedish Academy of Sciences and of The Royal Physiographic Society in Lund, and honorary corresponding member of Romaniae Scientiarum Societas. He is a cofounder and honorary member of the European Colloid and Interface Society (ECIS). He was Director for a national program on Colloid & Interface Technology sponsored by the Swedish Foundation for Strategic Research and also a member of the Collegium of this foundation. For the period 2006-2009, Björn Lindman is President of the International Association of Colloid and Interface Scientists (IACIS).

Håkan Wennerström was member of the Nobel Committee for Chemistry, regular member of the board of the Science and Technology Committee of the Swedish Research Council, member of the scientific innovation group (Idérådet), Lund University, member of the Scientific Advisory Board of Crafoord Foundation, and chairman of he Liquids Board of the European Physical Society.

Olle Söderman is vice dean at the Science faculty for the period 2006-2009, member of the Science Faculty Board and chairs the Undergraduate Training Committee of the faculty. Olle served on PhD thesis committee for Anna Karlsson, Medical Radiation Physics, Malmö University hospital.

Lennart Piculell is a section editor for the Polyelectrolytes section of Current Opinion in Colloid and Interface Science, a member of the editorial board of Carbohydrate Polymers, and a member of the international organizing committee of the biannual International Polyelectrolyte Symposia. He participated as a mentor in the mentor programme for young women researchers at the Faculty of Science, Lund University. He is a member of the board of the Department of Chemistry at Lund University and a member of the board of the Division of Surface Chemistry of the Swedish Chemical Society. He served on PhD thesis committees for Margareta Hägerlöf, Biochemistry, Lund University, Geraldine Lafitte Physical Chemistry 1, Lund University and Carmen Carla Quiroga Ledezma, Food Technology, Lund University, and as a deputy member of PhD thesis committees for Carin Malmborg Physical Chemistry 1, Lund University.

Tommy Nylander was external examiner for the PhD thesis of Maria Sandström, Physical Chemistry, Uppsala University, Sweden; Arja Paananen, Physical Chemistry, Åbo Akademi University, Finland; Andreas Larsson, Department of Physics, Chemistry, and Biology, Linköping University, Sweden; Veneta Svetlozara Alahverdjieva, Physical Chemistry, University of Potsdam, Germany. Tommy Nylander was in the editorial board of Journal of Colloid Interface Science and Chemistry and Physics of Lipids. Tommy Nylander is a member (from December 2007 chairman) of the expert panel for Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning and he is also a member of Subcommittee 9 of the Scientific Council at Institute Laue Langevin, Grenoble France.

Karin Schillén was deputy member of the board of the Department of Chemistry. Karin served on PhD thesis committees for Jane Larsen, Lund University, Carin Malmborg, Lund University and Peter Nilsson, Uppsala University

Viveka Alfredsson served on the PhD thesis committee for Kjell Wikander, Chalmers University of Technology, Gothenburg, Sweden and Abbas Saeed Hameem, Stockholm University, Sweden

Emma Sparr participated in a development and leadership training program at Lund University, "Academic Traineeship" (by nomination from the Science faculty).

## AWARDS

Björn Lindman became Honorary Professor of Nanjing University of Science and Technology, and got the Bror Holmberg Medal of the Swedish Chemical Society at a ceremony in Uppsala. At a ceremony in Nanjing, China, he was also retained as Honorary Consultant of Nanjing Water Treatment Center of Engineering & Technology. He was appointed Foreign Editor of Fine Chemicals, a journal of the Chemical Industry and Engineering Society of China.

## COURSES AND TEACHING

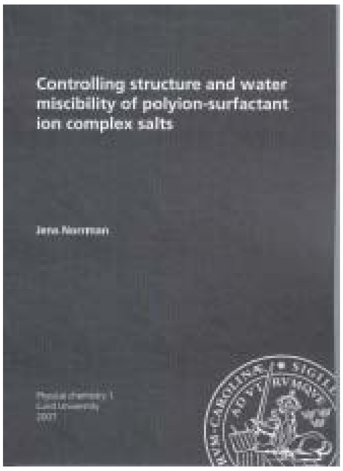
Members of the department are involved in a number of undergraduate courses. The first year of chemistry studies at the Chemical Center consists of four 5-week chemistry courses (which are given both during the fall and the spring semesters), one 9-week course in physical chemistry and a 9-week course in mathematics. Viveka Alfredsson, Johan Reimer and Daniel Topgaard gave lectures, exercises and tutorials at the first basic chemistry course, which was given for the first time during the fall semester. The topic of the third first-year course is thermodynamics and introductory quantum mechanics and spectroscopy. Karin Schillén is the main teacher for this course and Karin gave the lectures and exercise sessions in thermodynamics together with Christoffer Åberg. Johan Reimer has the main part of his position within the undergraduate education, where he among other things administrates the first year courses. Furthermore, Karin Schillén became the head teacher in Physical Chemistry in May 2007, with the responsibility of organizing the teaching given by the members of the department.

As regards higher courses, the department gives one basic and one advanced course in surface and colloid chemistry and one advanced physical chemistry course. The basic colloid course is headed by Ulf Olsson and was taught by Ulf, Lennart Piculell, and Sam Edgecombe. The advanced surface and colloid chemistry course given during the fall semester is organized and taught by Lennart Piculell (main teacher) along with Håkan Wennerström, Emma Sparr, Tommy Nylander, Per Linse and Regine von Klitzing, Technical University Berlin, Germany. This course is based on the text book "The Colloidal Domain" by Fennell Evans and Håkan Wennerström. The advanced physical chemistry course was given during the spring semester by Ulf Olsson, Daniel Topgaard and Per Linse. This course is focused on the following three methodological parts: (i) scattering techniques (ii) nuclear magnetic resonance and (iii) statistical mechanics and computer simulations. Christoffer Åberg also gave exercise sessions on the advanced course "Chemist's Modelling Tools". Finally, a number of our graduate students serve as teaching assistants on all courses given by the department.

Lennart Piculell delivered 3 popular lectures at "Naturvetenskap- & teknikdagar för gymnasister".

Björn Lindman was one of the teachers on the annual course on surfactants and polymers in aqueous solution, this year given in Lisbon, Portugal and Basking Ridge, New Jersey, and he also taught on courses at Coimbra University, Portugal, Trondheim University of Technology, Norway, Nanjing University of Science and Technology, and University of Maribor, Slovenia.

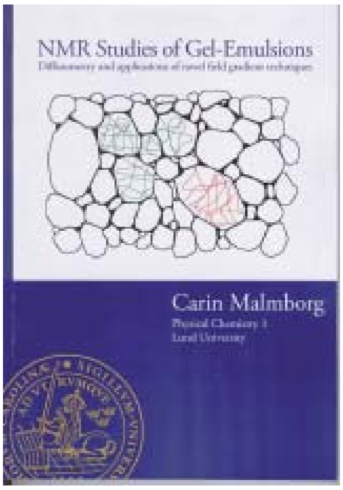
# DOCTORAL THESIS



Controlling structure and water miscibility of polyion-surfactant ion complex salts

Jens Norrman

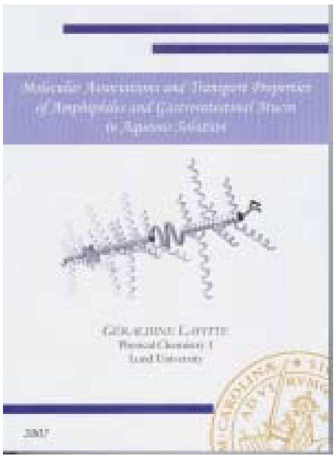
June 8, 2007  
**Jens Norrman**  
*Controlling structure and water miscibility of polyion-surfactant ion complex salts.*  
Opponent: Prof. Alexei Khokhlov,  
Physics Dept., Moscow State University, Russia



NMR Studies of Gel-Emulsions

Carin Malmborg

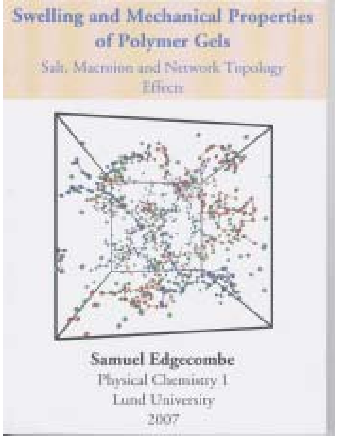
June 15, 2007  
**Carin Malmborg**  
*NMR Studies of Gel-Emulsions. Diffusometry and applications of novel field gradient techniques.*  
Opponent: Prof. Monika Schönhoff,  
Inst.für Physikalische Chemie, Universität Münster, Germany



2007

September 27, 2007  
**Géraldine Lafitte**  
*Molecular Associations and Transport Properties of Amphiphiles and Gastro-Intestinal Mucin in Aqueous Solution.*  
Opponent: Dr Francois Mariette, PRISM, Cemagref, Rennes, France

December 7, 2007
**Samuel Edgecombe**
*Swelling and Mechanical Properties of Polymer Gels.*
*Salt, Macroion and Network Topology Effects.*
Opponent: Prof. Jaan Noolandi,
Stanford University, USA



# WELCOME TO VISITORS

Dear Visitor,

We receive many guests, who stay with us from a few hours or a day of discussions, seminar etc., to one or more years for postdocs and foreign students. Visitors are very important for us and help us to improve our level of research and education. Careful planning can significantly improve these visits. The Annual Report partly serves the purpose of introducing a person to our department prior to a call.

We hope to continue to have many visitors and here we give some information, which may be helpful for you if you plan to visit us.

To arrange a visit, you may contact an appropriate member of our department. Depending on the nature of the visit different arrangements may be made. Help with accommodation can be provided by Majlis Larsson. In many cases we have found that smaller, less formal seminars, lead to better information exchange.

The Chemical Center and Lund can be reached in many ways. Below we give some useful hints:

We recommend the visitors to fly to Kastrup Airport, Copenhagen. Then, take a train (frequency every 20 min.) from Kastrup Airport over the Öresund bridge to Malmö (30 min). At Malmö railway station, change to a local train (Pågatåg) to Lund railway station (15-20 min). You may take a taxi from Malmö to Lund (about 20 km). Also, there are few direct train connections between Copenhagen airport and Lund railway station.

# MEMBERS OF THE DEPARTMENT

## Scientists/Teachers

Viveka Alfredsson, associate prof.
Daniel Angelescu, postdoc
Tarek Awad, postdoc
Joakim Balogh, researcher
Justas Barauskas, postdoc
Richard Campbell, postdoc
Anna Carnerup, postdoc
Parveen Choudhary, postdoc
Rita Dias, postdoc
Alfredo Gonzáles Pérez, postdoc
Ola Karlsson, adjunct prof.
Ali Khan, associate prof. em.
Björn Lindman, prof.
Per Linse, prof.
Maria G. Miguel, visiting prof.
Andreas Mohr, postdoc
Tommy Nylander, prof.
Gerd Olofsson, associate prof.
Ulf Olsson, prof.
Nikolay Oskolkov, postdoc
Lennart Piculell, prof.
Gabriel Rata, postdoc
Johan Reimer, lecturer
Karin Schillén, associate prof.
Emma Sparr, assistant prof.
Olle Söderman, prof.
Fredrik Tiberg, adjunct prof.
Daniel Topgaard, assistant prof.
Stefan Ulvenlund, assistant prof.
Ingemar Wadsö, prof. em.
Håkan Wennerström, prof.
Malin Zackrisson, postdoc

## Technical-Administrative Personnel

Barbro Hansson, administrator
Majlis Larsson, administrator
Ingegerd Lind, MSc, engineer
Lennart Nilsson, MSc, electrical engineer
Gull-Britt Odeskog, administrator

## Graduate students working on a Ph. D. Thesis

Sanja Bulut
Jonas Carlstedt
Samuel Edgecombe
Niklas Källrot
Géraldine Lafitte
Peter Linton
David Löf
Carin Malmborg
Markus Nilsson
Jens Norrman
Luis Pegado
Joakim Stenhammar
Pauline Vandoolaeghe
Agnes Zettergren
Christoffer Åberg
Ingrid Åslund
Marie-Louise Örberg

# GUESTS

Arteaga, Nagore, Univ. of the Basque Country, Spain (L)
Asad Ayobi, Mehran, Moscow State Univ., Russia (S)
Bernardes, Juliana, UNICAMP, Brazil (S)
Blanco, Elena, Univ. of Santiago de Compostela, Spain (S)
Brito, Rodrigo, Univ. Porto, Portugal (S)
Bucak, Seyda, Yeditepe Univ., Istanbul, Turkey (S)
Burrows, Hugh, Coimbra Univ., Portugal (S)
Cabane, Bernard, ESPCI, Paris, France (S)
Choudhary, Parveen, University of Essen, Germany (L)
Clauzel, Maryline, Univ. Louis Pasteur, Strasbourg, France (L)
Danino, Dganit, Technion Univ. Haifa, Israel (S)
Edwards, Mark, Glaxo Smith Cline, UK (S)
Ferreira, Tiago, Coimbra Univ., Portugal (L)
Goldman, Steve, Procter & Gamble, Cincinnati, USA (S)
Grainger, David, Univ. of Utah, Salt Lake City, USA (S)
Greene, Wren, UC Santa Barbara, USA (S)
Huang, Lily, UCLA, Los Angeles, USA (S)
Imai, Mazayuki, Ochanomizu University, Japan (S)
Jausovec, Darja, University of Maribor, Slovenia (S)
Kato, Tadashi, Metropolitan Univ. Tokyo, Japan (S)
Kekicheff, Patrick, Strasbourg Univ., France (S)
Khokhlov, Alexey, Moscow State Univ., Russia (L)
von Klintzing, Regine, Technical Univ. of Berlin, Germany (S)
Kokol, Vanja, Univ. of Maribor, Slovenia (S)
Küster, Simon, RWTH Achen, Germany (S)
Lasic, Samo, Univ. Ljubjana, Slovenia (S)
Luigjes, Bob, Univ. of Utrecht, The Netherlands (S)
Lundberg, Dan, Coimbra Univ., Portugal (S)
Mariette, Francois, Cemagref, Rennes France (S)
Martin, Rachel W., UC Irvine California, USA (S)
Medronho, Bruno, Coimbra Univ. (S)
van der Merren, Paul, Gent Univ. Belgium (S)
Mohr, Andreas, University of Essen, Germany (L)
Müllner, Markus, Univ. Bayreuth, Germany (S)
Nasimova, Irina, Moscow State University, Russia (S)
Noolandi, Jaan, Stanford Univ., USA (S)
Nowacka, Agnieszka, Poznan, Polen (S)
Nunes, Pedro, Coimbra Univ.Portugal (S)
Ortiz, Rafael, Procter & Gamble, Cincinnati, USA (S)
Oskolkov, Nikolay, Moscow State Univ., Russia (S)
Reichhardt, Nina, Heinrich-Heine-University, Düsseldorf, Germany (S)
Saveyn, Pieter, Gent Univ. Belgium (L)

Schelero, Natascha, Technical Univ. of Berlin, Germany (S)
Schmidt, Claudia, Universität Paderborn, Germany (L)
Schönhoff, Monika, University of Münster, Germany (S)
Segad Meehdi, Mohammed, Baghdad Univ., Irak (S)
Serra, Elia, CSIS, Madrid, Spain (S)
Silva, Bruno, Univ. of Porto, Portugal (S)
Snowden, Martin, Greenwich Univ., UK (S)
Stevens, Sam, Univ. of Manchester, UK (S)
Suganuma, Yukiko, Ochanomizu University, Japan (S)
Tonigold, Katrin, Univ. of Ulm, Germany (L)
Valente, Artur, Univ. Coimbra, Portugal (S)
Zhang, Jianming, Duke Univ., USA (L)
Zhao, Boxin, UC Santa Barbara, USA (S)

(L)= Long-term (S)= Short-term

On Tuesday the 3rd of July the Department received the visit of a group of PhD students from the Laboratory of Physical Chemistry and Colloid Science (PCC) of Wageningen University and Research Center (WUR). This was integrated on a two week educational tour to companies and reasearch groups at universities and institutes in Sweden and Denmark, guided by Professors J. Lyklema, M. A. Cohen Stuart and W. Norde. The event consisted of a common day of seminars held both by PhD students from our department (Jonas Carlstedt, Salomé Santos and Samuel Edgecombe) and the Wageningen group, besides general scientific discussions and visit to the Labs.

The Wageningen group consisted of Agata Brzozowska, Marat Charlaganov, Bas Hofs, Saskia Lindhoud, Aernout Martens, Bart Postmus, Paulina Skrzeszewska, Joris Sprakel, Ilja Voets, Wiebe de Vos, Kathelijne Wintraecken and Yun Yan. Their tour also included participation in the 11th European Student Colloid Conference, 29th June-2nd July, Ven, Sweden, also organized by PhD students at our department (Samuel Edgecombe, Marie-Louise Örberg and David Löf).

# PUBLICATIONS

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(29) Lafitte, G.; Söderman, O.; Thuresson, K.; Davies, J.
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# TELEPHONE LIST

Physical Chemistry 1
Centre for Chemistry and Chemical Engineering
P.O. Box 124
SE-221 00 Lund
Telephone. +46 46 2228150
Facsimile: +46 46 2224413
Web Address: www.fkem1.lu.se

Direct phone: +46 46 22+extention

| **Name** | **Extension** | **Home phone no.** |
|---|---|---|
| Viveka Alfredsson | 28155 | 046-152979 |
| Daniel Angelescu | 24954 | |
| Mehran Asad Ayoubi | 28154 | |
| Johanna Bailey | 28154 | |
| Sebastian Björklund | 23677 | |
| Camilla Black | 28188 | |
| Jonas Carlstedt | 28163 | |
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| Anna Clemens | 28188 | |
| Tiago Ferreira | 28188 | |
| Richard Gillams | 28188 | |
| Barbro Hansson | 28219 | |
| John Janiak | 24682 | |
| Ola Karlsson | 20112 | |
| Vitaly Kocherbitov | 070-7457220 | 040-86154 |
| Niklas Källrot | 24682 | 046-184088 |
| Majlis Larsson | 28150 | 046-293834 |
| Ingegerd Lind | 23489 | 046-292845 |
| Björn Lindman | 28160 | 046-141547 |
| Per Linse | 28151 | 046-140548 |
| Peter Linton | 23332 | 046-188382 |
| Dan Erik Lundberg | 28148 | |
| David Löf | 24682 | 040-971874 |
| Irina Nasimova | 28154 | |
| Lennart Nilsson | 28249 | 046-148810 |
| Markus Nilsson | 28175 | 046-128224 |
| Peter Nilsson | 23677 | |
| Agnieszka Nowacka | 23247 | |
| Tommy Nylander | 28158 | 046-145492 |
| Gerd Olofsson | 28185 | 046-51835 |
| Ulf Olsson | 28159 | 046-53312 |
| Nikolay Oskolkov | 23677 | |
| Luis Pegado | 24954 | |
| Lennart Piculell | 29518 | 046-128912 |
| Gabriel Rata | 24504 | |
| Nina Reichhardt | 23332 | |
| Johan Reimer | 28133 | 046-120424 |
| Salome Santos | 28163 | |

| | | |
|---|---|---|
| Karin Schillén | 21439 | 046-123322 |
| Emma Sparr | 21536 | 046-127497 |
| Joakim Stenhammar | 28188 | |
| Olle Söderman | 28603 | 040-151292 |
| Fredrik Tiberg | 28150 | |
| Daniel Topgaard | 28204 | 046-306976 |
| Stefan Ulvenlund | 046-337847 | 046-143531 |
| Ingemar Wadsö | 28180 | 046-2116228 |
| Pauline Vandoolaeghe | 23332 | |
| Wei Wang | 28154 | |
| Håkan Wennerström | 29767 | 046-142980 |
| Agnes Zettergren | 24682 | 0707-877061 |
| Christoffer Åberg | 28148 | 046-306751 |
| Ingrid Åslund | 24812 | 046-2718518 |
| Marie-Louise Örberg | 24504 | 046-152422 |

| | |
|---|---|
| NMR lab | 29462 |
| Surface force lab | 24147 |
| Light-scattering lab | 29185 |

E-mail addresses: firstname.surname@fkem1.lu.se (å,ä,ö=a,a,o)
Example: Hakan.Wennerstrom@fkem1.lu.se

This report is produced by Johan Reimer