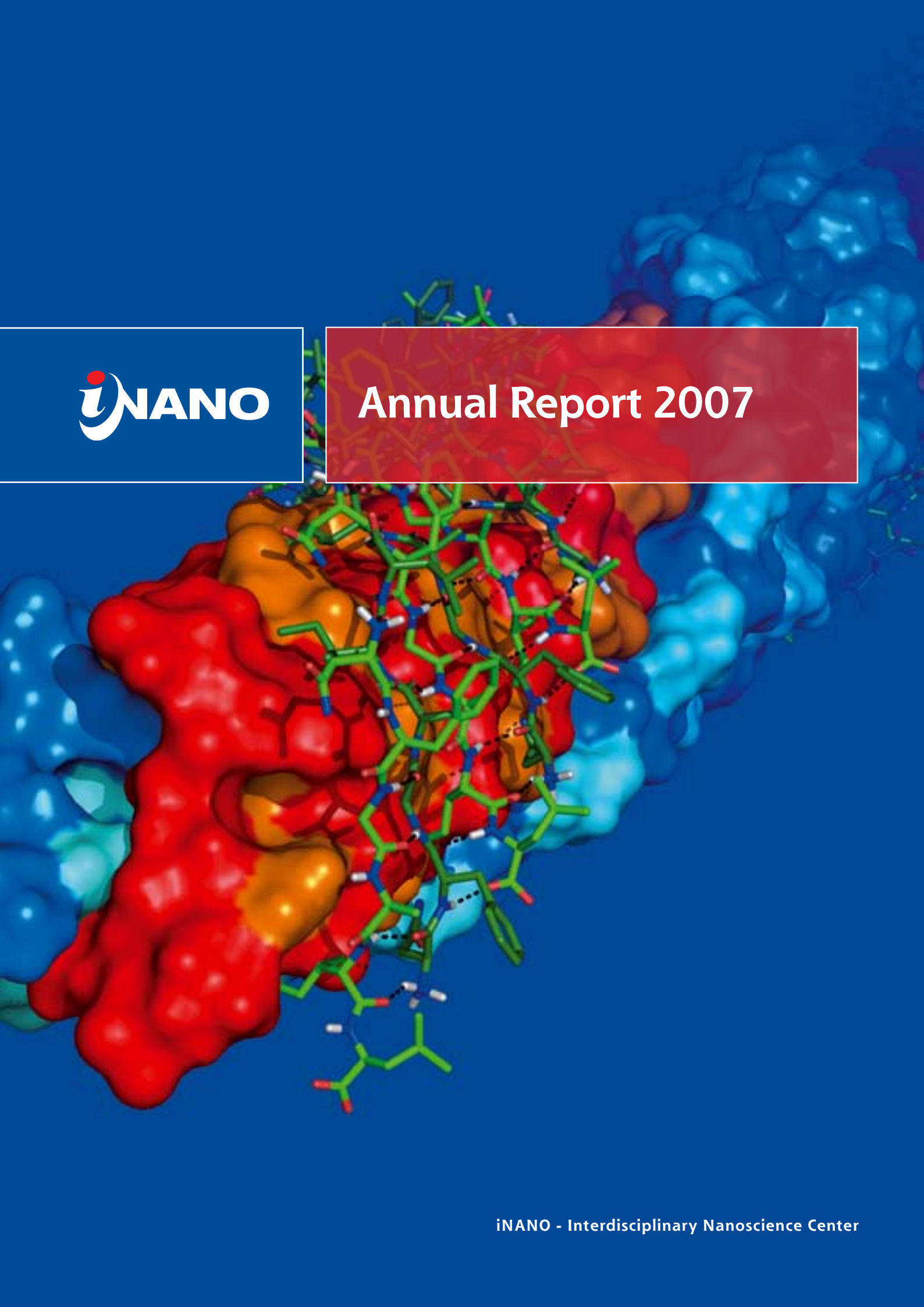
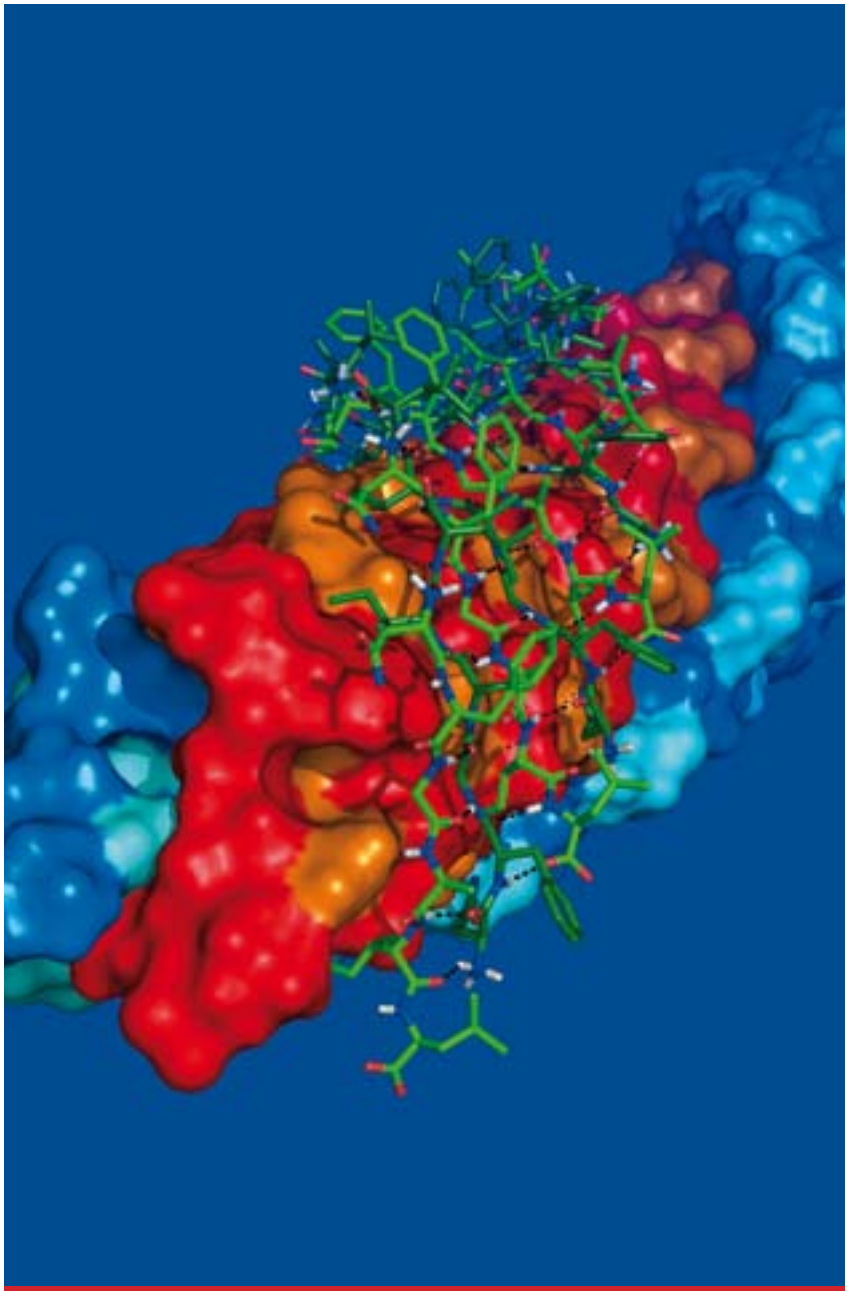


Annual Report 2007

iNANO - Interdisciplinary Nanoscience Center



Structure of amyloid fibrils formed by a decapeptide from the human Islet Amyloid PolyPeptide (hIAAP), amylin, relevant in context of diabetes. The structure was determined by solid-state NMR spectroscoy within the inSPIN research center.

Annual report, 2007, published April 2008
iNANO – Interdisciplinary Nanoscience Center
The Faculty of Science, University of Aarhus
Ny Munkegade, Building 1521, DK-8000 Aarhus C, Denmark

www.inano.dk

Editors: Signe Osbahr, Annette Riisberg, Brian Bech Nielsen
and Flemming Besenbacher, iNANO and Rolf Haugaard Nielsen
Design: WAYPoint Communication ApS
Printed in Denmark by Form og Farve

Content

Message from the Director

Flemming Besenbacher
director

It is with great pleasure that I present the annual report 2007 for iNANO, the Interdisciplinary Nanoscience Center. As predicted in our annual report from last year, the positive development witnessed in 2006 continued throughout 2007 so I am delighted to present some of this year's achievements.

By Flemming Besenbacher

iNANO status

iNANO continued to grow at a fast pace in, 2007, and at the end of the year 60 senior researchers, 45 postdocs, and 115 PhD students were associated with our research center. The iNANO scientists obtained excellent research results in, 2007, as evidenced by the long list of publications, which includes many papers in high-impact journals. The overall mission of iNANO continues to be three-fold; education of outstanding young scientists, carrying out research at the highest international level, while at the same time focusing on collaboration and technology transfer to Danish industry. We are continuously striving to fulfil this mission, which will be facilitated by the completion of the iNANOhouse within a few years. This leads me to report on one of the most important events in 2007 for iNANO: In August we cut the first turf on the new clean-room facility. This event marked the beginning of a process that will end up with a new 10,000 m2 laboratory complex dedicated to nanoscience and nanotechnology. With this iNANOhouse we will acquire excellent opportunities to perform first-class interdisciplinary research in well-equipped laboratories and give nano-students outstanding training during their PhD projects.

Research highlights

In March the Center of Excellence Centre for DNA Nanotechnology (CDNA) was established with a major grant from the Danish National Research Foundation, and in August the center was inaugurated. The research at CDNA is dedicated to explore DNA as a programmable tool for assembling molecules and nanostructures. This truly interdisciplinary center is headed by Professor Kurt V. Gothelf.

In November, the Program Committee for Energy and Environment (EnMi) under the Danish National Strategic Research Council granted 30 million Danish kroner to the Center for Energy Materials (CEM) at iNANO to conduct research in materials promoting environmentally friendly forms of energy. This newly established interdisciplinary center is headed by Professor Bo Brummerstedt Iversen.

From the Danish National Programme Commission on Nanoscience, Biotechnology and IT (NABIIT) iNANO received 8 and 7.8 million Danish kroner, respectively, in support of two research projects entitled 'Nano- and bio-functionalised surfaces for biofilm prevention', and 'Hybrid functionals for metal oxide surfaces and nano-particles'. The two projects are headed by Professor Niels Peter Revsbech/ Assistant Professor Rikke Meyer and Associate Professor Bjørk Hammer, respectively.

I would like to express my sincere congratulations to assistant professor Liv Hornekær, who was awarded a European Research Council (ERC) starting independent researcher grant to study the interaction of hydrogen with polycyclic aromatic hydrocarbons. The € 1,500,000 grant was awarded in an extremely fierce European competition with less than 300 successful applicants out of a total of more than 9000, and only two such grants were given to young talented researchers in Denmark.

Student issues

Next I would like to focus on our nanoscience education and our brilliant nano students, who obtained remarkable achievements in 2007. First of all, an important goal was reached in, 2007, as the nanoscience education was fully implemented. Given that the nanoscience education started in 2002 the first student with a full Master's in nanoscience should graduate in 2007 – which in fact happened in August 2007. With their strong interdisciplinary background our Master's students are attractive candidates for jobs in industries and other private companies or as scientists at various public research institutions. Where the researcher's path is well known, the new Master's students and their competences in nanoscience are still largely unknown to industry. In the years to come iNANO will make these nano students known to Danish companies, and an iNANO alumni organisation has been established, such that older nano students can mentor the new nano-students.

In March three talented young students from iNANO, Karin Dooleweerdt, Jonas Ørbæk Hansen and Niels Vinther Voigt, participated in Grundfos Challenge '07 with the theme "How is innovation used and protected to create long-term competitive advantage?". I am proud to say that they won the competition with their project about how to ensure a more efficient irrigation for the farmer. We already have a new strong iNANO team ready for the 08 Challenge.

In July the first international nanoscience student conference, INASCON (http://www.inascon.org/), was held at Danparcs in Silkeborg 30

km west of Aarhus. A group consisting of four of our great and very dynamic nano students made an outstanding effort in arranging and organizing the conference. Nanoscience students from all over Europe showed a great interest in the conference, where 100 people from 18 universities representing nine different European countries created the basis for the networking activities among nano students that was the goal of the conference. The conference was a fantastic success, and another group of iNANO students have already volunteered to organize it again next year.

iNANO PhD students

I am very glad to see that a very large proportion of the enrolled nano-students are so talented that they continue on the PhD educational track. More than 50% of the students enrolled in 2002 have now started on a PhD programme. This high percentage underlines the fact that the students choosing the nanoscience education are generally very bright, dedicated and focused, and they contribute to the continued growth of the research activities at iNANO in a very significant way. This year's 115 PhD students represent a 25 % increase compared to last year's 92 PhD students. This very significant increase clearly underlines the great prospects and potentials of nanoscience and the success of iNANO in particular, and iNANO is happy to help the Rector of the University of Aarhus to fulfil his goal of doubling the number of PhD students within the next five years.

This year our graduate school, iNANOschool, obtained a grant of approximately eight million Danish kroner from the Danish Ministry of Science, Technology and Innovation in support of our new initiative: 'Making good even better', hence providing support for raising the quality of our graduate school to even higher standards than the present.

A collaboration between iNANO and a Danish company often begins with a co-financed PhD stipend, and last year's goal to expand the portfolio of such projects has been met in 2007. Thus, we obtained 10 co-financed scholarships, and in total 61 out of the 115 PhD students enrolled at iNANO are carrying out co-financed projects, and as many as 23 of these are co-financed by a Danish company.

Networks, outreach and innovation

Another very important mission of iNANO is to strength the collaboration with national and international companies. The industry is showing increasing interest for cooperation and technology transfer, and the number of contacts with companies keeps growing. Industry is realizing that there may often be nanotechnological solutions to industrial problems, which results in better and optimized productions and processes. In 2007 iNANO collaborated with more than 60 national and international companies. Hence, through fruitful collaboration with industrial partners, iNANO is exploiting the possibility to go from nanoscience to the implementation of nanotechnology.

In, 2007, iNANO decided to aid the conversion of its high level of science into more invention disclosures, patent applications and license negotiations with Danish and international companies by establishing a fruitful cooperation with a group of international commercialisation experts. We expect this venture to mature further in 2008. MaxInno assisted in raising general IP awareness among graduate students and professors, reviewed 20 cases in, 2007, of which 11 were accepted for filing patents, 4 continued into national phases, and 6 cases were brought into serious negotiations with world-leading companies in their fields. Furthermore, iNANO

Message from the Director

has developed a model for proof-of-concept and "bridge" funding - which is the most appropriate vehicle for future commercialisation.

In 2007 the Nanotechnological network of knowledge, NaNet (www.nanet.nu), was reorganised, and a network coordinator working full time is placed at iNANO. The coordinator is engaged in strengthening iNANO's contacts to industry and outreach activities in general. Thus, in the fall of 2007 iNANO had many meetings with various companies, all interested in learning how nanotechnology can improve their specific production. The NanoFOOD consortium (www.inano.dk/nanofood) maintains the contacts and cooperation with companies involved in food production and nutrition. Hence, together these two networks increase the innovative collaborations between iNANO and industry, thereby bridging the gap between nanoscience and nanotechnology to the benefit of Danish society.

As part of a European project (NANOCAP, www.nanocap.eu), iNANO hosted members from 5 trade unions, 5 environmental NGOs and 4 universities in August in a capacity building exercise. The workshop included training on different aspects of nanoscience and nanotechnology and substantial dialogue between researchers, NGOs and trade union members. The goal was to enable the partner organisations to form a position on nanotechnology based on knowledge of both the potential benefits and potential risks, as opposed to prejudice.

iNANO and globalisation

Internationally there is a growing realisation that nanotechnology will affect the economic and technological competitiveness of all countries enormously, and hence leading countries such as USA, Russia, England, China, Japan, and India invest heavily in nanotechnology. If Denmark wants to be among the leading countries in the world within certain nanotechnological areas, we need to raise our stakes. Communication with the outside world and exchange of knowledge is of extreme importance. We need to interact with the very best groups world-wide, and we need to recruit the most talented and bright students internationally if we want to stay in the race. China for example is developing faster than any other country, it has an enormous pool of highly-dedicated and talented students, and it is of outmost importance that we maintain and build up our contacts with this country. At iNANO we have already established strong contacts with leading Chinese research centers and universities, and I am personally very dedicated to further enhancing this collaboration.

iNANO has several international research collaborators at some of the world's most prestigious universities and research centers, and currently 14 foreign PhD students are enrolled at iNANOschool. With the increasing need for highly educated people and researchers in Denmark, international research collaborations become an increasingly important source to make Danish research known in other countries, and ultimately to attract excellent foreign students and researchers. Hence, the overall goal is to strengthen the degree of internationalization at iNANO even further.

Acknowledgements

I would like to express my sincere thanks to all iNANO scientists and administrative staff. They keep doing a wonderful job in a from time to time very hectic, but hopefully stimulating environment with short deadlines and long working hours. Also, I would like to thank all the students for their commitment, their initiatives and for bringing new talent to iNANO again and again. On this basis the prospects for iNANO in 2008 are indeed very promising.

Simulation of the south-facing front of the iNANO-house by Jørn Langvad A/S

Young iNANO researchers win:

The Grundfos Challenge

Fierce competition and copycat products make pump production an increasingly competitive business. How can the Danish company Grundfos sustain its leading position in the world market? Three PhD students from iNANO came up with an innovative concept and won the Engineers' price at the Grundfos Challenge competition.

By Rolf Haugaard Nielsen

For Karin Dooleweerdt participating in the Grundfos Challenge 2007 will always be a week to remember. And not just because she and her fellow PhD students from iNANO, Jonas Ørbæk Hansen and Niels Vinther Voigt, won the "Engineers' price" of DKK 75,000 in competition with six other teams from Danish Universities. "It was hard work, a great experience and an eye-opener to the importance of interdisciplinary teamwork in an innovative private company", Karin says.

Grundfos is well aware that good pumps alone are not sufficient to maintain the company's strong global position. To achieve that innovative methods, services, or processes must accompany the pumps. The main challenge for the competing teams was to come up with a good idea and a detailed implementation plan. An additional task was to establish strong teamwork in the group, exploiting in full the individual competencies of the team members.

For the iNANO team the starting point was the fact that water resources are becoming increasingly scarce in many parts of the world due to a growing population; a trend that may be enhanced in the future by climate change. "Thus, we wanted to develop a sustainable concept that saves water and improves crop irrigation at the same time", says Karin.

Their idea was to build an intelligent irrigation system by applying sensors that measure the humidity of the soil and control the groundwater pumps. In this way it will be possible to use just the right amount of water – and no more - at the right time and place in the fields. "If water shortages become more frequent, irrigation may be restricted, and it will be of utmost importance to use the available water in a sustainable manner", Karin points out. "From a business perspective it is important that the built-in intelligence in the system will make it difficult for others to produce cheap copycats".

The implementation strategy was to start with pilot projects in Europe, where water shortages are common in the growing season and the agriculture is well advanced. If these projects were successful, the next step would be to hit the big market in the USA. Later as the technology matures and gets cheaper, the intelligent pumping and irrigation system could be applied in the developing countries.

During the entire week all teams received excellent coaching in playing "the innovation piano" spanning from business models over collaboration processes to technologies and customer services. "We were coached by high-ranking members of the Grundfos staff, and they were really committed and inspiring", Karin says.

Educational activities

Undergraduate studies

A full programme of nanotechnology education is offered at iNANO, reaching from Bachelor to PhD level. The interdisciplinary Bachelor's and Master's programme in Nanotechnology was introduced in 2002 and has since then had a yearly uptake of 40-60 highly motivated and very skilled young students. In 2007 the frontrunners on the nanotechnology study programme handed in and defended their Master's thesis, thereby being among the first to gain a dedicated Master's degree in Nanoscience.

The philosophy behind the interdisciplinary Bachelor's degree programme in nanotechnology is to provide the students with a broad and solid foundation in physics, chemistry, molecular biology, and mathematics enabling them to pursue genuinely interdisciplinary research projects within nanoscience and nanotechnology. A number of courses are followed along with students of these core disciplines. In addition, the nano students are presented with courses specifically targeted to the nanoarea. In the course "Introduction to Nanotechnology" the first year students are introduced to key nano concepts such as scanning probe techniques and bottom-up/top-down synthesis of nanostructures. The course ends with a project carried out in research groups at the iNANO Center. In subsequent courses more advanced nano-projects and exercises are carried out, and during the final year of the Bachelor's degree programme they can choose to follow the courses "Nanocharacterisation" and "Current Nanoscience" that introduce a number of experimental characterisation techniques for nanoscience, as well as important subject areas for current nanoscience research. Elective course modules allow individual planning of the course programme to the particular interest of the students. The Bachelor's degree programme is completed by a Bachelor's project individually supervised by iNANO researchers.

During the subsequent Master's degree programme the students specialize in nano-physics, nano-chemistry or nano-biology. Here they choose from the extensive course catalogue offered at the Faculty of Science and follow course programmes developed through individual counselling. In the compulsory "Student's Colloquium" the students gain experience in presenting a subject of their own choice to a wider audience, and in the Patent/Innovation course they are introduced to concepts of commercialisation, which is highly relevant to anyone who wishes to enter into a commercial exploitation of nanotechnology. The specialisation courses ena-

Master project in nanotechnology		
Specialisation - 4	Innovation and Enterpreneurship	Specialisation - 10
Specialisation - 3	Specialisation - 6	Specialisation - 9
Specialisation - 2	Specialisation - 5	Specialisation - 8
Specialisation - 1	Student's colloquium	Specialisation - 7
Current nanoscience	Bachelor project	Bachelor project
Nanocharaterisation	Molecular structure	Experimental mol.bio.
Solid state physics	Elective-2	Bionanotechnology
Statistical mechanics	Elective-1	Fourier analysis
Quantum mechanics	Theory of Science	Nano project
Non-classical physics	Statistics and data processing	Linear algebra
Numerical physics	Experimental nano-exercises	Basic molecular biology
Introduction to programming	Thermodynamics/kinetics	Basic biochemistry
Waves and optics	Organic chemistry	Nano intro
Electromagnetism		Basic biology
Mechanics/thermodynamics	Numerical physics	Calculus - 2
Introductory mechanics	Introductory chemistry	Calculus - 1

Course programme for nanotechnology students who commenced their studies in 2007. Legend: blue: physics courses, yellow: chemistry courses, orange: molecular biology courses, red: mathematics/computer science courses, green: nanoscience courses, grey: specialisation modules

Master project in nanotechnology			
Materials	Bio	Physics	
Nanofabrication and characterisation	Quality control	Physical Chemistry	
Nanostructures in biological organisms	Biochemical reactions in the body	Optical, electronic, magnetic properties of nanostructures	
Fluid dynamics in small structures	Biosensors	Statistical mechanics	Solid state physics and chemistry
		Organic and inorganic nanostructures	
Spectroscopy	Data processing	Differential equations	
Quantum mechanics	Structure of solids and liquids	Molecular biophysics	Computer modelling
Laboratory training	Fourier and Vector Analysis		
Electromagnetic fields in nanostructures	Gene technology	Basic optics	Ethics
The composition of matter	Chemical and biological molecular structures		Scientific communication and methods
Mathematics	Mechanics	Thermodynamics	Scientific models of the universe
Mathematics	Scientific models of the universe	Basic chemistry	IT
		Atoms and molecules	

Course programme for the Bachelor's degree programme in nanotechnology at Aalborg University. Numbers in parenthesis are the length of the course in ECTS

ble the students to commence their one-year Master's project, or alternatively to seek admittance to the PhD programme of iNANOschool PhD programme.

In addition to these educational activities, iNANO invites high-school classes to visit the centre and perform experimental exercises. In 2007 special emphasis was put on expanding and consolidating this programme, which is important both as a general community outreach activity and in terms of recruiting prospective students for the education in nanotechnology. In our dedicated exercise laboratory the students can gain hands-on experience with the important nano-characterisation technique of Scanning Probe Microscopy by examining a range of micro and nano surface structures. Other exercises involve construction of a solar cell based on molecular nanotechnology or using DNA to steer the self-assembly of colloidal nanoparticles.

At Aalborg University, an engineering programme focused on nanotechnology was initiated in 2003 (www.physics.aau.dk). The programme consists of a combination of courses and projects with different themes for each semester (see Figure 2). Two-year Master's programmes with specialisations in physics, materials and in biotechnology are currently running.

An industry-related Master's project in Nanotechnology

The first students from the interdisciplinary education in nanotechnology graduated as Masters in 2007. One of them was Karina Matthiesen, who chose to specialize in nano-biology during her Master's programme. Her Master's project was carried out at one of the industrial collaboration partners of iNANO. In the words of Karina herself:

"I chose to spend my Master's project year at H. Lundbeck A/S, which is a Danish pharmaceutical company. The project dealt with an enzyme called phosphodiesterase that regulates the concentration of the intracellular signaling molecule cyclic AMP. An imbalance in the regulation of cyclic AMP in specific parts of the brain is associated with schizophrenia and is therefore relevant to Lundbeck that specializes in treatment of psychiatric and neurological diseases. For my thesis, some of the properties of this enzyme were characterized by various *in vitro* methods, including both standard molecular biology methods and nanotechnological methods.

Interdisciplinarity and innovation are keywords in the nanotechnology education and this has provided me with a solid foundation to pursue a career in a pharmaceutical company, where you often work in cross-disciplinary projects and where obtaining new patents is absolutely essential."

Director Jan Egebjerg from Lundbeck comments:

"We have a long tradition for supervising Master's and PhD students with diverse educational backgrounds. We are highly positive towards new initiatives such as the study programmes at iNANO that seek to provide an optimum combination of competences."

The successful collaboration has now led to an industrial PhD during which Karina Matthiesen will participate in research partly at Lundbeck and partly at the University of Aarhus.

List of Master's theses:

Karina Matthiesen
Title: Pharmacologic and Functional Analysis of GAF Domains from Phosphodiesterases 2, 10 and 11

Ole Risum Jacobsen
Title: Measurement of Peptides, Bacteria and Enzymes using a Cantilever Sensor

Erik Leth Frisenvad
Title: Nanoindenteringsundersøgelse af knogle
Underprojekt: Undersøgelse af te-doteret Zn4Sb3

INASCON

– promoting networking amongst European nanoscience students

The INASCON participants

In 2007 four nanoscience students from iNANO and three students from the University of Basel organized a conference for undergraduate nanoscience students from all over Europe. The conference was called the International Nanoscience Student Conference (INASCON), and the aim was to promote networking amongst young nanoscience researchers.

In a field as broad as nanoscience it is vital to know people at other universities who have expertise in other areas of research, as it can lead to potential collaborations. The goal of the INASCON conference was to promote networking at a very early stage, and thus this conference was arranged for students, as opposed to normal conferences that tend to focus on established researchers and professors. To catch the students' interest, not only talks on hot research topics were chosen, but also talks on less hardcore issues such as education, how to combine work and family, which roads are possible when one has a PhD or a MSc degree, and the ethical aspects of nanotechnology. These topics were included to make the students think not only about science, but also about life as a scientist.

The planning stage took six months with countless phone conferences and e-mails back and forth between Switzerland and Denmark, finding the right location, speakers, workshop topics, and thousands of other things. A web page was set up (http://www.inascon.org/) for online registration and information, and posters and other PR material were sent out to European universities that have a nanoscience curriculum.

There was of course also a need for funding of the conference, so the organizers applied for several grants and succeeded in raising sufficient funds. The main part of the funding came from the Frontiers Network of Excellence, and in addition grants were received from Fabrikant Mads Clausens Fond, Karl Pedersens og Hustrus Industrifond, Merck, Ciba, Novartis, Roche, Dansk Ungdoms Fællesråd, Swiss Nanoscience Institute and Syngenta.

Students from nine countries

Nanoscience students showed great interest in the conference, with 100 people from 18 universities representing nine different European countries attending, and right from the start this high number of participants encouraged people to network, which was the main aim of the confer-

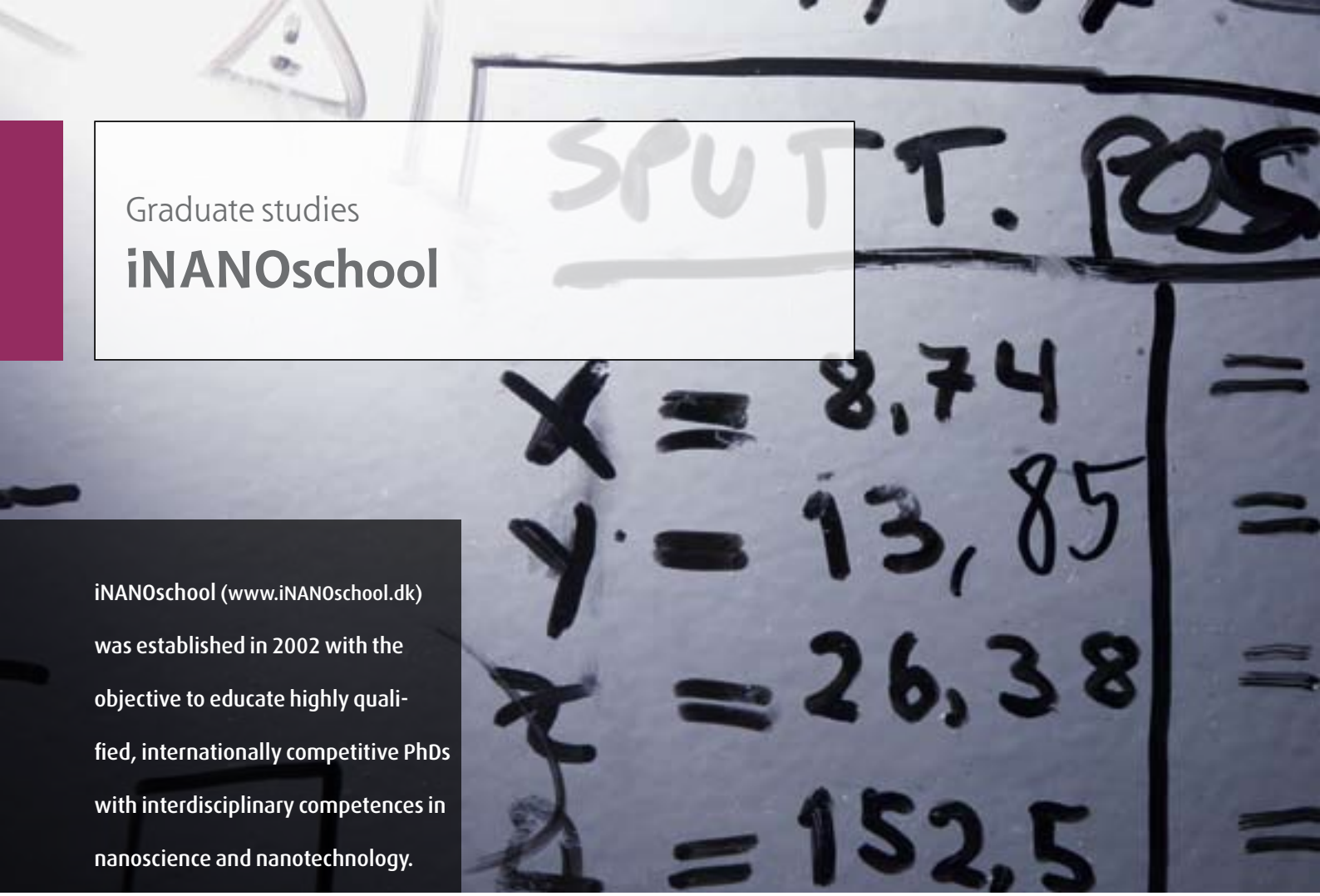
ence. The setting in the beautiful Danish countryside at Danparcs near Gjern created the perfect relaxed location. The students were housed in small houses with eight people in each house. They were intentionally mixed with students from different universities, so they could get to know each other.

The conference itself went very smoothly with exciting lectures given by experienced researchers on hot topics in nanoscience. There were also ten student talks, where the students presented work they had performed so far during their short career in science. This was a golden opportunity to present one's work to the other students, get feedback and ideas, and of course practice giving talks in front of a large audience. These students will be prepared for when it really matters!
In the workshops questions about family, ethics and similar issues were discussed. Of cause no final answer came from these discussions, since there were many different opinions about these topics. However, the idea behind the workshops was not to find some undisputable truth, but to make the students think about these issues.

In addition, a panel discussion was held on the path from the academic life at a university to a career in the high-tech industry. The panel participants included a representative from a company, a representative from the Danish Association for Masters and PhDs, a previous iNANO student who had just been employed, and a career psychologist. The four participants each held a short presentation pointing out what they found important issues when making the transition from academia to industry. Afterwards the students could ask questions to any of the four participants. This session was highly praised by the students, because many of them were in doubt about their possibilities after graduation due to the fact that the nanoscience education is so new.

Overall, the INASCON conference was a great success, and the feedback from the students was very positive. It is therefore likely that the conference will be repeated in coming years.

The INASCON organizers. From left to right
Front Row: Patrick Bosshart, Johan Frederik Kraft, Géraldine Geux.
Back Row: Line Holdt Rude, Thomas Dyrlund, Kasper Jahn, Frank Zoeller



Graduate studies

iNANOschool

iNANOschool (www.iNANOschool.dk) **was established in 2002 with the objective to educate highly qualified, internationally competitive PhDs with interdisciplinary competences in nanoscience and nanotechnology.**

iNANOschool was established with funding from the Danish Research Training Committee, the University of Aarhus, the County of Aarhus, and a large number of high-tech industrial partners. iNANOschool offers a broad range of PhD courses within nanoscience and nanotechnology and provides facilities for and supervision of an increasing number of PhD students to advance their graduate education to the highest level. Besides the focused PhD courses, such activities include a major annual meeting, autumn schools, student networks and activities to promote the exchange with other international institutions, mainly in Europe and Asia. The research areas within iNANO and iNANOschool are highly integrated and truly interdisciplinary and cover at present such diverse research fields as functional nanomaterials, energy and nanocatalysis, bionanotechnology, nanomedicine including drug delivery and biocompatibility, molecular self-assembly, nanophotonics, nanoscience in food technology, nanotoxicology, nanoethics, along with numerous basic long-term generic nanoscience research projects. Overall, the research activities are at the international forefront of science and serve as an ideal framework for education and industrial collaborations.

During 2007 24 PhD students completed their PhD studies (a list of the PhD titles is provided on page 38), and 43 new PhD students were enrolled in iNANOschool. To introduce the new students to iNANOschool an introduction meeting followed by an informal barbecue was set up during the summer. Most PhD students and several supervisors participated in this successful event.

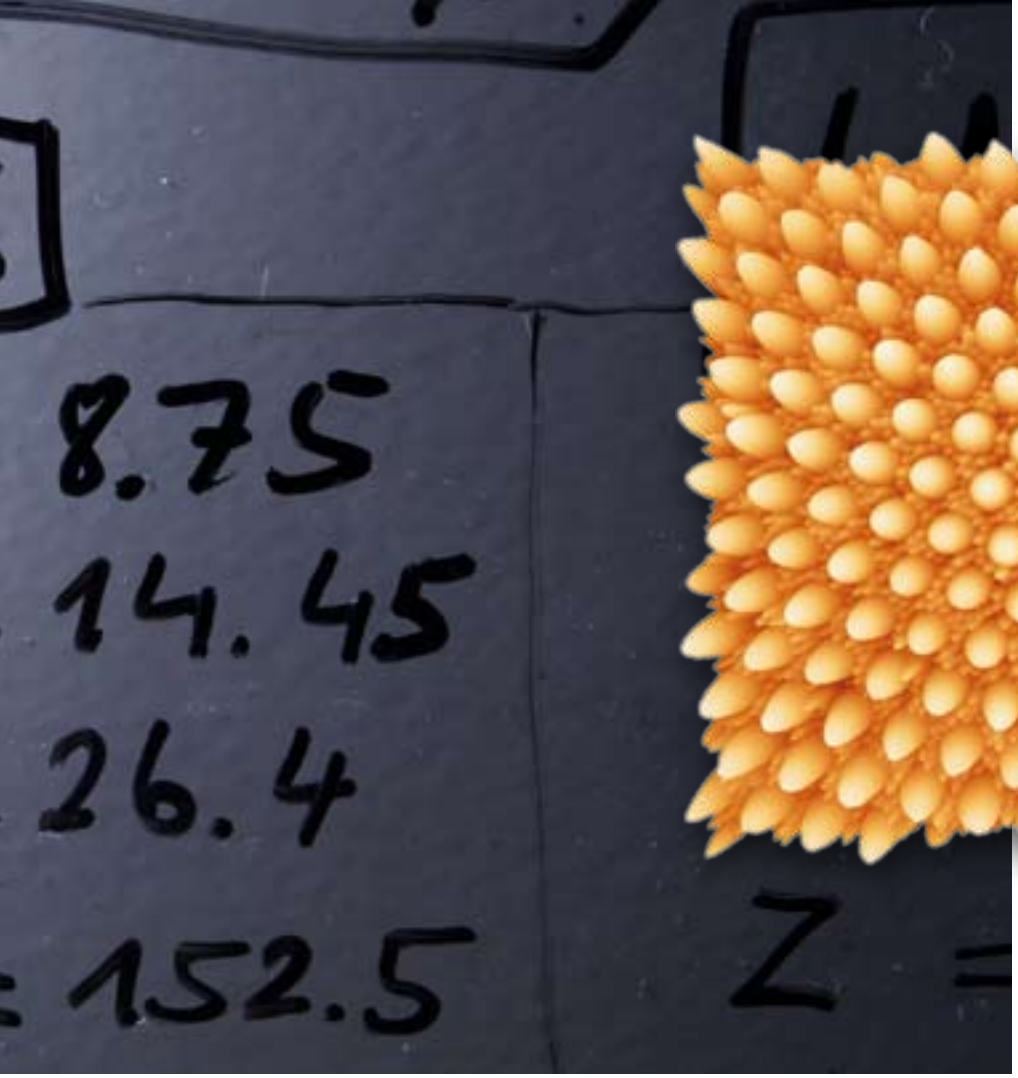
Academic activities at iNANOschool

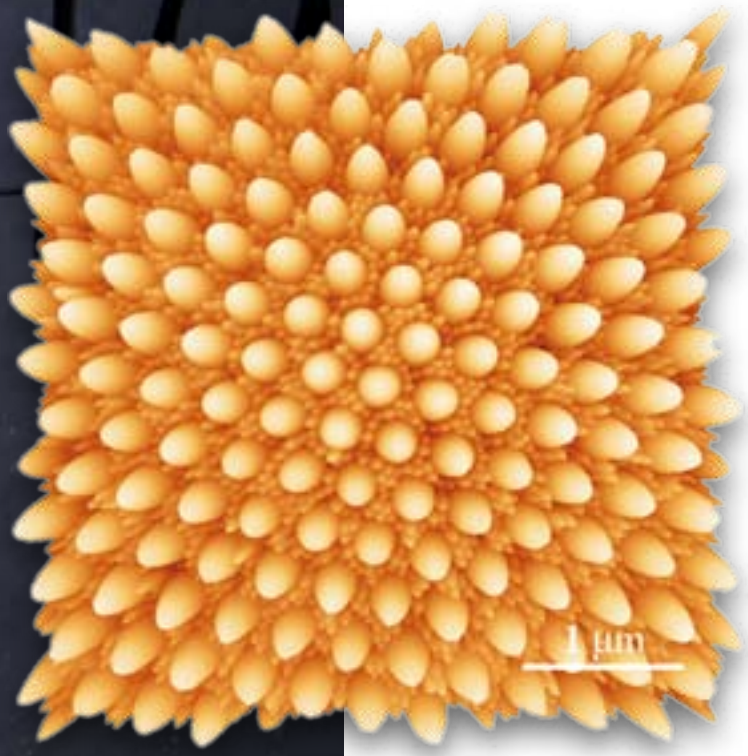
Courses

An important task for iNANOschool has been to establish a fairly large number (14 in total) of new PhD courses within nanoscience and nanotechnology. These courses serve to educate the students in high-priority research fields together with innovation, commercial and ethical aspects of nanotechnology. Moreover, a course to improve the abilities of PhD students to communicate their research in oral as well as in writing has been established. Most courses are offered on an annual or biannual basis and are primarily structured as one- or two-week courses. In that way, the interference between courses and research projects or stays abroad is kept at a minimum. It is worth noting that other national and international institutions also benefit from the specific iNANOschool courses by sending their students to iNANO for short visits. In return iNANOschool's PhD students get excellent networking opportunities with students from other institutions. During 2007 iNANOschool offered the following courses: Nanomaterials and nanosynthesis (N3), Bionanotools and protein structures (N9), Drug delivery (N11), Course in academic/professional presentations (N17), Innovation and entrepreneurship, and Autumn School.

The course *Nanomaterials and nanosynthesis* was organised as a one-week intense course at Fuglsøcentret near Aarhus. The course aimed to give an introduction to the concepts of nanomaterials and nanosynthesis followed by specialized talks covering subjects such as: nanostructural and material design, nanocrystal structures, colloidal quantum dots, spintronics and supercritical fluids and functional nanomaterials. The one-week course model at a remote location gives the students unique opportunities to interact with each other and with the lecturers in an informal setting (full program can be found at the iNANO webpage).

Two other courses (N9 and N11) were organised at the university in order to be able to use the experimental facilities. The aim of the *Bionanotools and protein structure* course is to introduce the students to a number of analytical measurement and analytical tools used for the structure-function analysis of biological macromolecules, or biological nanomachines such as functional proteins, membrane pumps and channels. The aim of the *Drug delivery* course is to provide insight into theory and technical requirements for delivery of nucleic acid-based





gene silencing therapeutics in established cell lines, primary cells and animals. The last course *Innovation and Entrepreneurship* introduces concepts of commercialization, which are highly relevant to anyone who wishes to enter into a commercial exploitation of nanotechnology. The course was co-organized as an undergraduate and graduate course.

At least every second year iNANOschool arranges an *Autumn School*, where leading international experts give lectures on different aspects of nanoscience, and students are invited to present and discuss their own research projects in a poster session. The theme of *Autumn School 2007* was based on *Providing tools for becoming a young talented researcher*. This meant that the lectures approached subjects such as "How to make a good presentation", "How do journals work", "How to write a referee report", "How to write a high profile paper", "How to write an application for grants", "How to write an application and go to an interview", etc. PhD students in the second half of their education gave a 15-min presentation of their research projects. The talk was followed by 5 minutes of questions from the audience, and after the presentation a senior scientist from iNANO gave the student individual feedback on her/his presentation. There was also a poster session, where all participants could present a poster. The program was much appreciated, and there are plans to present similar lectures to postdocs during an evening event in the near future.

Workshops/seminars

In order to stimulate interdisciplinary research activities and give all students direct access to the most recent research results on the international research arena, weekly *iNANO seminars* are operated with remarkable success. At these seminars, internationally well-recognized scientists give tutorials on different aspects of nanoscience, and scientists associated with iNANO present their most recent results. The seminars are very popular, and typically about 80-100 graduate students and researchers broaden their horizons on current issues in nanoscience through these seminars. A second seminar series is devoted to the iNANO specialized lectures, where more specialized topics such as specific state-of-the-art experimental techniques and results are presented.

All PhD students at iNANOschool participate actively in the *iNANO Annual Meeting*, where outstanding, international scientists present talks on hot topics in nanoscience and nanotechnology. A poster session for PhD students and postdocs allows them to present and discuss their own projects and to gain knowledge about other current projects within iNANO.

Nanorama
– students get together

Nanorama is a self-run organisation for undergraduates to PhD students. It started in the spring of 2005 and is now in its third year. Nanorama arranges different activities such as the "Nano Friday Bar" and joint ventures with other student organisations.

By the Board of Nanorama

The aim of Nanorama is to strengthen the social relations between nanoscience students from different year groups. This goal is pursued by supporting and initiating different activities, such as sporting events and informal gatherings.

The Board of Nanorama is composed of seven students representing almost all of the year groups. This arrangement is essential for supporting the idea of encouraging nanoscience students to socialize among the year groups. The Board is elected twice a year in the beginning of a semester, which gives the board members flexibility to participate in activities arranged by Nanorama and the opportunity to leave the Board after a short term to focus on their studies.

Among the activities in 2007 was the participation in the yearly race "The Aarhus 1900 relay". In this event the nanoscience students were represented by two teams and a large backing group supporting them with food, drinks, and encouraging shouts.

Other extracurricular events arranged by Nanorama include company visits, Christmas lunches, etc. We also plan to arrange a panel discussion with people from a trade union, the industry and a psychologist and a recently graduated student who will answer questions from the audience about career possibilities after graduation.

6th iNANO Annual Meeting 2008:

Getting ready for the nanotech revolution

As nanoscience begins to spawn a rapidly increasing nanotechnology industry, it is of utmost importance to investigate the effects of nanomaterials on human health and the environment in due time. This was one of the key messages from the iNANO meeting 2008.

By Rolf Haugaard Nielsen, Science journalist

The increasing ability to manipulate matter at the atomic scale may enable a broad range of beneficial applications in electronics, green chemistry, health care, medicine, cosmetics, textiles, materials, and engineering. Pertinent to the implementation of these promising nanotechnologies is a thorough understanding of the interactions between nanoscale materials, human health, and the environment.

Even though information on nanomaterial-biological interactions is currently being gained from a broad array of animal models and laboratory assays, Stacy Lynn Harper from the Oregon Nanoscience and Microtechnologies Institute spelled it out clearly: "We are starting from scratch". On the other hand, as the new science of nanotoxicology picks up speed during the burgeoning years of the nanotech industry, we still have a timely opportunity to obtain comprehensive data on the health and environmental effects of nanomaterials and to develop science-based design principles for high-performance and environmentally benign materials.

"Public perception is the most important aspect since it may hinder support and progress for nanotechnology. Activists are already making the case that untested nanomaterials are being forced on the public, and the absence of nanotoxicological data is not helpful", Stacy Lynn Harper emphasized.

A global knowledge base

A thorough knowledge of nanomaterial-biological interactions can only be obtained from the inclusion of the entire body of data produced from global efforts in the field. Thus, a collaborative and intelligent information system capable of integrating all relevant data is required to elucidate the underlying principles of the interactions between nanomaterials and biological systems. To achieve this goal the Origon State University is developing a global knowledge base of Nanomaterial-Biological Interactions.

This NBI knowledge base will serve as a repository for data of nanomaterial characteristics such as purity, electronic properties, size, shape, and composition as well as synthesis methods and interactions with biological systems. These interactions must be defined at multiple levels – molecular, cellular, and organismal – to provide a framework for extrapolations to relevant scenarios.

"We aim to identify key parameters required to predict the biological interactions of new nanomaterials. Such predictive models may assist industry in designing safe nanotechnologies by identifying benign and toxic nanomaterials at a very early stage of development", Stacy Lynn Harper said.

Toxicology in zebrafish

Speaking of her own research, Harper told the audience about a new and promising animal model for nanotoxicology research; zebrafish. Today cell culture studies are often preferred because they are rapid, efficient and cheap. However, direct translation to humans may be problematic due to health risks. Animal studies mostly employ rodent models, which are generally expensive and time-consuming.

"A pair of zebrafish produces 200-300 embryos per week, and it is cheap and easy to house huge samples. The zebrafish genome is very well known, and most of the body organs develop within 48 hours. Thus, toxicological investigations can often be completed within a few days. Furthermore, zebrafish are transparent, making it easy to spot malformations without interfering", Stacy Lynn Harper said.

Magic with benzene rings

Prominent among the emerging nanotechnologies is the utilization of organic semiconductors

6th iNANO Annual Meeting 2008

in electronic and optoelectronic devices such as field-effect transistors, light-emitting diodes and solar cells. In his talk Klaus Müllen from the Max-Planck-Institute for Polymer Research in Mainz emphasized that the development of efficient devices requires careful molecular design and complex supramolecular architecture. "We need the right molecule, and we must create a macroscopic state", Klaus Müllen said.

In a synthesis-driven approach towards molecular electronics Müllen and his co-workers use the benzene ring as a versatile building block, and in a tour-de-force he showed the audience a vast amount of structures that can be produced by self-assembly processes. Starting with 1D polyphenylenes Klaus Müllen proceeded to 3D structures as beautiful as snowflakes and then presented the synthesis and characterization of giant 2D graphenes.

In solution these graphene discs can assemble into columns that can lead current along their cores with very high charge carrier mobility, enabling fast switching. By controlling the processing conditions, these columns can assemble edge-on a surface in order to transport current from the source to the drain in a field-effect transistor, or stack face-on. Such vertical columns with built-in dye molecules are favourable for applications in organic light-emitting diodes or solar cells, where light has to be transported into or out of the device.

Nanotech for solar energy

"Energy is the biggest problem of humanity", said Michael Grätzel from Ecole Polytechnique Fédérale de Lausanne at the beginning of his talk. "The demand for energy is expected to double in 25 years, and we do not know how to fill the gap when oil production declines".

Renewable energy sources will be much in need, and solar energy is attractive because solar panels occupy very limited land areas compared to growing crops for production of bioethanol. "There is a lot of sunshine out there. Solar cells could supply substantial amounts of power to the grid and electricity for plug-in hybrid vehicles, provided we develop efficient methods to store electricity", Michael Grätzel said.

Nanotechnology may lead to breakthroughs for cheap and efficient solar cells as well as high-capacity batteries that can be recharged quickly. For cathodes in lithium ion batteries Grätzel's group is developing cheap, safe and environmentally benign materials such as lithium manganese oxides. Large particles of these oxides are too sluggish to recharge, but nanocrystals perform well. "As we go from micron-sized particles to nanocrystals, recharging may be up to a million times faster", Michael Grätzel said. In the experimental batteries the insulating nanocrystals are coated with a conductive additive that forms a continuous network allowing charges to zoom across the particle surfaces. Redox reactions are used to drive the charges.

Grätzel is most renowned for his work on dye-sensitized solar cells. These thin film solar cells are based on a multitude of nanoparticles of the semiconductor titanium dioxide, which are coated with a dye that absorbs photons from sunlight. The dye molecules transfer energized electrons through the TiO_2-particle network to the electrode. Electron holes are left behind in the dye layer, and those holes are filled with low-energy electrons from a counter electrode, allowing the cycle to be repeated over and over again. Commercial production of dye-sensitized solar cells has just begun in the UK, and these cells can serve as building materials and may be used for architectural and decorative applications. They are also making their debut in electronic devices such as mobile phones.

Today dye-sensitized solar cells convert 11 per cent of the energy from sunlight into electricity compared to 20 per cent for standard silicon solar cells. Field tests have shown, however, that dye-sensitized solar cells work well in the relevant temperature range from 25-65 degrees Celsius, whereas the efficiency of polycrystalline silicon cells declines by 20 percent over the same range. The Grätzel cells also collect more sunlight during the entire day due to a lower sensitivity to the angel of incidence.

"In a new European consortium we aim to improve the efficiency to 14 per cent by optimizing the nanostructure of the semiconductor particles and by adding infrared sensitizers to the ruthenium dye", Michael Grätzel told the audience.

Tuning mesoporous crystals

Osamu Terasaki from Stockholm University in Sweden spoke of mesoporous crystals, which are micron-sized crystals with pores measuring only a few nanometres. These highly ordered crystals have attracted great scientific interest because of the potential applications in catalysis and sensing due to their large surface area, tuneable pore size, well-defined structure and modifiable surface properties. For example, the ability to design morphologies is important in catalysis, where the size and shape of the porous supports for the catalytically active nanocrystals influence both the activity and selectivity of many chemical reactions.

Mesoporous crystals can also be used as templates for growing single-walled carbon nanotubes and silicon nanowires, Terasaki told the audience. Lately he and his co-workers have succeeded in growing crystals with chiral pores using amino acids as templates. Chiral structures are mirror images of each other and can be compared to the left and right hand. They are common in biology, where one chiral form usually dominates – some notable examples are amino acids and DNA – but rare in inorganic materials. Chiral mesoporous crystals may be useful as biocompatible materials for implants as well as for drug delivery applications.

Moving towards efficient drugs

Nanoparticles as drug delivery vehicles have high priority in nanomedicine research since they can be designed to hide from the immune system in the blood stream and release their drug directly into the target cells.

In his lecture Ernst Wagner from Ludwig-Maximilians Universität in Munich told the audience about nanoparticles that home in on the EGFR receptor that is over-expressed on the surface of certain cancer cells and subsequently enter these cells. When the drug is released inside the tumour cell, the cell commits suicide with minimum effect on the healthy cells in the body.

This strategy has proven extremely efficient in mice for treating glioblastoma, which is the most lethal brain cancer in humans. The drug was double-stranded RNA that induces apoptosis in cells, and it was shielded by polymer nanoparticles equipped with the hormone that actives the EGFR receptor.

Particularly impressive is a strong bystander effect that inhibits the growth of adjacent, untransfected tumour cells. This effect is mediated by interferon produced by the transfected cells. In the mice model all controls died, while all treated mice remain free from cancer a year after the experiment. The treatment had no obvious adverse effects on the normal brain tissue.

In the animal experiments the nanoparticles were directly pumped into the tumours using osmotic micro-pumps. This technique is not an option in the human trials being planned at the moment, but for obvious reasons Ernst Wagner was rather tight-lipped about the exact method to be applied in brain cancer patients.

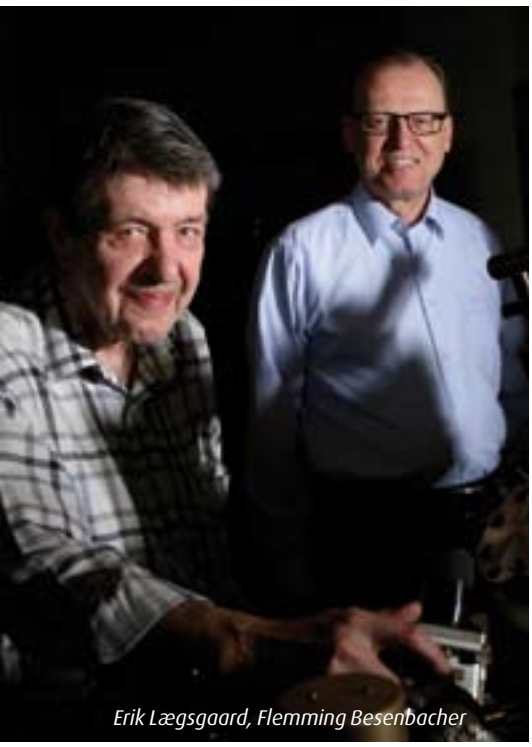
Progress in nanomedicine

Jeffrey Schloss from National Institute of Health (NIH) in Maryland, USA, gave a fascinating overview of the large number of research projects supported by the NIH Nanomedicine Roadmap.

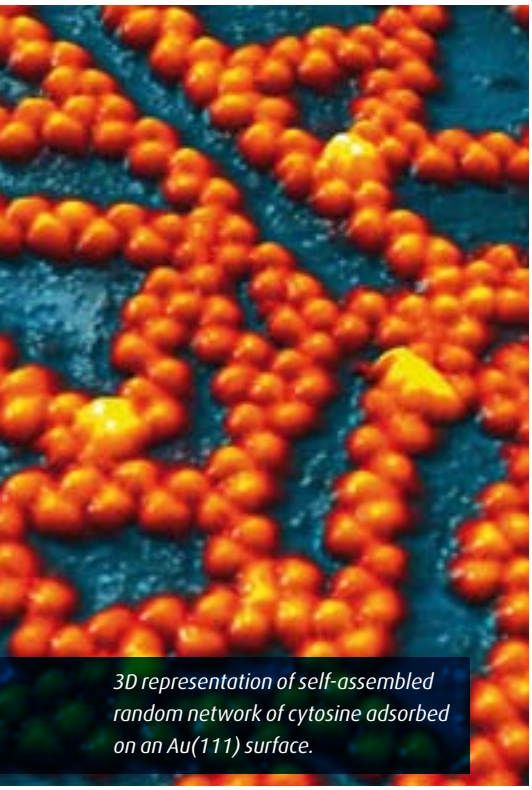
This programme spans the entire spectrum from basic science to the clinic. "Operating on the same size scale as does molecular biology, nanotechnology offers unique means to measure and manipulate biological systems, revealing information that is otherwise difficult or impossible to obtain", Jeffrey Schloss said. "This may help us to fulfil the broad goals of nanoscience and nanotechnology research at the NIH, which are to improve our capabilities to detect, diagnose, treat, and ultimately prevent, diseases and disabilities".

After his talk Jeffrey Schloss was asked by the audience "which of the many ships that have been sent to sea are most likely to reach the harbour?" Schloss answered: "In five years we will be a lot better at doing things we already know how to do, and this may lead to clinical applications of nanotechnology for diagnostics and drug delivery. Meanwhile, imaging techniques will improve our basic understanding of diseases such as cancer, neurodegenerative diseases and arthrosclerosis. In the longer perspective I guess that entirely new paradigms will emerge from the on-going nanomedicine research".

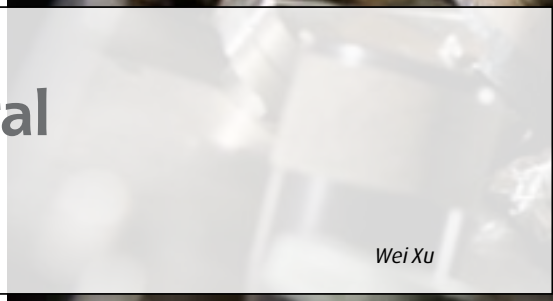
Identifying elementary structural motifs in a 2D organic glass



Erik Lægsgaard, Flemming Besenbacher



3D representation of self-assembled random network of cytosine adsorbed on an Au(111) surface.



Wei Xu

The microscopic description of glasses and amorphous solids is very challenging because of the lack of long-range order in their structure. From interplay between imaging with submolecular resolution and theoretical calculations a breakthrough made at iNANO provides a new framework for understanding medium-range order in amorphous and glassy systems.

By Wei Xu, Erik Lægsgaard and Flemming Besenbacher

Glasses and amorphous solids such as plastics, expanded polystyrene and foam rubber are materials whose atomic or molecular constituents lack long-range order in their structures, and this poses a tremendous challenge to the microscopic description of their structures. Using the extremely powerful in-house built Aarhus Scanning Tunneling Microscope (STM) we have identified the medium-range ordering of a 2D organic glass in real space for the first time, thus providing a general methodology to study the glassy systems at the submolecular scale. The breakthrough simplifies enormously the task of understanding - and predicting - the structure of glass and other amorphous materials from first-principle calculations. This new insight may lead to new high-tech applications.

A model system of 2D organic glass

The structure of amorphous solids has traditionally been studied by diffraction techniques, which provide a very detailed description of such materials at the macroscopic scale. However, much less is known about the local structure of disordered solids at the molecular scale.

Some organic molecules can form hydrogen bonds via peripheral functional groups that may be distributed in a highly anisotropic way. These molecules have the potential to organize in random arrangements when deposited on an atomically flat solid surface. The structure and dynamics of such systems can be addressed by scanning probe techniques at the molecular level, provided the adsorption geometry is planar. Thus, they have the potential to become a model system for studies on the structure of amorphous solids.

The scientists at iNANO investigated the structure of a disordered cytosine network on a gold surface. Experimentally we found that the cytosine molecules are sufficiently mobile on the surface, so that the molecular layer can be considered as a two-dimensional fluid at room temperature. Upon quenching to temperatures below 150 K, a random cytosine network which may actually represent a 2D glass is formed.

Elementary structural motifs

By means of variable-temperature STM we obtained real-space molecular-resolution information on the disordered cytosine network on the Au(111) surface. The observed network is disordered in two dimensions, but all the molecules lay flat on the substrate, allowing direct inspection by STM, the technique of choice for revealing the atomic-scale realm of matter.

An outstanding student from China

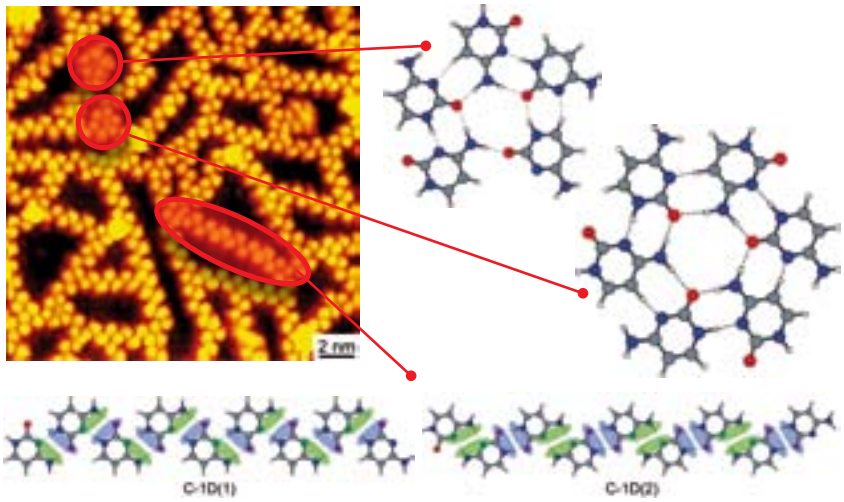
Wei Xu finished his Bachelor's degree in physics at Hebei University. In 2003 he arrived in Denmark to take his Master's degree in technical physics at the University of Aarhus and was subsequently in 2004 accepted as a PhD student at iNANO in the SPM group under the supervision of Professor Flemming Besenbacher.

During his four-year PhD study Wei Xu has worked very hard, he has shown a great ability to perform experimental research of a very high standard, he has matured significantly and is today regarded as a truly outstanding student. Wei Xu has made many novel and exciting discoveries about the self-assembly of biologically relevant organic molecules on surfaces, and his results have been published in leading scientific journals such as Science, Physical Review Letters, Journal of the American Chemical Society, and Small. In the fall of 2008 Wei Xu will take up a postdoc position at Penn State University in the USA to develop his research potential further.

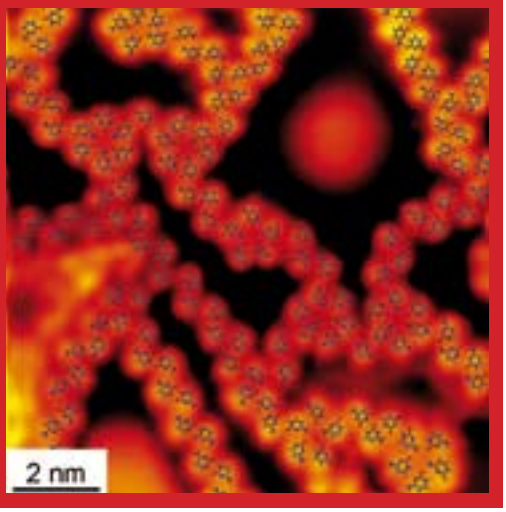
Our experiments in conjunction with a systematic theoretical analysis of possible interconnections between cytosine molecules allow us to identify a small amount of nanoscale elementary structural motifs such as zigzag filaments and polygonal rings. In fact the disordered cytosine network can be explained by putting together these fundamental building elements in all possible ways; an analogue is a complex structure built from a few types of LEGO blocks.

The identification of such elementary structural motifs opens a new avenue to understand medium-range order in amorphous and glassy systems, which is of utmost importance in materials science. The motifs explored in this study may be widespread among amorphous solids, and systematic investigation of elementary structural motifs and their possible interconnections can enormously simplify the task of understanding glassy structures from first-principle calculations.

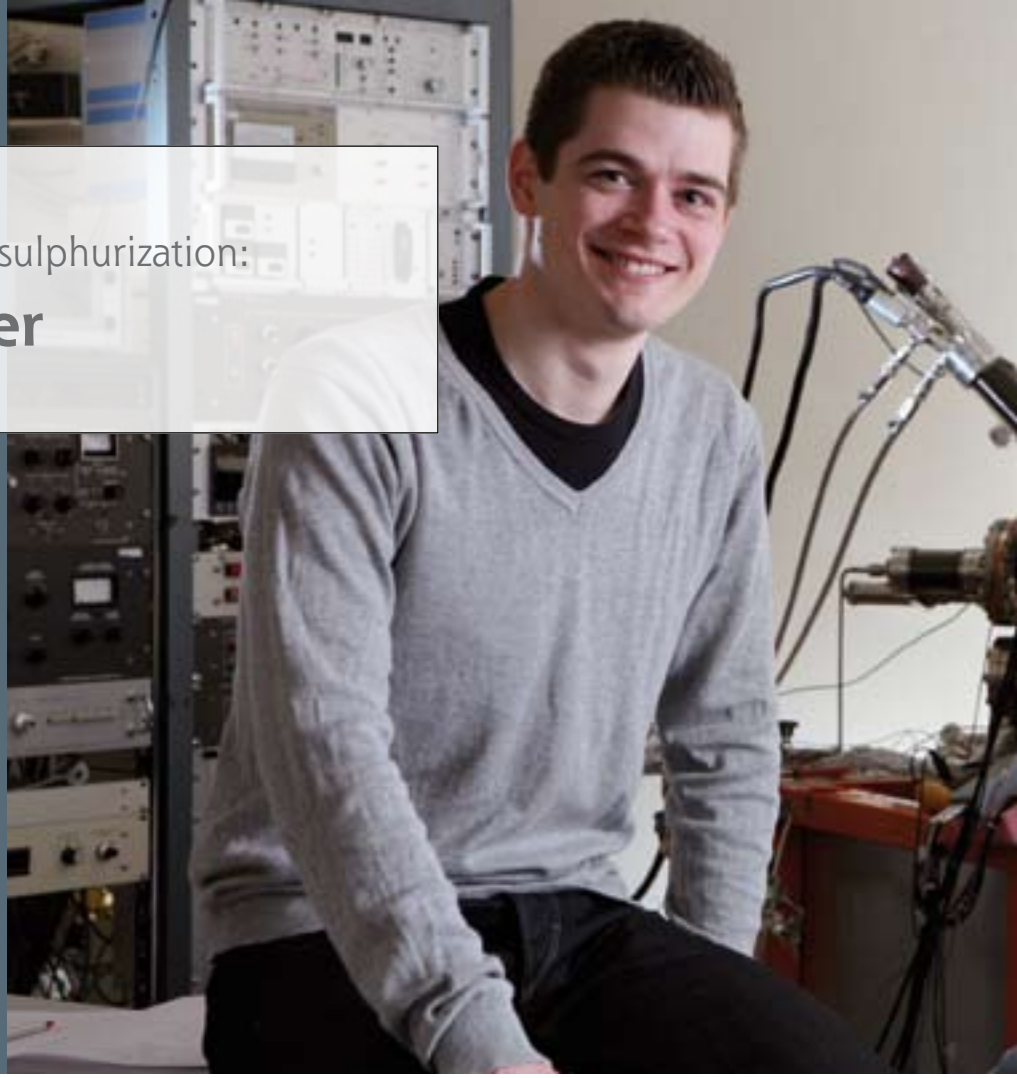
The results were obtained in a joint effort between the SPM group at the University of Aarhus and the theory group from King's College London: R. Otero, M. Lukas, R. E. A. Kelly, W. Xu, E. Lægsgaard, I. Stensgaard, L. N. Kantorovich and F. Besenbacher, Science 319, 312 (2008).



Three elementary structural motifs – a filament, a 5-fold ring and a 6-fold ring - are compared with the theoretical models.



STM image of a 'glassy state' of cytosine on the gold surface. The overlay illustrates how a few elementary hydrogen-bonded structural motifs and their possible connections explain the image.



MoS_2 nanoclusters for desulphurization: Size does matter

When materials are reduced to the nanoscale, new interesting structural and electronic phenomena often occur. At iNANO we have revealed a novel size- dependent morphology of MoS_2 nanoclusters. These nanoclusters constitute the active species of the environmentally highly important desulphurization catalyst.

By Jakob Kibsgaard, Jeppe V. Lauritsen, and Flemming Besenbacher

Within the science of nanomaterials it is well known that "small is different", and properties such as conductivity, colour, reactivity, magnetism, and melting point may be entirely different for a nanoparticle compared to the same material with macroscopic dimensions. Obviously, dimensions are an important parameter to consider in the development of new nanomaterials; in particular when it comes to catalysis, where the active materials are confined to a limited number of metals. Thus, tuning the size of the catalytic nanoparticles may be a promising way to develop new and better catalysts.

The molybdenum disulphide (MoS_2) based desulphurization catalyst constitutes one of the most important environmental catalysts as it removes sulphur from fossil fuels. Without this removal, the sulphur would cause massive acid rain problems such as forest decline. The recent focus on environmental issues and a stricter legislation on the sulphur content in fuels have generated great interest in understanding and improving the desulphurization catalyst.

To gain a basic atomic-scale insight into the morphology of the active catalyst and the desulphurization process we have used the Scanning Tunneling Microscope (STM) at iNANO to study the catalytic active MoS_2-based nanoparticles.

Size-dependent structure and magic size particles

In the desulphurization process hydrogen reacts with sulphur atoms located on the edges of the triangular MoS_2 nanoparticle to form hydrogen sulphide, which is removed from the reactor. Soon the resultant vacancy at the nanoparticle edge is filled with sulphur containing oil molecules, which are subsequently removed, leaving the sulphur atom behind; the catalytic cycle is closed.

In 2007 we revealed that the morphology of MoS_2 nanoparticles is extremely dependent on their size. The experiments were conducted by synthesizing a variety of MoS_2 particles with different sizes and analyzing their morphologies in STM images with atomic resolution.

All MoS_2 nanoparticles, independent of their size, display a very distinct triangular shape. However, a detailed analysis reveals a change in the edge structure when the particle size is reduced to less than 100 atoms in total. As the particle size decreases below this limit, the stoichiometry of the nanoparticles deviates from the bulk MoS_2 value as the relative sulphur con-

The STM microscope zooms in on individual atoms

The working principle of the STM is that a sharp tip is raster scanned across the sample. By varying the height of the tip above the sample according to a small current between the tip and the sample, topographical images of the sample can be created.

What sets the STM apart from all other structural techniques is its ability to resolve the individual atoms in, e.g. nanoparticles. The STM images allow direct identification of defects or other features constituting the active catalytic sites, which are almost impossible to observe with averaging spectroscopic or diffraction techniques.

Jakob Kibsgaard,
Jeppe V. Lauritsen

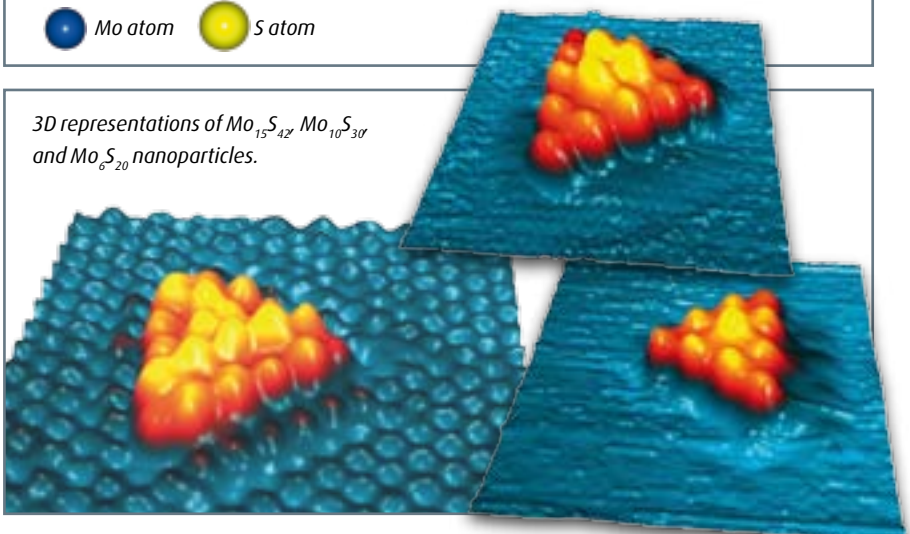
A PhD student makes the cover of Nature Nanotechnology

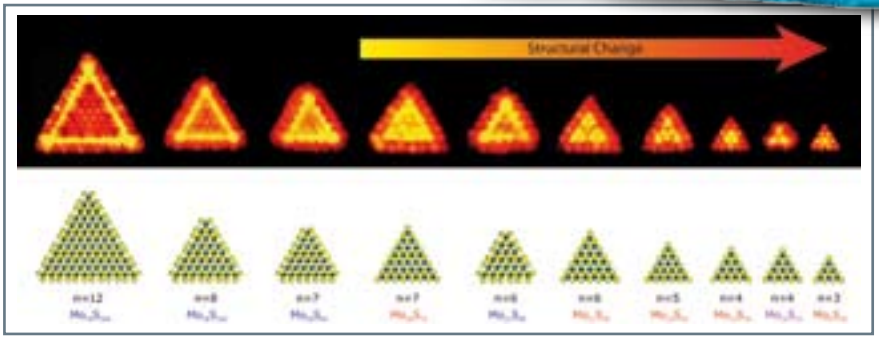
It is not common for a PhD student to make the cover of a high-ranking journal like Nature Nanotechnology, but Jakob Kibsgaard did it. He is 27 years old and was admitted to the physics and chemistry study at the University of Aarhus in 2000. In 2003 he was a summer student at Haldor Topsøe A/S. Since August 2004 Jakob Kibsgaard has been enrolled as a PhD student in physics and nanoscience at iNANO and the Department of Physics and Astronomy, working on a PhD project co-financed by Haldor Topsøe A/S. In his PhD project Jakob has used STM to investigate various aspects of MoS_2-based desulphurization catalysts, e.g. the effects of promoter atoms and the support.

STM image and ball model of a MoS_2 nanoparticle with 8 Mo atoms along the edge. The ball model (top and edge view) show the pairing of the edge-terminating S dimers that favour particles with an even number of Mo atoms along the edge.

Mo atom *S atom*

3D representations of $Mo_{15}S_{42}$, $Mo_{10}S_{30}$, and Mo_6S_{20} nanoparticles.





Gallery of different MoS_2 clusters.

tent increases. The observed change in edge structure occurs to lower the sulphur to molybdenum ratio in these small particles since they become unstable if they are too rich in sulphur.

The experiments also demonstrated that for particles with more than 100 atoms only particles with a certain "magic" number of molybdenum atoms are stable. This effect is caused by the tendency of the edge-terminating sulphur dimers to pair up favouring particles with an even number of molybdenum atoms along the edge of the particle.

The discovery of the size-dependent shape of MoS_2 nanoparticles may help improve industrial catalysts. The chemical and thus catalytic properties are affected when the edge structure is changed. The results suggest that tailoring the nanoparticles to a specific size can help optimize the desulphurization activity.

The described results were published by J.V. Lauritsen, J. Kibsgaard, S. Helveg, H. Topsøe, B.S. Clausen and F. Besenbacher in Nature Nanotechnology vol. 2, 2007.

Nanocrystals for the next generation of solar cells

Mads Møgelmose Kjeldsen,
Arne Nylandsted Larsen

Collaboration with industry

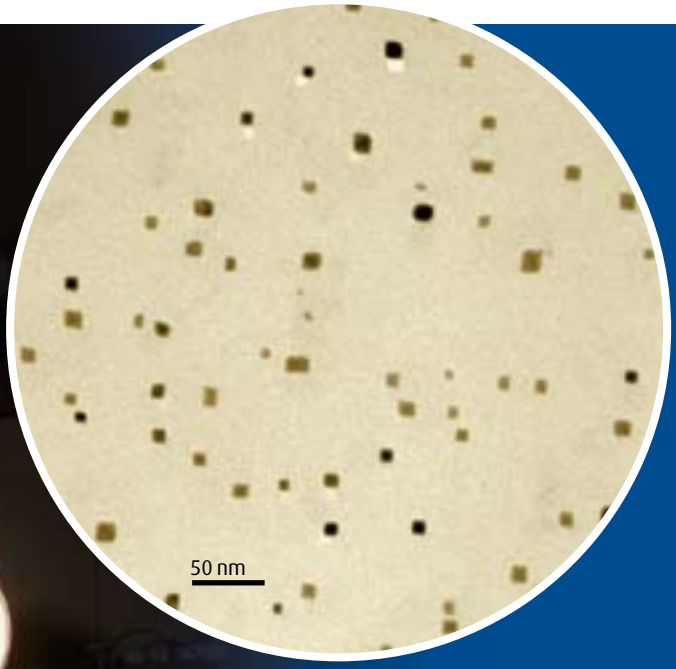
The Semiconductor Group at iNANO and Department of Physics and Astronomy collaborates closely with the Danish solar cell company RAcell Solar A/S on the development of third-generation solar cells based on nanotechnology, and with RAcell Solar A/S and the Norwegian producer of silicon feed stock material, Elkem, on the use of metallurgical grade silicon for first-generation solar cells.

Solar cells are key components in establishing a CO_2 free, sustainable energy source. Materials with incorporated nanostructures are predicted to improve the efficiency of solar cells by increasing the harvest of unused energy from the sun.

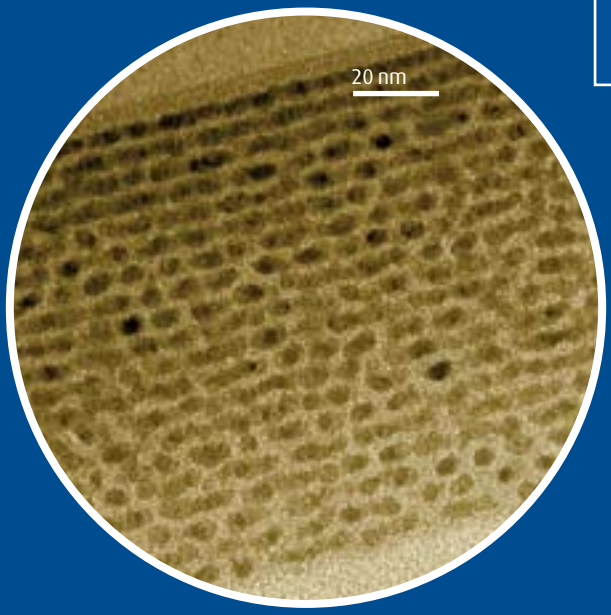
By Mads Møgelmose Kjeldsen and Arne Nylandsted Larsen

A solar cell is a device that converts sunlight directly into electricity, and solar cells are of great interest because they provide a carbon-free, sustainable energy source. The most important properties of solar cells are their cost and efficiency. The efficiency of a solar cell is the proportion of the energy in the sunlight that is converted into electricity. Thus, a good solar cell has high efficiency and/or can be produced at a low cost.

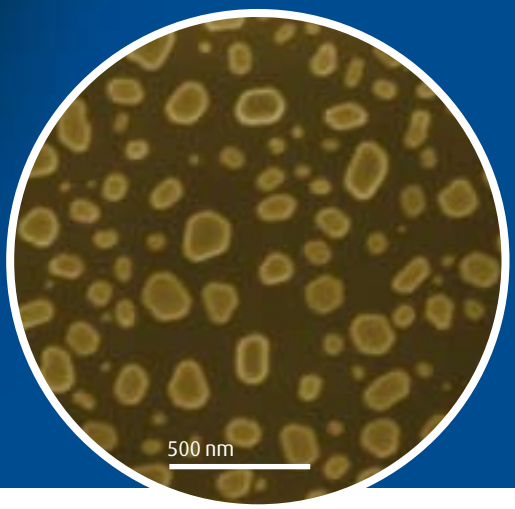
Today conventional solar cells have efficiencies at about 20 per cent. A typical price per kWh is $ 0.20, which is too high to compete with electricity produced from fossil sources - competition requires a kWh price of about $ 0.02. A reduced price per square meter or an increased efficiency is two ways to achieve this goal. The Semiconductor Group at iNANO and the Department of Physics and Astronomy undertakes research activities following both paths.



This Transmission Electron Microscopy (TEM) image shows tin nanostructures. The nanocrystals have rectangular shapes and sizes around 10 nm.



The TEM image shows a multilayer structure of germanium nanocrystals incorporated into a silicon dioxide matrix. This structure may significantly increase the generation of current inside the solar cell.



This Scanning Electron Microscopy (SEM) image shows gold nanodots on the top-surface of a silicon substrate produced by evaporation of a 10 nm thick gold layer followed by heat treatment at 500 °C for 15 min.

Today most solar cells are made of silicon because this material is abundant, has good electrical properties and the silicon technology is very advanced. However, due to its indirect band gap silicon is weak at absorbing light. This is where nanoscience comes to the rescue. In sufficiently small nanocrystals the band gap becomes quasi-direct, which gives rise to strong light absorption. Thus, the optical properties of silicon can be improved by adding nanocrystals. Our research is focused on exploring the properties of nanostructures in semiconductor materials and applying them in solar cells.

Increasing the current

Since silicon is the favourite material for commercial solar cells, we experiment with silicon-based structures containing nanocrystals of silicon or other materials. Inside the solar cell nanocrystals are used to increase the generation of current. In this context silicon and germanium are of particular interest because they are both fairly easy to work with in the laboratory and fully compatible with the silicon technology.

In silicon-based tandem solar cells the top cell is based on nanocrystals, while the bottom cell is a standard silicon cell. In such tandem cells the band gap of the top cell should ideally be around 1.6 eV. This can be achieved most easily by means of silicon nanocrystals, but light absorption is theoretically expected to be strongest in germanium.

Harvesting more sunlight

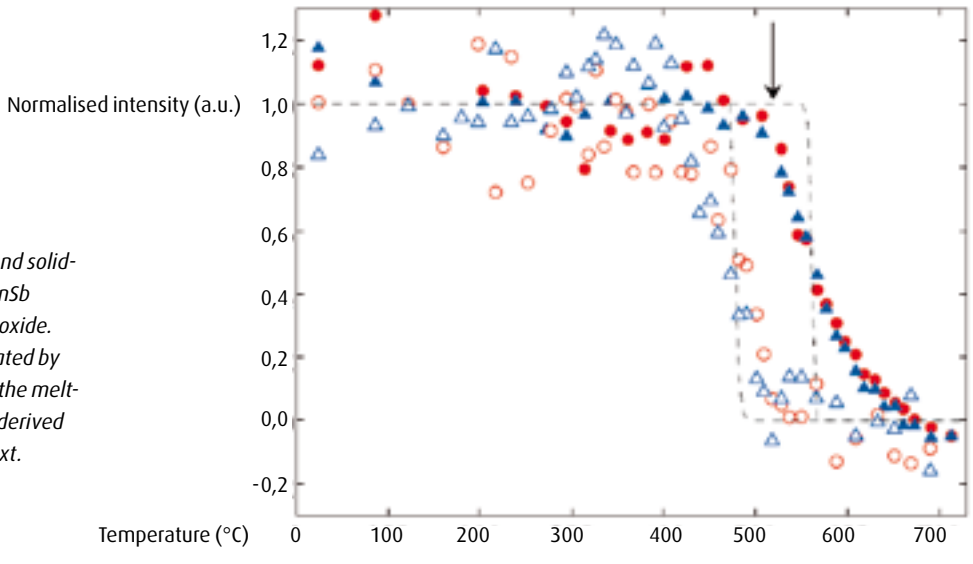
Nanostructures close to the surface of the solar cell can improve the coupling of the light into the solar cell via excitation of localized surface plasmons. Metals are useful for this purpose, and we are in particular studying the effect of silver and gold nanoparticles as their resonance frequencies match the solar spectrum. One element of special interest is tin due to the fact that tin is able to crystallize in two different structures - as a semiconductor and as a metal - depending on the processing conditions. Hence tin nanostructures might be useful inside the solar cell and on the surface as well. We can now produce both semiconductor and metal tin nanocrystals in thin layers of crystalline silicon - and currently we are studying their optical properties.

The entire solar spectrum

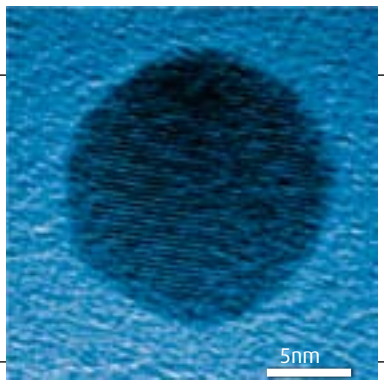
The greatest challenge in solar cell design is to combine materials in such a way that all the different wavelengths of the sunlight are efficiently used to generate current in the cell. In this context nanocrystals has a great advantage because their properties can be controlled by changing their size and shape. In the future the utilization of nanocrystals may make it possible to design a solar cell tailored to capture the entire spectrum of light from the sun.

Superheating and undercooling of nanocrystals

Amélie Têtu,
Brian Bech Nielsen



Measured melting (solid symbols) and solidification (open symbols) curves for InSb nanocrystals embedded in silicon dioxide. The bulk melting temperature indicated by an arrow. The dashed lines indicate the melting and solidification temperatures derived from the model mentioned in the text.



Transmission electron microscope picture of an indium antimonide (InSb) nanocrystal embedded in silicon dioxide. The crystal structure is revealed by the interference pattern observed as parallel lines across the crystal.

Standard thermodynamics cannot explain why some nanocrystals embedded in a host material melt at temperatures well above the bulk melting temperature. Now these unusual observations have found a qualitative explanation.

By Amélie Têtu and Brian Bech Nielsen

Melting is probably the most familiar phase transition, and it may come as a surprise that we still have something to learn. However, as we move our attention to smaller and smaller systems the surface begins to reveal itself in the physical properties of the systems.

We are used to the fact that at a given pressure the melting of a solid body occurs at a constant temperature - the bulk melting temperature. However, this is true only for macroscopic bodies, which we may define simply as bodies that are visible to the naked eye. For very small free-standing particles with diameters in the nanometer range standard thermodynamics predicts that the melting temperature decreases as the particle size gets smaller. Thus, we expect that the melting temperature of a nanoparticle must be lower than the bulk melting temperature for the same material.

Amorphous host material

This expectation is often confirmed by detailed experiments, but in a handful of cases nanocrystals embedded in a crystalline host material melt at a temperature exceeding the bulk melting temperature. This so-called superheating has often been explained by the suppression of the vibrational motion of surface atoms of the nanocrystal due to their well-ordered bonding to the surrounding crystalline medium. However, recently Xu and co-workers from the University of California in Berkeley reported superheating of germanium nanocrystals embedded in an amorphous silicon dioxide, where well-ordered bonding is impossible.

We have demonstrated that superheating also occurs for indium antimonide (InSb) nanocrystals embedded in amorphous silicon dioxide; the bulk melting temperatures are 527o C for InSb and 1650 o C for SiO_2. In agreement with Xu and co-workers we also find that the melted nanocrystals may be undercooled before they solidify and regain their crystal structure at a temperature well below the bulk melting point.

Explained by nucleation theory

We have successfully modelled both the superheating and the undercooling with classical nucleation theory without the need to invoke suppression of the vibrations of surface atoms.

At the bulk melting temperature a free-energy barrier separates the solid and the melted phase of the nanocrystal, and additional thermal energy – which is the same as higher temperature - is needed to pass over it. According to the model the parameter that controls the barrier height is the interface energy between the solid and the melt. For InSb the density of the melt is 11 per cent higher than for the solid, and this substantial difference implies a large interface energy due to the mismatch between the interatomic distances in the solid and the melt. Hence the unusual observation of superheating finds a rather simple qualitative explanation.

Internationalization at iNANO

Amélie Têtu, a 28-year old Canadian subject, began her PhD studies at iNANO in 2004. Since then she has been working with photonic band gap materials and properties of InSb nanocrystals. Amélie was awarded the PhD degree in January 2008 after a very successful oral defence of her thesis.

Amélie received her Master's degree from Laval University in her home city of Québec, but decided to continue her training in Aarhus: "I wanted to do my PhD at another institution and in another country, because I think it is a good way to gain experience. Denmark has a reputation for excellent research, and I knew of a group doing nice work in the field of optics, so I contacted the group and got a position as a PhD student".

In Canada the PhD training takes from four to seven years, and there are no teaching obligations. At iNANO Amélie's training period was only three years and included teaching obligations. "This implies that there is much more collaboration within a group, which, I think, is much closer to a working environment in industry".

Amélie now masters the Danish language fluently. She says: "It was not easy to integrate myself, but I do not think Denmark differs from other countries in that respect. I knew that I had to learn the language, and this is difficult because all Danes speak English. I do not regret my efforts, however, since I have met some really nice people. "

Soft and small:

Micelles as giant "atoms" with tuneable properties

Micelles formed by block copolymers have found widespread industrial use and have great potential as drug delivery vehicles. Fundamental studies of these extremely versatile systems show that they can be tailored to behave like gasses, liquids and solids.

By Jan Skov Pedersen

Self-assembly based nanostructures are found everywhere in our daily life. Well-known examples are polymers, diary products, cosmetics, pharmaceuticals, paint, ink, lubricants, adhesives and detergents. These systems are referred to as soft matter because they are easily deformed without much effort and without heating. In addition, soft matter is characterized by the fact that major changes in its properties can be triggered by small changes in temperature and concentrations.

A frequent component in commercial soft matter products is block copolymers consisting of two chemically different polymers linked together by a chemical bond. Such block copolymers can spontaneously self-assemble into micelles when dissolved in water. Micelles have a compact core consisting of a polymer that cannot be dissolved in water and a swollen expanded corona of a water-soluble polymer.

We investigate block copolymers containing the most widespread synthetic water-soluble polymer; polyethylene oxide (PEO). Micelles containing PEO in their corona are technologically interesting due to their widespread use in industrial products. They are ingredients of, for example, liquid hand soap, shampoos, and lotions. Furthermore, PEO is a biocompatible polymer, which is not easily recognized by the human immune system. In tailor-made drug delivery particles, PEO therefore provides a 'stealth' property enabling the particle to survive in the body and arrive at the tissue where the drug is to be released.

A very versatile system

We study the fundamental properties of block copolymers with PEO. It is a very versatile system, and the properties of the micelles – as well as of the system they exist in - can be varied by changing the molecular mass of the two blocks of the polymer. For high-mass PEO blocks, the micelles have a large, soft corona and behave like extremely soft spheres, while they are more like hard spheres with shorter PEO blocks and high density of the polymer in the corona.

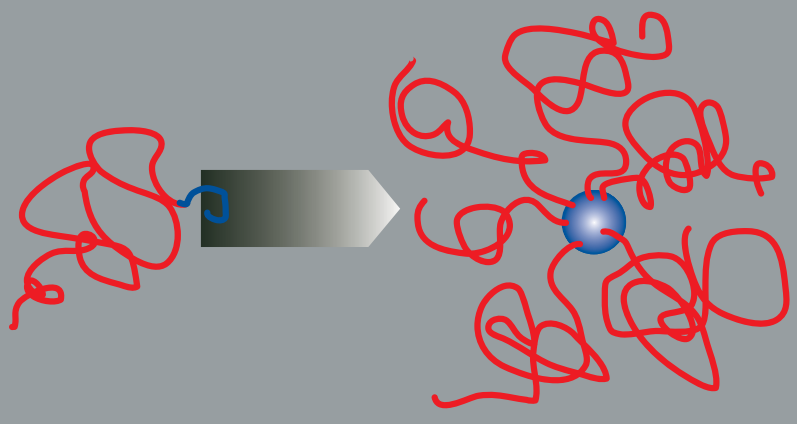
In general the micelles repel each other because overlap of their coronas is unfavourable due to the local high density of the PEO. However, at high temperature close to the boiling point of water the PEO polymers start to attract each other, and the micelle repulsion becomes weaker. If salt is added to the water, the micelles will directly attract each other and form very large aggregates. The interaction between the micelles can thus be tuned and varied in a convenient temperature window to a much larger degree than possible in atomic matter.

Gas, liquid and solid

By varying the temperature and concentration of the micelles in solution, the system displays different states of matter very similar to those of traditional atomic systems. In this challenging model system the micelles act as giant super atoms with tuneable properties, and states of matter such as gas, liquid and solid phases can be studied for a broad range of properties.

Experimental methods

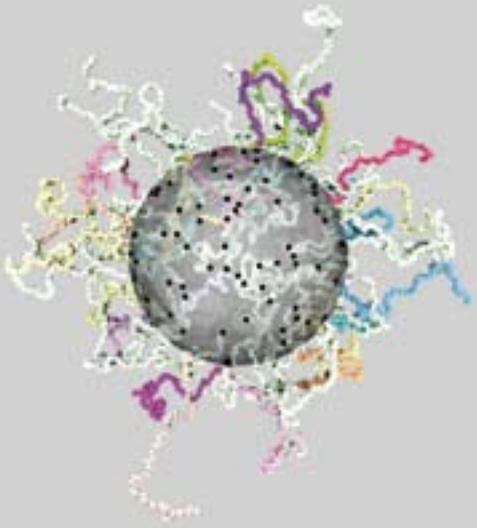
Due to the size of the micelles, the relevant length scale for structural characterization is in the nanometer range. For this purpose we use scattering techniques such as small-angle X-rays scattering (SAXS) and light scattering. These methods do not provide us with direct images of the structure but data in a transformed space, and we are investing considerable efforts in modelling the data. Furthermore, we are currently developing new modelling and analysis tools using computer simulations.



Micelle formation of a block copolymer with a short blue block that is not soluble in water and a long red block that is water soluble. As the copolymer aggregates, a micelle is formed with a compact core of blue blocks surrounded by a diffuse corona of red blocks.

Jan Skov Pedersen

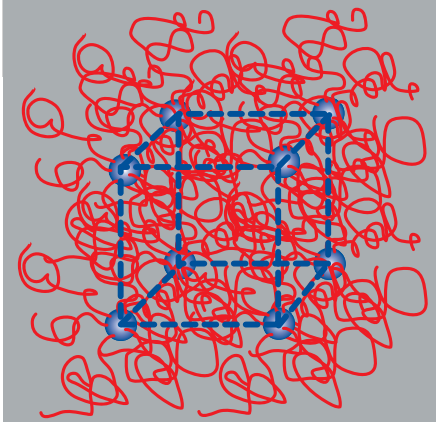
Computer simulation of the three-dimensional structure of a micelle. The core has been cut in two, and only chains attached to the shown part of the core are displayed.



At low concentration, the micelles are in a gas state where they move independent of each other. At higher concentrations, the micelles are still free to move, but arranged like molecules in a liquid with local ordering in neighbouring shells. At higher temperature, this liquid phase may coexist with a solid phase in which the particles are immobilized. At the highest concentrations the micelles can form crystal-like solids where the particles are organized in a regular lattice. Block copolymer micelles are also able to form an amorphous solid similar to glass, where the particles are unorganized as in a liquid but unable to move.

Solid gel-like glassy phases also occur at lower concentrations when the micelles attract each other. This attraction can lead to the formation of clusters of micelles that span the whole sample, while the properties change from liquid-like to solid-like. This particular attractive glass phase is unique for systems with large nanoparticles and demonstrates behaviours not found in atomic systems.

When heating an atomic system, its phases always change from solid to liquid and finally to gas. However, in micelle systems with PEO polymers in the corona increasing temperature can lead to a change from liquid to a solid phase. This fascinating inverse melting behaviour does not occur in any atomic solids.



Solid crystalline phase formed by the micelles at high concentrations. The micelles are organized in a regular lattice.

Telomeric DNA revealed at the molecular level

Victoria Birkedal

In the new single molecule fluorescence laboratory at iNANO we explore the conformations of DNA molecules with telomeric sequences at the molecular level. Telomeres are essential for replication and normal cell function, and they are important targets for anticancer drugs.

By Victoria Birkedal

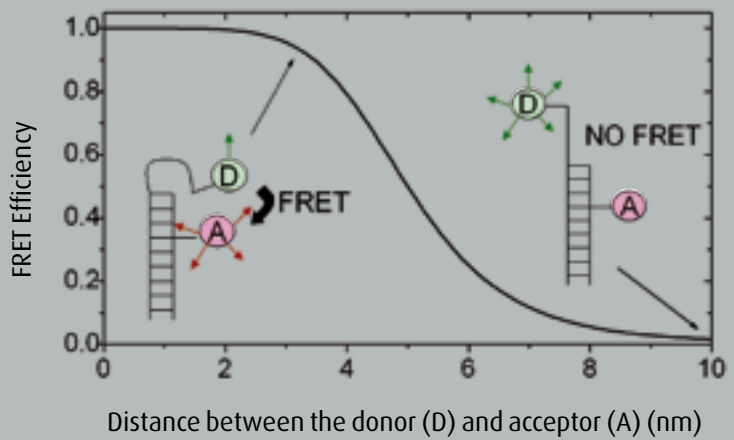
Structure and function of biological molecules are closely related in all living cells. The cell is a small biochemical factory driven by interactions between DNA, RNA and proteins that are based on the recognition of specific structures and conformational changes of these molecules. Elucidating the structures and dynamics of nucleic acids and proteins is thus essential to understand their specific functions. At iNANO, we have built a new fluorescence lab that allows us to study the conformational changes of single biomolecules at the nanoscale. We are now investigating specific DNA structures such as the ones found in telomeres.

Telomeres are situated at the end of the chromosomes inside the nucleus of cells. They are composed of a specific sequence repeated over and over again and contain a double-stranded DNA part that ends with a single-stranded G-rich overhang. Telomeres do not contain genetic information, and they get shorter and shorter with each cell replication. When telomeres become too short, the cell dies. In certain cells, such as stem cells and cancer cells, telomeres can be extended by an enzyme called telomerase. Telomeres and a series of associated proteins are essential for genome integrity and appear to play an important role in cellular aging and cancer protection.

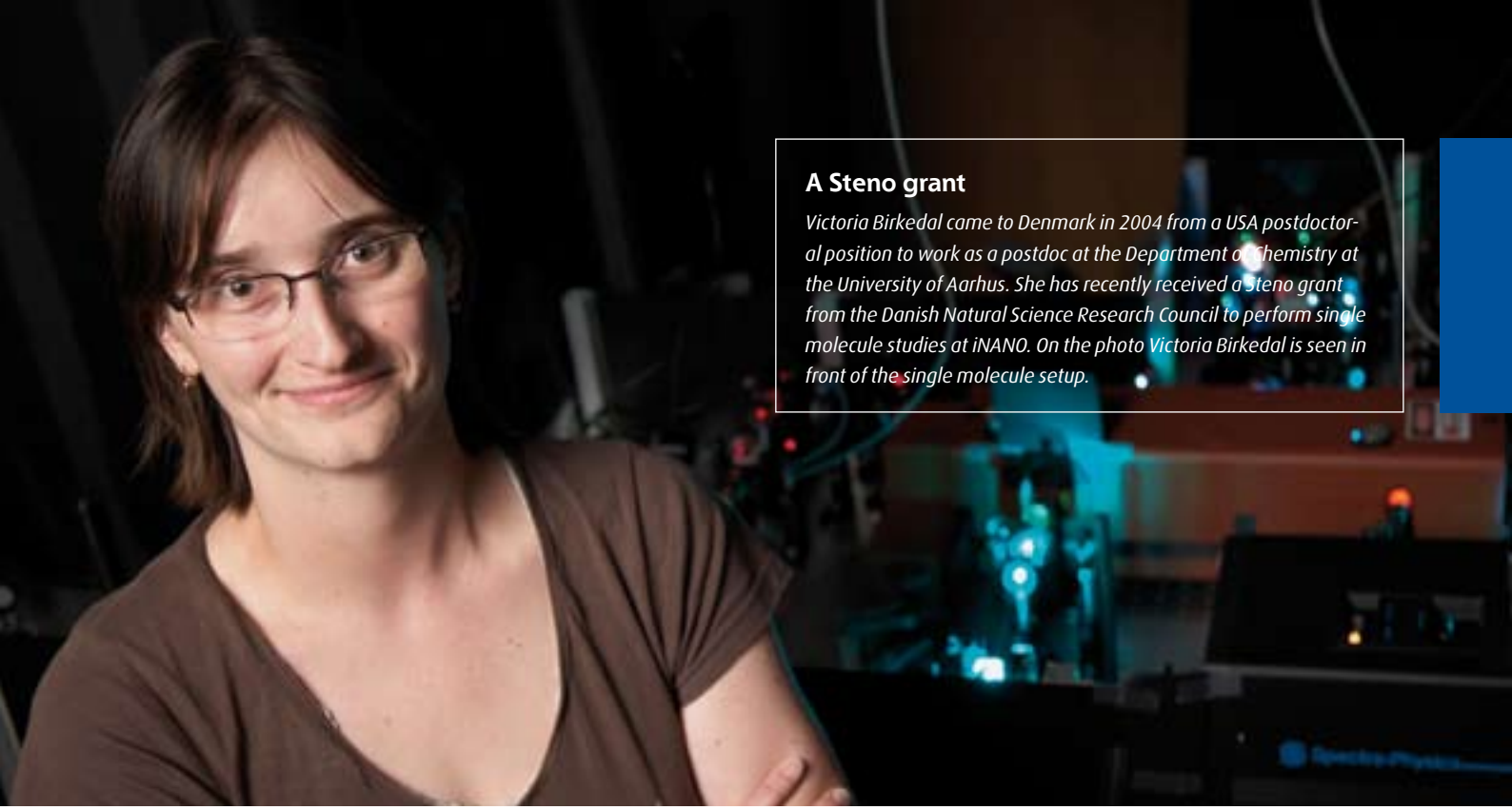
Telomere DNA forms specific structures. One of them, the G-quadruplex, has attracted a lot of interest because it can block telomere elongation by telomerase, and thus it is currently a target for the design of anticancer drugs. We focus our attention on the G-quadruplexes structures of telomeric DNA that can adopt several conformations.

Single molecule detection

Single molecule detection is a powerful technique. It allows us to follow molecules one by one instead of the ensemble average that is obtained by tra-



FRET efficiency is a function of the distance between a donor and acceptor fluorophore pair. The donor is excited by a laser, and if the two fluorophores are close to each other (left drawing), a large acceptor emission is observed. If the fluorophores are too far away from each other (right drawing), only donor emission is measured.



A Steno grant

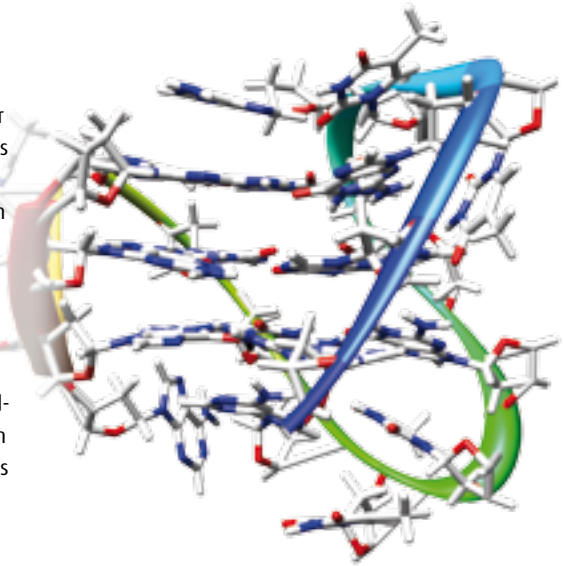
Victoria Birkedal came to Denmark in 2004 from a USA postdoctoral position to work as a postdoc at the Department of Chemistry at the University of Aarhus. She has recently received a Steno grant from the Danish Natural Science Research Council to perform single molecule studies at iNANO. On the photo Victoria Birkedal is seen in front of the single molecule setup.

ditional experimental methods. Single molecule studies thus permit us to uncover the properties of individual molecules and to resolve statistically and dynamically heterogeneous populations that would otherwise be hidden in the ensemble average. They also permit us to detect rare or transient events that are difficult or impossible to synchronize, but may be biologically important. In the case of our investigations of telomere DNA, they allow us to obtain valuable information on a heterogeneous population of G-quadruplexes; about their conformations, their dynamics and how they interact with a number of proteins.

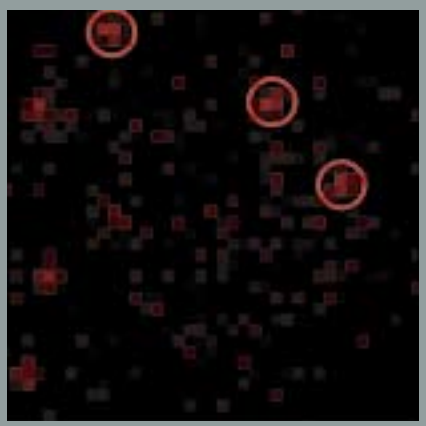
Using optical microscopy it is difficult to obtain a detailed image of a single molecule which is usually smaller than the diffraction limit of visible light at around 200 nm. To obtain information on how molecules change their conformation at the nanoscale, we use a technique called Fluorescence Resonance Energy Transfer (FRET). Here two fluorophores are attached at strategic places on the DNA molecule, and the FRET technique is based on monitoring the energy transfer between the donor/acceptor pair of fluorophores by recording their fluorescence after donor excitation. The energy transfer efficiency depends on the distance between the two fluorophores and allows us to detect conformational changes on the 2-10 nm scale.

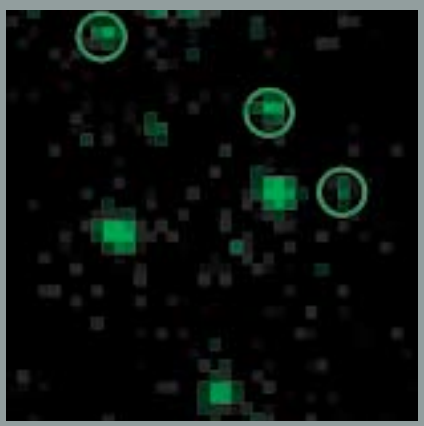
Insights and applications

Our single molecule investigations of the G-quadruplexes reveal a very heterogeneous population with several distinct G-quadruplex conformations coexisting for a given DNA telomeric sequence. Advances in the understanding of G-quadruplex conformations and their dynamics may contribute to areas such as anticancer drug design, nanodevices and salt sensors and improve our basic understanding of the biological function of G-quadruplexes.



The model shows one of the possible conformations of the folded G-quadruplex structure called the hybrid II conformation (PDB: 2JPZ).





Observation of individual G-quadruplex molecules attached to a surface. The left image shows fluorescence from the acceptor and the right image from the donor. The three highlighted events are from single telomere DNA molecules that display FRET with varying efficiencies.

Organising biomolecules to programme stem cells

The use of stem cells may lead to future treatments of a range of deadly diseases. Artificial nanostructured materials containing biological components may be a promising route for programming stem cells in order to harness their therapeutic value.

By Duncan Sutherland

Cells interact with their surroundings as well as material surfaces through a multitude of specific reactions. Receptors on the cell surface bind to particular molecules in the surroundings by a lock and key type interaction, and by utilizing many different receptors that each picks out one particular molecule from thousands, the cell can sense its environment and receive instructions from the rest of the body.

These interactions occur at the nanoscale, and an improved understanding of the importance of geometry and distance at this length scale could lead to the development of smart materials, which are able to manipulate interactions between cells and their surroundings and thus control cellular fate and function.

Cells and their surroundings

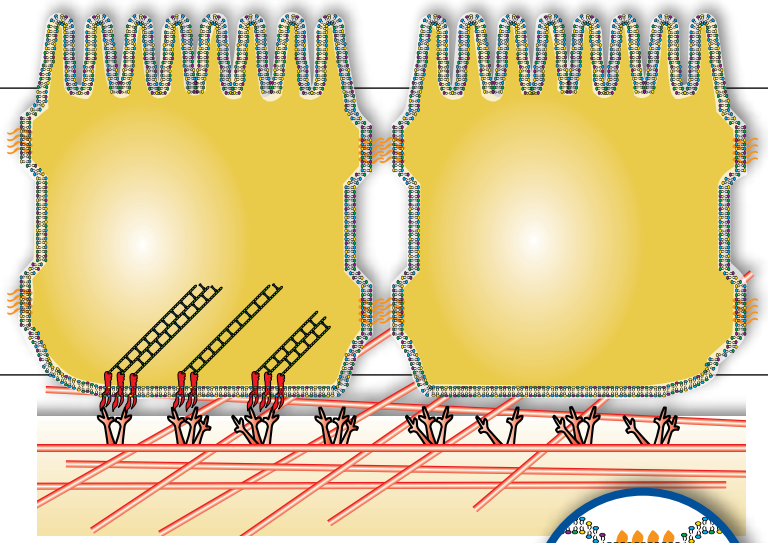
The adhesive contacts between cells and their environment are formed by multiple proteins on the cell surface clustering together into organic nanostructures that link the exterior of a cell and its internal skeleton. Nanostructured interfaces where components of the cell or extracellular matrix are positioned at specific locations can be used to gain a deeper understanding of how cells form such adhesive contacts and how these contacts participate in the signalling processes within the cell.

The interactions between cells and their surroundings are mediated through the cell membrane. A major component of the cell membrane are the small hydrophobic – water hating – molecules called lipids that spontaneously form the membrane and act as an anchor for other biomolecules. The composition of the cell membrane plays a key role in the ability of cells to sense and react to their surroundings, and the bending of that thin membrane is important for transport of molecules, nutrients, and drug carriers into the cells.

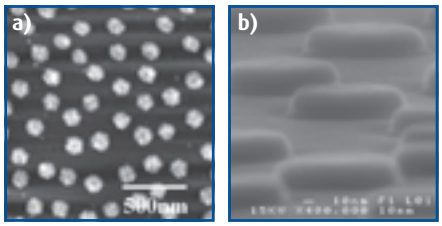
Components of the cellular surface can be used to build and study simplified cell membranes on solid surfaces in order to understand specific interactions in detail. The inclusion of geometric structures on the surface can mimic natural membrane bending in cells.

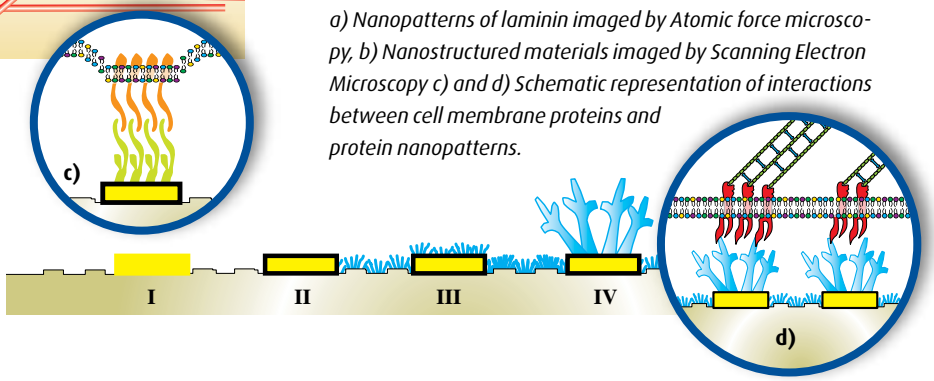
The stem cell challenge

Most of the time cells need no help from the outside, but when things go wrong medical science can give a helping hand. One area of current



A cell interacts with its environment through specific interactions between molecules in its outer membrane and those in the surroundings receiving and giving biochemical and mechanical signals.





Nanostructured biointerfaces can be used to study the events occurring at, e.g. cell-extracellular matrix or cell-cell contacts. a) Nanopatterns of laminin imaged by Atomic force microscopy, b) Nanostructured materials imaged by Scanning Electron Microscopy c) and d) Schematic representation of interactions between cell membrane proteins and protein nanopatterns.

promise in health care is the use of stem cells to treat a range of challenging and deadly diseases. The powerful and versatile stem cells have the ability to reproduce by self-renewal without growing old, and to differentiate into the multitude of specialised cells that make up our bodies. Such differentiated cultures may provide replacement cells, tissues or organs to replace failing body tissues in patients.

The balance between self-renewal and differentiation relies on a complex set of signals from the extracellular matrix and the neighbouring cells in specialised microenvironments.

Nanostructured biointerfaces

Artificial nanostructured material biointerfaces build-up by nanoengineering and including specific biological adhesive and signalling components represent one route to control how stem cells react and to harness their therapeutic value. Such biomimetic environments may steer the growth and differentiation of extracted stem cells in the laboratory to provide specific cell types for patient treatments or may guide a patient's own stem cells on the surface of a medical implant to improve the healing process in the body.

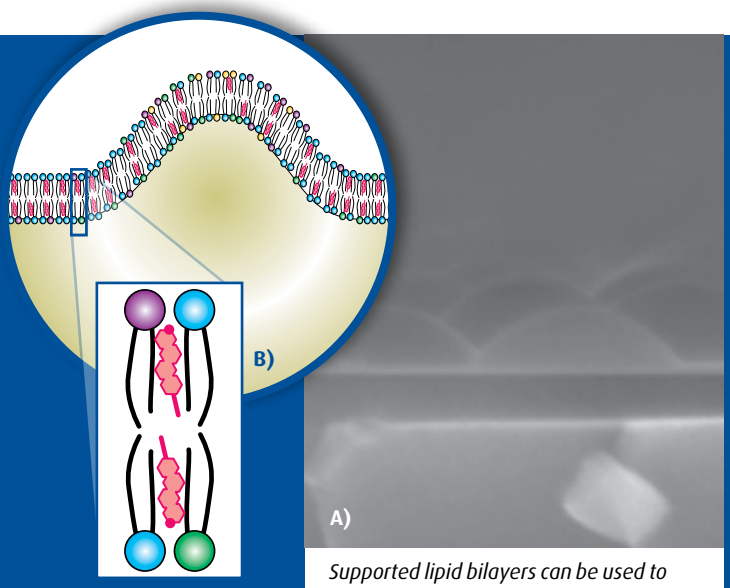
A current major effort is to utilise nanoengineered materials to understand and control biological systems at the nanoscale. The promise of new therapeutics in the area of nanomedicine requires the seamless integration of physics, chemistry and engineering on one hand with molecular biology, cell biology and clinical science on the other.

Conceptual leaps through cultural diversity

In March of 2006 Associate Professor Duncan Sutherland moved from Chalmers in Sweden to the iNANO Center to form the Nanobiointerfaces Group. Two PhD students, Jenny Malmström and Maria Sundh, and postdoc Hossein Agheli followed Duncan to Aarhus, and this gave the group a distinctly international character right from the start.

Good research requires good people, and attracting and motivating talented young researchers is a core activity of all research leaders. A clear opportunity for augmenting the local talent is to supplement the group with gifted and highly motivated PhD students and post docs from abroad.

Collaborative networks and international visibility are other key facilitators. A cosmopolitan atmosphere in a research group and strong international partners ensure that the potential of a talented team can be converted into science that is competitive on the world stage. Each new member brings new experiences and ideas. As the Nanobiointerfaces Group has grown in recent years, the cultural diversity has increased with group members from seven nationalities.

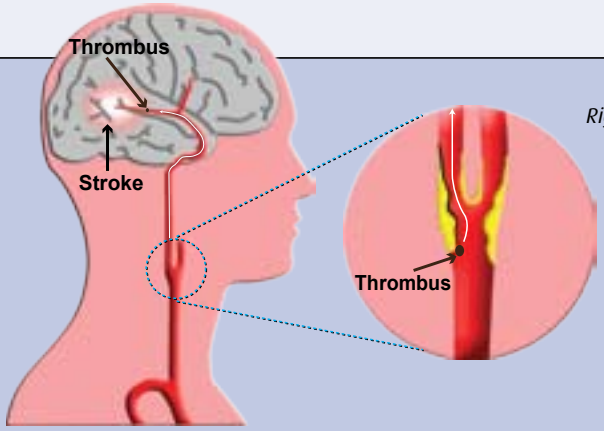


Supported lipid bilayers can be used to study the interactions between lipids and other biomolecules a) Controlled nanoscale support templates to mimic membrane curvature b) Schematic representation of curved supported lipid bilayers.

Patient risk assessment using computational methods in medicine

Patient-specific computer models can predict the risk of catastrophic plaque ruptures that lead to strokes and heart attacks. Envisioned is a future where computer simulations can be used to develop new superior methods for diagnostics, surgery planning, and drug delivery.

By Samuel Kock and Jens Vinge Nygaard



Right: A plague with a ruptured cap. Left: Brain with stroke.

Atherosclerosis is the most common cause of death and severe disability in the world. Its prevalence and incidence is related to the increased wealth in the developed countries and the changing lifestyle in the third world, which is approaching the western way of living.

The disease progresses by fat entering the walls of the blood vessels. Macrophages, the garbage collectors of the immune system, quickly arrive to remove the lipids but end up literally eating themselves to death when they take up fat from the blood. Thus, a lipid-rich necrotic core called a plaque is formed in the blood vessel, and the surrounding muscle cells secrete collagen-rich extracellular matrix to cover the lesion with a fibrous cap that separates the plaque from the blood stream. If the cap ruptures, the exposed lipids cause blood to clot on top of the rupture. The clot may be torn off and carried by the blood to the brain, where it may induce a stroke because the blood vessels of the brain are narrower than the vessels in the body.

Currently, the risk of having a plaque rupture and subsequent stroke is assessed by evaluating how much a blood vessel at the plaque site is narrowed compared to a healthy blood vessel. However, an estimation of the risk purely by measuring the diameter of the blood vessel ignores the morphological composition of the plaque.

Insights from fracture mechanics

From mechanics of materials it is well known that the risk of fractures is closely related to the composition of a material and the forces that build up inside it. We have shown that these internal forces vary significantly at the plaque site depending on the number of cores, their size and location compared to the blood stream as well as the flow dynamics in the blood stream during each heartbeat. The mechanical response of a blood vessel couples with the surrounding tissue, and as atherosclerosis progresses, the interactions become more complex. This is due to the large differences in stiffness that exist between the tissues present in blood vessels; e.g. lipids, calcifications, collagen, and blood.

We suggest that these internal forces may be a superior risk marker of strokes, because they combine all the information into one parameter that can be related to the known theory of fracture mechanics. Hence, it is possible to account for the catastrophic rupture of a plaque as internal forces are redistributed due to remodelling of tissue during atherosclerotic progression.

A clinically relevant 2D model

Hitherto, the clinical usefulness of mechanical stress level calculations has been hampered by prohibitive simulation timeframes due to extensive computer memory usage when handling time-dependent 3D images. We have submitted a patent on an approach that reduces the huge amount of data in a 3D image of a patient blood vessel down to 2D images. These images are automatically converted into 2D models that show how different kinds of tissue are organized in the blood vessel and how the level of internal forces changes during a heartbeat. The decreased model size reduces the computational time from days to minutes, making the method very clinical relevant.

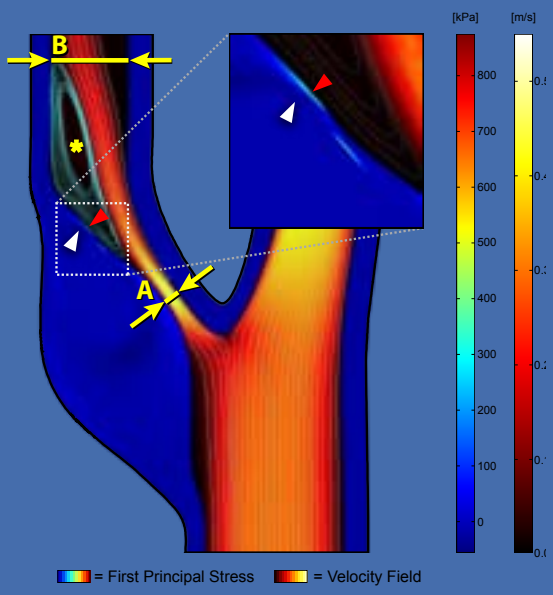
This project is extremely interdisciplinary as it involves both the Faculties of medicine and natural science and corresponds to the concept of translational medicine, connecting basic research with patient care. At the moment we need to validate our findings through scanning and simulations of hundreds of patients. We envision that these types of patient-specific computer models can assist doctors in decision making, and that similar models in animals may aid drug development to a far larger extent than experienced today.

Calculating the risk of plaque rupture

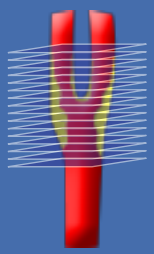
Today, the risk of plaque rupture is assessed by measuring to which degree the affected blood vessels (A/B) are narrowed. However, stress levels are expected to be a superior risk marker. Maximum stress levels (red/white arrowheads) typically occur at the place of minimal fibrous cap thickness but may occur elsewhere.

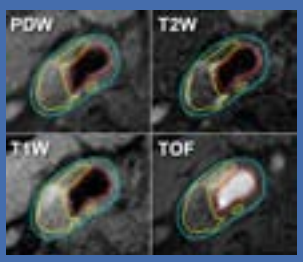
To determine the risk of plaque rupture we use longitudinal models generated from magnetic resonance imaging scans. These models enable us to calculate blood flow and stress levels inside the plaque and the surrounding tissues.

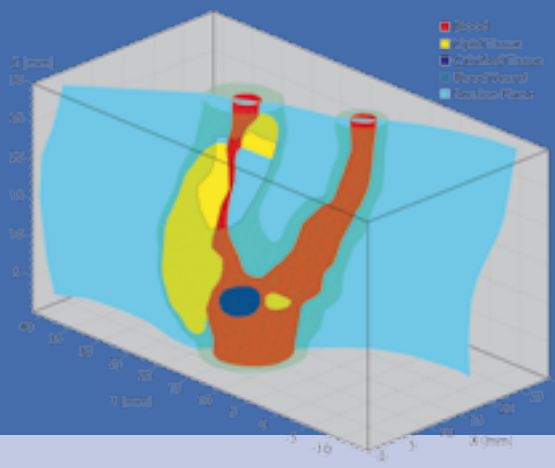
Samuel Kock,
Jens Vinge Nygaard



From MRI scans it is possible to segment the atherosclerotic lesions in the carotid arteries into lipid-rich necrotic cores, fibrous caps, blood stream and normal vessel walls. Using contours derived from the scans, a 3D shell model is constructed. This model is sectioned automatically by a surface intersecting the centre of the blood stream and extended throughout the model. The intersections between the shell model and this surface generate a longitudinal 2D model, which is used in a finite element software package to calculate internal stress levels.







iNANO and industry

Chairman's Statement

The mission of iNANO is based on the three equally important pillars: research, education, and innovation. As chairman of the iNANO Board, I am pleased to note that also in 2007 iNANO fulfilled our ambitious expectations in all three focus areas. In the following I shall highlight only a few major developments in 2007. Firstly, iNANO researchers secured substantial funding for nano-related research. As one example a new Center for Energy Materials was established with a major grant from the Danish Council for Strategic Research. Secondly, the number of PhD students enrolled in the iNANO graduate school (iNANOschool) continued to increase in, 2007, from 92 at the beginning of the year to 117 at the year's end. Finally, the numbers of patents and collaborative projects with industrial partners also increased in 2007.

The construction of a clean-room facility, which represents the first phase of a new ~10.000 m2 laboratory complex (iNANOhouse), was initiated in 2007 and will be commissioned during 2008. The whole complex will be ready in 2011, and we are confident that the iNANOhouse will boost iNANO research and accelerate our collaboration with industry. In order to support innovation derived from iNANO activities and strengthen iNANO's ability to secure transfer of the latest technology to Danish industry, the board is currently discussing different models on how to establish an iNANO bridge fund, with the objective to bring iNANO inventions the crucial step further from patent to "proof of concept".

It is comforting to note that according to government plans public funding for research in general will increase in the years to come. It is, however, disappointing that a national research program dedicated to nanoscience and nanotechnology has not been established in Denmark, contrary to other developed countries including EU. We sincerely hope that in the coming years significant new national funds dedicated to nano-related research will become available to the long-term benefit of the Danish society.

I wish to thank my colleagues on the iNANO Board for their commitment and valuable contributions in the past year, and I look forward to continuing our fruitful collaboration in 2008. Finally, I wish to express my sincere respect and appreciation for the dedicated and hard work carried out by the iNANO staff in 2007. Thanks to their efforts and commitment I have no doubt that iNANO will continue to flourish and fulfil its mission in the years to come.

Hans Jørgen Pedersen
CEO of Danfoss Bionics A/S
Chairman of the iNANO Board

Industrial collaborators

Aalborg Portland Group, Denmark
AarhusKarlshamn A/S, Denmark
Alfa Laval Nakskov A/S, Denmark
ALK-Abelló A/S, Denmark
Arla Foods amba, Denmark
AstraZeneca, United Kingdom
Beneq Oy, Finland
Biocompatibles, United Kingdom
Biomodics, Denmark
Bioneer, Denmark
Capres A/S, Denmark
Carlsberg Research Center, Denmark
CemeCon Scandinavia, Denmark
CeNTect Gmbh, Germany
Chew Tech I/S, Denmark
CLC-Bio A/S, Denmark
Coloplast Research A/S, Denmark
Danfoss A/S, Denmark
Danfoss Bionics, Denmark
Danisco A/S, Denmark
Danish Genome Institute, Denmark
Danish Technological Institute, Denmark
Dantherm A/S, Denmark
Dyrup A/S, Denmark
FeF Chemicals A/S, Denmark
Fertin Pharma, Denmark
Fibertex, Denmark
Fresenius Kabi AG, Germany
GPV Group, Denmark
Gram Commercial A/S, Denmark
Gram Equipment A/S, Denmark
Grundfos A/S, Denmark
H2 Logic ApS, Denmark
Haldor Topsøe A/S, Denmark
IBSEN Photonics A/S, Denmark
Ignis Photonyx A/S, Denmark
Image Metrology, Denmark
Innoscan, Denmark
Institute of Photonic Technology, Germany
Integrated DNA Technologies, USA
Interuniversitair Micro-electronica Centrum vzw, Belgium
JPK Instruments, Germany
KinaseDetect ApS, Denmark
Koheras, Denmark
LeoPharma A/S, Denmark
Lundbeck A/S, Denmark
LU-VE S.p.A, Italy
Macrozymes, The Netherlands
Mankiewicz Gebr. & Co KG, Germany
Merck & Co, USA
Merck Serono International, Switzerland
Molegro Aps, Denmark
Nanon A/S, Denmark
NanoNord A/S, Denmark
NIL Technology, Denmark
Nilan A/S, Denmark

NKT Research & Innovation A/S, Denmark
Novo Nordisk A/S, Denmark
Novozymes, Denmark
OFS Fitel Denmark A/S, Denmark
Oticon, Denmark
Pepscan Therapeutics, The Netherlands
Pharmexa A/S, Denmark
Pipeline Biotech A/S, Denmark
PolyPlus-transfection, France
Profos AG, Germany
Q-sense AB, Sweden
RAcell Solar A/S, Denmark
Regulon Inc, Greece
Rho-BeSt Coating plc, Germany
RiboTask ApS, Denmark
RiNA GmbH, Germany
Rockwool, Denmark
Sanofi-Aventis, Germany
Santaris Pharma A/S, Denmark
SCF Technologies, Denmark
SP Group A/S, Denmark
SPECS, Germany
Stensborg A/S, Denmark
Systematic Software Engineering A/S, Denmark
The Imego Institute, Sweden
Unisense A/S, Denmark
Varian Inc., USA
Veeco Instruments GmbH, Germany
Velux A/S, Denmark
Vestas Wind Systems A/S, Denmark
Vipergen, Denmark
Wyeth Discovery Research A/S, USA

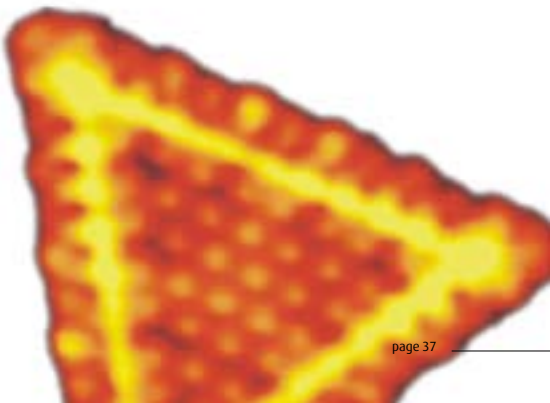
Academic collaborators

Academic collaborators

Academic institutions with whom the senior staff at iNANO collaborates.

Aalborg University, Aalborg, Denmark
Advanced Photon Source, Chicago, USA
Antwerp University, Antwerp, Belgium
Århus University Hospital, Aarhus, Denmark
Arizona State University, Arizona, USA
Australian National University, Canberra, Australia
Beijing University, Beijing, China
Bergen Universitet, Bergen, Norway
Biomedical Sciences Research Center "Al. Fleming", Greece
Centre Européen de Calcul Atomique et Moléculaire, Lyon, France
Centre National de la Recherche Scientifique, Toulouse, France
Centro Atomico Bariloche, San Carlos de Bariloche, Argentina
Chalmers University of Technology, Gothenburg, Sweden
CNRS, Orleans, France
Consiglio Nazionale delle Ricerche, Bologna, Italy
Cornell University, New York, USA
CSIRO Molecular and Health Technologies, Melbourne, Australia
Danish Cancer Society, Copenhagen, Denmark
Danish Institute for Fishery Research, Copenhagen, Denmark
Danish Institute for Food and Veterinary Research, Aarhus, Denmark
Danish Meat Research Institute, Slagelse, Denmark
Demokritos/IMEL, Athens, Greece
Donostia International Physics Center, Donostia/San Sebastian, Spain
Duke University, North Carolina, USA
Ecole Polytechnique Fédérale de Lausanne, Switzerland
ETH, Zurich, Switzerland
European Synchrotron Radiation Facility, Grenoble, France
Flinders University, Adelaide, Australia
FOM-AMOLF, Amsterdam, The Netherlands
Forschungszentrum Dresden-Rossendorf, Dresden, Germany
Forschungszentrum Karlsruhe GmbH, Karlsruhe, Germany
Fraunhofer IME, Germany
Freiburg University, Freiburg, Germany
Freie Universität Berlin, Berlin, Germany
French National Institute for Health and Medical Research, Paris, France
Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin, Germany
Geological Survey of Denmark and Greenland, Copenhagen, Denmark
German Aerospace, Cologne, Germany
GSF-Forschungszentrum Umwelt und Gesundheit Neuherberg, Neuherberg, Germany
Hannah Research Institute, Ayr, Scotland
Harvard Medical School, Boston, USA
Harvard University, Cambridge, USA
Hasylab, Hamburg, Germany
Helmholtz Center, Munich, Germany
Helsinki Technical University, Helsinki, Finland
Hokkaido University, Sapporo, Japan
Imperial College London, London, UK
Institut de Génétique Moléculaire de Montpellier, Montpellier, France
Institute for Energy Technology, Kjeller, Norway
Institute for Materials Research, Berlin, Germany
Institute for Solid State Research, Dresden, Germany
Institute for Solid State Research, Jülich, Germany
Institute of Microbial Technology, Chandigarh, India
Instituto Superior Tecnico, Lisbon, Portugal
Jagiellonian University, Krakow, Poland
Jet Propulsion Laboratory, Pasadena, USA
Johan Wolfgang Goethe University, Frankfurt, Germany
Johns Hopkins University, Baltimore, USA
Karolinska Institutet, Stockholm, Sweden
Katholieke Universiteit Leuven, Leuven, Belgium
Laboratoire de Recherche sur les Polyméres, CNRS, Thiais, France
Lawrence Berkeley National Laboratory, Berkeley, USA
Lehigh University, Pennsylvania, USA
Liebniz Institut für Pharmakologie, Berlin, Germany
Los Alamos Natl. Lab., Los Alamos, USA
Lund University, Lund, Sweden
Madurai Kamaraj University, Madurai, India
Max-Planck-Gesellschaft zur Förderung der Wissenschaften, Stuttgart, Germany
Max-Planck-Gesellschaft zur Förderung der Wissenschaften, Munich, Germany
Max-Planck-Institut für Festkörperforschung, Stuttgart, Germany
Max-Planck-Institut für Mikrostrukturphysik, Halle, Germany
Max-Planck-Institute for Infection Biology, Berlin, Germany
Max-Planck-Institute for Solid State Research, Stuttgart, Germany
Max-Planck-Institute für Biophysikalische Chemie, Göttingen, Germany
Max-Planck-Institute, Dresden, Germany
McGill University, Montreal, Quebec, Canada
Melbourne University, Melbourne, Australia
MESA+ Institute for Nanotechnology, Enschede, The Netherlands
Monash University, Clayton Victoria, Australia
National Center for Nanoscience and Technology, Beijing, China
National High Magnetic Field Lab, Tallahassee, USA
National Jewish Medical and Research Center, Denver, USA
National Research Centre for the Working Environment, Copenhagen, Denmark

National Research Council, Ottawa, Canada
NCCR, Basel, Switzerland
NIH, Bethesda, USA
Northwestern University, Evanston, USA
Norwegian University of Life Science, Aas, Norway
Oak Ridge National Laboratory, Oak Ridge, USA
Odense University Hospital, Odense, Denmark
Osaka City University, Osaka, Japan
Oxford University, Oxford, UK
Pacific Northwest National Laboratory, WA, USA
Polish Academy of Sciences, Warsaw, Poland
Pondicherry Engineering College, Puducherry, India
Poul Scherrer Institute, Villigen, Switzerland
Rice University, Houston, USA
Risø, Roskilde, Denmark
Roskilde University Center, Roskilde, Denmark
Rutgers University, New Jersey, USA
Sandia National Laboratories, Albuquerque, New Mexico
Sincrotrone Trieste, Trieste, Italy
Swiss Federal School of Technology, Zurich, Switzerland
Technical University Delft, Delft, Holland
Technical University of Darmstadt, Darmstadt, Germany
Technical University of Denmark, Kgs. Lyngby, Denmark
Technical University of Munich, Munich, Germany
Technische Universität Wien, Vienna, Austria
Texas A&M University, College Station, Texas, USA
Texas Tech Health Sciences Center, Amarillo, Texas, USA
The Forsyth Institute, Boston, USA
The Ian Wark Research Institute, University of South Australia, Adelaide, Australia
The University of Edinburgh, Edinburgh, UK
Universidad Autónoma de Madrid, Madrid, Spain
Universität Basel, Basel, Switzerland
Universitat Autònoma de Barcelona, Barcelona, Spain
Universität Hannover, Hannover, Germany
Universität Osnabrück, Osnabrück, Germany
Université de la Mediterranee, Marseilles, France
Université du Québec, Montreal, Canada
Universiteit van Amsterdam, Amsterdam, The Netherlands
University of Nagoya, Nagoya, Japan
University of Auckland, Auckland, New Zealand
University of Birmingham, Birmingham, UK
University of California, Riverside, USA
University of California, San Francisco, USA
University of California, Santa Barbara, USA
University of Cambridge, Cambridge, UK
University of Cardiff, Cardiff, UK
University of Catania, Catania, Italy
University of Copenhagen, Copenhagen, Denmark
University of Essex, Colchester, UK
University of Florida, Gainesville, USA
University of Ghent, Ghent, Belgium
University of Glasgow, Glasgow, UK
University of Goa, Goa, India
University of Gothenburg, Gothenburg, Sweden
University of Guelph, Guelph, Canada
University of Iceland, Reykjavik, Iceland
University of Illinois, Urbana-Champaign, USA
University of Karlsruhe, Karlsruhe, Germany
University of Kiel, Kiel, Germany
University of Kuopio, Kuopio, Finland
University of La Plata, La Plata, Argentina
University of London, London, UK
University of Malmö, Malmö, Sweden
University of Milan, Milan, Italy
University of New Hampshire, Durham, USA
University of New South Wales, Sydney, Australia
University of Nottingham, Nottingham, UK
University of Padova, Padova, Italy
University of Parma, Parma, Italy
University of Pennsylvania, Philadelphia, USA
University of Perugia, Italy
University of Pittsburgh, Pittsburgh, USA
University of Queensland, Brisbane, Australia
University of Rennes, Rennes, France
University of Rome “La Sapienza”, Roma, Italy
University of Sheffield, Sheffield, UK
University of Southern California, Los Angeles, USA
University of Southern Denmark, Odense, Denmark
University of Stockholm, Stockholm, Sweden
University of Sydney, Sydney, Australia
University of Tennessee, Knoxville, USA
University of Turin, Turin, Italy
University of Toronto, Toronto, Canada
University of Tsukuba, Tsukuba, Japan
University of Ulster, Belfast, UK
University of Washington, Seattle, USA
University of Western Australia, Perth, Australia
University of Western Ontario, London, Canada
Uppsala University, Uppsala, Sweden
VTT Technical Research Centre of Finland, Espoo, Finland
Westfälische Wilhelms-Universität, Münster, Germany
Zhejiang University, Hangzhou, China
Zurich Research Laboratory, Zurich, Switzerland



PhD theses

Andresen, Esben Ravn, Fiber-based implementation of coherent anti-stokes raman scattering microspectroscopy and microscopy

Bünger, Mathias Hauge, Studies of bone nanostructure - an important component of bone quality

Bødker, Julie Støve, Effects of monoclonal antibodies on the activity of PAI-1

Enevoldsen, Georg Herborg, Scanning Probe Microscopy studies of a metal oxide surface - a detailed study of the TiO_2(110) surface

Hansen, Jacob Ask, Metal sulfide nanoparticle based electrochemical biosensors

Hansen, Signe Grann, Functionalized thioglucosaminides - their synthesis and reactivities, applications in oligochitosan syntheses and as glycon in a chromogenic exo-chitosanase substrate

Hemmersam, Anne Gry, Protein adsorption and nanostructuring - studies of model systems relevant for implant materials

Hovgaard, Mads Bruun, From protein adsorption to amyloid fibrillation - a biological surface science approach

Jensen, Christina Munch, Modification of peptides. Development of SmI2 promoted C-C Bond forming reactions & synthesis of serine protease inhibitors & determination to the oligomerisation state of alamethicin

Jensen, Jesper Skov, Silicon based materials for optical applications

Johannesen, Sine Abraham, Application of carbohydrate derivatives in asymmetric synthesis and as ligands in metal ion complexes

Kehlet, Cindie Theilgaard, Design of NMR experiments for biological applications using optimal control theory

Lamberg, Anders, Stimulation of orthopedic implant fixation – investigations of osteogenic growth factors and topical delivery systems

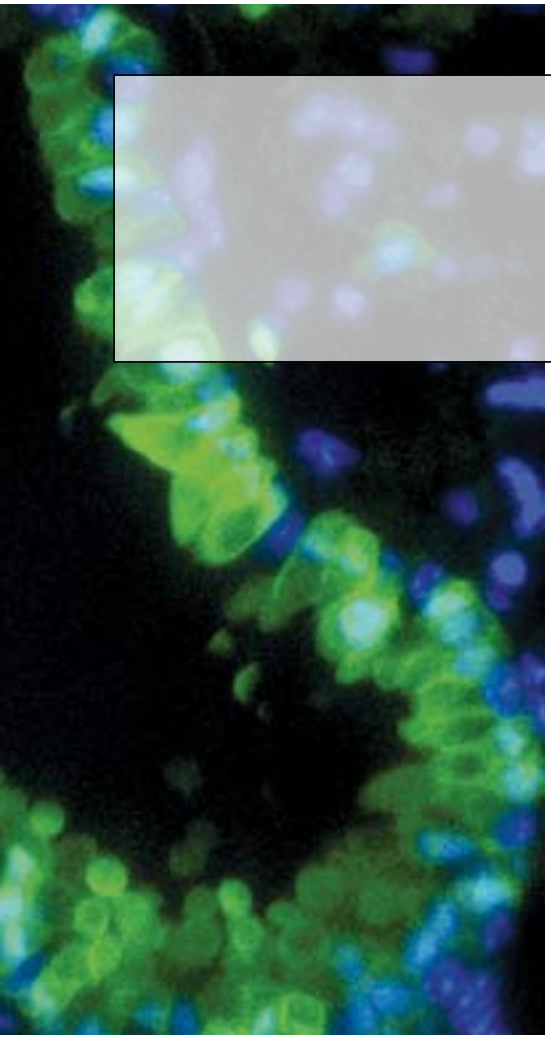
Lie, Mette Alstrup, Molecular modeling of biochemical binding and reaction mechanisms, exemplified from enzyme, protein and organocatalysis

Lorentzen, Martin, Fundamentals, applications and developments of a piezoresistive cantilever sensor

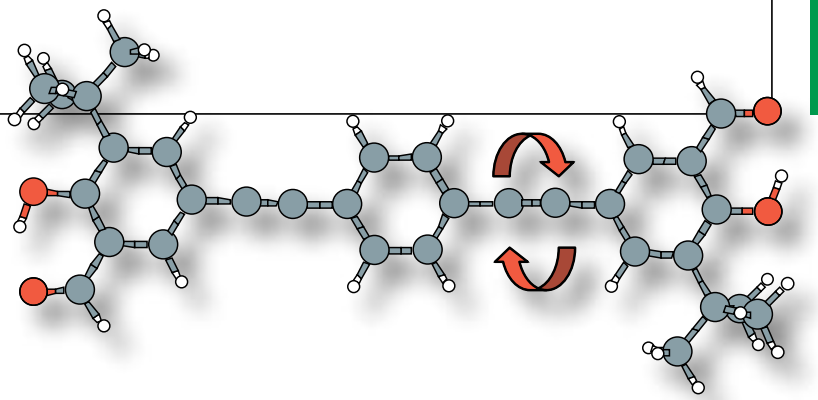
Matthiesen, Jesper, The influence of point defects on TiO_2(110) surface properties – a scanning tunneling microscopy study

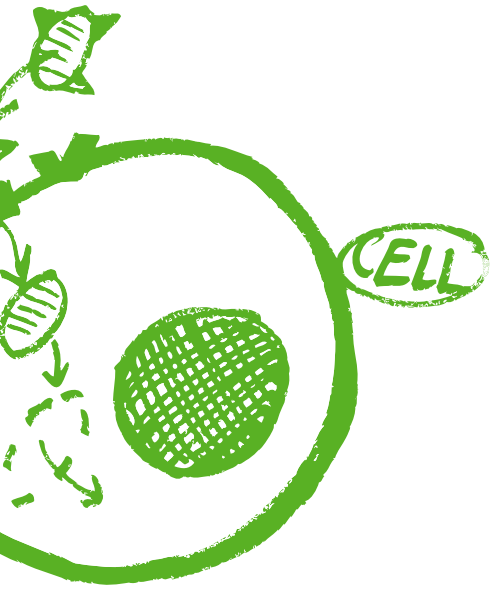
Nielsen, Carsten Krogh, Mode locked fiber lasers: theoretical and experimental developments

Weigelt, Sigrid, Self-assembly, dynamics, and reactions of organic molecules on metal surfaces: a scanning tunneling microscopy study



Publications





Agnholt, J, Kelsen, J, Schack, L, Hvas, CL, Dahlerup, JF & Sørensen, ES, 2007, 'Osteopontin, a protein with cytokine-like properties, is associated with inflammation in Crohn's disease', Scand J Immunol, Vol. 65, pp. 453-60.

Almtoft, KP, Kristensen, MH, Chevallier, J & Bøttiger, J, 2007, 'Characterization of nanostructured Cr2Nx/Cu multilayers deposited by reactive DC magnetron sputtering', Surface & Coatings Technology, Vol. 201, No. 8, pp. 4767-4776.

Almtoft, KP, Ejsing, AM, Bøttiger, J, Chevallier, J, Schell, N & Martins, R, 2007, 'The dependence of the nanostructure of magnetron sputtered Cu-Ag alloy films on composition and temperature', Journal of Materials Research, Vol. 22, No. 4, pp. 1018-1023.

Andersen, ES, Lind-Thomsen, A, Knudsen, B, Kristensen, SE, Havgaard, JH, Torarinsson, E, Larsen, N, Zwieb, C, Sestoft, P, Kjems, J & Gorodkin, J, 2007, 'Semiautomated improvement of RNA alignments', RNA, Vol. 13, pp. 1850-1859.

Andersen, FF, Knudsen, B, Oliveira, C, Frøhlich, RF, Krüger, D, Bungert, J, Agbandje-McKenna, M, McKenna, R, Veigaard, C, Juul, S, Koch, J, Rubinstein, JL, Guldbrandtsen, B, Hede, MS, Karlsson, G, Andersen, AH, Pedersen, JS & Knudsen, BR, 2007, 'Assembly and structural analysis of a covalently closed nano-scale DNA cage', Nucleic Acids Res.

Andersen, SU, Algreen-Petersen, RG, Hödl, M, Jurkiewicz, A, Cvitanich, C, Braunschweig, U, Schauser, L, Oh, S, Twell, D & Jensen, EØ, 2007, 'The conserved cysteine-rich domain of a tesmin/TSO1-like protein binds zinc in vitro and TSO1 is required for both male and female fertility in Arabidopsis thaliana', Journal of Experimental Botany, Vol. 58, pp. 3657-3670.

Andersson, KS, Gläsmaster, K, Hanarp, P, Senatier, B & Sutherland, D, 2007, 'Patterning colloidal monolayer films with micro contact particle stripping', Nanotechnology.

Andreasen, P, 2007, 'PAI-1 - a potential therapeutic target in cancer', Current Drug Targets, Vol. 8, pp. 1020-1041.

Andresen, ER, Thøgersen, J, Nielsen, CK & Keiding, SR, 2007, 'Fiber laser-based light source for coherent anto Stokes Raman scattering microspectroscopy', Optics Express, Vol. 15, No. 8, pp. 4848-4856.

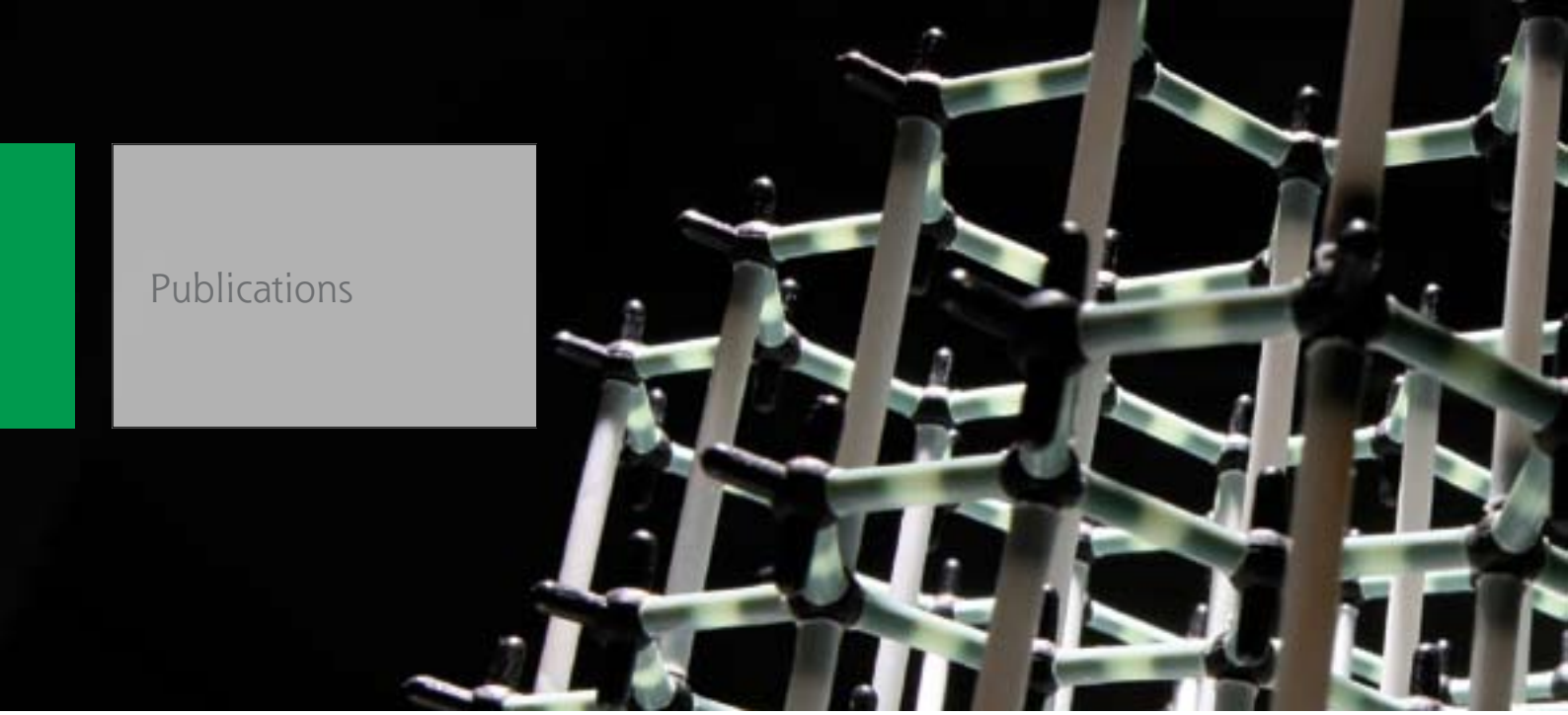
Arleth, L, Svensson, B, Mortensen, K, Pedersen, JS & Olsson, U, 2007, 'Block-Copolymer Microemulsion with Solvent-Induced Segregation', Langmuir, Vol. 23, pp. 2117-2125.

Arnbjerg, J, Johnsen, M, Nielsen, C, Jørgensen, M & Ogilby, PR, 2007, 'Effect of sensitizer protonation on singlet oxygen production in aqueous and non-aqueous media', J.Phys.Chem. A, Vol. 111, pp. 4573-4583.

Arnbjerg, J, J. Paterson, M, B. Nielsen, C, Jørgensen, M, Christiansen, O & Ogilby, PR, 2007, 'One- and two-photon photosensitized singlet oxygen production: Characterization of aromatic ketones as sensitizer standards', J. Phys. Chem. A, Vol. 111, pp. 5756-5767.

Arnbjerg, J, Jiménez-Banzo, A, Paterson, MJ, Nonell, S, Borrell, JI, Christiansen, O & Ogilby, PR, 2007, 'Two-photon absorption in tetraphenylporphycenes: are porphycenes better candidates than porphyrins for providing optimal optical properties for two-photon photodynamic therapy?', J. Am. Chem.Soc., Vol. 129, pp. 5188-5199.

Balling, P, Raarup, M, Elstrøm, UV, Martinussen, P, Petrunin, VV & Andersen, T, 2007, 'Doppler tuning



Publications

vuv spectroscopy of D- over an extended photon-energy range around the n = 2 threshold', Phys. Review A, Vol. 76, No. 044701.

Balogh, J, Olsson, U & Pedersen, JS, 2007, 'A SANS Contrast Variation Study of Microemulsion Droplet Growth', J. Phys. Chem. B, Vol. 111, No. 4, pp. 682-689.

Berry, CC, Curtis, ACG, Oreffo, ROC, Agheli, H & Sutherland, D, 2007, 'Human fibroblast and human bone marrow cell response to lithographically nanopatterned adhesive domains on protein rejecting substrates', IEEE Transactions of Nanobioscience, Vol. 6, No. 3, pp. 201-9.

Bertelsen, K, Pedersen, JM, Rasmussen, BS, Skrydstrup, T, Nielsen, NC & Vosegaard, T, 2007, 'Membrane-bound conformation of peptaibols with methyl-deuterated a-amino isobutyric acids by 2H solid-state NMR spectroscopy', J. Am. Chem. Soc., Vol. 129, pp. 14717-14723.

Bertelsen, K, Pedersen, JM, Nielsen, NC & Vosegaard, T, 2007, '2D separated-local field spectra from projections of 1D experiments', J. Magn. Reson., Vol. 184, pp. 330-6.

Bertin, A, Renouard, M, Pedersen, JS, Livolant, F & Durand, D, 2007, 'H3 and H4 Histone Tails Play a Central Role in the Interactions of Recombinant NCPs', Biophysical Journal, Vol. 92, No. 7, pp. 2633-2645.

Besenbacher, F, Sutherland, D & Hovgaard, MB, 2007, 'From nanoscience to nanotechnology: Utilising the nanoscale', Toxicology Letters, No. 172, pp. S34-S34.

Besenbacher, F, Lauritsen, JV & Wendt, S, 2007, 'STM studies of model catalysis', Nanotoday, Vol. 2, p. 4.

Bisgaard, CF, Jayatissa, MN, Enghild, JJ, Sanchéz, C, Artemychyn, R & Wiborg, O, 2007, 'Proteomic investigation of the ventral rat hippocampus links DRP-2 to escitalopram treatment resistance and SNAP to stress resilience in the chronic mild stress model of depression.', Journal of molecular neuroscience : MN, Vol. 32, No. 2, pp. 132-44.

Bjerring, M, Nielsen, JS, Nielsen, NC & Krebs, FC, 2007, 'Polythiophene by solution processing', Macromolecules, Vol. 40, pp. 6012-6013.

Bock, K, Besenbacher, F & Didrichsen, B, 2007, 'Du store kineser', Berlingske Tidende.

Bramsen, JB, Lauersen, M, Damgaard, C, Willsen, S, Wengel, J & Kjems, J, 2007, 'Improved silencing properties of small interfering RNAs with segmented sense strand', Nucleic Acids Res, Vol. 35, pp. 5886-5897.

Brand, A, Müller, B, Wüest, A, Dinkel, C, Revsbech, NP, Nielsen, LP, Pedersen, O, Damgaard, LR, Larsen, LH & Wehrli, B, 2007, 'Mikrosensor for in situ flow measurements in benthic boundary layers at submillimeter resolution with extremely slow flow', Limnology and Oceanography: Methods, Vol. 5, pp. 185-191.

Busse, CW, Weigelt, S, Petersen, L, Lægsgaard, E, Besenbacher, F, Linderoth, TR, Thomsen, AH, Nielsen, M & Gothelf, KV, 2007, 'Chiral ordering and conformational dynamics for a class of oligo-phenylene-ethynylenes on Au(111)', J.Phys. Chem. B, Vol. 111, pp. 5850-5860.

Bösenberg, U, Doppiu, S, Mosegaard, L, Barkhordarian, G, Eigen, N, Borgschulte, A, Jensen, TR, Cerenius, Y, Gutfleisch, O, Klassen, T, Dornheim, M & Bormann, R, 2007, 'Hydrogen sorption properties of MgH2–LiBH4 composites ', Acta Materialia, Vol. 55, pp. 3951-3958.

Canning, J, Skivesen, N, Kristensen, M, Frandsen, L, Lavrinenko, A, Martelli, C & Tetu, A, 2007, 'Mapping the broadband polarization properties of linear 2D SOI photonic crystal waveguides', Optics Express, Vol. 15, No. 23.

Castelletto, V, Parras, P, Hamley, I, Bäverbäck, P, Pedersen, JS & Panine, P, 2007, 'Wormlike Micelle Formation and Flow Alignment of a Pluronic Block Copolymer in Aqueous Solution', Langmuir, Vol. 23, No. 13, pp. 6896-6902.

Chen, M, Maetzke, A, Jensen, SK & Gothelf, KV, 2007, 'Rearrangement of S-2-Aminoethyl Phosphorothioates to N-2-Mercaptoethylphosph oramidates and Application for Labeling of DNA', Eur. J. Org. Chem., Vol. 35, pp. 5826-5833.

Christensen, AN, Jensen, TR, Bahl, CR & DiMasi, E, 2007, 'Nano size crystals of goethite, Ð-FeOOH: Synthesis and thermal transformation', J. Solid State Chem., Vol. 180, pp. 1431-1435.

Christensen, M & Iversen, BB, 2007, 'Host Structure Engineering in Thermoelectric Clathrates', Chem. Mater., Vol. 19, pp. 4896-4905.

Clarke, B, Kingshott, P, Rochev, Y, Hou, X, Gorelov, A & Carroll, W, 2007, 'Effect of nitinol wire surface properties on Albumin adsorption', Acta Biomat., Vol. 3, No. 1, pp. 103-111.

Clo, E, Snyder, J, Ogilby, PR & Gothelf, KV, 2007, 'Control and selectivity of photosensitized singlet oxygen production: challenges in complex biological systems', ChemBioChem, Vol. 8, pp. 475-481.

Coriani, S, Høst, S, Jansik, B, Thøgersen, LS, Olsen, J, Jørgensen, P, Reine, S, Pawlowski, F, Helgaker, T & Salek, P, 2007, 'Linear-scaling implementation of molecular response theory in self-consistent field electronic-structure theory', Journal of

Chemical Physics, Vol. 126, No. 15, pp. 154108-1 - 154108-11.

Dalby, MJ, Gadegaard, N, Agheli, H, Sutherland, D & Wilkinson, CDW, 2007, 'Group analysis of regulation of fibroblast genome on low adhesion surfaces', Biomaterials, Vol. 28, No. 10, pp. 1761-1769.

Dalby, MJ, Gadegaard, N, Herzyk, P, Sutherland, D, Agheli, A, Wilkinson, CDW & Curtis, ASG, 2007, 'Nanomechanotransduction and Interphase Nuclear Organization; Influence on Genomic Control', Journal of Cellular Biochemistry, pp. 1234-1244.

Dalsgaard, TK, Otzen, D, Nielsen, JH & Larsen, LB, 2007, 'Changes in structures of milk proteins upon photo-oxidation', J. Agr. Food Chem., No. 55, pp. 10968-10976.

Dauksaite, V, Lorentzenn, M, Besenbacher, F & Kjems, J, 2007, 'Antibody-based protein detection using piezoresistive cantilever array', Nanotechnology, Vol. 18, pp. 1-5.

Diaconescu, B, Pohl, K, Vattuone, L, Savio, L, Hofmann, P, Silkin, VM, Pitarke, JM, Chulkov, EV, Echenique, PM, Farias, D & Rocca, M, 2007, 'Low-energy acoustic plasmons at metal surfaces', Nature, Vol. 448, p. 57.

Dmitriev, A, Pakizeh, T, Rindzevicius, T, Käll, M & Sutherland, D, 2007, 'Gold-silica-gold nanosandwiches - tunable bimodal plasmonic resonators', Small, Vol. 3, No. 2, pp. 294-299.

Dong, M, Xu, S, Oliveira, C, Pedersen, JS, Thiel, S, Besenbacher, F & Vorup-Jensen, T, 2007, 'Conformational changes in mannan-binding lectin bound to ligand surfaces', The Journal of Immunology, Vol. 178, pp. 3016-3022.

Dong, M, Xu, S, Bünger, H, Birkedal, H & Besenbacher, F, 2007, 'Temporal Assembly of Collagen Type II Studied by Atomic Force Microscopy', Advanced Engineering Materials, Vol. 9, No. 12, pp. 1129-1133.

Dong, M, Howard, K, Oupicky, D, Bisht, H, Kjems, J & Besenbacher, F, 2007, 'Visualisation of Thermal Activated Nanocarriers Using In Situ Atomic Force Microscopy', Nanotechnology.

Drews, J, Goutianos, S, Kingshott, P, Hvilsted, S, Rozlosnik, N, Løgstrup Andersen, T, Almdal, K & Sørensen, B, 2007, 'Plasma Polymerised Thin Films of Maleic Anhyride and 1,2 Methylenedioxybenzene for Improving the Adhesion Strength of Carbon Surfaces', J. Vac. Sci. Technol. A., No. 25, pp. 1108-1117.

Ebran, J, Hansen, AL, Gøgsig, T & Skrydstrup, T, 2007, 'Studies on the heck reaction with alkenyl phosphates:Can the 1,2-migration be Controlled? Scope and limitations.', J. Am. Chem. Soc., Vol. 129, pp. 6931-6942.

Enevoldsen, GH, Foster, AS, Christensen, MC, Lauritsen, JV & Besenbacher, F, 2007, 'Noncontact atomic force microscopy studies of vacancies and hydroxyls of TiO_2(110): Experiments and atomistic simulations', Physical Review B, Vol. 76, No. 20.

Fage-Pedersen, J, Jacobsen, RS & Kristensen, M, 2007, 'Poled-glass devices: influence of surfaces and interfaces', Journal of the Optical Society of America B, Vol. 24, No. 5, pp. 1075-1079.

Fage-Pedersen, J, Frandsen, LH, Lavrinenko, AV, Borel, PI, Lirong, Y, Tetu, A & Kristensen, M, 2007, 'Electro-optic property and use of slow ligth', DOPS Nyt, Vol. 7, No. 2, p. 14.

Fago, A, Dalsgaard, T & Fago, A, 2007, 'Nitrite-dependent vasodilation is facilitated by hypoxia and is independent of known NO-generating nitrite reductase activities', American Journal of Physiology - Heart and Circulatory Physiology, Vol. 292, pp. H3072-H3078.

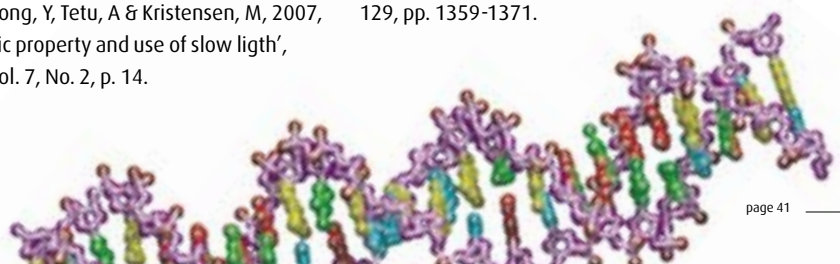
Fago, A & Jensen, F, 2007, 'The role of blood nitrite in the control of hypoxic vasodilation', Advances in Experimental Biology, Vol. 01, pp. 199-212.

Fatouros, DG, Deen, R, Arleth, L, Bergenstahl, B, Nielsen, FS, Pedersen, JS & Mullertz, A, 2007, 'Structural Development of Self Nano Emulsifying Drug Delivery Systems (SNEDDS) During In Vitro Lipid Digestion Monitored by Small-angle X-ray Scattering', Pharmaceutical Research, Vol. 24, No. 10, pp. 1844-1853.

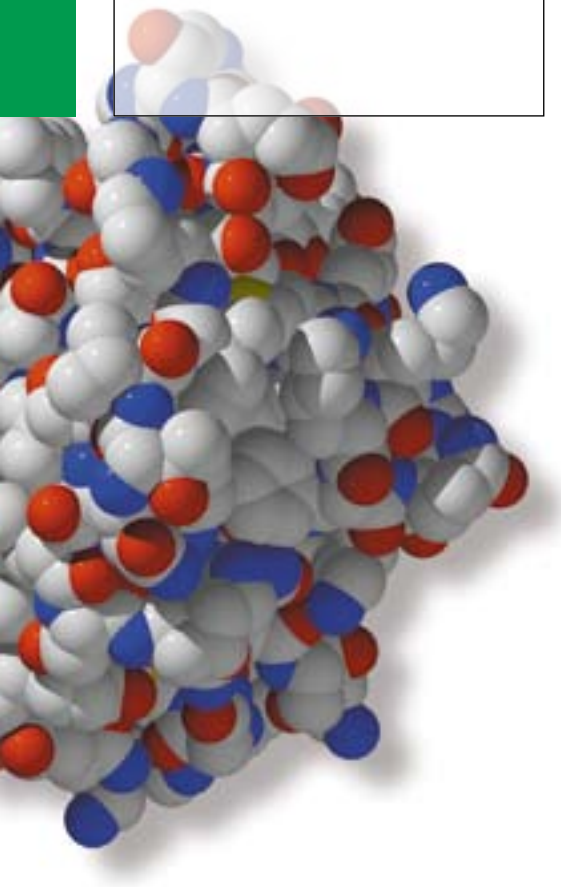
Frederiksson, H, Alaverdyan, Y, Dmitriev, A, Langhammer, C, Sutherland, D, Zäch, M & Kasmeo, B, 2007, 'Hole-Mask Colloidal Lithography', Advanced Materials, Vol. 19, No. 23, pp. 4297-4302.

Gaiduk, P, Prokeph'ev, S, Kazuchits, N, Plebanovich, V, Wesch, W & Nylandsted Larsen, A, 2007, 'Nano-cluster formation in Ge+Sn implanted SiO_2 layers', Nuclear Instruments and Methods in Physics Research B, Vol. 257, pp. 60-63.

Gansäuer, A, Barchuk, A, Keller, F, Schmitt, M, Grimme, S, Gerenkamp, M, Mück-Lichtenfeld, C, Daasbjerg, K & Svith, H, 2007, 'Mechanism of Titanocene-Mediated Epoxide opening through Homolytic Substitution', J. Am. Chem. Soc., Vol. 129, pp. 1359-1371.



Publications



Goncalves S, E, Poulsen, L & Ogilby, PR, 2007, 'Mechanism of the Temperature Dependent Degradation of Polyamide 66 Films Exposed to Water', Polym. Degrad. Stab., Vol. 92, pp. 1977-1985.

Gorczyca, I, Christensen, NE, Svane, A, Laaksonen, K & Nieminen, R, 2007, 'Electronic Band Structure of InxGa1-xN under Pressure', Acta Phys. Polon. A, Vol. 112, pp. 203-207.

Gromadski, KB, Schümmer, T, Strømgaard, A, Knudsen, CR, Kinzy, TG & Rodnina, MV, 2007, 'Kinetics of the interactions between yeast elongation factors 1A and 1Balpha, guanine nucleotides, and aminoacyl-tRNA.', The Journal of biological chemistry, Vol. 282, No. 49, pp. 35629-37.

Hansen, AL, Ebran, J, Gøgsig, T & Skrydstrup, T, 2007, 'Investigations of the Suzuki-Miyaura and Negishi couplings with alkenyl phosphates: application to the synthesis of 1,1-disubstituted alkenes', J. Org. Chem., Vol. 72, pp. 6464-6472.

Hansen, JA, Sumbayev, VV & Gothelf, KV, 2007, 'An Electrochemical Sensor Based On The Human Estrogen Receptor Ligand Binding Domain', Nano Lett., Vol. 7, pp. 2831-2834.

Hansen, JØ, Kehlet, C, Bjerring, M, Vosegaard, T, Glaser, S, Khaneja, N & Nielsen, NC, 2007, 'Optimal control based design of composite dipolar recoupling experiments by analogy to single-spin inversion pulses', Chem. Phys. Lett., Vol. 447, pp. 154-161.

Hansen, SG & Skrydstrup, T, 2007, 'A simple procedure to 3,6-dibenzoylated glucosamine derivatives. Potential building blocks for oligochitosan synthesis.', Eur. J. Org. Chem., pp. 3392-3401.

Hatz, S, Lambert, JDC & Ogilby, PR, 2007, 'Measuring the Lifetime of Singlet Oxygen in a Single Cell: Addressing the Issue of Cell Viability', Photochem. Photobiol. Sci., Vol. 6, pp. 1106-1116.

Heegaard, P, Boas, U & Otzen, D, 2007, 'Dendrimer effects on peptide and protein fibrillation', Macromolecular Bioscience, No. 7, pp. 1047-1059.

Helveg, S, Li, W, Bartelt, N, Horch, S, Lægsgaard, E, Hammer, B & Besenbacher, F, 2007, 'Role of surface elastic relaxations in an O-induced nanopattern on Pt(110)-(1 × 2)', Physical Review Letters, Vol. 98, pp. 115501-1.

Holm, AIS, Hvelplund, P, Kadhane, U, Larsen, MK, Lui, B, Nielsen, SB, Panja, S, Pedersen, JM, Skrydstrup, T, Støchkel, K, Williams, E & Worm, ES, 2007, 'On the Mechanism of Electron-Capture-Induced Dissociation of Peptide Dications from 15N-Labeling and Crown-Ether Complexation', Journal of Phys. Chem. A, Letters, Vol. 111, pp. 9641-9643.

Holmberg, M, Stibius, K, Ndoni, S, Larsen, N, Kingshott, P & Hou, X, 2007, 'Protein aggregation and degradation during iodine labeling and its consequences for protein adsorption to biomaterials ', Anal. Biochem., Vol. 363, No. 1, pp. 120-125.

Hornekær, L, Otero, W, Lægsgaard, E & Besenbacher, F, 2007, 'Long range orientation of meta-stable atomic hydrogenadsorbate clusters on the graphite(0001) surface', Chemical Physics Letters, Vol. 446, pp. 237-247.

Hovgaard, MB, Dong, M, Otzen, D & Besenbacher, F, 2007, 'Quartz crystal microbalance studies of multilayer glucagons fibrillation at the solid-liquid interface', Biophys J. BioFAST, Vol. 93, pp. 2162.

Howard, K, Dong, M, Oupicky, D, Bisht, HS, Bus, C, Besenbacher, F & Kjems, J, 2007, 'Nanocarrier Stimuli-Activated Gene Delivery', Small, Vol. 3, No. 1, pp. 54-57.

Howard, KA & Kjems, J, 2007, 'Polycation-based nanoparticle delivery for improved RNAi therapeutics', Expert Opin. Biol. Ther, Vol. 7, pp. 1811-1822.

Iversen, BB, 2007, 'Low-Temperature Structural Transitions in Phonon-Glass Thermoelectric Material Zn4Sb3: Ordering of Zn interstitials and defects', Chem. Mater., Vol. 19, pp. 834-838.

Jacobsen, MF, Clo, E, Mokhir, A & Gothelf, KV, 2007, 'Model Systems for Activation of Nucleic Acid Encoded Prodrugs', ChemMedChem, Vol. 2, pp. 793-799.

Jacobsen, MF, Andersen, CS, Knudsen, MM & Gothelf, KV, 2007, 'Synthesis of Rigid Dimers and Trimers of Adenine and Thymine', Org. Lett., Vol. 9, pp. 2851-2854.

Jakobsen, MR, Haasnoot, J, Wengel, J, Berkhout, B & Kjems, J, 2007, 'Efficient inhibition of HIV-1 expression by LNA modified antisense oligonucleotides and DNAzymes targeted to functionally selected binding sites', Retrovirology, Vol. 4, p. 29.

Jensen, JS, Buttenschön, DA, Pedersen, TPL, Chevallier, J, Nielsen, BB & Nylandsted Larsen, A, 2007, 'Heat treatment of metal-capped SiO_2 films containing Si nanocrystals', Journal of

Applied Physics, Vol. 101, p. 056108.

Jensen, TR, Jørgensen, L, Wiedermann, A, Jørgensen, J, Hazell, RG & Jakobsen, HJ, 2007, 'Piperazinium dihydrogen phosphate, C4H12N2(H2PO4)2: Synthesis, 31P CP/MAS NMR, structural and thermal investigations ', Solid State Sciences, Vol. 9, pp. 72-81.

Johannesen, SA, Pedersen, BO, Duus, JØ & Skrydstrup, T, 2007, 'Studies directed to understanding the structure of chitosan-metal complexes: investigations of mono- and disaccharide models with platinum (II) group metals', Inorg. Chem., pp. 4326-4335.

Johannesen, SA, Sinou, D, Framery, E & Skrydstrup, T, 2007, 'Evaluation of disaccharide-based ligands for Pd(0)-catalyzed assymetric allylations', Tetrahedron Lett., Vol. 48, pp. 3569-3573.

Johnsen, S, Bentien, A, Madsen, GKH, Nygren, M & Iversen, BB, 2007, 'Crystal structure and transport properties of nickel containing germanium clathrates', Phys. Rev. B, Vol. 76, pp. 245126-1-7.

Jørgensen, J, Mosegaard, L, Thomsen, LE, Jensen, TR & Hanson, JC, 2007, 'Formation of Ð-Fe2O3 nanoparticles and vacancy ordering: An in situ X-ray powder diffraction study ', J. Solid State Chem., Vol. 180, pp. 180-185.

KamiÐska, A, Franssen, G, Suski, T, Gorczyca, I, Christensen, NE, Svane, A, Suchocki, A, Lu, H, Schaff, WJ & Dimakis, E, 2007, 'Role of conduction-band filling in the dependence of InN photoluminescence on hydrostatic pressure', Phys. Rev. B, Vol. 76, No. 075203.

Karring, H, Valnickova, Z, Thøgersen, I, Hedegaard CJ, C, Møller-Pedersen, T, Kristensen, T, Klintworth, G & Enghild, JJ, 2007, 'Evidence against a blood derived origin for transforming growth factor beta induced protein in corneal disorders caused by mutations in the TGFBI gene.', Mol Vis.

Kehlet, C, Bjerring, M, Sivertsen, AC, Kristensen, T, Enghild, JJ, Glaser, SJ, Khaneja, N & Nielsen, NC, 2007, 'Optimal control based NCO and NCA experiments for spectral assignment in biological solid-state NMR spectroscopy', Journal of Magnetic Resonance, Vol. 188, pp. 216-230.

Kläning, U, Byberg, JR, Daasbjerg, K, Sehested, K & Appelman, EH, 2007, 'Electron Transfer Reactions of Peroxydisulfate and Fluoroxysulfate with the Cyanide Complexes M(CN)n4- (M = Fe(II), Ru(II), Os(II), Mo(IV), W(IV))', J. Phys. Chem. A, Vol. 111, pp. 1419-1425.

Kristensen, PK, Pedersen, TG, Zhu, K, Yu, D, 2007, Energy transfer from polyfluorene based Polymer to Europium Complex, Eur. Phys. J. Appl. Phys. 37, pp. 57-59.

Kristensen, T, Edwards, TM, Kohno, S, Baatrup, E & Guillette Jr., LJ, 2007, 'Fecundity, 17ß-estradiol concentrations and expression of vitellogenin and estrogen receptor genes throughout the ovarian cycle in female Eastern mosquitofish from three lakes in Florida', Aquatic Toxicology, Vol. 81, pp. 245-255.

Kumarappan, V, Viftrup, S, Holmegaard, L, Bisgaard, C & Stapelfeldt, H, 2007, 'Aligning molecules with long or short laser pulses', Physica Scripta, Vol. 76, pp. C63-C68.

Kusano, Y, Mortensen, H, Stenum, B, Goutianos, S, Mitra, S, Ghanbali-Shiahkali, A, Kingshott, P, Sørensen, B & Bindslev, H, 2007, 'Atmospheric plasma treatment of glassy carbon for adhesion improvement', Int. J. Adhesion Adhesives, Vol. 27, No. 5, pp. 402-408.

Kusano, Y, Mortensen, H, Stenum, B, Kingshott, P, Andersen, TL, Brøndsted, P, Bilde-Sørensen, BF, Sørensen, BF & Bindslev, H, 2007, 'Atmospheric pressure plasma treatment of glass fibre composites for adhesion improvement', Plasma Proc. Polym., Vol. 4, No. S1, pp. 455-459.

Larsen, KL, Andersen, SB, Mørkbak, AL, Wimmer, R, 2007, Inclusion Complexes of Fusidic Acid and Three Structurally Related Compounds with Cyclodextrins, Journal of Molecular Inclusion Phenomena and Macrocyclic Chemistry. Vol. 57, pp. 185-190.

Larsen, P, Dueholm, MS, Christiansen, G, Nielsen, JL, Otzen, D & Nielsen, PH, 2007, 'Amyloid adhesins are abundant in natural biofilms', Env. Microbiol., No. 9, pp. 3077-3090.

Lauritsen, JV, Kibsgaard, J, Olesen, GH, Moses, P, Hinnemann, B, Helveg, S, Nørskov, J, Clausen, B, Tospøe, H, Lægsgaard, E & Besenbacher, F, 2007, 'Location and coordination of promoter atoms in Co and Ni-promoted MoS2-based hydrotreating catalysts', J. of Catalysis, Vol. 249, p. 220.

Lauritsen, JV, Kibsgaard, J, Helveg, S, Topsøe, H, Clausen, BS, Lægsgaard, E & Besenbacher, F, 2007, 'Size-dependent structure of MoS2 nanocrystals', Nature Nanotechnology, Vol. 2, pp. 53-58.

Lindsay, K, Ferrando, F, Christensen, KL, Overgaard, J, Roca, T, Bennasar, M & Skrydstrup, T, 2007, 'SmI2-Promoted Radical Addition Reactions with N-(2-Indolylacyl)oxazolidinones: Synthesis and Bisindole Compounds', J. Org. Chem., Vol. 72, pp. 4181-4188.

Publications

Liu, X, Howard, K, Dong, M & Kjems, J, 2007, 'Chitosan/siRNA nanoparticles for gene silencing: formulation and characterization.', Biomaterials, Vol. 28, pp. 1280-1288.

Lizzit, S, Petaccia, L, Goldoni, A, Larciprete, R, Hofmann, P & Zampieri, G, 2007, 'C 1s photoemission spectrum in graphite(0001)', Physical Review B, Vol. 76, pp. 153408.

Lykke-Andersen, S, Piñol-Roma, S & Kjems, J, 2007, 'The human ADAR1 transcripts contain an alternative retained intron within a region that functions both as a 5'UTR and an ORF', RNA, Vol. 89, No. 10.

Malmström, J, Agheli, H, Kingshott, P & Sutherland, D, 2007, 'Viscoelastic Modelling of Highly Hydrated Laminin Layer at Homegenous and Nanostructured Surfaces - Quantification Protein Layer Properties using QCM-D and SPR', Langmuir, No. 23, pp. 9760-9768.

Mamdouh, W, Dong, M, Kelly, REA, Kantorovich, LN & Besenbacher, F, 2007, 'Coexistence of homochiral and heterochiral adenine domains at the liquid/solid interface', Journal of Physical Chemistry B Letters, Vol. 111, No. 42, pp. 12048 -12052.

Mamdouh, W & Besenbacher, F, 2007, 'Scanning probe microscopies beyond imaging: manipulation of molecules and nanostructures', Small, Vol. 3, No. 3, pp. 512-513.

Mankelow, TJ, Burton, N, Stefansdottir, FO, Spring, FA, Parsons, SF, Pedersen, JS, Oliveira, C, Lammie, D, Wess, T, Mohandas, N, Chasis, JA, Brady, RL & Anstee, DJ, 2007, 'The Laminin 511/521-binding site on the Lutheran blood group Glycoprotein is located at the flexible junction of Ig domains 2 and 3', Blood, Vol. 110(9), pp. 3398-3406.

Marques Pereira, RN, Jensen, JS, Chevallier, J, Nielsen, BB & Nylandsted Larsen, A, 2007, 'Paramagnetic defects and amorphous network reconstructionof magnetron sputtered a-SiO2 : Ge films', Journal of Applied Physics, Vol. 102, pp. 04409-1-044309-6.

Martelli, C, Canning, J, Kristensen, M & Groothoff, N, 2007, 'Refractive index measurements within a photonic crystal fibre based on short wavelength diffraction', Sensors, Vol. 7, pp. 2492-2498.

Matthey, D, Wang, J, Wendt, S, Matthiesen, J, Schaub, R, Lægsgaard, E, Hammer, B & Besenbacher, F, 2007, 'Enhanced bonding of gold nanoparticles on oxidized TiO_2(110)', Science, Vol. 315, pp. 1692-1696.

Mesli, A, Kruszewski, P, Dobaczewsi, L, Kolkovsky, V, Nylandsted Larsen, A & Abrosimov, N, 2007, 'Point defects in SiGe alloys: structural guessing basedon electronic transition analysis', J Mater Sci.

Morgenstern, K, Kibsgaard, J, Lauritsen, JV, Lægsgaard, E & Besenbacher, F, 2007, 'Cobalt growth on two related close-packed noble metal surfaces', Surface Science, Vol. 601, pp. 1967-1972.

Morth, JP, Pedersen, BP, Toustrup-Jensen, MS, Sørensen, TL, Petersen, J, Andersen, JP, Vilsen, B & Nissen, P, 2007, 'Crystal structure of the sodium-potassium pump.', Nature, Vol. 450, No. 7172, pp. 1043-1049.

Mosegaard, L, Møller, B, Jørgensen, J, Bösenberg, U, Dornheim, M, Hanson, JC, Cerenius, Y, Walker, G, Jakobsen, HJ, Besenbacher, F & Jensen, TR, 2007, 'Intermediate phases observed during decomposition of LiBh4', Journal of Alloys and Compounds, Vol. 446-447, pp. 301-305.

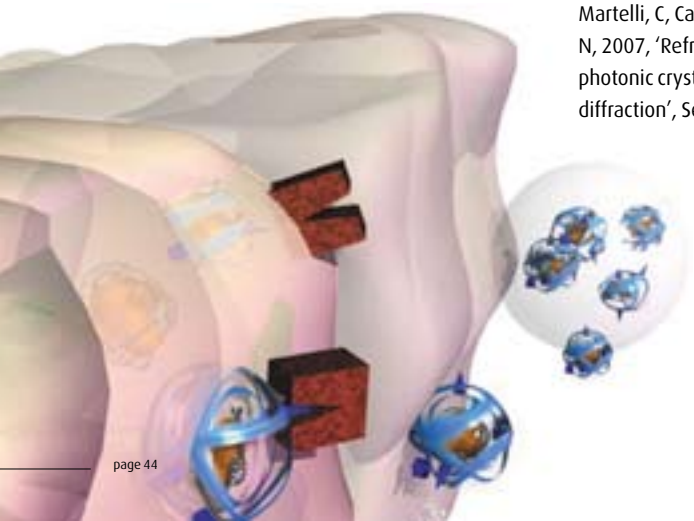
Mukhopadhyay, R, Al-Hanbali, O, Pillai, S, Hemmersam, AG, Meyer, RL, Hunter, A, Rutt, K, Besenbacher, F, Moghimi, S & Kingshott, P, 2007, 'Ordering of binary polymeric nanoparticles on hydrophobic surfaces assembled from low volume fraction dispersions', Journal of the American Chemical Society, Vol. 129, No. 44, pp. 13390-13391.

Møller, D, Sørensen, JL, Thomsen, JB & Drewsen, M, 2007, 'Efficient qubit detection using alkaline-earth-metal ions and a double stimulated Raman adiabatic process', Phys. Rev. A, Vol. 76, No. 062321.

Nielsen, CK & Keiding, SR, 2007, 'All-fiber mode-locked fiber laser', Optics Letters, Vol. 32(11), pp. 1474-76.

Nielsen, FS, Gibault, E, Ljusberg-Wahren, H, Arleth, L, Pedersen, JS & Müllertz, A, 2007, 'Characterization of Prototype Self-Nanoemulsifying Formulations of Lipophilic Compounds', J. of Pharmaceutical Sciences, Vol. 96, No. 4, pp. 876-892.

Nielsen, L, Lindsay, K, Faber, J, Nielsen, NC & Skrydstrup, T, 2007, 'Stereocontrolled Synthesis of Methyl Silanediol Peptide Mimics', Journal of Organic Chemistry, Vol. 72, pp. 10035-10044.



Nielsen, LT, Vase, KH, Dong, M, Besenbacher, F, Pedersen, SU & Daasbjerg, K, 2007, 'Electrochemical approach for constructing a monolayer of thiophenolates from grafted multilayers of diaryl disulfides', J. Am. Chem. Soc., Vol. 129, pp. 1888-1889.

Nielsen, MM, Andersen, KK, Westh, P & Otzen, D, 2007, 'Unfolding of ß-sheet proteins in SDS', Biophys. J., No. 92, pp. 3674-3685.

Nielsen, NC, Malmendal, A, Bertram, HC, Petersen, BO, Madsen, JC, Pedersen, H, Hoppe, C, Mølgaard, C, Michaelsen, KF & Duus, JØ, 2007, 'Effect of magnetic field strength on NMR-based metabonomic of human urine data - A comparative study of 250, 400, 500 and 800 MHz', Analytical Chemistry, Vol. 79(18), pp. 7110-7115.

Nielsen, NC, Malmendal, A, Vestergaard, M, Oksbjerg, N, Young, JF, Bertram, HC, Theil, PK, Petersen, AD, Poulsen, KA & Rasmussen, M, 2007, 'In vito and in vivo studies of cretine monohydrate supplementation to Duroc and Landrace pigs', Meat Science, Vol. 76, pp. 342-51.

Nielsen, NC, Malmendal, A, Sørensen, JG, Loeschcke, V, Bundy, JG, Overgaard, J & Holmstrup, M, 2007, 'Metabolomic profiling of rapid cold hardening and cold shock in Drosophila melanogaster', J. Insect Physiol., Vol. 53, pp. 1218-32.

Nielsen, NC, Petersen, SV, Valnickova, Z, Oury, TD, Crapo, JD & Enghild, JJ, 2007, 'The Subunit Composition of Human Extracellylar Superoxide Dismutate (EC-SOD) Regulate Enzymatic Activity', BMC Biochemistry, Vol. 8, p. 19.

Nielsen, NC, Vosegaard, T, Ishijima, MK & Watts, A, 2007, 'Helix Conformations in 7TM Membrane Protein Determined using Oriented Sample Solid-State NMR', Biophys J., Vol. 94, pp. 241-250.

Nylandsted Larsen, A & Mesli, A, 2007, 'The hidden secrets of the E-center in Si and Ge', Physica B, Vol. 401-402, pp. 85-90.

Nørlund Christensen, A, Jensen, TR, Bahl, CRH & DiMasi, E, 2007, 'Nano-size crystals of goethite FeOOH: Synthesis and thermal transformation', J Solid State Chem, Vol. 180, pp. 1431-1435.

Offersen, BV, Pfeiffer, P, Andreasen, P & Overgaard, J, 2007, 'Urokinase plasminogen activator and plasminogen activator inhibitor type-1 in nonsmall-cell lung cancer: relation to prognosis and angiogenesis.', Lung Cancer, Vol. 56, No. 1, pp. 43-50.

Ohno, A, Sasaki, S, Nishibori, E, Aoyagi, S, Sakata, M & Iversen, BB, 2007, 'X-ray charge density study of chemical bonding in skutterudite CoSb3', Phys Rev. B, Vol. 76, pp. 64119/1-64119/6.

Olesen, C, Winther, AL, Picard, M, Nielsen, CG, Morth, JP, Oxvig, C, Møller, JV & Nissen, P, 2007, 'The structural basis of calcium transport by the calcium pump', Nature, Vol. 450, No. 7172, pp. 1036-1042.

Orts, WJ, Roa-Espinosa, A, Sojka, RE, Glenn, GM, Imam, SH, Erlacher, K & Pedersen, JS, 2007, 'Use of Synthetic Polymers and Biopolymers for Soil Stabilization in Agricultural, Construction, and Military Applications', J. Mater. in Civil Engineering, Vol. 19, No. 1, pp. 58-66.

Otzen, D, Sehgal, P & Nesgaard, L, 2007, 'Alternative membrane protein conformations in alcohol', Biochemistry, No. 46, pp. 4348-4359.

Otzen, D & Nielsen, PH, 2007, 'We find them here, we find them there: Functional bacterial amyloid', Cell. Mol. Life Sci.

Pedersen, BL, Birkedal, H, Nishibori, E, Bentien, A, Sakata, M, Nygren, M, Frederiksen, P & Iversen, BB, 2007, 'Hg0.04Zn3.96Sb3: Synthesis, Crystal Structure, Phase Transition, and Thermoelectric Properties', Chem. Mater., Vol. 19, pp. 6304-6311.

Pedersen, BP, Buch-Pedersen, MJ, Morth, JP, Palmgren, MG & Nissen, P, 2007, 'Crystal structure of the plasma membrane proton pump.', Nature, Vol. 450, No. 7172, pp. 1111-1114.

Pedersen, JS, Cannavaccioulo, L & Schurtenberger, P, 2007, 'Scattering from Wormlike Micelles', Surfactant Science Series, Vol. 140, pp. 179-222.

Pedersen, SU, Vase, KH, Holm, AH, Daasbjerg, K & Norrman, K, 2007, 'Covalent Grafting of Glassy Carbon Electrodes with Diaryliodonium Salts: New Aspects', Langmuir, Vol. 23, No. 7, pp. 3786-3793.

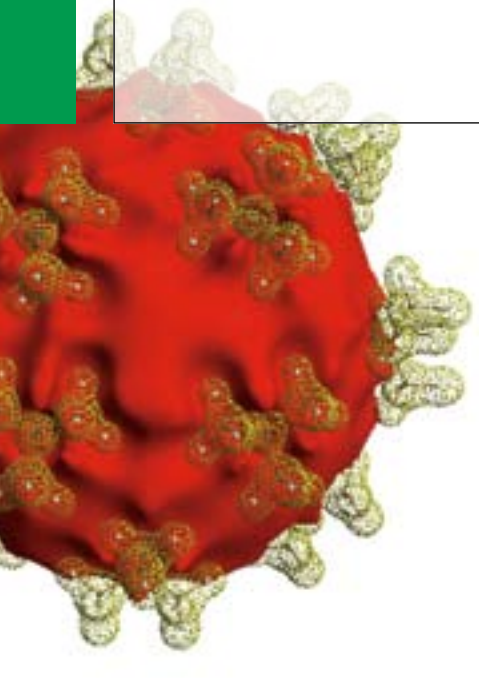
Pedersen, TG, 2007, Exact polarizability of low-dimensional excitons, Solid State Commun. 141, 569.

Pedersen, TG, 2007, Cornean H, 'Optical second harmonic generation from Wannier Excitons', Europhysics Letters 78, 27005.

Petersen, C, Thøgersen, J, Jensen, SK & Keiding, SR, 2007, 'Electron detachment and relaxation of OH-(aq)', J. Phys. Chem. A, pp. 11410-11420.

Poulsen, RD, Jørgensen, MRV, Overgaard, J, Larsen, FK, Morgenroth, W, Graber, T, Chen, Y & Iversen, BB, 2007, 'Synchrotron X-Ray Charge-Density Study of Coordination Polymer $[Mn(HCOO)_2(H_2O)_2]\infty$', Chem. Eur. J., Vol. 13, pp. 9775-9790.

Publications



Purice, A, Schou, J, Kingshott, P, Pryds, N & Dinescu, M, 2007, 'Characterization of lysozyme films produced by matrix assisted pulsed laser evaporation (MAPLE)', Appl. Surface Science, Vol. 253, No. 15, pp. 6451-6455.

Purice, A, Schou, L, Kingshott, P & Dinescu, M, 2007, 'High Fluence Diposition of Polyethylene Glycol Films at 1064 nm by Matrix Assisted Pulsed Laser Evaporation (MAPLE)', Appl. Surf. Sci., Vol. 253, No. 19, pp. 7952-7956.

Purice, A, Schou, J, Kingshott, P & Dinescu, M, 2007, 'Production of active lysozyme films by matrix assisted pulsed laser evaporation at 355 nm', Chem.Phys.Lett., Vol. 435.

Rasmussen, BS, Pedersen, JM, Sørensen, J, Egebjerg, J, Schiøtt, B, Mortensen, KK & Skrydstrup, T, 2007, 'Enantioselective Proteins: Selection, Binding Studies and Molecular Modeling of Antibodies with Affinity towards Hydrophobic BINOL Derivatives', ChemBioChem, Vol. 8, No. 16, pp. 1974-1980.

Rechendorff, K, Hovgaard, MB, Foss, M & Besenbacher, F, 2007, 'Influence of surface roughness on quartz crystal microbalance measurements in liquids', Journal of Applied Physics, Vol. 101, pp. 114502.

Ricaud B, Pedersen TG, Cornean HD, 2007, Ground and excited states in semiconductor carbon nanotubes: Perturbation and variational approach, Cont. Math. 447, 45.

Roberts, R, Revsbech, NP & Damgaard, L, 2007, 'Effect of water velocity and benthic diatom morphology on the water chemistry experienced by postlarval abalone', Journal of Shellfish Research, Vol. 26, No. 3.

Rottach, DR, Curro, JG, Budzien, J, Grest, GS, Svaneborg, C & Everaers, R, 2007, 'Molecular Dynamics Simulations of Polymer Networks Undergoing Sequential Cross-Linking and Scission Reactions', Macromolecules, Vol. 40, pp. 131-139.

Runager, K, Enghild, JJ & Klintworth, G, 2007, 'Focus on molecules: Transforming growth factor beta induced protein (TGFBIp).', Exp Eye Res.

Schillinger, R, Sljivancanin, Z, Hammer, B & Greber, T, 2007, 'Probing enantioselectivity with x-ray photoelectron spectroscopy and density functional theory', Physical Review Letters, Vol. 98, pp. 136102.

Schougaard, SB, Reitzel, N, Bjørnholm, T, Kjaer, K, Jensen, TR, Shmakova, OE, Colorado Jr., R, Lee, TR, Choi, J, Markert, JT, Derro, D, de Lozanne, A & McDevitt, JT, 2007, 'Direct imaging by atomic force microscopy of surface-localized self-assembled monolayers on a cuprate superconductor and surface X-ray scattering analysis of analogous monolayers on the surface of water', Thin Solid Films, Vol. 515, pp. 8424-8429.

Schneider, MA, Wahl, P, Vitali, L, Diekhöner, L, Vogelgesang, R, Kern, K, 2007, Local measurement of hot-electron phase-coherence at metal surfaces, Applied Physics A; 88, pp. 443-447.

Schwarzenbach, D, Birkedal, H, Hostettler, M & Fischer, P, 2007, 'Neutron diffraction investigation of the temperature dependence of crystal structure and thermal motions of red HGI2', Acta Cryst. B, Vol. 63, pp. 828-835.

Schiøtt, B, Sørensen, J, Clausen, HF, Overgaard, J & Poulsen, RD, 2007, 'Short strong hydrogen bonds in 2-acetyl-1,8-dihydroxy-3,6-naphtalene - An outlier to current hydrogen bonding theory?', J. Phys. Chem. A, Vol. 111, pp. 345-351.

Sehgal, P, Bang Nielsen, S, Pedersen, S, Wimmer, R & Otzen, D, 2007, 'Modulation of cutinase structure and stability by phospholipid detergents', Biochim. Biophys. Acta, No. 1774, pp. 1544-1554.

Silva, A, Pedersen, K, Diekhöner, L, Morgen, P, Li, Z, 2007, Ordered Au(111) layers on Si(111), Journal of Vacuum Science and Technology, 25, pp. 908-911.

Sinning, S, Christensen, HS, Boye, SV, Thingaard, J, Wiborg, O, Schiøtt, B & Bols, M, 2007, 'QSAR studies and pharmacophore identification for acryl-substituted cycloalkenecarboxylic acid methyl esters with affinity for the human dopamine transporter', Bioorganic & Medicinal Chemistry, Vol. 15, pp. 5262-5274.

Sivertsen, AC, Gasior, M, Bjerring, M, Hansen, SU, Lopez, OL, Nielsen, NC & Bols, M, 2007, 'Active Site Protonation of 1-Azafagomine in Glucosidases Studied by Solid-State NMR Spectroscopy', European Journal of Organic Chemistry, pp. 1735-1742.

Skibsted, J, Andersen, MD & Jakobsen, HJ, 2007, 'Applications of solid-state Nuclear Magnetic Resonance (NMR) in studies of Portland cements-based materials', Zement Kalk Gips, Vol. 60, No. 6, pp. 70-83.

Skivesen, N, Têtu, A, Kristensen, M, Kjems, J, Frandsen, LH & Borel, PI, 2007, 'Photonic-crystal waveguide biosensor', Optics Express, Vol. 15, No. 6, pp. 3169-3176.

Skivesen, N, Kristensen, M, Kjems, J, Frandsen,

LH, Borel, PI & Tetu, A, 2007, 'Metal-clad waveguides anvendt som optiske bio-sensorer', DOPS Nyt, Vol. 07, No. 1, p. 20.

Skivesen, N & Kristensen, M, 2007, 'Protein detection with photonic-crystal waveguide sensor', DOPS Nyt, Vol. 07, No. 2, p. 8.

Song, YJC, Lundvig, DMS, Huang, Y, Gai, WP, Blumbergs, PC, Højrup, P, Otzen, D, Halliday, GM & Jensen, PH, 2007, 'p25a Relocalizes in Oligodendroglia from Myelin to Cytoplasmic Inclusions in Multiple System Atrophy', Am. J. Path., No. 171, pp. 1291-1303.

Sommer, C, Deen, R, Pedersen, JS, Strunz, P & Garamus, VM, 2007, 'Microemulsion Droplets Decorated by Brij700 Block Copolymer: Phase Behavior and Structural Investigation by SAXS and SANS', Langmuir, Vol. 23, pp. 6544-6553.

Sridharan, MG, Sillassen, MB, Bøttiger, J, Chevallier, J & Birkedal, H, 2007, 'Pulsed DC magnetron sputtered Al2O3 films and their hardness', Surface & Coatings Technology, Vol. 202, No. 4-7, pp. 920-924.

Stiehler, M, Mygind, T, Dolatshahi-Pirouz, A, Kassem, M, Lind, M, Baatrup, A, Foss, M, Besenbacher, F, Bünger, C & Haisheng, L, 2007, 'Morphology, proliferation, and osteogenic differentiation of mesenchymal stem cells stimulated by Ti, Ta, and Cr surfaces', J Biomed Mater Res A.

Stigsnaes, P, Frøkjær, S, Bjerregaard, S, van der Weert, M, Kingshott, P & Horn Møller, E, 2007, 'Characterisation and physical stability of PEGylated glucagon', Int.J.Pharm., Vol. 330, No. 1-2, pp. 89-98.

Thaysen-Andersen M, M, Thøgersen, I, Lademann, U, Offenberg, H, Giessing, A, Enghild, JJ, Nielsen, H, Brünner, N & Højrup P., P, 2007, 'Investigating the biomarker potential of glycoproteins using comparative glycoprofiling - application to tissue inhibitor of metalloproteinases-1.', Biochim Biophys Acta.

Thijs, L, Vinck, E, Bolli, A, Trandafir, F, Wan, X, Hoogewijs, D, Coletta, M, Fago, A, Weber, RE, Doorslaer, SV, Ascenzi, P, Alam, M, Moens, L & Dewilde, S, 2007, 'Characterization of a globin-coupled oxygen sensor with a gene-regulating function', The Journal of Biological Chemistry, Vol. 282, No. 52, pp. 37325-37340.

Vang, RT, Lægsgaard, E & Besenbacher, F, 2007, 'Bridging the pressure gap in model systems for heterogeneous catalysis with high-pressure scanning tunneling microscopy', Physical Chemistry Chemical Physics.

Vase, KH, Holm, AH, Winther-Jensen, B, Pedersen, SU & Daasbjerg, K, 2007, 'Evaluation of various strategies to formation of pH responsive hydroquinone-terminated films on carbon electrodes', Electrochimica Acta, Vol. 53, pp. 1680-1688.

Vázquez-Campos, S, Péter, M, Dong, M, Xu, S, Xu, W, Gersen, H, Linderoth, TR, Schönherr, H, Besenbacher, F, Crego-Calama, M & Reinhoudt, DN, 2007, 'Self-organization of gold-containing hydrogen-bonded rosette assemblies on graphite surface', Langmuir, No. 23, pp. 10294-10298.

Viftrup, S, Kumarappan, V, Trippel, S & Stapelfeldt, H, 2007, 'Holding and Spinning Molecules in Space', Phys. Rev. Lett., Vol. 99, No. 143602.

Volkov, VS, Bozhevolnyi, SI, Frandsen, LH & Kristensen, M, 2007, 'Direct Observation of Surface Mode Excitation and Slow Light Coupling ind Photonic Crystal Waveguides', Nano Letters, Vol. 7, No. 8, pp. 2341-2345.

Vorup-Jensen, T, Chi, L, Gjelstrup, LC, Jensen, UB, Jewett, C, Xie, C, Shimaoka, M, Lindhardt, R & Springer, A, 2007, 'Binding between the Integrin { alpha} Xbeta2 (CD11c/CD18) and Heparin', J Biol Chem, Vol. 282, pp. 30869-77.

Wahl, P, Simon, P, Diekhöner, L, Stepanyuk, VS, Bruno, P, Schneider, M. A, Kern, K, 2007, Exchange interaction between single magnetic adatoms, Physical Review Letters, 98, p. 056601.

Wang, J & Hammer, B, 2007, 'Oxidation state of oxide supported nanometric gold', Topics in Catalysis, Vol. 44, No. 1-2, pp. 49-56.

Weigelt, S, Busse, CW, Bombis, C, Knudsen, MM, Gothelf, KV, Strunskus, T, Wöll, C, Dahlbom, M, Hammer, B, Lægsgaard, E, Besenbacher, F & Linderoth, TR, 2007, 'Covalent interlinking of an aldehyde and an amine on n Au(111) surface in ultrahigh vacuum', Angewandte Chemie, Vol. 46.

Weigelt, S, Busse, CW, Nielsen, M, Gothelf, KV, Lægsgaard, E, Besenbacher, F & Linderoth, TR, 2007, 'Influence of molecular geometry on the adsorption orientation for oligophenylene-ethynylenes on Au(111)', Journal of Physical Chemistry B Letters, Vol. 111.

Weijo, V, Manninen, P, Jørgensen, P, Christiansen, O & Olsen, J, 2007, 'Second-order Møller-Plesset perturbation theory in the projected atomic orbital basis: studies on locality and an implementation', J. Chem. Phys., Vol. 127, p. 074106.

Wu, Q, Sjåstad, AO, Vistad, ØB, Knudsen, KD, Roots, J, Pedersen, JS & Norby, P, 2007, 'Characterization of exfoliated layered double

Publications

hydroxide (LDH, Mg/Al = 3) nanosheets at high concentrations in formamide', J. Mater. Chem., Vol. 17, No. 10, pp. 965-971.

Wygrecka, M, Markart, P, Morty, R, Kanse, S, Andreasen, P, Wind, T, Vuenther, V & Preissner, K, 2007, 'Plasminogen activator inhibitor-1 is a major physiological inhibitor of factor VII-activating protease.', J.Biol.Chem.

Xu, S, Dong, M, Liu, X, Howard, KA, Kjems, J & Besenbacher, F, 2007, 'Direct Force Measurements between siRNA and Chitosan Molecules Using Force Sprectroscopy', Biophysical Journal, No. 93, pp. 952-959.

Xu, S, Dong., M, Liu, X, Howard, K, Kjems, J & Besenbacher, F, 2007, 'Direct Force Measurements of between siRNA and Chitosan Molecules', Bionanotechnology.

Xu, W, Dong, M, Gersen, H, Rauls, E, Vasques-Campos, S, Crego-Calama, M, Reinhoudt, DN, Stensgaard, I, Lægsgaard, E, Linderoth, TR & Besenbacher, F, 2007, 'Cyanuric acid and melamine on Au(111): Structure and energetics of hydrogen-bonded networks', Small, Vol. 5, pp. 854-858.

Xu, W, Dong, M, Gersen, H, Vázquez-Campos, S, Lægsgaard, E, Stensgaard, I, Crego-Calama, M, Reinhoudt, J, Linderoth, TR & Besenbacher, F, 2007, 'Enhanced stability of large molecules vacuum-sublimated onto Au(111) achieved by incorporation of coordinated au-atoms', Journal of American Chemical Society, No. 129.

Xu, W, Ross, KEA, Otero Martin, R, Schöck, M, Lægsgaard, E, Stensgaard, I, Kontorovich, L & Besenbacher, F, 2007, 'Probing the hierachy of thymine-thymine interactions in self-assembled structures by STM manipulation', SMALL, Vol. 3, No. 12, pp. 2011-2014.

Xu, W, Dong, M, Gersen, H, Rauls, E, Vasques-Campos, S, Crego-Calama, M, Reinhoudt, DN, Stensgaard, I, Lægsgaard, E, Linderoth, TR & Besenbacher, F, 2007, 'Cyanuric acid and melamine on Au(111): Structure and energetics of hydrogen-bonded networks', Small, Vol. 5, pp. 854-858.

Yu, D, Steffensen, K, Grønlund, JT, Nielsen, AL, Wimmer, R, Larsen, KL, 2007, Regioselective alkanoylation of cyclodextrins, I: Journal of Inclusion Phenomena and Macrocyclic Chemistry. Vol. 57, pp. 333-338.

Zarifi A, Fisker C, Pedersen TG, 2007, 'Theoretical study of the quadratic electrooptic effect in semiconducting zigzag carbon nanotubes', Phys. Rev. B76, 45403.

Zhao, G, Yuan, C, Wind, T, Andreasen, P, Huang, Z & Huang, M, 2007, 'New pharmacophore for serine protease inhibition revealed by crystal structure of human urokinase-type plasminogen activator complexed with a cyclic peptidyl inhibitor, upain-1', J. Struct. Biol., Vol. 160.

Åhlund, J, Schnadt, J, Nilson, K, Göthelid, E, Schiessling, J, Besenbacher, F, Mårtensson, N & Puglia, C, 2007, 'The adsorption of iron phthaloyaninen on graphite: A scanning tunneling microscopy study', Surface Science, pp. 3661-3667.

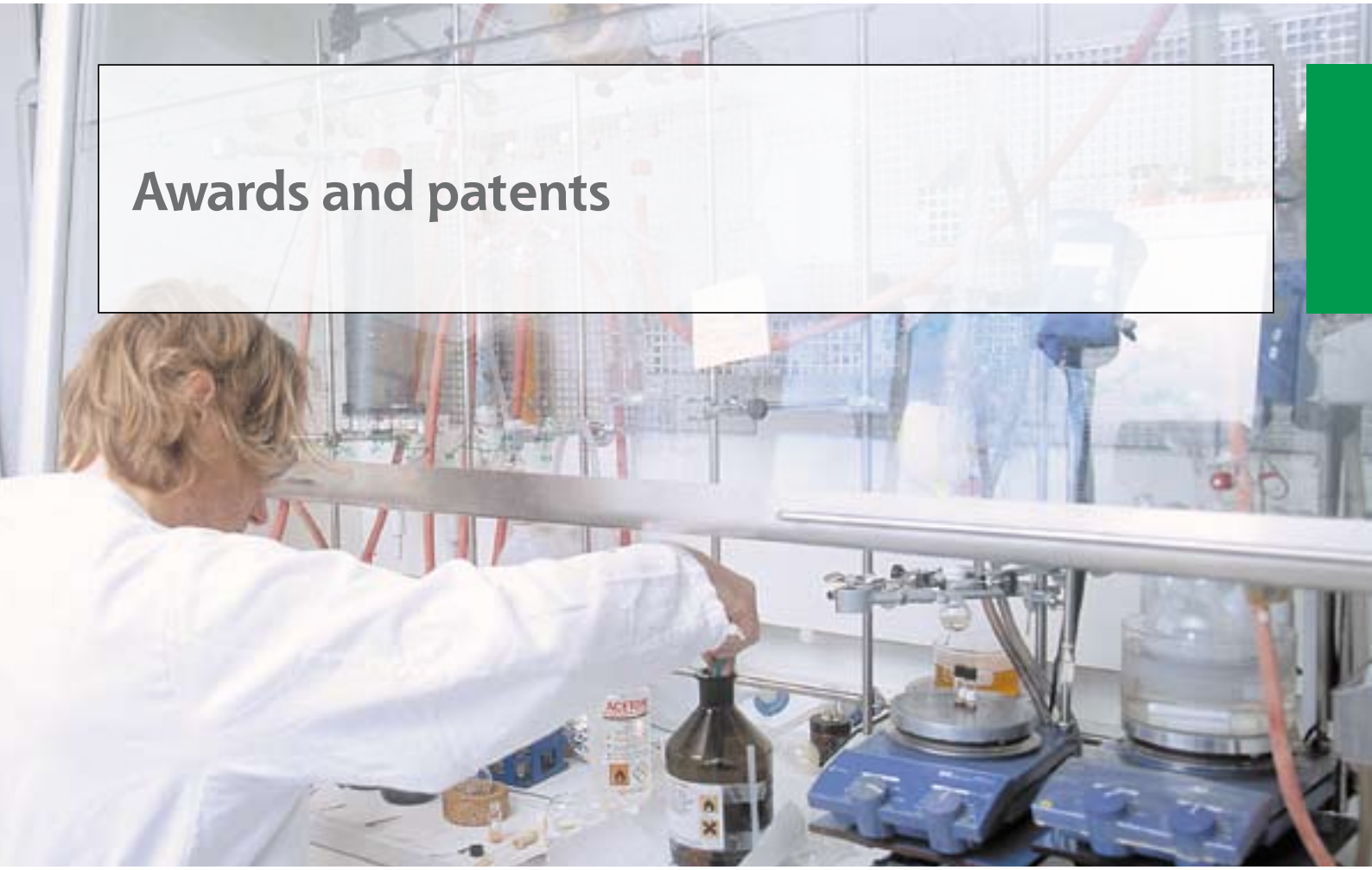
Formidling

Besenbacher, F, 2007, Nanoteknologi, miljø og sundhed: Ansvarlig udnyttelse af teknologi i udvikling, Miljøministeriet, København.

Besenbacher, F, Bech, L & Osbahr, S, 2007, 'Videnskaben bag nanoteknologien', Global Økologi, Vol. 14, No. 2, pp. 8-11.

Hansen, KB, Larsen, MGG & Baatrup, E, 2007, 'Fisk på p-piller', Aktuel Naturvidenskab, No. 5, pp. 8-11.

Awards and patents



Awards

Bjørk Hammer:
The Lundbeck prize for young researchers

Flemming Besenbacher:
Honorary Professorhips at Henan University and Tianjin University

Jan Skov Pedersen:
Carlsberg's Chemistry Prize

Jørgen Kjems:
Danmarks Naturvidenskabelige Akademis pris

Niels Chr. Nielsen:
Danisco Award 2007

Rikke Louise Meyer:
L'Oréal Denmark Award

Søren Nielsen:
EliteForsk Award

Jonas Ørbæk Hansen, Niels Vinther Voigt, Karin Doolewerdt:
Grundfoss Challenge

Patents

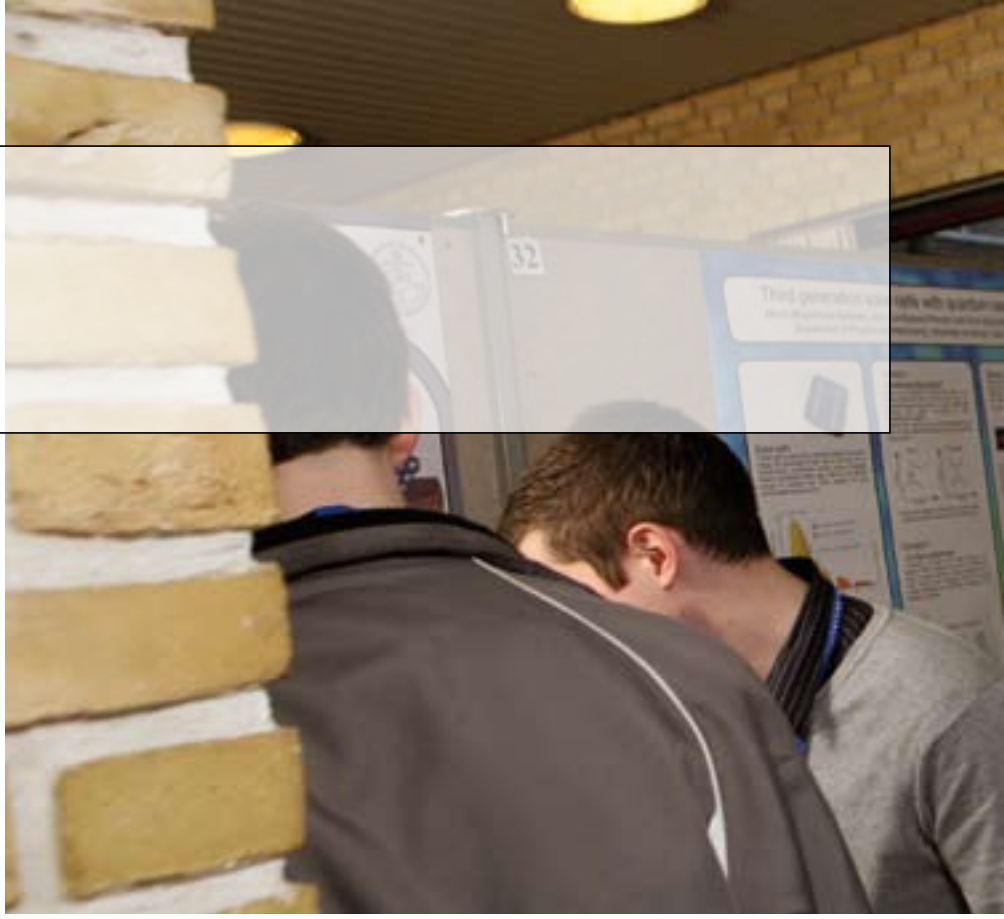
Arpanaei, A, Hobley, T, Thomas, O, Winther-Jensen, B, and Kingshott, P:
Surface modification of beads from bioprocesses, PA 2007 00872.

Broch-Nielsen, T, Bondergaard, J, Besenbacher, F, and Kingshott, P:
Material Comprising and Consisting of Fibres and Nanoclay, WO2007048547, DE102005051844.

Broch-Nielsen, T, J., B, Besenbacher, F, Kingshott, P, and Moelgaard, S:
Superhydrophobic coating of a polymer nonwoven, in particular a polypropylene nonwoven, WO2007048630, DE102005051550.

Staudt Kvistgaard, A, Sørensen, ES, and Burling, H:
Bovine osteopontin formulations for the improvement of the wound healing process, WO 2007/068252 A2.

Invited talks



Peter Andreasen, A novel type of agent blocking the association of uPA to its receptor uPAR: uPA-binding aptamers, XIth International Workshop on Molecular and Cellular Biology of Plasminogen Activation, Sweden

Peter Balling, Laser ablation with ultrashort laser pulses, Advanced Laser Technologies ALT'07, University of Oulu, Levi, Finland

Peter Balling, Using a femtosecond laser for micro- and nanomachining, Sensing the nanoworld, Aalborg, University of Aalborg, Denmark

Erik Baatrup, Viriability in measures of reproductive success in laboratory-kept colonies of zebrafish

Erik Baatrup, Effects of 17b-estradiol on sperm motility in Java medaka

Flemming Besenbacher, An introduction to nanoscience and nanotechnology, and antifouling surfaces in the food industry, Danisco Innovation Forum, Copenhagen, Denmark

Flemming Besenbacher, Atomic-scale studies of hydrodesulfurization model catalysts by scanning tunneling microscopy, Tsinghua University, China

Flemming Besenbacher, Cross-disciplinary Research at the iNANO Center, CAS Nordic Forum, Lund, Sweden

Flemming Besenbacher, DNA building blocks studied by high-resolution, fast-scanning STM, Inauguration of Center for DNA Nanotechnology, Aarhus, Denmark

Flemming Besenbacher, Dynamics of nanostructures on surfaces revealed by high-resolution, fast-scanning STM, Royal Institute of Technology

Flemming Besenbacher, Dynamics of Nanostructures on Surfaces Revealed by High-resolution, Fast-Scanning STM, Dresden Collogium, Dresden, Germany

Flemming Besenbacher, Dynamics of Nanostructures on Surfaces Revealed by High-Resolution, Fast-Scanning STM, International Max Planck Research School Workshop on Surface Science, Ringberg, Germany

Flemming Besenbacher, Dynamics of nanostructures on surfaces revealed by high-resolution, fast-scanning STM, IVC17/ICSS13 and ICN+T2007 Congress, Stockholm, Sweden

Flemming Besenbacher, Establishing a new interdisciplinary bachelor and master nano curriculum and a PhD graduate school at iNANO, IVC17/ICSS13 and ICN+T2007 Congress, Stockholm, Sweden

Flemming Besenbacher, Dynamics of Nanostructures on Surfaces Revealed by High-Resolution, Fast-Scanning STM, 31st Coca Beach Conference, Daytona Beach, USA

Flemming Besenbacher, Dynamics of nanostructures on surfaces revealed by high-res-

olution, fast-scanning STM, International Nanoscience Symposium, Hamburg, Germany

Flemming Besenbacher, Dynamics of nanostructures on surfaces revealed by high-resolution, fast-scanning STM, NanoChina2007, Beijing, China

Flemming Besenbacher, Enhanced Bonding of Gold Nanoparticles on Oxidized TiO_2(110), TNT, 2007, San Sebastian, Spain

Flemming Besenbacher, Establishing a new interdisciplinary bachelor and master nano-curriculum and a PhD graduate school at iNANO, ICMAT, 2007, Singapore

Flemming Besenbacher, From Nanoscience to Nanotechnology, Henan University, China

Flemming Besenbacher, High-resolution scanning tunneling microscopy studies of surface reactions on rutile Tio2(110), ACS Spring Meeting, Chicago, USA

Flemming Besenbacher, Højteknologifondens virkemidler: Input fra en universitetspartner, Netværksdag, Danish Advanced Technology Foundation, Copenhagen, Denmark

Flemming Besenbacher, Nanoparticles catalysts, NanoCap Meeting, Aarhus, Denmark

Flemming Besenbacher, Nanoscience and nanotechnology in society, Princess Chulabhorn International Science Congress, Bangkok, Thailand

Flemming Besenbacher, Nanoscience and Nanotechnology in the 21st century, 75th Anniversary - Institute of Physics and Chemistry, Madrid, Spain

Flemming Besenbacher, New Atomic-Scale Insights into Cluster-size, Promoter and Support Effects of MoS_2-based Hydrotreating Models Catalysts, 2007 Euopcat VIII, Turku, Finland

Flemming Besenbacher, Organic molecules on surfaces studied by STM: Dynamics Chirality, organization and self-assembly, ICMAT, 2007, Singapore

Flemming Besenbacher, Organic molecules on surfaces studied by STM: Dynamics, chirality, organization and self-assembly, National Nanoscience Center

Flemming Besenbacher, Pharma og Nanoscience, Food Pharma Tech, Herning, Denmark

Flemming Besenbacher, SPM studies of Cysteine Dimerization, Glucagon Fibrillation, and DNA Nanostructures, ICMAT, 2007, Singapore

Flemming Besenbacher, STM of models systems relevant for catalysis, CAMD Symposium, Copenhagen, Denmark

Flemming Besenbacher, Vil nanoteknologi føre til den næste industrielle revolution?, Rotary, Birkerød, Denmark

Flemming Besenbacher, Vil nanoteknologi føre til den næste industrielle revolution?, Rotary, Varna, Århus, Denmark

Niels Egede Christensen, Ab initio calculations of physical properties of solids, Univ. of La Laguna

Niels Egede Christensen, Ab initio theory of optical properties including electron-hole correlations, "Functional materials and nanotechnologies" FM&NT-2007, Riga, Latvia

Niels Egede Christensen, Excitonic effects in optical properties of semiconductors, UNIPRESS

Niels Egede Christensen, Simple metals under pressure are not "simple", Univ. of La Laguna

Lars Diekhöner, Magnetic exchange coupling between single Cobolt atoms, Colloquium, Department of Physics and Chemistry, University of Southern Denmark

Lars Diekhöner, Nanoteknologi: Fysik på nanoskala, Folkeuniversitetet Aalborg

Angela Fago, Not only oxygen, the other side of globin function, 7th International Congress of Comparative Physiology and Biochemistry (ICCPB), Brazil

Angela Fago, Unraveling the origin of the nitrite-mediated hypoxic vasodilation, Society for Experimental Biology, Annual Main Meeting, UK

Invited talks

Bjørk Hammer, Adsorption of an amino acid on a chiral surface: Cys/Au(17 11 9), CECAM, Lyon, France

Bjørk Hammer, Au clusters on reduced or oxidized TiO_2(110) surfaces, Stockholm, Sweden

Bjørk Hammer, Binding and activity of Au clusters to TiO_2(110) surfaces in different oxidation states, Lyngby, Denmark

Bjørk Hammer, Computersimuleringer, Århus, Ungdommens Naturvidenskabelige Forening

Bjørk Hammer, Formation of Au clusters on rutile TiO_2(110), ACS, Boston, USA

Bjørk Hammer, Gold nano-clusters on TiO_2: Structure and activity, University of Leiden, Leiden, Germany

Bjørk Hammer, The role of cationic Au in binding and activating Au nanoclusters on TiO_2(110), Fritz-Haber-Instituttet, Berlin, Germany

Bjørk Hammer, The role of cationic Au in binding and activating Au nanoclusters on TiO_2(110), GRC Ventura, California, USA,

Bjørk Hammer, Unique catalytic behavior of oxide supported nano-sized Au particles, Odense, University of Southern Denmark, Denmark

Philip Hofmann, Band dispersion in fulleride films", European Workshop on ab-initio approaches to electron-phonon coupling and superconductivity, Spain

Philip Hofmann, Probing conductivity on the nanoscale, Nanomat07

Philip Hofmann, Quantitative measurement of surface conductance using microscopic four point probes, Symposion on Surface Science

Philip Hofmann, The electronic structure of Bi surfaces, Universitet Bielefeld

Philip Hofmann, The electronic structure of surfaces: spin-orbit interaction and transport properties, University of Liverpool, UK

Philip Hofmann, The electronic structure of surfaces: spin-orbit interaction and transport properties, Aalborg Universitet, Denmark

Philip Hofmann, The electronic structure of surfaces: spin-orbit interaction and transport properties, University of Nottingham, UK

Philip Hofmann, The electron-phonon interaction probed by angle-resolved photoemission, San Sebastian, Spain

Peter Kingshott, Advancing in Advancing the Performance of Sustainable Hygiene and Personal Care Products, The Future of Sustainable Hygiene Products Meeting, Czech Republic

Peter Kingshott, Designing antifouling surfaces with the help of highly sensitive and specific surface analytical techniques, At the surface of biotechnology, Biotech Forum, Stockholm, Sweden

Peter Kingshott, Nanostructuring of surfaces with colloidal crystals, PTS Meeting on nanostructured surfaces, Copenhagen, Denmark

Peter Kingshott, Playing with surface chemistry to try and stop proteins and cells from sticking, Frontiers Research Meeting, Touluse, France

Jørgen Kjems, Genesilencing using polymeric nanocarrier systems, Nordita Conference, Copenhagen, Denmark,

Kim Lambertsen Larsen, General overview of cyclodextrins and their food applications, Danisco

Kim Lambertsen Larsen, Introduction to Cyclodextrins, Lundbeck

Kim Lambertsen Larsen, Introduction to Cyclodextrins, LEO Pharma

Trolle René Linderoth, Chiral switching and chiral recognition for organic molecules on surfaces studied by UHV-STM, CECAM workshop: Chiralilty and Molecular Recognition at Surfaces, France

Trolle René Linderoth, Large organic molecules on surfaces studied by UHV-STM: Dynamics, Chirality and Organization, Max Planck Institut, Stuttgart, Germany

Niels Christian Nielsen, Danisco Award 2007 prize lecture: Insoluble Proteins, Nanoscience, Surface and Food Science, European Congress on Chemical Engineering; LMC Congress in Innovations in Food Technology, Copenhagen, Denmark

Niels Christian Nielsen, Design of Experiments for Biological Solid-State NMR using Optimal Control, 16th Triennial Conference for the International Society of Magnetic Resonance (ISMAR), Kenting, Taiwan

Niels Christian Nielsen, NMR with potential for Food Science. Metabonomics: Metabonomics, high-field MRI and low-field instrumentation

for process control - and structure determination, Danisco Innovation Forum, Copenhagen, Denmark

Niels Christian Nielsen, Novel Solid-State NMR Experiments Developed Using Optimal Control Theory, Current Trends in Biological Solid-State NMR Spectroscopy, Pune, India

Niels Christian Nielsen, Optimal control for Design and Optimization of Solid-State NMR Experiments, Control, Constraints and Quanta (ESF conference), Bedlewo, Poland

Niels Christian Nielsen, Optimal Control Theory in Relation to Solid-State NMR: Recent Progress and Future Challenges, PRAQSYS, 2007, The Principles and Applications of Control in Quantum Systems, Sydney, Australia

Niels Christian Nielsen, Solid-State NMR of Membrane Proteins, Copenhagen, Leo Pharma

Niels Christian Nielsen, Solid-State NMR Studies of Oriented Membrane Proteins - Approaches for Non-Perfectly Aligned Large Membrane Proteins, 13th National Magnetic Resonance Society Meeting, Pune, India

Niels Christian Nielsen, Triple-Oscillating Field Technique for Accurate Distance Mesurements by Solid-State NMR, GDCh 29th Annual Discussion Meeting: Magnetic Resonance in Biophysical Chemistry, Göttingen, Germany

Poul Nissen, Crystallisation and structure determination of membrane proteins, Membrane protein crystallography, EMBO, Gunnar von Heijne, EMBO workshop 'New Methods in Membrane Protein Research', Stockholm, Sweden

Poul Nissen, Structure and function of P-type ATPase pumps, P-type ATPase cation pumps in cell membranes, Ramon Serrano, XIV International Workshop on Plant Membrane Biology, Valencia, Spain

Poul Nissen, The role of GTP hydrolysis in translocation, Derek Logan, Structural Biology Network, 2007, Tällberg,

Poul Nissen, Cation pumps - from crystal structures to molecular pharmacology and physiology, Scandinavian Association of Urology, NUF, 2007, Aarhus, Denmark

Poul Nissen, Membrane proteins and large assemblies, Synkrotronstråling, EMBL-Hamburg, Petra-III workshop at EMBL-Hamburg, Hamburg, Germany

Thomas Garm Pedersen, Excited states in nanosized electronic systems, AMO seminar, Aarhus University, Denmark

Thomas Garm Pedersen, Optical properties of nanotubes, -wires and –particles, Talk at MCI, SDU Sønderborg, Denmark

Peter Remsen Ogilby, Creating and Detecting Reactive Oxygen Species, Particularly Singlet Oxygen, at the Sub-Cellular Level, International Symposium on Reactive Oxygen Species in Plant Sciences, Copenhagen, Denmark

Peter Remsen Ogilby, The Photosensitized Production and Optical Detection of Singlet Oxygen with Sub-Cellular Resolution in Single Cells, Congress of the European Society for Photobiology, Bath, UK

Peter Remsen Ogilby, The Singlet Oxygen Microscope: Experiments with Sub-Cellular Resolution in Single Cells, University of Heraklion

Peter Remsen Ogilby, The Singlet Oxygen Microscope: Experiments with Sub-Cellular Resolution in Single Cells, 23rd International Conference on Photochemistry, Cologne, Germany

Peter Remsen Ogilby, The Singlet Oxygen Microscope: Experiments with Sub-Cellular Resolution in Single Cells, University of Constance

Peter Remsen Ogilby, The Singlet Oxygen Microscope: Experiments with Sub-Cellular Resolution in Single Cells, Symposium on Nanotechnology, Aalborg, Denmark

Peter Remsen Ogilby, The Singlet Oxygen Microscope: From Phase-Separated Polymers to a Single Biological Cell, 2nd Joint Portuguese-Spanish Photochemistry Meeting, Faro, Portugal

Peter Remsen Ogilby, The Singlet Oxygen Microscope: From Phase-Separated Polymers to a Single Biological Cell, KAIST School of Molecular Science International Symposium, Jeju Island, South Korea

Peter Remsen Ogilby, The Singlet Oxygen Microscope: From Phase-Separated Polymers to a Single Biological Cell, Pohang University of Science and Technology

Peter Remsen Ogilby, The Singlet Oxygen Microscope: From Phase-Separated Polymers to a Single Biological Cell, University of Algarve

Niels Peter Revsbech, Analysis of marine environments with amperometric gas microsensors and microscale biosensors, ETH, Zurich

Niels Peter Revsbech, Galathea 3, Voer, Voer Beboerforening

Niels Peter Revsbech, Galathea 3: Havet ud for Peru, spisekammer og renseanlæg, Randers, Galathea Danmark

Niels Peter Revsbech, Galathea 3: Havets økosystem truet af overudnyttelse, forurening og klimaændring?, Randers, Galathea Danmark

Niels Peter Revsbech, Økologien som forståelsesramme, Ørsted, Ørsted KFUM og K

Jørgen Bengaard Skibsted, Characterization of cement minerals, cements and their reaction products at the atomic and nanoscale level, 12th International Congress on the Chemistry of Cement, Montréal, Canada

Jørgen Bengaard Skibsted, FUTURECEM: Fremtidens cement, Kemilærerdag - Kemisk Institut, Aarhus Universitet, Aarhus, Denmark

Jørgen Bengaard Skibsted, Solid-state MAS NMR studies of inorganic materials: cements, heterogeneous catalysts, and porous materials, iNANO PhD Summer School on Inorganic Materials, Denmark

Jørgen Bengaard Skibsted, Solid-state MAS NMR studies of quadrupolar-spin nuclei in heterogeneous catalysts and Portland cement-based materials, 29th Annual Discussion Meeting of the Fachgruppe Magnetresonanz of the Gesellschaft Deutscher Chemiker, Göttingen, Germany

Esben Skipper Sørensen, Osteopontin - a multifunctional milk protein, 1st Arla Foods Research Seminar, Arla Foods Amba, Denmark

Esben Skipper Sørensen, Osteopontin: Structure-Function Relationships, Gordon Researh Conference - Small integrin-binding proteins, Gordon Research Conference, Biddeford, Maine, USA,

Jens Lykke Sørensen, Doppler cooling on an electrical quadrupole transition, Fundamental Quantum Processes in Atomic and Molecular Systems. Annual NordForsk network Meeting, 2007, Nesbud, Island

Leif Østergaard, Vilkår for Tværdisciplinær Forskningsledelse, Forskningsledernetværket FL1, Denmark

Leif Østergaard, Nye perfusionsteknikker ved akut apopleksi, Dansk Neuroradiologisk Selskab: E-kursus, Apopleksi: Diagnose, Klinik og Behandling, Aarhus, Denmark

Invited talks

Leif Østergaard, Vejen er kort fra Grundforskning til Patientbehandling og Innovation, Århus Sygehus, Århus Universitetshospital, Forskningens Dag, Aarhus, Denmark

Leif Østergaard, Perfusion MRI, Scandinavian MR Physics Course, Lund, Sweden

Leif Østergaard, Dynamic Susceptibility Contrast Perfusion Imaging, European Society of Magnetic Resonance in Medicine (ESMRMB) Lectures on Magnetic Resonance, Quantitative Perfusion Imaging, Freiburg, Germany

Leif Østergaard, Introduction to Perfusion and Physiology, European Society of Magnetic Resonance in Medicine (ESMRMB) Lectures on Magnetic Resonance, Quantitative Perfusion Imaging, Freiburg, Germany

Leif Østergaard, Clinical Importance of Perfusion Imaging, European Society of Magnetic Resonance in Medicine (ESMRMB) Lectures on Magnetic Resonance, Quantitative Perfusion Imaging, Freiburg, Germany

Leif Østergaard, Bioimaging and nanotechnology, Interdisciplinary Nanoscience Center, University of Aarhus, iNANO Autumn School, Fuglsø, Denmark

Leif Østergaard, Faglige fællesskaber som Det Nye Universitetshospitals organiseringsprincip: Billeddiagnostik, Region Midtjylland, Seminar, Styregruppen for Det Nye Universitetshospital (DNU) i Århus, Aarhus, Denmark

Leif Østergaard, MR ved akut apopleksi, Dept. Radiology, Rikshospitalet, Staff Meeting, Oslo, Norway

Leif Østergaard, Stroke MRI, Nordic Imaging Lab, nICE Workshop, Bergen, Norway

Leif Østergaard, I-Know - A Diagnostic Support System in the Treatment of Acute Stroke, Center of Pervasive Computing, Staff Meeting

Leif Østergaard,Om Moderne Skanningsmetoder, Hjernen og Musik, Dansk Medicoteknisk Selskab, 25. landsmøde, Denmark

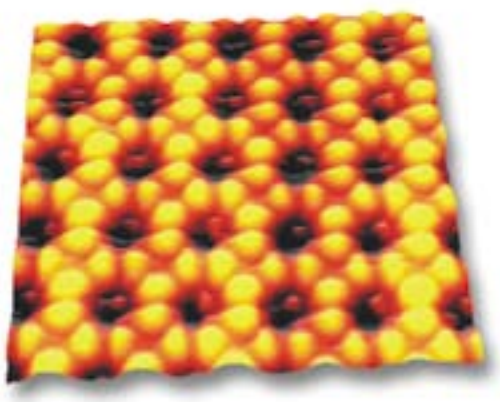
Leif Østergaard, Hjerneforskning: Fra Fysik og Musik til Patientbehandling, University of Aarhus, Aarhus University Anniversary, Aarhus, Denmark

Leif Østergaard, Advanced Stroke MRI: Prediction of Outcome, Nordic Stroke Society, Nordic Stroke 2007 - 14th Nordic Meeting on Cerebrovascular diseases

Leif Østergaard, MRI stroke pathophysiology, Nordic Stroke Society, Nordic Stroke 2007 - 14th Nordic Meeting on Cerebrovascular Diseases

Leif Østergaard, Perfusion MRI Methodology, National Institutes of Health, American Society of Neuroradiology, NER Foundation Workshop on Advanced Neuroimaging and Acute Stroke, Washington DC, USA

Leif Østergaard, Modeling the regulation of cerebral oxygen extraction by flow heterogeneity, International Society for Magnetic Resonance in Medicine (ISMRM), Workshop on Cerebral Perfusion and Brain Function: Novel Techniques and Applications



Leif Østergaard, Latest Advances in DSC-MRI in Acute Stroke, International Society for Magnetic Resonance in Medicine (ISMRM), Workshop on Cerebral Perfusion and Brain Function: Novel Techniques and Applications

Leif Østergaard, DSC-MRI: Technical Updates, International Society for Magnetic Resonance in Medicine, Workshop on Cerebral Perfusion and Brain Function: Novel Techniques and Applications

Leif Østergaard, Perfusions- og diffusions MR ved apopleksi: De nyeste teknikker, Nordic Society of Neuroradiology, Annual Meeting

Leif Østergaard, MR eller konventionel CT inden trombolysebehandling. Gør det en forskel?, Nordic Society of Neuroradiology, Annual Meeting

Leif Østergaard, Introduktion til tumor-perfusion, Nordic Society of Neuroradiology, Annual Meeting

Leif Østergaard, Fiber tracking som led i præoperativ planlægning ved hjernetumorer, Nordic Society of Neuroradiology, Annual Meting, Denmark

Leif Østergaard, Gadovist og Akut Apopleksi, Bayer-Schering Symposium, ISMRM/ESMRMB Annual Meeting, Berlin, Germany

Leif Østergaard, MRI in Stroke, International Society of Magnetic Resonance in Medicine and European Society of Magnetic Resonance in Medicine and Biology, ISMRM/ESMRMB Joint Annual Meeting, Berlin, Germany

Leif Østergaard, Vejen fra Grundforskning til Patientbehandling og Innovation er kort, University of Aarhus, Visit by the Danish Parliaments Committee on Science and Technology and the Danish Minister of Science, Technology and Innovation (Helge Sander), Aarhus, Denmark

Leif Østergaard, Musik og depression, Eli Lily / Boehringer Ingelheim, Depressionspatienten i praksis: Symposium for praktiserende læger

Leif Østergaard, Diffusion and Perfusion MR imaging of the brain: Imaging techniques, protocols and post-processing, European Society of Radiology, European Congress of Radiology

Colloquia

iNANO annual meeting 2007

January 18, Professor Colin J. Lambert, Department of Physics, Lancaster University, "The future of nanoelectronics: disruption, convergence and delivery

January 18, Professor Horst Vogel, Laboratory of Physical Chemistry of Polymers and Membranes, Swiss Federal Institute of Technology Lausanne, "Investigating cellular signalling by micro- and nanotechnology"

January 18, Professor Chen Wang, National Center for Nanoscience and Technology, "Weak forces in building low dimensional molecular nanostructures"

January 18, Professor Sarah H. Tolbert, Department of Chemistry and Biochemistry, UCLA, "Nanoscale optical, electronic, magnetic, and structural materials through inorganic/organic self-organization"

January 18, Professor Francesco Stellacci, Department of Materials Science and Engineering, Massachusetts Institute of Technology, "Supramolecular Nanomaterials and Lithography"

January 18, Professor, Director Chiming Wei, Cardiothoracic-Renal Molecular Research Program, Department of Surgery, Johns Hopkins University School of Medicine, "New Technology and Clinical Applications of Nanomedicine"

iNANO colloquia, Aarhus

January 12, Professor Ruth Duncan, Welsh School of Pharmacy, Cardiff University, Cardiff, Wales, UK, "Nanomedicine: their design, preclinical development and medical use"

February 2, Jesper Glückstad, Research Professor, Programmable Phase Optics group, Risø National Laboratory, Roskilde, Denmark, "Manipulating microtools with nanofeatures using light in 3D real-time"

February 9, Professor Klaus D. Jandt, Institute of Materials Science and Technology, Friedrich-Schiller-University Jena, Germany, "Nanostructure and properties at phase boundaries of biomedical and bio-polymers and mineralised tissues - a tour de force"

February 16, Professor Ian Robinson, London Centre for Nanotechnology (LCN), London, UK, "Lensless Imaging of Nanomaterials by Inversion of Coherent X-ray Diffraction"

March 2, Dr. Michael Hirscher, Max-Planck-Institute for Metals Research, Stuttgart, Germany, "Hydrogen Storage by Physiorption on Novel Porous Materials"

March 16, Prof. Per Halkjær Nielsen, Department of Biotechnology, Chemistry and Environmental Engineering, Aalborg University, Denmark, "Linking identity and function of microorganisms in biofilms"

March 23, Professor Roger Strand, The Centre for the Study of the Sciences and the Humanities (SVT), University of Bergen, Bergen, Norway, "Mapping Nanoethical Challenges"

March 30, PhD Thorkild Sørensen, The Danish Patent and Trademark Office, Taastrup, Denmark, "Business & patent law"

April 13, Professor, Dr. Alfred Nordmann, Institut für Philosophie, Technische Universität Darmstadt,Darmstadt, Germany, "Material and Device - Nanotechnological Visions and their Neglect of Materials Research"

April 20, Professor, Dr. Martin Wegener, Institut für Angewandte Physik, Universität Karlsruhe, Karlsruhe, Germany, "Photonic metamaterials: Optics starts walking on two feet"

April 27, Dr. Karl-Heinz Ernst, Empa - Swiss Laboratories for Materials Testing and Research, Dübendorf, Switzerland, "World in a mirror: Our handed universe"

May 11, Dr. Marc Grynpas, Department of Laboratory of Medicine and Pathobiology and Institute for Biomaterial and Biomedical Engineering, University of Toronto, "Biological and Material determinants of Bone Fragility"

June 1, Professor Hans Jørn Kolmos, Clinical Microbiology Department, Institute of Clinical Research, University of Southern Denmark, Denmark, "Current issues in infection control"

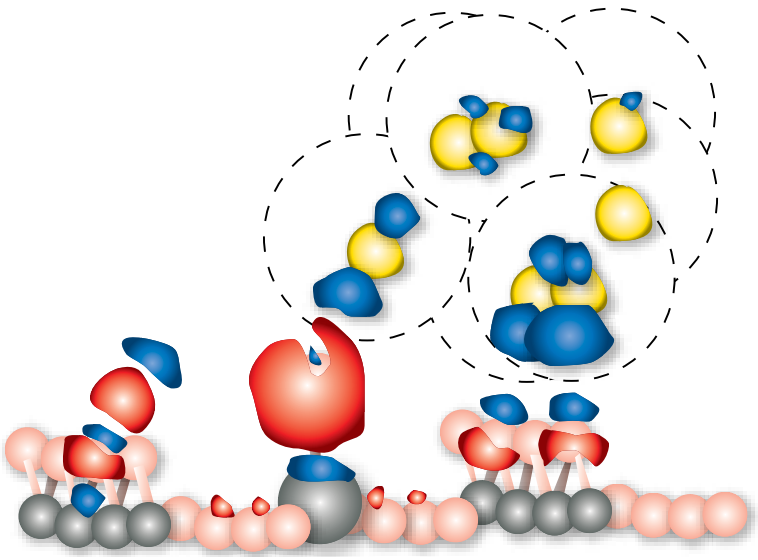
June 8, Prof. Per Claesson, Visiting Villum Kann Rasmussen Professor, Dept. of Chemistry, AU and Dept. of Chemistry, Surface Chemistry, Royal Institute of Technology, Stockholm, Sweden, "Responsive surface layers"

June 15, Prof. Marcus Textor, ETH Zurich, BioInterfaceGroup, Laboratory for Surface Science and Technology, Department of Materials, Zürich, Switzerland, "Surface functionalization by microfabrication and molecular assembly techniques to direct biological response"

June 22, Prof. Allan S. Hoffman, Member of National Academy of Engineering, University of Washington, Seattle, USA, "Evolution of Controlled Drug delivery Systems from Macroscopic Inserts and Implants to Microscopic Particles to Nano-scale Polymer-drug Complexes and Conjugates"

August 17, Professor Oliver Seitz, Dept. of Organic and Bioorganic Chemistry, Dept. of Chemistry, Humboldt-Universität zu Berlin, Berlin, Germany, "Recognizing and controlling biomolecular interactions"

August 31, Professor Arben Merkoci, Catalan Institute of Nanotechnology (ICN), Nanobioelectronics & Biosensors Group,



Barcelona, Spain, "Carbon Nanotubes and Nanoparticles for biosensing applications"

September 14, Prof. Chunli Bai, Key Laboratory of Molecular Nanostructure and Nanotechnoloy, Institute of Chemistry, Chinese Academy of Sciences, Beijing, China, "Progress of Nanoscience and Nanotechnology in China"

September 21, Prof. Mark E. Welland, Nanoscience Centre, Cambridge, UK, "1D nanowires of peptides; growth, structure and implications for Amyloid and related diseases"

September 28, Bo Barker Jørgensen, Center for Geomicrobiology, Department of Biological Sciences, University of Aarhus, Denmark, "Center for Geomicrobiology – exploring the deep biosphere"

October 5, Professor David G. Castner, Director, National ESCA & Surface Analysis Center for Biomedical Problems an NIH-funded resource, Departments of Bioengineering & Chemical Engineering, University of Washington, Seattle, USA, "The structure and hybridization properties of DNA surfaces"

October 19, Professor John Pethica, Dept. of Materials, University of Oxford, England, "Nanoimprint lithography of thin polymer films"

October 26, Antonio Nanci, Professor of cell biology and Director of Laboratory for the Study of calcified tissues and biomaterials, Faculty of Dentistry, Université de Montréal, Canada, "Nanostructured surfaces for applications in regenerative medicine"

November 2, Professor Daniel Otzen, iNANO Center, University of Aarhus, Aarhus, Denmark, "From pathology to functionality: understanding, preventing and exploiting protein aggregation and fibrillation"

November 9, Professor Harm-Anton Klok, Institute of Materials, Ecole Polytechnique Federale de Lausanne (EPFL), Lausanne, Switzerland, "Surface-initiated polymerization as a tool for the fabrication of bioactive surfaces and microfabrication of thin inorganic films"

November 16, Professor, Dr. Peter Fratzl, Max-Planck-Institut für Kolloid- und Grenzflächenforschung, Wissenschaftspark Golm, Potsdam, Germany, "Learning from Nature's Hierarchical Materials"

November 23, Professor Hans Oberleithner, Institute of Physiology, University of Münster, Germany, "Nuclear pores: targets for hormones and nanoscientists"

November 30, Associate Professor Trolle René Linderoth, iNANO and Dept. of Physics and Astronomy, University of Aarhus, Aarhus, Denmark, "Large organic molecules on surfaces studied by UHV-STM: Dynamics, Chirality and Organization"

December 7, Professor Suzi Jarvis, UCD Conway Institute of Biomolecular and Biomedical Research, University College Dublin, Dublin, Ireland, "Using nano-mechanics to explore biological function"

Specialized iNANO lectures

January 3, Postdoctoral Associate Lisbet Kværnø, Department of Chemistry and Chemical Biology, Harvard University, Cambridge, USA, "Synthesis and In Vitro Evaluation of Novel Cholesterol Absorption Inhibitors & Towards the Total Synthesis of ent-Azaspiracid-1"

January 24, Professor Richard F. W. Bader, Department of Chemistry, McMaster University, Hamilton, ON, Canada, "Recent advances in the physics of an open system"

January 25, Dr. Stepan Shipovskov, Centre of Excellence for Biocatalysis, Manchester Interdisciplinary Biocentre, University of Manchester, Manchester, UK, "Non-aqueous biocatalysis. From classic organic media to sustainable ones"

January 29, Per Eklund, The Department of Physics, Chemistry and Biology (IFM), University of Linköping, Linköping, Sweden, "Materials science and applications of nanostructured Ti-Si-C thin films"

January 30, Phil Denby, Risø, Denmark, "High vacuum preparation of nanocrystals, characterisation and properties"

March 1, Volodymyr Nechyporuk-Zloy, Universitätsklinikum Münster, Institut für Physiologie II, Westfälische Wilhelms-Universität Münster, Münster, Germany, "Identification and dynamics of single potassium channel proteins in the membrane of migrating cells"

March 15, Dr. Herma Cuppen, Observatory Leiden, University of Leiden, Leiden, The Netherlands, "Monte Carlo simulations of interstellar surface chemistry"

March 16, Dr. Marta Tello, Optoelectronics Group, Cavendish Laboratory, University of Cambridge, Cambridge, UK, "Kelvin probe microscopy on vacuum sublimed pentacene transistors"

March 19, Ph.D. Yoshihide Watanabe, Material Engineering Div.3, Toyota Motor Corporation, (Catalysis Lab., TOYOTA Central R&D Labs. Inc.), Shizuoka, Japan, "Introduction of cluster research at Toyota & Catalytic properties of size-selected Pt clusters on TiO_2(110) surface"

March 20, Director, Prof. Dr. Wolfhard Möller, Institute of Ion Beam Physics and Materials Research, Forschungszentrum Dresden-Rossendorf, and Institute of Applied Physics, Dresden University of Technology, Dresden, Germany, "Nanostructures by ion-driven self-organisation"

Colloquia

March 22, M.Sc., Ph.D. Louise Ejsing, "Magnetic immunoassaying - planar Hall sensor for influenza detection"

April 23, PhD, Research Fellow San Hein, Centre of Biotechnology, Division of Chemical & Biomolecular Engineering, School of Chemical & Biomedical Engineering, Nanyang Technological University, Singapore, "Chitosan: a versatile biopolyelectrolyte"

April 27, Dr. Karl-Heinz Ernst, Empa - Swiss Laboratories for Materials Testing and Research, Dübendorf, Switzerland, "Chiral conglomerate formation at surfaces"

May 10, Head of School, Prof. Tim Wess, Cardiff School of Optometry and Vision Sciences, Cardiff University, Cardiff, UK, "Structural hierarchies in biological tissues from nanoscale to functional materials"

May 22, Björn Högberg, Dept. of Engineering, Physics and Mathematics, Mid Sweden University, "DNA-Mediated Self-Assembly of Nanostructures"

May 25, Phillip Sprunger, Dept. of Physics, Louisiana State University, "Growth and Properties of Ag Nanowires on Cu(110) and Ni(110)"

May 29, Tamás Keszthelyi, Institute of Surface Chemistry and Catalysis, Chemical Research Centre, Budapest, Hungary, "Investigations of interfacial structures and phenomena by sum-frequency"

July 9, James K. Gimzewski, Distinguished Professor, Dept. of Chemistry and Biochemistry, University of California, Los Angeles, USA, "Nanomechanics of human cancer cells and cell lines studied using AFM and nanomirrors"

August 8, Sibylle Gemming, Institute of Ion Beam Physics and Materials Research Forschungszentrum, Dresden, Germany, "Theorectical study of molybdenum sulfide nanostructures"

August 20, Jesper Donsmark, Niels Bohr Institute, University of Copenhagen, Denmark and Dept. of Biophysics, Leiden University, Netherlands, "Single molecule dynamics at surfaces"

August 20, Anton Resin, Lund University, "Super-/and ultrahydrophobicity. Applications to the improved surface based bioanalysis and lab-on-a-chip"

September 11, N Chandrasekhar, Institute of Materials Research and Engineering and Department of Physics, NUS, Singapore, "BEEM : Probing charge transfer from a metal electrode into a molecule/polymer/insulator with nanometer resolution"

September 18, Donald A. Tryk, Kanagawa Academy of Science and Technology and Tokyo Metropolitan University, Xintong Zhang, Akira Fujishima, Kanagawa Academy of Science and Technology, "Is there really a photo-induced hydrophilic effect on titanium dioxide?"

September 21, Professor Neville V. Richardson, EaStCHEM, School of Chemistry, North Haugh, Univeristy of St. Andrews, St. Andrews, Scotland, "Some aspects of chirality in molecules adsorbed at metal surfaces"

September 24, Peter So, Professor of mechanical engineering and biological engineering, Massachusetts Institute of Technology, Cambridge, USA, "Two-Photon 3D Tissue Cytometry: High Throughput, High Content Imaging"

September 27, Dr. Jean-Louis Mergny, Laboratoire de Biophysique – Muséum National d'Histoire Naturelle, INSERM/ CNRS, Paris, France, "DNA comes in many forms: G-quadruplex formation at human telomeres and beyond"

October 11, Professor Francesco Priolo, MATIS CNR-INFM, Catania, Italy, Dipartimento di Fisica e Astronomia,Università di Catania, Catania, Italy, "Advances in Silicon Nanophotonics"

October 19, Prof. Dr. Franz J. Giessible Institute of Experimental and Applied Physics Physics and Technology on the Nanoscale, University of Regensburg, Germany, "Simultaneous measurements of currents and forces in combined STM/ AFM – what can we learn from"

October 24, Dr. Helmut Thissen, CSIRO Molecular and Health Technologies, Clayton, Australia, "Screening and controlling cell-surface interactions for applications in regenerative medicine"

October 24, Director Jens Rostrup-Nielsen, Haldor Topsøe A/S and member of ERC & Professor Carlos A. Bernardo, Iberian International Nanotechnology Laboratory (INL) "European Reseach Council: Opportunities and Traps and Plans for Iberian Nanotechnology Laboratory"

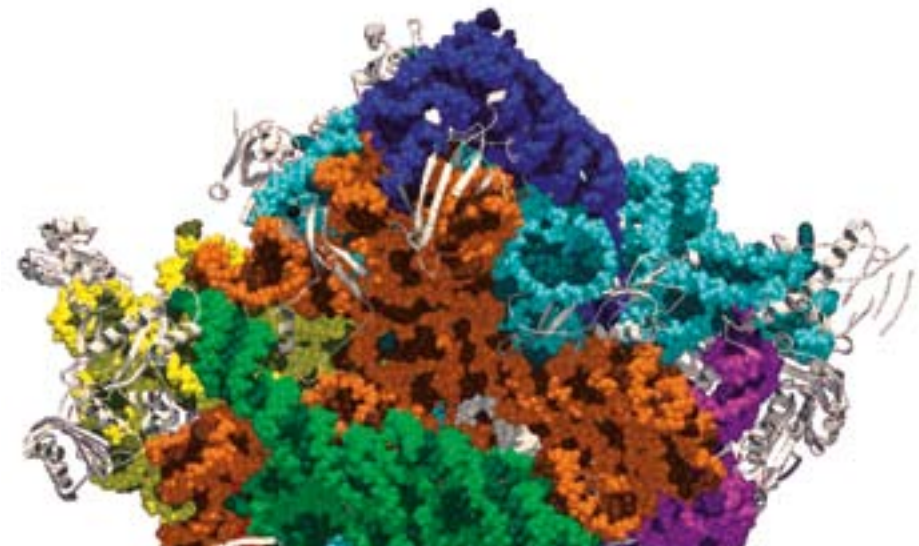
November 7, Professor Michael Reichling, Fachbereich Physik, Universität Osnabrück, Germany, "Revealing atomic and nanoscale surface and defect structures on simple oxides and a mineral surface"

November 7, Adjunct Professor Lars Österlund, FOI & Dept. of Solid State Physics, Ångström Laboratory, Uppsala University, Sweden, "What makes a good TiO_2 photocatalyst?"

December 7, Professor Fredrik Höök, Dept. of Applied Physics, Chalmers University of Technology & Solid State Physics, Lund University, Sweden, "Miniturized bioanalytical sensors: challenges and opportunities"

December 12, Dr. Daniel Mittleman, Electrical and Computer Engineering Department, Rice University, Houston, Texas, "Terahertz spectroscopy in the near field"

December 17, Lara Ferrigi, Institutt for Kjemi, Universitetet i Tromsø, "Linear and Nonlinear properties of molecules in solution"



Staff

Appointments of staff associated with iNANO in 2007

Jan Johannes Enghild
was appointed Professor at Department of Molecular Biology

Arne Nylandsted Larsen
was appointed Professor with Special Responsibilities at Department of Physics and Astronomy

Brian Bech Nielsen
was appointed Professor at Department of Physics and Astronomy

Daniel Otzen
was appointed Professor at iNANO

Senior staff

Andreasen, Peter, AU
Autrup, Herman, AU
Balling, Peter, AU
Besenbacher, Flemming, AU
Birkedal, Henrik, AU
Birkedal, Victoria, AU
Bozhevolnyi, Sergey, AAU
Bünger, Cody E., AU
Bøttiger, Jørgen, AU
Baatrup, Erik, AU
Christensen, Niels Egede, AU
Diekhöner, Lars, AAU
Duch, Mogens, AU
Daasbjerg, Kim, AU
Enghild, Jan Johannes, AU
Fago, Angela, AU
Foss, Morten, AU
Gothelf, Kurt Vestager, AU
Hammer, Bjørk, AU
Hofmann, Philip, AU
Hornekær, Liv, AU
Howard, Ken, AU
Iversen, Bo Brummerstedt, AU
Jakobsen, Hans Jørgen, AU
Jensen, Jan Egebjerg, AU
Jensen, Torben René, AU
Keiding, Søren, AU
Kingshott, Peter, AU
Kjems, Jørgen, AU
Knudsen, Charlotte Rohde, AU
Kristensen, Martin, AU
Larsen, Arne Nylandsted, AU
Larsen, Kim Lambertsen, AAU
Lauritsen, Jeppe Vang, AU
Linderoth, René Trolle, AU
Lægsgaard, Erik, AU
Mamdouh, Wael, AU
Malmendal, Anders, AU
Meyer, Rikke Louise, AU
Nielsen, Brian Bech, AU
Nielsen, Niels Chr., AU
Nielsen, Per Halkjær, AAU
Nissen, Poul, AU
Ogilby, Peter Remsen, AU
Olsen, Jeppe, AU
Otzen, Daniel, AU
Pedersen, Finn Skou, AU
Pedersen, Jan Skov, AU
Pedersen, Kjeld, AAU
Pedersen, Thomas Garm, AAU
Pedersen, Steen Uttrup, AU
Pyrz, Ryszard, AAU
Revsbech, Niels Peter, AU
Schiøtt, Birgit, AU
Sigsgaard, Torben, AU
Skibsted, Jørgen, AU
Skrydstrup, Troels, AU
Stapelfeldt, Henrik, AU
Stensgaard, Ivan, AU
Sutherland, Duncan, AU
Svaneborg, Carsten, AU
Søballe, Kjeld, AU
Søgaard, Erik G., AAU
Sørensen, Esben Skipper, AU
Sørensen, Jens Lykke, AU
Uyar, Tamer, AU
Vorup-Jensen, Thomas, AU
Vosegaard, Thomas, AU
Østergaard, Leif, AU

iNANO - Interdisciplinary Nanoscience Center

Faculty of Science, University of Aarhus

Ny Munkegade, Building 1521, DK-8000 Aarhus C , Denmark

www.inano.dk

inano@inano.dk