iNANO

Annual Report 2004

iNANO - Interdisciplinary Nanoscience Center

AALBORG UNIVERSITET AD NYE VEJE

SOLIDUM PETIT IN PROFUNDIS · UNIVERSITAS ARHUSIENSIS ·

Board Members

Hans Jørgen Pedersen, General Manager, Danfoss Bionics, Danfoss A/S
Charlotte Poulsen, Enzyme Development Director, Danisco A/S
Heins Kart Petersen, Manager of Sensor Division, Grundfos A/S
Ole Jensen, Managing Director, Nanonord A/S
Ove Poulsen, Rector, University College of Aarhus
Bjerne Clausen, Research Manager, Haldor Topsøe A/S
Erik Meineche Schmidt, Dean, Faculty of Science, University of Aarhus
Søren Mogensen, Dean, Faculty of Health Sciences, University of Aarhus
Finn Kjærsdam, Dean, Faculty of Science, Aalborg University

Daily management

Niels Chr. Nielsen - Deputy director
Peter Thostrup - Research coordinator
Flemming Besenbacher - Director
Kjeld Pedersen - Deputy director
Jørgen Kjems - Deputy director

Annual Report 2004, published June 2005
iNANO - Interdisciplinary Nanoscience Center
The Faculty of Science, University of Aarhus
Ny Munkegade, Building 520, 8000 Aarhus C , Denmark

www.inano.dk

Editors: Peter Thostrup and Flemming Besenbacher, iNANO, and Rolf Haugaard Nielsen
Design: WAYPoint Communication ApS
Printed in Denmark by Kerteminde Tryk Odense

Content

Message from the Director

This is the first annual report from the Interdisciplinary Nanoscience Center (iNANO) at the University of Aarhus and Aalborg University. The iNANO centre has experienced a rapid development in 2004, and has indeed continued a strong development ever since its inauguration in 2002

In January 2002, Helge Sander, the Danish Minister of Science, Technology and Innovation, inaugurated the iNANO center. At the inauguration, Nobel Laureate Heinrich Rohrer and Professor Andreas Engel gave invited lectures which stressed the central role of advanced new technologies based on nanoscience in modern-day value creation. Today, I am proud to say that iNANO is taking powerful strides towards fulfilling these promises and has placed itself in a leading role in supporting the Danish society's ambition to become a world-wide high-technology leader.

The iNANO center was established with the aim of fostering interdisciplinary research within the area of nanoscience and nanotechnology, i.e. promote synergistic interactions that cross traditional scientific boundaries. iNANO provides a framework in which leading-edge expertise in physics, chemistry, molecular biology, biology, engineering and medicine are combined to create an interdisciplinary environment of international stature with regards to science and technology, and a regional and national power hub for enhancing industrial competitiveness.

The iNANO mission

The mission of iNANO is based on three equally important aims/fields:

1. to play a key role in the education of the next generation of scientists in nanotechnology at the Bachelor, Master, PhD, and postdoctoral levels
2. to strengthen interdisciplinary research in nanoscience and nanotechnology and catalyze collaborations with other international nanoscience research groups
3. to provide an innovative interface for transfer and transformation of basic nanoscientificknowledge to nanotechnology in Danish industry, i.e. assist the creation of spin-off companies and catalyse innovative projects in existing companies.

All three aspects of iNANO's activities are covered in separate chapters in this report.

Pioneering undergraduate education

At international level, iNANO has played a pioneering role in establishing a new interdisciplinary curriculum in nanotechnology. Prior to the official inauguration of iNANO, plans for a new undergraduate education in nanotechnology were sent to the Ministry of Science, Technology, and Innovation and the Ministry of Education. The curriculum covers a broad spectrum of introductory, advanced, and specialized courses, which aim at providing the students with a sufficiently broad basis to conduct interdisciplinary research in the nano-area and at the same time achieve disciplinary depth and specialized skills in selected areas.

Graduate education – iNANOschool

In December 2002, a vocationally oriented graduate school associated to iNANO, iNANOschool (www.iNANOschool.dk), was established. iNANOschool received a large grant from the Danish Research Training Council (FUR), which released further funds from the Faculties of Science and Health Sciences at the University of Aarhus, from the County of Aarhus, and several leading Danish companies. The result of the latter funds was a trebling of the original FUR grant which in turn makes it possible for us to award further PhD stipends.

Interdisciplinary research activities

The iNANO research centre provides the framework for interdisciplinary projects in the area of nanoscience and nanotechnology, and at present 20 different research groups and a total of close to 100 scientists (full, associated, and assistant professors) and 80 PhD students are associated with iNANO. Since the official inauguration in 2002, iNANO has played an important role in setting up an increasing number of visionary interdisciplinary projects. Current research activities fall within the following six target areas:

- Bio-nanotechnology
- Nanomedicine
- Nanophotonics and electronics
- Functional nanomaterials
- Nanocatalysis and energy storage
- NanoFood

iNANO has been very successful in attracting grants. In April 2003 the first funds from the national programme "National Effort in Nanotechnology and Nanoscience" were awarded, and iNANO received the largest grant of all,

Flemming Besenbacher
director

i.e., DKK 25 million out of a total of DKK 60 million, for the four targeted projects:

1. Molecular self-assembly and surface functionalisation
2. Designing biosensors using conformational changes in biomolecules
3. Drug-delivery from nanoparticles
4. Light emission from nanocrystals in silicon-based semiconductors

For the second round of applications from the Danish nano-programme, the public research funding structure had changed. The funding body was now the "Programme Committee for Nano, Bio, and IT technology" under the Strategic Research Council (www.forsk.dk). The application conditions also changed and focus was moved to the direct involvement from industry. In December 2004, iNANO was awarded the largest grant of DKK 15 million from the second round. We set up four new targeted projects with industrial collaboration in which the companies also take part in the project management:

5. Nanocrystalline oxide coatings (Grundfos A/S, SCF Technologies A/S)
6. Nano-functionalised 3D scaffolds as advanced bioactive materials for bone reconstruction (Danfoss A/S)
7. Nano-probes for monitoring DNA damage response (Kræftens Bekæmpelse, BioImage A/S)
8. A 2-D micro and nanoscale structural platform for drug screening (H. Lundbeck A/S, NanoNord A/S)

EU projects are another large source of research funding. As a signature of our international stature, iNANO in 2004 played an important role in attracting a grant for one of the prestigious EU Instrumental Network of Excellences, Frontiers (www.frontiers-eu.org), officially entitled "Research, processes and facilities directed at instrumentation for manufacturing and analysis of single molecules, individual nano-structures and 2-3 D architectures of them, targeted at life sciences." Furthermore, iNANO researchers have with success competed for funding for three Integrated Projects (IPs), one Research Infrastructures Action, and four Specific Targeted Research Projects (STREPs).

Collaboration with industry and innovation

An important element of iNANO is the collaboration with national and international industrial companies. Some of the Danish companies with interest and expertise in nanotechnology are represented on the iNANO board . Today INANO have formal collaboration with the following companies: Danfoss A/S, Haldor Topsøe A/S, H. Lundbeck A/S, Grundfos A/S, Arla Foods amba, Danisco A/S, Cantion A/S, CemeCon A/S, NanoNord A/S, Radiometer A/S, Novozymes A/S and Fibertex A/S. In 2004 iNANO was awarded a large grant from Haldor Topsøe A/S to set up a state-of-the-art atomic force microscope for studying support materials for catalysts, and also a collaborative project was established with Cantion A/S in which iNANO works with Cantion on the development of cantilever-based biosensor applications.

In 2004, a unique partnership was set up in which iNANO works with Cantion on the development of cantilever-based biosensor applications, granting the university access to clean-room research and production facilities situated at NanoNord A/S. Concurrently, the Department of Physics and Nanotechnology at Aalborg University has moved into the building adjacent to the clean-room facilities. We expect this joint venture to impart a great amount of momentum to especially an expansion of the synthesis facilities under the auspices of iNANO.

Also in 2004, a consortium named "Nanofood" was established to strengthen research activities in the area of food technology, focusing on improved food safety and healthy nutrition. The initiative came from the local authorities who facilitated the creation of the consortium, which is now affiliated with iNANO. The partners in Nanofood include a number of strong industrial players in the region such as Arla Foods, Danisco, Aarhus United, Danish Crown, and Systematic Software Engineering in collaboration with the University of Aarhus (iNANO), the Danish Technological Institute and the University College of Aarhus. The initiative is supported by the Municipality and County of Aarhus.

The future of iNANO

By now both the educational and the fundamental nanoscience research efforts in iNANO are well established. The next difficult step, which has already been initiated, is to assist the transformation of nanoscience research into nanotechnology in collaboration with existing and new industrial partners. On a daily basis, iNANO is approached by small and medium sized companies who wish to explore the possibility of initiating joint activities in the nano area.

A recent Danish Technological Foresight report on nanotechnology (www.teknologiskfremsyn.dk) recommends the establishment of two national nanotechnology competence centres for strategic nano research and innovation. iNANO has worked hard to achieve critical mass, breadth and international stature to be able to attract one of these national nanocenters and to manage such a centre with its full spectrum of basic research activities and collaborative projects with industry. The Board of the University of Aarhus has selected nano-technology as one of six focus areas, and steps are currently being taken to erect a new building – an iNANO complex – with clean-room synthesis facilities, laboratories, offices and space for industrial collaboration and innovation. An iNANO complex in Aarhus will prove crucial to the success of interdisciplinary projects in that the project partners will be able to work under the same roof and interact freely on a daily basis, as is already the case at iNANO's Aalborg site.

NaNet – a nanotechnological network of knowledge

In 2004 a national Network of Knowledge on Nanotechnology, NaNet, was established to offer assistance to especially small and medium-size enterprises with an interest in nanotechnology. NaNet is a collaborative effort between the major Danish universities and national laboratories: the Technical University of Denmark, the Copenhagen University, The University of Southern Denmark, the Aalborg University and the University of Aarhus.
A network office will be set up at the University of Aarhus in early 2005. Through web pages and workshops, NaNet will work to disseminate knowledge generated at the universities into society with the aim of improving the competitiveness of Danish industry.

Educational activities

Undergraduate studies

The plans for the undergraduate studies were approved in January 2002, and in September 2002, 37 new students commenced their studies at the University of Aarhus. In 2004 the experience gained from the education of these frontrunners and the feedback from them led us to redefine the 3rd and 4th year of the nanostudy programme curriculum and to introduce three specialisations: nano-physics, nano-chemistry, and nano-bio (www.inano.dk/studerende). The course programme for the 4th study year has been decided in consultation with iNANO researchers who are expected to act as future supervisors for Master or PhD projects. In the 4th year, four new courses are introduced: Nanocharacterisation, Current Nanoscience, Student's colloquium, and a patent/innovation course. These four courses will run for the first time in 2005/2006, when the "oldest" students will be in their 4th study year. The former two will introduce a number of experimental characterisation techniques for nanoscience and important subject matters for nanoscience research. The colloquium will give the students experience in presenting a subject of their own choice in a coherent manner to a wider audience. Finally, the patent/innovation course introduces concepts of commercialisation which are highly relevant to anyone who wishes to enter into a commercial exploitation of nanotechnology.

In September 2003 and 2004, 45 students and 66 students enrolled on the nanotechnology study programme, respectively. These are high numbers in comparison with the traditional disciplines at the Faculty of Science, and a number of mainly social initiatives (counselling, "nano café", extra instructors, etc.) have helped lower the drop-out frequency below that of other disciplines. This great success has now led us and the University of Aarhus to impose a quota of 60 nanotechnology students in the years to come.

In 2004 iNANO arranged a very successful five-day study trip for a group of 28 third-year students to the nanoscience centres in Cambridge, Oxford and London, with which iNANO have established collaboration regarding the Bachelor and Master educations.

At Aalborg University, a new engineering programme focused on nanotechnology started in 2003 (www.physics.aau.dk). At present, 30 and 45 students are enrolled in the first and second year of the Bachelor part, respectively. The programme consists of a combination of courses and projects with different themes for each semester (see Figure).

Master project in nanotechnology		
Specialisation - 6	Innovation/patent	Specialisation - 10
Specialisation - 5	Student's colloquium	Specialisation - 9
Specialisation - 4	Current nanoscience	Specialisation - 8
Specialisation - 3	Nanocharacterisation	Specialisation - 7
Solid state physics	Theory of Science	Bachelor project
Statistical mechanics	Experimental mol.bio.	Bachelor project
Specialisation - 2	Bionanotechnology	Nano project
Specialisation - 1	Bioinformatics	Intro to programming
Experimental exercises	Chemical binding and molecular spectroscopy	Linear algebra - 2
Statistics and data handling		Linear algebra - 1
Introduction to quantum mechnics	Inorganic chemistry	Basic molecular biology
	Thermodynamics/kinetics	Basic biochemistry
Waves and optics / Nano project	Organic chemical reactions	Basic biology - 2
Electromagnetism	Organic chemistry	Basic biology - 1
Mechanics/thermodynamics	Numerical physics	Calculus - 2
Introductory mechanics	Introductory chemistry	Calculus - 1

Course programme for new nanotechnology students. Legend: blue: physics courses, yellow: chemistry courses, orange: molecular biology courses, red: mathematics/computer science courses, green: nanoscience courses, grey: specialisation modules. A prominent feature of the nanotechnology course programme are the projects in the 1st, 2nd, and 3rd years.

Master project	
Semester project	Nano specialization: Physics, Bio, Health care or Production
Semester project	Nano specialization: Physics, Bio, Health care or Production
Semester project	Nano specialization: Physics, Bio, Health care or Production
Semester project	Nanofabrication and characterization, Cellular physiology, Quality control, Nanostructures in biological organisms, Biochemical reactions in the body, Opto-electronic of nanostructures
Semester project	Quantum mechanics, Structure of solids and liquids, Molecular biophysics, Computer modelling, Spectroscopy, Mathematics
Semester project	Quantum mechanics, Structure of solids and liquids, Molecular biophysics, Computer modelling, Spectroscopy, Mathematics
Semester project	Electromagnetic fields in nanostructures, Gene technology, Basic Optics, Ethics, Laboratory training, Mathematics
Semester project	The composition of matter, Chemical and biological molecular structures, Scientific communication and methods, Mathematics 2, Mechanics and Thermodynamics
Semester project	Atoms and molecules, Basic Chemistry , IT, Scientific models of the universe, Mathematics 1

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

Two-year Master programme with specialisations in physics, biotechnology, health care, and production techniques are currently being planned in details.

Education and industry

The nanotechnology study programme aims at educating and providing students with the ability to work in research laboratories in private companies. Consequently, one of the new initiatives is a project performed at a company, e.g. in connection with a Bachelor's project during the third year of the nanotechnology Master programme. The students Karina Matthiesen and Lina Sjøberg have started a Bachelor's project with Danisco A/S, one of the world's leading food ingredients companies. Their project concerns the enzyme hexose oxidase, which is used for industrial baking processes. The students investigate the nano-structure and stability of the enzyme with e.g. the Circular Dichroism technique.

Graduate studies - iNANOschool

A vocationally oriented graduate school, iNANOschool (www.inanoschool.dk), was started in 2002 shortly after the inauguration of iNANO. The activities in iNANOschool (mainly PhD projects and graduate courses) are based on a large grant of DKK 12 mill. from the former Danish Research Training Council (FUR), which is now called the Danish Research Training Committee (FUU). The grant only pays 1/3 of a PhD stipend in a so-called co-financing scheme, meaning that the Faculty of Science and the Faculty of Health Sciences contribute another 1/3, the remaining 1/3 coming from a private company or a public body, in our case the County of Aarhus.

Currently, 21 PhD projects are financed by the FUR funds. The total number of PhD students enrolled in iNANOschool is, however, as high as 80, the remainder being financed by e.g. faculty funds or funds obtained bythe individual research groups in iNANO from other sources, such as the national effort in nanotechnology and nanoscience. The originally granted funds have now all been preplanned, and an application for new stipends was recently submitted.

In 2004, a number of graduate course were held as part of the iNANOschool activities:

N9: Bionanotools and protein structure
N13: Biosensors on the micro and nanoscale to sense biological processes (5 ECTS)
N17: Formidlingskursus (in Danish)
N18: Membrane protein biophysics (4 ECTS)
N19: Course in academic/professional presentations
PhD school: Spectroscopy of Nanosized particles and Nanosurfaces - Femtobiology, Single Molecule Spectroscopy, Correlation Spectroscopy Applications and Promises

Finally, iNANO organised a very successful autumn school at Fuglsøcentret near Aarhus on October 8-12, 2004 with attendees from ten European countries. We were able to present a number of excellent lecturers:

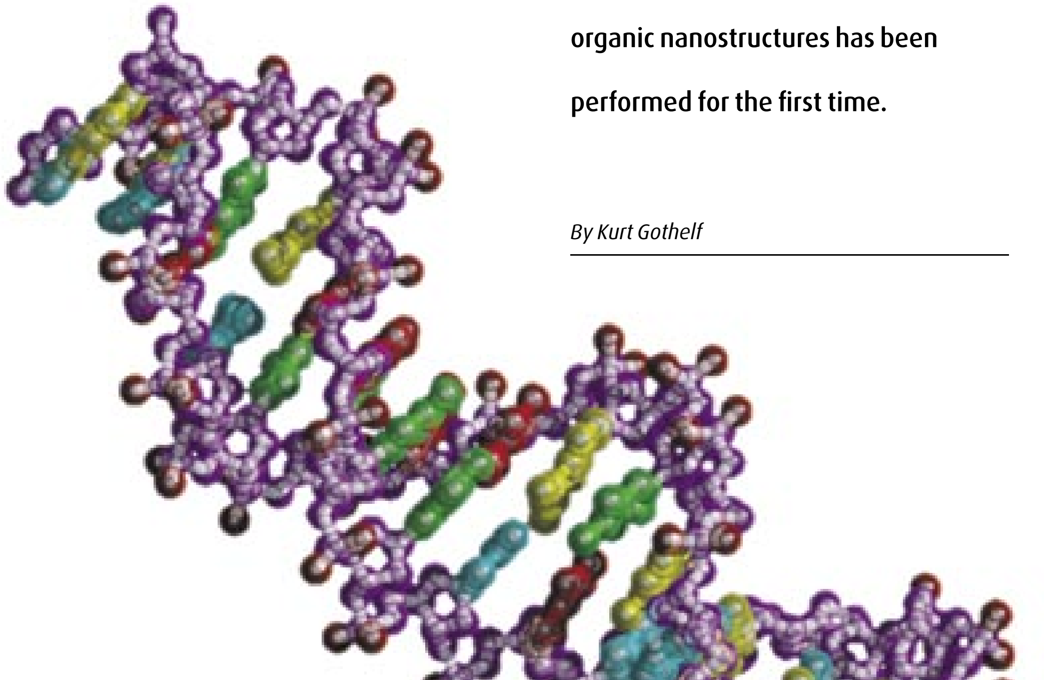
1. Aric Menon, the Technical University of Denmark, Department of Micro and Nanotechnology: "Cantilever nano-biosensors"
2. Bo Brummerstedt Iversen,the University of Aarhus, iNANO: "Synthesis of novel nanomaterials"
3. Ryszard Pyrz, the Aalborg University, Institute of Mechanical Engineering: "Nanocomposites for structural applications"
4. Mikael Käll, Chalmers Göteborg University, Department of Applied Physics: "Nanoplasmonics"
5. Thomas Zwieg, Danish Technological Institute, Aarhus: "Functionalisation of surfaces by SAM, Silane and Sol-Gel. Technology - Fundamentals and applications "
6. Eduoard Bertrand, CNRS, Institut de Génétique Moléculaire de Montpellier: "Detection of single mRNA and DNA molecules in living cells"
7. Nynke Dekker, the Delft University of Technology, Molecular Biophysics Group: "Single molecules: Elasticity, polymer physics, and interactions with proteins"
8. Lars Montelius, the University of Lund, Department of Physics: "Nanoimprint lithography: An emerging technology with large area nanostructuring capability"
9. Henrik Birkedal, the University of Aarhus, iNANO: "Biomineralization. An overview of how nature makes nanomaterials"
10. Mathis Riehle, the University of Glasgow, the Centre for Cell Engineering: "Topography, a simple way to form an advanced interface on biomaterials. Nano and microfeatures for cell biology"
11. Mike Horton, the University College London, the Bone and Mineral Centre: "AFM applications for cell biology"
12. Martin Read, the University of Birmingham, Wolfson Research Laboratories: "Developing synthetic vectors to overcome intracellular barriers"
13. Ken Howard, the University of Aarhus, iNANO: "Drug delivery technology for therapeutic and prophylactic applications"
14. Yrjö Konttinen, the Biomedicum Helsinki: "Aseptic loosening of the totally replaced hip"
15. Andreas Züttel, the Institute for Renewable Energy Switzerland: "Hydrogen at nanomaterials"
16. Jens K. Nørskov, the Technical University of Denmark, Center for Atomic-scale Materials Physics: "Catalysis by metallic and biological nanostructures"

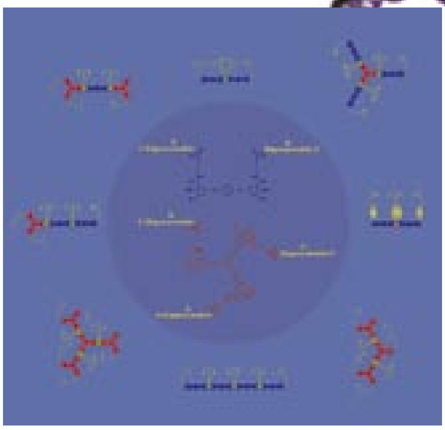
DNA-directed assembly:

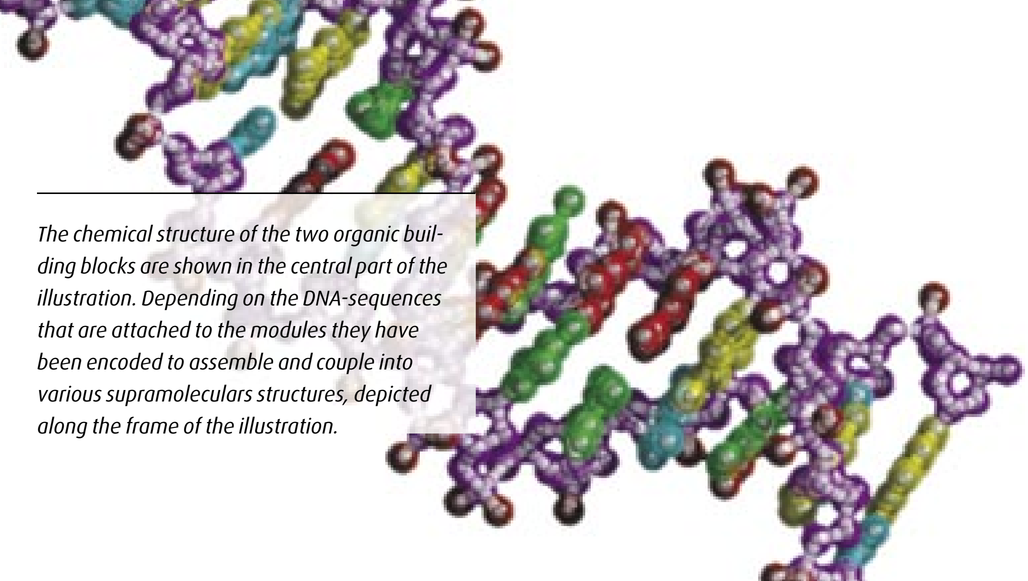
A potential molecular electronics construction set

A major challenge in nanotechnology is to assemble molecular building blocks into complex functional nanodevices. The unique ability of DNA to recognize complementary DNA sequences may provide the solution. At the iNANO center DNA-directed assembly and coupling of organic nanostructures has been performed for the first time.

By Kurt Gothelf







The chemical structure of the two organic building blocks are shown in the central part of the illustration. Depending on the DNA-sequences that are attached to the modules they have been encoded to assemble and couple into various supramoleculars structures, depicted along the frame of the illustration.

The toolbox is ready: Several classes of organic compounds with potential application in functional nanodevices have been synthesized and tested. Single molecule functionalities include electronic, optical, mechanical, catalytic and receptor properties as well as molecules with geometries that make them suitable as nanoconstruction scaffolds. But unfortunately no simple and efficient technologies exist to connect several of these building blocks or to make them communicate in order to obtain an integrated device.

The Organic Nanochemistry group at iNANO is exploring new principles for the assembly and coupling of synthetic compounds. One of the best ways to solve this fundamental problem is to mimic nature's ability to arrange and connect molecular building blocks by self-assembly. The group has successfully exploited the universal encoding material of nature - DNA - to encode organic building blocks to assemble into predetermined aggregates. This is the first example of the DNA-directed assembly and covalent coupling of organic nanostructures. Furthermore both the modules and the linkages bridging them are designed to conduct an electric current necessary for electronic communication between the building blocks.

Connecting the building blocks

Two advanced organic building blocks were designed and synthesized. Each module possesses a rigid linear backbone in order to avoid folding into undesired shapes. Chemical linker groups are placed at both ends of the backbone to enable covalent bonding between the building blocks. Finally,

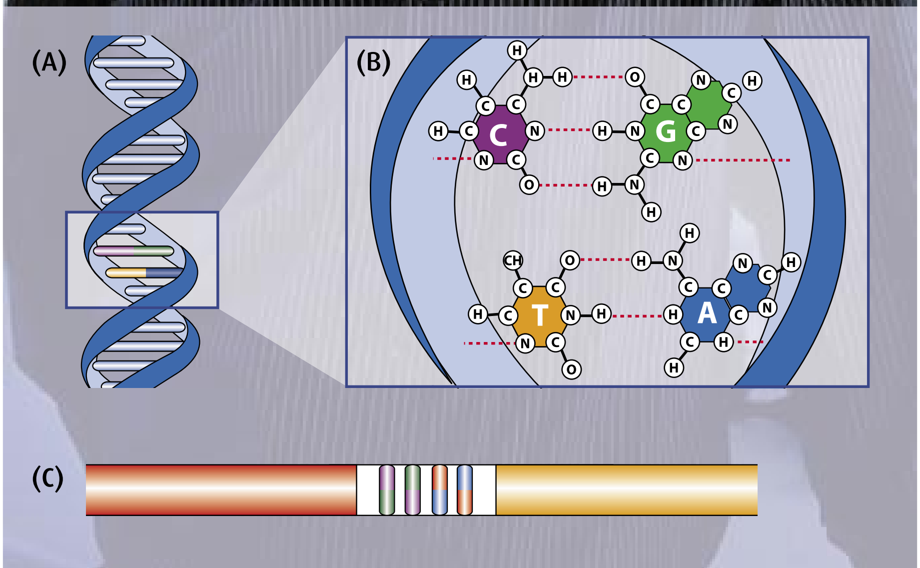
Kurt Gothelf
Associate Professor

at short piece of single-stranded DNA is placed at each terminus. The DNA strand of one building block recognizes single-stranded DNA with a complementary sequence tied to another building block in an entirely predictable way. When this happens the two DNA strands combine into a double helix joining the two modules. Having done its job the DNA helix is cleaved from the assembled building blocks.

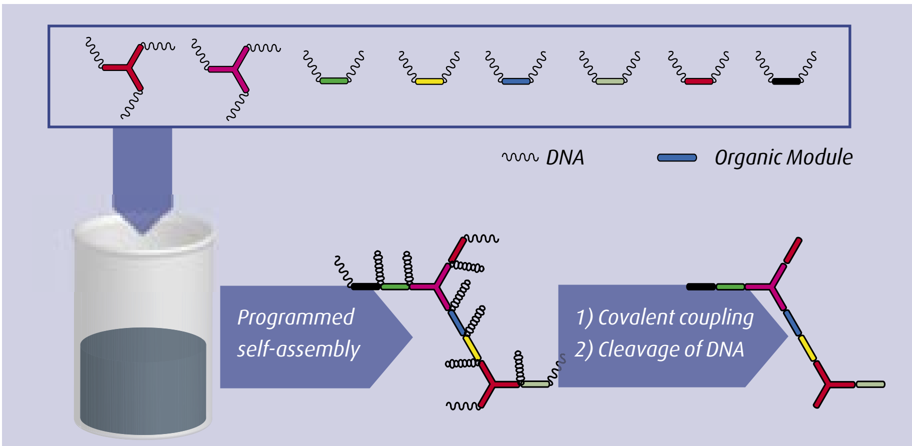
The organic compounds can be encoded by their DNA strands to couple with high specificity into a variety of different combinations depending on their DNA sequences. The coupling reaction result in metal containing and potentially conducting bridges between the modules, and the system is therefore an early example on a potential molecular electronics construction set. If extendable to the assembly of hundreds or even thousands of organic modules this approach could solve some of the fundamental problems of connecting building blocks in nanoscience. The possible ability to create complex functional nanostructures and eventually to construct organic nanodevices with this new nanoassembly concept has urged the researchers to protect the intellectual rights in a patent.

A new start up company

DNA-directed methods to control and encode chemical reactivity is a field of increasing industrial interest and in recent years a number of start up companies based on DNA-directed chemistry have appeared. The Organic Nanochemistry group is currently involved one of these new companies which is in the very early phase.



Single strands of DNA combine to form a double helix only if their sequences are complementary (A). Thymine always couples to adenine and guanine to cytosine (B). Therefore DNA-directed assembly of organic building blocks is extremely specific (C).



The rigid organic building blocks are equipped with a sequence of single-stranded DNA at both ends. As complementary DNA strands combine to form a double helix selected building blocks are connected and subsequently coupled with covalent bonds. Finally DNA is cleaved from the resulting nanostructure.

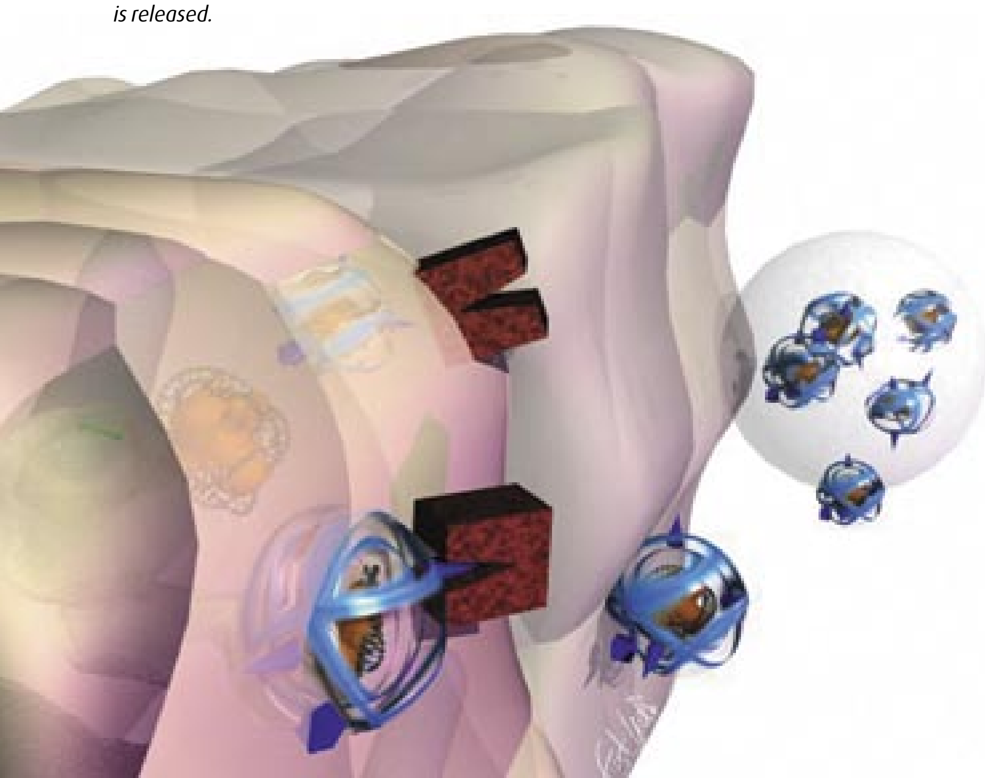
Drug delivery:

Nanocarriers ferry medicine into diseased cells

Small interfering RNA's is a potential new universal drug for treatment of a variety of human diseases but efficient delivery into diseased cells remains a major challenge. Polymeric nanocarriers containing the drugs may solve the problem.

By Jørgen Kjems and Kenneth Howard

Within the body, naked siRNA is degraded by enzymes. To avoid this we have incorporated siRNA in nanoparticles able to reach target cells intact. Microencapsulation technology has been used to surround nanoparticles in a biodegradable coat for sustained release delivery. After release the nanoparticles bind to receptors in the cell membrane and are subsequently transported into the cell. Inside the cytoplasm, the nanoparticle matrix dissolves and the drug is released.



Small interfering RNA's (siRNA) have emerged as a new and very efficient tool to downregulate gene expression in humans, animals and plants. In particular, high expectations have been given to siRNA as a potential new universal drug for treatment of a variety of human diseases such as cancer, rheumatoid arthritis, brain diseases and viral infections. For instance, we have found that the introduction of siRNA targeted against the activated oncogene H-Ras in proliferating cancer cells, is able to revert the cells back into normal cells. H-Ras is involved in many types of cancer.

Reaching the target cells

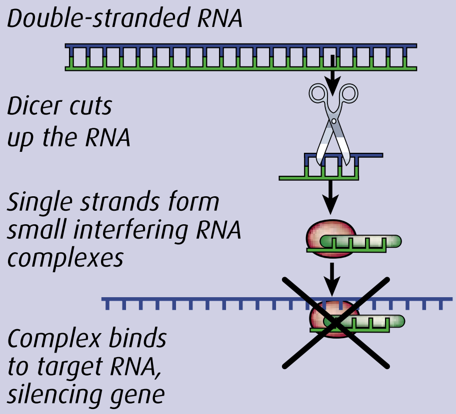
A major challenge, however, remains in order to ensure the efficient delivery of siRNA drugs to diseased cells in living animals and eventually in humans. It requires the ability of intact siRNA to migrate through the body, reach diseased tissue, enter the cells and accumulate in therapeutically effective levels.

To accomplish this we have mixed anionic siRNA's with cationic polymers, and have thus achieved incorporation of potential drugs in spherical nanoparticles measuring 100-300 nanometres. The nanocarriers protect the siRNA from being degraded by enzymes inside the body. Once the target cells have been reached, the nanoparticles bind to specific receptors in the cell membrane, and the nanoparticles (nanocarriers) are subsequently transported into the cells.

Releasing the drug

To ensure that the siRNA cargo is released inside the cells, the nanocarriers were designed to selectively degrade under intracellular conditions; termed bioresponsive system bioresponsive system.

The siRNA-containing nanoparticles have been tested in cultured cells for biological activity. To visualize sufficient uptake and correct localization of the siRNA we incorporated fluorescent markers in the siRNA and the polymer particles. This allowed us to follow the constituents in a culture of fixated cells. The experiments show that siRNA is accumulating near the nuclear membrane, which generally correlates with the biological function.

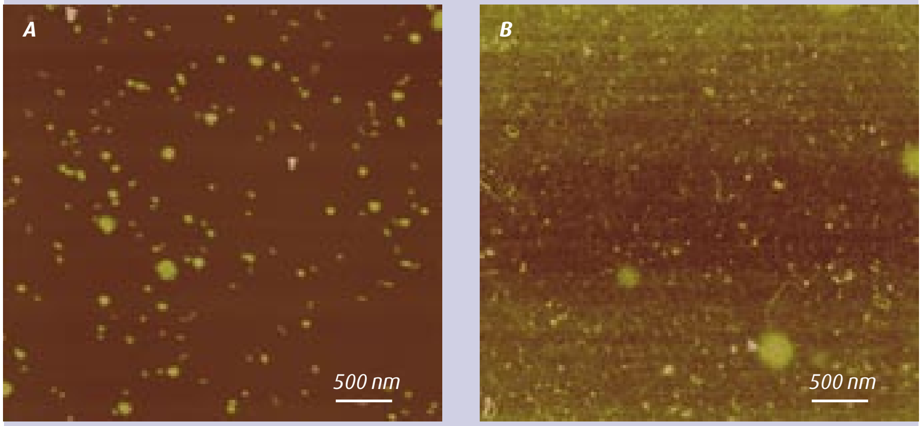


RNA interference is a natural defence mechanism neutralizing double-stranded RNA inside cells in order to eliminate e.g. RNA viruses. First, viral RNA is digested into siRNA's by an enzyme called Dicer. Next, each siRNA is split into single strands that are incorporated into a protein complex. This complex binds to the viral target gene, silencing the gene or limiting its expression. In a similar way, synthetic siRNA drugs are able to inhibit specific disease genes, for instance, activated cancer genes.

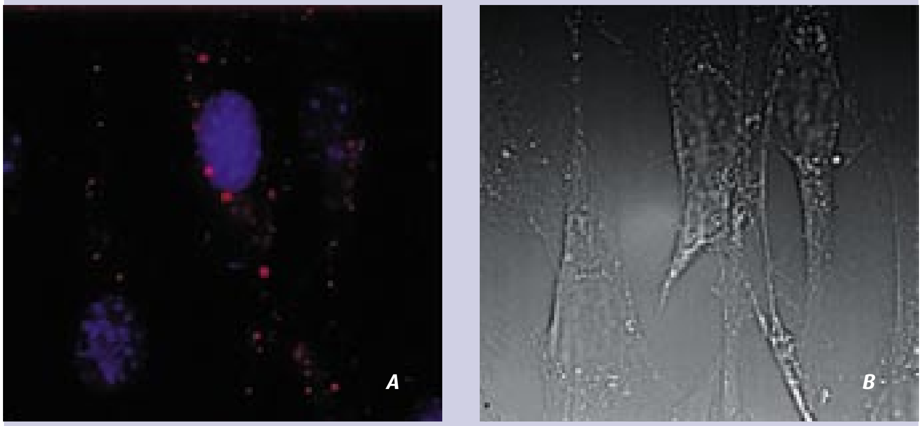
Finally, we took the most promising siRNA formulations to test where the capacity of limiting the expression of a single gene was evaluated in mice. For visualization of the biological effect we initially focused our studies on the enhanced green fluorescent protein (EGFP), which is ubiquitously expressed in a mouse model from an engineered transgene.

After intravenous or nasal delivery of siRNA directed towards the EGFP gene, the mice were sacrificed and analyzed in detail for the EGFP expression. The efficient knock-down of EGFP in a subset of cells suggests that the siRNA is effectively taken up by some cells, but further optimization of the nanoparticles is required to get systemic delivery to all organs of the mouse.

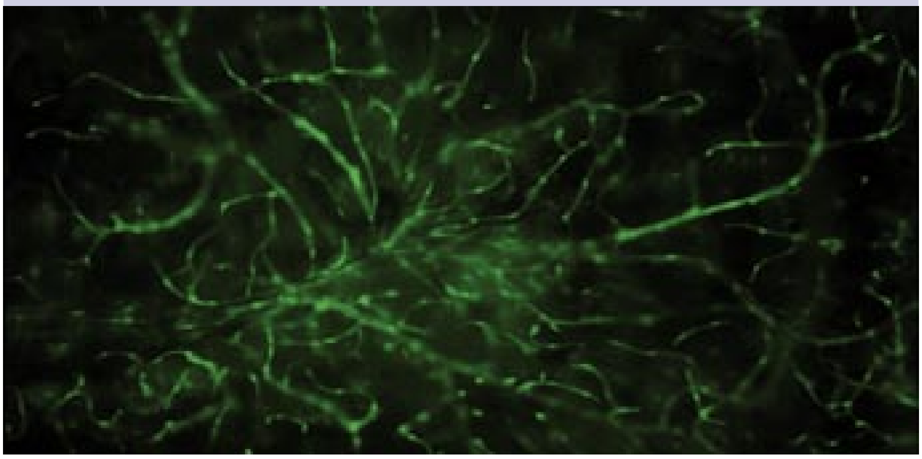
Nasal delivery of siRNA drugs is of particular interest for treatment of psychiatric diseases by regulating the amounts of key neurotransmitters in the brain, while intravenous delivery is well suited to treat e.g. leukaemia.



The reducing environment in the cytoplasm opens the nanoparticle polymer matrix. In an experiment to model intracellular conditions, the reducing agent DTT dissolved the nanoparticles and released the incorporated nucleic acid; this is shown in the AFM image in panel B. Panel A shows an untreated sample with intact nanoparticles.



Once inside a cell, siRNA binds to the nuclear membrane: Panel A, cell with siRNA stained red and nucleus blue; Panel B, light image of Panel A.



A section of brain taken from a green-glowing transgenic mouse. The image shows EGFP fluorescent vessels.

Bone nanostructure:

Improving the biocompatibility of implants

Knowledge about implant biocompatibility can be obtained by examining the nanostructure of new bone formed on implants. This may lead to the development of new generations of biomaterials with improved properties and implants that will last a lifetime.

By Mathias Bünger, Morten Foss, Henrik Birkedal, Jan Skov Pedersen

Degenerative disorders, trauma and cancer of the human movement apparatus represent a tremendous socio-economical challenge. The main surgical treatments are artificial joint replacements, bone synthesis and reconstructions for spinal diseases. The use of metals for these types of implants has in general evolved to be a success. However, many patients experience implant loosening due to insufficient biocompatibility and biointegration of the implant; This typically happens for one in ten patients over a ten-year period. The loosening of implants often causes the patient severe pain, and he/she must endure another operation in order to replace the implant.

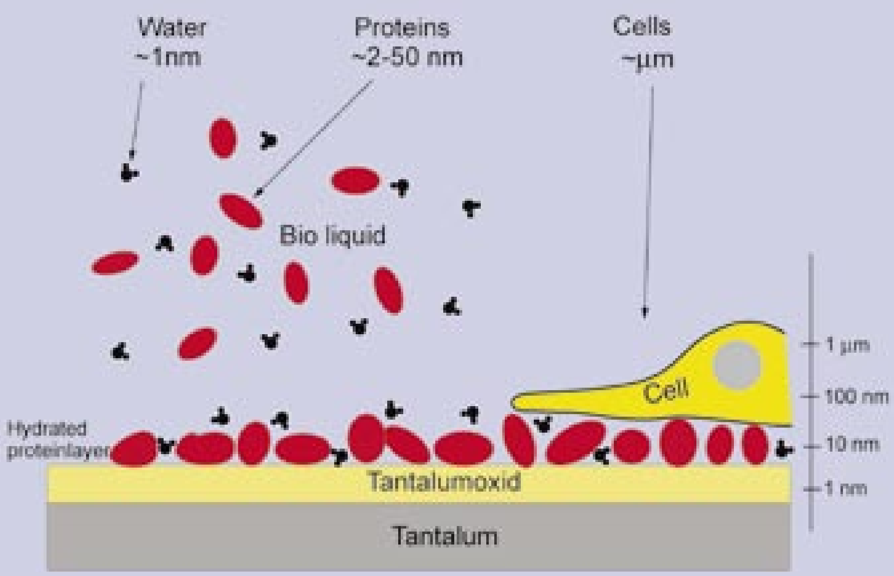
The detailed understanding of an artificial material's biocompatibility requires knowledge ranging from biomolecular adsorption on surfaces to evaluation of clinical models. At iNANO we have a truly interdisciplinary team of researchers coming from medicine, molecular biology, chemistry and physics, working on bone growth in connection with orthopaedic implants. The ultimate goal is to use nanotechnology to improve the understanding of the processes involved in biocompatibility and biointegration at the molecular level and to create chemically functionalized and nanostructured surfaces with improved biocompatibility.
In order to bring knowledge from the lab to the patient, we are engaged in a close collaboration with our industrial partner, Danfoss. The company has excellent industrial facilities for the production of a new generation of implants.

Sublime architecture

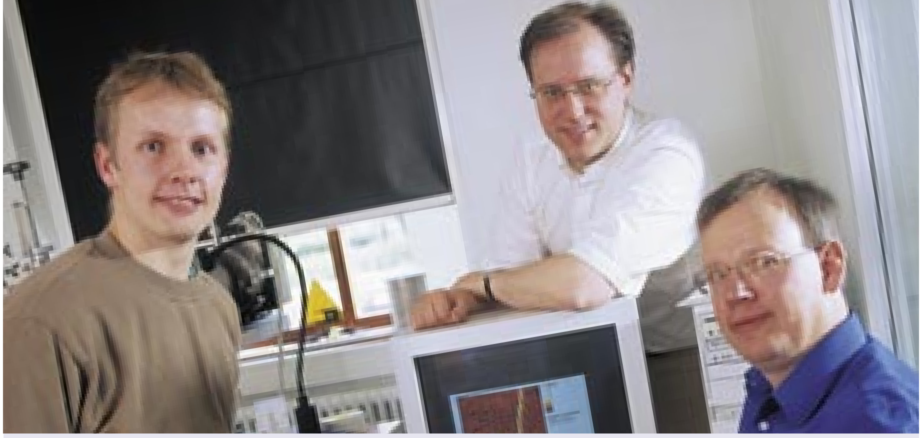
The unique properties of bone are a list of apparent contradictions: Rigid, but flexible; lightweight, but solid enough to support tissue; mechanically strong, but porous. In order to meet these different demands, bone has a hierarchical structure that extends from the nanoscale to the macroscopic length scale. On the smallest scale, bone is a composite material consisting of a mineral phase of carbonated hydroxyapatite, basically lime stone, and an organic phase of mainly collagen. By combining the tensile strength of collagen with the hardness and stiffness of the hydroxyapatite nanocrystallites, the favourable properties of bone are obtained.

Bone formation on implants

The ideal implant surface is able to attract bone forming cells and stimulate their synthesis of proteins which enhance the deposition of hydroxyapatite to form new bone around the implant. Simultaneously, processes that degrade bone must be inhibited. The implant must also possess mechanical properties mimicking the structure of



The biocompatibility of an artificial material in the body is extremely complicated and involves processes on several length scales. When the material is placed in tissue, a race for the surface starts immediately. Within a few milliseconds a layer consisting of water and biomolecules from the physiological liquid is formed on the implant surface. Subsequently, cells from the surrounding tissue migrate to the area due to stimulation by cytokines and growth factors in the bio-layer. The chemical and topographical properties of the implant surface strongly influence the properties of the bio-layer, and this influence needs to be understood and controlled in order to optimize biocompatibility.

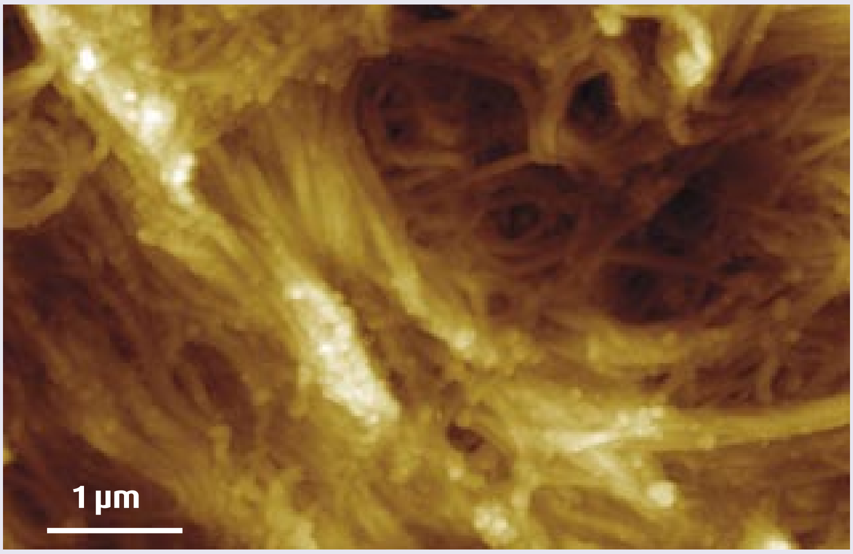


Mathias Bünger, Henrik Birkedal, Jan Skov Pedersen

natural bone in order to make the new bone stick firmly and permanently to the implant. Knowledge about the structure of bone and how bone forms on the nanometer length scale will be extremely useful for the development of new implant surfaces with increased biocompatibility.

However, we have not yet achieved this crucial knowledge. Thus, in one project we have applied scanning small angle X-ray scattering (sSAXS) and atomic force microscopy (AFM) to study the nanostructure of bone with respect to bone growth around implants. sSAXS offers position resolved information about the thickness, shape and orientation of the hydroxyapatite nanocrystallites, whereas AFM offers the extremely high resolution imaging of the individual molecules in bone.

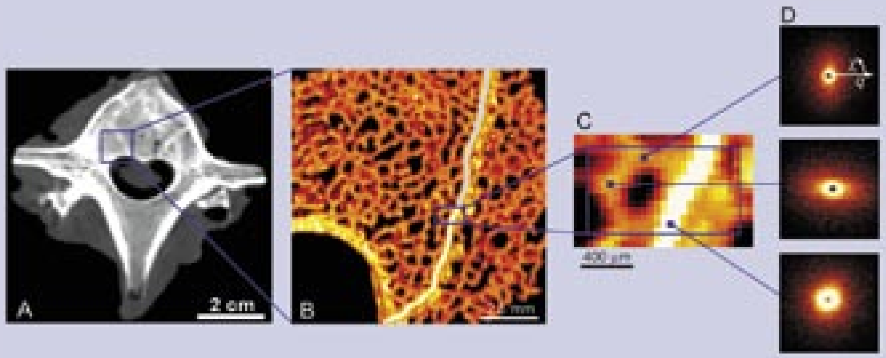
A growth plate has been investigated as a model system for bone mineralization and growth. By use of AFM we have identified fibrous structures which are most likely to be different types of collagen. sSAXS data show that these fibres have internal inhomogenities with a characteristic length scale of a few nanometres, which match the size of the mineral particles formed in the mature bone.



The surface of an implant must match the nanoscale structure of growing bone in order to achieve good biocompatibility. The AFM image shows the central unmineralized part of the growth plate in pig vertebra (in collaboration with M. B. Hovgaard). Abundant fibrous structures are identified. The fibres are approximately 100 nanometres thick and seem to aggregate into larger bundles with no preferred orientation.

Curriculum Vitae: Mathias Hauge Bünger

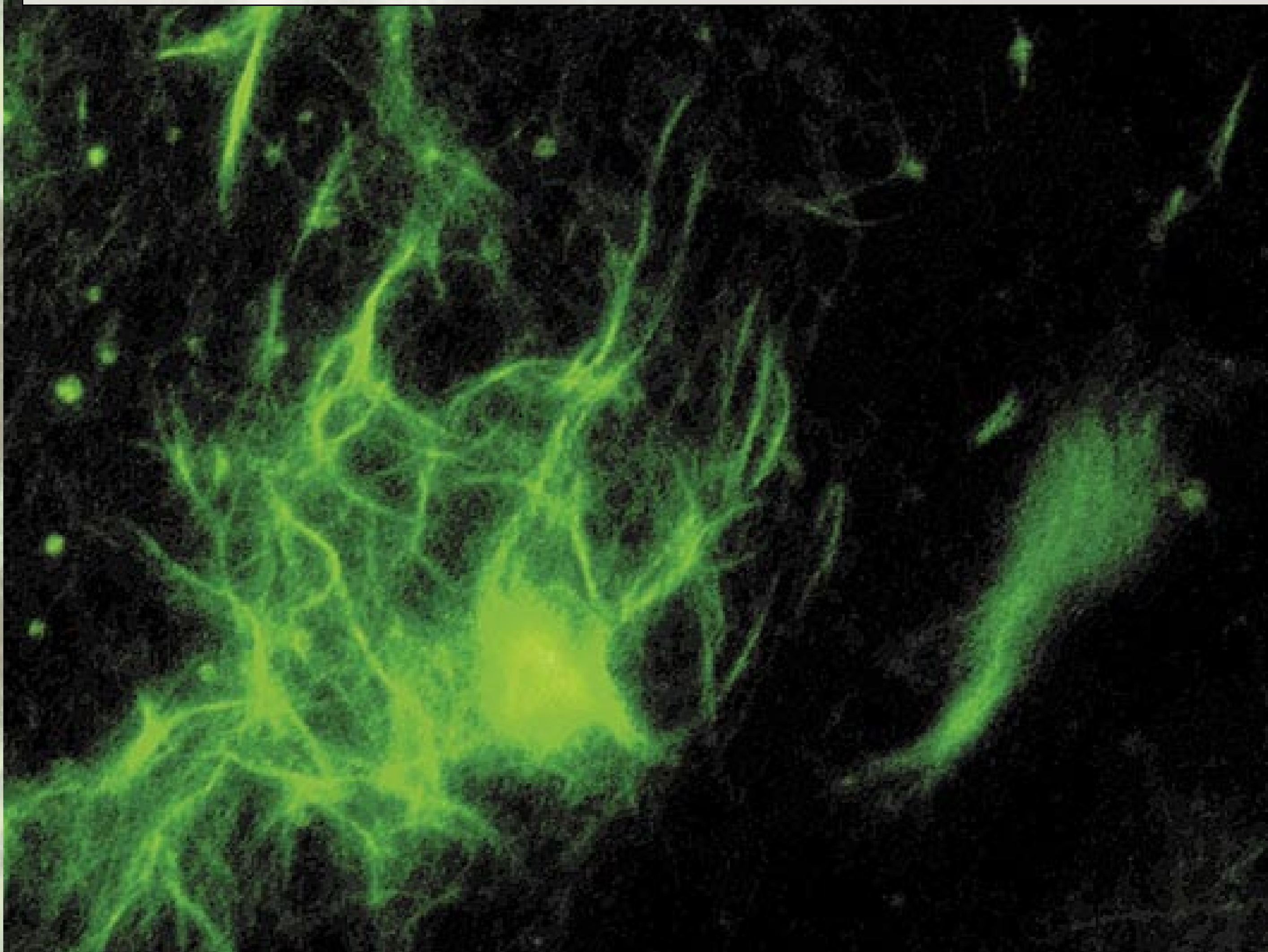
- *28 years old*
- *Researcher in bone formation and implant fixation since 1999, where he did a research year at the Department of orthopedics and Department of endocrinology at Aarhus University Hospital.*
- *Since February 2004, enrolled at the PhD program at the iNANO centre.*
- *In his PhD project bone formation and bone mineralization are investigated with respect to implant fixation and metabolic bone diseases using a number of nanobased techniques.*



Knowledge about bone formation in the nanometer length scale may be obtained by the use of advanced X-ray based techniques like sSAXS. A) Computerized tomography (CT) image of a pig vertebra. B) Survey sSAXS scan: The black area, bottom left, is the vertebral canal. The orange/red colour represents mineralized bone. The black regions are the bone marrow cavities. The white line shows the growth plate of the bone that is responsible for the development of the lateral part of the vertebral bone. C) High-resolution sSAXS scan of the growth plate and the adjacent region of bone. D) Raw SAXS images from the bone and growth plate.

Protein fibrils:

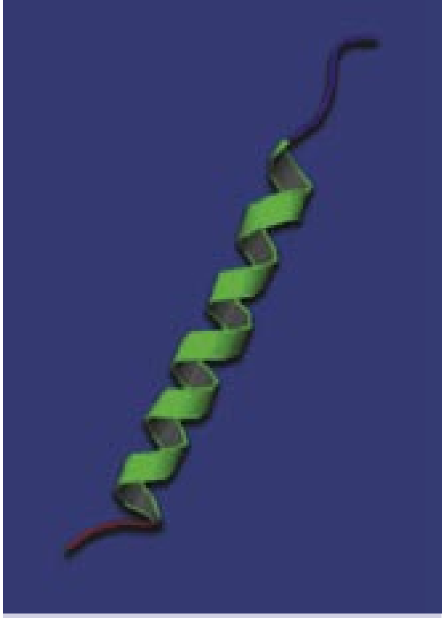
A key to dementia – with a potential as scaffolds for nanochips



Optical microscopy studies of glucagon fibrils stained with the fibril-specific dye Thioflavin T.

The accumulation of protein fibrils in the brain is the hall-mark of dementia diseases. Biophysical analyses of the formation of such fibrils may shed light on the deposition process and may even suggest ways to prevent it. Meanwhile designer fibril structures may prove useful as scaffolds for nanoscale integrated circuits.

By Daniel Otzen, Department of Life Sciences, Aalborg University
Collaborators: Jesper S. Pedersen, Mingdong Dong and Flemming Besenbacher



Structure of monomeric glucagon, emphasizing its α-helical structure.

In the brain, proteins such as β-amyloid and prions aggregate to form long and thin needle-shaped structures called fibrils, and when these fibrils accumulate they give rise to incurable and fatal dementia diseases such as Alzheimer's, Parkinson's and Creutzfeldt-Jakob disease.

At iNANO we are currently studying the formation of protein fibrils in laboratory systems by characterizing their properties using atomic force microscopy (AFM), infrared spectroscopy (FTIR) and fluorescence analysis. It is of fundamental interest to determine the relevance of our observations to the formation of similar structures in the living brain. Although amyloid deposits are generally dominated by a single component, minor species of other proteins may play an important part in strengthening or otherwise modifying the aggregate. We anticipate that a thorough biophysical analysis of these multi-component aggregates will shed more light on the deposition process and may even suggest ways to prevent it. This research is carried out in collaboration with Novo Nordisk A/S.

Essentially all proteins can fibrillate provided the right conditions, but fortunately only a subset of these are physiological. However, some amyloid structures serve a biological purpose: Bacteria exploit them to form bio films allowing them to adhere to surfaces, and in humans such fibrils form a matrix for building up skin colour pigment melanosomes. We have recently found such amyloid structures to be surprisingly widespread in bacteria, and are currently pursuing a more detailed identification of the molecular components of these structures.

Designer fibrils

With the exception of these few examples, amyloid proteins and peptides have not been designed from nature's hand to form one particular well-defined fibril structure. Therefore it might be expected that different fibrils can be formed under different conditions. We have found a striking illustration of this in the fibrillation behaviour of the peptide hormone glucagon. Although the concentration of this peptide in the body is too low for forming aggregates, it fibrillates easily under laboratory conditions.

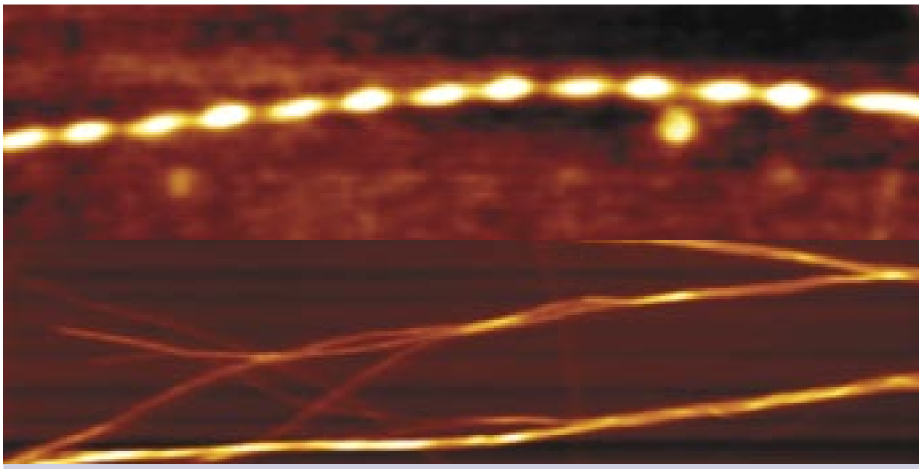
By varying conditions such as temperature, peptide concentration, ionic strength and the nature of the salt, it is possible to obtain fibril structures which differ fundamentally from each other. This is the case both in terms the secondary structure, the local formation of amino acids into β-sheets and α-helixes, as wells as the tertiary structure, the organisation of β-sheets and -helixes into the three dimensional peptide structure. The thermal and kinetic stability of the fibrils also vary considerably. The different structures are all well-defined in terms of thermodynamic properties such as heat capacity, melting temperature and unfolding rate constants.

The fibril type may be further manipulated by replacing individual amino acids in the peptide. Some individual fibril types can breed true in the sense that fibrils formed under certain conditions can be used as seeds to propagate formation of the same type of fibrils under different conditions which in the absence of these exogenously added fibrils would lead to another type of fibril. We are currently characterizing the mechanical properties of a range of different fibril types using atomic force microscopy.

Scaffolds for nanoscale circuits

The ability of proteins to organize in regular and robust structures is useful in many contexts. We anticipate that the prospect of obtaining designer fibril structures with specifically designed properties under controlled conditions may have implications for their application in nanotechnology.

Fibrils of prion proteins have already been used by other research groups as scaffolds for nanoscale integrated circuits, but in this case the fibrils had not been optimized for application conditions. By carefully designing fibrils with desired shapes and specific thermodynamic and chemical properties this approach could prove to be valuable for the development of methods to assemble nanoscale building blocks into functional nanodevices.



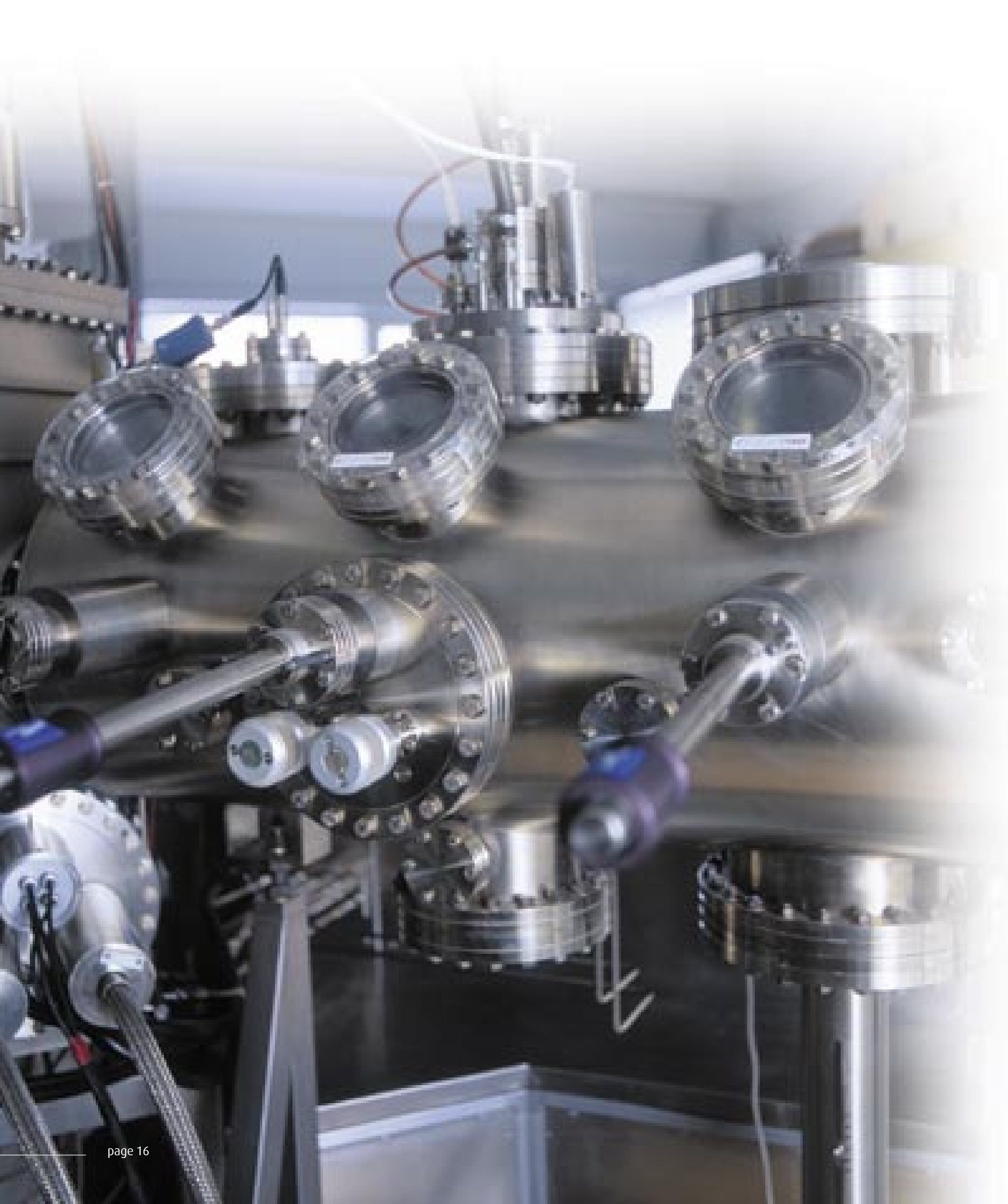
AFM pictures of glucagon fibrils, showing how pairs of fibrils intertwine to form clusters similar to beads on a string.

Nanocrystals:

Keeping pace with Moore's law in silicon

Eventually, completely new nanotechnologies may replace silicon chips. For the next 10-15 years, however, silicon-based devices are expected to remain the mainstream technology. Further size reductions and speed improvements of electronics and photonics can be achieved by exploiting the unique quantum properties of very small nanocrystals.

By Arne Nylandsted Larsen and Brian Bech Nielsen



Silicon-based chips are expected to remain the mainstream technology for logic and memory applications for as far into the future as can be reliably foreseen. For the next couple of decades, the introduction of new silicon-based concepts to accomplish further size reductions is much more likely than a replacement by completely new technologies such as molecular or carbon nanotube devices or single-electron transistors. However, new silicon-based materials containing nanostructures will be needed to achieve this goal, and also to keep pace with Moore's law, predicting that the number of transistors on an integrated circuit will double every 18 months.

Our research is focused on the synthesis and characterization of very small silicon and germanium nanocrystals in thin silicon oxide (SiO_2) layers on crystalline silicon substrates. The direct applications of these structures are in photonics and electronics, and potentially in extremely fast opto-electronic chips in which both electronic and optical functions are integrated in the same chip. Silicon is the leading semiconductor in microelectronic applications, and is thus the material of choice for reliable and low-cost opto-electronic integrated circuits. Today, however, bulk silicon is unsuitable as light emitter, which limits its use in opto-electronics.

Light emission from nanocrystals

Quantum confinement of electrons and holes within small nanocrystals incorporated into sensitive areas of a device might enhance the photonic capability of silicon to such a degree that efficient silicon-based light emitters may be realized. Light can be emitted when an electron recombines with a hole in the semiconductor. For this to happen efficiently, the electron and the hole must be close to each other and have overlap-

The Molecular Beam Epitaxy (MBE) instrument at the University of Aarhus.

Arne Nylandsted Larsen
Associate Professor

ping momentum distributions. Unfortunately, this overlap is not possible in a macroscopic silicon crystal, but when the electron and the hole are confined within the small volume of nanocrystals their positions are defined to such a degree that their momenta become undetermined according to one of the basic laws of quantum mechanics, the Heisenberg uncertainty relation. Therefore, the momentum distributions of the electron and the hole get smeared out and overlap, thus enabling light emission.

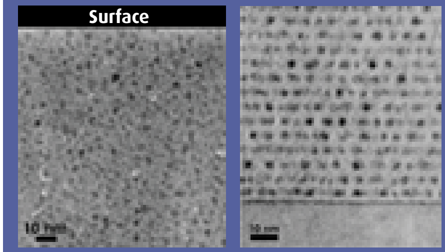
Controlled synthesis

A prerequisite for a light emitter based on nanocrystals is that the crystals can be synthesized at a high density, with a narrow size distribution, and with an average diameter smaller than 3-4 nanometres. We now master the synthesis of such structures with a variety of deposition techniques. Germanium and silicon nanocrystals have been produced in thin layers of silicon oxide on top of silicon substrates, and the size and spacing between the nanocrystals can be controlled very accurately.

Photoluminescence investigations of silicon nanocrystals have shown that the crystals are optically active at room temperature. The very strong luminescence, excited with 488 nanometer ultraviolet light, is centred on a wavelength of 900 nanometres, which corresponds to infrared light emitted from 3-4 nanometer sized crystals. Visible light with wavelengths below 700 nanometres is also emitted. If the size of the nanocrystals can be further reduced, the wavelengths will be shortened accordingly, thus rendering the production of silicon-based lasers with a range of different colours possible.

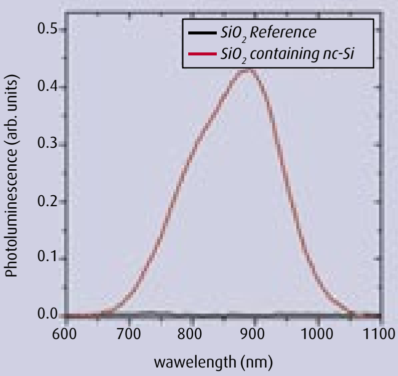
Tuning the wavelength

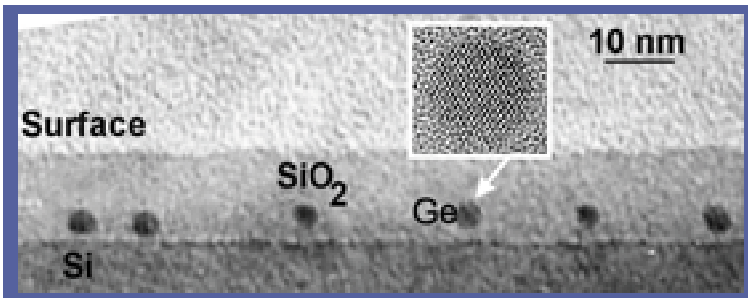
The addition of rare earth dopants to structures containing germanium or silicon nanocrystals in silicon oxide layers is presently a major activity. The nanocrystals and the rare earth ions interact, leading to a strongly enhanced luminescence from the rare earth ions. The advantage of these systems is that by choosing the appropriate rare earth element, the emission wavelength can be altered to fulfil the demands of a particular opto-electronic device.



Silicon-based light emitters for extremely fast opto-electronic chips may be based on nanocrystals. The electron microscopy image to the left shows a cross section of a CVD-deposited silicon oxide layer with 8 per cent germanium after a heat treatment at 1000°C. During the heat treatment, the germanium atoms precipitate into evenly distributed nanoclusters. The image to the right shows layered germanium nanocrystals in silicon oxide produced by magnetron sputtering.

Light emission from silicon nanocrystals: The luminescence peak is in the infrared at a wavelength of 900 nanometres. The photo – taken with a standard digital camera - shows the emission of visible light at wavelengths around 700 nanometres.





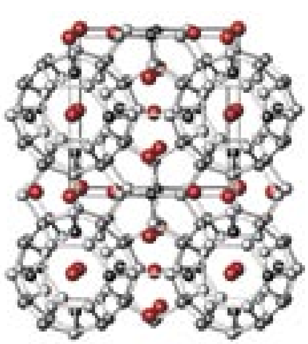
Example to illustrate how well we can control the spatial distribution of nanocrystals. The structure is grown by molecular beam epitaxy and consists of a silicon substrate with a silicon oxide top-layer including germanium nanocrystals of very high density. The diameter of the nanocrystals is 4 nanometer, and they are situated in a plane separated from the substrate by 4 nanometres. The insert shows a high-resolution transmission electron microscopy image demonstrating that the nanocrystals are spherical and crystalline. This particular structure is part of a field effect transistor.

Thermoelectric materials:

Utilization of waste heat – and electricity for Mars missions

Thermoelectric materials turn heat into electricity without any pollution. The converters have no moving parts and are therefore extremely reliable and well suited for space missions. On Earth waste heat abounds in modern societies and many applications of thermoelectric devices can be envisaged.

By Bo Brummerstedt and Anders Bentien



The new synthesis method developed at iNANO allows the production of large single crystals which are vital for characterisation. By use of single-crystal neutron triple axis spectroscopy we have provided the first direct evidence of the central paradigm of the PGEC concept of rattling guest atoms capable of scattering heat carrying phonons. The guest atoms (red) are situated in nanocavities in the centres of the circular structures.

Thermoelectricity can be generated in all conductive materials. When a temperature gradient is applied across a sample, electrons diffuse from the hot to the cold part due to the larger thermal speed of the electrons in the hot region. Consequently, a charge difference builds up between the hot and cold region, creating a voltage and producing an electric current.

Thermoelectric materials can be used for either cooling or power generation. Although current devices have a low conversion efficiency of around 10 per cent, they are strongly advantageous as compared to conventional energy technologies. The converters have no moving parts and are therefore both reliable and durable. Also, they are scalable and hence ideal for miniature power generation, and no pollutants are released to the environment. If significantly improved thermoelectric materials can be developed, thermoelectric devices may replace the traditional cooling system in refrigerators. They could also make power generators in cars obsolete by utilizing heat from the exhaust gasses, or they may possibly be used to convert huge amounts of industrial waste heat into electricity.

The conversion efficiency of thermoelectric materials can be improved either by lowering their thermal conductivity and thus sustain the heat for longer periods, or by enhancing their capacity for producing electricity. Unfortunately, the reduction of thermal conductivity usually means that the power factor follows suite - and vice versa. At iNANO we thus focus our research on a range of new materials. The efforts involve the development of new synthesis methods and extensive physical property and structural characterization.

Bound for Mars

Revolutionizing new ideas for the optimization of thermoelectric materials were introduced by Slack with the phonon glass electron crystal (PGEC) concept. An ideal thermoelectric material conducts heat as badly as amorphous glass, and electrons as well as a crystal. An example is inorganic clathrates which are promising for power generation at temperatures above 600 oC. The material consists of an open framework of gallium and germanium atoms that acts as an electron crystal. In this structure guest atoms are selectively incorporated in nanocavities. The atoms vibrate independently of the crystal structure, and when in sync with the heat waves they scatter the heat and lower the thermal conductivity of the clathrates.

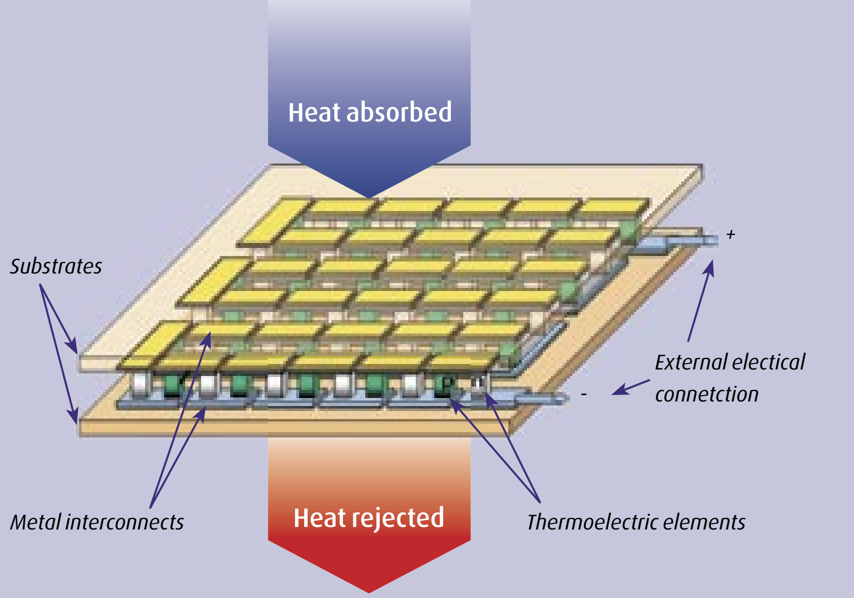
We have developed a new synthesis method which enables us to produce both p and n-type materials needed in a thermoelectric module. High-temperature transport measurements have been carried out at the Jet Propulsion Laboratory, and apart from a high conversion efficiency, tests

also showed that our material has an extraordinary stability. Even after extensive thermal cycling the properties are unchanged. The clathrates are among the target materials for NASA's high-temperature converters for future Mars missions.

Making use of waste heat

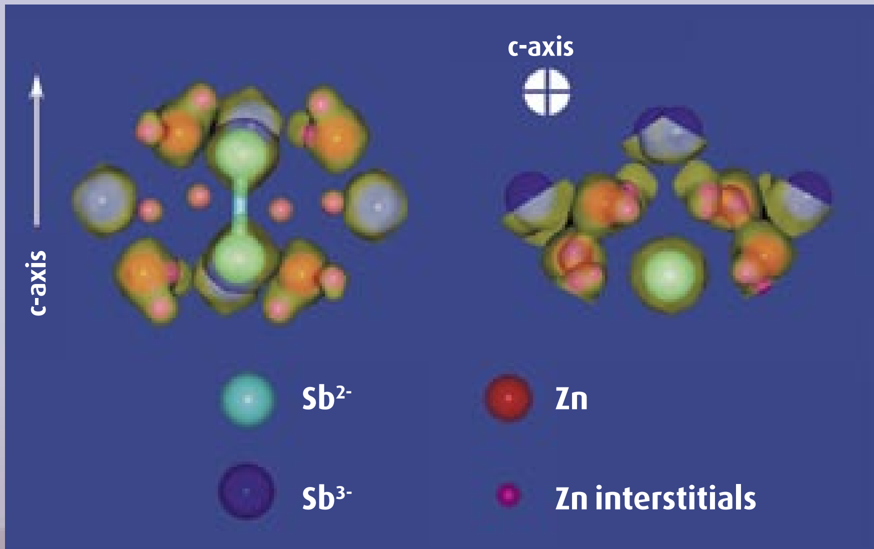
Other efforts focus on the power generation at intermediate temperatures. Zincantimonide has very high conversion efficiencies in the temperature range 200-400 oC, making this material a promising candidate for devices to utilize waste heat. We have developed a new synthesis method which produces zinkantimonide with an enhanced conversion efficiency and less degradation upon thermal cycling.

We collaborate with world centres for thermoelectric research such as NASA's Jet Propulsion Laboratory and the German Aerospace in Cologne, and participate in European projects on thermoelectrics (www.nanothermel.org). We cooperate with the industrial partner Grundfos A/S on a further development of zincantimonides, and in a new project we try to incorporate thermoelectric materials into energy systems in collaboration with the Institute for Energy Technology at Aalborg University.



A thermoelectric device converts heat into electricity (Jeff Snyder and James Lim, JPL).

Clathrate crystals produced at iNANO are among the target materials for NASA's high-temperature thermoelectric converters for future Mars missions. Heat for the converters will be provided by radioactive sources.

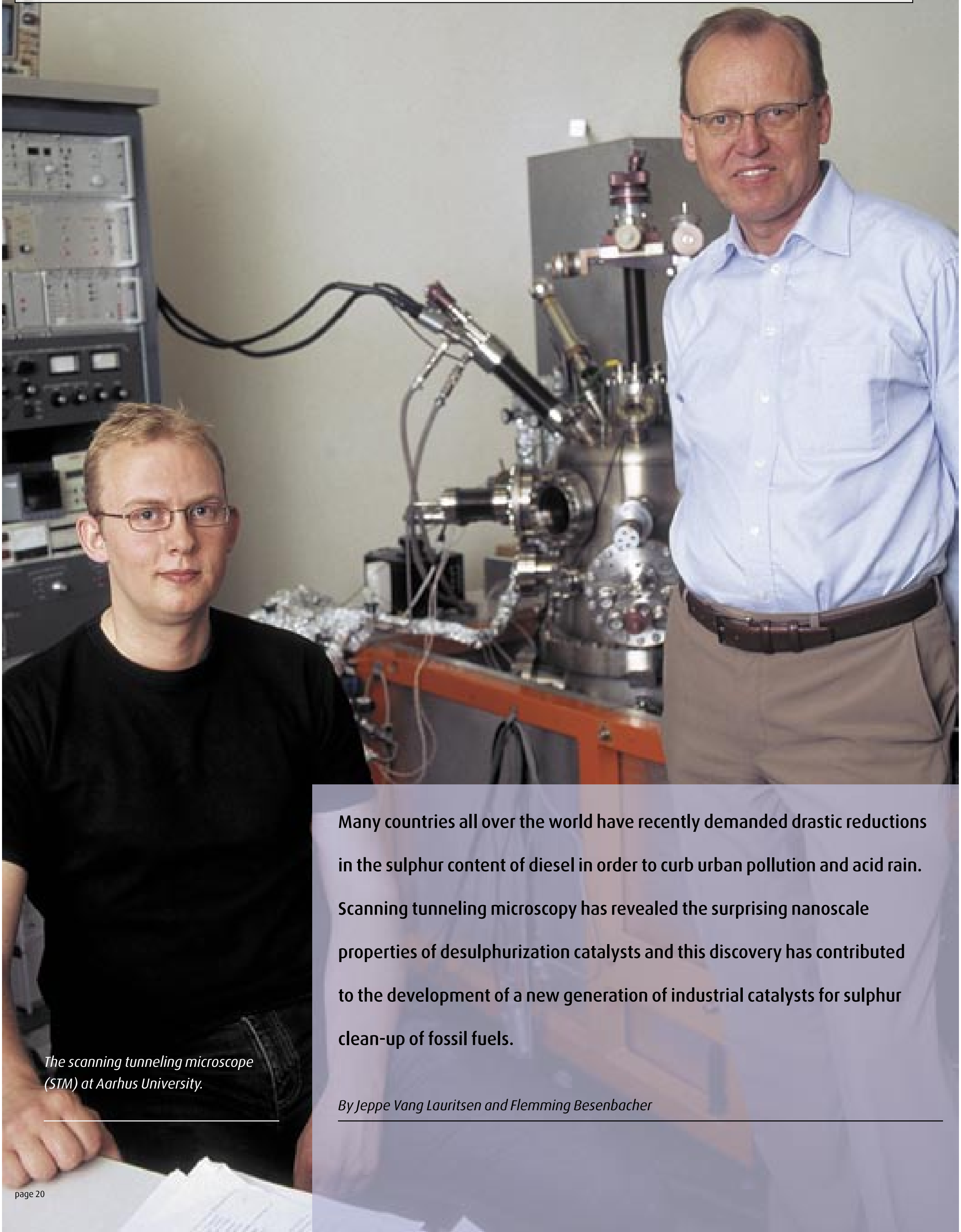


The mechanism for the excellent thermoelectric properties of zincantimonide (Zn4Sb3) was a mystery until 2004. By use of synchrotron radiation we showed that the material has small Zn inclusions in an otherwise perfect crystalline network. These inclusions act as scattering centres for phonons, limiting the heat transport.

Courtesy NASA/JPL-Caltech

Nanocatalysis:

A better catalyst for desulphurization of fossil fuels



The scanning tunneling microscope (STM) at Aarhus University.

Many countries all over the world have recently demanded drastic reductions in the sulphur content of diesel in order to curb urban pollution and acid rain. Scanning tunneling microscopy has revealed the surprising nanoscale properties of desulphurization catalysts and this discovery has contributed to the development of a new generation of industrial catalysts for sulphur clean-up of fossil fuels.

By Jeppe Vang Lauritsen and Flemming Besenbacher

The results of basic experimental and theoretical nanoscience have in recent years been applied in industry at an amazing speed. Aided by latest STM investigations at iNANO the Danish company Haldor Topsøe A/S is currently implementing a new generation of hydrode-sulphurization catalysts used at oil refineries worldwide for sulphur clean-up of fossil fuels.

Catalysis is of vital importance in our society and constitutes a cornerstone of life from biological processes to large-scale production of bulk chemicals. The availability of plentiful and inexpensive chemicals relies on industrial catalytic processes and without them it would be impossible to maintain the current living standard for more than a minute fraction of the present human population. Other technologies, including production of pharmaceuticals, means of environmental protection, and production and distribution of sustainable energy also depend on catalysis.

At iNANO we are at the forefront of research in nanocatalysis which is expected to revolutionize the way catalysts are being prepared. The traditional empirical way of discovering a catalyst was always hampered by labour-intensive batch-testing, but now with the ability to design and characterize new nanomaterials and predict their catalytic capabilities from first principles, a new era is within reach.

Speeding up chemical reactions

A catalyst is a material that can accelerate a chemical reaction dramatically or change its product distribution towards a specific compound without being consumed itself during the reaction.

Although nanoscience has only recently materialized as a new interdisciplinary area of science, the manufacturing of structures on the nanometer scale has been a central issue in catalysis research and development for decades. This fact relates to the structure of a heterogeneous catalyst, which requires control of materials ranging from macroscopic dimensions down to the nanoscale. A heterogeneous catalyst typically consists of few nanometer wide catalytically active nanoparticles dispersed on a highly porous support material which can have surface areas up to 250 m^2 per gram.

Application of nanotechnology concepts in catalysis is already beginning to show a great industrial impact. The detailed understanding of the chemistry of nanostructures and the ability to control materials on the nanometer scale will ensure a more rational and cost-efficient development of new and improved catalysts for chemical production.

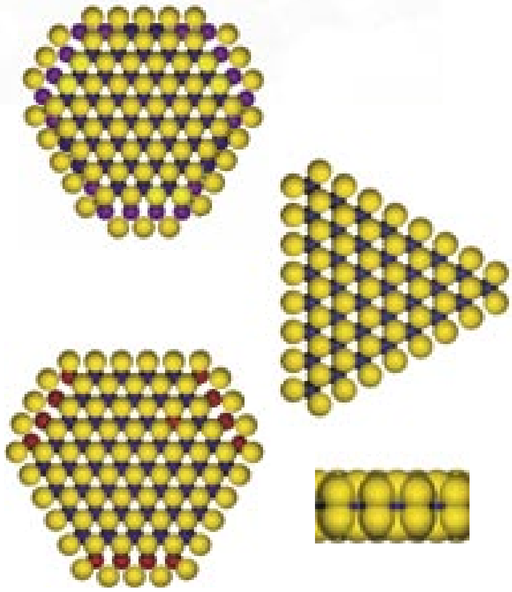
Brim technology has the edge

Recent nanotechnology research performed at iNANO has aided the Danish company Haldor Topsøe A/S in implementing a new generation of hydrodesulphurization catalysts to be used for sulphur clean-up of fossil fuels worldwide.

Fundamental studies by means of scanning tunnelling microscopy have shown that the 2-3 nanometer wide active MoS_2 particles that form the active basis of the catalyst performs significantly different from what is predicted from the macroscopic behaviour of MoS_2. These nanoscale properties control the catalysis to high degree. In particular, it was shown that the edges of the clusters expose one-dimensional metallic edges, so-called brim states, which can bind and subsequently desulphurize the sulphur-bearing molecules in crude oil.

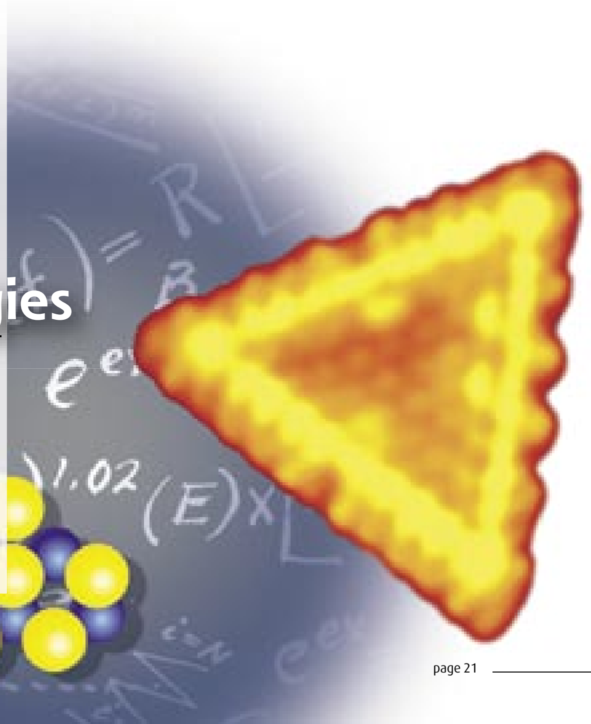
In the latest generation of brim technology hydrodesulphurization catalysts it was possible to optimize the effect of the brim states and thereby make the catalyst more active. This is an example on how nanotechnology discoveries performed under controlled laboratory conditions can successfully assist the development of real technical catalysts operating in industrial plants.

"It has been exiting and inspiring to see true 3D pictures of a desulphurization catalyst at work at the atomic scale. The impressive STM pictures from iNANO are also used in the marketing of our new desulphurization catalysts", says director Henrik Topsøe from Haldor Topsøe A/S.



The ball models show the structure of the active MoS_2 nanoparticles modified by Co and Ni as it was observed in STM images. Addition of Co and Ni promotes the activity of the catalyst by an order of magnitude, and direct nanoscale images by STM may reveal the origin of this effect.

BRIM™ Technologies



The STM image shows a snapshot of desulphurization in progress. A sulphur atom in a crude oil molecule binds near the edge of the active MoS_2 nanocluster, which is the first step in the reaction. The sulphur atom then reacts with hydrogen to form hydrogen sulphide which is subsequently removed from the reactor.

iNANO and industry

As newly elected Chairman of the Board, I would like to express my full support to the visionary concept behind iNANO. As a representative for industry, I am very excited about being part of the initiatives taking place within iNANO to facilitate a closer interaction between nanoscience research and its application in industry.

The vision is to create mechanisms for demonstrating proof-of-concept of a given product or process, which can then be transferred from the research environment to a start-up company or into an existing company. The fulfilment of this vision asks for a number of important factors to come into play, many of which are already in the pipeline.

First, increased awareness in research environments of the needs of industry is required. The flow of information, however, must be reciprocal to ensure that collaborative projects are based on a mutual agenda setting. These functions are being built up at the moment under the auspices of NaNet, a national network of knowledge on nanotechnology, which will located in both the Copenhagen area and in Aarhus.

Second, a place for direct interaction is required. A future iNANO house will hold both research activities and space for companies to perform research and development in collaboration with iNANO scientists.

Third, but not least, a solid commitment is required from the funding bodies, which have been announced as strategic players in the field of nanotechnology, e.g. the High-technology Foundation and the Danish Strategic Research Council. These bodies, however, depend on political goodwill, which has already been announced but still lacks actual initiatives.

Hans Jørgen Pedersen, Danfoss A/S,
Chairman of the Board

Industrial Partners

Haldor Topsøe A/S - www.haldortopsoe.com
Grundfos A/S - www.grundfos.com
Danfoss A/S - www.danfoss.com
Danisco A/S - www.danisco.com
NanoNord A/S - www.nanonord.dk
H. Lundbeck A/S - www.lundbeck.com
Cantion A/S - www.cantion.com
Arla Foods amba - www.arlafoods.dk
Aarhus United A/S - www.aarhusunited.com
Danish Crown amba - www.danishcrown.dk
Systematic Software Engineering A/S - www.systematic.dk
Teknologisk Institut - www.teknologisk.dk
Forskningscenter Foulum - www.agrsci.dk/centre/forskningscenter_foulum
Århus Kommune - www.aarhuskommune.dk
Århus Amt - www.aaa.dk
Delta - www.delta.dk
Flextronics A/S - www.flextronics.com
NKT Research & Innovation A/S - www.nkt.dk
Capres A/S - www.capres.com
MicroelektronikCentret - www.mic-dtu.dk
Bioneer A/S - www.biosite.dk
Chew Tech I/S - www.chewtech.dk
Coloplast Research A/S - www.coloplast.dk
Identity Ltd.
Pipeline Biotech A/S - www.pipeline-biotech.dk
Zgene A/S - www.zgene.dk
BioImage - http://www.bioimage.com/
CemeCon - www.cemecon.dk
H2 Logic ApS - www.h2logic.dk
HIRC - www.hirc.dk
Hybon/Cemtec - www.cemtec.dk
Image Metrology A/S - www.imagemet.com
OFS Fitel Denmark A/S - www.ofs.dk
SCF Technologies - www.scf-technologies.com
Unisense A/S - www.unisense.dk
Versamatrix A/S - www.versamatrix.dk
Aalborg Portland - www.aalborg-portland.dk
DHI- Water & Environment - www.dhi.dk
Kræftens bekæmpelse - www.cancer.dk
Sahva - www.sahva.dk
Stryker - www.sryker.com

Acamedic Partners

Chalmers University of Technology, Sweden

Ruprecht-Karls-Universitaet Heidelberg, Germany

University of Glasgow, Scotland

Universite de Bordeaux, France

Karolinska Institutet, Sweden

Eidgenoesische Technische Hochschule Zuerich, Swizerland

Centre National de la Recherche Scientifique, France

International Business Machines Corporation, Zurich Research Laboratory, Swizerland

The University of Birmingham, England

Freie Universitaet Berlin, Germany

University of Cambridge, England

Technical University Delft, Holland

Interuniversitair Micro-electronica Centrum vzw, Belgium

Forschungszentrum Karlsruhe GmbH, Germany

CeNTect Gmbh, Germany

Universitaet Basel, Swizerland

Max-Planck-Gesellschaft zur Förderung der Wissenschaften, Germany

Westfälische Wilhelms-Universität, Germany

University of Oxford, England

Technische Universität Dresden, Germany

Ole Jensen, director NanoNord A/S

At NanoNord, our business model is a combination of business talent and visions of the future. But in order to transform such visions to success, it takes the right resources, and though we have managed to acquire first class technical equipment and have come a long way towards building the right infrastructure, we are acutely aware that the most important resource in a successful business is the human one.

This is where our co-operation with iNANO plays an essential part. We already exchange resources between our commercial environment and the educational/research environment of iNANO, as we share many physical resources such as technical equipment, cleanroom & other facilities.

As we see it, this unique, practical sharing of resources is an important step towards intensifying the many NanoNord & iNANO synergy effects as we see them - including the exchange of human knowledge, development results, and inspiration for future research and education. Therefore, it goes without saying that we value the iNANO effort highly.

A_1 $\Omega_1(N_1, V_1, E_1)$ possible microstates
A_1 and A_2 in thermal contact ; $A^{(0)} \equiv A_1 + A_2$
$E_1 + E_2 = \text{const.}$ ... $(E_1)\,\Omega_2(E_2) = \Omega_1(E_1)\,\Omega_2(E^{(0)} - E_1)$
... value) ...

Phd Theses 2004

Vestergaard, Ebbe Kruse: Scanning Tunneling Microscopy Studies of Model Systems Relevant to Catalysis

Frederiksen, Peter Kaidin: The Two-Photon Photosensitized of Singlet Oxygen

Lynge, Thomas Bastholm: Tight-binding treatment of conjugated polymers

Pedersen, Shona: Protein stability, folding and the interaction with ultra-violet light

Jakobsen, Loise Odgaard: Structural studies of cation and nucleotide binding sites in the Na,K-ATPase.

Larsen, Allan Godsk: Studies on Self-Assembled Monolayers on Gold by Electrochemical Methods
Pedersen, Katrine Egelund : Inactivation of Plasminogen Activator Inhibitor-I

Nielsen, Anne Ahlmann: Pathogenesis by Murine Leukemia Viruses

Bahrami, Shervin: Plus-strand RNA viruses infect on animal cells

Rasmussen, Søren Vestergaard: Stem-loop Structures in the 5´UTR of Retroviral RNAs with a Function in Dimerization and Encapsidation.

Elmengaard, Brian: The effect of bioactive surface treatment on fixation of primary and revision implants

Jensens, Thomas Bo: Improvement and substitution of bone allograft around non-cemented implants

Simonsen, Charlotte: Biotic Iron Precipitation in Sand Filtration System by Gallionella Ferruginea: Morphology and Content of Exopolymers

Simonsen, Nana T.: Influence of the aluminium coagulant, PAX14, on Microthrix parvicella

Publications

Aagaard, L.; Rasmussen, S.V.; Mikkelsen, J.G.; Pedersen, F.S.: Efficient replication of full-length murine leukemia viruses modified at the dimer initiation site regions. *Virology*; 318: 360-370, 2004.

Africh, C.; Esch, F.; Li, W.X.; Corso, M.; Hammer, B.; Rosei, R.; Comelli, G.: Two-step reaction on a strained, nanoscale segmented surface. *Phys. Rev. Lett.*; 93(12): 126104, 2004.

Alonso, R.E.; Svane, A.; Rodríguez, C.O.; Christensen, N.E.: Erratum: Nuclear quadrupole moment determination of ^{35}CL, ^{79}Br, and ^{127}I. *Phys. Rev. B*; 70: 119901-1, 2004.

Alonso, R.E.; Svane, A.; Rodríguez, C.O.; Christensen, N.E.: Nuclear quadrupole moment determination of $_{35}$CL, $_{79}$Br, and $_{127}$I. *Phys.Rev B*; 69: 125101-1, 2004.

Andersen, E.S.; Antoranz Contera, S.; Knudsen, B.; Damgaard, C.K.; Besenbacher, F.; Kjems, J.: Role of the transactivation response element in dimerization of HIV-1 RNA. *Journal of Biological Chemistry, USA*; 279: 22243-22249, 2004.

Andersen, F.; d'Amore, F.; Nielsen, F.C.; van Solinge W.; Jensen T.; Jensen, P.D.: Unexpectedly high but still asymptomatic iron overload in a patient with pyruvate kinase deficiency. *Hematol J*; 5:543-5, 2004

Andersen, M.D.; Jakobsen, H.J.; Skibsted, J.: Characterization of white Portland cement hydration and the C-S-H structure in the presence of sodium aluminate by ^{27}Al and ^{29}Si MAS NMR spectroscopy. *Cement Concrete Res.*; 34: 857-868, 2004.

Andersen, R.B.; Karring, H.; Møller-Pedersen, T.; Valnickova, Z.; Thøgersen, I.B.; Hedegaard, C.J.; Kristensen, T.; Klintworth, G.K.; Enghild, J.J.: Purification and structural characterization of transforming growth factor beta induced protein (TGFBIp) from porcine and human corneas. *Biochemistry*; 43(51): 16374-16384, 2004.

Andersen, T.V.; Hilligsoe, K.M.; Nielsen, C.K.; Thøgersen, J.; Hansen, K.P.; Keiding, S.R.; Larsen, J.J.: Continuous-wave wavelength conversion in a photonic crystal fiber with two zero-dispersion wavelengths. *Optics Express*; 17(12): 4113-4122, 2004.

Andersson, N.; Alberius, P.C.A.; Pedersen, J.S.; Bergstrom, L.: Structural features and adsorption behaviour of mesoporous silica particles formed from droplets generated in a spraying chamber. *Micropor. Mesopor. Mat.*; 72(1-3): 175-183, 2004.

Arnbjerg, J.; Johnsen, M.; Schack, N.B.; Ogilby, P.R.: Mikroskopi med singlet oxygen. *Dansk Kemi*; 85(11): 29-31, 2004.

Bahrami, S.; Duch, M.; Pedersen, F.S.: Change of tropism of SL3-2 murine leukemia virus, using random mutational libraries. *J. Virol.*; 78: 9343-9351, 2004.

Balling, P.; Fregenal, D.; Ichioka, T.; Knudsen, H.; Kristiansen, H.-P.E.; Merrison, J.; Uggerhøj, U.I.: Perspectives for pulsed positrons. *Nucl. Instr. Meth. B*; 221: 200, 2004.

Beermann, J.; Marquart, C.; Bozhevolnyi, S. I.: Two-photon mapping of molecular orientations in hexaphenyl microrings. *Laser Phys. Lett.*; 1 (5): 264-268, 2004.

Beermann, J.; Bozhevolnyi, S.I: Microscopy of localized second-harmonic enhancement in random metal nanostructures. *Phys. Rev. B;* 69: 155429, 2004.

Beermann, J.; Bozhevolnyi, S.I.; Bordo, V.G.; Rubahn, H.G.: Two-photon mapping of local molecular orientations in hexaphenyl nanofibers. *Opt. Commun*.;.237 (4-6): 423-429. 2004.

Beermann, J.; Bozhevolnyi, S.I.: Second-harmonic near-field optical microscopy of periodic nanoholes in metal films. *Laser Phys. Lett.*; 1 (12): 592-597, 2004.

Bentien, A.; Christensen, M.; Bryan, J.D.; Sanchez, A.; Paschen, S.; Steglich, F.; Stucky, G.D.; Iversen, B.B.: Thermal conductivity of thermoelectric clathrates. *Phys. Rev. B*; 69: 45107-45107, 2004.

Bertram, H.C.; Kristensen, N.B.; Malmendal, A.; Nielsen, N.C.; Jensen, S.K.; Harnon, D.L.: An NMR-based metabolomic approach to assess metabolism in splanchnic tissues of steers. *J. Anim. Feed Sci.*; 13: 295-298, 2004.

Besenbacher, F.; Kjems, J.: Biomolekyler visualiseret med scanning-probe-mikroskopi. *Carlsbergfondets Årsskrift 2003, Danmark*: 52-57, 2004.

Besenbacher, F.; Nylandsted Larsen, A.; Bech Nielsen, B.; Stensgaard, I.: Funktionelle nanoklynger: nanoreaktivitet og nanoluminiscens. *KVANT*; 15(2): 13-17, 2004.

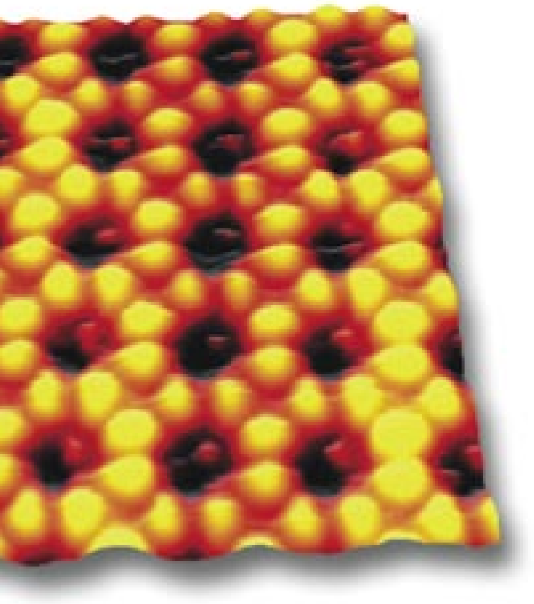
Birkedal, H.; Madsen, D.; Mathiesen, R.H.; Knudsen, K.; Weber, H.P.; Pattison, P.; Schwarzenbach, D.: The charge density of urea from synchrotron diffraction data. *Acta Crystallogr. A.*; 60: 371-381, 2004.

Bladt, V.; Steengaard-Pedersen, K.; Poulsen, L.H; Pedersen, O.B.; Laursen, B.; d'Amore, F.: Late puerperal immunothrombocytopenia and retained placenta in a 33-year old woman with antiphospholipid syndrome. *Eur J Haematol;* 73:437-440, 2004.

Blakskjær, P.; Gavrila, A.; Andersen, L.; Skrydstrup, T.: An improved protocol for the SmI2-promoted C-alkylation of peptides: degradation and functionalization of serine residues in linear and cyclic peptides. *Tetrahedron Lett.*; 45: 9091-9094, 2004.

Bochenek, B.; Pyrz, R.: Reconstruction of random microstructures- a stochastic optimisation problem. *Comput. Mat. Sci.;* .34: 93-112, 2004.

Publications



Bowler, R.P.; Duda, B.; Chan, E.D.; Enghild, J.J.; Ware, L.B.; Matthay, M.A.; Duncan, M.W.: Proteomic analysis of pulmonary edema fluid and plasma in patients with acute lung injury. *Am. J. Physiol. Lung Cell. Mol. Physiol.*; 286(6): 1095-1104, 2004.

Bozhevolnyi, S.; Lozovski, V.; Sladkov, M.: Surface wave scattering by a nano-object situated on a surface. *Surf. Sci.;*.554: 33-42, 2004.

Bozhevolnyi, S.I.; Volkov, V.S.: Near-field characterization of planar photonic-crystal-waveguide structures. *Phil. Trans. R. Soc. Lond. A;*.362 (1817): 757-769, 2004.

Brezesinski, G.; Möhwald, H.; Jensen, T.R.; Kjaer, K.; Godovsky, Y.K.; Belousov, S.I.; Makarova, N.N.: Smart polysiloxane monolayers and self-organized ultrathin films. *Nonlinear Optics and Quantum Optics;* 31-44, 2004.

Broqvist, P.; Molina, L.M.; Grönbeck, H.; Hammer, B.: Promoting and poisoning effects of Na and Cl coadsorption on CO oxidation over MgO-supported Au nanoparticles. *J. of Catalysis*; 227: 217, 2004.

Cannavacciuolo, L.; Pedersen, J.S.: Moments and distribution function of polyelectrolyte chains. *J. Chem. Phys.*; 120(18): 8862-8865, 2004.

Cargnoni, F.; Nishibori, E.; Rabiller, P.; Bertini, L.; Snyder, G.J.; Christensen, M.; Gatti, C.; Iversen, B.B.: Interstitial Zn atoms do the trick in thermoelectric zinc antimonide, Zn_4Sb_3: A combined maximum entropy method X-ray electron density and ab initio electronic structure study. *Chem. Eur. J.*; 10: 3861-3870, 2004.

Carney, P.S.; Frazin, R.A.; Bozhevolnyi, S.I.; Volkov, V.S.; Boltasseva, I.; Schotland, J.C.: Computational lens for the near field. *Phys. Rev. Lett*.; 92 (16): 163903, 2004.

Carrasco, M.L.; Duch, M.; Pedersen, F.S.: The 5' part of a tRNA as a template in reverse-transcriptase-mediated retroviral recombination in vivo. *J. Gen. Virol.*; 85: 1965-1969, 2004.

Carvalho, A.S.;. Santos, A.M. ; Neves-Petersen, M.T.; Petersen, S.B.; Aires-Barros, M.R.; Melo, E.P.: Conformational states of HRPA1 induced by thermal unfolding: effect of low molecular wieght solutes. *Biopolymers*; 5 (75): 173-86, 2004.

Castelletto, V.; Hamley, I.W.; Pedersen, J.S.: Small-angle neutron scattering study of the structure of superswollen micelles formed by a highly asymmetric poly(oxybutylene)-poly(oxyeth ylene) diblock copolymer in aqueous solution. *Langmuir*; 20(7): 2992-2994, 2004.

Castelletto, V.; Hamley, I.W.; Xue, W.; Sommer, C.; Pedersen, J.S.; Olmsted, P.D.: Rheological and structural characterization of hydrophobically modified polyacrylamide solutions in the semidilute regime. *Macromolecules*; 37(4): 1492-1501, 2004.

Chatterton, D.E.W.; Rasmussen, J.T.; Heegaard, C.W.; Sørensen, E.S.; Petersen, T.E.: In vitro digestion of novel milk protein ingredients for use in infant formulas: Research on biological functions. *Trends Food Sci. Tech.*; 15: 373-383, 2004.

Christensen, A.N.; Jensen, T.R.; Hanson, J.C.: Formation of ettringite, Ca6Al2(SO4)3(OH)12.26H 2O, AFt, and monosulfate, Ca4Al2O6(SO4).14H2O, AFm-14, in hydrothermal hydration of Portland cement and of calcium aluminum oxidecalcium sulfate dihydrate mixtures studied by in situ synchrotron X-ray powder diffraction. *J. Solid. State. Chem.*; 177(6): 1944-1951, 2004.

Christensen, A.N.; Jensen, T.R.; Scarlett, N.V.Y.; Madsen, I.C.; Hanson, J.C.: Hydrolysis of pure calcium aluminates and of cement clinker components investigated by in-situ synchrotron X-ray powder diffraction. *J. Am. Ceram. Soc.*; (87): 1488-1493, 2004.

Christensen, F.B.; Bünger, C.: Stratification surgery for mechanical low back pain. Indication, operation procedures and outcome. *Editorial Review: Stand. J of Rheumatology*, 2004.

Christensen, M.; Iversen, B.B.; Bertine, L.; Gatti, C.; Toprak, M.; Muhammed, M.; Nishibori, E.: Structural study of Fe doped and Ni substituted thermoelectric skutterudites by combined synchrotron and neutron powder diffraction and *ab initio* theory. *J. Appl. Phys.*; 96(6): 3148-3157, 2004.

Christodoulou, J.; Malmendal, A.; Harper, J.F.; Chazin, W.J.: Evidence for differing roles for each lobe of the Calmodulin-like domain in a calcium-dependent protein kinase (CDPK). *J. Bio. Chem.*; 279: 29092-29100, 2004.

Coello, V.T.; Søndergaard, T.; Bozhevolnyi; S.I.: Modeling of a surface plasmon polariton interferometer. *Opt. Commun; .*240 (4-6): 345-350, 2004.

Coppens, P.; Iversen, B.; Larsen, F.K.: The use of synchrotron radiation in X-ray charge density analysis of coordination complexes. *Coordin. Chem. Rev.*; 249: 179-195, 2004.

Cornean, H.; Duclos, P.; Pedersen, T.G.: One dimensional models of excitons in carbon nanotubes. *Few Body Systems;* 34: 155 2004.

Crosby, R.; Jones, K.S.; Law, M.E.; Nylandsted Larsen, A.; Lundsgaard Hansen, J.: {311} defect evolution in ion-implanted, relaxed $Si_{1-x}Ge_x$. *J.Vac.Sci.Technol.B*; 22 (1): 468, 2004.

Crosby, R.T.; Jones, K.S.; Law, M.E.; Saavedra, A.F.; Hansen, J.L.; Larsen, A.N.; Liu, J.: Strain Relaxation of Ion-implanted Strained Silicon on Relaxed SiGe. *Mat. Res. Soc. Symp. Proc.*; 810: C4.12.1, 2004.

Damgaard, C.K.; Andersen, E.S.; Knudsen, B.; Gorodkin, J.; Kjems, J.: Characterization of novel interactions in the HIV-1 leader RNA. *J. Mol. Biol.*; 336: 369-379, 2004.

Davies, J.C.; Nielsen, R.M.; Thomsen, L.B.; Chorkendorff, I.; Logadóttir, Á.; Lodziana, Z.; Nørskov, J.K.; Li, W.X.; Hammer, B.; Longwitz, S.R.; Schnadt, J.; Vestergaard, E.K.; Vang, R.T.; Besenbacher, F.: CO desorption rate dependence on CO partial pressure over platinum fuel cell catalysts. *Fuel Cells*; 4: 309, 2004.

Dekkers, M.K.; Søballe K.: Activities and impairment in the early stage of rehabilitation after Colles'fracture. *Disabil Rehabil.* 3; 26(11*)*: 662-8, 2004.

Dybkær K.; Zhou, G.; Iqbal, J.; Kelly, D.; Xiao, L.; Sherman, S.; d'Amore, F.; Chan, W.C.: Is the universal RNA standard from stratagene suitable for analysis of lymphoid tissue? *Biotechniques;*, 37: 470-472, 2004.

Dobaczewski, L.; Bonde Nielsen, K.; Zangenberg, N.; Bech Nielsen, B.; Peaker, A.R.; Markevich, V.P.: Donor level of bond-center hydrogen in germanium. *Phys. Rev. B*; 69: 245207-1, 2004.

Drescher, W.; Weigert, K.P.; Bunger, M.H.; Ingerslev, J.; Bunger, C.; Hansen, E.S.: Femoral head blood flow reduction and hypercoagulability under 24 h megadose steroid treatment in pigs. *J Orthop Res.*; 22 (3):501-8, 2004.

Duch, M.; Carrasco, M.L.; Jespersen, T.; Hansen B.D.; Pedersen, F.S.: Transgene stability for three replication competent murine leukemia virus vectors. *Gene*; 329: 61-69, 2004.

Duch, M.; Jespersen, T.; Carrasco, M.L.; Aagaard, L.; Pedersen, F.S.: An RNA secondary structure bias for non-homologous reverse transcriptase mediated deletions in vivo. *Nucl. Acids Res.*; 32: 2039-2048, 2004.

Durand, M, K.V.; Bødker, J.S.; Christensen, A.; Dupont, D.M.; Hansen, M.; Jensen, J.K.; Kjelgaard, S.; Mathiasen, L.; Pedersen, K.E.; Skeldal, S.; Wind, T.; Andreasen, P.A.: Plasminogen activator inhibitor-1 and tumour growth, invasion, and metastasis. *Thromb. Haemostas.*; 91: 438-449, 2004.

Ehlers, F.J.; Christensen, N.E.: Phosphorus under pressure: Ba-IV-type structure as a candidate for P-IV. *Phys. Rev. B*; 69: 214112-1, 2004.

Enemærke, R.J.; Larsen, J.; Skrydstrup, T.; Daasbjerg, K.: Mechanistic Investigation of the Electrochemical Reduction of Cp_2TiCl_2. *Organometallics*; 23: 1866-1874, 2004.

Enemærke, R.J.; Larsen, J.; Skrydstrup, T.; Daasbjerg, K.: Revelation of the nature of the reducing species in titanocene halide promoted reductions. *J. Am. Chem. Soc.*; 126: 7853-7864, 2004.

Fantner, G.E.; Birkedal, H.; Kindt, J.H.; Hassenkam, T.; Weaver, J.C.; Cutroni, J.A.; Bosma, B.L.; Bawazer, L.; Finch, M.M.; Cidade, G.A.G.; Morse, D.E.; Stucky, G.D.; Hansma, P.K.: Influence of the degradation of the organic matrix on the microscopic fracture behavior of trabecular bone. *Bone*; 35: 1013-1022, 2004.

Filinchuk, Y.E.; Birkedal, H.; Cerny, R.; Hostettler, M.; Yanson, T.I.; Bodak, O.I.; Yvon, K.: Chemical heterogeneity of a crystal built of nanoscale coherently twinned $Yb_{2-x}(Fe,Ga)_{17+2x}$ polytypes. *Chem. Eur. J.*; 10: 2972-2976, 2004.

Frandsen, L.H.; Harpøth, A.; Borel, P.I.; Kristensen, M.; Jensen, J.S.; Sigmund, P.: Broadband photonic crystal waveguide 60 degree bend obtained utilizing topology optimization. *Optics Express*; 12 (24): 5916, 2004.

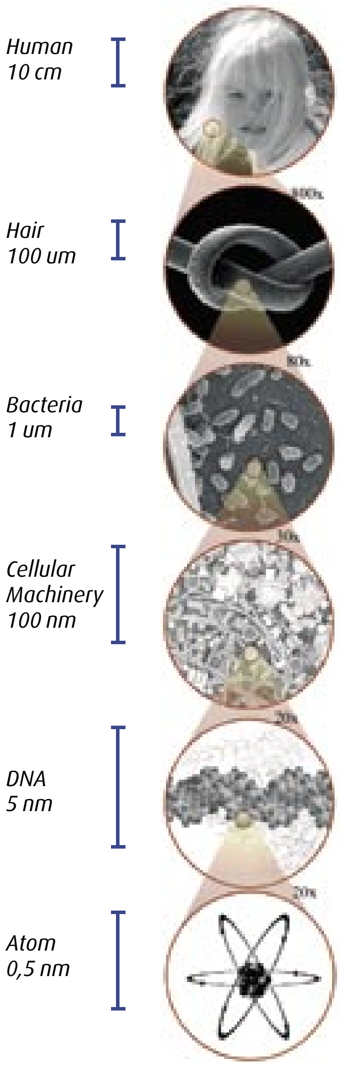
Fojan, P.; Petersen, S.B.; Jonson, V.; Wimmer, R.; Pedersen, S.: Sorbitol prevents the self-aggregation of unfolded lysozyme leading to an up to 13 C stabilisation of the folded form. *Journal of Biotechnology;* 2004

Fowlkes, J.L.; Serra, D.M.; Bunn, R.C.; Thrailkill, K.M.; Enghild, J.J.; Nagase, H.: Regulation of insulin-like growth factor (IGF)-I action by matrix metalloproteinase-3 involves selective disruption of IGF-I/IGF-binding protein-3 complexes. *Endocrinology*; 145(2): 620-626, 2004.

Giavani, T.; Bildsøe, H.; Skibsted, J.; Jakobsen, H.J.: A solid-state ^{14}N magic-angle spinning NMR study of some amino acids. *J. Magn. Reson.*; 166: 262-272, 2004.

Gliemann, J.; Hermey, G.; Nykjær, A.; Petersen, C.M.; Jacobsen, C.; Andreasen, P.A.: The mosaic receptor sorLA/LR11 binds components of the plasminogen activating system and PDGF-BB similarity to low density lipoprotein receptor-related protein (LRP1) but mediates slow internalization of bound ligand. *Biochem. J.*; 381: 203-212, 2004.

Publications



Godovsky, Y.K.; Brezesinski, G.; Ruiz-Garcia, J.; Möhwald, H.; Jensen, T..R.; Kjaer, K.; Makarova, N..N.: Stepwise collapse of cyclolinear polysiloxane Langmuir monolayers studied by brewster angle microscopy and grazing incidence X-ray diffraction. *Macromolecules*; 37(13): 4872-4881, 2004.

Grunwald, T.; Pedersen, F.S.; Wagner, R.; Überla, K.: Reducing lentiviral vector mobilization by primer complementation and self-inactivation. *J. Gene Med.*; 6: 147-154, 2004.

Hanford, L.E.; Enghild, J.J.; Valnickova, Z.; Petersen, S.V.; Schaefer, L.M.; Schaefer, T.M.; Reinhart, T.A.; Oury, T.D.: Purification and characterization of mouse soluble receptor for advanced glycation end products (sRAGE). *J. Biol. Chem.*; 279 (48): 50019-50024, 2004.

Hansen, M.R.; Vosegaard, T.; Jakobsen, H.J.; Skibsted, J.: ^{11}B Chemical Shift Anisotropies in Borates from ^{11}B MAS, MQMAS, and Single-Crystal NMR Spectroscopy. *J. Phys. Chem. A.*; 108: 586-594, 2004.

Helgaker, T.; Ruden, T.A.; Jørgensen, P.; Olsen, J.; Klopper, W.: A priori calculation of molecular properties to chemical accuracy. *J. Phys. Org. Chem.*; 17: 913-933, 2004.

Hohwy, T.; Bang, K.; Steiniche,T.; Peterslund, N.A.; d'Amore, F.; Alemtuzumab induced remission of both severe paraneoplastic pemphigus and leukemic bone marrow infiltration in a case of treatment-resistant B-cell chronic lymphocytic leukemia. *Eur J Haematol*. 73: 206-209, 2004.

Illemann, M.; Hansen, U.; Nielsen, H.F.; Andreasen, P.A.; Høyer-Hansen, G.: Leading edge myofibroblasts in human colon cancer express PAI-1. *Am. J. Clin. Pathol.*; 122: 256-265, 2004.

Ivarsen, A.; Thøgersen, J.; Keiding, S.R.; Hjortdal, J.O.; Møller-Pedersen, T.: Plastic particles at the LASIK interface. *Ophthalmology*; 1(111): 18-23, 2004.

Ivarsen, A.; Thøgersen, J.; Keiding, S.R.; Møller-Pedersen, T.: Plastic particles at the LASIK interface. *Ophthalmology*; 111: 18-23, 2004.

Jacobsen, M.F.; Ionita, L.; Skrydstrup, T.: Highly diastereoselective mannich-type reactions of chiral N-acylhydrazones. *J. Org. Chem.*; 69: 4792-4796, 2004.

Jakobsen, M.; Damgaard, C.K.; Andersen, E.S.; Podhajska, A.; Kjems, J.: A genomic SELEX strategy to identify accessible and dimerization sensitive target sites in HIV-1 RNA. http://nar.oupjournals.org/cgi/content/full/32/7/e67. *Nucl. Acids Res.*; 32: e67, 2004.

Jacobsen, S.; Sonne-Holm, S.; Søballe, K.; Gebuhr, P.; Lund, B.: The distribution and interrelationships of radiographic features of osteoarthrosis of the hip. A survey of 4151 subjects of the Copenhagen City Heart Study. The Osteoarthrosis Substudy. *Osteoarthritis and Cartilage*; 12 (9): 698-703; 2004.

Jacobsen, S.; Holm, S.S.; Lund, B.; Søballe, K.: The relationship of hip joint space to self reported hip pain; A survey of 4.151 subjects of the Copenhagen City Heart Study: the Osteoarthritis Substudy. *Osteoarthritis Cartilage*; 12 (9): 692-7; 2004.

Jacobsen, S.; Holm, S.S.; Søballe, K.; Lund, B.: Factors influencing hip joint space in asymptomatic subjects; A survey of 4151 subjects of the Copenhagen City Heart Study: The Osteoarthritis Substudy. *Osteoarthritis Cartilage*; 12 (9): 704-10; 2004.

Jantunen, E.; d'Amore, F.: Stem cell transplantation (SCT) for peripheral T-cell lymphomas (PTCL). *Leukemia and Lymphoma*; 45: 441-446, 2004.

Jensen, J.K.; Durand, M.K.V.; Skeldal, S.; Dupont, D.M.; Bødker, J.S.; Wind, T.; Andreasen, P.A.: Construction of a plasminogen activator inhibitor-1 variant without measurable affinity to vitronection buth otherwise normal. *FEBS Lett*; 556: 175-179, 2004.

Jensen, H.; Joensen, K.D.; Jorgensen, J.E.; Pedersen, J.S.; Sogaard, E.G.: Characterization of nanosized partly crystalline photocatalysts. *J. Nanopart. Res.*; 6: 519-526, 2004.

Jensen, H.; Joensen, K.D.; Jørgensen; J.E., Pedersen, J.E.; Søgaard, J.S.; Gydesen, J.: Characterization of nanosized partly crystalline photocatalysts. *Journal of Nanoparticle Research*; 6: 519-526, 200

Jensen, T.B.; Rahbek, O.; Overgaard, S.; Søballe, K.: Platelet rich plasma and fresh frozen bone allograft as enhancement of implant fixation. *Journal of Orthopaedic Research*; 22: 653-658, 2004.

Jensen, T.H.: *Budbringere og biokemi. Del af artiklen: Tre nye forskningscentre på Aarhus Universitet*. Pressemeddelelse 3. november 2004. AU's pressetjeneste til danske nyhedsmedier, 2004.

Jensen, T.H.; Boulay, J.; Olsen, J.R.; Colin, J.; Weyler, M.; Libri, D.: Modulation of transcription affects mRNP quality. *Mol. Cell*; 22: 235-244, 2004.

Jensen, T.R.: Hydrogen-samfundet - en renere fremtid. *Aktuel Naturvidenskab*; 1: 11-14, 2004.

Jensen, T.R.: Poul la Cour og vindmøllerne. *Aktuel Naturvidenskab*; 2: 37, 2004.

Johannesen, S.A.; Albu, S.; Hazell, R.G.; Skrydstrup, T.: Radical addition of nitrones to acrylates mediated by SmI2: asymmetric synthesis of Ð-amino acids employing carbohydrate-based chiral auxilliaries. *Chem. Commun.*: 1962-1963, 2004.

Justesen, P.H.; Kristensen, T.; Ebdrup, T.; Otzen, D.E.: Investigating phospholipase action on vesicles and supported planar bilayers using a quartz crystal microbalance. *J. Coll. Int. Sci.*; 279: 399–409, 2004.

Jørgensen, J.-E.; Marshall, W.G.; Smith, R.I.; Staun Olsen, J.; Gerward, L.: High-pressure neutron powder diffraction study of the *Im*-3 phase of ReO_3. *J. Appl. Crystallogr.*; 37: 857-861, 2004.

Kanjilal, A.; Hansen, J.L.; Gaiduk, P.; Nylandsted Larsen, A.; Normand, P.; Dimitrakis, P.; Tsoukalas, D.; Cherkashin, N.; Claverie, A.: Size and aerial density distributions of Ge nanocrystals in a Si_2O layer produced by molecular beam epitaxy and rapid thermal processing. *Appl. Phys. A*, 2004.

Karring, H.; Thøgersen, I.B.; Klintworth, G.K.; Enghild, J.J.; Møller-Pedersen, T.: Proteomic analysis of the soluble fraction from human corneal fibroblasts with reference to ocular transparency. *Mol. Cell. Proteomics*; 3(7): 660-674, 2004.

Kashiwagi, M.; Enghild, J.J.; Gendron, C.; Hughes, C.; Caterson, B.; Itoh, Y.; Nagase, H.: Altered proteolytic activities of ADAMTS-4 expressed by C-terminal processing. *J. Biol. Chem.*; 279(11): 10109-10119, 2004.

Kehlet, C.T.; Sivertsen, A.C.; Bjerring, M.; Reiss, T.O.; Khaneja, N.; Glaser, S.J.; Nielsen, N.C.: Improving solid-state NMR dipolar recoupling by optimal control. *J. Am. Chem. Soc.*; 126: 10202-10203, 2004.

Keiding, S.R.; Madsen, D.; Larsen, J.; Jensen, S.K.; Thøgersen, J.: When molecules meet: a femtosecond study of the protonation of a base. *Chem. Phys. Lett.*; 390: 94-97, 2004.

Knudsen, B.; Andersen, E.S.; Damgaard, C.; Kjems, J.; Gorodkin, J.: Evolutionary rate variation and RNA secondary structure prediction. *Comput. Biol. Chem.*; 28: 219-226, 2004.

Kristensen, T.; Thorup, K.; Gylling, A.; Scheving, M.; Thøgersen, I.B.; Valnickova, Z.; Petersen, S.V.; Enghild, J.J.: Structural determinants for proteolysis in the heparin-binding domain of EC-SOD. In: *1st International Conference on EC-SOD*. 1st International Conference on EC-SOD, September, 2004.

Kristensen, T.B.; Pedersen, K.: Second-harmonic generation pulse splitting in quartz observed by frequency-domain interferometry. *Optics Communications*; 233: 219-223 2004.

Kühnle, A.; Molina, L.M.; Linderoth, T.R.; Hammer, B.; Besenbacher, F.: Growth of unidirectional molecular rows of cysteine on Au(110)-(1x2) driven by adsorbate-induced surface rearrangements. *Phys. Rev. Lett.*; 93 (8): 086101, 2004.

Larsen, J.; Rasmussen, B.S.; Hazell, R.G.; Skrydstrup, T.: Preparation of a novel diphosphine-palladium macrocyclic complex possessing a molecular recognition site. Oxidative addition studies. *Chem. Commun.*: 202-203, 2004.

Lauritsen, J.V.; Bollinger, M.V.; Lægsgaard, E.; Jacobsen, K.W.; Nørskov, J.K.; Clausen, B.S.; Topsøe, H.; Besenbacher, F.: Atomic-scale insight into structure and morphology changes of MoS_2 nanoclusters in hydrotreating catalysts. *Journal of Catalysis*; 221: 510-522, 2004.

Lauritsen, J.V.; Nyberg, M.; Nørskov, J.K.; Clausen, B.S.; Topsøe, H.; Lægsgaard, E.; Besenbacher, F.: Hydrodesulfurization reaction pathways on MoS_2 nanoclusters revealed by scanning tunneling microscopy. *Journal of Catalysis*; 224: 94-106, 2004.

Li, W.X.; Österlund, L.; Vestergaard, E.K.; Vang, R.T.; Matthiesen, J.; Pedersen, T.M.; Lægsgaard, E.; Hammer, B.; Besenbacher, F.: Oxidation of Pt(110). *Phys. Rev. Lett.*; 93 (14): 146104, 2004.

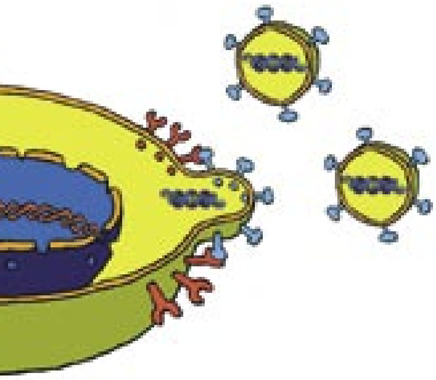
Li, H.; Zou, X.; Xue, Q.; Egund, N.; Lind, M.; Bünger, C.: Anterior lumbar interbody fusion with carbon fiber cage loaded with bioceramics and platelet-rich plasma. An experimental study on pigs. *Eur Spine J.* ; 34: 354-8, 2004.

Li, H.; Zou, X.; Xue, Q.; Egund, N.; Lind, M.; Bünger, C.: Effects of autogenous bone graft impaction and tricalcium phosphate on anterior interbody fusion in the porcine lumbar spine. *Acta Orthop.* June: 2004.

Lipschutz, B.H.; Frieman, B.; Birkedal, H.: Scavenging and reclaiming phosphines associated with group 10 metal-mediated couplings. *Org. Lett.*; 6: 2305-2308, 2004.

Longwitz, S.R.; Schnadt, J.; Kruse Vestergaard, E.; Vang, R.T.; Lægsgaard, E.; Stensgaard, I.; Brune, H.; Besenbacher, F.: High-coverage structures

Publications



of carbon monoxide adsorbed on Pt(111) studied by high-pressure scanning tunneling microscopy. *Journal of Physical Chemistry B*; 108: 14497-14502, 2004.

Lynge, T.B.; Pedersen, T.G.: Density-functional-based tight-binding approach to phonon spectra of conjugated polymers, *Phys. Stat. Sol*. (b) 241: 1005, 2004.

Lynge, T.B.; Pedersen, T.G.: Density-functional-based tight-binding approach to polarons in conjugated polymers. *Comp. Mat. Sci*.; 30: 212 (2004).

Løkke, M.; Christensen, N.E.; Risshede, J.; Bjarklev, A.: Group-theoretical description of the triangular air-silica photonic crystal - out-of-plane propagation. *Optics Express*; 12: 6299, 2004.

McKenna, B.J.; Birkedal, H.; Bartl, M.H.; Denning, J.; Stucky, G.D.: Micrometer-sized spherical assemblies of polypeptides and small molecules by acid-base chemistry. *Angew. Chem. Int. Edit.*; 43: 5652-5655, 2004.

Mechlenburg, I.; Nyengaard, J.; Rømer, L.; Søballe, K.: Changes in loadbearing area after Ganz periacetabular osteotomy evaluated by multislice CT scanning and stereology. *Acta Orthop Scand*; 75 (2):147-53, 2004.

Mikkelsen, J.G.; Rasmussen, S.V.; Pedersen, F.S.: Complementarity-directed RNA dimer-linkage promotes retroviral recombination in vivo. *Nucl. Acids Res.*; 32: 102-114, 2004.

Mogensen, J.E.; Sehgal, P.; Otzen, D.E.: Activation, inhibition and destabilization of Thermomyces lanuginosus lipase by detergents. *Biochemistry;* 44: 1719-1730, 2004.

Mogensen, J.E.; Ibsen, H.;,Lund, J.; Otzen, D.E.: Elimination of an off-pathway folding intermediate by a single point mutation. *Biochemistry*; 43: 3357-3367, 2004.

Molina, L.M.; Hammer, B.: Theoretical study of CO oxidation on Au nanoparticles supported by MgO(100). *Phys. Rev. B*; 69: 155424, 2004.

Molina, L.M.; Rasmussen, M.D.; Hammer, B.: Adsorption of O_2 and oxidation of CO at Au nanoparticles supported by TiO_2(110). *J. Chem. Phys.*; 120 (16): 7673, 2004.

Morgen, P.; Skivesen, N.; Jensen, J.M.; Robenhagen, U.; Andersen, J.; Hansen, J.K.; Li, Z.; Pedersen, K.: Oxidation properties of Al-nanostructures on Si surfaces. *Physica Scripta*; T114: 164-166, 2004.

Nicolaisen, M.H.; Risgaard-Petersen, N.; Revsbech, N.P.; Reichardt.W.; Ramsing, N.B.: Nitrification-denitrification dynamics and community structure of ammonia oxidizing bacteria in a high yield irrigated Philippine rice field. *FEMS Microbiology Ecology*; 49: 359-369, 2004.

Nielsen, N.C.; Malmendal, A.; Vosegaard, T.: Techniques and applications of NMR to membrane proteins. *Mol. Membr. Biol.*; 21: 129-141, 2004.

Nielsen, O.I.; Gribsholt, B.; Kristensen, E.; Revsbech, N.P.: Microscale distribution of oxygen and nitrate in sediment inhabited by *Nereis diversicolor*: spatial patterns and estimated reaction rates. *Aquat. Microb. Ecol*; 34: 23-32, 2004.

Nielsen, U.G.; Topsøe, N.-Y.; Brorson, M.; Skibsted, J.; Jakobsen, H.J.: The complete ^{51}V MAS NMR spectrum of surface vanadia nanoparticles on anatase (TiO_2): Vanadia surface structure of a $DeNO_x$ catalyst. *J. Am. Chem. Soc.*; 126 (15): 4926-4933, 2004.

Nikolajsen, T.; Leosson, K.; Bozhevolnyi, S.I.: Surface plasmon polariton based modulators and switches operating at telecom wavelengths. *Appl. Phys. Lett.*; 85 (24): 5833-5835, 2004.

Nikolajsen, T.; Leosson, K.; Bozhevolnyi, S.I.: Dynamic photonic components utilizing long-range surface plasmon polaritons. *DOPS-NYT*; 2: 6-9, 2004.

Nilsson, J.; Sengupta, J.; Frank, J.; Nissen, P.: Regulation of eukaryotic translation by the RACK1 protein: a platform for signalling molecules on the ribosome. *EMBO Rep*; 5: 1137-1141, 2004.

Nissen, P.; Nyborg, J.: *Encyclopedia of Biological Chemistry. EF-G and EF-Tu structures and translation elongation in bacteria*. 2. Elsevier Inc, Oxford: 1-5 pages, 2004.

Nissen, P.; Nyborg, J.: Ternary complex of elongation factor Tu. In: *Special Series: Classical Structures*. http://www.ergito.com, 2004.

Nygaard, M.; Zerahn, B.; Bruce, C.; Søballe, K.; Borgwardt A.: Early periprosthetic femoral bone remodeling using three different bearing surface combinations in total hip arthroplasties. A prospective randomized study. *European Cells and Materials*; 8:65-73; 2004.

Olesen, C.; Sørensen, T.L.; Nielsen, R.C.; Møller, J.V.; Nissen, P.: Dephosphorylation of the calcium pump coupled to counterion occlusion. *Science*; 306: 2251-2255, 2004.

Olesen, C.; Sørensen, T.L.; Nielsen, R.C.; Møller, J.V.; Nissen, P.: *Protein data bank deposition. Accession number 1XP5*, 2004.

Olesen, C.; Sørensen, T.L.; Nielsen, R.C.; Møller, J.V.; Nissen, P.: *Århus-forskere fortsat førende i verden i viden om ion-pumper*. Pressemeddelelse 23. december 2004. AU's pressetjeneste til danske nyhedsmedier, 2004.

Olesen, J.R.; Jensen, T.H.: Århus-forskere offentliggør ny viden om cellens basale processer. *Pressemeddelse* 22. oktober 2004. AU pressetjeneste til danske nyhedsmedier, 2004.

Olsen, D.A.; Petersen, S.V.; Oury, T.D.; Valnickova, Z.; Thøgersen, I.B.; Kristensen, T.; Bowler, R.P.; Crapo, J.D.; Enghild, J.J.: The intracellular proteolytic processing of extracellular superoxide dismutase (EC-SOD) is a two-step event. *J. Biol. Chem.*; 279: 22151-22157, 2004.

Otero, R.; Hümmelink, F.; Sato, F.; Legoas, S.B.; Thostrup, P.; Lægsgaard, E.; Stensgaard, I.; Galvao, D.S.; Besenbacher, F.: Lock-and-key effect in the surface diffusion of large organic molecules probed by STM. *Nature Materials*; 3: 779, 2004.

Otero, R.; Naitoh, Y.; Rosei, F.; Jiang, P.; Thostrup, P.; Gourdon, A.; Lægsgaard, E.; Stensgaard, I.; Besenbacher, F.: One-dimensional assembly and selective orientation of Lander molecules on an O-Cu template. *Angewandte Chemie, International Edition*; 43 (16): 2092-2095, 2004.

Otero, R.; Rosei, F.; Naitoh, Y.; Jiang, P.; Thostrup, P.; Gourdon, A.; Lægsgaard, E.; Stensgaard, I.; Joachim, C.; Besenbacher, F.: Nanostructuring Cu surfaces using custom-designed molecular molds. *Nano Letters*; 4 (1): 75-78, 2004.

Otzen, D.E.; Oliveberg, M.: Transient formation of nanocrystalline structures during fibrillation of an Alzheimer-like peptide. *Prot. Sci.*; 13: 1417-21, 2004.

Otzen, D.E.; Oliveberg, M.: Correspondence between anomalous *m*- and ΔC_p-values in protein folding, *Prot. Sci.*; 13: 3253-3263, 2004.

Otzen D.E.; Burlacu, S.; Akke, M.; Oliveberg, M.: Transient aggregation and stable dimerization induced by introducing an Alzheimer sequence into a water-soluble protein. Biochemistry; 43: 12964-78, 2004.

Palmqvist, A.E.C.; Iversen, B.B.; Zanghellini, E.; Behm, M.; Stucky, G.D.: A crystalline microporous narrow-bandgap semiconductor. *Angew. Chem. Int. Edit.*; 43: 699-704, 2004.

Pan, Y.; Birkedal, H.; Pattison, P.; Brown, D.; Chapuis, G.: Molecular dynamics study of tryptophylglycine: A dipeptide nanotube with confined water. *J. Phys. Chem. B.*; 108: 6458-6466, 2004.

Pedersen, A.B.; Johnsen, S.P.; Overgaard, S.; Søballe, K.; Sørensen, H.A.T.; Lucht, U.: Registration in the Danish Hip Arthroplasty Registry. Completeness of total hip arthroplasties and predictive value of registered diagnosis and postoperative complications. *Acta Orthopaedica Scandinavic*; 75 (4):434-441; 2004.

Pedersen, A.S.(ed.).; Jensen, J.O.; Jensen, T.R.; Vegge, T.: Brintlagring. In: *Brintforskning i Danmark - udfordringer og perspektiver. Hvidbog om forskningsstrategi for brintbaseret energiforsyning i Danmark*. Nørskov, J.K.; Feidenhans'l, R. (Eds.): Chap. 3, 2004.

Pedersen, E.; Simonsen, E.B.; Alkjær, T.; Søballe, K.: Walking pattern in adults with congenital hip dysplasia. *Acta Orthop Scand*; 75 (1): 2-9; 2004.

Pedersen, J.S.; Christiansen, G.; Otzen, D.E.: Modulation of S6 fibrillation by unfolding rates and gatekeeper residues. *J. Mol. Biol.*; 341: 575–588, 2004.

Pedersen, J.S.: A flux- and background-optimized version of the NanoSTAR small-angle X-ray scattering camera for solution scattering. *J. Appl. Crystallogr.*; 37: 369-380, 2004.

Pedersen, J.S.; Schurtenberger, P.: Scattering functions of semidilute solutions of polymers in a good solvent. *J. Polym. Sci. Pol. Phys.*; 42: 3081-3094, 2004.

Pedersen,K.: Second-harmonic generation spectroscopy on thin metal films on Si(111). *Physica Scripta*; T109: 96-105, 2004.

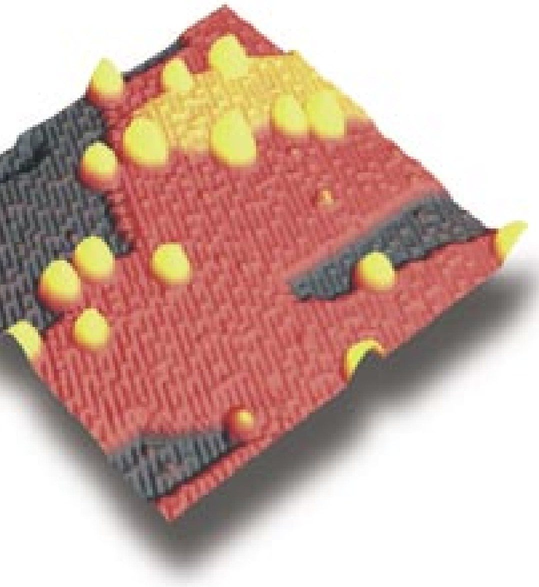
Pedersen, K.; Bozhevolnyi, S.I.; Pedersen, T.G.: Nano-Optik. *Kvant*;.2: 8-12, 2004.

Pedersen, K.; Kristensen, P.K.; Rafaelsen, J.; Skivesen, N.; Pedersen, T.G.; Morgen, P.; Li, Z.; Hoffmann, S.V.: Second-harmonic generation and photoemission from Al quantum wells on Si(111)7×7, *EPIOPTICS 7- Proceedings of the 24th Course of the International School of Solid State Physics, Erice 2002*: 86-94, 2004.

Pedersen, T.G.: Density-functional-based tight-binding calculation of excitons in conjugated polymers. Phys. Rev. B; 69: 075207, 2004.

Pedersen, T.G.: Exciton effects in carbon nanotubes. *Carbon*; 42: 1007, 2004.

Publications



Peltzer y Biancá, E.L.; Desimoni, J.; Christensen, N.E.: Electronic structure of FCC-Fe_nX (X=C, N; *n*=4, 8) alloys. *Physica B*; 354: 341, 2004.

Petersen, S.V.; Due, A.V.; Valnickova, Z.; Oury, T.D.; Crapo, J.D.; Enghild, J.J.: The structure of rabbit extracellular superoxide dismutase differs from the human protein. *Biochemistry*; 43 (44): 14275-14281, 2004.

Petersen, S.V.; Oury, T.D.; Østergaard, L.; Valnickova, Z.; Wegrzyn, J.; Thøgersen, I.B.; Jacobsen, C.; Bowler, R.P.; Fattman, C.L.; Crapo, J.D.; Enghild, J.J.: Extracellular superoxide dismutase (EC-SOD) binds to type i collagen and protects against oxidative fragmentation. *J. Biol. Chem.*; 279 (14): 13705-13710, 2004.

Poulsen, R.D.; Bentien, A.; Graber, T.; Iversen, B.B.: Synchrotron charge-density studies in materials chemistry: 16 K X-ray charge density of a new magnetic metal-organic framework material, $(Mn_2(C_8H_4O_4)_2(C_3H_7NO)_2$. *Acta Crystallogr. A.*; 60: 382-389, 2004.

Rasmussen, M.D.; Molina, L.M.; Hammer, B.: Adsorption, diffusion, and dissociation of molecular oxygen at defected TiO_2(110): A density functional theory study. *J. Chem. Phys.*; 120 (2): 988, 2004.

Rasmussen, S.V.; Pedersen, F.S: Complementarity between RNA dimerization elements favors formation of functional heterozygous murine leukemia viruses. *Virology*; 329: 440-453, 2004.

Risgaard-Petersen, N.; Meyer, R.L.; Schmid, M.; Jetten, M.S.M.; Enrich-Prast, A.; Rysgaard, S.; Revsbech, N.P.: Anaerobic ammonium oxidation in an estuarine sediment. *Aquat. Microb. Ecol*; 36: 293-304, 2004.

Risgaard-Petersen, N.; Nicolaisen, M.H.; Revsbech, N.P.; Lomstein, B.Aa.: Competition between ammonia-oxidizing bacteria and benthic microalgae. *Appl. Environm. Microbiol*; 70(9): 5528-5537, 2004.

Rousseau, C.; Nielsen, N.; Bols, M.: An artificial enzyme that catalyses hydrolysis of aryl glycosides. *Tetrahedron Lett.*; 45: 8709-8711, 2004.

Ruden, T.A.; Helgaker, T.; Jørgensen, P.; Olsen, J.: Coupled-cluster connected quadruples and quintuples corrections to the harmonic vibrational frequencies and equilibrium bond distances of HF, N_2, F_2, and CO. *J. Chem. Phys.*; 121 (12): 5874-5884, 2004.

Schiøtt, B.: On the possible involvement of collective domain movement in the catalytic reaction of soluble epoxide hydrolase. *Int. J. Qantum. Chem.*; 99: 61 - 69, 2004.

Schiøtt, B.: The influence of solvation on the asp-his interaction in subtilisins. Insights from a density functional theory study. *Chem. Commun.*; 498-499, 2004.

Schiøtt, B.; Overgaard, J.; Larsen, F.K.; Iversen, B.B.: Testing theory beyond molecular structure: Electron density distributions of complex molecules. *Int. J. Quantum. Chem.*; 96: 23 - 31, 2004.

Sehgal P.; Doe, H.; Sharma, M.; Otzen, D.E.: Interaction between phospholipid vesicles and long chain zwitterionic surfactant. *Colloid Polymer Sci.*; 282: 677-683, 2004.

Sengupta, J.; Nilsson, J.; Gursky, R.; Spahn, C.M.T.; Nissen, P.; Frank, J.: Identification of the versatile scaffold protein RACK1 on the eukaryotic ribosome by cryo-electron microscopy. *Nat. Struct. Biol.*; 11: 957-962, 2004.

Sengupta, J.; Nilsson, J.; Gursky, R.; Spahn, C.M.T.; Nissen, P.; Frank, J.: *Protein data bank deposition. Accession number 1TRJ*, 2004.

Silvestri, H.H.; Bracht, H.A.; Sharp, I.D,; Hansen, J.; Nylandsted Larsen, A.; Haller.E.E.: Simultaneous phosphorus and Si self-diffusion in extrinsic, isotopically controlled silicon heterostructures. *Mat. Res. Soc. Symp. Proc.*; 810: C3.3.1, 2004.

Siminovitch, D.; Untidt, T.S.; Nielsen, N.C.: Exact effective Hamiltonian theory. II: Expansion of matrix functions and entangled unitary exponential operators. *J. Chem. Phys.*; 120: 51-66, 2004.

Slattery, S.A.; Nikogosyan, D.N.; Plougmann, N.; Sørensen, H.R.; Kristensen, M.: Efficient Bragg grating fabrication in Ge-rich fibre by high-intensity femtosecond 264 nm irradiation. *Electronics Letters*; 40 (23), 2004.

Snabe, T.; Petersen, M.T.N.; Petersen, S.B.: Enzymatic lipid removal from surfaces - lipid desorption by a pH-induced electrostatic explosion. *Chemistry and Physics of Lipids;* 2004.

Snyder, G.J.; Christensen, M.; Nishibori, E.; Caillat, T.; Iversen, B.B.: Disordered zinc Zn_4Sb_3 with phonon-glass and electron-crystal thermoelectric properties. *Nature Materials*; 3: 458-463, 2004.

Snyder, J.W.; Zebger, I.; Gao, Z.; Poulsen, L.; Frederiksen, P.K.; Skovsen, E.; McIlroy, S.P.; Klinger, M.; Andersen, L.K.; Ogilby, P.R.: Singlet oxygen microscope: From phase-separated polymers to single biological cells. *Acc. Chem. Res.*; 37: 894-901, 2004.

Sommer, C.; Pedersen, J.S.: Temperature dependence of the structure and interaction of star-like PEG-based block copolymer micelles. *Macromolecules*; 37(5): 1682-1685, 2004.

Sommer, C.; Pedersen, J.S.; Stein, P.C.: Apparent specific volume measurements of poly(ethylene oxide), poly(butylene oxide), poly(propylene oxide), and octadecyl chains in the micellar state as a function of temperature. *J. Phys. Chem. B.*; 108 (20): 6242-6249, 2004.

Stensgaard, I.: Ion scattering. In: *Encyclopedia of Analytical Science, 2nd Edition*. Worsfold, P.; Townshend, A.; Poole, C. (Eds.). Elsevier, 2004.

Stensgaard, I.: Metal clusters on oxides. In: *Encyclopedia of nanoscience and nanotechnology*. Schwarz, J.A.; Contescu, C.I.; Putyera, K. (Eds.). Marcel Dekker, New York: pp. 1813-1820, 2004.

Stieger, M.; Pedersen, J.S.; Lindner, P.; Richtering, W.: Are thermoresponsive microgels model systems for concentrated colloidal suspensions? A rheology and small-angle neutron scattering study. *Langmuir*; 20 (17): 7283-7292, 2004.

Stieger, M.; Richtering, W.; Pedersen, J.S.; Lindner, P.: Small-angle neutron scattering study of structural changes in temperature sensitive microgel colloids. *J. Chem. Phys.*; 120 (13): 6197-6206, 2004.

Svaneborg, C.; Pedersen, J.S.: Monte Carlo simulations and analysis of scattering from neutral and polyelectrolyte polymer and polymer-like systems. *Curr. Opin. Colloid In.*; 8(6): 507-514, 2004.

Svith, H.; Jensen, H.; Almstedt, J.; Andersson, P.; Lundbäck, T.; Daasbjerg, K.; Jonsson, M.: On the nature of solvent effects on redox properties. *J. Phys. Chem. A.*; 108: 4805-4811, 2004.

Szalay, P.G.; Thøgersen, L.S.; Olsen, J.; Kállay, M.; Gauss, J.: Equilibrium geometry of the ethynyl (CCH) radical. *J. Phys. Chem. A.*; 108: 3030-3034, 2004.

Søgaard, E.G.: The concepts of learning based on the AAU teaching model in chemical engineering education; In The Aalborg PBL model, eds. A.Kolmos, F.K.Fink and L.Krogh . *Aalborg University Press*: 233-247, 2004.

Søndergaard T.; Bozhevolnyi, S.I.: Surface plasmon polariton scattering by a small particle placed near a metal surface: An analytical study. *Phys. Rev. B*; 69: 045422, 2004.

Sørensen, H.R.; Canning, J.; Kristensen, M.: Laser hypersensitisation using 266 nm light. *Laser Phys. Lett.*; 1-4, 2004.

Sørensen, K.D.; Quintanilla-Martinez, L.; Kunder, S.; Schmidt, J.; Pedersen, F.S.: Mutation of all Runx (AML1/core) sites in the enhancer of T-lymphomagenic SL3-3 MLV unmasks a significant potential for myeloid leukemia induction and favors enhancer evolution towards induction of other disease patterns. *J. Virol.*; 78: 13216-13231, 2004.

Sørensen, T.L.; Clausen, J.D.; Jensen, A.L.; Vilsen, B.; Møller, J.V.; Andersen, J.P.; Nissen, P.: Localization of a K+-binding site involved in dephosphorylation of the sarcoplasmic reticulum Ca2+-ATPase. *J. Biol. Chem.*; 279: 46355-46358, 2004.

Sørensen, T.L.; Møller, J.V.; Nissen, P.: *Banebrydende molekylær studier af calciumpumpen*. Pressemeddelse 11. juni 2004. AU's pressetjeneste til danske nyhedsmedier, 2004.

Sørensen, T.L.; Møller, J.V.; Nissen, P.: Phosphoryl transfer and calcium ion occlusion in the calcium pump. *Science*; 304(5677): 1672-1675, 2004.

Sørensen, T.L.; Møller, J.V.; Nissen, P.: *Protein data bank depositions. Accession numbers IT5S, IT5T*, 2004.

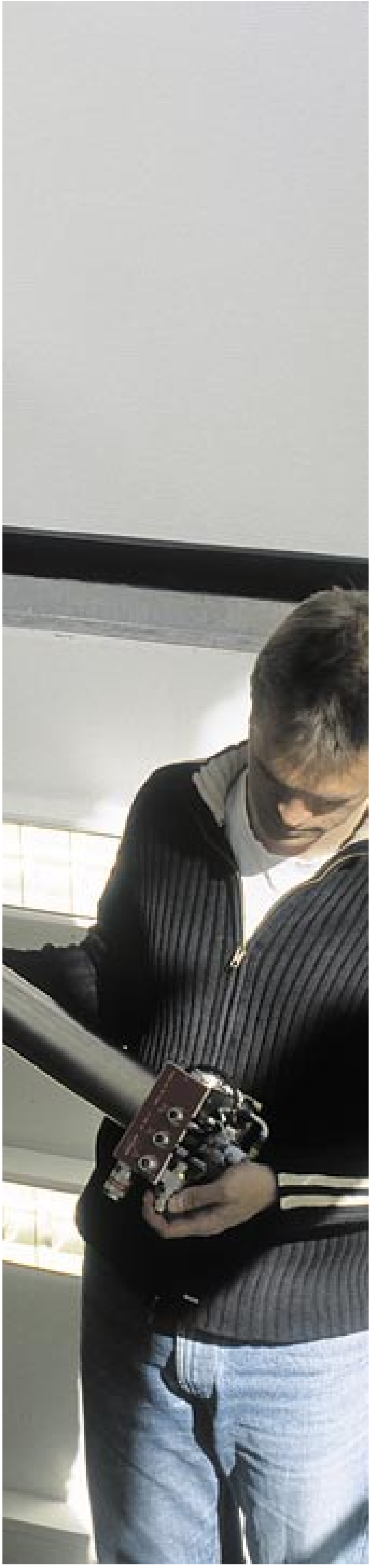
Thøgersen, J.; Jensen, S.K.; Christiansen, O.; Keiding, S.R.: Fast photodynamics of aqueous formic acid. *J. Phys. Chem. A.*; 37 (108): 7483-7489, 2004.

Thøgersen, L.; Olsen, J.: A coupled cluster and full configuration interaction study of CN and CN-. *Chem. Phys. Lett.*; 393: 36-43, 2004.

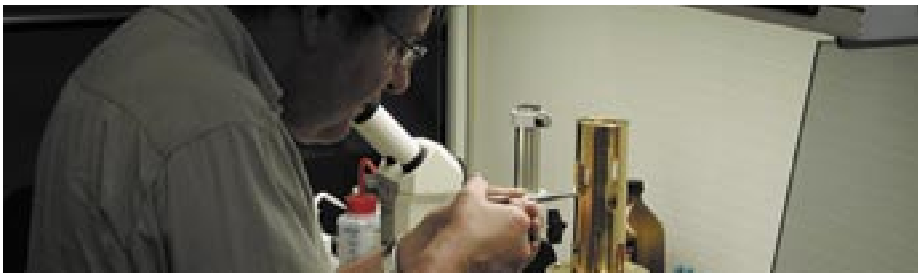
Thøgersen, L.; Olsen, J.; Yeager, D.; Jørgensen, P.; Salek, P.; Helgaker, T.: The trust-region self-consistent field method: Towards a black box optimization in Hartree-Fock and Kohn-Sham theories. *J. Chem. Phys.*; 121: 16-27, 2004.

Tolstrup, M.; Østergaard, L.; Laursen, A.L.; Pedersen, F.S.; Duch, M.: HIV/SIV escape from immune surveillance: Focus on *nef*. *Curr. HIV Res.*; 2: 141-151, 2004.

Ulrich-Vinther, M.; Duch, M.R.; Søballe K.; O'Keefe, R.J.O.; Schwarz, E.M.; Pedersen, F.S.: In vivo gene delivery to articular chondrocytes medicated by an adeno-associated virus vector. *Journal of Orthopaedic Research*; 22 (4): 726-734; 2004.



Publications



Vanmeerbeek, P.; Clauws, P.; Vrielinck, H.; Pajot, B.; van Hoorebeke, L.; Nylandsted Larsen, A.: High-resolution local vibrational mode spectroscopy and electron paramagnetic resonance study of the oxygen-vacancy complex in irradiated germanium. *Phys. Rev. B*; 70: 035203, 2004.

Vestermark, M.T.; Bechtold, J.E.; Swider, P.; Søballe, K.: Mechanical interface conditions affect morphology and cellular activity of sclerotic bone rims forming around experimental loaded implants. *Journal of Orthopaedic Research*;. 22: 647-652; 2004.

Villesen, P.; Aagaard, L.; Wiuf, C.; Pedersen, F.S: Identification of endogenous retroviral reading frames in the human genome. *Retrovirology*; 1: 32, 2004.

Volkov, V.S.; Bozhevolnyi, S.I.; Taillaert, D.: Near-field imaging of light diffraction out of slab waveguides. *Laser Phys. Lett*.; 1: 311-316, 2004.

Volkov V.S.; Bozhevolnyi, S.I.; Bordo, V. G.; Rubahn, H.-G.: Near-field imaging of organic nanofibers. *J. Microscopy*; 215: 241-244, 2004.

Vorum, H.; Østergaard, M.; Hensechke, P.; Enghild, J.J.; Riazati, M.; Rice, G.E.: Proteomic analysis of hyperoxia-induced responses in the human choriocarcinoma cell line JEG-3. *Proteomics*; 4 (3): 861-867, 2004.

Vosegaard, T.; Nielsen, N.C.: Improved pulse sequences for pure exchange solid-state NMR spectroscopy. *Magn. Reson. Chem.*; 42 (2): 285-290, 2004.

Wahlström, E.; Vestergaard, E.K.; Schaub, R.; Rønnau, A.; Vestergaard, M.; Lægsgaard, E.; Stensgaard, I.; Besenbacher, F.: Electron transfer-induced dynamics of oxygen molecules on the TiO_2 (110) surface. *Science*; 303: 511-513, 2004.

Wang, C.L.; Hodgson, G.; Malek, T.; Pedersen, F.S.; Wabl, M.: A murine leukemia virus with Cre-LoxP excisible coding sequences allowing superinfection, transgene delivery, and generation of host genomic deletions. *Retrovirology*; 1: 5, 2004.

Wang, J.; Pyrz, R.: Micromechanics of layered silicate-reinforced nanocomposites, Part 1 – Basic theory and formulas. *Comp. Sci. Techn.*; 64: 925-934, 2004.

Wang, J.; Pyrz, R.: Micromechanics of layered silicate-reinforced nanocomposites, Part 2 – Analyses. *Comp. Sci. Techn.*; 64: 935-944, 2004.

Zhaler, A.M.; Damgaard, C.K.; Kjems, J.; Caputi, M.: SC35 and hnRNPs A/B binding to a juxtaposed ESE/ESS element regulates HIV-1 tat exon 2 splicing. *J. Biol. Chem.*; 279: 10077-10084, 2004.

Zangenberg, N.R.; Chevallier, J.; Hansen, J.L.; Nylandsted Larsen, A: The influence of oxide/nitride surface layers on diffusion in Si and SiGe. *Appl. Phys. A*; DOI:10.1007: 00339-004-2958-6, 2004.

Xue, Q.; Li, H.; Zou, X.; Bunger, M.; Egund, N.; Lind, M.; Christensen, F.B.; Bunger, C.: Healing properties of allograft from alendronate-treated animal in lumbar spine interbody cage fusion. *Eur Spine J.*; July, 2004.

Zebger, I.; Snyder, J.W.; Andersen, L.K.; Poulsen, L.; Gao, Z.; Lambert, J.D.C.; Kristiansen, U.; Ogilby, P.R.: Direct optical detection of singlet oxygen from a single cell. *Photochem. Photobiol.*; 79: 319-322, 2004.

Zou, X.; Li, H.; Bunger, M.; Egund, N.; Lind, M.; Bunger, C.: Bone ingrowth characteristics of porous tantalum and carbon fiber interbody devices: an experimental study in pigs. *Spine J.*; 4 (1): 99-105, 2004.

Zou, X.; Li, H.; Chen, L.; Baatrup, A.; Bunger, C.; Lind, M.: Stimulation of porcine bone marrow stromal cells by hyaluronan, dexamethasone and rhBMP-2. *Biomaterials*; 25 (23): 5375-85, 2004.

Zou, X.; Li, H.; Egund, N.; Lind, M.; Bunger, C.: Inhibition of spinal fusion by use of a tissue ingrowth inhibitor. *Eur Spine J.*; 2:157-63, 2004.

Awards and patents

Awards

Flemming Besenbacher, appointed EU project ambassador for the Aarhus Municipality EU Office in Brussels, Belgium

Flemming Besenbacher, Danmarks Naturvidenskabelige Akademis Industripris 2004 (Industrial prize of the Danish Academy of Natural Sciences 2004)

Niels Chr. Nielsen, Bjerrum Chemistry Prize 2004

Niels Chr. Nielsen, Bjerrum-Brøndsted-Lang lecture

Torben H. Jensen, EMBO Young Investigator Award 2003-2006

Cody Bünger, Knighted by the Danish Queen

Cody Bünger, German Rheumaorthopaedic Association "Arthur Vick-Preis for Rheumaorthopaedics"

Patents

Mogen R. Duch, Jeannette Justesen, Finn Skou Pedersen, Morten Foss, Flemming Besenbacher, Brian Elmengaard, Kjeld Søballe: Differential cell attachment (DCA)-metoden - en metode til at kvantificere biokompatible materialers affinitet for relevante celletyper under forhold, der simulerer in-vivo situationer

J.H. Hyldtoft, B.S. Clausen, F. Besenbacher, R.T. Vang, J.K. Nørskov, C.G.L. Olsen, E.K. Vestergaard: Fuel cell and anode, patent number 04012278.0

Gothelf, Kurt Vesterager; Brown Raymonds; Macromolecular architectures, EC: C07C271/20; C12N15/10; (+4), IPC: B01J19/00

Gothelf, Kurt Vesterager: Bis-heterocyclic derivatives. EC: C07D261/04; C07D261/08, IPC: C07D261/08; A61K31/42

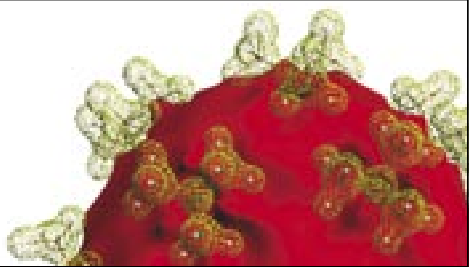
Cody Bünger: Application for US patent submitted: A process to enhance bone ingrowth into porous tantalum trabecular metal scaffold. Inventors: Zou Xuenong, Li Haisheng, and Cody Bünger

Application in progress for EU patent: Methods for preparation of stem cells and hyaluronic acid in the form of an injectable gel during the period of operation to enhance spinal fusion. Inventors: Zou Xuenong, Li Haisheng, Zou Lijin, and Cody Bünger

Application in progress for international patent: Stem cell research platform-- porcine telomerase catalytic subunit (pTERT)-transfected bone marrow stromal cells (BMSCs-TERT). Inventors: Zou Lijin, Zou Xuenong, Li Haisheng, Tina Mygind, and Cody Bünger

Poul Nissen: "Method of rational drug design based on binding ability with elongation factor Tu". Application no. PA 2004 01923. Inventors: Poul Nissen and Andrea Parmeggiani, Aarhus University

Invited talks



Francesco d´Amore, "Current therapeutic approaches in non-Hodgkin lymphoma", European Hematology Association, Geneva, Switzerland

Francesco d´Amore, "Targeted treatment of non-Hodgkin's lymphomas", European Association of Nuclear Medicine, Helsinki, Finland

Peter Andreasen,"PAI-1 and uPA as therapeutic targets", Gordon Research Conference on Plasminogen Activation and Extracellular Proteolysis, Ventura, USA

Peter Balling, "Micro and nano-machining with ultrashort laser pulses", FemtoMat 2004, Bad Kleinkirchheim, Austria

Peter Balling, "Micro and nano-machining with ultrashort laser pulses: From basic science to the real world", International workshop on laser cleaning IV, Sydney, Australia

Flemming Besenbacher, "Det interdisciplinære Nanoscience Center ved Aarhus Universitet", Steno Museet, Aarhus, Denmark

Flemming Besenbacher, "Atomic-scale design of new catalysts with added functionality", Nanotechnology and functional surfaces, Malmö, Sweden

Flemming Besenbacher, "Lock-and-Key Effect in the Surface Diffusion of Complex Molecules Probed by STM", VW Symposium - Single Molecules, Kloster Banz, Germany

Flemming Besenbacher, "Nanostructures at surfaces explored by high-resolution, fast-scanning STM", First International Symposium on Standard Materials and Metrology for Nanotechnology (SMAM-1), Tokyo, Japan

Flemming Besenbacher, "Dynamic studies of atomic-scale processes on oxide surfaces", 1st. workshop for joint program Japan-US research collaboration for synchrotron radiation nanomaterials science, Tokyo, Japan

Flemming Besenbacher, "Nanoscience – nanoteknologi", the Society of Science and Letters, University of Aarhus, Denmark

Flemming Besenbacher, "Nanoscience og nanoteknologi", Danisco, Denmark

Flemming Besenbacher, "Nanoteknologi: Eller småt har aldrig været større", Alexandra Instituttet, University of Aarhus, Denmark

Flemming Besenbacher, "Atomic-scale Studies of Hydrodesulfurization Model Catalysts by Scanning Tunneling Microscopy", Molecular Aspects of Catalysis by Sulfides (MACS III), Ascona, Switzerland

Flemming Besenbacher, "Fra nanoscience til nanoteknologi", 50th Anniversary of the Faculty of Science, University of Aarhus, Denmark

Flemming Besenbacher, "Dynamic STM studies of model systems relevant to catalysis", Catalysis from First Principles, Høsterkøb, Denmark

Flemming Besenbacher, "Diffusion of adatoms and vacancies on metal and oxide surfaces revealed by high-resolution, fast-scanning STM", 16th International Vacuum Congress, 12th International Conference on Solid Surfaces, and 8th International Conference on Nanometer-Scale Science and Technology, Venice, Italy

Flemming Besenbacher, "Nanostructures at surfaces explored by high-resolution, fast-scanning STM", Nano 2004 - 7th International Conference on Nanostructured Materials, Wiesbaden, Germany

Flemming Besenbacher, "Atomic insight into reactions on $TiO_2(110)$", 13th International Congress on Catalysis, Paris, France

Flemming Besenbacher, "Catalysis and surface reactivity at the atomic scale", Microscopy and Microanalysis in Catalysis, the Microscopy Society of America (MSA), Savannah, Georgia, USA

Flemming Besenbacher, "Atomistic insight into surface reactions on $TiO_2(110)$", Workshop honouring Gerhardt Ertl:"Surface Science Quo Vadis?", Ringberg Castle, Germany

Flemming Besenbacher, "Dynamics of surface processes in relation to nanocatalysis", NCSS-5, Tampere, Finland

Flemming Besenbacher, "Emnemæssige prioriteringer i handlingsplanen og væsentligste teknologiske forventninger på de prioriterede områder", Danish Ministry of Science, Technology and Innovation, Denmark

Flemming Besenbacher, "Dynamics of Adatoms and Vacancies on Oxide Surfaces revealed by high-resolution", fast-scanning STM SFB616 Workshop „Energiedissipation an Oberflächen", Germany

Flemming Besenbacher, "Dynamics of nanostructures on surfaces revealed by high-resolution, fast-scanning STM", Seeing at the Nanoscale European Conference II, Grenoble, France

Flemming Besenbacher, "High-resolution, high-pressure STM studies of model catalysts", CECAM workshop: In situ atomic scale characterization of surfaces under high pressures: Recent advances in experiment and theory, Lyon, France

Henrik Birkedal, "Hard Biomaterials - An Overview of How Nature Makes Nanomaterials", iNANOschool Nanoscience PhD Graduate School 2004, Fuglsø, Denmark

Henrik Birkedal, "Hard Biological Materials - Insights from synchrotron X-ray diffraction, scattering and absorption spectroscopy", NorFa Research Training Course on Application of X-ray Synchrotron Radiation in Chemistry, Physics, Biology and Medicine, Sandbjerg, Denmark

Sergey I. Bozhevolnyi, "Integrated photonic circuits based on surface plasmon polaritons", From Photonic Crystals to Metamaterials – Artificial Materials in Optics, 323. WE-Heraeus-Seminar, Bad Honnef, Germany

Sergey I. Bozhevolnyi, "Linear and nonlinear multiple scattering of surface plasmon polaritons at nanostructured surfaces", E-MRS Spring Meeting, Strasbourg, France

Sergey I. Bozhevolnyi, "Near-field characterization of photonic crystal waveguide components", 13th International Laser Physics Workshop, Trieste, Italy

Sergey I. Bozhevolnyi, "SNOM characterization of PBG components", PIPE symposium on PBG based integrated optics, Aarhus, Denmark

Cody Bünger, "Nanoscience and biocompatibility", University of Tampare, Finland

Cody Bünger, "The application of cages in spine fusion", GICD, Cortina D'Ampezzo, Italy

Cody Bünger, "New Strategies in management of Spinal Stenosis in Scandianavia", Annual Congress of the Japanese Orthopedic Association, Kobe, Japan

Cody Bünger, "Evidence of Lumbar Spine Fusion", Annual Congress of the Japanese Orthopedic Association, Kobe, Japan

Cody Bünger, "Lumbar Spine Fusion", Chinese Orthopedic Society, Guangzou, China

Cody Bünger, "Tissue Engineering in Lumbar Spine Fusion", Chinese Orthopedic Society, Guangzou, China

Cody Bünger, "A new Strategy in the Treatment of Spinal Metastasis", Juhai Medical University, China

Cody Bünger, "Lumbar spine fusion versus total disc arthroplasthy", The Cuban Orthopedic Society and SICOT, Havana, Cuba

Cody Bünger, "Prediction of survival in patients with metastasis of the spine", The Cuban Orthopedic Society and SICOT, Havana, Cuba

Cody Bünger, "Nanoscience og nye ortopædiske implantater" Lægedag 2004, Aarhus, Denmark

Jørgen Bøttiger, "Real-time in-situ diagnostics of PVD growth using synchrotron radiation", 9th International Conference on Plasma Surface Engineering, Garmisch-Partenkirchen, Germany

Niels E. Christensen, "Alkali Metals under Pressure: New Phases, New Properties", Fourth International Conference on Chemistry and Molecular Spectroscopy, Punta de Tralca, Chile

Niels E. Christensen, "Superconducting Li and Insulating Na", Frontiers in Electronic Structure Theory, Høsterkøb, Denmark

Kim Daasbjerg, "Electrochemical Studies of Free Radicals, Organometallic Compounds and Surface Modified Carbon Materials", Electrochemical Society Meeting", Padova, Italy

Jan J. Enghild, "Extracellular superoxide dismutase binds to type I collagen and protects against oxidative fragmentation", The 3rd International Conference on Superoxide Dismutases. Recent Advances and Clinical Applications, Paris, France

Jan J. Enghild, "Proteome analysis of normal human corneas", Annual Meeting of the Association for Research in Vision and Ophthalmology (ARVO), Fort Lauderdale, Florida, USA

Jan J. Enghild, "Extracellular superoxide dismutase (EC-SOD) binds to type i collagen and protects against oxidative fragmentation", 1st international Conference on superoxide dismutase, Sandbjerg, Denmark

Jan J. Enghild, "The dual nature of human extracellular superoxide dismutase: one sequence and two structures", 1st international Conference on superoxide dismutase, Sandbjerg, Denmark

Kurt Gothelf, "Modular DNA-Programmed Assembly of Nanostructures", Duke University, Durham, USA

Kurt Gothelf, "DNA-Programmed Assembly of Organic Nanostructures", University of Copenhagen, Denmark

Kurt Gothelf, "DNA-Directed Assembly of Molecular Nanostructures", Technical University of Denmark, Denmark

Kurt Gothelf, "DNA-Programmed Assembly of Organic Nanostructures", The Royal Veterinary and Agricultural University, Denmark

Kurt Gothelf, "At bygge med LEGO på nanoskala", Kemilærerdag, Aarhus, Denmark

Kurt Gothelf, "Molekylær arkitektur", Folkeuniversitetet Aarhus, Denmark

Bjørk Hammer, "On the role of defects and special sites for the reactivity of Au clusters and surfaces - a DFT perspective", Surface Science Research Centre, Liverpool, UK

Bjørk Hammer, "Reactivity of low coordinated metal sites", Hjortviken, Sweden

Bjørk Hammer, "Reactivity under high oxygen pressures", Chalmers University of Technology, Gothenburg, Sweden

Bjørk Hammer, "Special sites at oxide supported metal clusters -- and at metal supported oxide clusters", Catalysis from First Principles, Høsterkøb, Denmark

Bjørk Hammer, "Catalysis on oxide supported, nano-sized gold clusters", Catalysis from First Principles, Høsterkøb, Denmark

Bjørk Hammer, "Special sites at oxide supported metal clusters -- and at metal supported oxide clusters", University of Jyvaaskylaa, Finland

Bjørk Hammer, "Pt surfaces under high CO and O2 pressures", Lyon, France

Philip Hofman, "Electron-phonon coupling and spin-orbit splitting in quasi twodimensional metals: the surfaces of Bi", Forschungszentrum Jülich, Germany

Philip Hofman, "Electron-phonon coupling and spin-orbit splitting in quasi twodimensional metals: the surfaces of Bi", Frühjarstagung des AK Festkörperphysik der DPG, Regensburg, Germany

Philip Hofman, "Electron-phonon coupling and spin-orbit splitting in quasi twodimensional metals: the surfaces of Bi", Universität des Saarlandes, Saarbrücken, Germany

Philip Hofman, "Some unresolved problems in electron spectroscopy from graphite", Donostia International Physics Center, Donostia-San Sebastian, Spain

Philip Hofman, "Electron-phonon coupling and spin-orbit splitting in quasi twodimensional metals: the surfaces of Bi", Technische Universität Chemnitz, Germany

Bo Brummerstedt Iversen, "Structure based development of new thermoelectric materials", Gordon Conference on Electron Distributions and Chemical Bonding, Massachussets, USA

Bo Brummerstedt Iversen, "Structure based development of new thermoelectric materials", University of Milano, Italy

Bo Brummerstedt Iversen, "Structure based development of new thermoelectric materials", University of Rennes, France

Bo Brummerstedt Iversen, "Structure based development of new thermoelectric materials", Bente Lebech Symposium, Risø, Denmark

Bo Brummerstedt Iversen, "Structure based development of new thermoelectric materials",

Invited talks

Conference on intermetallic and Zintl Phases, Stockholm, Sweden

Bo Brummerstedt Iversen, "Syntese og karakterisering af nye nanomaterialer", Grundfos, Bjerringbro

Bo Brummerstedt Iversen, "Application of synchrotron radiation in charge density research", NorFa Research Training Course on Application of X-ray Synchrotron Radiation in Chemistry, Physics, Biology and Medicine, Sandbjerg, Denmark

Bo Brummerstedt Iversen, "Termoelektriske materialer", UNF Aalborg, Denmark

Bo Brummerstedt Iversen, "Synthesis of nanomaterials", iNANOschool Nanoscience PhD Graduate School 2004, Fuglsø, Denmark

Hans Jørgen Jakobsen, "Solid-State N-14 MAS NMR Spectroscopy – Applications to Chemistry and Materials Sciences", Symposium on Solid-State NMR in Materials, Diepenbeek, Belgium

Hans Jørgen Jakobsen, "N-14 MAS NMR of Solids – Experimental Strategies and Applications", 45th Experimental NMR Conference, Pacific Grove, California, USA

Torben Heick Jensen, "Coupling between transcription and RNA processing", Baeza, Spain

Torben R. Jensen, "Nye materialer til hydrogen opbevaring og heterogen katalyse", Temadag i Dansk Keramisk Selskab, Studenternes Hus, Aarhus, Denmark

Torben R. Jensen, "New Nano-porous Materials with Different Structural Dimensionality; Synthesis and Crystal Structure", The 18th Nordic Structural Chemistry Meeting (NSM-18), Helsinki, Finland

Torben R. Jensen, "Towards a Hydrogen based Society, New Materials for Hydrogen Storage", Institutt for Energiteknikk, Oslo, Norway

Jørgen Kjems, "HIV-1 TAR RNA dimerizes in the presence of NC and facilitates the first-strand transfer" RNA society meeting, Madison, Wisconsin, USA

Jørgen Kjems, "Finding the weak spot in an mRNA", EURIT conference on RNAi, Berlin, Germany

Jørgen Kjems, "Structure and function of the HIV-1 leader", NORFA society meeting, Bergen, Norway

Jørgen Kjems, "Life Science and nanoapplications", FRONTIERS meeting on Life science and nano applications, Enschede, The Netherlands

Arne Nylandsted Larsen, "Silicon based photonics – novel prospects", NKT-Summer School, Fuglsø, Denmark

Trolle Linderoth, "Diffusion of adatoms and vacancies on metal and oxide surfaces revealed by high-resolution fast-scanning STM", Beijing TEDA 2004 – Scanning Probe Microscopy, Sensors and Nanostructures, China

Erik Lægsgaard, "STM - Instrumental Problems and Solutions", 5th. Nordic-Baltic Scanning Probe Microscopy Workshop, Trondheim, Norway

Brian Bech Nielsen, "Hydrogen defects in Si1-xGex and GaN observed after low temperature proton implantation", Gordon Conference on Point defects, Line Defects, and Interfaces, New London, New Hampshire, USA

Brian Bech Nielsen, "Hydrogen related defects in group-IV semiconductors", Hahn-Meitner-Institut, Berlin, Germany

Niels Christian Nielsen, "Applications of SIMPSON and SIMMOL for Experiment Design and Data Analysis in Solid-State NMR Spectroscopy", Gordon Conference on Computional Aspects of Biomolecular NMR, Ventura, California, USA

Niels Christian Nielsen, "Bjerrum-Brøndsted-Lang Lecture 2004", Carlsberg Research Center, Copenhagen, Denmark

Niels Christian Nielsen, "Niels Bjerrum Chemistry Prize Lecture: Solid-State NMR Towards Membrane Proteins", The Royal Danish Academy of Sciences and Letters, Copenhagen, Denmark

Niels Christian Nielsen, "Do you use all Spins and the Flexibility of your Rf? Automated Design of Improved Solid-State NMR Experiments using Optimal Control", 45th Experimental NMR Conference, Pacific Grove, California, USA

Niels Christian Nielsen, "Membrane Proteins and New Methods for Experimental Design", ACS Meeting, Indianapolis, Indiana, USA

Niels Christian Nielsen, "Towards Structural Analysis of Membrane Proteins Using Solid-State NMR Spectroscopy", Danish Pharmaceutical University, Copenhagen, Denmark

Poul Nissen, "Crystallography of membrane proteins", Biophysics of Membrane proteins, Aalborg, Denmark

Poul Nissen, "The Calcium Pump, Reloaded. Structure and function of the Ca^{2+}-ATPase", EMBO YIP program, annual meeting, Germany

Poul Nissen, "Structure and function of the Calcium Pump", Max IV workshop, Our Future Light Source, Lund, Sweden

Peter R. Ogilby, "The Singlet Oxygen Microscope: From Phase-Separated Polymers to a Single Biological Cell", Joint German, Swiss, Austrian, and Hungarian Chemical Society Meeting, Badgastein, Austria

Peter R. Ogilby, "The Singlet Oxygen Microscope", VIII Latin American Encounter on Photochemistry and Photobiology, La Plata, Argentina

Peter R. Ogilby, "The Singlet Oxygen Microscope", Annual Meeting of the Danish Chemical Society, Odense, Denmark

Peter R. Ogilby, "The Singlet Oxygen Microscope", International Symposium on Photonics and Biphotonics, Stockholm, Sweden

Peter R. Ogilby, "The Singlet Oxygen Microscope", University of California-Berkeley, USA

Peter R. Ogilby, "The Singlet Oxygen Microscope", University of California-Los Angeles, USA

Jeppe Olsen, "Converging Density Parameter Equations: A Study of Extremely Ill-conditioned Equations", Workshop on mathematical challenges of quantum chemistry, The University of Warwick, Coventry, England

Jeppe Olsen, "Coupled Cluster Calculations with Quadruple and Higher Excitations. What Accuracy May We Obtain?", Henreich-Heine Universitate, Dusseldorf, Germany

Daniel Otzen, "Folding of membrane proteins", University of Toulouse, France

Daniel Otzen, "Stability of membrane proteins", University Miguel Hernández, Elche, Spain

Daniel Otzen, "Mechanisms of protein fibrillation", University of Copenhagen, Denmark

Daniel Otzen, "Structural polymorphism in fibrillation", University of Aarhus, Denmark

Daniel Otzen, "Mechanisms of protein folding", University of Copenhagen, Denmark

Finn Skou Pedersen, "Replication-competent and conditionally replication-competent retroviral vectors", Cancer, the New Frontier Current Research and Future Treatment Strategies Inaugural Symposium of the new Christian Doppler Laboratory for Gene Therapeutic Vector Development, University of Veterinary Medicine, Vienna, Austria

Finn Skou Pedersen, "Insertional mutagenesis and cancer induction by simple retroviruses", University of Copenhagen, Denmark

Finn Skou Pedersen, "Targeting and Efficiency of Gene Delivery by Replication-competent Retroviral Vectors", Mini-symposium on Gene Targeting, Copenhagen, Denmark

Finn Skou Pedersen, "Mutation of all Runx (AML1/core) sites in the enhancer of T-lymphomagenic SL3-3 murine leukemia virus unmasks a significant potential for myeloid leukemia induction and favors enhancer evolution toward induction of other disease patterns", 16th International Workshop on Retroviral Pathogenesis, Montreal, Canada

Jan Skov Pedersen, "Instrumentation for small-angle scattering", 7th European Summer School on Scattering Methods Applied to Soft Condensed Matter Bombannes, France

Jan Skov Pedersen, "Model Fitting and Simulation Techniques", 7th European Summer School on Scattering Methods Applied to Soft Condensed Matter, Bombannes, France

Jan Skov Pedersen, "Form and structure factors, interactions, modeling", EMBO Practical Course on Solution Scattering from Biological Macromolecules, European Molecular Biology Laboratory, Hamburg, Germany

Jan Skov Pedersen, "Recent Advances in the Analysis of SAXS and SANS Data from Block Copolymer Micellar Solutions", The Sixth International Conference on X-Ray Investigations of Polymer Structure (XIPS'2004), Ustroñ, Poland

Jan Skov Pedersen, "The pinhole SAXS facility for solution scattering at the University of Aarhus", Workshop on Small Angle Scattering from Soft Matter, Lund, Sweden

Thomas Garm Pedersen, "Linear and Nonlinear Optical Properties of Excitons in Carbon Nanotubes", E-MRS Spring Meeting, Strasbourg, France

Birgit Schiøtt, "DFT-calculations of short strong hydrogen bonds. Implications for Serine Proteases", Annual Meeting of the Danish Chemical Society, Odense, Denmark

Birgit Schiøtt, "Protein-Ligand Complexes Studied by Molecular Dynamics Simulations", H. Lundbeck A/S, Valby, Denmark

Jørgen Skibsted, "Incorporation of aluminum in the C-S-H phase characterized by solid-state NMR spectroscopy", Hal Taylor Conference on Cement and Concrete Science, Les Diablerts, Switzerland

Troels Skrydstrup, "Recent Applications of Samarium Diiodide in Organic Synthesis", Cheminova, Lemvig, Denmark

Troels Skrydstrup, "Application of Samarium Diiodide in the Realm of Carbohydrates and Peptides", Carbohydrate Symposium in the Memory of Professor Christian Pedersen, Carlsberg Laboratories, Denmark

Troels Skrydstrup, "Recent Applications of Samarium Diiodide for C-C Bond Formations Via Radical Intermediates", International Symposium on Organic Free Radicals, Porto Vechia, France

Troels Skrydstrup, "Application of Reagent Controlled Radical Chemistry in Organic Synthesis" Université de Rouen, Rouen, France

Troels Skrydstrup, "Recent Applications of Samarium Diiodide in Organic Synthesis", Acadia Pharmaceuticals, Copenhagen, Denmark

Troels Skrydstrup, "Application of Reagent Controlled Radical Chemistry in Organic Synthesis" University of Oslo, Norway

Troels Skrydstrup, "Application of Reagent Controlled Radical Chemistry in Organic Synthesis" Université d'Orléans, France

Troels Skrydstrup, "Application of Reagent Controlled Radical Chemistry in Organic Synthesis" École Polytechnique, Palaiseau, France

Kjeld Søballe, "State-of-the-Art Total Hip and Knee Replacement: Controversies and Solutions", 18th Annual Vail Orthopaedic Symposium, Colorado, USA

Kjeld Søballe, "ZMR Modulary Uncemented Stem During Revision", Uncemented Total Hip Arthrosplasty – an Update, Göteborg, Sweden

Kjeld Søballe, "Scientific development of Ca PO_4 coatings", Long term results of HA coated prostheses: A strategic meeting, London, England

Kjeld Søballe, "Sealing of interfaces, can it protect against wear products?" Ullevål Universitetssykehus, Norway

Kjeld Søballe, "Hoftekirurgi – nye aspekter", Gigtforeningens Repræsentantskabsmøde, Aarhus, Denmark

Colloquia

iNANO colloquia 2004

January 19, iNANO annual meeting

Joachim P. Spatz, Biophysical Chemistry, University of Heidelberg: Micro- and Nanolithographic Tools for Designing Biophysical Models of Cell Adhesion and Mechanics

Horst Weller,Institut für Physikalische Chemie, University of Hamburg: Synthesis,properties and self-assembly of nanoparticles

Orlando Auciello, Materials Science Division, Bldg. 212 Argonne National Laboratory: Nanomaterials

Mayor Marcel, Institute of Nanotecnology, Karlsruhe Molecular Electronics

Peter O'Hare, Marie Curie Research Institute, The Chart Oxted, Surrey: Bionanoscience: Delivery and regulated release from Vectosomes, novel protein-based particles

T. Martin Schmeing, Yale University: Structural Studies of the Peptidyl Transferase Reaction

iNANO colloquia

January 26, Tomoji Kawai, Osaka University, Japan, DNA Nanotechnology

January 30, Suzanne Jarvis, Trinity College, Ireland, Investigating molecular function with a nano-mechanical probe

February 6, Søren Nielsen og Jørgen Frøkier, University of Aarhus, Denmark, 1-Aquaporin water channels: from molecular structure to clinical medicine

February 20, Bjørn Hauback, Institute for Energy Technology, Norway, Storage of hydrogen in metal hydrides – focus on alanates

March 3, Angela Fargo, University of Aarhus, Denmark, Physiology at the (na)NO level: the biology of nitric oxide and the discovery of new functions in heme proteins

March 12, Franz Giessibl, Universität Augsburg, Germany, Mapping out the atom – advances in scanning probe miscoscopy

March 12, Patrick Frederix, University of Basel, Switzerland, Observation of biomolecules at work in the AFM

March 19, Hans Christian Thøgersen, University of Aarhus, Denmark, From structure/ function analysis of the human C-type lectin like protein Tetranect into the creation of a platform for the development of second-generation antibody analogue therapeutic proteins

April 16, Niels Peter Revsbech, University of Aarhus, Denmark, Biosensors based on immobilized bacteria

April 23, Wayne Goodman, Texas A&M University, USA, Heterogeneous catalysis: From imagining to imaging a working surface

April 26, Lone Frank, Weekendavisen, Denmark, Mod en ny natur

April 30, Daniel Müller, BIOTEC, Max-Planck-Institute of Molecular Cell Biology, Germany and Masakazu Aono, NIMS, Osaka University, Imaging, unfolding and refolding of single membrane proteins, electrical conductivities of organic and inorganic nanomaterials

May 14, Michael Grätzel, Faculte des Sciences de Dases, Lausanne Switzerland, The fascinating world of nanocrystals: From high power lithium batteries to sensors,fast displays and efficient solar cells

June 1, Stanley J. Opella, Center of NMR Spectroscopy and Imaging of Proteins, University of California San Diego, USA, NMR structural studies of proteins in biological supramolecular assemblies

June 2, Thom Labean, Duke University, Durham, USA, Self-assembling DNA structures for nanofabrication and computation

June 11, George M. Whitesides, Harvard University, USA, Bio/surface chemistry. Molecular-level design of surfaces for biocompatibility and bio-specific interactions

June 18, Michael Grunze, Universität Heidelberg, Germany, Chemical Nanolithography approaches to bio-functional surfaces

June 25, Hannes Jonsson, University of Washington, USA, Towards a hydrogen based economy in Iceland: From nanoscale research to implementation studies

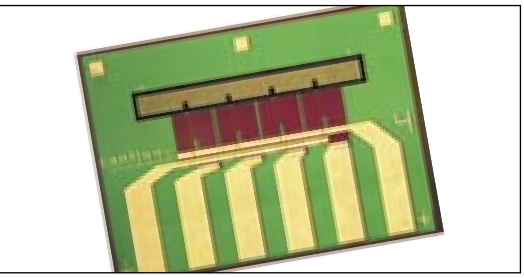
August 6, Michael Reichling, Universität Osnabrück, Germany, Non-contact AFM measurements on CeO_2(111)

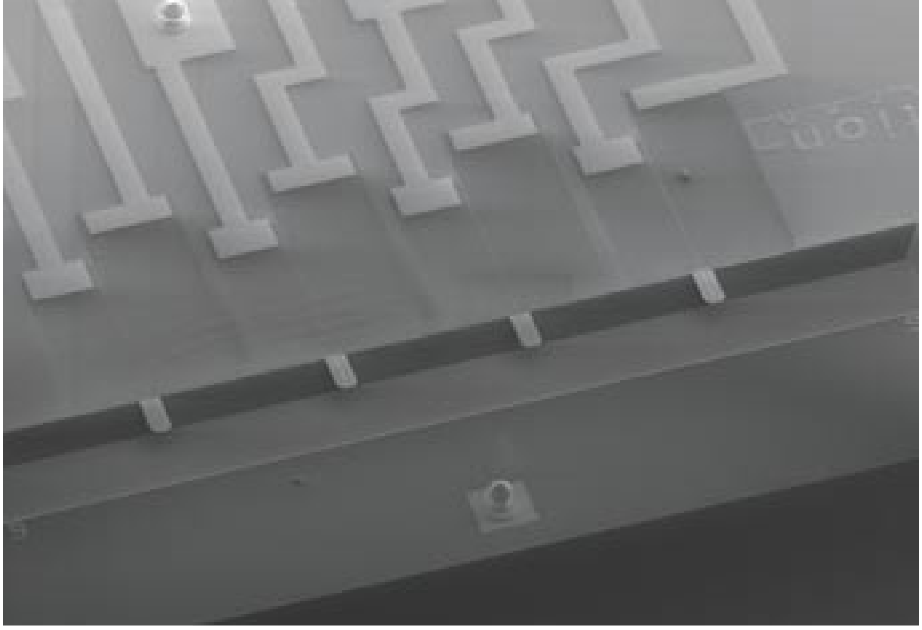
September 17, John T. Yates, Jr., Surface Science Center, Department of Chemistry, University of Pittsburgh, USA, Adsorption on carbon single walled nanotubes – filling the world's smallest tests tubes

October 1, Moeim Mogihimi, University of Brighton, UK, Nanomedicine: rational approaches in nanodesign and site-specific targeting

October 15, Thomas Steitz, Yale University, USA, The molecular machines of life

November 5, Dimitrios Stamou, University of Copenhagen, Denmark, Microarrays of single nanocontainers and nanoreactors





November 12, Galen Stucky, University of Santa Barbara, USA, Learning from nature: Molecular assembly in small places

November 19, Jesper Wengel, University of Southern Denmark, Denmark, LNA (Locked Nucleic Acid) and functionalized LNA: Towards efficient gene silencing and novel nucleic acid architectures

November 26, Itamar Willner, Hebrew University, Jerusalem, Israel, Biomolecule/ nanoparticle hybrid systems for sensory, nanocircuitry and nanodevice applications

December 3, Robert Doubleday, Cambridge University, UK, Nanoscience and society: rethinking research in a changing context

December 10, John Jansen, Neijmegen University Medical Center, the Netherlands, Engineered bone

iNANO specialized colloquia

January 5, Ralf Richter, Laboratoire d'Imagere Moleculaire et Nano-Bio-Technologie Bordeaux, France, Pathways of lipid vesicle deposition on solid surfaces: a study combining QCM-D and AFM

January 9, Benjamin Davis, University of Oxford, UK, Sugars and enzymes: Exploring and exploiting the interactions of carbohydrates with proteins

January 12, Henkjan Gersen, University of Twente, the Netherlands, Pulse propagation studied en route in photonic crystals: a real space investigation

January 23, T. Martin Schmeing, Yale University, USA, Structural studies of the peptidyl transferase reaction

February 4, Ken Howard, University College of London, UK, Polymeric gene delivery systems and novel modifications to increase blood circulation, stability and cell targeting

February 18, Dinko Chakarov, University of Chalmers, Sweden, Photo-stimulated processes at surfaces

February 26, Steven de Feyter, Katholieke Universiteit Leuven, Belgium, A twist of chirality and anisotropic self-assembly: let nature do the job

February 26, Henrik Grönbeck, Competence Centre for Catalysis and Department of Applied Physics, Chalmers University of Technology, Sweden, Transition metal systems supported by alkaline-earth metal-oxide surfaces

March 3, Maria Peter, University of Twente, the Netherlands, Catalytic probe lithography performed on Recative SAMs

March 26, Charlotte Poulsen, Danisco, Denmark, Biotechnology in the development of new food ingredients

April 1, Kristian O. Sylvester-Hvid, University of Copenhagen, Denmark, 2D modeling of thin-film polymer-based photovoltaic devices

April 15, Lars Kildemark, Cantion A/S, Denmark, Cantilever chips for detection of molecules

April 16, Grant Blouse, Henry Ford Health System, USA, Protein engineering and fluorescence technologies provide new insight into the mechanism of serpin inhibition

April 21, Takayuki Suzuki, Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin, Germany, Atomically resolved structure of InAs quantum dots grown on GaAs substrates

April 23, Hans-Joachim Freund, Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin, Germany, Oxidation catalysts: Model studies

April 26, Bjørn Stokke, Dept. of Physics, NTNU, Norway, Compacting DNA to nanosized particles using chitosan

May 12, Edouard Bertrand, CNRS – Montpellier, France, RNA localization in the cytoplasma: insights form single molecule imaging

May 25, Leonard C. Feldman, Vanderbilt University, USA, Interdisciplinary nano-science at Vanderbilt University

May 27, Poul Nissen, University of Aarhus, Denmark, Phosphoryl transfer and calcium ion occlusion in the calcium pump

June 1, Francesca M. Marassi, The Burnham Institute, La Jolla, USA, NMR structural studies of proteins in lipid bilayer

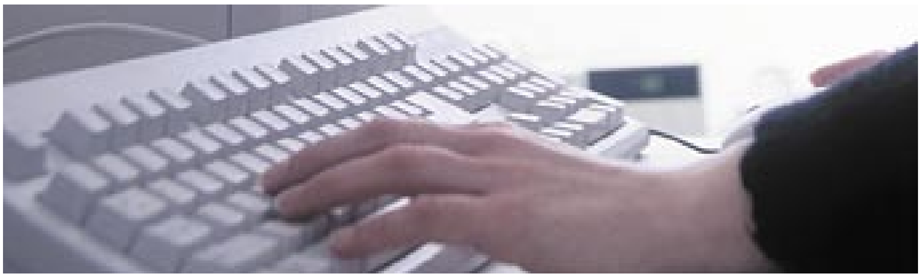
June 30, Stefan Wendt, Texas A&M University, USA, Two examples for modelling catalysts utilizing ultrathin films: RuO_2(110) as an efficient oxidation catalyst, and SiO_2 as a typical support material

September 1, Marcel J. Rost, Leiden University, the Netherlands, SPM goes video rate and beyond

September 16, John T. Yates, Jr., Surface Science Center, Department of Chemistry, University of Pittsburgh, USA, Photochemistry on titanium dioxide surfaces

September 17, John T. Yates, Jr., Surface Science Center, Department of Chemistry, University of Pittsburgh, USA, Dynamical and electronic behavior of chemisorbed organic molecules – connection to molecular electronics

Colloquia



September 20, Federico Rosei, INRS-EMT, Université du Quebec, Canada, Critical issues in the growth of Ge(Si) nanostructures on Si

September 21, Holm Schwarze PhD (physics); Verena Simpson PhD (biochemistry); Audur Sverrisdottir Civ.Ing. (biotechnology) of Zacco Denmark A/S, From idea to patent - valuable skills within research and innovation

October 5, Gerhard Gröbner, Umeå Universitet, Sweden, Membrane surfaces involved in diseases: Their mechanism of action studied by biophysical methods including solid state NMR

October 6, K. Nättinen, P. Bairos, University of Jyväskylä, Finland, Synthesis of Non-interpenetrated metal-organic frameworks

October 7, Karl-Heinz Heinig, Research center Rossendorf, Dresden, Germany, Nanostructure formation with ion beams

October 18, Masaharu Komiyama, Yamanashi University, Japan, Observation of photon absorption sites on TiO2(110) surface by photoexcited STM

October 20, Zeljko Sljivancanin, Polytechnique Federale de Lausanne, Switzerland, Ammonia synthesis on a supported iron nanoclusters

October 29, Steven Tait, University of Washington, Seattle, USA, Sintering kinetics of Pd nanoparticles on Al2O3(0001) by NC-AFM and small alkane desorption kinetics from MgO(100) and Pt(111) by TPD

November 10, Kristian Mølhave, Danmarks Tekniske Universitet, Denmark, Tools for manipulation and characterization of nanostructures

November 26, Zhipan Liu, Dept. of Chemistry, University of Cambridge, UK, Theory of CO oxidation over Au based catalysts: from supported nanoparticlesto single atom

December 1, Hans Fogelberg, Science and Technology Studies, Gothenburg University, Sweden, Bringing visibility to the invisible: What is a social understanding of nanotechnology?

December 7, Ib Johannsen, Versamatrix, Denmark, Segmented polymer networks - Nanotechnology on macroscale

December 8, Luis M. Molina, Departamento de Fisica Teorica, Universidad de Valladolid, Spain, Catalysis at small supported Au clusters support and dopant effects

December 9, Adam S Foster, Laboratory of Physics, Helsinki University of Technology, Finland, Probing insulating surfaces at the atomic scale

December 20, Docent Duncan Sutherland, Chalmers University of Technology, Gothenburg, Sweden, Artificial, nanostructured biointerfaces

December 21, Andreas Stierle, Max-Planck-Institut für Metallforschung, Stuttgart, Germany, Oxidation of nano-materials

iNANO staff

Management

Besenbacher, Flemming - Director
Dandanell, Jeanette - Academic Linguist
Jensen, Signe - EU coordinator
Kjems, Jørgen - Vice director
Litvak, Lone - Administration and accounting
Nielsen, Niels Chr. - Vice director
Pedersen, Kjeld - Vice director
Thostrup, Peter - Research coordinator

Senior staff

d'Amore, Francesco, AU
Andreasen, Peter, AU
Balling, Peter, AU
Besenbacher, Flemming, AU
Birkedal, Henrik, AU
Bozhevolnyi, Sergey, AAU
Bünger, Cody E., AU
Christensen, Niels Egede, AU
Daasbjerg, Kim, AU
Duch, Mogens, AU
Enghild, Jan Johannes, AU
Foss, Morten, AU
Gothelf, Kurt Vesterager, AU
Hammer, Bjørk, AU
Hofmann, Philip, AU
Iversen, Bo Brummerstedt, AU
Jakobsen, Hans Jørgen, AU
Jensen, Jan Egebjerg, AU
Jensen, Torben Heick, AU
Jensen, Torben René, AU
Keiding, Søren, AU
Kjems, Jørgen, AU
Kristensen, Martin, AU
Larsen, Arne Nylandsted, AU
Linderoth, René Trolle, AU
Lægsgaard, Erik, AU
Malmendal, Anders, AU
Nielsen, Brian Bech, AU
Nielsen, Niels Chr., AU
Nissen, Poul, AU
Ogilby, Peter Remsen, AU
Olsen, Jeppe, AU
Otzen, Daniel, AAU
Pedersen, Finn Skou, AU
Pedersen, Jan Skov, AU
Pedersen, Kjeld, AAU
Pedersen, Thomas Garn, AAU
Petersen, Steffen B., AAU
Petersen, Torben Ellebæk, AU
Pyrz, Ryszard, AAU
Revsbech, Niels Peter, AU
Schiøtt, Birgit, AU
Skibsted, Jørgen, AU
Skrydstrup, Troels, AU
Stensgaard, Ivan, AU
Søballe, Kjeld, AU
Søgaard, Erik, AAU
Sørensen, Esben Skipper, AU
Thostrup, Peter, AU
Vosegaard, Thomas, AU
Yoshida, Kenichi, AAU

iNANO - Interdisciplinary Nanoscience Center
The Faculty of Science, University of Aarhus
Ny Munkegade, Building 520, 8000 Aarhus C , Denmark

www.inano.dk