

UiO : **Centre for Materials Science and Nanotechnology**
University of Oslo

Strategic plan 2010-2016



VISION

SMN promotes cutting-edge research related to functional materials and nanoscience for applications within environmental and energy technologies and shall educate creative and innovative candidates for industry.

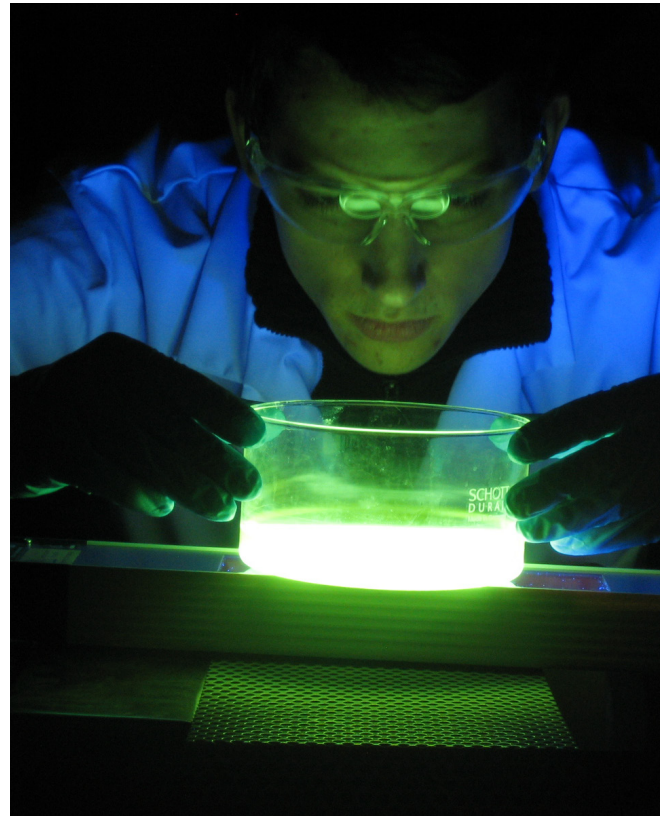


Foto: Ola Nilsen

Sustainable energy towards 2016

Energy is the key factor for the development of the modern society. Without the utilization of fossilized energy resources like coal, oil and gas, most of the major industrial and technological breakthroughs would not have been possible. Unfortunately, the large energy consumption by the last generations has also had negative consequences for the environment and most probably the climate. This is the major global challenge of our time.

Today, approximately 85 % of world energy consumption is based on fossil resources. This forms a contrast to the fact that the solar radiation which reaches the earth's surface in one hour equals the Earth's overall energy consumption for one year. Energy is not scarce – what remains the challenge is our ability to utilize the sources in a sustainable manner. Today, the share of the world energy consumption that is based on direct solar radiation (heat and solar cells) is less than one percent! Energy coming from wind and waves can also be utilized more efficiently.

The principles of capturing and storing renewable energy are well known, but in many cases we lack new and more effective materials in order to realize the technology and make it competitive - so that it can be widely adopted. This also applies to more efficient and climate-friendly usage of fossilized fuel. Advanced materials research is thus needed for an effective utilization of the vast quantities of energy that surrounds us. And the challenge should not be underestimated! Scientific "quantum leaps" are required in order to really make progress. For these reasons, the universities' focus on renewable energy and climate-friendly



usage of fossil fuels must be intensified. Basic research is the core activity of the universities. It is our chemists' and physicists' ability to develop new materials that will give us the key to this "energy code". But importantly, we can never schedule breakthroughs. The history of science has repeatedly shown that breakthroughs tend to come both uneven and unexpected. Massive research is the only way forward – this provides extended knowledge and increased understanding - and also new, clear-headed researchers who can continue challenging the established truths.

The key challenge is thus to ensure the massive research efforts on renewable energy and climate-friendly use of fossil fuels, which in time will provide sustainable solutions. What will follow from this is a large international knowledge-based industry. In this picture, SMN aims at taking a central national role based on a strong and broad educational platform, strong and dynamic research groups and systematic development of new research talents.

Oslo, September 2010

Svein Stølen
Head of SMN

SMN at the beginning of a new strategy period

The Centre for Materials Science and Nanotechnology comprises research groups from the Department of Physics (Fi) and Chemistry (Ki). Through joint academic and social meeting places and in general good and extensive cooperation, these groups constitute a dynamic environment, with large temporary projects based on different and varying cooperational constellations.

Now at the beginning of a new strategy period, the centre's impact can be illustrated by the fact that our researchers

- are hosting a Centre for Research-based Innovation (SFI) - Innovative Natural Gas Processes and Products (inGAP)
- constitute a key partner in a centre for renewable energy (FME), the Norwegian Research Centre for Solar Cell Technology
- coordinate two - and participate in an additional six - major research projects funded by the EU Framework Programme 7

- participate in eight competence projects with user participation (KMB)

- are project manager for 28 projects funded by the Research Council of Norway

A total of 13 permanent academic and 4 administrative employees are attached to the centre. In addition, SMN consists of about 60 doctoral students, postdocs and researchers, as well as 30 master students.

The centre's high academic quality is clearly reflected in the recent international evaluations of Chemistry (2009) and Physics (2010) organized by the Research Council of Norway. Here, the research at SMN is described partly as world leading. Even though the centre is focusing and will continue focusing on basic research, it is also a goal that SMN contributes to innovation and value creation in Norway. The 13 permanent academic employees have since 2004 been responsible for 15 patent applications and and overseeing the development of three successful start-up companies.



SMN SEEN FROM THE OUTSIDE



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The scientific quality and productivity of the Physical Electronics subgroup is excellent. The group has an internationally leading position in some activities (wideband gap semiconductors, photovoltaics cell), and a high degree of international publications in good journals. A relevant number of excellent PhD and MSc students is involved in the research that is also performed in strong collaboration with industries, national and international universities and with SINTEF. The management of sophisticated and complex facilities (MiNaLab) is very good, with good strategy and clear future planning.”

Source: *Basic Physics Research in Norway – an evaluation, 2010.*

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The group for Functional inorganic materials is arguably one of the most internationally well-known and successful research groups in chemistry in Norway.... In addition to their work in proton conductors, they have made important contributions in the materials chemistry of other important materials classes such as multiferroics and functional oxides, indicating that they display both excellent problem selection and high research quality.... It is a well diversified group that encompasses many of the subspecialties that are needed to formulate a high-quality, coordinated effort in materials physics and materials chemistry.”

Source: *Basic Chemistry Research in Norway, 2009.*

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The Catalysis Group is relatively small, with, however, a unique position in Norway... The research area (“heterogeneous catalysts using microporous and mesoporous solids such as zeolites or MOF”) has been developed more recently and has now reached a high scientific level. Although this field of research leads to more applied projects, the fundamental aspects of the work, through mechanistic and modelling studies, remain one of the objectives of the group. Some of the recent work on the characterisation of porous materials is particularly interesting, and has given rise to excellent publications.

Source: *Basic Chemistry Research in Norway, 2009.*

SUCCESS IN NORWAY

SMN focuses on innovation. In 2006 former centre director Helmer Fjellvåg received the Birkeland Innovation Award for promoting an innovation culture at the university. Fjellvåg has together with Ola Nilsen founded the Baldur Coatings Inc. This is a company that exploits the group's research expertise in the development and implementation of thin film technology for existing and new industry.

Truls Norby has developed two start-up firms. The first one is NorECs Norwegian Electroceramics AS, which commercializes scientific equipment developed by SMN. This firm was proclaimed as one of the fastest-growing (Gasselle) businesses in 2009 by the leading national newspaper for business and trade. The second firm is Protia AS, which develops and commercializes technology based on proton leading ceramics. Protia AS won the national DnB NOR Innovation Award in 2010 with the concept of "Energy Catalytic Membrane".

Moreover, SMN also collaborates extensively with complementary research groups at NTNU and the institute sector, especially SINTEF and IFE. In connection with the Research Council's announcement of funding for advanced scientific equipment and large infrastructure of national character in 2009 and 2010, this partnership successfully resulted in funding of two initiatives: the National Surface and Interface Characterization Laboratory (NICE) and the National Micro-and Nano-fabrication Facility (Norfab). UiO's share of this instrumentation will be located in the MiNa laboratory, where SMN has 440 m² clean room and 6 laboratories at its disposal - with advanced instrumentation for synthesis, fabrication and characterization.



Foto: Niklas Lello

CENTRES OF EXCELLENCE



Innovative Natural Gas Processes and Products (inGAP)

inGAP is a national, interdisciplinary centre for processing the perhaps most important natural resource in Norway: natural gas. inGAP is a National centre for research-based innovation, appointed by the Research Council of Norway. inGAP's vision is value creation in natural-gas processes through rational design of processes and products based on atomistic and mechanistic insight in catalyst and reactor parameters under operative conditions.

The centre is organized so that each partner builds further on its leading competence within the area. SMN's contribution is of fundamental character – within material synthesis, material characterization, mechanism studies and quantum modelling. Professor Unni Olsbye is the head of the centre.



The Norwegian Research Centre for Solar Cell Technology (FME sol)

FME Sol is a national centre for research on solar cell technology that embraces all the central research institutions within the field (IFE, SINTEF, NTNU and UiO) and Norwegian solar cell industry. The main objective is “to give current and future companies in the Norwegian PV industry long-term access to world leading technological and scientific expertise and thereby enabling this industry to become one of the most important land-based industries in Norway”.

SUCCESS IN EUROPE



Efficient and robust fuel cell with novel ceramic proton conducting electrolyte (EFFIPRO)

EFFIPRO will develop electrolytes and electrodes for proton conducting solid oxide fuel cells (PC-SOFCs) based on novel LaNbO_4 -type and similar proton conducting oxides. It is the goal that PC-SOFCs will be available by 2020, accelerate the use of fuel cells, reduce CO_2 emissions, and increase efficiency by 10% where applied, promote the hydrogen society, and be a dominating fuel cell technology.

Involved in this are six partners from the university- and institute sector, and also a partner from the industry.

SMN coordinates two large projects financed by the EU framework programme 7.

Materials for High Energy Accumulators in Traction and Tools (MAHEATT)

MAHEATT aims to take Li-ion batteries to the next level of performance. The main purpose of the MAHEATT project is to develop prototypes for the next generation of Li-ion batteries with a special focus on automotive applications (hybrid vehicles and electric traction) and handheld devices. This will be achieved by developing improved cathode materials based on nanostructures that leads to better kinetics and stability.

Five partners from the university- and institute sector and also three industrial partners contribute with their competence within synthesis, advanced characterization, theory, modelling and up-scaling.

Four priority areas for 2010-2016

Sustainable energy utilization

Massive research efforts on renewable energy and climate-friendly use of fossil fuels will eventually provide the necessary sustainable solutions. As a result, a great international knowledge-based industry will evolve. SMN wants a central national role based on a strong and broad education platform. Based on this foundation, SMN will support interdisciplinary research and cultivate new major research projects in cooperation with research institutes, industrial partners and other universities.

Development of research talents

Approximately 120 people are currently associated with SMN. Only 13 of these are permanent academic staff. We thus have a major responsibility to contribute to the development and recruitment of a large and diverse group of young, talented master students, PhD students, postdocs and researchers. Research education is for this reason one of SMNs main focus areas for the coming strategy period.

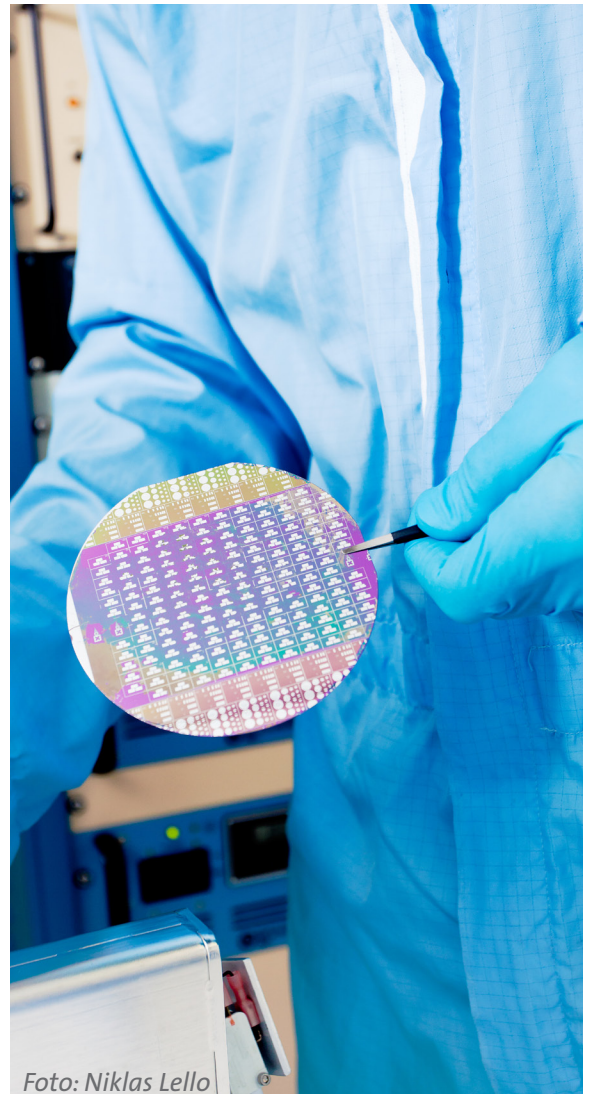


Foto: Niklas Lello

Innovation

Creativity is a central aspect of all research. SMN's goal is that this creativity will be reflected in commercial applications of the research. Already today SMN constitutes one of the most innovative research environments at UiO. Three of the four UiO spin-off companies related to renewable energy, Protia AS, Baldur Coatings AS and NorEcs AS, have originated from SMN.

Team SMN

The work burden for researchers with success is today considerable. The competition is very hard, and much work is placed into a large number of applications that often involve many partners. When they are won, the projects are to be directed – and the task of supervising the PhD-students is substantial. In addition, there are reports and dissemination of results. This implies that the permanent academic staff is vulnerable. It is therefore, to a greater extent than previously, important to organize good administrative support. World class research requires administrative support of corresponding quality.



Foto: Niklas Lello

Sustainable energy utilization

Goal

The Centre for materials science and nanotechnology aims at promoting cutting-edge research and education related to functional materials and nano-science applications for environmental and energy technology. SMN shall be an attractive national and international partner.

This implies that

- we attract large and important research projects both nationally and internationally
- we attract good national and international candidates for permanent and temporary positions
- our research has strong visibility both nationally and internationally

Therefore, we will

- maintain a strong knowledge platform and with this the ability to create, characterize, and understand materials and predict their properties
- facilitate, support and give priority to new cross-cutting projects that could form the basis for future research
- further develop cooperation with universities and research institutes both nationally and internationally
- be a professional meeting point both nationally and internationally
- place emphasis on guidance and good academic and social integration of students and researchers in the research groups
- further develop the interaction between research and administrative and technical support
- focus on strategic investment and cooperation related to research infrastructure
- actively participate in science policy making both nationally and internationally (EU)



Foto: Niklas Lello

Development of research talents

Goal

SMN will systematically develop creative and innovative candidates for industry and society.

This implies that

- we shall provide an international stimulating research environment that contributes to the individual's development with independence, freedom and creativity as key values
- we systematically shall give students experience in fields such as project management, supervision, laboratory operations and writing applications

Therefore, we will

- support inspiring studies and research through good interaction, accessibility and interdisciplinary contacts
- develop interdisciplinary meeting points that offer expertise in technology and methodology (Research Schools)
- make sure that PhDs, postdocs and researchers are given feedback and career guidance
- offer courses in research and project management
- make sure that the students of the bachelor and master programmes Materials, Energy and Nanotechnology (MENA) have a good study environment, sufficient technical information and good contacts with the senior researchers



Photo: Niklas Lello

Innovation

Goals

SMN will carry out fundamental research that can trigger new technology and contribute to the commercialization of research results.

This implies that

- we shall report the potential inventions and innovations (through the so-called DOFIs) and actively develop patent applications
- we will help to initiate and develop start-up companies

Therefore, we should

- focus on the interaction between research and innovation
- be a preferred research partner on new materials for new energy technology for Norwegian industry within our areas of expertise
- support patenting through the UiO technology management BIAS-system
- support the management of commercialization processes
- focus on potential applications and commercialization of our research



Team SMN

Goals

The administrative group Team SMN shall give the excellent international scientists a first-rate administrative support.

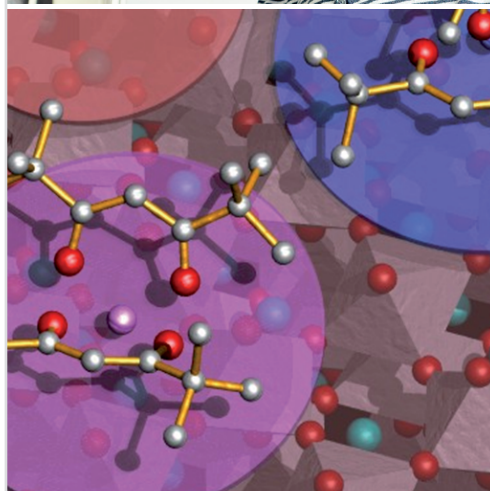
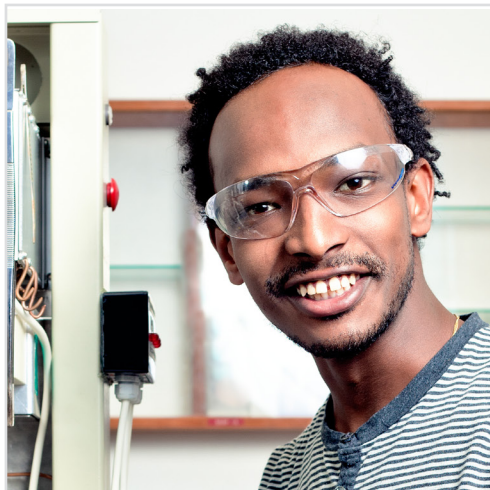
This implies that we

- will be in charge of the administrative processes, so that the project leaders can be fully focused on their research.

Therefore, we will

- provide administrative support and facilitate large applications towards EU and RCN
- professionalize the management of the projects
- facilitate efficient operations and better utilization of the technical infrastructure
- be one step ahead and contribute to forming opportunities for collaborations with the industry and other potential partners





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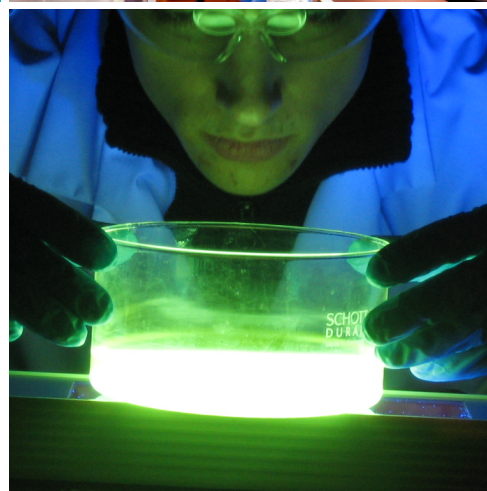
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