



RESEARCH CONFERENCES

ESF-FWF Conference in Partnership with LFUI

Nanotechnology for Sustainable Energy

Universitätszentrum Obergurgl (Ötz Valley, near Innsbruck) • Austria
14-19 June 2008

Chair: **Bengt Kasemo**, Chalmers University of Technology, SE
Co-Chair: **Michael Grätzel**, Ecole Polytechnique Fédérale de Lausanne, CH

www.esf.org/conferences/08257

H₂ production & storage

Photo-voltaics

(O)LEDs

Fuel cells

Batteries

Photo-catalysis

Emission cleaning

NANOTECHNOLOGY FOR SUSTAINABLE ENERGY

An ESF-FWF Research Conference in Partnership with LFUI
June 14 -19, 2008 - Obergurgl, Austria

Chair: Bengt Kasemo, Chalmers University, Göteborg, Sweden Vice-chair: Michael Grätzel, EPFL, Lausanne, Switzerland

Conference Highlights

Please provide a brief summary of the conference and its highlights in non-specialist terms (especially for highly technical subjects) for communication and publicity purposes. (ca. 400-500 words)

The ESF conference “Nanotechnology for Sustainable Energy” was the first of its kind held in Europe. It attracted almost 120 researchers and industry representatives to apply for participation. Due to space limitations, only 65 of these applicants were accepted. Thus, together with a set of top-level invited speakers, around 80 established experts in the field as well as a few “newcomers” gathered in the Austrian alps to discuss issues related to supplying mankind with clean and sustainable energy. In particular, the opportunities offered by novel nanotechnology concepts and methods were discussed. Topical areas, which were covered by the conference, include but are not limited to solar cells, light-emitting diodes, fuel cells, batteries, heterogeneous catalysis, thermoelectric materials, as well as hydrogen production and storage (see Annexes 1 (conference synopsis) and 2 (conference program)).

Given the novelty of the field and the importance of finding sustainable energy sources for the future, the conference has received considerable interest in various media. The conference chair has been interviewed twice by the ESF office, and his profile will be published in an upcoming issue of the ESF Conferences' newsletter. The editors of two high-level scientific journals attended the conference, and one of these journals has published a “News and Views” article, which summarizes the conference (Nature Materials, Vol. 7, October 2008, page 772). Additionally, a student in media/public understanding of science was present at the conference; she has prepared a detailed conference report (Annex 3).

The aforementioned factors (novelty and importance of the topic) were very likely also key factors in attracting additional sponsoring money for the conference, beyond the support offered by ESF and FWF. ESF/FWF and several companies have supported the conference in a very generous way.

The conference was built around 18 invited talks of roughly one hour duration each, given by international experts and covering the subject areas mentioned above. These invited talks were complemented by 20 contributed short talks (20 minutes each), which were selected from the submitted poster abstracts and which were considered to be of exceptionally high quality. For both invited talks and contributed talks, an important goal was to leave ample room for discussion (Gordon Conference style). Time for more informal discussions was provided during the afternoons, during which no talks were scheduled.

In order to foster interaction among the conference participants, all meals were offered at the conference location and at given times. Additionally, a get-together and a conference dinner were arranged. The two poster sessions (with free drinks) were further, excellent opportunities for interaction. Poster exposure time was generous to allow the young participants much time to discuss their results.

The invited speakers and conference participants came from 18 different countries in Europe, US and other parts of the world. About one third of the participants were younger than 30 years of age, and there was a reasonable gender balance (25% female participants).

The most important conclusions and challenges, which were identified at the meeting, include:

- The potential of nanoscience is immense and has been exploited to a small degree only.
- In methodology for fabrication/synthesis and characterization of nanostructures, there are strong synergies between different fields, which could be further enhanced.
- There is no single energy source and/or technology, which we should focus on; it is essential that a number of promising tracks are persuaded in parallel.
- Although the field is already quite interdisciplinary, further efforts to foster collaborations across disciplines are required.
- Education and training of a young generation of researchers, which can drive the development of the field in the future, is very important. The field is a strong attractor on students and could be a vehicle to attract the best students to this area and to science and technology in general.
- There is a strong need to study novel materials which go beyond the world of inorganic materials.

- Mother nature is a great source of inspiration from which we can and should learn. Ultimately, we need scientific approaches to move beyond naturally evolved materials.
- Knowledge-based approaches are essential and cannot be substituted by empirical or combinatorial strategies.

All in all, the conference was a very successful and highly stimulating event as evidenced by the large number of applicants and the very high evaluation scores. Top international speakers, highly motivated young scientists, two excellent poster sessions, and a flawless organization by the ESF conference management have contributed to this success.

Motivated by this success, the possibility of arranging a second conference in two years from now was discussed at the conference. The idea was very well received and strongly supported, and this year's conference vice chair, Michael Grätzel, has therefore decided to submit an application for a second conference to ESF.



I hereby authorize ESF – and the conference partners to use the information contained in the above section on 'Conference Highlights' in their communication on the scheme.

Scientific Report

Executive Summary

(2 pages max)

History and Conference Participants

The first step towards realization of this conference was the submission of a conference proposal to the ESF in October 2006. The evaluation of the proposal was positive and conference funding was granted by ESF in collaboration with FWF in May 2007. After having asked and then appointed Professor Michael Grätzel as conference vice-chair, a suitable set of potential invited speakers was identified and contacts were established. The conference was announced via various channels and in several iterations, both by the ESF conference office and by the chair and vice chair in their networks, which led to a high number of applications. A database of >200 email addresses was established to this end, which is vital for wide exposure. Out of the 120 applications, which were submitted to ESF by the application deadline, ca. 65 were selected (space and lodging allowed no more than this number) and invited to participate. The selection was primarily based on scientific excellence, but further criteria such as geographical balance, age balance (with a particular focus on younger researchers), and gender balance were also taken into account. About 30 of these 65 participants were given grants for the conference stay and traveling, using the ESF and sponsor funds. Conference participants and invited speakers came from 18 countries, mainly lying in Europe but also including the US, Canada, Iran, China, and Japan. The majority of conference participants (70%) were younger than 40 years of age. Female participants constituted about 25% of all attendees (invited speakers, committee, participants).

The conference took place in Obergurgl, Austria, during the period June 14-19, 2008.

Conference Objectives

The most important issues and objectives expressed in the original proposal to ESF and in the conference synopsis (see Annex 1) are:

- I. To gather top-level scientists in the area
- II. To keep the scientific quality of the meeting at a high level, and to foster scientific excellence in the area
- III. To make both an inventory and exposure of the state-of-the-art N&N based energy research, technologies and opportunities
- IV. To demonstrate and discuss the potential of nanotechnology to contribute towards sustainable energy sources and use
- V. To identify synergies between disciplines and people
- VI. To catalyze global contacts and collaborations among world-leading experts and laboratories
- VII. To provide a younger generation of researchers with a vision as well as the knowledge, stimulus and tools to realize this vision
- VIII. To provide generous time for discussions and social interactions
- IX. To strengthen the European research arena, and to claim Europe's interest in taking an important role in the development of a sustainable energy system

In retrospective, we are confident that all of these objectives were met. A distinguished set of high-profile invited speakers attended the meeting (objective I) and contributed towards keeping the scientific level of

the meeting at a very high level (objective II). Thanks to a large number of applications, we were able to select the best applicants for participation and thus further assure objective II. The tutorial level of the speakers was generally very high. Objectives III and IV were met considering that the invited speakers and the conference participants came from various sub-areas in the field and were able to provide a broad overview of current and future use of nanoscience and nanotechnology in energy science. The very mixed set of participants, both with respect to scientific background, nationality and age, was instrumental in reaching objectives V, VI and VII, while objectives VI, VII and VIII were achieved by including generous timeslots for discussions and various social gatherings in the conference program (Annex 2). The ratio of European to non-European attendees was around 2:1, which we consider a good spread in the context of objective IX.

Media Presence and Exposure

Media presence at the meeting was good, with the editors of *Nature Materials* and the newly launched *Energy and Environmental Science* journals being presented during the entire meeting. The former journal has published a "News and Views" article in which one of the invited speakers summarizes the conference to a broad readership (see *Nature Materials*, Vol. 7, October 2008, page 772). Additionally, a student in media and public understanding of science (Ms Katarina Kasemo) attended the meeting. Her conference report, which includes a number of interviews with conference participants, is included in Annex 3 of this report. Furthermore, in the aftermath of the conference it has been selected for special exposure by ScienceDaily (see <http://www.sciencedaily.com/releases/2008/10/081013112451.htm>), EurekAlert! (see http://www.eurekalert.org/pub_releases/2008-10/esf-erb100908.php) and many other online forums. Last but not least, the ESF Conferences' newsletter "Encounters" has published the conference chair's profile in its November 2008 issue.

Economy

The ESF/FWF contribution of 55'000 EUR was instrumental to arrange this conference. It was used to cover expenses for invited speakers and the organizing committee (travels, accommodation) on one hand, and to support a selected number of conference participants on the other hand. Over 30 participants were offered a conference grant covering their accommodation, and 28 of these additionally received a travel grant, the amount of which was adjusted to the respective participant's travel distance. The selection of grantees was based on similar criteria as described above for the selection of participants.

Additional funding for the conference was sought by contacting a number of potential sponsors. A large number of companies and organizations have given us their highly appreciated support (a list of sponsors is presented in Annex 4). Contributions were either made at a defined level, namely the platinum (5'000 EUR), the gold (2'000 EUR) or the silver level (1'000), or dedicated to a particular purpose. The sponsor contributions of ca. 19'000 EUR in total were used partially to offer more generous travel grants to invited speakers, to offer additional conference and travel grants to young participants, and to make the meeting pleasurable by offering free drinks at the poster sessions. This led to high attendance at both poster sessions. Additionally, the sponsor contributions covered expenses for the abstract booklet (layout, printing). Two of our sponsors kindly dedicated their contributions to three poster prizes and prizes for the three best contributed talks, respectively, and were present at the conference and the award ceremonies for these prizes.

Impressions and Conclusions

We consider this conference a great success with respect to both scientific content, level of the presentations, number and quality of applicants, geographical and gender balance, the conference location, opportunities for interaction, and sponsor contributions, and we are thus very satisfied with its outcome. Our view is shared by a large number of conference participants, who have provided us with their formal or informal feedback (see for instance Annex 3 for short interviews with some of the participants, or Annex 5 for the

conference evaluation).

Given this very successful outcome, this year's vice-chair has submitted an application to ESF for a follow-up conference. We envision a second conference, where many of this year's topics reoccur, but with a new set of speakers. Additionally, we plan to bring in some new topics (e.g. clean coal conversion; CO₂ sequestration, conversion and storage; materials) and hope to be able to attract contributions from big industries (such as Shell or E.ON) in order to highlight existing and potential applications of nanotechnology in the energy sector.

Scientific Content of the Conference

(1 page min.)

- Summary of the conference sessions focusing on the scientific highlights
- Assessment of the results and their potential impact on future research or applications

The format of this conference followed the scheme of other research conferences organized by the European Science Foundation (ESF), i.e. around 20 invited talks by distinguished speakers/scientists were blended with two poster-sessions and a dozen short, contributed talks, which were selected from the submitted abstracts based on scientific quality and relevance to the conference.

The invited talks were divided into nine sessions, namely photovoltaics, hydrogen production, hydrogen storage, fuel cells, organic light emitting diodes, batteries, catalysis, thermoelectrics, and nanosafety and nanoethics (see Annex 2 for details).

The speakers of the **photovoltaics** (PV) session reported on recent progress in the development of dye-sensitized solar cells, including aspects such as improved dyes, the use of dye cocktails, improved charge collection, the elimination of a transparent conductive oxide layer, the construction of light and flexible cells, and the integration of PV-cells into buildings (windows). Multiple exciton generation (MEG) from a single photon in quantum dots was discussed as a way to improve the conversion efficiency of Generation III solar cells in the blue end of the solar spectrum. Recent developments in the synthesis and characterization of semiconductor quantum dots, including size, shape and surface control, were described.

Different routes to the **production of hydrogen** were presented, among others via visible-light responsive photocatalytic water splitting on (oxy)nitrides, via steam reforming, and via water electrolysis. The role of nanostructuring the catalyst and the identification of active sites were treated in detail, and an innovative approach to suppress the recombination of hydrogen and oxygen, which hampers traditional approaches to photocatalytic water splitting, was introduced.

Another important hurdle on the way to a hydrogen economy is the compact and safe **storage of hydrogen**. The state-of-art methods for hydrogen storage were reviewed and compared. Complex metal hydrides, in combination with appropriate catalysts, and new combinations of lightweight materials were shown to possess desirable properties, and nanostructured and nanosized materials were pointed out to play crucial roles for thermodynamics, catalytic steps and kinetics.

Advanced **fuel cell technologies**, the third cornerstone of the hydrogen economy, can benefit in various ways from nanoscience and nanotechnology, as catalysts, as nanostructured membranes, or as porous electrode structures. It was demonstrated how nanotechnology can contribute significantly to a fundamental understanding of the microscopic processes occurring at fuel cell electrodes by using nanostructured model electrodes. A common problem associated with low-temperature PEM fuel cells is an overpotential at the cathode which hampers performance. Density functional theory calculations were shown to be an extremely valuable tool to identify the origin of the overpotential for the commonly used electrode material, platinum, and ways to reduce the overpotential were discussed. The similarities between reactions occurring in a fuel cell and electrochemical water splitting were analyzed and frameworks to understand these reactions were presented.

A number of issues with today's **Li-ion batteries** were reviewed and include the employed materials being scarce and not completely environmentally benign. An intense search for alternative, abundant and cheap materials was reported on, and it was shown how moving from bulk to nanomaterials, can significantly improve electrode properties of compounds which so far have been disregarded. The use of partially graphitized carbon as a meso-structured material with pore dimensions on the order of 3-5 nm, and its employment as an electrically conductive scaffold to encapsulate active electrode materials were discussed. A virus-enabled lithium ion rechargeable battery was presented, and it was shown that it has many improved properties over conventional batteries.

The importance of **heterogeneous catalysis** for efficient and clean use of our existing energy supply was

outlined. It was pointed out that the immensely large scale at which energy-related catalytic reactions are carried out requires optimized catalysts, and that in possible future energy scenarios the role of chemical reactions for exploiting renewable energy conversion technologies will become even more important. Optimized heterogeneous catalysis was shown to have an enormous potential for energy saving strategies as well. Catalytic vehicle emission control is another important application of heterogeneous catalysis, which is intimately coupled to strategies for improved fuel efficiency. Nanostructuring and nanomaterials contribute to catalysis in several ways, for instance via the optimized use of valuable constituents through strict size and shape control, or as zeolites and oxide-supported nanoparticles for new lean-NO_x reduction technologies. It was noted that catalysis has long been and continues to be nanoscience and technology - what has changed in recent years is the availability of methods that dramatically improve our ability to synthesize, characterize and manipulate material structures at the nanoscale in a systematic and controlled way.

The potential of **thermoelectric generators** (i.e. devices which directly convert heat (in a temperature gradient) into electricity with no moving parts) for residential cogeneration or waste heat recovery in automobiles was reviewed, and it was explained that the use of thermoelectric generators has been limited to niche applications by the low efficiency of the thermoelectric materials thus far. Recently, several routes towards higher efficiency have been discovered, with a general feature of these new materials being that they all involve complex nanostructured materials.

With nanotechnology being a novel, but rapidly developing field, very little is known about the biological and health effects of nanoparticles. Consequently, safety aspects (often referred to as ELSA aspects) need to be taken seriously and were presented and discussed at the meeting. The societal implications and ethical aspects of nanotechnology were elucidated. It was pointed out that it is important to distinguish between “**nanosafety**” and “**nanoethics**”, which are only partly overlapping, and to reflect on what are real threats and what is fiction. The importance of a serious consideration of these aspects with respect to the public and media was emphasized. It is important both to be alert on risk and safety aspects and to prevent backlashes in nanotechnology-based development.

The contributed talks and posters partially covered topics, which were covered in one or more of the nine sessions with invited talks, and partially extended the range of the invited talks towards other application areas.

The abstracts of all invited talks, contributed talks and posters are documented in the conference abstract booklet, which has been distributed to all conference participants and sponsors.

Forward Look

(1 page min.)

- *Assessment of the results*
- *Contribution to the future direction of the field – identification of issues in the 5-10 years & timeframe*
- *Identification of emerging topics*

The most important conclusions and challenges, which were identified at the meeting, include:

- The potential of nanoscience is immense and has been exploited to a small degree only.
- The development is evolutionary rather than revolutionary, with niche applications from nanotechnology already being implemented or coming in the near future, and becoming successively broader and with more systems-oriented applications following later, on time scales of 5-30 years.
- There is no single energy source and/or technology, which we should focus on; it is essential that a number of promising tracks are pursued in parallel. The future energy supply system is likely to be more diversified than today's mainly fossil fuel based society.
- Although the field is already quite interdisciplinary, further efforts to foster collaborations across disciplines, and between sciences and engineering are required.
- There are strong synergies between different application areas, for instance with respect to nanofabrication tools and characterization tools, which are largely common between different application areas (some are yet area-specific).
- Education and training of a young generation of researchers, which can drive the development of the field in the future, is very important.
- There is a strong need to look beyond traditional, inorganic materials.
- Mother nature is a great source of inspiration from which we can and should learn. Ultimately, we need scientific approaches to move beyond naturally evolved materials.
- Knowledge-based approaches are essential and cannot be substituted by empirical or combinatorial strategies.

The following emerging topics were identified:

- Photovoltaic cells – flexible, light-weight, building-integrated cells; more economically viable cells/concepts; new concepts such as multiple carrier generation
- Hydrogen production – novel materials with engineered band gaps for visible light absorption; nanostructured catalyst particles; understanding and design of active sites
- Hydrogen storage – novel materials based on complex metal hydrides; nanostructured materials for improved kinetics, thermodynamics and catalysis
- Fuel cells – improved membranes; nanostructured model electrodes to improve understanding; ditto DFT calculations; uncovering synergies/similarities with water splitting reaction
- Li-ion batteries – novel nanomaterials, which are environmentally benign and abundantly available; virus-enabled (biomimetic) approaches
- Catalysis – transition from “implicit nanotechnology” content to “explicit” and systematic use of nanotechnology, including model systems for improved understanding
- Thermoelectrics – nanomaterials with higher thermoelectric coefficient; novel application areas such as waste heat recovery

The possibility of arranging a second conference in two years from now was discussed at this year's conference. The idea was very well received and strongly supported by the conference participants. In fact, all participants who filled out the evaluation questionnaire think that the conference should be repeated (cf. Annex 5). This year's conference vice chair, Michael Grätzel, has therefore decided to submit an application for a **2nd ESF Conference on “Nanotechnology for Sustainable Energy”**, planned for 2010 in Obergurgl, Austria, to ESF on September 15. If granted, the 2nd conference will be chaired by Prof. Michael Grätzel,

EPFL, Switzerland, with Prof. Jean-Marie Tarascon, University of Picardie Jules Verne, France, as vice-chair. This was discussed, communicated and strongly supported at the end of this year's conference.

▪ *Is there a need for a foresight-type initiative?*

This first conference has demonstrated clearly that there are a wide variety of ongoing activities in the field of Nanotechnology for Sustainable Energy. The majority of these activities have a strongly interdisciplinary character, and there are strong synergies between several of these activities, which are, however, not optimally utilized today.

The conference has also resulted in a list of several emerging topics, which show great promise for improved, sustainable energy systems in the future. We are convinced that at least some of these will influence our everyday lives on a medium- to long-term perspective. As in all other fields where nanotechnology is expected to play a major role, it has also in the energy and environmental area an "enabling technology" character, meaning that it creates a generic platform with many features that are independent of specific applications areas, e.g. synthesis and fabrication, analysis and characterization and generic functions. Therefore, nanotechnology bridges over disciplinary borders as almost no other area and naturally creates synergies between disciplines in both research and education.

Based on these observations and considerations, our conclusion is that a foresight-type activity would be beneficial to the field. The purpose of such an activity would be at least four-fold, namely to:

- Identify and (further) discuss synergies between currently on-going efforts
- Identify and discuss technological opportunities related to emerging topics, and discuss how these can be achieved most efficiently based on the field's previous failures and success stories
- Discuss how one can take advantage of the bridging character of nanotechnology in organization and funding of research and education
- Discuss how the field is perceived by the public, and identify ways to improve public understanding of the field

Atmosphere and Infrastructure

▪ *The reaction of the participants to the location and the organization, including networking, and any other relevant comments*

The participants' feedback regarding the atmosphere and the infrastructure of the conference has been extremely positive (see Annex 5). The venue was considered very well suited for this type of conference, as all the participants were housed in close vicinity to the lecture and dining halls, which facilitated interaction and informal discussions among the conference participants. The younger participants valued the willingness of the invited speakers to be visible and to engage in discussions. The results of the evaluation sheets handed out after the conference show that a majority of the conference participants (80%):

- Considered this event to be more than "just a meeting".
- Feel that there was an atmosphere conducive to easy exchange of information.
- Think that the schedule allowed ample time for informal discussion.
- Agree completely that the balance between young and senior participants was appropriate.

Sensitive and Confidential Information

This report will be submitted to the relevant ESF Standing Committees for review.

In order to promote transparency, it is ESF policy to also publish the Scientific Reports on its website. Any confidential information (i.e. detailed descriptions of unpublished research, confidential discussions, private information) should therefore not be included in this report. Confidential issues can be addressed in the next page, which will not be published.



I hereby authorize ESF to publish the information contained in the above Scientific Report on the ESF Research Conferences Webpages. No sensitive or confidential information (see above) has been included in this report

Confidential Issues

▪ *Any other issues, not to be included in the published report.*

None.

Date & Authors:

Chair and vice-chair of the conference:

Bengt Kasemo, Chalmers University of Technology, Sweden

Michael Grätzel, Ecole Polytechnique Fédérale de Lausanne, Switzerland

December 15, 2008

Annex 1: Conference Synopsis

Maybe the largest challenge for our global society is to find ways to replace the slowly, but inevitably vanishing fossil fuel supply, and at the same time avoiding negative effects from the current energy system on climate, environment and health.

Nanoscience and Nanotechnology (N&N) can contribute to a positive development in this direction in several ways, for instance by contributing to more efficient harvesting of sun light, by providing thermoelectric materials to harvest energy from temperature gradients, by providing energy storage technology e.g. in batteries and for hydrogen storage, by enabling light-weight materials for transportation, by influencing the energy efficiency of industrial production and of household energy use (e.g., through fuel cells, catalysis, reduced friction losses), and by offering schemes to clean up harmful emissions resulting from various energy systems.

Topical areas covered by this conference are those where N&N will, or may, have an impact on the development of a sustainable energy system, including environmental aspects. The conference includes both basic science of relevance for energy/environmental technology and more application oriented research. The objective is to gather experts in the respective fields at one conference with the aim to make both an inventory and exposure of the state-of-the-art N&N based energy research, technologies and opportunities. We thereby hope to foster scientific excellence in this area, to identify synergies between disciplines and people, and to catalyze global contacts and collaborations among world-leading experts and laboratories. The conference has a strong educational character in as much as it shall provide a younger generation of researchers with a vision, as well as the knowledge and tools to realize this vision.

The format of this conference follows the scheme of other research conferences organized by the European Science Foundation (ESF), i.e. there is a strong focus on scientific quality of the talks and on generous time for discussions and social interactions. This is achieved by complementing 20-25 invited talks by distinguished speakers/scientists with poster-sessions and a few young investigator talks. Joint meals and a social program enable further opportunities for contact and informal networking. The conference venue is located in the beautiful Austrian Alps (Universitätszentrum Obergurgl, Ötztal).

Annex 2: Conference Program

Saturday, 14 June

Late afternoon / early evening	Registration at the ESF desk
19.00	Welcome Drink
20.00	Dinner

Sunday, 15 June

08.30-09.00	Welcome address and conference opening
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Session 1: Nanoscience and Nanotechnology (N2) for Photovoltaics

Chair: Bengt Kasemo, Chalmers, SE

09.00-09.55

Michael Grätzel

Ecole Polytechnique Fédérale de Lausanne, CH
The magic world of nanocrystals, from batteries to solar cells

09.55-10.50

Peng Wang

Changchun Institute of Applied Chemistry, CN
High-performance dye-sensitized solar cells based on advanced organic optoelectronic materials

10.50-11.20

Coffee break

Chair: Michael Grätzel, EPFL, CH

11.20-12.15

Arthur Nozik

National Renewable Energy Laboratory, US
Multiple exciton generation: silicon QDs, QD arrays, QD solar cells, and controversy

12.15-13.10

Richard Schaller

Los Alamos National Laboratory, US
Multiexcitations from a single photon absorption in semiconductor nanocrystals

13.15

Lunch

Session 1; cont.

Chair: Michael Zäch, Chalmers, SE

16.00-16.55

Shuzi Hayase

Kyushu Institute of Technology, JP
Research on dye sensitized solar cells from view point of charge collection using nano-interface modification

16.55-17.20

Coffee break

Session 2: N2 for Hydrogen Production

Chair: Jens Norskov, Technical University of Denmark, DK

17.20-18.15

Kazunari Domen

University of Tokyo, JP

Overall water splitting on heterogeneous photocatalysts

18.15-19.10

Ib Chorkendorff

Technical University of Denmark, DK

Identifying the site and new materials for hydrogen production

19.15-20:45

Dinner

Contributed Talks

Chair: Bengt Kasemo, Chalmers, SE

20.45-21.20

Philip Earis, Energy and Environmental Science

Vincent Dusastre, Nature Materials

Poster Session I

21.20

Poster Session I

Monday, 16 June

Session 3: N2 for Hydrogen Storage

Chair: Jürgen Behm, Universität Ulm, DE

09.00-09.55

Louis Schlapbach

Swiss Federal Lab for Materials Science and Technology, CH

Hydrogen Storage for Mobility, a Challenge for Materials Science and Technology

Contributed Talks

09.55-10.50

Christoph Langhammer, Chalmers University

Carl Hägglund, Chalmers University

Almantas Pivrikas, Johannes Kepler University Linz

10.50-11.20

Coffee break

Session 4: N2 for Fuel Cells

Chair: Richard Schaller, Los Alamos, US

11.20-12.15

R. Jürgen Behm

Universität Ulm, DE

Nanosciences and nanotechnology in fuel cell research

12.15-13.10

Jens Norskov

Technical University of Denmark, DK

Understanding electrocatalysis for fuel cells and water splitting

13.15

Lunch

Session 5: N2 for (O)LEDs and PV

Chair: Michael Grätzel, Ecole Polytechnique Fédérale de Lausanne, CH

16.00-16.55

Thomas Kempa

Harvard University, US

Lecture title

16.55-17.20

Coffee break

17.20-18.15

Horst Weller

Universität Hamburg, DE

Fabrication of quantum dots and their use for solar applications

Contributed Talks

Chair: Kalyanasundaram Kuppaswamy, EPFL, CH, and **Carl Hägglund**, Chalmers, SE

18.15-19.10

Michael Bertoz, Dyesol Ltd.

Spike Wadman, Utrecht University

Jun-Ho Yum, EPFL

19.15-20:45

Dinner

20.45-21.20

Dimas De Oteyza, Donostia Internat. Physics Center

Mukundan Thelakhat, University of Bayreuth

Poster Session II

21.20

Poster Session II

Tuesday, 17 June

Session 6: N2 for Batteries

Chair: Jeffrey Snyder, California Institute of Technology, US

09.00-09.55

Angela Belcher

Massachusetts Institute of Technology, US

From Nature and back again... Giving new life to materials for energy, electronics and the environment

09.55-10.50

Jean-Marie Tarascon

University of Picardie Jules Verne, FR

Materials in nanometric forms for sustainable Li-based batteries

10.50-11.20

Coffee break

Chair: Charles Peden, Pacific Northwest National Laboratory, US

11.20-12.15

Linda Nazar

University of Waterloo, CA

High-capacity nanostructured cathodes for energy storage

12.15-13.10

Robert Schlögl

Fritz-Haber Institut der MPG, DE

The critical role of heterogeneous catalysis for energy storage and conversion

13.15

Lunch

Afternoon

Half-day free time

19.15

Get-together & Conference Dinner

Wednesday, 18 June**Session 7: N₂ for Catalysis****Chair: Ib Chorkendorff, Technical University of Denmark, DK**

09.00-09.55

Charles Peden

Pacific Northwest National Laboratory, US

*The nanoscience of next generation automobile emission control catalysts***Contributed Talks**

09.55-10.50

Fabio Di Fonzo, Politecnico di Milano

Cristina Giordano, MPI of Colloids and Interfaces

Raheleh Mohammadpour, Sharif University of Techn.

10.50-11.20

Coffee break

Chair: Michael Wark, Hannover University, DE

11.20-13.10

Rasmus M. Nielsen, Technical University of Denmark

Nima Taghavinia, Sharif University of Technology

Scott Warren, EPFL

Holger Wolfschmidt, TU München

Nam-Hee Kwon, High Power Lithium

13.15

Lunch

Session 8: N2 for Thermoelectrics

Chair: Michael Zäch, Chalmers, SE

16.00-16.55

G. Jeffrey Snyder

California Institute of Technology, US

Nanostructured thermoelectric materials for sustainable power generation and cooling

16.55-17.20

Coffee break

Session 9: Nanosafety and Nanoethics

Chair: Michael Zäch, Chalmers, SE

17.20-18.15

Bengt Kasemo

Chalmers University of Technology, SE

Nanosafety and nanoethics – facts and fiction

Contributed Talks

Chair: Arthur Nozik, National Renewable Energy Laboratory, US

18.15-19.10

Gerrit Boschloo, Uppsala University

Dominik Eder, University of Cambridge

Anna Tröger, University of Erlangen-Nuremberg

19.15-20:45

Dinner

Next Conference and Closing Remarks

Chair: Bengt Kasemo, Chalmers University of Technology, SE

20.45-21.30

Forward Look Plenary Discussion

Thursday, 19 June

Breakfast & Departure

Annex 3: Media Report by K. Kasemo

In Obergurgl there seemed to be a consensus about the most important reason to be there: networking. Most of the scientists appreciated the relaxed atmosphere and took chances to make contacts.

In the evening bar mingle they talked about this and that and a good deal of scientific philosophy and ethics was discussed. What is a proof? What kind of power should the professors have? Is it a good thing that we have to teach?

- Applying for money, I'll write whatever I have to, and it usually works, someone says.

Some are upset that the older and experienced speakers get more time for their lectures in the conference.

- But it's only fair, someone else argues. Our time will come.

And no matter how late they stay up talking and cheering, the morning lectures at nine seem to be full. Off course, you see someone nodding off now and then, but to be honest, isn't that business as usual?

The company also takes advantage of the four-hour free time after a heavy lunch. Having eaten a three-course lunch (yes, every day) the Obergurgl scientists disappear. They must be digesting it in their rooms or on a walk in the mountains. In the common areas there are only a few people left, and where else would they go but to bed or walking?

When you look outside from the conference building you notice – after breathing in the fresh air – silence. Then you see the mountain clouds and a few houses with some goats in the garden. If you take a few steps – more fresh air coming to you – you will see the empty lift system (this is a big skiing resort at that time of year) and the mountains rising around you. At approximately 2000 meters, it still seems to be a long way up to the top of the mountains.

Perhaps the scientists who come here stand outside the conference house and look up on these mountaintops and think about their own striving. Sometimes it is cloudy, sometimes in bright sunlight and almost always in the company of others.

Meet (some of) the speakers

Louis Schlapbach made himself famous at the conference asking, as he put it, "politically incorrect" questions. Although he only stayed a few days before going back to Switzerland, his contribution will no doubt be remembered. In his speech, the actual subject – Hydrogen storage – was generously mixed with ancient Greeks and other historical references.

Mr. Schlapbach has worked both as a scientist, as a teacher/mentor and with administration in the scientific world. Without a doubt he mentions the work with and guidance of young scientists as his most important contribution – the one he will think proudly of as an 85 year old.

On a normal day Louis Schlapbach bikes five kilometers to work, eats the sandwich he hates for lunch and for sure does his share of overtime, apart from the normal work. To cope with this, he has found the perfect place to relax. In a place called La Rochelle in France he reloads his batteries in the good company of his wife.

Kazunari Domen recently moved from one university to another in the city of Yokohama, Japan. This means that the trip to work today takes him one hour, instead of the 15 minutes it used to take. He explains that he lives outside the city, in the same area as his two sons and grandchildren. Therefore, moving is not an option – he spends a lot of time with his family. This leads to the question "maybe it was not such a good idea to switch university" and Mr. Domen responds with a very characteristic laugh:

- In my new university the quality of the students is much higher, and Mr. Domen lets me know that choosing the second best at work is not an option either.

Having no idea what the ESF is, **Richard Schaller** made his own analysis when he got the invitation to the conference. Michael Grätzel and other well known scientists was one parameter. The description of a Gordon look-alike conference another.

- In the huge ten to 20 thousand people conferences in America interaction is impossible, he says.

And interaction is a very important reason for going to a conference. Mr. Schaller took the opportunity and although someone told me he stayed up quite late, in the morning I would find him at the nine o'clock speech.

Most scientists seem to spend a lot of time working. Most people seem to know of examples, usually funny stories, of scientists working through the night or missing something important since their attention is on the job. And perhaps there is a common understanding, that this is what is required of a good scientist. Mr. Schaller seems to think differently though. He leaves the rest of us thinking when he finishes our conversation:

- Science will take as much as you give it.

Vincent Dusastre – the first non-native English editor of a Nature magazine, seems to be addicted to work, as most of the participants in Obergurgl. With a background as a scientist, who took the chance and applied to Nature Materials, Dusastre moves among the nano-knowing scientists in Obergurgl with ease. This is business as usual to him and he seems to enjoy it.

Once a year or so, Dusastre visits his home area in France – Toulous. Here he meets with family and old friends. Apart from this, the only time he talks about something that is not work related is the ten minutes bike ride back and forth to work. Perhaps once a scientist, always a work-o-holic?

A small part of the speakers in Obergurgl created laughs, and I think only one of them succeeded in repeating that performance. **Robert Schlögl** did. He seemed to enjoy giving his speech and he took the opportunity to put nanotechnology in a bigger perspective.

- There shouldn't be a fight between different techniques – which is the better one – because we are going to need them all, to face the energy challenge, he said.

Perhaps the holistic view in his speech came naturally. In the afternoon break Mr. Schlögl (and many of the other participants) took a walk in the beautiful mountains surrounding the conference building.

Voices by (some of) the participants

"I didn't expect so many participants to go outside... But I would have expected it even less, had we been a group of only theoretical physicists!"

"It's really great to meet the celebrities of my field and even greater talking to the real stars as chemist to chemist – not as professor to PhD."

"All the speakers hold a high scientific standard".

"I haven't been to many conferences, so the first day I made a mistake. Now I have realized how important it is to make contacts. Fortunately this was easy, since many of us have a common interest – football!"

"I believe that some of the professors ask questions and show interest at the poster sessions just to be polite".

"I am here to meet people and find inspiration. I actually got an idea from one of the lectures, that I am going to try at home".

"The lectures give me a good overview of the scientific field. It is very important to be here and see what others are working on".

Annex 4: Sponsors

Platinum sponsor:



Gold sponsors:



Silver sponsors:



Poster prize sponsor:



Annex 5: Evaluation Questionnaire Results (data collected and analyzed by ESF)Conference Title: **Nanotechnology for Sustainable Energy**

Place and Dates: Obergurgl, near Innsbruck, Austria, 14 - 19 June 2008

Total number of participants: 88

Number of questionnaires received: 50

of which: Participants: 41

Speakers: 9

CONFEREE PROFILE1 - Age Group:

	20's	30's	40's	50's	60's	Unspec.
Participants	18	14	4	2	1	2
Speakers	0	2	0	4	2	1
Total	36%	32%	8%	12%	6%	6%

2 - Sex:

	Male	Female	Unspec.
Participants	35	6	0
Speakers	8	1	0
Total	86%	14%	0%

3 - Country Group:

	EU	Other WE	CEE	Other	Unspec.
Participants	30	1	2	5	3
Speakers	3	1	1	4	0
Total	66%	4%	6%	18%	6%

* EU = European Union ; WE = Western Europe ; CEE = Central and Eastern Europe

4 - Employer/Occupation:

	Academic	Industry	Unspec.
Participants	39	1	1
Speakers	8	0	1
Total	94%	2%	4%

5 - Number of EURESICO meetings previously attended:

	None	1-2	2-5	5-10	10+	Unspec.
Participants	34	6	0	0	0	1
Speakers	5	1	3	0	0	0
Total	78%	14%	6%	0%	0%	2%

THE CONFERENCE

SCIENCE (primarily the Speaker's responsibility)

1 - Presentations were at the "cutting edge of the science"

	AC	MA	NO	MD	DC	Unspec.
Participants	34	7	0	0	0	0
Speakers	9	0	0	0	0	0
Total	86%	14%	0%	0%	0%	0%

2 - Presentations defined and analysed the most important problems and opportunities

	AC	MA	NO	MD	DC	Unspec.
Participants	27	12	2	0	0	0
Speakers	9	0	0	0	0	0
Total	72%	24%	4%	0%	0%	0%

3 - Presentations were well delivered

	AC	MA	NO	MD	DC	Unspec.
Participants	23	14	2	1	0	1
Speakers	9	0	0	0	0	0
Total	64%	28%	4%	2%	0%	2%

4 - Presentations were conducive to discussion

	AC	MA	NO	MD	DC	Unspec.
Participants	27	12	2	0	0	0
Speakers	9	0	0	0	0	0
Total	72%	24%	4%	0%	0%	0%

DISCUSSION (responsibility shared by Session Chairmen and Conferees)

1 - There was sufficient time for formal discussion

	AC	MA	NO	MD	DC	Unspec.
Participants	23	16	1	1	0	0
Speakers	9	0	0	0	0	0
Total	64%	32%	2%	2%	0%	0%

2 - Session Chairmen stimulated the discussion, not simply managed them

	AC	MA	NO	MD	DC	Unspec.
Participants	6	28	7	0	0	0
Speakers	5	4	0	0	0	0
Total	22%	64%	14%	0%	0%	0%

3 - Discussions evoked and explored new research directions

	AC	MA	NO	MD	DC	Unspec.
Participants	9	20	11	1	0	0
Speakers	5	4	0	0	0	0
Total	28%	48%	22%	2%	0%	0%

4 - Discussions involved the whole group and were not dominated by a few individuals

	AC	MA	NO	MD	DC	Unspec.
Participants	10	23	5	3	0	0
Speakers	6	2	1	0	0	0
Total	32%	50%	12%	6%	0%	0%

AC = Agree Completely
MA = Mild Agreement
NO = No Opinion

MD = Mild Disagreement
DC = Disagree Completely

SCOPE (primarily the responsibility of the chairman)

1 - Themes and aims were timely

	AC	MA	NO	MD	DC	Unspec.
Participants	31	9	1	0	0	0
Speakers	9	0	0	0	0	0
Total	80%	18%	2%	0%	0%	0%

2 - Themes and aims were clearly communicated to conferees

	AC	MA	NO	MD	DC	Unspec.
Participants	30	10	1	0	0	0
Speakers	9	0	0	0	0	0
Total	78%	20%	2%	0%	0%	0%

3 - Stated conference aims were fully realised

	AC	MA	NO	MD	DC	Unspec.
Participants	29	10	2	0	0	0
Speakers	8	1	0	0	0	0
Total	74%	22%	4%	0%	0%	0%

ATMOSPHERE (responsibility shared by all) and GENERAL LAYOUT

1 - The conference was more than "just a meeting", or a collection of lectures

	AC	MA	NO	MD	DC	Unspec.
Participants	32	6	1	0	1	1
Speakers	8	1	0	0	0	0
Total	80%	14%	2%	0%	2%	2%

2 - There was an atmosphere conducive to easy exchange of information

	AC	MA	NO	MD	DC	Unspec.
Participants	33	7	0	0	0	1
Speakers	8	1	0	0	0	0
Total	82%	16%	0%	0%	0%	2%

3 - The schedule allowed ample time for informal discussion

	AC	MA	NO	MD	DC	Unspec.
Participants	30	8	2	0	0	1
Speakers	9	0	0	0	0	0
Total	78%	16%	4%	0%	0%	2%

4 - A representative balance of all national groups was achieved

	AC	MA	NO	MD	DC	Unspec.
Participants	23	16	1	0	0	1
Speakers	6	2	0	0	0	1
Total	58%	36%	2%	0%	0%	4%

5 - The balance between young and senior participants was appropriate

	AC	MA	NO	MD	DC	Unspec.
Participants	29	10	1	0	0	1
Speakers	9	0	0	0	0	0
Total	76%	20%	2%	0%	0%	2%

AC = Agree Completely
 MA = Mild Agreement
 NO = No Opinion

MD = Mild Disagreement
 DC = Disagree Completely

6 - The poster session provided significant scientific input to the meeting

	AC	MA	NO	MD	DC	Unspec.
Poster	13	9	2	0	0	0
No Poster	15	8	2	0	0	1
Total	56%	34%	8%	0%	0%	2%

AC = Agree Completely

MA = Mild Agreement

NO = No Opinion

MD = Mild Disagreement

DC = Disagree Completely

7 - Should the conference be repeated ?

	Yes	No	Unspec.
Participants	41	0	0
Speakers	9	0	0
Total	100%	0%	0%

WHAT BENEFIT do you expect / did you get? (more than one answer possible)

	A	B	C	D	E	F
Participants	27	18	15	13	0	0
Speakers	6	6	7	3	1	0
Total	66%	48%	44%	32%	2%	0%

A = a fine tuning of your research direction

B = new lasting contacts

C = a new collaboration with another lab

D = an exchange with another lab

E = a new employee

F = a new employer

THE MANAGEMENT / ORGANISATION (responsability of EURESCO)

1 - Administration before the conference

	E	G	S	U	Unspec.
Participants	33	6	1	0	1
Speakers	9	0	0	0	0
Total	84%	12%	2%	0%	2%

2 - Administration during the conference

	E	G	S	U	Unspec.
Participants	32	7	0	0	2
Speakers	9	0	0	0	0
Total	82%	14%	0%	0%	4%

E = Excellent

G = Good

S = Satisfactory

U = Unsatisfactory