

Annual Report 2006

Department of Chemistry

DEPARTMENT OF CHEMISTRY, NTNU

Høgskoleringen 5, 7491 Trondheim, Norway

Phone: +47 73550870

Fax: +47 73550877

E-mail: postmottak@chem.ntnu.no

Head of Department:

Professor David Nicholson

Deputy Head of Department:

Associate professor Trond Peder Flaten

Head of Administration:

Anne Langseth

COVER PAGE

The red colour of this marvellous flower is due to anthocyanins (from Greek: flower, blue) which are water-soluble pigments that appear red to blue according to pH. Anthocyanin pigments help insects to locate flowers. The colourful skins of fruits may be recognized by animals which will eat the fruits and disperse the seeds. Anthocyanins act also as powerful antioxidants protecting the plant from radicals formed by UV light or during metabolic processes.

Photo: David Nicholson

Contents	Page
Foreword	4
Research	
Highlights	
• A unique combination – Raman spectroscopy integrated into a synchrotron beamline	5
• Use of neutrons in chemistry: Diffusion of hydrogen in carbon materials	6
• A chemical reaction in a flame: What are the transport properties of reactants and products	8
• Transport on a nanoscale; at surfaces and contact lines	9
• The importance of separating mirror image molecules	10
• Put in source. New building blocks for chemists and the chemical industry	11
• Substrate limitations to the use of tetrabutylammonium-difluoride in fluorination of α -bromoacetophenones	12
• Electrifying teaching – from decomposing water to laparoscopy on an eel	14
• Electric potentials at potentially low price?	15
• Amino acids in the adsorbed state on charged metal surfaces	16
• Nanobased <i>in situ</i> sensors for environmental and industrial monitoring	18
• Automated voltammetric monitoring system in complex environmental samples	19
Projects	
• Applied biocatalysis: Stereosensitive and environmentally-friendly reactions catalysed by enzymes, COST action D25	20
• HUNT – The Nord-Trøndelag health study trace elements and health	22
Activities	
• Scientific publications	24
• Extracurricular Activities and Seminar Attendance	29
Graduate Students	
• Subjects and student attendance	41
• Students	44
Post Graduate Students	
• PhD in chemistry / Dr.scient. in chemistry	45
• MSc in chemistry / Cand.scient in chemistry	46
• MSc in chemistry / Siv.ing.	47
• Dr.ing. / Ph.D. projects in progress	48
• Student exchange to and from NTNU	50
Staff	
• Scientific staff	51
• Administrative staff	54
• Technical staff	54
• Scientific assistants	55
• Demonstrators and Guest Professors/Researchers	56

Foreword

This has been a year of change, opportunity and challenges for the Department. We started the process of restructuring our scientific profile in accordance with the Plan worked out at our Strategy Seminar at Bårdshaug in February 2006.

Obviously, the most important strategic actions relate to the appointment of new staff members as current staff retire. This will be an ongoing process over the years to come. A particular challenge for us is to recruit staff of the calibre that measures up to our ambitions and we are particularly conscious of the need to recruit highly qualified women.

Connected to these changes in staffing arises the obvious question: What should the size of the Department be? It does not follow that a retiring member of staff is automatically replaced. Every vacant position is subjected to a review. Since our teaching is defined as being research-based the guiding parameter is the teaching load borne by the Department as a whole. We aim for an average 50:50 ratio of research to teaching. Currently, the teaching load for some of our staff members is higher than this. Whilst this situation can be accepted for short periods it is unsustainable over time. We also need to factor in the fact that nearly 90% of NTNU's grant to the Department covers salaries which in the context of the Faculty's policy of reducing this figure to 80% is more than a challenge, it is a problem.

We are operating in a climate in which the University Board has a vision of NTNU being the highest ranked Norwegian university and amongst the ten best in Europe. Is this goal attainable? Well, the currently highest-ranked universities receive basic grants well in excess of those received by Norwegian universities. For example, the premier European technical university (Imperial College, London) receives funds that are four times more per student than NTNU, and EPFL, Lausanne which at rank ten occupies the position NTNU has set its sights on receives three times more. This ambition is clearly not commensurate with the current economics.



Our response to the realities of this economic climate is to make sure that our own house is in order. We are reviewing our portfolio of courses in order to see whether we can prune their number to a level that is consistent with the overall 50:50 split between teaching and research. This is conditional on not compromising the quality of our graduates. We also need to stimulate those activities that generate external income which at the same time needs to be balanced against the requirement that the Department carries out quality basic research. An area that we have focused on in 2006 is innovation. We have identified three promising areas for innovation. NTNU's Technology Transfer Office (TTO) is an integral part of the process. This will be a topic at our Strategy Seminar in April 2007.

David Nicholson



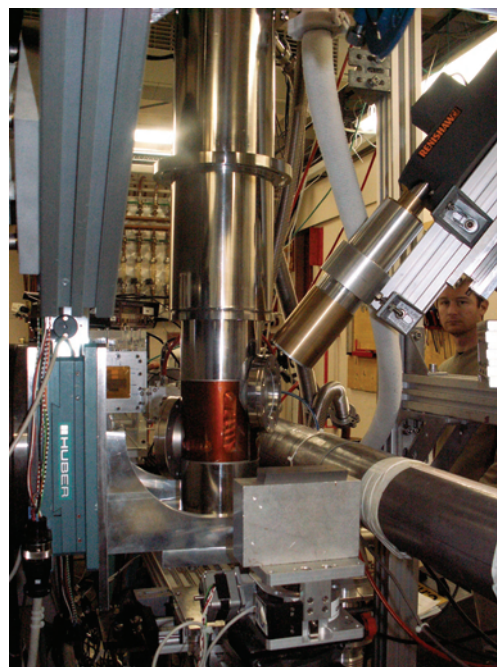
A Unique Combination - Raman spectroscopy Integrated into a Synchrotron Beamline

NTNU and the University of Lausanne are the founders of the Swiss-Norwegian Beamlines (SNBL) at the European Synchrotron Radiation Facility, Grenoble, France. SNBL is owned and operated by the SNX Foundation which is a consortium of Norwegian and Swiss universities and funding agencies.

On behalf of the Norwegian User Community, the Department of Chemistry was granted kr 1.0 million from the Norwegian Research Council to finance 50% of a Raman Spectrometer that will be incorporated into one of our beamlines. The Faculty contributed kr. 150.000. Our Swiss partners will contribute the remaining 50%.

The particular SNBL beamline concerned here is the unfocused line dedicated to X-ray diffraction (XRD) and absorption spectroscopy (XAS). These are the techniques of choice for studying long- and short-range order respectively in the solid state. In contrast, Raman spectroscopy is able to probe the scale between these two extremes. This is what makes the combination interesting to groups in both countries because all three techniques have in common that they are very suitable for *in situ* studies on a wide range of problems relating to various materials e.g. catalysts at relevant working conditions. Indeed, the combination is necessary for some studies. For example, the charge/defect distribution in NdNiO_3 is not detectable by XRD techniques but Raman scattering provides this information. [1]

With the availability of modern lasers and CCD detectors, the past decade has seen considerable improvements in Raman instrumentation.[2] It is now possible to simplify measures in ways conducive to *in-situ* measurements. [3]



The synergy between the synchrotron techniques and Raman spectroscopy is very attractive in advanced studies and a number of combined Raman and XRD or XAS experiments have been performed *ex situ*. However, more complex scientific problems cannot be satisfied by the *ex situ* approach. Fortunately, we are now at a stage where current methodology permits more ambitious experiments in which it is possible to fully integrate the techniques and carry out *in situ* experiments on the same sample under identical conditions.

This integrated approach is only possible at a synchrotron. In 2007 SNBL will concentrate resources on creating the first truly multipurpose Raman-synchrotron user facility.

References

1. M. Zaghrioui, A. Bulou, P. Lacorre, and P. Laffez, *Phys.Rev.B*, 64:081102, 2001.
2. W.H. Weber, R. Merlin "Raman Scattering in Materials Science," Springer-Verlag, 2000.
3. G. Mestl, M.P. Rosynek, J.H. Lunsford: . *Phys. Chem. B*, **101** (45), 9321 -9328, 1997

David G. Nicholson

Use of Neutrons in Chemistry: Diffusion of Hydrogen in Carbon Materials.

This is a PhD programme in inorganic/physical chemistry, and a part of the “Storforsk” project financed by the Research Council of Norway entitled “Transport on a nanoscale; at surfaces and contact lines in PEM fuel cells.” The project includes both theoretical and experimental works. In this programme we focus on the diffusion of hydrogen in the carbon material that is used in the PEM fuel cell. Neutrons are used to study the interactions between hydrogen and carbon.

Why use neutrons?

The neutron is a powerful tool for studying all types of matter: solids, liquids and gases. Neutrons have significant advantages over other kinds of radiation in the study of microscopic structure and dynamics. Neutrons scatter from materials by interacting with the nucleus of an atom and not the electron cloud. This means that the scattering power (cross-section) of an atom is not strongly related to its atomic number (the number of positive protons in the atom, and the number of negative electrons since the atom must remain neutral). This behaviour is in contrast with that shown by X-rays and electrons where the scattering power increases in proportion to the number of electrons in the atom. This means that neutrons are much better scattered by light atoms, e.g. hydrogen, in the presence of heavier atoms, or their neighbours in the Periodic Table. The latter have different scattering cross sections and therefore can be distinguished. Moreover, the nuclear dependence of scattering allows isotopes of the same element to have different scattering lengths for neutrons.

Where can we use neutrons?

Among several neutron sources, the Institute Laue-Langevin (ILL), Grenoble, France, is available for research scientists.[1] The ILL is an international research centre of neutron science and technology. ILL is the leading neutron source in Europe, and is funded by 13 countries. Its neutrons and scientific instrumentation are used by research scientists from the partner countries, and in addition the facility is available to about 1500 visiting scientists annually from several other countries. Neutrons at the ILL are produced by a High Flux Reactor, and it produces the most intense neutron flux in the world: 1.5×10^{15} neutrons per second per cm^2 with a thermal power of 58.3 MW. Normally, there are 4 cycles a year, providing 225 days for science.



An view of ILL. The neutron reactor is seen as the white cylinder to the left in the picture. With courtesy of the ILL.

Our first neutron experiment

We have studied the interactions between the surface of Vulcan XC-72R amorphous carbon and hydrogen molecules. The aim is to find the surface self diffusion coefficient of hydrogen molecules on a typical catalyst support used in the PEM fuel cell. This is fundamental to understanding the transport phenomena of hydrogen gas to the catalyst particles.



Sample and cryostat placed in the neutron beam. Photo: Astrid Lund Ramstad.

To achieve this we adsorbed a monolayer of H_2 on the carbon at 2K and measured the quasi-elastic neutron scattering (QENS) at increasing temperatures up till 300K by using the IN5 Time-of-flight (TOF) spectrometer at ILL [1]. The measured data was treated and we attempted to fit to the data. The model by Chudley and Elliott [2] was found to give the best fit, and this model has been used earlier in a similar study by Narehood *et al.* [3]. Diffusion coefficients were found for temperatures ranging from 40 to 70K by fitting a Lorentzian function to the measured spectra, thereby finding the HWHM as a function of $Q < 1 \text{ \AA}^{-1}$ (Figure 1).

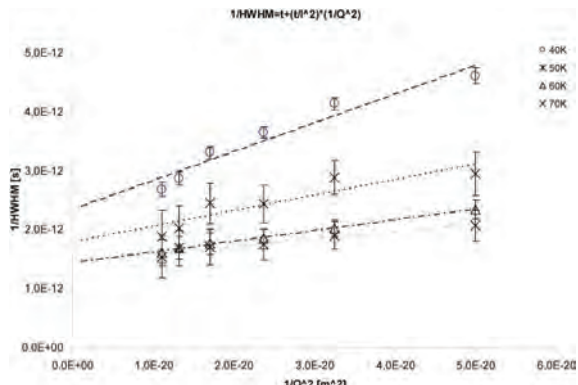


Figure 1: Fit to the inverse of HWHM versus the inverse of Q^2 .



These diffusion coefficients were then plotted in an Arrhenius plot to estimate the diffusion coefficient at room temperature (Figure 2).

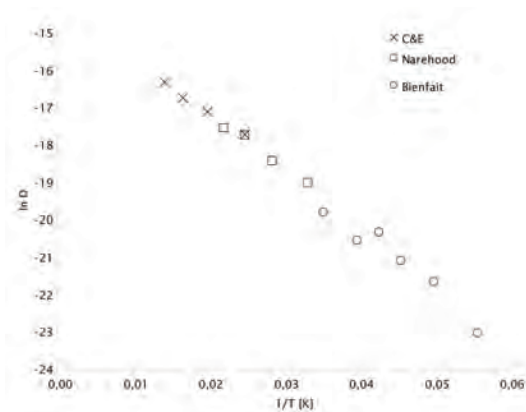


Figure 2: The data set from Narehood [3], Bienfait [4] and our fit to the C&E [2] model follows a similar trend.

The slope of the Arrhenius plot is $D_0 = 4.89 \cdot 10^{-7} \text{ m}^2/\text{s}$, and the activation energy is $E = 127.5 \text{ K}$. From this we can estimate the diffusion coefficient at room temperature from the equation $D_T = D_0 \cdot \exp(E/T)$, and

we get $D(300\text{K}) = 7.48 \cdot 10^{-7} \text{ m}^2/\text{s}$. This is an estimate of the surface diffusion of H_2 and further work is needed to improve our data. Data from a larger temperature range for our system would be desirable. Simulations of the system together with experimental data can give us a better view of how the transport on a small scale behaves.



This project is funded by the Research Council of Norway as a "Storforsk"- Programme led by Professor Signe Kjelstrup.

References

1. The ILL website: <http://www.ill.fr/>
2. Chudley & Elliott, Egelstaff, Oxford Science Publications, 1992.
3. D. G. Narehood, J. V. Pearce, P. C. Eklund, P. E. Sokol, R. E. Lechner, J. Pieper, J. R. D. Copley, J. C. Cook, Physical Review B (Condensed Matter and Materials Physics), 67 (2003) 205409.
4. M. Bienfait, P. Zeppenfeld, R. C. Ramos, J. M. Gay, O. E. Vilches, G. Coddens, Phys. Rev. B, 60 (1999) 11773.

Mr. Ole-Erich Haas and Dr. Astrid Lund Ramstad

A chemical reaction in a flame: What are the transport properties of the reactants and products?

In the extensive computer programs that are used to calculate fires, for instance on oil installations, it is common to assume that most of the chemical reactions that take place are in local equilibrium. This simplification allows one to calculate an approximate time-dependent turbulent flow pattern.

We have studied a chemical reaction in a large temperature gradient using molecular dynamics simulations. With this technique we succeeded in finding molecular support for the above assumption.

The reaction comes to equilibrium in every tiny control volume. Also, we were able to derive the transport equations for the components in the reacting gas, and reduce the data to give transport coefficients. Surprisingly, we found that the chemical reaction had a large impact on the thermal conductivity through the diffusion coefficient. Also, contrary to common belief, a large coupling coefficient was found for the coupling of heat and mass. These results must have a bearing on models like the ones mentioned above.

Recognition

The significance of the first part of this work, which is part of the PhD of Jing Xu, was recognised by being selected for the front cover of issue no 17 of Physical Chemistry, Chemical Physics, 2005.



This project is funded by the Research Council of Norway as a Storforsk Programme led by Professor Signe Kjelstrup.



Jing Xu, Dick Bedeaux and Signe Kjelstrup

In August 2006, Jing Xu obtained A prize for excellence in Thermodynamics from The International Association of Chemical Thermodynamics, on their Conference in Boulder, US, this year.

Publications

J. Xu, S. Kjelstrup and D. Bedeaux, Molecular dynamics simulations of a chemical reaction; conditions for local equilibrium in a temperature gradient, *Phys. Chem. Chem. Phys.* **8** (2006) 2017-2027

J. Xu, S. Kjelstrup, D. Bedeaux, J.M. Simon, Transport properties of $2F = F_2$ in a temperature gradient as studied by molecular dynamics simulations. *Phys. Chem. Chem. Phys.*, **9** (2007) 1-13

Transport on a nanoscale; at surfaces and contact lines

One objective of our research is to gain understanding of transport phenomena on the nanometer length scale, and develop tools that can be used to describe this transport. In order to achieve this we

1. continue the development of mesoscopic nonequilibrium thermodynamics
2. develop tools to predict surface transport properties
3. use molecular dynamics to obtain molecular insights
4. study transport around contact lines, as in fuel cells
5. study active transport in biological systems

Some glimpses on the activities in 2 and 3 are given below. (Progress on 5 was reported last year.)

Predicting rates of evaporation and condensation

Evaporation and condensation of liquids are central and well studied phenomena. Even so, the methods for calculating their rates are not well established. We have shown that there is considerable interference (so-called coupling) between the heat and mass flows that must be accounted for. Therefore, not only the resistance to mass and heat are needed to predict the rate of evaporation, but also the coupling resistance of heat and mass.

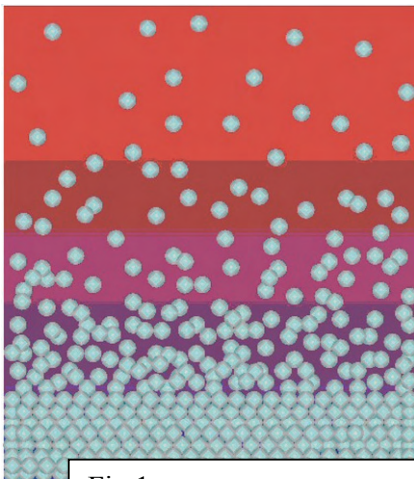
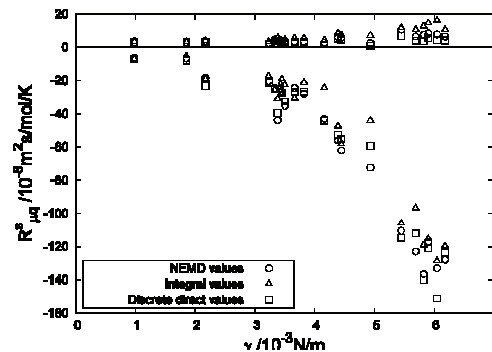


Fig.1.
Evaporation of liquid takes place when there are differences in temperature and pressure across the surface

One of the major accomplishments in 2006 has been the development of the analytical formulae for these coefficients, the so-called *integral relations* for surface transfer coefficients.

Another highlight was their verification by molecular dynamics (NEMD) simulations, work that was carried out in collaboration with our guest professor from The University of Bourgogne, France, Jean-Marc Simon. Results from these simulations are shown in Figure 2.



The figure shows the coupling coefficient, the coefficient that is frequently neglected, as calculated by the new formulae by Johannessen and Bedeaux, and computed from NEMD simulations by Simon and coworkers. The upper part of the figure give results for the vapor side of the surface, while the lower part of the figure give results for the liquid side of the interface.

This project is funded by the Research Council of Norway as a Storforsk Programme led by Professor Signe Kjelstrup.

Signe Kjelstrup and Dick Bedeaux

Publications:

E. Johannessen, D. Bedeaux, *Integral Relations for the Heat and Mass Transfer Resistivities of the Liquid-Vapor Interface*, Physica A 370 (2006) 258-274.

J.-M. Simon, S. Kjelstrup, D. Bedeaux, J. Xu, E. Johannessen, *Interface film transfer coefficients Verification of integral relations by nonequilibrium molecular dynamics simulations*, J. Phys.Chem. B, 110 (2006) 18528-18536

The importance of separating mirror image molecules

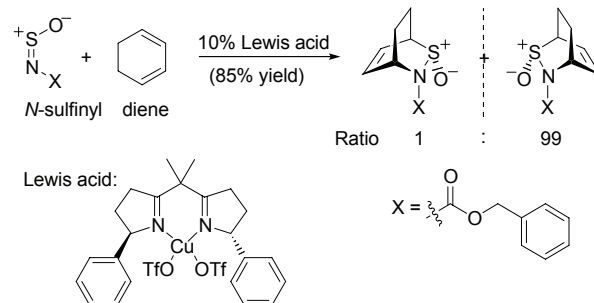
The Thalidomide scandal (1956 – 1962) is the best known example that mirror image molecules can lead to very different effects: one molecule provided relief from morning sickness and other symptoms for pregnant women, whilst the mirror image led to serious deformations. Dr. Odd R. Gautun has developed methods for separating mirror image molecules.

Many organic molecules occur as two variants with identical chemical composition. The only difference is that they mirror each other in the same way that the left hand is a mirror image of the right. “If a chemical reaction is performed without considering mirror images you will create as a rule just as many right hands as left hands” explains Associate Professor Odd R. Gautun of the Department of Chemistry, at the Norwegian University of Science & Technology (NTNU) in Trondheim.

This is an important consideration the pharmaceutical industry where eight of the world’s most sold products have non-identical mirror images, or “enantiomers”. The two mirror image molecules can have completely different effects on the human body. In the worst case, one compound can be a drug whilst its mirror image is toxic or otherwise harmful. A more benign example comes from the world of citrus fruits: the scent of oranges and lemons are “chiral enantiomers”.

Chiral production instead of separation

Pharmaceutical companies are of course most interested in the enantiomer that displays a healing effect. It is difficult to separate enantiomers after they have been produced and Dr. Gautun is focusing instead on developing methods that produce a single enantiomer. In one of these methods a catalyst is used that is itself enantiomerically pure. “We have tried to develop a new synthetic method which provides spatial control during the introduction of nitrogen into organic molecules. This allows us to synthesise many interesting molecules such as amino acids and penicillin-like substances. Our goal is to develop a process that requires very little catalyst” explains Gautun.



Anhydrous systems

The method employs metal atoms surrounded by organic molecules to direct the reaction. Gautun and his research colleagues, amongst others Molla M. Edenshaw and Annette Bayer, have achieved very good results for certain reagents. “For other systems the results have been poor. Over time we hope to develop catalyst systems that are more robust and which can function in water. For the time being we have to perform the reactions under anhydrous conditions. Many of the catalysts we use are known already, but we have worked with new combinations of reactants and additives to improve the catalyst’s efficiency and lifetime. We are also investigating the mechanisms in the reactions and we are trying to reveal their secrets so that we can optimise them” explains Gautun, and he adds “the thalidomide scandal is actually a poor example. In that case the “healthy” enantiomer was transformed into the poisonous enantiomer within the body

Translated from an article by Bjarne Røsjø, NFR

Put in source (translated from Norwegian interview ect.) New building blocks for chemists and the chemical industry

Some time ago, researchers at NTNU developed a process that made nitropyridine available for both research and commercial exploitation. This opened the door to new possibilities, which Prof. Anne Fiksdahl has used to produce a range of new pyridine compounds. The basis for this is the importance of pyridine as a fundamental building block for natural products, pharmaceuticals and agricultural products.

The relatively simple pyridine molecule is found in a wide range of biologically active natural products, and in valuable products within pharmaceuticals and agriculture. The Organic Chemistry Group at the Norwegian University of Science & Technology (NTNU) in Trondheim has been an important contributor to research into pyridine compounds since 1990, when Prof. Jan Bakke developed a new process for the nitration of pyridines. Previously, nitropyridines could only be obtained by nitration in low yields and under extreme conditions. Norsk Hydro, which at that time had a high level of activity within fine chemicals, supported the project.

A battery of new compounds

Professor Bakke's discovery made a series of nitropyridines readily available for synthetic and commercial use. Prof. Anne Fiksdahl starting with the Bakke nitration process, has produced a number of heterocyclic compounds most of which had not been previously synthesised. In addition, some known compounds can be synthesised more effectively.

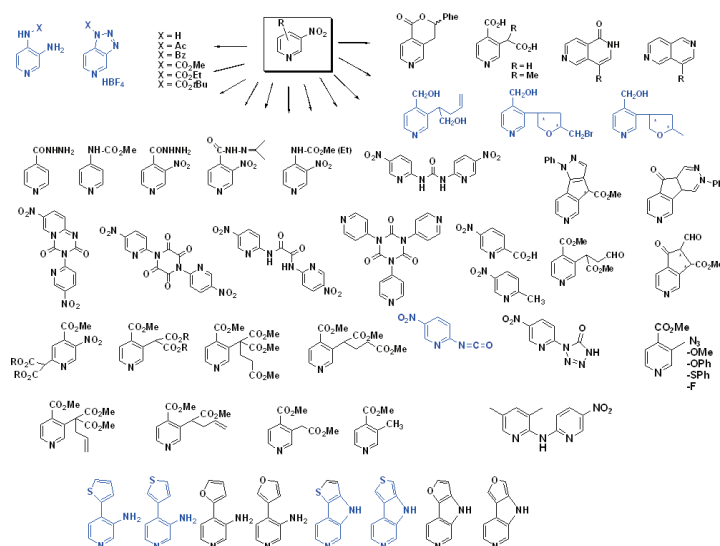
Professor Fiksdahl's group has prepared a list of 40 novel compounds (see below). The next stage of this research is to select some as candidates for testing for biological activity against fungi, viruses, bacteria and cancer cells.

Exciting group of compounds

Professor Bakke's process made new classes of pyridine compounds available. For example, prior to this process it had been impossible to prepare heterocyclic isocyanates because these compounds are unstable. Fiksdahl discovered that the introduction of a nitro-group stabilises the isocyanate thereby giving synthetic chemists a completely new group of compounds to study. "These are important precursor molecules because they expand the range of building blocks that can be used to synthesise completely new heterocyclic materials. For example, isocyanates are an exciting group of chemicals that are used as the basis for polyurethanes." The Norwegian Research Council (Program for catalysis and synthetic organic chemistry) supported the project with a grant for a PhD student, the importance of which Fiksdahl emphasises. "If it is not possible to pursue true basic research within organic chemistry then, by the same token, it is not possible to acquire a truly broad education in chemistry or to develop industrial applications"

The KOSK II programme is currently supporting the nitropyridine project further and collaboration has been established with chemists at the universities of Tromsø and Hamburg.

Application of nitropyridine derivatives for the preparation of new heterocyclic compounds



Substrate limitations to the use of tetrabutylammonium difluoride in fluorination of α -bromoacetophenones

The importance of fluorinated compounds in pharmaceutical science has been thoroughly recognised^{1,2}, and a number of drugs on the market contains fluorine. Although the acetophenone skeleton is a frequent encountered structural motif in drug structures, the utilisation of α -fluoroacetophenones is not overwhelming. One reason might be that routes for formation of α -fluoroacetophenones are not straight forward in terms of reagent availability and handling³⁻⁶. The main strategies are shown in Figure 1.

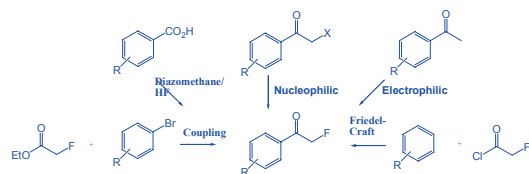


Figure 1. Main routes to α -fluoroacetophenones.

α -Bromoacetophenones are commonly used pharmaceutical intermediates, and would be a convenient source of new fluoroketones. Encouraged by previously reported fluorinations of 2-bromo-1-phenylethanone (**1a**) using tetrabutylammoniumhydrogen difluoride (TBAHF₂)^{7,8}, α -bromoacetophenones were selected as starting materials for the preparation of α -fluoroacetophenones, **2a-2i**.

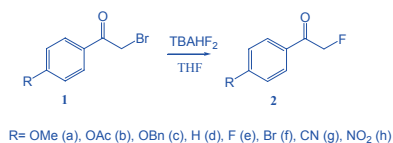


Figure 2. Fluorination of α -bromoacetophenones

Activation of TBAHF₂ using amine bases

Activation of the reagent using pyridine or triethylamine has been claimed beneficial⁸. In our hands, this depleted the yield by the side reactions shown in Figure 3. Using 2,6-lutidine, such adducts were not observed in the timeframe of the reaction. However, no benefit could be seen in its use.

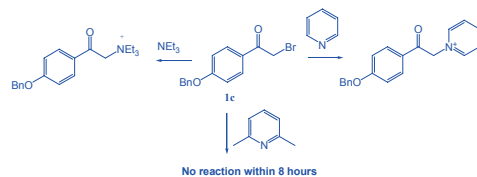


Figure 3. By-products observed when using amines as activators in nucleophilic fluorination

Fluorination of α -bromoacetophenones

A series of α -bromoacetophenones (Figure 2) were subjected to fluorination using TBAHF₂ as fluoride source with no activating amine and THF as reaction solvents. The results are summarised in Table 1.

Table 1. Reaction yield in fluorination of α -bromoacetophenones 1a-1i.

Substrate	Reaction time (h)	Reaction yield (%)	Isolated yield (%)
OMe	3	69	48
OBn	3	58	51
H	6	47	Not det.
F	6	48	36
Br	7.5	39	33
CF ₃	9	37	31
CN	2.5	24	20
NO ₂	3	24	20
OAc	6	12	10

The yield varied depending on the R-group of the aromatic ring. Decent yields were observed for "electron rich" acetophenones, whereas a steady decrease in yield was observed upon introduction of more electron withdrawing substituents. A fairly good correlation between reaction yield and the Hammett σ -constant was found (Figure 4).

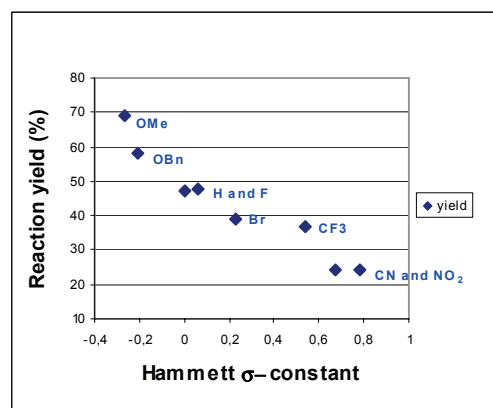


Figure 4. Reaction yield vs. the Hammett σ -constant.

Fluorination of the bromoketone **1b** resulted in a very modest outcome. The acetyl group does not survive the reaction conditions, and the released acetic acid acts as a competing nucleophile at the bromoketone.

Yield depleting side reactions:

In order to improve the reaction it is of importance to identify the yield depleting side-tracks.

All reactions were associated with production of polar oligomers with unresolved structure. Some of these structural elements contained fluorine.

Hydrolysis can be easily tracked by NMR, and did not appear as a major problem (1-2%). The formed α -hydroxyacetophenones, **3**, could act as nucleophiles on another bromoketone. However, these dimer ethers, **4**, were not observed.

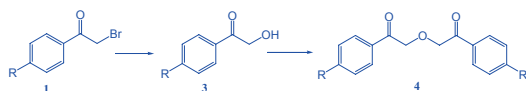


Figure 5. Hydrolysis of the α -bromoacetophenones.

Evidence was found for two types of condensation reactions taking place. For the α -bromoacetophenones **1d-1i** interesting cyclopropane structures **5** were formed. When R=H, F, Br and CF₃, the formation of these compounds accounted for ca 20% loss in yield. The assumed reaction pathway is shown in Figure 6.

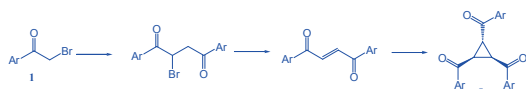


Figure 6. Reaction pathway to cyclopropane-1,2,3-triyltris(aryl)methanones (**5**).

For the methoxy- (**1a**) and benzyloxy- (**1c**) derivatives, compound **5** was not identified. However in reaction of **1a**, NMR indicated the presence of the intermediate 2,3-buten-1,4-dione.

A dimeric by-product was also observed. The enolate of the bromoketones adds in an Aldol reaction to the carbonyl carbon of another bromoketone. The resulting bromohydrin then cyclises to the epoxide **6**.

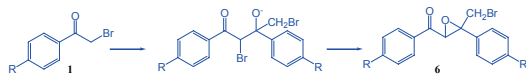


Figure 7. Aldol reaction followed by cyclisation to the epoxide **6**.

The epoxide **6d** was isolated and characterised by NMR. This reaction does not seem to be a major

side track. However, compound **6** is highly reactive and might be an intermediate in formation of more complex oligomers.

Conclusions

α -Bromoacetophenones containing electron donating substituents can be fluorinated in decent yield using tetrabutylammonium hydrogen fluoride. However, a continuous drop in yield was observed when the electronic content of the aromatic ring is increased.

Activation of the reagent does not seem beneficial for this substrate class.

Several important side tracks have been identified, which will guide in further optimisation of this reaction.

Reference List

1. Begue, J. P.; Bonnet-Delpon, D. *Journal of Fluorine Chemistry* **2006**, *127* (8), 992-1012.
2. Kirk, K. L. *Journal of Fluorine Chemistry* **2006**, *127* (8), 1013-1029.
3. Bridge, C. F.; O'Hagan, D. *Journal of Fluorine Chemistry* **1997**, *82* (1), 21-24.
4. Katoch-Rouse, R.; Pavlova, O. A.; Calder, T.; Hoffman, A. F.; Mukhin, A. G.; Horti, A. G. *Journal of Medicinal Chemistry* **2003**, *46* (4), 642-645.
5. Kitazume, T.; Asai, M.; Lin, J. T.; Yamazaki, T. *Journal of Fluorine Chemistry* **1987**, *35* (3), 477-488.
6. Ramachandran, P. V.; Teodorovic, A. V.; Gong, G.; Brown, H. C. *Tetrahedron: Asymmetry* **1994**, *5* (6), 1075-1086.
7. Bosch, P.; Camps, F.; Chamorro, E.; Gasol, V.; Guerrero, A. *Tetrahedron Lett.* **1987**, *28* (40), 4733-4736.
8. Moughamir, K.; Atmani, A.; Mestdagh, H.; Rolando, C.; Francesch, C. *Tetrahedron Lett.* **1998**, *39* (40), 7305-7306.

Erik Fuglseth and Bård Helge Hoff

Electrifying teaching - from decomposing water to laparoscopy on an eel.

For some years the Department of Chemistry has collected material from the former chemistry departments of the College of Arts and Science and the Norwegian Institute of Technology. (The two institutions merged in 1996 to form NTNU.) This year, the collection was incorporated into a recently established course on the history of science (in collaboration with the Department of Physics). A number of permanent staff members were involved in this course.

Firstly, the students were assigned course work, the results of which were put on display in an exhibition, "BLÅ 1910" ("Blue 1910") in Realfagsbiblioteket (the Science Library). The exhibition gratifyingly was received with acclaim by the University newspaper "Universitetsavisen".

Secondly, three iconic historical experiments were replicated. The experience of preparing these, accompanied by research on the original texts from various sources, made it possible to present contributions in two international conferences, thereby enhancing incrementally our department's contribution to the famous FRIDA (Forskningsresultater, informasjon og dokumentasjon av vitenskapelige aktiviteter) database that is an important factor in enhancing our income.



One of these experiments was the decomposition of water in an instrument made by the Norwegian instrument maker, Ole Georg Gjøsteen, around the turn of the 19th century. It was used as a demonstration experiment at the former Norwegian Institute of Technology, NTH, after it was inaugurated in 1910. The decomposition of water is a more than 200 years old iconic experiment, which is still depicted in most general chemistry books today. As a power supply another icon in the history of our subject, namely the voltaic pile, was constructed with the help of Egil Torsetnes in accordance with Volta's letter to Sir Joseph Banks in March 1800 which was read for the Royal Society.

We were able to show that an apparently simple experiment, portrayed and quoted for more than 200 years as the ultimate proof for the composition of water, the ratio of hydrogen to oxygen in the water molecule being exactly 2 to 1, that includes a trust in Avogadro's law, Gay-Lussac's law, stoichiometry in general and Faraday's law may be flawed?

As in the good spirit of the 19th century we used the human body, that is our hands (and not mouth, nose, ears, eyes or other parts of evacuation which so many who investigated the power of electricity at the time used) as an analytical instrument to detect the power of our pile, the effect of which is expressed on the face of some students as they are being electrocuted.



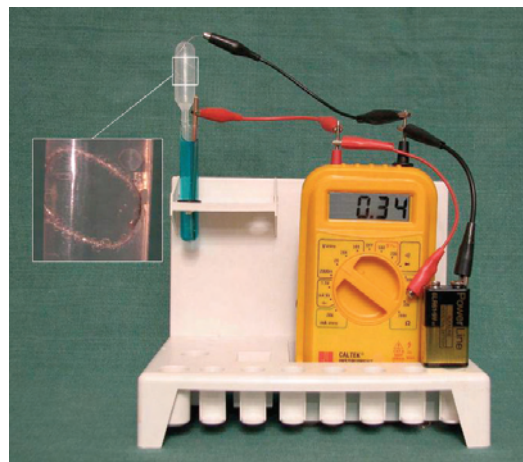
The analogy between the natural world, in this case in the form of the electric eel, and science was further investigated when we purchased a, to us, representative of these animals from our local fish market, which we by laparoscopy searched for its electric organ with even less sophisticated biological know-how. We were soon to realise that our animal was far from a representative of the electric eel; nor was our place of dissection very accurate, both blunders well known already in 1773 when Mr Welsh laments that these extraordinary animals do not grace the British seas when he was forced to conduct his research in the slightly hostile environment of La Rochelle. We were further to agree with the Maire of La Rochelle who also attended these experiments of which he reported "That indeed all yet done was little more than opening the door to inquiry".

Lise Kvittingen

Electric potentials at potentially low price?

The Chemistry Education Group continues to investigate and develop classical experiments and traditional methods in chemistry teaching practice. Too many experiments are uncritically handed down through generations of chemists and textbooks. Few bother to scrutinise the applied models, equipment used, chemical waste problems and incoherent explanations. The combination of declining school budgets and children's and youth's love for hands-on experience demands an intellectual and practical investment in this important area of chemistry education.

This year Per Odd Eggen, a Ph.D. student in our Department, received the Adèle La Roche prize which aims at stimulating competency in and interest for chemistry in Norwegian schools. Per Odd Eggen has investigated the manner in which electrochemistry is presented in higher secondary schools and basic university level and is developing a cheap, simple, and hopefully, robust hydrogen electrode that will remedy some experiments which suffer from low budgets.



These types of investigations and developments depend on extensive periods of interchange between users and researchers before robust results are obtained. Currently, the electrode is used in a number of Norwegian schools as well as in South Africa.

Lise Kvittingen

Amino acids in the adsorbed state on charged metal surfaces

The outstanding importance of amino acids as building blocks of proteins is well known but many amino acids enjoy a particular attention due to specific health and nutritional issues. Selenomethionine (SeMet, inset to Figure) which belongs to this category is a selenium analogue of the essential amino acid methionine and is widely used as a nutritional supplement in order to correct for selenium deficiency in humans and livestock. We decided to investigate this compound [1], [2] not only because of its biological relevance but also because it displays some interesting features from the standpoint of molecular electronics. Indeed, selenium functionalities display a strong affinity to metals like gold and promote the adsorption of organic derivatives to this metal surface. In this form, the selenium functionality is an efficient electron bridge between a metal and a conducting molecule.

We have previously investigated the reactivity of organic monoselenides (including an electron acceptor moiety) in an adsorbed state on gold [3], [4]. Compared to these compounds, SeMet has a less intricate structure that provides evidence of characteristic features of monoselenide functionality through interactions with a metal surface. Moreover, adsorbed SeMet is relevant to the study of the effects of charged interfaces on the ionisation of amino acid functionalities.

The interaction of SeMet with the charged gold surface, as well as the reactivity of the adsorbed species in contact with aqueous solutions, was studied by electrochemical methods (including electrochemical impedance spectrometry) and by the piezoelectric nanobalance.

An examination of electric charge distribution at the interface revealed the ionisation state of the adsorbed amino acid molecule as a function of solution pH. Relevant results are presented in the Figure which displays the distribution of protonation states for the dissolved (broken lines) and adsorbed (full line) form. From this it is clear, that the adsorption induces a marked decrease in the acidic strength of the carboxyl group whereas the ionisation of the amino group experiences negligible modifications under these conditions. The modification of the acidity is the result of the interplay between various factors like surface electric charge, hydrogen bonding and electrostatic interactions. These results demonstrate for the first time the possibility of tuning the ionisation constant of an amino acid by a physical process: adsorption at a charged metal. Up till now, chemical derivatisation that involves a significant alteration of the molecule configuration was the only way for achieving this goal. Self-assembly of amino acids by chemisorption at metal surfaces can therefore be a viable approach that contributes to the field of artificial enzymes [5] since modifying the acid strength of the amino acid residue could imparts catalytic activity to the system.

The reactivity of the selenium group was mainly established by means of the piezoelectric nanobalance in conjunction with electrochemical determinations. It was observed that adsorption causes partial conversion to seleno-homocysteine of SeMet by cleaving the methyl selenium group. The stoichiometry of the electrochemical oxidation processes involving the adsorbed compounds was also assessed and elemental selenium, as well as different oxygenated organic selenium derivatives, were identified as oxidation products.

Another feature of interest is the metal ion binding to adsorbed amino acids and its effects on the electrochemical reactivity of the metal ion. We have demonstrated that SeMet can act as a catalyst in nickel ion reduction [2] and this property was applied to develop an analytical method for determining SeMet in nutritional supplements. According to the manufacturer's guidelines, selenium can be present in such products either as an organic (SeMet) or inorganic compound (sodium selenite or selenious acid). Our method can reliably detect SeMet without interference from various forms of inorganic selenium. Further investigations proved that analogous methods are suitable for determining other amino acids of nutritional relevance such as arginine and ornithine [6].

In conclusion, amino acid adsorption to metal surface via side-chain functionality may modify the acid-base behaviour of the specific amino acid groups with potential applications in controlling the reactivity of such compounds. Our continuing studies are aimed at exploring in more detail the effect of the surface electric charge and surface ion distribution in order to design a procedure for gradually tuning the acid properties of the adsorbed amino acid. Photoelectron spectrometry will be employed for investigating the interaction of the binding group with the gold substrate.

Support

This work involved scientists from NTNU and universities in Romania and Poland. It was partially supported by the NATO Science for Peace Program under Project PST.EAP.CLG 980619. Two of the authors (B.K. and D.G.) were exchange students (Erasmus program) from the University of Lodz, Poland.

References

- [1] A. Banica, A. Culetu, F.G. Banica, *J. Electroanal. Chem.*, 599 (2007) 100.
- [2] F. G. Banica, B. Kafar, S. Skrzypek, W. Ciesielski, *Electroanalysis*, 18 (2006) 2269.

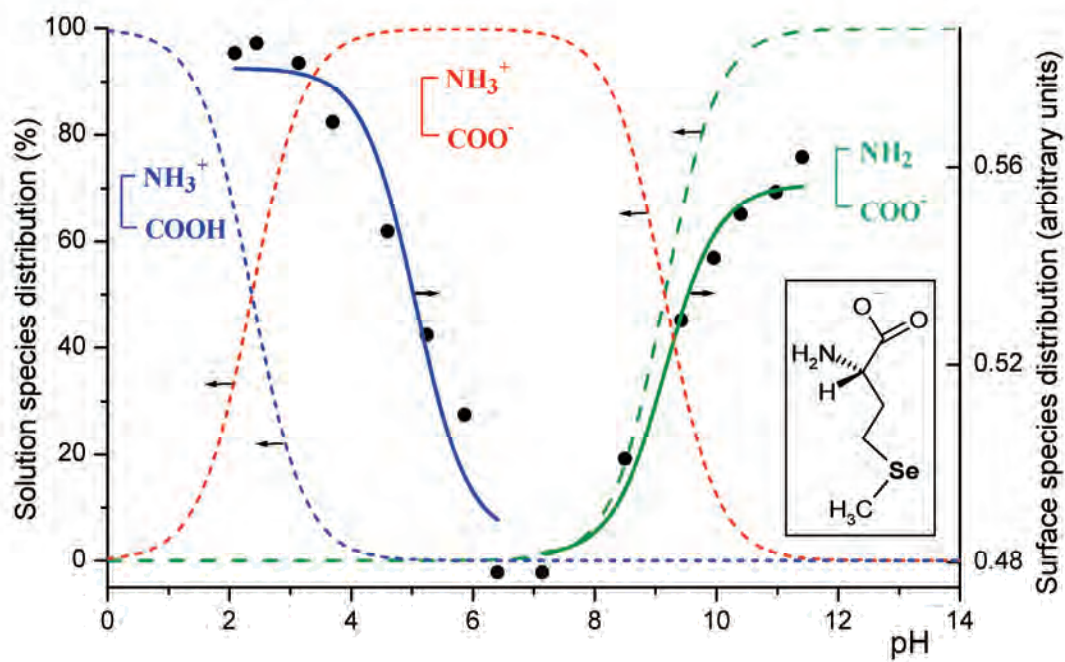
[3] B.-J. Foss, A. Ion, V. Partali, H.-R. Sliwka, F. G. Banica, *J. Electroanal. Chem.*, 593 (2006) 15-28.

[4] B.-J. Foss, A. Ion, V. Partali, H.-R. Sliwka, F. G. Banica, *Collect. Czech. Chem. Commun.*, 69 (2004) 1971.

[5] Y. Murakami, J. Kikuchi, Y. Hisaeda, O. Hayashida, *Chem. Rev.* 96 (1996) 721.

[6] F. G. Banica, Dariusz Guziejewski, S. Skrzypek, W. Ciesielski, (a) 11th International Conference on Electroanalysis; Bordeaux, 11-15 June 2006; (b) Manuscript in preparation.

Florinel-Gabriel Banica



Nanobased *in situ* sensors for environmental and industrial monitoring

In several current process-analytical techniques there is a lack of speed, accuracy, and sensitivity in the measurements. Furthermore, in many cases the overall cost of carrying out the measurements is too high. Accordingly, there is a need to develop new sensor systems that meet the demands for future use. Ion Selective Field Effect Transistor (ISFET) technology is an interesting alternative that makes possible the development of sensors that are robust enough to satisfy the stringent demands of the environmental and industrial markets for monitoring key chemicals. This technology contributes to sustainable growth through the provisions of eco-efficient solutions to tackling a range of environmental problems at different levels.

ISFET is the technology of choice because of its versatility with respect to the solvents used, low manufacturing costs, and the high degree of selectivity relative to traditional ion selective electrodes. ISFET technology is based on monitoring changes in an electrical signal caused by chemical reactions on a sensor surface.

The basis for these sensors is the Metal Oxide Field Effect Transistor (MOSFET), where the metal oxide layer is replaced with an ion selective surface. The field-effect-transistor (FET) unit is simply a transistor that relies on an electric field to control the shape, and hence the conductivity of a channel in a semiconductor material. ISFET sensors utilising solid-state electronics have significant advantages over traditional ion selective electrodes, including high stability, increased robustness in difficult matrixes, multisensor possibilities, miniaturisation and microfabrication, large scale low costs fabrication, *in vivo* use and lab-on-a-chip systems.

The inherent stability, selectivity and robustness gives ISFET electrodes unique properties that are relevant for process and quality control over a wide range of matrixes in industry, environmental monitoring, and medicine. The scientific and commercial challenge is to develop small micro-systems based on nanotechnology.



ISFET and solid state sensors

There is an extensive group of potential users of ISFET sensors in areas such as medicine, food industry (food quality and food safety), the chemical and metallurgical industries, in process and product control, waste water and environmental monitoring, sensors in technological devices (in cars, boats, airplanes etc.). An area of special interest is the offshore and marine sector.

Øyvind Mikkelsen

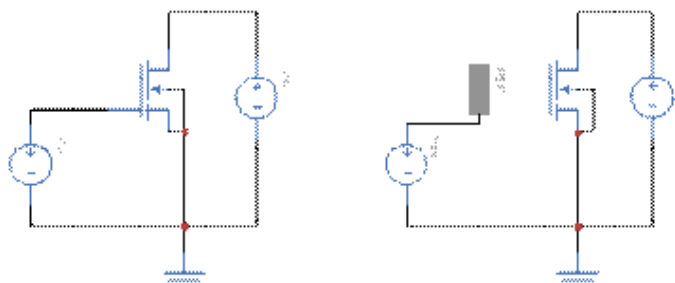


Figure.1 The MOSFET/ISFET setup circuit

Automated voltammetric monitoring system in complex environmental samples

In 2006 the Analytical Chemistry Group at NTNU embarked on a new challenge by carrying out research on voltammetry applied to complex wastewater analysis. An online automated monitoring station has been installed at the Høvringen Wastewater Treatment Plant for monitoring trace metals in the treated effluents, which are discharged into Trondheim Fjord

Voltammetry has recently proved its usefulness in monitoring trace metals in various environmental samples. Monitoring stations have been previously successfully installed by our group in order to monitor trace metals in river or sea water. Systems for the online monitoring of heavy metals in complex wastewater samples are not common presently, and extensive research is currently being carried out by us. The results obtained from the monitoring station are encouraging and form the basis for further development. Whereas the voltammetric system measures the electrolabile metal content (which is very important because this amount often represents the toxic part in a water system of metals that are readily accessible to organisms and bioaccumulation) ICP-MS gives the total metal content. Comparing results obtained by these two analytical methods enables us to determine the distribution and speciation of the metals.

Voltammetric measurements were carried out on a sample that closely resembled the original wastewater. The addition of chemicals was limited to an absolute minimum. All chemical analyses were performed automatically, but some technical maintenance was manually carried out. Although the voltammetric system used in the field requires some technical maintenance, the equipment can work automatically for up to five days and still give reliable information. This period should be sufficient for a large water treatment plant where operators are present only for a few hours during day shifts. Furthermore, the manual maintenance routine takes

only about 10 - 30 minutes, and may in the future be carried out by any personnel.

Kristina Strasunskiene and Øyvind Mikkelsen



Figure 1. Høvringen wastewater treatment plant is situated 2 km north west of the city near Trondheim fjord.

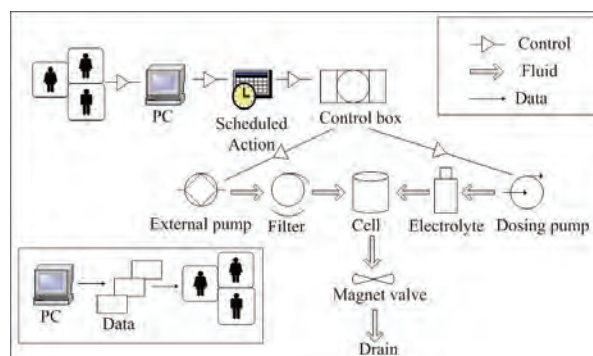


Figure 2. Schematic diagram of automatic monitoring system.

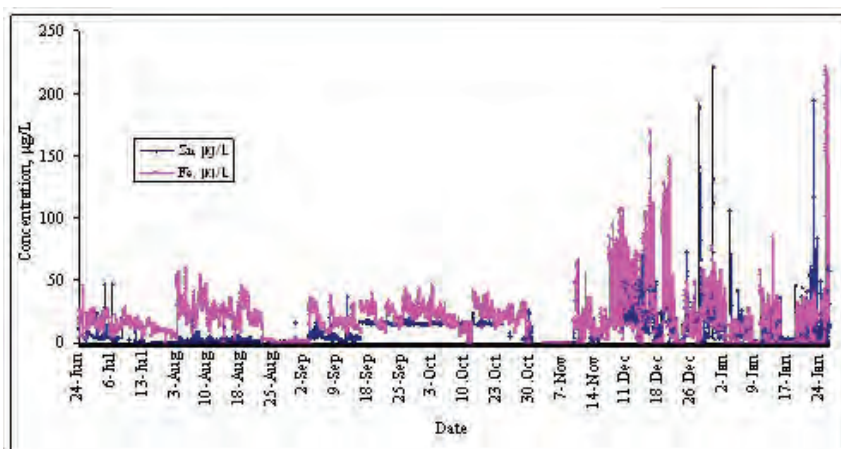


Figure 3. Continuous voltammetric measurements of zinc and iron at the Høvringen wastewater treatment plant (Trondheim, Norway). The measurements have been performed every 30 minutes in a period of 7 months.

Applied Biocatalysis: Stereoselective and Environmentally-friendly Reactions Catalysed by Enzymes, COST Action D25.

ABOUT COST

Founded in 1971, COST is an intergovernmental framework for European **Co-operation in the field of Scientific and Technical Research**, allowing the co-ordination of nationally funded research on a European level. COST Actions cover basic and pre-competitive research as well as activities of public utility.

The goal of COST is to ensure that Europe holds a strong position in the field of scientific and technical research for peaceful purposes, by increasing European co-operation and interaction in this field.

The member countries participate on an "à la carte" principle and activities are launched on a "bottom-up" approach. One of its main features is its built-in flexibility. This concept clearly meets a growing demand and in addition, it complements the Community programmes.

COST has a geographical scope beyond the EU and most of the Central and Eastern European countries are members. COST also welcomes the participation of interested institutions from non-COST member states without any geographical restriction.

COST has developed into one of the largest frameworks for research co-operation in Europe and is a valuable mechanism co-ordinating national research activities in Europe. Today COST had around 230 running Actions (2006) and involves approx. 30,000 scientists from 34 European member countries and more than 160 participating institutions from 23 non-member countries and Non Governmental Organisations.

European Science Foundation, ESF provides the COST Office through an European Commission contract.

The Council of the European Union provides the COST Secretariat.

COST COUNTRIES

In total, institutions from 58 countries participate in COST under different forms:

The 34 member states are:

Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, The Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, The Republic of Serbia, Former Yugoslav Republic of Macedonia.

CHEMISTRY AND MOLECULAR SCIENCES AND TECHNOLOGIES

The Domain Chemistry and Molecular Sciences and Technologies has the mission of fostering European

expertise in discovering, understanding, producing and manipulating molecular species. These research activities aim to develop experimental, theoretical and analytical tools to enhance the development of chemical transformations, reactivity and function. The CMST aims to apply such knowledge and innovation to industrial processes and production.

COST ACTIONS

COST is based on Actions. These are networks of co-ordinated national research projects in fields, which are of interest to a minimum number of participants (at least 5) from different member states. The Actions are defined by a Memorandum of Understanding (MoU) signed by the Governments of the COST states wishing to participate in the Action. The duration of an Action is generally 4 years.

ACTION D25: APPLIED BIOCATALYSIS: STEREOSELECTIVE AND ENVIRONMENTALLY-FRIENDLY REACTIONS CATALYSED BY ENZYMES

D25 was initiated in 2001 by professor Thorleif Anthonsen who wrote the memorandum of understanding and defended it for the Technical Committee in Brussels. The MoU was accepted and 22 nations signed it. These are the nations underlined above under COST countries.



COST and ESAB (European Federation of Biotechnology, Section for Applied Biocatalysis) members in Bymarka in connection with the conference: Applied Biocatalysis 1980-2020: The future impact of modelling proteins and thermodynamics.

The main objective of the Action was to develop new biocatalytic reactions with special emphasis on stereoselectivity and environmentally friendly processes. This objective has been pursued by providing new biocatalysts and new biocatalytic processes. The wide field of biocatalysis will ideally

comprise researchers from areas such as microbiology, enzymology, molecular biology, structural biology and organic chemistry. The Action, which is terminated in April 2007, has also attracted industrial research groups interested in production of enantiopure chiral building blocks mainly for synthesis of pharmaceutical purposes.

The Action consists of six Working Groups.

1. New Enzymes and Selective Methods for Glycosidase-Catalysed Synthesis of Bioactive Glycosides and Glycomimetics. Coordinator Vladimir Kren, CZ.
2. Nitrile- and Amide-hydrolyzing Enzymes as Tools in Organic Chemistry, Coordinator Ludmila Martínková, CZ.
3. New Biotransformations Using Enzymes and Catalytic Antibodies, Coordinator Jean-Louis Reymond, CH.
4. Solving the Problems Enzymes Encounter in Organic Solvents, Coordinator Ulf Hanefeldt, NL.
5. Biooxidation, Coordinator Marko Mihovilovic, AT.
6. Enzymatic approaches to the synthesis and manipulation of non-natural amino acids, Coordinator Stefano Servi, IT.



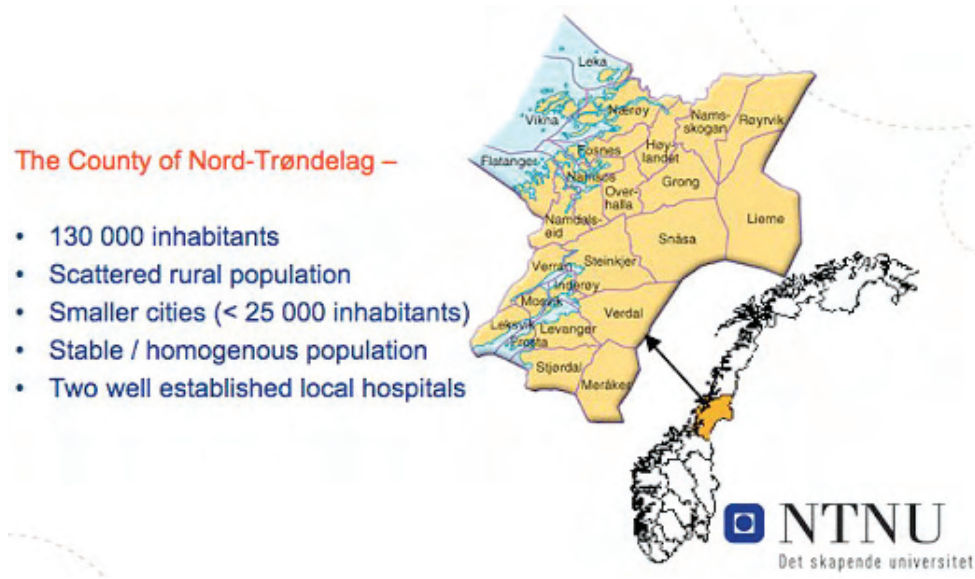
COST participants at workshop in Greece, Pia Hara from Turku Finland together with the Biocatalysis Group at NTNU, from left Erik Fuglseth, Geir Kildahl-Andersen and Anders Riise Moen.

The results of the action will be available in a comprehensive report. A special issue of *Journal of Molecular Catalysis, B Enzymatic*, and a book entitled *Modern Biocatalysis* (Wiley) with contributions of the Action members, will be published in 2007/08. The network that has been formed during the Action, comprises 48 research groups in Europe. This will form a platform for future collaborations. There are several calls in the 7th Framework programme in which Biocatalysis and Bioprocesses are important. These include *Lignocellulosis Enzymes for biomass pre-treatment*, *Lipid Enzymes for lipid modification*, *Designer Enzymes for Bioprocesses*, *More robust micro-organisms*, *Improved Microbes*, *Enzymes for conversion to Bioethanol*, *Novel Enzymes* and more.

Moreover, in the SusChem programme the first of eight themes of *major importance for sustainable chemistry* implies *Biocatalysis-novel and improved enzymes and processes*.

Thorleif Anthonsen

HUNT – The Nord-Trøndelag health study Trace elements and health



The County of Nord-Trøndelag –

- 130 000 inhabitants
- Scattered rural population
- Smaller cities (< 25 000 inhabitants)
- Stable / homogenous population
- Two well established local hospitals

The Nord-Trøndelag health study (HUNT) is one of the largest health studies ever performed. HUNT is owned by NTNU, and organized as part of the Faculty of Medicine at NTNU. The goal of HUNT has been to study the health of all inhabitants above 20 years of age in Nord-Trøndelag County. A large amount of information has been collected: Each participant has received a questionnaire by mail which is filled out before the participant attends the screening site, which is set up in each municipality in Nord-Trøndelag county according to a time schedule. At the screening site, the participant receives one or more additional questionnaires, which is filled out partly at the screening site and partly later, and returned by mail. Also at the screening site, clinical measurements (blood pressure, height, weight etc.) are performed and blood samples are collected. Together, the data from the questionnaires, clinical measurements and blood samples comprise a huge database for research.

In most respects, Nord-Trøndelag County is fairly representative of Norway, for example regarding geography, economy, industry, and sources of income, age distribution, morbidity and mortality. The population in the county (128,694 residents per 1 January 2006) is stable, with a net out-migration of only 0.3% per year (1996-2000), and homogenous (less than 3% non-Caucasian), making it well suited for epidemiological studies.

What makes the HUNT database very valuable for research is the large amount of information collected from each participant, the large number of participants in a wide age range covering an entire county population, and particularly the fact that the study has been repeated, so the participants can be followed over time. At present (January 2007), the data collection phase of the third generation of

HUNT studies has just started. In short, the 3 HUNT studies are (see the HUNT website for additional information, http://www.hunt.ntnu.no/index_nyforside.php?side=english):

HUNT 1 was carried out in 1984-1986, and was primarily designed to cover four sub-studies: on hypertension, diabetes, lung diseases and quality of life. No blood samples were collected, except in a sub-study on diabetes. About 88% of the population aged 20 and older participated (74,599 persons).

HUNT 2 was carried out in 1995-1997, and comprised a considerably larger scientific programme than HUNT 1. The main objectives were aimed at the large public health issues like cardiovascular disease, diabetes, obstructive lung disease, osteoporosis and mental health. About 71% of the population aged 20 and older participated (66,140 persons). In addition, the age group 13-19 years was added as a separate study (Young-HUNT). Venous blood samples were collected from 98.7% of the participants (65,291 persons) and stored in a biobank, frozen at -70°C .

HUNT 3 was started in October 2006, and the data collection will be finished in June 2008 (Verran and Namsos municipalities). In 2006, the 3 municipalities Snåsa, Grong and Lierne were sampled, with a participation rate of 70% of all inhabitants above 30 years, indicating that the total participation rate will be similar to HUNT 2. This is very encouraging, because the participation rate declined from 88% to 71% from HUNT 1 to HUNT 2, and a declining participation rate seems to be a general problem for health surveys worldwide. A high participation rate is crucial for the scientific value of a health study, particularly regarding the representativity of the results obtained.

For HUNT 3, the most important difference relative to HUNT 1 and HUNT 2 is the emphasis on blood samples. 5 blood samples will be collected in Vacutainers from each participant. Each of these blood samples will be divided into several sub-samples (aliquots), avoiding the need to thaw the entire sample when blood is needed for a particular research project. All in all, about 4 million samples of blood or blood fractions (including DNA and RNA) will be stored in the new biobank building in Levanger. All of these samples will be stored frozen, most at $-80\text{ }^{\circ}\text{C}$, but some also in the gas phase of liquid nitrogen (about $-180\text{ }^{\circ}\text{C}$). The logistics for storing and retrieving these 4 million samples has represented enormous challenges, and the building costs for the new biobank building are about 60 million Nkr. In addition to this, the costs for HUNT 3 have been estimated to about 160 million Nkr, of which about 50% (excluding the biobank building) is related to the blood sampling.

The planning phase of HUNT 3 has lasted for several years. Instrumental to the planning has been the 17 thematic groups, of which "Environmental medicine" is one. The authors are key persons in this thematic group, and our main contribution to the design of HUNT 3 is that the last of the 5 blood samples collected will be devoted to the analysis of trace elements and other compounds which may indicate environmental exposure. This blood sample will be collected and treated in such a way as to minimize external contamination from metals and other trace elements. The sample (7 mL, collected in a Vacutainer specially designed for trace metal sampling) will be divided into seven 0.8 mL aliquots (in polypropylene tubes), six of which will be stored at $-80\text{ }^{\circ}\text{C}$ and one in liquid nitrogen.

One of the main uses for these "trace element blood samples" will be in so-called "nested case-control studies" and studies of similar design. In such studies, cases of a particular disease diagnosed in the population of Nord-Trøndelag subsequent to the HUNT 3 screening are compared with disease-free control persons. Blood samples are then retrieved from the biobank for these cases and controls, together with relevant questionnaire and clinical

data. The nested case-control design is very powerful in studies of disease causes, largely because blood samples and information are collected before the disease manifests itself. It will of course take several years before studies of this kind can be conducted on the HUNT 3 material. Currently, we are performing a nested case-control study of trace elements in Parkinson's disease, using the blood samples collected in HUNT 2 in 1995-1997. This study will be part of Kristin Gellein's doctoral thesis at the Department of Chemistry, and has been performed in collaboration with neurologists in Nord-Trøndelag (Ole-Petter Dahl, Sascha Mitrovic and Dusan Duraj).

We will also perform other types of studies of trace elements. One such study under current planning is to collect age-matched samples from urban and rural societies ranging from the coast to the mountains. We will include "new" trace elements for which "normal values" have not been established in Norway. These "new" trace elements originate from products which has reached the market place during the last 10-30 years and where the population have had no previous exposure. Typical examples of such products are computer hardware and other consumer electronics.

The key to our planned trace element studies in HUNT 3 is our recently acquired HR-ICP-MS analytical instrument, the most powerful analytical technique currently available for multielement analysis at low concentrations. The instrument is described in an article by Lierhagen and Flaten in the 2005 Annual Report from the Department of Chemistry. Another important tool is our new (installed at the Department of Chemistry in January 2007) microwave-based UltraCLAVE instrument for rapid and efficient digestion of blood and other samples. With these tools, we are confident that the HUNT material will form a basis for numerous research projects (including Master's and PhD theses) and national and international collaborations for many years to come at our two departments.

Trond Peder Flaten, Department of Chemistry
Tore Syversen, Department of Neuroscience

Scientific publications

Chemistry Dissemination

Eggen, Per-Odd; Grønneberg, Truls; Kvittingen, Lise. Small-scale and low-cost galvanic cells. *Journal of Chemical Education* 2006;83:1201-1203

Eggen, Per-Odd; Kvittingen, Lise. Elektrolyse av vann. *Naturfag* 2006(2):66-67

Eggen, Per-Odd; Kvittingen, Lise. Lag ditt eget batteri. *Naturfag* 2006(2):64-65

Eggen, Per-Odd; Grønneberg, Truls; Kvittingen, Lise. Simple electrochemical cells. *Microscale*

Chemistry - Experimentation For All Ages, p. 119-120. Eds. Hugerat, Muhamad; Schwartz, Peter; Livneh, Mordechai. Pub: Israel, Haifa: The Academic Arab College for Education in Israel 2006.

Kvittingen, Lise; Sjursnes, Birte; Eggen, Per Odd. Two simple and small scale experiments with enzymes. *Microscale Chemistry - Experimentation For All Ages*, p. 222-225. Eds. Hugerat, Muhamad; Schwartz, Peter; Livneh, Mordechai. Pub: Israel, Haifa: The Academic Arab College for Education in Israel 2006.

Environmental and Analytical Chemistry

Banica, Florinel Gabriel; Kafar, Beata; Skrzypek, Slawomira; Ciesielski, Witold. Selenomethionine-catalyzed nickel ion reduction at a mercury electrode: applications in the analysis of nutritional supplements. *Electroanalysis* 2006;18(22):2269-2272

Berg, Torunn; Fjeld, E; Steinnes, Eiliv. Atmospheric mercury in Norway: Contributions from different sources. *Science of the Total Environment* 2006;368:3-9

Garcia, S.; Gellein, Kristin; Syversen, Tore; Aschner, M. Iron deficient and manganese supplemented diets alter metals and transporters in the developing rat brain. *Toxicological Sciences* 2006;95:205-214

Garcia, Stephanie; Gellein, Kristin; Syversen, Tore; Aschner, Michael. A manganese-enhanced diet alters brain metals and transporters in the developing rat. *Toxicological Sciences* 2006;92(2):516-525

Garmo, Øyvind Aaberg; Lehto, NJ; Zhang, H; Davison, W; Røyset, Oddvar; Steinnes, Eiliv. Dynamic aspects of DGT as demonstrated by experiments with lanthanide complexes of a multidentate ligand. *Environmental Science & Technology* 2006;40:4754-4760

Garmo, Øyvind Aaberg; Naqvi, Kalbe Razi; Røyset, Oddvar; Steinnes, Eiliv. Estimation of diffusive boundary layer thickness in studies involving diffusive gradients in thin films. *Analytical and Bioanalytical Chemistry* 2006;386(7-8):2233-2237

Gioia, R; Steinnes, Eiliv; Thomas, GO; Mejier, SN; Jones, Kevin C. Persistent organic pollutants in European background air: derivation of temporal and latitudinal trends. *Journal of Environmental Monitoring* 2006;8

Grotmol, Tom; Bernhoft, Aksel; Eriksen, Gunnar Sundstøl; Flaten, Trond Peder. Endocrine

Disrupters. Proceedings from a symposium held at The Norwegian Academy of Science and Letters, Oslo, 13-14 October 2005. Oslo: Novus Forlag 2006. ISBN 978-82-7099-437-3. 164 s.



Mikkelsen, Øyvind; Garnier, C; Lesven, L; Billon, G; Magnier, A; Pižeta, I. Voltammetric procedure for trace metal analysis in polluted natural waters using homemade bare gold-disk microelectrodes. *Analytical and Bioanalytical Chemistry* 2006;386(2):313-323

Mikkelsen, Øyvind; Schröder, Knut Henning; Van den Berg, Constant M. G. Determination of labile iron at low nmol L⁻¹ levels in estuarine and coastal waters by anodic stripping voltammetry. *Electroanalysis* 2006;18(1):35-43

Skjelkvåle, Brit Lisa; Steinnes, Eiliv; Rognerud, Sigurd; Fjeld, Eirik; Berg, Torunn; Røyset, Oddvar. Trace metals in Norwegian surface waters, soils, and lake sediments - relation to atmospheric deposition. Oslo: Norsk institutt for vannforskning 2006. ISBN 82-577-4943-5. 69 p.

Skogvold, Silje Marie; Mikkelsen, Øyvind; Billon, G; Garnier, C; Lesven, L; Barthe, JF. Electrochemical properties of silver-copper alloy microelectrodes for use in voltammetric field apparatus. *Analytical and Bioanalytical Chemistry* 2006;384

Steinnes, Eiliv; Friedland, AJ. Metal contamination of natural surface soils from long-range atmospheric transport: Existing and missing knowledge. *Environmental Reviews* 2006;14:169-186

Organic Chemistry

Andreassen, Einar Johan; Bakke, Jan Magnus. Preparation of 6-azaaxindole (6-azaindol-2(3H)-one) and substituted derivatives. *Journal of Heterocyclic Chemistry* 2006;43

Elgsæter, Arnljot; Foss, Bente Jeanette; Li, B.; Sliwka, Hans-Richard; Partali, Vassilia; Melø, Thor Bernt; Naqvi, Kalbe Razi; Næss, Stine Nalum. Hydrophilic carotenoids: Surface properties and aggregation of crocin as a biosurfactant. *Helvetica Chimica Acta* 2006;89

Endeshaw, Molla; Bayer, Annette; Hansen, Lars Kristian; Gautun, Odd Reidar. Catalytic Asymmetric Hetero Diels-Alder Reactions of N-Sulfinyl Dienophiles with Chiral Bis(oxazoline)copper(II) and -zinc(II) Triflates. *European Journal of Organic Chemistry* 2006:5249-5259



Foss, Bente Jeanette; Ion, A; Partali, Vassilia; Sliwka, Hans-Richard; Banica, Florinel Gabriel. Electrochemical and EQCM investigation of a selenium derivatized carotenoid in the self-assembled state at a gold electrode. *Journal of*

Strasunskiene, Kristina; Mikkelsen, Øyvind; Schrøder, Knut Henning; Rydningen, Marion. Continuous monitoring of trace metals in wastewater effluents using voltammetric system. I: Water and environmental management series. Young Researchers 2006 : IWA Publishing 2006. ISBN 1843395134. p. 279-286

electroanalytical chemistry and interfacial electrochemistry 2006;593:15-28

Hansen, Lars Kr.; Tjosås, Freddy; Fiksdahl, Anne. Methyl 5-nitro-2-(phenylamino)pyridine-4-carboxylate. *Acta Crystallographica. Section E: Structure Reports Online* 2006;62:O3728-O3729

Hoff, Bård Helge; Anthonson, Thorleif; Fuglseth, Erik. New chiral building blocks from acetovanillone using lipase A and B from *Candida antarctica*. *Tetrahedron: asymmetry* 2006;17(8):1290-1295

Holt, Jarle; Bakke, Jan Magnus; Fiksdahl, Anne. 1,3-dihydro-2H-imidazo[4,5-c]pyridin-2-one. *Journal of Heterocyclic Chemistry* 2006;43

Holt, Jarle; Fiksdahl, Anne. N-acyl and N-alkoxycarbonyl derivatives of 1H-1,2,3-triazolo[4,5-c]pyridine; Preparation and application. *Journal of Heterocyclic Chemistry* 2006;43

Hovelstad, H; Leirset, Ingebjørg; Oyaas, K; Fiksdahl, Anne. Screening analyses of pinosylvins stilbenes, resin acids and lignans in Norwegian conifers. *Molecules* 2006;11

Hymete, Ariaya; Rohloff, Jens; Iversen, Tor-Henning; Kjösen, Helge. Volatile constituents of the roots of *Echinops kebericho* Mesfin. *Flavour and fragrance journal* 2006;22(1):35-38

Kildahl-Andersen, Geir; Anthonson, Thorleif; Jensen, Synnøve Liaen. Novel diapocarotenoid dications with VIS/NIR absorption. *Tetrahedron Letters* 2006;47

Knag, Magne Kawai; Bilkova, Katerina; Gulbrandsen, Egil; Carlsen, Per Henning; Sjöblom, Johan. Langmuir-Blodgett films of dococyltriethylammonium bromide and octadecanol on iron. Deposition and corrosion inhibitor performance in CO₂ containing brine. *Corrosion Science* 2006;48:2592-2613

Liu, Huiling; Bernhardsen, M; Fiksdahl, Anne. Polybrominated diphenyl ethers (BDEs); preparation of reference standards and fluorinated internal analytical standards. *Tetrahedron* 2006;62

Lutnaes, Bjart Frode; Brandal, Øystein; Sjöblom, Johan; Krane, Jostein. Airchzeal C-80 isoprenoid tetraacids responsible for naphthenate deposition in crude oil processing. *Organic and biomolecular chemistry* 2006;4:616-620

Moen, Anders Riise. Nye trender i organisk og organometallisk kjemi : det 10. Organisk kjemiske høstmøte. Kjemi 2006(1):24

Nytoft, Peter; Lutnaes, Bjart Frode; Johansen, Jon Eigill. 28-Nor-spergulanen, a novel series of rearranged hopanes. Organic Geochemistry 2006;37(7):772-786

Samsun, Mohamad Baharin Bin; Yousef, Y. A.; Melø, Thor Bernt; Partali, Vassilia; Jávorfí, T; Sliwka, Hans-Richard; Naqvi, Kalbe Razi. Singlet oxygen quenching by thione analogues of canthaxanthin, echinenone and rhodoxanthin. Journal of Photochemistry and Photobiology. B, Biology 2006;84(2):135-140

Sperstad, Sigmund; Lutnaes, Bjart Frode; Stormo, Svein Kristian; Jensen, Synnøve

Liaaen; Landfald, B. Torularhodin and torulene are the major contributors to the carotenoid pool of marine *Rhodospiridium babievae* (Golubev). Journal of Industrial Microbiology & Biotechnology 2006;33

Størseth, Trond Røvik. Structural characterization and potential as immunostimulants. Trondheim: NTNU 2006. ISBN 82-471-7787-0. 145 p.

Tjosås, Freddy; Fiksdahl, Anne. A simple synthetic route to methyl 3-fluoropyridine-4-carboxylate by nucleophilic aromatic substitution. Molecules 2006;11:130-133

Øpstad, Christer Lorentz; Partali, Vassilia. Synthesis and properties of hydrophilic highly unsaturated amphiphiles for gene transfer. NTNU-Trondheim: Øpstad L. Christer 2006. 86 p.

Physical Chemistry and Biochemistry

Afset, Jan Egil; Bruant, G; Brousseau, R; Harel, J; Anderssen, Endre; Bevanger, Lars Solbu; Bergh, Kåre. Identification of virulence genes linked with diarrhea due to atypical enteropathogenic *Escherichia coli* by DNA microarray analysis and PCR. Journal of Clinical Microbiology 2006;44:3703-3711

Aquilante, Francesco; Pedersen, Thomas Bondo; Sánchez de Merás, Alfredo; Koch, Henrik. Fast noniterative orbital localization for large molecules. Journal of Chemical Physics 2006;125(17):174101-174107

Bedeaux, Dick; Kjelstrup, Signe; Öttinger, Hans Christian. On a possible difference between the barycentric velocity and the velocity that gives translational momentum in fluids. Physica A: Statistical Mechanics and its Applications 2006;371:177-187

Bedeaux, Dick; Kjelstrup, Signe; Zhu, Lianjie; Koper, Ger J.M.. Nonequilibrium thermodynamics-A tool to describe heterogeneous catalysis. Physical Chemistry, Chemical Physics 2006;8:5421-5427

Burheim, Odne Stokke; Kjelstrup, Signe; Vie, Preben Joakim Svela; Møller-Holst, Steffen. A method to measure thermal conductivities and contact resistances of fuel cell components . I: Proceedings of the 19th International Conference of Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems (ECOS 2006). Athens: National Technical University of Athens 2006. ISBN 960-87584-1-6. p. 1445-1450

Buttingsrud, Bård; Alsberg, Bjørn Kåre. Superresolution of hyperspectral images. Chemometrics and Intelligent Laboratory Systems 2006;84:62-68

Buttingsrud, Bård; Ryeng, Einar; King, Ross D.; Alsberg, Bjørn Kåre. Representation of molecular

structure using quantum topology with inductive logic programming in structure-activity relationships. Journal of Computer-Aided Molecular Design 2006;20:361-373

Chassagne, Claire; Bedeaux, Dick; Van der Ploeg, JPM; Koper, GJM. Electrically induced anisotropy in a colloidal dispersion of nanospheres as measured by electric birefringence. Journal of Colloid and Interface Science 2006;295



Cuesta, Garcia; Pedersen, Thomas Bondo; Koch, Henrik; Sanchez de Meras, Alfredo. Carbon Nanorings: A Challenge to Theoretical Chemistry. *ChemPhysChem* 2006;7:2503-2507

Gidskehaug, Lars; Anderssen, Endre; Alsberg, Bjørn Kåre. Cross model validated feature selection based on gene clusters. *Chemometrics and Intelligent Laboratory Systems* 2006;84(1 - 2):172-176

Hansen, Halvor Schrøder; Åstrand, Per-Olof; van Duin, Adri C. T. Modelling of carbohydrates with a reactive force field. Trondheim: Tapir trykk AS 2006. 58 p.

Helbæk, Morten; Kjelstrup, Signe. Fysikalsk kjemi. Bergen: Fagbokforlaget 2006. ISBN 8245004049. 796 s.

Iwakabe, K.; Nakaiwa, Masaru; Huang, K.; Nakanishi, Toshinari; Røsjorde, Audun; Ohmori, takao; Endo, Akira; Yamamoto, Takuji. Energy saving in multicomponent separation using an internally heat-integrated distillation column (HIDiC). *Applied Thermal Engineering* 2006;26:1362-1368

Johannessen, Eivind; Bedeaux, Dick. Integral relations for the heat and mass transfer resistivities of the liquid-vapor interface. *Physica A: Statistical Mechanics and its Applications* 2006;370:258-274

Johansen, Tore Harry; Hagen, Kolbjørn. Conformational structure of gaseous 3-chloropropanoyl chloride by electron diffraction, normal coordinate analysis, and ab initio molecular orbital, and density functional theory calculations. *Journal of Physical Chemistry A : Molecules, Spectroscopy, Kinetics, Environment and General Theory* 2006;110:11136-11144

Kjelstrup, Signe; Bedeaux, Dick; Johannessen, Eivind. Elements of irreversible thermodynamics for engineers. Trondheim: Tapir Akademisk Forlag 2006. ISBN 8251921287. 123 p.

Kjelstrup, Signe; Johannessen, Eivind; Røsjorde, Audun. Entropy Production Minimization Confirm Two Well Established Process Technologies. I: Proceedings of the 19th International Conference of Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems (ECOS 2006). Athens: National Technical University of Athens 2006. ISBN 960-87584-1-6. p. 503-512

Kjelstrup, Signe; Ramstad, Astrid Lund. Prosjekter i fysikalsk kjemi grunnkurs. Trondheim: Tapir akademiske forlag 2006. ISBN 82-519-1748-4. 124 p.

Koch, Henrik. Fast noniterative orbital localization for large molecules. *Journal of Chemical Physics* 2006;125(17)



Liu, Xiangrong; Zhu, Bin; Xu, Jing. Development of low temperature and surface tolerant solid oxide fuel cells using Li₂SO₄-ceria composite electrolytes. *Journal of Power Sources* 2006

Meland, Anne-Kristine; Kjelstrup, Signe; Bedeaux, Dick. Rate limiting proton hydration in the anode of the polymer electrolyte membrane fuel cell. *Journal of Membrane Science* 2006;282:96-108

Nakajima, Hironori; Nohira, Toshiyuki; Ito, Yashuhiro; Kjelstrup, Signe; Bedeaux, Dick. The surface adsorption of hydride ions and hydrogen atoms on Zn studied by electrochemical impedance spectroscopy with a non-equilibrium thermodynamic formulation. *Journal of Non-Equilibrium Thermodynamics* 2006;31:231-255

Osted, Anders; Kongsted, Jacob; Mikkelsen, Kurt V.; Åstrand, Per-Olof; Christiansen, Ove. Statistical mechanically averaged molecular properties of liquid water calculated using the combined coupled cluster/molecular dynamics method. *Journal of Chemical Physics* 2006;124:124503

Ratushnaya, Valeria; Kulinskii, Vladimir; Zvelindovsky, Andrei; Bedeaux, Dick. Hydrodynamic model for the system of self propelling particles with conservative kinematic constraints; two dimensional stationary solutions. *Physica A: Statistical Mechanics and its Applications* 2006;366:107-114

Rubi, Miguel; Bedeaux, Dick; Kjelstrup, Signe. Thermodynamics for single-molecule stretching experiments. *Journal of Physical Chemistry. B, Condensed Matter, Materials, Surfaces, Interfaces & Biophysical* 2006;110

Sandvik, Arne Kristian; Alsberg, Bjørn Kåre; Nørsett, Kristin; Yadetie, Fekadu; Waldum, Helge; Lægreid, Astrid. Gene expression analysis and clinical diagnosis. *Clinica Chimica Acta* 2006;363

Simon, Jean-Marc; Bedeaux, Dick; Kjelstrup, Signe; Johannessen, Eivind. Transfer Coefficients for liquid-vapor transitions derived for n-octane. I: Proceedings of the 19th International Conference of Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems (ECOS 2006). Athens: National Technical University of Athens 2006. ISBN 960-87584-1-6. p. 347-353

Simon, Jean-Marc; Bedeaux, Dick; Kjelstrup, Signe; Xu, Jing; Johannessen, Eivind. Interface film resistivities for heat and mass transfers-integral relations verified by non-equilibrium molecular dynamics. *Journal of Physical Chemistry. B, Condensed Matter, Materials, Surfaces, Interfaces & Biophysical* 2006;110:18528-18536

Smalø, Hans Sverre; Weck, Gaetan; Åstrand, Per-Olof. Molecular Mechanics Model for Electronic Polarization: a Combined Atom-Atom Charge-Transfer and Point-Dipole Interaction Model. I: Recent Progress in Computational Sciences and Engineering. Leiden: Brill Academic Publishers 2006. ISBN 9004155422. p. 1200-1203



Tofteberg, Terje; Åstrand, Per-Olof; Karlström, Gunnar. Combined quantum chemical and statistical mechanical simulations of the divalent cations of Mg, Ca, Sr, and Cu in water. Trondheim: Tapir trykk AS 2006. 71 p.

Tøndel, Kristin; Anderssen, Endre; Drabløs, Finn. Design of selective protein inhibitors using PASSA and PAS-Dock. Abstracts of papers – American Chemical Society 2006;231

Tøndel, Kristin; Anderssen, Endre; Drabløs, Finn. Protein Alpha Shape (PAS) Dock: A new gaussian-based score function suitable for docking in homology modelled protein structures. *Journal of Computer-Aided Molecular Design* 2006;20(3):131-144

van der Avoird, A; Pedersen, TB; Dhont, GSF; Fernandez, B; Koch, Henrik. Ab initio potential-energy surface and rovibrational states of the HCN-HCl complex. *Journal of Chemical Physics* 2006;124

Xu, Jing; Kjelstrup, Signe; Bedeaux, Dick. Molecular dynamics simulations of a chemical reaction; conditions for local equilibrium in a temperature gradient. *Physical Chemistry, Chemical Physics* 2006;8:2017-2027

Xu, Jing; Kjelstrup, Signe; Bedeaux, Dick; Røsjorde, Audun; Rekvig, Live. Verification of Onsager's reciprocal relations for evaporation and condensation using non-equilibrium thermodynamics. *Journal of Colloid and Interface Science* 2006;299:452-463

Zhu, Lianjie; Koper, Ger J.M.; Bedeaux, Dick. Heats of transfer and the surface temperature for a catalytic hydrogen oxidation reaction. *Journal of Physical Chemistry. B, Condensed Matter, Materials, Surfaces, Interfaces & Biophysical* 2006;110:4080-4088

Zhu, LJ; Koper, GJM; Bedeaux, Dick. Heats of transfer in the diffusion layer before the surface and the surface temperature for a catalytic hydrogen oxidation ($H_2 + (1/2)O_2 \rightarrow H_2O$) reaction. *Journal of Physical Chemistry A : Molecules, Spectroscopy, Kinetics, Environment and General Theory* 2006;110

Zvolinschi, Anita; Johannessen, Eivind; Kjelstrup, Signe. The second-law optimal operation of a paper drying machine. *Chemical Engineering Science* 2006;61:3653-3662

Honours, Extracurricular activities, Participation in courses, conferences, lectures and study visits

B. Alsberg

Conference "Det 18. norske kjemometrisymposium", Hafjell, Norway, March 20 – 22, 2006.
Co-author on lecture on: Separering av proteinsegment fra støysegment ved DPLSR i 2D gel elektroforese.

Regional forsknings- og utviklingskonferanse 2006 "Forskning – endring satt i system", Stjørdal, Norway, April 24 – 25, 2006.
Co-author on poster presentation: Definisjon av en "livsstilsalgoritme" til anvendelse for forebygging, diagnose og terapi ved kronisk sykdom.

7th Siena Meeting From Genome To Proteome, Siena, Italy, Sep. 3 – 7, 2006.
Co-author on poster presentation: Automatic spot classification in 2DE gel analysis Genome To Proteome.

The 16th European Symposium on Quantitative Structure-Activity Relationships & Molecular Modelling, Italy, Sep. 10 – 17, 2006.
Co-author on poster presentation: An alignment-free methodology for modelling field-based 3D-structure activity relationships using inductive logic programming.

E. Anderssen

231st American Chemical Society National Meeting, Atlanta, Georgia, USA, March 26 – 30, 2006.
Co-author on lecture on: Design of selective protein inhibitors using PASSA and PAS-Dock.

The 7th International Conference on Systems Biology, ICSB 2006, Japan, Oct. 8 – 13, 2006.
Co-author on poster presentations: "A nutrigenomics approach to define a "lifestyle algorithm" to be used in chronic disease prevention", "Optimization of cDNA microarrays procedures using optimization criteria that does not rely on an external standard" and "Global gene expression in HEK 293 cells with controllable ICER I or II gamma overexpression".

T. Andreassen

Conference "21. Organisk kjemisk vintermøte", Skeikampen, Norway, Jan. 12 – 15, 2006.
Co-author on poster presentation: Sigmatropic rearrangements of allylic sulfinimidamides.

Final seminar: Catalysis and Organic Synthetic Chemistry (KOSK), Gardermoen, Norway, Nov. 2 – 3, 2006.
Co-author on poster presentation: Stereoselective ene-reactions with N-sulfinyl sulfinamides.



T. Anthonsen

Member of Editorial Board: Journal of Molecular Catalysis, B Enzymatic Biocatalysis and Biotransformation.

Chairman Management Committee COST Action D25. Applied Biocatalysis, Stereoselective and Environmentally Friendly Reactions Catalyzed by Enzymes. 22 Member Countries.

Conference "21. Organisk kjemisk vintermøte", Skeikampen, Norway, Jan. 12 – 15, 2006.
Co-author on lecture on: Spectroscopic and chemical studies on Lewis acid reactions of retinoids and carotenoids.
Co-author on poster presentations: "Novel Diapocarotenoid Dications - Filling the Gap in the VIS-NIR Spectra of Carotenoids" and "Regioselective hydrolysis of fully acetylated methyl and benzyl glycopyranosides with acetyl xylan esterase from *Bacillus pumilus* as catalyst".

Meeting about the Research Report "Grunnlag for en innovasjonspolitik?", NTVA, Oslo, Jan. 18, 2006.

Industrial visit, NATURAL, Hovdebygda, Norway, Feb. 2, 2006.
Lecture on: Enzymkatalyse i organisk kjemi.

COST, Chairman Management Committee, Meeting Working Group 4, Milano, Italy, March 10 – 11, 2006.
Lecture on: Chemo-enzymatic synthesis of enantiopure 2-C-methyl threitol and 2-C-methyl erythritol 2-C-methyl-D-erythritol from *Convolvulus glomeratus*, 1976-2006.

Board Meeting European Federation of Biotechnology, ESAB, Brussels, April 1 – 2, 2006.

Activities

Opponent Doctoral Thesis of Jostein Hattelid, "Preparation of α -substituted carbonates and esters as prodrugs of nucleosides", University of Oslo, Norway, April 6, 2006.

47th ENC Conference, Monterey, California, USA, April 23 – 28, 2006.
Co-author on poster presentation: NMR of Charged Carotenoid Species - Solved and Unsolved Problems.

Nordiske Polymerdager, Copenhagen, Denmark, May 29 – 31, 2006.
Co-author on poster presentation: Immobilization of lipases on planar gold silica surfaces.

COST, WG3 Workshop, Karolinska institutet, Stockholm, Sweden, Sep. 19 – 20, 2006.

Annual Meeting, The Research Council of Norway, Oslo, Sep. 27, 2006.

Conference "Organisk kjemisk høstmøte" and KOSK. Sluttsseminar for NFR-programmet: Katalyse og organisk syntetisk kjemi, Gardermoen, Norway, Nov. 2 - 3, 2006.

Co-author on poster presentation: Chemoenzymatic Methods for Synthesis of Enantiopure Biologically Active Compounds. Study of Enzyme Mechanism.

COST, Chairman Management Committee, Meeting Working Group 6, Nov. 17 – 18, 2006.

COST, Chairman Workshop NTNU, Trondheim, Dec. 9 – 10, 2006.



F.G. Banica

Research cooperation at Polytechnica University of Bucharest, Romania, Jan. 31 – Feb. 3, 2006.

ESEAC 2006: 11th International Conference on Electroanalysis, Bordeaux, France, June 11 – 15, 2006.

Co-author on poster presentation: Voltammetric determination of arginine using the catalytic nickel reduction.

13th Young Investigators' Seminar on Analytical Chemistry (YISAC2006), Zagreb, Croatia, July 5 - 8, 2006.

Co-author on lecture on: Modified Carbon Paste Electrode for single-use metal ion sensors. An assessment of QuadraPure TU as a metal ion receptor.

7th Annual Meeting of the International Society of Electrochemistry, Edinburgh, UK, Aug. 26 – Sep. 1, 2006.

Co-author on poster presentation: Electrochemical Impedance Spectrometry as a Tool for Characterizing Carbon Paste Electrodes.

D. Bedeaux

HERCULES 2006, Grenoble, France, Feb. 23, 2006.

Co-author on poster presentation: Diffusion of Hydrogen in PEM Fuel Cell Catalyst Carbon Support.

7th International Meeting on Thermodiffusion, San Sebastián, Spain, May 29 – June 2, 2006.

Co-author on poster presentation: The heat of transfer in a chemical mixture.

XX Sitges Conference on Statistical Mechanics. Physical Biology: from Molecular Interactions to Cellular Behaviour, Barcelona, Spain, June 5 – 9, 2006.

Co-author on lectures on:

"Thermodynamics for single-molecule stretching experiments" and "A thermodynamic basis for active transport in biology: The Ca-ATPase".

Co-author on poster presentation: Defining the local temperature of adsorbed argon in a nanoporous zeolitic membrane.

19th International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems, ECOS 2006, Crete, Greece, July 12 – 14, 2006.

Co-author on lecture on: Transfer coefficients for liquid-vapor transitions derived for n-octane.

19th International Conference on chemical Thermodynamics, Boulder, Colorado, USA, July 30 – Aug. 4, 2006.

Co-author on lecture on: Molecular dynamics simulations of a chemical reaction; condition for local equilibrium in a temperature gradient.

Rhodos Conference on Thermodynamics, Sep. 3 – 7, 2006.

Co-author on lecture on: On a possible difference between the barycentric velocity and the velocity that gives translational momentum in fluids.

Cargese Summer School on Soft Matter, Corsica, France, Oct. 2 – 13, 2006.

Co-author on poster presentation: The van der Waals square gradient model for non-equilibrium mixtures.

Research stay at Federal University of Rio de Janeiro, Brazil; Nov. 5 – 20, 2006.

Co-author on lecture on: "Heat and mass flow through and into membranes" and "A thermodynamic description of active transport in the Ca-ATPase".

AICHE Annual Meeting, San Francisco, California, USA, Nov. 12 – 16, 2006.

Co-author on lectures on: "Transport coefficients for liquid-vapor transition" and "Transport Properties of a Reacting Binary Fluid, from Non-Equilibrium Molecular Dynamics Simulations".

T. Berg

Eight international conference on mercury as a global pollutant, Madison, Wisconsin, USA, Aug. 6 – 11, 2006.

Co-author on lecture on:

The fate of atmospheric mercury at Svalbard.

Co-author on poster presentation:

Elevated concentrations of mercury in mosses growing at the Arctic coast of Norway – a phenomenon caused by Arctic mercury depletion events.

Guest Lecture at UNIS, Svalbard, Norway, Sep. 25, 2006.

Lecture on: Sources and emissions of heavy metals.

Guest Lecture at UNIS, Svalbard, Norway, Sep. 26, 2006.

Lecture on: Transport pathways and processes leading to environmental.

Guest Lecture at UNIS, Svalbard, Norway, Sep. 27, 2006.

Lecture on: Temporal trends.

Guest Lectures at UNIS, Svalbard, Norway, Sep. 28, 2006.

Lectures on: "Spatial patterns" and "The environmental impact of acid mine drainage".

The Second Workshop on Information Warehouse of Persistent Organic Pollutants (POPs) in East Asian Countries, Seoul, South Korea, Nov. 2 – 3, 2006.

Lecture on: EMEP-CCC's Warehouse of POPs.

User Course Tekran Mercury Monitor, Toronto, Canada, Dec. 11 – 19, 2006.

L. Boman

Conference "Sanibel Symposium", Florida, USA, Feb. 26 – March 3, 2006.

Research stay at University of Nagoya, Japan, April 2 – July 25, 2006.

T. Bruvoll

The Pittsburg Conference, Orlando, USA, March 10 – 17, 2006.

Meeting and Conference HP Technology@ Work, Berlin, Germany, April 21 – 28, 2006.

International Supercomputer Conference, Dresden, Germany, June 26 – July 3, 2006.

O. Burheim

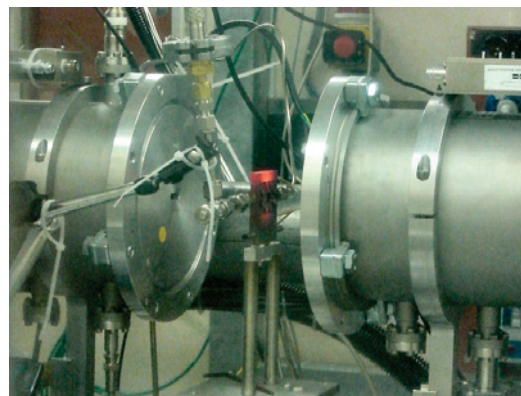
19th ECOS Conference, Crete, Greece, July 12 – 14, 2006.

Co-author on poster presentation: A method to measure thermal conductivities and contact resistances of fuel cell components.

B. Buttingsrud

The 16th European Symposium on Quantitative Structure-Activity Relationships & Molecular Modelling, Italy, Sep. 10 – 17, 2006.

Co-author on poster presentation: An alignment-free methodology for modelling field-based 3D-structure activity relationships using inductive logic programming.



P. – O. Eggen

Læreplan i Kjemi for videregående skole, LP06. Utdanningsdirektoratet 2006.

Leader of National Committee for new Chemistry Curriculum, Norwegian Directorate for Education and Training, Læreplan for Kunnskapsløftet 2006.

Eggen, P.O. (2006) Recipient of Adele la Roche Scholarship 2007 for the contribution: A simple hydrogen electrode.

Activities

Eggen, P.O. and Kvittingen, L (2006) Elektrolyse av kaliumiodid, www.naturfag.no

Eggen, P.O. and Kvittingen, L (2006) Elektrolyse av vann 1 g 2, www.naturfag.no

Eggen, P.O. and Kvittingen, L (2006) Enkelt batteri, www.naturfag.no

In-service courses for sec. school teachers, County of North and South Trøndelag, *Budding Researchers (Forskerspiren)*, April 20 and May 5, 2006, Department of Chemistry, NTNU.

Kurs for kjemilærere i Sogn og Fjordane fylkeskommune, Førde, Norway, Aug. 17 – 18, 2006.

Lecture on: Kjemiforsøk til den nye læreplanen med hovedvekt på elektrokjemi.

Faglig-pedagogisk dag ved NTNU 2006, Nov. 21, 2006.

Co-author on lecture on: Bleiekjemi og hydrogenelektrode.

Chemistry Education (Incorporating Local Knowledge and Appropriate Technology) in NUFU-project: Children, young people and local knowledge in Ethiopia and Zambia 2007-2011. A collaboration between Department of Chemistry, Geography, Anthropology and Norwegian Center for Child Research.

A. Fiksdahl

Board Member of the KOSK Research Program, The Research Council of Norway (2000 – 2006).

Deputy Head of the Board of “Faggruppen for Organisk Kjemi” (the Group of Organic Chemistry) of the Norwegian Chemical Society.

Section Leader, Organic Chemistry Group, at the Department of Chemistry, NTNU.

Appointed Guest Professor at Hebei University, China (2005 – 2010).

Conference “21. Organisk kjemisk vintermøte”, Skeikampen, Norway, Jan. 12 – 15, 2006.
Co-author on poster presentation: Synthetic applications of alfa-pyridyl malonate.

Opponent Doctoral Thesis of Karl F.S. Alnes, University of Bergen, Norway, March 2006.

1st European Chemistry Congress, Budapest, Hungary, Aug. 27 – 31, 2006.
Co-author on poster presentation: Synthetic Applications of alfa-pyridyl malonate.

NWO Gebied Chemische Wetenschappen. Div. Synthetische Chemie, Lunteren, Netherlands, Oct. 23 – 25, 2006.
Co-author on poster presentation: N-Acyl and N-Alkoxy-carbonyl derivatives of 1H-1,2,3-triazolo[4,5-c]pyridine; preparation and application.

2nd DRC-LST/BSDL Symposium 2006, Delft, Netherlands, Nov. 1, 2006.

Co-author on poster presentation: N-Acyl and N-Alkoxy-carbonyl derivatives of 1H-1,2,3-triazolo[4,5-c]pyridine; preparation and application.

Final Seminar: Catalysis and Organic Synthetic Chemistry (KOSK), Gardermoen, Norway, Nov. 2 – 3, 2006.

Co-author on poster presentation: Nitropyridyl isocyanates, carbamates, amides and carboxylates in heterocyclic chemistry.



T.P. Flaten

Deputy Head of the Department of Chemistry.

Editor, Norsk Epidemiologi (Norwegian Journal of Epidemiology).

Group Leader, Theme Group “Environment”, The Nord-Trøndelag Health Study 3 (HUNT 3).

Board member, The Committee for Geomedicine of the Norwegian Academy of Science and Letters.

Board Member, Norwegian Chemical Society, Trondheim Branch.

3rd Nordic Conference on Plasma Spectrochemistry, Loen, Norway, June 11 – 14, 2006.

Co-author on poster presentation: Trace elements in cerebrospinal fluid from patients with a rare familial neurological disease in Norway.

Administrator, Doctoral Thesis of Kåre Helge Karstensen, “Co-processing of hazardous wastes in cement kilns – an important factor in the formation of dioxins?”, Department of Chemistry, NTNU, Dec. 18, 2006.

Ø. Garmo

3rd Nordic Conference on Plasma Spectrochemistry, Loen, Norway, June 11 – 14, 2006.

Co-author on poster presentation: DGT – Predict fish stress from toxic aluminium in acid surface water.

O.R. Gautun

Conference "21. Organisk kjemisk vintermøte", Skeikampen, Norway, Jan. 12 – 15, 2006. Co-author on poster presentations: "Aziridines from L-Aspartic Acid" and "Sigmatropic rearrangements of allylic sulfinimidamides".

Final seminar: Catalysis and Organic Synthetic Chemistry (KOSK), Gardermoen, Norway, Nov. 2 – 3, 2006.

Co-author on poster presentation: Stereoselective ene-reactions with N-sulfinyl sulfonamides.

K. Gellein

3rd Nordic Conference on Plasma Spectrochemistry, Loen, Norway, June 11 – 14, 2006.

Co-author on poster presentation: Trace elements in cerebrospinal fluid from patients with a rare familial neurological disease in Norway.

**L.H. Gidskehaug**

Det 18. norske kjemometrisymposium, Hafjell, Norway, March 20 – 22, 2006.

Lecture on: Utvidelser til kryssmodellvalideringen - med applikasjon på mikromatrisedata.

K. Glavatskiy

Cargese Summer School on Soft Matter, Corsica, France, Oct. 2 – 13, 2006.

Co-author on poster presentation: The van der Waals square gradient model for non-equilibrium mixtures.

O. – E. Haas

Nordic Hydrogen Seminar 2006, Oslo, Norway, Feb. 6 – 8, 2006.

Co-author on lecture on: Nanostructured Electrocatalysts for PBI Fuel Cell.

HERCULES 2006, Grenoble, France, Feb. 23, 2006.

Co-author on poster presentation: Diffusion of Hydrogen in PEM Fuel Cell Catalyst Carbon Support.

Research stay at ILL, Grenoble, France, Nov. 19 – 29, 2006.

J. Holt

NWO Gebied Chemische Wetenschappen. Div. Synthetische Chemie, Lunteren, Netherlands, Oct. 23 – 25, 2006.

Co-author on poster presentation: N-Acyl and N-Alkoxycarbonyl derivatives of 1H-1,2,3-triazolo[4,5-c]pyridine; preparation and application.

2nd DRC-LST/BSL Symposium 2006, Delft, Netherlands, Nov. 1, 2006.

Co-author on poster presentation: N-Acyl and N-Alkoxycarbonyl derivatives of 1H-1,2,3-triazolo[4,5-c]pyridine; preparation and application.

Final Seminar: Catalysis and Organic Synthetic Chemistry (KOSK), Gardermoen, Norway, Nov. 2 – 3, 2006.

Co-author on poster presentation: Nitropyridyl isocyanates, carbamates, amides and carboxylates in heterocyclic chemistry.

C.L. landoli

AICHE Annual Meeting, San Francisco, California, USA, Nov. 12 – 16, 2006.

Co-author on lecture on: Exergy analysis of a Gas To Liquid Process.

E.E. Jacobsen

Conference "Organisk kjemisk høstmøte", Sluttseminar for NFR-programmet: Katalyse og organisk syntetisk kjemi, Gardermoen, Norway, Nov. 2 – 3, 2006.

Co-author on poster presentation: Chemoenzymatic Methods for Synthesis of Enantiopure Biologically Active Compounds. Study of Enzyme Mechanism.

S.L. Jensen

Conference "21. Organisk kjemisk vintermøte", Skeikampen, Norway, Jan. 12 – 15, 2006.

Co-author on lecture on: Spectroscopic and chemical studies on Lewis acid reactions of retinoids and carotenoids.

Co-author on poster presentations: "Novel Diapocarotenoid Dications - Filling the Gap in the VIS-NIR Spectra of Carotenoids" and "Carotenoid Anions - Not So Easy".

47th ENC Conference, Monterey, California, USA, April 23 – 28, 2006.

Co-author on poster presentation: NMR of Charged Carotenoid Species - Solved and Unsolved Problems.

E. Johannessen

Research stay at TU Delft, Netherlands, until July 15, 2006.

Delft Centre for Computational Science and Engineering Symposium, Delft, Netherlands, March 31, 2006.

Activities

Co-author on poster presentation: Optimal Distributors for Nanoporous Catalysts.

Delft Centre for Computational Science and Engineering Symposium, Delft, Netherlands, March 31, 2006.

Co-author on lecture on: Optimal Porosity Distribution in Diffusion-Reaction Problems in Porous Materials Interaction.

19th International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems, ECOS 2006, Crete, Greece, July 12 – 14, 2006.

Co-author on lectures on: "Entropy Production Minimization Confirm Two Well Established Process Technologies" and "Transfer coefficients for liquid-vapor transitions derived for n-octane".

The 5th International Mesostructured Materials Symposium, Shanghai, China, Aug. 5 – 7, 2006.

Co-author on lecture on: Optimizing Transport in Nanostructured Catalysts: a Computational Study.

The 19th International Symposia on Chemical Reaction Engineering, Berlin, Germany, Sep. 3 – 6, 2006.

Co-author on poster presentation: Optimizing Transport in Nanostructured Catalysts: a Computational Study.

AICHE Annual Meeting, San Francisco, California, USA, Nov. 12 – 16, 2006.

Co-author on lecture on: Transport coefficients for liquid-vapor transition.



G. Kildahl-Andersen

Conference "21. Organisk kjemisk vintermøte", Skeikampen, Norway, Jan. 12 – 15, 2006.

Lecture on: Spectroscopic and chemical studies on Lewis acid reactions of retinoids and carotenoids.

Co-author on poster presentations: "Novel Diapocarotenoid Dications - Filling the Gap in the VIS-NIR Spectra of Carotenoids"

and
"Carotenoid Anions - Not So Easy".

47th ENC Conference, Monterey, California, USA, April 23 – 28, 2006.

Co-author on poster presentation: NMR of Charged Carotenoid Species - Solved and Unsolved Problems.

Conference "Organisk kjemisk høstmøte", Sluttseminar for NFR-programmet: Katalyse og organisk syntetisk kjemi, Gardermoen, Norway, Nov. 2 - 3, 2006.

Co-author on poster presentation: Chemoenzymatic Methods for Synthesis of Enantiopure Biologically Active Compounds. Study of Enzyme Mechanism.

S. Kjelstrup

Professor in part time position at TU Delft, Netherlands, Jan. 2 – 28, May 29 – 31, June 9 – July 11 and Nov. 1 – 5, 2006.

Nordic Hydrogen Seminar 2006, Oslo, Norway, Feb. 6 – 8, 2006.

Lecture on: Calculating gradients in potential, concentration and temperature across a PEM fuel cell MEA.

HERCULES 2006, Grenoble, France, Feb. 23, 2006.

Co-author on poster presentation: Diffusion of Hydrogen in PEM Fuel Cell Catalyst Carbon Support.

7th International Meeting on Thermodiffusion, San Sebastián, Spain, May 29 – June 2, 2006.

Co-author on poster presentation: The heat of transfer in a chemical mixture.

XX Sitges Conference on Statistical Mechanics.

Physical Biology: from Molecular Interactions to Cellular Behaviour, Barcelona, Spain, June 5 – 9, 2006.

Co-author on lectures on:

"Thermodynamics for single-molecule stretching experiments" and "A thermodynamic basis for active transport in biology: The Ca-ATPase".

Co-author on poster presentation: Defining the local temperature of adsorbed argon in a nanoporous zeolitic membrane.

The 4th International Conference on Fuel Cell Science, Engineering and Technology (FUELCELL 2006), Irvine, California, June 19 – 21, 2006.

Co-author on lecture on: In Situ Calorimetric Measurements in a Polymer Electrolyte Fuel Cell.

19th International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems, ECOS 2006, Crete, Greece, July 12 – 14, 2006.

Co-author on lectures on: "Entropy Production Minimization Confirm Two Well Established Process Technologies" and "Transfer coefficients for liquid-vapor transitions derived for n-octane".

Co-author on poster presentation: A method to measure thermal conductivities and contact resistances of fuel cell components.

19th International Conference on chemical Thermodynamics, Boulder, Colorado, USA, July 30 – Aug. 4, 2006.

Co-author on lecture on: Molecular dynamics simulations of a chemical reaction; condition for local equilibrium in a temperature gradient. Rhodos Conference on Thermodynamics, Sep. 3 – 7, 2006.
Co-author on lecture on: On a possible difference between the barycentric velocity and the velocity that gives translational momentum in fluids.

Opening Day, Process and Energy Laboratory, TU Delft, Netherlands, Sep. 22, 2006.

Lecture on: Thermodynamics: From single molecules to many politicians.

Nordic PEMFC 06, Stockholm, Sweden, Sep. 25 – 27, 2006.

Co-author on lecture on: In-situ calorimetric measurements in a polymer electrolyte fuel cell.

Research stay at Federal University of Rio de Janeiro, Brazil; Nov. 5 – 20, 2006.

Co-author on lectures on: "Heat and mass flow through and into membranes" and "A thermodynamic description of active transport in the Ca-ATPase".

AICHE Annual Meeting, San Francisco, California, USA, Nov. 12 – 16, 2006.

Co-author on lectures on: "Exergy analysis of a Gas To Liquid Process", "Transport coefficients for liquid-vapor transition" and "Transport Properties of a Reacting Binary Fluid, from Non-Equilibrium Molecular Dynamics Simulations".

H. Koch

Research Cooperation at University of Valencia, Spain, Feb. 16 – 22, April 5 – 19, May 6 – 16, June 10 – July 7, July 26 – Aug. 20, Sep. 6 – 18, Oct. 13 – 28, Dec. 8 – 19, 2006.

Research project at University of Nagoya, Japan, March 7 – 22, May 20 – June 6, July 7 – 26, Nov. 9 – 26, 2006.

Conference "Sanibel Symposium", Florida, USA, Feb. 26 – March 5, 2006.

T. Kumelj

The 9th Sostrup Summer School "Quantum Chemistry and Molecular Properties", Ry, Denmark, June 25 – July 7, 2006.

L. Kvittingen

Eggen, P.O. and Kvittingen, L (2006) Elektrolyse av kaliumiodid, www.naturfag.no

Eggen, P.O. and Kvittingen, L (2006) Elektrolyse av vann 1 g 2, www.naturfag.no

Eggen, P.O. and Kvittingen, L (2006) Enkelt batteri, www.naturfag.no

In-service courses for sec. school teachers, County of North and South Trøndelag, *Budding*

Researchers (Forskerspiren), April 20 and May 5, 2006, Department of Chemistry, NTNU.

Kurs for kjemilærere i Sogn og Fjordane fylkeskommune, Førde, Norway, Aug. 17 – 18, 2006.

Lecture on: Kjemiforsøk til den nye læreplanen med hovedvekt på elektrokjemi.

2nd International Conference of the European Society for the History of Science, Cracow, Poland, Sep. 6 – 9, 2006.

Co-author on lecture on: From Fertile Centers to Seeding the Periphery. Ellen Gleditsch: Pioneer Woman from Norway.

Symposium on "Chemistry and Archeology", Aristotle University, Thessaloniki, Greece, Oct. 9 – 12, 2006.

Faglig-pedagogisk dag ved NTNU 2006, Nov. 21, 2006.

Co-author on lecture on: Bleiekjemi og hydrogenelektrode.

Chemistry Education (Incorporating Local Knowledge and Appropriate Technology) in NUFU-project: Children, young people and local knowledge in Ethiopia and Zambia 2007-2011. A collaboration between Department of Chemistry, Geography, Anthropology and Norwegian Center for Child Research.

S. Lierhagen

3rd Nordic Conference on Plasma Spectrochemistry, Loen, Norway, June 11 – 14, 2006.

Co-author on poster presentation: Trace elements in cerebrospinal fluid from patients with a rare familial neurological disease in Norway.



B.F. Lutnæs

9th National NMR Meeting, Skeikampen, Norway, Jan. 9 – 12, 2006.

Co-author on lecture on: Archaeal C80 isoprenoids responsible for naphthenate deposition in crude oil production.

Activities

Conference "21. Organisk kjemisk vintermøte", Skeikampen, Norway, Jan. 12 – 15, 2006. Co-author on lecture on: C80 isoprenoids responsible for naphthenate deposition in crude oil production. Co-author on poster presentations: "Carotenoid Anions - Not So Easy" and "Identification of the early eluting hopane series related to 17a-diahopanes. Synthesis from hop-17(21)-enes and detection of intermediates in sediments".

47th Experimental NMR Conference, Monterey, California, USA, April 23 – 28, 2006. Co-author on poster presentations: "Structure determination of C80 isoprenoids responsible for naphthenate deposition in crude oil processing" and "NMR of Charged Carotenoid Species - Solved and Unsolved Problems".

Euromar 2006, York, UK, July 16 – 21, 2006. Co-author on poster presentations: "Structure determination of C80 isoprenoids responsible for naphthenate deposition in crude oil processing" and "Characterisation of lignosulphonate by NMR spectroscopy".

NMR user meeting 2006, Norway, Dec. 11, 2006. Co-author on lecture on: Analysis of lignosulfonate by NMR spectroscopy.

K. Mathisen

Research stay at the European Synchrotron Radiation Facility (ESRF) Swiss-Norwegian Beam Line, Grenoble, France, Feb. 16 – 20, March 16 – 22, May 4 - 11 and Nov. 24 – Dec. 5, 2006.

Research stay at MaxLab., Lund, Sweden, May 11 – 14, 2006.

Workshop on X-ray absorption spectroscopy and micro-spectroscopic techniques, Villigen PSI, Switzerland, Feb. 20 – 21, 2006. Poster presentation on: The influence of silicon on the catalytic properties of CuSAPO-5 towards the selective reduction of NO_x in the presence of propene.

Nano Meeting at the ESRF Swiss-Norwegian Beam Line, Grenoble, France, June 21 – 25, 2006.

The 13th International Conference on X-ray Absorption Fine Structure (XAFS13), Stanford University, California, USA, July 9 – 14, 2006. Poster presentation on: Comparing CuAPO-5 with Cu:ZSM-5 in the selective catalytic reduction of NO_x. An in situ study.

Ø. Mikkelsen

Section Leader, Analytical and Environmental Chemistry Group, Department of Chemistry, NTNU.

Co-author on guest lecture on: Remote and automatic Monitoring of heavy Metals in natural Water and Effluents. Kasetart University, Bangkok, Thailand, Feb. 23, 2006.



Co-author on guest lecture on: Surveillance of the level of heavy metal pollution in the Bangkok river system. Present status and the future plans. Bangkok, Thailand, Feb. 24, 2006.

Co-author on guest lecture on: The challenge of controlling heavy metal concentrations in natural waters by remote controlled systems. Pennsylvania State University, USA, April 21, 2006.

NEEC meeting, Beijing, China, June 6-7, 2006. Co-author on lecture on: Automatic and Remotely Controlled Monitoring of Heavy Metals in Waters. New methods and new equipment are now available.

ESEAC 2006, 11th International Conference on Electroanalysis, Bordeaux, France, June 11 – 15, 2006.

Co-author on lecture on: Speciation studies of iron in a river water system entering brackish and estuarine water zone.

Co-author on poster presentations: "Zinc and iron speciation in polluted river courses", "Continuous Heavy Metal Monitoring in Wastewater", "Study of electrochemical properties of gold-bismuth electrodes. Applications in voltammetric detection of sub nM copper, lead and mercury in natural waters", "Electrochemical properties of silver-copper alloy microelectrodes for use in voltammetric field apparatus", "Development of gold-disk microelectrodes for trace metals voltammetric analysis in natural waters" and "Determination of Zinc in Seawater by Anodic Stripping Voltammetry".

Meetings to organize Research Cooperation, University of Science and Technology Lille (USTL), France, June 17 – 21, 2006.

Swiss-Norwegian Seminar "Synchrotron Radiation in Studies of Nanoscaled Materials", SNBL/ESRF, Grenoble, France, June 22 – 23, 2006.

4th SusChem Stakeholder Workshop, Budapest, Hungary, Aug. 28, 2006.

Co-author on guest lecture on: Remote and unattended monitoring of heavy metals in water and effluents. A new method with new possibilities. University of Graz, Austria, Oct. 23, 2006.

Conference WWEM 2006 (Water, Wastewater & Environmental Monitoring), Telford, England, Nov. 1 – 2, 2006.

Co-author on lecture on: Remote Monitoring of Heavy Metals in Water and Effluents. A challenge when involving long term stability and the exclusive use of non-toxic reagents.

A.R. Moen

Conference "21. Organisk kjemisk vintermøte", Skeikampen, Norway, Jan. 12 – 15, 2006.

Lecture on: Regioselective hydrolysis of fully acetylated methyl and benzyl glycopyranosides with acetyl xylan esterase from *Bacillus pumilus* as catalyst.

Working Group Meeting, COST D25 2006, Milano, Italy, March 10 – 11, 2006.

Lecture on: Regioselective hydrolysis of fully acetylated glycosides catalyzed by acetyl xylan esterase from *Bacillus pumilis*.

Nordiske Polymerdager, Copenhagen, Denmark, May 29 – 31, 2006.

Co-author on poster presentation: Immobilization of lipases on planar gold silica surfaces.

Conference "Organisk kjemisk høstmøte", Sluttseminar for NFR-programmet: Katalyse og organisk syntetisk kjemi, Gardermoen, Norway, Nov. 2 - 3, 2006.

Co-author on poster presentation: Chemoenzymatic Methods for Synthesis of Enantiopure Biologically Active Compounds. Study of Enzyme Mechanism.



D.G. Nicholson

Head of the Department of Chemistry.

EXAFs Project, Grenoble, France and PSI, Zurich, Switzerland, Feb. 16 – 23, 2006.

Board Meeting NSR A/S and Project Meetings at University of Oslo, March 14 – 19, 2006.

Research stay at the European Synchrotron Radiation Facility (ESRF) Swiss-Norwegian Beam Line, Grenoble, France, March 1 – 5, April 10 – 15, June 21 – 25, 2006.

Research stay at MaxLab, Lund, Sweden, May 5 – 12, 2006.

Council Meeting SNX (SNBL), Nice, France, May 31 – June 5, 2006.

The 13th International Conference on X-ray Absorption Fine Structure (XAFS13), Stanford University, USA, July 6 – 18, 2006.

Project SNBL-ESRF, Royal Institution, London, UK, Aug. 25 – 28, 2006.

Symposium on "Chemistry and Archeology", Aristotle University, Thessaloniki, Greece, Oct. 9 – 12, 2006.

Research stay and SNX Council Meeting at the European Synchrotron Radiation Facility (ESRF) Swiss-Norwegian Beam Line, Grenoble, France, Nov. 26 – Dec. 5, 2006.

C. Nordhei

1st Nanolab User Meeting, Jægtvolden, Inderøy, Norway, March 9 – 10, 2006.

Co-author on poster presentation: In situ XAS studies of nanophase ferrites and their catalytic reactivity for selective reduction of NO.

Research stay at the European Synchrotron Radiation Facility (ESRF) Swiss-Norwegian Beam Line, Grenoble, France, May 4 – 13 and Nov. 19 – 29, 2006.

Conference XAFS13, Stanford University, USA, July 9 – 14, 2006.

Co-author on poster presentation: A Preliminary XAS (XANES/XAFS) Study of Nanophase Ferrites during CO₂ Decomposition.

V. Partali

Conference "21. Organisk kjemisk vintermøte", Skeikampen, Norway, Jan. 12 – 15, 2006. Co-author on poster presentations: "Stable blue carotenoids" and "Attempted synthesis of cationic carotenoid phospholipids for DNA transfer".

Symposium on "Chemistry and Archeology", Aristotle University, Thessaloniki, Greece, Oct. 9 – 12, 2006.

A.L. Ramstad

Section Leader, Physical Chemistry Group, Department of Chemistry, NTNU.

HERCULES 2006, Grenoble, France, Feb. 23, 2006.

Co-author on poster presentation: Diffusion of Hydrogen in PEM Fuel Cell Catalyst Carbon Support.

1st Nanolab User Meeting, Jægtvolden, Inderøy, Norway, March 9 – 10, 2006.

Activities

Co-author on poster presentation: In situ XAS studies of nanophase ferrites and their catalytic reactivity for selective reduction of NO.

Swiss-Norwegian Seminar "Synchrotron Radiation in Studies of Nanoscaled Materials", SNBL/ESRF, Grenoble, France, June 22 – 23, 2006.

Conference XAFS13, Stanford University, USA, July 9 – 14, 2006.

Co-author on poster presentation: A Preliminary XAS (XANES/XAFS) Study of Nanophase Ferrites during CO₂ Decomposition.

Research stay at ILL and SNBL/ESRF, Grenoble, France, Nov. 20 – 24, 2006.

M.B. Rye

18. norske kjemometrisymposium, Hafjell, Norway, March 20 – 22, 2006.

Co-author on lecture on: Separering av proteinsegment fra støysegment ved DPLSR i 2D gel elektroforese.

7th Siena Meeting From Genome To Proteome, Siena, Italy, Sep. 3 – 7, 2006.

Co-author on poster presentations: "Automatic spot classification in 2DE gel analysis Genome To Proteome" and "Viewing Images As Spectra: A Novel approach of analysing 2DE proteome data".

C. Sanz-Navarro

12th Nordic Symposium on Catalysis, NTNU, Trondheim, May 28 – 30, 2006.

Co-author on poster presentation on: Molecular Dynamics Simulations of the Binding of Platinum Clusters to Graphite Sheets.

K. Schröder

Guest lecture on: Remote and automatic Monitoring of heavy Metals in natural Water and Effluents. Kasetsart University, Bangkok, Thailand, Feb. 23, 2006.

Guest lecture on: Surveillance of the level of heavy metal pollution in the Bangkok river system. Present status and the future plans. Bangkok, Thailand, Feb. 24, 2006.

Guest lecture on: The challenge of controlling heavy metal concentrations in natural waters by remote controlled systems. Pennsylvania State University, USA, April 21, 2006.

NEEC meeting, Beijing, China, June 6-7, 2006.
Lecture on: Automatic and Remotely Controlled Monitoring of Heavy Metals in Waters. New methods and new equipment are now available.

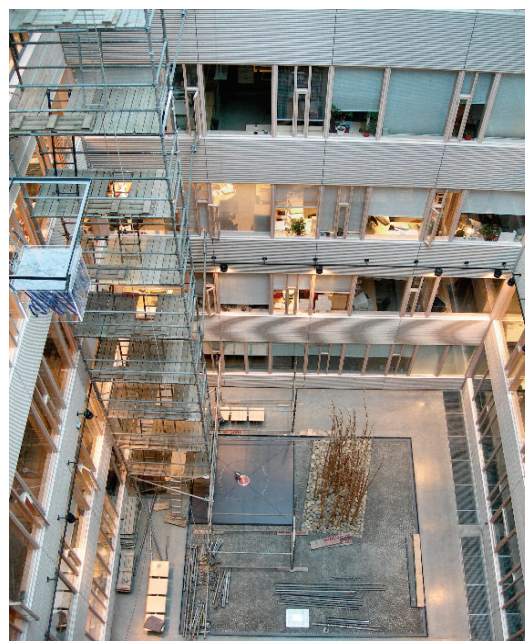
ESEAC 2006, 11th International Conference on Electroanalysis, Bordeaux, France, June 11 – 15, 2006.

Co-author on lecture on: Speciation studies of iron in a river water system entering brackish and estuarine water zone.

Co-author on poster presentations: "Zinc and iron speciation in polluted river courses", "Study of electrochemical properties of gold-bismuth electrodes. Applications in voltammetric detection of sub nM copper, lead and mercury in natural waters", "Determination of Zinc in Seawater by Anodic Stripping Voltammetry" and "Continuous Heavy Metal Monitoring in Wastewater".

Guest lecture on: Remote and unattended monitoring of heavy metals in water and effluents. A new method with new possibilities. University of Graz, Austria, Oct. 23, 2006.

Conference WWEM 2006 (Water, Wastewater & Environmental Monitoring), Telford, England, Nov. 1 – 2, 2006. Lecture on: Remote Monitoring of Heavy Metals in Water and Effluents. A challenge when involving long term stability and the exclusive use of non-toxic reagents.



J. – M. Simon

7th International Meeting on Thermodiffusion, San Sebastián, Spain, May 29 – June 2, 2006.

Co-author on poster presentation: The heat of transfer in a chemical mixture.

XX Sitges Conference on Statistical Mechanics. Physical Biology: from Molecular Interactions to Cellular Behaviour, Barcelona, Spain, June 5 – 9, 2006.

Co-author on poster presentation: Defining the local temperature of adsorbed argon in a nanoporous zeolitic membrane.

19th International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems, ECOS 2006, Crete, Greece, July 12 – 14, 2006.

Co-author on lecture on: Transfer coefficients for liquid-vapor transitions derived for n-octane.

AICHE Annual meeting, San Francisco, California, USA, Nov. 12 – 16, 2006.

Co-author on lectures on: "Transport coefficients for liquid-vapor transition" and "Transport Properties of a Reacting Binary Fluid, from Non-Equilibrium Molecular Dynamics Simulations".

S.M. Skogvold

ESEAC 2006, 11th International Conference on Electroanalysis, Bordeaux, France, June 11 – 15, 2006.

Co-author on lecture on: Speciation studies of iron in a river water system entering brackish and estuarine water zone.

Co-author on poster presentations: "Zinc and iron speciation in polluted river courses", "Determination of Zinc in Seawater by Anodic Stripping Voltammetry", "Electrochemical properties of silver-copper alloy microelectrodes for use in voltammetric field apparatus" and "Study of electrochemical properties of gold-bismuth electrodes. Applications in voltammetric detection of sub nM copper, lead and mercury in natural waters".

H.S. Smalø

International Conference of Computational Methods in Sciences and Engineering 2006 (ICCMSE 2006), Chania, Crete, Greece, Oct. 26 – Nov. 1, 2006.

Co-author on lecture on: Molecular Mechanics Model for Electronic Polarization: a Combined Atom-Atom Charge-Transfer and Point-Dipole Interaction Model.

A.O. Steen

User Course Tekran Mercury Monitor, Toronto, Canada, Dec. 11 – 19, 2006.

E. Steinnes

19th Task Force Meeting of the ICP Vegetation, Wales, Jan. 30 – Feb. 2, 2006.

Lecture on: Long range transport of trace metals to Norway as evident from moss analysis and other

Conference Pierwiastki Sladove W Srodowiscu, Sarnowek, Poland, May 11 – 12, 2006.

Lecture on: Use of peat cores from ombrotrophic bogs to assess the atmospheric deposition of trace elements: Comparison of data from Poland and Norway.

Seminar "Forurensning i ferskvannsmiljø", Lillehammer, Norway, June 7 – 8, 2006.

Lecture on: Lokale kontra langtransporterte forurensninger

3rd Nordic Conference on Plasma Spectrochemistry, Loen, Norway, June 11 – 14, 2006.

Lecture on: Atmospheric metal deposition in Norway 1977-2005 studied by moss analysis using ICP-MS. Co-author on poster presentations: "DGT – Predict fish stress from toxic aluminium in acid surface water" and "Trace elements in cerebrospinal fluid from patients with a rare familial neurological disease in Norway".

18th World Congress of Soil Science, Philadelphia, Pennsylvania, USA, July 9 – 15, 2006.

Lecture on: Soil Science and Geomedicine.

8th international Conference on mercury as a global pollutant, Madison, Wisconsin, USA, Aug. 6 – 11, 2006.

Co-author on lecture on: The fate of atmospheric mercury at Svalbard.

Co-author on poster presentation: Elevated concentrations of mercury in mosses growing at the Arctic coast of Norway – a phenomenon caused by Arctic mercury depletion events.

NATO Workshop, Recent Advances in Adsorption Processes for Environmental Protection and Security, Kiev, Ukraine, Sep. 9 – 12, 2006.

Lecture on: Speciation of heavy metals in water.

The 7th International Symposium on Environmental Geochemistry, Beijing, China, Sep. 24 – 27, 2006.

Lectures on: "Trace elements in natural organic-rich surface soils: Contributions from natural and anthropogenic sources" and "Distribution of 28 elements in podzol profiles studied by fractional extractions and multivariate statistics".

Conference SETAC North America 27th Annual Meeting, Montreal, Canada, Nov. 5 – 9, 2006.

Lecture on: Trace elements in organic-rich surface soils: Contributions from natural and anthropogenic sources.



K. Strasunskiene

3rd Biennial International young Researchers Conference, Singapore, May 21 – 29, 2006.

Lecture on: Continuous Monitoring of Trace Metals in Wastewater Effluents using voltammetric System.

Activities

ESEAC 2006, 11th International Conference on Electroanalysis, Bourdeaux, France, June 11 – 15, 2006.

Co-author on poster presentation: Continuous Heavy Metal Monitoring in Wastewater.

Course in Electro Chemistry, Lille, France, Nov. 23 – Dec. 22, 2006.

F. Tjosås

Conference “21. Organisk kjemisk vintermøte”, Skeikampen, Norway, Jan. 12 – 15, 2006.

Co-author on poster presentation: Synthetic applications of alfa-pyridyl malonate.

1st European Chemistry Congress, Budapest, Hungary, Aug. 27 – 31, 2006.

Co-author on poster presentation: Synthetic Applications of alfa-pyridyl malonate.

Xu, J.

7th International Meeting on Thermodiffusion, San Sebastián, Spain, May 29 – June 2, 2006.

Co-author on poster presentation: The heat of transfer in a chemical mixture.

19th International Conference on chemical Thermodynamics, Boulder, Colorado, USA, July 30 – Aug. 4, 2006.

Lecture on: Non-equilibrium molecular dynamics studies of a chemical reaction - conditions for local equilibrium in a temperature gradient.

Co-author on lecture on: Molecular dynamics simulations of a chemical reaction; condition for local equilibrium in a temperature gradient.

AICHE Annual meeting, San Francisco, California, USA, Nov. 12 – 16, 2006.

Co-author on lectures on: “Transport coefficients for liquid-vapor transition” and “Transport Properties of a Reacting Binary Fluid, from Non-Equilibrium Molecular Dynamics Simulations”.

C.L. Øpstad

Conference “21. Organisk kjemisk vintermøte”, Skeikampen, Norway, Jan. 12 – 15, 2006.

Co-author on poster presentation: Attempted synthesis of cationic carotenoid phospholipids for DNA transfer.

J.E. Aaseng

Conference “21. Organisk kjemisk vintermøte”, Skeikampen, Norway, Jan. 12 – 15, 2006.

Co-author on poster presentation: Aziridines from L-Aspartic Acid



P. – O. Åstrand

Undertegnning av ny tungregningsavtale med IBM 2006, Trondheim, May 2, 2006.

Lecture on: Molekylmodellering i Nanovitenskap.

Research Cooperation at University of Copenhagen, Denmark, March 21 – 24 and Oct. 9 – 16, 2006.

12th Nordic Symposium on Catalysis, NTNU, Trondheim, May 28 – 30, 2006.

Co-author on poster presentation on: Molecular Dynamics Simulations of the Binding of Platinum Clusters to Graphite Sheets.

International Conference of Computational Methods in Sciences and Engineering 2006 (ICCMSE 2006), Chania, Crete, Greece, Oct. 26 – Nov. 1, 2006.

Co-author on lecture on: Molecular Mechanics Model for Electronic Polarization: a Combined Atom-Atom Charge-Transfer and Point-Dipole Interaction Model.

Spring examination

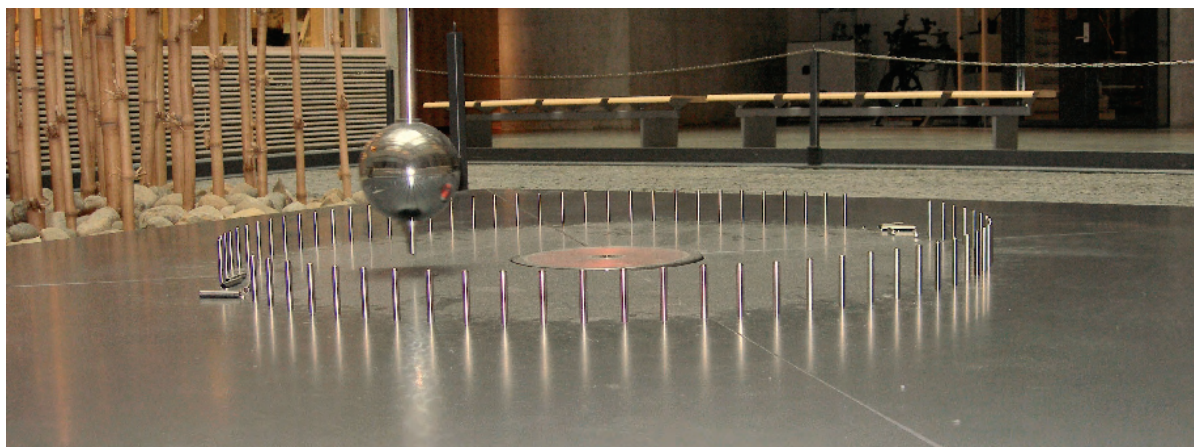
Course no.	Course title (credits)	Lectures and exercise coordinators	Candidates/Passed
RFEL1001	Natural Science and World Views (7,5)	Reidar Edvald Stølevik Karl Erik Zachariassen	67/51
KJ1020	Organic Chemistry (15)	Vassilia Partali	131/95
KJ2020	Organic Chemistry, Advanced Course (7,5)	Bård Helge Hoff	21/13
KJ2022	Spectroscopic Methods in Organic Chemistry (7,5)	Elisabeth E Jacobsen	15/13
KJ2024	Organic Synthesis, Laboratory (7,5)	Per Henning Carlsen Odd Reidar Gautun	8/8
KJ2041	Physical Chemistry II (7,5)	Reidar Edvald Stølevik	10/9
KJ2043	Physical Methods in Structural Chemistry (15)	Kolbjørn Hagen Astrid Lund Ramstad Reidar Edvald Stølevik	3/3
KJ2050	Analytical Chemistry, Basic Course (7,5)	Knut Henning Schrøder Florinel Gabriel Banica Øyvind Mikkelsen	17/17
KJ2053	Chromatography (7,5)	Anne Fiksdahl Rudolf Schmid	28/27
KJ2070	Environmental Chemistry (15)	Øyvind Mikkelsen Morten Jartun	26/25
KJ3055	Analytical Atomic Spectrometry (7,5)	Florinel Gabriel Banica	6/6
KJ3065	Enzyme chemistry (7,5)	Torbjørn Ljones	7/7
KJ8100	Organic Medicinal and Pharmaceutical Chemistry (7,5)	Derek James Chadwick	-
KJ8103	Research Proposal in Organic Chemistry (7,5)	Per Henning Carlsen	-
KJ8106	Advanced Organic Chemistry (7,5)	Per Henning Carlsen	-
KJ8200	Spectroscopy and Chemometrics (7,5)	Bjørn Kåre Alsberg	-
KJ8202	Thermodynamics of Hydrocarbon Mixtures (7,5)	Tore Haug-Warberg	-
KJ8203	Statistical Thermodynamics and Computer Simulations (7,5)	Per-Olof Åstrand	-
KJ8204	Quantitative Structure-Activity Relationships (7,5)	Bjørn Kåre Alsberg	-
KJ8205	Molecular Modelling (7,5)	Per-Olof Åstrand	2/2
KJ8208	Advanced Irreversible Thermodynamics (6)	Signe Kjelstrup	-
TKJ4105	Chromatography (7,5)	Anne Fiksdahl Rudolf Schmid	3/2
TKJ4110	Organic Chemistry, Advanced Course (7,5)	Bård Helge Hoff	9/7
TKJ4115	Spectroscopic Methods in Organic Chemistry (7,5)	Elisabeth E Jacobsen	2/2
TKJ4130	Organic Synthesis, Laboratory (7,5)	Per Henning Carlsen Odd Reidar Gautun	12/12
TKJ4135	Organic Synthesis, Advanced Course (7,5)	Odd Reidar Gautun	17/13
TKJ4145	Industrial Organic Chemistry, Research Projects (7,5)	Reinert Fure	4/4
TKJ4160	Basic Physical Chemistry and Laboratory (15)	Signe Kjelstrup Per-Olof Åstrand Henrik Koch	72/66
TKJ4165	Quantum Chemistry, Basic Course (7,5)	Henrik Koch	6/6
TKJ4175	Chemometrics, Basic Course (7,5)	Bjørn Kåre Alsberg	4/4
TKJ4190	Physical Chemistry, Project Work (7,5)	Terje Bruvoll	-
TKJ4195	Chemometrics, Advanced Course (7,5)	Bjørn Kåre Alsberg	-
TKJ4850	Experts in Team, Interdisciplinary Project (7,5)	Per-Olof Åstrand	30/30

Autumn examination

Course no.	Course title (credits)	Lectures and exercise coordinators	Candidates/Passed
KJ1000	General Chemistry (15)	Thorleif Anthonen Torbjørn Ljones	224/205
KJ1030	Inorganic Chemistry (15)	Astrid Lund Ramstad	36/28
KJ1040	Physical Chemistry (15)	Reidar Edvald Stølevik Astrid Lund Ramstad	35/27
KJ2031	Inorganic Chemistry, Advanced Course (7,5)	Karina Mathisen	13/12
KJ2051	Analytical Chemistry, Advanced Course I (7,5)	Øyvind Mikkelsen Florinel Gabriel Banica	11/10
KJ2090	Chemistry Education - Chemistry Dissemination (7,5)	Per Odd Eggen	-
KJ2091	Teacher training/dissemination project in chemistry (7,5)	Lise Kvittingen	3/2
KJ3021	Nuclear Magnetic Resonance Spectroscopy (7,5)	Per Eugen Kristiansen	13/11
KJ3058	Analytical Chemical Separation Techniques (7,5)	Rudolf Schmid	2/2
KJ3071	Applied geochemistry (7,5)	Rolf Tore Ottesen	23/23
RFEL3093	Episodes from the history of science	Lise Kvittingen Roland Wittje	10/8
KJ8021	Stereochemistry and Synthesis of Chiral Compounds (7,5)	Thorleif Anthonen	3/3
KJ8026	Biocatalysis in Organic Chemistry (7,5)	Thorleif Anthonen	2/2
KJ8052	Analytical Electrochemistry and its Application within Industrial and Environmental Monitoring (7,5)	Øyvind Mikkelsen	7/7
KJ8056	Chemical and Sensors and Biosensors (7,5)	Florinel Gabriel Banica	5/5
KJ8070	Advanced Aquatic Chemistry (15)	Trond Peder Flaten	4/4
KJ8102	Research Proposal in Organic Chemistry (7,5)	Per Henning Carlsen	1/1
KJ8104	New Methods in Organic Synthesis (7,5)	Anne Fiksdahl	3/3
KJ8105	Organometallic Compounds in Organic Synthesis (7,5)	Odd Reidar Gautun	-
KJ8206	Advanced Quantum Chemical Methods (7,5)	Henrik Koch	-
KJ8207	Advanced Microarray Data Analysis (7,5)	Bjørn Kåre Alsberg	9/9
TKJ4100	Basic Organic Chemistry and Laboratory (15)	Per Henning Carlsen	74/55
TKJ4125	Natural Products Chemistry (7,5)	Elisabeth E Jacobsen	18/15
TKJ4170	Quantum Chemistry, Advanced Course (7,5)	Henrik Koch	2/2
TKJ4180	Physical Organic Chemistry (7,5)	Rudolf Schmid	11/5
TKJ4185	Chemical Instrumentation and Experimental Measurements (7,5)	Terje Bruvoll	2/2
TKJ4195	Chemometrics, Advanced Course (7,5)	Bjørn Kåre Alsberg	2/2
TKJ4200	Irreversible Thermodynamics (7,5)	Signe Kjelstrup	8/8
TKJ4205	Computational Chemistry (7,5)	Per-Olof Åstrand	5/5
TKJ4700	Physical Chemistry, Specialization (22,5)	Terje Bruvoll	1/1
TKJ4725	Organic Chemistry, Specialization (22,5)	Odd Reidar Gautun	10/10

Re-sit examination

Course no.	Course title (credits)	Lectures and exercise coordinators	Candidates/Passed
RFEL1001	Natural Science and World Views (7,5)		15/14
KJ1000	General Chemistry (15)		13/8
KJ1020	Organic Chemistry (15)		14/7
KJ1030	Inorganic Chemistry (15)		3/1
KJ2020	Organic Chemistry, Advanced Course (7,5)		4/3
KJ2022	Spectroscopic Methods in Organic Chemistry (7,5)		2/2
KJ2041	Physical Chemistry II (7,5)		2/2
KJ2070	Environmental Chemistry (15)		1/1
KJ2050	Analytical Chemistry, Basic Course (7,5)		2/2
KJ3065	Enzyme chemistry (7,5)		1/1
KJ8021	Stereochemistry and Synthesis of Chiral Compounds (7,5)		
KJ8052	Analytical Electrochemistry and its Application within Industrial and Environmental Monitoring (7,5)		2/2
KJ8103	Research Proposal in Organic Chemistry (7,5)		1/1
TKJ4100	Basic Organic Chemistry and Laboratory (15)		12/3
TKJ4110	Organic Chemistry, Advanced Course (7,5)		1/1
TKJ4115	Spectroscopic Methods in Organic Chemistry (7,5)		1/1
TKJ4120	Nuclear Magnetic Resonance Spectroscopy (7,5)		2/1
TKJ4135	Organic Synthesis, Advanced Course (7,5)		3/3
TKJ4160	Basic Physical Chemistry and Laboratory (15)		2/2
TKJ4175	Chemometrics, Basic Course (7,5)		1/1
TKJ4180	Physical Organic Chemistry (7,5)		1/1



Siv.ing. students

3. year (MTKJ)

Hilde, Ingeborg Lundby
Krakeli, Tor Arne
Kvalvåg, Sondre Schnell
Landsem, Eva
Mui, Vivian Wing Laam
Ringholm, Magnus
Strand, Lilian Helene Sola
Sørensen, Benedicte Riise
Sørum, Christopher
Voldsund, Mari
Wilhelmsen, Øyvind
Åstrand, Ove Alexander

4. year (MTKJ)

Berg, Michel Brunes
Høgmoen, Hanne
Lervik, Anders
Melnes, Silje

5. year (SIK1)

Arstad, Ane
Eriksen, Kristine Løland
Hagen, Linda Jeanette
Haugmo, Ingvil Eide
Håland, Torfinn
Insua Pérez, Juan Francisco (International student)
Kjerstad, Ivar Brøndbo
Møll, Maria Førde
Nicolaisen, Alexander
Nilsen, Robert
Reian, Gard
Vevestad, Solrun Johanne
Vårdal, Ingeborg Herum

Master students

Chemistry (MKJ)

Alsвик, Inger Lise
Angelsen, Ragnhild Beate Strand
Berge, May Britt
Drange, Kristine
Frigstad, Marte Marie Hansen
Haugseth, Øyvind
Helland, Tone
Hermann, Solveig
Kjøglum, Kristin Tyldum
Lorentzen, Marianne
Lystvet, Sina Maria
Martinsen, Thomas
Møllegård, Ståle
Neerland, Elisabeth
Nordløkken, Marit
Skårn, Jenny Skeide
Tjemsland, Johanne Marie
Tronstad, Ingvild
Aaen, Ingrid

Environmental toxicology and chemistry (MFORU)

Halkjelsvik, Anveig Bjordal
Holsen, Aase Marie Hersleth
Ottemo, Vivian Grønhaug

Natural Resource management (MNATR)

Salomonsen, Silje Naper

Master of Science Education (MLREAL)

Brimi, Aslak Opsahl
Frøland, Stine Lindset
Hansen, Mari Roen
Hole, Marianne Prestvik
Holt, Yngvil
Valved, Hilde
Østebrød, Tonje Birgitte

Biotechnology (MBIOT5)

Midtaune, Håkon

Cand.scient. students

Chemistry (MNKJ/H)

Azizyan, Mahnaz
Holm, Eva
Storstad, Trond Magne
Sveinhaus, Krister

Biotechnology (MNBTEK/H)

Bergene, Nina Iren

PhD in Chemistry / Dr.scient. in Chemistry

PhD Øyvind Aaberg Garmo	Diffusive gradients in thin films as a tool for metal fractionation and assessment of metal bioavailability to fish.
Trial lecture	Effekter av metaller på marine organismer
Supervisors	Professor Eiliv Steinnes Forsker Oddvar Røyset, NIVA
Evaluation committee	Professor Johan Ingri, Division of Applied Geology, Luleå University of Technology, Sweden Professor, dr.philos. Brit Salbu, Institutt for plante- og miljøfag, Universitet for miljø-og biovitenskap, Ås, Professor Torunn Berg, Institutt for kjemi, NTNU
PhD Jarle Holt	Nitropyridine carbamates, amides and carboxylates in heterocyclic chemistry
Trial lecture	Tautomerism in heterocyclic systems
Supervisor	Professor Anne Fiksdahl
Evaluation committee	Prof.tekn.dr. Jan Bergmann, Karolinska Institutet, Huddinge, Sverige Prof. Fil.dr. Jan Skramstad, Kjemisk institutt, Universitetet i Oslo Førsteamanuensis Dr.rer.nat. Vassilia Partali, Institutt for kjemi, NTNU
Dr.scient. Kåre H. Karstensen	Co-processing of hazardous wastes in cement kilns – an important factor in the formation of dioxins?
Trial lecture	The toxicology of dioxins and dioxin-like PCBs. A comparison of their human burden in developing and developed countries
Supervisor	Professor Eiliv Steinnes
Evaluation committee	Professor, dr.ing. Dieter Mutz, University of Applied Sciences Northwestern Switzerland, Muttenz, Switzerland Professor, dr.philos Knut Lehre Seip, Høgskolen i Oslo Førsteamanuensis Trond Peder Flaten, Institutt for kjemi, NTNU
PhD Trond Røvik Størseth	Chrysolaminarans from marine diatoms. Structural characterization and potential as immunostimulants
Trial lecture	Marine Polysaccharides: Sources, Structure and Function
Supervisors	Førsteamanuensis Vassilia Partali, Institutt for kjemi, NTNU Professor Geir Johnsen, Institutt for biologi, NTNU Forskningssjef Kjell Inge Reitan, SINTEF Fiskeri og Havbruk
Evaluation committee	Professor dr. Otto Pulz, Inst. für Getreideverarbeitung, Germany Researcher, PhD Are Kristiansen, FMC Biopolymer, Oslo Professor Torbjørn Ljones, Institutt for kjemi, NTNU
Dr.ing. Anita Zvolinschi	On exergy analysis and entropy production minimisation in industrial ecology
Trial lecture	An introduction to the life-cycle assessment of energy systems, with a focus on natural gas as energy carrier
Supervisors	Professor Signe Kjelstrup Professor Helge Bratlebø, Industriell økologi
Evaluation committee	Professor Robert U. Ayres, INSEAD Business School, Fontainebleau Cedex, France Sjefsforsker, dr.ing. Erik Lindeberg, SINTEF petroleumforskning Professor dr. Edgar Hertwich, Program for industriell økologi, Institutt for energi og prosesssteknikk

MSc in Chemistry /Cand.scient. in Chemistry 2006:

Iren Abrahamsen **Dopamin β -Monooksygenase. Bindingsstudier med kobber og sink**

Supervisor: Professor Torbjørn Ljones
Examiner: Professor Lars Skjeldal

Ola A. Eggen: **Fordeling av naturlig og antropogent bly i jord studert ved bruk av
sekvensielle ekstraksjoner og stabile blyisotiper**

Supervisor: Professor Eiliv Steinnes
Examiner: Rådgiver Bjørn Ove Berthelsen

Camilla Constance Johnsen **Utvikling av automatisk målesystem for tungmetall- og
spormetallanalyser i forurenset elvevann**

Supervisors: Professor Øyvind Mikkelsen
 Stipendiat Kristina Strasunskiene
Examiner: Rådgiver Kalman Nagy

Marion Rydningen **Kontinuerlig overvåking av tungmetaller i avløpsvann**

Supervisors: Professor Øyvind Mikkelsen
 Stipendiat Silje Skogvold
Examiner: Rådgiver Kalman Nagy

CAND.SCIENT.- 2006:

Kristin Holmgren **Lipid accumulation and growth inhibition induced by n-3 PUFAs in
human colon cancer cells – effects in vitro and in vivo**

Supervisors: Førsteamanuensis Svanhild Schønberg
 Førsteamanuensis Vassilia Partali
Sensor: Seniorforsker Iciar Martinez



MSc in Chemistry/Siv.ing. 2006

MSc Halvor Schrøder Hansen Supervisor: Examiner:	Modelling of carbohydrates with a reactive force field Professor Per-Olof Åstrand Førsteamanuensis Vidar Remi Jensen
Siv.ing. Silja Jaatun Supervisors: Examiner:	Biomembrane with Albedo Effect Professor Signe Kjelstrup and Professor II Kristian Lien Seniorforsker Torleif Holt
Siv.ing. Tor Erik Holt Kristensen Supervisor: Examiner:	Stereoselective ene reactions of aza analogues of sulfur dioxide Førsteamanuensis Odd Reidar Gautun Førsteamanuensis Annette Bayer
MSc Thai Trung Mai Supervisor: Examiner:	Asymmetriske hetero diels alder reaksjoner av nitrogen-analoger til svoveldioksid Førsteamanuensis Odd Reidar Gautun Førsteamanuensis Kåre B. Jørgensen
Siv.ing. Jardar Ingarson Mellesdal Supervisors: Examiner:	A study of new amphiphilic compounds Professor Per Henning Carlsen and Professor Arnjot Elgsæter Førsteamanuensis Kåre B. Jørgensen
MSc Erland Nordgård Supervisor: Examiner:	Synthesis of optically active amphiphiles, dye molecules and studies of their interactions Professor Per Henning Carlsen Førsteamanuensis Kåre B. Jørgensen
MSc Nina Marie Pettersen Supervisor: Examiner:	Syntese av bis-heterosykliske forbindelser fra pyridylmalonat Professor Anne Fiksdahl Professor Lise-Lotte Gundersen
MSc Vegar Stockmann Supervisor: Examiner:	Synthesis of β -carboline analogues Professor Anne Fiksdahl Professor Lise-Lotte Gundersen
MSc Terje Tofteberg Supervisors: Examiner:	Combined quantum chemical and statistical mechanical simulations of the divalent cations of Mg, Ca, Sr and Cu in water Professor Per-Olof Åstrand and Professor Gunnar Karlstöm Professor Knut I. Børve
Siv.ing. Christer Lorentz Øpstad Supervisor: Examiner:	Synthesis and properties of hydrophilic highly unsaturated amphiphiles for gene transfer Førsteamanuensis Vassilia Partali Førsteamanuensis Birte Sjursnes

The following Dr.ing./Ph.D. projects are in progress:

Student	Title	Thesis advisor
Andreassen, Trygve PhD	Assymetriske ene-reaksjoner med aza-analoger til svoveldioksid.	Odd Reidar Gautun
Boman, Mats Henrik Linus PhD	Analytical coupled-cluster calculation of gauge invariant optical properties.	Henrik Koch
Burheim, Odne Stokke PhD	Elektronisk utfelling av jern. (eng.: Electrowinning of iron from chloride melts).	Signe Kjelstrup
Buttingsrud, Bård PhD	En forbedret metode for sammenlikning av 3D-molekylelektronstrukturen i rasjonell legemiddeldesign.	Bjørn Kåre Alsberg
Flatberg, Arnar PhD	Simulation of microarray experiments and protomic 2D gel electrophoresis.	Bjørn Kåre Alsberg
Gellein, Kristin PhD	Trace elements and health – in vitro, experimental animal and human population studies.	Trond Peder Flaten
Gidskehaug, Lars H. Dr.ing.	Chemometric methods for variable-selection and normalisation of microarray-data.	Bjørn K. Alsberg
Glavatskiy, Kirill Sergeevich PhD	Multi-component evaporation as described using the Nonequilibrium van der Waals square gradient model.	Dick Bedeaux
Gonzalez, Susana Villa PhD	Synthesis of optically active surfactants and the study of their properties.	Per Carlsen
Haas, Ole-Erich PhD	Transport on a nanoscale; at surfaces and contact lines in PEM fuel cells.	Astrid Lund Ramstad
Hestad, Øystein Leif PhD	Elektroniske prosesser i frosne dielektriske væsker under høy elektrisk felt påkjenning	Per-Olof Åstrand
Inzoli, Isabella Maria PhD	Molecular modelling of coupled transport of heat and mass	Signe Kjelstrup
Kildahl-Andersen, Geir PhD	Chemoenzymatic Methodes for Synthesis of Rnantiopure Biologically Active Compounds. (Kjemoenzymatiske metoder for syntese av enantiomert rene biologisk aktive stoffer).	Thorleif Anthonsen
Kumelj, Tjasa PhD	Free energy calculations of ligand-protein interactions.	Per-Olof Åstrand
Meland, Anne-Kristine PhD	Optimalization of Pemfc Anode Reaction.	Signe Kjelstrup
Moen, Anders Riise PhD	Synthesis of enantiopure fine chemicals and drugs	Thorleif Anthonsen
Nordhei, Camilla PhD	Strctural Studies of Functional Oxides and their Catalytic Behaviour –XAS and XRD Studies of Nanophase Spinels.	Astrid Lund Ramstad
Rye, Morten Beck PhD	Scale space based image registration of proteomic gels.	Bjørn K. Alsberg
Ryeng, Einar PhD	Analyse av mikromatrisedata med induktiv logikk-programmering.	Bjørn K. Alsberg

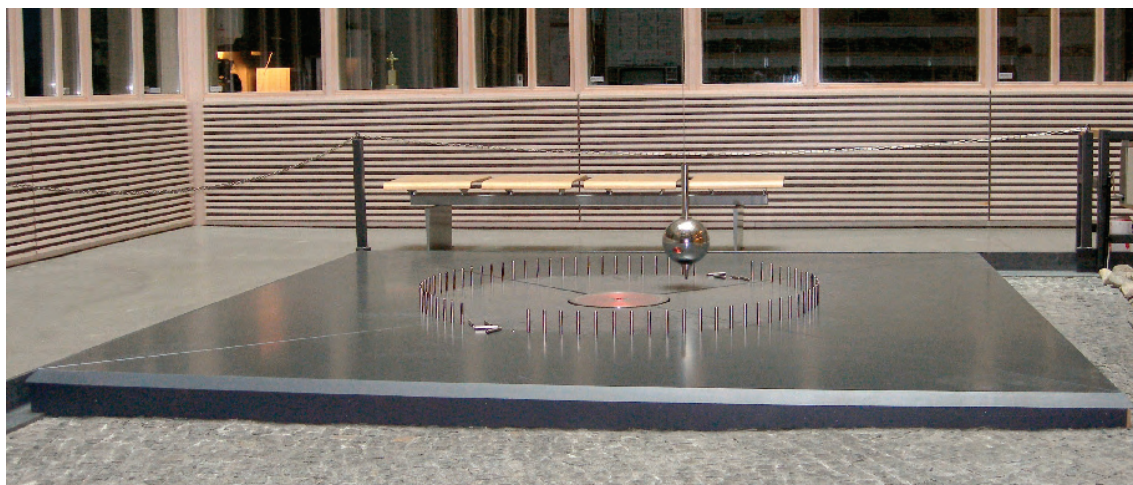
Skogvold, Silje Marie PhD	Overvoltage in Voltammetry: Fundamental Processes, related to Analytical Sensor Development for Online and Remote Trace Analyses.	Knut Schrøder
Smalø, Hans Sverre PhD	Moleculaar models of electronic processes in liquids.	Per-Olof Åstrand
Steen, Anne Orderdalen .PhD	Atmosfærisk spesiering av kvikksølv I polare områder.	Torunn Berg
Stockmann, Vegar PhD	Synthetic Applications of Nitropyridine Derivatives	Anne Fiksdahl
Strasunskiene, Kristina PhD	Automatically measuring systems for heavy metals and trace Metals in waste water from sewage discharge and incineration plants. Early warning systems.	Knut Schrøder
Tjosås, Freddy PhD	Fuced heterocycles from nitropyridines.	Anne Fiksdahl
Xu, Jing PhD	A Nonequilibrium Molecular Dynamics Simulation Study of Chemical Reactors	Signe Kjelstrup
Yu, Qiang PhD	Synthesis of Nucleic Base containing oligomers and polymers.	Per H. Carlsen
Øpstad, Christer Lorentz	Synthesis and properties of hydrophilic highly unsaturated amphiphiles for gene transfer	Vassilia Partali
Aaseng, Jon Erik PhD	Asymmetric synthesis of substituted 2-aminotetralins. (Assymetrisk syntese av substituerte 2-aminotetraliner).	Odd Reidar Gautun

External students

Student	Title	Thesis advisor
Hokstad, Jorunn Nerbø Dr. ing.	Interactions between oil, surface-active agents and water: An organic analytical study of processes taking place when marine oil spills are treated with oil spill agents.	Anne Fiksdahl
Ingebrigtsen, Stian PhD	Elektroniske prosesser i flytende dielektrika under høye elektriske felt påkjenninger.	Per-Olof Åstrand
Jartun, Morten PhD	Urban risk – Dispersion mechanism and possible health effects of PCB in the urban environment.	Eiliv Steinnes
Li, He PhD	Modifikasjon av carotenoider (eng.: Modification of carotenoids).	Vassilia Partali
Løkken, Torbjørn Vegard PhD	Analyser av vandduggpunkt og hydrokarbonduggpunkt i naturgass. (eng.: Determination of water dewpoint and hydrocarbon dewpoint in natural gas)	Rudolf Schmid
Svendsen, Monica Lian PhD	Systemanalyse av metallforurensning I det terrestriske miljø I Odda-området.	Eiliv Steinnes
Sørbye, Karsten Alstad Dr. ing.	Dihydroksyacetonderivater, fremstilling og reaktivitet.	Per Carlsen
Aarhaug, Thor Anders PhD	Ny membran for polymer brenselceller.	Signe Kjelstrup

Student exchange from NTNU, Departement of Chemistry 2006

Name	Specialization	Level	Institution
Madeleine Hystad	BKJ-Struct. chem.	BSc, 3th yr	University of British Columbia, Canada
Marte Marie Hansen Frigstad	MKJ-Org.chem.	MSc, 4th yr	Institute for Chemical and Environmental Research, Barcelona, Spain
Ivar Brønbo Kjerstad	MTKJ-Org.chem.	MSc, 5th yr	Universidad Politécnica de Valencia, Spain
Robert Nilsen	MTKJ-Org.chem.	MSc, 5th yr	Universidad Politécnica de Valencia, Spain
Terje Tofteberg	MTKJ-Fys.chem.	MSc, 5th yr	Lunds Universitet, Sweden (Erasmus)



Student exchange to NTNU, Department of Chemistry 2006

Name	Institution
Burghaus, Jens	RWTH, Aachen, Germany
Cabana, Beatriz Louriño	Universidad de la Coruña, Spain
Fernandez, Juan Lorenzo	Universidad de la Coruña, Spain
Galik, Michal	University of Pardubice, Czech Republic
Gilles, Sandra	Freiberg Univ. of Mining and Technology, Germany
Heffels, Karl-Heinz	RWTH, Aachen, Germany
Holkenbrink, Annika	Georg-August-Universität, Göttingen, Germany
Insua, Juan Francisco	Universidad de la Coruña, Spain
Kaffarnik, Stefanie	Universität Hamburg, Germany
Lesven, Ludovic	University of Lille, France
Mikysek, Tomas	University of Pardubice, Czech Republic
Schaefer, Katrin	Universität Hamburg, Germany
Uhlmann, Stefanie	Philipps Universität Marburg, Germany
Willibald, Julian	Ludwig-Maximilians-Universität, Munich, Germany

Academic Staff

Organic Chemistry



Group Leader
Professor, Dr.ing.
Anne Fiksdahl



Adjunct Professor, Ph.D.
(Oxford) . Derek Chadwick



Associate Professor, Dr.rer.nat.
(Fribourg). Vassilia Partali



Professor, Dr.ing.
Thorleif Anthonen



Associate Professor, Dr.ing.
Odd Reidar Gautun



Associate Professor, Dr.rer.nat.
(Zürich). Rudolf Schmid



Professor, Ph.D. (Buffalo).
Per Carlsen



Associate Professor, Dr.scient
Bård Helge Hoff

Physical Chemistry



Group Leader
Associate Professor, Dr.scient.
Astrid Lund Ramstad



Professor, Dr.philos.
Kolbjørn Hagen



Professor, Dr.philos.
Reidar Stølevik



Professor, Dr.scient.
Bjørn Alsberg



Proferssor, Dr.techn.
Signe Kjelstrup



Professor, Ph.D. (Lund)
Per-Olof Åstrand



Adjunct Professor, Dr.philos.
(Utrecht). Dick Bedeaux



Professor, Ph.D. (Århus).
Henrik Koch



Assistant Professor
Terje Bruvoll



Professor, Ph.D.
Torbjørn Ljones

Environmental and Analytical Chemistry



Group Leader
Dr.Scient
Øyvind Mikkelsen



Associate Professor, Dr.scient.
Lise Kvittingen



Professor, Dr.philos.
Knut Schrøder



Associate Professor, Dr.ing.
(Bucharest) Florinel G. Banica



Ph.D.
Karina Mathisen



Professor, Dr.philos.
Eiliv Steinnes



Professor, Dr.scient.
Torunn Berg



Professor, Ph.D. (London)
David Nicholson



Associate Professor, Dr.ing.
Trond Peder Flaten



Adjunct Professor
Rolf Tore Ottesen

Staff

Administrative staff



Head of administration
Anne Langseth



Senior consultant
Lillian Hanssen



First secretary
Aase Sæther



Consultant
Inger Marie Frøseth



Consultant
Ingrid Kristine Tømmerdal

Technical staff



Senior Technician
Stein Almo



Chief Technician
Julie Jackson



Technician
Nina Klausen



Chief Technician
Syverin Lierhagen



Chief Technician
Tron Rolfsen



Technician
Kari Tanem



Technician
Kjersti Ljones



Technician
Gunnar Svare



Technician
Roger Aarvik

Temporary Lecturers

Hårklau, Halvard
Jacobsen, Elisabeth E.

Scientific Assistants

Ahmad, Iftikhar
Alsvik, Inger Lise
Andreassen, Trygve
Angelsen, Ragnhild Strand
Boman, Linus
Buttingsrud, Bård
Drange, Kristine
Frigstad, Marte Marie Hansen
Fuglseth, Erik
Gellein, Kristin
Gonzalez, Susana Villa
Haas, Ole-Erich
Hancke, Ragnhild
Helgerud, Trygve
Jartun, Morten
Kildahl-Andersen, Geir
Kjøglum, Kristin
Lorentzen, Marianne

Lystvet, Sina
Markussen, Christine
Midtaune, Håkon
Mikkelsen, Øyvind
Moen, Anders Riise
Steen, Anne O.
Storstad, Trond Magne
Strasunskiene, Kristina
Størseth, Trond Røvik
Tjosås, Freddy
Tronstad, Ingvild
Valved, Hilde
Yu, Qiang
Øpstad, Christer L.
Østebrød, Tonje
Øvergård, Tommy

Demonstrators (Master students)

Berge, May-Britt
 Bolstad, Kjersti Hysing
 Borander, Andreas
 Dahl, Espen Hvidsten
 Dahlstrøm, Per Kristian
 Engøy, Ingemund F.
 Finnstun, Elin
 Frafjord, Anders Malm
 Fugleneb, Astrid Kobro
 Gilles, Sandra
 Grave, Anlaug Haukvik
 Gundersen, Tony
 Hancke, Ragnhild
 Hansen, Halvor Schrøder
 Hansen, Marianne Roen
 Hermann, Solveig
 Hole, Marianne P.
 Håkonsen, Bjørn Isak
 Håland, Torfinn
 Haaversen, Linn Christine Loe

Johnsen, Camilla C.
 Jonassen, Hilding
 Lervik, Anders
 Lian, Nikolai
 Lie, Aleksander
 Lorentzen, Marianne
 Martinsen, Morten
 Mellesdal, Jardar Ingarson
 Melnes, Silje
 Midtaune, Håkon
 Milli, Guro K.
 Røst, Even Sjøegaard
 Sivertsen, Sveinung
 Storstad, Trond Magne
 Tuvnes, Henrik J.
 Vevelstad, Solrun Johanne
 Wilhelmsen, Øivind
 Østebrød, Tonje
 Øverby, Anders
 Åstrand, Ove Alexander

Guest professors/researchers/lecturers

Adri van Duin	Jan 7 – 10, 2006
Miguel Rubi	Feb. 16 – March 2, 2006 and Oct. 9 – 18, 2006
Ana Ion	Jan. 30 – Feb. 20, 2006
Jim Gawell	May 4 – Aug. 31, 2006
Asbjørn Holt	Sep. 25 – 29, 2006
Fernando Bresme	Sep. 4 – Oct. 31, 2006
Jan V. Sengers	Oct. 12 – 25, 2006
José Ortiz de Zárate	Oct. 12 – 25, 2006
Mohamed Ahmed ElKasaby	Oct. 30 – Nov. 3, 2006
James Burger	from Nov. 7, 2006
Svenja Röttger	Nov. 20 – Dec. 15, 2006
Rolf Manne	Nov. 15 – 24, 2006
Jean-Marc Simon	to Aug. 31, 2006
Madame Curie Student Sten Richard Sott	to Nov. 30, 2006
Professor Jürgen Heck, Universität Hamburg, Germany Student lecture. "Newer Organic Synthesis Methods"	March 27, 2006
Professor Jürgen Heck, Universität Hamburg, Germany Student lecture. "Newer Organic Synthesis Methods"	March 28, 2006
Professor Jürgen Heck, Universität Hamburg, Germany Student lecture. "Newer Organic Synthesis Methods "	March 31, 2006
Associate Professor Marianne Glerup, Department of Chemistry, University of Oslo "Can we tailor the physical properties of Carbon nanotubes by substitutional doping?"	April 21, 2006
Senior Researcher at Institute for Energy Technology (IFE), Kjeller, Norway and Adjunct Professor at Department of Physics, NTNU, Kenneth Knudsen	Nov. 17, 2006
Manager Jan Arild Hustad, Sigma-Aldrich "The Evolution of PEPPSI: Design, Preparation, Catalytic Reactivity, and Applications to Synthesis".	Dec. 8, 2006

Annual Report for Department of Chemistry 2006



NTNU – Innovation and Creativity

The Norwegian University of Science and Technology (NTNU) in Trondheim represents academic eminence in technology and the natural sciences as well as in other academic disciplines ranging from the social sciences, the arts, medicine, architecture to fine arts. Cross-disciplinary cooperation results in ideas no one else has thought of, and creative solutions that change our daily lives.

Address, contact information

Department of Chemistry, NTNU
N-7491 Trondheim,
Norway

E-mail: postmottak@chem.ntnu.no

