“Making the invisible visible”

The top figure shows a hand holding some white powder. To the human eye it seems that only one component is present when in reality there are two different compounds. The PryJector invention visualises the different components in situ by combining a hyperspectral camera, a chemometric model and an ordinary computer projector. Hyperspectral cameras record a whole spectrum in every pixel (here in the near infrared range) and a chemometric model is used to extract chemical information from each spectrum. In this example the chemometric model is used for classification. When the model is applied to each pixel, a chemical image results which contains the predicted chemical information in each pixel instead of light intensities at different wavelengths. The chemical image is then projected back onto the surface under study in order to visualise to the user where the different components are located. This can be seen in the figure at the bottom where false colour coding is used to highlight the regions for the different components. © Bjørn K. Alsberg
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Foreword

The State of the Department of Chemistry 2010

State of the Department

In connection with previous years’ Activity Reports I have previously commented on the fact that we are not operating in an economic climate that is conducive to basic or curiosity-driven research. A cash-strapped Research Council is of little use to a basic research department because even well-received applications are more often rejected than accepted. In addition to this unfortunate reality we recognise the need for us to increase our focus, capacity and capability for research. In order to increase time spent gainfully on research we must reduce our overall teaching burden. This is complicated by the requirement that we need to maintain competitiveness. There is no clear answer to the question: “how big should a chemistry department be?” In our particular case the realities of funding means that size is dictated by teaching and it is here we need to dimension in a way that actually does benefit research.

These factors moved us to define 2010 as the crucial year for formulating a new strategy plan (2011 – 2015) that will take over from the current one that expires in 2010. Accordingly, a detailed programme was worked out which revolved around examining a wide range of options relating to research, teaching, health and safety and innovation. The result was a much more intense strategy process than is normal-so much so that I sum up here – also because it is felt to be a good model for later strategic planning. The process consisted of:

Inviting three prominent researchers from the different NTNU chemistry departments to constitute a Committee of the Future. The members were Professors Tor Grande (Chair), Sigurd Skogestad and Eriv Steinnes and they operated under a mandate given by me and reported to me. I very much appreciate the sterling work laid down by the committee which also included the time-consuming task of individually interviewing and evaluating the scientific staff.

Weekly meetings that involved all members of staff (research, technical and administrative). These meetings were devoted to predetermined topics relating to research options for the different groups, presentation of current teaching loads and the way forth, discussions on health and safety including the psychosocial environment, the role played by the administration, etc.

Environmental and analytical chemistry had included a position within marine chemistry on its wish list for the previous strategy plan. I considered it necessary that this position be revaluated before being presented as a viable option for the next strategy plan. According, a Seminar on Marine Chemistry was organised in February 2010 at Bårdshaug Hotel. Around forty participants from various NTNU departments and also external institutions/companies (eg NINA, STATOIL, SINTEF) and from abroad. The message is clear: marine chemistry would be a good option for the department which would fit well with NTNU’s marine activities.

The Strategy Seminar itself was held at Jægvolden Fjordhotell in March 2010. The aforementioned processes converged in this seminar and resulted in an outline with some details of the departments Strategy Plan which was scheduled to be presented to the Departmental Board in December 2010 after a series of follow-up general meetings.

This process was very important because it ensured that the staff know that they are important and can identify with the strategy plan.

All in all, 2010 was a good year for the department because it marks the start of period with positive developments. These include:

Funding from NTNU central for making possible the implementation of plans (actually scheduled for 2010) for relocating the organic chemists to the Main Science Building. These plans are an integral part of our strategy for encouraging research synergies. The move is expected to be completed within the first six months of 2011.

Three new scientific positions were approved by the departmental board and by the Faculty. They are: chemical didactics; computational chemistry; and marine chemistry. The computational chemistry position is part of a collaboration with the Departments of Chemical Engineering and Materials Science and Engineering and reflects our strategy of collaborating with these applied chemical departments.

Two technical positions have also been approved; they are assigned to be ancillary instructors in teaching. This is part of our strategy to increase time spent on research.

We took the initiative to invite other departments and external organisations such as SINTEF and STATOIL to join a mass spectrometry consortium. Part of our contribution is to allocate a new higher technical position, the position was filled in 2010. The consortium is applying for the considerable funds needed for instrumentation.

The department also plays a prominent role in another consortium this time international, namely the Swiss-Norwegian Beam Lines (SNBL) at the European Synchrotron Radiation Facility (ESRF). I am currently Chairman of the SNX- Council which runs SNBL which is important for three of the faculties departments.

David G. Nicholson
Former Head of Department
RENEWABLE ENERGY AND EFFICIENT ENERGY CONVERSION

The research on renewable energy sources and on energy efficiency in the group of non-equilibrium thermodynamics increased in 2010. A new laboratory is now being set up for the experimental part of the activity.

Experimental and theoretical projects are now financed by NFR programs FRIENERGI, NANOMAT and KMB (FUME), by our Faculty at NTNU and by the EU 7th Framework program DeCarbit. Three projects are described in more detail below. The current projects are:

1. Reverse electrodialysis; reducing the power loss in a laboratory cell (in collaboration with Queens University, Fuel Cell Centre and Wetsus)

2. Polymer electrolyte fuel cells, reducing power loss in the catalysis and increasing the durability (in collaboration with SINTEF/IFE)

3. Dissipated energy on a North Sea oil platform (in collaboration with Statoil)

4. Reducing the dissipated energy in cryogenic air separation (DeCarbit)

5. The driving forces in heterogeneous catalysis

6. Reducing the dissipated energy in the ferroalloy industry (in collaboration with the ferroalloy industry)

7. Dissipation in molecular motors

Signe Kjelstrup, prof. dr.techn. et dr. ing, leader

The picture shows the group working on renewable and efficient energy conversion.

Behind, from the left: Dick Bedeaux, Mari Voldsund, Ragnhild Skorpa, Thor Anders Aarhaug, Leen van der Ham, Marit Takla
Front row: Odne Stokke Burheim, Signe Kjelstrup, Papy Zefania
Absent: Anders Lervik, Kirill Glavatskiy
Dissipated energy on a North Sea oil platform

The dissipated energy or entropy production on a particular oil producing platform located in the North Sea is evaluated using exergy analysis. The main process on the platform converts a mix of water and reservoir petroleum into stabilized oil and gas for export, treated water and gas for injection back into the reservoir. A gas-fired power plant supplies the power needed for these operations. The efficiency of all subprocesses is of interest. The main process is divided into several sub-processes; one separation section, two gas compression sections and one export oil pumping section. A flowsheet for the platform processes is simulated, and the dissipated energy is calculated as the exergy loss in each process unit is using exergy balances.

The analysis is now done for the two production years; 2009 and 2015. For 2009, the analysis is based on historical data, while the analysis for 2015 is based on predicted data. The main difference between the two years is an increase in the gas to oil ratio of the petroleum feed stream. The gas compressors are the bottleneck of the system, and less oil is produced while the same compressor work is done. The specific power consumption and an overall exergy efficiency for the process is calculated for each of the two years, and the dissipated energy is calculated for each of the platform sub-processes, locating improvement possibilities.

A North Sea platform. The major aim of the project is to find good parameters for evaluating and monitoring the performance of the platform

Mari Voldsund, PhD student
Reducing the dissipated energy in cryogenic air separation.
Air distillation columns with intensified heat integration

Cryogenic distillation of air is one of the main process steps of an Integrated Gasification Combined Cycle (IGCC). It is also one of the most costly steps. An IGCC with pre-combustion CO2 capture is currently one of the main options for the carbon neutral production of electricity from fossil fuels. In addition to coal or gas, it requires pure oxygen and nitrogen as feeds. Those are nowadays typically obtained using a cryogenic air separation unit (ASU). As part of the European collaboration project DECARBit, we are currently investigating methods to improve the efficiency of a cryogenic ASU, with a focus on the use of novel distillation techniques.

We have first performed a detailed mapping of streams of exergy and lost exergy (dissipated energy) of a complete ASU, showing that about one quarter of the total exergy destruction is located in the distillation column section of the process [1].

The distillation section of a conventional ASU contains two columns operate at different pressures. By positioning the low pressure column (LPC) on top of the high pressure column (HPC), a single heat exchanger can be used that functions as reboiler for the LPC and as condenser for the HPC. According to the second law of thermodynamics, it is more efficient to distribute the thermal energy supply or removal over the entire length of the column, than to add or remove such energy only at the top and bottom. Therefore we propose that the duty of the combined reboiler-condenser is spread out over a larger part of the column, moving the LPC into the HPC, as schematically illustrated in Figure 1.

A theoretical study concludes that the effect of this heat integration, in combination with a reduction in the ratio of the two operating pressures, can lead to a reduction in the dissipation by 25%.

Because of the novelty of this type of heat integration, the study theoretical study is based on several assumptions [2]. More accurate predictions require experimental verification of those assumptions. Currently, an experimental set-up is under construction that enables detailed investigations of the most critical assumptions. The design and construction of this set-up is done in close collaboration with SINTEF Energy Research. The experimental activities are expected to take place during the summer and fall of 2011.

References:

Leen van der Ham, PhD student
Dissipation in molecular motors

A biomolecular motor is a protein which converts chemical energy into mechanical work. The chemical energy can be used to bring about such processes as muscle contraction, active transport of ions and molecules across cell membranes and the synthesis of biomolecules. In the operation of a biomolecular motor, energy is also converted to heat which can be used to maintain a constant (and high) body temperature. As proteins function in a narrow temperature range, the excess heat must be removed efficiently. The energy flow in proteins is also important for the understanding of how proteins function.

The Ca$^{2+}$-ATPase ("calcium pump"), see Fig.1, is a biomolecular motor which pumps calcium-ions across cell membranes, utilizing the chemical energy stored in ATP.

![Atomistic models of the Ca$^{2+}$-ATPase embedded in phospholipid bilayers. The Ca$^{2+}$-ATPase pumps Ca$^{2+}$-ions across the membrane against a concentration gradient, utilizing the energy of the ATP-reaction. The pump undergoes several conformational changes during the operation, and two of the conformations are shown: the calcium pump with bound Ca$^{2+}$-ions (to the left, coloured blue) and the calcium pump with no bound Ca$^{2+}$-ions (to the right, coloured pink).](image)

Experiments have shown that there is significant energy dissipation when the molecular motor Ca$^{2+}$-ATPase is in operation [1]. Although the experiments provide quantitative details of energetics and structure, we need a theoretical formalism to interpret experimental results. As a matter of fact, heat regulation or thermogenesis is as yet unexplained in biology. In recent work, Kjelstrup and co-workers proposed that thermogenesis can be described by mesoscopic non-equilibrium thermodynamics (MNET) and subsequently applied this to the Ca$^{2+}$-ATPase molecular motor [2].

We have studied the heat transfer in the Ca$^{2+}$-ATPase using molecular dynamics simulations [3]. We can then simulate the molecular motor using classical mechanics and an atomistic model and give a microscopic picture of the operation of the motor. We have obtained the thermal conductivity of the calcium pump and found that the protein-water interface is important for the heat transfer from the protein to the surrounding water [3].

References:


Anders Lervik, PhD student
Polymer electrolyte fuel cell laboratory

In general, the group has focused on transport phenomena and irreversible thermodynamics of Polymer Electrolyte Membrane Fuel Cells, PEMFC. Hence, up to this point a special attention has been given to thermal measurements and model development. A five year research project “Thermal Effects in Polymer Electrolyte Fuel Cells” was terminated in 2010 but a new research project on PEMFC nanodesign (NICE) was granted by the NANOMAT program.

With the PhD defended in November 2009, Dr. Burheim finalised the project “Thermal Effects in Polymer Electrolyte Fuel Cells” during January and February 2010 - leading to two accepted peer-reviewed articles [1, 2]. The group also participated at the 8th ASME fuel cell conference submitting two papers, which where both well received at the conference’s oral sessions. The experience with thermal conductivity measurements from this project is lead to a collaboration effort to develop a second generation apparatus at a Fuel Cell Research Center, FCRC, at Queens Univ., Ontario, Canada, where Burheim currently is a member of the PEMFC research group.

The NANOMAT project NICE aims to test a fuel cell construct with more uniform entropy production [3].

Salt power by RED

Reverse Electro-Dialysis is a way to produce power which utilises the Gibbs energy of mixing of sea and river water. By directing the flow of sea and river water into compartments separated by anionic and cationic selective membranes, respectively, the Gibbs energy can be converted into a DC electrochemical potential. Extracting this energy can be done via electrochemical reactions at the ends of a stack of these compartments. This is illustrated by the means of ferric and ferrous chloride in Fig.2.
The project started March 1, 2010, as an international collaboration effort between NTNU and Queens Univ., Kingston, Ontario Canada, and NTNU, Norway, granted by the FRIENERGI programme of the Norwegian Research Council, NFR. To start different electrode systems and their dissipation were investigated. As a part of the Norwegian - Canadian collaboration effort, Burheim visited the group at Queens university for a total of three months and wrote a textbook chapter on salt/river water power production along with Professor J.G. Pharoah.

The group was also responsible for arranging a session on different sea/river water power production technologies during the international meeting "Renewable Energy Research Conference" hosted by NTNU in June 2010. The group presented the first results related to the electrode system efficiencies. This led to collaboration with a Dutch team at "wetsus", Leeuwarden, which currently hosts the world’s largest research group within the field of sea/river water power production. As a part of this collaboration effort, the postdoc in the group at NTNU joined "wetsus" as a part time postdoc (25%).


Odne Burheim, post doc

1. Centre of excellence for sustainable water technology
Recovering Dissipated Energy from the Ferro-Silica-Alloy Industry

As a part of the KMB project FUME, granted by the Norwegian research Council, NFR, and the Norwegian Ferroalloy Producers Reasearch Association, FFF, master student M. Takla graduated on a thesis related to conversion of thermal energy to electricity by the means of thermoelectric devices. The work was presented at the Renewable Energy Research Conference in Trondheim June 2010.

The ferroalloy industry is an energy intensive industry and a large producer of metal alloys as well as waste heat. For instance, in 2007 the Norwegian ferroalloy industry needed input of 8.3 TWh and generated 4.8 TWh of waste heat. In comparison, the total Norwegian power consumption was 226 TWh. Hence, utilization of waste heat is of great interest to the industry in order to improve on the energy efficiency.

M. Takla is now a PhD-student at the NT-faculty funded by the FUME sub-project Energy Emmisions. As a part of this study, a first large scale thermoelectric module for electric regeneration of thermal energy, has been designed and put into production. This is to be deployed at the casting area of Elkem Salten, see Fig.3. The aim is to perform the first exergy analysis of a ferroalloy production plant.

Fig.3. Casting metals and radiating thermal energy at the silicon plant of Elkem Salten.

1. ENOVA, Utnyttelse av spillvarme fra norsk industri – en potensialstudie, ENOVA report 2009:1

Marit Takla, PhD student
Modelling enzyme sensors by using dimensionless parameters and variables

Although the best known example of biosensor is the glucose sensor for determining the glucose content in blood, many other applications in clinical chemistry, food industry biosciences and environment monitoring are possible and research work in this area is very active. As a complement to experimental investigations, theoretical modeling of biosensors plays a key role since it provides a rational basis for designing the biosensor in order to achieve expected performances in terms of sensitivity, selectivity and dynamic range.

This contribution refers to modeling amperometric enzyme sensors that consist of a biocatalytic layer sandwiched between a semipermeable membrane and an electrode. The biocatalytic layer includes one or several molecular layers including both the enzyme (E) and an electron transfer mediator (M). By successive electron transfer reactions, electrons are conveyed from substrate (S) to the electrode whereas both the enzyme and the mediator swing between reduced and oxidized forms. As the biocatalytic layer is extremely thin, no concentration gradients develop within and diffusion processes are confined into the semipermeable membrane.

Modeling aims at deriving mathematical equations that relate the response (here, current) to the substrate concentration. In order to impart the equation a general character, it is necessary to resort to dimensionless variables and parameters. Thus, the substrate concentration should be expressed as $S = s/K_M$ where $s$ is the actual concentration and $K_M$ is the Michaelis-Menten constant. The kinetic behavior of this system is determined by two dimensionless parameters: $\alpha = \frac{v_{\text{max}}}{k_{S,m}K_M}$ and $r_T = \frac{k_2}{k_M}$.

The $\alpha$ parameter represents the rapidity of the enzyme reaction relative to the rapidity of the diffusion process. It depends on both enzyme constants ($v_{\text{max}}$ and $K_M$) and the mass transfer coefficient of the substrate in the membrane ($k_{S,m}$). It depends also on the thickness of the biocatalytic layer ($l$). A very low $\alpha$ value indicates that the overall reaction rate is determined by the enzymatic reaction; in the opposite case, it is the diffusion which dictates the overall velocity of the reaction.

The $r_T$ parameter is the turnover number of the enzymatic reaction relative to that of the enzyme reaction with the mediator.

Maximum sensitivity is achieved at an electrode potential that is positive enough with respect to the standard potential of the mediator, such as to keep all mediator in the oxidized state. The current recorded under these conditions assumes a limiting, potential-independent value ($i_l$) which is given by the following equation:

$$\frac{i_l}{i^*} = \frac{\alpha}{(r_T + 1)S + \alpha + 1}$$
Here \( i^* \) is a normalizing parameter which represents the particular value of the current obtained at \( \alpha >> 1, r_T << 1, E >> E^0 \) and \( S = 1 \).

The above equation demonstrates that the limiting current is a non-linear function on the substrate concentration, which is not convenient for practical applications. However, it can be proved that the response function is quasi-linear if the substrate concentration fulfills the following condition:

\[
S \leq 0.05 \left( \alpha + 1 \right) \left( r_T + 1 \right)^{-1}
\]

Under these circumstances, the limiting current turns directly proportional to concentration, as required for analytical applications:

\[
\frac{i}{i^*} = \frac{\alpha}{1 + \alpha} S
\]

Clearly, the best sensitivity results when the sensor is designed such that \( S \) and the current becomes independent on enzyme concentration and its kinetic parameters.

A key parameter is the electrode potential, \( E \), which determines the concentration of the oxidized mediator. A rational for selecting the value working potential is provided by the following equation:

\[
\frac{i}{i^*} = \frac{\alpha}{\alpha + 1} S \left( 1 + S \frac{r_T}{\alpha + 1} e^{-\frac{E}{RT}(E-E^0)} \right)^{-1}
\]

This equation proves that the current increases as the potential shifts negative of the standard potential of the mediator \( E^0 \) and reaches the limiting value, \( i^* \), when the following condition is met:

\[
E \leq E^0 - \frac{RT}{F} \ln \frac{\alpha}{S r_T} + 0.076 \text{ V}
\]

Therefore, such a theoretical treatment allows selecting the optimal parameters such that the sensor exhibits a linear response over a broad concentration range and achieves a maximum sensitivity.

Florinel-Gabriel Banica
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Sliwka, Hans-Richard; Partali, Vassilia; Lockwood, Samuel F.

Spånger, Christian; Fiksdahl, Anne.
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Physical Chemistry

Aarset, Kirsten; Boldermo, Kjell Gunnar; Hagen, Kolbjørn.
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Simon, Jean Marc; Haas, Ole-Erich; Kjelstrup, Signe. Adsorption and Desorption of H2 on Graphite by Molecular Dynamics Simulations. The Journal of Physical Chemistry C 2010; Volum 114. (22) s. 10212-10220

Smalø, Hans Sverre; Åstrand, Per Olof; Ingebrigtsen, Stian. Calculation of Ionization Potentials and Electron Affinities for Molecules Relevant for Streamer Initiation and Propagation. IEEE transactions on dielectrics and electrical insulation 2010; Volum 17. (3) s. 733-741

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van der Ham, Leen; Bock, Robert; Kjelstrup, Signe. Modelling the coupled transfer of mass and thermal energy in the vapour-liquid region of a nitrogen-oxygen mixture. Chemical Engineering Science 2010; Volum 65. (6) s. 2236-2248

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Wilhelmsen, Øivind; Johannessen, Eivind; Kjelstrup, Signe. Energy efficient reactor design simplified by second law analysis. International journal of hydrogen energy 2010; Volum 35. (24) s. 13219-13231

Zhu, Yi-An; Chen, De; Zhou, Xing-Gui; Åstrand, Per Olof; Yuan, Wei-Kang. First-principles calculations of C diffusion through the surface and subsurface of Ag/Ni(1 0 0) and reconstructed Ag/Ni(1 0 0). Surface Science 2010; Volum 604. (2) s. 186-195

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

B. Alsberg

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

Lecture on: "Localisation and Visualisation of Bone Fragments using Hyperspectral Technology".


Lecture on: "Hyperspektral-kamera med projektor - gjør det usynlige synlig".

T. Anthonsen

Co-Author on Poster Presentation: Isoenzymes of Porcine Pancreatic Lipase with opposite Stereoselectivity.


Co-Author on Poster Presentation: Desymmetrisation Catalysed by Porcine Pancreatic Lipase.

RRB6 - the 6th International Conference on Renewable Resources and Biorefineries, Düsseldorf, Germany, June 7 – 9, 2010.
Co-Author on Poster Presentation: Isoenzymes from Crude Porcine Pancreatic Lipase with Opposite Stereoselectivity.

Co-Author on Poster Presentation: Biocatalysis for Green Chemistry.


M. Ardelan


Co-Author on Lecture on: Changes in Mobility and Solubility of Metals at the Seawater/Sediment Interface following CO2 Seepage from Sub-sea Reservoirs.

F.G. Banica

Norwegian Coordinator for International Co-operation Project “Training and Education of Students in Nanotechnology Focused Bioelectrochemistry and Biophysics”; NTNU and Comenius University, Bratislava, Slovak Republic.

Referee for the Czech Science Foundation

Lecture on: Nanomaterials Applications in Electrochemical Biosensors.

Member of Organizing Committee of Summer School “Bionanotechnology, Biophysics and Bioelectrochemistry” in co-operation with Department of Physics, NTNU and Faculty of Science, Comenius University, Bratislava, Slovak Republic, at NTNU, June 21 - 24, 2010.
Co-Author on Lecture on: Self-Assembled Biomolecular Layers on the Gold Electrode with Incorporated Calixarenes for Biosensing Applications.


D. Bedeaux

Invited Lecture, Darmstadt, Germany, Jan. 20 – 22, 2010. Lecture on: Non-equilibrium Thermodynamics of the three-Phase Contact Line.


Seminar Continuum Physics and Engineering Applications, Budapest University of Technology, Hungary, June 3 – 7, 2010. Co-Author on Lecture on: Transport Coefficients of N-butane into and through the Surface of Silicalite-1 from a Non-equilibrium Molecular Dynamics Study.


T. Berg


IPY Oslo Science Conference, Oslo, June 8 – 12, 2010. Co-Author on Lecture on: GEM Measurements during 8 years at Zeppelin, Ny-Ålesund and its Relation to Climate.

Activities

“Sykere elg i sør”. Interview on Internet, Oct. 20, 2010.


The 3rd NorthPOP Conference, Kaliningrad, Russia, Nov. 15 – 19, 2010.
Co-Author on Lecture on: Arctic Mercury Measurements.

Co-Author on Lecture on: Inputs and Outputs of Hg and MeHg in a Catchment Perspective.

M. Bjørgen


O. Burheim


Co-Author on Lecture on: Reverse Electrodialysis – a Renewable DC Power Source.


K.L. Bøyesen


P. Carlsen


A. Esmurziev

Co-Author on Lecture on: Chemo-enzymatic Synthesis of Benzoylated Hexapyranosides and Derivatives.

A. Fiksdahl

Board Member of the KOSK II Research Program, The Research Council of Norway.

Board Member of “Faggruppen for Organisk kjemi” (the Group of Organic Chemistry) of the Norwegian Chemical Society.

Co-Author on Lectures on: “New Chiral N-Heterocyclic Carbene (NHC) Ligands” and “New Gold Catalysed Tandem Cyclisation”.
Co-Author on Poster Presentation: Indole-based Diynes; Substrates for Gold-Catalysed Cyclisations.

Member of National Committee for 18th International Conference on Organic Synthesis (ICOS-18) in Bergen, Aug. 1 – 6, 2010.

T.P. Flaten

Deputy Head of the Department of Chemistry.

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

Board Member, Norwegian Chemical Society, Trondheim Branch.

Editor, Norsk Epidemiologi (Norwegian Journal of Epidemiology).

Co-Author on Lecture on: NOM Foams as Indicators of Trace Metal Transport in NOM rich Streams.
Co-Author on Lectures on: “Can Levels of Trace Elements in Moose (Alces Alces) Liver Explain Regional Differences in their Health Status?” and “Can Trace Elements in Moose (Alces Alces) Feed Explain Regional Health Differences?”.

“Sykere elg i sør”. Interview on Internet, Oct. 20, 2010.

“Heavy Metals May Influence Moose Health”. Interview on Internet “Science Daily”, Nov. 7, 2010

E. Fuglseth

Co-Author on Lecture on: Microwave Assisted Side Chain Fluorination of 1-Arylethanones.
Co-author on Poster Presentation: Ruthenium Catalysed Asymmetric Transfer Hydrogenation of Fluorinated Ketones.

O.R. Gautun


K.F. Gebremariam


Co-Author on Poster Presentation: Analysis of Pigments in Various Ethiopian Paintings using Portable X-ray Fluorescence Analyzer.

A. Gerontas

Lecture on: Mikhail Tsvet and Richard Willstätter; or “how and why would the Race for Chlorophyll Send the first Steps of Chromatography out of Track”.


Lecture on: The Birth and the first Steps of High Performance Liquid Chromatography in the Laboratories of Yale University; an Example of the Exchanges between Academia and Industry in the United States of the 1960s.

K. Glavatskiy

Co-Author on Poster Presentation: Stability of Gas Hydrates from Heat of Adsorption?


Co-Author of Lecture on: Adsorption of CO2 by Gas Hydrates.

Co-Author on Lecture on: Molecular Simulations of Gas Hydrates.

S.V. Gonzalez

27th Montreux Symposium on LC/MS and Course CID, Montreux, Switzerland, Nov. 8 – 14, 2010.

L. van der Ham


Co-Author on Lecture on: The Importance of Coupling between Thermal and Molar Fluxes in a Nitrogen-Oxygen Distillation Column.

The old giant is falling

B.H. Hoff

Co-Author on Lectures on: “Chemo-enzymatic Synthesis of Benzoylated Hexapyranosides and Derivatives” and “Microwave Assisted Side Chain Fluorination of 1-Arylethanones”.

The old giant is falling
Activities

Co-Author on Poster Presentations: “Pyrrolopyrimidines as Potential Kinase Inhibitors”, “Ruthenium Catalysed Asymmetric Transfer Hydrogenation of Fluorinated Ketones” and “Synthesis of new Chiral Building Blocks: 1-Aryl-2-Fluorethylamines”.

S. Iftekhar


Co-Author on Lecture on: NOM Foams as Indicators of Trace Metal Transport in NOM rich Streams.

S.L. Jensen

“Feminint forbilde i teknologisk miljø”. Interview in the Newspaper “Adresseavisen”, Sep. 11, 2010.

S.J. Kaspersen


Co-author on Poster Presentation: Pyrrolopyrimidines as Potential Kinase Inhibitors.


Co-Author on Poster Presentation: Stability of Gas Hydrates from Heat of Adsorption?


Co-Author on Lecture on: Non-equilibrium Thermodynamics Applied to Transport of N-butane through a Membrane of Silicalite. The Effect of Coupling between Heat of Adsorption and Mass Transfer.


Co-Author on Lecture on: Transport Coefficients of N-butane into and through the Surface of Silicalite-1 from a Non-equilibrium Molecular Dynamics Study.


Co-Author on Lecture on: Thermodiffusion in Chemically Reacting Binary Mixtures with Nonlinear Kinetics.

XII Sitges Conference on Statistical Mechanics, Sitges, Spain, June 7 – 11, 2010.


Co-Author on Lecture on: Reverse Electrodialysis – a Renewable DC Power Source.


Co-Author on Lectures on: “The Importance of Coupling between Thermal and Molar Fluxes in a Nitrogen-Oxygen Distillation Column”, “Exergy Analysis of the Oil and Gas Separation Processes on a North Sea Oil Platform” and “Nature-Inspired Design of a Polymer Electrolyte Fuel cell”.


Co-Author of Lecture on: Adsorption of CO2 by Gas Hydrates.

S. Kjelstrup


Lake Kvistingen in June
Activities


Research Stay at Complutense University, Applied Physics Department, Madrid, Spain, Nov. 6 – 12, 2010.


Lecture on: Development of Non-equilibrium Thermodynamics Theory using Molecular Dynamics Simulations.
Co-Author on Lecture on: Molecular Simulations of Gas Hydrates.

H. Koch

T. Kristiansen

L. Kvittingen
Co-Author on Poster Presentation: Analysis of Pigments in Various Ethiopian Paintings using Portable X-ray Fluorescence Analyzer.


T. Ljones
RRB6 - the 6th International Conference on Renewable Resources and Biorefineries, Düsseldorf, Germany, June 7 – 9, 2010.
Co-Author on Poster Presentation: Isoenzymes from Crude Porcine Pancreatic Lipase with Opposite Stereoselectivity.

A. Lykknes

Co-Author on Lecture on: "Dialogene i naturfagskrivningen”.


M. Martinsen
Research Stay at Vancouver Island University, Department of Chemistry, Canada, May 31 – Oct. 6 and Nov. 29 – Dec. 22, 2010.
Co-Author on Poster Presentation: Seasonal, Spatial and Temporal Variations of Air Toxics in the Seattle-Tacoma Airshed Measured by Membrane Introduction Tandem Mass Spectrometry (MIMS-MS/MS).

Co-Author on Lectures on: "The Development of a Rugged, Field-Portable Membrane Introduction Tandem Mass Spectrometer (MIMS-MS/MS) and its use as an On-line Monitor for Volatile and Semi-Volatile Organic Compounds in the Alberta Oil Sands" and "On-line Monitoring of Air Toxics in the Seattle-Tacoma Airshed from a Mobile Membrane Introduction Tandem Mass Spectrometry System".

The little stream in the forest

K. Mathisen
Activities

S. Melnes

Co-Author on Lecture on: “Studies towards the Synthesis of Potential Therapeutic Agents against the Hematologic Cancer Multiple Myeloma.

Ø. Mikkelsen

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

Co-Author on Lecture on: NOM Foams as Indicators of Trace Metal Transport in NOM rich Streams.

Co-Author on Lecture on: High Biogeochemical and Biological Monitoring in a Polluted Water System, the Deûle Canal (Northern France).


Lecture on: “Deo-sjøkk” Stands på Researchers’ Night.


Research Co-operation (Aurora) at Université du Sud Toulon Var, La Garde, France, Dec. 1 – 7, 2010.


Co-Author on Lecture on: The Development of a Rugged, Field-portable Membrane Introduction Tandem Mass Spectrometer (MIMS-MS/MS) and its use as an on-line Monitor for Volatile and Semi-Volatile Organic Compounds in the Alberta Oil Sands.

M.A. Mohsin

Co-Author on Lecture on: Self-Assembled Biomolecular Layers on the Gold Electrode with Incorporated Calixarenes for Biosensing Applications.

D.G. Nicholson

Head of the Department of Chemistry.

Chairman, SNX Council, Swiss-Norwegian Beamlines at the European Synchrotron Radiation Facility, Grenoble, France.

Scientific Advisory Council, Max IV Synchrotron Project, Max-Lab., Lund, Sweden.


M. Nordløkken

Co-Author on Lectures on: “Can Levels of Trace Elements in Moose (Alces Alces) Liver Explain Regional Differences in their Health Status?” and “Can Trace Elements in Moose (Alces Alces) Feed Explain Regional Health Differences?”.

“Sørlandselgen er sjuk og skrøpelig”. Interview on Internet: gardsdrift.no, Oct. 20, 2010.

“Sykere elg i sør”. Interview on Internet, Oct. 20, 2010.
Activities

“Sykere elg i sør”. Interview in the Newspaper “Fædrelandsvennen”, Oct. 21, 2010.

“Sykere elg i sør”. Interview in the Newspaper “Aftenposten morgen”, Oct. 21, 2010.


“Heavy Metals May Influence Moose Health”. Interview on Internet “Science Daily”, Nov. 7, 2010

V. Partali
Section Leader, Organic Chemistry Group, Department of Chemistry, NTNU.

Co-author on Poster Presentation: Exploring Co-lipid Formulations with a Novel Rigid, Polyene Cationic Nucleic Acid Delivery Vector.

Annual Meeting at Weill Cornell Medical College in Quatar, Doha, Quatar, Nov. 6 – 13, 2010.

E. – M. Sandru
Lecture on: Controlling Aggregation – Aggregates of Predefined Size from Highly unsaturated Selena Phospholipid.

ICOS 18 – 18th International Conference on Organic Synthesis, Bergen Norway, Aug. 1 – 6, 2010.
Poster Presentation: Controlling Aggregation – Aggregates of Predefined Size from Highly unsaturated Selena Phospholipid.

R. Schmid

Research Stay at Leismer Statoil, Wood Buffalo, AB, Canada and Vancouver Island University, Nanaimo, BC, Canada, Sep. 3 – 16, 2010.

Co-Author on Lecture on: The Development of a Rugged, Field-portable Membrane Introduction Tandem Mass Spectrometer (MIMS-MS/MS) and its use as an On-line Monitor for Volatile and Semi-Volatile Organic Compounds in the Alberta Oil Sands.

A. Simic


Co-Author on Poster Presentations: “Intoxication with Cupro II Sulphat - Case Report” and “Clinical Manifestation of Bensodiazepines Poisoning”.

N. Simic

Bruker Scandinavia; NMR Users’ Seminar, Oslo, Norway, Jan. 11 – 12, 2010.


R. Skorpa

Research Stay at FCRC/Queens University, Kingston, Ontario, Canada, Nov. 1 – 12, 2010.

E. – M. Sandru

Co-Author on Poster Presentations: “Intoxication with Cupro II Sulphat - Case Report” and “Clinical Manifestation of Bensodiazepines Poisoning”.

C. Sperger

Co-Author on Lectures on: “New chiral N-Heterocyclic Carbene (NHC) Ligands” and “New Gold Catalysed Tandem Cyclisation”.
Co-Author on Poster Presentation: Indole-based Diynes; Substrates for Gold-Catalysed Cyclisations.

Co-Author on Lecture on: New Gold Catalysed Tandem Cyclisations.
Co-Author on Poster Presentation: Synthesis and Application of new Chiral N-Heterocyclic Carbenes.

A.O. Steen

Activities

The 3rd NorthPOP Conference, Kaliningrad, Russia, Nov. 15 – 19, 2010.
Co-Author on Lecture on: Arctic Mercury Measurements.

E. Steinnes

Lecture on: Airborne PCBs in the Norwegian Environment: Concentrations and Fractionation of PCB Congeners in Surface Soil from 58o to 80o Northern Latitude.

Co-Author on Lectures on: “Can Levels of Trace Elements in Moose (Alces Alces) Liver Explain Regional Differences in their Health Status?”, “Can Trace Elements in Moose (Alces Alces) Feed Explain Regional Health Differences?” and “Changes in Mobility and Solubility of Metals at the Seawater/Sediment Interface following CO2 Seepage from Sub-Sea Reservoirs”.

Co-Author on Lecture on: Impact of the Chernobyl Accident on Norway: Lessons Learnt.

Lecture on: Biomonitoring of Air Pollutants on the Local and Regional Scale using Mosses: Strong and Weak Points.

“Heavy Metals May Influence Moose Health”. Interview on Internet “Science Daily”, Nov. 7, 2010

R.B. Strand

Co-Author on Poster Presentation: Synthesis and Application of new Chiral N-Heterocyclic Carbenes.

T. K. Thvedt

Co-Author on Lecture on: Microwave Assisted Side Chain Fluorination of 1-Arylethenones.

M. Voldsund

Co-Author on Lecture on: Exergy Analysis of the Oil and Gas Separation Processes on a North Sea Oil Platform.


C.L. Øpstad

Research Stay at Weill Cornell Medical College in Quatar, Doha, Quatar, March 28 – April 2, 2010.

P. – O. Åstrand

Guest Lecture on: Combined Charge-Transfer and Point-Dipole Interaction Model for Electronic Polarization.

Guest Lecture on: Combined Charge-Transfer and Point-Dipole Interaction Model for Electronic Polarization.

Lecture on: Combined Charge-Transfer and Point-Dipole Interaction Model for Electrostatic Interactions.

Co-Author on Lecture on: Molecular Modeling.

The arches of Orkla bridge
## Spring examination

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<td>KJ3000</td>
<td>Organic Medicinal and Pharmacaceutical Chemistry (7,5)</td>
<td>Derek James Chadwick</td>
<td>7/6</td>
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<tr>
<td>KJ3055</td>
<td>Analytical Atomic Spectrometry (7,5)</td>
<td>Florinel Gabriel Banica</td>
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<tr>
<td>KJ3065</td>
<td>Enzyme chemistry (7,5)</td>
<td>Torbjørn Ljones</td>
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<td>KJ8100</td>
<td>Organic Medicinal and Pharmacaceutical Chemistry (7,5)</td>
<td>Derek James Chadwick</td>
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<td>KJ8106</td>
<td>Advanced Organic Chemistry (7,5)</td>
<td>Per Henning Carlsen</td>
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<td>KJ8901</td>
<td>Enzyme chemistry (7,5)</td>
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<td>Organic Chemistry, Advanced Course (7,5)</td>
<td>Bård Helge Hoff</td>
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<td>TKJ4130</td>
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<td>Vassilia Partali</td>
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<td>Anne Fiksdahl</td>
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<td>TKJ4160</td>
<td>Basic Physical Chemistry and Laboratory (15)</td>
<td>Signe Kjelstrup</td>
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<td>Henrik Koch</td>
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<td>TKJ4166</td>
<td>Chemical Bond Theory and Spectroscopy (7,5)</td>
<td>Henrik Koch</td>
<td>20/14</td>
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<td>TKJ4175</td>
<td>Chemometrics, Basic Course (7,5)</td>
<td>Bjørn Kåre Alsberg</td>
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<tr>
<td>TKJ4215</td>
<td>Statistical Thermodynamics in Chemistry and Biology (7,5)</td>
<td>Per-Olof Åstrand</td>
<td>27/27</td>
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## Autumn examination

<table>
<thead>
<tr>
<th>Course no.</th>
<th>Course title (credits)</th>
<th>Lecturers and exercise coordinators</th>
<th>Candidates/Passed</th>
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<tbody>
<tr>
<td>KJ1000</td>
<td>General Chemistry (15)</td>
<td>Kolbjørn Hagen, Torbjørn Ljones</td>
<td>188/171</td>
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<tr>
<td>KJ1030</td>
<td>Inorganic Chemistry (15)</td>
<td>Torbjørn Ljones, Tina Kristiansen</td>
<td>42/36</td>
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<tr>
<td>KJ1041</td>
<td>Chemical Bond, Spectroscopy and Kinetics (7,5)</td>
<td>Henrik Koch, Tina Kristiansen</td>
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<tr>
<td>KJ2050</td>
<td>Analytical Chemistry, Basic Course (7,5)</td>
<td>Øyvind Mikkelsen, Florinel Gabriel Banica</td>
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<td>KJ3001</td>
<td>Stereochemistry and Synthesis of Chiral Compounds (7,5)</td>
<td>Per Henning Carlsen</td>
<td>6/6</td>
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<td>KJ3021</td>
<td>Nuclear Magnetic Resonance Spectroscopy (7,5)</td>
<td>Nebojsa Simic</td>
<td>17/16</td>
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<tr>
<td>KJ3050</td>
<td>Marine Organic Environmental Chemistry (7,5)</td>
<td>Øyvind Mikkelsen</td>
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<tr>
<td>KJ3053</td>
<td>Analytical Methods for Industrial- and Environmental Monitoring (7,5)</td>
<td>Øyvind Mikkelsen</td>
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<tr>
<td>KJ3056</td>
<td>Chemical Sensors and Biosensors (7,5)</td>
<td>Florinel Gabriel Banica</td>
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<td>KJ3058</td>
<td>Analytical Chemical Separation Techniques (7,5)</td>
<td>Rudolf Schmid</td>
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<td>KJ3070</td>
<td>Advanced Aquatic Chemistry (15)</td>
<td>Trond Peder Flaten</td>
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<td>KJ3071</td>
<td>Applied Geochemistry (7,5)</td>
<td>Rolf Tore Ottesen</td>
<td>19/19</td>
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<td>KJ6002</td>
<td>Basic Chemistry 2 (Continuing education for teachers) (7,5)</td>
<td>Lise Kvittingen</td>
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<tr>
<td>KJ8021</td>
<td>Stereochemistry and Synthesis of Chiral Compounds (7,5)</td>
<td>Per Henning Carlsen</td>
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<td>Øyvind Mikkelsen</td>
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<td>KJ8104</td>
<td>New Methods in Organic Synthesis (7,5)</td>
<td>Bård Helge Hoff</td>
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<td>TKJ4102</td>
<td>Basic Organic Chemistry and Laboratory (15)</td>
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<td>TKJ4180</td>
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<td>TKJ4525</td>
<td>Organic Chemistry, Specialization Course (7,5)</td>
<td>Anne Fiksdahl</td>
<td>11/11</td>
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## Re-sit examination

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<th>Course no.</th>
<th>Course title (credits)</th>
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<td>RFEL1001</td>
<td>Natural Science and World Views (7,5)</td>
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<td>KJ1000</td>
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<td>Spectroscopic Methods in Organic Chemistry (7,5)</td>
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<td>KJ2031</td>
<td>Inorganic Chemistry, Advanced Course (7,5)</td>
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<td>Chromatography (7,5)</td>
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<td>Nuclear Magnetic Resonance Spectroscopy (7,5)</td>
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<td>RFEL3093</td>
<td>Episodes from the history of science (7,5)</td>
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<td>KJ8052</td>
<td>Analytical Electrochemistry and its Application within Industrial and Environmental Monitoring (7,5)</td>
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<td>Statistical Thermodynamics in Chemistry and Biology (7,5)</td>
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Post Graduate Students

Siv.ing. students

3. year (MTKJ)
Glansberg, Karin Märta
Hauge, Hans Henrik R.
Holden, Mia Cathrine Hellandsjø
Kolstad, Aleksander
Lauvås, Marie Jacobsen
Myhre, Rolf Heilemann
Rysdå, Line
Skjønsfjell, Ellen Martine

4. year (MTKJ)
Bøe, Maren Seljenes
Bergersen, Amund Dolva
Ellila, Georg
Elnan, Jørund
Gulbrandsen, Tore Aarhus
Han, Jin
Isaksen, Stian Moe
Kaur, Maya
Larsen, Synne
Solemslie, Henrik Winther
Strand, Mikael
Surdal, Cecilie
Tveeikrem, Marit Elise Endresen
Vo, Mong Truc

5. year (MTKJ)
Blakstad, Guro
Bugge, Steffen
Kaasa, Kristin
Solvang, Tina
Tungen, Jørn Eivind

Master students in progress

Chemistry (MKJ)
Berge, May Britt
Borkenhagen, Marius
Borkowska, Zuzanna
Egeness, Mari Jystad
Emdal, Martin Folke
Forselv, Stian
Haugland, Marius Myren
Heggøy, Anette
Henriksen, Stine
Hjertenæs, Eirik
Hoholm, Rebecca Stavrum
Høås, Morten Juul
Høyvik, Ida-Marie
Kvithyll, Heidi
Larsen, Rune
Lindjerdet, Per Magnus
Martinsen, Morten
Moen, Ingvill Marie
Nauste, Kristian Bunkholt
Norang, Mona Skagseth
Ohm, Ragnar Gaard
Opsahl, Anette
Rise, Astrid Toftaker
Simensen, Jan Tore
Sivertsen, Sveinung Sundfør
Strandberg, Trond
Sørensen, Lisbet
Aaen, Ingrid

Environmental toxicology and chemistry (MSENVITOX)
Alston, John Fraser
Bechmann, Pernille
Eskeland, Maren
Hunnestad, Annie Vera
Høydal, Liv Mari Brunstad
Haakseth, Anne-Britt
Kamalia, Uswatun Hasanah Isna
Larsen, Katrine Hervik
Liu, Zhucheng
Melting, Kine
Nordum, Mats
Sanchez, Nicolas
Slinde, Gøril Aasen
Sundeng, Kathrine Helen
Trefjord, Terese

Master of Science Education (MLREAL)
Andersen, Marthe Kristin
Buraas, Ida Kristine
Paulsrud, Lars Evensen
Pedersen, Lars Størseth

Natural Resource Management (MSNARM)
Som, Bozumeh
## The following Ph.D. projects are in progress:

<table>
<thead>
<tr>
<th>Student</th>
<th>Title</th>
<th>Thesis advisor</th>
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<tbody>
<tr>
<td>Bøyesen, Katrine</td>
<td>Combined Raman, X-ray Absorption, Scattering and diffraction studies on nanoparticulate VOx species in micro and mesoporous systems for the selective oxidation of propene and propane.</td>
<td>Karina Mathisen</td>
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<td>Chu, Chunmei</td>
<td>Automated de novo optimization of functional organometallic compounds by integrating a QSAR/genetic algorithm method.</td>
<td>Bjørn K. Alsberg</td>
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<td>Esmurziev, Aslan</td>
<td>Synthesis of new fluorinated uronic acids and total synthesis of new uridine diphosphate fluoro-uronic acids. (Syntese av fluoreerte uronsyrer og talsyntes av nye uridine difosfat fluoro-uronsyrer.)</td>
<td>Bård Helge Hoff</td>
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<td>Flatberg, Arnar</td>
<td>Simulation of microarray experiments and protsomic 2D gel electrophoresis.</td>
<td>Bjørn K. Alsberg</td>
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<td>Gebremariam, Kidane Fanta</td>
<td>Analytical methods for art objects investigation</td>
<td>Lise Kvittingen</td>
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<td>Gerontas, Apostolos</td>
<td>A history of the development of column chromatography: From Tswet to HPLC</td>
<td>Annette Lykknes</td>
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<td>Ham, Leen van der</td>
<td>Optimising the Second law efficiency of a cryogenic air separation unit</td>
<td>Signe Kjelstrup</td>
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<td>Iftekhar, Shafia</td>
<td>Trace metals and natural organic matters in rivers.</td>
<td>Torunn Berg</td>
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<td>Kaspersen, Svein Jacob</td>
<td>New pyrrolo, thieno and furopyrimidine targeting tyrosine kinases (cancer) and protozoas: synthesis and bioactivity</td>
<td>Bård Helge Hoff</td>
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<td>Kristiansen, Tina</td>
<td>Aerogels: A new class of materials for catalytic purposes.</td>
<td>David G. Nicholson</td>
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<td>Kumelj, Tjasa</td>
<td>Free energy calculations of ligand-protein interactions.</td>
<td>Per-Olof Åstrand</td>
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<td>Lervik, Anders</td>
<td>Energy transfer in biomolecular motors</td>
<td>Signe Kjelstrup</td>
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<td>Løkken, Torbjørn Vegard</td>
<td>Analyser av vannduggpunkt og hydrokarbonduggpunkt i naturgass. (Determination of water dewpoint and hydrocarbon dew-point in natural gas.)</td>
<td>Rudolf Schmid</td>
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<td>Martinsen, Morten</td>
<td>Development of an on-line monitoring platform and procedure for rapid environmental and process monitoring of heavy oil extraction operations and industrial activity</td>
<td>Øyvind Mikkelsen</td>
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<td>Mekki, Miriam</td>
<td>Development and application of response methods for large molecular systems.</td>
<td>Henrik Koch</td>
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<td>Melnes, Silje</td>
<td>Rational drug design synthesis of potential selective inhibitors of tyrosin kinase 2.</td>
<td>Odd Reidar Gautun</td>
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<tr>
<td>Student</td>
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<td>Thesis advisor</td>
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<td>Mohsin, Muhammad Ali</td>
<td>Surface functionalization by bio-organic materials.</td>
<td>Florinel G. Banica</td>
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<td>Nordløkken, Marit</td>
<td>Spormetaller i hjortedyr i Norge. (Trace of elements in Norwegian deer).</td>
<td>Torunn Berg</td>
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<td>Raju, Rajesh</td>
<td>Optically active amphiphiles and artificial cells</td>
<td>Per Carlsen</td>
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<td>Sandru, Eugenia-Mariana</td>
<td>Synthese av høy umettete bioorganiske forbindelser. (Synthesis of highly unsaturated bioorganic compounds.)</td>
<td>Vassilia Partali</td>
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<td>Saepurahman</td>
<td>Spectroscopic studies of zeolites and zeolite facilitated oxygenate/hydrocarbon conversion reactions.</td>
<td>Morten Bjørgen</td>
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<td>Simic, Anica</td>
<td>Trace elements and persistent organic pollutants (POPs) in blood serum samples from the Nord-Trøndelag health study (HUNT) and the possible role of trace elements in type 2 diabetes.</td>
<td>Trond Peder Flaten</td>
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<td>Skorpa, Ragnhild</td>
<td>A thermodynamic base for reaction kinetics. Studied by non-equilibrium molecular dynamics simulations.</td>
<td>Signe Kjelstrup</td>
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<td>Steen, Anne Orderdalene</td>
<td>Atmosfærisk spesiering av kvikksølv i polare områder.</td>
<td>Torunn Berg</td>
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<td>Strand, Ragnhild B.</td>
<td>Heterocyclic synthetic chemistry based on nitropyridine derivatives.</td>
<td>Anne Fiksdahl</td>
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<td>Syed, Majid Bukhari</td>
<td>Isolation and structure elucidation of natural Bioactive molecules of plant origin.</td>
<td>Nebojsa Simic</td>
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<td>Takla, Marit</td>
<td>Methods to utilize waste heat in the ferro alloy industry.</td>
<td>Signe Kjelstrup</td>
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<td>Thvedt, Thor Håkon Krane</td>
<td>Enzymatic resolution coupled with in-situ racemisation for production of enantiopure amines. Application of the building blocks in preparation of potential antifungal compounds.</td>
<td>Bård Helge Hoff</td>
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<td>Zaidi, Asma</td>
<td>Synthesis of highly unsaturated amino acids.</td>
<td>Vassilia Partali</td>
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<td>Zeeshan, Muhammad</td>
<td>Optical resolution by fractional aggregation.</td>
<td>Vassilia Partali</td>
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<td>Voldsund, Mari</td>
<td>Entropy production in process equipment</td>
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<td>Weggeberg, Hanne</td>
<td>Metal characterization of different size fractions of airborne particulate matter and adverse health effects in humans</td>
<td>Trond Peder Flaten</td>
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<td>Aarhaug, Thor Anders</td>
<td>Ny membran for polymer brenselsceller.</td>
<td>Signe Kjelstrup</td>
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## MSc in Chemistry

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Supervisor</th>
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<tbody>
<tr>
<td>Braaten, Hans Fredrik Veiteberg</td>
<td>Er kvikksølv i sne i Arktis av atmosfærisk eller marin opprinnelse. En studie av metylkvikksølv, totalkvikksølv og marine hovedioner i arktisk snø</td>
<td>Professor Torunn Berg</td>
<td>Senior Research Scientist, dr.scient. Hilde Thelle Uggerud, NILU Associate Professor Trond Peder Flaten</td>
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<tr>
<td>Engø, Ingemund Magnus Falkberget</td>
<td>Synthesis and reduction of 1-aryl-2,2-difluoroethanones</td>
<td>Associate Professor Bård Helge Hoff</td>
<td>Researcher, dr.scient. Harald Svendsen, EPAX AS Dr.ing. Eva Mørkved</td>
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<tr>
<td>Edvardsen, Tove-Nanny Falkberget</td>
<td>Large and extra-large pore acidic ITQ-zeotypes: An in-situ spectroscopic study of fundamental properties</td>
<td>Associate Professor Morten Bjørgen</td>
<td>Post.doc. Karina Mathisen</td>
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<tr>
<td>Egede-Nissen, Cecilie Falkberget</td>
<td>Utvikling av en ny type elektrokjemisk DGT-enhet for overvåking av spormetall i kystvann ved bruk av, og kvalitetssikring med, komplementerende målinger</td>
<td>Professor Øyvind Mikkelsen</td>
<td>Professor Emeritus Knut Schrøder Stipendiat Kristina Strasunske</td>
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<tr>
<td>Haug, Siri Falkberget</td>
<td>Bruk av DGT og voltammetri for varsling av forhøyede konsentrasjoner av sulfid som indikator for korrosjonsfremmende miljø</td>
<td>Professor Øyvind Mikkelsen</td>
<td>Professor Emeritus Knut Schrøder Stipendiat Kristina Strasunske</td>
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<td>Helgerud, Trygve Falkberget</td>
<td>Synthesis and application of new chiral N-heterocyclic carbenes</td>
<td>Professor Anne Fiksdahl</td>
<td>Associate Professor Tore Lejon, UiT Professor Emeritus Jan Magnus Bakke</td>
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<td>Hoffaniska, Idar Falkberget</td>
<td>Synthesis and characterization of microporous zeotypes with the AFN topology: Phase impurities and thermal stability</td>
<td>Associate Professor Morten Bjørgen</td>
<td>Post.doc. Karina Mathisen</td>
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<tr>
<td>Hovde, Gunnhild Falkberget</td>
<td>Studie av fysikalsk-kjemiske parametere i elvevann. Kvalitetssikring av miljødata</td>
<td>Professor Øyvind Mikkelsen</td>
<td>Professor Emeritus Knut Schrøder Stipendiat Kristina Strasunske</td>
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<td>Høyvik, Ida-Marie Falkberget</td>
<td>Part A: Structures and conformational energies of selected fluoropropenes. Part B: Alternative forms of exchange correlation functionals derived from pair-creation transformations</td>
<td>Professor Henrik Koch</td>
<td>Professor Kenneth Ruud, UiT Professor Per-Olof Åstrand</td>
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### Post Graduate Students

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<tr>
<th>Name</th>
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<th>Examiners</th>
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<tr>
<td>Skorpa, Ragnhild</td>
<td>Assessing the surface sites of the microporous materials H-ITQ-7 and H-Beta using FT-IR spectroscopy and various molecular probes</td>
<td>Associate Professor Morten Bjørgen</td>
<td>Post.doc. Karina Mathisen</td>
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<td>Research Scientist, dr.scient. Merete Hellner Nilsen, UiO</td>
<td>Professor David Nicholson</td>
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<tr>
<td>Sveinhaug, Kriste</td>
<td>Studie av voltammetrisk respons for analyse av spormetaller under påvirkning av mekanisk fremdrevet vibrasjon</td>
<td>Professor Øyvind Mikkelsen</td>
<td>Research Scientist Kalman Nagy, SINTEF</td>
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<td>Stipendiat Kristina Strasunske</td>
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<td>Volynkin, Andrey Sergeevich</td>
<td>Synthesis, characterization, and catalytic studies of ITQ-33. Conversion of methanol to hydrocarbons over a microporous germano-aluminosilicate</td>
<td>Associate Professor Morten Bjørgen</td>
<td>Post.doc. Karina Mathisen</td>
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<tr>
<td>Mekki, Miriam</td>
<td>Quantum chemical calculations on pristine and boron substituted carbon nanotubes</td>
<td>Professor Henrik Koch</td>
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<td>Professor Vassilia Partali</td>
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<tr>
<td>Slungård, Sigrid Volden</td>
<td>Asymmetrisk transfer hydrogenering av 1-aryletanoner og 1-aryl-2,2,2-trifluoretanoner</td>
<td>Associate Professor Bård Helge Hoff</td>
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<tr>
<td>Takla, Marit</td>
<td>Recovering industrial waste heat by the means of thermoelectricity</td>
<td>Professor Signe Kjelstrup</td>
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<td>Research Scientist, dr.ing. Andreas Grimstedt</td>
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<td>Synthesis of highly unsaturated cationic amphiphiles</td>
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<td>Professor Vassilia Partali</td>
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</table>

### MSc in Chemistry/Siv.ing.

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Supervisor</th>
<th>Examiners</th>
</tr>
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<td>Lyngvi, Eirik</td>
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<td>Professor Vassilia Partali</td>
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</tbody>
</table>
Post Graduate Students

Willassen, Veronica
Supervisor: Associate Professor Bård Helge Hoff
Examiners: Dr.ing. Harald Svensen, Epax
Associate Professor Bård Helge Hoff

Synthesis of new tyrosine kinase inhibitors

MSc in Education, chemistry

Belsaas, Kristin
Supervisor: Associate Professor Trond Peder Flaten
Examiners: Professor Øyvind Mikkelsen
Professor Emeritus Elliv Steinnes
Stipendiat Kristina Strasunske

Bruk av DGT og HR-ICP-MS for studier av metallers døgn- og sesongvariasjoner i vassdrag

Dahl, Anette
Supervisor: Associate Professor Trond Peder Flaten
Examiners: Professor Torunn Berg
Professor Emeritus Eiliv Steinnes
Bjørn Øve Berthelsen, Trondheim Kommune

Förändring över tid i koncentration av metaller i naturlig jord på Sørlandet i Norge

Hoston, Audhild
Supervisor: Associate Professor Trond Peder Flaten, Professor II Rolf Tore Ottesen
Examiners: Chief Engineer Toril Haugland
Professor Torbjørn Ljones

PAH og PCB i byjord fra Dublin. Kilder og forurensningsstatus

Milli, Guro Kristine
Supervisor: Associate Professor Trond Peder Flaten, Professor II Rolf Tore Ottesen
Examiners: Chief Engineer Toril Haugland
Professor Torbjørn Ljones

Mulige aktive forurensningskilder i havneområdet i Trondheim

MSc in Environmental toxicology and chemistry (MFORU)

Granly, Toril
Supervisor: Associate Professor, Dr.ing. Trond Peder Flaten
Dr.med. Jan Olav Aaseth, Sykehuset Innlandet
Professor Torbjørn Ljones

Biologiske virkninger av metylglykosal (MGA) in vitro

Examiners: Professor Lars Skjeldal
Professor, Dr.scient Torunn Berg

Detail from Realfagbygget
# Post Graduate Students

## Ph.d. in Chemistry

### Eggen, Per-Odd

**Current chemistry experiments and practice in electrochemistry education.**

<table>
<thead>
<tr>
<th>Trial lecture</th>
<th>Semiconductors as a new topic in upper secondary school chemistry in Norway: What should be the aims and which principles, models, devices and applications should be studied?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisor</td>
<td>Professor Lise Kvittingen</td>
</tr>
</tbody>
</table>
| Evaluation committee | Professor Jorge Ibanez, Universidad Iberoamericana, Depto. de Ing. y Ciencias Quimicas, Mexico  
Dr. Scient Vivi Ringnes, Hosle, Norway  
Professor Vassilii Partali, Department of Chemistry, NTNU |

### Fuglseth, Erik

**Synthesis of 1-aryl-2-fluoroethanones and their use in the preparation of enantioenriched 1-aryl-2-fluoroethanols and 1-aryl-2-fluoroethylamines.**

<table>
<thead>
<tr>
<th>Trial lecture</th>
<th>Organic based solar cells: principles, challenges and prospects.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisor</td>
<td>Associate professor Bård Helge Hoff</td>
</tr>
</tbody>
</table>
| Evaluation committee | Associate Professor Trond Ulven, Department of Chemistry, University of Southern Denmark, Odense, Denmark  
Professor Tore Lejon, Department of Chemistry, University of Tromsø, Tromsø, Norway  
Associate Professor Nebojsa Simic, Department of Chemistry, NTNU, Trondheim, Norway |

### Hestad, Øystein Leif

**Prebreakdown phenomena in solids and liquids stressed by fast transients: The effect of additives and phase.**

<table>
<thead>
<tr>
<th>Trial Lecture</th>
<th>Possible influences of interfaces and nanofiller nature and shape on prebreakdown phenomena.</th>
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<tbody>
<tr>
<td>Supervisor</td>
<td>Professor Per-Olof Åstrand</td>
</tr>
</tbody>
</table>
| Evaluation committee | Professor Markus Zhan, Massachusetts Institute of Technology, USA  
Ph.D. Arnaud Allais, HV-MV Materials and Technologies, France  
Associate Professor Wilhelm Glomm, Department of Chemical Engineering, NTNU |

### Ryeng, Einar

**Analysis of Microarray Data Using Inductive Logic Programming and Ontological Background Information.**

<table>
<thead>
<tr>
<th>Trial lecture</th>
<th>Chemical graph theory</th>
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</thead>
<tbody>
<tr>
<td>Supervisor</td>
<td>Professor Bjørn K. Alsberg</td>
</tr>
<tr>
<td>Co-supervisor</td>
<td>Associate Professor Tore Amble, Department of Computer and Information Science, NTNU</td>
</tr>
</tbody>
</table>
| Evaluation committee | Researcher PhD Amanda Clare, Department of Computer Science, University of Wales, UK  
Associate Professor Bjørn Grung, Department of Chemistry, University of Bergen, Norway  
Professor Signe Kjelstrup, Department of Chemistry, NTNU |

### Smale, Hans Sverre

**Modeling molecular properties of interest for streamer studies.**

<table>
<thead>
<tr>
<th>Trial lecture</th>
<th>The electronic structure of graphene: why is this hot stuff.</th>
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<tbody>
<tr>
<td>Supervisor</td>
<td>Professor Per-Olof Åstrand</td>
</tr>
</tbody>
</table>
| Evaluation committee | Associate Professor Rampi Ramprasad, Chemical, Materials & Biomolecular Engineering School of Engineering, University of Connecticut, USA  
Professor Kenneth Ruud, Dept. of Chemistry, Universitetet i Tromsø  
Professor Henrik Koch, Department of Chemistry, NTNU |

### Stockmann, Vegar

**Synthetic applications of Nitropyridine deratives.**

<table>
<thead>
<tr>
<th>Trial lecture</th>
<th>Structure, synthesis and mode of action of antimicrobial and lice agents used in fish farming.</th>
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<tbody>
<tr>
<td>Supervisor</td>
<td>Professor Anne Fiksdahl</td>
</tr>
</tbody>
</table>
| Evaluation committee | Professor Tekn. Dr. Jan Bergman, Institut för Biovitenskaper, Karolinska Institutet, Sweden  
Director R&D PhD Ingrid Hegbom Ekman, Cambrex Karlskoga AB, Sweden  
Assistant Professor PhD Bård Hoff, Department of Chemistry, NTNU |
Strasunske, Kristina  
Automatic monitoring systems for trace metals in natural and waste water - Nafion coated solid metal electrodes for sensitivity enhancement and stability improvement.

Trial lecture  
Methods for speciation of trace elements in the marine system, with special emphasis on ligand competition/CSV for copper speciation and CSV for iodine speciation.

Supervisor  
Professor Øyvind Mikkelsen

Co-supervisor  
Professor emeritus Knut Henning Schrøder

Evaluation committee  
Professor CMG van den Berg, Earth and Ocean Sciences, University of Liverpool, UK
Senior Scientist Ivanka Pizeta, Division for Marine and Environmental Research, Ruder Boskovic Institute, Croatia
Professor Trond Peder Flaten, Department of Chemistry, NTNU

Øpstad, Christer Lorentz  
Carotenoid Surfactants and Transfection Agents The Colourful Chemistry of Polyenes.

Trial lecture  
Oxidative degradation products of carotenoids – natural occurrence, biological importance, chemical synthesis.

Supervisor  
Professor Vassilia Partali

Co-supervisor  
Guest Researcher Richard Sliwka, Department of Chemistry, NTNU

Evaluation committee  
Dr Hansgeorg Ernst, BASF, Ludwigshafen, Germany
Chief Operation Officer Dr Erik Lüddecke, BASF, Germany
Professor Per Henning Carlsten, Department of Chemistry, NTNU

Aaseng, Jon Erik  
Asymmetric synthesis of substituted 2-aminotetralins.

Trial lecture  
Enantioselective synthesis based on organocatalysis by proline or proline derivatives.

Supervisor  
Associate professor Odd Reidar Gautun

Evaluation committee  
Professor Kristina Luthman, Department of Chemistry, University of Gothenburg
Associate Professor Bengt Erik Haug, Centre for Pharmacy, University of Bergen
Professor Per Carlsen, Department of Chemistry, NTNU
Post Graduate Students

Student Exchange from NTNU, Department of Chemistry

<table>
<thead>
<tr>
<th>Name</th>
<th>Specialization</th>
<th>Level</th>
<th>Institution</th>
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<tbody>
<tr>
<td>Bøe, Maren Seljenes</td>
<td>MTKJ-Org.chem.</td>
<td>MSc, 3rd yr</td>
<td>University of California, Berkeley, USA</td>
</tr>
<tr>
<td>Gulbrandsen, Tore A.</td>
<td>MTKJ-Org.chem.</td>
<td>MSc, 4th yr</td>
<td>University of Helsinki, Finland</td>
</tr>
<tr>
<td>Heggøy, Anette</td>
<td>MKJ-Envir.chem.</td>
<td>MSc, 4th yr</td>
<td>The University of British Columbia, Canada</td>
</tr>
<tr>
<td>Kaasa, Kristin</td>
<td>MTKJ-Org.chem.</td>
<td>MSc, 4th yr</td>
<td>Danmarks Tekniske Universitet, Denmark</td>
</tr>
<tr>
<td>Kaur, Maya</td>
<td>MTKJ-Org.chem.</td>
<td>MSc, 4th yr</td>
<td>Universidad Politécnica de Valencia</td>
</tr>
<tr>
<td>Ohm, Ragnhild Gaard</td>
<td>MKJ-Org.chem.</td>
<td>MSc, 4th yr</td>
<td>Seoul National University</td>
</tr>
<tr>
<td>Surdal, Cecilie</td>
<td>MTKJ-Org.chem.</td>
<td>MSc, 4th yr</td>
<td>The University of Western Australia</td>
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Student exchange to NTNU, Department of Chemistry

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<tr>
<td>Granados, Cindy</td>
<td>University of Rouen, France</td>
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<td>Jozic, Robert-Jan</td>
<td>Hogeschool Leiden, Netherlands</td>
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<tr>
<td>Superville, Pierre-Jean</td>
<td>USTL, Lille, France</td>
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</table>

From Bakklandet
Staff

Academic Staff

Organic Chemistry

Group Leader
Professor, Dr.rer.nat. (Fribourg). Vassilia Partali

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

Professor, Dr.ing. Anne Fiksdahl

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

Associate Professor, Dr.ing. Odd Reidar Gautun

Associate Professor, Ph.D. (Niš), Nebojsa Simic

Associate Professor, Dr.scient Bård Helge Hoff
Physical Chemistry

Group Leader
Professor, Dr.scient.
Bjørn Alsberg

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

Assistant Professor
Terje Bruvoll

Professor, Dr.techn.
Signe Kjelstrup

Professor, Ph.D. (Århus).
Henrik Koch

Associate Professor. Ph.D.
Morten Bjørgen

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

Professor, Ph.D. (Lund)
Torbjørn Ljones
Environmental and Analytical Chemistry

Group Leader
Professor, Dr.Scient
Øyvind Mikkelsen

Professor, Dr.scient.
Lise Kvittingen

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

Associate Professor, Dr.ing.
Florinel G. Banica

Associate Professor, Ph.D.
Karina Mathisen

Associate Professor, Ph.D.,
Annette Lykknes

Professor, Dr.scient.
Torunn Berg

Professor, Ph.D. (London)
David Nicholson

Professor, Dr.ing.
Trond Peder Flaten

Adjunct Professor
Rolf Tore Ottesen
Administrative staff

Head of administration
Lena Frostad

Senior executive officer
Lillian Hanssen

Higher executive officer
Bjørn Syvertsen

Executive officer
Inger Marie Frøseth

Higher executive officer
Ingrid Kristine Tømmerdal

Technical staff

Staff engineer
Stein Almo

Staff engineer
Julie Asmussen

Head engineer
Susana Villa Gonzalez
Staff

Head engineer
Julie Jackson

Head engineer
Syverin Lierhagen

Staff engineer
Gunnar Svare

Staff engineer
Nina Klausen

Senior engineer
Tron Rolfsen

Staff engineer
Roger Aarvik

Scientific Assistants

Burheim, Odne S.
Bøyesen, Katrine Lie
Gebremariam, Kidane Fanta
Gerontas, Apostolos
Gonzalez, Susana
Hjertenaes, Eirik
Kaspersen, Svein Jacob
Klausen, Nina
Kumelj, Tjasa
Lervik, Anders
Lystvet, Sina Maria
Martinsen, Morten
Mekki, Miriam
Nordløkken, Marit
Sandru, Eugenia-Mariana
Simic, Anica
Smala, Hans Sverre
Takla, Marit
Thvedt, Thor Håkon Krane
Voldsund, Mari
Volynkin, Andrey
Vågenes, Birgitte
Weggeberg, Hanne

Demonstrators

Andersen, Marthe K.
Baumberger, Sigrid
Bersås, Anita
Birkestel, Karianne
Blakstad, Guro
Braa, Peder R.
Bugge, Steffen
Buraas, Ida Kristine
Bøe, Maren S.
Courtade, Gaston
Elgaaen, Christian
Ellila, Georg
Emdal, Martin Folke
Evensen, Agnete Sion
Han, Jin
Haugland, Marius M.
Hellstrøm, Kaja C.
Hjetland, Ola S.
Hjort, Ida
Hoholm, Rebekka S.
Jacobsen, Julie Berild
Staff

Demonstrators contd.

Kirste, Karsten
Kvithyll, Heidi
Kjøglum, Kristin T.
Lakså, Solveig M.B.
Larsen, Synne
Linde, Henrik
Løvås, Jim
Madland, Eva
Mattson, Ingrid
Mekki, Miriam
Mikalsen, Ragni
Myhre, Rolf H.
Nauste, Kristian B.
Ohm, Ragnhild
Ouassou, Jabir Ali
Slinde, Geril Aasen
Solemslie, Henrik W.
Solvang, Tina
Strand, Mikael
Tungen, Jern E.
Tveeikrem, Marit Elise
Trefjord, Terese
Van der Wijst, Cornelis
Yttervik, Johan Hatling
Aasgaard, Lasse S.

Guest professors/researchers/lecturers

Josep Bonet Jun. 1 – 5, 2010
Thijs J.H. Vlugt Feb. 1 – 5, 2010
Cédric Garnier Feb. 20 – 28, 2010
Erwan Tessier Apr. 26 – May 7, 2010
Andrzej Bobrowski Apr. 26 – May 7, 2010
Aleksandra Liberska May 31 – June 4, 2010
Gabriel Billon June 1 – Sep. 30, 2010
Michael Pungente June 14 – 18, 2010
Thijs J.H. Vlugt July 5 – 9, 2010
Professor A. Bobrowski, AGH-University of Science and Sep. 18 – 21, 2010
Technology, Krakow, Poland: June 2, 2010
“Application of Catalytic Adsorptive Stripping Voltammetry
In Trace Analysis and Chromium Speciation Studies”

WinterSolstice 2010
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, teacher education, architecture to fine art. Cross-disciplinary cooperation results in innovative breakthroughs and creative solutions with far-reaching social and economic impact.

Address, contact information
Department of Chemistry, NTNU
N-7491 Trondheim,
Norway

E-mail: postmottak@chem.ntnu.no