

Process Chemistry Centre today

Åbo Akademi Process Chemistry Centre (PCC) has been working as a research centre since 1999. The concept of the centre and the four research teams forming the PCC have developed tremendously over this time. We were four professors with similar philosophy on research related to process chemistry and how to work together. We also launched the concept Molecular Process Technology to describe our approach to the subject.

The PCC was appointed a Centre of Excellence in research by the Academy of Finland for two consecutive periods: 2000–2005 and 2006–2011. The AoF also nominated a Scientific Advisory Board (SAB) for both periods to follow up our activity and to help us to develop the PCC. After every annual meeting, the SAB gave a report, where our activity over the past year was critically evaluated and the SAB also proposed how we should further develop the PCC. Our own idea was to create an Industrial Advisory Board to which we invited representatives from industrial companies and national organizations working in our field of research. The IAB has also actively been involved in developing the PCC by advising us what is important in the research in their particular area of activity and business.

The PCC started as four individual research teams but over the years has developed into a unique research community with common projects. The teams are doing high level research work in their individual field of expertise but together they form a pyramid with four strong corners as the base and with a solid and sharp summit.

The scientific activity of the PCC can best be evaluated by looking at the numbers of peer reviewed publications and PhD examinations within the



Professor Ari Ivaska

Centre. In the year 2000 we published 60 papers and 5 PhD examinations were accomplished. In 2011 the corresponding numbers were 148 and 10. The number of joint publications between the members of the teams has also developed in a similar way. The scientific productivity of the PCC in 2011 was 60% of the publications of the Department of Chemical Engineering and even 30% of the entire University. The PCC can be proud of all the researchers, seniors as well as juniors, and our students for their commitment to our research community. Our visitors have also greatly contributed to the success of the Centre.

The PCC has always been very international. We have many international senior and junior researchers. Half of our PhD students have their lower degree from abroad. Our graduates are spread over the whole world working in academia, research institutions, industrial companies and governmental organizations. They all are excellent ambassadors of the PCC and the educational system of Finland in general.

Ari Ivaska

Åbo Akademi Process Chemistry Centre Annual Meeting 2012

The Åbo Akademi Process Chemistry Centre Annual Meeting 2012 was held on August 1 in the Arken building. The meeting included a general introduction of the progress of our Centre followed by selected project presentations and a get-together with refreshments. Current research projects and future plans were presented and a poster session with flash presentations was held. Invited presenters were **Prof. Johanna Ivaska** from Turku Centre for Biotechnology and **Prof. Ronald Österbacka** from Center for Functional Materials (FUNMAT).

Workshop on hemicelluloses

The Åbo Akademi Process Chemistry Centre arranged a workshop on hemicelluloses – extraction, reactions, kinetics and catalysis on November 22, 2012. The speakers and their title were **Chunlin Xu** (*Hemicelluloses - Occurrence, Structural Features and Application Potential*), **Jens Krogell** (*Extraction of Hemicelluloses - Batch Reactor*), **Henrik Grénman** (*Extraction of Hemicelluloses - Cascade Reactor*), **Tapio Salmi** (*Hemicellulose Hydrolysis Kinetics*), **Yasuhito Sugano** (*Electrochemical Oxidation of Hemicelluloses*), and **Olatunde Jogunola** (*Cellulose Derivatives in Ionic Liquids*). The workshop continued with discussion and brainstorming.

15th Nordic Symposium on Catalysis on Åland became a success

The Finnish Catalysis Society hosted the 15th Nordic Symposium on Catalysis in the capital of Åland islands, Mariehamn on June 10–12, 2012. The conference site was the Cultural and Conference Centre Alandica. Åbo Akademi Process Chemistry Centre acted as a local arranger. For the first time in the history of Nordic symposia in catalysis, the scientific committee was composed of leading scientists from the whole Fenno–Scandic area. The main topics of the symposium were ‘Catalysis of Renewables’ and ‘Catalysis, Nordic Countries and Baltic Sea’.

The conference was opened in a very relaxed atmosphere. At the opening ceremony, several speeches were given. The vice prime minister of Åland, **Mr. Roger Nordlund**, described the life and administration of Åland as an autonomous part of Finland. **Docent Johanna Mattila** from Åbo Akademi told about Husö biological research station and the alarming ecological state of Baltic Sea.

The Nordic symposium on catalysis became a success: the event gathered about 200 participants in sunny Mariehamn enjoying the marvelous beauty of the Åland archipelago. Participants came from 20 countries and the scientific quality was of high level. We could listen to three plenary lectures, one ecological lecture, four keynote lectures and around 60 oral presentations. About 90 posters were presented. The highlights of the conference were the plenary lectures of **Dr. Toni Kinnunen** (Ecocat, exhaust catalysis), **Prof. Graham Hutchings** (Cardiff, catalysis on gold) and **Prof. Uwe Bornscheuer** (Greifswald, enzymatic catalysis). Nordic keynote lectures were given by **Stig Helveg** (Haldor Topsoe, elucidating catalysts on the atomic level), **Karoliina Honkala** (University of Jyväskylä, hydrocarbon chemistry on palladium based materials with olefines), **Stian Svelle** (University of Oslo, synergies between experiments and theory in zeolite catalysis) and **Anders Hellman** (Chalmers, active phases in catalytic reactions). The Berzelius prize for outstanding research was given to Stig Helveg.

Åland is rich in historical buildings and monuments, so the social programme became exceptionally enjoyable. Sunday afternoon, June 10, an excursion was organized to Kastelholm and Bomarsund castles. The conference dinner took place at Hotel Arkipelag. After the Nordic symposium it was again clear that the catalysis research in Nordic countries is on a very high international level. The next Nordic Symposium on Catalysis will take place in Oslo, Norway.



Jubilee seminar in honour of Prof. Ari Ivaska

Professor Ari Ivaska retired on September 1, 2012 after working as the Professor of Analytical Chemistry for 25 years. On Thursday, August 16, 2012, a jubilee seminar was organized in Axelia II.

The seminar consisted of 10 lectures given by invited guests from universities around Finland as well as from USA. Finally **Prof. Ari Ivaska** himself gave a presentation titled "*The Highlight of my Career*". The event was open for the entire Åbo Akademi staff. The day ended with a gala dinner at the steamship Bore.



Jubilee Seminar of Prof. Ari Ivaska

Prof. Mikko Hupa 60 years seminar

The 60 year seminar of **Professor Mikko Hupa** was celebrated on September 14, 2012 in Arken. The topic of the seminar was "*From Molecular Understanding to Industrially Relevant High-Temperature Processes*". The seminar started with coffee and registration followed by the Åbo Akademi welcome speech given by **Rector Jorma Mattinen** as well as the organizers welcome by **Patrik Yrjas**. Thereafter **Professor Kim-Dam Johansen** from the Technical University of Denmark presented "*25 Years of Nordic Cooperation*" and the program of the seminar consisted of presentations by several invited speakers from USA, Australia, Canada, and Europe. Flash poster presentations by graduate students on selected research projects were also given. The evening dinner was held at



60 Year Seminar of Prof. Mikko Hupa

Research Highlights: Glasses in clinical applications

Dr. Susanne Fagerlund at the PCC defended her thesis in inorganic chemistry entitled "*Understanding the in vitro dissolution rate of glasses with respect to future clinical applications*" on December 5, 2012. The study focuses on how bioactive glasses dissolve in the human body. Glass is a common material that can be used as medical implants. These implants, mainly used for reparation of bones, are inorganic silica-based melt-derived compositions that dissolve in contact with the body. It is vital that the reactivity of glasses used in medical applications is controlled. The goal of the work was to develop a simple and accurate method for quantifying the *in vitro* dissolution rate of highly different types of glass compositions with interest for future clinical applications. A sensitive on-line analysis method utilizing inductively coupled plasma optical emission spectrometry and a flow-through micro-volume pH electrode was developed in laboratory conditions for the understanding of the dissolution rate of bioactive glass.



Dr. Susanne Fagerlund

Johan Gadolin Scholarships

The Johan Gadolin Scholarship Programme invites PhD students and post docs to join the Åbo Akademi Process Chemistry Centre for a period of 3 to 12 months at Åbo Akademi University. They participate in ongoing research projects and benefit from an innovative top-level research environment. The following guests took part in the Johan Gadolin Scholarship Programme 2012.

Wood and Paper Chemistry: **Prothiba nath Banerjee**, post doc, India, 15.9.2011–14.9.2012; **Enma Conde**, post doc, Spain, 1.7–30.7.2012; *Combustion & Materials Chemistry*: **Ravi Inder Singh**, post doc, India, 1.8.2011–31.7.2012; *Catalysis and Reaction Engineering*: **Nicola Gemo**, PhD student, Italy, 1.3.2011–29.2.2012; **Martina Stekrova**, PhD student, Czech Republic, 1.9.2012–28.2.2013; **Erik Hagebols**, PhD student, the Netherlands (student in Great Britain), 1.11.2011–31.1.2012; **Irene Huerta Illera**, PhD student, Spain, 3.9.2012–3.3.2012; **Yuliya Demidova**, PhD student, Russia; *Process Analytical Chemistry*: **Yasuhito Sugano**, post doc, Japan, 1.2.2012–31.1.2013; **Patrycja Bober**, PhD student, Poland (student in Czech Republic) 15.9–15.12.2012.

GUEST LECTURERS

Prof. Leon Lefferts, Faculty of Science and Technology, University of Twente, The Netherlands: "*Heterogeneous Catalysis in Liquid Phase: Diffusion and Tools*" on January 23, 2012.

Prof. Arkady A. Karyakin, Electrochemical Methods Laboratory, Moscow State University: "*Advanced Biosensors Based on New Technologies*" on March 8, 2012.

Prof. Orlando Rojas, North Carolina State University, USA and Aalto University, Finland: "*Value-Added Materials and Functional Structures from Lignocellulosics*" on April 26, 2012.

Prof. Fritz Scholz, Institute of Biochemistry, University of Greifswald, Germany: "*The Interaction of OH Radicals with Metal Electrodes: Implications for Electrochemistry and Surface Science*" on June 15, 2012.

Prof. David Officer, University of Wollongong, Australia: "*Monomers and Oligomers for Conducting Polymers*" on August 28, 2012.

Dr. Sergey S. Shevkopyas, Biomedical Engineering, Tulane University, USA: "*Blood Microfluids: Basic, Applied, Practical*" on August 28, 2012.

Prof. Emil Paleček, Institute of Biophysics, Czech Academy of Science, Brno, Czech Republic: "*Electrochemical Sensing of Biomacromolecules*" on October 4, 2012.

Prof. Christopher Hardacre, School of Chemistry and Chemical Engineering, Queen's University, Belfast, United Kingdom: "*Designing Catalysts for Low Pressure and Temperature Acid and Amide Hydrogenation*" on October 12, 2012.

Dr. Mikhail Balakshin, Department of Wood and Paper Science, North Carolina State University, Raleigh, North Carolina, USA: "*Towards Comprehensive Characterization of Lignin and LCC (in Various Lignocellulosics)*" on November 9, 2012.

Prof. Richard K. Brow, Department of Materials Science and Engineering, Missouri University of Science and Technology, USA: "*Corrosion of Specialty Glasses*" on December 4, 2012.

DOCTORAL DEFENSES

Xiaoju Wang: "*Enzyme Electrode Configurations: for Application in Biofuel Cells*" on February 17, 2012. Opponent: **Prof. Shelley D. Minter**, University of Utah, USA.

Maija Blomquist: "*Electrochemical and Spectroelectrochemical Characterization of Alkylated and Thiolated Polyanilines*" on March 9 2012. Opponent: **Prof. Arkady A. Karyakin**, M.V. Lomonosov Moscow State University, Russia.

Patrycja Piotrowska: "*Combustion Properties of Biomass Residues Rich in Phosphorus*" on April 4, 2012. Opponent: **Prof. Peter Ashman**, University of Adelaide, Australia.

Victor Sifontes Herrera: "*Hydrogenation of L-arabinose, D-galactose, D-maltose and L-rhamnose*" on May 4, 2012. Opponent: **Dr. Jyrki Kuusisto**, Danisco Sweeteners/DuPont Nutrition & Health, Finland.

Grzegorz Lisak: "*Ion Selective Electrodes for Determination of Low and Ultra Low Concentrations of Lead (II) in Natural Waters*" on June 14, 2012. Opponent: **Prof. Fritz Scholz**, University of Greifswald, Germany.

Dorota Bankiewicz: "*Corrosion Behaviour of Boiler Tube Materials during Combustion of Fules Containing Zn and Pb*" on June 16, 2012. Opponent: **Prof. Kim-Dan Johansen**, Technical University of Denmark, Denmark.

Pingping Su: "*Sorption of Metal Ions to Wood, Pulp and Bark Materials*" on September 21, 2012. Opponent: **Prof. Raimo Alén**, University of Jyväskylä, Finland.

Olga Simakova: "*Catalysis by Gold for Biomass Transformations*" on October 12, 2012. Opponent: **Prof. Chris Hardacre**, Queen's University, Belfast, United Kingdom.

Susanne Fagerlund: "*Understanding the in Vitro Dissolution Rate of Glasses with Respect to Future Clinical Applications*" on December 5, 2012. Opponent: **Prof. Richard Brow**, Department of Materials Science and Engineering, Missouri University of Science and Technology, USA.

Marceline Neg Akieh-Pirkanniemi: "*Electroactive Ion Exchange Membranes based on Conducting Polymers*" on December 14, 2012. Opponent: **Prof. Csaba Visy**, University of Szeged, Hungary.

PCC FACTS AND MISSION

The Åbo Akademi Process Chemistry Centre (ÅA-PCC) studies physio-chemical processes at the molecular level in environments of industrial importance, in order to meet the needs of tomorrow's processes and product development. Our particular focus on the understanding of complex process chemistry we call *Molecular Process Technology*.

The Centre consists of four research groups at the Department of Chemical Engineering, Åbo Akademi University:

- Combustion & Materials Chemistry (Prof. Mikko Hupa)
- Catalysis and Reaction Engineering (Academy Prof. Tapio Salmi)
- Process Analytical Chemistry (Prof. Ari Ivaska)
- Wood and Paper Chemistry (Prof. Stefan Willför)

In the year 2011, about 130 people (including 20 senior researchers) took part in the PCC activities with a total funding of approximately 7 million euro.

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