Newsletter

PCC

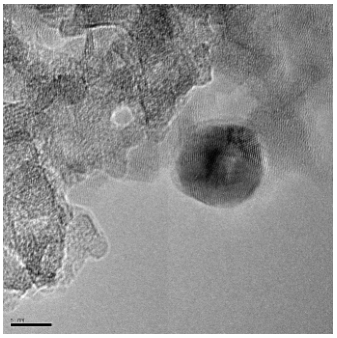
Åbo Akademi Process Chemistry Centre

No. 8 2 / 2004

From nano to mega

*Micro, nano, pico.....*I learnt at school in the seventies, as the famous SI system was introduced and implemented. What these minor fractions really implied remained somewhat unclear for us youngsters. It is difficult for a human being to understand such big and very small numbers.

In recent times we have learnt that it is necessary to understand these very small numbers to obtain large amounts (!) of research funding: the breakthrough of nanotechnology is the slogan of today. The development of physical instruments enables us to see and visualise things in nanoscale. Typical examples are tunneling electron microscopy and high-resolution transmission electron microscopy (TEM).



Silver nanoparticle (5 nm) on exhaust catalyst

In the field of catalysis, the breakthrough of nanotechnology is inevitable. Metal particles with diametres of a few nanometers are on the outer surface and inside the pores of carrier material. With TEM we get images, which reveal how these minor metal spots are deposited on the surface, and even the particle size distribution is obtained from the lovely pictures. We look through a new window to the world, which exists since the origins of catalysis. Researchers can include the pictures in the manuscripts being submitted to scientific journals. In the long run, these beautiful pictures are not enough. A deeper interpretation is required. Nanotechnology should lead to the birth of a new generation of heterogeneous catalysts, to more active and selective ones. In the future, we shall tailor the metal particles on the catalyst surface (size and shape), we make bi- and multimetallic catalysts, which provide an optimal selectivity of a desired product. Physical observations in nanoscale help us to do better chemistry and improved engineering.

Photo by José Villegas

Prof. Tapio Salmi is the head of the Kinetics & Catalysis group.

The equipment needed for nanotechnology is sometimes very expensive. Here we must turn to politicians who understand very large numbers: millions of euros are sometimes needed to purchase and develop research instruments used in nanotechnology. In terms of costs we quickly exchange prefixes from kilo to mega. - A friend who works with zeolites told me that actually nano(meter) is not enough, but Ångström is needed (1Å=10^{-10} m). Anders Jonas Ångström (1814-1874) was professor in Uppsala.

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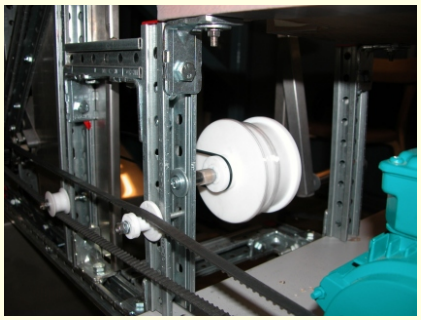
Bioglass is commercialised



Preparation of bioactive glass fibre
Photo by Kaj Fröberg

Biomaterials based on bioactive glass have received permission to be commercialised. The products are to be used in facial and cranial surgery. In the future several new products based on bioactive glass and their composites will be launched.

The development and preparation of bioactive glass, which is used in the final products, is carried out in the Combustion & Materials Chemistry group. The research on the topic was initiated 20 years ago by Professor Emeritus Kaj Karlsson (Combustion & Materials Chemistry group, Åbo Akademi) and Professor Antti Yli-Urpo (Odontological Institution, University of Turku). Further information is given by Dr. Heimo Ylänen (heiyla@utu.fi).

International Academic Summer School

A summer school in "Advanced Experimental Methods in Chemical Engineering" was arranged by Åbo Akademi University, Lappeenranta University of Technology and Tallinn Technical University in August 2004. The course, which was held in Kuressaare, the capital city of Saarenmaa island, Estonia, attracted a large number of PCC students.

The summer school's goal was to broaden the experimental perspective of chemical engineers by presenting various experimental methods and modelling techniques in an interdisciplinary manner. "How could I obtain more exciting and more precise information on my experimental system", was the question prior to the course.

PCC Annual Seminar

The PCC annual meeting was held in the new ÅA building "Arken", on the 19th of August 2004. The 2003 activities were presented by the group leaders and, according to tradition, young PCC scientists also had a chance to show their results in the form of short "snapshots" of their work.

Later that evening, the participants had the pleasure of visiting the beautiful city of Naantali, where the dinner was arranged in the "Kaivohuone" restaurant. One of the highlights of the evening was the new PCC song, which nicely describes the activities of the four laboratories.

Prof. Ivaska is giving his speach about Naantali

Our family (Mel: My Bonny and new words by J. Werkelin)

My father makes counterfeit money,
my mother brews synthetic gin.
My sister sells kisses to sailors,
and that's how the money rolls in.
||: By Jove, by Jove,
By Jove how the money rolls in,
rolls in :||

But I went to Pulp engineering,
saving my virtues from sin.
Supplying my father with paper,
to see that the money rolls in.
||: By Jove… :||

I learned my way in Analytics
to measure correctly and win.
The secret lies in calibration,
for that's how the money rolls in
||: By Jove… :||

My knowledge is deep in Kinetics,
The rate may be low to begin.
If speed is required I fix it,
and that's how the money rolls in.
||: By Jove… :||

Combustion with fluidization,
on top of the bed or within.
The blanket and sheets are included,
for that's how the money rolls in.
||: By Jove… :||

Text and photos by Fredrik Klingstedt

....outside restaurant "Kaivohuone"

The Distinguished Lecturer Series continues....

EUROPACATVIII congress to Turku/Åbo in 2007

The biggest European congress in catalysis, EUROPACATVIII comes to Turku/Åbo in 2007. The council of the European Federation of Catalytic Societies (EFCATS) decided November 20th in Berlin to give the responsibility of organising the EUROPACATVIII 26-31 August 2007 to the Nordic catalysis community. This is the first time that the meeting has been held on Fenno-Scandian soil. The congress is anticipated to gather more than 1000 participants and will be held at the Turku

Per Brahe Prize 2004 to Päivi Mäki-Arvela

Docent Päivi Mäki-Arvela from the PCC recently received the researcher's prize at Åbo Akademi, the Per Brahe prize, which is awarded annually to 1-2 researchers at Åbo Akademi. The candidates are selected from all fields of study, ranging from theology to technology. The prize is given to a young scientist with exceptional merits. Päivi Mäki-Arvela was awarded the prize for her breakthrough research in the catalysis of organic reactions and her commitment to science and education. Currently docent

Improving the infrastructure of PCC

New laser ablation system

Laser ablation is used for analyses of solid samples. The method can also be used for mapping the surface elemental distribution. The new laser ablation system, UP-213, from New Wave Research, has several advantages compared with our old system:

Photo and text by Paul Ek

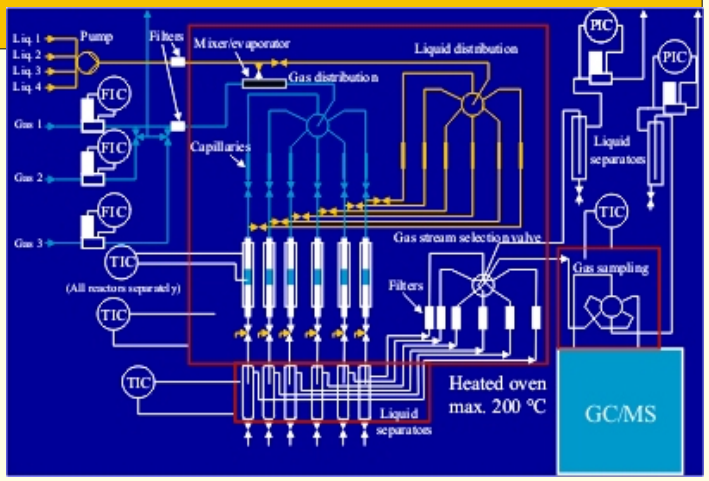
The laser wavelength is 213 nm, which gives a better absorption of the laser beam on the surface of transparent materials like glass, resulting in a more well defined crater. Due to a different operational mode, the stability of the new laser is also better. The new instrument gives a smaller spot size, making it possible to analyse small samples in detail. The software is easy to operate and allows more flexibility in the control of the laser movement. It also makes it possible to use the same computer to combine the new laser ablation system with the excisting ICP-MS Elan 6100 DRC+ instrument and to control their operations. More information on the laser ablation technique can be obtained from the laboratory manager Paul Ek (Paul.Ek@abo.fi) from the Process Analytical Chemistry group.

High-throughput

A reactor system for accelerated screening of catalysts is being constructed in the laboratory of the Kinetics & Catalysis group.

It consists of six parallel fixed bed reactors where gas/solid, liquid/solid or gas/liquid/solid reactions can be utilised. The effluents from the reactors are analysed by an on line GC/MS (Agilent 6890N/5973N) and by a HPLC (Agilent 1100 Series). The maximum pressure and temperature of the system is 90 bar and 600 °C, respectively.

Text and figure by Kari Eränen



The Distinguished Lecturer Series continues....

Doctoral defenses

Ville Nieminen: "Skeletal Isomerization of *n*-Butane and Linear Butenes over Porous Solid Acid Catalysts" (11.06.2004). Opponent: Professor Leonid Kustov from N.D. Zelinsky Institute of Organic Chemistry and Chemistry Department of Moscow State University, Moscow, Russian Federation.

Fredrik Sandelin: "Reaction Kinetics and Catalyst Deactivation in Dynamic Two-phase Fixed Bed Reactor Models" (18.08.2004). Opponent: Professor Miloš Marek from the Center for Nonlinear Dynamics of Chemical and Biological Systems, Department of Chemical Engineering, Institute of Chemical Technology, Prague, Czech Republic.

Niko Musakka: "Experimental Study and Mathematical Modelling of Organic Decomposition Reactions in Liquid Phase"(22.10.2004). Opponent: Professor Janez Levec from Department of Chemical Engineering, University of Ljubljana, Slovenia.

Jan Hájek: "Selective Hydrogenation of Cinnamaldehyde" (29.10.2004). Opponent: Professor Peter Claus from Technische Universität Darmstadt, Germany.

Kari Eränen: "Abatement of Nitric Oxide by Catalytic Decomposition and Selective Catalytic Reduction with Hydrocarbons" (30.10.2004). Opponent: Professor Anders Holmen from Norwegian University of Science and Technology, Faculty of Natural Sciences and Technology, Department of Chemical Engineering, Trondheim, Norway.

Lenita Lindberg: "Dissolved and Colloidal Substances and Bacterial Activity in Papermaking" (12.11.2004). Opponent: Dr Pieter Pauly from Papiertechnische Stiftung, Munich, Germany.

Veikko Niiniskorpi: "Development of phases and structures during pelletizing of Kiruna magnetite ore" (26.11.2004). Opponents: Professor Emeritus Kaj Karlsson from Åbo Akademi, Turku, Finland and Docent Kyösti Heinänen from Rautaruukki Oyj.

Nikolai DeMartini: "Conversion Kinetics for Smelt Anions: Cyanate and Sulfide" (10.12.2004). Opponent: Professor Adriaan van Heningen from University of Maine, USA.

Four Doctors and one Licentiate from the PCC in one day
Photo by Fredrik Klingstedt

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PCC Facts and Mission

The Åbo Akademi Process Chemistry Centre (ÅA-PCC) studies physico-chemical processes at the molecular level in environments of industrial importance, in order to meet the needs of tomorrow's process 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 Chemical Engineering Faculty of Åbo Akademi University: *Combustion & Materials Chemistry* (Prof. Hupa), *Kinetics & Catalysis* (Prof. Salmi), *Process Analytical Chemistry* (Prof. Ivaska) and *Wood and Paper Chemistry* (Prof. Holmbom). In the year 2003, about 130 people (including about 30 senior researchers) took part in the PCC activities with a total funding of approximately 5.6 Million €.

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