## New Application Developments in PGMs – July 2010

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**Simulation-based matchmaking for shape memory alloys: Palladium**
the innovations-report, 01 July 2010

RUB-researchers discover shape-memory metals with unprecedented functional stability

http://www.innovations-report.com/html/reports/materials_science/simulation_based_matchmaking_shape_memory_alloys_157336.html

A new shape memory alloy with up to now unprecedented functional stability was developed by researchers from the Institute for Materials at the Ruhr-Universität Bochum in cooperation with researchers from the USA and Japan. Based on a theoretical prediction, they used combinatorial materials science methods, i.e. so-called materials libraries, for a targeted search of optimized alloy compositions. The result consists of four components: titanium, nickel, copper and palladium: $Ti_{50.2}Ni_{34.4}Cu_{12.3}Pd_{3.1}$.

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**Oxidative flow: Palladium**
SCIENCE, 02 July 2010, Volume 329, Issue 5987

http://www.sciencemag.org/content/vol329/issue5987/twil.dtl

http://dx.doi.org/10.1039/c0gc00106f

Researchers from the Department of Chemistry, University of Wisconsin-Madison, USA and Chemical Product Research and Development Division, Eli Lilly and Company, USA, employ a dilute stream of 8% oxygen in nitrogen, so as to avoid combustion hazards, and they implement a continuously flowing reaction process to optimize mixing. Using several previously reported palladium-based catalysts, they demonstrate high alcohol oxidation yields across a diverse substrate pool on scales ranging from tens of grams to a kilogram.

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**Stacked platinum**
SCIENCE, 02 July 2010, Volume 329, Issue 5987

http://www.sciencemag.org/content/vol329/issue5987/twil.dtl

http://dx.doi.org/10.1021/ja910886g

Platinum is a remarkably versatile chemical catalyst. Recently, chemists have also begun to direct its coordination properties toward the assembly of complex supramolecular structures. Peter D. Frischmann, Samuel Guieu, Raymond Tabeshi and Mark J. MacLachlan at the Department of Chemistry, University of British Columbia, Canada, constructed a family of tunable Schiff base proligands that were designed to self-assemble in head-to-tail fashion when coordinated to Pt(II). The proligands--substituted salicylaldimines--could be generated in situ or before metalation.

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**Direct imaging of single metal atoms and clusters in the pores of dealuminated HY zeolite: Iridium.**
Nature Nanotechnology, 05 July 2010, 506-510

http://dx.doi.org/10.1038/nnano.2010.92

Volkan Ortalan of the Department of Chemical Engineering and Materials Science, University of California-Davis, with colleagues here and from the Chemistry, Materials and Life Sciences Directorate, Lawrence Livermore National Laboratory, have shown that aberration-corrected scanning transmission electron microscopy can be used to determine the locations of individual metal atoms and nanoclusters within the pores of a zeolite. They imaged the active sites of iridium catalysts anchored in dealuminated HY zeolite crystals, determined their locations and approximate distance from the crystal surface, and deduced a possible cluster formation mechanism.

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**Colorful warning: Selective, sensitive CO detection with a rhodium complex.**
PhysOrg.com, 06 July 2010.

http://www.physorg.com/news197619439.html

Image: http://cdn.physorg.com/newman/gfx/news/201023press.gif

Spanish researchers working with Ramon Martinez-Manez have developed a sensitive and selective detector that reliably detects CO in air. As the scientists from the IDM Research Institute at the Polytechnic University of Valencia report in the journal Angewandte Chemie, their system involves a special rhodium complex that distinctly changes colour in the presence of CO.

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**Energy harvesting technology: Platinum**
PR.com, 11 July 2010

Dr. Shi’s research focuses on miniature energy harvesting technologies that could potentially power wireless electronics, portable devices, stretchable electronics, and implantable biosensors.

http://www.pr.com/press-release/247826

Dr Yong Shi, a professor in the Mechanical Engineering Department at the Stevens Institute of Technology, USA, uses a piezoelectric nanogenerator based on PZT nanofibers. The PZT nanofibers, with a diameter and length of approximately 60 nm and 500 μm, are aligned on interdigitated electrodes of platinum fine wires and packaged using a soft polymer on a silicon substrate.

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**The role of steps in surface catalysis and reaction oscillations: Palladium.**
Nature Chemistry, Published online 11 July 2010

Restricted Link (Free Abstract): http://dx.doi.org/10.1038/nchem.728

Atomic steps at the surface of a catalyst play an important role in heterogeneous catalysis, for example as special sites with increased catalytic activity. Exposure to reactants can cause entirely new structures to form at the catalyst surface, and these may dramatically influence the reaction by 'poisoning' it or by acting as the catalytically active phase. For example, thin metal oxide films have been identified as highly active structures that form spontaneously on metal surfaces during the catalytic oxidation of carbon monoxide. Here, the researchers present operando X-ray diffraction experiments on a palladium surface during this reaction. They reveal that a high density of steps strongly alters the stability of the thin, catalytically active palladium oxide film. The researchers show that stabilization of the metal, caused by the steps and consequent destabilization of the oxide, is at the heart of the well-known reaction rate oscillations exhibited during CO oxidation at atmospheric pressure.

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**Stable catalyst for hydrogen generation: Iridium**
Highlights in Chemical Technology, 14 July 2010

http://www.rsc.org/Publishing/ChemTech/Volume/2010/09/stable_catalyst.asp

Image: 3 equivalents of hydrogen are released from the ammonia-borane store,

http://www.rsc.org/images/C0DT00091D-400-FOR-TRIDION_tcm18-186644.jpg

Maria Angeles Garralda and her team at University of Pais Vasco in Spain have demonstrated the first homogenous catalysis reaction using an iridium catalyst for hydrolysing ammonia-boranes, which produces up to three equivalents of hydrogen in a very efficient reaction. As well as being more efficient than previous systems, the iridium catalyst has the added advantage that it is stable in water and air, so does not require an inert atmosphere.

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**Grow-your-own approach to wiring 3D chips: Platinum**
tech - New Scientist, 15 July 2010

http://www.newscientist.com/article/dn19181-growyourown-approach-to-wiring-3d-chips.html

http://dx.doi.org/10.1126/science.1190496

Instead of soldering prefabricated wires in place, as is traditionally one to connect two parts of a chip, Min-Feng Yu and Jie Hu at the University of Illinois at Urbana-Champaign have developed a technique to grow tiny 3D wires in situ which are tailor-made for their location. They developed an electrodeposition method that exploits the thermodynamic stability of a microscale or nanoscale liquid meniscus to "write" pure copper and platinum three-dimensional structures of designed shapes and sizes in an ambient air environment.

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**An ancient clock: Osmium**
Physics, 15 July, 2010

**http://physics.aps.org/synopsis-for/10.1103/PhysRevC.82.015802**

In three papers published in Physical Review C, the international Neutron Time-Of-Flight (n_TOF) collaboration and scientists working at the Karlsruhe Van de Graaff accelerator in Germany present data and calculations that better characterize a unique clock for measuring the age of our galaxy.

Rhenium-187 (187Re), an element similar in mass to gold, was produced in the first stellar explosions after the birth of our galaxy. 187Re beta-decays into osmium-187 (187Os) with a half-life of 41 billion years-slowly enough so that the relative abundance of 187Re to 187Os provides a good measure of the time that has elapsed since our galaxy first formed.

However, additional nuclear processes, other than the decay of 187Re, change the abundance of 187Os, which can cause error in the rhenium-osmium clock. The n_TOF work is therefore aimed at precisely determining the neutron-capture cross sections of 187Os and its adjacent osmium isotopes, 186Os and 188Os, which allows one to make an accurate subtraction of this direct contribution. In tandem, the Karlsruhe experiments probe reactions from excited nuclear states that are expected at the high temperatures present in stellar cores.

The n_TOF facility bombards a target of osmium nuclei with a pulse of neutrons produced by the 20-GeV CERN proton synchrotron accelerator to make precise measurements of these neutron cross sections. The experiment is specially designed to simultaneously measure the reaction cross sections for many different neutron energies, yielding thermally averaged cross sections relevant to the hot stellar production process. Complimentary measurements of the inelastic scattering cross section were performed at the Karlsruhe 3.7-MV Van de Graaff accelerator and together with the n_TOF results and a detailed analysis, provide an updated assessment of the Re/Os cosmochronometer.

The new data limit the nuclear physics uncertainties for the rhenium-osmium clock to less than 1 Gyr, allowing a more accurate estimate for the age of our galaxy.

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**Different Strokes: Platinum**
Science News, Friday, 16 July, 2010

http://www.sciencenews.org/view/generic/id/61234/title/Different_strokes

Image: Gray lines show a diverse collection of microswimmers' moves from start (pink) to finish (blue) over 25 seconds, http://www.sciencenews.org/view/access/id/61236/name/ls_microswimmer_fig_a-f.gif
http://dx.doi.org/10.1103/PhysRevLett.99.048102

Designing microswimmers with diverse behaviors is a step toward the ultimate goal of designing tiny, controllable machines tuned for delicate tasks in the inner space of the human body. Researchers dream about making small swimmers that can one day clear out blood clots, blast through clogged arteries or deliver chemotherapy directly to a tumor.

The researchers coated half of 2-micrometer-wide polystyrene beads with platinum. In water spiked with hydrogen peroxide, these swimmers start to motor. The beads' metallic coating burns hydrogen peroxide as a fuel: platinum splits hydrogen peroxide into water and oxygen. As the reaction takes off, the pressure on the coated side of the bead changes, causing the beads to swim.
After the platinum coats were applied, the coated beads glommed together in groups. Swimmers made up of two beads swam in diverse patterns, the team saw.

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**Carbon nanotubes as transistor material: Palladium**
PhysOrg.com, 21 July, 2010

**http://www.physorg.com/news198948792.html**

Image: A single carbon nanotube (CNT) is grown between two contacts. The ends were coated by vapour-deposition of palladium to connect to the suspended transistor channel. (Photo: M. Muoth / ETH Zurich), **http://cdn.physorg.com/newman/gfx/news/Figure_3a_version_5_Ruegg_eng_flat.jpg**

Christofer Hierold, Professor of Micro and Nanosystems at ETH Zurich, and his research group, in particular the doctoral student Matthias Muoth, have succeeded in constructing a hysteresis-free field effect transistor based on an individual CNT with metallic nano-contacts. The researchers reported this recently in "Nature Nanotechnology". Hierold emphasises that "We have now created a component that allows us to take a big step forwards, especially in micro- and nanosystems technology, i.e. in the area of integrated functional materials for sensors and actuators**."**

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**Smart' sand: grain-sized nanotechnology electronic noses are on the horizon: Platinum, palladium.**
Nanowerk Spotlight, 28 July, 2010

http://www.nanowerk.com/spotlight/spotid=17373.php

Image: One of the possible device architectures (not actual device used): morphologically encoded nanostructure in contact with array of metal electrodes. Each segment has a different resistance what will provide the required diversity in sensing and as a result the recognition capability. (Image: Dr. Kolmakov, Southern Illinois University at Carbondale), http://www.nanowerk.com/spotlight/id17373_1.jpg

http://dx.doi.org/10.1021/nn100435h

Andrei Kolmakov, an associate professor in the physics department at Southern Illinois University at Carbondale, and a team of researchers from Karlsruhe Institute of Technology, Rensselaer Polytechnic Institute, Sincrotrone Trieste, and first author Victor V. Sysoev from Saratov State Technical University, have published their findings in the July 20, 2010 online issue of ACS Nano ('Single-Nanobelt Electronic Nose: Engineering and Tests of the Simplest Analytical Element'). The researchers demonstrated a novel analytical sensor which mimics our olfaction system. The difference between this and similar prior e-noses is that the active element of this new device is an individual wedge-like nanowire (nanobelt) made of tin dioxide. The required diversity of the sensing elements is encoded in the nanobelt morphology via longitudinal width variations of the nanobelt realized during its growth and via functionalization of some of the segments with a palladium catalyst. The nanobelt was indexed with a number of platinum electrodes in a way that each segment of the nanobelt between two electrodes defines an individual sensing elemental receptor of the array.

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**Graphene exhibits bizarre new behaviour well-suited to electronic devices: Platinum**
UC Berkeley NewsCenter, 29 July 2010

http://www.berkeley.edu/news/media/releases/2010/07/29_graphene.shtml

Image: Scanning tunneling microscope image of a single layer of grapheme on platinum with four nanobubbles at the graphene-platinum border and one in the patch interior. The inset shows a high-resolution image of a graphene nanobubble and its distorted honeycomb lattice due to strain in the bubble,

http://www.berkeley.edu/news/media/releases/2010/07/images/nanobubble.jpg

Graphene, a sheet of pure carbon heralded as a possible replacement for silicon-based miconductors, has been found to have a unique and
amazing property that could make it even more suitable for future electronic devices. Physicists at the University of California, Berkeley, and the Lawrence Berkeley National Laboratory (LBNL) have found that when graphene is stretched in a specific way it sprouts nanobubbles in which electrons behave in a bizarre way, as if they are moving in a strong magnetic field. The new effect was discovered by accident when a UC Berkeley postdoctoral researcher and several students in the lab of Michael Crommie, professor of physics at UC Berkeley and a faculty researcher at LBNL, grew graphene on the surface of a platinum crystal. Graphene is a one atom-thick sheet of carbon atoms arranged in a hexagonal pattern, like chicken wire. When grown on platinum, the carbon atoms do not perfectly line up with the metal surface's triangular crystal structure, which creates a strain pattern in the graphene as if it were being pulled from three different directions.

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**Catalytic reaction lends a hand with sensing: Palladium**
Highlights in Chemical Science, 30 July 2010

http://www.rsc.org/Publishing/ChemScience/Volume/2010/08/catalytic_reaction.asp

Image: Phenylboronic acid and saccharide boronate used to measure saccharide levels, http://www.rsc.org/images/c0CC01019g-FOR-TRIDION-350_tcm18-187616.jpg

Boronic acid sensing of saccharide is enhanced by coupling it with a catalytic reaction claim Chinese scientists. Saccharides affect many metabolic processes in the body so monitoring their levels is important. Yun-Bao Jiang at Xiamen University used the Suzuki catalytic reaction, where palladium catalyses the reaction of organic halides with boronic acids to form new carbon-carbon bonds, to amplify the signal of his sensing method. Normally the Suzuki reaction is carried out at high temperature to avoid unwanted side reactions. However, Jiang used one of these room temperature side reactions, the Suzuki homocoupling reaction (where two boronic acid molecules react together) to amplify the signal of the sensing method.

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