New Application Developments in PGMs – April 2010

Shining light on graphene-metal interactions: Ruthenium
PhysOrg.com, 02 April 2010

http://www.physorg.com/news189413854.html
Image: Measurement of the electronic bands of bilayer graphene onruthenium, which have the characteristics of freestanding monolayergraphene. One of these characteristics is a typical cone-like shape of the bands near the Fermi energy. The inset shows a calculation of these "Dirac cones" for omparison. Shown in the background is a schematicrendering of the lattice structure of graphene,

http://cdn.physorg.com/newman/gfx/news/1-shininglight.jpg

Peter Sutter, a materials scientist in Brookhaven National Laboratory's Center for Functional Nanomaterials, grows graphene on a metal substrate, a technique that can produce single-layer sheets over very large areas, thousands of times larger than the pieces made with the "Scotch tape" method. First, a single crystal of ruthenium is heated up to temperatures higher than 1000 degrees Celsius while exposing it to a carbon-rich gas. At high temperatures, carbon atoms are able to squeeze into spaces within the metal crystal, similar to water being taken in by a sponge. As the crystal is slowly cooled, these carbon atoms are expelled to the surface of the metal, where they form individual layers of graphene. The number of layers formed can be controlled by the amount of carbon atoms initially absorbed into the ruthenium crystal.

A step toward lighter batteries: Platinum
MIT news, 02 April 2010

http://web.mit.edu/newsoffice/2010/liair-batteries-0402.html

In a paper published in the journal Electrochemical and Solid-State Letters, Yang Shao-Horn, an MIT associate professor of mechanical engineering and materials science and engineering, along with some of her students and visiting professor Hubert Gasteiger, reported on a study showing that electrodes with gold or platinum as a catalyst show a much higher level of activity and thus a higher efficiency than simple carbon electrodes in lithium-oxygen batteries. In addition, this new work sets the stage for further research that could lead to even better electrode materials, perhaps alloys of gold and platinum or other metals, or metallic oxides, and to less expensive alternatives.

Hydrogenate a nitro group and an isoquinoline ring in the presence of two chlorine atoms: Platinum
Noteworthy Chemistry, 05 April 2010.

http://portal.acs.org/portal/PublicWebSite/noteworthy/archive/CNBP_024558

During the development of a manufacturing method of a new anticonvulsant, M. D. Walker and co-workers at GlaxoSmithKline Pharmaceuticals (Stevenage, UK) optimized a key reduction step. The hydrogenation of 7-nitro-5,8-dichloroisoquinoline is carried out under acidic conditions by using a platinum-based catalyst with HOAc or H_2SO_4 as a cocatalyst.

Berkeley researchers light up white OLEDs: Iridium.
Berkeley Lab News Center, 05 April 2010.

http://newscenter.lbl.gov/feature-stories/2010/04/05/white-oleds/

Image: Biwu Ma, a staff scientist with the Molecular Foundry, was part of a research team that found a new way to process white OLEDs for solid state lighting, http://newscenter.lbl.gov/wp-content/uploads/Biwu1.jpg

Using polymer nanoparticles to house light-emitting 'inks', scientists at the Molecular Foundry, a U.S. Department of Energy nanoscience center located at Berkeley Lab, and the University of California, Berkeley, have made a thin film OLED using iridium-based guest molecules to emit various colors of visible light. The polymer nanoparticle surrounding a guest light-emitter serves as a 'do not disturb' sign, isolating guest molecules from one another. Each guest can then emit light without pesky interactions with neighboring nanoparticles, resulting in white luminescence.

Polymer to Catch Precious Metals
Russia-InfoCentre, 07 April .2010

http://www.russia-ic.com/news/show/9963/

Researchers from St. Petersburg State University built a new filter for effective extraction of noble metals from industrial waste waters. The filters help extracting ions of gold, silver and platinum from processing media, as well as purifying solutions from photographic, jewelry, and electroplating industries. The filtering unit consists of several layers of porous carbon material, covered with a conducting polymer, able to reduce ions of precious metals.

From crab shell to fuel cell: Platinum.
Highlights in Chemical Technology, 09 April 2010

http://www.rsc.org/Publishing/ChemTech/Volume/2010/05/from_crab_shell.asp

A research group from Fudan University, led by Yong-Yao Xia, has demonstrated that crab shell has a well aligned porous structure at the microscopic level. Exploiting this unique structure, they have generated porous carbon nanofibre arrays by combining the hard crab shell template with an established soft templating method. The pore structure is suitable for charge storage by ion adsorption/desorption as an electrode material for supercapacitors or platinum catalyst loading for fuel cell applications.

MIT researchers harness viruses to spilt water: Iridium
MIT news, 11 April 2010

MIT teams biologically based system taps the power of sunlight directly, with the aim of turning water into hydrogen fuel.

http://web.mit.edu/press/2010/virus-water.htm l

The team, led by Angela Belcher, the Germeshausen Professor of Materials Science and Engineering and Biological Engineering, MIT, engineered a common, harmless bacterial virus called M13 so that it would attract and bind with molecules of a catalyst (the team used iridium oxide) and a biological pigment (zinc porphyrins). The viruses became wire-like devices that could very efficiently split the oxygen from water molecules.

Over time, however, the virus-wires would clump together and lose their effectiveness, so the researchers added an extra step: encapsulating them in a microgel matrix, so they maintained their uniform arrangement and kept their stability and efficiency.

Here's an efficient synthesis of cycloheptenones: Rhodium.
Noteworthy Chemistry, 12 April 2010.

http://portal.acs.org/portal/PublicWebSite/noteworthy/archive/CNBP_024599

Image:
http://portal.acs.org/portal/binfetch/consumption?fileUrl=/stellent/groups/web/documents/article/%7Eexport/CNBP_024599%7E3%7EHTML_DC_TEMPLATE%7ESNIPPET_LAYOUT/21148-2.jpg

P. A. Wender and co-workers at Stanford University report an intermolecular [5 + 2] cycloaddition between vinylcyclopropanes and alkynes that is mediated by cationic Rh(I) complex 1. Catalyst 1 is exceptionally reactive; it provides the desired cycloadducts (2) in 5-15 min at room temperature with high yields (91-97%) from most of the reactants studied.

The least stable catalyst responds fastest: Palladium.
News and Agenda - University of Amsterdam, 13 April 2010

http://www.english.uva.nl/news/news.cfm/2438D526-1A2B-46B0-992DD2A56EC450D1

Researchers in the field of chemistry from The Netherlands, have developed a new method to quickly and easily select the most active catalyst to bring about a specific chemical reaction. The relative stability of a mixture of metal complexes can be determined through the application of mass spectroscopy. The least stable complex of this mixture results in the fastest catalytic reaction. The researchers demonstrated this concept in the palladium-catalysed allylic alkylation reaction using diphosphine and IndolPhos ligands and supported their results with high-level density functional theory calculations.

Catalyst selection based on intermediate stability measured by mass spectrometry

Nature Chemistry, 2010, 2, (5), 417-421

http://dx.doi.org/10.1038/nchem.614

Oxoboryl Complexes: Boron-Oxygen Triple Bonds Stabilized in the Coordination Sphere of Platinum.
Science, 16 April 2010, Vol. 328, no. 5976, pp. 345-347

http://dx.doi.org/10.1126/science.1186028

Boron has a tendency to share electrons with multiple different atoms, hence exhibiting a rich cluster chemistry, in contrast to the more traditional two-center, two-electron bonds prevailing in the compounds of most other light elements. Braunschweig et al. of the Institut für Anorganische Chemie, Julius-Maximilians-Universität Würzburg, have coaxed boron into a more confined setting and made a boron analog of carbon monoxide as a triply bonded BO anion that was stabilized by coordination to a platinum center. The product formed easily in room temperature solution from a precursor substituted with a silyl group on the oxygen and a bromide on the boron and exhibited surprising stability toward heating and photolysis. The BO anion is a fundamental binary material, isoelectronic with CO, CN-, and NO+, which have been the key binary ligands in organometallic and coordination chemistry for more than 50 years.

Nano-networks of platinum and platinum alloy catalysts show higher catalytic activity
Nano Patents and Innovations, 20 April 2010

http://nanopatentsandinnovations.blogspot.com/2010/04/nano-networks-of-platinum-and-platinum.html

Institute of Nuclear Energy Research, Taiwan, has U.S. Patent 7,700,520 for its preparation of 3D nanonetwork structures of noble metal catalysts, i.e., platinum and platinum alloys which have high catalytic efficiencies.

New strategy yields best ever catalyst for ammonia decomposition: Platinum.
Chemistry World, 25 April 2010.

http://www.rsc.org/chemistryworld/News/2010/April/25041001.asp

US researchers have developed a new strategy for predicting bimetallic catalysts. They have already put it to good use in identifying a nickel-platinum catalyst that they claim is the best ever for the ammonia decomposition reaction - potentially a vital reaction if ammonia is to become an important means of storing hydrogen.

Flexible palladium-catalysed amidation reactions for the synthesis of complex aryl amides.
Tetrahedron Letters, 19 May 2010, Volume 51, Issue 20, Pages 2685-2689

http://dx.doi.org/10.1016/j.tetlet.2010.03.051

Researchers from the Antibacterial Discovery Performance Unit, Infectious Diseases CEDD, GlaxoSmithKline, UK, have synthesized complex aryl amides using palladium-catalysed amidation reactions. Use of these conditions allowed for the coupling of a variety of aryl halides and triflates with a host of primary amides in high yields.

Nano-infused filters prove effective: Palladium.
Rice University | News & Media, 22 April 2010

http://www.media.rice.edu/media/NewsBot.asp?MODE=VIEW&ID=14119

Rice University researchers and their colleagues in Finland and Hungary have found a way to make carbon nanotube membranes that could find wide application as extra-fine air filters and as scaffolds for catalysts that speed chemical reactions. The team tested the filters' ability to act as catalysts by depositing palladium onto the nanotubes and using them to turn propene into propane, a benchmark test for catalysis.

Making Complanadine A: Iridium
Latest News | Chemical & Engineering News, 23 April 2010

http://pubs.acs.org/cen/news/88/i17/8817notw9.html

Complanadine A aids production of nerve growth factors, something of interest in regenerative medicine and Alzheimer’s disease research. But the molecule is too scarce to study in depth.

Daniel F. Fischer and Richmond Sarpong, Department of Chemistry, University of California, Berkeley, made the natural product via an iridium-catalyzed C–H functionalization and a Suzuki coupling.

Synthetic enzymes could help ID proteins: Rhodium.
Rice University | News & Media, 28 April 2010

http://www.media.rice.edu/media/NewsBot.asp?MODE=VIEW&ID=14160&SnID=1521497554

Rice University chemists have created a synthetic enzyme that could help unlock the identities of thousands of difficult-to-study proteins, including many that play key roles in cancer and other diseases.

"We have combined the chemical capabilities of rhodium with what biology already knows about recognizing and selecting specific proteins," said study co-author Zachary Ball, assistant professor of chemistry at Rice. "The result is a tool that, in many ways, is more powerful than any biological or chemical approach alone."

Ball and postdoctoral research associate Brian Popp wondered if they could marry the selectivity of enzymatic reactions with a rhodium-based catalyst. They tested the idea by attaching their catalyst to a short segment of protein that can wrap with other proteins, like strands of rope fiber. This "coiled coil" wrapping motif is common in biology, particularly in signaling proteins. Signaling proteins are those that activate or deactivate key processes like apoptosis, the "programmed death" response that's known to play a key role in cancer.