



New Application Developments in PGMs – September 2010

Thermoelectrics: Unearthing hidden 'talent': Platinum, palladium.

A*STAR Research, 01 September 2010

Two oxides show strong thermoelectric properties despite being metallic.

<http://www.research.a-star.edu.sg/research/6206>

Image: Fig. 1: Crystal structure of delafossite oxides PtCoO₂ and PdCoO₂. © 2010 K. Ong, http://www.research.a-star.edu.sg/images/figures/hi_4177.jpg

A combinatorial approach to the identification of self-assembled ligands for rhodium-catalysed asymmetric hydrogenation.

Nature Chemistry, Published online 22 August 2010

<http://www.nature.com/nchem/journal/vaop/ncurrent/abs/nchem.800.html>

Joerg Wieland and Bernhard Breit at the Institut für Organische Chemie und Biochemie, Freiburg Institute for Advanced Studies (FRIAS), Albert-Ludwigs-Universität Freiburg, Germany, combined a diversity-oriented ligand synthesis, a catalyst-generation process driven by self-assembly and, finally, a combinatorial iterative library deconvolution strategy to identify the optimal catalyst. As a test case, rhodium-catalysed asymmetric hydrogenation was studied and, from a library of 120 self-assembling catalysts, highly enantioselective catalysts for the asymmetric hydrogenation of different olefinic substrates were identified within 17 experiments. Comparison of the results of the iterative library deconvolution strategy with those of the classic parallel-screening process confirmed the validity of this approach.

OLEDs need gentle treatment: Iridium.

Highlights in Chemical Science, 01 September 2010

<http://www.rsc.org/Publishing/ChemScience/Volume/2010/09/OLEDs.asp>

Etienne Baranoff and his group at the Swiss Federal Institute of Technology at Lausanne, investigated a potentially promising compound Ir(2-phenylpyridine)₂(2-carboxy-4-dimethylaminopyridine) known as N984 (a trans complex). Heating and depositing the compound onto OLED devices results in formation of the cis isomer too, they found. This leads to a dramatic reduction in device performance, which they have attributed to the difference in highest occupied molecular orbitals between the two isomers. Baranoff believes that this discovery will be useful for scaling up and improving performance reproducibility.

Millersville teen hard at work on 'green chemistry' project: Rhodium

LancasterOnline.com News, 06 September, 2010

<http://articles.lancasteronline.com/local/4/286265>

He was hooked.

After a seventh-grade science project on acid rain and metals whetted his appetite for higher-level research, Jonathan Rajaseelan discovered he and scientific experimentation had quite good chemistry.

For the rising senior at Lancaster Country Day School, his interest has paid off — literally.

Rajaseelan, 17, was recently awarded a \$50,000 scholarship from the Davidson Institute for Talent Development for his research project, "Novel Rhodium N-heterocyclic Carbene Complexes for Green Chemistry."

The name may be a mouthful, but for Rajaseelan, an enthusiastic chemist, the project may eventually yield everyday benefits.

In his experiment, which made him one of three students nationally to win the Davidson Institute's \$50,000 scholarship prize, Rajaseelan produced six new chemical complexes with the metal rhodium.

The rhodium complexes act as catalysts in organic synthesis reactions used to produce pharmaceuticals and industrial chemicals.

Rajaseelan explained that his project's practical application lies in the fact that hydrogen gas is usually the catalyst used in such reactions but can be replaced by the safer and more inexpensive compounds he manufactured.

"It applies to many industries," said Rajaseelan, who began research on the experiment the summer after his freshman year.

His work has the potential to contribute to greener medicine-making methods.

Rajaseelan lives at 166 Springdale Lane in Millersville, with his parents, Nilmini and Edward.

Rajaseelan said he is passionate about green chemistry and hopes to continue research in the field in college by studying chemistry and biology, and maybe even going to medical school.

Even now, Rajaseelan plans to continue experimentation with his rhodium complexes. In fact, the Lancaster teen said, he was in the lab just a few weeks ago doing just that.

"When you're studying, it's just sort of knowledge," Rajaseelan said. "There are the fundamentals; there's a toolbox."

He wants something more.

"It's just really neat to do as a researcher," he said of making his ideas come to life in the lab. "You can apply what you've learned."

And he's learned a lot.

Rajaseelan took high-school level biology in eighth grade and completed a chemistry course the following summer.

While he hasn't neglected physics — he took his first course in ninth grade and is taking Advanced Placement this year — Rajaseelan's heart is in chemistry and biology, so much that he has taken molecular biology and organic chemistry, both college-level courses.

While the high school student said it would be "a bit of a reach right now" for his project to immediately take on practical significance within the medical industry, he acknowledged this as his ultimate goal.

"It would be an amazing thing," Rajaseelan said. "If it ended up making any difference, it really makes all the work worth it."

Complex syntheses lead to potential AIDS and HIV drugs: Palladium

Patent Watch, 06 September 6, 2010

http://portal.acs.org/portal/PublicWebSite/patent/archive/CNBP_025587

Image: http://portal.acs.org/portal/binfetch/consumption?fileUrl=/stellent/groups/web/documents/article/%7Eexport/CNBP_025587%7E2%7EHTML_DC_TEMPLATE%7ESNIPPET_LAYOUT/25714%7E1.jpg

H. B. Arzeno and co-inventors at Roche Palo Alto LLC have developed a process for preparing a range of triazolones such as compound 8 that are useful for treating AIDS and HIV. A nitro group is catalytically hydrogenated with Pd/C and VO(acac)₂ in one of the stages.

Electron microscopy gets twisted: Platinum mask

Nature News, 15 September 2010

Spiralling electron beams have the potential to measure and manipulate the properties of single atoms.

<http://www.nature.com/news/2010/100915/full/news.2010.468.html>

A spider-web-like highly expandable sensor network for multifunctional materials: Platinum

Chemistry World, 14 September 2010

Artificial skin gets touchy

<http://www.rsc.org/chemistryworld/News/2010/September/14091001.asp>

<http://dx.doi.org/10.1002/adma.201000661>

Giulia Lanzara and her colleagues in the Department of Aeronautics and Astronautics at Stanford University have found a way of making a compacted, parcelled up small circuit and effectively unfolding it into a large circuit of predetermined geometry. The researchers used conventional microcircuitry methods to deposit platinum spots on a thin film of the flexible polymer polyimide. These spots are then connected by thin gold wires. The wires are looped back and forth resembling a folded ribbon. Multiple spots and nodes and wires can be patterned in this way. 'We then use an etching mask and remove all the excess polymer substrate from surface, leaving only the wires and nodes,' says Lanzara. The circuit can now be expanded with the folded wires able to simply extend like a concertina to up to 16 times their original length. The platinum nodes can be fabricated to act as resistors that are sensitive to pressure, while the gold wires are sensitive to changes in temperature. In this way the expanded circuit can detect changes in pressure and temperature. 'We can fabricate the initial circuit so that it can be extended to form the final shape of circuit we require, in two or three dimensions and with different densities of component on the circuit, so that on an artificial hand, for example we could have a greater density of sensor nodes at the fingertips,' says Lanzara.

Synthesize ring-fused quinazolinones with an efficient domino reaction: Palladium

Noteworthy Chemistry, 13 September, 2010

http://portal.acs.org/portal/PublicWebSite/noteworthy/archive/CNBP_025692

Image:

http://portal.acs.org/portal/binfetch/consumption?fileUrl=/stellent/groups/web/documents/article/%7Eexport/CNBP_025692%7E2%7EHTML_DC_TEMPLATE%7ESNIPPET_LAYOUT/26048%7E1.jpg

F. Zeng and H. Alper at the University of Ottawa used a domino reaction in their novel syntheses of quinazolino[3,2-a]quinazolinones (e.g., 1) from a bifunctional carbodiimide. Palladium complex-catalyzed treatment of 5 with alkyl or arylamines initiates a domino addition-carboxamidation reaction that forms five bonds in a single step to build the target 6-substituted quinazolino[3,2-a]quinazolinone core 1. Yields were in the 75-89% range for 14 of the 16 variants studied.

Surface materials: Super clean glass: Palladium

Nanowerk News, 15 Sep, 2010

<http://www.nanowerk.com/news/newsid=18035.php>

<http://dx.doi.org/10.1021/am900726k>

Image: Fig. 1: Glass coated with palladium-functionalized titania degrades surface contaminants when exposed to sunlight, <http://www.nanowerk.com/news/id18035.jpg>

Controlled selectivity for palladium catalysts using self-assembled monolayers

Nature Materials, 12 September 2010

<http://dx.doi.org/10.1038/nmat2849>

Image: The structure of a propanethiol SAM on Pd(111). The figure on the right is a space-filling model shown from above, which illustrates the space available on the surface for reaction,

<http://www.nature.com/nmat/journal/vaop/ncurrent/carousel/nmat2849-f2.jpg>

J. William Medlin with researchers from Department of Chemical and Biological Engineering, University of Colorado at Boulder and Department of Chemistry and Geochemistry, Colorado School of Mines describe the preparation of highly selective Pd catalysts involving the deposition of n-alkanethiol self-assembled monolayer (SAM) coatings. These coatings improve the selectivity of 1-epoxybutane formation from 1-epoxy-3-butene on Pd catalysts from 11 to 94% at equivalent reaction conditions and conversions. Although sulphur species are generally considered to be indiscriminate catalyst poisons, the reaction rate to the desired product on a catalyst coated with a thiol was 40% of the rate on an uncoated catalyst.

Hybrid nanoscale inorganic cages: Ruthenium

Nature Materials, 19 September 2010

<http://dx.doi.org/10.1038/nmat2848>

Uri Banin with colleagues at Institute of Chemistry, The Hebrew University of Jerusalem, The Center for Nanoscience and Nanotechnology, The Hebrew University of Jerusalem and Ernst Ruska-Centre for Microscopy and Spectroscopy with Electrons, Research Centre Juelich report the integration of the two powerful concepts of cages and hybrid nanoparticles. A previously unknown edge growth mechanism has led to a new type of cage-structured hybrid metal-semiconductor nanoparticle; a ruthenium cage was grown selectively on the edges of a faceted copper(I) sulphide nanocrystal, contrary to the more commonly observed facet and island growth modes of other hybrids. The cage motif was extended by exploiting the open frame to achieve empty cages and cages containing other semiconductors. Such previously unknown nano-inorganic cage structures with variable cores and metal frames manifest new chemical, optical and electronic properties and demonstrate possibilities for uses in electrocatalysis.

High-color-rendering white organic LEDs based on novel phosphors: Iridium, osmium

SPIE Newsroom | Illumination & Displays, 20 September 2010.

A combination of efficient true-blue iridium complexes and improvements to device architecture significantly enhances the color performance of white-emitting organic LEDs.

<http://spie.org/x41771.xml?highlight=x2408&ArticleID=x41771>

Take a new route to lactic acid: Palladium

Patent Watch, 20 September, 2010

http://portal.acs.org/portal/PublicWebSite/patent/archive/CNBP_025742

<http://www.cas.org/pwatch/092010.html>

G. Eastham of Lucite International UK discloses a catalyst system capable of carbonylating vinyl acetate to methyl acetoxypropionate isomers. The methyl 2-acetoxypropionate isomer can be converted to lactic acid. In one example, 0.6 mmol Pd(OAc)₂ and 0.75 mmol 1,2-bis(2-phosphinomethyl-1,3,5-trimethyl-6,9,10-trioxadamantyl)benzene are weighed into a 500 mL round-bottom flask under an oxygen-free environment. Degassed MeOH (300 mL) is added, and the solution is stirred for 1 h. Then 1.2 mmol MeSO₃H and 50 mL vinyl acetate are added. This solution is placed in an autoclave, heated to 60 °C, pressurized with CO to 10 bar, and allowed to react for 3 h. Analysis of the reaction products by GC indicated that vinyl acetate conversion is ~62%, and the linear/branched product ratio is 6.16:1. The reaction products, methyl 2-acetoxypropionate and methyl 3-acetoxypropionate are separated by distillation.

Self-pumping membrane mimics cell machinery: Platinum

Chemistry World, 21 September 2010

<http://www.rsc.org/chemistryworld/News/2010/September/21091001.asp>

Image: Gold and platinum electrodes are deposited on the opposing surfaces of a polycarbonate membrane to form the self-pumping membrane. © Advanced Materials, http://www.rsc.org/images/pump-300_tcm18-190967.jpg

US researchers have imitated the transport functions of biological membranes by incorporating tiny pumps into synthetic membranes. They say their 'self-pumping' mimics could be used in "compartment-less fuel cells". Henry Hess at Columbia University in New York and In-Kook Jun at the University of Florida have designed a polycarbonate membrane with a built-in pump action that's driven, like in nature, by chemical energy. They sandwiched their membrane between gold and platinum electrodes. On the platinum side, hydrogen peroxide splits to form oxygen molecules, hydrogen ions and electrons. The electrons flow between the two electrodes, while the hydrogen ions are pumped through 1 μm wide pores towards the gold electrode.

Hydrogen-powered, solar-inspired nano-battery: Platinum, palladium

Newswise, 22 September, 2010

<http://www.newswise.com/articles/hydrogen-powered-solar-inspired-nano-battery>

There's a big buzz today over future nanostructure devices performing specialized jobs in everything from electronics to medicine. But what's still needed are unconventional ways to power these tiny machines.

Eduard Karpov (<http://www.uic.edu/depts/cme/people/faculty/ekarpov.html>), University of Illinois at Chicago assistant professor of civil and materials engineering, just received a three-year, \$217,000 grant from the National Science Foundation to develop a new battery he is calling a catalo-thermionic generator.

It will generate power on a flat planar surface, just like in a photovoltaic or solar cell, only instead of sunlight being the energy source, hydrogen oxidation will power the electron flow.

Unlike conventional hydrogen fuel cell technology that has been around for more than a century, this new approach, called "chemovoltaics," harnesses energy from hydrogen oxidation taking place on a film-like catalytic metal surface. Unlike fuel cells, the chemovoltaic device can be very small and flat and does not release or absorb heat, allowing it to run at much cooler temperatures. But like fuel cells, its energy production byproduct is only water.

"This device is the child of the nanotechnology era," Karpov said. "It consists of nano-thickness layers of catalytic material on top of semiconductor substrates.

"We know the basic physics, but utilizing it for an energy application is a new idea," he said.

Karpov and his UIC laboratory team will test structural variations for building these nano-sized devices to generate maximum power. They will also test various types of catalytic materials such as platinum, palladium or some oxides to see what works best, vary the thicknesses of the catalytic material to see if that makes a difference, and try various patterned surfaces on the catalyst to learn if this affects performance.

Karpov envisions initial applications for these tiny generators in critical military devices where their small size and low weight will outweigh the high startup costs. As the technology develops, the generator might be attached directly to computer chips as a power source, or to tiny devices such as a nano-robot.

"Our main task is to show that this phenomenon, in principle, can lead to a commercially viable technology that has the potential to compete with fuel cells," he said.

A new approach to high-performance catalysts: Rhodium

AlphaGalileo | News Release, 22 September 2010

<http://www.alphagalileo.org/ViewItem.aspx?ItemId=85814&CultureCode=en>

<http://dx.doi.org/10.1038/nchem.800>

A working group led by Professor Bernhard Breit, Institut für Organische Chemie und Biochemie, Freiburg Institute for Advanced Studies (FRIAS), Albert-Ludwigs-Universität Freiburg has developed a new process for generating and identifying catalysts that uses a combinatorial approach where catalyst libraries are produced by simply mixing complementary components. In this case, catalytically active rhodium(I) centres are modified with phosphine ligands which bond to them.

The UJI and the company Neuron BPh show the potential of new compounds for being used in neurodegenerative diseases: Ruthenium.

Universitat Jaume I | Notices, 22 September, 2010

http://www.uji.es/UK/noticies/detall&id_a=22418037

The pharmaceutical division of the company Neuron BPh and the research group of Organometallic Chemistry and Homogeneous Catalysis of the Universitat Jaume I, have evaluated the possible applications of a series of ruthenium compounds for their future use in the treatment of neurodegenerative disease such as Alzheimer.

The research, recently published in the prestigious journal Zebrafish, has come to the conclusion that the ruthenium compound used has the ability to act as a neuroprotective or antitumoral depending on the concentration in which it is applied. So that, in low doses, the compound acts as antioxidant preventing the deterioration of cells, which means it could be used for treatments of neurodegenerative diseases like Alzheimer or Parkinson. While in high concentrations, this compound may become a toxic substance that causes the selective death of diseased cells and, therefore, is a good candidate for the design of antitumoral drugs.

Research in biomedical applications of these compounds is relatively recent, so the Universitat Jaume I is at the forefront of this new field of research through collaboration with the company of Grenada. The results have already been presented at various scientific meetings, in particular, at the European congress 6th Zebrafish Genetics and Developmental Meeting held in Rome, and at the 32nd Reunión Biental de la Real Sociedad Española de Química which was held in Oviedo, Spain, in 2009.

As for the development of the project, the compounds were obtained through synthesis procedures developed by the research group of the UJI, led by professor Eduardo Peris. The company Neuron BPh, meanwhile, undertook in vitro tests. Subsequently, the company of Grenada checked the compounds obtained in their Toxicology Platform for their safety. To do this, they used an animal model increasingly used in the proofs of drug safety: zebrafish embryo.

The group of Organometallic Chemistry and Homogeneous Catalysis has been able to carry out this research thanks to grants received by the Ministry of Education and the foundation Fundació Bancaixa-UJI. The team that has participated in this research is composed by PhD student Amparo Prades, PhD Macarena Poyatos and tenured professor of the area of Inorganic Chemistry, Eduardo Peris. The research group has an extensive experience in the design, synthesis and description of organometallic compounds, and is the group of the Universitat Jaume I with more quotations, according the ISI web of Science database.

Neuron BPh, meanwhile, has participated in the project with the company's own funds and with staff attached to its Division BioPharma, specially its director, Javier S. Burgos, from Valencia; PhDs Juan Alfaro and María del Carmen Ramos; and Jorge Ripoll as technical staff. The mission of the company focuses on drugs and nutraceuticals discoveries for the prevention and treatment of neurodegenerative diseases, and, in particular, of Alzheimer's disease and, additionally provides biotechnological services to pharmaceutical, chemical, food processing and biofuel companies.

The project, that arose from a collaboration of the director of the Division BioPharma with the tenured professors of the UJI Eduardo Peris (Department of Inorganic and Organic Chemistry) and Aurelio Gómez (Department of Agricultural Sciences and Natural Environment), has allowed to establish a framework of steady work between the UJI and the company. At present, they're in talks to establish a new research project which will allow giving value to more researches of the group of professor Peris in the field of biomedicine.

Challenging aqua regia's throne: Platinum, palladium

Chemistry World, 23 September 2010

School of Materials Science & Engineering, Georgia Institute of Technology's organic aqua regia can selectively dissolve a range of noble metals

<http://www.rsc.org/chemistryworld/News/2010/September/23091001.asp>

<http://dx.doi.org/10.1002/anie.201001244>

Use DMSO for a benign synthesis of palladium nanoparticles

Noteworthy Chemistry, 27 September, 2010

http://portal.acs.org/portal/PublicWebSite/noteworthy/archive/CNBP_025792

Image:

http://portal.acs.org/portal/binfetch/consumption?fileUrl=/stellent/groups/web/documents/article/%7Eexport/CNBP_025792%7E3%7EHTML_DC_TEMPLATE%7ESNIPPET_LAYOUT/26488%2.jpg

C. B. Roberts and coauthors at Auburn University (Alabama) and Georgia Tech (Atlanta) have used DMSO (dimethyl sulfoxide) as the solvent and capping agent in a ligand-free preparation of palladium nanoparticles.

Taiwan researchers announce breakthrough in cancer diagnosis: Platinum

FOCUS TAIWAN, 30 September 2010

http://focustaiwan.tw/ShowNews/WebNews_Detail.aspx?ID=201009300008&Type=aLIV

A Taiwan-developed technology could allow cancer patients to undergo same-day CT and MRI scans without the need to wait for the clearance of contrast agents, cutting diagnostic times in half, a pair of researchers announced at a news conference Wednesday.

Laboratory tests of iron and platinum (FePt) nanoparticles for dual modal CT/MRI molecular imaging, the first of its kind in the world, was conducted by a research team led by Chen Chia-chun, a professor with Academia Sinica and National Taiwan Normal University in Taipei, and Shieh Dar-bin, a doctor and professor with National Cheng Kung University Medical Center in Tainan.

The research was partly funded by the National Science Council. Results of in vitro and in vivo testing were carried in the Sept. 29 issue (<http://dx.doi.org/10.1021/ja1035013>) of the Journal of the American Chemical Society as a cover story (<http://pubs.acs.org/action/showLargeCover?issue=355010408>).

Chen said both CT and MRI scans are costly and time-consuming, with patients often having to wait for two months to be examined, at the cost of up to NT\$6,300 (US\$200) each.

According to the Bureau of National Health Insurance, the number of patients receiving CT scans totaled 1.02 million in Taiwan in 2008, while 350,000 patients received MRIs.

Some patients developed side effects after receiving CT or MRI scans because of the currently used contrast agents, Chen said.

The water-soluble FePt nanoparticles, however, presented excellent biocompatibility and hemocompatibility in all test concentrations for the imaging contrast, Chen said, adding that they are stable and do not easily oxidize or decompose.

With FePt nanoparticles, patients do not need to receive CT and MRI scans on separate occasions as the new diagnostic tools can perform the dual function of showing the position of cancer lesions and their molecular characteristics, Chen said.

Shieh said that the FePt nanoparticles are potentially capable of allowing doctors to find cancer cells' molecular expressions, helping them to determine what kind of chemotherapy should be prescribed to first-stage cancer patients after surgery.

Currently, MRI and CT scans should be performed on a patient with an interval of 24 hours to allow the preceding contrast agent to die out, Shieh said.

Chen said that FePt nanoparticles have a high potential for mass, commercial production.

"It would be a star product in the world's nearly US\$5 billion medical diagnosis market," he said.

Patent rights are being applied for in nations worldwide, Chen said, adding that it would take roughly five years for the nanoparticles to complete human trials before being put on the market.

For more scientific research papers on platinum group metals go to: www.platinummetalsreview.com