New Application Developments in PGMs – September 2009

New approach to a classic structure: Oxidative ring-closing reaction boosts yield of key erythromycin precursor: Palladium
Latest News | Chemical & Engineering News, 02 September 2009

http://pubs.acs.org/cen/news/87/i36/8736notw1.html

Image: New Twist: The classical approach (top reaction) to 6-dEB (right) was an acylation-based ring-closing at a stereochemically defined alcohol (top left), whereas the new strategy (bottom) involves oxidation of a stereochemically versatile C–H bond. The ring-closing site (C13) is yellow: http://pubs.acs.org/cen/_img/87/i36/8736notw1_strc.gif

Work by associate professor of chemistry M. Christina White and graduate student Erik M. Stang of the University of Illinois, Urbana-Champaign, marks the first use of a highly selective C–H oxidative macrolactonization to create the core structure, in a new total synthesis of 6-deoxyerythronolide B (6-dEB).

They carried out the reaction at a late stage (step 19 of 22) in the 6-dEB synthesis. They marked the carbon atom to be oxygenated (designated C13) with an adjacent double bond that then served as a target for the Pd/bis-sulfoxide catalyst they used. The group developed a catalytic chelate-control model to predict that oxidative macrolactonization would occur stereoselectively at that particular carbon.

Amping up the protein power: Palladium
materialsviews.com, 08 September 2009

http://www.materialsviews.com/matview/display/en/1058/TEXT

Silke Behrens, Oded Shoseyov and their teams in Karlsruhe and Rehovot use proteins as a self-assembling template for metal nanoparticles.

One stumbling block in previous attempts to use proteins as biotemplates has been that they are quite sensitive to their environment, and subtle shifts in temperature, acidity and the other chemicals present can cause the assembly to fail. In this paper, the team overcame this hurdle by using "stressed" proteins produced by aspen plants under drought conditions, which are much more robust and can cope with fluctuations in their environment. They managed to create complexes of proteins and palladium nanoparticles of roughly 3 nm diameter. The Pd particles are catalytically active, and when the complexes were used in a sensing test, the catalyzed reaction causes an amplification in detection signal.

Daisy-chain polymers bring artificial muscles a step closer: Ruthenium
Chemistry World, 09 September 2009

http://www.rsc.org/chemistryworld/News/2009/September/09090902.asp

American chemists have made molecular 'daisy-chains' containing threaded rings that can be pulled taut or slackened by chemical stimuli. The polymers are a step towards making materials that stretch or contract on demand, and show great potential for applications such as actuators in nanomachinery or designing artificial muscles.

The team started with a monomer that resembles an arm with an open hand, containing a large pincer-like open ring system at one end. In the middle of the monomer is an ammonium group, where the ring can be attached - but the molecule is too constrained to bind to itself.

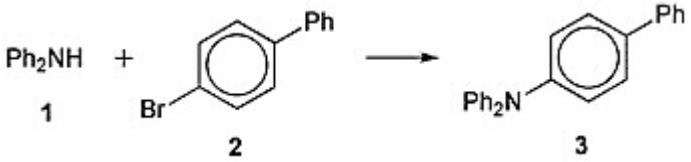
Using a ring-closing metathesis reaction with one of Grubbs' ruthenium-based catalysts, the rings can snap closed around other monomers - resulting in dimers that look like two arms holding each other at the elbow. These interlocking ring systems are known as catenanes.

The dimers can then be polymerised, and in a simple reversible reaction the ammonium binding group can be removed or added. This allows the rings to slide up or down the arm of the molecule - lengthening or shortening the polymer structure.

Use a microreactor to optimize a Buchwald amination: Palladium
Patent Watch, 14 September 2009

http://portal.acs.org/portal/PublicWebSite/patent/archive/CNBP_022916

The first step in the process (Xerox Corp., U.S. Patent 7,563,932, July 21, 2009) is the formation of the catalyst system by the reaction of a solution of P-n-Bu3 in toluene with Pd(OAc)2 in 1,3-dioxolane, followed by the addition of sodium tert-pentoxide to give solution A. A second solution (B) is prepared by dissolving ~1.13 mol/L each of reactants 1 and 2 in 1,3-dioxolane. The microreactor is maintained at 70 °C, and solutions A and B are conveyed into the reactor using HPLC pumps at 1 mL/min each.



The residence time in the microreactor is 23.5 min; over a period of 18 min, the conversion averaged 92%. Details of the recovery of 3 are not described, nor is the final product yield given.

The procedure gives a high conversion in a continuous process, but whether it is applicable to large-scale use is not known.

Convert the batch hydrogenation of an aromatic dinitro compound to a continuous process: Palladium
Noteworthy Chemistry, 14 September 2009

http://portal.acs.org/portal/PublicWebSite/noteworthy/archive/CNBP_022915

J. G. Van Alsten, M. L. Jorgensen, and D. J. am Ende at Pfizer Global R&D (Groton, CT) describe a proof-of-concept study of the hydrogenation of an aromatic dinitro intermediate in the synthesis of the antismoking drug varenicline (marketed as Chantix in the United States and Champix in the European Union) to form the corresponding diamine.

The two catalysts screened were 5% Pd on carbon support, and were obtained in very different morphologies.

How nanotechnology promises to greatly reduce the manufacturing cost of fuel cells: Platinum
AZoNano.com, 16 September 2009

http://www.azonano.com/details.asp?ArticleId=2391

Professor Rod Boswell and the Space Plasma, Power & Propulsion Group at The Australian National University have sputter coated the surface of carbon nanofibres with platinum.

The tremendous advantage of this nanotechnology electrode is that its vast surface area and microscopically thin platinum coat reduce the amount of platinum required to about 15% of that in a conventional electrode of the same power specification.

"Smaller isn't always better": Catalyst simulations could lower fuel cell cost: Platinum
UW-Madison News Releases, 17 September 2009

http://www.news.wisc.edu/releases/15511

University of Wisconsin-Madison materials science and engineering assistant professor Dane Morgan and Ph.D. student Edward (Ted) Holby have developed a computational model that could optimize an important component of fuel cells.

Rapid catalyst degradation means the fuel cell doesn't last long, and the U.S. Department of Energy estimates fuel cells must function for 5,000 hours, or approximately seven months of continuous use, to be practical for automotive energy solutions.

Morgan and Holby, who are working in collaboration with Professor Yan Shao-Horn from the Massachusetts Institute of Technology, have found a possible solution to the rapid degradation problem: When it comes to catalyst particle size, sometimes smaller isn't better.

Their modeling work, which is funded by 3M and the U.S. Department of Energy, shows that if the particle size of a platinum catalyst is increased to four or five nanometers, which is approximately 20 atoms across, the level of degradation significantly decreases. This means the catalyst and the fuel cell as a whole can continue to function for much longer than if the particle size was only two or three nanometers.

Thin-film salt and paper battery: Platinum
Printed Electronics World, 18 September 2009

http://www.printedelectronicsworld.com/articles/thin_film_salt_and_paper_battery_00001689.asp

Image: Photograph of the composite paper battery cell before and after sealing it into a polymer coated aluminum pouch:

http://www.printedelectronicsworld.com/idtechex/images/illustrations/200x150/upload20090916222626.jpg

A new thin-film paper battery that holds great promise for applications in areas where conventional Li-ion batteries are not the perfect choice has been developed by a research group led by Prof. Maria Stromme at Uppsala University, Sweden.

To form the rechargeable flexible battery, thin pieces of the cellulose composite a nanostructured high-surface area material were used as electrodes, which were separated by a filter paper soaked in a salt solution made of sodium chloride that acts as electrolyte. Two platinum foils were used as current collectors. Total thickness of this cell was measured ~2 mm.. To avoid evaporation of water from the electrolyte additional encapsulation in needed.

Oscillatory system to deliver drugs: Palladium
News - The Engineer, 23 September 2009

http://www.theengineer.co.uk/Articles/313205/Oscillatory+system+to+deliver+drugs.htm

Newcastle University researchers have developed an oscillatory system that includes a palladium iodide catalyst, potassium iodide, oxygen, sodium acetate, methanol and phenylacetylene. The team believes that such an oscillatory system could be chemically bonded onto a smart polymer gel and used for drug delivery devices.

Alloys of platinum and early transition metals as oxygen reduction electrocatalysts
Nature Chemistry, 23 September 2009

http://dx.doi.org/10.1038/nchem.367

Improvements in the activity and stability of catalysts for oxygen reduction reactions are needed to make low-temperature, polymer electrolyte membrane fuel-cells viable for mobile applications. Pt3Sc and Pt3Y are shown experimentally by Technical University of Denmark and Stanford University researchers to have greater catalytic activity than pure Pt after being identified through computational investigation of Pt- and Pd-based alloys.

Catalytic catamarans: Common industrial catalyst sports rafts made of platinum
EurekAlert!, 24 September 2009

Best view yet of catalyst used for energy and environment applications suggests tricks to improve performance

http://www.eurekalert.org/pub_releases/2009-09/dnnl-ccc091809.php

Image: Rafts of catalytic platinum oxide float above a sea of aluminum oxide, anchored by bonds between platinum and aluminum:

http://www.eurekalert.org/multimedia/pub/16871.php?from=144857

Converting benzene to cyclohexylbenzene in good selectivity: Palladium
Patent Watch, 28 September 2009

http://portal.acs.org/portal/PublicWebSite/patent/archive/CNBP_023023

J. H. Dakka, L. C. DeCaul, and T. Xu of ExxonMobil Research and Engineering Co. disclose a catalyst that can convert benzene to cyclohexylbenzene with good selectivity. The catalyst is prepared by impregnating 5 g of γ-Al2O3 with a Pd(NO3)2 solution and calcining the palladium-impregnated Al2O3 at 350 °C for 3 h in air. The Pd loading is 0.3 wt%. The Pd–Al2O3 catalyst is mixed in a 1:3 w/w ratio with a crushed 80% molecular sieve MCM-49–20% Al2O3 extrudate and pelletized at 20,000 psig.

Here's how to make a platinum–ruthenium alloy catalyst with controlled internal structure
Noteworthy Chemistry, September 28, 2009

http://portal.acs.org/portal/PublicWebSite/noteworthy/archive/CNBP_023022

T. K. Sau, M. Lopez, and D. V. Goia at Clarkson University (Potsdam, NY) report a polyol method for depositing Pt–Ru nanoparticles with controlled size and internal composition on a carbon support. The key to precipitating a truly alloyed Pt–Ru catalyst is to ensure a similar reduction rate for both metals; this can be accomplished by properly selecting the polyol, pH, temperature, and the modality of combining the reactants.

2009 Thomson Reuters Citation Laureate for Chemistry: Ruthenium
Chemie.DE, 25 Sep 2009

http://www.chemie.de/news/e/106822/

"Thomson Reuters Predicts Nobel Laureates"

Thomson Reuters announced the 2009 Thomson Reuters Citation Laureates - researchers likely to be in contention for Nobel honors - in anticipation of this year's Nobel Prize winners in the sciences and in economics to be announced from October 5-12.

The 2009 Thomson Reuters Citation Laureates by Nobel Prize category are as follows:

Chemistry

Michael Gratzel (Professor and Director, Laboratory of Photonics and Interfaces, Swiss Federal Institute of Technology (EPFL)) for his invention of dye-sensitized solar cells, now known as Gratzel cells.

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