Johnson Matthey

Platinum Metals Review

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A Novel Palladium Catalyst for Drug Synthesis

The complex molecules used in today's pharmaceuticals rely on finely-tuned methods of preparation, in which palladium-based catalysts play a central role. These catalysts allow for a variety of products to be economically produced under mild conditions with high chemoselectivity, minimising both the use and the formation of undesirable substances. A new palladium compound, di-μ-bromobis(tri-*tert*-butylphosphine)dipalladium(I), has higher catalytic activity for cross-coupling reactions than previous generations of catalysts – including for α-arylations, a particularly challenging type of reaction. Thomas J. Colacot of Johnson Matthey's Catalysis and Chiral Technologies business unit in West Deptford, USA, provides some details on the handling and applications of the catalyst compound in this useful review.

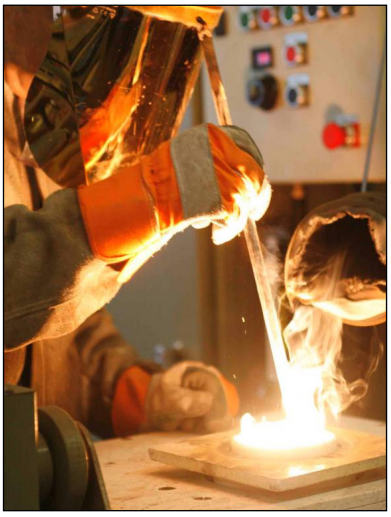
Left: Pure Pd(I) dimer, $[Pd(\mu\text{-}Br)(^{t}Bu_3P)]_2$ (Image from Johnson Matthey Catalysts, 'Coupling Catalysis Application Table')

Promising Palladium Alloys for Jewellery and Watchmaking

Palladium as a jewellery metal is proving to be an increasingly popular alternative to white gold, especially as its purer white colour means that no rhodium plating is required. However, the relatively low hardness of common 950 palladium alloys has limited their use in some applications such as watchmaking. Now in this paper by Andreas Blatter and colleagues at PX Group and Cartier Horlogerie in Switzerland, new palladium alloys are presented which have hardness values comparable to gold and platinum alloys. The alloying elements aluminium and ruthenium have been chosen to strengthen the alloy without compromising either the colour or the good workability that is a feature of 950 palladium alloys.

Above: Palladium-aluminium-ruthenium discs with ceramic inlays, showing the potential use of these alloys in decorative items

Melting the Platinum Group Metals

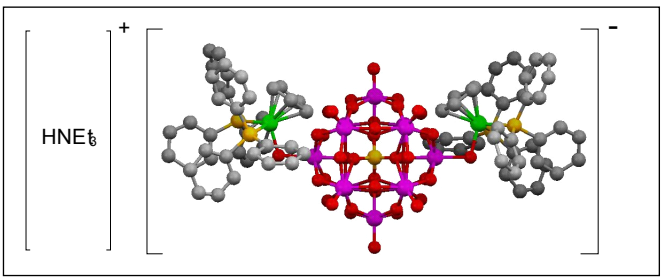


The history behind the development of melting techniques for platinum and the other pgms is traced up to the present day in this article by Bill Griffith of Imperial College London. Platinum in its pure metallic form could not be successfully melted before Joseph Priestley discovered oxygen, and this breakthrough came in the late 18th century. The other platinum group metals were melted during the early 19th century and by the mid-19th century commercial-scale production of platinum had become possible for the first time. Modern industrial production uses electrical heating to achieve the high temperatures required to melt these metals.

Left: Casting of molten platinum (Image courtesy of Johnson Matthey Noble Metals)

Conference Reviews:

Heterogeneous catalysis underlies many environmentally important technologies, such as the removal of pollutants from automotive exhaust gas. Stan Golunski and Andy York of JMTC Sonning review ***The Taylor Conference 2009*** and note an encouraging development in this field: the convergence of laboratory research techniques on idealised catalyst surfaces with the innovations that are occurring at the 'coalface' of industrial application.



Above: A heterogeneous catalyst that combines an active ruthenium organometallic centre with a polyoxometallate cage (Courtesy of Karen Wilson, University of York, UK)

Similarly, the third ***Novel Chiral Chemistries Japan*** (NCCJapan) Conference and Exhibition, held in Tokyo on 18th and 19th April 2009, showcased developments in asymmetric catalysis for pharmaceuticals and fine chemicals. There is a great deal of activity centred around the use of pgm-based systems with phosphine ligands, and the review of the conference by David Ager (DSM) provides an excellent overview of the state-of-the-art in this area.

Returning to metals and metalworking, the subjects of palladium alloys and alloy hardness also featured at ***The 23rd Santa Fe Symposium***, which was held in Albuquerque, New Mexico, USA in May 2009. Chris Corti (CoreGOLD Consultancy, UK) reviews advances in the field of jewellery metallurgy and manufacturing presented at this symposium – including a promising method for casting 950 palladium alloys, using an innovative melting technique borrowed from the dental industry.

Left: A piece cast in 950 palladium alloy, using a two-part platinum investment (Courtesy of Paolo Battaini, 8853 SpA, Italy)

Book Review:

Once a distant prospect, fuel cell-powered automobiles have already proven themselves in a number of pilot schemes. A book that manages to comprehensively cover both the science and the application of polymer electrolyte membrane (PEM) fuel cell catalysts would be of real value to researchers and engineers working towards full commercial application of the technology. A book which can justifiably claim to have achieved this, ***"PEM Fuel Cell Electrocatalysts and Catalyst Layers: Fundamentals and Applications"***, edited by Jiujun Zhang, is reviewed for *Platinum Metals Review* by Gregory Offer of Imperial College London.

PGM Highlights:

Along with our regular selection from the patent and scientific literature, this issue includes the first of a new occasional series, which aims to provide a more in-depth look at developments in a particular area of pgm technology. In this first article, we review progress in ruthenium dyes used to generate solar power – the device exploiting this functionality is attracting increasing commercial interest, and is also an elegant example of the central role the pgms play in so many sustainable technologies.

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