

## Platinum Metals Review July 2009

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Among items appearing in this issue:

### **Using Palladium to Control the Ripening of Fresh Produce**

Andrew Smith, Stephen Poulston and Liz Rowsell (Johnson Matthey Technology Centre, Sonning Common, U.K.), Leon Terry (Plant Science Laboratory, Cranfield University, U.K.) and James Anderson (Surface Chemistry and Catalysis Group, Department of Chemistry, University of Aberdeen, U.K.) studied a new palladium-promoted zeolite material developed by the Johnson Matthey scientists. They demonstrated that the material effectively adsorbs ethylene, which is the chemical that induces ripening in many fruit and vegetables. The technology has potential for commercial application as it can be used to prolong the shelf-life of most fresh produce under conditions of high humidity and low or room temperature.

### **Thermodynamic Properties of Platinum Diatomics**

The application of platinum compounds covers a wide range of fields, from the biological sciences where reactions occur at relatively low temperatures, to high-temperature chemistry and astrophysics. The temperature-dependent properties of these compounds at the molecular level vary accordingly. However, diatomic molecules containing platinum, for example platinum monohydride (PtH), have unique properties which make experimental study difficult. Pavitra Tandon and Kailash Uttam, of the Department of Physics at the University of Allahabad in India, discuss a method in which this problem is circumvented by determining the thermodynamic quantities from spectroscopic data using partition function theory. Gibbs energy, enthalpy, entropy and specific heat capacity of four platinum diatomic molecules have been calculated across the temperature range from 100 K to 3000 K.

### **Carbon-Supported Catalysts for Processing of Hydrocarbons**

Catalysts that are composed of platinum group metals (pgms) finely dispersed on an activated carbon support are some of the best-known and most widely-used catalysts, due to their high activity at low temperatures. Martyn Twigg, Chief Scientist of Johnson Matthey PLC, reviews the book "Carbons and Carbon Supported Catalysts in Hydroprocessing", by Edward Furimsky, which discusses the preparation and catalytic activity of activated carbons and metal compounds supported on carbons. The focus of the book is on their application to hydroprocessing reactions of crude oils, which is an area that to date has not been well explored as these reactions generally occur at high temperature.

### **Unique Metallurgy of Iridium**

Iridium is the only refractory face centred cubic metal, and has a number of characteristics that are unlike other metals. However, no information on the defect structure of polycrystalline iridium is currently available in the literature. This work by Peter Panfilov and Alexander Yermakov of Ural State University, Russia, and Olga Antonova and Vitalii Pilyugin of the Ural Division of the Russian Academy of Sciences aims to elucidate the metallurgy behind the deformation behaviour of polycrystalline iridium at room temperature.

### **Fuel Cells Science: The State of the Art**

Don Cameron, an independent consultant in the field, reviews the fourth Fuel Cells Science and Technology conference: 'Scientific Advances in Fuel Cell Systems', which took place on the 8th and 9th October 2008 in Copenhagen, Denmark. While platinum is still the standard catalyst for low-temperature fuel cells, cost reduction efforts are in progress, either by replacing it (generally with a substantial performance penalty) or minimising loadings. However, pgms remain at the forefront of fuel cell science, being used not just in the electrocatalyst but in a number of other fuel cell-related applications.

### **Platinum-Aluminium-Based Alloys: The Next Stage**

A range of platinum-based superalloys which show very promising properties has been developed under the Platinum Development Initiative. In this paper, which continues the series by Lesley Cornish and colleagues at the DST/NRF Centre of Excellence in Strong Materials, the University of the Witwatersrand and Mintek, South Africa, a quaternary alloy with a microstructure analogous to nickel-based superalloys is presented. The optimum composition range is found to be from Pt<sub>84</sub>:Al<sub>11</sub>:Cr<sub>3</sub>:Ru<sub>2</sub> to Pt<sub>80</sub>:Al<sub>14</sub>:Cr<sub>3</sub>:Ru<sub>3</sub>. The Pt-based alloys included in the study have ultimate tensile strength values within the same range as other high-temperature alloys such as CMSX-4, which has an ultimate tensile strength of 870 MPa.

### **PGM-Based Technologies for NOx Abatement**

Selected presentations from the 5th International Conference on Environmental Catalysis (held in Belfast, Northern Ireland, from 31st August to 3rd September, 2008) are discussed by Rodney Foo and Noelia Cortes Felix of the Johnson Matthey Technology Centre at Sonning Common, U.K. Autocatalysts account for a large proportion of the world's pgm use and developments in the field must be considered in any projections of future demand. Refinements in the role of the pgms in controlling nitrogen oxides from automotive emissions are evaluated in this review.

### **Reforming Carbon-Based Fuels for Fuel Cells**

Joseph McCarney, Business Development Manager for Johnson Matthey's Stationary Emissions Control business unit, reviews a timely new book by Gunther Kolb on "Fuel Processing for Fuel Cells". Processing carbon-based fuels to efficiently produce hydrogen is one route to more extensive application of fuel cell technology. Reforming of these fuels requires catalysis at each stage, and platinum, palladium and rhodium may all find application here.

### **Platinum Market Review**

"Platinum 2009", Johnson Matthey's latest market survey of the pgms, was published in May 2009. The platinum market was in deficit by 375,000 oz in 2008 – a year which saw a 5% fall in demand offset by a 9.5% fall in supply. The review quantifies and discusses the factors behind these numbers, and those for the other pgms in the calendar year 2008, and provides a short-term outlook on the status of the pgm market in 2009. It also includes a special feature on palladium use in diesel oxidation catalysts, an application which played a major role in the increased demand for palladium seen in Europe in 2008.

### **Abstracts and New Patents**

Highlights from recently published scientific and patent literature are presented.

### **The Impact of Carbon Dioxide Legislation on PGM Demand**

Lucy Bloxham, a Senior Market Analyst for Johnson Matthey Precious Metals Marketing, U.K., in a Final Analysis discusses the likely impact of legislation seeking to reduce carbon dioxide emissions from road transport. Leaving aside longer-term strategies for 'clean' transport, in the shorter term automotive manufacturers are focusing on three different engine technologies for improving fuel consumption and thereby lowering CO<sub>2</sub> output to meet set targets by 2015/16. These are: diesel engines, downsized turbocharged gasoline engines combined with direct injection, and hybrid gasoline- or diesel-electric vehicles. The technology behind each of these must be understood to consider the potential effect on demand for the pgms.

### **Contact**

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