

Platinum Metals Review July 2007

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Among items appearing in this issue:

Platinum-Based Superalloys Development (Part I)

L. A. Cornish^{1,2,3}, R. Süß^{1,2,3}, A. Watson⁴ and S. N. Prins^{5,6} (¹Mintek; ²DST/NRF Centre of Excellence in Strong Materials; ³University of the Witwatersrand, South Africa; ⁴University of Leeds, U.K.; ⁵National Metrology Institute of South Africa; and ⁶Pennsylvania State University, U.S.A.) present work carried out as part of a collaborative project to build up a platinum-aluminium-chromium-ruthenium database, for the prediction of phase diagrams for alloy development. They constructed a preliminary version of the database from assessed thermodynamic data-sets for binary systems, which they combined and extrapolated into ternary systems. They report very good agreement between experimental phase equilibrium data and calculated results, confirming that the higher-order systems can confidently be calculated from binary systems.

Rhodium-Based Catalyst Enhances Industrial Process (Part I)

The 'LP OxoSM Process' is one of the best known applications of industrial-scale chemistry using a platinum group metal (pgm). Richard Tudor and Michael Ashley (Davy Process Technology Ltd, London, U.K.) describe the large cost benefits brought to oxo producers by the adoption of a low-pressure rhodium-based catalyst system, in place of high-pressure cobalt catalysed processes. These benefits derive from improved feedstock efficiency, lower energy usage, and simpler and cheaper plant configurations. This article reviews the background to the process and its development to the point of first commercialisation.

Organometallic Chemistry of PGMs

The 4th Cape Organometallic Symposium: Organometallics and Their Applications was held from 10th to 11th August 2006 at the Cape Town Waterfront, South Africa. Professor John R. Moss (University of Cape Town) was the chairman. This selective review, by David J. Robinson (CSIRO Minerals, Karawara, Australia), focuses on the organometallic chemistry of the pgms, covering fields including nanotechnology, catalysis, mechanistic studies and synthesis of metallacycles and clusters.

Prediction of PGM Vapour Pressure Values

Readily usable equations which accurately predict values of vapour pressure over a wide range of temperatures and pressures have important practical uses. John W. Arblaster (Coleshill Laboratories, West Midlands, U.K.) gives an equation for the immediate assessment of vapour pressures for the pgms, fitted for the solid and liquid metals separately:

$$\ln(p, \text{ bar}) = A + B \ln(T) + C/T + DT + ET^2$$

where p is the vapour pressure, T is the temperature in kelvin and A , B , C , D and E are constants. This equation can easily be evaluated by computers and scientific calculators. A simple and rapid use of iteration values of temperature at fixed vapour pressure enables temperature-dependent values of vapour pressure to be obtained.

Membranes for Chemical Processing

Hugh Hamilton (Johnson Matthey Technology Centre, Sonning Common, U.K.) reviews the book: "Nonporous Inorganic Membranes: for Chemical Processing", edited by Anthony F. Sammells and Michael V. Mundschau. The book provides an overview of dense oxygen and hydrogen transport membranes, and the roles they could play in developing technologies to improve on the poor efficiencies associated with simple combustion processes. The book's editors, themselves long-time practitioners in the field of dense membrane research, have assembled a group of authors whose names will be familiar to researchers in the area.

Improved Platinum-Copper on Carbon Catalyst

Hany M. AbdelDayem (Chemistry Department, Ain Shams University, Cairo, Egypt) prepared a range of supported bimetallic platinum-copper catalysts by reduction of oxide precursors by the hydride anion, using both sodium and calcium hydrides. The catalytic performance of the resulting samples for the hydrodechlorination of 1,2-dichloroethane was investigated, to gain understanding of metal alloying phenomena governing the variation in ethene selectivity with time on stream. A 'PtCuCaH' catalyst, synthesised by reduction with calcium hydride at 450°C, showed high selectivity towards ethene.

Fuels and Emissions Technologies

Andrew P. E. York (Johnson Matthey Technology Centre, Sonning Common, U.K.) attended the Society of Automotive Engineers (SAE) 2007 Fuels and Emissions Conference, from 23rd to 25th January 2007 in Cape Town, South Africa. Topics reviewed include synthetic fuels, covering coal-, gas- and biomass-to-liquids technologies, biodiesel, other oxygenated fuels and hydrogen. Developments in exhaust emission controls, including improvements in rhodium three-way catalyst technology, also featured prominently.

Contributions to PGM Chemistry

On 3rd May 2007, two Royal Society of Chemistry National Chemical Landmark plaques were unveiled at Imperial College London, commemorating two past Nobel Laureates: Sir Geoffrey Wilkinson FRS and Sir Derek Barton FRS. This article, by Professor Bill Griffith (Department of Chemistry, Imperial College, London, U.K.), concentrates on the contributions by Sir Geoffrey Wilkinson to pgms chemistry, which include the isolation of the rhodium-based 'Wilkinson's catalyst'.

New Johnson Matthey Autocatalyst Plant for South Korea

In January 2007, the latest of eleven Johnson Matthey autocatalyst manufacturing plants opened at Jangan-Myeon, South Korea, with an initial production capacity of 2 million autocatalysts per year. The second stage, to begin operating by the end of 2007, is the Applications and Test Centre, for catalyst development. Carlos Silva (Johnson Matthey Emission Control Technologies, South Korea) is the General Manager for the plant.

PGM Market Review

Market data on the pgms supply and demand for the calendar year 2006 are summarised from "Platinum 2007", published in May 2007 by Johnson Matthey.

Abstracts and New Patents

A selection of abstracts from the scientific and patent literature is presented.

Final Analysis: The Advantages of Platinum for Catalytic Converters

Stan Golunski (Johnson Matthey Technology Centre, Sonning Common, U.K.) discusses the advantages of platinum over other metals for use in catalytic converters. These include its high melting point; its interactions with 'poisons' (such as sulfur compounds) are limited to the metal surface; and it can be efficiently recycled.

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