

# Patents

## CATALYSIS – APPLIED AND PHYSICAL ASPECTS

### Polymetallic Reforming Catalyst

China Petroleum & Chemical Corp, *Chinese Appl.* 102,441,377; 2012

The catalyst consists of (in wt%): 0.1–2 Pt; 0.01–2 Ir; 0.1–1 Sn; and 0.5–5 Cl on an Al<sub>2</sub>O<sub>3</sub> support. An impregnating solution with Ir acetylacetonate, Pt(II) acetylacetonate, C<sub>6</sub>–C<sub>10</sub> alkane and C<sub>6</sub>–C<sub>7</sub> aromatic hydrocarbon is first prepared. The Sn containing Al<sub>2</sub>O<sub>3</sub> support is impregnated with the impregnating solution at 0–50°C for 10–200 h; the weight ratio of water to chlorine is controlled at 1–150:1; water-chlorine activation of impregnated solid is carried out at 370–700°C; and the product is reduced to obtain the polymetallic reforming catalyst.

## EMISSIONS CONTROL

### Supported Bilayer Three-Way Catalyst

Mitsubishi Motors Corp, *Japanese Appl.* 2012-154,250

The exhaust gas treatment for an internal combustion engine consists of an exhaust gas treatment unit in the exhaust pipe and an air-fuel ratio controller. The treatment unit has a supported bilayer TWC comprising a Rh-containing upper layer and a Pd-containing lower layer. The alkali metal content in the lower layer is higher than in the upper layer. The controller controls the air-fuel ratio within a predetermined range based on a theoretical ratio.

## FUEL CELLS

### Fuel Cell Catalyst Preparation

Blue Nano Inc, *World Appl.* 2012/102,714

A fuel cell catalyst consist of a 3D nanoporous Au with additional coatings of Pt, Pd, Ru and/or Bi. The catalyst has a thickness of 0.05–50 μm; a width of 0.1–100 cm; and a length of 0.2–1000 cm. This catalyst is prepared by immersing Au-Ag alloy in concentrated HNO<sub>3</sub> from 1–1000 minutes at 0–60°C, to selectively remove Ag to form a nanoporous Au, this is then rinsed in deionised water and one (or more layers) of Pt is deposited onto the surface. Either Bi or Ru are deposited onto the surface of the nanoporous Au-Pt resulting in a nanoporous Au-Pt-Bi or nanoporous Au-Pt-Ru catalyst.

### Core-Shell Catalytic Nanoparticles

UTC Power Corp, *World Appl.* 2012/105,978

A process for forming core-shell catalytic NPs comprising a Pd core enclosed by a Pt shell is claimed. The percentage of the surface area of the core-shell catalytic NPs is increased by storing in a hydrogen environment for absorbing hydrogen into the Pd core and depositing Pt atoms on the surface of the core-shell catalytic NPs by reducing a Pt salt, selected from K<sub>2</sub>PtCl<sub>4</sub>, H<sub>2</sub>PtCl<sub>4</sub>, Pt(CN)<sub>2</sub>, PtCl<sub>2</sub>, PtBr<sub>2</sub> and Pt(acac)<sub>2</sub>, with hydrogen absorbed into the Pd core. The percentage of surface area of the core-shell catalytic NPs covered by Pt can also be increased by subjecting these NPs to ~50 potential cycles between 0.65 V and 1.0 V with ~5 seconds at each potential, before incorporating into the catalyst layer of an electrochemical cell. The mass activity of the core-shell catalytic NPs is increased by ~20% after the potential cycling.

### Electrode Catalyst

Samsung Electronics Co Ltd, *US Appl.* 2012/0,196,207

A fuel cell electrode catalyst consists of Pd, a transition metal selected from: Ti, V, Cr, Mn, Fe, Co, Ni, Cu and Zn; and a precious metal which has a higher standard reduction potential than the transition metal. The precious metal is selected from: Pt, Rh, Ir, Au and Ag. The catalyst has a C-based support. The electrode catalyst is formed by substituting transition metal atoms in the surface of a first catalyst with precious metal atoms by mixing the first catalyst, the precious metal precursor and a glycol-based solvent or an alcohol-based solvent and heat treating the mixture at ~80–400°C for ~1–4 h.

## METALLURGY AND MATERIALS

### Platinum Base Alloy in Jewellery

Krastsvetmet, *Russian Patent* 2,439,181; 2012

The Pt base alloy consists of (in wt%): 95.0–95.5 Pt; 1.5–3.5 Co; 0.5–less than 1.0 Ga; and the remainder is Cu. This alloy has good casting ability, is not prone to pore formation, has satisfactory microhardness of 1900 MPa and is suitable for jewellery manufacture by investment microcasting.

## APPARATUS AND TECHNIQUE

### Platinum Alloy Spark Plug

J. T. Boehler and E. P. Passman, *US Appl.* 2012/0,220,180

The process for manufacturing a spark plug consists of securing a Pt-based alloy electrode tip to both the centre and side ground electrodes by resistance welding. The Pt-based alloy comprises of (in wt%): 20–35 Pd; 0–15 Ir; and the remainder is Pt, e.g. the Pt alloy comprises: 35 wt% Pd; 10 wt% Ir; and 55 wt% Pt. The electrode tips are configured as a pad, rivet or a wire.

### Catalyst for Life Support System

T. A. Nalette and C. Eldridge, *US Appl.* 2012/0,258,013

A catalyst for a life support system consists of Pt disposed on TiO<sub>2</sub> support particles. The surface area is variable and the % Pt is a percentage of the combined weight of Pt and the TiO<sub>2</sub> support particles. The ratio of the surface area: % Pt is between 5 and 50 m<sup>2</sup>/% Pt g. The surface area of the catalyst is ~150 m<sup>2</sup> g<sup>-1</sup> and Pt is 3–30 wt%. The ratio of % Pt:pore volume is between 7.5 and 100% Pt g cm<sup>-3</sup>. The catalyst is disposed within the air conditioning passage in a life support system.

## MEDICAL AND DENTAL

### Flexible Circuit Electrode Array for Artificial Vision

J. M. Neysmith *et al.*, *US Appl.* 2012/0,192,416

The method of manufacturing a flexible circuit electrode array involves the following steps: a polymer base layer is deposited, a first metal layer is deposited onto this base layer and patterned to form the first metal traces, a polymer interlayer is deposited on the base layer and is patterned to provide vias, and a second metal layer is deposited on the interlayer and is patterned to form the second metal traces. A polymer top layer is deposited on the interlayer and the second metal traces to form a flexible circuit. Electrodes are electroplated through openings in the polymer top layer which protrude above this layer. This is embedded in a curved body which conforms to the spherical curvature of the retina and is useful for retinal stimulation to create artificial vision. The metal is selected from Pt, Pd, Rh, Ir, Ir oxide, Ru, Ru oxide, Ti, Au, Ag, Nb and TiN. The polymer is selected from polyimide, thermoplastic polyimide, silicone, parylene, LCP, epoxy resin, PEEK, TPE or a mixture. During the stage of depositing a metal, a Ti adhesion layer and Pt conducting layer are preferably deposited.

### Gold-Palladium Alloy in Medical Devices

Kunming Institute of Precious Metals, *Chinese Appl.* 102,517,470; 2012

The Au-Pd alloy consists of (in wt%): 5–30 Pd; 0.1–5 Nb; 0.1–5 Zr; 0.1–5 Mo; 0.1–5 Ta; 0.1–5 Yb; 0.1–5 Gd; 0.1–5 Tb; and the remainder is Au. The preparation method

involves batching, smelting, casting, rolling, drawing and heat treating. The advantages of the Au-Pd alloy are high hardness, high wear resistance, high corrosion resistance, no toxicity, no irritation to humans and high biocompatibility. This alloy could be widely used as dental and acupuncture materials.

## PHOTOCONVERSION

### Tridentate Bis-Carbene Complexes

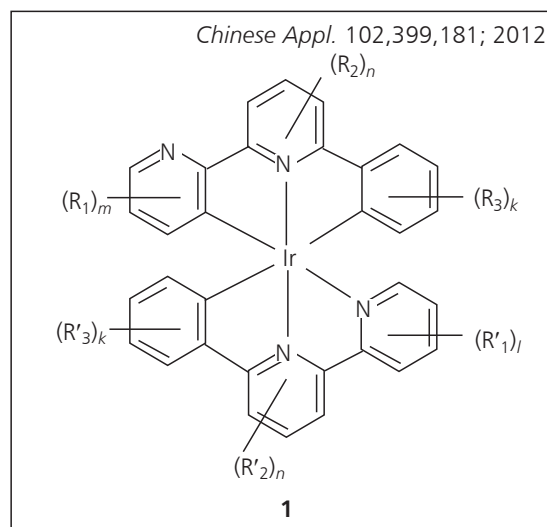
Universal Display Corp, *World Appl.* 2012/116,234

A process for making tridentate bis-carbene complexes of Ru and Os is claimed. The use of DMSO solvates of Ru(II) and Os(II) halide salts gives a good yield of the corresponding complexes. The method of manufacturing involves mixing a salt, MX<sub>2</sub>L<sub>n</sub>, where M is Ru or Os, X is Cl, L is DMSO and *n* is 4, with carbene precursors, a carbene forming agent selected from Ag<sub>2</sub>O or Cu(I) alkoxide and a polar solvent selected from 2-methoxyethanol, 2-ethoxyethanol or a mixture, and heating the reaction mixture. These complexes may be used in OLEDs for improved performance.

### Preparing Luminescent Iridium Complexes

Beijing Normal Univ., *Chinese Appl.* 102,399,181; 2012

The preparation of Ir complex, **1**, involves adding IrCl<sub>3</sub>·3H<sub>2</sub>O, the corresponding 6-aryl-2,2'-bipyridine ligand and a solvent selected from ethylene glycol ethyl ether, butyl ether, butanol, toluene, DMSO and DMF into a three-neck flask, reacting under reflux at 100–160°C, and stirring for 1–3 days. In **1** *m* = 0–3; *l* = 0–4; R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub> and R'<sub>3</sub> are selected from deuterium, tritium, halogen, cyano, amino, nitro, hydroxy, carboxy, or substituted or unsubstituted ether group/ester



group/C1–C50 alkyl/C2–C50 alkenyl/C2–C50 alkynyl/C3–C50 cycloalkyl/C1–C50 alkoxy/C5–C50 alkenyl aryl/C3–C50 heteroaryl;  $n = 0–3$ ; and  $k = 0–4$ .

air blowing with the transition of Bi into its oxide and conversion of Pt into a Pt-rich globule. The advantages of this method are that it is low cost and is relatively simple.

## REFINING AND RECOVERY

### Separation of Rhodium

Sumitomo Metal Mining Co Ltd, *Japanese Appl.* 2012-158,778

The process of separating Cu and Rh from raw materials involves forming a Cl leaching solution with gaseous Cl<sub>2</sub> followed by an extraction process which involves solvent extracting Cu from the leaching solution. Steps (a)–(c) are carried out between the leaching and extraction process and the resulting Cu-removed mother liquor is fed to the extraction process: (a) the leaching solution is neutralised by adding alkali to control the pH to 7–9, resulting in a hydroxide precipitate; (b) this is then redissolved by adding H<sub>2</sub>SO<sub>4</sub>, producing a solution of hydroxide; and (c) the hydroxide solution is crystallised by heating and concentrating then cooling to separate the precipitated Cu sulfate crystal and Cu-removed mother liquor. This method decreases the loss of Rh in Cu sulfate.

### Extraction from Spent Platinum Alloy Gauze

S. Yao *et al.*, *Chinese Appl.* 102,586,607; 2012

The process for extracting Pt, Rh and Pd from spent Pt alloy gauze involves dissolving the gauze in HCl and HNO<sub>3</sub>, removing the nitro group, treating with NaCl, filtering to obtain the complexing solution of Pt, Rh and Pd, separating Pt through NH<sub>4</sub>Cl precipitation, separating Rh and Pd with NaNO<sub>2</sub> complexing method, purifying Rh with ammonium hexanitrosorhodate method, purifying Pd with dichlorodiammine palladium(II) method, adding N<sub>2</sub>H<sub>4</sub>·H<sub>2</sub>O, reducing to acquire spongy Pt, Pd and Rh powders, vacuum drying, roasting and repurifying. The extracted Pt, Pd and Rh have a purity of >99.9%.

### Recovery of Platinum from Electronic Scrap

Siberian Federal Univ., *Russian Patent* 2,458,998; 2012

A process for recovering Pt from electronic scrap involves crushing of the scrap and melting in a furnace using a molten collector, comprising metallic Bi with 0.5–1.0% In. This is mixed with the electronic scrap at a ratio of 2.0–2.5:1 by weight at 800°C and kept at this temperature for 30–45 minutes, followed by an increase in the furnace temperature to 900–1000°C. The obtained Bi-Pt alloy melt is oxidised by