

# Patents

## CATALYSIS – APPLIED AND PHYSICAL ASPECTS

### Core-Shell Catalyst Particle

Toyota Jidosha Kabushiki Kaisha, *US Appl.* 2012/0,010,069

A core-shell catalyst particle is produced by preparing a core particle containing a first core metal (selected from Pd, Ag, Rh, Os or Ir) which has a standard electrode potential of at least 0.6 V and a second core metal (selected from Co, Cu, Fe or Ni) with a lower electrode potential. The second core metal is eluted by adjusting the pH (2 to 4) and the potential (–2 V to 1 V) of the core particle and the shell portion is coated on the core particle by displacement plating to replace a Cu monoatomic layer deposited by underpotential deposition. The shell portion includes a metal selected from Pt, Ir and Au. The average diameter of the core particle is 4–40 nm.

### Mixed Bed Polymeric Catalyst

Dow Global Technologies LLC, *Chinese Appl.* 102,309,989; 2012

A mixed bed polymeric catalyst consists of 10–90 wt% of a first catalyst having ion exchange resin loaded with zerovalent metal selected from Pt, Pd, Rh, Ir, Ru, Cu, Au or Ag and 10–90 wt% of a second catalyst which has a strong acidic ion exchange resin without metal, this comprises of a styrenic strong acid cationic resin with a moisture hold capacity from 10–90% and a volume capacity from 0.5–7 meq l<sup>-1</sup>. The first and second catalysts both have a particle size of 100 µm to 2 mm. The metal is uniformly distributed throughout the mixed bed. This catalyst is used for the hydrogenation of alkynes, alkenes, aldehydes, ketones, alcohols, nitriles, amines and nitro groups.

## CATALYSIS – REACTIONS

### Producing Olefin Oxide

Sumitomo Chem. Co, Ltd, *World Appl.* 2012/005,824

A method for producing an olefin oxide e.g. propylene oxide involves reacting an olefin (propylene) with O<sub>2</sub> at 100–350°C in the presence of a catalyst consisting of CuO, OsO<sub>2</sub>, an alkali metal or alkaline earth metal and a halogen component. This catalyst is obtained by impregnating a porous support (selected from Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>, TiO<sub>2</sub> or ZrO<sub>2</sub>) with a solution containing Cu<sup>2+</sup> ions,

Os<sup>3+</sup> ions, alkali metal or alkaline earth metal ions and halogen ions, followed by calcining the composition. The molar ratio of Cu:Os in the catalyst is 1:99 to 99:1.

## EMISSIONS CONTROL

### Two Layers in an Exhaust Gas Purifying Catalyst

Johnson Matthey Plc, *US Appl.* 2012/0,031,085

An exhaust gas purifying catalyst comprises two catalyst layers, each containing different compositions of fire resistant inorganic compound (this is a powder selected from Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>-Al<sub>2</sub>O<sub>3</sub>, zeolite, TiO, SiO<sub>2</sub>, CeO<sub>2</sub> and ZrO<sub>2</sub> or a mixture and has an average particle diameter of 2–10 µm). The first catalyst layer is selected from Pt, Pd, Rh or Pt/Pd and the second catalyst layer is selected from Pt, Pd, Rh, Rh/Pt and Rh/Pd, with both layers extending a length of ≥40% to <100% of the total passage length. The first layer is extended from the exhaust gas introduction port side to the discharge port side and the second layer is extended from the exhaust gas discharge port side to the introduction port side so that both layers are partly overlapped.

### Treatment of Nitrogen Oxides and/or Particulate Matter in Lean Gas

Johnson Matthey Plc, *British Appl.* 2,481,057; 2011

A method for treating NO<sub>x</sub> and PM or both comprises of: (a) a NO conversion catalyst (for converting NO to NO<sub>2</sub>) supported on a substrate monolith, the catalyst contains a Mn oxide and one or more of Pt, Pd and Rh in a loading of 1–240 g ft<sup>-3</sup>; (b) a SCR catalyst (for selectively catalysing the reduction of NO<sub>x</sub> to N<sub>2</sub>) supported on a flow-through substrate monolith and located downstream from the NO conversion catalyst; and optionally (c) a catalysed filter substrate for removing PM to combust it in NO<sub>2</sub>.

## FUEL CELLS

### Platinum Alloy Catalyst

Johnson Matthey Plc, *World Appl.* 2012/017,226

A Pt alloy catalyst, PtXY, where X = Ni, Co, Cr, Cu, Ti or Mn and Y = Ta or Nb (which is less leachable than X in an acidic environment) with (in at%): 20.5–40 Pt; 40.5–78.5 X; and 1–19.5 Y is utilised for PAFC and PEMFC. This catalyst is supported on a conductive support material and is used at the fuel cell cathode.

## METALLURGY AND MATERIALS

### Palladium-Containing Alloy for Jewellery Ware

Pasquale Bruni Spa, *World Appl.* 2012/017,299

An alloy consists of (in wt%): 4–4.5 Au; 35–68 Ag; 8–30 Pd; and one or more elements selected from Ir, Cu, Zn, Ni and Si in a total amount from 18–32 wt% or In in a total amount from 25–32 wt%. This alloy can be used for goldware or jewellery.

### Platinum Jewellery Alloy

Krastsvetmet, *Russian Patent* 2,439,180; 2012

An alloy comprising of (in wt%): 99–99.5 Pt; 0.1–0.7 Ir; 0.1–0.5 Co; and the balance Ga. This alloy is suitable for manufacturing jewellery, especially chains, using investment microcasting or plastic deformation.

## APPARATUS AND TECHNIQUE

### Palladium in Heating Circuit

Delphi Technol., Inc, *World Appl.* 2011/153,517

A planar device consists of a heater circuit which is formed by first depositing a heater precursor material consisting of Pd, optionally alloyed with Rh to reduce its tendency to oxidise, in a predetermined pattern on the surface of a first unfired ceramic substrate. This is then laminated to a second unfired ceramic substrate where Pd is in contact with the second substrate to form a laminated combination, this is then fired in an oxidising atmosphere at 400–850°C sufficiently slowly to prevent the formation of voids in the final structure. The line widths of the heater circuit are 0.1–0.25 mm in the area which reaches the highest temperature.

## MEDICAL AND DENTAL

### Stent Delivery Catheter

Kaneka Corp, *Japanese Appl.* 2012-000,328

A stent delivery catheter has a multilayer shaft tube comprising of an outer layer, a reinforcement layer and an inner layer. A tubular member (e.g. Pt-Ir) is formed between the outer layer and reinforcement layer on the shaft tube end.

## PHOTOCONVERSION

### Reflective Electrode for Light-Emitting Diode

LG Innotek Co, Ltd, *European Appl.* 2,410,583; 2012

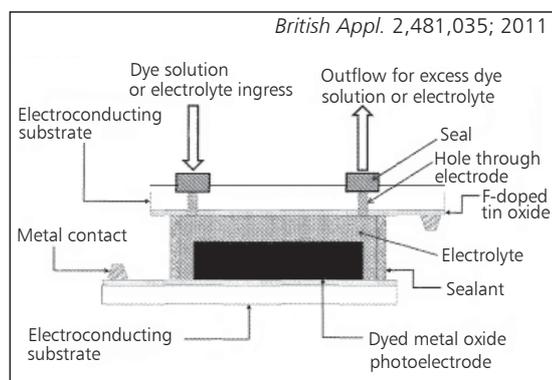
The structure of a LED comprises of two conductive semiconductor layers and an active layer. An electrode is disposed on the first semiconductor layer and a

reflective electrode (surrounded by a channel layer selected from Pt, Pd, Rh, Ir, Ti, Ni and W, and connected to a support substrate through an adhesive layer) is disposed on the second semiconductor layer which also has an ohmic layer disposed on the current blocking layer.

### Solar Cells with Multiple Dyes

Bangor Univ., *British Appl.* 2,481,035; 2011

A method for the preparation of dye-sensitised solar cells with multiple dyes consists of: (a) preparing the first electrode from an electroconducting substrate, which is a glass or polymer plate coated with a transparent conducting oxide, preferably SnO<sub>2</sub> which has been preferably doped with F; (b) applying  $\geq 1$  layers of a paste of TiO<sub>2</sub> NPs on the conducting side of the substrate; (c) subjecting the coated substrate to a thermal treatment from 300–600°C for 1 h; (d) preparing a second electrode in the same way as the first electrode and additionally coating it with Pt; (e) optionally pre-dyeing the first coated electrode with a solution containing  $\geq 1$  dyes; (f) piercing two perforations in the first and/or second electrode and sealing these together with glue or a thermoplastic polymer; (g) injecting or pumping  $\geq 2$  solutions containing  $\geq 1$  different dyes under vacuum to covalently bind the dye(s) to the surface of the metal oxide; (h) injecting or pumping the electrolyte (selected from a liquid nitrile solvent containing a redox couple selected from Ru bipyridyl complexes, Ru terpyridyl complexes, coumarins, phthalocyanines, squaraines, indolines or triarylamine dyes) through the holes in the electrodes; (i) sealing the holes in the electrodes with glue or a thermoplastic polymer; and (j) providing an external connection between the two electrodes for electron transport. The dyeing between the sealed electrodes takes place from 10–70°C and the electrolyte is added <10 min after the dye, therefore, the dyeing is completed in 10 min.



A "cocktail" dyed solar cell using 2 different dyes within the same photoelectrode

### Platinum in Dye-Sensitised Solar Cell

Toyo Aluminium Ltd, *Japanese Appl.* 2011-171,133

A cathode for a dye-sensitised solar cell contains an Al substrate. The surface of the substrate is laminated by sputtering with at least one metal selected from Pt, Au or Ag. The Al substrate is 7–200 µm thick and the Pt, Au or Ag layer is 1–50 nm thick. The cathode is suitable for a dye-sensitised solar cell using an ionic liquid free from iodine or iodide.

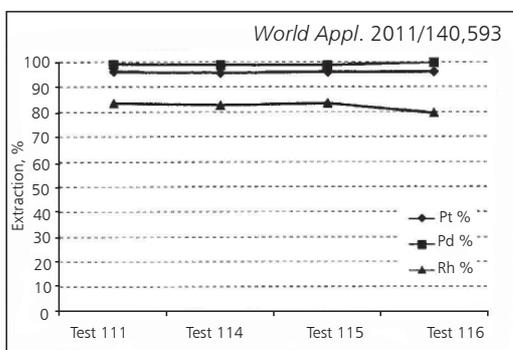
then heat treating at ~900–1120°C for ~1–8 h prior to depositing an Al-containing overlay coating which has also been coated with a ceramic coating. The stabilising layer consists of ~75 at% pgm and optionally Ni, Co, Cr, Al and/or Ru in a combined amount of up to 25 at%. This layer has a thickness of ~3–12 µm.

## REFINING AND RECOVERY

### Recovery of Platinum Group Metals

Wintermute Metals Pty Ltd, *World Appl.* 2011/140,593

A method for extracting pgms from a pgm-containing material, especially spent automotive catalysts, is claimed. This involves mixing the pgm-containing material with a chloride leaching solution which consists of 10–20 wt% HCl and ≥1 trivalent metal chloride salt selected from AlCl<sub>3</sub>, FeCl<sub>3</sub>, CrCl<sub>3</sub> or lanthanide chloride salts. This process occurs in an overpressure of Cl<sub>2</sub> gas of ~1–2 atm at ~55–90°C for ~120 min. The leachate solution may be recycled for use as the chloride leaching solution. The recovery of pgms in the leachate solution involves subjecting this solution to electrowinning, cementation, solvent extraction, gas-reduction or adsorption.



Leaching with 15% HCl and Cl<sub>2</sub> gas at 90°C for 5 min

## SURFACE COATINGS

### Coating for Gas Turbine Engine Component

General Electric Co, *US Patent*, 8,084,094; 2011

A coating system is applied to the surface of a substrate (formed from a Ni-base alloy e.g. Ni<sub>3</sub>Al) to prevent the formation of a secondary reaction zone. This system involves plating a stabilising layer (selected from the pgms: Pt, Pd, Rh or Ir) on the surface of the substrate