

# Patents

## CATALYSIS – APPLIED AND PHYSICAL ASPECTS

### Palladium Hydrogenation Catalyst

Shell Internationale Research Maatschappij BV, *European Appl.* 2,570,470; 2013

A monolithic- or honeycomb-based Pd catalyst comprises Pd and two other metals, where the first metal is Pt and the second metal is Bi or the first metal is Ag and the second metal is Mn. The support is Al<sub>2</sub>O<sub>3</sub> or a modification thereof. The weight ratio of Pd to the total of the first and second metals is 2:1 to 1:4. This Pd catalyst is used in the selective hydrogenation of unsaturated hydrocarbons which includes acetylene.

## CATALYSIS – INDUSTRIAL PROCESS

### Platinum-Palladium Alloy Plate for Nuclear Power Plant

Nuclear Power Institute of China, *Chinese Appl.* 102,744,062; 2012

A catalysis plate comprises a transition layer, prepared from (in wt%) 85–95 Al<sub>2</sub>O<sub>3</sub> and 5–15 CeO<sub>2</sub>, set on the surface of the base plate, which is FeCrAl heat-resistant steel with a thickness of 0.04–0.12 mm. There is a catalysis layer on the transition layer. The catalysis layer is prepared by mixing (in wt%) 5–25 Pt and 75–95 Pd. The catalysis plate is set on a vertical slot of the catalyst bed drawer situated at the hollow end-opening shell of a hydrogen recombiner. The advantages of the catalysis plate are good low-temperature and low hydrogen concentration running performances, and high-temperature thermal stability.

### Palladium Catalyst for Synthesising Paracetamol

Ural Federal University, *Russian Patent* 2,461,543; 2012

A simplified process for producing paracetamol in high yields involves the reduction of *p*-nitrosophenol in ethyl acetate in the presence of a Pd/C-containing catalyst by H<sub>2</sub> at 2–4 atm and 20–50°C. This is followed by acylation of the intermediate *p*-aminophenol and the end product recovery.

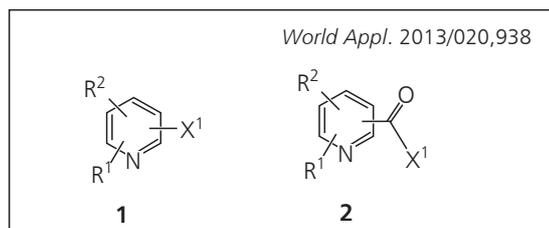
## CATALYSIS – REACTIONS

### Preparation of Halogenated Pyridines

Lonza Ltd, *World Appl.* 2013/020,938

A continuous method for preparing **1**, where **2** is

contacted with a metal catalyst or a metal catalyst on a support or a mixture, preferably Pd(0) or Ru(0), at 150–800°C in gaseous phase. R<sup>1</sup> and R<sup>2</sup> are identical or different and selected from H, halogen, C<sub>1–6</sub> alkyl, CN, CF<sub>3</sub>, C<sub>1–6</sub> alkoxy or C<sub>1–6</sub> alkoxy carbonyl and X<sup>1</sup> is F, Cl or Br. The support is selected from C, Al<sub>2</sub>O<sub>3</sub>, BaSO<sub>4</sub>, SiO<sub>2</sub>, aluminosilicate and mixtures thereof.



### Production of Alcohols

Celanese International Corp, *US Appl.* 2013/0,035,517

The process for producing alcohols consists of: (a) converting a first feed composition comprising acetic acid in a hydrogenation reactor in the presence of a first catalyst selected from Ru/SiO<sub>2</sub>, Pd/C or Fe/C to produce a product containing acetone; (b) hydrogenating a second feed composition comprising acetone, produced in the first step, in the presence of a second catalyst in a second reactor to produce a hydrogenation effluent comprising isopropanol and acetone; and (c) separating at least a portion of the acetone from the isopropanol and returning the acetone to the second reactor. The second catalyst is selected from Pt/Sn, Pt/Ru, Pt/Re, Pd/Ru, Pd/Re, Co/Pd, Co/Pt, Co/Cr, Co/Ru, Co/Sn, Ag/Pd, Cu/Pd, Cu/Zn, Ni/Pd, Au/Pd, Ru/Re and Ru/Fe.

### Continuous Production of Arylamine by Palladium

Xerox Corp, *US Appl.* 2013/0,046,110

A method for producing an arylamine product involves a continuous Buchwald-Hartwig reaction of an arylamine reactant, e.g. 3-methoxy diphenylamine, with dibromobiphenyl, a sodium *tert*-pentoxide and dichlorobis(di-*tert*-butylphenylphosphine)palladium(II) in toluene in a continuous fluid conduit device. The arylamine product is continuously produced at a space time yield of ~100 g l<sup>-1</sup> h<sup>-1</sup> with a rate product of ~0.6 g min<sup>-1</sup>. The diameter of the continuous fluid conduit is >1 mm, the pressure is ~6–25 bar and the temperature is between room temperature and ~200°C.

## EMISSIONS CONTROL

### Wall Flow Type Exhaust Gas Purification Filter

NGK Insulators, Ltd, *European Appl.* 2,565,408; 2013

A wall flow type exhaust gas purification filter consists of a honeycomb structure which has porous ceramic partition walls forming cells which function as exhaust gas passages. The opening ends of alternate cells are plugged. There is a large pore region with average pore size  $\geq 15 \mu\text{m}$  and a small pore region with average pore size  $\leq 8 \mu\text{m}$  and they each have an area of  $\geq 0.1 \text{ mm}^2$ . The catalysts are selected from at least two of Pt, Pd and Rh and a ternary catalyst containing at least one of  $\text{Al}_2\text{O}_3$ ,  $\text{CeO}_2$  or  $\text{ZrO}_2$ ; these are coated on the internal portions and surfaces of the partition walls.

## FUEL CELLS

### Platinum Loading for Fuel Cell Electrode

UTC Power Corp, *World Appl.* 2013/009,275

The electrode for PEMFC comprises a Pt catalyst, C support particles and an ionomer. The Pt loading for both anode and cathode is  $< 0.2 \text{ mg cm}^{-2}$  and the ionomer-to-carbon ratio is between  $\sim 0.5$ – $0.9$ . The electrode has a thickness of  $\sim 2$ – $5 \mu\text{m}$ .

### Fuel Cell Catalyst Layer

National Taiwan University of Science and Technology, *US Appl.* 2013/0,065,155

A catalyst layer for a fuel cell consists of a catalyst support comprising  $\text{Ti}_x\text{M}_{1-x}\text{O}_2$ , where M is selected from Group 2, Group 5, Group 6, Group 7, Group 8, Group 9, Group 10, Group 11, Group 12 and Group 13 metal;  $0 < x \leq 0.9$ ; and a catalyst comprising Pt or Pt alloys. The Group 8, Group 9 and Group 10 metals are selected from Pd, Rh, Ir, Os, Ru, Fe, Co and Ni. The method for making the catalyst layer involves: (a) a hydrothermal synthesis of a first precursor, Ti halide and a second precursor, an oxoanion- or polyoxometalate-containing salt, to form the  $\text{Ti}_x\text{M}_{1-x}\text{O}_2$  catalyst support; (b) dispersing the catalyst support into a solvent, selected from water, ethylene glycol, DMF, acetonitrile and butanol; and (c) adding a Pt or Pt alloy catalyst to form a mixture. This is then microwave heated to form the catalyst layer. The stability and performance of the cell can be enhanced.

### Palladium Catalyst Fine Particles

Toyota Motor Corp, *Japanese Appl.* 2013-013,878

The catalyst particles consist of Pd-containing centre particles, which include Pd(111) face, coated with Pt-containing outermost layers. The process for manufacturing the catalyst particles includes:

(a) preparing the precursors in which the Pd-containing particles with Pd(111) face are coated with Pt-containing outermost layers; (b) putting the coated particles in contact with an acid solution to dissolve  $\geq 1$  atom layer of Pd(111) face in dissolution-precipitation equilibrium state of Pt; and (c) depositing Pt on the fcc site of the Pd(111) face. The catalyst particles are used in fuel cells.

## METALLURGY AND MATERIALS

### Synthetic Diamonds from Platinum Carbonyl Compounds

I. V. Fedoseev *et al.*, *Russian Patent* 2,469,952; 2012

Synthetic diamonds are obtained by the decomposition of solid Pt carbonyl compounds in a hermetic container at  $310$ – $800^\circ\text{C}$  for 1–2 h. The ratio of the Pt carbonyl compounds to container volume is 1:1.1 to 1:100 in a neutral atmosphere. After opening the container, the diamonds are separated by treating with *aqua regia*. The advantage of this process is an increase in the size of the obtained diamonds.

### Jewellery and Industrial Alloys with Palladium

Hochschule Pforzheim University, *German Appl.* 102,011,011,448; 2012

A Pt-, Pd- or Au-based alloy consists of metals or metalloids, each of the alloy with at least 10 ppm and boron which hardens the alloy. The typical examples are (in wt%) 95Pt-4.85Pd-0.15 B and 75Au-15Pd-9.7Ag-0.28 B. The alloys are used as catalysts, materials for crucibles or devices for the glass and chemical industries as well as materials for clock cases or jewellery.

## APPARATUS AND TECHNIQUE

### Platinum in Nanobiosensor

X. Wang, *Chinese Appl.* 102,749,355; 2012

The nanobiosensor consists of an electrode, made from one or a combination of Pt, Au, Ag, Cu, graphite or glass, wrapped by a nano gel or nanotube array nanocarrier which is attached to a biosensing assembly, a current amplifier and a display alarm device. The nanobiosensor has high sensitivity and a high performance/price ratio and can be used in air quality detection.

## ELECTROCHEMISTRY

### Platinum Electrode for Lithium-Air Battery

Inha-Industry Partnership Institute, *US Appl.* 2013/0,022,529

The method for preparing Pt- $\text{MnO}_2/\text{C}$  complex consists of: (a) preparing  $\text{MnO}_2/\text{C}$  by dispersing C in

KMnO<sub>4</sub>, applying microwaves for ~5–10 mins, filtering and drying the solution to obtain MnO<sub>2</sub>/C; and (b) preparing Pt-MnO<sub>2</sub>/C by dispersing MnO<sub>2</sub>/C in ethylene glycol, adding a Pt precursor, chloroplatinic acid, and applying microwaves for ~5–10 mins to obtain Pt-MnO<sub>2</sub>/C complex. Pt-MnO<sub>2</sub>/C is used in the positive electrode material of a Li-air battery where 20 parts by weight of the Pt precursor is used per 100 parts by weight of C.

## PHOTOCONVERSION

### Binuclear Phosphorescent Iridium Complex

Nanjing University of Posts and Telecommunications, *Chinese Appl.* 102,617,652; 2012

The preparation of the binuclear phosphorescent Ir complex with two-photon absorption characteristic comprises: (a) preparing an aromatic group substituted N,N ligand *via* the Sonogashira coupling reaction; (b) obtaining bromo phenylquinoline *via* the Friedlander condensation reaction; (c) reacting with butyllithium at -78°C in THF to obtain mesitylboryl group-containing C,N ligand; and (d) obtaining the corresponding complex product *via* coordination reaction. The binuclear phosphorescent Ir complex has a strong two-photon absorption characteristic between 730–840 nm and up conversion phosphorescence. This complex can be used in two-photon excitation induced fluoride ion probe, time-resolved imaging, two-photon fluorescence microscopy imaging and biological fluorescence sensors.