presence of $IrClCO(PPh_3)_2$ at 1 atm, 20–50°C showed that the minimum permissible ratio of initial K_3IrCl_6 to PPh_3 in the complex is 1 : 7. The reaction is first order with respect to the initial complex and the acid. Dehydrogenation is preceded by formation of $IrCO(PPh_3)_2HCOO$.

Hydrido Transition-metal Cluster Complexes

H. D. KAESZ, *Chem. Br.*, 1973, **9**, (8), 344–352

These complexes, among which those of Ru and Os are important, may provide an important link between the study of soluble molecular complexes (homogeneous catalysis) and of solid state and surface phenomena (heterogeneous catalysis).

FUEL CELLS

Direct Biological Fuel Cell

J. F. HENRY and J. H. FISHMAN, *Extended Abstr., 143rd Mtg., Electrochem. Soc.*, 1973, **73-1**, (May), 723–724, abstr. 295

Au-Pd alloys are used for the electrodes of a direct fuel cell consuming O_2 and fuels available in blood. Details of electrode construction and cell performance parameters are given.

ELECTRICAL AND ELECTRONIC ENGINEERING

Platinum-Rhenium-Tungsten Alloy Thin Film Resistors

C. Y. ANG, R. F. BAILEY and J. R. OGREN, *Extended Abstr., 143rd Mtg. Electrochem. Soc.*, 1973, **73-1**, 541–542, abstr. 221

Ternary alloy films were prepared by RF sputtering using a target 11% Re–20% W–Pt formed by powder metallurgy techniques. The sputtering procedure, composition analysis, thickness measurements, and determination of electrical resistivity as a function of film thickness and temperature are described.

Stability of Thick-film Resistors under High Electromagnetic Stress

P. W. POLINSKI, *Solid State Technol.*, 1973, **16**, (5), 31–35, 58

Tests on RuO_2 crystal, Ru resinate and Pd-Ag thick-film resistor compositions under high electromagnetic stress of several kV/in showed wide variations in conductivity. The conduction mechanism in the stable RuO_2 composition for a total fired resistor thickness of 13–15 μm forms very close to the Al_2O_3 substrate in a microlayer a few μm thick. The conduction layer is thicker for lower resistivity compositions where the RuO_2 content is higher but it is still close to the surface of the substrate. This formation is probably due to the dense RuO_2 crystals settling out while the composition is held at the high peak firing temperature.

TEMPERATURE MEASUREMENT

Measurement of Temperature of the Glass Mass in a Furnace with a Cooled Metallic Cladding

A. G. GURKOV, V. I. POKOLENKO and V. N. RUSLOV, *Steklo Keram.*, 1973, (5), 11–12

Pt thermocouples with a cooled metallic cladding to protect them are used to compare the temperatures at various points in a furnace containing molten glass.

The Departure of IPTS-68 from Thermodynamic Temperatures between 725°C and 1064.43°C

T. J. QUINN, T. R. D. CHANDLER and M. V. CHATTLE, *Metrologia*, 1973, **9**, (1), 44–46

The departure of IPTS-68 from thermodynamic temperatures at 725–1064.43°C is discussed with particular reference to the Pt:13%Rh-Pt thermocouple.

Contribution to the Study of the Effect of Pressure on the Platinum : Rhodium-Platinum Thermocouple

M. LALLEMAND, J. BRIELLES, D. VIDAL and P. MALBRUNOT, *J. Phys. D*, 1973, **6**, (9), 1052–1057

Variations of the melting points of Au and Ag with pressure were measured with a Pt:10% Rh-Pt thermocouple under hydrostatic conditions. Results indicate a decrease of thermocouple e.m.f. with pressure, corresponding to 0.5 ⊥ 0.2°C/kbar between 960 and 1100°C.

NEW PATENTS

METALS AND ALLOYS

Hydrogen Diffusion Membranes

N. R. D. C. *U.S. Patent* 3,713,270

H_2 is separated from gas mixtures using membranes made from an alloy of Pd with lanthanides, (not La or Pr), e.g. 8·5%Y–Pd or 10%Ce–Pd.

Spinneret Alloy

COMPTOIR LYON-ALEMAND LOUYOT & CIE. *French Patent* 2,133,178

Spinnerets for synthetic fibre production are made from an alloy of 80.5–90% Au, 10–19.5% Pt and 0–3% of at least one of Rh, Ir, Ru, Os and Re.

Platinum Group Metal Cladding

JOHNSON MATTHEY & CO. LTD
French Patent 2,142,425

A core of refractory metal is surrounded by an intermediate layer of MgO on which is deposited a Pt group metal.

CHEMICAL COMPOUNDS

Organometallic Complexes

STUDIENGESELLSCHAFT KOHLE m.b.H.
British Patent 1,315,473

Pt group metal complexes may be produced electrolytically by using a cathode of the requisite metal and an electrolyte containing the complexing agent.

ELECTROCHEMISTRY

Electrochemical Cells

PHILIP MORRIS INC. *British Patent* 1,318,713

Electrochemical cells using a fluoride electrolyte have Au or Pt metal cathodes.

Hydrogen Absorption in Electrochemical Cells

UNION CARBIDE CORP. *British Patent* 1,321,853

Pd is used with MnO_2 in a binder to form a device absorbing and oxidising H_2.

Electrolysis Electrodes

P.P.G. INDUSTRIES INC. *British Patent* 1,323,756

Electrolysis electrodes have a Ti or similar metal base plated with a Pt group metal from an organic bath containing a highly ionisable electrolyte. A typical bath contains 0.78g H_2PtCl_6, 75ml absolute EtOH, 15 ml H_2SO_4, 20 ml toluene and 20 ml acetone.

Electrolysis Electrode

P.P.G. INDUSTRIES INC. *U.S. Patent* 3,718,551

The electrolysis of brines is effected with a Ti base electrode coated with a mixture of amorphous TiO_2 and Ru or RuO_2.

Electrochemical Electrodes

SOLVAY & CIE. *French Appl.* 2,140,074

Electrochemical electrodes are made from a body of Ti or Ti alloy coated with a layer of heat-decomposable compounds of Ir and at least one of Li, B, Be, Mg, Ga and Ge in a liquid vehicle.

ELECTRODEPOSITION AND SURFACE COATINGS

Osmium Electrodeposition

INTERNATIONAL NICKEL LTD.
British Patent 1,322,175

Os is electroplated at a temperature of at least 50°C from a hexachlorosmate bath (preferably $(NH_4)_2OsCl_6$) containing sulphamic or sulphuric acid to give a pH of 0–4.

Silver-Palladium Plating

ALLIS-CHALMERS MFG CO. *U.S. Patent* 3,725,219

An article is provided with an Ag strike, plated with Ag from a cyanide bath, plated with Pd from a chloride bath and then the Ag and Pd fused together.

LABORATORY APPARATUS AND TECHNIQUES

Gas Analysis

ESSO RESEARCH & ENGINEERING CO.
British Patent 1,320,954

A gas stream containing a low concentration of hydrocarbons is analysed by passing it over a heated noble metal or noble metal alloy wire whose heating voltage is sequentially varied. A Pt or Pd wire is preferred.

Oxygen Control Cell

BABCOCK & WILCOX CO. *German Offen.* 2,242,851

The O_2 contents of gases are metered by a cell having porous Pt electrode strips. These may be soldered using Au to thermoelements.

HETEROGENEOUS CATALYSIS

Hydrocarbon Conversion Catalyst

UNIVERSAL OIL PRODUCTS CO.
British Patent 1,323,913

An exceptionally active and resistant catalyst for hydrocarbon conversion contains Pt, Sn and Ge on a support. In one example 0.2% Ge, 0.375% Sn and 0.375% Pt are used on an Al_2O_3 carrier.

Motor Fuel Production

SUN OIL CO. OF PENNSYLVANIA
U.S. Patent 3,719,586

Light naphtha is reformed, mixed with heavy naphtha and then hydrocracked over a Pd-zeolite catalyst to yield a motor fuel.

Exhaust Gas Catalysts

ESSO RESEARCH & ENGINEERING CO.
U.S. Patent 3,719,739

Nitrogen oxides are removed from engine exhaust gases over catalysts consisting of 10–60% Ir and 40–90% Ru, as metals and/or oxides, on a conductive support such as stainless steel or chromium steel.

Conversion Catalyst

F.C. WILHELM *U.S. Patent* 3,725,304

A Pt-Sn catalyst for hydrocarbon conversion is obtained by impregnating Al_2O_3 or another support with a trichlorostannate chloroplatinate anionic complex and calcining.

Phthalic Acid Purification

STANDARD OIL CO. *U.S. Patent* 3,726,915

The alloying of Cu with Pd on C in a Cu:Pd ratio of less than 0.5:1 enhances the activity of the Pd when used for reduction purposes, especially the selective reduction of formyl benzoic acid in crude phthalic acid.

Hydroforming Catalyst

CIE. FRANÇAISE DE RAFFINAGE
French Patent 2,130,881

A new hydrorefining catalyst contains 0.02–2% Pt, 0.02–2% Ir and 0.02–2% Sn on a support.

Ruthenium Impregnation

JOHNSON MATTHEY & CO. LTD.
French Appl. 2,140,599

A graphite or carbon article is purged with a gaseous fluid and is then impregnated using a solution or suspension of an Ru compound or metallic Ru in a solvent which is then evaporated.

Oxidation–Reduction Catalyst

JOHNSON MATTHEY & CO. LTD.
German Offen. 2,231,296

A core of inert material such as a ceramic is coated with an intermediate layer containing a rare-earth oxide, and then with a mixture of alloy of Pt, Rh and optionally a base metal. The Rh represents 1–50% and the base metal, if present, 0.01–25% of the total metal. The catalyst can be used for hydrocarbon oxidation and nitrogen oxide reduction reactions.

NO_x Removal Catalyst

FORD-WERKE A.G. *German Offen.* 2,241,582

Nitrogen oxides are removed from I.C.E. exhaust gases over a Pt and/or Pd catalyst which also oxidises CO and unburnt hydrocarbons.

Catalyst for Nitric Acid Production

DEUTSCHE GOLD & SILBER-SCHEIDEANSTALT
German Offen. 2,145,842

HNO_3 is produced from NH_3 by oxidation over a fine gauze consisting of 40–75% Pd, 1–8% Rh and/or Ru, remainder Pt.

Catalyst Support

JOHNSON MATTHEY & CO. LTD.
German Offen. 2,248,811

A support suitable for a Pt catalyst consists of a layer of heat resistant cord made from compressed tube or gauze, which has a substantially uniform thickness and at least one flat surface, attached to a gauze plate.

NO_x Removal

FORD-WERKE A.G. *German Offen.* 2,251,615

Nitrogen oxides are reduced in a first catalyst zone and then the products are passed over an Ru catalyst to remove any NH_3 present.

NO_x Removal Catalyst

JOHNSON MATTHEY & CO. LTD.
German Offen. 2,253,070

Nitrogen oxides are removed from exhaust gases over a catalytic mixture of 5–75% Ru, 0–30% base metal and remainder (not less than 5%) Pt on a suitable support. Examples of base metals which may be present are Co, Ni, V, Fe, Cr and Re. This is equivalent to *Dutch Appl.* 72.14540.

Oxidation–Reduction Catalyst

JOHNSON MATTHEY & CO. LTD.
German Offen. 2,256,195

An oxidation-reduction catalyst consists of an alloy or mixture of 5–55% Ru, 1–20% Rh, 0–20% base metal and remainder Pt. This is equivalent to *Dutch Appl.* 72.15560.

Oxidation–Reduction Catalyst

JOHNSON MATTHEY & CO. LTD.
German Offen. 2,257,228

An oxidation-reduction catalyst, e.g. for treating I.C.E. exhaust gases, consists of an inert carrier such as zircon-mullite carrying a mixture of Pt and Rh, the Rh representing up to 20% of the total metal. This is equivalent to *Dutch Appl.* 72.15719.

Catalytic Exhaust Gas Treatment

KALI-CHEMIE A.G. *German Offen.* 2,158,877

Exhaust gas is mixed with air and treated in a first oxidising bed with a mixture of Rh and Ir or Pd on a support.

HOMOGENEOUS CATALYSIS

Ethylene Dicarboxylic Acid

DENKI KAGAKU KOGYO K.K.
British Patent 1,323,619

Acetylene and CO are reacted to give ethylene dicarboxylic acid in the presence of a Pd salt of a strong acid, an amino acid and a solvent.

Polynuclear Aromatic Compounds

GULF RESEARCH & DEVELOPMENT CO.
U.S. Patent 3,728,409

Polyphenyls and related compounds are produced by condensation in the presence of a Pt group metal salt and a strong acid. For example C_6H_6, PdOAc and H_2SO_4 in the presence of O_2 give a mixture of biphenyl and terphenyl.

CHEMICAL TECHNOLOGY

Nucleating Medium

HUGHES AIRCRAFT CO. *British Patent* 1,314,238

Pd *p*-toluene sulphonate is a suitable nucleation-inducing compound in a nucleating medium for photographic purposes.

Flame Retardants for Elastomers

GENERAL ELECTRIC CO. *U.S. Patent* 3,711,520

The fire resistance of a silicone elastomer stock is improved by adding Pt or Pt compounds and a Group II metal oxide. In an example the Pt source added is a reaction product of chloroplatinic acid and a tetravinyl tetramethyl cyclotetrasiloxane.

Photoreducible Palladium Compounds

EASTMAN KODAK CO. *U.S. Patent* 3,719,490

Physical development of Ag latent images is catalysed by light sensitive Pd compounds able to generate metal nuclei. These compounds have the formula $(PdL_x)_yA_z$. Where L is a halogen, carboxylic acid, aryl, N, As, Sb or P ligand, A is H, anion or metal cation, x is 0–4, y is 1–4 and z is 0–2, e.g. potassium palladium oxalate.

Rhodium in Silver Halide Emulsions

EASTMAN KODAK CO. *U.S. Patent* 3,720,516

Ag halide grains are precipitated in the presence of a Rh salt and a Mn stabiliser.

GLASS TECHNOLOGY

Platinum in Optical Glass Filters

V.E.B. JENAER GLASWERK SCHOTT & GEN.
British Patent 1,317,395

About 0.0001–0.01 at.% Pt is added to glass for optical filters to provide centres for crystallites.

Platinum-based Alloys

JOHNSON MATTHEY & CO. LTD
British Patent 1,318,201

Alloys suitable for making articles which come into contact with molten glass, especially spinnerets, contain 15–25% Rh, 1–4% Au and the balance Pt. A diagram specifies the range.

ELECTRICAL AND ELECTRONIC ENGINEERING

Electrolytic Capacitor

PLESSEY CO. LTD. *British Patent* 1,317,494

A capacitor has a cathode of inert material coated on the face wetted by the electrolyte with a Pt group metal paint. A ceramic paint containing Pt and Ir or Au and Pd is suggested.

Thick Film Resistors

R.C.A. CORP. *British Patent* 1,320,625

The resistivity of screen printed resistors produced using Ag-Pd is adjusted by allowing a certain dwell time at room temperature between printing and firing.

Intermetallic Contact

R.C.A. CORP. *British Patent* 1,321,034

An intermetallic contact is produced in an opening on a semiconductor by applying a metal such as Pt, Pd or Rh which is able to alloy with the semiconductor.

Semiconductor Devices

WESTERN ELECTRIC CO. INC.
British Patent 1,323,828

Avalanche breakdown is avoided by using a Pt Schottky barrier with extensive overhang.

Semiconductor Interconnections

R.C.A. CORP. *U.S. Patent* 3,714,521

W semiconductor interconnections are coated with Pt where leads are to be attached.

Cathode Construction

GENERAL ELECTRIC CO. *U.S. Patent* 3,717,503

The electron emission of a cathode is increased selectively by placing a control grid above the cathode and evaporating Os or Ir through the openings on to the cathode.

Magnetic Recording Medium

FUJI PHOTO FILM CO. LTD.
U.S. Patent 3,717,504

A magnetic recording medium has a magnetisable surface layer coated with thin Ni and Rh layers.

Palladium Circuits in Alumina

AMERICAN LAVA CORP. *U.S. Patent* 3,723,176

A green sheet is produced from prefired Al_2O_3. This is screen printed with a circuit using a Pd ink. The circuit is covered with more Al_2O_3 and contacts provided. The second layer of Al_2O_3 is also screen printed with a Pd ink and the whole unit fired.

Platinised Fuse

WESTINGHOUSE ELECTRIC CORP.
U.S. Patent 3,727,091

An electric lamp containing halogen has a Pt-coated Ni or nichrome fuse wire.

Integrated Circuits

INTERELECTRIC A.G. *German Offen.* 2,135,488

Pt group metal plating is used to reinforce thinner regions of integrated circuits.

TEMPERATURE MEASUREMENT

Resistance Thermometer Element

JOHNSON MATTHEY & CO. LTD.
German Offen. 2,256,203

A temperature-sensitive element is made from a layer of glass containing conducting particles attached to a non-conducting support. Au, Ag, Pt metals, Fe, Ni, Co and Cu may form the particles. This is equivalent to *Dutch Appl.* 72.15561.