metal by stannous chloride. A double Te precipitation is performed on samples. This method can handle quantities of rocks up to 30g in mass, and can therefore be used on rocks containing very little precious metals.

Interfacial Noble-Metal Corrosion in Metal to Ceramic Reaction Welding

H. J. DE BRUIN, *Nature*, 1978, **272**, (5655), 712–713

Welding refractory ceramic oxides to transition metals to form Pd/MgO and Pd/Al_2O_3 couples involves two different bond types when annealed in air. Below 800°C a visible intermediate oxide layer forms, the thickness of which increases with time, and the bond strength depends on the corrosion of the metal and strength of the oxide layer. Above 800°C there is a sharp metal-ceramic interfacial discontinuity and the bond strengths reach their maximum after a few hours and do not deteriorate with time. These different bond types suggest a new corrosion phenomenon.

ELECTRICAL AND ELECTRONIC ENGINEERING

Investigation of the Ti-Pt Diffusion Barrier for Gold Beam Leads on Aluminium

S. P. MURARKA, H. J. LEVINSTEIN, I. BLECH, T. T. SHENG and M. H. READ, *J. Electrochem. Soc.*, 1978, **125**, (1), 156–162

Ti-Pt diffusion barriers were inserted between Al and Au beam leaded sealed structures (used in integrated circuit multichip assemblies) to stop interactions. The Al-Ti-Pt-Au structures were then aged and examined by electron microscopy, X-ray diffraction and sheet resistance measurements. Metallurgical interactions occurred at hillocks in Al, forming black spots which eventually covered the surface. This was inhibited by annealing Al before barrier metallisation and using at least 2000Å each of Ti and Pt in the barrier. Thicker Ti covers the Al hillocks and prevents Al-Pt interactions, and thicker Pt prevents Ti-Au interactions.

The Semiconductivity and Stability of Palladium Oxide

E. REY, M. R. KAMAL, R. B. MILES and B. S. H. ROYCE, *J. Mater. Sci.*, 1978, **13**, (4), 812–816

The use of Pd oxide in photoelectrolytic cells was investigated in an attempt to use it to convert sunlight to electricity. Pd oxide is a semiconductor with an estimated bond gap at 820nm. The extrapolated bond gaps of Pd oxide films, prepared by oxidation of sputtered Pd films were examined by optical absorption spectroscopy and photoconductivity measurements. Band gaps occur at 2.13±0.03 and 2.67±0.03eV, respectively. Photoconductivity occurs for energies smaller than the extrapolated band gap. The thermal stability of the films was reduced from 580K in a vacuum down to 350K by H_2.

TEMPERATURE MEASUREMENT

Temperature Detectors

Engng. Mater. Design, 1978, **22**, (4), 284

A ceramic bodied Pt resistance thermometer covering the temperature range −220°C to +800°C has been developed, with a close physical tolerance (±0.013mm) for interchangeability. Thermal shocks do not alter its stability.

MEDICAL USES

Stainless Tubing Provides High-Reliability Connector

E. J. STEFANIDES, *Design News*, 1978, **34**, (1), 82–83

A high-reliability connector for the leads of a cardiac pacing system is used for a lithium battery powered pulse generator. It provides a low-resistance electrical connection with high mechanical strength. One end of each conductor is attached to the flat-tipped platinum-iridium electrodes. The terminals and the electrodes are encased in moulded silicone rubber jackets.

NEW PATENTS

ELECTROCHEMISTRY

Electrode

T.D.K. ELECTRONICS CO. LTD. *British Patent* 1,508,091

Cl_2 is produced free from O_2 by the electrolysis of brine in the presence of an anode which is a conductive substrate (Ti, Ta or Zr) coated with a mixture of Pd oxide (5-40 mol.%), Ru oxide (2-10 mol.%), and Sn oxide (50-93 mol.%), of which up to 40 mol.% may be substituted by TiO_2.

Electrodes

SOLARIO LTD. *U.S. Patent* 4,054,496

In the electrolysis of heavy water the electrodes may be of Ru, Rh, Pd, Os, Ir or Pt, or coatings of these metals on substrates of Ti, Nb or Ta.

Palladium Electrode

SEMICONDUCTOR SENSORS INC. *U.S. Patent* 4,058,368

A device for the detection of hydrogen has a metal electrode made of Pd, Ni and/or Pt.

Noble Metal Catalyst for Oxygen Electrode

W. A. ARMSTRONG *U.S. Patent* 4,066,823

A gas permeable hydrophobic electrode consists of a current collecting grid formed of Pt, Au or Ag; a catalyst chosen from Ag, Pt or Pd and a hydrophobic semipermeable membrane.

ELECTRODEPOSITION AND SURFACE COATINGS

Electroless Plating

A.M.P. INC. *British Patent* 1,499,163

The electroless deposition of Au on to a plastic surface is catalysed by the thermal decomposition products of a Pt or preferably Pd organo complex.

Vacuum Deposition of Ruthenium

INCO EUROPE LTD. *British Patent* 1,499,549

Ru is deposited on to a hot substrate, such as a cutting tool, from a complex RuL_3, where L is a β-dicarbonyl compound.

Electroforming Meshes or Screens

E.M.I. LTD. *British Patent* 1,499,876

A mesh of Cu is obtained by electrodeposition into a grooved pattern scribed on a nonconductive substrate, the grooves being rendered conductive by a sputtered layer of Pd.

Metal Foil Production

IMPERIAL METAL INDUSTRIES (KYNOCH) LTD. *British Patent* 1,504,360

Metal foils are obtained by electrodeposition on to a rotating anode of a platinum group metal from a consumable cathode of Cu or Au.

Electroless Plating

SHIPLEY CO. INC. *British Patent* 1,507,730

Nonconductive substrates are sensitised for electroless plating by immersion in a solution of Pd chloride and stannous chloride. The plating solutions of base metal, Pd or Au are stabilised by S.

Gold-Coloured Films

P.P.G. INDUSTRIES INC. *U.S. Patent* 4,065,626

Transparent substrates, such as glass, are provided with multiple coatings of Cu, Ni and Cu oxide in combination to give them a gold-coloured appearance and selective reflectance and transmittance properties for radiation over an extended spectral range. The layer nearest the substrate contains Pd.

Palladium Activator for Electroless Deposition Processes

INTERNATIONAL BUSINESS MACHINES CORP. *U.S. Patent* 4,066,809

In a three-step seeding process for preparing substrate surfaces for electroless deposition, a Pd chloride activator is used together with a Pd chloride/stannous chloride/HCl seeder bath.

LABORATORY APPARATUS AND TECHNIQUES

CO_2 Sensor

U.K. SECRETARY OF STATE FOR SOCIAL SERVICES *British Patent* 1,503,908

A CO_2 sensor, particularly suitable for monitoring the partial pressure of CO_2 in a blood stream, has a sensing electrode of Pd-H or Ir-H, and a Ag reference electrode.

Platinum Catalyst for Detecting Combustible Gases

BAILEY METER CO. *U.S. Patent* 4,063,898

A detector for monitoring combustible gases in an airstream uses a Pt tube as catalyst, formed around one of two thermocouple functions.

JOINING

Platinum for Use as Braze Metal

R. D. MITCHELL *U.S. Patent* 4,063,909

An abrasive compact of diamond and/or cubic boron nitride abrasive particles, bonded into a hard conglomerate, has a metal brazing layer of Pt bonded to at least one of its surfaces.

HETEROGENEOUS CATALYSIS

Silicones

UNION CARBIDE CORP. *British Patent* 1,500,924

Silicones prepared by the Pt-catalysed addition of aliphatically unsaturated epoxy compounds to hydrosiloxanes are used in emulsions for treatment of paper and textile fabrics.

Purification of I.C.E. Exhaust Gas

NISSAN MOTOR CO. LTD. *British Patent* 1,501,054

The air:fuel supply ratio to an I.C.E. provided with catalytic exhaust-gas purification means is monitored by an oxygen-sensor device using an electrolytic element coated with microporous layers of Pt.

Oxygenated Hydrocarbons Synthesis

UNION CARBIDE CORP. *British Patents* 1,501,891–2

Ethanol, acetaldehyde and acetic acid are obtained by reaction of CO with H_2 in the presence of Rh, optionally in the presence of Fe, as catalyst.

I.C.E. Exhaust Gas Catalyst Support

U.O.P. INC. *British Patent* 1,502,882

A tension- and deformation-resistant ceramic catalyst support comprises a honeycomb formed by fusing and sintering together specially formed curved wall sheets, each set of walls being at about 120° with respect to adjacent walls. The support is coated with catalyst, of Groups I, V, VI or VIII, especially Pt, Pd, Cu, Ag, V, Cr, Fe, Co or Ni.

Battery Recombination Catalyst

ROBERT BOSCH G.m.b.H. *British Patent* 1,503,736

A secondary battery includes a catalyst for recombination of H_2 and O_2. The catalyst consists of a carrier such as Al_2O_3 or Al silicate coated on its upper surface with a thin layer of Pd or Pt and then with a water-repellent material, such as porous PTFE.

Aminoacids

CHINOIM GYOKYSZERES VEGHESZETI TERMEKEK GYARART *British Patent* 1,504,541

In the preparation of aminoacids from their derivatives, protective groups may be removed by hydrogenolysis in the presence of Pd/C.

Mo and W Bronzes for NO_x Decomposition

JOHNSON MATTHEY & CO. LTD. *British Patent* 1,507,976

Catalysts for the purification of air comprise a ceramic or metallic support carrying a bronze of general formula A_xBO_y, where A is a metal of Groups IA, IIA or the lanthanide group, Pb, Tl, Cu, Ni, H, NH_4 or Ag; B is Ti, V, Nb, Mo, Ta, W, Re or Pt, x is 0–2 and y is 2–3.

Olefin Oxidation Catalysts

UNION OIL CO. OF CALIFORNIA *U.S. Patent* 4,057,575

Olefins are converted to esters or ethers by reaction with a carboxylic acid or alcohol and oxygen in the presence of a SiO_2-supported catalyst which is a Group VIII noble metal, preferably Pt or Pd, and a non-noble metal redox agent.

Catalyst Containing a Platinum Group or Noble Metal

INSTITUT FRANCAIS DU PETROLE *U.S. Patent* 4,058,450

A catalyst for use in a process for preparing aromatic hydrocarbons from gasolines, free from olefin or diene consists of an alumina support, one or more halogens and at least two metals or their compounds chosen from the platinum group metals, such as Pt, Ir and Rh, and optionally an additional metal which may be Ag or Au.

Group VIII Metal Hydrogenation Catalyst

SHELL OIL CO. *U.S. Patent* 4,059,644

Group VIII metals such as Pt, Pd and Rh are used as hydrogenating catalysts in the second step of a 2-step process for preparing high density fuels from (meth)cyclopentadiene dimers.

Palladium Hydrogenation Catalyst

E. I. DU PONT DE NEMOURS & CO. *U.S. Patent* 4,061,598

A catalyst of high activity and long life for use in the manufacture of H_2O_2 is obtained by impregnating Al_2O_3 with Pd under conditions such that the pore surfaces are rendered alkaline and the rate of metal diffusion is controlled.

Silicone-Curing Catalyst

GENERAL ELECTRIC CO. *U.S. Patent* 4,061,609

The curing of a vinyl-containing polysiloxane rubber is catalysed by not less than 0.1 ppm Pt.

Palladium Catalyst for Alcoholysis Reaction

SUN VENTURES INC. *U.S. Patent* 4,064,180

The ionic alcoholysis of Binor–S, a 14C heptacyclic saturated hydrocarbon, in the presence of a primary alcohol, hydrogen and Pd/C or Pd/Al_2O_3 as catalyst yields new alkyl ethers of Binor–S for use as a high energy fuel.

Platinum or Palladium Coated Ribbon Catalyst

E. C. BETZ *U.S. Patent* 4,065,268

A catalyst bed, for use in converting hydrocarbon waste gas streams consists of catalytically active crimped metal ribbon, of at least two different crimp configurations. The ribbon may be coated with Pt and/or Pd as catalyst.

Palladium Hydrogenation Catalyst

TEXACO INC. *U.S. Patent* 4,066,699

Nitrated hydrocarbons, such as nitroparaffins, are reduced to amines using a Pd/C catalyst characterised by low ash and/or halide contents.

Noble Metal Catalyst for Coal Liquefaction Catalyst

BATTELLE MEMORIAL INSTITUTE *U.S. Patent* 4,067,795

Particles of solid hydrocarbonaceous material are electroplated with a metal catalyst, including Pt, Ag or Au, suspended in a hydrocarbon oil and subjected to hydrogenolysis to liquify them. The oil product is separated from the char/catalyst metal residue.

Platinum Group Metal Catalyst for Production of Hydrogen Rich Gas

CONTINENTAL OIL CO. *U.S. Patent* 4,067,958

A hydrogen-rich gas is produced from a fuel gas containing CO and N_2 and/or methane by a two-stage process, the second stage of which uses a platinum group metal catalyst.

Platinum Group Catalyst for Hydrocarbon Conversion

U.O.P. INC. *U.S. Patents* 4,069,135–7

A multiple stage catalytic hydrocarbon conversion system uses gravity flowing catalyst particles which consist of a platinum group metal on Al_2O_3. Suitable metals are Pt, Ir, Rh and Pd. There are variations in the amount of catalyst used in each zone.

Platinum Group Metal Catalyst

ATLANTIC RICHFIELD CO. *U.S. Patent* 4,069,388

Oxalate esters are prepared by the oxidative carbonylation of an alkoxycycloalkene with CO,

an alcohol and oxygen in the presence of an amine base and a metal salt, such as Pd, Pt or Rh, as catalyst.

Three-Way Control of an Exhaust Stream

GENERAL MOTORS CORP. *U.S. Patent* 4,071,600

The procedure involves contacting the exhaust gas with a Rh catalyst and contacting the gas with a Pt or Pd catalyst, without adding O_2 to the exhaust gas.

Platinum Group Metal Catalyst for Terephthalic Acid Purification

JOHNSON MATTHEY & CO. LTD. *French Appl.* 2,342,955

Terephthalic acid is purified by hydrogenation of the aldehyde impurities using a catalyst containing two metals chosen from Pt, Pd, Rh, Ru, Os and Ir. Other transition metals may also be present.

Rh/SiO_2 for NO_x Removal

JOHNSON MATTHEY & CO. LTD. *French Appl.* 2,344,323

A process for removal of NO_x and/or oxidation of hydrocarbons and CO uses as catalyst one or more of the platinum group metals, Au and Ag supported on or associated with SiO_2, Al_2O_3 or mixtures thereof.

Hydrogenation Catalyst

JOHNSON MATTHEY & CO. LTD. *German Offen.* 2,722,771

The hydrogenation of animal and vegetable oils is catalysed by a product obtained by deposition on a porous particulate carrier of Pd bisacetylacetonate, and heating to deposit metallic Pd on the particle surfaces and in the larger pores only. The deposition is carried out in the vapour phase and the carrier may be maintained at a temperature above the decomposition temperature of the Pd compound.

Hydrogenation Catalysts

UNIROYAL INC. *German Offen.* 2,736,228

p–Aminarylamines are obtained by hydrogenation or reductive alkylation of corresponding nitrosoarylamines in the presence of a platinum group metal sulphide, preferably 5% on C.

Supported Palladium Catalyst

JOHNSON MATTHEY & CO. LTD. *Dutch Appl.* 77.05481

A supported Pd catalyst is prepared by the vapour deposition of a compound of Pd on to the surface of a solid porous particulate support in such a way that metallic Pd is deposited upon the outer surfaces of the particles and within the pore mouths only of those pores having a diameter greater than 50Å. The preferred support is powdered charcoal and the catalyst is useful for the hydrogenation of trienoic unsaturated fatty acids to the dienoic forms.

HOMOGENEOUS CATALYSIS

Ruthenium and Osmium Metallocenes as Dopants for Liquid Crystals

HUGHES AIRCRAFT CO. *U.S. Patent* 4,066,569

Metallocenes, including those of Ru and Os, when mixed with conjugated cyanoorganic compounds, such as 7, 7', 8, 8'–tetracyanoquinodimethane, act as dopants for liquid crystals.

FUEL CELLS

Fuel Cell Electrodes

SHELL INTERNATIONAL RESEARCH MIJ B.V. *British Patent* 1,501,102

A catalytic Group VIII metal Pd, Rh, Ir, Os, Ru, Ni or preferably Pd is covered with a layer of H_2 and then with a discontinuous layer of a cocatalyst metal which may be Ag, Au, platinum group metal, lanthanide metal or oxides thereof.

Fuel Cell

UNITED TECHNOLOGIES CORP. *British Patent* 1,504,676

In a fuel cell which has electrodes of Pt black on PTFE, a porous electrolyte-retaining matrix comprises 95–98% of SiC particles having a size of $<10\mu m$ and 2–5% of binder.

Platinum Catalyst for Fuel Cell Electrode

UNITED TECHNOLOGIES CORP. *U.S. Patent* 4,058,482

A fuel cell electrode has a mixture of polymer coagglomerates, PTFE and Pt/C catalyst.

CHEMICAL TECHNOLOGY

Photographic Emulsions

KODAK LTD. *British Patent* 1,500,278

Cationic complexes of Ru can be used at considerably lower concentrations than the Co and Cr complexes to improve the sensitivity and contrast of Ag halide photographic emulsions.

Fine-Gauge Wire Production

SUMITOMO ELECTRIC INDUSTRIES LTD. *British Patent* 1,500,751

A hydrostatic extrusion process is used for producing wires of Pt or Au of diameter $<250\mu m$.

Hydrogen Filter

RESOURCE SYSTEMS INC. *U.S. Patent* 4,056,373

A hydrogen-purification filter is a helical tubular coil of a Pd alloy.

Ferromagnetic Powders

FUJI PHOTO FILM CO. LTD. *U.S. Patent* 4,063,000

The properties of Fe, Ni and/or Co ferromagnetic metal powders may be improved by 0.5–5% of Rh, Pd, Ag, Au or lanthanide metal.

Hydrogen Storage

JOHNSON MATTHEY & CO. LTD.

French Appl. 2,337,303

Apparatus for H_2 storage comprises a membrane constructed of Pd or 20% Ag-Pd in gas-tight connection with a heat-exchange chamber containing an intermetallic compound capable of reversibly absorbing H_2, for example $LaNi_5$ for ambient temperature operation or Mg_2Ni for operation at 250°C.

GLASS TECHNOLOGY

Platinum Metal/Porcelain Articles

NATIONAL RESEARCH DEVELOPMENT CORP.

U.S. Patent 4,064,311

Porcelain is fired on to a metal substrate, specifically a platinum group metal. The substrate already has an adherent layer of a metal oxide on its surface of Sn or In which is wetted by the fused porcelain.

Noble Metal-Containing Cermets

JOHNSON MATTHEY & CO. LTD.

French Appl. 2,336,358

The cermets consist of a ceramic particle phase and a metallic phase of Ru, Rh, Pd, Os, Ir, Pt, Au, Ag or their alloys, the greater part of the surface of the ceramic particles being treated with an additive which will form a solid solution with materials of the first and second phases.

Glass Fibres

SIEMENS A.G. *German Offen.* 2,629,658

Glass fibres in which the core and periphery are of different composition are obtained by drawing from a double crucible of Pt, Ir or a Pt-Rh alloy.

ELECTRICAL AND ELECTRONIC ENGINEERING

Anode

PHILIPS ELECTRONIC & ASSOCIATED INDUSTRIES LTD. *British Patent* 1,498,654

A layered rotary anode for an X-ray tube has an electron target area of W alloyed with Os, Ir, Pt, Ru, Rh or Pd.

Display Devices

NIPPON TOKI K.K. *British Patent* 1,499,524

Fluorescent display devices are produced using conductive pastes which contain a vehicle, binders, and finely divided Pt, Pd, Rh, Au or Ag.

Self-Defogging Glass

ASAHI GLASS CO. LTD. *British Patent* 1,504,654

A glass plate for a vehicle window is provided with electrodes of Ru oxide, a sensitive membrane of a metal orthophosphate covering the gap between the electrodes, and a screen-printed heating element of Pd, Pt or Ag.

Resistance Heater

CORNING GLASS WORKS *U.S. Patent* 4,057,707

An electrical cooking or heating unit is a glass-ceramic plate heated by a strip of electrical-resistance alloy containing preferably about 5% Au, optionally 1–4% Rh, remainder Pt.

Palladium and Platinum Catalytic Anodes

R.C.A. CORP. *U.S. Patent* 4,060,660

Pt or Pd catalytic anodes can be used in a glow discharge chamber for applying a d.c. glow discharge to a heated glassy substrate in the presence of a volatile hydrocarbon.

TEMPERATURE MEASUREMENT

Resistance Thermometer

W.C. HERAEUS G.m.b.H. *British Patent* 1,501,959

Thermal stresses in conventional Pt/ceramic resistance thermometers are reduced by depositing a layer having an intermediate thermal coefficient of expansion on to the substrate before depositing the Pt resistance layer. The intermediate layer is at least one of TiO_2, ferric oxide and lanthanide metal(s) oxide.

Precious Metal Chips for Temperature Sensor

HITACHI LTD. *U.S. Patent* 4,058,787

A thermistor for sensing high temperatures contains precious metal chips which are used to form a contact between the shaft and the sheath of the electrode. The chips are of Pt, Rh, Pd and/or their alloys.

MEDICAL USES

Acyl Cyanoguanidines

MERCK & CO. INC. *British Patent* 1,502,740

Procedures for production of the title compounds, useful in treatment of rheumatoid arthritis, may include catalytic hydrogenation of a nitro-compound to the corresponding amine in the presence of Pd or Pt.

Tooth Crowning Process

O. W. ROGERS *British Patent* 1,502,813

The base of an impression of a tooth cavity is electrolytically coated with Pt, Pd, Rh, Au or an alloy thereof, the impression material is removed, and a porcelain inlay is built up on the metal base.

Antidandruff Agents

F. HOFFMANN-LA ROCHE & CO. A.G.

British Patent 1,504,350

Antidandruff agents comprise aryl-long-chain-polyene amides, and may be obtained by partial hydrogenation of corresponding acetylenic compounds in the presence of a Pd catalyst.