

economical than graphite anodes as the investment and operating costs are lower and they use less electricity. They also give a purer product.

ELECTRICAL AND ELECTRONIC ENGINEERING

Thick-film Conductor Adhesion Reliability

W. A. CROSSLAND and L. HAILES, *Solid State Technol.*, 1971, 14, (2), 42-47

The degradation of adhesion of soldered Pd containing thick-film conductors on exposure to high temperatures was examined. A mechanism is proposed. Adhesion degradation can be reduced by proper choice of materials and processing conditions.

Process and Performance Characteristics of "Birox" Thick-film Resistor Compositions

L. C. HOFFMAN and M. J. POPOWICH, *Solid State Technol.*, 1971, 14, (1), 33-37

A review of the properties of the "Birox" thick-film resistor compositions which contain Pd, Au and Ag is given. The effect of variations in the firing temperature and time, type of termination material and resistor geometry on key electrical properties is discussed.

NEW PATENTS

METALS AND ALLOYS

Dispersion Hardening of Metals

JOHNSON MATTHEY & CO. LTD

U.S. Patent 3,547,712

The mechanical properties of dispersion hardened noble metals or copper are improved by cold working and annealing. The extent of cold working is such that recrystallisation during annealing gives an elongated grain structure highly oriented in the direction of working. Typically the method is applied to Pt or Pt-Rh alloys containing dispersed TiC.

Platinum-Rhodium-Gold Alloys

JOHNSON MATTHEY & CO. LTD

Dutch Appl. 70,08,179

Alloys able to withstand attack by molten glass contain 9-25% Rh, 1-4 wt.% Au and the remainder Pt.

Alloys Containing Pt Group Metals

JOHNSON MATTHEY & CO. LTD

Italian Patent 842,682

A method of making alloys of one or more Pt metals with up to 20 at.% Sc, Ti, V, Y, Zr, Nb, Hf, Ta, or a rare earth metal is described. The Pt metal is melted in a crucible in an Ar atmos-

The Formation and Degradation of Ti-Ag and Ti-Pd-Ag Solar Cell Contacts

Conf. Record of 8th IEEE Photovoltaic Specialists Conf., Seattle, 4-6 Aug. 1970, 40-50

The structure of Ti-Ag and Ti-Pd-Ag solderless solar cell contacts were evaluated before and after 80°C, 95% relative humidity exposure. The contacts were found to contain TiH₂ and undergo structure changes in HT-HH environments which render them unstable.

TEMPERATURE MEASUREMENT

Low Temperature Thermometry in High Magnetic Fields. II. Germanium and Platinum Resistors

L. J. NEURINGER, A. J. PERLMAN, L. G. RUBIN and Y. SHAPIRA, *Rev. Sci. Instrum.*, 1971, 42, (1), 9-14

The effect of static magnetic fields up to 210 kG on the characteristics of commercial Ge and Pt resistance thermometers was measured at 3.5-78 K. Measurements of the transverse and longitudinal magnetoresistance were taken. For Pt thermometers the magnetoresistance above 30 K is small enough for it to become practical to correct for it.

phere; the crucible is evacuated when the base metal is added. Rh-Pt-Zr alloys are particularly mentioned.

CHEMICAL COMPOUNDS

Hexaruthenium Octadecacarbonyl

LONZA LTD

U.S. Patent 3,542,513

Ru₆(CO)₁₈ is obtained by heating [Ru(CO)₄]₃ in a substantially O₂-free atmosphere at 150-250°C and maintaining the CO partial pressure during the reaction at 0.2-2 atm.

Production of Allyl Ruthenium Tricarbonyl Halides

LONZA LTD

U.S. Patent 3,546,264

The production of π-allyl Ru tricarbonyl halides is based on the reaction of [Ru(CO)₄]₃ with allyl halides in an inert solvent under an inert atmosphere. They are used as carbonylation catalysts.

ELECTROCHEMISTRY

Electrolytic Cell

ADMIRALTY MATERIALS LABORATORY

British Patent 1,218,038

In a brine electrolysis cell, one electrode is made

of Pt, Pd, Pd-Ag alloy or graphite, and the other of microporous Ag sheets, Cu or Hg.

Electrochemical Cell

LEESONA CORP. *U.S. Patent 3,553,022*
A lightweight electrode has a hydrophobic polymer core with an additive, e.g. graphite, to make it conductive. One face of the core is coated with a mixture of catalyst and polymer, e.g. Pt black and ptf. *U.S. Patent 3,553,024* describes a similar cell electrode.

Electrochemical Devices

TECHNICAL OPERATIONS INC.
U.S. Patent 3,554,795
Ultra-thin film solid electrolyte devices for batteries, sensors, etc., are described. Vacuum deposition is used to deposit all the layers. A typical cell is Pt/AgI/Ag.

ELECTRODEPOSITION AND SURFACE COATINGS

Electrodeposition of Rhodium

SEL-REX CORP. *British Patent 1,223,186*
A bright Rh deposit is obtained by the electrolysis of an aqueous solution of a Rh salt, sulphamic acid, and sufficient of a Cu salt to provide a Cu:Rh ratio between 0.05% and 5.00%.

Metallisation of Titanate Wafers

R.C.A. CORP. *British Patent 1,227,518*
A conductive coating is formed on the surface of a titanate ceramic sheet by applying a metallising composition. This contains finely divided Pt or Pd (and optionally Ag and/or Au) and a compound which decomposes on heating to give Au, Ag or Hg. Further heating sinters metal to ceramic.

A Platinum-coated Nickel-Iron-Chromium Alloy Article

OWENS ILLINOIS INC. *U.S. Patent 3,542,583*
In a process for coating the surface of a Ni-Cr-Fe alloy with Pt, the surface of the alloy is first cleaned to remove all oxides and foreign material and then heated to a temperature of about 500°F. Molten Pt is then sprayed on to the surface at a sufficiently high velocity to rupture any oxides formed on the surface of the base alloy and metallurgically to bond the Pt to the alloy. In this way a strong bond between the alloy and Pt is achieved.

Electrodeposition of Palladium

H. C. ANGUS, et al. *U.S. Patent 3,544,435*
Pd is electrodeposited in a single cell using a bath consisting of an aqueous ammoniacal solution of tetramminopalladous bromide having a pH of 9-10. Ductile coatings suitable for electrical contacts are produced.

Electrodeposition of Thick Coatings of Palladium

U.S. SECRETARY OF THE INTERIOR
U.S. Patent 3,547,789

Thick adherent coatings of Pt, Pd or alloys of Pt and Pd with other Pt metals are obtained by passing current through a molten cyanide or cyanide-cyanate bath exposed to O₂ at 350-600°C. The current is passed from Pt or Pd electrodes to the article to be plated.

Rhodium Plating Baths

DEUTSCHE GOLD- UND SILBER-SCHIEDANSTALT
German Appl. 1,922,421
Thick, crack-free, bright Rh coatings are obtained from baths in which Rh is at least partly complexed with S compounds. See also *French Patent 2,030,835*.

HETEROGENEOUS CATALYSIS

Platinum Catalyst

W. R. GRACE & CO. *British Patent 1,218,334*
HCN is produced by the reaction of NH₃ with a saturated hydrocarbon (e.g. CH₄) in the presence of 0.01-2.0 wt.% of Pt on a refractory mullite base.

Ammonia-dissociation Catalyst

GENERAL ELECTRIC CO. *British Patent 1,224,565*
A catalyst for the dissociation of NH₃ consists of Ir or an alloy of Ir with e.g. Pt, Ti, Ta, Fe or Ni.

Reforming Catalyst

CHEVRON RESEARCH CO. *British Patent 1,226,071*
A catalyst for the low-pressure reforming of hydrocarbons consists of a porous inorganic oxide carrier with 0.01 to 3 wt.% of Pt, 0.01 to 5 wt.% of Re and 0.1 to 3 wt.% of a halogen.

Hydrogenation Catalyst

BRITISH PETROLEUM CO. LTD
British Patents 1,226,131 and 1,226,132
A catalyst particularly useful for the production of fuel oils from waxy residues consists of a mordenite partly ion-exchanged with a Pt group metal. Pt or Pd are preferred.

Reforming Catalyst

UNIVERSAL OIL PRODUCTS CO.
British Patent 1,226,807
Supported Pt is used in one of the stages of production of aromatic hydrocarbons from petroleum fractions.

Catalytic Dewaxing

CHEVRON RESEARCH CO. *U.S. Patent 3,539,495*
A waxy hydrocarbon oil feed is catalytically dewaxed in the presence of H₂ using a catalyst of 0.01-3% Pt and 0.01-5% Re on a porous solid carrier.

Oxidation of Ferrous Compounds and Reduction of Ferric Compounds

JOHNSON MATTHEY & CO. LTD
U.S. Patent 3,542,508

A continuous method of oxidising ferrous compounds to ferric compounds and of reducing ferric compounds to ferrous compounds by the use of a supported Pt group metal catalyst in a trickle column is described. These reactions offer a route to the recovery of Fe contained in, for example, H₂SO₄ and HCl solutions.

Hydrocarbon Conversion Catalyst

UNIVERSAL OIL PRODUCTS CO.
U.S. Patent 3,544,451

Hydrocarbons are converted in contact with a catalyst consisting of Pt and Re on a support. The support contains Al₂O₃ and finely divided mordenite and is made by mixing the components in an aqueous medium in the presence of a source of halogen.

Hydrocarbon Conversion Catalyst

TEXACO INC. U.S. Patent 3,551,516
The isomerisation of paraffinic hydrocarbons is catalysed by a composite of Pt and Al₂O₃ activated by CCl₄, CHCl₃, methylene chloride, phosgene or trichloroacetyl chloride.

Aromatic Hydrocarbon Production

ASAHI KASEI K.K.K. U.S. Patent 3,554,901
Aromatic compounds are produced by contacting a mixture of H₂ and hydrocarbons with a supported mixture of 0.1–1.0% Pt, 0.1–1.0% Pd and 5–25% Cr₂O₃.

Naphtha Reforming

CHEVRON RESEARCH CO. U.S. Patent 3,554,902
Naphtha is reformed over a supported catalytic mixture containing 0.01–3% Pt and 0.001–1% Ir in the presence of less than 15 ppm S.

Hydrocarbon Conversion Catalyst

TEXACO INC. U.S. Patent 3,555,107
A hydrocarbon conversion catalyst consists of Ru, Rh, Pt or Pd deposited on an Al₂O₃ which has been activated with an organic chloride.

Alcohol and Aldehyde Production

ETHYL CORP. U.S. Patent 3,557,219
Alcohols and/or aldehydes are obtained by the carbonylation of olefins in the presence of metallic Rh.

Hydrocracking Catalyst

CHEVRON RESEARCH CO. U.S. Patent 3,558,472
A hydrocracking catalyst consists of a crystalline zeolitic molecular sieve cracking component, 0.01–2.0% Pt, Pd or Ir or their compounds and 0.01–2.0% of Re or its compounds. See also U.S. Patents 3,558,475, 3,558,477 and 3,558,479.

Hydroreforming Catalysts

CIE FRANCAISE DE RAFFINAGE
French Patent 2,031,984

New catalysts consist of a support, such as Al₂O₃ or a zeolite, of specific surface 15 m²/g or more and pore volume greater than 0.1 cm³/g carrying 0.02–2% Pt metal and 0.02–2% Pb, Ge and/or Sn.

Olefin Production

DEUTSCHE ERDOL A.G. German Appl. 1,922,642
Normal olefins are produced from n-paraffins by contact at high temperature with a supported mixture of Pt and Cd.

Removal of Oxides of Nitrogen from Waste Gases

JOHNSON MATTHEY & CO. LTD
Dutch Appl. 70.13,586

Waste gases produced in the manufacture of HNO₃ are combined with a gaseous reducing fuel and passed over a supported mixture or alloy containing 50–80% Pt and 50–20% Rh in order to remove oxides of NH₃. A preferred reducing fuel is CH₄. With 35% Rh-Pt, ignition temperatures as low as 315°C are attainable.

Removal of Organic Pollutants from Waste Gases

JOHNSON MATTHEY & CO. LTD
Dutch Appl. 70.13,587

Organic compounds (including CO and hydrocarbons) which are present in waste gases and which otherwise cause atmospheric contamination are oxidised to CO₂ and H₂O by passage, together with O₂, over a supported mixture or alloy containing 50–80% (by weight) Pt and 50–20% Rh. Significantly improved results with a wide range of organic contaminants and with internal combustion engine exhausts are claimed.

HOMOGENEOUS CATALYSIS

Hydrogenation Catalyst

IMPERIAL CHEMICAL INDUSTRIES LTD
British Patent 1,222,216

Aldehydes or ketones are converted to alcohols by H₂ in the presence of a carboxylic acid and a mixed-ligand complex of Ir. The ligands may be PPh₃ or AsPh₃.

Hydroformylation Catalyst

MONSANTO CO. British Patent 1,223,201

A catalyst medium for hydroformylation is a solution of a coordination complex of Rh, in which at least one of the ligands is halogen and one a tertiary amine, phosphine, arsine or stibine (MR₃). A stoichiometric excess of at least 2 moles of MR₃ is present per mole of Rh complex. A heterogeneous vapour phase system is also described.

Organosiloxane Compositions

GENERAL ELECTRIC CO. *U.S. Patent 3,539,530*
An organopolysiloxane having terminal organosiloxy units is reacted with a silicon hydride in the presence of a Pt catalyst, e.g. H_2PtCl_6 .

Silane Addition Reactions

IMPERIAL CHEMICAL INDUSTRIES LTD
U.S. Patent 3,546,266

Organic Si compounds are produced by olefin addition to a Si-H bond in the presence of a Rh catalyst of formula $RhX(RR'R''Y)_3$, where X is an anion and the R's are organic groups. Y is As, Sb or P.

Oxalic Acid Production

AMERICAN CYANAMID CO. *U.S. Patent 3,555,084*
Oxalic acid is produced when acetylene is oxidised with an alkali metal ferricyanide and OsO_4 or an alkali metal osmiate.

Unsaturated Compound Reactions

G. WILKINSON *French Patent 1,601,798*

Unsaturated compounds are hydrogenated, hydroformylated or carbonylated to give aldehydes or ketones in the presence of a Pt metal halide or pseudohalide complexed with a PPh_3 where one phenyl group has electron-donating substituents. In one example $RhCl_3$ is complexed with tri-(paramethylphenyl) phosphine. A phosphine:Rh ratio of 2:1 is preferred.

Dehydration of Alcohols

STE USINES CHIMIQUES RHONE-POULENC
French Patent 2,029,290

Alcohols which do not have any unsaturation on the α -C atom are dehydrated to ethers and/or olefins over Group VIII noble metal catalysts, especially Ru, Rh or Os acetylacetonates or other complexes.

Ruthenium Carboxylates

JOHNSON MATTHEY & CO. LTD
Dutch Appl. 70.10,315

A new composition of matter is a Ru carboxylate of formula $Ru_2(OCOR)_4$, where R is an optionally substituted alkyl or aryl group. It is produced by heating together a soluble Ru salt, a soluble carboxylate and the corresponding carboxylic acid, e.g. acetic acid. The compounds may be stabilised by complexing them with pyridine or a phosphine. Protonation with strong acids produces species showing high activity for the catalysis of hydrogenation and other reactions.

Transition Metal Carboxylate Catalysts

JOHNSON MATTHEY & CO. LTD
Dutch Appl. 70.10,375

Transition metal compounds useful for catalysis are obtained by complexing a Pt group metal or other transition metal carboxylate, thiocarboxylate or dithiocarboxylate with a stabilising ligand. In

one example a Rh benzoate catalyst is stabilised by a phosphine. Protonation of these compounds with strong acids produces species of the type M_2^{4+} (where M is the transition metal used) showing a high activity for the catalysis of hydrogenation and other reactions. Preferred Pt group metals are Rh and Ru.

Homogeneous Hydrogenation of Olefins

JOHNSON MATTHEY & CO. LTD
Italian Patent 851,328

A $(PPh_3)_3ClRh$ complex which has a CH_3 or methoxy group in the *p* position of the Ph groups is used as a catalyst for the hydrogenation of olefins such as cyclohexene, hex-1-ene, *cis*- or *trans*-4-methylpent-2-ene.

Improved Hydroformylation Catalysts

JOHNSON MATTHEY & CO. LTD
Italian Patent 859,655

Catalysts such as $RhH(CO)(MR_3)_3$ where M is P, As or Sb, and R is aryl, alkyl or aralkyl radicals are used for the hydroformylation of olefinically unsaturated compounds. The reaction is carried out in an aldehyde or alcohol solvent in the presence of a base.

FUEL CELLS AND BATTERIES

High-capacity Metal/Air Battery

LEESONA CORP. *British Patent 1,221,196*

In a high capacity metal/air battery, one face of the cathode member is coated with a catalyst which is a uniform mixture of Pt and p.t.f.e. particles.

Fuel Cell Electrode

GENERAL ELECTRIC CO. *British Patent 1,221,981*

A fuel cell electrode consists of a mixture of a noble metal (i.e. Rh, Ru, Pd, Os, Ir or Pt or mixtures or alloys thereof) with a W bronze.

Fuel Cell

GENERAL ELECTRIC CO. *British Patent 1,224,932*

Fuel for a fuel cell is provided by gases from the dissociation of NH_3 on an Ir or Ir alloy catalyst.

Fuel Cell

GENERAL ELECTRIC CO. *British Patent 1,227,762*

A fuel cell consists of an air electrode, an air oxidant, an electrolyte, an NH_3 fuel and a catalytic fuel electrode which is a Pt-Ir alloy containing at least 20% by weight of Ir.

Electrically Conductive Hermetic Seals

WESTINGHOUSE ELECTRIC CORP.
U.S. Patent 3,555,667

Structural members, e.g. in fuel cells, are sealed using a Pt-Au sandwich. The members are each coated with Pt and the central bonding layer consists of Au or an alloy of Au with 18% Ni.

CHEMICAL TECHNOLOGY

Sheathed Metals

JOHNSON MATTHEY & CO. LTD
British Patent 1,222,434

In the sheathing of a base metal such as Mo or W with a Pt group metal, migration of the base metal to the sheathing metal is reduced by evacuating the intervening space and introducing an inert gas such as Ar, N₂ or He. The invention also includes the use of a barrier layer of refractory oxide, nitride or carbide which prevents physical contact between the core and the sheath.

Titanium Tetrachloride Heating

LAPORTE TITANIUM LTD *U.S. Patent 3,554,708*
TiCl₄ is heated by passage through heating tubes having inlets and outlets made of Pt or an alloy of Pt with Rh, Ru or Ir.

Contact Furnace for Gas Oxidation

FRIEDRICH UHDE G.m.b.H.
German Appl. 1,919,635

A contact furnace for gas oxidation using Pt and Rh has mineral wool mats at intervals behind the catalyst zone to collect the vaporised catalyst.

GLASS TECHNOLOGY

Containers for Molten Glass

PILKINGTON BROS. LTD *British Patent 1,222,248*
A container for molten glass has its inner glass-contacting surfaces made of Ir or an alloy containing at least 50% Ir and its outer surfaces coated with Rh.

Spinneret for Glass Fibres

PILKINGTON BROS. LTD *French Appl. 2,029,484*
A spinneret for glass fibres is made in two parts. The body is made from an alloy of 5-40% Rh, 0-20% Ir and the remainder Pt, the total content of Rh and Ir being not more than 40%. The working faces across which the fibres are drawn are made from an alloy of up to 60% Pt, 0-25% Rh, 0-20% Ir, 2-10% Au, 0-5% Cu and 0-10% Pd, the total content of Rh and Ir being not more than 25%.

ELECTRICAL AND ELECTRONIC ENGINEERING

Composite Electrode

K.D.I. CHLORO GUARD CORP. *U.S. Patent 3,547,600*
A three component electrode having enhanced resistance to high voltage damage is described. It may particularly be used for chlorinating and hypochlorinating. It consists of a Ti or Nb body, an intermediate layer of 0.0003-0.01 inch

Ta or Nb and an outer layer of 0.003-0.005 inch of Pt, Rh, Ir, Ru or their alloys.

Resistive Film

BOURNS INC. *U.S. Patent 3,551,355*
A resistive film for a potentiometer consists of a glass frit and 1-7% of Ru conductive particles.

Resistor Oxide Compositions

E. I. DU PONT DE NEMOURS & CO.
U.S. Patent 3,553,109
New resistors have the composition (M_xBi_{2-x}) (M'_yRu_{2-y})O_{7-2z}, where M is Y, Ti, In, Cd, Pb or a lanthanide, M' is Pt, Ti, Sn, Cr, Rh, Ir, Re, Zr, Sb or Ge, x is 0-2, y is 0-2 and z is 0-1. This mixed oxide is combined with an inorganic binder, a noble metal and a binary oxide. A typical resistor contains 22-76% Bi₂Ru₂O₇, 15-64% binder, 3-30% Au and 0.5-5% CoO.

Indirectly Heated Cathode

U.S. PHILIPS CORP. *U.S. Patent 3,553,521*
An indirectly heated cathode has a refractory metal support, such as Mo or W, coated with a Pt metal to minimise oxidation. Rh, Ir and Ru are the preferred metals.

Methanol Combustion Anode

ROBERT BOSCH G.m.b.H. *German Appl. 1,546,693*
Anodes for the electrochemical combustion of methanol, particularly in fuel cells, have a catalyst consisting of an alloy of Ru with one or two other Pt metals and/or Au.

Condenser Cathode

ERO-TANTAL-KONDENSATOREN G.m.b.H.
German Appl. 2,020,778
A condenser cathode is formed of Cu or Ag or their alloys and is coated with a non-porous layer of Au or Pt or a Au-Pt alloy.

TEMPERATURE MEASUREMENT

Temperature Sensitive Bridge Circuits

N. R. DAVIS *British Patent 1,222,379*
A bridge circuit incorporates a temperature sensor element, e.g. a Pt resistance element.

High Stability Sheathed Thermocouple

JOHNSON MATTHEY & CO. LTD
German Appl. 2,022,322
A noble metal thermocouple is insulated by MgO₂ or BeO₂, has air or any other oxidising medium removed and is protected by an inert gas. The sheath contains a "getter" such as Ti, Zr or Ta which maintains oxidising potential at a low level. It may also contain a small percentage of the more volatile components of the noble metal limbs.