

ABSTRACTS

of current literature on the platinum metals and their alloys

PROPERTIES

Thermal Expansion of Platinum from 293 to 1900K

T. A. HAHN and R. K. KIRBY, *A.I.P. Conf. Proc.*, 1972, (3), 87-95

An expression for the linear thermal expansion of Pt from 293-1900K is given to the T^6 term.

The Determination of the Thermal Expansion of Platinum by X-Ray Diffraction

D. L. EVANS and G. R. FISCHER, *A.I.P. Conf. Proc.*, 1972, (3), 97-104

X-ray diffractometry of electrically heated Pt ribbon and of Pt powder gave the same values of linear thermal expansion, which agreed with those of Kirby and Rothrock found by optical comparator (1968). Pt strip is a reliable standard for X-ray studies of low X-ray absorption materials, e.g. glass-ceramics.

On the Determination of the Surface Stress of Copper and Platinum

H. J. WASSERMAN and J. S. VERMAAK, *Surface Sci.*, 1972, 32, (1), 168-174

Lattice constants of very small Pt nuclei ($r = 19-122\text{\AA}$) in evaporated films were plotted against their radii to give the surface stress of Pt (2574 ± 400 dyne/cm at 65°C). Correlation between surface stress and surface tension shows that lattice contraction in small particles is due to surface properties.

A Thermodynamic Study of Solid Pd-Pt Alloys

J. B. DARBY and K. M. MYLES, *Metall. Trans.*, 1972, 3, (3), 653-657

The vapour pressure of Pd over Pd-Pt alloys was measured by torsion-effusion. The enthalpy of formation of these alloys was found by calorimetry. The thermodynamic results provided additional evidence for the existence of short-range order in the Pd-Pt system.

Absorption of Hydrogen by Palladium-Platinum Alloys under High Pressures of Hydrogen Gas

B. BARANOWSKI, F. A. LEWIS, S. MAJCHRZAK and R. WISNIEWSKI, *J. Chem. Soc., Faraday Trans. I*, 1972, 68, (5), 824-831

The effects of absorption of H on the electrical resistance of Pd-Pt alloys was studied up to 24,000 atm at 25°C . With increasing Pt concentration, there is a gradual but continuous modification of the relationship between H content and the

chemical potential of H, and for any given reference pressure, H solubility is always a decreasing function of Pt concentration.

Long-range Order and Ordering Kinetics in CoPt_3

H. BERG and J. B. COHEN, *Metall. Trans.*, 1972, 3, (7), 1797-1805

X-ray study of the formation of a Cu_3Au -type L1_2 superlattice in CoPt_3 shows it is first order and follows Rothstein's equation; a two-phase region exists at $668-685^\circ\text{C}$ (T_c). CoPt_3 tolerates less long-range order ($S=0.64$) than Cu_3Au before disordering. Domain growth is similar to grain growth.

Identification of the Superconducting Phases in the Molybdenum-Platinum System

R. FLÜKIGER, A. PAOLI, R. ROGGEN, K. YVON and J. MULLER, *Solid State Commun.*, 1972, 11, (1), 61-63

X-ray, metallographic, magnetic and calorimetric analyses of 0-50 at.% Pt-Mo alloys were used to characterise the superconductivity of each phase. Maximum T_c (7.5K) occurs in the partially ordered hexagonal DO_{19} -type phase (≥ 30 at.% Pt) not the Al_5 -type as previously thought.

Quenching Effects in Au-Pd Alloys Studied by Electrical Resistivity

P. VALEMBOIS, *Ph.D. Thesis, Univ. of Pennsylvania*, 1971, *Univ. Microfilms Order No.* 72-17431, 285 pp

The specific resistivity of 0-50 at.% Pd-Au alloys was measured from 250°C up to the melting point. Quenched-in defects were followed by electrical resistivity measurements during isothermal ageing. Literature studies conclude that SRO exists in Ag-Pd, Au-Pd and Cu-Pd and increases the electrical resistivity. Quenched-in vacancies provide low temperature atomic mobility for establishment of SRO. Compositional dependence of vacancy parameters is minimal.

On the Short-range Order Formation in Gold-Palladium Alloys

H. HAAS and K. LÜCKE, *Scripta Metall.*, 1972, 6, (8), 715-720

The changes in resistivity during isothermal annealing at different temperatures are compared for quenched 10 at.% Pd-Au and Ag-Au. All the alloys show increased resistivity due to short-range order formation. Differences in behaviour between Pd-Au and Ag-Au are explained by a repulsion between vacancies and Pd atoms but

not Ag atoms causing greater ordering of Ag-Au by the same number of diffusional jumps.

Influence of the Size of Domains on the Properties of Copper-Palladium Alloys

L. N. BUINOVA, V. I. SYUTKINA, O. D. SHASHKOV and E. S. YAKOVLEVA, *Fiz. Metal. Metalloved.*, 1972, **33**, (6), 1195-1206

The direction of rotation of the periodic antiphase domain boundary within every C-domain of ordered Cu-Pd is the same. Long-range ordering occurs quickly within them when the rate of cooling is 100 deg C/day but growth of the domains requires prolonged treatment with cooling at 2 deg C/day. The domain boundaries are substantial obstacles to electron conduction. Domain size affects the mechanical properties of the alloy. Breaking down the domains increases the yield point and reduces the creep.

On the Compound Pd₂AlCu and Its Alloys with Silver

L. A. PANTELEIMONOV, D. N. GUBIEVA, N. R. SEREBRYANAYA, V. V. ZUBENKO and B. A. POZHARSKII, *Vest. Moskov. Univ., Ser. II, Khim.*, 1972, **27**, (2), 420-423

The phase diagram of the Pd₂AlCu-Ag system is given showing polymorphous transformations of Pd₂AlCu at 335°C and 825°C.

On the Phase Diagram of Pd-In-Sn and of Some Related Alloys

I. KOSOVINC, M. EL-BORAGY and K. SCHUBERT, *Metall*, 1972, **26**, (9), 917-920

The various structures occurring in the Pd-In-Sn and related systems were examined by the powder technique of X-ray diffraction.

Superconductivity in the Palladium-Hydrogen and Palladium-Nickel-Hydrogen Systems

T. SKOSKIEWICZ, *Phys. Status Solidi A - Appl. Res.*, 1972, **11**, (2), K123-K126

Loading 0-5 at.% Ni-Pd with H₂ by electrolysis of 0.1N H₂SO₄, followed by controlled desorption leaving H:Pd \geq 0.81, causes a broad superconductivity transition starting at up to 5.5K for higher H concentrations.

Weldability of a Corrosion-resistant Titanium-Palladium Alloy

A. BENEŠ and K. ŠTUPL, *Zvaranie*, 1972, **21**, (2), 38-46

The weldability of 0.05-0.2 and of 0.7 %Pd-Ti hot-rolled sheet was compared to that of pure Ti by mechanical and corrosion tests and metallography. O₂, N₂, H₂ etc. from the Ar atmosphere diffuse faster into Ti-Pd than into Ti causing greater hardness of the alloys. α Alloys form in the weld and transition zones. The alloys have higher corrosion resistance and a finer structure.

Optical Properties of Iridium at 77 and 295°K

M. M. KIRILLOVA, L. V. NOMEROVANNAYA and M. M. NOSKOV, *Fiz. Metal. Metalloved.*, 1972, **34**, (2), 291-296

Refractive index and absorption coefficient of Ir were measured at 77 and 295K in the spectral range 15-0.302 μ m (0.08-4.08 eV). A two-band conduction model for optical properties in the infrared range was considered. Interband electron transfer occurs at \geq 0.4 eV and causes peaks of the light conduction of 0.44, 1.0, 1.6 and 2.8 eV.

Phase Diagram of the Zirconium-Osmium System in the 50-100 at.% Osmium Region

V. N. EREMENKO, T. D. SHTEPA and E. L. SEMENOVA, *Dopovidi Akad. Nauk Ukr. R.S.R., Ser. B*, 1972, **34**, (1), 50-52

X-ray and microstructural analyses of 50-100 at.% Os-Zr alloys show the existence of the eutectic compounds ZrOs₂ (a=5.20Å, c=8.53Å), which melts congruently at 2660°C, and ZrOs (CsCl-type structure, a=3.26Å), which melts incongruently at 2040°C. A phase diagram is given.

Electronic Specific Heat of Iron-Rhodium and Iron-Rhodium-Iridium Alloys

B. FOGARASSY, T. KEMENY, L. PAL and J. TOTH, *Phys. Rev. Lett.*, 1972, **29**, (5), 288-291

The electronic specific heat of Fe_{49.5}Rh_{50.5-x}Ir_x (x=1.5, 3.0, 5.0, 6.5), Fe_{49.1}Rh_{50.9} and Fe₅₂Rh₄₈ was measured. The coefficient of the linear term, γ_{AF} , in the specific heat of antiferromagnetic alloys contains a large magnetic contribution which is attributed to the small fraction of Fe atoms occupying Rh sites of nearly zero exchange field. Measured γ_{AF} values fail to confirm the simple electronic nature of the first-order antiferromagnetic-ferromagnetic transition assumed in current theory.

Interaction of the Intermetallic Compounds RuTi-RuHf

D. D. GULAMOVA, M. V. RAEVSKAYA, I. G. SOKOLOVA, F. S. LITVAK and E. M. SOKOLOVSKAYA, *Vest. Moskov. Univ., Ser. II, Khim.*, 1972, **27**, (4), 489-490

The permanent intersolubility of RuTi and RuHf was established by physico-chemical analysis.

Absolute Thermoelectric Power of Chromium-Ruthenium Alloys

T. F. DE YOUNG, S. ARAJS and E. E. ANDERSON, *J. Less-common Metals*, 1972, **29**, (1), 93-96

The variation with temperature of the absolute thermoelectric power of 0-8.3 at.% Ru-Cr alloys, between 350 and 1000K, shows large anomalies due to the paramagnetic-antiferromagnetic transition. The relative size of the anomaly can be roughly correlated to that shown by the resistivity; it increases with Ru concentration up to 3.0 at.% and then decreases.

Electrical Conductivity and Thermal Conductivity of Rhenium, Osmium, Iridium and Some of Their Alloys with Thorium and Lanthanum over a Wide Range of Temperature

A. A. GUGNIN, S. N. L'VOV, P. I. MAL'KO, V. F. NEMCHENKO and I. P. STARODUBOV, *Poroshkovaya Metall.*, 1972, (1), 65-70

The electrical and thermal conductivities of Re, Os and Ir and of Re-Th, Os-Th and Ir-La alloys were studied as a function of temperature up to 1700°C. The alloys had a higher resistivity and lower thermal conductivity than the metals. Typical variations from 125 to 1325°C were 50-100 μ ohm cm and 0.5-0.2 W/cm/deg C.

CHEMICAL COMPOUNDS

Proposed Mode of Action of Antitumour Platinum Compounds Based upon Studies with *cis*-Dichloro([G-³H]-dipyridine)-platinum(II)

J. A. HOWLE, G. R. GALE and A. B. SMITH, *Biochem. Pharmacol.*, 1972, 21, (10), 1465-1475

Studies of *cis*-dichloro([G-³H]-dipyridine)-platinum(II) suggest that its antitumour and antimetabolic properties depend on the dissociation of one or both Cl atoms from the Pt atom to give a cationic, aquated species which forms an acid-resistant bond with intact cells and with DNA.

Effect of *cis*-Platinum(II) Diamminodichloride on Bone Marrow

M. ŽÁK, J. DROBNÍK and Z. REŽNÝ, *Cancer Res.*, 1972, 32, (3), 595-599

Injecting mice with the antitumour agent *cis*-Pt(II) diamminodichloride has the same effect on mitotic index and cell counts as do low doses of X-irradiation.

Inhibition of Leucine Aminopeptidase and Malate Dehydrogenase by Aquoplatinum(II) Complexes

P. MELIUS, J. E. TEGGINS, M. E. FRIEDMAN and R. W. GUTHRIE, *Biochim. Biophys. Acta*, 1972, 268, (1), 194-198

Leucine aminopeptidase, elevated levels of which are found in certain tumours, and malate dehydrogenase are inhibited by Rb₂PtBr₄ solutions. The active species is shown to be PtBr₃(H₂O)⁻.

Anisotropic Thermopower in the Quasi-One-Dimensional Conductor K₂Pt(CN)₄Br_{0.3}·3H₂O

D. KUSE and H. R. ZELLER, *Solid State Commun.*, 1972, 11, (2), 355-358

The thermopower of K₂Pt(CN)₄Br_{0.3}·3H₂O is small, anisotropic, temperature dependent above 150K, and increasing below that, and negative, indicating conduction by negative carriers.

Studies of Palladium and Platinum Triphenylphosphine Complexes with Carbon Monoxide at High Pressures

T. INGLIS and M. KILNER, *Nature Phys. Sci.*, 1972, 239, (88), 13-15

Infrared spectroscopy of M(PPh₃)_x (M=Pd, x=4; M=Pt, x=3, 4) under high pressures of CO indicated all members of the series M(CO)_{4-x}(PPh₃)_x (x=1-4, according to temperature).

Mean Palladium- and Platinum-Halogen Bond Energies in Complexes of the Divalent and Tetravalent Metals

F. R. HARTLEY, *Nature Phys. Sci.*, 1972, 236, (66, Apr. 3), 75-77

The mean energies of Pd- and Pt-halogen bonds in complexes were evaluated using a Born-Haber cycle and the relative values found to be Pt-Cl > Pd-Cl, Pt-Cl > Pt-Br and M(II)-X > M(IV)-X.

Methods for Studying Oxygen-Platinum Metals Interactions

A. OLIVEI, *J. Less-common Metals*, 1972, 29, (1), 11-23

The thermodynamic properties of the volatile products of O₂-Pt metal reactions were studied by 'pumping' of O₂ by a hot Pt metal filament, and by mass spectrometric analysis of flash desorbed oxidation products and measurement of the rate of evaporation of gases effusing from a Langmuir cell. The quasi-equilibrium approach was applied to the reactions.

New Nitrido and Oxo Complexes of Ruthenium

D. PAWSON and W. P. GRIFFITH, *Chem. & Ind.*, 1972, (15, Aug. 5), 609

The first complexes to contain a terminal Ru≡N bond, Cs₂[RuNX₃] (X=Cl, Br), were prepared by adding RuO₄ in CCl₄ to aqueous NaN₃ (Ru : N₃⁻ = 1 : 2) at 0°C in the presence of excess HX and Cs⁺. New ruthenyl complexes *trans*-Cs₂[RuO₂X₄] (X=Br⁻, CN⁻, $\frac{1}{2}$ OX²⁻) were prepared by reacting RuO₄ in CCl₄ with the acid and Cs⁺; cooling was essential. The tetrammine and pyridine analogues were similarly prepared. All the complexes are diamagnetic.

ELECTROCHEMISTRY

Hydrogen Evolution at Platinum Electrodes in Molten Potassium Bisulphate

D. GILROY, *Electrochim. Acta*, 1972, 17, (10), 1771-1782

The hydrogen evolution reaction at bright Pt electrodes in molten KHSO₄ was studied at 270-430°C by steady-state and transient methods. At low potentials the atom-atom combination step is rate determining. At high potentials the ion-atom electrochemical desorption step is rate determining. The two regions are separated by a

transition region in which hysteresis is observed. The absorption isotherm for H atoms shows two-dimensional condensation.

Electrolytic Separation Factors on Platinum under Non-steady State Conditions

B. DANDAPANI and M. FLEISCHMANN, *J. Electroanal. Chem. Interfacial Electrochem.*, 1972, **39**, (2), 315-321

A new method was used to study the non-steady state separation factor of hydrogen and deuterium on Pt. The measurement of the separation factor on Pt as a function of frequency can be interpreted only in terms of a progressive weakening of the Pt-H bond with increasing coverage. The discharge of H⁺ on D must also be much faster than that of D⁺ on H.

The Oxygen Film on Platinum Electrodes and the Electro-oxidation of Acetate Ions

P. R. NADEBAUM and T. Z. FAHIDY, *Electrochim. Acta*, 1972, **17**, (9), 1659-1681

Recent literature is reviewed and a consistent and mathematical model is presented to account for the various phenomena observed during the electrolysis of aqueous acetate solutions at Pt electrodes. The complex interaction of a number of competing reactions is discussed, with particular emphasis on oxygen film formation on the Pt surface and its influence on the various acetate ion oxidation reactions.

Effect of the Conditions of Deposition on the Structure and Properties of Rhodium Electrode Catalysts

A. A. SUTYAGINA, N. P. MATVEIKO and G. D. VOVCHEKNO, *Vest. Moskov. Univ., Ser. II, Khim.*, 1972, **27**, (4), 414-416

The structure, H₂ adsorption and catalytic activity of Rh/Rh electrodes in nitrobenzene depend on the surface area of the support and current density during electrodeposition.

Adsorption of Hydrogen by Skeleton Iridium-Ruthenium Electrode Catalysts in 1N Sulphuric Acid Solution

KH. I. YANKOVSKII, A. D. SEMENOVA, G. D. VOVCHEKNO and N. V. KROPOTOVA, *Vest. Moskov. Univ., Ser. II, Khim.*, 1972, **27**, (4), 417-419

The capacity for H₂ adsorption by skeleton Ir-Ru electrodes is considered.

ELECTRODEPOSITION AND SURFACE COATINGS

Epitaxy at Low Temperatures by Vapour Deposition of Pd, Pt, Rh and Ir Observed by Field Ion Microscopy

W. R. GRAHAM, D. A. REED and F. HUTCHINSON, *J. Appl. Phys.*, **43**, (7), 2951-2956

The minimum substrate temperatures required

for the formation of vapour-deposited epitaxial layers of Pd, Pt, Rh and Ir on either Ir or Rh are respectively 50, 100, 180 and 300K, thus indicating that the minimum temperature increases with the binding energy of the deposited metal. Conditions for epitaxy in these metals are discussed.

LABORATORY APPARATUS AND TECHNIQUE

A Multiconductor Feedthrough for Very Low Temperature Applications

B. M. ABRAHAM and J. TAGUE, *Rev. Sci. Instrum.*, 1972, **43**, (5), 835-836

A multiconductor electrical feedthrough for use down to 4.2K consists of a Pt tube containing a ceramic spacer for the Pt wires. Jena 16^{III} red stripe glass powder is melted around the wires to form a seal.

JOINING

Ceramic-Metal Reaction Welding

H. J. DE BRUIN, A. F. MOODIE and C. E. WARBLE, *J. Mater. Sci.*, 1972, **7**, (8), 909-918

When bonding ceramics with metals, either noble metal-ceramic oxide bonding occurs by the formation of a liquid-like intermediate phase (for Au, Pt, Pd) with maintenance of a sharp discontinuity at the interface, or bonding of oxides to other transition metals, e.g. Fe, Co, Ni, occurs by diffusion. Both mechanisms occur below the melting point of any component, in any compatible atmosphere, under little pressure and without deformation.

Bonding of Metals to Ceramics and Glasses

J. T. KLOMP, *Am. Ceram. Soc. Bull.*, 1972, **51**, (9), 683-688

Pt, Fe, Ni, Cu, Al, and Pb were bonded to glasses and ceramics by heating to $\sim 0.9T_m(\text{metal})$ under pressures of from $< 0.1\text{N/m}^2$ for Pt to 10MN/m^2 for Al and Pb.

HETEROGENEOUS CATALYSIS

Bimetallic Pays off in 3-year Run

C. THOMPSON and W. E. LEMEN, *Oil Gas J.*, 1972, **70**, (36, Sept. 4), 80-81

At Mohawk Petroleum Corp., California, a bimetallic platforming catalyst showed excellent stability during three years' operation with no yield decline, change in H₂ purity or shutdown for regeneration.

Japanese Discover Unique Low-pressure Reforming Catalyst

Oil Gas J., 1972, **70**, (37, Sept. 11), 73

Asahi Chemical Industry Co. has discovered that

a Pt-Pb catalyst with Cd addition leads to high yields of reformat, aromatics, H₂, and higher octane output during low-pressure reforming. Despite the reputation of Pb as a catalyst poison, Pb increases the activity of Pt. The new catalyst is said to be high in dehydrogenation activity with preferred Pb:Pt ratio <3, preferred pressure <300 p.s.i.g. (specifically ~140 p.s.i.g.), accelerated isomerisation for fractions lighter than n-C₇H₁₆ but aromatisation taking preference for heavier fractions. Deactivation is said to be slow even at 50–150 p.s.i.g. and regeneration is via the O²-C¹ method for long runs. Activity and stability were maintained equal to fresh catalyst over 42 cycle runs.

A New Reforming Catalyst

T. IWASAKO, K. OHKI and H. KOMINAMI, *Abstr. Papers, 164th Natl. Mtg., Am. Chem. Soc., 1972, INDE 14*

Studies have been made of the preparation, regeneration, reaction conditions and addition of a third component to a Pt-Pb catalyst which is very effective for reforming under lower pressures and especially for aromatisation of paraffin.

Catalytic Dehydrogenation and Oxidation of Propanol-2 on Platinum

B. J. WOOD, H. NIKI and H. WISE, *J. Catalysis, 1972, 26, (3), 465-469*

Ultra-high vacuum studies show that a clean Pt surface is an active and specific catalyst for the dehydrogenation of propanol-2 to acetone but that it is rapidly poisoned by preferential adsorption of CO. Addition of O₂ caused heterogeneous oxidation of propanol-2.

Modification of Platinum Black by Chlorides of the Alkaline Earth Metals

A. B. FASMAN, A. P. GOROKHOV, D. V. SOKOL'SKII, YU. F. KLYUCHNIKOV and I. A. SAPUKOV, *Zh. Fiz. Khim., 1972, 46, (8), 2015-2019*

Studies of the catalytic activity, structure and chemical composition of Pt black produced by reduction of PtO₂ and modified by additions of alkaline earth metal chlorides showed that the latter lead to fewer crystals and grains of PtO₂ and Pt, to increased specific surface and to a pore distribution displaced towards larger radii. Modified catalysts were significantly more active and more stable than the conventional.

Adsorption and Catalytic Properties of Platinum Supported on Carbon and Gold Substrates

L. S. KANEVSKII, V. SH. PALANKER and V. S. BAGOTSKII, *Kinet. Kataliz, 1972, 13, (4), 992-997*

Studies of the electrochemical and catalytic properties of Pt deposited on smooth inert Au and pyrolytic graphite show that the Pt micro-crystals deposited influence the subsequent activity, and affect the adsorption and electro-

catalytic behaviour of the system. H₂ adsorption is greater on platinised pyrolytic graphite than on unplatinised. Adsorption energies of H₂ on platinised and on smooth Pt differ. Likewise the specific catalytic activity of Pt deposits for dissociation and ionisation of H₂ and for HCOOH oxidation is greater than that of smooth Pt, especially for supports with low amounts of Pt.

Removal of Odours by Catalytic Incineration

R. A. SEARLES, *Environmental Pollution Management, 1972, 2, (7), 280-283*

Malodorous effluent gases from a wide variety of industries can be treated effectively and economically by the Honeycat system which uses a Pt/ceramic honeycomb catalyst for incineration at low temperatures.

On the Effect of the Conditions of Preparation on the Properties of Platinum/Alumina Catalysts

B. B. ZHARKOV, G. N. MASLYANSKII, N. E. BUYANOVA, V. I. RYBAK, T. M. KLIMENKO, and A. E. RUBINOV, *Zh. Prikladnoi Khim., 1972, 45, (7), 1434-1438*

Addition of CH₃COOH to aqueous H₂PtCl₆ being used to prepare Pt/Al₂O₃ alters the adsorption characteristics of the H₂PtCl₆ on the Al₂O₃ so that the dispersion of Pt is changed and so is activity for reduction. Thermal stability of the catalysts drops as the amount of added CH₃COOH increases.

Small Angle X-ray Scattering Investigation of Platinum Metal Dispersions on Alumina Catalysts

T. E. WHYTE, P. W. KIRKLIN, R. W. GOULD and H. HEINEMANN, *J. Catalysis, 1972, 25, (3), 407-415*

Metal particle diameters and distributions in Pt/Al₂O₃ catalysts were investigated by small angle X-ray scattering. Scattering by pores of the support was eliminated by controlled adsorption of CH₂I₂ and C₄H₉I. The Guinier and Porod radii were calculated. The diameters increased on ageing. Clusters of very small Pt particles were indicated.

Carbon Molecular Sieve Supports for Metal Catalysts. I. Preparation of the System Platinum Supported on Polyfurfuryl Alcohol Carbon. II. Selective Hydrogenation of Hydrocarbons over Platinum Supported on Polyfurfuryl Alcohol Carbon

J. L. SCHMITT and P. L. WALKER, *Carbon, 1971, 9, (6), 791-796; 1972, 10, (1), 87-92*

I. Carbonised polyfurfuryl alcohol (PFA) will behave as a 4 Å molecular sieve when in large particles, or a 5 Å sieve after grinding or when an activated C filler is added to the partially-polymerised PFA, causing microcracks to form during carbonisation. These cracks act as diffusion pathways and hasten equilibrium. Varying PFA: filler ratio gives different adsorption properties.

Pt is added to the PFA before curing as almost all the adsorption is by the PFA, not the filler. II. A composite C molecular sieve-Pt catalyst was prepared and shown to act as a 5 Å sieve with slit-shaped pores or pore constrictions. Using a continuous flow technique, shape selectivity was demonstrated for the competitive hydrogenations of 3-methyl-1-butene with both 1-butene and cyclopentene. No selectivity was observed in the 1-butene : isobutene system.

Catalytic Isomerisation of Normal Nonane

D. KIOUSSIS, *Chem. Chron.*, 1972, 1, (1), 22-28

Isomerisation of *n*-nonane over 0.27 wt.%Pd/Al₂O₃-B₂O₃ gives mainly methyloctanes with more branching at high conversions. Hydrocracking is favoured >425°C. A carbonium ion mechanism is proposed.

Isomerisation of *n*-Pentane on Type Y Zeolites Containing Palladium

V. I. GARANIN, KH. M. MINACHEV and T. A. ISAKOVA, *Neftekhimiya*, 1972, 12, (4), 501-505

Isomerisation of *n*-pentane at 360°C, 15-20 atm on Pd/CaY in the presence of H₂ reaches 57% or 90% of equilibrium yield. Reaction kinetics and procedure can be described by an equation of the form $r = k \cdot P_{C_5H_{12}} / P_{H_2}$, and by the tendency to isomerise to paraffins via olefins.

Catalytic Properties of Palladised Zeolites for Hydrogenation of Dimethylethynylcarbinol

D. V. SOKOL'SKII, N. A. GOGOL' and N. I. SHLIOMENZON, *Kinet. Kataliz*, 1972, 13, (4), 982-986

Liquid-phase hydrogenation of dimethylethynylcarbinols over 0.1-5.0 wt.%Pd/zeolites showed that total and specific catalytic activities are related to the amount of Pd and the type of zeolites. Low Pd% samples behave like Pt, high Pd% samples like Pd. Reduction occurred principally at the acetylenic bond.

Olefin Hydrogenation Catalysed by Supported and Unsupported Mixed Metals

S. H. INAMI and H. WISE, *J. Catalysis*, 1972, 26, (1), 92-96

The hydrogenation activities of Pd-Au catalysts as alloy microspheres and as the mixed metals dispersed on α -Al₂O₃ were studied, and details are given of their comparative performance in some typical hydrogenation reactions.

The Exchange with Deuterium and Deuteration of Benzene on Evaporated Palladium-Gold Alloy Films

A. CINNEIDE and J. K. A. CLARKE, *J. Catalysis*, 1972, 26, (2), 233-241

At Pd < 60 at.% the activity of Pd-Au films falls to zero for C₆H₆ deuteration and is decreased for C₆H₆-D exchange, indicating a dissociative

mechanism. In *p*-xylene hydrogenation, 'roll-over' probability seems insensitive to Au content.

Electronic Substituent Effects on the Adsorption and Hydrogenation of the Olefinic Bond on Palladium

A. P. G. KIEBOOM and H. VAN BEKKUM, *J. Catalysis*, 1972, 25, (3), 342-349

The electronic substituent effects on the rate of hydrogenation of 2-aryl-3-methyl-2-butenes and substituted 3,4-dihydro-1,2-dimethylnaphthalenes, using Pd/C as a catalyst, are small. The transition state is similar to the initial state. Adsorption involves a π -olefin complex.

Resin-bound Transition Metal Complexes

J. P. COLLMAN, L. S. HEGEDUS, M. P. COOKE, J. R. NORTON, G. DOLCETTI and D. N. MARQUARDT, *J. Am. Chem. Soc.*, 1972, 94, (5), 1789-1790

Resin-bonded homogeneous Rh catalysts exhibit superior lifetimes and ease of product separation and also maintain high concentrations of unsaturated complex provided chelation is prevented.

Polymer Supported Rhodium(I) Hydrogenation Catalysts: Factors Controlling Substrate Selectivity

R. H. GRUBBS, L. C. KROLL and E. M. SWEET, *Abstr. Papers*, 164th Natl. Mtg., Am. Chem. Soc., 1972, POLY 46

An analysis is given of parameters causing selectivity in olefin reduction in the presence of a Rh(I) catalyst attached to a divinylbenzenestyrene copolymer bead by a phosphine link. The catalyst can be used repeatedly.

Electron Spectroscopy for Chemical Analysis (ESCA) Studies on Catalysts. Rhodium on Charcoal

J. S. BRINEN and A. MELERA, *J. Phys. Chem.*, 1972, 76, (18), 2525-2526

ESCA studies of Rh foil, Rh/C and Rh₂O₃ showed that catalytic activity depends on surface oxide concentration.

Hydrogenation of Hydrocarbons on Rhodium Catalysts

A. M. SOKOL'SKAYA and K. K. KUZEMBAEV, *Izv. Akad. Nauk Kaz. S.S.R., Ser. Khim.*, 1972, 22, (1), 21-26

On hydrogenation in MeOH solution over Rh/BaSO₄ and Rh black, 1-hexene gave 2-hexene and *n*-hexane and cyclohexene yielded cyclohexane and C₆H₆; PhC \equiv CH selectively gave styrene and then PhEt.

The Hydroisomerisation of *n*-Butenes. 2. The Reaction of 1-Butene over Mercury-poisoned Rhodium-Silica Catalysts

G. WEBB and J. I. MACNAB, *J. Catalysis*, 1972, 26, (2), 226-232

As Hg adsorption is increased, the rates of

hydrogenation and exchange of 1-butene over Rh/SiO₂ decrease uniformly but isomerisation is unaffected up to $\theta_{H_2} > 80\%$, suggesting the first two occur on the metal and the last on the support, after migration.

Hydrogenation of Aniline in the Liquid Phase. VI. Hydrogenation of Aniline with Ruthenium-Palladium and Ruthenium-Platinum Alloy Catalysts Supported on Activated Carbon

K. IKEDATE and S. SUZUKI, *Nippon Kagaku Kaishi*, 1972, (5), 830-836

Ru and Pd catalysts have low activity for PhNH₂ hydrogenation whereas Ru-Pd shows activity which passes through a maximum for PhNH₂ at 25 at.%Ru and for C₆H₆ at 75%Ru. Ru-Pt has greater activity than pure Pt for PhNH₂ hydrogenation but for C₆H₆ it is less.

Selective Hydrogenation of Carbonyl Groups of α,β -Unsaturated Aldehydes in the Presence of Iridium Catalysts

E. N. BAKHANOVA, A. S. ASTAKHOVA, KH. A. BRIKENSHEIN, V. G. DOROKHOV, V. I. SAVCHENKO and M. L. KHIDEKEL', *Izv. Akad. Nauk S.S.S.R., Ser. Khim.*, 1972, (9), 1993-1998

α,β -Unsaturated aldehydes such as furylacrolein, crotonic and cinnamic aldehydes and citral are reduced quantitatively in the presence of Ir catalysts to the corresponding unsaturated alcohols. Allyl alcohol is the main product of hydrogenation of acrolein.

Novel Procedures for the Preparation of Platinum and Other Metals in Forms Having Abnormally High Catalytic Activity

D. J. BOOTH, D. BRYCE-SMITH and A. GILBERT, *Chem. & Ind.*, 1972, (17), 688-689

Pt, Pd and Ru catalysts prepared by reacting a solid metal halide with sodium naphthalide, etc., have very small crystallite size, unusual chemical and electrostatic properties and extremely high catalytic activity for the oxidation of organic compounds by O₂. They can be rendered non-pyrophoric without loss of activity.

Investigation of Hydrogen Adsorption on 'Boride' Catalysts of the Platinum Group Metals

V. M. VARUSHCHENKO, B. D. POLKOVNIKOV, G. A. BOGDANOVSKII and V. M. AKIMOV, *Izv. Akad. Nauk S.S.S.R., Ser. Khim.*, 1972, (7), 1662-1665

The phase composition of Pt, Pd and Rh borides were compared with those of Pt, Pd and Rh blacks by X-radiography. There is little difference between borides and blacks in capacity to adsorb H₂ or in specific surface area. Heats of adsorption of H₂ and metal-H bond energies were calculated from charging curve data. Heat of adsorption is proportional to amount and stage of charging.

Investigation of the Hydrogenation of *p*-Carboxybenzaldehyde in the Presence of Pd, Ru and Rh Catalysts

L. KH. FREIDLIN, E. F. LITVIN, R. N. GURSKII, G. K. OPARINA and R. V. ISTRATOVA, *Izv. Akad. Nauk S.S.S.R., Ser. Khim.*, 1972, (8), 1738-1742

Hydrogenation of *p*-carboxybenzaldehyde over 0.5%Pd/C, 5%Rh/C and 5%Ru/C is zero order with respect to the substrate and first order with respect to H₂. There is subsequent hydrogenolysis on Pd/C at the C-OH bond to form carbonyls. Hydrogenolysis is very slow on Rh/C but on Ru/C there is selective formation of *p*-carboxybenzyl alcohol.

New Hydrosilylation Catalysts: Platinum and Rhodium Complexes with Polymeric Ligands

M. ČAPKA, P. SVOBODA, M. KRAUS and J. HETFLJEŠ, *Chem. & Ind.*, 1972, (16), 650-651

Pt and Rh complexes coordination-bonded to organic polymers catalyse hydrosilylation, giving high yields under mild conditions, the activity being dependent on the nature of the ligand. These catalysts can be easily recovered from the reaction system and recycled.

Palladium-catalysed Vinylic Hydrogen Substitution Reactions with Aryl, Benzyl, and Styryl Halides

R. F. HECK and J. P. NOLLEY, *J. Org. Chem.*, 1972, 37, (14), 2320-2322

A vinylic H of an olefinic compound is replaced by the aryl, benzyl or styryl group of a halide by reaction at 100°C in the presence of a hindered amine and finely divided Pd metal formed by in situ reduction of PdAc.

HOMOGENEOUS CATALYSIS

Palladium(II)-catalysed Exchange and Isomerisation Reactions. III. Allylic Ester Isomerisation in Acetic Acid Catalysed by Palladium(II) Chloride

P. M. HENRY, *J. Am. Chem. Soc.*, 1972, 94, (15), 5200-5206

In the presence of Pd(II) salts in CH₃COOH, unsymmetrical allylic esters will undergo either simultaneous exchange and isomerisation - a reaction of first order in [LiOAc] which takes place by acetoxypalladium-deacyloxypalladium; or isomerisation without exchange - a zero order reaction in [LiOAc] involving an acetoxonium-type intermediate.

IV. The Exchange of Vinylic Chloride with Radioactive Lithium Chloride Catalysed by Palladium(II) Chloride in Acetic Acid

P. M. HENRY, *J. Org. Chem.*, 1972, 37, (15), 2443-2447

The kinetics and stereochemistry of the Pd-catalysed exchange of vinyl chloride with LiCl

are examined. It probably proceeds at rate = $k[\text{Li}_2\text{Pd}_2\text{Cl}_6][\text{vinyl chloride}][\text{LiCl}]/[\text{LiCl}]$ and by means of a rapid preequilibrium step to form a π complex which is attacked by Cl^- to give a chloropalladation adduct; dechloropalladation completes the exchange.

V. The Exchange of Allylic Trifluoroacetates with Lithium Chloride Catalysed by Palladium(II) Chloride in Acetic Acid

P. M. HENRY, *Inorg. Chem.*, 1972, **11**, (8), 1876-1879

The most probable rate expression and mechanism for the exchange of allylic trifluoroacetates with LiCl are analogous to those of vinyl chloride with radioactive LiCl .

Oxidation of Olefins by Palladium(II). IV. Effect of Palladium(II) Chloride Concentration on Rate in Aqueous Solution

P. M. HENRY, *J. Am. Chem. Soc.*, 1972, **94**, (13), 4437-4440

The rates of oxidation of C_2H_4 and C_3H_6 in a solution where $[\text{PdCl}_4^{2-}] = 0.01-0.2 \text{ M}$ and $[\text{NaCl}] = 0.2-0.5 \text{ M}$ were found to fit the expression: $-d[\text{olefin}]/dt = k_1[\text{PdCl}_4^{2-}][\text{olefin}]/[\text{H}^+][\text{Cl}^-]^2$. A second term introduced by Moiseev for these higher Pd(II) concentrations is doubted.

Synthesis and Catalytic Properties of π -Allyl Complexes of Palladium(II) in the Oligomerisation of Butadiene-1,3

A. S. BEREN'LYUM, I. V. KALECHITS, L. G. KORABLEVA, I. P. LAVRENT'EV, M. L. KHIDEKEL' and L. P. KHROMCHENKOVA, *Izv. Akad. Nauk S.S.S.R., Ser. Khim.*, 1972, (8), 1841-1843

A series of mono- and binuclear π -allyl Pd(II) complexes with O-, N- and S-containing ligands were synthesised. Pyrazine-2,3-dicarbonic acid in the presence of Pd(II) complexes and monoethyl ether anions forms the linear trimer butadiene-1,3,n-dodecatetraene-1,3,6,10. A method of transferring Pd(II) complexes in a catalytically active form in the oligomerisation of butadiene-1,3 is proposed to account for the effect of aprotic dipolar solvents.

Catalytic Oligomerisation of Butadiene on Rh(I) Complexes

P. S. CHERKII, M. L. KHIDEKEL', I. V. KALECHITS, O. N. EREMENKO, G. I. KARYAKINA and A. S. TODOZHKOVA, *Izv. Akad. Nauk S.S.S.R., Ser. Khim.*, 1972, (7), 1579-1583

$\text{LRh(CO)}_2\text{Cl}$ complexes, where L is benzotriazole, acridine, imidazole or benzimidazole, were synthesised and used in $\text{C}_2\text{H}_5\text{OH}$, CH_3OH or CH_3OCH_3 to catalyse butadiene conversion to a mixture of 4-vinylcyclohexene, 1,5-cyclooctadiene and 1,4-trans-polybutadiene; in DMF only 4-vinylcyclohexene is produced. Solutions of binuclear Rh(I) complexes in DMF with 4-vinylcyclohexene form 1,5-cyclooctadiene complexed with n-phenylenediene and 1,3,7-octatriene

in the presence of benzidine complexes. This is connected with the doublet mechanism of the two active centres of the complexed catalyst.

Rhodium(I)-catalysed Dismutation of Electron-rich Olefins: Rhodium(I) Carbene Complexes as Intermediates

D. J. CARDIN, M. J. DOYLE and M. F. LAPPERT, *J. Chem. Soc., Chem. Commun.*, 1972, (16), 927-928

Dismutation of two electron-rich olefins, C_2X_4 and C_2Y_4 , proceeds only in the presence of an additive, in particular a Rh(I) complex, by the formation of catalytically active intermediate carbene complexes.

Hydrogen Transfer Reactions. 28. Chiral Tertiary Phosphine-induced Asymmetric Induction in the Homogeneous Hydrogenation of Olefins with Rhodium-Phosphine Complexes

L. HORNER and H. SIEGEL, *Phosphorus*, 1972, **1**, (5), 209-216

The products of hydrogenation of α -substituted styrenes, catalysed by reaction products of di- μ -chlorobis(1,5-hexadiene)dirhodium and chiral phosphines, are optically active with 2-19% induction of chirality and their configurations are related to those of the phosphines. Na ethylate increases the hydrogenation rate.

Rhodium Complex Catalysed Hydrosilylation of Carbonyl Compounds

I. OJIMA, M. NIHONYANAGI and Y. NAGAI, *J. Chem. Soc., Chem. Commun.*, 1972, (16), 938

$(\text{PPh}_3)_3\text{RhCl}$ catalyses the hydrosilylation of carbonyl compounds under mild conditions giving high yields. $(\text{PPh}_3)_3\text{RhH}(\text{SiEt}_3)\text{Cl}$ is an intermediate.

Homogeneous Hydrogenation Using Hydrogen Peroxide-activated Iridium Complexes

F. VAN RANTWIJK, T. G. SPEK and H. VAN BEKKUM, *Rec. Trav. Chim. Pays-Bas*, 1972, **91**, (8), 1057-1068

Chlorotris(triphenylphosphine)Ir(I) and trans-carbonylchlorobis(triphenylphosphine)Ir(I) were treated with H_2O_2 to yield catalysts for homogeneous hydrogenation. Activation appears to involve selective oxidation of one triphenylphosphine ligand. Hydrogenation of terminal or cis-substituted olefinic double bonds, catalysed by both complexes, is accompanied by extensive isomerisation.

Some Aspects of the Polymerisation of Cycloolefins by Group VIII Metal Catalysts

L. PORRI, R. ROSSI, P. DIVERSI and A. LUCHERINI, *Abstr. Papers, 164th Natl. Mtg., Am. Chem. Soc.*, 1972, POLY 54

$[(\text{Cyclooctene})_2\text{IrX}]_2$, $[\text{C}_8\text{H}_{10}\text{RuX}_2]_2$ (X = Cl,

OCOF_3 , $(\text{CO})\text{Cl}$ and $\text{H}_2\text{IrCl}_6 \cdot 6\text{H}_2\text{O}$ are all very active for the polymerisation of norbornene, via ring-opening, but not of cyclopentene and cyclooctene, although the Ir catalysts give copolymers of norbornene with cyclopentene and cyclooctene and the Ru catalysts become active for cyclopentene polymerisation after H_2 treatment. Metathesis is suggested as the mode of action.

The Oxidation of 2-Propanol by Ruthenium Tetroxide

D. G. LEE and M. VAN DEN ENGH, *Can. J. Chem.*, 1972, **50**, (13), 2000-2009

The kinetics of the oxidation of 2-propanol by RuO_4 in aqueous solutions of HClO_4 were studied, and show two separate mechanisms to apply. At moderate acid concentrations ($\sim 6.5M$ HClO_4) the rate determining step involves hydride abstraction, whilst at very high acid concentrations it is carbonium ion formation.

Investigation of the Homogeneous Hydrogenation of Acetylene and Ethylene Compounds in the Presence of $\text{RuCl}_2(\text{PPh}_3)_3$

E. F. LITVIN, L. KH. FREIDLIN and K. K. KARIMOV, *Izv. Akad. Nauk S.S.S.R., Ser. Khim.*, 1972, (8), 1853-1854

Acetylenic bonds of hexyne-1 were reduced selectively in the presence of $\text{RuCl}_2(\text{PPh}_3)_3$ but the rate of saturation was much less than the formation of hexene-1. Disubstituted acetylenes were reduced stereospecifically to form *cis*-ethylenes.

FUEL CELLS

Precious Metal Anodes: State of the Art

E. W. DREYMAN, *Mater. Protection Performance*, 1972, **11**, (9), 17-20

The characteristics and applications of Pb-Pt, Pt on Ti, Pt on Nb, Pt on Ta, and Ru oxides on Ti as impressed current anodes are reviewed.

GLASS TECHNOLOGY

Sintering of Ag-Pd in the Presence of a Reactive Glass

S. S. COLE, *J. Am. Ceram. Soc.*, 1972, **55**, (6), 296-299

Fired size versus timeⁿ plots for 20 wt.% Pd-Ag show that sintering occurs by grain boundary diffusion in the powder alone and by solution precipitation in the presence of up to 9 vol.% glass.

Plastic Flow and Fracture of Metallic Glass

H. J. LEAMY, H. S. CHEN and T. T. WANG, *Metall. Trans.*, 1972, **3**, (3), 699-708

Studies of the plastic flow and fracture of three $\text{Pd}_{0.8}\text{Si}_{0.2}$ -based alloys show that they are brittle and fracture intergranularly in the fully crystalline

state but that plastic flow precedes shear-initiated fracture in the glassy and microcrystalline states.

ELECTRICAL AND ELECTRONIC ENGINEERING

Oxidation of Platinum Group Metal Contacts by the Mechanochemical Reaction

S. SHIMOSATO, *J. Japan Inst. Metals*, 1972, **36**, (6), 610-616

The oxidation of Pt, Pd and Rh contacts was studied by contact resistance measurement, observation and E.P.M.A. Contact resistance increases markedly after operation in purified air, due to mechanochemical oxidation, but this is inhibited in unpurified air by the adsorption of H_2O and organic vapours on the contact.

Internal Stresses and Interdiffusion of Ti-Pd-Au Films Studied by X-ray Diffraction Techniques

S. S. LAU and R. C. SUN, *Thin Solid Films*, 1972, **10**, (2), 273-282

The effect of ageing at 284-425°C on the mechanical and structural properties of three layer Ti/Pd/Au electrical conductor films was studied. Stresses in Au film on Pd/Ti are independent of the substrate ceramic and are lower than those of Au films deposited directly on the Ti bonding layer. During ageing substantial interdiffusion between Au and Pd occurs, the diffusion rate of Pd being greater than that of Au.

Rh-doped LiNbO_3 as an Improved New Material for Reversible Holographic Storage

A. ISHIDA, O. MIKAMI, S. MIYAZAWA and M. SUMI, *Appl. Phys. Lett.*, 1972, **21**, (5), 192-193

The use of Rh as a new dopant for LiNbO_3 for hologram production is described. Doping with Rh introduces a new absorption band peaking at $\sim 4880\text{\AA}$, and greatly improves the recording sensitivity, diffraction efficiency, erasing sensitivity and the persistence of holograms.

ThO_2 on Ir Cathodes for Electron Bombarded Semiconductor Devices

H. F. GRAY, F. H. HARRIS, T. PANKEY and G. A. HAAS, *Rev. Sci. Instrum.*, 1972, **43**, (8), 1113-1115

ThO_2 on Ir was shown to be superior to standard oxide cathodes as an electron emitter for electron bombarded semiconductor devices. Quadrupole and Auger measurements showed little reduction of ThO_2 by Ir and negligible evaporation products. ThO_2 on Ir is resistant to air and to poisoning and can be reactivated fully.

Preparation, Structure and Electrical Properties of Thick Ruthenium Dioxide Films

S. PIZZINI, G. BUZZANCA, C. MARI, L. ROSSI and S. TORCHIO, *Mater. Res. Bull.*, 1972, **7**, (5), 449-462

Electron microscopy, electrical conductivity and

X-ray diffraction studies carried out on thick polycrystalline RuO_2 films, obtained by decomposition of RuCl_3 , show that below 700°C the conductivity and lattice constant depend on Cl content but above 800°C the conductivity depends only on temperature and has a positive coefficient. The films are shown to be Cl-doped oxide.

TEMPERATURE MEASUREMENT

The Movable-junction Stationary-lead Thermocouple

E. G. MURDOCK and E. H. MCLAREN, *Rev. Sci. Instrum.*, 1972, **43**, (5), 787-790

Two types of movable-junction Pt : 10%Rh-Pt

research thermocouples have been developed, one to measure temperature and low gradients accurately from $0-1100^\circ\text{C}$ and the other to determine the immersion characteristics of each thermoelement of a couple.

A Method for the Control and Measurement of Wire Temperature in Preparatory Anneals on Standard Pt/Pt-10Rh Thermocouples

E. H. MCLAREN, E. G. MURDOCK and C. G. M. KIRBY, *Rev. Sci. Instrum.*, 1972, **43**, (5), 827-828

A method is described for annealing Pt : 10% Rh-Pt thermocouples at $0-1450^\circ\text{C}$ (particularly at 450°C) by means of a 60Hz heating current and simultaneously measuring and controlling the temperature to $\pm 10^\circ\text{C}$ using the d.c. thermal e.m.f.

NEW PATENTS

METALS AND ALLOYS

Lead Alloys

BADISCHE ANILIN- & SODA-FABRIK A.G.

British Patent 1,293,031

The corrosion resistance of Pb alloys is improved by adding 0.05-0.2% Pd.

Nitrogen-free Platinum Powders

E. I. DU PONT DE NEMOURS & CO.

U.S. Patent 3,667,935

N_2 -free Pt powders are prepared by precipitation from an aqueous PtCl_2 solution with Zn and HCl. This N_2 -free Pt powder is relatively coarse and can be used in the production of various electrical circuit structures.

Dental Alloy

AURIUM RESEARCH CORP. *U.S. Patent* 3,667,936

An alloy for dental frames which are to carry ceramic coverings contains 8-50% Pd, 3-12% In and the remainder mostly Au or Au and Ag.

CHEMICAL COMPOUNDS

Production of Platinum and Palladium Complexes

PHILLIPS PETROLEUM CO. *U.S. Patent* 3,671,560

Elementary Pd or Pt is reacted directly with a trisubstituted phosphine to give a zerovalent complex with 4 phosphine groups, e.g. $\text{Pd}(\text{PPh}_3)_4$.

Rhodium-Tellurium Oxide

SOLVAY & CIE.

French Appl. 2,099,648

A new compound of Rh and Te has the formula Rh_2TeO_6 . It crystallises as a trirutile tetragonal system. It can be used as a semiconductor, catalyst, electrode material etc. The tungsten analogue Rh_2WO_6 has similar properties (*French*

Appl. 2,099,649). *French Appl.* 2,099,647 is more general and covers the A_2BO_6 compounds where A is Co, Cr, Fe, Mn, Al, Ga, Ir, Rh or V and B is Te, W, Mo, Re. Pt group metal-Te oxides as electrochemical electrodes are covered by *French Appl.* 2,099,650.

ELECTROCHEMISTRY

MATSUSHITA ELECTRIC INDUSTRIAL CO. LTD.

British Patent 1,284,279

The catalyst for an electrode of an electrochemical cell is made by reducing a mixed solution of a U compound and an active catalyst metal compound of a Pt group metal to produce a U-containing active catalyst metal.

Electrolysis Electrode Coating

P.P.G. INDUSTRIES INC.

U.S. Patent 3,663,414

An anode for the electrolysis of an aqueous solution includes an electroconductive base member, typically Ti, and an electroconductive coating or surface including an inner layer of a Pt group metal and an outer layer of a Pt group metal oxide.

Electrochemical Electrodes

SOLVAY & CIE.

U.S. Patent 3,668,005

Electrochemical electrodes are made by coating a base with RuO_2 . The base electrode, consisting of Ti, Ta, etc., is first etched and coated with an oxidisable substance, such as an oil, grease or hydrocarbon. The coated surface is then exposed to RuO_4 which oxidises the coating and deposits RuO_2 .

Electrode for a Conducting Cell

E. SLEVOGT

German Offen. 2,061,976

A cell for measuring electrical conductivity is provided with an electrode made with a Pd skeleton or of compressed Pd powder.