

# ABSTRACTS

of current literature on the platinum metals and their alloys

## PROPERTIES

### The Wetting of High Temperature Oxides by Molten Platinum and Its Work of Adhesion

E. L. LUBININ, S. G. GUSHCHIN, A. I. TIMOFEEV and L. V. UZBERG, *Izv. Vysshikh Ucheb. Zaved., Tsvetnaya Metal.*, 1976, **19**, (5), 151-152

Studies of the wetting of BeO, MgO, Y<sub>2</sub>O<sub>3</sub> and ZrO<sub>2</sub>+20% Y<sub>2</sub>O<sub>3</sub> by molten Pt were carried out in He atmosphere at temperatures ranging from the melting point of Pt up to 2100°C, using the sessile drop method. It is shown that BeO is least wetted by Pt. The wetting angle  $\theta$  of Pt on BeO changes from 120 to 110° at 1800-2000°C, and the work of adhesion changes from 800 to 1100 MJ/m<sup>2</sup> in this temperature range. The wetting angles on MgO and Y<sub>2</sub>O<sub>3</sub> were 92 and 88° respectively and were found practically constant with temperature. The value of  $\theta$  on ZrO<sub>2</sub>+20% Y<sub>2</sub>O<sub>3</sub> decreases with increasing temperature from 85 to 60° and the work of adhesion increases from 1950 to 2400 MJ/m<sup>2</sup>.

### Effect of Carbon and Water on Wetting and Reactions of B<sub>2</sub>O<sub>3</sub>-containing Glasses on Platinum

G. A. HOLMQUIST and J. A. PASK, *J. Am. Ceram. Soc.*, 1976, **59**, (9-10), 384-386

The wetting characteristics of molten B<sub>2</sub>O<sub>3</sub> and B<sub>2</sub>O<sub>3</sub>-containing glasses on Pt were studied using the sessile drop method, at 700-1000°C under ambient pressures of 10<sup>-4</sup> torr to 1 atm. It is shown that in atmospheres free of carbonaceous gases, the contact angle for all glasses on Pt was small and independent of pressure and temperature. Adsorption of C at the metal surface increased the contact angle. Absorption of H<sub>2</sub>O vapour by the glasses resulted in a reaction at the solid/liquid interface, spreading of the glass and adherence.

### Adsorption of H<sub>2</sub> and CO on Clean and Oxidised (110) Pt

R. W. MCCABE and L. D. SCHMIDT, *Surface Sci.*, 1976, **60**, (1), 85-98

Studies of binding states and sticking coefficients of CO and H<sub>2</sub> on clean and oxide covered (110) planes of Pt were made using flash desorption mass spectrometry and Auger electron spectroscopy. The results show that both adsorbates have higher binding energies on the oxide than on the clean surface. Initial sticking coefficients for CO were 1.0 and 0.85 and for H<sub>2</sub> 0.15 and 0.28 on clean and oxidised surfaces respectively.

### Interaction of Hydrogen with Pt(111): The Role of Atomic Steps

K. CHRISTMANN and G. ERTL, *Surface Sci.*, 1976, **60**, (2), 365-384

The interaction of H<sub>2</sub> with stepped Pt(S)-9(111) × (111) surface was studied using LEED, AES, ELS, thermal desorption and work function techniques. It was found that the saturation coverage with dissociatively adsorbed H<sub>2</sub> at 120K is near unity. The presence of steps increased the initial sticking coefficient by a factor of four to a value of 0.34. The activity for H<sub>2</sub>-D<sub>2</sub> exchange reaction was enhanced by an order of magnitude. A model in which two different types of adsorbed H atoms are associated with the atomic steps is proposed.

### Ductile-Brittle Transition in Metallic Glasses

H. S. CHEN, *Mater. Sci. Engng.*, 1976, **26**, (1), 79-82

Studies of the ductile-brittle behaviour in (M<sub>1-x</sub>N<sub>x</sub>)<sub>0.75</sub>P<sub>0.15</sub>B<sub>0.06</sub>Al<sub>0.03</sub> alloy with M, N = Fe, Co, Ni, Cr and Mo show that the Fe, Co, Mo and Cr metallic glasses are very brittle in comparison with the Ni, Pd and Pt based glasses. It is suggested that the incomplete *d*-shell orbitals of the Fe, Co, Cr and Mo atoms lead to higher resistance to shear strains and brittle behaviour. The Ni, Pd and Pt glasses by filling the *d*-shell of the transition metals ensure a relatively low shear modulus and ductile behaviour.

### Strengths and Stiffnesses of Metallic Glasses

L. A. DAVIS, C.-P. CHOU, L. E. TANNER and R. RAY, *Scripta Metall.*, 1976, **10**, (10), 937-940

The elastic and plastic properties of a number of metallic glasses including Pd<sub>80</sub>Si<sub>20</sub>, Pd<sub>77.5</sub>Cu<sub>8</sub>Si<sub>16.5</sub> and Pd<sub>40</sub>Ni<sub>40</sub>P<sub>20</sub> were studied and a simple correlation of the strengths and stiffnesses of these glasses was observed. The correlation between the strengths and stiffnesses is given in terms of the Vickers hardness, Young's modulus, density and the velocity of extensional mode ultrasonic waves.

### The Motions of Hydrogen Impurities in $\alpha$ -Palladium Hydride

W. DREXEL, A. MURANI, D. TOCCHETTI, W. KLEY, I. SOSNOWSKA and D. K. ROSS, *J. Phys. Chem. Solids*, 1976, **37**, (12), 1135-1139

Studies of the intensity distribution of inelastically scattered thermal and hot neutron on H impurities in  $\alpha$ -palladium hydride were made as a function of concentration, temperature, momentum transfer and different annealing procedures.

The results show that at higher concentrations and with insufficient annealing treatment clusters of H atoms are formed even in the  $\alpha$ -phase, producing a local lattice distortion.

### Superconductivity in the Pd<sub>1-x</sub>M<sub>x</sub>H<sub>c</sub> (M is Noble Metal) and PdB<sub>y</sub>H<sub>c</sub> Alloy Systems

A. W. SZAFRAŃSKI, T. SKOŚKIEWICZ and B. BARANOWSKI, *Phys. Status Solidi A, Appl. Res.*, 1976, **37**, (2), K163-K164

The dependence of the transition temperature  $T_c$  on the H<sub>2</sub> content in several Pd-Cu and Pd-Ag alloys and on the H + B content in several Pd-B alloys was studied. The results show that the increase of H<sub>2</sub> concentration causes an increase of  $T_c$  and that the higher the Cu, Ag or B concentration the lower is the  $c$ -value corresponding to the appearance of superconductivity. The presence of noble metal (and also B) atoms in the Pd alloy considerably reduces the solubility of H<sub>2</sub>.

### Metallic Glasses

H. S. CHEN, *Mater. Sci. Engng.*, 1976, **25**, 59-69

A review of the physical properties of metallic glasses including Pd-Au-Si, Pd-Cu-Si, Pd-Si, Pd-Ni-P and Pt-Ni-P, is presented. The formation, stability and glass transition as well as structure, structure relaxation and crystallisation are discussed. The mechanical behaviour and magnetic properties are summarised. Acoustic and electron transport properties are described.

### The $\beta \rightarrow \alpha$ Phase Transformation in Palladium-Hydrogen Alloys

H. C. JAMIESON, G. C. WEATHERLY and F. D. MANCHESTER, *J. Less-Common Metals*, 1976, **50**, (1), 85-102

A room temperature study has been made of the  $\beta \rightarrow \alpha$  phase transformation in thin foils of annealed  $\beta$ -palladium hydride using electron microscopy and diffraction techniques. Initially coherent precipitation of  $\alpha$  was observed close to the surface of the foil while the transformation proceeds in a discontinuous manner accompanied by the formation of a high dislocation density and microcracks in the  $\alpha$  phase. It is thought that the rate of transformation is controlled by the formation of molecular H<sub>2</sub> at the foil surface.

### The Internal Friction and Elastic Modulus of Amorphous Pd-Si and Fe-P-C Alloys

T. SOSHIRODA, M. KOIWA and T. MASUMOTO, *J. Non-Cryst. Solids*, 1976, **22**, (1), 173-187

Internal friction of an amorphous Pd-Si alloy was measured from room temperature to  $\sim 550^\circ\text{C}$  using a specially designed micro-tension pendulum. It is shown that the internal friction of the amorphous alloy increases steeply with temperature. A wide range of distribution in activation energies was observed. The shear modulus was found to increase by  $\sim 30\%$  upon crystallisation.

### The Influence of Adsorbed Carbon on the Condensation of Molecular NaCl on Ir and Pt

YU. A. GEL'MAN, YU. N. LYUBITOV, V. I. MIKHAILOV, V. F. VINOGRADOV and A. A. CHERNOV, *Kristallografiya*, 1976, **21**, (6), 1175-1177

Studies of the nucleation and growth of NaCl crystals on Ir and Pt show that the condensation rate on clean substrates is considerably higher than that on substrates covered with adsorbed C. This is attributed to a lower energy of adsorption of the NaCl on the C covered surfaces of Pt or Ir.

### Thermal Expansion Measurements Near the Antiferromagnetic Phase Transitions in K<sub>2</sub>ReCl<sub>6</sub> and K<sub>2</sub>IrCl<sub>6</sub>

H. W. WILLEMSSEN, R. L. ARMSTRONG and P. M. MEINCKE, *J. Low Temp. Phys.*, 1977, **26**, (1/2), 299-309

The linear thermal expansion coefficient measurements for K<sub>2</sub>IrCl<sub>6</sub> and K<sub>2</sub>ReCl<sub>6</sub> show anomalous behaviour near the antiferromagnetic phase transition. The results show that the contribution of the next-nearest-neighbour exchange interaction to the thermal strain is of opposite sign for the two compounds.

### Studies of the Phase Composition and Electrical Transport Properties of the RuO<sub>2</sub>-TiO<sub>2</sub> System

YU. E. ROGINSKAYA, B. SH. GALYAMOV, V. M. LEBEDEV, I. D. BELOVA and YU. N. BENEVTSEV, *Zh. Neorg. Khim.*, 1977, **22**, (2), 499-504

X-ray studies of the RuO<sub>2</sub>-TiO<sub>2</sub> phase diagram at 900, 1200 and 1350°C show that there are two regions of limited solubility, one near the TiO<sub>2</sub> and another near the RuO<sub>2</sub>. In the remaining concentration range there exist two rutile phases which are solid solutions of TiO<sub>2</sub> in RuO<sub>2</sub> and RuO<sub>2</sub> in TiO<sub>2</sub>. The dependence of electrical conductivity and thermal e.m.f. of the Ti<sub>1-x</sub>Ru<sub>x</sub>O<sub>2</sub> ( $x=1-6$  mole%) solid solutions on the composition, temperature and partial pressure of O<sub>2</sub> is discussed. The defect structure in the crystal lattice of these solid solutions is presented.

## CHEMICAL COMPOUNDS

### An Analytical Study of Platinum Silicide Formation

J. B. BINDELL, J. W. COLBY, D. R. WONSIDLER, J. M. POATE, D. K. CONLEY and T. C. TISON, *Thin Solid Films*, 1976, **37**, (3), 441-452

AES, secondary ion mass spectroscopy and electron probe microanalysis were used to study the kinetics of Pt silicide formation and the surface effects were found to relate to O<sub>2</sub> and Al contamination of the films. The contaminants moved with the Pt-Pt silicide interface during subsequent annealing, while additional oxidation occurred at the surface due to some very small amount of O<sub>2</sub> in the annealing ambient.

### Crystal Structure of Pd<sub>16</sub>S<sub>7</sub>

P. MATKOVIĆ, M. EL-BORAGY and K. SCHUBERT, *J. Less-Common Metals*, 1976, **50**, (2), 165-176

Crystallographic studies of the Pd-S system show that the phase Pd<sub>16</sub>S<sub>7</sub> has a cubic body-centred structure with 46 atoms in the cubic cell and is related to the  $\gamma$ -brass structure. The phases Pd<sub>4</sub>S, Pd<sub>3</sub>S.b, Pd<sub>16</sub>S<sub>7</sub>, PdS and PdS<sub>2</sub> were interpreted as energetically favourable in terms of the two-electron correlation model.

## ELECTROCHEMISTRY

### The Effect of Anions on Hydrogen Chemisorption and Oxide Formation on Pt in Aqueous Acids

P. N. ROSS, *J. Electroanal. Chem. Interfacial Electrochem.*, 1977, **76**, (1), 139-145

A potentiodynamic cyclic voltammetry method was used to study the component processes of H chemisorption on Pt and Pt oxide formation in H<sub>2</sub>SO<sub>4</sub>, HClO<sub>4</sub> and HF aqueous acids. Processes of H adsorption/desorption and Pt oxide formation occurred only in H<sub>2</sub>SO<sub>4</sub> and not in HClO<sub>4</sub> or HF, and thus represent anion interference with the faradaic reactions. The strong H species were observed in 1M HF + 10<sup>-3</sup>M H<sub>2</sub>SO<sub>4</sub>.

### Effect of the Addition of Ruthenium Trichloride on Oxygen Overvoltage at a Platinum Anode in Aqueous Acidic Solution

C. IWAKURA, A. ASADA and H. TAMURA, *Denki Kagaku*, 1976, **44**, (10), 639-645

The effect of the addition of RuCl<sub>3</sub> on O<sub>2</sub> overvoltage was studied at a Pt anode in aqueous acidic solution using cyclic voltammetry, potential-time curves and by determination of evolved O<sub>2</sub> gas. The RuCl<sub>3</sub> addition noticeably decreased the overvoltage for the anodic evolution of O<sub>2</sub> at low anodic potentials which was attributed to the presence of Ru species as active sites, incorporated in the oxide film of the Pt anode. The results at relatively high anodic potentials showed that RuCl<sub>3</sub> additions slowed down the O<sub>2</sub> evolution, due to simultaneous oxidation of the Ru species.

### Reduction of Nitric Oxide at a Platinum Cathode in an Acidic Solution

L. J. J. JANSSEN, M. M. J. PIETERSE and E. BARENDRECHT, *Electrochim. Acta*, 1977, **22**, (1), 27-30

Studies of the reduction of NO were carried out at a Pt electrode in 4M H<sub>2</sub>SO<sub>4</sub> using the measurement of potential/current relations and by the determination of the current efficiencies for N<sub>2</sub>O, NH<sub>3</sub>, hydrazine and H<sub>2</sub> formation at fixed potentials from 0 to -400mV. The results showed that in the potential range of the first wave (> -30mV) NO was reduced only to N<sub>2</sub>O. In the second wave (from -50 to -250mV), NO was reduced to hydroxylamine, NH<sub>3</sub> and NO<sub>2</sub>.

### Electrochemical Study of Palladium Powder Catalysts

T. MALLÁT, É. POLYÁNSZKY and J. PETRÓ, *J. Catalysis*, 1976, **44**, (3), 345-351

The potentiodynamic polarisation method was used for electrochemical studies of the Pd-H system. The Pd catalyst prepared by reducing H<sub>2</sub>PdCl<sub>4</sub> solution was used in a powder form and the amount and nature of H<sub>2</sub> sorbed on the catalyst was studied in various electrolytes. It is shown that the shape of the potentiodynamic curves and the number of hydrogen maxima depend on the age of the catalyst and on the electrolyte. The ratio of adsorbed and dissolved H<sub>2</sub> was affected by the catalyst preparation method.

### The Anodic Dissolution of Noble Metals in Relation to Their Solid State Cohesion

A. K. VIJH and G. BÉLANGER, *Corrosion Sci.*, 1976, **16**, (11), 869-872

Studies of the rates of anodic dissolution for Rh, Pd, Ir, Pt and Au at a given value of the anodic dissolution overpotential  $\eta$  show that these rates in 1M H<sub>2</sub>SO<sub>4</sub> are inversely related to the metal-metal bond energies of the noble metals.

### Effect of Working Electrode Substrate on the Deposition of Iron in Molten LiF-BeF<sub>2</sub>-ThF<sub>4</sub> (72-16-12 mole %)

D. L. MANNING and G. MAMANTOV, *High Temp. Sci.*, 1976, **8**, (3), 219-224

Studies of the Fe(II) reduction at Ir, Au and pyrolytic graphite electrodes were carried out using voltammetric and chronopotentiometric methods and LiF-BeF<sub>2</sub>-ThF<sub>4</sub> as a solvent. It is shown that the Fe<sup>2+</sup> is reversibly reduced to a soluble form at Au and to an insoluble form at pyrolytic graphite. The Fe<sup>2+</sup> reduction at Ir gives both soluble and insoluble products depending on the temperature. Diffusion coefficient and activation energy values are derived.

## ELECTRODEPOSITION AND SURFACE COATINGS

### Electrodeposited Noble Metal Coatings from the Present Day Point of View

H. GROSSMANN, *Galvanotechnik*, 1977, **68**, (1), 48-53

A review of the current methods of plating Pt group metals and Au for decorative purposes is presented.

### Increase of the Corrosion Resistance of Electrolytic Chromium Coatings by Modification with Palladium

N. D. TOMASHOV, G. P. CHERNOVA, and T. A. FEDOSEEVA, *Zashchita Metal.*, 1976, **12**, (1), 3-6

Studies of the corrosion resistance and the electrochemical behaviour of electrodeposited coatings

of Cr modified with 1-3% Pd were carried out. The results show that these coatings are considerably more corrosion resistant in 20% H<sub>2</sub>SO<sub>4</sub> and 5% and 10% HCl solutions than the unmodified coatings.

## HETEROGENEOUS CATALYSIS

### New Hydrogenation Catalysts with Platinum Deposited on Polyamide-66. IV. Comparison of the Activities of Different Catalysts in the Hydrogenation of Styrene

J.-R. BERNARD, C. HOANG-VAN and S. J. TEICHNER, *J. Chim. Phys.*, 1976, 73, (7-8), 799-802

Spectroscopic studies of the catalytic activity of the Pt/polyamide-66 catalyst made during the hydrogenation of styrene into ethylbenzene at 100°C showed that the activity of the catalyst did not depend on the total Pt content but was proportional to the amount of Pt at surface of the nylon. The influence of the preparation of the catalyst, of the solvent and of the nature of the Pt compound on its catalytic activity was discussed.

### Catalytic Reforming of Benzene Fractions on Polymetallic Catalysts

G. N. MASLYANSKII, B. B. ZHARKOV, A. P. FEDOROV, T. M. KLIMENKO, R. N. SHAPIRO and R. F. PANNIKOVA *Khim. Tekhnol. Topliv Masel*, 1977, (1), 16-20

The catalytic reforming of benzene was carried out over polymetallic 0.6 wt.% Pt/Al<sub>2</sub>O<sub>3</sub> and 0.35 wt.% Pt/Al<sub>2</sub>O<sub>3</sub> catalysts at pressures of 15-35 atm. The results show that high benzene and toluene outputs are obtained during reforming over the 0.35 wt.% Pt/Al<sub>2</sub>O<sub>3</sub> catalyst. The lowering of the working pressure down to 14 atm led to a further increase of the hydrocarbon output.

### Relative Importance of Thermal and Chemical Deactivation of Noble Metal Automotive Oxidation Catalysts

R. A. DALLA BETTA, R. C. MCCUNE and J. W. SPRYS, *Ind. Engng. Chem., Prod. Res. Dev.*, 1976, 15, (3), 169-172

The deactivation of a series of monolithic Pt/Al<sub>2</sub>O<sub>3</sub> and Pt+Pd/Al<sub>2</sub>O<sub>3</sub> catalysts was studied after operation in vehicles for 50,000 miles. It is shown by transmission electron microscopy that the metal particles grew from ~60Å to 1000Å. The CO chemisorption techniques show that the available metal area decreased to  $3 \times 10^{-4}$  m<sup>2</sup>/g. The thermal sintering causes loss of 95% of the original metal area and poisons deactivate 95% of the remaining metal area.

### Sulphur Storage on Automotive Catalysts

K. C. TAYLOR, *Ind. Engng. Chem., Prod. Res. Dev.*, 1976, 15, (4), 264-268

Studies of the Pt-Pd/Al<sub>2</sub>O<sub>3</sub> pellets catalyst activity for SO<sub>2</sub> oxidation were made in a catalytic

reactor. It was found that the catalyst composition, support characteristics and catalyst pretreatment influence the catalytic oxidation of SO<sub>2</sub>, but the main influence is due to S storage on pelleted catalysts. It is suggested that S storage may provide an effective means of lowering H<sub>2</sub>SO<sub>4</sub> emissions.

### The Kinetics of Hydrogen Peroxide Decomposition on Platinum Adsorption Catalysts

Z. V. LUK'YANOVA, T. G. MARTYNYUK, V. I. SHEKHOBALOVA and T. A. POSPELOVA, *Zh. Fiz. Khim.*, 1976, 50, (11), 2837-2840

Kinetic studies of H<sub>2</sub>O<sub>2</sub> decomposition on Pt/SiO<sub>2</sub>, Pt/Al<sub>2</sub>O<sub>3</sub> and Pt/SiO<sub>2</sub>-Al<sub>2</sub>O<sub>3</sub> adsorption catalysts and on Pt black show that the reaction order is ~0.6 and it does not depend on the nature of the carrier. Deactivation of the catalysts during decomposition changes the order as well as the rate constant of the reaction. The apparent activation energy was determined to be 9-11 kcal/mole for all the catalysts.

### Platinum-Rhenium-Alumina Catalysts. III. Catalytic Properties

C. BETIZEAU, G. LECLERCQ, R. MAUREL, C. BOLIVAR, H. CHARCOSSET, R. FRETU and L. TOURNAYAN, *J. Catalysis*, 1976, 45, (2), 179-188

Studies of the activity of Pt-Re/ $\alpha$ -Al<sub>2</sub>O<sub>3</sub> and Pt-Re/ $\gamma$ -Al<sub>2</sub>O<sub>3</sub> catalysts in five different reactions showed that the activity is not the sum of the activities of Pt and Re. The activity vs. composition curves have one or two maxima in benzene hydrogenation, benzene-deuterium exchange, cyclopentane and butane hydrogenolysis. The rate of 1,1,3-trimethyl cyclohexane dehydrogenation was found to decrease with increase of Re.

### A Study of the Chemisorption of Nitric Oxide on PdY Zeolite. Evidence for a Room Temperature Oxidative Dissolution of Pd Crystallites

M. CHE, J. F. DUTEL, P. GALLEZOT and M. PRIMET, *J. Phys. Chem.*, 1976, 80, (21), 2371-2381

Studies of NO adsorption on a PdY zeolite in oxidised and reduced forms were carried out using i.r. and E.P.R. spectroscopies. It is shown that NO can be reduced in N<sub>2</sub>O and the Pd can be reoxidised to such an extent that all the metal atoms are redispersed as cations on the support. These results are of practical interest for the elimination of NO in automobile exhaust and are important in the problem of catalysts ageing.

### On the Catalytic Reduction of Nitric Oxide in the Presence of Oxygen

R. SIGG and E. WICKE, *Z. Phys. Chem., Neue Folge*, 1976, 103, (1-4), 181-192

Studies of the reduction of NO by H<sub>2</sub> and CO over a number of Pd, Ag and Fe mixed catalysts supported on  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> showed that the three-component catalyst Pd/Ag/Fe had a remarkable

selectivity for the NO reduction by H<sub>2</sub> and CO even at O<sub>2</sub> concentrations of 2% at the inlet. The relatively low excess temperatures of the Pd/Ag/Fe catalyst indicated a reduced selectivity of the CO oxidation by O<sub>2</sub> as compared to the other catalysts.

#### Study of Adsorption Properties of a Pd/Al<sub>2</sub>O<sub>3</sub> Catalyst

V. A. HAIDIN, G. D. ZAKUMBAEVA and D. V. SOKOL'SKII, *Zh. Fiz. Khim.*, 1977, **51**, (1), 183-187  
Studies of the H<sub>2</sub> sorption and specific adsorption of Zn and Cd cations on 0.05g Pd/Al<sub>2</sub>O<sub>3</sub> catalyst were carried out using 1N H<sub>2</sub>SO<sub>4</sub>, H<sub>2</sub>O and NH<sub>4</sub>OH solvents. It is shown that the quantity of adsorbed cations depends on their concentration in the solution and on the nature of the solvent. The effect of temperature on the amounts of sorbed H<sub>2</sub> and adsorbed cations is discussed.

#### Organic Hydrogen Getters

R. L. COURTNEY and L. A. HARRAH, *J. Mater. Sci.*, 1977, **12**, (1), 175-186

A 5% Pd-CaCO<sub>3</sub> catalyst in combination with an unsaturated dimerised phenyl propargyl ether-DPPE was developed for getting H<sub>2</sub> irreversibly from closed systems via a chemical reaction. The activation energy for H<sub>2</sub> uptake was found to be 9.4 kcal/mole at 22-55°C. The getter material can be used as a powder or be packaged in a bag through which H<sub>2</sub> can permeate. The getter is shown to be non-explosive and non-phosphoric.

#### Electrochemical Study of Palladium-Copper Catalysts

T. MALLÁT, J. PETRÓ, É. POLYÁNSZKY and T. MÁTHÉ, *Acta. Chim. Acad. Sci. Hung.*, 1976, **90**, (4), 333-344

The correlations between the H<sub>2</sub> sorption and catalytic activity of Pd-Cu powder catalysts with 0, 10, 20, 30, or 40 at.% Cu were studied using galvanostatic and potentiodynamic methods in 1N NaOH and 1N H<sub>2</sub>SO<sub>4</sub> respectively. The catalyst activities were measured in liquid-phase hydrogenation at 25°C and 1 atm. The quantitative decrease of the dissolved H<sub>2</sub> was observed on 0-20 at.% Cu-Pd catalysts while for 20-40 at.% Cu-Pd catalysts, the decrease was primarily in the adsorbed H<sub>2</sub>.

#### The Effect of Thermal Treatment on the Catalytic Activity of Skeleton Iridium in the Acetone Reduction

O. G. NOVOZHILOVA, A. I. PLETYUSHKINA, A. D. SEMENOVA and G. D. VOYCHENKO, *Vest. Moskov. Univ. Ser. II, Khim.*, 1976, **17**, (5), 615-617

Studies of the catalytic activity of a skeleton Ir electrode catalyst in the acetone reduction show that thermal treatment of the catalyst in a H<sub>2</sub> atmosphere at 100-600°C has no significant effect on the adsorption and hydrogenation of acetone.

#### The Catalytic Activity of Rh, Ru and Ir Blacks, Deposited on Pt Supports, in the Processes of Reduction and Electroreduction of Maleic Acid

D. G. NARYSHKIN and I. V. KUDRYASHOV, *Zh. Fiz. Khim.*, 1976, **50**, (9), 2315-2319

The catalytic activities of Pt supported Rh, Ru and Ir black electrodes were studied in the electroreduction and hydrogenation of maleic acid. The results show that the catalytic activity changes in the following order Rh > Ir > Ru.

#### The Kinetics and Mechanism of Carbon Monoxide Hydrogenation over Silica-Supported Ruthenium-Copper Catalysts

G. C. BOND and B. D. TURNHAM, *J. Catalysis*, 1976, **45**, (2), 128-136

Studies of the activity of Ru-Cu/SiO<sub>2</sub> catalysts for CO hydrogenation at 530-670K show that the activity decreases with increasing Cu content, while the activation energy remains constant at 21 kcal/mole. The catalyst containing 1% Ru and 0.32% Cu initially produces less ethane and propane than does the pure Ru catalyst.

#### Ruthenium Zeolite Hydrogenation Catalysts

B. COUGHLAN, S. NARAYANAN, W. A. MCCANN and W. M. CARROLL, *Chem. and Ind.*, 1977, (3), 125-127

The catalytic activities of Ru L, A, X, Y and mordenite zeolites, catalysts with widely different cation densities, cation binding energies, pore structure and molecular sieve properties were studied in the hydrogenation of benzene. The results show that a Ru-L zeolite in which the Ru metal is highly dispersed is an excellent hydrogenation catalyst. Good activities were also observed for Ru zeolites X, Y and mordenite in which the metal is not so well dispersed.

## HOMOGENEOUS CATALYSIS

#### The Isotopic Exchange of Benzofurans with Heavy Water in the Presence of Potassium Tetrachloroplatinate

E. A. KARAKHANOV, A. G. DELOV, L. V. POPOV and E. A. VIKTOROVA, *Vest. Moskov. Univ. Ser. II, Khim.*, 1976, **17**, (5), 595-597

Studies of H-D exchange between heavy water and benzofurans were carried out at 120°C in the presence of homogeneous K<sub>2</sub>PtCl<sub>4</sub> as a catalyst. The difference in reactivity of benzofuran and its alkyl derivatives was discussed in terms of a homogeneous dissociative  $\pi$ -complex mechanism.

#### Transition Metal Catalysed Rearrangements of Small Ring Organic Molecules

K. C. BISHOP, *Chem. Rev.*, 1976, **76**, (4), 461-486

The literature on the molecular rearrangements, catalysed by transition metals, in organic molecules with three- and four-membered rings is critically surveyed. (132 Refs.)

## CHEMICAL TECHNOLOGY

### Enhanced Low Temperature Sintering of Tungsten

R. M. GERMAN and Z. A. MUNIR, *Metal. Trans.*, 1976, **7A**, (12), 1873-1877

The influence of Pd, Pt, Fe, Co, Ni and Cu additions on the sintering of a fine W powder was studied using the isothermal and constant heating rate experiments at 900-1400°C. The results show that Pd is the best activator for the densification of W, followed by Ni, Co, Pt and Fe. A considerable acceleration of the sintering process is obtained when four atomic monolayers of Pd are present on the W powder surface. Near-theoretical densities are achieved at temperatures as low as 1200°C.

## ELECTRICAL AND ELECTRONIC ENGINEERING

### Differences between Platinum- and Gold-doped Silicon Power Devices

M. D. MILLER, *I.E.E.E. Trans. Electron Devices*, 1976, **ED-23**, (12), 1279-1283

The effects of Au and Pt diffusions on the properties of Pt- and Au-doped p<sup>+</sup>-n<sup>-</sup> junctions were studied. It was found that there are substantial differences between the energy levels introduced by these impurities. Pt shows improved high-temperature properties and turn-on performance and is better for devices which are switched on rapidly.

## NEW PATENTS

### METALS AND ALLOYS

#### Solution Hardened Alloys Containing Palladium

U.S. ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION *U.S. Patent* 3,976,479

Solution hardened alloys of Cu, for example, containing equal atomic percentages of Pd and Al are formed by using at least two solutes which form associated solute pairs in the solvent metal lattice.

#### Ruthenium Powder Alloy

GENERAL MOTORS CORP. *U.S. Patent* 3,977,841

Ductile Ru alloys are prepared by mixing 70-80% Ru powder with 20-30% prealloyed powder (containing Co, Ni, Cr, W and Si), both powders being of less than 200 mesh size, pressing at 35,000-50,000 psi, and sintering in dry and/or in a vacuum, at 2150-2250°F for 30-45 min.

### Materials Selection in Hybrid Product Design

R. D. GOLD, *Solid State Technol.*, 1977, **20**, (1), 31-35 and 57

The Pd-Ag conductor paste was found to be economical and reliable as a solderable conductor when used with a Sn-free Pb-Ag-In solder, in the manufacture of power hybrid voltage regulators.

## MEDICAL USES

### Anti-tumour Agents Synthesised from K<sub>2</sub>PtCl<sub>4</sub> and Polymeric or Cyclic Phosphazenes

H. R. ALLCOCK, R. W. ALLEN and J. P. O'BRIEN, *J. Chem. Soc., Chem. Commun.*, 1976, (18), 717-718

Complexes between a square-planar Pt unit, K<sub>2</sub>PtCl<sub>4</sub>, and polymers such as the phosphazenes [NP(NHMe)<sub>2</sub>]<sub>n</sub>, [NP(NHMe)<sub>2</sub>]<sub>4</sub> or [NPMes]<sub>4</sub> were obtained. These complexes of the type [H<sub>2</sub>N<sub>4</sub>P<sub>4</sub>R<sub>8</sub>]<sup>2+</sup>[PtCl<sub>4</sub>]<sup>2-</sup> show significant anti-tumour behaviour in preliminary testing.

### An Explanation for the Efficacy of Attack by Platinum Blue Drugs on Biopolymers

C. G. F. BLAKE, S. J. OATLEY and R. J. P. WILLIAMS, *J. Chem. Soc., Chem. Commun.*, 1976, (24), 1043-1044

Platinum halides and amides can react to form platinum blues, useful anti-tumour agents which are used as stains for biological specimens. Studies made of the interaction of these polymeric compounds with protein crystals have suggested a possible mode of action.

### Ruthenium Alloy for Use in Composite Seals

W. H. FENGLER *U.S. Patent* 3,991,229

A base metal, such as the Al or Fe housing of a rotary or reciprocating-piston I.C.E. and a sealing member for its pistons or rotor are coated with a layer of a wear resistant alloy such as Ru-W.

## ELECTRODEPOSITION AND SURFACE COATINGS

### Platinum-Rhodium Containing High Temperature Alloy Coating

CHROMALLOY AMERICAN CORP.

*British Patent* 1,463,447

The heat resistance of Ni- and/or Co-based alloys is improved by cleaning the surface of the alloy, thermally diffusing first and second coatings of Rh and Pt respectively on to the alloy surface and pack-aluminising the alloy.