

# ABSTRACTS

*of current literature on the platinum metals and their alloys*

## PROPERTIES

### Platinum as a Thermal Conductivity Standard

G. A. SLACK, *J. Appl. Phys.*, 1964, **35**, (2), 339-344  
An evaluation of data on the thermal conductivity  $K$  of Pt suggests that Pt would make a reproducible  $K$  standard in the range 75-2047°K. From 200 to 2047°K,  $K$  conforms to within  $\pm 2\%$  of  $K = (0.64_8 + 1.8 \times 10^{-4}T)W/cm \text{ deg.}$  but further work, especially at higher temperatures, is required before adoption of the standard.

### Absolute and Relative Linear Thermal Expansion Coefficients of Vitreous Silica and Platinum

L. F. OLDFIELD, *Glass Technol.*, 1964, **5**, (1), 41-50  
Work on expansion coefficients was reviewed and standard values are recommended: for Pt:  $\alpha_{(50-400^\circ\text{C})} = 9.56 \times 10^{-6}/^\circ\text{C}$ ,  $\alpha_{(50-350^\circ\text{C})} = 9.50 \times 10^{-6}/^\circ\text{C}$ ;  $\alpha_{(20-350^\circ\text{C})} = 9.46 \times 10^{-6}/^\circ\text{C}$ ; for vitreous  $\text{SiO}_2$ :  $\alpha_{(50-400^\circ\text{C})} = 0.60 \times 10^{-6}/^\circ\text{C}$ ,  $\alpha_{(50-350^\circ\text{C})} = 0.61 \times 10^{-6}/^\circ\text{C}$ ,  $\alpha_{(20-350^\circ\text{C})} = 0.60 \times 10^{-6}/^\circ\text{C}$ ; expansion of Pt relative to  $\text{SiO}_2$ :  $8.88 \pm 0.03 \times 10^{-6}/^\circ\text{C}$ .

### Change of Platinum Resistance by Hydrogen

R. J. GALAGALI, *Br. J. Appl. Phys.*, 1964, **15**, (2), 208-209

A glowing Pt filament was cooled by the presence of even a trace of  $\text{H}_2$  and the resistance decreased more as  $p_{\text{H}_2}$  increased. Ar had no effect and air had only a minor effect, even at higher temperatures. Ageing of Pt and electrical excitation of  $\text{H}_2$  modified the effect somewhat. It is suggested that energy derived from the wire dissociated  $\text{H}_2$  to H at the Pt surface, hence cooling the wire.

### Oxidation of the Platinum Metals in Air

W. L. PHILLIPS, *Am. Soc. Met. Trans. Q.*, 1964, **57**, (1), 33-37

Oxidation rates were measured in air over the range 800-1400°C. Each metal obeyed the linear weight loss law. Activation energies were: Os, 10 kcal/mole; Ru, 46.1 kcal/mole; Ir, 9.2 kcal/mole; Pd, 24.2 kcal/mole; Pt, 25.4 kcal/mole; Rh, 29.6 kcal/mole.

### A Constitution Diagram for the Tungsten-Palladium System

W. K. GOETZ and J. H. BROPHY, *J. Less-Common Metals*, 1964, **6**, (5), 345-353

X-ray and metallographic studies confirmed that no intermediate phase exists in the W-Pd system above 1100°C. The solubility of Pd in  $\alpha$ -W at

1815°C is 5%, decreasing to 1.5% at 1100°C. The Pd-rich solid solution forms peritectically from liquid and  $\alpha$ -W at 1815°C, 78% Pd. W is 0.5% less soluble at 1100°C. The solid solution lattice parameters have a minimum at 90% Pd.

### The System Palladium-Tungsten-Rhenium

M. A. TYLKINA, V. P. POLYAKOVA and E. M. SAVITSKII, *Zh. Neorg. Khim.*, 1964, **9**, (3), 671-673  
Raising the Re content of Pd-rich alloys in the Pd-W-Re system decreased their melting points and electrical resistance but increased their hardness, resistance to deformation and temperature coefficient of resistivity. Microstructural analysis further elucidated the structure of the system.

### Heat Capacity of Ni-Pd Alloys

C. A. MACKLIET and A. I. SCHINDLER, *J. Phys. Chem. Solids*, 1963, **24**, (12), 1639-1643

Measurements in the liquid He range for pure Pd and 20, 40, 60 and 80 at.% Ni-Pd alloys gave electronic specific heat coefficients of 9.38, 10.66, 8.54, 7.82 and 7.52 mJ/mole°K<sup>2</sup>, respectively, and Debye temperatures 272, 295, 305, 330.5 and 388°K. The band structure of the system is discussed.

### Alloys of Thorium with Certain Transition Metals. III. The System Thorium-Palladium

J. R. THOMSON, *J. Less-Common Metals*, 1964, **6**, (2), 94-99

X-ray and metallographic studies at 1000-1500°C showed that at 1000°C seven Th-Pd compounds are stable. The solid solubility of Th in Pd is not more than 15-17%.  $\text{Th}_2\text{Pd}$  and "ThPd" crystallise at  $1162 \pm 12$  and  $1412 \pm 12$ °C respectively.  $\text{ThPd}_5$  melts above 1500°C. " $\text{Th}_3\text{Pd}_4$ " and  $\text{Th}_3\text{Pd}_5$  form peritectically at  $1325 \pm 12$  and  $1387 \pm 12$ °C respectively.  $\text{ThPd}_4$  and another compound occur in the 79-85% Pd range. Their phase relationships are not known. A sharp minimum in the solidus-liquidus curve occurs at 12% Th;  $1125 \pm 12$ °C.

### New Ferromagnetic 5:2 Compounds in the Rare Earth-Palladium Systems

A. E. BERKOWITZ, F. HOLTZBERG and S. METHFESSEL, *J. Appl. Phys.*, 1964, **35**, (3/2), 1030-1031

Magnetic data are tabulated for  $\text{Gd}_5\text{Pd}_2$ ,  $\text{Tb}_{5.10}\text{Pd}_{1.90}$ ,  $\text{Dy}_{5.07}\text{Pd}_{1.93}$  and  $\text{Ho}_{5.04}\text{Pd}_{1.96}$ .  $\text{Gd}_5\text{Pd}_2$  is ferromagnetic below 335°K. The other compounds are b.c. tetragonal isostructures with para- to metamagnetic transitions at 62, 41, 27°K. They become ferromagnetic at lower temperatures with very high hysteresis. Energy

products  $(B \times H)_{\max}$  of 20 to  $26 \times 10^6$  GOe at  $4.2^\circ\text{K}$  have been observed.

### Arsenides of the Transition Metals. VII. The Palladium-Arsenic System

G. S. SAINI, L. D. CALVERT, R. D. HEYDING and J. B. TAYLOR, *Canad. J. Chem.*, 1964, **42**, (3), 620-629

Seven intermediate phases in the Pd-As system were detected by X-ray diffraction and thermal analysis.

### Exchange Inversion in Ternary Modifications of Iron Rhodium

P. H. L. WALTER, *J. Appl. Phys.*, 1963, **35**, (3/2), 938-939

The exchange inversion temperature  $T_s$ , residual magnetisation and maximum magnetisation of Fe-Rh alloys are affected by the nature and amount of transition metal modifiers added. 2 at.% Co, Ni, Cu, Nb, Mo, Ta or W is enough to eliminate the inversion. Ru, Os, Ir, or Pt additions raise  $T_s$  and Pd, V, Mn, or Au decrease  $T_s$ . For FeRhIr<sub>x</sub>,  $T_s$  increases as x increases from 0-0.25. For FeRhPd<sub>x</sub>,  $T_s$  decreases as x increases.

### Solid Solutions of Rhodium with Copper and Nickel

H.-L. LUO and P. DUWEZ, *J. Less-Common Metals*, 1964, **6**, (3), 248-249

The Rh-Cu and Rh-Ni alloy systems form continuous series of solid solutions, as shown by X-ray techniques. The Rh-Cu alloys are metastable. 50 and 75 at.% Cu-Rh alloys annealed *in vacuo* at 600 and 800°C for seven to ten days decomposed into two f.c.c. solid solutions with 9.2 and 81.5 at.% Cu concentrations. No decomposition or ordering of Rh-Ni alloys was observed after similar heat treatment.

### The Change of Resistivity of Rh after Cold Work

J. G. M. VAN KUIJK, *Physica*, 1964, **30**, (2), 398-400  
0.25 mm Rh wires had 20 $\mu$  grain size after annealing at 1050°C, resistivity of 4.5 $\mu\Omega\text{cm}$  at 0°C and 0.53 $\mu\Omega\text{cm}$  at -196°C. Load and resistivity changes at -196°C and 30% maximum extension, and isochronous annealing curves at -196°C after pulse annealing at temperatures between -196°C and 500°C are illustrated.

### Recovery of the Resistivity of Pt after Deformation at Low Temperature

L. C. MENTING, *Ibid.*, 407-409

Comparisons of the recoveries for Pt, Rh and Cu after stretching and rolling in liquid N<sub>2</sub> are tabulated.

### Resistivity of Ruthenium

R. J. TAINSH and G. K. WHITE, *Canad. J. Phys.*, 1964, **42**, (1), 208-209

Thermal resistivity data from 90 down to 2°K

and electrical resistivity data from 293 down to 2°K for a Ru rod confirmed previous results for the pure h.c.p. metal. Values obtained were  $\rho_0 = 0.018_4$ ,  $\rho_i(90^\circ\text{K}) = 0.9_3$ ,  $\rho_i(273^\circ\text{K}) = 6.72 \mu\Omega\text{cm}$ ;  $W_i(30^\circ\text{K}) = 0.03_8$ ,  $W_i(80^\circ\text{K}) = 0.53_5 \text{ cm deg } w^{-1}$ .

### Ferromagnetism and Incipient Superconductivity in a CeRu<sub>2</sub> + 7.3% GdRu<sub>2</sub> Alloy

J. J. DRAUTMAN, C. J. ANDERSON and R. DEL GROSSO, *J. Appl. Phys.*, 1964, **35**, (3/2), 974-975

Measurements between 1.3 and 20°K showed that this alloy is weakly ferromagnetic below 4.15°K.  $T_m$  for CeRu<sub>2</sub> was 5.1°K; for the alloy was 3.2°K. A superconducting transition reduced the positive susceptibility. The resistance was less, but did not reach zero.

### Superconductivity of Solid Solutions of Ti and Zr with Co, Rh and Ir

C. J. RAUB and G. W. HULL, *Phys. Rev.*, 1964, **133**, (4A), A932-A934

Transition temperature-composition curves for  $\alpha$  and  $\beta$ -Ti and Zr solid solutions showed that  $T_c$  rises with increasing valence electron concentration n. Small Co, Rh and Ir additions to  $\alpha$ -Ti or Zr raise  $T_c$  by 2 to 4 times.  $T_c$  has a 4°K maximum for 90 at.% Ti in the b.c.c. region of the  $\beta$ -Ti alloys.

### Superconductivity of Precious Metals and their Alloys

C. J. RAUB, *Z. Metallkunde*, 1964, **55**, (4), 195-199

A review of the superconductivity of Au, Ag, the Pt metals, and their alloys. The transition temperatures are very low. No solid solutions of Au or of Ag but of some of the Pt metals are superconducting. Noble metal additions to group V superconductors reduce  $T_c$ ; to group IV they increase  $T_c$ . General features of Pt metal compound superconductors are summarised. (42 references)

## CHEMICAL COMPOUNDS

### Fluorides of the Noble Metals. Part III. The Fluorides of Platinum

N. BARTLETT and D. H. LOHMANN, *J. Chem. Soc.*, 1964, (Feb.), 619-626

Attempts to prepare and isolate PtF<sub>2</sub> and PtF<sub>3</sub> were unsuccessful. Pure PtF<sub>4</sub> was shown to be diamagnetic with a structure similar to UCl<sub>4</sub>. Complex fluorides of Pt(IV) and Pt(V) have been prepared and their properties are discussed. PtF<sub>6</sub> is sufficiently strong an oxidising agent to oxidise molecular oxygen and this property is discussed.

### Carbonyl Complexes by Reaction with Alcohols

L. VASKA, *Abs. Papers, 147th Meeting, Am. Chem. Soc.*, 1964, 4L-8

Carbonyl complexes including [MX<sub>3</sub>(CO)L<sub>2</sub>]

(M=Ru, Os, Rh, Ir),  $[MX_2(CO)L_3]$ ,  $[MHX(CO)L_3]$  (M=Ru, Os),  $[MHX_2(CO)L_2]$ ,  $[MX(CO)L_2]$  (M=Rh, Ir) have been synthesised without using CO. Certain transition metal halides reacted with some group VA donor ligands (e.g.  $Ph_3P$ ) in alcohols and similar solvents to form complexes with CO groups co-ordinated to the metals. The CO originated from the solvents.

### Some Ethylenediamine Derivatives of Tetra-valent Platinum

I. I. CHERNYAEV, N. N. ZHELIGOVSKAYA, LE TI-K'EN and D. V. KURGANOVICH, *Zh. Neorg. Khim.*, 1964, 9, (3), 562-568

The following Pt complexes were isolated:  $EnCl_2Br_2Pt$ ,  $EnCl_2ClOHPT$ ,  $EnCl_2(NO_3)_2Pt$ ,  $EnCl_2ClNO_3Pt$ ,  $EnCl_2BrNO_3Pt$ ,  $EnCl_2BrNO_2Pt$ ,  $EnCl_2IOHPt$ ,  $EnCl_2INO_2Pt$ ,  $EnCl_2NO_2OHPt$ . They were studied by X-ray and thermal methods and their solubilities and conductivities were determined and tabulated.

### Transition Metal Complexes of Secondary Phosphines. IV. Some Complexes of Ruthenium, Rhodium and Palladium

R. G. HAYTER, *Inorg. Chem.*, 1964, 3, (2), 301-302  
Chloro complexes of Ru, Rh and Pd were prepared and attempts were made to convert them to P-bridged complexes, with success only with  $[PdCl_2\{HP(CH_3)_2\}_2]$  converted to  $[PdCl\{P(CH_3)_2\}\{HP(CH_3)_2\}_2]$ . Two forms, presumed to be *cis* and *trans*, of  $[RhCl_2\{HP(C_6H_5)_2\}_2]$  were isolated.  $[RhCl\{HP(C_6H_5)_2\}_3]$  could only be formed by the  $[RhCl(C_2H_5)_2]_2$ -di-phenylphosphine route.

### Mass Spectrometric Study of Gaseous Oxides of Rhodium and Palladium

J. H. NORMAN, H. G. STALEY and W. E. BELL, *J. Phys. Chem.*, 1964, 68, (3), 662-663

Studies on the volatility of Rh and Pd in the 1900-2100°K range at  $10^{-5}$ - $10^{-3}$  atm.  $O_2$  pressures indicated the existence of  $RhO$ ,  $RhO_2$  and  $PdO$ .  $\Delta H^\circ_{2000}$  values were determined for the Rh oxides.

## ELECTROCHEMISTRY

### Nature of Potentials Established on Some Electrodes of Metals of the VIII Group

A. DAMJANOVIC, M. L. B. RAO and J. O'M. BOCKRIS, *Extended Abs., Theoretical Div., Electrochem. Soc.*, 1964, 2, (May), 159-161, abs. 205

Potential and  $pO_2$  did not follow a simple Nernst relationship when noble metal electrodes were immersed in solutions at 0-80°C. Electrodes tested were Ru, Rh, Ir, Pt, Pd, Au, 13 wt.% Rh-Pt, 20 wt.% Rh-Pt and 50 wt.% Rh-Pt. Coverage by  $O_2$  was related to the number of unpaired d-electrons. A graph of  $O_2$  coverage against at.% Rh in Rh-Pt alloys was a straight line.

### On the Study of Mixed Potentials in Noble Metal-Oxygen-Acid Systems

J. P. HOARE, *Extended Abs. Theoretical Div., Electrochem. Soc.*, 1964, 2, (May), 162-163, abs. 206

Rest potentials of Pt, Au, Rh, Pd and Ir electrodes in  $O_2$ -saturated  $H_2SO_4$  solutions were studied as functions of pH,  $pO_2$ , and electrode pretreatment in order to determine the nature of the potential-determining reactions. If the rest potential is independent of  $pO_2$ , there may be a metal-metal oxide system or a mixed potential. Different polarisation curves at low current densities in  $O_2$ - and  $N_2$ -stirred solutions indicated a mixed potential. The mechanism for each noble metal was considered.

### A Study of Surface Oxides on Platinum Electrodes

J. S. MAYELL and S. H. LANGER, *J. Electrochem. Soc.*, 1964, 111, (4), 438-446.

Anodic oxidation and cathodic stripping tests on smooth Pt, Pt black, and Pt black-polytetrafluoroethylene moulded electrodes showed that the initial oxidation sequence is  $Pt \rightarrow Pt(OH)_2 \rightarrow Pt(O)_2$ , which was used to determine the Pt electro-active areas, but that at higher potentials smooth Pt forms  $Pt(O)_4$  and PtO whereas Pt black forms  $Pt(O)_{\sim 2.5}$ . A "tight" PtO structure on smooth Pt at higher potentials may account for their unusual properties whereas none forms on Pt black—perhaps because of irregular Pt atom arrangements and its catalytic behaviour.

### Voltammetric Study of the Reduction of Molecular Oxygen on Bright Platinum in Perchloric Acid Solution

M. W. BREITER, *Electrochim. Acta.*, 1964, 9, (4), 441-450

Cathodic reduction mechanisms for  $O_2$  at bright Pt in 1 N  $HClO_4$  include neither formation of adsorbed O atoms as intermediates nor participation of adsorbed H atoms. Periodic current-potential curves at 30 mV/sec and impedance measurements at 1000 c/s showed that  $O_2$  or  $H_2$  coverage of the electrode at a given potential are the same in the presence or absence of  $O_2$  reduction.  $O_2$  coverage inhibits  $O_2$  reduction and  $Cl^-$  adsorption has a similar effect.

### Anodic Formation and Cathodic Removal of Oxides on Palladium

YU. A. MAZITOV, K. I. ROSENAL' and V. I. VESELOVSKII, *Zh. Fiz. Khim.*, 1964, 38, (1), 151-155

Kinetics of the formation and reduction of oxides on Pd in concentrated KOH solution were studied in the -30 to +95°C range. At anodic potentials the surface was covered with an oxide of Pd (II) commencing at 1.05 v and at  $O_2$  evolution potentials with two oxides, the second of which may have been a superoxide. The slope of the Tafel equation for cathodic reduction of both oxides

was 55 mV. An additional reduction overvoltage of the second oxide was associated with concentration polarisation in the oxide layer.

### An Electrochemical Study of Thin Adsorbed Oxygen Films on Rhodium in Oxygen-saturated Acid Solution

J. P. HOARE, *J. Electrochem. Soc.*, 1964, **111**, (2), 232-236

After determination of rest potentials of Rh electrodes in O<sub>2</sub>-saturated acid solutions as functions of time, pH, partial pressure of O<sub>2</sub>, and electrode preparation, two electrode systems could be distinguished; Rh/Rh-O with an adsorbed layer of O atoms on the Rh surface (mixed rest potential  $930 \pm 20$  mV); Rh/Rh<sub>2</sub>O<sub>3</sub> with adsorbed oxide layer on the Rh surface (mixed rest potential  $880 \pm 10$  mV). These O<sub>2</sub> films were good electronic conductors but poor catalysts for peroxide decompositions. The properties of the two films differed because of different Rh to O bondings.

## LABORATORY APPARATUS AND TECHNIQUE

### Determination of Oxygen in Gases

*Control*, 1964, **8**, (70), 195-196

A brief description of the B.I.S.R.A. Pt/zirconia/Pt reversible electrochemical cell for O<sub>2</sub> determination. The e.m.f. of the cell depends only on the O<sub>2</sub> of the unknown gas if the gas at the reference electrode remains constant. The ranges are 550-1200°C and  $1-10^{-20}$  atm.

### A High Temperature Differential Calorimeter

C. V. THOMASSON and D. A. CUNNINGHAM, *J. Sci. Instrum.*, 1964, **41**, (5), 308-310

The endothermic heats of reaction of raw materials for glass making were measured by heating samples and a fired alumina reference at 10°C/min in 0.2 mm Pt sheet crucibles of identical heat capacity. Zero temperature difference during an endothermic process was maintained by heating the sample by a 24 s.w.g. 10% rhodium-platinum element in the form of two D-shaped coils with 0.2 mm Pt rod leads. The crucibles were cemented together, the sample above the reference, and ten Pt:13% Rh-Pt thermocouples, five in each crucible, measured the temperature.

### Thermal Condensation of Polymerisations of Inorganic Monomers in Platinum-Metal Crucibles

M. C. MILLER, D. W. RHYS and R. A. SHAW, *Ind. Chem.*, 1964, **40**, (4), 183-187

The effect of the Pt-metal sintered crucibles on the preparation of phospham macromolecules from 6- and 8-membered ring aminocyclophosphazenes was studied. Pt and Pd crucibles were attacked severely after only one or two pyrolyses.

Rh and Ir crucibles were slightly discoloured and corroded. Only Ru remained bright and unattacked. Phosphide formation and attack are discussed. Thermogravimetric analysis indicated phospham decomposition on Rh at only 650°C but stability with Ru until 850-950°C.

### Ceramic Double Cell for Crystal Growth by Fused Salt Electrolysis

W. KUNNMANN and A. FERRETTI, *Rev. Scient. Instrum.*, 1964, **35**, (4), 465-466

A low cost cell consists of two alumina concentric crucibles supported in a Pt safety cup. The electrodes are a Pt strip anode and a Pt disc cathode. Leads, inner crucible supports and cover are also Pt. Single crystals of Na-Mo bronzes were produced satisfactorily at 550°C.

## CATALYSIS

### Catalysts Are Made Shape-selective. Zeolitic Materials Contain Uniform Size Pores, Catalyse Only Molecules of Certain Size and Shape

*Chem. Eng. News*, 1964, **42**, (6), 45

Pt/zeolite catalysts are shape-selective for hydrogenation of linear hydrocarbons; e.g. a 9:1 molar ratio of H<sub>2</sub>:butene had 95% of 1-butene converted to alkane but less than 1% isobutene was hydrogenated. This was because molecules with one side group have effective diameters greater than the pores of the zeolites and cannot enter the cavities, but the linear molecules can do so.

### Particle to Particle Migration of Hydrogen Atoms on Platinum-Alumina Catalysts from Particle to Neighbouring Particles

S. KHOBIAR, *J. Phys. Chem.*, 1964, **68**, (2), 411-412

H<sub>2</sub> alone or with Al<sub>2</sub>O<sub>3</sub>, at room temperature, did not reduce yellow WO<sub>3</sub> but, with Pt/Al<sub>2</sub>O<sub>3</sub>, blue W<sub>4</sub>O<sub>11</sub> was formed immediately. This is evidence for dissociation of H<sub>2</sub> on Pt and H atom migration to WO<sub>3</sub> mixed with catalyst to cause reduction.

### Kinetics of Ethylene Hydrogenation over a Platinum-Silica Catalyst

J. H. SINFELT, *J. Phys. Chem.*, 1964, **68**, (4), 856-860

When C<sub>2</sub>H<sub>4</sub> was hydrogenated over 0.05% Pt/SiO<sub>2</sub> catalyst at 45-93°C in a flow reactor system, the rate of reaction was proportional to  $\sqrt{P_{H_2}}$  but as  $P_{C_2H_4}$  increased the rate decreased and approached zero order dependence at sufficiently higher pressures. Apparent activation energy was 16 kcal/mole.

### Composition and Structure of a Catalyst Used in the Synthesis of HCN from NH<sub>3</sub> and CH<sub>4</sub> at 1150 to 1200°C

F. ENDTER, *Abs. Papers, 147th Meeting, Am. Chem. Soc.*, 1964, 10K-28

Pt catalyst coatings on the inner walls of extern-

ally heated, sintered corundum tubes, in which the synthesis takes place, became coated with C, which had to be burned off. After 400 hours operation and 3-5 reactivations no further C deposits or deactivation occurred. The aged catalyst contained Pt<sub>3</sub>Al, Pt<sub>5</sub>Al and AlN. To reduce this initial activation period finely dispersed Al<sub>2</sub>O<sub>3</sub> is now incorporated in the catalyst coating. No C deposits occur and maximum HCN yields begin at once.

#### On a New Method for the Investigation of Heterogeneous Catalytic Reactions. I. Decomposition of Ammonia on Platinum

YA. M. FOGEL', B. T. NADYKTO, V. F. RYBALKO, R. P. SLABOSPITSKII, I. E. KOROBCHANSKAYA and V. I. SHVACHKO, *Kinetika i Kataliz*, 1964, 5, (1), 154-162.

The mechanisms of the catalytic decomposition of NH<sub>3</sub> on Pt and of catalyst-poisoning and activation were established by a new mass-spectrometric method based on simultaneous observation of the intensities of primary and secondary ions. First, NH is adsorbed on the catalyst after NH<sub>3</sub> decomposes into NH and H<sub>2</sub>. Secondly, two adsorbed NH molecules react to form N<sub>2</sub> and H<sub>2</sub> molecules.

#### Reduction of Platinum Oxide by Organic Compounds. Catalytic Self-activation in Deuterium Exchange Reactions

J. L. GARNETT and W. A. SOLLICH, *J. Phys. Chem.*, 1964, 68, (2), 436-437

PtO<sub>2</sub> was reduced by C<sub>6</sub>H<sub>6</sub> above 90°C and then catalysed isotope exchange between C<sub>6</sub>H<sub>6</sub> and heavy water. At 120°C equilibrium was reached after 24 hr shaking. "Self-activation" of PtO<sub>2</sub> presumably occurred by C-H bond rupture in C<sub>6</sub>H<sub>6</sub>. Aromatic compounds were more reactive than aliphatic compounds for "self-activation" and isotope exchange. Tritiation without H<sub>2</sub> pre-activation of catalyst is now possible.

#### The Hydrogenation of Dihydrolanosteryl and Dihydroagnosteryl Acetates

J. D. CHANLEY and T. MEZZETTI, *J. Org. Chem.*, 1964, 29, (1), 228-229

Hydrogenation of these substances in acetic acid with added HClO<sub>4</sub> using Adams' catalyst at atmospheric pressure produced an easily separable mixture of the saturated acetate 3β-acetoxy-5α-lanostane (67% yield) and the saturated ether 3β-ethoxy-5α-lanostane (24% yield). The reactions are slow but were previously believed not to occur. For 340 mg dihydroagnosteryl acetate, 300 mg PtO<sub>2</sub> were used at first and 200 mg extra catalyst after 48 hours.

#### Catalysis by Oxides and by Oxide-Supported Metals. Kinetic, I.R. and Adsorption Studies

V. KEVORKIAN, P. J. LUCCHESI, J. H. SINFELT and D. J. YATES, *Chim. e Ind.*, 1964, 46, (1), 46-50

Oxide (Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>) and Pt/oxide catalysts were

studied. Oxide support surfaces behave like polar solvents due to H<sub>2</sub>O, OH groups or impurities. Their dielectric constants were determined under different conditions, including temperature variation. The supports are not inert and are heterogeneous. Pt may be very finely dispersed on the supports and may interact with them. Kinetics due to surface migration are considered.

#### Hydrogenolysis of Ethane over Supported Platinum

J. H. SINFELT, *J. Phys. Chem.*, 1964, 68, (2), 344-346

The apparent activation energies for the hydrogenolysis of C<sub>2</sub>H<sub>6</sub> over 0.6 wt.% Pt/Al<sub>2</sub>O<sub>3</sub> and 0.6 wt.% Pt/SiO<sub>2</sub> were 31 and 54 kcal/mole respectively, suggesting that the supports and Pt interacted, but in different ways. The rate of hydrogenolysis increased with C<sub>2</sub>H<sub>6</sub> partial pressure to a power in the 0.7-0.9 range but decreased with increasing H<sub>2</sub> partial pressure. The suggested mechanism involved extensive surface dehydrogenation followed by a slow breaking of C-C bonds.

#### Studies of the Hydrogen Held by Solids. V. Investigation of Platinum Supported on Alumina Catalysts by Exchange with Deuterium Gas

W. K. HALL and F. E. LUTINSKI, *J. Catalysis*, 1963, 2, (6), 518-527

Both the Pt surface area and number of alumina hydroxyl ions were determined in the same investigation by D<sub>2</sub> exchange as the temperature was raised. All the metal-associated H<sub>2</sub> could be exchanged at -80°C (H/Pt=0.7 to 0.9). Hardly any D<sub>2</sub> exchange occurred with the support below 100°C. Pt is believed to be present as submicroscopic crystallites. More than one species of H<sub>2</sub> on the support was indicated. Fluoriding increased the temperature interval of D<sub>2</sub> exchange.

#### Catalytic Transformations of Cyclododecane in the Presence of Platinised Charcoal

E. S. BALENKOVA, A. YU. ALYBINA, T. I. ADVEEVA, S. I. KHROMOV and B. A. KAZANSKII, *Dokl. Akad. Nauk S.S.S.R.*, 1964, 155, (1), 118-121

Cyclododecane and H<sub>2</sub> were led over 5% Pt/C at 3000°C, producing paraffins, naphthenes and aromatic fractions. 50% was converted. Principal products were benzpentalane, indane, dimethylnaphthalene, benzcyclooctane and *n*-dodecane.

#### Production of Benzene by Catalytic Aromatisation of Gasoline

J. VYBIHAL, *Internat. Chem. Eng.*, 1964, 4, (1), 104-109 (Eng. trans. of *Chemicky Průmysl*, 1963, (8), 393-397)

Optimum conditions for preparation of C<sub>6</sub>H<sub>6</sub> from gasoline derived from Romaskin crude are

reforming over a Pt catalyst at 65–120°C, 15–20 atm. Space velocity and catalyst properties are also important. The composition of the input gasoline—C<sub>8</sub>H<sub>12</sub>, methylcyclopentane and aromatics content generally—affects the output. Specimen fractions of wide and narrow limits are used as examples.

#### Effect of Ultrasonics on the Genesis and Properties of Heterogeneous Catalysts

LI VEN<sup>1</sup>-CHZHOU, A. N. MAL'TSEV and N. I. KOBOZEV, *Zh. Fiz. Khim.*, 1964, **38**, (1), 80–88

Ultrasonic irradiation can increase or reduce the catalytic activity of Pt and Pd black depending on the gaseous atmosphere and the ultrasonic frequency. Tests with N<sub>2</sub>, H<sub>2</sub>, and air showed that the best conditions for preparing active Pt black are N<sub>2</sub> atmosphere and high frequency (3000 Kc/s).

#### Activity of Pt Black Prepared in an Ultrasonic Field from H<sub>2</sub>PtCl<sub>6</sub> Solutions of Various Concentrations

*Ibid.*, (2), 439–441

Pt black catalysts prepared in an ultrasonic field are best produced from dilute H<sub>2</sub>PtCl<sub>6</sub> solutions and their activity depends upon initial Pt concentration. 0.5, 0.25, 0.1 and 0.05% Pt concentrations were studied.

#### Promotion of Raney Palladium and Platinum Catalysts by Boron

B. D. POLKOVNIKOV, A. A. BALANDIN and A. M. TABER, *Izv. Akad. Nauk S.S.S.R., Ser. Khim.*, 1964, (2), 267–270

2 and 4 wt.% B additions to Raney Pd and Pt catalysts considerably increased their catalytic activity and stability during hydrogenation tests with cyclopentadiene, cyclohexane, cinnamaldehyde, and crotonaldehyde at 20°C and atmospheric pressure. Results are fully tabulated and discussed.

#### The Catalytic Oxidation of Olefins on Metal Films

W. R. PATTERSON and C. KEMBALL, *J. Catalysis*, 1963, **2**, (6), 465–478

Acyclic olefins were oxidised at Pt and Pd films mainly to CO<sub>2</sub> and H<sub>2</sub>O. Side reactions produced acetone from propylene and higher olefins and, over Pd, *tert*-butyl ethyl ketone from *tert*-butylethylene. C<sub>2</sub>H<sub>4</sub> oxidation over Pt from 5 to 100°C gave results similar to those with Pd. The reaction kinetics were determined. Tests with Rh, Au and W films showed that metal-O<sub>2</sub> bond strength governs catalytic activity. C<sub>6</sub>H<sub>12</sub> and C<sub>6</sub>H<sub>6</sub> oxidation over Pd and the effect of HCl on Pd film catalytic activity were also studied.

#### Palladium-catalysed Olefin Isomerisation

N. R. DAVIES, *Austral. J. Chem.*, 1964, **17**, (2), 212–218

The isomerisation of 1-octene to *cis*- and *trans*-

2-octene, *trans*-3-octene and *trans*-4-octene is catalysed by sodium chloropalladate (II) in glacial HAc at 55–65°C. N.m.r. analysis of the products from 1-octene-3d<sub>2</sub> suggests that the mechanism involves the stepwise migration of H atoms along the C chain.

#### Physical Chemistry of Concentrated Ozone. XII. The Low Temperature Heterogeneous Catalytic Decomposition of Concentrated Liquid Ozone

G. I. EMEL'YANOVA, V. P. LEBEDEV and N. I. KOBOZEV, *Zh. Fiz. Khim.*, 1964, **38**, (1), 170–175

Pt and Pd actively catalyse the decomposition of 100% liquid O<sub>3</sub> at –195.8 and –183°C. Unoxidised Ag is slightly active. Fe, Cu, and oxides of Fe, Cu, and Ni are inactive. The third order kinetics are caused by poisoning of the catalyst surface by O<sub>2</sub> produced in the reaction. The apparent activation energy in the range studied is 1000 cal/mole. Oxide catalysts effective at room temperature were inactive in both liquid and gas phase (–81°C) catalysis. Catalyst efficiencies at –195.8°C were found to be: Pt black, 4.48 × 10<sup>-8</sup> molecule. sec.<sup>-1</sup> atom<sup>-1</sup>; Pd black, 7.53 × 10<sup>-8</sup> molecule. sec.<sup>-1</sup> atom<sup>-1</sup>.

#### Improved Procedures for Converting Higher α-Olefins to Methyl Ketones with Palladium Chloride

W. H. CLEMENT and C. M. SELWITZ, *J. Org. Chem.*, 1964, **29**, (1), 241–243

Hexene-1 and higher α-olefins, which do not readily react with aqueous PdCl<sub>2</sub> solution, may be converted to methyl ketones with 80% yield by using PdCl<sub>2</sub> and CuCl<sub>2</sub> in dimethylformamide solvent containing 12–17% H<sub>2</sub>O by volume. Results for the conversion of 1-dodecene to 2-dodecanone showed that more H<sub>2</sub>O reduced the yield considerably. The method can be adapted to use *p*-benzoquinone instead of CuCl<sub>2</sub>. The olefin feed rate must be controlled. Other factors affecting the reaction are catalyst concentration and temperature.

#### Studies of Mixed Adsorption Catalysts for Dehydrogenation. Part I. Pd/SiO<sub>2</sub> as Catalyst for the Dehydrogenation of Cyclohexane

A. A. ALCHUDZHAN, M. A. MANTIKYAN and A. M. AIKAZYAN, *Izv. Akad. Nauk Armyan. S.S.R., Khim. Nauki*, 1963, **16**, (4), 303–314

Decreased activity of freshly-prepared Pd/SiO<sub>2</sub> in cyclohexane dehydrogenation was due not to H<sub>2</sub> produced in the process but to H<sub>2</sub> adsorbed while reducing the catalyst before use. Catalyst treated in air had higher activity. Studies at 320, 265 and 240°C showed that adsorption of C<sub>6</sub>H<sub>6</sub>, C<sub>6</sub>H<sub>12</sub> or dehydrogenation products reduces catalyst activity. Air treatment restored the activity. Deactivated catalyst after 20 days storage also was restored to a stable activity.

## Part II. Pd-Ag/SiO<sub>2</sub> as Catalyst for the Dehydrogenation of Cyclohexane

*Ibid.*, 315-325

Catalysts tested contained either 1.0 or 0.2 wt. % Pd and varying amounts of Ag, such that the Pd:Ag ratio varied between 32:1 and 1:9. Addition of Ag to 1% Pd/SiO<sub>2</sub> decreased the activity but a maximum activity was obtained for Pd:Ag=4:1 with 0.2% Pd/SiO<sub>2</sub>. The degree of activity also depended on the number of sites on SiO<sub>2</sub> filled by Pd or Ag. A comparison was made with the hydrogenation of benzene.

## Deactivation of Palladium-Alumina Catalysts

D. G. MANLY and F. J. RICE, *J. Phys. Chem.*, 1964, **68**, (2), 420-421

Regeneration at 650°C for 13 hr did not restore deactivated 0.3% Pd/Al<sub>2</sub>O<sub>3</sub> catalyst to its original level of activity. After regeneration *in vacuo*, CO adsorption was complete but in air was only 80% and in O<sub>2</sub> only 36%. These effects are attributed to the growth of Pd crystals accelerated by O<sub>2</sub>, even below 400°C.

## Double Bond Migration and Racemisation during the Hydrogenation of Olefins

W. D. HUNTSMAN, N. L. MADISON and S. I. SCHLESINGER, *J. Catalysis*, 1963, **2**, (6), 498-505  
Pd/C considerably catalysed the double bond migration and racemisation of optically active alkenes. Generally about 52% racemisation occurred. Racemisation by processes other than double bond migration was not detected. Bases present reduced the migration rate.

## On the Interaction between Acetylene and Palladium Salts in Aqueous Solution

O. N. TEMKII, S. M. BRAILOVSKII, R. M. FLID, M. P. STRUKOVA, V. B. BELYANIN and M. G. BAITSEVA, *Kinetika i Kataliz*, 1964, **5**, (1), 192-193

Pd compounds and aldehydes were formed during the reaction of C<sub>2</sub>H<sub>2</sub> and PdCl<sub>2</sub>, according to the acidity and temperature of the aqueous solution. Acrolein and formaldehyde were formed in increasing amounts as the temperature rose to 100°C by the decomposition of PdC<sub>4</sub>H<sub>5</sub>OCl formed at 20-25°C; the hydrate PdC<sub>4</sub>H<sub>7</sub>O<sub>2</sub>Cl formed at 1-2°C. Acetaldehyde was formed by the hydration of C<sub>2</sub>H<sub>2</sub> with Pd(II) as catalyst. Propionaldehyde was formed by the decomposition of π-complexes of Pd.

## Catalytic Exchange of Methane and Deuterium on Platinum, Ruthenium and Platinum-Ruthenium Alloys

D. W. MCKEE and F. J. NORTON, *J. Phys. Chem.*, 1964, **68**, (3), 481-489

Pt-rich alloys were more active catalysts than Ru-rich alloys for CH<sub>4</sub>-D<sub>2</sub> exchange in the 70-200°C range. 10-25% Ru-Pt reached the highest specific activity. The orders of formation

of the deuteromethanes indicated different reaction mechanisms; stepwise exchange for Pt, multiple exchange for Ru. When one mechanism dominated, measurement of HD on the metal surface gave the rate of exchange.

## The Role of Supports in Catalytic Hydrogenation. Part II. Activation Effects of Various Metallic Oxide Carriers on Palladium with relation to the Magnetic Susceptibility and Adsorption Capacity of the Catalyst, and Studies on the Sintering of Palladium Catalysts

E. B. MAXTED and S. I. ALI, *J. Chem. Soc.*, 1964 (March), 1127-1132

Adsorption capacity and catalytic activity cannot be correlated for fast reactions, and susceptibility and activity only increase together up to a certain limiting quantity of Pd on the support. Where the oxide has high susceptibility there is no correlation. MgO+CeO<sub>2</sub> and MgO+ThO<sub>2</sub> give the greatest activities as supports. Pd catalysts with larger pores after sintering have higher activities. Decrease of activity on sintered catalyst is also related to Pd content, sintering temperature and duration of sintering.

## Catalytic Activity of Noble Metal Alloys. Methane-Deuterium Exchange and Propane Cracking on Platinum-Palladium and Palladium-Rhodium Alloys

D. W. MCKEE and F. NORTON, *Abs. Papers, 147th Meeting, Am. Chem. Soc.*, 1964, 29H-68

The order of catalytic activity for CH<sub>4</sub>-D<sub>2</sub> exchange and C<sub>3</sub>H<sub>8</sub> cracking was Pt>Pd>Rh with alloys showing intermediate activities. Pt and Pd exhibited stepwise exchange and Rh exhibited predominantly multiple exchange at higher temperatures. Alloys showed mainly stepwise exchange with more multiple exchange at higher temperatures. An atomic radius-exchange relation was observed and exchange mechanisms are discussed.

## Selective Hydrogenation of Haloalkenes to Haloalkanes Using Rhodium Catalyst

G. E. HAM and W. P. COKER, *J. Org. Chem.*, 1964 **29**, (1), 194-198

Rh/Al<sub>2</sub>O<sub>3</sub> successfully catalysed the hydrogenation of haloalkenes to haloalkanes. 40-60% chloroalkane yields were obtained from 1-chloropropene, allyl chloride and 1, 3-dichloropropene, and a 96% yield of 2-chlorohexane from 5-chlorohexene-1. Neither Rh, Pd, nor Pt catalysed hydrogenation of chloroalkanes under similar conditions. Yields depended on the solvent, on poisoning by thiophene and on the catalyst support. The order of yields with catalyst is Rh>Pd>Pt. Isomerisation of *cis*- or *trans*-dichloropropene over Rh catalyst did not occur in the absence of H<sub>2</sub> but there was some in partially dehydrogenated material.

## FUEL CELLS

### High-performance Propane Fuel Cells

W. T. GRUBB, *Nature*, 1964, **201**, (4920), 699-700  
A complete  $C_3H_8-O_2$  fuel cell operating at  $150^\circ C$  with Pt electrodes and 85% (14.6 M)  $H_3PO_4$  electrolyte had a limiting current density imposed by the kinetics of electro-oxidation in excess of  $500 \text{ mA/cm}^2$ . The form of the e.m.f.-current density curve indicates that current density probably is limited by a diffusion process involving  $C_3H_8$  or  $CO_2$ . Electrode structure is therefore a critical factor.

### Physical Chemistry and Construction of Fuel Cells. II. Different Types of Electrode for Fuel Cells in Current Use

G. FEULLADE, *La Technique Moderne*, 1964, **56**, (1), 16-20

Pt metals are used in many of the types of fuel cells summarised. The research organisations and companies engaged on fuel cell projects are surveyed. (64 refs.)

### A Simple Gas Electrode Structure for the Evaluation of Catalysts (Electrocatalysts) in Working Fuel Cells

W. T. GRUBB and C. J. MICHALSKE, *J. Electrochem. Soc.*, 1964, **111**, (4), 477-478

Details are given for preparing a Pt black electrode by applying an aqueous slurry to a metal mesh screen, drying it, and treating it with hydrocarbon wax to make it hydrophobic. It can be used in  $H_2-O_2$  fuel cells up to  $65^\circ C$  in immobilised liquids. 1:1 Pt black/Ag powder mixture gave similar results in alkaline electrolyte.

## CATHODIC PROTECTION

### Lead/Platinum Anodes for Marine Applications

D. B. PEPLOW and L. L. SHREIR, *Corrosion Technol.*, 1964, **11**, (4), 16-18

Pb/Pt bielectrodes were tested in sea-water at  $50 \text{ A/ft}^2$  for one year and appeared to offer an inexpensive system of power-impressed marine protection. Six Pb alloys were studied. Small Te or Bi additions to 1% Ag-Pb alloy reduce Pb peroxide formation. Anode structure and electrochemical mechanism are described.

## CHEMICAL TECHNOLOGY

### Ultrapure Hydrogen in Metal Processing

G. L. MATLACK, *Metal Progress*, 1964, **85**, (3), 114-117

$H_2$  derived from dissociated  $NH_3$  is purified by using the Bishop Ag-Pd alloy diffusion cell. Complete units based on these cells have been designed

by the Drever Co. The first commercial installation by Drever is saving Magnetics, Inc. an estimated \$50,000 per year.

## GLASS TECHNOLOGY

### Measurement of Kinematic Viscosity at Elevated Temperatures

W. SKATULLA and S. SCHÖNE, *Silikat Technik*, 1964, **15**, (1), 5-10

Ir-Pt alloy is used in the tube furnace and stirrer of a rotating viscometer used to measure the dynamic viscosity of optical glass up to  $1500^\circ C$ . The temperature is measured with a Pt:Rh-Pt thermocouple. The kinematic viscosity in stokes is then obtained by dividing the dynamic viscosity in poise by the density in  $\text{g/cm}^3$ .

## ELECTRICAL ENGINEERING

### Pressed Tungstate Cathode on Iridium Base

A. I. ZHADAN and B. M. TSAREV, *Radiotekh. i Elektronika*, 1964, **9**, (2), 355-356

Pressed cathodes of baria-calcia-tungstate on Ir bases can be used from  $450$  to  $1350^\circ C$ , whereas W base cathodes which have lower heat of vaporisation, can only be used from  $550$  to  $1250^\circ C$ . The Ir-based cathodes emit  $7 \text{ A/cm}^2$  at  $1000^\circ C$ , they are activated quickly and they have good reproducibility. Little sublimation is noticed. Use in V.H.F. apparatus is possible. The effect of surface films on the emission is discussed.

## TEMPERATURE MEASUREMENT

### Reference Tables for Thermocouples of Iridium-Rhodium Alloys versus Iridium

G. F. BLACKBURN and F. R. CALDWELL, *J. Res. Nat. Bur. Stds.*, 1964, **68C**, (1), 41-59

Temperatures from  $0$  to  $2150^\circ C$  are tabulated against e.m.f. in mV for Ir:60% Ir-Rh and Ir:50% Ir-Rh thermocouples. Temperature-e.m.f. relationships are also given for Ir versus 10, 25, 75 and 90% Ir-Rh alloys. 50% Ir-Rh gives the maximum thermal e.m.f. (12.2 mV at  $2150^\circ C$ ) and may provide the optimum thermocouple combination.

### Some Recent Developments in Noble Metal Thermocouples

L. O. OLSEN, *Soc. Automotive Eng. Paper 750 A*, 1963, (Sept.), 10 pp.

Empirical reference tables of temperatures versus thermal e.m.f. are presented for Pd:15% Ir-Pt, Platinel II, Ir:40% Ir-Rh, Ir:50% Ir-Rh and Ir:60% Ir-Rh. Experimental apparatus and test procedures are described briefly. Work on the thermoelectric stability of Platinel II is discussed.



### **A Dew Point Meter Based on Thermoelectric Cooling**

O. G. GRIFFIN and C. M. STRINGFIELD, *J. Scient. Instrum.*, 1964, **41**, (4), 241

The dew point of a gas flowing in a tube is measured by observing the temperature at which condensation forms on a mirror surface that is heated and cooled electrically. The Pallador thermocouple is soldered into a cavity in the centre of the mirror. Dew points  $20^{\circ}\text{C} <$  gas temperature and from 50 to  $-5^{\circ}\text{C}$  have been measured in gas flows of 40 l/min.

### **Thermal and Hydrostatic Behaviour of Miniature Platinum Resistance Elements**

C. M. KNOBLER, W. I. HONEYWELL and C. J. PINGS, *Rev. Sci. Instrum.*, 1963, **34**, (12), 1437-1438

Glass-clad Pt wire resistance elements by Degussa were calibrated against an N.B.S. Pt resistance thermometer from 77 to  $300^{\circ}\text{K}$ . No systematic resistance deviations were observed. Pressures up to 2,000 p.s.i. at room temperature caused no damage to the elements. Slight decrease in resistance up to 1,500 p.s.i. was equivalent to  $30-150 \times 10^{-6} \text{ }^{\circ}\text{K/p.s.i.}$

## **NEW PATENTS**

### **Rhodium Trichloride Catalyst**

E. I. DU PONT DE NEMOURS & CO.

*British Patent* 948,041

An acyclic hydrocarbon diene having 6 or 7 carbon atoms is made by: (1) condensing ethylene or propylene with 1,3-butadiene in presence of a  $\text{RhCl}_3$  catalyst until the catalyst is deactivated, (2) isolating the catalyst residue, (3) mixing it with 1 mole of aqueous HCl solution per mole of initial catalyst and, (4) using this reactivated residue as a substitute in stage (1).

### **Preparation of Dicyanogen**

ROHM & HAAS G.m.b.H. *British Patent* 948,113

A catalyst formed of an alloy of two or more Pt metals or of one or more Pt metals with one or more Group VIA metals is used in preparation of dicyanogen by oxidation of HCN. 99% Pt and 1% Pd alloy preferred.

### **Production of Aromatic Halogen Compounds**

MONSANTO CHEMICALS LTD *British Patent* 948,281

Pt or Pd, in the form of a halide of Pd or Pd/C, may be used in a process of providing halogeno-substituted aromatic compounds.

### **Purifying Sulphuric Acid**

V.E.B. FARBENFABRIK WOLFEN

*British Patent* 948,381

Concentrated  $\text{H}_2\text{SO}_4$  containing oxidised N compounds is purified by electrolysis at  $55-80^{\circ}\text{C}$ . and current density at anode of  $0.08-0.12 \text{ A/cm}^2$  and at cathode of  $0.20-0.25 \text{ A/cm}^2$  in one or more closed cells using a cathode of Pt and an anode of Pt or Pb oxide.

### **Catalytic Igniters**

ROLLS-ROYCE LTD. *British Patent* 948,578

A prime mover ignition device comprises a number of cylindrical foraminates rolls of Pt or Rh or Pt-Rh alloy, supported in an annular formation by a mass of refractory material, having a flow passage or passages extending through it to lead combustion mixture to the rolls.

### **Hydrogenation of Cycloaliphatic Compounds**

BADISCHE ANILIN & SODA-FABRIK A.G.

*British Patent* 948,861

Metallic Pd and heavy metal ions (Cu, Ag, Zn, Cd, Hg, Tl, Pb, Sn, Sb, Bi, V or Zr) are used in the partial hydrogenation of cycloaliphatic compounds.

### **Production of Ethylene-diamine or its Derivatives**

THE PURE OIL CO. *British Patent* 948,965

A Group VIII noble metal catalyst is used in the preparation of mineral acid salts or N-acyl derivatives of ethylene diamine by reacting cyanogen with hydrogen at  $0^{\circ}-300^{\circ}\text{C}$  and a pressure of over 50 lb/sq. in. in the presence of the catalyst.  $\text{Rh/Al}_2\text{O}_3$  is used.

### **Fuel Cell**

ALLIS-CHALMERS MANUFACTURING CO.

*British Patents* 948,984; 948,985; 948,986

Relate to improved liquid fuel cell of the low temperature catalyst-activated type, which offers increased current density and in which the internal resistance of the cells is reduced. The fuel electrode (948,985) carries a catalyst of a Pt group metal.

### **Organosilicon Compounds**

UNION CARBIDE CORP. *British Patent* 949,044

Catalyst of elemental Pt on  $\gamma\text{-Al}_2\text{O}_3$  is used in a process of preparing organosilicon compounds by reacting  $\text{CH}_3\text{Cl}$  and a hydrogen halosilane of given general formula in the presence of the catalyst.

### **Preparation of Trans-9-oxodec-2-enoic Acid**

"SHELL" RESEARCH LTD. *British Patent* 949,319

Refers to the use of a Pd/ $\text{BaSO}_4$  catalyst at one stage in the preparation of the above compound.

### **Boron Doping Alloys**

WESTINGHOUSE ELECTRIC CORP.

*British Patent* 949,653

Discloses a novel method of preparing a doping