

ABSTRACTS

of current literature on the platinum metals and their alloys

PROPERTIES

Collision Dynamics and Decomposition of NaCl

Nanometer Particles on Hot Platinum Surfaces

J. G. KORSGREN and J. B. C. PETERSSON, *J. Phys. Chem. B*, 1999, 103, (47), 10425–10432

The collision dynamics of NaCl particles (15–80 nm) on a hot Pt surface (1200–1500 K) (1) were studied by molecular beam techniques. The particles were directed toward a polycrystalline Pt surface with a velocity of 260 m s⁻¹. The particle-surface interactions were found to be highly inelastic, and the angular distributions indicated that the scattered particles lose > 90% of their kinetic energy in the surface normal direction. On (1) NaCl melts and decomposes.

Template-Assisted Growth of Hexagonal Poly- or Single-Crystalline Quasi-2D Palladium Nanoparticles

J. WALTER, *Adv. Mater.*, 2000, 12, (1), 31–33

Quasi 2D Pd nanoparticles were obtained using a graphite lattice as a template. The precursor PdCl₂-graphite intercalation compounds were synthesised by mixing highly oriented pyrolytic graphite with anhydrous PdCl₂ in ampoules under Cl₂, and then heated at 600°C for 7 days.

The Effect of Carbon Monoxide and Steam on the Hydrogen Permeability of a Pd/Stainless Steel Membrane

A. LI, W. LIANG and R. HUGHES, *J. Membrane Sci.*, 2000, 165, (1), 135–141

Measurements of the H₂ permeation rate through a Pd/stainless steel membrane were carried in the presence of CO and steam and with CO/steam mixtures. Significant reductions in H₂ permeability were observed because the adsorption of CO or steam on the Pd surface decreases the actual permeation area of the Pd membrane, which changes the rate-controlling step of H₂ permeation. Low concentrations of CO additions had little effect on H₂ permeability, whereas addition of steam had much more effect.

Magnetic Properties of RRh₂Ge₂ Single Crystals (R = Gd, Tb, Dy)

D. GIGNOUX, A. HIMORI, D. SCHMITT and T. SHIGEOKA, *J. Magn. Magn. Mater.*, 2000, 208, (1–2), 49–54

RRh₂Ge₂ (1) show a magnetic behaviour characteristic of various isomorphous ternary compounds, namely sharp and smooth metamagnetic transitions, flat and non-flat intermediate plateaux in the magnetisation curves. (1) exhibit a complex low-temperature behaviour due to the interplay of exchange and crystal field interactions. Successive phase transitions occur below the Néel temperature.

Constitution of the Al–Ir–Ru System

P. J. HILL, L. A. CORNISH and M. J. WITCOMB, *J. Alloys Compd.*, 1999, 291, (1–2), 130–144

The phase diagram of Al–Ir–Ru was investigated using optical microscopy, SEM, EDAX and XRD. The B2 phase was found to extend across the ternary with a minimum width around the centre of ~ 2 at.% Al within the ternary. Solid solubilities for the extensions of various binary extensions were observed. A previously unreported ternary phase ~ Al₅₃Ir₂₀Ru₂₇ was identified and shown to form peritectically from B2. Al was found to be soluble up to ~ 10 at.% in (Ru) and nearly 20 at.% in (Ir). The hardness measurements of the B2 phase increased with Ir substitution.

Microstructure, Crystallography, and Shape Memory Effect in Equiatomic NbRu

R. W. FONDA and H. N. JONES, *Mater. Sci. Eng.*, 1999, A273–275, 275–279

The microstructure and crystallography of Nb₅₀Ru₅₀ (1) were examined by TEM and electron diffraction. Strong similarities between (1) and Ta₅₀Ru₅₀ (2) were demonstrated. Both alloys exhibit a highly twinned microstructure with a shape accommodating appearance. Electron diffraction identified that, like (2), the room-temperature crystal structure of (1) is monoclinic. (1) exhibits shape memory effect.

CHEMICAL COMPOUNDS

Ferrocene End-Capped Palladium(II) and Platinum(II) Complexes with Thiophene Spacers

K. R. J. THOMAS, J. T. LIN and K.-J. LIN, *Organometallics*, 1999, 18, (25), 5285–5291

Heterobimetallics (1) containing ferrocene and Pt(II) or Pd(II) separated by a varying conjugation length constructed from vinylthiophene subunits were synthesised by oxidative addition of ferrocene-substituted halothiophenes with zerovalent Pt or Pd phosphine precursors. The reversible redox chemistry of (1) was dependent on the conjugation length.

Molecular Mechanics (MM3*) Force Field Parameters for Calculations on Palladium Olefin Complexes with Phosphorus Ligands

H. HAGELIN, M. SVENSSON, B. ÅKERMARK and P.-O. NORRBY, *Organometallics*, 1999, 18, (22), 4574–4583

Molecular mechanics force field parameters were developed for the title complexes, based on crystal structure and quantum chemical data. The bonding to Pd is described by a valence bond approach, with interactions between the olefin and other ligands modelled by a combination of van der Waals forces and torsional interactions. The force field can yield useful predictions in the Pd-assisted allylic alkylation.

The Ternary Silicide ZrPd₃Si₃, a Stacking Variant of the α -FeSi₂ and Re₃B Structure Types

M. WANG and A. MAR, *Chem. Mater.*, 1999, 11, (11), 3232–3237

ZrPd₃Si₃ (1) was synthesised by arc-melting powders of Zr, Pd and Si. (1) has a new structure type and crystallises in the orthorhombic space group *Cmcm* with $a = 3.8127(4)$ Å, $b = 15.551(1)$ Å, $c = 7.0390(5)$ Å and $Z = 4$. Structure calculations confirm the weak metallic behaviour of (1); support the simultaneous existence of metal–metal, metal–nonmetal and nonmetal–nonmetal bonding; and suggest a reduced state for the Pd atoms. The structure of (1) is considered to be alternating “ZrSi₂” and “Pd₃Si”. (1) has a room temperature resistivity of 1.7×10^{-3} Ω cm.

Neodymium Rhodium Aluminide NdRh₄Al_{15.37}

B. FEHRMANN and W. JEITSCHKO, *J. Alloys Compd.*, 2000, 298, (1–2), 153–159

The new compound NdRh₄Al_{15.37} (1) was prepared by the reaction of Nd, Rh and an excess of Al at high temperature and cooling at a slow rate. (1) has the tetragonal space group *P4₂/nnc*, $a = 912.4(1)$ pm, $c = 1561.6(3)$ pm, $Z = 4$. The atoms occupy twelve atomic sites, all with high coordination numbers. Four of the nine Al positions are very close to each other, forming a nearly straight row with partial occupancy. Similar to other structures of intermetallics with a high Al content, (1) is partitioned into layers of two types. One is h.c.p. and puckered and consists of Rh and Al atoms. The other type of layer is less densely packed and contains Al, Rh, and all of the Nd atoms.

ELECTROCHEMISTRY

Anion and Water Involvement in Hydrous Ir Oxide Redox Reactions in Acidic Solutions

C. BOCK and V. I. BIRSS, *J. Electroanal. Chem.*, 1999, 475, (1), 20–27

Ir oxide films (1) grown in 0.6 M HClO₄, 0.4 M H₂SO₄ and 0.4 M HNO₃ solutions gave a super-Nernstian E/pH response of -68 mV, using constant ionic strength H₂SO₄ + Na₂SO₄ test solutions. This indicated the injection/expulsion of protons and some solution anions during the reduction/oxidation of Ir(+III)/Ir(+IV). An unaccounted mass change was interpreted as due to H₂O flux in/out of (1).

Preparations and Electrochemical Properties of Pyrazine-Bridged Ruthenium-Binuclear Complexes Exhibiting Molecular Hysteresis

A. TOMITA and M. SANO, *Inorg. Chem.*, 2000, 39, (2), 200–205
cis-cis-[(NH₃)₂(L)Ru-pz-Ru(NH₃)₂(dmsO)](PF₆)₂ (L = NH₃ (1), pyridine (2), benzonitrile (3)) exhibited molecular hysteresis. Simulations of both cyclic voltammograms and thin-layer cyclic voltammograms gave redox potentials, isomerisation rates and inter-conversion rates of (1), (2) and (3). The rates of conversions between two isomeric intermediate states were 5×10^{-6} and 4×10^{-4} s⁻¹ for (1), 4×10^{-5} and 4×10^{-4} s⁻¹ for (2), and 2×10^{-4} and 5×10^{-5} s⁻¹ for (3).

ELECTRODEPOSITION AND SURFACE COATINGS

Platinum Microelectrodes with Unique High Surface Areas

J. M. ELLIOT, P. R. BIRKIN, P. N. BARTLETT and G. S. ATTARD, *Langmuir*, 1999, 15, (22), 7411–7415

Nanostructured Pt films (1) were electrodeposited onto microelectrodes from an hexagonal lyotropic liquid crystalline plating mixture of octaethylene glycol monohexadecyl ether, H₂O, and H₂PtCl₆·6H₂O. Cyclic voltammetry in dilute H₂SO₄ and Cu underpotential demonstrated that (1) have high surface areas (with roughness factors of ~ 210).

On the Voltammetric Behavior of a Platinized Titanium Surface with Respect to the Specific Hydrogen and Anion Adsorption and Charge Transfer Processes

J. INIESTA, J. GONZÁLEZ-GARCÍA, J. FERNÁNDEZ, V. MONTIEL and A. ALDÁZ, *J. Mater. Chem.*, 1999, 9, (12), 3141–3145

The surface preparation of the Ti substrate by sand-blasting and the washing procedure to minimise or to avoid Cl⁻ contamination are crucial steps for obtaining Pt/Ti electrodes (1) with H₂ adsorption-desorption behaviour similar to that of polycrystalline Pt electrodes. The Pt plating was carried out at a constant current density of 5 mA cm⁻² for 100 min at 90–95°C. Pt deposits with a thickness of 5–10 μm are obtained (with roughness factor of ~ 125).

Kinetics of Interfacial Reaction Between Eutectic Sn-Pb Solder and Cu/Ni/Pd Metallizations

G. GHOSH, *J. Electron. Mater.*, 1999, 28, (11), 1238–1250

The interfacial microstructure and the kinetics of interfacial reaction were studied using diffusion couples of eutectic Sn-Pb solder and electroplated Ni/Pd on Cu substrate. In the thin film limit of the Pd layer, the presence/absence of Pd-bearing intermetallic was determined by the initial thickness of the Pd layer and the processing temperature, and not by the processing time. Depending on the thickness of the Pd layer, both PdSn₃ and PdSn₅ phases were observed near the solder-substrate interface.

PdCl₂ Anchorage onto the Surface of Polystyrene Films via Oxygen and Ammonia Plasma Treatment

P. C. L'ARGENTIÈRE and H. A. TAHER, *J. Chem. Technol. Biotechnol.*, 2000, 75, (1), 25–28

Plasma treatments of polystyrene in the presence of O₂ or NH₃ caused an increase in the surface free energy of the polymer. After treatment with PdCl₂ to prepare polymer-bound complex catalysts, the amount of Pd anchored to the NH₃ plasma-treated polymer surface is greater than in O₂ plasma treatments. This was explained on the basis of the higher nucleophilic character of the amine groups. No Pd was detected in the untreated polystyrene surface.

Preparation of Epitaxial Ultrathin RuO₂-TiO₂(110) Films by Decomposition of Ru₃(CO)₁₂

G. A. RIZZI, A. MAGRIN and G. GRANOZZI, *Surf. Sci.*, 1999, 443, (3), 277–286

Ru₃(CO)₁₂ (1) has been used as a source for depositing Ru particles and RuO₂ films on a TiO₂(110) surface. At 300°C in ultrahigh vacuum (1) was completely decomposed, and the deposited Ru particles showed some residual C contamination. RuO₂ ultrathin epitaxial films were obtained by heating the Ru deposit at 300°C or by directly decomposing (1) in O₂. The new RuO₂-TiO₂ interface is reactive.

APPARATUS AND TECHNIQUE

An Amperometric Detector with a Platinum Tubular Electrode for High Performance Liquid Chromatography

J. CVAČKA, F. OPEKAR, J. BAREK and J. ZIMA, *Electroanalysis*, 2000, 12, (1), 39–43

An amperometric detector based on a Pt tubular electrode was constructed from a long narrow-bored Pt tube which was directly connected to the column outlet. The Pt tube was immersed in a vessel containing an electrolyte solution in which a common reference and counter electrodes were also immersed. As only the internal Pt wall was exposed to the electrolyte solution, the Pt tube was not uniformly polarised and only a certain length of the tube from its outlet attained a potential suitable for the detection. The detector was demonstrated for routine analytical measurements in liquid chromatography.

A Novel Gas Sensor Based on SnO₂/Os Thin Film for the Detection of Methane at Low Temperature

F. QUARANTA, R. RELLA, P. SICILIANO, S. CAPONE, M. EPIFANI, L. VASANELLI, A. LICCIULLI and A. ZOCCO, *Sens. Actuators B*, 1999, 58, (1–3), 350–355

Os-doped SnO₂ thin films for CH₄ detection were prepared by the sol-gel method. Os doping was found to improve the gas sensitive properties of the SnO₂ films, enhancing the sensitivity to CH₄ and simultaneously lowering the best operating temperature. The Os probably catalyses the oxidation of CH₄.

HETEROGENEOUS CATALYSIS

HCN Synthesis from Methane and Ammonia:

Mechanisms of Pt⁺-Mediated C–N Coupling

M. DIEFENBACH, M. BRÖNSTRUP, M. ASCHI, D. SCHRÖDER and H. SCHWARZ, *J. Am. Chem. Soc.*, 1999, 121, (45), 10614–10625

The Pt⁺-mediated coupling of CH₄ and NH₃ was studied. Mass spectrometry showed that C–N bond formation is catalysed efficiently by Pt⁺. The B3LYP hybrid DFT/HF functional was used to investigate computationally the experimentally observed reaction channels. A comparison of Pt⁺ with Fe⁺, Co⁺, Rh⁺, W⁺, Os⁺, Ir⁺ and Au⁺ shows that Pt⁺ is unique in its ability to activate 1 equivalent of CH₄ and to mediate C–N bond coupling.

VOC Removal: Investigation of Ethylacetate Oxidation over Supported Pt Catalysts

P. PAPAETHIMIOU, T. IOANNIDES and X. E. VERYKIOS, *Catal. Today*, 1999, 54, (1), 81–92

Steady-state kinetic experiments on the oxidation of trace amounts of ethyl acetate over various supported Pt catalysts showed that Pt/W⁶⁺-doped TiO₂ (1) is the most active. Acetic acid and acetaldehyde are the main byproducts at low and intermediate conversions. The high activity of (1) is attributed to the presence of a large number of acidic sites with appropriate strength on the W⁶⁺-doped TiO₂ surface, which lead to the formation of a large pool of reactive intermediates with high mobility.

Palladium-Catalyzed Aryl-Aryl Coupling in Water Using Molecular Hydrogen: Kinetics and Process Optimization of a Solid-Liquid-Gas System

S. MUKHOPADHYAY, G. ROTHENBERG, H. WIENER and Y. SASSON, *Tetrahedron*, 1999, 55, (51), 14763–14768

Reductive homocoupling of substituted chlorobenzenes to the respective biphenyls was achieved in H₂O using H₂ and NaOH in the presence of catalytic amounts of PEG-400 and Pd/C (1) at 90–120°C. The molecular H₂ acts as the *in situ* catalyst regenerator. The solid (1) can be efficiently recycled simply by filtration and washing with H₂O and MeOH. After 7 runs, (1) retained > 99% of its activity.

Catalytic Behavior of a Wool-Pd Complex in Asymmetric Hydrogenation of Diacetone Alcohol and 3-Methyl-2-butanone

M.-Y. YIN, G.-L. YUAN, M.-Y. HUANG and Y.-Y. JIANG, *J. Mol. Catal. A: Chem.*, 1999, 147, (1–2), 89–92

A chiral natural biopolymer wool-Pd complex (1) was prepared by the reaction of a definite amount of washed wool pieces with PdCl₂·2H₂O in EtOH. (1) catalysed the asymmetric hydrogenation of diacetone alcohol to (R)-2-methyl-2,4-pentanediol (2) and 3-methyl-2-butanone to (R)-3-methyl-2-butanol (3) at 30°C and under 1 atm H₂. At optimum Pd content, (2) and (3) could be obtained with 73% and 100% optical yields, respectively. (1) could be reused without appreciable change in optical catalytic activity.

Use of Periodic Variations of Reactant Concentrations in Time Resolved DRIFT Studies of Heterogeneously Catalysed Reactions

E. E. ORTELLI, J. WAMBACH and A. WOKAUN, *Appl. Catal. A: Gen.*, 2000, 192, (1), 137–152

Amorphous Pd₂₅Zr₇₅ alloy catalyst (1) for CO oxidation was prepared by the melt spinning technique. Sine wave modulation of feed gas concentrations was used to induce dynamic variations in the concentrations of products, intermediates and reactants in the oxidation of CO over (1). These were monitored *in situ* in a DRIFT cell and consecutively analysed with a micro-kinetic model to obtain information on the reaction pathway and rate constants.

Synthesis of Allylbenzenes by Cross-Coupling of Allyl Bromide with Arylboronic Acids Using a Palladium Chloride and Tetraphenylphosphonium Bromide Intercalated Clay Catalyst

R. S. VARMA and K. P. NAICKER, *Green Chem.*, 1999, 1, (5), 247–249

Suzuki coupling of allyl halides and arylboronic acids has been achieved using a reusable catalyst system of PdCl₂ and tetraphenylphosphonium bromide intercalated clay (1). The rate of reaction with (1) is much faster when compared to homogeneous conditions. (1) was retrieved from the aqueous layer for further reuse without any loss in catalytic activity.

Liquid Phase Methanol Carbonylation Catalysed over Rhodium Supported on Hydrotalcite

M. P. KAPOOR and Y. MATSUMURA, *Chem. Commun.*, 2000, (1), 95–96

Mg–Al hydrotalcites containing nanometre size Rh particles (1) were synthesised and shown to be active for MeOH carbonylation at 473 K in the presence of MeI. The main products were methyl acetate (MeOAc) and dimethyl ether. An increase in Rh to 2.1 wt.% enhanced formation of MeOAc but a further increase of Rh to 3.0 wt.% resulted in a lower yield of MeOAc. The activity of (1) towards MeOAc mainly depended on the estimated surface area of Rh.

First Heterogenisation of Rh–MeDuPHOS by Occlusion in PDMS (Polydimethylsiloxane) Membranes

I. VANKELECOM, A. WOLFSON, S. GERESH, M. LANDAU, M. GOTTLIEB and M. HERSHKOVITZ, *Chem. Commun.*, 1999, (23), 2407–2408

Immobilisation of Rh–MeDuPHOS was achieved by occluding the catalyst in a PDMS membrane. The occluded catalyst (1) was tested in methylacetoacetate hydrogenation. In ethylene glycol, the activity of (1) (membrane thickness 452 μm) was lower than in the homogeneous reaction but remained constant in a second run, in which the same enantioselectivity was maintained. In MeOH, the activity of (1) (thickness 578 μm) could be increased fourfold, while leaving enantioselectivity almost unaffected.

A Mesoporous Ruthenium Silica Hybrid Aerogel with Outstanding Catalytic Properties in the Synthesis of *N,N*-Diethylformamide from CO₂, H₂ and Diethylamine

L. SCHMID, M. ROHR and A. BAIKER, *Chem. Commun.*, 1999, (22), 2303–2304

Mesoporous Ru silica hybrid aerogel (1) containing well dispersed bidentate RuCl₂[Ph₂P(CH₂)₃PPh₂]₂ complexes was synthesised using a sol-gel method. (1) gave turnover frequencies up to 18,400 h⁻¹ and 100% selectivity from CO₂, H₂ and diethylamine for the formation of *N,N*-diethylformamide. The most influential parameters were: amount of (1), reaction temperature and total pressure.

HOMOGENEOUS CATALYSIS

An Active Site Model and the Catalytic Activity Mechanism of the New Fullerene-Based Catalyst – (η²-C₆₀)Pd(PPh₃)₂

E. SULMAN, I. YANOV and J. LESZCZYNSKI, *Fullerene Sci. Technol.*, 1999, 7, (3), 467–484

A theoretical description of the adsorption of C₂H₂ on Pd-phosphine fullerene complexes has been developed based on quantum chemical calculations. This process can be considered as a model of the preliminary stage of triple C bond scission in acetylenes. Based on the calculations and experimental data, it was concluded that the preliminary interactions of the catalyst with the substrate facilitate the interaction of the complex substrate-catalyst with H₂ by decreasing the energy barrier.

The Birth and Development of π-Allylpalladium Chemistry

J. TSUJI, *J. Synth. Org. Chem., Jpn.*, 1999, 57, (12), 1036–1050

A review of π-allylpalladium chemistry is presented. The Pd-catalysed decarboxylation of allyl carbonates, allyl β-keto carboxylates and allyl formates has now been achieved. A new generation of β-keto esters and malonates was obtained by the introduction of the Pd-catalysed reaction of their allylic esters. Hydrogenolysis of allylic compounds can be used for deprotection of the allyl protecting group. (57 Refs.)

Synthesis and Characterization of Monomeric and Dimeric Palladium(II)-Ammonium Complexes:

Their Use for the Catalytic Oxidation of Alcohols

S. BOUQUILLON, A. DU M. D'HARDEMARE, M.-T. AVERBUCH-POUCHOT, F. HÉNIN and J. MUZART, *Polyhedron*, 1999, 18, (26), 3511–3516

The addition of R₄NX to PdCl₂ gave (R₄N)₂PdX₄ (1). A dinuclear complex, (n-Bu₄N)₂Pd₂Cl₆, was obtained from the crystallisation of the corresponding monomeric species under controlled conditions. For the Pd-catalysed oxidation of alcohols with 1,2-dichloroethane as stoichiometric oxidant, similar results were obtained using either (1) or PdCl₂/Adogen 464 as catalyst. In the absence of R₄NX, PdCl₂ is rather ineffective.

Synthesis of Novel (Bis)(diarylamino)thiophenes via Palladium-Catalysed Reaction of (Di)bromothiophenes with Diarylamines

M. WATANABE, T. YAMAMOTO and M. NISHIYAMA, *Chem. Commun.*, 2000, (2), 133–134

Pd(OAc)₂/PBu^t₃ (1) was shown to catalyse the coupling of (di)bromothiophenes and diarylamines to afford (bis)(diarylamino)thiophenes. Although 2(,5)-(di)bromothiophenes usually do not undergo the amination reaction due to strong coordination to the Pd catalyst, (1) allows the amination to occur in the presence of a small amount of Pd. The use of the bulky and electron rich PBu^t₃ ligand realised the Pd-catalysed formation of (bis)(diarylamino)thiophenes.

Preparation of Poly(aryleneethynylene) Type π -Conjugated Polymers Constituted of 2-Alkylbenzimidazole-4,7-diyl Units by Using Palladium Catalyzed Cross Coupling Reaction

T. MORIKITA, H. HAYASHI and T. YAMAMOTO, *Inorg. Chim. Acta*, 1999, 296, (1), 254–260

Pd(PPh₃)₄-catalysed polycondensations between 4,7-dibromo-2-alkylbenzimidazoles (alkyl = *n*-C₇H₁₅, *n*-C₁₂H₂₅, *n*-C₁₈H₃₇) and 1,4-diethynyl-2,5-disubstituted benzenes (substituents: *O*-*n*-C₆H₁₃, *O*-*n*-C₁₂H₂₅, *n*-C₁₂H₂₅, *O*-*n*-C₁₈H₃₇) gave poly(aryleneethynylene) polymers including the benzimidazole unit in the π -conjugated main chain. Yields were 70–90%.

Methane Formation during the Iridium/Iodide Catalysed Carbonylation of Methanol

T. GHAFAR, J. P. H. CHARMANT, G. J. SUNLEY, G. E. MORRIS, A. HAYNES and P. M. MAITLIS, *Inorg. Chem. Commun.*, 2000, 3, (1), 11–12

[Ir(CO)₂I₂Me]⁻ (1) reacts with carboxylic acids or H₂ at elevated temperatures to cleave the Ir(III)-methyl bond liberating CH₄. The carboxylic acids remove alkyl groups by a concerted process via a cyclic transition state. CH₄ can arise from (1) during MeOH carbonylation, either by reaction with CH₃CO₂H or by hydrogenolysis.

FUEL CELLS

Anodic Catalysts for Polymer Electrolyte Fuel Cells: the Catalytic Activity of Pt/C, Ru/C and Pt-Ru/C in Oxidation of CO by O₂

C. BRACCHINI, V. INDOVINA, S. DE ROSSI and L. GIORGI, *Catal. Today*, 2000, 55, (1–2), 45–49

Studies of the catalytic activity for oxidation of CO on Pt/C, Pt-Ru/C (Pt:Ru atomic ratio = 20, 3, 1, 1/3) and Ru/C (all containing 20 wt.% metal) catalysts claim that fuel cells with Pt-Ru/C anodes perform better than those with Pt/C anodes due to Ru active sites facilitating oxidation of CO present as an impurity in the H₂-reformed fuel. At 300–400 K, the TOF per active metal atom was 50–300 times higher on Pt-Ru/C than on Pt/C. Addition of H₂O markedly decreased the activation energy for the Pt-Ru(1:1)/C alloy.

Performance of Proton Exchange Membrane Fuel Cell Electrodes Prepared by Direct Deposition of Ultrathin Platinum on the Membrane Surface

S. Y. CHA and W. M. LEE, *J. Electrochem. Soc.*, 1999, 146, (11), 4055–4060

PEMFC electrodes were fabricated using plasma-sputtering that deposited Pt directly onto the surface of the Nafion electrolyte. Multiple sputterings with application of the C/Nafion ink on the surface after each sputtering were found to enhance the utilisation of the catalyst. The reported Pt utilisation efficiency, equivalent to 0.043 mg Pt cm⁻² loading of Pt, is ~ 10 times higher than that of electrodes produced by conventional methods.

Chemical Synthesis and Characterization of Mo_xRu_ySe_z(CO)_n Electrocatalysts

P. J. SEBASTIAN, *Int. J. Hydrogen Energy*, 2000, 25, (3), 255–259

Mo_xRu_ySe_z(CO)_n electrocatalyst (1) was prepared by the pyrolysis of Ru₃(CO)₁₂ + Mo(CO)₆ + Se at 140°C and sintering in a Se atmosphere at 250°C. (1) is almost amorphous in nature and possesses catalytic activity for O₂ reduction in a PEFC. The electrocatalytic activity diminished with Se incorporation in the lattice of the formed Mo-Ru-CO clusters.

ELECTRICAL AND ELECTRONIC ENGINEERING

Effect of Orientation of *c*-Axis on Ba₂CuPt₂O₈ Compounds of Fluorine-Doped YBa₂Cu₃O_x Superconductors

T. HAMADA, R. MORIMO, K. KUMAMOTO, B. IBUSUKI, K. NAGATA and A. TAKADA, *J. Mater. Sci.*, 1999, 34, (19), 4705–4710

Ba₂CuPt₂O₈ compounds (1) were synthesised by a solid state reaction at > 800°C. The influence of (1) on the critical current density of the title YBCO superconductors was investigated using two types of (1). One sample was not heat treated, i.e., source materials, and the other was heat treated at 950°C. The former affected the orientation of the *c*-axis, but the latter did not have an influence on the orientation of the *c*-axis, and damaged the superconductivity of the samples quenched above 850°C.

Integration of GaN Thin Films with Dissimilar Substrate Materials by Pd-In Metal Bonding and Laser Lift-off

W. S. WONG, A. B. WENGROW, Y. CHO, A. SALLEO, N. J. QUITORIANO, N. W. CHEUNG and T. SANDS, *J. Electron. Mater.*, 1999, 28, (12), 1409–1413

GaN thin films grown on sapphire substrates have been bonded and transferred onto GaAs, Si and polymer “receptor” substrates using a low temperature Pd-In bond followed by a pulsed UV-laser lift-off process to remove from the sapphire. The GaN/sapphire structures were joined to the receptor substrate by pressure bonding a Pd-In bilayer coated GaN surface onto a Pd-coated receptor surface at 200°C.

Studies of Ir-Ta-O as High Temperature Stable Electrode Material and Its Application for Ferroelectric SrBi₂Ta₂O₇ Thin Film Deposition

F. ZHANG, J.-S. MAA, S. T. HSU, S. OHNISHI and W. ZHEN, *Jpn. J. Appl. Phys., Part 2, Lett.*, 1999, 38, (12A), L1447–L1449

An Ir-Ta-O/Ta/Si structure was fabricated with Ir-Ta-O as electrode and Ta as diffusion barrier layer on a Si substrate. The Ir-Ta-O film (1) was deposited by reactive sputtering. (1) exhibited extraordinary high-temperature stability with good conductivity and integrity. By using (1) as the bottom electrode for depositing SrBi₂Ta₂O₇ thin film at 800°C, good ferroelectric properties were achieved.