Advancements in Hydrogen Technology

REPORT OF THE HYPOTHESIS III SYMPOSIUM

International participation in the developing technological and academic aspects of hydrogen-centred economies has again been demonstrated at the third symposium in the HYPOTHESIS series. Symposia in this series have been held during the intermediate years of the World Hydrogen Energy Conferences and cover many aspects of concern to the hydrogen economy, such as hydrogen production, distribution and transportation, safety factors and information about techniques of handling hydrogen and combinations of hydrogen with other gases.

This year HYPOTHESIS III was held from the 4th to 9th July in the historical Dimitri Mendeleev Institute of the St. Petersburg State University, Russia, under the chairmanship of N. V. Egonov and secretaryship of V. P. Denissov.

Particular areas where platinum and palladium are involved include membrane processes and where they give an advantage in intermediate stages of reactions in which hydrogen plays a part. Currently, very active areas of research with catalytic involvement include those giving improved efficiencies for fuel cell electrodes. M. Khalioullin, N. Kuleshov, S. Grigoriev and V. Fateev (Moscow Power Engineering Institute, Russian Research Centre "Kurchatov Institute", Russia) reported studies under high pressure conditions, using iridium, platinum and lead oxide anode electrocatalysts.

The advantage of having platinum additions in the active carbon anode of an air-metal hydride, hydrogen gas rechargeable battery, was described by N. Kuriyama, T. Sakai, H. Tanaka, H. Takeshita and I. Uehara (Osaka National Research Institute, Japan). Advantageous electrode activity, obtained by improving the catalysts for advanced nickel hydride batteries, was described in a paper by V. N. Verbetsky, O. A. Petrii and S. V. Mitrokhin (Lomonosov Moscow State University, Russia), J. S. Sung (Korea Institute of Energy Research) and N. V. Korovin (Moscow Power Engineering Institute, Russia).

An improvement in the production of hydrogen by photochemical techniques, brought about by the presence of platinum catalysts, was reported in a contribution from V. I. Korotkov, S. O. Stepanova and V. V. Akulinichev (St. Petersburg State University). While, valuable improvements using low loaded platinum catalysts in polymer electrolyte based fuel cells, were reported by G. Squadrito, E. Passalacqua, F. Lufrano and A. Patti (National Research Centre, S. Lucia-Messina, Italy).

Improvements in hydrogen storage after platinum was incorporated in nanomaterial carbon were reported in a paper by I. E. Gabis (St. Petersburg State University) and S. K. Gordeev (Central Research Institute of Materials, St. Petersburg, Russia). It was suggested by B. P. Tarasov (Institute of New Chemical Problems of RAS, Chernogolovka, Russia) that platinum absorbed within fullerides and allied structures as $C_{60}(Pt, Pd_x)$ may provide a new class of reversible hydrogen absorbents.

The utilisation of palladium or palladium alloy membranes for the production of the highest levels of purity of hydrogen gas was reported by S. Morooka and K. Kusakabe (Kyushu University, Japan). The integration of a palladium alloy purification membrane with a methanol-steam reformer for hydrogen production was reported by J. C. Amphlett, L. M. Kearns, R. F. Mann and B. A. Peppley (Royal Military College of Canada).

The superpermeable behaviour towards hydrogen of composite membranes formed from non-metal monolayers and metallic layers, where a palladium layer is one of the alternatives, was reported in a contribution from A. Livshits, M. Notkin, A. Samartsev, A. Doroshin, V. Alimov and A. Busnyuk (Bonch-Bruyevich University, Russia), N. Ohyabu and H. Suzuki (National Institute for Fusion Science, Japan) and M. Bacal (École Polytechnique, Palaiseau, France).

Gorsky Effect strain gradient components of hydrogen diffusion parameters for palladium and compositions of palladium-platinum and palladium-silver alloys were interrelated in a contribution from F. A. Lewis (Queen's University of Belfast, U.K.) and K. Kandasamy (University of Jaffna, Sri Lanka).

Studies of pressure (p)-composition (c)-temperature (T) relationships in conjunction with relationships between hydrogen content and relative electrical resistance, R/R_0, were reported by A. K. M. Fazle Kibria, T. Kubota, A. Kagawa and Y. Sakamoto (Nagasaki University, Japan).

A new flat structured membrane, for the production of pure hydrogen, made from a palladium-indium-rhenium alloy, was recommended for use over a large temperature range (100 to 800°C). Reported by E. M. Chistov, V. M. Gryasnov, N. R. Roshan and D. I. Slovetsky (A. V. Topchiev Institute of Petrochemical Syntheses, Russia), the membrane displays resistance to corrosion over a wide range of hydrosulfurous and hydrocarbon atmospheres.

At the end of the conference, each participant was presented with a CD-ROM of the proceedings; however, it is also planned to publish selected contributions in a special issue of the *International Journal of Hydrogen Energy*. The next symposium in the series, HYPOTHESIS IV, will be held from 9th to 14th September 2001 in Stralsund, Germany. Fax: (+49-3831) 456-687; E-mail: hypotheses@fh-stralsund.de; URL: http://www.hypothesis.de/.

F. A. LEWIS

Intracellular Measurements by Pt/Ir Microelectrode

To study the behaviour of biological cells, it is necessary to investigate their electrophysiological properties. Cells display an electrical potential difference across their cell membrane which is extremely small, but is important to the cell. Positive current is said to cross the cell membrane from inside to outside and all cells have negative membrane potentials, typically of size ~ -80 mV.

Transmembrane potentials are conventionally measured using borosilicate or aluminium silicate glass micropipettes, the narrow tips of which can easily break or become clogged with air bubbles formed when the pipette is filled with electrolyte.

Now, researchers from laboratories in Switzerland have developed a new microelectrode for this purpose based on a sharp platinum/iridium needle (M. Schwank, U. Müller, R. Hauert, R. Rossi, M. Volkert and E. Wintermantel, *Sens. Actuators B, Chem.*, 1999, **56**, (1–2), 6–14).

Platinum-20 per cent iridium wire, 250 μm in diameter, was electrochemically etched in molten salt solution until the required high aspect ratio was obtained. The needles produced were uniformly shaped and slim, to minimise damage to the membrane cell, and have a typical radius of curvature of 300 nm. The needle was electrically insulated, except for the tip, by a thin film of hydrogenated amorphous carbon.

The tip of the needle was made into a conducting microelectrode of small radius of curvature, by transforming it using a scanning tunneling microscope working in a high pressure oxygen atmosphere. The high electrical resistance of the tip was successfully reduced. Penetration into cells by this conducting tip has to be smaller than the size of a cell, which is typically ~ 30 μm for a liver cell.

While there are disadvantages with this technique, such as slow response time and the measured potential of a biological cell differing from that measured conventionally, these microelectrodes have lateral resolution < 100 nm and improved mechanical properties.

Platinum Loss from Alloy Catalyst Gauzes in Nitric Acid Plants

In the April 1999 issue of *Platinum Metals Review*, on page 65, in Fig. 3, the caption should read "Dependence of the relative weight losses,..."; in the right hand column, the nineteenth line should read "relative platinum loss per cent for the three PPR#1"; and the twenty fourth and twenty fifth lines "3.95×10^{-4} per day for PPR#1 alloy gauze and 2.95×10^{-4} per day for PPR#2 alloy gauze", respectively. In Table III on page 66, omit "wt.%" from the fifth column headed $[Pt]:[Pt]_0$. On page 68, the equation should be "$2Pd + PtO_2 \rightarrow 2PdO + Pt$".

The Oxidation of Alcohols to Aldehydes or Ketones

In the July 1999 issue of *Platinum Metals Review*, on page 100, the second column in the Table should read "Stoichiometric oxidations, % conversion" and in that column, the twelfth line next to $(4\text{-Me-py})_2$ (in the first column) should read "30".