

Poltarzewski, V. Alderucci, G. Maggio and N. Giordano, CNR Institute, Messina, Italy) as well as in cases of methanol fuel cells (B. Ganser and B. Hohlein, Forschungszentrum Jülich).

## Hydrogen Isotope Separation and General Information

Platinum metal activated electrode surfaces were among those examined by D. L. Stojic, S. S. Miljanic, T. D. Grozdic and M. M. Jakšić, University of Belgrade, within a study of electrolytic separation of protium and deuterium, and information available for palladium concerning hydrogen isotope exchange processes has been utilised for the development of a method to abstract tritium from tritium polluted water (B. Andreev, Y. Sakharovskij, A. Perevezentsev and M.

Rosenkovich, Mendeleev Institute of Chemical Technology, Moscow).

Articles which concerned the availability of information within general areas of study were presented by R. Fromageau, E.N.S.C., Paris and by V. A. Goltsov, C. Droniou and M. Rubinstein, L. F. Goltsova and V. A. Garkusheva, Polytechnic Institute, Donetsk.

Presented papers have been collected into a proceedings volume, "Hydrogen Energy Progress IX", edited by T. N. Veziroglu, C. Derive and J. Pottier and printed by M.C.I., Paris on behalf of the International Association for Hydrogen Energy. The next World Hydrogen Energy Conference will be held in Orlando, Florida during 1994 under the chairmanship of Dr David L. Block of the Florida Solar Energy Center, Cape Canaveral. F.A.L.

## Platinum and Iridium Intermetallic Films

Carbon-carbon composites have high strength but their structural use is restricted by their rapid degradation in oxidising environments at temperatures as low as 500°C. For demanding aerospace applications such as for rocket nozzles and jet engine combustion chambers, where temperatures in excess of 2000°C may be encountered, a coating that would provide oxidation-resistance for even a short time would be advantageous.

As part of a programme to develop high-temperature, oxidation-resistant coatings for carbon-carbon composites researchers at GenCorp Aerojet Electronic Systems Division, in Azusa, California, investigated a closed-shell molecule, the Engel-Brewer compound zirconium triplatinide,  $ZrPt_3$  (1). This material was selected because its melting point is in excess of 2190°C and it can be formed by heating a mixture of the two elements at temperatures above 2500°C.

An electron-beam evaporation procedure was used to build up a multilayered structure of zirconium and platinum on both pyrolytic graphite and phenolic resin/graphite samples. Three layers of each metal were deposited to give a total thickness of either 0.5 or 2.0  $\mu\text{m}$ , the relative thicknesses of the individual layers being determined by the amounts calculated to yield stoichiometric  $ZrPt_{33}$ , when homogenised. Preliminary results demonstrated that the zirconium/platinum multilayers were adherent and provided oxidation-resistance to the underlying substrate. The metallic layers react together

at high temperatures, either during a preparatory annealing stage or in high temperature operation, to form the stable oxidation-resistant  $ZrPt_3$  compound. Also, the highly reflective nature of the coating reduced the heat load on the substrates for short-time and high-temperature applications.

A more recent paper from the same laboratory reports the results of an investigation of the reaction mechanisms of oxygen, hydrogen and water vapour with  $ZrPt_3$  and also  $HfIr_3$  as a function of temperature and under ultra high vacuum conditions (2). The effect of hydrogen on the oxidation reaction is considered to be particularly relevant as hydrogen is present in rocket exhaust emissions.

The results indicate that these compounds only partially react with oxygen and water vapour, forming a surface oxide layer with a maximum thickness of 35Å. Vacuum annealing and hydrogen dosing prior to oxidation inhibit any subsequent oxidation of  $ZrPt_3$ , while exposure to hydrogen after oxidation reduces the surface oxide.

These materials show promise as oxidation-resistant coatings, providing they completely cover the carbon substrate.

### References

- 1 M. D. Alvey and P. M. George, *Carbon*, 1991, 29, (4/5), 523-530
- 2 R. F. Fisher, M. D. Alvey and P. M. George, *J. Vac. Sci. Technol. A*, 1992, 10, (4), 2253-2260