Hydrogen Material Science and Metal Hydride Chemistry

PLATINUM AND PALLADIUM ALLOYS FEATURED

Under the auspices of the National Space Agency of Ukraine, the Third Inter-Republic Conference on Hydrogen Material Science and Chemistry of Metal Hydrides was recently held from the 9th to the 15th October in the attractive surroundings of the Conference Centre of the Ukrainian Academy of Sciences at Katsiveli near Yalta, in the Crimea.The conference was organised under the joint chairmanship of Professor V. A. Lavrenko and Dr D. V. Schur of the Institute for Materials Science of the Ukrainian Academy in Kiev, supported by an enthusiastic young committee. Approximately ninety contributions were presented with intermediate poster sessions. In an introductory address Professor B. Baranowski, of the Institute of Physical Chemistry of the Polish Academy in Warsaw, drew attention to the fact that the present conference was the first in the series at which some of the papers would be given in English, namely those originating from laboratories in the United Kingdom, Germany, Poland and Taiwan. Contributions delivered in Russian came from laboratories in the republics of Belarus, Russia, Kazakhstan, Uzbekhistan and Armenia, in addition to a majority from Ukraine. Excellent concurrent translations in English and Russian were provided in all sessions.

Palladium and Palladium Alloys

A main topic area of the conference concerned hydrogen storage together with complementary issues such as developments in fuel cells and hydride batteries. Related current progress was discussed by Lavrenko who presented a comprehensive introductory survey, including reference to the phase relationships of intermetallic compounds of the transition elements.

For palladium and palladium alloys, similarities between analogous factors in regard to the phase relationships, and to strain gradient effects during hydrogen permeation experiments, were considered and discussed in two joint papers presented by R.-A. McNicholl and F. A. Lewis, Queen's University, Belfast, X. Q. Tong, Birmingham University, K. Kandasamy, University of Jaffna and Y. Sakamoto, Nagasaki University. Similar problems in interpreting phase relationships were found for analogous studies on zirconium-vanadium alloys and palladium-zirconium alloys. These were discussed in two papers by I. U. Zavaly of the Department of Physics and Mechanics of the Ukrainian Academy in Lvov. Involvements of Gorsky Effects, produced by localised lattice strain gradients, could be inferred from electron microscopic observations during annealing of palladium containing low hydrogen contents. This was reported by T. P. Perng, from the Department of Materials Science and Engineering, Hsinchu, National Academy, Taiwan, Republic of China.

Structures and Hysteresis Phenomena

Alternative structural change possibilities arising from dislocation production and associated structural damage, occurring concurrently on the introduction of hydrogen into palladium alloys, were dealt with in three papers on palladium-tungsten, palladium-samarium, palladium-copper and palladium-platinum alloys from G. P. Revkevich, A. A. Katsnelson, I. V. Dolya, M. Mitkova and M. M. Kanyazeva of Moscow State University. Theoretical correlations between hydrogen pressure-composition-temperature relationships and regarding dependencies of various physical parameters on hydrogen content, in relation to hydrogen occupation of particular combinations of interstitial sites in palladium alloys, were discussed in a contribution by Z. A. Matysina and S. Yu. Zaginaichenko, of the Metallurgical Institute, of the State University in Dniepropetrovsk.

For palladium-hydrogen and nickel-hydrogen

systems the significance in the correlations between their pressure-composition isothermals, in relation to hysteretic and critical point phenomena and also to magnetic parameters, was discussed in a contribution from I. Dugandzic and H. J. Bauer of the Physics Department, University of Munich. A particularly extensive discussion followed the presentation, by Baranowski, of a fresh quantitative explanation for the size of the hysteretic effects in pressure-composition relationships and associated thermodynamic parameters of the nickel-hydrogen, and particularly palladium-hydrogen, systems.

Contributions to the conference are planned to be published in the *International Journal of Hydrogen Energy* and it is anticipated that further conferences in the series will continue to take place on a biennial basis. F.A.L.

Optically Readable Hydrogen Sensor Uses Palladium

A wide range of hydrogen-air compositions explode on ignition, and may cause serious accidents. To avoid such situations arising a variety of hydrogen sensors has been developed. At present, the hydrogen concentration in an atmosphere is usually measured by monitoring changes in an electrical property of the sensor as reaction with the hydrogen gas takes place. To enhance the sensitivity of such sensors it is necessary to maintain clean surfaces, and therefore they are generally heated to temperatures above 150°C. Thus there has been a need to develop an accurate hydrogen sensor which could operate at room temperature.

Researchers at Nagaoka University of Technology and at the University of Tokyo, Japan, had observed that the optical transmittance of palladium thin films depends strongly on the presence of hydrogen in the ambient atmosphere; now they have developed a hydrogen sensor which utilises this phenomenon and operates at room temperature. (Y.-S. Oh, J.-I. Hamagami, Y. Watanabe, M. Takata and H. Yanagida, *J. Ceram. Soc. Jpn.*, 1993, **101**, (6), 618–620).

The sensor consists of a palladium thin film deposited on a glass substrate by radio-frequency magnetron sputtering. When a sample is exposed to hydrogen the optical transmittance to light of wavelength 780 nm increases and becomes saturated at a constant value, but on exposure to dry air the transmittance returns to its original value. It is reported that these reactions are perfectly reversible even after multiple repeats. For a thin film of specified thickness, the optical transmittance of the sensor was found to depend on the hydrogen concentration; with an increase in hydrogen concentration the relative change in transmittance increased, the response time decreased, and the recovery time increased.

This new optically readable palladium thin-film hydrogen sensor has excellent sensitivity and is compatible with fibre optics.

It is suggested that this novel palladium sensor may be selective only to hydrogen. Furthermore, the dependence of optical transmittance on the hydrogen concentration in the ambient atmosphere has also been observed for radio-frequency sputtered platinum films.

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Since 1980 the Institute of Precious Metals, Kunming, China, has been producing a quarterly scientific periodical entitled *Precious Metals*. Sponsored by the China National Nonferrous Metals Industry Corporation, the journal reports important research achievements in precious metals research in China. Publication is in Chinese, although English translations are given of the contents table, a brief abstract of each paper and associated key-words, and some figure captions. As may be deduced from the title, the journal covers gold and silver in addition to the six platinum group metals. The scope of the journal is somewhat wider than that of *Platinum Metals Review*, in that the subject matter includes: exploration, mining and mineral dressing, extraction, separation, purification and analysis, and the recovery of precious metals from secondary resources. Also covered are measurements of physical properties, the use of precious metals and alloys by the chemical, dental, electronics and jewellery industries; and the study of precious metals chemicals, complexes and drugs. More information about *Precious Metals* may be obtained from the Precious Metals Editorial Panel, Institute of Precious Metals, Kunming, (650221), Yunnan, People's Republic of China.