

A Conference on Hydrogen in Metals

THE CONTINUING IMPORTANCE OF PALLADIUM

The first metal hydride to be studied was of course that of palladium, discovered by Thomas Graham over a hundred years ago, and more than a fifth of the papers presented at an International Meeting on Hydrogen in Metals organised by the Deutsche Bunsengesellschaft für Physikalische Chemie and the Faraday Division of The Chemical Society, held in Munster, in March, described the absorption of hydrogen by palladium and its alloys. A number are reviewed briefly here.

Palladium chemisorbs hydrogen at its surface and, as pressure increases, this enters the metal to form α - and then β - (or α') phase hydride; the concentration in the β -phase is close to that in liquid hydrogen.

Composition isotherms exhibit hysteresis and F. A. Lewis, W. D. McFall and T. C. Witherspoon of Queen's University, Belfast, compared the hysteresis noted in pressure-x and electrical resistance-x isotherms for the sorption of hydrogen by palladium and its alloys, and concluded that these reflected dimensional differences. They highlighted the need for greater consideration of the single-phase regions at the onset of phase transitions. Consideration of previous X-ray work indicated that the β -phase could exist below the pressure at which it was normally formed, $P_{\alpha\beta}$, during absorption. The rate of absorption by palladised palladium wire from 0.003M H_2SO_4 at 1 atmosphere (10^{16} molecules/cm²/s) at 283 to 358K was diffusion limited. The nature of the absorbed species, whether H^- , H^+ or H_3 , is still uncertain. D. H. Everett, of Bristol University, and P. A. Sermon, of Brunel University, reported that increasing the surface area of palladium increased its absorption of hydrogen as to the α -phase, decreased its absorption as to the β -phase, lowered the pressure required for the β -phase to nucleate in the α -phase and increased the pressure at which the

α -phase nucleated in the β -phase. Thus the susceptibility of palladium to hysteresis was reduced as its surface area increased.

The shortening and thickening of palladium wires when repeatedly charged and discharged with hydrogen was confirmed by D. J. Gillespie and A. C. Ehrlich of the Naval Research Laboratory, Washington, D.C., using electrical resistivity measurements of $Pd_{95}Rh_5H_x$. F. M. Mazzolai, M. Nuovo and R. Franco, Istituto di Acustica "O. M. Corbino", Rome, and F. A. Lewis related these macroscopic dimensional changes resulting from $\alpha \rightarrow \beta$ and $\beta \rightarrow \alpha$ phase transformations to anelastic processes.

One use of metal hydrides is to separate hydrogen isotopes. H. Brodowsky and D. Repenning, of the Institut für Physikalische Chemie, Universität, Kiel, considered the separation factor, α , defined as the ratio of isotopes in the gaseous to absorbed phases, and found it increased as x increased and as the temperature decreased.

D. T. Hughes and I. R. Harris, of the University of Birmingham, described hydrogen diffusion through PdZ_zH_x , where Z was a rare earth such as Ce, Gd or notably Y and z is 6 to 8 per cent, which is up to 2.7 higher than through commercial $Pd_{0.75}Ag_{0.25}$ membranes developed in the 1950s. This resulted from greater high-temperature solubility gradients in the rare-earth alloys, which had higher lattice parameters than palladium.

A wide range of metal hydrides are being developed rapidly to meet the needs of gas purification, isotope separation, gas storage, energy conversion and many other uses summarised by J. J. Reilly, Brookhaven National Laboratory, Upton, New York.

The papers presented at this conference, or their abstracts, will be published in *Zeitschrift für Physikalische Chemie* over the coming months. P.A.S.