

# Hydrogen Interactions in Metal Systems

## HYDROGEN IN METAL SYSTEMS II

EDITED BY F. A. LEWIS AND A. ALADJEM, Scitec Publications, Uetikon-Zurich, Switzerland, 2000, 517 pages, ISBN 3-908450-55-1, U.S.\$ 264, £150

As the importance of the hydrogen economy continues to increase, the interactions of hydrogen with other elements is becoming a significant area of scientific research. Most metal-hydrogen reactions have been studied to various depths and reporting this breadth of work is one of the strengths of "Hydrogen in Metals II", a sequel to a prior publication (1) in the Solid State Phenomena Series. The book gives a thorough treatment to hydrogen systems of the elements in Groups 6 to 11 of the Periodic Table. These elements, in their elemental and alloy states, form the basis for many engineering materials. The editors, in particular Fred Lewis, have been in this field for many years; Lewis's book on palladium-hydrogen systems is deemed a cornerstone work (2).

The chapters deal with each group of transition metals in turn, beginning with chromium, molybdenum and tungsten which lack significant hydrogen sorption properties, but are the building blocks of some high performance alloy systems. Chromium (like vanadium) forms ternary hydrides with elements such as titanium. These hydrogen storage alloys hold promise for storage and battery applications.

The reaction of hydrogen with iron introduces the fundamental treatment of absorption, desorption and diffusion. The permeation of hydrogen through these materials is also examined, but becomes more important when dealing with palladium alloys. Little work is reported on reactions of hydrogen with the first platinum group metals, ruthenium and osmium, so the need for more research on understanding hydrogen reactions with these metals gives an opportunity for fundamental work.

Cobalt is an endothermic absorber of hydrogen and usually cobalt hydride is formed chemically or under high hydrogen pressure. Binary systems of cobalt, rhodium and iridium again require more understanding of their reactions with hydrogen as

little work seems to have been done in this area.

The largest chapter in the book (some two-thirds of the book) covers the interactions of nickel, palladium and platinum with hydrogen. The chapter first looks at the nickel-hydrogen reaction, then deals in great detail with platinum, palladium and their alloys. This chapter provides the reader with a grounding in how hydrogen interacts with these metals, the diversity of the reactions depending on the history of the sample and the method of measurement, but most important, it shows that a good understanding is needed of the fundamental approach to hydrogen storage and fuel cell electrode applications. The information on palladium alloys used in diffusion membranes is equally thorough, and again presents an area requiring more work.

The final chapter deals with copper, silver and gold. Unlike palladium, these are not absorbers of hydrogen, but interactions still occur in many ways. Alloying palladium with this group has given many alloys for possible hydrogen permeation membrane applications.

The reference sections reflect the increasing interest in hydrogen-metal interactions. However, this volume will probably only interest those in academia or those researching applications. It would have been useful to have this book in the context of the emerging hydrogen economy. While it contains useful material it has some publishing flaws which detract from its overall presentation. The editors have done an excellent job in collating and summarising a wealth of past and current work in the field.

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### References

- 1 F. A. Lewis and A. Aladjem, "Hydrogen in Metals I", Trans Tech Publications, Uetikon-Zurich, 1996
- 2 F. A. Lewis, "The Palladium Hydrogen System", Academic Press, New York, 1967

### The Author

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