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Hydrogen in Intermetallic Compounds II

Surface and Dynamic Properties, Applications

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Preface

Interdisciplinary research topics are inevitably associated with both opportunities and risks. These stem, for example, from the different ways of investigating problems and the different expressions used to describe the same phenomenon by scientists from different fields. "Hydrogen in and on Metals" is one such topic. It attracts metallurgists, solid state scientists from both physics and chemistry, mechanical and chemical engineers and energy technology specialists.

Phenomena related to the topic "Hydrogen in Metals" and the physics behind them as they were understood at the end of the 1970s are reviewed in the books *Hydrogen in Metals*, Vol. I and II, edited by G. Alefeld and J. Völkl (Vols. 28 and 29 of Topics in Applied Physics). These books, which deal mainly with hydrogen in elemental metals, are still very valuable and will continue to be important in the coming years.

Since their publication, many new results have been obtained, and have considerably improved both our knowledge and understanding. Much recent work has been stimulated by the extraordinary properties of hydrogen-storing intermetallic compounds and by the constant threat of an energy crisis. The recent progress, which has involved *intermetallic compounds* and alloys rather than elemental metals, has been reviewed in many good articles, either at a technical, purely scientific level, or at a more popular level. Until now, however, the details of this important field have never been collected and presented in the form of a book.

Thus, the aim of the two volumes "Hydrogen in Intermetallic Compounds" is to give a thorough description of the various aspects of the topic in a series of chapters written by specialists in the field, and to review major progress on hydrogen in and on elemental metals. This second volume begins with introductory remarks concerning the latest results, suggestions for future R & D work, safety aspects and experimental techniques and contains a table with the most important physical and chemical properties of hydrogen gas. Then surface properties and activation (Chap. 2), dynamics of hydrogen in long-range diffusion and local modes (Chap. 3), and intrinsic kinetics (Chap. 4) are reviewed. The applications of metal hydrides and the application-oriented material properties are described in Chap. 5. The final chapters, 6 and 7, are dedicated to special experimental techniques.

Volume I concentrated on the preparation and characterization of intermetallics and hydrides, thermodynamic properties, crystal structure, electronic

properties, heat of formation models, together with magnetism and superconductivity.

As the interaction of hydrogen with metals and alloys is, and will be, of significant importance for basic research as well as for hydrogen energy technology, fusion, catalysis, getters, electrochemical cells and many other applications, I hope that these two volumes will help many scientists to find the information they are looking for, to spread the fascination which we the authors already share, and to stimulate further work.

Working with hydrogen and its isotopes is sometimes risky, whereby the risk can be of either physical or political origin: Henry Cavendish performed a clever series of experiments on the reaction of acids with metals and in 1766 submitted his results on the evolution of what we call hydrogen gas in the form of three scientific papers on *factitious air* to a scientific journal (Philosophical Transactions). Cavendish was convinced that the evolved factitious air was contained in the metals (phlogiston theory). Antoine Laurent Lavoisier, fermier général (tax inspector) and chemist published his revolutionary "Traité élémentaire de chimie" in 1789. He clearly showed that Cavendish's factitious air originated in the decomposition of water and therefore named it hydrogen. Lavoisier presented his results orally in 1783 at the Royal Academy of Sciences in Paris. He also "went public" and presented the results in a theatre play in which the books on the phlogiston theory were burned. Lavoisier, who had revolutionized chemistry with his modern mind became a victim of the French Revolution: After being condemned to death he asked for a two week stay of execution in order to finish his experiments. "La République n'a pas besoin de Savans, ni de Chymistes" decided the tribunal; thus Lavoisier mounted the scaffold. Recently, outbreaks of cold fusion fever were initiated by a communication in a non-scientific magazine. The idea was revolutionary, but soon showed a lack of reasonable reproducibility. If we were to turn the clock back 200 years, a large part of the scientific community would surely have called for the initiators to mount the scaffold.

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Fribourg, January 1992 Louis Schlapbach

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