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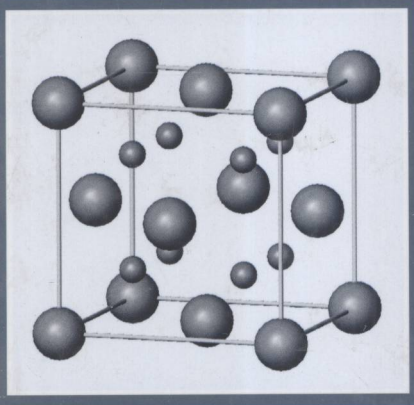

Solid-state hydrogen storage

Materials and chemistry

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Solid-state hydrogen storage

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Preface

Energy is a requirement for any civilisation, whether from wood, fossil fuels, nuclear or renewable sources (such as solar, wind and tidal). The more developed a nation, the higher the energy need per capita as energy consumption moves away from being primarily for heating and cooking and pervades all aspects of life (domestic, work and leisure). For example, the greater wealth of a nation leads to higher rates of consumption and increased demand for transportation. Cheap and abundant reserves of oil and coal have fuelled an extraordinarily rapid rate of technological development in the Western world over the past century. Developing countries such as China and India are set to emulate this transition which, owing to the large populations of both countries, will lead to unprecedented global energy demand. The Intergovernmental Panel on Climate Change (IPCC) has shown that the increasing concentrations of carbon dioxide are caused by human activities, and that increased carbon dioxide levels lead to global warming (with the associated problems of rising sea levels and more frequent and extreme adverse weather events). These are global problems which will affect all countries.

A potential solution is to develop a low-carbon future, where fossil fuel use is reduced, replacing it with zero-carbon energy sources such as from renewables. Hydrogen and electricity can both be used as convenient energy carriers for renewable energy sources. In a low-carbon future, a more robust energy network will probably incorporate both. One sector where hydrogen is likely to have a major impact is transport because hydrogen fuel cells have a higher energy density than current battery technologies, which severely limits the range for current electric vehicles. The importance of hydrogen for our low-carbon future is highlighted by the International Energy Agency's (IEA) Hydrogen Implementing Agreement. IEA activities bring together scientists from around the globe to collaborate on solutions to the current technical barriers hindering our transition to a hydrogen economy. One focus is the compact and lightweight storage of hydrogen.

Over the past decade, there have been many significant advances in the storage of hydrogen in porous materials, complex hydrides and liquid hydrides,

and in catalysts to accelerate the cycling kinetics for these materials. It is therefore very timely to bring together many of the leading experts in this field and have them report the exciting developments for these systems. There are so many different types of materials being investigated for hydrogen storage applications that it is beyond the scope of this book to include chapters on them all; hence the focus is on the new materials which have been intensively investigated over the past decade. The book also examines some of the techniques to characterise these materials to determine physical and structural changes, investigate the interactions of hydrogen with substrates and the accurate measurement of hydrogen storage capacities. In addition to the science and engineering related specifically to the storage medium, there are also chapters on the effect of hydrogen on structural materials (e.g. the walls of a pressure vessel where hydrogen embrittlement can be a significant problem) and the socio-economic factors that may influence our transition to a low-carbon future.

This collection will inevitably be of interest to experienced scientists and engineers in the field as well as postgraduate and undergraduate students keen to explore either energy and/or hydrogen technologies. Global solutions are urgently needed if we are to avoid a global catastrophe. The range of nationalities of the contributing authors indicates the effort from around the world being devoted to hydrogen storage and it is the hope of the editor that this book will be a valuable resource to, and help inspire, young researchers in this exciting and challenging field.

Dr Gavin Walker
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