PREFACE

The growing demand for energy, brought about by the rising standard of living in the developing world and global population growth, has made it imperative that new energy sources beyond fossil fuels be found to sustain and grow the current economy. The limited supply of fossil fuels and its adverse effect on the environment also makes it necessary that these sources should be abundant, renewable, secure, clean, safe, and cost-effective. In this regard hydrogen, the most abundant element in the universe and third most abundant element on the earth, has the potential to meet this growing energy need. In addition, hydrogen offers many advantages over other fuels: it is non-toxic, clean to use, and packs more energy per unit mass than any other fuel. However, hydrogen is not an energy source but an energy carrier. Since it does not occur freely in nature and is gaseous at room temperature and pressure, it needs to be produced and stored. To be economical, the production costs not only have to be lowered, but safe and cost effective means of storing, distributing and using hydrogen must also be found. The public also needs to be educated about hydrogen as an alternate fuel. Critical to the success of a hydrogen economy is our understanding of the interaction of hydrogen with materials and solving numerous materials issues relevant to the production, storage, and distribution of hydrogen and its use in fuel cells.

To address the above complex issues an "International Symposium on Materials Issues in a Hydrogen Economy" was held in Richmond, Virginia from November 12-15, 2007. The symposium dealt with the fundamental science and technology challenges related to the production, storage, distribution and use of hydrogen in fuel cells, and safety concerns. Nearly 150 researchers from Physics, Chemistry, Materials Science, and Engineering communities of 17 countries around the world attended this symposium and shared their ideas and results, delineated outstanding problems, and discussed future research. This book contains the proceedings of this symposium.

The topics will include:

Production and Delivery:	Nuclear, Thermo-chemical, Photo-electrochemical, Photo-biological, and Biomass.
Storage:	Liquid, Compressed Gas, and Solid State (complex light metal hydrides, zeolites, clathrates, metal-

	organic frameworks, carbon and boron-nitride based nanostructures, chemical hydrides).
Fuel Cells:	Polymer electrolyte and Hydro-carbon membranes.
Cross-cutting fields:	Catalysis, Nanostructures, Education, Safety, and Economics

The symposium featured 36 invited speakers and 82 contributed presentations addressing issues in production, storage, distribution, safety, education, and economics. Professor John B. Fenn, Nobel Laureate in Chemistry addressed the opening session. The symposium was sponsored by Virginia Commonwealth University and endorsed by American Physical Society, Materials Research Society, and American Chemical Society.

This symposium would not have been possible without the tireless efforts of the members of the International Advisory Board, the National and Local Organizing Committee and financial support from Virginia Commonwealth University, National Science Foundation, Department of Energy, Dominion Resources, Philip Morris USA, and General Motors. Our special thanks go to Dr. Sa Li for help in preparing the proceedings and to the undergraduate and graduate students and postdoctoral fellows in the Physics and Engineering Departments of Virginia Commonwealth University for volunteering their services during the organization of this symposium, to the conferees for the high quality of their participation, and last but not the least to Mrs. Barbara Martin for her assistance through out the two year period this symposium was in the making.

Richmond, Virginia
January, 2009

P. Jena
A. K. Kandalam
Q. Sun