

Tatsumi Ishihara
Editor

FUEL CELLS AND HYDROGEN ENERGY

Perovskite Oxide for Solid Oxide Fuel Cells

 Springer

Perovskite Oxide For Solid Oxide Fuel Cells Fuel Cells And Hydrogen Energy

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Perovskite Oxide For Solid Oxide Fuel Cells Fuel Cells And Hydrogen Energy:

Perovskite Oxide for Solid Oxide Fuel Cells Tatsumi Ishihara, 2009-06-12 Fuel cell technology is quite promising for conversion of chemical energy of hydrocarbon fuels into electricity without forming air pollutants There are several types of fuel cells polymer electrolyte fuel cell PEFC phosphoric acid fuel cell PAFC molten carbonate fuel cell MCFC solid oxide fuel cell SOFC and alkaline fuel cell AFC Among these SOFCs are the most efficient and have various advantages such as flexibility in fuel high reliability simple balance of plant BOP and a long history Therefore SOFC technology is attracting much attention as a power plant and is now close to marketing as a combined heat and power generation system From the beginning of SOFC development many perovskite oxides have been used for SOFC components for example LaMnO based oxide for the cathode and 3 LaCrO for the interconnect are the most well known materials for SOFCs The 3 current SOFCs operate at temperatures higher than 1073 K However lowering the operating temperature of SOFCs is an important goal for further SOFC development Reliability durability and stability of the SOFCs could be greatly improved by decreasing their operating temperature In addition a lower operating temperature is also beneficial for shortening the startup time and decreasing energy loss from heat radiation For this purpose faster oxide ion conductors are required to replace the conventional Y O stabilized ZrO 2 3 2 electrolyte A new class of electrolytes such as LaGaO is considered to be 3 highly useful for intermediate temperature SOFCs **Solid Oxide Fuel Cells** Bin Zhu, Rizwan Raza, Liangdong Fan, Chunwen

Sun, 2020-06-02 Presents innovative approaches towards affordable highly efficient and reliable sustainable energy systems Written by leading experts on the subject this book provides not only a basic introduction and understanding of conventional fuel cell principle but also an updated view of the most recent developments in this field It focuses on the new energy conversion technologies based on both electrolyte and electrolyte free fuel cells from advanced novel ceria based composite electrolyte low temperature solid oxide fuel cells to non electrolyte fuel cells as advanced fuel to electricity conversion technology Solid Oxide Fuel Cells From Electrolyte Based to Electrolyte Free Devices is divided into three parts Part I covers the latest developments of anode electrolyte and cathode materials as well as the SOFC technologies Part II discusses the non electrolyte or semiconductor based membrane fuel cells Part III focuses on engineering efforts on materials technology devices and stack developments and looks at various applications and new opportunities of SOFC using both the electrolyte and non electrolyte principles including integrated fuel cell systems with electrolysis solar energy and more Offers knowledge on how to realize highly efficient fuel cells with novel device structures Shows the opportunity to transform the future fuel cell markets and the possibility to commercialize fuel cells in an extended range of applications Presents a unique collection of contributions on the development of solid oxide fuel cells from electrolyte based to non electrolyte based technology Provides a more comprehensive understanding of the advances in fuel cells and bridges the knowledge from traditional SOFC to the new concept Allows readers to track the development from the conventional SOFC to the non

electrolyte or single component fuel cell Solid Oxide Fuel Cells From Electrolyte Based to Electrolyte Free Devices will serve as an important reference work to students scientists engineers researchers and technology developers in the fuel cell field

Intermediate Temperature Solid Oxide Fuel Cells Gurbinder Kaur,2019-11-21 Intermediate Temperature Solid Oxide Fuel Cells Electrolytes Electrodes and Interconnects introduces the fundamental principles of intermediate solid oxide fuel cells technology It provides the reader with a broad understanding and practical knowledge of the electrodes pyrochlore perovskite oxide electrolytes and interconnects which form the backbone of the Solid Oxide Fuel Cell SOFC unit Opening with an introduction to the thermodynamics physiochemical and electrochemical behavior of Solid Oxide Fuel Cells SOFC the book also discusses specific materials including low temperature brownmillerites and aurivillius electrolytes as well as pyrochlore interconnects This book analyzes the basic concepts providing cutting edge information for both researchers and students It is a complete reference for Intermediate Solid Oxide Fuel Cells technology that will be a vital resource for those working in materials science fuel cells and solid state chemistry Provides a single source of information on glass electrolytes interconnects vanadates pyrochlores and perovskite SOFC Includes illustrations that provide a clear visual explanation of concepts being discussed Progresses from a discussion of basic concepts that will enable readers to easily comprehend the subject matter

Solid Oxide Fuel Cells Radenka Maric,Gholamreza Mirshekari,2020-12-08 Solid Oxide Fuel Cells From Fundamental Principles to Complete Systems is a valuable resource for beginners experienced researchers and developers of solid oxide fuel cells SOFCs It provides a fundamental understanding of SOFCs by covering the present state of the art as well as ongoing research and future challenges to be solved It discusses current and future materials and provides an overview of development activities with a more general system approach toward fuel cell plant technology including plant design and economics industrial data and advances in technology Provides an understanding of the operating principles of SOFCs Discusses state of the art materials technologies and processes Includes a review of the current industry and lessons learned Offers a more general system approach toward fuel cell plant technology including plant design and economics of SOFC manufacture Covers significant technical challenges that remain to be solved Presents the status of government activities industry and market This book is aimed at electrochemists batteries and fuel cell engineers alternative energy scientists and professionals in materials science

Electrochemical Energy Pei Kang Shen,Chao-Yang Wang,San Ping Jiang,Xueliang Sun,Jiujun Zhang,2018-10-08 Electrochemical Energy Advanced Materials and Technologies covers the development of advanced materials and technologies for electrochemical energy conversion and storage The book was created by participants of the International Conference on Electrochemical Materials and Technologies for Clean Sustainable Energy ICES 2013 held in Guangzhou China and incorporates select papers presented at the conference More than 300 attendees from across the globe participated in ICES 2013 and gave presentations in six major themes Fuel cells and hydrogen energy Lithium batteries and advanced secondary batteries Green energy for a clean environment Photo

Electrocatalysis Supercapacitors Electrochemical clean energy applications and markets Comprised of eight sections this book includes 25 chapters featuring highlights from the conference and covering every facet of synthesis characterization and performance evaluation of the advanced materials for electrochemical energy It thoroughly describes electrochemical energy conversion and storage technologies such as batteries fuel cells supercapacitors hydrogen generation and their associated materials The book contains a number of topics that include electrochemical processes materials components assembly and manufacturing and degradation mechanisms It also addresses challenges related to cost and performance provides varying perspectives and emphasizes existing and emerging solutions The result of a conference encouraging enhanced research collaboration among members of the electrochemical energy community Electrochemical Energy Advanced Materials and Technologies is dedicated to the development of advanced materials and technologies for electrochemical energy conversion and storage and details the technologies current achievements and future directions in the field

Carbon Dioxide Reduction through Advanced Conversion and Utilization Technologies Yun Zheng,Bo Yu,Jianchen Wang,Jiujun Zhang,2019-05-03 Carbon Dioxide Reduction through Advanced Conversion and Utilization Technologies covers fundamentals advanced conversion technologies economic feasibility analysis and future research directions in the field of CO₂ conversion and utilization This book emphasizes principles of various conversion technologies for CO₂ reduction such as enzymatic conversion mineralization thermochemical photochemical and electrochemical processes It addresses materials components assembly and manufacturing degradation mechanisms challenges and development strategies Applications of conversion technologies for CO₂ reduction to produce useful fuels and chemicals in energy and industrial systems are discussed as solutions to reduce greenhouse effects and energy shortages Particularly the advanced materials and technology of high temperature co electrolysis of H₂O and CO₂ to produce sustainable fuels using solid oxide cells SOCs are reviewed and the introduction fundamentals and some significant topics regarding this CO₂ conversion process are discussed This book provides a comprehensive and clear picture of advanced technologies in CO₂ conversion and utilization Written in a clear and detailed manner it is suitable for students as well as industry professionals researchers and academics

Advances in Medium and High Temperature Solid Oxide Fuel Cell Technology Marta Boaro,Aricò Antonino Salvatore,2016-11-24 In this book well known experts highlight cutting edge research priorities and discuss the state of the art in the field of solid oxide fuel cells giving an update on specific subjects such as protonic conductors interconnects electrocatalytic and catalytic processes and modelling approaches Fundamentals and advances in this field are illustrated to help young researchers address issues in the characterization of materials and in the analysis of processes not often tackled in scholarly books

High Temperature Solid Oxide Cells Junwei Wu,Dong Ding,Jae-ha Myung,Tenglong Zhu,2021-11-05 **Materials for High-Temperature Fuel Cells** San Ping Jiang,Yushan Yan,2013-04-11 The world's ever growing demand for power has created an urgent need for new efficient and sustainable sources of energy

and electricity Today's consumers of portable electronics also demand devices that not only deliver more power but are also environmentally friendly Fuel cells are an important alternative energy source with promise in military commercial and industrial applications for example power vehicles and portable devices A fuel cell is an electrochemical device that directly converts the chemical energy of a fuel into electrical energy Fuel cells represent the most efficient energy conversion technologies to date and are an integral part in the new and renewable energy chain e.g. solar wind and hydropower Fuel cells can be classified as either high temperature or low temperature depending on their operating temperature and have different materials requirements This book is dedicated to the study of high temperature fuel cells In high temperature fuel cells the electrolyte materials are ceramic or molten carbonate while the electrode materials are ceramic or metal but not precious metal High operation temperature fuel cells allow internal reforming promote rapid kinetics with non precious materials and offer high flexibilities in fuel choice and are potential and viable candidate to moderate the fast increase in power requirements and to minimize the impact of the increased power consumption on the environment Materials for High Temperature Fuel Cells is part of the series on Materials for Sustainable Energy and Development edited by Prof Max Q Lu The series covers advances in materials science and innovation for renewable energy clean use of fossil energy and greenhouse gas mitigation and associated environmental technologies **Energy Materials** Bibhu Prasad

Swain, 2023-07-27 This book presents the latest progress in energy materials energy storage batteries and supercapacitors The contents include topics such as fundamentals of energy materials photovoltaic materials and devices electrochemical energy conversion and storage and lighting and light emitting diodes Chapters include experimental approaches to device fabrication photovoltaics and supercapacitors applications etc It also discusses energy materials characterization preparation methods and performance testing techniques The book provides ideas on the design and development of nanoscale devices and covers various applications of nanomaterials This book is useful for researchers and professionals working in the fields of materials science *Solid Oxide Fuel Cells* Radenka Maric, 2020-12-08 Solid Oxide Fuel Cells From Fundamental Principles to Complete Systems is a valuable resource for beginners experienced researchers and developers of solid oxide fuel cells SOFCs It provides a fundamental understanding of SOFCs by covering the present state of the art as well as ongoing research and future challenges to be solved It discusses current and future materials and provides an overview of development activities with a more general system approach toward fuel cell plant technology including plant design and economics industrial data and advances in technology Provides an understanding of the operating principles of SOFCs Discusses state of the art materials technologies and processes Includes a review of the current industry and lessons learned Offers a more general system approach toward fuel cell plant technology including plant design and economics of SOFC manufacture Covers significant technical challenges that remain to be solved Presents the status of government activities industry and market This book is aimed at electrochemists batteries and fuel cell engineers alternative energy scientists and

professionals in materials science **Harnessing Synthetic Nanotechnology-Based Methodologies for Sustainable Green Applications** G rrard Eddy Jai Poinern, Suraj Tripathy, Derek Fawcett, 2023-07-24 Nanotechnology is at the forefront of many of the latest developments across science and technology but to generate and deploy these applications macroscopic levels of nanoscale materials have to be carefully generated whilst remaining cost effective These materials need to be reliable consistent and safe and as a general principle industries should consider green sustainable methods in the synthesis of these material and their applications as well This book introduces readers to the field of green nanotechnologies and their possible applications to create a safer world This accessible and practical guide will be a useful resource for material scientists engineers chemists biotechnologists and scientists working in the space of nanomaterials in addition to graduate students in physics chemistry biomedical sciences and engineering THIS BOOK Presents an accessible introduction to the topic in addition to more advanced material for specialists in the field Covers a broad spectrum of topics in this new field Contains exciting case studies and examples such as quantum dots bionanomaterials and future perspectives Dr G rrrard E J Poinern holds a Ph D in Physics from Murdoch University Western Australia and a Double Major in Physics and Chemistry Currently he is an Associate Professor in Physics and Nanotechnology in the School of Engineering and Information Technology at Murdoch University He is the director of Murdoch Applied Innovation and Nanotechnology Research Group Murdoch University In 2003 he discovered and pioneered the use of an inorganic nanomembrane for potential skin tissue engineering applications He is the recipient of a Gates Foundation Global Health Grand Challenge Exploration Award for his work in the development of biosynthetic materials and their subsequent application in the manufacture of biomedical devices He is also the author of the 2014 CRC Press experimental textbook A Laboratory Course in Nanoscience and Nanotechnology Associate Professor Suraj Kumar Tripathy is Associate Dean of the School of Chemical Technology at Kalinga Institute of Industrial Technology Bhubaneswar India He currently leads the Chemical Bioprocess Engineering Lab CBEL at KIIT which focuses on achieving sustainability in materials processing and utilization CBEL explores opportunities in valorization of waste materials secondary resources and investigate their applications in catalysis water treatment and biomedical systems CBEL also works closely with industries to develop suitable waste management and resource recycling strategies to optimize the potential of circular economy model Dr Derek Fawcett is the Defence Science Centre research fellow at Murdoch University Australia His research involves the investigation and development of new advanced materials and their use in innovative engineering systems He has published over seventy peer reviewed research papers in international journals and is the co author of four book chapters on applied nanotechnology **Solid Oxide Fuel Cell Lifetime and Reliability** Nigel Brandon, 2017-05-23 Solid Oxide Fuel Cell Lifetime and Reliability Critical Challenges in Fuel Cells presents in one volume the most recent research that aims at solving key issues for the deployment of SOFC at a commercial scale and for a wider range of applications To achieve that authors from different regions and backgrounds address topics such as electrolytes

contaminants redox cycling gas tight seals and electrode microstructure Lifetime issues for particular elements of the fuel cells like cathodes interconnects and fuel processors are covered as well as new materials They also examine the balance of SOFC plants correlations between structure and electrochemical performance methods for analysis of performance and degradation assessment and computational and statistical approaches to quantify degradation For its holistic approach this book can be used both as an introduction to these issues and a reference resource for all involved in research and application of solid oxide fuel cells especially those developing understanding in industrial applications of the lifetime issues This includes researchers in academia and industrial R D graduate students and professionals in energy engineering electrochemistry and materials sciences for energy applications It might also be of particular interest to analysts who are looking into integrating SOFCs into energy systems Brings together in a single volume leading research and expert thinking around the broad topic of SOFC lifetime and durability Explores issues that affect solid oxide fuel cells elements materials and systems with a holistic approach Provides a practical reference for overcoming some of the common failure mechanisms of SOFCs Features coverage of integrating SOFCs into energy systems

Proceedings of the Fifth International Symposium on Solid Oxide Fuel Cells (SOFC-V) U. Stimming, 1997 *Solid Oxide Fuel Cells VII* Electrochemical Society. High Temperature Materials Division, Electrochemical Society. Battery Division, 2001 *Solid Oxide Fuel Cells 12 (SOFC-XII)* S. C. Singhal, K. Eguchi, 2011-04-25 This issue of ECS Transactions contains papers from the Twelfth International Symposium on Solid Oxide Fuel Cells SOFC XII a continuing biennial series of symposia The papers deal with materials for cell components and fabrication methods for components and complete cells Also contained are papers on cell electrochemical performance and its modelling stacks and systems and prototype testing of SOFC demonstration units for different applications

Proceedings of the Fourth International Symposium on Solid Oxide Fuel Cells (SOFC-IV) M. Dokiya, 1995 [Solid Oxide Fuel Cells](#) Jeffrey Fergus, Rob Hui, Xianguo Li, David P. Wilkinson, Jiujun Zhang, 2016-04-19 The First Book Centered on Materials Issues of SOFCs Although the high operating temperature of solid oxide fuel cells SOFCs creates opportunities for using a variety of fuels including low grade hydrogen and those derived from biomass it also produces difficulties in materials performance and often leads to materials degradation during operation

High-Temperature Solid Oxide Fuel Cells for the 21st Century Kevin Kendall, Michaela Kendall, 2015-11-21 High temperature Solid Oxide Fuel Cells Second Edition explores the growing interest in fuel cells as a sustainable source of energy The text brings the topic of green energy front and center illustrating the need for new books that provide comprehensive and practical information on specific types of fuel cells and their applications This landmark volume on solid oxide fuel cells contains contributions from experts of international repute and provides a single source of the latest knowledge on this topic A single source for all the latest information on solid oxide fuel cells and their applications Illustrates the need for new more comprehensive books and study on the topic Explores the growing interest in fuel cells as viable

sustainable sources of energy

First European Solid Oxide Fuel Cell Forum Ulf Bossel, 1994

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Perovskite Oxide For Solid Oxide Fuel Cells Fuel Cells And Hydrogen Energy Introduction

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