Solid Oxide Fuel Cell Technology Principles

Solid Oxide Fuel Cell TechnologyModeling Solid Oxide Fuel CellsSolid Oxide Fuel CellsSolid Oxide Fuel CellsSolid Oxide Fuel Cell Lifetime and ReliabilityHigh-Temperature Solid Oxide Fuel Cells for the 21st CenturyHigh-temperature Solid Oxide Fuel Cells: Fundamentals, Design and ApplicationsProceedings of the Fourth International Symposium on Solid Oxide Fuel Cells (SOFC-IV)Solid Oxide Fuel Cells 12 (SOFC-XII)Solid Oxide Fuels Cells: Facts and FiguresFuel Cell TechnologySolid Oxide Fuel CellsProceedings of the Fifth International Symposium on Solid Oxide Fuel Cells (SOFC-V)Solid Oxide Fuel Cells IXSolid Oxide Fuel CellsSolid Oxide Fuel CellsAdvances in Solid Oxide Fuel Cells IX, Volume 34, Issue 4Advances in Medium and High Temperature Solid Oxide Fuel Cell TechnologyHybrid Systems Based on Solid Oxide Fuel CellsModels for Solid Oxide Fuel Cell Systems K Huang Roberto Bove Bin Zhu Radenka Maric Nigel Brandon Kevin Kendall S.C. Singhal M. Dokiya S. C. Singhal John T.S. Irvine Nigel Sammes Jeffrey Fergus U. Stimming S. C. Singhal S. C. Singhal Radenka Maric Narottam P. Bansal Marta Boaro Mario L. Ferrari Dario Marra

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high temperature solid oxide fuel cell sofc technology is a promising power generation option that features high electrical efficiency and low emissions of environmentally polluting gases such as co2 noox and sox it is ideal for distributed stationary power generation applications where both high efficiency electricity and high quality heat are in strong demand for the past few decades sofc technology has attracted intense worldwide r d effort and along with polymer electrolyte membrane fuel cell pemfc technology has undergone extensive commercialization development this book presents a systematic and in depth narrative of the technology from the perspective of fundamentals providing comprehensive theoretical analysis and innovative characterization techniques for sofc technology the book initially deals with the basics and development of sofc technology from cell materials to fundamental thermodynamics electronic properties of solids and charged particle transport this coverage is extended with a thorough analysis of such operational features as current flow and energy balance and on to voltage losses and electrical efficiency furthermore the book also covers the important issues of fuel cell stability and durability with chapters on performance characterization fuel processing and electrode poisoning finally the book provides a comprehensive review for sofc materials and fabrication techniques a series of useful scientific appendices rounds off the book solid oxide fuel cell technology is a standard reference for all those researching this important field as well as those working in the power industry provides a comprehensive review of solid oxide fuel cells from history and design to chemistry and materials development presents analysis of operational features including current flow energy balance voltage losses and electrical efficiency explores fuel cell stability and durability with specific chapters examining performance characterization fuel processing and electrode poisoning

this book fills the need for a practical reference for all scientists and graduate students who are seeking to define a mathematical model for solid oxide fuel cell sofc simulation structured in two parts part one presents the basic theory and the general equations describing sofc operation phenomena part two deals with the application of the theory to practical examples where different sofc geometries configurations and different phenomena are analyzed in detail

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

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

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

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

high temperature solid oxide fuel cells fundamentals design and applications provides a comprehensive discussion of solid oxide fuel cells

sofcs sofcs are the most efficient devices for the electrochemical conversion of chemical energy of hydrocarbon fuels into electricity and have been gaining increasing attention for clean and efficient distributed power generation the book explains the operating principle cell component materials cell and stack designs and fabrication processes cell and stack performance and applications of sofcs individual chapters are written by internationally renowned authors in their respective fields and the text is supplemented by a large number of references for further information the book is primarily intended for use by researchers engineers and other technical people working in the field of sofcs even though the technology is advancing at a very rapid pace the information contained in most of the chapters is fundamental enough for the book to be useful even as a text for sofc technology at the graduate level

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

solid oxide fuel cells sofcs operate at high temperatures allowing more fuel flexibility and also useful heat output and so increase total efficiency but does give some interesting engineering challenges solid oxide fuels cells facts and figures provides clear and accurate data for a selection of sofc topics from the specific details of ni cermet anodes chemical expansion in materials and the measuring and modelling of mechanical stresses to the broader scope of the history and present design of cells to sofc systems and the future of sofc celebrating ulf bossel s work on solid oxide fuel cells and especially his running of the european fuel cell forum solid oxide fuels cells facts and figures covers important topics on the way including intermediate temperature fuel cells metal supported fuel cells and both new materials and engineering solutions to some of the challenges of getting sofc to market the chapters are based on the special plenary talks given by some of the most respected and talented people in the field at the 2010 european sofc forum in luzern and the title for this book comes from the report produced by ulf for the iea final report on sofc data facts and figures swiss federal office of energy berne 1992 the comprehensive nature of solid oxide fuels cells facts and figures makes it a key resource of sofc topics for students lecturers researchers and industry practitioners alike

fuel cells are a very promising technology for the clean and efficient production of power fuel cell technology is an up to date survey of the development of this technology and will be bought by researchers and graduate students in materials control and chemical engineering working at universities and institutions and researchers and technical managers in commercial companies working in fuel cell technology

the first book centered on materials issues of sofcsalthough 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 operatio

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

ceramic engineering and science proceedings volume 34 issue 4 advances in solid oxide fuel cells ix a collection of 13 papers from the american ceramic society s 37th international conference on advanced ceramics and composites held in daytona beach florida january 27 february 1 2013 this issue includes papers presented in symposium 3 10th international symposium on solid oxide fuel cells materials science and technology

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

a comprehensive guide to the modelling and design of solid oxide fuel cell hybrid power plants this book explores all technical aspects of solid oxide fuel cell sofc hybrid systems and proposes solutions to a range of technical problems that can arise from component integration following a general introduction to the state of the art in sofc hybrid systems the authors focus on fuel cell technology including the components required to operate with standard fuels micro gas turbine mgt technology for hybrid systems is discussed with special attention given to issues related to the coupling of sofcs with mgts throughout the book emphasis is placed on dynamic issues including control systems used to avoid risk conditions with an eye to mitigating the high costs and risks incurred with the building and use of prototype hybrid systems the authors demonstrate a proven economically feasible approach to obtaining important experimental results using simplified plants that simulate both generic and detailed system level behaviour using emulators computational models and experimental plants are developed to support the analysis of sofc hybrid systems including models appropriate for design development and performance analysis at both component and system levels presents models for a range of size units technology variations unit coupling dynamics and start up and shutdown behaviours focuses on sofcs integration with mgts in light of key constraints and risk avoidance issues under steady state conditions and during transient operations identifies interaction and coupling problems within the gt sofc environment including exergy analysis and optimization demonstrates an economical approach to obtaining important experimental results while avoiding high cost components and risk conditions presents analytical computational and experimental tools for the efficient design and development of hardware and software systems hybrid systems based on solid oxide fuel cells modelling and design is a valuable resource for researchers and practicing engineers involved in fuel cell fundamentals design and development it is also an excellent reference for academic researchers and advanced level students exploring fuel cell technology

this book presents methodologies suitable for the optimal design of control and diagnosis strategies for solid oxide fuel cell sofc systems one key feature of the methodologies presented is the use of modeling tools with an ideal balance between accuracy and computational burden particular emphasis is given to the useful combination of models within a hierarchical framework to reduce the experimental efforts required for

characterization and testing such tools are proven to be highly effective for sofc systems destined for both residential and transportation applications throughout the book optimization is always conceived in such a way so as to allow the sofc systems to work efficiently while guaranteeing safe thermal operation as well as an extended lifetime this book is aimed at scientists and engineers involved in the design of marketable sofc systems it gathers the knowledge and experience derived from other research and industry practice for which control and diagnosis have proven to be the main keys to success and market penetration

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