



Functional materials for sustainable energy applications

Edited by John Kilner, Stephen Skinner, Stuart Irvine
and Peter Edwards

Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy

**Michael Ball, Angelo Basile, T. Nejat
Veziroglu**



Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy:

Functional Materials for Sustainable Energy Applications John A. Kilner, Stephen J. Skinner, Stuart J. C. Irvine, 2012-10-12 *Functional Materials for Sustainable Energy Applications* J A Kilner, S J Skinner, S J C Irvine, P P Edwards, 2012-09-28 Global demand for low cost efficient and sustainable energy production is ever increasing Driven by recent discoveries and innovation in the science and technology of materials applications based on functional materials are becoming increasingly important Functional materials for sustainable energy applications provides an essential guide to the development and application of these materials in sustainable energy production Part one reviews functional materials for solar power including silicon based thin film and dye sensitized photovoltaic solar cells thermophotovoltaic device modelling and photoelectrochemical cells Part two focuses on functional materials for hydrogen production and storage Functional materials for fuel cells are then explored in part three where developments in membranes catalysts and membrane electrode assemblies for polymer electrolyte and direct methanol fuel cells are discussed alongside electrolytes and ion conductors novel cathodes anodes thin films and proton conductors for solid oxide fuel cells Part four considers functional materials for demand reduction and energy storage before the book concludes in part five with an investigation into computer simulation studies of functional materials With its distinguished editors and international team of expert contributors Functional materials for sustainable energy applications is an indispensable tool for anyone involved in the research development manufacture and application of materials for sustainable energy production including materials engineers scientists and academics in the rapidly developing interdisciplinary field of sustainable energy An essential guide to the development and application of functional materials in sustainable energy production Reviews functional materials for solar power Focuses on functional materials for hydrogen production and storage fuel cells demand reduction and energy storage **Membrane Reactors for Energy Applications and Basic Chemical Production** Angelo Basile, Luisa Di Paola, Faisal Hai, Vincenzo Piemonte, 2015-02-05 Membrane Reactors for Energy Applications and Basic Chemical Production presents a discussion of the increasing interest in membrane reactors that has emerged in recent years from both the scientific and industrial communities in particular their usage for energy applications and basic chemical production Part One of the text investigates membrane reactors for syngas and hydrogen production while Part Two examines membrane reactors for other energy applications including biodiesel and bioethanol production The final section of the book reviews the use of membrane reactors in basic chemical production including discussions of the use of MRs in ammonia production and the dehydrogenation of alkanes to alkenes Provides comprehensive coverage of membrane reactors as presented by a world renowned team of experts Includes discussions of the use of membrane reactors in ammonia production and the dehydrogenation of alkanes to alkenes Tackles the use of membrane reactors in syngas hydrogen and basic chemical production Keen focus placed on the industry particularly in the use of membrane reactor technologies in energy

Sustainable Energy from Salinity Gradients Andrea Cipollina, Giorgio Micale, 2016-03-01 Salinity gradient energy also known as blue energy and osmotic energy is the energy obtainable from the difference in salt concentration between two feed solutions typically sea water and river water It is a large scale renewable resource that can be harvested and converted to electricity Efficient extraction of this energy is not straightforward however Sustainable Energy from Salinity Gradients provides a comprehensive review of resources technologies and applications in this area of fast growing interest Key technologies covered include pressure retarded osmosis reverse electrodialysis and accumulator mixing Environmental and economic aspects are also considered together with the possible synergies between desalination and salinity gradient energy technologies Sustainable Energy from Salinity Gradients is an essential text for R D professionals in the energy water industry interested in salinity gradient power and researchers in academia from post graduate level upwards For more than ten years the Editors have been sharing substantial research activities in the fields of renewable energy and desalination successfully participating to a number of European Union research projects and contributing to the relevant scientific literature with more than 100 papers and 2 books on Desalination technologies and their coupling with Renewable Energy They are intensely working in the field of Salinity Gradient Power carrying out research with specific focus on open loop and closed loop reverse electrodialysis and pressure retarded osmosis Covers applications of pressure retarded osmosis reverse electrodialysis and capacitive mixing for salinity gradient power in one convenient volume Presents the environmental aspects and economics of salinity gradient energy Explores possible synergies between desalination and salinity gradient energy

Thermoelectric Polymers Inamuddin, Tariq Altalhi, Mohammad Abu Jafar Mazumder, 2024-03-15 The book presents recent developments in the field of thermoelectric polymers and polymer composites It focuses on the link between thermoelectric characteristics and material structure Topics covered include chemical composition microstructure dopants doping levels methods of fabrication thermoelectric effect thermoelectric device conversion efficiency and thermoelectric properties of conducting polymers Keywords Cage Compounds Calixarenes Conducting Polymers Cryptophanes Energy Conversion Half Heusler Compounds Skutterudite Compounds Hybrid Thermoelectric Materials Supramolecular Chemistry Thermoelectric Conversion Efficiency Thermoelectric Plastics Functional Materials for Sustainable Energy Applications

, 2012 Global demand for low cost efficient and sustainable energy production is ever increasing Driven by recent discoveries and innovation in the science and technology of materials applications based on functional materials are becoming increasingly important Functional materials for sustainable energy applications provides an essential guide to the development and application of these materials in sustainable energy production Part one reviews functional materials for solar power including silicon based thin film and dye sensitized photovoltaic solar cells thermophotovoltaic device modelling and photoelectrochemical cells Part two focuses on functional materials for hydrogen production and storage Functional materials for fuel cells are then explored in part three where developments in membranes catalysts and membrane electrode

assemblies for polymer electrolyte and direct methanol fuel cells are discussed alongside electrolytes and ion conductors novel cathodes anodes thin films and proton conductors for solid oxide fuel cells Part four considers functional materials for demand reduction and energy storage before the book concludes in part five with an investigation into computer simulation studies of functional materials With its distinguished editors and international team of expert contributors Functional materials for sustainable energy applications is an indispensable tool for anyone involved in the research development manufacture and application of materials for sustainable energy production including materials engineers scientists and academics in the rapidly developing interdisciplinary field of sustainable energy An essential guide to the development and application of functional materials in sustainable energy production Reviews functional materials for solar power Focuses on functional materials for hydrogen production and storage fuel cells demand reduction and energy storage

Electrical Drives for Direct Drive Renewable Energy Systems Markus Mueller, Henk Polinder, 2013-03-25 Wind turbine gearboxes present major reliability issues leading to great interest in the current development of gearless direct drive wind energy systems Offering high reliability high efficiency and low maintenance developments in these direct drive systems point the way to the next generation of wind power and Electrical drives for direct drive renewable energy systems is an authoritative guide to their design development and operation Part one outlines electrical drive technology beginning with an overview of electrical generators for direct drive systems Principles of electrical design for permanent magnet generators are discussed followed by electrical thermal and structural generator design and systems integration A review of power electronic converter technology and power electronic converter systems for direct drive renewable energy applications is then conducted Part two then focuses on wind and marine applications beginning with a commercial overview of wind turbine drive systems and an introduction to direct drive wave energy conversion systems The commercial application of these technologies is investigated via case studies on the permanent magnet direct drive generator in the Zephyros wind turbine and the Archimedes Wave Swing AWS direct drive wave energy pilot plant Finally the book concludes by exploring the application of high temperature superconducting machines to direct drive renewable energy systems With its distinguished editors and international team of expert contributors Electrical drives for direct drive renewable energy systems provides a comprehensive review of key technologies for anyone involved with or interested in the design construction operation development and optimisation of direct drive wind and marine energy systems An authoritative guide to the design development and operation of gearless direct drives Discusses the principles of electrical design for permanent magnet generators and electrical thermal and structural generator design and systems integration Investigates the commercial applications of wind turbine drive systems

IoT for Sustainable Smart Cities and Society Joel J. P. C. Rodrigues, Parul Agarwal, Kavita Khanna, 2022-05-10 This book provides a sound theoretical base and an extensive practical expansion of smart sustainable cities and societies while also examining case studies in the area to help readers understand IoT driven

solutions in smart cities The book covers fundamentals applications and challenges of IoT for sustainable smart cities and society With a good understanding of IoT and smart cities and the associated communication protocols the book provides an insight into its applications in several areas of smart cities Models architectures and algorithms are presented that provide additional solutions The main challenges discussed that are associated with IoT involved include security privacy authenticity etc The book is relevant to researchers academics professionals and students

Advanced Membrane Science and Technology for Sustainable Energy and Environmental Applications Angelo Basile,Suzana Pereira Nunes,2011-08-24

Membrane materials allow for the selective separation of gas and vapour and for ion transport Materials research and development continues to drive improvements in the design manufacture and integration of membrane technologies as critical components in both sustainable energy and clean industry applications Membrane utilisation offers process simplification and intensification in industry providing low cost and efficient and reliable operation and contributing towards emissions reductions and energy security Advanced membrane science and technology for sustainable energy and environmental applications presents a comprehensive review of membrane utilisation and integration within energy and environmental industries Part one introduces the topic of membrane science and engineering from the fundamentals of membrane processes and separation to membrane characterization and economic analysis Part two focuses on membrane utilisation for carbon dioxide CO₂ capture in coal and gas power plants including pre and post combustion and oxygen transport technologies Part three reviews membranes for the petrochemical industry with chapters covering hydrocarbon fuel natural gas and synthesis gas processing as well as advanced biofuels production Part four covers membranes for alternative energy applications and energy storage such as membrane technology for redox and lithium batteries fuel cells and hydrogen production Finally part five discusses membranes utilisation in industrial and environmental applications including microfiltration ultrafiltration and forward osmosis as well as water wastewater and nuclear power applications With its distinguished editors and team of expert contributors Advanced membrane science and technology for sustainable energy and environmental applications is an essential reference for membrane and materials engineers and manufacturers as well as researchers and academics interested in this field Presents a comprehensive review of membrane science and technology focusing on developments and applications in sustainable energy and clean industry Discusses the fundamentals of membrane processes and separation and membrane characterization and economic analysis Addresses the key issues of membrane utilisation in coal and gas power plants and the petrochemical industry the use of membranes for alternative energy applications and membrane utilisation in industrial and environmental applications

Waste to Energy Conversion Technology Naomi B Klinghoffer,Marco J Castaldi,2013-05-15 Increasing global consumerism and population has led to an increase in the levels of waste produced Waste to energy WTE conversion technologies can be employed to convert residual wastes into clean energy rather than sending these wastes directly to landfill Waste to energy conversion

technology explores the systems technology and impacts of waste to energy conversion Part one provides an introduction to WTE conversion and reviews the waste hierarchy and WTE systems options along with the corresponding environmental regulatory and techno economic issues facing this technology Part two goes on to explore further specific aspects of WTE systems engineering and technology and includes chapters on municipal solid waste MSW combustion plants and WTE systems for district heating Finally part three highlights pollution control systems for waste to energy technologies Waste to energy conversion technology is a standard reference book for plant managers building engineers and consultants requiring an understanding of WTE technologies and researchers scientists and academics interested in the field Reviews the waste hierarchy and waste to energy systems options along with the environmental and social impact of WTE conversion plants Explores the engineering and technology behind WTE systems including considerations of municipal solid waste MSW its treatment combustion and gasification Considers pollution control systems for WTE technologies including the transformation of waste combustion facilities from major polluters to pollution sinks

Hydrogen Production, Storage and Utilization Slimane Merouani,Oualid Hamdaoui,2025-03-03 Hydrogen Production Storage and Utilization focuses on the latest advancements innovative methods and practical applications in the field of hydrogen energy It encompasses a comprehensive exploration of various hydrogen production techniques including thermal approaches such as thermochemical water splitting and advanced gasification processes as well as water electrolysis which covers both high temperature and low temperature electrolysis methods The book also delves into cutting edge photocatalysis highlighting recent breakthroughs in photocatalytic materials and reaction efficiencies along with sonochemical methods that utilize ultrasound waves to enhance hydrogen yield Additionally it explores biological production techniques involving microbial and enzymatic pathways The book also provides an in depth analysis of current progress and future prospects in hydrogen storage technologies addressing challenges and innovations in materials and methods for storing hydrogen efficiently and safely It covers a range of storage solutions including compressed gas liquid hydrogen metal hydrides and novel chemical storage systems Furthermore the book highlights the potential applications of hydrogen in various sectors such as transportation power generation and industrial processes emphasizing advancements in fuel cells hydrogen combustion engines and other utilization strategies By examining these cutting edge technologies and their practical implementations the book underscores the transformative potential of hydrogen in reshaping the energy landscape It emphasizes the role of hydrogen as a key component in achieving a sustainable and clean energy future reducing reliance on fossil fuels mitigating environmental impacts and enhancing energy security

Green Adsorbents to Remove Metals, Dyes and Boron from Polluted Water Inamuddin,Mohd Imran Ahamed,Eric Lichtfouse,Abdullah M. Asiri,2020-08-31 This book reviews adsorption techniques to clean wastewater with focus on pollution by dyes and heavy metals Advanced adsorbents include carbon nanomaterials biomass cellulose polymers clay composites and chelating materials

Advances in Thermal Energy Storage Systems

Luisa F. Cabeza,2014-10-31 Thermal energy storage TES technologies store thermal energy both heat and cold for later use as required rather than at the time of production They are therefore important counterparts to various intermittent renewable energy generation methods and also provide a way of valorising waste process heat and reducing the energy demand of buildings This book provides an authoritative overview of this key area Part one reviews sensible heat storage technologies Part two covers latent and thermochemical heat storage respectively The final section addresses applications in heating and energy systems Reviews sensible heat storage technologies including the use of water molten salts concrete and boreholes Describes latent heat storage systems and thermochemical heat storage Includes information on the monitoring and control of thermal energy storage systems and considers their applications in residential buildings power plants and industry

Magnetic Fusion Energy George Neilson,2016-06-02 Magnetic Fusion Energy From Experiments to Power Plants is a timely exploration of the field giving readers an understanding of the experiments that brought us to the threshold of the ITER era as well as the physics and technology research needed to take us beyond ITER to commercial fusion power plants With the start of ITER construction the world s magnetic fusion energy MFE enterprise has begun a new era The ITER scientific and technical S T basis is the result of research on many fusion plasma physics experiments over a period of decades Besides ITER the scope of fusion research must be broadened to create the S T basis for practical fusion power plants systems that will continuously convert the energy released from a burning plasma to usable electricity operating for years with only occasional interruptions for scheduled maintenance Provides researchers in academia and industry with an authoritative overview of the significant fusion energy experiments Considers the pathway towards future development of magnetic fusion energy power plants Contains experts contributions from editors and others who are well known in the field

Compendium of Hydrogen Energy Ram Gupta,Angelo Basile,T. Nejat Veziroglu,2016-02-03 Compendium of Hydrogen Energy Volume 2 Hydrogen Storage Distribution and Infrastructure focuses on the storage and transmission of hydrogen As many experts believe the hydrogen economy will at some point replace the fossil fuel economy as the primary source of the world s energy this book details hydrogen storage in pure form including chapters on hydrogen liquefaction slush production as well as underground and pipeline storage Other sections in the book explore physical and chemical storage including environmentally sustainable methods of hydrogen production from water with final chapters dedicated to hydrogen distribution and infrastructure Covers a wide array of methods for storing hydrogen detailing hydrogen transport and the infrastructure required for transition to the hydrogen economy Written by leading academics in the fields of sustainable energy and experts from the world of industry Part of a very comprehensive compendium which looks at the entirety of the hydrogen energy economy

Compendium of Hydrogen Energy Velu Subramani,Angelo Basile,T. Nejat Veziroglu,2015-05-23 Compendium of Hydrogen Energy Hydrogen Production and Purification the first text in a four volume series focuses on the production of hydrogen As many experts believe that the hydrogen economy will eventually replace the

fossil fuel economy as our primary source of energy the text provides a timely discussion on this interesting topic The text details the methods of hydrogen production using fossil fuels also exploring sustainable extraction methods of hydrogen production from water and hydrogen purification processes Provides a comprehensive understanding of the current methods used in the production of hydrogen Discusses the hydrogen economy and its potential to replace fossil fuels as our primary source of energy Details the methods of hydrogen production using fossil fuels also exploring sustainable extraction methods of hydrogen production from water and hydrogen purification processes

Fuel Flexible Energy Generation John Oakey, 2015-12-08 Fuel Flexible Energy Generation Solid Liquid and Gaseous Fuels provides updated information on flexible fuel energy generation the process by which one or more fuels can be combusted in the same boiler or turbine to generate power By adapting or building boilers and turbines to accept multiple fuel sources they can be co fired with biomass and waste derived fuels allowing a reduction in carbon output thus providing cleaner energy Fuel flexibility is becoming more important in a world of diminishing fossil fuel stocks Many countries are investing in the development of more efficient fuel flexible boilers and turbines and their use is becoming more prevalent in industry as well This book provides comprehensive coverage of flexible fuel energy generation across all potential fuel types and was written by a selection of experts in the field who discuss the types of fuels which can be used in fuel flexible energy generation from solid fuels to biomass fuels the preparation of fuels to be used in fuel flexible operations that includes their handling and transport and combustion and conversion technologies with chapters ranging from large scale coal gasification to technology options and plant design issues Focuses on fuel flexibility across all potential fuel types Includes thorough treatment of the technology being developed to allow for fuel flexibility Written by leading experts in the field Provides an essential text for R D managers in firms which produce boilers or turbines those who work in the fuel industry and academics working in engineering departments on energy generation

Compendium of Hydrogen Energy Michael Ball, Angelo Basile, T. Nejat Veziroglu, 2015-08-28 Compendium of Hydrogen Energy Volume 4 Hydrogen Use Safety and the Hydrogen Economy focuses on the uses of hydrogen As many experts believe the hydrogen economy will at some point replace the fossil fuel economy as the primary source of the world's energy this book investigates the uses of this energy from transport to stationary and portable applications with final sections discussing the difficulties and possibilities of the widespread adoption of the hydrogen economy Written by both leading academics in the fields of sustainable energy and experts from the world of industry Part of a very comprehensive compendium which across four volumes looks at the entirety of the hydrogen energy economy Covers a wide array of hydrogen uses and details safety tactics hydrogen applications in transport and the hydrogen economy as a whole

Advances in Batteries for Medium and Large-Scale Energy Storage C Menictas, M Skyllas-Kazacos, T M Lim, 2014-12-09 As energy produced from renewable sources is increasingly integrated into the electricity grid interest in energy storage technologies for grid stabilisation is growing This book reviews advances in battery technologies and

applications for medium and large scale energy storage Chapters address advances in nickel sodium and lithium based batteries Other chapters review other emerging battery technologies such as metal air batteries and flow batteries The final section of the book discusses design considerations and applications of batteries in remote locations and for grid scale storage Reviews advances in battery technologies and applications for medium and large scale energy storage Examines battery types including zing based lithium air and vanadium redox flow batteries Analyses design issues and applications of these technologies

Structural Materials for Generation IV Nuclear Reactors Pascal Yvon, 2016-08-27 Operating at a high level of fuel efficiency safety proliferation resistance sustainability and cost generation IV nuclear reactors promise enhanced features to an energy resource which is already seen as an outstanding source of reliable base load power The performance and reliability of materials when subjected to the higher neutron doses and extremely corrosive higher temperature environments that will be found in generation IV nuclear reactors are essential areas of study as key considerations for the successful development of generation IV reactors are suitable structural materials for both in core and out of core applications Structural Materials for Generation IV Nuclear Reactors explores the current state of the art in these areas Part One reviews the materials requirements and challenges in generation IV systems Part Two presents the core materials with chapters on irradiation resistant austenitic steels ODS FM steels and refractory metals amongst others Part Three looks at out of core materials Structural Materials for Generation IV Nuclear Reactors is an essential reference text for professional scientists engineers and postgraduate researchers involved in the development of generation IV nuclear reactors Introduces the higher neutron doses and extremely corrosive higher temperature environments that will be found in generation IV nuclear reactors and implications for structural materials Contains chapters on the key core and out of core materials from steels to advanced micro laminates Written by an expert in that particular area

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Table of Contents Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy

1. Understanding the eBook Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy
 - The Rise of Digital Reading Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy
 - Advantages of eBooks Over Traditional Books
2. Identifying Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction

- Determining Your Reading Goals
- 3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy
 - User-Friendly Interface
- 4. Exploring eBook Recommendations from Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy
 - Personalized Recommendations
 - Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy User Reviews and Ratings
 - Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy and Bestseller Lists
- 5. Accessing Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy Free and Paid eBooks
 - Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy Public Domain eBooks
 - Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy eBook Subscription Services
 - Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy Budget-Friendly Options
- 6. Navigating Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy eBook Formats
 - ePub, PDF, MOBI, and More
 - Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy Compatibility with Devices
 - Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Functional Materials For Sustainable Energy Applications Woodhead

- Publishing Series In Energy
 - Highlighting and Note-Taking Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy
 - Interactive Elements Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy
- 8. Staying Engaged with Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy
- 9. Balancing eBooks and Physical Books Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy
 - Setting Reading Goals Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy
 - Fact-Checking eBook Content of Functional Materials For Sustainable Energy Applications Woodhead Publishing Series In Energy
 - Distinguishing Credible Sources

13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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