Thermoelectrics And Its Energy Harvesting 2 Volume Set Materials Preparation And Characterization In Thermoelectrics

Thermoelectrics Handbook
III-nitride Devices and Nanoengineering
Energy Harvesting with Functional Materials and Microsystems
Advanced Thermoelectric Materials
Organic Thermoelectric Materials
Semiconductor Thermoelectric Generators
Innovative Materials and Systems for Energy Harvesting Applications
Thermoelectrics
Waste Energy Harvesting
Modules, Systems, and Applications in Thermoelectrics
Thermoelectric Materials
Thermoelectric Microgenerators. Optimization for energy harvesting
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Green Energy Advances
Thermoelectric Energy Conversion
Low-Grade Thermal Energy Harvesting

PRESTON WILEY

Thermoelectrics Handbook Trans Tech Publications Ltd
The demand for secure, affordable and clean energy is a priority call to humanity. Challenges associated with conventional energy resources, such as depletion of fossil fuels, high costs and associated greenhouse gas emissions, have stimulated interests in renewable energy resources. For instance, there have been clear gaps and rushed thoughts about replacing fossil-fuel driven engines with electric vehicles without long-term plans for energy security and recycling approaches. This book aims to provide a clear vision to scientists, industrialists and policy makers on renewable energy resources, predicted challenges and emerging applications. It can be used to help produce new technologies for sustainable, connected and harvested energy. A clear response to economic growth and clean environment demands is also illustrated.
III-nitride Devices and Nanoengineering Momentum Press
A preponderance of data indicates that humanity's reliance on fossil fuels for energy is deleterious to the longevity of our species and habitats. To counter this dependence, efficiency improvements are needed in the sustainable generation of energy as well as in energy conversion and with materials that are cost-competitive with traditional carbon-heavy energy sources. Organic electronic materials, with their lightweight, ubiquitous elements and promising performance, could meet these demands. However, ongoing challenges like poor conductivity due to lack of long-range order and air-instability through reactions with ambient water and oxygen undermine their efficacy. By structuring organics to better mimic inorganic systems or developing hybrid organic/inorganic materials, we can overcome some of these limitations. First, we develop a model hybrid polymer-metal system to achieve the electrode performance of a conventional metal system at a tenth of the cost. Incorporation of this system into an organic solar cell results in a 7x improvement in the power conversion efficiency over a bare silver electrode without the need for additional costly evaporation steps. Second, we consider materials for thermoelectric energy harvesting, a compelling technology because of its capability to directly convert waste heat into electrical energy. However, the widespread application of this technology has yet to be realized due to challenges associated with achieving a material that features low thermal conductivity despite high electrical conductivity with strong temperature dependence. The intrinsically low thermal conductivity of organic systems makes them appealing for thermoelectric applications; however, their performance is generally impeded by low charge mobility, arising from a lack of long-range order. We investigate a solvent treatment method for inducing greater order in the conductive polymer PEDOT:PSS that results in record electrical conductivities in excess of 8000 S/cm. By tuning the solvent and other parameters, we are able to double the previous record for solution-processable organic thermoelectric performance. Lastly, we explore a newly emerging class of hybrid thermoelectric materials: conductive metal-organic frameworks (MOFs). The long-range order in MOFs coupled with their intrinsic porosity hints a path toward high thermoelectric performance. However, full utilization of this promising material system requires greater understanding of how each of the elements in the MOF affects performance. We use the M-HAB family (HAB = hexaaminobenzene, M = Co, Cu, Ni, Zn) to explore how the character of the metal ion and its preferred coordination geometry impact thermoelectric performance and the air-stability thereof.
Energy Harvesting with Functional Materials and Microsystems Royal Society of Chemistry
Wearable electronics, wireless devices, and other mobile technologies have revealed a deficit and a necessity for innovative methods of gathering and utilizing power. Drawing on otherwise wasted sources of energy, such as solar, thermal, and biological, is an important part of discovering future energy solutions. Innovative Materials and Systems for Energy Harvesting Applications reports on some of the best tools and technologies available for powering humanity’s growing thirst for electronic devices, including piezoelectric, solar, thermoelectric, and electromagnetic energies. This book is a crucial reference source for academics, industry professionals, and scientists working toward the future of energy.
Advanced Thermoelectric Materials CRC Press
Energy Harvesting Technologies provides a cohesive overview of the fundamentals and current developments in the field of energy harvesting. In a well-organized structure, this volume discusses basic principles for the design and fabrication of bulk and MEMS based vibration energy systems, theory and design rules required for fabrication of efficient electronics, in addition to recent findings in thermoelectric energy harvesting systems. Combining leading research from both academia and industry onto a single platform, Energy Harvesting Technologies serves as an important reference for researchers and engineers involved with power sources, sensor networks and smart materials.
Organic Thermoelectric Materials World Scientific
Comprising two volumes, Thermoelectrics and Its Energy Harvesting reviews the vast improvements in technology and application of thermoelectric energy with a specific intention to reduce and reuse waste heat and improve novel techniques for the efficient acquisition and use of energy.Materials, Preparation, and Characterization in Thermoelectrics i
Semiconductor Thermoelectric Generators Woodhead Publishing
This book summarises the significant progress made in organic thermoelectric materials, focusing on effective routes to minimize thermal conductivity and maximize power factor.
Innovative Materials and Systems for Energy Harvesting Applications IGI Global
Low-Grade Thermal Energy Harvesting: Advances in Thermoelectrics, Materials, and Emerging Applications provides readers with fundamental and key concepts surrounding low-grade thermal energy conversion while also reviewing the latest research directions. The book covers the most promising and emerging technologies for low-grade heat recovery, harvesting and conversion, including wearable thermoelectrics and organic thermoelectrics. Each chapter includes key materials, principles, design and fabrication strategies for low-grade heat recovery. Special attention on emerging materials such as organic composites, 2D materials and nanomaterials are also included. The book emphasizes materials and device structures that enable the powering of wearable electronics and consumer electronics. The book is suitable for materials scientists and engineers in academia and R&D in manufacturing, industry, energy and electronics. Introduces key concepts and fundamental principles of low-grade thermal energy harvesting, storage and conversion Provides an overview on key materials, design principles and fabrication strategies for devices for low energy harvesting applications Focuses on materials and device designs that enable wearable thermoelectrics and flexible electronics applications
Thermoelectrics Woodhead Publishing
This work examines the feasibility of applying thermoelectric generators as power sources for implantable applications. Thermoelectric design principles, manufacturing methods and novel materials are foundational aspects of the work. Rapid advancements in the field of biomedical engineering has led to the vast number of implantable medical devices developed within the last few decades. As implantable medical devices provide more functionality, sufficient energy storage

while maintaining compactness becomes challenging. The lifetime of implanted medical devices will often be much shorter than the expected lifespan of patients, adding risks and costs to the patient in the form of additional surgical procedures. A perpetual power source that extends the longevity of implantable devices still remains elusive. This presents opportunities for solid-state thermal energy harvesting with thermoelectric energy generators (TEGs) that scavenge waste heat, the most abundant source of energy from the body. Thermoelectric energy generators (TEGs) provide solid-state energy by converting temperature differences into usable electricity. Since the fat in the human body provides thermal insulation, the largest temperature differences (typically 1-5 K) are found in the highest fat regions of the body. Bioheat transfer modeling shows that the optimal placement of TEGs for energy generation is in the abdomen under high convective conditions. Based on average 100 µW (at 1 V) input power requirements of implantable medical devices, thermoelectric and heat transfer design theories suggest a need for high aspect ratio thermoelectric elements in high density arrays to take advantage of the low temperature differences in the fat layer. In order to maximize power output, traditional thermoelectric device designs must be abandoned and a planar TEG device design is proposed as an effective and scalable method for implantable medical applications. Dispenser printing was then shown as a scalable and repeatable manufacturing method for depositing thick-film thermoelectric materials in the fabrication of planar TEGs. The use of printed fabrication methods led to the development and synthesis of novel printable composite thermoelectric materials. The thermoelectric properties of the printed thermoelectric materials were analyzed and carefully characterized as a function of temperature. The maximum dimensionless figure of merit (ZT) at 302K for an n-type Bi2Te3-epoxy composite was 0.18 when cured at 250°C, while the ZT of a p-type Sb2Te3-epoxy composite cured at 350°C was 0.34. A 50-couple TEG prototype with 5 mm x 640 µm x 90 µm printed element dimensions was fabricated on a polyimide substrate with evaporated metal contacts. The prototype device produced a power output of 10.5 µW at 61.3 µA and 171.6 mV for a temperature difference of 20K resulting in a device areal power density of 75 µW/cm2. The results of the work are promising and alternative methods to improve the performance of future devices are proposed. While the initial focus of this work was specific to the field of biomedical devices, the technologies that have been developed are applicable to other fields involving energy harvesting. The prospective impact of this work ultimately paves the path towards the advanced healthcare system of the future based on integrated autonomous wireless systems for the needs of "aging in place" or "aging at home" technologies.

Waste Energy Harvesting Royal Society of Chemistry

Waste Energy Harvesting overviews the latest progress in waste energy harvesting technologies, with specific focusing on waste thermal mechanical energies. Thermal energy harvesting technologies include thermoelectric effect, storage through phase change materials and pyroelectric effect. Waste mechanical energy harvesting technologies include piezoelectric (ferroelectric) effect with ferroelectric materials and nanogenerators. The book aims to strengthen the syllabus in energy, materials and physics and is well suitable for students and professionals in the fields.

Modules, Systems, and Applications in Thermoelectrics BoD – Books on Demand

Devices, nanoscale science and technologies based on GaN and related materials, have achieved great developments in recent years. New GaN-based devices such as UV detectors, fast p-HEMT and microwave devices are developed far more superior than other semiconductor materials-based devices.Written by renowned experts, the review chapters in this book cover the most important topics and achievements in recent years, discuss progress made by different groups, and suggest future directions. Each chapter also describes the basis of theory and experiment.This book is an invaluable resource for device design and processing engineers, material growers and evaluators, postgraduates and scientists as well as newcomers in the GaN field.

Thermoelectric Materials Springer

This unique compendium emphasizes key factors driving the performance of thermoelectric energy conversion systems. Important design parameters such as heat transfer at the boundaries of the system, material properties, and form factors are carefully analyzed and optimized for performance including the cost-performance trade-off. Numbers of examples are provided on the applications of thermoelectric technologies, e.g., power generation, cooling of electronic components, and waste heat recovery in wearable devices.This must-have volume also includes an interactive modeling software package developed on the nanoHUB (https://nanohub.org/) platform. Professionals, researchers, academics, undergraduate and graduate students will be able to study the impact of material properties and key design parameters on the overall thermoelectric system performance as well as the large scale implementation in the society.

Thermoelectric Microgenerators. Optimization for energy harvesting Springer

For decades, people have searched for ways to harvest energy from natural sources. Lately, a desire to address the issue of global warming and climate change has popularized solar or photovoltaic technology, while piezoelectric technology is being developed to power handheld devices without batteries, and thermoelectric technology is being explored to convert wasted heat, such as in automobile engine combustion, into electricity. Featuring contributions from international researchers in both academics and industry, Energy Harvesting with Functional Materials and Microsystems explains the growing field of energy harvesting from a materials and device perspective, with resulting technologies capable of enabling low-power implantable sensors or a large-scale electrical grid. In addition to the design, implementation, and components of energy-efficient electronics, the book covers current advances in energy-harvesting materials and technology, including: High-efficiency solar technologies with lower cost than existing silicon-based photovoltaics Novel piezoelectric technologies utilizing mechanical energy from vibrations and pressure The ability to harness thermal energy and temperature profiles with thermoelectric materials Whether you’re a practicing engineer, academician, graduate student, or entrepreneur looking to invest in energy-harvesting devices, this book is your complete guide to fundamental materials and applied microsystems for energy harvesting.

Organic Thermoelectric Materials Springer Science & Business Media

Thermoelectric generators (TEGs) and their applications have gained momentum for their ability to use waste thermal energy. More contemporary technology must offer more exceptional energy-efficient applications at a lower cost. New technology must also have an ability to generate electric power through the conversion of wasted heat. The TEG has demonstrated its efficiency and how it can offer increased potential by adding an MPPT algorithm to increase the power flow while decreasing the cost of operation. The limitations can be offset by the use of lower cost manufacturing materials and automated systems in the TEG units. It is also important to note the cost per watt found in using a thermoelectric generator is estimated to be $1/W for an installed device. To achieve this goal, the optimum operating point should be monitored by DC to DC converters. The DC to DC converters should also be driven through a generated pulse using an MPPT algorithm.

Hybrid and Fully Thermoelectric Solar Harvesting Springer Science & Business Media

Environmental and economic concerns have significantly spurred the search for novel, high-performance thermoelectric materials for energy conversion in small-scale power generation and refrigeration devices. This quest has been mainly fueled by the introduction of new designs and the synthesis of new materials. In fact, good thermoelectric material

Thermoelectrics and its Energy Harvesting, 2-Volume Set John Wiley & Sons

This book contributes to understanding the development and application of green energy solutions. The term ""green energy"" is widely used today to indicate sustainable energy sources with zero or minimal environmental and economic impact, obtained from various renewable energy sources. The contents presented in this book deal with different solutions, from small-scale applications (thermoelectric energy harvesting) to energy efficiency in buildings with local renewable energy production (also in critical seismic sites), local energy systems (smart energy management of storage and complex interactions), exploitation of biomasses from agricultural wastes, and voluntary certifications associated with energy trading in large energy systems. These aspects mark a more sustainable evolution of the society with wider green energy usage.

Energy Storage and Conversion Materials Springer Science & Business Media

Thermoelectricity can be used to generate electrical power from temperature gradients or differences in naturally occurring geothermal heat and rocks, or from waste heat in man-made equipment and industrial processes. Thermoelectric energy harvesting systems are finding commercial applications to replace or recharge batteries in low power electronic systems. This chapter provides the fundamental thermoelectric theory related to power generation, including the theoretical analysis and numerical calculations required to calculate the thermoelectric efficiency and electrical power generated when a single thermoelectric couple, and a 127 couple thermoelectric module, are subject to different temperature gradients. A thermoelectric energy harvesting system, incorporating a low power boost converter and DC to DC converter, coupled with electrical energy storage in supercapacitors, is presented and enables a thermoelectric energy harvesting system to provide sufficient electrical power to operate low power electronic components and systems. The short-term challenge for thermoelectric energy harvesting is to become a cost effective and practical solution to replace batteries, and to be scaled to provide sufficient power to operate electrical rotating machines such as low power motors and pumps. The long-term challenge is to improve the efficiency, power output, and cost of thermoelectric modules and energy harvesting systems, and to develop from low power to low-to-medium power applications.

A Thermoelectric Energy Harvesting System CRC Press

Ten years ago, D.M. Rowe introduced the bestselling CRC Handbook of Thermoelectrics to wide acclaim. Since then, increasing environmental concerns, desire for long-life electrical power sources, and continued progress in miniaturization of electronics has led to a substantial increase in research activity involving thermoelectrics. Reflecting the latest trends and developments, the Thermoelectrics Handbook: Macro to Nano is an extension of the earlier work and covers the entire range of thermoelectrics disciplines. Serving as a convenient reference as well as a thorough introduction to thermoelectrics, this book includes contributions from 99 leading authorities from around the world. Its coverage spans from general principles and theoretical concepts to material preparation and measurements; thermoelectric materials; thermoelements, modules, and devices; and thermoelectric systems and applications. Reflecting the enormous impact of nanotechnology on the field-as the thermoelectric properties of nanostructured materials far surpass the performance of conventional materials-each section progresses systematically from macro-scale to micro/nano-scale topics. In addition, the book contains an appendix listing major manufacturers and suppliers of thermoelectric modules. There is no longer any need to spend hours plodding through the journal literature for information. The Thermoelectrics Handbook: Macro to Nano offers a timely, comprehensive treatment of all areas of thermoelectrics in a single, unified reference.

Thermoelectrics Elsevier

Advanced Thermoelectric Materials for Energy Harvesting Applications is a research-intensive textbook covering the fundamentals of thermoelectricity and the process of converting heat energy into electrical energy. It covers the design, implementation, and performance of existing and advanced thermoelectric materials. Chapters examine such topics as organic/inorganic thermoelectric materials, performance and behaviors of thermoelectric devices, and energy harvesting applications of thermoelectric devices.

Thermoelectric Simulations, Energy Harvesting Innovations John Wiley & Sons

Thermoelectrics: Design and Materials HoSung Lee, Western Michigan University, USA A comprehensive guide to the basic principles of thermoelectrics Thermoelectrics plays an important role in energy conversion and electronic temperature control. The book comprehensively covers the basic physical principles of thermoelectrics as well as recent developments and design strategies of materials and devices. The book is divided into two sections: the first section is concerned with design and begins with an introduction to the fast developing and multidisciplinary field of thermoelectrics. This section also covers thermoelectric generators and coolers (refrigerators) before examining optimal design with dimensional analysis. A number of applications are considered, including solar thermoelectric generators, thermoelectric air conditioners and refrigerators, thermoelectric coolers for electronic devices, thermoelectric compact heat exchangers, and biomedical thermoelectric energy harvesting systems. The second section focuses on materials, and covers the physics of electrons and phonons, theoretical modeling of thermoelectric transport properties, thermoelectric materials, and nanostructures. Key features: Provides an introduction to a fast developing and interdisciplinary field. Includes detailed, fundamental theories. Offers a platform for advanced study. Thermoelectrics: Design and Materials is a comprehensive reference ideal for engineering students, as well as researchers and practitioners working in thermodynamics. Cover designed by Yujin Lee

Thermoelectric Energy Conversion CRC Press

Comprising two volumes, Thermoelectrics and Its Energy Harvesting reviews the vast improvements in technology and application of thermoelectric energy with a specific intention to reduce and reuse waste heat and improve novel techniques for the efficient acquisition and use of energy. Materials, Preparation, and Characterization in Thermoelectrics investigates the upsurge in activity in all aspects of thermoelectrics and the rapid advances in nanotechnology fueling the development of nano-architectured materials with substantially improved thermoelectric performance. Modules, Systems, and Applications in Thermoelectrics discusses the practical, novel, and truly groundbreaking applications of thermoelectrics in a range of markets. It details the U.S. interest in alternative energy and energy harvesting, the strong interest in Japan, Korea and Europe to incorporate thermoelectric generators in cars to reduce fuel consumption and meet EU carbon dioxide emission targets; and the European plans to build an isotopic powered thermoelectric generator.

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