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The Physics of Solar Cells Aug 21 2023 This book provides a comprehensive introduction to the physics of the photovoltaic cell. It is suitable for undergraduates, graduate students, and researchers new to the field. It covers: basic physics of semiconductors in photovoltaic devices; physical models of solar cell operation; characteristics and design of common types of solar cell; and approaches to increasing solar cell efficiency. The text explains the terms and concepts of solar cell device physics and shows the reader how to formulate and solve relevant physical problems. Exercises and worked solutions are included.

Lithium-Ion Batteries and Solar Cells Dec 13 2022 Lithium-Ion Batteries and Solar Cells: Physical, Chemical, and Materials Properties presents a thorough investigation of diverse physical, chemical, and material properties and special functionalities of lithium-ion batteries and solar cells. It covers theoretical simulations and high-resolution experimental measurements that promote a full understanding of the basic science to develop excellent device performance. Employs first-principles and the machine learning method to fully explore the rich and unique phenomena of cathode, anode, and electrolyte (solid and liquid states) in lithium-ion batteries Develops distinct experimental methods and techniques to enhance the performance of lithium-ion batteries and solar cells Treats syntheses, fabrication, and measurements Discusses open issues, challenges, and potential commercial applications This book is aimed at materials scientists, chemical engineers, and electrical engineers developing enhanced batteries and solar cells for peak performance.

Solar Cells and Energy Materials Mar 04 2022 Solar Cells and Energy Materials takes an in-depth look at the basics behind energy, solar energy as well as future and alternative energy materials. The author presents insights into the current state-of-the-art of solar cells, including their basic science, inorganic, organic and Perovskite-type cells. The author also gives an outlook into next generation energy materials and sources. The focus of this book is not only the presentation of available and developing energy materials, but their thorough examination and characterization. In addition to solar cell technology and the promising application of nanostructures like quantum dots, the author discusses the science and potential of nuclear fusion materials and other energy materials like hydrogen storage materials, BN nanomaterials, alternative fuel cells and SIC FET.

Physics of Solar Cells Oct 11 2022 Peter Würfel describes in detail all aspects of solar cell function, the physics behind every single step, as well as all the issues to be considered when improving solar cells and their efficiency. Based on the highly successful German version, but thoroughly revised and updated, this edition contains the latest knowledge on the mechanisms of solar energy conversion. Requiring no more than standard physics knowledge, it enables readers to understand the factors driving conversion efficiency and to apply this knowledge to their own solar cell development.

Organic Solar Cells Jan 02 2022 Organic solar cells have emerged as new promising photovoltaic devices due to their potential applications in large area, printable and flexible solar panels. Organic Solar Cells: Materials and Device Physics offers an updated review on the topics covering the synthesis, properties and applications of new materials for various critical roles in devices from electrodes, interface and carrier transport materials, to the active layer composed of donors and acceptors. Addressing the important device physics issues of carrier and exciton dynamics and interface stability and novel light trapping structures, the potential for hybrid organic solar cells to provide high efficiency solar cells is examined and discussed in detail. Specific chapters covers key areas including: Latest research and designs for highly effective polymer donors/acceptors and interface materials Synthesis and application of highly transparent and conductive graphene Exciton and charge dynamics for in-depth understanding of the mechanism underlying organic solar cells. New potentials and emerging functionalities of plasmonic effects in OSCs Interface Degradation Mechanisms in organic photovoltaics improving the entire device lifetime Device architecture and operation mechanism of organic/ inorganic hybrid solar cells for next generation of high performance photovoltaics This reference can be practically and theoretically applied by senior undergraduates, postgraduates, engineers, scientists, researchers, and project managers with some fundamental knowledge in organic and inorganic semiconductor materials or devices.

PHOTOVOLTAICS - Laboratory Techniques and Procedures - A manual to test Solar cells and panels Apr 12 2020 This manual presents the basic theory of PV panels and various parameters influencing the performance of a PV cell. The techniques to measure the various parameters are also discussed. This is an attempt to cater the need of the students and to the learning community to understand the basics of Photovoltaics and to do a basic test to understand the working of PV cells. The manual explains the PV technology measurement techniques in easy-to-understand terms. FOREWORD Solar is becoming a popular and convenient alternate source of energy. Solar is also a renewable energy. One important accessory for generating electricity through sunrays - that is - solar is a solar panel consisting of cells. A first step would be testing the panels and cells for establishing the parameters, meeting the laid down standards. While a lot of literature is available to measure the performance of panels, there is a need for a well written simple manual to guide the students. This manual by C S Ramya fills the need. Plus this manual is an excellent starting point for students who wish to foray into Solar Energy. CS Ramya has brought her professional and academic experience more than adequately. Her presentation is lucid. And helped with appropriate diagrams and formulae. CS Ramya has captured the essentials well. Thus this manual by CS Ramya is timely and well thought out. This manual elucidates simple steps. CS Ramya deserves to be complimented for bringing out this manual for the benefit of students wanting to excel in Solar energy. D Suresh (Fondly known as Solar Suresh) B Tech (IIT M) , PG Dip in Mgt (IIM A)

Solar Energy Conversion Sep 29 2021 A large number of solar cell and solar cell systems are described in this volume. The theory of their operation, their design and the levels of their performance is discussed. Originally the book appeared in 1978 but extensive change over the intervening years in the fields of energy generation and consumption, solar energy and solar cells, has necessitated the publication of an updated version. The text initially surveys the requirements of humanity, the subsequent need for solar cells, the nature of sunlight and the properties of semiconductors. Concrete examples, extensive references and theoretical arguments are then used to present a comparison of options available in the design and operation of solar cells and solar cell systems. The cells - constructed from single, crystal, polycrystalline and amorphous semiconductors - and the systems - have varying designs and differing levels of solar energy for input and produce electricity or electrical and thermal energies. Solar cell production, economics and environmental effects are considered throughout the publication.

Modelling and Optimization of Photovoltaic Cells, Modules, and Systems Aug 17 2020 This book presents a study to determine the current limitations in the area of Photovoltaics (PV) as a source of renewable energy and proposes strategies to overcome them by applying optimization approaches in three main areas, namely related to photovoltaic solar cells, modules, and systems. These include grid metallization design of Si-based solar cells and modules; cost-effectiveness analysis between Si-based monofacial and bifacial grid-connected PV systems; optimal diesel replacement strategy for the progressive introduction of PV and batteries; dispatch strategy optimization for PV hybrid systems in real time. The novelty of the work presented in this book is of high interest to the scientific community but also to the PV manufacturers, installation companies, and investors.

Solar Photovoltaic Cells Mar 16 2023 Solar Photovoltaic Cells: Photons to Electricity outlines our need for photovoltaics - a field which is exploding in popularity and importance. This concise book provides a thorough understanding of solar photovoltaic cells including how these devices work, what can be done to optimize the technology, and future trends in the marketplace. This book contains a detailed and logical step-by-step explanation of thermodynamically-consistent solar cell operating physics, a comparison of advanced multi-junction CPV power plants versus combined-cycle thermal power plants in the framework of energy cascading, and a discussion of solar cell semiconductor resource limitations and the scalability of solar electricity as we move forward. Quantitative examples allow the reader to understand the scope of solar PV and the challenges and opportunities of producing clean electricity. Provides a compact and focused discussion of solar photovoltaics and solar electricity generation. Helps you understand the limits of solar PV and be able to predict future trends. Quantitative examples help you grasp the scope of solar PV and the challenges and opportunities of producing electricity from a renewable resource.

Solar Cells Oct 31 2021 The fourth book of the four-volume edition of 'Solar cells' consists chapters that are general in nature and not related specifically to the so-called photovoltaic generations, novel scientific ideas and technical solutions, which has not properly approved. General issues of the efficiency of solar cell and through hydrogen production in photoelectrochemical solar cell are discussed. Considerable attention is paid to the quantum-size effects in solar cells both in general and on specific examples of super-lattices, quantum dots, etc. New materials, such as cuprous oxide as an active material for solar cells, AlSb for use as an absorber layer in p-i-n junction solar cells, InGaAsN as a promising material for multi-junction tandem solar cells, InP in solar cells with MIS structures are discussed. Several chapters are devoted to the analysis of both status and perspective of organic photovoltaics such as polymer/fullerene solar cells, poly(p-phenylene-vinylene) derivatives, photovoltaic textiles, photovoltaic fibers, etc.

Solar Cells and Their Applications Aug 09 2022 Present solar cells have a lower cost, higher efficiency and longer lifetime than those produced 10 years ago. In this comprehensive resource, international authorities discuss recent advances in solar cell research which have enhanced the capabilities of solar cells in applications running the gamut from space power to miniature devices.

Dye-sensitized Solar Cells and Solar Cell Performance Aug 29 2021 Dye-Sensitized Solar Cells & Solar Cell Performance

Comprehensive Guide on Organic and Inorganic Solar Cells Sep 17 2020 Comprehensive Guide on Organic and Inorganic Solar Cells: Fundamental Concepts to Fabrication Methods is a one-stop, authoritative resource on all types of inorganic, organic and hybrid solar cells, including their theoretical background and the practical knowledge required for fabrication. With chapters rigorously dedicated to a particular type of solar cell, each subchapter takes a detailed look at synthesis recipes, deposition techniques, materials properties and their influence on solar cell performance, including advanced characterization methods with materials selection and experimental techniques. By addressing the evolution of solar cell technologies, second generation thin-film photovoltaics, organic solar cells, and finally, the latest hybrid organic-inorganic approaches, this book benefits students and researchers in solar cell technology to understand the similarities, differences, benefits and challenges of each device. Introduces the basic concepts of different photovoltaic cells to audiences from a wide variety of academic backgrounds Consists of working principles of a particular category of solar technology followed by dissection of every component within the architecture Crucial experimental procedures for the fabrication of solar cell devices are introduced, aiding picture practical application of the technology

Solar Cell Materials Jan 22 2021 This book presents a comparison of solar cell materials, including both new materials based on organics, nanostructures and novel inorganics and developments in more traditional photovoltaic materials. It surveys the materials and materials trends in the field including third generation solar cells (multiple energy level cells, thermal approaches and the modification of the solar spectrum) with an eye firmly on low costs, energy efficiency and the use of abundant non-toxic materials.

Photovoltaic Solar Energy Generation May 14 2020 The intention of this book is to provide an impression of all aspects of p- tovoltaics (PV). It is not just about physics and technology or systems, but it looks beyond that at the entire environment in which PV is embedded. The ?rst chapter is intended as an introduction to the subject. It can also be considered an executive summary. Chapters 2–4 describe very brie?y the basic physics and technology of the solar cell. The silicon cell is the vehicle for this description because it is the best understood solar cell and also has the greatest practical importance. A reader who is not interested in the ph- ical details of the solar cell can skip Chap.2 and still understand the rest of the book. In general, it was the intention of the authors to keep the book at a level that does not require too much previous knowledge of photovoltaics. Chapter5isdevotedtoothermaterialsandnewconceptspresentlyunder-velopment or consideration. It intends to provide an impression of the many possibilities that exist for the conversion of solar radiation into electricity by solid state devices. These new concepts will keep researchers occupied for decades to come. Chapter 6 gives an introduction to cell and module techn- ogy and also informs the reader about the environmental compatibility and recycling of modules. The following chapters are devoted to practical applications. Chapters 7 and 8 introduce systems technology for di?erent applications. The envir- mental impact of PV systems and their reliability is the subject of Chap.9.

High-Efficiency Solar Cells Jun 07 2022 As part of the effort to increase the contribution of solar cells (photovoltaics) to our energy mix, this book addresses three main areas: making existing technology cheaper, promoting advanced technologies based on new architectural designs, and developing new materials to serve as light absorbers. Leading scientists throughout the world create a fundamental platform for knowledge sharing that combines the physics, materials, and device architectures of high-efficiency solar cells. While providing a comprehensive introduction to the field, the book highlights directions for further research, and is intended to stimulate readers’ interest in the development of novel materials and technologies for solar energy applications.

Solar Cells and Photocells Dec 21 2020

Solar Cells and Light Management Mar 24 2021 Solar Cells and Light Management: Materials, Strategies and Sustainability provides an extensive review on the latest advances in PV materials, along with light management strategies for better exploiting the solar spectrum. Following a brief review of the current status of solar cells, the book discusses different concepts, principles and technologies for solar devices, starting with standard silicon cells and then covering organic-hybrid, DSSC, perovskite, quantum dots and nanostructured oxide solar cells. Other sections focus on light manipulation and spectral modification, materials for spectral conversion, and environmental and sustainably considerations. An emergy analysis, which is an extension of the Life Cycle Assessment methodology, is applied to the study of solar PV systems, thus allowing for effective integrated indicators. Provides a comprehensive picture of light management strategies Features the most recent advances in the field, including novel materials and advanced solar cell technologies Presents a resource that is applicable to both new or experienced researchers in the field Contains a section on environmental and sustainability issues

Low-Cost Solar Electric Power Jun 14 2020 This book describes recent breakthroughs that promise major cost reductions in solar energy production in a clear and highly accessible manner. The author addresses the three key areas that have commonly resulted in criticism of solar energy in the past: cost, availability, and variability. Coverage includes cutting-edge information on recently developed 40□ efficient solar cells, which can produce double the power of currently available commercial cells. The discussion also highlights the potentially transformative emergence of opportunities for integration of solar energy storage and natural gas combined heat and power systems. Solar energy production in the evening hours is also given

fresh consideration via the convergence of low cost access to space and the growing number of large terrestrial solar electric power fields around the world. Dr. Fraas has been active in the development of Solar Cells and Solar Electric Power Systems for space and terrestrial applications since 1975. His research team at Boeing demonstrated the first GaAs/GaSb tandem concentrator solar cell in 1989 with a world record energy conversion efficiency of 35%, garnering awards from Boeing and NASA. He has over 30 years of experience at Hughes Research Labs, Chevron Research Co, and the Boeing High Technology Center working with advanced semiconductor devices. In a pioneering paper, he proposed the InGaP/GaInAs/Ge triple junction solar cell predicting a cell terrestrial conversion efficiency of 40% at 300 suns concentration. Having become today's predominant cell for space satellites, that cell is now entering high volume production for terrestrial Concentrated Photovoltaic (CPV) systems. Since joining JX Crystals, Dr. Fraas has pioneered the development of various thermophotovoltaic (TPV) systems based on the new GaSb infrared sensitive PV cell. Dr. Fraas holds degrees from Caltech (B.Sc. Physics), Harvard (M. A. Applied Physics), and USC (Ph.D. EE).

Stability and Degradation of Organic and Polymer Solar Cells Jul 16 2020 Organic photovoltaics (OPV) are a new generation of solar cells with the potential to offer very short energy pay back times, mechanical flexibility and significantly lower production costs compared to traditional crystalline photovoltaic systems. A weakness of OPV is their comparative instability during operation and this is a critical area of research towards the successful development and commercialization of these 3rd generation solar cells. Covering both small molecule and polymer solar cells, Stability and Degradation of Organic and Polymer Solar Cells summarizes the state of the art understanding of stability and provides a detailed analysis of the mechanisms by which degradation occurs. Following an introductory chapter which compares different photovoltaic technologies, the book focuses on OPV degradation, discussing the origin and characterization of the instability and describing measures for extending the duration of operation. Topics covered include: Chemical and physical probes for studying degradation Imaging techniques Photochemical stability of OPV materials Degradation mechanisms Testing methods Barrier technology and applications Stability and Degradation of Organic and Polymer Solar Cells is an essential reference source for researchers in academia and industry, engineers and manufacturers working on OPV design, development and implementation.

Thin Film Solar Cells Dec 01 2021 Thin-film solar cells are either emerging or about to emerge from the research laboratory to become commercially available devices finding practical various applications. Currently no textbook outlining the basic theoretical background, methods of fabrication and applications currently exist. Thus, this book aims to present for the first time an in-depth overview of this topic covering a broad range of thin-film solar cell technologies including both organic and inorganic materials, presented in a systematic fashion, by the scientific leaders in the respective domains. It covers a broad range of related topics, from physical principles to design, fabrication, characterization, and applications of novel photovoltaic devices.

Materials for Solar Cell Technologies I Feb 15 2023 The book reviews recent research and new trends in the area of solar cell materials. Topics include fabrication methods, solar cell design, energy efficiency and commercialization of next-generation materials. Special focus is placed on graphene and carbon nanomaterials, graphene in dye-sensitized solar cells, perovskite solar cells and organic photovoltaic cells, as well as on transparent conducting electrode (TCE) materials, hollow nanostructured photoelectrodes, monocrystalline silicon solar cells (MSSC) and BHJ organic solar cells. Also discussed is the use of graphene, sulfides, and metal nanoparticle-based absorber materials. Keywords: Solar Cell, Graphene Nanomaterials, Carbon Nanomaterials, Graphene in Dye-sensitized Solar Cells, Perovskite Solar Cells, Organic Photovoltaic Cells, Transparent Conducting Electrode (TCE) Materials, Hollow Nanostructured Photoelectrodes, Monocrystalline Silicon Solar Cells (MSSC), BHJ Organic Solar Cells, Electrochemical Sensing, Low Band-Gap Materials, Absorber Materials for Solar Cells.

Solar Cells and Their Applications Jan 14 2023 A major update of solar cell technology and the solar marketplace Since the first publication of this important volume over a decade ago, dramatic changes have taken place with the solar market growing almost 100-fold and the U.S. moving from first to fourth place in the world market as analyzed in this Second Edition. Three bold new opportunities are identified for any countries wanting to improve market position. The first is combining pin solar cells with 3X concentration to achieve economic competitiveness near term. The second is charging battery-powered cars with solar cell–generated electricity from arrays in surrounding areas—including the car owners' homes—while simultaneously reducing their home electricity bills by over ninety percent. The third is formation of economic "unions" of sufficient combined economic size to be major competitors. In this updated edition, feed-in tariffs are identified as the most effective approach for public policy. Reasons are provided to explain why pin solar cells outperform more traditional pn solar cells. Field test data are reported for nineteen percent pin solar cells and for ~500X concentrating systems with bare cell efficiencies approaching forty percent. Paths to bare cell efficiencies over fifty percent are described, and key missing program elements are identified. Since government support is needed for new technology prototype integration and qualification testing before manufacturing scale up, the key economic measure is identified in this volume as the electricity cost in cents per kilowatt-hour at the complete installed system level, rather than just the up-front solar cell modules' costs in dollars per watt. This Second Edition will benefit technologists in the fields of solar cells and systems; solar cell researchers; power systems designers; academics studying microelectronics, semiconductors, and solar cells; business students and investors with a technical focus; and government and political officials developing public policy.

How to Solar Power Your Home Feb 20 2021 Now more than ever, the question of economic and environmentally friendly energy sources has become a hot topic in almost every American home. With that in mind, more and more people are turning to alternatives such as solar power as a means of saving money and reducing their imprint on the environment. This nearly carbon neutral method comes with hefty tax rebates from the federal government and in states like California and New Jersey massive rebates from the state. More states are considering similar rebates and with a 3 to 8 year energy savings possible according to a recent report by the New York Times, it is an ideal solution for anyone looking to save money in the long term and help the planet immediately. This book will guide anyone interested in the process of installing and utilizing solar power for their home in the process of searching for, buying, or building their own solar power system. Learn how solar power and other alternative energy sources can help to save the world regardless of the cost and how you can start surveying your own energy use and efficiency. Learn how you can start making basic adjustments to become more efficient and how solar power can help you before you start any major projects. Learn what solar power requires, from cost and equipment to maintenance and preparation in certain times of the year. Learn how solar power works and how to start evaluating the potential of it for your building needs. Take the cost of installing solar power and learn how long it will take to make money back on your investment, including information on federal and state rebates that might affect you. Multiple individuals who have successfully installed solar power in their homes have been interviewed and their experiences included in this guide to help you learn what others go through and how they came out. Learn how the installation process works and how it can be done in your landscape, in small projects, for heating and purifying water, swimming pool heating, and other smaller projects. Learn about how individuals construct solar power systems on their own to save money and what is involved in a full PV system. Finally, learn how the market for green homes has made it possible to extract a huge return on investment from building or remodeling a home with solar power. For anyone who has ever considered solar power as a viable means to save money and the environment, this guide will help you get started right away.br> Atlantic Publishing is a small, independent publishing company based in Ocala, Florida. Founded over twenty years ago in the company presidentâe(tm)s garage, Atlantic Publishing has grown to become a renowned resource for non-fiction books. Today, over 450 titles are in print covering subjects such as small business, healthy living, management, finance, careers, and real estate. Atlantic Publishing prides itself on producing award winning, high-quality manuals that give readers up-to-date, pertinent information, real-world examples, and case studies with expert advice. Every book has resources, contact information, and web sites of the products or companies discussed.

Solar Cells Jun 19 2023 Enormous leaps forward in the efficiency and the economy of solar cells are being made at a furious pace. New materials and manufacturing processes have opened up new realms of possibility for the application of solar cells. Crystalline silicon cells are increasingly making way for thin film cells, which are spawning

experimentation with third-generation high-efficiency multijunction cells, carbon-nanotube based cells, UV light for voltage enhancement, and the use of the infrared spectrum for night-time operation, to name only a few recent advances. This thoroughly updated new edition of Markvart and Castaner's Solar Cells, extracted from their industry standard Practical Handbook of Photovoltaics, is the definitive reference covering the science and operation, materials and manufacture of solar cells. It is essential reading for engineers, installers, designers, and policy-makers who need to understand the science behind the solar cells of today, and tomorrow, in order to take solar energy to the next level. A thorough update to the definitive reference to solar cells, created by a cast of international experts from industry and academia to ensure the highest quality information from multiple perspectives Covers the whole spectrum of solar cell information, from basic scientific background, to the latest advances in materials, to manufacturing issues, to testing and calibration. Case studies, practical examples and reports on the latest advances take the new edition of this amazing resource beyond a simple amalgamation of a vast amount of knowledge, into the realm of real world applications

Solar Cells Apr 17 2023 This book addresses the rapidly developing class of solar cell materials and designed to provide much needed information on the fundamental principles of these materials, together with how these are employed in photovoltaic applications. A special emphasize have been given for the space applications through study of radiation tolerant solar cells. This book present a comprehensive research outlining progress on the synthesis, fabrication and application of solar cells from fundamental to device technology and is helpful for graduate students, researchers, and technologists engaged in research and development of materials.

Thin-Film Solar Cells May 06 2022 The first comprehensive book on thin-film solar cells, potentially a key technology for solving the energy production problem in the 21st century in an environmentally friendly way. It covers a wide range of scientific and technological aspects of thin film semiconductors - deposition technologies, growth mechanisms and the basic properties of amorphous and nano-crystalline silicon - as well as the optimum design theory and device physics of high-efficiency solar cells, especially of single-junction and multi-junction solar cells. The development of large-area solar cell modules using single and multi-junction solar cells is also considered. Examples of recent photovoltaic systems are presented and analysed.

Principles of Solar Cells, LEDs and Diodes Oct 19 2020 The book will cover the two most important applications of semiconductor diodes – solar cells and LEDs - together with quantitative coverage of the physics of the PN junction at the senior undergraduate level. It will include: Review of semiconductor physics Introduction to PN diodes The solar cell Physics of efficient conversion of sunlight into electrical energy Semiconductor solar cell materials and device physics Advanced solar cell materials and devices The light emitting diode Physics of efficient conversion of electrical energy into light Semiconductor light emitting diode materials and device physics Advanced light emitting diode materials and devices

Handbook of Photovoltaic Science and Engineering Jul 08 2022 The most comprehensive, authoritative and widely cited reference on photovoltaic solar energy Fully revised and updated, the Handbook of Photovoltaic Science and Engineering, Second Edition incorporates the substantial technological advances and research developments in photovoltaics since its previous release. All topics relating to the photovoltaic (PV) industry are discussed with contributions by distinguished international experts in the field. Significant new coverage includes: three completely new chapters and six chapters with new authors device structures, processing, and manufacturing options for the three major thin film PV technologies high performance approaches for multijunction, concentrator, and space applications new types of organic polymer and dye-sensitized solar cells economic analysis of various policy options to stimulate PV growth including effect of public and private investment Detailed treatment covers: scientific basis of the photovoltaic effect and solar cell operation the production of solar silicon and of silicon-based solar cells and modules how choice of semiconductor materials and their production influence costs and performance making measurements on solar cells and modules and how to relate results under standardised test conditions to real outdoor performance photovoltaic system installation and operation of components such as inverters and batteries. architectural applications of building-integrated PV Each chapter is structured to be partially accessible to beginners while providing detailed information of the physics and technology for experts. Encompassing a review of past work and the fundamentals in solar electric science, this is a leading reference and invaluable resource for all practitioners, consultants, researchers and students in the PV industry.

Solar Cell Device Physics May 26 2021 Solar Cell Device Physics offers a balanced, in-depth qualitative and quantitative treatment of the physical principles and operating characteristics of solar cell devices. Topics covered include photovoltaic energy conversion and solar cell materials and structures, along with homojunction solar cells. Semiconductor-semiconductor heterojunction cells and surface-barrier solar cells are also discussed. This book consists of six chapters and begins by introducing the reader to the basic physical principles and materials properties that are the foundations of photovoltaic energy conversion, with emphasis on various photovoltaic devices capable of efficiently converting solar energy into usable electrical energy. The electronic and optical properties of crystalline, polycrystalline, and amorphous materials with both organic and inorganic materials are considered, together with the manner in which these properties change from one material class to another and the implications of such changes for photovoltaics. Generation, recombination, and bulk transport are also discussed. The two mechanisms of photocarrier collection in solar cells, drift and diffusion, are then compared. The remaining chapters focus on specific solar cell device classes defined in terms of the interface structure employed: homojunctions, semiconductor-semiconductor heterojunctions, and surface-barrier devices. This monograph is appropriate for use as a textbook for graduate students in engineering and the sciences and for seniors in electrical engineering and applied physics, as well as a reference book for those actively involved in solar cell research and development.

Solar Cells and Light Management Jul 28 2021 Solar Cells and Light Management: Materials, Strategies and Sustainability provides an extensive review on the latest advances in PV materials, along with light management strategies for better exploiting the solar spectrum. Following a brief review of the current status of solar cells, the book discusses different concepts, principles and technologies for solar devices, starting with standard silicon cells and then covering organic-hybrid, DSSC, perovskite, quantum dots and nanostructured oxide solar cells. Other sections focus on light manipulation and spectral modification, materials for spectral conversion, and environmental and sustainably considerations. An emergy analysis, which is an extension of the Life Cycle Assessment methodology, is applied to the study of solar PV systems, thus allowing for effective integrated indicators.

Advances in Thin-Film Solar Cells Apr 24 2021 Solar energy conversion plays a very important role in the rapid introduction of renewable energy, which is essential to meet future energy demands without further polluting the environment, but current solar panels based on silicon are expensive due to the cost of raw materials and high energy consumption during production. The way forward is to move towards thin-film solar cells using alternative materials and low-cost manufacturing methods. The photovoltaic community is actively researching thin-film solar cells based on amorphous silicon, cadmium telluride (CdTe), copper indium gallium diselenide (CIGS), and dye-sensitised and organic materials. However, progress has been slow due to a lack of proper understanding of the physics behind these devices. This book concentrates on the latest developments and attempts to improve our understanding of solid-state device physics. The material presented is mainly experimental and based on CdTe thin-film solar cells. The author extends these new findings to CIGS thin-film solar cells and presents a new device design based on graded bandgap multi-layer solar cells. This design has been experimentally tested using the well-researched GaAs/AlGaAs system, and initial devices have shown impressive device parameters. These devices are capable of absorbing all radiation (UV, visible and infra-red) within the solar spectrum and combine "impact ionisation" and "impurity photovoltaic" effects. The improved device understanding presented in this book should impact and guide future photovoltaic device development and low-cost thin-film solar panel manufacture. This new edition features an additional chapter besides exercises and their solutions, which will be useful for academics teaching in this field.

Solar Cells and Modules May 18 2023 This book gives a comprehensive introduction to the field of photovoltaic (PV) solar cells and modules. In thirteen chapters, it addresses a wide range of topics including the spectrum of light received by PV devices, the basic functioning of a solar cell, and the physical factors limiting the efficiency of solar cells. It places particular emphasis on crystalline silicon solar cells and modules, which constitute today more than 90 % of all modules sold worldwide. Describing in great detail both the manufacturing process and resulting module performance, the book

also touches on the newest developments in this sector, such as Tunnel Oxide Passivated Contact (TOPCON) and heterojunction modules, while dedicating a major chapter to general questions of module design and fabrication. Overall, it presents the essential theoretical and practical concepts of PV solar cells and modules in an easy-to-understand manner and discusses current challenges facing the global research and development community.

Solar Cells Apr 05 2022

Fundamentals of Solar Cell Design Nov 19 2020 Solar cells are semiconductor devices that convert light photons into electricity in photovoltaic energy conversion and can help to overcome the global energy crisis. Solar cells have many applications including remote area power systems, earth-orbiting satellites, wristwatches, water pumping, photodetectors and remote radiotelephones. Solar cell technology is economically feasible for commercial-scale power generation. While commercial solar cells exhibit good performance and stability, still researchers are looking at many ways to improve the performance and cost of solar cells via modulating the fundamental properties of semiconductors. Solar cell technology is the key to a clean energy future. Solar cells directly harvest energy from the sun's light radiation into electricity are in an ever-growing demand for future global energy production. Solar cell-based energy harvesting has attracted worldwide attention for their notable features, such as cheap renewable technology, scalable, lightweight, flexibility, versatility, no greenhouse gas emission, environment, and economy friendly and operational costs are quite low compared to other forms of power generation. Thus, solar cell technology is at the forefront of renewable energy technologies which are used in telecommunications, power plants, small devices to satellites. Aiming at large-scale implementation can be manipulated by various types used in solar cell design and exploration of new materials towards improving performance and reducing cost. Therefore, in-depth knowledge about solar cell design is fundamental for those who wish to apply this knowledge and understanding in industries and academics. This book provides a comprehensive overview on solar cells and explores the history to evolution and present scenarios of solar cell design, classification, properties, various semiconductor materials, thin films, wafer-scale, transparent solar cells, and so on. It also includes solar cells' characterization analytical tools, theoretical modeling, practices to enhance conversion efficiencies, applications and patents.

Organic Solar Cells Nov 12 2022 This book covers in a textbook-like fashion the basics or organic solar cells, addressing the limits of photovoltaic energy conversion and giving a well-illustrated introduction to molecular electronics with focus on the working principle and characterization of organic solar cells. Further chapters based on the author's dissertation focus on the electrical processes in organic solar cells by presenting a detailed drift-diffusion approach to describe exciton separation and charge-carrier transport and extraction. The results, although elaborated on small-molecule solar cells and with focus on the zinc phthalocyanine: C60 material system, are of general nature. They propose and demonstrate experimental approaches for getting a deeper understanding of the dominating processes in amorphous thin-film based solar cells in general. The main focus is on the interpretation of the current-voltage characteristics (J-V curve). This very standard measurement technique for a solar cell reflects the electrical processes in the device. Comparing experimental to simulation data, the author discusses the reasons for S-Shaped J-V curves, the role of charge carrier mobilities and energy barriers at interfaces, the dominating recombination mechanisms, the charge carrier generation profile, and other efficiency-limiting processes in organic solar cells. The book concludes with an illustrative guideline on how to identify reasons for changes in the J-V curve. This book is a suitable introduction for students in engineering, physics, material science, and chemistry starting in the field of organic or hybrid thin-film photovoltaics. It is just as valuable for professionals and experimentalists who analyze solar cell devices.

The Physics of Solar Cells Jun 26 2021 The book provides an explanation of the operation of photovoltaic devices from a broad perspective that embraces a variety of materials concepts, from nanostructured and highly disordered organic materials, to highly efficient devices such as the lead halide perovskite solar cells. The book establishes from the beginning a simple but very rich model of a solar cell, in order to develop and understand step by step the photovoltaic operation according to fundamental physical properties and constraints. It emphasizes the aspects pertaining to the functioning of a solar cell and the determination of limiting efficiencies of energy conversion. The final chapters of the book establish a more refined and realistic treatment of the many factors that determine the actual performance of experimental devices: transport gradients, interfacial recombination, optical losses and so forth. The book finishes with a short review of additional important aspects of solar energy conversion, such as the photonic aspects of spectral modification, and the direct conversion of solar photons to chemical fuel via electrochemical reactions.

Physics of Solar Cells Jul 20 2023 The new edition of this highly regarded textbook provides a detailed overview of the most important characterization techniques for solar cells and a discussion of their advantages and disadvantages. It describes in detail all aspects of solar cell function, the physics behind every single step, as well as all the issues to be considered when improving solar cells and their efficiency. The text is now complete with examples of how the appropriate characterization techniques enable the distinction between several potential limitation factors, describing how quantities that have been introduced theoretically in earlier chapters become experimentally accessible. With exercises after each chapter to reinforce the newly acquired knowledge and requiring no more than standard physics knowledge, this book enables students and professionals to understand the factors driving conversion efficiency and to apply this to their own solar cell development.

Materials Concepts for Solar Cells Sep 10 2022 A modern challenge is for solar cell materials to enable the highest solar energy conversion efficiencies, at costs as low as possible, and at an energy balance as sustainable as necessary in the future. This textbook explains the principles, concepts and materials used in solar cells. It combines basic knowledge about solar cells and the demanded criteria for the materials with a comprehensive introduction into each of the four classes of materials for solar cells, i.e. solar cells based on crystalline silicon, epitaxial layer systems of III-V semiconductors, thin-film absorbers on foreign substrates, and nano-composite absorbers. In this sense, it bridges a gap between basic literature on the physics of solar cells and books specialized on certain types of solar cells. The last five years had several breakthroughs in photovoltaics and in the research on solar cells and solar cell materials. We consider them in this second edition. For example, the high potential of crystalline silicon with charge-selective hetero-junctions and alkaline treatments of thin-film absorbers, based on chalcopyrite, enabled new records. Research activities were boosted by the class of hybrid organic-inorganic metal halide perovskites, a promising newcomer in the field. This is essential reading for students interested in solar cells and materials for solar cells. It encourages students to solve tasks at the end of each chapter. It has been well applied for postgraduate students with background in materials science, engineering, chemistry or physics.

Rectenna Solar Cells Feb 03 2022 Rectenna Solar Cells discusses antenna-coupled diode solar cells, an emerging technology that has the potential to provide ultra-high efficiency, low-cost solar energy conversion. This book will provide an overview of solar rectennas, and provide thorough descriptions of the two main components: the diode, and the optical antenna. The editors discuss the science, design, modeling, and manufacturing of the antennas coupled with the diodes. The book will provide concepts to understanding the challenges, fabrication technologies, and materials required to develop rectenna structures. Written by experts in their specialized fields.