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Barry P. Rand | Henning Richter

ORGANIC SOLAR CELLS

Fundamentals, Devices, and Upscaling



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Organic Solar Cells Barry P. Rand, Henning Richter, 2014-08-26 Organic photovoltaic OPV cells have the potential to make a significant contribution to the increasing energy needs of the future In this book 15 chapters written by selected experts explore the required characteristics of components present in an OPV device such as transparent electrodes electron and hole conducting layers as well as electron donor and acceptor materials Design preparation and evaluation of these materials targeting highest performance are discussed This includes contributions on modeling down to the molecular level to device level electrical and optical testing and modeling as well as layer morphology control and characterization The integration of the different components in device architectures suitable for mass production is described Finally the technical feasibility and economic viability of large scale manufacturing using fast inexpensive roll to roll deposition technologies is assessed

Progress in High-Efficient Solution Process Organic Photovoltaic Devices Yang Yang, Gang Li, 2015-02-17 This book presents an important technique to process organic photovoltaic devices The basics materials aspects and manufacturing of photovoltaic devices with solution processing are explained Solution processable organic solar cells polymer or solution processable small molecules have the potential to significantly reduce the costs for solar electricity and energy payback time due to the low material costs for the cells low cost and fast fabrication processes ambient roll to roll high material utilization etc In addition organic photovoltaics OPV also provides attractive properties like flexibility colorful displays and transparency which could open new market opportunities The material and device innovations lead to improved efficiency by 8% for organic photovoltaic solar cells compared to 4% in 2005 Both academic and industry research have significant interest in the development of this technology This book gives an overview of the booming technology focusing on the solution process for organic solar cells and provides a state of the art report of the latest developments World class experts cover fundamental materials devices and manufacturing technology of OPV technology

Organic Solar Cells Barry P. Rand, Henning Richter, 2014-08-26 Organic photovoltaic OPV cells have the potential to make a significant contribution to the increasing energy needs of the future In this book 15 chapters written by selected experts explore the required characteristics of components present in an OPV device such as transparent electrodes electron and hole conducting layers as well as elect

Organic Electronics Stephen R. Forrest, 2020 This textbook provides a basic understanding of the principles of the field of organic electronics through to their applications in organic devices Useful for the student and practitioner it is both a teaching text and a resource that is a jumping off point for learning working and innovating in this rapidly growing field Provided by publisher

Organic and Hybrid Solar Cells Lukas Schmidt-Mende, Jonas Weickert, 2016-05-24 With the increasing world energy demand there is a growing necessity for clean and renewable energy The sun being one of the most abundant potential sources accounts for less than 1% of the global energy supply The market for solar cells is one of the most strongly increasing markets even though the prize of conventional

solar cells is still quite high New emerging technologies such as organic and hybrid solar cells have the potential to decrease the price of solar energy drastically This book offers an introduction to these new types of solar cells and discusses fabrication different architectures and their device physics on the bases of the author s teaching course on a master degree level A comparison with conventional solar cells will be given and the specialties of organic solar cells emphasized

Organic Solar Cells Wallace C.H. Choy,2012-11-19 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 [Fundamentals of Solar Cell Design](#)

Inamuddin,Mohd Imran Ahamed,Rajender Boddula,Mashallah Rezakazemi,2021-08-24 Edited by one of the most well respected and prolific engineers in the world and his team this book provides a comprehensive overview of solar cells and explores the history of evolution and present scenarios of solar cell design classification properties various semiconductor materials thin films wafer scale transparent solar cells and other fundamentals of solar cell design 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 harvested 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 its notable features such as cheap renewable technology scalable

lightweight flexibility versatility no greenhouse gas emission and economy friendly and operational costs Thus solar cell technology is at the forefront of renewable energy technologies which are used in telecommunications power plants small devices to satellites 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 This outstanding new volume Provides state of the art information about solar cells Is a unique reference guide for researchers in solar energy Includes novel innovations in the field of solar cell technology Audience This book is a unique reference guide that can be used by faculty students researchers engineers device designers and industrialists who are working and learning in the fields of semiconductors chemistry physics electronics light science material science flexible energy conversion industrial and renewable energy sectors

Solar Cells S. K. Sharma, Khuram Ali, 2020-01-07 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

Organic Solar Cells Modest Voronov, 2017 The last two decades have seen unprecedented research progress made in the fabrication and testing of organic solar cell OSC devices due to among other things rapid growth of interest in the development of organic materials for photovoltaic applications the ease of processing and the prospect of achieving high power conversion efficiency PCE cost effectively The effects of impurity doping at the ppm level in photovoltaic organic semiconductors including i Seven nines purification of organic semiconductors ii pn control of single and co deposited organic semiconductors by impurity doping iii ionisation sensitisation of doping showing the doping efficiency of 100% iv ppm doping effects in the simplest n p homojunction organic photovoltaic cells and v the Hall effect of bulk doped organic single crystals are discussed in Chapter One In Chapter Two the fabrication and characterisation of perovskite type solar cells are reviewed and summarised such as $\text{CH}_3\text{NH}_3\text{PbI}_3$ HC NH_2 2 PbI_3 and CsSnI_3 which are expected for solar cell materials Chapter Three proposes an experimental method to tailor SDE and optimise the power conversion efficiency PCE based on the electrical transport curve Chapter Four provides a brief history of organic photovoltaic cell devices factors limiting stability and power conversion efficiency fundamental parameters that have been

reported to improve the general performance of the devices and recent developments in organic solar cell devices

Principles of Solar Cells, LEDs and Related Devices Adrian Kitai, 2018-09-06 The second edition of the text that offers an introduction to the principles of solar cells and LEDs revised and updated The revised and updated second edition of Principles of Solar Cells LEDs and Related Devices offers an introduction to the physical concepts required for a comprehensive understanding of p n junction devices light emitting diodes and solar cells The author a noted expert in the field presents information on the semiconductor and junction device fundamentals and extends it to the practical implementation of semiconductors in both photovoltaic and LED devices In addition the text offers information on the treatment of a range of important semiconductor materials and device structures including OLED devices and organic solar cells This second edition contains a new chapter on the quantum mechanical description of the electron that will make the book accessible to students in any engineering discipline The text also includes a new chapter on bipolar junction and junction field effect transistors as well as expanded chapters on solar cells and LEDs that include more detailed information on high efficiency devices This important text Offers an introduction to solar cells and LEDs the two most important applications of semiconductor diodes Provides a solid theoretical basis for p n junction devices Contains updated information and new chapters including better coverage of LED out coupling design and performance and improvements in OLED efficiency Presents student problems at the end of each chapter and worked example problems throughout the text Written for students in electrical engineering physics and materials science and researchers in the electronics industry Principles of Solar Cells LEDs and Related Devices is the updated second edition that offers a guide to the physical concepts of p n junction devices light emitting diodes and solar cells

Organic Solar Cells Wolfgang Tress, 2014-11-22 This book covers in a textbook like fashion the basics of 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

Advanced Materials and Nano Systems: Theory and Experiment - Part 2 Dibya Prakash Rai, 2022-09-30 The discovery of new materials and the manipulation of their exotic properties for device fabrication is crucial for advancing technology Nanoscience and the creation of nanomaterials have taken materials science and electronics to new heights for the benefit of mankind Advanced Materials and Nanosystems Theory and Experiment covers several topics of nanoscience research The compiled chapters aim to update students teachers and scientists by highlighting modern developments in materials science theory and experiments The significant role of new materials in future technology is also demonstrated The book serves as a reference for curriculum development in technical institutions and research programs in the field of physics chemistry and applied areas of science like materials science chemical engineering and electronics This part covers 12 topics in these areas Recent advancements in nanotechnology a human health Perspective An exploratory study on characteristics of SWIRL of AlGaAs GaAs in advanced bio based nanotechnological systems Electronic structure of the half Heusler ScAuSn LuAuSn and their superlattice Recent trends in nanosystems Improvement of performance of single and multicrystalline silicon solar cell using low temperature surface passivation layer and antireflection coating Advanced materials and nanosystems Effect of nanostructure materials on optical properties of some rare earth ions doped in silica matrix Nd₂Fe₁₄B and SmCO₅ a permanent magnet for magnetic data storage and data transfer technology Visible light induced photocatalytic activity of MWCNTS decorated sulfide based nano photocatalysts Organic solar cells Neodymium doped lithium borosilicate glasses Comprehensive quantum mechanical study of structural features reactivity molecular properties and wave function based characteristics of capmatinib

Modelling and Design of Nanostructured Optoelectronic Devices Jagdish A. Krishnaswamy, Praveen C.

Ramamurthy, Gopalkrishna Hegde, Debiprosad Roy Mahapatra, 2022-04-02 This book approaches the design of functionally superior optoelectronic devices through the use of bio inspired nanostructures and multiscale material structures through a step by step approach The book combines both the fundamental theoretical concepts involved in understanding and numerically modelling optoelectronic devices and the application of such methods in addressing challenging research problems in nanostructured optoelectronic design and fabrication The book offers comprehensive content in optoelectronic materials and engineering and can be used as a reference material by researchers in nanostructured optoelectronic design

Organic Flexible Electronics Piero Cosseddu, Mario Caironi, 2020-09-29 Organic Electronics is a novel field of electronics that has gained an incredible attention over the past few decades New materials device architectures and applications have been continuously introduced by the academic and also industrial communities and novel topics have raised strong interest in such communities as molecular doping thermoelectrics bioelectronics and many others Organic Flexible Electronics is mainly divided into three sections The first part is focused on the fundamentals of organic electronics such as charge transport

models in these systems and new approaches for the design and synthesis of novel molecules The first section addresses the main challenges that are still open in this field including the important role of interfaces for achieving high performing devices or the novel approaches employed for improving reliability issues The second part discusses the most innovative devices which have been developed in recent years such as devices for energy harvesting flexible batteries high frequency circuits and flexible devices for tattoo electronics and bioelectronics Finally the book reviews the most important applications moving from more standard flexible back panels to wearable and textile electronics and more futuristic applications like ingestible systems Reviews the fundamental properties and methods for optimizing organic electronic materials including chemical doping and techniques to address stability issues Discusses the most promising organic electronic devices for energy electronics and biomedical applications Addresses key applications of organic electronic devices in imagers wearable electronics bioelectronics

The Physics of Solar Cells Juan Bisquert, 2017-11-15 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

Fundamentals of Photovoltaic Modules and Their Applications G. N. Tiwari, Swapnil Dubey, 2010 Presently there is no single publication available which covers the topics related to photovoltaic PV or photovoltaic thermal PV T technologies thermal modelling CO₂ mitigation and carbon trading This book disseminates the current knowledge in the fundamentals of solar energy photovoltaic PV or photovoltaic thermal PV T technologies energy security and climate change and is aimed at undergraduate and postgraduate students and professionals The main emphasis of the book is on the design construction performance and application of PV and PV T from the electricity and thermal standpoint Hot topics covered in the book include energy security of a nation climate change CO₂ mitigation and carbon credit earned by using PV or PV T technologies Carbon Trading This information will prove helpful in filling the gap between the researchers and professionals working on the application of photovoltaic and global climate change It also covers economic cost effective and sustainable aspects of photovoltaic technologies The book gives a detailed history of the new technological developments in PV T systems worldwide with system photographs and references and elaborates on the fundamentals of hybrid systems and their

performances with thermal modelling Energy and exergy analysis techno economic analysis and carbon trading are key chapters for research professionals The book also includes important case studies to aid understanding of the subject for all readers

Comprehensive Energy Systems Ibrahim Dincer, 2018-02-07 Comprehensive Energy Systems Seven Volume Set provides a unified source of information covering the entire spectrum of energy one of the most significant issues humanity has to face This comprehensive book describes traditional and novel energy systems from single generation to multi generation also covering theory and applications In addition it also presents high level coverage on energy policies strategies environmental impacts and sustainable development No other published work covers such breadth of topics in similar depth High level sections include Energy Fundamentals Energy Materials Energy Production Energy Conversion and Energy Management Offers the most comprehensive resource available on the topic of energy systems Presents an authoritative resource authored and edited by leading experts in the field Consolidates information currently scattered in publications from different research fields engineering as well as physics chemistry environmental sciences and economics thus ensuring a common standard and language

Rational Design of Solar Cells for Efficient Solar Energy Conversion Alagarsamy Pandikumar, Ramasamy Ramaraj, 2018-09-05 An interdisciplinary guide to the newest solar cell technology for efficient renewable energy Rational Design of Solar Cells for Efficient Solar Energy Conversion explores the development of the most recent solar technology and materials used to manufacture solar cells in order to achieve higher solar energy conversion efficiency The text offers an interdisciplinary approach and combines information on dye sensitized solar cells organic solar cells polymer solar cells perovskite solar cells and quantum dot solar cells The text contains contributions from noted experts in the fields of chemistry physics materials science and engineering The authors review the development of components such as photoanodes sensitizers electrolytes and photocathodes for high performance dye sensitized solar cells In addition the text puts the focus on the design of material assemblies to achieve higher solar energy conversion This important resource Offers a comprehensive review of recent developments in solar cell technology Includes information on a variety of solar cell materials and devices focusing on dye sensitized solar cells Contains a thorough approach beginning with the fundamental material characterization and concluding with real world device application Presents content from researchers in multiple fields of study such as physicists engineers and material scientists Written for researchers scientists and engineers in university and industry laboratories Rational Design of Solar Cells for Efficient Solar Energy Conversion offers a comprehensive review of the newest developments and applications of solar cells with contributions from a range of experts in various disciplines

Polymer Photovoltaics Fei Huang, Hin-Lap Yip, Yong Cao, 2016 An international perspective on the latest research in polymer solar cell technology

Springer Handbook of Semiconductor Devices Massimo Rudan, Rossella Brunetti, Susanna Reggiani, 2022-11-10 This Springer Handbook comprehensively covers the topic of semiconductor devices embracing all aspects from theoretical background to fabrication

modeling and applications Nearly 100 leading scientists from industry and academia were selected to write the handbook's chapters which were conceived for professionals and practitioners material scientists physicists and electrical engineers working at universities industrial R D and manufacturers Starting from the description of the relevant technological aspects and fabrication steps the handbook proceeds with a section fully devoted to the main conventional semiconductor devices like e g bipolar transistors and MOS capacitors and transistors used in the production of the standard integrated circuits and the corresponding physical models In the subsequent chapters the scaling issues of the semiconductor device technology are addressed followed by the description of novel concept based semiconductor devices The last section illustrates the numerical simulation methods ranging from the fabrication processes to the device performances Each chapter is self contained and refers to related topics treated in other chapters when necessary so that the reader interested in a specific subject can easily identify a personal reading path through the vast contents of the handbook

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Table of Contents Organic Solar Cells Fundamentals Devices And

1. Understanding the eBook Organic Solar Cells Fundamentals Devices And
 - The Rise of Digital Reading Organic Solar Cells Fundamentals Devices And
 - Advantages of eBooks Over Traditional Books
2. Identifying Organic Solar Cells Fundamentals Devices And
 - 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 Organic Solar Cells Fundamentals Devices And
 - User-Friendly Interface
4. Exploring eBook Recommendations from Organic Solar Cells Fundamentals Devices And
 - Personalized Recommendations
 - Organic Solar Cells Fundamentals Devices And User Reviews and Ratings

- Organic Solar Cells Fundamentals Devices And and Bestseller Lists
- 5. Accessing Organic Solar Cells Fundamentals Devices And Free and Paid eBooks
 - Organic Solar Cells Fundamentals Devices And Public Domain eBooks
 - Organic Solar Cells Fundamentals Devices And eBook Subscription Services
 - Organic Solar Cells Fundamentals Devices And Budget-Friendly Options
- 6. Navigating Organic Solar Cells Fundamentals Devices And eBook Formats
 - ePub, PDF, MOBI, and More
 - Organic Solar Cells Fundamentals Devices And Compatibility with Devices
 - Organic Solar Cells Fundamentals Devices And Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Organic Solar Cells Fundamentals Devices And
 - Highlighting and Note-Taking Organic Solar Cells Fundamentals Devices And
 - Interactive Elements Organic Solar Cells Fundamentals Devices And
- 8. Staying Engaged with Organic Solar Cells Fundamentals Devices And
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Organic Solar Cells Fundamentals Devices And
- 9. Balancing eBooks and Physical Books Organic Solar Cells Fundamentals Devices And
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Organic Solar Cells Fundamentals Devices And
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Organic Solar Cells Fundamentals Devices And
 - Setting Reading Goals Organic Solar Cells Fundamentals Devices And
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Organic Solar Cells Fundamentals Devices And
 - Fact-Checking eBook Content of Organic Solar Cells Fundamentals Devices And
 - 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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