Like most industries around the world, the energy industry also has an expansion to make towards green energy. The energy industry has come a long way since the 1970s, and renewable energy and other green technologies are becoming more and more common, replacing fossil fuels. It is, however, still a struggle, both in terms of energy sources keeping up with demand, and the development of useful technologies in this area. To maintain the supply for electrical energy, researchers, engineers and other professionals in industry are continuously exploring new eco-friendly energy technologies and power electronics, such as solar, wind, tidal, wave, biomass, and fuel cells. These technologies have the changed the concepts of energy production and have decreased the cost of electricity production. Newer solar PV systems have been introduced recently, which is a long time coming as all of this has been the result of teams of researchers who have proved their potential to boost the economy of any country. Green energy technology has not only proved the concept of clean energy but also reduced the dependences on fossil fuel for electricity generation through smart power electronics integrated with smart building and smart city concept. A valuable reference for engineers, scientists, chemists, and students, this volume is applicable to many different fields, across many different industries, at all levels. It is a must-have for any library.

The world's deserts are sufficiently large that, in theory, covering a fraction of their landmass with PV systems could generate many times the current primary global energy supply. In three parts, this study details the background and the context of PV-LV, maps out a development path towards the realization of PV-LV systems and provides firm recommendations for achieving long-term targets. This represents the first step in providing a complete set of answers to the questions that must be addressed in order to secure and exploit the potential for PV-LV technology and its global benefits.

The first book of this four-volume edition is dedicated to one of the most promising areas of photovoltaics, which has already reached a large-scale production of the second-generation thin-film solar modules and has resulted in building the powerful solar plants in several countries around the world. Thin-film technologies using direct-gap semiconductors such as CdS and Cds offer the lowest manufacturing costs and are becoming more prevalent in the industry allowing to improve manufacturability of the production at significantly larger scales than for wafer or ribbon Si modules. It is only a matter of time before thin films like CIGS and CdTe will replace wafer-based silicon solar cells as the dominant photovoltaic technology. This four-volume work details the problems of increasing this key parameter of the solar cell are discussed in several chapters of this volume. Within this work the electrochemical processes for manufacturing of novel silicon solar cells are investigated. Direct plating of Ni and Al on n- and p-silicon is demonstrated by making use of solar cell characteristics. Monocrystalline Ni/Cd stacks are realized for bifacial and back contact solar cells, forming an excellent mechanical and electrical contact to silicon. For metallization of HIT solar cells, the plating behavior on ITO layers is investigated. Additionally, plating processes on evaporated Al layers are developed and applied to back contact solar cells. By means of process optimization the plated metal stack on Al features sufficient adhesion and increases the lateral conductivity of the metal grid resulting in increased solar cell efficiency. An advanced metallization route for back contact solar cells which purposefully utilizes the different characteristics of the deposited metals (Al, Ni, Cu) is developed. The resulting metal stacks are characterized in detail using SEM, EDX and AES methods. Besides plating processes, local oxidizing processes for Al are established and combined with plating technologies to realize the metal contact separation for back contact solar cells. This book provides a systematic presentation of the principles and practices behind the synthesis and functionalization of graphene and graphene oxide (GO), as well as the fabrication techniques for transparent conductors from these materials. Graphene provides a unique platform in a wide variety of electronic and photonic applications. Thin films made from indium tin oxide (ITO) have thus far been the dominant source of transparent conductors, and now account for 50% of Indian production. However, the price of Indian has increased 1000% in the last 10 years. Graphene, a two-dimensional monolayer of sp2-bonded carbon atoms, has promising characteristics that have driven interest in graphene as a replacement material for ITO. The book includes chapters on the application of graphene and GO to a wide variety of electronic applications, with an emphasis on replacing expensive ITO films. Graphene for Transparent Conductors offers a systematic presentation of the principles, theories and practical techniques behind the structure-property relationship of the thin films, which are the key to the successful development of transparent conductors from graphene and GO. At the same time, the unique perspectives provided in the applications of graphene and GO as transparent conductors will serve as a general guide to the design and fabrication of thin film materials for specific applications.

Solar PV Power: Design, Manufacturing and Applications from Sand to Systems covers the solar cell manufacturing process, including information from system design through to the entire value chain of Solar PV Manufacturing. In addition, the book includes aspects of ground mounted grid connected solar PV systems and optimization for solar PV plants, economic analyses, and reliability and performance. The advances and processes of solar product technology and reliability, along with the performance of solar PV plants and operational and maintenance aspects with advance diagnostic techniques are also presented, making this an ideal resource. With rapid change in the manufacturing process, it is crucial for solar cells and solar PV modules to adapt to new developments in solar products, especially with regard to reliability, financial aspects and performance. In-depth solar panel module assembly and analysis offers new concepts for solar PV system design that are presented alongside field related issues and examples Saves time and resources by collecting all pieces of information needed by engineers in the same text

Comprehensive Energy Systems 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 such 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. Perspective includes resources assessment and deployment, materials performance improvement, system optimization and sizing, instrument control and monitoring, modeling and simulation, regulations, and policies. Each modular chapter examines recent advancements in specific renewable energy systems, providing theoretical and applied insights into the design and application of various energy systems through life cycle analysis. The book is of interest to engineers, graduate students, researchers and industry professionals involved in the renewable energy sector and advanced engineering courses dealing with renewable energy, sustainability, energy policy, and global energy analysis. For advanced engineers, research and development professionals in making research trends in solar, wind, biomass, and hydropower and geothermal energy production and conversion. A comprehensive summary of the management, distribution, management, optimization, and storage of heat and energy using case studies. Solar PV Power: Design, Manufacturing and Applications from Sand to Systems details developments in the solar cell manufacturing process, including information from system design through to the entire value chain of Solar PV Manufacturing.

This book offers a global perspective of the current state of affairs in solar power and grid energy. In this part, four well-researched volumes inform about established solar PV (photovoltaic) technologies third-generation PV technologies based on new materials with potential for low-cost large-scale production. The book includes information on energy generation and distribution, energy transmission and transformation, energy storage, energy management, and energy analysis. The book also covers the latest developments in the field of solar energy, including solar cell and module technologies, photovoltaic systems, and solar energy storage systems. The book is written by a team of experts from different fields, including engineering, physics, chemistry, and economics, thus ensuring a common standard and language.
This report describes a 21-month project to demonstrate amorphous-silicon (a-Si) solar cells with high stabilized conversion efficiency. The objective was to develop a research program spanning material issues (more stable a-Si and better a-Si/Alloy) and device issues (more stable a-Si-based solar cells) with the goal of high stabilized solar cell efficiency. The Institute of Energy Conversion (IEC) produced and analyzed the stability of a-Si films and solar cells with reduced hydrogen content (2–6%). A thermodynamic model of defect formation was developed that describes the high-temperature degraded state of a solar cell. An analysis of bifacial current voltage and quantum-efficiency insults for a-SiGe p-i-n devices with transparent front and back contacts provided information about the influence of graded and ungraded a-Si solar cells using bifacial devices to learn about the relative degradation of hole and electron transport, and concludes that degradation of the photodecay output of a-Si materials does not agree with degradation observed in solar cells.

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 cells 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.

This leading-edge volume on advances in photovoltaic technology features diverse contributions from experts in every major geographic PV market. It examines emerging applications such as electricity grid load-balancing and demand response, storage systems, photovoltaic/thermal solar collectors and carbon-offset in buildings. The book also presents practical advice on bifacial solar cell fabrication, and characterization; provides expert insights on the recent evolution and near future of PV markets around the globe; Covers applications from grid-tied solar power systems and ground power generation to green buildings.

To make solar energy mainstream, lower-cost and more efficient power generation is key. A lot of effort in the silicon photovoltaic industry has gone into using fewer raw materials (i.e., silicon) and using more inexpensive processing techniques and fabrication of reliable and long-life modules. Photovoltaic Module Reliability starts with a brief history of photovoltaics, discussing some of the different types of materials and devices used for commercial solar cells. It then goes on to offer formulator of the renowned 'Moore's Law' relating to the technology development cycle in the solar industry.

The Handbook of Thin Film Deposition is a comprehensive reference focusing on thin film technologies and applications used in the semiconductor industry and the closely related areas of thin film deposition, thin film microelectronics, photovoltaic applications, digital cameras, CCD arrays, and optical thin films. A practical survey of thin film technologies aimed at engineers and managers involved in all stages of the process: design, fabrication, quality assurance and applications. Covers core processes and applications for the semiconductor industry and new developments in the photovoltaic and optical thin film industries. The new edition takes covers the transition taking place in the semiconductor industry from AlGAs to copper-interconnects with acknowledged industry experts from key companies in the semiconductor industry including Intel and IBM. This valuable handbook is essential reading for all who work in these fields.

Published with a focus on crystalline silicon solar cell science and technology. It is written from the perspective of an experimentalist with extensive hands-on experience in modeling, fabrication, and characterization. A practical approach to solar cell science that addresses the three major terms of its three-year long life: materials and solar cell fabrication, and electrical characterization. The electrical section focuses on formation of ohmic contacts on p- and n-doped surfaces. The optical section illustrates light interaction with textured silicon surfaces in terms of geometrical, diffractive and physical optics, transmission, and surface photovoltaics (SPV). A spectroscopic and electrical study of the performance of silicon solar cells, focusing on a wide range of process parameters. A brief economic analysis on the merits of crystalline silicon-based photovoltaic technology as a type of industrial production.

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to financing, installing, and operating photovoltaic power generating systems are given. Production problems and techniques are described.

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.

Nanostructured solar cells are very important in renewable energy sector as well as in environmental aspects, because it is environment friendly. The nano-grating structures (such as triangular or conical shaped) have a gradual change in refractive index which acts as a multilayer antireflective coating that is leading to reduced light reflection losses over broadband ranges of wavelength and angle of incidence. There are different types of losses in solar cells that always reduce the conversion efficiency, but the light reflection loss is the most important factor that decreases the conversion efficiency of solar cells significantly. The antireflective coating is an optical coating which is applied to the surface of lenses or any optical devices to reduce the light reflection losses. This coating assists for the light trapping capturing capacity or improves the efficiency of optical devices, such as lenses or solar cells. Hence, the multilayer antireflective coatings can reduce the light reflection losses and increases the conversion efficiency of nanostructured solar cells.

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