Physics Of Solar Cells By Jenny Nelson

Thin Film Solar CellsSolar CellsSolar CellsSolar CellsSolar Energy ConversionFundamentals Of Solar CellsSolar Cells and Their ApplicationsSolar Cells Development and FabricationSolar CellsSolar CellsSolar CellsCrystalline Silicon Solar CellsIntroducing CTS (Copper-Tin-Sulphide) as a Solar Cell by Using Solar Cell Capacitance Simulator (SCAPS)Thin-Film Solar CellsSolar Cell Device PhysicsThin Film Solar CellsFundamentals of Solar Cell DesignOrganic Solar CellsSolar Energy UpdateSolar Cells and Their Applications K. L. Chopra Ahmed Mourtada Elseman Sandeep Arya Chenming Hu R.C. Neville Alan Fahrenbruch Lewis M. Fraas Shivani Dhall Augustin McEvoy Leonid A. Kosyachenko S. K. Sharma Adolf Goetzberger Iraj Sadegh Amiri Yoshihiro Hamakawa Stephen J. Fonash Jef Poortmans Inamuddin Sujata N. Mustapure Lewis M. Fraas
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you 0 sun are the eye of the world you are the soul of all embodied beings you are the source of all creatures you are the discipline of all engaged in work translated from mahabharata 3rd century bc today energy is the lifeline and status symbol of civilized societies all nations have therefore embarked upon research and development pro grams of varying magnitudes to explore and effectively utilize renewable sources of energy albeit a low grade energy with large temporal and spatial variations solar energy is abundant cheap clean and renewable and thus presents a very attractive alternative source the direct conver sion of solar energy to electricity photovoltaic effect via devices called solar cells has already become an established frontier area of science and technology born out of necessity for remote area applications the first commercially manufactured solar cells single crystal silicon and thin film cds cu2s were available well over 20 years ago indeed all space vehicles today are powered by silicon solar cells but large scale terrestrial applications of solar cells still await major breakthroughs in terms of discovering new and radical concepts in solar cell device structures utilizing relatively more abundant cheap and even exotic materials and inventing simpler and less energy intensive fabrication processes no doubt this extraordinary challenge in r d has led to a virtual explosion of activities in the field of photovoltaics in the last several years

solar cell energy is the single most pressing issue facing humanity with a more technologically advanced society requiring better energy resources this book discusses technologies broadly depending on how they capture and distribute solar energy or convert it into solar power the major areas covered in this book are the theory of solar cells which explains the conversion of light energy in photons into electric current the theoretical studies are practical because they predict the fundamental limits of a solar cell the design and development of thin film technology based solar cells state of the art for bulk material applied for solar cells based on crystalline silicon c si also known as solar grade silicon and emerging photovoltaics

this book highlights developments in the field of solar cells the chapters in this book address a wide range of topics including the spectrum of light received by solar cell devices the basic functioning of a solar cell and the evolution of solar cell technology during the last 50 years it places particular emphasis on silicon solar cells cigs based solar cells organic solar cells perovskite solar cells and hybrid solar cells the book describes in detail the fabrication processes employed for different categories of solar cells it also provides the characterization techniques utilized in this sector to evaluate the performance of solar cells and the scope of this domain in the future overall it presents the essential theoretical and practical concepts of solar cells in an easy to understand manner

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

fundamentals of solar cells photovoltaic solar energy conversion provides an introduction to the fundamental physical principles of solar cells it aims to promote the expansion of solar photovoltaics from relatively small and specialized use to a large scale contribution to energy supply the book begins with a review of basic concepts such as the source of energy the role of photovoltaic conversion the development of photovoltaic cells and sequence of phenomena involved in solar power generation this is followed by separate chapters on each of the processes that take place in solar cell these include solar input properties of semiconductors recombination and the flow of photogenerated carriers charge separation and the characteristics of junction barriers and calculation of solar efficiency subsequent chapters deal with the operation of specific solar cell devices such as a single crystal homojunction si a single crystal heterojunction buried homojunction algaas gaas and a polycrystalline thin film cell cuxs cds this book is intended for upper level graduate students who have a reasonably good understanding of solid state physics and for scientists and engineers involved in research and development of solar cells

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

THIS BOOK COVERS THE BASIC SCIENTIFIC BACKGROUND OF SOLAR CELLS THEIR PRINCIPLES WORKING GROWTH OPERATING PARAMETERS COMMERCIALIZATION STATUS MANUFACTURING CHALLENGES AND FUTURE SCOPE OF SOLAR CELLS TOPICS COVERED RANGE FROM HISTORY AND DEVELOPMENTS OF SOLAR CELL GENERATION TO MARKET GROWTH AND DIFFERENT APPLICATIONS OF SOLAR CELLS INCLUDING IN DEPTH KNOWLEDGE ABOUT SI PSCS AND NEXT GENERATION MULTILAYER BANDGAP BASED SOLAR CELLS AND THEIR FABRICATION TECHNIQUES WITH ADVANCED METHODOLOGY KEY FEATURES EXPLAINS SOLAR CELLS AND THEIR GROWTH AT DIFFERENT STAGES DISCUSSES CHALLENGES IN THE FABRICATION COMMERCIALIZATION OF SOLAR CELLS AT THE LAB AND INDUSTRY LEVELS COMBINES FUNDAMENTAL EXPERIMENTAL AND THEORETICAL KNOWLEDGE WITH INDUSTRIAL NEEDS AND ENGINEERING DESIGN METHODS COVERS THE NEW GENERATION OF PEROVSKITE SOLAR CELLS AND THEIR SYNTHESIS TECHNIQUES EXPLORES MULTILAYER GRADED BANDGAP SOLAR CELLS AND THEIR IMPORTANCE IN EXISTING SOLAR TECHNOLOGY THIS BOOK IS SPECIFICALLY DESIGNED FOR GRADUATE STUDENTS AND RESEARCHERS IN SOLAR ENERGY TECHNOLOGY CELL DEVICE AND MATERIALS SCIENCE

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

THE SECOND BOOK OF THE FOUR VOLUME EDITION OF SOLAR CELLS IS DEVOTED TO DYE SENSITIZED SOLAR CELLS DSSCS WHICH ARE CONSIDERED TO BE EXTREMELY PROMISING BECAUSE THEY ARE MADE OF LOW COST MATERIALS WITH SIMPLE INEXPENSIVE MANUFACTURING PROCEDURES AND CAN BE ENGINEERED INTO FLEXIBLE SHEETS DSSCS ARE EMERGED AS A TRULY NEW CLASS OF ENERGY CONVERSION DEVICES WHICH ARE REPRESENTATIVES OF THE THIRD GENERATION SOLAR TECHNOLOGY MECHANISM OF CONVERSION OF SOLAR ENERGY INTO ELECTRICITY IN THESE DEVICES IS QUITE PECULIAR THE ACHIEVED ENERGY CONVERSION EFFICIENCY IN DSSCS IS LOW HOWEVER IT HAS IMPROVED QUICKLY IN THE LAST YEARS IT IS BELIEVED THAT DSSCS ARE STILL AT THE START OF THEIR DEVELOPMENT STAGE AND WILL TAKE A WORTHY PLACE IN THE LARGE SCALE PRODUCTION FOR THE FUTURE

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

THIS BOOK DISCUSSES THE ENHANCEMENT OF EFFICIENCY IN CURRENTLY USED SOLAR CELLS THE AUTHORS HAVE CHARACTERIZED DIFFERENT STRUCTURES OF THE SOLAR CELL SYSTEM TO OPTIMIZE SYSTEM PARAMETERS PARTICULARLY THE PERFORMANCE OF THE COPPER TIN SULPHIDE SOLAR CELL USING SOLAR CELL CAPACITANCE SIMULATOR SCAPS THIS RESEARCH CAN HELP SCIENTIST TO OVERCOME THE CURRENT LIMITATIONS AND BUILD UP NEW DESIGNS OF THE SYSTEM WITH HIGHER EFFICIENCY AND GREATER FUNCTIONALITY THE AUTHORS HAVE INVESTIGATED THE CORRESPONDING SAMPLES FROM VARIOUS VIEWPOINTS INCLUDING STRUCTURAL CRYSTALLINITY COMPOSITION AND SURFACE MORPHOLOGY OPTICAL UV VIS NEAR IR TRANSMITTANCE REFLECTANCE SPECTRA AND ELECTRICAL RESISTIVITY PROPERTIES DESCRIBES INVESTIGATIONS ON CU2SNS3 SOLAR CELLS AND PROSPECTIVE LOW COST ABSORBER LAYER OF THIN FILM SOLAR CELLS DISCUSSES THE POTENTIAL DEVICE STRUCTURE OF COPPER TIN SULPHIDE BASED ON THIN FILM TECHNOLOGIES EXPLAINS SOLAR CELL STRUCTURE OPTIMIZATION TO PERFORM A HIGHER CONVERSION EFFICIENCY OF COPPER TIN SULPHIDE

THE DEVELOPMENT OF CLEAN ENERGY RESOURCES AS ALTERNATIVES TO OIl HAS BECOME ONE OF THE MOST IMPORTANT CHALLENGES FOR MODERN SCIENCE AND TECHNOLOGY THE OBVIOUS MOTIVATION FOR THESE EFFORTS IS TO REDUCE THE AIR POLIUTION RESULTING FROM THE MASS CONSUMPTION OF FOSSIL FUELS AND TO PROTECT THE ECOLOGICAL CYCLES OF THE BIOSYSTEMS ON EARTH ANALYSES OF FUTURE ENERGY USAGE ENVISION THAT THE ENERGY STRUCTURE IN THE 21ST CENTURY WILL BE CHARACTERIZED AS A BEST MIX AGE INVOLVING DIFFERENT RENEWABLE ENERGY FORMS AMONG THE WIDE VARIETY OF RENEWABLE ENERGY PROJECTS IN PROGRESS PHOTO VOLTAICS IS THE MOST PROMISING AS A FUTURE ENERGY TECHNOLOGY IT IS POLLUTION FREE AND ABUNDANTLY AVAILABLE EVERYWHERE IN THE WORLD EVEN IN SPACE AND CAN ALSO OPERATE WITH DIFFUSE LIGHT HOWEVER A MAJOR BARRIER IMPEDING THE DEVEL OPMENT OF LARGE SCALE BULK POWER APPLICATIONS OF PHOTOVOLTAIC SYSTEMS IS THE HIGH PRICE OF SOLAR CELL MODULES THEREFORE REDUCTION OF THE COSTS OF SOLAR CELIS IS OF PRIME IMPORTANCE TO ACHIEVE THIS OBJECTIVE TREMENDOUS R D EFFORTS HAVE BEEN MADE OVER THE PAST TWO DECADES IN A WIDE VARIETY OF TECHNICAL FIELDS RANGING FROM SOLAR CELL MATERIALS CELL STRUCTURE AND MASS PRODUCTION PRO CESSES TO THE PHOTOVOLTAIC SYSTEMS THEMSELVES AS THE RESULT ABOUT AN ORDER OF MAGNITUDE COST REDUCTION HAS BEEN ACHIEVED IN THE PAST 10 YEARS

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

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

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

THE SOLAR ENERGY INDUSTRY IS GREATLY SUBSIDIZED FOR SEVERAL YEARS BUT THE COSTS OF INORGANIC SILICON SOLAR CELL POWER PLANTS OR PANELS ARE STILL NOT ECONOMICAL A METHOD FOR REDUCING THE MANUFACTURING COSTS OF SOLAR CELLS IS TO UTILIZE ORGANIC MATERIALS THAT COULD BE PROCESSED UNDER LOW DEMANDING SITUATIONS ORGANIC SOLAR CELLS HAVE NUMEROUS INTRINSIC ADVANTAGES LIKE THEIR FLEXIBILITY LOW MATERIAL LIGHTWEIGHT LOW MANUFACTURING COSTS LOW TOXICITY AND MINIMAL ENVIRONMENTAL IMPACT IN THE PAST FEW YEARS ORGANIC PHOTOVOLTAICS OPV HAS RECEIVED IMMENSE ATTENTION OWING TO THEIR EXCEPTIONAL FEATURES SUCH AS LOW TEMPERATURE SYNTHESIS LIGHT AND CHEAP MATERIALS SOLUTION PROCESSABILITY AND TUNABLE ELECTRONIC PROPERTIES APART FROM ENVIRONMENTAL AND ECONOMIC BENEFITS MOST OF THE ORGANIC SOLAR CELLS SCS EXHIBIT HIGHER EFFICIENCIES WHICH ARE COMPARABLE WITH THE EFFICIENCIES OF SILICON SOLAR CELLS THEY HAVE EXHIBITED CONVERSION EFFICIENCIES OF MORE THAN 13 TO DATE THIS BOOK ENCOMPASSES THE FUNDAMENTALS OF ORGANIC SOLAR PHOTOVOLTAICS THE DETAILED CONTENT OF THE BOOK ADDRESSES THE PHOTOVOLTAIC ENERGY CONVERSION LIMITS AND PROVIDES A WELL EXPLAINED OVERVIEW OF MOLECULAR ELECTRONICS WHICH FOCUSES ON THE WORKING PRINCIPLE MANUFACTURING AND CHARACTERIZATION OF POLYMERIC SOLAR CELLS DIFFERENT CHAPTERS OF THE BOOK FOCUS ON THE ELECTROCHEMICAL PROCESSES TAKING PLACE IN ORGANIC SOLAR CELLS BY OFFERING A DETAILED EXPLANATION OF THE EXCITON SEPARATION CHARGE CARRIER TRANSPORT AND ELECTRICITY GENERATION THE BOOK ALSO FOCUSES ON THE EXPERIMENTAL METHODOLOGIES FOR GETTING A THOROUGH UNDERSTANDING OF THE KEY PHOTOVOLTAIC PROCESSES IN DIFFERENT TYPES OF POLYMERIC SOLAR CELLS THE PRIMARY FOCUS OF THIS BOOK IS TO PROVIDE A COMPREHENSIVE ANALYSIS OF THE FUNDAMENTAL FEATURES OF ORGANIC SOLAR CELLS

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

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