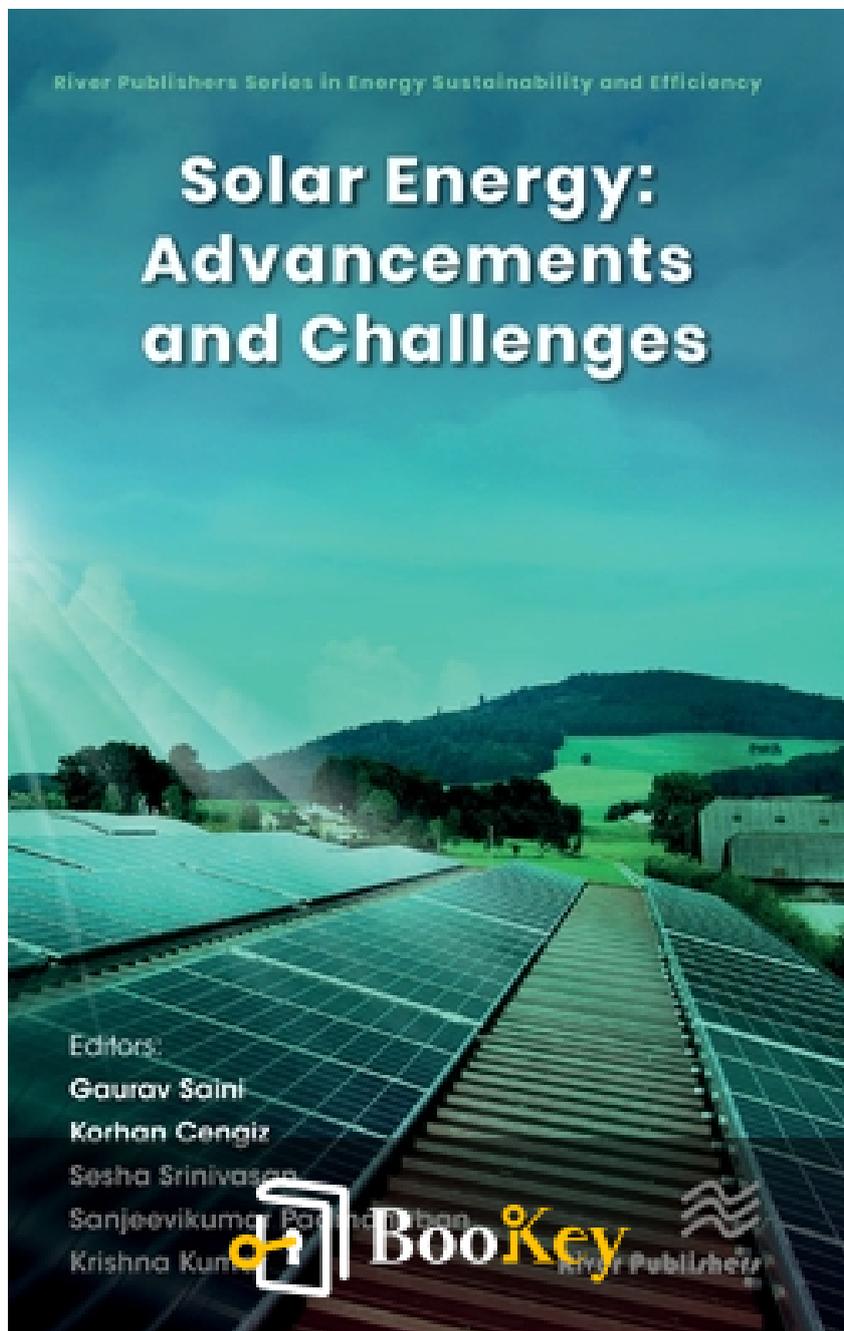


Solar Energy PDF (Limited Copy)

Gaurav Saini



More Free Book



Scan to Download

Solar Energy Summary

Harnessing the Sun for a Sustainable Future.

Written by Books OneHub

More Free Book



Scan to Download

About the book

In "Solar Energy," Gaurav Saini embarks on an illuminating journey into the world of renewable energy, unraveling the power and potential of harnessing the sun's rays for sustainable living. This insightful exploration not only highlights the urgent necessity of transitioning away from fossil fuels but also champions the technological advancements and practical applications of solar energy that make it a viable solution for global energy challenges. With a keen focus on innovative strategies, ecological benefits, and economic implications, Saini's work invites readers to envision a future where solar energy becomes the cornerstone of clean power, empowering communities and reshaping our planet's destiny. Dive into this compelling narrative and discover how solar energy can pave the way to a cleaner, brighter tomorrow.

More Free Book



Scan to Download

About the author

Gaurav Saini is an accomplished author and renewable energy expert, known for his deep commitment to sustainable practices and innovative solutions in the field of solar energy. With a solid educational background in environmental science and engineering, he has contributed significantly to various research and projects aimed at harnessing solar power efficiently. Saini's passion for clean energy is evident through his writings, where he demystifies complex solar technologies and promotes awareness about the benefits of renewable energy sources. Through his book, "Solar Energy," he aims to educate readers about the critical role of solar power in combating climate change and creating a sustainable future.

More Free Book



Scan to Download



Try Bookey App to read 1000+ summary of world best books

Unlock **1000+** Titles, **80+** Topics

New titles added every week

- Brand
- Leadership & Collaboration
- Time Management
- Relationship & Communication
- Business Strategy
- Creativity
- Public
- Money & Investing
- Know Yourself
- Positive Psychology
- Entrepreneurship
- World History
- Parent-Child Communication
- Self-care
- Mind & Spirituality

Insights of world best books



Free Trial with Bookey

Summary Content List

Chapter 1: Fabrication of Crystalline-Silicon Based Solar Cell

Chapter 2: Uncertainty-Based Battery Sizing in District Energy Community with Distributed Renewable Systems

Chapter 3: Design and Development of Solar-Powered Hybrid Energy Bank

Chapter 4: Maximum Power Point Tracking of PV System using ANN Algorithm

Chapter 5: BIM- and GIS-Based Residential Microgrid Modelling: Possibilities, Benefits, and Applications

Chapter 6: Comparative Study on the Thermo-Hydraulic Performance of Corrugated and Impinging Jet Solar Air Heater

Chapter 7: Leakage Current in Solar Photovoltaic Modules

Chapter 8: Reliability and Degradation Analysis of Crystalline Silicon Photovoltaic Module

Chapter 9: Synthesis and Characterization of Botanical Dye-Sensitized Solar Cell (DSSC) Based on TiO₂ Using Capsicum Annuum and Coriandrum Sativum Extracts

More Free Book



Scan to Download

Chapter 1 Summary: Fabrication of Crystalline-Silicon Based Solar Cell

In the first chapter of "Solar Energy" by Gaurav Saini, titled "Fabrication of Crystalline-Silicon Based Solar Cell," the authors Tamalika Panda and Santanu Maity delve deep into the processes involved in creating solar cells. They kick off with a clear motivation: as the global population increases, fossil fuels will eventually dwindle, necessitating a transition to renewable energy sources like solar energy, which converts sunlight into electricity. However, the high production costs of solar cells pose a significant challenge.

The chapter outlines various methods to mitigate these costs, including optimizing material consumption and refining fabrication techniques. They focus on the intricate steps of solar cell fabrication, starting from texturing and emitter diffusion to metallization and testing. The authors emphasize the essential role of the crystalline silicon (c-Si) wafer, detailing the creation and preparation of these wafers, such as from Czochralski (Cz) and float-zone (Fz) processes, explaining how refining silicon involves transforming it from less pure metallurgical forms to the higher purity needed for solar applications.

Throughout the narrative, there's an engaging description of technical processes like junction formation through diffusion, where dopants are

More Free Book



Scan to Download

introduced to create n-type and p-type layers. The importance of reducing electrical and optical losses through careful design choices, such as texturing the surface to minimize light reflection, is explored. The authors vividly explain how these steps not only enhance efficiency but also keep production costs in check.

Metallization, another crucial part of cell manufacturing, involves applying metallic contacts essential for electrical connections, and the authors go into details about the screen printing method utilized. They finish with a comprehensive testing phase to ensure the solar cells meet specific performance standards before leaving the production line.

In summary, Chapter 1 offers a meticulous look at the fabrications of crystalline-silicon solar cells, capturing both the complexity of the processes involved and the urgency of advancing sustainable energy technologies. It establishes a foundation for understanding how these renewable sources can effectively transition us away from fossil fuels, highlighting the delicate balance between cost, innovation, and efficiency in solar technology development.

More Free Book



Scan to Download

Chapter 2 Summary: Uncertainty-Based Battery Sizing in District Energy Community with Distributed Renewable Systems

In Chapter 2 of "Solar Energy" by Gaurav Saini, the discussion centers around the pressing need for renewable energy solutions as fossil fuel reserves dwindle and environmental concerns escalate. It highlights the challenge posed by intermittent renewable resources, such as solar and wind energy, which complicate energy consumption prediction and grid interaction. The chapter introduces a framework for a district energy community, a concept aimed at optimizing energy management through the integration of distributed renewable systems and robust storage solutions.

Key to this approach is the use of sophisticated computational techniques like the Metropolis' Hastings algorithm and a two-dimensional chain Monte Carlo (MCMC) method to quantify uncertainties in energy demand and generation scenarios. This means that rather than relying solely on traditional deterministic models, which could lead to inefficient energy management, a new uncertainty-based methodology is proposed. This method seeks to measure and adapt to unpredictable variables in energy consumption and renewable generation, ensuring better reliability and robustness of energy systems.

The chapter discusses various data-driven models trained with machine

More Free Book



Scan to Download

learning to predict energy demand across different building types—including offices, hotels, and residential spaces. It emphasizes that accurate predictions are critical for the successful integration of renewable energy in urban settings. Results indicate that, compared to deterministic predictions, those that account for uncertainty reveal a higher likelihood of energy demands surpassing renewable generation capabilities.

A significant portion of the discussion is dedicated to battery sizing, as effective storage solutions are crucial for maximizing renewable energy use. The chapter presents a risk-based approach for determining battery storage capacity that weighs various uncertainties identified through the analysis. It reveals that increased consideration of uncertainty can significantly raise the required battery capacity, illustrating the importance of preparing for variable energy demand scenarios.

The chapter concludes by noting that through a comprehensive understanding of uncertainties and the deployment of data-driven models, district energy communities can achieve better energy management, bolster renewable energy penetration, and ultimately lessen dependence on the grid. Overall, it portrays an optimistic vision for integrating renewable energy into urban environments, advancing sustainability, and enhancing energy resilience.

More Free Book



Scan to Download

Critical Thinking

Key Point: Adopting an uncertainty-based methodology in energy management

Critical Interpretation: Imagine embracing the uncertainty of your daily challenges just as the chapter illustrates the need for an uncertainty-based methodology in energy management. This perspective invites you to see unpredictability not as a hurdle, but as an opportunity for growth and adaptation. Just as energy systems can thrive by acknowledging the complexities of demand and generation fluctuations, you too can approach life with a flexible mindset, ready to learn and evolve with every twist and turn. Recognizing that uncertainty can lead to more robust solutions may inspire you to take risks, innovate in your career, and navigate personal relationships with resilience, empowering you to transform obstacles into stepping stones for success.

More Free Book



Scan to Download

Chapter 3: Design and Development of Solar-Powered Hybrid Energy Bank

Chapter 3 of "Solar Energy" by Gaurav Saini delves into the design and development of a solar-powered hybrid energy bank, a device aimed at enhancing the functionality of portable electronic gadgets, particularly mobile phones. As mobile phones rely significantly on battery power, the chapter emphasizes the need for power banks, especially in remote areas where electricity is scarce. The authors present an innovative approach that integrates solar panels with conventional charging mechanisms to create a sustainable power solution.

The chapter outlines the basic structure of the hybrid energy bank, which incorporates polycrystalline solar panels designed to convert sunlight into electrical energy. It features a lithium-ion battery, charge control module, and a DC/DC boost converter to manage the charging and discharging processes efficiently. The authors introduce a "charge control module" that prevents battery overcharge or complete discharge, ensuring the longevity of the device.

Install Bookey App to Unlock Full Text and Audio

Free Trial with Bookey



Why Bookey is must have App for Book Lovers



30min Content

The deeper and clearer interpretation we provide, the better grasp of each title you have.



Text and Audio format

Absorb knowledge even in fragmented time.



Quiz

Check whether you have mastered what you just learned.



And more

Multiple Voices & fonts, Mind Map, Quotes, IdeaClips...

Free Trial with Bookey



Chapter 4 Summary: Maximum Power Point Tracking of PV System using ANN Algorithm

In Chapter 4 of "Solar Energy," the discussion centers around maximizing the efficiency of photovoltaic (PV) systems in Malaysia through the implementation of a Maximum Power Point Tracking (MPPT) algorithm using Artificial Neural Network (ANN) technology. As electricity costs rise in Malaysia, driven by increased energy demand, many individuals are turning to solar energy as a sustainable, renewable solution. Given Malaysia's favorable sunny climate, utilizing solar energy could significantly alleviate rising electricity bills.

The chapter outlines the design and development of an ANN-based MPPT algorithm specifically tailored for solar PV systems. The authors aim to ensure that the PV system can convert the direct current (DC) generated by solar panels into a usable alternating current (AC) format, necessary for household appliances. This involves not only understanding ANN basics but also creating an effective model to facilitate this conversion.

The authors delve into various existing MPPT strategies, emphasizing those based on hill-climbing methods. They note the relevance of algorithms like Perturb and Observe and Incremental Conductance, highlighting their varying efficiencies and suitability under different conditions. A significant focus is placed on how these algorithms can track maximum power levels by

More Free Book



Scan to Download

adjusting system parameters dynamically in response to environmental changes.

The methodology section introduces the back-propagation technique used in ANN training, particularly the Levenberg-Marquardt algorithm, which enhances the ANN's capability to predict outcomes. By utilizing inputs such as irradiance and temperature, the network can adjust the duty cycle of a boost converter that amplifies energy output for household use.

In detailing design calculations, the chapter describes how the authors analyzed power consumption from common household appliances, calculated the necessary number of solar panels, and designed both a DC-DC boost converter and an inverter. These components are pivotal for transforming the collected solar energy into a usable form.

The results of their simulations demonstrate not only the efficacy of the ANN-based MPPT in tracking maximum power but also the inverter's successful conversion of DC to AC voltage suitable for home use. The chapter concludes by underscoring the advantages of using ANN for optimizing PV systems, showcasing its swift response and superior performance compared to traditional methods.

Overall, this chapter meshes advanced technology with practical approaches to renewable energy, reflecting a significant step towards improving solar

More Free Book



Scan to Download

energy accessibility and efficiency in Malaysia, inspiring readers with the potential of solar solutions in everyday life.

More Free Book



Scan to Download

Chapter 5 Summary: BIM- and GIS-Based Residential Microgrid Modelling: Possibilities, Benefits, and Applications

In Chapter 5 of "Solar Energy" by Gaurav Saini, we delve into the innovative integration of Building Information Modeling (BIM) and Geographical Information Systems (GIS) to enhance the planning of residential microgrids. The authors Jasim Farooq, Rupendra Kumar Pachauri, and Sreerama Kumar R. address the challenges posed by the increasing presence of solar energy in grid systems, particularly in remote areas, and propose a solution through BIM-GIS integration.

The chapter outlines how this integrated approach not only diminishes planning time and costs but also improves the automation and efficiency of the modeling process compared to traditional 2D-CAD methods. BIM offers detailed, building-level electrical data, while GIS excels in integrating this data for city-wide analysis. This partnership empowers comprehensive microgrid planning, allowing for meticulous electrical network modeling and spatial data analysis.

The authors discuss the benefits of BIM, such as its ability to conduct automated checks and energy analyses within its ecosystem, which streamlines pre-fabrication work. The chapter highlights how integrating BIM with GIS can facilitate better decision-making and optimization at both

More Free Book



Scan to Download

local and regional levels. The discussion also emphasizes the need for sophisticated algorithms and standardized modeling practices to fully harness this integrated approach.

Moreover, Farooq, Pachauri, and Kumar delve into practical applications, demonstrating how real-time data can enhance microgrid operations and disaster management efforts through improved planning capabilities. The authors stress the importance of effective data exchange between BIM and GIS systems, ensuring that critical information flows seamlessly for optimal outcomes in microgrid planning.

In concluding, this chapter positions BIM and GIS as transformative tools in the energy management landscape, poised to support sustainable practices and smarter built environments. It advocates for continued research and development of these technologies to refine their application in microgrid planning and management, highlighting their critical role in shaping the future of energy systems. The integration of these platforms not only advances efficiency but also paves the way for environmentally responsible approaches to urban planning.

More Free Book



Scan to Download

Chapter 6: Comparative Study on the Thermo-Hydraulic Performance of Corrugated and Impinging Jet Solar Air Heater

In Chapter 6 of "Solar Energy" by Gaurav Saini, the focus is on a comparative analysis of different types of solar air heaters (SAHs) which play a crucial role in addressing the increasing global energy demands. With the depletion of fossil fuels, renewable energy sources like solar energy are presented as viable alternatives. The chapter highlights the thermal performance of solar air heaters with different designs: a corrugated plate solar air heater (CSAH) and a jet impingement solar air heater (SAHJI), contrasting their efficiencies against a conventional smooth plate solar air heater (SSAH).

Siddhita Yadav and R. P. Saini utilized advanced computational fluid dynamics (CFD) simulations through the ANSYS FLUENT software to analyze and validate the thermal behaviors of these systems under controlled conditions. They created 3D models of CSAH and SAHJI, ensuring the duct sizes were similar for accurate comparisons. The study considered important

Install Bookey App to Unlock Full Text and Audio

Free Trial with Bookey



★ ★ ★ ★ ★
22k 5 star review

Positive feedback

Sara Scholz

...tes after each book summary
...erstanding but also make the
...and engaging. Bookey has
...ling for me.

Fantastic!!!



I'm amazed by the variety of books and languages Bookey supports. It's not just an app, it's a gateway to global knowledge. Plus, earning points for charity is a big plus!

Masood El Toure

Fi



Ab
bo
to
my

José Botín

...ding habit
...o's design
...ual growth

Love it!



Bookey offers me time to go through the important parts of a book. It also gives me enough idea whether or not I should purchase the whole book version or not! It is easy to use!

Wonnie Tappkx

Time saver!



Bookey is my go-to app for summaries are concise, ins curated. It's like having acc right at my fingertips!

Awesome app!



I love audiobooks but don't always have time to listen to the entire book! bookey allows me to get a summary of the highlights of the book I'm interested in!!! What a great concept !!!highly recommended!

Rahul Malviya

Beautiful App



This app is a lifesaver for book lovers with busy schedules. The summaries are spot on, and the mind maps help reinforce wh I've learned. Highly recommend!

Alex Walk

Free Trial with Bookey

Chapter 7 Summary: Leakage Current in Solar Photovoltaic Modules

In Chapter 7 of "Solar Energy" by Gaurav Saini, we dive into the complex world of leakage current in solar photovoltaic (PV) modules, which is an important aspect affecting their performance. The chapter begins with a clear introduction to PV cells, which are semiconductor devices designed to convert sunlight into electricity. These cells contain layers of silicon doped with different elements, creating an electric field that helps separate and collect charge carriers—electrons and holes—when sunlight strikes them.

As PV cells are grounded for safety and connected in series and parallel within a solar system, they experience significant voltage stress. This can lead to the generation of a current called leakage current, which can degrade the solar cell's performance over time, particularly through a phenomenon known as potential-induced degradation (PID). The chapter highlights that leakage current depends heavily on environmental factors like temperature and humidity, as well as the materials used in the PV modules.

The authors detail the mechanisms behind leakage current, explaining how it can flow through various paths in a PV module, such as through the encapsulant, glass, and other interfaces. Identification of these pathways is crucial, as it helps determine which components of the module are most vulnerable to degradation. Different models are referenced, emphasizing that

More Free Book



Scan to Download

understanding these paths aids in quantifying the physical and chemical changes occurring within the module under high-stress conditions.

Furthermore, the chapter discusses factors influencing leakage current, categorized into module factors—like the composition of glass and encapsulant materials—and environmental factors such as humidity and temperature. It emphasizes the role of sodium ions from materials that could drift towards the cell under high voltage, contributing to PID.

The authors also present analyses of leakage current behavior in different environmental conditions, noting how increased humidity enhances conductivity and facilitates leakage. Notably, the chapter delivers insights into how high temperatures can also affect leakage current, as temperatures affect the resistivity of the module components.

In conclusion, the chapter emphasizes the importance of recognizing the interplay between environmental conditions and material choices in PV modules, paving the way for more effective designs that are resilient against degradation and contribute to the longevity and efficiency of solar energy systems. The detailed examination of leakage current is framed as a pivotal aspect of ensuring solar technology remains a sustainable and effective source of renewable energy.

More Free Book



Scan to Download

Chapter 8 Summary: Reliability and Degradation Analysis of Crystalline Silicon Photovoltaic Module

Chapter 8 delves into the intricacies of reliability and degradation analysis of crystalline silicon photovoltaic (PV) modules. The authors, Roopmati Meena, Manish Kumar, and Rajesh Gupta from the Indian Institute of Technology Bombay, highlight the critical importance of long-term reliability in solar PV technology, especially as solar energy emerges as a pivotal solution for combating carbon emissions and power shortages.

The chapter begins by emphasizing that the reliability of PV modules is significantly influenced by various environmental factors such as temperature extremes, humidity, ultraviolet (UV) radiation, high winds, and hailstorms. These conditions, often acting concurrently, lead to different types of defects and degradation (D&D) that can evolve from minor issues during manufacturing to critical failures during operation.

At the heart of the discussion is the understanding that defects can arise at multiple stages: manufacturing, transportation, installation, and through ongoing exposure to the environment. For instance, during manufacturing, impurities in materials and mishandling can result in issues like shunting, where alternate current paths form, leading to power loss. The authors emphasize that many D&D are either initially unnoticed or set in motion during these early stages, which may propagate into more serious problems

More Free Book



Scan to Download

later.

The chapter outlines three main points affecting reliability: manufacturing flaws, transportation and installation mishaps, and external environmental factors. It describes how high temperatures can double the degradation rate of PV modules, while humidity can lead to corrosion of metallic contacts. Mechanical stresses from transportation and improper installation can induce micro-cracking in solar cells, which worsen with time.

Various types of degradation are meticulously categorized, with a focus on encapsulant degradation - particularly of the commonly used material ethylene vinyl acetate (EVA). EVA's vulnerability to high temperatures and UV exposure can lead to discoloration and delamination, while the entire metallization structure (e.g., silver gridlines and interconnect ribbons) is susceptible to corrosion due to moisture and air exposure.

The discussion also touches on more complex degradation phenomena, such as potential-induced degradation (PID), which has been a recent concern in large-scale installations. PID reflects systemic weaknesses in module architecture, resulting in shunts and corrosion from intrinsic materials like sodium ions migrating through the module structure.

In conclusion, the chapter stresses the need for a thorough understanding of the defects and degradation mechanisms for enhancing the reliability and

More Free Book



Scan to Download

efficiency of PV modules. The constant interplay of manufacturing quality, environmental stressors, and operational conditions demands innovative approaches to mitigate degradation, extending the lifespan of solar photovoltaic technologies, which are vital for a sustainable energy future. The authors advocate for continued research and development to not only address current challenges but also to lay the groundwork for cutting-edge PV technologies.

Aspect	Details
Chapter Overview	Focuses on reliability and degradation analysis of crystalline silicon PV modules.
Authors	Roopmati Meena, Manish Kumar, Rajesh Gupta (Indian Institute of Technology Bombay).
Importance	Long-term reliability is crucial as solar energy combats carbon emissions and power shortages.
Factors Influencing Reliability	Environmental factors: temperature extremes, humidity, UV radiation, high winds, hailstorms.
Defect Causes	Manufacturing, transportation, installation, ongoing environmental exposure.
Impact of Environmental Stressors	High temperatures double degradation, humidity leads to corrosion, mechanical stresses cause micro-cracking.
Types of Degradation	Encapsulant degradation (EVA vulnerability), corrosion of metallization structure, potential-induced degradation (PID).
Focus on EVA	EVA can discolor and delaminate under stress from heat and UV exposure.



Aspect	Details
Conclusion	Understanding D&D mechanisms is vital for improving PV module reliability; ongoing R&D essential for advancement.

More Free Book



Scan to Download

Critical Thinking

Key Point: Understanding the Factors Affecting Reliability of PV Modules

Critical Interpretation: Imagine embarking on your own journey where the reliability of your actions and decisions can significantly impact your path. Just like crystalline silicon photovoltaic modules face degradation through environmental challenges and manufacturing flaws, you too encounter obstacles that may arise unexpectedly. Learning from this chapter compels you to embrace the critical importance of assessing risks in your own life. By being proactive about understanding and addressing potential pitfalls—whether in personal projects or relationships—you cultivate resilience and adaptability. The wisdom of preventive measures allows you to navigate life's uncertainties effectively, ensuring that you can thrive despite the challenges encountered along the way.

More Free Book



Scan to Download

Chapter 9: Synthesis and Characterization of Botanical Dye-Sensitized Solar Cell (DSSC) Based on TiO₂ Using Capsicum Annuum and Coriandrum Sativum Extracts

In Chapter 9 of "Solar Energy," the authors Amit Shrivastava, Rupali Shrivastava, and Manoj Gupta present a fascinating exploration into the world of dye-sensitized solar cells (DSSCs) using natural pigments derived from plants. They focus on extracting dyes rich in beta-carotene from two common plants: Capsicum Annuum (bell pepper) and Coriandrum Sativum (cilantro), to create an eco-friendly solar energy solution.

The chapter begins by highlighting the urgent global need for sustainable energy solutions, particularly as demand for electricity surges alongside urbanization and pollution. Through an engaging narrative, the authors explain how DSSCs harness solar energy more effectively than traditional solar cells due to their simpler fabrication processes and cost-effectiveness. The authors reminisce about the inception of DSSCs in 1991 by scientist Michael Grätzel and the subsequent research that has flourished.

Install Bookey App to Unlock Full Text and Audio

Free Trial with Bookey



Read, Share, Empower

Finish Your Reading Challenge, Donate Books to African Children.

The Concept



This book donation activity is rolling out together with Books For Africa. We release this project because we share the same belief as BFA: For many children in Africa, the gift of books truly is a gift of hope.

The Rule



Earn 100 points



Redeem a book



Donate to Africa

Your learning not only brings knowledge but also allows you to earn points for charitable causes! For every 100 points you earn, a book will be donated to Africa.

Free Trial with Bookey