

1. Record Nr.	UNINA9911018907203321
Autore	Kumar Upendra
Titolo	Carbon-Based Nanomaterials for Green Applications
Pubbl/distr/stampa	Newark : , : John Wiley & Sons, Incorporated, , 2025 ©2025
ISBN	9781394243426 1394243421 9781394243402 1394243405 9781394243419 1394243413
Edizione	[1st ed.]
Descrizione fisica	1 online resource (642 pages)
Altri autori (Persone)	SonkarPiyush Kumar TripathiSuman Lata
Disciplina	620.193
Soggetti	Carbon compounds Nanostructured materials
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di contenuto	Cover -- Series Page -- Title Page -- Copyright Page -- Dedication -- Contents -- About the Editors -- List of Contributors -- Preface -- Acknowledgments -- Chapter 1 Green Energy: An Introduction, Present, and Future Prospective -- 1.1 Introduction -- 1.2 Present Status of Green Energy -- 1.3 Global Renewable Energy Capacity -- 1.4 Leading Green Energy Technologies -- 1.5 Challenges in Green Energy Adoption -- 1.6 Prospects of Green Energy -- 1.7 Sustainable Practices in Green Energy -- 1.8 Case Studies of Successful Green Energy Projects -- 1.9 Policy and Regulatory Framework for Green Energy -- 1.10 Opportunities and Challenges in the Evolution to a Green Energy Future -- 1.10.1 Opportunities -- 1.10.2 Challenges -- 1.11 Conclusion -- References -- Chapter 2 Properties of Carbon-Based Nanomaterials and Techniques for Characterization -- 2.1 Introduction -- 2.1.1 Carbon Nanotubes -- 2.1.2 Graphene -- 2.1.3 Graphene Oxide -- 2.1.4 Fullerenes -- 2.2 Significance in Green Energy -- 2.2.1

Energy Storage -- 2.2.2 Solar Energy -- 2.2.3 Catalysis and Fuel Cells -- 2.2.4 Thermal Management -- 2.2.5 Environmental Remediation --
 2.3 Techniques for Characterization of Properties of Carbon Nanomaterials -- 2.3.1 Electrical Conductivity -- 2.3.2 Thermal Conductivity -- 2.3.3 Mechanical Strength -- 2.3.4 Surface Area Characterization -- 2.3.5 Scanning Electron Microscopy -- 2.3.6 Energy Dispersive X-ray Spectroscopy -- 2.3.7 Transmission Electron Microscopy -- 2.3.8 Electron Energy Loss Spectroscopy -- 2.3.9 Atomic Force Microscopy -- 2.3.10 Raman Spectroscopy -- 2.3.11 Photoluminescence -- 2.3.12 Time-Resolved Photoluminescence -- 2.3.13 Thermal Gravimetric Analysis and Differential Scanning Calorimetry -- 2.3.14 Fourier Transform Infrared Spectroscopy -- 2.3.15 UV-Vis-NIR Spectroscopy -- 2.3.16 X-ray Photoelectron Spectroscopy -- 2.3.17 Small Angle X-ray Scattering -- 2.3.18 X-ray Diffraction Analysis -- 2.3.19 Scanning Electrochemical Microscopy -- 2.3.20 Electrochemical Impedance Spectroscopy -- 2.4 Conclusion -- References -- Chapter 3 Green Energy: Present and Future Prospectives -- 3.1 Introduction -- 3.1.1 Systematic Review Survey Reports -- 3.2 Sustainable Energy Resources -- 3.2.1 Wind Energy -- 3.2.1.1 Applications of Wind Turbine Systems -- 3.2.1.2 Advantages of Wind Energy -- 3.2.1.3 Disadvantages of Wind Energy -- 3.2.1.4 Future Prospectives and Challenges -- 3.2.2 Solar Energy -- 3.2.2.1 Applications of Solar Energy -- 3.2.2.2 Advantages of Solar Energy -- 3.2.2.3 Disadvantages of Solar Energy -- 3.2.2.4 Future Prospectives and Challenges -- 3.2.3 Biomass -- 3.2.3.1 Applications of Biomass -- 3.2.3.2 Benefits and Disadvantages of Biomass -- 3.2.3.3 Future Prospectives and Challenges -- 3.2.4 Geothermal Energy -- 3.2.4.1 Applications and Future Prospectives -- 3.2.5 Hydropower -- 3.2.6 Tidal and Wave Energy -- 3.2.6.1 Tidal Power -- 3.2.6.2 Wave Power -- 3.2.6.3 Benefits of Tidal and Wave Energy Systems -- 3.2.6.4 Challenges of Tidal and Wave Energy Systems -- 3.3 Non-Sustainable Energy Resources -- 3.3.1 Fossil Fuels -- 3.3.2 Atomic Energy -- 3.4 Existing Green Energy Models -- 3.5 Conclusions -- References -- Chapter 4 Carbon-Based 2D Materials: Synthesis, Characterization, and Their Green Energy Applications -- 4.1 Introduction -- 4.2 Synthesis of Graphene and Its Derivatives -- 4.2.1 Graphene-Based 2D Materials -- 4.2.2 Graphene -- 4.2.3 Graphene Oxide -- 4.2.4 Reduced Graphene Oxide -- 4.2.5 Graphitic Carbon Nitride -- 4.2.5.1 g-CN-ThinFilm -- 4.2.5.2 Graphitic Carbon Nitride (g-CN)-PowderForm -- 4.2.5.3 Thin Film of g-CN -- 4.3 Properties of g-CN -- 4.3.1 Morphological Properties -- 4.3.2 Band Gap -- 4.3.3 Other Properties -- 4.4 Applications of g-CN -- 4.4.1 g-CN Role in Organic Solar Cells -- 4.4.2 g-CN Role in Perovskite Solar Cells -- 4.4.3 g-CN Role in Dye-Sensitized Solar Cells -- 4.4.4 g-CN Role as a Photocatalyst -- 4.4.5 g-CN-Sensing Applications -- 4.4.6 g-CN Environmental Applications -- 4.5 Conclusion -- References -- Chapter 5 Exploring the Potential of Graphene in Sustainable Energy Solutions -- 5.1 Introduction -- 5.2 Usage of Graphene in Various Sectors -- 5.3 Implicit Operations of Graphene in the Renewable Energy Sector -- 5.3.1 Battery Technology -- 5.3.2 Touchscreen -- 5.3.3 Integrated Circuits -- 5.3.4 Flexible Memory -- 5.3.5 Solar Power Generation -- 5.3.6 Photovoltaic Cells -- 5.3.7 Solar Cells -- 5.3.8 Lithium-Ion Batteries -- 5.3.9 Supercapacitors -- 5.3.10 Graphene Transistors -- 5.3.11 Graphene Semiconductors -- 5.3.12 Graphene Sensors -- 5.4 Catalysis -- 5.5 Renewable Energies -- 5.6 Nanotechnology -- 5.7 Conclusion -- Chapter 6 Fullerene for Green Hydrogen Energy Application -- 6.1 Introduction -- 6.2 Green

Hydrogen Energy -- 6.3 Fullerene as a Hydrogen Storage Material --
 6.4 Size Effect of Fullerene and Hydrogen Storage Efficiency -- 6.5
 Functionalized Fullerene, Chemical Structure, and Its Hydrogen Storage
 Performance -- 6.5.1 Boron -- 6.5.2 Phosphorene or Black Phosphorus
 -- 6.5.3 Hexagonal Boron Nitride -- 6.5.4 Silicene -- 6.5.5 Carbon
 Nanotubes -- 6.5.6 Graphene -- 6.5.7 Ferrocene -- 6.5.8 MoS₂ --
 6.5.9 Organometallic Framework -- 6.6 Charged Fullerene as Hydrogen
 Storage System -- 6.7 Hydrogen Storage in Hydro- or
 Hydrogenated Fullerene -- 6.8 Conclusions and Future Outlook --
 Acknowledgments -- References -- Chapter 7 Graphyne-Based Carbon
 Nanomaterials for Green Energy Applications -- 7.1 Introduction --
 7.1.1 Structural Aspects of Graphyne -- 7.2 Graphyne-Based Carbon
 Nanomaterials for Green Energy Applications.
 7.2.1 Mechanisms Involved in Growth, Doping, Energy Storage,
 and Conversion Involving Graphyne -- 7.3 Fuel Cells -- 7.3.1 Oxygen
 Reduction Reaction (ORR) Catalyst for Hydrogen Fuel Cells or Metal-Air
 Batteries (MABs) -- 7.3.2 Lithium-Ion and Lithium-Metal Batteries --
 7.3.3 Supercapacitors -- 7.3.4 Wind Energy -- 7.4 Solar Energy -- 7.5
 Wastewater Treatment -- 7.6 Perspectives and Conclusion --
 Acknowledgments -- References -- Chapter 8 Mesoporous Carbon for
 Green Energy Applications -- 8.1 Introduction -- 8.2 Recent Advances
 in Synthetic Techniques -- 8.2.1 Hard Template Technique -- 8.2.1.1
 Carbon Precursors -- 8.2.2 Soft Template Technique -- 8.3
 Applications of Mesoporous Carbon -- 8.3.1 Applications in Lithium
 Batteries -- 8.3.2 Applications in Supercapacitors -- 8.3.3 Applications
 in Fuel Cells -- 8.4 Further Directions, Opportunities, and Challenges
 -- 8.5 Conclusions -- References -- Chapter 9 Green Synthesis of
 Carbon Dots and Its Application in Hydrogen Generation Through Water
 Splitting -- 9.1 Introduction -- 9.2 Carbon Dots -- 9.3 Processes Used
 for Synthesis of CDs -- 9.3.1 Bottom-Up Synthesis Processes --
 9.3.1.1 Solvothermal/Hydrothermal Method -- 9.3.1.2 Sol-Gel Method
 -- 9.3.1.3 Microwave Irradiation -- 9.3.1.4 Carbonization Route --
 9.3.2 Top-Down Synthesis Processes -- 9.3.2.1 Laser Ablation --
 9.3.2.2 Arc Discharge -- 9.3.2.3 Chemical and Electrochemical
 Oxidation Methods -- 9.3.2.4 Ultrasonic Treatment -- 9.4 Green
 Synthesis of Carbon Dots -- 9.4.1 Biomass-Based Green Synthesis
 of CDs -- 9.4.1.1 Plant Waste-Based Green Synthesis of Carbon Dots --
 9.4.1.2 Animal Waste-Based Green Synthesis of CDs -- 9.5 Application
 of CDs in Water Splitting -- 9.5.1 Hydrogen Generation via Water
 Splitting (Photoreduction) -- 9.5.2 Photocatalytic Degradation
 of Organic Pollutants.
 9.6 Factors Affecting Characteristics of Nanomaterials of Carbon in
 Photocatalytic H₂ Production -- 9.6.1 Doping -- 9.6.2 Defects -- 9.6.3
 Dimensions -- 9.7 Conclusion -- References -- Chapter 10 Carbon-
 Based Nanomaterials in Energy Storage Devices: Solar Cells -- 10.1
 Introduction -- 10.2 Carbon Nanotubes -- 10.2.1 Synthesis
 Techniques Concerning Carbon Nanotubes -- 10.2.2 Carbon Nanotube
 Applications in Solar Cell Technology -- 10.2.2.1 Transparent
 Conductive Electrodes -- 10.2.2.2 Charge Transport Materials --
 10.2.2.3 Enhanced Electron Transport -- 10.2.2.4 Improved Charge
 Collection -- 10.2.2.5 Transparency and Flexibility -- 10.2.2.6
 Lightweight and Flexible Design -- 10.2.2.7 Tunable Aspects of Optics
 -- 10.2.2.8 Durability and Longevity -- 10.2.2.9 Compatibility with
 Other Materials -- 10.2.2.10 Scalability -- 10.2.3 Recent
 Advancements and Challenges -- 10.2.3.1 Recent Advancements --
 10.2.3.2 Challenges -- 10.3 Graphene -- 10.3.1 Synthesis Techniques
 -- 10.3.2 Utilizing Graphene in Solar Cell Applications -- 10.3.2.1
 Transparent Conductive Electrodes -- 10.3.2.2 Charge Transport

Layers -- 10.3.2.3 Light-Harvesting Enhancements -- 10.3.3 Recent Advancements and Challenges -- 10.3.3.1 Recent Advancements -- 10.3.3.2 Challenges -- 10.4 Carbon Dots -- 10.4.1 Synthesis Techniques -- 10.4.2 Applications of Solar Cell Carbon Dots -- 10.4.2.1 Light Harvesting and Sensitization -- 10.4.2.2 Charge Separation and Transport of Electrons -- 10.4.2.3 Energy Storage and Electrochemical Applications -- 10.4.3 Recent Advancements and Challenges -- 10.4.3.1 Recent Advancements -- 10.4.3.2 Challenges -- 10.5 The Future of Carbon-Based Nanomaterials in Solar Cell Technology -- 10.5.1 Enhanced Light Harvesting and Absorption -- 10.5.2 Improved Charge Transport and Collection -- 10.5.3 Enhanced Stability and Durability. 10.5.4 Scalable Synthesis and Manufacturing.

Sommario/riassunto

Gain valuable insight into applying carbon-based nanomaterials to the green technologies of the future The green revolution is the most important technological development of the new century. Carbon-based nanomaterials, with their organic origins and immense range of applications, are increasingly central to this revolution as it unfolds. There is an urgent need for an up-to-date overview of the latest research in this ever-expanding field. Carbon-Based Nanomaterials for Green Applications meets this need by providing a brief outline of the synthesis and characterization of different carbon-based nanomaterials, including their historical backgrounds. It proceeds to move through each major category, outlining properties and applications for each. The result is an essential contribution to a huge range of sustainable and renewable industries. With contributions from a global list of distinguished writers, the book includes:

- * Discussion of nanomaterial applications in fields from drug delivery to biomedical technology to optics
- * Analysis of nanomaterial categories including graphene, fullerene, mesoporous carbon, and many more
- * Separate chapters describing aspects of supercapacitors, solar cells, and fuel cells

Carbon-Based Nanomaterials for Green Applications is ideal for scientists and researchers working in nanotechnology, life sciences, biomedical research, bioengineering, and a range of related fields.
