METAL CHALCOGENIDE NANOSTRUCTURES FOR RENEWABLE ENERGY APPLICATIONS

Edited by
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Preface

Meeting impending energy requirements by an ecologically benign approach entails scientific innovations to proficiently produce, store, transfer, and utilize enormous amounts of energy. The critical requirement to attain this goal demands to develop cost-effective materials by imparting novel intriguing features to convert maximum energy from sun and other renewable means.

Metal chalcogenide semiconductor nanostructures present the most important class of nanomaterial that provides highly anisotropic diverse morphologies, described by the efficient transport of electrons and excitons, and has been regarded as the most promising building block for nanoscale renewable energy nanodevices and nanosystems. The growth, characterization, and applications of nanostructures entreat various disciplines of science and engineering. The objective of this book is to illuminate the essentials, underlying science related to semiconductor metal chalcogenide nanostructures fabrication for potential renewable energy applications. The effect is an illustrative snapshot of the latest developments from diverse perspectives in a series of chapters based on synthesis, properties, characterization, and applications of metal sulfide, selenide, and telluride nanostructures from distinguished betrothed researchers.

This book contents are divided into three main sections.

Chapters 1–3 present an overview of increasing greenhouse emissions, recent research and substantial progress reported in the literature, covering formation of 0, 1, 2, and 3 dimensional metal sulfide, selenide, and telluride nanostructures. The application of chalcogenide materials for renewable energy conversion, which includes photovoltaics, hydrogen production, thermoelectrics, fuel cell, supercapacitors, and lithium-ion batteries and their future projections are covered in Chapter 1. The potential impact of materials for alternative energy conversion systems and various important renewable energy alternatives is anticipated in Chapters 2 and 3.

Chapters 4–7 are devoted to comprehensive synthesis of metal chalcogenide (sulfide, selenide, and telluride) nanostructures including inorganic graphenes (layered structures) by various important methods, their characterization and growth mechanism for the formation of enthralling morphologies, and various important protocols for surface functionalization of chalcogenides to improve the processability in technological applications are included in Chapters 4 and 5. The potential to engineer semiconductor nanostructures properties during and after fabrication presents an exciting realms and extensive prospect to simply improve the performance of renewable energy conversion systems. Chapters 6 and 7 provide detailed account of structural and optical properties of semiconductor chalcogenides.

Chapters 8–13 are typically covering applications of metal chalcogenides nanostructures in diverse renewable energy conversion devices. Chapter 8 presents updated works metal sulfide nanostructures for solar-driven hydrogen production through water splitting. Chapter 9 gives brief account on *hierarchical* chalcogenide nanostructures, their properties and applications in energy conversion devices. Chapters 10 and 11 are based on metal chalcogenides in photovoltaic applications. Chapter 12 focuses on theoretical work including indirect band gap calculations results and density functional theory. Chapter 13 focuses on metal telluride nanostructures for thermoelectric devices operating around room temperature.

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Dhahran, Saudi Arabia
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Part 1
RENEWABLE ENERGY CONVERSION SYSTEMS