Nanotechnology in Mechanical Engineering

This book discusses new trends in nanotechnology. It covers a wide range of topics starting from applications of nanomaterials in perovskite solar cells, pharmacy, and drug delivery to self-assembled growth of GaN nanostructures on flexible metal foils by laser molecular beam epitaxy. It also includes other interesting topics such as advancement in carbon nanotubes, processing techniques, purification, and industrial applications. It also covers metal-dielectrics for water treatment and recent advancements in nanotechnology-based electrochemical sensors for pathogen detection and many more. The book will be of great interest to researchers, professionals, and students working in the areas of nanomaterials and nanotechnology.

This book presents the selected proceedings of the 1st International Conference on Future Trends in Materials and Mechanical Engineering (IFCTMME-2020), organized by Mechanical Engineering Department, SRM Institute of Science and Technology (Formerly known as SRM University), Delhi-NCR Campus, Ghaziabad, Uttar Pradesh, India. The book provides a deep insight into the advancements in materials and mechanical engineering. A broad range of topics and issues in material development and modern mechanical engineering are covered, including polymers, nanomaterials, magnetic materials, fiber composites, stress analysis, design of mechanical components, theoretical and applied mechanics, tribology, solar, additive manufacturing, and many more. This book will prove its worth to a broad readership of engineering students, researchers, and professionals.

This book covers modern subjects of mechanical engineering such as nanomechanics and nanotechnology, mechatronics and robotics, computational mechanics, biomechanics, alternative energies, sustainability, and many more. It is also a useful reference for academics, mechanical engineering researchers, mechanical, materials, and manufacturing engineers, professionals in industrial engineering.

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This book presents a detailed overview of the rationale involved in the choice of materials for regeneration of different tissues and the future directions in this fascinating area of materials science with specific chapters on regulatory challenges & ethics, tissue engineered medical products.
Moreover, this unique resource presents the latest research on nanoscale transport phenomena and concludes with a look at likely future trends.

“Microsystems and Nanotechnology” presents the latest science and engineering research and achievements in the fields of Microsystems and nanotechnology, bringing together contributions by authoritative experts from the United States, Germany, Great Britain, Japan, and China to discuss the latest advances in microelectromechanical systems (MEMS) technology and micro/nanotechnology. The book is divided into five parts— the fundamentals of microsystems and nanotechnology, Microsystems technology, nanotechnology, application issues, and the developments and prospects—and is a valuable reference for students, teachers and engineers working with the involved technologies. Professor Zhaoyang Zhou is professor at the Department of Precision Instruments & Mechatronics, Tsinghua University, and the Chairman of the MEMS & NEMS Society of China. Dr. Tomasz Wygant is the Director of the Center for Nanostructure Characterization, Georgia Tech, USA. Dr. Ling Lin is a Professor at the Department of Mechanical Engineering, University of California at Berkeley, USA.

Conductive inks is a special type of ink that allows an electric current to flow through the ink. The conductive-ink-filled epoxy is also known as conductive composite because itself is based on more than two conductive materials. As interconnected conductive materials such as carbon black and hard carbon. As interconnected conductive inks, these perform good electrical, mechanical and thermal properties. Nonetheless, to-date, there are some issues with current conductive inks that available in the market namely printing quality, high electrical resistivity as well as inferior mechanical strength. Therefore, this book aims to produce highly functional conductive inks using two types of carbon-based conductive fillers with epoxy as a binder. More specifically, graphene nanoplatelets (GNP) and multiwalled carbon nanotube (MWCNT) were used to produce the hybrid conductive ink. It is very important to make sure the material has a contact with each other and therefore the movement of an electron will become easier.

Ongoing research in nanotechnology promises both innovations and risks, potentially and profoundly changing the world. This book helps to promote a balanced understanding of this important emerging technology, offering an informed and impartial look at the technology, its science, and its social impact. Nanotechnology is crucial for the next generation of industries, financial markets, research labs, and our everyday lives: this book provides an informed and balanced look at nanotechnology and its social impact. Offers a comprehensive background discussion on nanotechnology itself, including its history, its science, and its future, creating a clear understanding of the technology that evaluated used and social issues. Authored by a nanoscientist and philosophers, offer an accurate and accessible look at the science while providing an ideal text for ethics and philosophy courses. Explore the most immediate and urgent areas of social impact of nanotechnology.

The usage of nanoscience and nanotechnology in engineering directly links academic research in nanoscience and nanotechnology to industries and daily life. As a result, numerous nanomaterials, nanodevices and nanosystems for various engineering purposes have been developed and used for human betterment. This book, which consists of eight self-contained chapters, provides the essential theoretical knowledge and important experimental techniques required for the research and development on nanoscience and nanotechnology in engineering, and deals with the five key topics in this area— Nanoscience and Nanotechnology in Engineering is based on the many lectures and courses presented around the world by its authors.

This title includes a number of Open Access chapters. Considered the next industrial revolution, nanotechnology is an exciting field with new advances being reported regularly. It is a very diverse and highly interdisciplinary field, involving the science and engineering fields. Nanotechnology deals with the smallest building blocks of matter and applies concepts and theories from atomic and molecular level imaging, manipulating, and controlling of materials, which lead to the creation of new materials, new manufacturing processes, and new applications. This book covers many emerging and important issues in nanotechnology, and it adapts to cancer research and treatment, material properties analysis, new materials, and much more.

Nanomaterials have been rapidly growing in recent years and their research has been directed to the utilization of renewable energy sources for a cleaner and healthier environment. For over two decades, researchers have investigated many possibilities in terms of renewable energies to generate sustainable energy. Solar cells, fuel cells, photovoltaics, supercapacitors, batteries, and wind turbines have the potential to be efficient methods to directly convert one type of energy into another. In these new energy systems, various types of nanotechnology and their products have been used to increase the efficiencies of these energy systems.

However, these new developments also bring many uncertainties and risks to human health and the environment. Therefore, the future of nanotechnology depends mainly on public acceptance of the risks associated with the use of nanomaterials and their benefits. Risk assessment of nanomaterials is mainly the basis of formulating guidelines of protecting human health and the environment. This chapter provides information on the current state of nanomaterials used by the energy industry and offers suggestions for continuing our path toward sustainable development in the energy field.

Synthetic Engineering Materials and Nanotechnology covers the latest research and developments of synthetic processes, materials, applications and technologies. In addition, innovations in synthetic engineering materials and techniques are analyzed. Each chapter addresses key concepts, properties and applications of important categories of synthetic materials, including metals, new materials, and advanced materials. Advances in nanomaterials produced by synthetic engineering methods are also considered, including ceramic, carbon, metal oxides, composites, and membrane-derived nanomaterials. The primary synthetic engineering materials and techniques covered include thermomechanical, chemical, physical, chemical, electrochemical, bottom-up, hybrid and biological methods. This book is suitable for early career researchers in academia and R&D in various sectors, and for those who are engaged in nanoscience and engineering, mechanical engineering and chemical engineering. Provides the fundamental material production and synthetic methods, including their properties, experimental and characterization techniques, and applications. Reviews the advances of synthetic engineering methods for nanomaterials applications, including electropinning, atomic layer deposition, ion implantation, bottom-up, hybrid strategies, and more.

A fundamental part of modern technology is composed of devices that use special materials as main components. Since the last few decades of the last century and even more recently, a remarkable development has been achieved in new micro- and nanostructured materials with compositional structures and production methods that open unprecedented technological, economic, and ecological perspectives due to high yields, economies of scale, the possibility of reducing weight and size, and the low environmental impact of the equipment that contains them. This book offers a collection of excellent studies that use state-of-the-art methodologies developed by professional researchers from different countries in diverse areas of materials. In this way, this book is particularly useful to academics, scientists, practicing researchers, and postgraduate students whose work relates to the latest nanomaterial technologies.

This book highlights the mechanical properties of nanomaterials produced by several techniques for various applications. The areas obtained in some materials are discussed on the chapter about deformation processes. Partial dislocations and grain boundary sliding deformation phenomena in nanomaterial specimens are also deeply discussed. Tests for tension, compression, and hardness are described. The behavior of nanomaterials is compared to macroscopic specimens, and the results obtained for different fabrication methods are also compared. The special characteristics of nanomaterials are summarized at the end of the book.

Engineered nanoparticle and nanocomposites, with their extraordinary mechanical and electronic properties, have garnered much attention in recent years. With a broad range of practical applications, including nanoelectronics, composites, chemical sensors, biosensors, microscopy, nanomechanical systems, and many more, the scientific community is more motivated than ever to move beyond basic properties and explore the unique issues associated with carbon nanotube-based applications. Engineered nanoparticles and nanocomposites are exceptionally interesting from a fundamental research point of view. They open up new perspectives for various applications, such as nanotransistor circuits, field-emission displays, artificial muscles, or added reinforcements in alloys. This informative book is an introduction to the physical concepts needed for investigating carbon nanotubes and other one-dimensional solid-state systems. Written for a wide audience of readers, each chapter consists of an instructive approach to the topic and sustainable ideas for solutions. This new book presents leading-edge research in this dynamic field. It reviews the recent progress in applications of engineered nanoparticle and nanocomposites and their composites. The advantages and disadvantages of different methods are discussed. The ability of continuum methods to bridge different scales is emphasized. Recommendations for future research are given by focusing on what each method has to learn from the nano-scale. This book has been written to provide current knowledge to support researchers entering this scientific area of carbon nanotubes and help them choose the appropriate modeling tool for accomplishing their study and where to place their efforts to further improve continuum methods.
This book gathers the latest advances, innovations, and applications in the field of mechanical engineering, as presented by leading international researchers and engineers at the 2020 International Conference on Mechanical Engineering and Materials (ICMEM), held in Beijing, China on October 16-17, 2020. ICMEM covers all aspects of mechanical engineering and materials sciences, such as computer-aided design, virtual design and design visualization, intelligent design, usability design, automobile structure, human-machine interface design, manufacturing engineering, aerospace engineering, automation and robotics, micro-machining, MEMS?NEMS, composite materials, biomaterials, smart materials, superconducting materials, materials properties and applications, materials manufacturing, nanotechnology, nano-materials and nano-composites, etc. The contributions, which were selected by means of rigorous international peer-review process, highlight numerous exciting ideas that will spur novel research directions and foster multidisciplinary collaborations.

This book is a detailed introduction to mechanical alloying, offering guidelines on the necessary equipment and facilities needed to carry out the process and giving a fundamental background to the reaction taking place. El-Eskandarany, a leading authority on mechanical alloying, discusses the mechanism of powder consolidations using different powder compaction processes. A new chapter will also be included on thermal, mechanically-induced and electrical discharge-assisted mechanical milling. Fully updated to the most recent developments and technologies, this second edition is the reference source for mechanical alloying, covering the fabrication of carbon nanotubes, surface protective coating and hydrogen storage technology. El-Eskandarany discusses the latest research into these applications, and provides engineers and scientists with the information they need to implement these developments. The industrial applications of nanocrystalline and metallic glassy powders are presented. The book also contains over 200 tables and graphs to illustrate the milling processes and present the properties and characteristics of the resulting materials. Guides readers through each step of the mechanical alloying process, covering best practices and offering guidelines on the required equipment. Tables and graphs are used to explain the stage of the milling processes and provide a comprehensive update on the previous edition, including new chapters to cover new applications.

How can nanotechnology not be the interest of any designer, engineer or architect? Exploring the intriguing new approaches to design that nanotechnologies offer, Nanomaterials, Nanotechnologies and Design is set against the sometimes fantastic sounding potential of this technology. Nanotechnology offers product engineers, designers and consumers a vastly enhanced palette of materials and properties, ranging from the profound to the superficial. It is for engineering and design students and professionals who need to understand enough about the subject to apply it with real meaning to their own work. * World-renowned author team address the hot-topic of nanotechnology. * The first book to address and explore the impacts and opportunities of nanotech for mainstream engineers, designers and architects. * Full colour production and excellent design appeal guaranteed to be of interest to everyone concerned with good design and the use of new materials.

Nanotechnology is a new and emerging discipline that is multidisciplinary and interdisciplinary. The usage of nanosystems, nanomaterials, nano-devices, etc. permeates all aspects of society. Cancer targeting and curing nanosystems are being introduced into the biomedical and pharmaceutical industry; so are high-light energy absorbing or bluish-white non-hybrid materials in the aerospace, automotive and marine industries; high-energy efficiency harvesting nanomaterials, etc. Society has a vested interest in knowing how these new materials can be used to change the economy and similar landscapes. The book outlines the regulatory and environmental issues related to nanotechnology per industry, offering guidelines in assessing the risks and discussing the legal and socioeconomic issues involved. Case studies will be utilized to provide examples of the positive and negative impacts of nanotechnology. Provides an overview and the basis for understanding the critical importance of the reactivity and efficacy of nanomaterials and the emerging role of nanotechnology in society. Explains the fundamentals, ethics, regulatory and environmental issues of nanosafety and how they shape the emerging nanotechnology industry and markets and includes extensive lists of glossary terms, terminologies and concepts needed for Material Safety Data Sheets. Discusses the relevance and specificity of nanosafety issues per industry and includes discussions on the "Homeland Security and Infrastructure Industries" of interest to most industries and systems. Outlines the legal and intellectual property ramifications of nanotechnology and its impact on productivity and society.

"This book provides the latest developments in the field of space research and structural mechanics. It also explores the mechanics of nanomaterials; the advancement of their electronic properties, the development of the methods of synthesis of the nanomaterials for fabricating nanodevices, and related technological expertise to assemble the nano components for fabricating the devices"--

This title includes a number of Open Access chapters. Considered the next industrial revolution, nanotechnology is an exciting field with new advances being reported regularly. It is a very diverse and highly interdisciplinary field, involving the science and engineering fields. Nanotechnology deals with the smallest building blocks of matter and involves atomic and molecular level imaging, manipulating, and controlling of these, which lead to the creation of new materials, new manufacturing processes, and new applications. This book covers many emerging and important issues in nanotechnology as it applies to cancer research and treatment, material properties analysis, new materials, and much more.

This is an introduction to the nanoscale for science, computer science, and engineering disciplines. That said, there does not exist an educational discipline, market segment, or career avenue which will not be impacted by nanotechnology. Nanoscience and nanotechnology, the application of the research-based nanoscale science, have changed significantly over the last three and a half decades. The "bulky" ball, 60 carbon atoms arranged like a soccer ball, and an often-used symbol for nanotechnology, was discovered in 1985 by R. Smalley, who later scientists at IBM were able to manipulate on a surface. In the intervening years, nanotechnology has evolved from a single focused research topic to an understanding that infiltrates every aspect of science and engineering disciplines. In addition, nanotechnology, and both naturally occurring and engineered nanomaterials, have become the focus of legal, environmental, and application and regulation disciplines. In the first portion of this text serves as an introduction to nanotechnology: its history, mathematical concepts, and instruments required to study and manipulate the world at the atomic scale. The latter portion of the text discusses the connectivity of nanotechnology to the more fundamental scientific disciplines as well as emerging technologies. There does not exist an educational discipline, market segment, or career avenue which will not be impacted by nanotechnology.

The recent introduction of nanomedicines in the drug therapy arena is revolutionizing the management of severe diseases. The key advance in this field is the optimization of the biological effects of drug molecules, thus improving the therapeutic effect while keeping to a very minimum the associated toxicity. Volume one of this book series, Nanomedicines in Drug Delivery, established the basic aspects in the development of drug loaded nanoparticles, so-called nanomedicine: nanodrugs, focusing on representative materials and strategies used in their formulation. Taking advantage of the advanced conceptualizations on nanomedicine engineering that were described in Volume one, Volume two: Nanomedicine-Engineering Strategies and Nanomedicines Against Severe Diseases, analyses in depth special features related to the formulation of nanoparticles for oral, dental, topical and transdermal, pulmonary, and nasal, ocular and otic, vaginal, and brain drug delivery and targeting. Particular aspects of nanomedicine engineering and in vivo fate associated with the route of drug administration are given special attention. In addition, an up-to-date overview is presented on the use of nanomedicines against severe diseases, such as cancer, cardiovascular diseases, neurodegenerative disorders, infectious diseases, chronic inflammatory diseases, and metabolic diseases. The chapters analyze the key factors that need to be controlled to optimize the therapeutic effect. Attention is further given to gene delivery and the recent concepts of nanotheranostics.

Reflecting the breadth of the field from research to manufacturing, Nanoscience and Nanotechnology: Advances and Applications delivers an in-depth coverage of emerging, high-impact nanotechnologies. Written by a multidisciplinary team of scientists and engineers and edited by prestigious faculty of the Joint School of Nanoscience and Nanotechnology, this book focuses on important breakthroughs in nanoelectronics, nanobiology, nanomedicine, nanomodeling, nanolithography, nanomanufacturing, and nanosafety. This authoritative text addresses concerns regarding the use of nanomaterials Discusses the advantages of nanocomposites versus conventional materials Explores self-assembly and biotemplating for nanoscale building blocks for electronics and optoelectronics, and biocompatible medical applications Covers composite and nanocomposite materials for neural, biomedical, and other applications Utilizes nanotechnology in the field of nanomedicine and drug delivery Discusses the realm of nanotechnology and its impacts in material and biological sciences.
This book is a concise but well-organized introduction to nanotechnology (NT) which the upstream oil industry is now vigorously adapting to develop its own unique applications for improved oilfield operations and, oil and gas production. Its reader will learn nanotechnology fundamentals, be introduced to important NT products and applications from other industries and learn about the current state of development of various NT applications in the upstream oil industry, which include innovative use of nanomaterials for enhanced oil recovery, drilling and completions, reservoir sensing, and production operations and flow assurance. Key Features: 

- Focuses on potential of nanoparticle-based agents and interventions for improving myriad of oilfield operations
- Unique guide for nanotechnology applications developers and users
- Introduces nanotechnology for oil and gas managers and engineers
- Includes research data discussions relevant to field
- Offers a practical applications-oriented approach

This book presents selected topics on nanotechnology applications in the strategic sector of space. It showcases some current activities and multidisciplinary approaches that have given an unprecedented control of matter at the nanoscale and will enable it to withstand the unique space environment. It focuses on the outstanding topic of dual-use nanotechnologies, illustrating the potential benefits of key enabling materials that can be used successfully both on earth and in space. It highlights the importance of space as a strategic sector in the global economy, with ever-increasing related businesses worldwide. In this light, it dedicates a chapter to the analysis of current and future markets for space-related nanotechnological products and applications.

Nanotechnology is the fastest-growing technology in the world, and it is also called the Industrial Revolution of the twenty-first century. Many research, development, and production operations are based on the potential of nanomaterials for enhanced oil recovery, drilling and completions, reservoir sensing, and production operations and flow assurance. Key Features: 

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