Preface

The constantly changing landscape of Nanotechnology challenges experts and practitioners to stay apprized of the field’s most up-to-date research. That is why Information Science Reference is pleased to offer this three-volume reference collection that will empower students, researchers, and academicians with a strong understanding of critical issues within Nanotechnology by providing both broad and detailed perspectives on cutting-edge theories and developments in the field. This collection is designed to act as a single reference source on conceptual, technical, and methodological issues, as well as provide insight into emerging trends and future opportunities within the discipline.

_Nanotechnology: Concepts, Methodologies, Tools, and Applications_ is organized into six distinct sections that provide comprehensive coverage of important topics. The sections are (1) Fundamental Concepts and Theories, (2) Tools and Technologies, (3) Development and Design Methodologies, (4) Utilization and Application, (5) Critical Issues, and (6) Emerging Trends. The following paragraphs provide a summary of what readers may expect from this invaluable reference tool.

Section 1, “Fundamental Concepts and Theories,” begins with several introductory chapters on Nanotechnology and its associated areas of research. _Nanosciences and Nanotechnologies_ by Ugo Finardi begins this volume with a discussion of the science behind technologies developed on the nanoscale. Further chapters utilize this introduction to investigate more specific facets of the field, including _Bionanotechnology_ by David E. Reisner, Samuel Brauer, Wenwei Zheng, Chris Vulpe, Raj Bawa, Jose Alvelo, and Mariekie Gericke, as well as _Parallel Quantum Chemistry at the Crossroads_ by Hubertus J. J. van Dam and _Synthesis and Characterization of Hexagonal Shaped Nanocrystalline Zinc Oxide Powders_ by M. Ahmad, E. Ahmed, N. R. Khalid, M. J. Jackson, and W. Ahmed. Another notable contribution to this field is the use of _Nanotechnology for Photovoltaic Energy_, as described in the chapter by Salahuddin Qazi and Farhan A. Qazi. This topic provides an effective transition into Section Two through its exploration of one of the many ways that Nanotechnologies can serve effectively in real-world settings.

Section 2, “Tools and Technologies,” discusses some of the many diverse uses of Nanotechnology in the modern world. This section begins with technologies for harnessing and effectively utilizing solar energy, notably _Quantum Well Solar Cells_ (Magdalena Lidia Ciurea, Ana-Maria Lepadatu, and Ionel Stavarache), _Nanotechnology and Polymer Solar Cells_ (Gavin Buxton), and _Quantum Dot Solar Cells_ (Yoshitaka Okada, Katsuhsia Yoshida, and Yasushi Shoji). Other uses of Nanotechnology covered in this section include high-performance computing, materials science, information systems, and sensor technologies, among others. One notable chapter, _System-Level Design of NoC-Based Dependable Embedded Systems_ by Mihkel Tagel, Peeter Ellerree, and Gert Jervan, investigates the miniaturization of computer chips into the subnanometer range. The final chapters in this section, _On the Forces Between Micro and Nano Objects and a Gripper_ by Galin Valchev, Daniel Dantchev, and Kostadin Kostadinov and _Neurosurgical Operations Using Navigation Microscope Integration System_ by Takashi Tamiya, Masahiko Kawanishi, Keisuke Miyake, Nobuyuki Kawai, and Shuxiang Guo, focus on the mechanical side of Nanotechnology, using microscopic robots for medical and engineering applications.
Section 3, “Development and Design Methodologies,” bridges the gap between the fundamentals of Nanotechnology and its application in a variety of environments and situations. The section opens with an extension of the previous discussion on nanoscale mechanics with chapters such as Robust Integral of NN and Error Sign Control for Nanomanipulation Using AFM by Qinmin Yang and Jiangang Lu. Following this, Section Three includes a range of chapters discussing the application of Nanotechnology and quantum physics principles, such as Quantum Confinement Modeling and Simulation for Quantum Well Solar Cells by Laurentiu Fara and Mihai Razvan Mitroi, and The Biotic Logic of Quantum Processes and Quantum Computation by Hector Sabelli and Louis H. Kauffman. Finally, this section concludes with several chapters on other uses for nanoscale technologies, including modeling and analysis of macroscopic systems, notably Basic Research on Elemental and Size Analytical System for Nano-Sized Suspended Particulate Matter Using Contactless Optical Measurement Techniques by S. Ikezawa and T. Ueda.

Section 4, “Utilization and Application,” continues with an in-depth look at some practical applications in the field of Nanotechnology. This section covers a wide range of topics because Nanotechnology is a critical component of many cutting-edge technologies and fields. Some notable examples present in this section include medical operations (Advances in Robot Surgery by Silvia Frumento, Roberto P. Razzoli, and Francesco E. Cepolina), biomedicine (On the Modeling of Carbon Nanotubes as Drug Delivery Nanocapsules by F. Alisafaei and R. Ansari), computing (Nanocomputing in Cognitive Radio Networks to Improve the Performance by Yenumula B. Reddy), and even art (NanoArt by Cris Orfescu). This wide variety demonstrates the ubiquity of technologies designed to be as small as possible, and the section ends with some of the most well-known applications of Nanotechnologies: materials science. Effects of Different Parameters on Delamination Factor of Glass Fiber Reinforced Plastic (GFRP) by Vikas Sharma, Vinod Kumar, and Harmesh Kumar discusses the properties of a new material made possible by Nanotechnology, while Phononic Engineering for Hot Carrier Solar Cells by Sana Laribi, Arthur Le Bris, Lun Mei Huang, Par Olsson, and Jean Francois Guillemoles describes and analyzes a novel, micro-engineered solar cell for more efficient solar energy capture, a topic that transitions effectively into the next section.

Section 5, “Critical Issues,” examines Nanotechnology applications to evaluate their effectiveness and explore methodologies and best practices for their implementation in real-world scenarios. The section begins with solar technologies and several designs for effective photovoltaic systems, including Analytical Models of Bulk and Quantum Well Solar Cells and Relevance of the Radiative Limit by James P. Connolly and Materials Characterization Techniques for Solar Cell Devices by Michael S. Hatzistergos. Following this, the section transitions into a discussion of particle science, particularly in the medical field, with chapters such as Studies on Gymnemic Acids Nanoparticulate Formulations Against Diabetes Mellitus by R. Ravichandran and Nanostructured Metal Oxide Gas Sensor by Jamal Mazloom and Farhad E. Ghodsi. Finally, the section continues with a focus on medicine with chapters such as Strategy and Policy Issues Related to Nanotechnology Innovations in Medical Education by Tamar Chachibaia, ending with a work that hearkens back to previous chapters on nanorobotics: Selective Pick-and-Place of Thin Film by Robotic Micromanipulation by Bruno Sauvet, Mohamed Boukhicha, Adrian Balan, Gilgueng Hwang, Dario Taverna, Abhay Shukla, and Stéphane Régnier.

Section 6, “Emerging Trends,” concludes this multi-volume reference with some of the latest advances in the field of Nanotechnology. The chapters in this section seek to expand upon the present research, as outlined in the previous five sections, in order to reach new conclusions and develop new applications for these emerging technologies. In Built-in Self Repair for Logic Structures, Tobias Koal and Heinrich Theodor Vierhaus devise a new method of self repair for nanoscale integrated circuits. Preparation of
a Uranium Conversion Plant’s Nuclear Waste for Final Disposal by Means of Magnetically Assisted Chemical Separation by Ahad Ghaemi, Mehdi Maghsudi, Fatemeh Hanifpour, and Mohammad Samadfam explores the nanoscience behind modern energy technologies, as does CuInGaSe Based Thin Films for Photovoltaic Solar Cells by Harry Efstathiadis and Adam Filios. Katsumi Yoshida discusses one area of materials science in Application of Electrophoretic Deposition for Interfacial Control of High-Performance SiC Fiber-Reinforced SiC Matrix (SiCf/SiC) Composites. Finally, this multi-volume reference work ends with, An Advanced Architecture of a Massive Parallel Processing Nano Brain Operating 100 Billion Molecular Neurons Simultaneously by Anirban Bandyopadhyay, Subrata Ghosh, Daisuke Fujita, Ranjit Pati, and Satyajit Sahu, their discussion centered on enhancing the computational power of the world’s strongest supercomputers.

As a comprehensive collection of research on current findings related to the development of interdisciplinary technologies, Nanotechnology: Concepts, Methodologies, Tools, and Applications provides researchers, administrators, and all audiences with a complete understanding of the latest advances, applications, and concepts in Nanotechnology. Although the primary organization of the contents in this multi-volume work is based on its six sections, offering a progression of coverage on the important concepts, technologies, methodologies, applications, critical concerns, and emerging trends, the reader can also identify specific content by utilizing the extensive indexing system found at the end of each volume. Given the vast number of issues concerning usage, successes and failures, policies, strategies, and applications of Nanotechnology in countries around the world, Nanotechnology: Concepts, Methodologies, Tools, and Applications addresses the demand for a resource that encompasses the most pertinent research on the technologies being employed to globally bolster the knowledge and implementation of Nanotechnology.