

# Preface

The advent of nanotechnology and nano-process engineering has brought about a new era of research in materials science, optics, chemistry, biology, and medicine among others. While the benefits, applications, and future possibilities offered by this new nano-science have been made center stage from their very inception, little has been said about the dangerous side effects both created by these new nanoscale processes and revealed by our deeper understanding of the nano world.

This collection of articles proposes to do just that, present the cutting-edge state of research in the harmful effects of human process-driven nanotechnology and propose realistic implementations of solutions to these issues. Specifically, we focus in this volume on nanoparticles and nanoparticle aggregates.

Nanoparticles as a by-product of human society are well known, ranging from, the worryingly common, nanoparticle aggregates present in combustion gases to the less encountered side effects of industrial processes such as metallic nano shavings or chemical nano residues. To gain a rigid scientific understanding of what these industrial side products entail, an exhaustive classification of the types of nanoparticles and nanoparticle aggregates that are a result of these processes is needed. The first part of this volume proposes to do just that and provides a detailed analysis of the properties, sources, and distribution of harmful nanoscale products in human society.

Second, it is also important to look at the effects of nanoparticles on the human body from a medical perspective. While medical science itself is no stranger to nanotechnology, much of the published body of work in this field focuses on the benefits that nanoscale processes can bring to diagnosis and treatment. While not attempting in any way to detract from the crucial importance of such breakthroughs, this volume will attempt to look at the harmful side effects that nanotechnology can have on human health. Consequently, the second part of the work focuses on this issue.

Thirdly, while characterization and analysis of nanoparticles and aggregates in controlled conditions is a challenge in itself, designing techniques that can work in a “real-life” environment requires even greater effort. In the third part of this

volume, we look at innovative techniques for nanoparticle characterization ranging from wide-spectrum atmospheric spectroscopy to localized sensing and characterization of nanoparticles in low concentration. By presenting these techniques, we hope to provide a blueprint for future technologies that will allow for the implementation of cheap, portable, and easy-to-use nanoscale detection and classification systems.

Finally, the issue of how these problems can be addressed and redressed is raised. In a positive twist of fate, it seems that nanotechnology itself provides the solution to the very dangers it can create. The fourth and final part of the volume presents several new techniques for nanoparticle sorting, manipulation, and separation that can limit the hazardous effects of these products on the environment and human health. Ranging through different methods, we attempt to provide a broad base as possible for those interested in the state of the art in this field.

We envision this book as a helpful primer for this crucial new era of nanoscience and invite all those interested to use it as a trusted source of information, be it in research, study or decision making. Covering such a large and diverse area of science and technology in an exhaustive manner, it is the authors' and editors' hope that this volume can become a crucial stepping stone for those interested in both entering this fascinating and important topic as well as those looking to further develop the scientific methods and related technical aspects.

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Nanoparticles' Promises and Risks

Characterization, Manipulation, and Potential Hazards  
to Humanity and the Environment

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