Engineering Materials

Amretashis Sengupta
Chandan Kumar Sarkar *Editors*

Introduction to Nano

Basics to Nanoscience and Nanotechnology

Springer

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Dedicated to Sri Sri Kaibalyanath, my parents and my teachers

Amretashis Sengupta

Foreword

Nanotechnology looks very much on the course to kick-start a new era in science and technology as well as industry in decades to come.

The true potential of the nanoscale, if properly exploited, would significantly improve many aspects of human living for the better.

In this scenario, nanotechnology education will play a pivotal role in preparing industry and society to fully embrace this new paradigm.

The efforts of Sengupta and Sarkar in providing students with a useful resource on this topic under one cover for venturing into the world of nanotechnology are most commendable.

A good aspect of this book is that it does not require any prerequisite of detailed knowledge of physics and materials sciences, but rather endeavors to introduce these concepts in a self-contained manner.

In this sense, the book strikes a nice balance between the building blocks of nanoscale physics and advanced topics such as nanotransistors, memories, and interconnects.

I feel that this book will be an important read for the young nanotechnologists and early-stage researchers, especially those working in the field of nanoelectronics.

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Preface

It is said that some of the biggest surprises often come in small packages such a statement fits perfectly in the case of nanotechnology. This interesting new field of science and technology is getting more and more intertwined with the thread of our daily lives by means of nanoscale devices in consumer electronics, nanomaterials, and composites in textiles, aerospace, automobile, rehabilitation aids, and various other products. Not only nanotechnology is employed in the high-tech products, but also it is actively pursuing pressing global problems such as safe drinking water, better crops, and cleaner energy.

As nanotechnology builds momentum to become the game changer of the twenty-first century, the study of nanoscience and technology as an interdisciplinary subject in academic institutions also holds a key to its success. People and ideas from various fields of natural and applied sciences and engineering can come together under the aegis of the nanotech wave to transform the future for the better.

In this wave, this book is but a tiny ripple to provide students new to the field of nanoscience and technology the basic skill sets and building blocks to form a better understanding of the subject. With a special focus on nanoelectronic devices, this book is likely to be useful for early-stage researchers working in the domain of nanoelectronics as well. The materials and chapters for this edited volume have been collected from various experts and researchers working actively in the concerned fields. We hope the students would find it a suitable companion as they take their first steps into the marvelous world of nanoscience and technology.

Finally, we would like to express our sincere thanks to all the contributors and authors, and colleagues without whose active participation it would not have been possible to bring out this book. Our special thanks to our students for their enthusiasm which motivated us in the first place to initialize such an effort.

Howrah and Kolkata
May 2015

Amretashis Sengupta
Chandan Kumar Sarkar

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About the Editors

Dr. Amretashis Sengupta received his B.Sc. (Hons.) in physics in 2005 and M.Sc. (physics) with specialization in Electronics in 2007 from the University of North Bengal, India. He recieved his M.Tech. (Nano Science and Technology) degree in 2010 from Jadavpur University, India. He received the Ph.D. (Engg.) degree from Jadavpur University, Kolkata, India, in December 2012. He is a recipient of university medals for ranking 1st class with 1st in M.Sc. and M.Tech. examinations. He was awarded the DST INSPIRE Fellowship for his doctoral work at Jadavpur University and the DST Postdoctoral Fellowship in NanoScience and Technology for his postdoctoral work at Indian Institute of Science, Bangalore. He received the DST INSPIRE Faculty award from the Department of Science and Technology, Government of India, in 2013. He is currently an assistant professor at the School of VLSI Technology, Indian Institute of Engineering Science and Technology (IIEST), Shibpur, India. His research interests are first principles-based simulations on 2D materials, non-equilibrium Green's function (NEGF)-based nanoelectronic device simulation for Graphene and other alternate 2D channel material FET, and nanocrystal-based nonvolatile memories. He is a member of IEEE and a reviewer of various reputed international journals such as IEEE T-ED, Journal of Computational Electronics, and Journal of Physics and Chemistry of Solids and Silicon.