

PREFACE

For many years now, engineering at the very small scale has remained the driving force behind a significant share of the global economy. Over the past four decades, microelectronic devices have proliferated and their myriad uses have increasingly defined our modern lifestyles. Throughout the microelectronics era, the sizes of individual devices integrated on semiconductor chips have been steadily reduced. With this trend still continuing, a future is in sight when we shall reach the end of the road for conventional device miniaturization. This will come about both as a result of the graininess of matter and the quantum mechanical nature of physical phenomena that become evident at very small length scales. Although the limitations would principally come from material science and physics, their repercussions would be largely economical. In order to keep the semiconductor industry profitable, new materials, processing techniques and device architectures will be needed. At the time of this writing we have about ten years to prepare for a graceful handover to alternative technologies. By all accounts, these futuristic technologies will exploit the physics and technology of novel devices whose dimensions will be measured in nanometers — 1 nanometer being one-billionth of a meter. Structures and devices at this scale are already at the heart of modern technology and these are going to play increasingly important roles in the future. Nanotechnology — the engineering discipline concerned with studying and fabricating such ultra small objects is now a thriving field in applied sciences and is attracting more researchers and funding throughout the world. Several countries have made nanotechnology funding a very high priority in their budget allocations, as an appreciation for its potential has grown in recent years. Developed countries as well as a number of developing countries see much promise from nanotechnology in fields as diverse as information technology and health care.

The interdisciplinary nature of nanotechnology is perhaps the most noticeable feature of this new field. The nano world can be approached from several different disciplines such as materials science, electronics, physics, chemistry and biology. This creates new opportunities for scientists and engineers as well as policy makers. It is clear that explorations and innovations in this realm will open up entirely new

possibilities. This is good news for a world that is increasingly short of non-renewable sources of both materials and energy. Recognizing the potential of nanotechnology, many companies have started research in this field and more are joining them every year. Universities too are increasingly active in this area. As researchers we need to have a broad understanding of what our fellow researchers are doing elsewhere. This book is geared towards satisfying that need. Nanotechnology being such a wide discipline, this book is only concerned with its applications in electronics and photonics and in that too it looks at only a narrow selection of topics. The book contains a selection of 16 chapters contributed by a number of research teams around the world. They have especially expanded and adapted these chapters from papers published by them in the recent past.

After the introductory chapter the book is divided into two parts. The first is comprised of works that deal with electronic applications of nanotechnology whereas the following part is constituted of nanotechnology applications in pushing the frontiers of photonic technologies. The chapters are focused on experimental aspects of nanotechnology rather than theoretical studies or computer modeling. All the contributors are active researchers in their fields of specialization and thus this book provides an up-to-date survey of the state of contemporary nanotechnology. The publisher, editor and contributors hope that it will be useful to both students and professional researchers alike.

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