

Preface

The *Nano and Giga Challenges* (NGC) conference series has had a long tradition of tutorial lectures given by world-renowned researchers. As early as the first forum in Moscow, Russia, in 2002, the organizers realized that publication of the lectures notes from NGC2002 would be a valuable legacy of the meeting and a significant educational resource and knowledge base for students, young researchers, and experts alike. Our first book was published by *Elsevier* and named after the meeting itself—*Nano and Giga Challenges in Microelectronics* [1]. Our subsequent books based on the tutorial lectures of the NGCM2004 [2], NGC2007 [3], NGC2009 [4], NGC2011 [5], and the current book derived from the NGC2014 conference have been published by Springer in the *Nanostructure Science and Technology* series.

Energy and information are essential elements for the development of human society, which are interconnected. Processing and storage of information requires energy consumption, while the efficient use and access to new energy sources requires new information (ideas and expertise) and the design of novel systems such as photovoltaic devices, fuel cells, and batteries. Semiconductor physics creates the knowledge base for the development of information (computers, cell phones, etc.) and energy (photovoltaics) technologies. The exchange of ideas and expertise between these two technologies is critical and expands beyond semiconductors. Efficient use of solar energy requires development of novel energy storage devices while biosystems provide new paradigms for the development of materials and devices for information (processing and storage) and energy (e.g., biofuel and artificial photosynthesis) technologies and biomedical applications (sensors and diagnostics).

Progress in information and renewable energy technologies requires miniaturization of devices and reduction of costs, energy, and material consumption. The latest generation of electronic devices is now approaching nanometer scale dimensions; new materials are being introduced into electronics manufacturing at an unprecedented rate; and alternative technologies to mainstream CMOS are evolving. The low cost of natural energy sources has created economic barriers to the development of alternative and more efficient solar energy systems, fuel cells,

and batteries. However, there is emergent understanding that the sustainable development of human society requires use of new alternate sources of energy to natural gas and oil.

Nanotechnology is widely accepted as a source of potential solutions in securing future progress for information and energy technologies. Our conference series is an interdisciplinary forum in education, research, and innovations in the development of new materials, devices, and systems for these key technologies. The NGC2014 conference (the sixth Nano and Giga Forum) invited academic and industrial researchers to present tutorial and original research papers dedicated to solving scientific and technological problems in the following areas of electronics, photonics, and renewable energy: atomic scale materials design, bio- and molecular electronics, high frequency electronics, fabrication of nanodevices, magnetic materials and spintronics, materials and processes for integrated and subwave optoelectronics, nanoCMOS, new materials for FETs and other devices, nanoelectronics system architecture, nano-optics and lasers, non-silicon materials and devices, chemical and biosensors, quantum effects in devices, nanoscience and technology applications in the development of novel solar energy devices, and fuel cells and batteries. We also invited inventors, entrepreneurs, and business leaders to explore the unique opportunity provided by our interdisciplinary forum for technical due diligence and potential commercialization of emerging new technologies.

The success of the NGC2014 conference [6], which resulted in the publication of this book, would have not been possible without generous support from many sponsors and research institutions. We gratefully acknowledge contributions and support of Arizona State University (host of the conference), Springer Publisher, National Institute of Health (NIH), and many other local, national, and international organizations and individual supporters.

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