Nanocose 3

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PREFACE

Nanocose 3

Nanoscale science and technology concerns the manipulation of matter on the nanometre length scale in the range 1–100 nm. Even though this might simply be seen as a natural extension of (sub)micron-scale physics and engineering, which has driven microelectronics development so far, the wealth of novel physical, chemical and biological behaviour that occurs at this scale makes nanoscience an exciting area of research. Instead of dealing with an 'infinitely' extended solid, or individual atoms and molecules, in nanoscience one investigates the properties of units containing a countable, relatively small number of atoms. These units, like clusters of atoms, carbon nanotubes, fullerenes or biomolecules, show fascinating electronic, optical and chemical properties by virtue of their nanometre dimensions. This is mainly because of the coherence length of the valence and conduction electrons, that becomes comparable with the physical dimensions of the units. By varying the size of the units and controlling their interactions, the fundamental properties of nanostructured materials may be modified and tuned.

Nanomaterials are at the leading edge of the rapidly developing field of nanotechnology. Their unique size-dependent properties make these materials interesting and indispensable in many areas of human activity. In particular, their applications in catalysis, biology and medicine as well as in the field of magnetic media are widespread, with a great number of examples provided by the technological handling of metallic and insulator nanoparticles.

Thus nanotechnology promises an unprecedented era of innovation across many disciplines and diverse applications. Its pursuits and activities are proliferating with different approaches, from top-down to bottom-up to converging techniques, and with varying degrees of maturity, ranging from simple concepts to commercialization. To penetrate deeper into this field, we organized the third Nanocose (Nanothings) conference which was held in Frascati (Roma, Italy) in October 2005, at the Villa Mondragone Congress Center of Roma 'Tor Vergata' University (www.villamondragone.it/), close to the hills of Roma. The conference (http://nanocose.roma2.infn.it/) focused on all areas of nanofabrication for accelerating nanotechnology progress: from innovative research to state-of-the-art development to cost-effective manufacturability in nanofabrication processes and technologies for current and novel devices and applications, including enabling and differentiating aspects in materials, characterization and reliability. It is also worth mentioning that similar processing schemes occur and perform very important functions in biological systems. Particular attention was devoted to self-assembly, which is one of the tools needed to create ordered nanostructures.

This special issue contains invited papers from Nanocose 3, which were selected from among the 100 papers presented at the conference. The conference was attended by more than 130 Italian researchers from universities as well as research centres such as CNR, ENEA and INFN, participating with the objective of finding common strategies to expand their work.

During the conference the Faculty of Science of the University of Roma 'Tor Vergata' conferred a 'Laurea Magistralis Honoris Causa' to Professor Michele Parrinello of the ETH of Zurich (Switzerland), with mention 'for his numerous and important contributions toward the comprehension of the microscopic mechanisms of matter, among them the innovative computation method called Car-Parrinello'. Thanks to this widely recognized method for predicting the physical properties of nanostructures, he has received a number of international acknowledgments and prizes.

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