Nanoscience and nanotechnology 2005

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PREFACE

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The field of nanoscience has witnessed a rapid growth in the last decade. Recently, the attention of the community of nanoscientists has been focusing more and more on technological applications. Nanotechnology is an enabling technology, with high potential impact on virtually all fields of human activity (industrial, health-related, biomedical, environmental, economy, politics, etc), yielding high expectations for solutions to the main needs of society, although having to address open issues with respect to sustainability and compatibility. The fields of application of research in nanoscience include: aerospace, defence, national security, electronics, biology and medicine. There has been significant progress in the understanding achieved in recent years, both from the theoretical and experimental point of view, along with a strong desire to assess the current state-of-the-art in this fast-growing field, stimulating, at the same time, research collaboration among the different stakeholders in the area of nanoscience and the corresponding technological applications, and possibly prompting the organization and presentation of joint projects in the near future, involving both industry and public research.

The International School and Workshop 'Nanoscience and Nanotechnology (N&N 2005)' was held on 14–16 November 2005 at Villa Mondragone, Monte Porzio Catone, Italy (http://www.lnf.infn.it/conference/nn2005). This workshop gathered together leading experts in research and innovative technologies in bio-medical, aerospace, optoelectronics, instrumentation and service fields. Coming from both academic research and industrial areas, participants included scientists from different backgrounds (physicists, chemists, biologists, engineers, physicians), researchers and executives from industry, as well as national security and military defence experts.

The WOrkshop (chaired by Dr S Bellucci and Professor A Bergamaschi, patronized by INFN (Italian Institute for Nuclear Physics), Roma Tor Vergata University and MTS Systems Corporation, and with additional sponsorship from 3M, RS, Wuerth, Physik Instrumente, Ape Research), yielded an opportunity for concrete planning of future devices, based on innovative (nano)materials, involving both industrial entities and public research institutes, as well as allowing sponsoring firms to present their instrumentation and success stories, based on current use by significant customers.

In order to foster the exchange of knowledge and collaboration among the different stakeholders in the field of nanotechnology, a special poster and equipment session was given by various firms showing their institutional activities in selected areas of application where nanoscience can have a deep impact. This session offered an opportunity for those who are new to the field to obtain contacts and prime up-to-date information from the experts. There was also the opportunity for sample testing by the participants. Tutorial lectures were delivered at the School, addressing general and basic questions about nanotechnology, such as: What is it? How does one go about it? What purposes can it serve? In tutorial sessions the nature of nanotechnology, the instruments in current use and possible applications were described at an introductory level.

The papers in this special section of *Journal of Physics: Condensed Matter* are the result of the Frascati meeting. The success of the workshop can be assessed on the basis of the level of participation (about 150 specialists coming from many different countries, from Europe to

Japan, the US and most of the former Soviet Union), as well as from the high quality of the presentations.

Participants of the Frascati meeting were asked to prepare their papers to include the outcome of discussions with their colleagues during and after the meeting. No length restrictions, except those imposed by scientific content, have been enforced. Manuscripts have undergone the normal thorough *Journal of Physics: Condensed Matter* peer review, and where necessary, revision. I hope that the resulting quality has made this section worth waiting for. Readers are encouraged to learn more about the activities presented at the conference and join the research into the technological applications of nanoscience.

Although this special section cannot be considered as the proceedings of the Frascati School and Workshop, it would never have materialized without the conference. The editor is therefore most grateful to all organizers and participants of the Frascati meeting. Their work has been of the utmost importance for the present volume.

Several successful meetings in this field have taken place in the past, such as the Nanotubes and Nanostructures (N&N) School and Workshop series [1,2], including:

(1) N&N2000: S Margherita di Pula (Cagliari), Italy, 24 September–4 October 2000
http://www.lnf.infn.it/conference/nn2000/default.html
(2) N&N2001: Frascati (Roma), Italy, 17–27 October 2001
http://www.lnf.infn.it/conference/nn2001/Welcome.html
(3) N&N2002: Frascati (Roma), Italy, 23–28 September 2002
http://www.lnf.infn.it/conference/nn2002/
(4) N&N2003: Frascati (Roma), Italy, 15–19 September 2003
http://www.lnf.infn.it/conference/nn2003/
(5) N&N2004: Frascati (Roma), Italy, 14–20 October 2004
http://www.lnf.infn.it/conference/nn2004/

The next meeting in the series, N&N 2006, will be held on 6–9 November 2006, at Villa Mondragone, Monte Porzio Catone (Rome), Italy (http://www.lnf.infn.it/conference/nn2006/). It is planned to submit selected papers, based on conference talks and related discussions, for publication in a special issue of *Journal of Physics: Condensed Matter*.

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References

[1] Bellucci S (ed) 2001 *Proceeding of the School and Workshop on Nanotubes and Nanostructures 2000 (Santa Margherita di Pula, Cagliari, Italy, 24 September–4 October 2000)* (Bologna: Italian Physical Society) ISBN 88-7794-291-6
[2] De Crescenzi M and Bellucci S (ed) 2003 *J. Phys.: Condens. Matter* **15** 34

Scientific Programme

- Micro-nano technologies for large space structures and systems (M Pimprikar, CANEUS, Canada)
- Basic and applied microbial investigations in space (F Canganella, Tuscia University, Italy)
- Radiation curing of epoxy resins in the presence of engineering thermoplastics: a way to produce nanostructured matrices for aerospace composites (G Spadaro, Palermo University, Italy)
- Definition of potential applications of nanotechnologies in the aerospace field (F Fossati, Alcatel Alenia Space, Torino, Italy)
- On the strength of the nanotube-based space elevator cable (N Pugno, Polito, Torino, Italy) (see also a recent communication in *Nature* www.nature.com/news)
- Finmeccanica nanotechnology studies and developments (C Falessi, SELEX-SI, Italy)
- *In planta* produced vaccines (E Albertini, Perugia University, Italy)
- FILAS and the Aerospace Technological District (G Lancia, FILAS, Roma, Italy)
- Small devices, big changes to improve human life (M A Bianchi, Roma–Policl. University, 'Umberto I'– Alcatel Alenia Space, Italy)
- Nanoparticles for solid rocket propellants (L Galfetti, Polimi, Milano, Italy)
- Manostructured surfaces of aluminium alloys for fabricating adhesive bonded joints (C Spadaro, Palermo University, Italy)
- Design of advanced fluorescence nano-biosensors for defense and national security (S D'Auria, CNR, Napoli, Italy)
- Vega launch system (M Lopez, ESA–ESRIN, Frascati, Italy)
- Present situation and forecasts of nanotechnology in Italy and Europe (E Mantovani, NANOTEC IT, Italy)
- Composite metallic materials for energy transport (E Orientale, 3M, Italy)
- Electromagnetic/photonic band-gap structures in the resonance domain (G Schettini, Roma Tre University, Italy)
- Disposable screen printed electrodes assembled as biosensors and immunosensors for rapid detection of nerve agents and pathogenic bacteria (G Palleschi, Roma Tor Vergata University, Italy)
- Temperature dependence of the dynamics of confined water absorbed in a polymer electrolyte fuel cell membrane at low hydration level (A Paciaroni, Perugia University, Italy)
- Description and possible applications of two different tabletop laser systems (P Ciuffa, Elettronica S.p.A., Roma, Italy)
- Porphyrins-based nanostructures for sensing applications (A D'Amico, Roma Tor Vergata University, Italy)
- Neutron spectroscopic characterization of fullerene networks, nanoparticles and nanotubes (H Schober, Institut Laue Langevin, Grenoble, France)
- Point defect aggregation and metallic colloid formation in ionic solids (A Popov, Riga University, Latvia)
- Growth process and some optical properties of nanoparticles copper sulfide, formed in polymer matrix (M Muradov, Baku State University, Azerbajan)
- Bandgap renormalization of nano-wires in GW approximation (K Nozari, Mazandaran University, Iran)
- Metamaterial sub-wavelength absorbers (F Bilotti, Roma Tre University, Italy)
- Towards integrated organic optoelectronics: status and perspectives of organic light-emitting transistors (M Muccini, CNR-ISMN, Bologna, Italy)
- Microwave irradiation as an alternative source for conventional annealing: a study of pure TiO_2, $NiTiO_3$, $CdTiO_3$ thin films obtained by a sol-gel process for electronic applications (R P Ayalasomayajula, CASTI, L'Aquila, Italy)
- Intraband absorption in semiconductor quantum wire with convex bottom in magnetic field (A Manaselyan, Yerevan State University, Armenia)
- Electronic instabilities in small-diameter carbon nanotubes (E Perfetto, CSIC, Madrid, Spain and INFN, Italy)

- Magnetic field influence on the spectrum rearrangement and the spin transition of coupled quantum dots (N Kaputkina, Moscow Institute for Steel and Alloys, Russia)
- On the mechanics of size scale plasticity relevant to the design of micro and nanodevices (H Espinosa, Northwestern University, USA)
- Instrumented indentation and viscoelastic materials (W C Oliver, MTS Systems, Minneapolis MN, USA)
- Relating morphology to nanoscale mechanical properties by AFM nanoindentation (S Piccarolo, Palermo University, Italy)
- Nanoindentation characterization of advanced ceramics (S Guicciardi, ISTEC–CNR, Faenza, Italy)
- Recent developments in micro and nanotribology (M Ciavarella, Poli Bari, Italy)
- Mechanical properties of three MEMS materials—SiC ultrananocrystalline diamond and hydrogen-free tetrahedral amorphous carbon (Ta-C) (H Espinosa, Northwestern University, USA)
- Nano imaging of mechanical properties (M Fajifrowski, MTS Systems, France)
- Resonance of curved nanowires (L Calabri, Firenze University, Italy)
- Simulation and characterization of transport properties of oxide nanodevices (V Dallacasa, Verona University, Italy)
- Nanoparticle toxicity and biological cell response (B Panessa-Warren, Brookhaven Nat. Lab, USA).
- Nanoparticle–hemoglobin cross-talk specific protein unfolding (P Sen, Jawaharlal Nehru University, New Delhi, India)
- Enhanced antibacterial properties of carbon nanotubes as additives in Fe^{+3} doped TiO_2 thin films deposited by sol-gel dip coating process (S Sabtucci, CASTI, L'Aquila, Italy)
- Nanofabrication for materials and biomedical applications (J B Warren, Brookhaven Nat. Lab, USA)
- Intellectual property and patents in nanoscience (C Germinario, SIB, Roma, Italy)
- Smart nanostructured materials for drug delivery (M Monduzzi, Cagliari University, Italy)
- Advances in functionalized surfaces for BioMEMS applications: 'lab-on-a-cell' chips and 'phage-displayed' detection microsystems. (S Carnazza, Messina University, Italy)
- Nanostructured soft composites: materials for an interactive interface between human and the environment (C Dispenza, Palermo University, Italy)
- Development of an integrated MEMS-based DNA analysis chip with active flow control components (D Palmieri, D'Appolonia S.p.A., Rome, Italy)
- Recent results on organic naonoparticles in biological media (B Fubini, University of Torino, Italy)
- Composite nanomaterials as platforms for medical and biotechnological applications (S Bellucci, INFN–Laboratori Nazionali di Frascati)
- S-phase pausing and sensitisation to apoptosis of tumor cells by carbon nanotubes (M De Nicola, Roma Tor Vergata University, Italy)
- Interaction between genes ACP, Zap-70 kinase and nanoparticles (N Lucarini, Camerino University, Italy)
- Carbon nanotubes cytotoxicity (M Bottini, Burnham Inst., USA, Roma Tor Vergata University, INFN-LNF)
- Occupational impact of nanotechnologies (A Magrini, Roma Tor Vergata University, Italy)
- Impact of micro- and nano-beams on medical and biological applications in particle accelerators (V Biryukov, IHEP–Protvino, Russia)
- Propagation of a solute wave in a curved artery (G Pontrelli, CNR, Roma, Italy)
- Reactivity of bioreactors, from the self-reproduction of submicrometric vesicles to protein expression within compartments (P Stano, E. Fermi Research Center and Roma Tre University, Italy)