J Nanopart Res (2011) 13:5585–5586
DOI 10.1007/s11051-011-0615-5

EDITORIAL

There is still plenty of room at the bottom: Nanostructured Materials 2010

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Published online: 29 October 2011

This issue contains a collection of papers presented at the X International Conference on Nanostructured Materials (NANO 2010), which was held in Rome on September 13–17, 2010.

The Nanostructured Materials is a biannual conference series, organized under the auspices of the International Committee on Nanostructured Materials, initiated in 1992, and the oldest conference series in the field. The Conference has a very interdisciplinary character, since facing the demanding societal challenges of the future will need more and more multidisciplinary approach, with teams where materials scientists, physicists, chemists, engineers, biologists, and physicians will work together side by side.

The NANO 2010 conference with more than 750 participants and 661 among plenary, invited, oral, and poster contributions, provided a forum for the presentation and discussion of new concepts, properties, and developments on cutting-edge science and novel materials at the nanoscale, including new functional nanomaterials and their applications in nanoelectronics, energy, medicine, nanobiotechnology, magnetic and photonic devices, and sensors.

The take-home message of the conference was, recalling the famous Feynman sentence, that "there is still plenty of room at the bottom". There is a continuing wide interest on the synthesis and characterization of nanostructured materials, with increasingly sophisticated techniques able to control size, shape, and porosity of any class of materials, as well as there is an increasing interest in opening the market to nanostructured materials and related devices. Nanostructured materials can play a pivotal role for sustainable development and alleviation of societal challenges, like lack of resources, namely energy, water, and food, and the need of better healthcare for aging population. These topics were well represented at the conference.

Nanomedicine is one of the expanding fields enormously boosted by innovative nanotechnologies. Nanoparticles promise revolutionary pharmacological approaches to improve or create ex-novo therapies. The therapeutic potential of nanoparticles with tailored nanostructures can be achieved using the core as a shuttle to carry active molecules, and may include additional determinants to perform specific functions like docking. A novel category of nanoparticles is that where the material itself may act directly as the therapeutic agent, primarily focusing at materials performing reversible antioxidant redox reactions. Magnetic nanoparticles in medicine can be used for early diagnosis, as contrast agents enhancing the

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signal in magnetic resonance image (MRI), and for therapy of tumors using drug delivery ability and magnetic hyperthermia. The challenge is to move into preventive clinical oncology by developing highly sensitive imaging agents and therapies that can identify and eliminate far smaller tumors (at cellular scale) than those detectable with present technologies. The new direction is using magnetic nanoparticles, suitably coated by an antibody that selectively binds to cancer cells, to exploit their multifunctional role for making possible the combination of diagnosis and therapy in a single procedure, known as theranostic. New approaches are being developed also for treating specific cancer cells, like brain tumors, which are among the hardest cancer cell to deal with, often unresponsive to treatments, difficult to access surgically, and quickly growing. The trend now is impeding the cancer cells growth, instead of killing them, by applying a low alternating field for a short time using magnetic nanoparticles, thus reducing the heating and possible damages to healthy neighboring cells. Carbon nanotubes have the potential of playing an important role in nanomedicine too, stimulating neuron connectivity and controlling and favouring neuronal plasticity for the therapy of neural diseases.

Basically, all the technologies needed for energy supply alternative to combustion of fossil fuels, including photovoltaics, fuel cells, batteries, supercapacitors, solar hydrogen, and biofuel production, are still too costly or with low efficiency for their widespread use. Materials with new properties and functionalities are needed for improving the performance of the different types of devices, and this can be achieved by engineering materials structure at the nanometer scale. Though different issues are present for the various technologies, often the approaches to tackle them are very close and the research strategies can be easily transferred from one field to the other.

Spintronics made a revolution in the design and operation of magnetic and magnetoelectronic devices. New fascinating phenomena have been observed and new frontiers in technology were opened facing the growing demand of more efficient devices and faster memories with higher capacities. However, the heat emitted from these devices is actually posing a limit on future miniaturization and is a drain on global energy supply. Energy is needed not only for the more conventional industrial and civil purposes, but the increasing use of electronic gadgets, such as laptops, video monitors, cellular phones, and music players, if kept at the same pace will cause by the year 2030 a global need for over 500 new coal fired power plants or their equivalent to energize them, as reported by the International Energy Agency. Remarkable advances are envisioned based on the quantum mechanical properties of the electron spin that enables it to communicate information in the absence of flow of an electrical current.

This issue contains 67 manuscripts reflecting the general trends described above. Papers span from the synthesis and characterization of oxide, metallic, polymer, carbon, semiconductor, composite and hybrid nanoparticles, and thin films, for applications in magnetism, spintronics, energy, photonics, optics, photovoltaics, catalysis, sensors, nanomedicine, nanobiotechnology, and nanofluids, in addition to a significant number of papers dealing with modeling and simulations at the nanoscale. These papers give a nicely varied and high quality snapshot of the field, and we hope that the readers will enjoy them and appreciate the significant effort authors have put in them.