



# SECOND INTERNATIONAL NANOTECHNOLOGY CONFERENCE ON COMMUNICATIONS AND COOPERATION

## Abstract

### **New Frontiers in Nanotechnology**

By Mike Roco, *NSF-NNI*

Nanoscience and nanotechnology have opened an era of integration of fundamental research and engineering from the atomic and molecular levels, increased technological innovation for economic manufacturing of products, and an enabling base for improving human health and cognitive abilities in long term. For this reason, government and industry investments worldwide for nanotechnology R&D have increased tenfold in seven years reaching over \$8 billion in 2005, and all Fortune 500 companies in materials, electronics and pharmaceutical have made investments in nanotechnology. This makes it all the more critical that we strike a proper balance between the promised benefits, and the necessary measures to mitigate and prepare for possible undesirable secondary effects.

Nanotechnology holds the promise to increase the efficiency in traditional industries and bring radically new applications through emerging technologies. Several R&D targets are accelerating the introduction of nanotechnology in industry, reducing suffering from chronic illnesses, converging science and engineering from the nanoscale in research and production, knowledge development and education from the nanoscale, and reorganization of businesses and organizations. Key challenges for the development of nanotechnology will be discussed.

The rudimentary capabilities of nanotechnology today for systematic control and manufacture at the nanoscale are envisioned to evolve in four overlapping generations of new nanotechnology products with different areas of R&D focus: passive nanostructures, active nanostructures, systems of nanosystems with three-dimensional features, and heterogeneous molecular nanosystems. Examples of R&D challenges that need increased research support are: (a) Tools for measurement and manipulation of matter with atomic precision, time resolution of chemical reactions, and for domains of engineering relevance; (b) Nanobiotechnology for understanding and simulation of human tissue and nervous system; (c) A new body of manufacturing knowledge to support the advances in nano and nano-bio science and engineering, including knowledge necessary for design, fabrication and assembly tools, as well as nanosystems; (d) Silicon semiconductor electronics and beyond; (e) Energy conversion; and (f) Water filtration and desalinization using nanotechnology.