

Nano-Science and Nanotechnology for the Future



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Abstract

Nanoscience and Nanotechnology have now developed enough to find solutions to the most serious problems like virus diseases, energy, food, space etc. Sufficient number of researchers have been trained, nano-tools, instruments and equipment have been invented and research laboratories have been established. Fundamental research has been one to provide advanced research that certainly will help solve waiting problems of humanity.

Keywords: Nano science; Nanotechnology; Research; Instrumentation; Laboratory; Diagnostics

Introduction

Need of future technologies are based on the human needs of the future. If we see the human needs of the future, these will generally remain the same. These are good health, sharp minds and clean environment including air, water, fire, earth and sky. Additional could be exploring and using outside world and the earth within [1]. However, the world is changing continuously hence, the needs in these fields are not of the same type but are changing continuously. We have to thus cater for the new needs in order to be compatible with the cold, hard realities of the future.

Need

The new realities are going to ask for new solutions. Imagination will have to be working effectively. This needs better and deeper research, talented researchers, helpful and communicating machines. The most worrying need is to control the virus, which has been creating havoc world over. The second need is to control the diseases like cancer, which have remained uncontrolled yet. Third is to remove hunger from the entire world. Fourth is to have sufficient energy for the future at nominal prices. Fifth is to control pollution globally by scientific means. Sixth is to reach the remotest planet to find out living spaces and needed minerals. Seventh is to have sharp innovators to do deep research. Eighth is to have compatible instruments for deep research. Ninth is to have fastest and cheapest communication systems. Like that needs may go on. How does nano-science and nanotechnology help in this? Nano means near atomic scale; an invisible field made visible through SEMs and TEMS and the nano-materials manipulated by AFMs. For this, dedicated and committed nano-

scientist and nanotechnologist researchers and mechanics are needed. Here study is limited to nano-medicine.

Initiation

When in 2005, I started B.Tech and M.Tech courses in nanotechnology in Punjab Technical University institutions, a few institutions had ventured in to this field. I had to prepare material through conferences and workshops and taught six courses out of the 12 subjects in first two batches. These included Nano-science, Nanotechnology, Nano-electronics, NEMS & MEMS, and Nano-medicine. Only three students registered for PhD in Nanotechnology initially. However as per a recent report, 163 academic institutions around the world offer a total of 283-degree programs in nanotechnology fields. Bachelor and master's programs in Micro-and-Nanotechnology; Nano-medicine; Nanotechnology and Micro-fabrication; Nano-science; Micro-and-Nano-systems; Nano-biosciences and Nano-medicine; Nano-biology; Nano-engineering; Photonics Engineering, Nano-photonics and Biophotonics; etc. - are the subjects [2]. Hence, we have variety of courses in number of institutions and sufficient numbers of researchers are also available.

However, Nanotechnology has not yet become an industry since exclusive research and production in any of the fields have not been done at a large scale [2].

Tools and instruments

Next, we need tools and instruments. The total market for instrumentation and tools for nanotechnology now exceeds

\$700 million, rising from the 2003 figure of \$199.2 million at an AAGR (Average Annual Growth Rate) of 22.4%. Atomic force microscopes dominate the sector [3]. It may be a decade till its real impact is seen. Modelling and simulation will also grow at a pace closer to industrial averages of about 9% [3].

It may take another 10 years to construct machines, which could help in mass production of nano-materials. Robotics is going to take very important place to have subassemblies, which may be manipulators arms as small as 10nm to 100nm size for the purpose of atom by atom placements. For example, diamond needs atomically made super hard smooth surfaces [4]. These nano mechanical devise would need very accurate Nano-computers for activating, deactivating and controlling them. Precise interventions can be carried out only by programmable nano-robots. In the fields of gentology pharmaceutical research and dentistry [5-7].

Laboratories

Then we need laboratories. Almost all the universities are having research in nano-science and nanotechnology. There are 24 independent laboratories on nanotechnology so far.

Summary

Nano-science and Nanotechnology are going to bring in a big change in the future in diagnosis and treatment. Enough researches, laboratories, tools, instruments and equipment

are now available for detailed, better and deeper research, talented researchers, helpful and communicating machines. Nanotechnology has brought in nano-robots to fight virus diseases and cancer. The concept of nano-doctors inside the body is being developed now. Now methods in research in agriculture expects to produce plenty food and at cheaper prices. Sufficient energy will be made available at nominal prices. Global pollution is also in the process of control through nanotechnology. Satellites are being fitted in with nano-equipment for conservation of energy and larger life. Deep nano-researchers are working hard to produce excellent research in this field. A new world will have much more to thank the nano- science and nanotechnology.

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