

Nanotechnology: Education & Research

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Abstract

Nanotechnology is the most emerging technology which caters to various interdisciplinary fields. The focus is on proper education and research for better development of this field. India is a promising country with lot of prospects. The global market is focusing to invest in India. Hence there is a need for skill-based education. The paper gives an insight about the scenario of Nanotechnology in India, understanding in the education and research.

Introduction

'Nano' in Greek means dwarf. Nanometer (nm) is a unit of measurement used to measure very small particles like atoms and molecules. Nanotechnology is a unique interdisciplinary field also called as molecular manufacturing, which includes the design and manufacture of extremely small electronic circuits and mechanical devices with molecular matter(1-4). This paper deals with importance of Nanotechnology in India in terms of Education and Research activities.

History of Nanotechnology

Nanotechnology (NT) the terminology and concept born in 1959 and was founded by the American physicist Richard P Feynman(1-2). But the term 'Nanotechnology' was first used in 1974 by Japanese scientist Prof. Norio Taniguchi at the Tokyo Science University. However it was introduced to the world in 1986 by K. Eric Drexler, an American Engineer and the founder of Foresight Nanotech Institute.

Nanotechnology Education in India

Nanotechnology (NT) describes the creation and utilisation of functional materials, devices and systems with novel functions and properties that are based either on geometrical size or on material-specific peculiarities of nano-structures(2,4).

The application of Nanotechnology will open new avenues of research in the world of science and engineering in almost every field, from medicine to fabrics. Nanotechnology field is an interdisciplinary subject which deals with Bio-informatics Bio- technology, Physics, Chemistry as well as other disciplines. Special Nanotechnology courses offer knowledge and training on the development and modification of devices with high precision where the particles are of nano-size. In India there is a huge demand for such skilled students and engineers in a good number of industries and laboratories. Even several new institutes are introducing several degree and postgraduate courses for the same. There are quite a number of institutes that offer Nano-Technology Courses in India. The M. Tech. in Nanotechnology is a post graduate degree courses that provides a thorough understanding on the core concepts of nanostructuring, nanofabrication, nanodesigning, characterization techniques and testing techniques for nano devices. Other courses include M. Tech. in Health Care Nanotechnology and Ph.D. in Nanoscience and Technology. These kind of courses enhances the professional development of the students.

Nanotechnology Institutes in India

There are several schools which run the nanotechnology courses. Some of the examples are as follows (<http://www.winentrance.com/nanotech.htm>):

- Jawaharlal Nehru Center for Advanced Scientific Research, Bangalore
- Central Scientific Instruments Organization, Chandigarh
- Indian Institute of Science, Bangalore
- National Physical Laboratory, Delhi
- National Chemical Laboratory, Pune
- Defence Materials Store Research & Development Organization, Kanpur
- Amity Institute of Nano-technology, Noida
- Solid State Physics Laboratory, Delhi;
- Indian Institutes of Technology at Kanpur, Chennai, Guwahati, Delhi and Mumbai.
- Banaras Hindu University, Varanasi

Eligibility: For admissions to M. Tech. (Nanotechnology) course candidates must have a B. Tech. / B. E. degree in Biotechnology, Chemical Engineering or Pharmaceutical Technology

Courses offered

There are several courses which are offered in the nanofield in India (e.g.):

- M.Sc in Nanoscience
- M.Tech in Nanoscience and Technology
- M.Tech in Nanotechnology
- Ph.D in Nanoscience and Technology
- Ph.D in Nanotechnology

Job Prospectus and Career Options in nanotechnology Education

The NT in India is still in infancy stage. Several efforts are being to avoid any lagging. Since NT is an interdisciplinary field hence the pass-out students with a degree in nanotechnology find employment opportunities in a various fields(3).Some of the areas where a nano-technologist can seek employment include the following:

- Medical Industry research and consulting- pharmaceutical, medical, agriculture, food and beverage, hospitals, environment industries.
- Research and development in government, universities and private research institutes
- Education, teaching and academic
- Entrepreneurial, management and investment advisors in biotechnology and research and development industry.
- Product development and advising.
- Communication and media, interfacing of new technologies.
- Many new industries emerging as a result of advances in nanotechnology
- Also in forensic, space research

Nanotechnology Research in India

A range of opportunities await candidates who are willing to go outside India where they can work in the segments of nano -polymer and nano- medicine and as integration engineers also. Lot of research opportunities exist in the areas of nano-device, nano-packaging, nano-wires, nano-tools, nano- biotechnology and nano crystalline materials, nano photonics and nano porous materials to name a few. Nano Science and Technology Institute, with its centers at Switzerland, Cambridge and Massachusetts offer a lot of job opportunities. ASME nano- technology institute in New York also provides job opportunities to deserving candidates.

Scope of NT in India

The scope and application of Nanotechnology is tremendous and mind-boggling and it is one of the hottest career

option available to Indian Engineering graduates. It is an apt career for those who have a scientific bent of mind and a passion for solving mysteries of the minutest molecules. Students with a science and engineering background and even mathematics with physics background can pursue Nanotechnology as a career. Candidates with M.Tech in Nanotechnology are in great demand both in India and abroad (<http://www.winentrance.com/nanotech.htm>). It is a powerful technology which aids the development of products with futuristic performance.

Some of the industries offering jobs in NT:

- Innovations Unified, Forevision Instruments,
- Qtech Nanosystems (P) Ltd, Velbio Nanotech,
- Yash Nanotech,
- Cranes software international ltd,
- Icon analytical Equipment Pvt Ltd.

Research Institutes :

Some of the prominent institutions offering courses in nanotechnology can be had from the following links(2,3):

Nano Mission, Department of Science and Technology, New Delhi

Technology Bhavan, New Mehrauli Road, New Delhi - 110016
Phone : 011-26963695

National Physical Laboratory, New Delhi

Dr. K.S. Krishnan Marg, New Delhi -110012
EPABX Lines: 91-11-25742610, 91-11-25742611, 91-11-25742612
Fax: 91-11-25726938, 91-11-25726952

National Chemical Laboratory (NCL), Pune

Dr. Homi Bhabha Road, Pune - 411008

Central Scientific Instruments Organisation, Chandigarh

Sector 30-C, Chandigarh- 160030

International collaborations

Nano Science and Technology Institute, with its centers at Switzerland, Cambridge and Massachusetts offer a lot of job opportunities. ASME nano- technology institute in New York also provides job opportunities to deserving candidates.

Nano Science and Technology Institute (NSTI)
One Kendall Square, PMB 308, Cambridge, MA 02139, U.S.A.

Conclusions and Future

India is a fastly developing country and hence has become an attractive destination for global investors. NT is being heralded as the next enabling technology that will radically change the future of several technologies, products and markets (www.nanoforum.com). Enormous research is going on in India with the emerging technology making path towards commercialization.

Due to excellent education system, R&D infrastructure and skilled engineers and scientist, several multi-national companies are opening new ventures in india. Currently over 150 MNC's have captive R&D centres in India, besides a host of government and privately funded R&D organizations (nanoforum.com).

In future, worldwide, nanotechnology is expected to contribute to wealth creation, sustainable development and other benefits for producers, consumers and society at large. But so far, Indian activities in nanoscience and nano-technology have mostly been neglected by the international community. The funds for research are not apt at times. Hence there is a need for good govt. policies and increase in publication and funds. The NT as new field is fast

emerging as the favorite of all kinds of technological arena and will be one of the most significant enabling technologies in the future. This field is expected to boom in the future and throw up a large number of job opportunities with handsome salary packages for Indians. Hence need for better awareness and investments.

References

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