

on the frontiers of SCIENCE

Small is big. With research, in practically every field, going down to the basic building blocks of life, be it discovering new characteristics or making new materials ranging from microscopic to mesoscopic, nanosciences is truly the science to watch out for in the future.

BY KANIKA TANDON

In today's world, small has big power and nanotechnology as a branch of science surely believes in the power of small. The word 'nano' literally means 'dwarf' and nanotechnology deals with the application of technology on particles as small as 100 nanometres. Since under such a small size the particles change characteristics—a metallic particle can display non-metallic qualities for instance—nanotechnology challenges the very basic rules of science itself. With nanotechnology research penetrating almost every sphere of life from forensic and space research to genetics, energy, clothing, healthcare, medicine, environment, food and beverage, cosmetics, pharmaceuticals and even defence, nanotechnology is the science of tomorrow



A CLOSER LOOK :
A bulk of
opportunity lies in
new inventions and
innovations

offering great scope for growth.

It is a multidisciplinary subject that demands a strong foundation (preferably a master's degree) in any of the science or engineering subjects. "Any person having strong fundamentals in physics, chemistry, mathematics, biology and/or in any of the engineering disciplines can pursue higher education (M.Tech/Ph.D) in nano science and technology," says B.L.V. Prasad of National Chemical Laboratories (NCL), Pune.

A majority of students go for nanotechnology only at the master's or doctoral level. However, there are institutes such as the Amity Institute of Nanotechnology, Noida, that provide nanotechnology and nanoscience at the graduation level as well. At the postgraduate level, the course in nanotechnology deals with size dependent properties of materials, synthesis of nanostructured materials by various methods like soft chemistry, evaporation, sputtering, laser ablation and CVD. Characterisation of nanostructured materials by sophisticated techniques is also taught.

A master's in nanosciences deals with aspects of materials at the nanoscale—this refers to the physical and chemical aspects of change in the properties of materials when it is brought down to 100 nanometers—domination of quantum behaviour and corresponding change in energy levels of the nanosized clusters. Students also study how this change occurs and leads to different optical, electrical, mechanical and thermal properties. Panjab University's University Centre of Instrumentation and Microelectronics (UCIM) provides a combined M.Tech degree in Nanoscience and Nanotechnology whereas, Amity Institute of Nanotechnology provides M.Tech

(Nanoscience) and M.Tech (Nanotechnology) as two separate programmes. Government sources reveal that three universities—Guru Gobind Singh Indraprastha University (GGSIPU), New Delhi, Jadavpur University, Kolkata and Anna University, Chennai, have been sanctioned grants to start MS and M.Tech level courses in Nanotechnology. The IITs have pioneered the cause of nanotechnology by encouraging students from various engineering fields to engage

in research work on promising areas. Doctoral programmes are also popular at organisations such as NCL, Pune, JNCASR, Bangalore, IISc, Bangalore and NPL.

These organisations have received a fillip from the Government's Rs 1,000 crore funded Nano mission that regularly picks up talent and promotes research. Students have to work on projects with senior scientists. At Amity, for example, summer trainings of two months are arranged



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GIREESH G V



S. SIVARAM DIRECTOR, NCL, PUNE

expert speak

Nanoscience and technology is a sub discipline of the broad field called advanced materials that comprises of organic, inorganic and biological materials.

Nanoscience materials involve both, soft and hard materials as well as hybrids of organic and inorganic materials.

Nanoscience and technology deals with the area of preparation, characterization, assembling, manipulation of materials that are nanosize in dimensions. As such, man has used this technology since very early times. Many of the life processes are defined by functions of biological materials in nano dimensions.

The recent excitement in this area is a consequence of superior analytical tools that can perceive matter down to a few nano meters and an ability to manipulate such matter and create new

functional devices for application in microelectronics, bio-medical technologies and sensors.

Consequently, developments in this field is a result of continuing refinement of our understanding of materials science in macroscopic, mesoscopic and nanoscopic dimensions. Such deep insights into the physics of these materials has lead to greater prospects for such materials in defined applications.

Nanoscience and technology must not be looked upon as a separate subject. It is built on sound foundation of physics, chemistry, biology and mathematics.

Additionally, without an adequate understanding of materials in varying lengths and time scales, that is, from microscopic to mesoscopic and finally nanoscopic, it will be impossible to create new applications of nanotechnology which is where the strength of this application science lies.

where students work with eminent scientists in national labs. The National Chemical Laboratories (NCL), Pune, on the other hand, has several collaborations with UK universities. Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bangalore and Indian Institute of Sciences, Bangalore also offer international exposure through multiple collaborations with universities abroad.

Nanotechnology is an exciting field of research and the research scholars might just attain a breakthrough and change the way things exist. There are number of opportunities waiting for students who opt for nanotechnology as their field of expertise. A typical research project could involve trained biologists, chemists, physicists and engineers. As nano-biologists, you can get into research in drug delivery, biomedical censor, diagnostics, biomedical engineering or tissue engineering. As nano-engineers you could specialise in memory applications,

With an ambitious Rs 1,000 crore Nanomission project, both the government and the private sector is committed to providing the best platform for budding nanoscientists

nano-transistors and silicon technology. As nano-chemists, you can research on catalyst reactions, developing paints and pigments, anti-rust coating and adhesive surfaces. Says Ajit Sapre, group president, RIL Research & Technology, "We primarily hire Ph.Ds in material science and synthesis, analytical sciences, modelling or simulation. Nano-bio interface experience is an added plus in candidates." Companies

sucha as Honeywell, Panacea Biotech, Dabur Research Foundation and Reliance have invested huge amounts of money in nanotechnology research and are eager to hire research fellows. Top research institutions including Indian Institute of Chemical Technology, Hyderabad, Central Electro-Chemical Research, Karaikudi, Glass Ceramic Research Institute, Kolkata, IISc.-Bangalore and Bhaba Atomic Research Centre have strong nanotech departments and are actively pursuing research cutting edge projects. As a scientist, one starts off at Rs 20,000 per month and can go upto Rs 5 lakh per month based on experience and place of work. Says Raman Srinivasa, professor, Centre for Research in Nanotechnology and Science (CRNTS), IIT, Mumbai, "The potential is great because the industry demands Ph.Ds. Companies are constantly wanting invent new products to stay ahead of the competition." There's definitely no looking back. ★

INSTITUTES

Amity Institute of Nanotechnology (AINT), Noida

Sector 44,
Noida- 201303,UP
Ph: 1800-11-00-00
Web: www.amity.edu
COURSES: **B.Tech, M.Tech, M.Tech Integrated, M Sc. Nanoscience**
Admission: through AIEEE
Fee structure: Rs 0.35-0.55 lakh per annum

Centre for Research in Nanotechnology and Science (CRNTS), IIT Bombay

Powai, Mumbai – 400076
Ph: 22-2572-2545
Fax: 22-2572-3480
Web: www.iitb.ac.in
COURSES: **Research**
Admission: through AIEEE
Fee- Rs 25,000- 30,000 per semester

Centre of Nanotechnology, IIT Kharagpur

Kharagpur - 721302
Ph: 3222-255221
Fax: 3222-255303
Web: www.iitkgp.ac.in
COURSES: **B.Tech, M.Tech, Dual degree, PhD,**
Admission: through AIEEE
Fee- Rs 25,000-30,000 per semester

Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore

54, Tughlakabad Institutional Area, Jakkur, Bangalore-560 064

Ph: 080-22082750
Web: www.jncasr.ac.in
COURSES: **Bachelors in Design, Multimedia, Fine Arts, PG Diploma in Design, Master's in Design, Certificate course in Advertising Design**

IIT Roorkee

Uttarakhand-247667
Ph-1332-285311
Web: www.iitr.ac.in
COURSES: **M.tech**
Admission: through AIEEE
Fee- Rs 25,000- 30,000 per semester

NIT Bhopal

Bhopal, India -462051
Ph: 755 5206006, 07, 08, 09, 10
Web: www.manit.ac.in
COURSES: **B. Tech, MCA**
Admission: through AIEEE, GATE

NIT Calicut

NIT Campus
Calicut - 673 601.
Ph.No. 0495 2286101
Web: www.nitc.ac.in
COURSE: **M.Tech (elective module available)**
Admission: through NITCET/ GATE

National Physical Laboratory (NPL) Delhi

Dr. K.S. Krishnan Marg,
New Delhi -110012
Ph: 11-25742610, 91-11-25742611
Web: www.nplindia.org
COURSES: **B.Sc and M.Sc in Mass Communication, Journalism and Advertising**

National Chemical Laboratory (NCL), Pune

Dr. Homi Bhabha Road,
Pune 411 008
Ph: 020-2590 2013
Web: www.ncl-india.org
COURSES: **Postgraduate course in Advertising and Public Relations Management. Also provides three-year fulltime course in BA (Hons) Mass Communication**

Vellore Institute of Technology

Vellore - 632 014
Tamilnadu
Ph: 416-2243091 / 93
Web: www.vit.ac.in
COURSES: **M.Tech,**
Admission: through entrance VITEEE
Fee structure: Rs 0.8-0.9 lakh per annum (PG courses)

