

NANOBIOTECHNOLOGY : An Emerging Research Field



Physics

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ABSTRACT

Nanobiotechnology has multitude of potentials for advancing medical science thereby improving health care practices using many novel nanoparticles and nanodevices with an enormous positive impact on human health. In India, there are many institutes which provide facilities of research in this field. The concept paper discusses the present and future of Nanobiotechnology and its research aspects in India.

NANO BIOTECHNOLOGY- AN INTRODUCTION:

Nanobiotechnology has several significant universal applications in this field of medicine, food and agriculture and environment and biodiversity conservation. For instance, the nanoparticles due to their small size have proved to be more efficient, target specific, water soluble and stable tools in drug delivery compared with the conventional routes of drug administration. Carbon nanotubes provide better standards of food storage by inhibiting the growth of microbes. Nanosensors and nanofilters offer the prospect of a clean and healthy environment. As evident from these examples, nanobiotechnology aims at increasing health by introducing advances in therapeutics, diagnostics, surgery, etc by virtue of bio principles, modelled in a nano frame, at a nanoscale. Examples include nanotube syringes, polymer nanospheres, nanocrystals, nanocarriers for macromolecules etc.

Status in India:

As we know that the more than 60% of the world population resides in Asia of which India and China together claim more than one-third (33%) of the total human population. The scope of biotech industries and nanotechnology in our country is increasing day by day. One interesting and good point is that India has signed tie-ups with the United States in nanotechnology research including nanobiotechnology. India has shown an appreciable development in the past years in nanobio research and now the nation has plunged itself into deep waters of nanobiotechnology. It is of top priority to promote nanobiotechnology research to address specific issues such as health related problems and treatment common to developing nations. Nanobiotechnology may, therefore, ease many avenues of life sciences by integrating cutting-edge applications of information technology and nanotechnology into contemporary biological issues. This technology has potential to remove obvious boundaries between biology, physics and chemistry, and shape up our current ideas and understanding. For this reason, many new challenges and directions may also arise in education, research and diagnostics in parallel by the extensive use of nanobiotechnology with the passage of time.

As the data have been collected in the field of nano science that more than 700 Indian institutes published more than eight thousand research papers in nanoscience and nanotechnology during 1980-2010. Among these institutes only 18 institutes produced more than 65% publications. The largest numbers of publications (723) were contributed by Indian Institute of Science (IISc), Bangalore followed by Indian Institute of Technology (IIT), Kharagpur (606); National Chemical Laboratory (NCL), Pune (589); Indian Association of Cultivation Science (IACS), Kolkata (563); and Bhabha Atomic Research Centre (BARC), Mumbai (434). BARC has basically focused its activity on micro design, simulation and Micro Electro Mechanical System (MEMS) packaging area. Analyses of the growth and decline in publication productivity using normalised activity index of 15 research institutes showed that only one (IIT M, Chennai) witnessed rise in its activity during 1982-1984. During 1985-1987, two institutes (BARC, Mumbai and IISc, Bangalore) witnessed rise in their activ-

ity. This situation improved gradually as during 2006-2008, eight institutes (NPL, New Delhi; IIT, Delhi; ICT, Hyderabad; University of Delhi, Delhi, IIT B, Mumbai; IACS, Kolkata; IIT, Kanpur; and BARC, Mumbai) witnessed rise in their activity.

RECENT WORKS:

- Enhanced photodynamic efficacy and efficient delivery of Rose Bengal using nanostructured poly (amidoamine) dendrimers: potential application in photodynamic therapy of Cancer, K. Karthikeyan, A. Babu, S. J. Kim, R. Murugesan, K. Jeyasubramanian, Cancer Nanotechnology, 2011.
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- Nanotechnology- based combinational drug delivery: an emerging approach for Cancer therapy, P. Parhi, C. Mohanty, S. K. Sahoo, Drug Discovery Today, 2012.
- Nanophase modification of concrete for enhancement of microbial properties and durability: present status and future scope- D. Ramchandran, V. Vishwakarma, S. S. Samal, International Conference on Nanoscience, Engineering and Technology, IEEE Xplore, 2011.
- Polyethylene glycol-modified gelatine/ polylactic acid nanoparticles for enhanced photodynamic efficacy of a hypochlorin derivative in vitro, A. Babu et al. Journal of Biomedical Nanotechnology, 2013.
- Bacterial exopolysaccharide based magnetic nanoparticles: a versatile nanotool for cancer cell imaging, targeted drug delivery and synergistic effect of drug and hyperthermia mediated cancer therapy, S. Babu et al., J Biomed Nanotechnology, 2014

PATENT WORKS:

- Sahoo SK and Vandana M: A water soluble PEGylated pemetrexed and a Process for the same. Indian patent Application No 1405/ KOL /2010 of 18/12/2010.
- Sahoo SK, Pardhi P and Mohanty C: Drug delivery formulation of rapamycin in the form of polymeric nanoparticles. Indian Patent Application No 38/ KOL /2011.
- Sahoo SK and Vandana M: A water soluble polymeric drug formulation and a process for the same. Indian patent Application No 77/ KOL /2011 of 20/1/2011.
- Maitra AN, Ghosh PK, Sahoo SK and Dabur Research Foundation, Sahibabad, Ghaziabad-201010, India. Formulation of paclitaxel, its derivatives or its analogs entrapped into Nanoparticles of Polymeric micelles.
- Sahoo SK and Mohanty C: A process for preparing curcumin loaded nanoparticulate system for Cancer therapy. Indian patent Application No 164/ KOL /2010 of 22/2/2010, International PCT Application No. PCT/ IN2010 /000618 of 26/10/2010.
- Sahoo SK and Mohanty C: A process for preparing curcumin encapsulated chitosan-Alginate sponge useful for wound healing. Indian Patent Application No. 1189/ KOL /2010 of

27/10/2010 and International PCT Application No. PCT/IN2010/000813 of 14/1/2011.

INTERNATIONAL CONTRIBUTION:

Deakin University and the Energy Resources Institute of India (TERI) have partnered to open new Bionanotechnology Research Centre in D3elhi. The Centre was opened by Deakin University's Vice-Chancellor, Professor Jane den Hollander, and the Director resolve issues such as food security amid climate uncertainty, remediation of polluted environments, deriving health applications from novel molecules as well as improving the lives of people in poor communities. The new centre will pool together the nanomaterials expertise from Deakin University's Institute for Technology Research and Innovation (ITRI) with the pharmacology, food agriculture, and environmental work of TERI's Biotechnology and Management of Bioresource Division (BMDDB). It will also provide the hub for the Deakin India Research Initiative (DIRI), launched last year, which plays host come 50 PhD students working in various Indian industries or with other research partners under the supervision of leading Indian And Australian researchers. It is also hoped that the Deakin/TERI partnership will lead further partnerships and collaborations between India and Australia. Research and Development in Nano-Science and Technology has been identified as a priority area in our S & T co-operation agreements with many countries such as USA, Germany, France, Italy, Russia, Japan etc. Apart from exploratory visits of Scientists, organization of joint workshops and conferences and joint research projects, coordinated access to sophisticated research facilities is an important component of such agreements.

A project "Euro India" announces the launch of its website at www.euroindianet.info. Euro India Net is designed to promote stronger collaboration between EU and Indian Scientists and Industrialists in the nanotechnologies and nanosciences. The project, coordinated by sociedade portuguesa de Invacao (SPI), began in April and is funded by the European Commission's 6th Framework Programme under the International cooperation priority the website is the focus point for information about the project and a means of establishing and strengthening EU-India collaboration in nanotechnology. Nanotechnology is an identified priority area for Canada-India collaboration (as defined by the Canada-India Joint Science and Technology Cooperation (Committee). Waterloo institute for nanotechnology (WIN) has established strong agreements with three of India's top institutions and is actively funding researcher and students through a matching programme between WIN and India's Nano Mission.

RESEARCH INSTITUTIONS:

- Centre for Nano Science And Engineering (CNSE), IISc, Bangalore: A major interest at CNSE falls under the broad category of "Nanobiotechnology" with a major thrust towards

bio-molecular sensing and drug delivery.

- Institute of Nano Science and Technology, Mohali, Punjab.
- Department Of Biochemistry, Calcutta University.
- Centre for Research in Nano Sciences and Nanotechnology, Calcutta University.
- Centre for Nanoscience and Nanotechnology, Jamia Millia Islamia.
- National Centre for Nanosciences and Nanotechnology, University of Madras.
- Nanotechnology Research Centre, SRM University
- Centre for Nano Science And Technology

MAJOR CONFERENCES:

- Advances in Polymer Science & Nanotechnology: Design and structure (PSNDS-11) at Applied Chemistry Department, M. S. University Vadodara, Gujrat.
- International Conference on Nanoscience and Technology 2012 (ICONSAT-2012). Hyderabad, India.
- National Conference, Bharti Vidhyapith University, Pune. ROMP is a versatile Synthetic Tool for Making Functional Biopolymers, Shunmugam.
- National Symposium on Recent Advances in Chemistry (NSRAC-2013) at Pondichery University.
- International Conference held between at IISc Bangalore, India. Polynorborene Based Nanocarriers for Biomedical Application Shunmugam.
- International conference on Nanoscience and Nanotechnology-ICONN 2013, Chennai, India.
- 3rd International Conference on Advanced Nanomaterials and Nanotechnology (ICANN-2013), Centre for Nanotechnology at the Institute of Technology Guwahati (IITG),India.
- Recent Advances in Polymer & Rubber Science & Technology, RAPT 2014, Calcutta University, Polymer Based Detection Approach to Metal Poisoning in Drinking Water, Shunmugam.
- National Conference on "Recent Trends in Research in Chemical Sciences"(RTRCS 2014), Manipal University Jaipur, Rajsthan.

CONCLUSION:

In India, the nanobiotechnology is gaining importance and it has become an interesting field to work. The field of nanotechnology and Nanobiotechnology is new but working on nano scale is not new in life science as well as other sciences. Presently many scientists are inventing nano scaled novel particulates matter, devices, systems, techniques which all are in nanoscale for the welfare of living organisms and the surrounding. So we are plunging into a new state of science and in future we can see a lot of nano science in nano scale.

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