# Concept and Approaches of Nano Technology

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## *Introduction*

Nanotechnology is the manipulation or self-assembly of individual atoms, molecules, or molecular clusters into structures to create materials and devices with new or vastly different properties. It is the science and technology that focuses on special properties of a material which emerge from nanometer size is becoming one of the most promising scientific fields of research in decades. It is enabling scientists to better understand better the relationships between macroscopic properties and molecular structure, degree of order, and intermolecular forces in synthetic materials and biological materials of plant and animal origin. The word nanotechnology is generally used for materials having size range between 1 and 100 nm however it is also inherent that these materials should display different properties from their micro or macro scale in terms of their physical strength, chemical reactivity, electrical conductance, malleability, ductibility, magnetism and optical effects (Huang et al. 2007). Nanotechnologies involve the understanding and control of matter at the nanoscale, namely, at dimensions between approximately 1–100 nm, where unique phenomena such as improved physical, chemical, and biological properties may enable novel applications.

## *Concept and term*

The term 'nanotechnology' was not used until 1974, when Norio Taniguchi, a researcher at the University of Tokyo, Japan used it to refer to the ability to engineer materials precisely at the nanometer level (Taniguchi 1974). "Nano-technology" mainly consists of the processing of, separation, consolidation, and deformation of materials by one atom or by one molecule. The prefix 'nano' is derived from the Greek word for dwarf. A nanometer (nm) is one billionth of a meter, or $10^{-9}$ m or one-millionth of a millimeter pico Newtons (pN = $10^{-12}$ N), and Angstrom (A = $10^{-10}$ m). Nanotechnology are the design, characterization, production and application of structures, devices and systems by controlling shape and size at nanometer scale. Nanoscience is the study of phenomena and manipulation of materials at atomic, molecular and macromolecular scales, where properties differ significantly from those at a larger scale. However, as the term 'nanotechnology' encompasses such a wide range of tools, techniques and potential applications, we have found it more appropriate to refer to 'nanotechnologies'. The first term of reference of this study was to define what is meant by nanoscience and nanotechnology. These new materials are manufactured to have unique physical or chemical properties, which arise from their small size, shape, surface area, conductivity, or surface chemistry, and have been applied in numerous ways in fields such as textiles, electronics, engineering, and medicine (Smith et al.

2007). The concept of a ‘‘nanometer’’ was first proposed by Richard Zsigmondy, the 1925 Nobel Prize Laureate in chemistry. He coined the term nanometer explicitly for characterizing particle size and he was the first to measure the size of particles such as gold colloids using a microscope. Modern nanotechnology was the brain child of Richard Feynman, the 1965 Nobel Prize Laureate in physics, at an American Physical Society meeting at California Institute of Technology on December 29, 1959, presented a lecture titled, ‘‘There’s Plenty of Room at the Bottom’’, in which he introduced the concept of manipulating matter at the atomic level. This novel idea demonstrated new ways of thinking and Feynman’s hypotheses have since been proven correct. It is for these reasons that he is considered the father of modern nanotechnology. (Hulla et al., 2015). In the 1980s the basic idea of this definition was explored in much more depth by Dr. K. Eric Drexler, who promoted the technological significance of nanoscale phenomena and devices through speeches and the books Engines of Creation. It is the manipulation of individual atoms and molecules into structures to create new products. Nano particles can be made by top down approach by reducing the size of the smallest structures to the nanoscale and the bottom up which involves manipulating individual atoms and molecules into nanostructures. The current challenges of sustainability, food security and climate change are engaging researchers in exploring the field of nanotechnology as new source of key improvements for the agricultural sector.

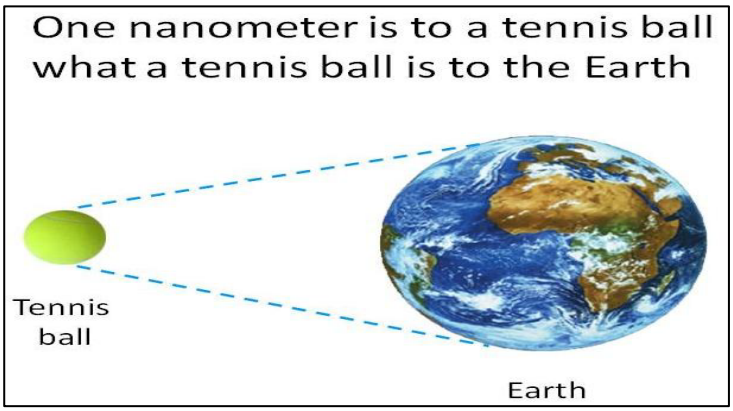


Fig. 1: Pictorial assumption of size of nano particles

***Approaches of nano technology***

Nanotechnology is usually represented by two different approaches, ‘top-down’ and ‘bottom-up’. ‘Top-down’ refers to making nanoscale structures from smallest structures by machining, templating and lithographic techniques, for example photonics applications in nanoelectronics and Nano engineering. Whereas ‘bottom-up’, or molecular nanotechnology, applies to building organic and inorganic materials into defined structures, atom by atom or molecule by molecule, often by self-assembly or self-organization, which are applicable in several biological processes. Biologists and chemists are actively engaged in the synthesis of inorganic, organic, hybrid and metal nanomaterial including different kinds of nanoparticles having unusual properties like optical, physical, biological, etc. Due to these properties, nanoparticles have enormous applications in many fields like electronic, medicine, pharmaceuticals, engineering and agriculture (Salata, 2004).

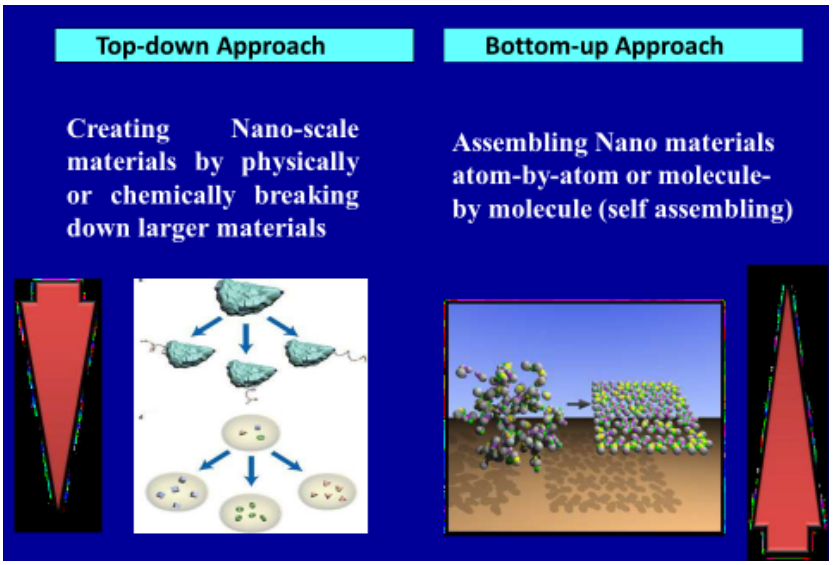


Fig. 2: Different approaches of nano technology

***Need of nano technology***

Nanotechnology has the potential to revolutionize the existing technologies used in various sectors including agriculture. Nanotechnology may have concrete solutions against many agriculture-related problems like insect pest management using traditional methods, adverse effects of chemical pesticides, development of improved crop varieties, *etc.* Nano materials in different forms can be used for efficient management of insect pests and formulations of potential insecticides and pesticides. Nanoparticle-mediated gene transfer would be useful for the development of new insect resistant varieties. Therefore, it can also be concluded that nanotechnology can provide green and eco-friendly alternatives for insect pest management without harming the nature.

One application of nanotechnologies in agriculture addresses low use efficiency of inputs. Nano sensors are devices that respond to environmental conditions converting them to a useful form of information. They are capable of detecting very small amounts of contaminants, pests, nutrients and even stress caused by nutrient deficiencies, drought, and temperature or pathogen presence. This detection engages nano delivery systems that deliver, with high precision, drugs or nutrients to crops and animals (Johnston, 2010).

***Function of nanotechnologies***

Nanotechnologies will fundamentally change the understanding and conditions of mankind and create new development opportunities for physics, chemistry, materials, biology, medical science, and other fields. Nanotechnologies can be used to operate genes freely, to produce plant and animal species with its excellent properties, and nanoparticles can be used as vectors for treating various diseases. When nano biology develops to a certain level, nanotechnologies can be used to produce nano biological cells with recognition ability and can absorb biological medicine which can inhibit cancer cells, which may then be injected into the human body to directly destroy cancer cells.

Nanotechnologies hold great potential for creating new materials with enhanced properties. A number of nanotech based products are finding applications in industries such as medical devices, imaging, sports, bio sensing, electronics, drugs, environmental cleanup, cosmetics and sunscreens, agriculture, textiles, food, etc. In the future, the global economy will be increasingly influenced by nanotechnologies, as more products containing nanotechnologies move from research and development into production and commerce (Sastry et al., 2011).

***Conclusion and future research***

Nanoparticle concentrations for application needs to be standardized for further improvement in crop growth and nutritional status. Internationally shortage of standard legislation, protocol for manufacture, use, export, import and information regarding fate, behaviour, ecological risk of Nano pesticides

***References***


- Ball, P. (2002). Natural strategies for the molecular engineer. Nanotechnology 13:15-28.
- Fadeyibi, A., Yisa, M.G., Adeniji, F.A., Katibi, K.K., Alabi, K.P. & Adebayo, K.R. (2018). Potentials of zinc and magnetite nanoparticles for contaminated water treatment. *Agricultural Reviews*, 39 (**2**) 175-180.
- Haijiao, L., Jingkang, W., Marco, S., Ting, W., Ying, B., & Hongxun, H. (2016). Advances in Materials Science and Engineering. An Overview of Nanomaterials for Water and Wastewater Treatment
- Huang, J., Li, Q., Sun, D., Lu, Y., Su, Y., Yang, X., Wang, H., Wang, Y., Shao, W., He, N., Hong, J. & Chen, C. (2007). Biosynthesis of silver and gold nanoparticles by novel sun dried *Cinnamomum camphora* leaf. Nanotechnology 18:105104
- Hulla, J.E., Sahu, S.C. & Hayes, A.W. (2015). Nanotechnology History and future. Human and Experimental Toxicology, 34 (12) 1318–1321.
- Johnston, C.T. (2010) Probing the nanoscale architecture of clay minerals. Clay Minerals 45: 245-279.
- Klaine, S.J., Alvarez, P.J., Batley, G.E., Fernandes, T.F., Handy, R.D., Lyon, D.Y., Mahendra, S., McLaughlin, M.J. & Lead, J.R. (2008). Nanomaterials in the environment behavior, fate, bioavailability, and effects. - *Environ. Toxicol. Chem*. 27: 1825-1851, 2008.
- Nel, A., Xia, T., Mädler, L. & Li, N. (2006). Toxic potential of materials at the nano level. - *Science* 311: 622-627, 2006
- Prashanth, S., Menaka, I., Muthezhilan, R. & Navin, K.S. (2011). Synthesis of plant-mediated silver nanoparticles using medicinal plant extract and evaluation of its antimicrobial activities. *Int J Eng Sci Technol,* 3:6235-50.

- Salata, O.V. (2004) Application of nanoparticles in biology and medicine. J Nano biotechnology 2:3.
- Smith, C.J., Shaw, B.J. & Handv, R.D. (2007) Toxicity of single walled carbon nanotubes to rainbow trout, (Oncorhynchusmykiss): respiratory toxicity, organ pathologies, and other physiological effects, *Aquat Toxicol* 82:94–109.
- Tilman, D., Cassman, K.G., Matson, P. A., Naylor, R., & Polasky, S. (2002). Agricultural sustainability and intensive production practices. *Nature*, 418(6898), 671–677.