Nanotechnology: The Multidisciplinary Technology – A Review

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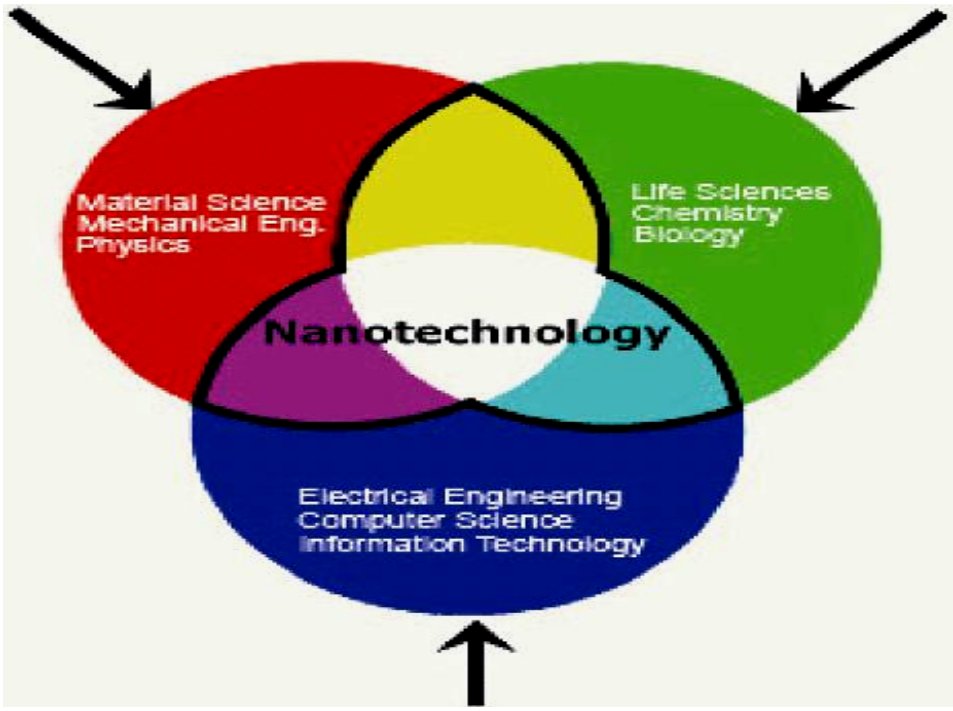
Nanotechnology has been defined as relating to material, system and processes which operate at a scale of 100 nm or less. It has interdisciplinary approaches. Nanotechnology has potential to change the entire scenario of the present food industry and agriculture with the help of nano-based technology. Environmental pollution is threat to the world's environment, many nano based eco-friendly tools has developed which can reduce the pollution and clean-up the existing pollutant. Nano is also playing important role in the field of medical science and veterinary science.

Key words: Nanotechnology, Food industry, Nano-particles.

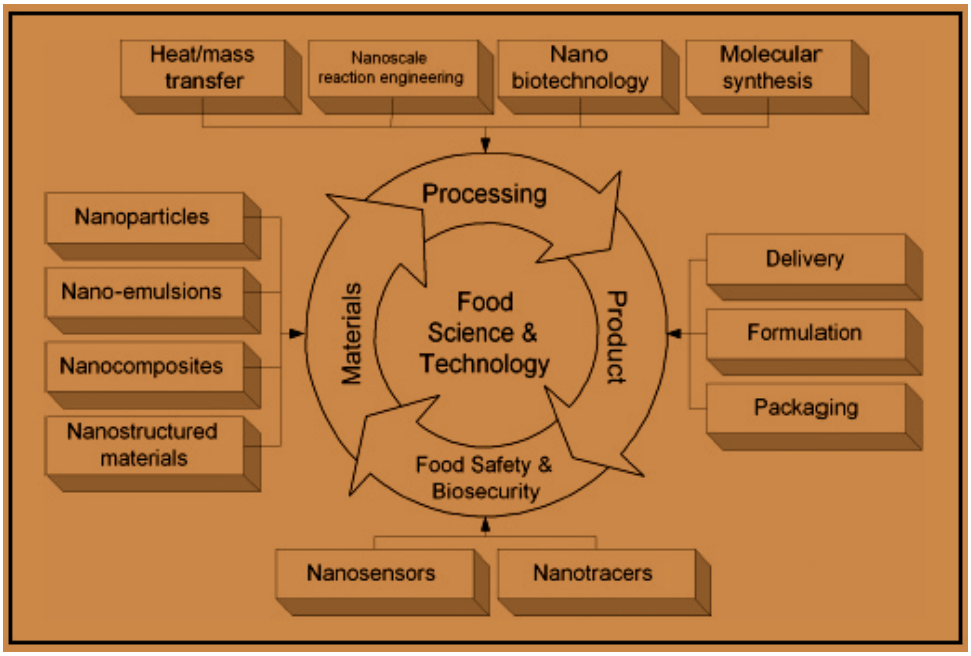
1. INTRODUCTION

Nanotechnology is the emerging science of the objects that are intermediate in size between the largest molecules and the smallest structures that can be fabricated by current photolithography, that is the science of the objects with smallest dimensions ranging from a few nanometers to less than 100 nanometers [1,2,3]. Nanotechnology has interdisciplinary approach and has entered in different fields of applied sciences such as medical sciences, agriculture, environmental sciences, animal sciences, chemistry, physics etc. The nanotechnology is provisionally defined as relating to the materials, systems and processes which operate at a scale of 100 nanometer (nm) or less. A nanometer is one billionth of a meter, overall nano refers to a size scale between 1nm and 100nm. In this scale, physical, biological, and chemical characteristics of materials have fundamentally different from each other and often unexpected actions are seen from them [4]. Biologist and chemists are actively engaged in the synthesis of organic, inorganic, hybrid and metal nanomaterials including different kind of nanoparticles having unusual properties like optical, physical, biological etc. Due to these properties, nanoparticles have enormous applications in many fields like medicine, electronics, engineering and agriculture etc. [5,6].



Interdisciplinary apporach of nanotechnology

Nanotechnology has massive ability to create revolution in the field of agriculture. Today to control diseases in plants mainly chemicals like pesticide, insecticide and weedicide etc. are used. Unlimited use of such chemicals is threat to the environment and ecosystem. Such chemical can pollute soil, water bodies and adversely affect the human health directly or indirectly. Nanotechnology help agriculture science and can reduce environmental pollution by production of weedicide, pesticide and fertilizers based on nanotechnology. Studies confirmed that metal nanoparticles are effective against plant pathogens, insect and pest. Hence, nanoparticle can be used in the preparations of new formulations like pesticide, insecticide, insect repellants [7-10]. Nano capscule can enable effective penetration of herbicides though the cuticle and tissues, allowing slow and constant release of the active substances [11]. Torney [12] reviewed that nanotechnology has promising applications in nanoparticle mediate gene transfer. It can used to deliver DNA and other chemicals to the desired plant tissues for protection of host plant against insect pest. Nano- emulsions is useful for the formulations of pesticides [13]. Barik [7] reviewed the use of nano-silica as nanopesticide. Mousavi & Rezaei [4] reviewed that detection and utilization of biomarkers in accurately indicating disease stage is also new area of research. Nano based diagnostic kits not only increase the speed of detection but also increase the power of detection [14].



Use of nanotechnology in food science

Nanotechnology also has potential application in food production and processing. Complex set of engineering and scientific challenges in the food and bio-processing industry for manufacturing high quality and safe food through efficient and sustainable means can be solved through nanotechnology. There is a lot of literature available indicate the use of nanotechnology in food industry [15,16]. Bacteria identification and food quality monitoring using biosensors, active, intelligent, and smart food packaging system, nanoencapsulation of bioactive food are few examples of emerging applications of nanotechnology for the food industry [17]. Recently, nano coatings are produced for fruits that cover the fruit completely, and prevent the fruit weight loss and shrinkage [18]. Smart packaging could sense and indicate when food is beginning to spoil & packaging that will better control gas diffusion. Polymer-silicate nanocomposites have also been reported to have improved gas barrier properties, mechanical strength, and thermal stability [19,20,21]. They can also improve the mechanical and heat resistance properties and lower the oxygen transmission rate. So, with this technology mass amount of food can be readily checked for their safety of consumption [22].

Now a days, pollution is a common problem in every country, there is great need to protect air, water and soil from pollution. There are many eco-friendly applications of nanotechnology. The use of zero-valent (iron nano particles) for the remediation of contaminated ground water and soil is good example of how environmental remediation can be improved with the help of nanotechnology [23]. Use of nano-based alternative (renewable) energy supplies and filter or catalysts will also help to reduce the pollution and clean-up existing pollutants [16]. Nano gas and nano smart dust sensors are useful in determining the amount of pollutant and dust in air [24]. Researchers have discovered unexpected magnetic interactions between ultra small specks, which can help to remove

arsenic from water using a magnet [25]. Dendrimers are helpful in removing metal contaminants [26].

Nanotechnology is helpful in development of sophisticated tools for detection of diseases like cancer and antherosclerosis etc. at early stage. Specific nano-particles can also be combined with nano-wires, nano-tubes, nano-cantilevers and microarrays to produce integrated and automated detection system [27]. Bhowmick *et al.* [28] has proved that 'Bhasmas' used in Ayurveda and homeopathic medicines are present in the form of nano-particles. Nanotechnology also has bright future approaches in veterinary and treatment of domesticated animals. Use of nano-tubes inside the skin of the livestock show peak real-time of estrus & estrogen hormone, and the exact and actual time of insemination [24,29,30].

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