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An overview on role of smallest technology to solve big innovation problems over worldwide: nanotechnology [Review Article]

Vaishnavi Gohri [1]*, Yashwant Sompura [2]

[1] *Oriental College of Pharmacy, Navi Mumbai, Maharashtra (400705) India*

[2] *University College of Science, MLS University, Udaipur, Rajasthan (313001) India*

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Abstract

From few decades, we saw that nanotechnology played an important role in agriculture, medicines and other fields of human welfare. The treatment of cancer is now possible due to nanotechnogy. Recently, nanotechnology develops various disease resistant crops. In this paper we will discuss about applications of nanotechnology in various fields.

KEYWORDS: Nanoparticles, Nano sensor, Nano knife.

1. Introduction

Nanotechnology is the use of matter on the atom, molecule & supramolecular stage for industrial growth purposes. Nano means a billionth of a matter just like an average human hair is about 80,000 nanometres wide. Around 2000 years ago sol de nanocrystal was used by Greeks and Romans to dye hair. In the Middle Ages Gold nanoparticles of different sizes used to produce different colours in stained glass windows. First concept given by *Dr. Richard P Feynman* and named by Norio Taniguchi in 1974. First book on nanotechnology introduced in 1986 written by K. Eric Drexler named it "Engines of Creation" **[1].** Modern developments of the atomic force microscope [AFM] and scanning tunnelling microscope [STM] are probes to launch nanotechnology. Nanolithography is introduced based on optical, X-rays, Electron beams etc. Carbons nanotubes are made which consist of the highest strength to weight ratio that helps in creating lightweight spacecraft, cancer treatments because of easy penetration and helps in developing sensors that can detect chemical vapours. Quantum dots are introduced which are used in Microelectromechanical systems (MEMS). Nanobots are useful for detection of toxic components in the environment, in drug delivery systems and in biomedical instrumentation. The nanoparticles dire in various dimensions, shapes and sizes apart from their material. A nanoparticle can be either a zero dimensional where the length, breadth and height is fixed at a single point (nanodots), one dimensional where it can possess only one parameter (graphene), two dimensional where it has length and breadth (carbon nanotubes), three dimensional where it has all the parameters such as length, breadth and height (gold nanoparticles). The nanoparticles are of different shapes, size and structure. The surface can be uniform or irregular with surface variations. Numerous synthesis methods are being developed to enhance the properties and reduce the production costs. Some methods are modified to achieve process-specific nanoparticles to increase their optical,

*Corresponding author e-mail: gohrivaishnavi123@gmail.com
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mechanical, physical and chemical properties. Its impact is vast in various fields related to science and technology like energy storage, defence and security, metallurgy and materials, electronics, optical engineering and communications, biomedical and drug delivery, agriculture and food, cosmetics and paints, biotechnology and textiles. Today scientist and engineers are developing a wide range to introduce nanoscale to take advantage of their enhanced properties such as higher strength, lighter weight, increased control of spectrum light, greater chemical reactivity than their larger scale counterparts. It has a potential to revolutionise a diverse range of fields, from healthcare to manufacturing **[2-5]**.

2. Synthesis of nanomaterial's

Here are two approaches by which we can prepare nanomaterials, the bottom-up approach and the top-down approach. nanoparticles are first obtained at the atomic level which result in integrating into the desired material. Further starts with a bulk material at the macroscopic level which follows by trimming of the material to the desired nanoparticles. selection of any of these methods in terms of costs, scalability, particle sizes and size distribution should be considered. Chemical methods provide an easy way to synthesize nanoparticles in solution. The most widely used chemical methods for the synthesis of nanoparticles are solid-state reaction, sol-gel technique, solvothermal method, hydrothermal method and molten salt method **[6]**. The inexpensive preparation is dry and wet mechanical grindings this most widely used for physical methods to synthesis the nanoparticles. Wet grinding provides various options to control the size of particles. In the physical methods it is required to have raw material to grind, surfactant to cover the particle surface and prevent their aggregation and overheating during grinding, example is oleic acid and fluid carrier where both raw material and surfactant are mixed with fluid carrier. Physical-chemical methods are also used to prepare nanoparticles with controllable sizes and shapes; a combination of chemical methods with external physical factors is needed **[8-9]**.

3. Application of nanotechnology in various field:

(1) Environment

Nanostructured filters that can remove virus cells and other impurities from water which help to create clean, affordable and sterile environment during scientific research. A nonfabric paper towel used which can absorbs 20 times its weight in oil, can be used for oil spill clean-up operations. Each development teaches us new ideas and technology, we used to get knowledge of what is better for development. Nanotechnology has the potential to improve current environmental protection measures and our understanding of the environment. It helps to reduce waste, improve energy efficiency, conserve energy and remediate waste.it pimples the interaction of nanoparticles with the environment and possible risks can be avoided **[6-8].** Sustainable manufacturing process based on the use of nanoscale science and technology integrated process and assembly that can serve human needs and be compatible with the surrounding ecosystem and population. It has many applications in green manufacturing belonging to Atom by Atom construction which shows less material to dispose of aspects and they involve the use of environmentally friendly starting materials and solvents, improved catalysts and significantly reduce energy consumption in the manufacturing process. It is also used in green energy as nanoproducts such as solar and fuel cell could lead to commercially viable alternative sources of clean energy. Environmental protection by using nanoparticles or Nano remediation has been successfully used to treat or decontaminate the air, water and soil for over a time]. Nano remediation is one of the effective solutions as it offers in situ treatment, eliminating the necessity of pumping the ground water out for treatment and evacuation to reach the target destination. The nanoparticles are placed at the desired location from where it going to improve or stop the contaminations. The general mechanism involved in decontamination is the redox reactions. The nanoparticles are used against the contaminants are most likely to be heavy metals, pathogens and organic contaminants which disinfect the surface water. It has proven to be efficient and reduce the need for chemicals. Oil spill is one of the major problems that arise nowadays worldwide as it may spread over very long distances. Cleaning them by conventional methods is difficult and time consuming, which makes the situation worse as it may spread more and can be cured by using nontechniques **[21-23].**

(2) Electronics

These screens are lighter and better picture quality, among everything. Nanotechnology used in electronics are called Nanoelectronics which are useful for various purposes like reducing the size of transistors used in integrated circuits, reducing power consumption, increasing density of memory chips, reducing cost of fabrication of integrated circuits due

to uses of nanolithography and it decreases the weight and thickness of the screens which improve quality of screens. Nanoelectronics covers the diverse set of devices and materials which change due to change in their mechanical properties and play a significant role in the working of this device. First transistors were built in 1947, and now 20 billion transistors-based circuits are integrated into a single chip. There are many more nanoelectronics devices nowadays known to us like Spintronics (role in data storage), Optoelectronics (detect and control light). Batteries made from nanocrystalline nickel and metal hydrides, due to their large surface area, require less recharging and last for a longer time **[25].** The increase in electrical conductivity of nanoparticles is used to detect gases like NO2 and NH3. This is due to increase in the pores of nanoparticles due to charge transfer from nanoparticles to NO2 as the gas molecules bind them together making them better gas sensors.

(3) Medicine

Main uses of nanotechnology occur in the medical field, allowing medicine to become more personalised, cheaper, safer and easier to deliver. This nanotechnology is used to improve drug delivery systems for a range of diseases including cancer, heart diseases, diabetes and other age-related problems in the area of intense research for scientists. Nowadays new methods of preventing, diagnosing and treating various diseases are introducing to the world. Cancerous cells are destroying by using nanotechnology is on growth and it pass through the various clinical trials. Nanoscience has also become sources to fight against atherosclerosis, Nano adjuvants with immunomodulatory properties used to delivery vaccine antigens, Nano-knife use for destroying cancer cells and carbon nanotubes which are already popular for damaging tissues and regenerate nerves in future. Nanotechnology is used in regeneration process of damage cells which has huge demand in tissue engineering. Treatments such as artificial implants and organ transplants having mostly risk to the life of an individual can be easily replaced by tissue engineering because of introduction of nanotechnology. One such example is the growth of carbon nanotube scaffolds. The use of gold in medicine is not new and it is used in Ayurveda in several practices. Gold is use for memory enhancement having minerals which is responsible for enhancing mental fitness of a baby, so it is used in some medicinal preparations.

(4) Cosmetics

Manufactures are nanoscale size ingredients to provide better UV protection, dipper skin penetration, long lasting effects, increased chlorinating quality and many more. Oil in water Nano emulsion is playing a major role as an effective formulation. Nanosomic, liposomes, fullerenes and solid lipid nanoparticles are some of particles which use in different types of nanomaterials to enhance their value Cosmetic products containing nanoparticles are moisturizer, soap, deodorant, toothpaste, shampoo, hair conditioner etc. Following tables shows benefits of nanoparticles in cosmeceuticals.

(5) Food industry

There are different nanoparticles, produced by two approaches and peculiar benefits to the food developments. Here used various types of ENPs (engineered nanoparticles) like Inorganic, organic and surface functionalized nanoparticles. Inorganic includes ENPs of transition metals, alkaline earth metal and non-metal this used in majority in packaging process of products. Organic includes substances encapsulated during nano delivery system for example vitamins, antioxidants, colours, flavour and preservatives. In organic nanoparticle production the focus is on development of nano sized organic substances having increased uptake, absorption and growth of bioavailability in the body. Surface functionalized nanoparticles are useful for antimicrobial, antioxidants or for preservative actions. It provides mechanical strength for example the use of nonclay in food packaging to develop materials with enhanced gas barrier properties. In food industries nanotechnology used in processing as well as in packaging of products.it is used as Anticaking agent to improve consistency and prevent lump formation. It improves the nutria, nano additives and nutraceuticals they enhance value of product. Nano capsules and nanocarriers are used to protect aroma, flavour and other ingredients in food. Nanoparticles used to improve physical performance of food result in smart packaging by using nano-biosensors for pathogen detection. Nano tubes are used in the packaging process they are made of alloys of carbon hence called carbon nanotubes having cylindrical nanostructure **[28-29].**

(6) Construction

Nanotechnology has improved the construction-based projects by making them cheaper, quicker and safer. For example; when nano silica is mixed with the concrete it results in increased mechanical strength of nanoparticles and improves durability. The addition of haematite nanoparticles increases the strength of the concrete. Steel is the most widely available and used material in the construction industry. Nanotechnology is used to increase the properties of steel, for example in bridge construction the use of nano size steel offers stronger steel cables. The other important construction material is glass.

Extensive research is being done on Nano constructive glasses as it has huge application in nanotech field. Since titanium dioxide nanoparticles have sterilizing and anti-fouling properties and catalyse powerful chemical reactions that breakdown volatile organic compounds and organic pollutants, it is used to coat glazing. The paints which we use have resistance against corrosion and its highly insulating because it contains Nano particles. The paints used to coat metal pipes to offer protection from saltwater attack are hydrophobic in nature. This can also enhance its properties by making them lighter for example on aircraft, it might reduce expenses construction **[31].**

(7) Agriculture

Nanotechnology in agriculture has gained good momentum in the last decade and is visually growing on a large scale. The stage of development is good, even though many methods came under the agricultural process. This might be attributed to a unique nature of farm production, which functions as an open system whereby energy and matter are exchanged freely. Gradually increase in demand is due to the higher inputs of nanotechnology used in industries. [32] Nanotechnology gave rise to new technologies which corelates the growth of crops which obviously implies on its productivity as well as it shows its properties in agrochemicals agents which improve crops production and scope to reduce pesticide applications in agriculture. DNA transfer in plants for the development of insect-resistant varieties, food processing and storage and increased product shelf life. Nanotechnology results in an increase in the development of biomass-to-fuel production. Scientist have aim to achieve overall benefits of nanotechnology in all the field related to food, agriculture, aquaculture and fisheries, it's become a revolutionary moment for field related science and technology.

4. Conclusions

It is clear from this paper that nanotechnology has man applications in various files of human welfare such pharmaceuticals, agriculture, food industry.

5. Authors' contributions

Yashwant Sompura provide general concept and drafted part of the manuscript. *Vaishnavi Gohri and Yashwant Sompura* wrote the manuscript. All *author's* read and approved it for publication.

6. Conflicts of interest

No conflict of interest declares by author

7. Funding sources

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