Applications of nanotechnology in Science and technology: - Review paper

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Abstract

Nanoscience and nanotechnology are the study and application of extremely small things and can be used across all the science field such as chemistry, biology, physics, material science Nanotechnology has emerged as an important field of modern scientific research due to its diverse range of applications in the area of electronics, material sciences, biomedical engineering, and medicines at nano levels such as healthcare, cosmetics, food and feed, environmental health, optics, biomedical sciences, chemical industries, drug-gene delivery, energy science, catalysis, reprography, light emitters, nonlinear optical devices, and photoelectron chemical applications and other applications. It gives a brief description about Nanotechnology and its application in various fields. In this paper we also discuss about present and future application of nanotechnology for human efforts but needs further study in sensor technology, cancer curing and drug delivery system. Nanomaterials are being used to build a new technology of solar cells, and novel hydrogen storage systems able to delivering clean energy to countries quiet reliant on traditional, non-renewable contaminating fuels.

***Keywords**:* Nanotechnology, Nano-Engineering, Application of Nanotechnology.

1. Introduction

Nanoengineering is a branch of engineering that deals with all aspects of the design, building, and use of engines, machines, and structures on the nanoscale. The word “nano” means dwarf in Greek language and is used to indicate one billionth of a meter or 10-9 and a world of things is built up from the small scale of nanometres’. The term nanotechnology was like piece of metal money by Norio Taniguchi a, researcher at the University of Tokyo, Japan. Nano science and technology is a broad and interdisciplinary area of research and development activity that has been growing like to explode worldwide in the past few years and making an action in all spheres of human-life. As well as, it has the potential for change the ways in which materials and products are created and the variety and nature of functionalities that can be reached.

2. Historical Background

The history of nanotechnology traces the development of the concepts and experimental work falling under the broad category of nanotechnology. Although nanotechnology is a similarly recent development in scientific research, the development of its central concepts happened over a longer period of time. The history of nanoparticle research very old and the use of these particles date back to the 9th century in Mesopotamia when artisans used these to generate a sparkling effect on the surface of pots. This lustre or glitter over pottery from the middle Ages and Renaissance is due to a metallic film that was applied to the transparent surface of a glazing. The lustre can still be visible if the film has resisted atmospheric oxidation and other weathering. The lustre is within the film itself which contained silver and copper nanoparticles dispersed homogeneously in the glassy matrix of the ceramic glaze. Artisans created the nanoparticles by adding copper and silver salts and oxides together with vinegar, ochre and clay, on the surface of previously-glazed pottery. Then the pots were placed into a kiln and heated to about 600 °C in a reducing atmosphere. With the heat the glaze would soften, causing the copper and silver ions to migrate into the outer layers of the glaze. Michael Faraday 1857 firstly proved scientifically that optical property of nanometals. Nanoparticles are either newly created via nanotechnology or are present naturally over the earth’s scab or in the environment reason by weathering of Au deposits. The metal formed by evaporation is coupled with minerals and been deposited continuously from saline ground water. Nanotechnology has been defined as technologies that mainly consist of the process of separation, consolidation and change the shape of materials by one atom or molecule (Taniguchi, 1974).

The following are the mile stones in the evolution of Nanotechnology.

- 3.5 Mrd. years: First cells with nano-machines.
- 400 B.C: Demokrit: Reasoning about atoms and matter.
- 1905: Albert Einstein: Calculated molecular diameter.

• 1931: Max Knoll, Ernst Ruska: Electron microscope.
• 1959: Richard Feynman: There is plenty of room at the bottom.
• 1968: Alfred Y.Cho, JohnArthur (Bell Labs): MBE (atomic layer growth).
• 1974: Norio Taniguchi: Nanotechnology for fabrication methods below1µm.
• 1981: Gerd Binnig and Heinrich Rohrer: Noble prize for inventing STM.
• 1985: Robert F.Carl, Harald W.Kroto: Richard Smalley: Bucky balls.
• 1986: K. Eric Drexler: writing with a STM tool.
• 1991: Sumio Ligima: Carbon Nanotubes.
• 1993: Warren Robinett, R.Stanley Williams: Combination of SEM and VR (virtual reality system).
• 1998: Cees Dekkar et al.: Carbon nano-tube transistor.
• 1999: James M. Tour and Mark A. Read: Single molecule switch.
• 2000: Eigler et al.: Construction of quantum mirrors.
• 2001: Florian Bambers: Soldering of nanotube with e-beam.
• 2004: Intel launches the Pentium IV 'PRESCOFT' processor based on 90nm technology.

The metals like Silver, gold, Titanium, Magnesium, Selenium, Iron, Tin etc were known only as a metal till recently and it is only when the nano-era came into existence that people started to believe that could even be produced at the nanoscale. The Nanoparticles were being used by various organisms for bioremediation of various metals before the existence of nanotechnology it remained unnoticed. The number of organisms has been used to purify environment by removing various reactive metal salts from the environment.

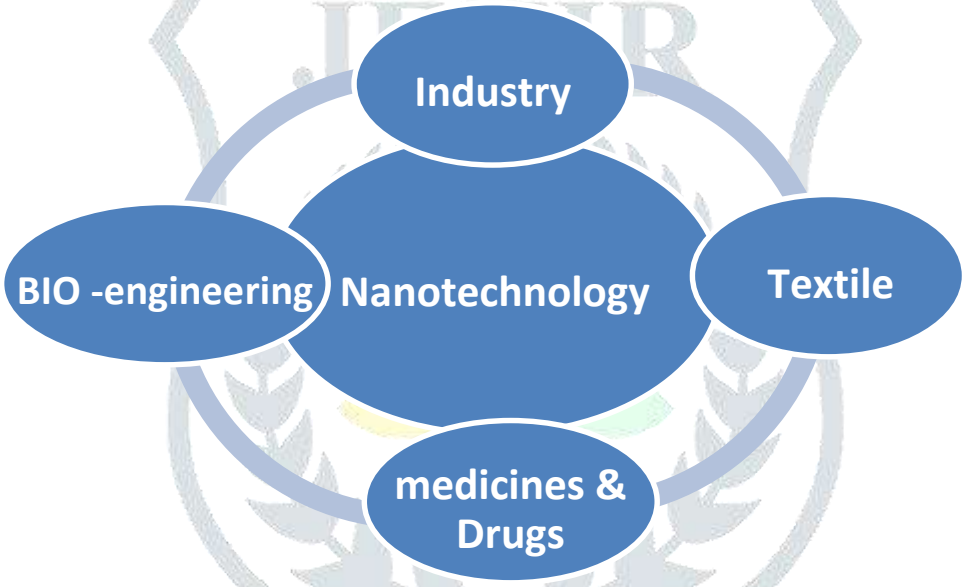

Figure 1 Application in different branches

3. Application of Nanotechnology

Medicine

The scientific and scientific analysis areas have utilized the exclusive qualities of nanomaterials for various programs (e.g., comparison providers for mobile picture and therapeutics for the treatment cancer). Conditions such as biomedical nanotechnology, bio-nanotechnology, and nano-medicine are used to explain this multiple area. Features can be included to nanomaterials by interfacing them with scientific elements or components. The size of nanomaterials is just like that of most scientific elements and structures; therefore, nanomaterials can be useful for both in vivo and in vitro biomedical analysis and programs. Thus far, the incorporation of nanomaterials with chemistry has led to the growth of analytic gadgets, comparison providers, systematic resources, actual physical rehabilitation programs, and medication distribution automobiles.

Diagnostics

Nanotechnology-on-a-chip is one more sizing of lab-on-a-chip technological innovation. Attractive nanoparticles, limited to an appropriate antibody, are used to brand specific elements, components or harmful bacteria. Silver nanoparticles marked with short sections of DNA can be used for recognition of inherited series in an example. Multicolour visual programming for scientific assays

has been obtained by embedding different-sized huge spots into polymeric microbeads. Nanopore technological innovation for research of nucleic chemicals transforms post of nucleotides straight into digital signatures.

Drug Delivery

The overall medication intake and side-effects can be reduced considerably by deposit the effective broker in the melancholy area only and in no higher amount than needed. This highly particular strategy decreases costs and human struggling. An example can be found in dendrimers and nanoporous materials. They could hold little medication elements moving them to the preferred location. Another perspective is based on little electromechanical systems; NEMS are being examined for the effective launch of medication. Some possibly important programs include cancer therapy with metal nanoparticles or silver seashells. A focused or customized medication decreases the medication intake and therapy costs leading to an overall socialbenefit by decreasing the costs to the public health system. Nanotechnology is also starting up new possibilities in implantable distribution techniques, which are often much better the use of injectable medication, because the latter frequently display first-order kinetics (the blood focus goes up quickly, but drops considerably over time). This fast increase may cause complications with poisoning, and medication effectiveness can reduce as the medication focus drops below the focused range.

Chemistry and Environment

Substance catalysis and purification methods are two popular illustrations where nanotechnology already performs a part. The functions provide novel components with designed functions and chemical properties: for example, nanoparticles with a unique chemical around, or particular visual qualities. In this feeling, chemical makeup is indeed a primary nanoscience. In a short-term viewpoint, chemical makeup will provide novel "Nonmaterials" and in the long run, excellent procedures such as "self-assembly" will allow time and energy protecting methods . In a feeling, all chemical functions can be recognized with regards to nanotechnology, because of its capability to produce certain elements. Thus, chemical makeup types a platform for nanotechnology offering tailor-made elements, polymers etc, as well as groups and nanoparticles.

Energy

An important subfield of nanotechnology related to energy nanofabrication. The most advanced nanotechnology tasks related to power are: storage, transformation, manufacturing developments by reducing materials and process rates, power saving and improved alternative power. Nanofabrication is the process of designing and creating devices on the nanoscale.

Industry

In electronics, **nanotechnology** enables the **manufacture** of tiny electronics and electric devices — like nanoscale transistors made out of carbon nanotubes. It can be applied in the production, processing, safety and packaging of food. Nanotechnology is also used in car manufacturing. Tire manufacturers are increasingly using polymer nanocomposites in high-end tires to increase their durability and wear resistance.

Textiles

The Use of engineered nanofibers already makes clothes water and stain-repellent or wrinkle- free. Textiles with a nano technological finish can be washed less frequently and at lower temperatures. Nanotechnology has been used to integrate tiny carbon particles membrane and guarantee full surface protection from electrostatic charges for wearer.

Cancer

Due to the small size of nano particles can be of great use in oncology, particularly in imaging. Nano particles, such as quantum dots, with quantum confinement properties, such as size-tunable light emission, can be used in conjunction with magnetic resonance imaging, to produce exceptional images of tumor sites. As compared to organic dyes, nano particles are much brighter and need one light source for excitation. Thus the use of fluorescent quantum dots could produce a higher contrast image and at a lower cost than organic dyes used as contrast media.

4. Conclusion

Nanotechnology is an emerging field that is potentially changing the way we treat diseases through its diverse range of applications like Nanomedicines to control microbial pathogens, Nanorobotics and drug delivery which is having great achievement to treat targeted diseases. Carbon nanotubes and biosensors have revolutionised the biomedical industry like regular self testing for glucose level, and could be used to monitor the pulse temperature diagnosing diseases etc. In the near future, the application of clean, non-toxic, and eco-friendly nanostructured material will be possible in industry and/or biomedicine. The other applications of nanotechnology like medical imaging, nucleic acid sequence and protein detection, water treatment has achieved a great success from last decade. Recent advances made in the fields of physic, chemistry and material sciences have provided a number of

nanomaterials with unique properties, which are expected to improve the treatment of many tumors otherwise resistant to current therapies. Nanotechnology covers a lot of domains today and will cover a lot more in the near future, it is infinity big and will make a lot of inventions come true.

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