A Review: Nanotechnology

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ABSTRACT
Nanotechnology is the development of engineering devices in nanometer range. Within the next few decades, a vast manufacturing will be made possible by nanotechnology. The purpose of this paper is to look into the present and future aspects of nanotechnogy. The paper gives the brief description of what is nanotechnology..?? It's uses and its applications in various fields.[2]

KEYWORDS
MIT- Massachusetts Institute Of Technology, DNA- Deoxyribo Nucleic Acid, NM- Nano Meter.

1. INTRODUCTION
Nanoscience is concerned with the production, characteristics and design of material having atleast one spatial dimension in the size range of 1-100 nanometre. Nanotechnology is the study of devices, products and process based upon individual or multiple integrated nanoscale components. [1]

An exciting but challenging aspect of nanosc,ience is that matter acts differently when particle are nanosized. This means that many macro level concepts of physics cannot be applied to understand nanoscience. [1] For example we cannot apply principle of classical physics which are otherwise applicable to motion of macro sized objects. At nanoscale level we have to apply quantum mechanical description. [2]

2. PROPERTIES OF NANOPARTICLES
The properties of a substance are usually measured by taking large sample volume. However when these properties were checked for same material at nanoscale level then large difference were observed in many physical properties. This implies that at nanoscale level, physical properties become sized dependent. [1]

2.1 Optical properties
Such as colour and transparency are observed to change at nanoscale level. For example Gold in bulk appears to be yellow in colour while nanosized gold appears red in colour. The main reason for change in optical properties at nanoscale level is that nanoparticles are so small that electros in them are not as freer to move as in case of bulk material. Because of this restricted moment of electrons, Nanoparticles reacted differently with light as compared to bulk material. [1]

2.2 Electrical properties
It is also observed to change at nanoscale level. These properties include conductivity, resistivity of a material. For example in case of carbon nanotube conductivity changes with the changing diameter or area of cross section. Carbon nanotubes can be conducting or semiconducting while graphite is a good conductor of electricity.[3]

2.3 Mechanical properties
It is observed that physical properties like strength, melting point also change at nanoscale level. For example bulk steel has highest strength then graphite. At nanoscale level cylinder of carbon are 100 times stronger than steel and are very flexible.[9]

2.4 Chemical properties
The percentage of surface items in nanoparticles is larges compared with bulk objects, thus reactivities of nonmaterial are more than bulk material.[10]

2.5 Magnetic Properties
These properties also show drastic change in nanoparticle due to surface effects in maganetic interactions.

3. HISTORY
The history of nanotechnology tells the development of the concepts and experimental work falling under the broad category of nanotechnology.

In **1959,** Feynman gives after-dinner talk describing molecular machines building with atomic precision. In **1974**, Taniguchi uses term "nano-technology" in paper on ion-sputter machining followed by it in year **1977;** Drexler originates molecular nanotechnology concepts at MIT. In the year **1981,** First technical paper on molecular engineering to build with atomic precision. In year **1986**, First book published First organization formed. By the time in year **1990,** Japan's STA begins funding nanotech projects followed by it in the year of **1997** First company founded: Zyvex First design of nanorobotic system was proposed . By the year**1998** First DNA-based nanomechanical device was designed. The year **2001, was stated with the** First report on nanotech industry U.S. announces first centre for military applications. **2003** Congressional implications hearings were introduced. **2006** National Academies nanotechnology report calls for experimentation toward molecular manufacturing and start implementing it. Technology Roadmap was released for Productive Nanosystems in the year **2008. 2009** year came up with anew height to the nanotechnology that gave us an improved walking DNA nanorobot. By the year **2011** First programmable nanowire circuits for nanoprocessors was discovered.[7]

4. USES
Nanotechnology is used to make the material effectively stronger, lighter, more durable, more reactive or better electrical conductors. It benefits us as it is possible to tailor the essential structures of materials at the nanoscale to achieve specific properties. Some of its important uses are:-

4.1 Carbon Nano tubes
These are the sheets of graphite rolled upto make a tube that is carbon macromolecules in cylindrical form. The nanotube dimensions are variable and can be as small as 0.4nm in diameter. The carbon-carbon bonds are sp2

hybridised due to this carbon nanotube has extra strength.[5]

4.2 Nanofilms

It is an assembly of quantum dot layers with gradient of nanoparticle size, composition or density. Nanofilms are used to protect or treat the surfaces in eyeglasses, computers and cameras.

4.3 Nanoscale Transistors

These are the advanced design reduced size transistors. These transistors minimized the leakage of current when the device is in the off state. In nanoscale transistors voltage of operation can be reduced without lose of performance which leads to less power dissipation per-operation.[4]

4.4 Water Treatment

Nanotechnology offers the potential of nanomaterials for the treatment of contaminated surface water, ground water and waste water which is due to micro organism and toxic metal ions.

4.5 Antimicrobial Bandages

An antibacterial bandage using nanoparticles of silver ion is created by Sir Robert Burrell which is very useful nowadays. These silver ions suppress the cellular respiration of microbes and kill them.[5]

4.6 Scratch-resistant coatings

These types of coating are commonly used in everything from carts to eyeglasses**.** It has been discovered that Scratch-resistant coatings can become more effective by adding aluminium silicate nanoparticles which increase the resistance to chipping and scratching.

4.7 Clothing

A thin layer of zinc oxide nanoparticles are used to coat fabrics of clothes which gives better protection from ultraviolet radiations. Nanoparticles in the form of hair or whiskers helps in repel water and make the clothe stain resistant. [8]

Everyday new products such as wrinkle resistance cosmetics, liquid crystal display (LCD) are coming in the market using the process of nanotechnology. There are also many other uses of nanotechnology rather than the above discussed.

5. APPLICATIONS

Nanotechnology is not strucked to any particular field. These technologies are very vast and have many applications in various fields. Some of the fields are described below:-

5.1 Medicine

The application of Nanotechnology in the field of medicine is to detect and treat damage to the human body and disease.[4]

5.1.1 Drug Delivery

It is a technique which reduces damage to healthy cells and allows earlier detection of disease. In drug delivery technique particles are engineered so that they are attracted to diseased cells, which allow direct treatment of disease.

5.1.2 Therapy Techniques

Nanosponges have been developed which absorb toxin and remove them from blood stream. Nanosponges are polymer nanoparticles which are coated by red blood cell membrane. Breast cancer tumours can be destroyed using targeted heat therapy. Nanotubes absorb infrared light from laser and produces heat that burns the tumour. [6]

5.1.3 Diagnostic Techniques

To monitor the level of nitric oxide in the blood stream sensors have been developed using carbon nano tubes embedded in a gel. As the nanoparticles are attached to molecules in the blood stream it indicates the start of an infection. When the sample is scanned for scattering the nanoparticles, RAMAN signal is enhanced which allow detection of molecules and indicates infectious disease at a very early stage.

5.2 Electronics

Nanotechnology holds many applications in the field of electronics or nanoelectronics. It increases the efficiency of electronic devices and reduces their weight and power consumption. [7]

5.2.1 Flexible Circuits

We are aiming for a combination of flexibility, a process of fabrication and less power requirements using cadmium selenide nanocrystals.

5.3 Silver Nanoparticle Ink

It is used to form conductive lines needed for circuit boards. It is a method to print prototype circuit boards using inkjet printers.[8]

5.4 Nanowires

The electrodes made from nanowires enable flat panel displays to be flexible and thinner than current flat panel displays. The semiconductor nanowires are used to built transistors and integrated circuits.

5.5 Food

The importance of nanotechnology is not less in food science. Some nanomaterials are developed that will effect not only the taste of food but also food safety and the health benefits that the food delivers.

5.6 Silver Nanoparticles

With the help of these nanoparticles the storage bins are being produces embedded in the plastics. It kills the bacteria and minimizes the health risks.

5.6.1 Clay Nanocomposites

In light weight bottles, cartons and packaging films clay nanocomposites are used to provide an impermeable barrier to gases like oxygen and carbon dioxide.

5.6.2 Zincoxide Nanoparticles

The strength and stability of the plastic film used for packaging can be improved using zinc oxide nano particles. It blocks Ultraviolet rays and provide anti bacterial protection.

5.7 Battery

Nanotechnology reduces the possibility of batteries catching fire, increase the available power from a battery and decrease the time required to recharge the battery.

5.7.1 Nitrogen-Doped CNT Catalyst

This type of catalyst is used in lithium air batteries to store up to 10 times as much energy as lithium ion batteries.

5.7.2 Lithium Ion Battery

In this type of battery silicon nanoparticles are used in the anode of battery that can recharge battery within 10minutes. [10]

5.7.3 Nanotubes on grapheme

The electrodes made from these have very high surface area and very low electrical resistance.

The application of nanotechnology are also in other fields such as fuel cells, solar cells, space, fuels, better air quality, cleaner water, fabric and chemical sensors.[8]

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