

NANOTECHNOLOGY IN ENGINEERING

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ABSTRACT

In today's world, continuous improvement is always paramount in all human endeavors. As a result, the available resources must be used optimally to cater to the teeming population. The thoughts above lead us to the production of many items in miniaturized nature by dealing with them in molecular or atomic forms. In light of the aforementioned technological advancement, nanotechnology has become a field that must be fully understood to enjoy the benefits that come with it.

Nanotechnology is an upcoming branch of Science and Engineering. This is the science that has to do with atoms and molecules manipulation in the nanoscale, which is measured with a nanometer. The use of nanotechnology has stretched across various streams of basic Sciences like Physics, Chemistry, Biology, and Material Science to almost all branches of Engineering starting from Mechanical, Electrical, Chemical, and Electronics to IT, Medicine, and Robotics. Nanotechnology has transformed science and engineering over the past two decades. The ability to see nano-sized material has opened a world of possibilities in industries and scientific processes.

This paper will dissect nanotechnology in engineering in general, where the introduction to nanotechnology will look at a general overview of nanotechnology. Also, a little bit of the history of nanotechnology is explained. The applications of nanotechnology with focus on engineering is discussed. The latter part of the paper delves into the advantages, problems, and limitations of nanotechnology.

Keywords: Nanotechnology, Nanometer, Nanoscale, Data, Engineering etc.

1.0 INTRODUCTION

The craving for smaller things in order to minimize cost and maximize profit is the order of the day. Also, thoughts of being mobile in all aspects of life, this is driving technology towards nanotechnology. The vision that smaller things have greater potential to satisfy human curiosity in term of mobility and size prompted to miniaturize things which resulted in creation of laptops, palmtops in place of desktop computers and microchips which can control such machines. In the nutshell world is demanding for smaller things which will be more efficient than today's things. This is prompted Scientists to come up with a technology that is Nanotechnology. This technology is future of technology and deals with nano size structures and its manipulation in atomic or molecular level. The technology is based on the manipulation of Individual atoms and molecules to build Nano Size structures having complex, atomic

specifications. The term ‘Nanotechnology’ was coined in 1976 by Norio Taniguchi and was made popular by K. Eric Drexler in Engines of Creations (1986).

Nanotechnology can be used to fabricate smaller, faster computer chips for more efficient computers, mobile phones or navigation systems. It leads to new lasers like the quantum dot laser which enable faster communication and new powerful data storage systems. Nanotechnology does not only bring improvements in semiconductor technology and microelectronics but the mastery of the materials and systems on the nanometer scale can also revolutionize traditional areas. Nano structured metallic and ceramic materials are more buoyant, stronger, and more rugged.

2.0 OBJECTIVES

The objective of the study is to study Nanotechnology and its application in engineering.

3.0 RESEARCH METHODOLOGY

The sources of the data are mainly from websites.

3.0 HISTORY OF NANOTECHNOLOGY

Although Nanotechnology seems to be the modern technology, however its history was found right from ancient times. The piece of Roman glass work, the Lycurgus cup in the 5th century. This magnificent cup depicts king Lycurgus dragged into the underworld by Amborsia. The stained-glass windows during the medieval time and visible in numerous churches are made of a composite of glass of nano-sized metal particles. Also, Chinese porcelain was made of gold nanoparticles, which has been in existence for ages. Bhasmas, ayurvedic medicines are popular in Indian subcontinent since 7th century A.D. They were widely recommended for the treatment of many disease conditions. These Bhasmas are claimed to be biologically produced nano-particles, which are prescribed with several other medicines of Ayurveda. Therefore, we can say that Nanotechnology was existing from ancient time. But it was not known as Nanotechnology.

Nanotechnology as a concept was firstly discussed in 1959 by renowned physicist Richard Feynman in his popular talk “There's Plenty of Room at the Bottom”. In his speech he described the possibility of synthesis via direct manipulation of atoms, but the term was introduced in 1974 by Norio Taniguchi of Tokyo Science University while describing semiconductor processes such as thin-film deposition that deals with control on the order of size of particles in manometers. His words to define nanotechnology was- "Nanotechnology mainly consists of the processing of separation, consolidation, and deformation of materials by one atom or one molecule."

4.0 NANOTECHNOLOGY APPLICATIONS

It is universally agreed that nanotechnology is a technology dealing with the materials or particles of nano size. The nano-particles through technology has explored a wide range of applications in the field of energy, data storage, medicine and drugs, food, agriculture, defence and security, bio engineering, fabrics and cosmetic industries.

The following are examples of the predominant engineering applications of nanotechnology/nano materials.

- In its various forms, biomedical applications of nanomaterials exist in varied degree. The technology is act of engineering that helps in the manufacturing of stronger, biocompatible, multifunctional and lighter devices. Also, nano particles are electrically active which inhibit the growth of harmful bacteria and fungus.
- Deodorizer unit and water dispenser to sterilize air and water are using silver nano particles.
- Data storage capacity of memory devices such as hard discs and memory chips is enhanced by nanotechnology with use of magneto resistance heads by adopting science of magneto resistance. Also, particles of metallic silver are used to coat optical surfaces.
- Nanomaterials have incorporated into television set manufacturing by the likes of LG and Samsung named as nano television to handles colour display. There some other products fall into this category, such as nanosilver seal refrigerator and washing machines that use nano-coating to create germ-free environment. Nanomaterials have also been incorporated in clothing world with wrinkle free and stain repellent threads and fabrics that can repel water too. These cloths can remain cool in summer and hot in winter. This is by attaching molecular structures to cotton fibers to prevent absorption.
- In the production of protective coatings, antireflection, scratch resistant, glare reducing and fog-resistant coating for eyeglasses, wind shields and sunglasses nano materials are used.
- In sports application, silver nano composite materials are used in manufacturing of sports products like high power tennis rackets, yachts and golf clubs.
- Nanomaterials are useful in the field of infrastructure development as well. Nano-cement composite are found to be much stronger than the conventional cement.
- In defense applications, alloy strength increases by adding nanocomposites.
- Nanotechnology has applications as thermal barrier and wear resistant coatings, high strength high-weight composites for increasing fuel efficiency, high temperature sensors, improved displays, battery technology and wear resistant tyres.
- In solar cell applications, Titanium nano powder is used.
- Nanomaterials have been used for drug delivery. Nanostructured coatings are deposited on human body implants like screws, plates, rods etc allowing devices to last longer without corrosion.
- Nanotechnology has wide application in the field of Cosmetics too. Many cosmetic materials contain nanoparticles which activate ingredients to go deep into skin layers. Now a days sunscreen lotions are made up of nano dispersed Zinc Oxides which provides broad spectral absorption range including ultraviolet.

The list below indicates a broad picture of applications of Nanotechnology in various fields.

1. Medicine
2. Water Purifications
3. Cosmetics
4. Bio Engineering
5. Data Storage
6. Thermal Imaging

7. Security
8. Drug Delivery
9. Optical Engineering
10. Infrastructure.

From the above discussed applications, it is evident that Nanotechnology is an emerging technology expected to have rapid and strong future developments. It is also predicted that this technology can contribute significantly to economic growth and job creation in the coming decades. According to scientists, nanotechnology is likely to have four distinct generations of advancement. We are currently experiencing the first or may be second generation of Nanomaterials. The first generation of materials has properties that are achieved by the incorporating "passive nanostructures". This can be in the form of coatings and/or the use of carbon nanotubes/fibers to have utility in various fields. The second generation makes use of active nanostructures, for example, by being bioactive to provide a drug at a specific target cell or organ. This could be done by coating the nanoparticle with specific proteins. This generation has exhibited various applications as discussed above. The complexity advances further in the third and fourth generations. Starting with an advance nano system like nano-robotics which is future engineering and moving on to a molecular nano system to control growth of artificial organs and genes in the fourth generation of nano materials.

5.0 CONCLUSION

It is very much evident from the literature that Science has progressed in last 3-4 decades very rapidly. The advancement in the different branches of Science has resulted into the development of different technologies. With the growing technology and constraints in the land and infrastructure, it has become a dire need of society to have smaller size of all kinds of goods. And that is the reason the technology has also shifted from Semi to Milito Micro to Nano. Days are not far from that Pico technology comes into the market after the saturation of Nanotechnology too. But it will not happen suddenly. With the existing nanotechnology, it is expected that almost all branches of engineering right from Electronics and medicine to Robotics will be nanotechnology-based because of its efficiency, durability, reliability, and reproducibility. Therefore, we can conclude with this paper that Nanotechnology is the future of engineering.

REFERENCES

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