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Review Article

Nanotechnology : A Review

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ABSTRACT

This review examines the current state of "Nanotechnology." It provides a succinct overview of nanotechnology and its applications in a number of industries, including solar cells, robotics, medicine, and computers. It also covers the potential applications of nanotechnology in the future.

INTRODUCTION

The study of manipulating matter at the atomic and molecular levels is known as nanotechnology. Nanotechnology is generally concerned with structures that are at least one dimension smaller than 100 nanometers, and it involves creating or altering materials that fall inside that range. The material becomes stronger, lighter, faster, smaller, and more resilient as a result. The capacity to frame exact machine parts and molecules is required for nanotechnology. Put differently, "nanotechnology" is the artificial capacity to create objects from the bottom up utilizing methods and instruments that are still being developed to produce high-performance goods. R. Feynman, a physicist, first proposed this theoretical possibility in 1959. The National Science Foundation defines nanotechnology as the capacity to comprehend, act upon, and regulate matter at the atomic and molecular levels [1].

The two main forces driving the worldwide competition in technology are science and engineering. Contemporary research, grounded on the unifying characteristics of nature at the nanoscale, provides a new basis for knowledge, innovation, and technological integration [1].

Because nanotechnology would significantly affect nearly every aspect of society and every industry in its evolved form, it is frequently proposed as a general-purpose technology [2].

In many fields of research and engineering, there is a long-term process of convergence and divergence. For instance, during the Renaissance, the goal was for the sciences to converge at a

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macro scale. In the 18th and 19th centuries, narrow disciplinary specialization (NDS) in science and engineering followed suit. Around the year 2000, the convergence at the nanoscale achieved its pinnacle, and in the ensuing decades, there is expected to be a divergence in the architectures of nano systems. Figure 1 illustrates the convergence of technology towards nanoparticles and the emergence of the Nano world [3].

Subdisciplines of Nanotechnology:-

This section gives a quick rundown of the various subfields within nanotechnology. Numerous goods pertaining to nanotechnology are currently in the market, and research in universities and research labs continues at a rapid pace. The development of nanotechnology branches has the potential to significantly impact the worldwide market for agricultural, non-fuel, and mineral commodities. Currently, the field of nanotechnology is considered revolutionary because of its impact on industrial applications. By employing emerging nanotechnologies, nanotechnology provides likely answers to a number of issues. There are numerous study areas and prospective applications that incorporate nanotechnology, depending on its robust inter-panel nature. These are a few fields where nanotechnology is being used [4].

1. Nanotechnology

The branch of nanotechnology that works at the nanoscale is called nano engineering. The nanometer, a unit of measurement equivalent to one billionth of a meter, is where the term "nano-engineering" originates. This branch emphasizes the engineering component of the field more so than the applied science component. Two methods of nano engineering are molecular self-assembly and scanning tunneling microscopy (STM).Whereas molecular self-assembly allows for the synthesis of any DNA sequence and the creation of custom proteins or regular patterns of amino acids, STM uses structures as small as a single atom [5].

2. Eco-friendly Nanotechnology

The area of nanotechnology known as "green nanotechnology" aims to improve the environmental sustainability of processes that have a negative impact on the environment. It entails producing environmentally friendly nanoproducts and utilizing them to promote sustainability [6]. Green nanotechnology aims to reduce potential risks to human health and the environment from the use of nanotechnology products and to encourage the substitution of more environmentally friendly nanoproducts for current ones. Green nanotechnology is the foundation for applications such as water treatment, solar cells [7], and nano remediation [8].

3. Hydrophilic Nanotechnology

The process of building up large masses from small ones is known as "wet nanotechnology" [9]. W. Eric Drexler proposed the concept of dry nano-assemblers. It turns out that the first field in which a nano-assembler achieves trading results is wet nanotechnology. Bioscience and pharmaceuticals are two of wet nanotechnology's key applications [10]. R.A.L. Jones combines elements of synthetic and natural nanotechnology to create biokleptic nanotechnology. Trillions of nanotech robots that mimic bacteria in structure are created using the tenets of biomimetic nanotechnology, and they are injected into patients to treat diseases like cancer [11].

Applications of Nanotechnology

Scientists and engineers have become adept at working with nonmaterial materials over the last 20 years, and research into this field is still ongoing. These days, nanoscale materials are used in the production of the majority of products. Sunscreens that reflect ultraviolet light with nanoscale titanium dioxide or zinc oxide help prevent sunburns. A dry powder at the nanoscale can neutralize gas. Accordingly, the production of

tool batteries uses nanoscale materials in order to produce more power faster while releasing less heat. Nanoscale silver is used in wound dressings to prevent bacterial growth [11]. Additional applications of nanotechnology include drug delivery, sports equipment, auto parts, battery storage, moisturizing cosmetics, and many more methods and goods based on nanoscale material are detailed in brute.

1. CNTs, or carbon nanotubes

Allotropes of carbon with a cylindrical nanostructure are called carbon nanotubes. More length than diameter—up to 2, 80, 00,000:1—has been achieved in the construction of nanotubes than in any other material. These carbon molecules are cylinder-shaped and have exceptional strength and distinct electrical characteristics. Their unique characteristics render them highly advantageous in numerous applications within the domains of electronics, nanotechnology, optics, materials science, and architecture. However, their possible toxicity may restrict their ultimate use [11].

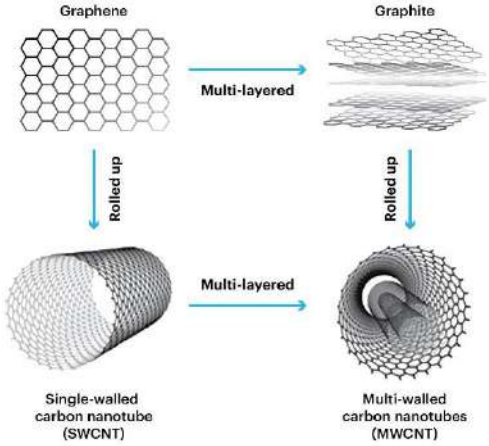

Fig.1 Carbon Nano tubes (CNT)

2. Thin nano film

Thin films can be made water-repellent, UV or IR-resistant, anti-reflective, anti-microbial, self-cleaning, anti-fog, scratch-resistant, or electrically conductive by combining a variety of nanoscale materials. Glasses, cameras, and computer displays are among the devices that use nanofilms [11].

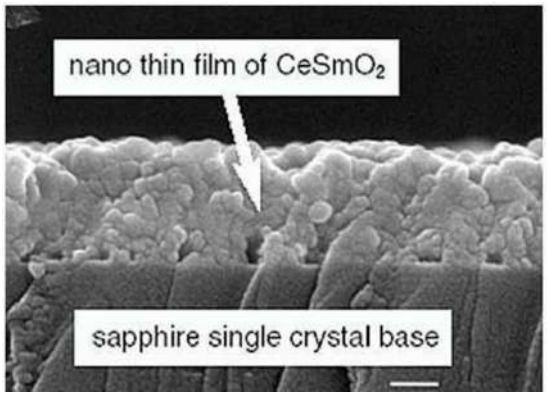

Fig. 2 Thin nano film

3.Nano scale Transistors

A transistor is a type of semiconductor electronic device that is used to increase or decrease electrical power and signal strength. A tiny quantity of electricity is employed as a gate in transistors to regulate the flow of a bigger quantity of electricity. The power of a computer increases with the number of transistors it contains. Computer power has increased daily due to the shrinking size of transistors. The best trading technology available to the industry up until now produced computer chips with 45-nanometer transistors. According to recent announcements, nanotechnology may enable transistors to be even smaller [11].

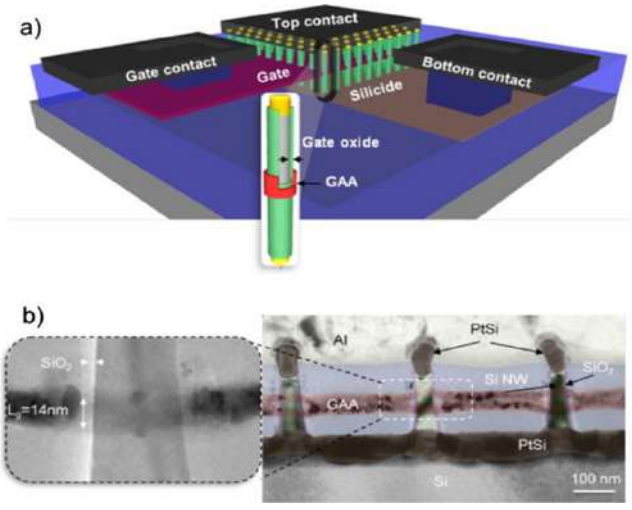

Fig.3 Nano-scale transistors

4. Drug-Delivery Technique using Dendrimers.

Figure 5 illustrates dendrimers, which are highly branched, star-shaped macromolecules with dimensions on the nanoscale. For a wide range of

uses, such as gene transfixation, drug delivery, energy harvesting, photoactivity, and cancer treatment, dendrimers are specifically created and produced. Dendrimers with branches that carry various materials can perform multiple functions simultaneously, including drug delivery, identifying locations, reporting therapy events, and detecting diseased cells and states (including cell death) [11].

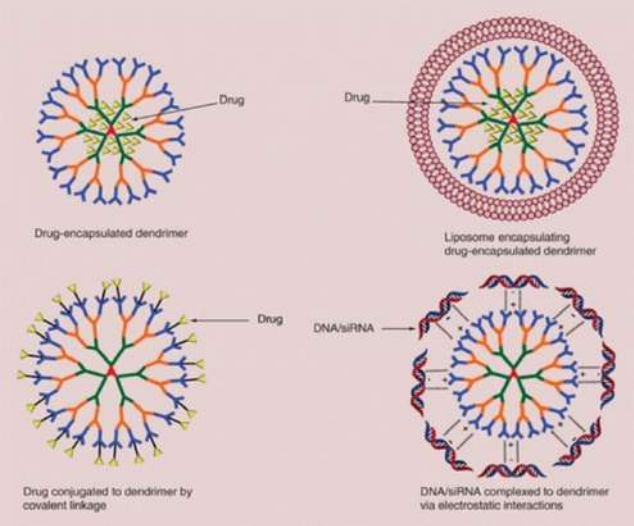

Fig. 4 Drug-Delivery Technique using Dendrimers

5. The method of water filtration.

Membranes based on carbon nanotubes are used to desalinate water, and nanoscale sensors are used to identify impurities in water systems. Figure 6 illustrates the use of carbon nanotubes in the filtration of water. The other nanoscale material with great potential for filtering and purifying water systems is titanium dioxide, which is also used in sunscreen as a bacterial neutralizer [11].

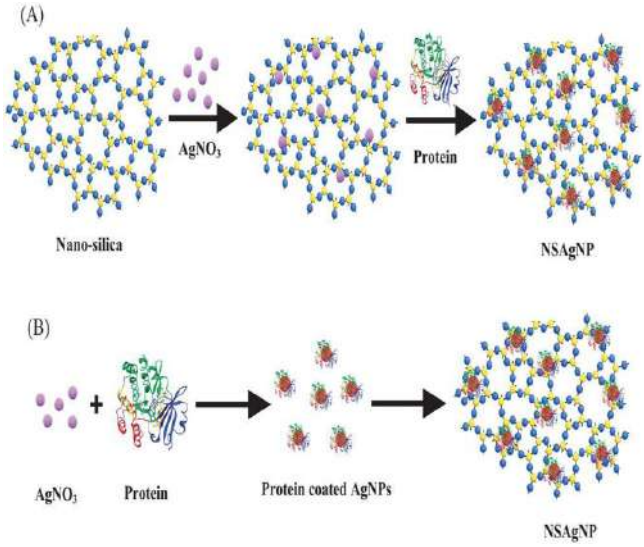

Fig. 5. The method of water filtration

CONCLUSION

The science of minute particles is known as nanotechnology. In the future, according to nanotechnology, products will be created at the atomic and molecular level and will offer practical, affordable solutions for securing renewable energy sources and maintaining a clean environment. Currently, a large number of scientists and engineers are developing novel applications of nanotechnology to advance humankind. Nanotechnology has many uses in fields such as robotics electronics, chemical engineering, biology, and electronics. With the aid of nanotechnology, medical professionals can now identify diseases in their early stages and treat conditions like diabetes, cancer, and heart disease with safer and more effective medications. Additionally, researchers envision new technologies that will shield military personnel and civilians from chemical and conventional weapons. Nanotechnology is already producing a wide range of advantageous materials and pointing to development in many fields, despite the fact

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