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A Review of Nanotechnology and Its Application

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Abstract: ***Nanotechnology is new frontiers of this century. Numerous advantages of nanotechnology depend on its capacity to modify materials at incredibly small scales to attain certain features that would significantly improve the materials science toolset. Considering the molecules and interacting groups of molecules in connection to the bulk macroscopic qualities of the material becomes necessary when controlling the underlying molecular structure, which provides control over the macroscopic chemical and physical properties. The main application and scientific, technological facets of nanotechnology are explained in this overview.***

Keywords: Nanotechnology and its Applications

1. Introduction

Nanotechnology has been employed in industries for different industrial applications and grows exponentially over few decades [1]. It has a great significant impact on medical equipment like imaging probes, drug delivery systems, and diagnostic biosensors in the pharmaceutical communities of practice. According to Morris [2] nanotechnology is the application of knowledge and control over matter at dimensions between 1 and 100 nm, where special physical features enable the development of novel applications. Hobson [3] said Nanotechnology, is the advancement of man - made or designed particles with dimensions in the nanoscale range (1 - 100nm). A field of expertise deals with objects and materials with nanoscale structures. Nanotechnology has created better power densities to maintain the storage charge that is employed for various battery types with reduced inflammable possibilities, and conversion of waste heat in nano - machine to useful energy. More so, solar film solar panels are being built by scientists that can be mounted to machines cases and lightweight piezo - electric nano - wires to produce usable energy from wind, friction, and body heat to operate mobile electronic equipment [5 - 6]. Nanoscale and sensors can help to deliver cost - efficient structural control of roads, bridges, trains, parking structures, and flooring over time. In the medical field, nanotechnology is being studied to improve injuries to the spinal cord or brain cells, or nerve cells. According to Matthew [8] nanotechnology creates multidimensional impacts on societies as the benefits are manifested daily. As scientists take advantage of atomic and molecular assemblages that are constructed at the nanoscale, nanotechnology has emerged as one of the emergent scientific initiatives of the early 21st century. This review explores the significant advancements in nanotechnology, its wide applications and future prospects.

2. Nanotechnology and its applications

The nanotechnology is a transforming skill that tends to stimulate scientific innovation while greatly benefiting society and its applications are reflected in the medical field, computing, engineering, etc.

2.1 Applications of nanotechnology in electronics

At nanoscale, materials have novel properties like increased strength, resiliency, electrical conductivity [7, 8]. Kumar et al. [9] studied the development of various signal transduction techniques using nanomaterials in the realm of biological and chemical analyses changing biosensors, and enabling in vivo research. Results from nanotechnology - based encouraging. This is accorded to their high surface permeability, surface - to - volume ratio, reactivity, and high penetrability, Nanomaterials use less substrate and material than larger materials and perform physical and chemical processes more effectively [10]. Nanotechnology has significantly improved computing and electronics by providing faster, smaller, and more portable systems that can manage and store larger amounts of information. Applications of nanotechnology include the followings: Nanoparticles copper suspension have been developed as a safer, cheaper, and more reliable alternative to lead base solder and other hazardous materials commonly used to fuse electronics in the assembling process, Enhancement in computer booting performance, and also to improve data saving during a system shutdown, Ultra high definition displays which production of ultra - responsive hearing aids, flash memory for smartphones, and more bright colors using quantum dots while using less energy and thumb drives. Pandey [10] mentions that when nanotechnology began to take center stage in research initiatives in both wealthy and developing nations of the world, it raised concerns among scientists about the function that it plays in electrical gadgets. The field of nanoelectronics, which was created by fusing nanotechnology and electronics, is concerned with handling, characterizing, building, and producing electronic devices at the nanoscale. The electrical characteristics of materials change as they are shrunk, and interatomic interactions and quantum phenomena assume a key role. To employ them in next - generation electronic devices, it is necessary to understand their electrical characteristics at the nanoscale. The age of nanoelectronics has begun as a result of the desire to reduce the size and increase component density.

2.2 Applications of Nanotechnology in Medical Fields

One of the most promising applications of nanotechnology in medicine is drug delivery. Nanomaterials can be designed to target specific cells or tissues, improving drug efficacy

and reducing side effects. For instance, liposomes, lipid - based nanoparticles, can encapsulate drugs and protect them from degradation, allowing for sustained release. Additionally, polymeric nanoparticles can be functionalized with ligands that bind to specific receptors on cancer cells, enabling targeted drug delivery. Sahoo et al. [11] mentioned that the use of nanotechnology in medicine and physiology involves materials and tools with a high degree of specificity for subcellular (i. e., molecular) interactions with the body. Bhattacharyya et al [12] said that Nanomedicine, which may be described as the molecular - level monitoring, maintenance, building, and management of human biological systems utilizing designed nanodevices and nanostructures, is only one step removed from nanotechnology. It may also be seen as an additional use of nanotechnology in the realm of diagnostics and medical sciences. These applications either make use of the special characteristics of nanoparticles as pharmaceuticals or drug - related substances on their own or are created for novel methods of controlled release, drug targeting, and recovery of medications with limited bioavailability. Nanoscale polymer capsules, for instance, may be created to disintegrate and release medications by predetermined charges as well as to permit separate releases in specific conditions, such as a corrosive environment, to encourage the absorption of a tumor as opposed to healthy tissues. The development of nanomedicine is currently extending medical tools, knowledge, and remedies. To provide precise solutions for illness prevention, diagnosis, and therapy, the application of nanotechnology in medicine draws on the natural scale of biological phenomena. Some of the medical improvements made possible by nanotechnology include better imaging and diagnostic tools made possible by nanotechnology to increase the effectiveness of treatments.

2.3 Applications of nanotechnology in energy

Nanotechnology is enhancing alternative energy sources and utilizing existing energy sources to help the world's expanding energy demands. [13]. The following are examples of how nanotechnology is used in the energy sector: Increased fuel production efficiency from petroleum - based raw materials thanks to improved catalysis Through improved combustion and less friction, this has helped to reduce fuel consumption in cars and power plants, Manufacturing membranes, and scrubbers made of carbon nanotubes to remove carbon dioxide from power plant exhaust, Using cheaper to produce and simpler to install nanostructured solar cells to convert sunlight into electricity, The use of carbon nanotubes to create longer, stronger, and lighter windmill blades and the creation of flexible piezoelectric nanowires that can be weaved into garments and thin film solar electric panels that can be mounted on computer boxes [14]. The exploration of alternative sustainable energy is a focus of active research and development.

2.4 Nanofilms

To make thin films water - repellent, anti - reflective, self - cleaning, ultraviolet or infrared - resistant, anti - fog, anti - microbial, scratch - resistant, or electrically conductive, several nanoscale materials can be utilized. Currently, nanofilms are utilized to cover or cure surfaces on cameras, computer displays, and eyeglasses [15]. Since its discovery, magnetism has attracted humans as a particularly spectacular physical phenomenon. To date, all parts of our society have undoubtedly benefited from its utility in applications. For the vast majority of the time that we have exploited magnetic phenomena, the implementation has been macroscopic, at least down to bulk engineering dimensions.

2.5 Application of Nanotechnology in Agriculture field

Nanotechnology has enormous potential applications in several industries, including health precaution, materials, textiles, info and communiqué knowledge, and energy. Particularly in the agricultural industry, nanotechnology is crucial for food processing, agricultural production, and packaging, water purification, food safety, as well as environmental cleanup as well as crop development, and plant defense. Through the use of site - specific medication and gene delivery systems, genetically enhanced plants and animals, and nanomaterials, agricultural output may be increased. Pramanik, et al. [16] mentioned that nanotechnology has been highlighted as a viable using technology to revitalize the food and agricultural industries and improve the standard of living for the underprivileged.

3. Contribution

The manipulation of matter at the nanoscale is revolutionizing numerous fields and has the potential profound societal impact**.** The contributions of nanotechnologies and their applications in science have solved various puzzles and challenges globally. The extent of growth achieved in computing, medicine and energy including other areas have become possible through the development of nanoparticles and nano - medicine which have helped to solve various problems.

4. Conclusion

The applications of nanotechnology are undeniably exciting and hold immense promise for better future, responsible innovation in paramount. In all over the world various researchers are developing new applications for nanotechnology to enhance the environment in which we live. These scientists picture a world in which atomic and molecularly precise new materials offer practical, affordable ways to utilize renewable energy sources and preserve the environment. They witness doctors treating conditions like cancer, heart disease, and diabetes with stronger, safer medications and spotting sickness in its earliest stages. They envision cutting - edge technologies that will shield our civilian population and military personnel from nuclear, biological, and chemical weapons. Nanotechnology is already creating a wide range of useful materials. It has made scientific inquiry at the molecular level possible, opening up a world of fresh possibilities. The benefits of nanotechnology have been captured by various researchers. Hence, there is a need to embrace more research in ways to improve the applications of nanotechnologies knowledge in engineering, computing, electronics, etc.

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