
Advances in nanotechnology

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ABSTRACT

Nanotechnology attempts to manipulate individual atoms and molecules of an object on the nanoscale. It is the science of using matter on a nanometer scale, which is expected to have strong future developments. Although it is hard to predict what will happen to nanotechnology in the next 100 years, we know that nanotechnology will be a powerful tool of science and technology in the future. In this article, recent trends in nanotechnology and future scope are discussed.

KEYWORDS

nanotechnology;
future of nanotechnology

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INTRODUCTION

Nanotechnology is the ability to understand, control, and manipulate matter at the level of individual atoms and molecules. Nanotechnology is a multidisciplinary field that covers engineering, physics, chemistry, and biology [1]. Within 50 years, nanotechnology has become the foundation for remarkable industrial applications [2]. The 21st century can be regarded as the century of nanotechnology. In the future, nanotechnology could enable objects to harvest energy from their environment. It has helped create batteries that can store more energy for electric cars and has enabled solar panels to convert more sunlight into electricity. Small things behave differently and old rules do not apply. Many diseases causing bacteria and viruses are nanosized. Measurement at the nanotechnology level is in nanometers (nm). The development of new instruments that allow researchers to observe and manipulate matter at the nano level has made nanotechnology to become more popular recently.

In 1959, Richard Feymann, who was the Nobel Prize-winning physicist, introduced the world to nanotechnology. The manipulation of atoms and molecules at the nanoscale makes the materials to possess unique characteristics [3]. Nanotechnology also includes domains like nanoscience, nanomaterials, nanomedicine, nano measurement, nanomanipulation, nanoelectronics, and nanorobotics. The diameter ranges of objects have been reduced to a few nanometers thanks to nanotechnology techniques and equipment. Nanotechnology may be regarded as the controlled manipulation or engineering of nanomaterials with at least one dimension less than 100nm. Thus, nanomaterials are basically chemical substances or materials that are manufactured and used at a very small scale. Nanoscale materials can be engineered from minerals and nearly any chemical substance [3]. Engineered nanomaterials have been deliberately manufactured by humans to have certain required properties. Nanomaterials may also be produced incidentally as a byproduct of mechanical or industrial processes. They can be classified in 0D, 1D, 2D, and 3D nanomaterials [4]. Fullerenes, graphene flakes, single wall carbon nanotube, and nanoparticles, etc. are regarded as nanomaterials. They are 100 times stronger than steel but six times lighter. Nanomaterials are widely used in consumer and industrial applications. They also have potential applications in the military sector. Nanotechnology has the idea that the technology of the future will be built on atoms. It has impact on every area of science and technology. Nanotechnology involves imaging, measuring, modeling, and manipulating matter at the nano scale. At this level, the physical, chemical, and biological properties of materials fundamentally differ from the properties of individual atoms and molecules or bulk matter [5].

RECENT ADVANCES

Nanotechnology has seen rapid growth, causing a positive impact on life in the sectors of food, medicine, energy, agriculture, environmental, and electronics

(1) Food nanotechnology

Food demand continually increases as the global population keeps growing. Nanotechnology is an efficient method in the food industry and the area of functional foods. Food nanotechnology is an emerging field, employed in food packaging, food quality, and food safety. The food industry is investigating researching foods that have a longer shelf life due to the nanoparticles.

(2) Nanomedicine

Nanomedicine includes tissue engineering, biomaterials, biosensors, and bioimaging. It involves diagnosing, treating, and preventing diseases using nanoscale structured materials and nanorobots. The long-term goal of nanomedicine research is to characterize the molecular-scale components known as nanomachinery [6]. Once nanomechanics are available, the ultimate dream of every physician throughout recorded history will become a reality. Programmable nanorobotic devices would allow physicians to perform precise interventions in the human body at the cellular and molecular levels. Nanomachines, nanorobots, and nanodevices can be used to develop a wide range of automatically precise microscopic manufacturing tools. You can imagine swarms of nanobots swimming through your veins and repairing cells. Nanomedicine may offer a new path forward for effective cancer treatment. Nanomedicine is predicted to become more high-tech and more effective in managing individual healthcare on a microscopic level. Nanotechnology-based drug delivery systems are being tried for conditions like cancer, diabetes, fungal infections, viral infections, and gene therapy. It has been predicted that nanotechnology will soon be used in brain implants capable of restoring lost memory. Nanotechnology is likely to revolutionize medicine in the future.

(3) Nanodentistry

Nanotechnology will change dentistry, healthcare, and human life more profoundly than many developments of the past. Nanotechnology has the potential to bring enormous changes into the field of dentistry. Nanotechnology has revolutionarized restorative dentistry by providing nanofillers. Nanodentistry may succeed in maintaining near-perfect oral health through the aid of nanorobotics, nanomaterials, and biotechnology [7].

(4) Energy generation and use

Nanoscales and nanoporous membranes are being used to facilitate production of biomass fuel. Nanomaterials are used for energy production and storage. Energy transmission could potentially be made efficient by using engineered nanomaterials. In the renewable-energy sector, nanotechnology has the potential to increase process efficiencies and process yields, decrease costs and enable energy processes. Fuel cells are cited as the engines of the future with the strongest impact on emissions. Nanotechnology is transforming photovoltaic cells [8]. In the future, novel, nanomaterials will make airplanes and vehicles lighter and therefore help reduce fuel consumption. Many research labs are working on nanotechnology-enabled batteries to increase their efficiencies for electric vehicles, home, or grid storage systems [9].

(5) Nanoelectronics

Reducing the size of electronic products is the need of the era and this can be achieved with the help of nanotechnology. Nanoelectronics shows promise as a technology to allow continuous miniaturization of objects. Flexibility is another major breakthrough in the world of electronics and flexible devices have started to make their way into the commercial realm. Flexible electronics is the future of mobile electronics with potential applications in wearable electronic devices, biomedical uses, compact portable devices, and robotic devices [10].

CONCLUSION

The emerging applications of nanotechnology in many industries create numerous jobs along the way. However, there are known barriers to future progress in nanotechnology and its applications. Nanotechnology has tremendous potential, but social issues of public acceptance, ethics, regulation, and human safety must be addressed before nanotechnology can be seen as the possibility of providing high quality healthcare. Critics expressed concerns that nanoparticles can have a negative impact on human health. Predicting the future of any major technology is hard. Nanotechnology has generated excitement worldwide and is being regarded as the key technology of the 21st century. This excitement is partly due to the development of new instruments for observing and manipulating matter at the nano level. Nanotechnology is the future of advanced development. Although nanotechnology is maturing rapidly, it is still in a formative phase. Nanotechnology will affect almost everything. It is expected to give impetus for a wide range of fields of application in almost all sectors of technology and industry. It will present new opportunities to make the stuff of life better and cheaper, using fewer raw materials. Dramatic breakthroughs will occur in diverse areas such as food, medicine, computing, energy, and robotics. How soon these innovative ideas would be completed at the Research and Development phase and enter the market is a pondering-worthy question. However, we can confidently say that nanotechnology is here to stay and its uses and applications can be made ethically to benefit mankind.

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