Essay

Nanotechnology

Name

Affiliation

Course

Date

Introduction

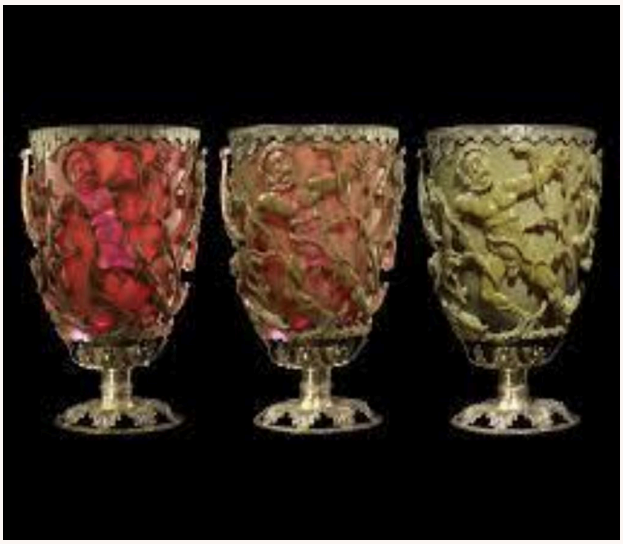
Nanotechnology (Nanotech) is a new technological innovation that encompasses the utilization of matter on atomic, molecular, and super-molecular levels for industrial purposes (Ramsden). Nanotechnology thus deals with the manipulation of matter on near-atomic sizes with the goal of the creation of new structures, gadgets, and materials. The technology has the potential to enhance science in various fields, including medical, consumer items, materials, energy, and manufacturing, among others (Ramsden). Ramsden ascertains that Nanotechnology leads to the engineering of new materials in ways that were impossible before. These materials (Nanomaterials) are those with a length scale of between one and one hundred nanometers (1-100nm) (Bayda et al.). This is the size at which materials first demonstrate distinctive features that influence their physical, chemical, and biological characteristics. Therefore, it makes a logical argument that the study, development, and use of these features are at the center of new technology development.

The history and development of Nanotechnology

For starters, Structures, gadgets, and systems having unique features as well as functionalities owing to their atoms' arrangement at a size of 1–100 nm constitute a developing study topic in nanotechnology. The early 2000s saw a rise in public awareness and debate over nanotechnology, which resulted in the first commercial uses of the technology. There are several applications for nanotechnologies in a wide variety of fields of science and engineering. The application to human health of nanotechnologies has been very successful in the treatment of cancer, notably in recent years. To better comprehend nanotechnology, it is useful to explore the history of discoveries that led to the present knowledge on nanotechnology (Bayda et al.).

Unfortunately, describing the development and history of nanotechnology is quite challenging due to two key reasons. For starters, the term nanotechnology has massive ambiguity due to the absence of an accepted and established definition and, secondly, the period corresponding to the early stages of nanotechnology development itself.

According to Bayda et al. Richard Feynman, an American physicist and Nobel prize laureate initially brought about the notion of nanotech around 1959 (Bayda et al.). This happened during a yearly meeting in Caltech institution, and Feynman presented a lecture dubbed “There’s Plenty of Room at the Bottom” (Bayda et al.). As he was presenting, Feynman brought up a unique hypothesis that suggested that there was the possibility of writing 24 volumes of the Britannica Encyclopedia on the head of a pin. Furthermore, he envisions the use of machines that could construct smaller other machines down to their molecular states. Following predecessor research, researchers have proven and actualized Feynman's idea, and thus Richard Feynman is well-thought-out the “Father of modern nanotechnology” (Bayda et al.).



The Lycurgus cup
(British Museum)

Nanotechnology was not used as a term until fifteen years afterwards when a Japanese researcher, Norio Taniguchi, demarcated the term in 1974 as “the processing of separation, consolidation, and deformation of materials by an atom” (Bayda et al.). Since this discovery, researchers globally have been advancing the technology and thus have formulated two key approaches, top-down and bottom-up, employed in the synesis of nanostructures.

Applications of nanotechnology

According to researchers, nanotech has three key applications since its mostly incorporated in the industrial sectors, medicinal and energy uses. Microscopic elements that fight tumor cells, faster microprocessors consuming less energies, longer lasting batteries, and solar panels that harvest twofold energy are all possibilities that have been brought about by nanotechnology. This field has all of the components necessary to usher in the next industrial revolution in the near future.

Medical application

Due to the potential for advances in the battle against illnesses such as cancer and atherosclerosis, the study of nanotechnology is unquestionably a major focus of nanotechnological research (Zdrojewicz et al.). A breakthrough in nanomaterials, molecular nanotechnology, and biotechnology might be made in one of the three primary fields of this science. Biocompatible materials and analytic procedures at the nanoscale have already gained widespread acceptance. Surgeons and dentists utilize them to investigate nerve cells and biomolecular studies. The other area of nanotechnology concerns molecularly engineered mechanical systems that might be used in medicine. Since the beginning of time, biotechnology has been defined as the use of biological systems in technical and industrial processes that include genetic engineering and the creation of artificial life (Zdrojewicz et al.).

Nanotubes, inorganic and organic compounds, have single or multiple walled structures arranged in

tubes and have graphene, which is used to construct their outside wall owing to their increased external surface area. They are able of pump chemotherapeutics with a high degree of efficiency. Furthermore, the tremendous significance in biomedicine rests on its capacity to be internalized by cells (Zdrojewicz et al.). **Nanocrystals** are used as methods to improve Pharmacodynamic as well as pharmacokinetic properties of less soluble medicines and also increasing the bioavailability and solubility of various substances. **Dendrimers**, nanomaterials that are branched with their internal structures having dendrons; these dendrons have functional groups that can be exchanged as substituents modifying the physical and chemical characteristics of the entire structure. **Liposomes**, which are about 30nm to a few micrometers, have lipid bilayers, making them more hydrophobic and also hydrophilic substrates that mitigate content degradation when exposed to various conditions. Thus, they are used as anticancer, analgesics, and antifungal medications (Zdrojewicz et al.). **Cancer treatment** nanomaterials have been used to fight against cardiovascular and cancer illnesses, which recently have resulted in massive premature deaths. Nanomedicines are used in cancer therapy since cancerous cells have a unique ability to resist modern medication. Surgical interventions, radiotherapy, and chemotherapy are the current methods used; they have severe systemic harm and destroy tissues around the cancer cells (Zdrojewicz et al.). Thus nanoshells, nanoparticles enclosed with gold and with the ability to target tumor cells, are under clinical trials. When injected, these nanoparticles accumulate in the affected tissue, causing the tumor ablation when irradiated with a laser (NIR).

Other applications

In **electronics**, nanotechnology has helped improve the efficiency of most of them, making electronics more sufficient and consuming less energy. Carbon nanotubes, for instance, have been undergoing research and testing, which are also a replacement of silicon as the main source for constructing smaller, quicker, as well as more effective microchips and electronics. Furthermore, carbon nanotubes would result in the development of lighter, conductive, and sturdier quantum nanowires. This is because its Graphene properties make them ideal for developing supple touchscreens.

For the **environment**, nanotechnology can be used in air purification using techniques such as ions and nanobubbles to purify wastewater, which is ecologically friendly. Additionally, nanocatalysts are used to improve the efficiency and environmental friendliness of chemical processes. Subsequently, nanobiosensors can detect pathogen in food in the food industry. Also, the use of nanocomposites helps improve production by improving mechanical and heat resistance as well as lessening oxygen circulation in wrapped products. Finally, in the fabric ecosystem, smart textiles that don't become stained or wrinkled may be developed together with light and more durable fabric for helmets or sporting gear (Iberdrola).

Conclusion

Nanotechnology has massively improved the construction and development of materials and their applications. The progression of this technology in various science fields has led to discoveries that improve man's existence. It has become increasingly possible to observe things at the nanoscale in various scientific fields, from physics to chemistry to computer science and biology. Nanotechnology has resulted in the development of more efficient gadgets that are smaller in size and highly portable; for instance, smaller chips have led to smaller sizes of computers. Take, for example, the new snapdragon 8 Gen 1 processor (4nm chipset) that is in the new smartphones has made phones more efficient, fast, slimmer, and less power consuming, making the devices more durable and cost-effective. Therefore, nanotechnology is a promising innovation that continues and will in the future lead to even more exciting discoveries, especially in food sustainability and the fighting of diseases.

Work cited

Bayda, Samer, et al. "The history of nanoscience and nanotechnology: From chemical–physical applications to nanomedicine." Molecules 25.1 (2019): 112.

British Museum. "Facebook." Facebook, 26 Mar. 2019, m.facebook.com/story.php?story_fbid=10157069541419723&id=72228529722. Accessed 13 Mar. 2022.

Iberdrola. "Nanotechnology: a Small Solution to Big Problems." Iberdrola, 11 July 2019, www.iberdrola.com/innovation/nanotechnology-applications. Accessed 13 Mar. 2022.

Ramsden, J J.. "What is Nanotechnology? Applied Nanotechnology, 3–13." (2018): doi:10.1016/b978-0-12-813343-9.00002-0

Zdrojewicz, Zygmunt, et al. "Medical applications of nanotechnology." Advances in Hygiene & Experimental Medicine/Postepy Higieny i Medycyny Doswiadczalnej 69 (2015).