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Applications of Nanomaterials

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***Abstract* – This paper helps to reader how Nano-technology deals with the production and use of materials with Nanoscale dimensions in different aspects of life. Nano-particles, due to their Nano-scale dimensions, have high surface-to-volume ratios and thus very specific properties. Nano-technology is a new and expanding technology, its main applications are the development of innovative methods to fabricate new products, to formulate new chemicals and materials, and to substitute the current generation of equipment with improved performance equipment, resulting in a lower consumption of materials and energy and decreased harm to the environment, as well offering environmental remediation. It reviews the applications of nano-technology in animal, agricultural, nutritional, medicinal, and pharmaceutical sciences, as well in catalysis and environmental remediation. The chapter provides descriptions of the most current applications of nano technology that influence different aspects of human life.**

***Keywords* – Carbon Nano tubes , Nano Biotechnology , Photocatalyst, Solar Cells, Hydrogen Fuel Cell, Animal Science.**

I. INTRODUCTION

The applications of nano-technology commonly incorporates industrial, medicinal, and energy uses. These include more durable construction materials, therapeutic drug delivery, and higher density hydrogen fuel cells that are environmental friendly. Being that nano particles and nano devices are highly versatile through modification of their physiochemical properties, they have found uses in nano scale electronics, cancer treatments, vaccines, hydrogen fuel cells, and nano graphene batteries. Nanotechnology uses of smaller sized materials allows for adjustment of molecules and substances at the nano scale level, which can further enhance the mechanical properties of materials or grant access to less physically accessible areas of the body.

II. APPLICATIONS OF NANO MATERIALS

Potential applications of carbon nanotube

Nanotubes can help with cancer treatment. They have been shown to be effective tumor killers in those with kidney or breast cancer. Multi-walled nanotubes are injected into a tumor and treated with a special type of laser that generates near-infrared radiation for around half a minute. These nanotubes vibrate in response to the laser, and heat is generated. When the tumor has been heated enough, the tumor cells begin to die. Processes like this one have been able to shrink kidney tumors by up to four-fifths.

Nanotubes show promise in treating cardiovascular disease. They could play an important role in blood vessel cleanup. Theoretically, nanotubes with SHP1i molecules attached to them would signal macrophages to clean up plaque in blood vessels without destroying any healthy tissue. Researchers have tested this type of modified nano-tube in mice with high amounts of plaque build up; the mice that received the nano-tube treatment showed statistically significant reductions in plaque build up compared to the mice in the placebo group. Further research is needed for this treatment to be given to humans.

Construction

Nano-technology has ability to observe and control the material world at a nano-scopic level can offer great potential for construction development. Nano-technology can help improve the strength and durability of construction materials, including cement, steel, wood, and glass.

By applying nano-technology, materials can gain a range of new properties. The discovery of a highly ordered crystal nano-structure of amorphous C-S-H gel and the application of photocatalyst and coating technology result in a new generation of materials with properties like water resistance, self-cleaning property, wear resistance, and corrosion protection. Among the new nano-engineered polymers, there are highly efficient super-plasticizers for concrete and high-strength fibers with exceptional energy absorbing capacity.

Nano biotechnology

The terms nano-biotechnology and bio-nanotechnology refer to the combination of ideas, techniques, and sciences of biology and nano-technology. More specifically, nano-biotechnology refers to the application of nano-scale objects for biotechnology while bio-nanotechnology refers to the use of biological components in nano-technology.

A common application of nano medicine is in therapeutic drug delivery, where nano-particles containing drugs for therapeutic treatment of disease are introduced into the body and act as vessels that deliver the drugs to the targeted area. The nano-particle vessels, which can be made of organic or synthetic components, can further be functionalized by adjusting their size, shape, surface charge, and surface attachments (proteins, coatings, polymers, etc.). The opportunity for functionalizing nano-particles in such ways is especially beneficial when targeting areas of the body that have certain physiochemical properties that prevent the intended drug from reaching the targeted area alone; for example, some nano-particles are able to bypass the Blood Brain Barrier to deliver therapeutic drugs to the brain. Nano-particles have recently been used in cancer therapy treatments and vaccine. Magnetic nano-robots have demonstrated capabilities to prevent and treat antimicrobial resistant bacteria. Application of nano-motor implants have been proposed to achieve thorough disinfection of the dentine.

III. Energy Applications

The energy applications of nano-technology relates to using the small size of nano-particles to store energy more efficiently. This promotes the use of renewable energy through green nano-technology by generating, storing, and using energy without emitting harmful greenhouse gases such as carbon dioxide.

Solar Cells

Nano-particles used in solar cells are increasing the amount of energy absorbed from sunlight. Solar cells are currently created from layers of silicon that absorb sunlight and convert it to usable electricity. Using noble metals such as gold coated on top of silicon, researchers have found that they are able to transform energy more efficiently into electrical current. Much of the energy that is loss during this transformation is due to heat, however by using nano-particles there is less heat emitted thus producing more electricity.

Hydrogen Fuel Cells

Nano-technology is enabling the use of hydrogen energy at a much higher capacity. Hydrogen fuel cells, while they are not an energy source themselves, allow for storing energy from sunlight and other renewable sources in an environmentally-friendly fashion without any CO2 emissions. Some of the main drawbacks of traditional hydrogen fuel cells are that they are expensive and not durable enough for commercial uses. However, by using nano-particles, both the durability and price over time improve significantly. In addition, conventional fuel cells are too large to be stored in volume, but researchers have discovered that nano-blades can store greater volumes of hydrogen that can then be saved inside carbon nano-tubes for long-term storage.

Nano-graphene Batteries

Nano-technology is giving rise to nano-graphene batteries that can store energy more efficiently and weigh less. Lithium-ion batteries have been the primary battery technology in electronics for the last decade, but the current limits in the technology make it difficult to densify batteries due to the potential dangers of heat and explosion. Graphene batteries being tested in experimental electric cars have promised capacities 4 times greater than current batteries with the cost being 77% lower. Additionally, graphene batteries provide stable life cycles of up to 250,000 cycles, which would allow electric vehicles and long-term products a reliable energy source for decades

Animal Science

Nowadays, the delivery of antibiotics and drugs to animals is carried out through their introduction into animal feeds and water or through muscular injections. Releasing a drug against a microorganism, despite its therapeutic and inhibitory effects on the development of a disease, is usually followed by a reduction of the drug's effect against subsequent infections. Currently available techniques at the nano-scale have the ability to diagnose and treat infections and nutritional and metabolic.

V. Conclusion

Nano-technology has the potential to revolutionize our lives. This is because it presents almost unlimited potential to make remarkable changes in virtually all fields ranging from medicine, computer technology, construction, environmental remediation, food industry, to new energy sources.

Despite presenting many potential benefits in many areas, nano-technology of today is still in its infancy as just a few

projects have been commercialized. Many are yet to undergo full lifecycle assessment. The number of nano-technology innovations continues to rise. However, the same cannot be said of research about their potential effects on environment and biological systems.

As the world readily adapts to this new technology wave, concomitant effort should be directed to the understanding of their possible impacts. This is essential to ensure that nano-materials do not become the new hazard of 21st century. The long-long term sustainability of this new technology may depend on the establishment of its risks.

REFERENCE

[1] "Nano-technology - 2nd Edition". www.elsevier.com. Retrieved 2021-04-09.
[2] "Nano-particles for Biomedical Applications - 1st Edition". www.elsevier.com. Retrieved 2021-04-09.
[3] "Nano-electronics - an overview | ScienceDirect Topics". www.sciencedirect.com. Retrieved 2021-04-09.
[4] Burke, A., Ding, X., Singh, R., Kraft, R. A., Levi-Polyachenko, N., Rylander, M. N., Szot, C., Buchanan, C., Whitney, J., Fisher, J., & Hatcher, H. C. (2009, August 4). Long-term survival following a single treatment of kidney tumors with multiwalled carbon nanotubes and near-infrared radiation. *Proceedings of the National Academy of Sciences of the United States of America*, 106(31), 12897–12902. https://doi.org/10.1073/pnas.0905195106
[5] "MIT engineers develop "blackest black" material to date". MIT News | Massachusetts Institute of Technology. 13 September 2019. Retrieved 2021-04-10.
[6] "Carbon nano-tubes and the pursuit of the ultimate body armor". Nano-werk. Retrieved 2021-04-10.
[7] Pelaz, Beatriz; Alexiou, Christoph; Alvarez-Puebla, Ramon A.; Alves, Frauke; Andrews, Anne M.; Ashraf, Sumaira; Balogh, Lajos P.; Ballerini, Laura; Bestetti, Alessandra; Brendel, Cornelia; Bosi, Susanna (2017-03-28). "Diverse Applications of Nano-medicine". ACS Nano-. 11 (3): 2313–2381. doi:10.1021/acsnano-.6b06040. ISSN 1936-086X. PMC 5371978. PMID 28290206.
[8] "Nano-particles for Biomedical Applications - 1st Edition". www.elsevier.com. Retrieved 2021-04-02.