"NANOTECHNOLOGIES AND THEIR SIGNIFICANCE IN ENVIRONMENTAL PROTECTION"

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Abstract:

Nanotechnology is a extremely wide term referring to the very minute particles which are used for the various purposes such as medicines, textiles, robotics, paint industry and various other fields, Nanotechnology may become the most demanded technology in the current and future world as it has immense potential, it have evolved in many different forms for example nanotechnology when used with in the field of medicine it open a wide area of avenue which is unexplored and can benefit many people in several ways like imaging, sensing, targeted drug delivery, and gene delivery systems, and artificial implants, Nanotechnology may become the most demanded technology in the current and future world as it has immense potential, nanotechnology may revolutionize the field of medicine as it can reach to the deepest part of the body with very little or no side effect, nanorobots the results of biotechnology may eliminate the cause of disease even before it appears on large scale in the body, it has the power to improve the quality of medicine and increase the overall health of the common person, nanotechnology in the field of medicine will be the boon to the mankind if the technology is carefully utilized.

Keywords: nanotechnology, nanoparticle, nanomedicine, drug delivery system.

Introduction

Nanotechnology has the potential to play a significant role in environmental protection and sustainability by enabling new and improved methods for monitoring, cleaning up, and mitigating environmental pollutants. It can also help to reduce resource consumption and energy use through the development of more efficient technologies.

For example, nanoparticles can be used to clean up oil spills, remediate contaminated soil and groundwater, and capture and remove air pollutants. Nanotechnology can also be used to create more efficient and effective methods for solar energy capture and storage, as well as for producing biofuels from renewable resources. Additionally, nanotechnology- enabled products, such as stronger and lighter materials, can reduce energy consumption in transportation and manufacturing.

However, it is important to consider the potential environmental and health impacts of nanotechnology, and to implement measures to minimize these risks. This includes ensuring that nanotechnology is developed and used in a responsible and sustainable manner, and that it is subject to proper regulation and oversight.

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Overall, nanotechnology has the potential to make a positive impact on the environment and sustainability, but it is essential to approach its development and application with caution and a commitment to responsible use.

Note, however, that nanotechnology currently plays a rather subordinate role in environmental protection, whether it be in research or in practical applications. Environmental engineering companies themselves attach only limited importance to nanotechnology in their respective fields.

Potential environmental benefits. Rising prices for raw materials and energy, coupled with the increasing environmental awareness of consumers, are responsible for a flood of products on the market that promise certain advantages for environmental and climate protection. Nanomaterials exhibit special physical and chemical properties that make them interesting for novel, environmentally friendly products. Examples include the increased durability of materials against mechanical stress or weathering, helping to increase the useful life of a product; nanotechnology-based dirt- and water-resistant coatings to reduce cleaning efforts; novel insulation materials to improve the energy efficiency of buildings; adding nanoparticles to a material to reduce weight and save energy during transport.

In the chemical industry sector, nanomaterials are applied based on their special catalytic properties in order to boost energy and resource efficiency, and nanomaterials can replace environmentally problematic chemicals in certain fields of application.

High hopes are being placed in nanotechnologically optimized products and processes for energy production and storage; these are currently in the development phase and are slated to contribute significantly to climate protection and solving our energy problems in the future (read more: "Nanotechnology in Energy").

Methods

In most commercially available nano-consumer products, environmental protection is not the primary goal. Neither textiles with nanosilver to combat perspiration odor, nor especially stable golf clubs with carbon nanotubes, help protect the environment. Manufacturers often promise such advantages, typically without providing the relevant evidence. Examples include self-cleaning surface coatings or textiles with spot protection, with are advertized as reducing the cleaning effort and therefore saving energy, water and cleaning agents.

Emphasis is often placed on the sustainable potential of where nanotechnology will take us. Nonetheless, this usually reflects unsubstantiated expectations. Determining the actual effects of a product on the environment – both positive and negative – requires examining the entire life cycle from production of the raw material to disposal at the end of the life cycle.

As a rule, the descriptions of environmental benefits fail to consider the amount of resources and energy consumed in producing the products (read more: "Nanotechnology and the environment – Potential benefits and sustainability effects").

Nanotechnology could make battery recycling economically attractive. Many batteries still contain heavy metals such as mercury, lead, cadmium, and nickel, which can contaminate the environment and pose a potential threat to human health when batteries are improperly

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disposed of. Not only do the billions upon billions of batteries in landfills pose an environmental problem, they also are a complete waste of a potential and cheap raw material.
Researchers have managed to recover pure zinc oxide nanoparticles from spent Zn-MnO2 batteries alkaline batteries.

Nanomaterials for radioactive waste clean-up in water.Scientists are working on nanotechnology solution for radioactive waste cleanup, specifically the use of titanate nanofibers as absorbents for the removal of radioactive ions from water. Researchers have also reported that the unique structural properties of titanate nanotubes and nanofibers make them superior materials for removal of radioactive cesium and iodine ions in water.

Nanotechnology-based solutions for oil spills.Conventional clean-up techniques are not adequate to solve the problem of massive oil spills. In recent years, nanotechnology has emerged as a potential source of novel solutions to many of the world's outstanding problems. Although the application of nanotechnology for oil spill cleanup is still in its nascent stage, it offers great promise for the future. In the last couple of years, there has been particularly growing interest worldwide in exploring ways of finding suitable solutions to clean up oil spills through use of nanomaterials.

Water applications. The potential impact areas for nanotechnology in water applications are divided into three categories treatment and remediation, sensing and detection, and pollution prevention (read more: "Nanotechnology and water treatment") and the improvement of desalination technologies is one key area thereof.

Nanotechnology-based water purification devices have the potential to transform the field of desalination, for instance by using the ion concentration polarization phenomenon (see: "Nanotechnology makes portable seawater desalination device possible").

Another, relatively new method of purifying brackish water is capacitive deionization (CDI) technology. The advantages of CDI are that it has no secondary pollution, is cost-effective and energy efficient. Nanotechnology researchers have developed a CDI application that uses graphene-like nanoflakes as electrodes for capacitive deionization. They found that the graphene electrodes resulted in a better CDI performance than the conventionally used activated carbon materials.

Carbon dioxide capture. Before CO2 can be stored in Carbon dioxide Capture and Storage (CCS) schemes, it must be separated from the other waste gases resulting from combustion or industrial processes. Most current methods used for this type of filtration are expensive and require the use of chemicals. Nanotechnology techniques to fabricate nanoscale thin membranes could lead to new membrane technology that could change that.

Hydrogen production from sunlight – artificial photosynthesis. Companies developing hydrogen-powered technologies like to wrap themselves in the green glow of environmentally friendly technology that will save the planet. While hydrogen fuel indeed is a clean energy carrier, the source of that hydrogen often is as dirty as it gets. The problem is that you can't dig a well to tap hydrogen, but hydrogen has to be produced, and that can be done using a variety of resources.

The dirtiest method – at least until highly efficient carbon capture and sequestration technologies are developed – is the gasification of coal (read more: "Nanotechnology could clean up the hydrogen car's dirty little secret"). The cleanest by far would be renewable energy electrolysis: using renewable energy technologies such as wind, solar, geo- and hydrothermal power to split water into hydrogen and oxygen.

Artificial photosynthesis, using solar energy to split water generating hydrogen and oxygen, can offer a clean and portable source of energy supply as durable as the sunlight. It takes about 2.5 volts to break a single water molecule down into oxygen along with negatively charged electrons and positively charged protons. It is the extraction and separation of these oppositely charged electrons and protons from water molecules that provides the electric power.

Results

Impacts of Nanotechnology on the Environment. Nanotechnology has the potential to have a significant impact on the environment. From saving raw materials to decreasing greenhouse gasses, it can help us to repair the environment. It can majorly help us with the following things:

Saving the Seas. We have all read the news about oil spilling into the seas, damaging the oceans, rivers, and marine life residing within. The nanotechnology-based solutions help to save the seas in several ways:

- It can yield a new generation of nanomembranes for the separation of water contaminants by removing and reducing water contaminants.
- Nanotechnology-based solutions can remove radioactive waste.
- The advancement of nanotechnology can help to expand the water supply by developing cost-effective treatments that can overcome the major challenges that current treatment technologies face.
- Nanotechnology helps in water cleaning by utilizing iron nanoparticles to remove organic solvents in groundwater.

Cleaning the Air. The planet is warming, and the polar ice caps are melting, all because of an increase in the amount of carbon dioxide. It is the biggest threat to the environment and the human race. Thus, it has resulted in increased amounts of greenhouse gasses, leading to drastic climate change.

Methods for the separation of carbon dioxide from gasses are highly expensive and not competitive for large-scale applications. However, the nanomaterial can work in the same yet cost-effective way without even additional compounds. Various nanoparticles are being developed to reduce greenhouse gas emissions. The addition of nanoparticles to fuel can improve fuel efficiency and reduce the rate of greenhouse gas production resulting from fossil fuel users.

Battery Recycling. Batteries are made up of heavy metals like mercury, lead, nickel, and cadmium, which can contaminate the environment and can cause potential threats to human health. But, with the help of nanotechnology, the use of cathode particles from lithium-ion batteries has made it possible to recycle and regenerate batteries to use as new ones.

Application of Nanotechnology to Environmental Issues. Nanotechnology researchers and developers are using the following avenues to repair the environment.

- Generating less pollution during the manufacture of materials.
- For the production of solar cells to generate electricity at a competitive cost.

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- To increase electricity generated by windmills.
- For cleaning organic chemicals that pollute the groundwater.
- Cleaning up oil spills.
- For the reduction of fuel cell costs.
- For storing hydrogen for fuel cell-powered cars.

Discussion

Negative Impacts of Nanotechnology on Environment. Nanomaterials can also have a negative impact. It has the potential to unintentionally form new toxic products. Although there is not much information regarding the environmental risks of manufactured nanomaterials. A few studies have been conducted to discover the impact of nanometers on the environment. There is no clear guideline to qualify the effects. A workshop, conducted by the National Science Foundation, and the US Environmental Protection Agency, to identify the risks concerning nanomaterials. The workshop aimed at determining the exposure and toxicity of manufactured nanoparticles and the sustainability of nanomaterials.

Following a critical risk assessment, issues regarding nanoparticles were identified:

- Manufactured nanoparticle's exposure assets.
- Toxicology of nanoparticles.
- Environmental and biological fate, persistence, transport, and transformation of manufactured nanoparticles.
- Recyclability and sustainability of manufactured nanoparticles.

Conclusion. Today, nanotechnology is becoming more and more real, and there is a need for discussion about the possible advances and impacts of technology on the environment. The increase in environmental problems is visible. Nanotechnology can cause positive and significant changes to air quality, water quality, and sustainable energy generation. It can help us to repair the environment and save it.

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