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NANO TECHNOLOGY IN POLLUTION PREVENTION

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Abstract--Nanotechnology is a field of applied science, focused on the design, synthesis, characterization and application of materials and devices on the nano scale. Like other area, nanotechnologies have some important contribution in monitoring, restoration and conservation of environment. Recently some of the important explored areas where scientific community have acknowledged are monitoring of air and water pollutants, waste water treatment, remediation of some persistent air and water pollutants and production of eco friendly materials and exploration of alternative source of energy for future. Nano scale materials have the potential to improve the environment, both through direct applications of those materials to detect, prevent, and remove pollutants, as well as indirectly by using nanotechnology to design cleaner industrial processes and create environmentally responsible products. There are, however, many uncertainties regarding the fundamental features of this technology, which have made it difficult to engineer applications for optimal performance or to assess the risk to human or ecological health.

Keywords: Nanotechnology, Application of Nanotechnology to monitor; restore; energy conservation towards environmental restoration.

I. INTRODUCTION

Nanotechnology is being explored to provide new solution for cleaning environment and improving the performance of conventional technologies. This technology is also explored for combating pollution by reducing the release or preventing the formation of pollutants. US National Nanotechnology initiative has identified "Environmental improvement" as one of the eight crosscutting areas of nanotechnology. It is the science of petite particles with dimensions in the order of 10-9 m, these minuscule particles are subject to the physical and chemical laws. Due to enormous surface area to mass ratio, nano particles exhibit exclusive properties which result in various fields like biomedicine, pharmaceuticals, cosmetics, and environment.

Nano is derived from the Greek word for dwarf. A nanometer is one billionth of a meter 10-9 and might be represented by the ten hydrogen atoms lined up in a raw. Because of their small size, nano particles have very high surface area compared with their bulk equivalent. Nano particles are more reactive and react to a greater extent because of their unusual crystal shapes, lattice order and small size provides more surfaces available for chemical interactions. There are wide categories of nano scale materials, nano tubes, nano shells, and metal oxides. The term "Pollution" has many definitions, one being "the presence of a substance in the environment whose chemical composition or quantity prevents the functioning of natural processes and produces undesirable environmental and health effects". With growing urbanization and increasing population, pollution has become the biggest environmental challenge. Moreover, the technological advancement has also given rise to new pollutants which are increasing at an alarming rate and are above the self remediating ability of the environment.

There is an urgent need to find technologies that would reduce these rates/pollution levels to risk-free status in quick and easy manner. Nanotechnology mainly consists of the processing of, separation, consolidation, and deformation of materials by one atom or molecule by using a set of precise tools. This branch of knowledge is a sub-classification of technology in colloidal science, biology, physics, chemistry and other scientific fields and involves the study of phenomena and manipulation of materials in the nano scale. This results in materials and systems that often exhibit novel and significantly changing physical, chemical and biological properties due to their size and structure and also has unique aspect of nanotechnology which opens new possibilities in surface-based sciences. In nature, nanotechnology first emerged billions of years ago at the point where molecules began to arrange in complex forms and structures that launched life on earth. Nano scale materials have the potential to improve the environment, both through direct applications of those materials to detect, prevent, and remove pollutants, as well as indirectly by using nanotechnology to design cleaner industrial processes and create environmentally responsible products. Nano technological products, processes and applications are expected to contribute significantly to environmental and climate protection by saving raw materials, energy and water as well as by reducing greenhouse gases and hazardous wastes. However, that nanotechnology currently plays a rather subordinate role in environmental protection.

II. 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. Nano materials exhibit special physical and chemical properties that make them interesting for novel, environmentally friendly products.

III. NANOTECHNOLOGY APPLICATIONS THAT BENEFIT THE ENVIRONMENT

Battery Recycling

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 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.

Radioactive Waste Clean-up in Water

Scientists are working on nanotechnology solution for radioactive waste cleanup, specifically the use oftitanate nanofibers as absorbents for the removal of radioactive ions from water. Researchers have also reported that the unique structural properties of titanate nano tubes and nano fibers 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 nano materials. Nanotechnology-based water purification devices have the potential to transform the field of desalination, for instance by using the ion concentration polarization phenomenon. 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 nano flakes 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 nano scale thin membranes could lead to new membrane technology .

IV. HYDROGEN PRODUCTION FROM SUNLIGHT-ARTIFICAL 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 "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. Working on the nano scale, researchers have shown that an inexpensive and environmentally benign inorganic light harvesting nano crystal array can be combined with a low-cost electro catalyst that contains abundant elements to fabricate an inexpensive and stable system for photo electrochemical hydrogen production. The water-repellent surface of lotus (Nelumbo nucifera) leaf and flower is due to nano sized wax papillae on the upper side of each epidermal cell. As a result, raindrops make a high contact angle with the papillae and roll off carrying dust and dirt particles, leaving the surface clean.

This self-cleaning property of highly hydrophobic surfaces, termed as the lotus effect, has opened the possibilities of fabricating super hydrophobic surfaces for a variety of products. Lotus, botanically named Nelumbo nucifera, is regarded as a sacred plant in Hindu mythology. Lotus is also India's national flower and is regarded as a symbol of purity. Its leaf and flower are water-repellant. A falling raindrop turns into a water bead and rolls off, taking along with it the dust and the dirt particle. Hence, despite growing in muddy waters, the lotus leaf surface stays relatively clean. Although the water repellency of lotus had long been recognized, its scientific basis was understood and examined leaf surfaces of lotus and several other plants using a scanning electron microscope which resolves structures as small as 1–20 nm (one nm = billionth or 10–9 of a meter). They established that the self cleaning property is due to the presence of convex papillae on the surface of leaves, coated with wax crystals of nano scopic dimension: ~10 to ~100 nm The papilla greatly reduces the contact area of water droplets with it. The water droplet, as for example due to rain or fog or dew, is dislodged, often coalescing into a bigger drop at the center of leaf surface that falls off with swaying of the leaf. Wax is comprised and prevent from water pollution.

V. CONCLUSION

Research varies in the approaches taken to reach the endpoint of treatment or remediation. Some researchers attempt to surface-coat molecules to pull them together, and maybe detoxify them while others coat them so that the desired nano product is isolated and collectable. Regardless of the strategy utilized, the nanotechnology will make possible great advances in our ability to clean up the environment. Proactive applications mainly include green manufacture and green energy productions. Green energy can be produced using nanotechnology to create solar and fuel cells as potential sources of commercially available alternative clean energy sources. Green manufacturing has two aspects: the use of nanotechnology in the design process to eliminate polluting waste products at their source and, alternately, the efficient production of nano materials themselves. Green manufacturing improves catalysis specificity, producing more of the desired compounds and less waste and pollution. Researchers are exploring how to stabilize nano particles without harmful additives that would pollute water and soil. Often these processes require less time, sometimes hours instead of days, and can potentially significantly reduce the cost of making nano particles. Consumption of energy during the manufacturing processes can also be reduced many aspects of nanotechnology and its application in manufacturing are devoted to the research and production of cleaner and more efficient energy sources.

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