APPLICATIONS OF NANOTECHNOLOGY

Ch Mahita
Lecturer in Physics, Sir C R R (A) College, Eluru, AP
B V Manoj Kumar
Lecturer in Chemistry, Sir C R R (A) College, Eluru, AP
S Krishna Kumari
Lecturer in Chemistry, Sir C R R (A) College, Eluru, AP
G Sarada
Lecturer in Chemistry, Sir C R R (A) College, Eluru, AP

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Abstract: Nanomaterials are the components that have in any event one spatial estimation in the size scope of 1 to 100 nanometers. Nanomaterials can be delivered with different adjustment measurements. It very well may be an alternate nanostructure, for example, quantum specks, nanocrystals, nuclear groupings, nanotubes, and nanowires, while the accumulation of nanostructures incorporates frameworks, sets, and supernets of various nanostructures. The synthetic and physical properties of nanomaterials can contrast extensively from mass or sub-atomic nuclear materials of a similar arrangement.

Nano Materials and Nanoparticle examination is right now a region of serious experimental exploration, because of a wide range of potential applications in biomedical, optical, and electronic fields. 27 research colleges are taking about Nano-composites everywhere all over the world, and market estimation over Asia Pacific is discharged per annum for Nano materials and Nano particles examination. The control of composition, size, shape, and morphology of Nano materials and Nano particles is an essential foundation for the development and application of Nano scale devices in all over the world.Encompassing nanoscale science, engineering, and technology, nanotechnology involves imaging, measuring, modelling, and manipulating matter at this length scale. A nanometer is one-billionth of a meter. A sheet of paper is about 100,000 nanometers thick; a single gold atom is about a third of a nanometer in diameter.

Nanotechnology Applications:

Medicine: Researchers are developing customized nanoparticles the size of molecules that can deliver drugs directly to diseased cells in your body. When it's perfected, this method should greatly reduce the damage treatment such as chemotherapy does to a patient's healthy cells. Nanomedicine and nano delivery systems are a relatively new but rapidly developing science where materials in the nanoscale range are employed to serve as means of diagnostic tools or to deliver therapeutic agents to specific targeted sites in a controlled manner.

Cancer nanotechnology is a branch of nanotechnology concerned with the application of both nanomaterials (such as nanoparticles for tumour imaging or drug delivery) and nanotechnology approaches (such as nanoparticle-based theranostics) to the diagnosis and treatment of cancer.Most harmful side effects of treatments such as chemotherapy are a result of drug delivery methods which do not pinpoint their intended target cells accurately.

Electronics: Nanotechnology holds some answers for how we might increase the capabilities of electronics devices while we reduce their weight and power consumption. Scientists have been studying and working with nanoparticles for centuries and they were unable to see the structure of nanoparticles. With the development of microscopes in recent decades, scientists got the ability to see nano-sized materials which are as small as atoms and this had opened up a world of possibilities in a variety of industries and scientific endeavors. Designers Face hurdles for the future of Nano electronics. High-performance logic circuits and Semiconductor memory had been the technology drivers to architect the miniaturization of the MOS transistor. The scaling of MOS transistor in nanoelectronics explores new materials like high-k gate dielectrics such as HfO_2, Er_2O_3, Gd_2O_3; new channel materials such as germanium and grapheme and finally new device structures like double-gate FET, FinFET, Schottky source/drain FET.

Nanotechnology Improve the Capabilities of Electronic Components as Given Below: By reducing the size of transistors used in integrated circuits. Researchers are developing a type of memory chip with a projected density of one terabyte of memory per square inch and this increases the density of memory chips. By improving display screens on electronics devices and this reduces power consumption and also the weight and thickness of the screens.

Food: Nanotechnology is having an impact on several aspects of food science, from how food is grown to how it is packaged. Companies are developing nanomaterials that will make a difference not only in the taste of food, but also in food safety, and the health benefits that food delivers. Nanotechnology can be used to enhance food flavor and texture, to reduce fat content, or to encapsulate nutrients, such as vitamins, to ensure they do not degrade during a product's shelf life. In addition to this, nanomaterials can be used to make packaging that keeps the product inside fresher for longer.

Inorganic nanomaterials for application in food food additives, food packaging or storage include ENMs of transition metals, such as silver and iron; alkaline earth metals, such as calcium and magnesium; and non-metals, such as selenium and silicates. Other ENMs that can potentially be used in food applications include titanium dioxide. Food packaging is the major area of application of metal (oxide) ENMs. Nanoselenium is being marketed as an additive to a green tea product, with a number of (proclaimed) health benefits resulting from enhanced uptake of selenium. Nanocalcium salts are the subject of patent applications for intended use in chewing gums. Nanocalcium and nanomagnesium salts are also available as health supplements.

Nanofood: The term 'nanofood' describes food that has been cultivated, produced, processed or packaged using nanotechnology techniques or tools, or to which manufactured nanomaterials have been added.Nanofood has, in fact, been part of food processing for centuries, since many food structures naturally exist at the nanoscale. The purpose of nanofood is to improve food safety, enhance nutrition and flavor, and cut costs. Although nanofood is still in its infancy, nanoparticles are now finding application as a carrier of antimicrobial polypeptides required against microbial deterioration of food quality in the food industry. The current nanotechnology applications in food science provide the detection of food pathogens, through nanosensors that are quick, sensitive and less labor-intensive procedures.

Fuel Cells: Nanotechnology is being used to reduce the cost of catalysts used in fuel cells to produce hydrogen ions from fuel such as methanol and to improve the efficiency of membranes used in fuel cells to separate hydrogen ions from other gases such as oxygen. Fuel cells contain membranes that allow hydrogen ions to pass through the cell but do not allow other atoms or ions, such as oxygen, to pass through. Companies are using nanotechnology to create more efficient membranes. There are many limitations preventing fuel cells from reaching widespread commercial use, however. Expensive materials such as platinum are needed for the electrode catalysts. Fuels other than hydrogen can cause fouling of the electrodes, and hydrogen is costly to produce and difficult to store. The most efficient types of fuel cell operate at very high temperatures, which reduces their lifespan due to corrosion of the fuel cell components. Nanotechnology may be able to ease many of these problems. Recent nanotechnology research has produced a number of promising nanomaterials which could make fuel cells cheaper, lighter and more efficient. The electrocatalytic activity of these modified nanotubes can actually be superior to that of platinum - the power output of a fuel cell using carbon nanotube electrodes is equal to or greater than that from the platinum equivalent.

Solar Cells: Companies have developed nanotech solar cells that can be manufactured at significantly lower cost than conventional solar cells. Nanotechnology solar cell which absorbs both sunlight and indoor light and converts it into electricity. The basic concept is that Plastic is made using nanoscale titanium particles coated in photovoltaic dyes, which generate electricity when they absorb light.

- Reduced manufacturing costs as a result of using a low temperature process similar to printing instead of the high temperature vacuum deposition process typically used to produce conventional cells made with crystalline semiconductor material.
- Reduced installation costs achieved by producing flexible rolls instead of rigid crystalline panels. Cells made from semiconductor thin films will also have this characteristic.
- Currently available nanotechnology solar cells are not as efficient as traditional ones, however their lower cost offsets this. In the long term nanotechnology versions should both be lower cost and, using quantum dots, should be able to reach higher efficiency levels than conventional ones.

Batteries: Companies are currently developing batteries using nanomaterials. One such battery will be a good as new after sitting on the shelf for decades. Another battery can be recharged significantly faster than conventional batteries.

Increasing the available power from a battery and decreasing the time required to recharge a battery. These benefits are achieved by coating the surface of an electrode with nanoparticles. This increases the surface area of the electrode thereby allowing more current to flow between the electrode and the chemicals inside the battery. This technique could increase the efficiency of hybrid vehicles by significantly reducing the weight of the batteries needed to provide adequate power. Increasing the shelf life of a battery by using nanomaterials to separate liquids in the battery from the solid electrodes when there is no draw on the battery. This separation prevents the low level discharge that occurs in a conventional battery, which increases the shelf life of the battery dramatically. Ultra-capacitors using nanotubes may do even better than batteries in hybrid cars. Electrical generator built with nanostructured material that can produce watts of electrical power from walking.

Space: Nanotechnology may hold the key to making space-flight more practical. Advancements in nanomaterials make lightweight spacecraft and a cable for the space elevator possible. By significantly reducing the amount of rocket fuel required, these advances could lower the cost of reaching orbit and traveling in space. Nanotechnology may hold the key to making space flight more practical. Advancements in nanomaterials make lightweight solar sails and a cable for the space elevator possible. By significantly reducing the amount of rocket fuel required, these advances could lower the cost of reaching orbit and traveling in space.Researchers are looking into the following applications of nanotechnology in space flight:

- Employing materials made from carbon nanotubes to reduce the weight of spaceships like the one shown below while retaining or even increasing the structural strength. Photo courtesy of NASA
- Using carbon nanotubes to make the cable needed for the space elevator, a system which could significantly reduce the cost of sending material into orbit.
- Working with Nano sensors to monitor the levels of trace chemicals in spacecraft to monitor the performance of life support systems.

Fuels: Nanotechnology can address the shortage of fossil fuels such as diesel and gasoline by making the production of fuels from low grade raw materials economical, increasing the mileage of engines, and making the production of fuels from normal raw materials more efficient. Making the production of fuels from low grade raw materials economical. Increasing the mileage of engines. Making the production of fuels from normal raw materials more efficient.

Nanotechnology can do all this by increasing the effectiveness of catalysts. Catalysts can reduce the temperature required to convert raw materials into fuel or increase the percentage of fuel burned at a given temperature. Catalysts made from nanoparticles have a greater surface area to interact with the reacting chemicals than catalysts made from larger particles. Nanotechnology, in the form of genetic engineering, can also improve the performance of enzymes used in the conversion of cellulose into ethanol. Currently ethanol added to gasoline in the United States is made from corn, which is driving up the price of corn. The plan is to use engineered enzymes to break down cellulose into sugar, is fermented to turn the sugar into ethanol. This will allow material that often goes to waste, such as wood chips and grass to be turned into ethanol.

Better Air Quality: Nanotechnology can improve the performance of catalysts used to transform vapors escaping from cars or industrial plants into harmless gasses. That's because catalysts made from nanoparticles have a greater surface area to interact with the reacting chemicals than catalysts made from larger particles. The larger surface area allows more chemicals to interact with the catalyst simultaneously, which makes the catalyst more effective.

Better Water Quality: Nanotechnology is being used to develop solutions to three very different problems in water quality. One challenge is the removal of industrial wastes, such as a cleaning solvent called TCE, from groundwater. Nanoparticles can be used to convert the contaminating chemical through a chemical reaction to make it harmless. Studies have shown that this method can be used successfully to reach contaminates dispersed in underground ponds and at much lower cost than methods which require pumping the water out of the ground for treatment.

Chemical Sensors: Nanotechnology can enable sensors to detect very small amounts of chemical vapors. Various types of detecting elements, such as carbon nanotubes, zinc oxide nanowires or palladium nanoparticles can be used in nanotechnology-based sensors. Because of the small size of nanotubes, nanowires, or nanoparticles, a few gas molecules are sufficient to change the electrical properties of the sensing elements. This allows the detection of a very low concentration of chemical vapors.

Chemical and Biological Sensors using Nanotechnology: Chemical sensor using Nano cantilevers that are oscillating at their resonance frequency. When the chemical attaches to the cantilever it stops the oscillation, which triggers a detection signal. Nano cantilevers can also be used to detect biological molecules, such as viruses. The cantilever is coated with antibodies that capture the particular virus, when a virus particle attaches to the an antibody the resonance frequency of the cantilever changes. Sensors using nanoporous silicon detection elements that could be incorporated into cell phones. This might allow a very widespread network of sensors to detect chemical gas leaks or release of a toxin. Sensors powered by electricity generated by piezoelectric zinc oxide nanowires. This could allow small, self contained, sensors powered by mechanical energy such as tides or wind.

Sporting Goods: If you're a tennis or golf fan, you'll be glad to hear that even sporting goods has wandered into the nano realm. Current nanotechnology applications in the sports arena include increasing the strength of tennis racquets, filling any imperfections in club shaft materials and reducing the rate at which air leaks from tennis balls. Increasing the strength of tennis racquets by adding nanotubes to the frames which increases control and power when you hit the ball. Reducing the rate at which air leaks from tennis balls so they keep their bounce longer.

Fabrics: Making composite fabric with nano-sized particles or fibers allows improvement of fabric properties without a significant increase in weight, thickness, or stiffness as might have been the case with previously-used techniques.

Nanotechnology fabrics are textiles manufactured to have special qualities like hydrophobicity and high durability. These characteristics are created by weaving nanofibers that have certain properties and by adding nanoparticles that can provide traits such as bacteria resistance and the "lotus plant" effect, which creates dirt and water resistance. **Nanotechnology fabrics** are a relatively new and expanding field. They have applications in bioengineering, electrical engineering and computer science. **Nanotechnology fabrics** can be produced using a number of different procedures. One of these processes is called Sol-gel and it immerses fabrics in a gel solution to deposit nanoparticles into the material. Another process uses plasma to create **nanotechnology fabrics**. Plasma creates radical sites on the fabric and can be used to insert nanoparticles onto the surface as well. Some important and useful applications for **nanotechnology fabrics** include wrinkle and stain resistant clothing and antimicrobial clothing for hospitals. These effects can be produced on fabrics using Thierry plasma systems with a fast and effective microwave plasma process.

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