Interdisciplinary Approach of Nanotechnology

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ABSTRACT
Nanotechnology is engineering and manufacturing at the molecular scale, thereby taking advantage of the unique properties that exist at that scale. Nanotechnology offers unprecedented opportunities for progress—defeating poverty, starvation, and disease, opening up outer space, and expanding human capacities. This paper explains exponential general-purpose molecular manufacturing, the basic concepts behind it, and inters disciplinary approach of nanotechnology. This paper reviews the study of the different aspects of nanotechnology such as Nanomedicine in curing the different type of diseases, Nanoelectronics offers a new approach for the electronic industry in the form of new circuit material, processors and storage devices, Environmental Nanotech includes cleaning up existing pollution and making alternatives energy sources more cost effective, Energy applications of Nanotechnology presents a way to replace fossil fuels with cheap sustainable energy. This paper reveals the fact that Nanotechnology has a positive economic impact on society.

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Review notes

1. INTRODUCTION TO NANOTECHNOLOGY
Nanotechnology is the creation of functional materials, devices and systems through control of matter at the scale of 1 to100 nanometers and the use of their properties are very small scale. Engineering on an extremely small scale-a billionth of a meter. Not just an extension of miniaturization, but making smart and good products with added functionality. The 'nano' in Nanotechnology is a short form of 'nanometer', which is a one billionth of a meter.

2. INTERDISCIPLANRY APPROACH TO NANOTECHNOLOGY
The field of nano-technology covers a broad area of expertise. Classical fields of Physics, Chemistry, Material Science, and Electrical /Mechanical /Chemical Engineering all are involved in the "new" field of nano. Research and development in that area is by its very nature inter-disciplinary. This presentation will give a personal perspective of any engineer in the area of nanoengineering. Besides engineering there are many disciplines like medicine, space, food, consumer products and environment in which nanotechnology is involved. The use of nanotechnology makes the applications of these disciplines very cost-effective, novel and will continue to have positive social impact.

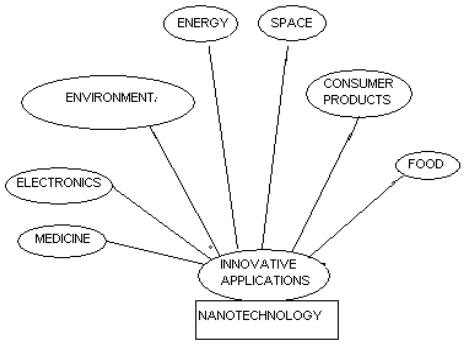

Fig 1: Application areas of nanotechnology

2.1 Nanotechnology And Energy
In order to make the next step forward from the current generation of technology, scientists and engineers have been developing Energy Applications of Nanotechnology. With the use of Nanotechnology a bold new research program can be find out to replace fossil fuels with cheap sustainable energy. The most advanced nanotechnology projects related to energy are: storage, conversion, manufacturing improvements by reducing materials and process rates and enhanced renewable energy sources.

To generate electricity from waste heat by nanotube sheets

Improving the performance of batteries with higher energy content or super capacitors with a higher rate of recharging

Improving the efficiency and reducing the cost of fuel cells

Making the production of fuels from raw material more efficient

Positive economic impacts on society

2.2 Nanotechnology and Environment
Nanotechnology is being used in various applications to improve the environment includes cleaning up existing pollution ,improving manufacturing methods to reduce generation of pollution and making alternatives energy sources more cost effective. The use of nanomaterials will affect organisms and ecosystems.

Nanotechnology's environmental implications can be split into two aspects: the potential for nanotechnological innovations to help improve the environment, and the possibly novel type of pollution that nanotechnological materials might cause if released into the environment. The most advanced nanotechnology applications related to environment are: to reduce air pollution, to reduce water pollution, to improve fuel and solar cells.

2.3 Air Pollution and Nanotechnology

There are two major ways in which nanotechnology is being used to reduce air pollution:

1) Catalyst, which are currently in use and constantly being improved upon
2) Nanostructured membranes, which are under development.

2.4 Water pollution and Nanotechnology

It includes two main aspects of water filtration and water remediation. Nanotechnology is being used to develop solutions to the three major problems regarding water pollution. One challenge is the removal of industrial water pollution. Another challenge is the removal of salt or metals from water. The third problem concerns the fact that standard filters do not work on virus cells.

Nanofiltration Nanoporous membranes are suitable for a mechanical filtration with extremely small pores smaller than 10 nm and may be composed of nanotubes. Nanofiltration is mainly used for the removal of ions or the separation of different fluids.

Magnetic nanoparticles offer an effective and reliable method to remove heavy metal contaminants from waste water by making use of magnetic separation techniques.

2.4.1 Nanomaterials and water filtration: The researchers have investigated how silica particles can be coated easily with a nanometer-thin layer of active material based on a hydrocarbon with a silicon-containing anchor. The coating is formed through a chemical self-assembly process so involves nothing more than stirring the ingredients to make the active particles. Nanomaterials such as carbon nanotubes and nanoparticles are contributing to the development of more efficient and cost-effective water filtration processes.

2.4.2 Nanotechnology for water remediation

In general, remediation technologies can be grouped into categories using thermal, physico-chemical or biological methods. Nanotechnology could play an important role in this regard. An active emerging area of research is the development of novel nanomaterials with increased capacity, and selectivity for heavy metals and other contaminants.

2.5 Fuel Cells and Nanotechnology

Improving the efficiency of fuel cells through the use of nanotechnology appears to be more plausible by using molecularly tailored catalyst, polymer membranes and improved fuel storage. In order for a fuel cell to operate a noble metal catalyst (usually platinum, which is very expensive) is needed to separate the electrons from the protons of the hydrogen atoms.

2.6 Nanotechnology and Electronics: Nanoelectronics

Nanotechnology has already reached the electronics industry with features in microprocessors now less than 100 nanometers (nm) in size. Smaller sizes allow faster processing times and also more processing power to be packed into a given area. Nanoelectronics increase the capabilities of devices while we reduce their weight and power consumption, it also reducing Power CC while decreasing the weight and thickness of screen.

Nanoelectronics on the other hand offer a new approach for the electronics industry in the form of new circuit materials, processors, information storage and even ways of transferring information such as optoelectronics.

Nanotechnology for Electronics –

2.6.1 Computers

Nanotechnology gives scope to develop new ideas and methods of running the following:

- super-fast processors
- New memory types
- Nanodots
- Quantum Computing

- ***Faster Processors***

Many companies are now in the late development stages of processor chipsets of around 60nm, with Intel being close to market with their 65nm products. The Intel chipsets feature greater performance as a result of a 10-15% improved drive current through the application of nanotechnology.

- ***New Memory Types***

Apple's latest Ipod boasting 60GB of memory. The desire is for larger storage in smaller spaces, but not at the expense of energy requirements. Current technology makes these demands very difficult to meet, but nanotechnology offers the solution. Initially, a component that produces is smaller in size but expensive.

- ***Nanodots***

Nanodots stand for nanosized 'dots' of nickel that are used to store terabytes of data, even for home and personal users. Each "nanodot" consists of a discrete ball of several hundred nickel atoms and can have one of two magnetic states. This allows them to hold a single bit of information - a '1' or a '0' - as is the computing convention.

- ***Quantum Computing***

Quantum computing is based on principles of quantum theory with computer technology, which explains the nature and behavior of energy and matter on the quantum (atomic and subatomic) level. Quantum computer could present a giant leap forward in computing capability, offering huge performance gains. Processing power, and related computing tasks would benefit hugely from quantum computing ability to operate in multiple states, processing all calculations and data permutations simultaneously.

2.6.2 Telecommunications and Handheld Devices:

Nanotechnology can offer improved versatility through faster data transfer, more mobile processing power and larger data storage.

2.6.3 Optics

Light emitting diodes (LEDs) lose very little energy as heat and also last up to 20 times longer than conventional light bulbs. With advances in their nanocrystalline structure in recent years, they are now emitting more light per watt of power consumed than incandescent bulbs and about the same as fluorescent bulbs.

Organic Light Emitting Diodes (or OLEDs) are cheaper and easier to manufacture than LEDs. These consist of thin layers of electrically conducting organic molecules which are approximately 100 nm thick.

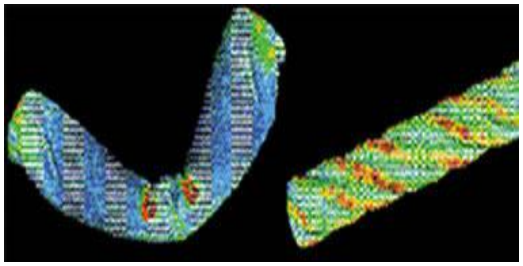

Fig.2: Structure of nanotubes

Carbon nanotubes are now being prepared for use in displays. Carbon nanotubes are up to 100 times stronger than steel, yet only 1/6 of the weight. They can even be flexible as the image below shows. In addition, they conduct electricity better than copper.

2.7 Nanotechnology and Medicine: Nanomedicine

Complex molecular machines use computer controlled molecular tools much smaller than a human cell and built with the accuracy and precision of drug molecules. Such tools will let medicine, for the first time; intervene in a sophisticated and controlled way at the cellular and molecular level. Nanotechnology will give us new instruments to examine tissue in unprecedented detail. Nanosensors smaller than a cell would give us an inside and exquisitely precise look at ongoing function

Major Nanomedicine Application Areas:

1) Drug Delivery to the diseased cell.
2) Diagnostic and Imaging Techniques
3) Anti-Microbial Technique
4) Repair specific diseased cells
5) Healing and repairing of skin tissue.

Curing Heart Disease through nanotechnology:

This technology detects and cures defective heart valves, detect and treat arterial plaque.

Curing Cancer through nanotechnology:

The scientists are working on the project to design the small devices (made up of molecule tools) which are able to identify and kill cancer cells before their form tumors. These devices have also the ability to destroy cancer tumors with minimal damage to healthy tissues.

Providing oxygen through nanotechnology:

Tissues in human body are damaged due to poor blood flow or inadequate oxygen. Sensors based upon nanoparticles are used to provide an artificial red blood cell to recover tissues.

Nanotechnology and Food

Nanotechnology has developed nanomaterial which will not only make food tasty but also a healthy and safe food.

The following are the major benefits of nanotechnology in the field of food and agriculture science:

- The food is enriched with vitamins and other proteins without affecting the taste or appearance.
- The various tools have been introduced for molecular treatment of diseases, rapid detection of disease from the plants.
- Silver nanoparticles in storage bins are used to kill bacteria from any material that was stored in plastic bins.
- Research is being conducted to develop nanocapsules that are used for flavor and color of food.
- Research is also doing on pesticides and herbicides. By releasing lower doses of pesticides, food will be much healthy and nutrient.
- Nanosensors are used to determine the nutrient need of plant. Displenser then release fertilizer or water as needed

Nanotechnology and Spaceflight

Nanotechnology is also being involved in making spaceflight practical. Advancements in nanomaterials make lightweight solar sails, reduces the cost of reaching orbit and traveling space. Nanosensors are to be used to monitor the levels of trace chemicals in spacecraft to monitor the performance of life support system. Scientists are working on nanosensors that will search the large areas of planet, trace of water or other chemicals in other planets. A compact chemical sensor using carbon nanotubes has been fabricated. Such a device would be ideal for use in NASA's Cosmo chemistry missions, Meyyappan said.

2.8 Nanotechnology and Consumer Products

Scientists are also working on various consumer products so that it will be provided to the consumer more economical and more beneficial products than the current used techniques.

In the following consumer products, nanotechnology is playing its role:

***Fabric*:** This technology improves the quality of fabric by reducing its weight, thickness with less cost.
***Cosmetic Products*:** Nanoparticles are more readily absorbed into the skin and as such repair damage easier and more efficiently, used to prevent graying hair and combat hair loss in some cases.
L'Oreal who has employed the technology in products such as Revitalift anti-wrinkle cream.
***Sports Products*:** Nanotechnology has developed tennis balls, tennis rackets, golf balls, nano ski wax, bowling balls.

3. CONCLUSION

Nanotechnology has the potential to improve the lives making them faster, economical and better. However, many of the applications are currently at an elementary stage and most are aimed at high value products and the field of nanotechnology covers a broad area of expertise. The described application appears to explore the benefits of nanotechnology while taking consumer confidence and acceptance.

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