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Application of nanotechnology in design & material science field

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Abstract: -- One of the most interesting things about nanotechnology is that the properties of many materials change when the size scale of their dimensions approaches nanometers. Materials scientists work to understand those property changes and utilize them in the processing and manufacture of materials at the nanoscale. The field of materials science covers the discovery, characterization, properties, and end-use of nanoscale materials.

Nanotechnology might be able to increase the efficiency of solar cells, but the most promising application of nanotechnology is the reduction of manufacturing cost. Utilizing nanotechnology in inexpensive solar cell would help to preserve the environment. This paper provides an overview of the current solar cell technologies and their drawbacks. Then, it explores the research field of Nano solar cells and the science behind them. The potential implications that these technologies would have on our society are also discussed.

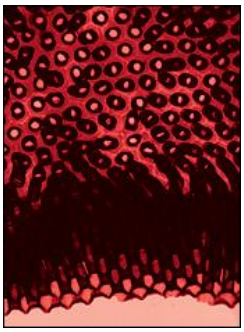
Most other engineering majors work with nanotechnology, but materials science and engineering is at the heart of it across all disciplines. For those who are passionate about nanotechnology, MSE is place to be for the most research, coursework, and experience in nanotechnology. Our department also administers the Clark School's Interdisciplinary Minor Program in Nanoscale Science and Technology, a program open to any student majoring in Engineering, Physics, or Chemistry.

Nanotechnology ("nanotech") is manipulation of matter on an atomic, molecular, and supramolecular scale. The earliest, widespread description of nanotechnology[1][2] referred to the particular technological goal of precisely manipulating atoms and molecules for fabrication of macroscale products, also now referred to as molecular nanotechnology. A more generalized description of nanotechnology was subsequently established by the National Nanotechnology Initiative, which defines nanotechnology as the manipulation of matter with at least one dimension sized from 1 to 100 nanometers.

INTRODUCTION

RENEWABLE energy is increasingly viewed as critically important globally. Solar cells, or photovoltaic, con-vert the energy of the sun into electricity.Before introducing new solar products, which use nanotechnology, it is necessary to explain the basic process that a normal solar cell uses. Conventional solar cells are called photovoltaic cells. These cells are made out of semiconducting material, usually silicon. When light hits the cells, they absorb energy though photons. This absorbed energy knocks out electrons in the silicon, allowing them to flow. By adding different impurities to the silicon such as phosphorus or boron, an electric field can be established. This electric field acts as a diode, because it only allows electrons to flow in one direction. Consequently, the end result is a current of electrons, better known to us as electricity.

This is a carbon nanotube, just a bit over 1 nanometer in width (100 nanometers is 1000 times smaller than the width of a human hair). Nanotubes are up to 100 times stronger than steel at only 1/6 the weight. They have a thermal conductivity near that of diamonds, and an electrical conductivity that can exceed that of copper. Inside this nanotube are "buckyballs", spherical carbon molecules. This combination has the potential to be used to create nanomechanical structures.



Professor Gary Rubloff's research group is designing nano-sized structures capable of storing solar or wind energy 10x more efficiently than what is currently available.

Positioning Nanoparticles Where You Need Them: Professor Oded Rabin and his graduate student have developed techniques to position silver nanocubes in predetermined locations on a substrate (surface). These techniques are needed to study interactions between

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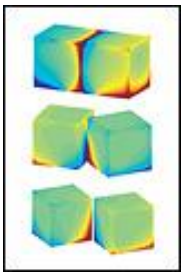
neighboring particles. In recent work the group succeeded to show that pairs of silver nanocubes, positioned face-to-face or edge-to-face, are very effective as chemical sensors utilizing a phenomena called Raman scattering.



Objective The most important goals of the basic, long-term research initiatives under NANOMAT - Nanotechnology and new materials, are to: 1. Ensure that Norwegian research in selected fields is of a high international calibre and, through a co-ordinated Norwegian initiative, make Norway an interesting partner for European and international research; 2. Support basic research that will result in new knowledge and serve as the basis for industrial growth; 3. Enhance expertise in technologies that will increasingly make their mark on and control our everyday routines and freedom of action; 4. Pave the way for new knowledge-based, research-intensive industry and more value added, based on new products and new technology in fields such as: sensors and smart materials, micro- and nanotechnology, new energy technology, new environmental technology, new process technology.
Reduction of the Cost of Solar Cells by Nanotechnology
Nanotechnology might be able to increase the efficiency of solar cells, but the most promising application of nanotechnology is the reduction of manufacturing cost. Chemists at the University of California, Berkeley, have discovered a way to make cheap plastic solar cells that could be painted on almost any surface.

Nanotechnology Improves the Solar Cell

Present 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 reachhigher efficiency levels than conventional ones. To coat the nanoparticles with quantum semiconductor crystals. Unlike conventional materials in which one photon generates just one electron, quantum dots have the potential to convert high-energy pho-tons into multiple electrons. Quantum dots work the same way, but they produce three electrons for every photon of sunlight that hits the dots. Electrons moves from the valance band into the conduction band the dots also catch more spectrums of the sunlight waves, thus increasing conversion efficiency to as high as 65 percent. Another area in which quantum dots could be used is by making so-called a hot carrier cells. Typically,the extra energy supplied by a photon is lost as heat, but with a hot carrier cells the extra energy from the photons result in higher-

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energy electrons which in turn leads to a higher voltage. The transport of electrons across the particle net-work is the major problem in achieving higher photo conversion efficiency in nanostructured electrode. Utilization of CNT network support to anchor light harvesting semiconductor particles by assisting the electron transport to the collecting electrode surface in DSSC. Charge injection from excited CdS into SWCNT excitation of CdS nanoparticle. When CNTSattached in Cdse&CdTe can induce charge transfer process under visible light irradiation. The enhanced interconnectivity between the titanium dioxide particles and the MWCNTs in the porous titanium dioxide film was concluded to be the cause of the improvement in short circuit current density.

Nanotechnology applications:

- Environmental purification
- Medicine and health
- Information and electronic technologies
- Advanced materials
- Agriculture
- Automotive
- Chemical, oil and gas industries
- Construction materials and household products
- Cosmetics
- Defence

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- Textiles
- Sporting goods and recreation
- Carbon technologies

Current Research

Nanomaterials

The nanomaterials field includes subfields which develop or study materials having unique properties arising from their nanoscale dimensions.[30]

- Interface and colloid science has given rise to many materials which may be useful in nanotechnology, such as carbon nanotubes and other fullerenes, and various nanoparticles and nanorods. Nanomaterials with fast ion transport are related also to nanoionics and nanoelectronics.
- Nanoscale materials can also be used for bulk applications; most present commercial applications of nanotechnology are of this flavor.
- Progress has been made in using these materials for medical applications; see Nanomedicine.

Applications

Nanostructures provide this surface with superhydrophobicity, which letswater droplets roll down the inclined plane.

As of August 21, 2008, the Project on Emerging Nanotechnologies estimates that over 800 manufacturer-identified nanotech products are publicly available, with new ones hitting the market at a pace of 3–4 per week.[13] The project lists all of the products in a publicly accessible online database. Most applications are limited to the use of "first generation" passive nanomaterials which includes titanium dioxide in sunscreen, cosmetics, surface coatings.

Implications

Main article: Implications of nanotechnology

An area of concern is the effect that industrial-scale manufacturing and use of nanomaterials would have on human health and the environment, as suggested bynanotoxicology research. For these reasons, some groups advocate that nanotechnology be regulated by governments. Others counter that overregulation would stifle scientific research and the development of beneficial innovations. Public health research agencies, such as the National Institute for Occupational Safety and Health are actively conducting research on potential health effects stemming from exposures to nanoparticles

Health and environmental concerns

Main articles: Nanotoxicology and Pollution from nanomaterials

Nanofibers are used in several areas and in different products, in everything from aircraft wings to tennis rackets. Inhaling airborne nanoparticles and nanofibers may lead to a number of pulmonary diseases, e.g. fibrosis.[70] Researchers have found that when rats breathed in nanoparticles, the particles settled in the brain and lungs, which led to significant increases in biomarkers for inflammation and stress response[71] and that nanoparticles induce skin aging through oxidative stress in hairless mice.

Regulation

Main article: Regulation of nanotechnology

Calls for tighter regulation of nanotechnology have occurred alongside a growing debate related to the human health and safety risks of nanotechnology.[81] There is significant debate about who is responsible for the regulation of nanotechnology. Some regulatory agencies currently cover some nanotechnology products and processes (to varying degrees) – by "bolting on" nanotechnology to existing regulations – there are clear gaps in these regimes.

CONCLUSION

1) Inexpensive solar cells, which would utilize nanotechnology, would help preserve the environment.

2) Coating existing roofing materials with its plastic photovoltaic cells which are inexpensive enough to cover a home's entire roof with solar cells, then enough energy could be captured to power almost the entire house. If many houses did this then our dependence on the electric grid (fossil fuels) would decrease and help to reduce pollution.

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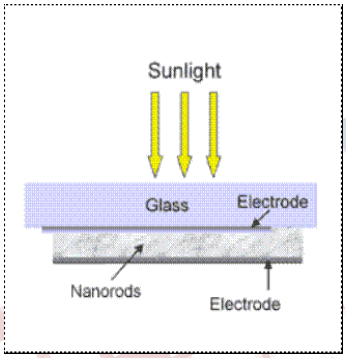
3) Inexpensive solar cells would also help provide electricity for rural areas or third world countries. Since the electricity demand in these areas is not high, and the areas are distantly spaced out, it is not practical to connect them to an electrical grid. However, this is an ideal situation for solar energy.
4) Cheap solar cell could be used for lighting, hot water, medical devices, and even cooking. It would greatly improve the standard of living for millions, possibly even billions of people.
5) Flexible, roller-processed solar cells have the potential to turn the sun's power into a clean, green, convenient source of energy Even though the efficiency of Plastic photovoltaic solar cell is not very great, but covering cars with Plastic photovoltaic solar cells or making solar cell windows could be generate the power and save the fuels and also help to reduce the emission of carbon gases.



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