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The Future Of Nanoscale Science And Technology

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***Abstract*:** *Recent developments in the field of nanoscale science and technology indicate a bright future for the growth of the field as well as its application potential. The fields is coming out of its nascent state and is maturing to have its own place in the competitive world of engineering. One can now systematically synthesize nanoscale materials with particular size and shape (distribution) and tune their optical, chemical, mechanical and electrical properties as per the requirements of applications. It is also important to note the pace of growth of fabrication techniques of nanoscale functional architectures consisting of materials with optical, electronic, magnetic and mechanical properties. The talk will concentrate on the recent developments in the field and potential applications in future technology.*

Carbon nanomaterialare normally synthesized from petroleum based precursors. Since these materials will be extensively used in 21st century, it is important that we develop technique which is not dependant on fissile fuel. Our group has been developing various plant-derived precursors for synthesizing carbon nanomaterials. Under this lecture, I shall try to give you the information about the various products which can be synthesized from plant derived precursors.

It is also important to develop applications of these materials; otherwise it will remain as an academic exercise. Hence we are also trying to study their applications like hydrogen storage, fuel cell, super capacitor, solar cell, microwave absorption and biological applications like killing pathogenic bacteria, cancerous cell etc. These applications would also be discussed in this seminar.

Key Words:*Nano science ,Buckminsterfullerene,DNA,Carbon Nano Tubes,Zigzag CNT.*

I. Introduction

Nanoparticles of carbon-rods, fibers, tubes with single or double walls, open or closed ends, and straight or spiral forms have been synthesized over past two decades. Not all single-wall carbon nanotubes are crated equal. There are 56 varieties with subtle differences in diameter or physical structure. These subtle differences lead to marked differences in electrical, optical and chemical properties. For example, about one-third is metals, and the rest are semiconductors. To control nanotube chemistry, the researchers added diazonium salts to nanotubes suspended in an aqueous medium. The diazonium reagent extracts an electric charge and chemically bonds to the nanotubes under controlled conditions. By adding a functional group to the end of the reagent, the researchers can create a 'handle' that they can use to selectively manipulate the nanostructure. There are different techniques for pulling on these handles, including chemical deposition and capillary electrophoresis. Since metals give up electrons faster than semiconductors, the diazonium reagent can be used to separate metallic nanotubes from semi conducting nanotubes. The chemistry is reversible. After manipulating these nanotubes, one can remove the chemical handle by applying heat. The thermal treatment also restores the pristine electronic structure of the nanotubes.Carbon nanotubes, which are used as reinforcing particles in nanocomposites, have been shown to have unique properties of stiffness, strength and electronic properties higher than any other material. These nanotubes are reported to be thermally stable under vacuum conditions up to 2800°C, to have a capacity to carry an electric current 1000 times better than copper wires, and to have twice the thermal conductivity of diamond. Nanocomputers based on carbon nanotubes have already been demonstrated. They are also used as electrically conductive fillers to dissipate static charges in equipment use to manufacture computer disc drives and semiconductor wafers. They can be used to make plastic automobile body panels conductive, so that they can be electro statically spray painted without the need of a costly primer coat. Single-walled carbon nanotubes, which are hollow cylinders of interlinked carbon atoms, are hard to make in large quantities. However, Carbon Nanotechnologies Inc., Houston is churning out commercial quantities at a pilot plant with the technical know-how transferred from the Rice University in Texas. They also licensed the process technology to DuPont for use in making nanotubes with application as field emitters in flat-panel displays. Hyperion Catalysis International Inc., Cambridge, Mass. is a leading player in the production and sale of multi-wall carbon nanotubes. One of its prime customer, General Electric, which employs nanotubes by trade name 'Fibrils', in a grade of Noryl Polyphenylene Oxide — Nylon blends for electro statically paintable car exteriors. Hyperion also sell Nylon-12 master batches containing nanotubes for static dissipation in automotive fuel lines, and polycarbonate-nanotube master batches for use in disc drive handling trays. Other concentrates based on polyether-ether-ketones (PEEK) and polyether imide (PEI), are intended for use in electrically dissipative containers that transport semiconductor wafers during manufacture

As better insulation materials:

Better insulation materials known as Vierogels' which are porous in nature and extremely light weight, are currently in use for insulation of offices, homes, etc. By using these materials, heating and cooling bills can be drastically reduced, thereby saving power and reducing attendant environment pollution. They are also being used as materials for 'Smart Windows' which darken when the Sun is too bright, and lighten themselves when the Sun is not shining too brightly.

Thermoelectric Devices based on Nanomaterials:

Nanoscience provides exciting new possibilities towards the development of thermoelectric materials with larger magneto resistance, and strong surface acidity. Thermoelectric devices are used for power generation and refrigeration. They are attractive because of high reliability, silent, vibration-free operation, no need for compressed gas, chemicals or other consumables,. and are completely scalable. However, because of their relatively high cost and low efficiency, these are restricted to applications like automotive seat coolers and generators in satellites and space probes.

Nanocatalysts:

Nanocrystalline materials possess extremely large grain boundaries relative to their grain size. Therefore, they are very active in terms of chemical, physical and mechanical properties. Due to their enhanced chemical activity, they can be used as catalysts to react with such noxious and toxic gases like carbon dioxide and nitrogen oxide in automobile catalytic converters and power generation equipment to prevent environment pollution arising out of burning of gasoline and coal.

Cutting Tools from Nanomaterials:

Cutting tools made of nanocrystalline materials such as — carbides of tungsten, tantalum and titanium, are much harder, wear and erosion resistant, last longer than their conventional counterparts. Towards miniaturization of microelectronic circuits, the industry needs micro-drills (drills <100im diameter) with enhanced edge retention and for better wear resistance.

Laptops and nanomaterials:

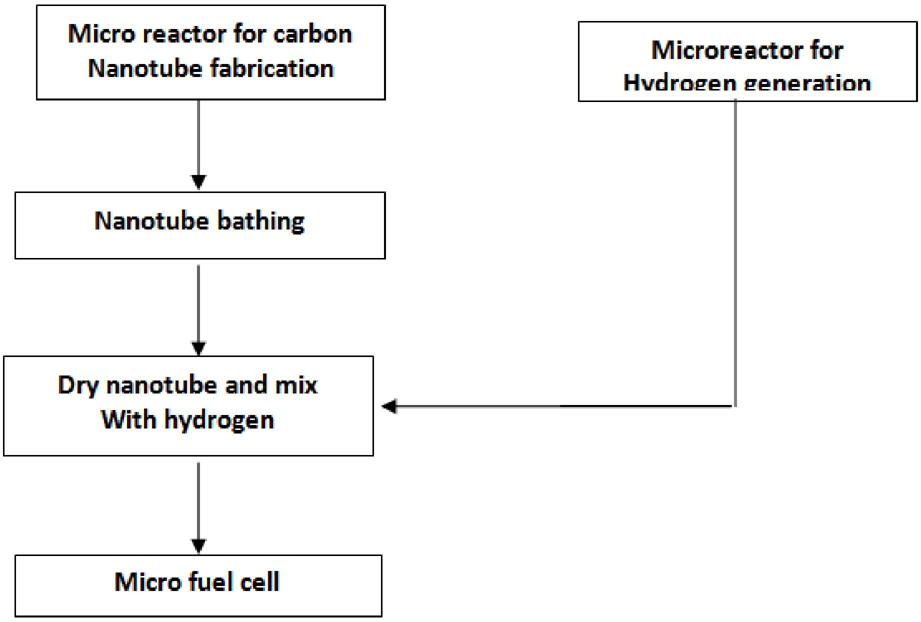
Flat-panel displays represent a huge market in the laptop computer industry. By synthesizing nanocrystalline phosphors, the resolution of these display devices can be greatly enhanced, and the manufacturing costs can be significantly reduced. Further, flat-panel displays constructed out of nanomaterials possess much higher brightness and contrast than the conventional ones due to their improved electrical and magnetic properties.

Improving resolution of Television and Monitors:

Nanociystalline zinc Selenide, Zinc Sulfide, Cadmium Sulfide and Lead Sulfide, synthesized by the sol-gel technique are the candidates for improving the resolution of monitors. The resolution of television or a monitor greatly depends on the size of the pixel. These pixels are essentially made of materials called 'phosphors', which glow when struck by a stream of electrons inside the cathode ray tube. The resolution improves with the reduction in size of the pixel or the phosphors. Therefore, the use of nanophosphors is envisioned to reduce the cost of these displays, with high-definition televisions and personal computers affordable by an average household.

Approaches of NanoTechnology

The two fundamental approaches of nanotechnology are graphically termed 'top-down' and 'bottom-up' . Top down refers to making nano scale structures by machining and etching techniques, whereas bottom-up, or molecular nanotechnology, applies to building organic and inorganic structures atom-by-atom, or molecule-by-molecule. Top—bottom or bottom-up is a measure of the level of advancement of nanotechnology. Nanotechnology, as applied today, is still mainly at what may be considered the more primitive bottom-top stage, building upward in the Molecular scale shown in the Fig.



Draw Backs of Carbon Nano Tubes

Technology is technically sound but some drawbacks are observed which are expected in medical field. CNT'S and fullerenes are potentially dangerous. Explore to fullerenes for 48 hours cause brain damage to fish. Exposure to fullerenes changes the gene markers [1] in the livers. Fullerenes kill water fleas — link in the marine food chain. Nanoparticles found to be accumulated in the bodies of lab animals and cause toxicity. Fullerenes travel freely through soil and could get absorbed by earth warm. Asbestos dust [2], accumulated in human body can cause cancer.

II. Conclusion

Through some disadvantages prevail; nanotechnology is the technology which is still in infancy. In the years to come it will definitely emerge out with wide spread applications. A day may come! A wonder may happen! Coal becomes Diamond! That is the ultimate fruit of Nanotechnology.

References

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