

Nano Science And Technology: Popular Uses

Mahadev Chattopadhyay

Assistant Professor of Physics,
Rishi Bankim Chandra College, Naihati, 24Pgs (N), WB.

Abstract: *Richard Feynman had a dream to write all the written words of history to fit on just one hundredth of an Inch cube without any violation of laws of physics. In 1959 AD, he told "There's plenty of room at the bottom". With the invent of Scanning Tunneling Microscope the nano world is gradually exploring to us. Its small size and large surface to volume ratio gives it's special properties which can be utilized in our practical life.*

Index Terms: *Carbon nano tubes, nano medicine, nano electronics, drug delivery, bucky ball.*

I. INTRODUCTION

One Nano metre= 10^{-9} metre. Human hair is approximately 70000-80000 nm. Nano materials are produced by 'bottom up' or 'top down' approach and self synthesized method.

Due to very high surface to volume ratio than the bulk material, it's chemical, magnetic, optical, electrical, thermal, mechanical etc. properties have some specialty and hence that are used in different fields such as instrumentation, medicine, energy production, electronics etc.

PROCESS OF SYNTHESIZE NANO MATERIAL: mechanical grinding, electro chemical etching, sol-gel method, precipitation, lithography, colloidal synthesis epitaxy etc.

EXAMPLES OF NANOMATERIALS: Carbon nano tube(CNT), Bucky ball(fullerene), Fe-Pt nano material, Silver nano cubes, SnO₂ nano flowers, nano springs, nano wires, Titanium nano flowers Au nano particles etc.

II. DIFFERENT USES

A. ENERGY PRODUCTION

Nano structured MnO₂ used for rechargeable batteries. Nano crystalline silicon, TiO₂ films are used for thin film Solar cell. Plastic solar cells (in nano size) converts sun lights 50,000 times more efficiently than conventional plastics. Microbial fuel cells (electrodes are made by CNT) is a device in which bacteria (eg-E-coli) consumes water soluble wastes

(sugar, starch, alcohol etc) and produces electricity, hydrogen and clean water.

Reaction rate of nano -aluminium can go so high that it is utilised as a solid fuel in rocket propulsion. CNT used to produce electricity from tap water. Nano robots and future nano devices needs some shorts of power. It can be available from light on nano scale. Photo sensitive azobenzene lengthen and contracts when exposed to light and thus converts light energy to mechanical energy. Nano robots and other nano devices now have a possible way of being self sustaining. Some molecules can switch between -trans and -cis via light waves.

B. MEDICALS

Gold nano particles used for medical purpose, nano silver is anti bacterial and anti fungal. Nano emulsion preserve active active ingredients such as Vitamins and anti Oxidant Iron nano particles are attached to bio probes about 40 nm long are injected into the patients body which sniffs out aggregate near the tumor cells. By applying alternating magnetic field from outside, iron is heated to about 170 °C, keeling the cancer cells. Au, Si etc. nano shells are injected inside the body which pile up near tumor cells. An IR LASER is used to heat the cells. Sign of genetic defects could be detected even before birth around of 8 weeks of pregnancy.

Magnetic nano particles coated with anti bodies to specific virus such as HIV could be injected in to blood streams to detect and fight virus.

Bucky ball is used for drug delivery. Pancreatic cell are encapsulated into nano particles that are sent into blood stream where they continue to secrete insulin.

Internal organs and cells can be tracked and imaged using nano particles using nano particles with the help of its Optical Luminescence property such as Si-Ge Quantum dots, Silver powder, ZnS, Selenides etc. Nano TiO₂, ZnO, provides UV protection property and used to produce Sun glass, Sun screen lotion etc. Very high sensitive Si-Ge Quantum dots are used to detect toxic gases, anthrax etc. Nano particles of Abraxane, doxil are used for treatment of breast cancer, lung cancer, pancreatic cancer and HIV related treatment.

Hearing aids, contact lens can be made by nano crystals. Arthroscopic surgery is one of the popular example of application of nano technology.

C. ELECTRONIC APPLICATIONS

Thin film of nano –structured metal oxides can be used as sensor of Nox, CO CO₂, CH₄ etc gases.

In 2001 IBM built the world's smallest computer logic circuit using CNT.

Microprocessor size can be reduced and speed of operation can be increased by nano materials.

Resolution of TV /Monitor greatly depends upon the size of pixel. Nano crystalline Zinc Selenide, Zinc Sulphide etc. can improve the resolution and HDTV can take this advantage. DVD coating using nano crystalline materials can improve the storage capacity super dense.

Connections among the components can be done by nano crystalline (Si-nano wires) substance with better thermal conductivity and ultra high purity. CNT used to replace MOSFET.

Quantum computers using new technology spintronics also can create magnetic RAM .Nano technology is used to produce LED, LASER, Optical fibre that are 50 nm wide without cladding can carry more signals. Nano tube transistors emits IR light used in Tele communications. Nano tubes can be used as Photo detectors.

D. INSTRUMENTS

STM (Scanning Tunneling Microscope), AFM (Atomic Force Microscope), Recording media, Nano Thermometer (used Liquid Gallium inside CNT)[29.78 °C -2403°C] etc uses nano size materials.

E. ELECTRICAL

Nano springs like telephone cords can be used to produce and detect nano sized magnetic field or used in AFM to bend springs.

Nano tubes have become Super conductors at some relatively high temperature. Some plastics with added nano tubes can conduct electricity.

F. MECHANICAL

Super para magnetic property of nano sized magnetic particles used for mechanical force transfer (ferro fluids) and magnetic refrigeration.

Nano phase ceramics are more ductile at elevated temperature. Cold welding property combined with ductility makes nano sized metallic powder suitable for metal –metal bonding, porous coating etc. Steel like plastics or conductive plastics can be developed by mixing CNT with other materials. Lithium storage or gas storage can be done within the cages of CNT. An improved variety of stainless steel has been developed based on nano–crystal addition.

G. HOUSEHOLD GOODS

Learning from the lotus leaf in which super hydrophobic surface coating of wax crystals of about 1 nm in diameter gives the idea of self cleaning cloths and also does not wet. UV protective stain resistive, anti bacterial, anti-odor clothing is produced using nano material coating. Utensils sports goods can be made by nano crystals coating to make them stain resistive anti bacterial

H. POLLUTION ELIMINATION

Enhanced chemical activity of the nano materials can be used as catalyst to react with noxious and toxic gases and removes pollution and generates electricity.

Gold coated Silicon bars (2-nm long, 50-nm thick) can catch molecules of contaminants. Arsenic detection is possible by Ag –nano particles. Gold nano particles embedded in porous manganese oxide used as a catalyst to break down volatile organic compounds in air. Solar powered nano filters removes anti bodies from water. Nano scavengers in which a layer of reactive nano silver or titanium dioxide particle coated on a synthetic core (anti Ferro) ultra responsive to magnetism can remove heavy metals and other pollutants. Oil drops from water surface can be removed by tiny and sticky nano particles of metals and carbon.

I. SPORTS

Golf balls, Tennis rackets, Tennis balls, Hockey stics, Sports shoe soles etc are when coated with nano materials, the quality along with strength, longevity etc. improves without increasing its weight.

Fishing rods coated with Silica nano particles, Silicon dioxide nano particles on the Tennis balls, Bicycles parts with nano tubes etc improves the quality and strength.

J. TOYS

Nano coating stain resistant toys, antibacterial baby pacifier, anti bacterial stuff toys, teddy bears can be produced.

K. COSMETICS

Nano TiO_2 , ZnO etc provides enhanced Sun Protection Factor (SPF) and these are transparent, retains skin color when added with cosmetics (lip stick, skin cleanser moisturizer etc).

and hence affects the regulatory mechanism. Some of the nano materials are biologically active may penetrate in to human skin lungs and causes toxicological reactions.

We can conclude that though it has some harmful effects it has a lot of positive, effective helpful applications.

III. CONCLUSIONS

The nano particles and nano crystals have applications areas but may bring some health and environmental dangers. Danger may come from potential toxicity of nano particles.

Some materials are harmless in bulk form where as becomes harmful in nano size. Because of large surface area, nano particles adsorb some important enzymes and proteins

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