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A Review on Application of Nanotechnology

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Abstract: *Nanotechnology is serving appreciably to enhance, even recasts, technology and industry sectors: information technology, energy, environmental science, medicine, food and agriculture, transportation. Today's nanotechnology tackles current progress in chemistry , physics, material science, and biotechnology to design unique material which possess novel properties as their structures are persistent on the nanometer scale. This paper analyses few of the various applications of nanotechnology .*

I. Introduction

Nanotechnology works at the very first level of framework of atoms and molecules for both living and anthropogenic system, which defines the properties and functions of all systems. Nanotechnology assures the ability to shape meticulous machine and components of molecular size.(3) The first observations and size measurements of nanoparticle had been made during the first decade of the 20th century by Richard Adolf Zsigmondy, where a specified study of gold sols and other nanomaterials with sizes down to 10 nm using an ultra microscope was made.

National Nanotechnology Initiative (NNI) says nanotechnology is the study of all particles have about 100 nanometers or less. The size of nanometer is one billionth of a meter.(4)The most important supremacy of nanoparticle is having large surface area to volume ratio, which leads to increase in the surface activity and create changes in their physical properties, and biological properties. These enhanced properties help in resistance against oxidation, mechanical abrasions, corrosions and high temperature. The U.S. National Nanotechnology Initiative Roco [3] has outlined four generations of nanotechnology development (Figure 1).(10)

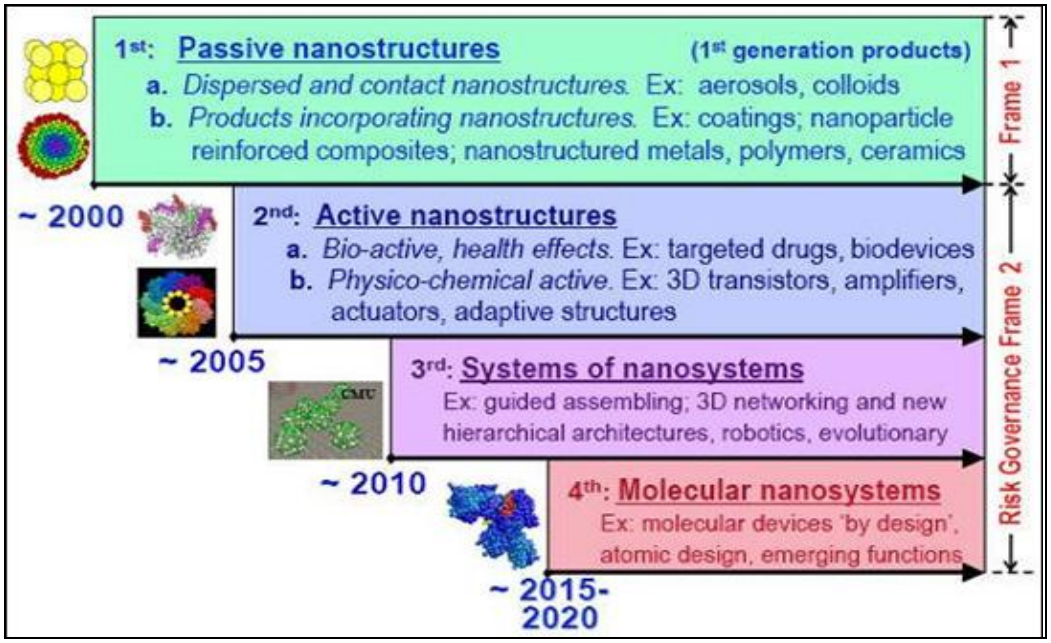

Figure 1: Generations of nanotechnology development Roco (10)

II. Application of Nanotechnology

Medicine

The present day nano-medicine drive involve a range of rewarding and emerging technologies including targeted drug delivery aimed at minimizing side effects, creation of implantable materials.(7)Molecular imaging is quite applicable for the early diagnosis of vital diseases. Biosensors fabricated from nanoscale components (e.g.; nanowires and nano-channels) can identify genetic and molecular events and have reporting capabilities, which gives the potential to detect rare molecular signals related with malignancy. Even targeted delivery of drugs, genes and proteins particularly to the cancerous cells with minimum influencing healthy cells injuries through the use of polymeric nanoparticles, liposome and nano-shells. Semiconducting nanocrystals like quantum dots can enhance biological imaging for medical diagnostics. When these are illuminated with ultraviolet light, they emit a wide spectrum of bright colours which can be utilized to detect and identify specific kinds of cells and biological activities. They provide optical property up to 1,000 times superior than traditional dyes used in tests like as MRIs, and render notably more information. To prompt growth of nerve cell from damaged spinal cord cells or brain cell, the research is still ongoing. (2)Nanotechnology has been used in cancer, diabetes, cardiovascular and pain managements, gene therapy, antibiotics, diagnosis and treatment by engaging nanoparticles that sense the difference in cells' DNA and changes in blood biochemistry for screening.(11)

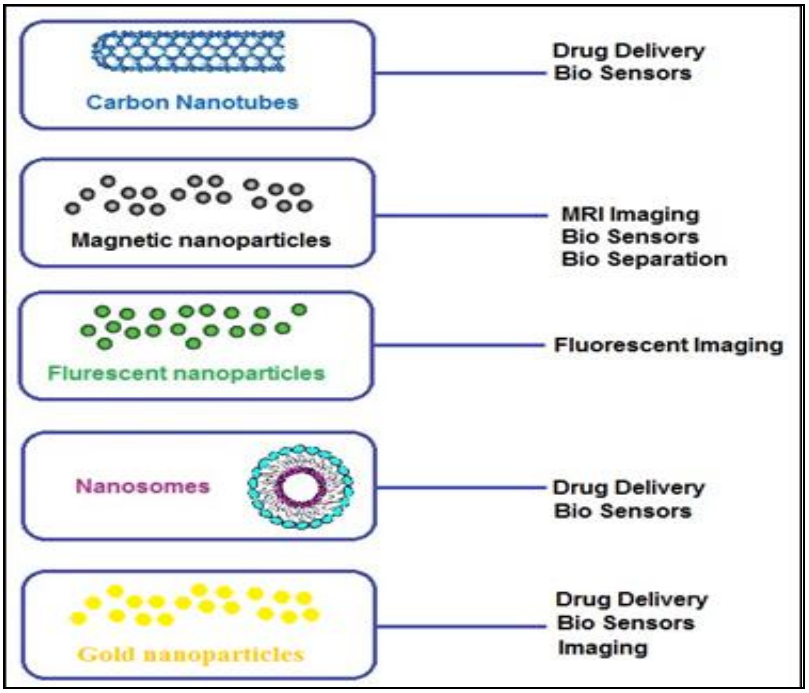

Figure 2: Medical applications.(7)

Application of Nanotechnology in Food and Agriculture

Nanotechnology has the potential to reform the agricultural and food industry with new appliance for the rapid disease detection, molecular healing of diseases, boosting the ability of plants to ingest nutrients etc. Research is in progress to increase the ability of pesticides and herbicides, allowing lower use of doses , to help the agriculturist learn about the best time of harvest for the crop, the vitality of the crop, and food safety issues, such as microbial or chemical contamination. Binding and removing arsenic from groundwater can be effectively done by nanoscale iron oxide particles. The iron nanoparticles catalyse the process of oxidation and breakdown of organic contaminants such as trichloroethene, carbon tetrachloride, dioxins, and PCBs to simpler carbon compounds which are less toxic.(8,9) Nanoemulsions have also proved efficient against a range of food pathogens, including Gram-negative bacteria. Nanoemulsions can even be used for surface decontamination in food processing manufactory. Nanotechnologies, hence will make a impact on the food production from primary stage at farming level, due to advances in pesticide efficiency and delivery (novel formulations and better crop adherence), to processing which accounts emulsion creation and encapsulation.(8,9)

Fig 3: Applications in food industry.

Nanotechnology in electronics

The nano-circuitry is finding its application in digital circuits, display operation, TFTs, printed electronics, high precision sensors, radio frequency (RF) signal processing and flexible electronics and many more. Nanomaterials such as carbon nanotubes, single walled carbon nanotubes and graphene exhibit exceptional electrical & physical properties in comparison to silicon. Field effect transistors of CNT'S are best in high-performance and energy-efficient digital electronics.(1,12) Graphene, the magic world has proven its capability in high speed electronics, data storage, LCD smart windows ,OLED displays, supercapacitor ,solar cells(5).The upper hand in using graphene in solar cell is its high electrical conductivity, better flexibility and performance than Indium tin oxide. Graphene electrodes when used in Li-ion batteries have ten times more charging capacity than conventional electrodes. Graphene nanomaterials also work as a good photo catalyst, e.g.: ZnO/Graphene composite performs way better than ZnO nanoparticle in the degradation of methyl blue dye in UV light. Current research work is also on Single electron transistor (SET) because of its capability to control the transport of only one electron, which in turn offers low power consumption and high performing speed.(6)

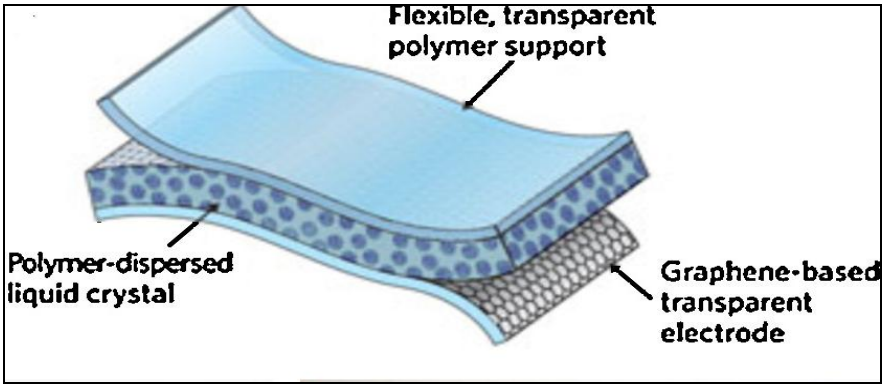

Figure 4: Design of LCD smart window (5)

III. Conclusion

Despite the fact that there are many research confrontations, nanotechnology as of now is bringing forth a wide range of beneficial materials. Nanotechnology is an up-and-coming science which can be anticipated as having speedy and well-built opportunities. It is envisaged to add appreciably to cost-effective augmentation. It has been prophesied by scientists that, nanotechnology is expected to have four discrete cohorts of progression and at present the work is going on at the first or probably second age band of nanomaterials. The unfolded future in nanotechnology engrosses much intricate responsibilities like sensing and investigating the surroundings utilizing nano-piles, along with its utility in the field of signal processing, medical imaging, and energy conversion and many more.

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