



Review of current tendencies in nanotechnology and its future opportunity

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Abstract

Nanotechnology has produced a lot of energy worldwide and is being referred to as the key technology of the 21st century. Nanotechnology is a designing of functional systems at the molecular level, covers a wide scope of themes and is centered around controlling and misusing the structure of matter on an expansive scale beneath 100 nanometers. Nanotechnology is the future of advanced development. It is everything today from clothes to foods there are every sector in its range we ought to advance it more for our future and for more developments in our current life. In this paper we have discussed the idea of Nanotechnology along with its history, applications, risks and development of nanotechnology in India. Nanotechnology can be characterized as the science of controlling matter at the nanometer scale keeping in mind the end goal to find new properties and potentially create new products. For the previous 30 years, an impressive measure of logical intrigue and R&D financing committed to nanotechnology has prompted rapid developments in all regions of science and engineering, including chemistry, materials, energy, medicine, biotechnology, agriculture, food, electronic devices, and consumer products. Effectively a few items have showed up in the marketplace and more will absolutely come in the future. A conceivable concern is the health, safety, and environmental effect of some of these items in India.

Keywords: Nanotechnology, world-wide, technology, future development, applications, consumer products, marketplace, Nanomaterials, Nano-biotechnology, India.

Introduction

The history of nanotechnology traces the advancement of the ideas and experimental work falling under the general class of nanotechnology. The development of nanotechnology in 1980's was caused by the meeting of experimental advances, for example, the innovation of the scanning tunneling magnifying instrument in 1981 and the discovery of fullerenes in 1985. In the early 2000's commercial application of nanotechnology were developed. It appears that nanotechnology has started to bloom in the past ten years, this is to a great extent because of the advancement of new instruments that allow researchers to watch and control matter at the Nano level. Technologies such as filtering tunneling microscopy, magnetic force microscopy, and electron microscopy enable researchers to watch occasions at the nuclear level. In the meantime, economic pressures in the electronics industry have constrained the improvement of new lithographic techniques that proceed with the unfaltering lessening in include size and cost. Similarly as Galileo's learning was constrained by the technology of his day, up to this point an absence of good instrumentation kept researchers from increasing more information of the nanoscale. As better instrumentation for watching, controlling and measuring occasions at this scale are developed, additionally propels in our comprehension and capacity will happen. As of now, researchers find two nano-size structures specifically noteworthy: nanowires and carbon nanotubes. Nanowires are wires with an exceptionally small diameter, once in a while as little as 1 nanometer. Scientists would like to utilize them to construct minor transistors for computer chips and different

electronic devices. Over the most recent few years, carbon nanotubes have overshadowed nanowires. Regardless we're finding out about these structures, yet what we've adapted so far is very exciting. A carbon nanotube is a nano-size cylinder of carbon atoms. Envision a sheet of carbon atoms, which would resemble a sheet of hexagons. On the off chance that you roll that sheet into a tube, you'd have a carbon nanotube. Carbon nanotube properties rely upon how you roll the sheet. At the end of the day, despite the fact that all carbon nanotubes are made of carbon, they can be altogether different from each other in view of how you adjust the individual atoms.

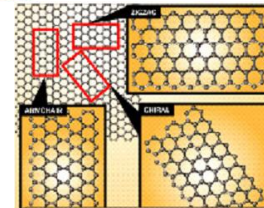
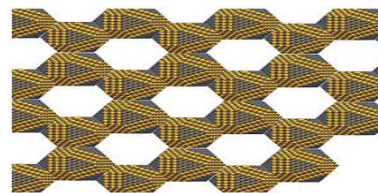


Fig 1: Carbon nanotubes

Fig 2: Structure of graphene

Review of literature: Nanotechnology, being an interdisciplinary field, has three main widely overlapping

areas: Nano electronics, nanomaterials and Nano biotechnology which discover applications in materials, electronics, environment, metrology, energy, security, robotics, healthcare, information technology, biomimetic, pharmaceuticals, manufacturing, agriculture, construction, transport, and food processing and storage. One pioneer in nanotechnology policy has identified four unmistakable ages in the advancement of nanotechnology products, to which we can include a possible fifth.

A. Passive Nanostructures: During the first period products will exploit the latent properties of nanomaterials, including nanotubes and Nano layers. For instance, titanium dioxide is regularly utilized as a part of sunscreens since it ingests and reflects bright light. At the point when separated into nanoparticles it winds up plainly straightforward to visible light, wiping out the white cream appearance related with traditional sunscreens. Carbon nanotubes are considerably more grounded than steel but just a small amount of the weight. Tennis rackets containing them guarantee to convey more prominent solidness without additional weight. As a third example, yarn that is covered with a Nano layer of material can be woven into recolor safe clothing. Each of these products takes preferred standpoint of the unique property of a material when it is manufactured at a nanoscale. However, for each situation the nanomaterial itself stays static once it is epitomized into the product.

B. Active Nanostructures: Active nanostructures change their state during use, reacting in predicable ways to the environment around them. Nanoparticles might search out cancer cells and after that release an attached drug. A nanoelectromechanical device embedded into development material could sense when the material is under strain and discharge an epoxy that repairs any burst. Or, on the other hand a layer of nanomaterial may react to the nearness of sunlight by emanating an electrical charge to power a machine. Items in this stage require a more noteworthy comprehension of how the structure of a nanomaterial determines its properties and a relating capacity to plan unique materials. They likewise raise further developed assembling and deployment challenges.

C. Systems of Nano systems: In this stage get together of Nano tools cooperate to accomplish a final goal. A key challenge is to get the principle segments to cooperate inside a system, conceivably trading data simultaneously. Proteins or infections may amass little batteries. Nanostructures could self-collect into a cross section on which bone or other tissues could grow. Smart clean strewn over a territory could detect the nearness of human beings and impart their area. Small Nano electro mechanical devices could seek out cancer cells and kill their conceptive limit. At this stage critical progressions in robotics, biotechnology, and new generation information technology will start to show up in products.

Nanotechnology and medical applications: Development of

more up to date drug delivery frameworks in light of nanotechnology methods is being striven for conditions like cancer, diabetes, fungal infections, and viral infections and in gene therapy. The main advantages of this methodology of treatment are focusing of the drug and upgraded safety profile. Nanotechnology has additionally discovered its utilization in diagnostic medicine as complexity operators, fluorescent colors and magnetic nanoparticles.

In-vitro Diagnostics: The area of in-vitro diagnostic medical devices is one of extraordinary development and potential for nanotechnology. The development of smaller scale and Nano fluidic frameworks takes into account the utilization of minor measures of analyte and the level of scaling down conceivable will take into account the advancement of genuine "lab-on-a-chip" devices capable of all the while doing handfuls, or even hundreds, of investigations in basically ongoing. Connected to other devices, this will take into consideration ceaseless checking of the patient's condition and varieties in treatment, e.g. drug delivery, to assess the patient's actual needs.

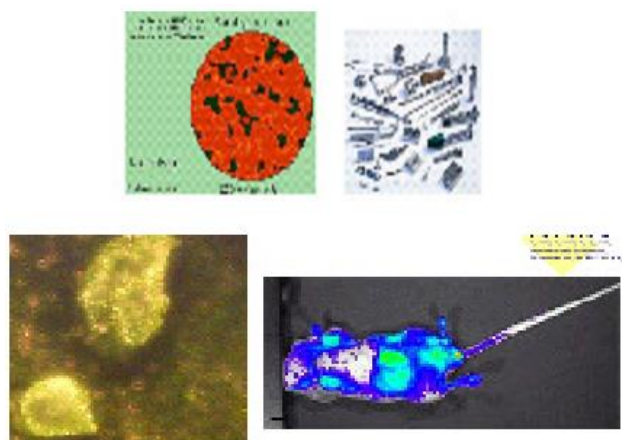


Fig 3: Gold nanoparticle, coated with antibodies and which fluoresce and heat up, can track and destroy cancer cells

Applications in electronics: The semiconductor industry has been able to improve the performance of electronic systems for more than four decades by downscaling silicon-based devices but this approach will soon encounter its physical and technical limits.

Spintronic: Similar to electrical charge, spin is another fundamental property of matter. While conventional electronic devices rely on the transport of electrical charge carriers, the emerging technology of spintronic employs the spin of electrons to encode and transfer information. Spintronic has the potential to deliver nanoscale memory and logic devices which process information faster, consume less power, and store more data in less space. The extension of the hard disk capacities to the gigabyte and the terabyte ranges was the main achievement of spintronic by taking advantage of Giant Magneto-Resistance (GMR) and Tunnel Magneto-Resistance (TMR) effects which are effective only at the nano scale.

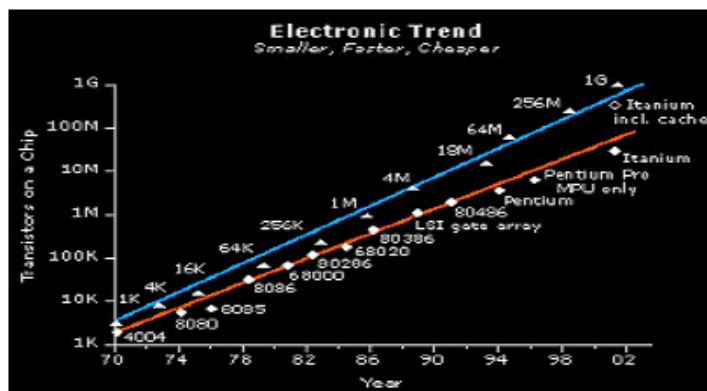


Fig 4: Trend of nanotechnology in electronic field

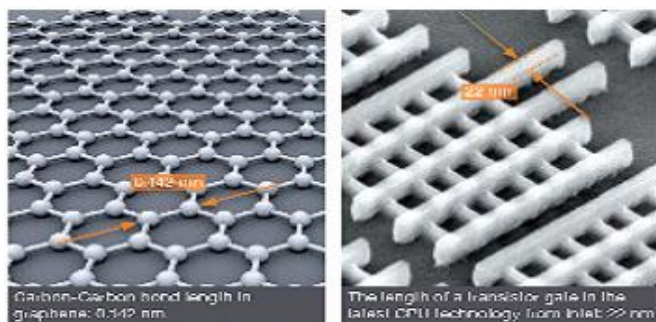


Fig 5: Bond length of carbon in grapheme

Nanotechnology in India:

In India, the nanoscience and technology undertaking has fundamentally been a government driven activity. Promoting nanotechnology and limit building activities including speculations, foundation of framework and assistance of public private partnerships are to a great extent being coordinated by national policy making organizations. Several government divisions and agencies, for example, the DST, DBT, DIT, CSIR, ICMR, DAE, DRDO and MNRE, have been supporting nanoscience and technology in diverse circles and limits. These activities have been becoming at a central level as well as state levels also, with states like Karnataka, Tamilnadu, and Haryana receiving an extremely proactive approach. Generally speaking, the help given by the government to nanoscience and nanotechnology has been described by accentuation on fundamental research, some help for development of applications, multidisciplinary and interdisciplinary research, sparse accentuation on risk related look into of nanotechnology, in specific examples of variety and covering R&D center. One of the biggest challenges has been as far as the interdisciplinary nature of nanotechnology in essence and the extent of its applications. These qualities and the positive thinking with respect to potential application of nanotechnology in an entire scope of circles, has to a degree prompt critical covers in the zones for R&D bolster distinguished by different agencies. For example in health, a solid engagement of agencies like DST, DBT, and ICMR and additionally the association of others like CSIR and even DRDO has been available. This may result in duplicative R&D endeavors and a waste of financial and human resources in this as of now cost intensive domain. Different related challenges are as absence of coordination, data stream,

covering orders and purviews. A lacking stream of information between policymakers and the scientific population and also amongst policymakers goes about as a hindrance in growing genuine limit because of failure to use existing limit, mastery and activities.

Recently launched Nanoscience and technology mission determines that one of its points is to develop applications that serve sectors like health, water and agriculture. In reality public funded projects have been instrumental in developing nanomaterial based water filters (IIT Chennai, ARCI) and in addition indicative units for tuberculosis (CSIO) and typhoid (DRDO and IISc). In addition IIT Bombay that has been produced as a Center of Excellence in nanotechnology has built up the Isen biochip that can permit the early location of heart attack. The Agarkar initiate is additionally building up a therapeutic nano-silver product that has antimicrobial movement and for which clinical trials are being considered. Additionally at the University of Delhi, the Department of Chemistry has concentrated on developing nanoparticle epitome for steroidal drugs delivery for visual applications. This technology is being exchanged to the business for commercialization. DST, the nodal division for organizing, planning and advancing S&T exercises in India is the main organization occupied with the development of nanoscience and nanotechnology. It is in charge of the principal program, the Nanoscience and Technology Mission (NSTM) built up to create India as a key player in Nanoscience and technology. While it will direct this activity between the years 2007-2012 it additionally facilitated the leader program, the Nanoscience and Technology Initiative (NSTI) that was spearheaded in 2001 until 2006. Public sector R&D establishments assume a prevalent part in nanotechnology R&D. Research in Nanoscience and nanotechnology is being completed in different scholarly and logical organizations. Premiers are the, 'Centers of Excellence (CoE) for Nanoscience and Technology' established under the NSTI by DST. The CoEs comprise of eleven "Units of nanoscience" that were made to seek after basic research in a few wide territories of nanoscience nanoscale systems and technology. Whereas seven "Centers for nanotechnology" were likewise started that could concentrate on R&D in specialty zones or in particular measurements such as Nano electronics (IIT Bombay) or nanoscale phenomena in biological systems and materials (Tata Institute of Fundamental Research-TIFR).

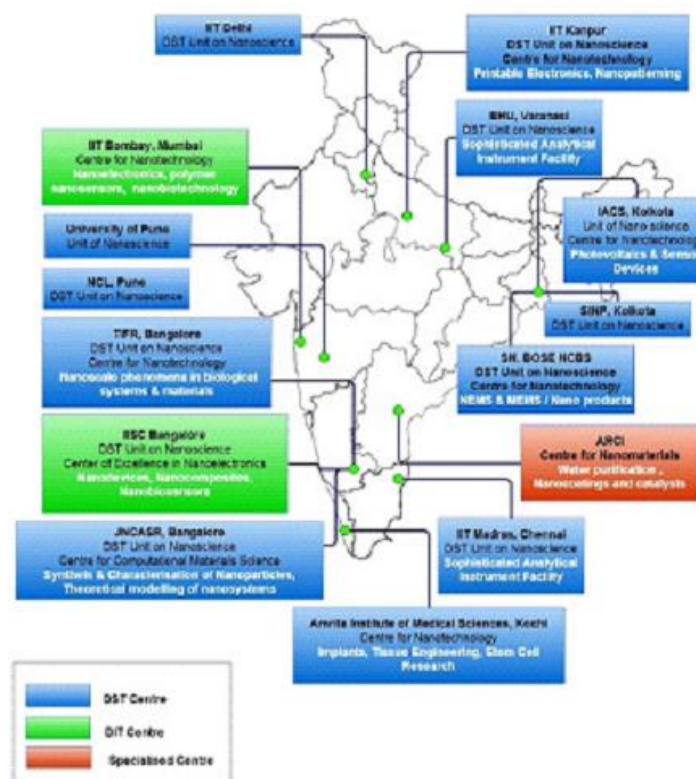


Fig 6: Nanotechnology in India

The “Centers” seeks to undertake R&D to develop specific applications in a fixed period of time. Another “Center for Computational Materials Science” has also been established. The S.N. Bose National Centre for Basic Sciences (SN Bose NCBS), Association for the Cultivation of Science (IACS), the Indian Institute of Science (IISc), Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) and IIT Kanpur, each host a Unit of Nanoscience as well as Centre for Nanotechnology.

Future Scope of Nanotechnology

Foreseeing the future of any major technology is troublesome. From one viewpoint, there frequently is an inclination to think little of the effect of a technology and the pace of its development. Nanotechnology development as of now is outpacing the forecasts made when the NNI (National Nanotechnology Initiative) was made in 2000. Around then, the emphasis was on the effect Nano might have in 20–30 years. Now, the investigation firm Lux Research predicts that by 2015 Nano will be fused in \$3.1 trillion of manufactured goods worldwide and will represent 11 percent of fabricating jobs globally.

A. Molecular Nano systems (2015-2020): This stage involves the intelligent design of sub-atomic and nuclear gadgets, prompting "exceptional comprehension and control over the basic building blocks of all natural and man-made things." Although the line between this stage and the last hazy spots, what appears to recognize items presented here is that issue is created at the sub-atomic and even nuclear level to take advantage of the particular Nano scale properties of

different elements. Research will happen on the association amongst light and matter, the machine human interface, and nuclear control to design molecules. Among the illustrations that Dr. Roco predicts are "multifunctional atoms, impetuses for amalgamation and controlling of engineered nanostructures, subcellular mediations, and biomimetic for complex system dynamics and control." Since the way from beginning revelation to item application takes 10-12 years, the introductory logical establishments for these technologies are as of now rising from laboratories. At this stage a solitary item will incorporate a wide assortment of limits including autonomous power generation, information processing and communication, and mechanical operation. Its produce infers the capacity to rework the essential building blocks of issue and life to achieve particular purposes. Nano products routinely connected to a field may seek out and change perilous materials and blend a predetermined measure of oxygen into the soil. Nano devices could meander the body, settling the DNA of damaged cells, checking key conditions and showing information in a meaningful shape on skin cells in a frame like a tattoo. Computers may work by perusing the brainwaves of the operator.

B. The Singularity (2020 and beyond): Every exponential bend in the long run achieves a point where the development rate turns out to be practically unbounded. This point is frequently called the Singularity. On the off chance that technology continues to progress at exponential rates, what occurs after 2020? Technology is prone to proceed, yet at this stage a few spectators gauge a period at which logical advances forcefully expect their own particular energy and

quicken at extraordinary levels, empowering items that today appear like sci-fi. Past the Singularity, human society is exceptionally unique in relation to what it is today. A few presumptions appear to drive expectations of a Singularity. The first is that proceeded with material requests and competitive pressures will keep on driving technology forward. Second, at some indicate counterfeit intelligence advances a point where PCs upgrade and quicken scientific discovery and technological change. At the end of the day, intelligent machines begin to produce discoveries that are excessively intricate for humans. At long last, there is a presumption that solutions to the majority of today's problems including material scarcity, human health, and environmental degradation can be unraveled by technology, if not by us, at that point by the computers we eventually develop. Regardless of whether one trusts in the Singularity, it is hard to overestimate nanotechnology's presumable ramifications for society. For a certain something, progresses in just the last five years have continued significantly quicker than even the best specialists had anticipated. Looking forward, science is probably going to keep beating desires, in any event in the medium-term. In spite of the fact that science may progress quickly, technology and everyday life are prone to change at a much slower pace for several reasons. First, it sets aside time for logical revelations to wind up embedded into new products, particularly when the market for those products is uncertain. Second, the two people and organizations can display a lot of protection from change. Since new technology regularly requires critical organizational change and cost so as to have its full effect, this can postpone the social impact of new discoveries. For example, computer technology did not noticeably affect economic productivity until the point that it turned out to be generally coordinated into business offices and, at last, business processes. It took firms over 10 years to go from supplanting the typewriters in their office pools to modifying their whole supply chains to take advantage of the Internet. Albeit a few firms received new technologies rapidly, others slacked far behind.

Risks in Nanotechnology

Nanoparticles are believed to present the greater risk because:

- They are relatively cheap and can be manufactured in large quantities
- They are already used in consumer products
- Their properties can be very different to the larger forms of the material they are made from
- They can be highly reactive
- The particles often have unknown toxicity
- Their toxicity can be difficult to quantify
- They can disperse easily in air or water

The importance of nanoparticles being considered as the most possibly perilous sort may change later on as different structures of nanotechnology turn out to be more typical and nanoparticles turn out to be better caught on. Beginning examinations completed how some nanoparticles are intensely lethal when contrasted with bigger particles made out of a similar material, for example, ultrafine carbon and diesel fumes particles separately. Certain organs in mice have been appeared to be antagonistically influenced by some nanoparticles and also fundamentally decreased posterity

creation in some aquatic life. On the off chance that these impacts are caused in other animals they may be possible in human; however there have been no human concentrates to affirm this. There are a few ways that nanoparticles can enter the body. These incorporate inhalation, ingestion, assimilation through the skin and direct injection for medicinal purposes. Once the particles are in the body they might be transported throughout the body before they are launched out, if by any means. The blood brain barrier, which protects the cerebrum from harmful chemicals in the blood, can be no hindrance at all to certain nanoparticles.

Conclusion

Nanotechnology has potential applications in many sectors including paints and coatings, textiles and clothing, cosmetics, food science, catalysis, etc. Moreover, nanotechnology presents new chances to enhance how we measure, screen, oversee. Nanotechnology has developed as a developing and quickly evolving field. New ages of nanomaterial will develop, and with them new and perhaps unexpected issues. Nanotechnology is the eventual fate of advanced development. It is everything today from clothes to foods there are every sector in its range we ought to advance it more for our future and for more developments in our current life.

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