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Evolution of Nanotechnology and Their Impact

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Abstract

It is an era of fast changing technologies in all fields of human and machine activities. While in Mechanical and Manufacturing fields it is very fast changing, other fields of human activities also do not have the isolation from past moving technologies. If a new technology is developing today and put into use it may be catering the need of the day but not the need of tomorrow. Formatting the need of tomorrow therefore improve technologies are required. In that process nanotechnology can be said to have taken place in industrial houses in particular. Nanotechnology is the art and science of manipulating matter at the atomic or molecular scale and holds the promise of providing significant improvements in technologies for protecting the environment. Nanotechnology pulls in information from physics, chemistry, engineering, and biology to study and use materials at the nano level to achieve various results. It will have a significant impact on almost all industries and all areas of society. It turns out that being able to see and work with things on a very small level has some very big ramifications not isolated to one industry or field. Currently there are no applicable standards to reliably measure nanotechnology on-line during volume production. Therefore there is a danger that every value chain, or chain segment, will develop their own heterogeneous standards based on secondary properties. This paper examines the development of nanotechnology and their impact in different areas.

Keywords: nanotechnology; technology; micron; nanometer; nonmaterial.

Introduction

When we are running in the competitive environment of various technologies, the importance of nanotechnology becomes greater in regard to the objectives of making better qualitative product with lesser cost. Although this objective happens to the binding on all manufacturing units particularly when the market is very competitive special care has to be taken to achieve the targeted objectives by going ahead of all the existing technologies. Nanotechnology is therefore plays very vital role in the field of manufacturing.

What is nanotechnology?

Nanotechnology is the term given to those areas of science and engineering where phenomena that take place at dimensions in the nanometer scale are utilized in the design, characterization, production and application of materials, structures, devices and systems. Nanotechnology is similar to micro technology, the technology of microelectronics used for modern computers. Nanotechnology is essentially the technology that attempts to utilize subatomic objects measured in nanometers [1].

Nanotechnology is the understanding and control of matter at dimensions of roughly 1-100 nm, where unique phenomena enable novel applications. A nanometer is 10^{-9} of a meter; a sheet of paper is about 100,000 nm thick. Encompassing nanoscale science, engineering and technology, nanotechnology involves imaging, measuring, modelling, and manipulating matter at this length scale. At this level, the physical, chemical and biological properties of materials differ in fundamental and valuable ways from both the properties of individual atoms and molecules or bulk matter [2].

Development of nanotechnology

The development of nanotechnology is generally understood to have begun in December

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1959 when physicist Richard Feynman gave a speech, "There's Plenty of Room at the Bottom", at an American Physical Society meeting at the California Institute of Technology in which he identified the potential of nanotechnology. Feynman said it should be possible to build machines small enough to manufacture objects with atomic precision, and that if information could be written on an atomic scale, "all of the information that man has carefully accumulated in all the books in the world can be written ... in a cube of material one two-hundredths of an inch wide—about the size of the smallest piece of dust visible to the human eye." He claimed that there were no physical laws preventing such achievements, while noting that physical properties would change in importance (e.g., gravity becoming less important), though surface phenomena would begin to dominate behavior [3].

In 1974, Norio Taniguchi first used the word "nanotechnology", in regard to an ion sputter machine, to refer to "production technology to get the extra-high accuracy and ultra-fine dimensions, i.e. the preciseness and fineness on the order of one nanometer" [4]. In the 1980s, Eric Drexler authored the landmark book on nanotechnology, "Engines of Creation" (Drexler 1986), in which the concept of molecular manufacturing was introduced to the public at large. It is due to Drexler that much of the public's imagination has been captured by the potential of nanotechnology and nano manufacturing [5]. Nanotechnology emerged as a viable prospect in 1982 when IBM researchers used the scanning tunneling microscope (STM) to display individual atoms of gold, and then later in 1989 when another team of IBM researchers manipulated thirty-five atoms of xenon to form the letters "IBM"[6]. In 1985, fullerenes, or "buckyballs," were discovered [7]. By the 1990s, nanotechnology was advancing rapidly. In 1990, the first academic nanotechnology journal was published, in 1993 the first Feynman Prize was awarded, and by 2000 President Bill Clinton announced the U.S. National Nanotechnology Initiative (NNI). Today several universities offer advanced degrees in nanotechnology and the federal government is a leading source for funding nanotechnology research and development.

The Center for the Environmental Implications of Nanotechnology (CEINT) is exploring the relationship between a vast array of nonmaterial—from natural, to manufactured, to those produced incidentally by human activities— and their potential environmental exposure, biological effects, and ecological impacts. Headquartered at Duke University, CEINT is a collaborative effort bringing together researchers from Duke, Carnegie Mellon University, Howard University, Virginia Tech, University of Kentucky, and Stanford University. CEINT academic collaborations include on-going activities coordinated with faculty at Baylor, Clemson, North Carolina State, and North Carolina Central universities, with researchers at NIST and EPA government labs, and with key international partners.

Created in 2008 with funding from the National Science Foundation and the US Environmental Protection Agency, CEINT performs fundamental research on the behavior of nano-scale materials in laboratory and complex ecosystems. Research includes all aspects of nonmaterial transport, fate and exposure, as well as ecotoxicological and ecosystem impacts. Additionally, CEINT is developing risk assessment tools to provide guidance in assessing existing and future concerns surrounding the environmental implications of nonmaterial [8].

Application of nanotechnology

There are many uses of nanotechnology in different fields as given below:

(i) Many scientists are now investigating the fundamental nature of nanotechnology in a wide spectrum of academic fields—from the basic sciences to engineering. Much of known science (e.g., colloid science, electronics, chemistry, physics, and genetics) will be applicable, but augmented with exciting new breakthroughs [9].

(ii) In medical systems, it could be possible to improve the tissue compatibility of implants to create scaffolds for tissue regeneration, or perhaps even to build artificial organs. Further, new types of genetic therapies and anti-aging treatments could be possible.

(iii) Nanotechnology is currently used by leading business houses and industrial research companies for a variety of technical and innovative applications [10]. Examples include:

- ExxonMobil is using zeolites, minerals with pore sizes of less than 1 nm, as a more efficient catalyst to break down or crack large hydrocarbon molecules to form gasoline.
- IBM has added nanoscale layering to disk drives, thus exploiting the giant magneto resistive effect to attain highly dense data storage.
- Gilead Sciences is using nanotechnology in the form of lipid spheres, also known as

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liposomes, which measure about 100 nm in diameter, to encase an anticancer drug to treat the AIDS-related Kaposi's sarcoma.
Carbon Nanotechnologies, a company co-founded by buckyball discoverer Richard E. Smalley, is making carbon nanotubes more affordable by using a new and more efficient manufacturing process.

- Nanophase Technologies is utilizing nanocrystalline particles, incorporated into other materials, to produce tough ceramics, transparent sun blocks, and catalysts for environmental uses, among other applications.
- Though vastly different in the outputs they produce, these companies all use nanotechnology to develop more efficient, affordable, and, most recently, environmentally-safe products**.**

Benefits of nanotechnology

The impact of nanotechnology extends from its medical, ethical, mental, legal and environmental applications, to fields such as engineering, biology, chemistry, computing, materials science, and communications.
Major benefits of nanotechnology include improved manufacturing methods, water purification systems, energy systems, physical enhancement, nanomedicine, better food production methods and nutrition and large scale infrastructure auto-fabrication. Nanotechnology's reduced size may allow for automation of tasks which were previously inaccessible due to physical restrictions, which in turn may reduce labour, land, or maintenance requirements placed on humans.

Potential risks include environmental, health, and safety issues; transitional effects such as displacement of traditional industries as the products of nanotechnology become dominant, which are of concern to privacy rights advocates. These may be particularly important if potential negative effects of nanoparticles are overlooked [11].

Recommendation

We should take the following aspects into consideration:

- A major concern regarding nanoparticles is that they might not be detectable after release into the environment, which in turn can create difficulties if remediation is needed. Therefore, analysis methods need to be developed to detect nanoparticles in the environment that accurately determine the shape and surface area of the particles (two of the factors that define their toxic properties).
- More information is needed regarding the structure-function relationships and in relating surface area and chemistry to functionality and toxicity.
- Full risk assessments should be performed on new nanomaterials that present a real risk of exposure during manufacture or use. Such assessments should take into consideration the toxicological hazard, the probability of exposure and the environmental and biological fate, transport, persistence, transformation into the finished product and recycling.
- Life cycle analysis will be a useful tool for assessing the true environmental impacts.
- When the use of scarce material is inevitable for the elaboration of the nanoparticles, an effective strategy for recycling and recovery is necessary [12].

Conclusion

Keeping the merits and probabilities of its use in wider range and more complicated competitions in the times to come it will always be appropriate if we are alert in driving its application much before in the related fields of technology probably it will prove to be the need of hour. Nanotechnology devices consume less energy, reduce material wastes, and help in sound monitoring. Nanotechnology can also be used to reduce and prevent the toxicity of nanoparticles in environment more efficiently [13].Recently, European researchers reviewed a number of relevant research activities, in particular, projects funded under the 6th Framework Programme in order to determine both the potential positive and negative implications of nanotechnology and future research needs. Current research shows that nanotechnology might be able to provide more sensitive detection systems for air and water quality monitoring, allowing for the simultaneous measurement of multiple parameters, a real time response capability, simplified operation and lower running costs compared to conventional methods.

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