Advance in Electronic and Electric Engineering.
ISSN 2231-1297, Volume 3, Number 5 (2013), pp. 575-578

http://www.ripublication.com/aeee.htm

C Nano-Materials & Nano-Technology

Sarrajusneha

Electronics & Communication Engineering (2nd Year) ,
Amity University, Lucknow, India.

Abstract

Nanotechnology is currently in a very infantile stage and is basically the creation of useful materials on the nanometer length scale which is about to effect almost every field of human life. It is an enabling technology that will impact electronics and computing, medicine ,materials and manufacturing ,catalysis , energy, space exploration and transportation. It will revolutionize future world by changing the current using materials in durability and reactivity. We have great opportunities to make things smaller in size , lighter in weight and stronger. Therefore scientists , engineers and many others have great interest in this emerging field. It provides us with a rich set of materials useful for probing the fundamental nature of matter. These materials have unique structures and properties which are paving way for many real world applications. It is not a new science and also not a new technology, rather it is an extension of the sciences and technologies that have already been in development for many years and it is the logical progression of the work that has been done to examine the nature of our world at even smaller scale. From the present activities going on in the world particular by no. of conferences, seminars and the money injected in this field, we can say that this rapidly expanding field is going to bring about an innovative transformation in upcoming years.

1. Introduction

Nanomaterialsare those materials possessing particle sizes on the order of a billionth of a meter, nanometer. They can be metals , ceramics , polymeric metals , or composite metals. Their defining characteristicis a very small feature size in the range 1-100 nanometers(nm). The unit of nanometer derives it’s prefix nano from a Greek word

meaning dwarf or extremely small. One nanometer spans 3-5 atoms lined up in a row. Nanomaterials are not simply another step in miniaturization, but a different arena entirely; the nanoworld lies midway between the scale of atomic and quantum phenomena and the scale of bulk materials.

Nanotechnology is the manipulation of matter on atomic and molecular scale.with this technology we can create unique materials and products which are stronger , lighter , cheaper , durable and precise.It is the creation of functional materials ,devices and systems , through the understanding and control of matter at dimensions in the nanometer scale length (1-100) nm, where new functionalities and properties are observed and harnessed for a broad range of applications.

2. History

The first mention of nanotechnology was in a talk given by Richard Feynman in 1959, entitled there's plenty of Room at the Bottom. Feynman suggested a means to develop the ability to manipulate atoms and molecules directly, by developing a set of one-tenthscale machine tools analogous to those found in any machine shop. These small tools would beused to develop and operate a next generation of one-hundredth-scale machine tools, and so forth.As the sizes get smaller, it would be necessary to redesign some tools because the relative strength of various forces would change. Gravity would become less important, surface tension would become more important, van der Waals attraction wouldbecome important, etc.Feynmanmentionedthese scaling issues during his talk.

In mid 1980's a new class of material , hollow carbon spheres was discovered. These spheres were called buckyballs or fullerenes , in honor of architect and futurist Buckminster Fuller, who designed a geodesic dome with geometry similar to that found on the molecular level in fullerenes. The C_{60}(60 carbon atoms chemically bonded together in a ball shaped molecule)buckyballs inspired research that led to fabrication of carbon nanofibers, with diameters under 100 nm.

In 1991, S.Iijima of NEE in Japan reported the first observation of carbon-nanotubes, which are now produced by a number of companies in commercial quantities. The world market for nano-composites grew to millions of pound by 1999 and is still growing fast.

3. Manufacturing Approaches

There are mainly two major approaches to getnanomaterials. One is the bottom up and the other is top down approach.

Bottom up manufacturing would providecomponentsmade of single molecules, which are held together by covalent forces that are far stronger than the forcesthat hold together macro-scale components. Furthermore, the amount of information that could be stored in devices build from the bottom up would be enormous. For example, use of AFM, liquid phase techniques based on inverse micelles, sol-gel processing,

chemicalvapordeposition (CVD), laser pyrolysis andmolecular self assemblyuse bottom up approach fornanoscale material manufacturing.

Top down method for manufacturing involves the construction of parts through methods such as cutting, carving and molding. Using thesemethods, we have beenable to fabricate a remarkable variety of machinery and electronics devices. However, the sizes at which we can make these devices are severelylimited by our ability to cut, carve and mold.

Milling, Nano-lithography,hydrothermal technique(for some materials), laser ablation, physical vapour deposition, electrochemicalmethod(electroplating) uses top down approach fornano-scale materialmanufacturing.

Nano science can use every element of periodic table dependingupon the target material which someoneis going to fabricate. The range ofnanomaterials starts from nano medicine and goes up tonano concretevianano electronics. Nano-technology provides usthe opportunity to synthesizenanoscalebuilding blocks with control on size, composition etc. Further assemblinginto largerstructureswith designed properties will revolutionize materials manufacturing. Metals, polymers,ceramicsetc can be manufactured at exact shape without machining.

Chemical catalysis benefits especially from nanoparticles, due tothe extremely large surface to volume ratio. The application potential of nanoparticles in catalysis ranges from fuel cell to catalytic converters and photocatalyticdevices. Catalysis is also important for the production of chemicals. Catalysis represents a major success story, both in the use of oxide-supported, highly dispersed metal (nanoscale active sites) catalysts and in the use of crystalline materials (zeolites) as highly selectivecatalysts. The availability of unlimited commercial quantities of zeolites has led to a modern revolution in catalysis [4]

4. Applications

- Nano-materials have actually been produced and used by humans for hundreds of years, the beautiful ruby red color of some glass is due to gold nanoparticles trapped in the glass matrix. The decorative glaze known as luster , found on some medieval pottery ,contains metallic spherical nanoparticles dispersed in a complex way in the glaze , which give rise to it’s special optical properties.
- Development of Nano-technology has been spurred by refinement of tools to see the nanoworld ,such as more sophisticated electron microscopy. By 1990, scientists at IBM had managed to position individual xenon atoms on a nickel surface to spell out the company logo, using scanning tunneling microscopy probes, as a demonstration of the extraordinary new technology being developed.
- Areas in which nano-technologies are expected to impact our every day lives : Electronics, Photonics, Information storage, Energy storage or transport, Bio-technology, Aerospace, Pharmaceuticals and drug delivery and environmental remediation etc;

- Engineers are trying to use nano-size wires to create small, more powerful microprocessors. Doctors are searching for ways to use nanoparticles in medical application.
- Scientists have found two nanosize structures namely nanowires and carbon nanotubes, of which nanowires are wires with a very small diameter ,sometimes as small as 1nanometer. They are used to build tiny transistors for computer chips and other electronic devices. In the last couple of years ,carbon nanotubes have overshadowed nanowires.
- Tiny nanorobots can go through our body cells and search for viruses and destroy them.

5. Conclusion

It is fascinating to consider the possibilities that harness the power of matter at the smallest scale may help us successfully deal with the challenges of the larger world. Nano-technology is the engineering functional system at the molecular scale. Though it is slow , it is steadily ushering in the new industrial revolution which is estimated to make a trillion dollar market . It is exciting emerging science and technological field which is all about building things atom by atom and molecule by molecule. It will surely change the nature of almost every human-made object in the following years. It is also called as 'platform technology' because it merges and converges with other technologies easily. If our economy is compared to a tree, then nano-electronics represents the hidden root system supporting huge diversity and richness above ground. ' K. Eric Drexler ' popularized the word NANO-TECHNOLOGY in the 1980's. There will be the existence of quantum computer which is billion times faster and a million times smaller in the following years.

6. Acknowledgements:

I sincerely, thank each and everyone especially my parents who supported and encouraged me in doing this research paper.

References

[1] David E.Newton (2002), Recent advances and issues in Molecular technology, Green wood publishing group
[2] Kenneth J. Klabunde (2001) ,Nanoscale materials in chemistry
[3] K. Eric Drexler (1992), Nano-systems