VIEW OF NANOTECHNOLOGY IN THE AREA OF MANUFACTURING SCIENCE AND ENGINEERING

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ABSTRACT

In the manufacturing science and technology field, the revolutionary changes are taking place. Nanotechnology stands for supporting these developments. The information age came into being on a wave of creativity in materials research. The term nanotechnology refers to a broad class of manufacture of compounds that have characteristic features in the nanometers. Nanotechnology is the processing of materials into microelectromechanical structures and devices whose sizes from hundredths to hundredths of a micrometer. Combing science and technology, nanotechnology builds at the atomic and molecular levels. The materials involved include diamond films, organic films, dielectrics, ferroelectric films and piezoelectric films. Processing techniques involved include ion implantation, optical and e- beam lithography, plasma and wet etchings and physical and chemical vapour deposition. These processes are producing flat panel display, microelectronics, optoelectronics and solid-state sensors. This technology can be well employed right from nuclear physics to biotechnology. Nanotechnology is referred to as Molecular nanotechnology describes the field, as a whole comprising molecular manufacturing together with its techniques, its products and their design and analysis. Nanotechnology is the fabrication of devices with precision to the scale yield precision on the atomic or molecular scale. The basis of nanotechnology is the fact that atoms making all things our physical world. These atoms can be manipulated to produce almost everything. Nanotechnology marks a drastically different approach to manufacturing than previous technologies have taken. Instead of scaling materials down to create some thing, nanotechnology produces things by building them up piece by piece on a molecular level. This process will allow us to feasibility create a variety of complex molecular machines capable of performing a broad scope of functions. In recent years, properties and structures of nano size materials have attracted many people’s attention. Their unique properties and small dimensionally give very promising future for various potential applications. Molecular nanotechnology describes the field, as a whole comprising molecular manufacturing together with its techniques, its products and their design and analysis. The nanotechnology supports innovative, fundamental research in the science and technology of such fabrication of nanostructural materials, components, devices and systems, leading to potential break through in manufacturability of new industrial products, or in enabling useful services and new applications.

1. INTRODUCTION

It is well known to the scientific world about four physical States of substances, viz. solid, liquid and plasma. Astonishingly nanotechnology has proved that “surface” is the fifth physical state of substance. Free movement of atoms in molecules determines the physical state of substances. Based on this fact, nanotechnology field has set trillion-dollar market for these products nanoscience and nanotechnology is concerned with study of properties of a few tens of atoms in a space of less than say 50nm[1]. We now have atomic resolutions microscope, which not only image individual atoms but also some times called molecular Nanotechnology. One can in principle, build things atoms by atom. From the nanotechnology properly arrange the atoms in coal , it can make diamond and rearrange the atoms in sand and add new trace element it can make a silicon chip. However this is a big challenge to technology as to how to build material in bulk from this way. The pictorial representation of the future growth through nanoscience and nanotechnology in the area of manufacturting [2] shown in the fig.1

Synthesis of material starting from constituent atoms and molecules to have desired characteristics is the basic theme of nanotechnology. This is known as the bottom-up approach in, in principle there are number of advantages like optimal use of building block, no wastage of materials, minimum use of energy, and better surface finish of the product at atomic level and many more. The concept of molecular assembler is simply a marvelous one, as it will open up immense opportunities in the field of life sciences. To take a few examples, one can look at the possibility of entering into the living cell and doing repair of the damages caused by the disease and modifies the functional ligand in molecules so that the cell retains the benign and healthy form. On the same lines, toxic compounds in the environment
can be transferred to useful byproducts and cleansing of the environment can be handed in an optimal way. Discovery of newer life saving and other drugs will not much easier even before reaching to the extent of cell damage repair mentioned above. Insufficient supply of healthy food can be tackled with advances made in the field of nanotechnology by attacking the problem at the root level from different angles. Many such possibilities can be easily added to the list as the life sciences areas are of direct concern to the health of humans and their habitat. Nanotechnology is going too affect the betterment of human lives in a revolutionary way.

Figure 1 View of nanoscience and nanotechnology in the field of manufacturing

Nanoscience is concerned with nano materials i.e. materials that have at least one of the three dimensions of about 1 to 10 nanometer[3]. The word ‘nano’ comes from the Greek word ‘nanos’ meaning dwarf. The term nano is the feeling of the site we note the dimension of one hydrogen atom is 0.1nm. Five atoms of carbon will combine to occupy a space of about 1 nanometer. It would take five million carbon atoms to take a dot as big as the period at the end of this sentence. The width of a DNA molecule is 2.5nm. These reduced dimensional systems have novel electronic, chemical, mechanical and optical properties.

The nano world can be considered as the borderland between the femtoworld (10^-15m) of nuclei and Pico world (10^-12m) of atoms and molecules where quantum laws operate and the macro world where the properties of materials emerge from the collective behaviour of trillions of atoms[4]. The properties of materials made of clusters of few tens to a few thousand atoms (nano particles are drastically different from the normal materials. The properties depend upon the size of the nanoparticles constituting the material. The unique properties of the nano structured materials relative to the conventional materials result from an inter play among three fundamental features as atomic domains (cluster, layer), environments (grain boundaries) and interaction between their constituent domains.

2. RESULTS AND DISCUSSIONS

Recent research into carbon nanotubes, rolled sheets of carbon just 1/50,000 the thickness of human hair, has turned up evidence that they are excellent conductors of heat and electricity. The present industrial focus on nanotubes, nanowires and nanorods manufacturing. The nanotubes formed by vapourified carbon that condenses into a series of hexagons naturally curl into hollow tubes. The twist of the tubes determines its particular electronic properties. If the carbon molecules conduct electricity as if the sheet were a metallic substance, currently available techniques can yield nanotubes of mixed types including tubes with in tubes called multiwalled nanotubes. It is found that these mixtures of multiwalled tubes are good for field emitters. Nanotubes are about six times lighter and ten times stronger than steel that is a wonder material for spacecraft. Further if the nanotubes are joined together end to end, then their junction acts as an electronic diode. Further research is proceeding to construct nano transmitters that could be build into electrical circuits.

Advancements in molecular nanotechnology since the introduction of the concept include scanning probe microscopes, design of proteins by molecular biologists, design of molecules to trap other molecules and ions, many scientific work station and molecular modeling software that permit faster testing and construction of new designs, biomimetics and neat-net-shape processes that have eliminated the traditional secondary processes accompanying manufacturing. The next steps the development of new conceptual and mathematical tools to design and analyze a limited class of molecular manufacturing systems. The total costs of manufactures, excluding cost of development and distribution, will be almost determined by the cost of materials.
Much active research in engineering involves building mechanical systems on ever-smaller scales using microtechnologies. The micro scale is, in terms of volume, one hundred and nine times larger than the nanometer scale and micro technologies provide no mechanism for gaining precise, molecular control of the surface and the interior of complex, three-dimensional structure. The materials involved can include diamond films, organic film semiconductors, dielectrics and metal films. Nanotechnology is using in automobile field, biomedical engineering field, software engineering, electronic industry, textile industries, power sectors and metal processing industries.

Over the next twenty years, the development of this new manufacturing system for the bulk processing of materials and fabrication of custom products will rely on the use of small manufacturing systems working in parallel with locally available materials. The products will exhibit order of magnitude improvements in mechanical properties and will be of high quality and low cost. Bulk processing will be attained when these machines will have sufficient general capabilities to, first of all, manufacture copies of themselves and second, be programmed to manufacture finished products directly from raw materials, thus by passing traditional fabrication techniques.

CONCLUSIONS
As discussed in results and discussions in this paper, apart intrinsic conducting or semi-conducting properties of the molecules, the other most significant property of such molecules being leveraged by nanoelectronics is the property of self assembly. Most of the molecules self assemble to form nano layers on smooth metal surfaces. One of the biggest obstacles in silicon technology is nano patterning as lithographic techniques have reached their practical resolution limit, which suggests that self assembly will be a big advantage over conventional technology.

There are immense opportunities for nanocrystalline materials for mechanical, electrical and magnetic applications. Nanotechnology is emerging as a basic technology providing a field, which is becoming the focus of attraction of all fundamental sciences. Physics provides possibility of maneuvering things atom by atom. Chemistry provides way of synthesizing molecules providing clues for building materials on molecular level. Bioscience provides possibility of under standing how science builds material as proteins are molecular machines, which routinely manipulate individual atoms. Nanotechnology is the epitome of this and essentially accentuates the inter dependency of these Fields. These are just the surfaces of the effects that nanotechnology will affect. Better spacecraft, devices to repair living cells, all these and more are possible given the potential of nanotechnology. This would give us the option of assembling these tiny parts into intelligent machines, based on the use of myriad’s of nano scopic parallel processing devices which make descriptions, compare them to recorded patterns, and then exploit the memories of all their previous experiences. Though the use of nanotechnology, the number of possible worlds we can create is limited only by what we can imagine. Nanotechnology used in FMCG composite field, biomedical engineering field, automobile engineering field, sportswear, electronic industry, and textile industries, power sectors mechanical manufacturing and processing industries. Nanotechnology works at the atomic or molecular level to create structures, machines and formations that can have helpful functions. Machines that are made using nanotechnology are mostly modeled after those in nature and can possibility be used for storage or to do mechanistic work. Nanotechnology can open doors for the new dawn in the world.

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REFERENCES
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