RESEARCH ARTICLE
International Journal of Multidisciplinary and Scientific Emerging Research

Available at http://www.ijmser.com/ (ISSN 2349 – 6037)

Implementation and Application of nanotechnology in industrial Sector

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Accepted **04** December 2014, Available online **11** December 2014, **Vol.3, No.2 (December 2014)**

Abstract

In a world of information, digital technologies have made copying fast, cheap, and perfect, quite, independent of cost or complexity of the content. What if the same were to happen in the world of matter? The production cost of a ton of tetra byte RAM chips would be about the same as the production cost of steel. Design costs matter, production costs would not matter. Hard to imagine ? Not for the new breed of scientist who says that the 21st century could see all these science fiction dreams come true that is because of molecular nanotechnology, a hybrid of chemistry and engineering that would let us manufacture anything with atomic precision. Nanotechnology at times becomes easier to predict. Computers will compute faster, and materials will become stronger and medicine will cure more diseases. The technology that works at nano meter scale of molecules and atoms will be a large part of this future, enabling great improvements in all the fields of human presence. But it could also create some problems.

Keywords: *Nano-Wires, Problem with Nano technology, Potential side effect and Application.*

1. INTRODUCTION

Nanotechnology can best be considered as a 'catch-all' description of activities at the level of atoms and molecules that have applications in the real world. Nanotechnology is the creation of functional materials, devices and systems through control of matter on the nanometer length scale (1-100 nanometers), and exploitation of novel phenomena and properties (physical, chemical, biological, mechanical, electrical...) at that length scale. For comparison, 10 nanometers is 1000 times smaller than the diameter of a human hair. A scientific and technical revolution has just begun based upon the ability to systematically organize and manipulate matter at nanoscale.

2. HISTORY

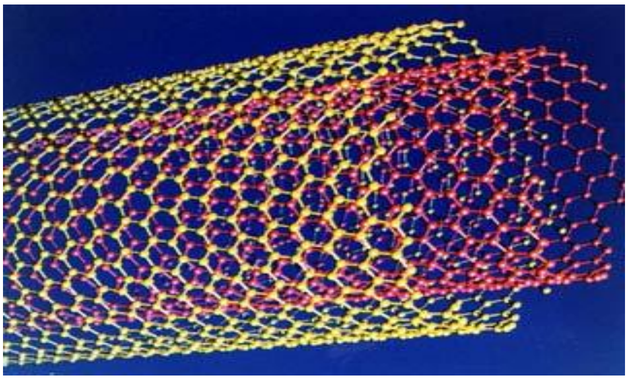
The first mention of nanotechnology (not yet using that name) occurred in a talk given by Richard Feynman in 1959, entitled there plenty of Room at the Bottom. Feynman suggested a means to develop the ability to manipulate atoms and molecules "directly", by developing a set of one-tenth-scale machine tools analogous to those found in any machine shop. As the sizes get smaller, we would have 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 would become important, etc. Feynman mentioned these scaling issues during his talk. Nobody has yet effectively refuted the feasibility of his proposal.

3. HOW WILL NANO TECHNOLOGY CHANGE THE WORLD:

3.1 First Bricks Then the Building: Before nanotechnology can become anything other than a very impressive computer simulation, nanotechnologists are inventing an assembler, few-atoms-large nanomachines that can custom-build matter. Engineers at Cornell and Stanford, as well as at Zyvex (the self-described "first molecular nanotechnology development company") are working to create such assemblers right now.

The first products will most likely be super strong nano-scale building materials, such as the Bucky tubes. Fullerenes, or buckminsterfullerene in full, are molecules composed entirely of carbon, taking the form of a hollow sphere, ellipsoid, tube, or ring. They are sometimes called buckyballs or buckytubes, depending on the shape.

Bucky tubes are chicken-wire-shaped tubes made from geodesic dome-shaped carbon molecules. These tubes are essentially nanometer-sized graphite fibers, and their strength is 100 to 150 times that of steel at less than one-fourth the weight. Fullerenes are similar in structure to graphite, which is composed of a sheet of linked hexagonal rings, but they contain pentagonal (or sometimes heptagonal) rings that prevent the sheet from being planar. Cylindrical fullerenes are often called nanotubes. The smallest fullerene in which no two pentagons share an edge (which is destabilizing — see pentalne) is C60, and as such it is also the most common. A common method used to produce fullerenes is to send a large current between two nearby graphite electrodes in an inert atmosphere. The resulting carbon plasma arc between the electrodes cools into sooty residue from which many fullerenes can be isolated. The key to manufacturing with assemblers on a large scale is self-replication. One nano-sized robot making wood one nano-sized piece at a time would be painfully slow. But if these assemblers could replicate themselves, we could have trillions of assemblers all manufacturing in unison. Then there would be no limit to the kinds of things we could create. "Not only will our manufacturing process be transformed, but our concept of labor. Consumer goods will become plentiful, inexpensive, smart, and durable.



3.2 Carbon Nanotube

An electronic device known as a diode can be formed by joining two nanoscale carbon tubes with different electronic properties. Carbon nanotubes are tubular carbon molecules with properties that make them potentially useful in extremely small scale electronic and mechanical applications. They exhibit unusual strength and unique electrical properties, and are extremely efficient conductors of heat.

A nanotube has a structure similar to a fullerene, but where a fullerene's carbon atoms form a sphere, a nanotube is cylindrical and each end is typically capped with half a fullerene molecule. Their name derives from their size; nanotubes are on the order of only a few nonometers wide (on the order of one ten-thousandth the width of a human hair), and their length can be millions of times greater than their width.

Nanotubes are composed entirely of sp2 bonds, similar to graphite. Stronger than the sp3 bonds found in diamond, this bonding structure provides them with their unique strength. Nanotubes naturally align themselves into "ropes" held together by Van der Waals force. Under high pressure, nanotubes can merge together, trading some sp2 bonds for sp3 bonds, giving great possibility for producing strong, unlimited-length wires through high-pressure nanotube linking.

3.3 Nano Wire

A"nano wire" is a wire of dimensions of the order of a nanometer (10 - 9 meters). The nano wires could be used, in a near feature, as components of nanotechnology to create electrical circuits out of compounds that are capable of being formed into extremely small circuits. Nano wires are not observed spontaneously in nature and must be produced in a laboratory. Nano wires can be either suspended or deposited.

3.4 Use of Nanowires

To create active electronic elements, the first key step was to chemically dope a semiconductor nano wire. This has already been done to individual nano wires to create p-type and n-type semi-conductors. The next step was to find a way to create a p-n junction, one of the simplest electronic devices. After p-n junctions were built with nano wires, the next logical step was to build logic gates. By putting several p-n junctions together, researchers have been able to create the basis of all logic circuits: the AND, OR, and NOT gates have been built from semiconductor nano wire crossings.

3.5 The Ways That Molecular Nanotechnology Could Change Our Lives

(A) Manufacturing and Industry:

Nanotechnology will render the traditional manufacturing process Obsolete. For example, we'd no longer have a steel mill Outfitted with enormous, expensive machinery, running on fossil fuels and employing hundreds of human workers; instead we'd have a nanofactory with trillions of nanobots synthesizing steel, molecule by molecule. We'd simply design, engineer, and do a molecular model of any product we want, and then software could tell the nanobots how to make it.

(B) Use of Natural Resources:

Rather than clear-cutting forests to make paper, we'd have assemblers synthesizing paper. Rather than using oil for energy, we'd have molecule-sized solar cells mixed into road pavement a few hundred Famines would be obliterated, as food could be synthesized easily and cheaply with a microwave-sized nanobox that pulls the raw materials (mostly carbon) from the air or the soil, And by using nanobots as cleaning machines that break downpollutants.

(C) ***Medicine:***

Nanotechnology could also mean the end of disease as we know it. If you are caught by cold or contracted AIDS, you'd just drink a teaspoon of liquid that contained an army of molecule-sized nanobots programmed to enter your body's cells and fight viruses. If a genetic disease ran in your family, you'd ingest nanobots that would burrow into your DNA and repair the defective .Even traditional plastic surgery would be eliminated, as medical nanobots could change your eye color, alter the shape of your nose, or even give you a complete sex change without surgery.

4. WHAT NEW OBJECTS WILL APPEAR BECAUSE OF NANO TECHNOLOGY

These Robots look like "Rubic's Cubes" that can "slide" over each other on command, changing and moving in any overall shape desired for a particular task. These cubes communicate with each other and share power through simple internal induction coils, have batteries, a small computer and various kinds of internal magnetic and electric inductive motors (depending on size) used to move over other cubes. When sufficiently miniaturized (below 0.1mm) and fabricated using photolithography methods, cubes can also be programmed to assemble other cubes of smaller or larger size. This “self-assembly" is an important feature that will drop cost drastically.

5. WHICH INDUSTRIES WILL DISAPPEAR BECAUSE OF NANO TECHNOLOGY

Everything -- but software, everything will run on software, and general engineering, as it relates to this new power over matter... and the entertainment industry. Unfortunately, there will still be insurance salesmen and lawyers, although not in my solar orbiting city state. If as Drexler suggest, we can pave streets with self assembling solar cells, I would tend to avoid energy stocks. The mineral business is about to change.

6. WHICH NEW INDUSTRIES WILL APPEAR

Mega engineering for space habitation and transport in the Solar System will have a serious future. People will be surprised at how fast space develops, because right now, a very bright core of nano-space enthusiasts have engineering plans, awaiting the arrival of the molecular assembler. People like Forrest Bishop have wonderful plans for space transport and development, capable of being implemented in surprisingly short time frames. This is artificial life, programmed to "grow" faster than natural systems. I think Mars will be teraformed in less time than it takes to build a nuclear power plant in the later half of the good old, backward 20thcentury.

7. NEW ENTERTAINMENT/ EXPERIENCES WHICH WILL BE POSSIBLE WITH NANO TECHNOLOGY

Perhaps the definition of life and entertainment will become blurred, but as I have previously noted, you can have a LOT of fun with Utility Fog and a super internet. In the near term, how about designing a "roller coaster" that self assembles (traditional construction costs are not a consideration) and made of super materials 80-100 times as strong as and much lighter than steel. That first drop can be made from 14,000 feet! The ride can last until you need the skin replaced on your face. How about a tram ride through the Himalayas. Amateur underwater archeologist could map and recover ancient treasures from the Mediterranean in personal subs bristling with sensors.

8. PROBLEMS WITH CURRENT NANO TECHNOLOGY RESEARCH IDEA EQUIPMENTS

One of the big problems not fully appreciated with current ideas in nano technology research is the energy requirements for synthesizing bulk materials and big molecules. For this reason, bulk materials will never be synthesized using nano technology methods. Nanotechnology contributions would be limited to making simple precursors if that is energetically feasible and low cost enzymes that speed up various chemical reactions.

8.1 Cross Bonding

In trying to synthesize very large molecules, like DNA, the problems with cross bonding and reactive intermediate bonding unfavorably with other molecules poses a huge risk to making perfect molecules. The work of enzymes overcomes most of these difficulties. However, enzymes have to be developed that co- exist with other enzymes and other chemicals. In nature, this is achieved through millions of years of evolution where the right chemicals have been found to do the right job through natural selection pressures. Beyond that, compartmentalization is used where chemicals cannot co-exist through their design. The compartmentalization also requires various molecules to transport materials through membranes separating the compartments. All these operations require a huge diversity of chemicals that have to be researched and perfected so that they can co-exist with the previous set of chemicals.

8.2 Time-Restrictions

To perfect such systems require an unreasonable amount of effort on behalf of a nano technologist to search out all combinations. It requires considerable effort even now to research just one chemical in all its glorious working detail let alone combinations of chemicals in a system.

8.3 Reality

The idea of molecular assembly is taken from DNA synthesis where a small unit called ribosome attaches to a strand of DNA, moving along it 3 base pairs at a time to read the genetic code. The genetic code is a bit like binary code but binary codes have only two levels which are 0 and 1. The genetic code however consist of 4 different kinds of bases formed into complementary pairs, and since each of these base pairs can have 4 different values and when 3 sets of base pairs are read, there are 4^3 different levels or 64 levels that 3 base pairs can code. There are around 20 amino acids that are coded for by base pairs leaving some of the remaining 44 codes not to be used or to doubly code up existing amino acids.

8.4 Energy-Consumption

For one thing a robot arm that picks up a precursor and attaches them precisely to a growing molecule is particularly energy inefficient. You have to pick up the precursor from one place and place it an another which requires HUGE amounts of energy in relation to the actual work accomplished.

8.5 Lack of Selfrepair

Another subject not fully appreciated about the biological system is the self repair systems built in at all levels from repairing damaged DNA code to destroying molecules to re-manufacture them for re-use. Small machines need self repair at all levels to cope with the high breakage rates found at the smaller scales. Nanotechnologists cannot even begin to address the question right now because they don't have any nano technology machines ready for this work to be carriedout!

9. WHEN WILL NANO TECHNOLOGY ARRIVE

Arrive is broadly defined as the first universal Assembler that has the ability to build with atoms anything ones software defines. A universal assembler may look like a micro oven, connected to a raw atomic feed stock, like carbon black, o2, sulfur power. Now most of the people understand that it will take a long, disciplined effort, and it will not be an accidental discovery. Even so, they seem to believe that shortly after getting the first nanotech manipulators, well get many of the nanotech miracles. But probably the first thing we are likely to get with nanotech will be cute publicity demos that may not even be visible to the naked eye. It took over a decade after serious nanotechnology research got underway, to create the first nanotech robotic arm. Then we jumped over about another decade while they create the first self replicating-nanofactory.

10. POTENTIAL-SIDE-EFFECTS

What will happen to the global order when assemblers and automated engineering eliminate the need for most international trade? How will society change when individuals can live indefinitely? What will we do when replicating assemblers can make almost anything without human labor? What will we do when AI systems can think faster than humans.

10.1 The Right Tools in the Wrong Hands

As with computers, nanotechnology and programmable assemblers could become ordinary household objects. It's not too likely that the average person will get hold of and launch a nuclear weapon, but imagine a deranged white separatist launching an army of nanobots programmed to kill anyone with brown eyes or curly hair. And even if nanotechnology remains in the hands of governments, think what a Stalin or a Saddam Hussein could do. Vast armies of tiny, specialized killing machines that could be built and dispatched in a day; nano-sized surveillance devices or probes that could be implanted in the brains of people without their knowledge.

10.2 Attack of Nano Robots

And what about the old sci-fi fear that robots will evolve greater intelligence than humans, become scientist, and take over the world? Certainly nanomachines might replicate and spread faster than we could control them. One point most fail to realize when first considering the effects of nanotechnology on population (the demise and reversal of aging), is that the same nanotechnology will open up outer space with all its unimaginable quantities of material, energy and elbowroom, with truly inexpensive access, great safety (massively redundant systems) made possible by the new economics of self replicating machinery.

11 ENERGY PRODUCTIONS AND POWER TRANSMISSION

Nanotechnology is a key enabling technology both to exploit traditional energy sources in a more efficient, safe and environmentally friendly manner, and to tap into the full potential of sustainable energy sources such as biomass, wind, geothermal and solar power. It also offers solutions to reduce energy losses in power transmission.

11.1 Bright Perspectives for Solar Energy

The conversion efficiency of photovoltaic and photochemical solar cells is traditionally governed by a compromise – in order to absorb enough light, at least micrometre-thick layers are required, while charge carrier collection is more efficient the thinner the active layer is. Several types of nanomaterials that absorb light very efficiently are currently under development;

they include quantum dots, plasmonically active metallic nanoparticles and nanowires. Charge carrier collection can be improved by designing nanostructures which exhibit short collection paths with reduced recombination losses. Consequently, less active material is needed and purity requirements can be relaxed. Graphene is a promising alternative to indium tin oxide, a scarce material commonly used to fabricate transparent electrodes in solar cells and LCD displays. Nanotechnology-enabled solar cells can thus be produced at a lower cost and in a more resource-efficient way. Since they can be made flexible, integrating them into buildings is possible.

11.2 Turning Waste Heat into Valuable Electricity

Thermoelectic materials convert heat directly into electricity (and vice versa) and can thus recycle some of the energy contained in, for instance, hot exhaust streams. While low efficiency has traditionally limited the use of thermoelectrics to niche markets, recently developed nanostructured thermoelectrics, with much better performance than bulk thermoelectrics, mark the beginning of a new era. Progress has also been made towards inexpensive, large-scale production methods. Beyond transport and industrial production, interesting application areas include the transformation of low-grade solar thermal or geothermal energy, or the use of human body heat to power portable electronics.

11.3 Powering Personal Electronics with Your Own Body

A nanogenerator is a device, which harvests external mechanical energy and converts it into electricity as a result of bending or stretching nanostructured piezoelectric materials such as zinc oxide nanowires. The mechanical energy may be provided in a countless number of ways, e.g. virtually any body movement, a rolling tire, vibrations, or airflow. Nanogenerators capable of powering commercial liquid-crystal displays or light-emitting diodes have been demonstrated. Further development will result in devices powerful enough to drive portable electronics such as a cell phone, or to extract electricity from wind or waves on a large scale.

12. APPLICATIONS

12.1 Medicine

Nanorobots are programmed to attack and reconstruct the molecular structure of cancer cells and virus to make them harm less. Nanorobots could also be programmed to perform delicate surgeries.

12.2 Supercomputing

Nanotechnology will be needed to create new generation of computer components. They can store trillions of bytes of information in a structure of sugar cube. Eg: Nanocomputer: a computer whose fundamental components measure only few nano meters, there by offering tremendous speed and density .If the researches are fruitful then there will be infinite applications.

12.3 Military Application

The U.S. Army and the Massachusetts Institute of Technology (MIT) are cooperating on a large-scale program to use nanotechnology to design a new battle suit for soldiers. The goal is to create a “bullet-resistant jumpsuit, no thicker than ordinary spandex, that monitors health, eases injuries, communicates automatically and reacts instantly to chemical and biological agents

12.4 Smart Drugs Cancer Treatment

A good deal of research, involving a variety of different nanotechnologies, is being devoted to cancer detection and cure (Zhang 2007). One of the main goals of using nanotechnology for medical purposes is to create devices that can function inside the body and serve as drug delivery systems with specific targets (Pathak and Katiyar 2007). Current treatments for cancer using radiation and chemotherapy are invasive and produce debilitating side effects. These treatments kill both cancerous and healthy cells. Nanotechnology has the potential to treat various forms of cancer by targeting only the cancer cells. Researchers at Rice University have developed a technique utilizing heat and nanoparticles to kill cancer cells. Gold-coated nanoparticles designed to accumulate around cancer cells are injected into the body. Sources of radiation, similar to radio waves, are then used to transmit a narrow range of electromagnetic frequencies that are tuned to interact with the gold nanoparticles. The particles are heated by the radiation and can kill the cancer cell without heating the surrounding non-cancerous cells.

CONCLUSION

Humanity will be faced with powerful, accelerated social revolutions as a result of nanotechnology. In the near future, a team of scientists will succeed in constructing the first nano-sized robot capable of self replication. Consumer goods will become plentiful, inexpensive, smart, and durable. Medicine will take a quantum leap forward. Space travel and colonization will become safe and affordable. For these and other reasons global life styles will change radically and human behavior drastically impacted.

REFERENCES

[1] Lecoanet, H.F., Bottero, J.Y., Wiesner, M.R. 2004. Laboratory Assessment of the Mobility of

Nanomaterials in Porous Media. Environ. Sci. Technol. 38:5164-5169.

[2] Lovern, S.B. and Klaper, R. 2006 *Daphnia magna* mortality when exposed to titanium dioxide and fullerene (C60) nanoparticles. Environ. Toxicol. Chem. 25(4):1132-1137.

[3] Maynard, A.D., Kuempel, E.D. 2005. Airborne Nanostructured Particles and Occupational Health. J. Nanoparticle Res. 7(6): 587-624.

[4] National Institute for Occupational Health and Safety. 2004. Nanotechnology Workplace Safety and Health. http://www.cdc.gov/niosh/topics/nanotech/default.html