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A Study on the Nanotechnology – The New Frontier of the Future Technology

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Abstract **-Imagine the chips embedded in the human body reporting every body movement and just waiting to strike at those nasty bacterial invaders, clothing smart enough to monitor out health and save us from environmental hazards, huge buildings and machines having the capability to repair and adjust themselves to the vagaries of the environment, or a regular wristwatch doubling up as a supercomputer. Thanks to nanotechnology, all of these wonders, and many more, are possible.**

Scientific discoveries and inventions have in fact propelled man to challenge new frontiers. And with his superior brain, man has been able to deliver most of these goodies. Nanotechnology is one such technological wonders that we are experiencing now. Scientists and engineers are working round the clock to achieve breakthroughs that could possibly be the answer to human misery.

This paper mainly contains about Nanotechnology and its 'various' applications. And this tells about the history of Nanotechnology and its necessity. This also discusses how it will improve our lives and about the applications in wide range.

Keywords: **Embedded, environmental hazards, inventions.**

I. INTRODUCTION

Scientists have been trying to understand the nature and through research in various disciplines such as physics, chemistry, Botany, Zoology etc. deciphering the secrets to evolve appropriate technologies to improve the quality of life. For most the 20th century, scientists have practised what can be called "top-down science". The goal has been to simplify our understanding of matter by breaking it in to its basic building blocks ranging from atom, nuclei, nucleons, quarks and beyond. Starting from the understanding of the basic interactions in elementary particles, attempt is made to explain the structure and properties of materials and all possible phenomena. Scientists will now like to understand how simple atoms and molecules come together and arrange themselves to form complex systems, such as living cells that make life possible on earth.

This "bottom-up" approach deals with how complex systems are built from simple atomic-level constituents which has opened up new horizons of research in the area of Nanoscience and Nanotechnology.

It is the study of properties of a few tens of atoms in a space of less than say 50 nm. "It is amazing what one can do by just putting atoms where you want them" says Richard Smalley, co-discoverer of Buck ball in 1985 winner of a Nobel Prize. It has revolutionized the basic sciences and has given rise to a new discipline, called Nanoscience, which is gradually proving to be the nucleus around which all existing sciences will prosper. Nanotechnology is the study and use of materials, devices and systems on the scale of a nanometer. If we can learn to manipulate the characteristics of individual atoms we can revolutionize the fields of utter importance.

II. NANOSCIENCE AND NANOTECHNOLOGY

Nanoscience is concerned with nanomaterials, i.e. materials that are at least one of the dimensions of about 1 to 10 nanometers. The word 'nano' comes from the Greek word "nanos" meaning dwarf. The term nano is the factor 10-9 or one billionth. Just to get a feeling of the size, we note that the diameter of one hydrogen atom is 0.1 nm. Five atoms of carbon would occupy a space about 1 nanometer wide. It would take 5 million carbon atoms to make a dot as big as the period at the end of this sentence. The width of a DNA molecule is 2.5 nm. These reduced dimensional systems have novel electronic, chemical, mechanical and optical properties.

III. WHY WOULD WE DEVELOP IT?

According to Moore's law, the number of transistors on a chip doubles every 18 months, and new micro transistors are crammed onto the tiny chipset for more sophisticated performance.

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Going by this law, experts are of the opinion that sooner than later the current standards would no longer be feasible for further deployment and the hardware needed to be needed considerably. This is where nanotechnology comes into picture.

Scientists are of the opinion that precision has been mentioned as a benefit of molecular machines and are one of the keys to understanding why we would want to develop this technology.

Additional benefits arise when we consider the size of devices that we will be able to create. Once we are working on the atomic scale, we can create machines that will go places about which we could once only dream. With this technology, more information will be packed into smaller and smaller spaces, and we will be able to do much more with much less. We continue to explore the costs and the benefits of developing nanotechnology.

IV. How The Idea Took Place?

An idea is nothing but a spark of intelligence, call it a brainstorm or power infinite. Nanotechnology was conceived in Southern California in 1969, when Nobel Laureate physicist Richard P.Feynman gave a new-famous lecture at the California Institute of Technology in Pasadena. The talk was titled "There's Plenty of Room at the Bottom" and it outlined the theoretical concept of manipulating atoms to build the molecules. At that time, people were quite apprehensive about such a phenomenon, and termed it as neat impossible.

To substantiate his claims, Dr.Feynman explained that the principles of physics don't deny the possibility of manipulating things atom by atom—the idea of using small machines to make even tinier machines, and so on down to the atomic level itself. Dr.Feynman is therefore credited with being the first person to advance the possibility of molecular assembly, several decades before the invention of atomic force microscopes that would prove his concept possible.

Another technologist named Mr.Drexler envisioned a future in which machines far smaller than dust motes would construct everything from chairs to rocket engines, atom by atom, hence the idea of nanorobots to treat human ills, cell by cell. In 1986, Mr Drexier published 'Engines of Creation', which proposed the building of molecular machines, atom by atom through the use of 'assemblers'. He also noted the virtually unlimited potential of nanotechnology to construct almost anything establishing himself as a leading proponent of nanotechnology.

V. How Will Nanotechnology Improve Our Lives?

One of the first obvious benefits is the improvement in manufacturing techniques. We are taking familiar manufacturing systems and expanding them to develop precision on the atomic scale. This will give us greater understanding of the building of things, and greater flexibility in the types and quantity of things we may build. We will be able to expand our control of systems from the macro to the micro and beyond, while simultaneously reducing the cost associated with manufacturing products. Some of the most dramatic changes are expected in the field of medicine.

Nanotechnology is expected to touch almost every aspect of our lives, right down to the water we drink and the air we breathe. Once we have the ability to capture, position, and change the configuration of a molecule, we should be able to create filtration systems that will scrub the toxin from the air or remove hazardous organisms from the water we drink. So we should be able to begin the long process of cleaning up our environment with its applications.

Nanotechnology will help by allowing us to deliver more machines of smaller size and greater functionality into space, paving the way for solar system expansion. Technologists have suggested that applications of medical nanotechnology might even go so far as to allow us to adapt our bodies for survival in space or on other extraterrestrial lands. While this is certainly a long way off, it provides a glimpse of the thorough control that nanotechnology may provide.

Taking all of this into account, it is clear that nanotechnology should improve our lives in any area that would benefit from the development of better, faster, stronger, smaller, and cheaper systems.

VI. Applications

A. Nanostorage

0's and 1's make up the digital information and research is going on to cram as much information as possible. Experts claim that, with technology notwithstanding, computer storage densities could reach terabits or even petabits.

Matter could be condensed to such a phenomenal level that we could store an entire encyclopedia in our wristwatch. Though we are still a long way from such a development, we are definitely moving in that direction.

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The quest for more has led IBM gaining an upper hand when it used nanotechnology. The company has created a storage device that could store up to 25 million textbook pages of information in a chip of the size of a postage stamp.

The chip, code-named 'Millipede', has more than a thousand heated spikes, which can read tiny indentations onto a polymer film. The indentations that are left on the polymer film measure about 10 nanometers each and carry a digitized version of the data. Data can be written and rewritten several times with further improvements one would be able to store more than 3 billion bits of data in the space occupied by just one hole in a standard punch card.

B. Millipede in Action

Millipede chips are 20 times more densely packed than current hard drives. Each miniscule 'arm' (or 'leg' to be more precise) can write information by making tiny indentations on a thin film of polymer, which constitutes the storage medium. IBM claims that with such a technology, cell phones would be able to carry around 10GB of data.

C. Smart Clothing

"Smart dressing for smart people" seems to be the catch-line for the textile industry. With nanotechnology, even the finest textile fibers could have sensors, computers, and motors embedded in the fabric. The micro granules that form the basic molecular structure are smaller than a grain of sand, thereby forming a barrier that causes heavy liquids and stains to gently roll off. The fabric sensors ensure that garments resist fading or crumpling, and also monitor the body odour.

Likewise, clothing would be smart enough to change according to the ambient temperature. It will keep you warm in winter or cool and dry in summer. In the future, we could have garments that clean and mend themselves, and grow or shrink to fit a variety of shapes and sizes.

The above 'smart shirt' is developed by Sensatex and monitors the vital signs of those involved in high-stress occupations. The parameters monitored are heart rate, respiration rate, body temperature, and calorie burn rate.

D. Airbag in Automobiles

Safety has now become a mandatory feature specially in cars. There are devices intelligent enough to determine the rate of impact of collision and the amount of pressure and timing to be released for the air bag to be activated. They are fitted mostly over crash zones such as fenders, bumpers, and side impact beams on the car (vehicle).

At any given time, some goodwill cars have 60 to 70 microprocessors, each assigned a specific task. The intelligent sensors built on the car then take account of the speed, timing, and the other vital factors that make car traveling a bit safer. These high-profile cars also feature accelerometers that shift the balance of the car when it takes corner, providing better stability while driving on uncertain roads and its sure needs to do some intelligent calculations.

In order to increase the safety of two wheeler occupants, professionals have come up with a unique airbag, called the D-Air system, which inflates in about 30 milliseconds and maintains pressure for up to 20 seconds. The accelerometers present on the computer system of the airbag and on the bikes register the amount of impact and then swing into action.

Another system called STM (sensing, triggering, and memory) contains an electronic control unit that continuously monitors accelerations and decelerations of the motorcycle. It sends this information to a microprocessor, where an algorithm analyses the 'impact pulse'. A further analysis recognizes the pulse and sends an electrical current to the inflator initiator.

E. Screening at Airports

After the 9/11 disaster, airports all over the world have gone for the highest security check-ins. The Regional Airport Authority of Louisville is banking on nanotechnology to counter any external terrorist strike. According to them new devices for baggage screening will be tiny enough to be wells between tickets counter positions to scan each bag as the passenger checks it in.

F. Nanorobots

The nanorobots have two spaces which should be considered separately its interior and its exterior. The nanorobot exterior will be exposed to the diverse chemical brew that makes up our human biochemistry. But the interior of the nanorobot may be a highly controlled environment, possibly a vacuum, into which external liquids cannot normally intrude.

Each species of medical nanorobot will be designed to accomplish a specific task. The machines, or 'nanorobots', would have onboard sensors and computers. Before being sent into the body, they would have to be programmed with a set of characteristics that lets them clearly distinguish their targets from everything else.

Nanorobots will be designed with a high level of redundancy to ensure fail-operational and fail-safe performance, further reducing the medical risk.

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Some nano robots will be able to effuse themselves from the body via the usual human excretory channels.

G. Carbon Nanotubes

Carbon nanotube transistor, an electronic device based on a single rolled-up sheet of carbon atoms, has been built by researchers in the Netherlands providing a demonstration of room-temperature, carbon-based electronics at the single-molecule scale.

In the device, a semiconducting carbon nanotube (only about 1 nm in diameter) bridges two closely separated metal electrodes (400 nm apart) atop a silicon surface coated with silicon dioxide. Applying an electric field to the silicon (via a gate electrode) turns on and off the flow of current across the nanotube, by controlling the movement of charge carriers onto it. Although carbon nanotubes are robust and durable molecules, they can't yet be made uniformly. While this can provide disadvantages, it can also bring about advantages such as the possibility of a metal-semiconductor junction made completely of carbon nanotubes.

H. Smart Medicine

However science has progressed through course of time, it has still not found a cure for common cold. With this in mind, doctors, scientists, and researchers all over the world are looking at nanotechnology for finding the necessary breakthroughs.

Let's go back to the mid-sixties when a popular movie named "Fantastic Voyage" introduced to us the idea of miniaturizing humans. This movie raised the aspirations of the medical and research fraternity the world over to think and at to conquer the medicine world.

With nanotechnology, it is possible to guard human body against harmful diseases. Consider tiny nanomachines embedded in our body performing their duties as disciplined soldiers with clockwork precision. Their work involves detecting intruders (virus or foreign cells), isolating them at a particular junction, and finishing them off before they can potentially cause any further harm.

Thanks to advances in nanotechnology, hopefully, a few decades from now your doctor will simply hand you a simple pill packed with millions of sensors, each programmed to seek out and kill the cancer cells in your body. The nanorobots or the agents would go about doing their work, cleansing the harmful calls from the body without you knowing it.

VII. INDIAN SCENARIO

"The convergence of ICT, nanotechnology, and biological sciences is in the horizon. India is even better placed to exploit this revolution than any other nation," said President of India A.P.J. Abdul Kalam while addressing the nation on the eve of Republic Day of 2003.

The scope of nanotechnology is quite evident as our country has another incubator in the form of IndiaNano (www.indiaco.com). The firm has tied up with several US companies that are predominantly working on nanotech products.

IndiaNano is an initiative supported by the US and Indian research organizations, investment firms, and corporations, aimed at developing a platform for collaboration between academia, corporates, government, private labs, entrepreneurs, investors, and service providers in order to harness the benefits of advances in materials and manufacturing, electronics, medicine and healthcare, environment and energy management, chemicals, biotechnology, agriculture, information technology, and national security that have been enabled by the breakthroughs in nanotechnology.

VIII. CONCLUSION

Realizing the importance of nanotechnology, Japan, Korea, and China have adopted cording offices at the national level similar to the United States National Sciences & Technology Council.

Of course, nanotechnology is a wonderful tool, but what would happen if this technology fell into the wrong hands? One might ask about the legal implications of self-replicating nanotechnology or even the harmful effects of bioterrorism.

Some people claim the nanotechnology has severe implications: smart dust would invade our privacy and be as lethal, disruptive, and dangerous as nuclear weapons! So should the sciences stop researching nanotechnology simply because of uncertainties as to where it might lead.

The truth is that we simply don't know where new technologies would lead, and we can never be fully secure against scientific error or scientific terror. Remember how a small and simple idea has revolutionized our lives, be it the telephone or washing machine. Initially people were skeptical about man's landing on the moon, but today we see the usefulness of this wonderful technology in the form of satellite communications.

REFERENCES

[1] Electronics for you-April, June 2003
[2] www.forsight.org
[3] www.nanomedicine.com
[4] IEEE spectrum- Nanotechnology
[5] www.nanoquest.com
[6] www.zyvex.com
[7] www.nanodot.com