A

Seminar report

On

Carbon Nano Technology

Submitted in partial fulfillment of the requirement for the award of degree of Bachelor of Technology in Computer Science

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Acknowledgement

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Last but clearly not the least, I would thank The Almighty for giving me strength to complete my report on time.

Preface

I have made this report file on the topic **Carbon Nano Technology**; I have tried my best to elucidate all the relevant detail to the topic to be included in the report. While in the beginning I have tried to give a general view about this topic.

My efforts and wholehearted co-corporation of each and everyone has ended on a successful note. I express my sincere gratitude to …………..who assisting me throughout the preparation of this topic. I thank him for providing me the reinforcement, confidence and most importantly the track for the topic whenever I needed it.

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INTRODUCTION

Albert Einstein, as part of his doctoral dissertation, calculated the size of a single sugar molecule from experimental data on the diffusion of sugar in water. His work showed that each molecule measures about a nanometer in diameter. At a billionth of a meter, a nanometer is the essence of small. The width of 10 hydrogen atoms laid side by side, it is one thousandth the length of a typical bacterium, one millionth the size of a pinhead, one billionth the length of Michael Jordan's well-muscled legs. One nanometer is also precisely the dimension of a big windfall for research. Almost 100 years after Einstein's insight, the nanometer scale looms large on the research agenda.

Nanotechnology is the study and use of materials, devices, and systems on the scale of a nanometer (a billionth of a meter, or 10^{-9}m). If researchers can learn to manipulate individual atoms at this scale, some experts believe the results could lead to a revolution in computing, electronics, energy, materials design, manufacturing, medicine, and numerous other fields. 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. Payoff is anticipated within the next 10-15 years.

WHAT IS NANOTECHNOLOGY?

For most of this century, scientists have practiced "top-down science," a reductionist approach in which the goal is to simplify our understanding of matter by breaking it into its basic building blocks, ranging from quarks to neutrinos. But, in recent years, interest has arisen in complexity. Scientists want to know 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 "bottoms-up" science, which deals with how complex systems are built from simple atomic-level constituents, spawned nanoscience. It is the study of the properties of tens of or hundreds of atoms or molecules in a space with a diameter of less than 50 nanometers. But there is a *there* in both nanoscience and nanotechnology. The nanoworld is a weird borderland between the realm of individual atoms and molecules (where quantum mechanics rules) and the macroworld (where the bulk properties of materials emerge from the collective behavior of trillions of atoms, whether that material is a steel beam or the cream filling in an Oreo). At the bottom end, in the region of one nanometer, nanoland bumps up against the basic building blocks of matter. As such, it defines the smallest natural structures and sets a hard limit to shrinkage: you just can't build things any smaller. e of two large atoms or four small ones). The emerging field-new versus old nanotech-deals with materials and systems having these key properties: they have at least one dimension of about one to 100 nanometers, they are designed through processes that exhibit fundamental control over the physical and chemical attributes of molecular-scale structures, and they can be combined to form larger structures.

Sandwiching several nonmagnetic layers, one of which is less than a nanometer thick, between magnetic layers can produce sensors for disk drives with many times the sensitivity of previous devices, allowing more bits to be packed on the surface of each disk. Since they were first introduced in 1997, these giant magneto resistive heads have served as an enabling technology for the multibillion-dollar storage industry. New tools capable of imaging and manipulating single molecules or atoms have ushered in the new age of nano. The icons of this revolution are scanning probe microscopes-the scanning tunneling microscope and the atomic force microscope, among others-capable of creating pictures of individual atoms or moving them from place to place.

Nano technology would help in-

1. Advanced miniaturization is a key thrust area to enable new science and exploration missions.
2. Ultra small sensors, power sources, communication, navigation, and propulsion systems with very low mass, volume and power consumption are needed.
3. Revolutions in electronics and computing will allow reconfigurable, autonomous, "thinking" spacecraft.
4. Nanotechnology presents a whole new spectrum of opportunities to build device components and systems for entirely new space architectures.

Electron transfer properties of macro-sized & nano-sized particles of the same material are different.

MATERIAL	MACRO-SIZE	NANO-SIZE
PbS	Is an insulator	Becomes conductor
FeO_3	Band gap is 1.95 eV	Band gap is 3.1 eV
Carbon	Electron emission at 2500 V.	Electron emission at much lower voltage-2.5V

TYPES OF CARBON NANO MATERIAL

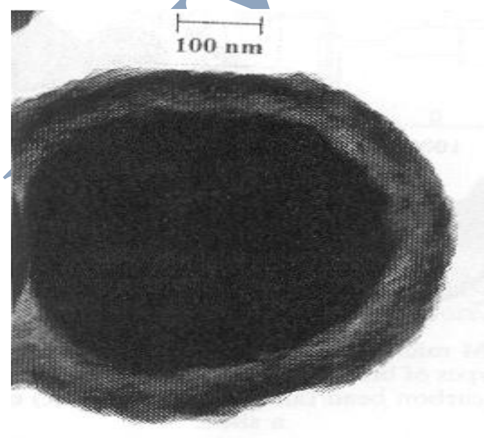
Carbon nano material can be of the following types-

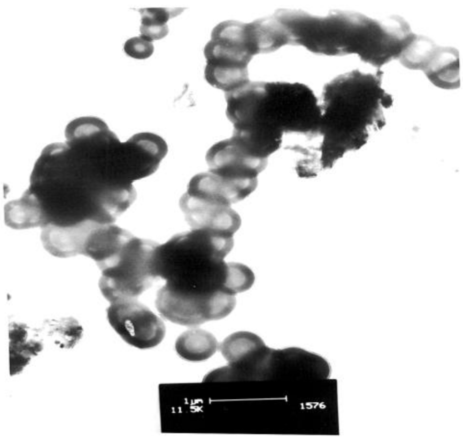
- **Carbon nano beads**
- **Carbon nano fibers**
- **Carbon nano tubes**
- **Diamond like carbon**
- **Many other shapes**

1. CARBON NANO-BEADS

PROPERTIES OF CARBON NANO BEADS-

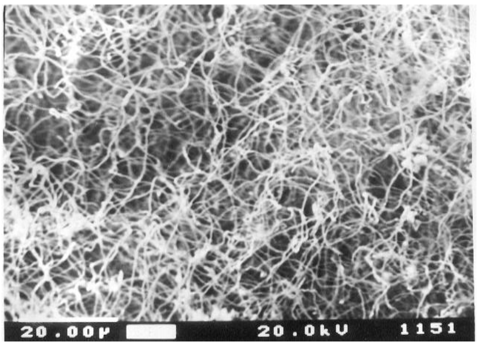
1. **Spherical (Solid and hollow)**
2. **Sizes 200 nm - 800 nm**
3. **Interconnected & spongy**

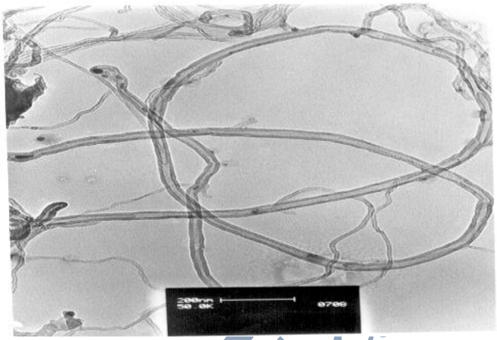




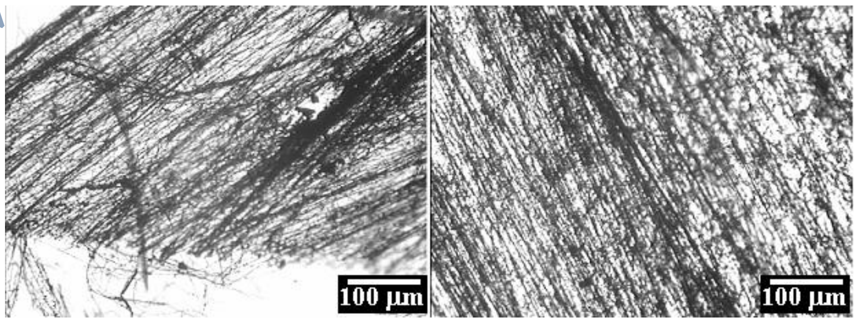
2. CARBON NANO FIBRES

- **Coiled Type Carbon Fiber**

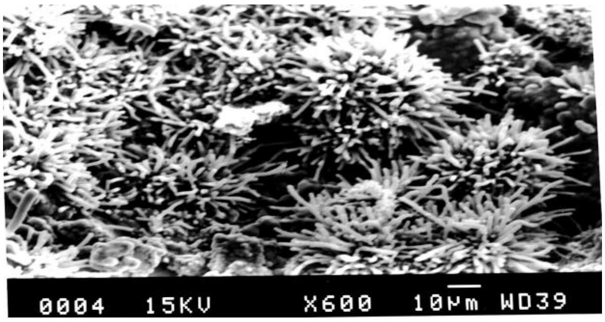


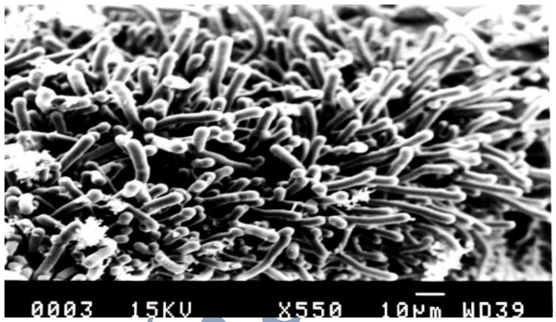


- **Flexible Hair Like Fiber**

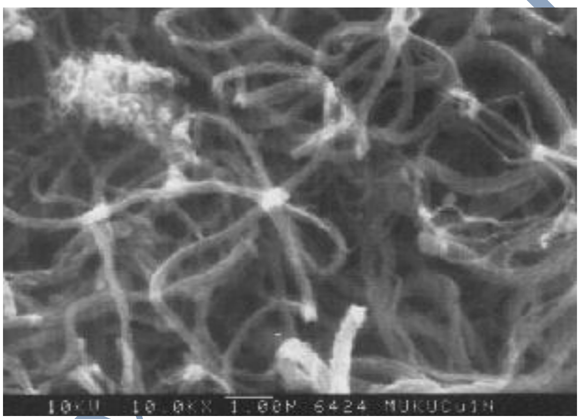


- **Cactus Flower Like Fiber**

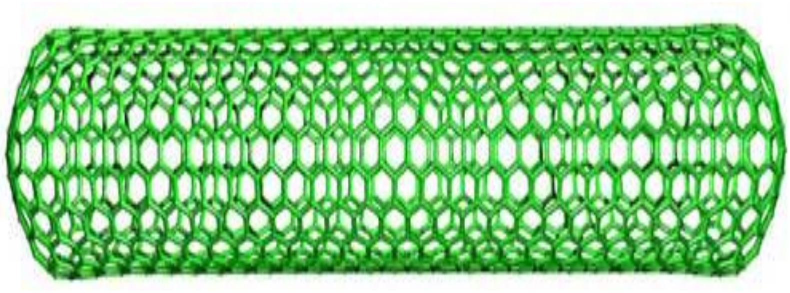




- **Octopus Like nano Fiber**



3. CARBON NANOTUBE



- Carbon nano - materials are synthesized from fossil fuels related precursors e.g. acetylene, benzene, xylene & also from graphite.
- The latest trend is to use plant based precursors

PREPARATION OF CNT

•Carbonaceous material (precursor) is heated to just below their boiling point to generate vapor.

•The vapor along with a carrier gas (N_2 or Ar) is sent to a furnace heated at pyrolyzing temperature (650 – 1000^{0}C).

•Pyrolyzed material is CNM; which is further purified to remove graphitic carbon.

•Catalysts like Fe, B, Ni & Co are used during pyrolysis to produce different forms of carbon nano-material

APPLICATIONS OF CARBON NANOTECHNOLOGY

1. NANOSCALE DIGITAL CHIP DESIGN

Computer chips will get smaller, more powerful, connected and pervasive. They will bring digital intelligence into all kinds of objects and spaces. The encounter system combines silicon virtual prototyping and detailed IC implementation into a unified architecture with a single in memory data model and user interface. The latest version of Encounter Platform supports both SUN and LINUX.

2. BIOCHIPS FOR HEALTHCARE

Biochips are ushering in anew era in health care. They will help to understand the role played by genes in health and disease. Many of these innovations are rightly termed as lab-on-chip. With biochips, it would be easy to speed up development and discovery of drugs, improve diagnostics tools, and even chart out a significant procedure for determining the best treatment for a specific disease.

As of now, practical applications are being developed, which include handheld devices for testing microbes in food and identifying criminals by their DNA’s. Very soon biochips will also play a big role in detection of biological and chemical warfare agents.

3. NANOTECHNOLOGY FOR SOLAR CELLS

Carbon nanotubes--tiny straw like cylinders of pure carbon--have interesting electrical properties. Indeed, they have already been used to manufacture tiny transistors and nanowires. Now scientists say the minuscule cylinders may one day find their way into solar cells

To make the altered nanotubes, Dirk M. Guldi of the University of Notre Dame and his colleagues attached molecules of ferrocene to their walls. Made up of two flat rings of five carbon atoms each that sandwich an iron atom, ferrocene is known for its tendency to give up its electrons. The scientists determined that when they exposed their altered nanotubes to light in the visible range, carbon atoms in the walls of the tubes accept the electrons originally associated with the ferrocene molecules. "This separation of charge is sufficiently long-lived for us to divert and use the electrons," Guldi notes.

This is the first time hybrid nanotubes complexes have been shown to undergo such photo induced electron transfer. And it didn't take much: the researchers added just one ferrocene group for every 100-carbon atom in the nanotubes. The results, meet the first criteria for the development of solar cells based on modified carbon nanotubes.

THE ONCE AND FUTURE NANO-MACHINE

Among the promised fruits of nanotechnology, small machines have always stood out. Their attraction is straightforward. Large machines--airplanes, submarines, robotic welders, and toaster ovens--are unquestionably useful. If one could take the same ideas used to design these devices and apply them to machines that were a tiny fraction of their size, who knows what they might be able to do? Imagining two types of small machines--one analogous to an existing machine, the second entirely new--has captured broad attention. The first is a nanoscale submarine, with dimensions of only a few billionths of a meter--the length of a few tens or hundreds of atoms. This machine might, so the argument goes, be useful in medicine by navigating through the blood, seeking out diseased cells and destroying them.

The second--the so-called assembler--is a more radical idea, originally proposed by futurist K. Eric Drexler. This machine has no macroscopic analogue (a fact that is important in considering its ultimate practicality). It would be a new type of machine--a universal fabricator. It would make any structure, including itself, by atomic-scale "pick and place": a set of nanoscale pincers would pick individual atoms from their environment and place them where they should go. The Drexlerian vision imagines society transformed forever by small machines that could create a television set or a computer in a few hours at essentially no cost. It also has a dark side. The potential for self-replication of the assembler has raised the prospect of what has come to be called gray goo: myriads of self-replicating nanoassemblers making uncountable copies of themselves and ravaging the earth while doing so.

Does the idea of nanoscale machines make sense? Could they be made? If so, would they be effectively downsized versions of their familiar, large-scale cousins, or would they operate by different principles? Might they, in fact, ravage the earth?

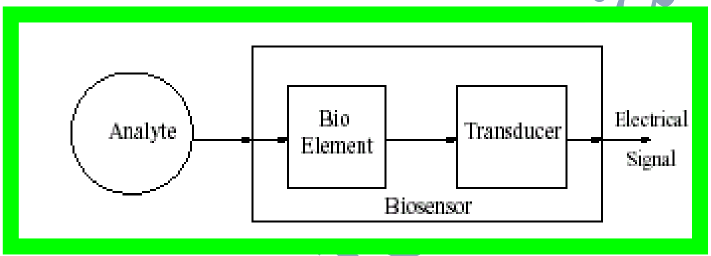
We can begin to answer these intriguing questions by asking a more ordinary one: What is a machine? Of the many definitions, I choose to take a machine to be "a device for performing a task." Going further, a machine has a design; it is constructed following some process; it uses power; it operates according to information built into it when it is fabricated. Although machines are commonly considered to be the products of human design and intention, why shouldn't a complex molecular system that performs a function also be considered a machine, even if it is the product of evolution rather than of design?

Issues of teleology aside, and accepting this broad definition, nanoscale machines already do exist, in the form of the functional molecular components of living cells--such as molecules of protein or RNA, aggregates of molecules, and organelles ("little organs")--in enormous variety and sophistication. The broad question of whether nanoscale machines exist is thus one that was answered in the affirmative by biologists many years ago.

APPLICATIONS OF CARBON NANOTUBES

- **USE OF CNT IN BIOSENSOR SYSTEM**

Biosensors are detection devices that translate biological activity into readable electrical signals. They are used to detect and quantify pollutants in the environment and chemicals in food or pharmaceuticals. The history of biosensors started in the year 1962 with the development of enzyme electrodes by the scientist Leland C. Clark.



- **CNT IN ATOMIC FORCE MICROSCOPY**

In AFM Si tip of atomic size is used for scanning.
When the electron of the outer most shell of the tip atom, comes in contact with the electron of the scanning surface, it produces current, which is measured.
Si tip in presence of moisture and air gets oxidized.
Covering the Si tip with single wall CNT stops the oxidation of Si and Carbon being a hard material does not break easily.

- **USE OF CNT IN DRUG DELIVERY**

SWNTs can be cut into smaller sections. to get open end tubes Which can be filled with a variety of materials e.g. enzymes.
The enzyme or biomolecule gets encapsulated & protected within CNT
Subsequent analysis of the catalytic activity of the immobilized enzymes showed that a significant amount of the enzyme retains its activity
To use this system for drug delivery CNT is solubilized in water by adding suitable functional group e.g. OH , COOH, SO3H etc.
This type of research is expected to help in drug delivery to infected human organs.
A suitable drug can be inserted into the hollow space of the nanotubes and can be injected into body (with functionalized soluble carbon nanotubes). Drug will start operating slowly at the site, which is infected

- **NANO TECH DEVICES: MADE OF SPINACH PROTEINS AND CARBON NANOTUBES.**

The scientists gathered evidence that spinach is a plant with potential. They became particularly interested in a chlorophyll-containing protein in spinach called Photo system I (PSI, pronounced PS One). They knew it performed photosynthesis using the energy of the sun to make plant tissue. But another amazing feature of this photosynthetic reaction center was that when it receives a photon of light, electrical current flows through it in one direction in 10 to 30 Pico seconds — 100 times faster than in a silicon photodiode. Thus, spinach proteins could be used as a photo battery or solar electric cell.

Then these 10-NM spinach proteins could be used as nanodiodes to transmit current in one direction and block it in the other in the absence of light, making possible the fabrication of biomolecular electronic devices. The researchers met the challenge, suggesting that the next generation of opto-electronic devices may be based on spinach, not silicon. After isolating PSIs from spinach leaves, they learned how to make current flow along spinach proteins by depositing a platinum electrical contact on the end of each PSI. Next they showed that platinum anchors PSIs to a gold surface.

A major challenge was to orient the PSIs so that all the same ends point in the same direction either perpendicular or parallel to a metal surface. In 1997 the researchers found an effective way to achieve preferred orientation of PSIs: chemical treatment of the atomically flat gold surface on a mica substrate. They coated gold surfaces chemically with 2-mercaptoethanol and found that most of the PSIs point up, like lawn grass.

The sulfur atom in this molecule attaches strongly to gold, and the molecule's other end selectively binds to the positively charged free end of a PSI, causing it to be perpendicular to the surface. The next step was to build a biomolecular device. Greenbaum met with Simpson to plan the design of a hybrid nanodevice using spinach reaction centers as the diodes. Their expertise is needed because the nanodiodes made of oriented spinach proteins are to be connected by nanowires made of carbon nanotubes.

ADVANTAGES

1) Safe and affordable.

2) Medicine (detection of diseases).

3) In computer use.

4) Pollution free environment.

5) Safe assembly of consumer goods.

6) Molecular food synthesis.

CONCLUSION

Nanotechnology is a hybrid science combining engineering and chemistry. Atoms and molecules stick together because they have complementary shapes that lock together, or charges that attract. Just like with magnets, a positively charged atom will stick to a negatively charged atom. As millions of these atoms are pieced together by Nan machines, a specific product will begin to take shape.

The goal of nanotechnology is to manipulate atoms individually and place them in a pattern to produce a desired structure. There are three steps to achieving nanotechnology-produce Trillions of assemblers and replicators will fill an area smaller than a cubic millimeter, and will still be too small for us to see with the naked eye. Assemblers and replicators will work together like hands to automatically construct products, and will eventually replace all traditional labor methods. This will vastly decrease manufacturing costs, thereby making consumer goods plentiful, cheaper and stronger. Nanotechnology will impact every facet of society, from medicine to computerized goods.

The promises of nanotechnology sound great, don't they? May be even unbelievable? But researchers say that we will achieve these capabilities within the next century. And if nanotechnology is, in fact, realized, it might be the human race's greatest scientific achievement yet, completely changing every aspect of the way we live.

DISADVANTAGES

1) Atomic bomb & grenade.

2) Spread diseases.

3) World wide hunder.

4) Corruption of world.

5) Computer generated fake reality.

REFERENCES

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