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Subject Review: Application of Nanotechnology in Computer Science

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ABSTRACT

Nanotechnology refers to engineered structures, devices, and systems. It is the manipulation of matter on a near-atomic scale to produce new structures, materials and devices. Nanomaterials have a length scale between 1 and 100 nanometers. By controlling atoms and molecules, companies can develop nanomaterials no more than 100 nanometers thick and apply these materials to industries like healthcare, sports and electronics. In this paper, we explore the development of nanotechnology which provides good chance to develop a smaller, faster and reliable computer. This paper tells about the advantages of nanotechnology using nano tubes in place of silicon chip that is to be used in the CPU's of computer.

Keywords: Characteristics Technic, Nanotechnology, Nanoparticles, Nanostructure, Synthesis Technic.

1. INTRODUCTION

The extensive use of computer and its wide application in the modern world have forced the researchers to improve and manufacture a smaller, faster and a more reliable computer. This objective can be fulfilled by nanotechnology. Using nanotechnology we can design and manufacture electronic components and devices that can be used directly to make smaller, faster and reliable computer. According to M.C. Roco, the third and fourth generation of nanotechnology would rely heavily on research in computer science. Now, let us try to understand the meaning of nanotechnology and its implication [1].

In computer science, nanotechnology is a sort of engineering aimed at creating electronic components and devices that are measured in nanometers, which are very small in size and structure. It combines ideas from physics, engineering, and other fields. Today, anyone can carry a computer in one hand – A computer (hundreds of times slower) was the size of a room 40 years ago. Miniaturization of microprocessors is currently in process at nano meter scales [2].

2. CLASSIFICATION OF TECHNOLOGIES FOR SYNTHESIS OF NANOMATERIAL

There are two general approaches for the synthesis of nanomaterial

I. Top- down approach

II. Bottom–up approach

In Top-down approach refers to slicing or successive cutting of a bulk material to get nano sized particles. The starting material is solid state, one mechanical method is used like cutting, etching, grinding, ball milling. And the other is Lithographic method where photo lithographic and Electron beam lithographic.

In Bottom- up approach refers to the buildup of a material from the bottom. Atom by atom, molecule by molecule. Atom by atom deposition leads to formation of self-assembly of atom or molecule and clusters. These cluster come together to from self-assemble monolayer on the surface of substrate.

In Bottom- up approach the starting material is either gaseous state or liquid state of matter. Its two type method. Physical and chemical processing methods. In physical method, physical vapor deposition (PVD),

evaporation (thermal, e – beam) sputting, plasma arching, laser ablation.In chemical method, chemical vapor deposition (CVD), PECVD, electrolatic deposition, sol-gel method, pyrolysis, micro emusion route [3].

3. CURRENT SCENARIOS OF NANOTECHNOLOGY AND COMPUTER SCIENCE

The impact of nanotechnology on computers has a few unique twists; which are mainly in the research and development phases. Here are examples of how nanotechnology has changed computer and its various aspects.

3.1 Carbon Nanotube Computer: Carbon nanotubes (CNTs) are hollow cylinders composed of a single sheet of carbon atoms. It has been observed that CNT has same property as Silicon transistor and thus they act as semiconductor which makes them suitable for being used as transistor in computer chips. A team of Stanford engineers has built a basic computer using carbon nanotubes, which has the potential to make a new generation of electronic devices that run faster, and makes use of less energy, as compared with silicon chips. This nanotube processor is made up of 178 transistors, each of which contains carbon nanotubes that are about 10 to 200 nanometer long. It has been reported by the they have made six versions of carbon nanotube computers, out of which one them can be connected to external hardware, and a numerical keypad that can be used to input numbers for addition.

3.2 Quantum Computing

Quantum computing may well be the future of most high-end data centers. These future computers are not based upon digital 1's and 0's. Instead these future computers are based upon qubits (quantum bits). The power of magnetic forces at a subatomic scale will unleash the exponential power of future computers. By manipulating the rotation of atoms, data can be transmitted and stored at an unprecedented rate. Physicists have found a way to extend the quantum lifetime of electrons by more than 5,000 per cent. Electrons exhibit a property called 'spin' and work like tiny magnets which can point up, down or a quantum superposition of both. The state of the spin can be used to store information and so by extending their life the research provides a significant step towards building a usable quantum computer

3.3 Computational Nanotechnology

Nanoscale systems, though infinitesimal, are made up of thousands, even hundreds of thousands, of atoms. Thus, describing their electronic structures and dynamics requires significant theoretical skill and much computer power. It is the method to study nanoparticles using computer models to predict their behavior and inform real life nanoparticle physics and chemistry. Computational nanotechnology is a powerful tool for understanding nanoparticle physics and chemistry. After carrying out a simulated experiment, theory is developed to explain the observed results, which is then validated by conducting a lab experiment. If the predicted results and the theoretical results agree, then the theory is accepted. Unexpected results from laboratory work can also be examined with theoretical methods, which often lead to the development of new theory. One of the example of Computational Nanotechnology is development of Nano Design, A research group at NASA has been developing this lecular machines. The software architecture of NanoDesign is designed to support and enable their group to develop complex simulated molecular machines.

3.4 DNA Computing

DNA computation is based on the fact that technology allows us to 'sequence' (design) single DNA strands which can be used as representations of bits of binary data. Technology also allows us to massively 'amplify' (reproduce) individual strands until there are sufficient numbers to solve complex computational problems. DNA molecule has a double helix structure composed of two sugar phosphate backbones formed by the

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polymerization of deoxy-ribose sugar. Placed between two backbones are pairs of nucleotides Adenine, Cytosine, Guanine and Thymine. DNA computers use single strands of DNA to perform computing operations. DNA computing focuses on the use of massive parallelism, or the allocation of tiny portions of a computing task to many different processing elements. The structure of the DNA allows the elements of the problem to be represented in a form that is analogous to the binary code structure. Trillions of unique strands of DNA are able to represent all of the possible solutions to the problem. Some scientists predict a future where our bodies are patrolled by tiny DNA computers that monitor our well-being and release the right drugs to repair damaged or unhealthy tissue.

3.5 Single Electron Transistor

The single electron transistor is made of an island connected through two tunneling junctions to a drain and a source electrode, and through a capacitor to a gate electrode. When all the biases are zero, electrons do not have enough energy to tunnel through the junction. However, if you increase the bias, but keep it less than the coulomb gap voltage, increasing the gate bias above the point of maximum slope on the coulomb staircase causes the state with one or zero excess electrons on the island to have the same energy, resulting in the coulomb barrier being removed and allowing electrons to tunnel through the junctions and between the source and the drain.

3.6 Nanobots

Nanobots will be the next generation of nanomachines. Advanced nanobots will be able to sense and adapt to environmental stimuli such as heat, light, sounds, surface textures, and chemicals; perform complex calculations; move, communicate, and work together; conduct molecular assembly; and, to some extent, repair or even replicate themselves. Nanotechnology is the science and application of creating objects on a level smaller than 100 nanometers. The extreme concept of nanotechnology is the "bottom up" creation of virtually any material or object by assembling one atom at a time. Although nanotech processes occur at the scale of nanometers, the materials and objects that result from these processes can be much larger. Large-scale results happen when nanotechnology involves massive parallelism in which many simultaneous and synergistic nanoscale processes combine to produce a large-scale result. Nanorobots have potential applications in the assembly and maintenance of sophisticated systems. Nanorobots might function at the atomic or molecular level to build devices, machines, or circuits, a process known as molecular manufacturing. Nanorobots might also produce copies of themselves to replace worn-out units, a process called self-replication [4].

4. APPLICATIONS IN COMPUTER SCIENCE

Nanotechnology has a wide range of applications and has impacted the telecommunications industry in several ways.

4.1 Wireless technology

The telecommunication enterprise will radically get changed into the brand new Nanotechnology. Nanotechnology effect in operation of both cellular as well as core network, and by addition perfection in security and the better effect on the sensor makes the nanotechnology the hugest from previous traditional technologies.

4.2 Internet of Things (IoT) Technology

Internet of Things (IoT) is the arrangement of physical articles or things introduced with equipment, programming, sensors and network system to enable it to achieve more essential regard and organization by

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exchanging data with the executive and other related objects. The nanotechnology with the internet of thing will provides a Nano size of things able to communication together with the ability to interact with human or machines in a good and efficient manner.

4.3 Body Area Network

Body area network devices now can be coordinated into dress or body. Much work has been finished by many research groups on improvement of intelligent Nano materials and combination of microelectronics into garments or implanted in the human body. The embedded sensors in a size like a grain of rice can be utilized to measure many medical metrics inside the body such as measuring the flow rate of blood in the arteries within the human body, a complex surgical, internal survey of vital parts of the body and likewise be utilized for medication treatments for nerve or tissue incitement.

4.4 Mobile and wireless devices

Portable devices for calculation and sensing are becomes a key dreams of remote business to have surrounding knowledge which they are constantly accessible and prepared to serve the client. These devices can attached to human situations like home, office, open spots in conjunction with cell phones. One of the key requirements for implanting devices into physical objects of the world requires that devices able to adjust to their surroundings and turn into a part of the system of devices encompassing them. Such example for that is like organic frameworks which develop and adjust to nature independently.

4.5 Nano communication and networks

Nano machine is described as mechanical a device that relies on upon nanometer scale parts. the term of nuclear machine is known as a mechanical device that plays out an accommodating limit using fragments of nanometer scale and described sub nuclear structure able conveying, processing, information , detecting or potentially activation other system. To establish a bidirectional wireless Nano communication, a radio frequency systems should to be coordinated in the Nano machine which required a development in Nano scale antennas for very high frequencies.

4.6 Quantum computing

By replacing current computers by more progressed and quick preparing quantum computers innovation, the most exceptional innovation that will be in charge of adding new features and means of processing and computing in an intelligent way. In quantum computers, the binary rates in conventional computers are repeated by quantum bitsor qubits, which can be in a state of 0, 1 and superposition simultaneously.

4.7 Information storing and processing

For information processing and transmission, the development in electronic, optical and optoelectronic components are expected to producing a fast and precise process communication devices.

4.8 Nano Sensors and Nano Devices

Nano sensors and nano devices are providing new solutions for many aspects such in environmental and biological sensing that offers a high degree of detection sensitivity, and availability in static or dynamic situation in many applications such as health, safety, and monitoring.

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4.9 Nanotechnology in Electronics

Nano electronics holds some answers for how we might increase the capabilities of electronics devices while we reduce their weight and power consumption. Some of the nanoelectronics areas under development include:

a. Improving display screens on electronics devices. This involves reducing power consumption while decreasing the weight and thickness of the screens.

b. Increasing the density of memory chips. Researchers are developing a type of memory chip with a projected density of one terabyte of memory per square inch or greater.

c. Reducing the size of transistors used in integrated circuits. One researcher believes it may be possible to "put the power of all of today's present computers in the palm of your hand [5].

5. ADVANTAGE OF NANOTECHNOLOGY FOR COMPUTER SCIENCE

Nanotechnology is already in use in many computing, communications, and other electronics applications to provide faster, smaller, and more portable systems that can manage and store larger and larger amounts of information. These continuously evolving applications include:

1. Nanoscale transistors that are quicker, more powerful, and more energy-efficient; your computer's whole memory could be stored on a single tiny chip in the near future.

2.Magnetic random access memory (MRAM) enabled by nanometer-scale magnetic tunnel junctions that can quickly and effectively save even encrypted data during a system shutdown or crash, enable resume-play features, and gather vehicle accident data.

3.Displays for many new TVs, laptop computers, cell phones, digital cameras, and other devices incorporate nanostructured polymer films known as organic light-emitting diodes, or OLEDs. OLED screens offer brighter images in a flat format, as well as wider viewing angles, lighter weight, better picture density, lower power consumption, and longer lifetimes [2].

6. CONCLUSIONS

Enhanced Computing Power: Nanotechnology enables the development of smaller, more efficient transistors, leading to increased computing power and speed.

Quantum Computing: Nanomaterials facilitate the advancement of quantum computers, which promise to solve complex problems much faster than classical computers.

Data Storage: Nanotechnology improves data storage devices by allowing for higher density storage solutions and faster read/write speeds.

Energy Efficiency: Nano-scale components can reduce energy consumption in computing devices, contributing to more sustainable technology.

Conclusions: The integration of nanotechnology in computer science is poised to revolutionize the field, leading to advancements in processing capabilities, storage solutions, and overall energy efficiency. Continued research and development in this area are essential for overcoming current technological limitations and driving future innovations.

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