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Nanomaterial's Application in Communication Sectors and in Sustainable Environment

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Abstracts

There was an earlier saying that history cannot be changed. But the technology especially nanotechnology makes the revolutions in the history. In communication sector always the major factor was the medium. The change was so rapid. It is really thought provoking that how nanotechnology brings out revolutions in telecommunication as well as computing and networking industries. Increase in population causes rising demands for food, water, energy, education, healthcare, and employment. Nanotechnology reduces the impact of human activities on Earths global environment. The Nano products are rapidly increasing as more and more. The Nano engineered materials are reaching the global market. The continuous revolution in nanotechnology will result in the fabrication of nanomaterial which will enhance the living standard of citizens.

Keywords:- *Nanotechnology, Nano devices, Electronic communication, Communication in bacteria, Quantum Information Processing, drug delivery*

Introduction:-

The Nano science and nanotechnology involve the ability to see and to control individual atoms and molecules. Researchers are finding a large variety of ways to make materials at the Nano scale to take advantage of their enhanced properties such as higher strength, lighter weight, and greater reactivity than their larger counterpart. Nanotechnology is the act of preparation of materials at very tiny scales – at the level of atoms and molecules [1]. When materials are less than 100 nanometers, the normal rules of physics and chemistry will not apply and many materials start to show unique or surprising properties. They become very stronger or very reactive. For Ex. Solid like gold turn into liquid at room temperature liquid gold act as a catalyst, liquid silver has antimicrobial property or stable materials like aluminum becomes combustible. Like energy adequacy or climate change nanotechnology also helps in solving serious humanity problems such as fatal diseases –ex; in brain tumors and Alzheimer's disease. Nanotechnology is used extensively to provide targeted drugs therapy, diagnostics, tissue regeneration, cell culture, biosensors, and other tools in the field of molecular biology [2].

The Electronic communication can be defined as a communication by means of guided or unguided electromagnetic energy, or it is the all forms of communication via electronic means such as internet, satellite, cable, television, computers, networks, etc. A coherent technology will be required to continue the performance improvements in communication and informatics. The Nanotechnology interphases with biological, physical and chemical sciences can bring much faster and powerful information handling equipment [3]. The sudden leap to the nano regime will result in single-molecule and single-electron based transistors. And special devices can be made out of these kinds of

transistors. The developments in nanotechnology through which the impossible can be made possible with help of nanomaterial's with novel optical, electrical, and magnetic properties, compact as well as fast non-silicon based chipsets for processors, quantum computing and DNA computing, development of telecom switches which are fast and reliable, micro-electro-mechanical systems and above all the development [4].

Informatics mainly has a processor which translates one programme to another which can be accessed and used. Hence it is the backbone of the communication sector. Each processor will contain definite number of transistors with specific functions associated with it. The first microprocessor only had 22 hundred transistors. Now we are looking for the processors with a billion transistors so that the flexibility of designing devices will be enormous. The present communication systems are based fully on the silicon technology. The number of transistors on a chip doubles about every two years. Recently Intel has introduced 65 nm generation logic technology which helps in improving performance and reducing power. They introduced sleep transistors which conserve power by allowing transistors to sleep when not in use, similar to the human brain. Intel strained silicon enables faster transistors by physically stretching the lattice structure of silicon atoms, allowing electrons to flow faster with less resistance [5]. As can be seen, the silicon technology is entering into a near molecular regime as the current size has gone down to 25 nm. This scenario can even slowdown or even curtail the progress of silicon microelectronics where not only the manufacturing technology but also the fundamental science changes [6].

Medical and Healthcare studies:-

In diagnosis and treatment nanotechnology plays a major role. The effective health care is a challenge for millions of peoples living in remote areas. Highly sensitive, portable point-of-care test kits are of great use for diagnostic functions of a medical laboratory. Depending upon how they are designed and manual application, the hand held kits is used to test for viruses, bacteria or hormones [7]. Thus the hand held kits is used for testing infectious diseases such as malaria, cholera, HIV/AIDS and also other sexually transmitted diseases. Thus being low cost available in remote areas and government hospitals. Nanotechnology based inventions can be designed to detect the hazardous pollutants present in air. Also remediation of these toxic materials and leaks reduce fossil fuel emissions and separate gases. Nanotechnology in biomedical imaging will readily improve medical imaging techniques. Nanoparticles of gold, silver are very reactive and have optical properties which make them effective in medical field [8]. When this biomedical imaging is used in conjugation with magnetic resonance imaging can produce better image of tumor sites. Specific size of nanoparticles is used in drug delivery system. In this technique the active agents are injected on the affected area lowering side effects. This is highly selective and also cost effective technique.

Nanostructures can be used to recognize diseased cells and to inject drugs to the diseased cells or affected area to combat cancerous tumors without harming healthy cells .In obesity Nano particles can target and inhibit the growth of fat cells or deposits. Nanotechnology drugs delivery system possess multiple desirable attributes. Nanotechnology has a size such that it can be injected without occluding needles and capillaries which enables targeted drugs delivery causing affected area. Pancreatic cancer has a low survival rate (less than 5%), because this cancer is diagnosed in final stage. Scientists have manufactured tools for early diagnosis of pancreatic cancer by attaching a affected cancer cell to iron oxide Nano particles that are clearly visible under magnetic

resonance imaging (MRI). Nanotechnology in Dental Care millions of people suffer through dental problems. Nano robotics will ensure better dental health. Tooth repairing can be done by Nano dental techniques. Lost tooth can be repaired by using nanotechnology [9].

Energy and Environment Approach:-

Nanotechnology plays a crucial role in protecting the environment and producing energy for growing world. Modern technologies of Nano science helps in storage of energy, its conversion in other forms, ecofriendly manufacturing of materials, production of energy by renewable energy sources also known as Green energy. Nanotechnology increases the efficiency of fuel production from crude oil through better catalysis [10]. It also increases efficiency by reducing fuel consumption in vehicles and power plants through higher combustion and decreased friction. Nanotechnology can be used for less expensive energy production in solar technologies, fuel cells, hydrogen technology and Nano catalysis. In solar panels nanotechnology is used to convert solar energy into electric energy more efficiently decreasing cost of solar power in future world. By using nanotechnology solar panels can be in flexible rolls rather than discrete panels. In future instead of solar panels solar converters might even be paintable.

Nanotechnology is used in batteries which are quick chargeable, more efficient, longer life, light weight and have a high power density. Various Nano science based options are being pursued to convert waste heat in vehicles in agricultural equipment, homes, automobiles, power stations, computers to usable electric power. Energy efficiency and energy saving capacity is increasing due to nanotechnology in lighting systems, lighter and stronger vehicle parts to make easy transportation and light response smart coating for glass. In making all these nanotechnology helps in ecofriendly and green technologies that can minimize hazardous pollution [11].

In Vivo Communication:-

Communication inside the body is happening in two ways. One is Natural triggering second is Induced triggering. In Natural triggering contain reflex action, antibody generation etc. where the neurons are the carriers for the information transfer. Whereas in induced triggering the targeted drug delivery and isotropic activation analysis are there where the nano materials are having very significant role, where as in first case bio macro molecules are playing the significant role. In isotropic activation analysis a particular isotopic substitution will be responsible for the communication. The medium of communication will be always an aqueous system inside the body [12]. Hence not only the size but shape also matters. Nano devices to be used in vivo should be designed in such a way that there will be minimum amount of friction. Even though nanotechnology is in its infancy, scientists & technologists will make use of it in all phases of life like never before.

In future, they hope to mould quantum dots to track specific chemical reactions inside nuclei, such as how proteins assist repair DNA after irradiation. They have already visualized the ‘dots’ journey from the area surrounding the nucleus to inside the nucleus, an achievement that opens the door for real-time scrutiny of nuclear trafficking mechanisms. They also anticipate targeting other cellular organelles as well the nucleus, such as mitochondria and golgi bodies. Since, quantum dots emit different colors of light based on their size; they can be used to observe the transfer of material between cells. When a particular threshold concentration is reached, the signaling molecules will bind to the receptors in the bacterial cell, which lead to the changes in gene expression in the

responding cell. For intra-species quorum sensing, the emitter and responder are usually the same type of cells. Often, but not always, the genes that are involved in synthesis and response activate their own expression thus acting as an auto inducer. A signaling molecule is considered to act at low concentrations and not to be involved in primary metabolism [13].

Optical communication and Quantum Information processing:-

As devices become smaller the principles of quantum mechanics become more and more imperative. Many new theoretical ideas have come into view and fundamental quantum Communication physics researches have progressed in leaps and bounds over the last few years. Consequently, features of genuine Quantum Information Processing could soon begin to be feasible commercially. Quantum Information Processing (QIP) is a major area for research materials such as Gallium Nitride (GaN) or diamond-like-Carbon which can be potentially renovated into efficient devices. Quantum computing which was suggested in 1970s completely relies on quantum physics, which permits the atoms and nuclei to work together as quantum bits or qubits and to be the computers processor and memory [14].

Qubits can execute calculations exponentially faster than conventional computers. One important aspect of the communication sector is the security of information exchange. As the life is going to be networked in all sectors it is crucial to give more emphasis on the confidentiality of the official as well as personal mails. Quantum computing provides us unlimited processing power and secure communications. Those days have come to reality, when we can decode the encrypted conversations by terrorists or others. The compactness and the rapidness were the main achievements that the new developments in this era have brought out. The miniaturization as well as fast and rapid satellite communications, wireless LAN systems, cellular phones etc. are possible only because of the smart nano materials. Now the science and technology has developed to such an extent that a group of scientists were able to flip the electron and they noticed a current change associated with it. They have tried to flip a single electron upside down in an ordinary commercial transistor chip. That was the beginning of the quantum computers where a single electron spin represents a quantum bit, the fundamental building block of a quantum computer. It was amazing that the conventional silicon technology was sufficient and powerful enough to accommodate the future electronic requirements like quantum computing, which will depend on spin. Another recent approach was that to shine microwave radio frequency to flip the spin of electron. The experiments last but a fraction of second, but required years of work to reach this point. With 100 transistors, each containing one of these electrons, we could have the implicit information storage that corresponds to all of the hard disks made in the world, multiplied by the number of years the universe has been around.

As we have discussed quantum computation makes use of atoms as a basis for computation. Recently developed DNA computing provides an example of long term information storage [15]. It is very compact and replicable; however it is not very fast. So its use as a model for information processing seems to be limited. Even in biological systems short term information storage is an energy consuming process. One example is the brain activity. This information storage timescales are very low when compared with microelectronics. Quantum structure electronic devices (QSDs) can confine electrons into regions of less than 20 nm, enhancing their performance. A principal aim of nanotechnology is to produce three dimensionally confined quantum structure electronic

devices such as quantum wire and quantum dot devices. Some successful devices in this direction are quantum well lasers for telecommunications; High Electron Mobility Transistors (HEMTs) for low noise, high gain microwave applications; and Vertical Cavity Surface Emitting Lasers (VCSELs), for data communications, sensors, encoding and so on [16].

Optical communication is any form of telecommunication that uses light as the transmission medium. An optical communication system consists of a transmitter, which encodes a message into an optical signal, a channel, which carries the signal to its destination, and a receiver, which reproduces the message from the received optical signal. Optical fiber is the most universal type of channel for optical communications; still other types of optical waveguides are used within communications kit, and have even formed the channel of very short distance (e.g. chip-to-chip) ties in laboratory testing. The transmitters in optical fiber linkages are commonly light-emitting diodes (LEDs) or laser diodes. Infrared light, rather than visible light is utilized more frequently, because optical fibers transmit infrared wavelengths with less attenuation and dispersion. LEDs are mainly restricted to low data rates, up to about 100 Megabits per second (Mb/s). Lasers are exploited for higher data rates. These devices are often directly transformed which means that the light output is controlled by a current applied directly to the device. They have the potential to store lots of information in a tiny space. This could force technologies from computers and portable electronics such as cell phones and MP3 players, to radio frequency identification devices [17].

Satellite Communication:-

A satellite is a radio relay station in orbit above the earth that receives, amplifies and redirects analog and digital signals contained within a carrier frequency[18]. They are of three types. Geostationary (GEO) satellites are in orbit 22282 miles above the earth and rotate with the earth, thus appearing stationary. The downlink from GEOs to earth can be localized into small regions or cover up as much as a third of the earth's surface [19]. Low-earth orbit (LEO) satellites reside 1000 miles above the earth and revolve around the globe every couple of hours. They are in view for a few minutes, and multiple LEOs are required to keep continuous coverage. Medium-earth orbit (MEO) satellites are in the middle, taking about six hours to orbit the earth and can be viewed for a couple of hours [20]. The first communications satellite was launched in 1960 and it was an instrumented inflatable sphere which just reflected radio signals back to the earth [21]. Semiconductor quantum dots, which cover almost completely the entire spectral region from the ultraviolet to the far infrared, with a small number of substrate materials are communication suitable candidates in satellite communications.

Conclusions: -

Nanotechnology will be helpful to develop and improve the environment in various ways. It has brought a new era in science and technology, but the challenges is to overcome various difficulties it is possible to manipulate materials at small scales, photonic technologies will take over silicon technology. Smart molecules can be integrated into devices for specific applications. So, further research is necessary in this field to fulfill increased needs of peoples. Rapidly progressing research reveals that lot of development seems today are possible in the future. Nanomaterial has excellent physicochemical and biological properties as compared to other counterparts. Because of their peculiar size, shape chemical composition, surface structure, charge, solubility nanoparticles have applications in various fields.

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