NANOELECTRONICS: A TECHNOLOGICAL REVOLUTION OF 21ST CENTURY

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Abstract: ***Nanoelectronics is miniaturiasation of electronic deviceto increase the device intensity and the operating speed indicates that electronics devices has entered nanoscale, and new fabrication techniques, components and changed properties considered.Tihs paper is to give a brief summary regardingnano-electronics and its application in current century.***

Keywords: **DRAM, Nano photonics, Nano sensing, Nano Ionics, Quantum Computing, MRAM, PCM, MIM.**

1. Introduction

Manufactured products are made of atomic arrangements. Properties of the products which further depend on how the atoms are arranged. Manipulations on the molecular scale are very different from larger scales as in physical, electrical properties and the behavior of matter changes. Many scientific and technological advances recently occurred, depending on rearrangement of atoms on a small scale. Such technological advances are called "Nanotechnology", The word 'nano' comes from a word 'nanos' which means dwarf. It includes all technology that handles nano scale materials and in a narrow sense, technologies that handle unique phenomenon that arises in 10 to 100 nm size range.

Nanoelectronics deal with the use of nanotechnology in electronic component. This term comprises of a wide set of components and materials with the common characteristics such as they are very small than the inter atomic interactions and quantum mechanics properties need to be studied extensively. This includes hybrid molecules semiconductor electronics, one dimensional nanotubes, nanowires, or advanced molecular technology. .Nanotechnology is sometimes considered as a disruptive technology because present candidates are significantly different from the traditional transistors.

2. Methods of Preparation

Two possible approaches for obtaining structure within the size range of 1-100nm are generally discussed. The first is the top to down approach based on lithography which we are using nowadays to fabricate integrated circuits. It has been highly successful but lacks control on the single atom level. The second is bottom to top approach in which the complex structures are assembled from single atoms into super molecular structures. Carbon nanotubes are supermolecular structure for a chemist,1-dimensional structures for physicist. Later, more of the supermolecule structure will be studied on atomic level. Companies like IBM, MOTOROLA , HEWLETT are taking an active part in this development.

3. Approaches in Nanoelectronics

Nano circuitry is electrical circuits on the scale of nanometer, one nm equals to 10^{-9} m or equal to row of 10 hydrogen atoms. As circuits becoming smaller, there is an ability to fit more components on a computer chip . This allows more complex function using less power and at a faster speed. Nano circuits are organized into three

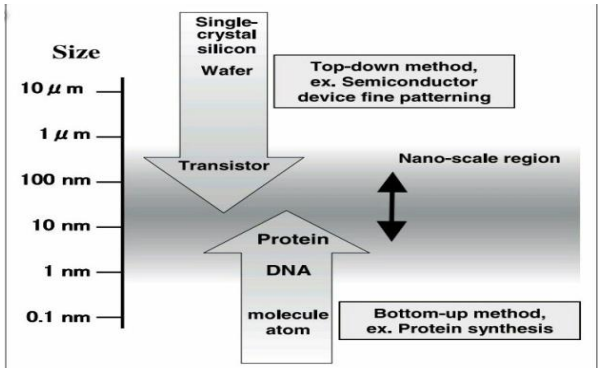

Fig.1. Nano circuitry

different parts. Transistors have been developed, structured using carbon nanotubes. Nanoelectronics makes the computer processor more powerful as compared to the conventional semiconductors techniques. A number of approaches currently being researched on interconnection and architecture, all deals on with nano scale.

Spintronics is considered with electromagnetic effects in nanostructures and molecules caused by the quantized angular momentum (the spin) that is associated with all

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fundamentals particles like electron [1, 2]. Magnetic moment of particle is directly proportional to its spin . So if we learn to manipulate not only charge ,but also spin on a single electron level, information may be stored and transported in the form of quantized units of magnetization
Nano sensors are any biological , chemical or surgery sensor points used to convey information about nanoparticles to the macroscopic world [9]. It uses small particles such as quantum dots to detect biological molecules, and indicates the presence either by emission or by scattering of light.

Nano photonics deals with the behavior of light on the nano scale, and has the goal of developing devices that take advantage of this behavior. Current advances in nanotechnology have resulted in new approaches for improvements in increasingly being replaced by optoelectronic devices such as photonic crystals and quantum dots.

Nano Ionics studies deals with the transportation of ion rather than electrons in nano scale system. A new territory has been discovered for the science of micro and nanoelectronics unlike classical it uses coherent superposition of "zero" and "one" and Quantum switch can be both open and close because it may be in a coherent super position of the two possibilities.

4. Applications

Nano radios includes new forms of lithography along with the use of nanowires or small molecule in place of traditional CMOS components. Field effect transistors have made using both semiconductor nanotubes and with hetero structured semiconductor nanowire. Research is an ongoing process to make cheaper solar cells with the help of nanostructure.

Magnetoresistive Random Access Memory (MRAM) with its spin dependent transport property based on nano scale magnetic film, it has the advantage of non-volatility, high integrity, high reliability, low power consumption, high access speed and strong radiation resistance.

Phase Change Memory (PCM) of large difference in electrical resistance of amorphous and crystalline phases, phase change memory (PCM) is used for digital data storage unit & is highly compatible with standard CMOS technology.

Metal Insulator Metal Technology (MIM) capacitor with high-dielectric can be used in the next generation DRAMS it will replace current MIS (Metal Insulator Semiconductor technology).

Multilayer Fluorescence can be used for high intensity data storage (FMD). A 6 layer FMD-ROM recording with capative over 25GB was demonstrated in 2003.

Medical Diagnostics area of medical services, more specifically medical electronics there is a demand for more accurate an quicker diagnostics. It has also been theorized that in the future neuron damage the neuron degenerating diseases could be overcome by the use of Nanoelectronics to communicate nerveimpulse to an external computer Medical electronics in the theory and practical life is very possible and the first evidence of this is the presence of Nanomotors, Nanodevices and Nanotransistors in biology. Nanomotors are present in very primitive life; the Myosin Kinesin and rotator motors for flagella which provide motion to bacteria through liquid media.

Transport and Security are highly reliable, smart and interactive low-cost devices will be created. They will be able to withstand harsh environment. Collision-avoidance devices, adaptive navigation systems, control of the in-car environment and entertainment system will increase our standard of living. Anti-terrorism and security applications International terrorism has stimulated massive investment in nanotechnology research for security systems, strongly boosting nanotechnology industries.

Nanoribotics is the technology of creating machines or robots at or close to the scale of a nanometre **[**7**].** Recently rice university has demonstrated a single-molecule car developed by a chemical process and including Bucky balls for wheels. The motorized model of the nano car is powered by light. Its rotating motor, a molecular framework that was developed by Ben L. Feringa at the university of /Groningen in the Netherland, was modified by Tour's group so that it would attach in – line with the nanocars classics. When light strikes the motors, it rotates in one direction, pushing the car along like a paddlewheel.

Components based on the Micro Electro Mechanical System (MEMS) and Nano Electro Mechanical System (NEMS) hold significant promises for future developments wireless communications.

5. Conclusion

Moving from micro to nanometer dimension allows chips to become so small and cheap that they can be integrated almost anywhere and interact with each other , making everyday activities systematically smarter and more reactive this could result in our living environment in home, car and office becoming sensitive and responsive to our presence .
Appliances such as computers, multimedia equipment and communication devices would be integrated into that environment allowing continuous and much simpler interaction , with information to enhance quality of life improve working condition and increases productivity.

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