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Nano Technology For Electronics And It

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ABSTRACT:

In recent years rapid advances in Nano Technology have provided a variety of nano products in different applications. One area of research is focused of the possible use of nano particles as a basic element of electronic devices. This paper is an attempt to look on nano technology for electronics as the revolutionary technology. For example nano technology for electronics is to be viewed as the technology that picks up where traditional MOSFET (Metal Oxide semi conductor field effect transistor) scaling stops. SILCON – BASED integrated circuits have experienced phenomenal growth since the invention and demonstration of the earliest devices; the first bipolar in 1948, the first planar integrated circuit in 1961 and the first general purpose metal – oxide – semiconductor field – effect transistor (MOSFET) in 1964. Today the semiconductor industry has combined revenues of over 350 billion dollars. This rapid technological progress was first predicted in 1965 by Gorbon Moore in the now famous "Moor's Law" which states that integrated circuit density and performance would double every 18 months. These improvements would come from reduced transistor dimensions, increased transistor counts, and increased operating frequencies. Silicon – based metal oxide – semiconductor (MOS) Technology will eventually run into fundamental limits and not be able to provide the expected increases in density and performance. Hence a new technology, nano technology will dominate in Electronics in the near future. This paper deals about that.

Key words: MOS, Transistor, Electronics, Nano Technology, Integrated Circuits.

I. INTRODUCTION

As conventional semiconductor devices follow Moore's Law to approach their physical limits we move in the direction of hybrid circuits which incorporate conventional as well as molecular components today. Quantum – effect nanoelectronic devices have already been fabricated in solid – state structures. These include quantum dots, which are nano – scale "boxes" holding a well defined number of electrons that can be put together to form lattices and cellular automata with special properties, as well as single – electron transistors devices that are controlled electron tunneling to amplify current. In addition, discovery of versatile carbon nanotubes and their ability to act as transistors and diodes promise new directions. Improvements on such novel circuits, for example large scale clocking schemes for quantum for cellular automata, as well as methods of integrating emerging molecular electronic components with current solid – state electronics are areas of active research. Architecture as well as manufacturing methods of such components and aggregate system enjoys intellectual property rights protection. One important consideration is that while it is easy to design around specific patented molecules and devices it is much harder to bypass architectural patents, hence their utility and effectiveness is arguably higher. Nanotechnology based memory chips due to their simpler more repetitive structure compared to more elaborate chips such as CPU's are widely believed to become one of the first components to be commercialized and integrated into existing solid – state circuits. Flat panel

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displays on carbon nanotubes field emitters are another application nearing commercialization. In future, however, it is likely that we design and fabricate electronic components as well as entire system using only molecules, with a number of advantages. Smaller component sizes yield higher circuit densities lower power consumption, possible more precise component fabrication as well as specific advantages such as higher operating temperatures for quantum dots, widening their range of application. Therefore novel methods of efficient synthesis and inexpensive mass fabrication of molecular electronics components represent a fertile development ground and are protectable under IP rights.

II. NANO SENSORS

Nano Sensors represent another area widely believed by researchers as well as investors to become one of the first commercialized applications of nanotechnology. Relation between structural and chemical properties of carbon nanotubes and their electrical properties have led to a number of sensor designs currently on the verge of mass production. An example of a carbon nanotube carbon dioxide (CO2) sensor is given by Ong & Grimes who, by tracking resonant frequency of a multi – wall carbon nanotubecoating, determine permitting of a coating which changes linearly in response to CO2 concentration. Installation of special purpose binding sites on tips of carbon nanotubes has been proposed to enable genome processing without the use of expensive PCR – based methods.[1] A much needed technique is an inexpensive high yield production method of carbon nanotubes, and novel methods of synthesis and production will be protectable with IP rights. Computational models of simulating mechanical behavior of carbon nanotubes are another active area protectable with patents, copyrights, trademarks and trade secrets.

III. NANO COMPUTER

Hardware Engineers are confident that the basic components would shrink the minicomputer more powerful than today's supercomputers. Nanocomputer is a supercomputer smaller than a human cell whose fundamental components measure less than 100nm. Nanocomputer can store trillions of bytes of information in structure of the size of sugar cube. When electrical devices are scaled down to the dimension of molecules, their behavior differs from their large counterparts.[3]

Silicon transistors will be phased out in the next 10 years and they will be replaced by carbon nanotubes'. Nanotube transistors can be made smaller than the smallest possible silicon transistor made of carbon nanotubes and have drawn tremendous interest from field ranging from condensed matter physics to chemistry, and from both academia and industry because of the unique properties of these structures promised unimaginable applicability and thus attracted a great deal of interest that continuous to this day. The single wall nanotubes (SWNT) emit electrons from their tips when exposed to electric field, enabling their application in flat – panel displays.

Their thin needle – like structure allow them to be used as probe tips in scanning tunneling microscopy and atomic force microscopy. The nanometer scale space inside and among the SWNs should provide larger gas adsorption capacities, which are especially exciting that could have a great impact as the critical temperature for superconductivity become higher.

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Another intriguing possibility is that we can use hollow space inside SWNTs, which are called peapods because of their shape. A recent report has claimed that 10 – wt% hydrogen uptake by SWNTs is possible. Smith and Luzzi first discovered fullerene – incorporated nanotube in 1998. The challenge now is to devise a way to mass – produce SWNTs of high purity and to control the length, diameter and chirality.[3]

The carbon when it reached temperatures of around 10,000°C, it formed an intersection web of carbon tubes, each just few billionths of a meter long. The researchers have called the solid a nanoform. This new form of carbon: a spongy solid that is extremely lightweight and, unusually, attached to magnet. The foam could one day help treat cancer and enhances brain scans, say the inventors. John Giapintzakis of the University of Crete has used an electron microscopy to study the structure of the nanoform.

IV NANOTECHNOLOGY OPTIONS FOR ELECTRONIC COMPONENTS

Exciting progress has been made over the past year in demonstrating carbon nanotube FET's (Field Effect Transistor) with reasonable transistor characteristics even demonstrated functioning logic elements and an SRAM (Static Random Access Memory) memory cell, albeit using resistor – transistor logic because only p – channel devices were available. Derive current of these transistors is low because the channel width is defined by the carbon nanotube width (1.0 – 1.4 nm), but when calculated in units of mA/m, these devices are beginning to approach what Si MOSFET'S can do. But, it is still not clear how carbon nanotube FET's will scale and whether they will be capable of surpassing Si MOSFETs. Key problems with carbon nano tubes at this point include the difficulty of forming low resistance contacts and difficulty forming nanotubes with the desired physical features (length, chirality's, single versus double walled). Also, the question of how to position large numbers of these nanotubes where you want them in a cost – effective way remains unanswered.

There are already many studies but no clear cut demonstrations of electronic devices based on a single molecule yet. Among the numerous problems to be solved the same are mentioned as:

- Realization of molecular devices: diode, conductivity of molecular wire, wiring, and connection to electrodes.
- Self – organization for 3D integration.
- Molecular circuit architecture (again fault tolerant).
- Connections and thermal dissipation.
- Use of DNA for the resolution of some algorithmic problems.

V. KEY ISSUES & POTENTIAL PROBLEM

It is important to develop new technology and continue the research of nanotechnology in this digital age; however, it is of equal importance to evaluate all potential threats that could be caused from the use of nanotechnology. Unforeseen dangers have been discovered in previous technological advancements. For example, silicone breast implants were found to be able to leak and therefore were dangerous for the patient. Also, power lines leaked radiation and caused cancer to those who lived by them. It is not possible to foresee all the problems ahead, yet by paying attention to the big, basic issues, it is possible to achieve the greatest challenges and get some idea of how to deal with them. It is important to study new dangers that could result

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from the use of nanotechnology in order to limit unforeseen dangers. The possible harmful effects of nanotechnology fall into the categories of biological, environmental, military, and the use of nano assemblers. The possible biological biology, which would cause problem in alternating DNA, cells, and our own biological beings.[4]

Applying nanotechnology could possibly be harmful for the environment in its testing and application. In an environment in the summer of 2002, nanotubes were injected into rats while killing 15% of them. Nanotechnology is being explored for potential military applications because it is cheap, easy to reproduce, and possibly could be useful in both arms and weapons. However, control is difficult, as described by the effects of nano assemblers. Nano assemblers, which are the construction tools in building nano robots, are used in self – copying nano robots and thus reducing manufacturing costs. However, replicating manufacturing systems could rapidly turn out the needed defenses in huge quantities. Also, besides deliberate attacks, the other concern is that a self – replicating molecular machine could replicate unchecked, converting most of the biosphere into copies of itself.[5]

VI. CONCLUSION

We have attempted to take a snapshot of research activities and recent developments in the field of Nanotechnology. It could not be complete by any means although we intended to report all significant ones here. Nanotechnology for electronics is to be viewed as the revolutionary technology that picks up where traditional MOSFET scaling stops. For this purpose several exciting nanotechnology directions are being explored and since this is a rapidly emerging field of research, it would be premature to rule in or out any approach. However, density, speed, energy and other operational requirements of logic and memory products need to be keep in mind as proceed into the world of nanotechnology.

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