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The Application of Microelectronics and Nanoelectronics

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Abstract: **The introduction to the term Nanoelectronics and Microelectronics. The term nanoelectronics deals with the manufacture of electronic devices at the nano scale i.e 10^-9 m.Whereas the microelectronics deals with the manufacture of electronic devices at the micro scale.The Nanoelectronics and Microelectronics has made a tremendous advancement in the past few decades.This paper contains a brief explanation on MOSFETS and MOORE'S LAW.Mosfets are the major building blocks of the computing devices.The mosfets are usually used a s switch and it has three terminals drain source gate.Moore's law is the observation that the number of transistor in a dense integrated circuit doubles every year. The microelectronics- research and development efforts.Nature of research and development-which includes improvement of silicon integrated circuit.Efforts of compound semiconductor electronics.Investigation on IC based materials other than semiconductor.In this paper advanced silicon integrated circuit has been discussed briefly.Nanoelectronics-the introduction,the technology,application of nanoelectronics- carbon nanotube,semiconducting nanowire,quantum cellular automation,has been briefly discussed.**

I. INTRODUCTION

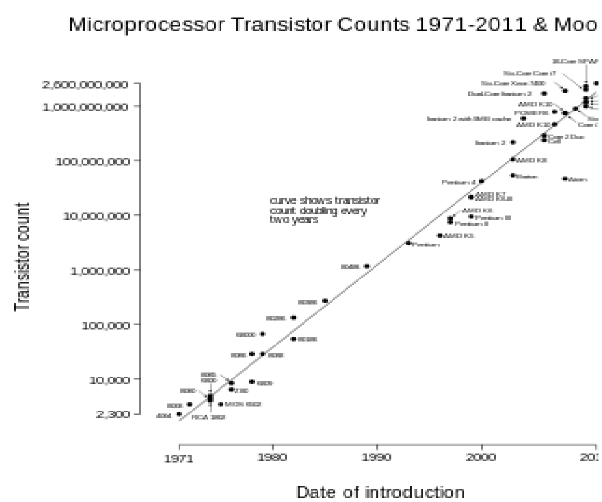
The term Nanoelectronics covers a diverse set of devices and materials with the common characteristics that they are very small that inter atomic interactions and quantum mechanical properties .The candidates include hybrid molecular semiconductor,nanotubes,nanowires or advanced molecular electronics.

Micro electronics comes under the branch of electronics microelectronics .microelectronics mainly deals with the study and manufacture of electronic components in a micro scale.These devices are made up of semiconductors.Many electronic devices are available in the microelectronic equivalent, these include capacitors resistors,transistors etc.wire bonding are also often used in microelectronics because of the usually small size of the components,leads and pads.

II. A BRIEF EXPLANATION ON MOSFETS

Mosfet is the major building block of various computing devices.The mosfet usually contains 3 terminals namely,drain,source,gate.mosfets are also used as switch.The source and drain are the two ends of the switch.

MOORES LAW Moore's law is the observation that the number of transistors in a dense integrated circuits doubles approximately every two years. The observation is named after Gordon Moore, the co-founder of Fairchild Semiconductor and intel, whose 1965 paper described a doubling every year in the number of components per integrated circuit, and projected this rate of growth would continue for at least another decade.[In 1975,[4 looking forward to the next decade,] he revised the forecast to doubling every two years.[The period is often quoted as 18 months because of Intel executive David House, who predicted that chip performance would double every 18 months (being a combination of the effect of more transistors and the transistors being faste



A plot of cpu transistor counts against dates of introduction. The line corresponds to the exponential growth with transistor counts doubling every two years

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III. THE MICROELECTRONICS

Microelectronics has been the fundamental building block of today's fastest moving technologies and it has progressed at a tremendous rate over a past few decades and has become the vital part of us commerce and defence.Microelectronics is the cornerstone of the information technologies that pervade virtually every aspects of contemporary life

Research and development (R&D) efforts have fueled progress in microelectronics technology at an extraordinary rate. Since the invention of the integrated circuit (IC) 27 years ago, the capabilities of these devices have more than doubled every 2 years. Currently, an IC with several hundred thousand components can be purchased for a few dollars-less than the 1950's price for a single component.the federal government has historically has played vital role in microelectronics research and development. Today, many factors, including
shifts in industry structure and limitations posed by technological trends, raise questions concerning the types and levels of Federal support for microelectronics R&D. To address these issues, this OTA background paper, requested by the House Committee on Science and Technology, describes the current state of microelectronics research and development by examining the technologies emerging from R&D efforts and the range of institutional support for R&D. Although other relevant Federal policies are discussed to some extent, the primary focus of the paper is the role of direct Federal support for microelectronics R&D

THE NATURE OF RESEARCH AND DEVELOPMENT IN MICROELECTRONICS

Microelectronics research and development activities can be separated into three categories

1.improvement in silicon integrated circuits

2.Efforts for compound semiconductor electronics.

3.investigation on ic's based on materials other than semiconductor
All these categories are based on design and most of these three categories are aimed at making better digital integrated circuits.Many other activities such as optoelectronics and microwave devices are also included

1.ADVANCED SILICON INTEGRATED CIRCUITS

There are many efforts taking place to improve silicon based microelectronics .in our practical application.These efforts can be grouped into three categories

1,circuits and packaging

2.fabrication process

Circuits for specific markets

CIRCUITS AND PACKAGING
circuits and packaging always deals with reducing the size of ic and increasing the package density.Scienitst and engineers are developing devices such as resistors capacitors and transistors that have featured size of less than 1 micron.These devices must also operate correctly and control the required amount of power. Here connections must shrink and conduct electric current with no résistance .these process are very complex .finally the package for the completed chip must allow signals to enter and leave the chip at high speed. These steps have been used to scale down silicon ICs over the past 25 years. Every new reduction in feature size has been significantly more difficult to achieve than the last, and progress has been possible only through the introduction of increasingly complex manufacturing technologies and device and circuit designs. Today's R&D workers face the greatest challenges yet.

DESIGN AND FABRICATION PROCESS
Fabrication technology is the process of depositing very thin layers of different metals ,insulators, and

semiconductor materials on the silicon substrate. Changing the impurity content of the semiconductor ,etching the layers, and defining the small features in the layer through lithography techniques. Now research is taking place to explore better techniques for fabrication. Manufacturing technology is a crucial part of these advances because progress in silicon scaling is based on the introduction and improvement of highly sophisticated equipment. Some examples are chemical- vapor-deposition (CVD) and evaporation systems to grow thin films of semiconductor crystals and metals; lithography equipment and plasma etchers to define the ultra small features of the IC; and furnaces and ion implanters to introduce the proper impurities to the wafer.

CIRCUITS FOR SPECIFIC MARKETS:

Currently, most ICs fall into a few standard categories: logic chips, memory chips, and microprocessors. However, as the design and manufacturing capabilities of the IC industry grow and become more flexible, a range of specialized integrated circuits will play a more central role. Application-specific ICs (ASICs) are projected to grow from their current 12 to 15 percent of the total IC market to 25 to 30 percent of the 1990 market. ' This category of integrated circuits includes custom chips, which are designed from scratch for the particular Application

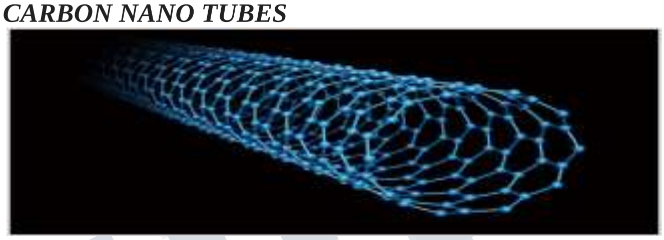
IV. NANOELECTRONICS

Currently, most ICs fall into a few standard categories: logic chips, memory chips, and microprocessors. However, as the design and manufacturing capabilities of the IC industry grow and become more flexible, a range of specialized integrated circuits will play a more central role. Application-specific ICs (ASICs) are projected to grow from their current 12 to 15 percent of the total IC market to 25 to 30 percent of the 1990 market. ' This category of integrated circuits includes custom chips, which are designed from scratch for the particular application, and chips that can be adapted by the user for the specific need. Further enhancements of the design process will expand users' ability to design their own ICs

THE TECHNOLOGY

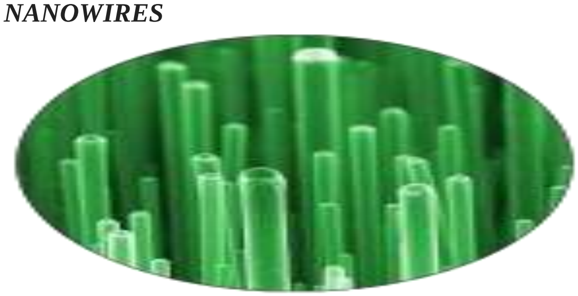
In nanoelectronics silicon transistors and copper wires would be replaced by a nanotechnology scale devices the move from microelectronics to nanoelectronics is because they can be chemically developed at much smaller sizes than the conventional elements which can be patterned with lithography. There are numerous technologies which can replace a transistor in many digital logic application .some of the application is carbon nanotubes,nanowires,quantum cellular automation etc. These devices offer few sizes of nanometers and could be self assembled.

CARBON NANO TUBES



A carbon nanotube is a tube-shaped material, made of carbon, having a diameter measuring on the nanometer scale. A nanometer is one- billionth of a meter, or about 10,000 times smaller than a human hair. CNT are unique because the bonding between the atoms is very strong and the tubes can have extreme aspect ratios.The structure of carbon nano tubes gives it a extraordinary strength which is attrarctive for the material use and also increases their durability.CNT were produce as a byproduct of an arc discharge Nanotubes are members of the fullerene structural family. Their name is derived from their long, hollow structure with the walls formed by one-atom-thick sheets of carbon, called grapheme.. These sheets are rolled at specific and discrete ("chiral") angles, and the combination of the rolling angle and radius decides the nanotube properties; for example, whether the individual nanotube shell is a metal or semiconductor. Nanotubes are categorized as ingle walled nanotube (SWNTs) and multi-walled nanotube. (MWNTs)experiment to create the carbon buckyballs .

NANOWIRES



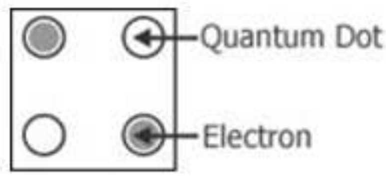
One-dimensional semiconducting nanowires allow for device engineering of next generation micro-electro-mechanical systems (MEMS) and optoelectronic devices. Our FirstNano® EasyTube® process equipment is used worldwide for advanced research and development of semiconducting nanowires and nanotubes. Example materials include silicon nanowires (SiNWs), silicon germanium nanowires (SiGe NWs), zinc oxide nanowires (ZnO NWs), and gallium nitride nanowires (GaN NWs) Alternatively, nanowires can be defined as structures that have a thickness or diameter constrained to tens of nanometers or less and an unconstrained length. At these scales, quantum mechanical effects are important — which coined the term "quantum wires ". Many different types of nanowires exist, including superconducting (e.g. YBCO[1]), metallic (e.g. Ni, Pt, Au), semiconducting (e.g. silicon nanowires (SiNWs), InP, GaN) and insulating (e.g. Sio2, TiO2) the problems encountered by nanowire at the nano scale are there is a tunneling o current ,the sub threshold current increases the power consumption and the leakage of the current .These are some unavoidable problems at the nano scale level..QUANTUM CELLULAR AUTOMATA

V. QUANTUM CELLULAR AUTOMTA

A cellular automata (CA) is a finite state machine consisting of a uniform (finite or infinite) grid of cells. Each cell can be in only one of a finite number of states at a discrete time. As time moves forward, the state of each cell in the grid is determined by a transformation rule that factors in its previous state and the states of the immediately adjacent cells (the cell's "neighborhood"). The most well-known example of a cellular automaton is John Horton Conway's "Game of Life", which he described in 1970.

Cellular automata are commonly implemented as software programs. However, in 1993.physical implementation of an automaton using quantum-dot cells. The automaton quickly gained popularity and it was first fabricated in
1997. Lent combined the discrete nature of both cellular automata and quantum mechanicss, to create nano-scale devices capable of performing computation at very high switching speeds (order of Terahertz) and consuming extremely small amounts of electrical power.

Today, standard solid state QCA cell design considers the distance between quantum dots to be about 20 nm, and a distance between cells of about 60 nm. Just like any CA, Quantum (-dot) Cellular Automata are based on the simple interaction rules between cells placed on a grid.



VI. CONCLUSION

As a conclusion I would like to say that the microelectronics and nanoelectronics are the trending technologies in todays modern science.it has done a great advancement in past few decades.this technology reduces the bulky sizes of electronics goods and makes it easy to handle these electronic goods at any time. Nanoelectronics and microelectronics covers a lot of domains today and it will also in futurity is quite big and make lot of discoveries and inventions come true