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A Study on the Usage of Semi Conductors

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Abstract: *Semiconductors are materials that have electrical conductivity between conductors such as most metals and nonconductors or insulators like ceramics. How much electricity a semiconductor can conduct depends on the material and its mixture content. Semiconductors can be insulators at low temperatures and conductors at high temperatures. As they are used in the fabrication of electronic devices, semiconductors play an important role in our lives.*
These materials are the foundation of modern day electronics such as radio, computers and mobile phones. Semiconductor material is used in the manufacturing of electrical components and used in electronic devices such as transistors and diodes. They can be classified into mainly two categories known as intrinsic semiconductors and extrinsic semiconductors. The current paper highlights the usage of semi-conductors.
Keywords: *Semiconductor, Material, Electrical*

I. Introduction

An intrinsic semiconductor material is very pure and possesses poor conductivity. It is a single element not mixed with anything else. On the other hand, extrinsic is a semiconductor material to which small amounts of impurities are added in a process called doping which cause changes in the conductivity of this material. The doping process produces two groups of semiconductors which are known as the negative charge conductor known as n-type and the positive charge conductor known as p-type. The materials selected to be added to an intrinsic depend on the atomic properties of both the material being added and the material to be doped.

Semiconductors are especially important as varying conditions like temperature and impurity content can easily change their conductivity. The combination of various semiconductor types together generates devices with special electrical properties, which allow control of electrical signals. Imagine a world without electronics if these materials were not discovered. Despite the fact that vacuum tubes can be used to replace them, using semiconductors has made electronics faster, reliable and a lot smaller in size. Also, they have allowed for creation of electrical devices with special capabilities which can be used for various purposes.

These days with the rise of very large scale integration(VLSI) technology the transistors, which are the building blocks of memory chips ,can be made as tiny as in the scale of nano meter which allows us to fit millions of them into a small area. And the building blocks of these transistors are semiconductors.

Semiconductors find wide range of application in modern day gadgets. In fact if you observe carefully you are surrounded by semiconductors. The cell phone you use or the laptop has millions of tiny transistors embedded in them in order to empower them with various functionalities. The LED which is aggressively replacing many of the existing lighting technologies is a semiconductor device.

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II. Usage Of Semi Conductors

Without transistors and integrated circuits made of semiconductors, much of modern life would be very different. No hand-held electronic games would entertain children for hours. No bar-code readers would speed checkout lines and compile inventories at the same time. And no computers would handle tasks at work and home, nor would microprocessors control the operations of cars, planes, and space vehicles.

The revolution in electronics that made such wonders possible began in 1947. That year Walter H. Brattain, John Bardeen, and William B. Shockley, working together at Bell Labs, made the first transistor. Their research led to a smaller, lighter, and more durable replacement for the vacuum tube, an innovation widely adopted in the 1920s. Vacuum tubes could amplify electrical signals in radios and record players and serve as the on-off switch necessary for the binary code employed in computers. The transistor, eventually more efficient and much smaller, could do this and more.

In effects first observed in the 1870s, some semiconductors respond to light by producing an electric current (the photovoltaic effect) or becoming able to conduct current (the photoelectric effect). Photovoltaic (solar) cells are used to provide electrical power to remote locations, on satellites, and, in combination with storage batteries, for some outdoor lighting.

Still other semiconductors give off light when they gain electrons. Gallium arsenide and aluminum phosphate, which were developed in the 1960s, are made into the light-emitting diodes (LEDs) used as displays in digital clocks, microwave ovens, and countless other electronic devices. Those same materials can be shaped to form a reflecting cavity that amplifies and directs the light it produces, creating a semiconductor laser. Semiconductor lasers are often paired with photoelectric cells in automatic doors, burglar alarms, bar-code readers, and fiber-optic communications devices.

An integrated circuit, or IC, contains many transistors and other devices on a single "chip" of silicon. Jack S. Kilby of Texas Instruments made the first IC in 1958. In 1959 Fairchild's Jean Hoerni invented the planar process, which Robert Noyce, another Fairchild scientist, used to produce a chip that, unlike Kilby's, did not require any external wiring: the circuit is printed in the dioxide layer. In 1960 Dawon Kahng and Martin Atalla of Bell Labs created the first metal oxide semiconductor (MOS), or field effect, transistor, the kind of transistor most used today.

Like planar processing and integrated circuits, MOS transistors transformed the semiconductor electronics industry. In 1965 Gordon Moore, a co-founder of both Fairchild and Intel, predicted that the number of transistors that would fit on a given area of silicon would double every year. In 1975 he modified this to every two years — still an astonishing prediction that has thus far proved accurate.

Transistors, and many other electronic devices, are made of semiconductors — materials that conduct electricity only weakly under certain conditions. Radar technology, developed during World War II, used tow semiconductors, germanium and silicon, to detect short-wave radio signals. Although the theory on which the Bell Labs scientists based their work was largely the product of the 1920s and 1930s, the wartime experience of purifying these elements and exploring their electronic properties brought the three scientists to the threshold of their invention.

The first transistor was a point-contact transistor, in which contact was made between a piece of germanium and three wires. Shortly thereafter Shockley invented the more reliable junction transistor, a "sandwich" of two types of germanium (N and P) produced by adding small amount of impurities. Silicon became the preferred material for making transistors; its ability to form a dioxide layer easily also made today's integrated circuits possible.

III. Discussion

The Semiconductor device is made up of a material that is neither a good conductor nor a good insulator, it is called a semiconductor. Such devices have established wide applications because of their reliability, compactness, and low cost. These are discrete components which are used in power devices, compactness optical sensors, and light emitters, including solid-state lasers. They have a wide range of current and voltage handling capabilities, with current ratings more than 5,000 amperes and voltage ratings more than 100,000 volts. More importantly, semiconductor devices lend themselves to integration into complex but readily build-up microelectronic circuits. They are having probable future, the key elements of the majority of electronic systems including communications with data-processing, consumer, and industrial-control equipment.

Semiconductor devices are nothing but electronic components that exploit the electronic properties of semiconductor materials, like as silicon, germanium, and gallium arsenide, as well as organic semiconductors. Semiconductor devices have replaced vacuum tubes in many applications. They use electronic conduction in the solid state as opposed to the thermionic emission in a high vacuum. Semiconductor devices are manufactured for both discrete devices and integrated circuits, which consist of from a few to billions of devices manufactured and interconnected on a single semiconductor substrate or wafer.

Semiconductor materials are useful by their behavior which can be easily manipulated by the addition of impurities is known as doping. Semiconductor conductivity can be controlled by the electric or magnetic field, by exposure to light or heat, or by the mechanical deformation of a doped mono crystalline grid; thus, semiconductors can make excellent sensors. Current conduction in a semiconductor occurs free of electrons and holes, collectively known as charge carriers. Doping of silicon is done by adding a small amount of impurity atoms and also for phosphorus or boron, significantly increases the number of electrons or holes within the semiconductor.

When a doped semiconductor contains excess holes it is called "p-type"(positive for holes)semiconductor, and when it contains some excess of free electrons, it is known as "n-type"(negative for electrons) semiconductor, is the sign of charge of the majority mobile charge carriers. The junctions which formed where n-type and p-type semiconductors are joined together is called p–n junction.

The silicon (Si) is most widely used material in semiconductor devices. It's having lower raw material cost and relatively simple process. Its useful temperature range makes it currently the best compromise among the various competing materials. Silicon used in semiconductor device manufacturing is presently fabricated into bowls that are large enough in diameter to allow the manufacture of 300 mm (12 in.) wafers.

Germanium (Ge) was a widely used in early semiconductor material, but its thermal sensitivity makes less useful than silicon. Nowadays, germanium is often alloyed with (Si) silicon for use in very-high-speed SiGe devices; IBM is a main producer of such devices.

IV. Conclusion

Gallium arsenide (GaAs) is also widely used with high-speed devices, but so far, it has been difficult to form large-diameter bowls of this material, limiting the wafer diameter sizes significantly smaller than silicon wafers thus making mass production of Gallium arsenide (GaAs) devices significantly more expensive than silicon.

All types of transistor can be used as the building blocks of logic gates, which is useful to design of digital circuits. In digital circuits like as microprocessors, transistors so which is acting as a switch (on-off); in the MOSFET, for example, the voltage applied to the gate determines whether the switch is on or off.

The transistors are used for analog circuits do not act as switches (on-off); relatively, they respond to a continuous range of input with a continuous range of output. Common analog circuits include oscillators and amplifiers. The circuits that interface or translate between analog circuits and digital circuits are known as the mixed-signal circuits.

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