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Important Role of used Semiconductor in aircraft devices

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ABSTRACT
In this research paper I Will focus on semi-conductor fundamentals which will Learn and why semiconductors are used in electronics and study and Examine the various types of semiconductor materials and study their electrical characteristics

I . OBJECTIVE

To know three Common Semiconductor devices•
- Describe the function of semiconductor in electronic equipment. describe the electrical characteristics of materials which are classified as semiconductors .
Known the two most Commonly used semiconductor as semiconductor•

Materials.
• Explain the difference between intrinsic and o doped semiconductors define the word hole as it. Applies•
• Explain how electrical current Plows through to semiconductor intrnsic and doped semiconductors.
- To know the name five advantages of semiconductor devices over Components with Similar Capabilities

II . INTRODUCTION

Importance of semiconductors: s essentially materials which Serve as the basic building are Very Important electronic Components
-These semiconductor used to used to construct same. Components and are in turn used To Construct electronic Circuits and equipment. the three most Commonly Semiconductor devices are diodes, transistors and integrated Circuits however other special Components, , are also available.
- The primary function of semiconductordevices in electronic equipment is to Control Currents away or voltages as to produce a desired end result. Example, diodes can be used as rectifiers in suchto produce pulsating dc from ac. Transistor Can be used a Variable resistance to. Vary as the current in a heating element or an integrated Circuit can be used to amplify and demodulate a radio signal, all of these components are made of special materials known a Semiconductor devices are and reliable .
The vacuum tubes that were once widely used in practically all types of electronic equipment Widely used in have been almost completely replaced by the newer and better Semi Conductor devices.

III . MATERIAL AND METHODS

•Semi-Conductor materials
The term Semiconductor; any materials that has characteristics which fall between those of insulators and Conductors. In other words, a semiconductor will not p Current as as readily nor used to describe block Current as effectively as an insulator. as a Conductor Some Semiconductor materials are pass will it actually pure elements which are found in the periodic table of elements while other Semiconductors may be classified as Compounds. As examples of semiconductor materials that are natural elements are Carbon (C), germanium (Ge), and Silicon (Si)

The Semiconductors that are suited to the greatest Variety of electronic and silicon.
Germanium is a brittle, grayish-white earth element that This Was discovered in 1886 .
This material may be recovered from the ash of Certain types of Coals in the form of germanium dioxide powder. This poweler may then be reduced to pure germanium which is in solid form.
Silicon is a non-metallic element which Was discovened in 1823. This material is found extensively in the earth's crust.
A white or sometimes Colorless Compound known as silicon dioxide (also called silica) occurs a bundantly in forms such as sand, quartz, agate, and flint.

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These Silicon Compounds can be chemically reduced to obtain pure Silicon which is in a solid form. These two materials have atomic structures which may be easily altered to obtain specific electrical characteristics.

Germanium and Silicon atoms and crystals

From Last studies Such as Copper and aluminum a to carry We know that metals Current in an electrical We learned that these metals are Conductors because they to current flow.

Offer are used Circuit.

We, In previous studies also learned that materials such as glass rubber, and Ceramic oppose the flow of electrical current and are therefore, classified as insulators .

Now will now examine the atomic structure of two materials (garmanium and silicon) which have characteristics that are between those of Conductors and insulators and find out why these materials fall into third classification known as semiconduct

Element : One of the 104 known chemical materials the Cannot subdivided into Simpler substances.

Atom: The smallest portion of an element that still exhibits all the characteristics of that element.

Semiconductor Atoms:

Before we actually examine the structure of germanium and silicon atoms and Crystals we must consider some importati rules which pertain to the number and placement of the electrons which revolve around the nucleus of all atoms .

Atoms Contain three basic Components: protons, neutrons, and electrons. The protons and neutrons are Located in the nucleus or Center of the atom while the electrons revolve around the nucleus in orbits.

The atom of each particular element will have aspecific number of protons in its nucleus and an equal number of electrons in orbit if the atom is neutral (has no charge). However, the exact manner in which the electrons are arranged around the nucleus is extremely important in determining the electrical characteristics of the element.

Generally, each electrons has its but certain orbits are grouped together Own to produce what is referred to as a shell. orbit, For all of the elements that are known to exist, there can only be a maximum of Seven shells .

The shell nearest the nucleus Can only hold 2 electrons while the second shell Can hold a maximum of 8 electrons. The third shell Cannot hold more than 18 electrons and the fourth can hold more than 32 and so on.

The outermost shell of a particular atom is called the Valence shell and the electrons that orbit within this shell are referred to as Valence electrons.

- The arrangement of the protons and electrons in three different atoms are shown in figure 1

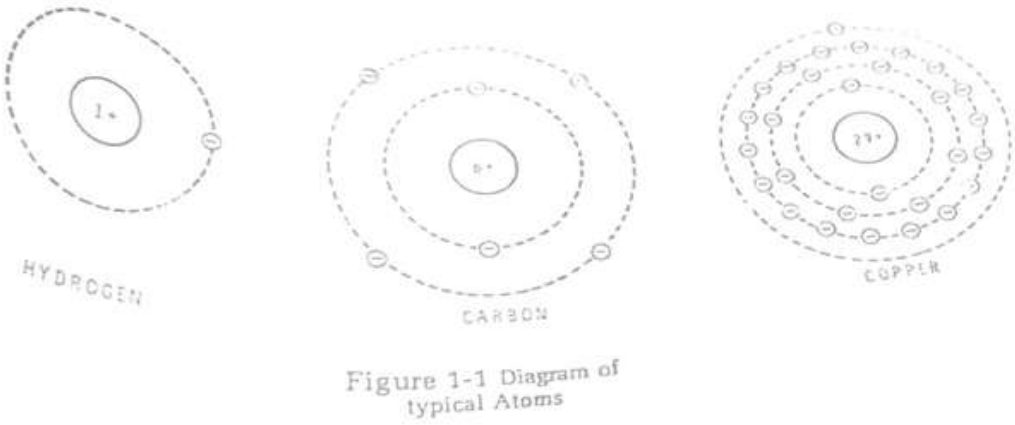

Figure 1-1 Diagram of typical Atoms

Figure 1 typical atoms

Notice that the hydrogen atom has only one shell, while the carbon atom has two and copper atom has four shells, Also notice that some of the shells contain less than the maximum number of electrons allowed. In any particular atom, the outer shell can never hold more than 8 electros, when exactly 8 electrons are present in the outer shell, the atom is considered to be .

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Completely stable and it will neither give up accept electrons easily. Elements which have atoms of this type These are neon and elements are inert argon. classified as gases and they resist any Sort of electrical or chemical activity.

- when an atom has 5 or more electrons in its outer shell, it tries to fill its shell so that it can reach a stable Condition.
- Elements of this type make good insulators because the individual atoms try to acquire electrons instead of giving them up. Therefore, the free movement of electrons from one atom to the next is inhibited . en an atom has Less than 4 electrons in it's outer shell it tends to give up these outer electrons easily. randomly drift from one atom to the next
- When an atom Contains exactly 4 electrons 4 in it's outer shell, it does not readily 9 give up or accept electrons.
- Elements which Conductors have atoms of this type make good because they Contain a large number of free-moving electrons which can Elements which contain atoms of this type do not make good insulators or Conductors and are, there referred to as Semiconductor material

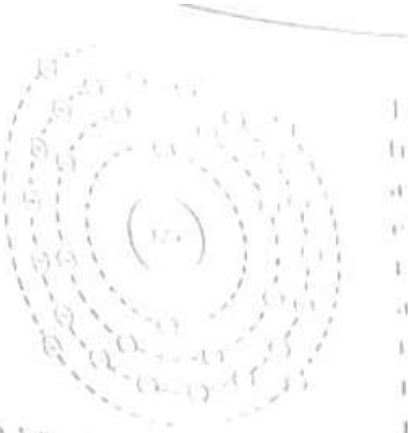

Figure 1-2 The Germanium Atom

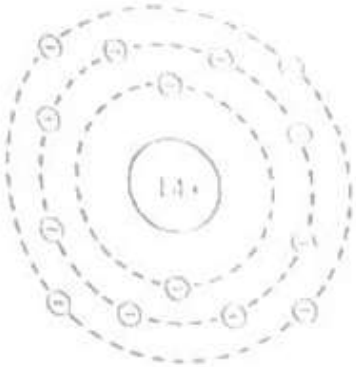

Figure 1-3 The Silicon Atom

Figure 1-4 Simplified Germanium and Silicon Atoms

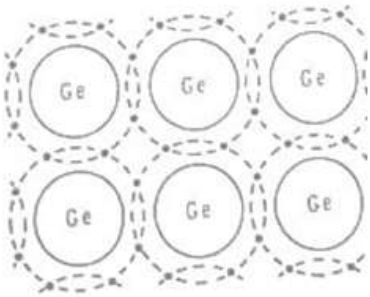

Figure 1-5 Simplified Diagram o Germanium Crystal Structure.

IV . RESULT AND DISCUSSION

- conduction in intrinsic germanium and Silicon.

Due to the Crystalline structure of pure Semiconductor materials such as germanium and silicon, each nucleus within the material sees eight valence electrons even though each atom actually has only four, Therefore each atom tends to be stable and will not easily give up or accept electrons. However;; this does not mean that pure semiconducer must, under all Conditions, resist.

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any Sort of electrical activity in the same manner as the inert gases previously described.

Holes:

To understand exactly why a semiconduct is able to allow current to flow, we must take a closer Look at the - internal structure of the material. I When an electron breaks away from a Covalent bond, an open space or Vacancy exists in the bond.

The space that was previously occupied by the electron is generally referred to as a hole. A hole simply represents the absence of an electron.

electron has a negative charge Since an the hole represents the absence of anegative charge,

- The number of electron-hole produced within a semicond will increase with temperature. However, even at room temperature, asmall number of electrons-hole pairs will exist.
- Some of the free electrons will tend to drift randomly, however, the holes will try to absorb some of the electrons. This means that some electrons
- This means that some electrons will Simply jump from one shell to another Shell which Contains a hole. If an electron jumps from one shell to fill ina hole, another hole is Created when the electron Leaves the shell, the hole therefore appears to move in the opposite directin of the electron

Results

Advantages

- Components which are made of semiconductor materials. Solid state are often referred to Components because they materials.
- Because of this ruggedness, Semiconductor devices are able to operate under extremely hazardous environmental Conditions.

reliability of solid-state devices. This ruggedness is responsible for the-

- The solid-state Construction also eliminate the need for filaments or heaters as found in all vacuum tubes.

-- This means that additional power is not, required operation to operate the filaments and Component is Cooler and more efficient.

- By eliminating the filaments a prime Source of trouble e is also a voided because the filaments generally have a Limited Life expectancy .
- The absence of filaments also means that, a Warm-up period is not required before the device Can operate properly.
- In other words, the solid-state Component operates the instant it receives electrical power.

-- Solid-state Components are also able to operate with very Low voltages (between 1 are and 25 volts) while vacuum tubes usually require an operating voltage of 100 volts or more

-This means that the solid-state components generally use less power.

- therefore, more suitable for use in portable equipment which obtains it's power from batteries.
- The Lower Voltages l are also much safer to work with
- Solid-State Components are much less expensive than Comparable vacuum tube Components

-The very nature of a solid-state Component makes it suitable for production in Mass quantities.

- A Large number of solid-state Components Can be Constructed as easily and quickly as a single component .

V . CONCLUSION

Low Temperature characteristics :

- At extremely Low temperatures, the valenceelectrons are held tightly to their parent atoms which are in Covalent bonds and are not allowed to drift through the Crystalline structures of either Semiconductor material. characteristics extremely low temperatures, the valence which drift are in
- Since the Valence electrons drift from a one atom to the next, the material cannot support current flow at this time. therefore, at extremely Low temperatures, pure germanium and silicon crystals function as insulators.

High Temperature characteristics :-

- As the tempezture of a germanium or silicon Crystal is increased, the Valence electrons within the material become agitated and some of them Will occasionally break away bonds. from the Covalent bonds .
- Therefore, a small number of electrons will be free to drift from one atom to the next in a random manner.
- These free. - moving electrons or free electrons are able to support a Small -! amount of electrical current if a voltage is applied to the semiconductor material. In other words sas the temperature of the Semiconductor material increases, material begins to acquire the characteristic of a Conductor.
- For all practical purposes, however, enough heat energy is available even at room temperature to produce a small number of free electrons

which Can Support a small amount of current

- Only when the semiconductor materials are exposed to extremely high temperatures, Can a

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point be reached where they will Conduct current as well ordinary Conductor.

- Under normal Conditions, however, this high temperature usage of semiconductors is never encountered

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