**Semi-conductor**

Name

Institution

Course

Professor

Date

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A semiconductor is a material which has an electrical conductivity value falling between that of a conductor, such as copper, and an insulator, such as glass. Its resistivity falls as its temperature rises. Its conducting properties may be changed in helpful ways such as introducing impurities in crystal structure. When two differently doped regions occur in the same crystal, a semiconductor is constructed. Semi-conductors show a range of different useful properties, such as passing current more easily in one direction than the other, showing variable resistance, and having sensitivity to light or heat. Some examples of semi-conductors include; silicon and germanium.

Fermi distribution applies to fermions, particles with half-integer spin which must obey the Pauli exclusion principle. Each type of distribution function has a normalization term multiplying the exponential in the denominator which may be temperature dependent. Electrons are an example of a type of particle called fermion. In addition to their charge and mass, electrons have another essential property called spin. It behaves as if it has some intrinsic angular momentum which causes each electron to have a small magnetic dipole.

A p-type semi-conductor is a semi-conductor created by doping intrinsic semi-conductor with an acceptor impurity. The majority carriers I p-type semi-conductors are holes and electrons are minority carriers in a p-type semi-conductor. In p-type semi-conductor, the hole density is much greater than the electron density. An n-type semi-conductor is an intrinsic semi-conductor doped with phosphorus, arsenic or antimony as an impurity. The majority of charge carriers in n-type semiconductors are electrons while holes are the minority carriers in n-type semiconductor. In the n-type semi-conductor the electron density is much greater than the hole density.

The extrinsic p-type semi-conductor is formed when a trivalent impurity is added to pure semi-conductor in a small amount, and as a result a large number of holes are created in it. This makes holes the majority carriers in p-type semi-conductors. A large number of holes are provided in the semi-conductor material by the addition of trivalent impurities like Gallium and Indium. An n-type semi-conductor is formed when a small amount of pentavalent impurity is added to pure germanium or silicon crystal. The addition of pentavalent impurity produces a large number of free electrons in the host crystal. This makes electrons to be the major carrier in n-type semi-conductors.

A p-n junction is an interface or a boundary between p-type semi-conductor and n-type semi-conductor, inside a semi-conductor. P-n junction in a semi-conductor is created by doping method. The p- side is positive and has excess hole, while n-side is negative with excess electrons. When we use various semi-conductor materials to form p-n junction, there will be a grain boundary that will prevent electros from moving from one side to the other by scattering electrons and holes, which will lead to doping method (He et al ., 2019).

Photo electric effect involves light photons knocking electrons out of a material completely, while photo voltaic mechanism involves photons from a light source knocking electrons only out of their atomic orbitals, but keeping them in the material which allows them to flow freely through the material. Photo electric effect takes place in a cathode ray tube with the participation of a cathode and anode connected via an external circuit while photo voltaic mechanism is observed when two metals are in conjunction with each other in a solution. The kinetic energy of the emitted electrons is important in the current produced by photo electric effect but not important in photo voltaic mechanism.

Photo voltaic cell is a power generation device that does not store current directly while batteries van continuously stores electricity for users to use any time. Photo voltaic cells are only useful during the day or when the weather is sunny, while batteries are useful at any time of the day at any environment provided, they are fully charged. Photo voltaic cells stores power from the main sun while batteries store power from power source battery. Small currents are discharged from photo voltaic cells while large current is discharged from batteries.

Some of the technologies used in improving the efficiency of a photo voltaic cell include; monocrystalline silicon which is also called single-crystal silicon. Its entire volume of the cell is single crystal of silicon. Polycrystalline silicon is another type of technology consisting of multiple small silicon crystals. Thin firm is a device that is designed to convert light energy into electrical energy. Thin firm cells use less semi-conductor material, making them lighter than crystalline silicon cells.

Multi junction cell contains multiple p-n junctions consisting of different semi-conductor materials. Multi junction devices use a high-bandgap top cell to absorb high energy photons while allowing the lower-energy photons to pass through. The use of multiple semiconducting materials allows the absorbance of a large range of wavelengths, improving the cell’s sunlight to electrical energy conversion efficiency. Due to the presence of two junctions, more power is produced resulting to high efficiency.

Shockley-quesser limit is the maximum theoretical efficiency of a solar cell using a single p-n junction to collect power from the cell where the only mechanism is radioactive combination in the solar cell. Sockley-queisser limit is calculated by examining the amount of electrical energy that is extracted per photon of incoming sunlight. There some assumptions associated with the Shockley- queisser limit that restricts its general application to all types of solar cells. Some of the assumptions include; one semi-conductor material per solar cell, one p-n junction per solar cell and all energy is converted to heat from photons greater than the band gap.

When the light reaches the p-n junction, the light photons enter the junction through a very thin p-type layer. The light energy in form of photons, supplies sufficient energy to the p-n type junction to create a number of electron-holes pairs. The incident light breaks the thermal equilibrium condition of the junction. This separation of the electron-hole pair is as result of the action of the electric field in the space charge region. Through providing external circuit between the p-type and n-type semi-conductor can initiate movement of electrons from the positive side to the negative side. 

 

Voltage of a single photovoltaic cell is 0.5 volts with low output power, so connecting a number of these cells together will be a system of 12 volts or 24 volts. There is a peak point in the photo voltaic panels called maximum power point. Some of the characteristics of solar power are renewable, solar panels produce electricity by transforming the continuous flow of energy from the sun to electricity. No harmful emissions are released to the air when electricity is produced in the solar panels (Yuan et al., 2020).

**reference**

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