Review on Solar Energy Generation

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Abstract-*The main purpose of this paper is to very deeply understanding the phenomenon of the working of the solar cell. We are here to discuss about the component and factor used in the solar cell very deeply and step by step and how can we modify the circuit of a solar cell to increase its efficiency and the power output with some basic and fundamental changes. We are discussing here the p-V effect with its all consequences and the semiconductor that can be used to built the solar plate or cell and the various method of doping to enhance the efficiency of the solar cell. Doping is the main factor that can enhanced the efficiency of the solar cell because of these doping the atomic structure of the Semiconductor is varies and give different output in different manner. With the help of doping we can enhance the speed and quantity of the electron transfer that effect directly to the flow of the electricity.Working Principal of solar cell*

Keywords:Solar cell, PV cell, Semi-conductor, Thermalisation, Doping.

I. INTRODUCTION

Sun powered cells, additionally called photovoltaic or PV cells, change daylight specifically to power. At the point when daylight strikes the sun based cell, electrons are thumped free. They push toward the treated front surface. An electron unevenness is made between the front and back. At the point when the two surfaces are joined by a connector, similar to a wire, a current of power goes between the negative and positive sides.

The working standard of sunlight based cells depends on the photovoltaic impact, i.e. the age of a potential distinction at the intersection of two unique materials in light of electromagnetic radiation. The photovoltaic impact is firmly identified with the photoelectric impact, where electrons are produced from a material that has ingested light with a recurrence over a material-subordinate edge recurrence. In 1905, Albert Einstein comprehended that this impact can be clarified by expecting that the light comprises of all around defined vitality quanta, called photons. The vitality of such a photon is given by

$$E = h\nu$$

Where, h is Planck's steady and ν is the recurrence of the light.

II. BASIC SEMICONDUCTOR PHYSICS

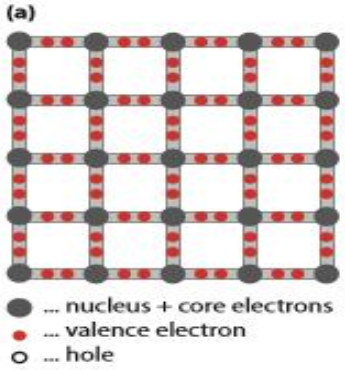
The primary fruitful sun oriented cell was produced using crystalline silicon (c-Si), which still is by a wide margin the most generally utilized PV material. In this manner we should utilize c-Si for instance to clarify the ideas of semiconductor material science that are important to sun oriented cell operation. This talk will give us an essential comprehension of how sunlight based cells in light of other semiconductor materials work. The focal semiconductor parameters that decide the plan and execution of a sun powered cell are:

1. Convergences of doping particles, which can be of two distinct sorts: giver molecules, which give free electrons or acceptor iotas, which acknowledge electrons. The convergences of benefactor and acceptor particles are indicated by ND and NA, individually, and decide the width of the space-charge locale of an intersection.

2. The versatility μ and the dissemination coefficient D of charge bearers is utilized to describe the vehicle of transporters transport because of float and dispersion, separately.

3. The lifetime τ and the dissemination length L of the overabundance bearers portray the recombination age forms.

4. The band hole vitality E.g., and the complex refractive list n−ik, where k is connected to the ingestion coefficient α, describe the capacity of a semiconductor to assimilate electromagnetic radiation.



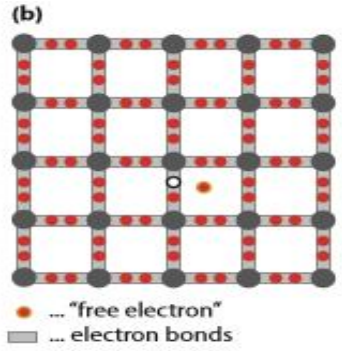


Figure-1: The bonding model of c-Si. (a) No bonds are broken. (b) A bond between two Si atoms is broken resulting in a free electron and hole.

III. GENERATION OF CHARGE CARRIERS DUE TO THE ABSORPTION OF PHOTON-SINTHES MATERIALS THAT FORM A JUNCTION

Absorption of a photon in a material means that its energy is used to excite an electron from an initial energy level Ei to a higher energy level Ef, as shown in Figure 1. Photons can only be absorbed if electron energy levels Ei and Ef are present so that their difference equals to the photon energy, hν = Ef − Ei. In an ideal semiconductor electrons can populate energy levels below the so-called valence band edge, EV, and above the so called conduction band edge, EC. Between those two bands no allowed energy states exist, which could be populated by electrons. Hence, this energy difference is called the band gap, E.g. = EC −EV. If a photon with an energy smaller than E.g. reaches an ideal semiconductor, it will not be absorbed but will traverse the material without interaction. In a real semiconductor, the valence and conduction bands are not flat, but vary depending on the so-called k-vector that describes the crystal momentum of the semiconductor. If the maximum of the valence band and the minimum of the conduction band occur at the same k-vector, an electron can be excited from the valence to the conduction band without a change in the crystal momentum. Such a semiconductor is called a direct band gap material. If the electron cannot be excited without changing the crystal momentum, we speak of an indirect band gap material. The absorption coefficient in an direct band gap material is much higher than in an indirect band gap material, thus the absorber can be much thinner . If an electron is excited from Ei to Ef, a void is created at Ei. This void behaves like a particle with a positive elementary charge and is called a hole. The absorption of a photon therefore leads to the creation of an electron-hole pair, as illustrated in Figure 1. The radiative energy of the photon is converted to the chemical energy of the electron-hole pair. The maximal conversion efficiency from radiative energy to chemical energy is limited by thermodynamics. This thermodynamic limit lies in between 67% for non-concentrated sunlight and 86% for fully concentrated sunlight.

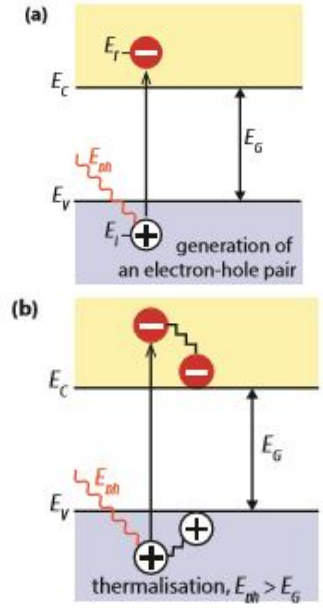


Figure-2: Illustrating the absorption of photon on a semiconductor with band gap

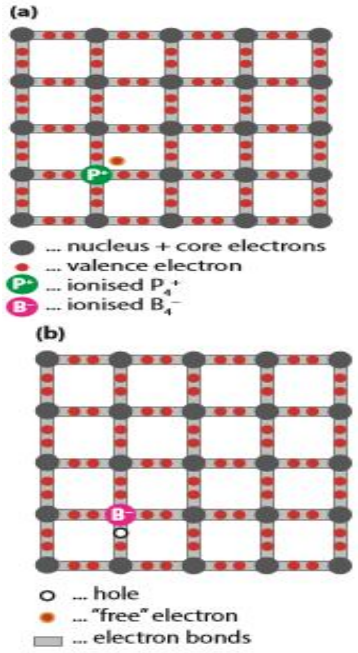


Figure-3: The doping process illustrated in using the bonding model

The concentrations of electrons and holes in c-Si can be manipulated by doping. Doping of silicon means that atoms of other elements substitute Si atoms in the crystal lattice. The substitution has to be carried out by atoms with three or five valence electrons, respectively. The most used elements to dope c-Si are boron (B) and phosphorus (P), with atomic numbers of 5 and 15, respectively. The process of doping action can best be understood with the aid of the bonding model and is illustrated in .When introducing phosphorus

atom into the c-Si lattice, four of the five phosphorus atom valence electrons will readily form bonds with the four neighbouring Si atoms. The fifth valence electron cannot take part in forming a bond and becomes rather weakly bound to the phosphorus atom. It is easily liberated from the phosphorus atom by absorbing the thermal energy, which is available in the c-Si lattice at room temperature. Once free, the electron can move throughout the lattice. In this way the phosphorus atom that substitutes a Si atom in the lattice "donates" a free (mobile) electron into the c-Si lattice. The impurity atoms that enhance the concentration of electrons are called donors. We denote the concentration of donors by ND. An atom with three valence electrons such as boron cannot form all bonds with four neighbouring Si atoms when it substitutes a Si atom in the lattice. However, it can readily "accept" an electron from a nearby Si-Si bond. A thermal energy that the c-Si lattice contains at room temperature is sufficient to enable an electron from a nearby Si-Si bond to attach itself to the boron atom and complete the bonding to the four Si neighbours. In this process a hole is created that can move around the lattice. The impurity atoms that enhance the concentration of holes are called acceptors. We denote the concentration of acceptors by NA.

IV. SUBSEQUENT SEPARATION OF THE PHOTO-GENERATED CHARGE CARRIERS IN THE JUNCTION.

Usually, the electron-hole pair will recombine, i.e. the electron will fall back to the initial energy level as illustrated in Figure: 2. The energy will then be released either as photon (radiative recombination) or transferred to other electrons or holes or lattice vibrations (non radiative recombination). If one wants to use the energy stored in the electron-hole pair for performing work in an external circuit, semi -permeable membranes must be present on both sides of the absorber, such that electrons only can flow out through one membrane and holes only can flow out through the other membrane as illustrated Figure: 2. In most solar cells, these membranes are formed by n- and p-type materials.

A solar cell has to be designed such that the electrons and holes can reach the membranes before they recombine, i.e. the time it requires the charge carriers to reach the membranes must be shorter than their lifetime. This requirement limits the thickness of the absorber. The maximal energy conversion efficiency of a single junction solar cell is considerably below the thermodynamic limit. This single band gap limit was calculated by Shockley and Queisser in 1961.

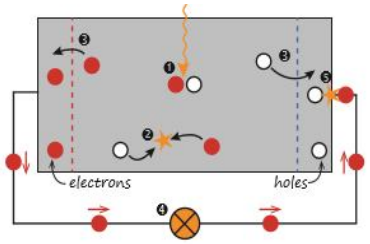


Figure-2: Very simple solar cell model

At Point-1 Absorption of a photon leads to the generation of an electron-hole pair. At Point-2 Usually, the electrons and holes will combine At Point 3 With semi-permeable membranes the electrons and the holes can be separated. At Point -4 The separated electrons can be used to drive an electric circuit. At Point-5 After the electrons passed through the circuit, they will recombine with holes.

V. LOSS MECHANISMS

The two most important loss mechanisms in single band gap solar cells are the inability to convert photons with energies below the band gap to electricity and thermalisation of photon energies exceeding the band gap, as illustrated in Figure: 1 (b). These two mechanisms alone amount to the loss of about half the incident solar energy in the conversion process.

VI. CONCLUSION

We made all these review toward the solar energy in different manner with the specialized view of the doping because of these doping the semiconductor should react in the different manner. Different type of doping differently effect the efficiency of the solar cell . So the doping requires vary amount of the research on it to developed the efficiency of the solar cell. Various type of the doping are already available but the various type of the doping should be developed toward research on them.

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