Solar cell experiment

Solar Cells are used to convert available light into electrical energy. They do this without the use of chemical reactions. This conversion process is based on the work done by a French physicist named Alexander Becquerel in 1839. He discovered the photoelectric effect which describes the release of positive and negative charge carriers in a solid state when light hits its surface. He found, when experimenting with an electrolytic cell made up of two metal electrodes, that some materials would produce small amounts of current when exposed to light.

Fifty years later a scientist named Charles Fritts created the first real solar cell using junctions by coating the semiconductor with a nearly transparent layer of gold. A semiconductor is a material such as silicon or germanium, where the material has properties which fall between conductors and insulators. However the efficiency of this conversion of light to electricity was less than 1 percent. Next in 1930 a semiconductor was made using copper oxide, yet the efficiency of the conversion was still less than 1 percent. This was overcome in 1954 when silicon was used for the semiconductor and the efficiency was increased to 6 percent. Then by 1989 the use of a device which concentrated light onto the cell surface using a lens, increased the efficiency to 37 percent.

This was because of the increased intensity and collected energy on the cell surface. How a Solar cell worksSemiconductors become conductors when given heat or energy, but are insulators at low temperatures. Over 95% of the semiconductors in the world are made from silicon. This is due to the fact that it is the second most abundant element in the earth’s crust. Therefore it is available in large quantities.

To make a solar cell the semiconductor must be doped or contaminated. Doping is intentionally adding chemical elements, which will obtain an excess of positive charge carriers (P-type semi conducting layer) or negative charge carriers (N-type semi conducting layer) from the semiconductor material. If two differently contaminated semiconductor layers are put together then a P-N junction forms on the boundary of the layers. There are two electrical contact layers, which allow electric current to flow in and out of the cell. The electrical contact layer at the top the top of the cell where the light enters is made of a good conductor, for example a metal.

The bottom contact layer must be a very good conductor and is always made of metal. Solar cells are photovoltaic cells; this means that they convert light into electricity. Photovoltaic cells are made of semiconductors. For example silicon, this is the most commonly used. When a photon of light hits the cells some of it is absorbed and so the energy from the light is absorbed into the semiconductor. This energy knocks an electron free, allowing it to move freely.

The photovoltaic cell has electric fields to make the electrons freed to flow in a certain direction. Metal contacts are placed on the top and bottom of the cell which draws the current off for use. Read what happenswhen atoms share electronsSilicon is has 14 electrons, meaning that its outer shell has only 4 electrons in and is half full. Therefore the silicon shares electrons with 4 other silicon atoms. This makes a crystalline structure.

However this is poor for conducting because it has no free electrons. This means that the silicon must be modified before using it in the solar cell. A silicon semiconductor contains impurities. When impurities are added to silicon, such as phosphorus, it makes the material a much better conductor. This is because the phosphorus has five electrons in its outer shell and not four. This means although the phosphorous still bonds with its neighbouring silicon atoms, there is one free electron which doesn't form part of the bond.

This means when energy is added that it is much easier to knock free a phosphorus electron because it was not bonded. This means that a lot more electrons break free than in pure silicon. These electrons can carry charge and are called free carriers. Making the silicon impure is called doping. When the silicon is doped with phosphorus, it becomes N-type. This means that it is negative because it has more electrons.

When silicon is doped with boron, which has only 3 electrons in its outer shell it forms the P-type junction (positive). There is a hole for each absence of an electron, which makes the silicon positive. When the two P and N-type silicon are added together they mix and form a barrier at the junction between the two. This makes it difficult for electrons on the N-side to cross to the P-side. This makes equilibrium at the junction, with an electric field separating both sides. The electric field allows electrons to flow from the P-side to the N-side but not in the opposite direction.

It allows the current to only flow in one direction, acting as a diode.(The electrons can only travel from p-type to n-type)Now when a light photon hits the cell with enough energy it will usually free an electron and a hole. If this occurs near the electric field the field will send the electron to the N-side and the hole to the P-side. This causes the neutrality to be disrupted and now electrons will flow back to the P-side, after being sent to the N-side, to unite with the holes. This will cause a current, and the cells electric field causes a voltage.

A solar cell is only able to absorb around 15% of the suns light energy, because the energy is not monochromatic, but of all different wavelengths. Some wavelengths will not have enough energy to knock free electrons. Therefore the energy just passes through. Some wavelengths have too much energy and only some is used to knock free electrons and the rest is lost. This accounts for 70% of the energy loss. Other reasons for energy loss are the silicon’s high internal resistance.

Some 5% of losses are saved by coating the semiconductor in antireflective coating. This is because silicon is shiny and therefore some energy would be lost due to it being reflected of the surface. This is stopped by the coating. AimTo investigate the factors which influence the output from a solar cell.

I will choose the variables of how much voltage is supplied, and also the distance of the lamp to the solar cell. I have chosen these variables because I believe these the variables which will have the greatest effect upon the experiment, and will give us the best results. The results we achieve should hopefully be corresponding and systematic results, which will give us a linear graph. Hypothesis1) I predict that as the distance between the lamp and the solar cell increases the output of the solar cell will decrease. 2) Secondly I believe that as the power is increased the output of the solar cell will increaseExplanation of Hypothesis1) The same amount of energy from the lamp will be given out throughout investigating this variable.

However as the distance is increased between the lamp and the solar cell, the light intensity will decrease. This is because the concentration of light becomes more dilute the further away it moves from the lamp. In a small area around the lamp the light will be concentrated and therefore give more energy to the solar cell. As the light energy moves further out it travels fills a greater area meaning that less energy reaches the solar cell as more the energy is spread throughout the surroundings.