Can Electricity be Made from Sunlight?

Overview: We'll get some hands-on experience with a real solar cell to answer the question of today's lab.

What to Learn: This lab will help you learn how and where most of our energy comes from - the sun!

Materials

- Silicon solar cell
- Two wires with alligator clips on each end of the wires
- Earphone or headset for a portable radio
- AA-size battery

Lab Time

1. Examine the metal shaft on the part of the earphone or headset that is inserted into a portable radio. You will notice that just above the tip of the shaft there is a plastic spacer. Clip on one of the wires below this spacer. Then clip on the other wire above this spacer.
2. To test that the wires are properly connected to the earphone or headset, take the unconnected ends of the two wires and touch them to an AA-size battery. One wire should touch the positive end of the battery, while the other should touch the negative end of the battery. Place the earphone or headset to your ear. If your connections are made correctly, you should hear a crackling sound in the earphone or headset. If you do not hear a crackling sound, check your connections carefully.
3. Take the earphone or headset, with wires attached, and the solar cell outside into the sunshine. Ask a friend to join you. Your friend can help you hold the solar cell.
4. Place the earphone or headset to your ear. Ask your friend to hold one of the flat sides of the solar cell facing the sun. The two flat sides of the solar cell are different. In this experiment, you will determine which flat side must face the sun for the cell to generate electricity.
5. While your friend holds one of the flat sides of the solar cell facing· the sun, you hold one of the alligator clips on the side of the cell facing the sun. At the same time, touch the other alligator clip to the opposite side of the cell. As you hold the alligator clips to the cell, avoid blocking the sunlight striking the solar cell.
6. Ask your friend to turn the solar cell over so that the side that was not facing the sun before now does. Touch a clip to the two sides of the solar cell.
7. After determining which side of the solar cell needs to face the sun to make a crackling sound in your earphone or headset, ask your friend to hold that side toward the sun. Touch the two alligator clips to each side of the solar cell. Move the alligator clip touching the bottom of the solar cell around the bottom side to keep making the crackling sound in your earphone or headset. Next, block the sunlight striking the solar cell.
8. Record your observations on the worksheet below.

Sun Energy Observations

1. Describe the difference between the two sides of the solar cell. Which side must be facing the sun to cause crackling in the earphone or headset when you touch the clips to the solar cell? What happens to the crackling sound when you block the sunlight from striking the solar cell?

2. When you examine your silicon solar cell, you will notice that the two flat sides of the cell are different. One side should have a silvery color, while the other side should appear dark. You should determine in this experiment that one side of the solar cell needs to face the sun for you to hear a strong crackling sound in the earphone or headset. The crackling sound is electricity, generated by the solar cell, passing through the earphone or headset. Can you hear it?

Reading

The solar cell you are using for this experiment is made from the element silicon. Silicon solar cells consist of two thin wafers of treated silicon that are sandwiched together. The treated silicon is made by first melting extremely pure silicon in a special furnace. Tiny amounts of other elements are added which produce either a small positive or negative electrical charge.

Usually, boron is added to produce a positive charge and phosphorus is added to produce a negative charge. The addition of these other elements to pure silicon to produce an electrical charge is called doping.

After being doped, the molten silicon is allowed to cool. As it cools, the doped silicon grows into a large crystal from which very thin wafers are cut. A wafer cut from a large crystal of silicon doped with boron is called the positive or P-layer because it has a positive charge. A wafer cut from a large crystal of silicon doped with phosphorous is called the negative or N-layer.

To make a solar cell, a positive wafer (called the P-layer) and a negative wafer (called the N-layer) are sandwiched together. This causes the P-layer to develop a slight positive charge, and the N-layer to develop a slight negative charge. The solar cell is connected to a circuit by wires leading from the P-layer and the N-layer. When light falls on the surface of the cell, electrons are made to move from one layer to the other. Thus, a current of electricity flows through the circuit.

The first solar cells provided electrical power for space satellites and vehicles. Satellites and space vehicles are still big users of solar cells. Solar cells are now being used to provide electrical power for calculators and similar devices, weather stations in remote areas, oil-drilling platforms, and remote communication relay stations.

The best silicon cells convert only a small portion of the sunlight striking the cells into electricity. The efficiency of solar cells is about 15 percent. This means that 15 percent of the sunlight that strikes the cell is converted into electrical energy. The sunlight that is not converted into electricity either reflects off the surface of the cell or is converted into heat energy.

Exercises Answer the questions below:

1. If two electrodes become activated by a current, which way will the ions flow?
    a. To the electrode of the same charge
    b. To the electrode of the opposite charge
    c. None of the above
2. What type of energy source is the solar panel most closely related to?
    a. Biofuel
    b. Chemical battery
    c. Nuclear reactor
    d. Plant energy
3. The solar cell's efficiency is not very good. How much of its energy is converted into electricity?
    a. 50 %
    b. 80%
    c. 30%
    d. Less than all of these
4. Name one common use for solar cells:

Answers to Exercises: Can Electricity Be Made From Sunlight?

1. If two electrodes become activated by a current, which way will the ions flow? (to the opposite-charged electrode)
2. What type of energy source is the solar panel most closely related to? (battery)
3. The solar cell's efficiency is not very good. How much of its energy is converted into electricity? (15 percent)
4. Name one common use for solar cells: (satellites, home power, power plants, road signs, monitoring stations, calculators, etc.)