Region II: Central Massachusetts

AbdurRahmaan Abdul-Basser: Alhuda Academy, Worcester

CleanTech*: Photovoltaic Cells and the Visible Light Spectrum*

About Me

My name is AbdurRahmaan Yahya Abdul-Basser and I am in the sixth grade at Alhuda Academy. I like being called Yahya. Some things I like to do are writing, drawing, video games, reading and playing soccer and basketball. I am about to move from my home in Framingham to NYC. I live with my mom, dad and my brother and sister. My favorite school subjects are writing, science, computer science, math and Phys. Ed.

I picked this project because I am interested in how solar cells work. I wanted to know how sunlight is converted to energy in a solar cell. I also wanted to see if sunlight is the only kind of light that works in solar cells. I was curious about why solar cells have silicon components. This experiment also combines a second interest of mine, light.

My Project

My project is about increasing the efficiency of a photovoltaic cell, more commonly known as a solar cell. Photovoltaic cells harness the sun's power. Photovoltaic panels contain many of these cells.

The Sun produces two kinds of energy, heat and light. The light energy is used to power photovoltaic cells. Solar energy is an effective alternative energy source because it does not produce pollution that can be harmful to life and damaging to the environment, and it is free to use. Solar cells can be useful in places like mountains and deserts because they are cheaper than building long power lines.

Photovoltaic cells are made from silicon or geranium semiconductors. Photovoltaic panels do not only work with sunlight. They can produce voltage from other sources of visible light. When they are hit by photons from sunlight, the electrons trapped inside are released. After the photons have knocked the

electron from one silicon cell the electrons move to another cell gaining more and more electrons. This process is called the photoelectric process.

Visible light in general is composed of seven different colors, each with their own wavelength. Visible light can have different concentrations of colors from the spectrum. The wavelengths follow the order of ROYGBIV (Red, Orange, Yellow, Green, Blue, Indigo and Violet), with red being the longest and violet the shortest. Albert Einstein received a Nobel Prize for discovering that the power of the photons depends on the wavelength of the light hitting the object.

Only 30% of all light that falls on modern photovoltaic cells is turned into actual electrical energy. I wanted to investigate whether changing the light source or the light color would increase the efficiency. I used a 6 volt photovoltaic cell, a digital multimeter, a box, sunlight, a desk lamp, fluorescent and incandescent bulbs, and 6 color filters. I used filters to block out certain light wavelengths. I graphed the voltage produced by my photovoltaic cell under the different light conditions.

For sunlight, the average was 6.4V, incandescent light 5.8V and fluorescent lights 3.5 volts. This information is useful because it means that when there is little or no sunlight, incandescent light sources can still power photovoltaic cells. This means that when we use artificial lights we can recycle some of that light energy.

When I used the filters with all the light sources, the voltage decreased-- but yellow had the least effect on the voltage. Green had the greatest effect on the voltage.

For the filters, the order of voltage production from greatest to least was yellow, magenta, red, cyan, blue and green. According to my filter transmission charts, the optimal light range for my cell is 500-750 nanometers in wavelength. In the future, this information could be used to make photovoltaic cells more efficient. Changing aspects of light like wavelength and frequency might help to increase our chance of a green future with photovoltaic panels.