CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
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Project Number
S0914

Project Title
Light, Color, and Electricity

Abstract

Objectives/Goals
The objective is to examine the effect of light color and intensity on the electricity output of photovoltaic (PV) cells. Since short wavelength light is more energetic than long wavelength light, my hypothesis is that light with shorter wavelengths would allow a PV cell to produce more electricity than light with longer wavelengths.

Methods/Materials
My first experiment was to determine the effect of sunlight intensity on the electricity output of two PV cells at noon. To increase intensity of light, a satellite dish was covered with foil and a PV cell was placed at its focal point. Its electricity output was compared to a PV cell directly facing the sun. The second experiment was to determine how color affected electricity production. I used a projector to project seven colored slides with wavelengths ranging from ~400 nm to 700 nm at the PV cell and light meter, and changed the distance between the PV cell and the projector from 3m to 0.5m in order to control the light intensity from ~50 to 15,450 lux.

Results
The satellite dish doubled the intensity of the light on the PV cell, up to 486,000 lux compared to 224,000 lux on the PV cell directly facing the sun. There is a correlation between light intensity and current produced by the PV cell, as current production also doubled in the PV cell facing the dish. Different colors of light did not have any appreciable effect on current production. All colors of light tested in the second experiment produced ~0.7 microamps/lux.

Conclusions/Discussion
Light intensity has a greater effect on current production than color. The photoelectric effect says electrons are emitted after absorbing light energy. If a photon can excite an electron, a brighter light containing more photons can generate more current. Color affects PV cell function by determining if electrons will be freed. An energetic photon gives an electron more energy, but energy greater than that needed to free the electron is wasted as heat. The number of electrons in the circuit determines current and the composition of the PV cell determines maximum voltage. Silicon cells are sensitive to the entire spectrum of visible light, which is only a tiny portion of the electromagnetic spectrum. Light intensity affects current, and voltage is determined by the composition of the solar cell.

Summary Statement
I studied the principles of the photoelectric effect and designed experiments to examine the effect of light color and intensity on the electricity output of photovoltaic cells.

Help Received
Mrs. Usher, my science teacher, provided guidance and feedback to my project report. My father helped assemble the satellite dish light concentrator, borrowed the projector, and printed the one-page poster display. My mother took the pictures as I did the experiments and borrowed books from libraries