CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
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Project Number
J0218

Project Title
The Photovoltaic Effect

Abstract

Objectives/Goals
My task in this project was to investigate how the frequency (color) of light affects the output of a solar panel. Based on my background research, my hypothesis was that the colors of light with higher frequencies would result in higher electrical power at the output of the solar panel.

Methods/Materials
The order from highest to least frequency corresponded to the following colors: sunlight, violet, blue, green, yellow, orange, and red. During the experiment, I used a monocrystalline solar panel and color filters to filter sunlight and change the independent variable color or frequency of light. I mounted the solar panel on a base made of Lego bricks to keep the angle towards the sun rays the same. The dependent variables, the output current and voltage, I measured with a multimeter. Then, I found the output electrical power by multiplying these two variables.

Results
The experiment results were different from what I had expected. Sunlight did result in the highest output power. However, colors like yellow and orange produced more electricity than darker colors.

Conclusions/Discussion
After analyzing the data, I came to the conclusion that the frequency of light shining on a solar panel does affect its output. My hypothesis was mainly based on a formula that showed the relationship between frequency and light energy. I assumed that the higher energy the photons had the more electrons would be released. I overlooked the fact that a single photon can only knock off a single electron, therefore how energized the light is doesn't necessary mean more electrons will be freed. I should have also taken into consideration that solar cells are made of various materials with different band gaps. A band gap is the energy needed to knock off an electron from its position and allow it to become part of the electrical current. The colors that have photon energies at the band gap will be the most efficient ones. Sunlight, having the broadest spectrum, has the highest number of photons within the band gap of the solar cell, therefore generates the highest power. For my monocrystalline solar panel the colors that worked best, after unfiltered sunlight, were yellow, orange, and red. The rest of the colors I tested had higher frequencies but generated lower output power.

Summary Statement
My project was based on finding out which frequency or color of light worked the best or in other words resulted in highest output power of a solar panel.

Help Received
My mom for helping with my online research and teaching me how to use the multimeter. My dad for assisting me during my experiment to complete the trials fast so the intensity of light wouldn't change much. Last but not least, my science teacher Mr. Cady for his valuable guidance.