CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)

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Project Number

S0806

Project Title

It's a Wonderful Light: An Experimental Study of a Fluorescent Solar Concentrator

Abstract

Objectives/Goals

This project examines the viability of one alternative form of solar concentration, the Fluorescent Solar Concentrator (FSC), as a more efficient and inexpensive method of photovoltaic (PV) solar power production. The potential advantages of this concentrator system are many, including decreased cost per unit energy output, small dependence on the angle with respect to the sun, and reduced heat dispersion problems in silicon (Si) PV solar cells.

Methods/Materials

I constructed a FSC by coupling a Si PV cell to the edge of each of various sheets of fluorescent acrylic. I conducted several experiments to examine the effect of different dyes, thicknesses, geometrical configurations, and other factors on the power output of the FSC system. I compared the data with a mathematical model, which was used to explore extrapolations of the FSC in geometry and dye performance. Finally, I examined the economic feasibility of the FSC using extrapolations of the model. I also conducted experiments to compare the photovoltaic power generation of the FSC with two geometrical optics concentration methods (a mirror array and a Winston cone).

Conclusions/Discussion

In comparing the FSC with other concentrators, the FSC is found to be a superior concentrator for Si PV cells. The FSC used in this project achieved concentration factors of 4 and material costs about ½-2/3 compared to a conventional bare Si PV cell system. With better dyes and improved plate mediums, the cost-benefit ratio could become much more favorable, allowing the FSC to become an important technology for a future of renewable energy.

Summary Statement

My project investigates an innovative method of solar concentration, taking advantage of the properties of fluorescence and total internal reflection, to reduce the cost and increase the viability of solar electrical generation.

Help Received

Mother helped proofread writeup; Father acted as mentor