CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

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Project Number

36493

Project Title

Solar Energy Concentrator Integrated into Windows: Smart Solar Energy Conversion

Abstract

Objectives/Goals

Converting solar energy into electricity has become very common. Modern buildings have many windows, which receive a lot of sun light. Is it possible to engineer an energy converter within windows? Is it possible to use large window areas to concentrate solar energy and direct it towards the solar cells embedded in the window sides? Our objective is to make a solar energy concentrator by coating the glass with a luminescent compound that can absorb and emit photons. We can use layers of glass to restrict the spatial region in which the light can propagate through. Energy concentration efficiency for luminescent solar concentrators is predicted to depend on the nature of luminescent compound, mainly the absorption and emission spectra of the luminescent compound, as well as its concentration and amount.

Methods/Materials

In our engineered window, the top and bottom layers were glass and the middle layer was a polymeric layer with a luminescent compound. A piece of glass was coated with the mixture of polymer and luminescent compound. Another piece of glass was placed onto the luminescent coating and solar cell was attached to the side of the glass structure. A lamp was used to illuminate the sample. The light irradiated by the luminescent compound generated the current in the photovoltaic cells. We measured this current using a voltmeter. We studied the effect of the nature of luminescent compound, concentration, total amount, and the nature of the polymers on the electric current generated.

Results

We were able to concentrate the light re-emitted within glass layers and guide it towards the sides of the glass. Samples with fluorescent pigment generated higher voltages compared to glass samples with no pigment. This increase in voltage became larger with the increase in sample thickness and concentration of the pigment. Blue Pigment was most effective in generating the electrical current. Purple Pigment was least effective in generating additional voltage signal.

Conclusions/Discussion

It was possible to integrate glass window with a solar panel. Electrical current generated in sample increases with increase in luminescent layer thickness and with increase in pigment concentration. Stronger visual luminescence of the pigment corresponded to higher voltage boost.

Summary Statement

It is possible to create a power-generating window by using a luminescent layer to capture and redirect solar energy towards solar panels located at the edge on the window.

Help Received

I designed and built the solar energy concentrator by myself. I got help in understanding the physics of waveguides from Dr. K. Mikhaylich in the Applied Materials, Corp.