CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

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Project Number

S1122

Project Title

A New Solar Panel Design: Producing Electricity Day and Night Using Photovoltaic, Seebeck, and Thermal Elements

Abstract

Objectives/Goals

Over the past 3 years, I have conducted 3 experiments to improve the efficiency of photovoltaic cells, and I realized that they have 3 major flaws: they do not generate electricity at night, get less efficient as they heat up, and do not use thermal energy. Instead of trying different methods to prevent these problems, this year, I am trying to use these problems to my advantage.

Methods/Materials

I constructed a three layer device with a photovoltaic cell on top, Seebeck elements in the middle, and a water tank with a small pump on the bottom.

1.At daytime, the sun heats up the photovoltaic cell, and cold water runs through the tank, creating a temperature gradient for the Seebeck elements to generate electricity.

2.The cold water in the tank also helps to cool down the photovoltaic cell, making it more efficient.

3.Throughout the day, the water then goes through a solar water heater, and the hot water is then stored in an insulated tank.

4.At night, the photovoltaic cell cools down, and the hot water made during the day will be pumped back through the tank, creating an inverse temperature gradient for the Seebeck elements to generate electricity.

I tested my device using a Vernier Stream analog to digital converter. I took measurements every 30 seconds for multiple 24 hour blocks using Logger Lite on my computer.

Results

At 12-3 PM in the beginning, the Seebeck elements steadily produced 10-12 milliwatts, because of the temperature gradient between the hot solar panel and the cold water. By 4 PM it dropped to 4 milliwatts. At night (8 PM- 8 AM), it produced 0.5-4 milliwatts because of the opposite temperature gradient. In the morning (10 AM-2PM), it produced 7.5-11 milliwatts.

Conclusions/Discussion

My prototype succeeded in my overall goal of using three major limitations of a photovoltaic cell to my advantage: decreasing efficiency due to heating up, lack of energy during the nighttime, and not using thermal energy. My new solar panel design generated electricity both during the day and night because it used visible light in the day, and stored thermal energy in the day, releasing the thermal energy during the night and generate electricity. This could have a big impact because solar panels are getting more popular and are a good way to produce electricity without harming the environment, and improving them would help many people.

Summary Statement

I designed a three component solar panel consisting of photovoltaic, Seebeck, and thermal elements, that generates electricity both day and night using visible light and thermal energy.

Help Received

My industrial tech teacher Mr. Booth at JLS (my former middle school) let me use his machine shop and taught me soldering and brazing techniques to build my water tank. My Dad helped with safety, getting materials, and advised me when I ran into problems.