CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

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Project Number

S1707

Project Title

Improving Solar Panel Efficiency with Thermoelectric Generator Units Using the Seebeck and Peltier Effects

Abstract

Objectives

Although solar is one of the primary sources of clean energy, current photovoltaic (PV) technology has an efficiency of only 15-20%, and temperature is one of the main factors affecting efficiency. As the ambient temperature increases, the power output of a PV cell decreases. The objectives of this study were two-fold: (1) to investigate the ability to convert the wasted heat energy from a solar panel into usable energy through the addition of thermoelectric generator units (Seebeck Effect), (2) to try and increase power output by using the thermoelectric generator units in the opposite orientation to decrease the solar panel temperature (Peltier Effect).

Methods

Thermoelectric generators (TEG) create voltage when there is a temperature differential between the two sides of the device; this is known as the Seebeck Effect. Conversely, when voltage is applied to the same device, a cooling effect occurs through heat transfer in the TEG (Peltier Effect). A small solar panel was tested in a closed system so that temperature readings could be obtained above and below the panel. To test using the Seebeck Effect, TEG units were attached to the underside of the solar panel; temperature, voltage, and current measurements were recorded when the panel was exposed to a light source. To test the Peltier Effect, the same TEG units were placed in the opposite orientation on the underside of the panel. A 9V battery was used as the power source; temperature, voltage, and current measurements were recorded.

Results

The results from the Seebeck Effect tests confirmed that, the excess heat could be converted to usable power. Although the overall amount of power generated was small, there was a significant increase in power as the temperature increased. With the Peltier Effect configuration, the goal was to increase solar panel efficiency by decreasing the temperature underneath the panel using the TEG. The peak temperature under the panel using the Peltier Effect was significantly lower (nearly 23°C). Unfortunately, a corresponding increase in power production was not observed.

Conclusions

Although the study did show that the excess heat could be converted to power using the Seebeck Effect, and the temperature under the panel could be significantly decreased using the Peltier method, due to the constraints of the system, the results were not as profound as hoped. The goal is to improve the overall results by creating a hybrid system which can take advantage of environmental conditions resulting in the increase of the TEG temperature differential.

Summary Statement

This project investigated the ability to improve solar panel efficiency by using thermoelectric generator units to increase power production using the Seebeck and Peltier Effects.

Help Received

None