CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Max Freedman

Project Number

J0205

Project Title

Get It While It's Hot: Harvesting Waste Heat with Peltier Devices

Abstract

Objectives/Goals

Data centers and supercomputers generate a large amount of excess heat, which is wasted into the environment. This waste heat could be harvested, and utilizing thermoelectric technology, could be transformed into an alternative energy source. I tested a thermoelectric unit that I built with Peltier devices under various conditions to generate electricity.

Methods/Materials

I set up a thermoelectric unit by assembling 8 Peltier devices in series between an aluminum heat sink (cold side) and a copper panel (hot side). The thermoelectric unit was tested under three different temperature conditions to create delta T (deg K). The three conditions are: Hot (cold side exposed to room temp air, hot side heated with heating pad), Cold (cold side submerged in alcohol with dry ice, hot side exposed to room temp air), and Null (cold side exposed to room temp air, hot side exposed to room temp air). Fifty data points were collected for each temperature condition. I analyzed the data by making a scatter graph to show all of the results together on one plot. I color-coded it to show the three conditions. Using a bar graph, I compared hot and cold condition for the same delta T (deg K). The experiment demonstrates the Seebeck-Peltier equation: V(volts) = A(volts/deg K) * Th-Tc (deg K) where (V) voltage is generated by (A) the Seebeck coefficient (or thermoelectric sensitivity V/K) multiplied by the delta of (Th) hot side deg K minus (Tc) cold side deg K .

Results

The data suggests that comparing similar delta T under hot and cold conditions shows (A) the Seebeck Coefficient is constant (not changing) with the different conditions. Both hot and cold conditions generate similar amounts of electricity. When delta T increases, voltage increases. Low delta T generates little voltage.

Conclusions/Discussion

The data suggests that the thermoelectric sensitivity, (A) in the Seebeck/Peltier equation, does not change with different temperature conditions. My findings can be used to help develop industrial applications for Seebeck/Peltier devices.

Summary Statement

The objective of the project is to test a thermoelectric unit under three different conditions to see which is best for generating electricity.

Help Received

John Rible for teaching me electronics, helping me design my thermoelectric unit. Dr. David Bernick UCSC for explaining concepts in physics and abstract review. Joshua Freedman for help with data analysis. Patty Freedman for background research and data recording.