Thermoelectric Generator Powered Tracking Concentrated Photovoltaic System

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The purpose of this experiment was to see if a motorized concentrated tracking photovoltaic system could be created that tracks the sun without utilizing the electricity generated by the photovoltaic cell. A parabolic aluminum primary reflector was paired with a dichroic film covered convex hyperbolic Lexan secondary to collect light for the photovoltaic cell while providing a UV/thermal image of the sun for tracking. Visible light passed through the film to the photovoltaic cell while UV and infrared light was focused on a 2x2 set of thermoelectric generators (TEGs). The output of the TEGs provided power and fed an electronic position sensing circuit to drive azimuth and elevation motors. Water flow was used to increase TEG power output and to improve the photovoltaic efficiency through water cooling. The aluminum concentrator with the Lexan piece and solar cell was mounted to a PVC frame so it could track the sun in both the elevation and azimuth directions. A HOBO data logger and ammeter were used to collect data. Over the course of a test, the water temperature increased by 34°F (18.9°C) producing 39 watts of thermal power. The thermoelectric generators produced 0.6 watts, and both motors only required 0.396 watts, meaning the apparatus successfully tracked the sun without stealing any electric output from the solar cell. It also produced hot water as a byproduct.

Awards Won:

Intel ISEF Best of Category Award of $5,000

Intel Foundation Cultural and Scientific Visit to China Award