CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
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Project Number
J1008

Project Title
V-Groove Solar Cell and Mirror Arrangement for Efficiency Enhancement

Abstract

Objectives/Goals
The objective is to determine if a novel V-groove solar panel using solar cells on one sidewall of the V-grooves and mirrors on the other sidewall can generate electricity more efficiently than a conventional planar solar panel.

Methods/Materials
A V-groove solar panel using solar cells and mirrors and a conventional planar solar panel were designed, assembled, and measured. In the V-groove configuration, solar cells of size 1cm x 1.1cm were attached to one sidewall of the V-grooves and flexible paper mirrors were attached to the opposite sidewall to reflect photons to the solar cells. In the planar solar panel, all solar cells were arranged on the same plane. The V-groove panel used 396 individual solar cells and 22 mirror stripes while the planar panel used 432 cells. Both panels had the same size of 20.5cm x 28.5cm x 2cm and the same light receiving area. Current-voltage characteristics were measured to compare their fill factor and maximum power capability.

Results
Measured fill factor was 0.74 for the V-groove panel and 0.70 for the planar panel, indicating that the V-groove panel had better efficiency. Open circuit voltages and short circuit currents of both panels were measured outdoors for two consecutive days to determine their maximum output power. In average, the maximum power capability of the V-groove panel was 10% higher than that of the planar panel.

Conclusions/Discussion
A V-groove solar panel using solar cells and flexible paper mirrors was demonstrated for the first time. It outperformed a conventional planar panel in terms of fill factor and maximum power capability. The improved performance of the V-groove panel was attributed to enhanced light trapping and reduced internal resistance. Separated measurements on an individual solar cell indicated that the antireflection coating of the solar cells seemed to work better at a slanted angle. The V-groove panel also had lower internal resistance due to less number of solar cells connected in series.

Summary Statement
A V-groove solar panel using solar cells and flexible paper mirrors was demonstrated for the first time and it outperformed a conventional planar solar panel.

Help Received
Mrs. Andrea Acres, my science teacher at Ridgecrest Intermediate School, guided me throughout the entire scientific research project. My parents provided financial support, transportation, and encouragement, and supervised my experimentation. Belps Manufacturing machined solar panel frames.