CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)
Albert C. Chen

Project Number
S1907

Project Title
Effectiveness of Novel Natural Dyes in Dye Sensitized Solar Cells

Abstract

Objectives/Goals
Dye sensitized solar cells are promising for their low cost, ability to work well in low light conditions, and absorption across the visible light spectrum. The objective is to determine the suitability of dyes extracted from rotten blackberry fruit, cranberry fruit, red globe grape peel, and soybean seed coat for use as sensitizers in dye sensitized solar cells (DSSCs) and to determine their relative performances in the solar cells. Dyes were also mixed to test for synergy of the dyes.

Methods/Materials
I made and tested my own solar cells, using ripe blackberry and ruthenium dyes as controls for comparison with literature. The appropriate fruit part was soaked in ethanol and water to make a dye sensitizer solution. A titanium dioxide semiconductor was prepared and spread on conductive glass pieces, then soaked in the prepared dye solutions. A conductive glass counter electrode was sandwiched to the photoanode, and a potassium iodide and iodine electrolyte was injected between the pieces of glass. Absorption spectra of the dyes were found with a UV/vis spectrophotometer, and open circuit voltage and short circuit current were recorded with a multimeter under various lighting setups. There were two trials.

Results
Although the theoretical power outputs were much lower than those reported in literature, the novel red globe grape, cranberry, black soybean, and rotten blackberry dyes were shown to be suitable for use in DSSCs. It was found that some dyes were more effective in low light conditions and others in high light conditions. The ripe blackberry dye outperformed the rotten blackberry dye. While there was no observed synergy overall in either of the mixed dyes, the mixed dye without the soybean dye performed better than the one with the soybean dye. The soybean dye had a different absorption spectrum from the other dyes.

Conclusions/Discussion
Lower theoretical power outputs than those in literature may be attributed to the specific assembly of the solar cells, namely the omission of an expensive platinum counter electrode. There is strong evidence supporting that the soybean dye is of a different class of natural dye than the other ones. Also, changes in chemical composition from the natural rotting process affected performance of the rotten blackberry dye. Finally, similar dyes performed better together than did different dyes.

Summary Statement
Rotten blackberry, cranberry, grape, soybean, and mixed dyes were used as sensitizers in dye sensitized solar cells to determine the effectiveness of the dyes and study their properties.

Help Received
Used lab equipment in Dr. Smith's lab at San Diego State University under the supervision of graduate assistant Patrick Staley; parents helped with poster.