CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Shyamal Buch

Project Number
J0806

Project Title
Live Green or Dye Hard: Analysis of Nanocrystal Dye-sensitized Solar Cells using New Low-Cost Robotic D-SCOPE

Abstract

Objectives/Goals
This project is about solar cells built using nanocrystals sensitized to visible light by plant-extract dyes. The objectives are: (1)To find which dye results in the best power output and fill factor, and (2)To design a new electronic tool to automate measurements of these solar cells. It is hypothesized that Raspberry and Blackberry dyes would provide the best results.

Methods/Materials
24 Dye-sensitized Solar Cells (DSCs) are constructed using 10 different plant-extract dyes, nanocrystals of Titanium Dioxide (TiO2), electrolyte, graphite, and conductive glass slides. The dyes used are: Blueberry, Blackberry, Raspberry, Cranberry, Pomegranate, Cherry, Frozen Blackberry, Beetroot, Red Cabbage, and Spinach. A Control cell is built with no dye.
A new robotic tool ("D-SCOPE") is designed to test these Dye-sensitized Solar Cells. A daylight lamp illuminates the solar cells within a light chamber. Programs are written to automate the process of obtaining characteristic curves of the solar cells. From these curves, the maximum power output and fill factor are derived.

Results
The 3 cells with the highest power output were Raspberry, Blackberry, and Pomegranate DSCs. They also had the best fill factor (46.03%, 43.23%, and 40.67%, respectively). D-SCOPE measurements met the targets for speed, accuracy and repeatability.

Conclusions/Discussion
My hypothesis was partially correct, since Raspberry and Blackberry dyes provided the best and third best power output, respectively. Dye-sensitized Solar Cells can convert abundant solar energy into electrical energy. Compared to silicon solar cells, DSCs cost less, are easier to make, and "green" (better for the environment). The new D-SCOPE tool which I designed enables automated measurements at much lower cost than lab equipment, and can fit student budgets.

Summary Statement
24 Dye-sensitized Solar Cells are built using 10 plant dyes, and their characteristic curves are obtained using a new robotic tool (D-SCOPE) which I designed.

Help Received
My teacher, Ms. Mohler, gave encouragement; Mr. Reinking introduced me to robotics & programming; Mr. Reidy of Hartford Glass provided conductive glass, TiO2 and electrolyte; Dad helped with soldering, sintering, & guidance; Mom & Sister helped with extracting dyes, taking pictures, & board layout.