CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Anish Seshadri

Project Number
31457

Project Title
Dye Sensitized Solar Cells and Everyday Foods

Abstract

Objectives/Goals
The purpose of this experiment is to find less expensive and more efficient organic dyes in everyday foods that can be used to build a solar cell. These easy to build solar cells could in future replace fossil fuels.

Methods/Materials
To create the nanocrystalline solar cell, a suspension of nanometer size particles of titanium dioxide is distributed uniformly on a glass plate which has previously been coated with a thin conductive layer of indium tin-oxide. The TiO2 film is dried and then heated on the glass to form a porous, high surface area TiO2 film. The TiO2 film on the glass plate is soaked with a few drops of natural food dye such as fresh raspberry juice. Many natural dyes can be utilized, but they must possess a chemical group that can attach to the TiO2 surface, and they must have energy levels at the proper position necessary for electron injection and sensitization. A single layer of dye molecules adsorbs to each particle of the TiO2 and acts as an absorber of light. To complete the device, a drop of liquid electrolyte containing potassium tri-iodide is placed on the film to enter into the pores of the film. A counter electrode layer of carbon is placed on top, and the sandwich is illuminated with bright sunlight through the TiO2 side.

Results
I had hypothesized that Anthocyanin-rich foods like blackberries, blueberries, red raspberries, red grapes and red cherries will produce more powerful solar cells than Other Flavonoid-rich foods like tea and fresh parsley when used as dye on titanium dioxide solar cells. The reasoning behind this hypothesis is based on the fact that anthocyanins have the ability to absorb light and convert it into electrons. This ability is not present in other flavonoids. The results prove that my hypothesis was correct.

Conclusions/Discussion
A very important conclusion drawn from this experiment is that the higher the Anthocyanin content of the food dye used for making the dye sensitized solar cell, higher is the average voltage measured between the positive and negative electrodes of the solar cell when exposed to bright sunlight. It should be noted that the efficiency of these solar cells can be greatly improved by improving the nature of the dye as well as using a chemical other than titanium dioxide as a coating on the indium tin-oxide glass.

Summary Statement
While making a dye sensitized solar cell based on Titanium dioxide, this experiment compares the efficiency of solar cells produced when Anthocyanin-rich foods and other flavanoid-rich foods with very low Anthocyanic content are used as dye

Help Received
I would like to acknowledge Ms. Aditi Risbud of the Molecular Foundry, a Department of Energy (DOE) user facility for interdisciplinary research at the nanoscale supported by the DOE office of Science. Ms. Risbud helped me by lending me the Indium tin-oxide coated glass and nanocrystalline Titanium dioxide