CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY

Name(s)

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Project Number

22697

Project Title

A Study of Light-Sensitive Electron Transfer between Anthocyanin Pigments and Nanocrystalline Titanium Dioxide

Abstract

Objectives/Goals

It is predicted that the electron transfer between anthocyanin pigments and nanocrystalline Titanium Dioxide, as measured in dye-sensitized solar cells, will vary with changes in the light source.

Methods/Materials

Anthocyanin solutions were prepared from natural and artificial sources. Each solution was analyzed by color, pH and paper chromatography. Three solar cells from each pigment were made by soaking Titanium Dioxide coated glass in each solution. The completed solar cells were exposed to different light sources (halogen, incandescent, Reveal and fluorescent). Solar cell voltage and current were then measured.

Results

The most efficient electron transfer occurred using the halogen light source followed by Reveal, incandescent and fluorescent. Solar cells made from red cabbage anthocyanin produced the highest average electron transfer at 400 millivolts. Data showed a pH to current relationship that peaked around a pH 2.5.

Conclusions/Discussion

The data supports the hypothesis that electron transfer between anthocyanin pigments and nanocrystalline Titanium Dioxide, is affected by changes in the light source. The light source affects the efficiency because each light source emits specific intensities of each wavelength of light. The anthocyanins can absorb some wavelengths more efficiently than others. The more light an anthocyanin absorbs the more electrons are excited and the higher the electron transfer efficiency. The efficiencies were the highest under the halogen light because halogen light is the closest to sunlight, which these pigments naturally absorb. The pH is an indicator of the stability of an anthocyanin molecule. Anthocyanins with lower pHs and therefore more stable molecular structures produced the highest current and had the lowest deviation between trials. Dye-based solar cells using anthocyanin have the potential to provide clean, natural and renewable energy for the future.

Summary Statement

This project compares the electron transfer efficiency between various natural and artificial anthocyanins and Titanium Dioxide under different lighting conditions.

Help Received

Father helped buy chemicals and equipment; Margaret Carlberg provided some information on anthocyanins.