CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

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Project Number

S0507

Project Title

Photoinduced Electron Transfer and Spectral Analysis of Anthocyanin Based Organometallic Dyes

Abstract

Objectives/Goals

The Objective was to determine if the addition of transition metal compounds to anthocyanin (a naturally occurring photosynthetic plant dye) affected the dye's absorption spectrum and electron transfer characteristics. Could a relationship be shown between the intensity or wavelength of the light absorbed by an organometallic dye and its electron transfer efficiency?

Methods/Materials

The absorption spectrum of anthocyanin dye (cyanidin-3-glucoside) in distilled water was measured between 350nm and 995nm using an ultraviolet/visible light spectrometer. The absorption spectra of serveral transition metal compounds in water and mixed with anthocyanin dye were also measured under identical conditions. These same mixtures of metallic compounds and anthocyanin formed new organmetallic dyes which were used to construct dye-sensitized solar cells. By measuring the voltage and current outputs of these cells, the electron transfer properties of the organometallic dyes were evaluated.

Results

Most of the organometallic dyes showed higher light absorbance over a larger range of frequencies than pure anthocyanin. However, several compounds, especially the acetates, actually had a decrease in absorbance. There did seem to be a direct relationship between light absorbance at 500nm and pH. There also seemed to be a correlation between pH and solar cell current. Only cells made from nickel chloride produced both higher average current and voltage than those of pure anthocyanin.

Conclusions/Discussion

Light absorbance for anthocyanin in water peaks around 500nm (there may be other peaks in the near ultraviolet spectrum beyond the range of the spectrometer used in this experiment). Data indicates that bonding and electron transfer between anthocyanin and metallic compounds increases as the pH decreases. Compounds therefore with a pH of around 1.5-2.0 and light absorbance that peak at 500nm will yield an organometallic dye that produces strong currents. Results indicate that futher research using nickel chloride may produce dyes with superior electron transfer capabilities. Research into clean and renewable energy sources such as dye-sensitized solar cells may hold the key to sustainable and continued life on this planet.

Summary Statement

This experiment indicates that there may be a relationship between the absorption spectra of certain anthocyanin based, organometallic dyes and their electron transfer capabilities in dye-sensitized solar cells.

Help Received

Margaret Carlberg answered questions---Mr Antrim provided spectrometer and chemicals