CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)

Asmita Kumar

Project Number

S0707

Project Title

New Organic Dye-Sensitized Photovoltaic Cell for Simultaneous Photon Energy Capture, Conversion, and Storage

Abstract

Objectives/Goals

To modify Grätzel type blackberry anthocyanin dye-sensitized photovoltaic cells and to improve the ability of the cell to simultaneously capture, convert, and store photon energy.

Methods/Materials

Grätzel type photovoltaic cells were made with ITO glass and KI/I electrolyte. Control cells had one electrode composed of a mesoporous titanium dioxide layer with absorbed blackberry anthocyanin dye and a graphite catalyst electrode. Modified cells included additional porous layers of silica gel on either or both control electrodes, the twin layers separated by tissue paper. Trial modifications also included carbon black or mixtures of carbon black and silica gel in layers on the control electrodes. Control and modified cells were tested for photovoltaic effect under halogen light and in darkness.

Results

All cells showed an ability to convert photon energy into electrical energy. After halogen light charging and storage in darkness, control cells showed energy supply with weak no load power of 2.25x10^-11 W/cm^2. The no load power of silica gel modified cells under similar dark conditions was 1.4x10^-9 W/cm^2, with maximum recorded power of 6x10^-8 W/cm^2 under load. Cells with carbon black layers showed a reversal of electrode potential in light and dark conditions.

Conclusions/Discussion

Organic dye-sensitized photovoltaic cells can capture, convert, and store photon energy. The storage capacity of standard Grätzel type photovoltaic cells is low as indicated by power under no load. This poor storage is attributed to the low amount of electrolyte and to the absence of sufficient dielectric material in the standard cell. The power capacity can be increased by modifying a standard cell using mesoporous silica gel layers on both electrodes with a porous paper separator. This modification potentially increases the amount of electrolyte and the amount of dielectric material in the cell, leading to improved storage capacity.

Summary Statement

The overall energy conversion and storage performance of organic blackberry dye-sensitized photovoltaic cells was improved by increasing electrolyte containment and capacitance through additional porous dielectric layers.

Help Received

Dad helped with heating of samples in kiln and provided supervision. Michael Reidy of Hartford Glass provided free glass, electrolyte, and titania. Sorbent Technologies provided free silica gel.