CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
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Project Number
31741

Project Title
The Effect of Various Colored Natural Dyes on Energy Output of Home-Made Dye-Sensitized Nanocrystalline Solar Cells

Abstract

Objectives/Goals
1) Build 14 home-made dye-sensitized nano-crystalline solar cells and test their output using natural dyes of different colors.
2) Hypotheses:
a) Green, as the most prevalent natural plant color will be the most efficient at absorbing light and will produce the highest electrical output.
b) Leaf dyes will work better than fruit dyes.

Methods/Materials
Materials:
Conductive glass slides, TiO2 powder, Potassium Iodide solution, vinegar, fruit and leaf juices, clear detergent, Petri dishes, beakers, pipettes, multi-meter, halogen lamp, precision scale, binder clips, alligator clamps, denatured alcohol, burner, mortar & pestle and various colored fruits and leaves.
Procedure:
Prepare titanium dioxide suspension. Place a drop on glass slide and roll it with a glass rod creating a thin film. Anneal the film by heating the slide at 400°C for 10 mins. After cooling, let the slide soak in plant dye for 15 min. Coat second slide with graphite using a pencil. Place the 2 slides together and clamp with binder clip. Insert a drop of KI electrolyte. Take voltage and current readings using multi-meter.

Results
A.Leaf dyes produced 77% more power than fruit dyes under sunlight & 43% more under halogen light.
B.Red dyes produced 284% more power than green under sunlight and 572% more under halogen light.
C.Red leaf produced 92% more power than red fruit.
D.Red dyes performed disproportionately better in sunlight than artificial light.

Conclusions/Discussion
The color red and not green was best which disproved the first part of the hypothesis. Red dyes probably absorb more light due to their highest wavelength. Leaf dyes, in general, performed better than fruit dyes with the exception of blackberry juice. Also, red leaves performed better than red fruit. Thus chlorophyll, in general, is better at absorbing light than anthocyanin so the second part of the hypothesis was proved.

These cells hold a promising future in our quest to find cost-effective, clean and renewable solutions to our growing energy needs but much work is still needed in readying this technology for heavy duty commercial uses.

Summary Statement
Test the output of various plant based dyes in home-made dye sensitized nanocrystalline solar cells as a possible cost-effective, clean, renewable energy source in the future for mankind's growing energy needs.

Help Received
Dad helped with experimental process and Mom helped with the board; Mr. Hobbs (science teacher) provided some of the equipment and general guidance.