Renewable Energy Systems

Solar Energy for Our Future
Nanocrystalline Dye-Sensitized Solar Cells

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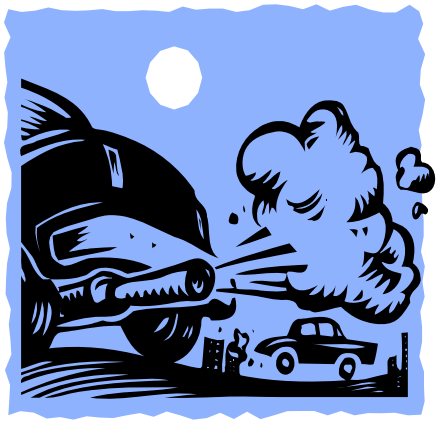
Solar Cells

This presentation will;

- Describe the nation's need for sustainable, renewable energy.
- Define solar cells and how they work.
- Identify the advantage and disadvantages of silicon vs. dye sensitized solar cells (DSSC's)
- Detail the procedures for making DSSC's
- Provides results of our experiments with DSSC's

A Changing Society



2.4% annual increase energy demand in US alone.

dangers of increased carbon dioxide emissions

Decreasing fossil fuels

=

Rising costs

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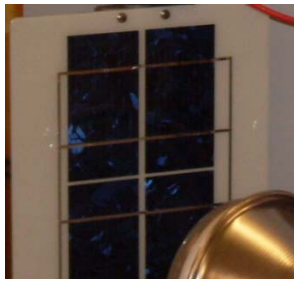
Why Solar Energy and How?

- Solar thermal (heat) energy is a carbon-free, renewable alternative to the power we generate with fossil fuels like coal and gas. It is the largest of all available carbon-neutral energy sources.
- Two Methods
  - Silicon Solar Cell

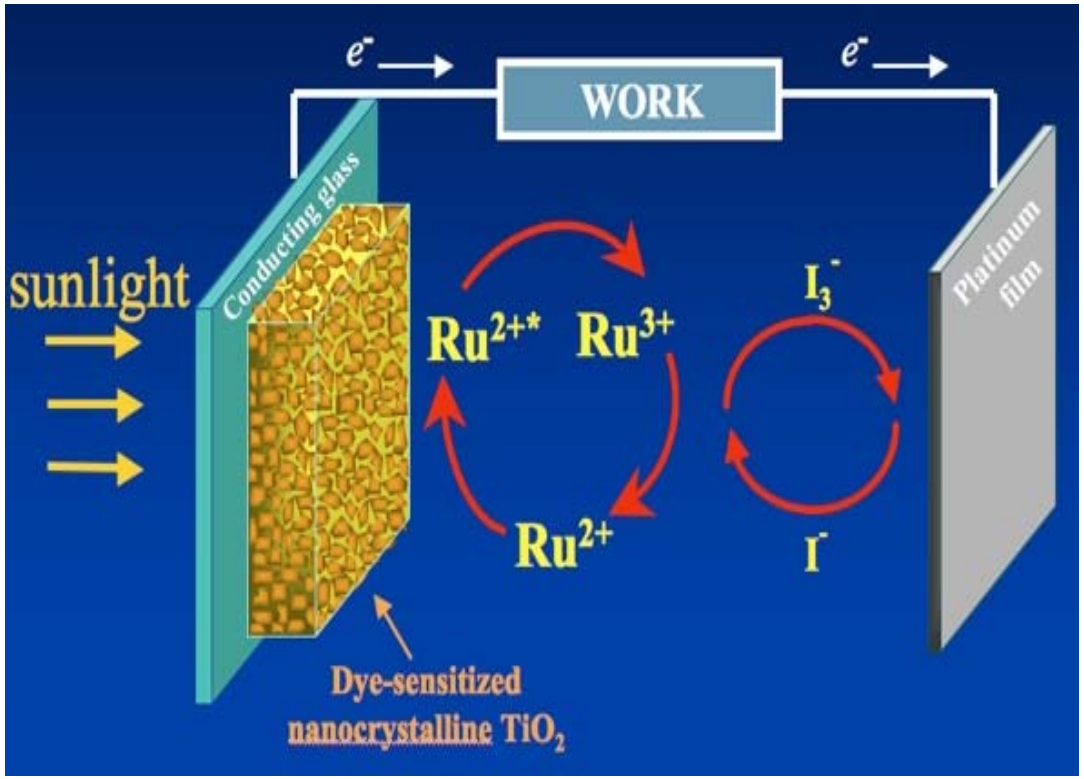


  - Dye Sensitized Solar Cell

DSSC's vs Silicon Solar Cells

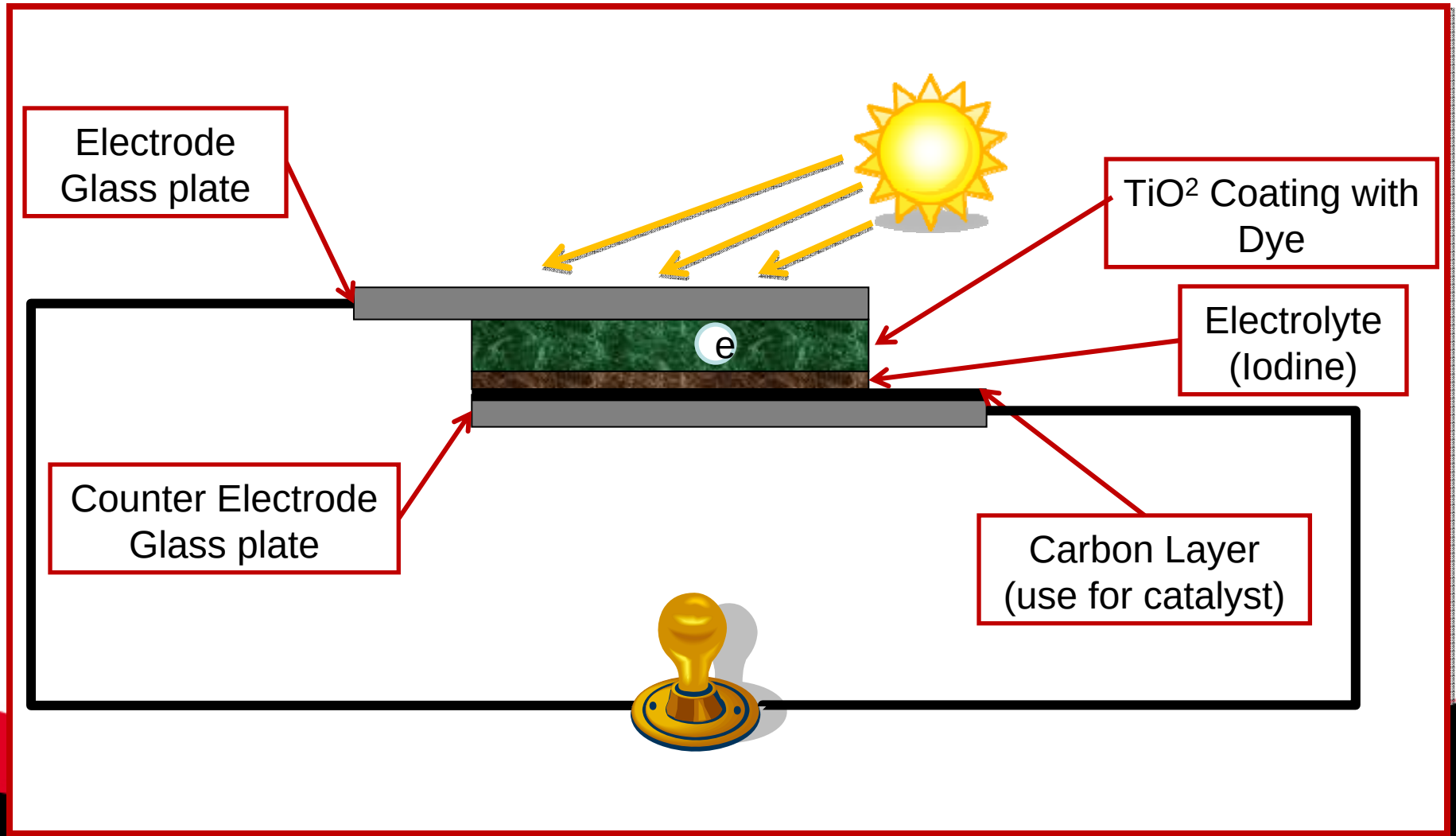
DSSC's	Silicon Solar Cells
Relatively cheap to produce	5 to 10 times more expensive than conventional alternatives
Experimental efficiencies up to 11%	Proven efficiencies over 30%
Will work in varied weather conditions w/o a real drop in their efficiency	Dependent on the light incidence angle and temperature
Leakage of liquid electrolytes	No leakage issues
Lighter weight and less brittle	Heavy, brittle and easy to break by wind, hail, or vibration damage.
Uses materials that are relatively common	Uses very hard to find materials www.material views.com

Dye Sensitized Solar Cells (DSSC's)



TiO_2=electron acceptor;
Iodide = electron donor;
Dye = photochemical pump
Carbon = catalyst

Nanocrystalline Dye Sensitized Solar Cell at Work



Making Dye Sensitized Solar Cells (DSSC's)

Dyes

Organic

Rasberries

Blueberries

Greens

Blackberries

Inexpensive

Readily available

Commercial/Synthetic

N719

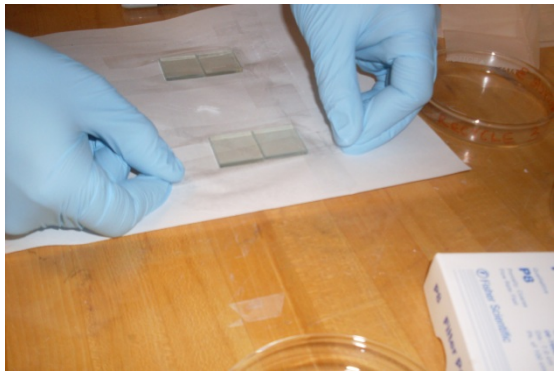
N3

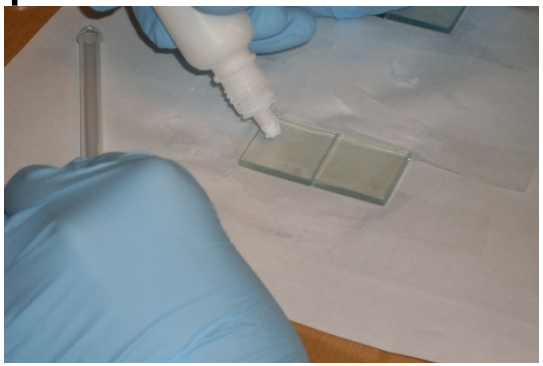
Costly

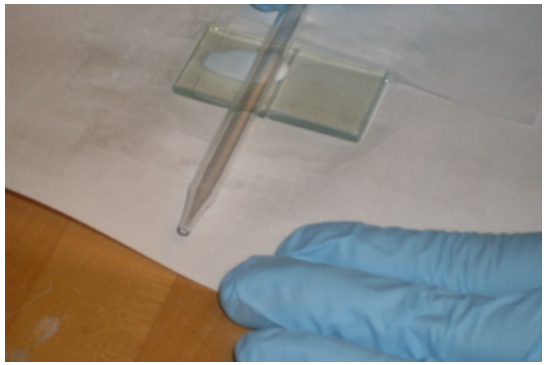
Less accessible

Making Dye Sensitized Solar Cells (cont'd.)

Step 1: Prepare the conductive plates with tape and apply the TiO_2 suspension





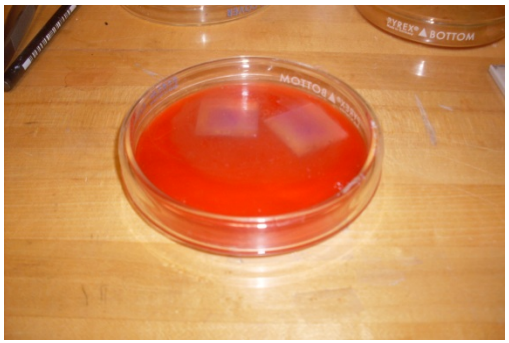


Step 2: Bake the plates

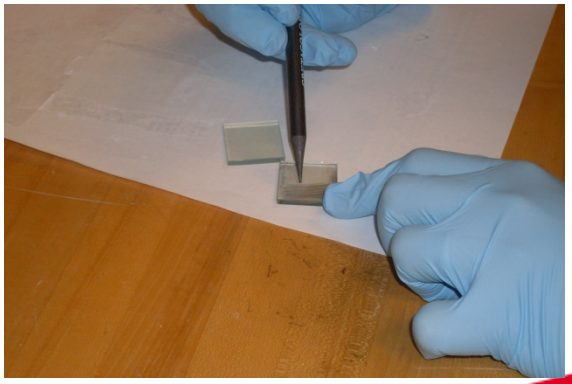
Making DSSCs (continued)

Step 3: Prepare the dye

Step 4: Place the TiO2 electrode plate into the dye

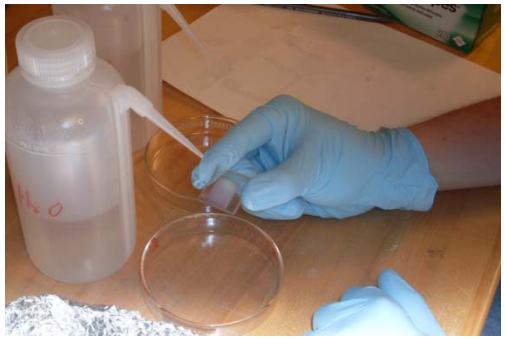


Step 5: Film the counter electrode glass plate



Making DSSCs (continued)

Step 6: Remove the plate from the dye. Rinse with H2O and EtOH. Pat dry.

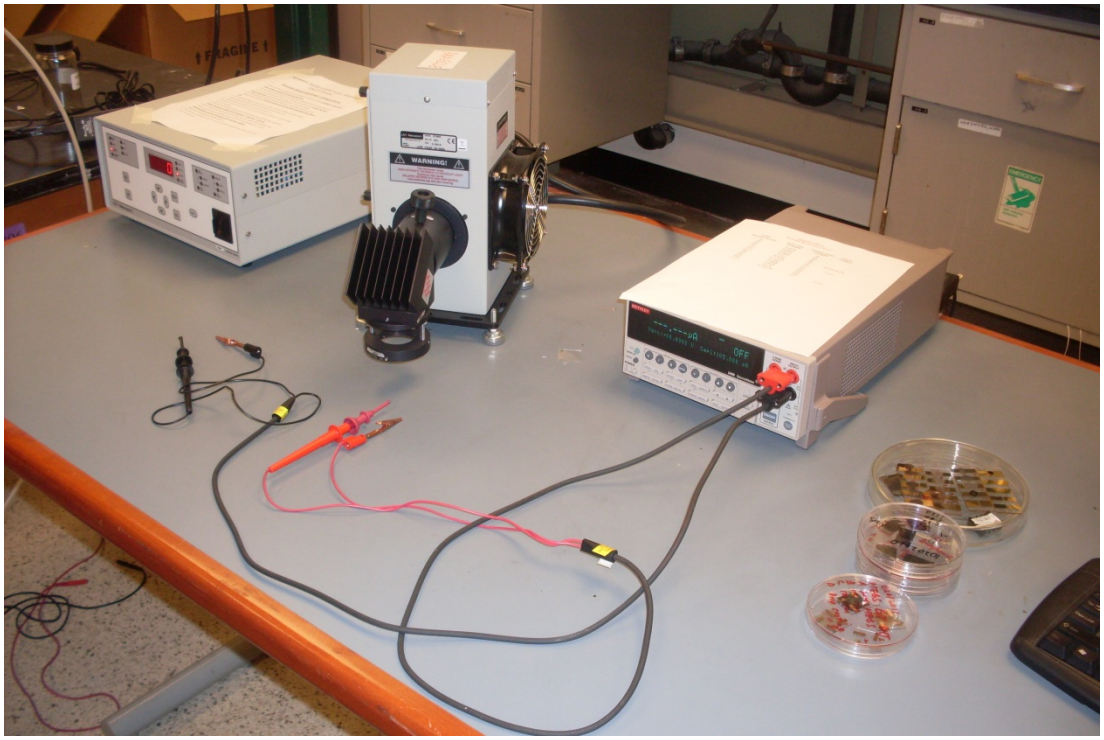


Step 7: Assemble the cell

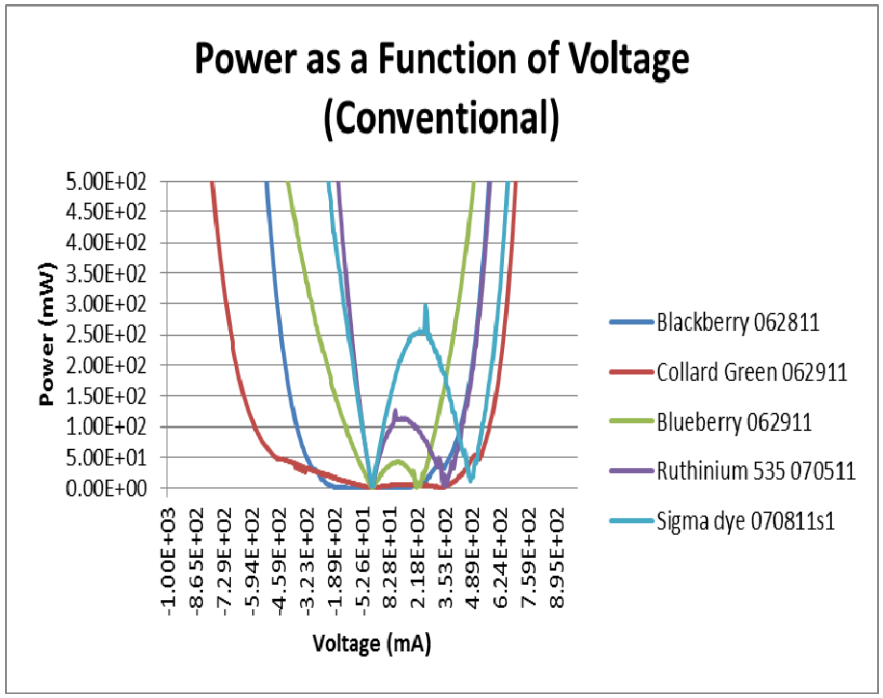
Step 8:
Apply the electrolyte

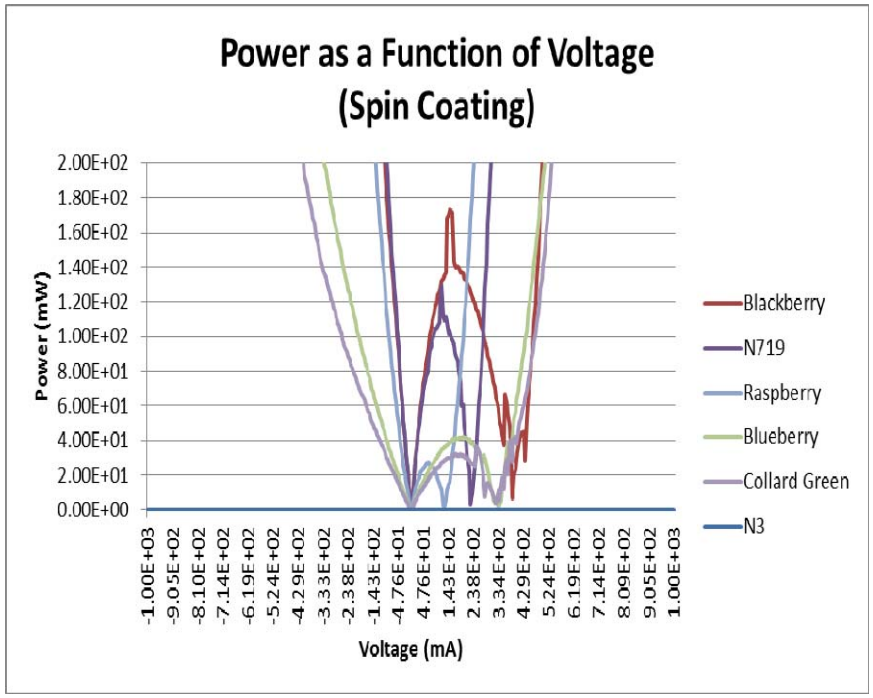
Testing DSSCs

A solar simulator is used to provide an energy source and an automated multimeter is used to provide current and voltage data.

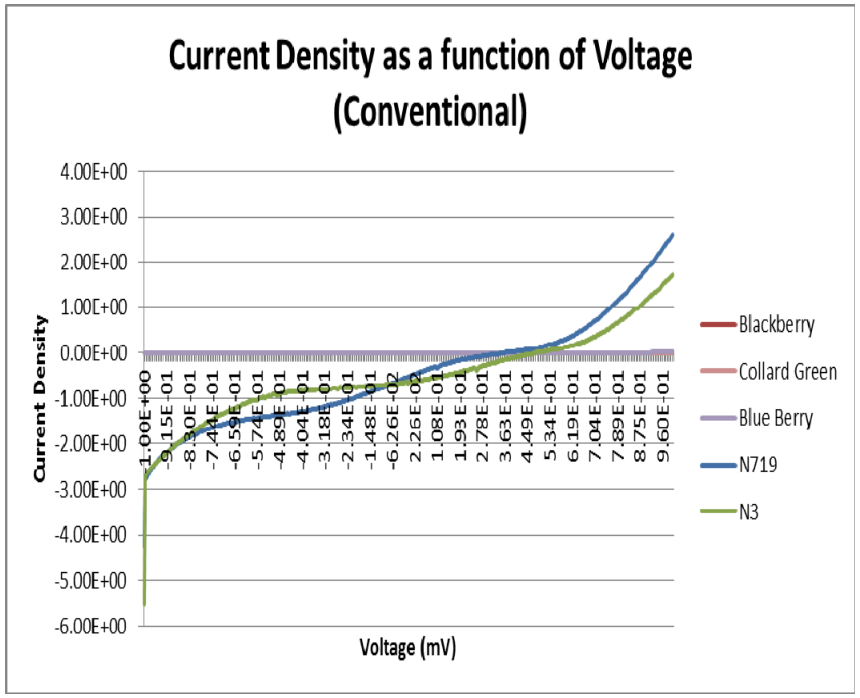


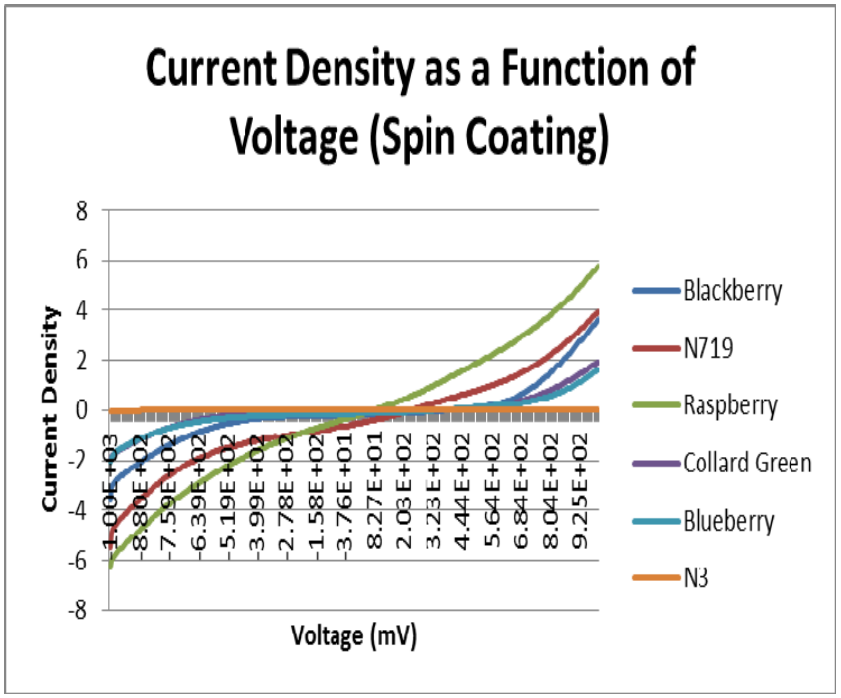
Test Results (continued)
DSSC's Power Output Values





Test Results
DSSC's Current Output Values





References

- http://ivanraposo.deviantart.com/art/Fossil-Fuels-are-running-out
- http://www.paranormalknowledge.com/articles/life-without-money.html
- http://www.ocf.berkeley.edu/~jordank/Jordan_Katz/Solar_Energy.html
- http://www.camse.org/scienceonthemove/documents/DSSC_manual.pdf
- Microsoft, Inc. (2009). Clip Art. Retrieved July 25, 2011, from http://office.microsoft.com/en-us/clipart/default.aspx

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Classroom Implementation Plan: DSSC's

Goal (InterdisciplinaryLesson - Engineering and Science)
Students will build a dye-sensitized solar cell to develop an understanding of how these cells convert light into energy.

Objectives: Students will be able to;
•Build a dye-sensitized solar cell and explore its photovoltaic properties.
•Build dye-sensitized solar cells using different dyes and explore the effect that different dyes have on voltage and current.
•Link dye-sensitized solar cells in series circuits and explore the voltage and current produced.
•Analyze the obtained data.
•Apply the cells as an energy source for an electrical load device.