

PROJECT 2: ENERGY

An exploration of Hydrogen Fuel Cells
and Solar Power

Why so Important?

- ▣ The energy resources currently available are beginning to dwindle and are causing environmental damage
- ▣ These technologies have the potential to solve many of the societal problems as well since free, cheap energy would remove the need for fighting over resources

Research

- ▣ Question #1: What effect does temperature have on the efficiency of a hydrogen fuel cell? (Phil)
- ▣ Question #2: What are the differences between dyes in dye-sensitive solar cells? (Jon)

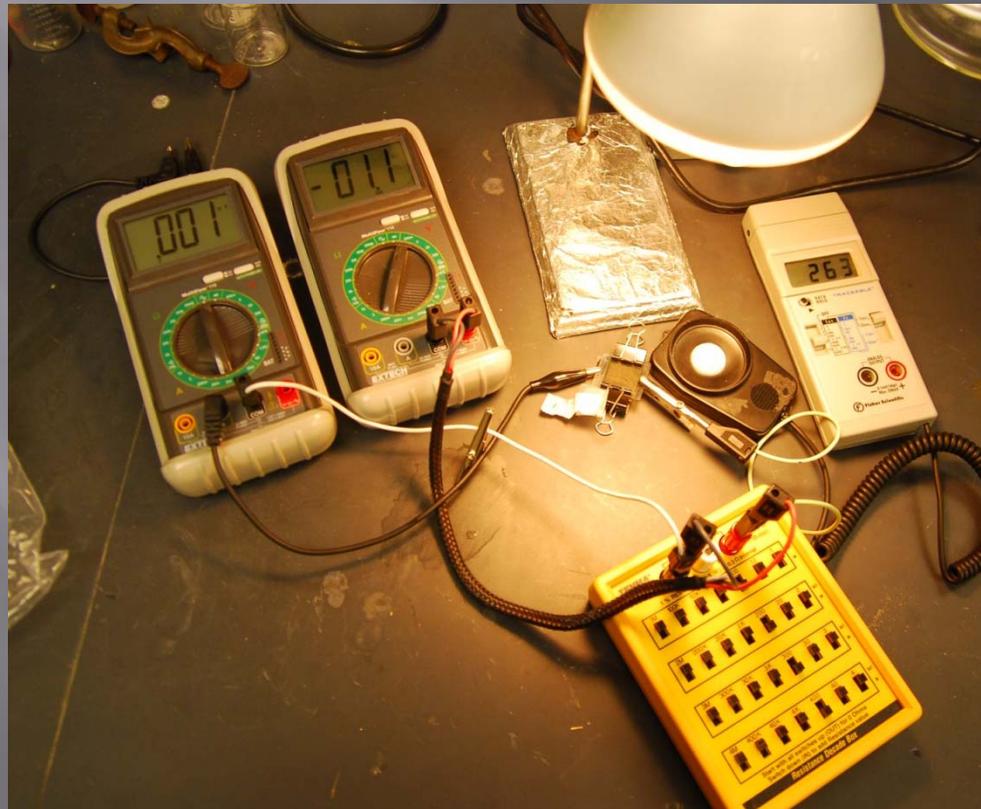
Jon's Experiment

- ▣ Testing effect of dye selection on the efficiency of Dye sensitized TiO_2 solar cells.



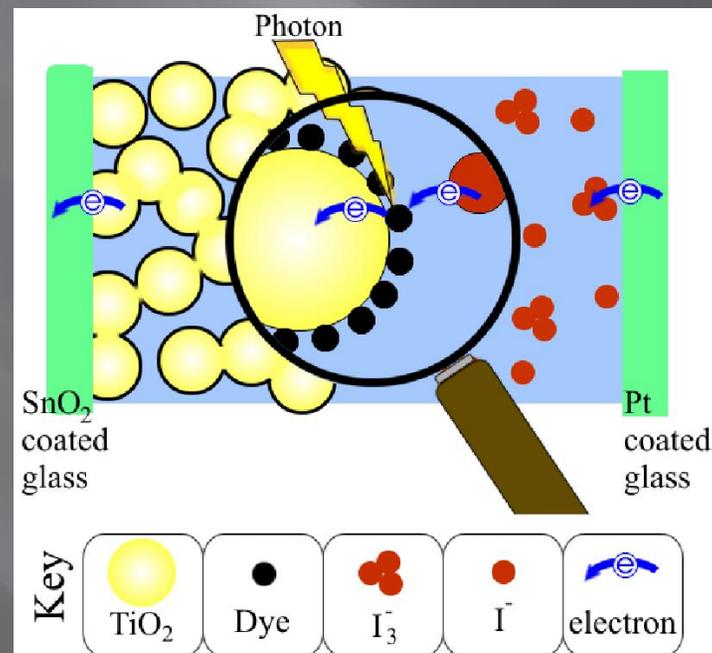
Jon's Experiment

- ▣ Using multimeters Jon measured voltage and current at different resistances



Jon's experiment

- Expected results
 - Dyes which absorb light over a broader spectra of light will inject more electrons to TiO_2 increasing the power output...

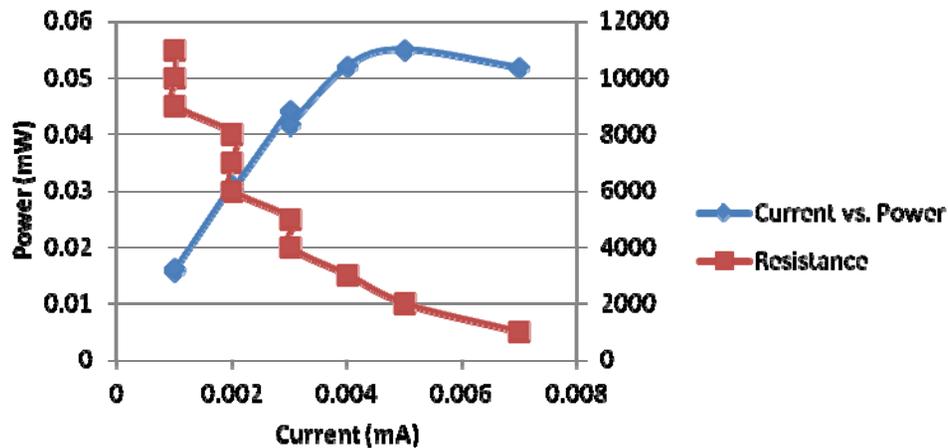


Jon's Experiment

- ▣ Problems with production process
 - Suggested heating process doesn't seem to reach the required temp. to achieve the needed annealing
 - Results seem to be an entire order of magnitude from the expected results...
 - If we use the Furnace to get to the right temp the glass breaks
 - We will try a different furnace next week

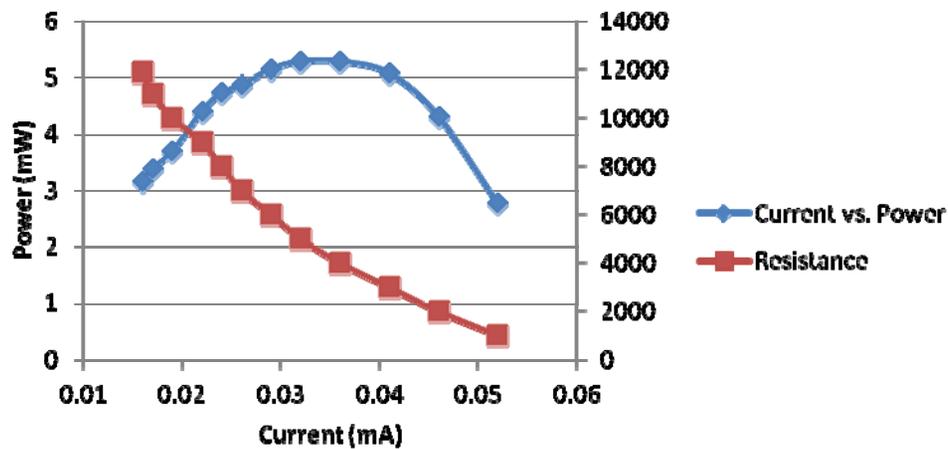
Oven vs. Heat Gun

Heat Gun



- Heat gun only reaches approximately 285C. Annealing at this temperature produced negligible results.

Oven



- Oven reached full 450C. Annealing at this temperature gave us results originally expected .

Hydrogen Fuel Cells

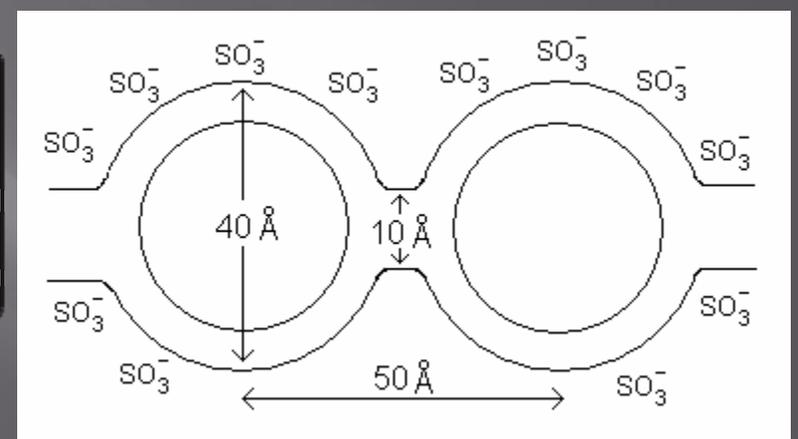
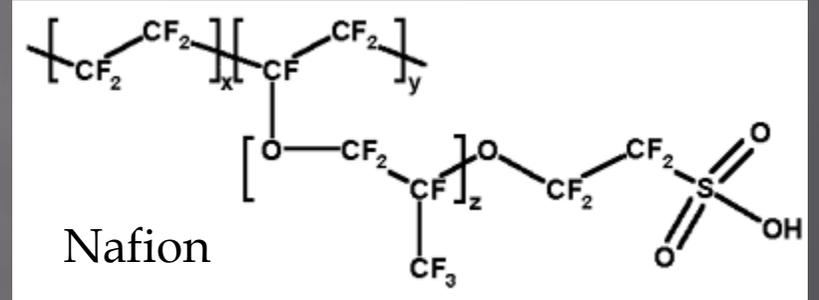
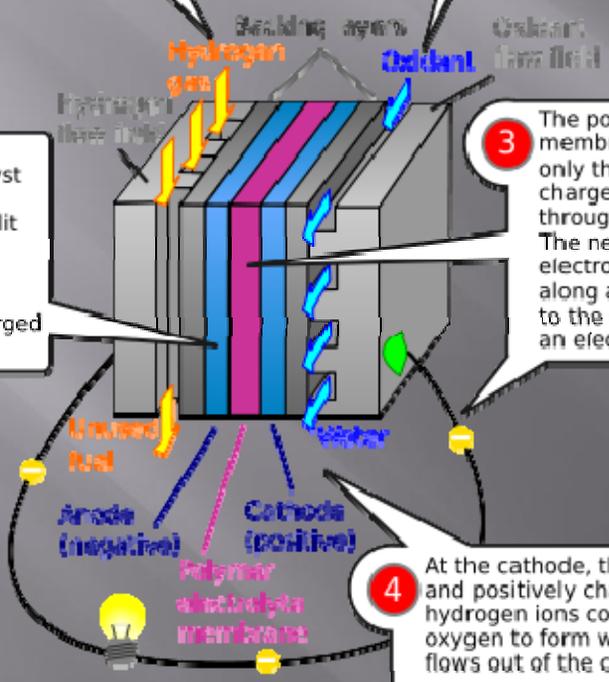
Proton exchange membrane fuel cell

1 Hydrogen fuel is channeled through field flow plates to the anode on one side of the fuel cell, while oxidant (oxygen or air) is channeled to the cathode on the other side of the cell.

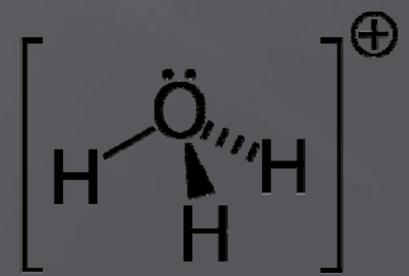
2 At the anode, a platinum catalyst causes the hydrogen to split into positive hydrogen ions (protons) and negatively charged electrons.

3 The polymer electrolyte membrane (PEM) allows only the positively charged ions to pass through it to the cathode. The negatively charged electrons must travel along an external circuit to the cathode, creating an electrical current.

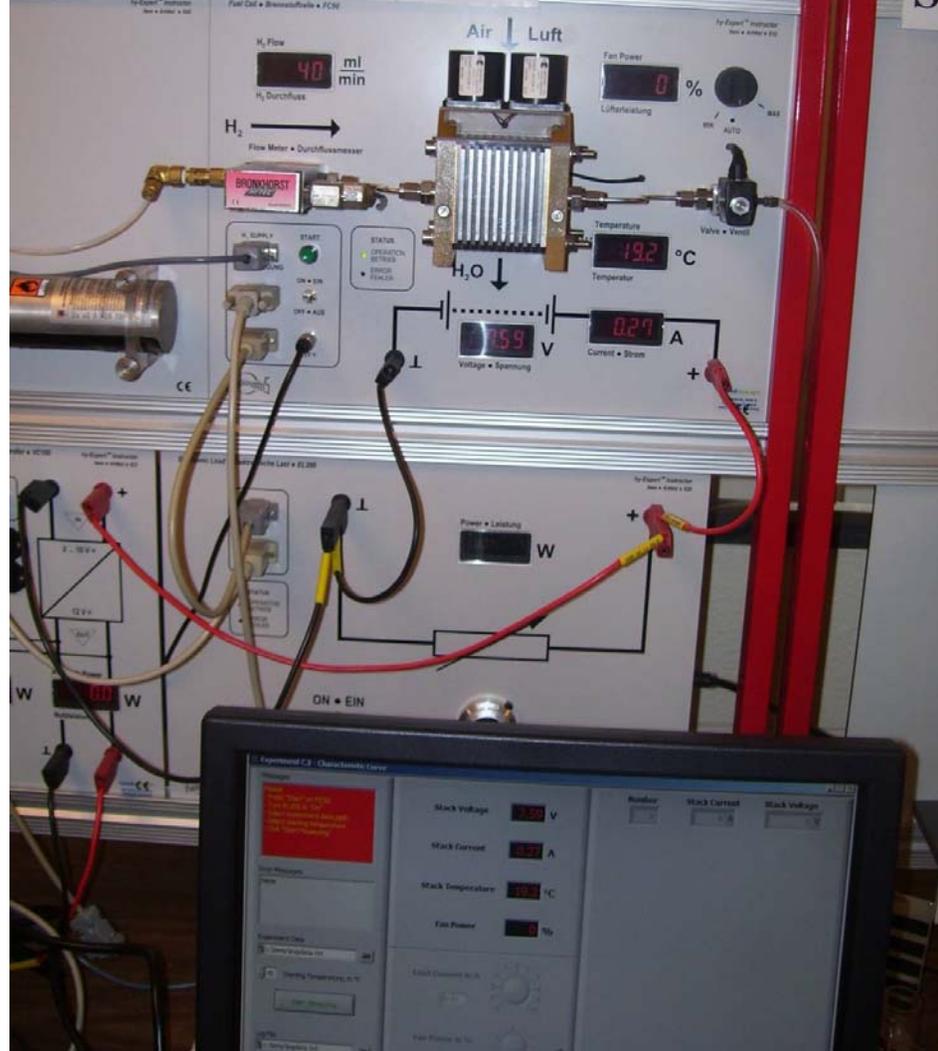
4 At the cathode, the electrons and positively charged hydrogen ions combine with oxygen to form water, which flows out of the cell.



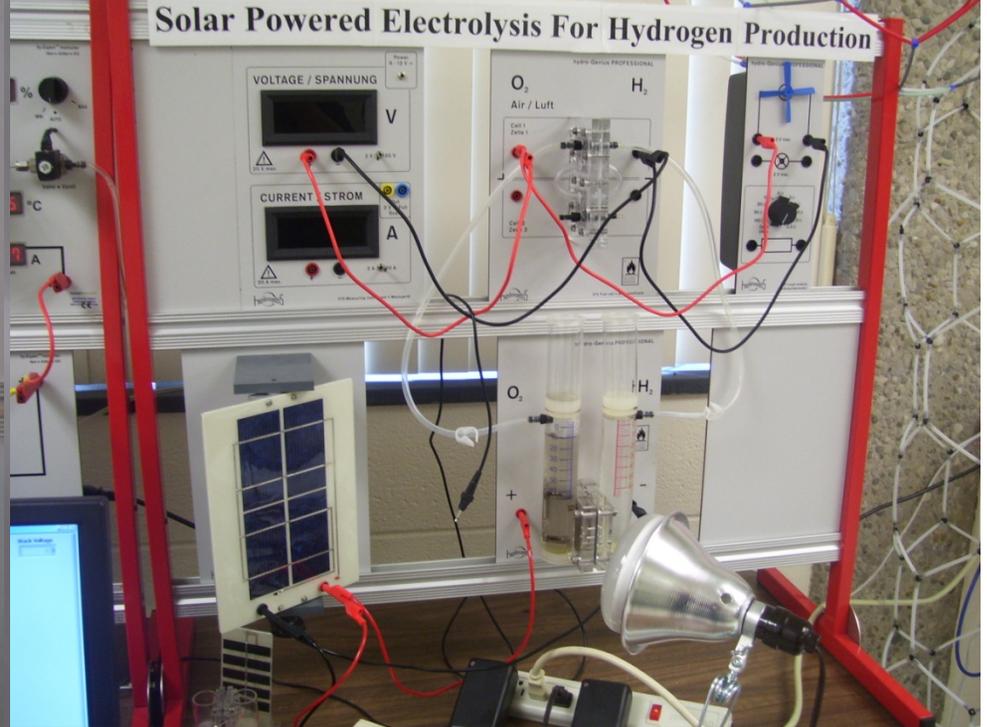
Schematic of PEM



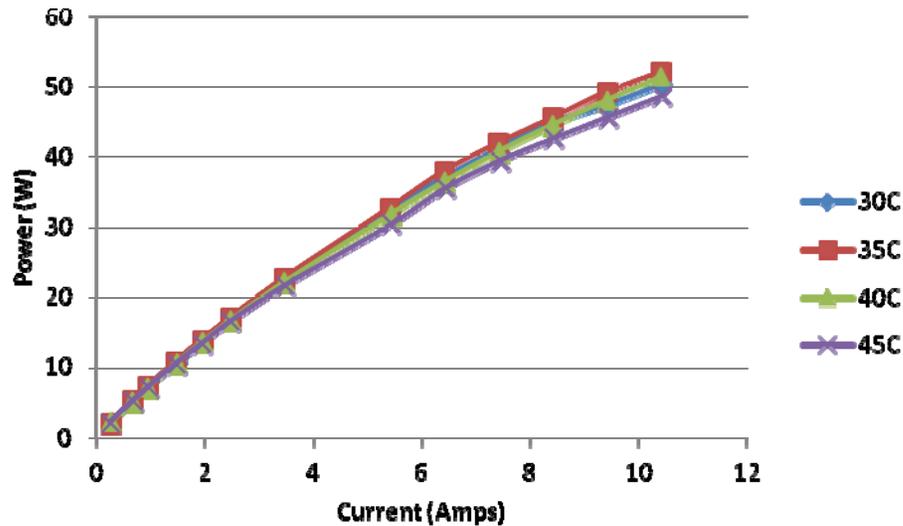
Large Membrane Fuel Cell



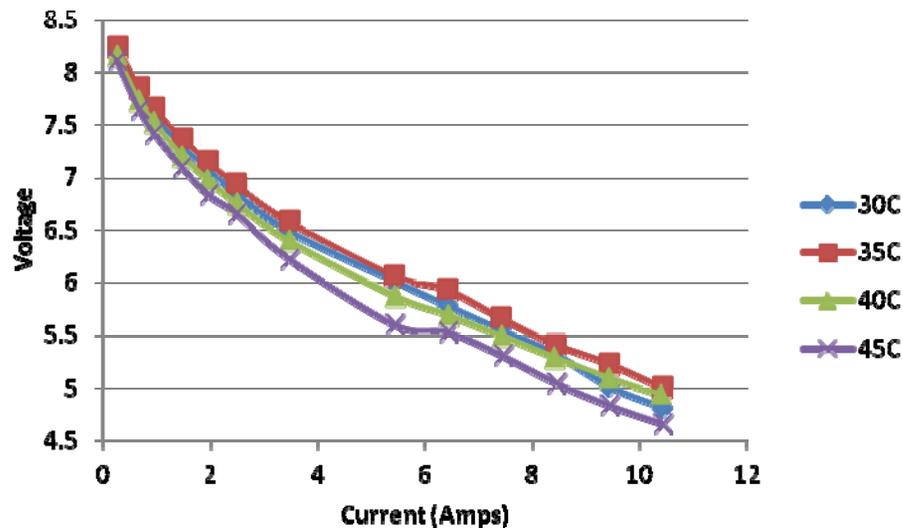
Solar Powered Electrolysis For Hydrogen Production



Phil's Research

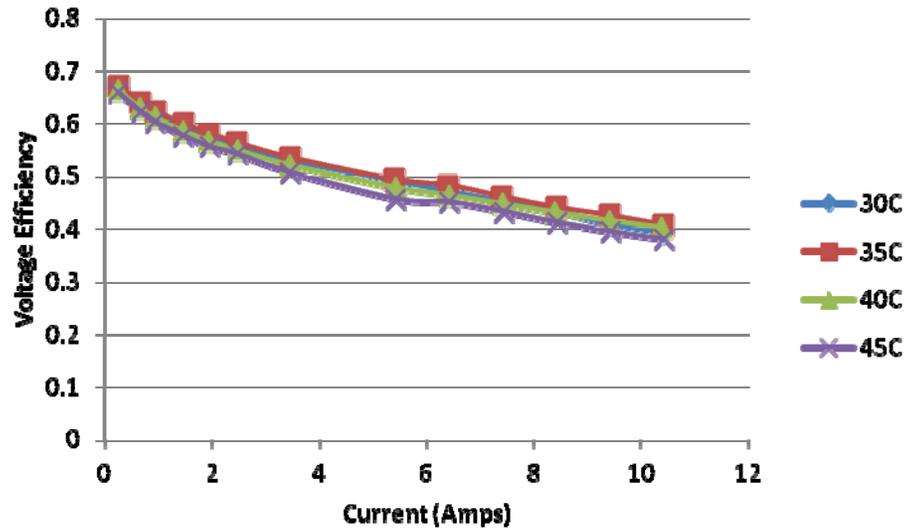


Here you can see a mostly linear curve of the relationship between power and current. As temperature increases, the power obtained falls off.

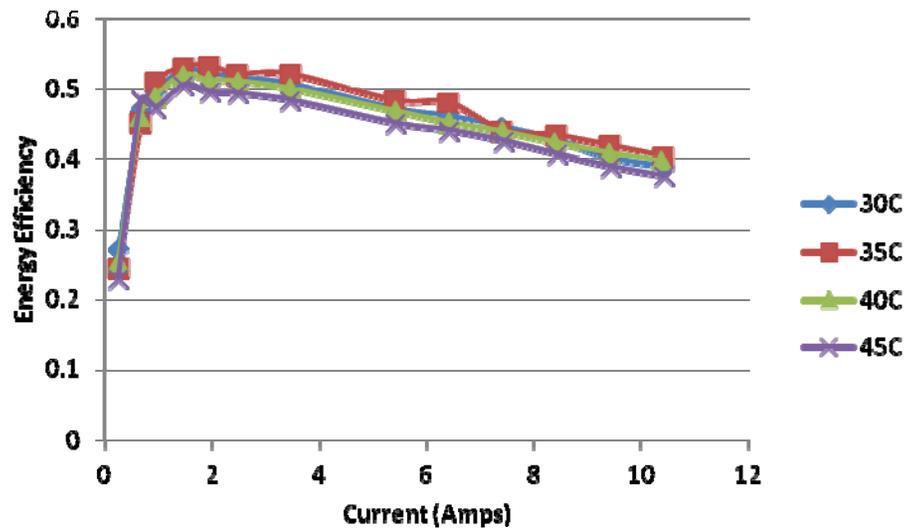


The voltage as a function of amps shows a decrease as current is increased. At 45C the fall off begins being more pronounced.

Phil's Research (Cont.)

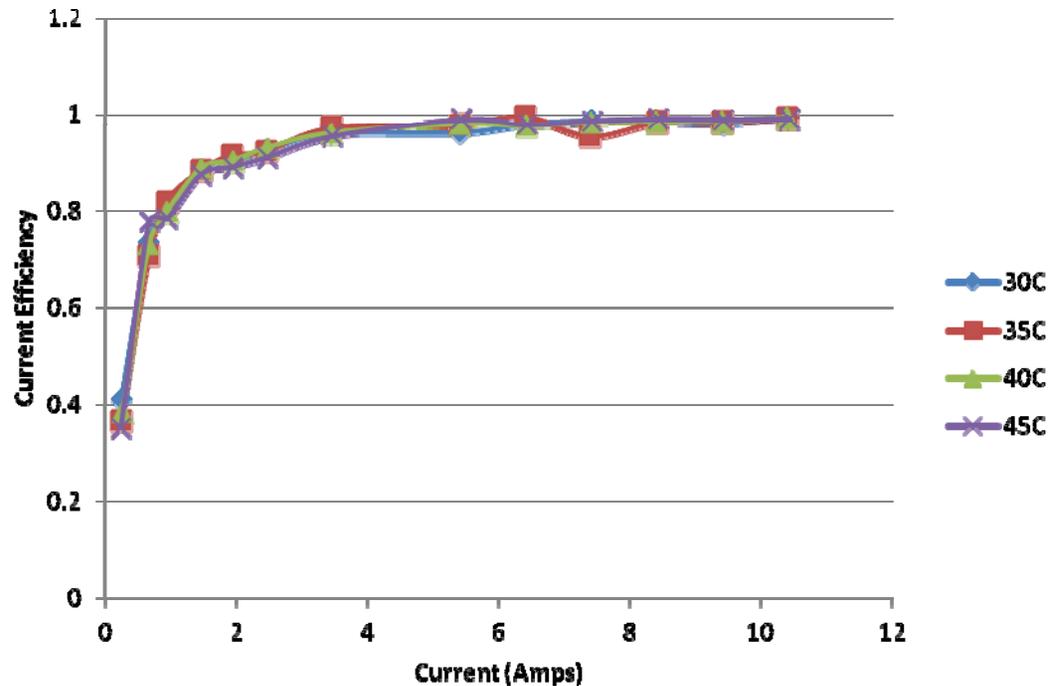


There is also a small drop in voltage efficiency as temperature increases.



Also, the energy efficiency of this stack seems to be affected as the temperature gets upward of 45C.

Phil's Research (Cont.)



Current efficiency for this hydrogen fuel cell stack is the only parameter Measured that was so far not reduced by the 45C temperature level.

Conclusions

- ▣ There is an overall decrease in efficiency as temperature increases in fuel cells
- ▣ Modifications must be made to extend temperature range
- ▣ During production of solar cells it was discovered that the process was flawed
- ▣ The annealing temperature is important and can have drastic effect on the results

Special Thank You

- ▣ Andrea Burrows, RET. coordinator
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- ▣ Feng Wang, GA