CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

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Project Number

31560

Project Title

Catalytic Conundrum: Comparing the Efficiencies of PEM Fuel Cells with Different Concentrations of Platinum Catalysts

Abstract

Objectives/Goals

The current situation facing the fuel cell economy is the cost of the platinum (Pt) catalyst required to make the cell work. My project was focused on determining whether fuel cells could be constructed with less Pt catalyst and still have a high enough efficiency to be cost effective. I hypothesized that there would be little statistical difference between the efficiencies of the concentrations of catalyst tested (0.1mg/cm^2, 0.3mg/cm^2).

Methods/Materials

My experiment was conducted with a PEM fuel cell attached via silica tubes to an electrolyser that converted distilled water into pure hydrogen and oxygen for fuel. The electrolyser was powered by a 6V lantern battery to keep a more consistent input power throughout the testing. Digital multimeters were attached to both the electrolyser and the fuel cell to measure input and output amps (I) and volts (V). These values were recorded every 30 sec. for 10 min. to rule out the effect on possible outliers in the data. I and V were multiplied together to find the input and output power (W). The output W was divided by the input W to evaluate efficiency. There were 10 trials for each test.

Results

The input power in trial 1 with the 0.1mg/cm^2 concentration of Pt was 2.68 W. It had an output power of 0.56 W and an efficiency of 20.99%. The input power in trial 1 with the 0.3mg/cm^2 concentration was 1.88 W, with an output power of about 0.70 W and an efficiency of 37.42%. By trial 10, the input power of the lower concentration was 1.17 W. The output power was 0.74 W and the efficiency was 63.78%. The input power of the higher concentration was 1.13 W, with an output power of 0.94 W and an efficiency of 83.34%.

Conclusions/Discussion

My hypothesis was proven to be incorrect. There was a statistical difference between the different concentrations of Pt catalyst used. I believe this is because the higher concentration of Pt created a higher surface area for the hydrogen atoms to partially bond with before losing their electrons to become positively charged ions. The efficiencies of each concentration consistently increased with each trial. I believe this is because the catalysts accumulated a higher concentration of hydrogen ions on their surfaces. This gradually overtook the impurities initially in the system. Further research into accurate costs for the catalysts and more statistical analysis needs to be done to draw more accurate conclusions.

Summary Statement

This experiment was conducted to see if the concentration of platinum catalyst in a proton exchange membrane fuel cell had a statistical effect on its efficiency.

Help Received

My mom purchased the supplies for experimentation. My grandma let me use her house to conduct the experiments and her computer to type my report.