CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
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Project Number
S0625

Project Title
Increasing the Efficiency of DMFCs Using Different Supply Conditions, Temperatures, and Catalysts

Abstract

Objectives/Goals
This project was designed to improve the efficiency of Direct Methanol Fuel Cells by testing different factors including oxygen flow rate, methanol solution concentration, temperature, and the nano-particle catalyst used. The most significant component of the project was the lab-synthesized catalyst that was developed for the anode of the fuel cell.

Methods/Materials
I constructed two different fuel cells by pressing two pieces of Teflon-coated carbon paper around a Nafion film. In both cells, the cathode was painted with a platinum black catalyst and the anode was painted with a carbon-supported platinum and ruthenium black catalyst. A commercial anode catalyst was purchased and compared to one synthesized in the lab using direct chemical reduction. This novel catalyst has a unique 90% carbon, 10% tantalum carbide support. This membrane-electrode assembly (MEA) was then placed within a fuel cell housing, and the entire fuel cell, using tubing, was fed with a methanol solution at the anode and oxygen at the cathode. After conditioning the cells, data collection began by evaluating current and voltage output at various oxygen flow rates, temperatures, and methanol solution concentrations. All of the data was collected on the computer using a fuel cell test system.

Results
The maximum power density attained was about 55 mW/cm^2. The cell did perform better at higher temperatures, as expected. The cell with the lab-synthesized catalyst was able to produce higher power density at lower currents. The stronger methanol solution, however, did not enable the fuel cells to perform significantly better. Overall, the second fuel cell with the synthesized catalyst had consistently better performance.

Conclusions/Discussion
Ultimately, my hypothesis was supported and the synthesized catalyst allowed the cell to perform better than the commercial catalyst; more research could lead to its use in commercial cells, as these fuel cells have enormous application. The ease of production and cost effectiveness of methanol along with the ability of the DMFCs to perform at relatively low temperatures will enable these fuel cells to become a significant, portable energy source for the future.

Summary Statement
I was trying to increase the performance of the fuel cell by testing different conditions but most importantly by developing my own novel, nano-particle catalyst in the lab.

Help Received
My mentor, Frederick Krause, gave me background information about the topic and helped me design my experiment, review my paper, and verify my claims.