CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
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Project Number
S0909

Project Title
Microbial Fuel Cells: The Design, Construction, and Evaluation of a Novel Fuel Cell

Abstract

Objectives/Goals
Objectives/Goals- Our objective was to build a microbial fuel cell of our own design and see if it would produce electricity with a bacterial environment growing in the anode compartment. The second goal was to test the fuel cell with waste matter such as sewage.

Methods/Materials
Methods/Materials- The microbial fuel cell was constructed from Plexiglas, metal valves, wire, two graphite electrodes, a proton exchange membrane, and silicon sealant which would be able to both produce electricity and harbor bacteria. It was built by taking the electrode and proton exchange membrane and encasing it in a Plexiglas compartment we designed with valves and wires connecting to the electrode; we then made it airtight with the sealant. The cultivation of our bacteria was done under anaerobic conditions using nitrogen gas to replace oxygen with the following nutrients: glucose (20mg/L) Wolfe#s vitamin solution (10ml/L) Wolfe#s Mineral Solution (10ml/L) Nutrient broth (8mg/L). The cultured bacteria were inserted into the anode chamber and the cell#s electrical output was tested using an amp meter and logger pro.

Results
Control test with no bacteria present produced an average of 0.07 volts. The solution produced a background signature which was taken into account. Pseudomonas putida, bacteria known for aiding in electron transport, averaged 0.11 volts. Rhodoferax ferrireducens, our primary bacteria, averaged 0.16 volts, with a maximum of 0.174 volts. Rhodoferax ferrireducens, on average, doubled voltage output compared to the control with no bacteria. A consortium of both bacteria, averaged 0.17 volts, with a maximum of 0.194 volts. This data supports the characteristics of each bacteria found in our research. We theorize that Pseudomonas aided Rhodoferax with transporting electrons to the electrode, creating an increase in voltage.

Conclusions/Discussion
Conclusion/Discussion- With our fuel cell design and setup, we were able to measure a power output greater with the bacteria in the anode chamber than with the nutrient solution alone. This shows that our design was successful in doing what we designed it to.

Summary Statement
In our project we are utilizing the natural properties of bacteria along with a fuel cell setup to generate electricity from hydrocarbon compounds such as glucose.

Help Received
Help was received from the professors of our lab and they supplied us with the materials necessary for the construction and evaluation of the fuel cell. The professors also explained some aspects of the project such as oxidation-reduction reactions, calculations for electrical units, and re-hydrating bacteria.