CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)

Ian J. Bennett

Project Number

S1701

Project Title

Microbial Fuel Cell, Year Three: Measuring the Percentage of Anode Electrode Colonization by Geobacter sulfurreducens

Abstract

Objectives/Goals

To determine the percentage of aluminum anode electrode surface area that will be colonized by biofilm produced by metal reducing microorganism Geobacter sulfurreducens in an anaerobic, batch system, at the end of 700 hours.

Methods/Materials

A small amount of Geobacter sulfurreducens was introduced into an anode in the presence of an aluminum electrode, electrically disconnected from the cathode, preventing electron transfer. Fumarate was the alternative electron acceptor. Microscopy provided magnified images of biofilm growth on the electrodes. A 700 hour time series of pictures, taken at six intervals, enabled the percentage of electrode surface area colonized to be estimated.

Results

A highly differentiated biofilm was observed colonizing 80.0% of the surface area at each of the anode electrode quadrants, and middle on the three aluminum anode electrodes, at time interval hour 700. The fluorescent images at the six intervals showed a steady increase in the percentage of the electrode surface area colonized by biofilm, in the anodes inoculated with Geobacter sulfurreducens. The findings at 20X magnification indicated that biofilm colonization did not reach a maximum plateau during the 700 hours.

Conclusions/Discussion

The data does support my hypothesis that at least 50.0% of the anode electrode surface area will be colonized by biofilm produced by Geobacter sulfurreducens at the end of 700 hours. Images of three electrodes at hour 700 showed 80.0% surface area colonization. Results showed Geobacter sulfurreducens produced high colonization levels on aluminum anode electrodes, with fumarate as the electron acceptor, while electrically disconnected from the cathode. Horizontal biofilm growth on the anode electrode reduces the time it takes to transfer each electron to the anode. These findings may be useful in contributing to research in bacterial behavior that selects for horizontal growth on the anode electrode. Benefits from these advancements may be a more efficient microbial fuel cell with increased power output.

Summary Statement

Quantify the percent colonization on an aluminum anode electrode by biofilm produced by Geobacter sulfurreducens, with the cathode disconnected, contributing to bacterial behavior research that leads to a more efficient microbial fuel cell.

Help Received

My parents drove me to the University of California, Berkeley. Ms. Erika Parra, Ph.D. candidate in Mechanical Engineering at the University of California, Berkeley, provided a culture of Geobacter sulfurreducens, access to lab space and the microscope, and answers to my questions during the research.