Microbial Fuel Cells

Current density generation using multiple substrates.

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Objective

• Effect on the performance of Microbial Fuel Cell using different enrichment medium.

Introduction

•Microbial fuel cell is a system that drives a current to generate electricity using bacteria found in nature

•Microbial fuel cell use various organism, substrates and wastewater to produce or harvest electricity

•There are two main components of the fuel cell; cathode and anode compartments along with a cation specific membrane

•In the anode compartment, microorganism oxidize substrates which generate electrons and protons. Electrons are then transferred to the cathode compartment via an external electric circuit. Protons are transferred to the cathode compartment through the cation specific membrane. Consumption of electrons and protons in the cathode compartment with oxygen results in formation of water.

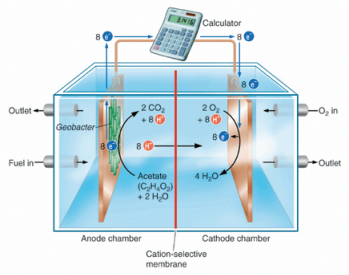

Figure 1: American Society for Microbiology

Method

Substrate	Electron Acceptor	Carbon Source
Modified Geobacter Medium 1 (MGM)	Oxygen	Sodium Acetate
MGM 2	Ferric	Sodium Acetate
MGM 3	Nitrate	Sodium Acetate
Leuria-Bertani (LB)	Oxygen	Yeast extract
Geobacter Medium (GM)	Ferric	Sodium acetate

Table 1: Five different substrates tested

- Inoculate mix culture into each of the five mediums
- Enrich the bacteria and transfer the solution every day depending on the growth of the bacteria for one month
- After one month, add the bacteria along with a solution of MGM into the MFC
- Change the solution in MFC every other day
- Test for current generation
- All the data for a month was collected and recorded in the Multimeter Data Logger (KEITHLEY, USA)
- Data points measured voltage over a 1000 Ω resistor

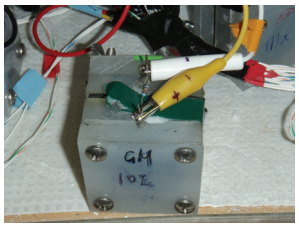

Figure 2:Microbial fuel cell, attached to the voltmeter

Figure 3: Aerobic mediums; LB and MGM

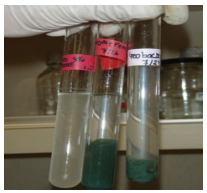

Figure 4: Anaerobic mediums; MGM+nitrate, MGM + ferric and Geobacter

Results

•Current density (mA/m^2) measurements were used to analyze the data

•Geobacter medium was the best substrate as it produced the highest value for current density of 7.750 mA/m^2.

•MGM+nitrate had the lowest current density with the value of 2.089 mA/m^2

Substrates	Average Current Density (mA/m^2)
Geobacter medium	7.750
MGM+ferric	3.270
MGM	2.980
LB	2.140
MGM+nitrate	2.090

Table 2: Average current density of five substrates tested

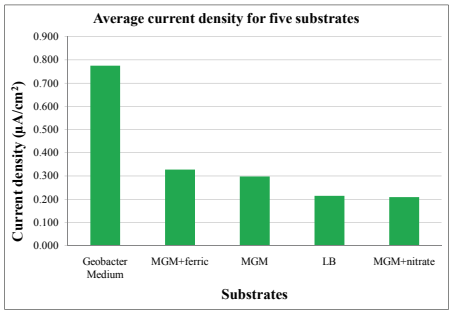

Figure 5: Average current density produced by each of the five substrates

Conclusion

•Geobacter medium produced the highest current density of 7.750 mA/m^2 over a month

•Mix culture enriched with Ferric such as Geobacter medium and MGM+ferric tend to be better electron acceptor than non ferric based solutions and produce higher current density

•Previous studies indicate that when a MFC is enriched by a mix culture, current density values of 10A/m^2 can be observed. (American Society for Microbiology)

•This was not the case for our experiment as we got lower numbers than what was expected.

Future Work

• To improve the results more than one batch should be ran so the bacteria can use the electrodes and can adjust to the environment

•Different enrichment methods should also be explored

•Bacterial community analysis can also be conducted to test for which species are present in the solution

Acknowledgements

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