New Polymer Binder for Microbial Fuel Cell Cathode

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Microbial Fuel Cells (MFCs) work by using bacteria to oxidize organic compounds at the anode. The electrons created from this reaction flow through a wire to the cathode. The protons diffuse through the buffered solution. At the cathode, oxygen is reduced to water.

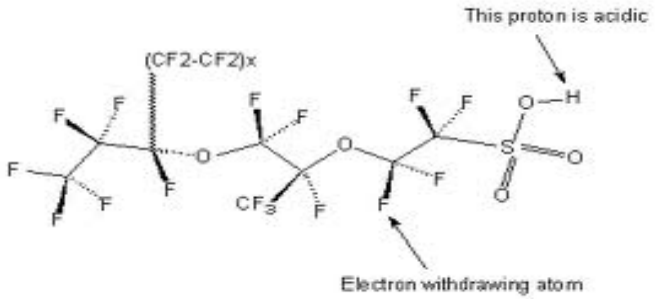
Nafion is currently the most widely used binder for MFC cathodes. Finding a cheaper polymer will be a major step in reducing the cost of MFCs.

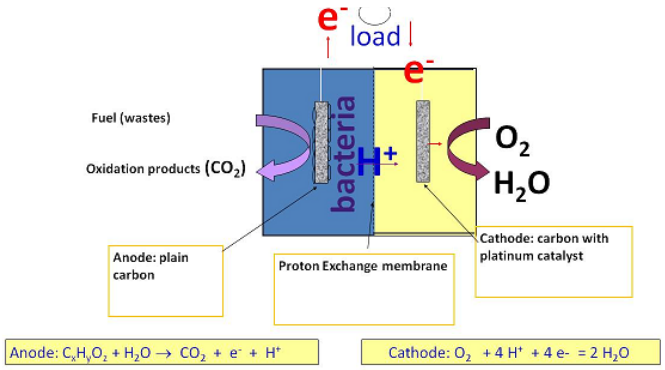
Nafion disadvantages
- Very expensive
- High oxygen permeability, which means lower efficiency and greater biofilm growth

Advantages
- Stable over long periods of time
- High power output

Polymer X adavtanges
- Cheap
- Slightly higher power output at current density of 1 mA/ cm^2
- Less permeable to oxygen

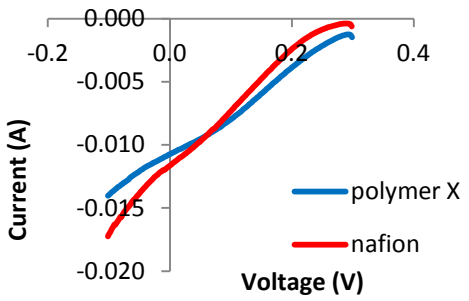
Possible problems
- degradation of the polymer by bacteria or the high pH of the cathode



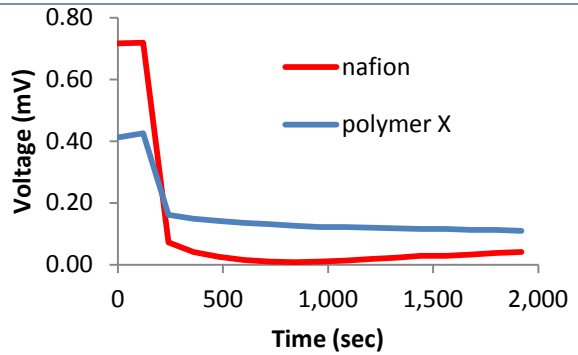


Schematic of an MFC

The cathode reaction is limited by proton diffusion. Protons move from the anode to cathode in the form of a phosphate buffer. Amine groups present on polymer X are ionized at the pH in an MFC. These positive ions serve as a counter ion to the negatively charged phosphate ions. This is thought to increase the rate of diffusion of the phosphate buffer.



Linear sweep voltammetry



Chronopotentiometry for a current density of 1 mA/ cm^2

Power output in MFC

A typical MFC with a nafion cathode produces about 1.0 mW of power

The MFC with the new cathode is currently producing 1.3 mW