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Alternate Approaches to Fuel Cell Development

In addition to the work proceeding with conventional proton exchange membrane (PEM) fuel cells, there are several alternative approached to fuel cell development being examined in HNEI's overall Fuel Cells program:

Bioactive Fuel Cells

Biocarbons for Fuel Cells

Methane Hydrate Benthic Fuel Cell

Bioactive Fuel Cells Back To Top

Researchers have the long-term goal of applying a basic understanding of charge transfer in biological catalysts to develop the engineering expertise necessary for the development of practical devices such as enzyme fuel cells, biosensors, and hydrogen production systems. The team's short-term goal is to construct a test-bed for enzyme and microbial fuel cells that will enable researchers to define techniques and limitations of operation with respect to important process variables such as temperature, pH, salinity, mediators, fuel purity, and mode of immobilization (i.e., direct attachment versus entrapment of enzyme).

Contact: Michael Cooney [1]

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Research in HNEI's Renewable Resources Research Laboratory [2] has led to the development of a thermochemical process that can produce large quantities of biomass-derived carbon. Under the HEET [3] Initiative, researchers will begin exploring the feasibility of using this energy source as a fuel for fuel cells. Biocarbon fuel cells developed under the initial phase of HEET resulted in the generation of about 400 mV (open-circuit), but power output was limited because of mechanical design considerations. Work will continue on defining appropriate cell geometry, construction materials, and operating protocols to permit the evaluation of this novel technology. Since biocarbons exhibit exceptionally high electrical conductivity, their use in high performance bipolar plates is being examined.

Contact: Michael Antal, Jr. [4]

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Work has begun on developing a biological benthic fuel cell for subsea applications. In the benthic fuel cell, methane gas serves as the primary carbon source for anaerobic consortia of archaea and sulfate-reducing bacteria in the sea floor sediment that produce sulfide, which is oxidized at the anode of the fuel cell. Oxygen reduction at the cathode in the water column completes the circuit of the fuel cell. Several factors affect power generation by the fuel cell, including methane concentrations, microbial anaerobic methane oxidation rates, and mass transport of compounds between the bacteria and electrodes. A study is underway to test the power output of the biological fuel cell in a simulated benthic environment and the effect of the fuel cell on anaerobic methane oxidation.

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