Microbial Fuel Cell

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At a Glance

What is it?

- The benthic microbial fuel cell is a new approach for generating power for long-term (persistent) operation of in-water sensors, underwater unmanned vehicles for surveillance and ocean environment monitoring.

How does it work?

- The microbial fuel cell generates electricity by harvesting fuels and oxidants that are both naturally occurring and locally replenished in many marine environments. Because it utilizes self-maintaining/self-repairing microbe-based catalysts and has no moving or consumable parts, it is capable of very long-term operation.

What will it accomplish?

- The technology offers an alternative to batteries which deplete and limit mission duration. When fully developed, the fuel cell will enable persistent and uninterrupted surveillance, and will dramatically reduce the logistics burden of maintaining remote sensors by reducing frequency of their redeployment.

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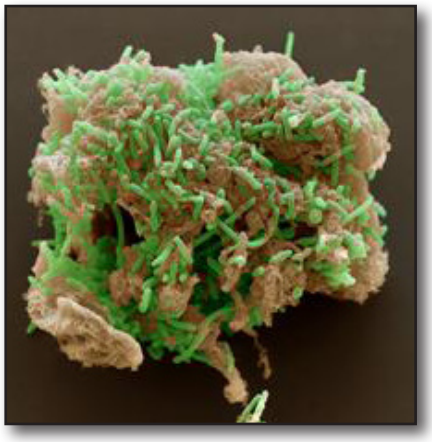

Microbial fuel cells offer a clean, efficient and reliable alternative to batteries and other environmentally harmful fuels. TIME magazine named the microbial fuel cell one of the "Top 50 Innovations for 2009."

In use today, the microbial fuel cell is an oceanographic mooring that, like the Geobacter shown above, exploits natural microbial wastes and processes to generate persistent electrical power at a typical density of 0.38W/m2 footprint area. The fuel cell has the ability to convert marine waste into reusable, clean energy.

These fuel cells may power remotely deployed Navy sensors, surveillance equipment and other underwater instruments, extending their battery duration (typically months) indefinitely.

In addition to persistence, these fuel cells harbor no reactive catalysts or hydrogen generation, nor do they require any oceanographic housings. They are sustainable, environmentally friendly, and don't involve hazardous reactants like a regular battery might because they use the natural carbon in the marine environment.

Field demonstrations have included microbial fuel cell-powered hydrophones, a meteorological buoy with real-time radio frequenty data exfiltration, an acoustic vector sensor, and a bottom-resting underwater unmanned vehicle. New fuel cell designs will be used to power a naval sensor network requiring 1-2W (continuously) and an underwater modem (20W; pulsed).

Research Challenges and Opportunities

- Reliable methods for anode emplacement in sediment
- Durable and efficient electrode materials
- Enhanced understanding of bacterial genetics/physiology enabling electron transfer to electrodes