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Commentary

Alternative Ways of Generating Electric Current by Using Microbial Oxidation: Microbial Fuel Cell

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ABOUT THE STUDY

Microbial Fuel Cell (MFC) is a type of bioelectric chemical fuel cell system that generates electric current by diverting electrons produced from the microbial oxidation of reduced compounds is called as fuel or electron donor on the anode to high-energy oxidized compounds including oxygen it is also called as oxidizing agent or electron acceptor on the cathode through an external electrical circuit. MFCs can be grouped into general categories: mediated and unmediated. The first Microbial Fuel Cell (MFC's), demonstrated in the early 20th century, used a mediator: a chemical that transfers electrons from the bacteria in the cell to the anode. Unmediated MFCs emerged in the 1970's; in this kind of MFC the bacteria typically have electrochemically active redox proteins such as cytochromes on their outer membrane that can transfer electrons directly to the anode. In the 21st century MFC's have started to find commercial use in wastewater treatment.

The working of microbial fuel cell technology is based on the principle of redox reactions. The bacteria oxidize the organic matter to produce carbon dioxide (CO_2), electrons, and protons. The natural metabolism of the microbes is utilized to generate electricity. A microbial fuel cell is a device that converts chemical energy to electrical energy through the action of micro-organisms. These electrochemical cells are constructed by using either a bio anode or a bio cathode.

Most microbial fuel cells contain a membrane to separate the compartments of the anode where oxidation takes place and the cathode where reduction takes place. The electrons produced during oxidation are transferred directly to an electrode. The electron flux is moved to the cathode. The charge balance of the system is maintained through ionic movement inside the cell, usually across an ionic membrane. Most microbial fuel cells use an organic electron donor that is oxidized to produce protons and electrons. Other electron donors have been reported, including sulfur compounds. The cathode reaction uses different types of high-energy electron acceptors, most often oxygen (O_2). Other electron acceptors studied include metal recovery by reduction, water to hydrogen, nitrate reduction, and sulfate reduction.

Microbial Fuel Cell's (MFC's) are attractive for power generation applications that require only low power, but where replacing batteries may be impractical, including wireless sensor networks. Wireless sensors powered through microbial fuel cell for example can be used for remote monitoring. Virtually any organic material could be used to feed the fuel cell, including coupling cells to wastewater treatment plants. Chemical technique wastewater and synthetic wastewater have been used to produce bioelectricity in dual and single chamber mediator less MFC's uncoated graphite electrodes.

Higher power production was observed with a biofilm-covered graphite anode. Fuel cell emissions are well under regulatory limits. MFCs convert energy more efficiently than standard internal combustion engines, which are limited by the Carnot efficiency. In theory, a microbial fuel cell is capable of energy efficiency far beyond 50%. Rosendale produced hydrogen with eight times less energy input than conventional hydrogen production technologies. Moreover, microbial fuel cells can also work at a smaller scale. Electrodes in some cases need only be 7 μm thick by 2 cm long, such that an MFC can replace a battery. It provides a renewable form of energy and does not need to be recharged. MFCs operate well in mild conditions, 20°C to 40°C and at pH of around 7 but lack the stability required for long-term medical applications including in pacemakers. Power stations can be based on aquatic plants including algae. If sited adjacent to an existing power system, the MFC system can share its electricity lines.

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