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POLYMERIC ELECTRODE DESIGN FOR IMPROVED BIOCATALYTIC CURRENT IN MICROBIAL FUEL CELL SYSTEMS

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As global energy consumption increases and contributes heavily to climate change, it is necessary to develop new sources of clean energy. The treatment of wastewater accounts for 3% of total energy usage in the United States, equivalent to the annual energy requirement of 9.6 million homes; however, the water itself can contain up to ten times the energy required to treat it. Microbial fuel cells (MFCs) take advantage of the ability of microorganisms to capture energy from their environments. These devices can harvest the chemical energy in wastewater to simultaneously produce clean electricity and remove contaminants, turning a waste product into an energy resource.

MFCs take advantage of the oxidative capabilities of various enzymes and bacteria in order to oxidize organic matter in wastewater, drive electrons through an electrical circuit, and generate useable power (Figure 1). One of the greatest challenges involves establishing efficient electronic communication between the microbial cells and the electrodes.

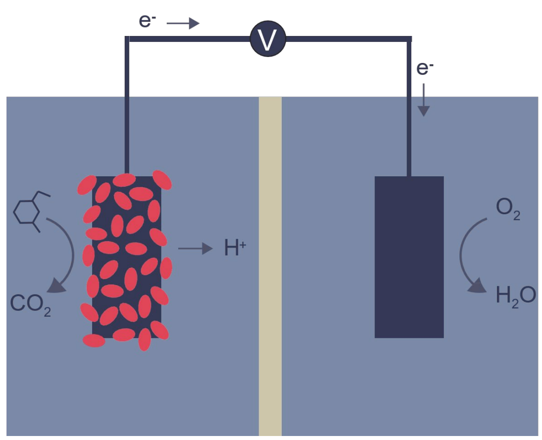

Figure 1: *A microbial fuel cell incorporates a microbial species which oxidizes organic compounds and produces an electrical current.*

This project focused on the design of a redox polymer to facilitate the transfer of electrons from the bacterial species, *R. capsulatus,* to the electrode. Several polymeric materials were synthesized, mixed with microbial cells, and deposited on carbon paper electrodes. The electrodes were electrochemically characterized, and the system was optimized to achieve the highest possible current density. This research represents a step toward an efficient, self-sustained MFC for concurrent renewable power generation and wastewater treatment.