The Development of a Mycelium-Based Proton Exchange Membrane for Ethanol Detection in Fuel Cells

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Ethanol detecting proton-exchange membrane fuel cells (PEMFCs) have been growing in prevalence over the past few decades due to its characteristic to detect alcohol with high accuracy for DUI detection; however, these sensors typically contain Nafion, a synthetic and expensive polymer. Mycelium has become an increasingly attractive material in electronics because its natural presence of chitin has high mechanical durability, electrochemical properties, and biodegradability. In this work, a fuel cell with a mycelium-based PEM has been developed to utilize the chemical energy in chitin and convert it into electrical energy for ethanol sensing. The fuel cell consists of harvested, lab grown Pleurotus ostreatus with mesh anode and cathode. The output open circuit voltage and amperometric response was analyzed using static headspace testing between ethanol concentrations ranging from 1 ppm to 500 ppm. The data displays that the mycelium PEM can differentiate between the myriad concentrations, supporting its sensitivity. The maximum open circuit voltage and current was noted as 0.8 mV and 150 nA respectively. This fungal PEMFC produced similar results in comparison to the commercially sold Nafion, suggesting it may serve as an adequate alternative. The developed mycelium PEM fuel cell sensor allows for economical and efficacious ethanol detection and promotes sustainable development with potential application in breathalyzers.

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