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Microbial Electrosynthesis from Carbon Dioxide to a Power-Driven Chemical Production Technology

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INTRODUCTION

Bio electrochemical techniques, such as electro fermentation and microbial carbon dioxide electrosynthesis, are emerging as interdisciplinary technologies capable of producing renewable fuels and chemicals (such as carboxylic acids). Benefits of electric bioprocessing include increased production rates, selectivity, and carbon conversion efficiency. However, product accumulation can lead to biocatalytic inhibition, and product isolation requires further efforts. The recent discovery of new photoenzymes capable of converting carboxylic acids to bioalkanes has provided opportunities for system integration, as well as promising approaches for product separation and characterization. An innovative cycling cascade system that combines the strengths of the catalysts to convert biomass and carbon dioxide into beneficial bio-alkanes. The recent concept of microbial electrosynthesi has evolved from low-level carbon dioxide to a power-driven chemical production technology using microorganisms as biocatalysts. Microbial electrosynthesis from carbon dioxide uses reducing equivalents generated at an electro polarizing cathode to bio-electrochemically reduce carbon dioxide to multi-carbon organic compounds. His use of carbon dioxide as a feedstock for chemicals has received a lot of attention because carbon dioxide is abundant and its use is independent of the food supply Chain.

DESCRIPTION

The highest acetate production rate of 149 mg was observed at an applied cell voltage of 3.1 V in batch mode. High acetate production with a maximum rate of 100 mg was achieved when operated in continuous mode. In continuous mode, acetate production was not maintained over long periods of operation, possibly due to poor retention of the microbial biocatalyst in the biocathode compartment (that is, airborne microorganisms were washed out of the system). The resumption of batch operations has resumed acetate production. This indicated a clear preponderance of suspended biocatalysts over attached (biofilm-forming) biocatalysts. Long-term carbon dioxide reduction at the biocathode resulted in the accumulation of acetate and also the formation of more reduced compounds such as ethanol and butyrate. Improving production rates and different biomass retention strategies (such as selection of biofilm-forming microorganisms) should be investigated to enable continuous biochemical production from carbon oxide using microbial electrosynthesis. Further process optimization is definitely needed to establish microbial electrosynthesis as an innovative and sustainable technology for the production of biochemicals from carbon dioxide as a next-generation feedstock [1-4].

CONCLUSION

Microbial catalysis of the reduction of carbon dioxide to polycarbon compounds at the cathode is a very attractive application for microbial electrosynthesis. Microorganisms reduce carbon dioxide by absorbing electrons or by reducing equivalents produced at the cathode. When gaseous carbon dioxide is used as the carbon source, the biological reduction process depends on the dissolution and mass transfer of carbon dioxide in the electrolyte. To solve this problem, a gas diffusion electrode was investigated by passing carbon dioxide through the gas diffusion electrode into the microbial electrosynthesis reactor for reduction at the biocathode. A combination of a catalyst layer (porous activated carbon and Teflon binder) and a hydrophobic gas diffusion layer form a three-phase interface in the electrode. Therefore, carbon dioxide and reducing equivalents are available for biocatalysts on the cathode surface. A concentrated inoculum consisting of acetogenic bacteria prepared from anaerobic sludge was used as a biocatalyst.

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CONFLICT OF INTEREST

The author's declared that they have no conflict of interest.

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