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Long-term operation of electro-biocatalytic reactor for carbon dioxide transformation into organic molecules

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Abstract

Electro-biocatalytic reactor was operated using selectively enriched mixed culture biofilm for about 320 days with CO₂/bicarbonate as C-source. Biocathode consumed higher current (-16.2±0.3 A/m²) for bicarbonate transformation yielding high product synthesis (0.74 g/l/day) compared to CO₂ (-9.5±2.8 A/m²; 0.41 g/l/day). Product slate includes butanol and butyric acid when CO₂ gets transformed but propionic acid replaced both when bicarbonate gets transformed. Based on electroanalysis, the electron transfer might be H₂ mediated along with direct transfer under bicarbonate turnover conditions, while it was restricted to direct under CO₂. Efficiency and stability of biofilm was tested by removing the planktonic cells, and also confirmed in terms of Coulombic (85-97%) and carbon conversion efficiencies (42-48%) along with production rate (1.2-1.7 kg/m² electrode) using bicarbonate as substrate. Selective enrichment of microbes and their growth as biofilm along with soluble CO₂ have helped in efficient transformation of CO₂ upto C₄ organic molecules.

Keywords: Microbial electrosynthesis (MES); bio-electrochemical system (BES); CO₂ capture and reduction; Butanol; Butyric acid

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