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Salinity-Gradient Energy Driven Microbial Electrosynthesis of Hydrogen Peroxide from Oxygen Reduction

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Hydrogen peroxide (H_2O_2) is widely used in various chemical industries and environmental remediation. Recently, bioelectrochemical systems (BES) have gained increasing attention for synthesizing H_2O_2 with simultaneous wastewater treatment^[1]. However, in order to get high-yield H_2O_2 requires additional electrical energy to power these BES or control the cathode potential. In this study, we develop an innovative BES called microbial reverse-electrodialysis electrolysis cell (MREC) to produce H_2O_2 in cathode. In the MREC(See Fig.1), the salinity-gradient energy between seawater and river water can be used to generate renewable electrical energy to replace the external power supply^[2]. Operational parameters such as air flow rate, pH, cathodic potential, flow rate of high and low concentration NaCl solution in RED were investigated as to improve the H_2O_2 yield. The optimal parameters for H_2O_2 production are air gas flow rate of 8-20 ml/min, cathode potential of -0.485 ± 0.025 V vs Ag/AgCl, the corresponding dissolved oxygen is 6.80 ± 0.30 mg/l in catholyte. Under the optimal conditions, a maximum H_2O_2 yield of 770 ± 18 mg/L could be obtained with corresponding H_2O_2 production rates of 0.44 ± 0.04 g/m²/h and current density of 1.40 ± 0.13 A/m². Results indicate the air gas flow rate and cathode potential are the key parameters for H_2O_2 production in MREC. This study indicates for the first time high yield synthesis of H_2O_2 from oxygen reduction in BES without external power supply, furthermore, we also discover the cathode potential can be controlled through adjusting the air flow rate without power supply and potentiostat.

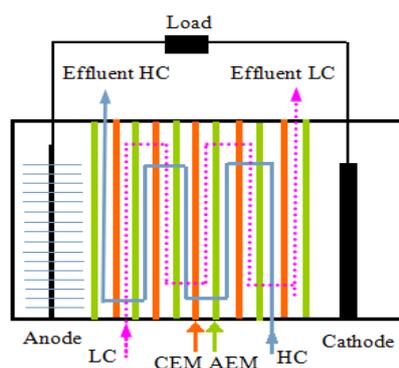


Fig. 1. Schematic of MREC (CEM, cation exchange membrane; AEM, anion exchange membrane; HC, high concentration solution; LC, low concentration solution;)

Reference

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