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Effects of cathode materials on H_2O_2 production in microbial fuel cells

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ABSTRACT

The application of microbial fuel cells (MFCs) on wastewater treatment has been evolving rapidly in recent years. It provides simultaneous pollutants removal as well as energy recovery in treating wastewater. MFCs can also be needed to produce H_2O_2 and drive electro-Fenton reaction to remove emerging contaminants in wastewater. However, the cell voltage produced in a MFC is lower than the voltage used to drive the conventional electro-Fenton system. Therefore, this study intended to explore the H_2O_2formation reactions on the cathode materials of the conventional electro-Fenton system in the MFC. In this study, H_2O_2 production kinetics on different cathode materials, including the non-catalytic materials such as graphite and steel plate, the high specific surface area materials such as carbon nanotubes, activated carbon, the catalytic materials such as platinum-titanium plate and the high specific surface area catalytic materials such as manganese oxide/carbon aerogel were evaluated. These cathode materials showed different H_2O_2 production performance. Among them, the manganese oxide/carbon aerogel with high specific surface area and catalytic activity demonstrated the best performance of H_2O_2 production among testing materials. The reaction kinetics of H_2O_2 production rates on high specific surface area cathode materials, the activated carbon and carbon nanotubes, were found to be pseudo-first order. However, for the cathode materials with catalytic surface, the manganese oxide/carbon aerogel and platinum titanium, the reaction kinetics of H_2O_2production rates were found to be pseudo-zero order within 12 h. Our results suggest that the catalytic cathode materials with high specific surface area, like manganese oxide/carbon aerogel, may be more promising for H_2O_2 production in MFCs to provide the electro-Fenton system. Therefore, the development of better cathode materials should be focused for the future application of MFCs driven electro-Fenton system.

Keywords: Microbial fuel cells (MFCs); Hydrogen peroxide; High specific surface area materials; Catalytic materials; Kinetics

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