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Enhanced energy recovery by manganese oxide/reduced graphene oxide nanocomposite as an air-cathode electrode in the single-chambered microbial fuel cell

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ABSTRACT

Microbial fuel cells (MFCs) provide an opportunity to harvest electrical energy from biodegradable organic wastes. In air-cathode MFCs, cathode plays an important role at which oxygen reduction reaction (ORR) occurs. Herein, MnO₂ nanorods are demonstrated as a potential air-cathode catalyst in a single-chambered MFC (sMFC). Synthesis of two different MnO₂ morphologies (nanoflakes and nanorods) is demonstrated at room temperature using a simple precipitation method. In order to improve the performance of MnO₂ as ORR electrocatalyst, graphene oxide (GO) is used as conductive matrix instead of carbon black. Furthermore, MnO₂/GO is hydrothermally treated to obtain MnO₂/reduced GO (h-MnO₂/rGO) nanocomposite. The sMFC comprising air-cathode with an optimum loading of h-MnO₂/rGO delivers 2.7 times higher volumetric power density than that of sMFC without a catalyst and comparable to the state-of-art Pt/C. This is ascribed to superior 4-electron ORR pathway by h-MnO₂/rGO and improved charge transport behavior of rGO support as confirmed through detailed electrochemical investigation. This work demonstrates a facile room temperature synthesis process of MnO₂ nanoflakes and nanorods, and their role as air-cathode electrocatalyst for competent power generation in sMFC.

Keywords: microbial fuel cells; nanorods; oxygen reduction reaction; air-cathode; manganese oxide; reduced graphene oxide.

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