Sediment Microbial Fuel Cell with Double-Anode Arrangement for Enhanced Oxygen Reduction Reaction

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Biofilms formed on the cathodes of sediment microbial fuel cells (SMFCs) are mainly composed of heterotrophic bacteria that inevitably attach to cathode catalytic sites, inhibit the oxygen reduction reaction (ORR), and affect the practical performances of SMFCs. In the present work, a novel double-anode sediment microbial fuel cell (DA-SMFC) was designed and constructed with a commercial nitric acid-activated carbon felt set at sediment-water interface, and its electrical power generation performance and antibacterial mechanism were investigated. The voltage generation capacity of DA-SMFC reached up to 376 mV, higher than those of the sediment microbial fuel cell (SMFC) (332 mV) with the carbon felt put in sediment, due to the higher total organic carbon (TOC) removal efficiency. The electrochemical impedance spectroscopy, bacterium protein content, and SEM analyses indicated that the formation of biofilm on the cathode of DA-SMFC was significantly inhibited, resulting in significantly reduced protein contents on cathode, and decreased R_{ct} from 118.9 Ω to 91.6 Ω . This novel DA-SMFC system exhibited excellent antibacterial performances by inhibiting the migration of organic matters from the sediments to the cathode in overlying water, which would promote the application of SMFC.

Keywords: Sediment microbial fuel cell, Double-Anode, Oxygen reduction reaction, Biofilm, Electricity generation

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