Mini-review: Anode modification for improved performance of microbial fuel cell

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\section*{A R T I C L E   I N F O}

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\section*{A B S T R A C T}

Microbial fuel cell (MFC) harnesses the metabolic activities of microorganisms to generate electricity from substrate oxidation. However, the power generated from the MFC is relatively low for practical applications, thus the urgent need for its improvement. In MFC, anode is a crucial component of the setup, both structurally and functionally. It provides support for bacterial attachment and simultaneously acts as a sink for electrons from substrate metabolism. Poor performance of anode electrode in MFC is still a major setback for its practical applications. Successful anode electrode modification is expected to enhance the MFC electricity generation efficiency. Materials such as carbon nanotube, stainless steel, conducting polymers, metal oxides, and electrolytes have been employed as anode electrode modifiers with varying degree of success. Henceforth, this communication highlights and discusses the latest research advances made in MFC anode electrode modification using the aforementioned materials. The importance of the modification methods and their consequences towards anode architecture, biocompatibility, and longevity to improve the overall MFC performance are discussed.

\section*{1. Introduction}

The energy derived from fossil fuel is both non-renewable and limited to meet the global increase in energy demand \cite{1}. In addition, the energy source is associated with the release of greenhouse gases leading to global warming and environmental pollution issues \cite{2}. Fossil fuels such as oil and gas are predicted to be depleted by the year 2042 \cite{3}. Hence, there is an exigent need to find alternative renewable sources of energy. Among such alternatives are biodiesel \cite{4}, bioethanol \cite{5}, biohydrogen, and biofuel cells \cite{6}, microbial fuel cell (MFC) diffusion across an ion exchange membrane into the cathode compartment where they subsequently combine with the final electron acceptor such as molecular oxygen to form water, thus completing the circuit and electricity generation process via the redox reaction process \cite{12-14}. Despite the environmental-friendly nature of MFC and its inherent simplicity, the characteristics of anode electrode material play a critical role and have been the major reason underlying the low efficiency in different MFC prototypes \cite{15-17}. Bacterial attachment and the ease of electron flow can be affected by the type of anode material and its composition \cite{18}. An ideal MFC anode material should be an electron donor for bacterial attachment and a high electron transfer rate.