Bioinspired Anode Materials Derived from Nutshells for Improved Microbial Fuel Cell Performance and Bioenergy Generation

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Abstract

Biochar, a highly carbonaceous material, results from the thermal decomposition of biomass in the absence of oxygen, yielding a stable solid product. This study investigates the electrochemical performance of biochar derived from peanut shell, coconut shell, and walnut shell in a dual-chamber microbial fuel cell (MFC). The biochar exhibits a unique combination of physicochemical properties, including macro-porosity, amorphousness, biocompatibility, and electrochemical conductivity, making it an ideal material for bio-electrochemical applications. Polarization curve analysis reveals that Peanut shell biochar (PSB) achieves the highest power density of 165 mW/m2, outperforming Coconut shell biochar (CSB), Activated Charcoal (AC), and Walnut shell biochar (WSB). The enhanced electrochemical performance of PSB was attributed to its unique combination of high surface area and suitable pore size distribution, enabling robust biofilm formation and efficient electron transfer. The high electrical capacitance of PSB facilitated enhanced electron transfer kinetics between microbial cells and the anode, boosting bio-electrochemical performance.

Keywords Microbial fuel cell; Bio electrochemical; Biochar's; Conductivity; Bioenergy

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