Enhanced Electrochemical Performance of Graphite Felt Electrodes Modified with Single-Walled and Multi-Walled Carbon Nanotubes for Redox Flow Batteries

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Redox flow batteries (RFBs) are a vital technology for large-scale stationary energy storage, and the Iron-TEMPO system stands out as a promising candidate due to its utilization of abundant, low-cost, and ecologically friendly active ingredients. However, the efficacy of these systems is frequently hampered by the slow electrochemical kinetics and insufficient surface area of typical graphite felt (GF) electrodes. In this study, we report on the surface modification of graphite felt using a synergistic mix of single-walled carbon nanotubes (SWCNTs) and multi-walled carbon nanotubes (MWCNTs) to improve its electrocatalytic activity. The hybrid CNT modification considerably enhances electroactive surface area and allows for quicker electron transport in both the iron-based anolyte and the TEMPO-based catholyte. In an Iron-TEMPO RFB setup, the modified graphite electrode demonstrated 90% Coulombic efficiency (CE) and 80% voltage efficiency (VE) at a current density of 5 mA cm^{-2}. These results show that integrating SWCNTs and MWCNTs onto the graphite felt surface efficiently minimizes overpotential and enhances the battery's overall energy efficiency.

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