

Title : Electrodeposited Pt Catalyst on Zirconium-based Metal-organic Frameworks modified Carbon Nanotubes to Enhance Catalyst Efficiency for Direct Alcohol Fuel Cells

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ABSTRACT

Fuel cells are a promising clean energy technology, with direct alcohol fuel cells (DAFCs) offering notable advantages such as high energy density, low operating temperature, and simple fuel handling. However, their performance is often limited by sluggish alcohol oxidation kinetics and CO poisoning. In this study, zirconium-based metal-organic frameworks modified carbon nanotubes (Zr-MOFs/CNT) were employed as an advanced support material to enhance the dispersion, stability, and CO tolerance of Pt catalysts. Pt nanoparticles were electrodeposited onto CNT supports containing varying Zr-MOFs loadings (1, 5, 10, and 20wt%) to enhance catalyst efficiency. Electrochemical performance was studied by the cyclic voltammetry (CV) technique for the electro-oxidation of various alcohols, including methanol, ethanol, n-propanol, n-butanol, ethylene glycol, and glycerol. The optimized Pt/10wt% Zr-MOFs/CNT catalyst has higher current densities compared to Pt/CNT, with methanol and ethanol oxidation currents increasing nearly threefold, and notable improvements were also observed for polyols such as ethylene glycol and glycerol. These enhancements are attributed to improved Pt dispersion and the synergistic effect of Zr-MOFs, which mitigates CO poisoning and stabilizes the catalyst. These findings highlight that Zr-MOFs/CNT composites provide a synergistic effect with Pt, offering improved alcohol oxidation kinetics and CO tolerance. Overall, Pt/10wt% Zr-MOFs/CNT emerges as a highly efficient and stable catalyst, underscoring their potential for advancing the DAFCs.

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