Preparation and Evaluation of Nickel Oxide-Carbon Nanotube Supported Palladium as Anode Electrocatalyst for Formic Acid Fuel Cells

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In this study, promotional effects of NiO on Pd/NiO-CNT catalysts (CNT: carbon nanotubes) for formic acid oxidation is investigated. Firstly, NiO is loaded on CNT in various amounts by precipitation-deposition method using urea as precipitating agent, and then palladium is deposited on the NiO-CNT support material by the borohydride reduction method. The synthesized catalysts are characterized by XRD, SEM-EDX, TEM, N₂ adsorption-desorption and XPS for their morphology, composition and electronic structure. Cyclic voltammetry, chronoamperometry, and carbon monoxide stripping voltammetry reveal that the addition of NiO enhances the electrocatalytic activity and stability of Pd/NiO-CNT catalysts remarkably. Highest current density (80.83 mA/cm²) is achieved for the catalyst with 15 wt. % NiO content which is three times higher than the current density shown by Pd/CNT (23.23 mA/cm²). The maximum power density in passive direct formic acid fuel cell is found to be 13.6 and 6.2 mW/cm² for Pd/15% NiO-CNT and Pd/CNT, respectively, which clearly demonstrate the beneficial effect of addition of NiO on Pd/NiO-CNT. The improvement in the electrocatalytic activity and stability is ascribed to the formation of small and highly dispersed Pd particles and the modification of electronic structure of Pd in presence of NiO.

Keywords: Nickel oxide; Carbon nanotubes; Palladium-electrocatalyst; Passive formic acid fuel cell

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