Hydrogen Production Using Electrodeposited Ni and Ni/Co on Carbon Paper as Cathode Catalyst in Microbial Electrolysis Cells

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Microbial electrolysis cells (MECs) utilize microorganisms to decompose organic matter in wastewater and produce hydrogen at the cathode. Thus, a low-cost and highly active cathode material is of great importance in such system. In this study, electrodeposited Ni, Co, and Ni/Co on carbon paper (CP) were prepared as cathode to replace platinum. At an applied voltage of 0.7 V, the Ni MEC cathode produced most gas of 11.40 mL at current density of 15.31 A m^{-2} , which was 73.24% higher than that of bare CP electrode (3.05 mL). Linear sweep voltammetry and Cyclic voltammetry measurements showed that the hydrogen evolution performance of the Ni cathode was significantly better than Co and Ni/Co cathodes. The Tafel plots proved that the hydrogen evolution overpotential of Ni cathode ($59.89 \text{ mV decade}^{-1}$) was lower than that of bare CP electrode ($99.22 \text{ mV decade}^{-1}$). Owing to the improved current density, hydrogen recovery rate and low hydrogen evolution overpotential, the developed electrodeposited Ni on CP materials possessed much higher catalytic activity than bare CP. Thus, electrodeposited Ni on CP are promising electrocatalysts for hydrogen evolution reaction and low-cost cathode materials in MECs.

Keywords: Microbial electrolysis cells; electrodeposited Ni/Co; carbon paper; hydrogen evolution reaction.

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