Investigation of hydrogen evolution on electrodeposited Ni/P coated carbon paper electrode in microbial fuel cell

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Microbial electrolytic cell (MEC) is an innovative bioelectrochemical technology for hydrogen production using various organics and even wastewater. The development of a nonprecious metal hydrogen catalyst is critical to MECs. Increasing the stability and activity of such catalyst remains a key challenge. In this study, Ni/P is prepared by electrodeposition on bare carbon paper. The prepared electrode material is used as a cathode electrocatalyst in an MEC. Here, we show that the Ni/P cathode material has excellent hydrogen generation catalytic activity, that is comparable to that of Pt and superior to that of Ni or bare carbon paper. Particularly, the electrode has the best hydrogen evolution ability when the $\text{Ni}^{2+}/\text{PO}_4^{3-}$ ratio is 50:30 and current density is 154.18 A m^{-2} , which is 12% larger than that of Pt. The cathode hydrogen recovery rate, hydrogen production rate and energy efficiency of the electrode are $74.54\% \pm 0.89\%$, $0.321 \pm 0.012 \text{ m}^3 \text{ H}_2 \text{ m}^{-3} \text{ d}^{-1}$ and $135.11\% \pm 5.36\%$, respectively, which are superior to those of Pt. The Ni/P cathode has good long-term stability. Results of this study, indicate that the Ni/P cathode is an alternative to Pt and have good prospects for MEC hydrogen evolution reaction (HER) cathode.

Keywords: MEC; Ni/P; electrodeposition; HER

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