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An Electrochemical Study on Ethanol Oxidation with Pt/Pd Composite Electrodes in Sodium Hydroxide Solution

Authors : Yu-Chen Luo, Wan-Tzu Yen, I-Ping Liu, Po-Hsuan Yeh, Yuh-Lang Lee

Abstract : The use of a Pt electrode leads to high catalytic efficiency in the ethanol electro-oxidation. However, the carbon monoxide (CO) released in the reaction will poison the Pt surfaces, lowering the electrocatalytic activity. In this study, composite electrodes are prepared to overcome the poisoning issue, and the related electro-oxidation behaviors are studied by surface-enhanced infrared absorption spectroscopy (SEIRAS) and cyclic voltammetry (CV). An electroless plating method is utilized to deposit Pt catalytic layers on the Pd film-coated FTO substrates. According to the SEIRAS spectra, the carbon dioxide signal of the Pt/Pd composite electrode is larger than that of the Pt one, whereas the CO signal of the composite electrode is relatively smaller. This result suggests that the studied Pt/Pd electrode has a better ability against CO poisoning. The CV analyses are conducted in alkaline environments, and current densities related to the ethanol oxidation in the forward scan (If) and to the CO poisoning in the backward scan (Ib) are measured. A higher ratio of If to Ib (If/Ib) usually represents a better ability against the poisoning effect. The If/Ib values are 2.53 and 2.07 for the Pt and Pt/Pd electrodes, respectively, which is possibly attributed to the increasing ability of CO adsorption of Pt electrode. Despite the lower If/Ib, the Pt/Pd composite electrode shows a higher ethanol oxidation performance in the alkaline system than the Pt does. Furthermore, its stability is also superior.

Keywords : cyclic voltammogram, electroless deposition, ethanol electro-oxidation, surface-enhanced infrared absorption spectroscopy
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