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Performance of BiCu2O modified Pd/C as an anode electrocatalyst for direct ethanol fuel cell system

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Abstract

BiCu2O Modified Pd/C nanocatalyst was synthesised via an eco-friendly method for fuel cell application. The obtained nanomaterials' structural composition, and electrochemical properties were investigated using chemical and physical techniques such as impedance spectroscopy (EIS), X-ray diffraction (XRD), high resolution-scanning electron microscopy (HR-SEM), and cyclic voltammetry (CV). The preparation of the BiCu2O Modified Pd/C catalyst was successfully verified by microscopic techniques, as shown by the presence of mixed nanostructures, Pd and BiCu2O coexisting. EIS measurements confirmed a smaller electron charge-transfer (160 O) for the prepared Pd/C-BiCu2O nanocatalyst. From the Pd oxide peaks, the electrochemical active surface area (EASA) values for Pd/C-BiCu2O and Pd/C were estimated to be 432.1 cm2 mg-1 and 79.2 cm2 mg-1, respectively. The resulting BiCu2O Modified Pd/C nanocatalyst showed increased ethanol oxidation activity (If/Ib=1.1) and was more resistant to poisoning by advanced oxidation species. Under passive conditions at 1 M ethanol in 1 M KOH, improved cell performance (cell output = 120 mW) with a high density of current (105 mAcm-2) and power density (25.7 mWcm-2) relative to the commercial Pd/C were obtained. The study opens and forges novel possibilities in the search for new carbon co-catalysts for direct ethanol fuel cell (DEFC) application because of the simplified green processing and the cost of the precursor and the Pd-based catalyst produced. The work involves using difficult waste streams produced by various agro-industrial operations to create high surface material for use in producing commodities with added value. This work will also help address climate action, clean and affordable energy crisis.