Abstract

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Insights into electrochemical behavior and kinetics of NiP on PEDOT:PSS/reduced graphene oxide as high-performance electrodes for alkaline urea oxidation

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Abstract

Highly efficient, abundant, and low-cost materials are highly demanded for energy conversion applications to address the rising consumption of energy. In this study, polythiophene/reduced graphene (PT/rGO) and PEDOT:PSS/rGO (both Clevios PH1000 and Clevios P Al PH4083) as an efficient and low-cost support material were synthesized via a one-pot two-step in situ chemical polymerization method to enhance the electrocatalytic performance of NiP towards urea oxidation in alkaline media. These materials were characterized using SEM, FTIR, XRD, UV-VIS and TGA devices. The physical characterization reveals nanospherical NiP with multifaceted phases dispersed on PT/rGO and PEDOT:PSS/rGO. The electrochemical activities of as-synthesized catalyst materials towards urea electrooxidation were tested by using cyclic voltammetry. The electrochemical activity test exhibits the significant performance improvement of NiP when supported on PT/rGO and both grades of PEDOT:PSS incorporated rGO materials. Among the support materials, the highest performance enhancement with a high current density of 91.2 $mAcm^{-2}$ and lower onset potential of 0.26 V, high electrochemically active surface area, high kinetics, and high stability towards alkaline urea electro-oxidation was achieved when NiP dispersed on the surface of PEDOT:PSS/rGO (PH4083). Thus, a new PEDOT:PSS/rGO (PH4083) supported NiP (NiP@PEDOT:PSS/rGO) remarkably outperformed commercial NiP, making it to be a promising anode electrocatalyst material for alkaline urea electro-oxidation in Direct Urea Fuel Cell (DUFC).

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