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RESEARCH ARTICLE

An evaluation of activation energy, surface area, and catalytic activity relationship of the developed nonmetal alloy decorated Schiff's base based conjugated conductive polymer composite electrodes for fuel cell applications

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Summary

In the present work, an attempt has been made to evaluate activation energy, electro-active surface area, kinetics, quantity of reacted methanol molecules, and catalytic activity relationship over the newly developed non-noble metal alloy decorated Schiff's base based conjugated conductive polymer composite electrodes for fuel cell applications. Typically, a new type of catalysts was developed using nickel and nickel-tin decorated conjugated Schiff's base based conductive polymer-palm flower carbon composites to utilize them in the form of possible high-performance catalysts. The bimetallic composition with different weight percentage concentrations of $NiSn_{10}$/CSP-PC, $NiSn_{20}$/CSP-PC, $NiSn_{30}$/CSP-PC, and Ni/CSP-PC nanoparticles decorated Schiff's base based conductive polymer-palm carbon (CSP-PC) composite electrode materials are developed through the facile chemical reduction route. Structure, composition, morphology, electro-active surface area, kinetics, activation energy, quantity of molecules reacted, and the electrocatalytic activity are evaluated by using different analytical techniques. The electrochemical studies indicate that the nickel nanoparticles deposited Schiff's base based conductive polymer-palm flower carbon composite electrode developed in the present work shows the enhanced electro-oxidation current, reduced onset potential, lower activation energy, higher electro-active surface, and improved stability than those of other Schiff's base based conductive polymer and palm flower carbon. Electrochemical characterization studies also indicate that the appropriate amount of tin doping (10%) improved not only the catalytic activity but also enhanced the long-term anti-poisoning ability than that of Ni/CSP-PC catalyst. The onset potential of the $NiSn_{10}$/CSP-PC catalyst for methanol oxidation is lower when compared with that of other catalysts having varied weight percentage compositions. With the best of our knowledge, this is considered to be the first report in the field of development of conjugated Schiff's base based conductive polymer-palm flower carbon composite as new support for efficient, low cost, and non-noble metal electrocatalysts for direct methanol fuel cell (DMFC) applications.

REFERENCES