Introducing a Novel Nanohybrids of Nickel and Cobalt Nanoparticles Loaded on Carboxymethyl Cellulose Core-Shell as an Anodic Catalyst for Urea Fuel Cells

Alboali, Fatimah (School: Alkifah Academy)

The utilization of wastewater containing urine as fuel in Urea Fuel Cells (UFCs) has attracted significant attention in the recent years as a safe and environmentally-friendly alternative energy source for fossil fuel and holds great potential to fulfill the rising energy demand. The use of a good anode catalyst is the main factor to increase the electrochemical oxidation performance of urea and further boosting the performances of UFCs. In this project, nickel and cobalt oxide nanoparticles were embedded with Carboxymethyl Cellulose (CMC) to produce the novel electrode material. The as-prepared Ni/Co@CMC material was characterized by FE-SEM, XRD, FTIR, XPS and EDX techniques. The electrochemical performance of Ni/Co@CMC nanohybrids electrode as an anode for UFCs in KOH medium was examined in the three-electrode system using cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) methods. The stability of the catalyst was studied by Chronoamperometric (CA) analysis. The catalyst showed a current density of 369.4 mA/cm². The fabricated anode exhibited enhanced urea electrochemical oxidation at different urea doses. The increased transfer of electrons during the formation of urea is indicated by the decrease of both charge transfer impedance and series resistance, which may be attributed to the strong electro-catalytic activity of Ni/Co@CMC nanohybrids as an electro-catalyst. This study presents a novel inexpensive bimetallic Ni/Co@CMC for the simple strategy of electrodes in UFCs. These results show the prepared materials improved performance in the electrooxidation of urea, demonstrating their suitability for treating urea-rich wastewater and using them in fuel cells