World Academy of Science, Engineering and Technology
International Journal of Chemical and Materials Engineering
Vol:14, No:09, 2020

NiSe-Ni_3Se_2/Multiwalled Carbon Nanotubes as Efficient Electrocatalysts for the Oxygen Evolution Reaction in Alkaline Media

Authors : Oluwaseun A. Oyetade, Roelof J. Kriek

Abstract : The development of effective catalysts for the oxygen evolution reaction (OER) is of great importance to combat energy-related concerns in the environment. Herein, we report a one-step solvothermal method employed for the fabrication of nickel selenide hybrids (NiSe-Ni_3Se_2) and a series of nickel selenide hybrid/multiwalled carbon nanotube composites (NiSe-Ni_3Se_2/MWCNT) as electrocatalysts for OER in alkaline media. The catalytic activities of these catalysts were investigated via several electrochemical characterization techniques, such as linear sweep voltammetry, chronoamperometric studies at constant potential, electrochemical surface area determination, and Tafel slope calculation, under alkaline conditions. Morphological observations demonstrated the agglomeration of non-uniform NiSe-Ni_3Se_2 microspheres around carbon nanotubes (CNTs), demonstrating the successful synthesis of NiSe-Ni_3Se_2/MWCNT nanocomposites. Among the tested electrocatalysts, the 20% NiSe-Ni_3Se_2/MWCNT nanocomposite demonstrated the highest activity, exhibiting an overpotential of 325 mV to achieve a current density of 10 $mA.cm^{-2}$ in 0.1 $mol.dm^{-3}$ KOH solution. The NiSe-Ni_3Se_2/MWCNT nanocomposites showed improved activity toward OER compared to bare NiSe-Ni_3Se_2 hybrids and MWCNTs, exhibiting an overpotential of 528, 392 and 434 mV for 10%, 30% and 50% NiSe-Ni_3Se_2/MWCNT nanocomposites, respectively. These results compare favourably to the overpotential of noble catalysts, such as RuO_2 and IrO_2. Our results imply that the addition of MWCNTs increased the activity of NiSe-Ni_3Se_2 hybrids due to an increased number of catalytic sites, dispersion of NiSe-Ni_3Se_2 hybrid nanoparticles, and electronic conductivity of the nanocomposites. These nanocomposites also demonstrated better long-term stability compared to NiSe-Ni_3Se_2 hybrids and MWCNTs. Hence, NiSe-Ni_3Se_2/MWCNT nanocomposites possess the potential as effective electrocatalysts for OER in alkaline media.

Keywords : carbon nanotubes, electrocatalysts, nanocomposites, nickel selenide hybrids, oxygen evolution reaction
Conference Title : ICEEP 2020 : International Conference on Electrochemistry and Electrochemical Processes
Conference Location : Paris, France
Conference Dates : September 17-18, 2020

Open Science Index, Chemical and Materials Engineering Vol:14, No:09, 2020 publications.waset.org/abstracts/124221.pdf