Abstract

Global energy consumption is rising, necessitating the development of innovative materials and technologies for efficient energy conversion. Today, non-platinum group metals (non-PGM) are being used to synthesize effective electrocatalysts for hydrogen generation. Producing high-efficiency electrocatalysts without the need for extra energy is thus very desirable yet challenging. Transition metal chalcogenides such as nickel (Ni), manganese (Mn), cobalt (Co), iron (Fe), and molybdenum (Mo) showed promising activity in Hydrogen evolution reaction (HER) and Oxygen evolution reaction (OER). The synthesis and characterization of selenium-based nanocomposites optimized for enhanced energy conversion applications are the subject of this study. Selenium, a versatile element, has exceptional semiconductor capabilities and has significant promise for sustainable energy solutions. This study looks at the design and production of selenium-based nanocomposites using several synthetic methods including the hydrothermal process. These nanocomposites' composition and structure are carefully altered to improve their performance in energy conversion systems. The incorporation of selenium with other materials, such as transition metal oxides, is being researched in order to exploit synergistic effects that improve energy conversion efficiency .Various characterization techniques were used in this investigation, including X-ray diffraction (XRD), scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDS), and spectroscopic analysis. These approaches allow for in-depth examination of nanocomposite morphology, crystallography, and chemical composition, yielding vital insights into structure-property connections. This research reveals the effective fabrication of a novel electrocatalyst made of earth-abundant transition metals such as $MoSe_2$ and Ce ($MoSe_2$) with a three-dimensional (3D) nanostructure and high activity on a Ni foam (NF) and FTO substrate using a simple hydrothermal approach. At a current density of $10mAcm^{-2}$, the catalyst Ce ($MoSe_2$)/NF had an overpotential of -344.8mV towards HER and 470mV at $50mAcm^{-2}$ towards OER.