Abstract

This study demonstrates the synthesis of pure and Mn-doped MoO_3 nanoparticles (NPs) through the utilization of the hydrothermal technique. X-ray diffraction (XRD) investigations were performed in order to examine the crystal structure and phase purity of both pristine and manganese-doped molybdenum trioxide nanoparticles (NPs). The findings of the study revealed that the mean diameters of the nanoparticles' crystallites varied between 59 and 11 nm. The NPs were subjected to vibrational spectral analysis, which was conducted in accordance with previously obtained structural data. The determination of the direct and indirect band gap energies of the samples was carried out utilizing the Tauc Plot equation. The obtained values for the direct band gap energies ranged from 4.4 eV to 3.9 eV, while the values for the indirect band gap energies ranged from 3.2 eV to 2.6 eV. In the context of electrochemical analysis, the deposition of Mn-doped MoO_3 samples onto a nickel foam substrate was carried out, utilizing Nafion ($C_7HF_{13}O_5S \cdot C_2F_4$) as a binder. The electrochemical characteristics of each specimen were examined using cyclic voltammetry (CV), galvanostatic charge-discharge (GCD), and electrochemical impedance spectroscopy (EIS) methodologies, employing a 6M KOH electrolyte solution. The findings of the study indicated that the MoO_3 nanocomposite without any doping had the greatest specific capacitance. Specifically, it achieved a value of 410 Fg^{-1} at a scan rate of 5 mVs^{-1} in cyclic voltammetry (CV) and 345.5 Fg^{-1} at a current density of 0.5 Ag^{-1} in galvanostatic charge-discharge (GCD) measurements. In addition, the aforementioned sample exhibited noteworthy energy density and power density measurements of 6.95 $Whkg^{-1}$ and 1250 Wkg^{-1}, correspondingly. The aforementioned findings underscore the potential utility of undoped MoO_3 in the realm of supercapacitor applications.