Abstract

This thesis endeavors to investigate the efficacy of Zn-doped binary composite materials (M_oS_2/MnO_2) as electrode materials for supercapacitors. By examining synthesis techniques, describing structural and morphological characteristics, and carrying out in-depth electrochemical analyses, this study seeks to offer a thorough grasp of the benefits and drawbacks of Zn doped binary composite (M_oS_2/MnO_2). TMCs have emerged as viable electrodes for pseudocapacitors due to their exceptional redox activity and abbreviated transport paths. Zn doping improves the conductivity of the unmodified electrode by inducing charge imbalance, which facilitates the hopping movement of charge carriers. High-performance supercapacitor electrode material improvement is expected to be significantly aided by the findings of this study. Scanning Electron Microscopy (SEM), energy dispersive spectroscopy (EDS), XRD, cyclic voltammetry, GCD analysis, and EIS were utilized for the characterization of the synthesized materials. They also address the urgent demand for effective and sustainable energy storage solutions by providing insightful information about the real-world uses of these materials in energy storage systems. A Zn-doped binary composite (M_oS_2/MnO_2) electrode material was prepared by hydrothermal process. This electrode, at 2.85 Ag^{-1}, had an energy density of 470 $Whkg^{-1}$ and capacitance of 1469 Fg^{-1} was computed. Interestingly, when submerged in a 1M KOH solution, these samples demonstrate the capacity to operate efficiently within a potential window (ΔV=0.8 V), making them excellent candidates for incorporation into a variety of electrical devices. This exceptional performance is mostly due to the distinctive morphology of the composite, which greatly improves its charge storage capacity. The exceptional electrochemical activity and pseudocapacitive behavior result from the synergy of its components.