ABSTRACT

The need for energy storage systems with high power density, fast charging capability, and good stability has encouraged the development of conductive polymer-based supercapacitor electrode materials. Polyaniline exhibits high pseudocapacitive performance; however, it undergoes structural degradation during redox cycling, requiring the presence of supporting materials. This study aimed to synthesize a sulfonated poly(eugenol-co-divinylbenzene)/polyaniline composite and evaluate its potential as a supercapacitor electrode material. Poly(eugenol-co-divinylbenzene) was synthesized through cationic addition polymerization using $BF_3O(C_2H_5)_2$ as a catalyst under inert conditions, followed by sulfonation with concentrated sulfuric acid. Polyaniline was synthesized via chemical oxidative polymerization using ammonium persulfate in an acidic medium. The sulfonated poly(eugenol-co-divinylbenzene)/polyaniline composite was prepared by physical blending using N-methyl-2-pyrrolidone as the solvent with the assistance of ultrasonication and magnetic stirring. Characterization was carried out using Fourier Transform Infrared (FTIR) spectroscopy, Cyclic Voltammetry (CV), and Electrochemical Impedance Spectroscopy (EIS). The results showed that sulfonated poly(eugenol-co-divinylbenzene) possessed a degree of sulfonation of 14.35% and a cation exchange capacity of 0.49 meq/g, indicating the successful introduction of sulfonate groups into the polymer chain. FTIR analysis of the composite revealed the presence of sulfonate, O–H, N–H, quinoid, and benzenoid groups, along with shifts in wavenumber that indicated electrostatic interactions between sulfonated poly(eugenol-co-divinylbenzene) and polyaniline. Electrochemical testing showed that the sulfonated poly(eugenol-co-divinylbenzene)/polyaniline composite exhibited a specific capacitance of 69.94 F/g and an ionic conductivity of 0.011 S/cm, which were higher than those of the individual constituent materials. These results demonstrate a synergistic effect between the two components, indicating that the composite has potential for development as an environmentally friendly supercapacitor electrode material with improved electrochemical performance.

Keywords: *Polyeugenol, Sulfonation, Polyaniline, Supercapacitor*.