ABSTRACT

Exploration of the development of more economical supercapacitor materials is carried out by utilizing wastestyrofoam. Styrofoam composed of polystyrene which is very easy to modify. One modification that can be done is the addition of sulfonate groups through sulfonation reactions. This modification causes polystyrene to have better ionic conductivity properties and has the potential to become an economically valuable conductive material in supercapacitors. A supercapacitor electrode material must have the ability to store and conduct electricity. To improve its ability as a supercapacitor material, sulfonated polystyrene can be added with polyaniline to increase electrical conductivity and $MnO_2$to increase the capacitance. This study aims to synthesize sulfonated polystyrene/polyaniline/MnO composites.$_2$and test its potential as a supercapacitor material. This research consists of several stages starting from the sulfonation of polystyrene from waste.styrofoamusing sulfuric acid, polyaniline synthesis, MnO synthesis$_2$, synthesis of sulfonated polystyrene/polyaniline/MnO composites$_2$, and supercapacitor electrode fabrication. Characterization of the synthesis results includes physical observations in the form of changes in form and color, melting point tests, determination of molecular weight, determination of the degree of sulfonation, analysis of functional groups with spectroscopyFourier Transform Infrared (FTIR), X-Ray Diffraction (XRD), as well Field Emission Scanning Electron Microscopy (FE-SEM) –Energy Dispersive X-ray Spectroscopy (EDX) – Mapping. The potential test of supercapacitor electrode material was carried out byCyclic Voltammetry (CV) and Electrochemical Impedance Spectroscopy (EIS). The final results of this study indicate that the sulfonated polystyrene/polyaniline/MnO composite$_2$successfully synthesized with the result being a blackish solid with a porous structure and MnO distribution.$_2$evenly. The FTIR results show the presence of a broad absorption band belonging to O–H originating from the sulfonate group in sulfonated polystyrene and a typical C–N absorption band of polyaniline. The presence of the sulfonate group of sulfonated polystyrene plays a role in providing active sites, which can facilitate ion exchange and support ionic conductivity. Meanwhile, polyaniline plays a role in providing a conductive path, as well as MnO_2increasing capacitance through redox mechanism. The presence of these three materials provides their respective functional characteristics to the performance of the supercapacitor electrode. The specific capacitance value obtained was 1.031 F/g with an electrical conductivity of 275.43×10^{-5}S/cm. These results open up opportunities for further development of economically valuable electrode materials through waste utilization.

Keywords : *composite, styrofoam waste, sulfonated polystyrene, polyaniline, MnO_2, supercapacitor*