

ABSTRACT

Electrode material for supercapacitors that excels in specific capacitance and electrical conductivity is conductive polymer. Poly Eugenol is a conductive polymer synthesized from renewable natural resources and can be modified with the addition of cross-linking agents such as diallyl phthalate to enhance structural density and thermal stability. The addition of sulfonate groups is another modification to improve ion exchange capacity and electrical conductivity in the polymer. This study aims to synthesize sulfonated eugenol-diallyl phthalate copolymer and test its potential as a supercapacitor material. The research began with the synthesis of eugenol diallyl phthalate copolymer through cationic polymerization using $\text{BF}_3\text{O}(\text{C}_2\text{H}_5)_2$ catalyst and modified by sulfonation using sulfuric acid. The synthesis results were characterized by determining molecular weight, solubility tests, melting point tests, functional group analysis with Fourier Transform Infrared (FTIR) spectroscopy, and thermal stability using Thermogravimetric Analysis (TGA). The potential of the supercapacitor electrode material was tested using Cyclic Voltammetry (CV) and Electrochemical Impedance Spectroscopy (EIS). The synthesized eugenol-diallyl phthalate copolymer was a pink solid with a yield of 68.44%. The success of the synthesis was indicated by the disappearance of the vinyl group ($\text{C}=\text{C}$ alkene) and the emergence of ester ($\text{C}=\text{O}$) and OH functional groups. It was soluble in organic solvents and insoluble in distilled water. TGA analysis showed a 5% and 10% mass loss at 176°C and 219°C , respectively. The sulfonated eugenol diallyl phthalate copolymer was a dark purple solid with a sulfonation degree of 17.18% and a cation exchange capacity of 0.4186 meq/g. It was soluble in organic solvents and insoluble in distilled water. The melting point increased from 85°C to 114°C and the molecular weight increased from 6739.99 daltons to 8342.25 daltons. Sulfonation was successfully carried out, indicated by the absorption of sulfonate groups ($-\text{SO}_3\text{H}$) at 1218 cm^{-1} ($\text{S}=\text{O}$), 1065 cm^{-1} ($\text{S}-\text{O}$), and 578 cm^{-1} ($\text{C}-\text{S}$). TGA analysis showed a 5% and 10% mass loss at 169°C and 215°C , respectively. The specific capacitance value was $3.2342 \times 10^{-3}\text{ F/g}$ and the ionic conductivity was $7.576 \times 10^{-6}\text{ S/cm}$.

Keywords: Sulfonated Eugenol Diallyl Phthalate Copolymer, Electrode Material, Supercapacitor