ABSTRACT

The rapid development of portable electronic devices and electric vehicles has increased the demand for safe and efficient energy storage systems, particularly lithium-ion batteries. One of the critical components affecting battery safety and performance is the separator. Commercial separators based on polyolefin materials still exhibit limitations, such as low thermal stability and poor electrolyte wettability. This study aims to synthesize and characterize PVA/$SiO_2 - Al_2O_3$ composite membranes as potential separators for lithium-ion batteries using the electrospinning method. A 10% (w/v) Poly(vinyl alcohol) (PVA) solution was combined with SiO_2 dan Al_2O_3 nanoparticles in various composition ratios and fabricated into nanofiber membranes using electrospinning at a voltage of 15 kV and a collector distance of 14 cm. The obtained membranes were characterized using Fourier Transform Infrared (FTIR) spectroscopy to analyze functional group interactions, X-Ray Diffraction (XRD) to determine the crystalline structure, and porosity testing using the n-butanol immersion method. FTIR results indicated a shift in the hydroxyl (–OH) group peak from 3293.28 cm^{-1} to 3307.17 cm^{-1}, confirming hydrogen bonding interactions between the PVA matrix and ceramic additives. XRD analysis revealed a decrease in the crystalline peak intensity at approximately $2\theta = 19.35°$, indicating an increase in the amorphous phase that facilitates ion mobility. Porosity measurements showed that all membranes possessed high porosity above 81%, with the highest value observed in the PVAS3 sample reaching 88.05%. These results demonstrate that the incorporation of SiO_2 and Al_2O_3 additives significantly improves the physicochemical properties of the membrane, indicating its potential application as a lithium-ion battery separator.

Keywords: *Battery Separator, PVA, Electrospinning, Silica, Alumina.*