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ABSTRACTS

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DEVELOPMENT OF PVDF POLYMER-BASED GEL POLYMER ELECTROLYTE FOR LITHIUM-ION BATTERIES

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Lithium-ion batteries are rechargeable and have a high energy density and used immensely in energy storage. As a conductive medium, the main function of the electrolyte in a Li-ion battery is to make it easier for lithium ions to travel between the anode and cathode. Higher viscosity gel electrolytes improve safety and flexibility for a range of applications, moving the field of lithium-ion battery technology forward. This study focuses on a specific gel electrolyte with the composition consisting of Polyvinylidenefluoride (PVDF) as the polymer, ethylene carbonate (EC) and dimethyl carbonate as plasticizers, and $LiClO_4$ as the salt. The significance of each component in this formulation is examined for its impact on the electrolyte performance. First, the effect of incorporating Li ions into the PVDF-based gel electrolyte on ionic conductivity was studied by adding Li salt to polymer with different weight ratios. The gel polymer electrolyte without Li ions showed a conductivity of $3.00 \times 10^{-5}\,\mathrm{S\,cm^{-1}}$ at room temperature. Among the ratios (0.1, 0.2, 0.3, 0.4, 0.6, 0.8), 0.2 Li ion weight ratio showed the highest conductivity of $6.86 \times 10^{-3}\,\mathrm{S\,cm^{-1}}$ at room temperature.Then, keeping other components constant, the conductivity was further improved by varying EC content to the polymer with weight ratios of 0.75, 1.00, 1.25 and 1.50. The highest conductivity of $7.27 \times 10^{-3}\,\mathrm{S\,cm^{-1}}$ at room temperature was observed for the 1.5 EC weight ratio, suggesting a synergistic effect in enhancing electrochemical performance. Interactions between polymers and salts were confirmed through FTIR measurements. The XRD study showed a distinctive peak at approximately $2\Theta = 20^{o}$ in the pure PVDF matrix, indicative of a highly crystalline phase resulting from polymer chain ordering. However, upon the addition of $LiClO_4$ salt and EC, the peak was broadened in the gel polymer electrolyte, signifying a reduction in crystallinity and an enhancement of the amorphous phase. This widening implies an improved activation of ion migration, fostering effective interaction between the polymer and Lithium ions. The findings provide compelling evidence for increased ion conductivities with the incorporation of $LiClO_4$ salts into the polymer matrix.

Key words: *Lithium-ion Batteries, Gel Polymer Electrolytes, PVDF Polymer, Conductivity*