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**IONIC CONDUCTIVITY AND STRUCTURAL STUDIES OF
THERMOPLASTIC POLYURETHANE-AMMONIUM NITRATE
BASED ON SOLID POLYMER ELECTROLYTES**

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ABSTRACT

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The rise of the global need of energy has heightened the necessity of safe, efficient, and sustainable energy storage systems to be used on a daily basis. Solid polymer electrolytes (SPEs) are potentially superior to traditional liquid electrolytes because they are safer, more thermally stable, and less prone to leakage; nevertheless, they usually have low ionic conductivity at ambient temperature. To address this, this study aims to improve the ionic conductivity of SPEs by incorporating thermoplastic polyurethane (TPU) as a polymer host, which is flexible, segments, and has excellent film-forming properties, and ammonium nitrate (NH_4NO_3) as a salt dopant, which has high ionic dissociation and low cost since no prior studies have systematically investigated this TPU- NH_4NO_3 combination. The solution casting technique was used to prepare TPU- NH_4NO_3 SPEs films with different concentrations of salt (5–30 wt.%). These films were then characterized using electrochemical impedance spectroscopy (EIS), Fourier-transform infrared spectroscopy (FTIR), optical microscopy (OM) and tensile testing. EIS analysis indicates that the film containing 20 wt.% NH_4NO_3 has the highest ionic conductivity of $1.81 \times 10^{-5} \text{ S/cm}$. The ATR-FTIR analysis indicated the presence of NH_4NO_3 in the TPU matrix and revealed typical N–H and NO_3^- vibrations, shift of the peaks and intensity variation, which demonstrates that there are strong polymer-salt interactions and lower crystallinity to support ion movement. Optical microscopy reveals that the film containing 20 wt.% NH_4NO_3 has the most uniform, smooth morphology with an indication of more efficient ion transport pathways. The highest tensile strength of 1.179 MPa and highest flexibility with 234.03% elongation at break were recorded in the TPU film with 20 wt.% NH_4NO_3 and demonstrates the best interactions between the polymer and the salt, whereas lower or higher salt concentrations decreased the mechanical properties. All in all, the results indicate that the TPU- NH_4NO_3 film containing 20 wt.% NH_4NO_3 has the best balance of ionic conductivity, structural interactions, morphology and mechanical strength, thus it is a viable electrolyte in solid-state energy storage that is inexpensive, safe, and environmentally friendly.

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