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Synthesis of New Bio-Based Solid Polymer Electrolyte Polyurethane-Liclo4 via Prepolymerization Method: Effect of NCO/OH Ratio on Their Chemical, Thermal Properties and Ionic Conductivity

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Abstract : Novel bio-based polymer electrolyte was synthesized with LiClO4 as the main source of charge carrier. Initially, polyurethane-LiClO4 polymer electrolytes were synthesized via polymerization method with different NCO/OH ratios and labelled as PU1, PU2, PU3, and PU4. Subsequently, the chemical, thermal properties and ionic conductivity of the films produced were determined. Fourier transform infrared (FTIR) analysis indicates the co-ordination between Li+ ion and polyurethane in PU1 due to the greatest amount of hard segment of polyurethane in PU1 as proven by soxhlet analysis. The structures of polyurethanes were confirmed by 13 nuclear magnetic resonance spectroscopy (13C NMR) and FTIR spectroscopy. Differential scanning calorimetry (DSC) analysis indicates PU 1 has the highest glass transition temperature (Tg) corresponds to the most abundant urethane group which is the hard segment in PU1. Scanning electron microscopy (SEM) of the PU-LiClO4 shows the good miscibility between lithium salt and the polymer. The study found that PU1 possessed the greatest ionic conductivity (1.19 × 10-7 S.cm-1 at 298 K and 5.01 × 10-5 S.cm-1 at 373 K) and the lowest activation energy, Ea (0.32 eV) due to the greatest amount of hard segment formed in PU 1 induces the coordination between lithium ion and oxygen atom of carbonyl group in polyurethane. All the polyurethanes exhibited linear Arrhenius variations indicating ion transport via simple lithium ion hopping in polyurethane. This research proves the NCO content in polyurethane plays an important role in affecting the ionic conductivity of this polymer electrolyte.

Keywords : ionic conductivity, palm kernel oil-based monoester-OH, polyurethane, solid polymer electrolyte
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