Enhancement of Ionic Conduction in Alginate–PVA Polymer Electrolytes Doped with Ammonium Thiocyanate

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Abstract

This study explores the eco-friendly enhancement of ionic conduction properties and transport properties in solid polymer electrolytes (SPEs) based on a sustainable alginate (Al) and polyvinyl alcohol (PVA) blend, modified by varying weight percentages (wt%) of ammonium thiocyanate (NH_4SCN) using a solution casting technique. The SPE system was characterized using Fourier-transform infrared (FTIR) spectroscopy, Thermal gravimetric analysis (TGA), X-ray diffraction (XRD), scanning electron microscopy (SEM), and electrical impedance spectroscopy (EIS). SEM images revealed significant modifications in surface morphology correlating with different NH_4SCN contents. FTIR analysis confirmed interactions

between the alginate–PVA matrix and NH_4SCN, evidenced by shifts and changes in peak intensities resulting from the protonation of H^+-OOC. Impedance studies indicated a reduction in bulk resistance (R_b) with increasing NH_4SCN content up to 35 wt%, achieving the highest ionic conductivity of 3.4×10^{-4} S cm^{-1} at room temperature. Temperature dependence studies revealed that the SPE systems adhere to Arrhenius behavior, with regression values nearing unity. Additionally, dielectric response analysis showed a consistent trend with ionic conductivity, indicating enhanced transport properties. These findings highlight the potential of alginate–PVA–NH_4SCN SPEs for use in environmentally friendly applications such as proton batteries and supercapacitors, offering a sustainable alternative in energy storage solutions. © The Author(s) 2025.

Author keywords

Grotthuss mechanism; Intermolecular interaction; Ionic conductivity; Transport properties

Indexed keywords

Engineering controlled terms

Blending; Ionic conduction in solids; Morphology; Scanning electron microscopy; Solid electrolytes; Surface morphology; Temperature distribution; Thermogravimetric analysis; Thorium compounds; X ray diffraction

Engineering uncontrolled terms

Alcohol polymers; Ammonium thiocyanate; Electrolyte systems; Fourier transform infrared; Grotthuss mechanism; Intermolecular interactions; Polymer electrolyte; Polyvinyls; Property; Solid polymer electrolytes

Engineering main heading

Electron transport properties; Fourier transform infrared spectroscopy; Ionic conductivity; Transport properties

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