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Studies on the ions transportation behavior of alginate doped with H^+ carrier-based polymer electrolytes

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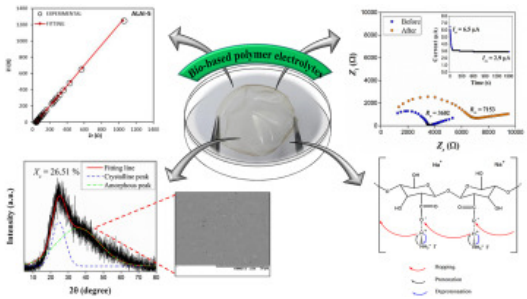
Highlights

- An innovative bio-based polymer electrolyte (PEs) based on alginate is successfully developed.
- The effect of H^+ carrier is influenced to increment in physicochemical properties of PEs.
- The H^+ ions contributes to the enhancement of ionic conductivity (~10^{-4} S/cm).
- H^+ transportation via dielectric response approaches validates with the trend of ionic conductivity.

Abstract

In the present work, amorphous bio-based polymer electrolytes (BBPEs) using alginate polymer as a matrix host and doped with varying amounts of ammonium iodide (NH_4I) have been developed via the solution casting technique. The physicochemical properties of alginate-NH_4I BBPEs were evaluated by using X-Ray diffraction (XRD), scanning electron microscope (SEM), Fourier transform infrared (FTIR), thermal gravimetric analysis (TGA), electrical impedance spectroscopy (EIS), and transference number measurement (TNM). The BBPEs film containing 25 wt % of NH_4I possessed the highest ionic conductivity of 1.29×10^{-4} S cm^{-1}, the highest amorphous phase, and good thermal stability of up to 234 °C. Based on the Nyquist fitting approaches, the ionic conductivity of the BBPEs was primarily influenced by the ion transportation, which was due to the interplay of segmental motion between the alginate and NH_4I, and also the H^+ hopping mechanism, as shown by FTIR. The proton transference number (t_{H^+} = 0.41) suggests that alginate BBPEs are promising materials in electrochemical device applications.

Graphical abstract



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Keywords

alginate; Proton (H^+); Amorphous polymer electrolyte; Thermal stability; Ionic conductivity

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