Anhydrous Proton Conduction of Soy Protein

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Water-soluble soy protein contains a large amount of acidic amino acids, such as glutamic and aspartic acids. Since these acidic amino acids possess the –COOH group in their side chain, the water soluble soy protein acts as an acidic polymer. Therefore, we prepared a composite material by the mixing of acidic protonated soy protein (SPH) and a basic heterocyclic molecule, such as imidazole (Im). The SPH-Im composite materials showed a thermal stability at ≤ 130 °C by the acid-base interaction between the acidic –COOH group, related to the side chain of the acidic amino acids, and basic Im molecule. Additionally, the proton conductivity of the SPH-Im composite material increased with the mixing of the Im molecule and reached a maximum proton conductivity at $R=0.2$. This proton conductivity was 4.4×10^{-4} S cm⁻¹ at 130 °C under flowing dry nitrogen. Furthermore, the E_a of the proton conduction in the SPH-Im composite material was 0.27 – 0.76 eV. These results suggested that the proton conductive mechanism in composite material was based on the anhydrous proton transfer from the –COOH group to the deprotonated –COO⁻ group.

Keywords: Composite material, Soy protein, Anhydrous proton conduction, Polymer electrolyte, Acidic amino acid

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