

Effect of new crystalline phase on the ionic conduction properties of sodium perchlorate salt doped carboxymethyl cellulose biopolymer electrolyte films

ABSTRACT

Dopant induced modifications in the microstructure of sodium carboxymethyl cellulose (NaCMC) were characterized by FTIR, XRD, DSC and EIS techniques. FTIR analysis exhibited a considerable microstructural modification in NaCMC upon NaClO₄·H₂O doping invoked through complex formation via Lewis acid-base interaction and hydrogen bond formation between ions and dipoles. This resulted in the modification in the orderliness/disorderliness of polymer chains as observed from XRD deconvolution. At higher salt concentrations, the complexity of the network causes the formation of new amorphous and crystalline phases as reflected in the XRD studies. DSC analysis showed an increase in T_g as the salt concentration increased, indicating a reduction in polymer chains flexibility. The contribution of free ions has masked over the enhancement in amorphous content to conductivity at a lower concentration of salt in the matrix, later on, the formation of a new crystalline phase due to transient crosslinks by Na⁺...ClO₄⁻...Na⁺ has affected the ion transport process.

Keyword: Carboxymethyl cellulose; Sodium perchlorate; Ionic conductivity; Transient crosslinks; Solid polymer electrolyte