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NOVEL HEXANOYL CHITOSAN/ENR25 BLEND POLYMER ELECTROLYTES FOR APPLICATION IN ELECTRICAL DOUBLE LAYER CAPACITOR (EDLC)

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ABSTRACT

Hexanoyl chitosan soluble in THF is prepared by acyl modification of chitosan. Epoxidized natural rubber (ENR25) (25 mol%) is chosen to blend with hexanoyl chitosan. Elastic property of hexanoyl chitosan was enhanced with the incorporation of ENR25. DSV and DSC studies revealed immiscibility of hexanoyl chitosan and ENR25. DSC results also demonstrate the dissolution of salt was favoured in ENR25 phase. Single salt polymer electrolytes based on hexanoyl chitosan-ENR25 were prepared by employing $LiN(CF_3SO_2)_2$ or $LiCF_3SO_3$ as the doping salt. The electrolytes were prepared by solution casting method. Conductivity enhancement was observed in the blends as compared to the neat hexanoyl chitosan. The maximum conductivities achieved for $LiCF_3SO_3$ - and $LiN(CF_3SO_2)_2$ - comprising electrolyte systems were 1.6 x 10^{-8} and 5.0 x 10^{-7} S cm^{-1}, respectively. The conductivity of $LiN(CF_3SO_2)_2$ system is higher compared to $LiCF_3SO_3$ system due to different lattice energy of salts. Deconvolution of spectra bands in the $\nu_{as}(SO_2^-)$ mode of $LiN(CF_3SO_2)_2$ and $\nu_s(SO_3^-)$ mode of $LiCF_3SO_3$ has been carried out to estimate the relative percentage of free ions and associated ions. The findings were in good agreement with conductivity results. FTIR results suggested that $LiN(CF_3SO_2)_2$ interacted with hexanoyl chitosan and ENR25. The effect of EMImTFSI on the conductivity of hexanoyl chitosan/ENR25-$LiN(CF_3SO_2)_2$ is further investigated. Upon addition of 12 wt% EMImTFSI, a maximum conductivity of 1.3×10^{-6} S cm^{-1} is achieved. Methods based on impedance spectroscopy and FTIR are employed to study the transport properties of the prepared polymer electrolytes. The ac conductivity of the EMImTFSI system was found to obey universal law, $\sigma(\omega) = \sigma_{dc} + A\omega^s$. The temperature dependence of exponent *s* is interpreted by the small polaron hopping (SPH) model. The optimized electrolyte was then used to fabricate the EDLC cell. The electrochemical stability for hexanoyl chitosan/ENR25-$LiN(CF_3SO_2)_2$-EMImTFSI was up to 2.7 V. The specific capacitance of the EDLC was calculated for various scan rates.

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