Article

High Proton Conducting Polymer Blend Electrolytes Based on Chitosan: Dextran with Constant Specific Capacitance and Energy Density

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Abstract: Polymer blend electrolytes based on chitosan: dextran (CS:Dext) incorporated with various amounts of ammonium fluoride (NH₄F) with constant specific capacitance (12.4 F/g) and energy density over 100 cycles were prepared using a solution cast technique. The blend electrolyte samples exhibit broader amorphous humps in X-ray diffraction (XRD) spectra compared to pure CS:Dext film. The Fourier transform infrared (FTIR) study indicates the complex formation of the added ammonium salt with the polymer blend functional groups through the shifting and decrease in the intensity of FTIR bands. The impedance plots were used to determine the conductivity of the samples. The field emission scanning electron microscopy (FESEM) images support the conductivity behavior of the samples. The impedance plots were applied in the determination of the conductivity of the samples in which the relatively highest conductivity was gained to be 1 × 10⁻³ S/cm. The transference number measurement (TNM) of the conducting electrolyte was 0.88, which portrays the dominancy of ion in the conduction process. Linear sweep voltammetry (LSV) verified the chemical stability and showed it to be 1.7 V and an effective electrical double layer capacitor (EDLC) that is applicable in electrochemical devices. The performance of the EDLC cell was examined using both cyclic voltammetry and constant current charge–discharge techniques at ambient temperature. The semi-rectangular shape of the cyclic voltammetry (CV) plot and no redox peak was observed. The charge-discharge process of the fabricated EDLC is durable over 100 cycles with an equivalent circuit resistance and power density of 194.5 Ω and 428 W/kg, respectively. Two main outcomes, the specific capacitance and energy densities of 12.4 Farad/g and 1.4 Wh/kg, respectively, are almost constant over 100 cycles.

Keywords: biopolymer; polymer blend electrolyte; XRD and FTIR analysis; impedance study; morphology study; TNM and LSV study; CV plot; EDLC study

1. Introduction

The modern lifestyle involves an increasing demand for the latest electronic devices, which indirectly increases electrical waste in the natural environment. Orlins et al. [1] documented the second highest contributor of electrical waste of electronic devices, which is mobile phone...