Protonic Transport Analysis of Starch-Chitosan Blend Based Electrolytes and Application in Electrochemical Device

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Two polymer electrolyte systems (unplasticized and plasticized) based on starch-chitosan blend doped with ammonium bromide (NH₄Br) were prepared. The conductivity was found to be influenced by the number density (n) and mobility (μ) of the ions. The highest conducting plasticized electrolyte had n and μ values of 8.75 × 10¹⁸ cm⁻³ and 1.03 × 10⁻³ cm² V⁻¹ s⁻¹, respectively. Ionic transference number for the highest conducting plasticized electrolyte was found to be 0.92. An electrochemical double layer capacitor (EDLC) using the highest conducting plasticized electrolyte was cycled for 500 times at 0.048 mA cm⁻².

Keywords Polymer electrolyte; starch-chitosan blend; ammonium bromide; transference number; EDLC

1. Introduction

Electrochemical devices such as batteries, solar cells, fuel cells, and electrochemical double layer capacitors (EDLCs) are constantly being investigated for energy storage [1–8]. The device performance depends strongly on the electrolyte employed [9–13]. Liquid electrolytes are preferred to be used in electrochemical devices due to their high ionic conductivity [14, 15]. However, the use of a liquid electrolyte in electrochemical devices suffers from problems, e.g. leakage, corrosion and solvent evaporation at high temperature [16–18]. Hence, researchers have turned their attention to solid polymer electrolytes (SPEs) which offer advantages such as thermally stable, the ability to eliminate corrosive solvents and harmful gas formation, and low volatility with easy handling [19]. However, the conductivity obtained by SPEs still needs to be improved.

The polymer blending method has been reported to be able to increase the conductivity of electrolytes [20–22]. According to Buraidah and Arof [21], blending two polymers can provide more complexation sites at which ion hopping and exchange can take place leading to an increase in conductivity. The conductivity of starch-ammonium nitrate (NH₄NO₃)