Charge Storage Performance of Structurally Flexible Hybrid Ionic Liquid Electrolyte in Supercapacitor

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July 19, 2023

Abstract

The electrochemical and charge storage performance of a fluorine-free structurally flexible pyrrolidinium-based ionic liquid hybrid electrolyte (HILE) in a symmetric graphite-based supercapacitor is thoroughly investigated. The HILE revealed thermal decomposition at 270 ^{o}C, a glass transition (T $_{g}$) temperature of -73 oC, and ionic conductivity of 0.16 mS cm $^{-1}$ at 30 oC. A systematic variable temperature ^{1}H and ^{31}P NMR spectroscopy and diffusometry, cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), and galvanostatic charge-discharge (GCD) are employed. HILE-based supercapacitor demonstrated a notable specific capacitance of 186 Fg $^{-1}$ at a scan rate of 1 mVs $^{-1}$ and a specific capacitance of 122 Fg $^{-1}$ at a current density of 0.5 Ag $^{-1}$. The maximum energy density of 49 Wh kg $^{-1}$, a power density of 370 W kg $^{-1}$ at a current density of 0.5 A g $^{-1}$ and a potential window of 4V were obtained. HILE displayed a promising electrochemical performance over a wide potential window of 4V and temperature range (-20 oC to 90 oC) in a symmetric graphite supercapacitor.

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