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Thermal Influence on the Electrochemical Behavior of a Supercapacitor Containing an Ionic Liquid Electrolyte

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Abstract

Emerging demands on heat-durable electronics have accelerated the need for high temperature supercapacitors as well as for understanding the influence of elevated temperatures on the capacitive behavior. In this work, we present a comprehensive study of the thermal influence on a supercapacitor containing 1-ethyl-3-methylimidazolium acetate (EMIM Ac) electrolyte and activated carbon (AC) electrodes. The performance variation as a function of temperature in a range from 21 °C to 150 °C reveals that a high specific capacitance of 142 F g^{-1} can be achieved at 150 °C at a current density of 2 A g^{-1} with a rate capability of 87% at 15 A g^{-1} (relative to 2 A g^{-1}). At 150 °C, equivalent series resistance (ESR) is only 0.37 Ω cm^2, which is a result of improved ionic conductivity of the electrolyte at elevated temperature. The ESR value of 2.5 Ω cm^2 at room temperature reflects a good compatibility between EMIM Ac and AC. In addition, a capacitance retention of more than 95% (in the end of 1000 cycles) is maintained up to120 °C followed by 85% at 150 °C. These results confirm EMIM Ac as a suitable candidate for carbon-based high temperature