

Accepted Manuscript

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PII: S0013-4686(18)30043-4

DOI: [10.1016/j.electacta.2018.01.029](https://doi.org/10.1016/j.electacta.2018.01.029)

Reference: EA 31011

To appear in: *Electrochimica Acta*

Received Date: 21 September 2017

Revised Date: 2 December 2017

Accepted Date: 4 January 2018

Please cite this article as: M. Haque, Q. Li, A.D. Smith, V. Kuzmenko, E. Köhler, P. Lundgren, P. Enoksson, Thermal influence on the electrochemical behavior of a supercapacitor containing an ionic liquid electrolyte, *Electrochimica Acta* (2018), doi: 10.1016/j.electacta.2018.01.029.

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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 cm², which is a result of improved ionic conductivity of the electrolyte at elevated temperature. The ESR value of 2.5 Ω cm² 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 to 120 °C followed by 85% at 150 °C. These results confirm EMIM Ac as a suitable candidate for carbon-based high temperature

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