Cell Optimisation of Supercapacitors through the use of a Quasi-reference Electrode and Potentiostatic Analysis

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In this study, the authors demonstrate a new potentiostatic aging method for the electrochemical stable potential window (ESPW) of supercapacitors and thus the calculation of the optimal mass ratio for electrode-electrolyte pairings. For this purpose a novel quasi-reference electrode (QRE) was incorporated within CR2032 coin cell containment enabling three electrode potentiostatic aging measurements to be performed using organic electrolytes whilst outside of a glovebox. Monitoring of the final current during potentiostatic aging was used to determine the ESPW of each electrode. Calculation of the voltage optimised mass ratio for activated carbon electrodes in 1 M $TEABF_4$ ACN and PC electrolytes was achieved through attained knowledge of the ESPW and associated capacitance values[1]. The validity of the technique and use of the QRE is verified by full cell potentiostatic aging experiments on mass balanced and mass symmetric supercapacitors[2]. For both electrolytes the operating voltage and cycle lifetime of the device was improved significantly.

References

[1] D. Weingarth, H. Noh, A. Foelske-Schmitz, A. Wokaun, R. Kötz, A reliable determination method of stability limits for electrochemical double layer capacitors, Electrochim. Acta. 103 (2013) 119–124.

[2] S. Vaquero, J. Palma, M. Anderson, R. Marcilla, Mass-balancing of electrodes as a strategy to widen the operating voltage window of carbon/carbon supercapacitors in neutral aqueous electrolytes, Int J Electrochem Sci. 8 (2013) 10293–10307.

Figures

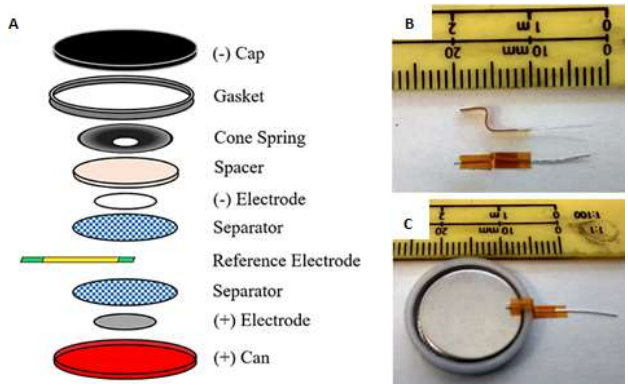

Figure 1: A) Schematic showing the setup of incorporating the Ag wire QRE within the CR2032 coin cell. **B)** and **C)** Images showing the Ag wire QRE and its incorporation.

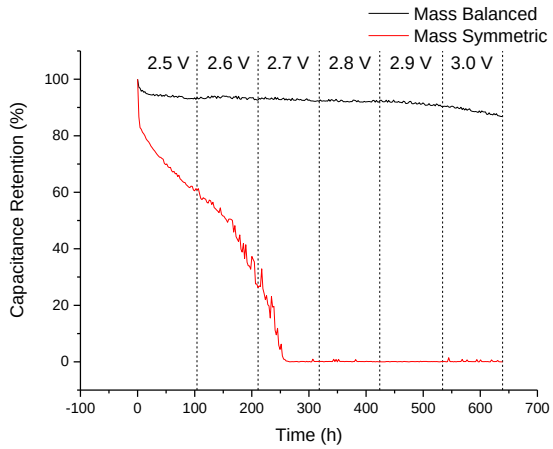

Figure 2: Cell capacitance retention with respect to time during cycling for mass symmetric (m^+/m^- = 1) and mass balanced (m^+/m^- = 2.4) cells up to different sequential cut off voltage ranging from 2.5 to 3 V for 1 M $TEABF_4$ in ACN.