Journal of Electroanalytical Chemistry 805 (2017) 126–132

Contents lists available at ScienceDirect

Journal of Electroanalytical Chemistry

journal homepage: www.elsevier.com/locate/jelechem

Improving the symmetry of asymmetric supercapacitors using battery-type positive electrodes and activated carbon negative electrodes by mass and charge balance

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ARTICLE INFO

Keywords:
Asymmetric supercapacitors
Magnesium cobaltite
Manganese cobaltite
Charge storage

ABSTRACT

Asymmetric supercapacitors (ASCs) are routinely fabricated using battery-type electrode materials as a positive electrode and electrochemical double layer materials as a negative electrode; the mass-loading in the electrodes is determined by assuming both to be capacitive charge storage materials. This protocol is erroneous as the cyclic voltammograms and galvanostatic charge-discharge curves of the resulting devices showed dissimilarity in the stored charges of the two electrodes and battery-type behaviors, respectively. Herein, we show by employing two choices of battery-type electrodes as positive electrodes and commercial activated carbon as negative electrode in 3 M LiOH electrolyte that equal mass loading in both electrodes leads to supercapacitive charge storage. The positive electrode to negative electrode mass ratio is varied from 0.75 to 1.5 in a mass interval of 0.25 which includes a mass ratio of the conventional method. The electrochemical studies of the fabricated ASCs show that the charge storage capabilities depend on the electrode mass. Electrochemical impedance spectroscopy studies show that the equal mass ratio has low series and charge transfer resistances and wider frequency dispersion of capacitance.