

Solid state electrochemical double layer capacitors with natural graphite and activated charcoal composite electrodes

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Abstract

Electrochemical double layer capacitors (EDLCs) which are fabricated using carbon based electrodes have been emerging at an alarming rate to fulfill the energy demand in the present day world. Activated charcoal has been accepted as a very suitable candidate for electrodes but its cost is higher than natural graphite. Present study is about fabrication of EDLCs using composite electrodes with activated charcoal and Sri Lankan natural graphite as well as a gel polymer electrolyte which is identified as a suitable substitute for liquid electrolytes. Electrochemical Impedance Spectroscopy, Cyclic Voltammetry and Galvanostatic Charge Discharge test were done to evaluate the performance of the fabricated EDLCs. Amount of activated charcoal and natural graphite plays a noticeable role on the capacity. 50 graphite: 40 AC : 10 PVdF showed the optimum single electrode specific capacity value of 15 F/g. Capacity is determined by the cycling rate as well as the potential window within which cycling is being done. Continuous cycling resulted an average single electrode specific capacity variation of 48 F/g - 16 F/g. Capacity fading was higher at the beginning. Later, it dropped noticeably. Initial discharge capacity drop under Galvanostatic Charge Discharge test was slightly fast but reached near stable upon continuous charge discharge process. It can be concluded that initially some agitation is required to reach the maturity. However, the results can be considered as encouraging to initiate studies on EDLCs using Sri Lankan natural graphite.

Keywords

electrochemical double layer capacitors; natural graphite; activated charcoal; gel polymer electrolytes; electrochemical impedance spectroscopy; cyclic voltammetry; galvanostatic charge discharge test