Investigation on Electrochemical Double Layer Supercapacitors using chemically treated activated charcoal powder with blend polymer gel electrolytes

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Chemical activation of charcoal powder was done by impregnation method in which KOH was used as activating agent. After treatment it was tested as electrode material for its application in electrochemical double layer capacitor (EDLCs) using PVdF-HFP - PMMA - NaSCN as blend polymer electrolytes. The chemically treated activated charcoal was characterized by BET surface area analyzer and it shows that it's effective surface area increases to more than double fold as compared to untreated charcoal, which makes it suitable for its application as electrode material in EDLCs. Blend polymer gel electrolyte comprising of polyvinylidene fluoride co-hexafluoropropylene (PVdF-HFP) - poly methyl methacrylate (PMMA) - sodium thiocyanate (NaSCN) was prepared by using standard solution cast technique. The optimum composition of gel electrolyte PVdF-HFP (80 wt%) - PMMA (20 wt%) - NaSCN (1.0 M) exhibits high ionic conductivity which is of the order of ~ 10^{-2} S cm^{-1} at room temperature with good mechanical/dimensional stability which is acceptable for their use in EDLCs as electrolyte. The EDLCs have been characterized using various techniques like ac impedance spectroscopy, cyclic voltammetry and galvanostatic charge-discharge. Figure 1 shows the typical impedance plot of an EDLC cell. The steep rising behavior in the lower frequency range confirms the capacitive behavior of the cell. Figure 2 shows the charge-discharge characteristics of an EDLC cell. The maximum capacitance values of 919 mF cm^{-2} (equivalent to single electrode specific capacitance of 497 F g^{-1}) have been observed and listed in Table 1. It corresponds to specific energy density of 68.95 Wh kg^{-1} and specific power density of 3.2 kW kg^{-1}.

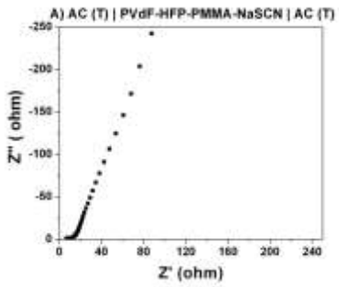

Fig.1: Typical impedance plot of EDLC cell A

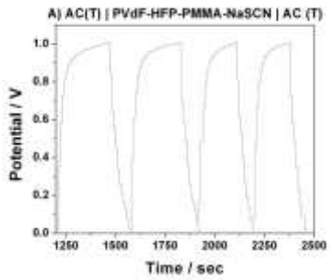

Fig.2: Charge Discharge curves of EDLC cell A

Table 1: Typical charge- discharge characteristics of cell A

Cell	R_i (Ω cm^2)	C_d (mF cm^{-2})	C (F g^{-1})	Energy density (Wh kg^{-1})	Power density (kW kg^{-1})
A	22.6	919	497	68.95	3.20

Working Voltage: 1.0 Volt
Cell A: AC (T) | PVdF-HFP (80 wt%) - PMMA (20 wt%) - NaSCN (1.0 M) | AC (T)