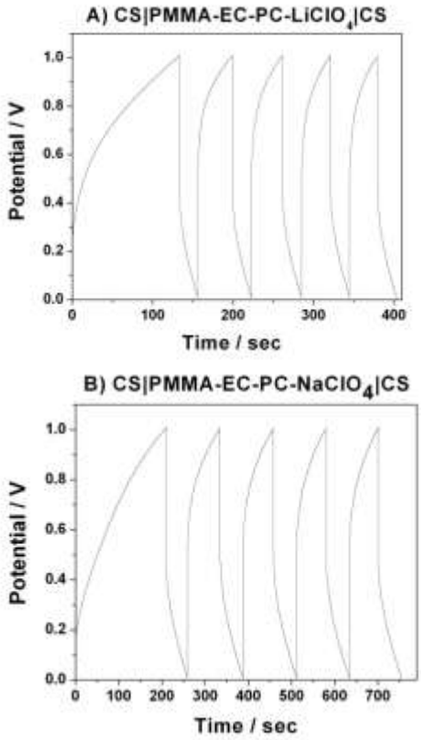
Fabrication and Characterization of Electrochemical Double Layer Capacitor using Biomass based Activated Carbon Electrode

Amrita Jain*[a], S K Tripathi[a]

[a] Department of Physics, Jaypee University of Engineering and Technology, AB Road, Raghogarh-473226, Guna, India

*Presenting Author Email: amritajain86@yahoo.in

A kind of activated carbon has been successfully prepared from coconut shell by impregnation method using KOH chemical activation and by further treatment at higher temperature using carbonization and pyrolysis methods. Further it was tested as electrode material in electrical double layer capacitors (EDLCs) with PMMA based polymeric gel electrolytes. Polymeric gel electrolytes comprising of poly methyl methacrylate (PMMA)-ethylene carbonate (EC)-propylene carbonate (PC)-salts ($LiClO_4$, NaClO4, $TEAClO_4$) are prepared by solution casting technique in view to using them as electrolytes in EDLCs. The optimum composition of gel electrolytes, PMMA (20 wt%) - EC: PC (1:1 v/v)-salts (1.0 M) exhibit highest ionic conductivity of the order of ~10^{-3} S cm^{-1} at room temperature with good mechanical/dimensional stability which is appropriate for their application in EDLCs. The EDLCs have been tested by using various techniques like linear sweep cyclic voltammetry, galvanostatic charge-discharge and ac impedance spectroscopy. Fig.1 shows the galvanostatic charge-discharge profile of cell (A-C). The values of capacitance as can be seen from Table-1 is 295-332 mF cm^{-2} (equivalent to single electrode specific capacitance of 281-316 F g^{-1} of coconut shell based activated charcoal) have been observed. It corresponds to energy density of 40-44 Wh kg^{-1} and power density of 3-6 kW kg^{-1}. A comparative studies shows almost comparable capacitance values for all the cells under present investigations having different cationic size, hence it reveals that there may be a predominate role of anions of the gel electrolytes in the capacitive behavior of EDLCs.



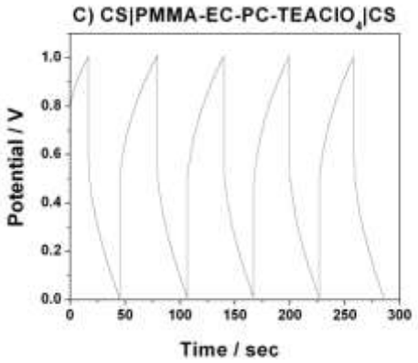


Figure 1: Typical charge-discharge profile of EDLC cells

Table 1: Typical charge-discharge profile of EDLC cells

Cell	R_i (Ωcm^2)	C_d (mF cm^{-2})	C (F g^{-1})	*ED	#PD
A	93	295	281	38.9	5.9
B	99	303	288	40.0	2.8
C	92	332	316	43.8	5.7

Working Voltage: 1.0 V
Cell A: CS | PMMA-EC- PC-$LiClO_4$ | CS
Cell B: CS | PMMA-EC- PC-$NaClO_4$ | CS
Cell C: CS | PMMA-EC- PC-$TEAClO_4$ | CS
CS: Coconut Shell
*ED: Energy Density in W h kg^{-1}
#PD: Power Density in kW kg^{-1}