Facile Way of Preparing Activated Carbon (AC) Electrodes from the Local Jack-Wood for Supercapacitors

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Supercapacitors (SCs) are used as high power density energy storage devices in many applications. Based on the charge-discharge mechanism, SCs are divided into three main classes; electrochemical double-layer capacitors (EDLCs), pseudo-capacitors, and hybrid capacitors. High specific surface area electrodes need to be developed using chemically and physically stable materials to prepare high energy density EDLCs having a long cycle life. By increasing the porosity of electrodes, the effective surface area of the interface can be enhanced. This study introduces a facile way of preparing activated carbon (AC) electrodes starting from the local Jack-wood. Besides, in this research, a novel low-cost SC is prepared using AC electrodes fabricated from Jack wood charcoal without using a binder or additive. The activation is done using a NaOH solution. AC electrodes of the size,1 cm × 2 cm × 0.5 cm, were used for SCs preparation. Platinum (Pt) electrodes were used as current collectors, and for this purpose, Pt was coated on one side of the carbon electrodes. The EDLCs were assembled using activated carbon electrodes and 5 M potassium hydroxide (KOH) electrolyte. For this purpose, polytetrafluoroethylene (PTFE) membrane filter paper separator having 0.2-µm pore size was sandwiched between two AC electrodes. To characterize EDLCs assembled, complex impedance, charge-discharge measurements, and cyclic voltammograms (CV) were measured with the help of PGSTAT128N – Metrohm Auto-Lab setup. The high chemical stability of the EDLCswithin, the charge-discharge window +0.5 V to -0.5 V, can be inferred from CV. The highest gravimetric capacitances of the SCs were 71.89 F g^{-1}. Power density of 342.12 W $kg^{-1}$and the energy density of 0.27 Wh kg^{-1} were exhibited by the EDLC prepared using Jack-wood AC electrodes. The prepared low-cost Supercapacitor is suitable for many applications that need power for a short period.

Keywords: Activated carbon, Electrical double layer, Gravimetric capacitance Jack-wood, and Supercapacitor