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FEASIBILITY OF COCONUT SHELL FLAKES DERIVED ACTIVATED CARBON ELECTRODES FOR SUPERCAPACITORS

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Apart from batteries and fuel cells, supercapacitors are gaining significant attention because of their unique features, such as excellent capacitance, fast charge-discharge rates, high power density, and long life cycle. Recent research has focused on biomass-derived carbon materials for use in electric double-layer supercapacitor (EDLC) electrodes due to their cost-effectiveness and eco-friendliness. Among these materials, coconut shell charcoal is a preferred candidate because of its abundance, microporous structure, and large surface area. This study investigated the suitability of activated coconut shell charcoal flakes as a supercapacitor electrode material. Cleaned coconut shells were burned in a low-oxygen environment for 2 hrs. The coconut shell charcoal was crumbled into flakes, washed, and dried on a hot plate at 150 °C for 1 hr. They were heated in a furnace to 900 °C in a low-oxygen environment for 20 min and immediately placed in a water bath for activation. This step was repeated five times. At each activation, a sample was taken and labelled for characterization. The activated charcoal flakes were cut into ($4 \times 4 \times 1.5$) mm^3 sized electrodes and sanded. A medium retention filter paper (separator) was sandwiched between two as-prepared charcoal flake electrodes, and the assembly was then placed between two titanium plates (current collectors) of ($20 \times 10 \times 0.45$) mm^3 size. This setup was clipped, and the filter paper was wetted with 2.5 M H_2SO_4 (electrolyte). The characteristics were investigated using cyclic voltammetry, galvanostatic charge-discharge analysis, and scanning electron microscopy. Results showed that the repetition of the activation process has a significant effect on the electrochemical properties of the supercapacitor. It was found that, within the range studied, the coconut shell charcoal flakes activated three times exhibited the optimal porous structure, with the highest specific capacitance value of 3.19 F/g, the highest energy density of 0.44 Wh/kg, and the lowest power density of 31.12 W/kg demonstrating their potential for use in supercapacitor electrodes.

Keywords: Activation, Coconut shell charcoal flakes, Specific capacitance, Supercapacitor