Processing Organic Waste Towards High Performance Carbon Electrodes for Electrochemical Capacitors

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Electrochemical properties of a family of carbons obtained from bio-waste have been investigated in terms of their application as electrode materials in electrochemical double layer capacitors. The precursor materials have been subjected to a special treatment involving activation in potassium carbonate and carbonization at 800°C in the flow of nitrogen. The resulting activated carbons exhibited high specific surface areas ranging from 840 to 1200 m² g⁻¹ and the total content of functional groups between 1.0 and 1.7 mmol per gram, depending on the source fruit material. Symmetrical capacitors have been assembled with two kinds of electrolytes, namely 6M KOH in water and 1M tetraethylammonium tetrafluoroborate in acetonitrile. Electrochemical characterization involved cyclic voltammetry, galvanostatic charge/discharge and electrochemical impedance spectroscopy techniques. Specific capacitances have been found to exceed 100 F g⁻¹ for 0.1 A g⁻¹ and to range from 17 to 45 F g⁻¹ for 10 A g⁻¹ in the aqueous electrolyte. In the organic electrolyte specific capacitances of 70 to 100 F g⁻¹ for 0.1 A g⁻¹ and 27 to 34 F g⁻¹ for 10 A g⁻¹ were determined. The observed high capacitances confirm that carbons obtained from waste biomass can be considered as promising electrode materials for high-performance supercapacitors.

Keywords: biowaste processing, one-step carbonization and activation, activated carbons, supercapacitors

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