Facile Method for Preparation of Porous Carbon Derived from Biomass for High Performance Supercapacitors

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A facile method is adopted to obtain three-dimensional porous carbonaceous material from biomass (fish seed) by pyrolysis and activation. The three-dimensional porous carbonaceous material is then fabricated as electrodes for a supercapacitor. Owing to fish seed being rich in elemental oxygen and nitrogen, the heteroatoms can introduce a pseudo-capacitance without doping. Scanning electron microscopy (SEM) analysis results show that the three-dimensional porous carbonaceous material exhibits an interconnected porous structure, which consists of micropores, mesopores and macropores. Adsorption-desorption measurements determine that its surface area is $3232 \text{ m}^2 \cdot \text{g}^{-1}$. Electrochemical measurements show that the biomass-derived porous carbon material displays a relatively high specific capacitance of $350 \text{ F} \cdot \text{g}^{-1}$ at $0.5 \text{ A} \cdot \text{g}^{-1}$ and an initial capacitance retention of 90.9% after 10,000 cycles in a three-electrode system, where KOH (6 M) is used as the electrolyte. In addition, the porous carbon material is also tested in a two-electrode system and exhibits a specific capacitance of $250 \text{ F} \cdot \text{g}^{-1}$ at $1 \text{ A} \cdot \text{g}^{-1}$, and the specific capacitance retention reaches 94% after 10,000 cycles at $10 \text{ A} \cdot \text{g}^{-1}$. Furthermore, the energy density of the supercapacitor is approximately $8.68 \text{ Wh} \cdot \text{kg}^{-1}$ at a power density of $125 \text{ W} \cdot \text{kg}^{-1}$ in the two-electrode system.

Keywords: Biomass; Direct pyrolysis; Porous carbon; Supercapacitors

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