Porous Carbon derived from Pine Nut Shell prepared by Steam Activation for Supercapacitor Electrode Material

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Porous activated carbon (AC) is prepared by the steam activation of biochar prepared from pyrolyzed pine nut shell as a precursor. The effects of various activation temperatures, activation times and steam flow rates on the structure and properties of the obtained ACs are compared and analyzed. The cyclic voltammetry, galvanostatic charge/discharge, electrochemical impedance spectroscopy and cycle stability properties of the ACs are measured in a three-electrode electrochemical system with 6 mol L⁻¹ KOH solution as the electrolyte. The results show that an activation temperature of 850°C, an activation time of 60 min and a steam flow rate of 18 ml h⁻¹ are the optimal conditions. The AC obtained under these conditions displays a specific surface area of 956 m² g⁻¹, a mesopore ratio of 37.1% and a specific capacitance of 128 F g⁻¹ at 0.5 A g⁻¹. Moreover, the AC has a well-developed interconnected hierarchical pore structure including micropores, mesopores and macropores and a good capacitance retention rate of 98% at a current density of 5 A g⁻¹ after 10000 cycles of testing. These high-performance ACs from biomass waste show potential industrial applications in energy storage.

Keywords: pine nut shell; hierarchical porous carbon; steam activation; supercapacitor electrode

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