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Synthesis and Characterization of Lignosulfonate-Derived Hierarchical Porous Graphitic Carbons for Electrochemical Performances

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PURPOSE OF THE ABSTRACT

Porous carbon can be widely applied in energy ranging from lithium-ion batteries to supercapacitors. We here propose a novel hierarchical porous graphitic carbon (HPGC) monolith to replace conventional activated carbon for achieving excellent electrochemical performance.

In a typical process, 2.0 g sodium lignosulfonate and 20 ml isopropanol were mixed under ultrasonication for 15 min. The slurry was poured into a high-pressure reactor and sealed for solvent thermal process, varying reaction temperatures and times. The gel-like precursors were washed by deionized water and dried in a vacuum oven at 80 °C. Finally the precursors were carbonized and graphitized at 900 °C in an argon atmosphere to get the target product HPGC.[1,2]

Herein the characterizations were investigated by TGA, BET, SEM, TEM etc. The electrochemical performance was investigated by CV.

The CV curves of HPGC supercapacitors at different scan rates (5, 10, 20, 40, 60 and 100 mV/s) are shown in Figure 1b. The shapes of the CV curves of HPGC were much closer to the quasirectangular shape, indicating the faster charging and discharging responses to the applied potential due to the significantly improved material conductivity. The cycling stability of HPGC was showed in Figure 1c. After 1000 cycles, the HPGC supercapacitors maintained 78% of the original capacitance (262 F/g at 20 mV/s), demonstrating its rigid framework. The above results demonstrate the good supercapacitor properties of HPGC and its high potential for energy storage applications.

In this study, we demonstrated an efficient method to obtain hierarchical porous graphitic carbons (HPGCs) with high surface area and monolithic structure from lignosulfonate precursor, a low-cost and renewable biomass. Herein a hierarchical mesoporous framework can be synthesized through direct graphitization of crosslinked and pre-carbonized lignosulfonate, without addition of other templating agents. Further improvements on the capacitive behavior of lignosulfonate-derived HPGC appear likely through the optimization of material preparation and supercapacitor assembly.

FIGURES

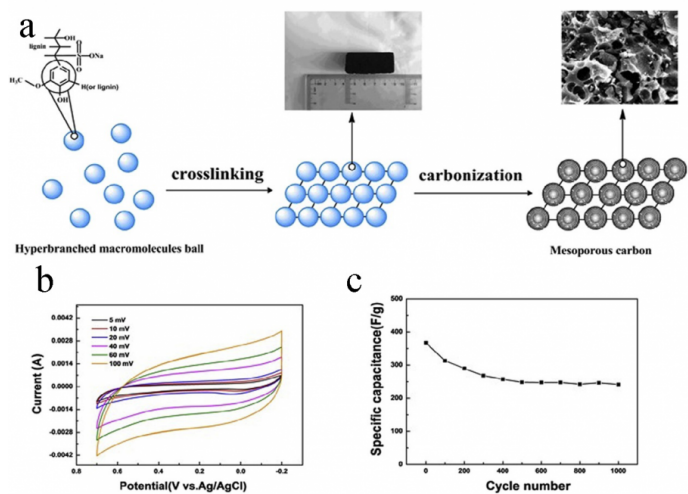


FIGURE 1

fig1

(a) The schematic procedure of synthesizing HPGC monolith from lignosulfonate, (b) CV of HPGC with various scan rates, (c) its capacitance retention.

FIGURE 2

KEYWORDS

Lignosulfonate | nanoporous carbon | solvothermal | supercapacitor

BIBLIOGRAPHY

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