Porous Carbon Material based on Biomass Prepared by MgO Template Method and ZnCl₂ Activation Method as Electrode for High Performance Supercapacitor

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Here, we use cotton as a biomass material, MgO as a templating agent, and ZnCl₂ as an activator to prepare a biomass-based porous carbon material. As a pore generator, MgO is incorporated into cotton carbon by absorbing a solution of Mg(NO₃)₂ in cellulose fibers, subsequent drying and carbonization processes. After removing the MgO template by acid leaching, a biomass-based porous carbon material having a low cost and a high specific surface area is prepared. ZnCl₂ has the functions of dehydroxylation and dehydration during the activation process, so that hydrogen and oxygen in the raw material are released in the form of water vapor to form a porous structure. Moreover, ZnCl₂ is transferred to ZnO during the activating process. The ZnO particles in the obtained material are removed by acid washing, and then these remained voids contribute additional porosity in internal structure. The experimental results show that the activated carbon material prepared by using MgO as the template agent ZnCl₂ as the activator has a specific surface area of up to 1990 m² g⁻¹. In the three-electrode system test, the current density is 1 A g⁻¹ and the capacitance is 240 F g⁻¹. When the current density is 20 A g⁻¹, the specific capacitance is 173 F g⁻¹, and the capacitance retention rate is 71%. In addition, the assembled symmetric supercapacitors were tested in 6M KOH aqueous solution and 1M Na₂SO₄ aqueous solution, respectively. The energy density in the alkaline system is 5.7 Wh kg⁻¹. The energy density in the neutral electrolyte is 12.5 Wh kg⁻¹ and the cycle stability is 89%.

Keywords: Biomass-based porous carbon, MgO template method, ZnCl₂ activation method, supercapacitor

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