Synthesis of Nitrogen and Phosphorus co-doped Carbon with Tunable Hierarchical Porous Structure from Rice Husk for High Performance Supercapacitors

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Nitrogen and phosphorus co-doped porous carbon (N/P-PC) was prepared via a simple direct pyrolysis method using rice husks as the carbon source and H₃PO₄ as the phosphorus source and activator. The acquired products are typical hierarchical porous carbons with a multiple-peaked pore size distribution of microporous and mesoporous structure, which has a high surface area and pore volume. The N₂ adsorption-desorption results show that the mesoporous distribution of N/P-PC can be adjusted in the range of 2-10 nm and the meso-porosity can be varied by changing the H₃PO₄ content. In particular, among the N/P-PC samples, N/P-PC-1:5 has the highest surface area of 2188 m²/g, pore volume of 3.025 cm³/g, and pore diameter of 5.537 nm. Electrochemical measurements also indicate that the assembled symmetric cell of N/P-PC-1:5 displays the highest specific capacitance of 236 F/g at a scan rate of 5 mV/s and 130 F/g at a current density of 0.5 A/g; it also has an excellent capacity retention of 100 % after 6000 cycles. The hierarchical porous structure and the synergistic action of nitrogen and phosphorus contribute to the advantageous electrochemical performance of the carbon material. The proposed strategy provides a facile method for preparing porous carbon from biomass waste.

Keywords: Co-doping, Rice husk, Supercapacitor, Tunable porous

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