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Enhanced specific capacitance of iron doped polyaniline/sulfonated carbon nanotubes after freeze-drying treatment for all-solid-state symmetric supercapacitor

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The electrode materials based on iron doped polyaniline (Fe-PANI) over the surface of sulfonated multi-walled carbon nanotubes (s-MCNTs) also followed by freeze-drying treatment (FD-Fe-PANI@s-MCNTs) are reported for high performance electrochemical energy storage applications. The structure, morphology and thermal properties of the obtained samples are detected. Also, N2 sorption isotherm for FD-Fe-PANI@s-MCNTs shows high specific surface area 280.26 $m^2 g^{-1}$ calculated by Brunauer-Emmett-Teller (BET) method after the freeze-drying treatment. The electrochemical properties of the electrode samples are assessed by cyclic voltammetry and galvanostatic charge/discharge testes in the 1 M H_2SO_4 aqueous electrolyte. The FD-Fe-PANI@s-MCNTs electrode with this high surface area shows high specific capacitance of 2105.64 F g^{-1} at 1 A g^{-1}. The symmetric solid-state supercapacitor device (SCs) based on FD-Fe-PANI@s-MCNTs electrode gave a specific capacitance of 776.85 F g^{-1} at 1 A g^{-1}, energy density 13.55 Wh kg^{-1}, power density 177.50 W kg^{-1} and exhibit rate capability (≈59% retention at 20 A g^{-1}). Furthermore, the symmetric supercapacitor device shows good cycling stability (91.6%) after 500 cycles at a scan rate 200 mV s^{-1}, suggesting the potential application of FD-Fe-PANI@s-MCNTs for energy storage devices.

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