Porous Core-shell Carbon Fibers: Wire-like All-Carbon Supercapacitor

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Hierarchical porous carbon-based supercapacitors have been attracting intense attention due to their high and stable electrical double-layer capacitance that may be used for advanced technologies. In this study, porous core-shell carbon fibers were produced by a simple and fast acid oxidation treatment of carbon fibers, and the morphological and structural evolutions were examined by SEM, TEM and Raman spectroscopic measurements. Detailed electrochemical characterization showed that porous core-shell carbon fibers exhibited a good supercapacitor performance with a high specific capacitance of 98 F/g at 0.5 A/g in 1 M H2SO4 liquid electrolyte and 20.4 F/g at 1 A/g in H2SO4/PVA solid electrolyte, and excellent capacitance retention at ~98.5% for the former and ~96% for the latter over 3000 cycles. The results demonstrated that porous core-shell carbon fibers might be used as effective electrode materials for the fabrication of wire-like all-carbon flexible supercapacitors with high physical flexibility and desirable electrochemical properties.

Fig.1 (a) The schematic diagram of fabricated wire-like all-carbon supercapacitor. CV curves as a function of scan rate (b) and galvanostatic charge/discharge curves as a function of current density (c) for a solid-state device. Photographs of (d) straight and (e, f) frizzy wire-like all-carbon supercapacitor. (g) CV curves at scan rate of 10 mV/s for wire-like all-carbon supercapacitor in different shapes. (h) Cycle performance and coulombic efficiency of wire-like all-carbon supercapacitor at 1 A/g over 3000 cycles. Inset: The last 20 charge-discharge curves of wire-like full of carbon-based supercapacitor.