

Making a wearable supercapacitor based on highly porous 3D nitrogen-doped graphene

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Abstract

In this paper, based on the hydrothermal method and using a non-toxic organic molecule, as a spacer (and nitrogen source), we synthesized a highly conductive and porous 3D graphene. Then, graphene is used as an electrode material to make a supercapacitor on the surface of activated carbon cloth electrode. The graphene is characterized by different methods, such as Fourier-transform infrared spectroscopy, thermogravimetric analysis, Raman spectroscopy, X-ray diffraction, energy-dispersive and transmission electron microscopy, energy-dispersive X-Ray spectroscopy, emission scanning electron microscopy, Barrett–Joyner–Halenda, and Brunauer–Emmett–Teller methods. The supercapacitor (2 and 3 electrodes) is studied by different electrochemical techniques, such as cyclic voltammetry, electrochemical impedance spectroscopy, and galvanostatic charge/discharge. The 3-electrode system shows a specific capacity 101 F g^{-1} at the current density of 1.7 A g^{-1} (or 0.5 mA cm^{-2}). The 2-electrode system (symmetric capacitor) has a power density of about 8000 W kg^{-1} and a maximum energy density of 12.85 Wh kg^{-1} .