Physical reduction of graphene oxide for supercapacitive charge storage

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ABSTRACT

The oxygen-containing functional groups in graphene oxide (GO) impose considerable limitations in their applications requiring chemical inertness and electrical conductivity such as supercapacitive charge storage. Chemical reduction of GO has been frequently employed; however, processing of large volume of hazardous solvents impose severe environmental concerns. This article demonstrates the optical reduction of freeze dried GO into reduced GO (rGO) by a computer controlled laser engraver as a plug and operate device. The conversion of GO into rGO as a function of laser powers has been monitored by X-ray diffraction, X-ray photon electron spectroscopy, Fourier transform infrared spectroscopy, Raman spectroscopy, Thermogravimetric analysis, and field emission scanning microscopy. The rGO thus produced has been evaluated for their charge storage capability in aqueous electrolytes. The best performing laboratory prototype demonstrated one of the best energy density of rGO electrodes in an aqueous electrolyte. The promising properties of the supercapacitors thereby developed as well as cost effectiveness and potential for large scale production engaging laser engraving process, the present work offers numerous potentials for deploying efficient and low cost supercapacitive devices.

KEYWORDS

Laser reduction of graphene oxide; Energy storage materials; Laser assisted manufacturing; Electrochemical double layer capacitors; Capacitive charge storage

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