Performance of Flexible and Binderless Polypyrrole/Graphene Oxide/Zinc Oxide Supercapacitor Electrode in a Symmetrical Two-Electrode Configuration

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ABSTRACT

A fast and facile approach based on potentiostatic electrochemical polymerization was used to prepare a polypyrrole/graphene oxide/zinc oxide (PPy/GO/ZnO) nanocomposite deposited on a flexible nickel foam. Fourier transform infrared spectroscopy and energy dispersive X-ray spectroscopy revealed the presence of zinc oxide on the PPy/GO/ZnO nanocomposite. A supercapacitor was fabricated by sandwiching a filter paper immersed in a sodium sulfate solution between two nickel foam electrodes coated with the PPy/GO/ZnO nanocomposite. The electrochemical performance of the supercapacitor was characterized using a two-electrode configuration, and the cyclic voltammetry curve recorded at a fast scan rate of 100 mV/s was pseudo-rectangular. A specific capacitance of 94.6 F/g at a current density of 1 A/g was obtained from constant current charge/discharge measurements. The utilization of the pseudo-capacitive behavior of the polypyrrole and zinc oxide, and the electrical double layer capacitance of the graphene oxide, gave rise to a high energy and power density of 10.65 Wh/kg and 258.26 W/kg at 1 A/g, respectively. The capacitance of the supercapacitor after 1000 galvanostatic charge/discharge cycles was 74% of its original value. The potential application of the as-fabricated supercapacitor in realistic energy delivery systems was demonstrated by its ability to light up a light emitting diode for about 2 minutes after being charged for approximately 30 seconds.

KEYWORDS: Supercapacitor electrode; Zinc oxide; Graphene oxide; Polypyrrole; Binderless

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