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"Green"-electrospun metal oxide nanowires for high performance supercapacitors

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Abstract

Storage of energy under the electrochemical double layer and fast reversible redox reaction mode, which devices are known as supercapacitors, with simultaneously high energy and power densities is an active area of research recently to develop deployable clean energy devices. The transition metal oxide semiconductors such as CuO, RuO2, MnO2, etc. offers pseudo capacitance arise from an electrochemical reaction in addition to the conventional double layer capacitance; therefore, they are a preferred choice to build highly efficient supercapacitors. In this research, we have developed nanowires of a number of transition metal oxides including CuO, NiO and Co_3O_4 by a commercially viable nanofabrication technique, known as electrospinning, and studied their structural, morphological, and electrochemical properties. The nanowires of ~ 50 – 60 nm were obtained by annealing the electrospun polyvinyl alcohol fibrous mats containing a uniform dispersion of metal acetate. The supercapacitor devices were fabricated by dispersing the 70 wt.% active material in 15 wt.% conducting carbon and 10 wt.% polyvinyl difluoride and pasted on a nickel foam substrate. KOH was used as the electrolyte. The specific capacitance and cycling stability of the devices were obtained from cyclic voltammetry and galvanostatic charge/discharge cycling, respectively. The devices exhibited a specific capacitance of ~620 F/g ,670 F/g and 1047 F/g for CuO, NiO and Co_3O_4, respectively at a current density of 1 A/g in 6M KOH with a columbic efficiency of ~96%. The electrospun metal oxide nanowires could therefore be an acceptable choice for building highly efficient supercapacitor devices.

Keywords: Renewable energy, Electrochemical energy storage, batteries, nanofabrication