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High performance supercapacitor electrodes from electrospun nickel oxide nanowires

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Abstract

Electrochemical energy storage using pseudocapacitive mode is under intense research owing to their potential in fabricating high performance renewable energy devices at a lower cost. In this paper we characterize nickel oxide (NiO) nanowires developed by electrospinning an aqueous polymeric solution containing nickel precursor for its application as a pseudocapacitors electrode. The wires are of diameter $\sim 50 - 70$ nm containing densely packed cuboidal grains ($\sim 10 - 20$ nm) with less degree of crystal defects. Electrochemical properties of the electrodes fabricated on a nickel foam substrates are evaluated by cyclic voltammetry (CV) and charge – discharge cycling (CDC), and electrochemical impedance spectroscopy (EIS) techniques. The best performing devices showed a specific capacitance (C_s) of $\sim 670 \text{ Fg}^{-1}$ with high cycling stability ($\sim 100\%$) for over 1000 cycles and Coulombic efficiency $\sim 98\%$. Lower electrochemical equivalent resistance ($\sim 0.76 \Omega$), charge transfer resistance ($\sim 0.45 \Omega$), and charge relaxation time (43 ms) are observed which are attributed to the defect free nanowire morphology that give rise to the superior performance.

Keywords: Renewable energy; electrochemical energy storage; batteries; nanofabrication; ceramic nanostructures

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