Modification of Capacitive Charge Storage of TiO_2 with Nickel Doping

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ABSTRACT

For practical deployment of supercapacitors characterized by high energy density, power density and long cycle life, they must be realized using low cost and environmentally benign materials. Titanium dioxide (TiO_2) is largely abundant in the earth's crust; however, they show inferior supercapacitive electrochemical properties in most electrolytes for practical deployment. In this paper, we show that nickel doped TiO_2(Ni:TiO_2) nanowires developed by electrospinning showed five times larger capacitance (~200 F g^{-1}) than the undoped analogue (~40 F g^{-1}). Electrochemical measurements show that the Ni:TiO_2 nanowires have 100% coulombic efficiency. The electrodes showed no appreciable capacitance degradation for over 5000 cycles. The superior charge storage capability of the Ni:TiO_2 could be due to its high electrical conductivity that resulted in five orders of magnitude higher ion diffusion as determined by cyclic voltammetry and electrochemical impedance spectroscopy measurements.

KEYWORDS: Ceramic nanostructures; Renewable energy; Batteries; TiO_2 nanostructures; One-dimensional nanostructures

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