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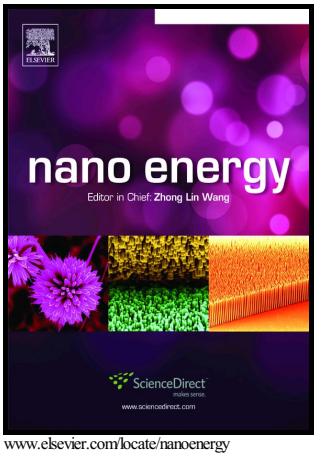

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Nitrogen-doped $Ti_3C_2T_x$ MXene electrodes for high-performance supercapacitors

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Abstract

A new type of nitrogen-doped two-dimensional MXene (N-$Ti_3C_2T_x$) was synthesized by post-etch annealing $Ti_3C_2T_x$ in ammonia as a promising electrode material for supercapacitors. The concentrations of nitrogen can be rationally controlled to produce N-$Ti_3C_2T_x$ materials with 1.7 - 20.7 at.% of nitrogen by simply tuning the annealing temperatures from 200 °C to 700 °C. The introduction of nitrogen as a heteroatom in the $Ti_3C_2T_x$ structure leads to a remarkable increase of the c-lattice parameter of MXene sheets from 1.92 nm in $Ti_3C_2T_x$ to 2.46 nm in N-doped ones upon ammonia treatment at 200 °C. More interestingly, the resultant doped MXene materials under optimized condition exhibited drastically improved electrochemical capacitances of 192 $F \cdot g^{-1}$ in 1 M H_2SO_4 and 82 $F \cdot g^{-1}$ in 1 M $MgSO_4$ electrolyte, which are remarkably higher than those of the un-doped $Ti_3C_2T_x$ materials (34 $F \cdot g^{-1}$ in 1 M H_2SO_4 and 52 $F \cdot g^{-1}$ in 1 M $MgSO_4$).