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Electrochemical performance of novel O3 layered Al,Mg doped titanates as anode materials for Na-ion batteries

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Abstract

The synthesis and the electrochemical behavior of Al,Mg-doped Na_yTiO_2, i.e. (Na_y $[Ti_{(1-x)}Al_x]O_2$, $0.05 \leq x \leq 0.40$, and Na_y $[Ti_{(1-x)}Mg_x]O_2$, $0.15 \leq x \leq 0.35$) layered oxide phases as potential anodes for Na-ion batteries have been investigated. They were synthesized by solid state route with controlled sodium vapor pressure in inert atmosphere. The study of the crystal structure by XRD revealed that a maximum of 10% Al and 15% Mg were doped in the O3-type structure without important structural changes associated with the replacement of Ti by Al/Mg ion. ^{23}Na solid state NMR measurements were performed to confirm the Mg doping, its effects on the local structure, and the disordered disposition of Mg in the compound. The synthesized phases were electrochemically active at low voltages (1.6–0.08 V *vs.* Na^+/Na). The high Mg-doped phase demonstrated improved high rate performance and a capacity of 107 mAh g^{-1} at C/20 rate with a voltage profile smoother than the undoped material.