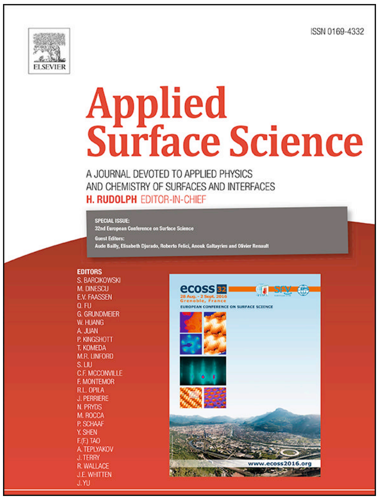

Full Length Article

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PII: S0169-4332(18)32223-2
DOI: https://doi.org/10.1016/j.apsusc.2018.08.087
Reference: APSUSC 40124

To appear in: *Applied Surface Science*

Received Date: 8 March 2018
Revised Date: 25 July 2018
Accepted Date: 8 August 2018

Please cite this article as: J.S. Ko, H-S. Kim, Lithium- and Sodium-Ion Storage Properties of Modulated Titanate Morphologies in Reduced Graphene Oxide Nanocomposites, *Applied Surface Science* (2018), doi: https://doi.org/10.1016/j.apsusc.2018.08.087

Lithium- and Sodium-Ion Storage Properties of Modulated Titanate Morphologies in Reduced Graphene Oxide Nanocomposites

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Abstract

Electrochemical energy storage (EES) systems rely on novel materials to meet stringent performance demands in terms of both high energy and high power. Although several new materials have been identified for EES, one method that seeks to amplify material properties has been to modulate morphologies at the nanoscale. This improvement in electrochemical properties is in large part due to the enhancement in surface area and mitigation of solid-state diffusion at the nanoscale domain. By using sodium titanate ($Na_2Ti_3O_7$) as a model compound, we employ efficient synthetic routes to prepare titanate nanosheets and nanotubes, and assess their charge-storage properties in both Li- and Na-ion non-aqueous electrolytes. Moreover, nanocomposites comprising reduced graphene oxide are constructed to further enhance rate capability. We perform a fundamental electroanalytical treatment of the charge-storage properties for titanate nanosheets and nanotubes and identify the underlying rate-determining mechanisms by kinetics analysis. In both Li- and Na-ion electrolytes, the nanotube–reduced graphene oxide nanocomposite exhibits pseudocapacitive behavior, indicated by broad voltammetric features and sloping charge-discharge voltage profiles under galvanostatic mode. This corresponding charge-storage process supports high capacities of 170 and 80 mAh g^{-1} in a Li- and Na-ion system, respectively, based on constant current measurements at a C-rate of 5C.