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## Full Length Article

Enhanced Electrochemical Performance of  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> Grains Grafted onto TiO<sub>2</sub>-Carbon Nanofibers via a Vapor-Solid Reaction as Anode Materials for Li-Ion Batteries

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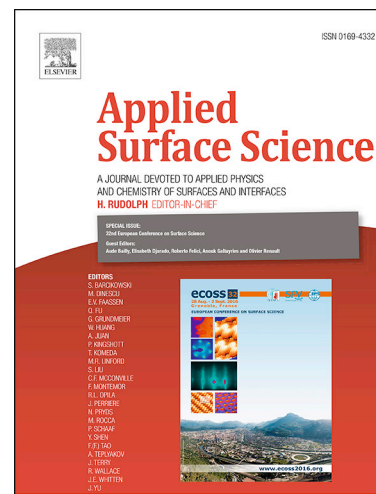
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# Enhanced Electrochemical Performance of $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> Grains Grafted onto TiO<sub>2</sub>-Carbon Nanofibers via a Vapor-Solid Reaction as Anode Materials for Li-Ion Batteries

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## Abstract

$\alpha$ -Fe<sub>2</sub>O<sub>3</sub> grains grafted onto TiO<sub>2</sub>/carbon nanofibers (CNFs) for use as anode materials in lithium-ion batteries have been successfully fabricated by electrospinning and vapor-solid reaction (VSR). Scanning electron microscopy (SEM), transmission electron microscopy (TEM) and N<sub>2</sub> adsorption-desorption isotherms reveal that the ultrafine  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> nanoparticles were formed on the TiO<sub>2</sub>/CNFs and have uniform dispersion along the fiber direction. The VSR approach could retard nucleation, thus making TiO<sub>2</sub>/CNFs with small Fe<sub>2</sub>O<sub>3</sub> grains grafting (approximately 5 nm in diameter). The TiO<sub>2</sub>/CNFs are capable of buffering the large volume variation of  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> during cycling and preventing electrode pulverization and aggregation, as well as providing sufficiently large interstitial space within the crystallographic structure to host Li ions. The electrochemical properties of the composite electrodes were tested by galvanostatic cycling at both constant and variable current rates. The composite delivers both good rate capability under an uprated current density of 1000 mA g<sup>-1</sup> and especially enhanced cycle stability (~600 mAh g<sup>-1</sup> after 200 cycles at a current density of 1000 mA g<sup>-1</sup>). The super electrochemical performance is attributed to a synergetic effect between  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> and TiO<sub>2</sub>-CNFs as well as the three-dimensional (3D) network, which contributes to greatly enhanced diffusion kinetics and structural stability for lithium-ion batteries. This VSR approach can be extended to other hierarchical metal oxide nanostructures for favorable applications in

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