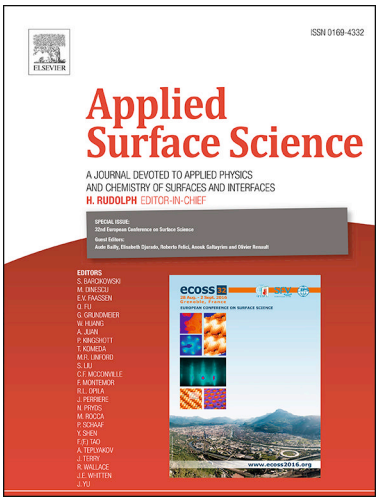

Full Length Article

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Enhanced Electrochemical Performance of α-Fe_2O_3 Grains Grafted onto TiO_2-Carbon Nanofibers via a Vapor-Solid Reaction as Anode Materials for Li-Ion Batteries

Yang Yang, Qinyi Liu, Meng Cao, Qin Ju, Haiying Wang, Renzhong Fu, Hongmei Ji and Gang Yang*

Jiangsu Laboratory of Advanced Functional Material, School of Chemistry and Materials Engineering, Changshu Institute of Technology, Changshu, China

Abstract

α-Fe_2O_3 grains grafted onto TiO_2/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_2 adsorption-desorption isotherms reveal that the ultrafine α-Fe_2O_3 nanoparticles were formed on the TiO_2/CNFs and have uniform dispersion along the fiber direction. The VSR approach could retard nucleation, thus making TiO_2/CNFs with small Fe_2O_3 grains grafting (approximately 5 nm in diameter). The TiO_2/CNFs are capable of buffering the large volume variation of α-Fe_2O_3 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^{-1} and especially enhanced cycle stability (~600 mAh g^{-1} after 200 cycles at a current density of 1000 mA g^{-1}). The super electrochemical performance is attributed to a synergetic effect between α-Fe_2O_3 and TiO_2-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