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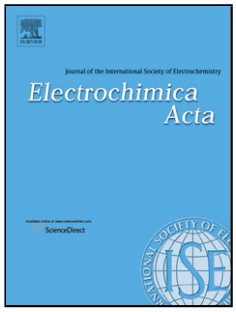

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Interpenetrating network of titania and carbon ultrafine fibers as hybrid anode materials for high performance sodium-ion batteries

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Highlights

- Anodes of sodium-ion battery were made from networks of titania and carbon fibers.
- IPN structure minimizes strain during ion de-insertion and prevents agglomeration.
- Discharge capacity was maintained at ~134 mA h g^{-1} after 100 cycles at 125 mA g^{-1}.

Abstract

Interpenetrating networks (IPNs) of titania, having high cycling stability and rate capability, and carbon, having high electrical conductivity and capacity, ultrafine fibers were fabricated by a co-electrospinning technique in opposite directions. The IPN structure promoted a contact between titania and carbon fibers, minimized strain during ion de-insertion, and prevented agglomeration that shortened the cycling stability. Images from scanning electron microscopy with backscattering electron detector and X-ray diffraction spectra confirm the existence of the IPN structure of both types of fibers. Thermogravimetric analysis and Raman spectroscopy of the composite fibers reveal their 37 wt% of titania content and 1.2 ratio between disorder and graphitic carbon (I_D/I_G). A galvanostatic curve displays stable reversible capacities of 202 and 247 mA h g^{-1} for charge and discharge after the fifth cycle at a current density of 25 mA g^{-1}. The material had a superior discharge capacity of 151 and 123 mA h g^{-1} at 125 and 250 mA g^{-1}, respectively. Moreover, the discharge capacity could be maintained at 134 mA h g^{-1} after 100 cycles at 125 mA g^{-1} with a Coulombic efficiency of more than 98%, presenting a long life cycle of batteries. Therefore, the prepared IPN composite fibers can be an efficient anode for sodium-ion batteries.

Keywords: carbon; composite fiber; electrospinning; sodium-ion battery; titania

1. Introduction