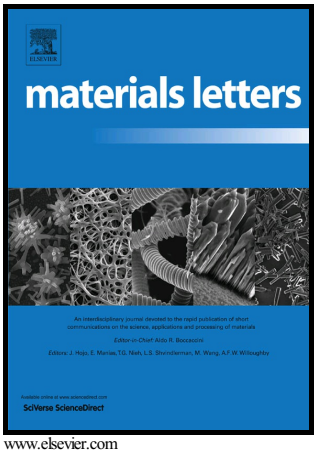

Free-standing, binder-free polyacrylonitrile/asphalt derived porous carbon fiber - a high capacity anode material for sodium-ion batteries

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Free-standing, binder-free polyacrylonitrile/asphalt derived porous carbon fiber - a high capacity anode material for sodium-ion batteries

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Abstract

A new kind of porous carbon nanofiber networks has been synthesized via electrospinning technique by using polyacrylonitrile and asphalt as carbon sources and Pluronic F127 as soft template. After stabilization and carbonization treatment, the obtained fabrics were directly utilized as self-supported anode materials for sodium-ion batteries. This kind of porous carbon nanofiber exhibits excellent sodium-ion storage properties, with a reversible capacity of 210 mA h g^{-1} at current density of 500 mA g^{-1} after 1000 cycles.

Keywords:

asphalt, electrospinning, carbon fibers, sodium-ion storage

1. Introduction

Sodium-ion batteries (SIBs) have receive much attention because of the abundance of sodium resources and their potential for large-scale commercial applications, e.g. grid energy storage [1, 2]. Until now, although a variety of host cathode materials have been successfully developed, the exploration of anode materials is still in its infancy for SIBs [3, 4]. Because of large interlayer distance and turbostratic structures, hard carbon seems to be more suitable for sodium-ion insertion/extraction [5]. A range of hard carbon materials have been studied previously, showing cheerful prospect with relatively high specific capacity and cycling stability [5, 6]. As an inexpensive, abundant chemical by-product, asphalt is widely used as carbon precursor because of its high carbon content. Nevertheless, to the best of our knowledge, few reports are focused on the preparation of SIBs electrodes by using asphalt as raw materials [7].

Recently, free standing and binder free electrode materials have become a hot topic due to their great potential in construction of full battery with high energy density [8, 9]. Inactive materials, including metal substrate, binder, and conductive agent are omitted in this kind of electrode, while all the active materials could participate in energy storage. For example, Sb/C fibers were synthesized by Wang's group, which demonstrated excellent cycling stability with high overall capacities at both low and high current rates[10].

Herein, electrospinning method was adopted to synthesize porous carbon fibers, utilizing inexpensive asphalt and polyacrylonitrile (PAN) as carbon precursors. In addition, Pluronic F127 was introduced to create meso/micropores. An amorphous carbon fabric was obtained through pyrolysis of such weaves. This work paves a new way for the fabrication of inexpensive SIBs anode materials, and it is also suitable for large-scale industrial production for its simplicity and versatility.