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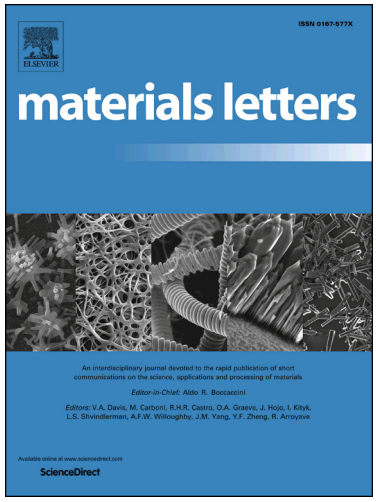

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Manganese Carbonate Nanograined Assembling Macrocube *via* a Facile Hydrothermal Process for High Performance Supercapacitors

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Abstract

Herein, a cubic architecture of a self-assembled nanograined manganese carbonate (cub-$MnCO_3$) on a three-dimensional (3D) macro-porous nickel-foam (NF) *via* a low-temperature (160 °C) hydrothermal process has been reported, which later is used as a binder-free supercapacitor electrode. The cub-$MnCO_3$ architecture provides large open channels by the interconnection of numerous nanograined $MnCO_3$ to enhance ion and electron diffusion pathways, facilitating the whole active electrode material by easier electrolyte penetration. The cub-$MnCO_3$ electrode exhibits a specific capacitance of 476 F g^{-1} at 1 A g^{-1} in 1 M KOH aqueous electrolyte solution, and excellent rate ability. The cycling performance of cub-$MnCO_3$ has revealed capacitance retention of 83.8% after 5000 cycles at a high current density of 10 A g^{-1}.

Keywords: nanograined structure; nickel foam; binder-free

1. Introduction

Supercapacitors have received considerable worldwide interest over the past few decades owing to their fast charge and discharge rates, high power density, longer cycle life, and higher reliability than lithium-ion batteries [1-3]. Pseudocapacitors, utilizing the fast and reversible electrochemical redox reactions of transition metal compounds such as hydroxides [4], oxides [5], carbonates [6], and polymers [7], often demonstrate remarkable theoretical capacitance. Among these electroactive materials, manganese compounds, such as oxides, hydroxides, and sulphides [8-11] etc., are being reported to exhibit excellent electrochemical performances. However, there are few reports on the electrochemical performance of $MnCO_3$. This study presents involvement of a novel macrocubic architecture of self-assembled nanograined cub-$MnCO_3$ on a 3D NF using a low-temperature facile hydrothermal method. The as-obtained cub-$MnCO_3$ is macrocubic in shape which is formed by assembling nanograined $MnCO_3$ [12], unlike the cube types of previously reported manganese compounds [13-16].

The as-obtained cub-$MnCO_3$-based electrode plays an important role in yielding a high specific capacitance when used in electrochemical supercapacitor application. Specifically as; (a) these nanograins have a large specific surface area due to which they greatly improve the electrode/electrolyte contact area and shorten the ion diffusion pathways considerably, (b) edge-like openings can provide large open channels in the nanograins for enhancing the ion and electron diffusion pathways, facilitating electrolyte