Synthesis of Hierarchical Bio-Inspired Pine Needle-Shaped MnO₂/CNTs/Carbon Cloth Composite as Highly Cycling Stable Symmetrical Supercapacitor

Yunyu Li^{1,*}, Yi Liu¹, Lingjun Guo², Xianglin Ji², Chuanyin Xiong², Zhigang Zhao², Qiang Song^{2,*}

¹ Xi'an Polytechnic University, Xi'an 710048, P R China

² Research Center of Carbon/Carbon Composites, State Key Laboratory of Solidification Processing, Northwestern Polytechnical University, Xi'an 710072, P R China

*E-mail: liyunnyu@mail.nwpu.edu.cn, songqiang511@nwpu.edu.cn

doi: 10.20964/2017.06.34

Received: 15 February 2017 / Accepted: 29 March 2017 / Published: 12 May 2017

In this work, bio-inspired hierarchical pine needle-shaped MnO₂-CNTs-CFC composite was prepared by an environmentally-friendly two-step electrophoretic deposition (EPD) method. The synthesis of MnO₂ on CNTs was inspired by the “pine needle”. The nanostructured needle-shaped MnO₂ which is more resistant than that larger MnO₂ structures to fracture, due to no sufficient initiate crack propagation for the total elastic energy stored in a small nanostructure during deformation, which would effectively enhance the cycling stability. The CNTs serve as substrate providing a conductive channel for MnO₂ to harvest and store the charge. The large quantity of CNTs on the surface of carbon cloth may facilitate the loading of Pine needle-shaped MnO₂, providing high speed channels for the charge carrier and pseudocapacitance. The electrochemical results show specific capacitance of 381.74 F·g⁻¹, the energy density of 35.6 Wh·kg⁻¹ at a scan of 1 mV·s⁻¹ and capacitance retention ratio of 85% at a scan of 500 mV·s⁻¹. The capacitance retention ratios of the flexible MnO₂-CNTs-CFC hybrid are no less than 75% when they endure various mechanical deformations. The flexible supercapacitor is obtained with promising electrochemical properties and rosy flexibility, demonstrating its great potential for wearable storage devices.

Keywords: Flexible super-capacitors; Bio-inspired; Electrophoretic deposition; MnO₂

[FULL TEXT](#)

© 2017 The Authors. Published by ESG (www.electrochemsci.org). This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).