Application of 3DG/CB/MnO$_2$ Electrode Material in Supercapacitors

Yu Cui$^1$, Shengming Xu$^2$, Junwei An$^{2,*}$, Shaohui Yan$^3,*$

$^1$ School of Civil Engineering, Chongqing University, Chongqing, 400044, China
$^2$ Institute of Nuclear and New Energy Technology, Tsinghua University, Beijing, 100084, China
$^3$ College of Environmental Science and Engineering, Taiyuan University of Technology, Taiyuan, 030024, China
*E-mail: shyan@buaa.edu.cn

doi: 10.20964/2016.07.83

Received: 26 April 2016 / Accepted: 20 May 2016 / Published: 4 June 2016

Using a three-dimensional graphene (3DG) prepared by a sol-gel method as skeleton material, and adding commercial carbon black as conductive additive, a novel composite electrode material (3DG/CB/MnO$_2$) is synthesized by hydrothermal method. The 3DG and 3DG/CB/MnO$_2$ composite are characterized by SEM and XRD. The SEM results indicate that the thickness of graphene sheets is homogeneous, and the MnO$_2$ nanoparticles are successfully deposited on the surface of the 3DG and carbon black to form a honeycomb structure, in which numerous pores are constructed by the graphene sheets and carbon nanotubes (CNTs). The XRD result shows that the state of the MnO$_2$ in the 3DG/CB/MnO$_2$ composite is $\delta$-MnO$_2$. The electrochemical test results display that the specific capacitances are 590, 433 and 247 F/g respectively at the current densities of 0.3, 1 and 3 A/g. Whereas, the specific capacitances of the MnO$_2$ nanoparticles at 0.3 A/g is only 433 F/g. After the 3DG/CB/MnO$_2$ composite is charge-discharge for 5000 cycles at the big current densities of 30 A/g, its specific capacitance decreases to 38 F/g from 55 F/g. The capacitance retention of the 3DG/CB/MnO$_2$ composite reaches to 70%, implying this composite is a supercapacitor electrode material which has the prospect of industrialization.

Keywords: Three-dimensional Graphene; MnO$_2$; Supercapacitor; Electrode Materials

© 2016 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/).