Electrochemical Capacitive Characteristics of TiO₂ Coated on Vertically Aligned Carbon Nanotubes

Haylay Ghidey Redda*, Ruei-San Chen, Wei-Nien Su

Graduate Institute of Applied Science and Technology, National Taiwan University of Science and Technology, Taipei 10607, Taiwan

*E-mail: ghaylay12@gmail.com

doi: 10.20964/2019.08.26

Received: 23 February 2019 / Accepted: 22 May 2019 / Published: 30 June 2019

Vertically aligned carbon nanotubes (VACNTs) were successfully grown onto stainless steel sheet (SUS) substrate at 750 °C by thermal chemical vapor deposition (TCVD) technique and were used as an electrode of the electric double-layer capacitor (EDLC). To grow VACNTs/SUS, Al (20 nm) was used as a buffer layer and Fe (5 nm) as a catalyst layer. To enhance the EDLC capacity, rutile phase of TiO₂ nanoparticles were deposited onto VACNTs by using radio-frequency magnetron sputtering technique with a target of TiO₂ in argon atmosphere without heating substrate. The as-prepared VACNTs/SUS and TiO₂/VACNTs/SUS were characterized with scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS), transmission electron microscopy (TEM), Raman spectroscopy and X-ray diffraction (XRD). The carbon nanotubes are found randomly oriented and approximately perpendicular to the surface of the SUS substrate. Raman spectroscopy results revealed that the crystalline structure of TiO₂ onto the surface of VACNTs was rutile. The electrochemical properties of EDLCs with VACNTs and TiO₂/VACNT composite electrodes were evaluated by cyclic voltammetry (CV) and galvanostatic charge-discharge using a three-electrode configuration system in 0.1 M KOH aqueous electrolyte solution at room temperature. The electrochemical measurements of electrode materials confirmed that the composition of TiO₂/VACNTs/SUS exhibited much higher specific capacitance (1289 F/g) compared to the pure VACNTs/SUS (606) at a scan rate of 0.01 V/s. These results indicate that the VACNTs/SUS and TiO₂/VACNT/SUS could be a candidate for advanced nanotechnology and electrochemical double-layer capacitor (EDLC) applications.

Keywords: Vertically aligned carbon nanotubes (VACNTs), Electrochemical double-layer capacitors (EDLCs), Titanium oxide (TiO₂).

[FULL TEXT](#)

© 2019 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/>).