Synthesis and supercapacitor performance of arrayed MWCNT-MnO_2 nanocomposites

Sie Y.C., Huang J.H.*, Chen Y.S.

Department of Materials Science and Engineering, National Tsing Hua University, Hsinchu 300, Taiwan
**e-mail: jihhuang@mx.nthu.edu.tw*

Hybrid nanocomposites containing CNTs and transition metal oxides have been considered potential electrode materials for supercapacitors. This work reports the fabrication and supercapacitor performance of arrayed MWCNT-MnO_2 nanocomposites. MWCNTs were grown directly on Si substrates by microwave plasma-enhanced chemical vapor deposition. MnO_2 was electrodeposited on MWCNTs from an aqueous solution containing 0.1 M $MnSO_4$ and 1 M Na_2SO_4. The depositions were carried out in a potential window of 0 to 1 V for 30, 50, and 70 scan cycles at scan rates of 20–200 mV/s. Prior to electro deposition, a 6 M HNO_3 solution was used to purify and activate the MWCNTs. The effects of the electro-deposition condition on the morphology and capacitance of the as-fabricated MWCNT-MnO_2 nanocomposites were investigated.

We found that MnO_2 could be uniformly coated on the sidewalls of MWCNTs at scan rates of 100 and 150 mV/s, which enhances the effective surface area for ion transportation at the MnO_2-MWCNT interface. The optimum electro-deposition condition is found to be a scan rate of 100 mV/s and scan cycle of 30. The resulting nanocomposite fabricated under this condition achieved a high specific capacitance of 649 F/g at 20 mV/s. The decay in specific capacitance based on this maximum value after a 1080-cycle teSt is only 4%, revealing the excellent stability of the product. This work demonstrates that arrayed MWCNT-MnO_2 nanocomposite is a potential cost-effective and clean supercapacitor material.