Short Communication

Structural and Morphological Properties of MnO₂/MWCNT Composite Grown Using the Hydrothermal Method for Supercapacitor Application

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Manganese dioxide and multi-walled carbon nanotubes (MWCNT) have received considerable recent interest for their potential application in supercapacitors, MnO₂ as a pseudocapacitor material and MWCNT as an electrochemical double layer capacitance (EDLC) material. The combination of MnO₂ and MWCNT is expected to make promising supercapacitor electrodes. In this study, MnO₂ was mixed with MWCNT during the hydrothermal process. The difficulty in obtaining MnO₂/MWCNT composite homogeneity in the hydrothermal process provides a challenge to scaling up production. KMnO₄ and MWCNT were mixed with 20 mL distilled water and stirred using a magnetic stirrer for 2 minutes, then placed into an autoclave. Heating of autoclave was carried out at 160°C for 3 hours in an oven and followed by cooling at room temperature naturally. Manganese dioxide/MWCNT composites were made in 1:1 and 3:1 ratios. The diffraction peaks of composites indicated that incorporation of MWCNT into MnO₂ has provided a crystalline orientation derived from MnO₂ and MWCNT. Scanning electron microscopy and TEM imaging demonstrated that MnO₂/MWCNT 3:1 composite attained better homogeneity than MnO₂/MWCNT 1:1 as indicated by the attachment of MnO₂ to the entire nanotubes surface of MWCNT. Increasing of conductivity values have been supported by MWCNT marked decreasing in the R_{ct} value in electrochemical impedance spectroscopy measurements. Based on cyclic voltammogram measurements, the MnO₂/MWCNT electrode 3:1 produced specific capacitation (C_s) of 252 F/g with stability up to 1000 cycles.

Keywords: MWCNT, MnO₂, hydrothermal method, structural, morphology, supercapacitor

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