Preparation and Electrochemical Performance of MnO₂/Fe₃O₄/MWCNTs nanocomposites as Anode for a Lithium-ion Battery

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doi: 10.20964/2020.12.45

Received: 9 August 2020 / Accepted: 15 September 2020 / Published: 31 October 2020

This paper was conducted on preparation and electrochemical performance of MnO₂/Fe₃O₄/MWCNTs nanocomposites as a Lithium-ion Battery Anode Material. For this purpose, hydrothermal synthesized MnO₂ and Fe₃O₄ nanoparticles and carboxylated multi-walled carbon nanotubes (MWCNTs) were used for preparation of MnO₂/MWCNTs, Fe₃O₄/MWCNTs and MnO₂/Fe₃O₄/MWCNTs nanocomposites. The structural characterization and electrochemical properties of prepared nanocomposites were studied. Results exhibited the high porosity and high density of both types of nanoparticles were incorporated on MWCNTs and high aspect ratio of MWCNT-based nanocomposites were prepared. The cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) measurements showed that synergistic incorporation of MnO₂ and Fe₃O₄ nanoparticles in nanocomposite improves the dynamic behavior and facilitates the electron transport between the nanocomposite and the electrolyte. The discharge capacities MnO₂/Fe₃O₄/MWCNTs nanocomposite for initial and after 70th cycle was obtained of 207.1 and 189.5 mAh g⁻¹ at 50 mA g⁻¹, respectively. Furthermore, the highest capacity retention was recorded of 93.3% and 91.0% for MnO₂/Fe₃O₄/MWCNTs at 50 mA g⁻¹ and 700 mA g⁻¹ after 70 cycles, respectively. Therefore, result showed that the MnO₂/Fe₃O₄/MWCNTs nanocomposite possesses more appropriate electrochemical properties than the MWCNTs, MnO₂/MWCNTs, and Fe₃O₄/MWCNTs nanocomposites because of the highest recorded values of discharge voltage plateau and specific capacity and more cycling stability and reversibility. The synergistic incorporation of MnO₂ and Fe₃O₄ nanoparticles in MWCNTs promoted the cycling and charge–discharge performances of composite.

Keywords: Lithium ion battery; Electrochemical impedance spectroscopy; MnO₂/Fe₃O₄/MWCNTs nanocomposite; Specific capacity; Cycling stability

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