Synthesis of CuMnO2/graphene quantum dot nanocomposites as novel electrode materials for high performance supercapacitors

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Abstract

Transition metal oxides are one of the promising materials for energy storage because they have rich redox reactions with good stability. In this study, CuMnO2 nanocrystals and CuMnO2/graphene quantum dot (GQD) composite were synthesized by hydrothermal method and used in constructing a new supercapacitor. GQD has been applied to increase specific capacity and improve efficiency of the supercapacitor. Various methods were used to identify the synthesized nanocomposite and to study its morphology, structure and surface area. Cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) were used to record and track the electrochemical behavior of the synthesized nanocomposite used as an electrode material. The study of changes in the capacity of CuMnO2/GQD and CuMnO2 electrodes during 5000 consecutive charge/discharge cycles showed that the stability of the electrode made of nanocomposite is higher and its capacity after this number of cycles reached 83.3%, while the capacity of the electrode made with CuMnO2 nanoparticles has reached 65.4%. The specific capacity of CuMnO2/GQD nanocomposite and CuMnO2 nanoparticles at a current density of 1 A g(-1) was calculated to be 520.2 and 381.5 C g(-1), respectively. The maximum specific energy of CuMnO2/GQD//AC asymmetric supercapacitor was obtained at a specific power of 1108.1 W kg(-1) equal to 47.9 Wh Kg(-1). Asymmetric supercapacitor capacitance decreased by only less than 13.3% after 5000 charge and discharge cycles, which is a very good cycle life compared to similar materials. All these results indicate that the CuMnO2/GQD nanocomposite can be deliberated as a possible option for fast and stable supercapacitor.

Keywords

Author Keywords: Manganese copper oxide; Supercapacitor; Graphene quantum dot; Nanocomposite; Nanostructure