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Polypyrrole Integrated MnCo2O4 Nanorods Hybrid as Electrode Material for High Performance Supercapacitor

Authors : Santimoy Khilari, Debabrata Pradhan

Abstract : Ever−increasing energy demand and growing energy crisis along with environmental issues emphasize the research on sustainable energy conversion and storage systems. Recently, supercapacitors or electrochemical capacitors emerge as a promising energy storage technology for future generation. The activity of supercapacitors generally depends on the efficiency of its electrode materials. So, the development of cost−effective efficient electrode materials for supercapacitors is one of the challenges to the scientific community. Transition metal oxides with spinel crystal structure receive much attention for different electrochemical applications in energy storage/conversion devices because of their improved performance as compared to simple oxides. In the present study, we have synthesized polypyrrole (PPy) supported manganese cobaltite nanorods (MnCo2O4 NRs) hybrid electrode material for supercapacitor application. The MnCo2O4 NRs were synthesized by a simple hydrothermal and calcination approach. The MnCo2O4 NRs/PPy hybrid was prepared by in situ impregnation of MnCo2O4 NRs during polymerization of pyrrole. The surface morphology and microstructure of as−synthesized samples was characterized by scanning electron microscopy and transmission electron microscopy, respectively. The crystallographic phase of MnCo2O4 NRs, PPy and hybrid was determined by X-ray diffraction. Electrochemical charge storage activity of MnCo2O4 NRs, PPy and MnCo2O4 NRs/PPy hybrid was evaluated from cyclic voltammetry, chronopotentiometry and electrochemical impedance spectroscopy. Significant improvement of specific capacitance was achieved in MnCo2O4 NRs/PPy hybrid as compared to the individual components. Furthermore, the mechanically mixed MnCo2O4 NRs, and PPy shows lower specific capacitance as compared to MnCo2O4 NRs/PPy hybrid suggesting the importance of in situ hybrid preparation. The stability of as prepared electrode materials was tested by cyclic charge-discharge measurement for 1000 cycles. Maximum 94% capacitance was retained with MnCo2O4 NRs/PPy hybrid electrode. This study suggests that MnCo2O4 NRs/PPy hybrid can be used as a low cost electrode material for charge storage in supercapacitors.

Keywords : supercapacitors, nanorods, spinel, MnCo2O4, polypyrrole
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