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Synthesis and electrochemical evaluation of the PANI/δ-MnO_2 electrode for high performing asymmetric supercapacitors

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Abstract

A comprehensive analysis of the effect of *in situ* polymerization of polyaniline (PANI) on hydrothermally synthesized Birnessite-type MnO_2 (δ-MnO_2) flowers on the structural, surface, morphological, and electrochemical properties is presented in this article. The PANI–MnO_2 electrodes showed ~170% higher specific capacitance than pure MnO_2; the factors contributing to this enhancement are systematically investigated and discussed. The PANI modification enabled the inactive surface of the MnO_2 to be electrochemically active and reduced the characteristic resistances and charge relaxation time. Furthermore, the PANI modification improved the composite conductivity and resulted in (i) reduction of surface pseudocapacitance from 87% (MnO_2) to 54% (PANI–MnO_2) and (ii) improvement of active charge contribution from 42% (MnO_2) to 46% (PANI–MnO_2). The mechanism of these changes is discussed. Furthermore, asymmetric (PANI–MnO_2//AC and PANI–MnO_2//OMC) and symmetric (AC//AC and OMC//OMC) (where AC is activated carbon and OMC is mesoporous carbon) supercapacitors are fabricated in coin cell casing and their charge storage properties are evaluated. Impressive increase in energy storage is observed; however, their properties varied according to the porosity of the carbon electrode. Results from this study provide a better understanding of the charge storage behaviour of polymer coated metal oxide electrodes with a varied choice of carbons in asymmetric supercapacitors.

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