Excellent capacitive performance of ruthenium and manganese oxides/graphene nanocomposite with hierarchical pore structures

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Incorporating transition metal oxide nanoparticles on nanocarbons (e.g. carbon nanotubes and graphenes) is a productive route to prepare robust and high performance electrode materials of energy storage devices. Because of the local oxygen functional groups and nano-sheet structures, graphenes can facilitate the uniform loading of metal oxide nanostructures. Previous studies showed that metal oxide and sulfide loaded graphene composites for supercapacitor application. In this work, we synthesized manganese and ruthenium oxide nanoparticles loaded graphene by a facile method with short reaction time and low temperature treatment. Physico-chemical characterization was carried out to analyze the nanostructures and chemical compositions of the nanocomposites. It was demonstrated that small metal oxide nanoparticles were uniformly decorated on graphene, forming hierarchical nanopore structures of micro- and meso-pores of controllable pore sizes. Because of the large active sites exploitation as well as highly nanoporous graphene network enhanced ion storage and mass transportation, current nanocomposites presented the superior capacitance performance to that of recently reported manganese or ruthenium oxide loaded carbon composites in literature. In addition, the excellent cycling stability, high capacitance and energy density of the nanocomposite versus their nanopore structures and the synergistic combination were discussed.