Ruthenium Oxide Thin Film Electrodes With High Rate Capability For Supercapacitors Application

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ABSTRACT

Ruthenium oxide (RuO_2) is known as the best electrode material for high power/energy density EC capacitors due to its outstanding specific capacitance and long cycle life. In addition to high specific capacitance and long cycle life, high conductivity and good electrochemical reversibility are advantages of ruthenium oxide over other electrode materials. Even with the disadvantage of the high cost of RuO_2 raw material, ruthenium oxide is still the most promising electrode material for pseudo-capacitors because of the poor capacitive behaviors of alternative metal oxides such as NiO, CoO_x and MnO_2.

Among various preparation techniques for ruthenium oxide, sol-gel process is the most widely used. Sol-gel process for hydrous RuO_2, however, is a highly complicated multi-step process and takes a relatively long process time as required in repeated filtering and washing steps of precipitated ruthenium oxide powders from precursor solution. In this work, we prepared RuO_2 thin film electrode in a simple process using electrostatic spray deposition, and it exhibits average specific capacitance of 650 F/g and excellent high rate capability. It was found that crystal structure, surface morphology, electrochemical properties such as CV and rate capability of RuO_2 thin film electrode were significantly affected by preparation condition and heat treatment process. The charge storage mechanism of RuO_2 thin film electrode is reported to be a protonation reaction between electrode and electrolyte in or near electrode/electrolyte interface. This reaction mechanism has been studied using electrochemical quartz crystal microbalance (EQCM) and rotating disk electrode (RDE). High rate capability and charge storage mechanism of RuO_2 thin film electrode will be discussed in detail at the conference.

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