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Electrochmically prepared Ruthenium Oxide for Supercapacitor Application

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In recent years, electrochemical (EC) capacitors have been interested in their potential applications of power source for hybrid electric vehicles (HEV), burst and pulse power source for digital mobile telecommunication devices, micro power source for medical instruments and back-up power source for computer memories. Energy storage mechanisms of EC capacitors are divided into two types: separation of charge at the interface between a solid electrode and an electrolyte, and fast faradaic reactions occurring at or near a solid electrode surface. The capacitance obtained by the first mechanism is called double - layer capacitance and the second is psuedo-capacitance.

Among transition metal oxides considered as the promising electrode materials for supercapacitors, ruthenium oxide (RuO_2) is known for one of the best electrode materials for high power / energy density EC capacitors due to its outstanding high specific capacitance and long cycle life. High specific capacitance of ruthenium oxide is resulted from pseudocapacitance which is originated by the faradaic reaction between Ru ions and H ions in acidic electrolyte.

Usually, ruthenium oxide for supercapacitor electrode material is prepared by thermal decomposition or sol-gel method. Recently, ruthenium oxide has been prepared by electrochemical synthesis techniques such as cathodic electrosynthesis or potential cycling method.

In this study, ruthenium oxides are prepared by electrochemical method. Ruthenium oxides are deposited on Pt substrate by potential cycling in aqueous solution of ruthenium chloride and they are annealed at various temperatures. The mechanism of ruthenium oxide growth during potential cycling is studied using the electrochemical quartz crystal microbalance (EQCM) and cyclic voltammetry (CV). These electrochemically prepared ruthenium oxide electrode are characterized by X-ray diffraction and thermogravimetric analysis with annealing temperatures. The electrochemical properties such as specific capacitance, reversibility, and high rate capability will be discussed in comparison with those from thermally prepared oxides.

References

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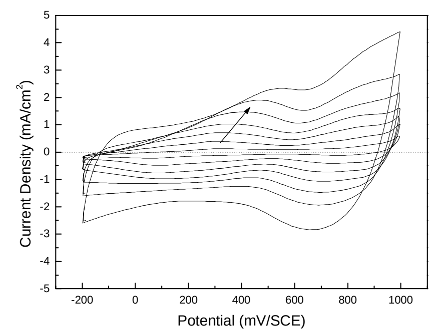

Fig.1. Formation of ruthenium oxide and its redox behavior during potential cycling.

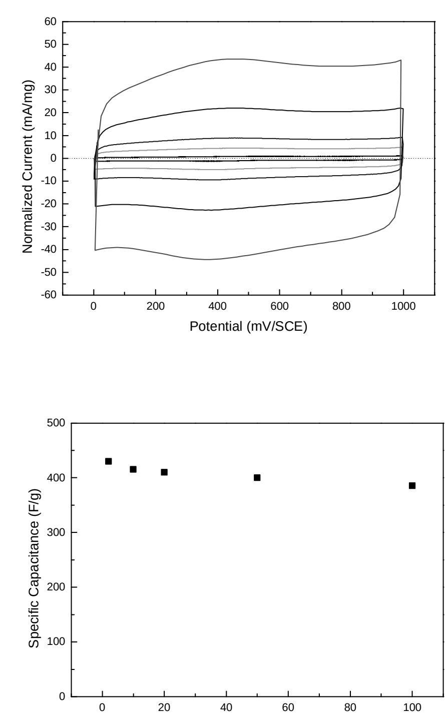

Fig. 2. Cyclic voltammogram and high rate capability of electrochemically prepared ruthenium oxide annealed at 200 C