Synthesis of Ruthenium contained Porous Silicate and Its Electrochemical Properties as Pseudocapacitor

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Intorduction

The potential power density and cycle life of electrochemical capacitor s are 2 orders of magnitude higher than those of rechargeable batteries. The electrochemical capacitor possesses electrodes, electrolyte, and separator. Several types of electrode materials have been developed. Activated carbon, foam, or carbon nanotubes represents one type of electrode material. Certain transition metal oxides such as RuO_2 and IrO_2 possess pseudocapacitance.Pseudocapacitance arises from highly reversible reactions, such as redox reactions, which occur at or near the electrode surfaces. In this study, ruthenium contained porous silicate prepared by rapid crystallization method were used as electrode of pseudocapacitor.

Experimental

Ruthenium contained porous silicate were prepared by rapid crystallization method[1]. Tetraethylammonium hydroxide(TEAOH) and tetramethylammonium hydroxide(TMAOH) was used as the template. As for Si source tetraethylorthosilicate(TEOS), and as for Na and Al sources, sodium hydroxide and aluminum isopropoxide(AIP) were used, respectively. And ruthenium chloride was used as Ru sources. Composition of the gel mixture was $6Na_2O$-$25(TEA)_2O$-$100SiO_2$-Al_2O_3-$1555H_2O$. And Ru/Si mole ratio give 1/200, 1/100, and 1/50. The gel mixture was stirred vigorously by a homogenizer until homogeneous gel was obtained. The mixure gel into stainless steel autoclave was heated for crystallization at 200℃ for 24hrs. After crystallization, crystal were separated from the mother liquor, washed with distilled water until pH value of washing water reached 7-8, and dried at 110℃ in oven 12hrs. And then heated at 540℃ for 3.5hrs.
Prepared powders were examined physical and electrochemical characteristics. 1M H_2SO_4 solution was used as electrolyte of pseudocapacitor.

Result and Discussion

Crystalline feature of prepared ruthenium contained porous silicate were a rectangle(Fig.1). BET surface area and average pore diameter was 401.78m^2/g and 18.69Å(Fig.2). As shown Fig. 3 and Fig. 4, it seems good electrochemical properties.

Reference

[1] T. Inui, ACS Symposium series, 398, 479(1989)

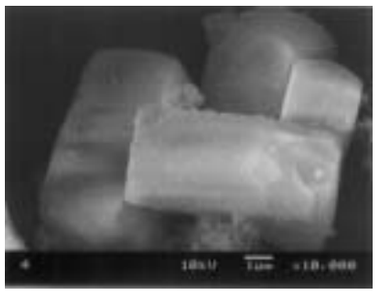

Fig. 1. Scanning electron micrographs of ruthenium contained porous silicate.

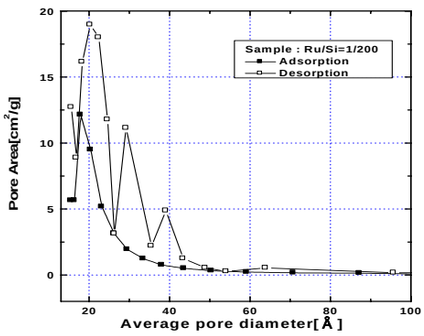

Fig. 2. Relationship of incrememental pore area with average porea diameter at adsorption and desorption of nitrogen molecules ruthenium contained porous silicate by rapid crystallization method.

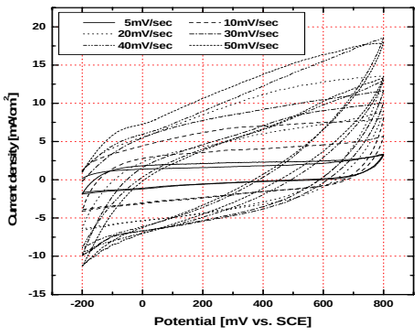

Fig. 3. Cyclic voltammograms of ruthenium contained porous silicate with various scan rates.

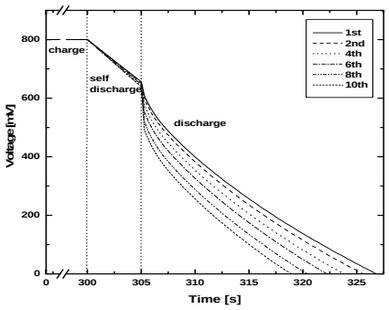

Fig. 4. Effect of self-discharge of ruthenium contained porous silicate.