Electronic Supplementary Material (ESI) for RSC Advances.

Nanosheet-Assembled 3D Nanoflowers of Ruthenium Oxide with Superior Rate Performance for Supercapacitor Applications

Ji-Young Kim, Kwang-Heon Kim, Hyun-Kyung Kim, Sang-Hoon Park, Kyung-Yoon Chung, and Kwang-Bum Kim*

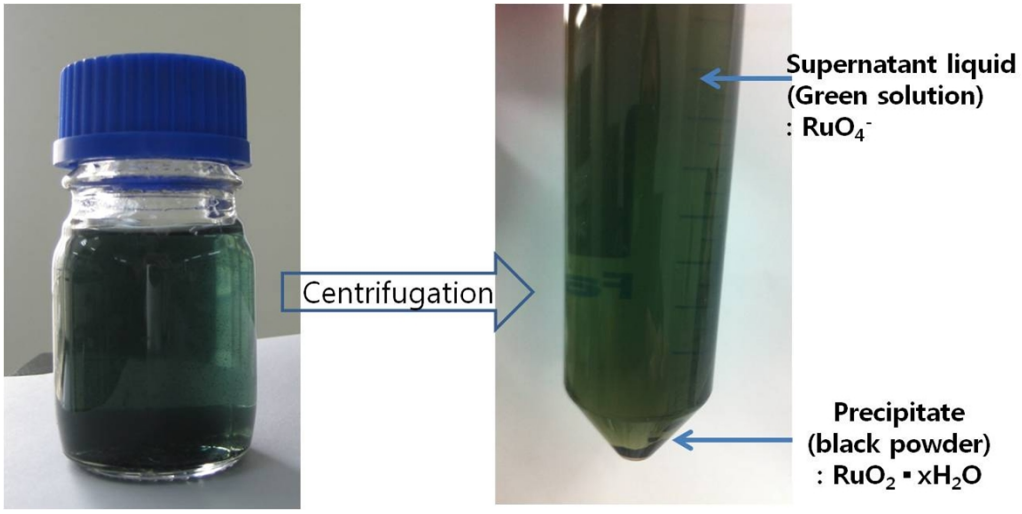

Figure S1. 10M NaOH aqueous solution after addition of $RuCl_3 \cdot nH_2O$ o at room temperature; The solutions appeared green in color immediately after addition of $RuCl_3 \cdot nH_2O$ to 10M NaOH aqueous solution. The black precipitates and the green supernatant liquid could be separated by centrifugation.

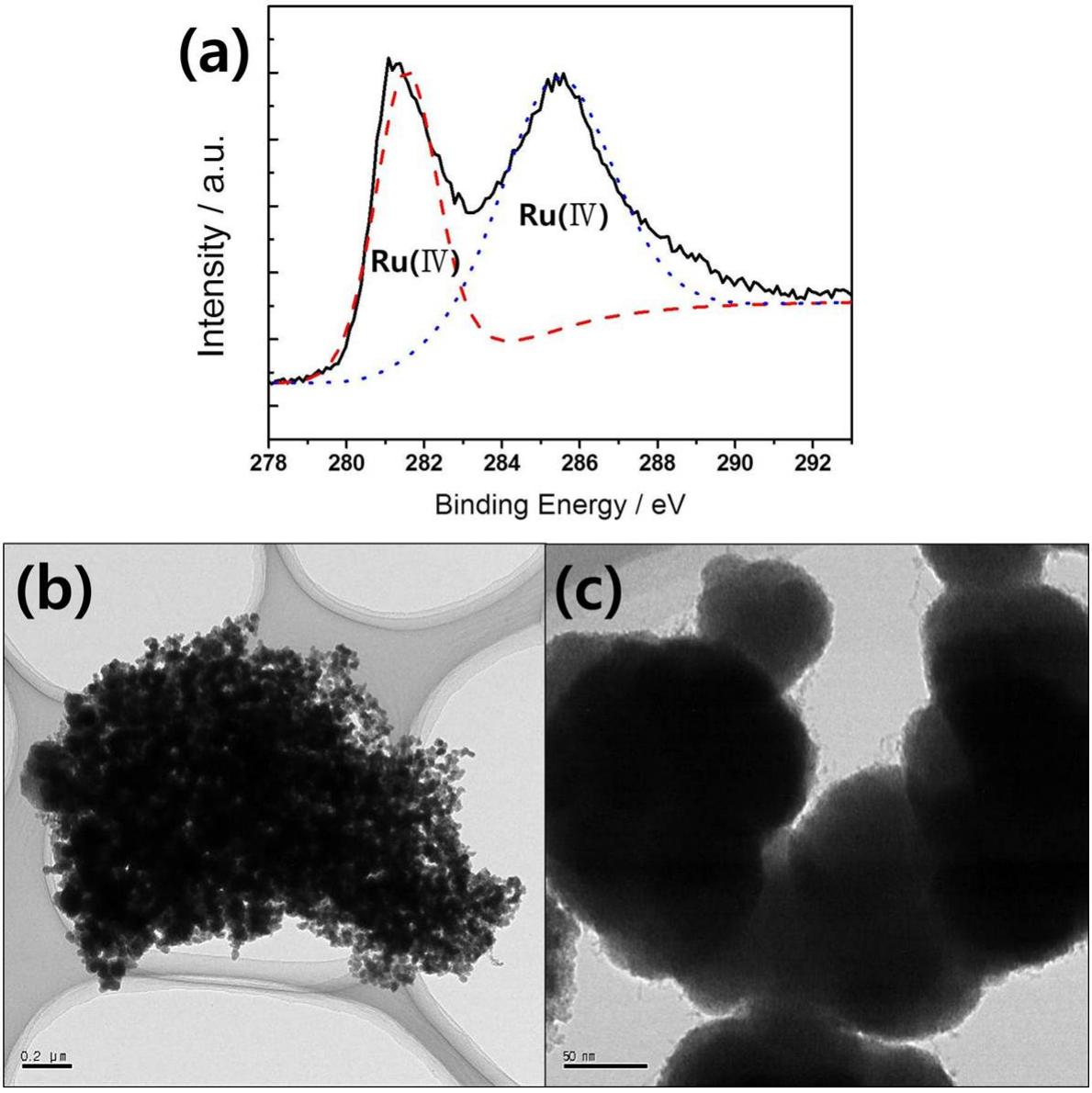

Figure S2. (a) XPS and (b) TEM images and of initial precipitates before microwave-hydrothermal reaction. (c) is a higher magnification image of of b)

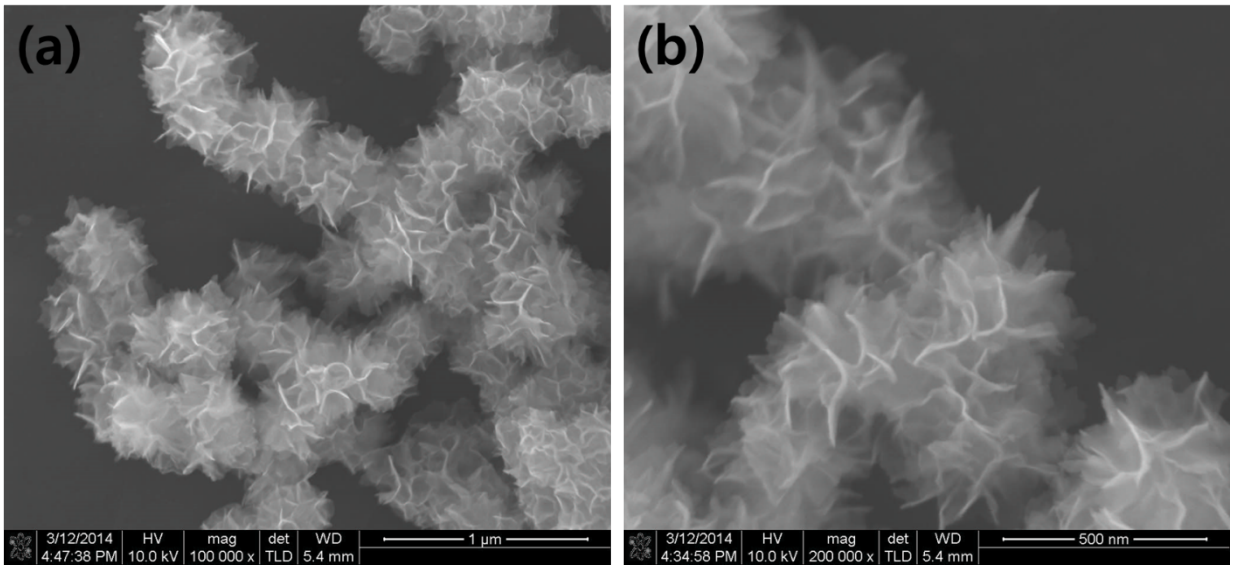

Figure S3. SEM images of 3D ruthenium oxide nanoflowers synthesized by microwave-hydrothermal process (reaction time = 240 min.) ((b) is a higher magnification image of of a)

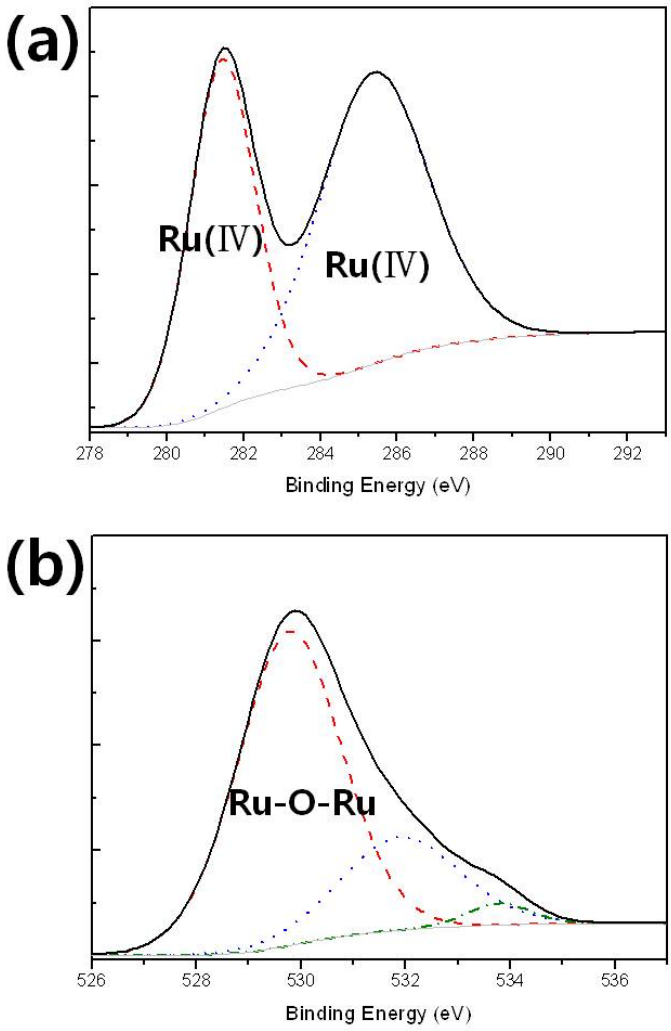

Figure S4 a) Ru3d and b) O1s XPS spectra of 3D ruthenium oxide nanoflowers synthesized by microwave-hydrothermal process (reaction time = 240 min.)

The Ru3d XPS spectra was found at 281.2 eV and 285.4 eV, which is attributed to Ru(IV) species, suggests the presence of RuO_2.

The O1s XPS spectra consist of an enhanced peak at 530.0 eV and a shoulder at 531.8 eV. According to literature, the former is assigned to RuO_2, while the latter is characteristic of oxygen containing impurities.

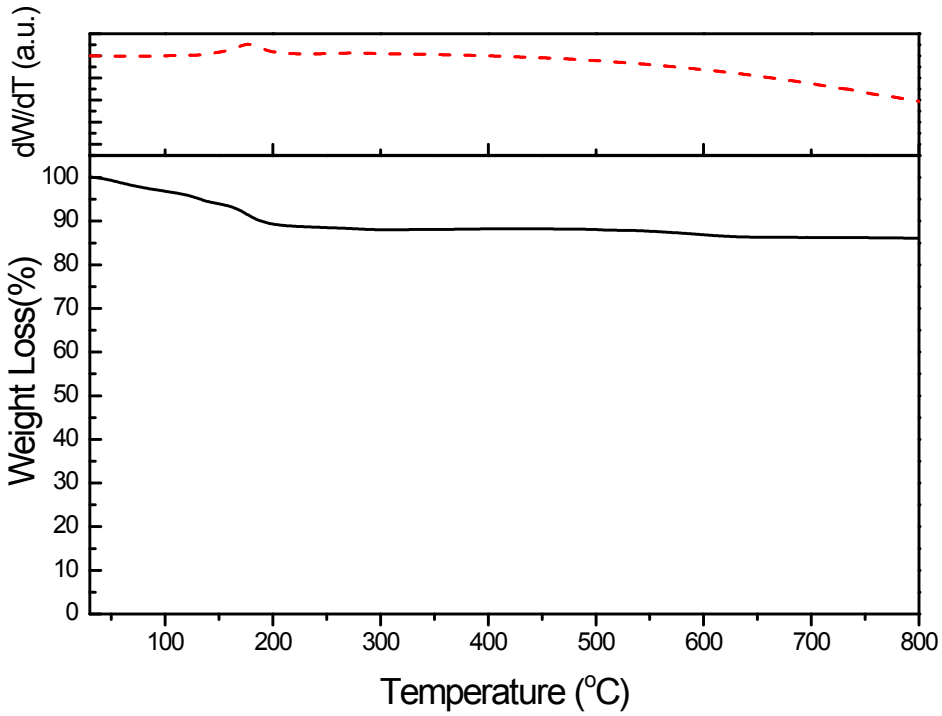

Figure S5. Thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) of 3D ruthenium oxide nanoflowers synthesized by microwave-hydrothermal process (reaction time = 240 min.) Temperature scan rate : 10 °C/min.

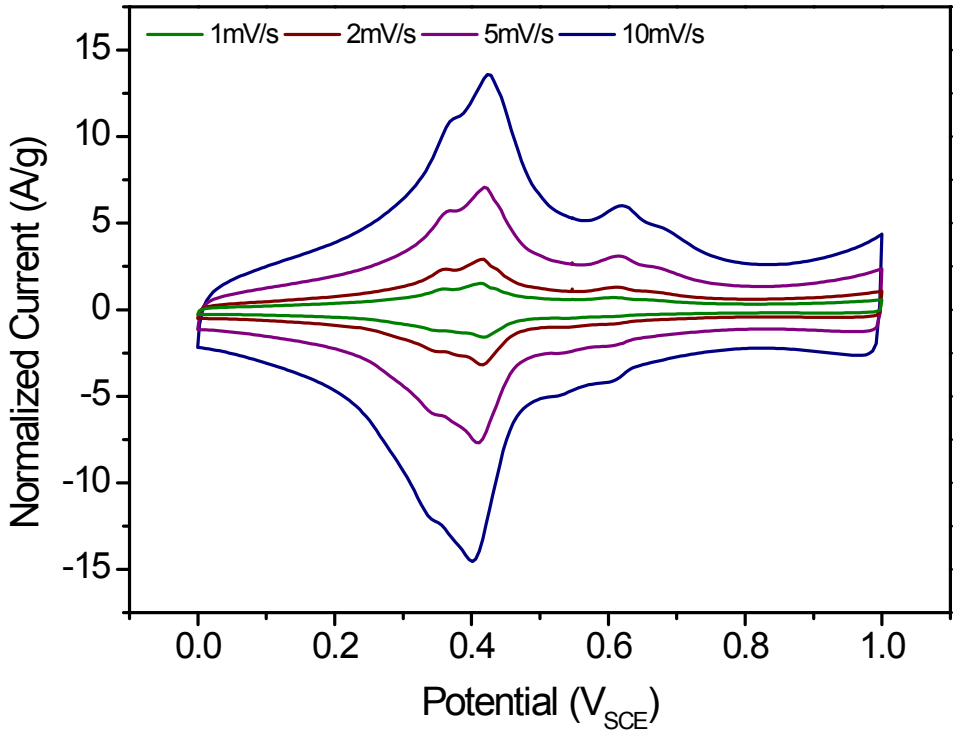

Figure S6. Cyclic voltammograms of 3D ruthenium oxide nanoflowers electrode synthesized by microwave-hydrothermal process (reaction time = 240 min.): scan rate: 1, 2, 5, and 10 mVs^{-1}

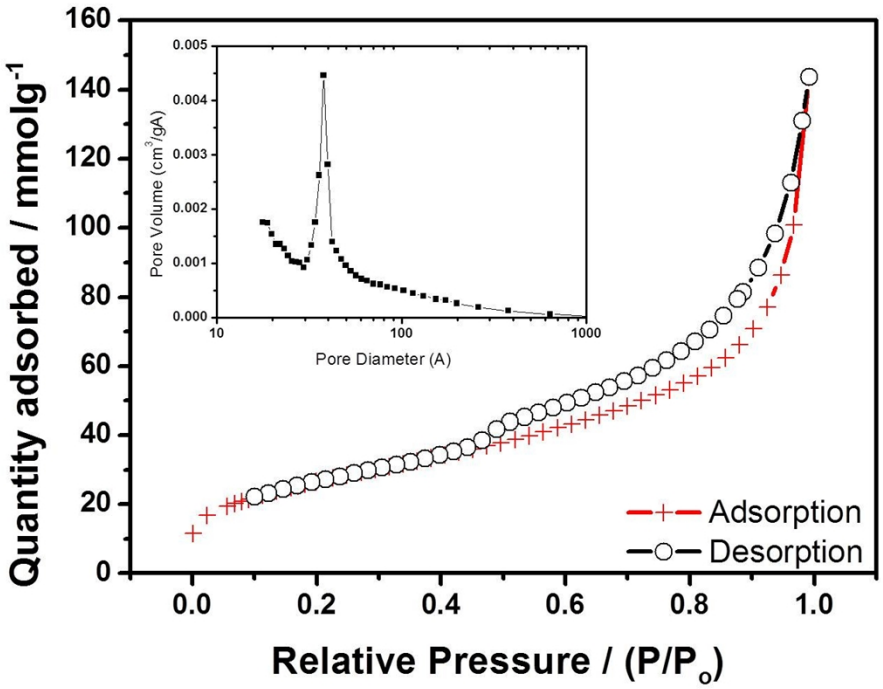

Figure S7. Nitrogen adsorption and desorption isotherm, and its corresponding pore size distribution curve (insets) of 3D ruthenium oxide nanoflowers, synthesized by microwave-hydrothermal process (reaction time = 240 min.)