

Electronic Supplementary Information (ESI)

Template Synthesis of Hollow Fusiform Ruthenium Oxides and its supercapacitor performance

I. Experimental Details:

Synthesis: All the reagents were analytical grade and utilized without further purification. α -Fe₂O₃ nanospindles were first prepared by a simple hydrothermal approach as described in our previous work^[1]. Typically, to prepare α -Fe₂O₃ nanospindles, 0.541 g FeCl₃•6H₂O and 3.0 mg NaH₂PO₄•2H₂O were dissolved in 80 mL deionized water and transferred to a Teflon-lined autoclave (100 mL), then heated at 100 °C for 48 h in an electric oven. The final precipitate was centrifuged and washed with deionized water and ethanol several times and dried at 60 °C in an electric oven. To obtain the hollow fusiform ruthenium oxides, 0.02 g of the prepared α -Fe₂O₃, 0.05 g RuCl₃•3H₂O and 1 mL HCl were dissolved in 70 mL deionized water and ultrasonicated for 30 min to give a well-distributed solution. Then the mixed solution was transferred into a 100 mL Teflon-lined autoclave and maintained at 180 °C for 6 h. After washing three times with distilled water, the black product was added to 1 M hydrochloric acid solution and placed for 1 day at 80 °C to remove the α -Fe₂O₃ template completely. The final product was collected by centrifugation after being washed with distilled water several times and finally dried at 60 °C.

Characterizations: The as-prepared products were characterized with X-ray powder diffractometer (XRD, X'Pert PRO MRD, PANalytical, Netherlands), scanning electron microscopy (SEM; JEOL, JSM-6700F), and transmission electron microscopy (TEM; JEM-2100 (HR), 200 kV). The EDS tests were carried out on the energy dispersive X-ray spectrometer (EDS) which was equipped on the SEM of QUANT200. The BET specific surface area was measured on a Bel Sorp-mini (S/N-00230).

Electrochemical measurements: All the electrochemical measurements (cyclic voltammetry and constant current charge-discharge) were performed on a CHI 440A electrochemical workstation (Shanghai CH Instrument, China) with a conventional three-electrode system composed of a working electrode, a platinum plate as auxiliary electrode and a saturated calomel electrode (SCE) as reference electrode. The working electrodes were prepared by mixing the active materials (85 wt%), acetylene black (10 wt%) and polyvinylidene fluoride (PVDF, 5 wt%) in isopropyl alcohol together and then coated on a platinum foil and dried naturally for about 12 h. All the electrochemical experiments were carried out in 1 M H₂SO₄ solution at room temperature.

II. Figures:

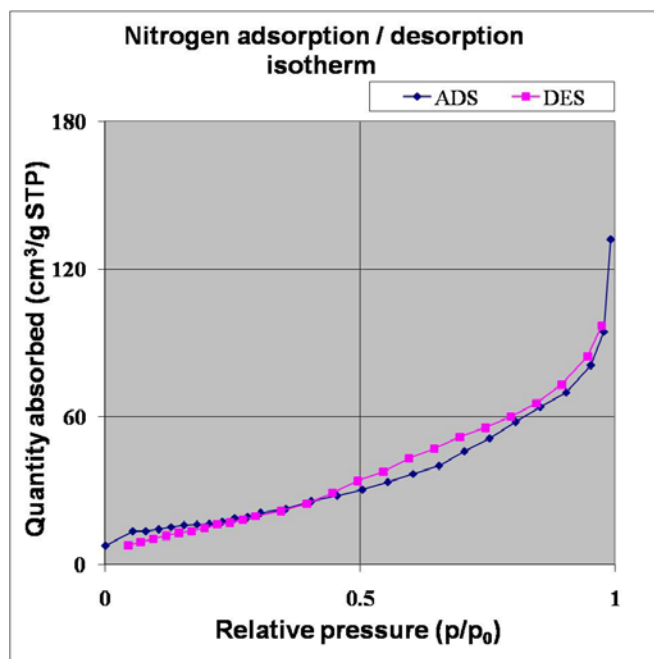


Fig.S1. Nitrogen adsorption–desorption isotherms of the as-prepared hollow fusiform $\text{RuO}_2 \cdot x\text{H}_2\text{O}$

Fig.S2. Thermogravimetric analysis (TGA) curve of as-prepared $\text{RuO}_2 \cdot x\text{H}_2\text{O}$. The weight loss of the sample is 12.1 %, reveals the oxide has a composition of $\text{RuO}_2 \cdot 1.08\text{H}_2\text{O}$.

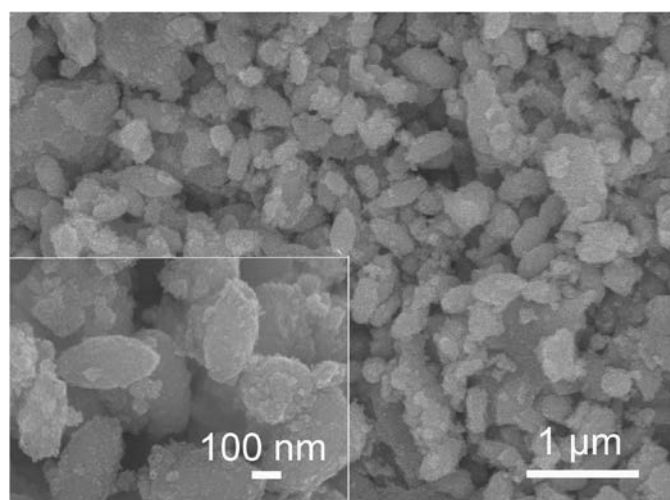


Fig.S3. SEM of the sample prepared with no HCl added into the reaction solution. The inset shows enlarged image.

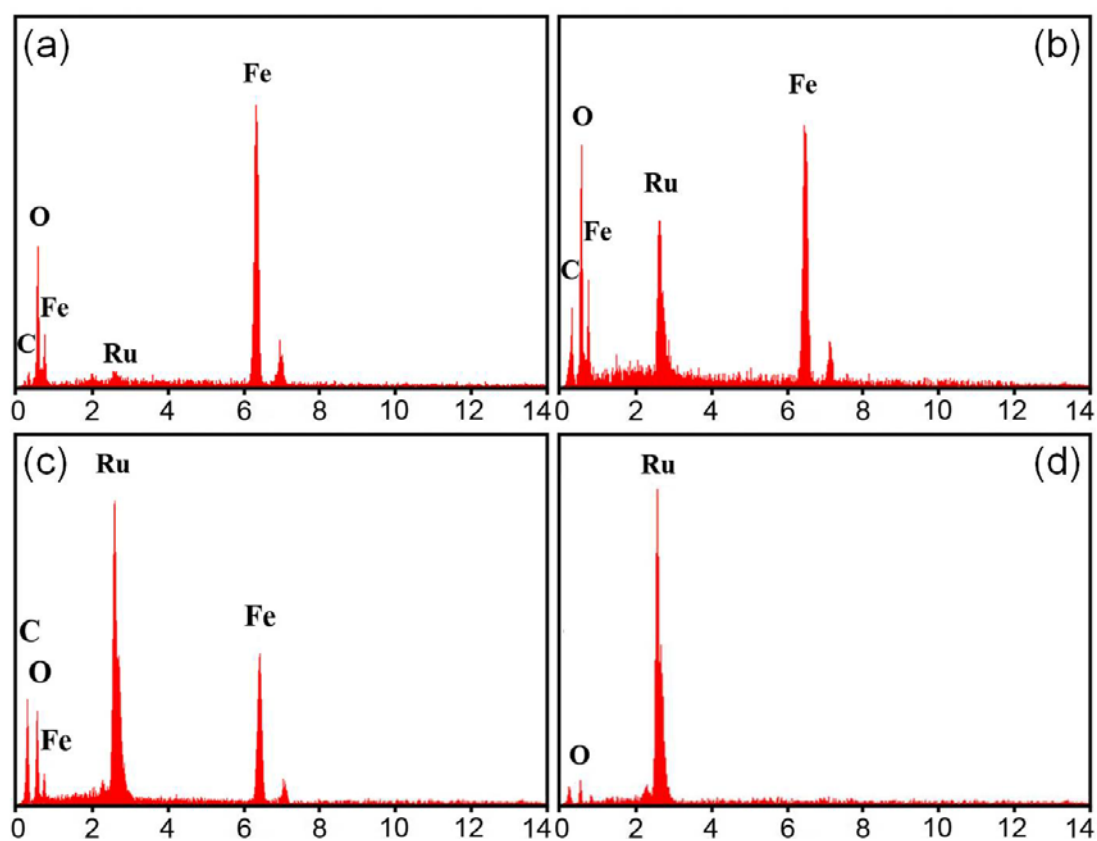


Fig.S4. The EDX results of the samples collected after (a) 30min, (b) 1h, (c) 6h reaction and (d) the final hollow fusiform $\text{RuO}_2 \cdot x\text{H}_2\text{O}$.

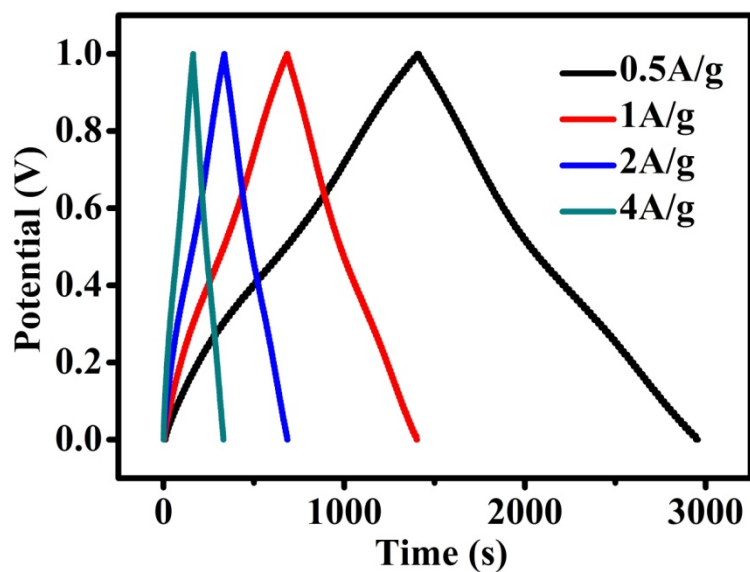


Fig.S5. Charge-discharge curves of the hollow fusiform RuO₂·xH₂O electrode at the low current densities of 0.5, 1, 2 and 4Ag⁻¹ with the corresponding specific capacitances of 772,718,698 and 671Fg⁻¹, respectively.

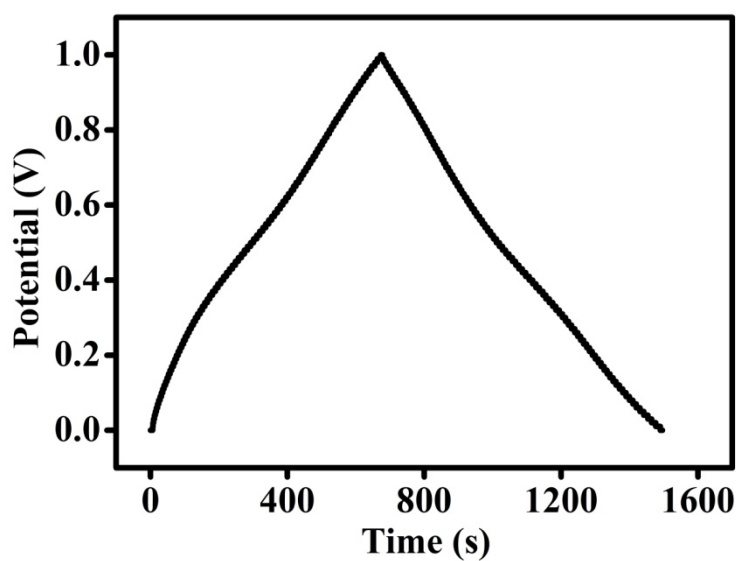


Fig.S6. Charge-discharge curve of the hollow fusiform RuO₂·xH₂O electrode after 1000 cycles at the current density of 1Ag⁻¹ (the charge time is 672s and discharge time is 823s).

References:

- [1] Y. Ke, Y. Zeng, X. L. Pu, L. F. Li, X. Wu, Z. H. Zhu and Y. Yu, *RSC Adv.*, 2012, 2, 5676.