

Electronic Supplementary Information (ESI)

**Facile synthesis of mesoporous cobalt oxide rugby for  
electrochemical energy storage**

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## **Experimental Details**

### **Synthesis of Samples**

The  $\text{Co}_3\text{O}_4$  rugby balls were synthesized as follows: 3 g urea, 1.5 g  $\text{Co}(\text{CH}_3\text{COO})_2 \cdot 4\text{H}_2\text{O}$ , and 3 g PVP ( $M_w=30000$ ) were dissolved into 120 mL ethylene glycol with continuous agitation, and then transferred to the Teflon-sealed autoclave and maintained at 200 °C for 16 h. The as-synthesized product was isolated by centrifugation, washed three times with water and ethanol, respectively, and finally dried in a vacuum oven at 60 °C for 24 h. After then, the thermal treatment of the precursor was carried out in air at 300 °C for 4 h.

Graphene hydrogels were prepared according to a previous reference <sup>1</sup>. In a typical procedure, a 60 mL graphite oxide ( $2 \text{ mg mL}^{-1}$ ) aqueous dispersion was obtained by sonication for 1 h <sup>2</sup>. Then the resulting mixture was sealed in a Teflon lined autoclave and was hydrothermally treated at 180 °C for 12 h. Finally, the as-prepared sample was freeze-dried overnight, followed by vacuum drying at 60 °C for several hours.

### **Characterization**

The products were characterized by field emission scanning electron microscopy (FESEM; Philips XSEM30, Holland), transmission electron microscope (TEM; JEOL, JEM-2010, Japan), X-ray diffraction (XRD; Philips PC-APD) with Cu  $K\alpha$  radiation ( $\lambda = 1.5418 \text{ \AA}$ ), Raman spectra (514 nm laser with RM100) and  $\text{N}_2$  adsorption/ desorption.

The as-prepared samples, acetylene black and polytetrafluoroethylene (PTFE) binder were mixed in a weight ratio of 75:20:5, using ethanol as the solvent to be pressed into nickel foam (1 cm × 1 cm), which were used as working electrodes. A typical experimental cell equipped with a working electrode, a platinum foil counter electrode, and an SCE reference electrode was used for measuring the electrochemical properties. The Co<sub>3</sub>O<sub>4</sub> rugby balls and the graphene hydrogels working electrodes were pressed together with a polypropylene membrane as separator to prepare the asymmetric supercapacitor. The loading mass ratio of the Co<sub>3</sub>O<sub>4</sub> and graphene hydrogels was estimated to be 1. The electrolyte was 1 M KOH. The specific capacitance is calculated by  $C_m = I \times \Delta t / (\Delta V \times m)$ , where  $C_m$  (F g<sup>-1</sup>) is the specific capacitance,  $I$  (A) is the discharge current,  $\Delta t$  (s) is the discharge time,  $\Delta V$  (V) is the potential change during discharge, and  $m$  (g) is the mass of the active material within the electrode.

1 L. Zhang and G. Shi, *J. Phys. Chem. C* 2011, **115**, 17206.

2 W. S. Hummers and R. E. Offeman, *J. Am. Chem. Soc.*, 1958, **80**, 1339.