Electronic Supplementary Information (ESI)

Synthesis of Fe_3O_4@SnO_2 core-shell nanorod film and its application as thin-film supercapacitor electrode

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I. Experimental Details:

Synthesis. Typically, the first step was the synthesis of Fe_3O_4 nanorod film. 0.946 g $FeCl_3 \cdot H_2O$ and 0.497 g Na_2SO_4 was mixed with 70 mL distilled water for 10 minutes at room temperature. Then, the resulting solution was transferred into a Teflon-lined stainless steel autoclave with a rectangular titanium (Ti) foil lying at the bottom and kept at 160 ^oC for 6 h. After cooling down to room temperature, the obtained film was taken out and immersed into a 100 mL aqueous solution containing 0.25 g glucose for 24 h. Finally, the film was dried at 60 ^oC and further annealed at 550 ^oC in the flow of Ar for 3 h. SnO_2 porous shell was coated on the surface of Fe_3O_4 nanorod core by a simple hydrothermal method. In detail, a 70 mL solution containing 0.0333 g $K_2SnO_3 \cdot 3H_2O$ and 0.3 g urea was heated in autoclave at 90 ^oC with the Fe_3O_4 film immersed in. After 2 h, the core-shell nanorod film was taken out and annealed at 500 ^oC in Ar gas for 2 h to improve the crystallinity and adhesion to the substrate.

Characterizations. The microstructure and morphology of the film was characterized by powder X-ray diffraction(XRD, Bruker D-8 Avance) measurement, transmission electron

microscopy (TEM) (JEM-2010FEF, 200 kV) and scanning electron microscopy (SEM, JSM-6700F). The BET specific surface area was measured on a Bel Sorp-mini (S/N-00230) Analyzer (accelerated surface area and porosimetry system). CHI 760D electrochemical workstation with a three-electrode mode was used to perform cyclic voltammetry and constant current charge-discharge behavior. Nanorod films were directly used as the working electrode. The reference electrode and counter electrode were Ag/AgCl and a platinum plate, respectively. Electrochemical impedance spectroscopy (EIS) was recorded on PARSTAT2273 by applying an AC voltage with 5 mV amplitude in a frequency range from 0.01 Hz to 100 kHz at open circuit potential. All the electrochemical experiments were carried out in 1 M Na_2SO_3 solution at room temperature.

II. Figures:

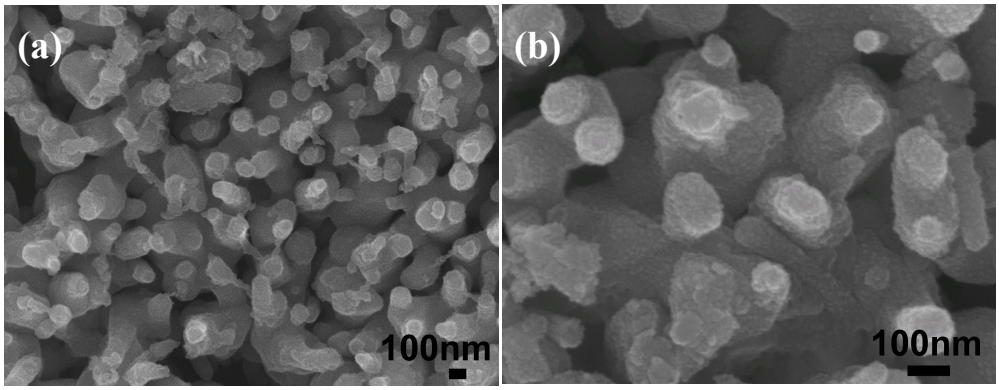

Fig.S1. (a) Low-magnification and (b) enlarged SEM images of Fe_3O_4@SnO_2 hybrid film electrode after 2000 cycles.

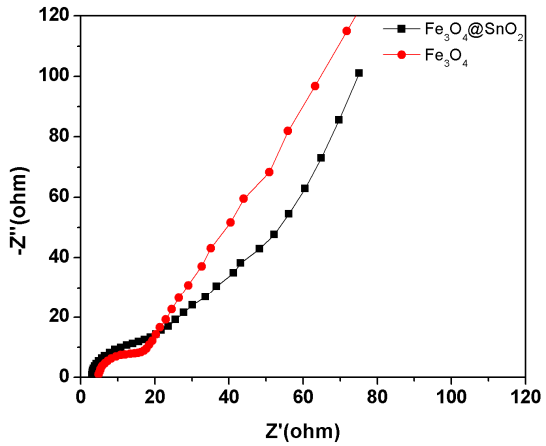

Fig.S2. EIS results of Fe_3O_4@SnO_2 and pristine Fe_3O_4 films after long-term cycling. Although the R_{ct} value of both the electrodes increases to ~12 Ω, it is still relatively small.