Supporting Information

Supercapacitive properties of Mn_3O_4 nanoparticles bio-synthesized by banana peel extract

Dongliang Yan,*[a] Huan Zhang,[a] Lin Chen,*[b] Guisheng Zhu,[a] Zhongmin Wang,[a] Huarui Xu,*[a] and Aibing Yu [c]

[a] *Guangxi Key Laboratory of Informati Materials, Guilin University of Electronic Technology, Guilin 541004, PR China*

[b] *Department of Material and Chemistry Engineering, Pingxiang University, Pingxiang 337055, PR China*

[c] *School of Materials Science and Engineering, University of New South Wales, Sydney, NSW 2052, Australia*

*Corresponding author Tel.: +86 773 2291159; fax: +86 773 2191903

E-mail addresses: dlyan@guet.edu.cn (DL Yan); rymw27@163.com (L Chen); huaruixu@guet.edu.cn (HR Xu)

Experimental

1. Preparation of banana peel extract

The waste banana peel (Fig. 1(b) inset left) is collected from Guilin local market and washed with sterile distilled water thoroughly. After the cleaned peel are dried at room temperature in a sterile room for 20 days, the 15 g air dried peel are cut into small pieces and mixed with 300 mL double distilled water in a round bottom flask followed by heating at a constant temperature of 90 °C for 5 h. The light-yellow banana peel extract (Fig. 1(b) inset right) is obtained by filtered using Whatman's No. 1 filter paper and resultant extract is stored at –4 °C for further experiment.

2. Synthesis of Mn_3O_4 nanoparticles

Banana peel extract (5 mL) was added dropwise to 50 mL of 0.05 M $KMnO_4$ (Beijing Chemical Regent Co.) aqueous solution under magnetic stirring at room temperature. After continuous stirring for 5 h, the dark brown product was collected, washed by ethanol several times and then dried in air at 60 °C overnight.

3. Characterization

A FEI Inspect F50 field emission scanning electron microscopy (FESEM) was used to image the morphology of the product. The structure and surface properties of the as-obtained sample were studied in detail by X-ray powder diffractometer (XRD, Rigaku Geigerflex D/Max 2200), fourier transform infrared spectroscopy (FT-IR, Bruker TENSOR27) and X-ray photoelectron spectroscopy (XPS, Thermo ESCALAB 250Xi).

4. Electrochemical Measurement

The Mn_3O_4 electrode was prepared by coated the mixtures of the resultant sample, acetylene black and polytetrafluoroethylene (PTFE) in a weight ratio of 0.8:0.15:0.05 onto a foamed nickel. The mass loading of active materials is 2.5 mg/cm^2. Electrochemical measurements were carried out using a CHI 660 E electrochemical workstation in a conventional three-electrode system, which a saturated calomel electrode (SCE) as the reference electrode, a 10×10 mm platinum plate as the counter electrode and the Mn_3O_4 electrode as the working electrode. Electrochemical impedance spectroscopy (EIS) was performed with an amplitude of 5 mV over a frequency range of 0.01-100 kHz. All the electrochemical tests were conducted in 0.5 M Na_2SO_4 solution at room temperature with the potential range of -0.2-0.8 V (*vs*. SCE).