**Supplementary Information**

# Solventless synthesis of iron-oxide/graphene nanocomposite and its application as anode in high-rate Li-ion batteries

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## Experimental

*Preparation of iron oxide nanoparticle*

In a typical synthesis, iron oxide nanoparticles were simply obtained through the heat treatment of as-prepared iron-oxide/graphene nanocomposite at 400 °C under air atmosphere for 6h.

## Characterization

Transmission electron microscopy (TEM) images were obtained using a JEOL EM-2100F microscope, and field-emission scanning electron microscopic (FE-SEM) images were obtained with a Hitachi S-4800 microscope. X-ray diffraction (XRD) analysis was carried out using a Rigaku Dmax 2500 diffractometer. The Brunauer-Emmett-Teller (BET) method was used to confirm the pore structure using a BELSORP-mini II (BEL JAPAN) nitrogen absorption analyzer. X-ray photoelectron energy spectra (XPS) was obtained using AXIS-His spectrometer.

A working electrode was prepared by following scheme. A dry powder (active material), super P (carbon additive), and poly(vinylidenefluoride) (binder) (85:5:10) were mixed and coated on a piece of copper foil (current collector). In graphene electrode preparation, the ratio was changed to 70:0:30. After removing the residual moisture by drying in a vacuum oven at 120 °C for 12 h, the electrode plate was pressed to enhance the inter-particle contact and to reinforce adhesion between particles and the current collector. The mass loading of electrodes was 1 mg/cm$^2$. The electrochemical tests were performed by using a coin-type electrochemical cell (2032-type) which was fabricated with lithium foils as the counter and reference electrodes and 1.0 M $LiPF_6$ dissolved in a mixture of ethylene carbonate (EC) and

dimethyl carbonate (DMC) (1:2 in vol. ratio) as the electrolyte. In order to cycle the coin-type electrochemical cells, they were discharged with constant current of 100 mA $g^{-1}$ to 0.05 V (vs. $Li/Li^+$) and charged with constant current of 100 mA $g^{-1}$ to 3.0 V (vs. $Li/Li^+$). In the rate capability test, the lithiation and delithiation current density was changed every five cycles according to this sequence of values: 100, 200, 500, 1000, 3000, 5000 and 100 mA $g^{-1}$. AC impedance measurement was made in the frequency range of 10 mHz ~ 100 kHz.

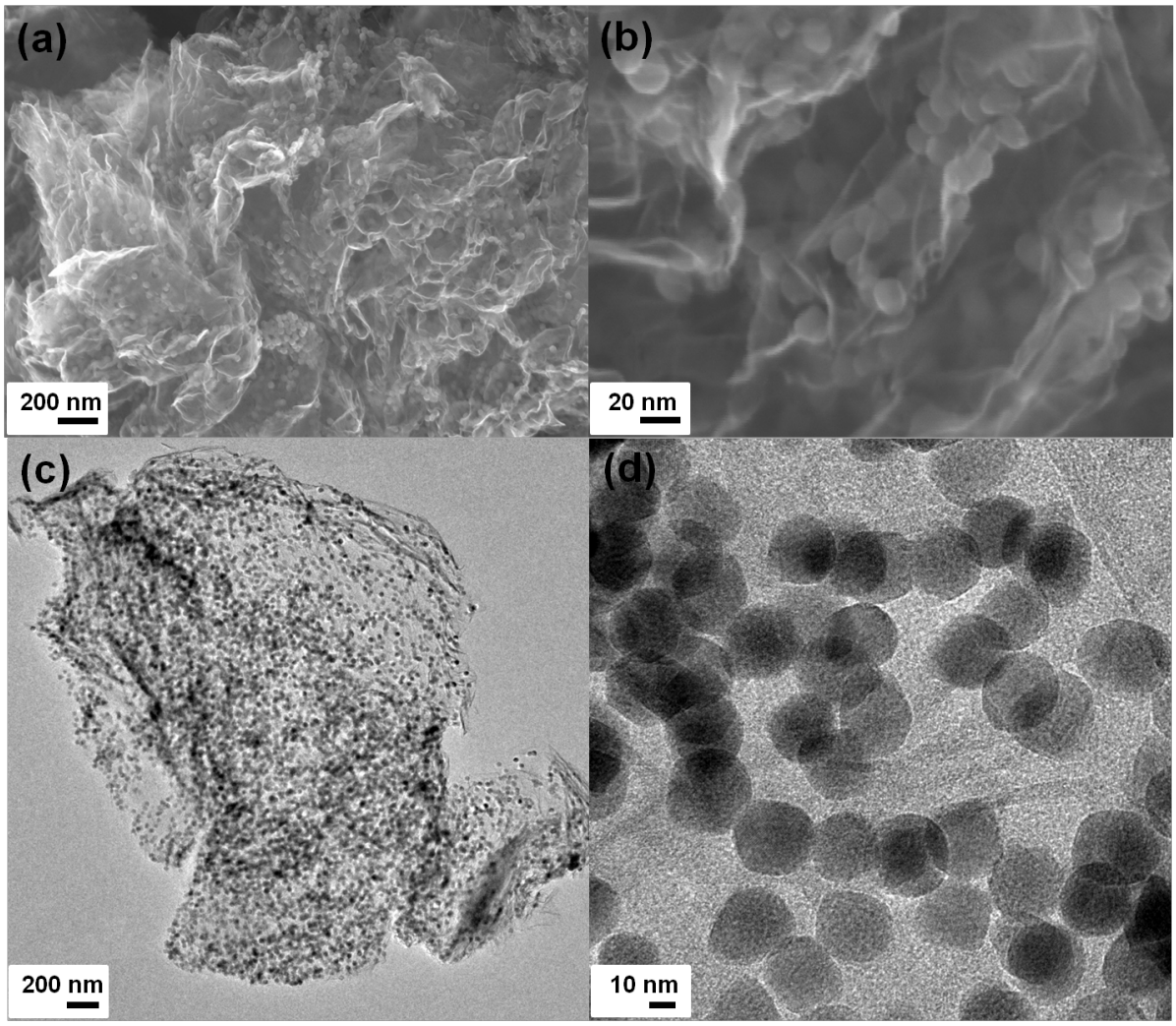


**Fig. S1** (a) Low and (b) high magnification FESEM image and c) Low and (d) high magnification TEM image of iron-oxide/graphene nanocomposite.

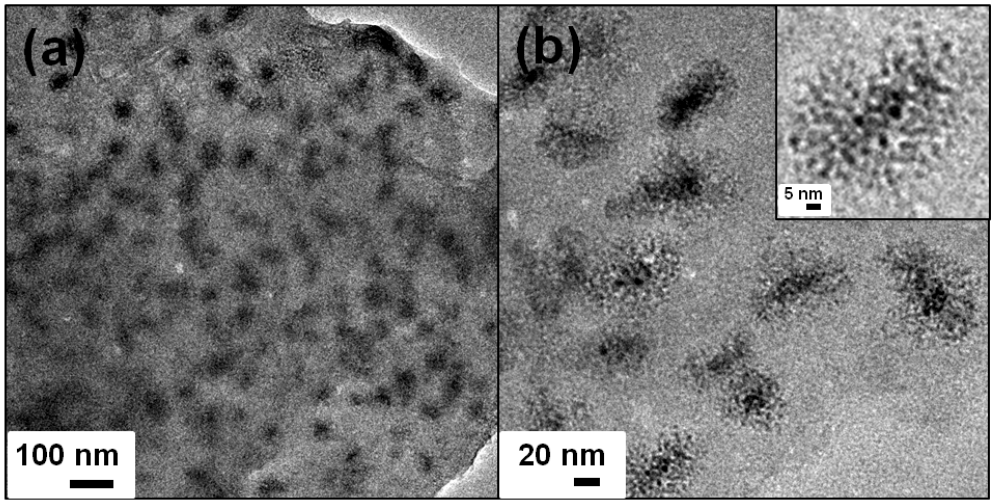


**Fig. S2** TEM images of iron-oxide/graphene nanocomposite after 50th charge/discharge cycling at a rate of 100 mA $g^{-1}$. The inset figure represents high resolution TEM image of the pulverized iron oxide nanoparticle.

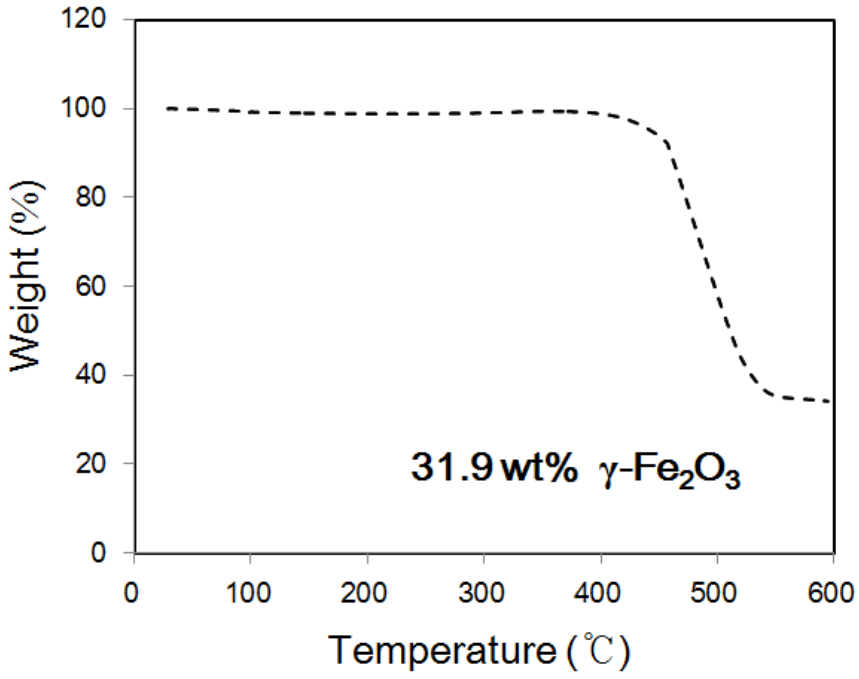


**Fig. S3** TGA result of the iron-oxide/graphene nanocomposite.