# Electronic Supplementary Information

## α-$Fe_2O_3$ Nanotubes with Superior Lithium Storage Capability

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### Experimental details

Cu nanowires used as sacrificial templates in this study were synthesized by the reaction between $Cu(NO_3)_2$ and hydrazine in the presence of ethylenediamine (EDA).[1] $Fe(OH)_x$ nanotubes were synthesized by dropwisely adding 10 mL of ethanol solution of $FeCl_3$ (5 - 7.5 mM) into a suspension of 0.008 mmol of Cu nanowires in a mixture solution of ethanol (10 mL) and aqueous NaCl solution (1.7 M, 0.2 – 0.4 mL) under stirring at room temperature for 10 – 30 min. The final products were collected by several rinse-centrifugation cycles. For the preparation of α-$Fe_2O_3$ nanotubes, the $Fe(OH)_x$ sample was annealed in air at 300 $^oC$ for 3 hours with a slow heating rate of 0.5 $^oC\ min^{-1}$.

All samples were characterized by field-emission scanning electron microscope (FESEM, JEOL, JSM-7600F), transmission electron microscope (TEM, JEOL, JEM-2010) and powder X-ray diffraction (XRD, Bruker, D8-Advance X-ray Diffractometer, Cu Kα).

The galvanostatic charging/discharging tests were conducted using Swagelok-type cells (X2 Labwares, Singapore) on a Neware battery tester with lithium foil as the counter and reference electrodes and 1.0 M $LiPF_6$ in mixed ethylene carbonate and diethyl carbonate (EC:DEC, 1:1 by weight) as the electrolyte. A cut-off voltage window of 0.01 – 3.0 V is used. The working electrode is composed of α-$Fe_2O_3$ nanotubes, carbon black (super-P-Li) and polyvinylidene difluoride (PVDF) in a weight ratio of 7:2:1. 1 C corresponds to 6Li per $Fe_2O_3$, and is equivalent to 1007 mA $g^{-1}$. Cyclic voltammetry (CV) study was carried out on an electrochemical workstation (CHI 660C) between 0.01 - 3.0 V at a scan rate of 0.5 mV $s^{-1}$.

**Reference:**

1. Chang, Y.; Lye, M. L.; Zeng, H. C. *Langmuir* **2005**, *21*, 3746.

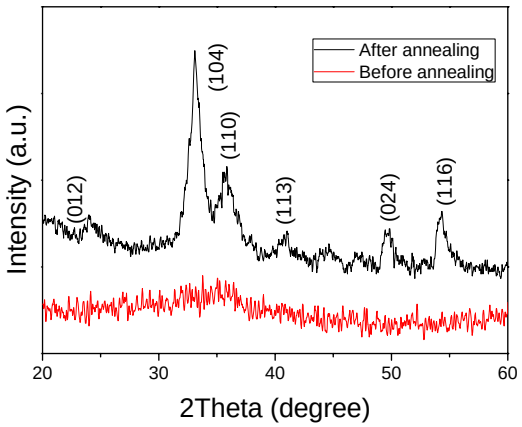


Fig. S1. XRD patterns of the samples before and after annealing in air.

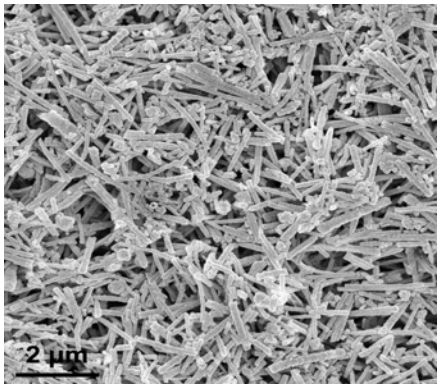


Fig. S2. Overview FESEM image of $Fe(OH)_x$ nanotubes.

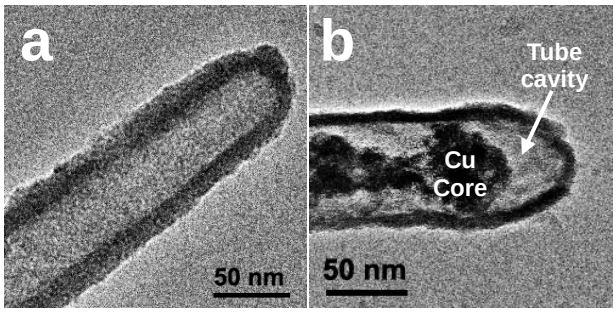


Fig. S3. TEM image showing (a) capped end of $Fe(OH)_x$ nanotubes; (b) one end of a nanotube with residual Cu, suggesting the formation of inner cavities before complete dissolution of the Cu template.

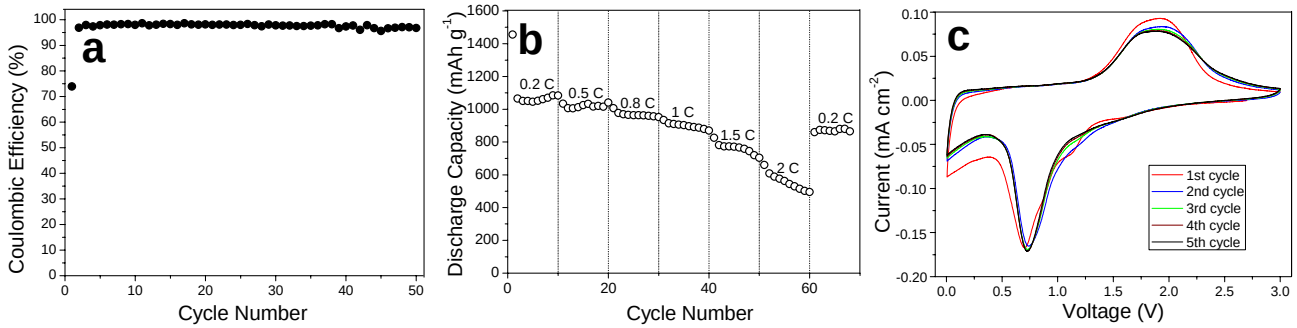


Fig. S4. (a) Coulombic efficiency of α-$Fe_2O_3$ nanotubes cycled between 0.01 – 3V at a 0.5C rate. (b) Rate capability of α-$Fe_2O_3$ nanotubes between 0.01 – 3.0 V; (c) cyclic voltammograms at a scan rate of 0.5 mV $s^{-1}$ between 0.01 – 3.0 V. All potentials are with reference to $Li/Li^+$.

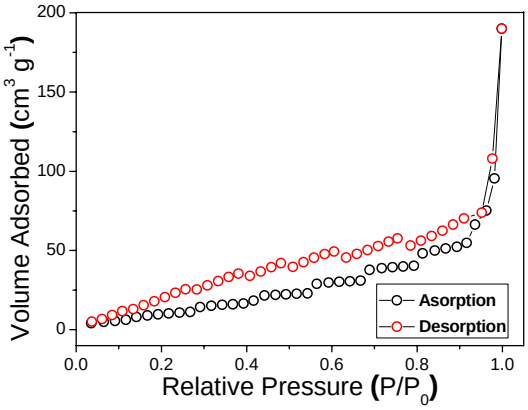


Fig. S5. $N_2$ adsorption/desorption isotherm of α-$Fe_2O_3$ nanotubes.