Electronic Supplementary Information (ESI) for

Evaporation-induced synthesis of carbon-supported Fe3O4 nanocomposites as anode material for lithium-ion batteries

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The bare Fe_3O_4 nanoparticals were synthesized by a simple hydrothermal method. In a typical synthesis, 600 mg Iron (III) acetylacetonate ($Fe(acac)_3$; 97%, Aldrich) powder was dissolved in 20 mL of trienthylene glycol (99%, Sigma) under magnetic stirring for 2 h to give a red wine-colored solution in a glass bottle (30 mL in volume). Then the glass was heated to 200 ^oC in an electric oven for 24 h. After cooling down to room temperature naturally, the product was centrifuged and washed several times in ethanol and deionized water before being dried at 60 ^oC for 12 h in an oven. The sample was then annealed in a tube furnace to 530 ^oC for 3 h under a continuous high-purity nitrogen gas to investigate annealing effects such as improved crystallinity.

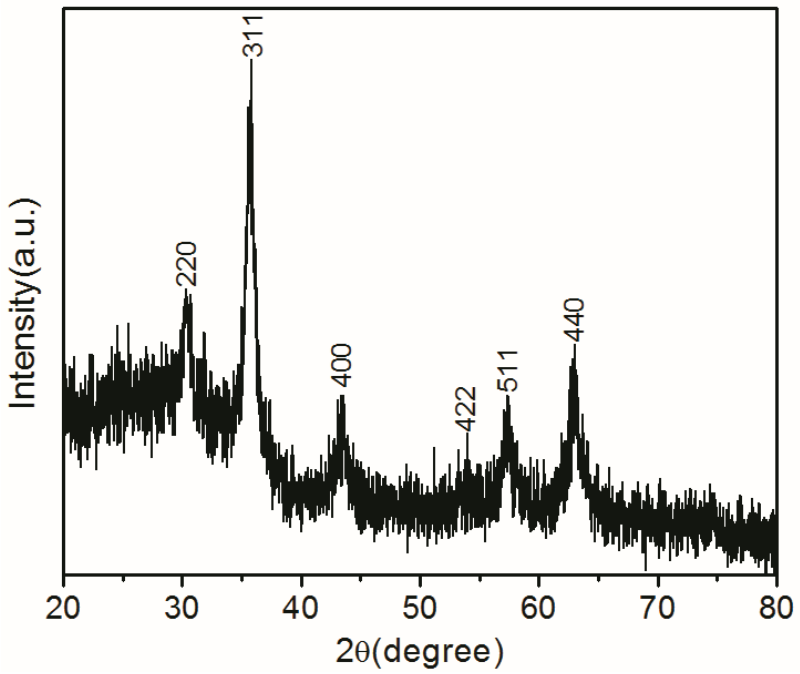

Fig. S1. XRD patterns of Fe_3O_4 nanoparticles

The XRD pattern of the Fe_3O_4 nanoparticals is shown in Fig. S1 and the diffraction peaks are good agreement with those Fe_3O_4 (Magnetite, JCPDS 85-1436).

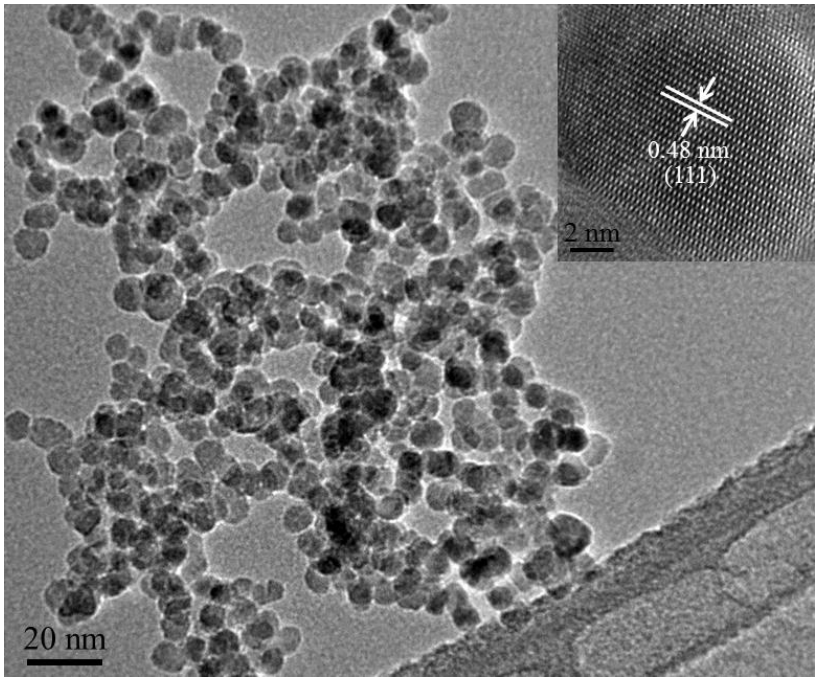

Fig. S2. TEM image of Fe_3O_4 nanoparticles, inset shows the HRTEM image of an individual nanoparticle.

The size of the Fe_3O_4 nanoparticles is found to be 8-10 nm as shown in the TEM image in Fig. S2. The high resolution TEM (HRTEM) image of the edge of an individual Fe_3O_4 nanoparticle, and a lattice spacing of 0.48 nm which is in good agreement with the d-spacing of (111) plane can be observed as shown in the inset of Fig. S2.

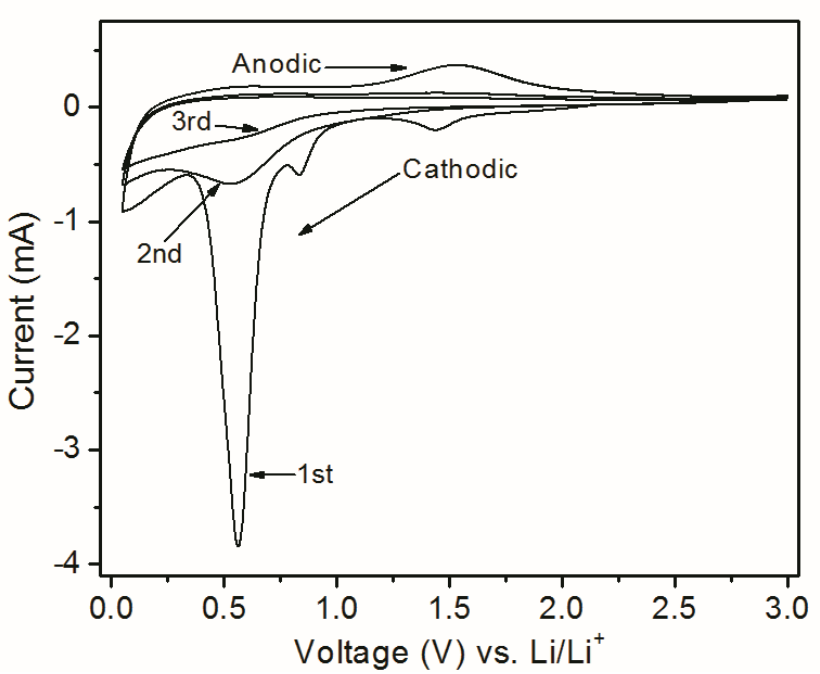

Fig. S3. Cyclic voltammograms of bare Fe_3O_4 nanocomposites from the first cycle to the third cycle

The CV curves of the bare Fe_3O_4 nanoparticles electrodes for the first three cycles in the voltage range from 5mV to 3V at the scan rate of 0.1 mV s^{-1} are shown in Fig.S3. In the first cathodic cycle, three reductions peaks are observed and two of them around 0.83 and 1.43 V which attributed to the formation of $Li_xFe_3O_4$. The strong peak around 0.56 V could be ascribed to the reduction of Fe^{3+} and Fe^{2+} to Fe^0 and the irreversible reaction related to the decomposition of the electrolyte. An anodic broad peak is appeared at about 1.55 V, corresponding to the reversible oxidation of Fe^0 to Fe^{3+} and Fe^{2+}. In the following second and third cycles, the cathodic peaks at around 0.83 and 1.43 V and the anodic peak at about 1.55 V disappear indicating the irreversibility of the reaction to form $Li_xFe_3O_4$. In addition, the cathodic peak at 0.06 V can be ascribed to the lithiation/delithiation of the residual carbon component.

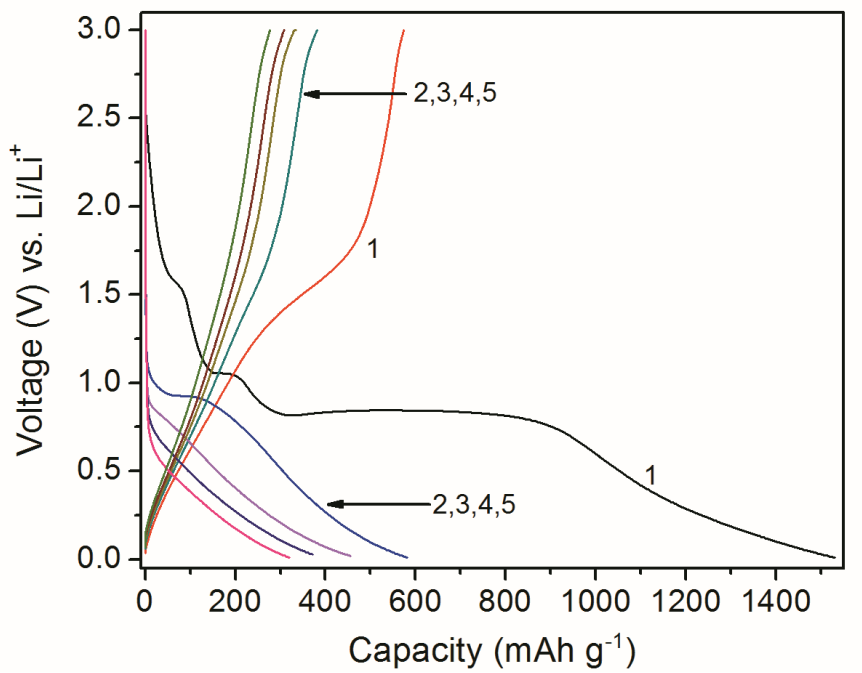

Fig. S4. Discharge/charge profile of bare Fe_3O_4 nanoparticles at a current rate of 0.1C.

The first five cycles discharge/charge voltage profiles of the bare Fe_3O_4 nanoparticles at a rate of 0.1C (1 C defined as 1000 mA g^{-1}) between 0.01 and 3 V are shown in Fig.S4. The specific discharge/charge capacity of the bare Fe_3O_4 fades which shows a poor cycling performance. The first specific discharge capacity is 1530 mAh g^{-1}. The capacity of the bare Fe_3O_4 nanoparticles decreased through the subsequent four discharge/charge cycles as shown in Fig.S4.

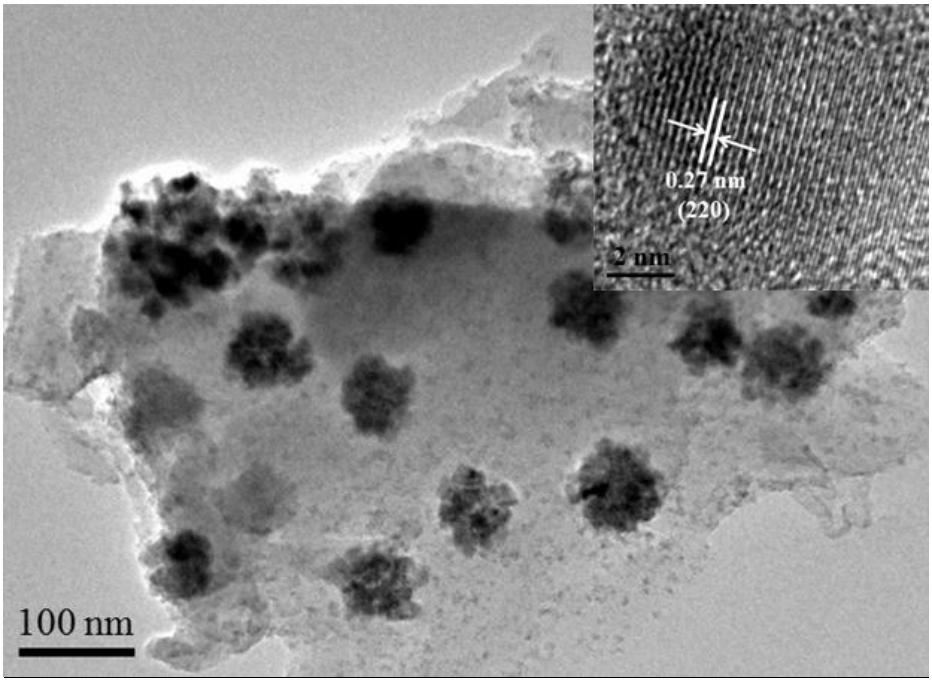

Fig. S5. TEM image of as-synthesized C-Fe_3O_4-NCs; inset shows the HRTEM image of the smaller individual nanoparticle.

Fig. S5 shows the TEM image of the as-synthesized C-Fe3O4-NCs, it can be seen that the big nanoparticles with size of 30-80 nm embedded in the carbon matrix uniformly and some smaller nanocrystals with size range from about 3 to 10 nm also can be seen in the carbon matrix. The inset shows the HRTEM image of an individual smaller nanocrystal with size of ~10 nm, the lattice spacing of 0.27 nm which is good agreement with the d-spacing of (220) plane.

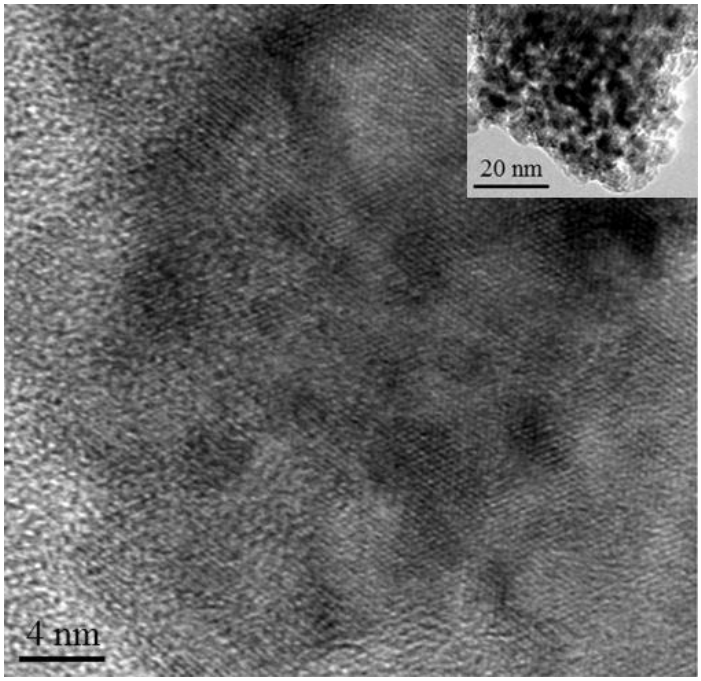

Fig. S6. HRTEM image of the bigger individual nanoparticle. Inset shows the corresponding TEM image of the bigger nanoparticle.

The HRTEM image of bigger individual nanoparticle indicated that the bigger nanoparticle is polycrystalline with grain size in range of ~3-6 nm as shown in Fig. S6. The corresponding TEM image of the individual nanoparticle is shown in inset of Fig. S6 which further confirmed the bigger nanoparticle was assembled by smaller nanocrystals.