Supplementary information

One-pot synthesis of ultrafine $ZnFe_2O_4$ nanocrystals anchored on graphene for high-performance Li and Li-ion batteries

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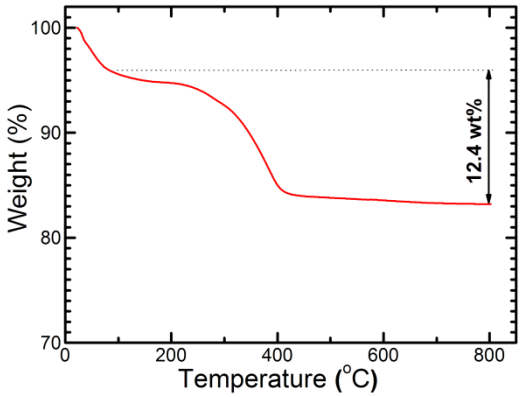

Fig.S1 TG curve of $ZnFe_2O_4$/G measured in air.

The weight loss before 100°C is due to the loss of the absorbed water trapped within the graphene sheets.[1] The weight loss between 100 °C and 800 °C is the removal of the oxygen-containing groups and the combustion of the carbon skeleton into carbon oxide.

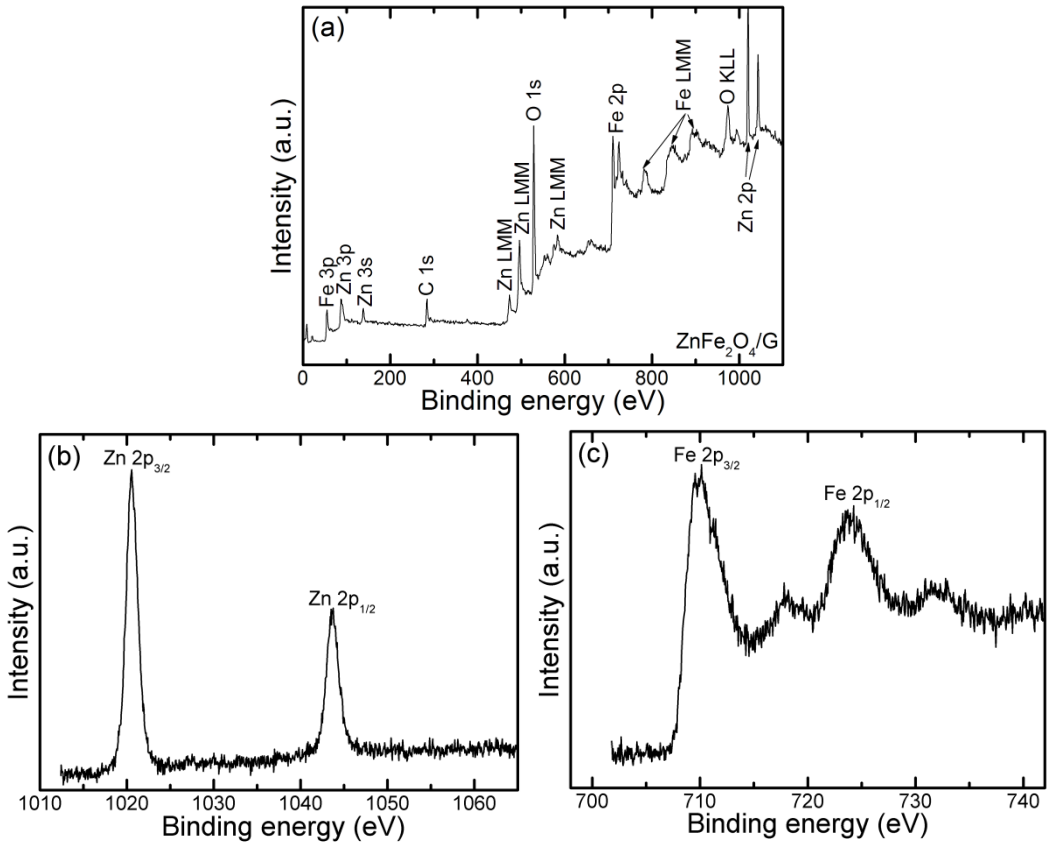

Fig. S2 XPS of $ZnFe_2O_4$/G: (a) survey spectra, (b) Zn2p spectra and (c) Fe2p spectra.

For the above spectra, the peaks at 1020.6 and 1043.7 eV correspond to the $Zn2p_{3/2}$ and $Zn2p_{1/2}$ bands, respectively, the peaks at 709.8 and 724.1 eV are related to the $Fe2p_{3/2}$ and $Fe2p_{1/2}$ bands, respectively, and the peak at 529.6 eV corresponds to O1s peak of $ZnFe_2O_4$.[2]

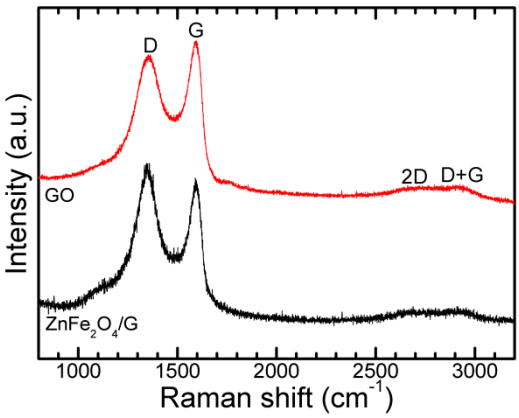

Fig. S3 Raman spectra of GO and $ZnFe_2O_4$/G.

In the above spectra, the two peaks at 1350 and 1580 cm^{-1} are related to the disordered (D) band and graphitic (G) band, respectively, of carbon-based materials.[3] Compared to those in GO, the peaks in $ZnFe_2O_4$/G exhibit an increased D/G intensity ratio, due to the decrease of the average size of the sp^2 domains.[3] The change in D/G intensity ratio indicates the reduction of GO to graphene.[4] The 2D peak at around 2700 cm^{-1} is broad and weak, suggesting that the graphene in $ZnFe_2O_4$/G is in few-layer form instead of single-layer form.[5] The peak at around 2900 cm^{-1} is the D+G mode of carbon material.[6]

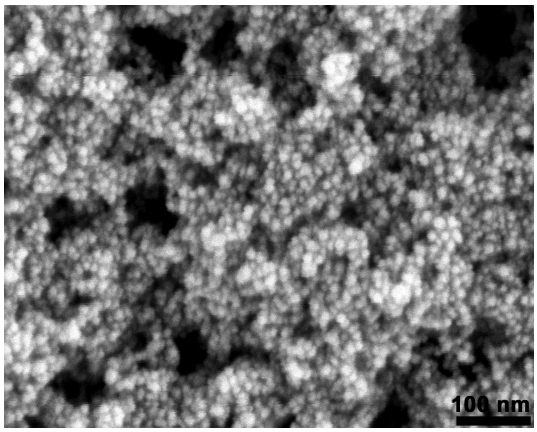

Fig. S4 SEM image of $ZnFe_2O_4$.

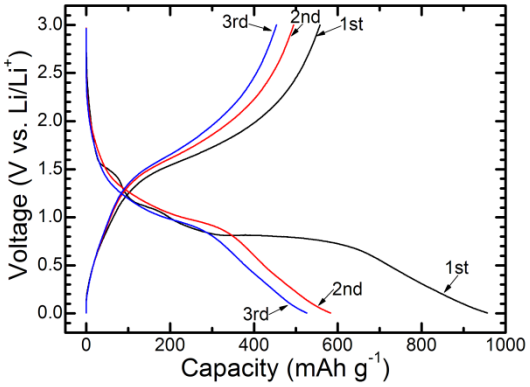

Fig. S5 The first three charge and discharge curves of $ZnFe_2O_4$ at 50 mA g^{-1}.

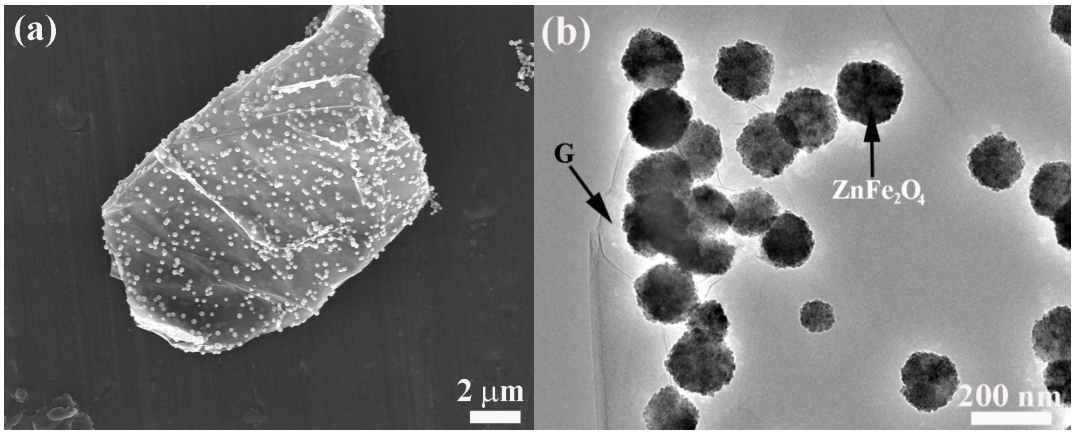

Fig. S6 (a) SEM and (b) TEM images of $ZnFe_2O_4$/G prepared in EG.

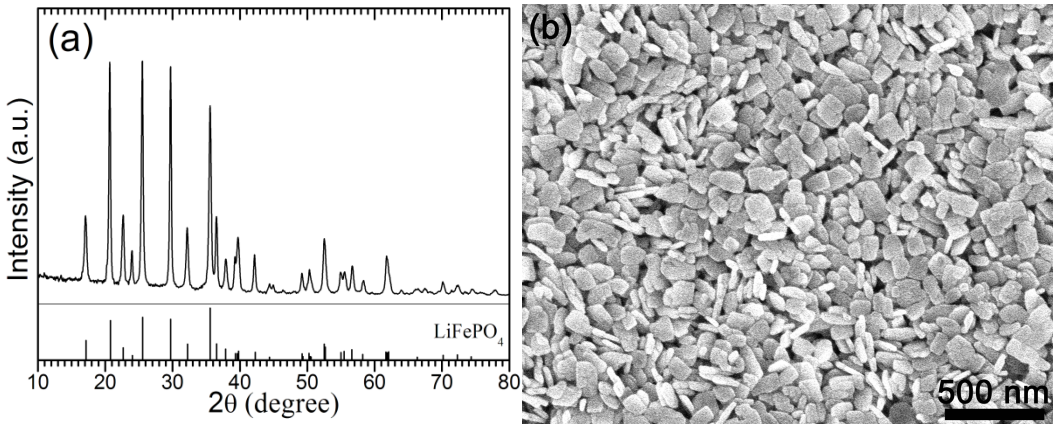

Fig. S7 (a) XRD patterns and (b) SEM image of $LiFePO_4$/C.

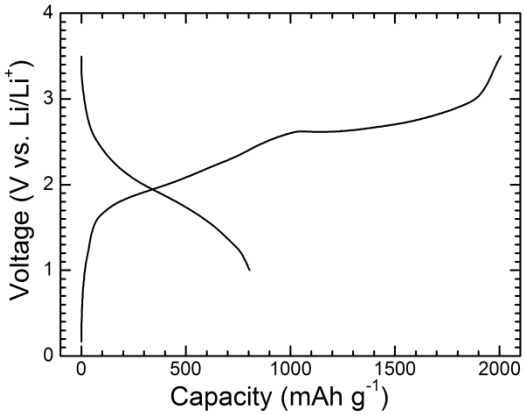

Fig. S8 The first charge and discharge curves of the $ZnFe_2O_4$/G–$LiFePO_4$/C full cell at 100 mA g^{-1}.

References

1 S. Dubin, S. Gilje, K. Wang, V. C. Tung, K. Cha, A. S. Hall, J. Farrar, R. Varshneya, Y. Yang and R. B. Kaner, *ACS Nano*, 2010, **4**, 3845–3852.

2 M. Wang, Z. H. Ai and L. Z. Zhang, *J. Phys. Chem. C*, 2008, **112**, 13163–13170.

3 F. Tuinstra and J. L. Koenig, *J. Chem. Phys.*, 1970, **53**, 1126–1130.

4 S. Stankovich, D. A. Dikin, R. D. Piner, K. A. Kohlhaas, A. Kleinhammes, Y. Y. Jia, Y. Wu, S. T. Nguyen and R. S. Ruoff, *Carbon*, 2007, **45**, 1558–1565.

5 A. C. Ferrari, J. C. Meyer, V. Scardaci, C. Casiraghi, M. Lazzeri, F. Mauri, S. Piscanec, D. Jiang, K. S. Novoselov, S. Roth and A. K. Geim, *Phys. Rev. Lett.*, 2006, **97**, 187401.

6 C. N. R. Rao, A. K. Sood, K. S. Subrahmanyam and A. Govindaraj, *Angew. Chem. Int. Ed.*, 2009, **48**, 7752–7777.