Supplementary Information

F-doped zinc ferrite as high-performance anode materials for lithium-ion battery

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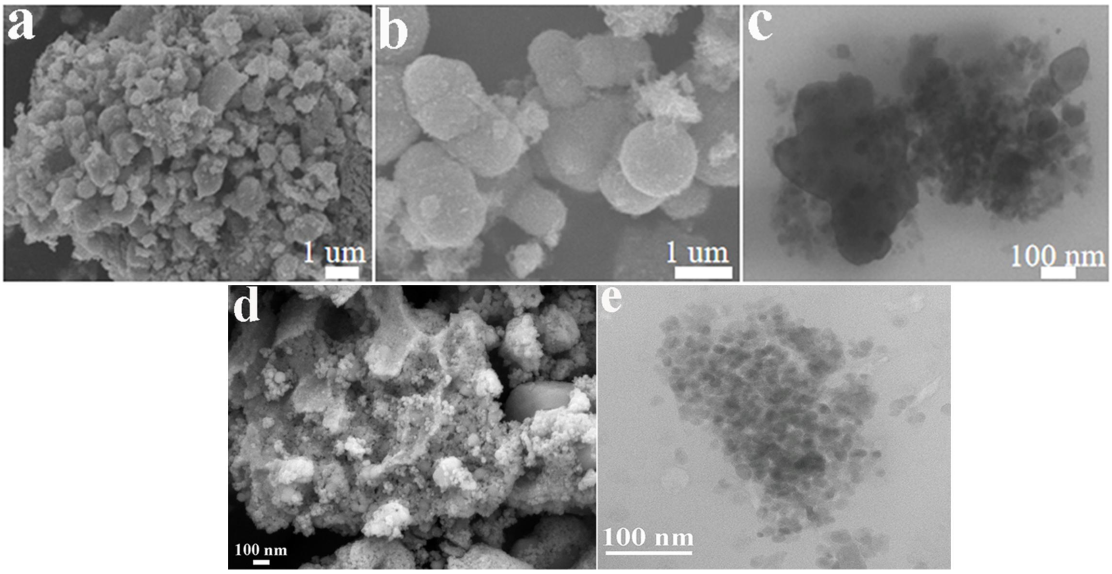

Fig. S1. (a-b) SEM images of ZFO; and (c)TEM image of ZFO;SEM and TEM images of $ZFO-F_3$

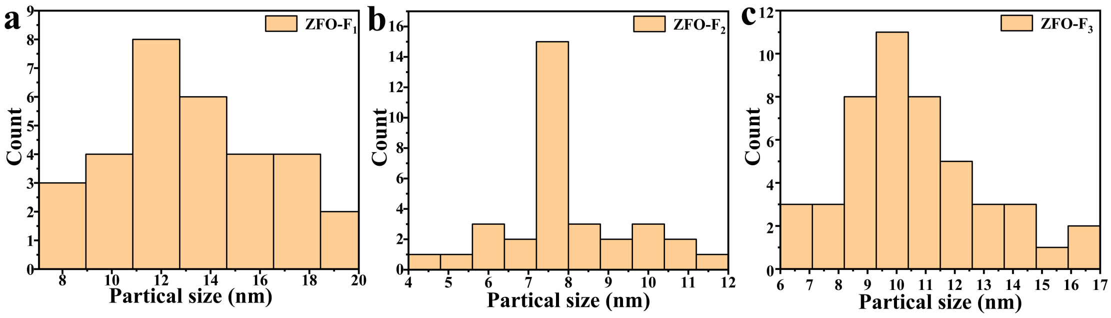

Fig. S2. The particle size distribution of ZFO-F$_1$ (a), ZFO-F$_2$ (b), ZFO-F$_3$ (c) calculated from SEM images.

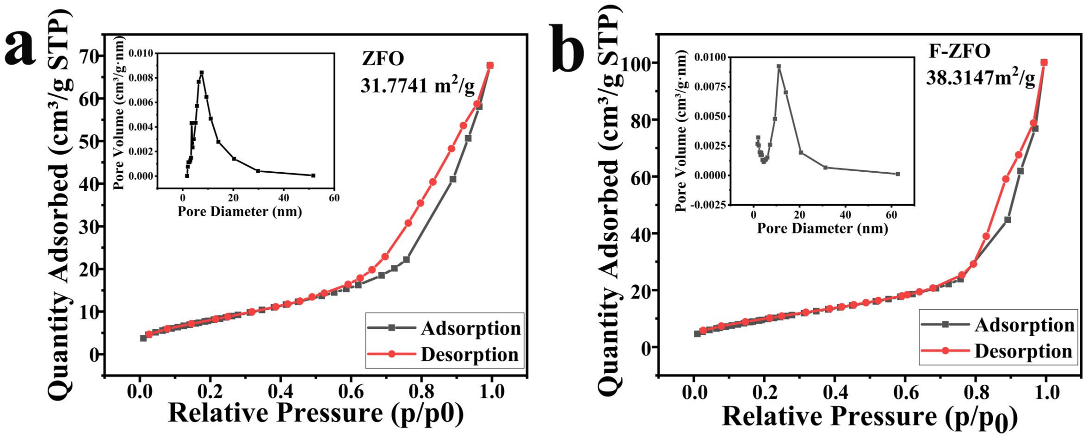

Fig. S3. N_2 adsorption-desorption isotherms and the corresponding pore size analysis. (a) ZFO and (b) ZFO-F_2.

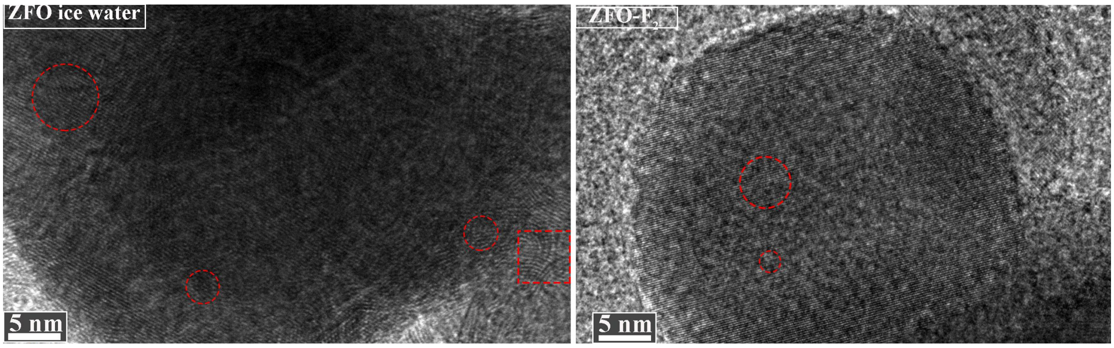

Fig. S4. HRTEM diagram of zinc ferrate quenched in ice water and fluorine salt solution respectively

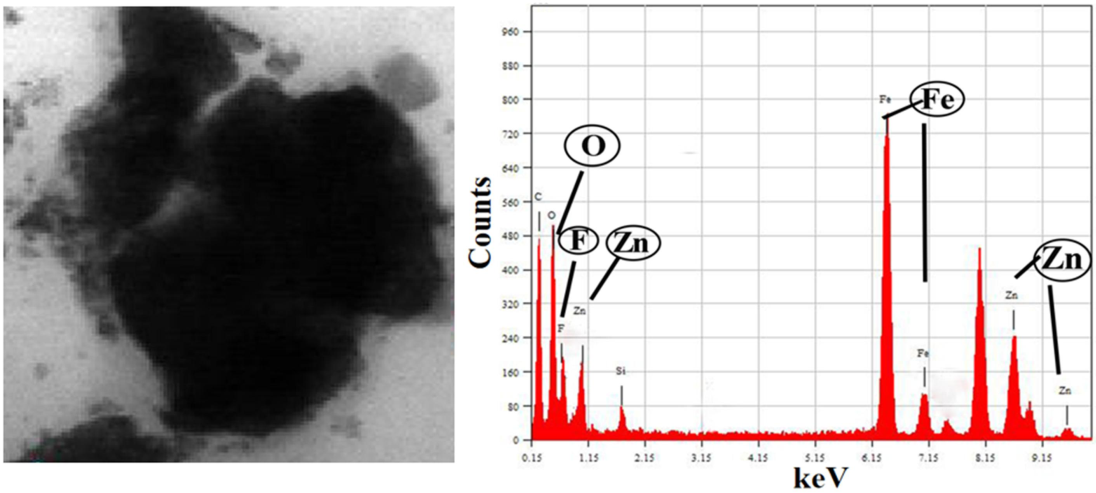

Fig. S5. The energy dispersive X-ray spectroscopy (EDX) of ZFO-F_2.

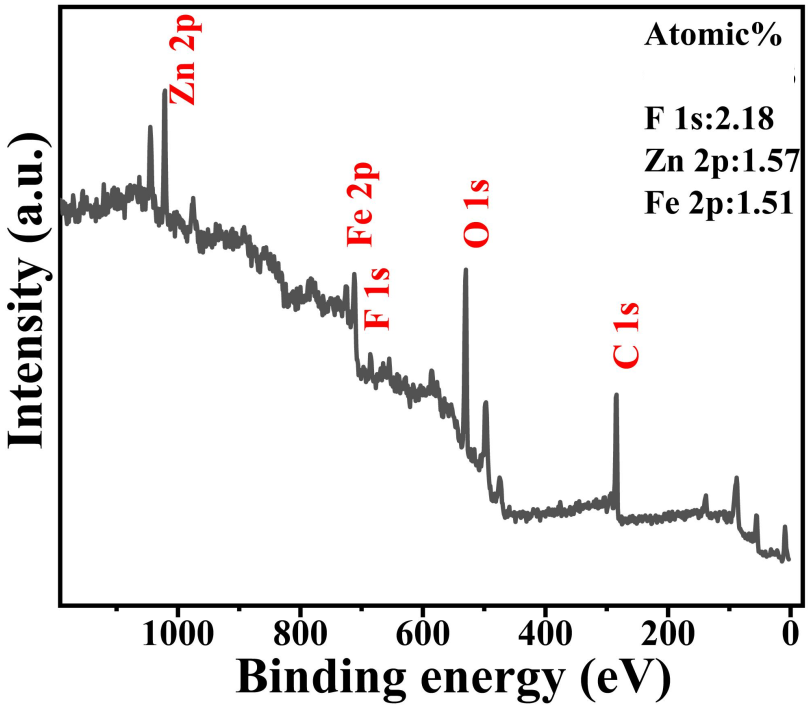

Fig. S6. Full XPS spectrum of ZFO-F_2.

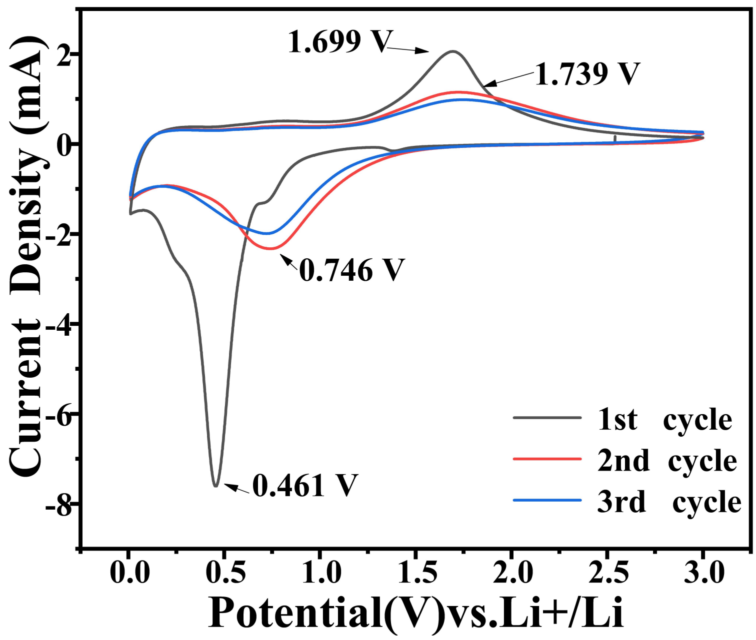

Fig. S7. CV results of the first three cycles of ZFO.

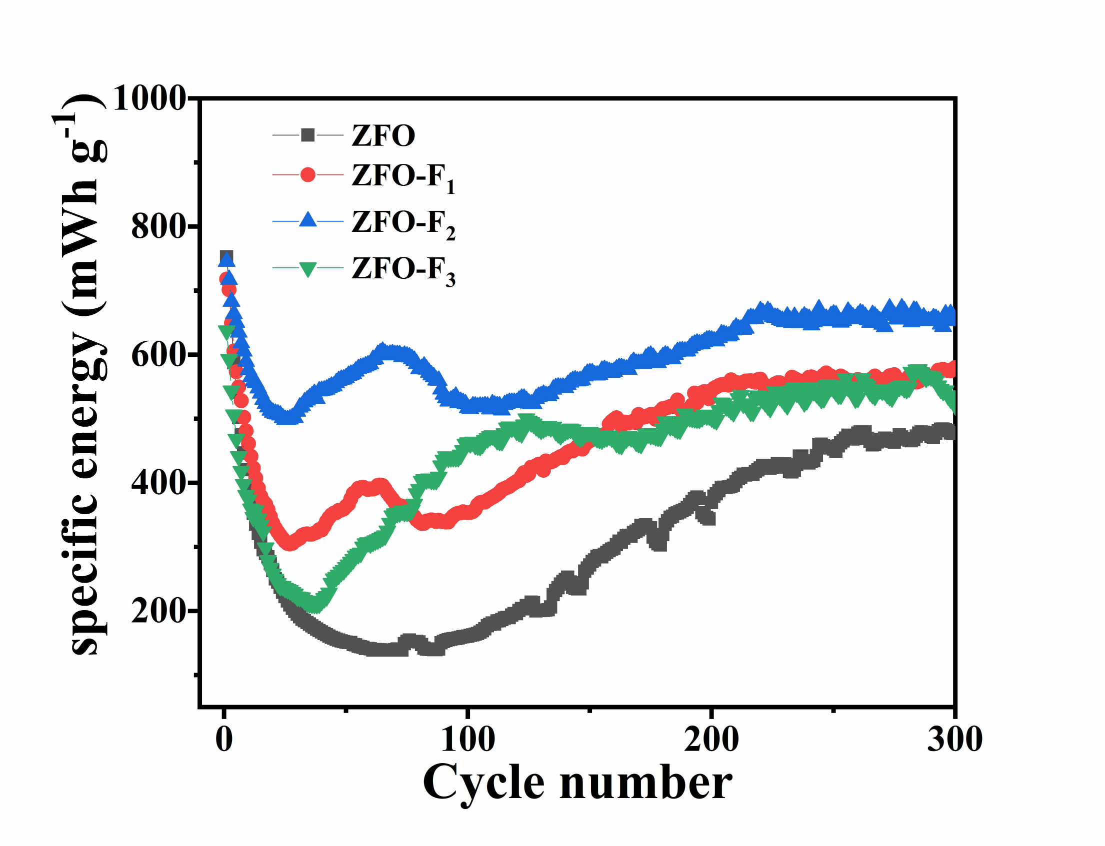

Fig. S8. Specific energy of ZFO, ZFO-F$_1$, ZFO-F$_2$, ZFO-F$_3$.

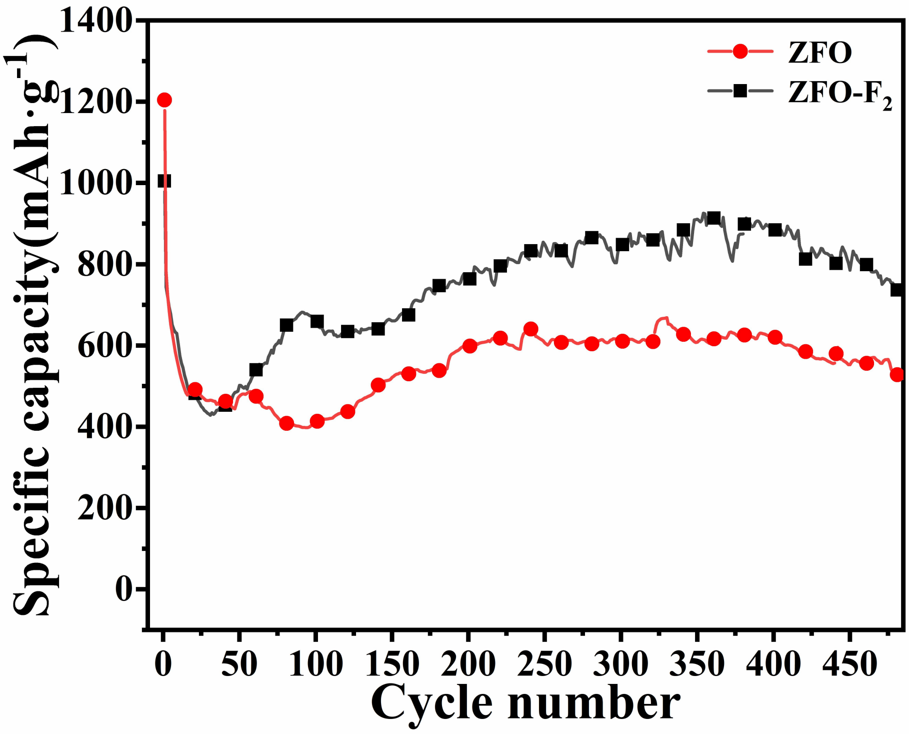

Fig. S9. Cycle life diagram of ZFO and ZFO-F_2 for 500 cycles

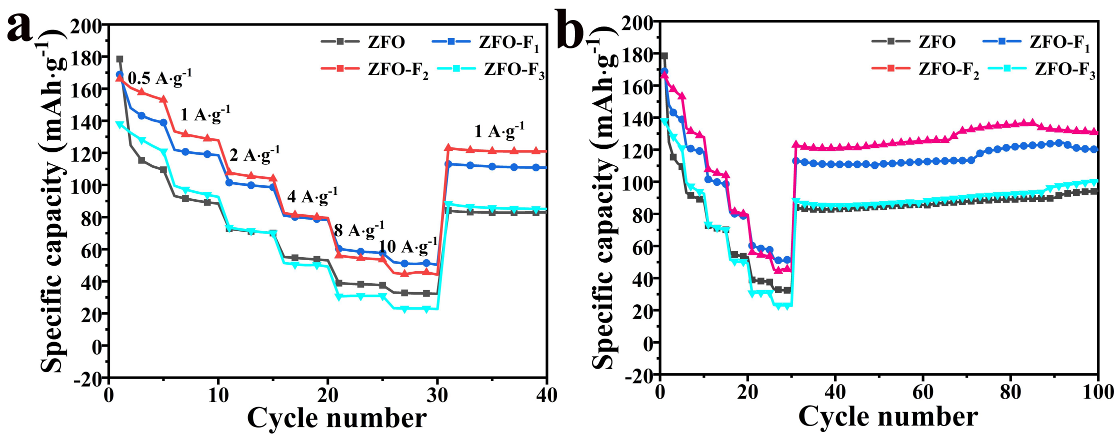

Fig. S10. Rate performance and cycle life diagrams for ZFO、ZFO-F_1、ZFO-F_2、ZFO-F_3 materials assembled into full cells(a,b)

Table S1. The (220) crystalline surface crystal spacing of ZFO, ZFO-F_1, ZFO-F_2, ZFO-F_3.

Materials	Lattice spacing (220)
ZFO	0.301 nm
ZFO-F_1	0.2985 nm
ZFO-F_2	0.2980 nm
ZFO-F_3	0.2982 nm

Table S2. The contents of various O formats in ZFO and ZFO-F (obtained by O 1s XPS spectra)

O1s	M-O bond (%)	Oxygen vacancy (%)	Oxygen absorption (%)
ZFO	50.22	47.77	2.01
$ZFO\text{-}F_1$	38.68	57.43	3.89
$ZFO\text{-}F_2$	26.12	68.73	5.15
$ZFO\text{-}F_3$	12.20	78.83	8.97

Table S3. The corresponding Rs、Rct and Warburg impedance values after fitting the impedance graphs of ZFO, ZFO-F_1, ZFO-F_2, ZFO-F_3.

materials	ZFO	ZFO-F_1	ZFO-F_2	ZFO-F_3
*R*s	5.576	4.902	3.28	5.277
R_{ct} (ohm)	101.1	80.52	43.12	82.00
W(S·sec^5)	0.005689	0.005866	0.01096	0.005765

Table S4. List of the initial conlumbic efficiency and cycling performance of recent reported $ZnFe_2O_4$ anode materials prepared by other methods.

Materials	Preparation methods	Initial conlumbic efficiency(%)	Cycling performance	Ref.
$ZnFe_2O_4$–Carbonaceous composites	Electrophoretic deposition	68.0	870 mAh·g^{-1} after 100 cycles at 0.5 A·g^{-1}	1
Fabrication of ultrafine $ZnFe_2O_4$ nanoparticles	Electrospinning technology and hydrothermal	71.7	789.7 mAh·g^{-1}after 300 cycles at 0.2 A·g^{-1}	2
multi-scaled $ZnFe_2O_4$microspheres	Self-template fabrication	70.6	681 mAh·g^{-1} after 200 cycles at 0.5 A·g^{-1}	3
Sulfur-doped $ZnFe_2O_4$ nanoparticles	Hydrothermal method	97.3	604 mAh·g^{-1}after 60 cycles at 0.1 A·g^{-1}	4
ZnO/$ZnFe_2O_4$/N-doped C micro-polyhedrons with hierarchical hollow structure	Self-template method	67.4	1000 mAh·g^{-1}after 100 cycles at 0.2 A·g^{-1}	5
MOF derived $ZnFe_2O_4$ nanoparticles	Scattered in hollow octahedra carbon skeleton	62.3	1780mAh·g^{-1}after 400 cycles at 0.2 A·g^{-1}	6
α-Fe_2O_3 nanoparticles into $ZnFe_2O_4$	In-situ encapsulation micro-sized capsules	68	650mAh·g^{-1}after 500 cycles at 0.2 A·g^{-1}	7
Nitrogen and sulfur co-doped graphene supported hollow $ZnFe_2O_4$ nanosphere composites	Two-step hydrothermal method	64	729.06 mAh·g^{-1}after 100 cycles at 0..3 A·g^{-1}	8
hollow $ZnFe_2O_4$ nanospheres	solvothermal method	73.9	1101.3 mAh·g^{-1} after 200 cycles at 0.2 A·g^{-1}	9

F-doped $ZnFe_2O_4$ particles	Solvent heating and quenching	72	968 mAh·g^{-1} after 200 cycles at 0.5 A·g^{-1}	This work

References

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