Supplementary Information

Rational design of walnut-like ZnO/Co_3O_4 porous nanospheres with substantially enhanced lithium storage performance

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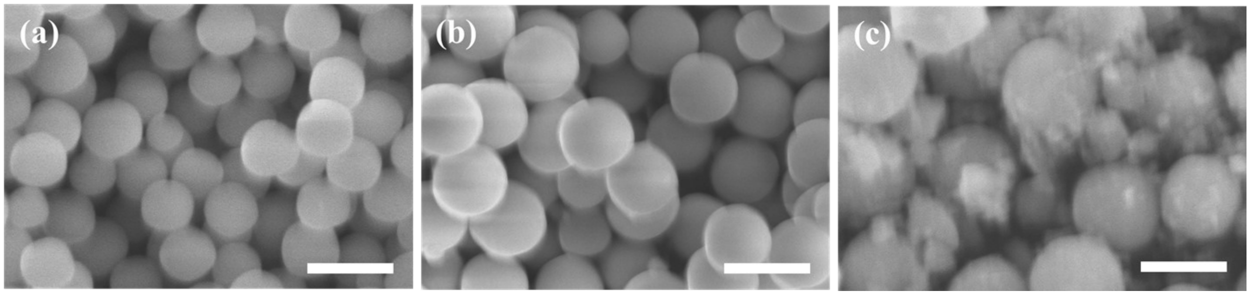

Fig. S1 SEM images of ZnO/Co_3O_4 samples obtained under different reaction times: (a) 1 h, (b) 2 h, (c) 3 h (scale bar: 200 nm).

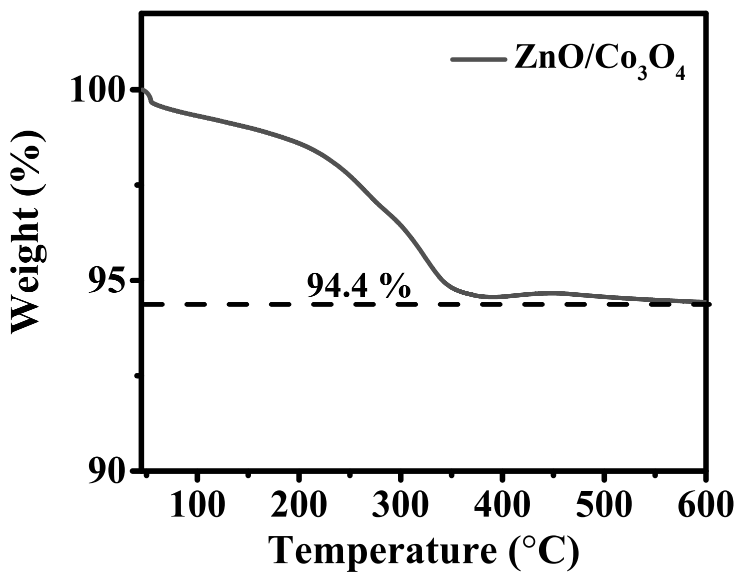

Fig. S2 TGA curve of as-obtained ZnO/Co_3O_4-pre.

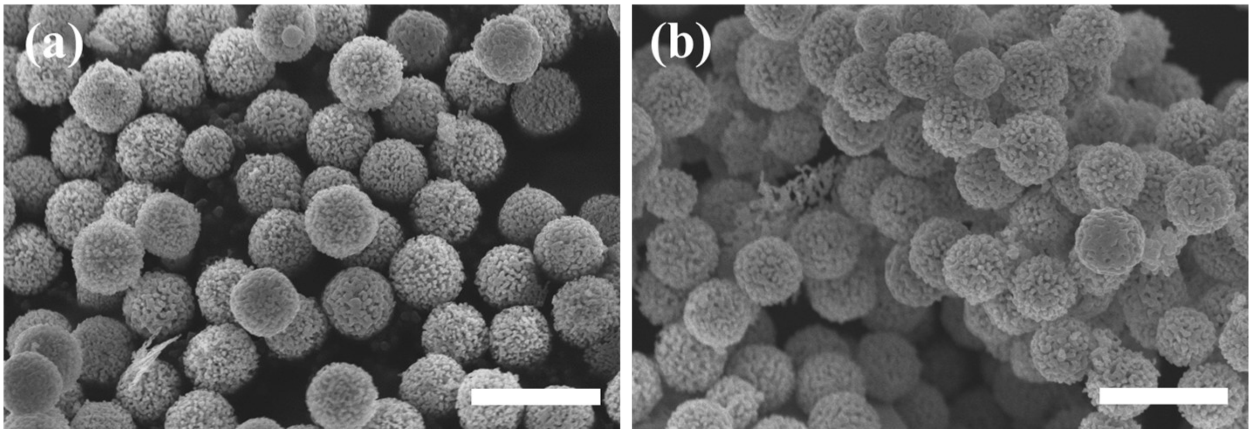

Fig. S3 SEM images of ZnO/Co_3O_4 samples annealed in air for 40 min at (a) 550 and (b) 650 °C (scale bar: 500 nm).

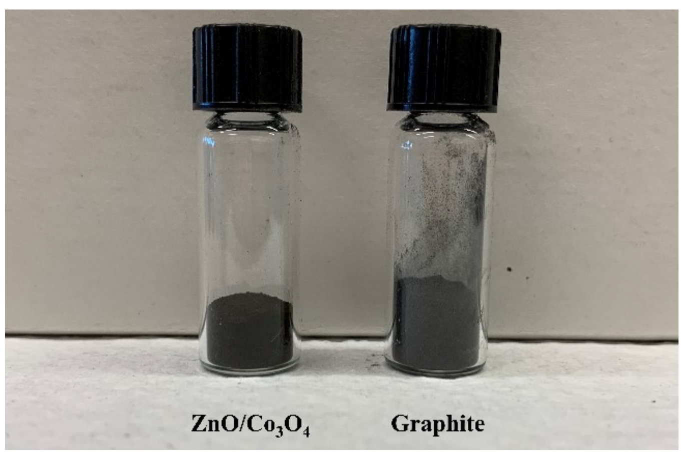

Fig. S4 Comparison between ZnO/Co_3O_4 and commercial graphite (0.4 g each).

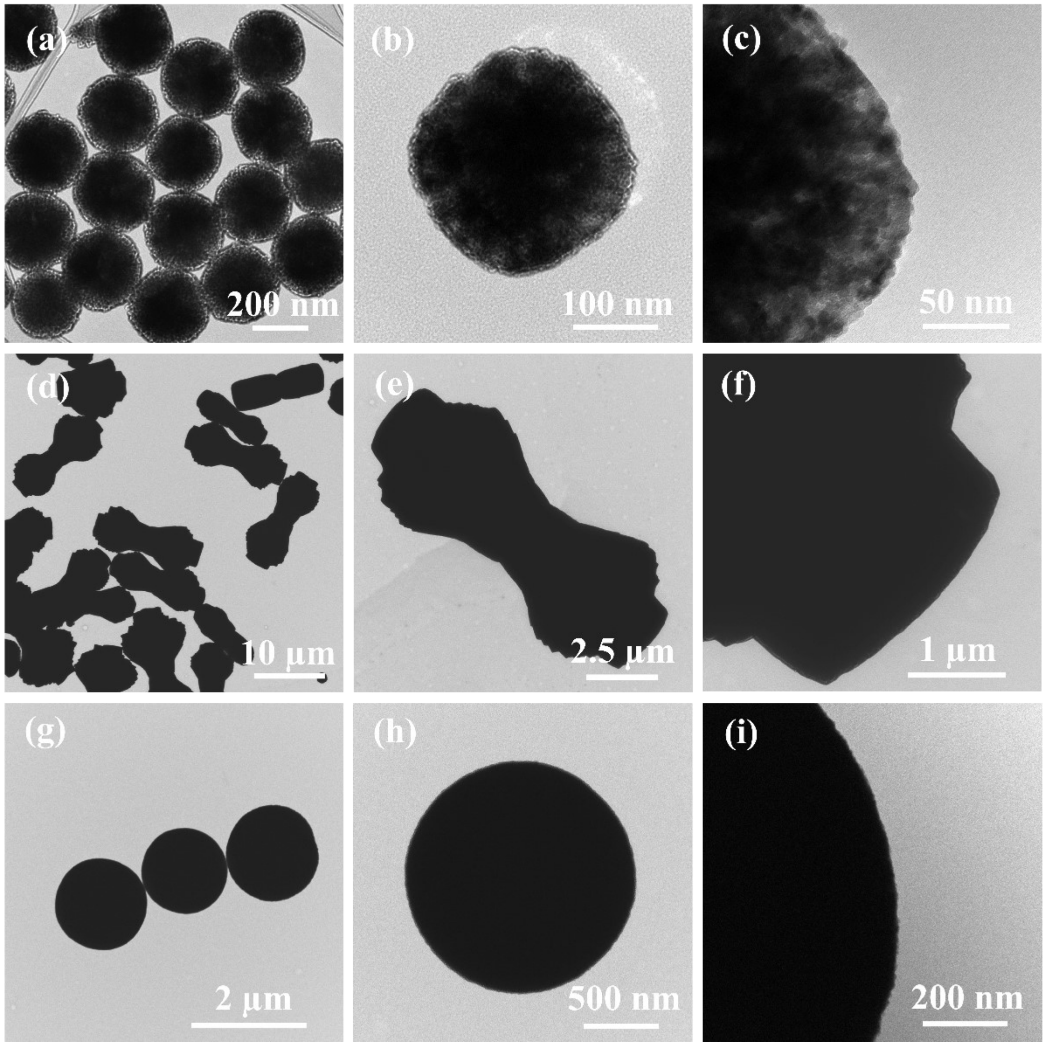

Fig. S5 TEM images of solvothermal precursors: (a-c) ZnO/Co_3O_4-pre, (d-f) ZnO-pre and (g-i) Co_3O_4-pre at different magnifications.

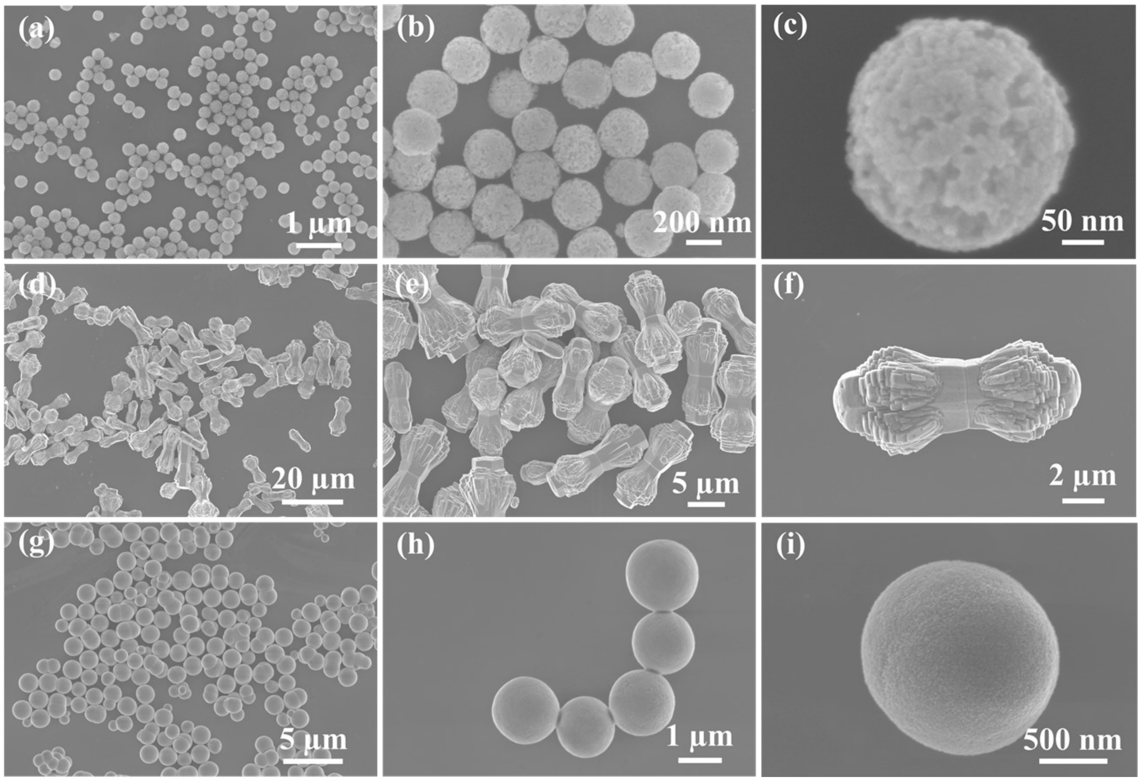

Fig. S6 SEM images of solvothermal precursors: (a-c) ZnO/Co_3O_4-pre, (d-f) ZnO-pre and (g-i) Co_3O_4-pre at different magnifications.

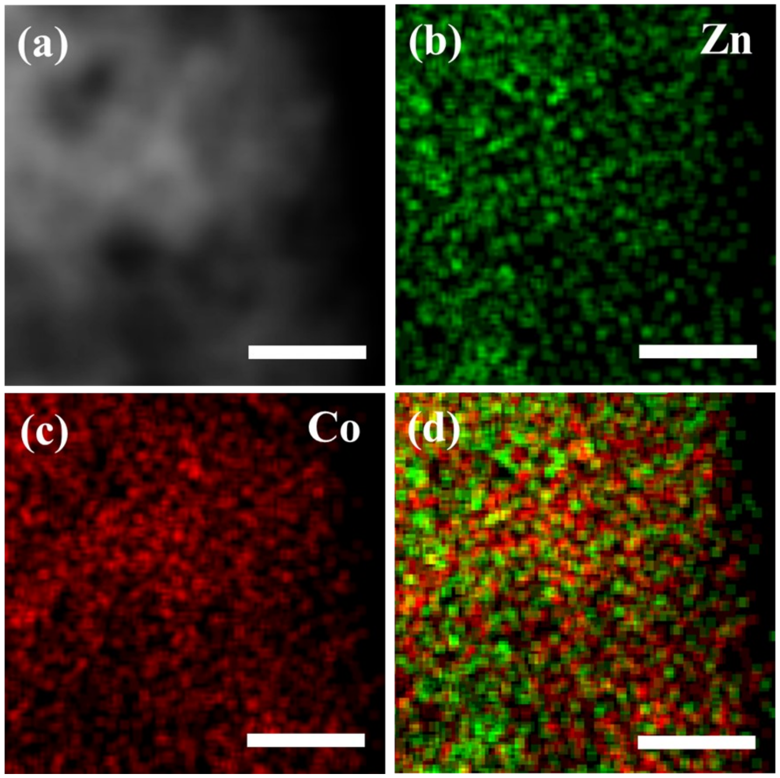

Fig. S7 (a-c) STEM image and elemental mappings of ZnO/Co_3O_4. (d) Spatial distributions of Zn and Co elements and EDS of ZnO/Co_3O_4 (scale bar: 6 nm).

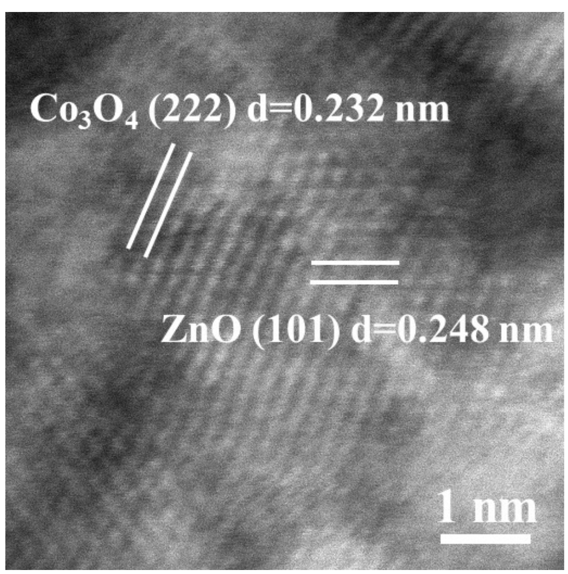

Fig. S8 HRTEM image of ZnO/Co_3O_4.

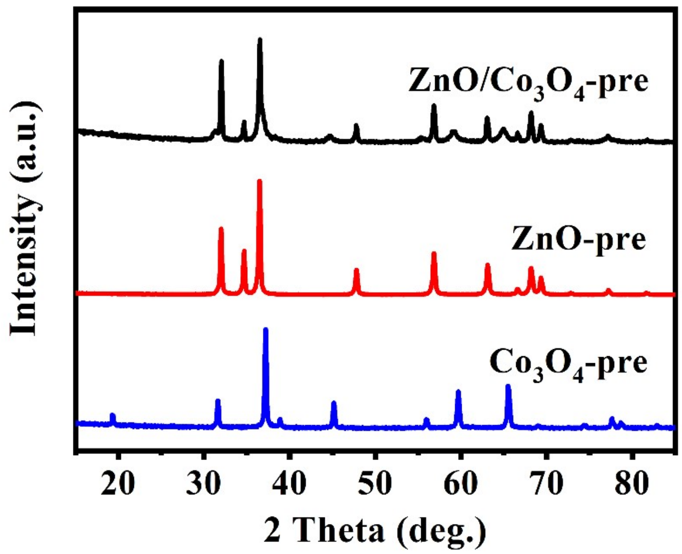

Fig. S9 XRD patterns of ZnO/Co_3O_4-pre, ZnO-pre and Co_3O_4-pre.

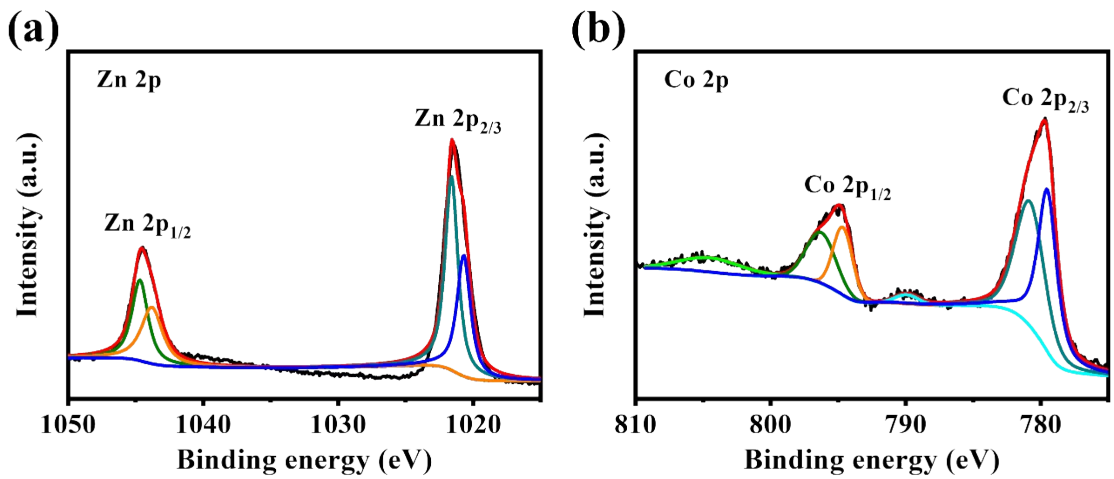

Fig. S10 (a) Zn 2p high-resolution XPS spectrum of ZnO. (b) Co 2p high-resolution XPS spectrum of Co_3O_4.

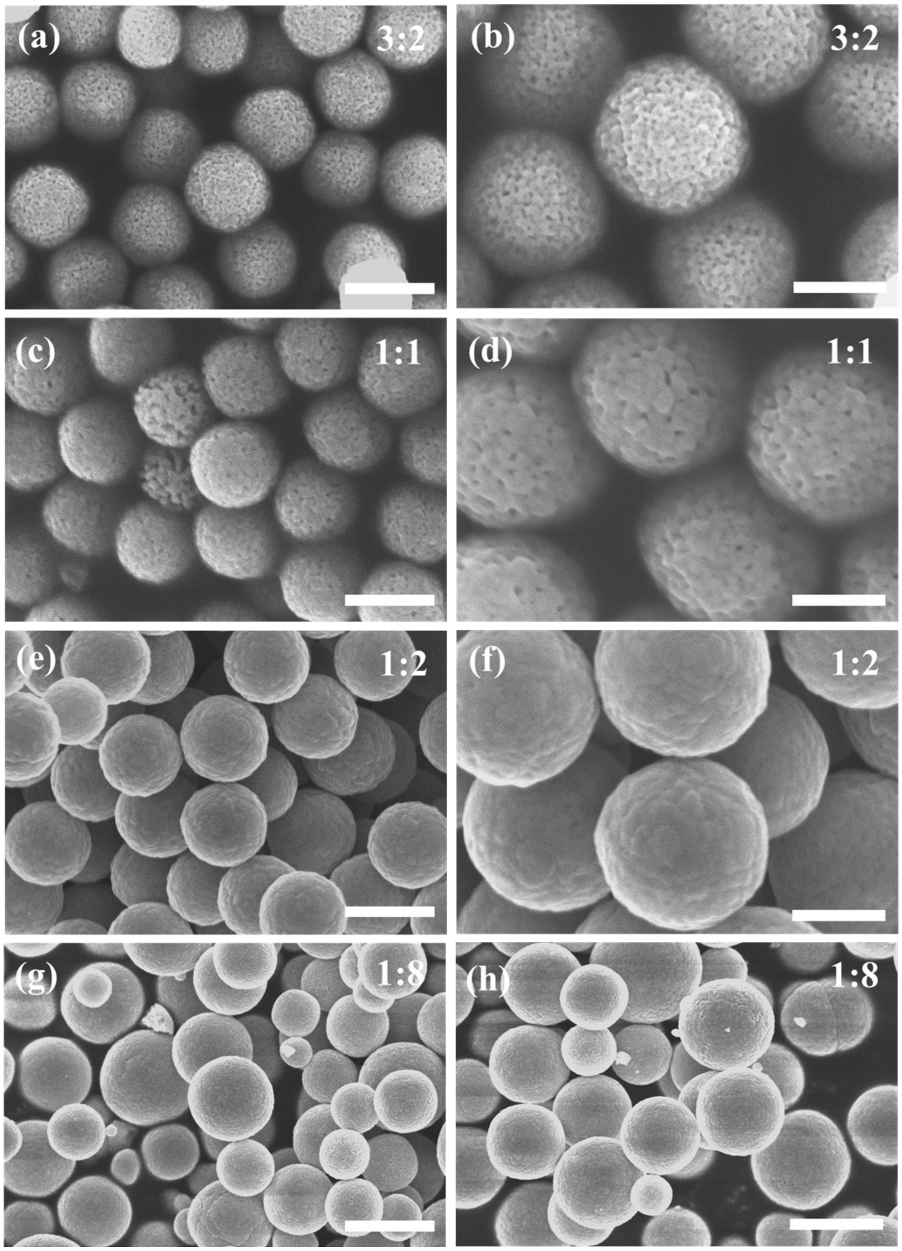

Fig. S11 ZnO/Co_3O_4 composites with different ratios of ZnO and Co_3O_4: (a, b) ZC-3-2, (c, d) ZC-1-1, (e, f) ZC-1-2, (g, h) ZC-1-8. Scale bars: 500 nm (a, c, e, g) and 150 nm (b, d, f, h).

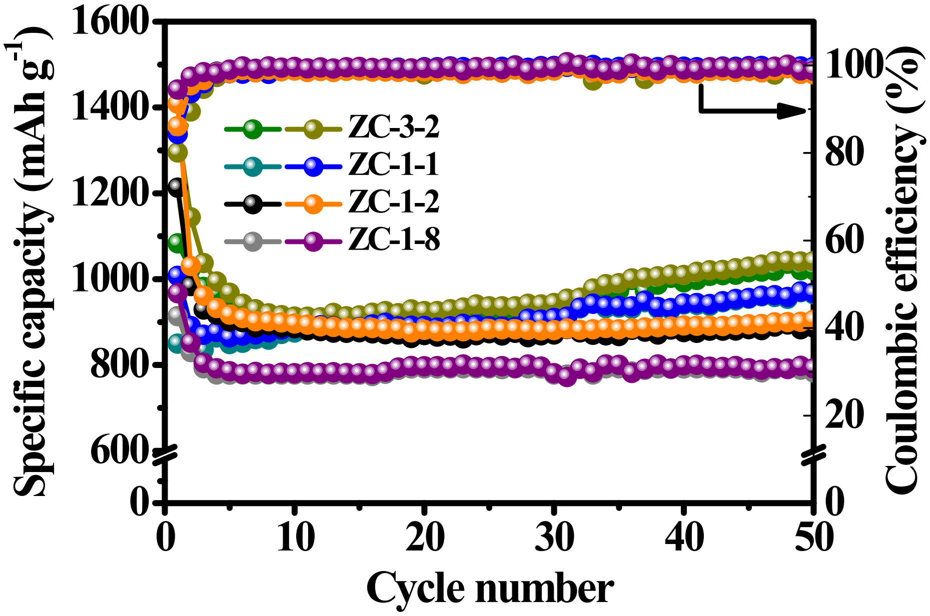

Fig. S12 Cycling performance of ZnO/Co_3O_4 composites with different ratios of ZnO and Co_3O_4: ZC-3-2, ZC-1-1, ZC-1-2 and ZC-1-8 at a current density of 0.1 A g^{-1}.

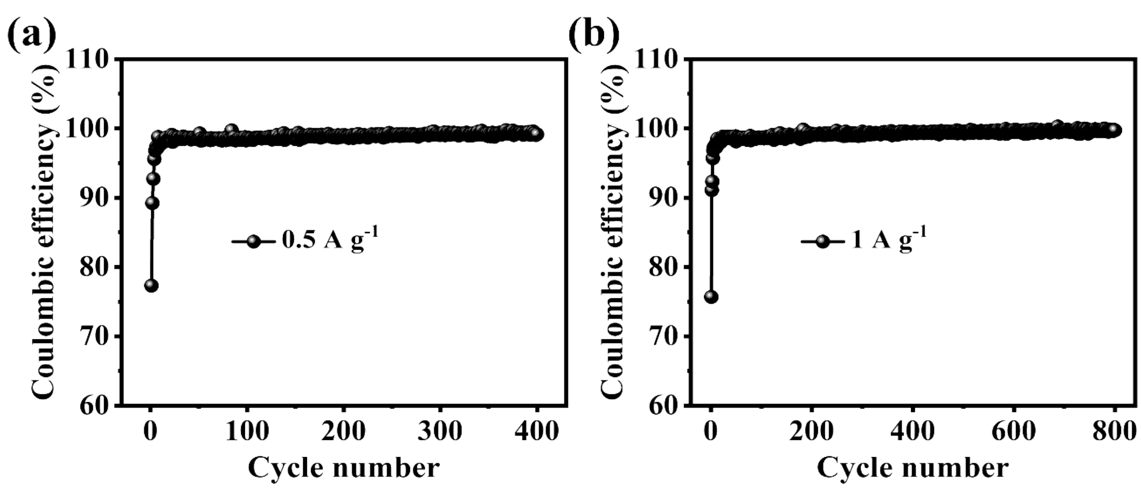

Fig. S13 Coulombic efficiencies of ZnO/Co_3O_4 at (a) 0.5 A g^{-1} and (b) 1 A g^{-1}.

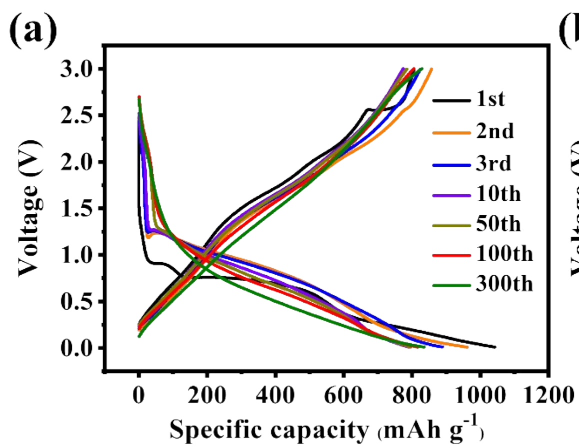

Fig. S14 Charge/discharge profiles of ZnO/Co_3O_4 at (a) 0.5 A g^{-1} and (b) 1 A g^{-1}.

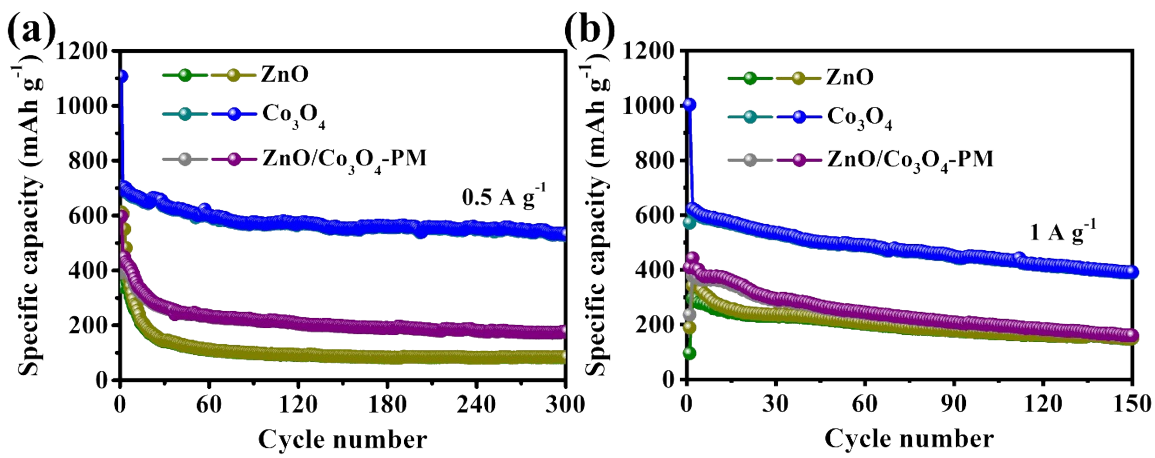

Fig. S15 Cycling performances of ZnO, Co_3O_4 and ZnO/Co_3O_4-PM at current densities of (a) 0.5 A g^{-1} and (b) 1 A g^{-1}.

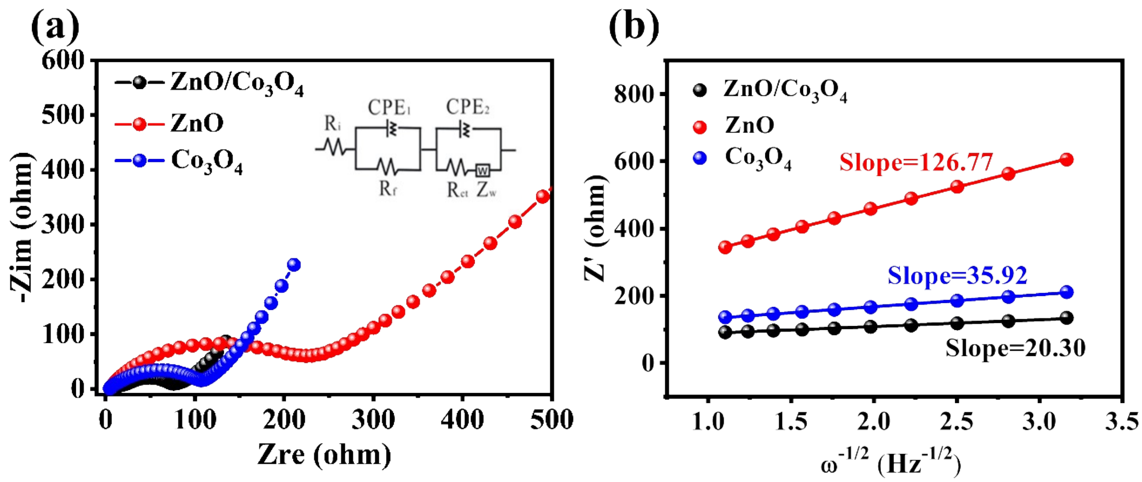

Fig. S16 (a) Nyquist plots of ZnO/Co_3O_4, ZnO and Co_3O_4 electrodes before cycling and (b) the corresponding fitted straight lines of Z′ *versus* $\omega^{-1/2}$ at low frequency.

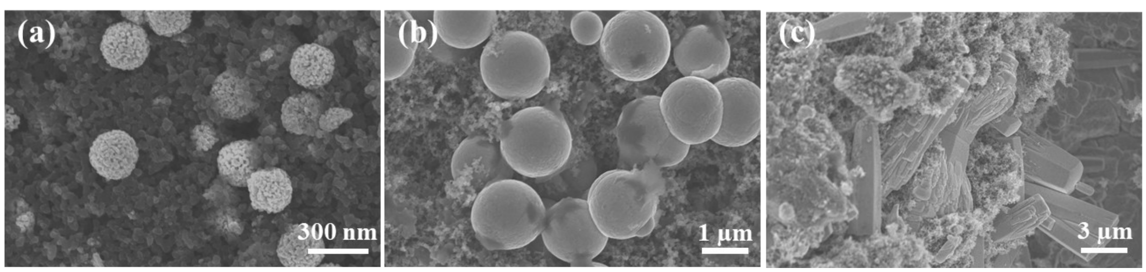

Fig. S17 SEM images of (a) ZnO/Co_3O_4, (b) ZnO and (c) Co_3O_4 fresh electrodes.

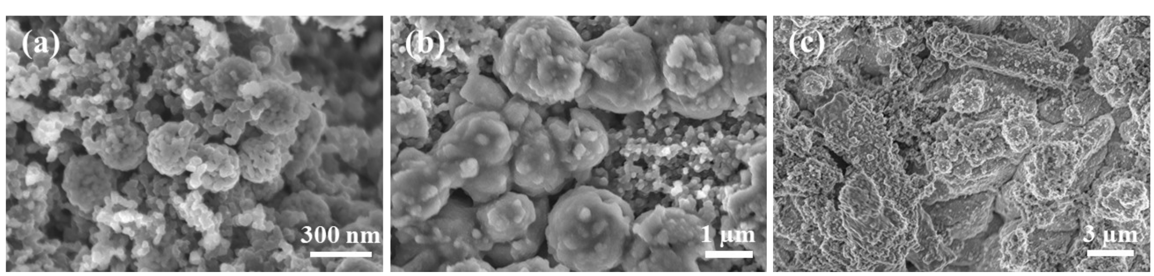

Fig. S18 SEM images of (a) ZnO/Co_3O_4, (b) ZnO and (c) Co_3O_4 electrodes after cycling at 0.1 A g^{-1} for 100 times.

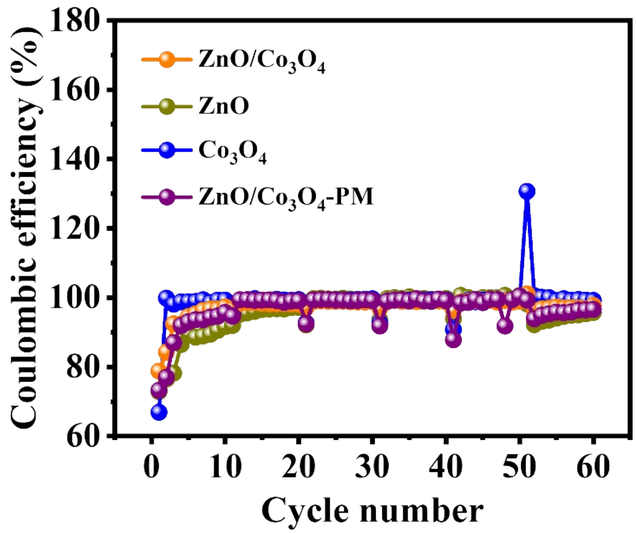

Fig. S19 Coulombic efficiencies of ZnO/Co_3O_4, ZnO, Co_3O_4 and ZnO/Co_3O_4-PM at various rates.

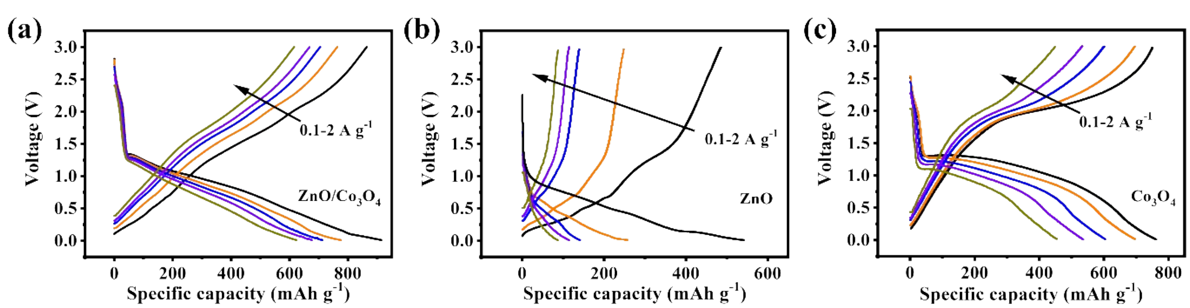

Fig. S20 Rate profiles of (a) ZnO/Co_3O_4, (b) ZnO and (c) Co_3O_4.

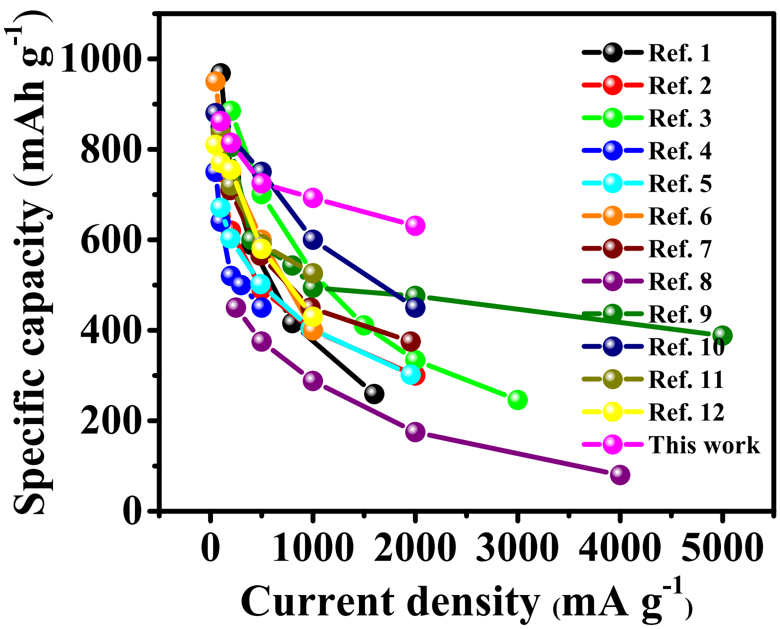

Fig. S21 Comparison of lithium storage performances of walnut-like ZnO/Co_3O_4 with reported ZnO/Co_3O_4 composites (ZnO/Co_3O_4 nanocomposite clusters[1]), ZnO ($ZnO/ZnFe_2O_4$,[2] $ZnO/Ni_3ZnC_{0.7}/C$,[3] ZnO nanoparticles,[4] ZnO nanoparticles in mesoporous carbon,[5] MOF-derived ZnO nanoparticles,[6] ZnO/MWCNT,[7] carbon/ZnO nanomembrane foam,[8] hollow ZnO nanoparticles[9]), and Co_3O_4 (hollow-structured Co_3O_4 nanoparticles,[10] MWCNT/Co_3O_4 Polyhedra,[11] Co_3O_4/Co nanoparticles enclosed graphitic carbon[12]).

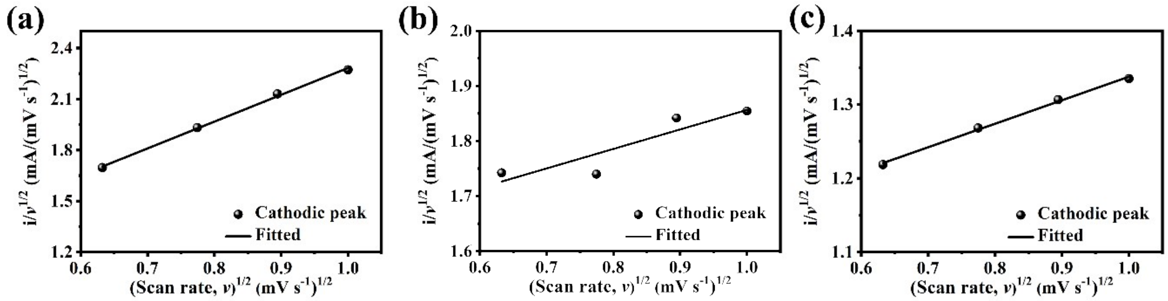

Fig. S22 Fitted straight lines of Z' *versus* $\omega^{-1/2}$ at low frequency region for (a) ZnO/Co_3O_4, (b) ZnO and (c) Co_3O_4.

Table S1 Specific surface areas and pore volumes of ZnO/Co_3O_4, ZnO and Co_3O_4.

Sample	**Specific surface area ($m^2\ g^{-1}$)**	**Pore volume ($cm^3\ g^{-1}$, $\times\ 10^{-3}$)**
ZnO/Co_3O_4	17.55	6.45
ZnO	0.75	0
Co_3O_4	2.91	1.69

Table S2 Specific surface areas and pore volumes of ZnO/Co_3O_4 composites with different ratios of ZnO and Co_3O_4: ZC-3-2, ZC-1-1, ZC-1-2 and ZC-1-8.

Sample	**Specific surface area (m^2 g^{-1})**	**Pore volume (cm^3 g^{-1}, × 10^{-3})**
ZC-3-2	17.55	6.45
ZC-1-1	13.78	4.12
ZC-1-2	7.56	2.55
ZC-1-8	1.88	0.66

References

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