Electronic Supplementary Information (ESI) *for*

K-ion and Na-ion storage performances of Co_3O_4-Fe_2O_3 nanoparticles-decorated super p carbon black prepared by a ball milling process

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Fig. S1

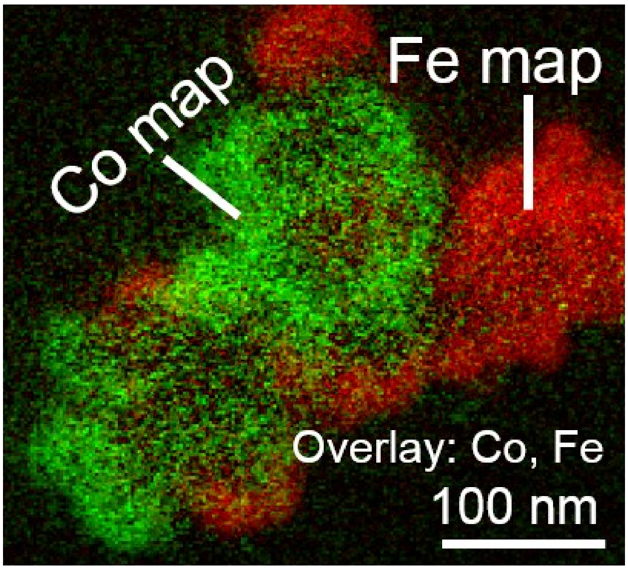

Fig. S1 An overlay of elemental Co and Fe mapping (colour scheme: cobalt- green; iron-red) taken from the region of Fig. 2c. Green colour is highlighting the location of Co_3O_4 which shows smaller particles size whereas red colour is highlighting the location of Fe_2O_3 which shows coarser particles size.

Fig. S2

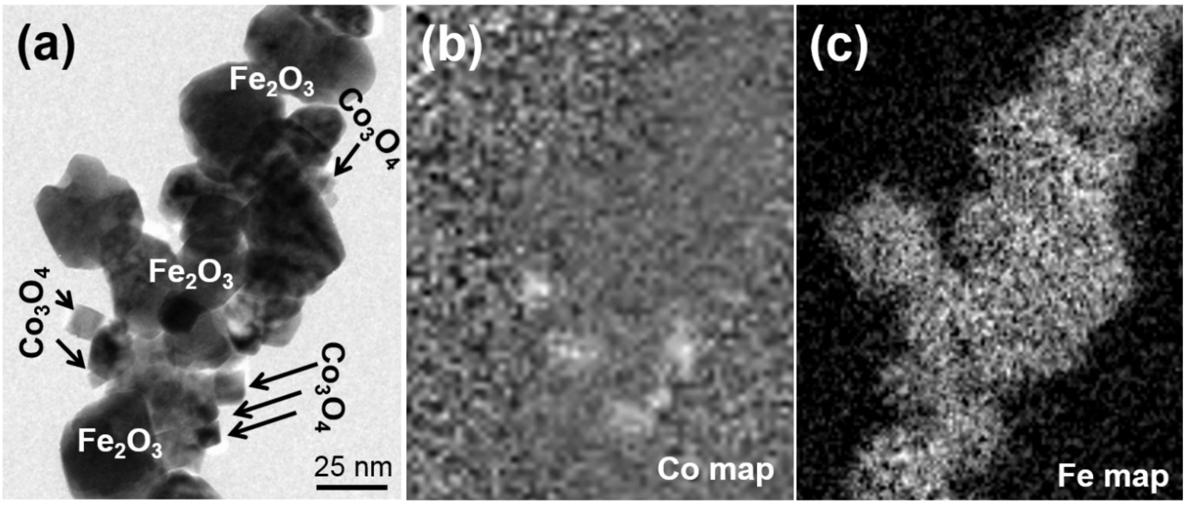

Fig. S2 An overlay of elemental Co and Fe mapping taken from the region of Fig. S2a. White spot is highlighting the location of Co_3O_4 which shows smaller particles size (Fig. S2b) whereas grey colour is highlighting the location of Fe_2O_3 which shows coarser particles size (Fig. S2c).

Fig. S3

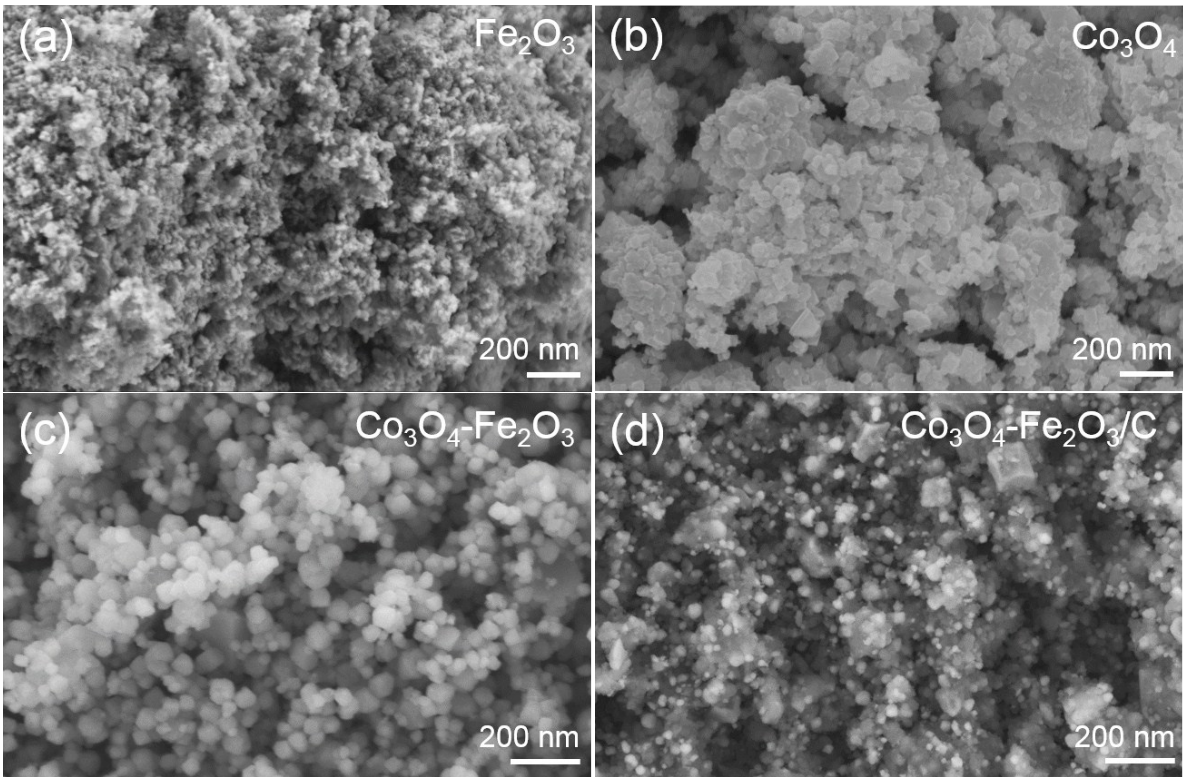

Fig. S3 SEM images of (a) Fe_2O_3, (b) Co_3O_4, (c) Co_3O_4-Fe_2O_3 and (d) hybrid Co_3O_4-Fe_2O_3/C samples.

Fig. S4

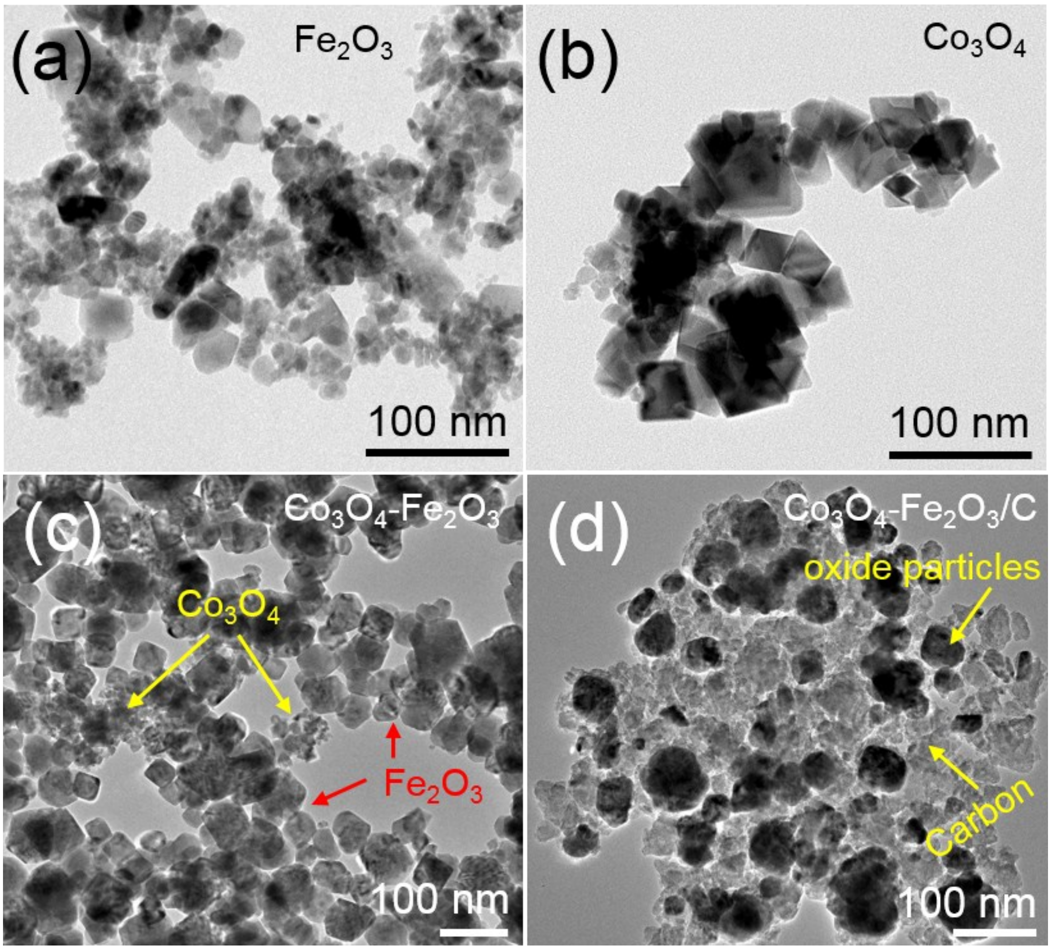

Fig. S4 TEM bright-field images: (a) Fe_2O_3, (b) Co_3O_4, (c) Co_3O_4-Fe_2O_3 and (d) hybrid Co_3O_4-Fe_2O_3/C samples.

Fig. S5

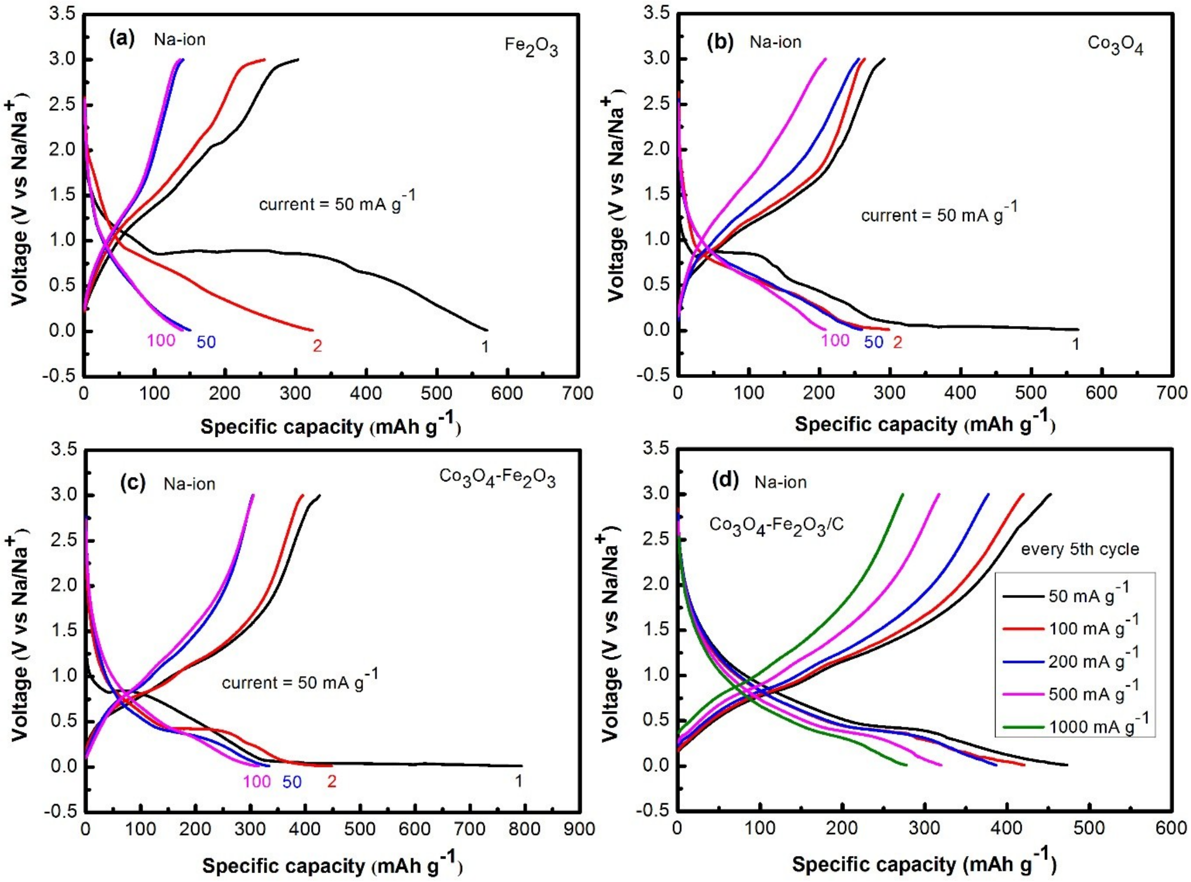

Fig. S5 Galvanostatic discharge/charge potential profiles for the selected cycles in Na-ion cells (a-d): charge-discharge curves of (a) Fe_2O_3; (b) Co_3O_4; (c) Co_3O_4-Fe_2O_3; and (d) Co_3O_4-Fe_2O_3/C electrodes.

Fig. S6

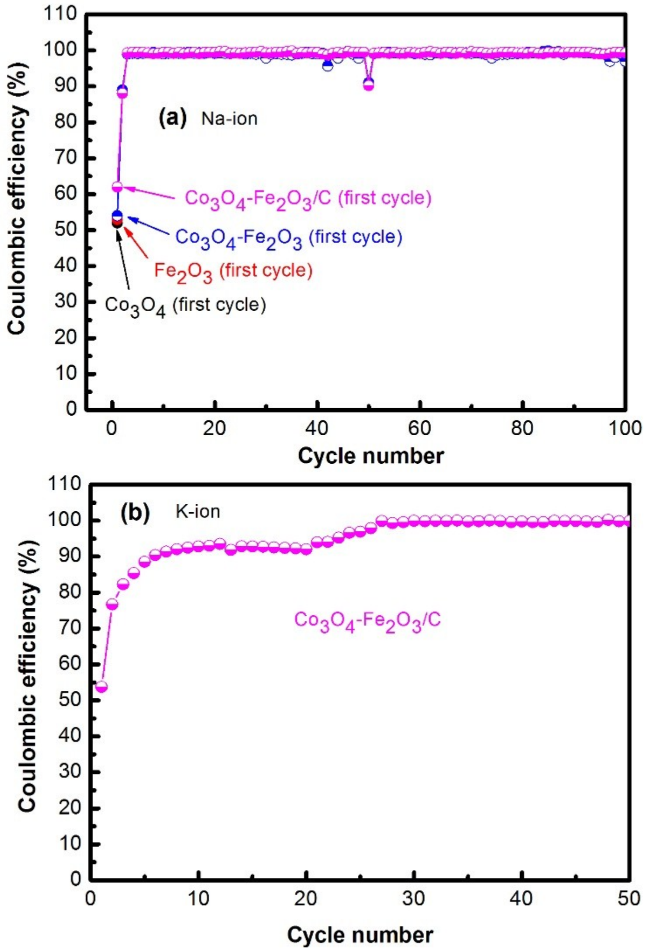

Fig. S6 Coulombic efficiencies: (a) Na-ion cell (obtained at 50 mA g^{-1} up to 100 cycles within the potential range of 0.01-3V); and (b) K-ion cell (obtained at 50 mA g^{-1} up to 50 cycles within the potential range of 0.01-3V).

Fig. S7

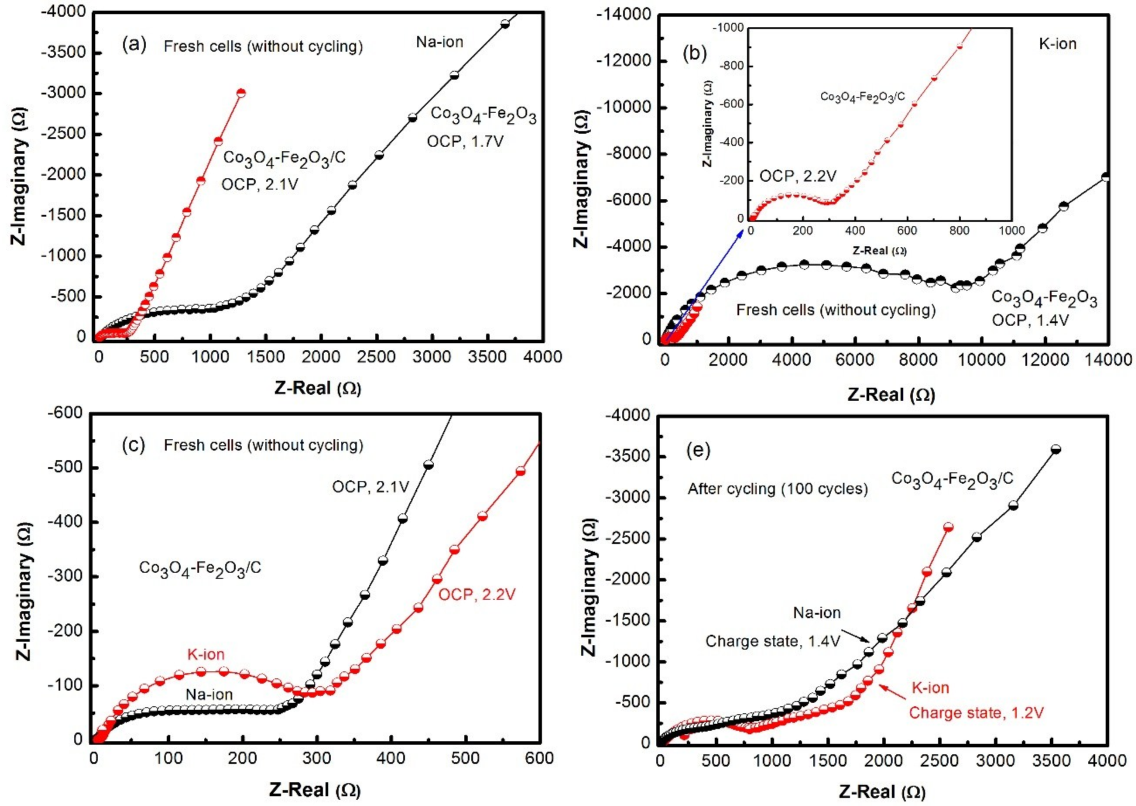

Fig. S7 Electrochemical impedance spectra of the Co_3O_4-Fe_2O_3 and hybrid Co_3O_4-Fe_2O_3/C electrodes in Na-ion and K-ion cells (a-d): (a, b) spectra taken at open circuit potential for the fresh cells (before cycling); (c) comparison of impedance between Na-ion and K-ion cells at open circuit potential for the fresh electrodes (before cycling); (e) spectra of the cycled electrodes taken after 100 cycles at the charge state.

Table S1. Comparison of electrochemical performance between hybrid Co_3O_4-Fe_2O_3/C electrode and related other hybrid metal oxide anode materials reported in N-ion and K-ion batteries.

Materials	Current rate mA g^{-1}	Capacity (mAh g^{-1})/Cycle number	Rate capacity (mAh g^{-1}) at relevant current rate (mA g^{-1})
Na-ion batteries			
Hybrid Co_3O_4-Fe_2O_3/C (This work)	50	410/100	472 at 50; 420 at 100; 386 at 200; 320 at 500; and 278 mAh g^{-1} at 1000 mA g^{-1}
Co_3O_4-Fe_2O_3 (This work)	50	314/100	468 at 50; 378 at 100; 322 at 200; 255 at 500; and 196 mAh g^{-1} at 1000 mA g^{-1}
Rod-like hybrid SnO_2-Fe_2O_3 [55]	25	313/30	-
Porous hybrid CuO-Cu_2O [56]	50	415/50	273 mAh g^{-1} at 500 mA g^{-1}
Hybrid CuO-Cu_2O/graphitized porous carbon [57]	50	303/200	-
Hybrid NiO-Ni/graphene [58]	200	385/190	385 at 200; 295 at 500; 248 at 1000; and 207 mAh g^{-1} at 2000 mA g^{-1}
Hollow α-Fe_2O_3@TiO_2 [59]	100	267/300	370 at 100 and 210 mAh g^{-1} at 2000 mA g^{-1}
K-ion batteries			
Hybrid Co_3O_4-Fe_2O_3/C (This work)	50	220/50	-
No reports are available on metal oxide as anode in K-ion batteries			

References

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