Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Electronic Supplementary Information for:

High energy density full lithium-ion cell based on specially matched coulombic efficiency

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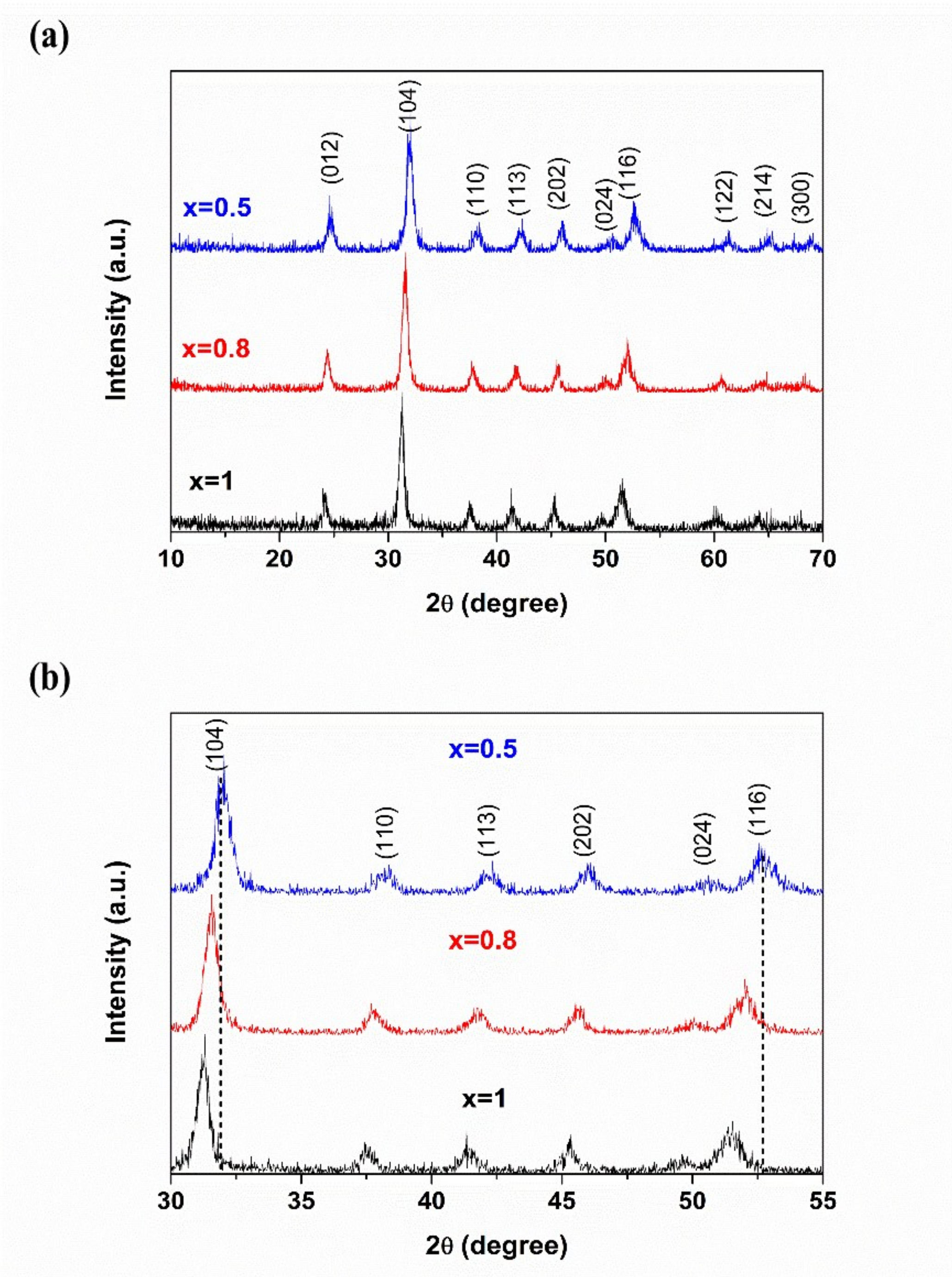

Fig. S1. XRD patterns of the as-solvothermal products $Mn_xCo_{1-x}CO_3$ (x=1, 0.8, 0.5), respectively (a). The diffraction patterns from30˚ to 55˚ (2θ) are zoomed (b).

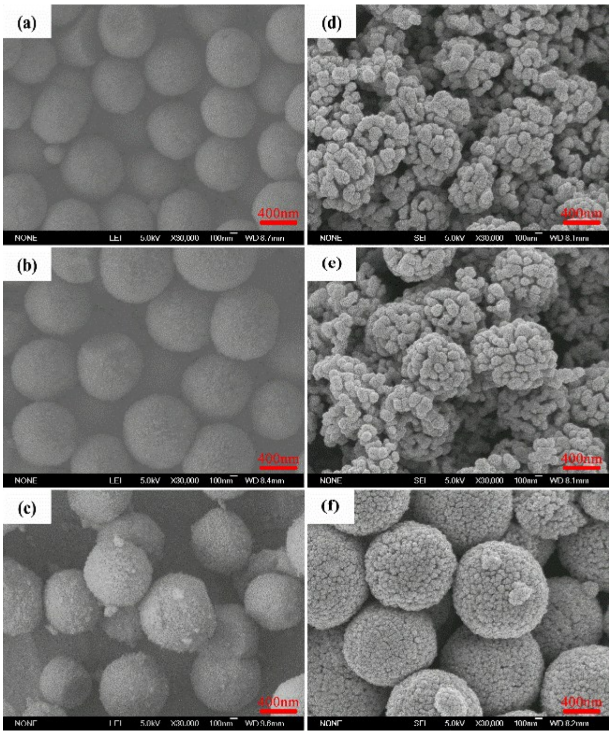

Fig. S2. SEM images of the $Mn_xCo_{1-x}CO_3$ precursors (x=1, 0.8, 0.5, a-c) and Mn_x-Co_{1-x} oxides intermediates (x=1, 0.8, 0.5, d-f) after 600˚C calcination at air atmosphere.

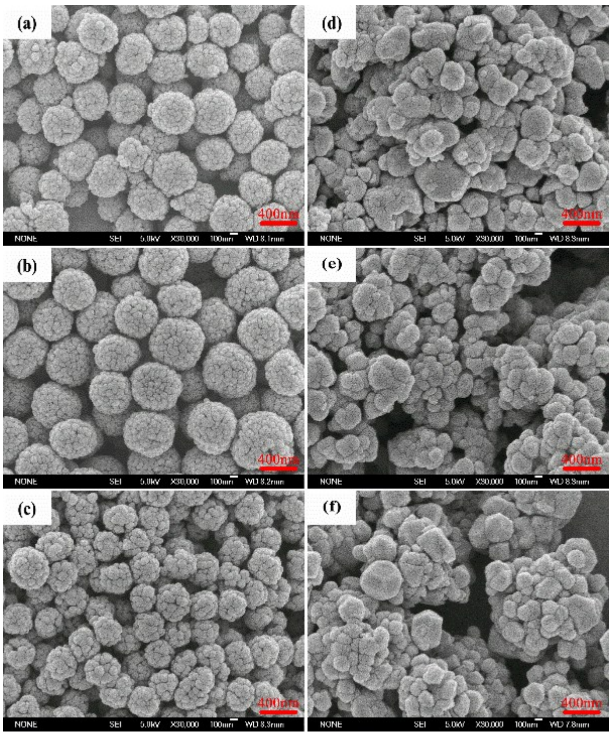

Fig. S3. SEM images of the $Mn_xCo_{1-x}O$ anodes (x=1, 0.8, 0.5, a-c), Li-rich cathodes with different compositions: LMNO (d), LMNCO (e) and LMCO (f).

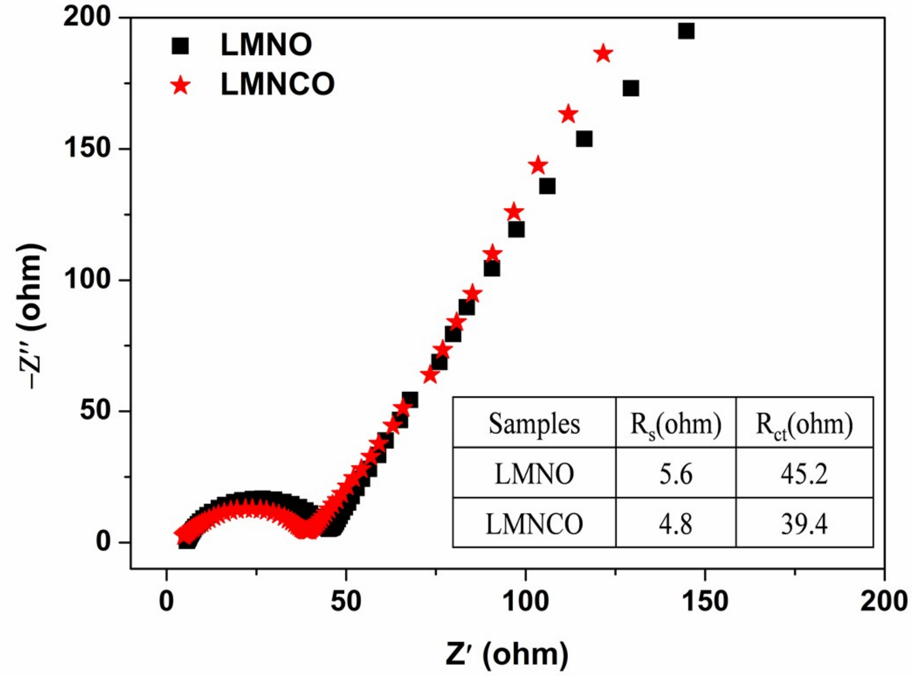

Fig. S4. The EIS of Li/LMNO (LMNCO) half-cells after 3 cycles at 0.1C. R_s represents the ohmic resistance and R_{ct} is the charge transfer resistance.

Table S1 The comparison of electrochemical performance of the Li-rich electrodes between this work and previously reported ones

Li rich materials	Cycling stability	Voltage stability	Refs
$Li_{1.2}Mn_{0.5}Co_{0.25}Ni_{0.05}O_2$	178.6 @0.8C (89.3%, 100 cycles)	--	1
Al_2O_3 coated $Li_{1.2}Ni_{0.2}Mn_{0.6}O_2$	192.9@0.2C (90.5%, 100 cycles)	--	2
Zr doped $Li_{1.2}Mn_{0.54}Ni_{0.13}Co_{0.13}O_2$	125@1C (78.6%, 100 cycles)	--	3
$Li_{1.231}Mn_{0.592}Ni_{0.2}O_2$	173.2@1C (89.73%, 69 cycles)	3.38 mV /cycle @0.1C	4
$LiFePO_4$ coated $Li_{1.2}Mn_{0.54}Ni_{0.13}Co_{0.13}O_2$	249.8@0.5C (92.8%, 120 cycles)	Negligible @0.5C	5
Cr doped $Li_{1.2}Ni_{0.2}Mn_{0.6}O_2$	200@0.08C (88.5%, 50 cycles)	≈2.8 mV /cycle @0.08C	6
$Li_{1.2}Mn_{0.54}Ni_{0.18}Co_{0.08}O_2$	216.5@0.8C (94.2%, 100 cycles)	1.4 mV /cycle @0.8C	7
$Li_{1.2}Ni_{0.2}Mn_{0.6}O_2$	141.3@1C (83.1%, 40 cycles)	--	8
Sn doped $Li_{1.2}Ni_{0.25}Mn_{0.55}O_2$	163@1.2C (92%, 200 cycles)	--	9
MgF_2 coated $Li_{1.2}Ni_{0.17}Co_{0.07}Mn_{0.56}O_2$	188@0.1C (86%, 50 cycles)	--	10
Na doped $Li_{1.14}Ni_{0.16}Co_{0.08}Mn_{0.57}O_2$	218.4@0.2C (98.8%, 100 cycles)	--	11
$Li_{1.2}Ni_{0.2}Mn_{0.6}O_2$	227.2@0.2C (95.8%, 130 cycles)	1.8 mV /cycle @0.2C	this work

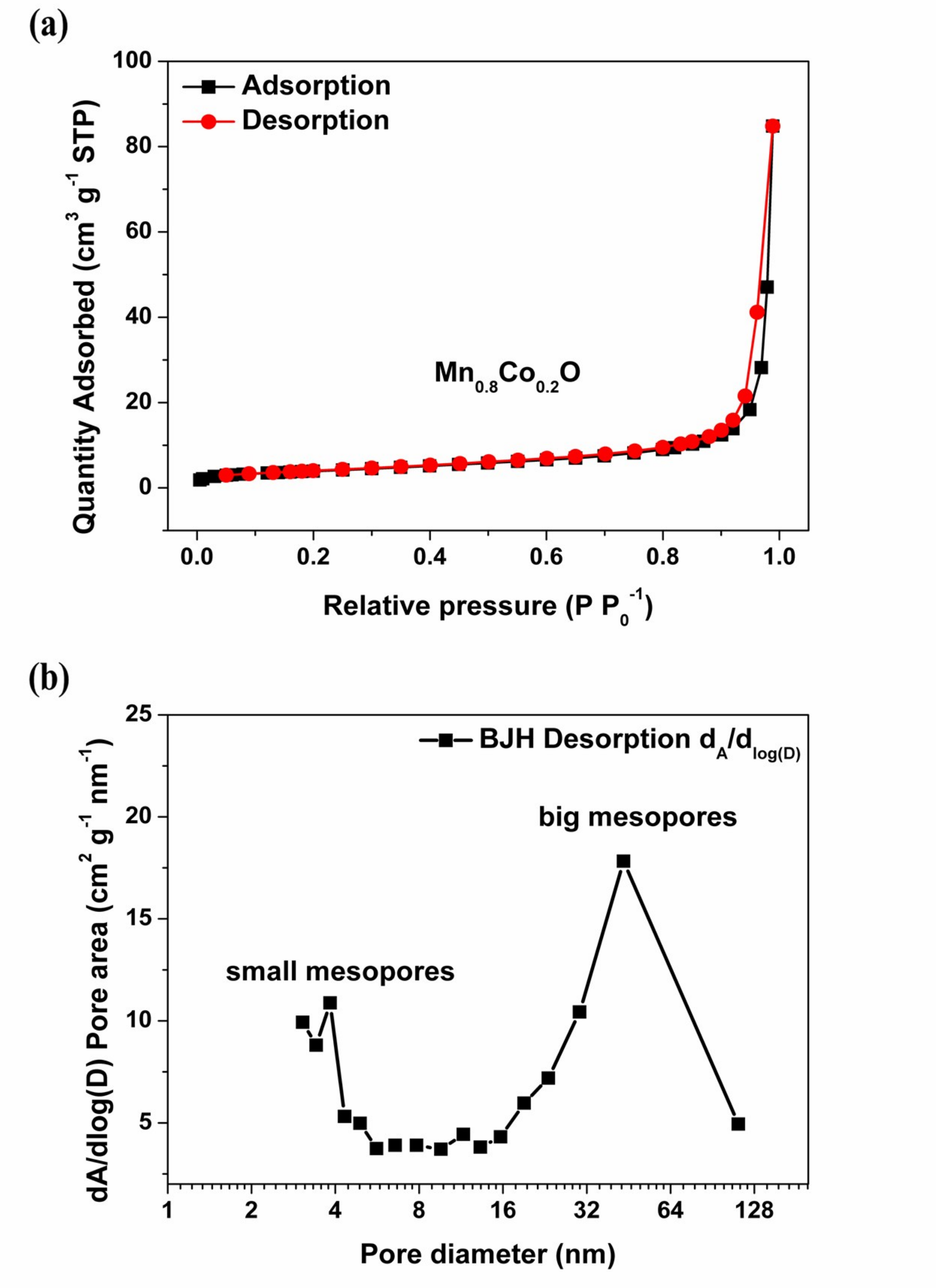

Fig. S5 The N_2-adsorption/desorption curves (a), and pore size distribution (b) of $Mn_{0.8}Co_{0.2}O$ anode.

Table S2 The comparison of electrochemical performance of the MnO-based electrodes between this work and previously reported ones

MnO electrodes	Cycling stability	Rate stability	Refs
Carbon coated MnO	797.6 @0.1 A/g (112.1%, 50 cycles)	429.4 @0.8 A/g 323.2 @2 A/g	12
RGO coated MnO	1044.2 @0.1 A/g (90.8%, 120 cycles)	750 @0.8 A/g 600 @1.6 A/g	13
Carbon coated MnO	987.3 @0.1 A/g (80.9%, 150 cycles)	532.2 @1 A/g 406.1 @3 A/g	14
MnO/carbon nanotube composite	841 @0.1 A/g (93.4%, 200 cycles)	600 @0.76 A/g 400 @1.5 A/g	15
MnO@C/RGO	863 @0.38 A/g (119.7%, 160 cycles)	550 @3.8 A/g 415 @7.6 A/g	16
MnO yolk–shell sphere	1000 @0.2 A/g (107%, 500 cycles)	710 @2 A/g 513 @4 A/g	17
MnO@C	832 @0.1 A/g (120.6%, 100 cycles)	440 @1 A/g 315 @2 A/g	18
MnO/Graphene	930 @0.5 A/g (147.6%, 500 cycles)	500 @0.5 A/g 300 @1 A/g	19
Carbon coated and N-doped MnO	578 @0.1 A/g (95%, 60 cycles)	320 @0.5 A/g 187 @2 A/g	20
Hollow MnO	1050 @0.5 A/g (175%, 150 cycles)	770 @0.5 A/g 650 @1 A/g	21
MnO/C nanopeapods	510 @2 A/g (100%, 1000 cycles)	630 @1 A/g 470 @5 A/g	22
$Mn_{0.8}Co_{0.2}O$	682 @0.4 A/g (110%, 200 cycles)	583 @4 A/g 484 @8 A/g	this work

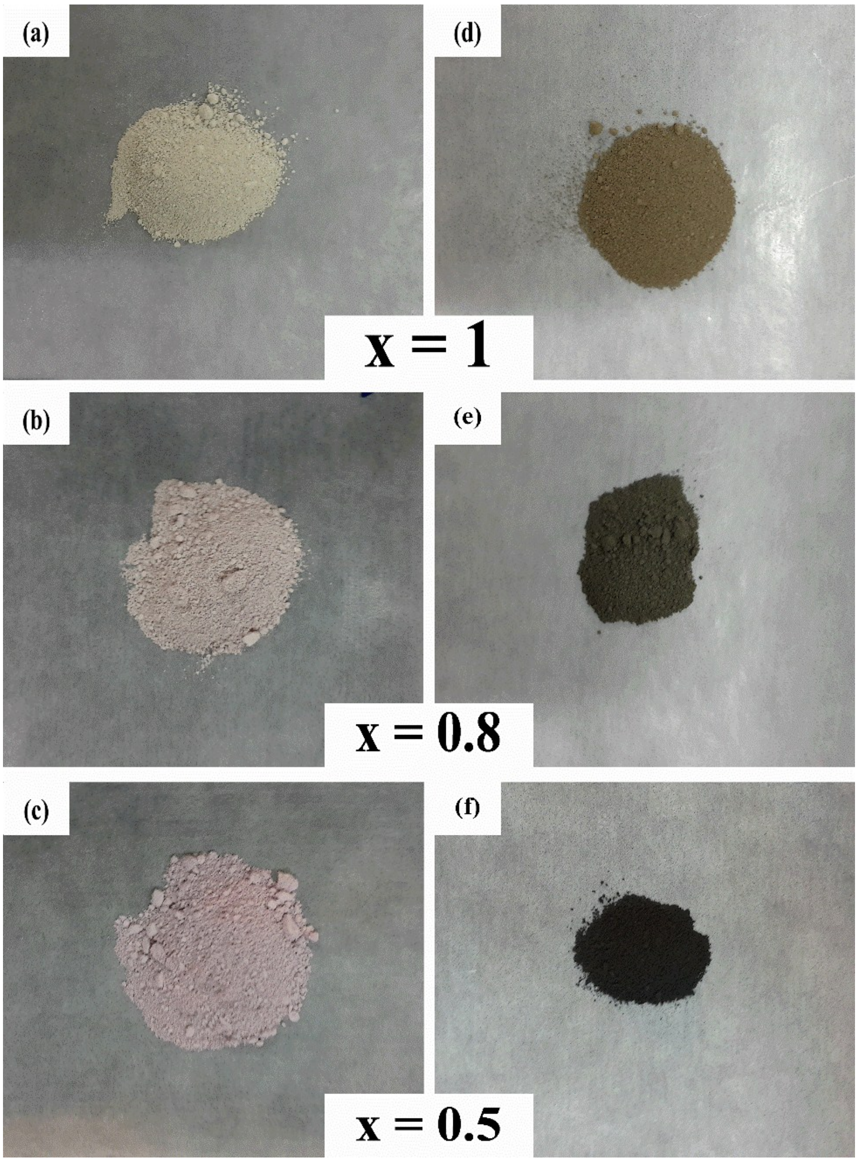

Fig. S6. The photos of the $Mn_xCo_{1-x}CO_3$ precursors (x=1, 0.8, 0.5, a-c) and the N_2 calcination products $Mn_xCo_{1-x}O$ anodes (x=1, 0.8, 0.5, d-f). The colors change from white to pink with the increase of Co content in the $Mn_xCo_{1-x}CO_3$ precursors, and the colors of the obtained $Mn_xCo_{1-x}O$ anodes change from brown to black in a way to provide that the electronic conductive of the anode materials is improved with increasing Co content.

Table S3 Comparison of electrodes' properties in assembling a full battery

Properties of electrodes	LMNO	$Mn_{0.8}Co_{0.2}O$	Graphite
Charge specific capacity (mAh g^{-1})	345	757	350
Discharge specific capacity (mAh g^{-1})	245	1040	372
Initial columbic efficiency	71.0%	72.8%	94.1%
Real density (g cm^{-3})	≈2.50	5.45	2.25

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