Supporting Information

Controllable charge capacity by black additive of high-energy-density sodium-ion battery

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Table S1. Summary of information on P2 type cathode for SIBs.

	material	Voltage (V)	Current Density (mA g^{-1})	First discharge capacity (mAh g^{-1})	Cycle retention (% @ cycle number)	Rate Capability (mAh g^{-1} @ x mA g^{-1} /1C)	ref
P2 type cathode	$Na_{2/3}MnO_2$	2.0-4.3	18	164	75 @ 100cycles	80 @ 180	9
	$Na_{2/3}[Ni_{0.2}Mn_{0.8}]O_2$	2.0-4.3	18	162	75 @ 100cycles	130 @ 180	9
	$Na_{2/3}[Ni_{0.3}Mn_{0.8}]O_2$	1.5-4.3	20	177	66 @ 50cycles	112 @ 200	10
	$Na_{0.67}[Fe_{0.35}Mn_{0.65}]O_2$	1.5-4.3	13	204	67 @ 30cycles	140 @ 260	8
	$Na_{0.67}[Ni_{0.15}Fe_{0.2}Mn_{0.65}]O_2$	1.5-4.3	13	208	71 @ 50cycles	160 @ 260	8
	$Na_{2/3}[Ni_{0.25}Ti_{0.3}Mn_{0.45}]O_2$	2.0-4.5	20	150	94 @ 25cycles	110 @ 200	11
	$Na_{0.66}[Ni_{0.26}Zn_{0.07}Mn_{0.67}]O_2$	2.2-4.25	24	130	90 @ 30cycles	90 @ 192	12
	$Na_{0.7}[Mn_{0.6}Ni_{0.3}Co_{0.1}]O_2$	1.7-4.0	13	120 m	94 @ 20cycles	80 @ 260	13

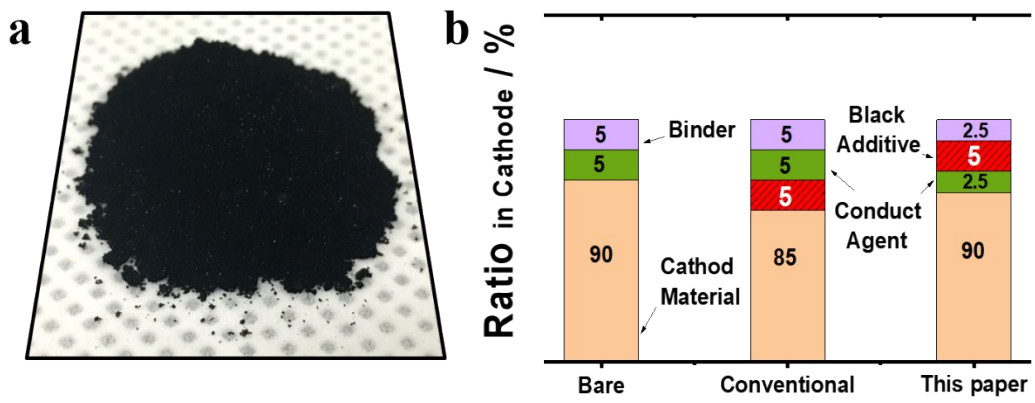

Fig. S1 (a) Image of additive-5% added $Na_{2/3}[Co_{0.05}Mn_{0.95}]O_2$ powder with conduct agent, (b) comparison of the different ratio for components in the cathode.

Table S2. Rietveld refinement results of XRD data with the electric conductivity and degree of distortion for $Na_{2/3}[Co_{0.05}Mn_{0.95}]O_2$.

$Na_{2/3}[Co_{0.05}Mn_{0.95}]O_2$			
Lattice parameter	**a-axis/Å**	**b-axis/Å**	**c-axis/Å**
	2.8387(2)	5.1830(6)	11.2750(5)
***Rwp* / %**		11.3 %	
Electric conductivity / S cm^{-1}		3.0×10^{-5}	

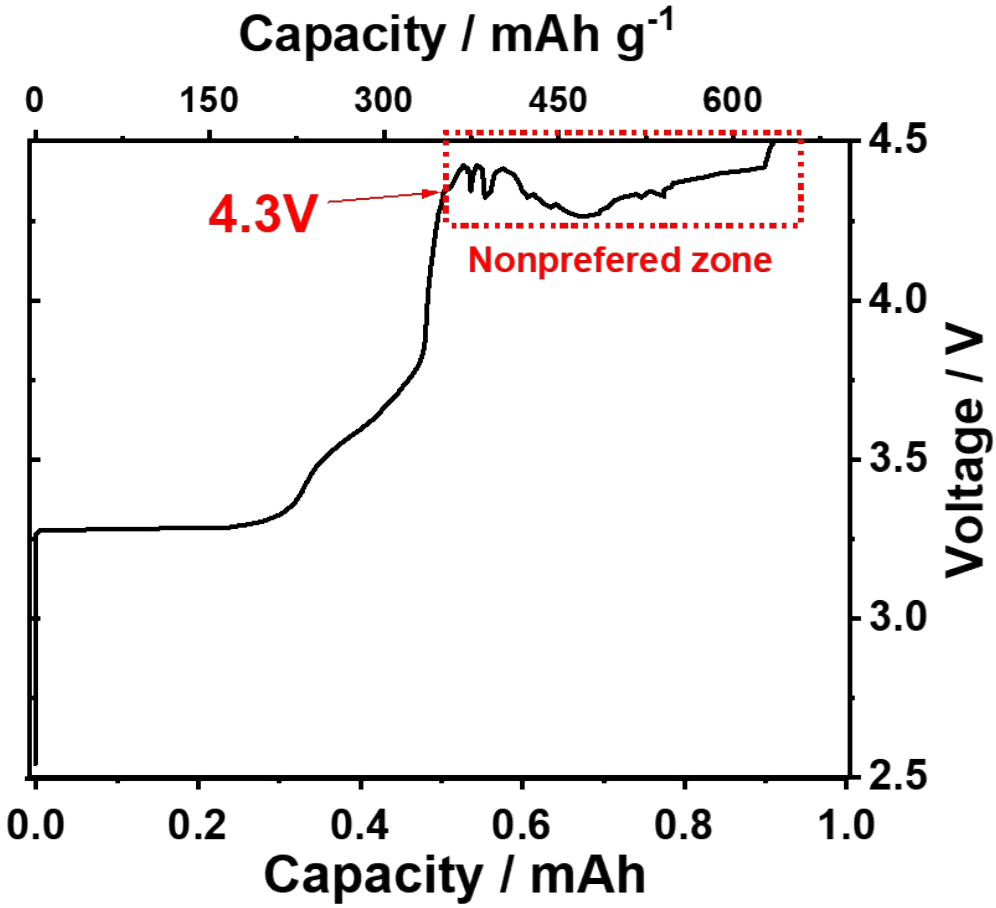

Fig. S2 Voltage profile during charge process of $NaNO_3$ electrode (voltage range from 1.5 to 4.5 V).

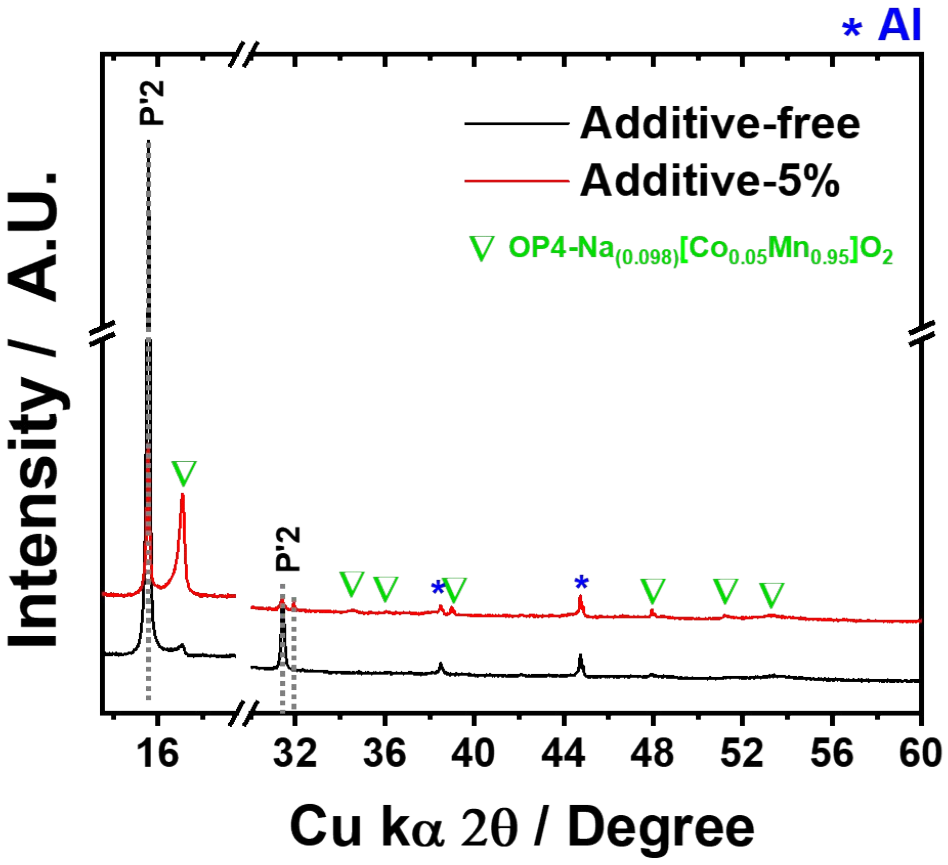

Fig. S3 ex-situ XRD results additive-free and additive-5% $[Co_{0.05}Mn_{0.95}]O_2$ electrodes charged to 4.3 V.

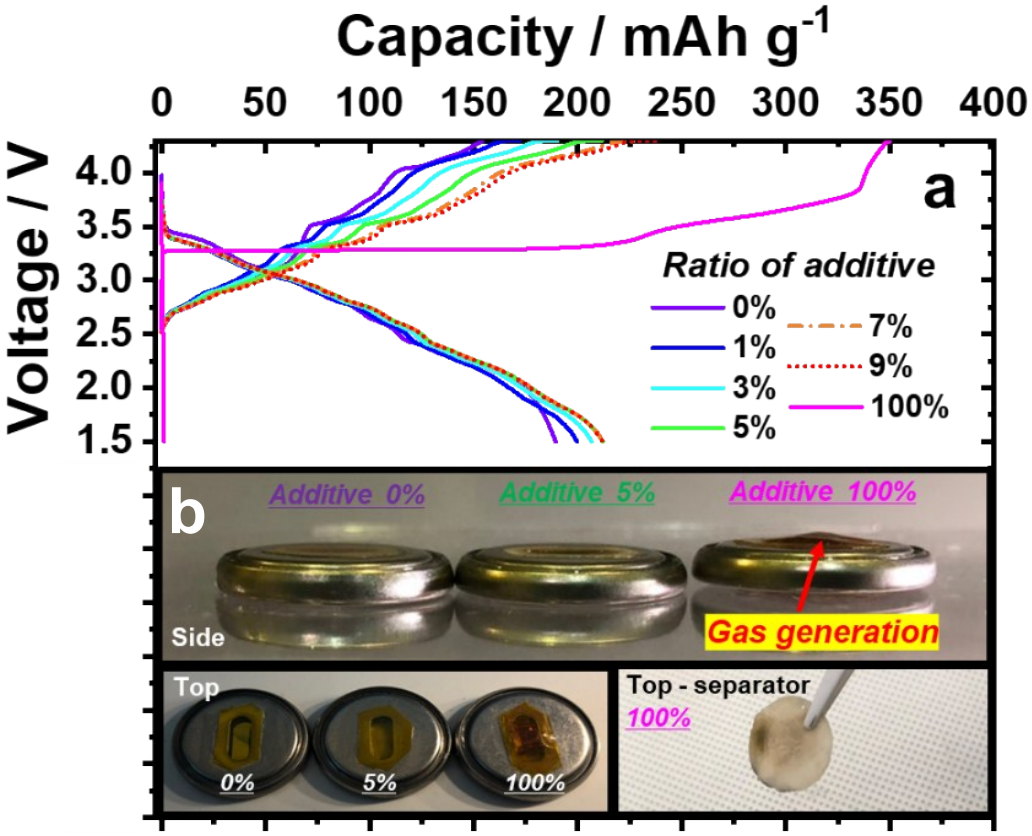

Fig. S4 (a) Charge and discharge curves (inset: images of cells for additive 0, 5, 100%) (b) charge and discharge capacity of additive-x% $Na_{2/3}[Co_{0.05}Mn_{0.95}]O_2$ electrode (x= 0, 1, 3, 5, 7, 9, 100); (b-top) side view of swelling using coin cells of which the cell cover has a hole tightly covered with imide film, (b-left bottom) top view of the swelling, and (b-right bottom) digital camera image of the glass fiber separator (GB 100R, separator) recovered from the $NaNO_2$ 100% electrode cell after charging to 4.3 V.

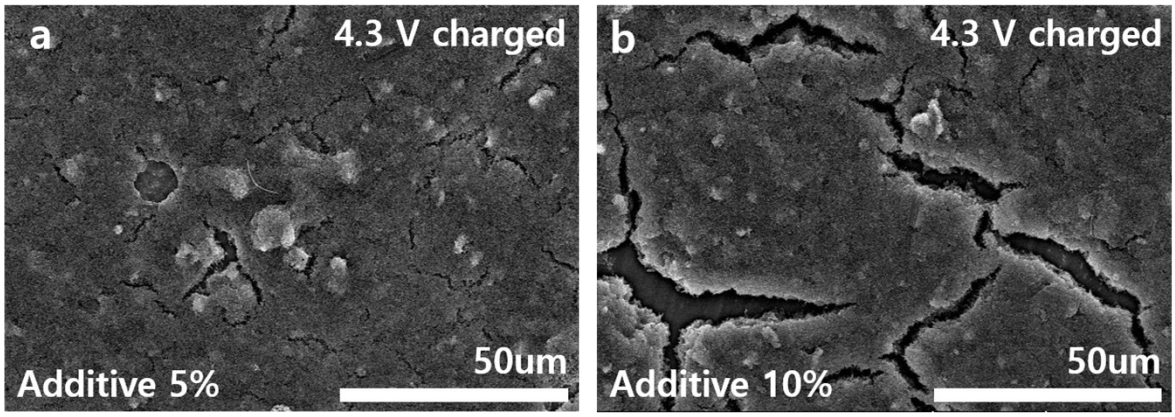

Fig. S5 SEM image for 4.3V charged electrode surface of additive (a) 5 % and (b) 10 % electrodes.

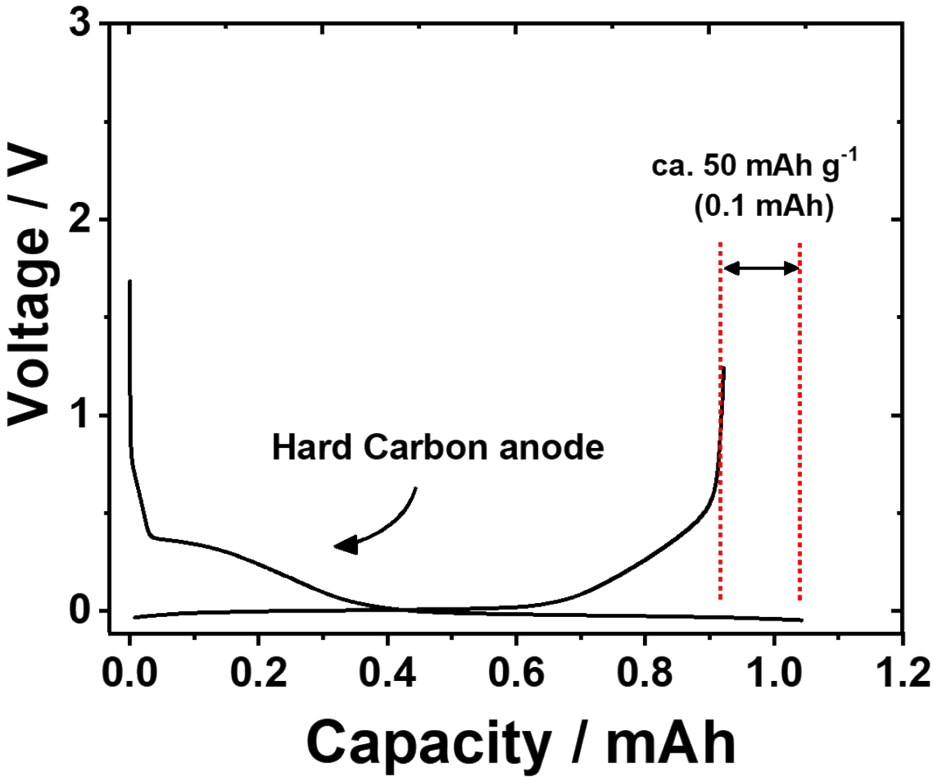

Fig. S6 Voltage profile of hard carbon as an anode in the half cell.

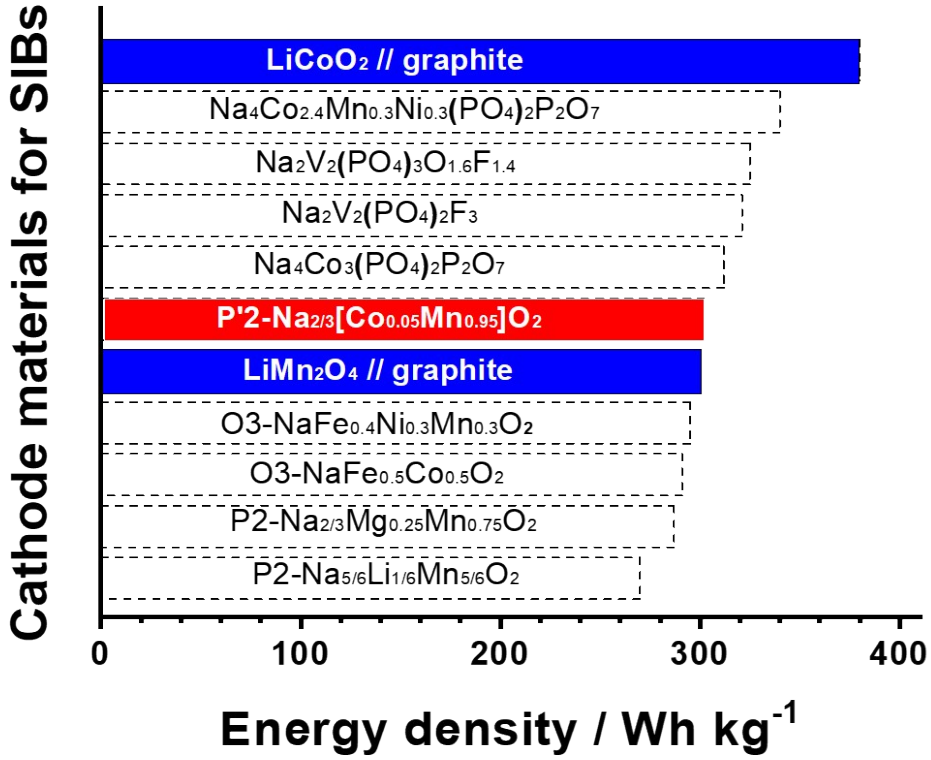

Fig. S7 Ragone plot comparing the energy density of additive-5% $Na_{2/3}[Co_{0.05}Mn_{0.95}]O_2$ with a number of the sodium cathode and commercially available cathode for LIBs.