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

Supporting Information

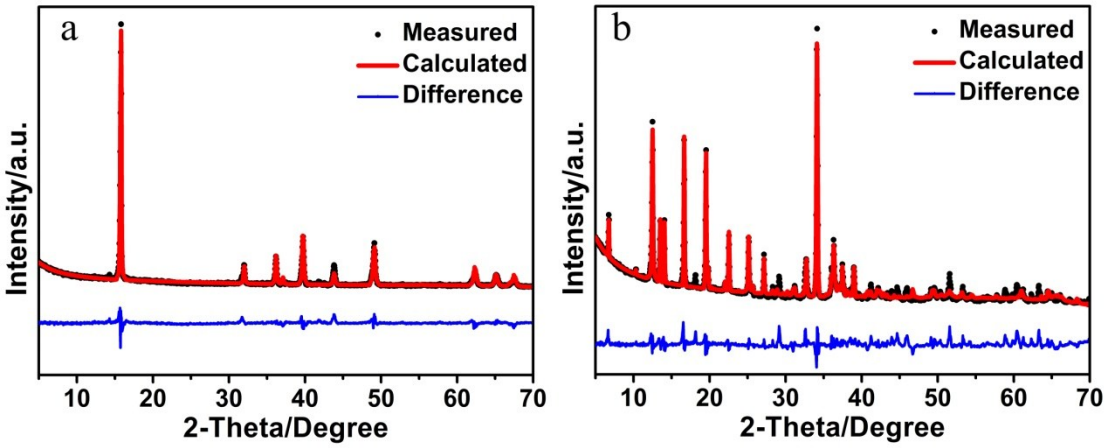

Figure S1 Rietveld refinements of (a) pure P2 -type and (b) T-type material.

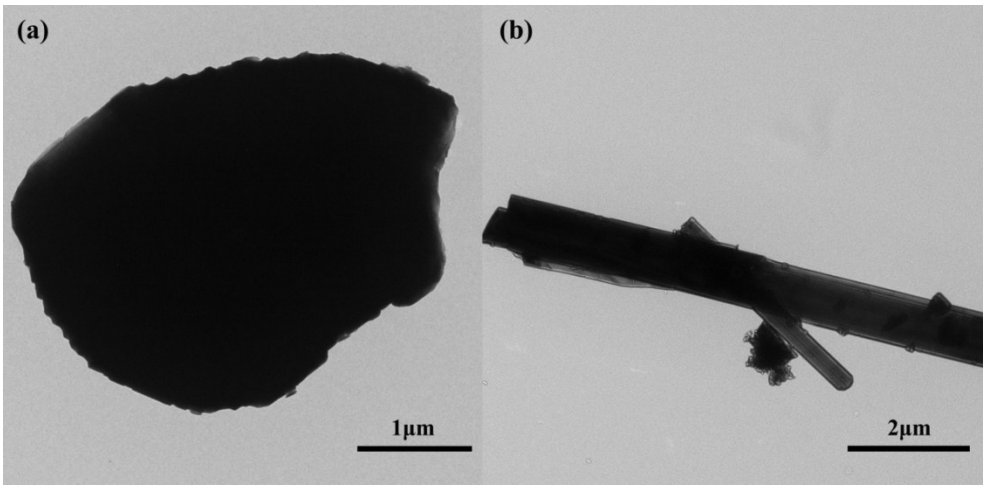

Figure S2 TEM image of (a) P2 -type and (b) T-type material.

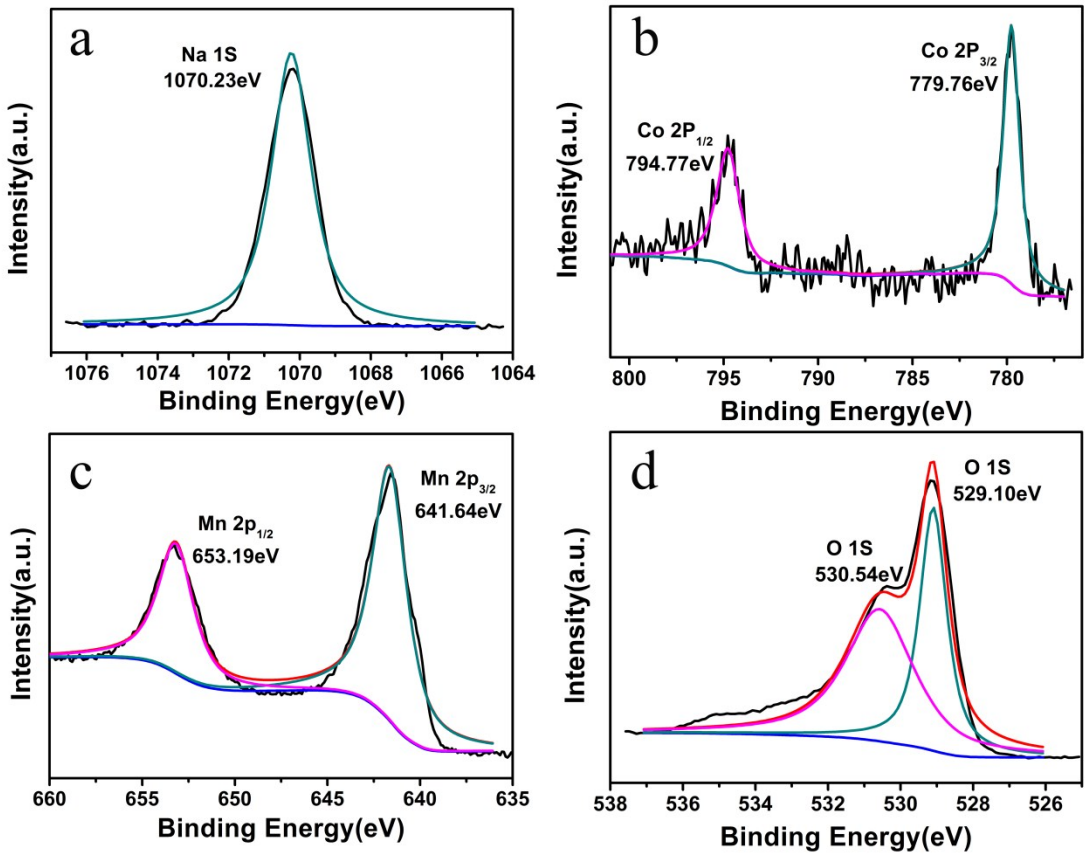

Figure S3. XPS analysis of the P2+T material: (a) XPS spectrum of Na 1s; (b)Co 2p; (c) Mn 2p; and (d) O 1s.

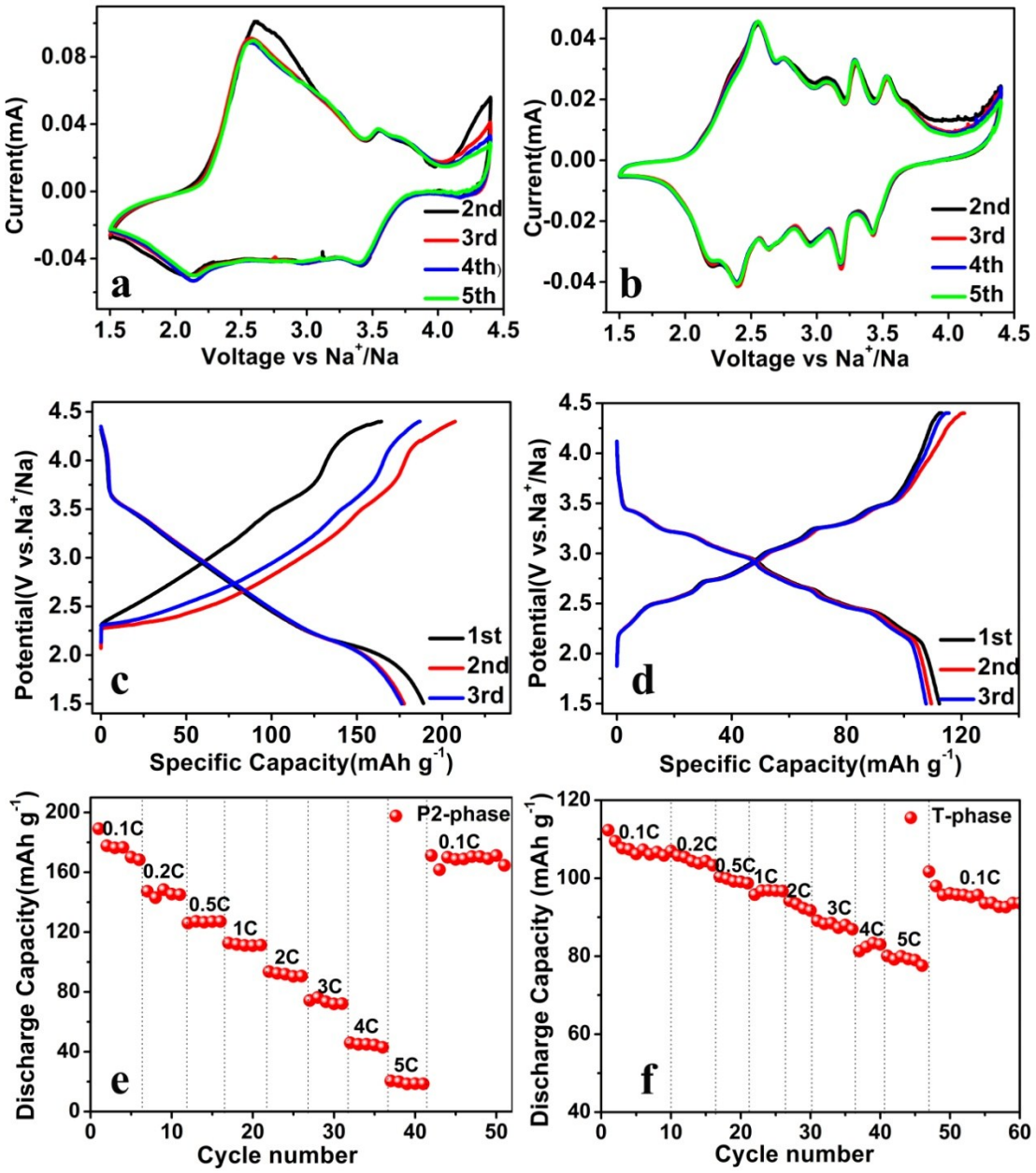

Figure S4.(a-b) Cyclic voltammogram of the P2- and T-phase electrode at a scan rate of 0.1 mVs^{-1}; (c-d) Typical charge/discharge voltage profiles of the P2- and T-phase electrode at a current rate of 0.04 C; (e-f) Rate performance of P2- and T-phase, electrode at various current rates.

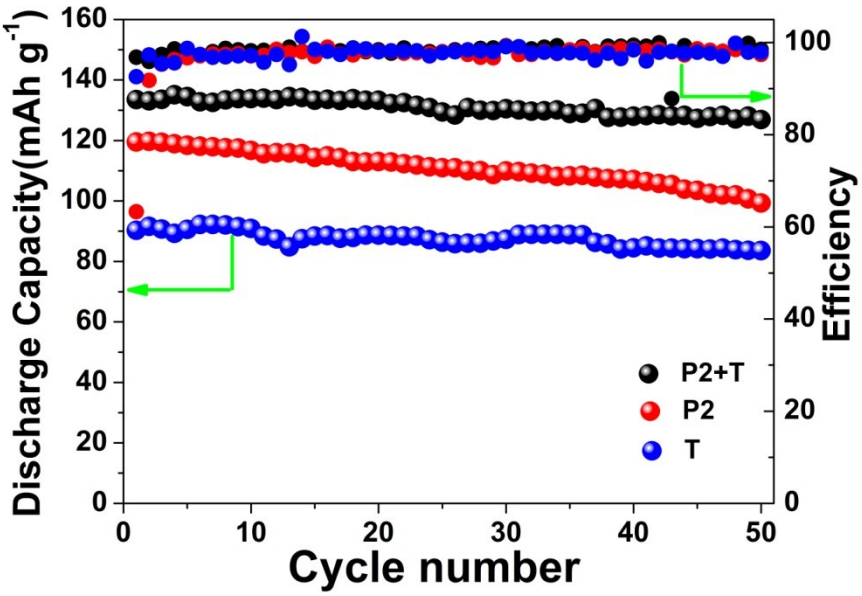

Figure S5. Specific discharge capacities and coulomb efficiencies versus cycle number for 50 cycles. Potential range: 2–4.4V.

In a narrow voltage of 2-4.4V, the P2+T phase material exhibits specific discharge capacities of 133.5 mAh g^{-1} and 126.9 mAh g^{-1} at the 1st and 50th cycle, resulting in 95% capacity retention (2nd–50th cycles). This performance is better than the other two materials. The P2 phase material shows a specific discharge capacity of 99.3 mAh g^{-1} after 50th cycles, with a cycle efficiency of 83.1%.

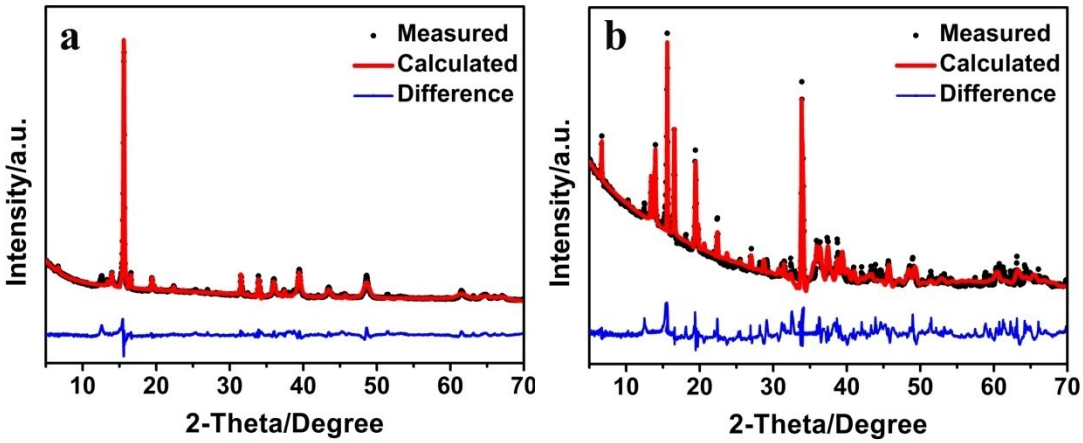

Figure S6 Rietveld refinements of P2+T-type $Na_xCo_{0.1}Mn_{0.9}O_2$ with varied P2: T ratio of 50%:50% (a), and 20%:80% (b).

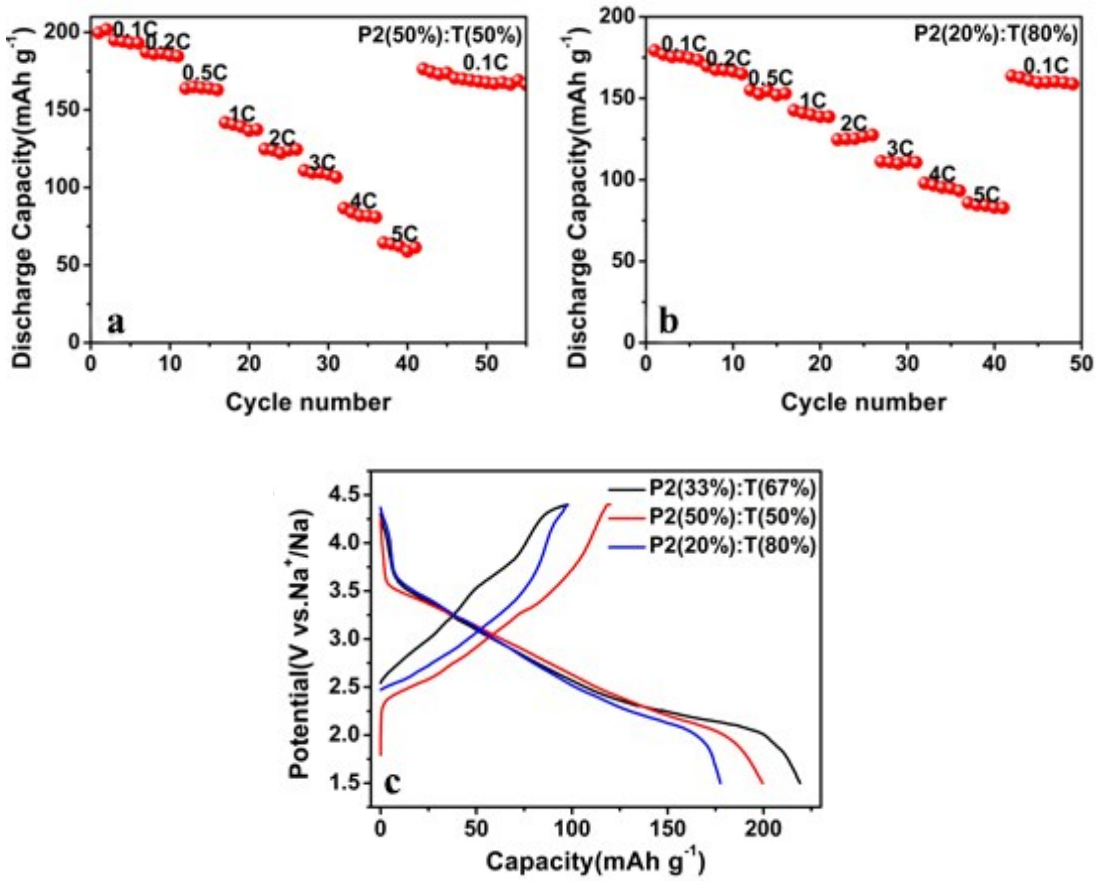

Figure S7 The C-rate performance of $Na_xCo_{0.1}Mn_{0.9}O_2$ with the radio between P2 and T of 50%:50% (a), and 20%:80% (b); (c) Charge/discharge curves of $Na_xCo_{0.1}Mn_{0.9}O_2$ with vried P2:T ratio.

Table S1 Lattice parameters of the P2 compound sample after Rietveld refinement.

Phase	P2 (JCPDS: 27-0751)	
Space Group	P63/mmc	
	a (Å)	2.8275
	b (Å)	2.8275
	c (Å)	11.0295(9)
	Volume ($Å^3$)	76.3651
Cell parameters	α (°)	90
	β (°)	90
	γ (°)	120
Agreement factors	Rwp (%)	6.88
	Rp (%)	8.56

Table S2 Lattice parameters of the T compound sample after Rietveld refinement.

Phase	T (JCPDS: 27-0751)	
Space Group	Pbam	
	a (Å)	9.1133(9)
	b (Å)	21.3177(3)
	c (Å)	2.8897(9)
	Volume ($Å^3$)	693.0517
Cell parameters	α (°)	90
	β (°)	90
	γ (°)	90
Agreement factors	Rwp (%)	5.97
	Rp (%)	9.8

Table S3 Lattice parameters of the P2+T compound sample after Rietveld refinement.

Phase	P2 (JCPDS: 27-0751)		T (JCPDS: 27-0750)	
Phase ratio	32.39%		63.61%	
space group	P63/mmc		Pbam	
	a (Å)	2.8791(1)	a (Å)	9.1125(1)
	b (Å)	2.8791(1)	b (Å)	26.4026(8)
	c (Å)	11.3380(5)	c (Å)	2.8235(1)
	Volume ($Å^3$)	81.396(4)	Volume ($Å^3$)	679.4678(5)
Cell parameters	α (°)	90	α (°)	90
	β (°)	90	β (°)	90
	γ (°)	120	γ (°)	90
Agreement factors	Rwp(%)	5.49	Rwp(%)	5.49
	Rp(%)	7.69	Rp(%)	7.69

Table S4 ICP-AES results of the P2+T compound sample

Theoretical chemical formula	**Measured atomic ratio**		
	Na	Mn	Co
$\mathbf{Na_xMn_{0.9}Co_{0.1}O_2}$	0.48	0.89	0.09

Table S5 Electrochemical performance comparison between the previously reported $Na_xMn_yM_{1-y}O_2$ cathodes and P2+T-type $Na_xCo_{0.1}Mn_{0.9}O_2$ composite cathode

Cathode materials	Rate capability	Cycling stability	First discharge capacity	Ref.
P2-Type $Na_{0.78}Ni_{0.23}Mn_{0.69}O_2$	80 mAh g^{-1} (605 mA g^{-1})	~120 mAh g^{-1} after 20 cycles (12 mA g-1)	180 mAh g^{-1} (12 mA g^{-1})	21
$Na_{0.67}Mn_{0.67}Ni_{0.33}O_2$	35 mAh g^{-1} (340 mA g^{-1})	~120 mAh g^{-1} after100 cycles (17 mA g^{-1})	150 mAh g^{-1} (17 mA g^{-1})	23
P2-type $Na_xFe_{1/2}Mn_{1/2}O_2$	58 mAh g^{-1} (1040 mA g^{-1})	~150 mAh g^{-1} after 30 cycles (13 mA g^{-1})	190 mAh g^{-1} (13 mA g^{-1})	25
P2/O3 composite $Na_{0.66}Li_{0.18}Mn_{0.71}Ni_{0.2}{}_1Co_{0.08}O_{2+}$	69 mAh g^{-1} (500 mA g^{-1})	~125 mAh g^{-1} after150 cycles (50 mA g^{-1})	200 mAh g^{-1} (10 mA g^{-1})	26
P2/O3 $Na_{1-x}Li_xNi_{0.5}Mn_{0.5}O_{2+d}$	78 mAh g^{-1} (150 mA g^{-1})	~134 mAh g^{-1} after20 cycles (15 mA g^{-1})	140 mAh g^{-1} (15 mA g^{-1})	27
P2/O3 $Na_xMn_yNi_zFe_{0.1}Mg_{0.1}O_2$	110 mAh g^{-1} (900mA g^{-1})	~130 mAh g^{-1}after50 cycles (180mAg^{-1})	154 mAh g^{-1} (18 mA g^{-1})	30
P2-$Na_xCo_yMn_{1-y}O_2$ (y = 0, 0.1)	120 mAh g^{-1} (400mA g^{-1})	~117 mAh g^{-1} after150 cycles (50 mA g^{-1})	188 mAh g^{-1}(20 mA g^{-1})	39
P2+T $Na_xMn_{0.9}Co_{0.1}O_2$	117 mAh g^{-1} (900mA g^{-1})	~145 mAh g^{-1} after50 cycles (180mAg^{-1})	219 mAh g^{-1}(18 mA g^{-1})	**This work**

Table S6 Na^+ Diffusion Coefficient(D) of P2, T and P2+T materials Calculated from the CV and EIS.

		P2	T	P2+T
D for CV	Average slope	0.00568	0.01436	0.01671
	D($\times 10^{-12} cm^2/s$)	2.156	76.55	434.24
D for EIS	Slope	13.07	32.83	8.23
	D($\times 10^{-12} cm^2/s$)	1.827	41.67	127.07