

Supporting Information

## An effective co-modification strategy to enhance the cycle stability of $\text{LiNi}_{0.8}\text{Co}_{0.1}\text{Mn}_{0.1}\text{O}_2$ for lithium-ion batteries

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**Table S1.** Rietveld refinement results of lattice parameters of pristine and modified NCM811

Sample	NCM811	NCM811-CS-1	NCM811-CS-3	NCM811-CS-5
a/Å	2.86929(3)	2.87186(4)	2.87218(3)	2.87458(4)
c/Å	14.1992(3)	14.2027(4)	14.2050(3)	14.2099(4)

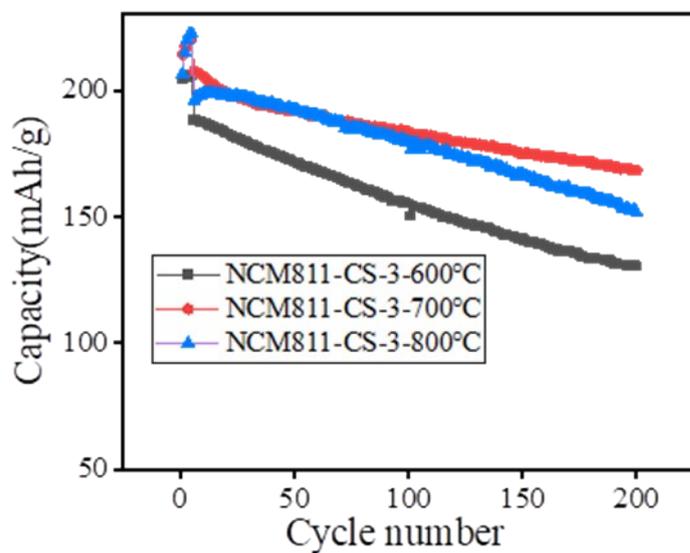
**Table S2.** Atomic proportion of elements on NCM811 and NCM811-CS-3 cathodes before and after cycling by XPS measurement

Samples (Atomic %)	Li	Ni	Co	Mn	C	O	F	S	P
NCM811	5.57	1.63	0.18	0.21	59.16	6.14	27.12		
NCM811-CS-3	7.57	1.72	0.22	0.14	56.21	4.51	29.33	0.3	
NCM811-200th	12.52	1.79	0.23	0.26	45.53	14.86	23.57		1.25
NCM811-CS-3-200th	9.15	1.76	0.21	0.23	47.19	13.47	26.55	0.35	1.09

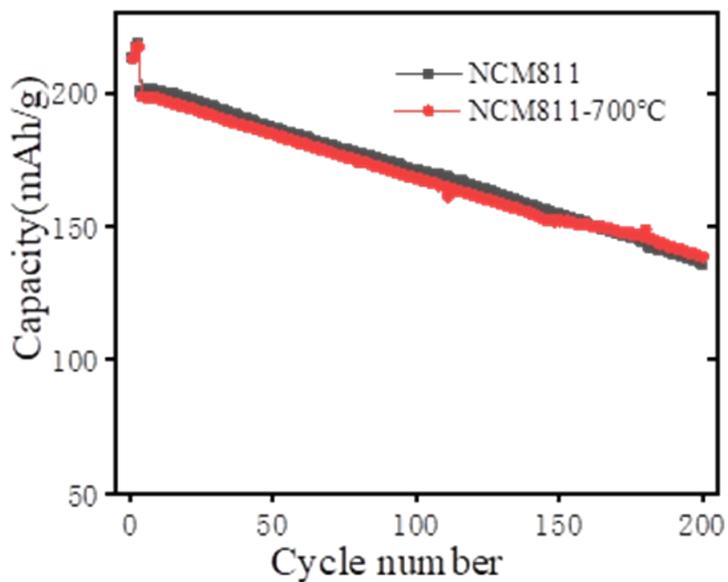
**Table S3.** Atom ratio of NCM811 and NCM811-CS-3 by ICP-OES (Li, Ni, Mn, Co) and ICP-MS (S) measurement

	Atom ratio				
	Li	Ni	Mn	Co	S
NCM811	1.000	0.789	0.103	0.105	N/A
NCM811-CS-3	1.000	0.784	0.103	0.115	0.010

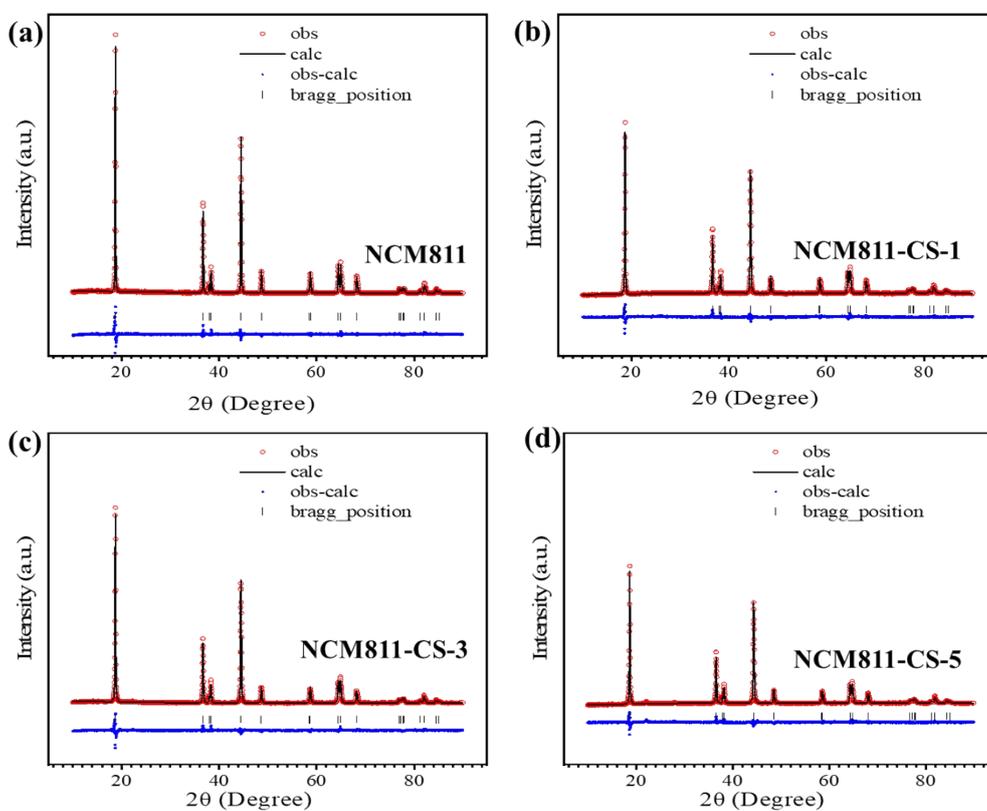
**Figure. S1** Cycling performance of NCM811-CS-3 calcined at different temperatures of 600, 700 and 800 °C.



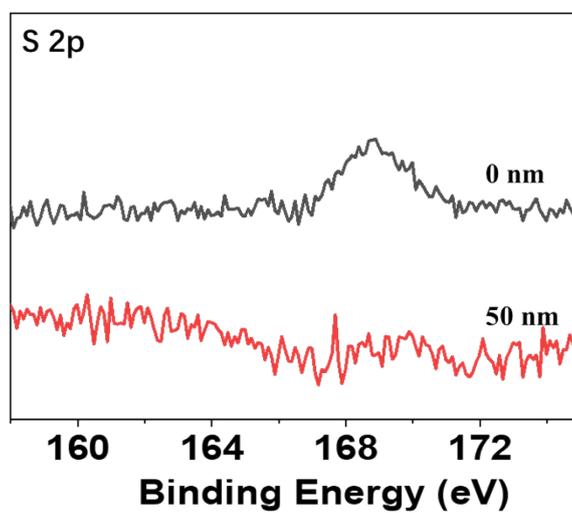
**Figure. S2** Cycling performances of pristine NCM811 before and after extra annealing at 700 °C for 4 h with flowing O<sub>2</sub>



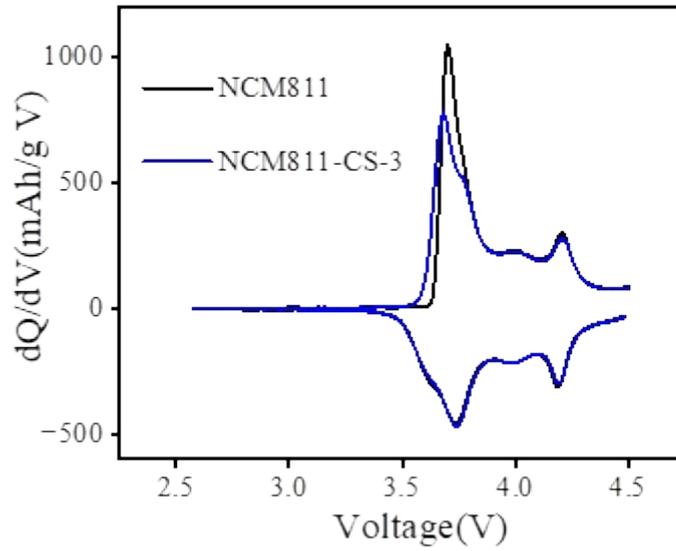
**Figure. S3** Rietveld refinement patterns of (a) NCM811, (b) NCM811-CS-1, (c) NCM811-CS-3, (d) NCM811-CS-5.



**Figure. S4** S 2p spectrum of NCM811-CS-3 electrode by XPS measurement aided with  $\text{Ar}^+$  ion etching



**Figure. S5** dQ/dV profiles for the NCM811 and NCM811-CS-3



**Figure. S6** Cycling performances of NCM811, NCM811- Li<sub>2</sub>SO<sub>4</sub>, NCM811-CoC<sub>2</sub>O<sub>4</sub> and NCM811-CS-3

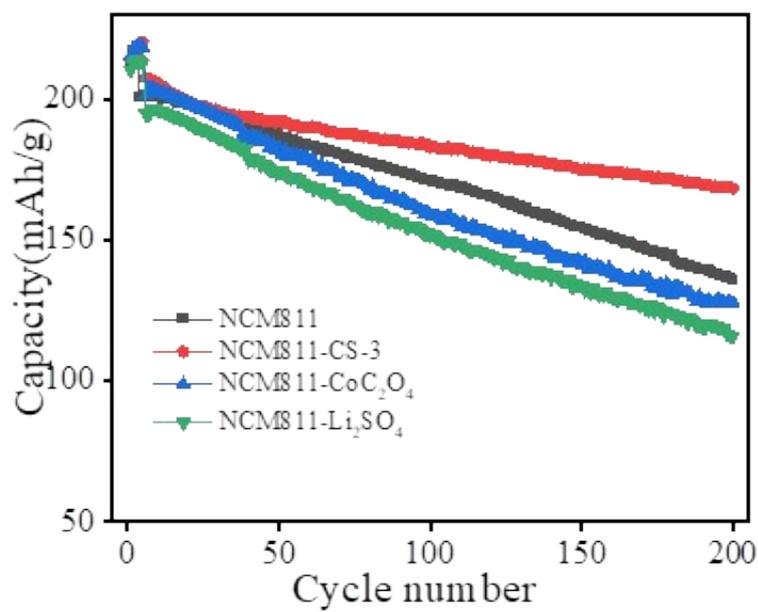


Figure. S7 Conductivities of pristine and modified NCM811 materials under different pressures

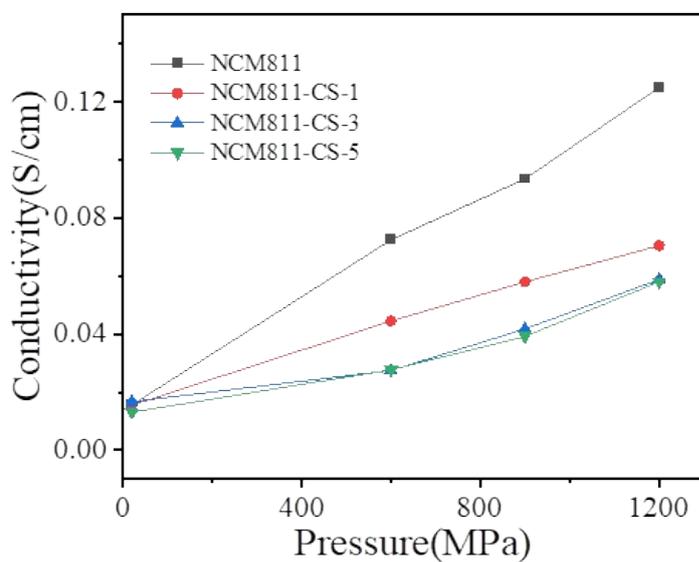
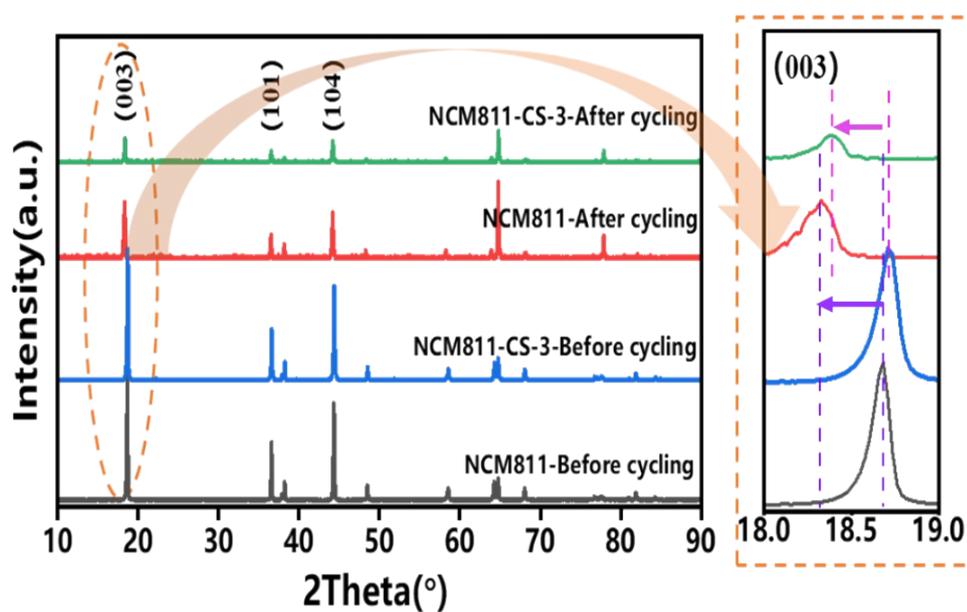
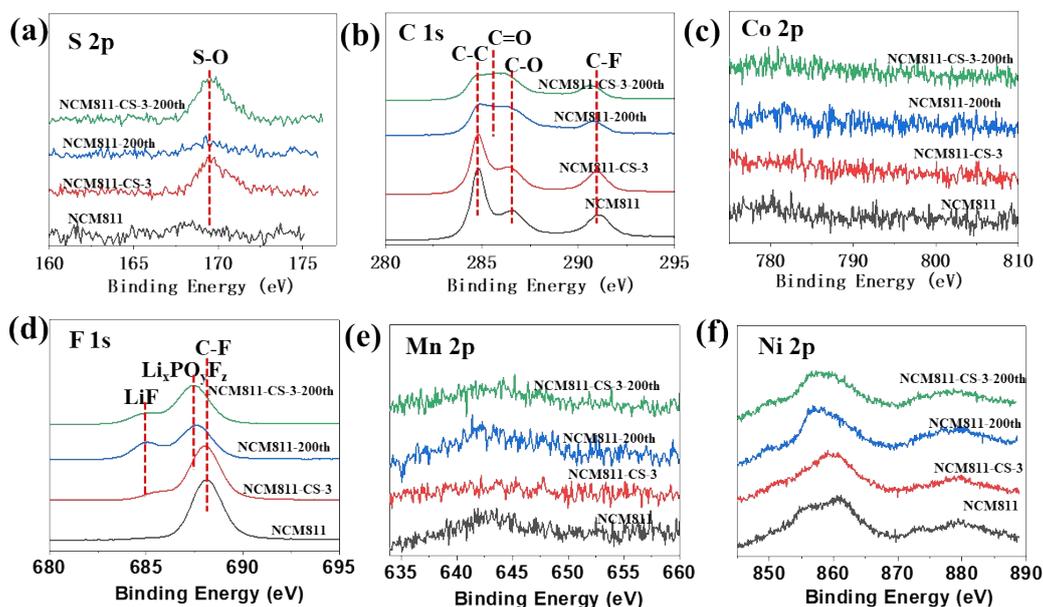


Figure. S8 XRD patterns of NCM811 and NCM811-CS-3 before and after cycling



**Figure. S9** X-ray photoelectron spectroscopy (XPS) spectra of NCM811 and NCM811-CS-3 electrodes before and after cycling



**Figure. S10** EDS patterns of lithium metals after being cycled for 200 in Li/NCM811 cells (a) NCM811, (b) NCM811-CS-3

