

## Supporting Information

### From Metal to Cathode Material: in situ Formation of LiCoO<sub>2</sub> with Enhanced Cycling Performance and Suppressed Phase Transition

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**Table S1.** Tap density and Compacted density of the M-LCO and C-LCO powder.

	Tap density (g cm <sup>-3</sup> ) C-LCO	Tap density (g cm <sup>-3</sup> ) M-LCO	Compacted density (g cm <sup>-3</sup> ) C-LCO	Compacted density (g cm <sup>-3</sup> ) M-LCO
Test 1	2.183	2.336	3.744	4.215
Test 2	2.217	2.357	3.886	4.348
Test 3	2.221	2.361	3.974	4.42
Average value	2.207	2.351	3.868	4.328
Standard deviation	0.021	0.013	0.116	0.104

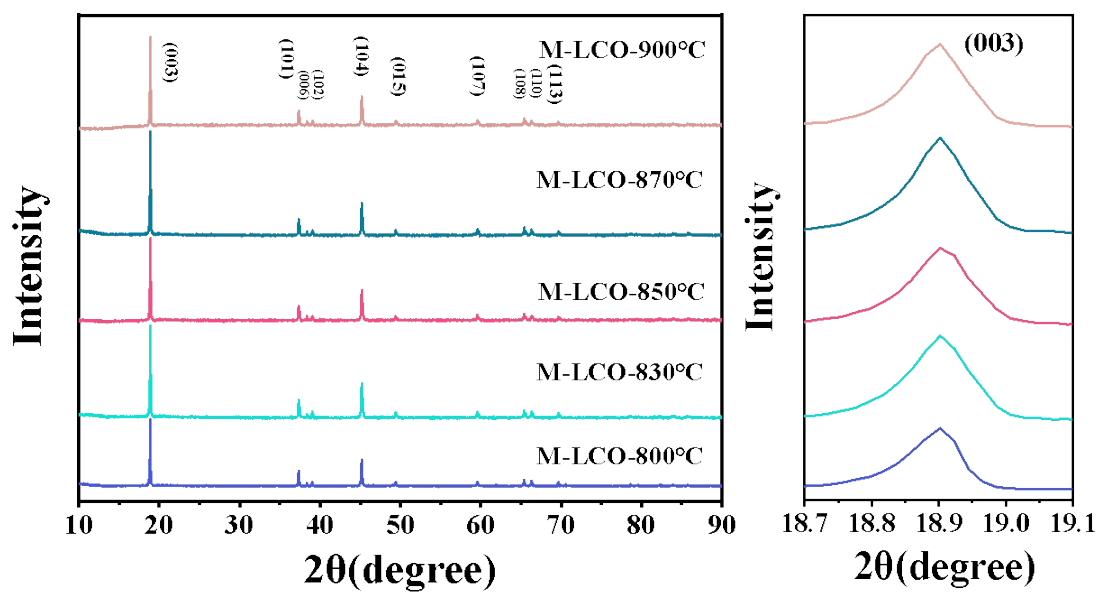
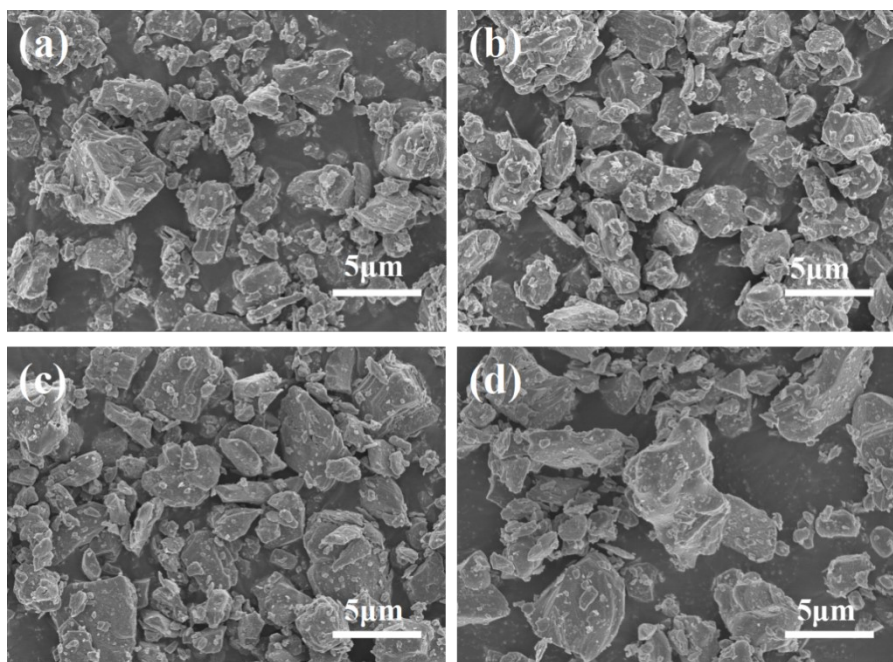


Fig. S1 XRD patterns of the M-LCO powder annealed at 800 °C, 830 °C, 850 °C, 870 °C, and 900 °C, respectively.

**Table S2.** The results of Rietveld refinement on the XRD data of the samples.

Sample	a	c	(003)/(104)	Co in Li (%)
C-LCO	2.815797	14.056887	2.23	1.06
M-LCO-850 °C	2.821124	14.087249	1.79	3.4



**Fig. S2** SEM image of the M-LCO powder annealed at (a) 800 °C; (b) 830 °C, (c) 870 °C and (d) 900 °C.

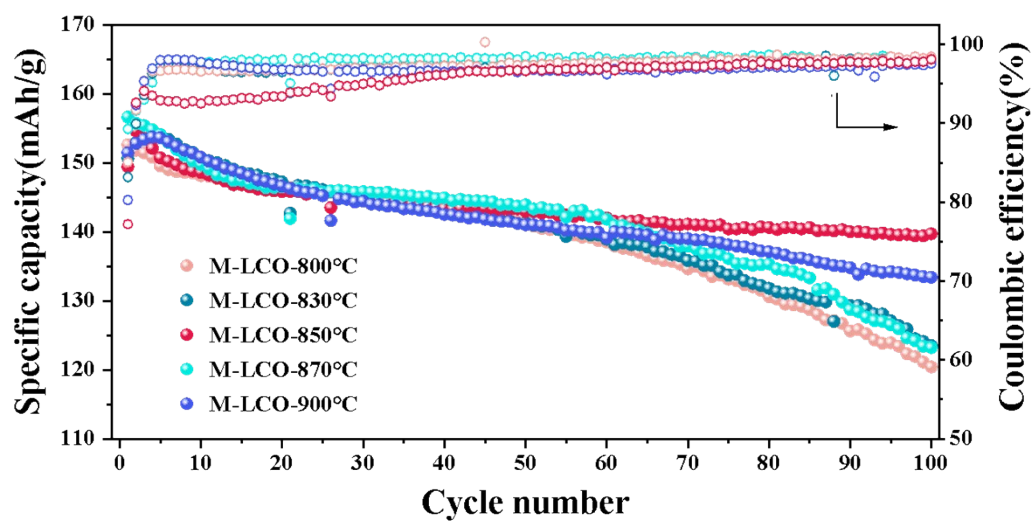
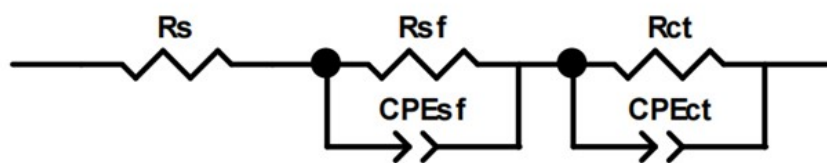


Fig. S3 Discharge specific capacity and Coulombic efficiency curves of M-LCO-850 °C annealed at 800 °C-900 °C, respectively.

**Table S3.** Discharge specific capacities of C-LCO and M-LCO-850 °C at different rates.

Sample	Discharge specific capacity (mAhg <sup>-1</sup> ) at 0.1 C	Discharge specific capacity (mAhg <sup>-1</sup> ) at 0.2 C	Discharge specific capacity (mAhg <sup>-1</sup> ) at 0.5 C	Discharge specific capacity (mAhg <sup>-1</sup> ) at 1 C	Discharge specific capacity (mAhg <sup>-1</sup> ) at 2 C	Discharge specific capacity (mAhg <sup>-1</sup> ) at 5 C
C-LCO	152	150	140	130	116	86
M-LCO-850 °C	160	161	149	143	130	98



**Fig. S4** Equivalent circuit diagram used to fit the EIS profiles of C-LCO and M-LCO-850 °C after 100 cycles.



**Table S4.** Fitted  $R_{sf}$  and  $R_{ct}$  values of the EIS after 100 cycles.

Sample	$R_{sf}/\Omega$	$R_{ct}/\Omega$
C-LCO	47.1	463.7
M-LCO-850 °C	27.34	297.8

**Table S5.** Calculated apparent diffusion coefficient  $D_{Li^+}$  of the M-LCO-850 °C and C-LCO cathodes.

Sample	0.2 mV s <sup>-1</sup>	0.4mV s <sup>-1</sup>	0.6 mV s <sup>-1</sup>	0.8 mV s <sup>-1</sup>
$D_{Li^+}$ (C-LCO)	$4.03 \times 10^{-9}$ cm <sup>2</sup> s <sup>-1</sup>	$6.49 \times 10^{-9}$ cm <sup>2</sup> s <sup>-1</sup>	$7.13 \times 10^{-9}$ cm <sup>2</sup> s <sup>-1</sup>	$6.74 \times 10^{-9}$ cm <sup>2</sup> s <sup>-1</sup>
$D_{Li^+}$ (M-LCO-850 °C)	$5.66 \times 10^{-9}$ cm <sup>2</sup> s <sup>-1</sup>	$9 \times 10^{-9}$ cm <sup>2</sup> s <sup>-1</sup>	$1.13 \times 10^{-8}$ cm <sup>2</sup> s <sup>-1</sup>	$9.77 \times 10^{-9}$ cm <sup>2</sup> s <sup>-1</sup>