Electronic Supplementary Material (ESI) for Sustainable Energy & Fuels.

Supplementary Information

Optimal synthetic condition for a novel and high performance Ni-rich cathode material of $LiNi_{0.68}Co_{0.10}Mn_{0.22}O_2$

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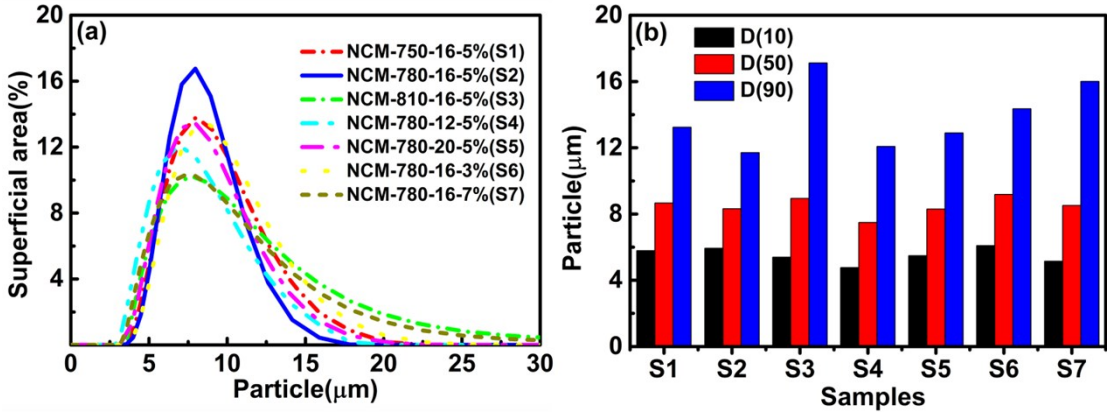

Figure S1 Laser particle size analysis of the $LiNi_{0.68}Co_{0.10}Mn_{0.22}O_2$ cathode materials synthesized under different conditions, (a) the normal distribution, and (b) the bar chart.

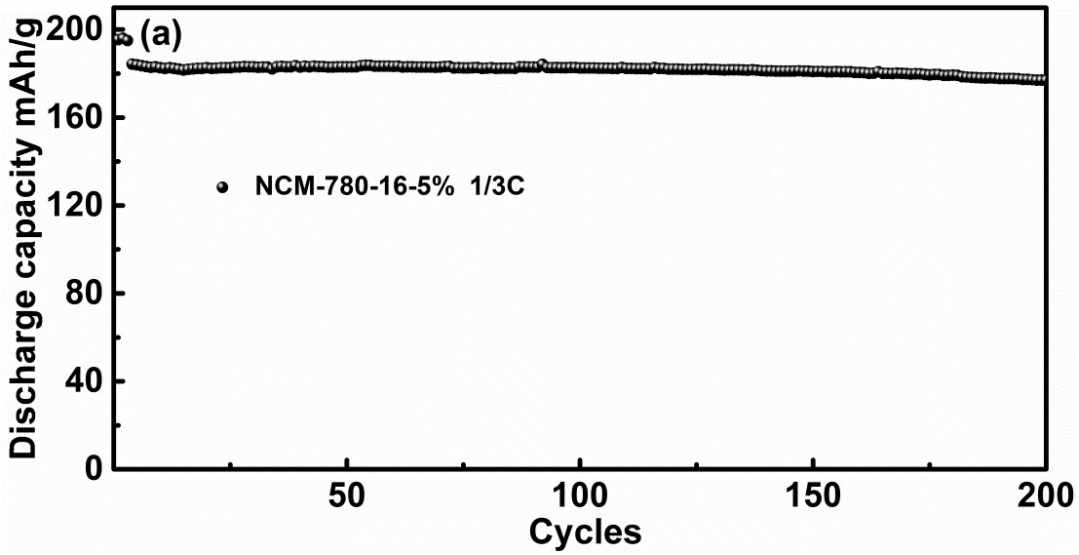

Figure S2 Cycling stability of the $LiNi_{0.68}Co_{0.10}Mn_{0.22}O_2$ cathode material synthesized with the optimized condition at the current rate of C/3. The electrode experienced the 3 formation cycles at C/10 before the long-term cycling testing.

Table S1. The I(003)/I(104) ratios of the $LiNi_{0.68}Co_{0.10}Mn_{0.22}O_2$ products prepared at different calcining temperature (750 ºC, 780 ºC and 810 ºC) with the fixed calcining time of 16 h and excess lithium (Li) amount of 5%.

Samples	I(003)/I(104)
NCM-750-16-5%	1.206
NCM-780-16-5%	1.339
NCM-810-16-5%	1.318

Table S2. The I(003)/I(104) ratios of the $LiNi_{0.68}Co_{0.10}Mn_{0.22}O_2$ products prepared at different calcining time (12 h, 16 h and 20 h) with the fixed calcining temperature of 780 ºC and excess lithium (Li) amount of 5%.

Samples	I(003)/I(104)
NCM-780-12-5%	1.212
NCM-780-16-5%	1.339
NCM-780-20-5%	1.346

Table S3. The I(003)/I(104) ratios of the $LiNi_{0.68}Co_{0.10}Mn_{0.22}O_2$ products prepared with different excess Li amount (3%, 5% and 7%, molar percent) with the fixed calcining temperature of 780 ºC and calcining time of 16 h.

Samples	I(003)/I(104)
NCM-780-16-3%	1.151
NCM-780-16-5%	1.339
NCM-780-16-7%	1.247

Table S4. The initial Coulombic efficiency of the $LiNi_{0.68}Co_{0.10}Mn_{0.22}O_2$ cathode materials synthesized under different conditions.

Samples	Initial Coulombic efficiency
NCM-750-16-5%	81.1%
NCM-780-16-5%	85.1%
NCM-810-16-5%	85.7%
NCM-780-12-5%	82.8%
NCM-780-20-5%	81.5%
NCM-780-16-3%	82.5%
NCM-780-16-7%	82.8%

Table S5. The calculated D_{Li}^+ of the corresponding electrodes as shown in Figure S2.

Sample	NCM-780-16-5%	NCM-810-16-5%	NCM-780-20-5%
cycles	D_{Li}^+ ($cm^2\ s^{-1}$)	D_{Li}^+ ($cm^2\ s^{-1}$)	D_{Li}^+ ($cm^2\ s^{-1}$)
10^{th}	$3.83*10^{-8}$	$2.62*10^{-8}$	$2.45*10^{-8}$
30^{th}	$1.80*10^{-8}$	$8.01*10^{-9}$	$1.19*10^{-8}$
60^{th}	$1.73*10^{-8}$	$4.41*10^{-9}$	$4.42*10^{-9}$
100^{th}	$1.51*10^{-8}$	$7.32*10^{-9}$	$9.78*10^{-9}$