

Electronic Supplementary Information for

Novel grain restraint strategy to synthesize highly crystallized $\text{Li}_4\text{Ti}_5\text{O}_{12}$ (~20 nm) for lithium ion batteries with superior high-rate performance

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Table S1. Rietveld refinement of XRD data for NC-LTO calcined at 750 °C.

Formula		Li ₄ Ti ₅ O ₁₂				
Crystal system		Cubic spinel				
Space group		<i>FD-3m</i>				
Site	Atom	x	y	z	Occupancy	B/Å ²
8a	Li ₁	0	0	0	1	1.78(36)
16d	Li ₂	5/8	5/8	5/8	0.1661	1.78(36)
16d	Ti ₁	5/8	5/8	5/8	0.8333	0.88(11)
32e	O ₁	0.3882	0.3382	0.3882	1	0.98(5)
Cell parameters		a = 0.8355 nm				
<i>R</i> _{wp} /%		9.1				
<i>R</i> _p /%		8.7				

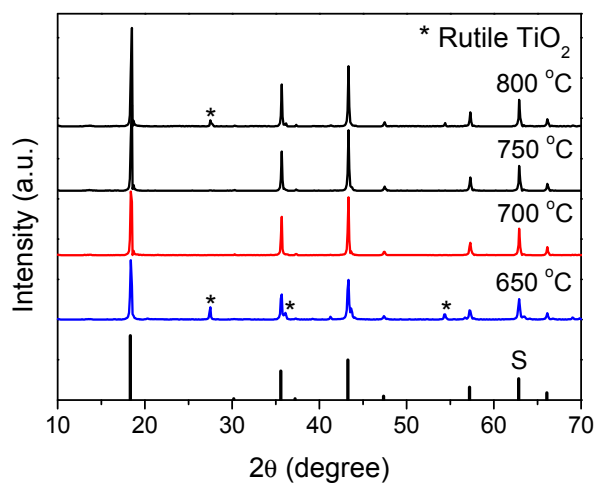


Fig. S1 XRD patterns of the standard spinel $\text{Li}_4\text{Ti}_5\text{O}_{12}$ (JCPDS Card No. 49-0207, noted as S) and the samples calcined at different temperatures in air.

Table S2. Comparison of rate performance for NC-LTO synthesized in this work with $\text{Li}_4\text{Ti}_5\text{O}_{12}$ reported in other literatures.

Material	Capacity (mAh g^{-1})			Reference
	1 C	10 C	20 C	
NC-LTO	168	155	139	In this paper
N doping $\text{Li}_4\text{Ti}_5\text{O}_{12}$	161	129		10
$\text{Li}_4\text{Ti}_5\text{O}_{12}$ /carbon nanotube	159	136	123	11
Nb doping $\text{Li}_4\text{Ti}_5\text{O}_{12}$	169		118	12
Ag doping $\text{Li}_4\text{Ti}_5\text{O}_{12}$	150			13
$\text{Li}_4\text{Ti}_5\text{O}_{12}$	80			14
Crystalline $\text{Li}_4\text{Ti}_5\text{O}_{12}$ nanostructure	160	120	100	15
$\text{Li}_4\text{Ti}_5\text{O}_{12}$ nanoparticle	150	104		16
$\text{Li}_4\text{Ti}_5\text{O}_{12}$ nanoparticle	140	100		17
Ordered macroporous $\text{Li}_4\text{Ti}_5\text{O}_{12}$	155			18
$\text{Li}_4\text{Ti}_5\text{O}_{12}/\text{TiO}_2$ nanocomposites	162	135		19
Microscale spherical $\text{Li}_4\text{Ti}_5\text{O}_{12}/\text{C}$	162	110		20
$\text{Li}_4\text{Ti}_5\text{O}_{12}/\text{C}$	150	130	120	21
$\text{Li}_4\text{Ti}_5\text{O}_{12}/\text{C}$	150	129		22

Table S3. Impedance fitting results of NC-LTO and Bulk-LTO electrodes.

Sample	R_e	CPE		R_{ct}	Z_w
		Y_0	n		
NC-LTO	5.1	4.9E-5	0.894	24.9	0.037
Bulk-LTO	5.8	5.1E-5	0.906	150.6	0.028

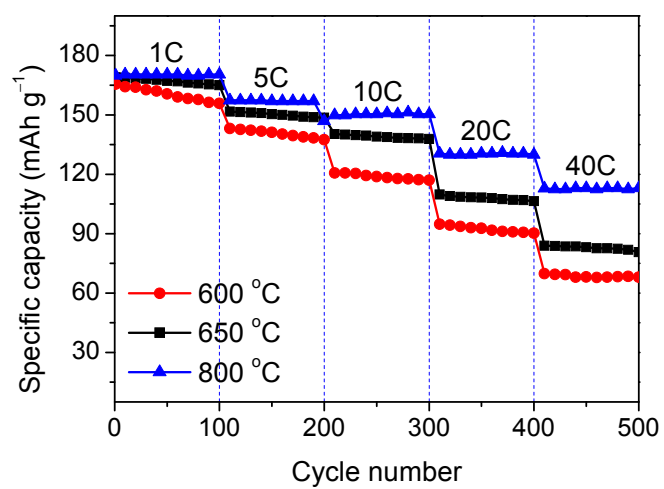


Fig. S2 Plots of discharge capacity versus cycle number for $\text{Li}_4\text{Ti}_5\text{O}_{12}$ calcined at 650 °C, 700 °C and 800 °C at different current rates (1 C, 5 C, 10 C, 20 C and 40 C).