

Supplementary Information

Fusing Ta-Doped $\text{Li}_7\text{La}_3\text{Zr}_2\text{O}_{12}$ Grains by Nanoscale Y_2O_3 Sintering Aids for High-Performance Solid-State Lithium Batteries

Hongyi Zhang^{a,1}, Yunfan Wu^{a,1}, Jie Zhu^a, Xujia Xie^a, Zixi Liu^a, Zewenhui Zhang^a, Yishu Ma^a, Ting Huang^a, Laisen Wang^a, Jie Lin^{a,*}, Qingshui Xie^{a,*}, Dong-Liang Peng^{a,*}

^a College of Materials, Collaborative Innovation Center of Chemistry for Energy Materials, State Key Laboratory for Physical Chemistry of Solid Surfaces, Fujian Key Laboratory of Surface and Interface Engineering for High Performance Materials, Xiamen University, Xiamen, Fujian, 361005, China

¹These two authors contributed equally to this work.

*Corresponding authors: linjie@xmu.edu.cn; xieqsh@xmu.edu.cn; dlpeng@xmu.edu.cn

Table S1. Stoichiometries of LLZTO pellets obtained from ICP-OES Tests.

Samples	Li	La	Zr	Ta	Y	Stoichiometries
LLZTO-P	7.30	3.27	1.54	0.19	0.00	$\text{Li}_{7.3}\text{La}_{3.27}\text{Zr}_{1.54}\text{Ta}_{0.19}\text{O}_{12}$
LLZTO-1%NYO	6.83	3.23	1.54	0.23	0.08	$\text{Li}_{6.83}\text{La}_{3.23}\text{Zr}_{1.54}\text{Ta}_{0.23}\text{Y}_{0.08}\text{O}_{12}$
LLZTO-2%NYO	6.76	3.21	1.53	0.26	0.13	$\text{Li}_{6.76}\text{La}_{3.21}\text{Zr}_{1.53}\text{Ta}_{0.26}\text{Y}_{0.13}\text{O}_{12}$
LLZTO-5%NYO	6.84	3.19	1.52	0.30	0.22	$\text{Li}_{6.84}\text{La}_{3.19}\text{Zr}_{1.52}\text{Ta}_{0.30}\text{Y}_{0.22}\text{O}_{12}$
LLZTO-10%NYO	7.08	3.13	1.57	0.30	0.65	$\text{Li}_{7.08}\text{La}_{3.13}\text{Zr}_{1.57}\text{Ta}_{0.30}\text{Y}_{0.65}\text{O}_{12}$

Table S2. Size data for measuring relative density.

Samples	Quality (mg)	Thickness (mm)	Diameter (mm)	Density (g cm^{-3})	Relative density (%)
LLZTO-P	839.65	1.50	12.10	4.87	90.87
LLZTO-1%NYO	843.08	1.52	12.08	4.84	90.34
LLZTO-2%NYO	813.98	1.44	12.08	4.93	92.06
LLZTO-5%NYO	777.16	1.42	11.64	5.15	96.00
LLZTO-10%NYO	495.08	1.08	11.56	4.37	81.53

Table S3. Comparison of ionic conductivity with reported LLZTO electrolytes.

Composition	Conductivity (S cm^{-1})	Synthesis method	Reference
$\text{Li}_{6.4}\text{La}_3\text{Zr}_{1.4}\text{Ta}_{0.6}\text{O}_{12}$	6.1×10^{-4}	Molten salt synthesis	1
10 mol% Al_2O_3 + $\text{Li}_{6.4}\text{La}_3\text{Zr}_{1.4}\text{Ta}_{0.6}\text{O}_{12}$	3.1×10^{-4}	Al_2O_3 sintering additive	2
5 wt% MgO + $\text{Li}_{6.4}\text{La}_3\text{Zr}_{1.4}\text{Ta}_{0.6}\text{O}_{12}$	5.2×10^{-4}	MgO sintering additive	3
6 wt% MgO + $\text{Li}_{6.4}\text{La}_3\text{Zr}_{1.4}\text{Ta}_{0.6}\text{O}_{12}$	5.17×10^{-4}	MgO sintering additive	4
1 mol% SiO_2 + $\text{Li}_{6.4}\text{La}_3\text{Zr}_{1.4}\text{Ta}_{0.6}\text{O}_{12}$	3.84×10^{-4}	SiO_2 sintering additive	5
SnO_2 coated $\text{Li}_{6.4}\text{La}_3\text{Zr}_{1.4}\text{Ta}_{0.6}\text{O}_{12}$	1.6×10^{-3}	Hot pressing and coating	6
$\text{Li}_{6.84}\text{La}_{3.19}\text{Zr}_{1.52}\text{Ta}_{0.30}\text{Y}_{0.22}\text{O}_{12}$	7.39×10^{-4}	Y_2O_3 sintering additive	This work

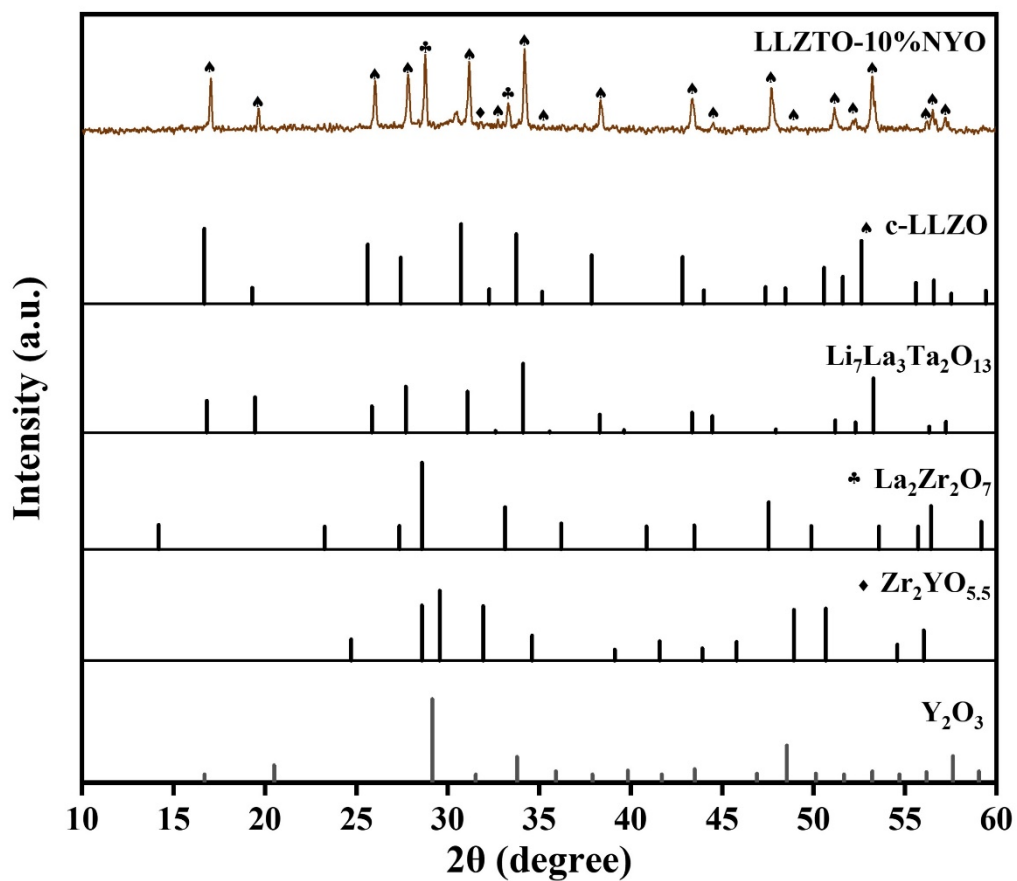


Figure S1. XRD patterns of LLZTO-10%NYO powder.

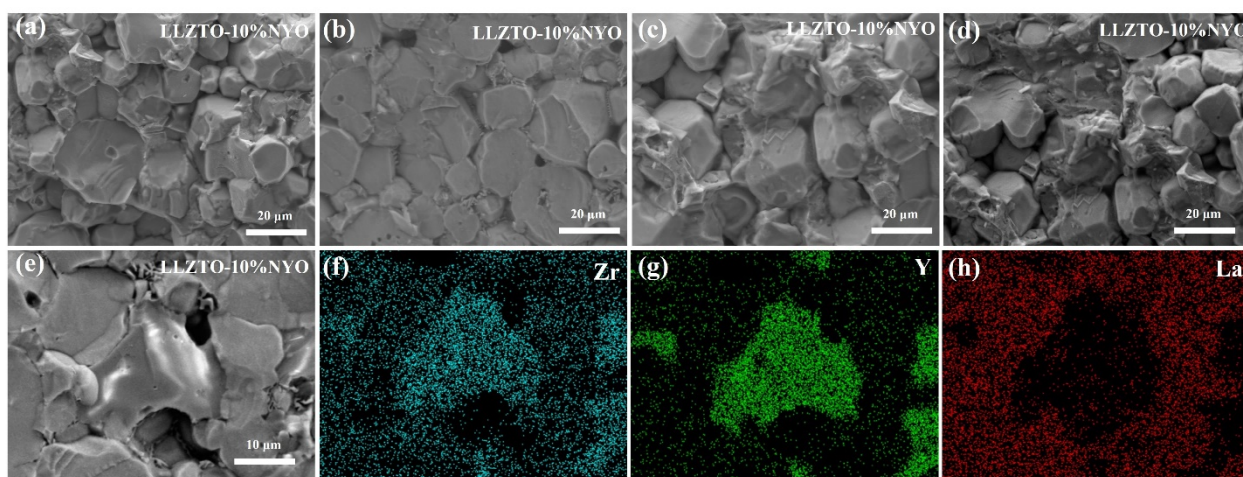


Figure S2. Cross-section SEM images (a-d) and elemental mappings (e-h) of LLZTO-10%NYO.

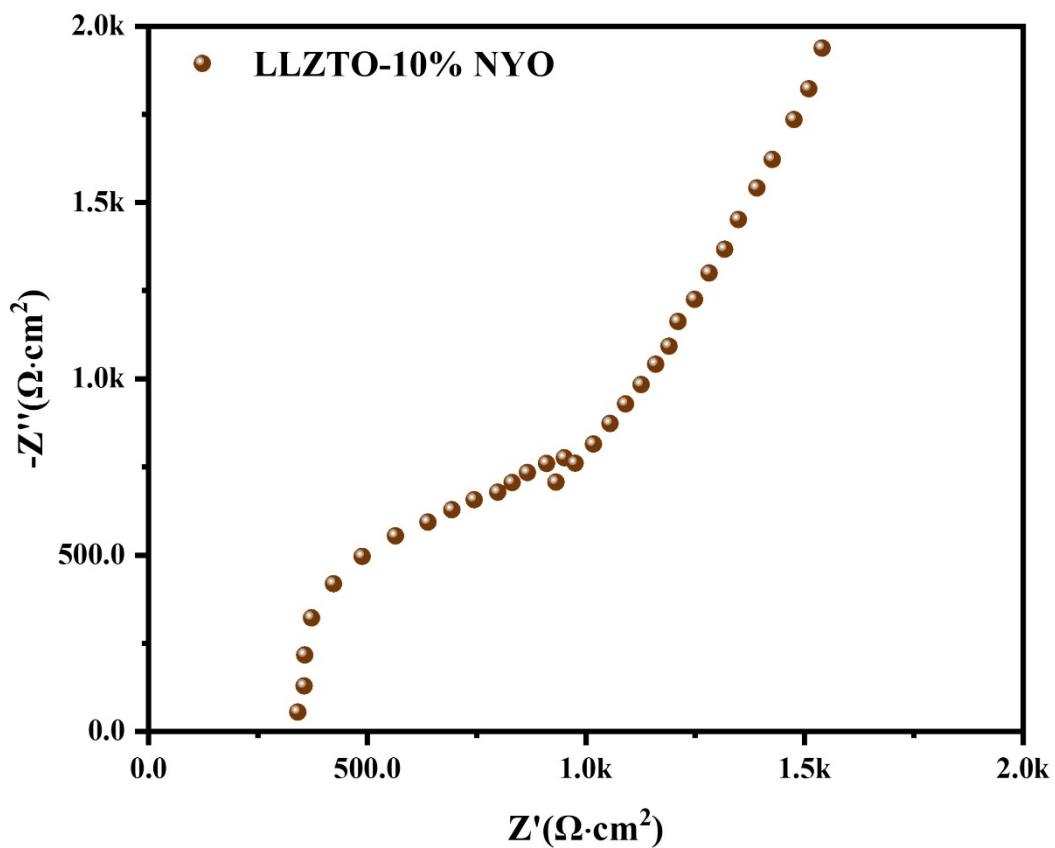


Figure S3. EIS plots of Ag|LLZTO-10%NYO|Ag cell.

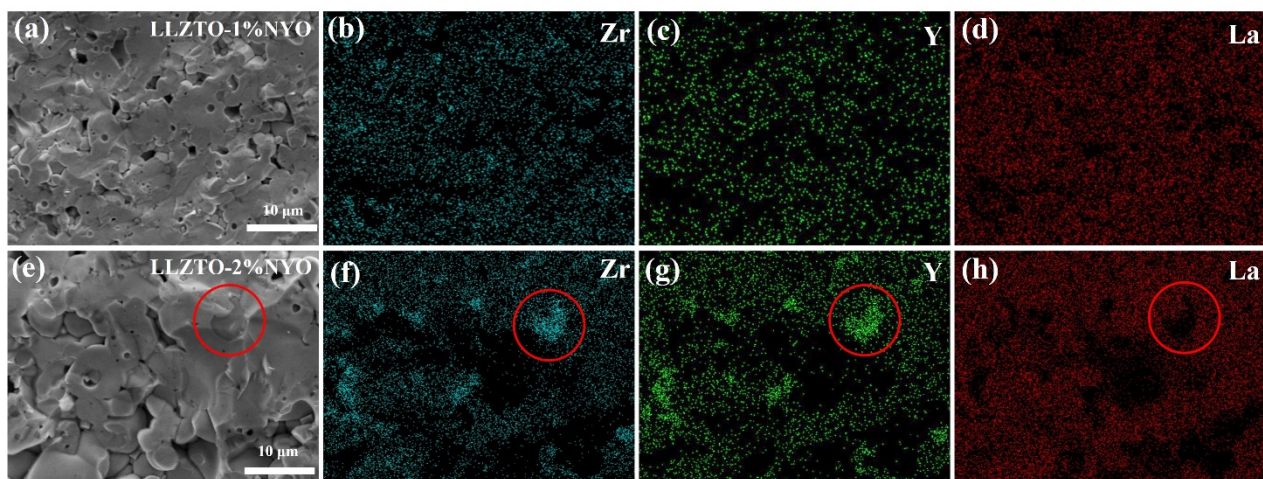


Figure S4. Elemental mappings of (a-d) LLZTO-1%NYO and (e-h) LLZTO-2%NYO pellets.

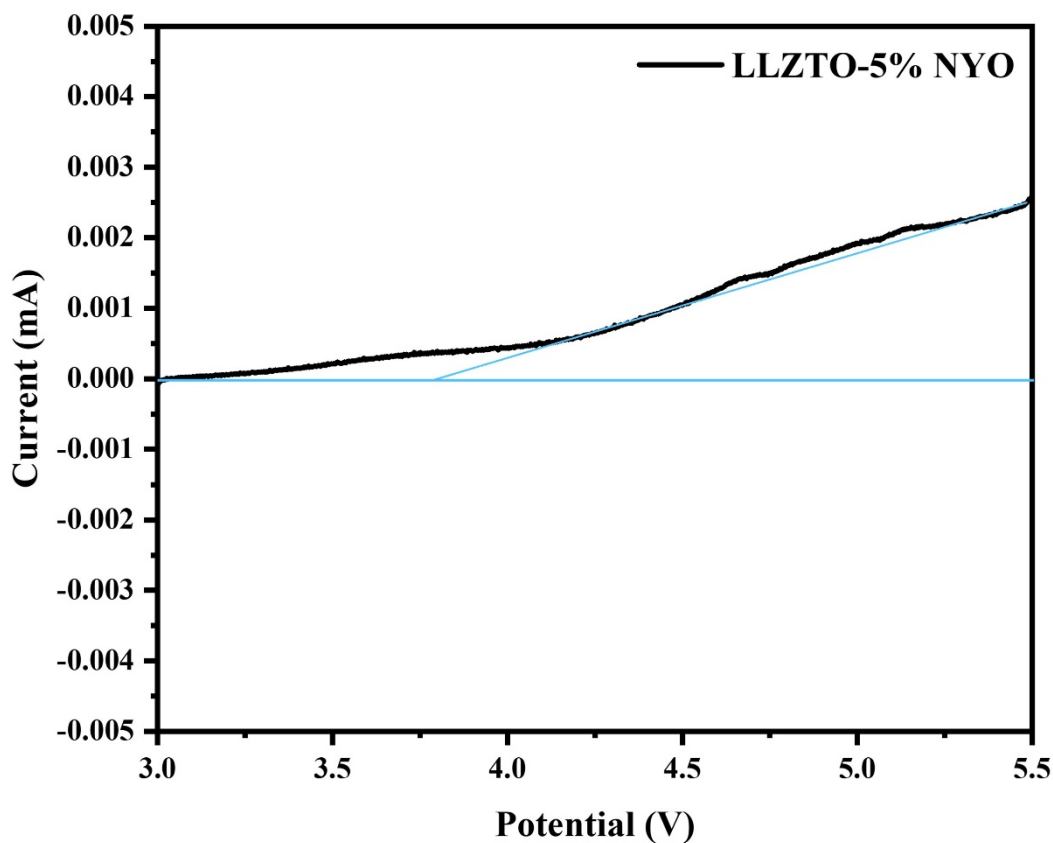


Figure S5. Linear scanning voltammetry (LSV) curve of SS|LLZTO-5%NYO|Li cell.

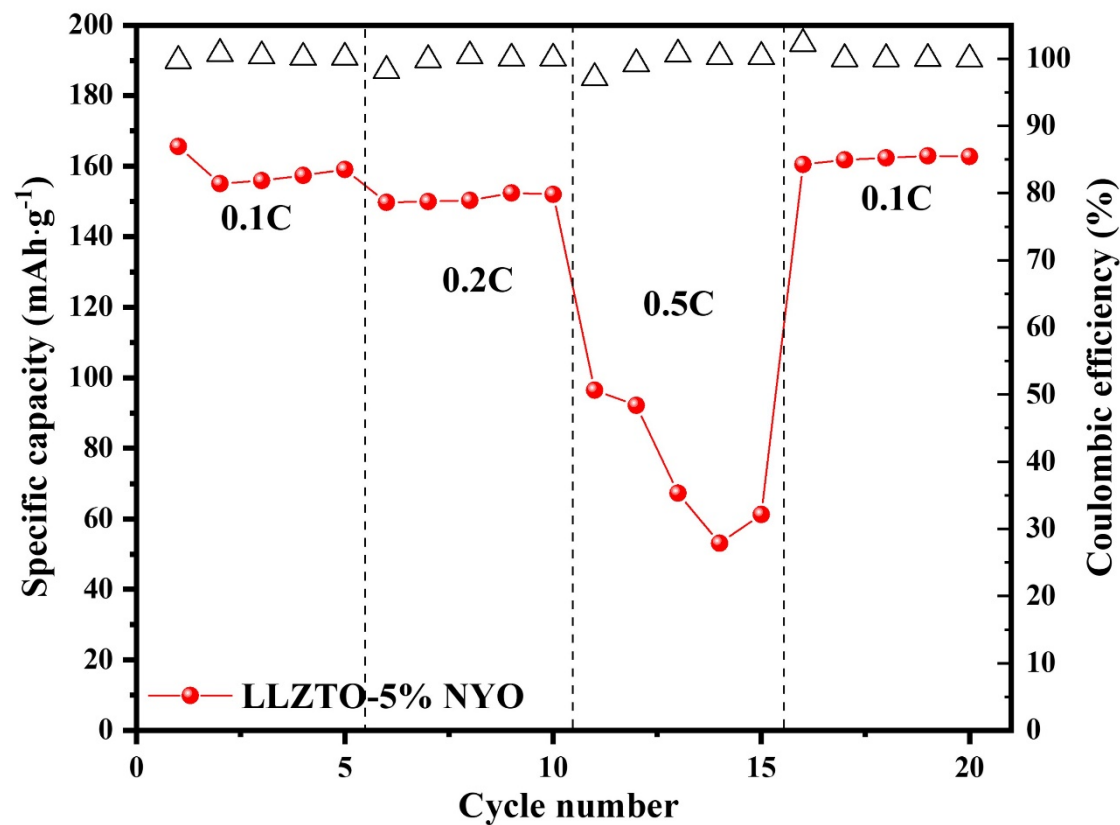


Figure S6. Rate Capability of LiFePO₄|LLZTO-5%NYO|Li full cell.

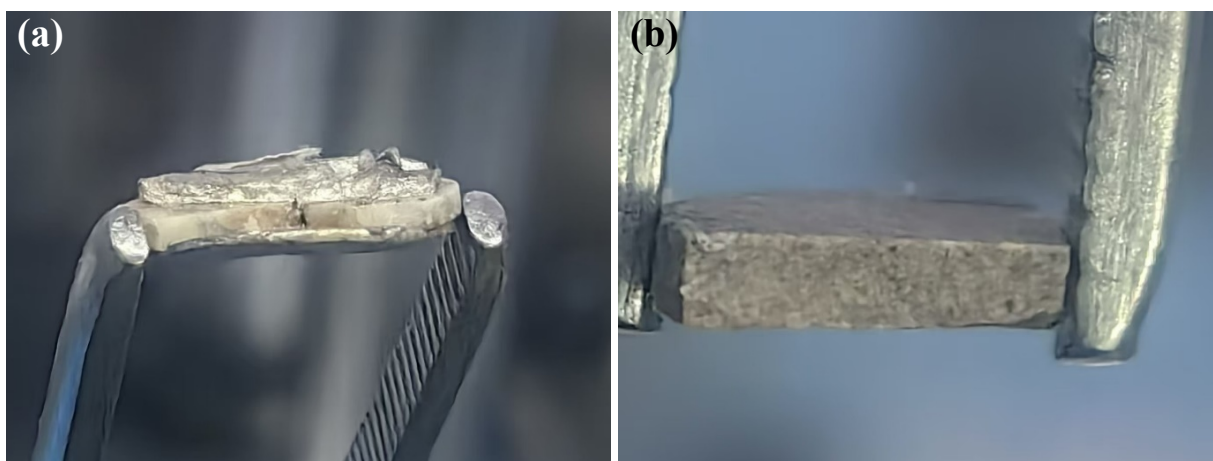


Figure S7. Cross section photos of (a) LLZTO-P and (b) LLZTO-5%NYO pellets after cycling.

References

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