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Supplementary Information

Spray-Flame Synthesis (SFS) and Characterization of $Li_{1.3}Al_{0.3-x}Y_xTi_{1.7}(PO_4)_3$ [LA(Y)TP] Solid Electrolytes

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Table S1. Rietveld analysis of XRD of as-synthesized samples.

Samples	Anatase1 (9852) (wt%)	Size (nm)	Anatase2 (9852) (wt%)	Size (nm)	Rutile (9161) (wt%)	Size (nm)
LATP	53.2	18.4	40.9	89.5	5.8	68.8
$LAY_{0.01}TP$	25.6	20.6	64.3	95	10.2	60
$LAY_{0.05}TP$	23.2	32.7	60.7	52.5	16.03	49.5
$LAY_{0.1}TP$	45.3	35.6	30.7	56.2	23.9	56.1
$LAY_{0.15}TP$	43	7.6	26.6	26.6	30.4	46.1

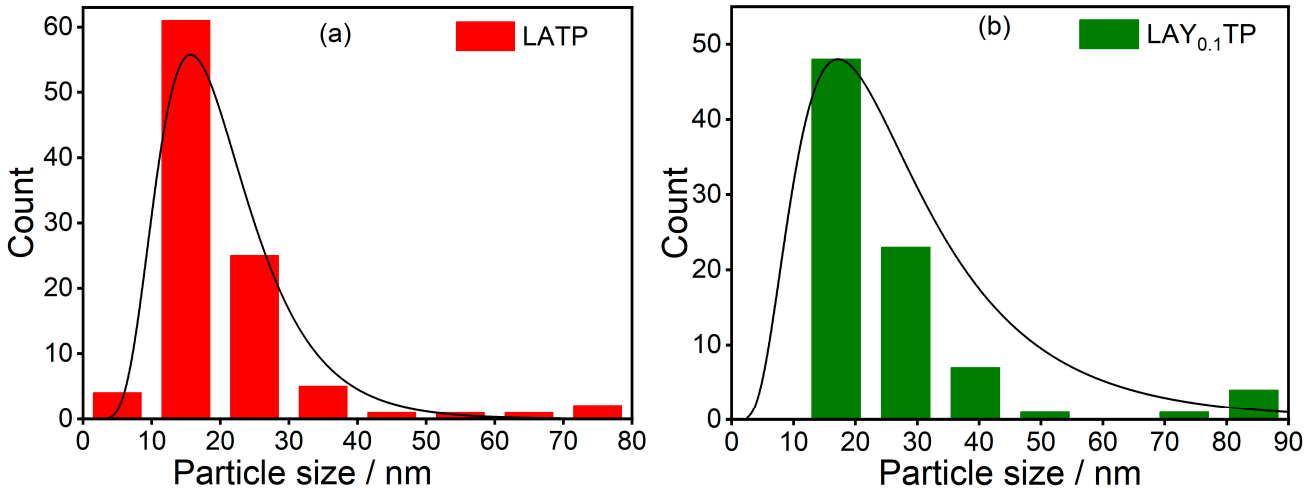


Figure S1. Particle-size distribution of (a) LATP (average particle size: 15.6 nm) and (b) $LAY_{0.1}TP$ (average particle size: 17.4 nm) as-synthesized samples.

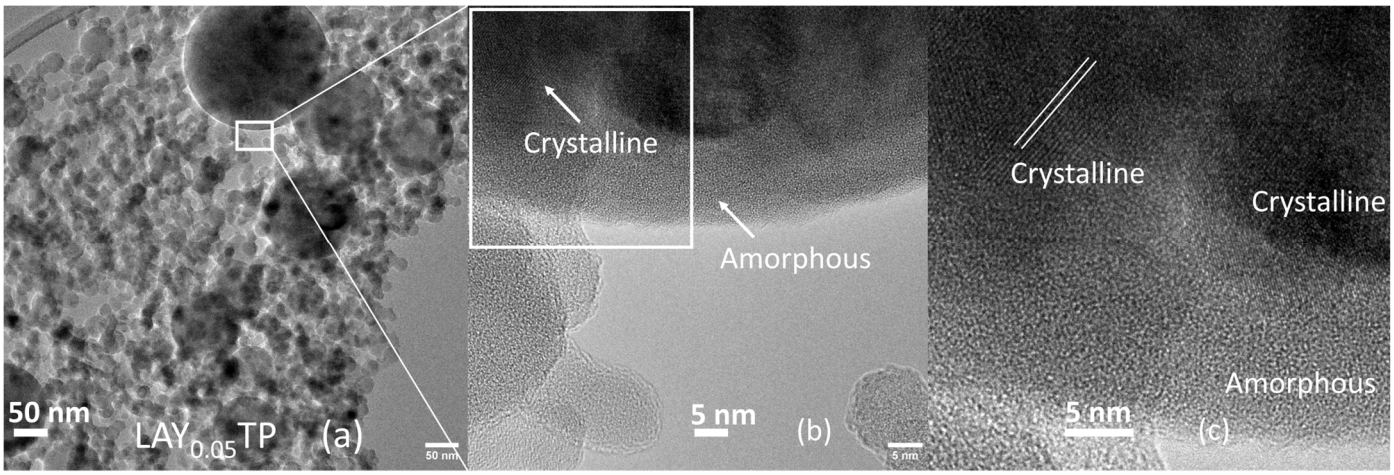


Figure S2. TEM (a) and HRTEM (b) image of $LAY_{0.05}TP$ nanoparticles. The (b) image shows the zoomed image of (a). The marked big (~ 300 nm) spherical particle has multiple crystalline small particles attached to its surface. One of these nanoparticles' crystalline fringes (A-TO or R-TO) are marked in (c).

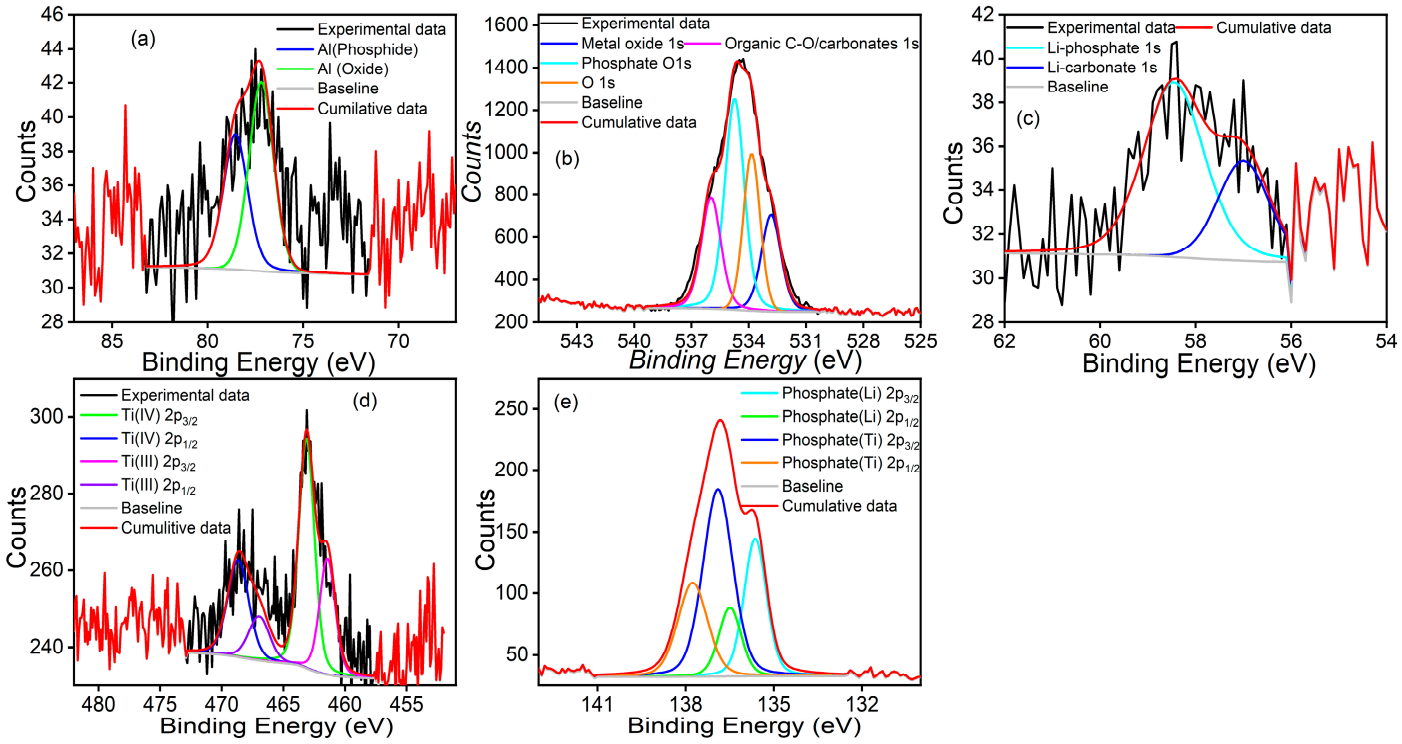


Figure S3. (a), (b), (c), (d), and (e) show the XPS spectra of Al 2p, O 1s, Li 1s, Ti 2p, and P 2p, respectively, of the LAYTP sample.

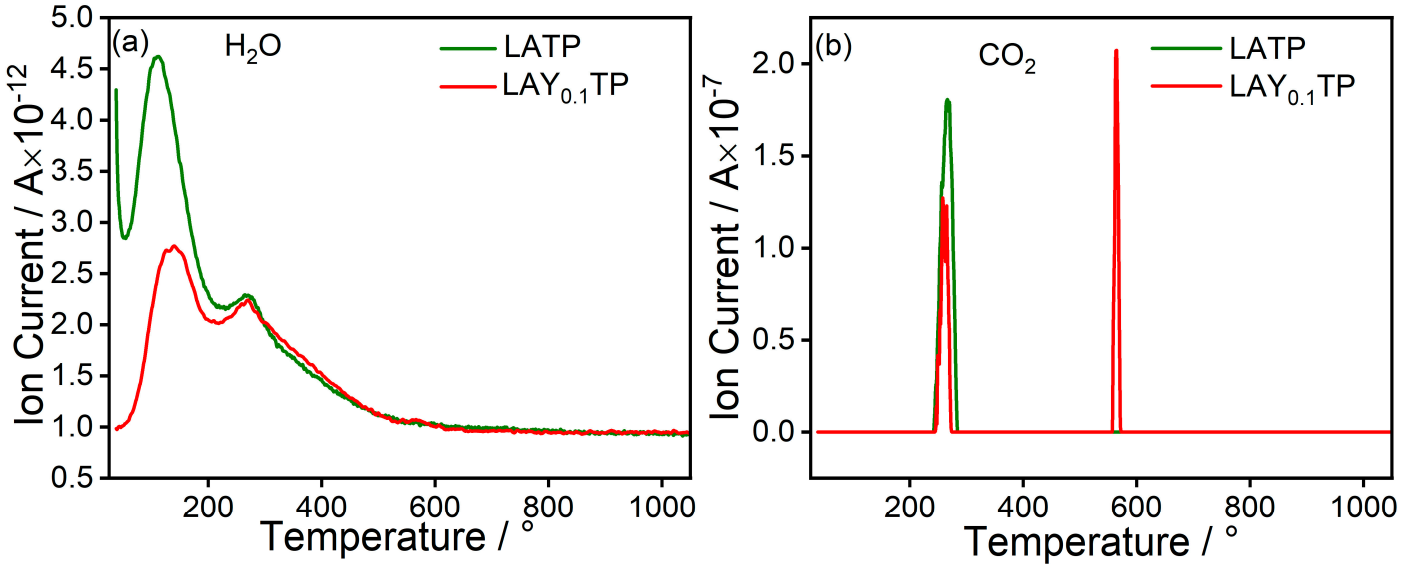


Figure S4. TGA-QMS signal of (a) H_2O, (b) CO_2 released during TGA experiment of doped and undoped samples.

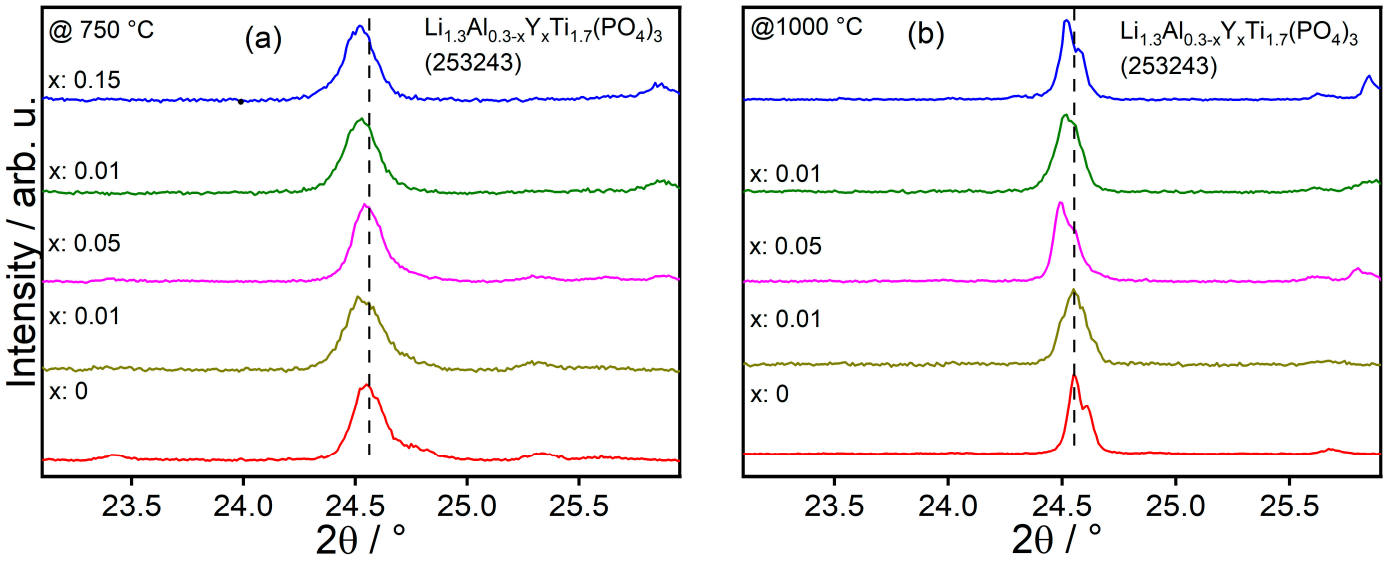
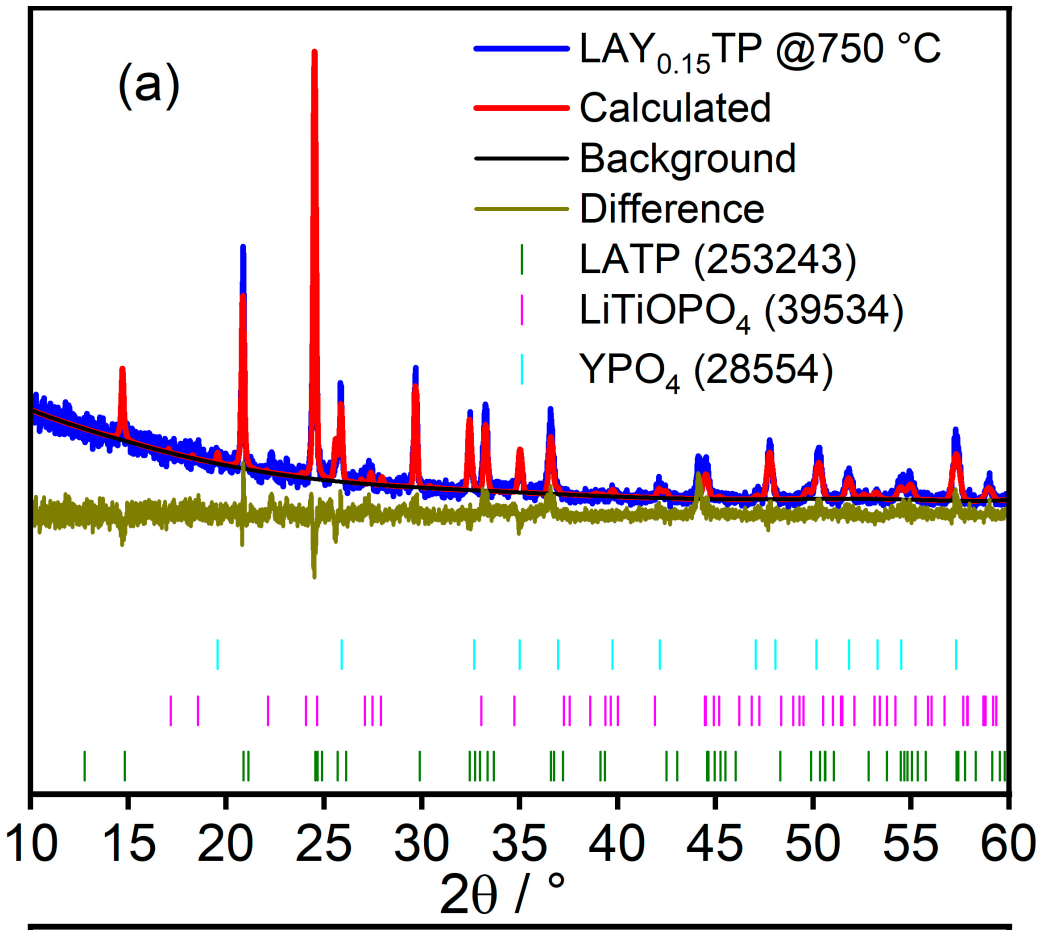


Figure S5. (a) & (b) shows the comparison XRD (in between 2θ: 23 to 26) of calcined samples at 750 and 1000 °C, respectively.

Table S2. Phase fraction of calcined samples.

Sample		**Phase fraction (wt %)**		
	Calcination Temperature (°C)	**LATP (253243)**	**$LiTiOPO_4$ (39534)**	**YPO_4 (28554)**
Melting Temp.			1085 °C [1]	1995 °C [2]
LATP	750	89.8	10.2	--
	1000	71.2	27.3	--
$LAY_{0.01}TP$	750	83.9	16.1	--
	1000	68.2	31.8	--
$LAY_{0.05}TP$	750	89.4	8.6	2
	1000	57.7	38.6	3.7
$LAY_{0.1}TP$	750	83.8	10.3	5.9
	1000	71.5	22.2	6.3
$LAY_{0.15}TP$	750	87.1	3.7	9.1
	1000	69.1	22.5	8.4


(a)
LAY0.15TP @750 °C
Calculated
Background
Difference
LATP (253243)
LiTiOPO4 (39534)
YPO4 (28554)
10 15 20 25 30 35 40 45 50 55 60
2θ / °

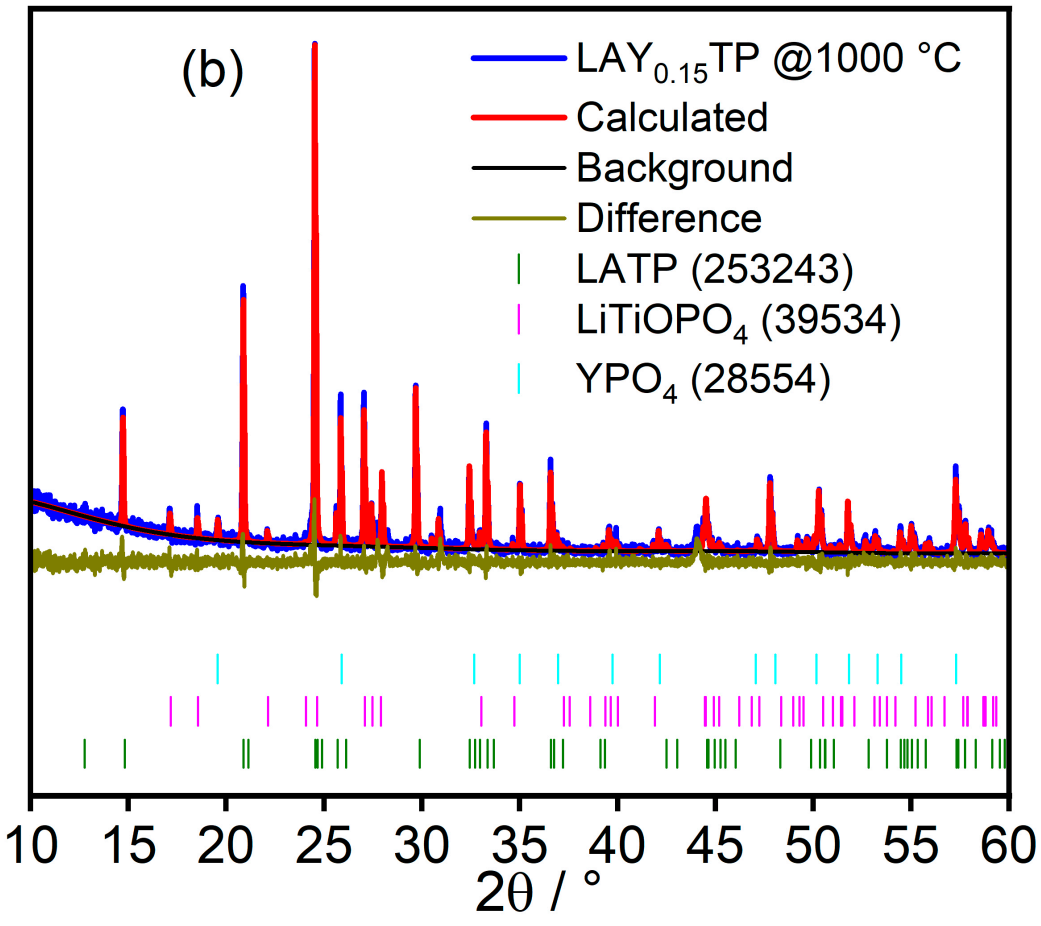

(b)
LAY0.15TP @1000 °C
Calculated
Background
Difference
LATP (253243)
LiTiOPO4 (39534)
YPO4 (28554)
10 15 20 25 30 35 40 45 50 55 60
2θ / °

Figure S6. Rietveld refinement of LAY0.15TP sample calcined at 750 (a) and 1000 °C (b), respectively.

Table S3. Literature comparison of doped LATP solid-electrolyte.

Sample	temperature (°C)	Time (h)	Single step	Ionic conductivity (mS/cm)	Year	Ref.
W-doped LATP	850	4	×	1.186	2024	[3]
Si-doped LATP	900	6	×	0.00169	2022	[4]
LATP	1050 (SPS)	0.083	×	1.0	2020	[5]
B doped LATP	900	5	×	0.24	2024	[6]
Ga doped LATP	1100	5	×	~1	2016	[7]
Ga doped LATP	230[í]	48	×	0.23	2019	[8]
Zr doped LATP	900	6	×	0.023	2020	[9]
B doped LATP	1200	1	yes	0.12	2020	[10]
Sn doped LATP	900	6	×	0.47	2022	[11]
Y doped LATP	750	1	×	0.84	this work	

SPS: Spark plasma synthesis; Í: Autoclave hydrothermal reaction

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