Electronic Supplementary Information (ESI) for:

High performing $Y_3H_5P_6O_{22}$ and $Er_3H_5P_6O_{22}$ proton conductors: Preparation and Conductivity Study

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Table S1 – Indexing powder X-ray diffraction (PXRD) data of the EHPO compound.

h	***k***	***l***	$2\theta_{obs}$	$2\theta_{calc}$	d_{calc}, Å	***I*, %**
0	0	2	10.022	10.023	8.8181	4
1	0	1	13.705	13.711	6.4535	30
1	0	3	19.789	19.786	4.4836	25
0	0	4	20.134	20.127	4.4082	25
1	1	2	20.712	20.713	4.2850	20
2	0	0	25.678	25.676	3.4668	100
1	1	4	27.163	27.183	3.2779	4
1	0	5	28.379	28.372	3.1432	80
2	1	1	29.222	29.220	3.0539	10
2	1	3	32.628	32.626	2.7425	6
2	0	4	32.841	32.841	2.7249	9
1	1	6	35.597	35.590	2.5205	35
2	2	0	36.628	36.630	2.4513	20
1	0	7	37.983	37.977	2.3674	4
2	1	5	38.636	38.636	2.3285	13
3	0	1	39.292	39.286	2.2915	6
1	1	7	40.201	40.220	2.2404	4
0	0	8	40.915	40.915	2.2039	10
3	0	3	41.972	41.974	2.1508	15
3	1	2	42.451	42.451	2.1277	18
2	1	7	46.412	46.410	1.9550	4
3	0	5	46.972	46.971	1.9329	20
3	2	1	47.526	47.527	1.9117	5
1	0	9	48.236	48.235	1.8852	15
2	0	8	48.934	48.935	1.8598	8
3	2	3	49.858	49.857	1.8276	10
3	1	6	52.002	51.999	1.7572	35
4	0	0	52.766	52.772	1.7333	15
3	2	5	54.295	54.296	1.6882	10
2	1	9	55.438	55.437	1.6561	10
2	2	8	56.062	56.072	1.6389	3
4	1	3	56.914	56.912	1.6166	4
4	0	4	57.052	57.051	1.6130	4
3	3	2	57.293	57.294	1.6068	6
1	0	11	59.111	59.112	1.5616	6
4	2	0	59.585	59.588	1.5503	8
4	1	5	60.999	60.998	1.5178	6
3	0	9	62.064	62.059	1.4943	5
0	0	12	63.240	63.241	1.4692	2
4	2	4	63.576	63.568	1.4625	3
3	3	6	65.281	65.282	1.4281	9
2	1	11	65.499	65.506	1.4238	10
5	0	1	67.740	67.731	1.3823	3
3	2	9	68.297	68.297	1.3723	5
4	0	8	68.859	68.861	1.3624	3

2	0	12	69.427	69.423	1.3527	4
5	0	3	69.613	69.610	1.3495	5

Table S2 – Indexing the powder X-ray diffraction (PXRD) data of the YHPO compound.

h	***k***	***l***	**$2\theta_{obs}$**	**$2\theta_{calc}$**	**d_{calc}, Å**	***I*, %**
0	0	2	10.026	10.023	8.8180	3
1	0	1	13.701	13.698	6.4593	15
1	0	3	19.774	19.763	4.4887	3
0	0	4	20.111	20.108	4.4125	45
1	1	2	20.683	20.685	4.2907	4
2	0	0	25.635	25.633	3.4724	100
1	1	4	27.128	27.144	3.2826	3
1	0	5	28.335	28.333	3.1474	90
2	1	1	29.164	29.169	3.0591	3
2	0	4	32.788	32.787	2.7293	6
1	1	6	35.532	35.535	2.5243	2
2	2	0	36.557	36.560	2.4558	10
1	0	7	37.923	37.919	2.3709	2
2	1	5	38.568	38.569	2.3324	7
3	0	1	39.210	39.209	2.2958	4
2	0	6	40.129	40.129	2.2452	3
0	0	8	40.851	40.853	2.2071	15
3	0	3	41.897	41.892	2.1548	10
3	1	2	42.366	42.367	2.1317	7
2	1	7	46.322	46.327	1.9583	2
3	0	5	46.875	46.880	1.9365	10
1	0	9	48.152	48.154	1.8881	25
2	0	8	48.847	48.848	1.8629	3
3	2	3	49.752	49.753	1.8311	4
3	1	6	51.893	51.895	1.7605	20
4	0	0	52.663	52.658	1.7368	10
3	2	5	54.181	54.182	1.6915	6
2	1	9	55.337	55.333	1.6590	6
3	3	2	57.165	57.167	1.6100	3
1	0	11	59.011	59.006	1.5642	6
4	2	0	59.451	59.452	1.5535	4
4	1	5	60.862	60.864	1.5208	3
3	0	9	61.937	61.934	1.4971	4
3	3	6	65.134	65.136	1.4310	5
2	1	11	65.362	65.378	1.4263	6
2	0	12	69.293	69.285	1.3551	2
5	0	3	69.457	69.444	1.3524	2

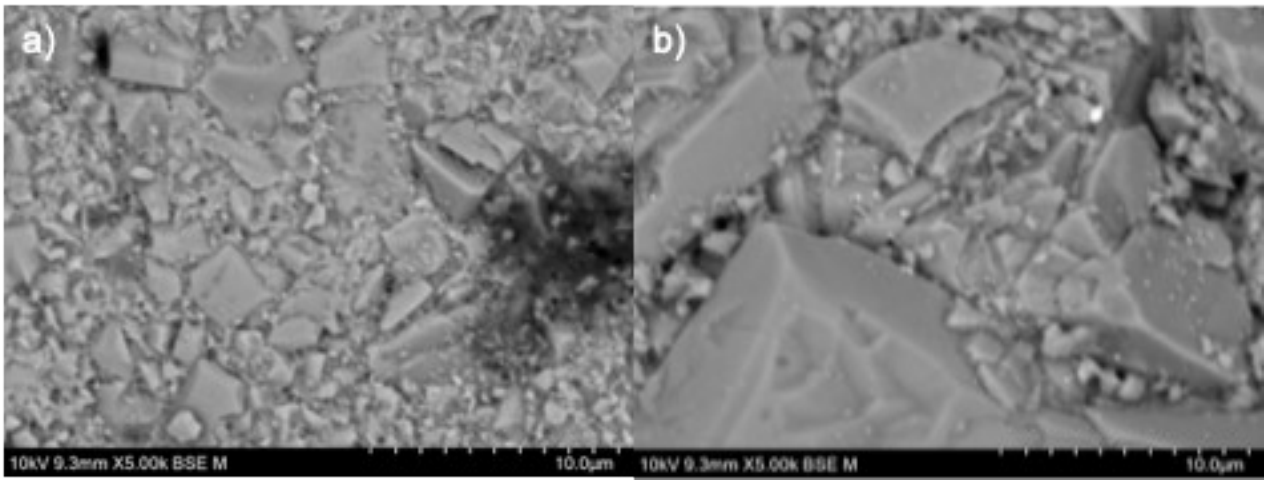

Figure S1 – Scanning electron microscopy (SEM) images obtained after cold sintering for a) EHPO and b) YHPO samples.

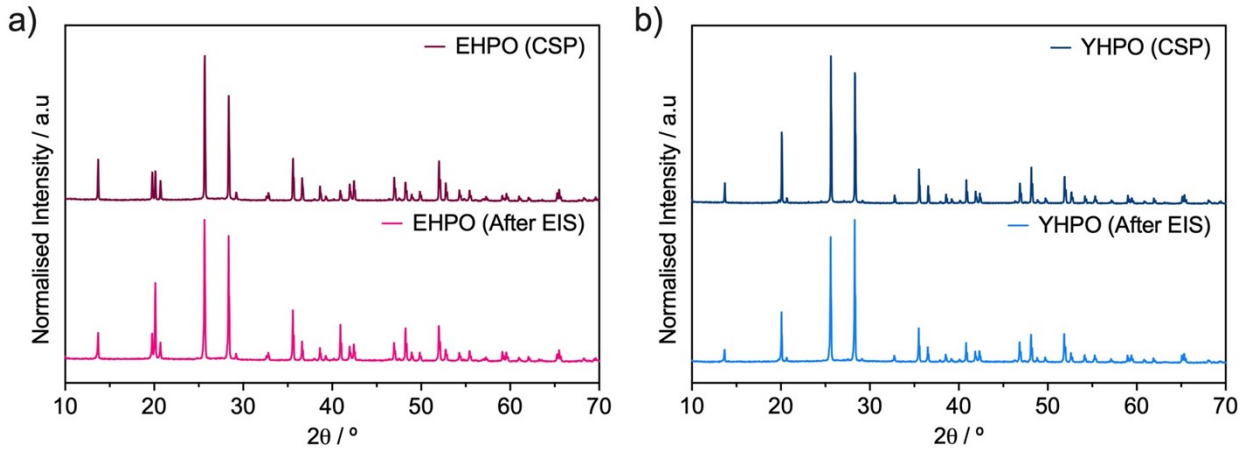

Figure S2 – Powder X-ray diffraction (PXRD) patterns obtained for the synthesised a) EHPO and b) YHPO compounds obtained after CSP, alongside with the patterns obtained for the samples after EIS measurements.