

Supporting information for

Effect of Boron Element in Li-P-S system

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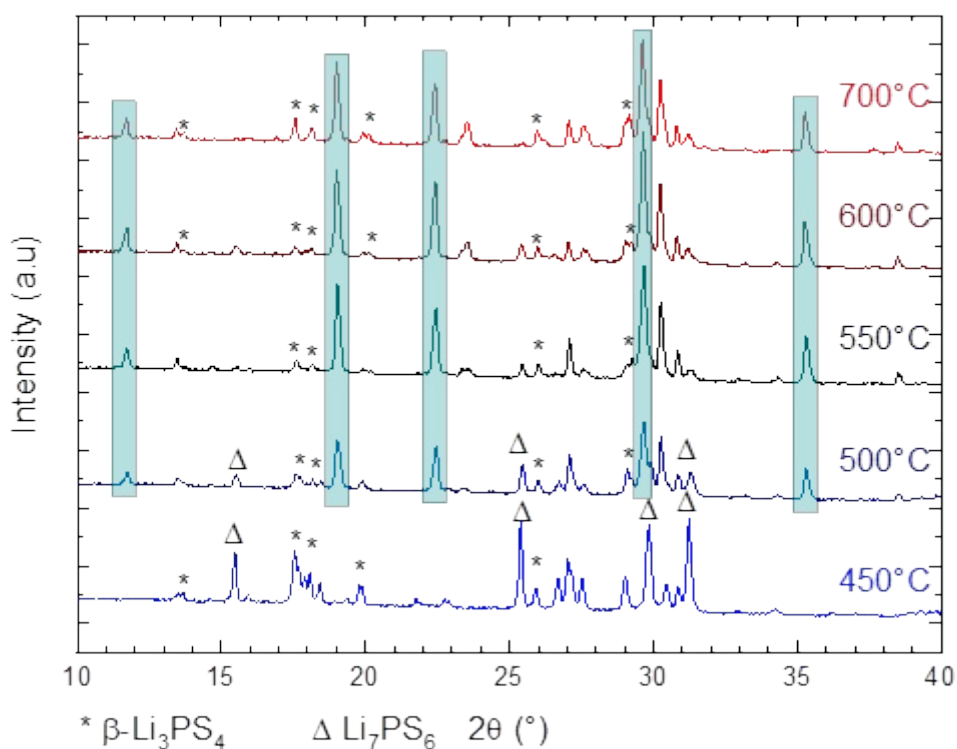


Figure S1. XRD patterns of the nominal chemical composition 0.6Li₃PS₄-0.4Li₃BS₃ at different annealing temperature between 450°C and 700°C. New peaks corresponding to the LGPS type structure are identified starting at 500°C (highlighted in blue), Impurities have been identified as: β-Li₃PS₄ (*) and Li₇PS₆ (Δ) phases.

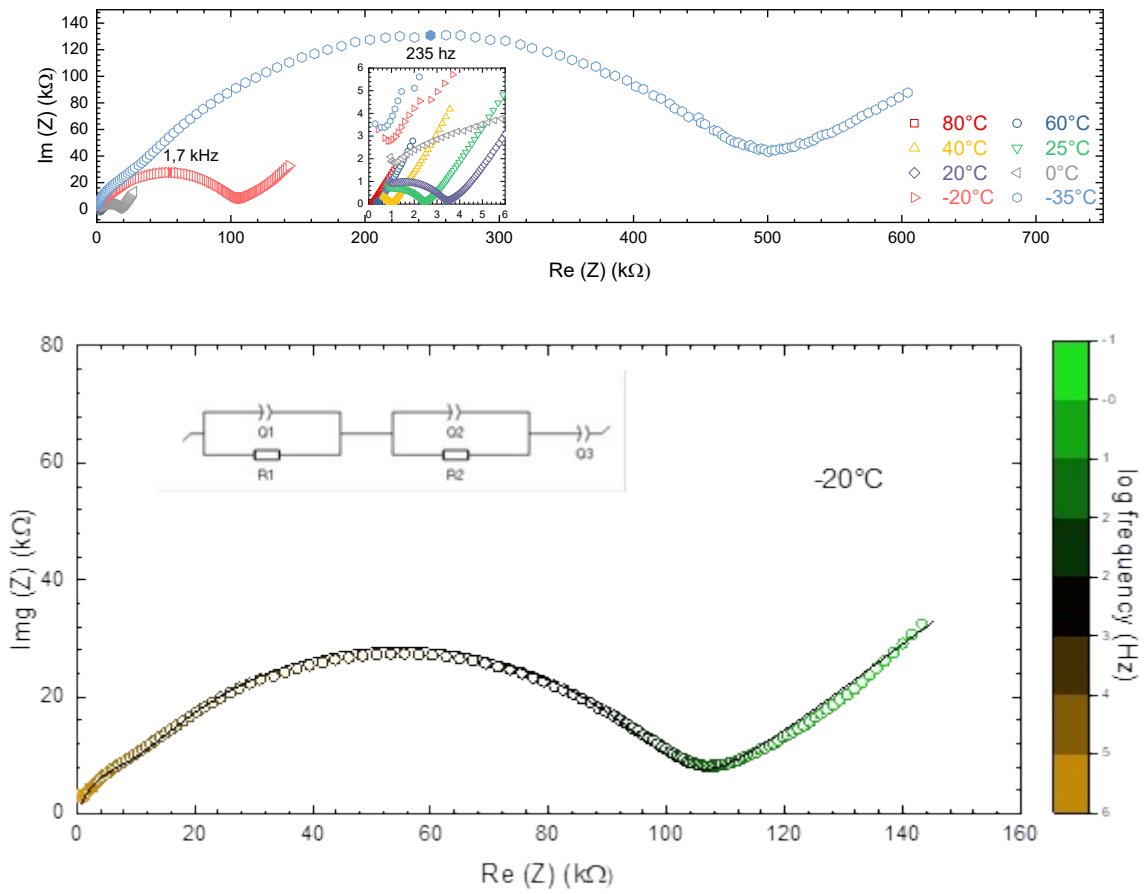


Figure S2. (a) Nyquist diagram of the sample $\text{Li}_3\text{P}_{0.6}\text{B}_{0.4}\text{S}_{3.6}$ at different temperature and (b) Fitted curve with the associated equivalent circuit for the Nyquist diagram at -20°C .

Table S1 Values from fitted diagram from sample $Li_3P_{0.6}B_{0.4}S_{3.6}$ at each temperature

Temperature	-35°C	-20°C	0°C	20°C
R1	9 245 Ohm (± 280)	3 167 Ohm (± 102)	N/A	N/A
Q1	0.534 9e-9 F.s ^(a-1) (± 6.2 e-11)	0.545 2e-9 F.s ^(a-1) (± 2.5 e-11)	N/A	N/A
a1	1	1	N/A	N/A
R2	459 394 Ohm (± 316)	100 862 Ohm (± 121)	16 643 Ohm (± 32.2)	3 607 Ohm (± 6.3)
Q2	20.14e-9 F.s ^(a-1) (± 6.2 e-11)	32.06e-9 F.s ^(a-1) (± 1.3 e-10)	69.52e-9 F.s ^(a-1) (± 3.0 e-9)	75.7 e-9 F.s ^(a-1) (± 5.2 e-9)
a2	0.639 (± 0.38 e-3)	0.622 (± 0.45 e-3)	0.574 (± 3.42 e-3)	0.585 (± 6.17 e-3)
Q3	7.498e-6 F.s ^(a-1) (± 2.1 e-8)	23.47e-6 F.s ^(a-1) (± 6.5 e-8)	75.77e-6 F.s ^(a-1) (± 0.38 e-6)	0.155 e-3 F.s ^(a-1) (± 0.42 e-6)
a3	0.361 (± 1.32 e-3)	0.414 (± 1.43 e-3)	0.5158 (± 1.11 e-3)	0.585 (± 1.61 e-3)

Temperature	25°C	40°C	60°C	80°C
R2	2 553 Ohm (± 8.0)	1 027 Ohm (± 3.2)	377 Ohm (± 1.17)	162 Ohm (± 1.27)
Q2	27.44e-9 F.s ^(a-1) (± 4.6 e-9)	45.52e-9 F.s ^(a-1) (± 4.71 e-9)	0.229e-6 F.s ^(a-1) (± 1.3 e-8)	N/A
a2	0.595 (± 4.8 e-3)	0.623 (± 6.5 e-3)	0.513 (± 0.18 e-3)	N/A
Q3	0.180e-3 F.s ^(a-1) (± 0.57 e-6)	0.277e-3 F.s ^(a-1) (± 0.59 e-6)	0.433e-3 F.s ^(a-1) (± 0.77 e-6)	0.607 e-3 F.s ^(a-1) (± 1.87 e-6)
a3	0.603 (± 2.2 e-3)	0.623 (± 1.3 e-3)	0.661 (± 0.97 e-3)	0.651 (± 1.63 e-3)

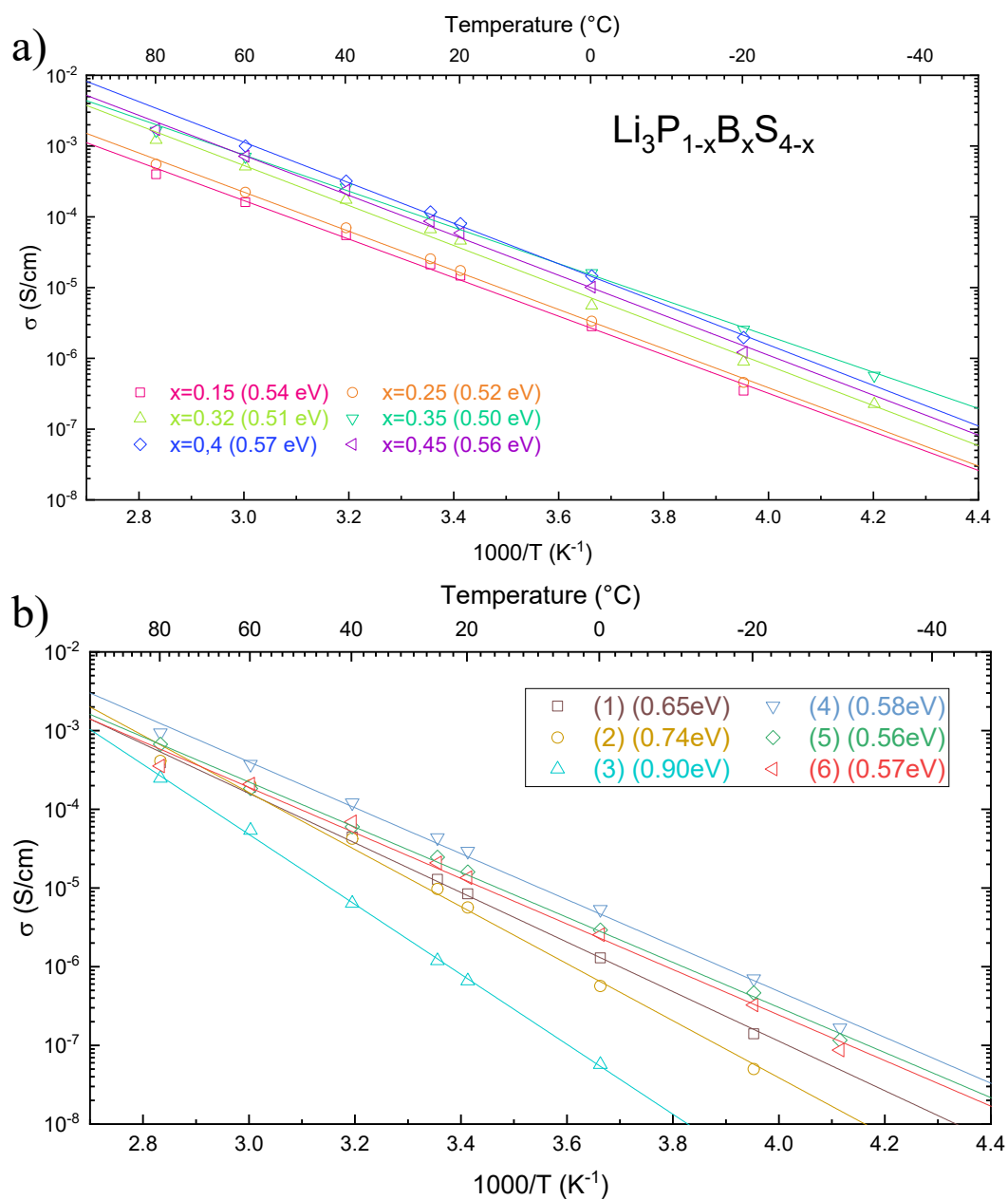


Figure S3. a) Arrhenius plot with associated activation energy of composition $Li_3P_{1-x}B_xS_{4-x}$ ($0.15 < x < 0.45$) in binary system, and b) Arrhenius plot with associated activation energy of compositions of the ternary $Li_2S-P_2S_5-B_2S_3$ system as given in the table 1.

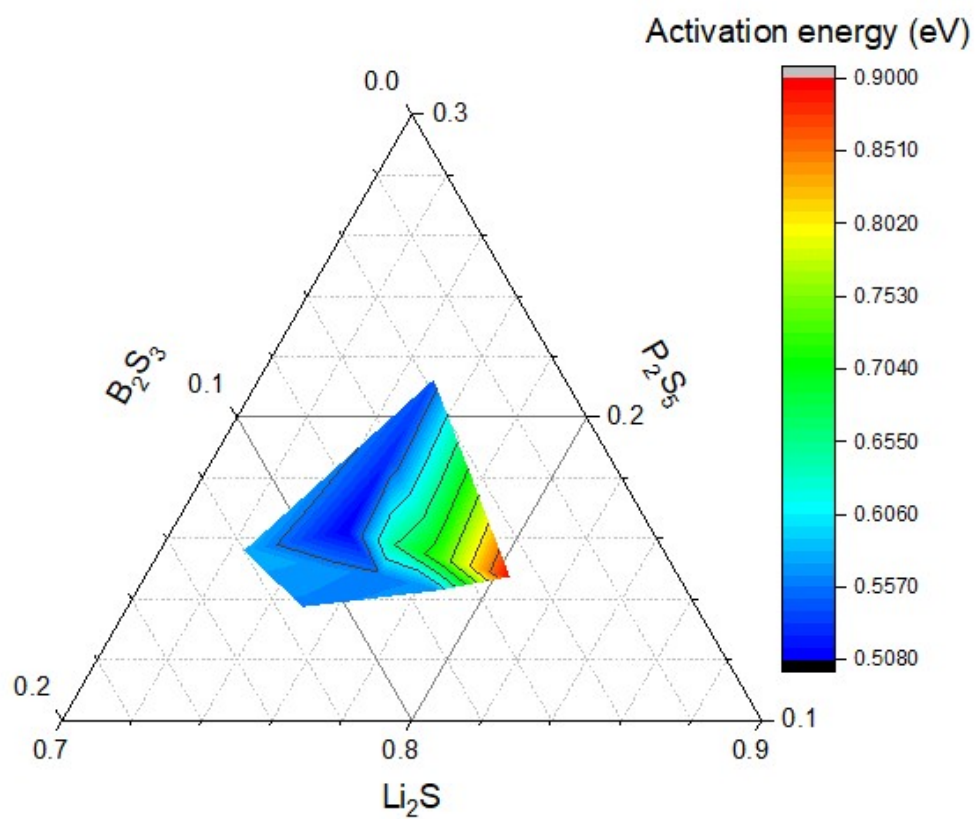


Figure S4. Contrast color of the activation energy in function of the composition inside the Li_2S - P_2S_5 - B_2S_3 ternary.

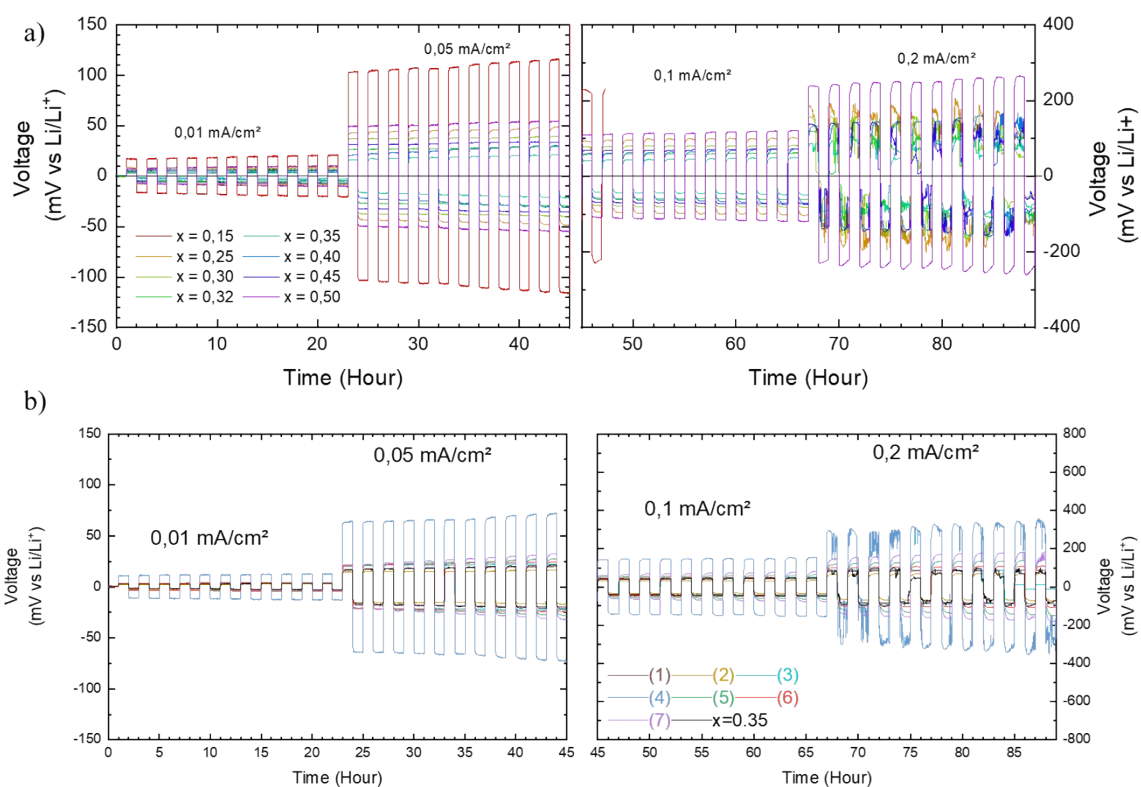


Figure S5. Polarization profile of symmetric cell made from compound a) $\text{Li}_3\text{P}_{1-x}\text{B}_x\text{S}_{4-x}$ ($0.15 < x < 0.5$) and b) other composition of the ternary $\text{Li}_2\text{S}-\text{P}_2\text{S}_5-\text{B}_2\text{S}_3$ at different current density