

THIN FILM LITHIUM ION CONDUCTING LiBSO SOLID ELECTROLYTE

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With technological target to improve ionic conductivity, lithium borate glasses have been intensively studied during recent years as lithium ion conducting electrolytes for solid state lithium batteries [1-2]. In this studies, thin film $(1-x)[0.5\text{Li}_2\text{O}-0.5\text{B}_2\text{O}_3]-x\text{Li}_2\text{SO}_4$ electrolyte (LiBSO) was fabricated by rf magnetron sputtering technique, using targets prepared from LiBO_2 and Li_2SO_4 mixed powder of various molar ratios ($x=0.4\sim 0.8$). The main objective of the study is to widen the vitreous domain (Fig. 1) to a regime containing higher amount of lithium, resulting in the enhancement of ionic conductivity.

According to the frequency response analysis, lithium ion conductivities of thin films ($\sigma_{\text{ion}}^{\text{DC}}$) show thermally activated behavior, as illustrated in Fig. 2. $\sigma_{\text{ion}}^{\text{DC}}$ increases up to $x = 0.7$, due to an increase of the number of charge carriers. As x increases further ($x = 0.8$), conductivity decreases and E_a increases again. In this case, the exponent of power law is above 1 from the AC conductivity plot (Fig. 3), which is not normal case for glassy conductors [3]. TEM observation indicates the different microstructure for the case of $x=0.8$. These facts imply that lithium ion conducting mechanism is different in Li_2SO_4 richer compositions. From FTIR results, as the amount of lithium sulfate increases, the relative peak intensities of SO_4^{2-} vibration and borate tetrahedra increase, which agrees with the other previous results [4]. The microstructure was investigated by NEXAFS method.

Thin film LiBSO electrolytes have improved ionic conductivity in the extended vitreous domain and are promising candidates for microbatteries.

References

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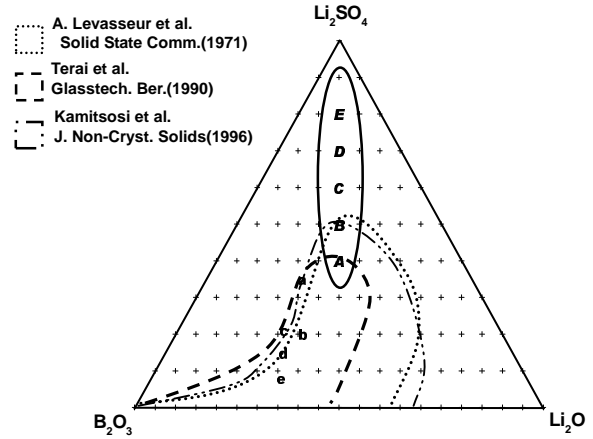


Fig. 1. Vitreous domain of $\text{B}_2\text{O}_3\text{-Li}_2\text{O-Li}_2\text{SO}_4$ ternary system.

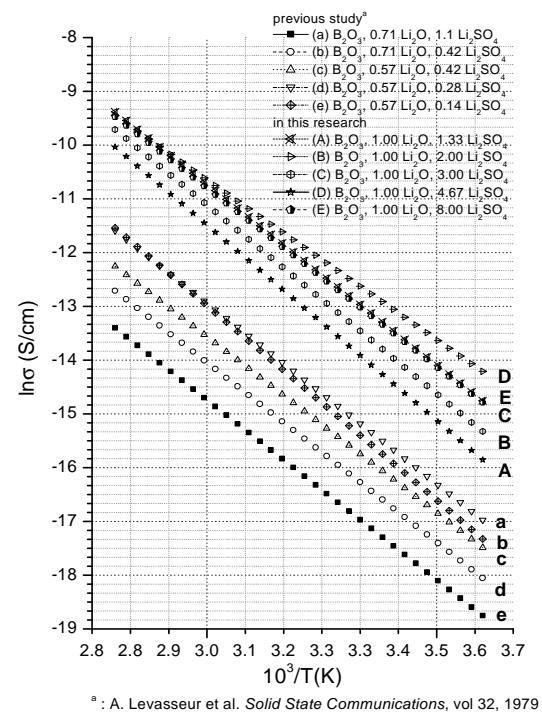


Fig. 2. Arrhenius plots of LiBSO thin films of all compositions, compared with the previous work.

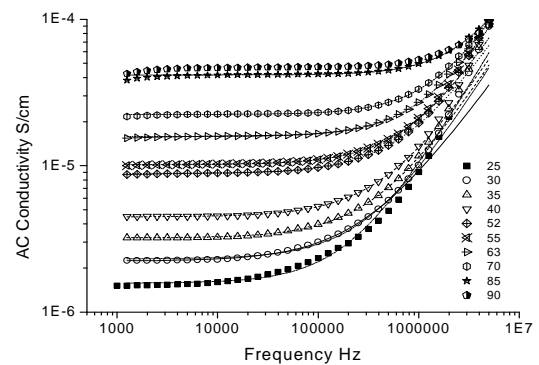


Fig. 3. AC conductivity plots of $x=0.8$ at different temperatures, fitted to single exponent power law equation