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Air-Stable, High-Conduction Solid Electrolytes of Arsenic-Substituted Li_4SnS_4

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5 **Supporting Information**

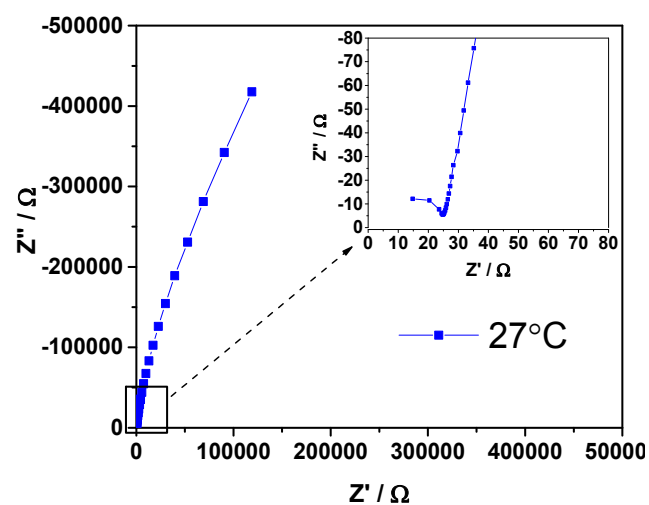


Fig. S1. Impedance spectrum of $\text{Li}_{3.833}\text{Sn}_{0.833}\text{As}_{0.166}\text{S}_4$ measured at room temperature. The total conductivity is determined by using the intercept between the semi-arc and straight line as the total resistance.

Powder XRD pattern of Li_4SnS_4 and Li_3AsS_4 with a molar ratio of 1:2 synthesized at identical conditions of the $\text{Li}_{3.833}\text{Sn}_{0.833}\text{As}_{0.166}\text{S}_4$ phase.

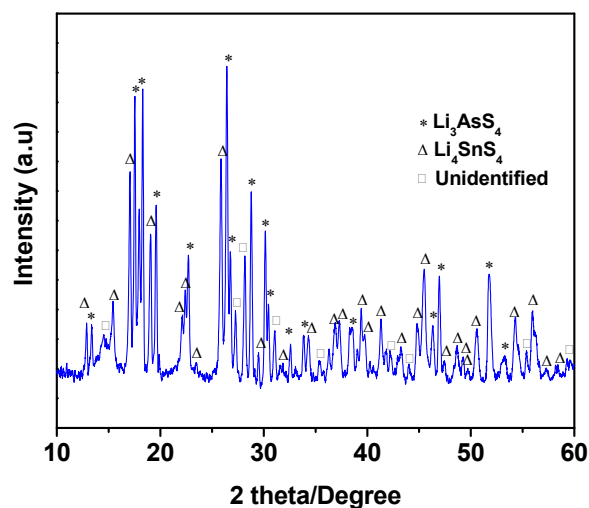


Fig. S2 Powder XRD pattern of As-substituted Li_4SnS_4 with a nominal composition of $\text{Li}_{10}\text{SnAs}_2\text{S}_{12}$ synthesized at identical conditions of $\text{Li}_{3.833}\text{Sn}_{0.833}\text{As}_{0.166}\text{S}_4$

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Table S1 Comparison of activation energy of various solid electrolytes

Solid Electrolytes	Activation Energies E_a (eV)	References
$\text{Li}_{10}\text{GeP}_2\text{S}_{12}$ (LGPS)	0.24	[9]
Nanoporous $\beta\text{-Li}_3\text{PS}_4$ ($\beta\text{-LPS}$)	0.35	[16]
Bulk $\beta\text{-Li}_3\text{PS}_4$	0.47	[23]
Hot pressed cubic $\text{Li}_7\text{La}_3\text{Zr}_2\text{O}_{12}$ (LLZO)	0.26	[24]
$\text{Li}_{3.838}\text{Sn}_{0.833}\text{As}_{0.166}\text{S}_4$	0.21	Our new electrolyte

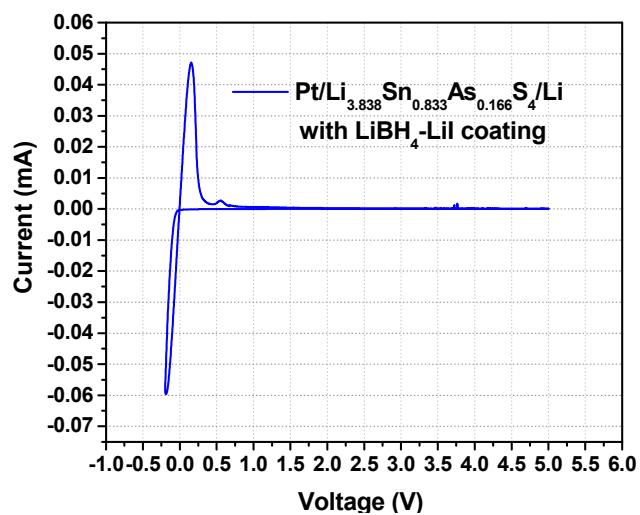


Fig. S3. Cyclic voltammogram of a $\text{Pt}/\text{Li}_{3.838}\text{Sn}_{0.833}\text{As}_{0.166}\text{S}_4/\text{Li}$ cell with $\text{LiBH}_4\text{-LiI}$ passivation layer at 1 mVs^{-1} showing plating and stripping of Li between -0.5 and 5.0V .

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