

Semi-solid Li-S battery electrolytes based on hyper-valent solvents

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The lithium–sulfur (Li-S) battery is one of the major candidates for next generation batteries, much owing to low cost and non-toxicity of starting materials and the possibility of high energy density cells.[1] However, many practical problems have hampered their commercialization; elemental sulfur (S₈) and lithium sulfide (Li₂S) being electronic insulators, polysulfides solvating and diffusing between the cathode and anode and generating an active material loss, lithium dendrite formation at the metal anode, *etc.*[2,3]

To overcome (some of) these problems, one strategy is to modify the current electrolyte concepts while another is to alter the electrolyte concept more fundamentally. The former has been tackled by *e.g.* employing fluorinated solvents to target the solubility properties.[4] To approach the latter, we propose the use of semi-solid electrolytes; materials without flow but malleable, to hinder the dissolution of sulfur and possibly also mitigate the creation of lithium dendrites. To still enable agreeable ion conductivities, we employ matrices of different solvents with large internal dipole moments *e.g.* atranes – silatranes as well as boratranes, to create Li⁺ conduction via percolation networks.[5] All resulting electrolytes were initially characterized with respect to a wide range of physico-chemical properties as well as basic electrochemical performance, such as conductivity (Figure 1), before progressing to feasibility tests in Li-S battery cells.

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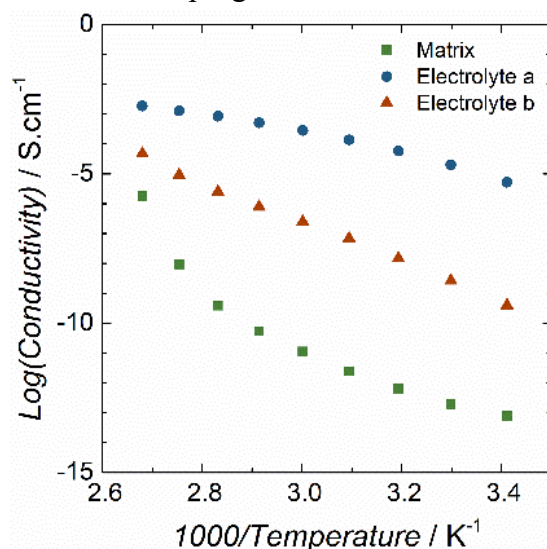


Figure 1. Arrhenius plots of two different hyper-valency-based electrolytes. The matrix is shown as comparison.

References:

- [1] Q. Pang, X. Liang, C.Y. Kwok, L.F. Nazar, Nat. Energy 1 (2016) 16132.
- [2] X. Judez et al., J. Electrochem. Soc. 165 (2018) A6008–A6016.
- [3] J. Scheers, S. Fantini, P. Johansson, J. Power Sources 255 (2014) 204–218.
- [4] S. Drvarič Talian, S. Jeschke, A. Vizintin, K. Pirnat, I. Arčon, G. Aquilanti, P. Johansson, R. Dominko, Chem. Mater. 29 (2017) 10037–10044.
- [5] T. Mizumo, R. Fujita, H. Ohno, J. Ohshita, Chem. Lett. 40 (2011) 798–800.