An in-situ formed SEI layer to stabilize the interface between Li metal and $Li_{10}SnP_2S_{12}$ sulfide solid electrolyte

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The power density for all-solid-state lithium batteries(ASLBs) is still far away from satisfactory on the account of high interfacial resistance at electrode / solid electrolyte interface. LGPS-type materials show extremely high Li^+ conductivity. But when in contact to Li metal, they can be reduced to produce Li_2S, Li_3P and Li-M alloy and form a mixed ionic and electronic conducting layer at the interface, which hinders the application of Li metal in such solid electrolyte system[1].

As is shown in previous literatures, ionic liquids were only used as wetting agent in quasi-solid-state batteries[2]. In this work, we report on a simple approach for the modification of the interface between Li and $Li_{10}SnP_2S_{12}$ sulfide solid electrolyte by utilizing $Pyr_{13}TFSI$ ionic liquid and 1.5 M LiTFSI/$Pyr_{13}TFSI$ ionic liquid. Our results demonstrate that the addition of 1.5M LiTFSI/$Pyr_{13}TFSI$ ionic liquid can not only promote intimate contact but can in-situ form a stable SEI layer at the interface between Li and solid electrolyte as well. A stable SEI layer instead of mixed conducting layer can prevent sulfide solid electrolyte from further decomposition and the symmetric cell shows stable cycle performance for more than 1000 hours with both the charge and discharge voltages reaching around 0.05 V at 0.038 mA cm^{-2}.

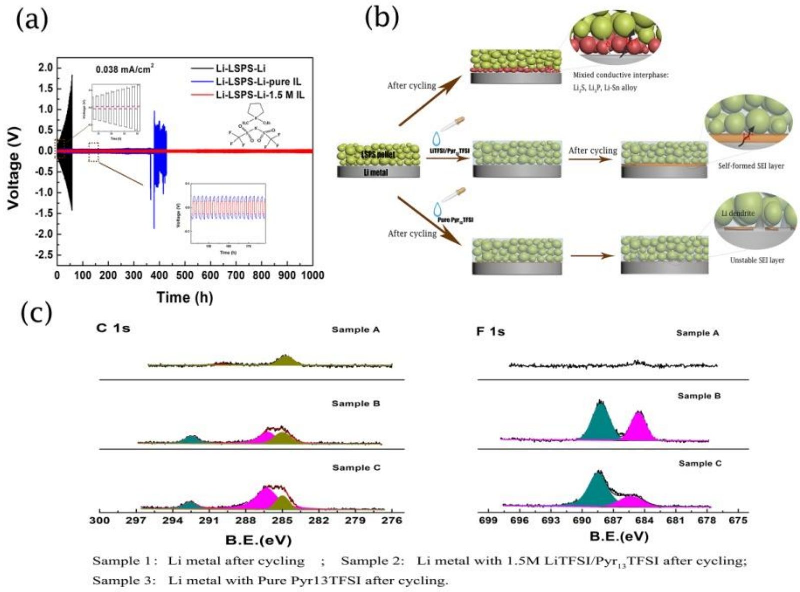

Fig. 1. (a) Lithium dissolution and deposition curves of the symmetric cells at 0.038 mA cm^{-2}; (b) The schematic of interfacial modification mechanism ; (c) C 1s and F 1s XPS spectra of different Li metals in symmetric cells after being etched for 1 minutes.

References:

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