

Stable multi-functional artificial solid electrolyte interfaces for lithium batteries

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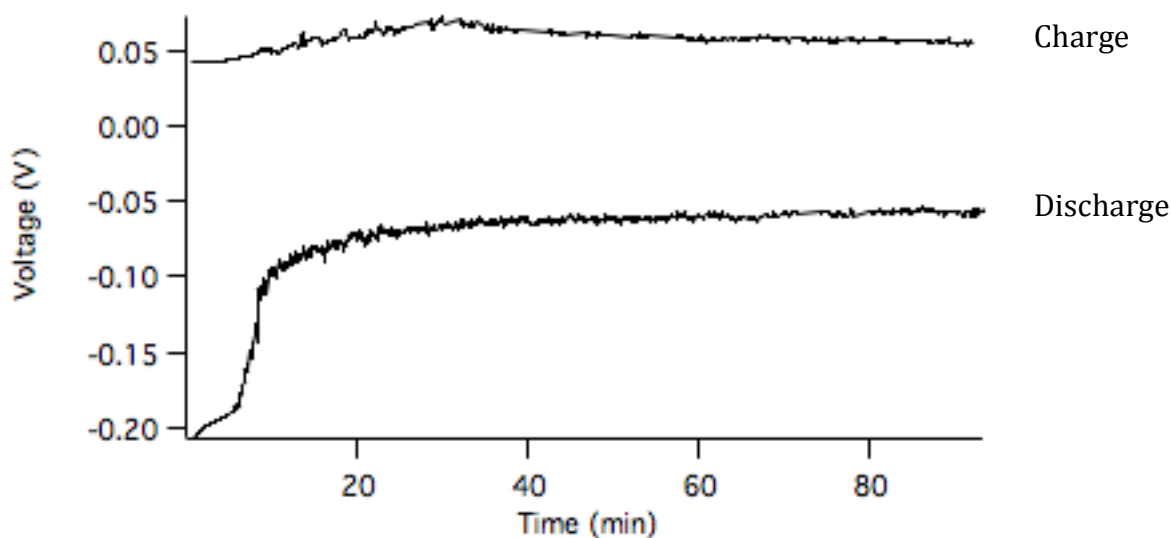


Figure S1. Voltage profile of the treatment of the lithium metal. The lithium metal is firstly discharged, then charged, both at a current density of $2\text{mA}/\text{cm}^2$ in AlI_3 containing DOL/DME electrolyte.

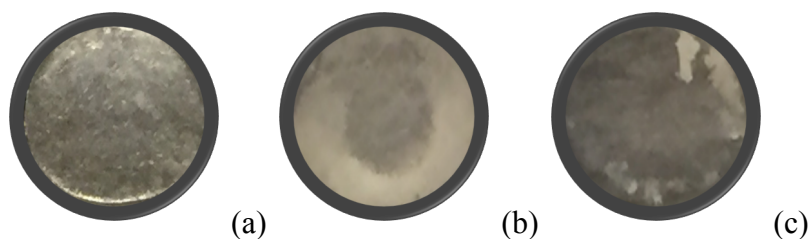


Figure S2. Photographic images of lithium metal under different treatment. a) pristine lithium. b) lithium metal pretreated in electrolyte without AlI_3 . c) lithium metal pretreated in electrolyte with AlI_3 .

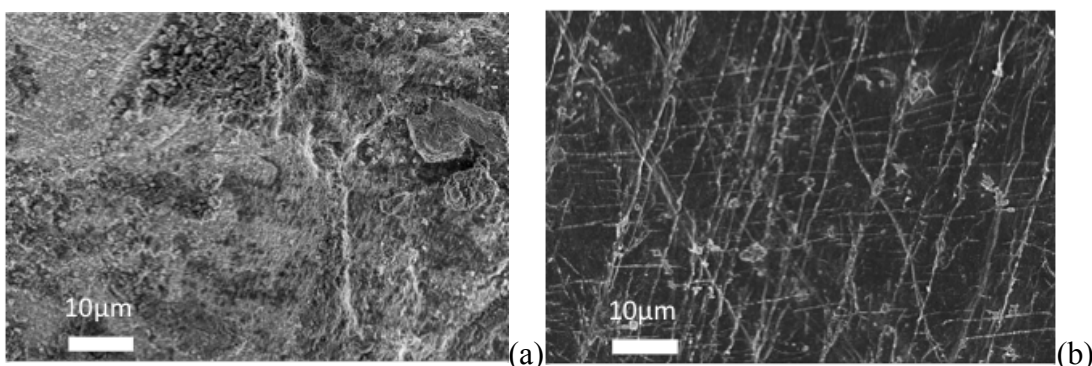


Figure S3. SEM images of lithium metal in contact with LiPS rich electrolyte after 3 days in symmetric cells with lithium metal of different treatment. a) pristine lithium metal. b) lithium metal pretreated with AlI_3 .

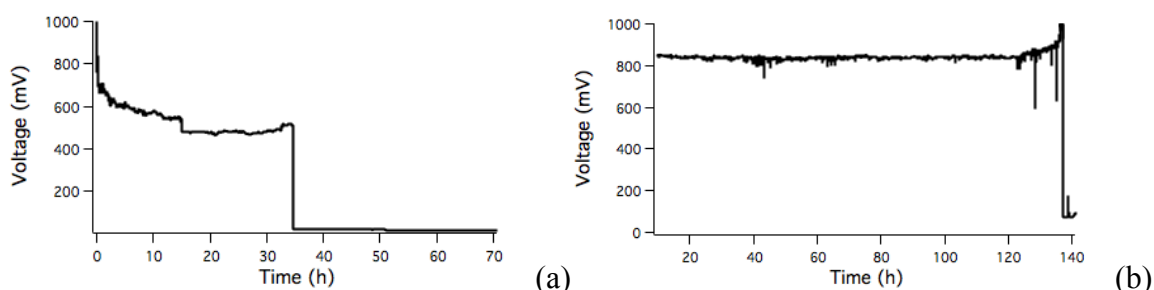


Figure S4. Potential profile for symmetric polarized at $2\text{mA}/\text{cm}^2$. a) with pristine lithium as electrodes. b) with pretreated lithium as electrodes.

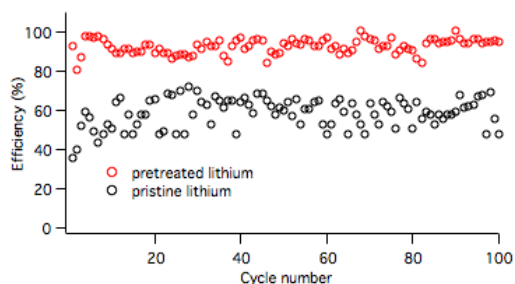


Figure S5. Lithium deposition efficiency of the Li/electrolyte/stainless steel cell with pristine lithium and pretreated lithium respectively in LiPS rich electrolyte. The cell is discharge for 30 min at a constant current density of $2\text{mA}/\text{cm}^2$, then charge back to 0.5V at the same current density.

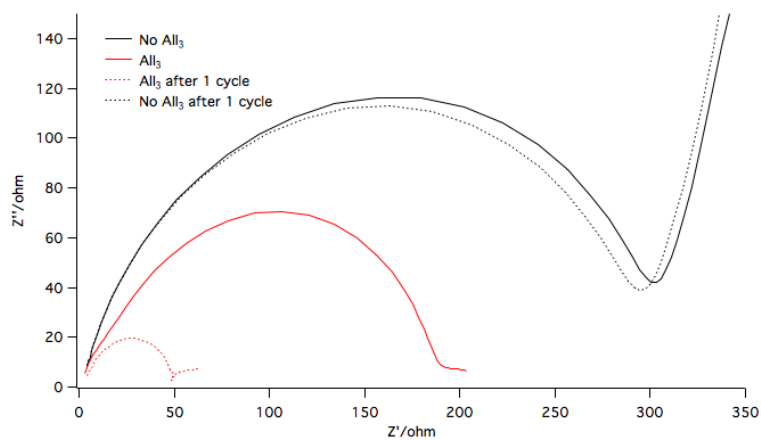


Figure S6. Impedance of the cell before and after treatment with AlI_3 .

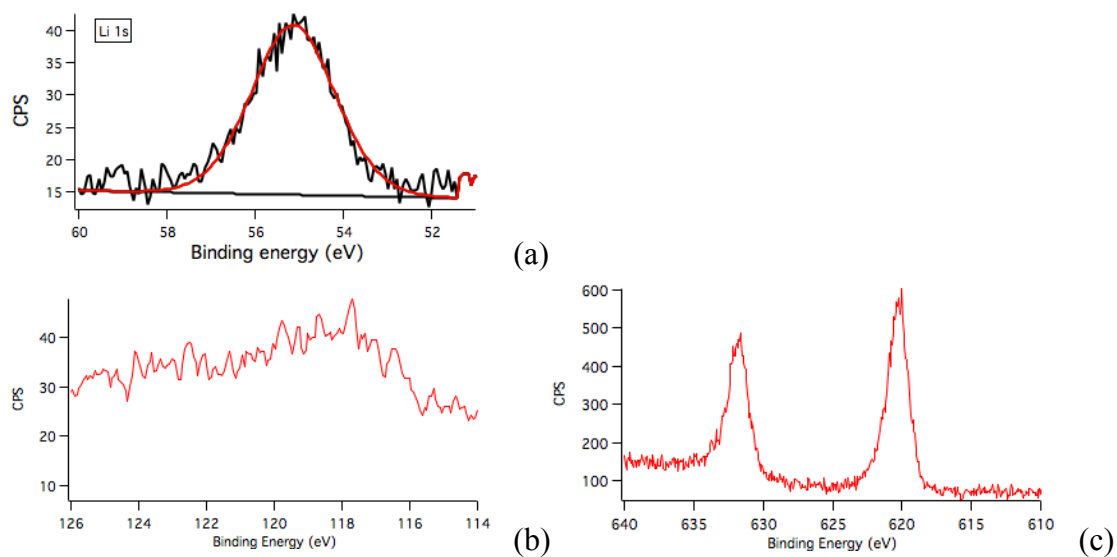
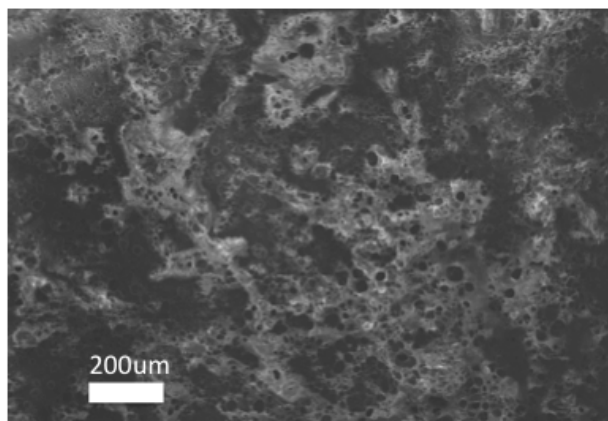
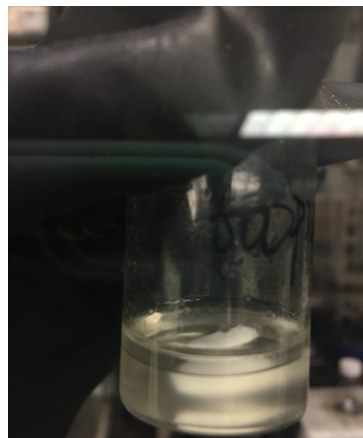


Figure S7. a) XPS of lithium metal in contact with electrolyte without AlI_3 . XPS of pretreated lithium metal after polarization test. b) Al 2s signal. c) I 3d signal.

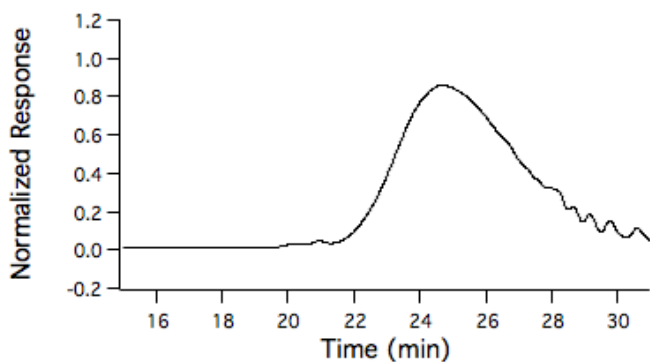


(a)

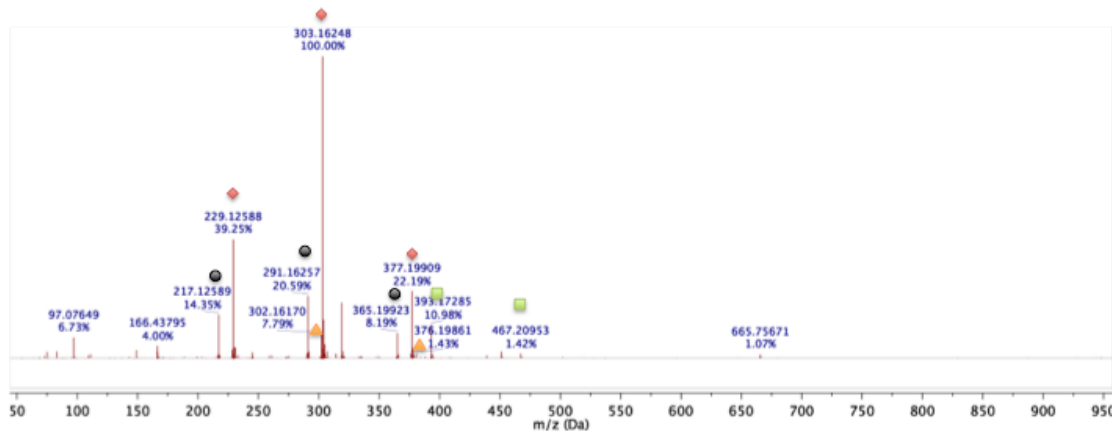


(b)

Figure S8. Clues for the additional protection polymer film on lithium metal surface. a) SEM image of lithium metal after short circuit in the polarization test. b) DOL/DME electrolyte containing AlI_3 after resting for 2 weeks.



(a)



(b)

Figure S9. Investigation of the gel structure formed in the AlI_3 containing electrolyte. a) Gel Permeation Chromatography (GPC) of the gel. b) Mass spectra of the gel. Different labels represent different series of species with a molecular weight difference of 74.

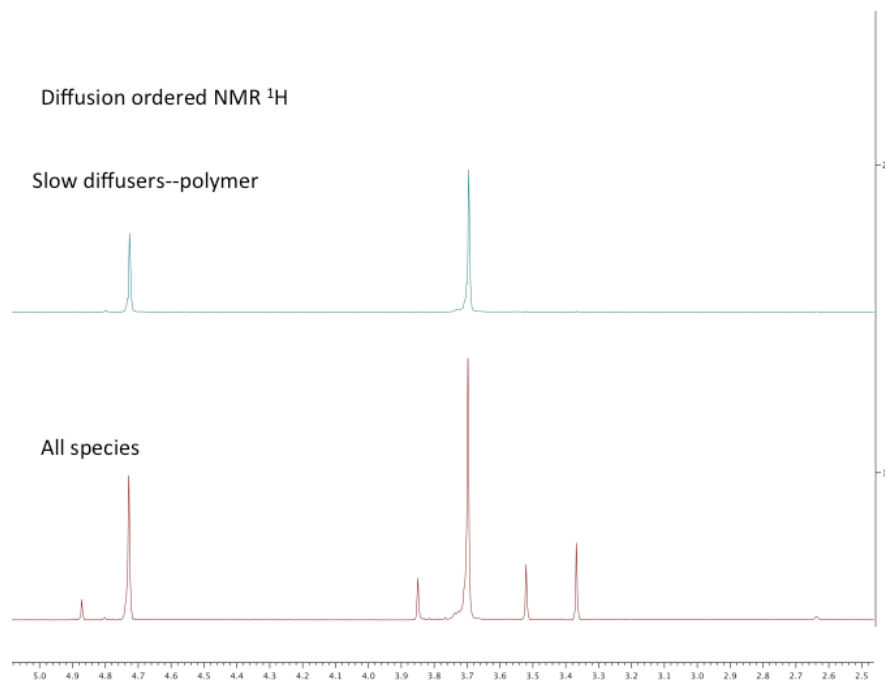


Figure S10. Diffusion ordered ^1H NMR of the gel.

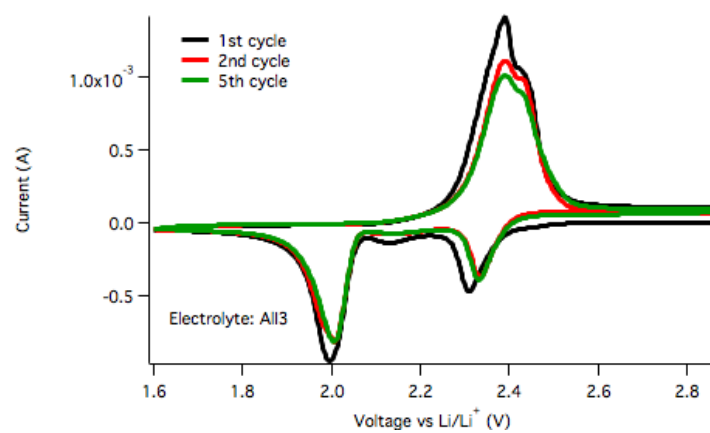


Figure S11. Cyclic Voltammetry of the Li-S battery applying the pretreated lithium as the anode.