

Supplementary information

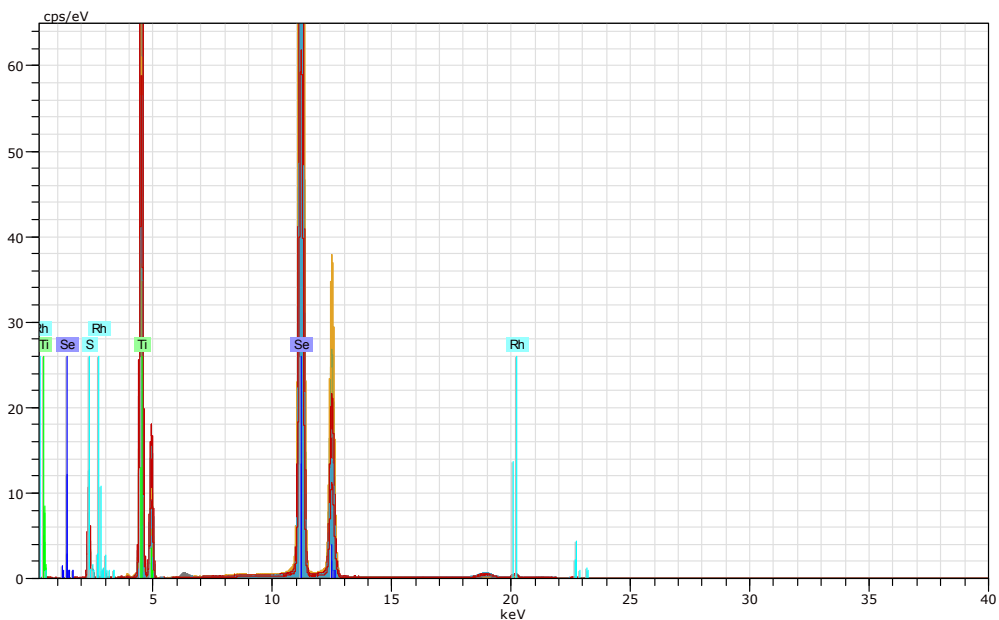


Figure S1. XRF Compositional Analysis of $\text{TiSe}_{0.6}\text{S}_{1.4}$

Mass percent (%)

Spectrum	S	Ti	Se
TiSSe .spx	26.80	38.78	34.42

Corresponding Atomic percent (%)

Element	S	Ti	Se
TiSSe	40.19	38.76	21.05

This is very close to ideal (calculated) atomic percent of $\text{TiS}_{1.4}\text{Se}_{0.6}$

(S → 46.67%, Ti → 33.33%, Se → 20%)

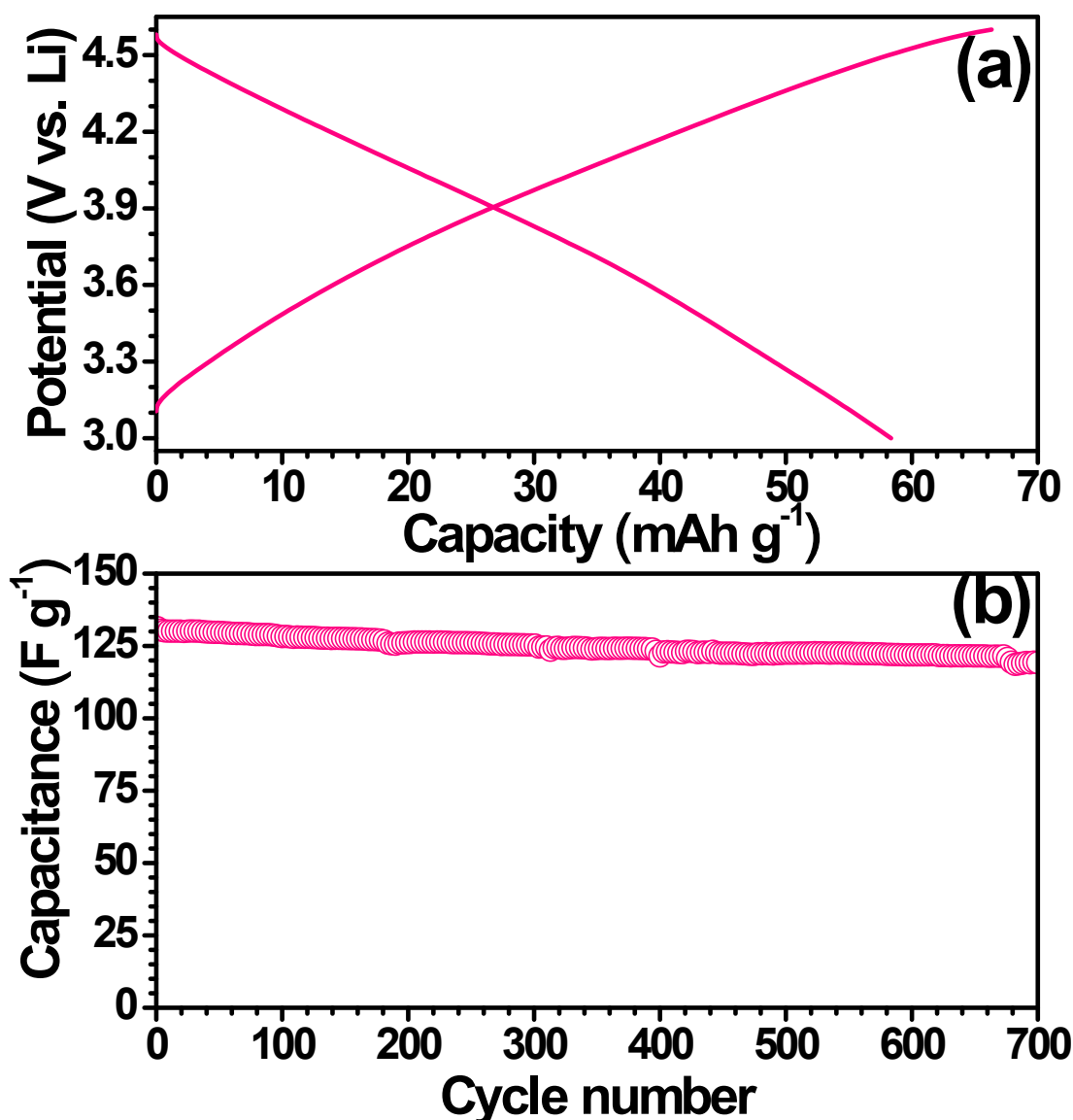


Figure S2. Electrochemical performance of AC in half-cell configuration (Li/AC): (a) typical charge-discharge curves recorded between 3-4.6 V vs. Li at a current density of 100 mA g⁻¹, and (b) cycling profiles. Active material loading: 10 mg.

The observed capacity can be converted in to specific capacitance according to the following equilibrium, $C(\text{F g}^{-1}) = \frac{i(\text{A}) \times t(\text{s})}{3600 \times m(\text{g})} = \text{mAh g}^{-1} \times \frac{3600}{dV(\text{mV})}$, where I is applied current, t is discharge time, m is weight of the active material and dV is testing window of the AC in half-cell configuration (mV, 1600 mV). The aforesaid equation is valid, if the charge-discharge curves is linear. The observed irreversibility in the half-cell is mainly due to the mild decomposition of the electrolyte, and unstable SEI formation.

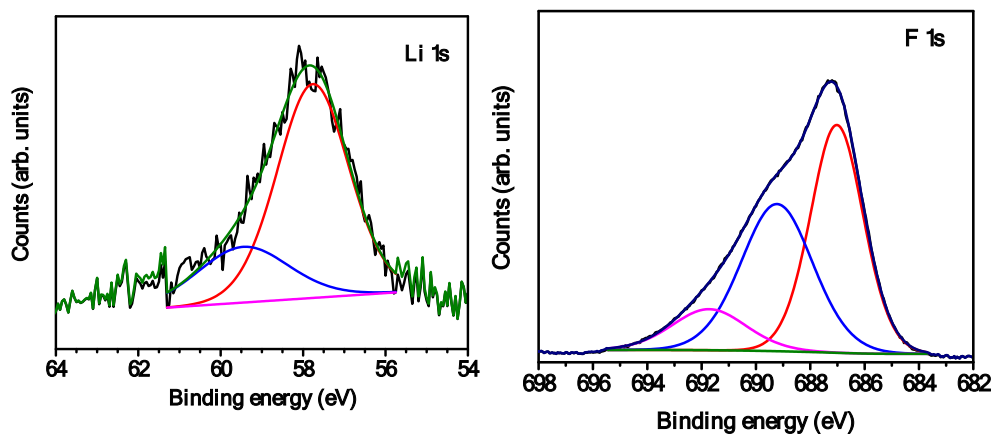


Figure S3. The XPS spectra of cycled AC electrode in half-cell assembly.

The core-level spectra of the Li 1s and F 1s. Since, LiF is the predominant by product during the decomposition of the electrolyte solution. The binding energy 685.6 eV is associated with the LiF. This clearly reveals that, there is a mild decomposition of the electrolyte occurs (based on the irreversibility observed in Figure S2), but it is not sufficient to form a stable SEI layer. This observed results are consistent with Naoi *et al.* (*J. Electrochem. Soc.*, 156, A563-A571, 2009)

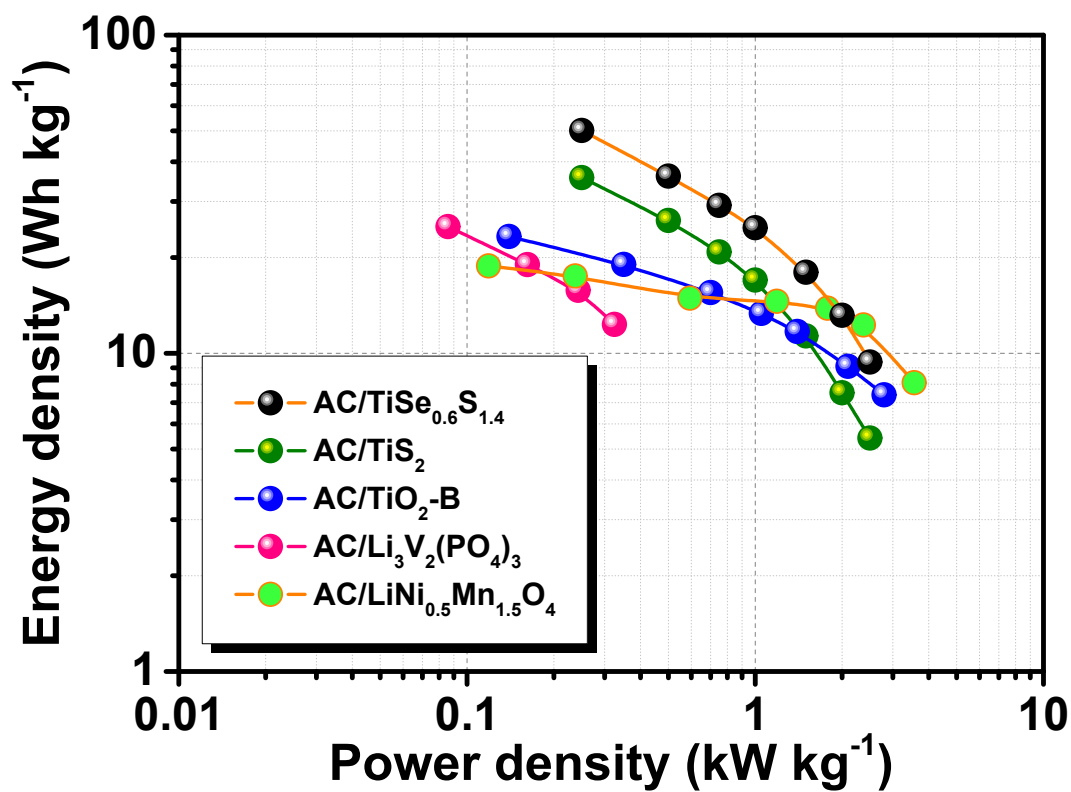


Figure S4. Ragone plot of various LIC configurations including AC/TiSe_{0.6}S_{1.4}