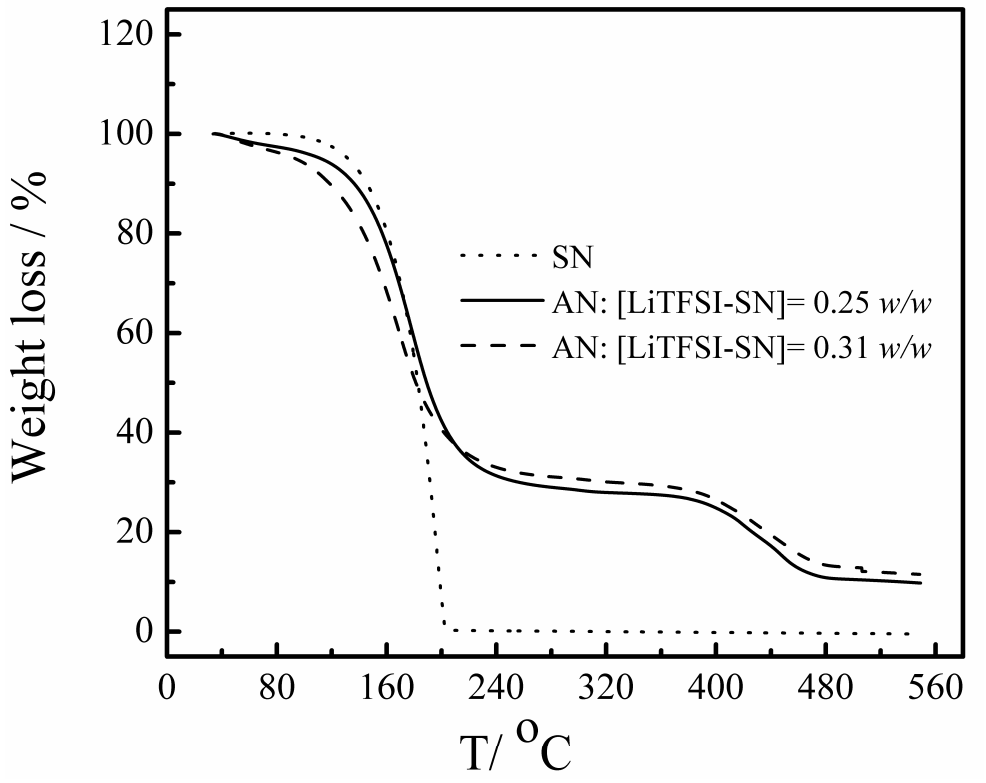
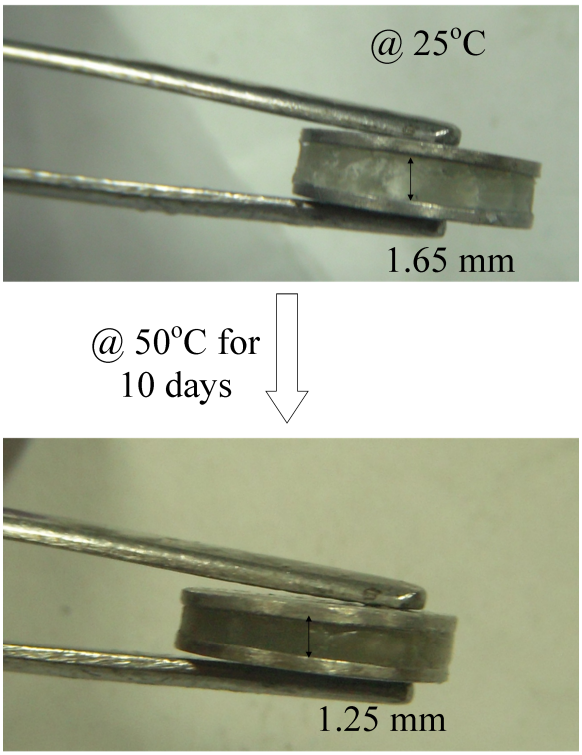
Supplementary Information



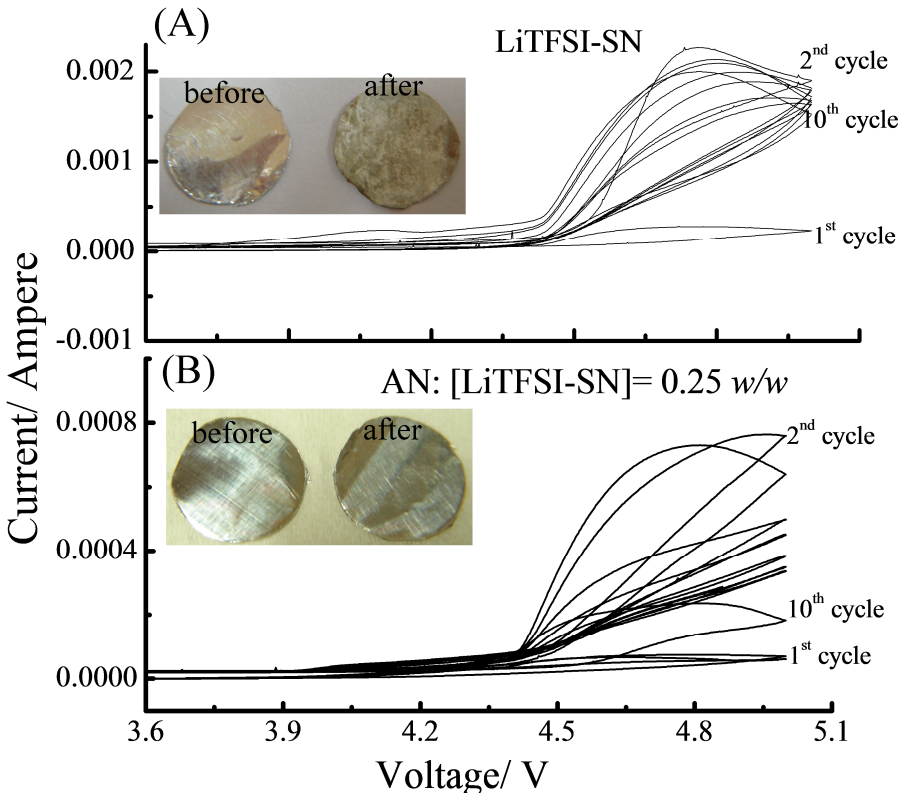
Supplementary Information-1. Thermogravimetric analysis for SN and polymer-gel samples from 25 ^{0}C to 550 ^{0}C at a heating rate of 5 ^{o}C/min.

TGA traces show a 100% weight loss in a single step between (100-205) ^{o}C for pure SN. Whereas the polymer-gel electrolytes showed a two step weight loss of total 89% between (100 – 450) ^{0}C. The initial loss of ≈ 73% in the (100-200) ^{0}C correspond to decomposition of un-polymerized monomers and neat succinonitrile present in the composite. The final step of 16% (200-450) ^{0}C corresponds to the cross-linked polymer network generated as a result of free radical polymerization.



Supplementary Information-2. Photograph for AN: LiTFSI-SN = 0.31 polymer-gel electrolyte sandwiched between two electrodes of a Swagelok™ cell at 25 ^{0}C (upper photograph) and 50 ^{o}C for a duration of 10 days (lower photograph).

Estimation for changes in dimension of the electrolyte when sandwiched between two electrodes and kept inside a Swagelok™ cell without a polymer separator for a long period of time (several days to a month) was done at 50 ^{o}C. We observe only 27 % decrease in the thickness of the electrolyte at 50 ^{o}C. We envisage that (and also evident from the upper photograph) the volume changes at ambient and sub-ambient temperatures will be even much less. This confirms that the polymer-gel electrolytes are safe for usage in batteries in the operation temperature range of (-20 – 60) ^{0}C.



Supplementary Information-3. Cyclic voltammogram of pristine SN-LiTFSI (A) and polymer-gel electrolyte (AN: [LiTFSI-SN] = 0.25) (B) using aluminium as working electrode and lithium as counter and reference electrode with a scan rate of 1 mV/sec (potential range: -0.5 to 5 V). Insets: Photograph of aluminium current collector taken before and after the measurement.

Corrosion studies have been done using aluminium as the working and lithium as counter and reference electrode. An incresease in anodic current was observed after 4.4 V for both polymer-gel as well as pristine plastic crystalline electrolyte. However, the magnitude of anodic current is observed to be lower and it decreases more significantly after second cycle for polymer-gel electrolytes compared to pristine SN-LiX. Decrease in anodic current for polymer-gel electrolyte signifies the formation of a passivation layer between the aluminium electrode and electrolyte which inhibits further corrosion of aluminium. Also it is clearly evident from the photographs of the aluminium current collectors taken before and after the corrosion test that the AN: [LiTFSI-SN] = 0.25 polymer-gel electrolyte is more electrochemically stable than the pristine SN-LiX electrolyte.