Supporting Information *for*

Separator-Free and Concentrated $LiNO_3$ Electrolyte Cells Enable Uniform Lithium Electrodeposition

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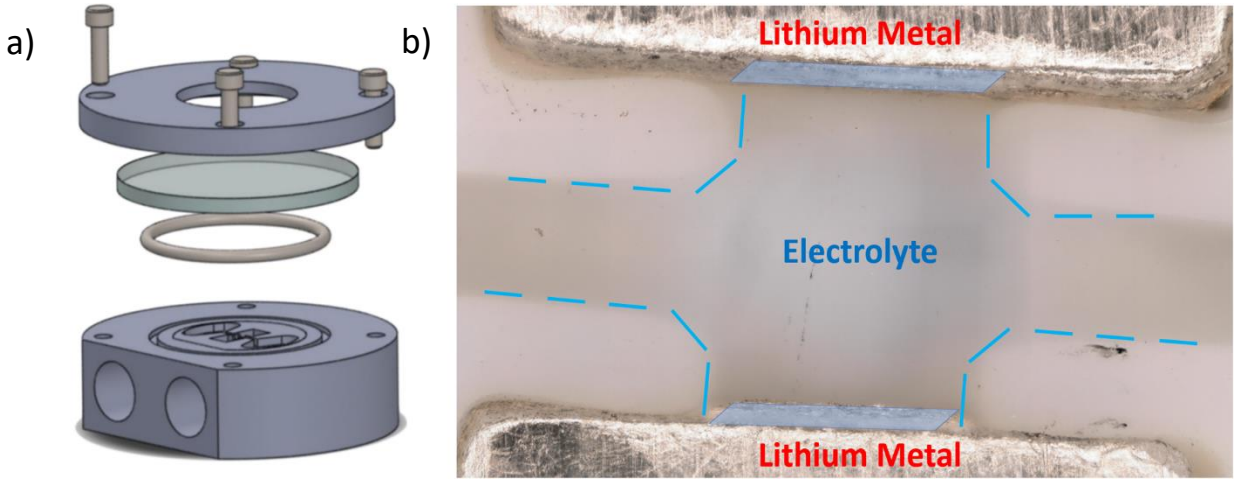

Figure S1. 3D CAD schematic of the optical cell utilized in this work (a). b) illustrates an assembled Li|Li visualization cell. The light blue outlines illustrate the walls of the optical cell that hold the lithium in place. The highlighted areas on the lithium electrodes are the deposition/dissolution sites. Only electrolyte, without a separator, spans the distance between the electrodes.

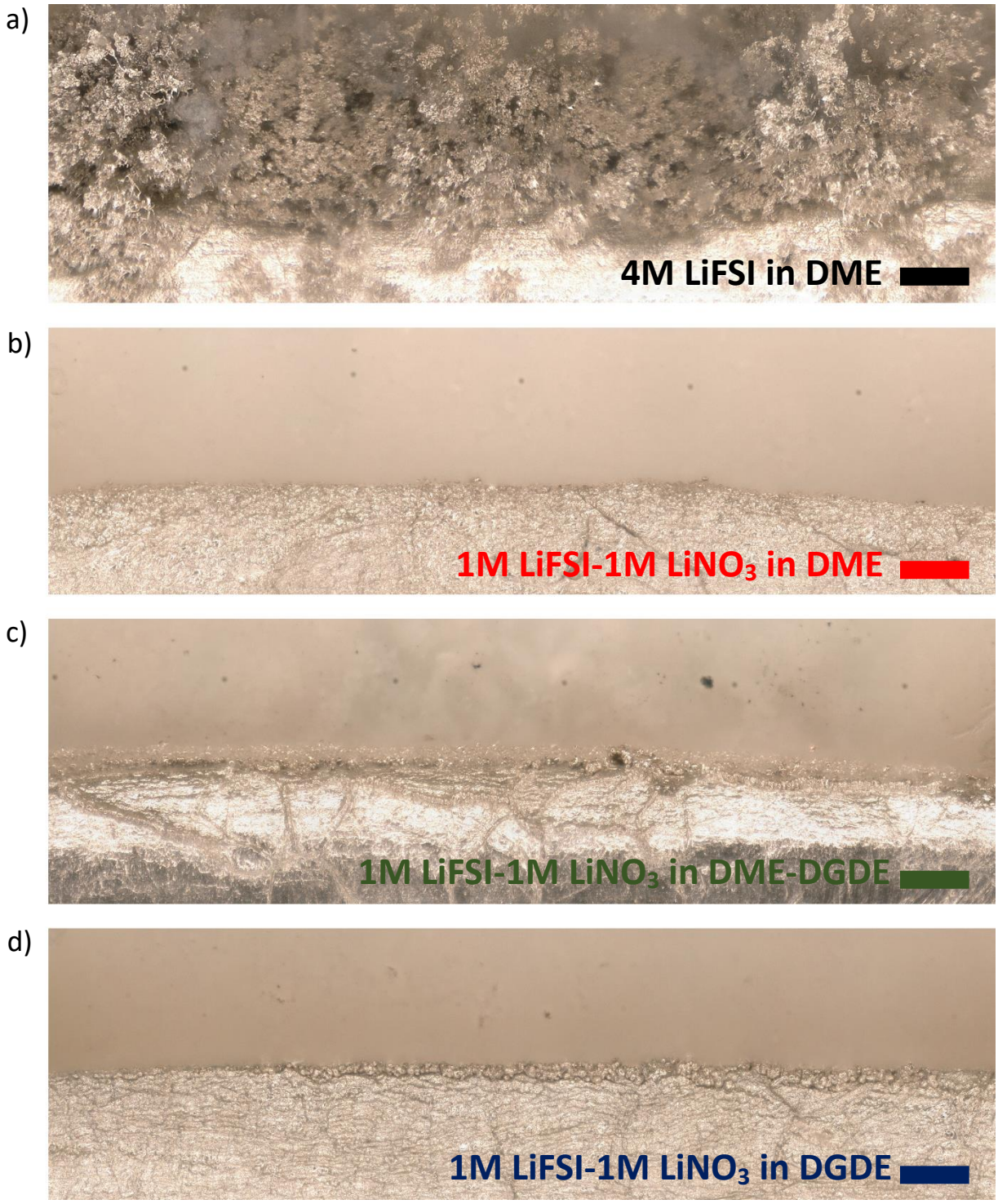

Figure S2. Lithium electrodes after passing 6 mAh cm^{-2} of charge with a current density of 1 mA cm^{-2}. Electrolytes utilized: (a) 4M LiFSI in DME, (b) 1M LiFSI with 1M $LiNO_3$ in DME, (c) 1M LiFSI with 1M $LiNO_3$ in DME and DGDE, and (d) 1M LiFSI with 1M $LiNO_3$ in DGDE. The scale bars are 200 µm.

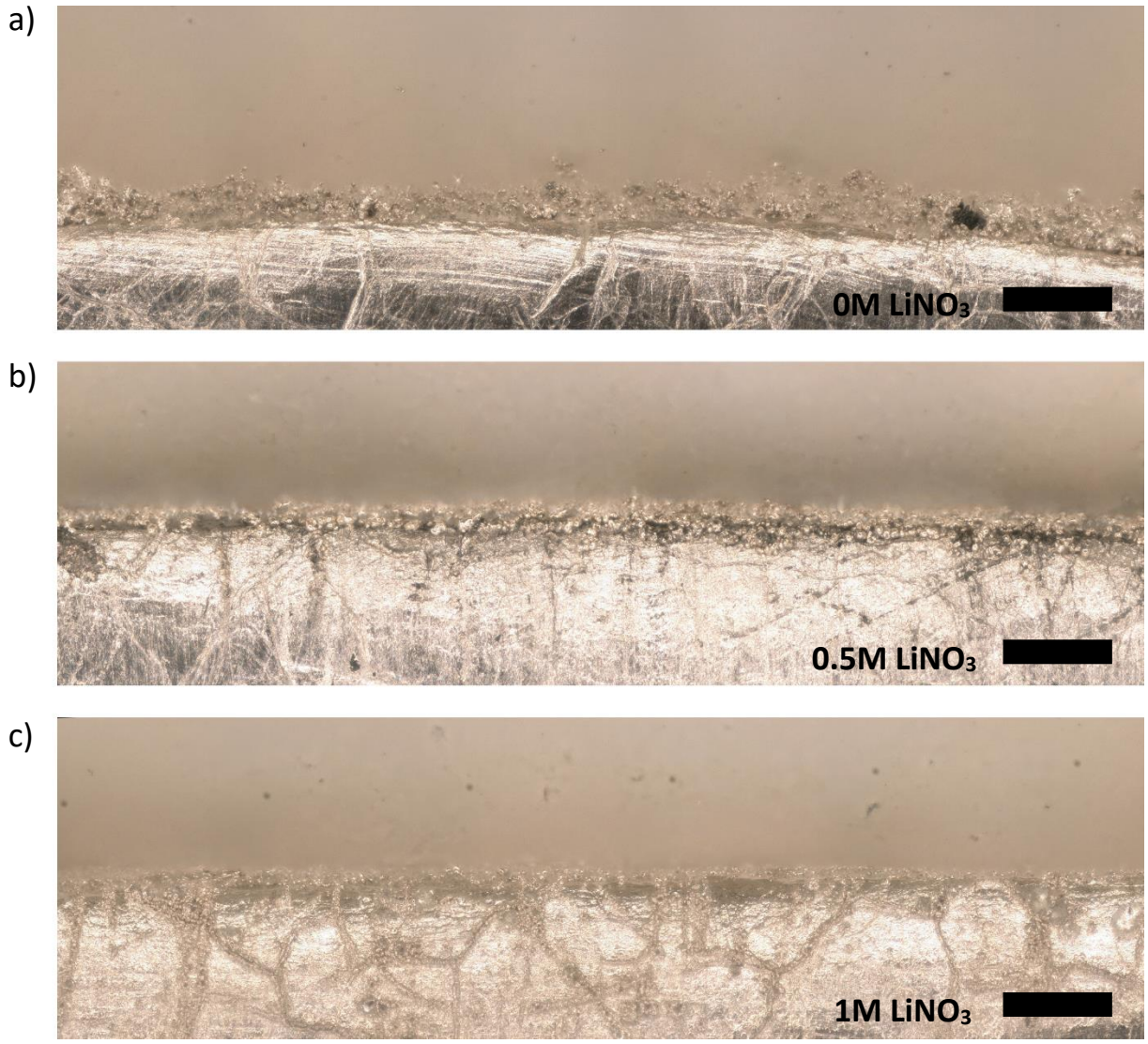

Figure S3. Lithium electrodes after passing 6 mAh cm^{-2} of charge with a current density of 0.5 mA cm^{-2} with 1M LiFSI co-salt and varying $LiNO_3$ concentrations: (a) no $LiNO_3$ salt, (b) 0.5M $LiNO_3$, and (c) 1M $LiNO_3$. Scale bars are 200 μm.

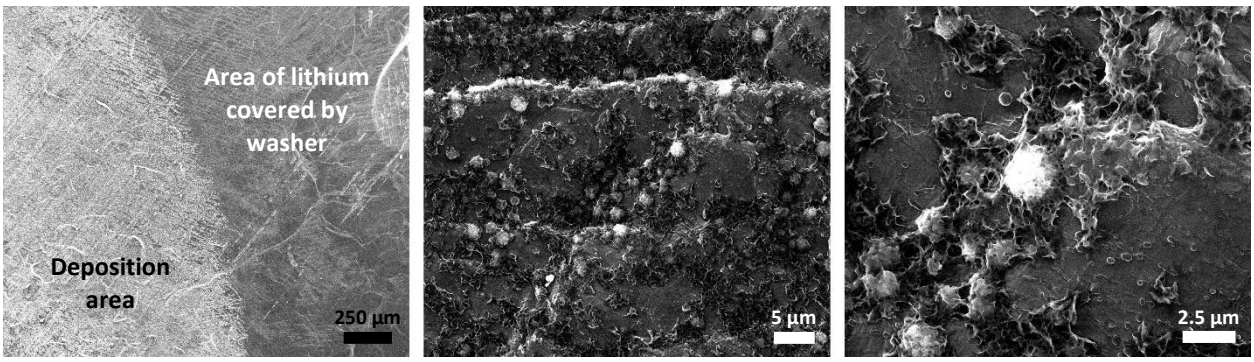

Figure S4. SEM images of a 1 mAh cm^{-2} Li-deposit cycled at 1 mA cm^{-2} using a 1M $LiNO_3$ with 1 M LiFSI in DGDE electrolyte. A washer was used in this electrodeposition.

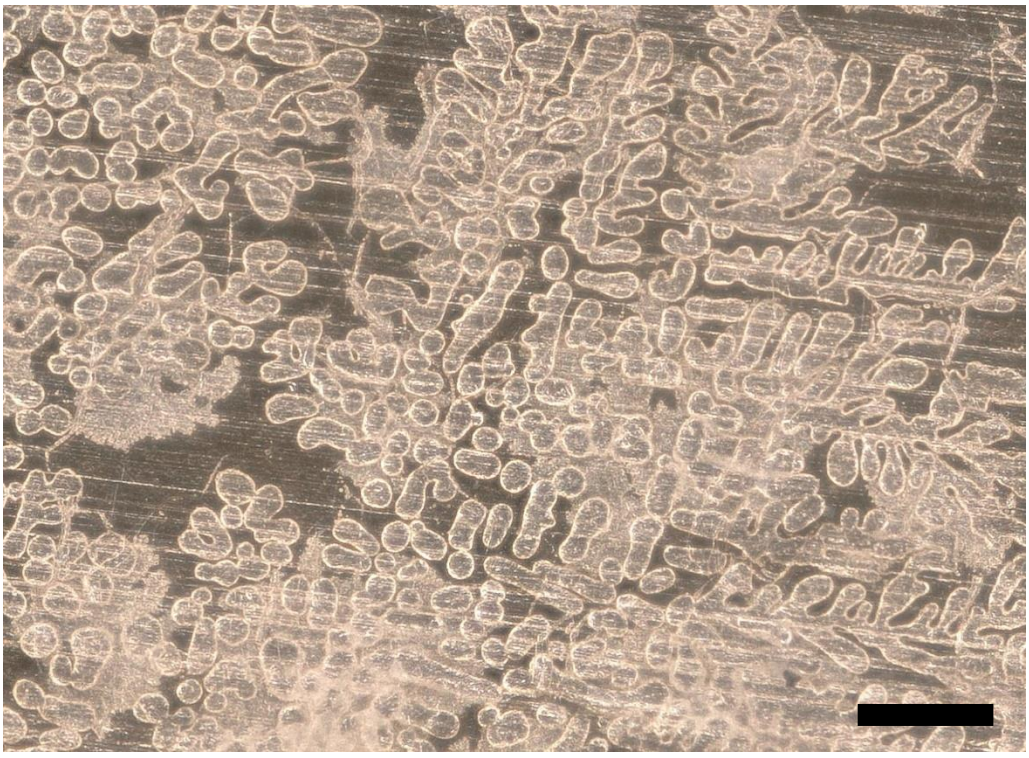

Figure S5. Optical image of a 1mAh cm^{-2} Li-deposit cycled at 1 mA cm^{-2} using a 1M $LiNO_3$ with 1 M LiFSI in DGDE electrolyte. A washer and polymer separator were used in this electrodeposition; the washer held the separator in place but did not press down on it where the deposition occurred. Scale bar is 100 µm.

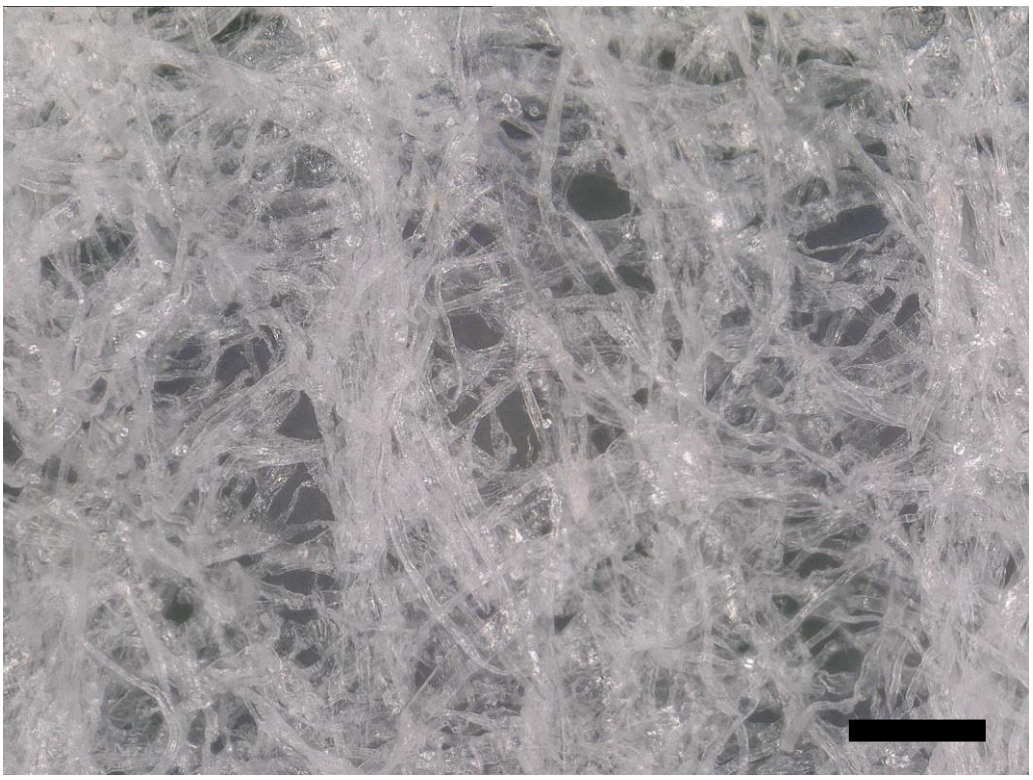

Figure S6. Optical image of Kimwipe. Scale bar is 200 μm.

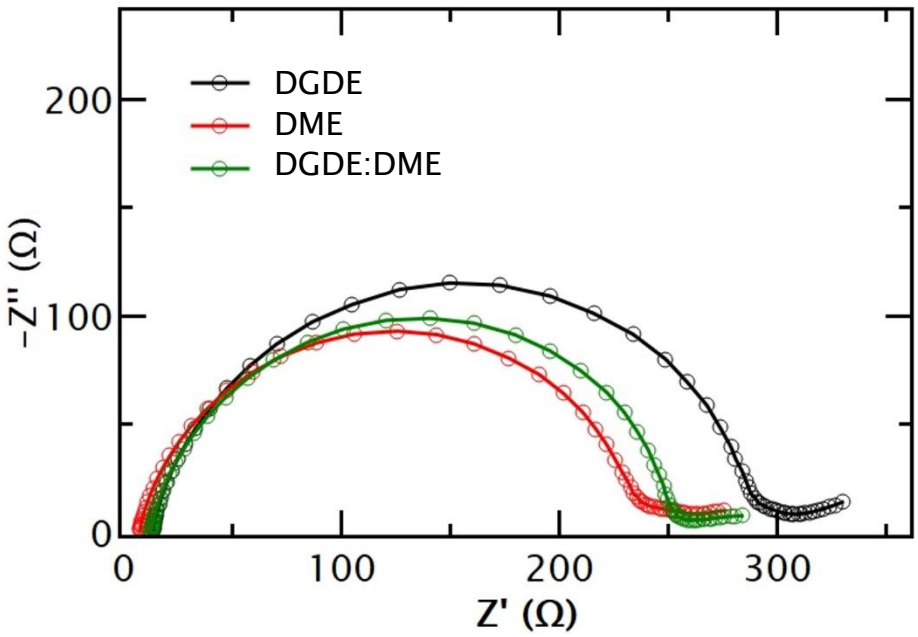

Figure S7. EIS spectra of 1M $LiNO_3$ with 1M LiFSI electrolytes in DGDE, DME, and DGDE:DME (1:1 vol%) symmetrical Li|Li cells before cycling.

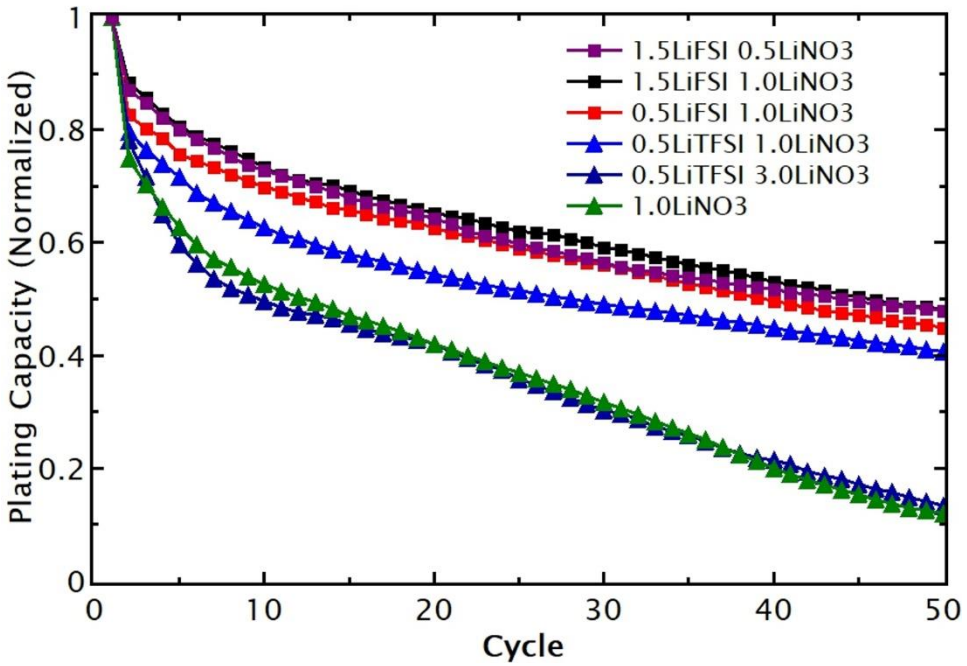

Figure S8. Retention of the coulombic capacity of LFP|Cu cells for different electrolytic solutions normalized to the first cycle. All electrolytes utilized the DGDE solvent.

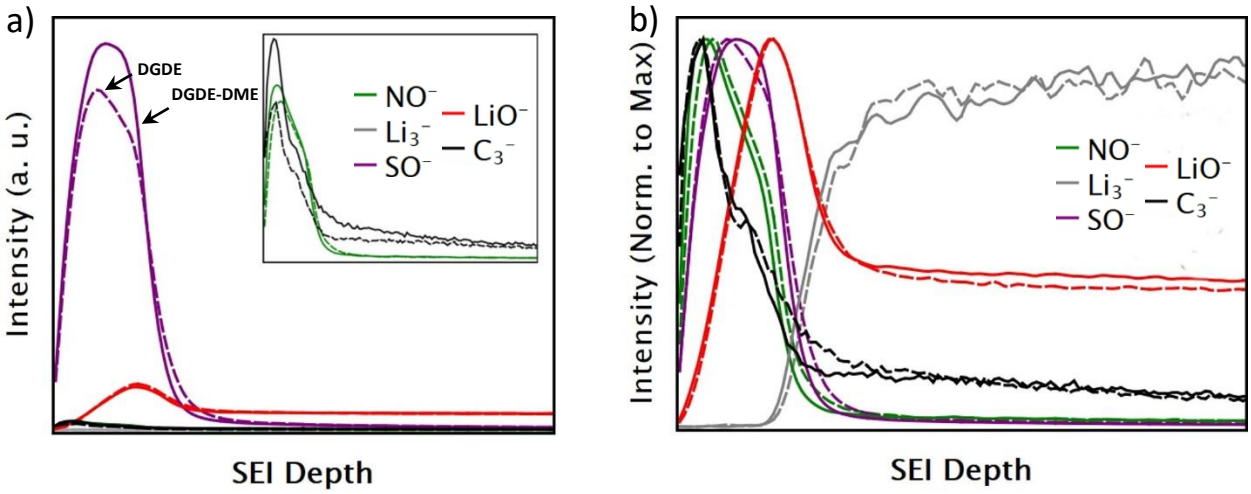

Figure S9. Time-of-flight depth profiling of the DGDE:DME (solid) and DME (solid) based electrolytes. a) compares the SEI of lithium electrodes soaked in electrolyte for the DME and DME-DGDE electrolytes and b) shows the same SEI normalized to the maxima of each individual species.