
Revitalizing interphase in all-solid-state Li metal batteries by electrophile reduction

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Supplementary Materials

Supplementary Fig. 1-56

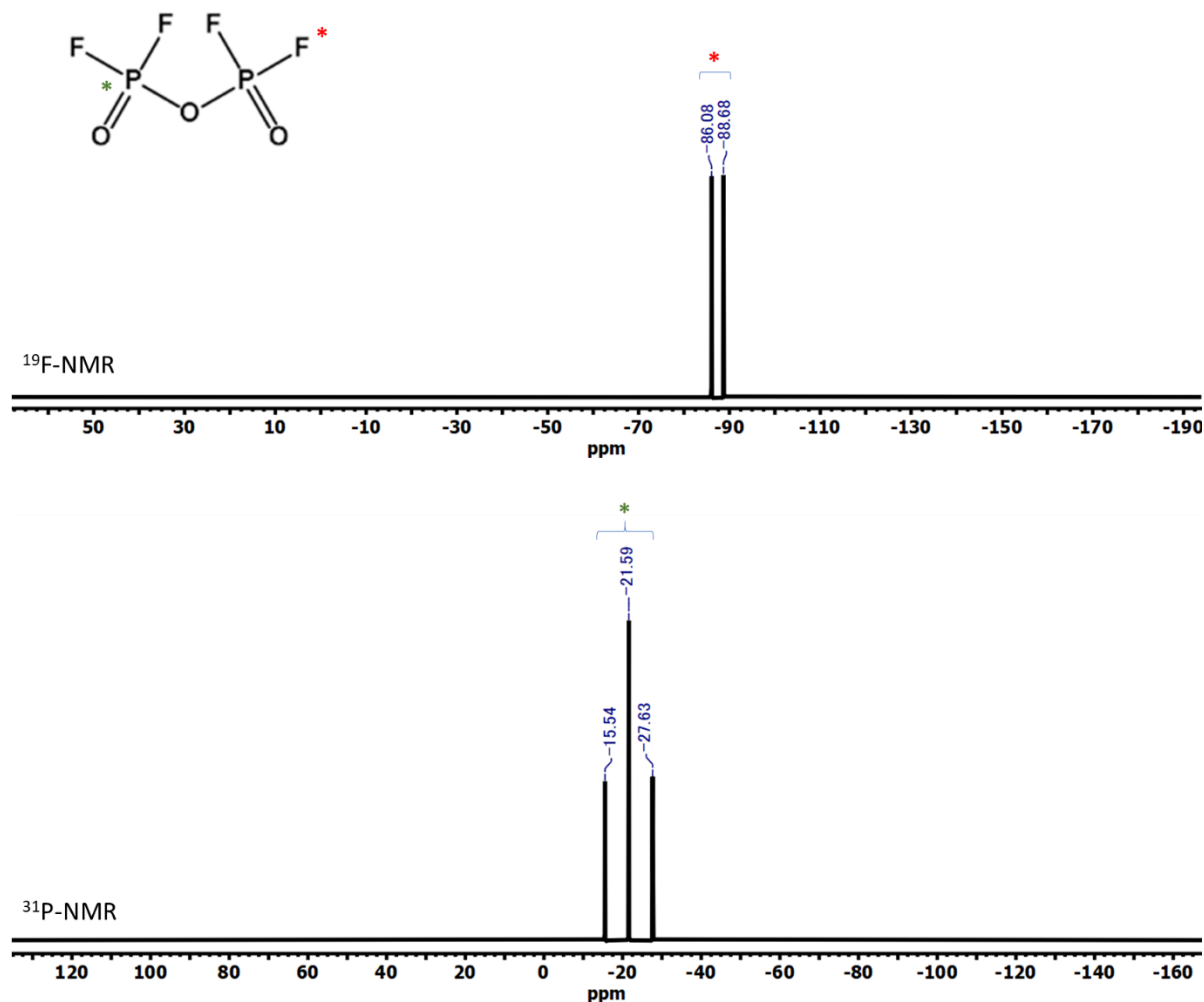
Supplementary Note. 1-2

Table S1-S4.

References (1-17)

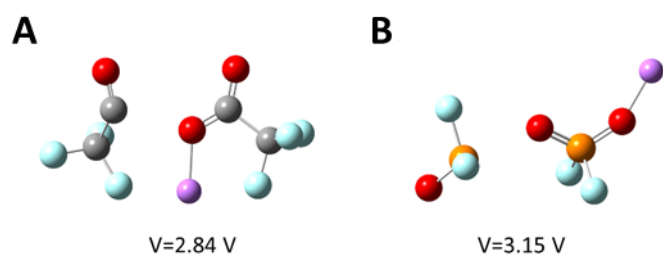
Supplementary Fig. 1.

Diphosphoryl fluoride was prepared by the reaction between difluorophosphoric acid and phosphoric anhydride. Difluorophosphoric acid (1.0 mol) and P_4O_{10} (0.25 mol) were heated under gentle reflux for 1 hour and the mixture was then distilled. The fraction boiling below 75 °C was collected and purified by fractional distillation. The product had a boiling point of 72 °C.



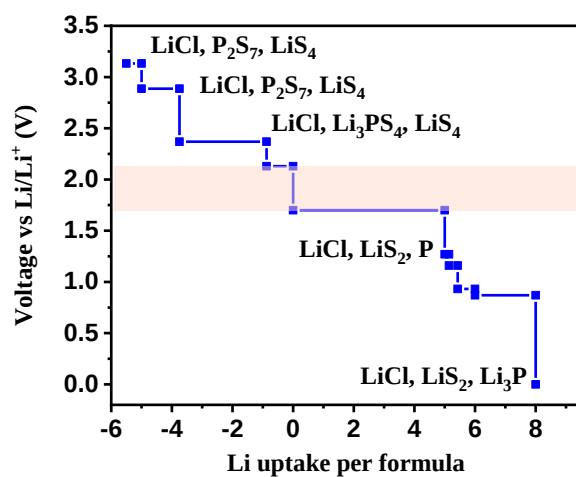
Supplementary Fig. 1. ^{19}F -NMR and ^{31}P -NMR of diphosphoryl fluoride. The ^{19}F NMR resonances are 1:1 doublets and ^{31}P NMR resonances are triplets consistent with a single phosphorus coupled to two fluorine.

Supplementary Fig. 2.



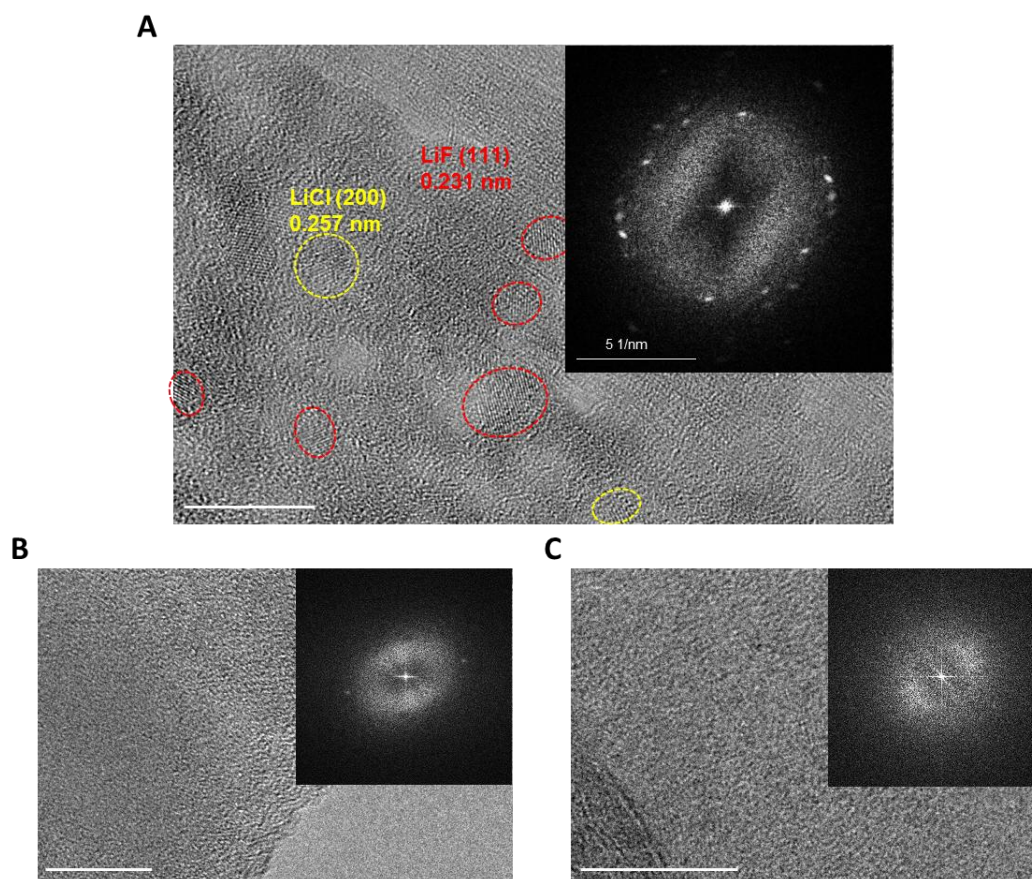
Supplementary Fig. 2. Optimized geometries and reduction potential of (A) Li(TFAA) and (B) Li(DPF) complex from quantum chemistry calculations at B3LYP/6-31+G(d) level. The red ball is O. The blue ball is F. The orange ball is P. The purple ball is Li. The gray ball is C.

Supplementary Fig. 3.



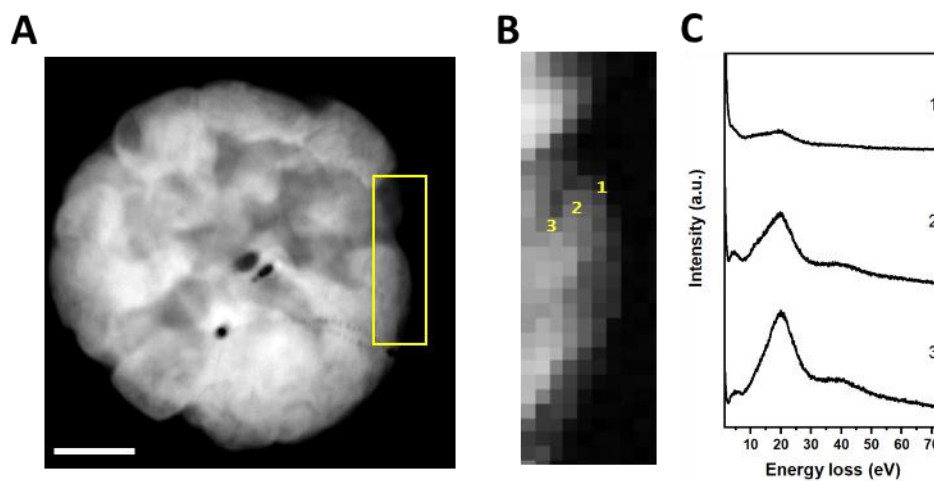
Supplementary Fig. 3. Calculated voltage profile of Li_{5.5}PS_{4.5}Cl_{1.5}. The pink region is the stability window of Li_{5.5}PS_{4.5}Cl_{1.5}. The stepwise oxidation/reduction products were also shown.

Supplementary Fig. 4.



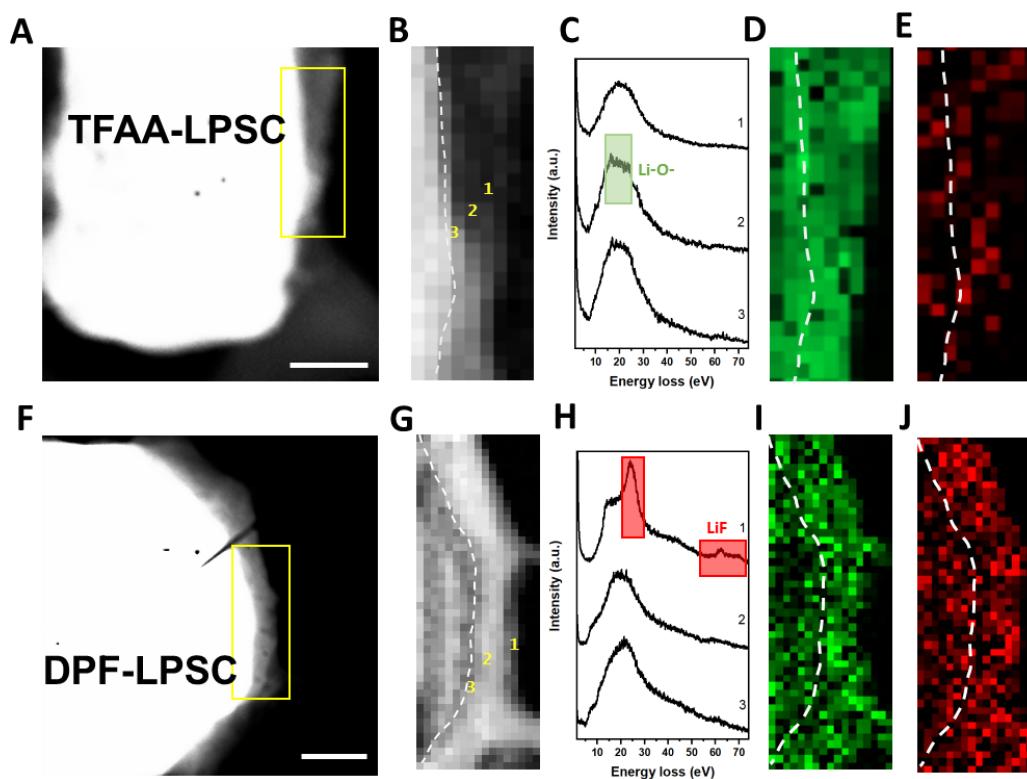
Supplementary Fig. 4. HT-TEM images of coating on (A) TBAF-LPSC particles and SREI on (B) TFAA-LPSC, (C) DPF-LPSC. The inset is the corresponding Fast Fourier Transform pattern. Scale bar: 10 nm.

Supplementary Fig. 5.



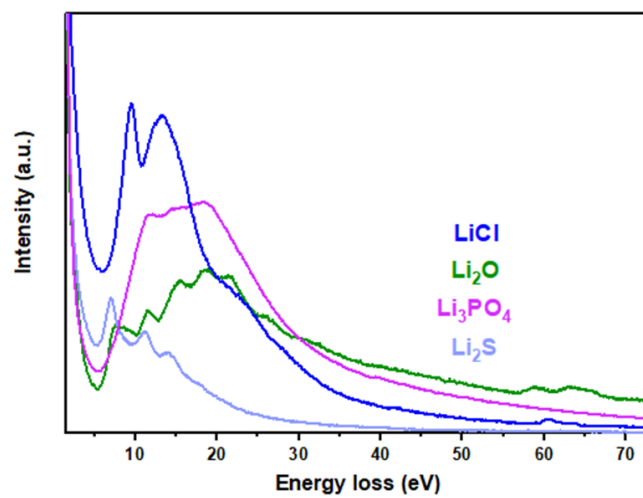
Supplementary Fig. 5. (A, B) High-angle annular dark-field imaging images and selected scanned area. (C) Three (labeled 1–3 from the surface to the inner layers) typical EELS spectra near the surfaces of the pristine LPSC particles. Scale bar: 200 nm.

Supplementary Fig. 6.



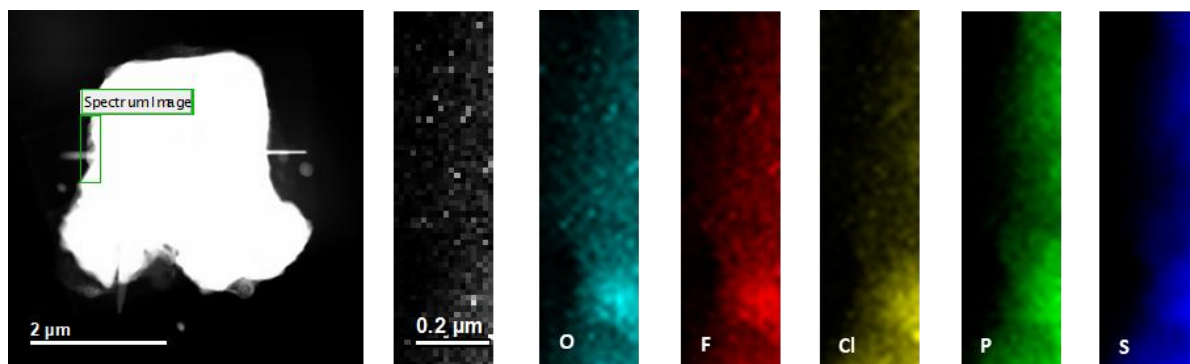
Supplementary Fig. 6. (A-J) LiF distribution in amorphous interphases formed by “electrochemical electrophile reduction”: High-angle annular dark-field imaging images of (A) TFAA-LPSC and (F) DPF-LPSC. EELS spectral images showing the Li-O- based composition (green) and LiF (red) distribution and percentage of the scanned area for (B, D, E) TFAA-LPSC and (G, I, J) DPF-LPSC, as well as three (labeled 1–3 from surface to inner) typical EELS spectra near the surfaces of the LPSC particles of (C) TFAA-LPSC and (H) DPF-LPSC. Scale bar: 200 nm.

Supplementary Fig. 7.



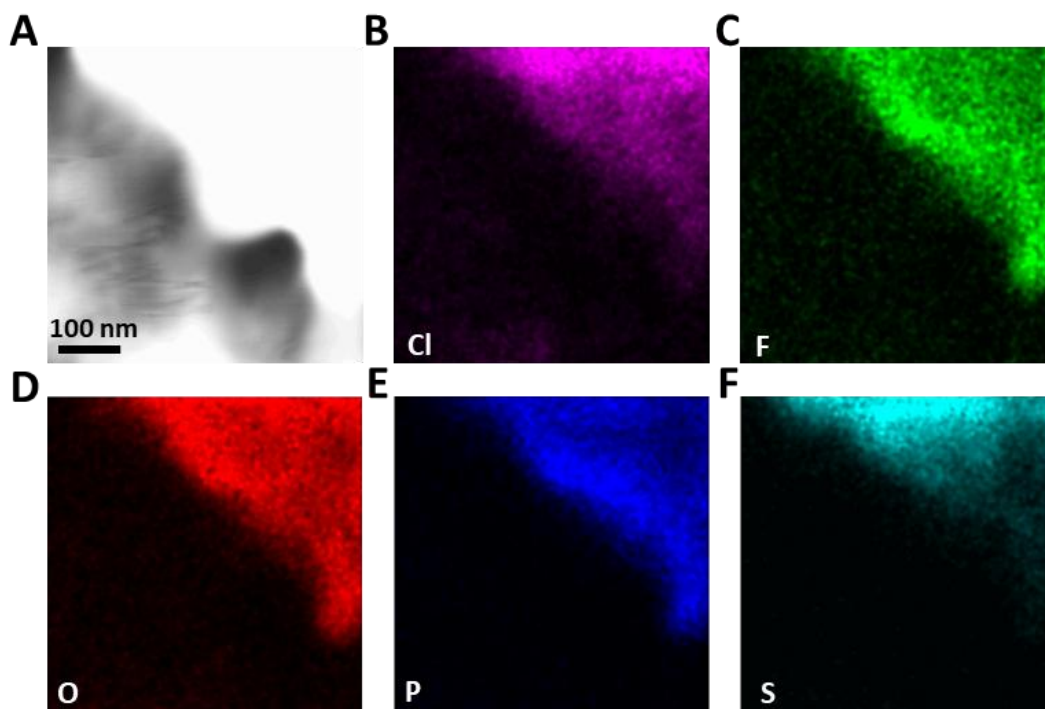
Supplementary Fig. 7. Typical standard EELS spectra of Li-based components.

Supplementary Fig. 8.



Supplementary Fig. 8. STEM EDS elemental mapping of DPF-LPSC particles.

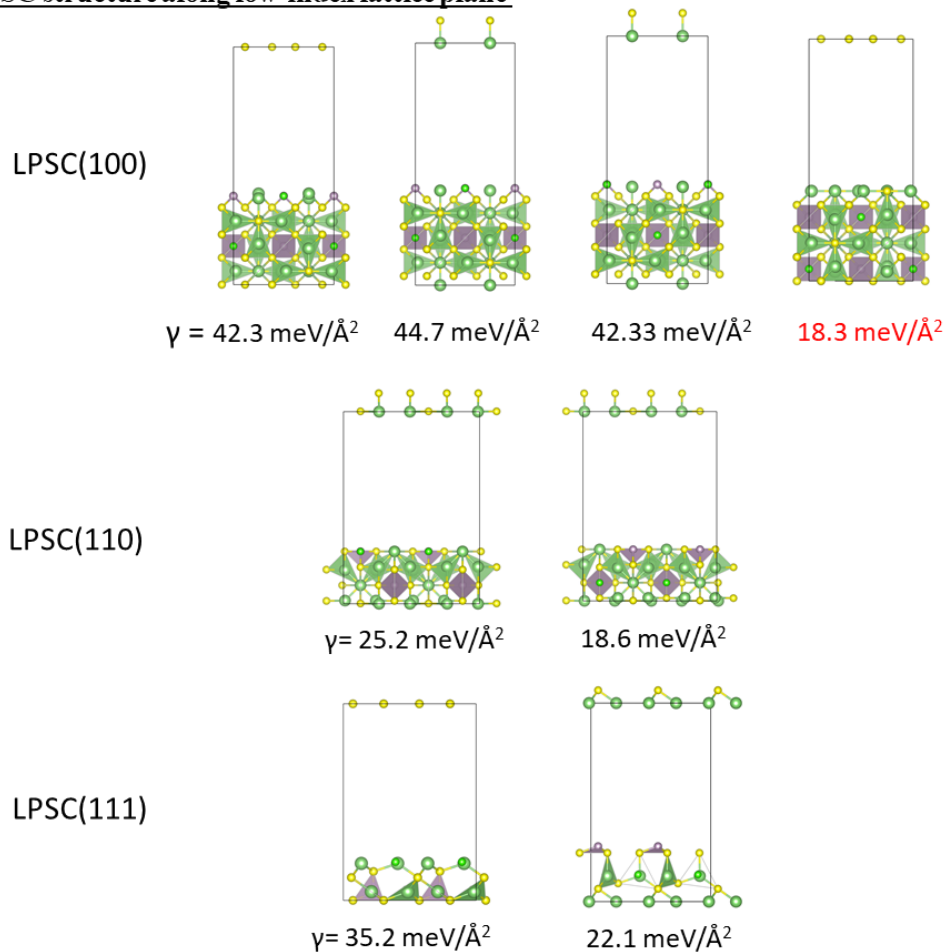
Supplementary Fig. 9.



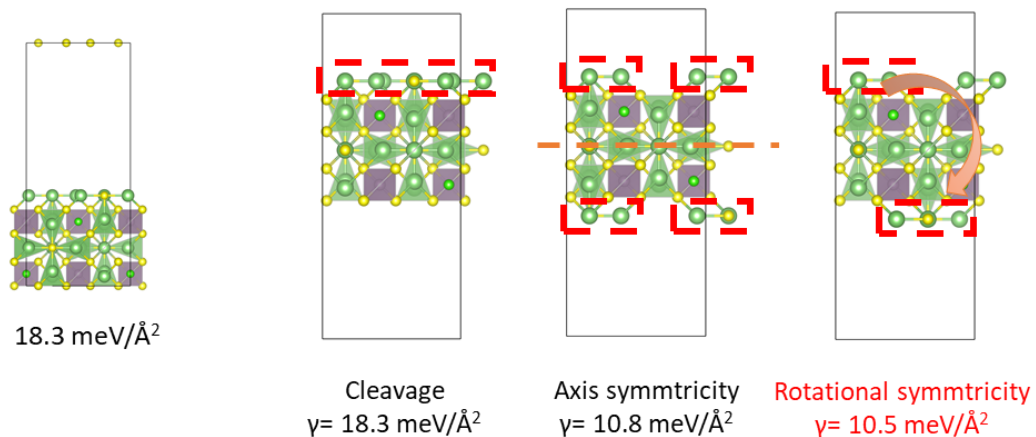
Supplementary Fig. 9. STEM EDS elemental mapping of DPF-LPSC particles.

Supplementary Fig. 10.

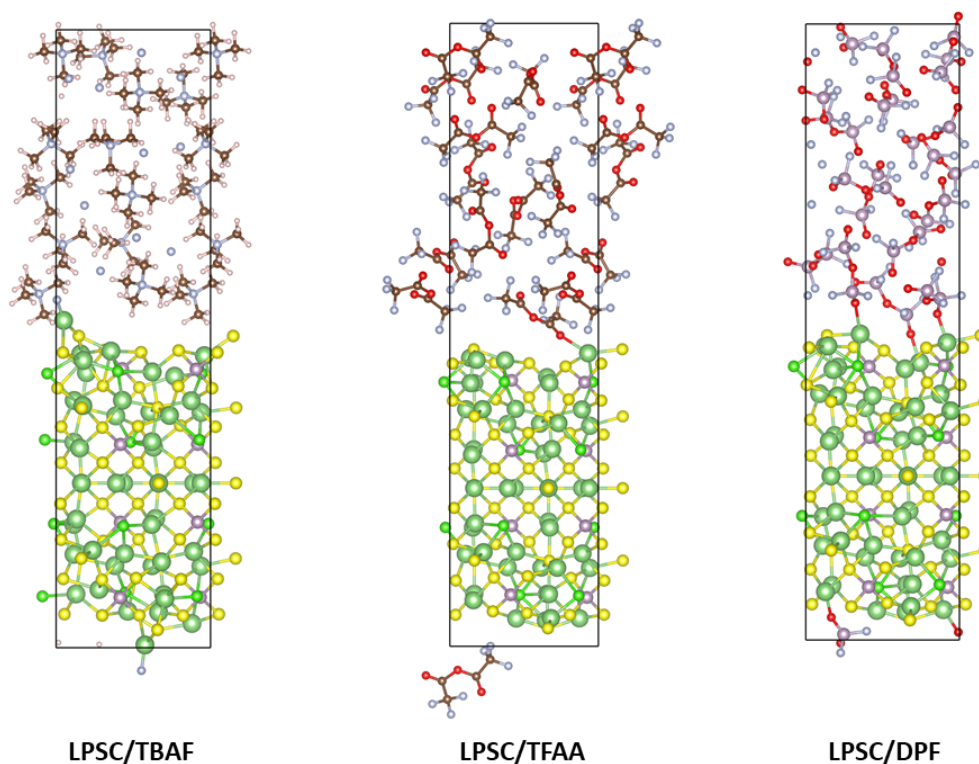
1. Finding the surface slab with the lowest surface energy γ by cleaving the bulk LPSC structure along low-index lattice plane



2. Ensure structure and properties of two LPSC surfaces (up and down) in the slab equivalent and with the lowest surface energy

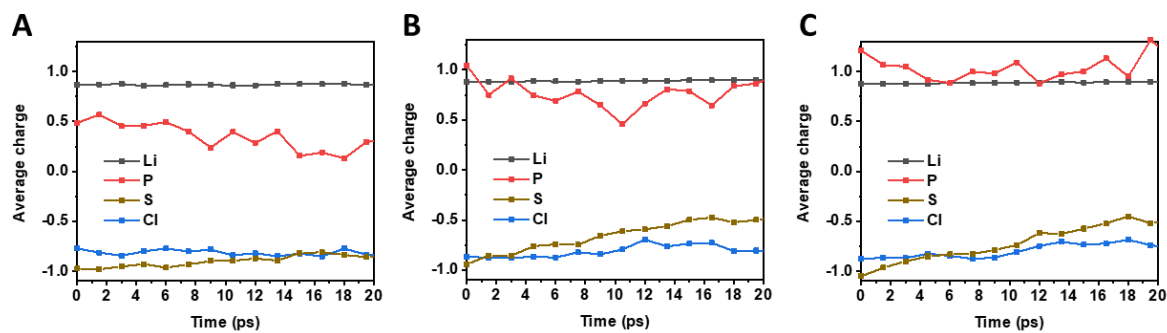


3. Using the slab to build LPSC/solvents system for AIMD simulations to investigate the interface reaction between LPSC solid electrolyte and TBAF, TFA and DPF.



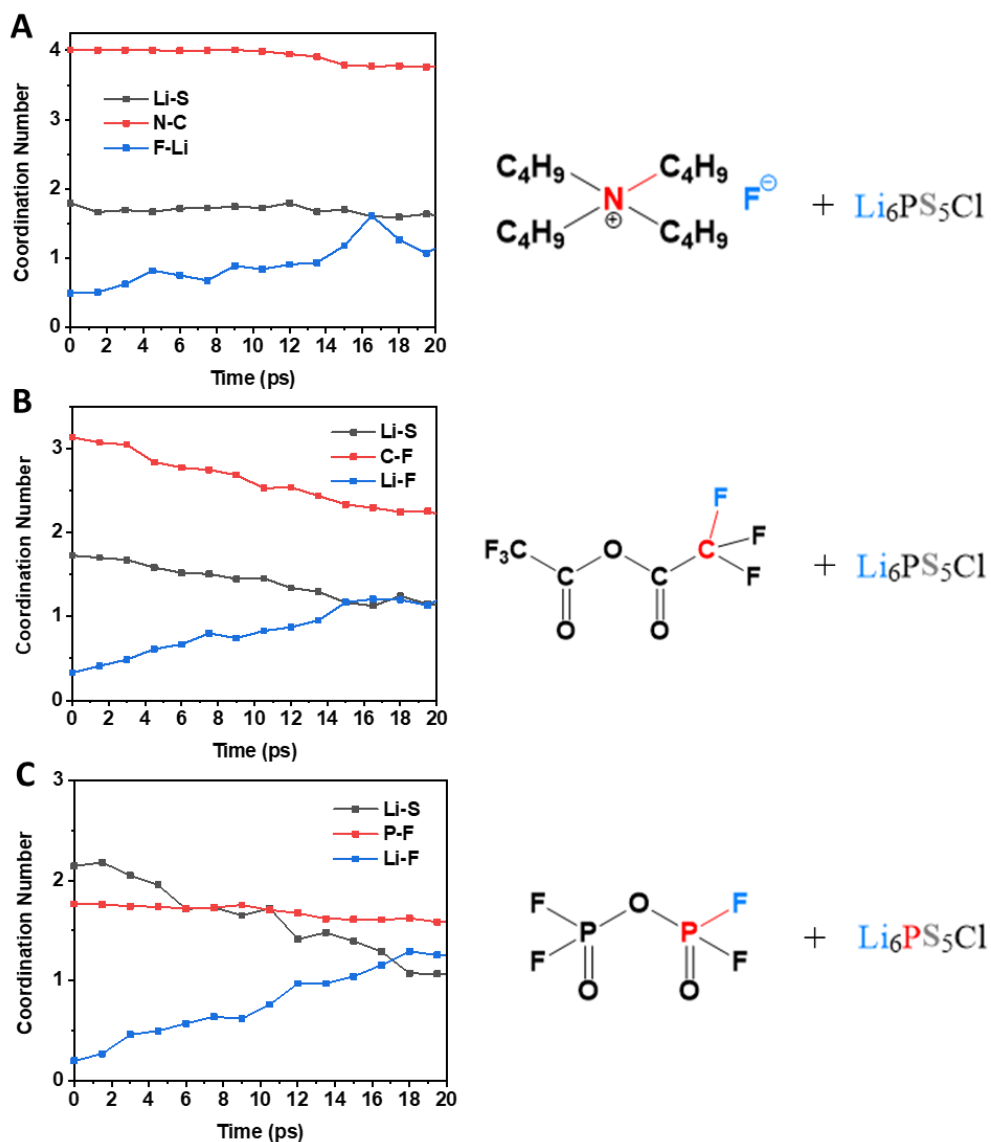
Supplementary Fig. 10. The 3 steps to build LPSC/Liquid Reactant system. γ represents the surface energy. The purple polyhedral represents PS₄ tetrahedron. The green polyhedral represents LiS₃ plane. Purple balls are P atoms, green balls are Li atoms and yellow balls are S atoms. Brown balls are C atoms. Blue balls are N atoms. Light blue balls are F atoms. Pink balls are H atoms. Red balls are O atoms. The model system has a supercell dimension of 10.26 Å * 10.26 Å * 42.14 Å, consisting of 11 - 16 liquid molecules depending on the density of liquid and two layers of LPSC with the rotational symmetry (100) surface.

Supplementary Fig. 11.



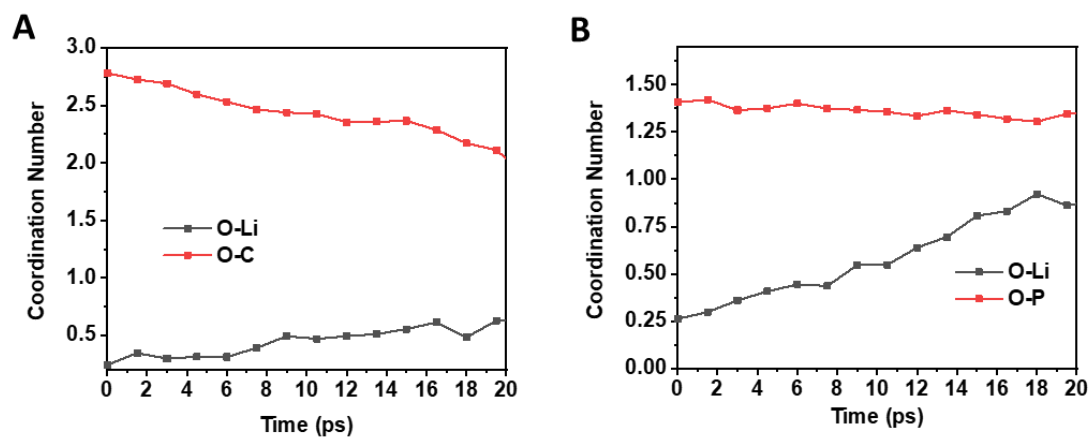
Supplementary Fig. 11. Evolution of the average charge of Li, P, Cl atoms along the AIMD simulations for the reaction of **(A)** LPSC with TBAF, **(B)** LPSC with TFAA, **(C)** LPSC with DPF.

Supplementary Fig. 12.



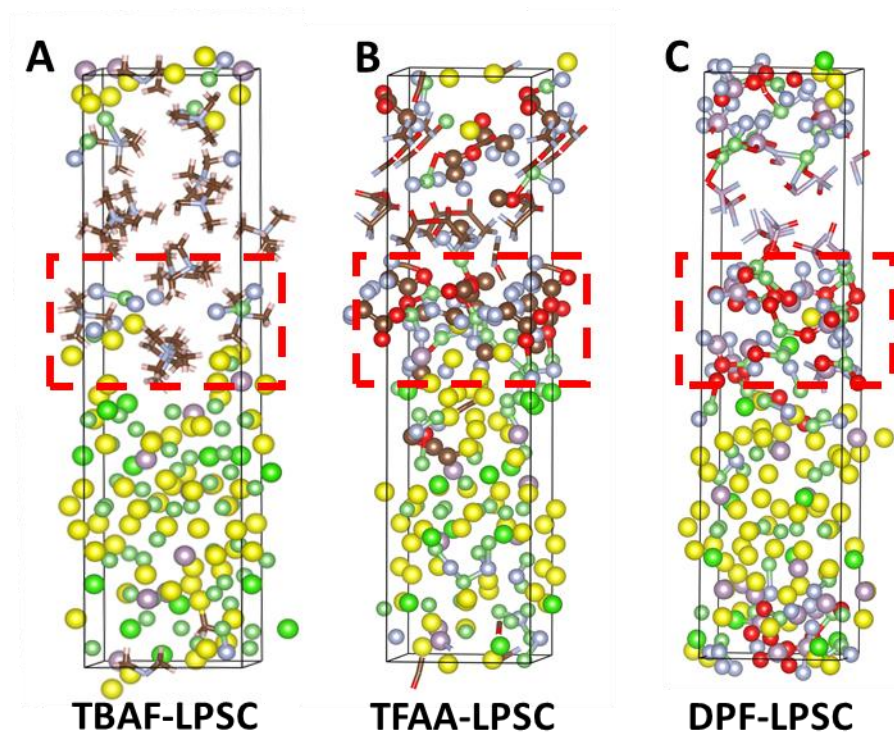
Supplementary Fig. 12. Using the coordination number to show the reaction process to form LiF in (A) LPSC (Li-S bond) and TBAF (N-C bond) and the formation of Li-F bond. (B) LPSC (Li-S bond) and TFAA (C-F bond) and the formation of Li-F bond. (C) LPSC (Li-S bond) and DPF (P-F bond) and the formation of Li-F bond.

Supplementary Fig. 13.



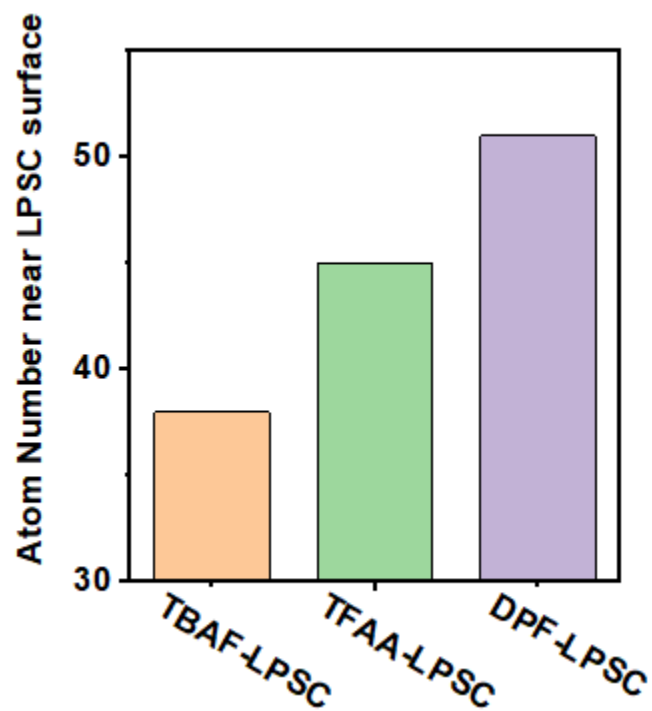
Supplementary Fig. 13. Using the O coordination number to show the reaction process to form Li-O in (A) LPSC and TFAA (O-C bond) and the formation of O-Li bond, and in (B) LPSC and DPF (O-P bond) and the formation of O-Li bond.

Supplementary Fig. 14.



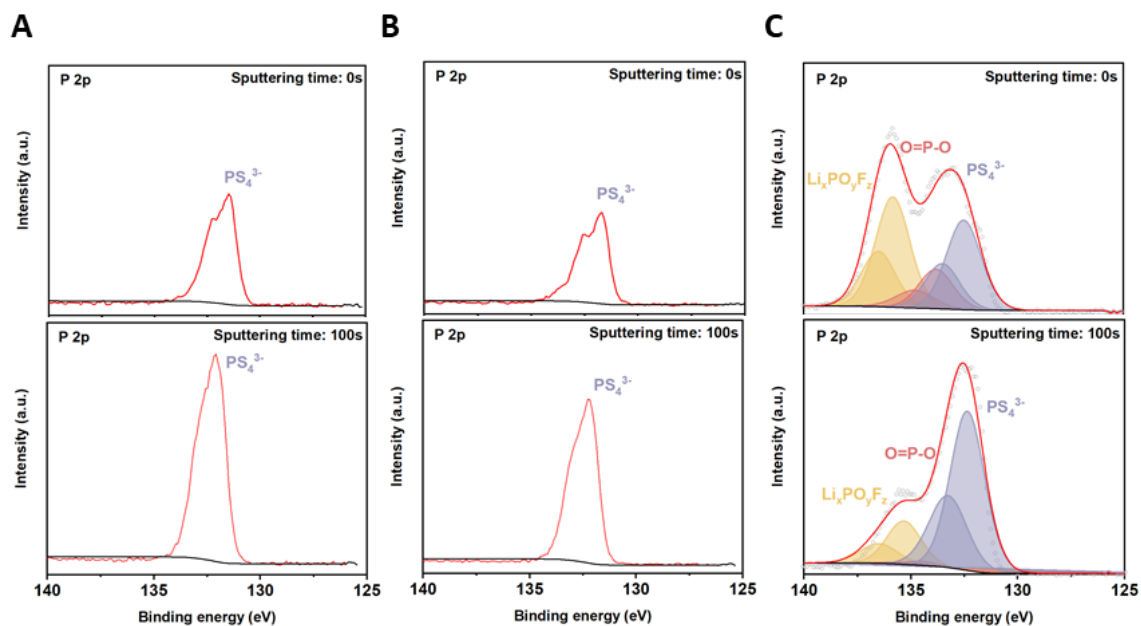
Supplementary Fig. 14. Snapshot of (A) LPSC and TBAF reaction, (B) LPSC and TFAA reaction, and (C) LPSC and DPF reaction after AIMD simulation. In the AIMD simulations, solvent molecules are presented by the sticks. Bulk LPSCs are presented by the balls without sticks. The formed SREI/coating is presented by the balls and sticks, which were marked by the red rectangular dash line. Purple balls are P atoms. Small green balls are Li atoms. Large green balls are Cl atoms. Yellow balls are S atoms. Brown balls are C atoms. Red balls are O atoms. Light blue balls are F atoms. Blue sticks are N atoms. Pink sticks are H atoms.

Supplementary Fig. 15.



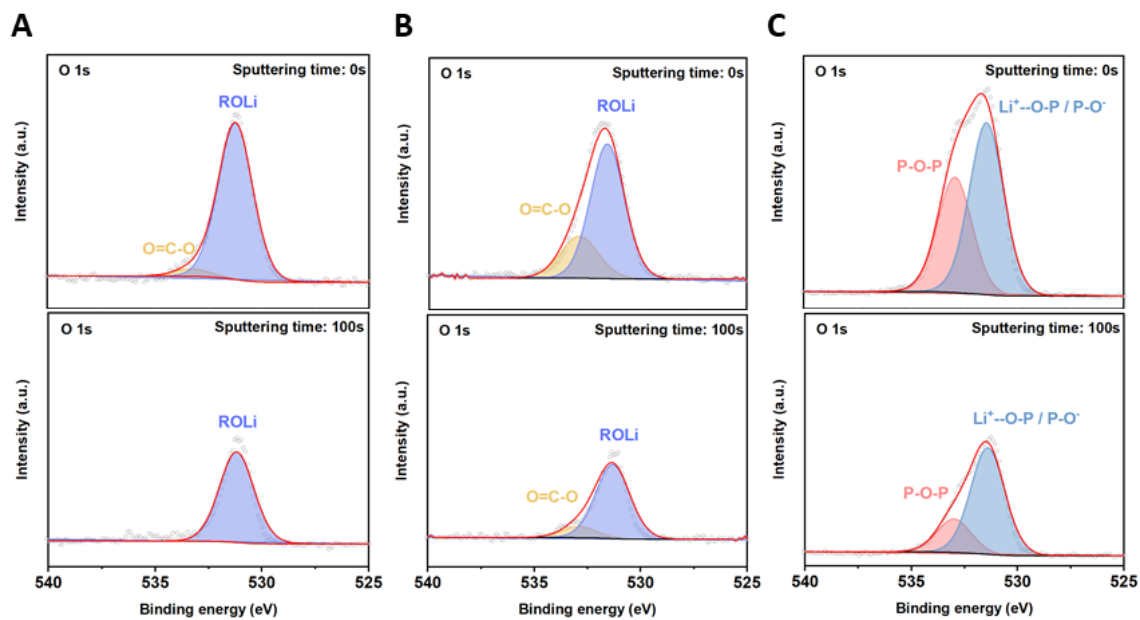
Supplementary Fig. 15. Corresponding atomic number near the surface of LPSC after reacting with TBAF, TFAA, and DPF in the AIMD simulations.

Supplementary Fig. 16.



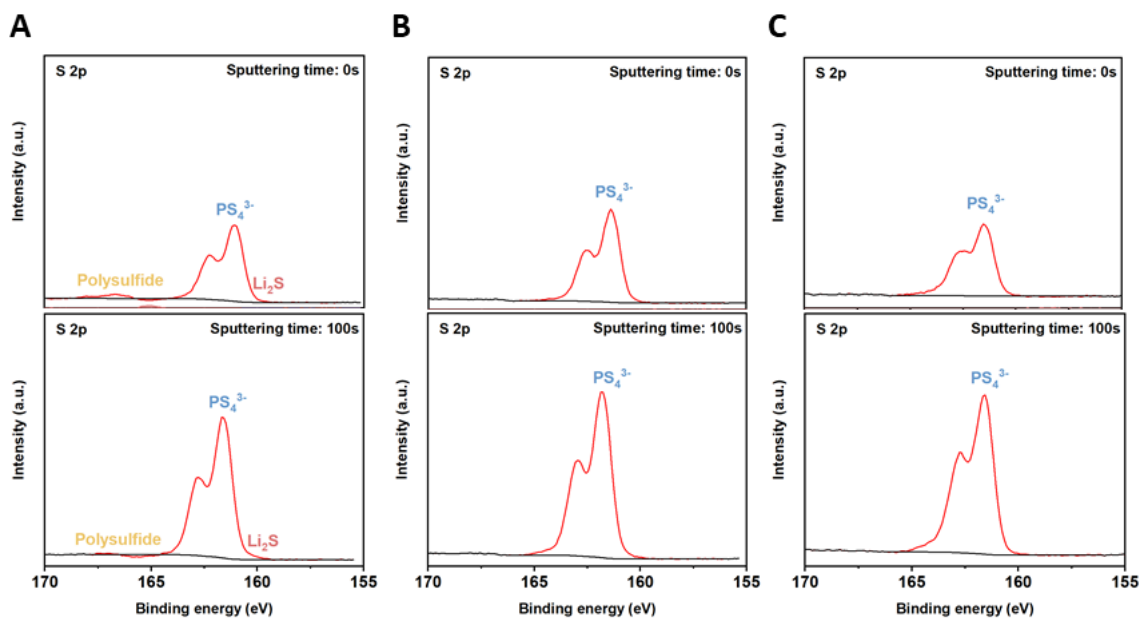
Supplementary Fig. 16. P 2p spectra of the surface of treated LPSC before/after sputtering for (A) TBAF-LPSC, (B) TFAA-LPSC, and (C) DPF-LPSC solid electrolyte pellets.

Supplementary Fig. 17.



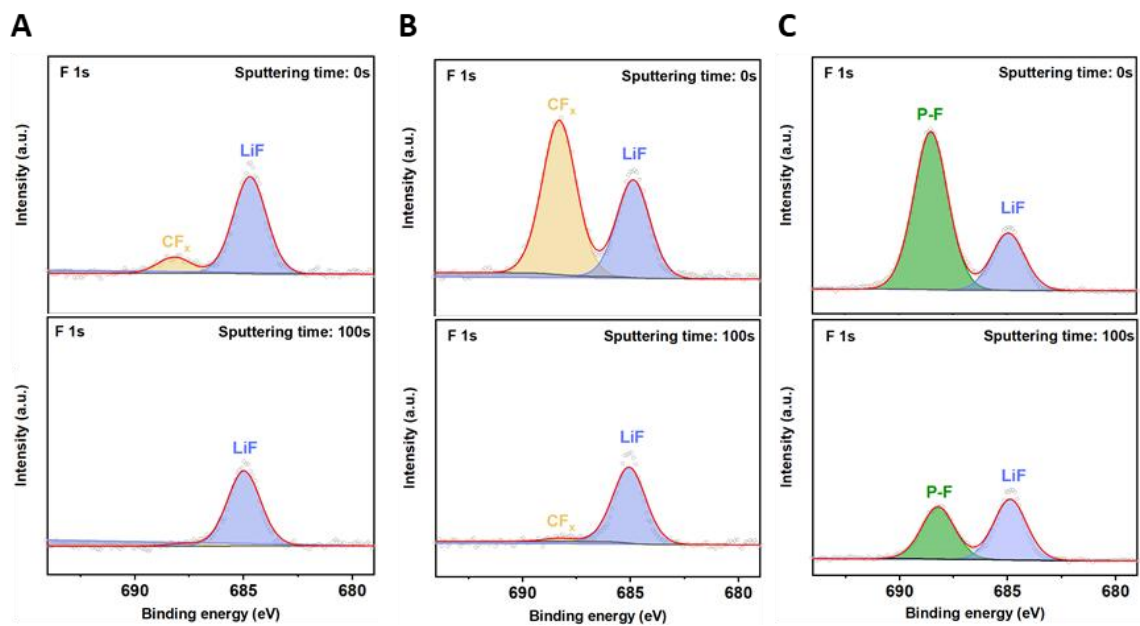
Supplementary Fig. 17. O 1s spectra of the surface of treated LPSC before/after sputtering for (A) TBAF-LPSC, (B) TFAA-LPSC, and (C) DPF-LPSC solid electrolyte pellets.

Supplementary Fig. 18.



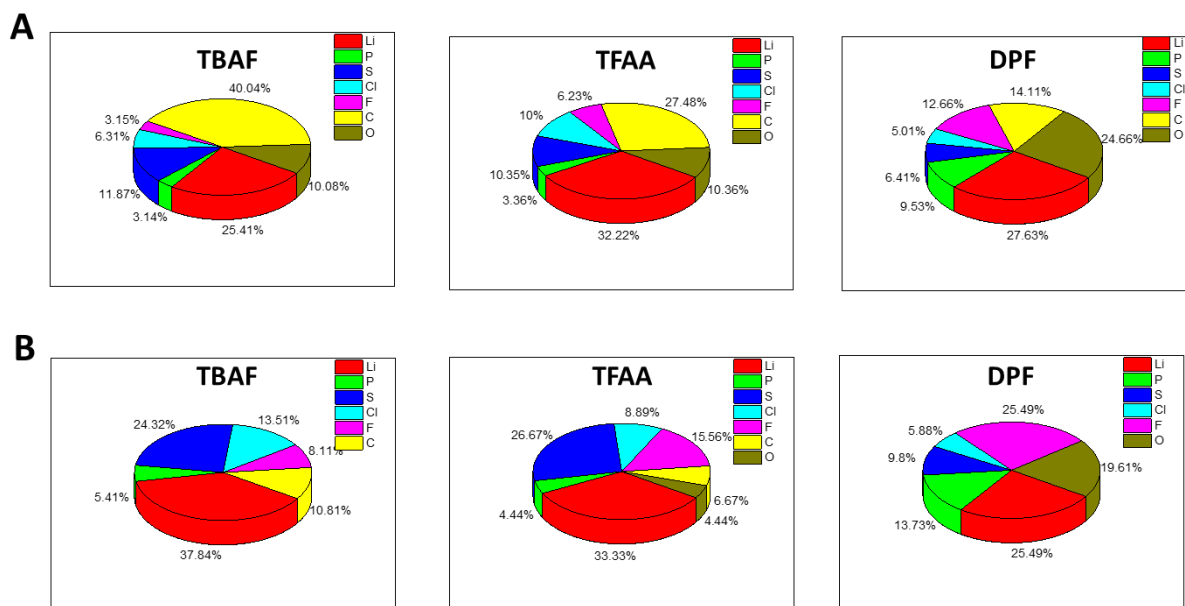
Supplementary Fig. 18. S 2p spectra of the surface of treated LPSC before/after sputtering for (A) TBAF-LPSC, (B) TFAA-LPSC, and (C) DPF-LPSC solid electrolyte pellets.

Supplementary Fig. 19.



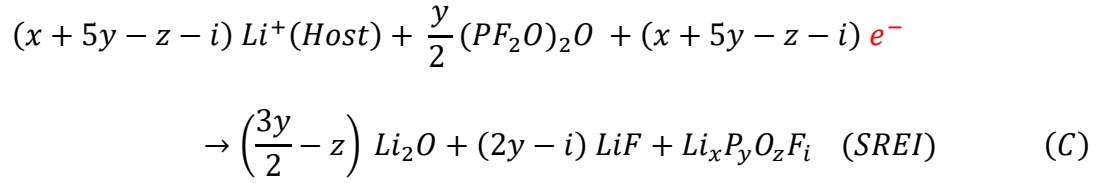
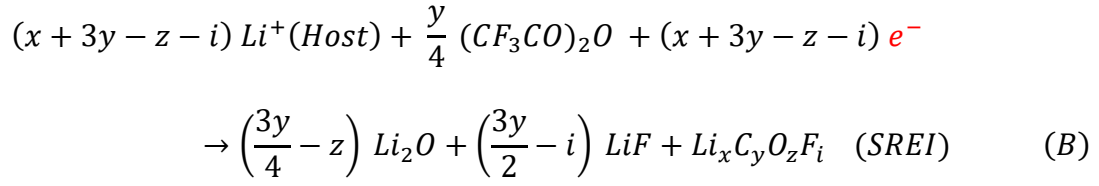
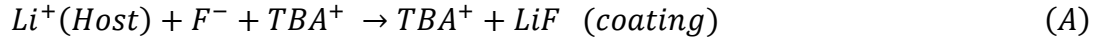
Supplementary Fig. 19. F 1s spectra of the surface of treated LPSC before/after sputtering for (A) TBAF-LPSC, (B) TFAA-LPSC, and (C) DPF-LPSC solid electrolyte pellets.

Supplementary Fig. 20.



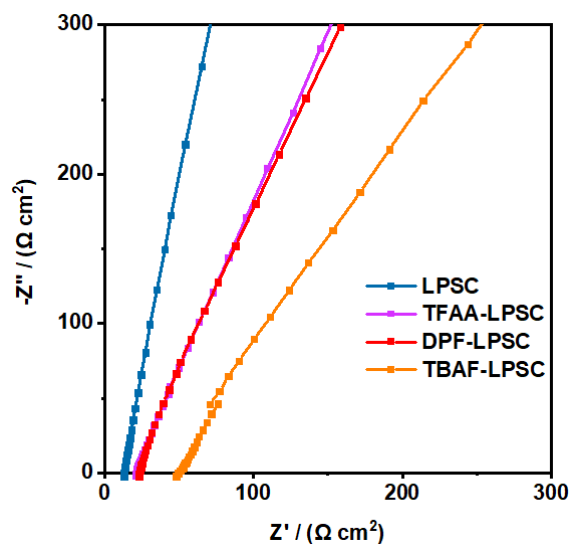
Supplementary Fig. 20. The composition of TBAF-coating and TFAA-, DPF-SREI on LPSC particle surface from (A) XPS experiment and (B) AIMD simulation.

Supplementary Fig. 21.



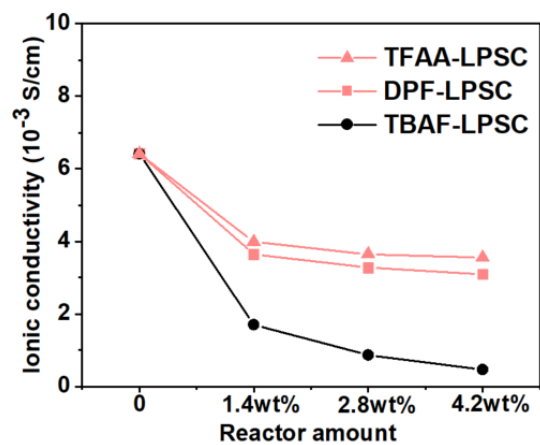
Supplementary Fig. 21. The proposed reaction equation for **(A)** TBAF-coating and **(B-C)** TFSA-, DPF-SREI.

Supplementary Fig. 22.



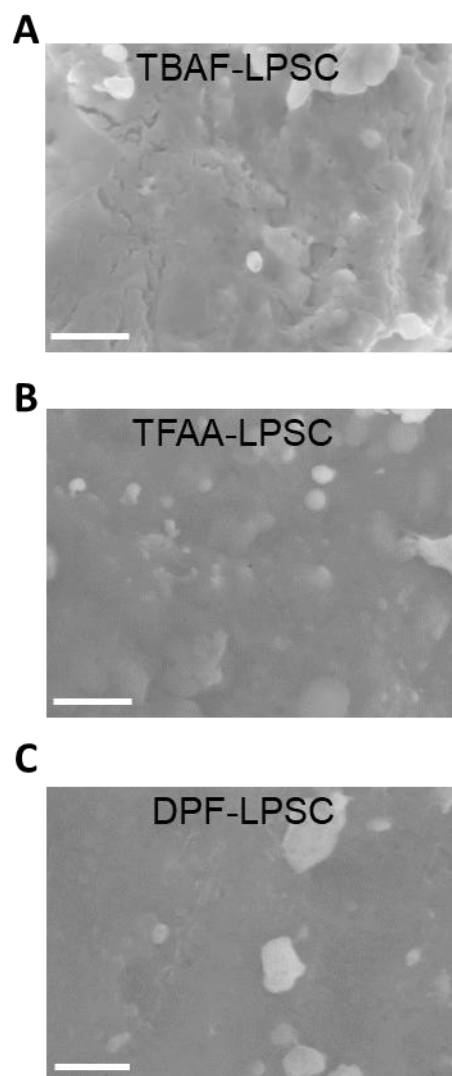
Supplementary Fig. 22. Resistance (ionic conductivity) of original LPSC, TFAA-LPSC, DPF-LPSC, and TBAF-LPSC solid electrolytes.

Supplementary Fig. 23.



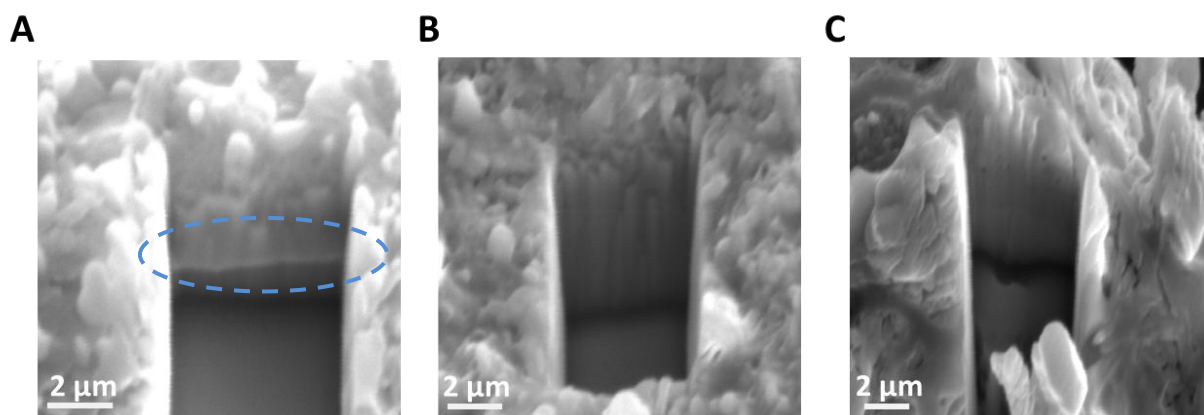
Supplementary Fig. 23. Ionic conductivity of LPSC after treating with different amounts (concentration) of TBAF, TFAA, and DPF in the same reaction time.

Supplementary Fig. 24.



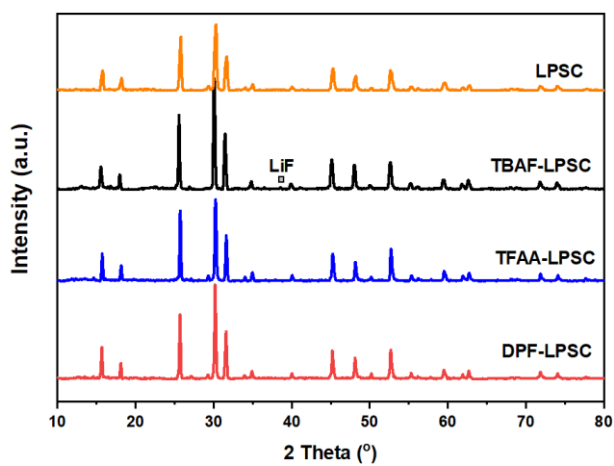
Supplementary Fig. 24. (A-C) SEM image of TBAF-, TFAA- and DPF-LPSC on the surface of treated LPSC particles. Scale bar: 2 μm .

Supplementary Fig. 25.



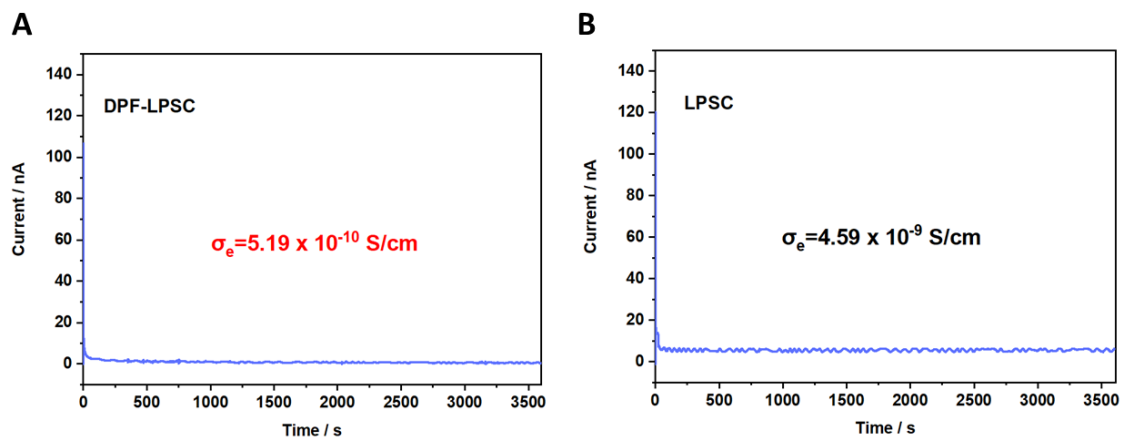
Supplementary Fig. 25. (A-C) Cross-section SEM images along the depth of Ga^+ 301 sputtered craters of (A) TBAF-LPSC, (B) TFAA-LPSC, (C) DPF-LPSC SSE particles.

Supplementary Fig. 26.



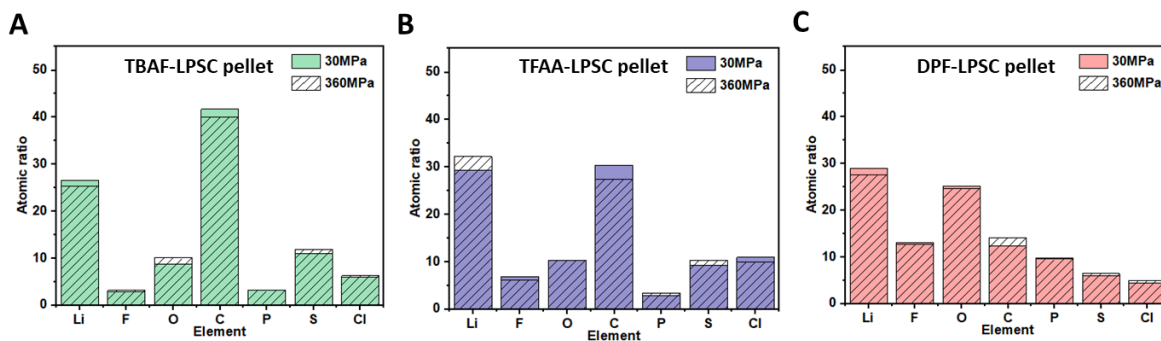
Supplementary Fig. 26. XRD patterns of original LPSC, TBAF-LPSC, TFAA-LPSC, and DPF-LPSC solid electrolytes.

Supplementary Fig. 27.



Supplementary Fig. 27. Direct current polarization data for electronic conductivity determination for **(A)** DPF-LPSC $5.19 \times 10^{-10} \text{ S cm}^{-1}$ and **(B)** LPSC $4.59 \times 10^{-9} \text{ S cm}^{-1}$. The electronic conductivity was calculated by using Ohm's law.

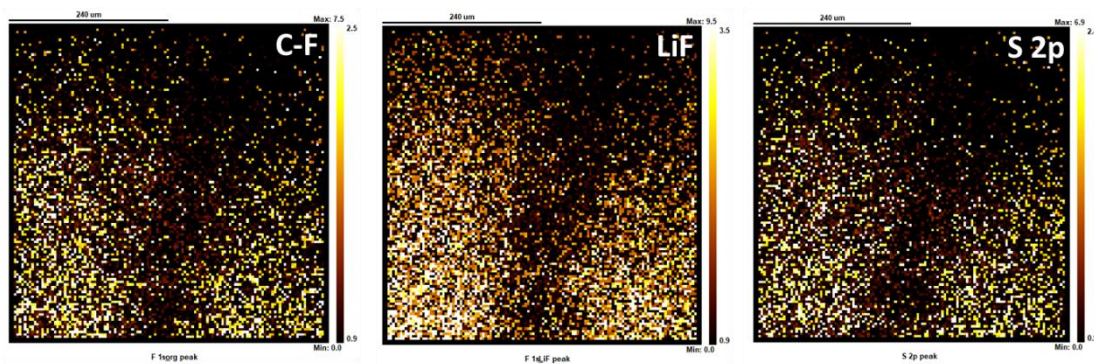
Supplementary Fig. 28.



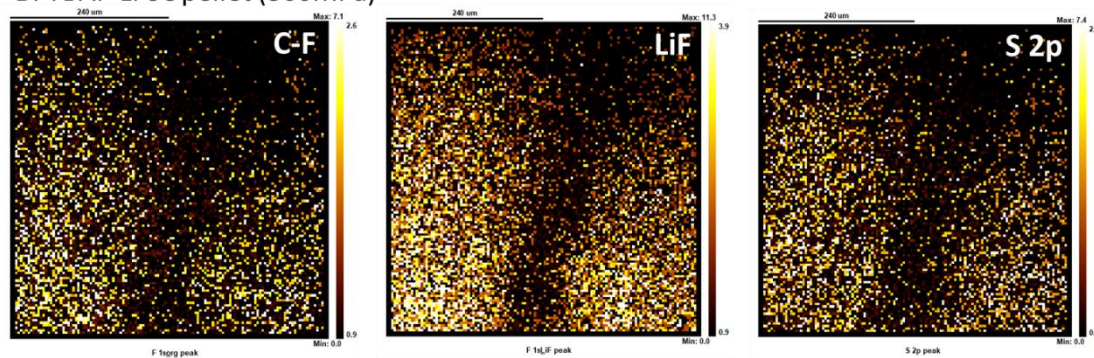
Supplementary Fig. 28. Quantified atomic composition ratios of the surface composition of SSE pellet of (A) TBAF-LPSC, (B) TFAA-LPSC, (C) DPF-LPSC processed by small (30MPa) and heavy (360MPa) pressing

Supplementary Fig. 29.

A: TBAF-LPSC pellet (30MPa)



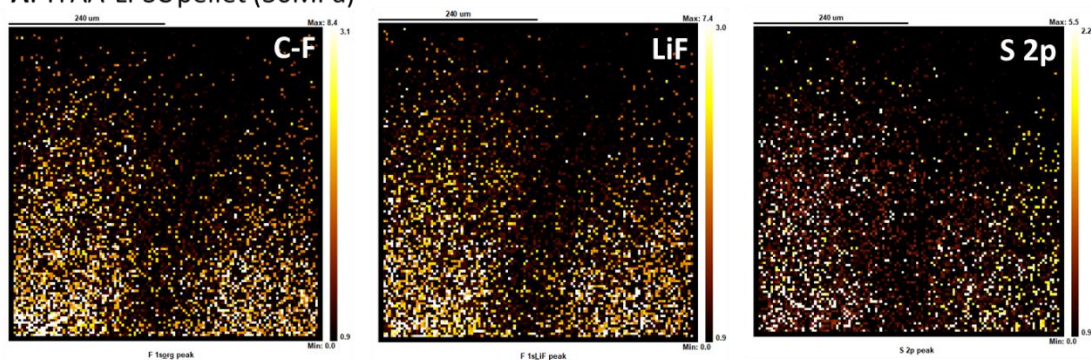
B: TBAF-LPSC pellet (360MPa)



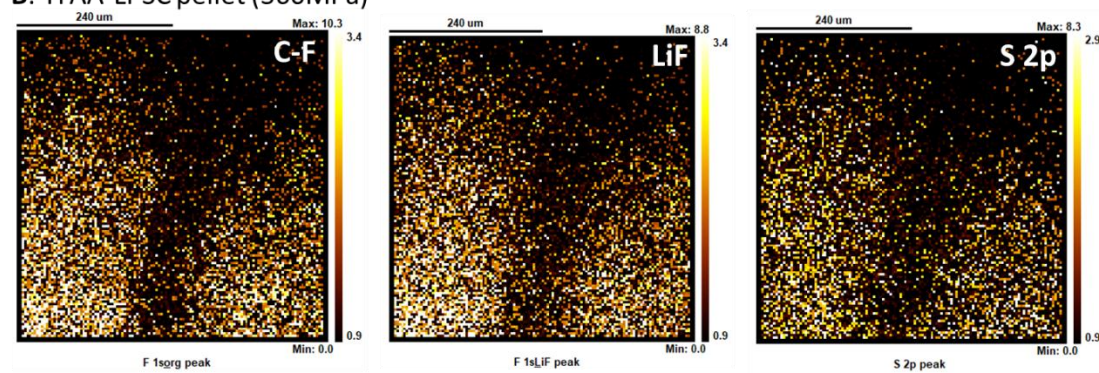
Supplementary Fig. 29. The XPS F 1s (C-F), F 1s (LiF), and S 2p peaks mapping of TBAF-LPSC pellet pressed under (A) 30MPa and (B) 360MPa.

Supplementary Fig. 30.

A: TFAA-LPSC pellet (30MPa)



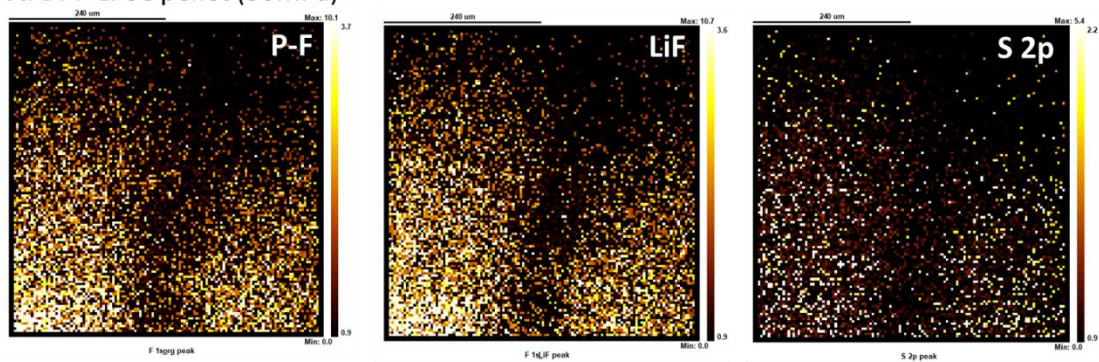
B: TFAA-LPSC pellet (360MPa)



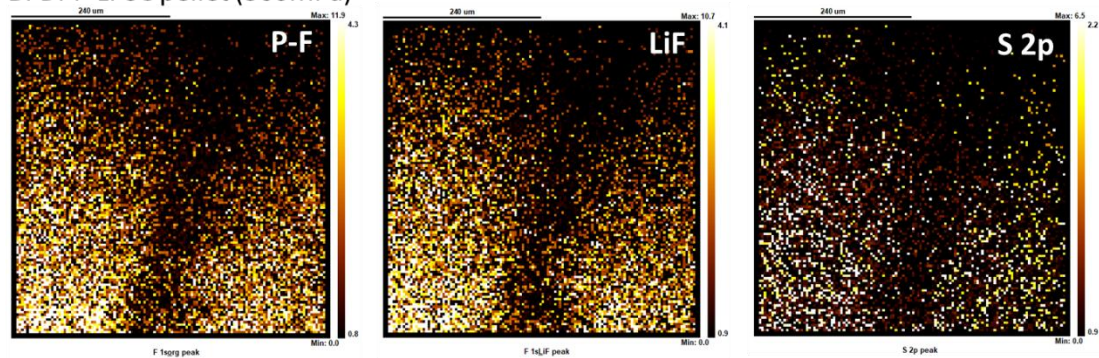
Supplementary Fig. 30. The XPS F 1s (C-F), F 1s (LiF), and S 2p peaks mapping of TFAA-LPSC pellet pressed under (A) 30MPa and (B) 360MPa.

Supplementary Fig. 31.

A: DPF-LPSC pellet (30MPa)

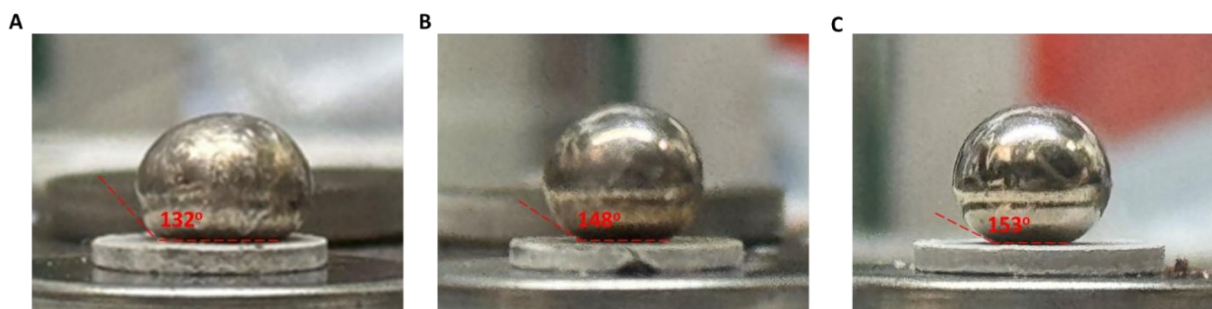


B: DPF-LPSC pellet (360MPa)



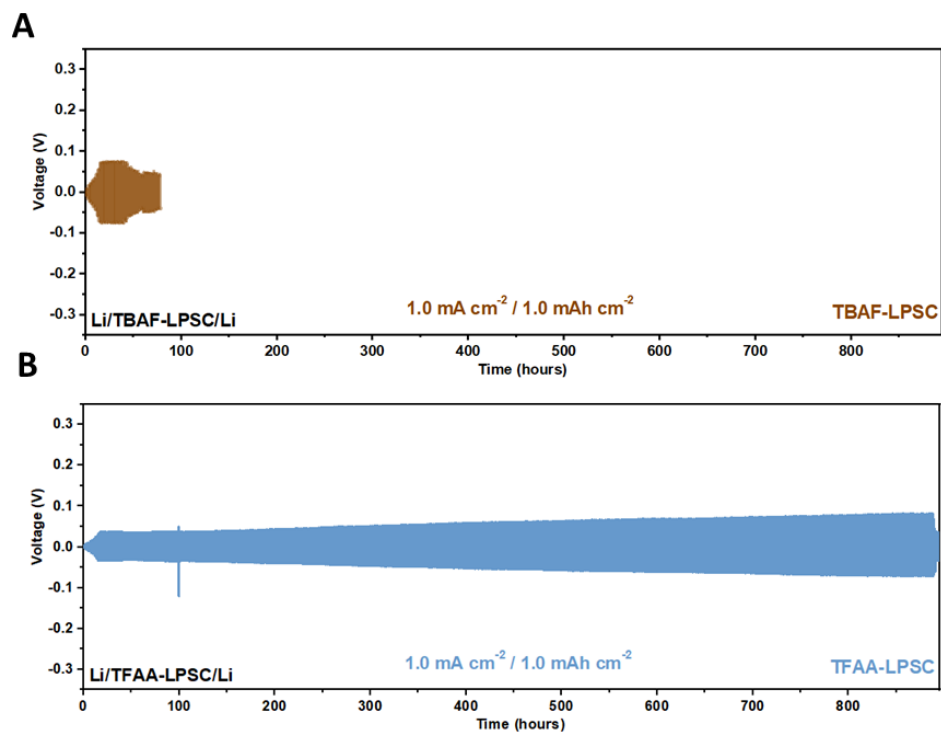
Supplementary Fig. 31. The XPS F 1s (P-F), F 1s (LiF), and S 2p peaks mapping of DPF-LPSC pellet pressed under (A) 30MPa and (B) 360MPa.

Supplementary Fig. 32.



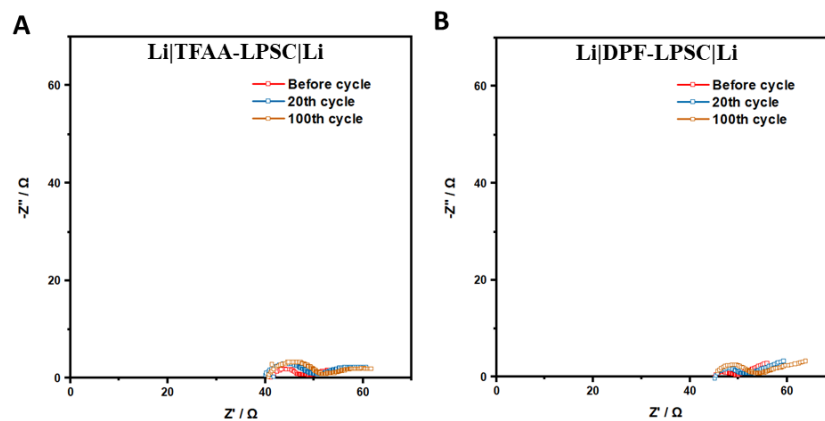
Supplementary Fig. 32. The contact angle test with molten lithium dropping on LPSC pellets of (A) TBAF-LPSC, (B) TFAA-LPSC, (C) DPF-LPSC.

Supplementary Fig. 33.



Supplementary Fig. 33. The cycling profile for Li||Li symmetric cells with (A) TBAF-LPSC and (B) TFAA-LPSC at current densities of 1 mA cm⁻² with 1h/1h plating/stripping time.

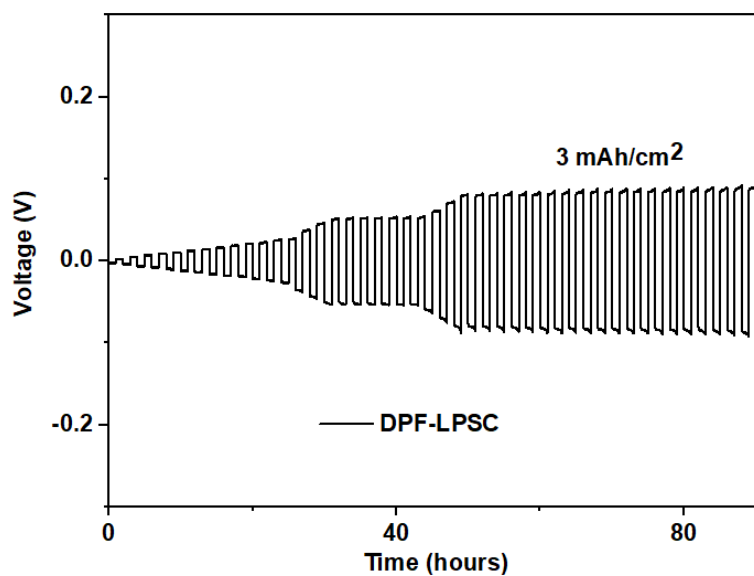
Supplementary Fig. 34.



Supplementary Fig. 34. EIS resistance evolution of Li|TFAA-LPSC|Li and Li|DPF-LPSC|Li.

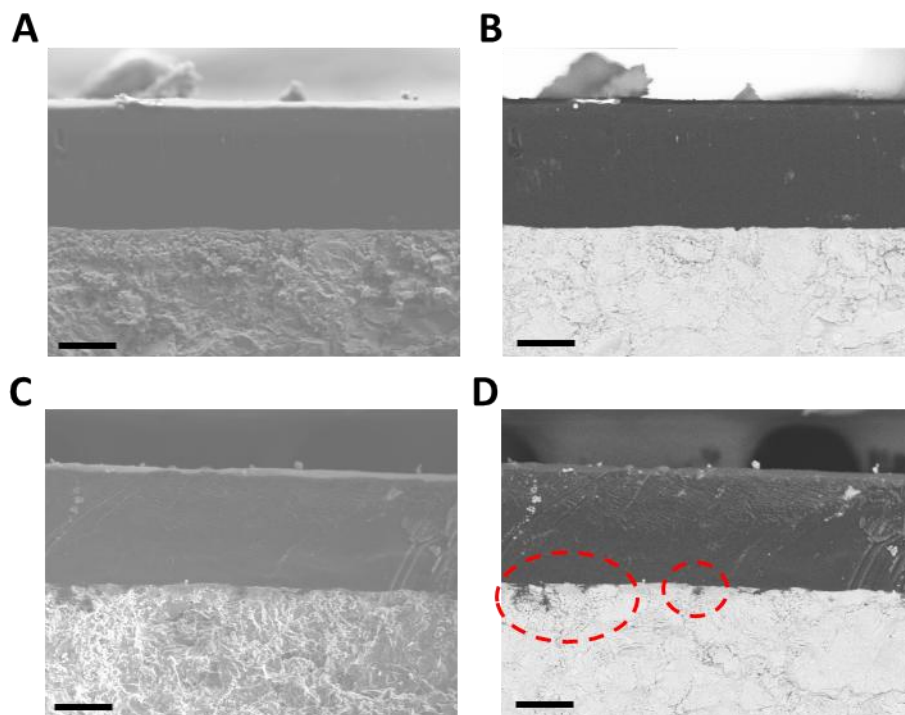
The first semi-circle belongs to the SEI and charge transfer.

Supplementary Fig. 35.



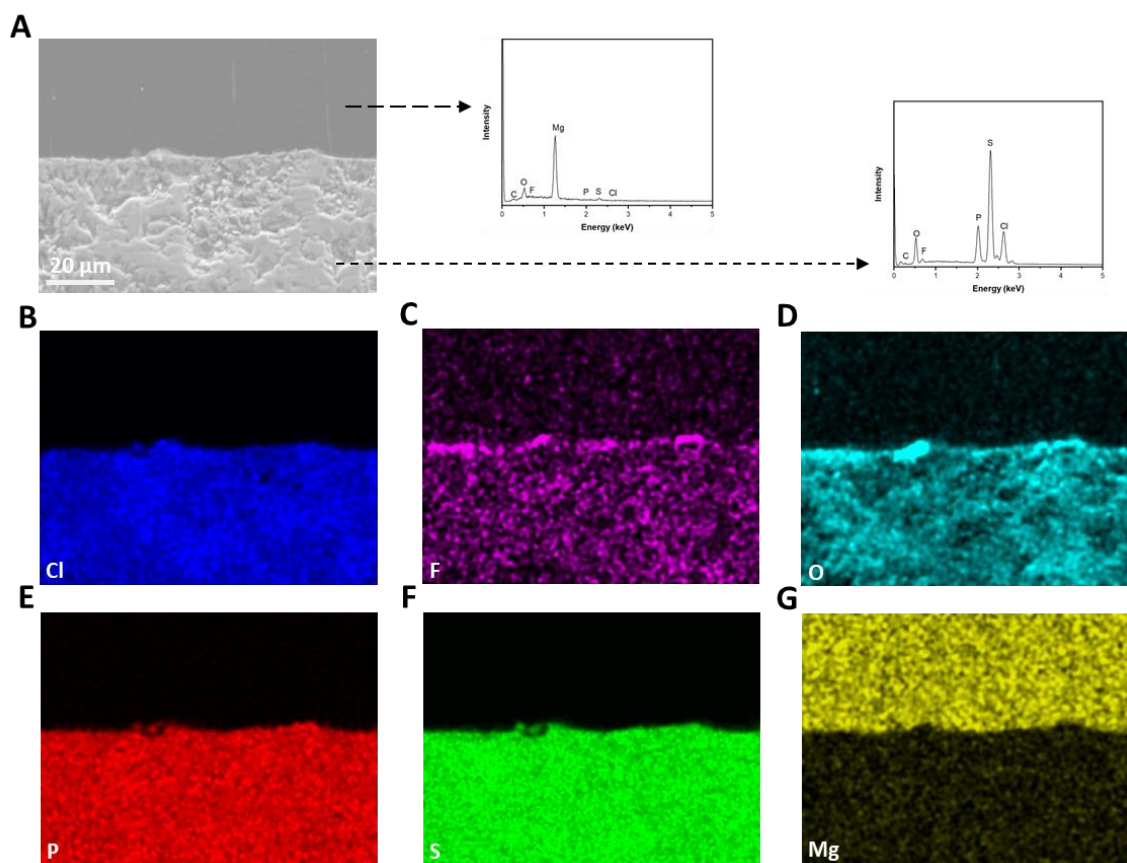
Supplementary Fig. 35. The cycling profile for Li||DPF-LPSC||Li cells at increasing current densities and fixed at 3 mA cm⁻² with 1h/1h plating/stripping time.

Supplementary Fig. 36.



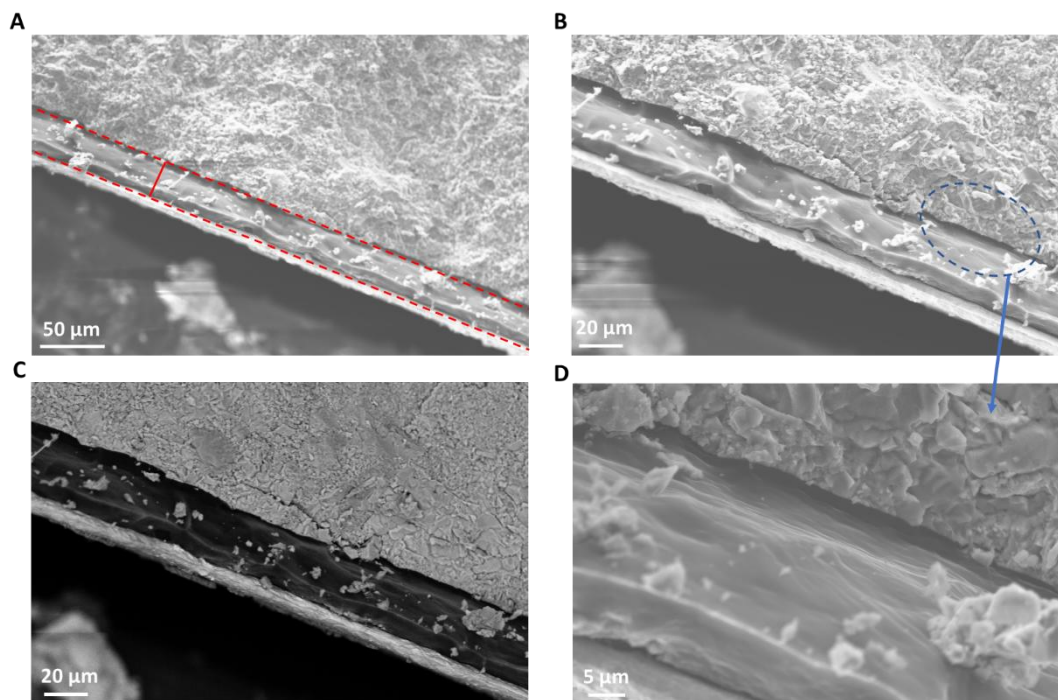
Supplementary Fig. 36. SEM and backscattering SEM image for the cross-section of (A, B) DPF-LPSC||Li interfaces and (C, D) LPSC||Li and after 50 Li plating/stripping cycles. Scale bar: 50 μm.

Supplementary Fig. 37.



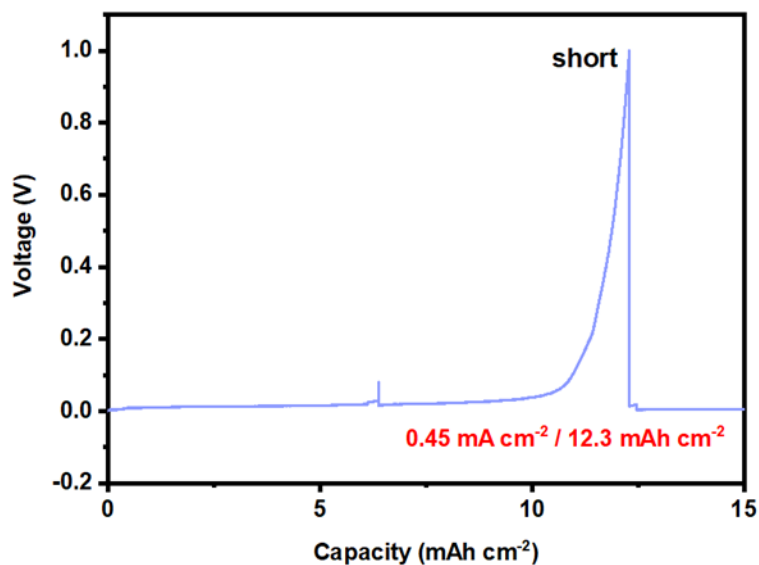
Supplementary Fig. 37. (A) SEM images and the corresponding EDS spectra and (B-G) EDS mapping of Cl, F, O, P, S, and Mg elements for the cross-section of DPF-LPSC||Li interface after 50 Li plating/stripping cycles. The occurrence of F and O signals on the Li metal side, and that of the Mg in the SSE side is due to the contrast noise, as indicated by the EDS spectra.

Supplementary Fig. 38.



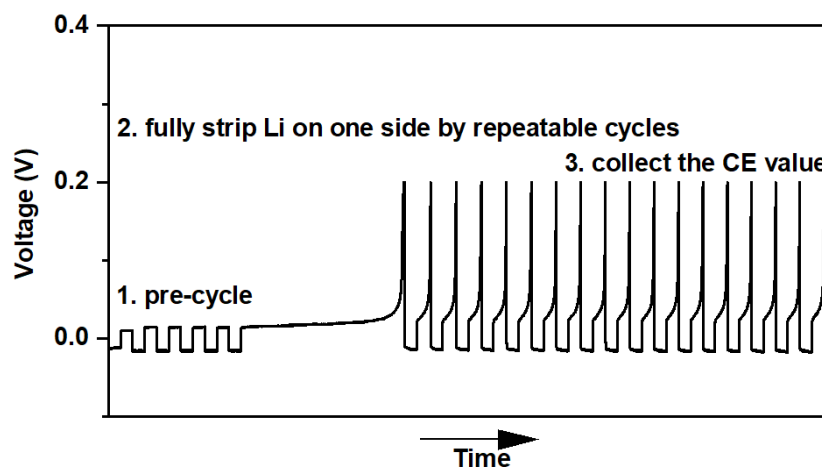
Supplementary Fig. 38. The cross-section morphology of 6mAh cm^{-2} lithium deposited in Li||DPF-LPSC||Cu half cell. Cu is used as a current collector for easy cutting to get the cross-section morphology. Fig. C is the backscattering SEM image.

Supplementary Fig. 39.



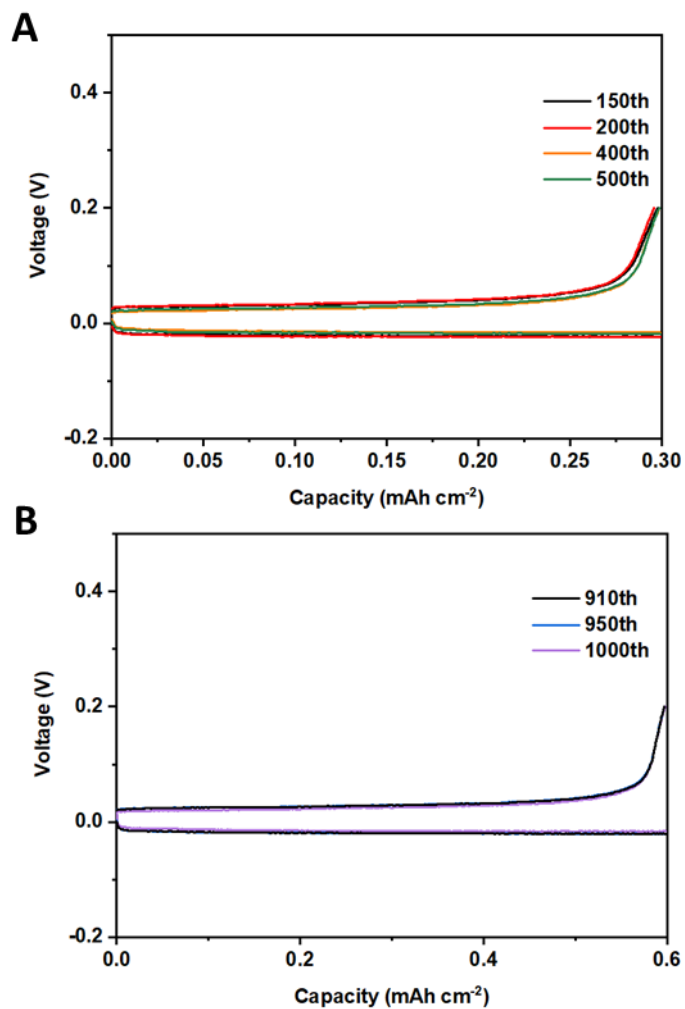
Supplementary Fig. 39. Critical capacity tested in Li||LPSC||Li symmetric cell with continuous Li plating at a constant current of 0.45 mA cm⁻².

Supplementary Fig. 40.



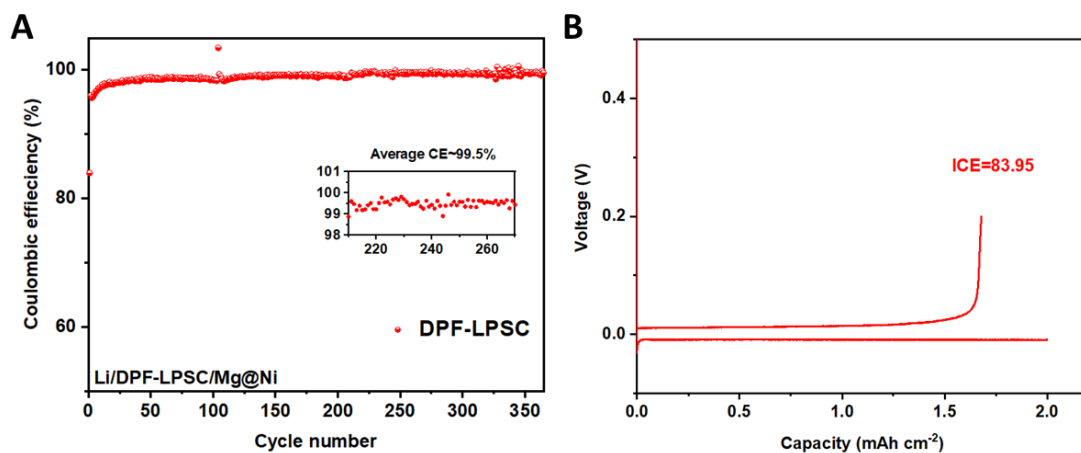
Supplementary Fig. 40. Schematic to show the coulombic efficiency testing protocol. The Li||LPSC||Li cells were first charged/discharged for 5 cycles using capacity control, and then all the lithium in Li on one side of the cells was completely stripped and repeated this process for some cycles to ensure the Li was completely stripped as Li||LPSC||Mg@SS cell

Supplementary Fig. 41.



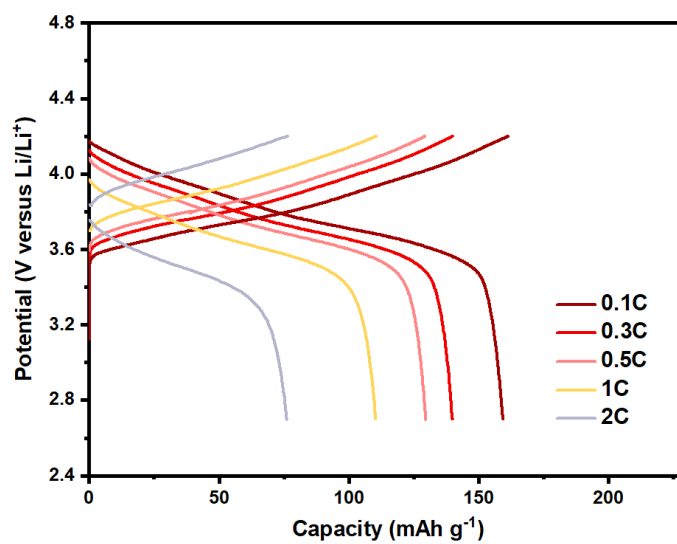
Supplementary Fig. 41. Charge/discharge profile of CE testing for Li||DPF-LPSC||Mg@SS at a current of 0.3 mA cm⁻² and capacity of (A) 0.3 mAh cm⁻², and (B) 0.6 mAh cm⁻².

Supplementary Fig. 42.



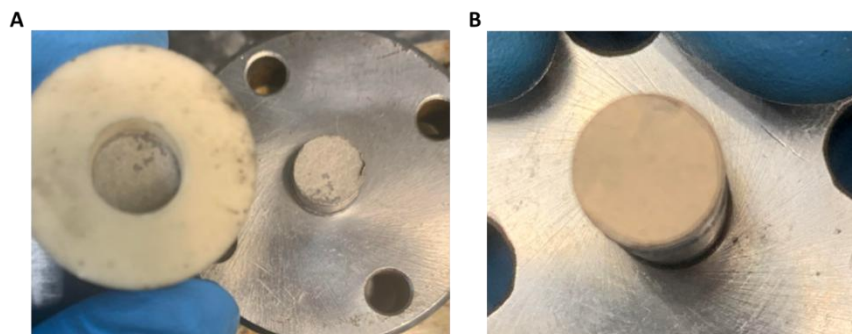
Supplementary Fig. 42. (A) The lithium coulombic efficiency of DPF-LPSC at a cycle current of 0.3 mA cm⁻² and capacity of 0.3 mAh cm⁻². ~50nm Mg layer was sputtered on the Ni foil as the current collector to help reduce the contact loss. (B) The corresponding initial CE in the first cycle with a capacity of 2 mAh cm⁻².

Supplementary Fig. 43.



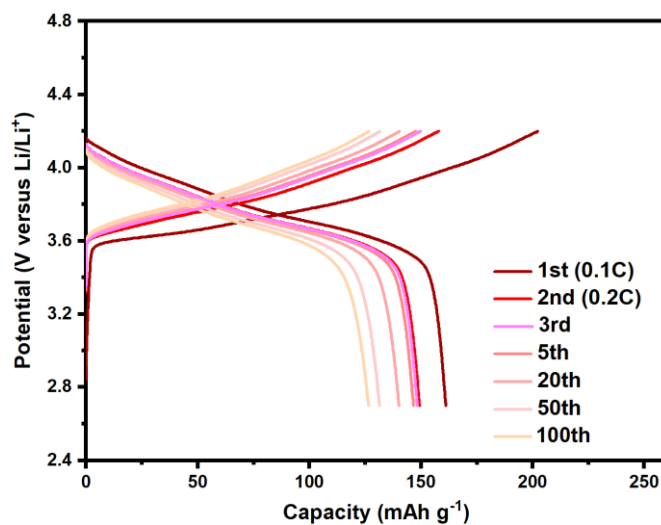
Supplementary Fig. 43. Voltage profiles of cell NCA||DPF-LPSC||Li at different C-rates.

Supplementary Fig. 44.



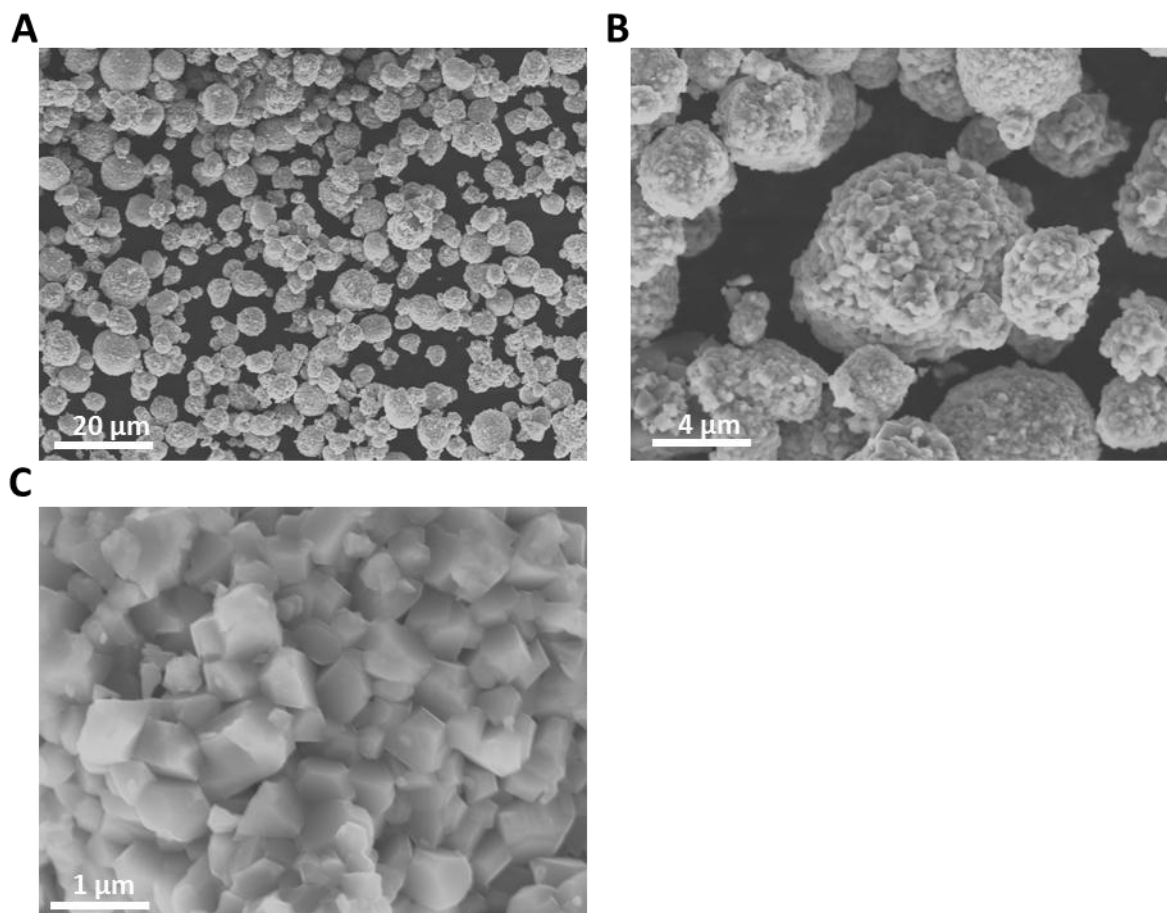
Supplementary Fig. 44. The images depict the disassembly of the SSE after full cell cycling for (A) LPSC and (B) DPF-LPSC.

Supplementary Fig. 45.



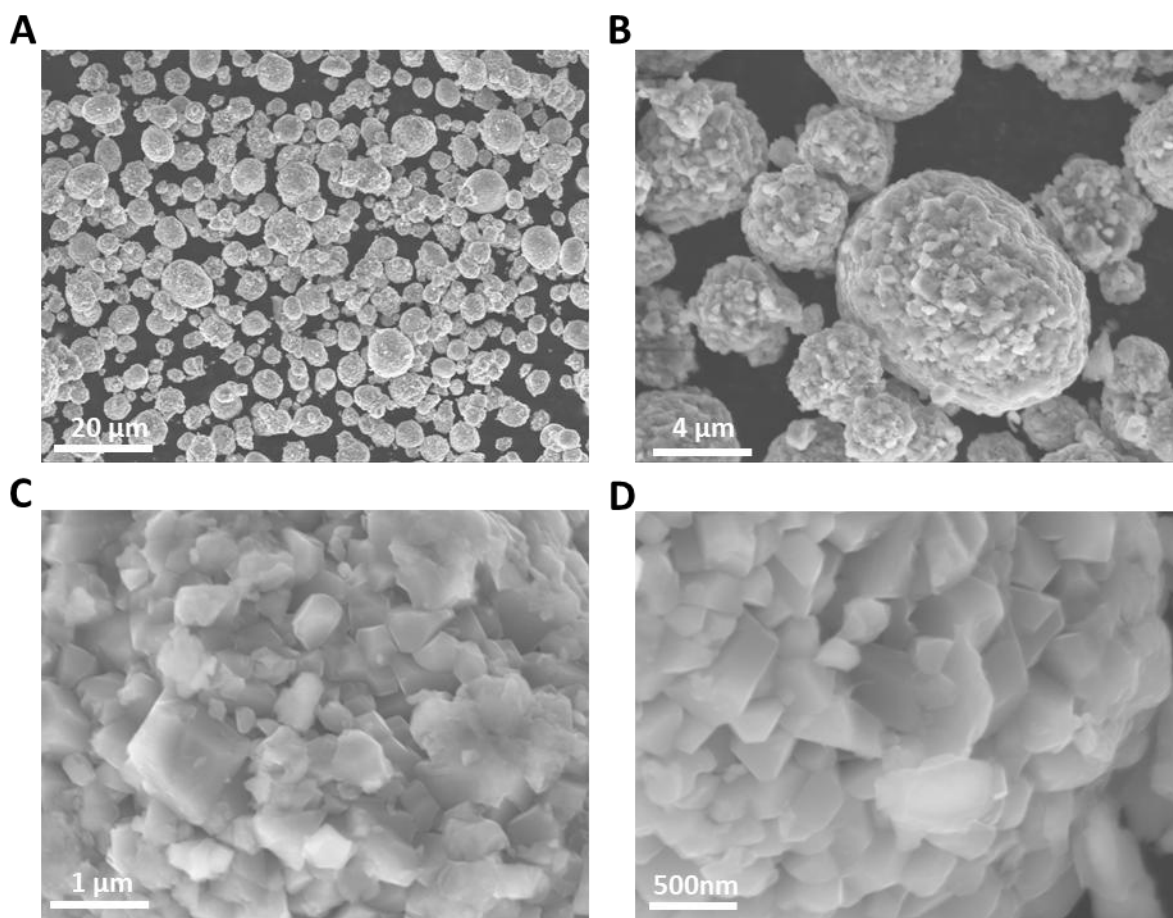
Supplementary Fig. 45. Voltage profiles of NCA||DPF-LPSC||Li with a loading of 3.5 mAh cm⁻² at 2.7-4.2V cut-off voltage.

Supplementary Fig. 46.



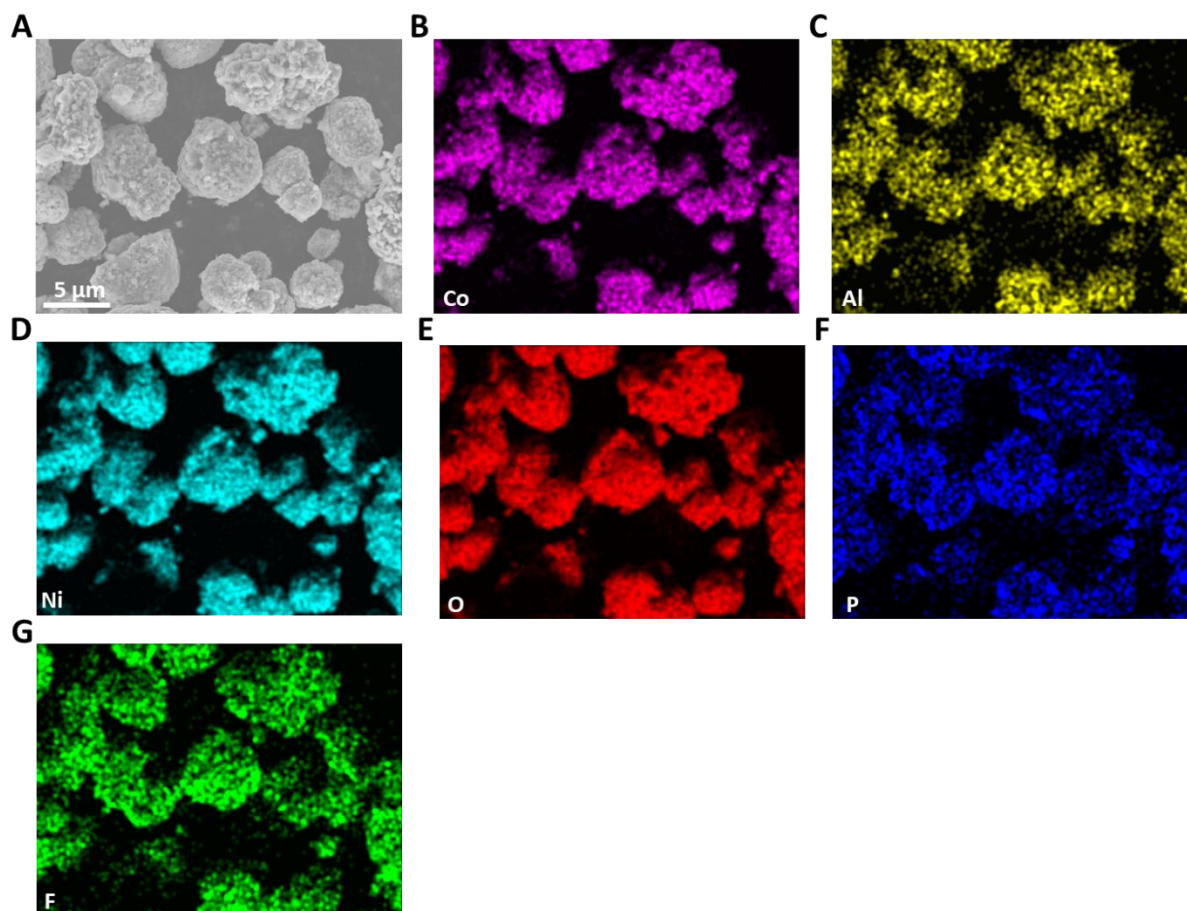
Supplementary Fig. 46. (A-C) SEM images of pristine NCA particles at different magnifications.

Supplementary Fig. 47.



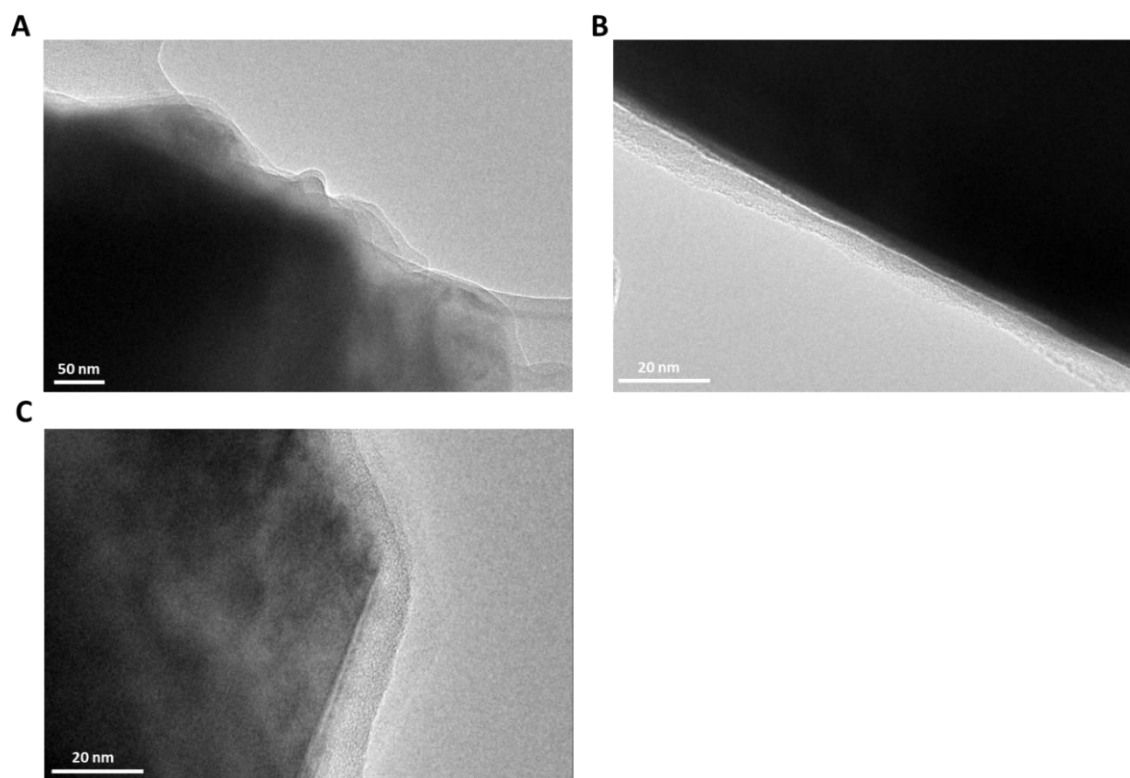
Supplementary Fig. 47. (A-D) SEM images of DPF-NCA particles at different magnifications.

Supplementary Fig. 48.



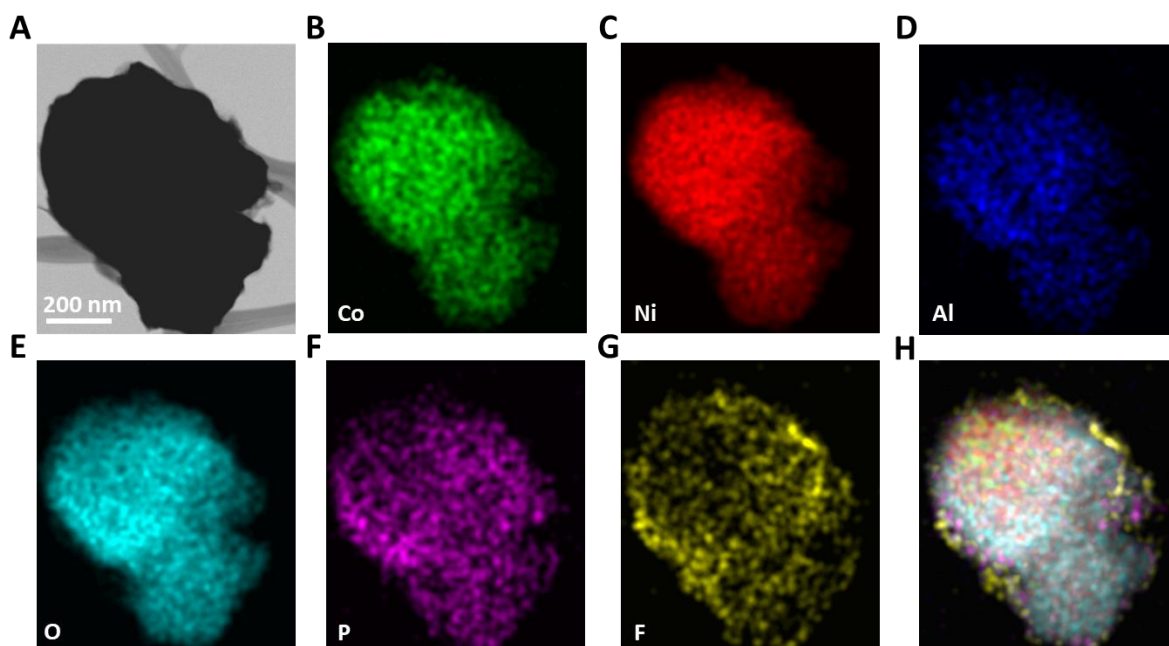
Supplementary Fig. 48. (A) SEM image and (B-G) element mapping of DPF-NCA particles with Co, Al, Ni, O, P, F elements.

Supplementary Fig. 49.



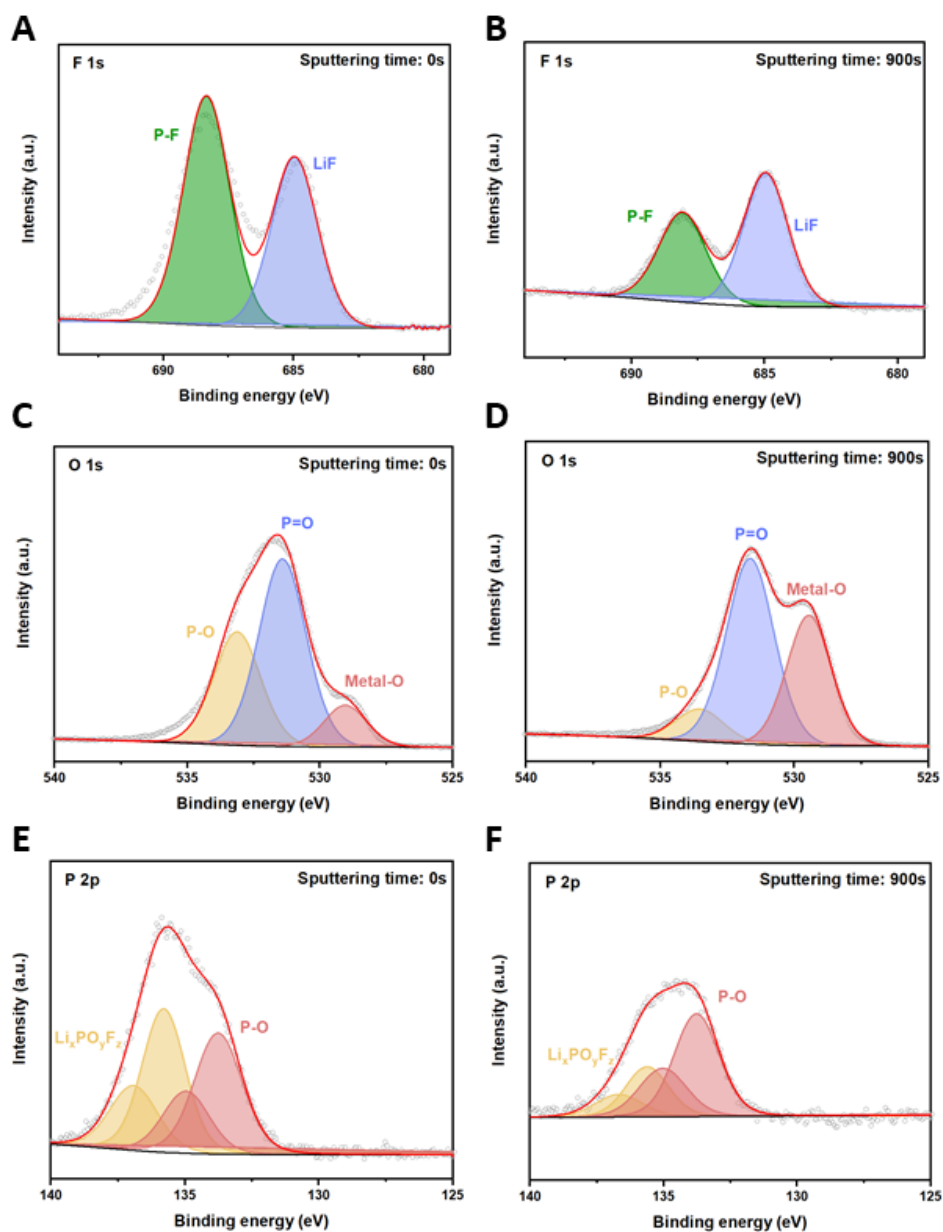
Supplementary Fig. 49. (A-C) High-resolution TEM images of DPF-NCA particles at different magnifications.

Supplementary Fig. 50.



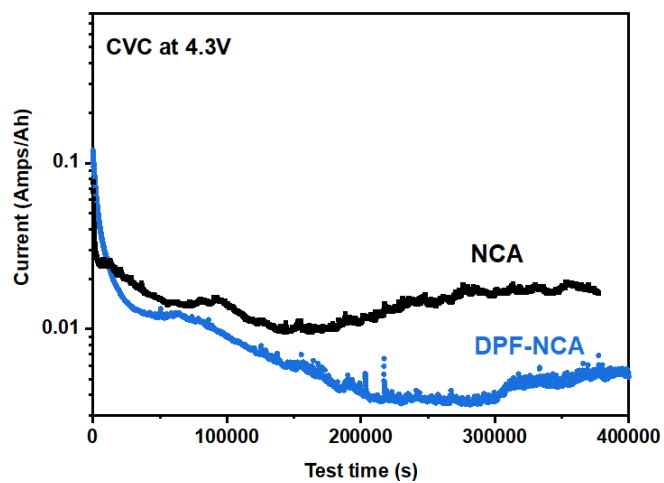
Supplementary Fig. 50. (A-G) High-resolution TEM images and mapping of DPF-NCA particles. (H) the color stack of element mapping.

Supplementary Fig. 51.



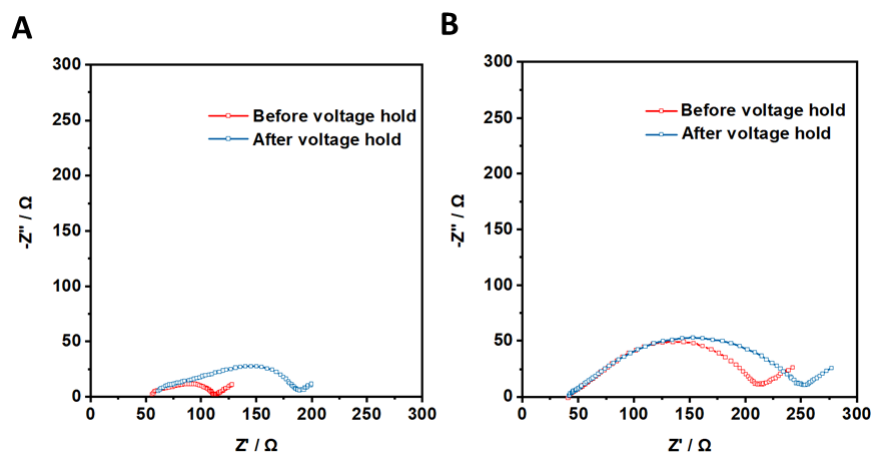
Supplementary Fig. 51. (A,B) F 1s, (C,D) O 1s and (E,F) P 2p spectra of the surface on DPF-NCA before/after sputtering.

Supplementary Fig. 52.



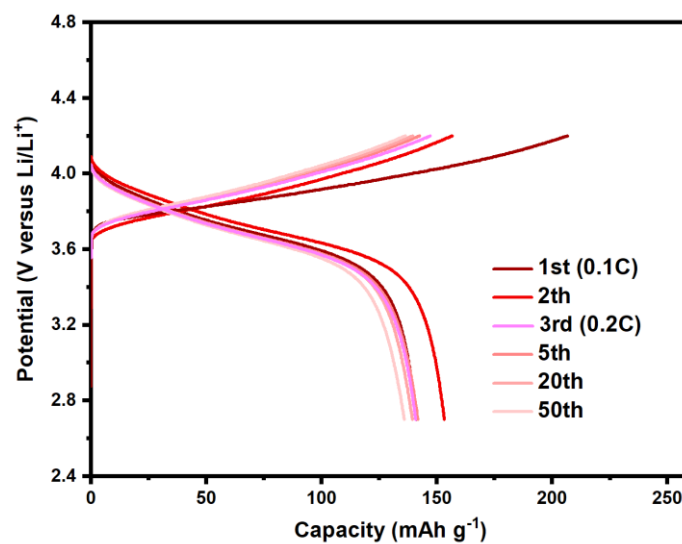
Supplementary Fig. 52. Leakage current of NCA||LPSC||Li and DPF-NCA||LPSC||Li cells when holding at 4.3V.

Supplementary Fig. 53.



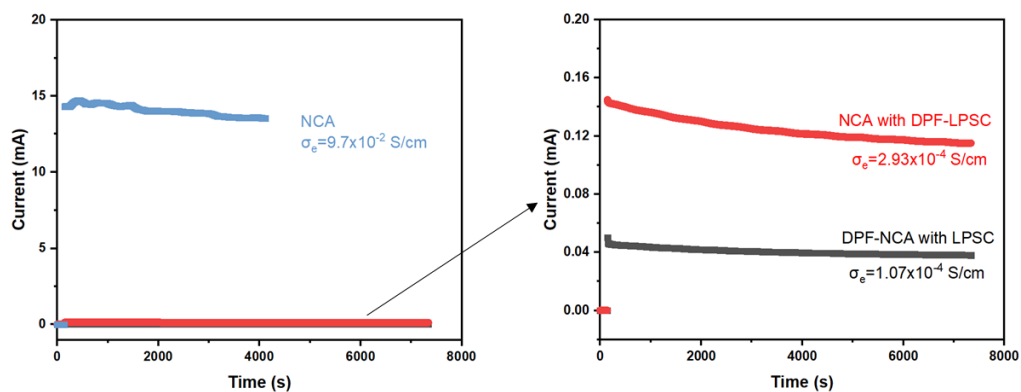
Supplementary Fig. 53. The EIS results before and after voltage hold of (A) NCA||LPSC||Li cells and (B) DPF-NCA||LPSC||Li.

Supplementary Fig. 54.



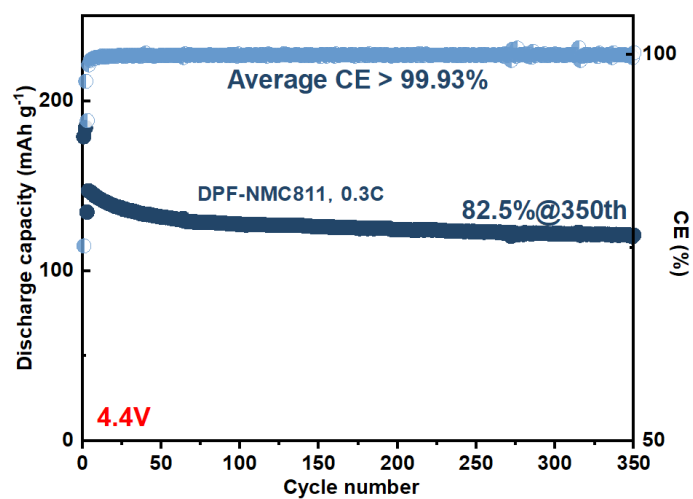
Supplementary Fig. 54. Voltage profiles of [DPF-NCA with LPSC]||DPF-LPSC||Li.

Supplementary Fig. 55.



Supplementary Fig. 55. The electronic conductivity of pure NCA pellet (left), “NCA with DPF-LPSC” pellet and “DPF-NCA with LPSC” pellet (right) were calculated by a potentiostatic polarization measurement. The powder was pressed into a pellet and stainless steel was used as an electronic conductor on both sides to do the test.

Supplementary Fig. 56.



Supplementary Fig. 56. Cycling performance of [DPF-NMC811 with LPSC]||DPF-LPSC||Li cell at 4.4V.

Supplementary Note 1.

Li compounds were commonly analyzed by using electron-energy loss near-edge fine structure (ELNES) features of the Li K-edge at ~55 eV energy loss¹. Indeed, each Li compound also has its unique low-loss EELS spectrum, correlated to the electronic excitations between valence and conduction bands, including the volume plasmon and interband transitions²⁻⁴, and provides an additional characteristic fingerprint of Li compounds^{5,6}. Hence, we performed the STEM-SI in the energy range between 0 and 75 eV for TFAA- and DPF-SREI and analyzed the composition by the multiple linear least squares (MLLS). Compared to the bare LPSC (Supplementary Fig. 5), SREI is observed on the surface of TFAA-LPSC (Supplementary Fig. 6A) and DPF-LPSC (Supplementary Fig. 6F). Supplementary Fig. 6B and 6G are the STEM-SI database recorded from the yellow box area. We further retracted the corresponding EELS spectra as a function of electron probe positions from surface (position 1) to inner part (position 3) (Supplementary Fig. 6C and 6H). We recorded the standard EELS spectra of Li₂O, Li₂S, LiCl, and Li₃PO₄ compounds in the energy loss range from 0.0 eV to 75 eV (Supplementary Fig. 7), and analyzed the spectra of SREI to infer the possible distribution of products using the MLLS method. The wide peak marked green (Supplementary Fig. 6C) is very close to the standard volume plasmon peak of Li₂O, Li₃PO₄, which probably suggests a mixture of Li₂O and other O-based components. Both TFAA-SREI and DPF-SREI (Supplementary Fig. 6D,I) contain a uniform distribution of this O-included composition, which is attributed to the interconnected -Li-O-, -O-C-/O=C- from electrochemical reduction of TFAA, and -Li-O-P, -O-P-/O=P- from electrochemical reduction of DPF. The EELS spectral feature of the DPF-SREI surface (position 1) reveals a significant shoulder at ~15 eV, a predominant peak at ~25 eV (Supplementary Fig. 6H), and Li K-edge at 62 eV followed by a wide peak until 70 eV, those spectral features are same with the standard LiF^{7,8}. The distribution of LiF

indicate that DPF-SREI (Supplementary Fig. 6J) was more enriched with LiF than TFSA-SREI (Supplementary Fig. 6E), agreeing with the electrophile design.

Supplementary Note 2.

We confirm the intact coating/SREI by the following three evidences:

Comparing the pressure and particle size with the reported literature with core/shell strategy:

The particle size of our SSE after modification primarily ranges from 1 μ m~3 μ m, with lots of smaller particles around 500 nm. Upon comparison with previous work on the coating of SSE particles or the core-shell structure of SSE (as shown in Table S1), our particle size and pressure values are slightly lower. Therefore, we anticipate that our SREI layer should be relatively intact based on those reports in previous studies.

XPS element ratio on SSE pellet of SREI coated LPSC pressing under 30MPa and 360 MPa:

A very low pressing pressure of 30MPa was first employed to press the pellets, ensuring the preservation of the coating layer as the control group. Then we used a much higher pressure of 360 MPa to press another batch of SSE pellets for comparative analysis with the low-pressure batch, as depicted in supplementary Fig. 28. Notably, there is no discernible difference between the surfaces pressed with low and high pressure, confirming the relative integrity of the coating and SREI after pressing the particles into pellet, and no obvious fresh LPSC surface (no increase in P, S, Cl) is exposed after pressing.

XPS imaging on SSE pellet of SREI coated LPSC pressing under 30MPa and 360 MPa:

XPS imaging is an advanced technology that allows mapping the specific peak rather than just elements. Unlike EDS mapping, XPS mapping is a mapping technology that can get accurate information near the very surface. Here, we use it to map the F 1s (C-F, P-F, LiF) with S 2p peaks on the surface of these pellets processed under 30MPa and 360MPa. Each mapping has a size of 480 μ m x 480 μ m, including at least hundreds of particles. Areas without signal occur due to artifacts from probe effects, as evidenced by consistent patterns in the same positions across all samples.

A comparison of SSE pellet processed under 30MPa and 360MPa revealed no increase in S signal intensity alongside a decrease in F signal intensity (Supplementary Fig. 29-31). This suggests that 360MPa is an acceptable pressure to maintain the stability of the coating layer during particle pressing in this study. If there were a freshly exposed LPSC surface, we would expect to observe an area with a strong S signal but little or no F signal. However, such areas were not observed in any of the three samples. Additionally, the F signal (max value) consistently remained much stronger than the S signal. These characteristics are particularly pronounced in the DPF-LPSC pellet (Supplementary Fig. 31), indicating the relatively robust properties of DPF-SREI compared to TFAA-SREI and TBAF-Coating.

Table S1. Summary of solid-state electrolytes and current technology.

Type	Advantages	Disadvantage
Oxide	• High electrochemical stability at both cathode and anode	• Poor contact with electrodes. • High cost. • Hard for large-scale process
Sulfide	• Good mechanical properties with good contact. • Moderate cost • Easy for large-scale process • High ionic conductivity	• Poor compatibility at high voltage • Low anode stability
Interlayer+Sulfide	• Good anode stability	• Reduce contact • Increase resistance • Increase cost • Reduce processability
SREI-Sulfide	• Improved stability at both cathode and anode • Easy to process with low cost	• Slightly reduce the ionic conductivity

Table S2. The comparison to the literature using SSE coating or core-shell strategy.

Materials	Particle size	Press pressure	Reference
LPSC with LiCl shell	A few μm	400 MPa	⁹
Li_2CO_3 coated LPSC	7 - 24 μm	370 MPa	¹⁰
Al_2O_3 coated LPSC	$\sim 3 \mu\text{m}$	700 MPa	¹¹
LPSC with SREI	500nm – 3 μm	360 MPa	This work

Table S3. Evaluation of the Li⁺ inventory loss in the first cycle of DPF-LPSC and pristine LPSC.

Sample	LPSC	DPF-LPSC		
Initial CE (<i>i</i> CE)	60.28% (0.6 mAh cm ⁻²)	62.26% (0.6 mAh cm ⁻²)	66.33% (0.75 mAh cm ⁻²)	83.95% (2.0 mAh cm ⁻²)
Average CE (<i>a</i> CE) (0.3 mAh cm ⁻²)	~97%	~99.35	>99.4	~99.5

Table S4. Assessment of the advances compared to state-of-the-art solid-state batteries.

	Anode	Interlayer	Cathode	High loading		Fast charge		Voltage (V)	Temp (°C)	Pressure (stack)	Lithium Plating /stripping CE	Reference
				mAh cm ⁻²	Cycle life	Capacity mAh cm ⁻² / C-rate	Cycle life(capacity retention)					
ASSLMB with interlayers on the anode and w/o coating on the cathode (high temperature and high pressure)												
LPSC (Multilayer)	Li	Li-graphite-LPSC-LGPS	NMC811	/		0.43 / 2C; 0.43 / 20C	2000 (80%); 10000 (82%)	4.2	55	50-250MPa	/	¹²
LPSC (Ag-C)	Li	Ag-C	Coated-NMC811	6.8	1000	/		4.25	60	2MPa; (warm isostatic press during assembling)	99.8% (anode-free)	¹³
LPSC	Si (0.2V)	Li-Si	Coated-NMC811	2	500	/		4.3	RT	50MPa	/	¹⁴
ASSLMB without interlayers												
Li ₂ In _x Sc _{0.666-x} Cl ₄	Li-In (0.62V)	/	NMC85	4.0	80	1.13 / 3C	3000 (80%)	4.3, 4.8	RT	250MPa	/	¹⁵
LaCl ₃ -based SSE	Li	/	NMC523	1.16	100	/		4.35	RT	/	/	¹⁶
LiPON	Li	/	/	/	/	/		/	RT	87.5KPa	82.7%	¹⁷
Electrophile treated-LPSC	Li(1%Mg)	/	NCA/ NMC811	7.1	650	1.3 / 2C	4500 (90%)	4.2, 4.5	RT	~2.5MPa	99.7%	This work

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