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Diluting Pyrrolidinium FSI Ionic Liquid Electrolytes for Lithium Metal Batteries: From Inert Fluorinated Ethers to Weakly Solvating Fluorinated Esters

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Abstract
Ionic liquid electrolytes (ILEs) based on LiFSI in N-methyl-N-propylpyrrolidinium bis(fluorosulfonyl)imide (Pyr13FSI) are among the most promising electrolytes for safe lithium metal batteries (LMBs). They are non-volatile and thermally stable, and their anion-rich Li^+ solvation yields a LiF-rich solid electrolyte interphase (SEI) on lithium. Their weakness is transport: a [LiFSI]2[Pyr13FSI]3 electrolyte has a viscosity of about 167 cP and a conductivity of only 2.2 mS cm^{-1} at room temperature. Locally concentrated ionic liquid electrolytes (LCILEs) address this by adding a low-viscosity, weakly or non-solvating fluorinated co-solvent that thins the bulk liquid while keeping the FSI^--dominated Li^+ shell. This short review summarizes how the concept evolved from hydrofluoroether diluents (BTFE, TTE, TfTHF) to aromatic and partially solvating co-solvents. It compares reported viscosity, conductivity, Li Coulombic efficiency (CE) and full-cell cycling, which reach 98–99.6% CE and stable cycling with NCM811 and $LiNiO_2$ cathodes. We then examine 2,2-difluoroethyl acetate (DFEA) as an emerging candidate. DFEA is oxidatively robust (to about 5.5 V) and highly conductive, but it binds Li^+ more strongly than classic diluents, so it may enter the solvation shell. We argue that a DFEA-modified Pyr13FSI electrolyte, paired with a small amount of fluoroethylene carbonate (FEC), should be treated as a partially solvating hybrid rather than a true LCILE. Its design therefore requires quantitative solvation analysis, SEI chemistry tracking, and testing under practical conditions (thin Li, lean electrolyte, high loading).

INTRODUCTION

The ultimate anode material is lithium metal which has a capacity of approximately 3,860 mAh g^{-1} and a lowest electrode potential of approximately −3,04 V vs. SHE [1] (ten times greater than that of graphite). The use of it is hampered primarily by the electrolyte. Lithium reacts with almost any organic solvent, which means the SEI formed is determined by the electrolyte chemistry, and for carbonate electrolytes the SEI is weak and has a variable composition [2]. This layer is cracked by repeated plating and stripping, results in lithium consumption and electrolyte consumption, formation of dendrites and "dead" lithium, and reduces the CE. Carbonates are also considered flammable, especially when a dendrite short circuits [1, 3].

This all changed with two electrolyte families. In the case of salt concentrated electrolytes, anions are pushed into the solvation shell of Li^+, which will be reduced first and form an inorganic LiF-rich SEI [4]. The idea is continued in ionic liquids (ILs), in which the liquid is composed of ions. The non-flammable and non-volatilization of the electrolyte, which results from dissolving LiFSI at high concentration in pyrrolidinium FSI ILs (such as Pyr13FSI, or C3mpyrFSI or PMpyrFSI), makes it possible to use this electrolyte for fast lithium cycling [5]. At 3.2 mol kg^{-1} LiFSI in C3mpyrFSI, CE on Ni rose from 64% at 1 mA cm^{-2} to 96% at 20 mA cm^{-2}, with a LiF-richer SEI at high current [6].

This chemistry comes at a cost of slow transport. The anion-rich shell gives rise to the same strong ion–ion interactions that make ILEs viscous and poorly conducting, at room temperature. A similar problem was addressed with the "localized high-concentration electrolytes" (LHCEs): a concentrated electrolyte was mixed with a non-electrolyte which did not dissolve the salt and kept concentrated clusters in a fluid matrix [7, 8]. The ILs approach results in locally concentrated ionic liquid electrolytes (LCILEs) when applied to ILs.

This brief review is intended to have three purposes. First, it provides a summary of the purpose of diluents in FSI based ILEs. Secondly, it contrasts representative LCILE systems in terms of performance in transport and performance in cells. Third, it evaluates DFEA, a fluorinated ester, and an FEC additive as candidates for the Pyr13FSI electrolytes and provides a list of the open questions which a systematic study needs to address (Fig. 1).

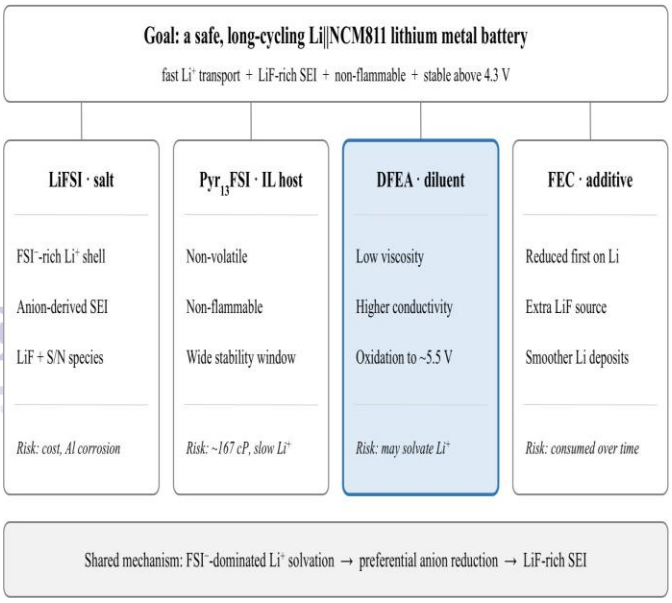


Fig. 1 Design logic of the LiFSI/Pyr13FSI/DFEA/FEC electrolyte reviewed here. The salt and IL host provide the anion-rich solvation and safety; DFEA (highlighted) targets the transport limitation; FEC reinforces the interphase. The bottom row of each column names the main risk discussed in Sections 3–6.

Scope and literature selection

This is a focused narrative review, not a systematic one. Literature was gathered from Web of Science, Scopus, Google Scholar and publisher databases (Wiley, RSC, ACS, Nature,

Elsevier) up to October 2026. Search strings combined "ionic liquid electrolyte", "Pyr13FSI/C3mpyrFSI", "LiFSI", "locally concentrated", "diluent", "fluorinated ether", "difluoroethyl acetate" and "fluoroethylene carbonate" with "lithium metal". We kept studies that (i) used an FSI-based IL with a lithium metal anode and (ii) reported transport data, Li CE or full-cell cycling. Non-IL studies were included only where they explain diluent physics (LHCE foundations) or the properties of DFEA and FEC. Readers seeking a broader overview of IL-based liquid and polymer electrolytes for lithium metal batteries are referred to recent reviews [9, 10].

LiFSI/Pyr13FSI electrolytes: why the interphase is good and transport is poor

In concentrated LiFSI/Pyr13FSI, nearly every Li^+ is surrounded by FSI^-; there is no neutral solvent to coordinate it. The Li^+–FSI^- clusters reduce at the lithium surface and leave an SEI dominated by LiF and sulfur/nitrogen-containing inorganics, which is thin, electronically insulating and mechanically robust [5, 6]. Molecular dynamics of a related fluorinated-cation system shows each Li^+ carrying about 3.9 FSI^- in its first shell, which illustrates how anion-dominated these liquids are [11].

The same clustering slows ions down. Li^+ moves as part of large, charged aggregates through a liquid in which every species is ionic, so viscosity is high and the Li^+ transference number is modest. For [LiFSI]2[Pyr13FSI]3, Liu et al. measured 167.4 cP and 2.2 mS cm^{-1} at room temperature [12]. A fluorinated-cation analogue, [LiFSI]2[PfMpyrFSI]3, reached 718 cP and only 0.54 mS cm^{-1} [11]. High viscosity also means poor wetting of polyolefin separators and thick cathodes, high polarization and limited rate capability. The design problem is therefore to speed up transport without giving up the anion-derived interphase.

Diluents in ionic liquid electrolytes

The LHCE principle and its transfer to ILs

In solvent-based LHCEs, an "inert" diluent such as bis(2,2,2-trifluoroethyl) ether (BTFE) or 1,1,2,2-tetrafluoroethyl-2,2,3,3-tetrafluoropropyl ether (TTE) is miscible with the solvent but does not dissolve the salt. Concentrated Li^+–anion–solvent clusters are preserved inside a low-viscosity matrix. This gave 99.3% Li CE and >95% retention over 300 cycles in Li||NCM cells [7], and stable Li||NCM811 cycling at 4.4–4.5 V under practical conditions [8]. A key lesson came from Cao et al.: fluorinated ethers, borates and orthoformates act as true diluents, but weakly solvating fluorinated carbonates enter the second solvation shell. This creates a "pseudo-LHCE" that loses part of the benefit. Diluent molecules sitting near the clusters can also speed up or slow down anion decomposition and so change the SEI [13].

ILs are a harder host for diluents. Hydrofluoroethers interact weakly with IL ions and are only partly effective, and many contain PFAS groups that face regulation [14]. Even so, the transport gains are large. Adding BTFE to LiFSI–Pyr14FSI ([LiFSI]3[Pyr14FSI]4[BTFE]4) lowered viscosity and increased Li^+–FSI^- complex formation, and Li||LFP cells kept 94.6% capacity after 400 cycles at 1 C; the undiluted IL failed within a few cycles [15]. Studies of ion dynamics across length scales show why: the HFE mixes fully with the IL, leaves Li^+ solvation unchanged, and raises conductivity mainly by lowering viscosity. The IL cation gains the most mobility, because it interacts preferentially with the HFE [16]. Fig. 2 summarizes how these ideas developed.

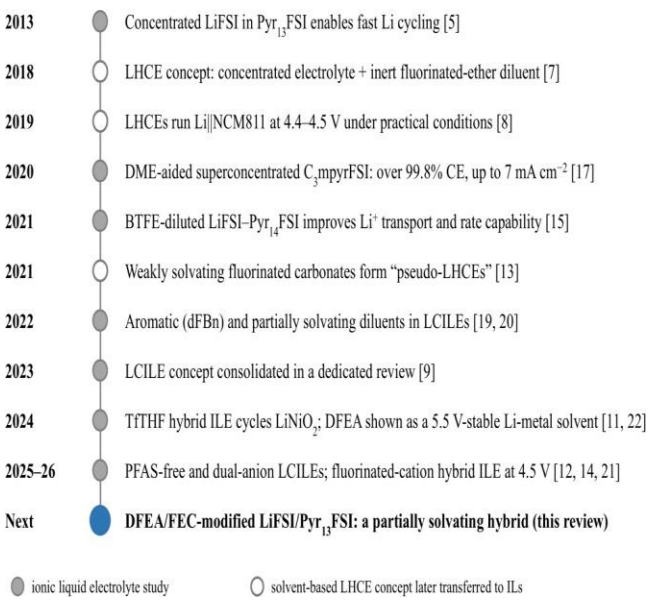


Fig. 2 Milestones in the development of diluted FSI-based ionic liquid electrolytes for lithium metal batteries. Filled markers denote IL-electrolyte studies; open markers denote solvent-based LHCE concepts that were later transferred to ILs. The highlighted entry is the DFEA/FEC strategy assessed in Section 5.

Beyond inert ethers: solvating, aromatic and partially solvating co-solvents

The diluent family has since widened along a scale of Li^+ affinity:

Solvating ether (DME). In 3.2 mol kg^{-1} LiFSI in C3mpyrFSI with DME, Li^+ is coordinated by both DME and FSI^-, with no free DME. Li||LFP cells (about 12 mg cm^{-2}) ran 350 cycles without fade at >99.8% CE and tolerated 7 mA cm^{-2} [17]. Follow-up work focused on controlling the resulting interphase [18].

Aromatic co-solvent (1,2-difluorobenzene). In LiFSI–EmimFSI–dFBn, Li CE reached 99.57% at 0.5 mA cm^{-2} and Li||NCM811 cells at 4.4 V retained 93% after 500 cycles [19]. Aromatic, less-fluorinated co-solvents interact with the IL cation, weaken cation–anion pairing and form nanosegregated domains, giving up to 99.7% CE without PFAS diluents [14].

Partially solvating diluent. Liu et al. showed that a diluent with some Li^+ affinity can be useful rather than harmful, for example in Li/sulfurized polyacrylonitrile cells [20].

Fluorinated cyclic ether (TfTHF). In [LiFSI]2[Pyr13FSI]3[TfTHF]3, viscosity fell from 167.4 to 41.7 cP and conductivity rose from 2.2 to 3.75 mS cm^{-1} [12]. With the fluorinated cation, TfTHF entered the Li^+ shell only slightly (about 0.5 per Li^+) and enabled $LiNiO_2$ and 4.7 V NCM622 cells [11].

Table 1 compares representative systems. Values are as reported; test conditions differ (Li thickness, loading, electrolyte amount, CE protocol), so the table shows trends rather than a ranking.

Table 1. Representative FSI-based ionic liquid electrolytes with diluents or co-solvents for lithium metal batteries.

System (molar ratio)	Diluent type	Viscosity (cP)	Conductivity (mS cm^{-1})	Li CE	Best full-cell result	Ref.
LiFSI–Pyr13FSI (2:3), no diluent	—	167.4	2.2	—	—	[12]
LiFSI–Pyr13FSI–TfTHF (2:3:3)	Fluorinated cyclic ether	41.7	3.75	98.5%	Li||NCM622, 4.5 V: 57.6% after 200 cycles	[12]
LiFSI–PfMpyrFSI–TfTHF	Fluorinated cycli	117 (from 718)	1.20 (from 0.54)	98.1%	Li||NCM622, 4.5 V: 97.4%	[11,

(2:3:3)	cether + fluorinated cation				after 200 cycles; LiNiO2: 78.6% after 300+ cycles	12]
LiFSI–Pyr14FSI–BTFE (3:4:4)	HFE	Reduced	Increased	—	Li‖LFP, 1 C: 94.6% after 400 cycles	[15]
LiFSI (3.2 mol kg^{-1})–C3mpyrFSI–DME	Solvating ether	—	—	>99.8% (full cell)	Li‖LFP, ~12 mg cm^{-2}: 350 cycles, no fade	[17]
LiFSI–EmimFSI–dFBn	Aromatic co-solvent	—	—	99.57 %	Li‖NCM811, 4.4 V: 93% after 500 cycles	[19]
LiFSI/LiTFSI–EmimFSI–BTFE	HFE, dual anion	—	1.053 (from 0.165)	99.18 %	20 µm Li‖LFP, 1 C: 99.93 % after 200 cycles	[21]

What the comparison shows

Three points stand out. First, any reasonable diluent cuts viscosity by a factor of about 4–6 and raises conductivity about 1.7- to 6-fold, so transport is no longer the main barrier (Fig. 3) [11, 12, 21]. Second, transport alone does not decide cycle life: the Pyr13FSI/TfTHF and PfMpyrFSI/TfTHF electrolytes have similar CE (98.5% vs. 98.1%), yet the second retains 97.4% instead of 57.6% at 4.5 V, because the fluorinated cation protects the cathode [12]. Third, diluents carry a cost in oxidative stability. In the dual-anion system, the undiluted ILs were stable to about 5.4 V but the BTFE-diluted ones only to about 4.2 V [21]. For high-voltage NCM811 cells, the diluent must therefore be chosen for its anodic stability as well as its viscosity.

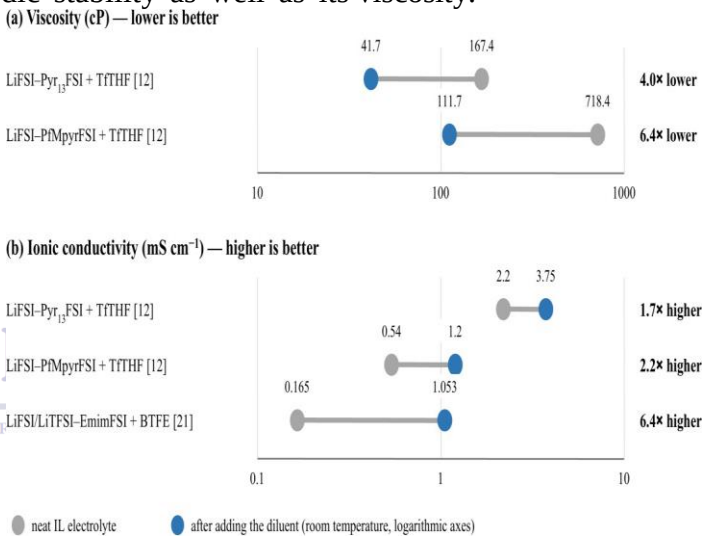


Fig. 3 Effect of dilution on (a) viscosity and (b) ionic conductivity of FSI-based ionic liquid electrolytes. Grey markers show the neat electrolyte and blue markers the diluted one; the ratio on the right is the improvement factor. Molar ratios: LiFSI:IL:TfTHF = 2:3:3 [12]; BTFE added at 1:1 to EmimFSI [21].

DFEA and FEC as a combined strategy for Pyr13FSI electrolytes

What is known about DFEA

Difluoroethyl acetate ($CH_3COOCH_2CHF_2$) is a partially fluorinated ester. Its best-documented use is as the main solvent of a carbonate-free electrolyte, 1.2 M $LiPF_6$ in

DFEA with 10 wt% FEC [22]. That electrolyte reached 7.2 mS cm^{-1} at 25 °C (vs. 2.5 mS cm^{-1} for the trifluoro analogue TFEA), resisted oxidation up to 5.5 V vs. Li^+/Li, did not ignite, and supported fast-charging and low-temperature (−65 °C) operation [22]. These are exactly the properties sought in a diluent for NCM811 cells: low viscosity, high anodic stability and low flammability.

Diluent or co-solvent? The solvation question

The same study shows a property that matters greatly for an IL host. DFT gives a DFEA–Li^+ binding energy of −101.3 kJ mol^{-1}, slightly stronger than TFEA (−96.5 kJ mol^{-1}) [22]. DFEA dissolves $LiPF_6$ on its own, which BTFE and TTE cannot do. The carbonyl oxygen can coordinate Li^+, and the CHF_2 group is less electron-withdrawing than CF_3. DFEA is therefore a weakly solvating molecule, not an inert diluent.

In LiFSI/Pyr13FSI, this has two consequences. If DFEA stays mostly outside the first shell, it behaves like an LCILE diluent and lowers viscosity while keeping the FSI^--rich shell. If it partly replaces FSI^-, Li^+ desolvation may become easier and conductivity higher, but the SEI may contain more ester-derived organic species. Cao et al. found that weakly solvating fluorinated carbonates produced a "pseudo-LHCE" with weaker performance [13], while partially solvating diluents have worked well in IL systems [11, 20]. Which regime a DFEA/Pyr13FSI electrolyte occupies depends on the Li:IL:DFEA ratio, and it has not yet been mapped.

Table 2 places DFEA among the co-solvents and additives used so far with FSI-based ILEs, ordered from non-solvating to solvating.

Table 2. Co-solvents and additives for FSI-based ionic liquid electrolytes: Li^+ affinity, main effect and main limitation.

Molecule	Class	Li^+ affinity	Main effect	Main limitation	Ref.
BTFE	Fluorinated linear ether	Non-solvating	Lower viscosity; more Li^+–FSI^- complexes; 94.6% retention (Li||LFP, 400 cycles)	Anodic limit fell to ~4.2 V in a diluted Emim FSI system; PFAS	[15, 21]
TTE	Fluorinated linear ether	Non-solvating	Viscosity 718 → 92 cP with PfMpyrFSI	Lower CE than TfTHF (97.7% vs 98.1%); PFAS	[11]
TfTHF	Fluorinated cyclic ether	Weak (~0.5 per Li^+)	Viscosity 167 → 42 cP with Pyr13FSI; $LiNiO_2$ and 4.7 V NCM622 cycling	Needs fluorinated cation for best high-voltage results	[11, 12]
dFBn	Fluorinated aromatic	Non- to weakly solvating	99.57% CE; 93% retention (Li||NCM811, 4.4 V, 500 cycles)	Tested with Emim FSI, not Pyr13 FSI	[19]
DFEA	Partially fluorinated ester	Weak–moderate (DFT	7.2 mS cm^{-1} and stable to 5.5 V as a $LiPF_6$	Not yet studied in an IL;	[22]

		binding −101 kJ mol^{-1})	solvent	may enter the Li^+ shell	
DME	Glyme ether	Solvating (in the shell, no free DME)	>99.8% CE; up to 7 mA cm^{-2}	Ethers are less stable at high voltage	[17]
FEC (additive, ~5 wt%)	Fluorinated cyclic carbonate	Solvating, reduced first	Smoother Li deposits; stable impedance; faster SEI formation	Consumed during cycling; amount must be optimized	[23, 24]

The role of FEC

FEC is the classic SEI-forming additive. Its reduction yields LiF and polymeric species. In carbonate electrolytes, FEC roughly doubled the Li exchange current density (about 15 to 30 µA cm^{-2}) and increased the SEI formation rate about 4.6-fold, without changing bulk Li^+ diffusion [24]. In an IL, 5 wt% FEC in Pyr14FSI/LiTFSI produced the smoothest lithium deposits, kept interfacial impedance stable during rest and at 60 °C, and improved Li||NCM622 capacity and CE, with little effect on viscosity or conductivity [23]. FEC thus complements a diluent: the diluent fixes bulk transport, and FEC reinforces the interphase if a weakly solvating diluent dilutes the anion contribution to the SEI. Two cautions apply. FEC is consumed during cycling and can generate gas, and it is reduced at a higher potential than FSI^-, so too much FEC could make the SEI FEC-derived rather than FSI-derived. The optimal amount is likely small (about 2–5 wt%) and should be established experimentally.

Proposed structure–property map

Taken together, the literature suggests the following working hypotheses for LiFSI/Pyr13FSI/DFEA/FEC:

Low DFEA content: true LCILE behavior; viscosity falls, the FSI^--rich shell is kept, and the SEI stays LiF/sulfur-rich.

Intermediate DFEA content: DFEA enters part of the second or first shell; conductivity and rate capability rise further, and the SEI contains more organic species, which FEC can compensate.

High DFEA content: the electrolyte approaches a fluorinated ester electrolyte with IL additive; non-flammability and CE are likely to decline.

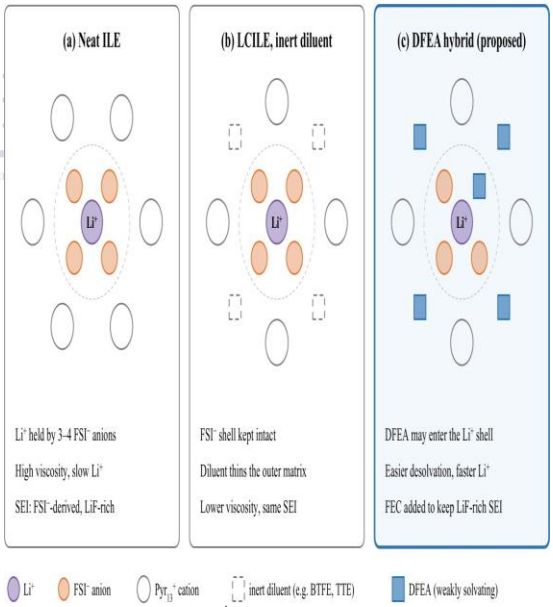


Fig. 4 Proposed Li^+ solvation environments. (a) Neat LiFSI/Pyr13FSI: Li^+ is coordinated almost entirely by FSI^-.
(b) Classic LCILE: an inert fluorinated ether stays outside the shell and only thins the matrix. (c) DFEA hybrid: DFEA may replace part of the FSI^- in the first shell (regime 2 above), which speeds desolvation but adds

ester-derived SEI species; FEC compensates at the lithium surface.

The optimum is expected at the boundary between regimes 1 and 2. Raman/FT-IR spectra of the FSI^- S–N–S band and the DFEA C=O band, ^7Li NMR, and MD coordination numbers should be used together to locate it (Fig. 4).

Research gaps and future directions

Quantified solvation of weakly solvating diluents in ILs. No study yet reports DFEA coordination numbers, Raman cluster populations (free FSI^-, contact ion pairs, aggregates) or $^7Li/^{19}F$ NMR shifts in Pyr13FSI. MD force fields for DFEA–IL mixtures also need validation against measured density, viscosity and diffusion coefficients.

Li^+ transport, not just conductivity. Lower viscosity speeds up all ions, and the IL cation may gain the most [16]. Li^+ transference numbers (Bruce–Vincent or PFG-NMR) should be reported alongside conductivity, since total conductivity can rise while the Li^+ share falls.

SEI origin. Diluents near the clusters can change how fast the anion decomposes [13]. Depth-profiled XPS (F 1s, S 2p, N 1s, C 1s) after formation and after long cycling is needed to separate FSI^--, FEC- and DFEA-derived species, ideally with cryo-TEM for SEI thickness and structure.

High-voltage stability. Diluted ILs can lose more than 1 V of anodic stability [21]. LSV on inert electrodes overstates real stability, so floating tests (potentiostatic holds at 4.3–4.6 V) and CEI analysis on NCM811 are needed.

Safety of the diluted liquid. Non-flammability is lost gradually as diluent is added. Self-extinguishing time, flash point and DSC with charged Li/NCM811 should be reported for each DFEA fraction, not only for the neat IL.

Practical conditions. Most reports use thick Li (250–500 µm), flooded electrolyte and low loading. Meaningful benchmarks are 20–50 µm Li, ≤3 g Ah^{-1} electrolyte and ≥3 mAh cm^{-2} cathodes, with CE measured by a standard protocol (for example the Aurbach method), as done in the thin-Li tests of [11] and [21].

Cost and sustainability. Pyr13FSI and LiFSI are expensive, and many fluorinated diluents are PFAS. DFEA has only a short fluorinated fragment; its environmental profile and the possibility of lower-cost, lower-fluorine alternatives deserve attention [14].

Table 3 turns these gaps into an experimental checklist for a DFEA/FEC-modified Pyr13FSI electrolyte.

Table 3. Key questions, recommended techniques and the observable that answers each.

Question	Techniques	Observable	What decides it
Does DFEA enter the Li^+ shell?	Raman, FT-IR, $^7Li/^{19}F$ NMR, MD	FSI^- S–N–S band; DFEA C=O band; coordination numbers	Free FSI^- / CIP / AGG fractions vs DFEA content
Does Li^+ transport improve?	Viscometry, EIS, Bruce–Vincent or PFG-NMR	Viscosity, conductivity, Li^+ transference number, diffusion coefficients	Li^+ conductance (conductivity × transference number), not conductivity alone
Is the SEI FSI^-- or FEC-derived?	Depth-profiled XPS, cryo-TEM	LiF, S/N species, C–O organics; SEI thickness	Inorganic fraction through the SEI depth
Is it stable	LSV, potentiosta	Leakage current;	Low, flat leakage

with NCM811?	tic floating at 4.3–4.6 V, CEI XPS	CEI thickness and composition	current at the cut-off voltage
Is it still safe?	Self-extinguishing time, flash point, DSC	Ignition behavior; exothermic onset	Non-flammable at the chosen DFEA fraction
Does it work in practical cells?	Li||Cu (Aurbach protocol), thin-Li Li||NCM811	Average CE; capacity retention	CE comparable to the best LCILEs (≥99.5% [19]) under lean conditions

Conclusions

LiFSI/Pyr13FSI electrolytes give lithium metal a safe, anion-derived, LiF-rich interphase, but their viscosity (about 167 cP) and modest conductivity (about 2 mS cm^{-1}) limit rate and cycle life. Diluting them into locally concentrated ionic liquid electrolytes has solved most of the transport problem: viscosity drops four- to six-fold, and reported systems reach 98–99.6% Li CE and hundreds of stable cycles with LFP, NCM811 and LiNiO2 cathodes. The field has also learned that diluents are never fully inert: their Li^+ affinity, anodic stability and interaction with the IL cation all shape the interphase.

DFEA fits this newer picture. Its low viscosity, high conductivity and oxidative stability to about 5.5 V make it attractive for NCM811 cells, but its Li^+ binding is stronger than that of classic hydrofluoroethers, so a LiFSI/Pyr13FSI/DFEA electrolyte is best described as a partially solvating hybrid. A small FEC addition is a logical way to secure a LiF-rich SEI in that regime. The decisive next step is a composition-resolved study linking DFEA fraction to solvation structure, Li^+ transference, SEI chemistry and cell performance under practical conditions. That map, rather than any single optimized formulation, would turn the DFEA/FEC concept into a general design rule for safe, long-life lithium metal batteries.

Author contributions

Najma Farid: conceptualization, literature investigation, writing – original draft.

Conflicts of interest

There are no conflicts to declare.

Abbreviations

Abbreviation	Meaning
AGG	Aggregate (Li^+ shared by several anions)
BTFE	Bis(2,2,2-trifluoroethyl) ether
CE	Coulombic efficiency
CEI	Cathode electrolyte interphase
CIP	Contact ion pair
dFBn	1,2-Difluorobenzene
DFEA	2,2-Difluoroethyl acetate
DFT	Density functional theory
DME	1,2-Dimethoxyethane
EIS	Electrochemical impedance spectroscopy
FEC	Fluoroethylene carbonate
FSI^-	Bis(fluorosulfonyl)imide anion
HFE	Hydrofluoroether
IL / ILE	Ionic liquid / ionic liquid electrolyte
LCILE	Locally concentrated ionic liquid electrolyte
LHCE	Localized high-concentration electrolyte
LMB	Lithium metal battery
MD	Molecular dynamics
NCM811	LiNi0.8Co0.1Mn0.1O2
PFAS	Per- and polyfluoroalkyl substances
Pyr13FSI	N-Methyl-N-

	propylpyrrolidinium bis(fluorosulfonyl)imide (also C3mpyrFSI, PMpyrFSI)
SEI	Solid electrolyte interphase
TfTHF	3,3,4,4-Tetrafluorotetrahydrofuran
TTE	1,1,2,2-Tetrafluoroethyl-2,2,3,3-tetrafluoropropyl ether
XPS	X-ray photoelectron spectroscopy

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