

Development of high-performance ionic electrolytes by target-specific combination of novel cation and anion structures

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Organic salts such as ionic liquids (ILs) and organic ionic plastic crystals (OIPCs) arise as promising electrolyte candidates for next generation high-performance battery technologies.¹ ILs and OIPCs offer promising properties to meet the criteria to develop lithium and sodium metal batteries of the future, providing benefits including good conductivity, stability, and safety; specifically, OIPCs, by preserving the solid-state integrity of the system. An important aspect in the development of such materials is to understand the influence of cation and anion chemistries on the physiochemical and electrochemical properties of the electrolyte. This work aims at pushing further such understanding, investigating three seldom-studied anions: trifluoromethanesulfonate ($[\text{CF}_3\text{SO}_3]^-$), difluoromethanesulfonyl-trifluoromethanesulfonyl-imide ($[\text{DFTFSI}]^-$),² and an ether-functionalized anion ($[\text{EFA}]^-$, also known as Froggy anion).³ Although these novel chemistries of anions have proved unique advantages in Li-salts, their application in ILs and OIPCs has yet to be explored. In this study, they were paired with pyrrolidinium or ammonium-based cations, selected for their potential to enhance conductivity and stability. The combinations of such anions and cations showed promising results, exhibiting thermal stability up to ≈ 300 °C and attaining ionic conductivity values of $5.6 \times 10^{-3} \text{ S cm}^{-1}$ at 60 °C. Furthermore, via extensive thermal behaviour analysis, this investigation helps redefining the current knowledge on the predictability of the ILs and OIPCs properties for their application in the battery field.

References

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