

Ion Transport Properties in Pyrrolidinium-Based Electrolytes Upon Mixing with Mg(FSA)₂

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Organic ionic plastic crystals (OIPCs) have emerged as promising solid electrolytes due to their favorable thermal stability, electrochemical stability, and ionic conductivity. Despite these advantages, their applications in Mg ion conduction remain underexplored. In this work, Mg-ion conductive composites were prepared by incorporating magnesium bis(fluorosulfonyl)amide (Mg(FSA)₂) into *N,N*-diethylpyrrolidinium bis(fluorosulfonyl)amide

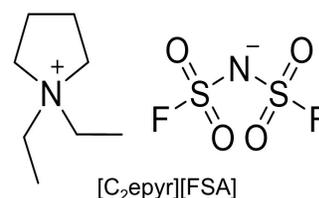


Figure 1. Chemical structure of OIPC used in this study.

bis(fluorosulfonyl)amide ([C₂epyr][FSA], Figure 1).¹ The influence of Mg-salt concentration on the physicochemical and electrochemical properties of the composites was investigated. Composites with less than 10 mol% Mg(FSA)₂ retained the solid state at room temperature, while higher concentrations induced a transition to a liquid state. Although the composite containing 10 mol% Mg(FSA)₂ exhibited the highest ionic conductivity in this study, a marked decrease in the Mg transference number ($t_{\text{Mg}^{2+}} < 0.16$) was observed in the liquid-state composites. In contrast, solid-state composites with Mg(FSA)₂ concentrations below 10 mol% maintained both high ionic conductivity and $t_{\text{Mg}^{2+}}$ values (≥ 0.26), as shown in Figure 2. Cyclic

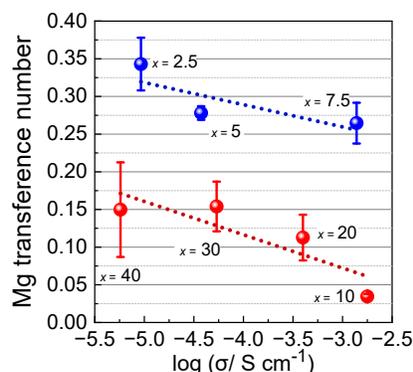


Figure 2. Relationship between Mg transference number and ionic conductivity of [C₂epyr]Mg-*x* at 25 °C (blue: solid, red: liquid)

voltammetry confirmed reversible Mg redox behavior at 60 °C for the 5 mol% composite. These results demonstrate that FSA-anion-based OIPC materials enable efficient Mg-ion conduction in the solid state, presenting viable approaches for developing high-performance solid-state Mg electrolytes.

References

1. Hirotsu, Y.; Kimura, M.; Nanbu, S.; Takeoka, Y.; Rikukawa, M.; Yoshizawa-Fujita, M.;* *Phys. Chem. Chem. Phys.* in press.



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