

## Physicochemical Behavior of Alkali Metal Chloride-Based Ionic Liquids

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Ionic liquids (ILs) are salts composed of anions and cations that exist in the liquid phase at or below 373 K (100 °C), and have attracted attention in various fields including material science and electrochemistry. Lewis acid–base type ILs, which are formed by mixing metal halides such as AlCl<sub>3</sub> with organic salts like 1-ethyl-3-methylimidazolium chloride ([C<sub>2</sub>mim]Cl), have been studied extensively. Recently, such ILs have been used as electrolytes for Al metal anode secondary batteries and for Al refining processes.<sup>1</sup> In this study, we attempted to develop novel Lewis acid–base type ILs composed of alkali metal salts, e.g., LiCl, and [C<sub>2</sub>mim]Cl, to characterize the anionic species in the ILs, and to reveal their physicochemical properties.

Alkali metal salt–[C<sub>2</sub>mim]Cl mixtures were prepared by mixing each salt in various molar ratios under an Ar atmosphere in a glove box. Those salts were purified using appropriate methods prior to use. The resulting mixtures were stored in the glove box, and all experimental operations and physicochemical property (viscosity, ionic conductivity, thermal behavior etc.) measurements were performed under moisture- and oxygen-free conditions.

The binary mixtures prepared in the range of 20-40 mol% LiCl were completely melted at temperatures below 373 K. We determined that those were ILs. To identify the ionic species in the ILs, Raman spectroscopy was conducted. In addition to peaks attributed to [C<sub>2</sub>mim]<sup>+</sup>, several unidentified peaks appeared in the low wavenumber region (250-650 cm<sup>-1</sup>). These were assignable to [LiCl<sub>2</sub>]<sup>-</sup>, whose presence has been previously reported.<sup>2,3</sup> The following equilibrium reaction would proceed when LiCl and [C<sub>2</sub>mim]Cl coexist:



However, the possible presence of other anionic species cannot be excluded. Further investigations using other analytical methods are currently being performed to clarify all the ionic species in the system. Thermal behavior of the synthesized LiCl–[C<sub>2</sub>mim]Cl ILs was evaluated by DSC. Glass transition temperatures were observed in the range of 243-273 K, increasing with higher LiCl content and anomalous thermal behavior was observed near the glass transition temperature, which is attributed to slow dynamics of the IL. Physicochemical properties will be reported at the conference.

### References

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