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A Study on Ion Transport Mechanism of Ionic Liquid for Lithium Secondary Battery Application

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With pursuing larger capacity and higher performance of rechargeable lithium ion secondary batteries, their safety issue has been accompanied as a major concern. Volatile and flammable liquid electrolytes have been considered a main cause for serious safety problems in lithium ion batteries. Among many efforts to improve the safety of lithium ion batteries, employing room-temperature molten salts (RTMS), *i.e.*, ionic liquid is considered one of the promising candidates [1]. Nonflammability and negligible vapor pressure of the RTMS is expected to improve the violent properties of liquid electrolytes. Many battery applications of the RTMS have been focused on the modification of liquid electrolytes. To fully understand the RTMS-based electrolytes, investigation of ion transport mechanism for each ion species is necessary.

The pulse-gradient spin echo NMR (PGSE-NMR) technique is shown to provide a direct measurement of the translational self-diffusion coefficients with good accuracy and reliability [2,3]. In the PGSE-NMR technique, all the diffusing species such as the cation, anion, and the solvent can be measured by using an appropriate NMR, respectively. With the ionic conductivity result of the RTMS-based electrolytes, it is possibly suggested that the PGSE-NMR data could provide a better insight for interpreting the ionic transport mechanism of the electrolytes.

In this study, the RTMS-based electrolytes consisting of butyldimethylimidazole-hexafluorophosphate, BDMI-PF_6) and propylene carbonate (PC) have been prepared and compared with a conventional electrolyte consisting of $LiPF_6$ and PC mainly in terms of the self-diffusion coefficients of ion species. Finally, performance of lithium ion batteries employing the BDMI-PF_6-added electrolytes was measured and explained on the basis of the ionic transport mechanism.

References

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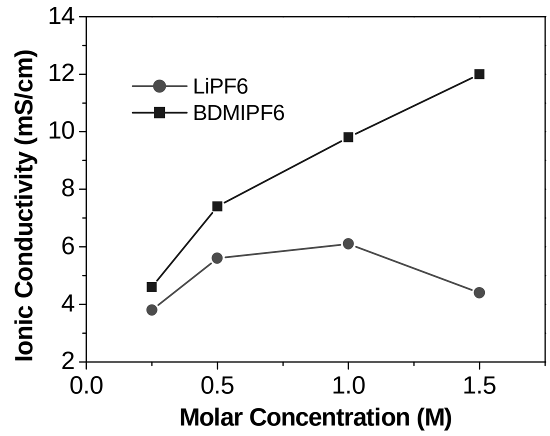
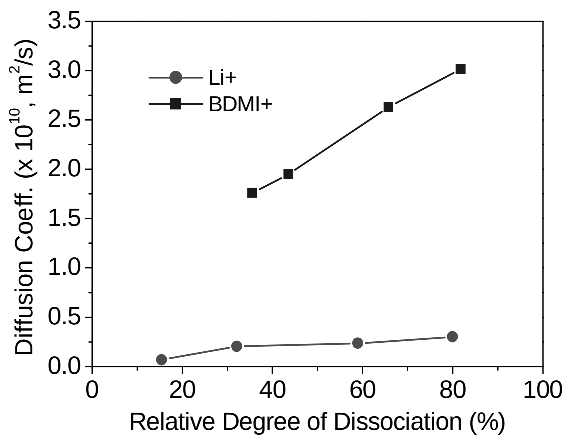
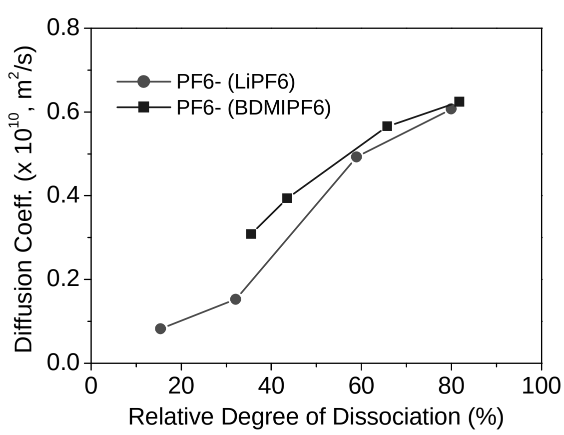


Fig. 1. Ionic Conductivity for $LiPF_6$-based electrolytes and BDMI-PF_6-based electrolytes.



(a)



(b)

Fig. 2. Comparison of diffusion coefficient for $LiPF_6$-based electrolytes and BDMI-PF_6-based electrolytes
(a) Cation (b) Anion.