Room Temperature Ionic Liquids Containing Ionized Solvent Molecule as an Involatile Additives for Lithium Battery Electrolyte

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Room temperature ionic liqudis (RTILs) have attracted attention as a novel safe electrolyte for electrochemical energy devices, such as lithium battery, because of various unique properties such as nonvolatility, and incombustibility.[1-6]

We have been studied on the preparation of RTILs based on quaternary ammonium cation and the application to lithium battery electrolyte since this system possess larger electrochemical window (*ca* 1.0 V) comparing with 1-ethyl-3-methylimidazolium (EMI).

The lithium cell performance using PP13-TFSI was changed with the kind of anode. In case of lithium metal anode, the coulombic efficiency was over 97%,[5] however, in case of graphitized carbon anode under 33%.[6]

To improve such coulombic efficiency, the use of additives has been reported in case of ILs based on ammonium based melt used for lithium battery electrolytes[7]. For example, the addition of 1 M of ethylene carbonate (EC) into RTILs effectively improved the lithium ion insertion into graphite in RTIL based on quaternary ammonium.[7] Such improvement with the use of organic compound have been also reported in case of RTILs based on EMI.[1,2]. However such additives are volatile and especially organic compounds such as EC are flammable, which might spoil the merit of using RTILs as nonvolatile and nonflammable electrolyte.

In this study, we would like to show that such demerit of the use of organic additives could be reduced by prepare cationic species containing the same chemical structure as organic solvents as shown in Fig.1 and also shows that these cation forms RTILs with TFSI anions.

The cationic species could be synthesized with halogenated solvent molecule and appropriate tertiary amine. Corresponding TFSI salts could be obtained by anion exchange reaction with the use of LiTFSI. These TFSI salts are melted in room temperature (25°C).

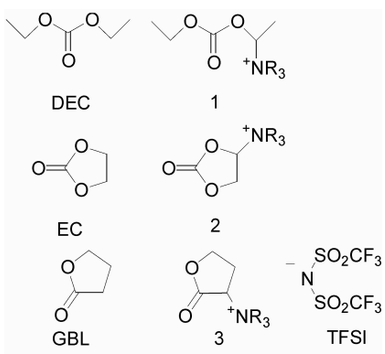

Fig. 1 Structure of organic solvents and the related cationic species and TFSI anion.

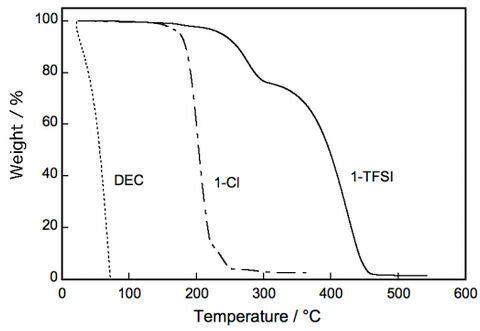

Fig. 2 TGA of diethylcarbonate (DEC) and the related salts 1-Cl and 1-TFSI (R= -CH_3). (10 °C/min.).

As shown in Fig.2, the volatility of organic solvents could be suppressed by the addition of ammonium group into organic molecule and the thermal stability was much more improved with changing anion from chloride to TFSI anion.

These TFSI melts might be expected as an nonvolatile and thermally stable additive to improve lithium battery performance using RTILs.

Acknowledgement

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