Electrochemical Properties of Polymer Electrolytes with Room-Temperature Ionic Liquids

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Rechargeable lithium batteries based on solid polymer electrolytes have been developed for higher energy densities and power storage. When rechargeable lithium batteries use lithium metal as an anode, aqueous electrolyte can not be used. Therefore, the organic liquid electrolytes have been used in the lithium batteries, and the gel polymer electrolytes containing liquid electrolytes have been also applied to the lithium battery system. The gel polymer electrolytes possess high ionic conductivities at room temperature, but exhibit low mechanical strength and loss of liquid electrolyte from highly swollen gel polymer.

Recently, ionic liquids are being investigated for many applications including reaction solvent, separation medium, and electrolyte. Since ionic liquids are liquids which are entirely composed of ions, they can have high ionic conductivity. They are also non-volatile, non-inflammability and exist as liquid state over a wide range of temperature[1].

In this work, microporous polymer electrolytes have been prepared by soaking the porous film into ionic liquid with a lithium salt. The microporous PVdF film was prepared by a phase inversion method. Various ionic liquids were prepared by a proper combination of cations and anions. Their ionic conductivity, interfacial stability, and decomposition voltage were investigated.

$BMIMBF_4$ and $BMIMPF_6$ salts were prepared according to the similar scheme of Ref. 2, and the synthesis of $BMIMSbF_6$ salt was similar to that of BF_4 and PF_6 salts with the exception that $NaSbF_6$ was used in place of $NaBF_4$ or $NaPF_6$. BMIMOTf and $BMIMNTf_2$ were also prepared according to the similar scheme of Ref. 3. All ionic liquids used here were pre-dried under reduced pressure (0.5 mmHg) at 50 ^oC for 24 h.

The ion conductivity of the polymer electrolyte with ionic liquid was 4.23×10^{-4} S/cm at room temperature. The electrochemical stability of the polymer electrolyte was evaluated by linear sweep voltammetric measurements at a scanning rate of 0.2 mV/s. The polymer electrolyte is stable up to 4.0 V, as shown in Fig.1. The initial discharge capacity and cycling efficiency were investigated in the lithium/sulfur cell using the polymer electrolyte with ionic liquids.

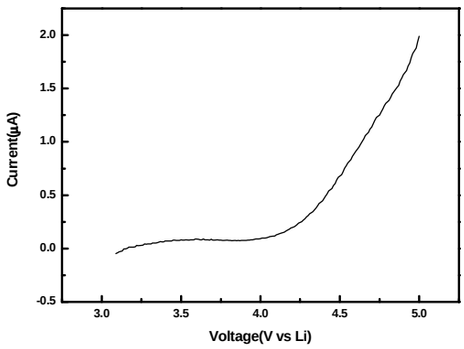

Fig.1. Linear sweep voltammetry for polymer electrolyte with $BMIMBF_4$-$LiBF_4$ (sweep rate: 0.2mV/s)

References

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