Ionic liquid based gel polymer electrolyte for lithium-oxygen battery

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Rechargeable lithium-oxygen (or lithium-air) batteries have attracted extensive interest due to their higher theoretical energy density in comparison with current lithium-ion batteries [1]. In general, a Li-O_2 battery consists of a Li metal anode, a Li^+-conducting electrolyte, and a porous air cathode. Based on the liquid electrolyte used, Li-O_2 batteries may be classified into non-aqueous aprotic, aqueous and mixed non-aqueous/aqueous systems. A greater focus has been on a non-aqueous aprotic system, due to its higher energy density. However, the use of liquid aprotic electrolyte, which is highly volatile and flammable and leakable, remains serious safety problems as well as the electrolyte decomposition. These problems would be solved if the liquid electrolytes are replaced with the liquid-free configuration such as polymer electrolyte.

Room temperature ionic liquid has attracted much attention not only as electrolyte solvents for rechargeable lithium battery but also as ionic conductors in solid electrolytes, due to its excellent properties such as high ionic conductivity, hydrophobicity, non-volatility and non-flammability [2]. A gel polymer electrolyte with the room temperature ionic liquid combines the advantages of both ionic liquid and polymer electrolyte, and therefore has merits of high ionic conductivity, wide electrochemical window and good charge/discharge performance.

In the present work, we report PVdF-co-HFP based polymer electrolyte with *N*-butyl-*N*-methylpyrrolidinum bis(trifluoromethanesulfonyl) imide ($PYR_{14}TFSI$) ionic liquid. Gel polymer electrolyte with ionic liquid (IL-GPE) is fabricated by simple casting method and is applied as solid electrolyte for Li-O_2 battery. The structure and electrochemical stability of IL-GPE are characterized and the cycling performance of Li-O_2 battery constructed using IL-GPE is evaluated. As shown in Fig. 1, the Li-O_2 battery with IL-GPE exhibits the stable cycle performance. This report suggests the possibility that gel polymer electrolyte with ionic liquid can be used as a candidate electrolyte to improve the electrochemical performance and stability of Li-O_2 battery.

Reference

[1] G. Girishkumar, B. McCloskey, A. C. Luntz, S. Swanson, W. Wilcke, *J. Phys. Chem. Lett.* 1 (2010) 2193.
[2] T. Kuboki, T. Okuyama, T. Ohsaki, N. Takami, *J. Power Sources* 146 (2005) 766.

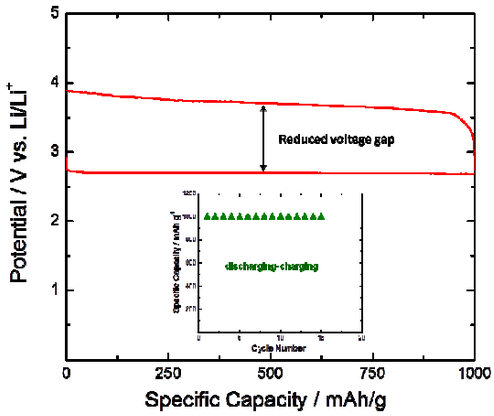

Fig. 1. Discharge-charge profile and cycling performance of the Li-O_2 battery (Li/IL-GPE/cathode) with a limited capacity of 1000 mAh/g.