Self-Discharge Behaviors of Lithium/Sulfur Cells with Gel Polymer Electrolyte

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Introduction

The lithium/sulfur cell was an extremely attractive redox couple because of high theoretical specific energy of 2600Wh/kg(1672mAh/g-sulfur), assuming complete reaction to the Li_2S. However, it was very difficult to make a high utilization Li/S cell because of high resistivity and reactivity of sulfur [1,2].

There have been only a few studies of Li/S cell. Cairns et al. [3] investigated on the discharge behaviors of Li/S batteries with various polymers at different temperatures. Chu et al. [4] reported the cycling properties of Li/S cell with PEO, PVdF and liquid electrolyte. Kim et al. [5] attempt to correlate the electrochemical behavior of the lithium sulfur battery with the physical characteristics of electrolyte. Shin et al [6] investigated on the effect of polymer electrolyte with ceramic filler on the electrochemical properties of Li/S cell.

However, there was no study on the self-discharge of the Li/polymer/S cell.

In this study, we investigated on the self-discharge of Li/S cell with gel polymer electrolyte at room temperature (25℃).

Experimental

The sulfur electrode was prepared by the glass casting using sulfur, carbon black and, PEO powders. The PVdF-HFP (Kynar 2801) film with plasticizer was used as electrolyte. Li/S cell was assembled in an argon atmosphere. In order to study the self-discharge of Li/S cell with PVdF gel polymer electrolyte, we measured the changes of OCV(open circuit voltage) and discharge curves with storage time.

In order to investigate on the reaction products, we used the X-ray diffractometer (XRD), differential scanning calorimeter (DSC), scanning electron microscope (SEM), and energy dispersive spectrometer (EDS).

Li/S cells were discharged at a current of 100 mA g^{-1} sulfur to a cut-off-voltage of 1.7V.

Results and discussion

Fig. 1 shows the change of discharge curve after 25days storage time.

After 25days, the upper plateau potential region, 2.4V, disappeared and the discharge capacity decreased to 25% of original sample.

Reference

1. E.Peled, Y.Sternberg, A.Gorenshtein, and Lavi, J. Electrochem. Soc., 136, 1621 (1989)
2. R.D.Rauh, K.Mabraham, G.F.Pearson, J.K. Surprenant, and S.B.Brummer, J. Electrocem. Soc., 126, 523 (1979)
3. D.Marmorstein, T.H.Yu, K.A.Striebel, F.R.McLarnon, J.Hou, and E.J.Cairns, Journal of Power Sources 89, 219 (2000)
4. M.Y.Chu, United States Patent No 5,814,420 Sep. 1998
5. D.R.Chang, S.H.Lee, S.W.Kim and H.T.Kim, Journal of Power Sources 4943, 1 (2002)
6. J.H.Shin, Y.T.Lim, K.W.Kim, H.J.Ahn, and J.H.Ahn, Journal of Power Sources 107, 103 (2002)

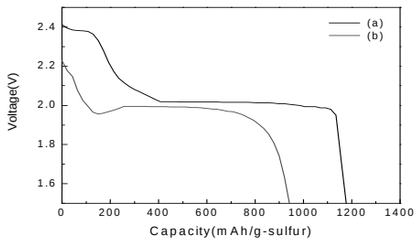

Fig. 1. The change of discharge curves of Li/S cells after 25days storage. a)original sample b)25days storage sample