The self-discharge property of Li/S cell at body temperature

Ic-Pyo Kim[a], Ki-Won Kim[a], Jou-Hyeon Ahn[b], Hyo-Jun Ahn[a], Jong-Seon Kim[a], Dong Ju Kim[a], Dong-Yeon Kim[a], Jung Hee Kwon[a], Jin Woo Park[a], Kwon-Koo Cho[a].

[a] *School of Materials Science & Engineering, i-Cube center, Gyeongsang National University, Gazwadong, 900, Jinju, Gyeongnam, 660-701, Korea*

[b] *Division of Chemical & Biological Engineering ,ITRC, Gyeongsang National University, Gazwadong 900, Jinju, Gyeongnam, 660-701, Korea*

INTRODUCTION

The battery is important power sources of medical devices such as pacemaker, neurostimulator, etc. The batteries like Li/SVO, Li/I_2 and Li/CF_x have been used as power sources. Li/S battery has a high theoretical energy density of 2600 Wh/kg, which is much higher than that of those batteries.[1-2] The self-discharge property of battery is one of the crucial facts for commercialization. Ryu et al[3-4]. reported the self-discharge property of Li/S cells at 25℃. From the view point of self-discharge Al was more adoptable than stainless steel for current collector. However no researches were reported on the self-discharge of Li/S cells at body temperature.[5-7]

In this study, we used Al foil as current collector of Li/S cell and investigated the self-discharge property of Li/S cell at body temperature. The self-discharge mechanism is investigated by means of differential scanning calorimetry (DSC), X-ray diffraction (XRD) analysis, and scanning electron microscopy (SEM).

EXPERIMENTAL

The sulfur electrode was composed of 60 wt.% elemental sulfur (−200 mesh, 99.98%, Aldrich), 20 wt.% carbon black and 20 wt.% copolymer of vinylidene fluoride and hexafluoropropylene (PVdF-co-HFP; Kynar 2801, Atochem). Sulfur, PVDF-co-HFP and carbon black in 1-methyl-2-pyrrolidinone (NMP) were stirred for 24h. The mixed slurry was pasted onto an Al current collector and dried in the air at room temperature and then in oven at 60℃ for 2 h. Lithium metal foil was used as anode electrode. The area and thickness of sulfur electrodes were approximately 0.8 cm^2 and 30μm, respectively. Electrolyte solutions were prepared by dissolving 1M $LiCF_3SO_3$ in solvent by stirring for 6 h. The Li/S cell was assembled by stacking in turn the 60% sulfur cathode, the porous polypropylene separator (Celgard 2200) soaked in electrolyte and lithium anode. Li/S cells were packaged into the swagelok type cell and assembled in an argon filled glove box. The discharge curves of Li/S cell were obtained at 37℃. Cell tests were carried out in galvanostatic way using WBCS3000 (WonA Tech Co., Korea) battery cycler. The cut-off voltage is 1.5V (versus Li) and current density during discharge is 100mA/g-sulfur. The morphologies of sulfur electrode were observed using scanning electron microscopy(SEM, JEOL, JSM-5600) and the thermal stability was examined using the differential scanning calorimetry(DSC). The crystalline structure of sulfur electrode was characterized by using X-ray diffraction(XRD). Cell tests were performed by galvanostatic way and cycle voltammertry measurements were performed at 37℃ by a scanning rate of 0.1mV/s.

REFERENCES

1. Jong-Won Lee and B. N. Popov, J. of Power Sources 161 (2006) 565-572
2. E.I. Eweka, C.O. Giwa, G.O. Mepsted, K. Green and D. Scattergood, J. of Power sources 162 (2006) 841-846
3. H.S. Ryu, H.J. Ahn, K.W. Kim, J.H. Ahn, J.Y. Lee, E.J. Cairns, J. of Power Sources 140 (2005) 365–369
4. H.S. Ryu, H.J. Ahn, K.W. Kim, J.H. Ahn, K.K. Cho, T.H. Nam, Electrochimica Acta 52 (2006) 1563–1566
5. Ho-Suk Ryu, Hyo-Jun Ahn, Ki-Won Kim, Jou-Hyun Ahn, Kwon-Koo Cho, Tae-Hyun Nam, Jong-Uk Kim and Gyu-Bong Cho, J. of Power Sources 163 (2006) 201–206
6. H.S. Ryu, H.J. Ahn, K.W. Kim, J.H. Ahn, K.K. Cho and T.H. Nam, Electrochimica Acta 52 (2006) 1563–1566
7. Xiujian Zhu, Zhaoyin Wen, Zhonghua Gu and Zuxiang Lin, J. of Power Sources 139 (2005) 269–273