

The Dependence of the Electrochemical Properties of Lithium Air Batteries on Manganese Salen Complex Concentration in Nonaqueous Electrolyte Solutions

Shuhei Sakamoto, Masahiko Hayashi, Masaya Nohara, Mikayo Iwata, Takeshi Komatsu
NTT Device Technology Laboratories, NTT Corporation,
3-1 Morinosato Wakamiya, Atsugi, Kanagawa 243-0198, Japan

E-mail: shuhei.sakamoto.xp@hco.ntt.co.jp

Lithium air secondary batteries (LABs) have attracted significant attention due to their high theoretical energy density. One of the major problems is their high charging overpotentials. To solve the problem, we are focusing on (R,R)-(-)-N,N-Bis(3,5-di-tert-butylsalicylidene)-1,2-cyclohexanediaminomanganese(III) chloride (MnSl) as an electrolyte additive. In our previous work, LAB cells using 1 mol/l LiTFSa/TEGDME with 0.005% of MnSl exhibited larger first discharge capacity of 893 mAh/g and good cycle retention of 87% at the 10th cycle than those without MnSl [3]. However, further improvement in the performance of MnSl is necessary for practical LAB cells. In this study, we investigated the dependence of the electrochemical properties of LABs on the MnSl concentration in electrolyte solutions. Various concentrations (0 - 8.0%) of MnSl (Sigma-Aldrich) vacuum-dried at 90°C for 12 h were added to 1 mol/l LiTFSa/TEGDME. Figure 1 shows first discharge/charge curves of LAB cells with MnSl under the condition of current density of 200 mA/g and cutoff voltage from 2.0 to 4.4 V. The cell with 2.0% of MnSl shows the highest discharge capacity of 4903 mAh/g and the lowest average charge voltage of 3.93 V among the cells tested. On the other hand, the cells with higher concentration of MnSl (4.0 and 8.0%) exhibited lower discharge capacities and higher average charge voltages. MnSl in high concentrations might diffuse to the lithium anode and cause side reactions such as lithium corrosion, similar to the way TEMPO lead to significant side reactions at the anode [4]. These results suggest that the concentration is one of the key factors determining the performance of MnSl.

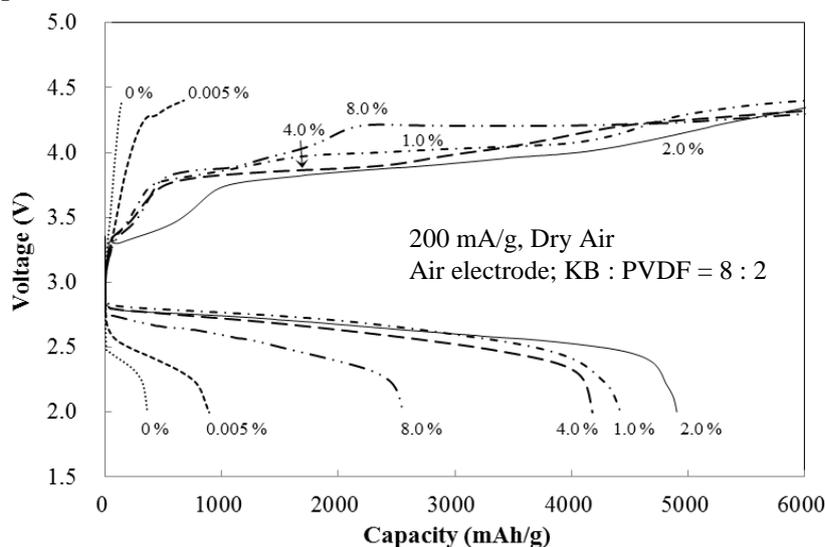


Fig.1 First discharge-charge curves of LAB cells using 1 mol/l LiTFSa/TEGDME with MnSl additive.

References

- [1] A. K. Thapa *et al.*, *Electrochem. Solid. St. Lett.*, **13**, A165, (2010).
- [2] B. D. McClosky *et al.*, *J. Am. Chem. Soc.*, **133**, 18038 (2011).
- [3] S. Sakamoto *et al.*, *232nd ECS Meeting, #535*, (2017).
- [4] B. J. Bergner *et al.*, *J. Am. Chem. Soc.*, **136**, 15054, (2014).