Investigation of degradation factor for lithium-sulfur batteries by quantitative determination analysis using UV-vis spectra

Yuki Ishino [a], Keitaro Takahashi [a], Wataru Murata [a], Minori Kamaya [a], Masayoshi Watanabe [b], Shiro Seki [a]

[a]*Graduate School of Applied Chemistry and Chemical Engineering, Kogakuin University, Tokyo, Japan*
[b]*Graduate School of Engineering , Yokohama National University, Kanagawa, Japan*

E-mail: b514009@ns.kogakuin.co.jp

Lithium-sulfur (Li-S) battery is expected for next generation rechargeable battery owing to have high capacity (1,645 mAh/g). The key issues of Li-S battery for cycle performances are the dissolution of lithium polysulfide as Li_2S_x. If we can suppress the dissolution of Li_2S_x, the battery life should be extended.

Solvate ionic liquid (SIL) is mixture of 1:1 complex from low-molecular weight ether and Li salt, which have high thermal/electrochemical stabilities owing to strong interaction of between ether oxygen and Li cation. Also SIL electrolyte can suppress the dissolution of Li_2S_x. Recently, high Li salt concentration more than conventional SIL into electrolyte is important for high performance LIBs and Li-S batteries not only the high stability but also low Lewis basicity of electrolytes for low solubility of impurity with charge/discharge. Fig. 1 shows cycle performance of $LiNi_{1/3}Mn_{1/3}Co_{1/3}O_2$ | $[Li(G3)_x]TFSA$ | Li cell. Excess Li salts achieved high cycle performances and stable charge-discharge operations [1].

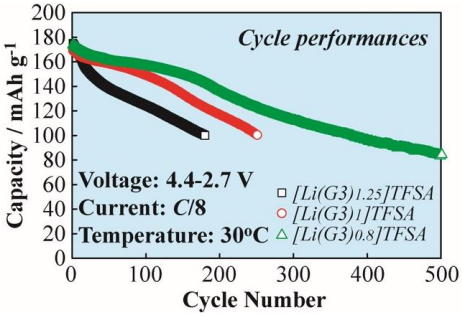

Fig. 1 Cycle performance of $LiNi_{1/3}Mn_{1/3}Co_{1/3}O_2$ |$[Li(G3)_x]TFSA$| Li cell.

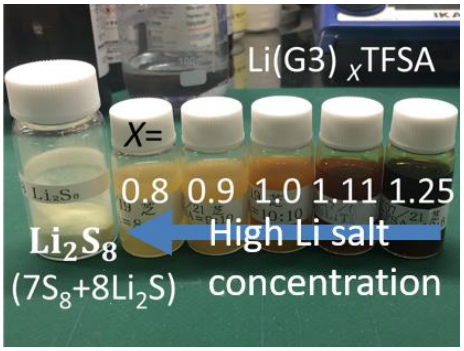

Fig. 2 Prepared SIL samples with saturated Li_2S_8.

However, quantitative analysis for dissolution of Li_2S_x into SIL has not investigated. In this study, to make clear relationship between composition ratio and dissolution of Li_2S_x, saturated solubilities of Li_2S_x were measured by electrochemical and UV-vis spectra.

Given amounts of glyme (G3,tryglyme) and LiTFSA of 10:8, 10:9, 10:10, 10:9 and 10:8(molar ratio) were prepared. Mixture of S_8 and Li_2S (S_8:Li_2S=7:8, Li_2S_8) were prepared. Fig. 2 shows appearances of five LiTFSA concentration SILs with saturated Li_2S_8. Then oxidize Li_2S_8 to S_8 and quantitative analysis using UV-vis spectra were carried out.

In the presentation, we will report to results of electrochemical and UV-vis spectra, and correlation of between dissolution amount of Li_2S_x and battery performances.

Reference:

[1] S.Seki *et. al*, *RSC Adv*., **6**, 33049-33047 (2016).