

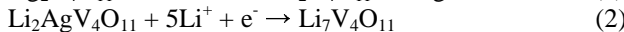
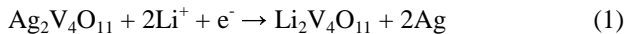
## Silver and Vanadium Dissolution in Li/SVO Primary Batteries

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SVO ( $\text{Ag}_2\text{V}_4\text{O}_{11}$ , Silver Vanadium Oxide) is a well-known, high-rate cathode material for lithium primary batteries. SVO has a theoretical capacity of 315mAh/g that corresponds to the following two reactions<sup>1</sup>:



A typical discharge profile is shown in Fig. 1. The first reaction corresponds to the reduction of silver and accounts for 29% of the total capacity. The second reaction corresponds to the reduction of vanadium.

One problem associated with the SVO material is that vanadium dissolves into the electrolyte. The dissolved V can then migrate to the lithium anode and deposit there. This phenomenon may cause an increase in impedance of the cell and result in deterioration of the battery performance. In this study, dissolution of SVO in several common electrolytes for lithium battery systems was evaluated. The effect of the depth of discharge (DOD) on SVO dissolution was also examined. In addition, the influence of storage time on the AC impedance of the lithium anode and SVO cathode was determined.

### Raw-material powder soaking test

1-g SVO powder was soaked in both 10-ml 1.2 M  $\text{LiPF}_6$  PC/DME (3:7 by volume) and 10-ml 1.2M  $\text{LiBF}_4$  PC/DME (3:7 by volume) for 3 weeks at 40°C inside an argon-filled glove box. The concentration of Ag and V dissolved in the electrolyte was determined using ICP-OES. A large amount (10-100ppm) of dissolved Ag and V was detected in 1.2M  $\text{LiPF}_6$  PC/DME while a small amount (< 5ppm) of dissolved Ag and V was detected in 1.2M  $\text{LiBF}_4$  PC/DME. This result indicates that the chemical composition of the salt of the electrolyte greatly affects Ag and V dissolution from the SVO material.

### Coin-type cell storage tests at different DOD values

2032 coin-type cells consisting of a SVO cathode, separator, and Li anode were assembled. Subsequently, the cells were conditioned to different DOD values as shown in Fig.1, and then stored at 60°C for 3 weeks. The electrolytes used were 1.2 M  $\text{LiPF}_6$  in PC/DME (3:7) and 1.2M  $\text{LiBF}_4$  in PC/DME (3:7). After storage, the amounts of Ag and V dissolved in the electrolyte and deposited on the lithium anode were determined by ICP-OES. ICP results are shown in Fig.2 and 3. The dissolution of Ag and V were observed in both  $\text{LiPF}_6$ -based and  $\text{LiBF}_4$ -based electrolytes. Higher amounts of dissolution were detected at lower values of DOD, with the amounts at 0% DOD. Also,  $\text{LiPF}_6$ -based cells showed

higher dissolution than  $\text{LiBF}_4$ -based cells. These results are in good agreement with those from the powder soaking tests.

### Three-electrode AC impedance tests

A three-electrode cell consists of one SVO working electrode, one Li counter electrode, and one Li reference electrode. The electrolyte used was 1.2 M  $\text{LiPF}_6$  PC/DME. The SVO working electrode was conditioned to 25% DOD and 45% DOD before storage. The AC impedance was measured before and after storage. The AC impedance showed two semi-circles that correspond to the Li anode and SVO cathode.

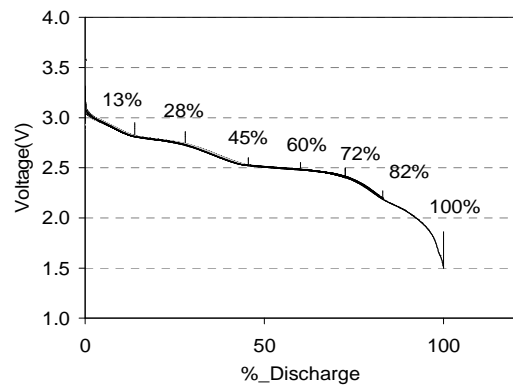


Fig.1 Li / SVO cell discharge profile

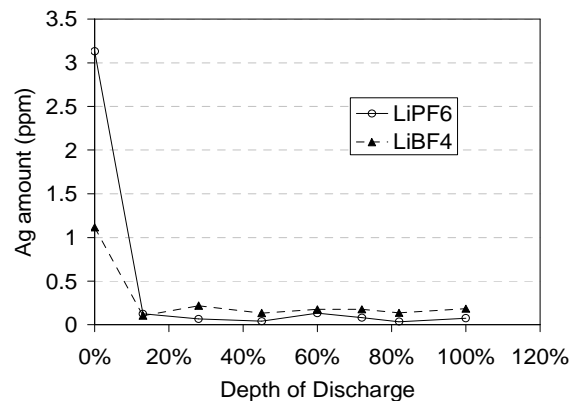


Fig.2 Ag amount in electrolyte at different DOD

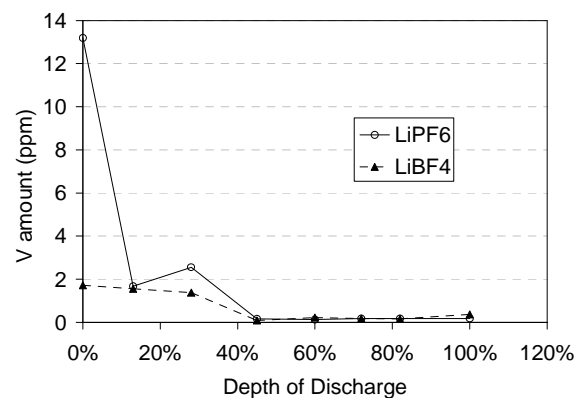


Fig.3 V amount in electrolyte at different DOD

## References

1. K. West and A.M. Crespi, J. Power Sources 54, 334 (1995)
2. H. Gan and E.S. Takeuchi, J. Power Sources 62, (1996)

