$LiFePO_4$ Cathode Made by Novel Water Soluble Elastomer for Low Cost Li-ion Batteries

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Introduction

The successful commercialization of Li-ion gel polymer batteries for portable electronic devices has led to other applications where the thickness and weight of batteries are important. With regard to large size applications such as in EV and HEV[1,2], in contrast, lower-cost cathode materials are required.

Recently, $LiFePO_4$ was investigated intensively as a potential cathode material for rechargeable Li-ion batteries[2,3] because of its low cost and safety.

Binder material is one of the crucial electrode components for the cell performance like cycle life. Elastomer is attractive binder, because it provides high active material ratio and flexibility to the cathode compared with conventional PVDF binder. In addition, water dispersion process of the slurry is environment-friendly.

In this paper, we report the results obtained with Li/gel electrolyte/$LiFePO_4$ cells by using a new water soluble elastomer binder (WSE) in the cathode. $LiPF_6$ salt in EC-DMC is used as solvent. Cathode with PVDF binder is compared with WSE.

Experimental

Li/$LiFePO_4$ configuration cells by using composite cathode based on WSE and PVDF, were evaluated. These cells contained gel polymer electrolyte with $LiPF_6$ salt in EC/DMC (1 : 1). Charge-discharge cycling and slow cyclic voltammetry of the cells were carried out using the galvanostatic method (MacPile^R, Claix, France). AC impedance spectroscopy was used to investigate the interface phenomena. The tested cells were maintained at an optimum compression of 10 psi. during the cycling. The cells were evaluated at different rates between the voltage limits of 2.5 V to 4 V.

Results

The data in Figure 1 shows a good performance of Li/gel polymer/$LiFePO_4$ based on WSE. A reversible capacity of 161 mAh/g was obtained at C/24 and coulombic efficiency of 90%. Compared to composite cathode with PVDF, the performance on the reversible capacity was 6% higher. These results indicate that WSE is well matched with $LiFePO_4$ by a good adhesion and good electrochemical affinity.

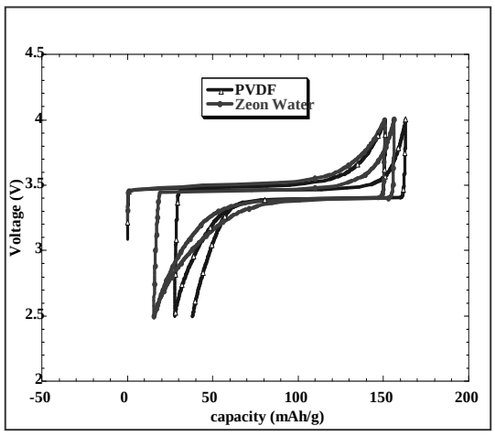

Fig. 1: Li/gel polymer/$LiFePO_4$, cathode with WSB binder compared to PVDF composite cathode.

References

1- http://berc.lbl.gov/BATT/BATT.html.
2- K. Striebel et al., 11th IMLB, Monterey CA (June 2002), abstract # 125.
3-N. Ravet et al. J. Power Sources, 97-98 (2001) 503-50.