Control of $AlPO_4$-Nanoparticle Coating on $LiCoO_2$ by Using Water and Ethanol

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The electrochemical properties of $AlPO_4$-coated $LiCoO_2$ cathodes prepared in a water and ethanol solvent were characterized with the view of stabilizing $LiCoO_2$ at charge-cutoff voltages of 4.6 V and 4.8 V. Aluminum nitrate ($Al(NO_3)_3 \cdot 9H_2O$, 1 g) and ammonium phosphate ($(NH_4)_2HPO_4$, 0.33 g) were dissolved in either distilled water or ethanol, and were mechanically mixed, until a white-colored $AlPO_4$-nanoparticle dispersed solution was observed. These were mixed with $LiCoO_2$ (with an average particle size of ~10 μm and BET surface area of 0.2 m^2/g), which were followed by drying at 130°C for 6 h and annealing at 700°C for 5 h, respectively. The estimated $AlPO_4$ to $LiCoO_2$ ratio was 0.3 wt. %.

In contrast to Al_2O_3-coated $LiCoO_2$, the phase transition from *H*1-3 to *O*1 appeared to be suppressed by the coating. Under the influence of the $AlPO_4$ crystallinity, the coated $LiCoO_2$ prepared in ethanol had better capacity retention than those prepared in water (Figs. 1 and 2). This enhancement also correlated with the improved suppression of Li-diffusivity decay in the coated cathode from the ethanol compared to that from water. In addition, the DSC results of the $AlPO_4$ nanoparticle-coated $LiCoO_2$ with ethanol showed an enhanced thermal stability compared to that with water.

Acknowledgement

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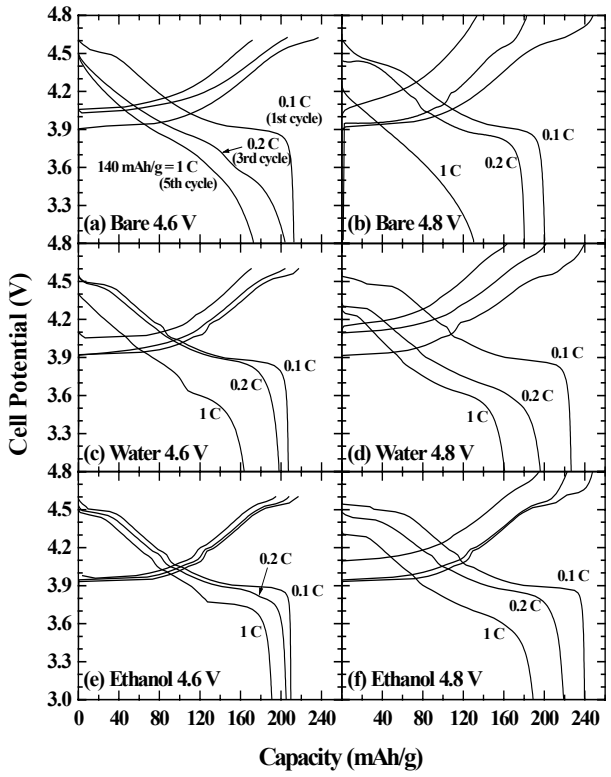

Figure 1. Plots of the first-, third-, and fifth-cycle voltage profiles of bare and coated $LiCoO_2$ prepared in water and ethanol, in the voltage range of 4.6 - 3 V and 4.8 - 3 V.

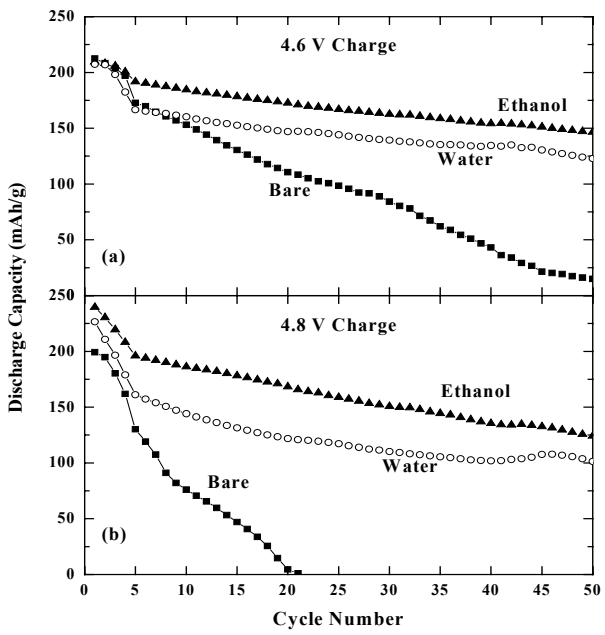

Figure 2. Plots of the discharge capacity vs. cycle number of bare and coated $LiCoO_2$ prepared in water and ethanol (a) between 4.6 and 3 V, and (b) between 4.8 and 3 V. The C rate was increased stepwise from 0.1 (2 cycles), 0.2 (1 cycle), 0.5 (1 cycle), and 1 C rates (46 cycles) in the coin-type half cells ($Li/LiCoO_2$).

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