In-situ XRD Investigation of Al-doped $LiMn_2O_4$ Cathode Material during Charging and Discharging in Nonaqueous Solution

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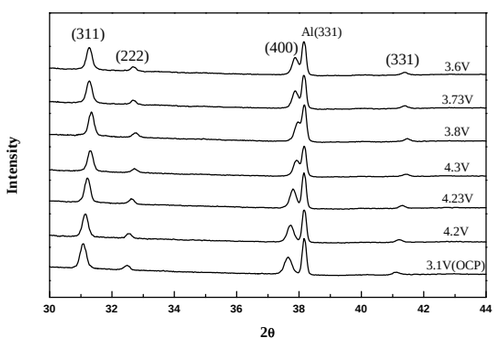
Al-doped $LiMn_2O_4$ material【1】has been used as a promising positive electrode in the rechargeable Li-ion batteries due to its low price, structural stability, long cycle life and environmental friendliness. Al dopant is mainly used to substitute Mn^{3+} site in $LiMn_2O_4$ material in order to prevent Mn^{3+} dissolution【2】and stabilize the cubic structure during charging and discharging process. Understanding the fading mechanism of a positive material is of great importance to improve its cell performance. Therefore, comparison of phase transition of $LiMn_2O_4$ and $LiAl_{0.15}Mn_{1.85}O_4$ materials during cycling was investigated by in-situ XRD in this work. The charge/discharge cycling processes are performed in Lithium-ion cell operated in EC+DEC(1:1)+$LiPF_6$ organic electrolyte by Maccor instrument in the potential range of 3.3 to 4.3 V at a c-rate of 0.1C.

Figure 1 and 2 display the in-situ XRD patterns of $LiMn_2O_4$ and $LiAl_{0.15}Mn_{1.85}O_4$ materials during charge and discharge cycling. The change in the lattice parameters and cell volume were observed in both these materials. However, the phase transition was found only in $LiMn_2O_4$ material (Fig. 1). Hence, the structure of $LiAl_{0.15}Mn_{1.85}O_4$ is more stable during cycling process (Fig. 2). The structure refinement will be analyzed by GSAS software.

Fig. 1 In-situ XRD patterns of $LiMn_2O_4$ material during cycling at between 3.3~4.3V.



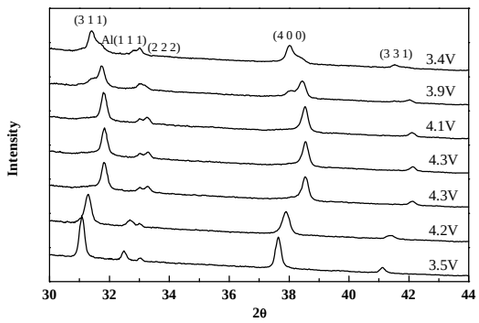


Fig. 2 In-situ XRD patterns of $LiAl_{0.15}Mn_{1.85}O_4$ material during cycling at between 3.3~4.3V.

Reference

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