

CHARACTERIZATION OF $\text{Li}_x\text{Mo}_{0.13}\text{Mn}_{1.87}\text{O}_4$ THIN FILMS FOR MICROBATTERIES

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In order to improve the electrochemical properties of spinel LiMn_2O_4 electrode, many transition metals have been introduced for substitution[1]. In our works, the spinel LiMn_2O_4 was deposited by sputtering and Mn ion was substituted for Mo by co-sputtering of MoO_2 -pellet.

LiMn_2O_4 thin films were deposited by using radio frequency magnetron sputtering with 2-inch diameter of LiMn_2O_4 target (99.97% purity). The chamber was evacuated to 5.0×10^{-6} Torr as a base pressure and working pressure was maintained to 10 mTorr with a forming gas of Ar and O_2 . RF power used during a process was 1.5 W/cm^2 . B-doped p-type Si (111) wafers were used as substrate on which Pt was deposited in thickness of 200 nm as a current collector by D.C. sputtering. To substitute cobalt ion, 1 cm-diameter MoO_2 pellets were placed on the LiMn_2O_4 target during sputtering. Deposited films were annealed using a horizontal tube furnace. Compositions of films were analyzed by ICP and RBS. Surface roughness of the film before and after the heat treatment was measured by AFM. Surface morphologies of the films were obtained by FE-SEM. For electrochemical analysis, half-cells were made with the annealed thin films as a cathode, the lithium metal as an anode, and 1 M solution of LiPF_6 in EC-DMC(1:1) as an electrolyte.

A composition of the Mo-doped films was $\text{LiMn}_{0.13}\text{Mn}_{1.87}\text{O}_4$. As shown in Fig.1, LiMn_2O_4 and $\text{LiMn}_{0.13}\text{Mn}_{1.87}\text{O}_4$ had almost same structure. Those films had a (111) preferred orientation and a small quantity of impurity phase such as Li_2MnO_3 . We conclude that no structural change occurred by substitution. Figure 2 showed the result of AFM measurement. Mo-doped film was rougher than the LiMn_2O_4 (Fig. 2). The higher value of roughness promised improved performance due to higher area of electrode/electrolyte interface, which was introduced the reaction area of intercalation reaction. As shown in Fig. 3, in spite of wide windows, the cycleability of the $\text{LiMn}_{0.13}\text{Mn}_{1.87}\text{O}_4$ film was better than that of the LiMn_2O_4 .

The results of XRD, FE-SEM and TEM of the cycled films will be discussed at the meeting.

AKNOWLEDGEMENTS

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REFERENCES

1. M. Hosoya, H. Ikuta, M. Wakihara, *Solid State Ionics*, **111**, 153 (1998)

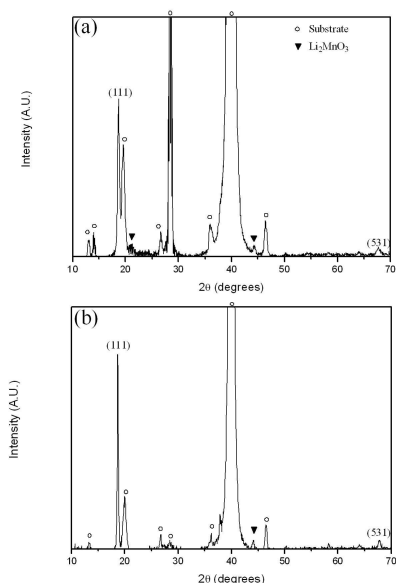


Figure 1. XRD patterns of the deposited films;
(a) LiMn_2O_4 and (b) $\text{LiMo}_{0.13}\text{Mn}_{1.87}\text{O}_4$

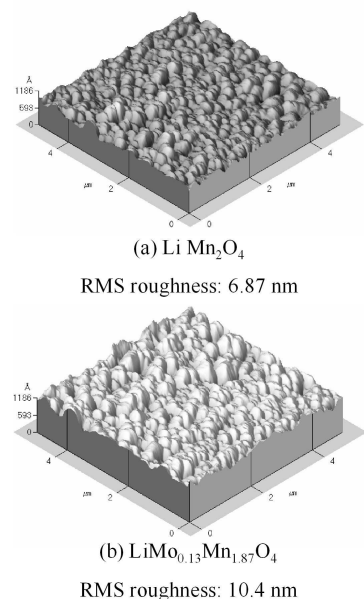


Figure 2. AFM images of the deposited films;
(a) LiMn_2O_4 and (b) $\text{LiMo}_{0.13}\text{Mn}_{1.87}\text{O}_4$

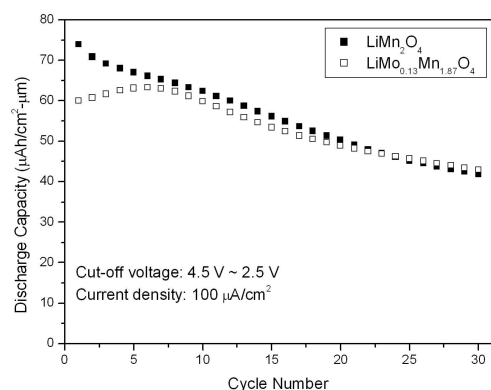


Figure 3. Discharge capacities of the deposited films.