The effect of post-deposition annealing on the N-doped LaB_6 thin film characteristics

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1. Introduction

The low work function of S/D electrodes is important to realize the n-type pentacene-based OFETs. Previously, we reported the improved N-doped LaB_6 thin film characteristics by the high temperature sputtering of 150°C [1-3].

In this study, the effect of post-deposition annealing (PDA) process for N-doped LaB_6 thin film formation was investigated.

2. Experimental procedure

The p-Si(100) substrate was cleaned by SPM and DHF. Then, a 10 nm thick SiO_2 gate insulator was formed by wet thermal oxidation at 850°C. Next, a 20 nm thick N-doped LaB_6 thin film was deposited utilizing RF sputtering with N-doped LaB_6 target. The sputtering power was 50 W, and the Ar gas flow rate was 10 sccm with a gas pressure of 0.35 Pa. The substrate temperature was 150°C. Then, the PDA process was performed for 1 min at 200°C-600°C in N_2. Then, the N-doped LaB_6 thin films were patterned by photo-lithography process. Finally, the Al back gate electrode was formed by thermal evaporation.

The sheet resistance was measured by 4-point probe. C-V characteristic for MOS diode with the electrode size of 40×40 μm^2 was measured by HP 4280A.

3. Results and Discussion

Figure 1 shows the PDA temperature dependence on the resistivity of N-doped LaB_6 thin films. The resistivity was decreased from 0.82 mΩcm to 0.39 mΩcm in case of PDA temperature of 200°C. Furthermore, the resistivity decreased with PDA temperature, and 0.25 mΩcm was obtained for the N-doped LaB_6 thin film annealed at 600°C.

Figure 2 shows the C-V characteristics of MOS diodes with N-doped LaB_6 electrode after 600°C PDA. The hysteresis was significantly decreased from 50 mV for as-deposited film to 7 mV after 600°C PDA. It was found that the flat-band voltage (V_{FB}) was shifted from -2.4 V to -1.4 V after the 600°C PDA. The extracted work function of N-doped LaB_6 was 3.6 eV.

4. Conclusions

We investigated the effect of PDA process on the N-doped LaB_6 thin film formation. The low resistivity of 0.25 mΩcm was obtained by the 600°C PDA. Furthermore, the hysteresis of C-V characteristics was decreased by the PDA process. Therefore, the PDA process would improve the N-doped LaB_6 thin film quality.

Acknowledgement

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References

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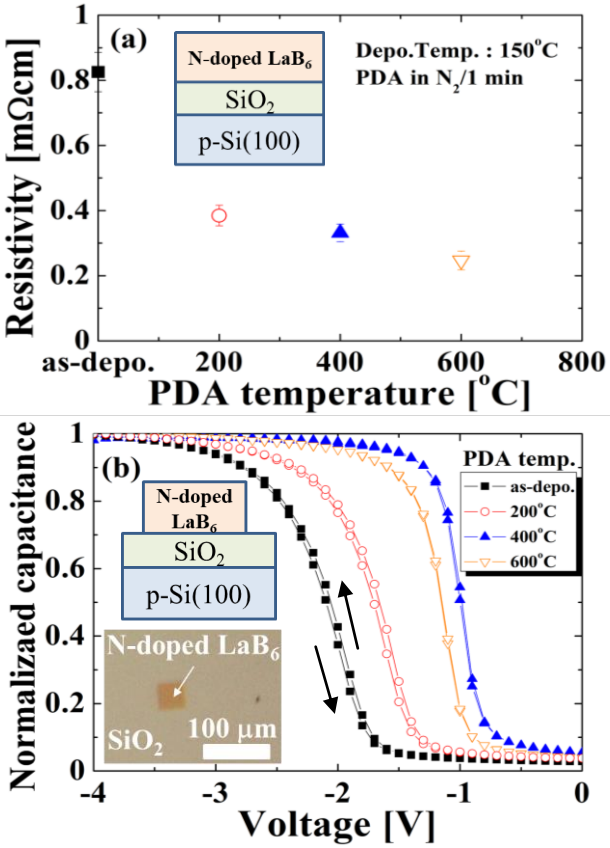

Figure 1. (a) PDA temperature dependence on the resistivity of N-doped LaB_6 thin film and (b) C-V characteristics with N-doped LaB_6/SiO_2/p-Si(100) MOS diodes.