

The floating-gate memory characteristics utilizing N-doped LaB_6 metal thin film and LaB_xN_y insulating layer

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1. Introduction

The nitrogen-doped (N-doped) LaB_6 has low resistivity, low work function, and chemical stability [1]. We have reported the thin film quality of N-doped LaB_6 electrode (metal : M) and formation of LaB_xN_y (insulator: I) thin film by Ar/N_2 plasma sputtering [2,3].

In this study, the MIMIS structure diode was investigated to floating-gate memory.

2. Experimental procedure

The p-Si(100) substrate was cleaned by SPM and DHF. Next, the N-doped LaB_6 metal layer and LaB_xN_y insulating layer as MIMIS structure with a thickness of 30/10/20/5 nm, respectively, were in-situ deposited on p-Si(100) by RF sputtering at room temperature (RT). The N-doped LaB_6 target was used (N: 0.4%) in this study. The sputtering conditions were 7 and 50 W, Ar/N_2 : 10/5 and 10/0 sccm, 0.42 and 0.35 Pa, for LaB_xN_y and N-doped LaB_6 , respectively. The post metallization annealing (PMA) process was carried out at 400°C/1 min in N_2 (1 SLM) ambient followed by the patterning with diluted nitric acid. The pattern size was $30 \times 30 \mu\text{m}^2$. Finally, the back Al electrode was formed. The electrical characteristics of the MIMIS diodes were evaluated by C-V measurement at RT.

3. Results and Discussion

The C-V characteristics for MIMIS diodes were shown in Fig.1. The program and erase (P/E) voltage/time were changed from ± 1 V/1 s to ± 5 V/1 s. Then, the flat-band voltage (V_{FB}) was extracted from the C-V curves that the gate voltage was applied from the negative to the positive direction. As shown in Fig. 1(a), the hysteresis was decreased from 260 mV to 170 mV by increasing programming voltage. On the other hand, the V_{FB} was shifted from -0.60 V to -0.18 V. In case of the erase condition, the hysteresis was increased from 260 mV to 550 mV. Furthermore, V_{FB} was shifted from -0.6 V to -1.2 V.

4. Conclusions

We investigated the MIMIS diode utilizing LaB_xN_y insulator and N-doped LaB_6 metal layer. The MIMIS diodes showed clear P/E state. Which would be improved by considering the design of MIMIS structure fabrication process.

Acknowledgement

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References

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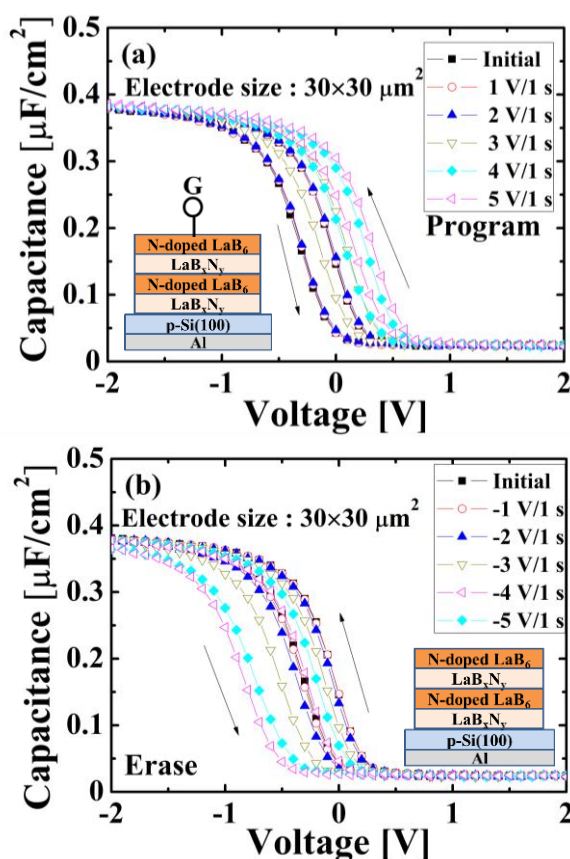


Figure 1. C-V characteristics of MIMIS diodes. Program (a) and erase (b) characteristics. The P/E pulses were ± 1 V- ± 5 V for 1s.