

The influence of sputtering condition for ferroelectric HfO₂ directly deposited on Si(100) by RF magnetron sputtering

Tokyo Institute of Technology¹, [○]Min Gee Kim¹, Masakazu Kataoka,

Rengie Mark D. Mailig, and Shun-ichiro Ohmi¹

E-mail: kim.m.ak@m.titech.ac.jp, ohmi@ee.e.titech.ac.jp.

1. Introduction

Nowadays, the ferroelectric HfO₂ is widely investigated because of its Si CMOS compatibility. To reduce the depolarization field, direct deposition of HfO₂ with low-temperature annealing process is necessary. In previous research, the control of gas flow ratio for reactive sputtering realized ferroelectric characteristics of undoped HfO₂ directly deposited on Si(100) substrates [1,2].

In this research, we investigated the effect of sputtering condition to improve the electrical characteristics of HfO₂/Si(100) structure.

2. Experimental Procedure

Firstly, the p-Si(100) substrates were cleaned by SPM and DHF solutions. HfO₂ was deposited by RF magnetron sputtering with Hf target. The Ar sputtering was performed before loading the substrates for the cleaning of the surface of Hf target. Then, 20-nm-thick HfO₂ was deposited at room temperature (RT) with Ar/O₂ flow ratio of 2.0/0.2 sccm and gas pressure of 0.35 Pa. The sputtering power was changed as 60 W and 80 W. Post-deposition annealing (PDA) was carried out at 600 °C for 30 s. Finally, Al electrode was evaporated through a stencil mask. The fabricated samples were characterized by C-V and J-V measurements.

3. Results and Discussion

Figure 1(a) shows the comparison of C-V characteristics of Al/HfO₂/p-Si(100) diodes. When the sputtering power was 80 W, the hysteresis was not observed in C-V characteristic, while the memory window (MW) of 0.3 V was obtained in case the sputtering power was 60 W. Furthermore, the stretch in C-V characteristic decreased by reducing the sputtering power [1].

Figure 1(b) shows the J-V characteristics of Al/HfO₂/p-Si(100) diodes. The leakage current was also decreased by reducing the sputtering power [1].

4. Conclusions

In this paper, the effect of sputtering power was investigated. The reduction of sputtering power to 60 W was effective to improve the

interface property with ferroelectric memory window of 0.3 V.

Acknowledgements

The authors would like to thank Prof. H. Funakubo for his useful discussion. This research is partially supported by the Cooperative Research Project of Research Center for Biomedical Engineering, Ministry of Education, Culture, Sports, Science and Technology. One of the authors (M. G. Kim) acknowledges Honjo International Scholarship Foundation (HISF) for financial support.

References

- [1] M. G. Kim, et al., The 65th JSAP spring meeting, p. 05-175 (2018).
- [2] M. Kataoka, et al., The 79th JSAP autumn meeting, p. 100000001-175 (2018).

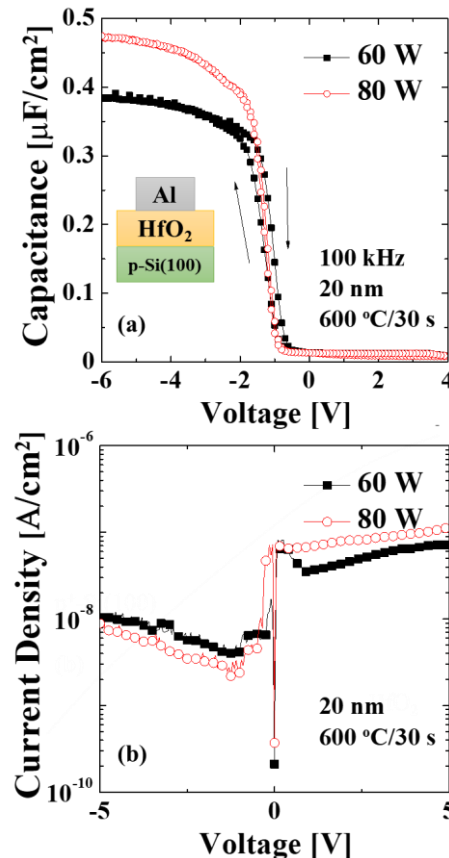


Figure 1. (a) C-V and (b) J-V comparisons with sputtering power of 60 W and 80 W.