X-ray Absorption Spectroscopy of High-k Gate Dielectric Insulating Layers for Next-Generation Semiconductor Devices by Superconducting Detectors

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Introduction

HfAlO is promising for a high-k gate dielectric material in next-generation CMOS-FET. O K-edge absorption spectra gives us information about crystallization, etc. STJ detectors are advantageous to x-ray absorption spectroscopy (XAS) of O K-edge because of no surface dead layers and high count rate.

Sample preparation

Atomic Layer Deposition (ALD) at 300°C with Hf[N(CH3)2]4 (TDMAH), Al(CH3)3 (TMA), H2O, ~10 nm, Hf:Al=1:3, and rapid thermal annealing at 800 °C.

Performance of STJ detectors in a soft X-ray region

Results and Conclusion

- The energy resolution : about 10 eV
- The fluorescent yield XAS spectra of O K-edge have shown that the crystallization of HfAlO films in as-deposited state with the ALD deposition.
- Future: no double peaks with Ta absorber