Characterization of γ-Al_2O_3/β-Ga_2O_3 interface with photo-assisted capacitance-voltage method

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[Introduction] β-Ga_2O_3 is promising for next-generation power devices such as metal-oxide-semiconductor field-effect transistors (MOSFETs). In a MOSFET, trap states residing at interface between a channel and adjacent layers influence the performance and durability. According to the previous studies [1, 2], γ-Al_2O_3 is prospected as a gate oxide for β-Ga_2O_3-based MOSFET with good performance. Here we report on the electrical characterization of γ-Al_2O_3/β-Ga_2O_3 interface with photo-assisted capacitance-voltage (*C*-*V*) method for accurate estimation of interface trap density (D_{it}) [3].

[Experiment] γ-Al_2O_3 epitaxial films were grown on unintentionally doped β-Ga_2O_3 (010) wafers by using oxygen-radical-assisted pulsed-laser deposition (PLD) at 500 ℃. Then MOS capacitors were fabricated with semitransparent Au top electrodes and ITO bottom ohmic contacts. The current density-voltage (*J*-*V*) and the photo-assisted *C*-*V* measurements were performed at RT with using a 300 W Xe lamp.

[Results and discussion] Figure 1 is the *J*-*V* curve in dark exhibiting a high breakdown electric field more than 10 MV/cm. Figure 2 shows the results of photo-assisted *C*-*V* measurement. There is a ledge in the curve after UV excitation. This ledge is attributed to retrapping of photoexcited electrons as the Fermi level reaches the deepest interface state. We calculated D_{it} from the voltage difference (ΔV) with respect to shifted dark curve (see Figs. 2 and 3). The peak at −0.5 eV corresponds to holes accumulated at the valence band offset. The average D_{it} after subtracting this peak is 2.0×10^{12} cm^{-2} eV^{-1}, which is smaller than that of amorphous Al_2O_3/β-Ga_2O_3 interface (5.5×10^{12} cm^{-2} eV^{-1}) estimated by the same method [4].

[1] M. Hattori *et al.*, *Jpn. J. Appl. Phys.* **55**, 1202B6 (2016).

[2] T. Kamimura *et al.*, *Jpn. J. Appl. Phys.* **55**, 1202B58 (2016).

[3] R. Yeluri *et al.*, *J. Appl. Phys.* **114**, 083718 (2013)

[4] Z. A. Jian *et al.*, *Appl. Phys. Lett.* **116**, 242105 (2020).

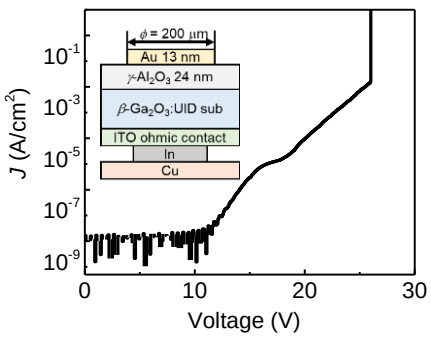

Fig. 1 *J*-*V* curve for a sample shown in inset.

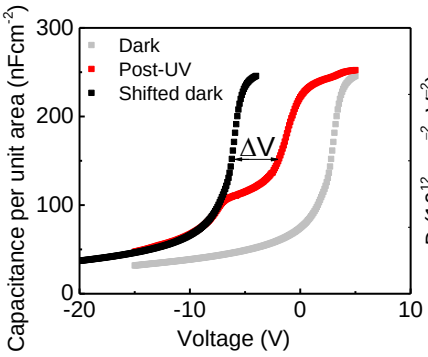

Fig. 2 C-V curves in dark (gray) and after UV photoexcitation for 15 s (red). The shifted dark curve (black) is also shown for clarity.

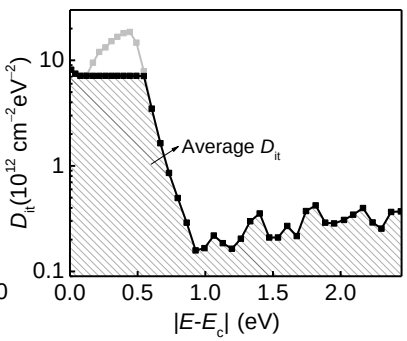

Fig. 3 D_{it} as a function of energy with respect to the conduction band maximum E_c.