Interface Trap-Induced Temperature Dependent Hysteresis and Mobility in $\beta$-Ga$_2$O$_3$ Field-Effect Transistors

Youngseo Park $^1$, Jiyeon Ma $^2$, Geonwook Yoo $^{2,*}$ and Junseok Heo $^{1,*}$

**Figure S1.** Output curves of $I_{DS}$ vs $V_{DS}$ at room temperature for $V_{GS} = -15, -10, -5, 0, 5$, and $10$ V. The good linearity of output curves indicate the Ohmic contact of the $\beta$-Ga$_2$O$_3$ FET.
**Figure S2.** Transfer curve for $V_{DS} = 1$ V in a linear scale at 180 K. The red dash line is tangential line at the maximum slope on transfer curve. The threshold voltage is defined as $x$-intercept of the red dash line.

**Table S1.** The density of the trapped and de-trapped charges and the time constants.

$$I = I_0 \pm \frac{\mu W V_{DS}(Q_1 e^{-t/\tau_{it1}} + Q_2 e^{-t/\tau_{it2}})}{L}$$

| $V_C = 0$ V | $V_C = 10$ V |
|----------------|----------------|
| **T [K]** | **Q_1+Q_2 [10^{9}$ cm$^{-2}$]** | **Q_1 [10^{9}$ cm$^{-2}$]** | **$\tau_{it1}$ [s]** | **Q_2 [10^{9}$ cm$^{-2}$]** | **$\tau_{it2}$ [s]** | **Q_1+Q_2 [10^{9}$ cm$^{-2}$]** | **Q_1 [10^{9}$ cm$^{-2}$]** | **$\tau_{it1}$ [s]** | **Q_2 [10^{9}$ cm$^{-2}$]** | **$\tau_{it2}$ [s]** |
| 280 | 19.23 | 2.33 | 19.41 | 16.9 | 153.13 | -5.53 | -2.52 | 3.35 | -3.01 | 51.04 |
| 290 | 33.18 | 4.14 | 13.44 | 29.04 | 148.44 | -7.73 | -3.55 | 2.95 | -4.18 | 50.72 |
| 300 | 38.61 | 4.77 | 6.16 | 33.84 | 72.24 | -11.06 | -6.09 | 1.73 | -4.97 | 34 |
| 310 | 42.56 | 6.63 | 3.51 | 35.93 | 34.86 | -10.71 | -6.55 | 1.57 | -4.16 | 25.35 |
| 320 | 42.7 | 5.84 | 1.52 | 36.86 | 13.89 | -9.61 | -5.69 | 0.95 | -3.92 | 10.96 |