Supplementary information

# P-type β-$Ga_2O_3$ films room-temperature $NH_3$ gas sensors with fast gas sensing and low limitation of detection

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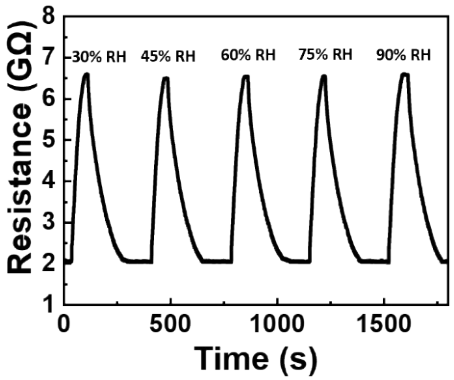


**Figure S1.** The transient response characteristics p-type N-doped β-$Ga_2O_3$ gas sensors under 50 ppm $NH_3$ with different humidity.

The transient humidity influence on $NH_3$ detection of the p-type N-doped β-$Ga_2O_3$ gas sensors is shown in Figure S1. The $NH_3$ response slightly increases as relative humidity increases from 30% to 90%. The humidity variation is only 1.07% of the $NH_3$ response, which shows low humidity effect. The p-type N-doped β-$Ga_2O_3$ gas sensor is stable over a large humidity range.

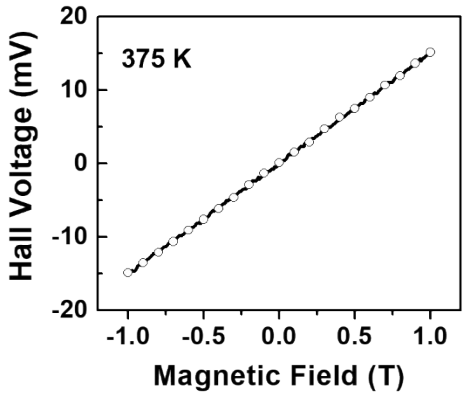


**Figure S2.** Hall voltage versus applied magnetic field for the N-doped β-$Ga_2O_3$ films at 375 K.

Figure S2 shows the magnetic-field-dependent Hall measurement conducted on N-doped β-$Ga_2O_3$ films at 375 K with a positive Hall coefficient. The Hall hole concentration is $4.15\times10^{15}$ $cm^{-3}$.

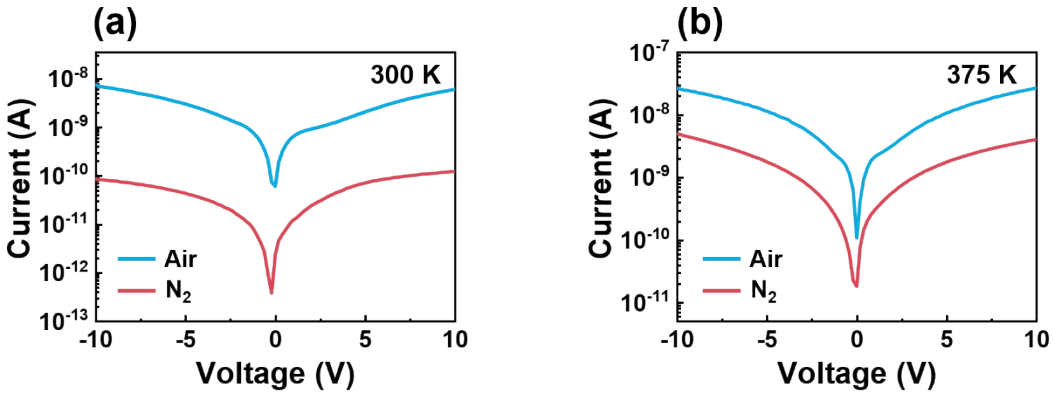


**Figure S3.** The *I*−*V* characteristics of the p-type β-$Ga_2O_3$ MSM sensors in dry air and $N_2$ (a) at 300 K and (b) 375 K.

The width of the HAL can be extracted from the *I*−*V* characteristics of p-type β-$Ga_2O_3$ MSM sensors in dry air and in the $N_2$ gas atmosphere (Figure S3) by equation:

$\sigma_g = \sigma_a \times exp(-e\Delta V_{sur}/kT)$

$\Delta x_{sur} = (2\varepsilon \Delta V_{sur}/eN_A)$

The width of HAL in dry air at 10 V bias is calculated to be 44.5 nm at 300 K ($x_{sur}$, $W_{HAL}$), and decreases to 19.7 nm at 375 K, which is suitable for RT gas sensing involving multi-carriers chemisorbed reactions