

## Electronic Supplementary Information

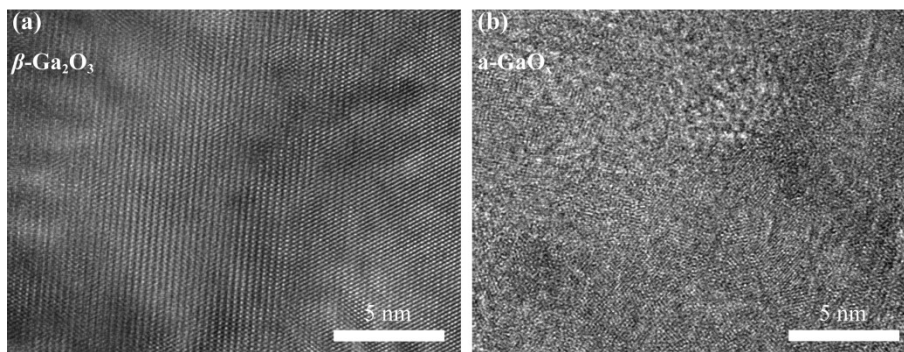
### **Ga<sub>2</sub>O<sub>3</sub> Based Multilevel Solar-Blind Photomemory Array with Logic, Arithmetic, and Image Storage Functions**

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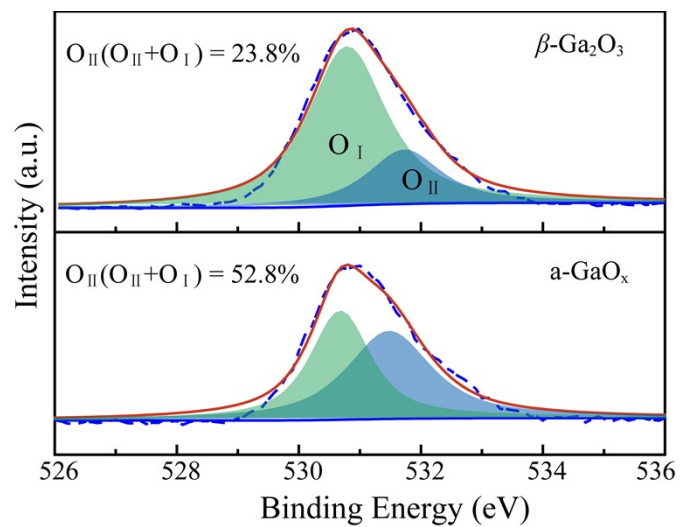
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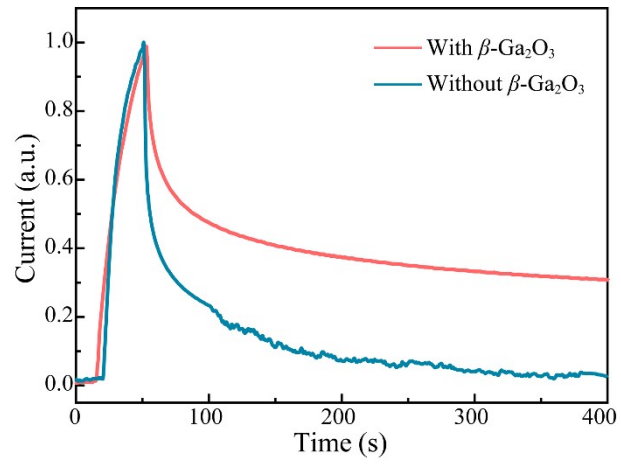
**Fig. S1** HRTEM images acquired from the  $\beta\text{-Ga}_2\text{O}_3$  (a) and  $\alpha\text{-GaO}_x$  (b).

HRTEM images show that  $\alpha\text{-GaO}_x$  is highly disordered and  $\beta\text{-Ga}_2\text{O}_3$  is highly crystallized.

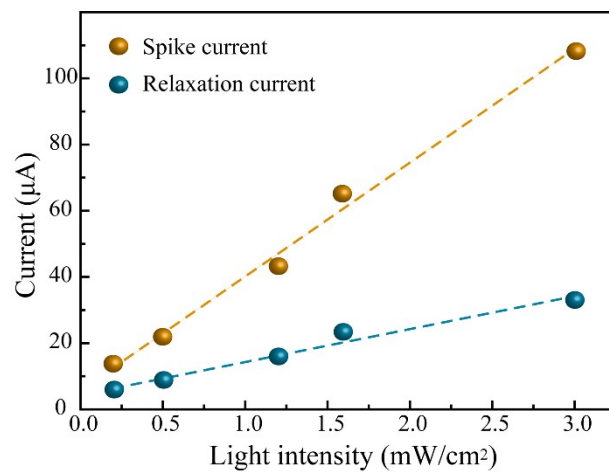


**Fig. S2** High-resolution O 1s XPS spectra of the  $\beta\text{-Ga}_2\text{O}_3$  and  $\text{a-GaO}_x$  films.

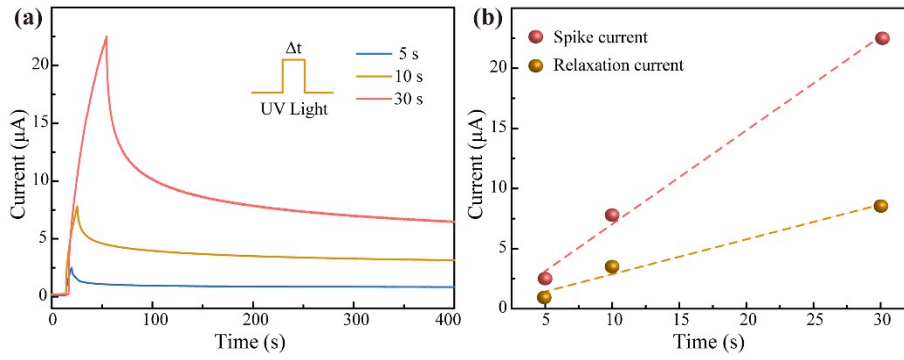
The XPS O 1s spectra can be used to analyze the quantities of oxygen vacancies of  $\text{Ga}_2\text{O}_3$ , which are determined to be 23.8% and 53.8% for  $\beta\text{-Ga}_2\text{O}_3$  and  $\text{a-GaO}_x$  films, respectively.



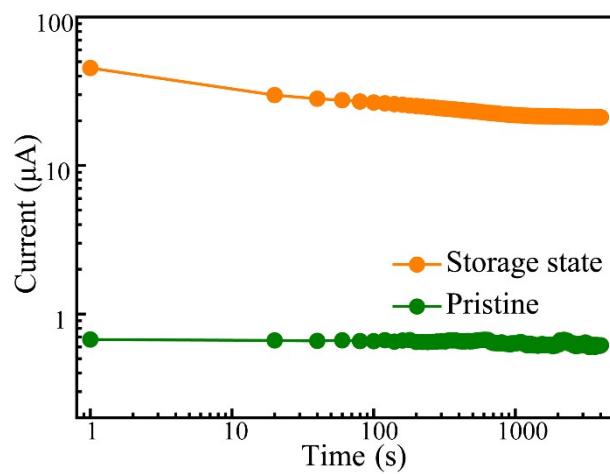
**Fig. S3** Readout current curves of photomemories with and without  $\beta$ -Ga<sub>2</sub>O<sub>3</sub>.



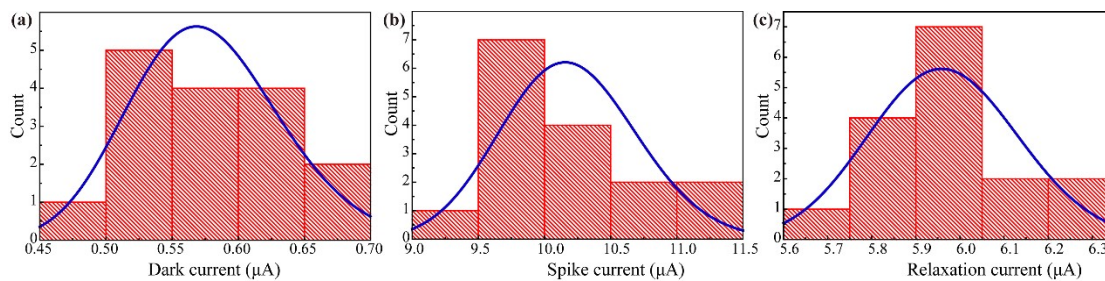
**Fig. S4** Dependence of the spike current and relaxation current of the photomemory cell on the intensity of the 254 nm illumination.



**Fig. S5** (a) Readout current as a function of light exposure times at  $V_{DS} = 5$  V and  $V_{GS} = 15$  V. (b) Dependence of the spike current and relaxation current of the photomemory cell on the light exposure times.

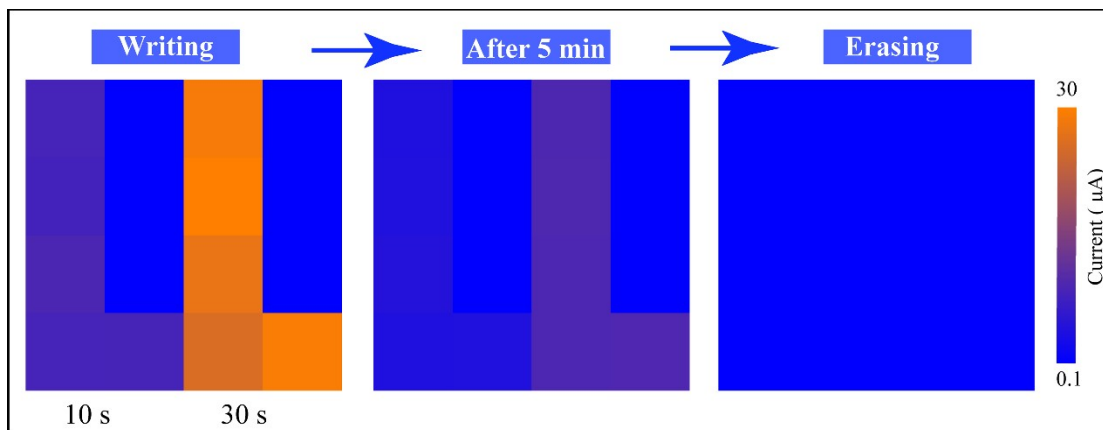


**Fig. S6.** Retention performance of the storage state programmed with 50 s illumination under 0.5 mW/cm<sup>2</sup>.



**Fig. S7** Statistical dark current (a), spike current (b) (intensity  $0.2 \text{ mW/cm}^2$ , pulse width 10 s) and relaxation current (c) of the 16 photomemory cells at  $V_{\text{DS}} = 5 \text{ V}$  and  $V_{\text{GS}} = 15 \text{ V}$ .





**Fig. S8** Measured results of multilevel imaging storage under different solar-blind light exposure times.