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Supplementary Information

Integrating Ultraviolet Sensing and Memory Functions in Gallium Nitride-based Optoelectronic Devices

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Supplementary Information 1

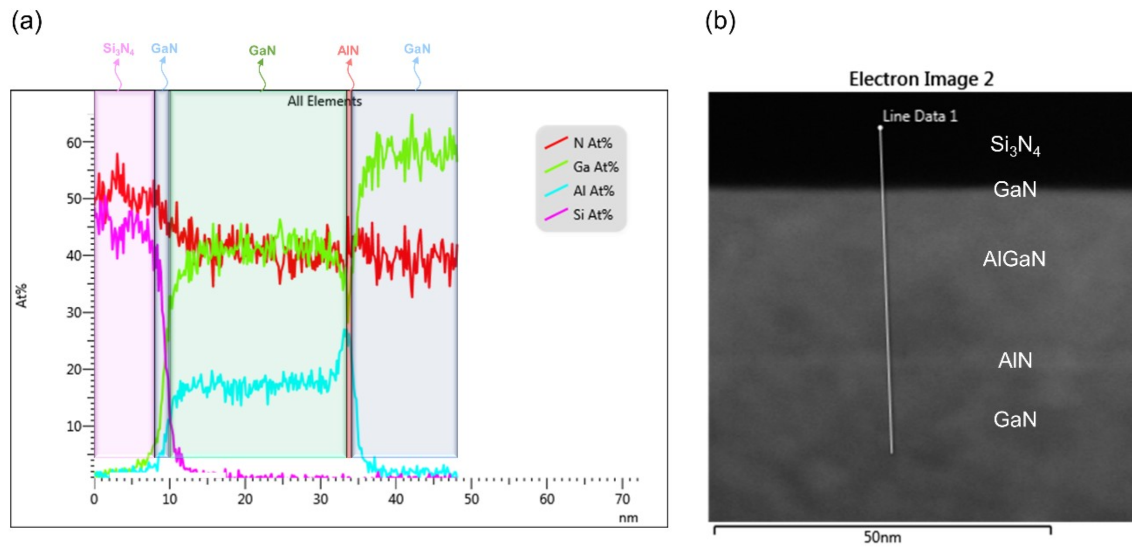

Figure S1. *(a) EDS results of Si, Al, Ga, N elements in the memory device. (b) The EDS image shows the cross-section multi-layer structure in gate region.*

Supplementary Information 2

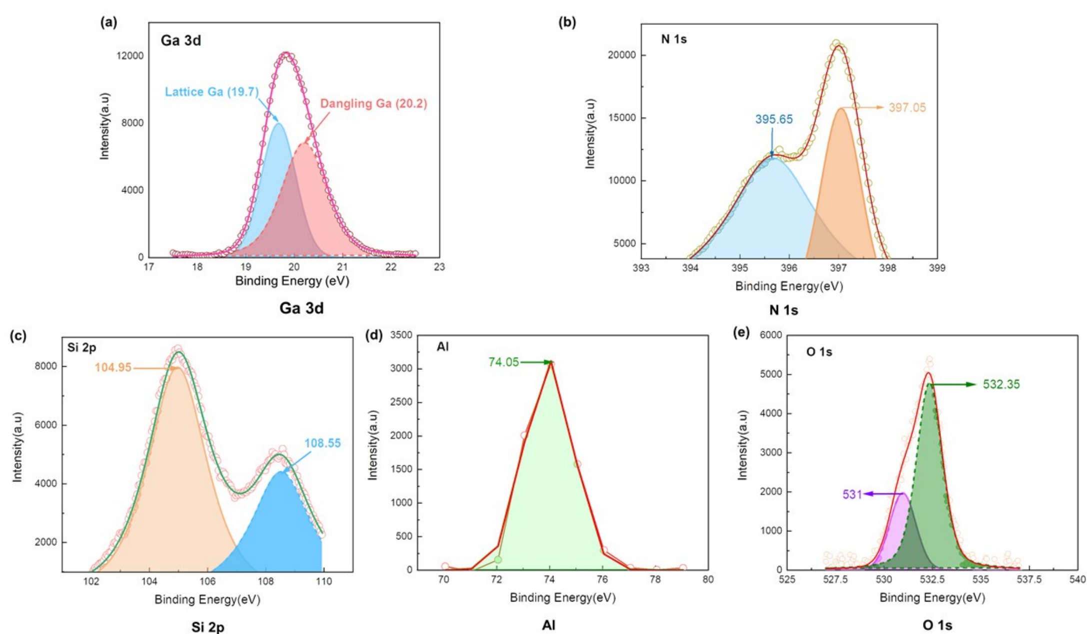

Figure S2. *X-ray photoelectron spectroscopy (XPS) spectra of GaN optoelectronic memory. (a) Ga 3d regions. (b) N 1s regions. (c) Si 2p regions. (d) Al region. (e) O 1s regions.*

Supplementary Information 3

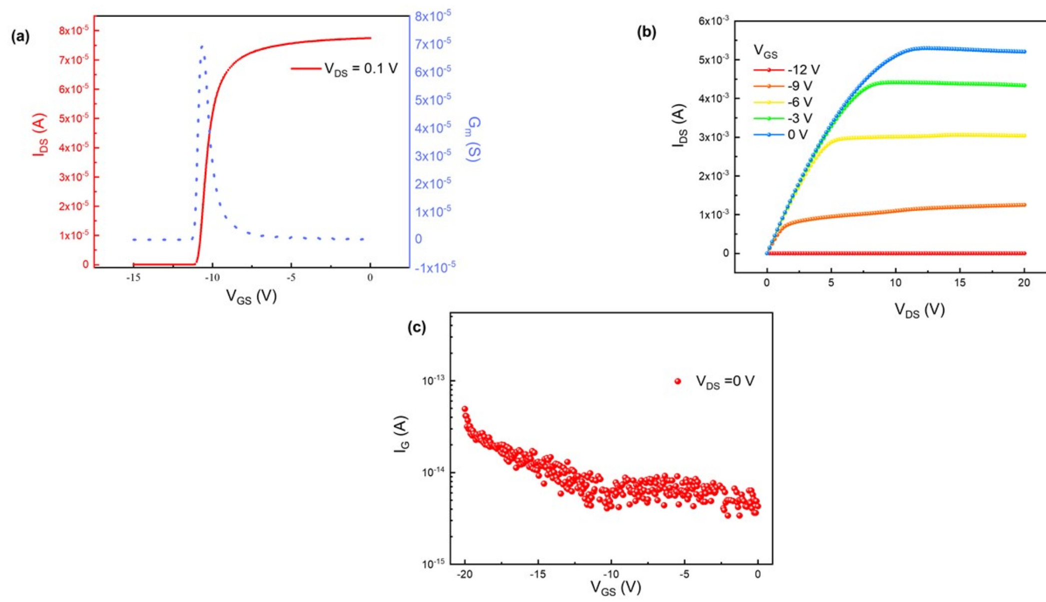

Figure S3. *Basic I-V characteristics of GaN optoelectronic memory. (a) The transfer characteristics. (b) The output characteristics. (c) The ultra-low gate leakage current.*

Supplementary Information 4

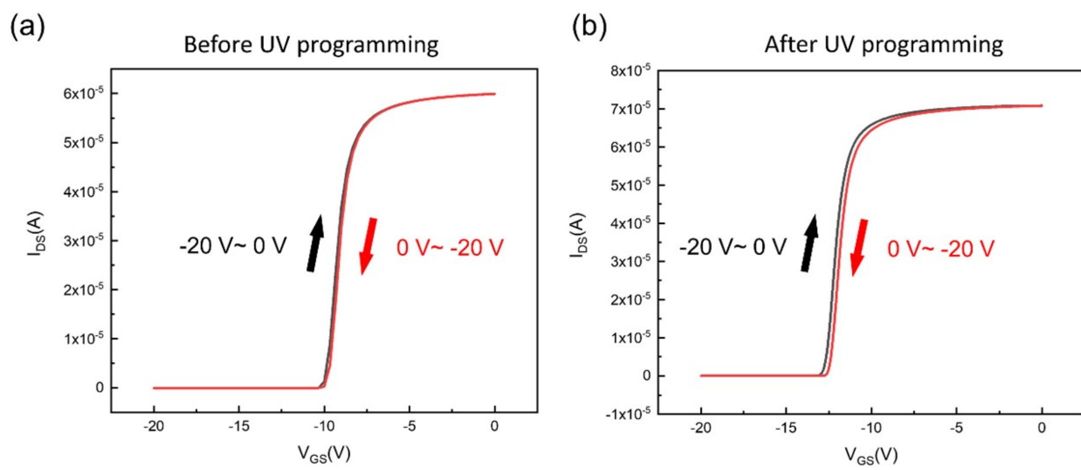

Figure S4. *(a) Hysteretic behavior before UV programming (b) Hysteretic behavior with respect to the incident UV powers.*

Supplementary Information 5

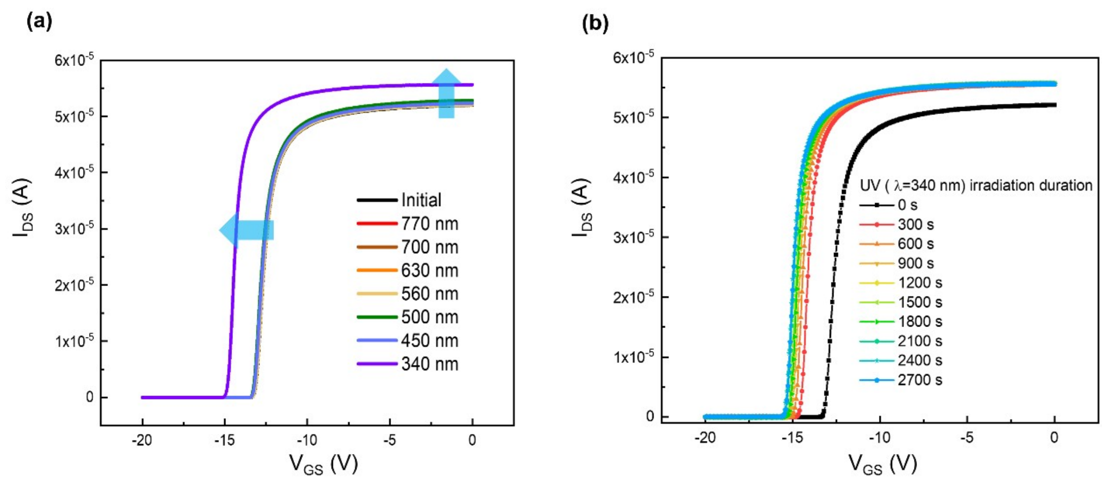

Figure S5. *(a) GaN optoelectronic memory's response to light exposure at various wavelengths. (b) Effects of UV irradiation duration on the programming speed and memory state.*

Supplementary Information 6

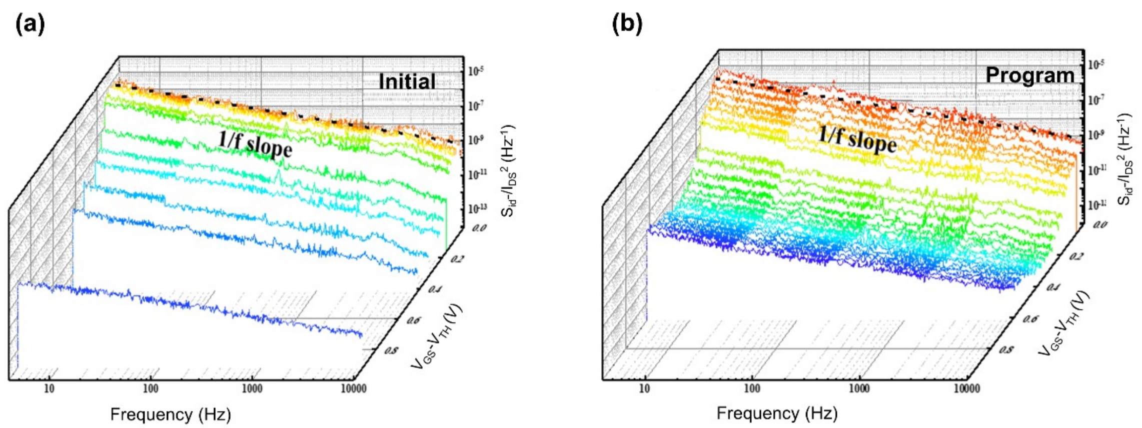

Figure S6. *1/f noise characteristics of GaN optoelectronic memory before and after UV programming. (a) Initial state. (b) Programmed with UV irradiation.*

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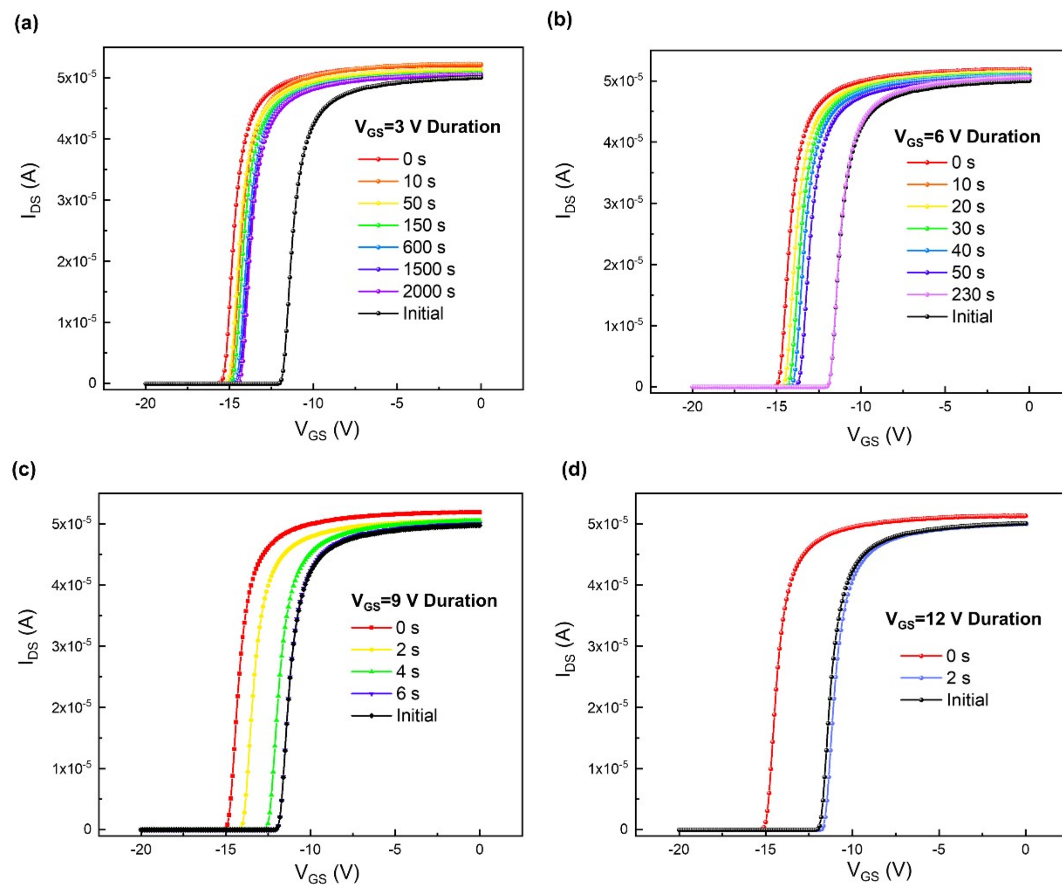

Figure S7. *The influence of gate voltage on the erasure time of GaN optoelectronic memory. Erase the device under different positive gate pressures: (a) 3V; (b) 6V; (c) 9V; (d)12V*

Supplementary Information 8

The biexponential fitting result of ΔV_{TH} retention characteristics in **Figure S8** a is shown in formula (1):

$$\Delta V_{TH} = 1.061e^{\left(-\frac{t}{936.286}\right)} + 0.26e^{\left(-\frac{t}{13509.522}\right)} + 1.661 \#(1)\#$$

The biexponential fitting result of ΔI_{DS} retention characteristics in **Figure S8** b is shown in formula (2):

$$\Delta I_{DS} = 1.524 \times 10^{-6}e^{\left(-\frac{t}{1627.469}\right)} + 7.822 \times 10^{-7}e^{\left(-\frac{t}{20890.698}\right)} +$$

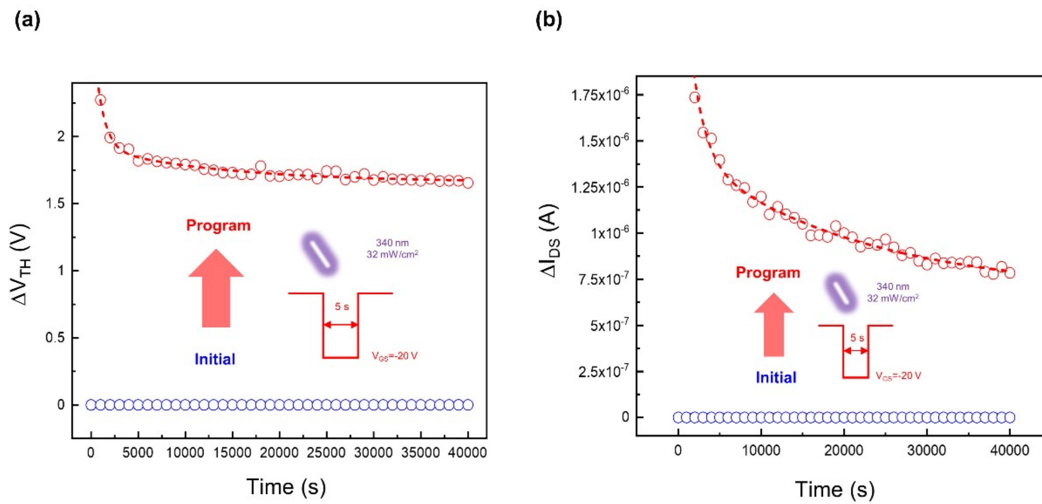

Figure S8. *(a)Fitting result of the retention curves for ΔV_{TH}. (b) Fitting result of the retention curves for ΔI_{DS}.*

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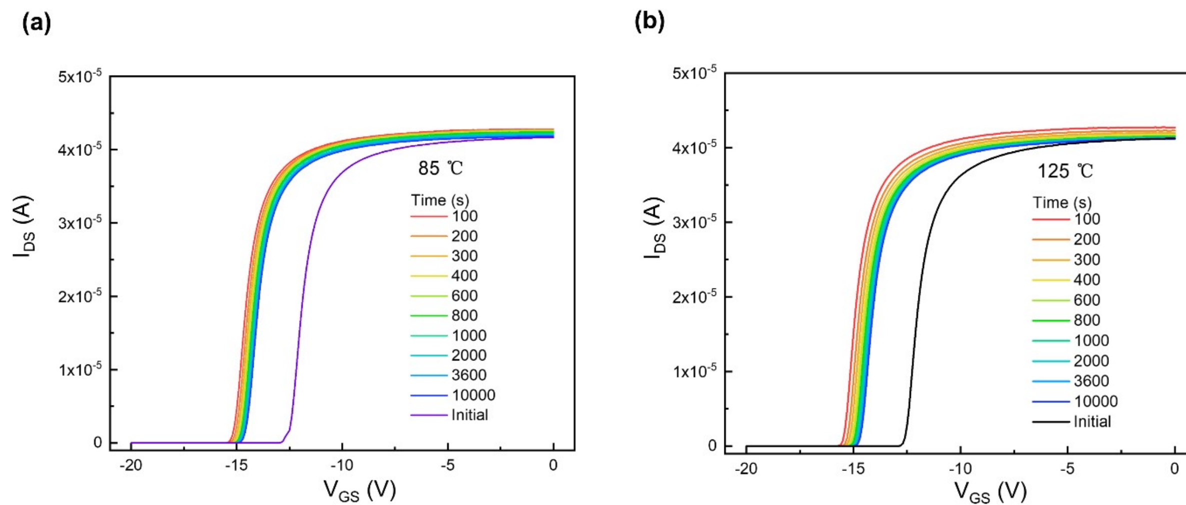

Figure S9. *Retention characteristics of GaN optoelectronic memory at different temperatures: (a) 85 ℃; (b) 125 ℃.*

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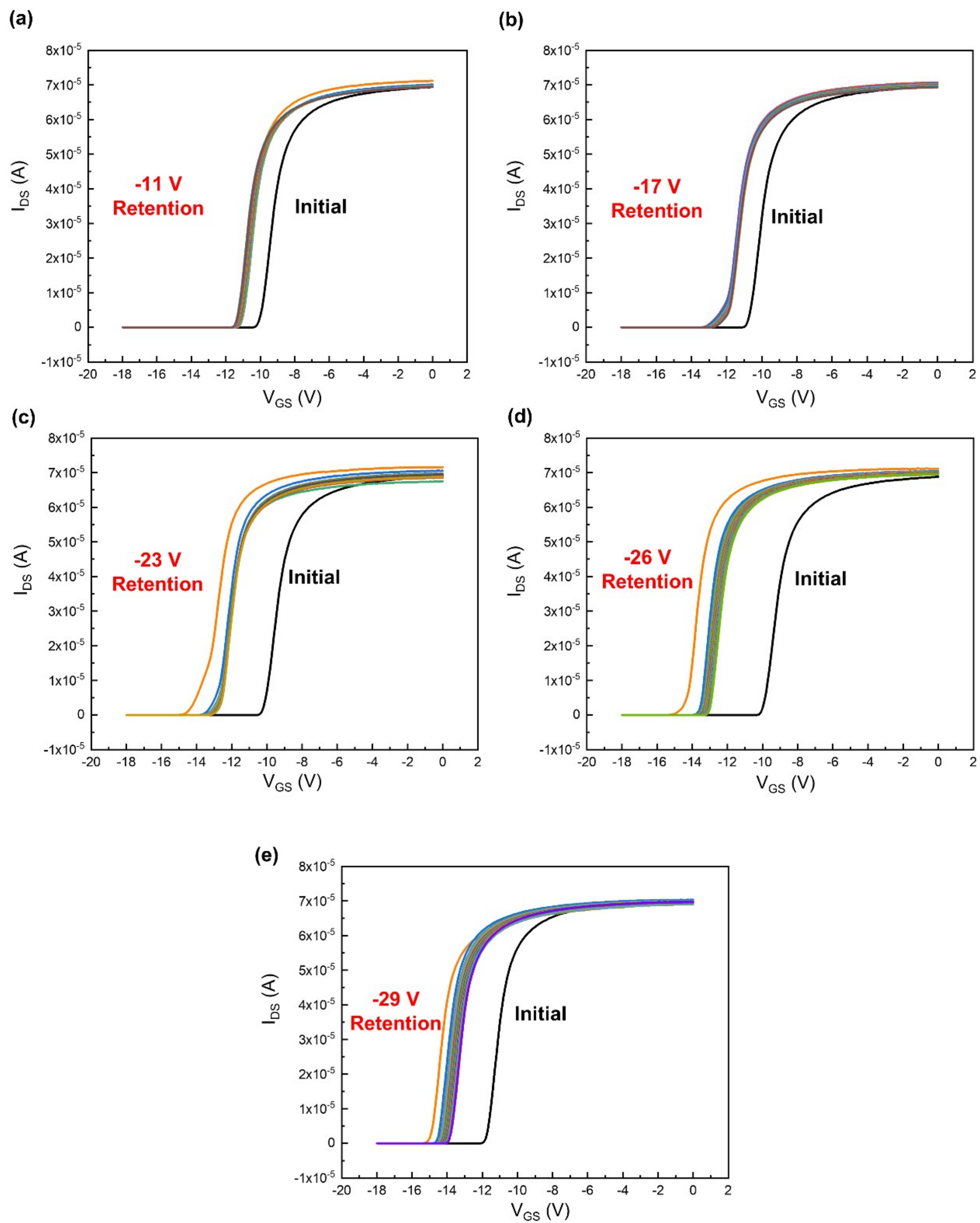

Figure S10. *The retention characteristics of the transition curves for five storage states of the memory: (a) -11 V; (b) -17 V; (c) -23 V; (d) -26 V; (e) -29 V.*