Supporting Information

Nonvolatile negative optoelectronic memory based on ferroelectric thin films

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Figure S1. (a) XRD θ-2θ scans for the BFO thin film grown on SRO buffered STO substrate. (b) Polarization-electric field (P-E) hysteresis loops at 100 K of the BFO thin film. The XRD result indicated good epitaxy of BFO/SRO films and we did not observe any reflections that would be indicative of second phases. In P-E loop, the value 2Pr is higher than 100 μC/cm², suggesting the excellent ferroelectric characterization of our BFO films. The asymmetricity of P-E loop can be attributed to the asymmetric top and bottom electrodes.
Figure S2. NPC effect induced from (a) 532 and (b) 1064 nm laser illumination. Illumination was performed in the ITO/BFO/SRO devices by green (532 nm, 2.33 eV) and NIR (1064 nm, 1.17 eV) laser, respectively. The APC effect was produced in over a broadband absorption that is much smaller than the band gap of the BFO film (2.7 eV).
Figure S3. $C-V$ curves measured at 1 MHz after annealing treatment in an oxygen-rich and oxygen-deficient environment, respectively. Firstly, the device was annealed in the oxygen-deficient environment, and it is found that the intensity of the two peaks range from -1 to 0 V exhibit a clear enhancement. Moreover, the following oxygen-rich annealing treatment results in the suppression of the peaks and the capacitance peaks caused by oxygen vacancies almost disappear. This result strongly indicates that the effect of annealing treatment on oxygen vacancy in our devices.
Figure S4. Retention performance of the $C$-$f$ curves after laser illumination for 1200 s. The $C$-$f$ curves remain stable in air after $10^3$ s after removing the illumination source, therefore allowing the nonvolatile storage of the capacitance information to be written optically.
Figure S5. *IV* curves obtained in dark (black) and after a voltage pulse of 6 V for 500 μs (blue). The reason consistent with the results of light illumination is that the electrons trapped in the oxygen vacancies of the interfacial region will be released under high positive voltage.