Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

Title: High-Performance Lead-Free Two-Dimensional Perovskite Photo Transistors Assisted by Ferroelectric Dielectrics

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(1) Here we fabricated conventional devices as the reference. All the fabrication parameters are the same as the ferroelectric devices except for the dielectrics changing from ferro-polymer P(VDF-TrFE) to SiO_2.

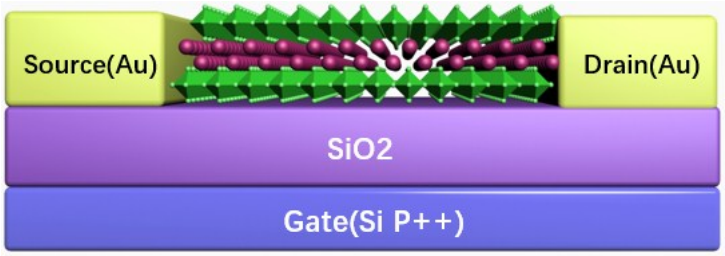

Figure S1. Schematic structure of reference devices. The devices own the same parameters as the ferroelectric devices except the dielectric layer changing from P(VDF-TrFE) (250 nm) to SiO_2 (285 nm).

(2) Transfer characteristic curves of the reference device.

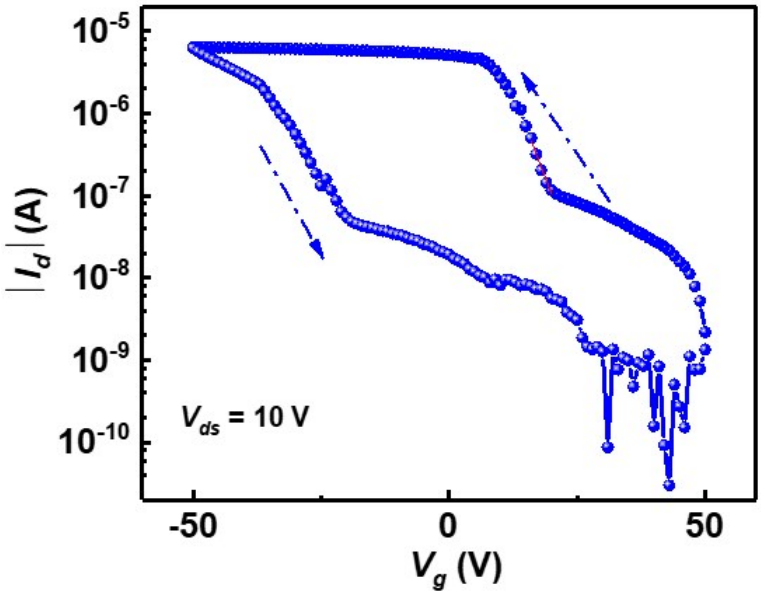

Figure S2. Transfer characteristic curves with V_{ds} = 10 V of the reference device under dark condition.

(3) Responsivity and detectivity under different wavelengths in visible-light spectrum region at fix intensity 18 μW cm^{-2} were measured. The performance of the devices was enhanced under "up" state with different wavelengths. The point represents average value and the two lines represent max and min value, respectively.

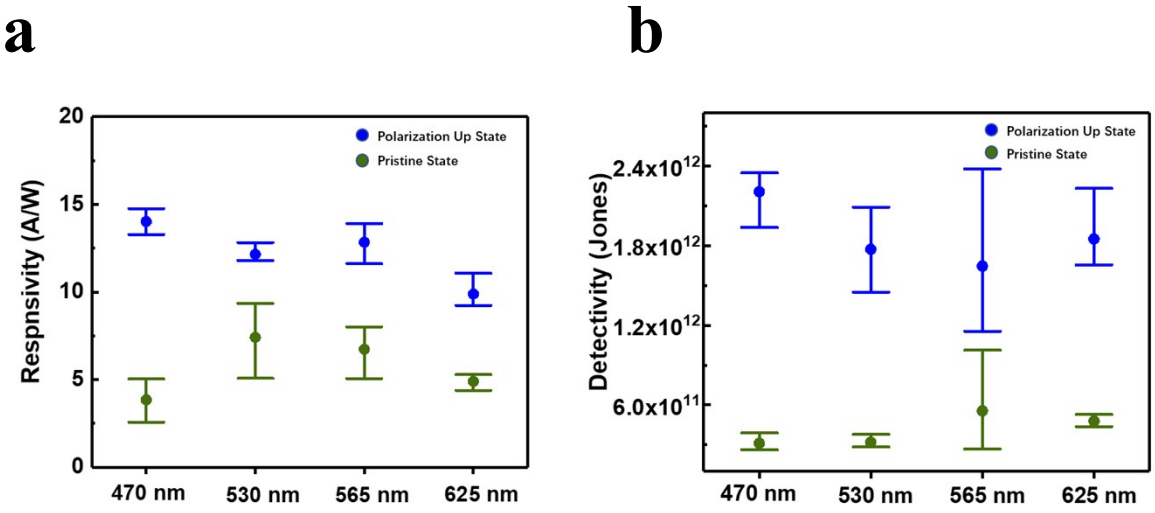

Figure S3. a) Responsivity and b) Detectivity of the devices at different wavelengths under pristine and "up" state.

(4) Photo-switching behavior of the reference device.

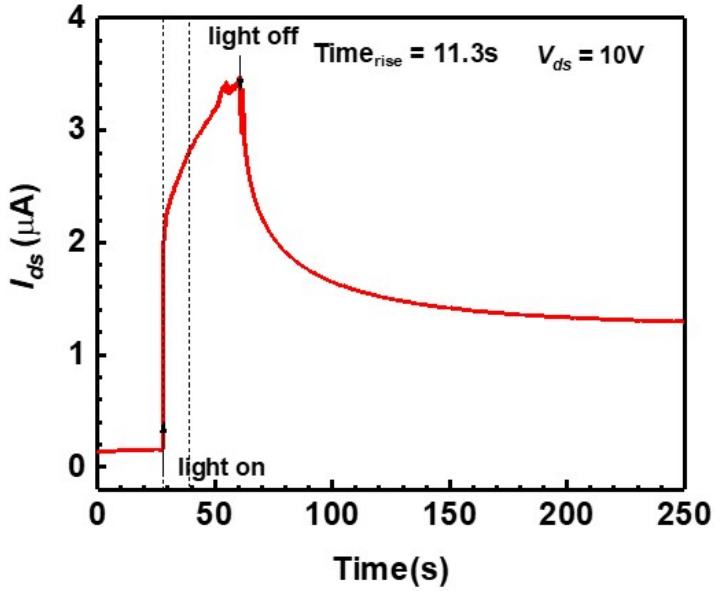

Figure S4. Light on-off character of the reference device with V_{ds} = 10 V. The photo switching behavior was tested under 470 nm wavelength with intensity 155 μW cm^{-2}.

(5) Enlarge views of the photo-switching performance of devices under "down" state and "up" state. The measured response time for the rise is I_{ds} increasing from 0 to 70% of the peak value. The response time for the decay is I_{ds} decreasing from peak value to 30%.

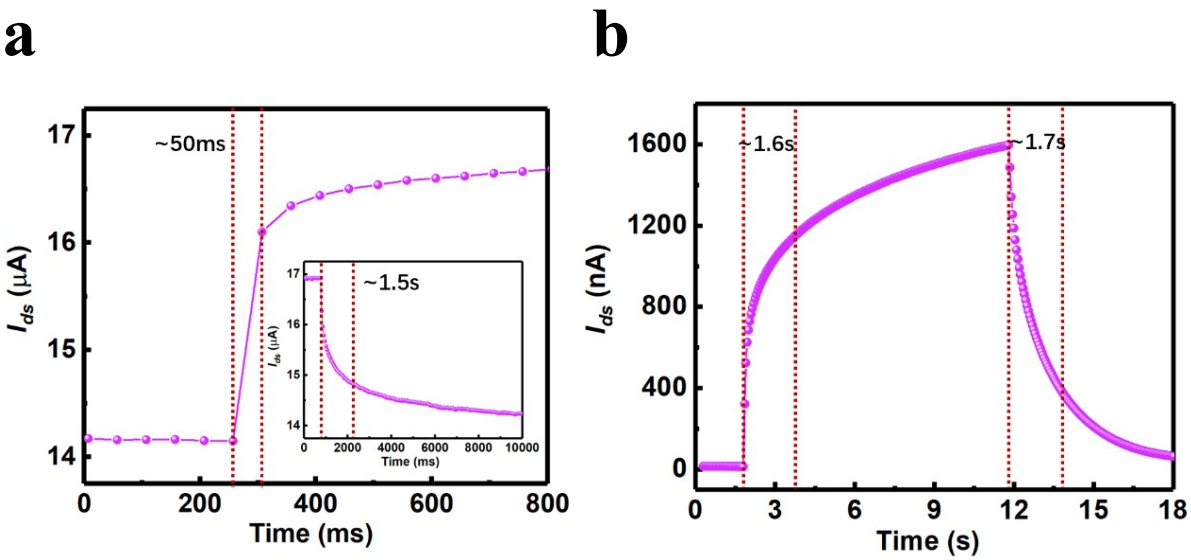

Figure S5. a) Enlarge views of the photo-switching behaviors of device under "down" state at intensity 155 μW cm^{-2}. b) An enlarge view of the photo-switching behaviors of device under "up" state at intensity 155 μW cm^{-2}.

Note:

Under this fast speed mode ("down" state), the rise time using the method I_{ds} from 0 to 80% and decay time from peak to 20% were also provided. Using this method, the rise time was ~100 ms and decay time was ~2 s. It was also better than previous work.[1,2]

(6) A summary table of previous work on this perovskite material.

Structure	Wavelength (nm)	R (A/W)	D^* (Jones)	Time rise	Time decay	Ref.
PET/rGo/PEDOT:PSS/$(PEA)_2SnI_4$	470	16	$1.92x10^{11}$	630 ms	3.6 s	[1]
SiO_2/$(PEA)_2SnI_4$	636	$1.4x10^4$	/	0.45 s	>10 s	[2]
P(VDF-TrFE)/$(PEA)_2SnI_4$	470	14.57	$1.74x10^{12}$	50 ms	1.5 s	This work

Table S1. A summary table of previous work about photo transistors based on this perovskite material.

References

[1] C. Chen, X. Zhang, G. Wu, H. Li, and H. Chen. Adv. Opt. Mater. **2017**, 5, 1600539.

[2] L. Qian, Y. Sun, M. Wu, C. Li, D. Xie, L. Ding, G. Shi, Nanoscale **2018**, 10, 6837.