

## Supporting Information

### **Title: Schottky junctions on perovskite single crystals: light-modulated dielectric constant and self-biased photodetection**

Parvez A. Shaikh<sup>1</sup>, Dong Shi<sup>2</sup>, Jose Ramon Duran Retamal<sup>3</sup>, Arif D. Sheikh<sup>1</sup>, Md. Azimul Haque<sup>1</sup>, Chen-Fang Kang<sup>3</sup>, Jr- Hau He<sup>3</sup>, Osman Bakr<sup>2,\*</sup> and Tom Wu<sup>1,\*</sup>

<sup>1</sup> Materials Science and Engineering, King Abdullah University of Science and Technology (KAUST), Thuwal 23955-6900, Saudi Arabia.

<sup>2</sup> Solar and Photovoltaic Engineering Research Center (SPERC), King Abdullah University of Science and Technology (KAUST), Thuwal 23955-6900, Saudi Arabia.

<sup>3</sup> Computer, Electrical and Mathematical Sciences and Engineering (CEMSE) Division, King Abdullah University of Science & Technology (KAUST) Thuwal 23955–6900, Saudi Arabia.

Correspondence and requests for materials should be addressed to T. W. ([tao.wu@kaust.edu.sa](mailto:tao.wu@kaust.edu.sa)) and O.B. ([osman.bakr@kaust.edu.sa](mailto:osman.bakr@kaust.edu.sa))

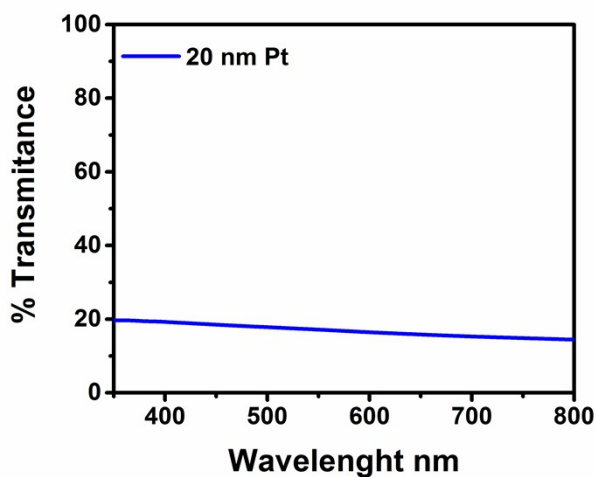
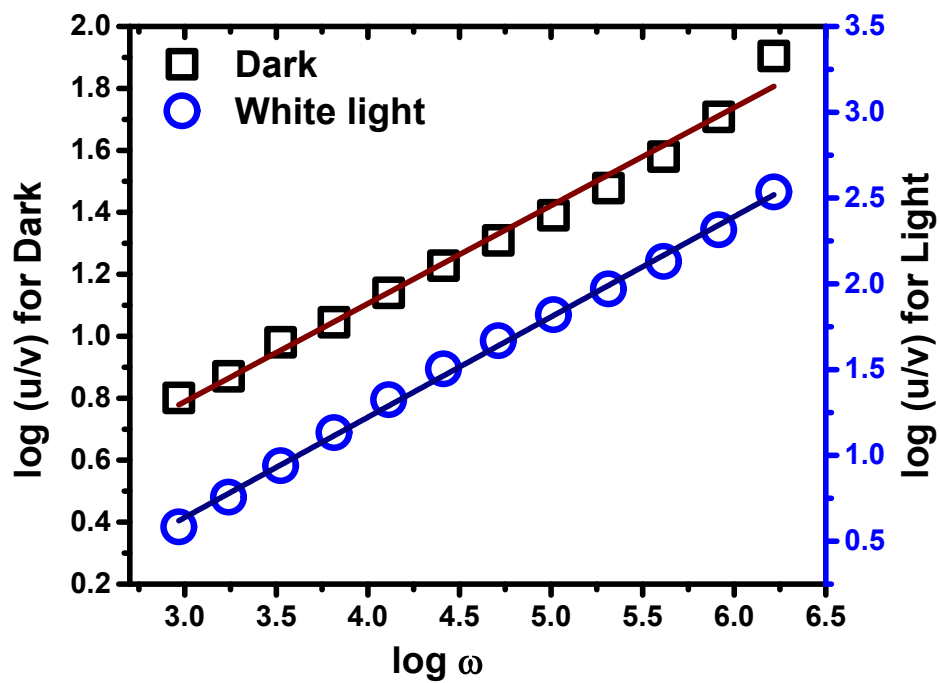


Figure S1. Transmission spectra for the semitransparent (20 nm) Pt layer sputtered on glass substrate.



**Figure S2:** Linear fitting for the plot of  $\log u/v$  Vs  $\log \omega$  where  $u = \varepsilon'_0 - \varepsilon'$  and  $v = \varepsilon' - \varepsilon'_\infty$ .

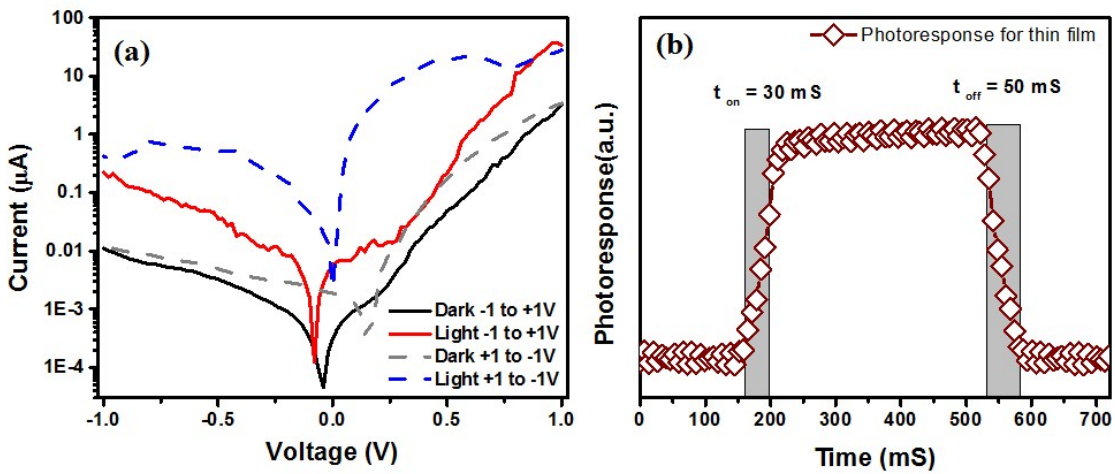


Figure S3 (a)  $I$ - $V$  data of the Pt-CH<sub>3</sub>NH<sub>3</sub>PbBr<sub>3</sub>-Au thin film photodetector measured under dark and light illumination conditions. (b) Response time measurement for CH<sub>3</sub>NH<sub>3</sub>PbBr<sub>3</sub> thin film device.

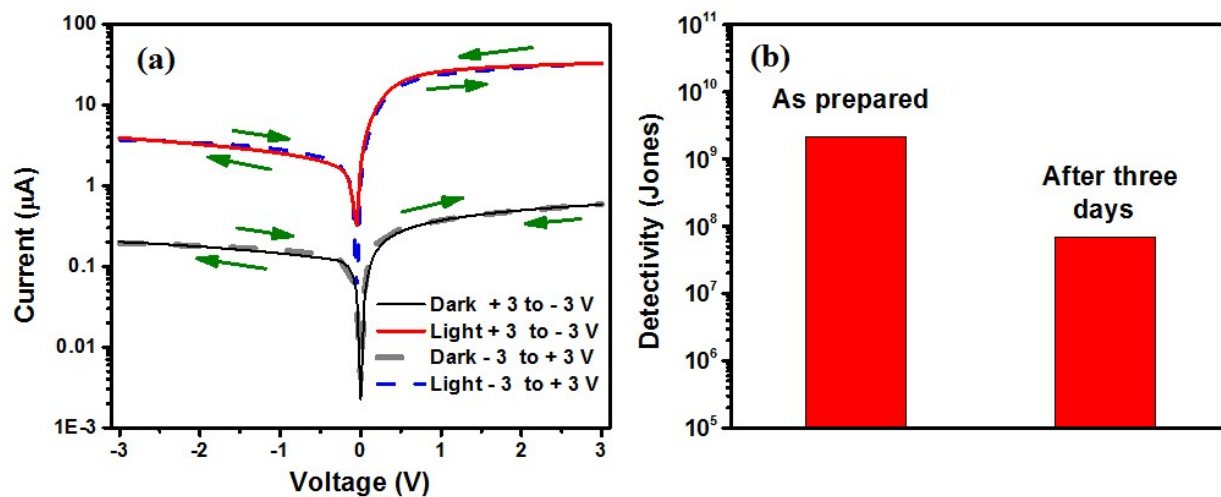


Figure S4 (a)  $I$ - $V$  data of the Pt-CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub>-Au photodetector measured under dark and white light illumination conditions. (b) Photodetectivity measured right after device fabrication and after three days.

**Table S1:** Comparison of reported thin-film photodetectors with our single-crystal device.

Device structure	Response time	Responsivity	Detectivity Jones	Stability
Au-CH <sub>3</sub> NH <sub>3</sub> PbBr <sub>3</sub> - Au	T <sub>on</sub> = 0.12 s T <sub>off</sub> = 0.086 s	---	---	-- Ref. 1
Au- CH <sub>3</sub> NH <sub>3</sub> PbI <sub>3-x</sub> Cl <sub>x</sub> - Au	T <sub>on</sub> = 0.2 μs T <sub>off</sub> = 0.7 μs	7.85 A/W at 2 V	---	60 days with CYTOP protecting layer, Ref. 2
ITO-CH <sub>3</sub> NH <sub>3</sub> PbI <sub>3</sub> - TiO <sub>2</sub> -ITO	T <sub>on</sub> = 0.02 s T <sub>off</sub> = 0.02 s	0.49 μA/W at 3 V	---	--- Ref. 3
Graphene- CH <sub>3</sub> NH <sub>3</sub> PbI <sub>3</sub> phototransistor	T <sub>on</sub> = 4 s T <sub>off</sub> = 6 s	1 A/W at 0.1 V	10 <sup>7</sup>	--- Ref. 4
ITO-CH <sub>3</sub> NH <sub>3</sub> PbI <sub>3</sub> - ITO	T <sub>on</sub> = 0.1 s T <sub>off</sub> = 0.1 s	36.7 mA/W at 3 V	---	--- Ref. 5
ITO-PEDOT:PSS- CH <sub>3</sub> NH <sub>3</sub> PbI <sub>3-x</sub> Cl <sub>x</sub> - PCBM-Hole blocking layer-Al	T <sub>on</sub> = 0.6 μs T <sub>off</sub> = 0.6 μs	----	10 <sup>14</sup>	--- Ref. 6
Pt-CH <sub>3</sub> NH <sub>3</sub> PbBr <sub>3</sub> (single crystal)-Au	T <sub>on</sub> = 70 μs T <sub>off</sub> = 150 μs	2 mA/W at 0 V and 100 mA/W at 3 V	10 <sup>10</sup>	45 days Our device without encapsulation

**Reference:**

- [1] S. Zhuo, J. Zhang, Y. Shi, Y. Huang, and B. Zhang, *Angew. Chem.* **2015**, 127, 1 – 5.
- [2] Y. Guo, C. Liu, *J. Phys. Chem. Lett.* **2015**, 6, 535–539.
- [3] H. R. Xia, J. Li, W.T. Sun, and L. M. Peng, *Chem. Comm.* **2014**, 50, 13695-13697.
- [4] Y. Lee, J. Kwon, E. Hwang, C.H. Ra, W. J. Yoo, J. H. Ahn, J. H. Park, and J. H. Cho, *Adv. Mater.* **2015**, 27, 41–46.
- [5] X. Hu, X. Zhang, L. Liang, J. Bao, S. Li, W. Yang, and Y. Xie, *Adv. Funct. Mater.* **2014**, 24, 7373–7380.
- [6] L. Dou, Y. Yang, J. You, Z. Hong, W. H. Li, G. Chang, and Y. Yang, *Nat. Commun.* **2014**, 5: 5404, 1-6.