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Supporting Information

A Visible Light Detector Based on Heterojunction Phototransistor with a Highly Stable Inorganic $CsPbI_xBr_{3-x}$ Perovskite and In-Ga-Zn-O Semiconductor Double-Layer

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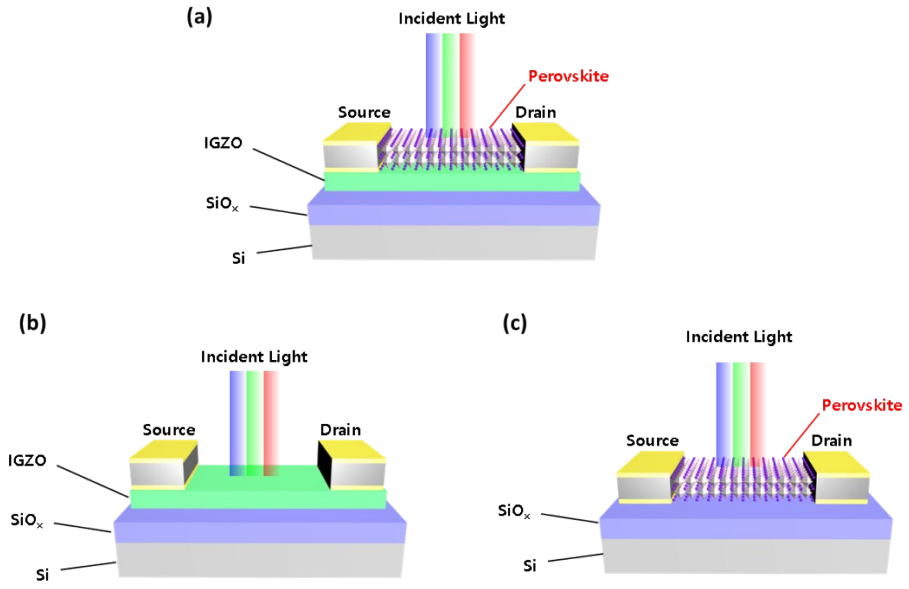

Fig. S1 The schematic of the device structures. (a) double-layered heterojunction phototransistor with perovskite / IGZO. (b) conventional IGZO phototransistor. (c) single-layered $CsPbI_2Br$ perovskite phototransistor.

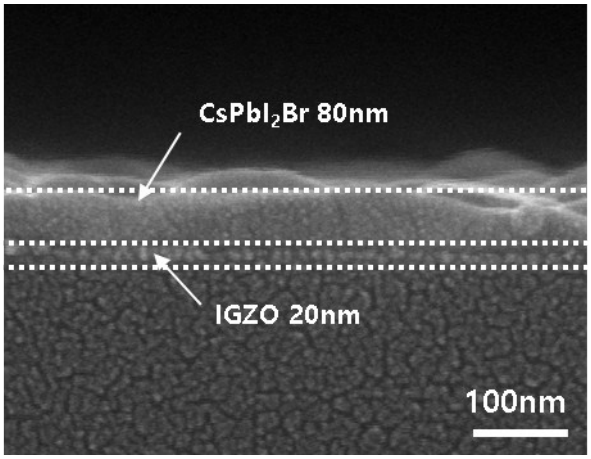

Fig. S2 SEM cross section of the heterojunction film with $CsPbI_2Br$ and IGZO.

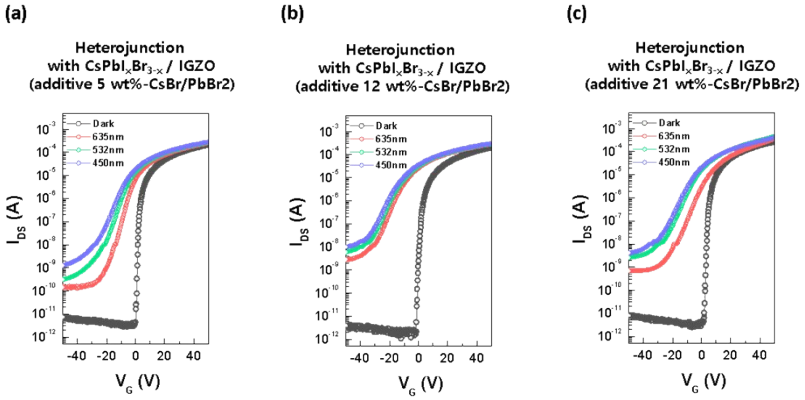

Fig. S3 Transfer characteristics of heterojunction phototransistors with $CsPbI_xBr_{3-x}$ / IGZO under dark and light irradiation (450 nm, 532 nm, and 635 nm wavelength of 1 mWcm-2 power density) at V_{DS} = 1 V, which perovskite films were fabricated with the different concentration of additives (a) 5 wt%-, (b) 12 wt%-, and (c) 21 wt%-$CsBr/PbBr_2$ in the $CsPbI_3$ precursor solution.

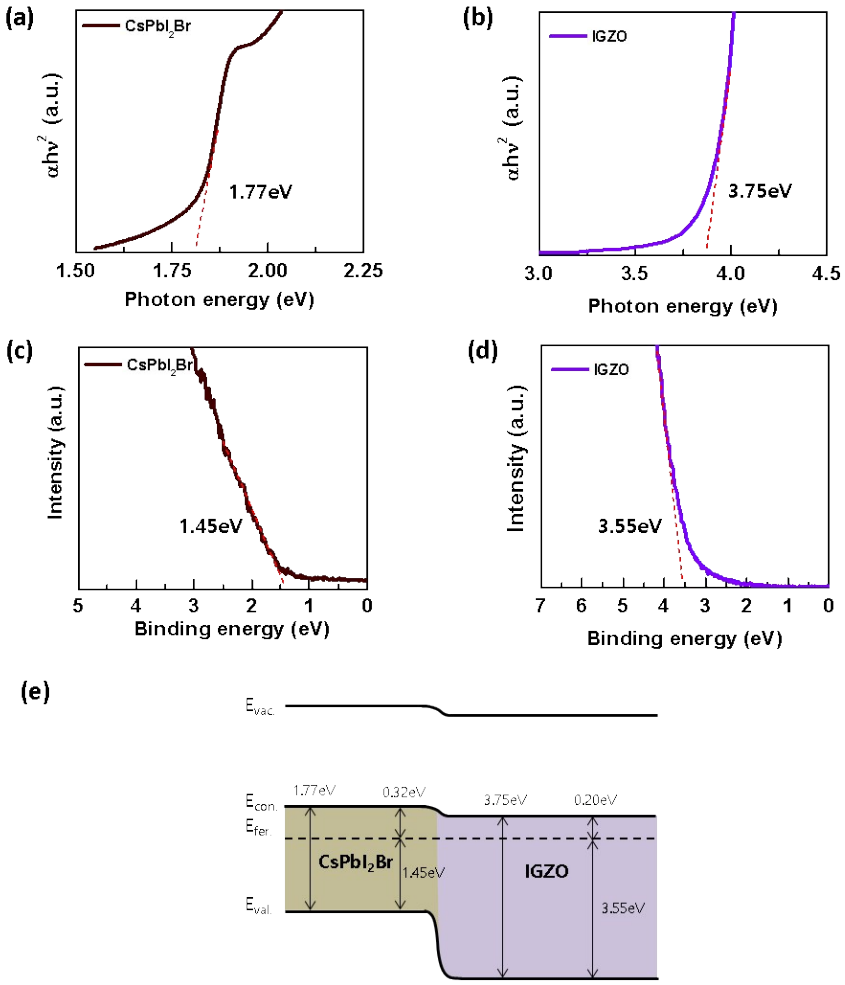

Fig. S4 Bandgap of the (a) $CsPbI_2Br$ and (b) IGZO by absorption peak. Work function of (c) $CsPbI_2Br$ and (d) IGZO by UPS. (e) Energy band diagram of heterojunction with $CsPbI_2Br$ / IGZO.

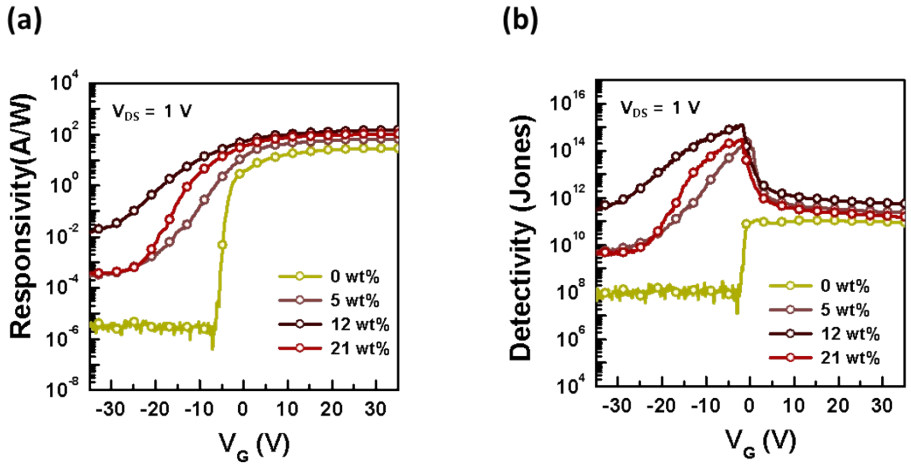

Fig. S5 (a) Responsivity and (b) Detectivity of heterojunction phototransistor with $CsPbI_2Br$ (additive 12 wt%-PbBr/$CsBr_2$ in the $CsPbI_3$ precursor solution) / IGZO under the 635 nm light illumination (power density = 1 $mWcm^{-2}$) at V_{DS} = 1 V.

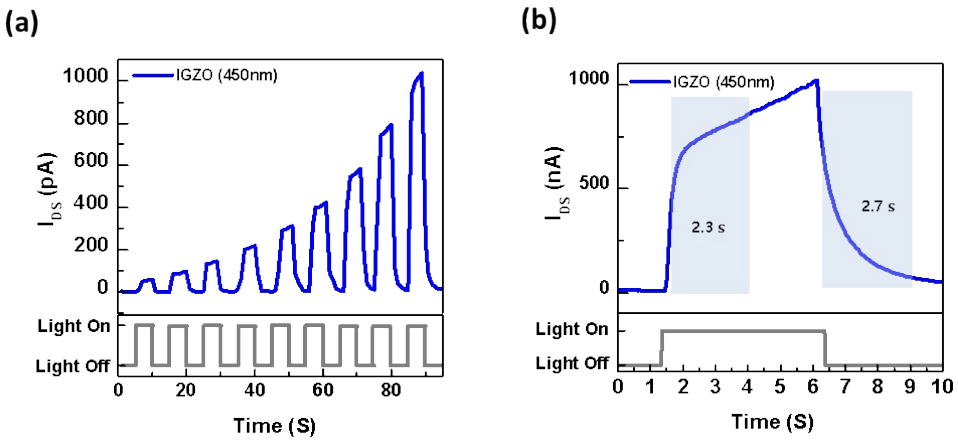

Fig. S6 (a) Transient response of conventional IGZO phototransistor under 450 nm pulse light at a constant V_G = -5 V, V_{DS} = 1 V. (b) Enlarged 1 cycle figure of the transient response of conventional IGZO phototransistor under 450 nm pulse light.

Table S1. Device characteristics of conventional IGZO phototransistor and heterojunction phototransistor with $CsPbI_2Br$ / IGZO at the dark state

Structures	Linear Mob. ($cm^2V^{-1}s^{-1}$)	S.S ($Vdec^{-1}$)	I_{off} (A)	I_{on} (A)
Conventional IGZO	15.11 ± 0.59	0.27 ± 0.04	(1.05 ± 0.05) × 10^{-12}	(2.40 ± 0.2) × 10^{-5}
$CsPbI_2Br$ / IGZO	12.71 ± 0.46	0.36 ± 0.07	(1.03 ± 0.04) × 10^{-12}	(1.29 ± 0.4) × 10^{-5}