Supporting Information

A Visible Light Detector Based on Heterojunction Phototransistor with a Highly Stable Inorganic CsPbI$_{3-x}$Br$_{x}$ 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$_2$Br perovskite phototransistor.
Fig. S2 SEM cross section of the heterojunction film with CsPbI$_2$Br and IGZO.
Fig. S3 Transfer characteristics of heterojunction phototransistors with CsPbI$_{3-x}$Br$_x$ / 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) CsPbI₂Br and (b) IGZO by absorption peak. Work function of (c) CsPbI₂Br and (d) IGZO by UPS. (e) Energy band diagram of heterojunction with CsPbI₂Br / IGZO.
Fig. S5 (a) Responsivity and (b) Detectivity of heterojunction phototransistor with CsPbI$_2$Br (additive 12 wt% PbBr/CsBr in the CsPbI$_3$ precursor solution) / IGZO under the 635 nm light illumination (power density = 1 mW cm$^{-2}$) 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 CsPbI₂Br / IGZO at the dark state

<table>
<thead>
<tr>
<th>Structures</th>
<th>Linear Mob. ((\text{cm}^2\text{V}^{-1}\text{s}^{-1}))</th>
<th>S.S ((\text{Vdec}^{-1}))</th>
<th>(I_{\text{off}}) ((\text{A}))</th>
<th>(I_{\text{on}}) ((\text{A}))</th>
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</thead>
<tbody>
<tr>
<td>Conventional IGZO</td>
<td>15.11 ± 0.59</td>
<td>0.27 ± 0.04</td>
<td>((1.05 ± 0.05) \times 10^{-12})</td>
<td>((2.40 ± 0.2) \times 10^{-5})</td>
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<tr>
<td>CsPbI₂Br / IGZO</td>
<td>12.71 ± 0.46</td>
<td>0.36 ± 0.07</td>
<td>((1.03 ± 0.04) \times 10^{-12})</td>
<td>((1.29 ± 0.4) \times 10^{-5})</td>
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