Supporting Information

Self-filtering red narrowband photodetector based on a perovskite/organic multi-stack photoactive layer

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Text S1

The specific detectivity $D*$ reflected the sensitivity of weak light detection can be calculated by[1]:

$$D^*(\lambda) = \frac{A^{1/2}}{NEP(\lambda)} = \frac{R\sqrt{A}}{S_n} \#(S1)$$

Where the *NEP* represent the noise equivalent power. The dark current (J_d) is often considered a major factor affecting the noise current, so when the J_d induces shot noise is the dominant factor, the shot noise limited D* can be calculated by [2,3]:

$$D^*_{shot}(\lambda) = \frac{R(\lambda)}{\sqrt{2qJ_d}} \#(S2)$$

Where R is the responsivity, q is the elementary charge and J_d is the dark current density.

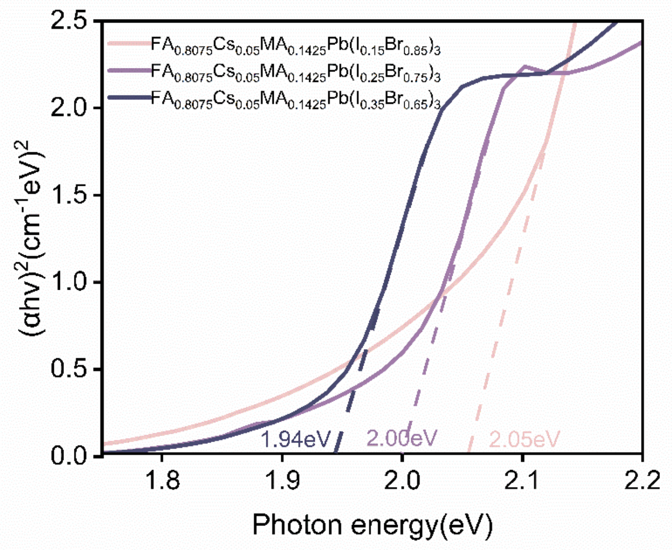

Figure S1. Absorption spectra of perovskite films with different ratios of Br^- and I^- (0.15:0.85, 0.25:0.75, 0.35:0.65) measured in the UV-vis range (300–800 nm).

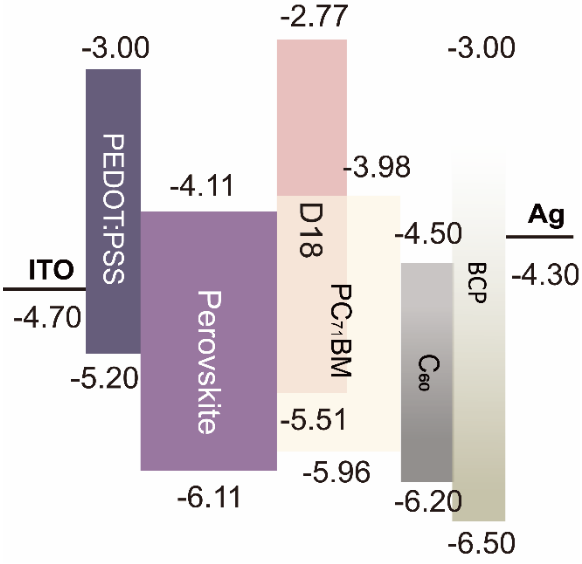

Figure S2. Device energy level diagram. The charge of longwave light separates at the donor-acceptor interface, and the carriers are transported to the electrodes to achieve a narrowband response.

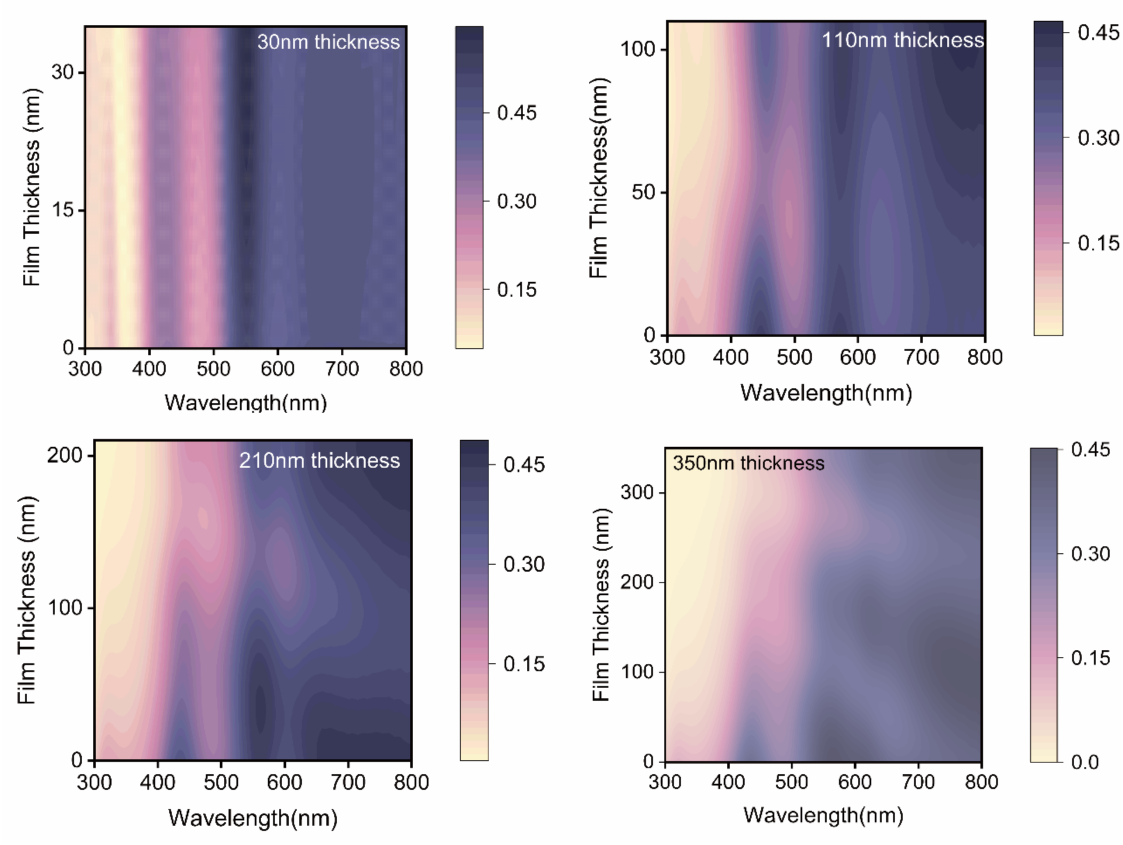

Figure S3. The simulation results or perovskite layers of different thicknesses by FDTD.

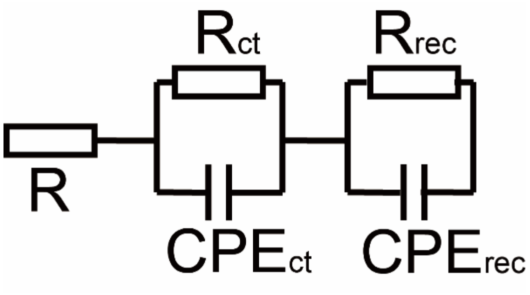

Figure S4. The fitting circuit obtained based on the EIS test results. “ct” is the abbreviation for charge transport, and “rec” stands for charge recombination.

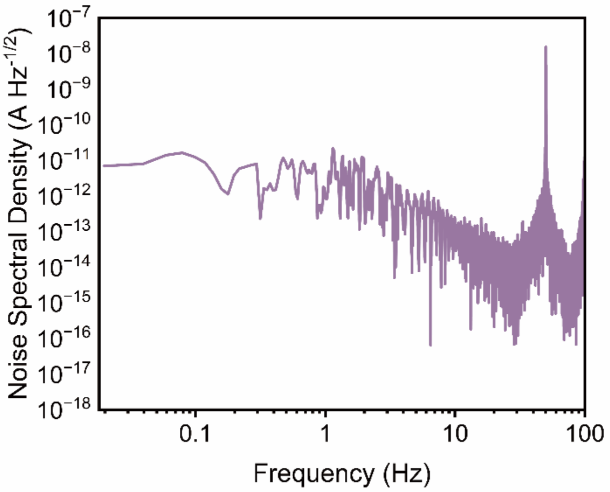

Figure S5. Noise current spectral density of the perovskite/organic multi-stack photodetector.

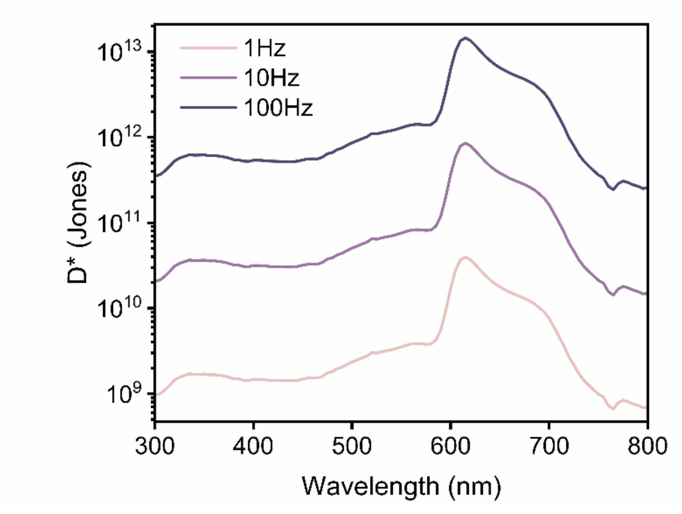

Figure S6. The specific detection rate (D^*) obtained from the noise current spectral density indicates that it has high sensitivity within the target wavelength range.

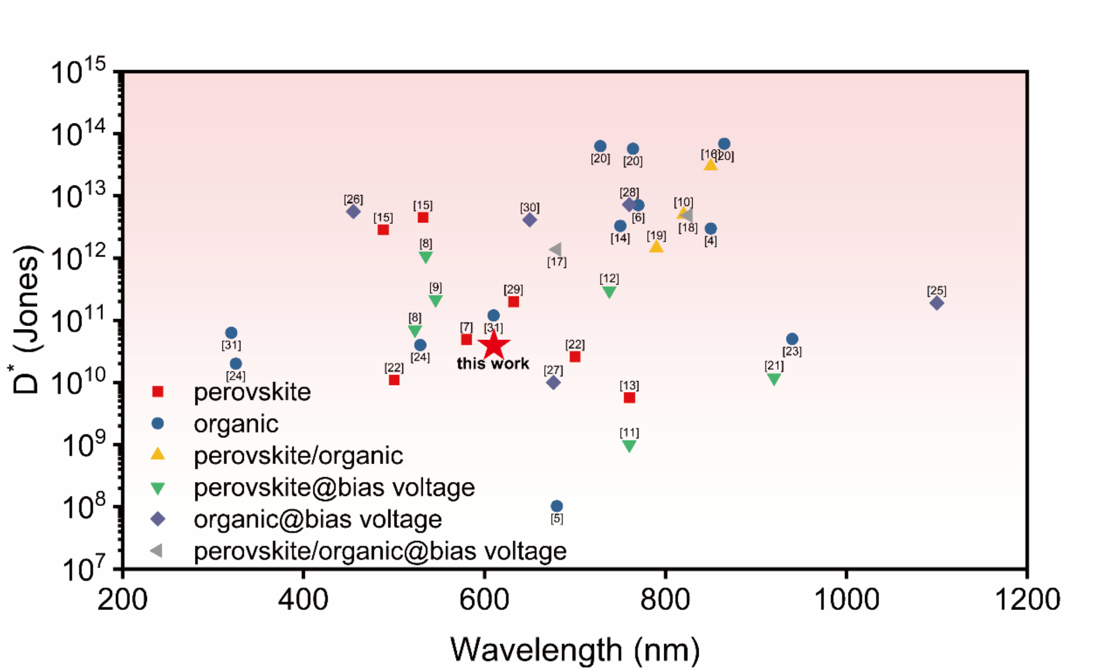

Figure S7. Benchmarking the detectivity of narrowband photodetectors from noise current spectral density [4–31].

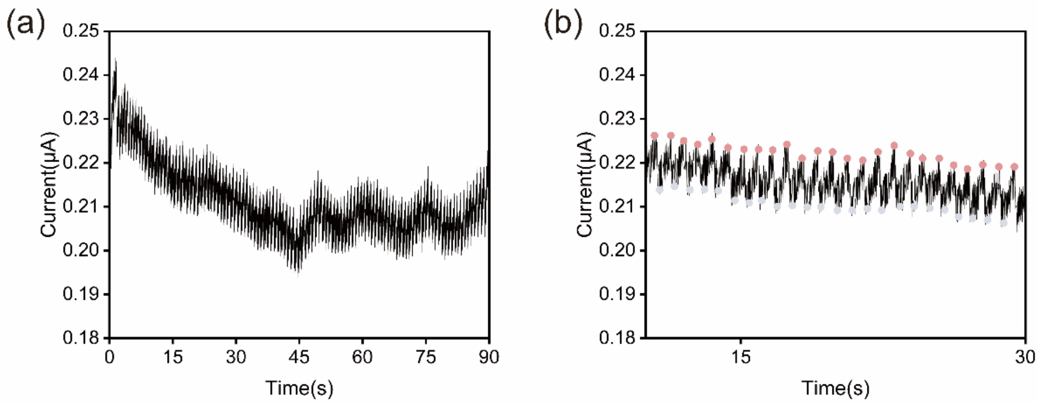

Figure S8. Direct pulse signal data obtained under the PPG principle. (a) The complete 90s pulse signal shows A significant drift in the current signal, which extends to 0.06μA. (b) Some signal diagrams clearly show each pulse waveform and the systolic and diastolic peaks.

Table S1. Parameter results of each component in the EIS fitting circuit of devices with different perovskite thicknesses.

	30nm	**110nm**	**210nm**	**350nm**
R_s(Ω)	143.4	210.8	319.3	363.8
R_{ct}(Ω)	1594	4230	4994	9352
R_{rec}(Ω)	4873	12084	26711	53637

Table S2. The peak values of IMVS curves and the calculation results of carries recombination lifetime for donor layer devices of different thicknesses.

	45nm	**65nm**	**160nm**	**345nm**
Peak (Hz)	7.24	16.79	105.93	131.32
τ_{rec} (ms)	21.98	9.47	1.50	1.21

Table S3. Comparison of pulse AC and DC between the broadband control device and the narrowband device.

	Direct current (DC) component initial	**Direct current (DC) component end**	**Alternating current (AC) component**	**Direct current (DC) component**	**AC/DC**
Broadband photodetector	9.840 μA	12.89 μA	0.4482 μA	11.82 μA	0.03792
Narrowband photodetector	1.395 μA	0.7781 μA	0.0396 μA	0.3718 μA	0.1065

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