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

Supporting Information:

Phase evolution and fluorescence stability of $CsPb_2Br_5$ microwires and its application to stable and sensitive photodetectors

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Experimental

Synthesis of $CsPb_2Br_5$ microwires

Preparation of $PbBr_2$ microwires: All experimental reactions were carried out under air conditions. 20 mg of $PbBr_2$ powder was dispersed into 10 mL of deionized water and sonicated for 30 min, and then was heated at 150°C for 1 h to prepare a supersaturated aqueous solution. 40 μL of $PbBr_2$ solution was added dropwise to the substrate and left for 3h to obtain white $PbBr_2$ microwires.

Synthesis of $CsPb_2Br_5$ microwires: The CsBr supersaturated solution was prepared by dissolving 10 mg of CsBr powder in 10 mL of ethanol solution. 40 μL CsBr solution was dropped onto the $PbBr_2$ microwires to form $CsPb_2Br_5$ microwires.

Photodetector Preparation

The substrates were washed with acetone, ethanol and deionized water. The Ti/Au interdigital electrode were deposited onto the glass substrate using electron beam evaporation to a thickness of 250 nm. The interdigital electrode has a finger length of 2 mm, a finger width of 40 μm and a finger spacing of 65 μm. The interdigital electrode will be kept in Ar at 200 °C for 30 min to reduce the interfacial contact and create a good ohmic contact resistance. The prepared $CsPb_2Br_5$ microwire photodetectors were synthesized on Ti/Au coated substrates.

Characterization of $CsPb_2Br_5$

Field emission transmission electron microscopy (FETEM, Tecnai G2 F20 S-TWIN) and X-ray diffraction (XRD, Bruker AXS D8 ADVANCE) were used to examine the crystallographic composition and the structure of the samples. The absorption spectrum was measured using a UV-3600 Plus spectrophotometer (SHIMADZU). The Raman spectrum was obtained using a scanning probe microscope (Multimode NS3a) with an excitation wavelength of 532 nm. Steady-state photoluminescence (PL) was excited by a 405 nm wavelength light using a spectrometer (PG2000 Pro, Ideaoptics Instruments Co., Ltd.). Wide-angle X-ray scattering (WAXS) images (Mar165CCD) were recorded at the BL16B1 beamline of the Shanghai Synchrotron Radiation Facility (SSRF). Time-resolved fluorescence spectral mapping was carried out using a Nanofinder FLEX2 confocal optical microscope (Tokyo Instrument Inc.). Current−voltage ($I-V$) curves of the $CsPb_2Br_5$ microwires were recorded using a source meter (Keithley 2400). The on/off photocurrent ratio was obtained using an electrochemical workstation (CHI 660E). The optical and electrical features of the prepared photodetectors were investigated at 5 V bias by using 405 nm laser irradiation.

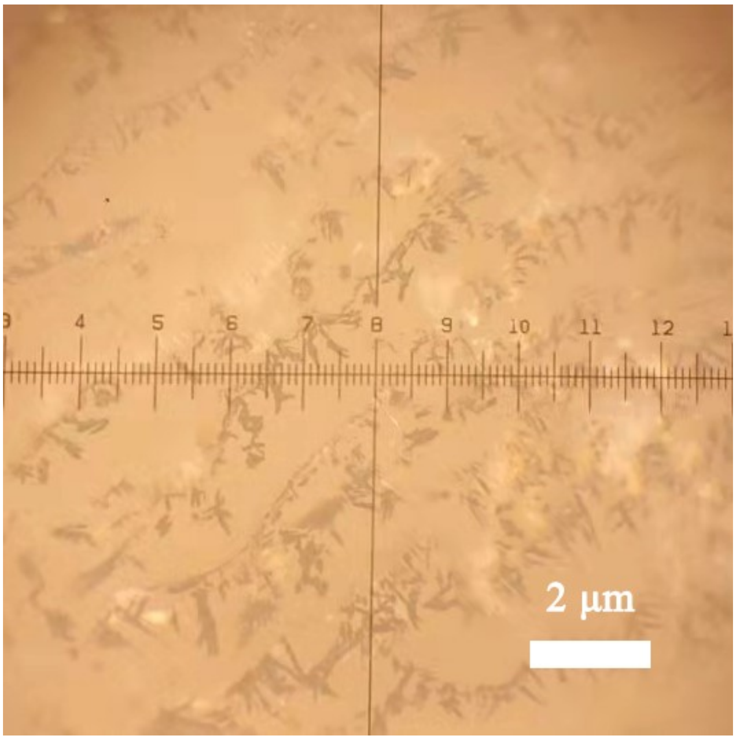

Fig. S1 $PbBr_2$ at the substrate temperature of 60 °C.

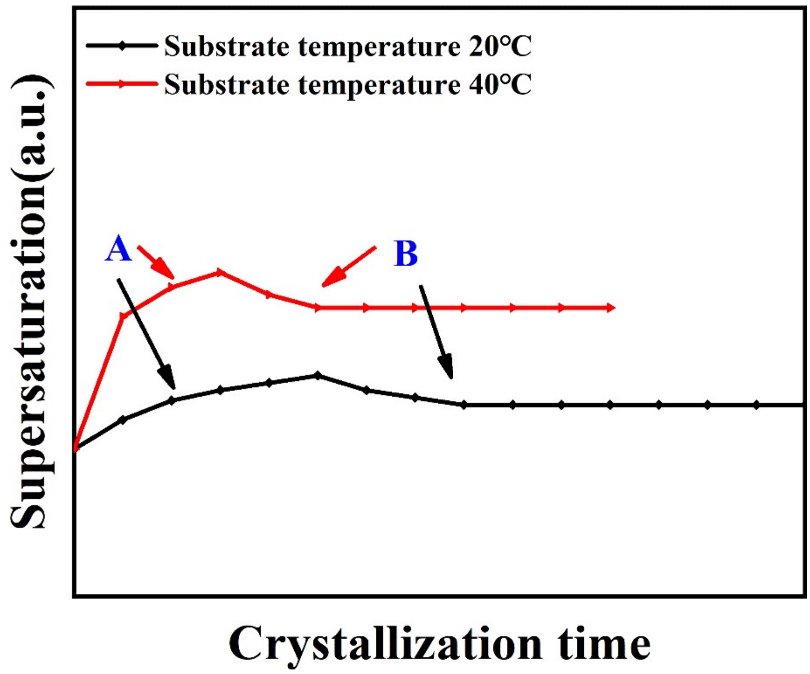

Fig. S2 Schematic diagram of supersaturation versus growth time when the substrate temperature is 20 °C and 40 °C, respectively.

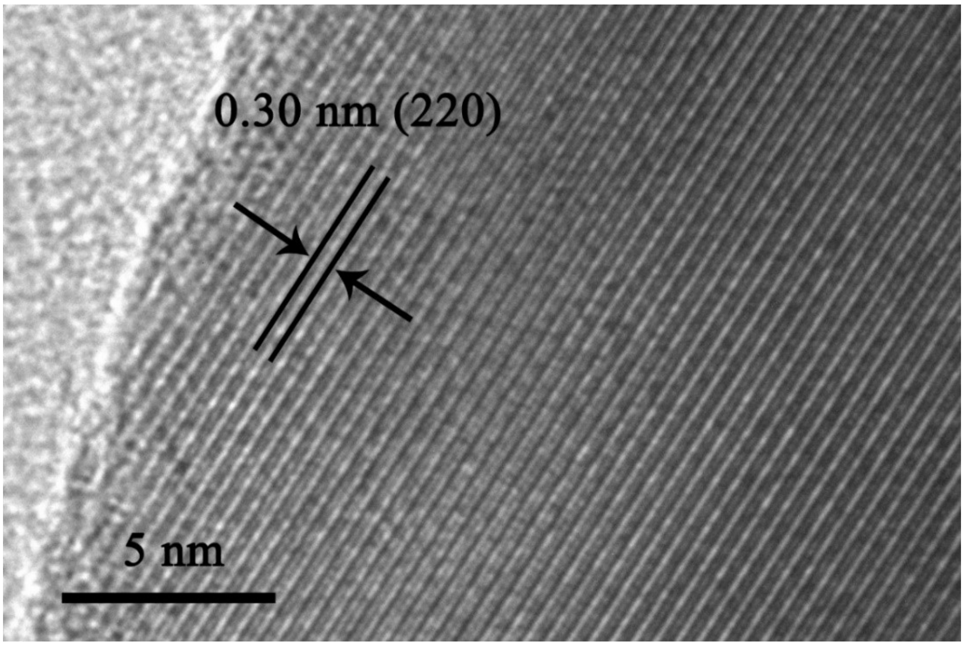

Fig. S3 HRTEM image of the edge of the $CsPb_2Br_5$ nanowire.

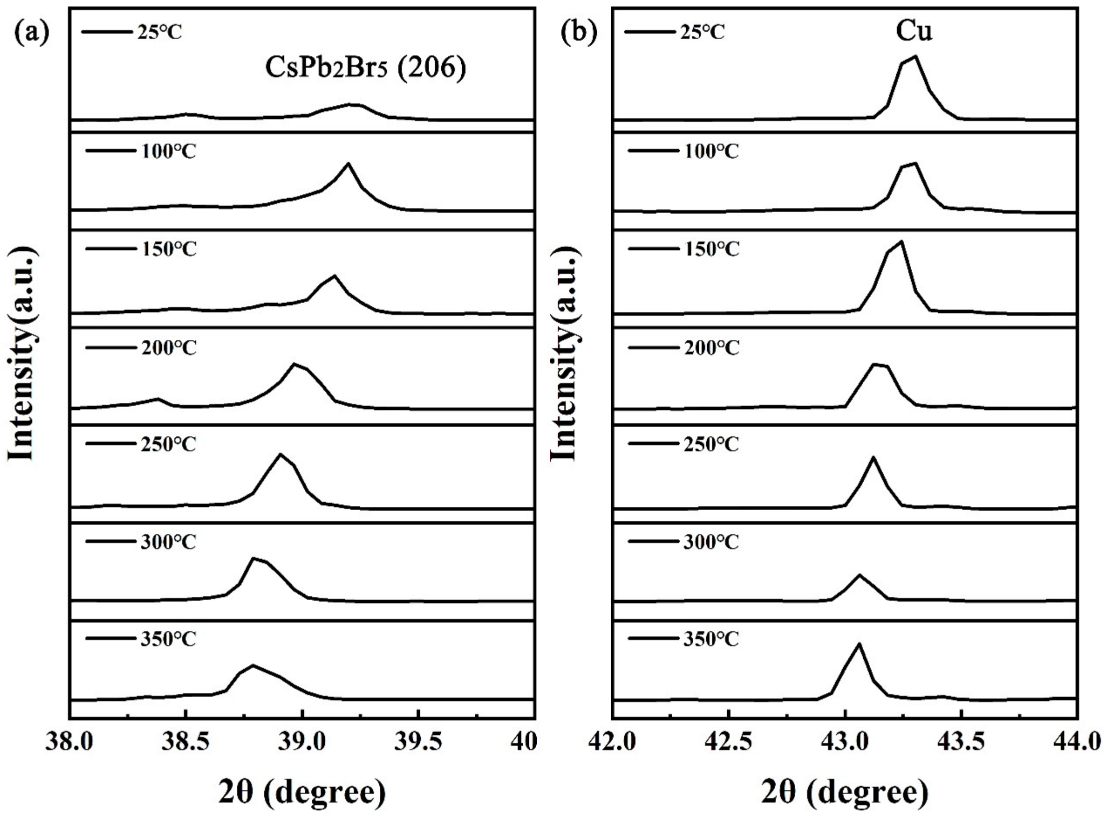

Fig. S4 The enlarged image of the (206) peak of $CsPb_2Br_5$ (a), and the Cu substrate diffraction peak (b).

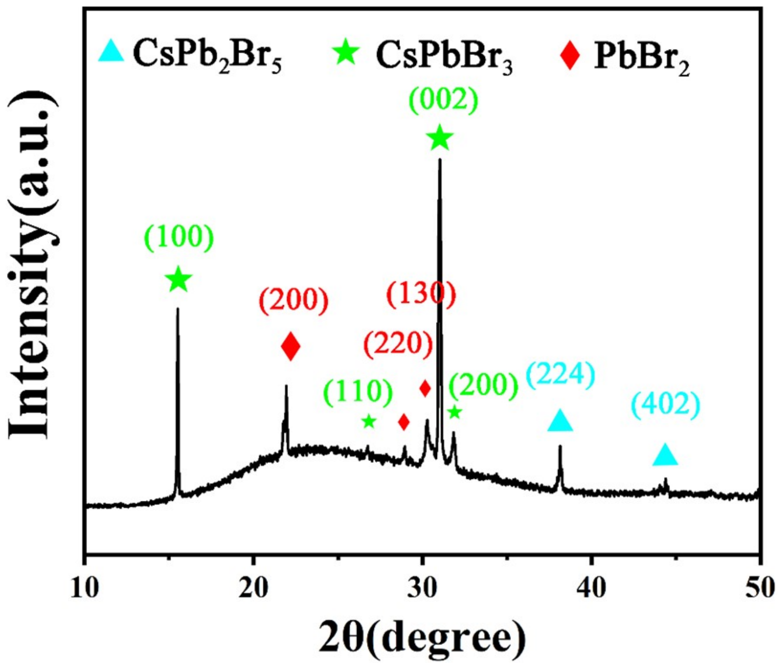

Fig. S5 XRD pattern of $CsPb_2Br_5$ microwires annealed at 400 ℃ in N_2 atmosphere.

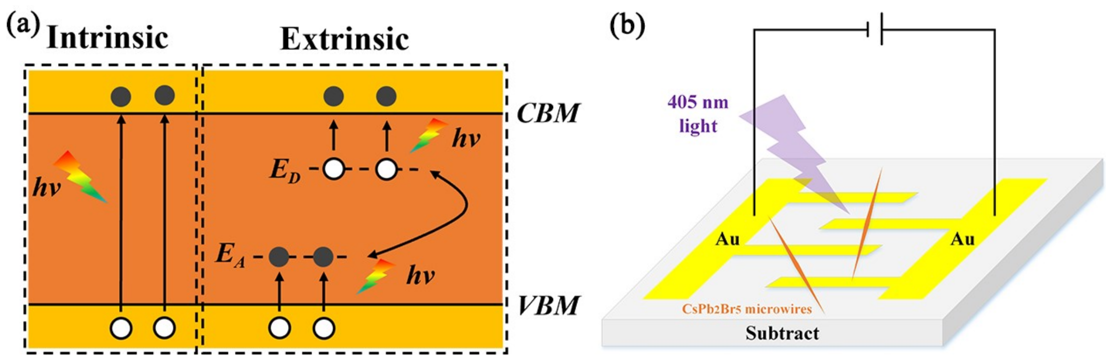

Fig.S6 (a) The diagram of the light absorption and formation of photogenerated carriers of the photoconductive type detector. (b) The test diagram of photoconductive type detector.

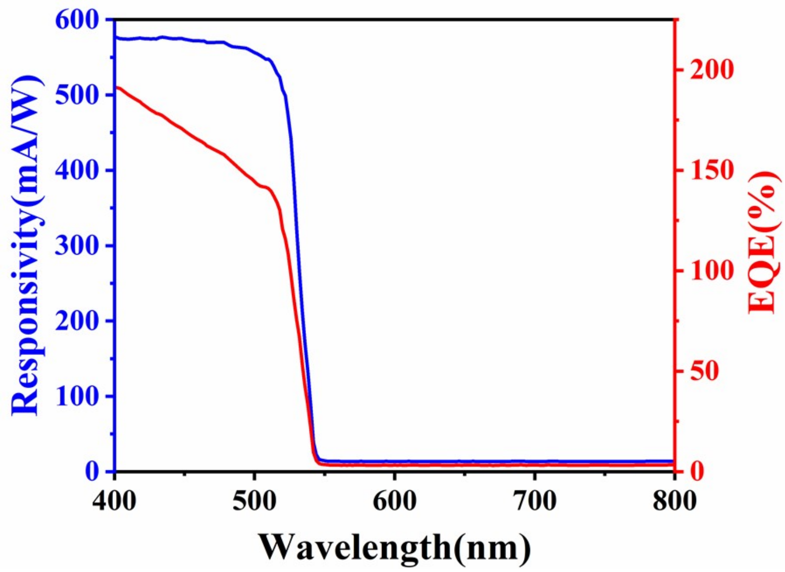

Fig. S7 The *ca.* R and EQE spectral response of the PD with the wavelengths ranged from 400 to 800 nm with a light intensity of 4.73 mW mm^{-2} and a bias voltage of 5 V.

Table S1. Fluorescence decay analysis parameters corresponding to the monitored red area of $CsPb_2Br_5$ microwire in Fig. 6 (e-h) at different temperatures.

	τ_1(ps)	τ_2(ps)	τ_{ave}(ps)
25℃	899.99(92.19%)	4984.5(7.81%)	12183
150℃	70.16(56.05%)	253.8(43.95%)	150.87
300℃	315.74(85.35%)	797.9(14.65%)	386.38
400℃	472.32(54.6%)	2338.7(45.4%)	1319.66

Table S2. Comparison of photoelectric performance of different representative lead halide perovskite photodetectors.

	rise time(ms)	decay time(ms)	R(mA/W)	D*(Jones)	[Ref.]
$CsPb_2Br_5$ microwires	90	43	640	$6.07*10^{10}$	this work
$CsPb_2Br_5$ nanosheets	43	85	75.4	$1.33*10^{10}$	[1]
$CsPb_2Br_5$ nano-/micro-sheets	180	130	20	10^{12}	[2]
$CsPb_2Br_5$ flake single crystals	40	120	25.1	--	[3]
$CsPbBr_3$ micro-nanowires	301	242	6440	$2.88*10^{12}$	[4]
$CsPbBr_3$ microwires	275	550	7660	$4.05*10^{12}$	[5]
CsPbBr3 nanosheets	48	18	44.9	$6.4*10^{8}$	[6]
$CsPbBr_3$ crystals	300	300	2100	--	[7]
$MAPbBr_3$ milliwires	407	895	--	--	[8]
$MAPbBr_3$ nanosheets	103	87	27	$6.38*10^{8}$	[9]
$MAPbBr_3$ single crystals	3500	100	6.1	--	[10]

Reference

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