Supporting information for

$MAPbBr_{3-n}X_n$ (X=Cl, I) Single Crystal Narrowband Photodetectors for Potential Application in Traffic Light Recognition

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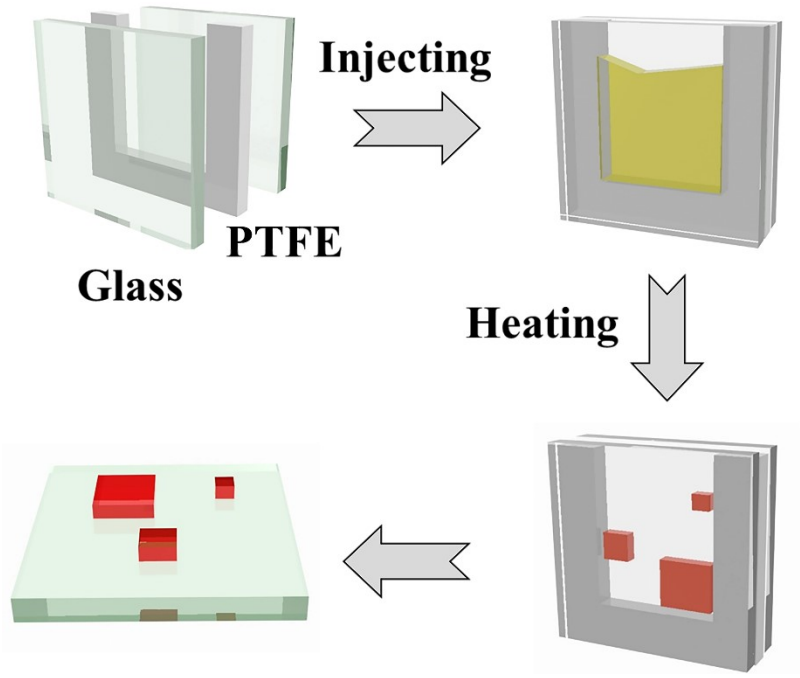

Figure S1. Preparation procedures of the $MAPbBr_{3-n}X_n$ crystal films.

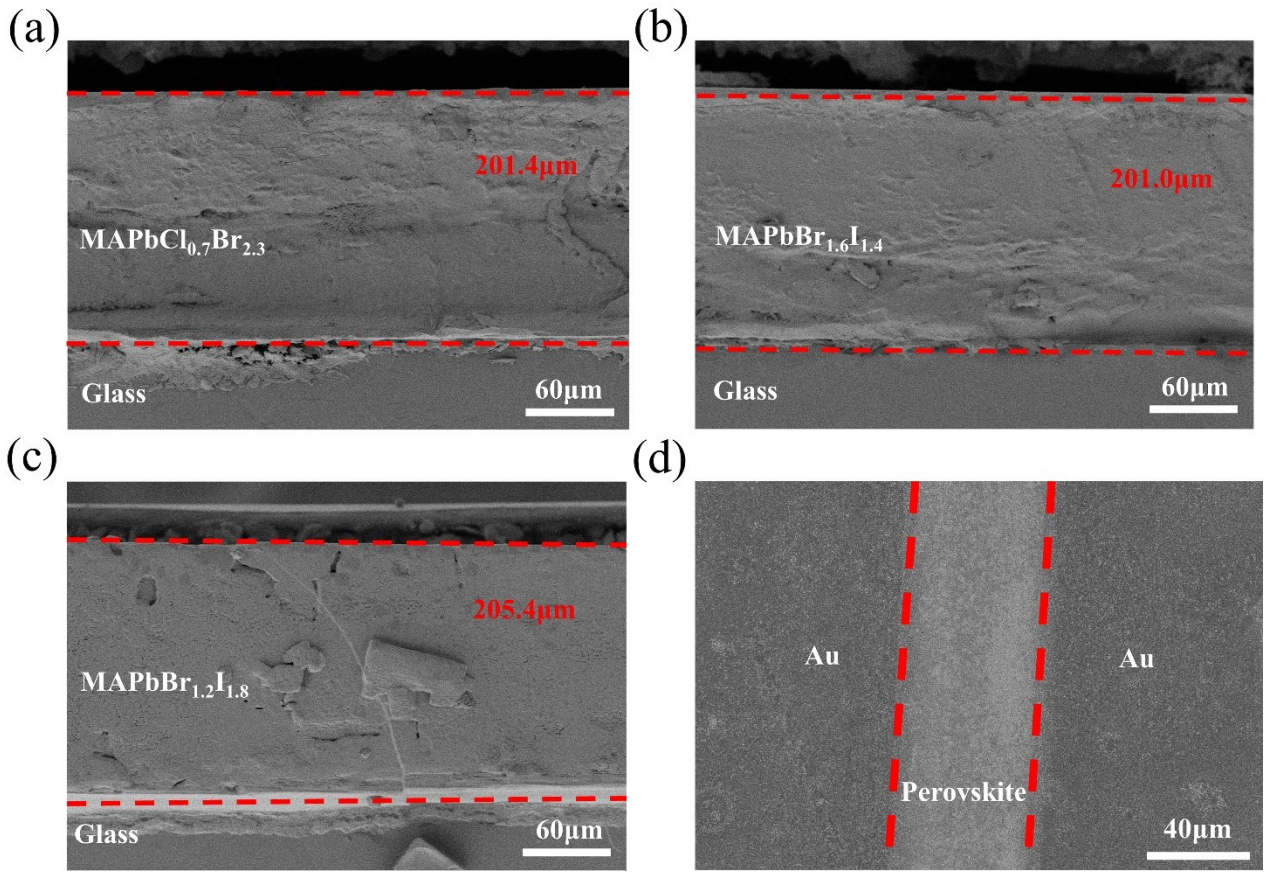

Figure S2. (a-c) Cross-sectional SEM image of the $MAPbCl_{0.7}Br_{2.3}$, $MAPbBr_{1.6}I_{1.4}$ and $MAPbBr_{1.2}I_{1.8}$ crystal films.

(d) SEM image of the device surface.

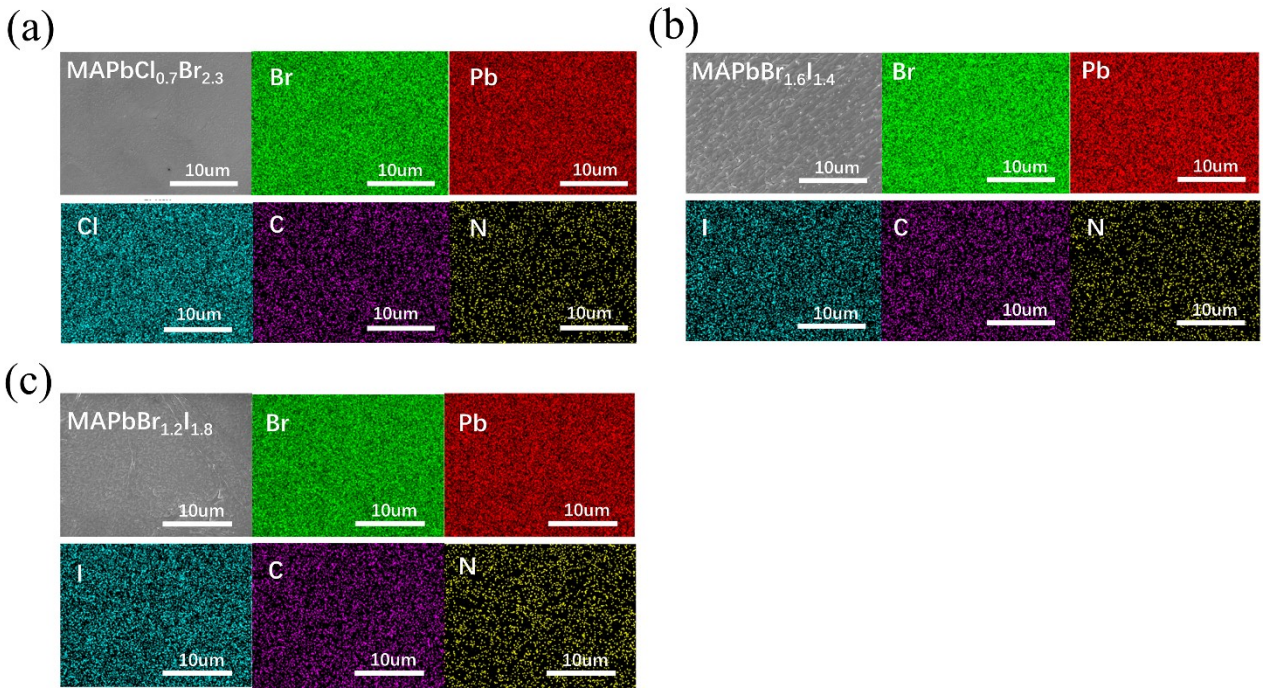

Figure S3. (a-c) EDS mapping patterns of the $MAPbCl_{0.7}Br_{2.3}$, $MAPbBr_{1.6}I_{1.4}$ and $MAPbBr_{1.2}I_{1.8}$ crystal films.

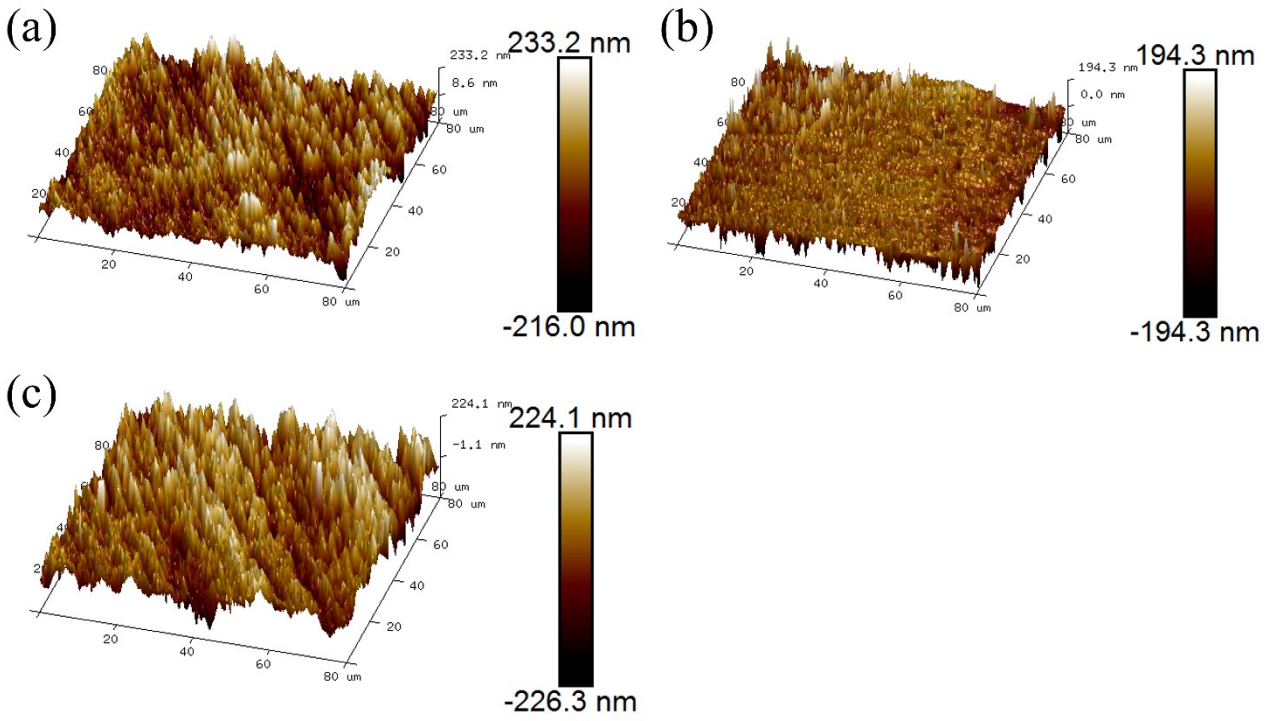

Figure S4. (a-c) AFM images of the top surface of the $MAPbCl_{0.7}Br_{2.3}$, $MAPbBr_{1.6}I_{1.4}$ and $MAPbBr_{1.2}I_{1.8}$ single crystal film.

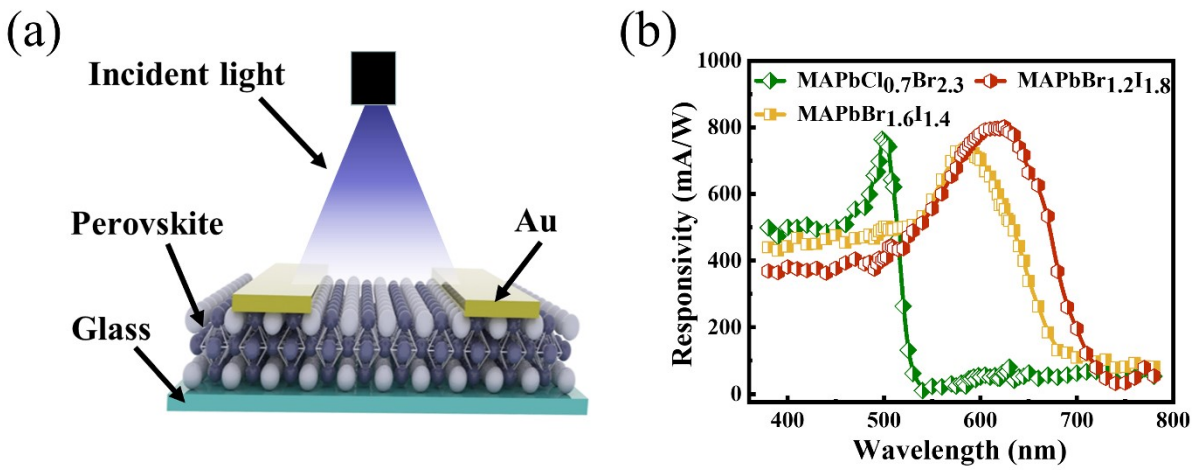

Figure S5. (a) Schematic diagram of $MAPbBr_{3-n}X_n$ (X=Cl, I) single crystal photodetector with light and gold electrode on the same side. (b) Response spectrum of the device with light and gold electrode on the same side.

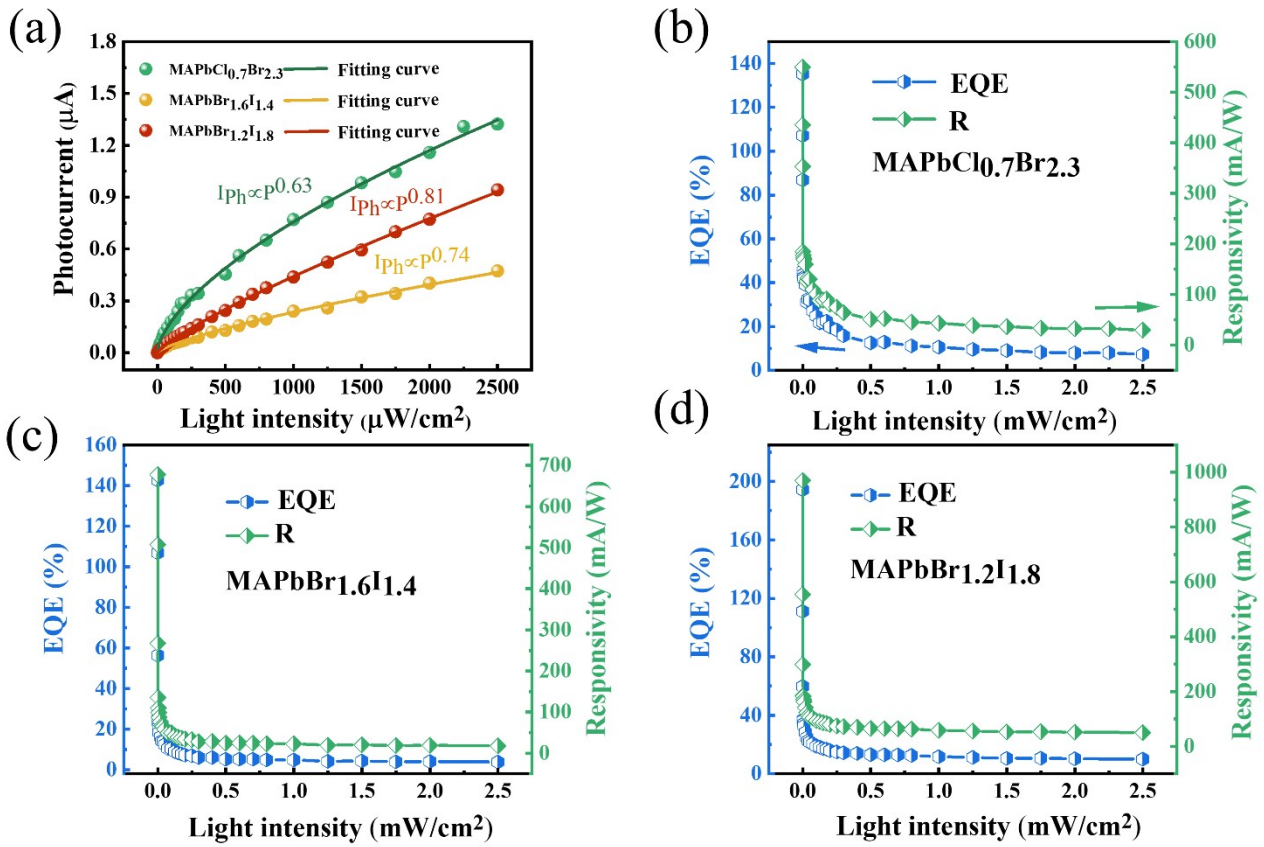

Figure S6. (a) The photocurrent as a function of light intensity. (b -d) Responsivity and EQE as a function of the light intensity of the $MAPbBr_{3-n}X_n$ single crystal narrowband photodetectors.

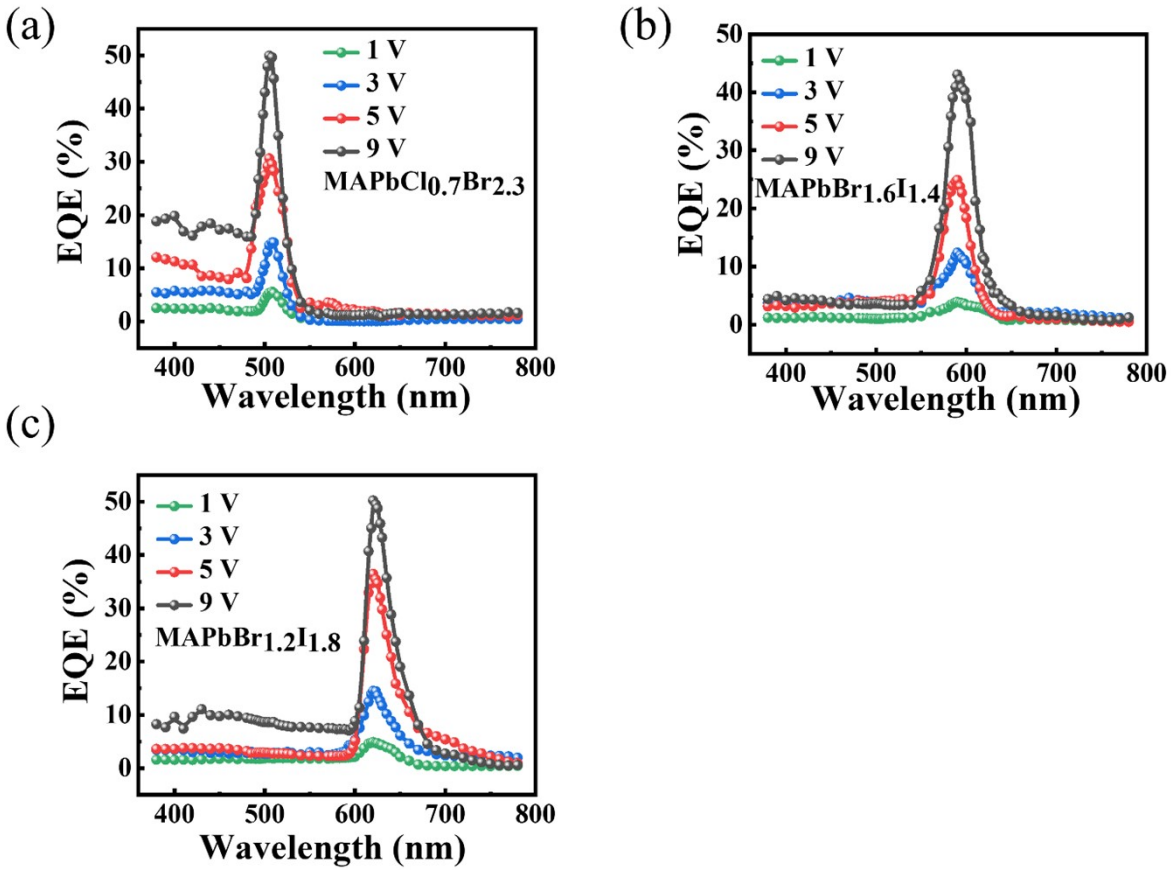

Figure S7. (a-c) *EQE* spectra of $MAPbCl_{0.7}Br_{2.3}$, $MAPbBr_{1.6}I_{1.4}$and $MAPbBr_{1.2}I_{1.8}$ narrowband photodetectors under different bias voltages.

Table S1. Summary of the reported perovskite narrowband photodetectors.

Materials	Thickness (μm)	Responsivity (mA/W)	EQE (%)	Peak Detectivity (Jones)	FWHM (nm)	Working Bias (V)	Ref.
Bulk $MAPbX_3$ single crystal	1000	7.34	1.6	2×10^{10}	20	-4	1
$MAPbBr_xI_{3-x}$ film	0.4-0.6	~56.2	~11	2×10^{11}	<100	-0.5	2
Bulk $CsPbBr_3$ single crystal	1500	590	131	-	<20	10	3
2D $(iso\text{-}BA)_2PbI_4$ single crystal	-	560	120	1.23×10^{10}	20	-5	4
$MAPbX_3$ film	0.5	76	12.1	-	28	0	5
$CsPbBr_3$ film	20	50	11	4×10^{11}	12	5	6
$MAPbI_3$ film	25.1	63.7	9.9	1.27×10^{12}	29	0	7
2D $(BA)_2(MA)Pb_2I_7$ single crystal	＜80	998	200	1×10^{11}	<60	5	8
$MAPbI_{3-x}Br_x$ film	＜0.47	~115	>20	1.37×10^{12}	50	-0.1	9
$PEA_2FA_{n-1}Pb_nI_{3n+1}$ film	＜16	35	＜6	1×10^{11}	20	-0.6	10
Bi-$MAPbX_3$/$MAPbY_3$ single crystal	~2000	>20	>3.8	1.2×10^{11}	~20	-20	11

$MAPbBr_{3-n}X_n$ single crystal film	200	~182	29.8	9.68×10^{10}	<35	5	This work

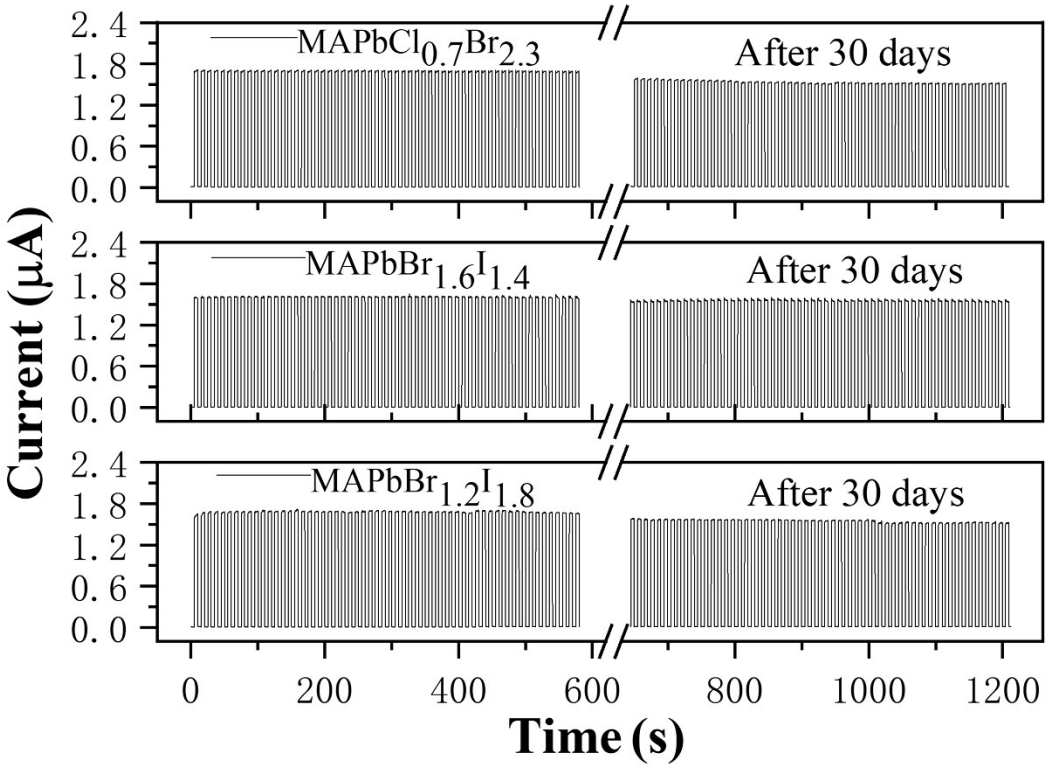

Figure S8. Photoresponse of the $MAPbCl_{0.7}Br_{2.3}$, $MAPbBr_{1.6}I_{1.4}$ and $MAPbBr_{1.2}I_{1.8}$ narrowband photodetector before and after 30 days storage in ambient condition, which is measured under 505, 590 and 620nm light illumination, respectively.

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