Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.
This journal is © The Royal Society of Chemistry 2020

Supporting Information

Diamine Tailored Smooth and Continuous Perovskite Single Crystal with Enhanced Photoconductivity

Wantian Yang, Jiarui Hu, Jian Chen, Yaxin Xu, Guoliang Tong, Haotian Fan, Xingchen Chai, Junnian Chen*, Yunbin He*

Ministry of Education Key Laboratory for the Green Preparation and Application of Functional Materials, Hubei Key Laboratory of Polymer Materials, School of Materials Science & Engineering, Hubei University, Wuhan 430062, P. R. China.

*E-mails: chenjunnian910@hubu.edu.cn; ybhe@hubu.edu.cn

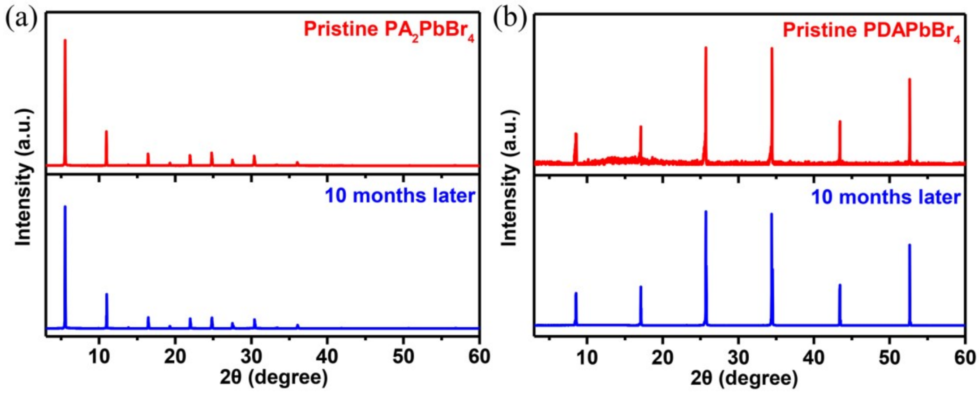

Fig. S1 Time-dependent XRD of (a) PA_2PbBr_4 and (b) $PDAPbBr_4$ single crystals. The XRD patterns of PA_2PbBr_4 and $PDAPbBr_4$ single crystals exhibit no obvious change when stored in the ambient atmosphere for ten months, indicating good stability.

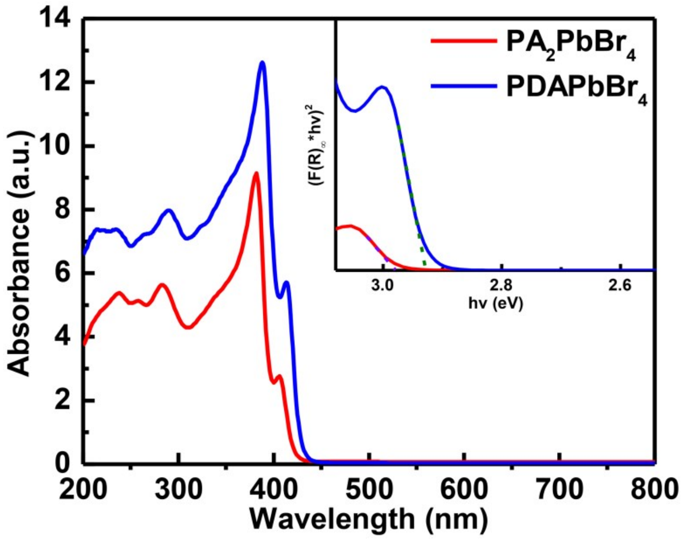

Fig. S2 Absorption spectra of PA_2PbBr_4 and $PDAPbBr_4$ perovskites at room temperature; the inset shows the band gaps determined from a Tauc plot. The sharp absorption edges of PA_2PbBr_4 and $PDAPbBr_4$ locate at 416 nm and 423 nm, affording the bandgap (Eg) of 2.98 eV and 2.93 eV by extrapolating the high-energy edge to the energy axis.

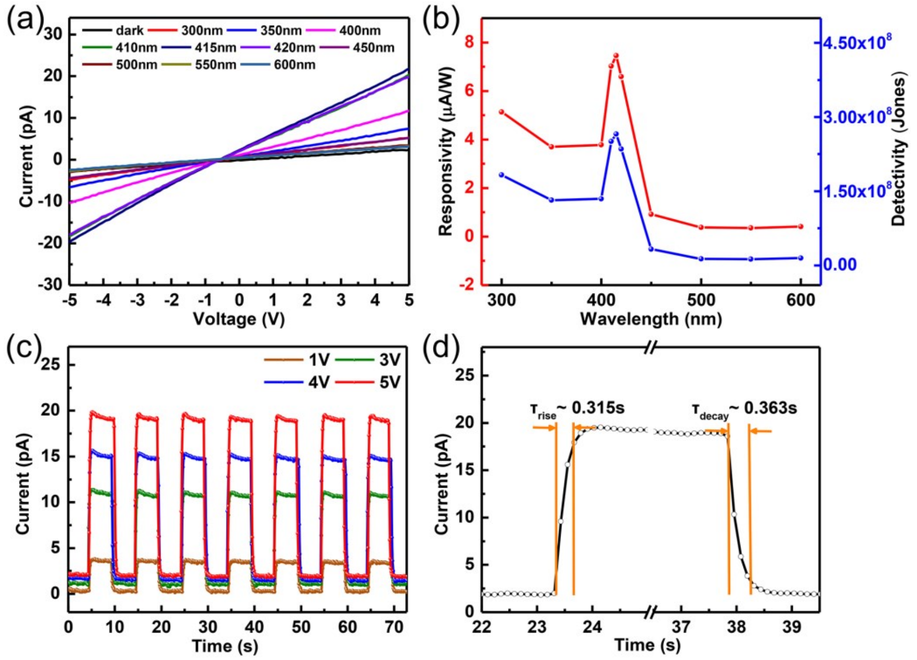

Fig. S3 Optoelectronic performance of PA_2PbBr_4 perovskite-based photodetector. (a) *I–V* characteristics of the PA_2PbBr_4-based device in the dark, and under light illumination at different wavelengths. The corresponding optical power values are 0.57, 1.35, 2.45, 2.55, 2.60, 2.65, 3.07, 2.78, 2.37, and 1.98 mW cm^{-2} for the given wavelengths of 300, 350, 400, 410, 415, 420, 450, 500, 550, and 600 nm, respectively. (b) Photoresponsivity and detectivity of PA_2PbBr_4-based device as a function of incident light wavelength. (c) Time-resolved photoresponse of the PA_2PbBr_4-based device under 415 nm light with 2.6 mW cm^{-2} light intensity. (d) Rise and decay curves of PA_2PbBr_4-based device. The optimum irradiation wavelength of the PA_2PbBr_4 photodetector was determined to be 415 nm via characterizing the wavelength-dependent photocurrent, which agrees well with the light absorption. The current of PA_2PbBr_4 perovskite is extremely low (2.5×10^{-12} A) in the dark, and could be increased to only 0.022 nA under light intensity of 2.6 mW cm^{-2} at a bias of 5V. Hence, a lower on-off current ratio of 9 was obtained for a PA_2PbBr_4 photodetector. The device showed the highest responsivity of $7.45x10^{-3}$ mA W^{-1} and detectivity of 2.66×10^{8} Jones under 415 nm light with 2.6 mW cm^{-2} light intensity. Moreover, the cycling behavior of

PA_2PbBr_4 perovskite also indicates good stability. The response time of the device was determined to be 315 ms and 363 ms for rise and decay times, respectively.

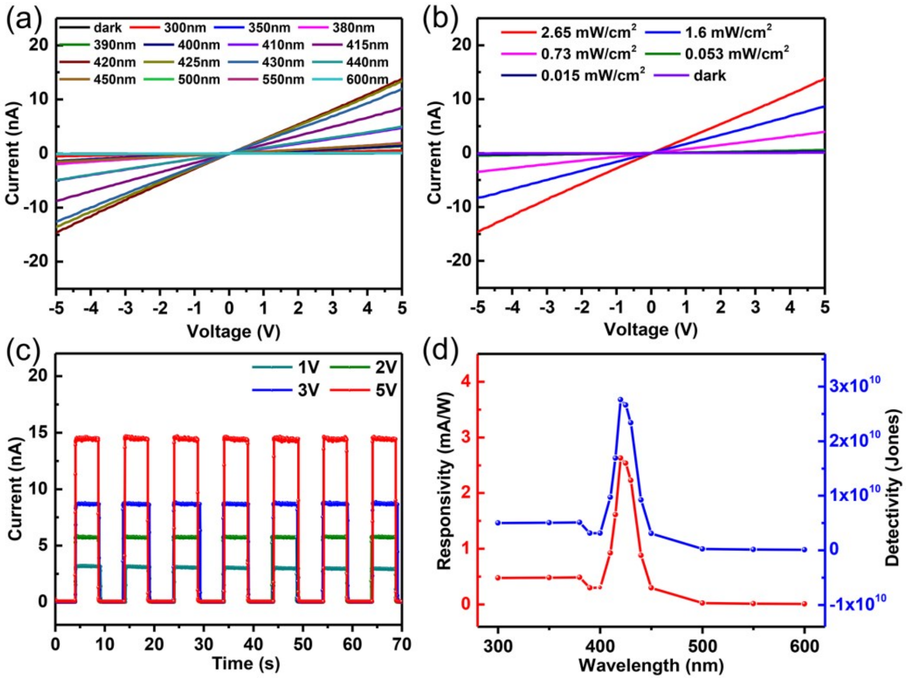

Fig. S4 Optoelectronic performance of $PDAPbBr_4$ perovskite-based photodetector. (a) *I–V* characteristics of the $PDAPbBr_4$-based device in the dark, and under light illumination at different wavelengths. The corresponding optical power values are 0.57, 1.36, 1.96, 2.22, 2.45, 2.55, 2.6, 2.65, 2.66, 2.69, 2.81, 3.07, 2.78, 2.37, and 1.98 mW cm^{-2} for the given wavelengths (unit of 300, 350, 380, 390, 400, 410, 415, 420, 425, 430, 440, 450, 500, 550, and 600 nm, respectively. (b) *I–V* characteristics of the $PDAPbBr_4$-based device in the dark and under 420 nm light illumination at different intensities. (c) Time-resolved photoresponse of the $PDAPbBr_4$-based device using 420 nm light at an intensity of 2.65 mW cm^{-2} with different bias. (d) Photoresponsivity and detectivity of $PDAPbBr_4$-based device as a function of incident light wavelength. The optimum irradiation wavelength of the $PDAPbBr_4$ photodetector was determined to be 420 nm via characterizing the wavelength-dependent photocurrent, which agreed well with the light absorption. The current of $PDAPbBr_4$ perovskite is low (57×10^{-12} A) in the dark, and could be enhanced to 13.99 nA under light intensity of 2.65 mW cm^{-2} at a bias of 5V. Hence, a higher on-off current ratio of 246 was obtained for the $PDAPbBr_4$ photodetector. The device showed responsivity of 2.63 mA W^{-1} and detectivity of 2.76×10^{10} Jones under 420 nm light with intensity of 2.65 mW cm^{-2}. The cycling behavior of $PDPbBr_4$ perovskite also indicates good stability.