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Supporting Information

Synergistic engineering of the Stokes shift for highly efficient and stable quasi-2D perovskite luminescent solar concentrators

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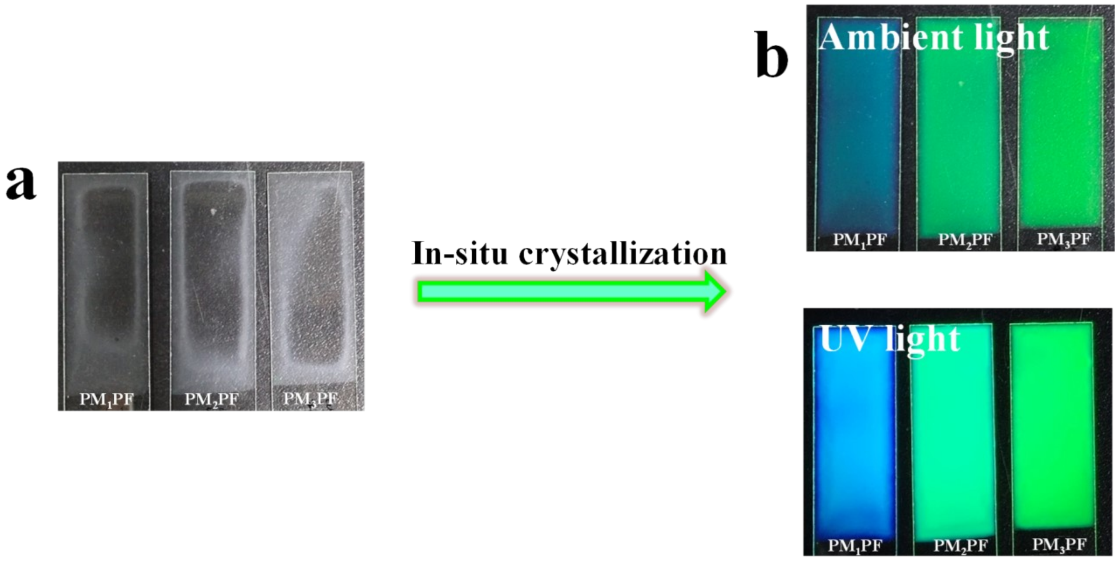

Figure S1. Photographs of $PM_{x-1}PF$ film (a) under ambient light after drying for 20 min and (b) under ambient light and UV light after drying for 18 h.

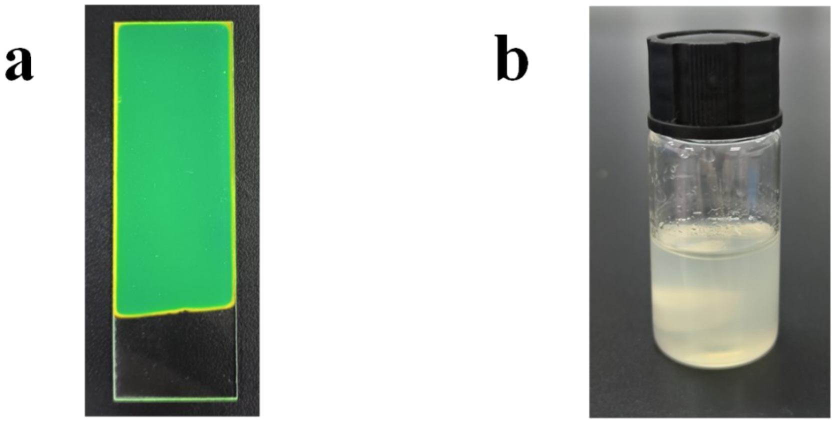

Figure S2. (a)Photograph of the composite film (PLQY 74.6%) under ambient light. The PVDF content in the precursor solution is 740 mg. The remaining components are consistent with those of PM_3PF. (b) Photograph of the precursor solution under ambient light, the PVDF content is 940 mg and the remaining components are consistent with PM_3PF.

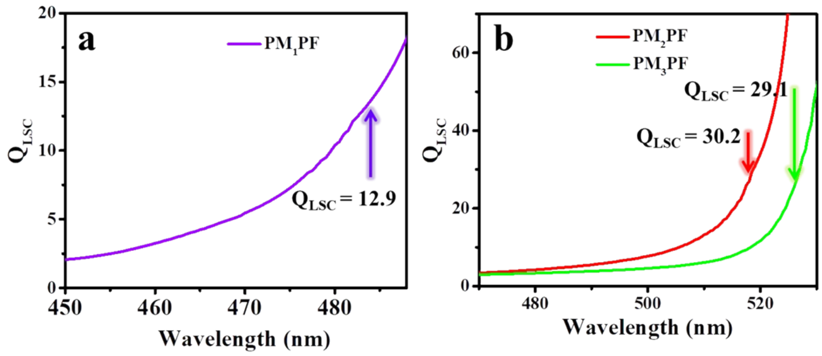

Figure S3. Quality factor Q_{LSC} as a function of wavelength. Here the Q_{LSC} is defined as the ratio of absorbance at the PL emission wavelength and excitation wavelength (365 nm). At the PL peak wavelength, for x = 2, 3 and 4 of $PM_{x-1}PF$, the Q_{LSC} is 12.9, 30.2 and 29.1, respectively.

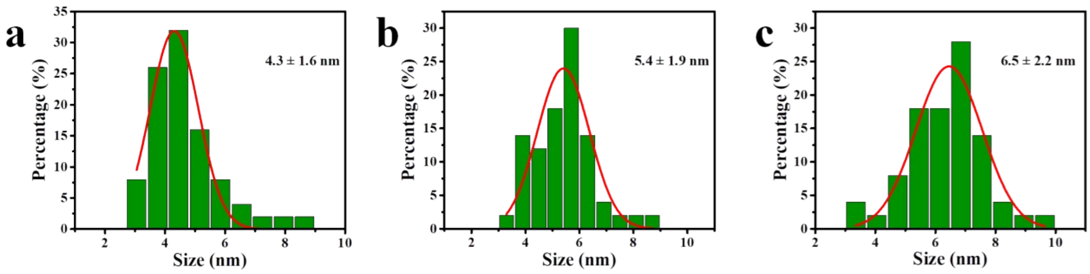

Figure S4. The size distributions of perovskite nanocrystals in PM_1PF (a), PM_2PF (b), and PM_3PF (c) films.

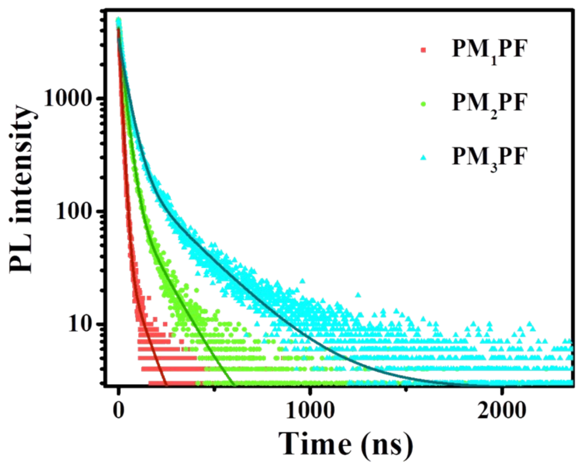

Figure S5. Photoluminescence decay curve of $PM_{x-1}PF$ film.

By combining the fluorescence lifetime and PLQY the radiative decay rate (K_r) and the nonradiative decay rate (K_{nr}) of quantum dots can be calculated by the following equations

$$\tau_{avg} = (K_r + K_{nr})^{-1} \quad (1)$$

$$PLQY = K_r(K_r + K_{nr})^{-1} \quad (2)$$

Table S1. Fitting parameters of photoluminescence decay curve of $PM_{x-1}PF$ film.

	τ_1 (ns)	A_1 (%)	τ_2 (ns)	A_2 (%)	τ_{avg} (ns)	K_r (μs^{-1})	K_{nr} (μs^{-1})	K_r/K_{nr}	PLQY(%)
PM_1PF	13.0	98.9	83.3	1.1	17.8	13.46	42.6	0.316	24.0
PM_2PF	27.0	96.4	141.1	3.6	45.7	21.10	0.80	26.3	96.3
PM_3PF	43.6	92.8	254.5	7.2	109.1	8.94	0.23	39.5	97.5

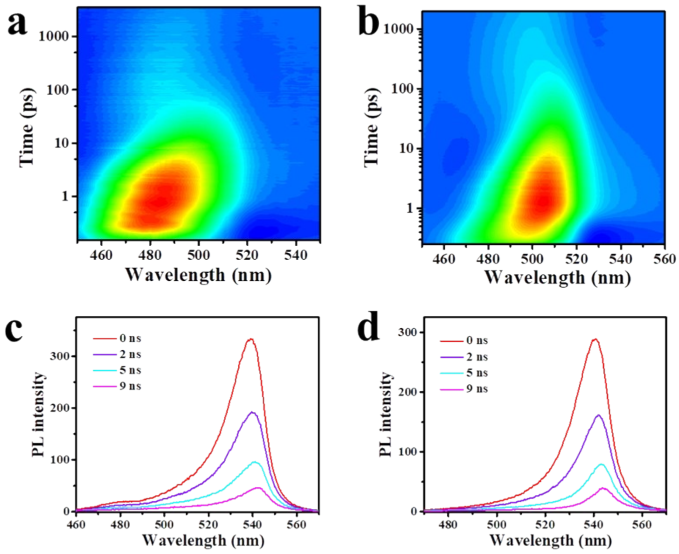

Figure S6. Transient-absorption spectra for PM_2PF (a) and PM_3PF (b) TRES at different time delays of the film PM_2PF (c) and PM_3PF (d).

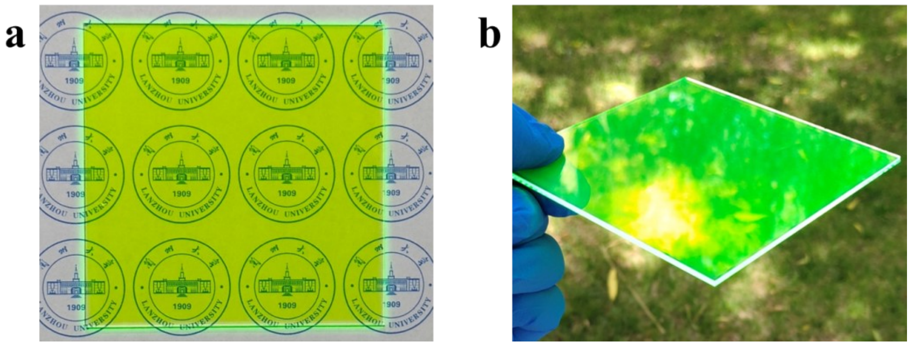

Figure S7. Photograph of LSC (10 cm × 10cm × 0.2 cm) under indoor (a) and outdoor (b) ambient light.

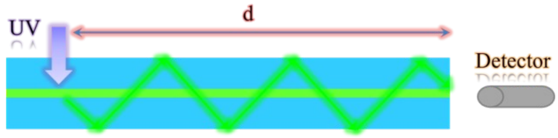

Figure S8. Schematic diagram of optical waveguide test.

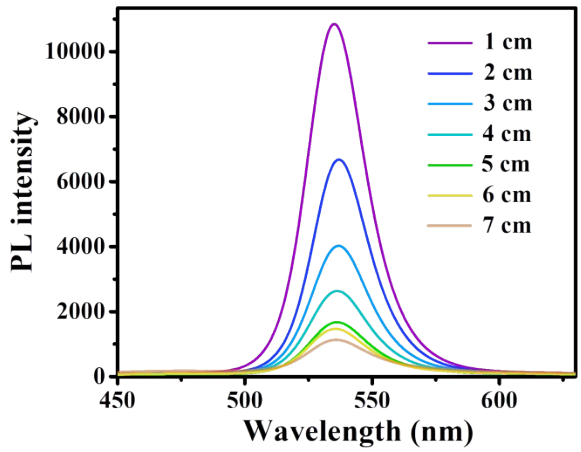

Figure S9. Photoluminescence spectra of MAPM film at different distances.

Table S2. Performance of different sizes of LSC.

Dimensions	Light Source	PLQY (%)	OQE (%)	η_{ext} (%)
2 cm × 2 cm × 0.15 cm	430 nm	94.5	56.6	6.7
5 cm × 5cm ×0.15 cm	430 nm	81.8	49.5	5.1

Table S3. External optical efficiency of different LSCs based on organic-inorganic hybrid and inorganic perovskite at similar size.

Type	Material	LSC dimension (cm)	η_{ext} (%)	
Organic-inorganic hybrid perovskite	PM_2PF	10 × 10 × 0.2	4.9	This work
	$HA_2MA_{x-1}Pb_xI_{3x+1}$	10 × 10 × 0.2	2.0	*Joule* 2020, 4, 631-643
	$FAPbBr_3$ NCs	10 × 10	0.9	*J. Mater. Chem. A* 2019, 7, 4872.
	$HA_2MA_{x-1}Pb_xBr_{3x+1}$	10 × 10 × 0.2	1.44	*Nature Energy* 2019, 4, 197-205
	$FAPbBr_3$ NCs	10 × 10	0.9	*J. Mater. Chem. A* 2019, 7, 4872.
Inorganic perovskite	$CsPbI_3$ NCs	5 × 15	3.1	*Angew. Chem. Int. Ed.* 2020, 59, 7738.
	Cs_4PbBr_6 NCs	10 × 10 × 0.2	2.4	*Adv. Funct. Mater.* 2019, 29, 1902262.
	$CsPbBr_{0.6}I_{2.4}$ NCs	10 × 10 × 0.2	2.4	*Nano Energy* 2017, 37, 214.

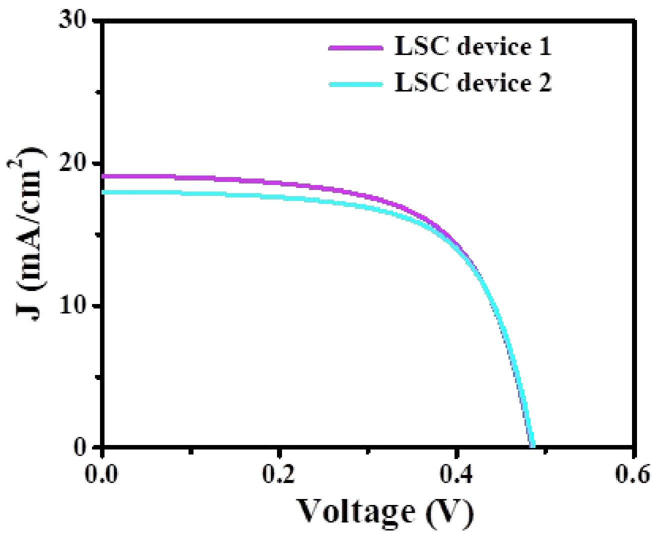

Figure S10. J-V curve of Si solar cell with coupled LSC (AM 1.5 G), the η_{ext} of LSC device 1 and device 2 are 4.9% and 4.6% respectively.