Supplementary Inforamtion

The Strain Effects in 2D Hybrid Organic–Inorganic Perovskite Microplates: Bandgap, Anisotropy and Stability

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Methods

Sample Fabrication. 2D perovskite crystals were synthesized according to the previously reported method.[1] The patterned nanopillars substrates were fabricated by electron beam lithography (TESCAN VEGA 3 SBH) and inductively coupled plasma etching on the Si substrate with a 100 nm SiO_2. After fabricating the substrate, we mechanically exfoliated thin 2D perovskite microplates from their bulk crystals on a polydimethylsiloxane (PDMS) stamp. The thin microplates were then transferred to prefabricated patterned nanopillars substrate under the aid of microscope and manipulator.

Material characterizations. Both Optical and fluorescence images were taken on an Olympus BX53M system fluorescence microscope. We used a 50X objective with a long focal length of 6.0 mm and a numerical aperture (NA) of 0.60. Therefore, the diameter of the laser spot size on samples is around 2 μm. The slit we used is around 200 μm and thus the probe area would be the excited area, which is around 4 μm^2. Since the area of the sample under single nano pillar is around 4~6 μm^2, the PL spectra were collected on the center of the nanopillars. SEM and AFM images were acquired by a tungsten filament scanning electron microscope (TESCAN VEGA 3 SBH) and a Bruker Dimension EDGE, respectively. The room-temperature PL studies were carried out on a home-built micro-Raman spectrometer (Horiba HR550) in a backscattering configuration, which was equipped with a 600 g/mm grating. The excited sources are a 473-nm and a 405-nm solid-state lasers with a power of 0.1~1 μW.

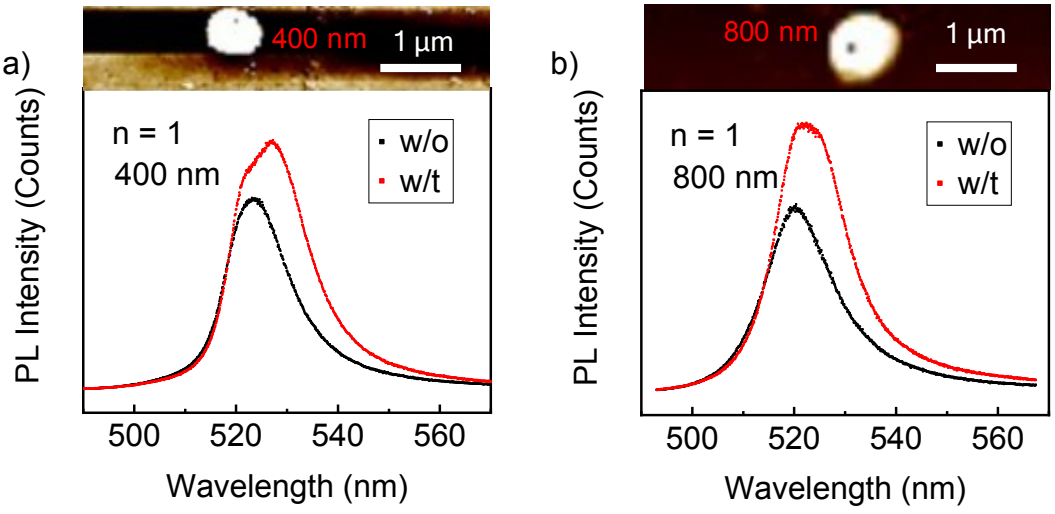

Fig S1. The PL spectra of $(BA)_2PbI_4$ (n=1) microplates without (w/o) and with (w/t) applying external strain on 400 nm nanopillars (a) and 800 nm nanopillars (b). Black squares: without strain; red squares: with strain.

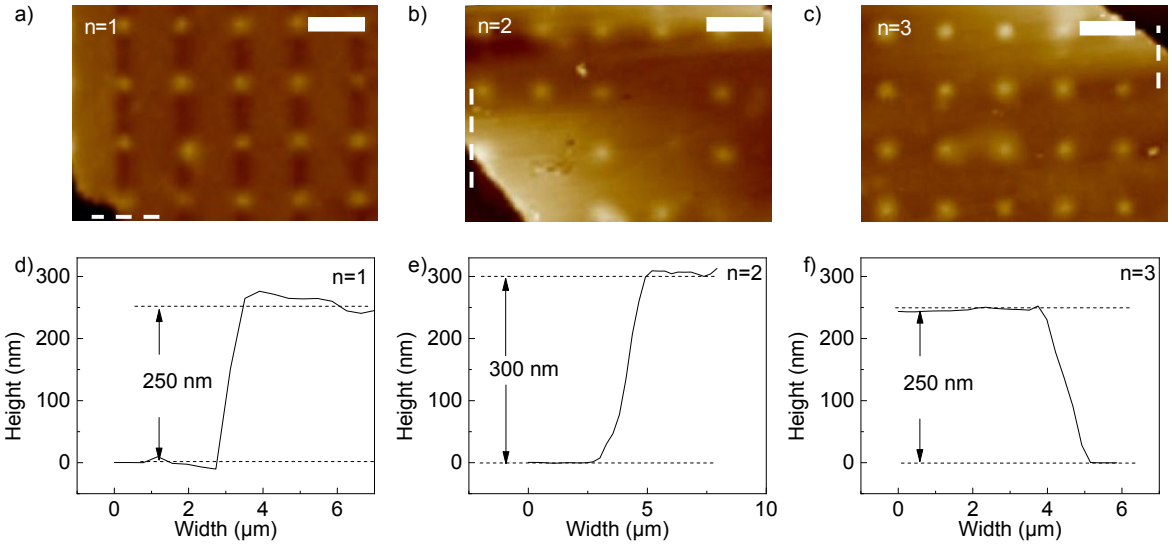

Fig S2. The atomic force microscopy images and extracted thickness of the as-exfoliated 2D perovskite $(BA)_2(MA)_{n-1}Pb_nI_{3n+1}$(n=1-3) microplates. The scale bars are 4μm.

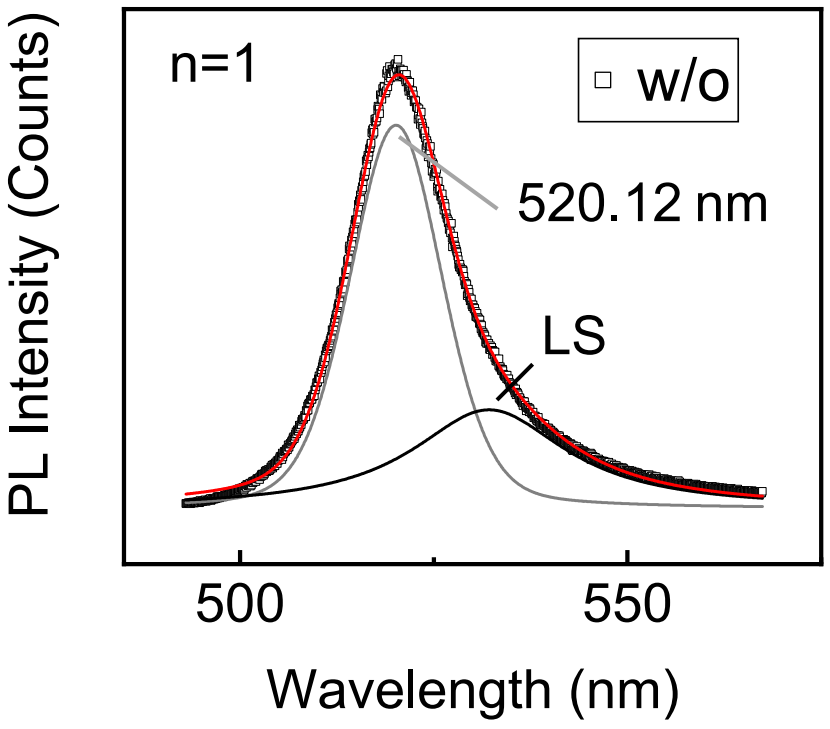

Fig S3. PL spectra with fitting results for $(BA)_2PbI_4$ (n=1) without strain. Black hollow squares: experimental data points; grey line: emission peak; black line: the low-energy shoulder (LS); red line: the final result of the fitting.

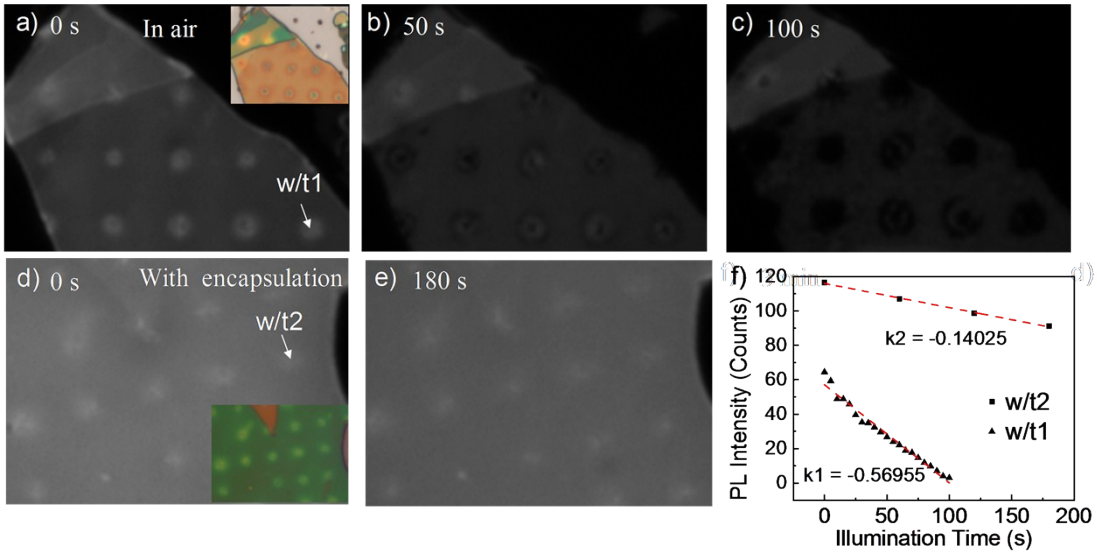

Fig S4. The continuous fluorescence mapping of $(BA)_2PbI_4$ (n=1) microplates in air for 0 s (a)/50 s (b)/100 s (c) and with encapsulation for 0 s and 180 s. Inset in (a) and (d) corresponding to their optical images respectively. (f) The extracted PL intensity versus illumination time at w/t1 and w/t2. The red dashed lines are linearly fitting results.

Table S1 Comparison of the change rate of the bandgap with the applied strain.

	$(BA)_2PbI_4$ [a]	$(BA)_2(MA)Pb_2I_7$ [a]	$(BA)_2(MA)_2Pb_3I_{10}$ [a]	$(BA)_2PbBr_4$ [b]	$(BA)_2(MA)_4Pb_5I_{16}$ [c]
Rate (mev/%)	-5.60	-2.74	-1.38	-18	13.3

[a] in our work [b] from ref.[2] [c] from ref.[3]

References

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