

Supporting Information

Controlling Screw Dislocation Evolutions towards High Homogeneous Quasi-Two-Dimensional $(\text{BA})_2(\text{MA})_{n-1}\text{Pb}_n\text{I}_{3n+1}$ Single Crystals for High Response Photo-detectors

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1. Descriptions of the raw materials purity

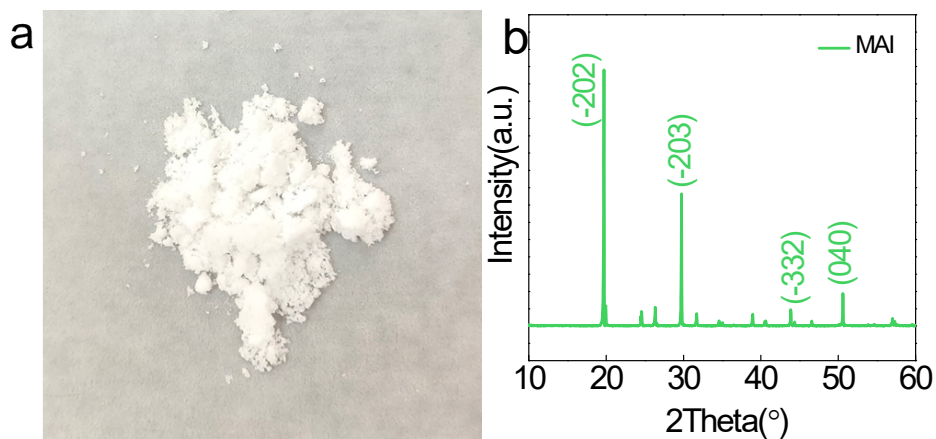


Figure S1 (a-b) Photograph and XRD pattern of MAI powders.

The synthesis process of MAI powders: Methylamine CH_3NH_2 solution and hydroiodic acid HI are reacted in an ice-water bath at a volume ratio of 6:5. After reacting for 4 hours, the mixed solution was sealed at 60°C for 24 hours. The crystallization of MAI is achieved by evaporating water at 60°C to obtain white MAI powder (Figure S1a). Figure S1b shows the XRD pattern of MAI powder.

2. Photographs of BMPI solution preparation

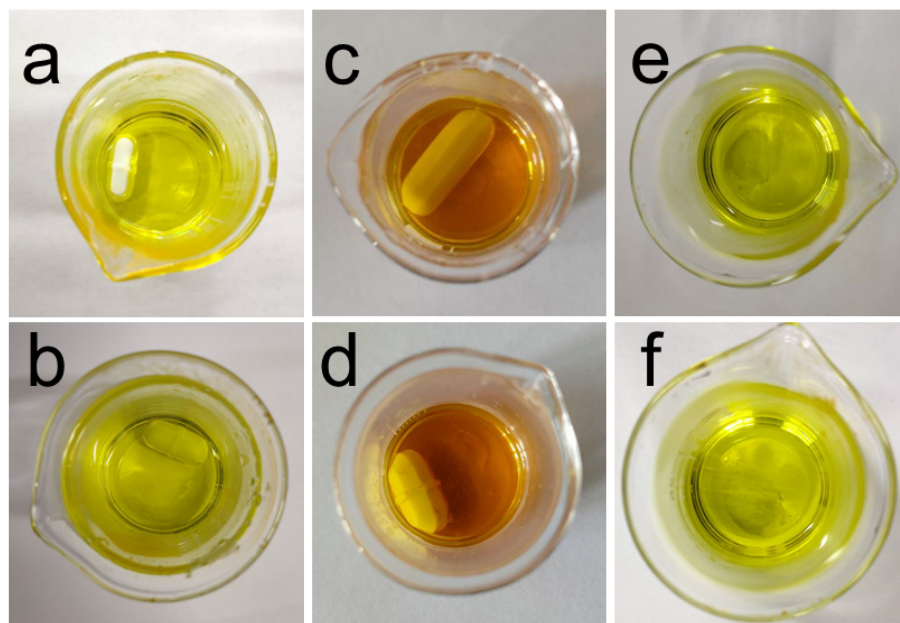


Figure S2 (a-b) Photographs of I solution; (c-d) Photographs of II solution; (e-f) Photographs of crystal growth solution.

3. Photographs of BMPI perovskite SCs growth

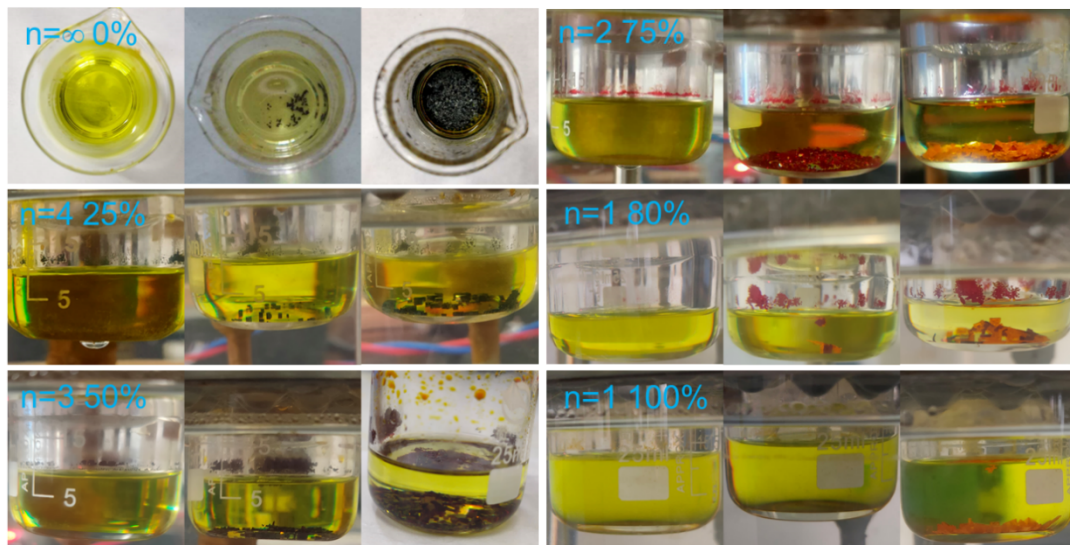


Figure S3 Photographs of BMPI ($n=1-4$ and ∞) SCs growth.

4. Crystal data for BMPI ($n=1-4$ and ∞) SCs at 293K

Table S1. Crystal data for BMPI ($n=1-4$ and ∞) SCs at 293K

n values	$n=1$	$n=2$	$n=3$	$n=4$	$n=\infty$
Crystal system	orthorhombic	orthorhombic	orthorhombic	orthorhombic	tetragonal
Space group	Pbca	Cc2m	C2cb	Cc2m	I4/mcm
Color	orange	red	dark red	black	black
a(Å)	8.8555(8)	8.9470(4)	8.9275(6)	8.9274(4)	8.8392(3)
b(Å)	8.6810(8)	39.347(2)	51.959(4)	64.383(3)	8.8392(3)
c(Å)	27.602(3)	8.8589(6)	8.8777(6)	8.8816(4)	12.6948(5)
$\alpha=\beta=\gamma$ (deg)	90	90	90	90	90
Volume(Å ³)	2121.89(4)	3118.67(3)	4118.04(5)	5104.9(4)	991.86(6)
Z	8	4	4	4	4
References	[1]	[2]	[2]	[2]	[3]

5. 2D AFM image of heterojunction structures on the (020) surface of $\text{BA}_2\text{MA}_3\text{Pb}_4\text{I}_{13}$ SCs

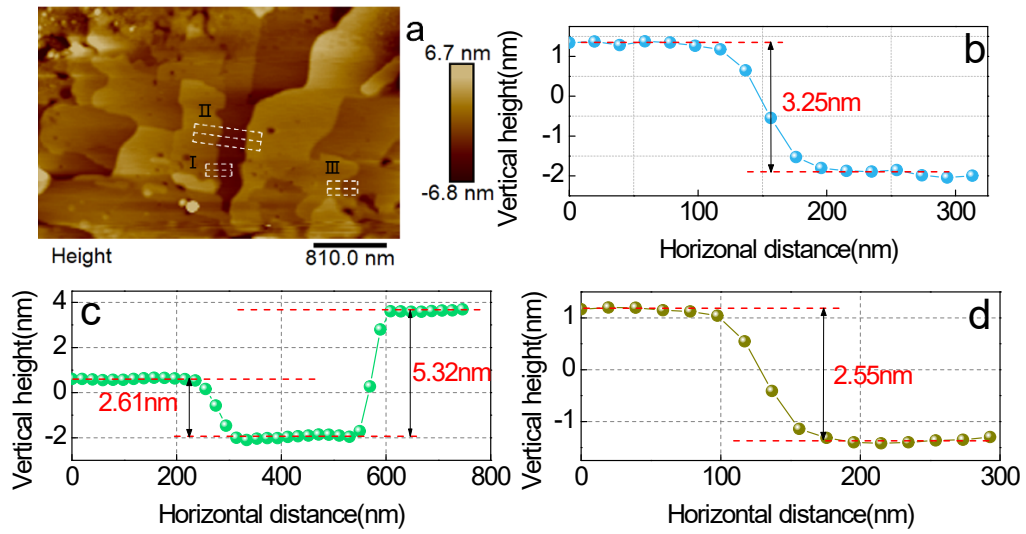


Figure S4. (a) 2D AFM images of heterojunction structures of $\text{BA}_2\text{MA}_3\text{Pb}_4\text{I}_{13}$ SCs; (b-d) step heights.

6. 2D AFM image of BA₂PbI₄ SCs

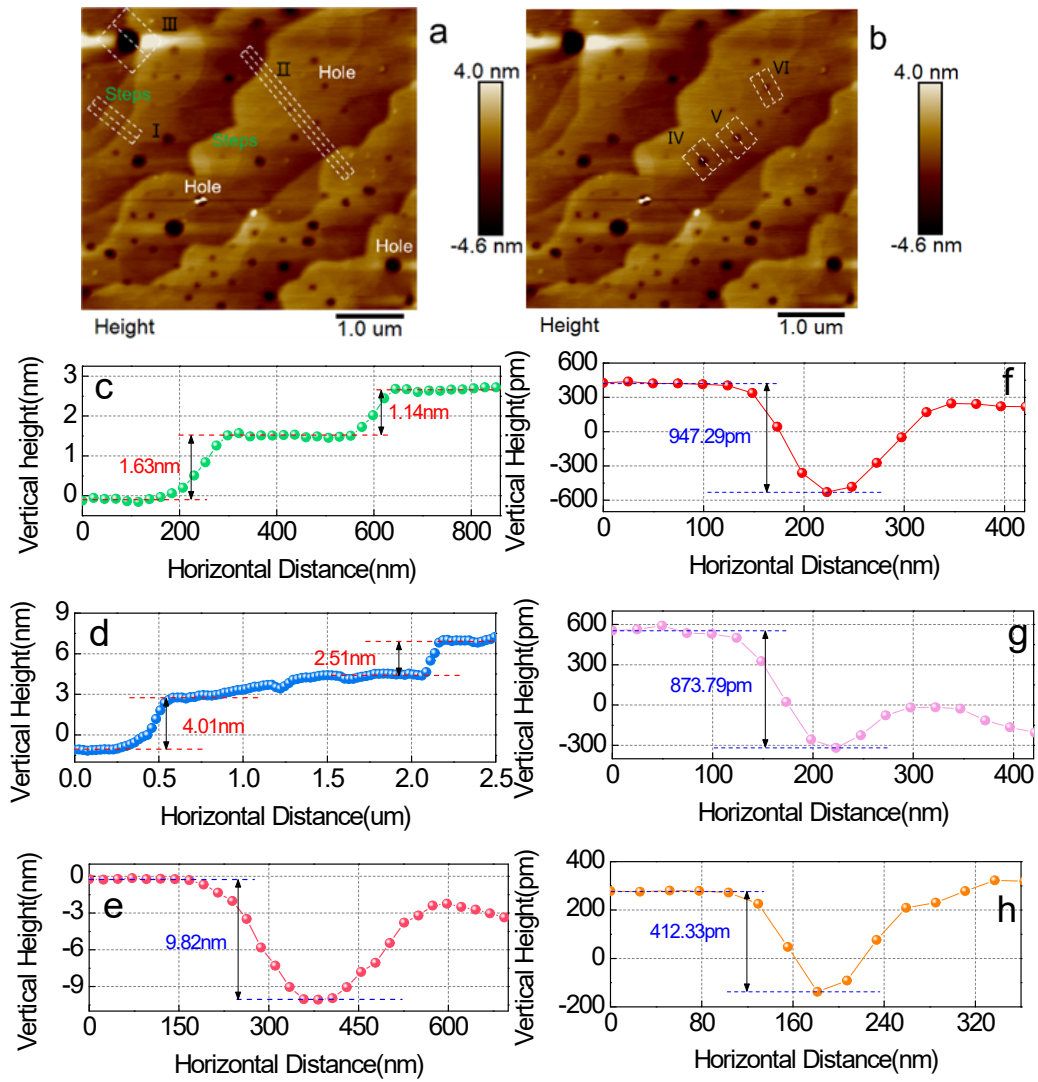


Figure S5. (a-b) 2D AFM image of growth steps and holes on (002) surface of BA₂PbI₄

(BA=20%) SCs; (c-h) step heights and hole depth files of the measured steps and holes.

7. Spiral dislocation diagram of BMPI ($n=2-3$) SCs

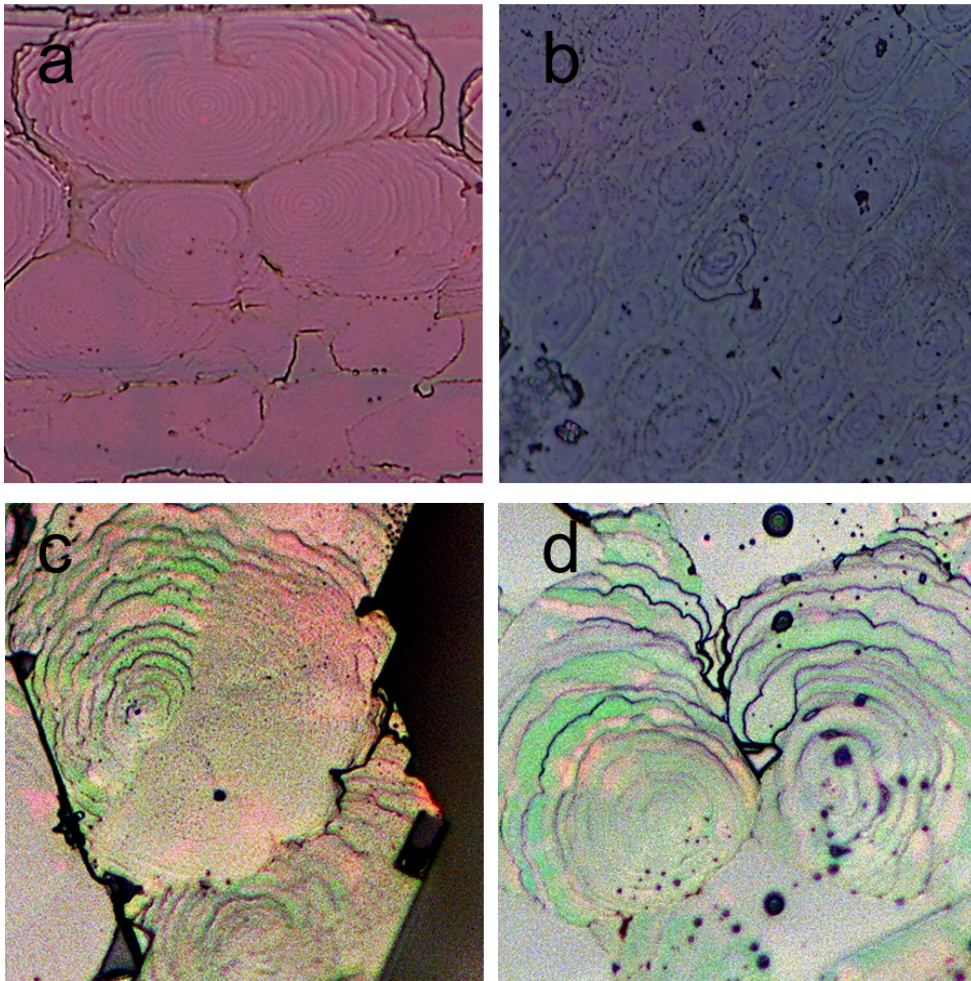


Figure S6. (a-d) Spiral dislocation diagram of BMPI ($n=2-3$) SCs (magnification: 50).

9. Length and width of screw dislocation steps

Table S2. Length and width of screw dislocation steps

number	Width (μm)	Length (μm)
1	2.05	2.25
2	2.16	1.72
3	2.37	1.79
4	2.05	2.25
5	1.73	1.72
6	1.51	1.62
7	1.51	1.40
8	1.83	1.62
9	1.62	1.96
10	1.51	1.62
11	1.51	1.29
12	1.62	1.83
13	1.62	1.72
14	1.62	1.79
Average	1.765	1.797

References

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