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Supporting Information

Ferroelastic Domains and Phase Transitions in Organic-Inorganic Hybrid Perovskite $CH_3NH_3PbBr_3$

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Table S1. Permissible extinction directions and orientations of ferroelastic domain walls which can be observed by polarized light microscope in (001), (110) and (111) crystal plates after transformation from cubic $m\bar{3}m$ phase to different ferroelastic phases: tetragonal (T), rhombohedral (R), orthorhombic (O_P and O_S). δ is the angle between crossed polarizers and <100> directions for (001) plates and the angle between crossed polarizers and $[\bar{1}10]$ direction for (110) and (111) plates at which the extinction is observed; a filled circle (●) indicates the possibility of domains which are in extinction at any δ; a crossed circle (⊕) indicates the possibility of regions without extinction at any δ. The φ is a permissible angle between a domain wall on the crystal surface and <100> or <$\bar{1}10$> directions (walls which are *not* perpendicular to a crystal surface are listed in brackets); angle φ_1 (for S walls) may adopt any values, except for 0°, 90° and ± 45°.

	100		110		111	
Phase	δ	φ	δ	φ	δ	φ
T	0°/90°, ●	(0°/90°), ±45°	0°/90°	90°, (±35°)	0°/90°, ±30°, ±60°, ⊕	(0°), 90°, ±30°, (±60°)
R	±45°	0°/90°, (0°/90°), ±45°	0°/90°, ±35°, ±55°, ⊕	0°/90°, (90°), (±35°), (±55°)	0°/90°, ±30°, ±60°, ⊕, ●	(0°), 90°, ±30°, (±60°)
O_P	0°/90°	(0°/90°), ±45°	0°/90°	90°, (±35°)	0°/90°, ±30°, ±60°, ⊕	(0°), 90°, ±30°, (±60°)
O_S	0°/90°, ±45°, ⊕	0°/90°, (0°/90°), ±45°, (±45°), (±φ_1), (90°±φ_1)	0°/90°, ±35°, ±55°	0°, (0°), 90°, (90°), (±35°), (±55°), ±φ_1	0°/90°, ±30°, ±60°, ⊕	(0°), 90°, ±30°, (±60°), (±30°±φ_1), (90°±φ_1)

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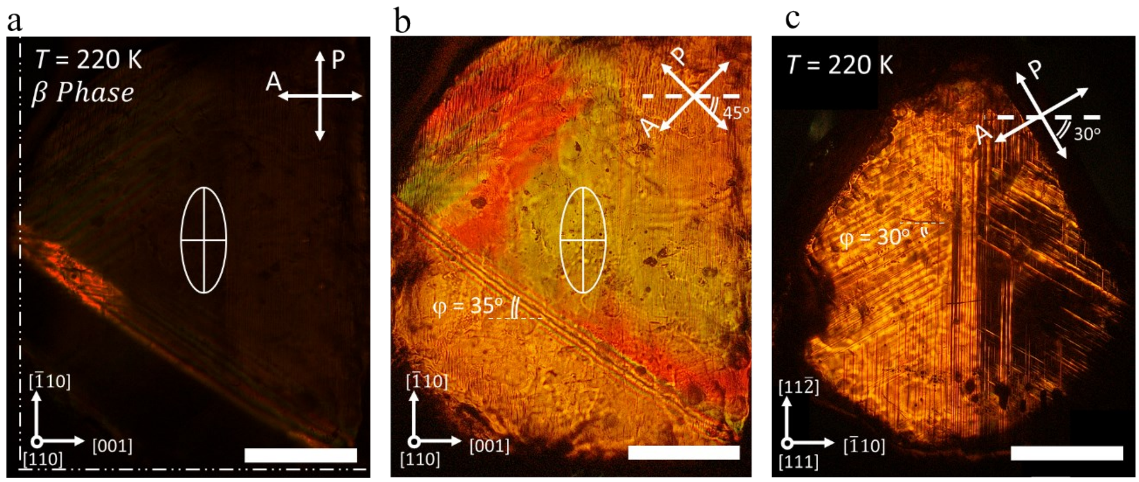

Figure S1. The domain structure of (110) $MAPbBr_3$ plate polished to the thickness of $t \approx 0.2$ mm in β phase with crossed polarizers (a) parallel to and (b) at a $\delta = 45°$ to the <100>. A bright stripe-like area appears along the domain wall with angle $\varphi = 35°$, which is the result of the light refraction on the inclined domain wall formed between two domains. The extinction angle of $\delta = 0/90°$ and domain wall angle of $\varphi = 35°$ are compatible with T phase. (c) The (111) plate in β phase with crossed polarizers at $\delta = 30°$ to the <1̄10> direction. The crystal shows extinction at the positions of polarizers separated by the angle of $\delta = 30°$ to [1̄10], which is allowed at any crystal symmetry according to Table S1. The crystal contains a large number of fine laminar domains with the size of ~ 20 µm, oriented at angles $\varphi \approx 90°$, ± 30° to [1̄10], which also can exist in any system. The temperature, the directions of crystallographic axes, indicatrix axis, polarizer directions, and the angles (δ, φ) are indicated, scale bars, 500 µm.

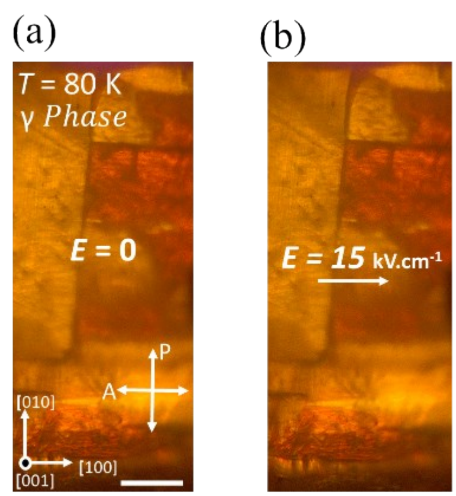

Figure S2. PLM images of a (001) oriented $MAPbBr_3$ crystal observed at 80 K in γ phase before (a) and after (b) application of an electric field E = 15 kV cm^{-1} along the [100] direction. The directions of crystallographic axes, the electric field, and the polarizers are indicated; scale bars = 200 µm

Movie S1. Application of electric field of 8 kV/cm in β phase of $MAPbBr_3$ crystal at 230 K. The Joule heating leads to the tetragonal-cubic transition, and after removing the field, the crystal returns to the tetragonal phase.