Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supplementary Information

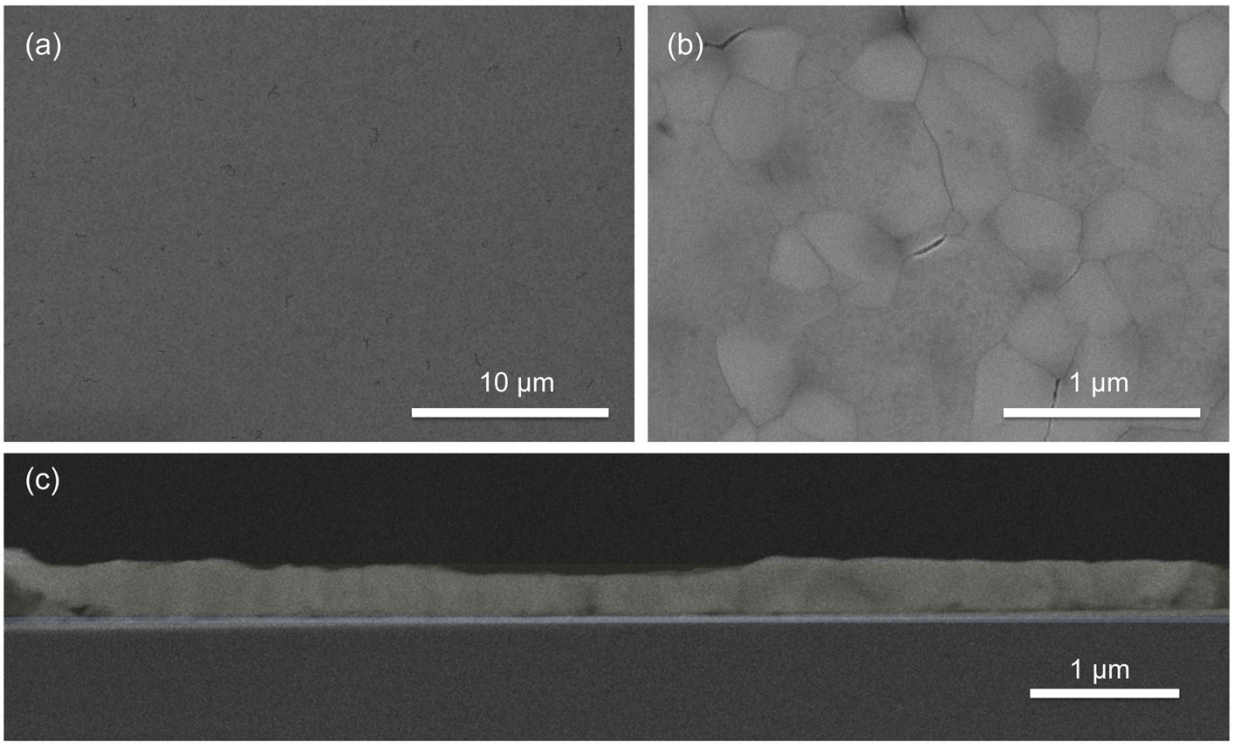


Figure S1. SEM image of CLIP fabricated perovskite thin films shows (a) high coverage and (b) unique morphology comprising a hybrid of perovskite networks and grains. Of particular importance is the single-slab like out-of-plane grain that can effectively bridge the extraction layers of opposite polarities.

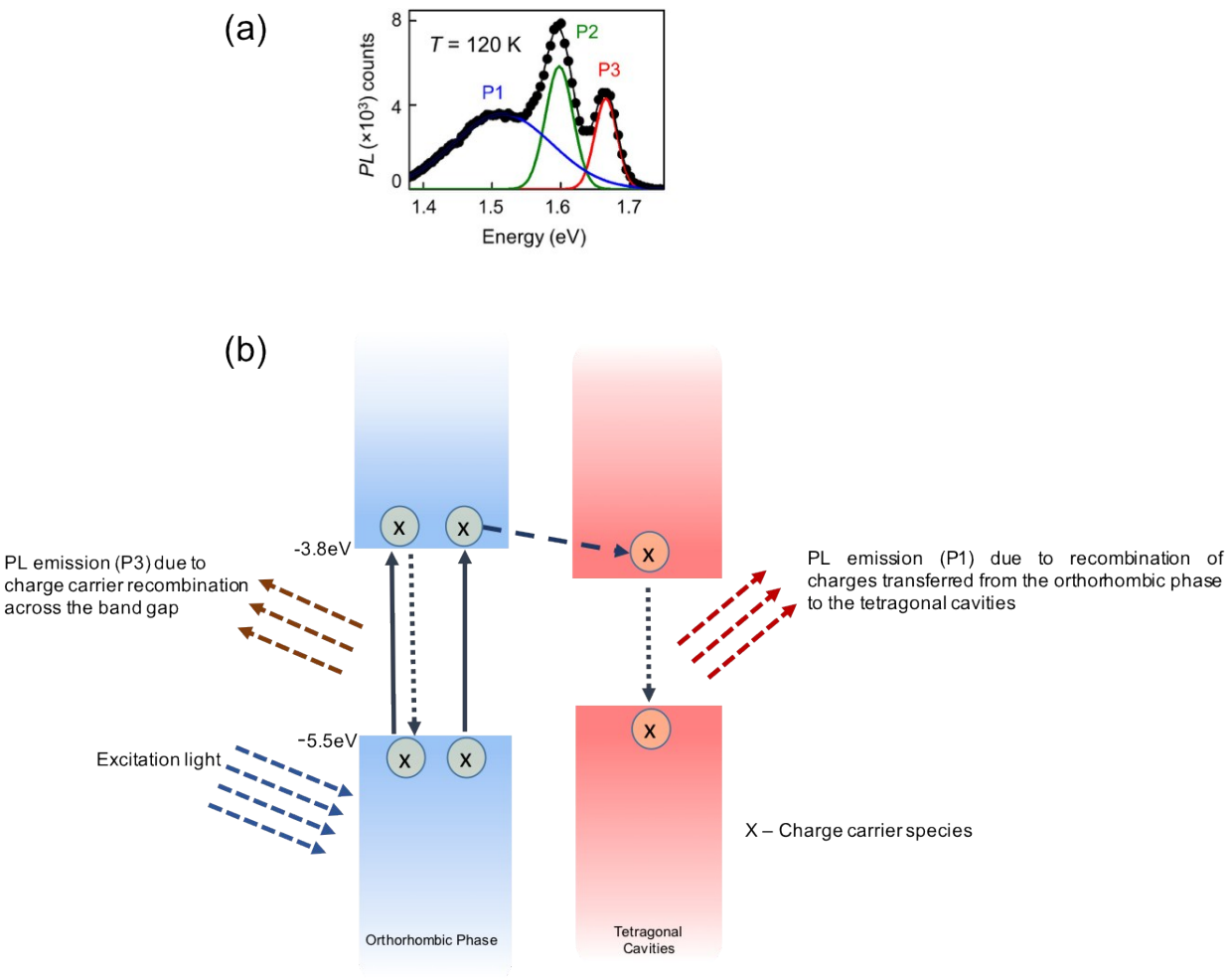
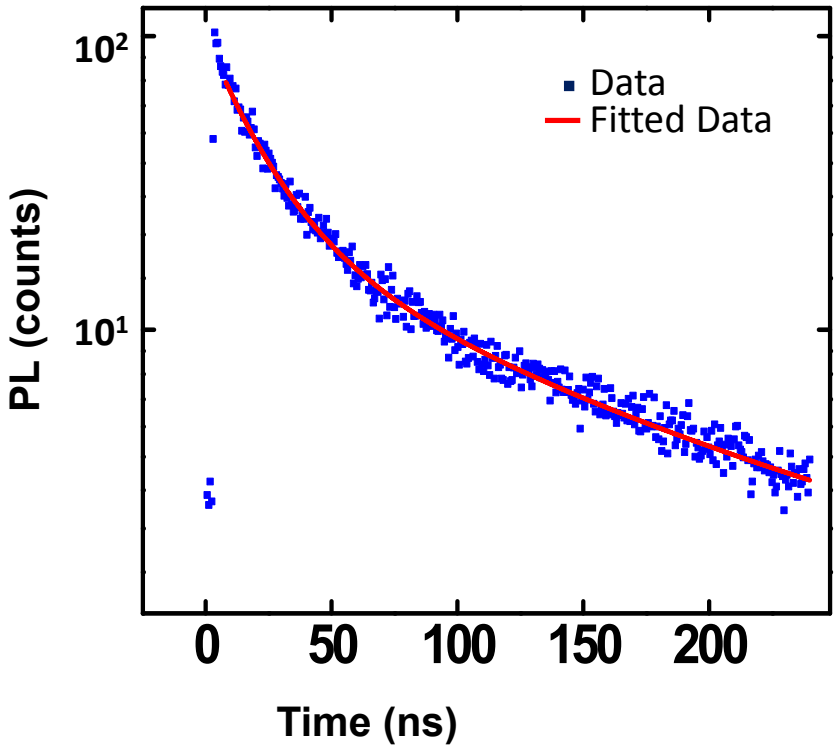


Figure S2. (a) PL spectrum at the cusp of the phase transition showing multi peak fits with peak designations. The black curve is the cumulative fitted peak. (R^2 =0.99). (b) Schematic showing charge carrier recombination and energy transfer process between orthorhombic phase and tetragonal cavities leading to band P1 and side band P3 in low temperature PL of Perovskite films. P2 peak not shown in schematic arise due to direct band gap recombination in the high temperature tetragonal phase.

As explained in the manuscript the recombination lifetime was fitted using a bi-exponential function: $PL(t) = A_1 e^{(-t/\tau_1)} + A_2 e^{(-t/\tau_2)}$, where t is time, τ_1 and τ_2 are recombination lifetimes and A_1 and A_2 are constants. If we plot Log (PL) vs time, we get $Log(PL(t)) = -(-t/\tau 1) + (-t/\tau 2) + Log(A_1 A_2)$, hence τ_1 and τ_2 are the two slopes of the graph

Fit Values:

A_1=48; τ_1=186 ns; A_2= 42; τ_2=24 ns Average Lifetime= 169ns



For the average lifetime we use: $\tau_{Avg} = \frac{A_1 {\tau_1}^2 + A_2 {\tau_2}^2}{A_1 \tau_1 + A_2 \tau_2}$

Figure S3. Time-resolved emission on a semi-log scale showing two distinct lifetimes at 295 K ($R^2 = 0.989$)