

## Supplementary Information

# Impact of Crystal Growth Diversity on Magneto-Photoluminescence and Circular Dichroism in Chiral Lead Halide Perovskites

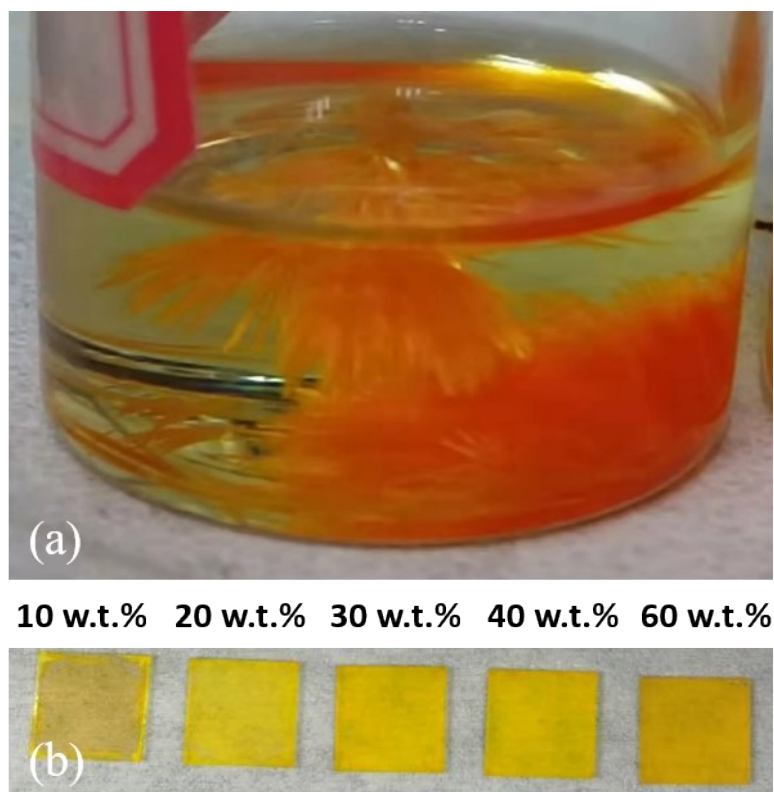
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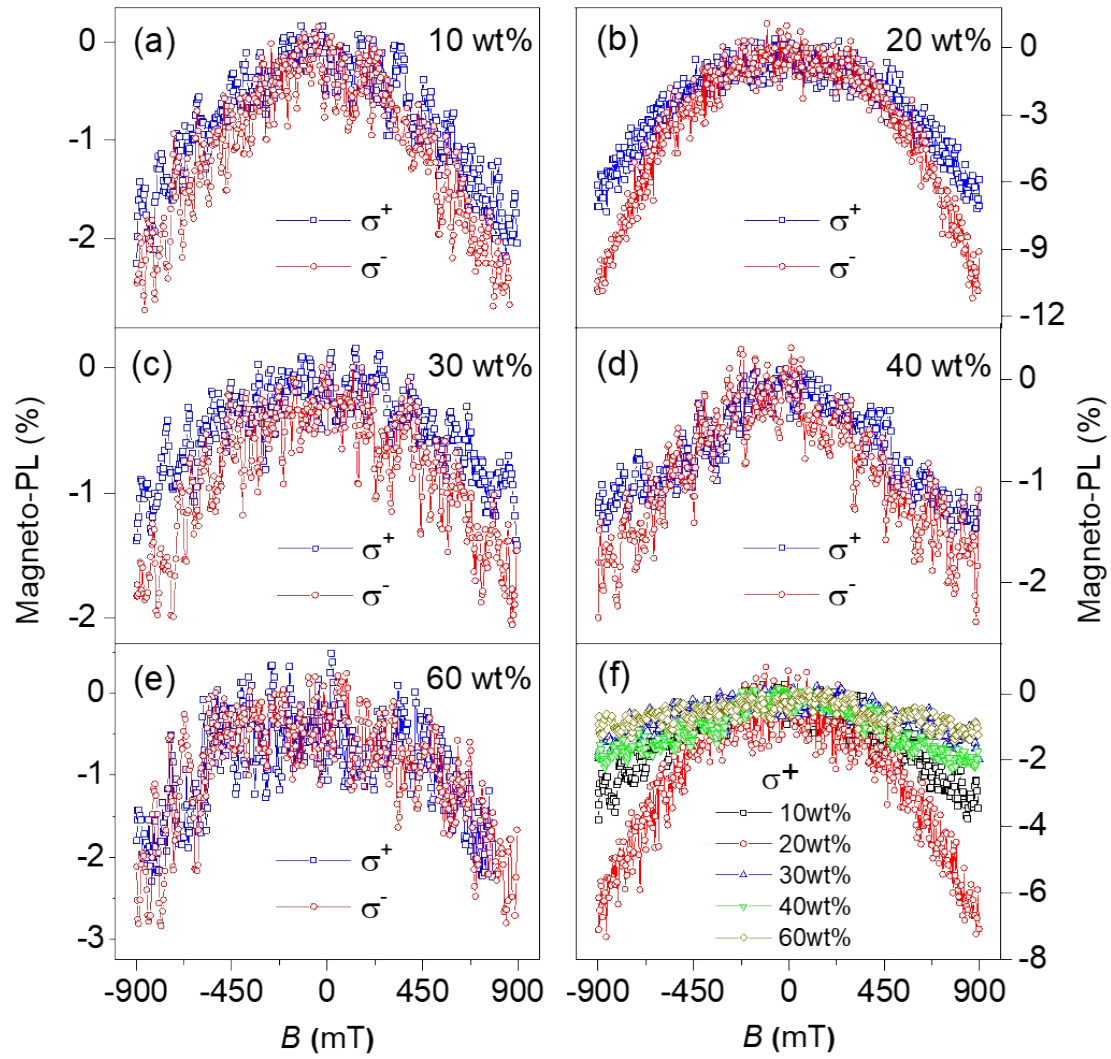
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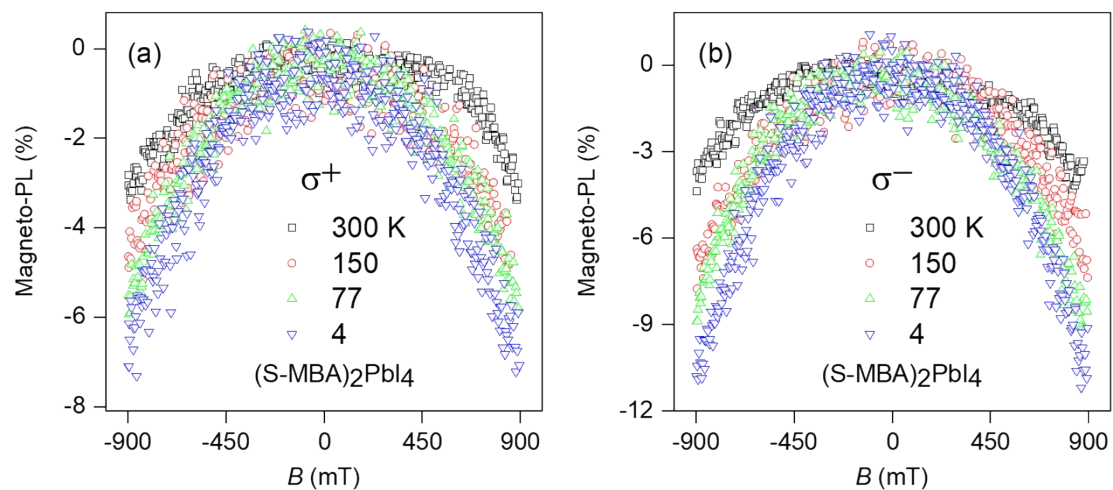
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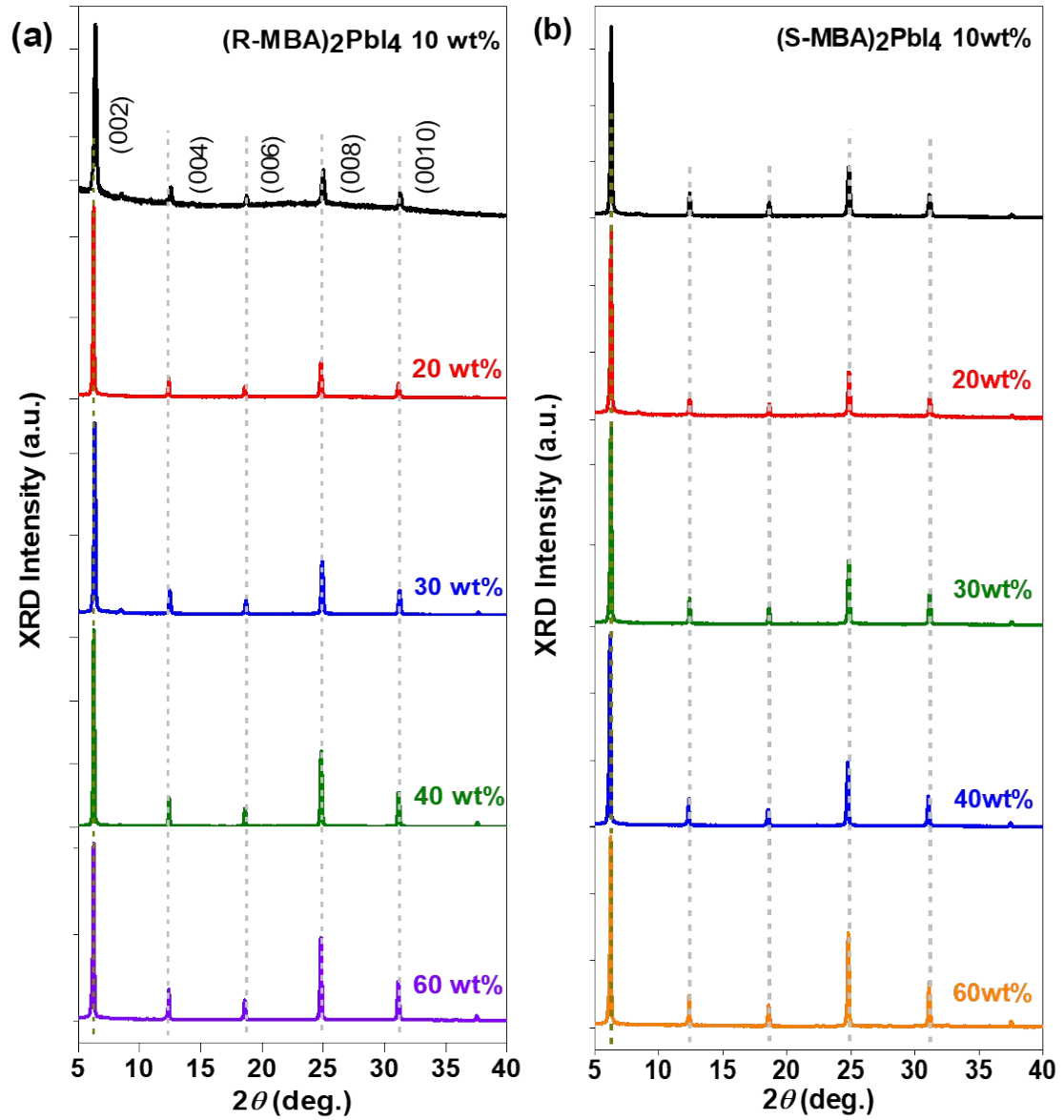
**S-Figure 1.** (a) The photographic image for the organic color needle-like single crystals  $(S\text{-MBA})_2\text{PbI}_4$  in the organic solvent. (b) The spin-coated  $(S\text{-MBA})_2\text{PbI}_4$  polycrystalline thin films after annealing. The w.t.% are 10, 20, 30, 40, 60 w.t.% respectively from left to right.



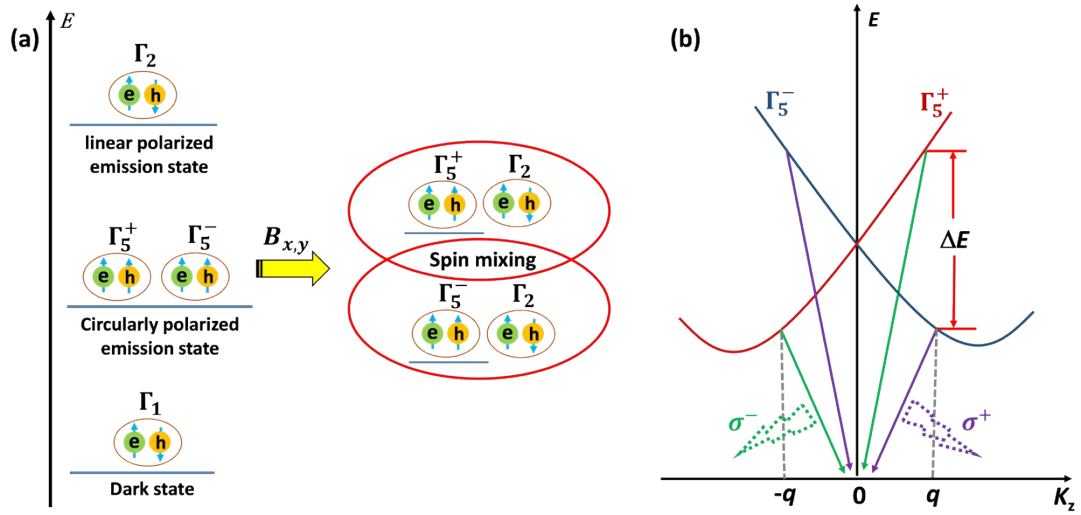
**S-Figure 2.** Experimental results of magneto-luminescence at 4 K due to the  $\sigma^+$  and  $\sigma^-$  photo-excitations for the  $(\text{S-MBA})_2\text{PbI}_4$  polycrystalline thin films. The films are fabricated by the precursors of different w.t.% such as (a) 10, (b) 20, (c) 30, (d) 40, (e) 60 w.t.%. (f) The comparison of the magneto-luminescence for the  $(\text{S-MBA})_2\text{PbI}_4$  thin films under the  $\sigma^+$  photo-excitation only at 4 K. The excitation wavelength is 405 nm.



**S-Figure 3.** Experimental results of temperature-dependent magneto-luminescence for (S-MBA)<sub>2</sub>PbI<sub>4</sub> thin films. The precursor solution concentration is 20 w.t.%. The photo-excitation wavelength is 405 nm.



**S-Figure 4.** Experimental results of XRD spectra for (a) (R-MBA)<sub>2</sub>PbI<sub>4</sub> and (b) (S-MBA)<sub>2</sub>PbI<sub>4</sub> thin films fabricated by different w.t.% such as 10, 20, 30, 40, and 60 w.t.%.



**S-Figure 5.** (a) Schematic illustration for the evolution of excitons states in LHP. (b) The dispersion relation of exciton states with the presence of CISOC.