Supporting Information

Manipulating Crystallization of Organolead Mixed-Halide Thin Films in Antisolvent Baths for Wide-Bandgap Perovskite Solar Cells

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Supplementary Figures

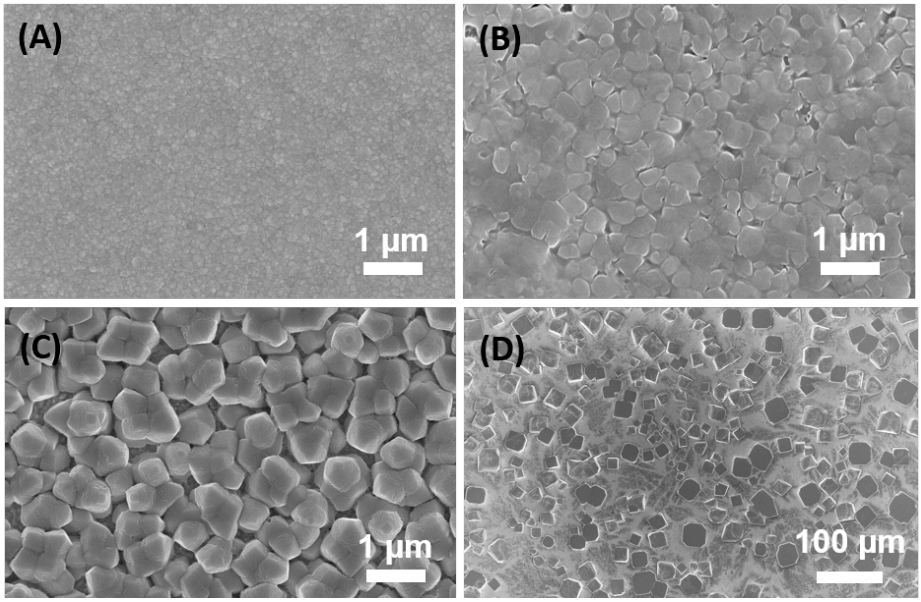

Figure S1. SEM Surface morphologies of the $MAPbI_3$ (A), $MAPbI_2Br$ (B), $MAPbIBr_2$ (C) and $MAPbBr_3$ (D) perovskite thin films as-formed in diethyl-ether (antisolvent) bath, showing enlargement of grains and reduced coverage with the increase of the Br content under the same processing condition. For the preparation of the film samples, a 42 wt% stoichiometric perovskite solution is used, and the procedure described Ref. 22 in the main text was followed. First, the precursor solution was spin-coated onto previously patterned fluorine-doped tin oxide (FTO) coated glass substrates, and the solution coated substrate was vertically dipped in an ~50 ml anhydrous diethyl-ether bath. The film was kept immersed for 2 min. The substrate was then taken out and dried rapidly with assistance of blowing N_2.

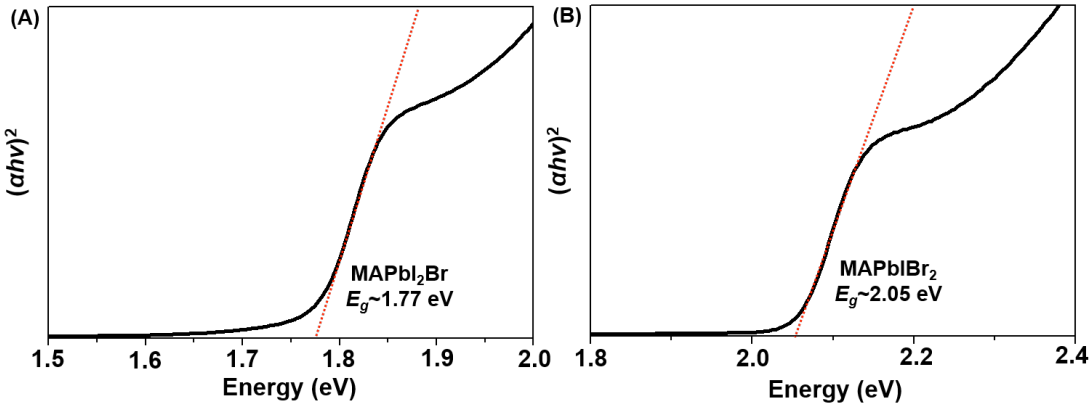

Figure S2. Tauc Plots of the as-prepared $MAPbI_2Br$ (A) and $MAPbIBr_2$ (B) perovskite thin films

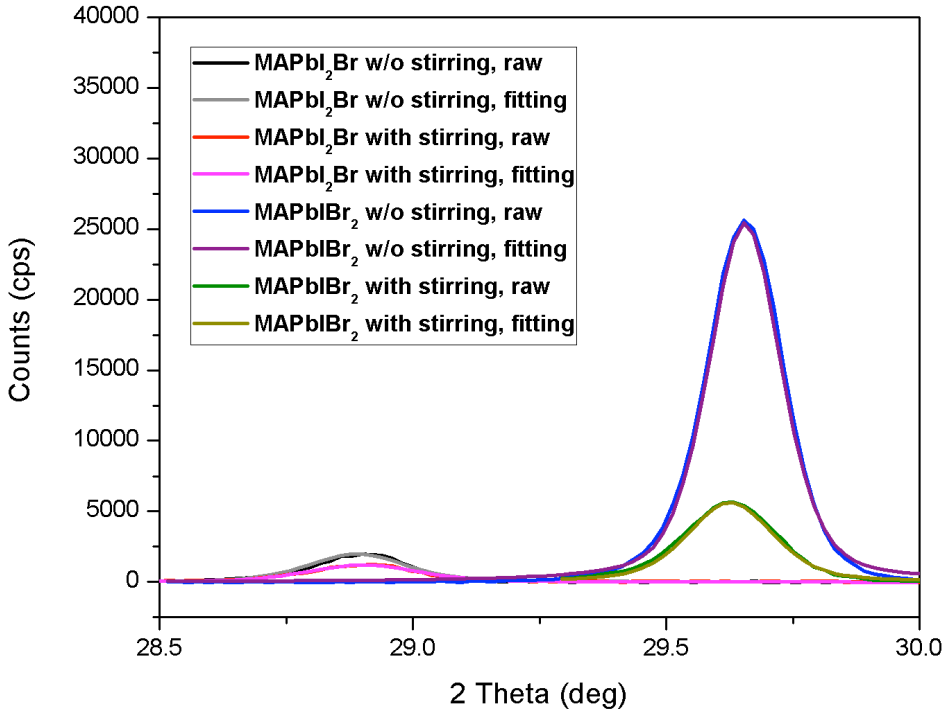

Figure S3. Fitting of (200) XRD peaks of $MAPbI_2Br$ and $MAPbIBr_2$ films made from antisolvent baths with or without stirring.

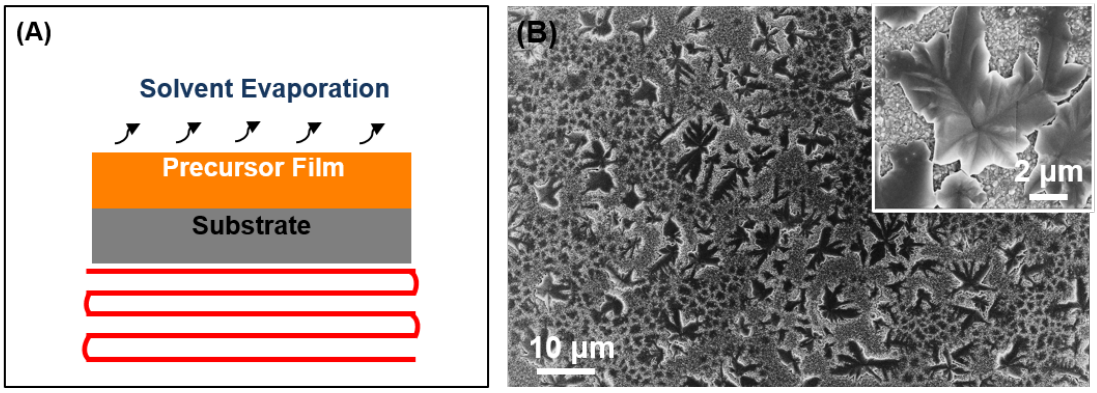

Figure S4. (A) Schematic representation of thermally-driven crystallization of organolead mixed halide perovskite using the conventional one-step method; (B) The resultant mixed halide ($MAPbI_2Br$) perovskite thin films showing poor coverage.

Table S1. Statistics of the photovoltaic performance parameters of PSCs based on $MAPbI_2Br$ and $MAPbIBr_2$ perovskite thin films fabricated with or without stirring.

		J_{SC} (mA cm^{-2})	V_{OC} (V)	FF	PCE (%)
$MAPbI_2Br$, with stirring	Average	15.21	1.091	0.64	10.56
	Std.*	0.09	0.026	0.02	0.52
$MAPbI_2Br$, w/o stirring	Average	14.73	1.080	0.57	9.13
	Std.*	0.57	0.017	0.04	0.78
$MAPbIBr_2$, with stirring	Average	8.26	0.985	0.55	4.46
	Std.*	0.21	0.023	0.05	0.36
$MAPbIBr_2$, w/o stirring	Average	4.17	0.887	0.51	1.90
	Std.*	0.25	0.111	0.05	0.31

* Standard deviation based on 8-12 cells.