Electronic Supplementary Material (ESI) for Materials Horizons.

Supplementary Information

New formation strategy of hybrid perovskites *via* room temperature reactive polyiodide melts

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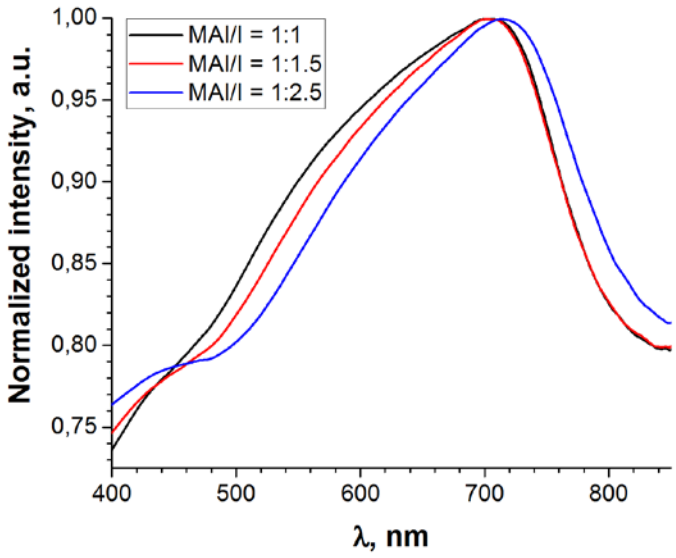

Figure S1. Absorption spectra of RPM with different composition ($MAI:I_2$).

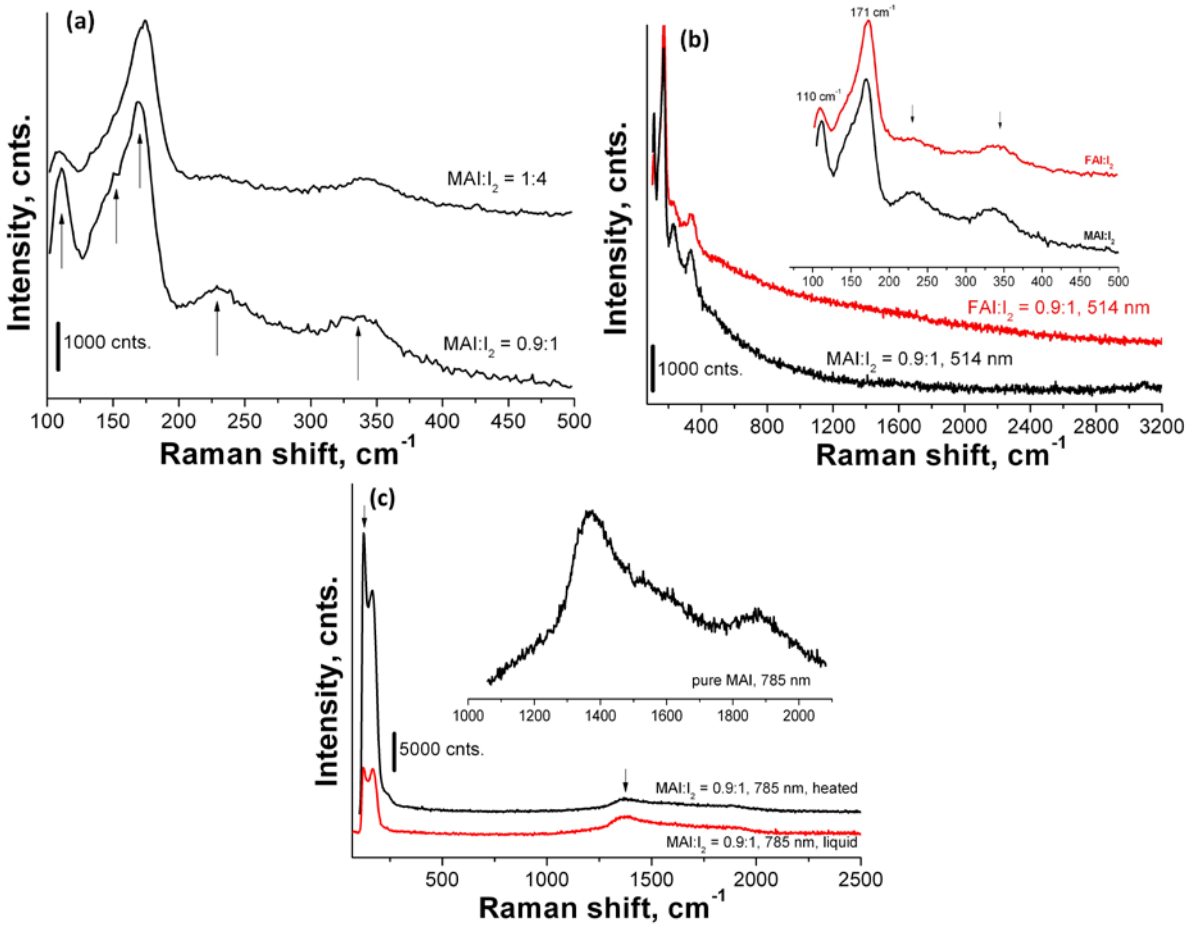

Figure S2. Local structure of RPM. (a) Comparison of resonant Raman spectra of the MAI/I_2 = 0.9:1 and 1:4 compositions (laser wavelength 514 cm^{-1}). Note that strong modes of the I_3^- ion (110, 169 cm^{-1}) are observed while the intensity of all the peaks are changed by iodine addition due to a contribution of other polyiodides and solvating molecular iodine, (b) basically similar resonant Raman spectra of RPM of the MAI/I_2 = 0.9:1 and FAI/I_2 = 0.9:1 compositions in the extended range, (c) a comparison of IR Raman spectra of RPM of the MAI/I_2 = 0.9:1 composition before and after iodine sublimation by drying (laser wavelength 785 cm^{-1}). The arrows indicate peaks of the MA^+ constituent.

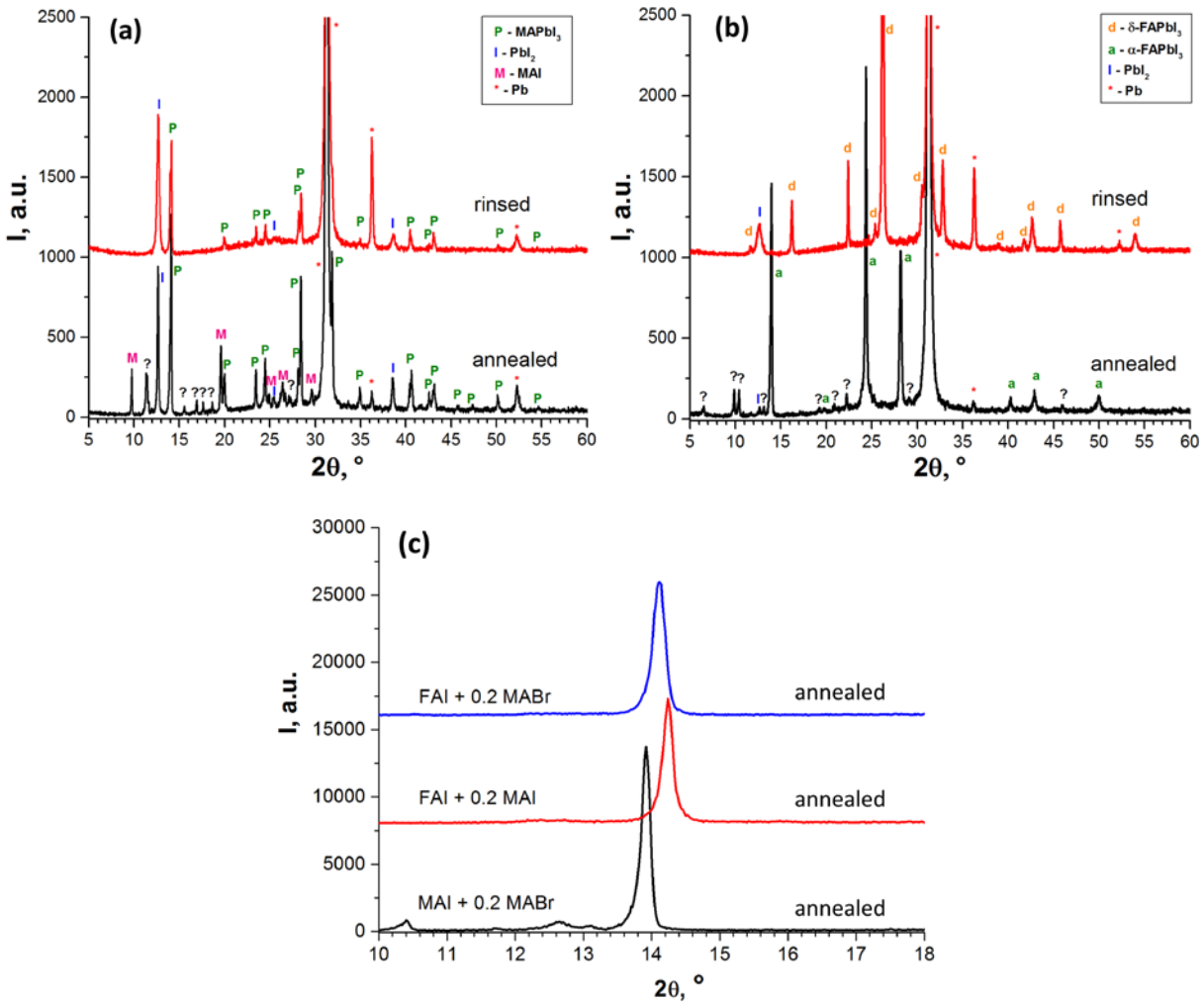

Figure S3. XRD of the films annealed at 115°C for 10 minutes after spin-coating and XRD of the films rinsed with isopropanol after spin-coating for comparison. (a) $MAPbI_3$ film obtained from RPM of FAI-I_2, (b) $FAPbI_3$ film obtained from RPM of FAI-I_2, (c) films with mixed compositions.

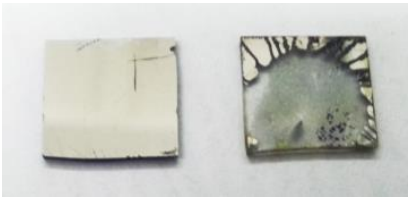

Figure S4. 50 nm thickness film of lead treated with MAI_{3+x} for 15 seconds.

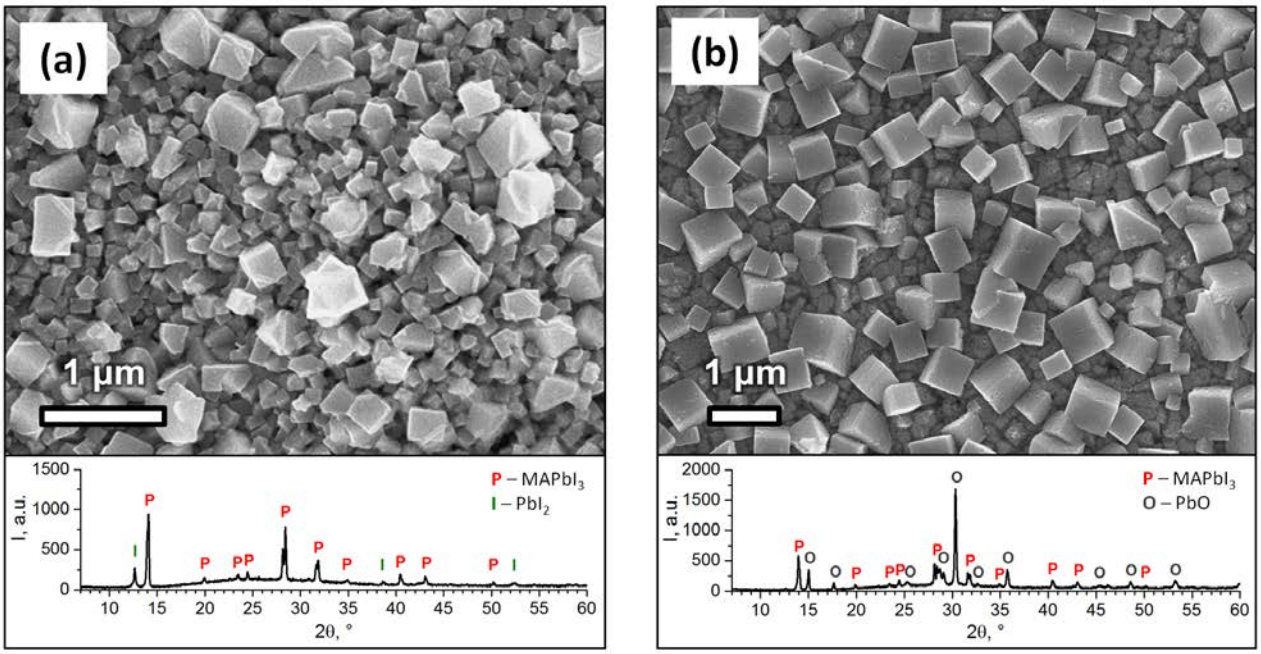

Figure S5. SEM and XRD of perovskite $MAPbI_3$ films obtained by reactions of MAI_{3+x} with PbI_2 film (a) and PbO film (b).

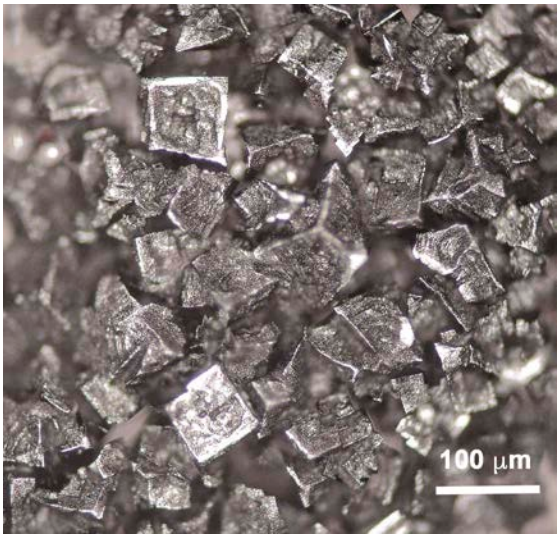

Figure S6. Perovskite $MAPbI_3$ crystals obtained through an iodine evaporation from the sample #4.

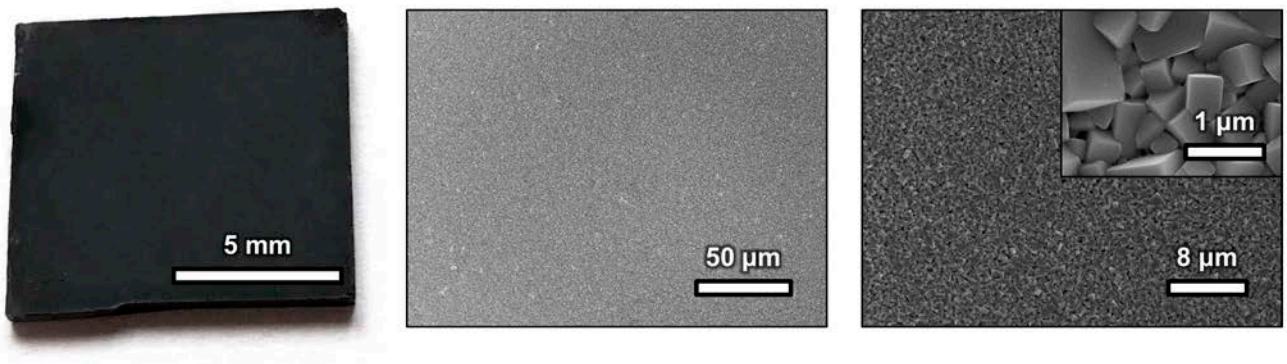

Figure S7. Perovskite $MAPbI_3$ obtained by reaction of MAI_{3+x} with 200 nm thickness film of lead.

Table S1. Charge carrier lifetimes in perovskite films obtained from the melts with various compositions.

Melt composition (X/I_2 = 1:2)	**Charge carrier lifetimes**	
	τ_1	**τ_2**
X = MAI	66 ns (29%)	210 ns (71%)
X = 0.8 MAI + 0.2 MABr	2 ns (83%)	13 ns (17%)
X = 0.8 FAI + 0.2 MAI	50 ns (45%)	190 ns (55%)
X = 0.8 FAI + 0.2 MABr	44 ns (55%)	164 ns (45%)