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Understanding the effect of light and temperature on the optical properties and stability of mixed-ion halide perovskites

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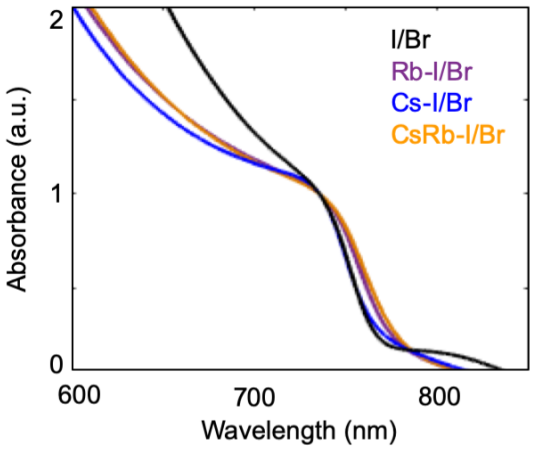
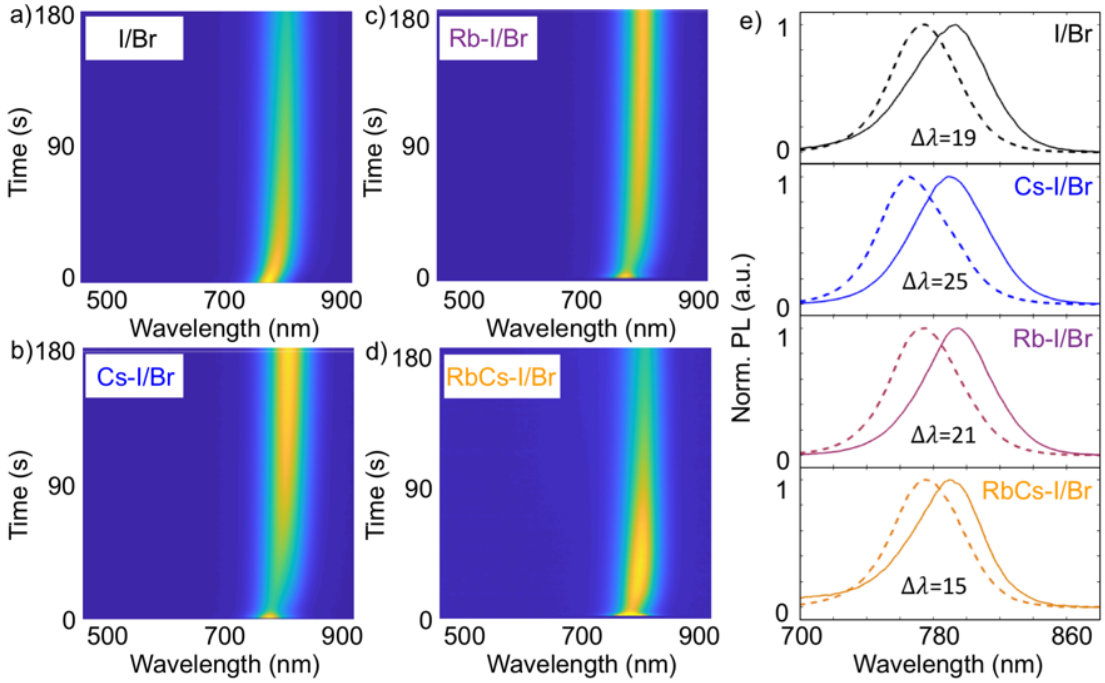


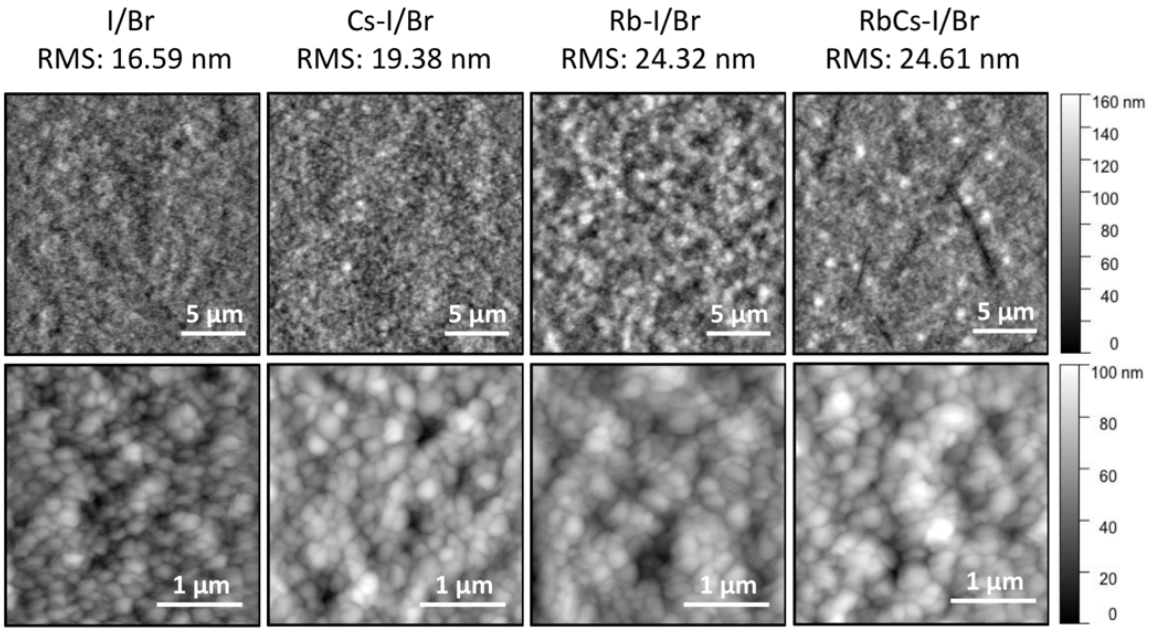
S1. Absorbance spectra of the pristine I/Br perovskite film and I/Br films doped with 5% Cs, 5% Rb or a mixture thereof at room temperature.



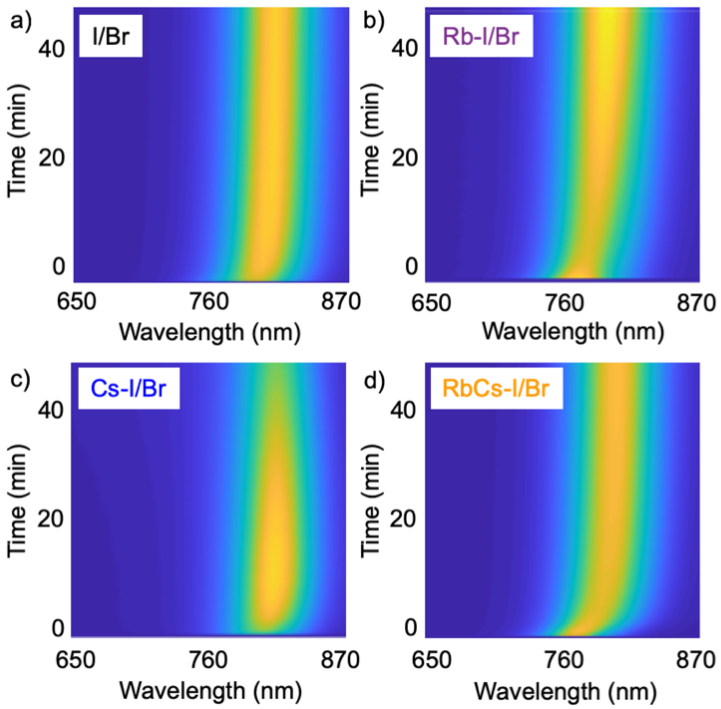
S2. a)-d) Waterfall plots showing the evolution of the PL intensity over time of the four different films under continuous steady-state illumination. The spectra are taken every 2 s for a total time of 3 min under 405 nm illumination at a power density of ~5 W/cm^2. The intensity gradient is shown from a low PL intensity (blue) to high PL intensity (yellow). e) PL spectra of the initial PL at t = 2 s (dashed lines) and after t = 180 s (solid lines) showing the shift of the PL peak due to halide segregation.

Table 1. Lattice parameters of the samples (cubic symmetry).

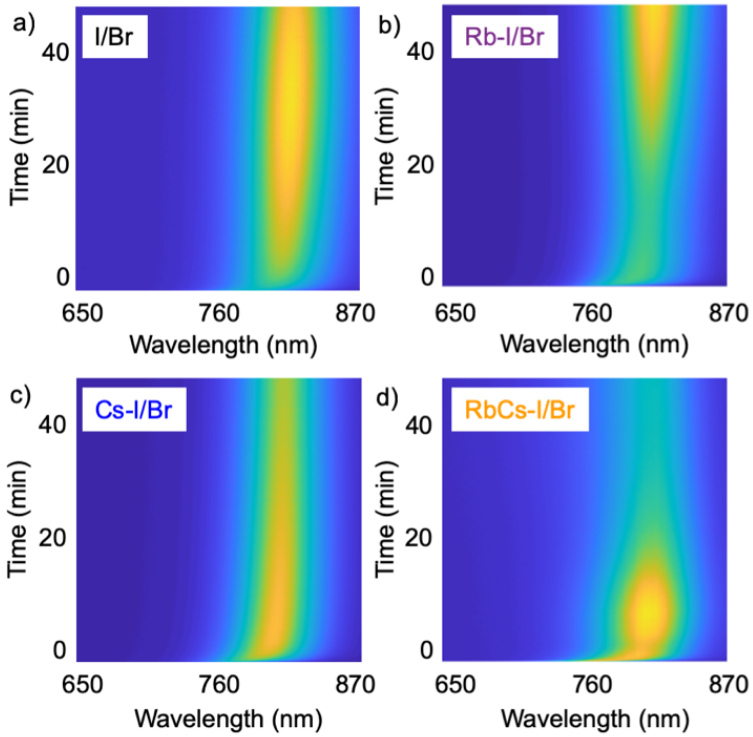
	a (Å)	Standard deviation
I/Br	6.26378	0.002413
Rb-I/Br	6.27449	0.003738
Cs-I/Br	6.26766	0.000605
RbCs-I/Br	6.27554	0.0002413



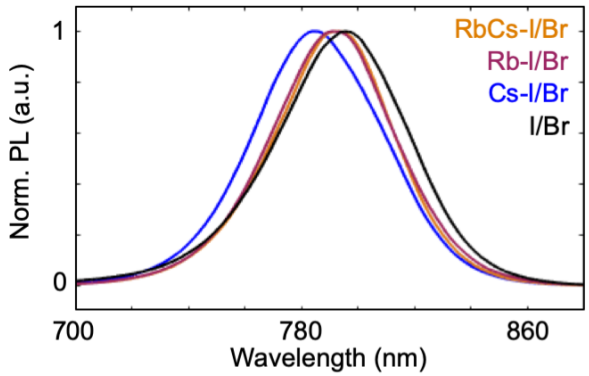
S3. AFM topography images of the different films. The first row shows an overview image of each film. The bottom row is a close up image to get insight into the grain distribution.



S4. Waterfall plots of the steady-state PL for the different films without temperature for the a) I//Br, b) Rb-I/Br, c) Cs-I/Br, and d) RbCs-I/Br samples. The PL spectra are taken every 2 s for a total time of 45 min. A continuous 405 nm laser with an incident power of 600 μW (~5 W/cm^2) was used. The intensity gradient is shown from a low PL intensity (blue) to a high PL intensity (yellow). A red-shift in the initial perovskite PL is observed to higher wavelength upon illumination.



S5. Waterfall plots of the steady-state PL for the different films after heating to 85 °C for 45 min for the a) I//Br, b) Rb-I/Br, c) Cs-I/Br, and d) RbCs-I/Br samples. The PL spectra are taken every 2 s for a total time of 45 min. A continuous 405 nm laser with an incident power of 600 µW (~5 W/cm^2) was used. The intensity gradient is shown from a low PL intensity (blue) to a high PL intensity (yellow).



S6. PL of the four films after the samples were heated and illuminated (compare Figure 2 main text) and stored overnight. The PL peak positions of the four different films is comparable to the initial peak PL position of the pristine films.