Bidirectional Halide Ion Exchange in Paired Lead Halide Perovskite Films with Thermal Activation

MAPbBr$_3$ and MAPbI$_3$ films cast onto glass slides and physically paired together undergo halide exchange to form mixed halide films. The change in halide composition in these two ~130 nm thick films occurs concurrently with Br$^-$ diffusing toward the MAPbI$_3$ film and I$^-$ diffusing toward the MAPbBr$_3$ film. The diffusion of these halide species, which is tracked through changes in the absorption, offers a direct measurement of thermally activated halide diffusion in perovskite films. The increase in the rate constant of halide diffusion with increasing temperature (from 8.3 × 10$^{-6}$ s$^{-1}$ at 23 °C to 3.7 × 10$^{-4}$ s$^{-1}$ at 140 °C) follows an Arrhenius relationship with activation energy of 51 kJ/mol. The thermally activated halide exchange shows the challenges of employing layers of different metal halide perovskites in stable tandem solar cells.

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