Supporting Information

Single-phase Alkylammonium Cesium Lead Iodide Quasi-2D Perovskite for Color-tunable and Spectrum-stable Red LEDs

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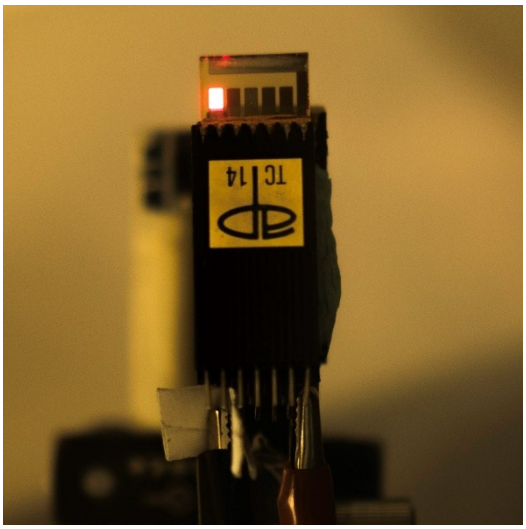

Figure S1. Photograph of $PA_2CsPb_2I_7$ PeLED (100 °C) under operation.

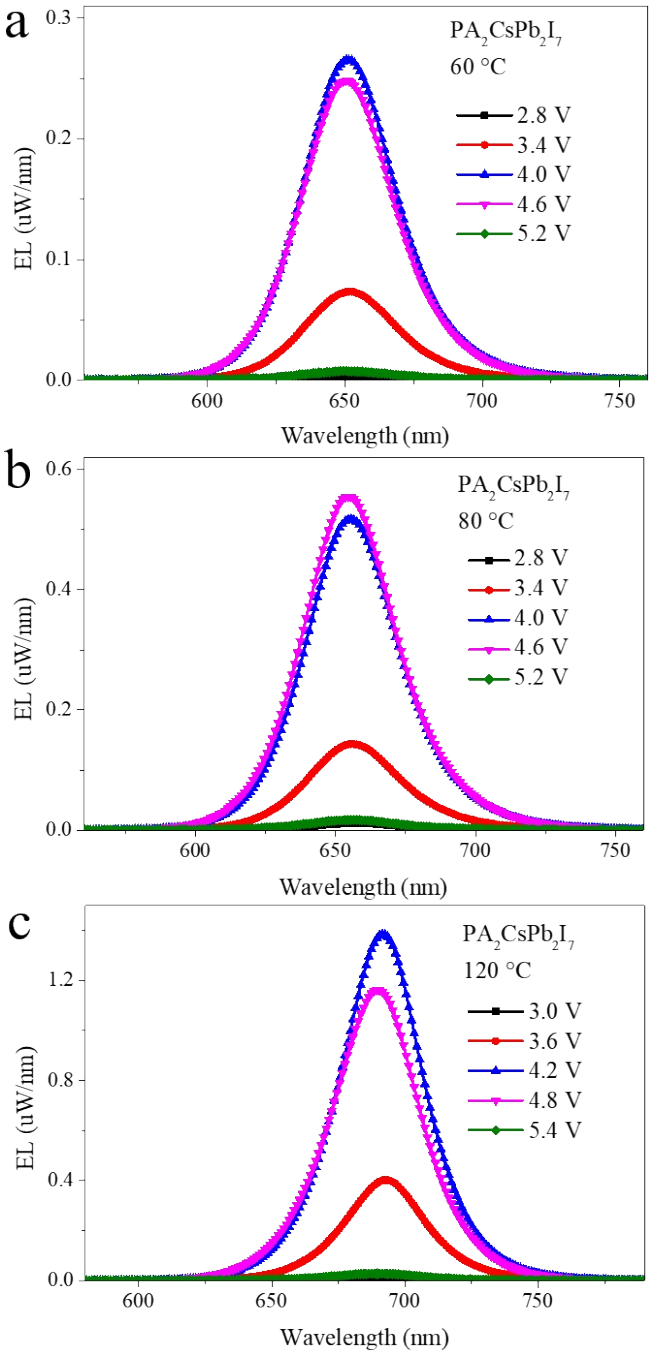

Figure S2. Voltage-dependent EL spectra of $PA_2CsPb_2I_7$ PeLEDs annealed at a) 60 °C, b) 80 °C, and c) 120 °C.

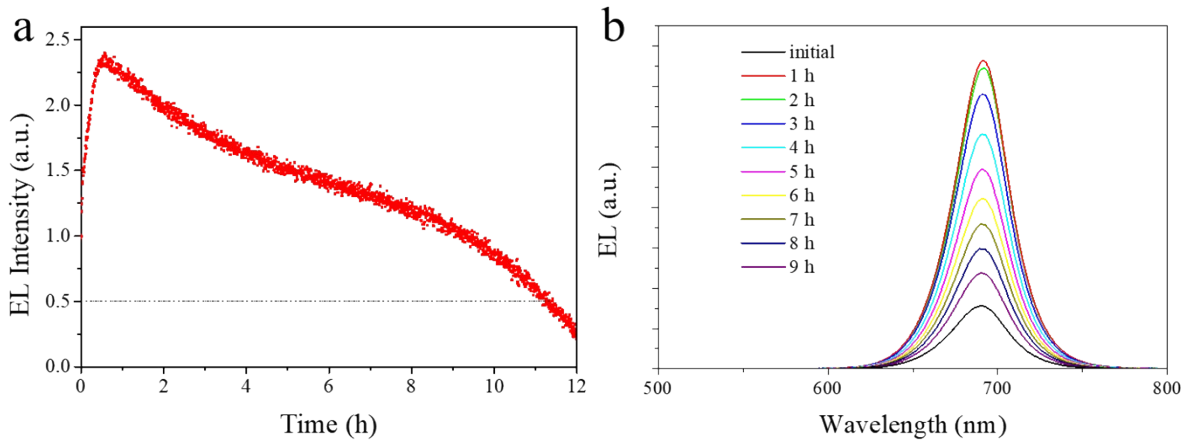

Figure S3. Device stability test of $PA_2CsPb_2I_7$ PeLEDs annealed 120 °C: a) EL intensity (I/I_0) against time; b) EL spectrum measured at different operation time. Measurement was carried out at a fix current density of 10 mA/cm^2 in glove box without encapsulation.

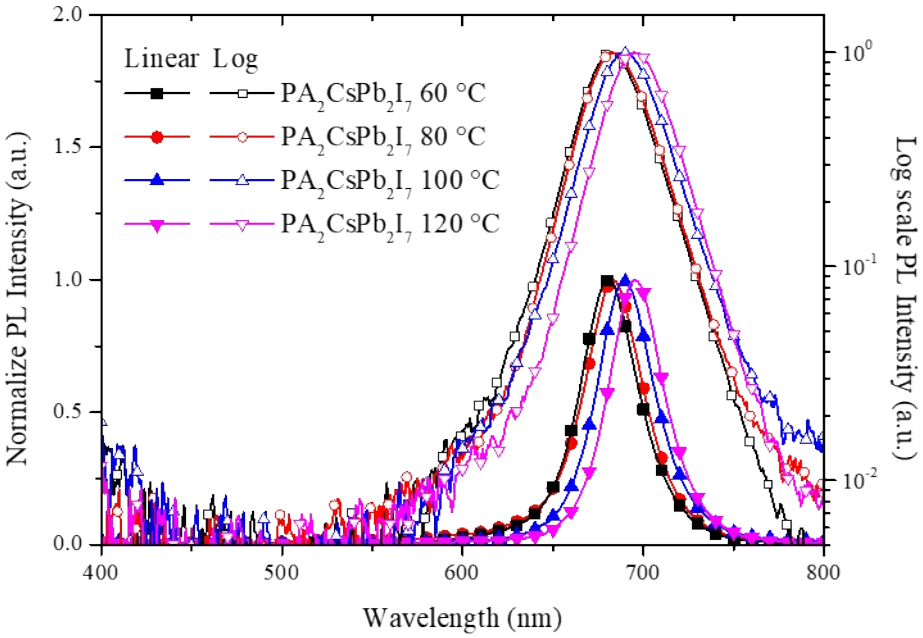

Figure S4. PL of $PA_2CsPb_2I_7$ thin films in linear and log scale.

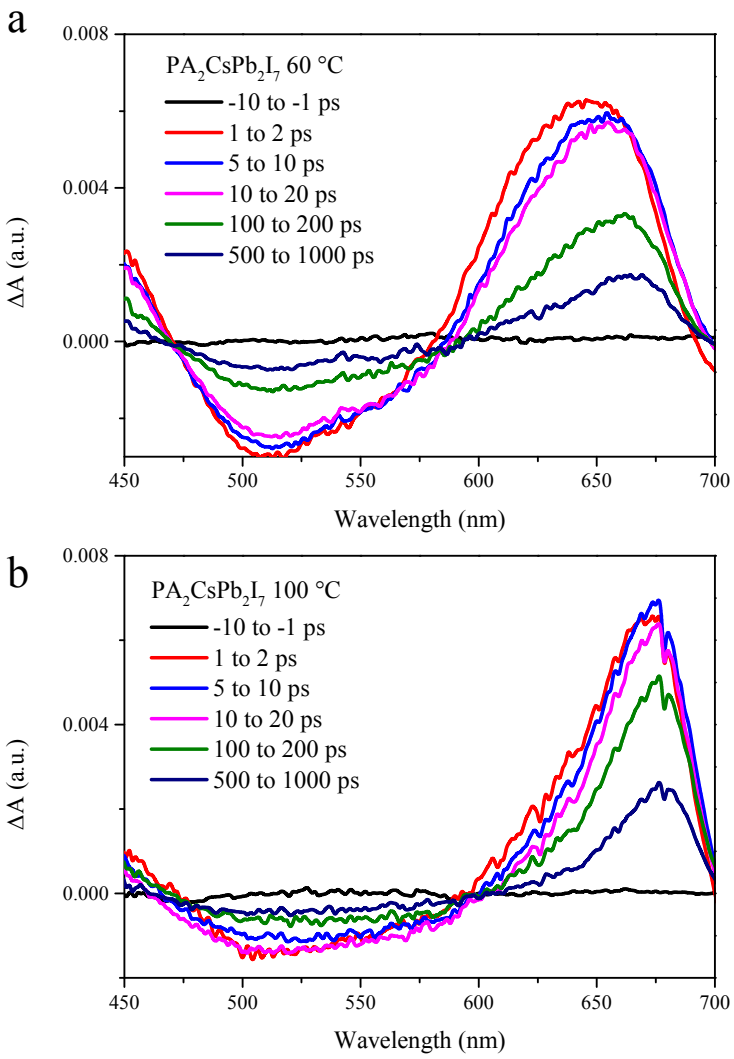

Figure S5. TA spectra of $PA_2CsPb_2I_7$ thin films annealed at 60 and 100 °C.

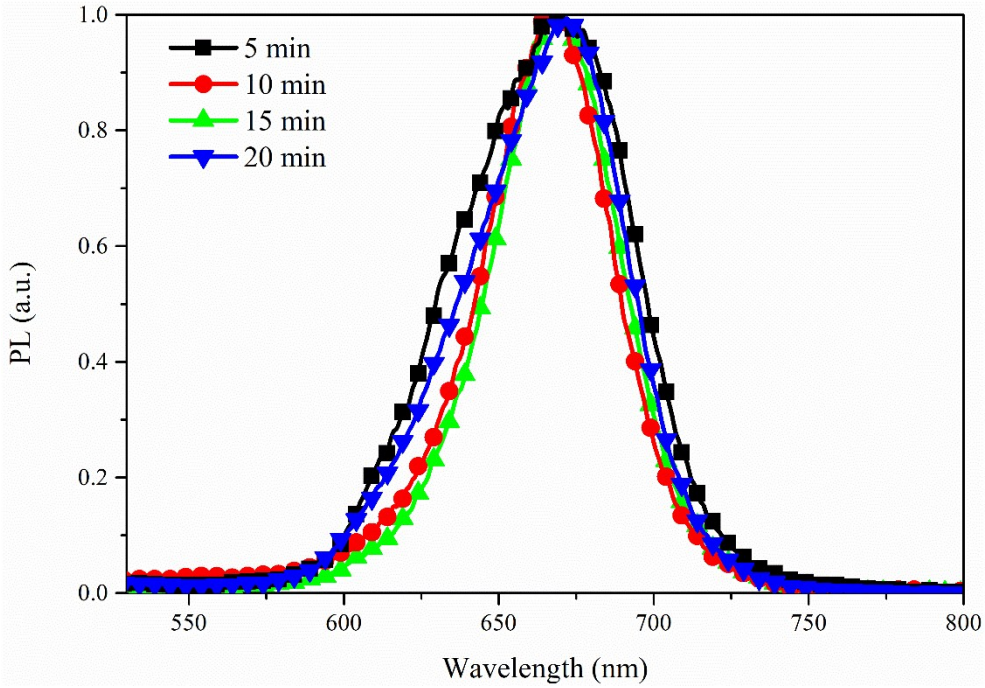

Figure S6. PL spectra of $PA_2CsPb_2I_7$ PeLEDs annealed 100 °C with different annealing times.

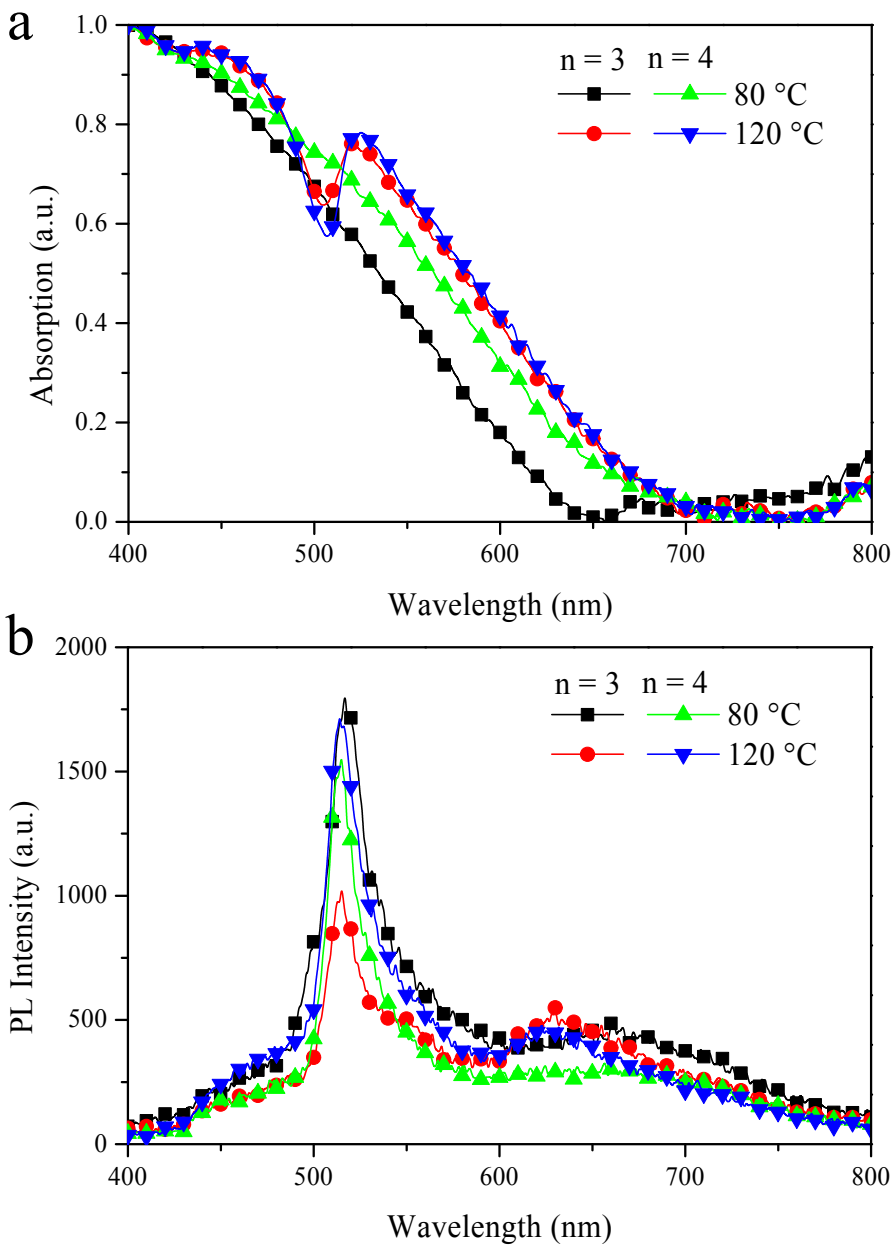

Figure S7. Absorption (a) and PL (b) spectra of $PA_2Cs_2Pb_3I_{10}$ (n = 3) and $PA_2Cs_3Pb_4I_{13}$ (n = 4) thin films.

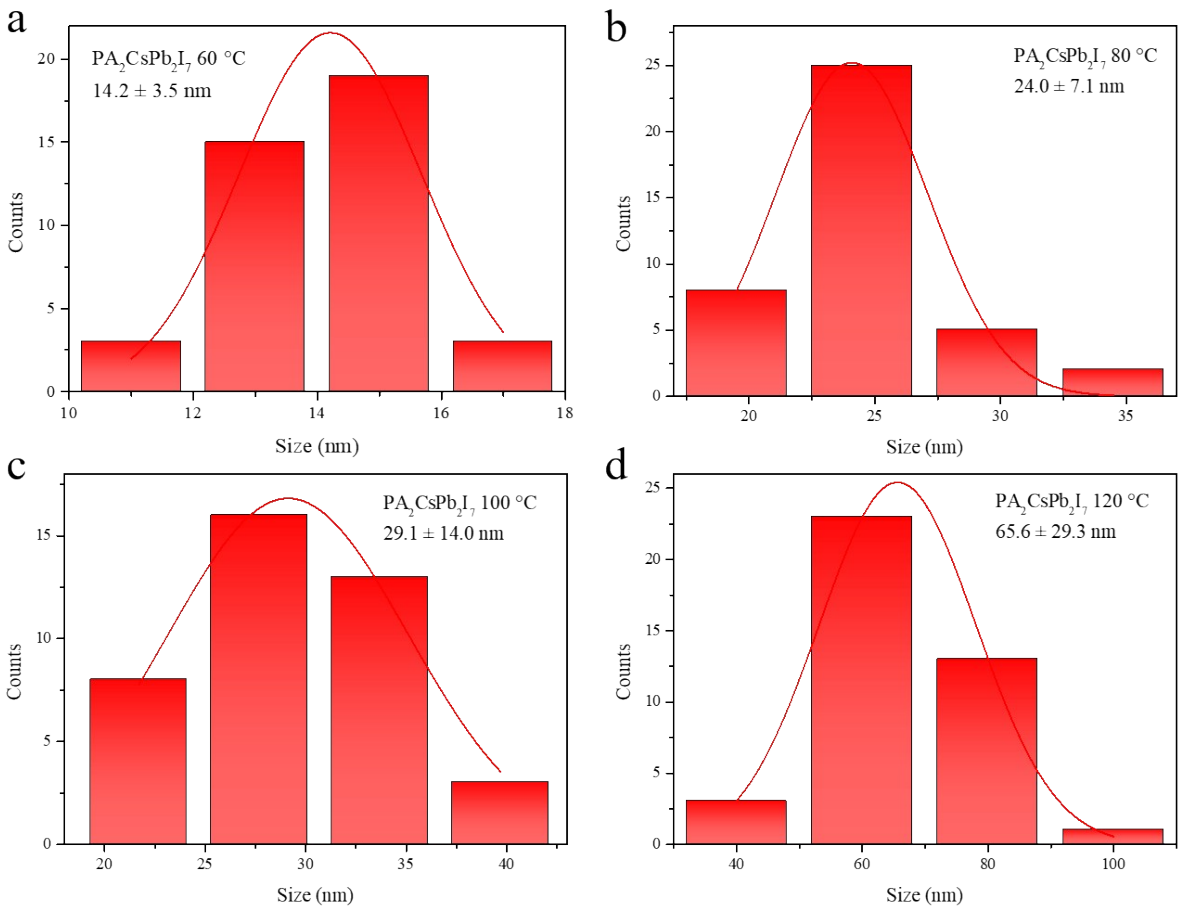

Figure S8. Histograms of grain size distribution for $PA_2CsPb_2I_7$ thin films annealed at 60 °C, 80 °C, 100 °C, and 120 °C, respectively. The grain size was measured by the grain edge length in the SEM images.

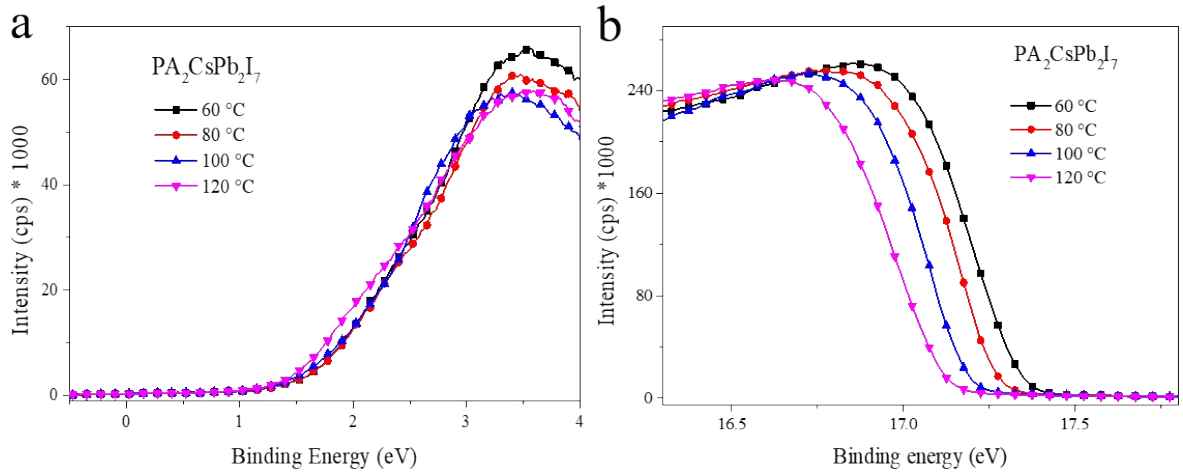

Figure S9. Ultraviolet photoelectron spectroscopy (UPS) results of $PA_2CsPb_2I_7$ thin films (60 °C, 80 °C, 100 °C, and 120 °C) on ITO substrate. Valance band maximum of $PA_2CsPb_2I_7$ gradually reduced with increased annealing temperature.

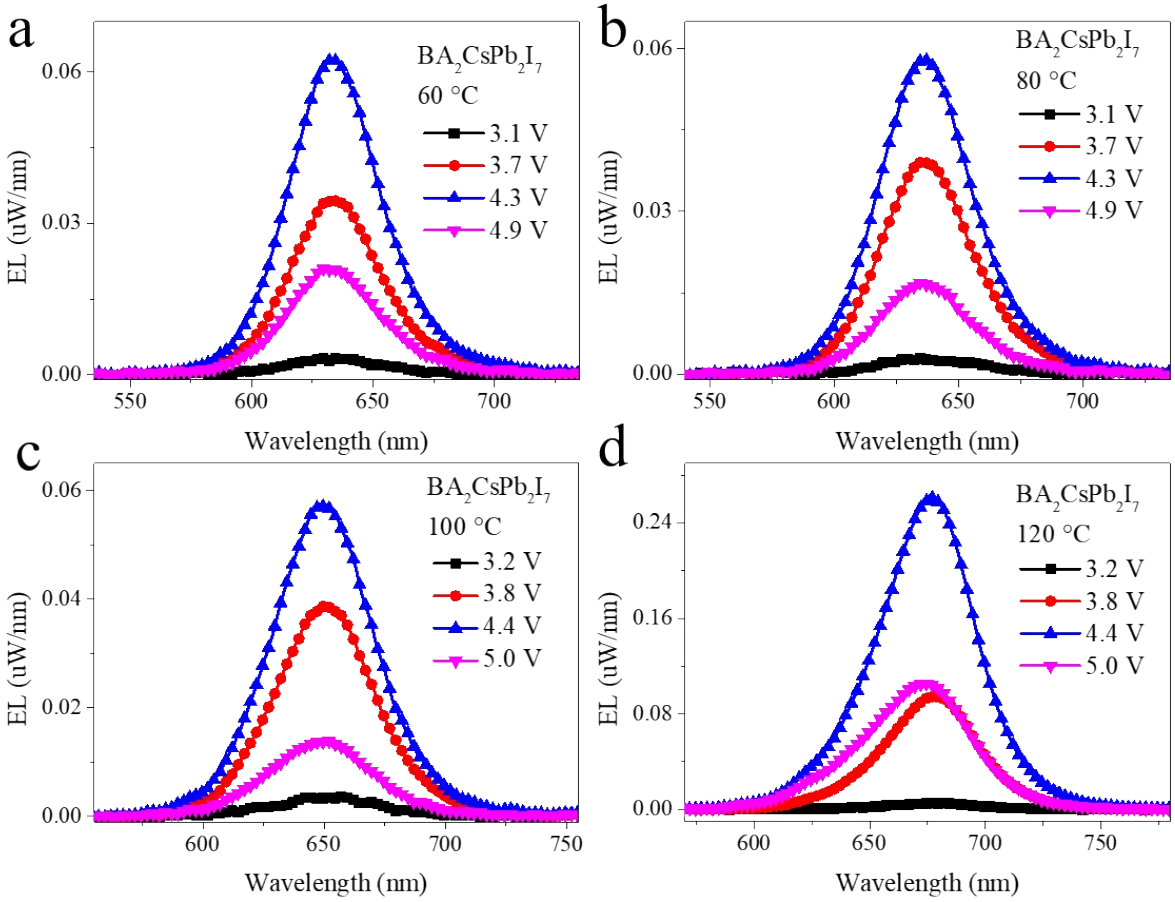

Figure S10. Voltage-dependent EL spectra of $BA_2CsPb_2I_7$ PeLEDs (60 °C (a), 80 °C (b), 100 °C (c), and 120 °C (d)).

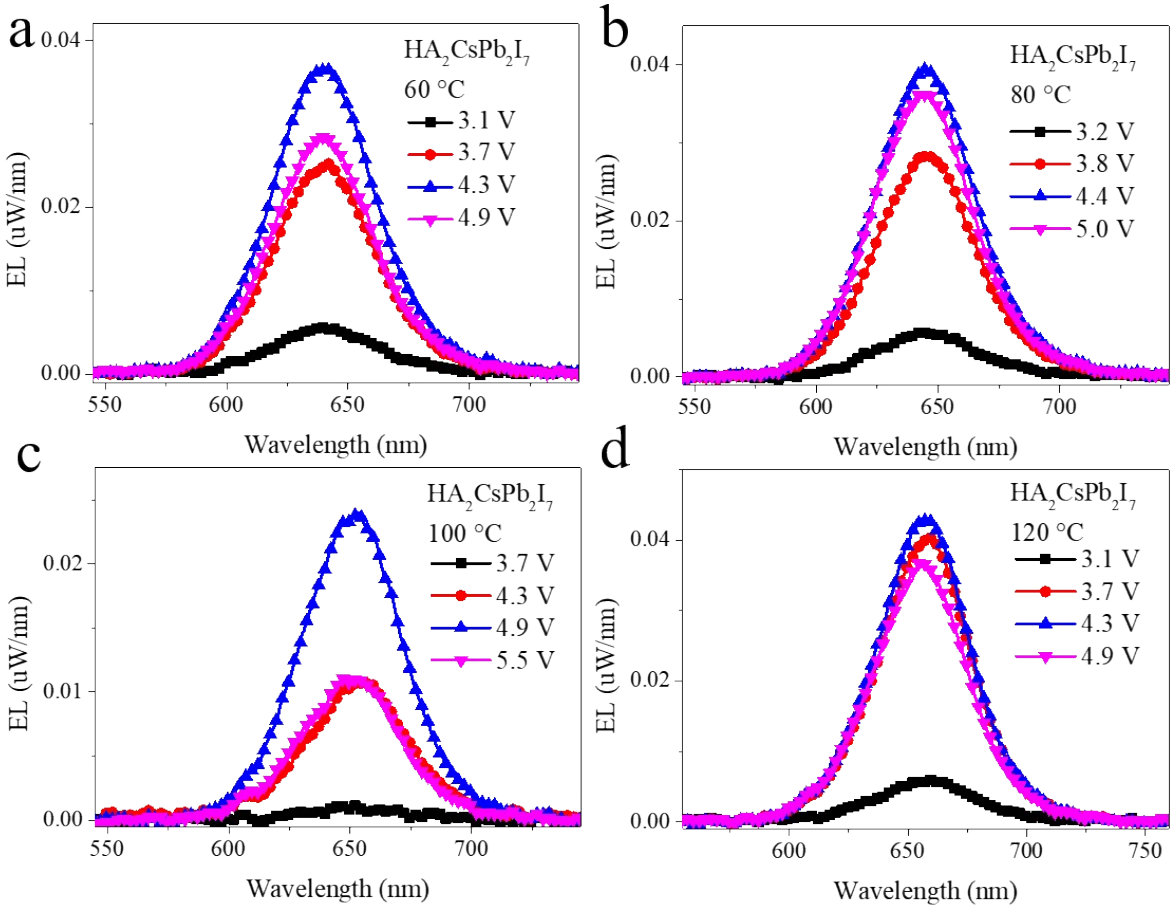

Figure S11. Voltage-dependent EL spectra of $HA_2CsPb_2I_7$ PeLEDs (60 °C (a), 80 °C (b), 100 °C (c), and 120 °C (d)).

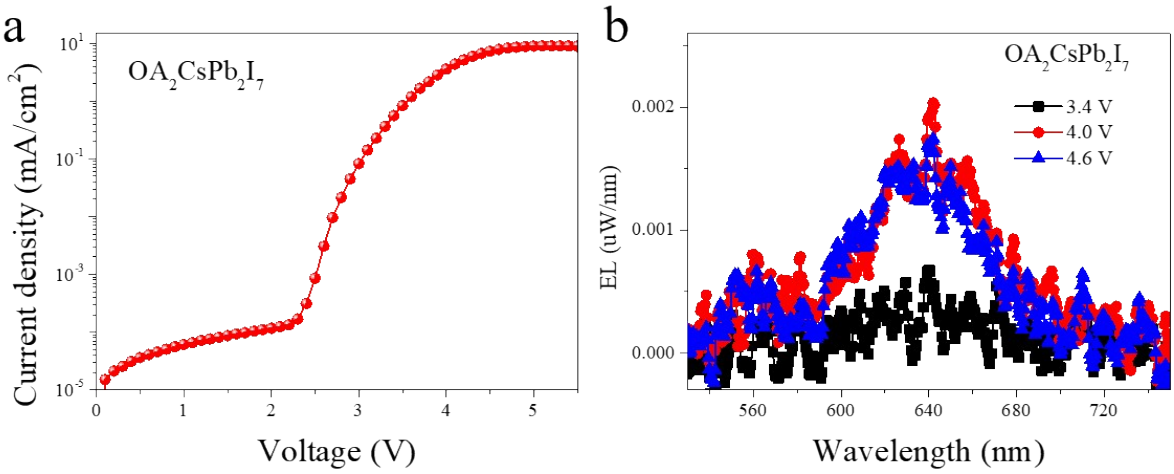

Figure S12. a) Current density-voltage curve and b) EL spectra of $(C_6H_{13}NH_3)_2CsPb_2I_7$ ($OA_2CsPb_2I_7$) PeLEDs.