

Supporting information

Dimensional Tailoring of Ultrahigh Vacuum Annealing-Assisted Quantum Wells for the Efficiency Enhancement of Perovskite Light Emitting Diodes

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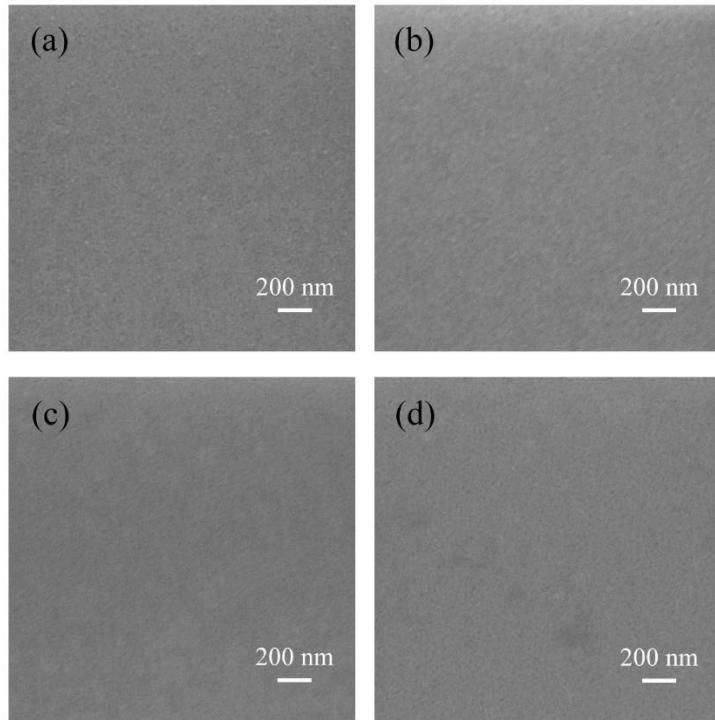


Figure S1. SEM images of perovskite films prepared from (a) Film-I, (b) Film-II, (c) Film-III and (d) Film-IV.

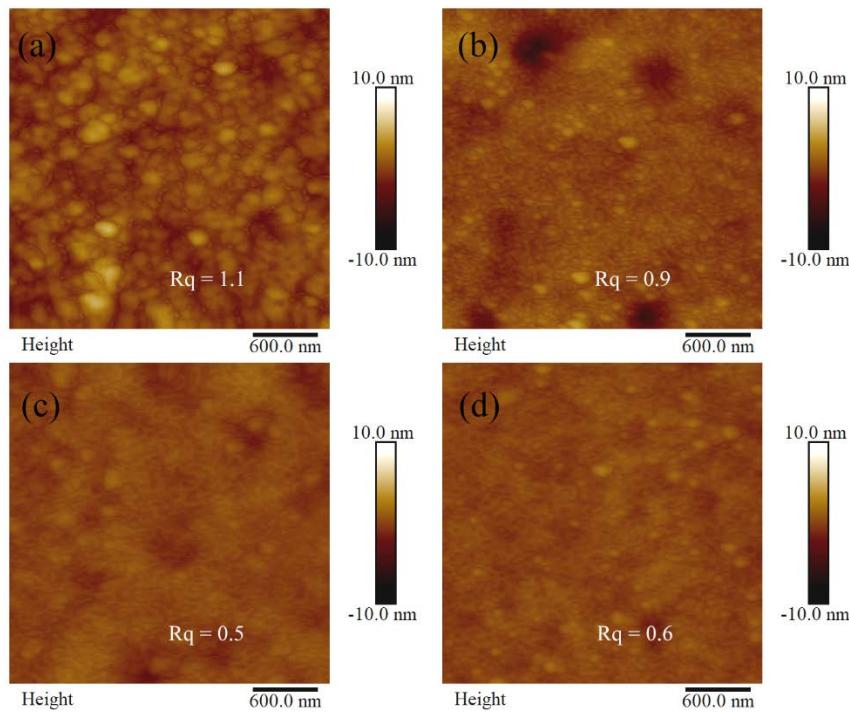


Figure S2. AFM images of perovskite films prepared from (a) Film-I, (b) Film-II, (c) Film-III and (d) Film-IV.

Table S1. PL decay time extracted from biexponential decay fitting and PLQY value.

	τ_1 (ns)	τ_2 (ns)	τ_{av} (ns)	PLQY(%)
Film-I	11.1	233.3	71.9	19.2
Film-II	16.1	43.1	52.6	31.6
Film-III	7.6	22.9	46.6	37.1
Film-IV	10.8	36.3	53.1	33.5

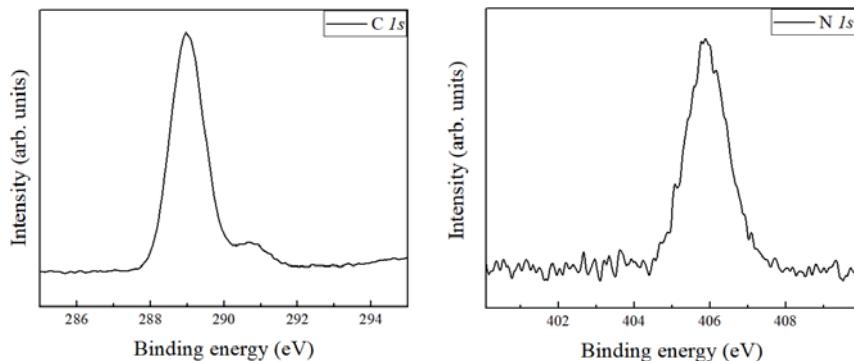


Figure S3. XPS core level spectra derived from pure NMAI

Table S2. XPS Binding energy (eV) of different elements referenced to the vacuum level.

	Naphthy l-C	Naphthylmeth yl-C	FA-C	FA-N	Naphthylmethyl -N	Pb $4f_{5/2}$	I $3d_{5/2}$
Film-I	289.0	290.8	292.5	404.6	406.3	147.3	623.2
Film-II	289.0	290.7	292.4	404.6	406.3	147.3	623.2
Film-III	289.0	290.6	292.3	404.6	406.3	147.3	623.2
Film-IV	289.0	290.5	292.3	404.6	406.2	147.3	623.2

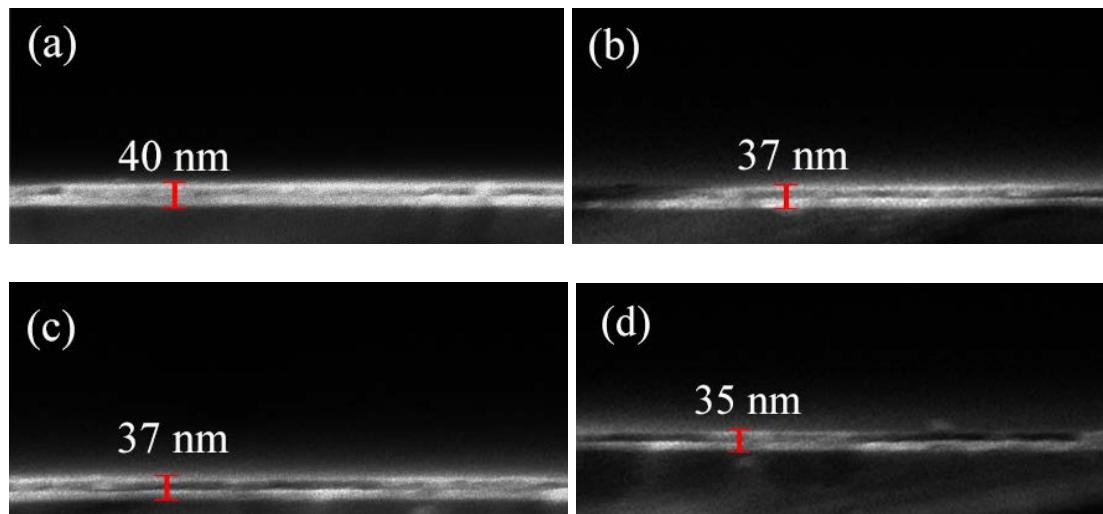


Figure S4. Cross-sectional SEM image of perovskite films, (a) Film-I, (b) Film-II, (c) Film-III and (d) Film-IV.

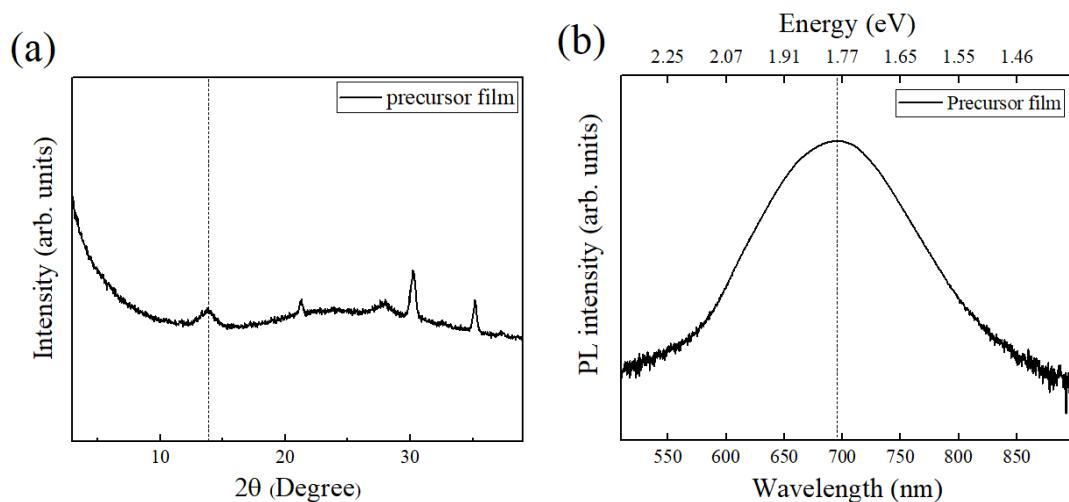


Figure S5. (a) XRD pattern and (b) PL emission of pristine perovskite film.

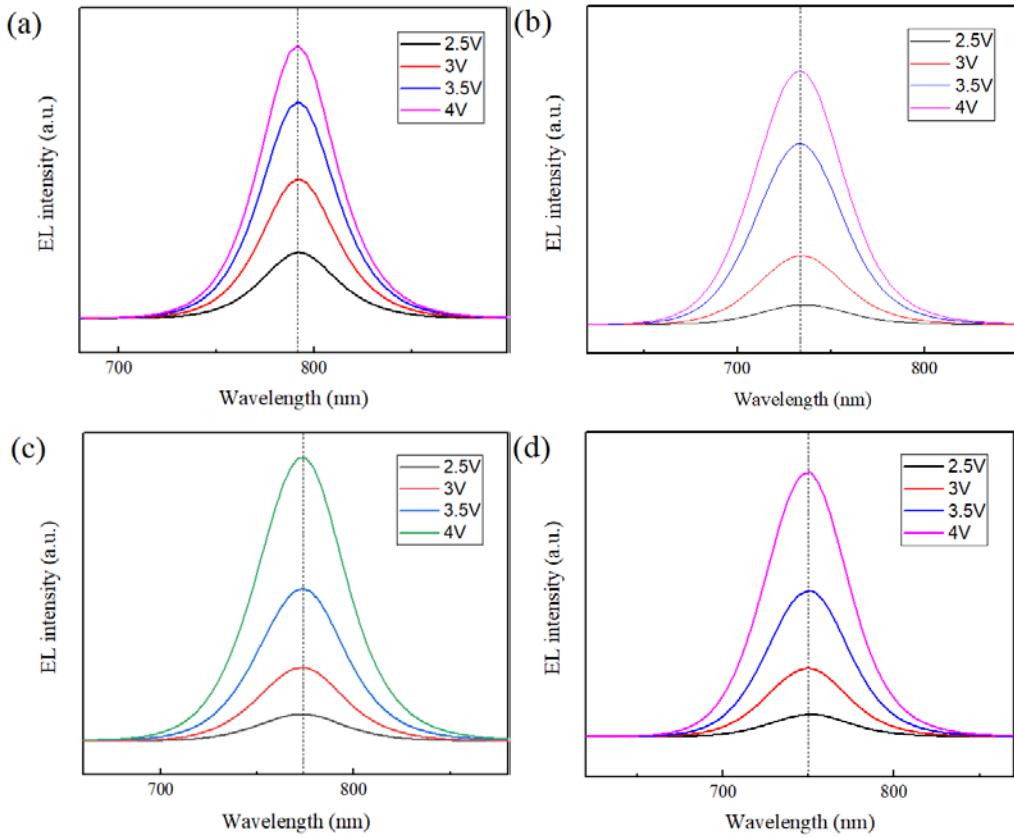


Figure S6. EL spectra of PLED devices obtained at various voltages from (a) Film-I, (b) Film-II, (c) Film-III and (d) Film-IV.

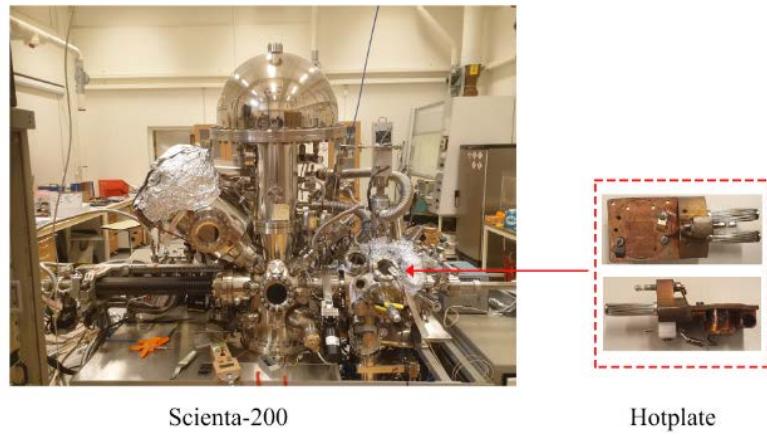


Figure S7. A picture of the ultra-high vacuum annealing hotplate mounted in Scieinta-200 preparation chamber with pressure (10^{-8} mbar).