Supporting Information

Efficiently Passivated PbSe Quantum Dot Solids for Infrared Photovoltaics

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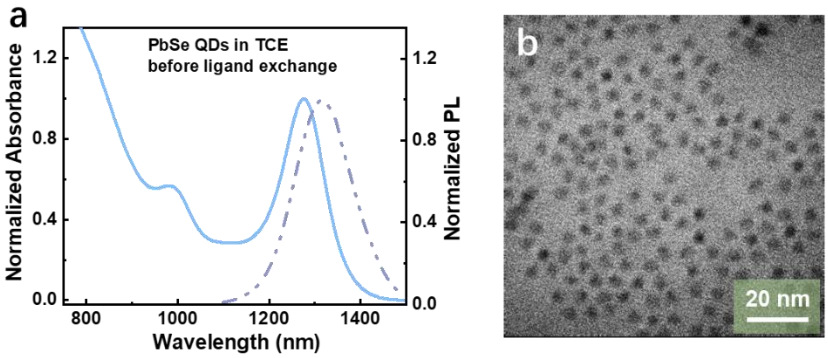

Figure S1. (a) Absorbance and PL spectra of the synthetic PbSe QDs in solution before ligand exchange. (b) The TEM image for PbSe QDs before ligand exchange. The average diameter of PbSe QDs could be around 4 nm.

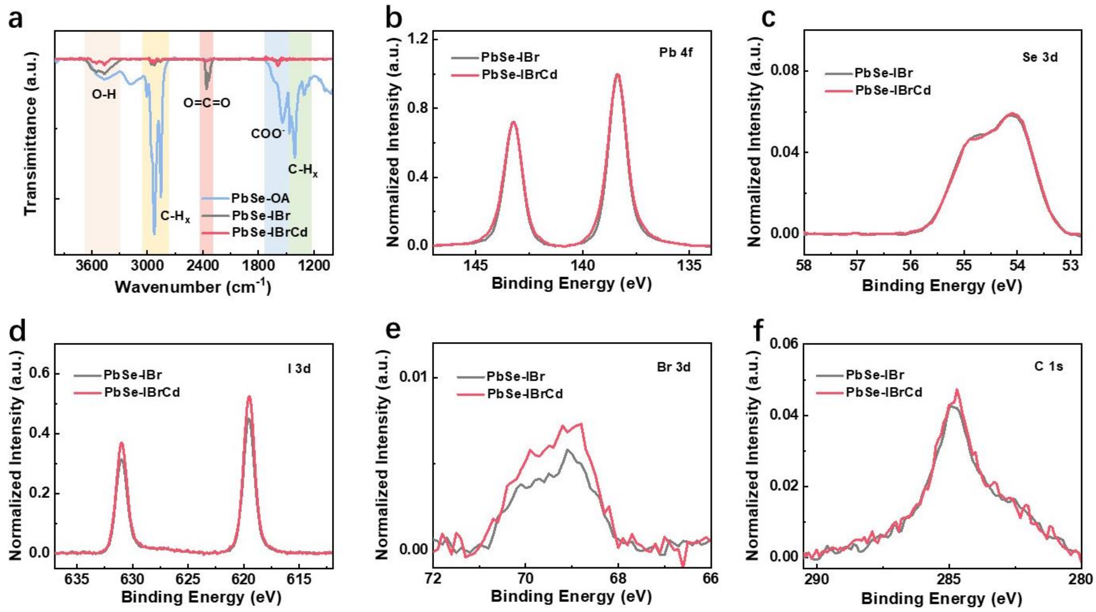

Figure S2. (a) FT-IR spectra of PbSe QDs capped with OA, bare halogen anion (I, Br) or hybrid ligand (I, Br, Cd). XPS spectra of the (b) Pb 4f, (c) Se 3d, (d) I 3d, (e) Br 3d and (f) C 1s for PbSe-IBr and PbSe-IBrCd ([Cd] = 40 mM) QD films.

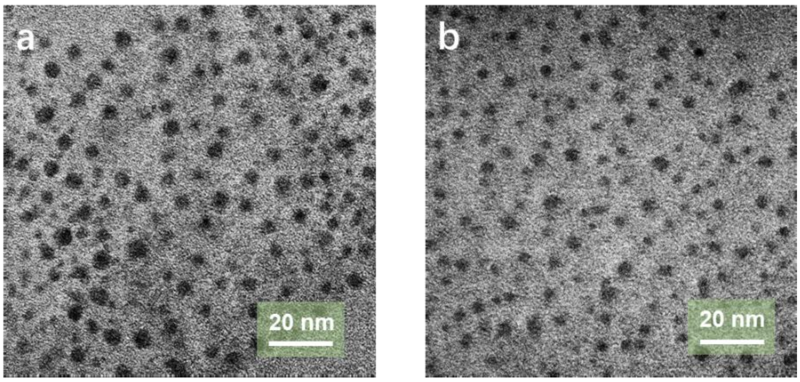

Figure S3. The TEM images for (a) PbSe-IBr QDs and (b) PbSe-IBrCd QDs ([Cd]=40 mM).

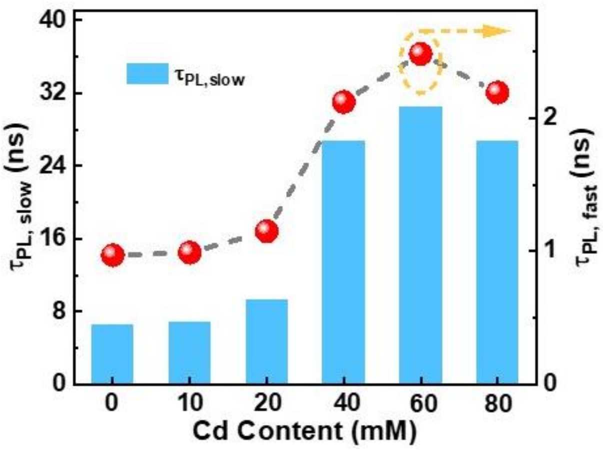

Figure S4. Fast and slow components of the PL decay fitted using the double exponentials. The fast component indicates the exciton dissociation, and the slow component is relevant with charge trapping.

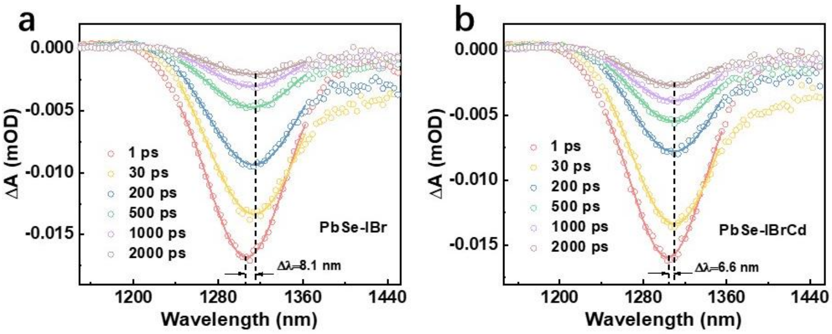

Figure S5. TA spectra of (a) PbSe-IBr and (b) PbSe-IBrCd QD films at various delay times.

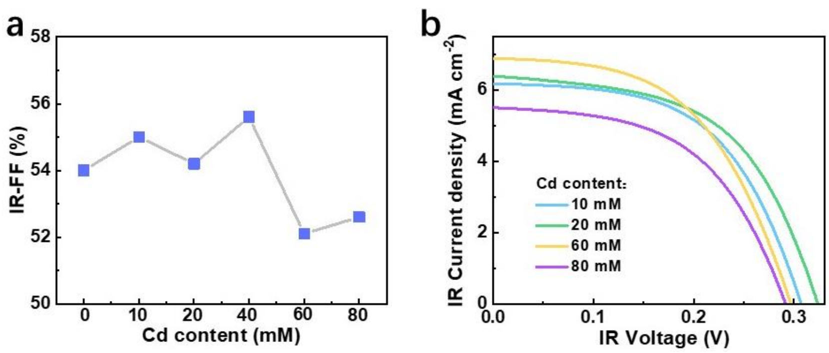

Figure S6. The 1100 nm-filtered (a) IR-FF and (b) *J-V* curves for PbSe QD based solar cells.

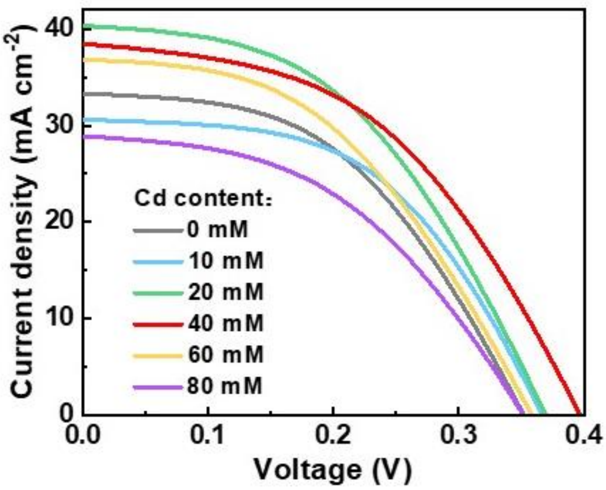

Figure S7. *J-V* plots of all solar cells under AM1.5 illumination.

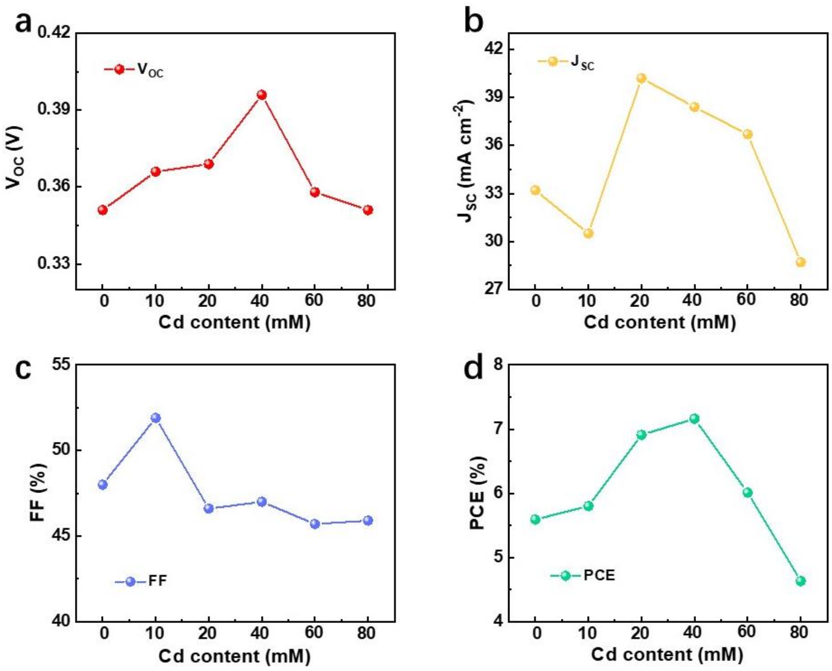

Figure S8. The dependence of (a) V_{oc}, (b) J_{sc}, (c) FF and (d) PCE on the Cd cations concentration for all solar cells under AM1.5 illumination.

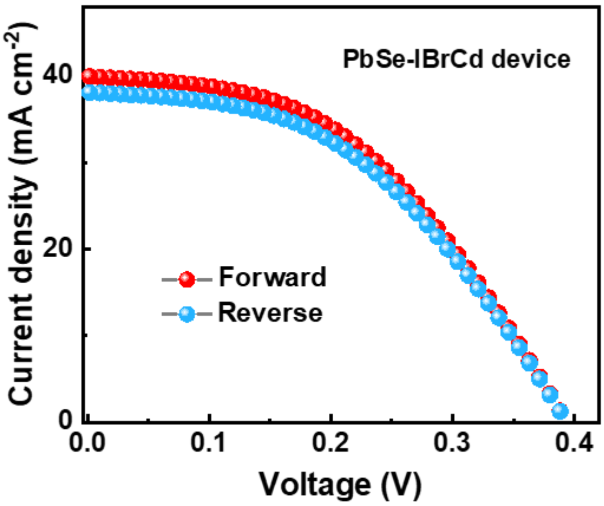

Figure S9. *J-V* (forward and reverse scanning) curves of device based on PbSe-IBrCd QDs ([Cd]=40 mM) under simulated AM 1.5G illuminations.

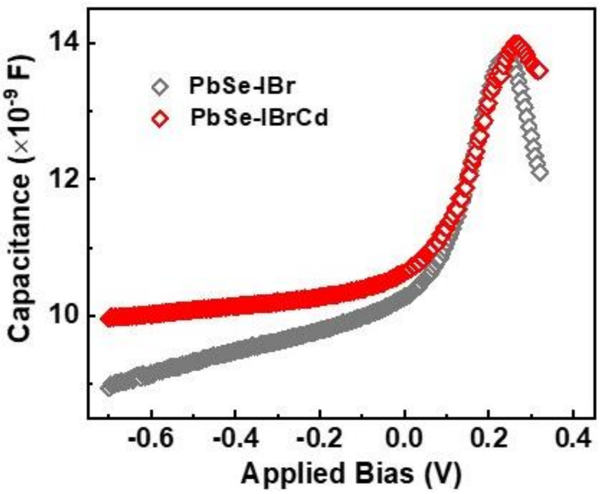

Figure S10. C-V curves of PbSe-IBr and PbSe-IBrCd QD based device.

Table S1. The fitted results of photoluminescence lifetime shown in Figure 3b according to a biexponential function.

Cd content (mM)	**y0**	**A1**	$\tau_{PL, fast}$	**A2**	$\tau_{PL, slow}$
0	0.012	3.40	0.97	0.28	6.50
10	0.011	3.47	0.99	0.25	6.90
20	0.023	2.67	1.15	0.23	9.30
40	0.013	1.54	2.12	0.15	26.73
60	0.014	1.38	2.48	0.16	30.43
80	0.014	1.44	2.19	0.17	26.74

Table S2. The performance of PbSe QD based photovoltaic measured with or without the 1100 nm filter.

Cd (mM)	**Solar illumination**	***Voc* (V)**	***Jsc* (mA cm^{-2})**	**FF (%)**	**PCE (%)**
0	AM1.5	0.351	33.2	48	5.59
	1100 nm Filter	0.289	6.06	54	0.95
10	AM1.5	0.366	30.5	51.9	5.8
	1100 nm Filter	0.306	6.18	55	1.05
20	AM1.5	0.369	40.2	46.6	6.91
	1100 nm Filter	0.323	6.39	54.2	1.12
40	AM1.5	0.396	38.4	47	7.16
	1100 nm Filter	0.347	6.78	55.6	1.31
60	AM1.5	0.358	36.7	45.7	6.01
	1100 nm Filter	0.297	6.87	52.1	1.07
80	AM1.5	0.351	28.7	45.9	4.63
	1100 nm Filter	0.291	5.50	52.6	0.85