Supporting Information for

Suppression of Halide Migration and Immobile Ionic Surface Passivation for Blue Perovskite Light-Emitting Diodes

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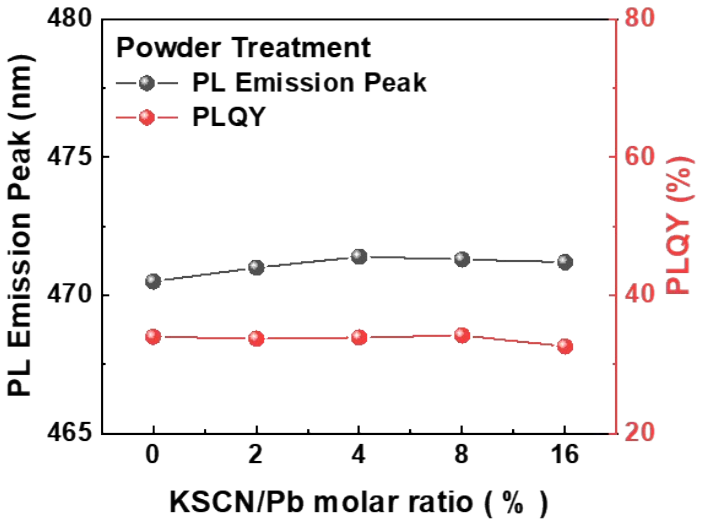

Fig. S1. Change in photoluminescence (PL) emission peak and PL quantum yields of PeNCs solution with increasing molar ratio of KSCN powder under same reaction time, 5 min.

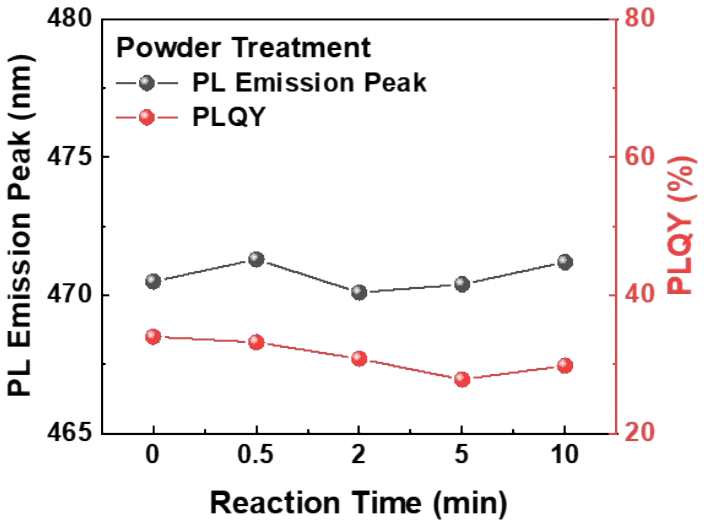

Fig. S2. Change in photoluminescence (PL) emission peak and PL quantum yields of PeNCs solution with increasing reaction time under same molar ratio of 8% KSCN powder.

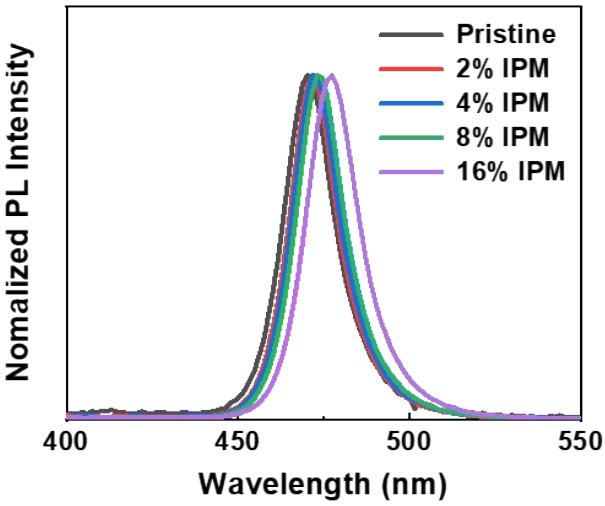

Fig. S3. Photoluminescence spectra of p- and IPM-PeNCs with increasing KSCN molar ratio. (KSCN power were dissolved in butanol with different molar ratio)

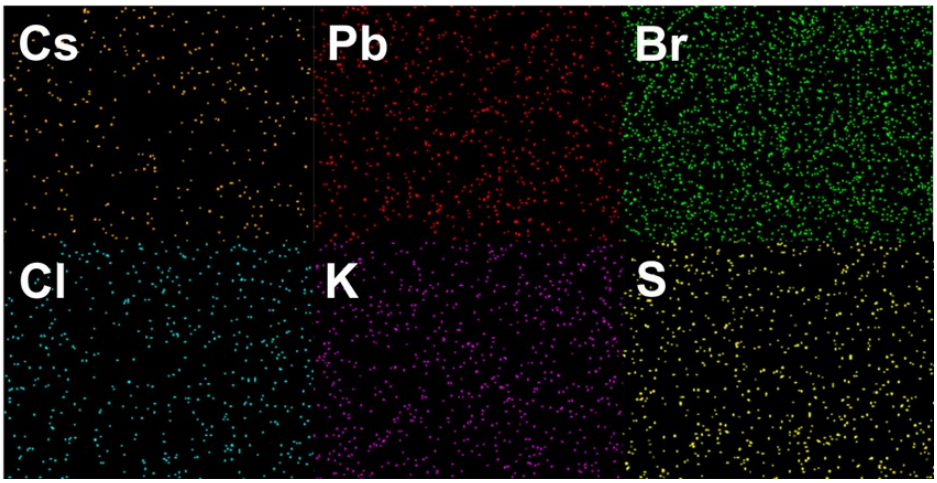

Fig. S4. Energy-dispersive X-ray spectroscopy images of deposited 8% IPM-PeNCs film for elemental mapping of Cs, Pb, Br, Cl, K, and S.

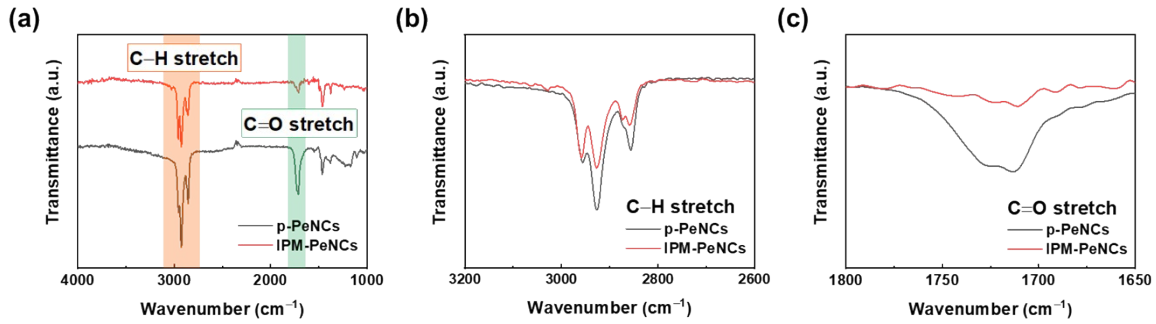

Fig. S5. (a) Fourier-transform infrared spectra of p- and 8% IPM-PeNCs solutions. (b, c) C-H stretch and C=O stretch regions, respectively.

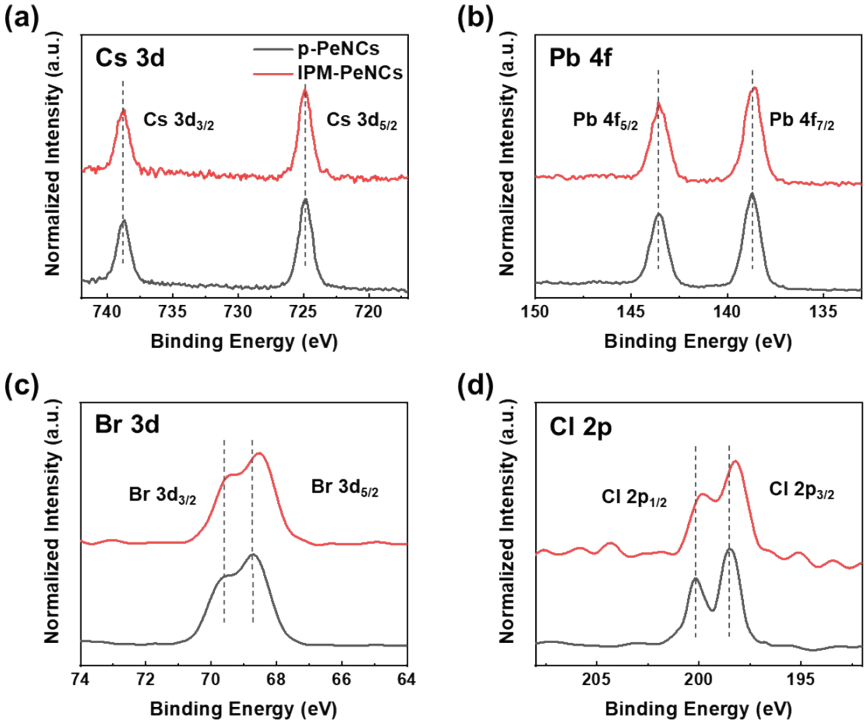

Fig. S6. X-ray photoelectron spectroscopy spectra corresponding to the (a) Cs 3d, (b) Pb 4f, (c) Br 3d and (d) Cl 2p core-level peak of p- and 8% IPM-PeNCs.

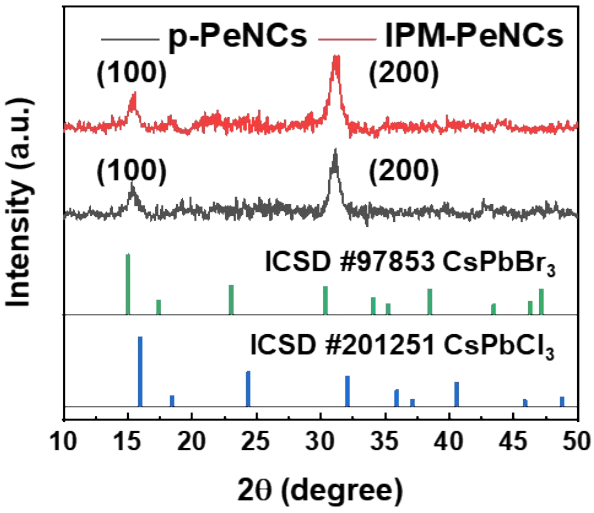

Fig. S7. X-ray diffraction patterns of deposited p- and 8% IPM-PeNCs films.

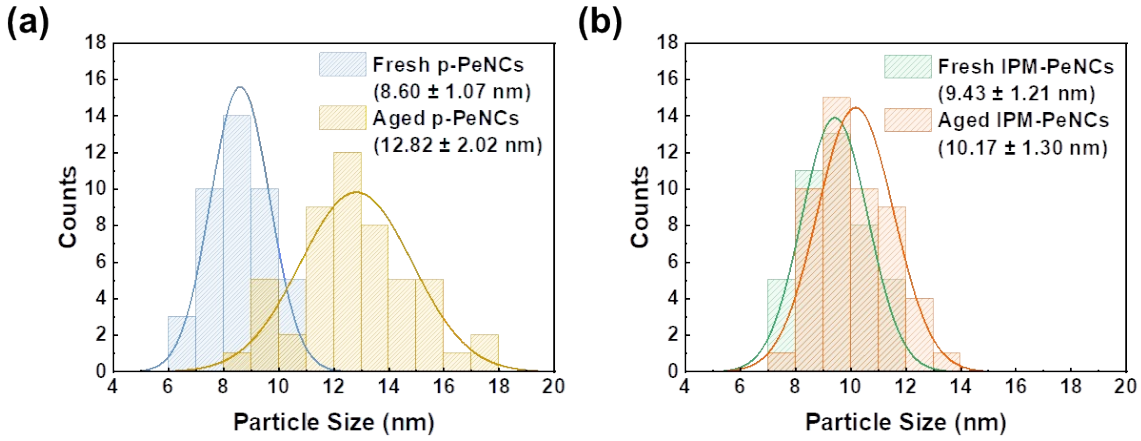

Fig. S8. Size distributions of (a) p- and (b) 8% IPM-PeNCs just synthesized and after 14 days obtained from transmission electron microscopy images.

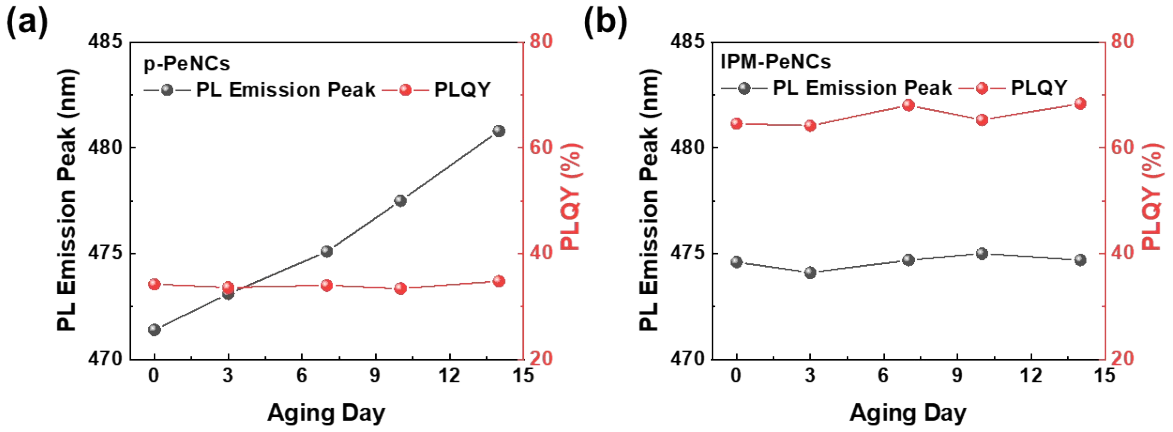

Fig. S9. Change in photoluminescence (PL) emission peak and PL quantum yields of p- and 8% IPM-PeNCs just synthesized and after being kept in ambient condition of over 60% humidity for 14 days.

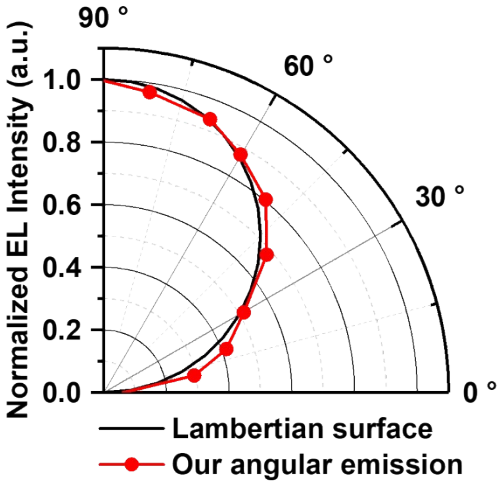

Fig. S10. Angular distribution of radiation intensity.

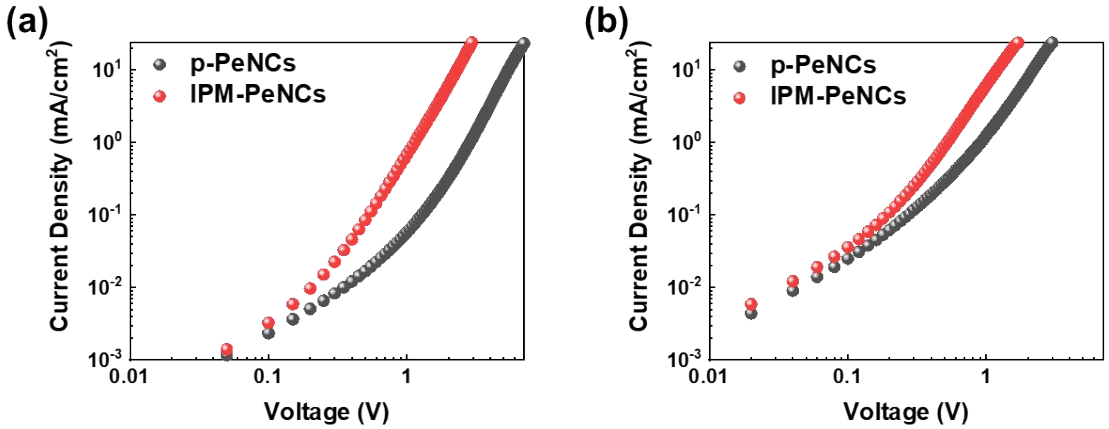

Fig. S11. *J-V* curves of (a) hole-only diodes and (b) electron-only diodes based on p- and 8% IPM PeNCs. Device structure: ITO/PEDOT:PSS (30 nm)/Poly-TPD (35 nm)/PeNCs (15 nm)/MoO_3 (5 nm)/Au (80 nm) for hole-only diodes, ITO/ZnO (25 nm)/PeNCs (15 nm)/TPBi (50 nm)/LiF (1 nm)/Al (100 nm) for electron-only diodes.

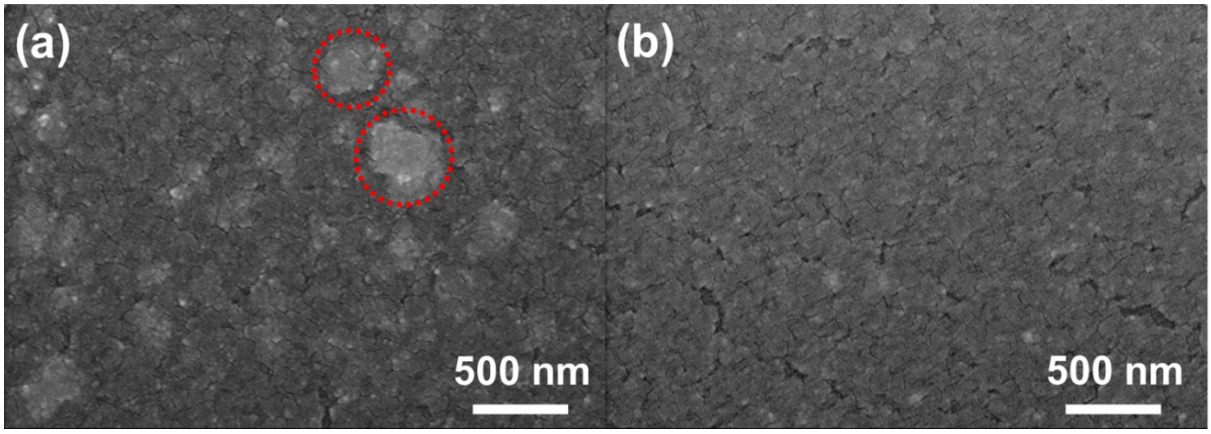

Fig. S12. Scanning electron microscope images of deposited (a) p- and (b) 8% IPM-PeNCs films.

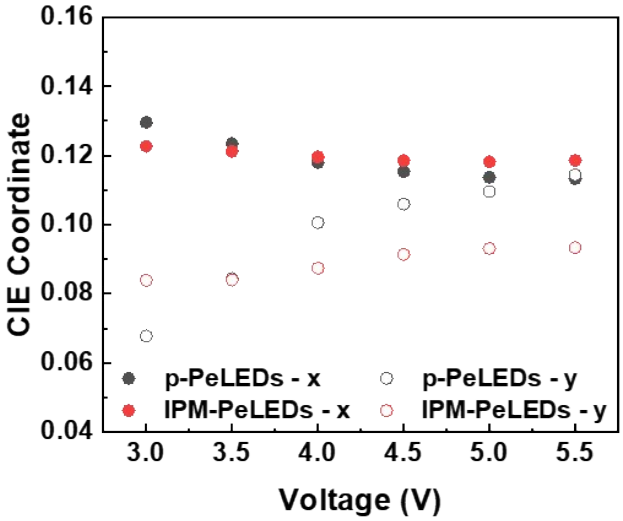

Fig. S13. CIE 1931 chromatic coordinates of p- and IPM-PeLEDs at different applying bias, respectively.

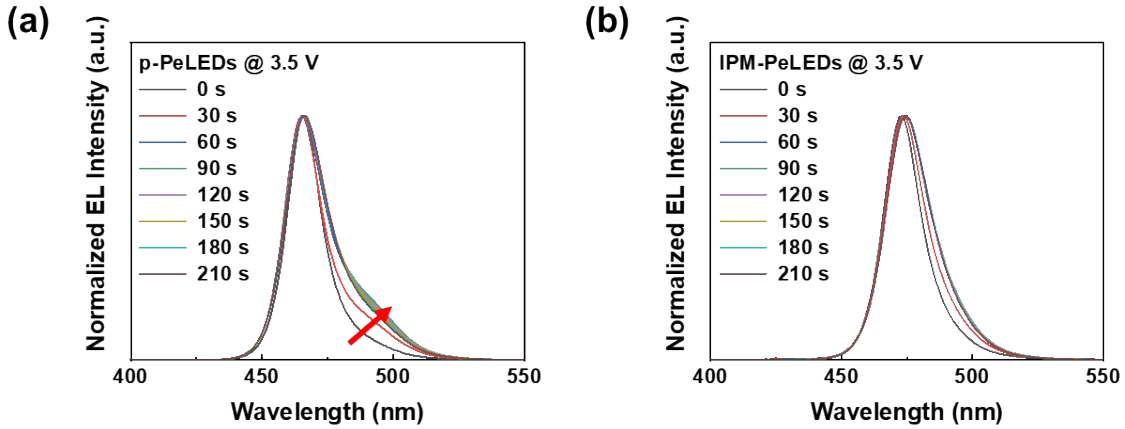

Fig. S14. Electroluminescence (EL) spectra peak positions at different operation times and fixed bias of 3.5 V for p- and IPM-PeLEDs.

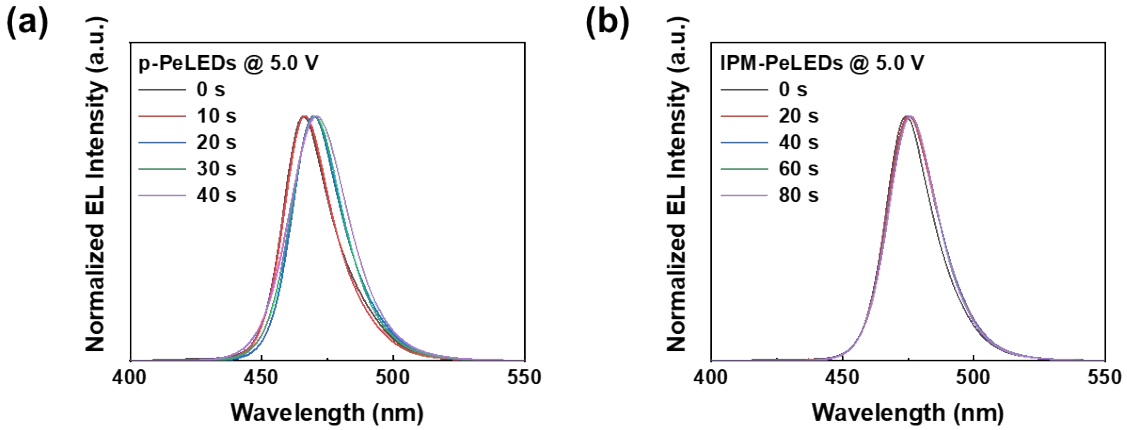

Fig. S15. Electroluminescence (EL) spectra peak positions at different operation times and fixed bias of 5.0 V for p- and IPM-PeLEDs.

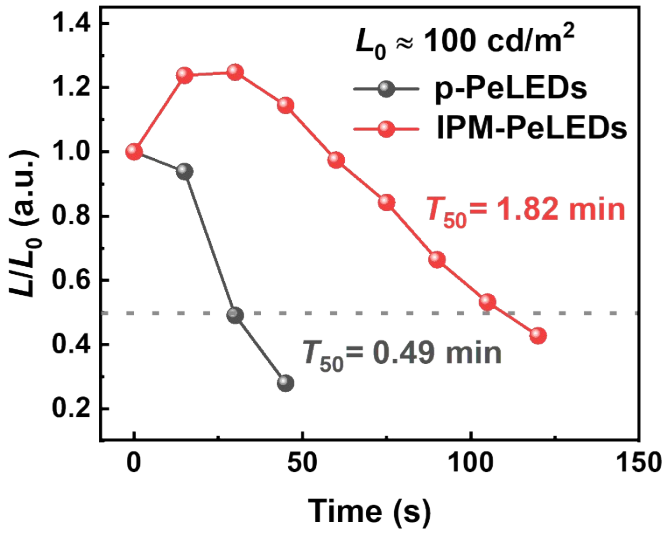

Fig. S16. Operational stability under continuous fixed bias, 5.0 V of p- and IPM-PeLEDs.

Table S1. Summary of optical parameters (PL peak positions and PLQY values) of p- and IPM-PeNCs solution with increasing molar ratio of KSCN powder under same reaction time, 5 min.

Condition	Pristine	2% IPM	4% IPM	8% IPM	16% IPM
PL peak (nm)	470.5	471.0	471.4	471.3	471.2
PLQY (%)	34.0	33.7	33.9	34.2	32.6

Table S2. Summary of optical parameters (PL peak positions and PLQY values) of p- and IPM-PeNCs solution with increasing reaction time under same molar ratio of 8% KSCN powder

Condition	Pristine	0.5 min	2 min	5 min	10 min
PL peak (nm)	470.5	471.0	471.4	471.3	471.2
PLQY (%)	34.0	33.2	30.8	27.8	29.8

Table S3. Summary of optical parameters (PL peak positions and PLQY values) of p- and IPM-PeNCs solution with increasing KSCN molar ratio.

Condition	Pristine	2% IPM	4% IPM	8% IPM	16% IPM
PL peak (nm)	470.5	471.7	472.4	473.6	477.1
PLQY (%)	34.0	51.4	58.3	64.0	74.1

Table S4. Tri-exponential fitting parameter for PL lifetimes of p-and 8% IPM-PeNCs solutions.

Condition	τ_1 (ns)	f_1 (%)	τ_2 (ns)	f_2 (%)	τ_3 (ns)	f_3 (%)	τ_{avg} (ns)	χ^2
p-PeNCs	33.60	34.59	4.54	53.14	169.25	12.28	34.81	1.22
IPM-PeNCs	246.36	11.70	55.78	36.71	8.17	51.59	53.52	1.28

Table S5. Summary of device characteristics of optimized PeLEDs based on p- and IPM-

Condition	Maximum Luminance [cd/m^2] [at voltage]	Maximum Luminous Efficiency [cd/A] [at voltage]	EQE [%] [at voltage]	EL [nm]
Pristine	291.8@6.5	0.45@4.0	0.60@4.0	469
2% IPM	298.1@6.0	0.60@4.0	0.78@4.0	470
4% IPM	286.3@6.0	0.73@4.0	0.92@3.0	472
8% IPM	221.5@5.5	1.73@3.5	2.04@3.5	475

PeNCs with increasing KSCN molar ratio[a]

[a]Device structure: ITO/PEDOT:PSS/Poly-TPD/PeNCs/TPBi/LiF/Al.