Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

Air-processed stable near-infrared Si-based perovskite light-emitting devices with efficiency exceeding 7.5%

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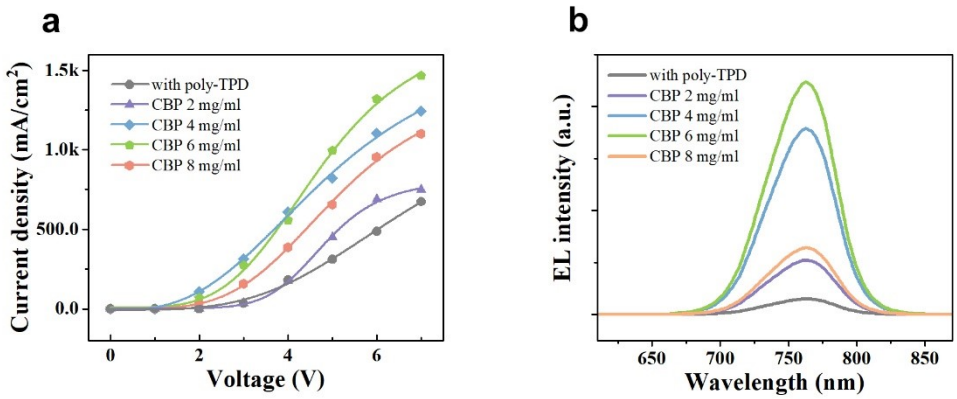

Figure S1. a) *J-V* curves and b) EL spectra of PeLEDs with different CBP concentrations.

Table S1. EL performance of device with various CBP concentrations

Device	P_{max} **(mW/cm²)**	EQE_{max} **(%)**
with poly-TPD	1.03	2.2
with CBP 2 mg/ml	0.74	1.5
with CBP 4 mg/ml	1.74	3.2
with CBP 6 mg/ml	2.65	4.1
with CBP 8 mg/ml	1.33	2.1

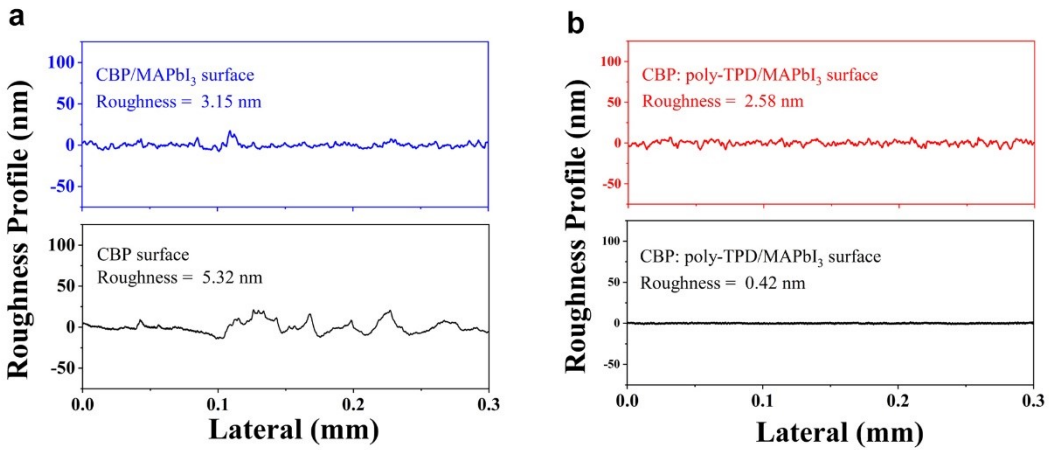

Figure S2. Surface morphology measured by a profiler. a) pure CBP and CBP/$MAPbI_3$ surface; b) CBP: poly-TPD and CBP: poly-TPD/$MAPbI_3$ surface.

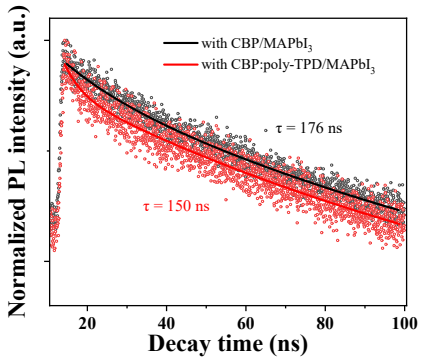

Figure S3. The TRPL spectra of CBP/$MAPbI_3$ and CBP: poly-TPD/$MAPbI_3$ films.

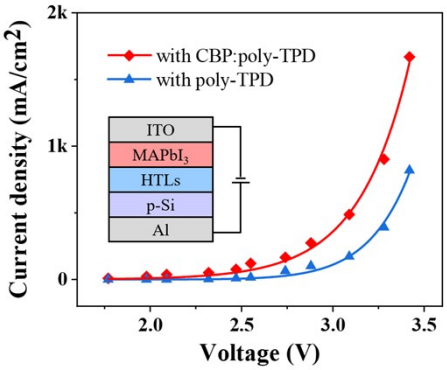

Figure S4. Current density-voltage relationship of controlled devices with CBP: poly-TPD (red line) or with poly-TPD (blue line).

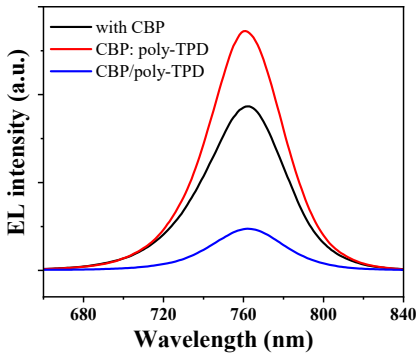

Figure S5. EL intensity of $MAPbI_3$ with pure CBP, CBP: poly-TPD and CBP/poly-TPD.

Hydrophobic polymers such as polystyrene (PS), polytetrafluoroethylene (PTFE), aerogel, and PMMA are often used to enhance the stability of devices. However, PTFE is difficult to dissolve; Aerogel can passivate perovskite prepared under air conditions, but the EQE of devices is very low [1]; Polystyrene is also commonly used, but it was reported that the PLQY of perovskite nanocrystals using polystyrene (27%) [2] was lower than that using PMMA (56%) [3]. We also did a control experiment using PS-doped anti-solvent, and the PL intensity is only enhanced 1.5 times, as shown in Figure 1, which is not so good as that using PMMA. Therefore, we selected PMMA in case to improve the fabrication process and the device performance. We have revised the corresponding part in the revised manuscript.

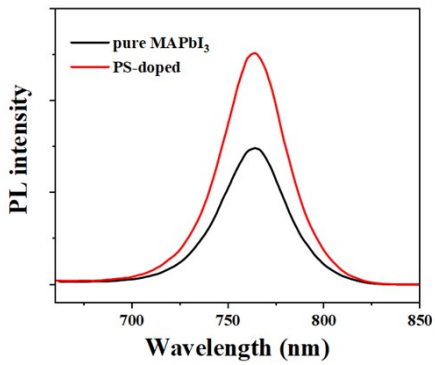

Figure S6. PL spectra of $MAPbI_3$ and $MAPbI_3$:PS film.

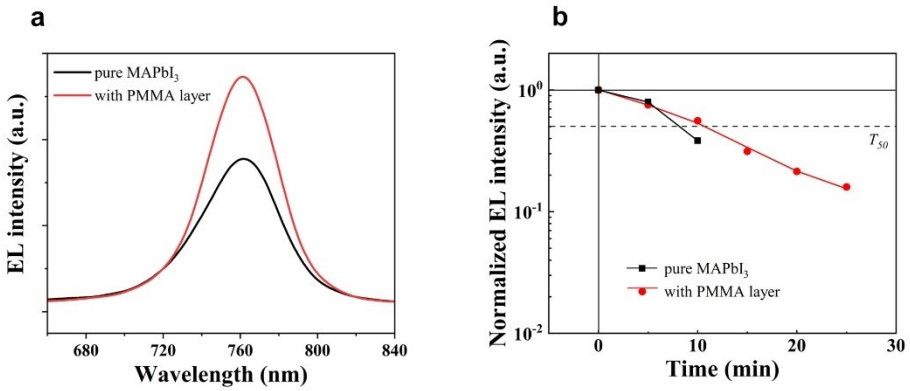

Figure S7. EL performance of PeLEDs with or without PMMA layer, a) EL spectra; b) stability.

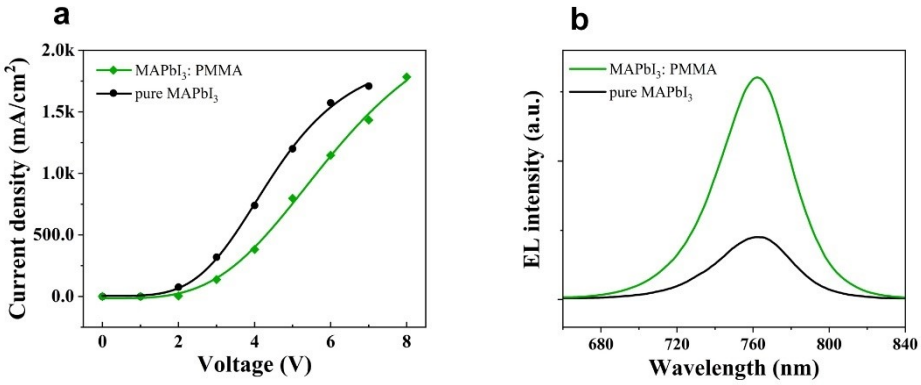

Figure S8. EL performance of PeLEDs with $MAPbI_3$ or with $MAPbI_3$: PMMA.

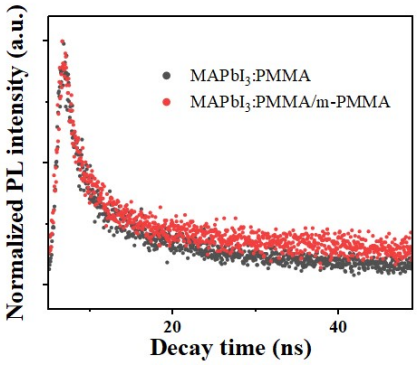

Figure S9 TRPL spectra of $MAPbI_3$: PMMA and $MAPbI_3$: PMMA/m-PMMA film.

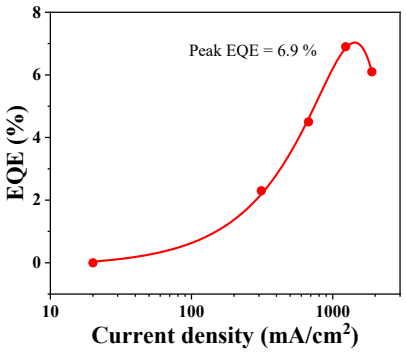

Figure S10. EQE of PeLED with m-PMMA layer under various operation current density.

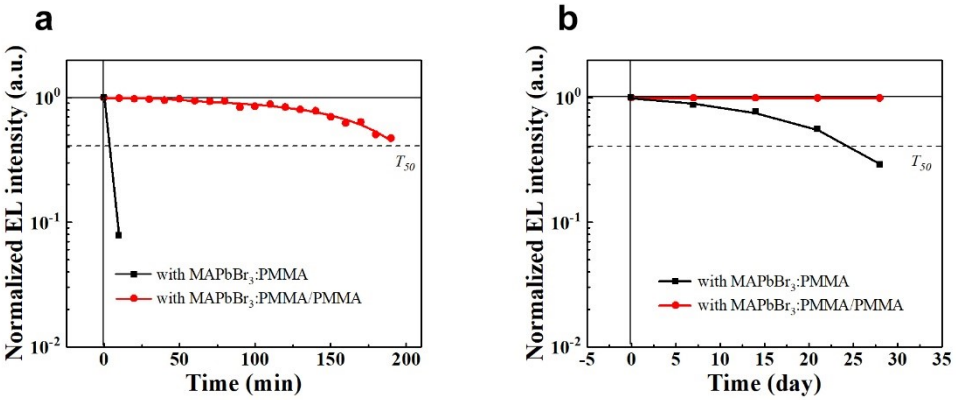

Figure S11. a) Operation stability of PeLEDs with $MAPbBr_3$: PMMA or with $MAPbBr_3$: PMMA/m-PMMA; b) Normalized EL intensity of the studied PeLEDs from 1 to 28 days in air-ambient under a humidity of ~30%.

References

[1] T. Kim, J.H. Kim, J.W. Park, *Solid-State Electronics* **2020**, *165*, 107749.

[2] H. Zhang, X. Wang, Q. Liao, Z. Xu, H. Li, L. Zheng and H. Fu, *Advanced Functional Materials*, 2017, **27**, 1604382.

[3] C. Chen, D. Li, Y. Wu, C. Chen, Z.-G. Zhu, W. Y. Shih and W.-H. Shih, *Nanotechnology*, 2020, **31**, 225602.