

# **A High-Performance Perovskite Light-Emitting Diodes Based on Double Hole Transport Layers**

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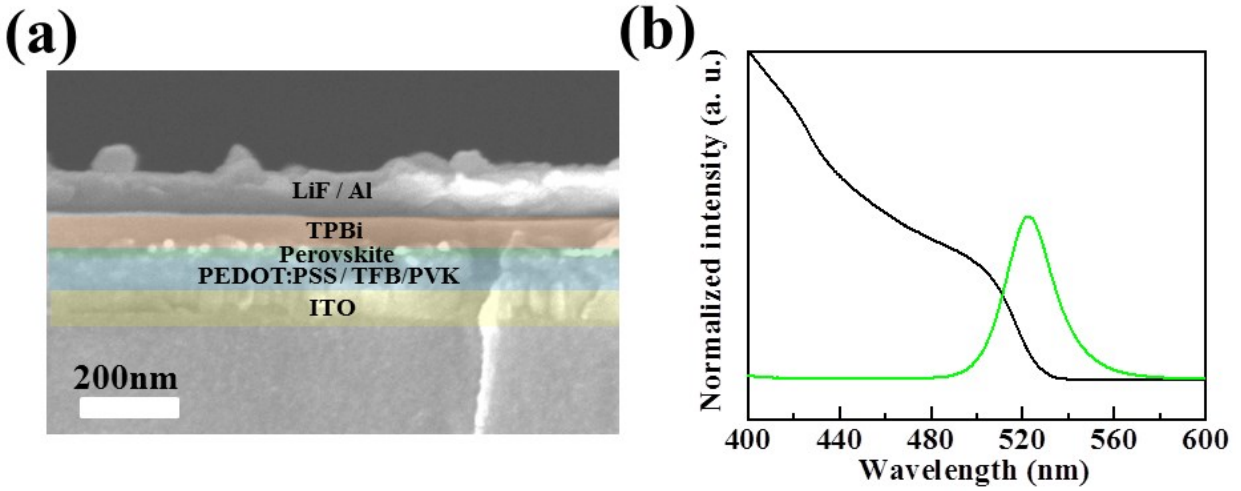


Figure S1. (a) Cross-sectional SEM image of the PeLEDs based on TFB/PVK double hole transport layers. (b) Normalized absorption and PL spectra of  $\text{FAPb}_{0.7}\text{Sn}_{0.3}\text{Br}_3$  NCs.

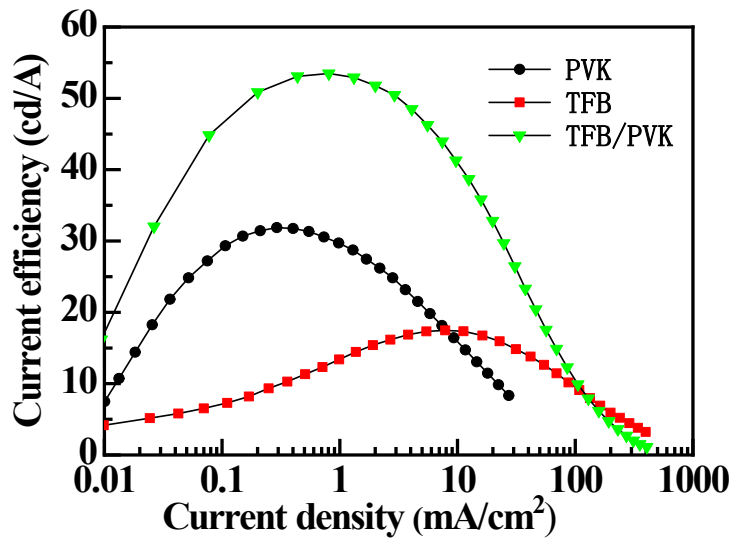


Figure S2. current efficiency -current density characteristics of the PeLEDs with single and double HTLs.

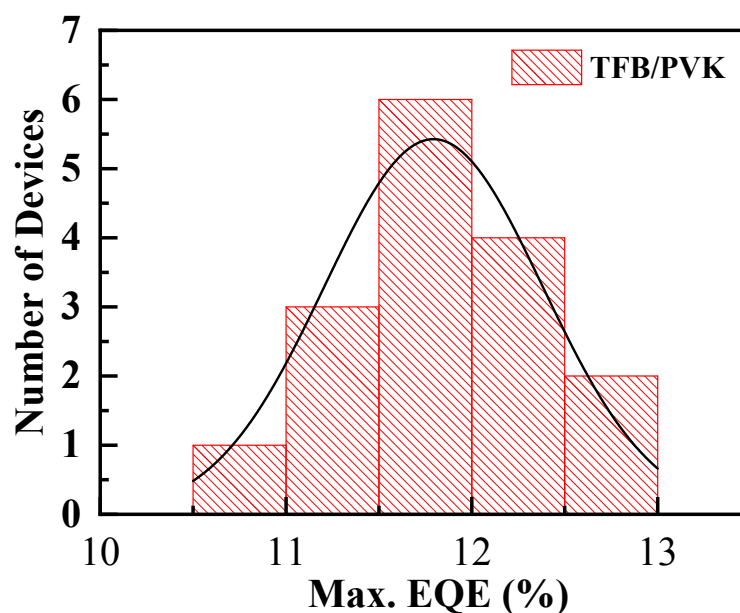


Figure S3. Histogram of the maximum EQEs measured from 16 devices.

Table S1 The PL decay lifetime at 525nm of the samples.

Sample	$\tau_1$ (ns)	A1	$\tau_2$ (ns)	A2	$\tau_3$ (ns)	A3	$\tau_{av}$ (ns)
ITO/ FAPb <sub>0.7</sub> Sn <sub>0.3</sub> Br <sub>3</sub>	106.9	474.8	21.2	1788.8	3	4311	61.5
ITO/PEDOT:PSS/PVK/ FAPb <sub>0.7</sub> Sn <sub>0.3</sub> Br <sub>3</sub>	85.9	479.2	16	1924.6	2.1	4861	49.1
ITO/PEDOT:PSS/TFB/ FAPb <sub>0.7</sub> Sn <sub>0.3</sub> Br <sub>3</sub>	5.7	444.2	0.2	5049	1.2	2621.5	2.7
ITO/PEDOT:PSS/TFB/PVK FAPb <sub>0.7</sub> Sn <sub>0.3</sub> Br <sub>3</sub>	20.4	289.6	3.2	1353.3	0.5	3428	11.3

Average PL lifetime calculated by the formula of  $\tau_{av} = (A_1 \tau_1^2 + A_2 \tau_2^2 + A_3 \tau_3^2 \dots + A_i \tau_i^2) / (A_1 \tau_1 + A_2 \tau_2 + A_3 \tau_3 \dots + A_i \tau_i)$

Table S2 Device performances of PeLEDs with single and double HTLs.

<b>Device</b>	<b>V<sub>on</sub> (V)</b>	<b>L<sub>max</sub> (cdm<sup>-2</sup>)</b>	<b>CE<sub>max</sub> (cd A<sup>-1</sup>)</b>	<b>PE<sub>max</sub>(lm W<sup>-1</sup>)</b>	<b>EQE<sub>max</sub>(%)</b>
PVK	3.7	2321	31.9	18.5	7.8
TFB	3.05	12960	17.5	9.5	4.3
TFB/PVK	2.92	10520	53.5	44.4	12.9