Supporting Information

Lifetime Elongation of Quantum-Dot Light-Emitting Diodes by Inhibiting Degradation of Hole Transport Layer

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Figure S1

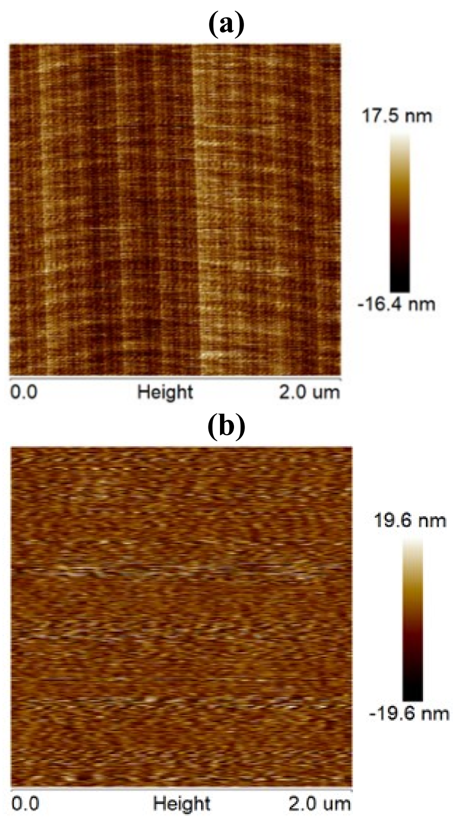

Figure S1. AFM image (a) TFB and (b) PVK

Figure S2

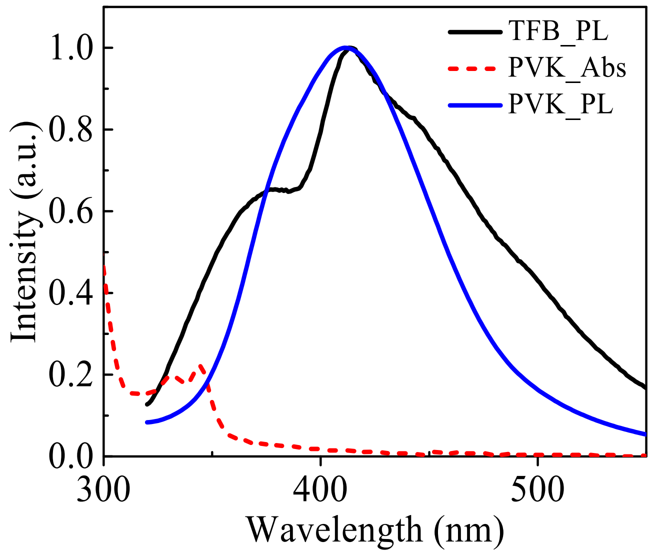

Figure S2. PL and absorption spectra of TFB and PVK

Transient electroluminescence (TREL)

TREL is to applied a rectangular pulse waveform to a QDLED, and the corresponding electrical current and electroluminescent (EL) response of device can be observed as illustrated in Fig. S3 [Ref. 39: *J. Appl. Phys., 89, 1704 (2001)*], where one can see the time between the turn-on of pulse and EL response defined as delay time (T_d).

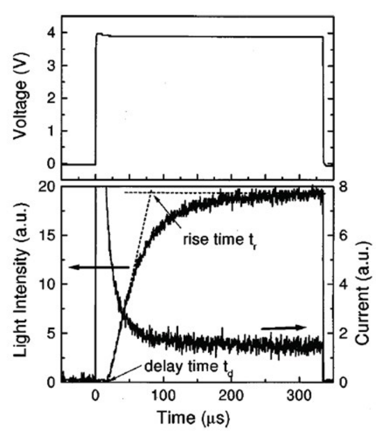

Figure S3. TREL measurement: the corresponding electrical pulse waveform, corresponding current density and optical intensity of device.

Delay time is typically attributable to the timespan of carrier injection and transport to the emission zone. Based on some assumptions such as assuming that the emitting is unipolar, and thereby the delay time can be expressed into Eq. (R1) [Ref. 40: *J. Appl. Phys., 94, 7796 (2003)*; Ref. 41: *Sci. Technol.,19, L56-L59 (2004)*]:

$$T_d = T_{inj} + T_{trans} \approx (R + R_0)C_i S \frac{E_{th}}{E_0} + \frac{d}{\mu E_{th}} \quad \text{.....................................(S1)}$$

Where R, R_0 and C_i represent the series resistance of device. E_{th} is the threshold electric field for charge injection, and E_0 is the electric field of the applied pulse voltage. T_d consist of two parts in terms of T_{inj} and T_{trans}. T_{inj} is for carrier injection and T_{trans}. is for carrier transporting. Accordingly, TREL is believed as a suitable method to characterize the carrier dynamics. Furthermore, electron transporting is superior than hole transporting due to the utilization of zinc oxide (ZnO) as electron transporting layer in QDLED, and the T_d is therefore dependent on the time of hole transporting. In current case, PVK layer is the difference between TFB and TFB/PVK devices and also the injection term T_{inj} could be assumed identical because of the same electrode and adjacent carrier transport layer. Hence, to calculate the T_d difference between TFB and TFB/PVK devices, which could reflect the hole transporting difference induced by PVK since above assumption. For example, as show in Figs. 4a and b, the T_d difference was 0.75 μs. If following down below calculations, the hole transporting mobility of approximately 7.46 $\times 10^{-6}$ ($cm^2S^{-1}V^{-1}$) induced by PVK was obtained, and which totally agree with previous literature [Ref:37 *RSC Adv. 2017, 7(69), 43366–43372.*].

$$\mu = \frac{d\ (difference)}{T_d(difference)E_{th}} = \frac{28 * 10^{-7}(cm)}{0.75 * 10^{-6}(s) \times 5(V)/100 * 10^{-7}(cm)} = 7.46 * 10^{-6}\ (cm^2/VS)$$