Electronic Supplementary Information

Does interfacial exciton quenching exist in high-performance quantum dot light-emitting diodes?

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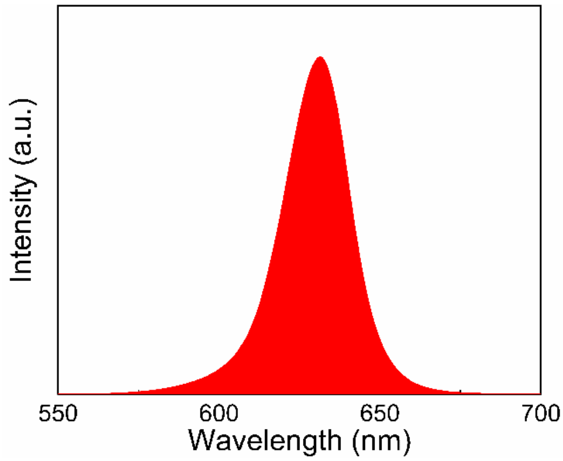

Figure. S1 EL spectrum of QLED

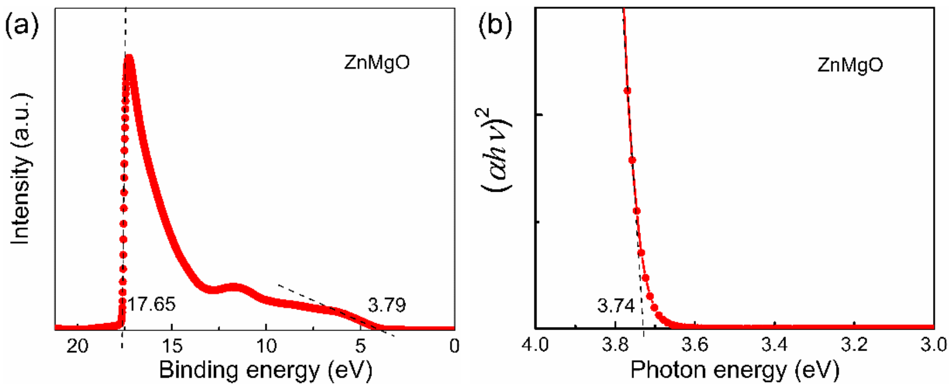

Figure. S2 (a) UPS spectrum of secondary-electron cutoff (left) and valence-band edge regions (right) of ZnMgO film, (b) $(\alpha h\upsilon)^2$-$h\upsilon$ plot converted from the ZnMgO absorption spectrum.

VBM and CBM of ZnMgO are estimated using the following equations:

$$VBM = E_{in} - (E_{cutoff} - E_{onset})$$

$$CBM = VBM + E_g$$

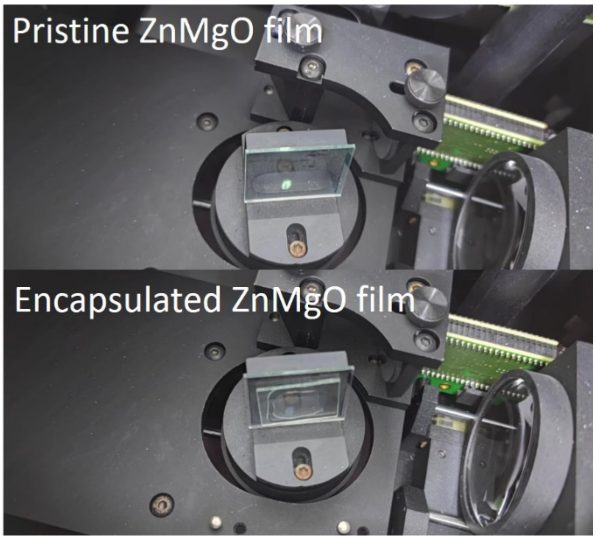

Figure. S3 photos of pristine and encapsulated ZnMgO films excited by 330 nm Xe lamp

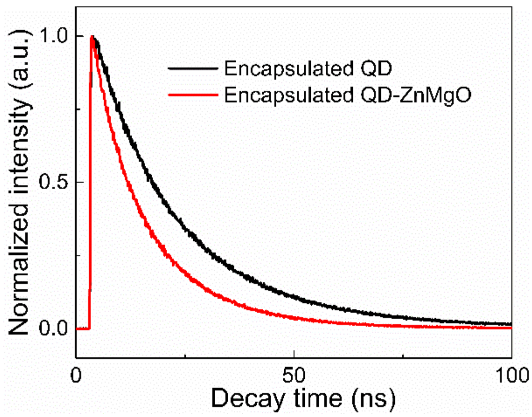

Figure. S4 TRPL characteristics of encapsulated QD and QD-ZnMgO films after they are exposed to air for 5 minutes.

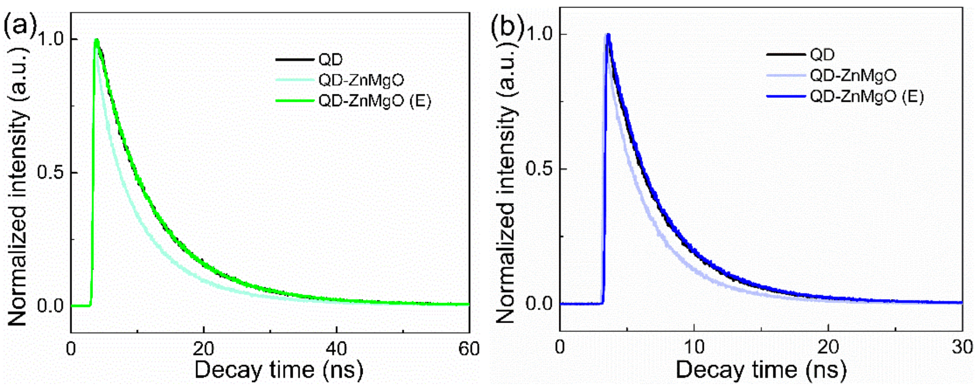

Figure. S5 TRPL characteristics of (a) pristine green QD, pristine and encapsulated green QD-ZnMgO films, and (b) pristine blue QD, pristine and encapsulated blue QD-ZnMgO films.

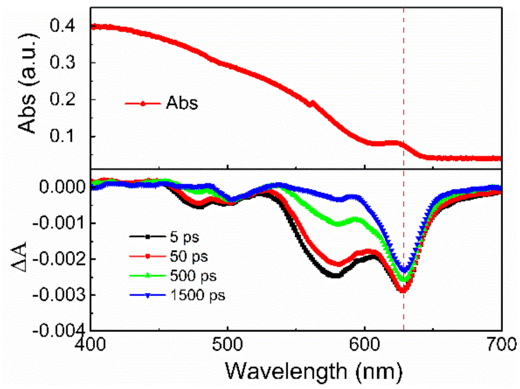

Fig. S6 TA and absorption spectra of QD.

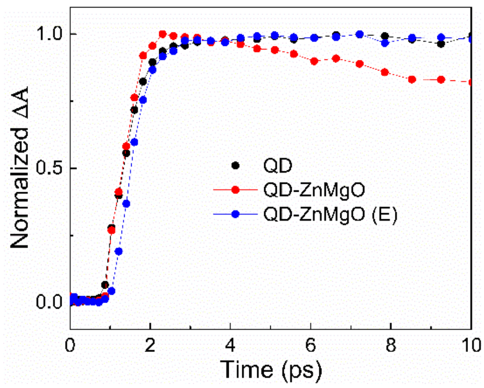

Figure. S7 TA kinetics of pristine QD, pristine and encapsulated QD-ZnMgO films at first 10 ps.

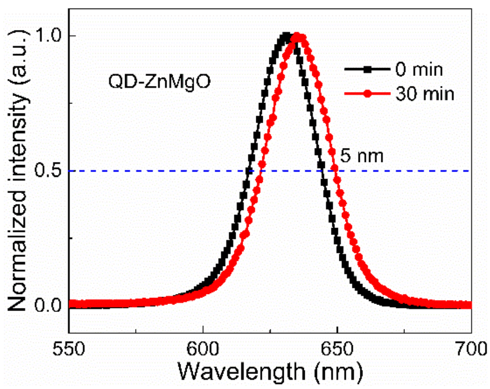

Figure. S8 Normalized PL intensity of QD-ZnMgO film at 0 minutes and 30 minutes.

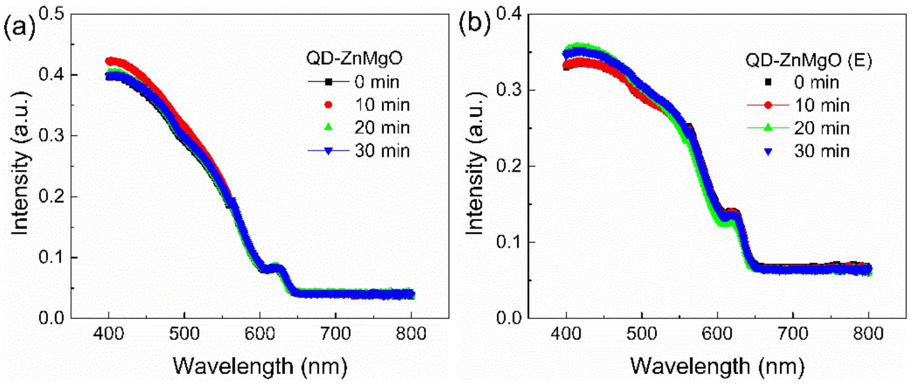

Figure. S9 Absorption intensity of (a) pristine and (b) encapsulated Q-ZnMgO films with a thickness of 20 μm over time.

Table S1 TRPL fitted data of QD and QD-ZnMgO films using double exponential decay

	A_1 (%)/τ_1 (ns)	**A_2(%) /τ_2 (ns)**	**τ (ns)**
QD	55.52/14.19	44.48/30.11	21.11
QD-ZnMgO	45.61/6.80	54.39/17.63	12.70

Exciton lifetime is calculated by $\tau = \sum A_i \tau_i$

Calculation of maximum EQE of QLED：

The EQE is described by

$$EQE = \eta_r \eta_{PL} \eta_{ex}$$

where η_r is the ratio of injected charges that form excitons in QD layer (also called charge balance factor), η_{PL} is the PLQY of QD film, η_{ex} is the light extraction efficiency. If we assume a near-unity charge balance factor (100%) and light out-coupling efficiency (20%-25%), considering a PLQY (50.2%) of QD-ZnMgO film, the maximum EQE of the QLED device should be 12.55%.

Instruction for the estimation of radiative transition rate and charge transfer rate：

The TA kinetics of pristine QD and encapsulated QD-ZnMgO films are fitted using a single exponential decay.

$$I = I_0 exp(-\frac{t}{\tau_r})$$

The TA kinetics of pristine QD-ZnMgO films is fitted by double exponential decay.

$$I = I_1 \exp\left(-\frac{t}{\tau_r}\right) + I_2 \exp\left(-\frac{t}{\tau_{CT}}\right)$$

The radiative transition rate is estimated to be $1/\tau_r$, the charge transfer rate is estimated to be $1/\tau_{CT}$.