Electronic Supplementary Material (ESI) for Nanoscale.


# Efficient and bright green InP quantum dots light-emitting diodes enabled by a self-assembled dipole interface monolayer

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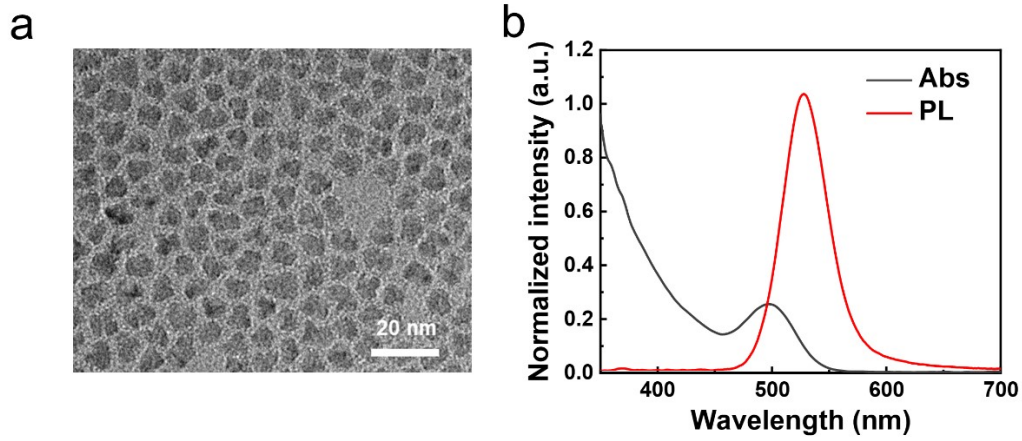


**Figure S1** (a) TEM image and (b) PL & absorption spectra of green InP QDs.

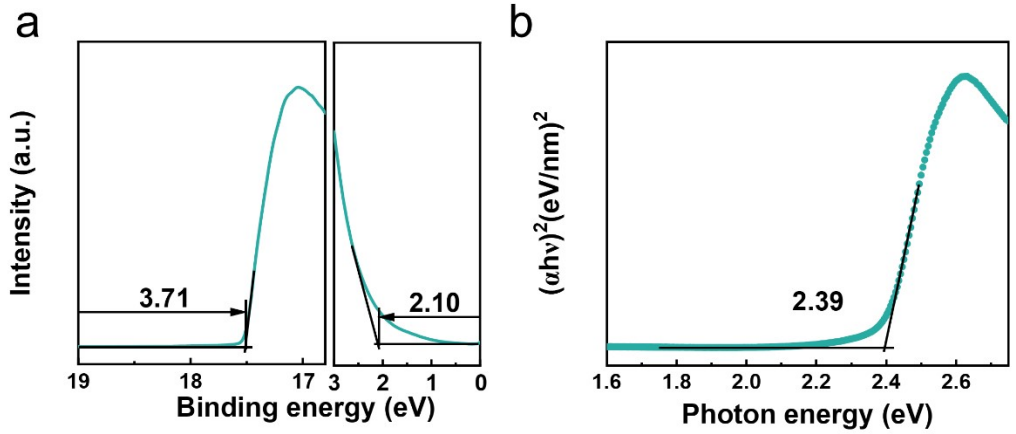


**Figure S2** (a) UPS spectra of the secondary-electron cut-off region and the valence band edge region of InP QDs film. (b) Dependence of $(\alpha h\nu)^2$ of InP QDs film upon the incident photon energy ($h\nu$).

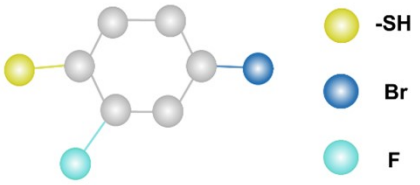


**Figure S3** The BFTP molecular model.

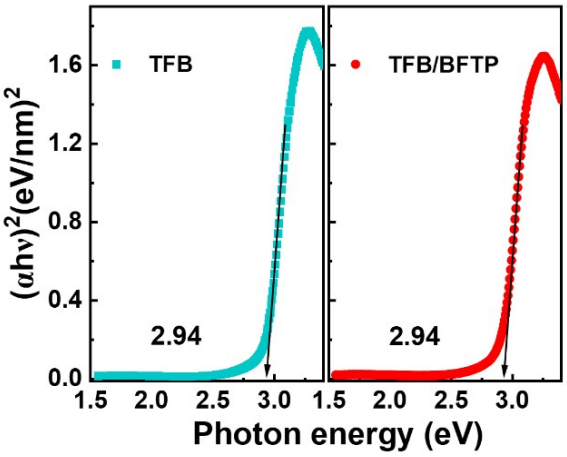


**Figure S4** Dependence of $(\alpha hv)^2$ of TFB and TFB/BFTP films upon the incident photon energy ($hv$).

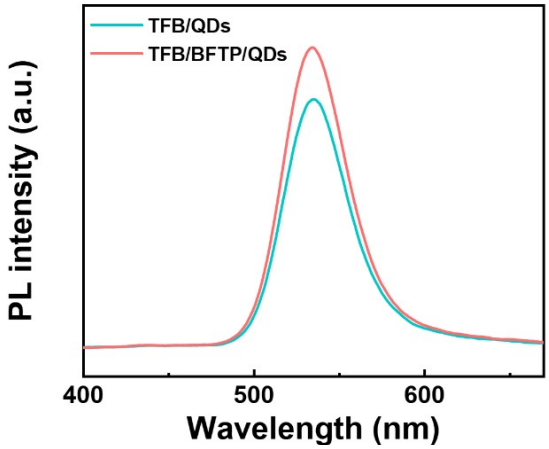


**Figure S5** The PL intensity of InP QDs on TFB and TFB/BFTP films.

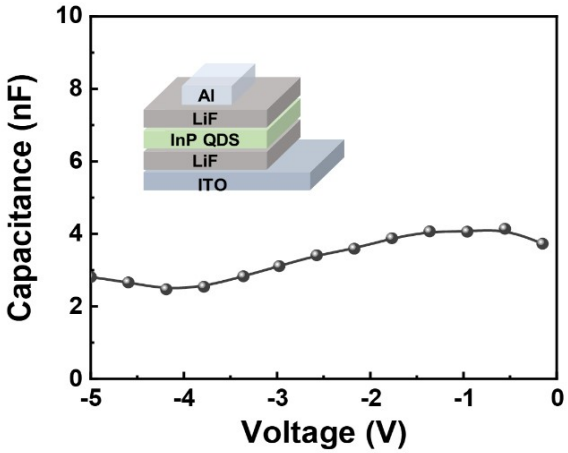


**Figure S6** Relative dielectric constant ($\varepsilon_r$) extraction by the capacitance ($C$)-voltage ($V$) measurement.

The *C-V* curve was measured from the devices with the structure of ITO/LiF (40 nm)/perovskite/LiF(40 nm)/Al. By confirming the *C* value of HTL/InP QDs contact interface by the saturated part in the *C-V* curve towards negative voltage, we extracted the $\varepsilon_r$ value of the contact interface by the following equation:

$$C = \frac{\varepsilon_0 \varepsilon_r S}{d}$$

where $\varepsilon_0$, *S* and *d* represent vacuum permittivity, device area and thickness of the QDs film, respectively. The $\varepsilon_r$ value was estimated to be 12.17.

The trap state density ($n_{traps}$) was determined using the trap-filled limit voltage equation:

$$n_{traps} = \frac{2\varepsilon_0 \varepsilon_r V_{TFL}}{ed^2}$$

where $V_{TFL}$ is the intersection voltage of the trap-filled limit and ohmic regime, and *e* is the elemental charge.

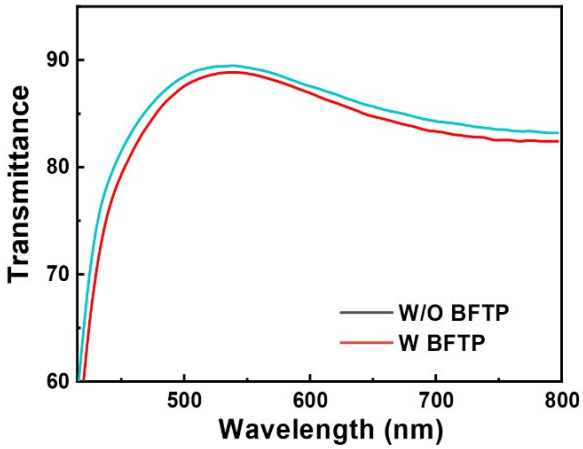


**Figure S7** Transmittance spectra for TFB (W/O BFTP) and TFB/BFTP (W BFTP) films on ITO substrate.

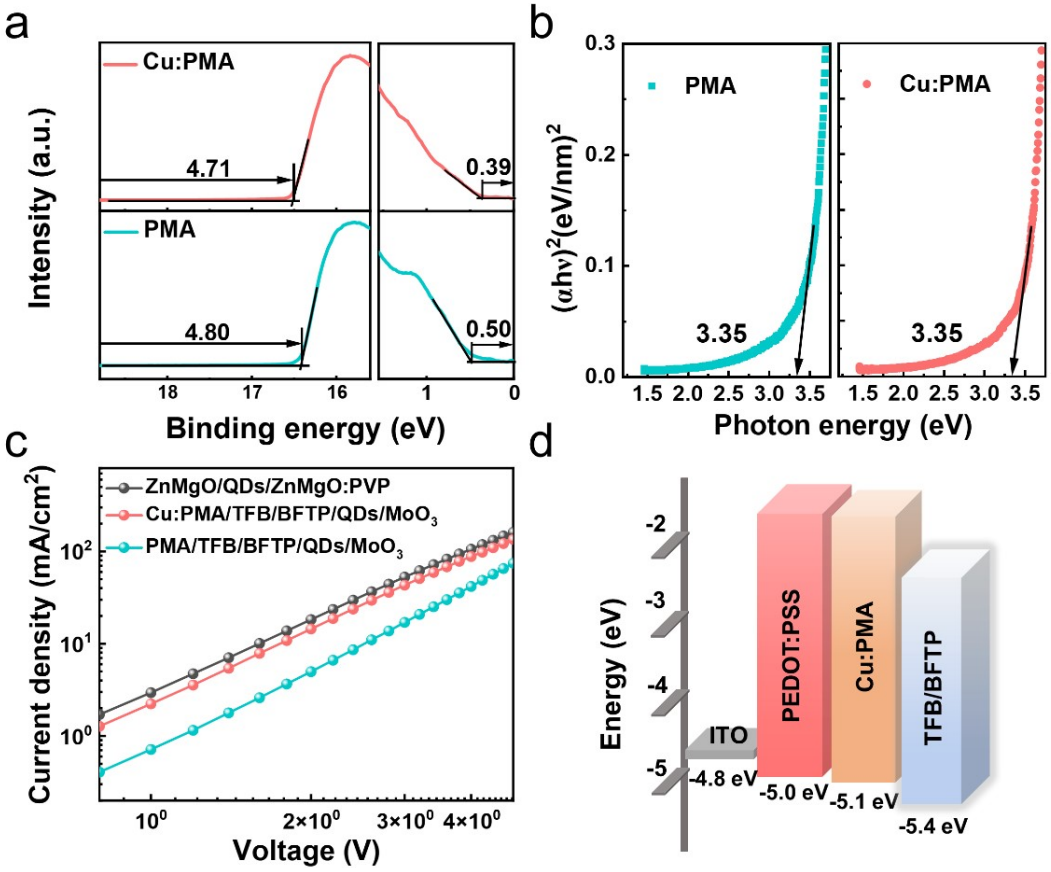


**Figure S8** (a) UPS spectra of the secondary-electron cut-off region and the valence band edge region of PMA and Cu: PMA films deposited on ITO substrate. (b) Dependence of $(\alpha h\nu)^2$ of PMA and Cu: PMA films upon the incident photon energy ($h\nu$). (c) *J-V* characteristics for the electron-only device with a structure of ITO/ZnMgO/QDs/ZnMgO:PVP/Al and the hole-only devices with a structure of ITO/PMA or Cu: PMA/TFB/BFTP/QDs/$MoO_3$/Al. (d) The band alignment diagram of PEDOT: PSS, Cu: PMA and TFB/BFTP layers.

**Table S1** Summary of the device performance of QLEDs without treatment (pristine), with BFTP, with Cu:PMA & BFTP.

| Sample | Von (V) | Peak EQE (%) | Peak Lum (cd/m$^2$) |
|---|---|---|---|
| pristine | 2.5 | 3.71 | 1792 |
| PEDOT:PSS/TFB/BFTP | 1.8 | 8.13 | 14085 |
| Cu:PMA/TFB/BFTP | 1.8 | 8.46 | 18356 |

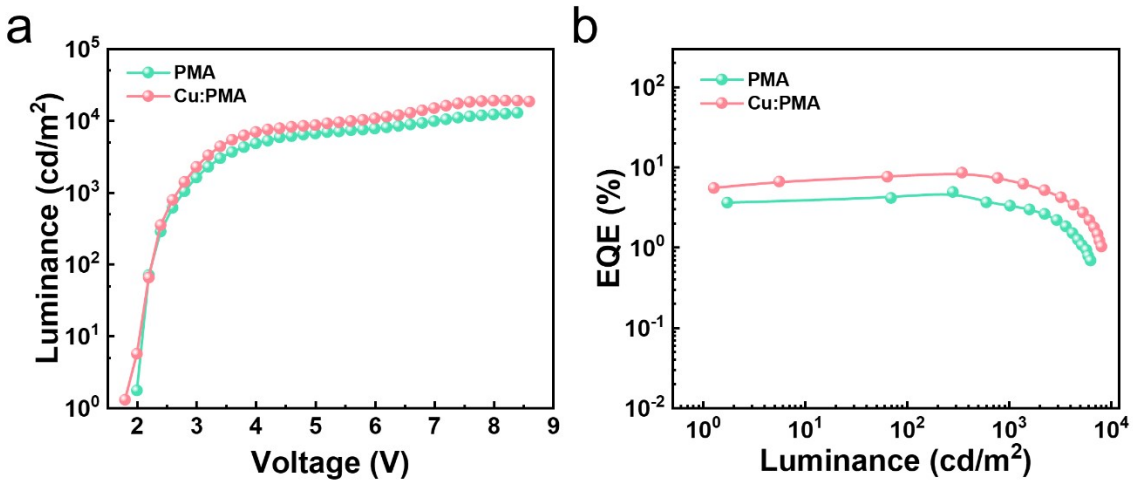


**Figure S9** (a) *L-V* and (b) *EQE-L* characteristics of PEDOT:PSS-based and Cu:PMA-based QLEDs.

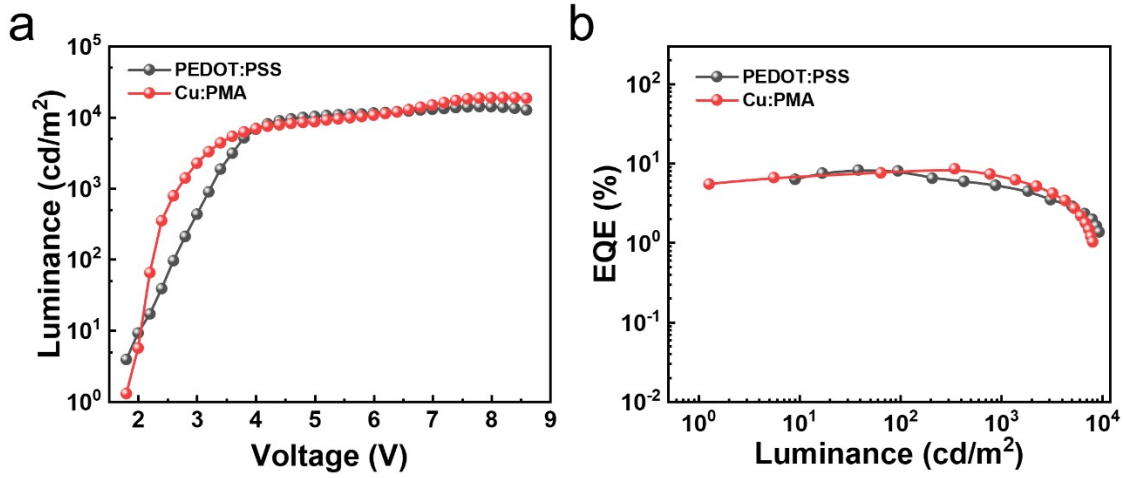


**Figure S10** (a) *L-V* and (b) *EQE-L* characteristics of PEDOT:PSS-based and Cu:PMA-based QLEDs.

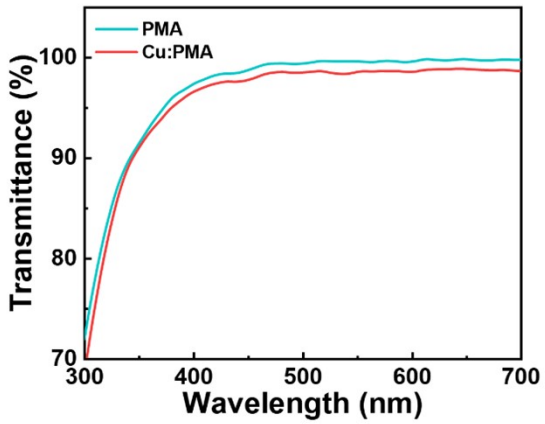


**Figure S11** Transmittance spectra for the PMA and Cu: PMA films.

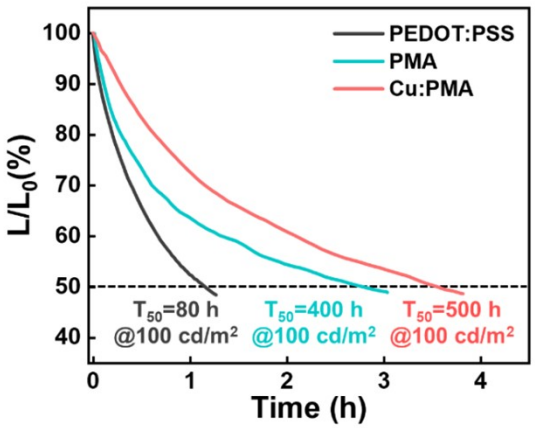


**Figure S12** Operational lifetimes of BFTP-based QLEDs with different hole injection layers (PEDOT: PSS, PMA and Cu: PMA HILs).