# Supporting Information

## Zn-Derived Ligand Engineering towards Stable and Bright $CsPbI_3$ Nanocrystals for White Emitting

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**Table S1.** Element molar ratios of $CsPbI_3$ NCs from XPS analysis.

| Sample | Cs [%] | Pb [%] | I [%] | Zn [%] |
|---|---|---|---|---|
| $CsPbI_3$ | 4.3 | 4.8 | 12.9 | 0 |
| Zn:$CsPbI_3$ | 4.2 | 4.6 | 11.8 | 0.5 |
| DDT-Zn:$CsPbI_3$ | 4.3 | 4.4 | 12.3 | 0.5 |

**Table S2.** PL peak position and FWHM of $CsPbI_3$ NCs

| Sample | PL peak [nm] | FWHM [nm] |
|---|---|---|
| Pb:Zn 1:0 | 696 | 33.9 |
| Pb:Zn 7:3 | 695 | 33.7 |
| Pb:Zn 1:1 | 693 | 34.2 |
| Pb:Zn 3:7 | 689 | 34.5 |
| Pb:Zn 1:3 | 687 | 36.2 |
| DDT 50 μL (Pb:Zn 3:7) | 689 | 34.0 |
| DDT 100 μL (Pb:Zn 3:7) | 689 | 33.6 |
| DDT 150 μL (Pb:Zn 3:7) | 689 | 34.3 |
| DDT 200 μL (Pb:Zn 3:7) | 689 | 33.9 |

**Table S3.** Radiative and non-radiative recombination rates of $CsPbI_3$ NCs

| Sample | $\tau_{ave}$ (ns) | PLQY (%) | $\Gamma_{rad}$ ($\mu s^{-1}$) | $\Gamma_{non-rad}$ ($\mu s^{-1}$) |
|---|---|---|---|---|
| $CsPbI_3$ | 49.8 | 20.5 | 4.1 | 15.9 |
| DDT-$CsPbI_3$ (DDT: 50 μL) | 51.7 | 22.3 | 4.3 | 15.0 |
| DDT-$CsPbI_3$ (DDT: 100 μL) | 55.6 | 25.9 | 4.7 | 13.3 |
| DDT-$CsPbI_3$ (DDT: 150 μL) | 53.7 | 24.9 | 4.6 | 13.9 |
| DDT-$CsPbI_3$ (DDT: 200 μL) | 52.1 | 23.5 | 4.5 | 14.7 |
| Zn:$CsPbI_3$ (Pb:Zn 3:1) | 96.8 | 45.7 | 4.7 | 5.6 |
| Zn:$CsPbI_3$ (Pb:Zn 7:3) | 107.1 | 51.3 | 4.8 | 4.5 |
| Zn:$CsPbI_3$ (Pb:Zn 1:1) | 114.1 | 55.6 | 4.9 | 3.9 |
| Zn:$CsPbI_3$ (Pb:Zn 3:7) | 150.1 | 78.1 | 5.2 | 1.5 |
| Zn:$CsPbI_3$ (Pb:Zn 3:1) | 129.6 | 65.2 | 5.0 | 2.8 |
| DDT-Zn:$CsPbI_3$ (Pb:Zn 3:7) (DDT: 50 μL) | 165.9 | 88.5 | 5.3 | 0.8 |
| DDT-Zn:$CsPbI_3$ (Pb:Zn 3:7) (DDT: 100 μL) | 178.6 | 95.4 | 5.4 | 0.2 |
| DDT-Zn:$CsPbI_3$ (Pb:Zn 3:7) (DDT: 150 μL) | 166.5 | 89.2 | 5.4 | 0.6 |
| DDT-Zn:$CsPbI_3$ (Pb:Zn 3:7) (DDT: 200 μL) | 85.5 | 40.6 | 4.8 | 7.0 |

The radiative and non-radiative recombination rates were estimated as follows.

$$\Gamma_{rad} = \eta_{PL}/\tau_{ave} \quad (1)$$

$$\Gamma_{non\text{-}rad} = (1 - \eta_{PL})/\tau_{ave} \quad (2)$$

Where, $\Gamma_{rad}$ and $\Gamma_{non\text{-}rad}$ were radiative and non-radiative recombination rates, respectively. $\eta_{PL}$ and $\tau_{ave}$ were the PLQY and average lifetime of samples, respectively.

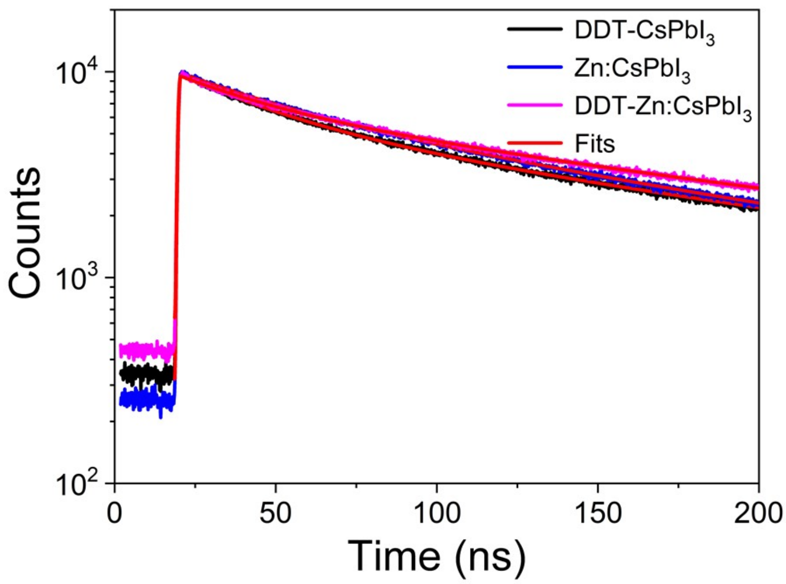


**Fig. S1** PL decay plots of DDT-$CsPbI_3$, Zn:$CsPbI_3$ and DDT-Zn:$CsPbI_3$ NCs.

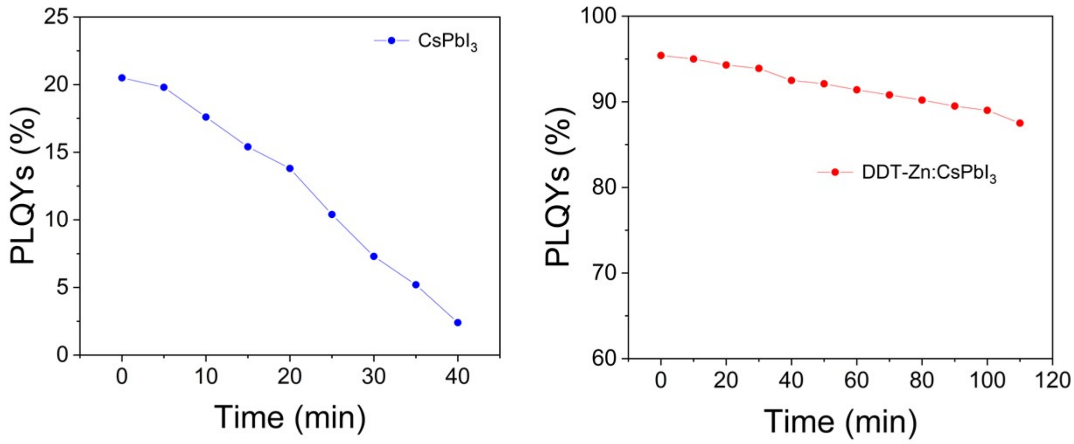


**Fig. S2** Evolution of PLQYs of $CsPbI_3$ and DDT-Zn:$CsPbI_3$ NCs under 365 nm UV light irradiation.

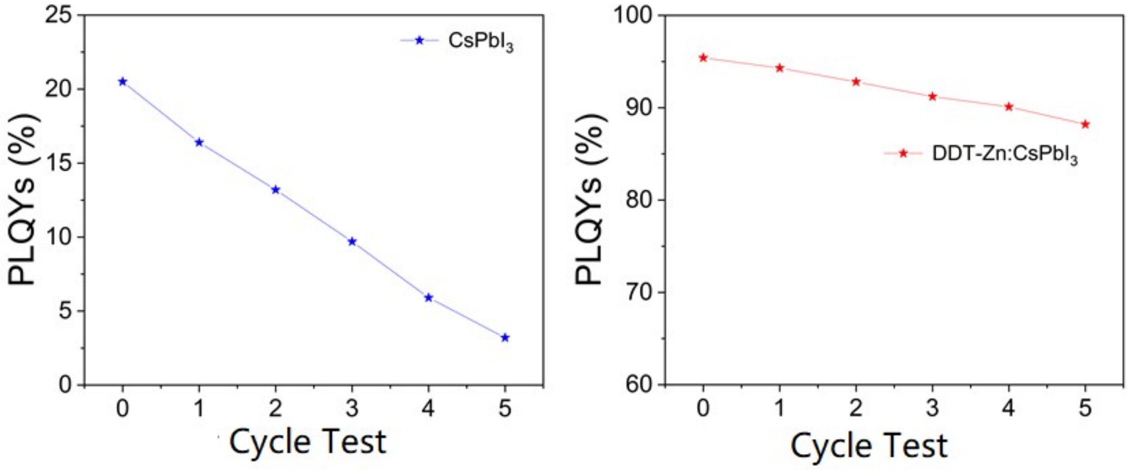


**Fig. S3** Evolution of PLQYs of $CsPbI_3$ and DDT-Zn:$CsPbI_3$ NCs after hot-treatment cycles.

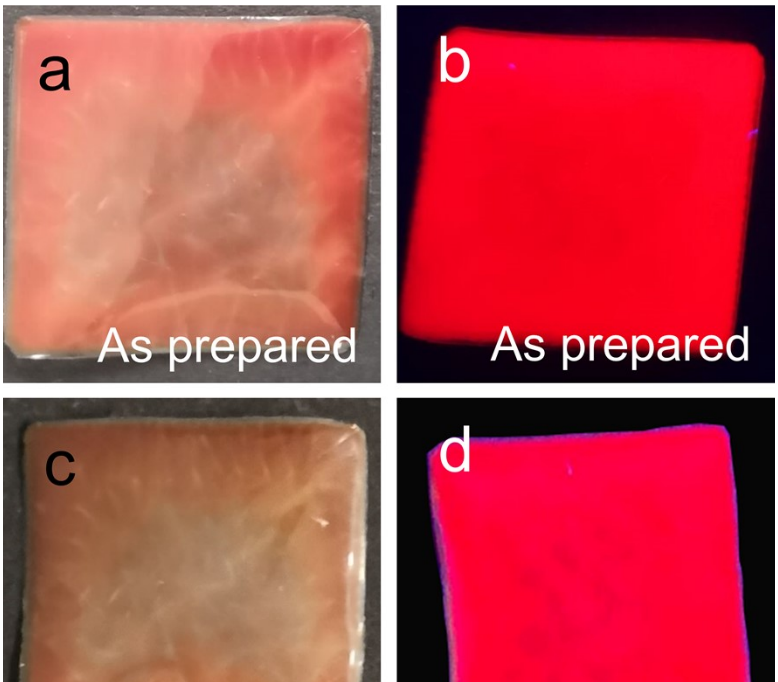


**Fig. S4** Photographs of as-prepared (a and b) DDT-Zn:$CsPbI_3$ NCs Films and after 100 days (c and d) under room light (a and c) and 365 nm UV light (b and d) irradiation.

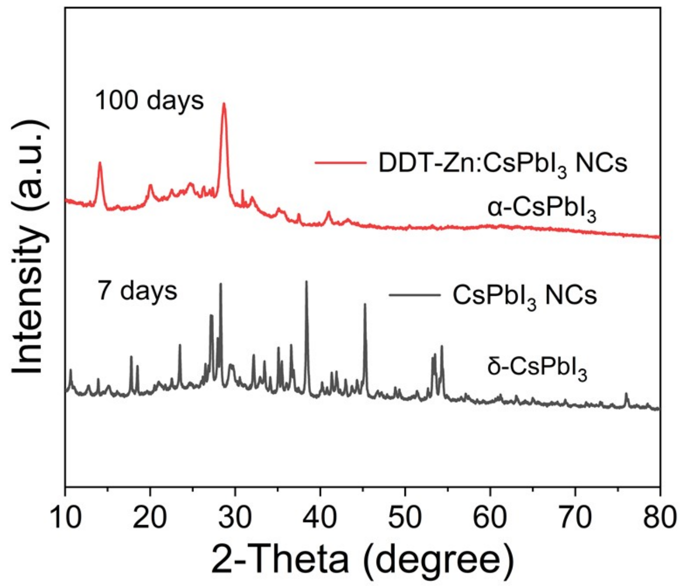


**Fig. S5** XRD patterns of $CsPbI_3$ and DDT-Zn:$CsPbI_3$ NCs after 100 days.

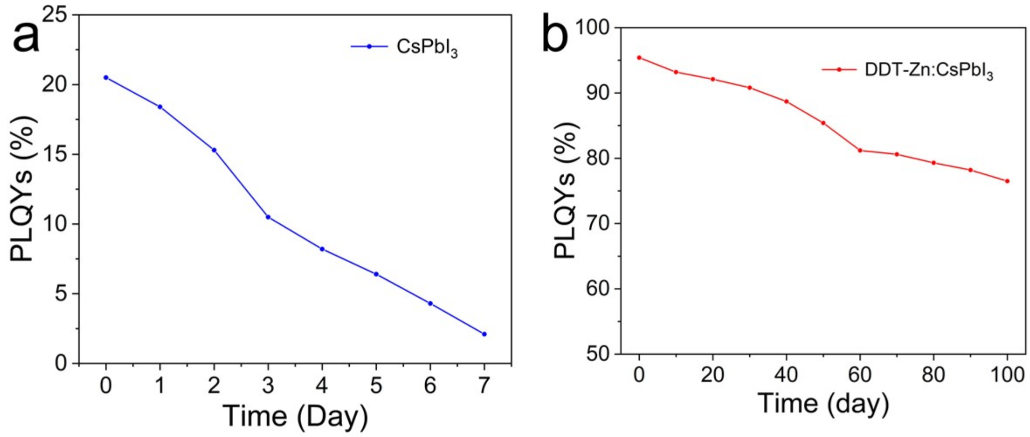


**Fig. S6** Evolution of PLQYs of $CsPbI_3$ and DDT-Zn:$CsPbI_3$ film after 100 days.

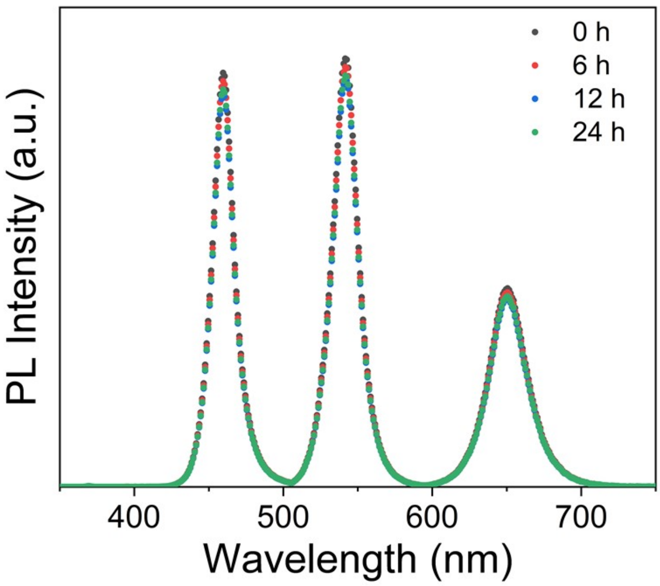


**Fig. S7** Emission spectra of WLEDs obtained after different running periods.

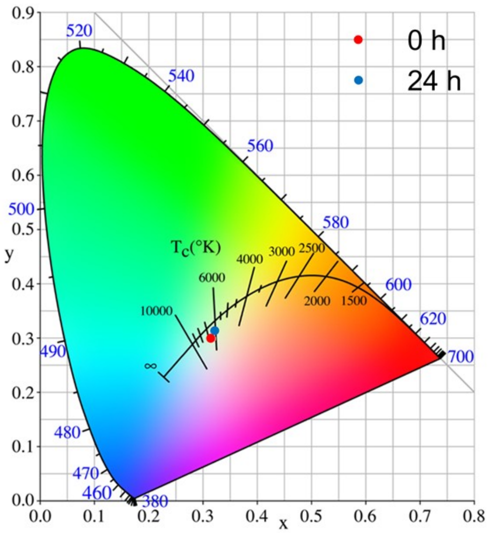


**Fig. S8** CIE coordinates of WLEDs obtained after different running periods.