Electronic Supplementary information

Red thermally activated delayed fluorescence material as triplet sensitiser for triplet-triplet annihilation up-conversion with high efficiency and low energy loss

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General Information

Absorption spectra were recorded on a SHIMADZU UV-2700 spectrophotometer. Fluorescence spectra were measured by using a HITACHI F-4600 fluorescence spectrometer. Up-converted emission spectra were recorded on HITACHI F-4600 with the excitation source using an external, adjustable, continuous semiconductor laser (532 nm, LSR532H-2W). The luminescence decay was carried out on CHI FLS-920 with the laser of 377 nm.
Determination of the $\Phi_{ISC}$ of BTZ-DMAC

The $\Phi_{ISC}$ of BTZ-DMAC was calculated according to following formula:

$$\Phi_{ISC} = \frac{\Phi_{DF}}{\Phi_{DF} + \Phi_{PF}} = \frac{R_{DF}}{\Phi} = R_{DF}$$

Where $\Phi_{ISC}$, $\Phi_{DF}$, $\Phi_{PF}$ and $R_{DF}$ represent the efficiency of ISC, the quantum yield of delayed fluorescence, the quantum yield of promoted fluorescence and the proportion of delayed fluorescence, respectively.

Determination of TTA-UC quantum yield

The TTA-UC quantum yield in deaerated benzene was calculated relative to a standard. Rhodamine 6G in ethanol (0.1 $\mu$M, $\Phi_{std} = 95\%$).

$$\Phi_{UC} = \Phi_{std} \left( \frac{A_{std}}{A_{UC}} \right) \left( \frac{I_{UC}}{I_{std}} \right) = 0.5\Phi_{UC}.$$ 

Where $\Phi$, $A$, and $I$ represent the quantum yield, absorbance at 532 nm, and integrated fluorescence spectral profile.
**Fig. S1** The absorption and emission spectra of DPA (5 mM) in toluene.

**Fig. S2** The absorption and emission spectra of BTZ-DMAC (1 mM) in toluene.