Electronic Supplementary Information

Red-to-blue photon up-conversion with high efficiency based on a TADF fluorescein derivative

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1、General Information

The steady-state absorption spectra were recorded on a Cary 60 UV-Vis spectrophotometer from Agilent Tech at room temperature. Fluorescence spectra were measured by using a Cary Eclipse fluorescence spectrophotometer from Agilent Tech at room temperature. Up-converted emission spectra were recorded on Cary Eclipse fluorescence spectrophotometer with the excitation source using an external, adjustable, continuous semiconductor laser (635 nm, MRL-Ⅲ-635-500mW). The luminescence decay was carried out on HORIBA DeltaFlex-01-NL with the SpectraLED laser (452 nm). Compound DCF-MPYM was synthesized and purified according to our reported work.[1]

2、Calculation of Triplet -Triplet Annihilation Up-conversion Quantum Yield

Steady-state absorption and fluorescence spectroscopy

The steady-state absorption and fluorescence spectroscopy were recorded with a UV-Visible spectrometer named Cary 60 and a fluorometer named Cary Eclipse from Agilent Tech at room temperature, respectively. The data were obtained under the control of a Windows-based PC running the manufacturers' supplied software.

Determination of TTA-UC quantum yield The TTA-UC quantum yield (Φ_{UC}) was calculated in tetrahydrofuran (THF) with the following equation[2]. The prompt fluorescence of methylene blue (MB) (Φ_{MB} = 0.03 in methanol) was as reference[3].

$$\Phi_{UC} = 2\Phi_{Std} \times \frac{1 - 10^{-A_{Std}}}{1 - 10^{-A_{Sam}}} \times \frac{I_{Sam}}{I_{Std}} \times \frac{\eta_{Sam}}{\eta_{Std}}$$

where Φ、A、I *and* η is represents the quantum yield、absorbance、integrated photoluminescence intensity and refractive index. The corresponding terms for the subscript std are for the reference quantum counter and sam for the sample of the TTA-UC system. The equation is multiplied by a factor of 2 so as to set the maximum quantum yield to unity.

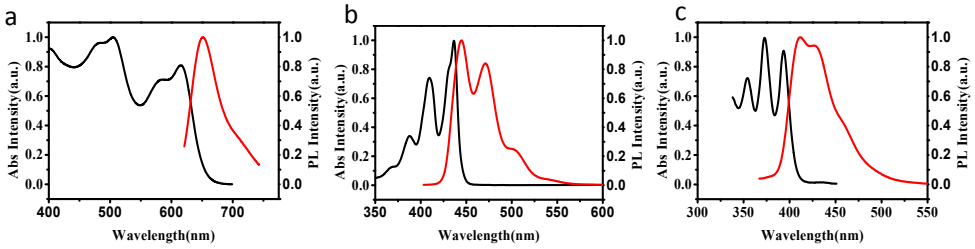

Figure S1. Normalized absorption（black line） and emission（red line）; (a) DCF-MPYM（λ_{ex}= 615 nm） (b) Perylene (λ ex= 388 nm);(c) DPA in tetrahydrofuran (THF) (λ_{ex}= 354 nm).

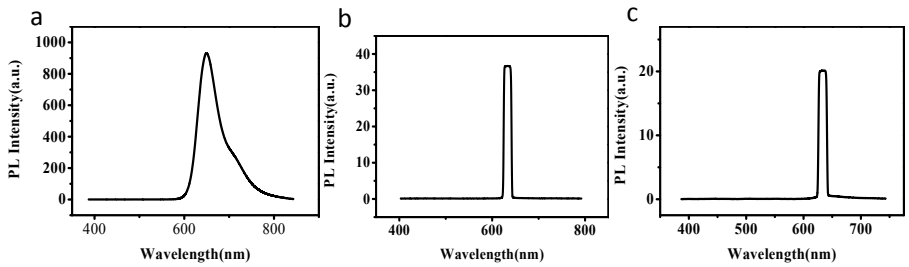

Figure S2. (a) Photoluminescence（PL） spectra of DCF-MPYM (2.0×10^{-5} M) in THF deaerated by argon bubbling for about 30 min (λ_{ex}= 635 nm)；(b) Photoluminescence（PL） spectra of perylene (2.0×10^{-4} M) in THF deaerated by argon bubbling for about 30 min (λ_{ex}= 635 nm)；(c) Photoluminescence （PL）spectra of DPA (1.6×10^{-3} M) in deaerated THF by argon bubbling for about 30 min (λ_{ex}= 635 nm).

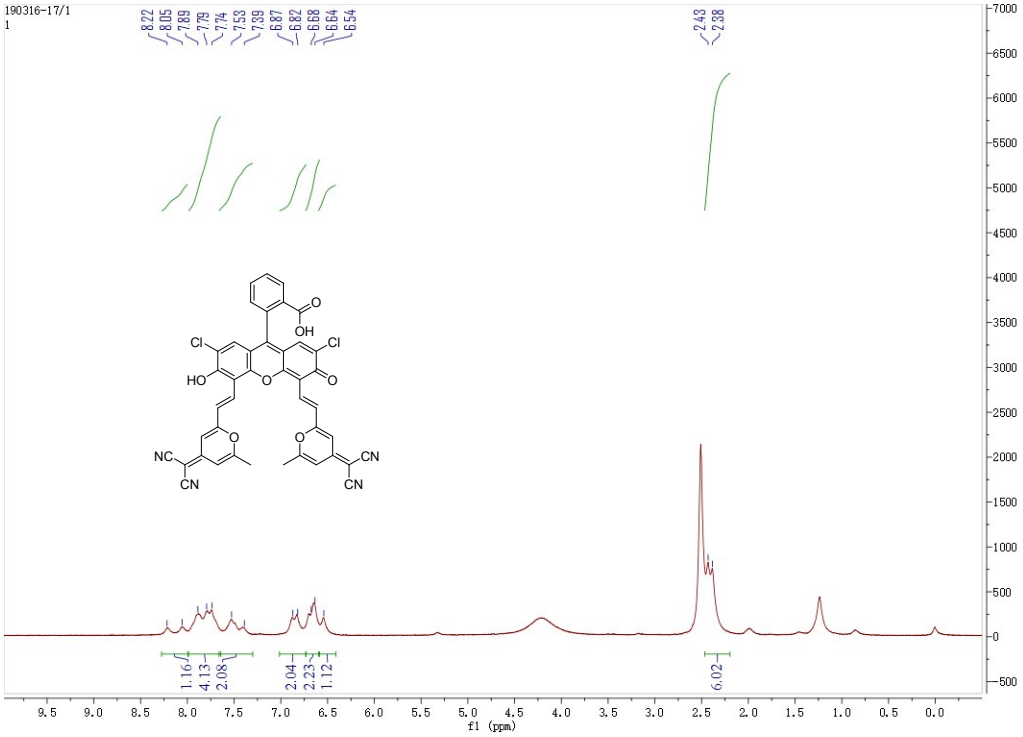

Figure S3. ^{1}H NMR spectrum of DCF-MPYM (in DMSO-d_6)

References:

1. X. Xiong, F. Song, S. Sun, J. Fan and X. Peng, *Asian Journal of Organic Chemistry*, 2013, **2**, 145-149.
2. Z. Wang, J. Zhao, A. Barbon, A. Toffoletti, Y. Liu, Y. An, L. Xu, A. Karatay, H. G. Yaglioglu, E. A. Yildiz and M. Hayvali, *Journal of the American Chemical Society*, 2017, **139**, 7831-7842.
3. J. Olmsted, *The Journal of Physical Chemistry*, 1979, **83**, 2581-2584.