Triple fusion upconversion using sterically protected 9,10-diphenylanthracene as emitter

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General procedures

All commercial reagents were used as received without further purification. Anhydrous solvents were obtained from drying columns with activated alumina. All air sensitive reactions were carried out under nitrogen atmosphere using standard Schlenk techniques. All reaction solvents were degassed with constant bubbling of nitrogen 30 minutes before addition to the reaction mixture. Solvents used for spectroscopy were degassed by repeated freeze-pump-thaw cycles. Reactions were monitored by thin-layer chromatography using silica gel on glass plates. Flash column chromatography was carried out using 230-400 mesh silica. The ¹H and ¹³C NMR spectra were collected using an Agilent MR400 (400 MHz) instrument. All NMR spectra, if not otherwise specified, were measured at 25 °C and calibrated using the residual solvent signals. X-ray crystal data were collected with an ADSC Quantum 210R diffractometer using the MX2 beamline at the Australian Synchrotron.



Photophysical characterization

Figure S1. Photoluminescence decays at 425 nm of the DPAs dilute toluene solution (a) and polyurethane thin film (b) with excitation at 405 nm. The instrumental response function (IRF) shown in black was recorded using a fused silica plate and was about 60 ps (fwhm).



Figure S2. (a) A double logarithmic plot of integrated upconverted emission dependence on excitation power density in toluene solution ([PtOEP]: 0.02 mM, [DPA]: 1 mM). (b) Stern-Volmer quenching of PtOEP (0.02 mM) in toluene solution (excited at 532 nm with the power density of 500 mW cm⁻²).



Figure S3. (a) A double logarithmic plot of integrated upconverted emission dependence on excitation power density in polyurethane film ([PtOEP]: 0.3 mM, [DPA]: 3 mM). (b) Stern-Volmer quenching of PtOEP (0.3 mM) in polyurethane film (excited at 532 nm with the power density of 500 mW cm⁻²).



Figure S4. (a) A double logarithmic plot of integrated upconverted emission dependence on excitation power density and (b) TTA-UC quantum yield as a function of excitation power density at 532 nm in polyurethane film ([PtOEP]: 0.4 mM, [DPA]: 8 mM).



Figure S5. The Q-band absorption spectra of PtOEP in THF solution and DPAs/PtOEP binary crystals.



Figure S6. A double logarithmic plot of upconverted emission in DPA/PtOEP (black), bDPA-1/PtOEP (red) and bDPA-2/PtOEP (blue) as a function of excitation power density at 532 nm.



Figure S7. (a) TTA-UC thin film of bDPA-2/PtOEP nanoparticles on glass slide, (b) TTA-UC thin film of bDPA-2/PtOEP nanoparticles on glass slide under excitation by 532 nm CW laser, (c) upconverted emission from the thin film through the 500 nm short pass filter under the excitation of 532 nm CW laser.



Figure S8. The phosphorescence decay at 645 nm of PtOEP in THF solution and DPAs/PtOEP binary crystals with excitation at 532 nm.



Figure S9. Transient absorption measurement of DPAs (3 mM) and PtOEP (0.3 mM) in polyurethane film monitored at 452 nm following 532 nm excitation.

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	τ_t solution (ms)	τ_t polyurethane (ms)
DPA	1.14	0.04/2.72
bDPA-1	0.58	0.02/2.62
bDPA-2	0.64	0.03/3.42