Supporting Information

Photouncaging of Carboxylic Acids from Cyanine Dyes with Near-Infrared Light

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Supporting Information

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Materials and Methods

Reagents and solvents of the highest purity available were used as purchased, or they were purified/dried using standard methods when necessary. The intermediates 4f, 6a–g were synthesized according to the published procedures1,2,3,4,5,6,7 or purchased from standard suppliers (Merck, TCI, Across Organics, etc.).

Flash column chromatography was performed using silica gel (230–400 mesh). 1H NMR spectra were recorded on 400 or 500 MHz spectrometers; 13C NMR spectra were obtained on 125 MHz instruments in CDCl3, CD3OD, and d6-DMSO. 19F NMR were obtained on 376 MHz or 470 MHz instruments. 1H chemical shifts are reported in ppm relative to CDCl3 (δ = 7.26 ppm), CD3OD (δ = 3.31 ppm) and d6-DMSO (δ = 2.50 ppm) as an internal reference. 13C chemical shifts are reported in ppm with CDCl3 (δ = 77.67 ppm), CD3OD (δ = 49.30 ppm) and d6-DMSO (δ = 39.52 ppm) as internal references. 19F NMR chemical shifts are reported in ppm either without internal standard, or in case of irradiation experiments using C6F6 (δ = −165.35 ppm) in a sealed capillary as an internal reference. Deuterated solvents were kept under nitrogen atmosphere.

Absorption spectra and molar absorption coefficients were obtained on a UV-vis spectrometer with matched 1.0-cm quartz cells. Fluorescence and excitation spectra were measured using a fluorescence spectrometer in a 1.0 cm quartz fluorescence cuvette at 20 °C. The sample concentrations were adjusted to keep the absorbance below 0.2 at the corresponding excitation wavelength. Each sample was measured five times, and the spectra were averaged. Emission and excitation spectra were normalized and corrected by the photomultiplier sensitivity function using correction files supplied by the manufacturer.

The exact masses of the synthesized compounds were obtained using a triple quadrupole electrospray ionization mass spectrometer in a positive or negative mode coupled with direct-inlet.

Synthesis of the Intermediates and Photocages

General Procedure for Synthesis of Esters 4a–e.
The corresponding acid (3a-c) (1.3 eq.), pyridine-4-yethanol (6e–d) (1 eq.) and DMAP (0.2 eq.) were dissolved in anhydrous CH2Cl2 (6 mL/mmol) and EDC.HCl (1.3 eq.) was added to the stirred solution under N2 atmosphere. The reaction mixture was stirred at room temperature for 96 h (if not stated different), transferred to a separatory funnel and extracted with sat. aq. NaHCO3 (3×50 mL). The organic phase was dried with MgSO4, volatiles were evaporated under reduced pressure and the residue was purified by column chromatography (SiO2, gradient CH2Cl2 - CH2Cl2/MeOH - 50:1, 40:1 and 30:1).

1-(Pyridin-4-yl)ethyl 4-fluorobenzoate (4a).
Prepared according to the general procedure from 4-fluorobenzoic acid (3a) (753 mg, 5.28 mmol), pyridin-4-yethanol (6d) (500 mg, 4.06 mmol), DMAP (99 mg, 0.81 mmol) and EDC.HCl (1012 mg, 5.28 mmol). Yield: 806 mg (81%). Colorless liquid. 1H NMR (400 MHz, d6-CDCl3) δ (ppm) 8.62 (dd, J1 = 4.6, J2 = 1.6 Hz, 2H), 8.13–8.08 (m, 2H), 7.35 (dd, J1 = 4.6, J2 = 1.4 Hz, 2H), 7.17–7.11 (m, 2H), 6.08 (q, J = 6.6 Hz, 1H), 1.67 (d, J = 6.7 Hz, 3H). 13C NMR (125 MHz, d6-CDCl3) δ (ppm) 166.0 (d, J = 254.2 Hz), 149.8, 149.5, 132.3 (d, J = 9.2 Hz), 126.1, 120.83,
120.76, 115.7 (d, J = 22.0 Hz), 71.5, 22.1. $^{19}$F NMR (470 MHz, d-CDCl$_3$) $\delta$ (ppm) -105.21. HRMS (ESI+) calcd. for [C$_{14}$H$_{13}$FNO$_2$]$^+$ 246.0925, found 246.0922.

1-(Pyridin-4-yl)ethyl 4-methoxybenzoate (4b).
Prepared according to the general procedure from 4-methoxybenzoic acid (3b) (819 mg, 5.28 mmol), pyridin-4-ylethanol (6d) (500 mg, 4.06 mmol), DMAP (99 mg, 0.81 mmol) and EDC.HCl (1012 mg, 5.28 mmol). Yield: 721 mg (69%). Colorless liquid. $^1$H NMR (400 MHz, d-CDCl$_3$) $\delta$ (ppm) 8.60 (dd, $J_1 = 4.5, J_2 = 1.6$ Hz, 2H), 8.05 (dd, $J_1 = 6.9, J_2 = 2.1$ Hz, 2H), 7.33 (dd, $J_1 = 4.6, J_2 = 1.5$ Hz, 2H), 6.95 (dd, $J_1 = 6.9, J_2 = 2.1$ Hz, 2H), 6.06 (q, $J = 6.7$ Hz, 1H), 3.87 (s, 3H), 1.65 (d, $J = 6.7$ Hz, 3H). $^{13}$C NMR (125 MHz, d-CDCl$_3$) $\delta$ (ppm) 165.9 (d, $J = 22.0$ Hz), 148.7, 147.7, 132.1 (d, $J = 22.0$ Hz), 82.2, 35.1, 25.9.

Synthesis of 2-pyridin-4-yl-prop-2-yl 4-fluorobenzoate (4e).
To a suspension of 4-fluorobenzoic acid (3a) (1.56 g, 10.9 mmol) in anhydrous CH$_2$Cl$_2$ (10 mL), oxalyl chloride (1.88 mL, 21.8 mmol) and DMF (2 drops) were added at room temperature under N$_2$ atmosphere. The mixture was stirred at room temperature for 30 minutes and the volatiles were evaporated under reduced pressure. The crude acyl chloride was used immediately in subsequent reaction. 2-(Pyridin-4-yl)propan-2-ol (6f) (1.5 g, 10.9 mmol) was dissolved in anhydrous THF (90 mL) and cooled in ice bath. n-BuLi (7.5 ml, 1.6 M in n-hexane, 12 mmol) was added to the cooled solution under N$_2$ atmosphere. The mixture was stirred at room temperature for 1 h and the acyl chloride (prepared as described above) in anhydrous THF (8 mL) was added dropwise. The mixture was stirred at room temperature for 48 h and quenched with sat. aq. NaHCO$_3$ (100 mL). EtOAc (50 mL) was added, and the mixture was separated. The water phase was extracted with EtOAc (3×50 mL) and the combined organic phases were dried with MgSO$_4$. Volatiles

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were evaporated under reduced pressure and the residue was purified by column chromatography (SiO₂, EtOAc/Hexanes gradient from 1:2 to 1:1) to afford the product. Yield 1.4 g (50%). White solid. M.p. 108.6–110.1 °C. ¹H NMR (500 MHz, d₆-CDCl₃) δ (ppm) 8.59 (d, J = 5.3 Hz, 2H), 8.04 (dd, J₁ = 9.0, J₂ = 6.5 Hz, 2H), 7.35 (d, J = 5.1 Hz, 2H), 7.14–7.11 (m, 2H), 1.88 (s, 6H). ¹³C NMR (125 MHz, d₆-CDCl₃) δ (ppm) 166.0 (d, J = 254.5 Hz), 164.2, 155.9, 149.2, 132.3 (d, J = 9.4 Hz), 127.0 (d, J = 2.9 Hz), 119.8, 115.8 (d, J = 22.0 Hz), 81.0, 28.4. ¹⁹F NMR (470 MHz, d₆-CDCl₃) δ (ppm) -105.24. HRMS (ESI+) calcd. for [C₁₅H₁₄FNO₂⁺] 260.1081, found 260.1087.

General Procedure for Synthesis of Zincke salts 5a–e.
The corresponding ester (1 eq.) and 2,4-dinitrophenyltosylate (6g) (1.1 eq.) were suspended in acetone (1.4 mL/mmol) and stirred at 40 °C for 18 h. After cooling to room temperature Et₂O (4 mL/mmol) was added, and the product was left to precipitate while stirred for 2 h. The solid was filtered, washed with Et₂O (8 mL/mmol) and dried on air.

1-(2,4-Dinitrophenyl)-4-(1-((4-fluorobenzoyl)oxy)ethyl)pyridin-1-ium 4-methylbenzenesulfonate (5a).
Prepared according to the general procedure from 4a (700 mg, 2.85 mmol) and 2,4-dinitrophenyl tosylate (6g) (1061 mg, 3.14 mmol). Yield 1.58 g (95%). White solid. M.p. 229.5–230.9 °C. ¹H NMR (400 MHz, d₆-DMSO) δ (ppm) 9.35 (d, J = 6.9 Hz, 2H), 9.12 (d, J = 2.5 Hz, 1H), 8.97 (dd, J₁ = 8.7, J₂ = 2.5 Hz, 1H), 8.54 (d, J = 6.8 Hz, 2H), 8.41 (d, J = 8.7 Hz, 1H), 8.24–8.19 (m, 2H), 7.48–7.41 (m, 4H), 7.10 (d, J = 7.8 Hz, 2H), 6.40 (q, J = 6.7 Hz, 1H), 2.28 (s, 3H), 1.76 (d, J = 6.7 Hz, 3H). ¹³C NMR (125 MHz, d₆-DMSO) δ (ppm) 165.5 (d, J = 252.4 Hz), 163.9, 163.5, 149.1, 146.2, 145.7, 143.0, 138.5, 137.5, 132.6 (d, J = 9.6 Hz), 131.9, 130.1, 128.0, 125.4, 124.4, 121.4, 116.0 (d, J = 22.3 Hz), 71.0, 20.7. ¹⁹F NMR (375 MHz, d₆-DMSO) δ (ppm) -104.81. HRMS (ESI+) calcd. for [C₂₀H₁₅FN₃O₆⁺] 412.0945, found 412.0951.

1-(2,4-Dinitrophenyl)-4-(1-((4-methoxybenzoyl)oxy)ethyl)pyridin-1-ium 4-methylbenzenesulfonate (5b).
Prepared according to the general procedure from 4b (700 mg, 2.72 mmol) and 2,4-dinitrophenyl tosylate (6g) (1012 mg, 2.99 mmol). Yield 1.51 g (93%). White solid. M.p. 197.0–200.6 °C. ¹H NMR (400 MHz, d₄-CD₃OD) δ (ppm) 9.28 (d, J = 2.4 Hz, 1H), 9.25 (dd, J₁ = 7.1, J₂ = 1.9 Hz, 2H), 8.91 (dd, J₁ = 8.7, J₂ = 2.5 Hz, 1H), 8.54 (d, J = 6.8 Hz, 2H), 8.41 (d, J = 8.7 Hz, 1H), 8.24–8.19 (m, 2H), 7.48–7.41 (m, 4H), 7.10 (d, J = 7.8 Hz, 2H), 6.40 (q, J = 6.7 Hz, 1H), 2.28 (s, 3H), 1.76 (d, J = 6.7 Hz, 3H). ¹³C NMR (125 MHz, d₆-DMSO) δ (ppm) 165.0, 164.4, 164.2, 149.6, 146.8, 146.2, 143.6, 139.0, 138.1, 132.4, 132.3, 130.6, 128.5, 125.9, 124.9, 121.9, 121.4, 116.0 (d, J = 22.3 Hz), 71.0, 21.3, 20.7. ¹⁹F NMR (375 MHz, d₆-DMSO) δ (ppm) -104.81. HRMS (ESI+) calcd. for [C₂₁H₁₈N₃O₇⁺] 424.1145, found 424.1151.

4-(1-((7-(Diethylamino)-2-oxo-2H-chromene-3-carbonyl)oxy)ethyl)-1-(2,4-dinitrophenyl)pyridin-1-ium 4-methylbenzenesulfonate (5c).
1-(2,4-Dinitrophenyl)-4-((4-fluorobenzoyl)oxy)-2,2-dimethylpropyl)pyridin-1-ium 4-methylbenzensulfonate (5d).

Prepared according to the general procedure from 4d (524 mg, 1.82 mmol) and 2,4-dinitrophenyl tosylate (6g) (676 mg, 2.00 mmol). Yield 1.09 g (95%).

White solid. M.p. 247.5–248.9 °C. H NMR (500 MHz, d6-DMSO) δ (ppm) 9.33 (d, J = 6.3 Hz, 2H), 9.11 (d, J = 2.5 Hz, 1H), 8.98 (dd, J1 = 8.7, J2 = 2.6 Hz, 1H), 8.5 (d, J = 6.5 Hz, 2H), 8.46 (d, J = 8.7 Hz, 1H), 8.24–8.19 (m, 2H), 7.57–7.37 (m, 4H), 7.11 (d, J = 7.8 Hz, 2H), 6.04 (s, 1H), 2.29 (s, 3H), 1.10 (s, 9H). C NMR (125 MHz, d6-DMSO) δ (ppm) 165.3 (d, J = 9.8 Hz), 131.6, 129.9, 127.7, 125.8, 125.2, 124.9 (d, J = 2.8 Hz), 121.1, 115.9 (d, J = 22.1 Hz), 80.4, 35.3, 25.1, 20.5. F NMR (470 MHz, d6-DMSO) δ (ppm) -104.58. HRMS (ESI+) calcd. For [C23H25FN3O6+] 454.1409, found 454.1439.

1-(2,4-Dinitrophenyl)-4-((4-fluorobenzoyl)oxy)propan-2-yl)pyridin-1-ium 4-methylbenzensulfonate (5e).

Prepared according to the general procedure from 4e (500 mg, 1.93 mmol) and 2,4-dinitrophenyl tosylate (6g) (717 mg, 2.12 mmol). Yield 1.06 g (92%).

White solid. M.p. 227.7–229 °C. H NMR (500 MHz, d6-DMSO) δ (ppm) 9.33 (d, J = 6.5 Hz, 2H), 9.11 (d, J = 2.5 Hz, 1H), 8.94 (dd, J1 = 8.7, J2 = 2.4 Hz, 1H), 8.47 (d, J = 6.5 Hz, 2H), 8.44 (d, J = 8.7 Hz, 1H), 8.12 (dd, J = 8.6, 5.5 Hz, 2H), 7.49 – 7.39 (m, 4H), 7.10 (d, J = 7.7 Hz, 2H), 2.28 (s, 3H), 1.97 (s, 6H). C NMR (125 MHz, d6-DMSO) δ (ppm) 166.9, 165.2 (d, J = 252.3 Hz), 163.4, 148.8, 145.8, 145.4, 142.8, 138.2, 137.3, 132.3 (d, J = 9.7 Hz), 131.7, 129.8, 127.7, 125.8 (d, J = 2.9 Hz), 125.2, 123.4, 121.1, 115.7 (d, J = 22.0 Hz), 80.3, 26.9, 20.5. F NMR (470 MHz, d6-DMSO) δ (ppm) -105.00. HRMS (ESI+) calcd. For [C21H17FN3O5+] 426.1101, found 426.1086.

1-(2,4-Dinitrophenyl)-4-((4-fluorobenzoyl)oxy)propan-2-yl)pyridin-1-ium 4-methylbenzensulfonate (5f).

Prepared according to the general procedure from 4f (200 mg, 1.12 mmol) and 2,4-dinitrophenyl tosylate (6g) (418 mg, 1.23 mmol). Yield 513 mg (83%).

White solid. M.p. 220.9–222.3 °C. H NMR (500 MHz, d6-DMSO) δ (ppm) 9.32 (d, J = 6.4 Hz, 2H), 9.11 (d, J = 2.5 Hz, 1H), 8.95 (dd, J1 = 8.7, J2 = 2.5 Hz, 1H), 8.43 (d, J = 8.7 Hz, 1H), 8.39 (d, J = 6.5 Hz, 2H), 7.45 (d, J = 7.7 Hz, 2H), 7.10 (d, J = 7.7 Hz, 2H), 2.28 (s, 3H), 2.14 (s, 3H), 1.81 (s, 6H). C NMR 13C NMR (126 MHz, d6-DMSO) δ (ppm) 170.1, 168.1, 149.6, 146.4, 146.3, 143.6, 138.9,
General Procedure for Synthesis of Cyanines 1a–f.
The corresponding Zincke salt 5a–f (1 eq.) and heterocycle 6a–e (3 eq) were suspended in a solution of AcOK in EtOH (300 µM, 20 mL/mmol). The reaction mixture was stirred at room temperature for 18 h in a flask covered with aluminum foil. The volatiles were evaporated under reduced pressure, EtO (3 mL/mmol) added and the precipitate was filtered, dried, washed with EtO (6 mL/mmol), H₂O (4 mL/mmol) and Et₂O (2.5 mL/mmol) (if not stated different). The crude product was purified by column chromatography (SiO₂, gradient CH₂Cl₂ - CH₂Cl₂/MeOH - 50:1, 40:1, 30:1(if not stated different)).

2-((1E,3Z,5E)-4-((1-(4-Fluorobenzoyl)oxy)ethyl)-7-((E)-1,3,3-trimethylindolin-2-ylidene)hepta-1,3,5-trien-1-yl)-1,3,3-trimethyl-3H-indol-1-ium iodide (1a)
Prepared according to the general procedure from 5a (245 mg, 0.42 mmol) and heterocycle 6a (379 mg, 1.26 mmol). Yield 178 mg (60%). Dark green solid. M.p. 153.3–154 °C. 1H NMR (500 MHz, d₄-CD₂OD) δ (ppm) 8.30 (dd, J₁ = 13.4, J₂ = 13.3 Hz, 2H), 8.19–8.16 (m, 2H), 7.51 (d, J = 7.3 Hz, 2H), 7.43 (dd, J₁ = 7.8, J₂ = 7.6, J₃ = 1.2 Hz, 2H), 7.32–7.26 (m, 6H), 6.71 (d, J = 13.4 Hz, 2H), 6.42 (d, J = 13.4 Hz, 2H), 6.34 (q, J = 6.8 Hz, 1H), 3.66 (s, 6H), 1.81 (d, J = 6.8 Hz, 3H), 1.75 (s, 6H), 1.68 (s, 6H). 13C NMR (125 MHz, d₄-CD₂OD) δ (ppm) 172.3, 166.1 (d, J = 3.0 Hz), 128.4, 126.1 (d, J = 9.6 Hz), 128.4, 121.4, 121.2, 115.4 (d, J = 22.5 Hz), 110.4, 104.9, 70.0, 49.0, 30.3, 26.9, 26.8, 20.3. 19F NMR (470 MHz, d₄-CD₂OD) δ (ppm) -107.13. HRMS (ESI+) calcd. for [C₃H₆FN₂O₂] 575.3074, found 575.3066.

2-((1E,3Z,5E)-4-((1-(4-Methoxybenzoyl)oxy)ethyl)-7-((E)-1,3,3-trimethylindolin-2-ylidene)hepta-1,3,5-trien-1-yl)-1,3,3-trimethyl-3H-indol-1-ium iodide (1b)
Prepared according to the general procedure from 5b (200 mg, 0.42 mmol) and heterocycle 6a (397 mg, 1.26 mmol). Yield 117 mg (39%). Dark green solid. M.p. 152.9–154 °C. 1H NMR (500 MHz, d₄-CD₂OD) δ (ppm) 8.30 (dd, J₁ = 13.4, J₂ = 13.4 Hz, 2H), 8.06 (dd, J₁ = 6.9, J₂ = 2.1 Hz, 2H), 7.50 (dd, J₁ = 7.5, J₂ = 7.3, J₃ = 1.2 Hz, 2H), 7.43 (dd, J₁ = 7.8, J₂ = 1.2 Hz, 2H), 7.31–7.25 (m, 4H), 7.04 (dd, J₁ = 6.8, J₂ = 2.0 Hz, 2H), 6.68 (d, J = 13.4 Hz, 2H), 6.40 (d, J = 13.4 Hz, 2H), 6.31 (q, J = 6.8 Hz, 1H), 3.88 (s, 3H), 3.65 (s, 6H), 1.79 (d, J = 6.7 Hz, 3H), 1.75 (s, 6H), 1.68 (s, 6H). 13C NMR (125 MHz, d₄-CD₂OD) δ (ppm) 172.3, 165.7, 164.1, 160.7, 144.1, 143.0, 141.1, 131.5, 128.4, 124.8, 121.9, 113.6, 110.4, 104.8, 69.6, 54.7, 48.9, 30.3, 26.9, 26.9, 20.4. HRMS (ESI+) calcd. for [C₃₀H₃₄N₂O₅] 587.3274, found 587.3286.

2-((1E,3Z,5E)-4-((1-((7-(Diethylamino)-2-oxo-2H-chromene-3-carbonyl)oxy)ethyl)-7-((E)-5-methoxy-1,3,3-trimethylindolin-2-ylidene)hepta-1,3,5-trien-1-yl)-5-methoxy-1,3,3-trimethyl-3H-indol-1-ium (1c)
Prepared according to the general procedure from 5c (200 mg, 0.28 mmol) and heterocycle 6b (282 mg, 0.85 mmol). Yield 128 mg (51%). Dark green solid. M.p. 173.0–173.6 °C. 1H NMR (500 MHz, d₄-CD₂OD) δ (ppm) 8.63 (s, 1H), 8.21 (dd, J₁ = 13.4, J₂ = 13.4 Hz, 2H), 7.57 (d, J = 9.0 Hz, 1H), 7.21 (d, J = 8.7 Hz, 2H), 7.11 (d, J = 2.5 Hz, 2H), 6.97 (dd, J₁ = 8.7, J₂ = 2.5 Hz, 2H), 6.83 (dd, J₁ = 9.1, J₂ = 2.4...
Potassium 3-(2-((1E,3Z,5E)-4-((4-fluorobenzoyl)oxy)ethyl)-7-(E)-5-methoxy-3,3-
dimethyl-1-(3-sulfonatopropyl)indolin-2-ylidene)hepta-1,3,3-trien-1-yl-1-ium-1-
yl)propane-1-sulfonate (1d)
Prepared according to the general procedure from 5a (250 mg, 0.42 mmol) and heterocycle 6c (400 mg, 1.28 mmol). Column chromatography gradient DCM/MeOH 20:1 to 2:1. Yield 266 mg (68%). Dark green solid. M.p. 211.8–213.7 °C.

2-((1E,3Z,5E)-4-((4-Fluorobenzoyl)oxy)-2,2-dimethylpropyl)-7-((E)-1,3,3-
dimethyl-3H-indol-1-ium-1-yl)propane-1-sulfonate (1e)
Prepared according to the general procedure from 5d (263 mg, 0.42 mmol) and heterocycle 6a (379 mg, 1.26 mmol). Yield 211 mg (68%). Dark green solid. M.p. 149.7–150.3 °C. 1H NMR (500 MHz, d_4-CD_3OD) δ (ppm) 8.26–8.19 (m, 4H), 7.50 (d, J = 7.4 Hz, 2H), 7.42–7.41 (m, 2H), 7.33–7.25 (m, 6H), 6.82 (d, J = 13.3 Hz, 2H), 6.45 (d, J = 13.4 Hz, 2H), 5.98 (s, 1H), 3.65 (s, 6H), 1.74 (s, 6H), 1.68 (s, 6H), 1.22 (s, 9H). 13C NMR (125 MHz, d_4-CD_3OD) δ (ppm) 171.8, 167.2 (d, J = 7.0 Hz, 4H), 129.8, 127.5 (d, J = 4.0 Hz), 126.2, 123.9, 123.3, 117.0 (d, J = 2.2 Hz), 111.8, 106.3, 81.2, 50.3, 37.5, 31.7, 28.4, 28.2, 27.8. 19F NMR (470 MHz, d_4-CD_3OD) δ (ppm) -107.25. HRMS (ESI+) calcd. for [C_{44}H_{50}FNO_{10}S_{2}^+] 617.3543, found 617.3546.

2-((1E,3Z,5E)-4-((4-Fluorobenzoyl)oxy)propan-2-yl)-7-((E)-1,3,3-
trimethylindolin-2-ylidene)hepta-1,3,5-trien-1-yl)-1,3,3-
trimethyl-3H-indol-1-ium iodide (1f)
Prepared according to the general procedure from 5e (150 mg, 0.25 mmol) and heterocycle 6a (227 mg, 0.75 mmol). The step of washing with water was omitted. Yield 44 mg (25%). Dark green solid. M.p. 118.1 °C (decomp.). 1H NMR (500 MHz, d_4-CD_3OD) δ (ppm) 8.11–8.01 (m, 4H), 7.44–7.38 (m, 4H), 7.27–7.21 (m, 6H), 6.74 (d, J = 12.8 Hz, 2H), 6.43 (d, J = 13.4 Hz, 2H), 3.62 (s, 6H), 1.93 (s, 6H), 1.54 (s, 12H). 13C NMR (125 MHz, d_4-CD_3OD) δ (ppm) 173.4, 167.4 (d, J = 235.1 Hz), 167.1, 165.5, 147.4, 144.5, 142.2, 133.5 (d, J = 9.5 Hz), 129.8, 128.3 (d, J = 2.8 Hz), 126.0, 123.2, 121.5, 117.0 (d, J = 22.4 Hz), 111.7, 106.2, 84.3, 50.2, 31.7, 28.4, 28.2. 19F NMR (470 MHz, d_4-CD_3OD) δ (ppm) -107.43. HRMS (ESI+) calcd. for [C_{39}H_{42}FNO_{15}^+] 589.3230, found 589.3223.
2-((1E,3Z,5E)-4-(2-Acetoxypropan-2-yl)-7-((E)-1,3,3-trimethylindolin-2-ylidene)hepta-1,3,5-trien-1-yl)-1,3,3-trimethyl-3H-indol-1-ium iodide (1g)
Prepared according to the general procedure from 5f (150 mg, 0.25 mmol) and heterocycle 6a (227 mg, 0.75 mmol). The step of washing with water was omitted. Yield 64 mg (34%). Dark green solid. M.p. 111.8 °C (decomp.). 1H NMR (400 MHz, d4-CD3OD) δ (ppm) 8.00 (dd, J1 = 13.5, J2 = 12.8 Hz, 2H), 7.46 (dd, J1 = 7.4, J2 = 1.2 Hz, 2H), 7.42–7.39 (m, 2H), 7.28 (d, J = 8.0 Hz, 2H), 6.66 (d, J = 12.8 Hz, 2H), 6.45 (d, J = 13.5 Hz, 2H), 3.64 (s, 6H), 2.02 (s, 3H), 1.78 (s, 6H), 1.65 (s, 12H).

13C NMR (125 MHz, d4-CD3OD) δ (ppm) 172.1, 166.4, 146.4, 143.1, 140.7, 128.4, 124.6, 121.9, 120.0, 110.3, 104.6, 82.1, 65.5, 48.9, 30.3, 26.9, 20.4, 14.0. HRMS (ESI+) calcd. for [C34H41N2O2]+ 509.3168, found 509.3166. The analytical data match those reported by Feringa and co-workers.8

Photophysical and Photochemical Measurements Methodology
Fluorescence Measurements and Quantum Yields.
Emission spectra were measured in methanol and PBS (pH 7.4, 10 mM, I = 100 mM, 20% DMSO) using a fluorescence spectrometer in a 1.0 cm quartz fluorescence cuvette at 20 °C. The sample concentrations were adjusted to keep the absorbance <0.15 at the corresponding excitation wavelength. Each sample was measured five times, and the spectra were averaged. Emission spectra were normalized and corrected by the photomultiplier sensitivity function using correction files supplied by the manufacturer. The fluorescence quantum yields (ΦF) were determined using integration sphere, each sample was measured five times using independent solutions keeping A<0.15, and the values were averaged. Three independent samples were measured and average with standard deviation of the mean are given.

Aggregation study.
Absorbance of solutions of 1a and 1d at different concentrations (conc. range from c= 1.2×10^{-5} to c= 8×10^{-7}) in PBS (pH 7.4, 10 mM, I = 100 mM, 10% FBS, 1% DMSO) was measured using UV-vis spectrometer.

Photolysis and Dark Stability.
A solution of photocage 1a–f (c ~1–1.5 × 10^{-5} M, 3100 μL, A < 1.5) in aerated methanol, or PBS (pH 7.4, 10 mM, I = 100 mM, with 20% DMSO) was stirred and left to equilibrate for 2–3 min at 20 °C. Afterward, the sample was irradiated with LEDs at 780 nm (~50 mW/cm²) or 820 nm (~25 mW/cm²) and the progress of the irradiation was monitored at the given time intervals by UV−vis spectrometry using a diode-array spectrophotometer. The total irradiation time was selected to reach >95% conversion and to obtain minimum of 30 experimental points. The procedure was repeated three times. The dark stability of 1a–f was recorded using the same procedure with exclusion of the irradiation source.

Photolysis in the presence of ¹O₂ quencher NaN3.
A solution of photocage 1d or ICG (c ~1–1.5 × 10^{-5} M, 3000 μL, A < 1.5) in H2O, or aq. NaN3 (~100 eq) was stirred and left to equilibrate for 2–3 min at 20 °C. Afterward, the sample was irradiated with LEDs at 780 nm (~50 mW/cm²) and the progress of the irradiation was monitored at the given time intervals by UV−vis spectrometry using a diode-array spectrophotometer. The total irradiation time was selected to reach >60% conversion and to obtain minimum of 30 experimental points. The procedure was repeated three times.
Reaction with $^{1}$O$_2$ generated thermally from an endoperoxide. 1,4-Dimethylnaphthalene-1,4-endperoxide (MNEP) was synthesized according to the published procedure. Photocage 3a (2 mg) in $d_4$-MeOD (0.5 mL) in NMR tube was treated with 5 or 25 equiv. of MNEP in dark at room temperature and $^{19}$F NMR spectra were recorded at indicated times (Figure S103–104).

NMR Irradiation Experiments.
Photocage 1a–g (~0.8–1 mg) was dissolved in aerated or degassed methanol (0.5 mL). Methanol for experiments in oxygen-free conditions was extensively degassed by 3–4 cycles of sonication under vacuum (~3 min each) followed by 3–4 cycles of sonication under N$_2$ overpressure (~3 min each) and the samples were prepared in a glovebox. A sealed capillary of C$_6$F$_6$ in methanol was used an internal standard for $^{19}$F NMR spectroscopy. The NMR tube was then irradiated with a beam of collimated light at 780 nm (Ø=7 mm; at a distance of collimator from the NMR tube ~5 cm) and $^1$H and $^{19}$F NMR spectra were recorded after indicated time intervals. For the experiment using 1f the NMR sample after irradiation with exclusion of oxygen was diluted and measured using HRMS. For 1g only $^1$H NMR spectra were recorded.

NMR Irradiation Experiment with Methylene Blue as Auxiliary $^{1}$O$_2$ Generator.
Photocage 1a (~0.8mg) and methylene blue (~1 eq) were dissolved CD$_3$OD (0.5 mL). A sealed capillary of C$_6$F$_6$ in methanol was used an internal standard for $^{19}$F NMR spectroscopy. The NMR tube was then irradiated with LED array at 590 nm and $^1$H and $^{19}$F NMR spectra were recorded after 2 h and 16 h.

Decomposition Quantum Yield Determination.
A solution of photocage 1a–f ($c < 1 \times 10^{-3}$ M, 3100 μL, A < 1.5) in aerated methanol, or PBS (pH 7.4, 10 mM, I = 100 mM with 20% DMSO) was stirred and left to equilibrate for 2–3 min at 20 °C. Afterward, the sample was irradiated with a beam of collimated light at 780 nm (Ø=7 mm) and UV–vis spectra were recorded periodically using diode-array spectrophotometer. The radiant power (flux; $\Phi_e$) of the light source was determined using calibrated Si-photodiode and optical power meter (~40 mW). The total irradiation time was selected to reach <10% conversion of the photocages and to obtain ten experimental points. The procedure was repeated three times. The quantum yield of decomposition $\Phi_{dec}$ was calculated according to the equation:

$$\Phi_{dec} = \frac{\Delta n_{dec}}{\Delta n_{abs}}$$  \hspace{1cm} (Eq. 1)

where $\Delta n$ is the number of moles of the photodecomposed photocage 1a–f calculated from the absorbance change at $\lambda_{max}$, and $\Delta n_{abs}$ is the number of moles of photons absorbed by the sample in the give time period, calculated according to the equation:

$$\Delta n_{abs} = \int_0^t \int_0^{\infty} (1 - 10^{-A(\lambda,t)}) L_{em}^{\lambda} \, d\lambda \, dt$$  \hspace{1cm} (Eq. 2)

where $A(\lambda,t)$ is the absorbance of the sample at the wavelength $\lambda$ in time $t$, and $L_{em}$ is the photon flux of the LED source at the wavelength $\lambda$ determined according to the equation:
$I_{\lambda}^{em} = q_n(\lambda) \frac{\Phi_e}{\int_{0}^{\infty} \frac{hc}{\lambda} q_n(\lambda) \, d\lambda}$  \hspace{1cm} (Eq. 3)

where $q_n(\lambda)$ is the emission spectrum of the LED source provided by manufacturer (counts vs. wavelength) and $\Phi_e$ is the radiant power (flux) measured by the optical power meter.

For experiments under exclusion of oxygen, the sample prepared as described above, was treated with Ar using continuous flux of Ar (2 bubbles per second) from a needle attached to a balloon filled with Ar, for 15 minutes.

**Photouncaging Followed by Emission Spectroscopy.**

A solution of 1e in PBS (pH = 7.4, 10 mM, with 20% DMSO; 3 mL; adjusted to $A_{808} = 0.36$) in a matched 1.0 cm quartz was stirred and irradiated with LED array at 820 nm (~20 mW cm$^{-2}$). The progress of the photolysis was monitored periodically at the given time intervals simultaneously by UV–vis and emission spectroscopy ($\lambda_{exc} = 390$ nm). Each spectrum was recorded once to minimize exposure of the sample to the excitation light source. The emission spectra were integrated and plotted in Figure 3D.

**Determination of the Yield of Acid Release by HPLC.**

Solutions of the photocages 1a–f (40–63 µM; 1.5 mL) in PBS (pH = 7.4, 10 mM, with 20% MeOH) were placed in transparent screw-capped HPLC vials and irradiated at 780 nm (1a, 1b, 1f; 25 mW cm$^{-2}$) or 820 nm (1c–d) for 1 hour, followed by incubation at 37 °C for 2 h. The control experiments were placed in amber vials, wrapped in aluminum foil and incubated at 37 °C for 2 h. The samples were then analyzed by HPLC equipped with C18 column (NUCLEODUR C18 Pyramid, 5 µm, 150×4 mm) and using a gradient of MeOH/H$_2$O+0.1% at a flow rate of 1 mL min$^{-1}$, T=30 °C and UV/DAD detectors. The chemical yields were calculated from calibration curves constructed from solutions of commercial 3a–c prepared in identical manner.

**Methodology of Biological experiments**

**Cell Viability Assays.**

HeLa cells were seeded in 96 well plates at a density of $4 \times 10^3$ (1.5×10$^3$ for 72 h viability assay) cells per well and grown to 30% confluence for 24 hours 37°C at 5% CO$_2$ atmosphere. The half of the media (50 µL) was removed and substituted with media containing different concentrations of 1a,1d or the photoproducts of 1d (DMSO stock solution with c ~ 1 × 10$^{-2}$ M of parent compound was diluted with DMEM (4.5 g/L glucose, L-glutamine, 1% pyruvate, 10% FBS, 1% P/S) to obtain stock solution with 1% DMSO, which was further diluted with DMEM (4.5 g glucose, L-glutamine, 1% pyruvate, 10% FBS, 1% P/S) to reach the final concentration of compound). The amount of DMSO in well was kept stable at 0.1%. The photoproducts were prepared by irradiation of solution of 1d (c ~ 1 × 10$^{-2}$ M) in DMSO at 780 nm light (25 mW/cm$^2$) for 16 hours. The cells were incubated for 24 h or 72 h at 37 °C at 5% CO$_2$ atmosphere after the addition of compound. The cells were then left to equilibrate to room temperature for 30 minutes and a half of the media (50 µL) media was removed. Then 50 µL of CellTitre-Glo (prepared according to Promega protocol) was added and the cells were mixed with the reagent using rocking shaker at maximum speed for 15 minutes. Then the cells were left at room temperature in dark for 30 minutes. The luminescence was detected using plate reader in luminescence mode as an integral over all wavelengths (1000 ms integration time), and a plot of the cell viability was obtained from three replicates under each condition.
All experiments were repeated three times using cells from different passages. The cell viability was calculated using cells with 0 µM concentration of compound as a reference.

**Widefield Fluorescence Microscopy Studies.**

HeLa cells were seeded in 8 well microscopy slides (ibidi) at density of $1.2 \times 10^4$ cells per well and grown to 80% confluency for 24 hours at 37°C at 5% CO$_2$ atmosphere. The half of the media (150 µL) was removed and substituted with DMEM (4.5 g/L glucose, L-glutamine, 1% pyruvate, 10% FBS, 1% P/S, w/o phenol red) containing 1e (c ~ 3 µM) or 3e (c ~ 3 µM) (prepared as for the cell viability studies, using DMEM w/o phenol red) or no compound. After 1 h of incubation at 37°C at 5% CO$_2$ atmosphere, the half of the media (150 µL) was removed and 150 µL of DMEM (4.5 g/L glucose, L-glutamine, 1% pyruvate, 10% FBS, 1% P/S, w/o phenol red) was added. This procedure was repeated 5 times to eliminate residues of the compounds used for incubation. The cells were placed in light microscope and kept at 37°C at 5% CO$_2$ atmosphere throughout the duration of experiments. The cells were visualized using Leica DMi8 fully motorized, inverted microscope with a fluorescence light source Leica LED8 at either 40× (for statistical calculations in Figure 3N–O, and Figure S108) or at 63× (for Figure 3A–M) magnification, using brightfield channel (40 ms), coumarin fluorescence channel (exc. 390 nm, 5% intensity, exposure 100 ms, 420–450nm detection), and NIR channel (exc. 747 nm, 10% intensity, exposure 20 s, 770–850 nm detection) in 20 cycles. The images were processed using ImageJ. The corrected total cell fluorescence (CTCF) was calculated from the fluorescence intensity by subtraction of the background intensity in the vicinity of the cells. This was performed for both coumarin and NIR channels and each time point between 0 and 400 seconds. Each time point was calculated using 30–50 living cells for experiments with 1e under irradiation or in the dark, and 20< cells for control experiment involving no incubation or incubation with free coumarin 3e. The experiments were performed using 3 technical and biological replicates. The enhancement was calculated as a ratio of CTCF$_t$ in time ($t$) and the initial CTF$_0$ was plotted against time. Average of the enhancement and standard deviation of the mean are depicted. For Figures 3A–M, a background subtraction with a rolling ball radius of 100 pixels was applied.

**MS spectroscopy**

![HRMS (ESI+): 4a](image)

**Figure S1.** HRMS (ESI+): 4a
Figure S2. HRMS (ESI+): 4b

Figure S3. HRMS (ESI+): 4c

Figure S4. HRMS (ESI+): 4d
Figure S5. HRMS (ESI+): 4e

Figure S6. HRMS (ESI+): 5a

Figure S7. HRMS (ESI+): 5b
Figure S8. HRMS (ESI+): 5c

Figure S9. HRMS (ESI+): 5d

Figure S10. HRMS (ESI+): 5e
Figure S11. HRMS (ESI+): 5f

Figure S12. HRMS (ESI+): 1a

Figure S13. HRMS (ESI+): 1b
Figure S14. HRMS (ESI+): 1c

Figure S15. HRMS (ESI+): 1d

Figure S16. HRMS (ESI+): 1e
Figure S17. HRMS (ESI+): 1f

Figure S18. HRMS (ESI+): 1g
NMR spectroscopy

Figure S19. $^1$H NMR (400 MHz, $d$-CDCl$_3$): 4a
Figure S20. $^{13}$C NMR (125 MHz, $d$-CDCl$_3$): 4a
Figure S21. $^{19}$F NMR (470 MHz, $d$-CDCl$_3$): 4a
Figure S22. $^1$H NMR (400 MHz, $d$-CDCl$_3$): 4b
Figure S23. $^{13}$C NMR (125 MHz, $d$-CDCl$_3$): 4b
Figure S24. $^1$H NMR (500 MHz, $d$-CDCl$_3$): (4c) *acetone
Figure S25. $^{13}$C NMR (125 MHz, $d$-CDCl$_3$): 4c *acetone
Figure S26. $^1$H NMR (500 MHz, $d$-CDCl$_3$): 4d
Figure S27. $^{13}$C NMR (125 MHz, $d$-CDCl$_3$): 4d
Figure S28. $^{19}$F NMR (470 MHz, $d$-CDCl$_3$): 4d
Figure S29. $^1$H NMR (500 MHz, $d$-CDCl$_3$): 4e
Figure S30. $^{13}$C NMR (125 MHz, $d$-$\text{CDCl}_3$): 4e
Figure S31. $^{19}$F NMR (375 MHz, $d$-CDCl$_3$): 4e
Figure S32. $^1$H NMR (400 MHz, $d_6$-DMSO): 5a
Figure S33. $^{13}$C NMR (125 MHz, $d_6$-DMSO): 5a
Figure S34. $^{19}$F NMR (375 MHz, $d_6$-DMSO): 5a
Figure S35. $^1$H NMR (400 MHz, $d_4$-CD$_3$OD): 5b
Figure S36. $^{13}$C NMR (125 MHz, $d_6$-DMSO): 5b, *acetone
Figure S37. $^1$H NMR (500 MHz, $d_6$-DMSO): 5c
Figure S38. $^{13}$C NMR (125 MHz, $d_6$-DMSO): 5c
Figure S39. $^1$H NMR (500 MHz, $d_6$-DMSO): 5d
Figure S40. $^{13}$C NMR (125 MHz, $d_6$-DMSO): 5d, *acetone
Figure S41. $^{19}$F NMR (470 MHz, $d_6$-DMSO): 5d
Figure S42. $^1$H NMR (500 MHz, $d_6$-DMSO): 5e
Figure S43. $^{13}$C NMR (125 MHz, $d_6$-DMSO): 5e
Figure S44. $^{19}$F NMR (470 MHz, $d_6$-DMSO): 5e
Figure S45. $^1$H NMR (500 MHz, $d_6$-DMSO): 5f
Figure S46. $^{13}$C NMR (125 MHz, $d_6$-DMSO): 5f
Figure S47. $^1$H NMR (500 MHz, $d_4$-CD$_3$OD): 1a
Figure S48. $^{13}$C NMR (125 MHz, $d_4$-CD$_3$OD): 1a
Figure S49. $^{19}$F NMR (470 MHz, $d_4$-CD$_3$OD): 1a
Figure S50. HSQC (500 MHz, 125 MHz, d₄-CD₃OD): 1a
Figure S51. HMBC (500 MHz, 125 MHz, $d_2$-$CD_2$OD): 1a
Figure S52. $^1$H NMR (500 MHz, $d_4$-CD$_3$OD): 1b
Figure S53. $^{13}$C NMR (125 MHz, $d_4$-CD$_3$OD): 1b
Figure S54. HSQC (500 MHz, 125 MHz, d₄-CD₃OD): 1b
Figure S55. HMBC (500 MHz, 125 MHz, $d_6$-CD$_3$OD): 1b
Figure S56. $^1$H NMR (500 MHz, $d_4$ CD$_3$OD): 1c
Figure S57. $^{13}$C NMR (125 MHz, $d_4$-CD$_3$OD): 1c, $^*CD_2CD_2OD-d_5$ residue from the deuterated solvent
Figure S58. HSQC (500 MHz, 125 MHz, $d_4$-CD$_3$OD): (1c)
Figure S59. HMBC (500 MHz, 125 MHz, $d_6$-CD$_3$OD): (1c)
Figure S60. $^1$H NMR (500 MHz, $d_{4}$ CD$_3$OD): 1e
Figure S61. $^{13}$C NMR (125 MHz, $d_6$-CD$_3$OD): 1e, *CD$_3$CD$_2$OD-$d_5$ residue from the deuterated solvent
Figure S62. $^{19}$F NMR (470 MHz, $d_6$-CD$_3$OD): 1e
Figure S63. HSQC (500 MHz, 125 MHz, $d_4$-CD$_3$OD): 1e
Figure S64. HMBC (500 MHz, 125 MHz, $d_{6}$-CD$_3$OD): 1e
Figure S65. $^1$H NMR (500 MHz, $d_4$-CD$_3$OD): 1d
Figure S66. $^{13}$C NMR (125 MHz, $d_5$-CD$_3$OD): 1d, *CD$_3$CD$_3$OD-$d_5$ residue from the deuterated solvent
Figure S67. $^{19}$F NMR (470 MHz, $d_4$-CD$_3$OD): 1d
Figure S68. HSQC (500 MHz, 125 MHz, d₄-CD₃OD): 1d
Figure S69. HMBC (500 MHz, 125 MHz, $d_6$-CD$_3$OD): 1d
Figure S70. $^1$H NMR (500 MHz, $d_4$-CD$_3$OD): 1f
Figure S71. $^{13}$C NMR (125 MHz, $d_4$-CD$_3$OD): 1f, *CD$_3$CD$_2$OD-$d_5$ residue from the deuterated solvent
Figure S72. $^{19}$F NMR (470 MHz, $d_4$-CD$_3$OD): 1f
Figure S73. HSQC (500 MHz, 125 MHz, $d_4$-CD$_3$OD): 1f
Figure S74. HMBC (500 MHz, 125 MHz, d$_r$-CD$_3$OD): 1f
Figure S75. $^1$H NMR (400 MHz, $d_4$-CD$_3$OD): 1g, *acetone, *grease
Figure S76. $^{13}$C NMR (125 MHz, $d_4$-CD$_3$OD): 1g
UV-Vis Absorption and Emission Spectroscopy

Figure S77. (left) UV-Vis absorption (red) and emission (blue) spectra of 1a in PBS (100 mM, pH = 7.4) with 20% of DMSO and in methanol, respectively. (right) Dependence of absorption at $\lambda_{\text{max}}$ on the concentration of 1a in PBS (100 mM, pH = 7.4) with 20% of DMSO (red).

Figure S78. (left) UV-Vis absorption (red) and emission (blue) spectra of 1b in PBS (100 mM, pH = 7.4) with 20% of DMSO and in methanol, respectively. (right) Dependence of absorption at $\lambda_{\text{max}}$ on the concentration of 1b in PBS (100 mM, pH = 7.4) with 20% of DMSO (red).

Figure S79. (left) UV-Vis absorption (red) and emission (blue) spectra of 1c in PBS (100 mM, pH = 7.4) with 20% of DMSO and in methanol, respectively. (right) Dependence of absorption at $\lambda_{\text{max}}$ on the concentration of 1c in PBS (100 mM, pH = 7.4) with 20% of DMSO (red).
Figure S80. (left) UV-Vis absorption (red) and emission (blue) spectra of 1d in PBS (100 mM, pH = 7.4) with 20% of DMSO and in methanol, respectively. (right) Dependence of absorption at $\lambda_{\text{max}}$ on the concentration of 1d in PBS (100 mM, pH = 7.4) with 20% of DMSO (red).

Figure S81. (left) UV-Vis absorption (red) and emission (blue) spectra of 1e in PBS (100 mM, pH = 7.4) with 20% of DMSO and in methanol, respectively. (right) Dependence of absorption at $\lambda_{\text{max}}$ on the concentration of 1e in PBS (100 mM, pH = 7.4) with 20% of DMSO (red).

Figure S82. (left) UV-Vis absorption (red) and emission (blue) spectra of 1f in methanol. (right) Dependence of absorption at $\lambda_{\text{max}}$ on the concentration of 1f in methanol.
Aggregation study.

**Figure S83.** (left) UV-Vis absorption (from blue to red) spectra of 1a in PBS (100 mM, pH = 7.4) with 1% of DMSO. (right) Dependence of absorption at $\lambda_{\text{max}}$ on the concentration of 1a in PBS (100 mM, pH = 7.4) with 1% of DMSO (red).

**Figure S84.** (left) UV-Vis absorption (from blue to red) spectra of 1a in PBS (100 mM, pH = 7.4) with 10% of FBS and 1% of DMSO. (right) Dependence of absorption at $\lambda_{\text{max}}$ on the concentration of 1a in PBS (100 mM, pH = 7.4) with 10% of FBS and 1% of DMSO (red).

**Figure S85.** (left) UV-Vis absorption (from blue to red) spectra of 1d in PBS (100 mM, pH = 7.4) with 1% of DMSO. (right) Dependence of absorption at $\lambda_{\text{max}}$ on the concentration of 1a in PBS (100 mM, pH = 7.4) with 1% of DMSO (red).
**Figure S86.** (left) UV-Vis absorption (from blue to red) spectra of 1a in PBS (100 mM, pH = 7.4) with 10% of FBS and 1% of DMSO. (right) Dependence of absorption at $\lambda_{\text{max}}$ on the concentration of 1d in PBS (100 mM, pH = 7.4) with 10% of FBS and 1% of DMSO (red).

**Plots of Photophysical and Photochemical Measurements**

**Photoirradiation experiments.**

**Figure S87.** (left) Irradiation of 1a (c ~ $8.4 \times 10^{-6}$ M) at 780 nm in aerated PBS (100 mM, pH = 7.4) with 20% of DMSO followed by UV-vis spectroscopy in 1-min intervals (blue to red). (right) Kinetic traces measured at $\lambda = 786$ nm for 1a in dark (blue) and under irradiation at 780 nm (red) PBS (100 mM, pH = 7.4) with 20% of DMSO. Normalized to $A = 1.0$ at $t = 0$ min. The error bars represent standard deviation of the mean from three independent samples.
Figure S88. (left) Irradiation of \(1\text{b} (c \sim 7.8 \times 10^{-6} \text{M})\) at 780 nm in aerated PBS (100 mM, pH = 7.4) with 20\%\ of DMSO followed by UV-vis spectroscopy in 1-min intervals (blue to red). (right) Kinetic traces measured at \(\lambda = 786\) nm for \(1\text{b}\) in dark (blue) and under irradiation at 780 nm (red) PBS (100 mM, pH = 7.4) with 20\%\ of DMSO. Normalized to \(A = 1.0\) at \(t = 0\) min. The error bars represent standard deviation of the mean from three independent samples.

Figure S89. (left) Irradiation of \(1\text{c} (c \sim 1.9 \times 10^{-5} \text{M})\) at 820 nm in aerated PBS (100 mM, pH = 7.4) with 20\%\ of DMSO followed by UV-vis spectroscopy in 30-sec intervals (blue to red). (right) Kinetic traces measured at \(\lambda = 808\) nm for \(1\text{c}\) in dark (blue) and under irradiation at 820 nm (red) PBS (100 mM, pH = 7.4) with 20\%\ of DMSO. The inset depicts a kinetic trace (\(\lambda = 808\) nm) of \(1\text{c}\) in dark (blue) over longer period of time. Normalized to \(A = 1.0\) at \(t = 0\) min. The error bars represent standard deviation of the mean from three independent samples.
Figure S90. (left) Irradiation of 1d (c ~ 1.2 × 10^{-5} M) at 820 nm in aerated PBS (100 mM, pH = 7.4) with 20% of DMSO followed by UV-vis spectroscopy in 1-min intervals (blue to red). (right) Kinetic traces measured at $\lambda = 817$ nm for 1d in dark (blue) and under irradiation at 820 nm (red) PBS (100 mM, pH = 7.4) with 20% of DMSO. Normalized to A = 1.0 at t = 0 min. The error bars represent standard deviation of the mean from three independent samples.

Figure S91. (left) Irradiation of 1e (c ~ 1.5 × 10^{-5} M) at 780 nm in aerated PBS (100 mM, pH = 7.4) with 20% of DMSO followed by UV-vis spectroscopy in 1-min intervals (blue to red). (right) Kinetic traces measured at $\lambda = 796$ nm for 1e in dark (blue) and under irradiation at 780 nm (red) PBS (100 mM, pH = 7.4) with 20% of DMSO. Normalized to A = 1.0 at t = 0 min. The error bars represent standard deviation of the mean from three independent samples.
Figure S92. (left) Irradiation of 1f (c ~ 1.5 × 10^{-5} M) at 780 nm in aerated methanol followed by UV-vis spectroscopy in 30-min intervals (blue to red). (right) Kinetic traces measured at λ = 806 nm for 1f in dark (blue) and under irradiation at 780 nm (red) methanol. Normalized to A = 1.0 at t = 0 min. The error bars represent standard deviation of the mean from three independent samples.

Figure S93. Emission spectra of 1c (c ~ 6 × 10^{-6} M) irradiated at 820 nm in aerated PBS (100 mM, pH = 7.4 with 20% of DMSO) in 1-min intervals for the first 5 minutes and then in 5-min intervals for the subsequent 55 minutes (blue to red).
Quantum Yields of Decomposition.

Figure S94. Quantum yield of decomposition of compounds 1a–e in PBS (100 mM, pH = 7.4; with 20% of DMSO).

Figure S95. Quantum yield of decomposition of compounds 1a in aerated MeOH, argon-saturated MeOH (Ar), and 1f in MeOH.
Photolysis in the presence of $^1$O$_2$ quencher NaN$_3$.

**Figure S96.** Kinetic traces at $\lambda = 779$ nm of ICG in water irradiated at 780 nm in the presence (blue) and absence (red) of NaN$_3$ (~100 eq). The error bars represent standard deviation of the mean from three independent samples.

**Figure S97.** Kinetic traces at $\lambda = 810$ nm of 1d in water irradiated at 780 nm in the presence (blue) and absence (red) of NaN$_3$ (~100 eq). The error bars represent standard deviation of the mean from three independent samples.
NMR Irradiation Experiments.

**Figure S98.** $^1$H NMR (400 MHz, CD$_3$OD) of 4-methoxybenzoic acid 3b compared to photocage 1b exposed to ambient light over the indicated period of time.

**Figure S99.** $^1$H NMR (400 MHz, CD$_3$OD) of 1a in CD$_3$OD irradiated at 780 nm (40 mW) for 24 h. Asterisks denote signals corresponding to ketone 7 which are in agreement with the literature values (all peaks shifted by exactly 0.1 ppm, presumably due to referencing issues): $^1$H NMR (400 MHz, $d_4$-CD$_3$OD) $\delta$ (ppm) 7.10 (t, $J = 8.8$ Hz, 2H), 6.99 (dd, $J = 7.5$, 1.0 Hz, 1H), 6.90 (dd, $J = 8.1$, 1.0 Hz, 1H), 3.12 (s, 3H), 1.24 (s, 6H).10
Figure S100. $^1$H NMR (500 MHz, CD$_3$OD) of 4-fluorobenzoic acid 3a and photocage 1a irradiated in CD$_3$OD at 780 nm for indicated time.

Figure S101. $^{19}$F NMR (476 MHz, CD$_3$OD) of 4-fluorobenzoic acid 3a and photocage 1a irradiated in CD$_3$OD at 780 nm for indicated time.
Figure S102. $^1$H NMR (500 MHz, CD$_3$OD) of 4-fluorobenzoic acid 3a and a mixture of photocage 1a and methylene blue (MB) in methanol irradiated at 590 nm.

Figure S103. $^{19}$F NMR (476 MHz, CD$_3$OD) of 4-fluorobenzoic acid 3a and a mixture of photocage 1a and methylene blue (MB) in methanol irradiated at 590 nm.
**Figure S104.** Reaction of 1a with 1,4-dimethylnaphthalene endoperoxide (25 eq.) for indicated time.

**Figure S105.** Reaction of 1a with 1,4-dimethylnaphthalene endoperoxide (5 eq.) for indicated time.
**Figure S106.** $^{19}$F NMR spectra of photocage 1e irradiated at 780 nm in aerated (left) and degassed (right) CD$_3$OD. (right) C$_6$F$_6$ used as a standard ($\delta = -165.35$ ppm)

**Oxygen-Free Irradiation Experiments of 1f.**
The two irradiation experiments were performed using two independently degassed batches of CD$_3$OD to eliminate the possibility of incomplete oxygen removal.

**Figure S107.** $^{19}$F NMR (476 MHz, CD$_3$OD): Photocage 1f before (red; integral=0.37) and after (blue; integral=1.09) irradiation in degassed CD$_3$OD at 780 nm for 16 h. The spectra were integrated using C$_6$F$_6$ as internal standard.
Figure S108. $^{19}$F NMR (476 MHz, CD$_3$OD): Photocage 1f after irradiation in degassed CD$_3$OD at 780 nm for 3 h (green, integral=1.52), 6 h (pink, integral=2.52) and 24 h (blue, integral=5.46). The spectra were integrated using C$_6$F$_6$ as internal standard.

Figure S109. $^{19}$F NMR (476 MHz, CD$_3$OD): Photocage 1f in CD$_3$OD kept in the dark – 0 h (red, integral=0.39), 16 h (blue, integral=0.47). The spectra were integrated using C$_6$F$_6$ as internal standard.
**Figure S110.** $^{19}$F NMR (476 MHz, CD$_3$OD): Photocage 1f irradiated in CD$_3$OD before (red) and after (blue) addition of 4-fluorobenzoic acid 3a.

**Figure S111.** HRMS (ESI) spectrum of photocage 1f irradiated in CD$_3$OD for 24 h with exclusion of oxygen.

**Figure S112.** HRMS (ESI) spectrum of photocage 1f kept in dark in CD$_3$OD for 24 h with exclusion of oxygen.
Figure S113. $^1$H NMR ($d_4$-CD$_3$OD) of the photocage 1g bearing acetate cargo$^8$ kept in dark or irradiated with 780 nm under ambient conditions for 20 h. Blue arrow denotes the released acetic acid.

Figure S114. Same as Figure S113, but superimposed. Photocage 1g at 0 h (red), photocage kept in dark for 20 h (blue) or irradiated with 780 nm under ambient conditions (green).
**Figure S115.** $^1$H NMR ($d_4$-CD$_3$OD) of the photocage 1g bearing acetate cargo$^8$ kept in dark or irradiated with 780 nm in the absence of oxygen for 20 h. Blue arrow denotes the released acetic acid.

**Figure S116.** Same as Figure S115, but superimposed. Photocage 1g at 0 h (blue), photocage kept in dark for 20 h (red) or irradiated with 780 nm in the absence of oxygen (green).
Table S1. Summary of the integrals from Figures S113–116 corresponding to the release of acetic acid from 1g. Residual peak of $d_4$-CD$_3$OD was used as the internal standard for quantification. The integral of the acetyl (CH$_3$ protons) in the photocage 1g at 0 h was 11.58 and 10.27 for the samples in the presence and absence of oxygen, respectively, and this value was treated as 100% yield.

| Sample                      | Ac Integral | Corrected Ac Integral | Yield |
|-----------------------------|-------------|-----------------------|-------|
| **+O$_2$**                  |             |                       |       |
| Photocage 1g, 0 h           | 0.50        | ****                  | ****  |
| Photocage 1g, Dark, 20 h    | 0.95        | 0.45                  | ~4%   |
| Photocage 1g, 780 nm, 20 h  | 4.93        | 4.43                  | ~38%  |
| **–O$_2$**                  |             |                       |       |
| Photocage 1g, 0 h           | 0.00        | ****                  | ****  |
| Photocage 1g, 780 nm, 20 h  | 0.69        | 0.69                  | ~7%   |
HPLC Analysis

Figure S117. Dependence of HPLC peak area on the concentration of 3a (NUCLEODUR C18 Pyramid, 5 µm, 150×4 mm, MeOH/H$_2$O+0.1% TFA (45→95%), 1.0 mL min$^{-1}$, T = 30 °C).

Figure S118. Dependence of HPLC peak area on the concentration of 3b (NUCLEODUR C18 Pyramid, 5 µm, 150×4 mm, MeOH/H$_2$O+0.1% TFA (45→95%), 1.0 mL min$^{-1}$, T = 30 °C).

Figure S119. Dependence of HPLC peak area on the concentration of 3c (NUCLEODUR C18 Pyramid, 5 µm, 150×4 mm, MeOH/H$_2$O+0.1% TFA (55→95%), 1.0 mL min$^{-1}$, T = 30 °C).
Figure S120. (left) HPLC traces of 3a (black), 1a after irradiation at 780 nm (red) in PBS (10 mM, pH = 7.4, with 20% of methanol) and 1a in dark (blue). (right) HPLC traces of 3b (black), 1b after irradiation at 780 nm (red) in PBS (10 mM, pH = 7.4 with 20% of methanol and 1b in dark (blue) and.

Biological Experiments

Figure S121. Cell viability after 72 h exposure of HeLa cells to 1d and photoproducts of 1d.
Figure S122. Representative fluorescence microscopy micrographs (40× magnification) of HeLa cells incubated with 3 μM of photocage 3c and irradiated with 747 nm light (cyan coumarin channel A–C; red cyanine channel D–F) or kept in dark (H–J), cells incubated with the free coumarin 3c and irradiated with 747 nm light (K–M), or cells only (N–P) irradiated at 747 nm as a function of time at 0, 100 and 400 s intervals. Raw micrographs without background correction are shown. Scale bar represents 30 μm.
Figure S123. A) Irradiation module with magnetic stirring and exchangeable LED modules. B) In-house built irradiation setup with collimated light beam (780 nm) with magnetic stirring and coupled to optical power meter. C) Setup from (B) mounted inside a UV-vis spectrometer.
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