Supporting Information

for

CF₃-containing Spiro-epoxyoxindoles via Corey–Chaykovsky Reaction of N-Alkyl Isatins with Ph₂S⁺CH₂CF₃OTf⁻

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1. General
All isolated compounds were characterized on Varian 300 and Bruker 400 spectrometers in CDCl$_3$. Chemical shifts were reported as $\delta$ values relative to internal CHCl$_3$ ($\delta$ 7.26 for $^1$H NMR and 77.0 for $^{13}$C NMR). $^{19}$F NMR chemical shifts were determined as $\delta$ values relative to external standard PhCF$_3$ at −63.00. High-resolution mass spectra (HRMS) were obtained on a 4G mass spectrometer by using electrospray ionization (ESI) analyzed by quadrupole time-of-flight (QTof). All melting points were measured with the samples after column chromatography and uncorrected. Column chromatography was performed on silica gel. Anhydrous THF was distilled over sodium benzophenone ketyl under Ar. All other solvents and reagents were used as obtained from commercial sources without further purification.

2. General Experimental Procedure
General Procedure for the Preparation of 3a–n.

To a solution of compound 1a (81 mg, 0.50 mmol) and compound 2 (418 mg, 1.00 mmol, 2.0 equiv) in THF (5.0 mL) was added TBAT (540 mg, 1.00 mmol, 2.0 equiv) at room temperature. After 12 h, 1a was completely depleted monitoring on TLC, the solvent was removed and the resulting residue was purified by flash column chromatography (PE:EA = 20:1) to give 3a (113 mg, 93%) as a white solid. 3b–n were prepared following a similar method. Conditions: 1 (0.50 mmol), 2 (1.00 mmol, 2.0 equiv), TBAT (1.00 mmol, 2.0 equiv), solvent (5 mL), room temperature, air.

Scaled-up experiment of 1a
To a solution of compound 1a (1.0 g, 6.2 mmol) and compound 2 (5.2 g, 12 mmol, 2.0 equiv) in THF (31.0 mL) was added TBAT (6.7 g, 12 mmol, 2.0 equiv) at room temperature. After 12 h was completely depleted monitoring on TLC, the solvent was removed and the resulting residue was purified by flash column chromatography (PE:EA = 20:1) to give 3a (1.4 g, 93%) as a white solid.

Procedure for the Preparation of compound 4 and 5.

3b (160 mg, 0.501 mmol), styrene (78 mg, 0.75 mmol, 1.5 equiv) were dissolved in 50 ml dry DCM in a schlenk quartz tube was degassed, refilled with Ar for three times, and then TPT (10 mg, 0.025 mmol, 0.05 eq) was added. The solution was radiated with 30 W LED UV lamp (365 nm) until 3b was completely depleted. After the solvent was removed under reduced pressure, the residue was separated by flash column chromatography (PE:EA = 20:1) to give 4a (74 mg, 35%) as a white solid and 4b (91 mg, 43%) as a white solid.
To a solution of compound 3a (49 mg, 0.20 mmol) and trimethylallylsilane (46 mg, 0.40 mmol, 2.0 equiv) in dry DCM (2 mL) was added BF₃ • Et₂O (57 mg, 0.40 mmol, 2.0 equiv) at 0 °C. The resulting solution was stirred at the room temperature and monitored by TLC. After 3a was completely depleted, the solvent was removed under reduced pressure and the resulting residue was purified by flash column chromatography (PE:EA = 5:1) to give 5 (49 mg, 86%) as a white solid.

3. Characterization Data

1-Methyl-3’-(trifluoromethyl)spiro[indoline-3,2’-oxiran]-2-one. Compound 3a (113 mg, Y = 93%, Rᵣ = 0.35 (PE:EA = 5:1)) was isolated as a white solid; mp 75–76 °C. ¹H NMR (400 MHz, CDCl₃) δ 7.44 (td, J = 7.6, 0.8 Hz, 1H), 7.37 (d, J = 7.6 Hz, 1H), 7.12 (td, J = 7.6, 0.4 Hz, 1H), 6.95 (d, J = 7.6 Hz, 1H), 4.11 (q, J = 5.6 Hz, 1H), 3.26 (s, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 169.3, 146.0, 131.5, 125.33 (q, J = 5.6 Hz), 123.2, 122.1, (q, J = 274.8 Hz), 117.5, 109.2, 60.1 (q, J = 42.5 Hz), 59.3 (q, J = 1.3 Hz), 26.7; ¹⁹F NMR (282 MHz, CDCl₃) δ -67.81 (d, J = 5.1 Hz, 3F); ESI-HRMS m/z calcd for C₁₁H₉F₃NO₂[M+H]^+ 244.0580, found 244.0577.

1-Benzyl-3’-(trifluoromethyl)spiro[indoline-3,2’-oxiran]-2-one. Compound 3b (137 mg, Y = 86%, Rᵣ = 0.45 (PE:EA = 5:1)) was isolated as a white solid; mp 100–101 °C. ¹H NMR (400 MHz, CDCl₃) δ 7.38 (d, J = 7.6 Hz, 1H), 7.36–7.25 (m, 6H), 7.07 (td, J = 7.6, 0.8 Hz, 1H), 6.85 (d, J = 8.0 Hz, 1H), 5.04–4.85 (m, 2H), 4.19 (q, J = 6.0 Hz, 1H); ¹³C NMR (100 MHz, CDCl₃) δ 169.6, 145.2, 134.6, 131.4, 128.9, 128.0, 127.3, 125.5 (q, J = 5.5 Hz), 123.3, 122.1 (q, J = 274.9 Hz), 117.5, 110.2, 60.3 (q, J = 41.5 Hz), 59.4 (q, J = 1.3 Hz), 44.4; ¹⁹F NMR (282 MHz, CDCl₃) δ -67.72 (s, 3F); ESI-HRMS m/z calcd for C₁₇H₁₃F₃NO₂ [M+H]^+ 320.0893, found 320.0890.

5-Fluoro-1-methyl-3’-(trifluoromethyl)spiro[indoline-3,2’-oxiran]-2-one. Compound 3c (116 mg, Y = 89%, Rᵣ = 0.29 (PE:EA = 5:1)) was isolated as a white solid; mp 113–114 °C. ¹H NMR (400 MHz, CDCl₃) δ 7.22-7.08 (m, 2H), 6.90 (dd, J = 8.4, 4.0 Hz, 1H), 4.12 (q, J = 5.6 Hz, 1H), 3.27 (s, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 169.0, 159.2 (d, J = 240.7 Hz), 142.0 (d, J = 2.1 Hz), 121.9 (d, J = 274.8 Hz), 119.1 (d, J = 8.8 Hz), 118.0 (d, J = 23.3 Hz), 113.6 (dq, J = 26.7, 5.9 Hz), 109.9 (d, J = 8.0 Hz), 60.1 (q, J = 42.5 Hz), 59.2, 26.8; ¹⁹F NMR (282 MHz, CDCl₃) δ -67.82 (d, J = 4.8 Hz, 3F), -119.15 (dd, J = 9.4, 6.0 Hz, 1F); ESI-HRMS m/z calcd for C₁₁H₉F₃NO₂ [M+H]^+ 262.0486, found 262.0485.
4-Chloro-1-methyl-3'-[(trifluoromethyl)spiro[indoline-3,2'-oxiran]-2-one. Compound 3d (108 mg, Y = 78%, Rf = 0.33 (PE:EA = 5:1)) was isolated as a white solid; mp 166–167 °C. 1H NMR (400 MHz, CDCl3) δ 7.36 (t, J = 7.6 Hz, 1H), 7.01 (d, J = 8.4 Hz, 1H), 6.84 (d, J = 7.6 Hz, 1H), 4.81 (q, J = 6.4 Hz, 1H), 3.26 (s, 3H); 13C NMR (100 MHz, CDCl3) δ 166.6, 146.7, 132.4, 130.6, 124.5, 121.6 (q, J = 276.9 Hz) 116.2, 107.6, 59.8 (q, J = 1.8 Hz), 57.6 (q, J = 44.2 Hz), 27.0; 19F NMR (282 MHz, CDCl3) δ -64.05 (d, J = 5.6 Hz, 3F); ESI-HRMS m/z calcd for C11H8ClF3NO2 [M+H]+ 278.0190, found 278.0190.

5-Chloro-1-methyl-3'-[(trifluoromethyl)spiro[indoline-3,2'-oxiran]-2-one. Compound 3e (132 mg, Y = 95%, Rf = 0.23 (PE:EA = 5:1)) was isolated as a white solid; mp 131–132 °C. 1H NMR (400 MHz, CDCl3) δ 7.42 (dd, J = 8.4, 2.0 Hz, 1H), 7.32 (s, 1H), 6.89 (d, J = 8.4 Hz, 1H), 4.12 (q, J = 5.6 Hz, 1H), 3.26 (s, 3H); 13C NMR (100 MHz, CDCl3) δ 168.8, 144.5, 131.4, 128.8, 125.7 (q, J = 6.0 Hz), 121.9 (q, J = 275.7 Hz), 119.1, 110.2, 60.2 (q, J = 42.5 Hz), 59.0 (q, J = 1.2 Hz), 26.8; 19F NMR (282 MHz, CDCl3) δ -67.72 (d, J = 4.8 Hz, 3F); ESI-HRMS m/z calcd for C11H8ClF3NO2 [M+H]+ 278.0190, found 278.0186.

4-Bromo-1-methyl-3'-[(trifluoromethyl)spiro[indoline-3,2'-oxiran]-2-one. Compound 3f (112 mg, Y = 70%, Rf = 0.32 (PE:EA = 5:1)) was isolated as a white solid; mp 158–160 °C. 1H NMR (400 MHz, CDCl3) δ 7.28 (t, J = 8.0 Hz, 1H), 7.18 (d, J = 8.0 Hz, 1H), 6.88 (d, J = 7.6 Hz, 1H), 4.90 (q, J = 6.0 Hz, 1H), 3.26 (s, 3H); 13C NMR (100 MHz, CDCl3) δ 166.7, 146.9, 132.5, 127.6, 121.6 (q, J = 276.9 Hz), 118.0, 117.8, 108.2, 60.1 (q, J = 1.6 Hz), 57.3 (q, J = 44.2 Hz), 26.9; 19F NMR (282 MHz, CDCl3) δ -63.81 (d, J = 5.6 Hz, 3F); ESI-HRMS m/z calcd for C11H8BrF3NO2 [M+H]+ 321.9685, found 321.9683.

5-Bromo-1-methyl-3'-[(trifluoromethyl)spiro[indoline-3,2'-oxiran]-2-one. Compound 3g (128 mg, Y = 80%, Rf = 0.27 (PE:EA = 5:1)) was isolated as a white solid; mp 122–123 °C. 1H NMR (400 MHz, CDCl3) δ 7.57 (dd, J = 8.4, 2.0 Hz, 1H), 7.46 (d, J = 0.4 Hz, 1H), 6.84 (d, J = 8.4 Hz, 1H), 4.12 (q, J = 5.6 Hz, 1H), 3.26 (s, 3H); 13C NMR (100 MHz, CDCl3) δ 168.7, 145.0, 134.4, 128.5 (q, J = 6.1 Hz), 121.9 (q, J = 274.8 Hz), 119.5, 116.0, 110.6, 60.2 (q, J = 42.6 Hz), 58.9 (q, J = 1.3 Hz), 26.8; 19F NMR (282 MHz, CDCl3) δ -67.76 (d, J = 4.8 Hz, 3F); ESI-HRMS m/z calcd for C11H8BrF3NO2 [M+H]+ 321.9685, found 321.9686.

6-Bromo-1-methyl-3'-[(trifluoromethyl)spiro[indoline-3,2'-oxiran]-2-one. Compound 3h (145 mg, Y = 90%, Rf = 0.57 (PE:EA = 5:1)) was isolated as a white solid; mp 127–128 °C. 1H NMR (400 MHz, CDCl3) δ 7.31–7.16 (m, 2H), 7.11 (d, J = 1.6 Hz, 1H), 4.11 (q, J = 6.0 Hz, 1H), 3.26 (s, 2H); 13C NMR (100 MHz, CDCl3) δ 169.2, 147.2, 126.6 (q, J = 5.7 Hz), 126.2, 125.6, 122.0 (d, J = 274.9 Hz), 116.4, 112.9, 60.1 (q, J = 42.5 Hz), 59.0 (q, J = 1.3 Hz), 26.9; 19F NMR (282 MHz, CDCl3) δ -67.60 (s, 3F); ESI-HRMS m/z calcd for C11H8BrF3NO2 [M+H]+ 321.9685, found 321.9683.
7-Bromo-1-methyl-3′-(trifluoromethyl)spiro[indoline-3,2′-oxiran]-2-one. Compound 3i (145 mg, Y = 90%, Rf = 0.62 (PE:EA = 5:1)) was isolated as a white solid; mp 119–120 °C. 1H NMR (400 MHz, CDCl3) δ 7.54 (dd, J = 8.0, 1.2 Hz, 1H), 7.31 (d, J = 7.6 Hz, 1H), 6.96 (t, J = 7.6 Hz, 1H), 4.12 (q, J = 6.0 Hz, 1H), 3.66 (s, 3H); 13C NMR (100 MHz, CDCl3) δ 170.0, 143.1, 137.1,124.3 (q, J = 5.6 Hz), 124.3, 121.9 (q, J = 275.1 Hz), 120.8, 103.4, 60.9 (q, J = 4.2 Hz), 58.8 (q, J = 1.4 Hz), 30.6; 19F NMR (282 MHz, CDCl3) δ -67.10 (s, 3F); ESI-HRMS m/z calcd for C11H8BrF3NO2 [M+H]+ 321.9685, found 321.9682.

5-Iodo-1-methyl-3′-(trifluoromethyl)spiro[indoline-3,2′-oxiran]-2-one. Compound 3j (162 mg, Y = 88%, Rf = 0.29 (PE:EA = 5:1)) was isolated as a white solid; mp 124–125 °C. 1H NMR (400 MHz, CDCl3) δ 7.76 (dd, J = 8.4, 1.6 Hz, 1H), 7.61 (s, 1H), 6.73 (d, J = 8.4 Hz, 1H), 4.10 (q, J = 6.0 Hz, 1H), 3.25 (s, 3H); 13C NMR (100 MHz, CDCl3) δ 168.5, 145.6, 140.2, 134.0 (q, J = 6.1 Hz), 121.9 (q, J = 274.9 Hz), 119.7, 111.1, 85.6, 60.2 (q, J = 42.5 Hz), 58.7 (q, J = 1.3 Hz), 26.8; 19F NMR (282 MHz, CDCl3) δ -67.85 (d, J = 4.2 Hz, 3F); ESI-HRMS m/z calcd for C7I2H1F3INO2 [M+H]+ 369.9546, found 369.9546.

1,5-Dimethyl-3′-(trifluoromethyl)spiro[indoline-3,2′-oxiran]-2-one. Compound 3k (108 mg, Y = 84%, Rf = 0.41 (PE:EA = 5:1)) was isolated as a white solid; mp 135–136 °C. 1H NMR (400 MHz, CDCl3) δ 7.24 (d, J = 7.8 Hz, 1H), 7.18 (s, 1H), 6.84 (d, J = 8.0 Hz, 1H), 4.10 (q, J = 6.0 Hz, 1H), 3.24 (s, 3H); 13C NMR (100 MHz, CDCl3) δ 169.3, 143.6, 133.0, 131.7, 126.0 (q, J = 5.4 Hz), 122.2 (q, J = 274.8 Hz), 117.4, 109.0, 60.1 (q, J = 42.4 Hz), 59.4, 26.7, 21.0; 19F NMR (282 MHz, CDCl3) δ -67.69 (d, J = 4.8 Hz, 3F); ESI-HRMS m/z calcd for C12H11F3NO2 [M+H]+ 258.0736, found 258.0733.

1,7-Dimethyl-3′-(trifluoromethyl)spiro[indoline-3,2′-oxiran]-2-one. Compound 3l (117 mg, Y = 91%, Rf = 0.45 (PE:EA = 5:1)) was isolated as a white solid; mp 129–130 °C. 1H NMR (400 MHz, CDCl3) δ 7.20 (d, J = 7.6 Hz, 1H), 7.16 (d, J = 7.6 Hz, 1H), 6.98 (t, J = 7.6 Hz, 1H), 4.08 (q, J = 6.0 Hz, 1H), 3.54 (s, 3H), 2.59 (s, 3H); 13C NMR (100 MHz, CDCl3) δ 170.3, 143.6, 135.3, 123.1, 123.0 (q, J = 5.6 Hz), 122.1 (q, J = 275.0 Hz), 121.0, 118.2, 60.7 (q, J = 42.4 Hz), 59.1 (q, J = 1.4 Hz), 30.3, 19.0; 19F NMR (282 MHz, CDCl3) δ -67.37 (s, 3F); ESI-HRMS m/z calcd for C12H11F3NO2 [M+H]+ 258.0736, found 258.0732.

5-Methoxy-1-methyl-3′-(trifluoromethyl)spiro[indoline-3,2′-oxiran]-2-one. Compound 3m (70 mg, Y = 51%, Rf = 0.24 (PE:EA = 5:1)) was isolated as a white solid; mp 150–152 °C. 1H NMR (400 MHz,
CDCl$_3$ $\delta$ 7.04–6.92 (m, 2H), 6.85 (d, $J$ = 8.0 Hz, 1H), 4.11 (q, $J$ = 6.0 Hz, 1H), 3.79 (s, 3H), 3.25 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 169.1, 156.2, 139.3, 122.1 (q, $J$ = 274.9 Hz), 118.7, 116.1, 112.5 (q, $J$ = 5.8 Hz), 109.7, 60.1 (q, $J$ = 42.5 Hz), 59.6 (q, $J$ = 1.1 Hz), 55.8, 26.8; $^{19}$F NMR (282 MHz, CDCl$_3$) $\delta$ -67.80 (d, $J$ = 5.1 Hz, 3F); ESI-HRMS m/z calcld for C$_{12}$H$_3$F$_3$NO$_3$ [M+H]$^+$ 274.0686, found 274.0682.

1-Methyl-5-nitro-3′-(trifluoromethyl)spiro[indoline-3,2′-oxiran]-2-one. Compound 3n (94 mg, Y = 65%, R$_t$ = 0.18 (PE:EA = 2:1)) was isolated as a white solid; mp 135–136 °C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.42 (dd, $J$ = 8.8, 2.4 Hz, 1H), 8.25 (d, $J$ = 1.6 Hz, 1H), 7.11 (d, $J$ = 8.8 Hz, 1H), 4.19 (q, $J$ = 5.6 Hz, 1H), 3.38 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 169.4, 151.2, 143.8, 128.2, 121.7 (q, $J$ = 274.9 Hz), 121.3 (q, $J$ = 6.2 Hz), 118.5, 109.1, 60.5 (q, $J$ = 42.8 Hz), 58.6 (q, $J$ = 1.3 Hz), 27.3; $^{19}$F NMR (282 MHz, CDCl$_3$) $\delta$ -67.69 (s, 3F); ESI-HRMS m/z calcld for C$_{13}$H$_3$F$_3$N$_2$O$_3$ [M+H]$^+$ 289.0431, found 289.0428.

Compound 4a (74 mg, Y = 35%, R$_t$ = 0.29 (PE:EA = 5:1)) was isolated as a white solid; mp 119–120 °C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.54 (d, $J$ = 7.6 Hz, 1H), 7.47 (d, $J$ = 7.2 Hz, 2H), 7.40 (t, $J$ = 7.6 Hz, 2H), 7.37–7.20 (m, 7H), 7.11 (t, $J$ = 7.6 Hz, 1H), 6.79 (d, $J$ = 8.0 Hz, 1H), 5.70 (dd, $J$ = 10.8, 5.6 Hz, 1H), 5.17–5.00 (m, 2H), 4.83 (d, $J$ = 15.6 Hz, 1H), 2.78 (t, $J$ = 12.0 Hz 1H), 2.52 (dd, $J$ = 12.8, 5.6 Hz, 1H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 174.7, 142.0, 140.1, 135.2, 129.0, 128.8, 128.7, 128.3, 128.0, 127.8, 127.0, 125.8, 125.2 (d, $J$ = 1.8 Hz), 123.4 (q, $J$ = 279.1 Hz), 122.8, 109.6, 82.8 (q, $J$ = 32.2 Hz), 82.7, 56.1, 47.8, 44.2; $^{19}$F NMR (282 MHz, CDCl$_3$) $\delta$ -72.52 (d, $J$ = 6.2 Hz, 3F); ESI-HRMS m/z calcld for C$_{25}$H$_3$F$_3$NO$_3$ [M+H]$^+$ 424.1519, found 424.1511.

Compound 4b (103 mg, Y = 43%, R$_t$ = 0.26 (PE:EA = 5:1)) was isolated as a white solid; mp 134–135 °C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.49 (d, $J$ = 7.2 Hz, 2H), 7.41 (t, $J$ = 7.6 Hz, 2H), 7.37–7.23 (m, 7H), 7.18 (t, $J$ = 7.6 Hz, 1H), 7.02 (t, $J$ = 7.6 Hz, 1H), 6.73 (d, $J$ = 8.0 Hz, 1H), 5.55 (dd, $J$ = 8.4, 7.6 Hz, 1H), 5.05 (d, $J$ = 15.6 Hz, 1H), 4.85 (d, $J$ = 15.6 Hz, 1H), 4.75 (q, $J$ = 6.9 Hz, 1H), 2.94 (dd, $J$ = 12.8, 6.8 Hz, 1H), 2.37 (dd, $J$ = 12.8, 9.5 Hz, 1H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 177.5, 142.4, 139.4, 135.3, 128.8, 128.8, 128.6, 128.2, 128.1, 127.8, 127.0, 125.8, 125.7 (q, $J$ = 2.7 Hz), 123.2 (q, $J$ = 278.5 Hz), 122.9, 109.3, 82.9 (q, $J$ = 31.7 Hz), 81.1, 55.4, 47.2, 44.0; $^{19}$F NMR (282 MHz, CDCl$_3$) $\delta$ -71.80 (dd, $J$ = 22.0, 6.8 Hz, 3F); ESI-HRMS m/z calcld for C$_{25}$H$_3$F$_3$NO$_3$ [M+H]$^+$ 424.1519, found 424.1510.
Compound 5 (49 mg, Y = 86%, Rf = 0.33 (PE:EA = 3:1)) was isolated as a white solid; mp 118–119 °C. 

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.51 (d, $J = 7.2$ Hz, 1H), 7.33 (td, $J = 7.6$, 0.8 Hz, 1H), 7.11 (t, $J = 7.6$ Hz, 1H), 6.87 (d, $J = 7.6$ Hz, 1H), 5.38–5.24 (m, 1H), 5.04 (d, $J = 16.8$ Hz, 1H), 4.92 (d, $J = 10.8$ Hz, 1H), 4.53 (q, $J = 6.8$ Hz, 1H), 4.09 (br s, 1H), 3.21 (s, 3H), 2.93 (dd, $J = 13.6$, 6.4 Hz, 1H), 2.76 (dd, $J = 13.2$, 8.0 Hz, 1H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 176.2, 143.1, 130.8, 128.6, 127.4, 125.3, 124.1 (q, $J = 282.1$ Hz), 122.8, 119.8, 108.2, 73.5 (q, $J = 30.2$ Hz), 53.2, 39.4, 26.2; $^{19}$F NMR (282 MHz, CDCl$_3$) $\delta$ -74.40 (d, $J = 6.5$ Hz, 3F); ESI-HRMS m/z calcd for $C_{14}H_{15}F_{3}NO_{2}$ [M+H]$^+$ 286.1049, found 286.1042.
4. NMR spectra

Fig. S1. $^1$H NMR of compound 3a (400 MHz, CDCl$_3$).

Fig. S2. $^{13}$C NMR of compound 3a (100 MHz, CDCl$_3$).
Fig. S3. $^{19}$F NMR of compound 3a (282 MHz, CDCl$_3$).

Fig. S4. $^1$H NMR of compound 3b (400 MHz, CDCl$_3$).
Fig. S5. $^{13}$C NMR of compound 3b (100 MHz, CDCl$_3$).

Fig. S6. $^{19}$F NMR of compound 3b (282 MHz, CDCl$_3$).
Fig. S7. $^1$H NMR of compound 3c (400 MHz, CDCl$_3$).

Fig. S8. $^{13}$C NMR of compound 3c (100 MHz, CDCl$_3$).
Fig. S9. $^{19}$F NMR of compound 3c (282 MHz, CDCl$_3$).

Fig. S10. $^1$H NMR of compound 3d (400 MHz, CDCl$_3$).
Fig. S11. $^{13}$C NMR of compound 3d (100 MHz, CDCl$_3$).

Fig. S12. $^{19}$F NMR of compound 3d (282 MHz, CDCl$_3$).
Fig. S13. $^1$H NMR of compound 3e (400 MHz, CDCl$_3$).

Fig. S14. $^{13}$C NMR of compound 3e (100 MHz, CDCl$_3$).
Fig. S15. $^1$H NMR of compound 3e (282 MHz, CDCl$_3$).

Fig. S16. $^1$H NMR of compound 3f (400 MHz, CDCl$_3$).
Fig. S17. $^{13}$C NMR of compound 3f (100 MHz, CDCl$_3$).

Fig. S18. $^{19}$F NMR of compound 3f (282 MHz, CDCl$_3$).
Fig. S19. $^1$H NMR of compound 3g (400 MHz, CDCl$_3$).

Fig. S20. $^{13}$C NMR of compound 3g (100 MHz, CDCl$_3$).
Fig. S21. $^{19}$F NMR of compound 3g (282 MHz, CDCl₃).

Fig. S22. $^1$H NMR of compound 3h (400 MHz, CDCl₃).
Fig. S23. $^{13}$C NMR of compound 3h (100 MHz, CDCl$_3$).

Fig. S24. $^{19}$F NMR of compound 3h (282 MHz, CDCl$_3$).
Fig. S25. $^1$H NMR of compound 3i (400 MHz, CDCl$_3$).

Fig. S26. $^{13}$C NMR of compound 3i (100 MHz, CDCl$_3$).
Fig. S27. $^{19}$F NMR of compound 3i (282 MHz, CDCl$_3$).

Fig. S28. $^1$H NMR of compound 3j (400 MHz, CDCl$_3$).
Fig. S29. $^{13}$C NMR of compound 3j (100 MHz, CDCl$_3$).

Fig. S30. $^{19}$F NMR of compound 3j (282 MHz, CDCl$_3$).
Fig. S31. $^1$H NMR of compound 3k (400 MHz, CDCl$_3$).

Fig. S32. $^{13}$C NMR of compound 3k (100 MHz, CDCl$_3$).
Fig. S33. $^{19}$F NMR of compound 3k (282 MHz, CDCl$_3$).

Fig. S34. $^1$H NMR of compound 3l (400 MHz, CDCl$_3$).
Fig. S35. $^{13}$C NMR of compound 3i (100 MHz, CDCl$_3$).

Fig. S36. $^{19}$F NMR of compound 3i (282 MHz, CDCl$_3$).
Fig. S37. $^1$H NMR of compound 3m (400 MHz, CDCl$_3$).

Fig. S38. $^{13}$C NMR of compound 3m (100 MHz, CDCl$_3$).
Fig. S39. $^{19}$F NMR of compound 3m (282 MHz, CDCl$_3$).

Fig. S40. $^1$H NMR of compound 3n (400 MHz, CDCl$_3$).
Fig. S41. $^{13}$C NMR of compound 3n (100 MHz, CDCl$_3$).

Fig. S42. $^{19}$F NMR of compound 3n (282 MHz, CDCl$_3$).
Fig. S43. $^1$H NMR of compound 4a (400 MHz, CDCl$_3$).

Fig. S44. $^{13}$C NMR of compound 4a (100 MHz, CDCl$_3$).
Fig. S45. $^{19}$F NMR of compound 4a (282 MHz, CDCl$_3$).

Fig. S46. $^1$H NMR of compound 4b (400 MHz, CDCl$_3$).
Fig. S47. $^{13}$C NMR of compound 4b (100 MHz, CDCl$_3$).

Fig. S48. $^{19}$F NMR of compound 4b (282 MHz, CDCl$_3$).
Fig. S49. $^1$H NMR of compound 5 (400 MHz, CDCl$_3$).

Fig. S50. $^{13}$C NMR of compound 5 (100 MHz, CDCl$_3$).
Fig. S5. $^{19}$F NMR of compound 5 (282 MHz, CDCl$_3$).