Supporting Information

For

Synthesis of Indolines via Pd(II)-Catalyzed Amination of C–H Bonds Using PhI(OAc)\textsubscript{2} as the Bystanding Oxidant

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**General Information:**

Solvents were obtained from Acros or Aldrich and used directly without further purification. Infrared spectra were recorded on a Perkin Elmer FT-IR Spectrometer. $^1$H and $^{13}$C NMR spectra were recorded on Varian-Inova (400 MHz and 100 MHz, respectively) and Bruker-DRX (500 MHz and 125 MHz, respectively) instruments internally referenced to SiMe$_4$ signal or chloroform. High resolution mass spectra were recorded at Center for Mass Spectrometry, The Scripps Research Institute. SFC (supercritical fluid chromatography) analysis was performed at 40 °C, using a Thar instrument fitted with a chiral stationary phase as indicated. Optical rotations were measured (Na D line) on a Perkin Elmer Model 343 Polarimeter fitted with a micro cell with a 1 dm path length. 2-Mercapto-quinioline, 2-mercapto-6-methylpyridine, 2-mercapto-pyridine, and phenethylamines were purchased from Oakwood, Sigma-Aldrich and Alfa-Aesar and were used as received. Palladium acetate was purchased from Sigma-Aldrich. (Diacetoxyiodo)benzene (Phi(OAc)$_2$) was commercial available from Sigma-Aldrich. Sodium hypochlorite (NaClO) was commercial “ultra” laundry bleach containing a stated concentration of 6% NaOCl.
Experimental Section:
Preparation of 2-Pyridinesulfonyl-Protected Phenethylamine Derivatives

1. Preparation of \(N\)-phenethylquinoline-2-sulfonamide:

2-Mercapto-quinoline (0.806 g, 5 mmol) was stirred in a mixture of 25 mL of CH\(_2\)Cl\(_2\) and 25 mL of 1 M HCl in a 125-mL Erlenmeyer flask for 10 min at -10 to 5 °C (internal temperature). Cold (5 °C) sodium hypochlorite (6% solution, 26 mL, 3.3 equiv) was added dropwise with stirring, maintaining the internal temperature at -10 to -5 °C. The mixture was stirred for 15 min at -10 to -5 °C (internal temperature) after the addition was completed. The mixture was transferred to a separatory funnel (pre-cooled with ice water) and the CH\(_2\)Cl\(_2\) layer was rapidly separated and collected in a clean 125-mL Erlenmeyer flask cooled in a dry ice-acetone bath. Phenethylamine (1.57 mL, 12.5 mmol) was added with stirring, whereupon the CH\(_2\)Cl\(_2\) layer became a white suspension. The flask was removed to an ice-water bath and the suspension was stirred for 30 min at 0 °C. The suspension was then washed with 1 M phosphoric acid (all solids dissolved at once), then with water, brine and then dried over sodium sulfate. The organic mixture was concentrated under reduced pressure, and the concentrate was purified by silica gel flash chromatography using 5% acetone in hexanes to give \(N\)-phenethylquinoline-2-sulfonamide as a white solid (1.34 g, 86% yield). \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 8.36 (d, \(J = 8.0\) Hz, 1H), 8.14 (d, \(J = 8.0\) Hz, 1H), 8.02 (d, \(J = 8.0\) Hz, 1H), 7.91 (d, \(J = 8.0\) Hz, 1H), 7.80–8.84 (m, 1H), 7.67–7.70 (m, 1H), 7.12–7.27 (m, 5H), 5.16 (t, \(J = 6.4\) Hz, 1H), 3.45 (q, \(J = 6.4\) Hz, 2H), 2.85 (t, \(J = 6.4\) Hz, 2H); \(^1\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 157.0,
2. Preparation of 6-methyl-N-phenethylpyridine-2-sulfonamide:

\[
\text{H}_2\text{N-} \begin{array}{c}
\text{S} \\
\text{N}
\end{array} \xrightarrow{1) \text{NaOCl, HCl}} \text{CH}_2\text{CH}_2\text{NH}_2 \xrightarrow{2) \text{PhCH}_2\text{CH}_2\text{NH}_2} \text{N-SO}_2
\]

2-Mercapto-6-methylpyridine (0.606 g, 5 mmol) was stirred in a mixture of 25 mL of CH\(_2\)Cl\(_2\) and 25 mL of 1 M HCl in a 125-mL Erlenmeyer flask for 10 min at -10 to 5 °C (internal temperature). Cold (5 °C) sodium hypochlorite (6% solution, 26 mL, 3.3 equiv) was added dropwise with stirring, maintaining the internal temperature at -10 to -5 °C. The mixture was stirred for 15 min at -10 to -5 °C (internal temperature) after the addition was completed. The mixture was transferred to a separatory funnel (pre-cooled with ice water) and the CH\(_2\)Cl\(_2\) layer was rapidly separated and collected in a clean 125-mL Erlenmeyer flask cooled in a dry ice-acetone bath. Phenethylamine (1.57 mL, 12.5 mmol) was added with stirring, whereupon the CH\(_2\)Cl\(_2\) layer became a white suspension. The flask was removed to an ice-water bath and the suspension was stirred for 30 min at 0 °C. The suspension was then washed with 1 M phosphoric acid (all solids dissolved at once), then with water, brine and then dried over sodium sulfate. The organic mixture was concentrated under reduced pressure, and the concentrate was purified by silica gel flash chromatography using 5% acetone in hexanes to give 6-methyl-N-phenethylpyridine-2-sulfonamide as a white solid (1.17 g, 85% yield). \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta 7.74–7.80 \text{ (m, 2H)}\), 7.12–7.33 (m, 6H), 5.00 (m, 1H), 3.33 (q, \(J = 6.4 \text{ Hz, 2H}\), 2.81 (t, \(J = 6.4 \text{ Hz, 2H}\), 2.59 (s, 3H); \(^13\)C NMR (100 MHz, CDCl\(_3\)) \(\delta 159.8, 156.5, 137.9, 137.7, 128.7, 128.6, 126.7, 126.5, 119.2, 44.7, 36.0, 24.2\); HRMS (ESI-
TOF) calcd. for C_{14}H_{17}N_{2}O_{2}S ([M+H]^{+}): 277.1005, Found: 277.1005.

3. Preparation of 2-pyridinesulfonyl-protected phenethylamine derivatives 1a–1o:

![Chemical structure](image)

**General Procedure:** 2-mercapto-pyridine (5 mmol) was stirred in a mixture of 25 mL of CH_{2}Cl_{2} and 25 mL of 1 M HCl in a 125-mL Erlenmeyer flask for 10 min at -10 to 5 °C (internal temperature). Cold (5 °C) sodium hypochlorite (6% solution, 26 mL, 3.3 equiv) was added dropwise with stirring, maintaining the internal temperature at -10 to -5 °C. The mixture was stirred for 15 min at -10 to -5 °C (internal temperature) after the addition was completed. The mixture was transferred to a separatory funnel (pre-cooled with ice water) and the CH_{2}Cl_{2} layer was rapidly separated and collected in a clean 125-mL Erlenmeyer flask cooled in a dry ice-acetone bath. Phenethylamine derivative (12.5 mmol) was added with stirring, whereupon the CH_{2}Cl_{2} layer became a white suspension. The flask was removed to an ice-water bath and the suspension was stirred for 30 min at 0 °C. The suspension was then washed with 1 M phosphoric acid (all solids dissolved at once), then with water, brine and then dried over sodium sulfate. The organic mixture was concentrated under reduced pressure, and the concentrate was purified by silica gel flash chromatography using 5% acetone in hexanes to give corresponding sulfonamide 1a–1o as a white solid.

^{1}H NMR (400 MHz, CDCl_{3}) δ 8.64 (d, J = 4.8 Hz, 1H), 7.99 (d, J = 8.0 Hz, 1H), 7.87–7.92 (dt, J_{1} = 2.0 Hz, J_{2} = 8.0 Hz, 1H), 7.46–7.49 (m, 1H), 7.24–7.29 (m, 2H), 7.18–7.23 (m, 1H), 7.11–
7.14 (m, 2H), 5.15 (br, 1H), 3.31–3.35 (m, 2H), 2.81 (t, J = 6.8 Hz, 2H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 157.5, 150.0, 138.0, 137.7, 128.8, 128.7, 126.7, 126.6, 122.1; 44.7, 36.2; HRMS (ESI-TOF) calcd. for C\(_{13}\)H\(_{15}\)N\(_2\)O\(_2\)S ([M+H]+): 263.0849, Found: 263.0849.

\(^{1}\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 8.64 (d, J = 4.8, 1H), 7.00 (d, J = 8.0 Hz, 1H), 7.90 (dt, \(J_1 = 2.0\) Hz, \(J_2 = 8.0\) Hz, 1H), 7.46–7.49 (m, 1H), 7.06–7.12 (m, 4H), 5.35 (m, 1H), 3.25–3.30 (m, 2H), 2.83 (t, \(J = 6.8\) Hz, 2H), 2.24 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 157.4, 150.0, 138.0, 136.2, 135.9, 130.4, 129.3, 126.8, 126.6, 126.1, 122.2, 43.5, 33.6, 19.2; HRMS (ESI-TOF) calcd. for C\(_{14}\)H\(_{17}\)N\(_2\)O\(_2\)S ([M+H]+): 277.1005, Found: 277.1006.

\(^{1}\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 8.64 (d, J = 4.8, 1H), 7.99 (d, \(J = 8.0\) Hz, 1H), 7.89 (dt, \(J_1 = 2.0\) Hz, \(J_2 = 8.0\) Hz, 1H), 7.45–7.49 (m, 1H), 7.07 (d, \(J = 8.0\) Hz, 2H), 7.01 (d, \(J = 8.0\) Hz, 2H), 5.14 (m, 1H), 3.30 (q, \(J = 6.8\) Hz, 2H), 2.76 (t, \(J = 6.8\) Hz, 2H), 2.30 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 157.4, 150.0, 138.0, 136.3, 134.6, 129.3, 128.6, 126.5, 122.2, 44.8, 35.7, 21.0; HRMS (ESI-TOF) calcd. for C\(_{14}\)H\(_{17}\)N\(_2\)O\(_2\)S ([M+H]+): 277.1005, Found: 277.1004.

\(^{1}\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 8.58 (d, J = 4.8, 1H), 7.95 (d, \(J = 8.0\) Hz, 1H), 7.86 (dt, \(J_1 = 2.0\) Hz, \(J_2 = 8.0\) Hz, 1H), 7.44–7.40 (m, 1H), 7.15–7.18 (m, 1H), 7.03–7.06 (m, 1H), 6.82 (t, \(J = 8.0\) Hz, 1H), 6.78 (d, \(J = 8.0\) Hz, 1H), 5.54 (m, 1H), 3.74 (s, 3H), 3.26–3.30 (m, 2H), 2.79 (t, \(J = 6.8\) Hz, 2H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 157.3, 157.2, 149.8, 137.8, 130.5, 128.0, 126.4, 126.1, 122.0, 120.5, 110.2, 55.1, 43.4, 30.8; HRMS (ESI-TOF) calcd. for C\(_{14}\)H\(_{17}\)N\(_2\)O\(_2\)S ([M+H]+): 293.0954, Found: 293.0952.

\(^{1}\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 8.60 (d, J = 4.8 Hz, 1H),
7.98 (d, J = 8.0 Hz, 1H), 7.88 (dt, J1 = 2.0 Hz, J2 = 8.0 Hz, 1H), 7.44–7.47 (m, 1H), 7.14–7.17 (m, 1H), 6.69–6.73 (m, 1H), 6.65–6.73 (m, 1H), 5.59–5.61 (m, 1H), 3.75 (s, 3H), 3.28–3.33 (m, 2H), 2.77 (t, J = 6.8 Hz, 2H); 13C NMR (100 MHz, CDCl3) δ 159.7, 157.2, 149.9, 139.3, 138.0, 129.5, 126.6, 122.1, 121.0, 120.5, 110.2, 55.1, 44.5, 36.1; HRMS (ESI-TOF) calcd. for C14H17N2O3S ([M+H]+): 293.0954, Found: 293.0956.

1H NMR (400 MHz, CDCl3) δ 8.65 (d, J = 4.8 Hz, 1H), 7.99 (d, J = 8.0 Hz, 1H), 7.90 (dt, J1 = 2.0 Hz, J2 = 8.0 Hz, 1H), 7.46–7.49 (m, 1H), 7.14–7.22 (m, 2H), 7.04 (dt, J1 = 8.0 Hz, J1 = 1.2 Hz, 1H), 6.95–6.98 (m, 1H), 5.27 (m, 1H), 3.33 (q, J = 6.8 Hz, 2H), 2.86 (t, J = 6.8 Hz, 2H); 13C NMR (100 MHz, CDCl3) δ 161.1 (d, Jc-F = 244.0 Hz), 157.3, 150.0, 138.0, 131.1 (d, Jc-F = 4.7 Hz), 128.6 (d, Jc-F = 8.1 Hz), 126.6, 124.7 (d, Jc-F = 15.8 Hz), 124.2 (d, Jc-F = 3.6 Hz), 122.2, 115.3 (d, Jc-F = 12.7 Hz), 43.4, 29.9; HRMS (ESI-TOF) calcd. for C13H14FN2O2S ([M+H]+): 281.0754, Found: 281.0754.

1H NMR (400 MHz, CDCl3) δ 8.62 (d, J = 4.8 Hz, 1H), 8.01 (d, J = 8.0 Hz, 1H), 7.90 (dt, J1 = 2.0 Hz, J2 = 8.0 Hz, 1H), 7.26–7.31 (m, 1H), 7.12–7.22 (m, 3H), 5.68 (m, 1H), 3.31–7.36 (m, 2H), 2.95 (t, J = 6.8 Hz, 2H); 13C NMR (100 MHz, CDCl3) δ 157.2, 149.9, 138.0, 135.5, 133.9, 131.1, 129.5, 128.1, 126.9, 126.6, 122.2, 42.8, 34.1; HRMS (ESI-TOF) calcd. for C13H14ClN2O2S ([M+H]+): 297.0459, Found: 297.0462.

1H NMR (400 MHz, CDCl3) δ 8.58 (d, J = 4.8 Hz, 1H), 7.95 (d, J = 8.0 Hz, 1H), 7.89 (dt, J1 = 2.0 Hz, J2 = 8.0 Hz, 1H), 7.46–7.48 (m, 1H), 7.18–7.14 (m, 2H), 7.08 (s, 1H), 6.98–7.00 (m, 1H), 6.04 (br, 1H), 3.26–3.30 (m, 2H), 2.77 (t, J = 6.4 Hz, 2H); 13C NMR
(100 MHz, CDCl₃) δ 156.9, 149.7, 140.1, 138.0, 137.9, 133.8, 129.8, 128.4, 126.8, 126.7, 121.9, 44.2, 35.5; HRMS (ESI-TOF) calcd. for C₁₃H₁₄ClN₂O₂S ([M+H]⁺): 297.0459, Found: 297.0460.

\[ \text{HRMS (ESI-TOF) calcd. for C₁₃H₁₄BrN₂O₂S ([M+H]⁺): 340.9954, Found: 340.9951.} \]

(100 MHz, CDCl₃) δ 157.2, 149.9, 138.1, 136.9, 131.6, 130.6, 126.6, 122.2, 120.5, 44.4, 35.6; HRMS (ESI-TOF) calcd. for C₁₃H₁₄BrN₂O₂S ([M+H]⁺): 340.9954, Found: 340.9952.

\[ \text{HRMS (ESI-TOF) calcd. for C₁₃H₁₄ClN₂O₂S ([M+H]⁺): 340.9954, Found: 340.9951.} \]

\[ \text{HRMS (ESI-TOF) calcd. for C₁₃H₁₄BrN₂O₂S ([M+H]⁺): 340.9954, Found: 340.9952.} \]

\[ \text{HRMS (ESI-TOF) calcd. for C₁₃H₁₄ClN₂O₂S ([M+H]⁺): 340.9954, Found: 340.9951.} \]
HRMS (ESI-TOF) calcd. for C_{14}H_{14}F_{3}N_{2}O_{2}S ([M+H]^+): 331.0723, Found: 331.0725.

\[ \text{H NMR (400 MHz, CDCl}_3\text{)} \delta 8.63 \text{ (d, } J = 4.8 \text{ Hz, 1H), 8.03 (d, } J = 8.0 \text{ Hz, 1H), 7.92 (dt, } J_1 = 2.0 \text{ Hz, } J_2 = 8.0 \text{ Hz, 1H), 7.50 (d, } J = 8.0 \text{ Hz, 1H), 7.45–7.43 \text{ (m, 1H), 7.27 (d, } J = 8.0 \text{ Hz, 2H), 5.27 (br, 1H), 3.36 (q, } J = 6.4 \text{ Hz, 2H), 2.91 (t, } J = 6.4 \text{ Hz, 2H); }^{13}\text{C NMR (100 MHz, CDCl}_3\text{)} \delta 157.5, 150.2, 143.7, 138.4, 132.6, 129.9, 127.0, 122.4, 118.9, 110.9, 44.4, 36.7; \text{ HRMS (ESI-TOF) calcd. for C}_{14}\text{H}_{14}\text{F}_{3}\text{N}_{2}\text{O}_{2}\text{S ([M+H]^+)}: 287.0728, Found: 287.0725.} 

\[ \text{H NMR (400 MHz, CDCl}_3\text{)} \delta 8.65 \text{ (d, } J = 4.8 \text{ Hz, 1H), 8.02 (d, } J = 8.0 \text{ Hz, 1H), 7.92 (dt, } J_1 = 2.0 \text{ Hz, } J_2 = 8.0 \text{ Hz, 1H), 7.58 (d, } J = 8.0 \text{ Hz, 1H), 7.43–7.50 \text{ (m, 2H), 7.35 (t, } J = 8.0 \text{ Hz, 2H), 7.27 (t, } J = 8.0 \text{ Hz, 1H), 7.20 (d, } J = 8.0 \text{ Hz, 2H), 4.85 (br, 1H), 3.52–3.33 \text{ (m, 2H), 2.98 (m, 1H); 1.39 (d, } J = 7.2 \text{ Hz, 3H); }^{13}\text{C NMR (100 MHz, CDCl}_3\text{)} \delta 157.2, 149.9, 142.9, 137.9, 128.6, 127.1, 126.8, 126.5, 122.1, 50.0, 40.0, 19.0; \text{ HRMS (ESI-TOF) calcd. for C}_{14}\text{H}_{14}\text{N}_{2}\text{O}_{2}\text{S ([M+H]^+)}: 277.1005, Found: 277.1005.} 

\[ \text{H NMR (400 MHz, CDCl}_3\text{)} \delta 8.59 \text{ (d, } J = 4.8 \text{ Hz, 1H), 7.97 (d, } J = 8.0 \text{ Hz, 1H), 7.88 (dt, } J_1 = 8.0 \text{ Hz, } J_2 = 1.6 \text{ Hz, 1H), 7.44–7.48 \text{ (m, 1H), 7.14–7.29 \text{ (m, 10H), } \delta 5.18 \text{ (t, } J = 6.4 \text{ Hz, 1H), 4.18 (t, } J = 8.0 \text{ Hz, 1H), 3.67 (dd, } J_1 = 6.4 \text{ Hz, } J_2 = 8.0 \text{ Hz, 2H); }^{13}\text{C NMR (100 MHz, CDCl}_3\text{)} \delta 157.3, 150.0, 140.8, 138.0, 128.8, 128.0, 127.0, 126.6, 122.2, 51.0, 47.7; \text{ HRMS (ESI-TOF) calcd. for C}_{19}\text{H}_{19}\text{N}_{2}\text{O}_{2}\text{S ([M+H]^+)}: 339.1162, Found: 339.1161.} 

\[ \text{H NMR (400 MHz, CDCl}_3\text{)} \delta 8.60 \text{ (d, } J = 4.8 \text{ Hz, 1H), 7.89 (d, } J = 8.0 \text{ Hz, 1H), 7.84 (dt, } J_1 = 2.0 \text{ Hz, } J_2 = 8.0 \text{ Hz, 1H), 7.41–7.45} 

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The residue was purified by chromatography on silica gel and the reaction mixture was stirred at 130 °C for 4 h. After cooled to room temperature, the mixture was concentrated under vacuum and the residue was purified by column chromatography on silica gel with a gradient eluent of hexane and ethyl acetate to give the corresponding products.

General Procedure of Pd(II)-Catalyzed Amination of C–H Bonds:

In a 20 mL seal tube, 2-pyridinesulfonyl-protected phenethylamine derivatives 1a–1o (0.2 mmol, 1 equiv), Pd(OAc)_2 (4.5 mg, 0.1 equiv), PhI(OAc)_2 (129 mg, 2 equiv) were dissolved in 20 mL dry toluene under air. The tube was sealed with a Teflon lined cap, and the reaction mixture was stirred at 130 °C for 4 h. After cooled to room temperature, the mixture was concentrated under vacuum and the residue was purified by column chromatography on silica gel with a gradient eluent of hexane and ethyl acetate to give the corresponding products.

**1**H NMR (400 MHz, CDCl_3) δ 8.60 (d, J = 4.4 Hz, 1H), 7.96 (d, J = 8.0 Hz, 1H), 7.82 (dt, J_1 = 1.6 Hz, J_2 = 8.0 Hz, 1H), 7.40–7.47 (m, 2H), 7.02–7.11 (m, 2H), 6.91–6.95 (m, 1H), 4.33 (t, J = 8.4 Hz, 2H), 3.05 (t, J = 8.4 Hz, 2H); **13**C NMR (100 MHz, CDCl_3) δ 156.2, 150.1, 141.5, 137.7, 131.9, 127.4, 127.0, 125.0, 123.6, 123.0, 114.5, 51.3, 28.0; HRMS (ESI-TOF) calcd. for C_{13}H_{17}N_2O_5S ([M+H]+): 261.0692, Found: 261.0695.

**1**H NMR (400 MHz, CDCl_3) δ 8.61 (d, J = 4.4 Hz, 1H), 7.96 (d, J = 8.0 Hz, 1H), 7.82 (dt, J_1 = 1.6 Hz, J_2 = 8.0 Hz, 1H), 7.40–7.43 (m, 1H), 7.28 (d, J = 8.0 Hz, 1H), 7.00 (t, J = 8.0 Hz, 1H), 7.75 (d, J = 8.0 Hz, 1H), 4.34 (t, J = 8.4 Hz, 2H), 2.96 (t, J = 8.4 Hz, 2H), 2.15 (s, 3H); **13**C NMR (100 MHz, CDCl_3) δ 156.1, 150.1, 141.1, 137.7, 134.6, 130.5, 127.5, 126.9, 124.6,
123.0, 111.6, 51.1, 26.8, 18.6; HRMS (ESI-TOF) calcd. for C_{14}H_{15}N_{2}O_{2}S ([M+H]^+): 275.0849, Found: 275.0850.

\[\begin{array}{c}
\text{Me} \\
\text{N} \\
\text{SO}_2(2\text{-Py})
\end{array}\]

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.62 (d, $J = 4.4$ Hz, 1H), 7.97 (d, $J = 8.0$ Hz, 1H), 7.83 (dt, $J_1 = 1.6$ Hz, $J_2 = 8.0$ Hz, 1H), 7.41–7.44 (m, 1H), 7.29 (s, 1H), 6.97 (d, $J = 8.0$ Hz, 1H), 6.75 (d, $J = 8.0$ Hz, 1H), 4.32 (t, $J = 8.4$ Hz, 2H), 2.30 (t, $J = 8.4$ Hz, 2H), 2.28 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 156.3, 150.1, 141.6, 137.7, 137.5, 128.9, 126.9, 124.7, 124.4, 122.9, 115.1, 51.7, 27.7, 21.5; HRMS (ESI-TOF) calcd. for C$_{14}$H$_{15}$N$_2$O$_2$S ([M+H]$^+$): 275.0849, Found: 275.0847.

\[\begin{array}{c}
\text{OMe} \\
\text{N} \\
\text{SO}_2(2\text{-Py})
\end{array}\]

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.61 (d, $J = 4.4$ Hz, 1H), 7.96 (d, $J = 8.0$ Hz, 1H), 7.83 (dt, $J_1 = 1.6$ Hz, $J_2 = 8.0$ Hz, 1H), 7.41–7.44 (m, 1H), 7.05–7.11 (m, 2H), 6.78 (t, $J = 8.0$ Hz, 1H), 4.35 (d, $J = 8.4$ Hz, 2H), 3.77 (s, 3H), 2.97 (t, 2H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 156.2, 156.0, 150.1, 142.8, 137.7, 128.9, 126.9, 123.0, 119.1, 107.3, 105.8, 55.2, 51.7, 25.0; HRMS (ESI-TOF) calcd. for C$_{14}$H$_{15}$N$_2$O$_2$S ([M+H]$^+$): 291.0798, Found: 291.0797.

\[\begin{array}{c}
\text{MeO} \\
\text{N} \\
\text{SO}_2(2\text{-Py})
\end{array}\]

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.61 (d, $J = 4.4$ Hz, 1H), 7.97 (d, $J = 8.0$ Hz, 1H), 7.84 (dt, $J_1 = 1.6$ Hz, $J_2 = 8.0$ Hz, 1H), 7.42–7.45 (m, 1H), 7.07 (d, $J = 1.6$ Hz, 1H), 6.95–6.98 (m, 1H), 6.47 (m, 1H), 4.35 (t, $J = 6.4$ Hz, 2H), 3.75 (s, 3H), 2.98 (t, $J = 6.4$ Hz, 2H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 159.5, 156.3, 150.1, 142.6, 137.7, 126.9, 125.2, 123.8, 123.0, 109.2, 99.5, 55.5, 52.2, 27.3; HRMS (ESI-TOF) calcd. for C$_{14}$H$_{15}$N$_2$O$_2$S ([M+H]$^+$): 291.0798, Found: 291.0797.

\[\begin{array}{c}
\text{F} \\
\text{N} \\
\text{SO}_2(2\text{-Py})
\end{array}\]

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.62 (d, $J = 4.4$ Hz, 1H), 7.98 (d, $J = 8.0$ Hz, 1H), 7.86 (dt, $J_1 = 1.6$ Hz, $J_2 = 8.0$ Hz, 1H), 7.44–7.48 (m, 1H), 7.24 (d, $J = 6.4$ Hz, 1H), 7.05–7.09 (m, 1H), 6.65 (t, $J =$
6.4 Hz, 1H), 4.39 (t, J = 6.4 Hz, 2H), 3.09 (t, J = 6.4 Hz, 2H); $^{13}$C NMR (100 MHz, CDCl$_3$) δ 159.1 (d, J$_{C-F}$ = 195.3 Hz), 156.1, 150.2, 144.2 (d, J$_{C-F}$ = 5.7 Hz), 137.8, 129.3 (d, J$_{C-F}$ = 8.6 Hz), 127.1, 123.1, 118.2 (d, J$_{C-F}$ = 17.6 Hz), 110.5 (d, J$_{C-F}$ = 16.1 Hz), 110.2 (d, J$_{C-F}$ = 2.5 Hz), 51.8, 24.4; HRMS (ESI-TOF) calcd. for C$_{13}$H$_{12}$F$_{2}$N$_2$O$_2$S ([M+H]$^+$): 279.0598, Found: 279.0596.

$^1$H NMR (400 MHz, CDCl$_3$) δ 8.61 (d, J = 4.4 Hz, 1H), 7.97 (d, J = 8.0 Hz, 1H), 7.85 (dt, J$_1$ = 1.6 Hz, J$_2$ = 8.0 Hz, 1H), 7.43–7.48 (m, 1H), 7.34–7.36 (m, 1H), 7.02–7.06 (m, 1H), 6.90–6.92 (m, 1H), 4.36 (t, J = 8.4 Hz, 2H), 3.09 (t, J = 8.4 Hz, 2H); $^{13}$C NMR (100 MHz, CDCl$_3$) δ 156.1, 150.2, 142.9, 137.8, 130.8, 130.3, 129.0, 127.1, 123.5, 123.0, 112.5, 51.0, 27.4; HRMS (ESI-TOF) calcd. for C$_{13}$H$_{12}$ClN$_2$O$_2$S ([M+H]$^+$): 295.0302, Found: 295.0303.

$^1$H NMR (400 MHz, CDCl$_3$) δ 8.61 (d, J = 4.4 Hz, 1H), 7.95 (d, J = 8.0 Hz, 1H), 7.85 (dt, J$_1$ = 1.6 Hz, J$_2$ = 8.0 Hz, 1H), 7.43–7.46 (m, 1H), 7.38 (d, J = 8.0 Hz, 1H), 7.06 (s, 1H), 7.05 (d, J = 8.0 Hz, 1H), 4.33 (t, J = 8.4 Hz, 2H), 3.03 (t, J = 8.4 Hz, 2H); $^{13}$C NMR (100 MHz, CDCl$_3$) δ 156.0, 150.2, 140.3, 137.8, 133.9, 128.8, 127.4, 127.1, 125.2, 123.0, 115.4, 51.6, 27.9; HRMS (ESI-TOF) calcd. for C$_{13}$H$_{12}$ClN$_2$O$_2$S ([M+H]$^+$): 295.0302, Found: 295.0305.

$^1$H NMR (400 MHz, CDCl$_3$) δ 8.61 (d, J = 4.4 Hz, 1H), 7.96 (d, J = 8.0 Hz, 1H), 7.86 (dt, J$_1$ = 1.6 Hz, J$_2$ = 8.0 Hz, 1H), 7.44–7.47 (m, 1H), 7.34 (d, J = 8.0 Hz, 1H), 7.21 (s, 1H), 7.19 (d, J = 8.0 Hz, 1H), 4.33 (t, J = 8.4 Hz, 2H), 3.05 (t, J = 8.4 Hz, 2H); $^{13}$C NMR (100 MHz, CDCl$_3$) δ 156.0, 150.2, 140.9, 137.8, 134.3, 130.4, 128.2, 127.1, 123.0, 116.3, 115.9, 51.5, 27.8; HRMS (ESI-TOF) calcd. for C$_{13}$H$_{12}$BrN$_2$O$_2$S ([M+H]$^+$): 338.9797, Found: 338.9798.
$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.6 (d, $J = 4.8$ Hz, 1H), 7.98 (d, $J = 8.0$ Hz, 1H), 7.88 (dt, $J_1 = 1.6$ Hz, $J_2 = 8.0$ Hz, 1H), 7.80 (d, $J = 1.6$ Hz, 1H), 7.45–7.48 (m, 1H), 7.04 (dd, $J = 8.0$ Hz, $J = 1.6$ Hz, 1H), 6.94 (d, $J = 8.0$ Hz, 1H), 4.33 (t, $J = 8.4$ Hz, 2H), 3.01 (t, $J = 8.4$ Hz, 2H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 156.0, 150.2, 143.0, 137.9, 130.9, 127.2, 126.5, 126.2, 123.0, 120.9, 117.4, 51.7, 27.6; HRMS (ESI-TOF) calcd. for C$_{13}$H$_{12}$BrN$_2$O$_2$S ([M+H]$^+$): 338.9797, Found: 338.9798.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.61 (d, $J = 4.4$ Hz, 1H), 7.99 (d, $J = 8.0$ Hz, 1H), 7.87 (dt, $J_1 = 1.6$ Hz, $J_2 = 8.0$ Hz, 1H), 7.65–7.67 (m, 1H), 7.45–7.48 (m, 1H), 7.17–7.24 (m, 2H), 4.36 (t, $J = 8.4$ Hz, 2H), 3.23 (t, $J = 8.4$ Hz, 2H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 155.9, 150.3, 148.1, 137.9, 129.9 (q, $J_{C-F} = 2.3$ Hz), 128.1, 127.2, 127.1 (q, $J_{C-F} = 31.2$ Hz), 123.7 (q, $J_{C-F} = 271.5$ Hz), 120.2 (q, $J_{C-F} = 4.7$ Hz), 117.5, 51.3, 27.0; HRMS (ESI-TOF) calcd. for C$_{14}$H$_{12}$F$_3$N$_2$O$_2$S ([M+H]$^+$): 329.0566, Found: 329.0569.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.61 (d, $J = 4.4$ Hz, 1H), 8.02 (d, $J = 8.0$ Hz, 1H), 7.92 (dt, $J_1 = 1.6$ Hz, $J_2 = 8.0$ Hz, 1H), 7.71 (s, 1H), 7.48–7.51 (m, 1H), 7.19–7.25 (m, 2H), 4.36 (t, $J = 8.4$ Hz, 2H), 3.17 (t, $J = 8.4$ Hz, 2H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 155.9, 150.3, 142.6, 138.1, 137.3, 127.7, 127.3, 125.8, 123.0, 118.7, 117.0, 111.4, 51.3, 28.2; HRMS (ESI-TOF) calcd. for C$_{15}$H$_{13}$N$_2$O$_2$S ([M+H]$^+$): 285.0698, Found: 285.0694.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.61 (d, $J = 4.8$ Hz, 1H), 7.98 (d, $J = 8.0$ Hz, 1H), 7.84 (dt, $J_1 = 1.6$ Hz, $J_2 = 8.0$ Hz, 1H), 7.58 (d, $J = 8.0$ Hz, 1H), 7.43–7.50 (m, 2H), 7.35 (t, $J = 8.0$ Hz, 2H), 7.27 (t, $J = 8.0$ Hz, 1H), 7.20 (d, $J = 8.0$ Hz, 2H), 4.49 (t, $J = 9.6$ Hz, 1H), 3.84 (dd, $J = 7.6$ Hz, $J =$
9.6 Hz, 1H); 3.33–3.43 (m, 1H), 1.23 (d, J = 6.8 Hz, 3H); 13C NMR (100 MHz, CDCl3) δ 156.0, 150.1, 141.0, 137.7, 136.8, 127.6, 126.9, 123.9, 123.7, 123.0, 114.1, 58.7, 34.7, 19.3; HRMS (ESI-TOF) calcd. for C14H15N2O2S ([M+H]+): 275.0849, Found: 275.0847.

1H NMR (400 MHz, CDCl3) δ 8.59 (d, J = 4.8 Hz, 1H), 8.00 (d, J1 = 8.0 Hz, 1H), 7.84 (dt, J1 = 1.6 Hz, J2 = 8.0 Hz, 1H), 7.55 (d, J = 8.0 Hz, 1H), 7.42–7.46 (m, 1H), 7.22–7.28 (m, 3H), 7.13–7.17 (m, 1H), 7.06–7.08 (m, 2H), 6.87–6.95 (m, 2H), 4.74 (t, J = 10.0 Hz, 1H), 4.50–4.54 (m, 1H), 4.24 (dd, J1 = 7.6 Hz, J2 = 10.0 Hz, 1H); 13C NMR (100 MHz, CDCl3) δ 156.1, 150.1, 142.2, 141.6, 137.8, 134.9, 128.7, 128.1, 127.9, 127.1, 127.0, 125.6, 123.9, 123.1, 114.2, 59.6, 46.4; HRMS (ESI-TOF) calcd. for C10H18NO3S ([M+H]+): 336.1058, Found: 336.1052.

1H NMR (400 MHz, CDCl3) δ 8.57 (d, J = 4.4 Hz, 1H), 7.94 (d, J = 8.0 Hz, 1H), 7.81 (dt, J1 = 1.6 Hz, J2 = 8.0 Hz, 1H), 7.49 (d, J = 8.0 Hz, 1H), 7.39–7.42 (m, 1H), 7.05–7.12 (m, 2H), 6.92–6.96 (m, 1H), 5.52 (dd, J1 = 10.8 Hz, J2 = 4.0 Hz, 1H), 3.76 (s, 3H), 3.52–3.59 (m, 1H), 3.20 (dd, J1 = 16.4 Hz, J2 = 4.0 Hz, 2H); 13C NMR (100 MHz, CDCl3) δ 171.8, 156.5, 150.1, 140.8, 137.7, 129.9, 127.8, 127.0, 124.8, 124.3, 123.1, 115.2, 63.5, 52.7, 33.1; HRMS (ESI-TOF) calcd. for C15H17N2O3S ([M+H]+): 318.0800, Found: 318.0805.

Removal of 2-Pyridylsulfonyl Protecting Group2:

A solution of 2o (32 mg, 0.10 mmol) in dry methanol (2 ml) was added to Mg powder
(24 mg, 1 mmol) in an ice bath. The reaction mixture was stirred for 3 hr under a nitrogen atmosphere until the substrate disappeared by TLC. To the reaction mixture equal volumes of diethyl ether and saturated aqueous NH₄Cl were added and the whole mixture was stirred for 2 hr. The organic layer was separated and the aqueous layer washed with ether. The combined organic layers were dried over MgSO₄. The organic mixture was concentrated under reduced pressure, and the concentrate was purified by silica gel flash chromatography using 5% acetone in hexanes to give 2p as colorless oil (15.2 mg, 86% yield). ¹H NMR (400 MHz, CDCl₃) δ = 7.09 (d, J = 7.6 Hz, 1H), 7.06 (t, J = 7.6 Hz, 1H), 6.76 (t, J = 7.6 Hz, 1H), 6.73 (d, J = 7.6 Hz, 1H), 4.40 (dd, J₁ = 10 Hz, J₂ = 5.6 Hz, 1H), 3.76 (s, 3H), 3.40 (dd, J₁ = 10 Hz, J₂ = 5.6 Hz, 1H), 3.32 (dd, J₁ = 16 Hz, J₂ = 10 Hz, 1H); ¹³C NMR (100 MHz, CDCl₃) δ 174.6, 149.9, 127.7, 126.6, 124.5, 119.6, 110.2, 59.8, 52.5, 33.7; HRMS (ESI-TOF) calcd. for C₁₀H₁₂NO₂ ([M+H]⁺): 178.0868, Found: 178.0864.
Determination of Enantiomeric Ratio

(R,S)-2o

(Condition: SFC, AD-H column, 5–50% MeOH, 2 mL/min, column temperature: 40.2 °C)

(S)-2o
(R,S)-2p

(Condition: SFC, AY-H column, 5-15-50% iPrOH, 2 mL/min, column temperature: 40.2 °C)

(S)-2p
References:

