Supporting Information

Synthesis of N-arylsulfonamide via a Copper-Catalyzed Reaction of Chloramine T and Aryl Boronic Acid at Room Temperature

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I. General Information

Solvents and reagents were used as received unless otherwise noted. Reactions were performed in an oven-dried test tube equipped with a magnetic stir bar. Thin layer chromatography was performed using Huanghai GF254 silica gel pre-coated plates (0.25 mm) and visualized by UV irradiation. Flash column chromatography was performed using Qing Dao Sea Chemical Reagent silica gel (200-300 mesh) with AR grade solvents. $^1$H NMR spectra were recorded on a Bruker Advance III spectrometer (400 MHz). Chemical shifts were reported as parts per million (ppm) in the δ scale downfield from TMS. Peaks were labeled as singlet (s), doublet (d), triplet (t), quartet (q) and multiplet (m). $^{13}$C NMR spectra were recorded on Bruker spectrometer with complete proton decoupling, and chemical shifts were reported in ppm from TMS with the solvent as the internal reference (CDCl3, δ = 77.0 ppm). High resolution mass spectrometry (HRMS) spectra were obtained on an ABSCIEX Q-TOF5600+ Instrument.

II. Preparation of substrates

Anhydrous chloramine T and all the aryl boronic acids are commercially available. Anhydrous chloramine T can also be prepared from chloramine T trihydrate via drying at 80 °C under vacuum, but precautions should be taken. $^1$

$N$-Chloro-$N$-sodio-4-chlorobenzensulfonamide (2b)$^2$

\[
\text{Cl} \quad \text{O} \quad \text{N} \quad \text{Na} \quad \text{Cl}
\]

To a stirred solution of NaOH (2.0 g, 50.0 mmol) in H$_2$O (25.0 ml), 4-chlorobenzensulfonamide (9.58 g, 50.0 mmol) was added at 0 °C. And the reaction mixture was added cold 15.2% aqueous sodium hypochlorite (52.5 mmol, 25.68 g) at the same temperature. After the reaction mixture was stirred for 44 h at room temperature, the resulting white suspension was filtered and the residual solid was washed with H$_2$O. The crude product was purified by recrystallization from H$_2$O to afford the desired product as white crystal, and dried at 80 °C under reduced pressure. $^1$H NMR (400 MHz, DMSO) δ 7.63 (d, $J = 8.5$ Hz, 2H), 7.44 (d, $J = 8.5$ Hz, 2H); $^{13}$C NMR (101 MHz, DMSO) δ 144.54, 134.01, 128.91, 127.95.

III. General experimental procedure for the reaction of chloramine T and aryl boronic acid

A test tube with stir bar was charged with N-Chloro-N-sodiosulfonamide 2 (0.3 mmol), aryl boronic acid 1 (0.36 mmol) and $^1$BuOK (50.5 mg, 0.45 mmol). A solution of Cu(OAc)$_2$ (2.7 mg, 0.015 mmol) in EtOH (1.5 mL) was then added to the test tube. The reaction mixture was stirred
under air at room temperature for 12 h, then the heterogeneous mixture was diluted with ethyl acetate. The resulting mixture was directly filtered through a pad of silica gel, then the silica gel was eluted with ethyl acetate. The organic solutions was combined, and the solvent was removed under reduced pressure. The crude product was purified by silica-gel column chromatography to afford the desired product.

4-Methyl-\(N\)-phenylbenzenesulfonamide (3a)

![Structure of 4-Methyl-\(N\)-phenylbenzenesulfonamide (3a)](image)

White solid (46.0 mg, 62% yield). \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 7.67 (d, \(J = 8.3\) Hz, 2H), 7.22 (t, \(J = 7.9\) Hz, 4H), 7.09 (dd, \(J = 9.4, 8.3\) Hz, 3H), 6.97 (s, 1H), 2.37 (s, 3H); \(^13\)C NMR (101 MHz, CDCl\(_3\)) \(\delta\) 143.87, 136.58, 136.14, 129.65, 129.30, 127.29, 125.30, 121.57, 21.52. Data is consistent with that reported in the literature.\(^3\)

\(N\)-(4-Fluorophenyl)-4-methylbenzenesulfonamide (3b)

![Structure of \(N\)-(4-Fluorophenyl)-4-methylbenzenesulfonamide (3b)](image)

Colorless oil (50.1 mg, 63% yield). \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 7.63 (d, \(J = 8.3\) Hz, 2H), 7.22 (d, \(J = 8.2\) Hz, 2H), 7.13 (s, 1H), 7.09 – 7.01 (m, 2H), 6.91 (t, \(J = 8.6\) Hz, 2H), 2.38 (s, 3H); \(^13\)C NMR (101 MHz, CDCl\(_3\)) \(\delta\) 160.65 (d, \(J = 245.2\) Hz), 144.02, 135.78, 132.40 (d, \(J = 2.9\) Hz), 129.70, 127.31, 124.57 (d, \(J = 8.3\) Hz), 116.08 (d, \(J = 22.8\) Hz). Data is consistent with that reported in the literature.\(^4\)

\(N\)-(3-Fluorophenyl)-4-methylbenzenesulfonamide (3c)

![Structure of \(N\)-(3-Fluorophenyl)-4-methylbenzenesulfonamide (3c)](image)

White solid (43.8 mg, 55% yield). \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 7.72 (d, \(J = 8.3\) Hz, 2H), 7.27 – 7.21 (m, 3H), 7.17 (td, \(J = 8.2, 6.5\) Hz, 1H), 6.90 (dt, \(J = 10.2, 2.2\) Hz, 1H), 6.82 (dd, \(J = 8.1, 1.4\) Hz, 1H), 6.77 (td, \(J = 8.4, 2.3\) Hz, 1H), 2.38 (s, 3H); \(^13\)C NMR (101 MHz, CDCl\(_3\)) \(\delta\) 163.06 (d, \(J = 246.7\) Hz), 144.28, 138.28 (d, \(J = 10.3\) Hz), 135.83, 130.53 (d, \(J = 9.3\) Hz), 129.83, 127.29, 116.28 (d, \(J = 3.0\) Hz), 111.88 (d, \(J = 21.2\) Hz), 108.14 (d, \(J = 25.3\) Hz), 21.55. Data is consistent with that reported in the literature.\(^5\)

\(N\)-(2-Fluorophenyl)-4-methylbenzenesulfonamide (3d)

![Structure of \(N\)-(2-Fluorophenyl)-4-methylbenzenesulfonamide (3d)](image)
White solid (35.8 mg, 45% yield); mp: 104-106 °C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.66 (d, $J = 8.3$ Hz, 2H), 7.59 (td, $J = 7.9$, 2.2 Hz, 1H), 7.22 (d, $J = 8.2$ Hz, 2H), 7.12 - 7.01 (m, 2H), 6.99 - 6.91 (m, 1H), 6.72 (s, 1H), 2.38 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 153.93 (d, $J = 244.4$ Hz), 144.18, 135.96, 129.69, 127.22, 126.08 (d, $J = 7.5$ Hz), 124.76 (d, $J = 3.9$ Hz), 124.68, 123.25, 115.41 (d, $J = 19.5$ Hz), 21.55; $^{19}$F NMR (376 MHz, CDCl$_3$) $\delta$ -129.96. HRMS (ESI) $m/z$ calcd. for C$_{13}$H$_{13}$FNO$_2$S [M+H]$^+$: 266.0646, found: 266.0646.

4-Methyl-N-(4-(trifluoromethyl)phenyl)benzenesulfonamide (3e)

$\text{F}_3\text{C}$
\[\begin{array}{c}
\text{N} \\
\text{T}s
\end{array}\]

White solid (48.2 mg, 51% yield). $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.74 (d, $J = 8.3$ Hz, 2H), 7.48 (d, $J = 8.5$ Hz, 2H), 7.38 (s, 1H), 7.26 (d, $J = 8.1$ Hz, 2H), 7.19 (d, $J = 8.5$ Hz, 2H), 2.39 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 144.55, 139.96, 135.80, 129.96, 127.27, 126.73 (q, $J = 33.1$ Hz), 126.66 (q, $J = 3.8$ Hz), 123.92 (q, $J = 271.7$ Hz), 119.73, 21.57. Data is consistent with that reported in the literature.3

N-(4-Chlorophenyl)-4-methylbenzenesulfonamide (3f)

\[\begin{array}{c}
\text{Cl} \\
\text{N} \\
\text{T}s
\end{array}\]

Colorless oil (54.9 mg, 65% yield). $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.67 (d, $J = 8.3$ Hz, 2H), 7.29 (s, 1H), 7.23 (d, $J = 8.1$ Hz, 2H), 7.20 - 7.15 (m, 2H), 7.06 - 7.00 (m, 2H), 2.38 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 144.19, 135.75, 135.21, 130.86, 129.79, 129.40, 127.28, 122.88, 21.54. Data is consistent with that reported in the literature.3

N-(3-Chlorophenyl)-4-methylbenzenesulfonamide (3g)

\[\begin{array}{c}
\text{Cl} \\
\text{N} \\
\text{T}s
\end{array}\]

White solid (48.2 mg, 57% yield). $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.71 (d, $J = 8.3$ Hz, 2H), 7.40 (d, $J = 6.2$ Hz, 1H), 7.25 (d, $J = 9.1$ Hz, 2H), 7.17 - 7.09 (m, 2H), 7.07 - 7.01 (m, 1H), 7.01 - 6.95 (m, 1H), 2.38 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 144.30, 137.94, 135.77, 134.91, 130.31, 129.85, 127.28, 125.16, 120.91, 118.91, 21.55. Data is consistent with that reported in the literature.4

N-(3,5-Dichlorophenyl)-4-methylbenzenesulfonamide (3h)

\[\begin{array}{c}
\text{Cl} \\
\text{Cl} \\
\text{N} \\
\text{T}s
\end{array}\]

White solid (50.3 mg, 53% yield). $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.73 (d, $J = 8.2$ Hz, 2H), 7.29 (d,
\( J = 8.5 \, \text{Hz, 3H}, \) 7.05 (d, \( J = 1.6 \, \text{Hz, 1H} \)), 7.01 (d, \( J = 1.6 \, \text{Hz, 2H} \)), 2.41 (s, 3H); \(^{13}\)C NMR (101 MHz, CDCl\(_3\)) \( \delta \) 144.73, 138.68, 135.61, 135.44, 130.04, 127.27, 125.00, 118.58, 21.61. Data is consistent with that reported in the literature.\(^6\)

**N-(4-Bromophenyl)-4-methylbenzenesulfonamide (3i)**

![Image](image1)

White solid (65.6 mg, 67% yield). \(^1\)H NMR (400 MHz, CDCl\(_3\)) \( \delta \) 7.66 (d, \( J = 8.3 \, \text{Hz, 2H} \)), 7.37 – 7.30 (m, 2H), 7.24 (d, \( J = 8.0 \, \text{Hz, 2H} \)), 7.09 (s, 1H), 7.01 – 6.93 (m, 2H), 2.38 (s, 3H); \(^{13}\)C NMR (101 MHz, CDCl\(_3\)) \( \delta \) 144.23, 135.76, 135.72, 132.38, 129.81, 127.28, 123.10, 118.55, 21.55. Data is consistent with that reported in the literature.\(^3\)

**N-(2-Bromophenyl)-4-methylbenzenesulfonamide (3j)**

![Image](image2)

White solid (51.9 mg, 53% yield). \(^1\)H NMR (400 MHz, CDCl\(_3\)) \( \delta \) 7.71 – 7.60 (m, 3H), 7.41 (dd, \( J = 8.0, 1.4 \, \text{Hz, 1H} \)), 7.30 – 7.24 (m, 1H), 7.21 (d, \( J = 8.0 \, \text{Hz, 2H} \)), 7.00 – 6.93 (m, 2H), 2.37 (s, 3H); \(^{13}\)C NMR (101 MHz, CDCl\(_3\)) \( \delta \) 143.68, 139.32, 136.49, 136.24, 135.32, 133.86, 129.84, 129.58, 127.31, 122.29, 118.38, 21.52, 21.32. Data is consistent with that reported in the literature.\(^7\)

**4-Methyl-N-(p-tolyl)benzenesulfonamide (3k)**

![Image](image3)

White solid (47.0 mg, 60% yield). \(^1\)H NMR (400 MHz, CDCl\(_3\)) \( \delta \) 7.64 (d, \( J = 8.3 \, \text{Hz, 2H} \)), 7.21 (d, \( J = 8.1 \, \text{Hz, 2H} \)), 7.02 (d, \( J = 8.3 \, \text{Hz, 2H} \)), 6.95 (d, \( J = 8.4 \, \text{Hz, 2H} \)), 6.83 (s, 1H), 2.37 (s, 3H), 2.26 (s, 3H); \(^{13}\)C NMR (101 MHz, CDCl\(_3\)) \( \delta \) 143.68, 136.24, 135.32, 133.86, 129.84, 129.58, 127.31, 122.29, 21.52, 20.83. Data is consistent with that reported in the literature.\(^3\)

**4-Methyl-N-(m-tolyl)benzenesulfonamide (3l)**

![Image](image4)

White solid (56.4 mg, 72% yield). \(^1\)H NMR (400 MHz, CDCl\(_3\)) \( \delta \) 7.68 (d, \( J = 8.3 \, \text{Hz, 2H} \)), 7.22 (d, \( J = 8.1 \, \text{Hz, 2H} \)), 7.09 (t, \( J = 8.0 \, \text{Hz, 1H} \)), 6.94 – 6.82 (m, 4H), 2.37 (s, 3H), 2.26 (s, 3H); \(^{13}\)C NMR (101 MHz, CDCl\(_3\)) \( \delta \) 143.78, 139.32, 136.49, 136.24, 129.61, 129.06, 127.29, 126.06, 122.12, 118.38, 21.52, 21.32. Data is consistent with that reported in the literature.\(^4\)

**4-Methyl-N-(o-tolyl)benzenesulfonamide (3m)**

![Image](image5)

White solid (51.6 mg, 70% yield). \(^1\)H NMR (400 MHz, CDCl\(_3\)) \( \delta \) 7.66 (d, \( J = 8.3 \, \text{Hz, 2H} \)), 7.21 (d, \( J = 8.1 \, \text{Hz, 2H} \)), 7.02 (d, \( J = 8.3 \, \text{Hz, 2H} \)), 6.95 (d, \( J = 8.4 \, \text{Hz, 2H} \)), 6.83 (s, 1H), 2.37 (s, 3H), 2.26 (s, 3H); \(^{13}\)C NMR (101 MHz, CDCl\(_3\)) \( \delta \) 143.68, 136.24, 135.32, 133.86, 129.84, 129.58, 127.31, 122.29, 21.52, 21.32. Data is consistent with that reported in the literature.\(^4\)
White solid (37.6 mg, 48% yield). $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.61 (d, $J = 8.3$ Hz, 2H), 7.31 (d, $J = 7.8$ Hz, 1H), 7.21 (d, $J = 8.1$ Hz, 2H), 7.17 – 7.10 (m, 1H), 7.10 – 7.05 (m, 2H), 6.43 (s, 1H), 2.39 (s, 3H), 2.00 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 143.79, 136.82, 134.54, 131.31, 130.78, 129.61, 127.19, 126.96, 126.20, 124.32, 21.54, 17.55. Data is consistent with that reported in the literature.\textsuperscript{8}

$N$-(4-Methoxyphenyl)-4-methylbenzenesulfonamide (3n)

White solid (39.1 mg, 47% yield). $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.58 (d, $J = 8.3$ Hz, 2H), 7.21 (d, $J = 8.1$ Hz, 2H), 7.00 – 6.94 (m, 2H), 6.78 – 6.72 (m, 2H), 6.50 (s, 1H), 3.75 (s, 3H), 2.38 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 158.03, 143.66, 136.15, 129.55, 128.93, 127.36, 125.51, 114.46, 55.43, 21.53. Data is consistent with that reported in the literature.\textsuperscript{3}

$N$-(2-Methoxyphenyl)-4-methylbenzenesulfonamide (3o)

White solid (60.7 mg, 73% yield). $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.64 (d, $J = 8.3$ Hz, 2H), 7.51 (dd, $J = 7.9$, 1.5 Hz, 1H), 7.18 (d, $J = 8.1$ Hz, 2H), 7.06 – 6.96 (m, 2H), 6.89 (td, $J = 7.8$, 1.0 Hz, 1H), 6.73 (dd, $J = 8.1$, 0.9 Hz, 1H), 3.64 (s, 3H), 2.35 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 149.48, 143.60, 136.40, 129.35, 127.28, 126.11, 125.24, 121.12, 121.03, 110.61, 55.63, 21.49. Data is consistent with that reported in the literature.\textsuperscript{3}

Benzyl (4-(4-methylphenylsulfonamido)phenyl)carbamate (3p)

White solid (71.3 mg, 60% yield); mp: 162-163 °C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.59 (d, $J = 8.2$ Hz, 2H), 7.42 – 7.30 (m, 5H), 7.25 (d, $J = 6.3$ Hz, 2H), 7.20 (d, $J = 8.1$ Hz, 2H), 6.98 (d, $J = 8.8$ Hz, 2H), 6.67 (s, 1H), 6.53 (s, 1H), 5.17 (s, 2H), 2.37 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 153.25, 143.83, 136.02, 135.91, 135.75, 131.71, 129.62, 128.64, 128.43, 128.32, 127.28, 123.81, 119.46, 67.16, 21.51. HRMS (ESI) $m/z$ calced. for C$_{21}$H$_{21}$N$_2$O$_4$S [M+H]$^+$: 397.1217, found: 397.1219.

$N$-(Benzo[d][1,3]dioxol-5-yl)-4-methylbenzenesulfonamide (3q)

55
White solid (32.3 mg, 37% yield); mp: 140-142 °C. $^1$H NMR (400 MHz, CDCl$_3$) δ 7.62 (d, $J = 8.3$ Hz, 2H), 7.23 (d, $J = 8.1$ Hz, 2H), 6.68 (d, $J = 2.2$ Hz, 1H), 6.67 (s, 1H), 6.62 (d, $J = 8.2$ Hz, 1H), 6.43 (dd, $J = 8.3$, 2.1 Hz, 1H), 5.93 (s, 2H), 2.39 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 148.07, 145.95, 143.82, 135.96, 130.19, 129.63, 127.37, 116.90, 108.21, 105.55, 101.52, 21.55. HRMS (ESI) $m/z$ calcd. for C$_{14}$H$_{14}$NO$_4$S [M+H]$^+$: 292.0638, found: 292.0639.

4-Methyl-N-(naphthalen-1-yl)benzenesulfonamide (3r)

Red solid (43.7 mg, 49% yield). $^1$H NMR (400 MHz, CDCl$_3$) δ 7.87 – 7.77 (m, 2H), 7.70 (dd, $J = 7.2$, 1.8 Hz, 1H), 7.64 (d, $J = 8.3$ Hz, 2H), 7.48 – 7.32 (m, 4H), 7.14 (d, $J = 8.2$ Hz, 2H), 7.03 (s, 1H), 2.33 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 143.77, 136.43, 134.25, 131.50, 129.55, 128.91, 128.40, 127.37, 127.17, 126.62, 126.27, 125.42, 122.68, 121.50, 21.48. Data is consistent with that reported in the literature.$^9$

4-Methyl-N-(naphthalen-2-yl)benzenesulfonamide (3s)

Yellow solid (61.5 mg, 69% yield). $^1$H NMR (400 MHz, CDCl$_3$) δ 7.74 (d, $J = 8.0$ Hz, 1H), 7.71 (d, $J = 8.3$ Hz, 4H), 7.54 (d, $J = 1.9$ Hz, 1H), 7.42 (dt, $J = 16.2$, 6.8, 1.2 Hz, 2H), 7.23 (dd, $J = 8.8$, 2.2 Hz, 1H), 7.18 (d, $J = 8.1$ Hz, 2H), 7.12 (s, 1H), 2.33 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 143.95, 136.10, 134.10, 133.66, 131.09, 129.70, 129.0, 128.97, 127.64, 127.51, 127.30, 126.68, 125.49, 121.01, 118.37, 21.49. Data is consistent with that reported in the literature.$^3$

$N$-(6-(Dimethylamino)pyridin-3-yl)-4-methylbenzenesulfonamide (3t)

White solid (37.6 mg, 43% yield); mp: 140-141 °C.$^1$H NMR (400 MHz, CDCl$_3$) δ 7.67 (d, $J = 2.6$ Hz, 1H), 7.59 (d, $J = 8.3$ Hz, 2H), 7.31 (dd, $J = 9.0$, 2.7 Hz, 1H), 7.22 (d, $J = 8.1$ Hz, 2H), 6.46 (s, 1H), 6.40 (d, $J = 9.1$ Hz, 1H), 3.04 (s, 6H), 2.39 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 158.02, 145.05, 143.69, 136.09, 135.90, 129.63, 127.40, 121.08, 105.69, 38.23, 21.55. HRMS (ESI) $m/z$ calcd. for C$_{14}$H$_{18}$N$_3$O$_2$S [M+H]$^+$: 292.1114, found: 292.1112.

4-Chloro-$N$-phenylbenzenesulfonamide (4a)
White solid (36.1 mg, 45% yield). $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.70 (d, $J = 8.7$ Hz, 2H), 7.39 (d, $J = 8.7$ Hz, 2H), 7.24 (d, $J = 8.1$ Hz, 2H), 7.14 (t, $J = 7.4$ Hz, 1H), 7.07 (d, $J = 7.4$ Hz, 2H), 6.98 (s, 1H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 139.62, 137.54, 136.05, 129.48, 129.36, 128.70, 125.86, 122.02. Data is consistent with that reported in the literature.$^3$

4-Chloro-$N$-(p-tolyl)benzenesulfonamide (4b)

Colorless oil (52.4 mg, 62% yield). $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.66 (d, $J = 8.6$ Hz, 2H), 7.39 (d, $J = 8.5$ Hz, 2H), 7.05 (d, $J = 8.3$ Hz, 2H), 6.94 (d, $J = 8.3$ Hz, 2H), 6.63 (s, 1H), 2.28 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 139.48, 137.62, 136.06, 133.22, 130.03, 129.29, 128.72, 122.80, 20.86. Data is consistent with that reported in the literature.$^{10}$

4-Chloro-$N$-(m-tolyl)benzenesulfonamide (4c)

White solid (58.3 mg, 69% yield); mp: 110-111 °C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.71 (d, $J = 8.7$ Hz, 2H), 7.40 (d, $J = 8.7$ Hz, 2H), 7.12 (t, $J = 7.8$ Hz, 1H), 6.94 (d, $J = 7.6$ Hz, 1H), 6.90 (s, 1H), 6.88 – 6.81 (m, 2H), 2.28 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 139.48, 137.62, 135.92, 129.32, 129.23, 128.69, 126.64, 122.56, 118.82, 21.31. HRMS (ESI) m/z calcd. for C$_{13}$H$_{13}$ClNO$_2$S [M+H]$^+$: 282.0350, found: 282.0349.

4-Chloro-$N$-(2-methoxyphenyl)benzenesulfonamide (4d)

White solid (63.4 mg, 71% yield); mp: 97-98 °C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.67 (d, $J = 8.6$ Hz, 2H), 7.52 (dd, $J = 7.9$, 1.5 Hz, 1H), 7.36 (d, $J = 8.6$ Hz, 2H), 7.07 (td, $J = 7.9$, 1.5 Hz, 1H), 6.98 (s, 1H), 6.91 (td, $J = 7.8$, 1.0 Hz, 1H), 6.74 (dd, $J = 8.2$, 0.8 Hz, 1H), 3.63 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 149.80, 139.33, 137.77, 128.99, 128.70, 125.95, 125.47, 121.81, 121.20, 110.69, 55.60. HRMS (ESI) m/z calcd. for C$_{13}$H$_{13}$ClNO$_3$S [M+H]$^+$: 298.0299, found: 298.0301.

4-Chloro-$N$-(4-fluorophenyl)benzenesulfonamide (4e)
White solid (42.9 mg, 50% yield). $^1$H NMR (400 MHz, CDCl$_3$) δ 7.66 (d, $J$ = 8.6 Hz, 2H), 7.42 (d, $J$ = 8.6 Hz, 2H), 7.04 (dd, $J$ = 10.2, 5.1, 2.8 Hz, 2H), 6.95 (t, $J$ = 8.5 Hz, 2H), 6.77 (s, 1H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 160.98 (d, $J$ = 246.3 Hz), 139.78, 137.20, 131.74, 129.42, 128.69, 125.11 (d, $J$ = 8.4 Hz), 116.33 (d, $J$ = 22.9 Hz). Data is consistent with that reported in the literature.$^{11}$

$\text{4-Chloro-N-(3-fluorophenyl)benzenesulfonamide (4f)}$

Colorless oil (48.0 mg, 56% yield). $^1$H NMR (400 MHz, CDCl$_3$) δ 7.75 (d, $J$ = 8.7 Hz, 2H), 7.43 (d, $J$ = 8.7 Hz, 2H), 7.20 (td, $J$ = 8.2, 6.4 Hz, 1H), 6.91 (dt, $J$ = 10.0, 2.2 Hz, 1H), 6.82 (ddd, $J$ = 7.3, 5.3, 3.3 Hz, 2H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 163.07 (d, $J$ = 247.3 Hz), 140.00, 137.72 (d, $J$ = 10.3 Hz), 137.20, 130.73 (d, $J$ = 9.3 Hz), 129.55, 128.67, 116.60 (d, $J$ = 3.1 Hz), 112.45 (d, $J$ = 21.2 Hz), 108.54 (d, $J$ = 25.3 Hz); $^{19}$F NMR (376 MHz, CDCl$_3$) δ -110.41. HRMS (ESI) m/z calcd. for C$_{12}$H$_{10}$ClFNO$_2$S [M+H]$^+$: 286.0099, found: 286.0102.

$\text{4-Chloro-N-(4-chlorophenyl)benzenesulfonamide (4g)}$

White solid (38.1 mg, 42% yield). $^1$H NMR (400 MHz, CDCl$_3$) δ 7.70 (d, $J$ = 8.7 Hz, 2H), 7.42 (d, $J$ = 8.7 Hz, 2H), 7.22 (d, $J$ = 8.8 Hz, 2H), 7.13 (s, 1H), 7.02 (d, $J$ = 8.8 Hz, 2H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 139.94, 136.99, 134.59, 131.58, 129.62, 129.52, 128.67, 123.37. Data is consistent with that reported in the literature.$^{10}$

$\text{N-(4-Bromophenyl)-4-chlorobenzenesulfonamide (4h)}$

White solid (44.7 mg, 43% yield). $^1$H NMR (400 MHz, CDCl$_3$) δ 7.70 (dd, $J$ = 8.9, 2.2 Hz, 2H), 7.46 – 7.40 (m, 2H), 7.40 – 7.34 (m, 2H), 7.05 (s, 1H), 7.01 – 6.93 (m, 2H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 139.95, 137.15, 135.13, 132.57, 129.54, 128.65, 123.51, 119.21. Data is consistent with that reported in the literature.$^{10}$

$\text{4-Chloro-N-(naphthalen-2-yl)benzenesulfonamide (4i)}$
White solid (54.3 mg, 57% yield); mp: 135-136 °C. $^1$H NMR (400 MHz, CDCl$_3$) δ 7.79 – 7.69 (m, 5H), 7.55 (d, $J = 1.9$ Hz, 1H), 7.49 – 7.39 (m, 2H), 7.36 (d, $J = 8.7$ Hz, 2H), 7.22 (dd, $J = 8.8$, 2.2 Hz, 1H), 7.19 (s, 1H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 139.69, 137.49, 133.61, 133.52, 131.31, 129.59, 129.41, 128.69, 127.69, 127.56, 126.87, 125.82, 121.15, 119.07. HRMS (ESI) $m/z$ calcd. for C$_{16}$H$_{13}$ClNO$_2$S [M+H]$^+$: 318.0350, found: 318.0347

IV. References

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**RG**: 195.94  
**DW**: 20.800 usec  
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**TE**: 298.8 K  
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**WDW**: EM  
**SSB**: 0  
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![Chemical Structure](attachment:image.png)
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AQ: 4.0894966 sec
RG: 63.57
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TE: 299.9 K
D1: 1.00000000 sec
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1.95  1.95
2.00  2.00

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![Diagram of molecular structure]