Supporting Information for

Facile synthesis of 2-substituted benzo[b]furans and indoles by copper-catalyzed intramolecular cyclization of 2-alkynyl phenols and tosylanilines

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1. General Methods.
All reactions were carried out in solvents dried using a Solvent Purification System (SPS). Thin layer chromatography was carried out using TLC aluminum sheets coated with 0.2 mm of silica gel (Merck Gf234). Chromatographic purifications were carried out using flash grade silica gel (SDS Chromatogel 60 ACC, 40-60 µm). NMR spectra were recorded at 23 ºC on Bruker Avance 400 Ultrashield apparatus. Mass spectra were recorded on a Waters LCT Premier Spectrometer (ESI).

2. Procedure for the preparation of 2-alkynyl phenols and tosylanilines.

General procedure 1: Pd(PPh₃)₂Cl₂ (0.06 mmol), CuI (0.12 mmol) and Et₃N (4.5 mmol) were added sequentially to a solution of 2-iodoaniline (or 2-iodophenol, 3 mmol) and corresponding alkyne (4.5 mmol) in THF (10 mL) at 23 ºC and the mixture was stirred at this temperature for 3 h before the solvent was evaporated. The residue was purified by flash column chromatography (hexane/EtOAc) to give 2-alkynyl aniline (or 2-alkynyl phenol).

General procedure 2: To a solution of 2-alkynyl aniline (2 mmol) in CH₂Cl₂ (4 mL) was added p-toluenesulfonyl chloride (2.4 mmol) and pyridine (8 mmol) at 23 ºC and the mixture was stirred at 23 ºC for 2 h before it was quenched with saturated aqueous NH₄Cl (10 mL). The aqueous layer was extracted with CH₂Cl₂ (5 mL) and the combined organic layer was washed sequentially with water (10 mL) and brine (10 mL), dried over anhydrous Na₂SO₄. The solvent was evaporated and the residue was purified by flash column chromatography (hexane/EtOAc) to give 2-alkynyl tosylaniline.

¹H NMR (400 MHz, CDCl₃) δ 7.58 - 7.50 (m, 2H), 7.46 - 7.42 (m, 1H), 7.39 - 7.35 (m, 3H), 7.32 - 7.28 (m, 1H), 7.02 - 6.98 (m, 1H), 6.92 (t, J = 7.6 Hz, 1H), 5.84 (br s, 1H). The data is in accordance with the literature.
$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.44 (m, 3H), 7.25 (m, 1H), 7.14 (d, J = 8.0 Hz, 2H), 7.03 (d, J = 8.2 Hz, 1H), 6.91 (m, 1H), 6.11 (br s, 1H), 2.35 (s, 3H). The data is in accordance with the literature.$^1$

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.48 (m, 2H), 7.41 (dd, J = 7.7, 1.4 Hz, 1H), 7.28 - 7.23 (m, 1H), 6.99 (d, J = 8.2 Hz, 1H), 6.95 - 6.87 (m, 3H), 5.85 (br s, 1H), 3.85 (s, 3H). The data is in accordance with the literature.$^2$

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.45 - 7.43 (m, 2H), 7.40 (dd, J = 7.6, 1.6 Hz, 1H), 7.33 - 7.31 (m, 2H), 7.27 (ddd, J = 8.4, 7.6, 1.6 Hz, 1H), 6.98 (dd, J = 8.4, 1.2 Hz, 1H), 6.91 (td, J = 8.0, 1.2 Hz, 1H), 5.82 (br s, 1H). The data is in accordance with the literature.$^3$

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.24 (d, J = 8.4 Hz, 2H), 7.69 (d, J = 8.4 Hz, 2H), 7.45 (d, J = 7.7 Hz, 1H), 7.33 (t, J = 7.8 Hz, 1H), 7.04 - 6.89 (m, 2H), 5.72 (br s, 1H). The data is in accordance with the literature.$^4$
$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.30 (dd, $J = 7.6$, 1.6 Hz, 1H), 7.26 - 7.22 (m, 1H), 6.95 - 6.93 (m, 1H), 6.85 (dt, $J = 7.6$, 1.2 Hz, 1H), 6.11 (br s, 1H), 2.48 (br s, 1H), 1.66 (s, 6H). The data is in accordance with the literature.$^5$

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.27 (d, $J = 7.6$ Hz, 1H), 7.17 (m, 1H), 6.91 (d, $J = 8.4$ Hz, 1H), 6.82 (m, 1H), 5.78 (br s, 1H), 1.34 (s, 9H). The data is in accordance with the literature.$^6$

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.68 (d, $J = 8.3$ Hz, 2H), 7.63 (d, $J = 8.3$ Hz, 1H), 7.49 - 7.45 (m, 2H), 7.42 - 7.36 (m, 4H), 7.32 - 7.27 (m, 1H), 7.20 (br s, 1H), 7.17 (d, $J = 8.2$ Hz, 2H), 7.07 (t, $J = 7.6$ Hz, 1H), 2.34 (s, 3H). The data is in accordance with the literature.$^7$

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.66 (d, $J = 8.0$ Hz, 2H), 7.62 (d, $J = 8.0$ Hz, 1H), 7.37 - 7.33 (m, 3H), 7.28 - 7.25 (m, 2H), 7.18 - 7.13 (m, 4H), 7.04 (td, $J = 7.6$, 0.8 Hz, 1H), 2.38 (s, 3H), 2.31 (s, 3H). The data is in accordance with the literature.$^8$
$^1$H NMR (400 MHz, CDCl$_3$) δ 7.68 - 7.65 (m, 2H), 7.61 (d, J = 8.2 Hz, 1H), 7.39 - 7.33 (m, 5H), 7.29 (td, J = 7.8, 1.6 Hz, 1H), 7.20 (bs, 1H), 7.16 (d, J = 8.0 Hz, 2H), 7.06 (td, J = 1.2, 7.6 Hz, 1H), 2.33 (s, 3H). The data is in accordance with the literature.\(^8\)

\[
\begin{array}{c}
\text{NHTs} \\
\end{array}
\]

$^1$H NMR (400 MHz, CDCl$_3$) δ 7.66 (d, J = 7.6 Hz, 2H), 7.57 (d, J = 8.4 Hz, 1H), 7.28 (bs, 1H), 7.22 - 7.17 (m, 4H), 6.96 (t, J = 8.0 Hz, 1H), 2.40 (t, J = 7.2 Hz, 2H), 2.33 (s, 3H), 1.60 - 1.54 (m, 2H), 1.50 - 1.40 (m, 2H), 0.96 (t, J = 7.6 Hz, 3H). The data is in accordance with the literature.\(^8\)

\[
\begin{array}{c}
\text{NHTs} \\
\end{array}
\]

$^1$H NMR (400 MHz, CDCl$_3$) δ 7.64 (d, J = 8.3 Hz, 2H), 7.58 (d, J = 8.3 Hz, 1H), 7.26 - 7.19 (m, 4H), 7.11 (br, 1H), 6.98 (t, J = 8.3 Hz, 1H), 2.36 (s, 3H), 1.32 (s, 9H). The data is in accordance with the literature.\(^9\)

\[
\begin{array}{c}
\text{NHTs} \\
\end{array}
\]

$^1$H NMR (400 MHz, CDCl$_3$) δ 7.65 (d, J = 8.4 Hz, 2H), 7.54 (d, J = 7.6 Hz, 1H), 7.26 - 7.19 (m, 5H), 6.97 (t, J = 7.6 Hz, 1H), 2.37 (s, 3H), 1.46 - 1.43 (m, 1H), 0.95 - 0.91 (m, 2H), 0.77 - 0.74 (m, 2H). The data is in accordance with the literature.\(^8\)

\[
\begin{array}{c}
\text{NHTs} \\
\end{array}
\]

$^1$H NMR (400 MHz, CDCl$_3$) δ 8.04 (d, J = 8.4 Hz, 1H), 7.73 (d, J = 8.3 Hz, 2H), 7.41 (d, J = 7.7 Hz, 1H), 7.24 (t, J = 7.8 Hz, 1H), 7.16 (t, J = 7.4 Hz, 1H), 7.09 (d, J = 8.3 Hz, 2H), 6.73 (s, 1H), 4.98 (br s, 1H), 2.22 (s, 3H), 1.88 (s, 6H). The data is in accordance with the literature.\(^10\)

\[
\begin{array}{c}
\text{NHTs} \\
\end{array}
\]
\[ \text{H NMR (400 MHz, CDCl}_3\text{)} \delta 7.63 (d, J = 8.4 \text{ Hz}, 2H), 7.46 (d, J = 8.4 \text{ Hz}, 1H), 7.18 (d, J = 7.6 \text{ Hz}, 2H), 7.08 - 7.00 (m, 3H), 2.40 - 2.36 (m, 5H), 2.21 (s, 3H), 1.59 - 1.53 (m, 2H), 1.49 - 1.41 (m, 2H), 0.96 (t, J = 7.2 \text{ Hz}, 3H). \] The data is in accordance with the literature.\[1] \]

3. Procedure for the synthesis of 2-substituted benzo[b]furans and indoles

\[
\begin{align*}
\text{CuCl (5 mol%), } & \text{Cs}_2\text{CO}_3 (5 \text{ mol%}) \\
\text{CH}_3\text{CN, 23 °C, 5 h} & \\
\end{align*}
\]

CuCl (2.5 mg, 0.025 mmol) and Cs$_2$CO$_3$ (8.1 mg, 0.025 mmol) were added to a solution of 2-alkynyl phenol (or 2-alkynyl tosylaniline, 0.5 mmol) in CH$_3$CN (2 mL) and the mixture was stirred at 23 °C for 5 h. Then Et$_2$O (10 mL) was added and the resulting mixture was washed sequentially with water (10 mL) and brine (10 mL), dried over anhydrous Na$_2$SO$_4$. The solvent was evaporated and the residue was purified by flash column chromatography (hexane/EtOAc) to give 2-substituted benzo[b]furans (or 2-substituted indoles).

\[
\begin{align*}
\text{Yield: 95%}. & \\
\end{align*}
\]

\[ \text{1H NMR (400 MHz, CDCl}_3\text{)} \delta 7.95 - 7.90 (m, 2H), 7.66 - 7.57 (m, 2H), 7.50 (t, J = 7.6 \text{ Hz}, 2H), 7.44 - 7.25 (m, 3H), 7.08 - 7.05 (m, 1H). \]

\[ \text{13C NMR (101 MHz, CDCl}_3\text{)} \delta 155.99, 154.97, 130.55, 129.30, 128.83, 128.59, 125.00, 124.32, 123.00, 120.97, 111.24, 101.38. \]

HRMS-ESI calculated for C$_{14}$H$_{11}$O [M+H]$^+$: 195.0810; found: 195.0814.

\[
\begin{align*}
\text{Yield: 90%}. & \\
\end{align*}
\]

\[
\begin{align*}
\text{Yield: 90%}. & \\
\end{align*}
\]
$^{1}$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.88 (d, J = 8.1 Hz, 2H), 7.70 - 7.62 (m, 2H), 7.43 - 7.31 (m, 4H), 7.06 (s, 1H), 2.51 (s, 3H).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 156.27, 154.86, 138.62, 129.54, 129.44, 127.83, 124.96, 124.06, 122.92, 120.81, 111.16, 100.63, 21.43.

HRMS-ESI calculated for C$_{15}$H$_{13}$O $\mathrm{[M+H]^+}$: 209.0966; found: 209.0962.

Yield: 89%.

$^{1}$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.85 - 7.77 (m, 2H), 7.59 - 7.48 (m, 2H), 7.24 (dt, J = 16.1, 7.3, 1.4 Hz, 2H), 7.02 - 6.95 (m, 2H), 6.90 (d, J = 1.0 Hz, 1H), 3.87 (s, 3H).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 160.00, 156.07, 154.71, 129.50, 126.43, 123.74, 123.37, 122.83, 120.57, 114.27, 110.99, 99.68, 55.37.

HRMS-ESI calculated for C$_{15}$H$_{13}$O$_2$ $\mathrm{[M+H]^+}$: 225.0916; found: 225.0920.

Yield: 93%.

$^{1}$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.76 - 7.71 (m, 2H), 7.56 - 7.51 (m, 1H), 7.47 (d, J = 8.1 Hz, 1H), 7.39 - 7.34 (m, 2H), 7.26 (ddd, J = 8.2, 7.2, 1.5 Hz, 1H), 7.23 - 7.17 (m, 1H), 6.95 (d, J = 1.0 Hz, 1H).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 154.91, 154.77, 134.32, 129.07, 129.04, 128.98, 126.13, 124.57, 123.11, 121.02, 111.21, 101.76.

HRMS-ESI calculated for C$_{14}$H$_{10}$ClO $\mathrm{[M+H]^+}$: 229.0420; found: 229.0426.

Yield: 77%.

$^{1}$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.32 - 8.27 (m, 2H), 8.01 - 7.97 (m, 2H), 7.65 - 7.61 (m, 1H), 7.57 - 7.52 (m, 1H), 7.36 (ddd, J = 8.4, 7.2, 1.4 Hz, 1H), 7.30 - 7.21 (m, 2H).
**\(^{13}\)C NMR** (101 MHz, CDCl\(_3\) \(\delta\) 155.44, 153.24, 147.25, 136.27, 128.64, 125.82, 125.21, 124.30, 123.54, 121.63, 111.49, 105.10.

**HRMS-ESI** calculated for C\(_{14}\)H\(_{10}\)NO\(_3\) [M+H]\(^+\): 240.0661; found: 240.0666.

\[
\text{Yield: 83%}
\]

**\(^1\)H NMR** (400 MHz, CDCl\(_3\) \(\delta\) 7.50 - 7.43 (m, 1H), 7.42 - 7.36 (m, 1H), 7.23 - 7.12 (m, 2H), 6.44 (d, \(J = 1.2\) Hz, 1H), 3.89 (t, \(J = 6.3\) Hz, 2H), 3.00 - 2.91 (m, 2H), 2.31 (s, 1H).

**\(^{13}\)C NMR** (101 MHz, CDCl\(_3\) \(\delta\) 156.04, 154.82, 128.76, 123.54, 122.66, 120.46, 110.88, 103.62, 60.61, 32.03.

**HRMS-ESI** calculated for C\(_{10}\)H\(_{10}\)NaO\(_2\) [M+Na]\(^+\): 185.0578; found: 185.0572.

\[
\text{Yield: 86%}
\]

**\(^1\)H NMR** (400 MHz, CDCl\(_3\) \(\delta\) 7.50 - 7.44 (m, 1H), 7.42 - 7.37 (m, 1H), 7.22 - 7.14 (m, 2H), 6.39 (q, \(J = 1.1\) Hz, 1H), 3.71 (t, \(J = 6.3\) Hz, 2H), 2.86 (td, \(J = 7.5, 0.9\) Hz, 2H), 1.99 (tt, \(J = 7.5, 6.3\) Hz, 2H), 1.87 (br s, 1H).

**\(^{13}\)C NMR** (101 MHz, CDCl\(_3\) \(\delta\) 158.75, 154.69, 128.90, 123.26, 122.51, 120.29, 110.77, 102.24, 61.90, 30.62, 24.81.

**HRMS-ESI** calculated for C\(_{11}\)H\(_{12}\)NaO\(_2\) [M+Na]\(^+\): 199.0735; found: 199.0739.

\[
\text{Yield: 81%}
\]

**\(^1\)H NMR** (400 MHz, CDCl\(_3\) \(\delta\) 7.47 (dd, \(J = 7.5, 1.5\) Hz, 1H), 7.40 (d, \(J = 8.0\) Hz, 1H), 7.24 - 7.12 (m, 2H), 6.52 (s, 1H), 2.18 (br s, 1H), 1.62 (s, 6H).

**\(^{13}\)C NMR** (101 MHz, CDCl\(_3\) \(\delta\) 163.03, 154.68, 128.32, 123.99, 122.72, 120.99, 111.18, 100.34, 69.33, 28.76.
HRMS-ESI calculated for C$_{11}$H$_{12}$NaO$_2$ [M+Na]$^+$: 199.0735; found: 199.0739.

Yield: 91%.

$^1$H NMR (400 MHz, CDCl$_3$) δ 7.47 - 7.41 (m, 1H), 7.38 (d, J = 7.8 Hz, 1H), 7.21 - 7.08 (m, 2H), 6.31 (s, 1H), 1.34 (s, 9H).

$^{13}$C NMR (101 MHz, CDCl$_3$) δ 167.40, 154.61, 128.92, 123.06, 122.28, 120.33, 110.79, 98.90, 32.97, 28.87.

HRMS-ESI calculated for C$_{12}$H$_{15}$O [M+H]$^+$: 175.1123; found: 175.1129.

Yield: 88%.

$^1$H NMR (400 MHz, CDCl$_3$) δ 8.44 (d, J = 4.8 Hz, 1H), 7.81 (d, J = 7.4 Hz, 2H), 7.67 - 7.63 (m, 1H), 7.38 (t, J = 7.5 Hz, 2H), 7.34 - 7.29 (m, 1H), 7.13 (s, 1H), 7.09 (dd, J = 8.3, 4.8 Hz, 1H).

$^{13}$C NMR (101 MHz, CDCl$_3$) δ 159.58, 149.04, 147.97, 146.03, 129.69, 129.52, 128.89, 125.29, 118.75, 117.72, 102.41.

HRMS-ESI calculated for C$_{13}$H$_{10}$NO [M+H]$^+$: 196.0762; found: 196.0766.

Yield: 95%.

$^1$H NMR (400 MHz, CDCl$_3$) δ 8.38 (d, J = 8.4 Hz, 1H), 7.57 (dd, J = 7.2, 2.5 Hz, 2H), 7.53 - 7.48 (m, 4H), 7.42 (ddd, J = 8.5, 7.2, 1.4 Hz, 1H), 7.36 - 7.30 (m, 3H), 7.10 (d, J = 8.1 Hz, 2H), 6.61 (s, 1H), 2.35 (s, 3H).

$^{13}$C NMR (101 MHz, CDCl$_3$) δ 144.50, 142.14, 138.30, 134.73, 132.43, 130.55, 130.34, 129.18, 128.63, 127.48, 126.80, 124.76, 124.29, 120.68, 116.66, 113.58, 21.51.

HRMS-ESI calculated for C$_{21}$H$_{18}$NO$_2$S [M+H]$^+$: 348.1058; found: 348.1051.
Yield: 91%.

\begin{align*}
^{1}H \text{ NMR} & (400 \text{ MHz}, \text{CDCl}_3) \delta 8.31 (d, J = 8.4 \text{ Hz}, 1H), 7.42 (t, J = 7.7 \text{ Hz}, 3H), 7.34 (\text{ddd}, J = 8.5, 7.2, 1.4 \text{ Hz}, 1H), 7.30 - 7.22 (m, 5H), 7.04 (d, J = 8.1 \text{ Hz}, 2H), 6.51 (s, 1H), 2.45 (s, 3H), 2.28 (s, 3H). \\
^{13}C \text{ NMR} & (101 \text{ MHz}, \text{CDCl}_3) \delta 144.46, 142.31, 138.61, 138.22, 134.65, 130.67, 130.20, 129.56, 129.17, 128.26, 126.80, 124.62, 124.28, 120.59, 116.68, 113.30, 21.53, 21.46. \\
\text{HRMS-ESI} & \text{ calculated for } C_{22}H_{20}NO_2S [M+H]^+: 362.1215; \text{ found: 362.1219.}
\end{align*}

Yield: 94%.

\begin{align*}
^{1}H \text{ NMR} & (400 \text{ MHz}, \text{CDCl}_3) \delta 8.33 (d, J = 8.4 \text{ Hz}, 1H), 7.47 - 7.43 (m, 3H), 7.42 - 7.35 (m, 3H), 7.30 - 7.25 (m, 3H), 7.04 (d, J = 8.1 \text{ Hz}, 2H), 6.55 (s, 1H), 2.28 (s, 3H). \\
^{13}C \text{ NMR} & (101 \text{ MHz}, \text{CDCl}_3) \delta 144.76, 140.83, 138.37, 134.76, 134.49, 131.50, 130.92, 130.47, 129.30, 127.83, 126.72, 125.08, 124.51, 120.85, 116.70, 114.08, 21.54. \\
\text{HRMS-ESI} & \text{ calculated for } C_{21}H_{17}ClNO_2S [M+H]^+: 382.0669; \text{ found: 382.0665.}
\end{align*}

Yield: 88%.

\begin{align*}
^{1}H \text{ NMR} & (400 \text{ MHz}, \text{CDCl}_3) \delta 8.19 (d, J = 8.2 \text{ Hz}, 1H), 7.64 (d, J = 8.3 \text{ Hz}, 2H), 7.45 - 7.40 (m, 1H), 7.29 - 7.17 (m, 4H), 6.40 (s, 1H), 3.05 - 2.95 (m, 2H), 2.35 (s, 3H), 1.75 (p, J = 7.6 \text{ Hz}, 2H), 1.46 (h, J = 7.4 \text{ Hz}, 2H), 0.98 (t, J = 7.3 \text{ Hz}, 3H). \\
^{13}C \text{ NMR} & (101 \text{ MHz}, \text{CDCl}_3) \delta 144.55, 142.52, 137.20, 136.26, 129.85, 129.75, 126.25, 123.74, 123.42, 120.01, 114.82, 108.59, 30.98, 28.74, 22.48, 21.54, 13.93. \\
\text{HRMS-ESI} & \text{ calculated for } C_{19}H_{22}NO_2S [M+H]^+: 328.1371; \text{ found: 328.1376.}
\end{align*}
Yield: 88%.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.05 - 8.01 (m, 1H), 7.47 - 7.37 (m, 3H), 7.21 - 7.13 (m, 2H), 7.10 (d, $J$ = 8.2 Hz, 2H), 6.61 (s, 1H), 2.28 (s, 3H), 1.60 (s, 9H).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 152.75, 144.03, 138.95, 136.84, 129.47, 129.24, 126.00, 124.14, 123.62, 120.30, 116.10, 110.76, 35.02, 31.37, 21.48.

HRMS-ESI calculated for C$_{19}$H$_{22}$NO$_2$S [M+H]$^+$: 328.1371; found: 328.1377.

Yield: 85%.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.24 (d, $J$ = 8.4 Hz, 1H), 7.75 - 7.70 (m, 2H), 7.41 - 7.37 (m, 1H), 7.28 (ddd, $J$ = 8.4, 7.2, 1.4 Hz, 1H), 7.23 - 7.17 (m, 3H), 6.19 (s, 1H), 2.46 (dddd, $J$ = 11.5, 8.4, 5.3, 1.2 Hz, 1H), 2.34 (s, 3H), 1.01 - 0.94 (m, 2H), 0.63 - 0.57 (m, 2H).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 144.62, 144.12, 137.40, 136.58, 129.67, 129.33, 126.60, 123.88, 123.39, 120.21, 114.50, 106.06, 21.56, 9.47, 8.44.

HRMS-ESI calculated for C$_{18}$H$_{18}$NO$_2$S [M+H]$^+$: 312.1058; found: 312.1055.

Yield: 90%.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.19 - 8.12 (m, 1H), 7.64 - 7.55 (m, 2H), 7.44 - 7.35 (m, 1H), 7.25 (ddd, $J$ = 8.5, 7.2, 1.4 Hz, 1H), 7.19 (td, $J$ = 7.4, 1.1 Hz, 1H), 7.13 (d, $J$ = 8.1 Hz, 2H), 6.51 - 6.43 (m, 1H), 3.98 (t, $J$ = 6.4 Hz, 2H), 3.31 - 3.22 (m, 2H), 2.66 (br s, 1H), 2.28 (s, 3H).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 144.88, 138.21, 137.24, 135.85, 129.88, 129.73, 126.23, 124.19, 123.69, 120.35, 114.88, 110.57, 61.69, 32.55, 21.53.

HRMS-ESI calculated for C$_{17}$H$_{17}$NNaO$_3$S [M+Na]$^+$: 338.0827; found: 338.0824.
Yield: 90%.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.93 (d, $J = 8.3$ Hz, 1H), 7.65 (d, $J = 8.1$ Hz, 2H), 7.34 (d, $J = 7.5$ Hz, 1H), 7.14 (dq, $J = 23.6$, 7.3 Hz, 2H), 7.06 (d, $J = 8.1$ Hz, 2H), 6.64 (s, 1H), 4.98 (br s, 1H), 2.20 (s, 3H), 1.78 (s, 6H).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 148.39, 144.81, 138.06, 134.99, 129.63, 129.06, 126.59, 125.01, 124.04, 121.08, 115.56, 111.24, 69.34, 31.08, 21.51.

HRMS-ESI calculated for C$_{18}$H$_{19}$NNaO$_3$S [M+Na]$^+$: 352.0983; found: 352.0988.

Yield: 86%.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.04 (d, $J = 8.5$ Hz, 1H), 7.60 (dd, $J = 8.5$, 2.0 Hz, 2H), 7.21 - 7.12 (m, 3H), 7.06 (dd, $J = 8.5$, 1.8 Hz, 1H), 6.33 - 6.27 (m, 1H), 3.01 - 2.92 (m, 2H), 2.39 (s, 3H), 2.32 (s, 3H), 1.78 - 1.66 (m, 2H), 1.44 (h, $J = 7.4$ Hz, 2H), 0.96 (t, $J = 7.4$ Hz, 3H).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 144.44, 142.57, 136.27, 135.44, 132.99, 130.11, 129.72, 126.22, 125.07, 120.02, 114.53, 108.53, 31.02, 28.78, 22.48, 21.53, 21.21, 13.94.

HRMS-ESI calculated for C$_{20}$H$_{24}$NO$_2$S [M+H]$^+$: 342.1528; found: 342.1521.

Yield: 82%.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.15 (d, $J = 1.7$ Hz, 1H), 7.55 (d, $J = 8.1$ Hz, 2H), 7.24 (d, $J = 8.3$ Hz, 1H), 7.13 (dd, $J = 13.7$, 8.2 Hz, 3H), 6.27 (s, 1H), 2.88 (t, $J = 7.7$ Hz, 2H), 2.29 (s, 3H), 1.64 (p, $J = 7.6$ Hz, 2H), 1.37 (h, $J = 7.4$ Hz, 2H), 0.89 (t, $J = 7.3$ Hz, 3H).
\[^{13}\text{C}\] NMR (101 MHz, CDCl\textsubscript{3}) \(\delta\) 144.93, 143.24, 137.52, 136.05, 129.92, 129.64, 128.28, 126.29, 124.00, 120.66, 114.98, 108.02, 30.82, 28.61, 22.44, 21.56, 13.88.

HRMS-ESI calculated for C\textsubscript{19}H\textsubscript{21}ClNO\textsubscript{2}S [M+H]\(^+\): 362.0982; found: 362.0988.

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5. \(^1\text{H}\) NMR and \(^{13}\text{C}\) NMR Spectra
化合物7/1

CDCl3

f1 (ppm)

2.96 1.00 2.05 3.24 1.14 4.11 2.14 1.00 2.35 6.61 7.09 7.11 7.31 7.32 7.33 7.35 7.35 7.40 7.41 7.42 7.42 7.43 7.44 7.44 7.48 7.49 7.50 7.50 7.51 7.52 7.56 7.57 7.57 7.58 7.58 8.37 8.40

C13CPD

21.51 113.58 116.66 120.68 124.29 124.76 126.80 127.48 128.63 129.18 130.34 130.55 132.43 134.73 138.30 142.14 144.50

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[Image of a chemical structure with peaks labeled for 1H and 13C NMR spectra.]
The image contains a spectrum graph with peaks at various chemical shifts. The chemical structure of the compound is also shown, with labels for Cl and Ts. The spectrum data includes peaks at different ppm values, indicating the presence of various functional groups or atoms within the molecule. The peaks at 2.93, 2.14, 2.06, 3.29, 2.09, 1.00, 3.00, 0.97, 1.98, 0.94, 0.87, 0.91, 1.32, 1.34, 1.36, 1.38, 1.40, 1.42, 1.60, 1.62, 1.64, 1.66, 1.68, 2.29, 2.86, 2.88, 2.90, 6.27, 7.10, 7.10, 7.12, 7.12, 7.14, 7.16, 7.20, 7.23, 7.25, 7.54, 7.56, 8.14, and 8.15 correspond to the observed signals in the spectrum.
