Supporting information for

Synthesis of phenothiazines from cyclohexanones and 2-aminobenzenethiols under transition-metal-free conditions

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General information:
All reactions were carried out under an atmosphere of oxygen unless otherwise noted. Flash chromatography was performed on neutral aluminum oxide (100-200 mesh). $^1$H NMR and $^{13}$C NMR spectra were recorded on Bruker-AV (400 and 100 MHz, respectively) instrument internally referenced to tetramethylsilane (TMS) or acetone signals. Mass spectra was measured on an Agilent 5975 GC-MS instrument (EI). The new compounds were characterized by $^1$H NMR, $^{13}$C NMR, MS and HRMS. The structure of known compounds were further corroborated by comparing their $^1$H NMR, $^{13}$C NMR data and MS data with those of literature. All reagents were obtained from commercial suppliers and used without further purification.

General procedure (for 0.2 mmol scale):
Potassium iodide (3.4 mg, 0.02 mmol), (benzylsulfonyl)benzene (A-1, 4.6 mg, 0.02 mmol) were added to a 10 mL reaction tube. The sealed tube was purged with oxygen for three times and was added 2-aminobenzenethiol (1a, 21.4 μL, 0.2 mmol), cyclohexanone (2a, 31 μL, 0.3 mmol) and chlorobenzene (0.8 mL) by syringe. The reaction vessel was stirred at 140 °C for 24 h. After cooling to room temperature, the volatiles were removed under reduced pressure. The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 20:1) to afford the desired product 3a as pale yellow solid (28.3 mg, 71% yield).

General procedure (for 0.5 mmol scale):
Potassium iodide (8.3 mg, 0.05 mmol), (benzylsulfonyl)benzene (A-1, 11.5 mg, 0.05 mmol) were added to a 10 mL reaction tube. The sealed tube was purged with oxygen for three times and was added 2-aminobenzenethiol (1a, 53.3 μL, 0.5 mmol), cyclohexanone (2a, 77.5 μL, 0.75 mmol) and chlorobenzene (0.8 mL) by syringe. The reaction vessel was stirred at 140 °C for 24 h. After cooling to room temperature, the volatiles were removed under reduced pressure. The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 20:1) to give the desired product 3a as pale yellow solid (70 mg, 70% yield).

10H-Phenothiazine (3a, CAS: 92-84-2)[1]
$^1$H NMR (400 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 7.82 (brs, 1H), 7.00-6.93 (m, 4H), 6.79 (t, $J = 7.0$ Hz, 2H), 6.71 (d, $J = 8.0$ Hz, 2H); $^{13}$C NMR (100 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 143.6, 128.5, 127.4, 123.1, 118.6, 115.6; MS (EI) $m/z$ (%) 199 (100), 167, 154, 140, 77.

3-Methyl-10$^H$-phenothiazine (3b, CAS: 3939-47-7)$^{[2]}$

The reaction was conducted with 2-aminobenzenethiol (1a, 21.3 $\mu$L, 0.2 mmol) and 4-methylcyclohexanone (2b, 36.8 $\mu$L, 0.3 mmol). The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 20:1) to give 3b as yellow solid (35.4 mg, 83%). $^1$H NMR (400 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 7.74 (brs, 1H), 6.97-6.93 (m, 2H), 6.77-6.60 (m, 5H), 2.16 (s, 3H); $^{13}$C NMR (100 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 143.8, 143.8, 141.0, 141.0, 132.3, 128.9, 128.3, 127.6, 127.3, 122.7, 118.3, 115.4, 20.5; MS (EI) $m/z$ (%) 213 (100), 198, 180, 167, 90.

3-Ethyl-10$^H$-phenothiazine (3c, CAS: 54027-87-1)$^{[3]}$

The reaction was conducted with 2-aminobenzenethiol (1a, 21.3 $\mu$L, 0.2 mmol) and 4-ethylcyclohexanone (2c, 42.3 $\mu$L, 0.3 mmol). The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 50:1) to give 3c as yellow solid (34.5 mg, 76%). $^1$H NMR (400 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 7.76 (brs, 1H), 6.95 (t, $J = 5.8$ Hz, 2H), 6.84-6.63 (m, 5H), 2.47 (m, 2H), 1.14 (m, 3H); $^{13}$C NMR (100 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 143.8, 141.2, 139.1, 128.3, 127.8, 127.3, 126.6, 122.7, 118.5, 118.4, 115.5, 115.4, 28.6, 16.3; MS (EI) $m/z$ (%) 227, 212 (100), 180, 167, 106.
**3-Pentyl-10H-phenothiazine (3d, CAS: 93730-07-5)[3]**

![Chemical Structure](image)

The reaction was conducted with 2-aminobenzenethiol (1a, 21.3 μL, 0.2 mmol) and 4-pentylcyclohexanone (2d, 57.0 μL, 0.3 mmol). The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 50:1) to give 3d as yellow solid (37.8 mg, 70%). 1H NMR (400 MHz, CD3COCD3, ppm) δ 7.76 (brs, 1H), 6.98-6.93 (m, 2H), 6.84-6.63 (m, 5H), 2.45 (m, 2H), 1.54 (m, 2H), 1.30 (m, 4H), 0.88 (m, 3H); 13C NMR (100 MHz, CD3COCD3, ppm) δ 143.8, 141.2, 137.6, 128.3, 127.3, 127.1, 127.0, 122.7, 118.5, 118.3, 115.9, 115.4, 35.6, 32.2, 32.1, 23.3, 14.5; MS (EI) m/z (%) 269, 212 (100), 180, 167, 152.

**3-tert-Pentyl-10H-phenothiazine (3e)**

![Chemical Structure](image)

The reaction was conducted with 2-aminobenzenethiol (1a, 21.3 μL, 0.2 mmol) and 4-(tert-pentyl)cyclohexanone (2e, 54.9 μL, 0.3 mmol). The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 20:1) to give 3e as yellow solid (43.0 mg, 80%). 1H NMR (400 MHz, CD3COCD3, ppm) δ 7.77 (brs, 1H), 6.97-6.93 (m, 4H), 6.78-6.66 (m, 3H), 1.59 (m, 2H), 1.21 (s, 6H), 0.66 (m, 3H); 13C NMR (100 MHz, CD3COCD3, ppm) δ 144.2, 143.8, 140.9, 128.3, 127.3, 126.0, 124.8, 122.7, 118.6, 118.0, 115.4, 115.1, 38.1, 37.4, 28.9, 9.6; HRMS (ESI, m/z): calcd for C17H19NS [M]+ 269.1233, found 269.1232.

**3-Phenyl-10H-phenothiazine (3f, CAS: 4018-68-2)[4]**

![Chemical Structure](image)

The reaction was conducted with 2-aminobenzenethiol (1a, 21.3 μL, 0.2 mmol) and 4-phenylcyclohexanone (2f, 52.2 mg, 0.3 mmol). The residue was purified by column
chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 20:1) to give 3f as yellow solid (44.6 mg, 81%). $^1$H NMR (400 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 7.97 (brs, 1H), 7.58 (d, $J = 6.4$ Hz, 2H), 7.41-7.25 (m, 5H), 6.99 (t, $J = 8.2$ Hz, 2H), 6.81-6.73 (m, 3H); $^{13}$C NMR (100 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 143.2, 142.8, 141.1, 136.1, 129.8, 128.5, 127.9, 127.8, 127.4, 127.1, 125.6, 123.2, 119.2, 118.3, 115.9, 115.7; MS (El) $m/z$ (%) 275 (100), 243, 152, 114, 77.

**Ethyl 10H-phenothiazine-3-carboxylate (3g)**

![Ethyl 10H-phenothiazine-3-carboxylate](image)

The reaction was conducted with 2-aminobenzenethiol (1a, 21.3 μL, 0.2 mmol) and ethyl 4-oxocyclohexanecarboxylate (2g, 47.8 μL, 0.3 mmol). The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 20:1) to give 3g as yellow solid (39.0 mg, 72%). $^1$H NMR (400 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 8.30 (brs, 1H), 7.62 (d, $J = 7.6$ Hz, 1H), 7.52 (s, 1H), 7.01 (d, $J = 6.8$ Hz, 1H), 6.95 (d, $J = 6.8$ Hz, 1H), 6.85 (d, $J = 6.8$ Hz, 1H), 6.73 (d, $J = 6.8$ Hz, 2H), 4.27 (m, 2H), 1.33 (t, $J = 6.2$ Hz, 3H); $^{13}$C NMR (100 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 166.1, 147.4, 147.4, 141.8, 130.4, 128.7, 128.4, 127.4, 125.1, 124.0, 117.9, 116.0, 114.8, 61.3, 14.8; HRMS (ESI, $m/z$): calcd for C$_{15}$H$_{13}$NO$_2$S [M]$^+$ 271.0662, found 271.0660.

**2-Methyl-10H-phenothiazine (3j, CAS: 5828-51-3)$^{[1]}$**

![2-Methyl-10H-phenothiazine](image)

The reaction was conducted with 2-aminobenzenethiol (1a, 21.3 μL, 0.2 mmol) and 3-methylcyclohex-2-enone (2j, 34.0 μL, 0.3 mmol). The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 20:1) to give 3j as yellow solid (22.2 mg, 52%). $^1$H NMR (400 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 7.76 (brs, 1H), 6.98-6.93 (m, 2H), 6.83-6.78 (m, 2H), 6.71 (d, $J = 7.6$ Hz, 1H), 6.63 (d, $J = 6.8$ Hz, 1H), 6.55 (s, 1H), 2.17 (s, 3H); $^{13}$C NMR (100 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 143.6, 143.4, 138.3, 128.3, 127.3, 127.1, 123.8, 122.9, 118.9, 116.4, 115.6, 115.2, 21.2; MS (El) $m/z$ (%) 213 (100), 198, 180, 167, 152.
3-Methyl-10H-phenothiazine (3k, CAS: 3939-47-7)[2]

![Structure of 3-Methyl-10H-phenothiazine](image)

The reaction was conducted with 2-amino-5-methylbenzenethiol (1b, 27.8 mg, 0.2 mmol) and cyclohexanone (2a, 31.0 μL, 0.3 mmol). The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 20:1) to give 3k as yellow solid (26.4 mg, 62%). This product is same as 3b. 1H NMR (400 MHz, CD3COCD3, ppm) δ 7.74 (brs, 1H), 6.97-6.93 (m, 2H), 6.77-6.60 (m, 5H), 2.16 (s, 3H); 13C NMR (100 MHz, CD3COCD3, ppm) δ 143.8, 143.8, 141.0, 141.0, 132.3, 128.9, 128.3, 127.6, 127.3, 122.7, 118.3, 115.4, 20.5; MS (EI) m/z (%) 213 (100), 198, 180, 167, 90.

3-Methoxy-10H-phenothiazine (3l, CAS: 1771-19-3)[1]

![Structure of 3-Methoxy-10H-phenothiazine](image)

The reaction was conducted with 2-amino-5-methoxybenzenethiol (1c, 31.1 mg, 0.2 mmol) and cyclohexanone (2a, 31.0 μL, 0.3 mmol). The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 10:1) to give 3l as white solid (26.6 mg, 58%). 1H NMR (400 MHz, CD3COCD3, ppm) δ 7.65 (brs, 1H), 6.98-6.94 (m, 2H), 6.78-6.59 (m, 5H), 3.71 (s, 3H); 13C NMR (100 MHz, CD3COCD3, ppm) δ 156.6, 144.2, 137.0, 128.5, 127.3, 122.6, 119.7, 118.0, 116.2, 115.4, 114.0, 112.8, 56.1; MS (EI) m/z (%) 229 (100), 214, 186, 154, 128.

3-Fluoro-10H-phenothiazine (3m, CAS: 397-59-1)[5]

![Structure of 3-Fluoro-10H-phenothiazine](image)

The reaction was conducted with 2-amino-5-fluorobenzenethiol (1d, 28.6 mg, 0.2 mmol) and cyclohexanone (2a, 31.0 μL, 0.3 mmol). The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 50:1) to give 3m as white solid (33.0 mg, 76%). 1H NMR (400 MHz, CD3COCD3, ppm) δ 7.90 (brs, 1H), 7.01-6.97 (m, 2H), 6.81-6.73 (m, 5H);
\[ ^{13}C \text{ NMR} (100 \text{ MHz, CD}_3\text{COCD}_3, \text{ppm}) \delta 159.4 (d, J = 237.1 \text{ Hz}), 143.6, 140.0, 128.8, 127.4, 123.2, 120.5 (d, J = 6.8 \text{ Hz}), 117.5, 116.1 (d, J = 8.0 \text{ Hz}), 115.6, 114.6 (d, J = 22.6 \text{ Hz}), 114.0 (d, J = 25.1 \text{ Hz}); \text{MS (EI)} m/\text{z} (%) 217 (100), 185, 172, 157, 91. \]

**3-Chloro-10H-phenothiazine (3n, CAS: 1207-99-4)**

![Chemical Structure](attachment:image.png)

The reaction was conducted with 2-amino-5-chlorobenzenethiol (1e, 31.9 mg, 0.2 mmol) and cyclohexanone (2a, 31.0 µL, 0.3 mmol). The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 20:1) to give 3n as yellow solid (35.0 mg, 75%). \(^1\text{H NMR} (400 \text{ MHz, CD}_3\text{COCD}_3, \text{ppm}) \delta 7.99 (\text{brs, 1H}), 7.01-6.95 (\text{m, 4H}), 6.82 (\text{m, 1H}), 6.71 (d, J = 6.8 \text{ Hz, 2H}); ^{13}C \text{ NMR} (100 \text{ MHz, CD}_3\text{COCD}_3, \text{ppm}) \delta 143.0, 142.5, 128.8, 128.2, 127.4, 127.0, 126.6, 123.4, 120.7, 117.6, 116.5, 115.8; \text{MS (EI)} m/\text{z} (%) 233 (100), 198, 188, 166, 154.

**2-Methyl-10H-phenothiazine (3o, CAS: 5828-51-3)**

![Chemical Structure](attachment:image.png)

The reaction was conducted with 2-amino-4-methylbenzenethiol (1f, 27.8 mg, 0.2 mmol) and cyclohexanone (2a, 31.0 µL, 0.3 mmol). The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 20:1) to give 3o as yellow solid (27.7 mg, 65%). This product is same as 3j. \(^1\text{H NMR} (400 \text{ MHz, CD}_3\text{COCD}_3, \text{ppm}) \delta 7.76 (\text{brs, 1H}), 6.98-6.93 (\text{m, 2H}), 6.83-6.78 (\text{m, 2H}), 6.71 (d, J = 7.6 \text{ Hz, 1H}), 6.63 (d, J = 6.8 \text{ Hz, 1H}), 6.55 (s, 1H), 2.17 (s, 3H); ^{13}C \text{ NMR} (100 \text{ MHz, CD}_3\text{COCD}_3, \text{ppm}) \delta 143.6, 143.4, 138.3, 128.3, 127.3, 127.1, 123.8, 122.9, 118.9, 116.4, 115.6, 115.2, 21.2; \text{MS (EI)} m/\text{z} (%) 213 (100), 198, 180, 167, 152.

**2-(Trifluoromethyl)-10H-phenothiazine (3p, CAS: 92-30-8)**
The reaction was conducted with 2-amino-4-(trifluoromethyl)benzenethiol hydrochloride (1g, 45.9 mg, 0.2 mmol) and cyclohexanone (2a, 31.0 μL, 0.3 mmol). The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether) to give 3p as yellow solid (32.0 mg, 60%). $^1$H NMR (400 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 8.11 (brs, 1H), 7.13-6.96 (m, 5H), 6.85 (m, 1H), 6.72 (d, $J$ = 6.8 Hz, 1H); $^{13}$C NMR (100 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 144.0, 142.4, 130.2 (q, $J$ = 31.9 Hz), 129.0, 127.8, 127.4, 125.3 (q, $J$ = 271.3 Hz), 124.0 (q, $J$ = 2.0 Hz), 123.8, 119.3 (q, $J$ = 4.0 Hz), 117.5, 115.9, 115.5 (q, $J$ = 3.8 Hz); MS (EI) m/z (%) 267 (100), 247, 235, 222, 91.

2-Fluoro-10H-phenothiazine (3q, CAS: 397-58-0)$^{[1]}$

The reaction was conducted with 2-amino-4-fluorobenzenethiol (1h, 28.6 mg, 0.2 mmol), and cyclohexanone (2a, 31.0 μL, 0.3 mmol). The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 50:1) to give 3q as yellow solid (25.2 mg, 58%). $^1$H NMR (400 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 8.07 (brs, 1H), 7.02-6.96 (m, 3H), 6.83 (m, 1H), 6.72 (d, $J$ = 6.0 Hz, 1H), 6.59-6.51 (m, 2H); $^{13}$C NMR (100 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 163.8 (d, $J$ = 240.5 Hz), 145.4 (d, $J$ = 10.5 Hz), 142.6, 128.6, 128.4 (d, $J$ = 9.7 Hz), 127.4, 123.6, 118.6, 115.8, 113.8, 109.3 (d, $J$ = 22.5 Hz), 102.8 (d, $J$ = 26.1 Hz); MS (EI) m/z (%) 217 (100), 185, 172, 157, 91.

2-Chloro-10H-phenothiazine (3r, CAS: 92-39-7)$^{[1]}$

The reaction was conducted with 2-amino-4-chlorobenzenethiol (1i, 31.9 mg, 0.2 mmol) and cyclohexanone (2a, 31.0 μL, 0.3 mmol). The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 20:1) to give 3r as yellow solid (32.7 mg, S8
70%). $^1$H NMR (400 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 8.02 (brs, 1H), 7.02-6.95 (m, 3H), 6.83-6.70 (m, 4H); $^{13}$C NMR (100 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 144.9, 142.6, 133.5, 128.7, 128.4, 127.4, 123.6, 122.6, 118.2, 117.6, 115.9, 115.2; MS (EI) m/z (%) 233 (100), 198, 188, 166, 154.

3-Chloro-7-methyl-10H-phenothiazine (3t, CAS: 35565-23-2)$^6$

![Chemical Structure](attachment:image.png)

The reaction was conducted with 2-amino-5-chlorobenzenethiol (1e, 31.9 mg, 0.2 mmol) and 4-methylcyclohexanone (2b, 36.8 μL, 0.3 mmol). The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 20:1) to give 3t as yellow solid (35.0 mg, 71%). $^1$H NMR (400 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 7.86 (brs, 1H), 6.99-6.97 (m, 2H), 6.83-6.78 (m, 2H), 6.68 (d, $J$ = 8.0 Hz, 1H), 6.61 (d, $J$ = 7.6 Hz, 1H), 2.18 (s, 3H); $^{13}$C NMR (100 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 142.8, 142.8, 140.6, 132.9, 129.3, 128.1, 127.7, 126.6, 120.7, 117.5, 116.3, 115.6, 20.5; MS (EI) m/z (%) 247 (100), 232, 212, 178, 168.

3-Chloro-7-ethyl-10H-phenothiazine (3u, CAS: 106837-73-4)$^7$

![Chemical Structure](attachment:image.png)

The reaction was conducted with 2-amino-5-chlorobenzenethiol (1e, 31.9 mg, 0.2 mmol) and 4-ethylcyclohexanone (2c, 42.3 μL, 0.3 mmol). The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 20:1) to give 3u as yellow solid (39.7 mg, 76%). $^1$H NMR (400 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 7.89 (brs, 1H), 6.97 (s, 2H), 6.87-6.82 (m, 2H), 6.70-6.63 (m, 2H), 2.48 (m, 2H), 1.14 (m, 3H); $^{13}$C NMR (100 MHz, CD$_3$COCD$_3$, ppm) $\delta$ 142.8, 140.6, 139.6, 128.1, 128.1, 126.7, 126.6, 120.7, 117.5, 117.5, 116.4, 115.7, 28.6, 16.2; MS (EI) m/z (%) 261 (100), 246, 210, 167, 123.

3-Chloro-7-tert-pentyl-10H-phenothiazine (3v)
The reaction was conducted with 2-amino-5-chlorobenzenethiol (1e, 31.9 mg, 0.2 mmol) and 4-(tert-pentyl)cyclohexanone (2e, 54.9 μL, 0.3 mmol). The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 20:1) to give 3v as yellow solid (49.0 mg, 81%). ^1H NMR (400 MHz, CD3COCD3, ppm) δ 7.91 (brs, 1H), 6.98-6.93 (m, 4H), 6.71-6.65 (m, 2H), 1.59 (m, 2H), 1.21 (s, 6H), 0.66 (m, 3H); ^13C NMR (100 MHz, CD3COCD3, ppm) δ 144.7, 142.8, 140.4, 128.1, 126.7, 126.6, 126.4, 124.9, 120.8, 117.2, 116.4, 115.4, 38.2, 37.4, 28.9, 9.6; HRMS (ESI, m/z): calcd for C17H18ClNS [M]+ 303.0843, found 303.0843

**Ethyl 7-chloro-10H-phenothiazine-3-carboxylate (3w)**

The reaction was conducted with 2-amino-5-chlorobenzenethiol (1e, 31.9 mg, 0.2 mmol) and ethyl 4-oxocyclohexanecarboxylate (2g, 47.8 μL, 0.3 mmol). The residue was purified by column chromatography on neutral aluminum oxide (petroleum ether/EtOAc = 20:1) to give 3w as yellow solid (52.0 mg, 85%). ^1H NMR (400 MHz, CD3COCD3, ppm) δ 8.41 (brs, 1H), 7.63 (d, J = 7.2 Hz, 1H), 7.53 (s, 1H), 7.03-7.01 (m, 2H), 6.73 (m, 2H), 4.27 (m, 2H), 1.33 (m, 3H); ^13C NMR (100 MHz, CD3COCD3, ppm) δ 165.9, 146.9, 140.8, 130.7, 128.1, 128.0, 128.0, 126.7, 125.5, 120.2, 117.4, 117.0, 115.1, 61.3, 14.8; HRMS (ESI, m/z): calcd for C15H13ClNO2S [M+H]^+ 306.0350, found 306.0350

**References**


$^1$H NMR and $^{13}$C NMR spectra
This page contains electronic supplementary material for the RSC Advances journal. The material includes two charts showing chemical spectra and structures labeled as 3f. The charts are labeled with chemical shifts in parts per million (ppm).