Supplementary Information

Metal-free sp^3 C-H functionalization: a novel approach for the syntheses of selenide ethers and thioesters from Methyl Arenes functionalization of arenes

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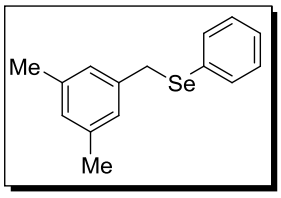
1. General information:

All chemicals were purchased from commercial suppliers and used without further purification. NMR spectra were recorded on a Varian Unity Inova-600 or a Varian Mercury-400 instrument using $CDCl_3$ as solvent. Chemical shifts are reported in parts per million (ppm) and referenced to the residual solvent resonance. Coupling constant (*J*) are reported in hertz (Hz). Standard abbreviations indicating multiplicity were used as follows: s = singlet, d = doublet, t = triplet, dd = double doublet, q = quartet, m = multiplet. High resolution mass spectra (HRMS) were performed on an electron ionization time-of-flight (EI-TOF) mass spectrometer at the National Chung Hsing University.

2. General procedure for Table 1

A vial sealed equipped with a magnetic stir bar was charged with diphenyl diselenide (0.5 mmol), mesitylene (1.0 mL) and DTBP (5.0 mmol), and the vial was sealed with a cap containing a PTFE septum and the reaction vessel was heated at 120 ℃ in an oil bath. After stirring at this temperature for 24 h, the reaction mixture was cooled to room temperature and diluted with ethyl acetate (20 mL). The resulting solution was directly filtered through a pad of celite then washed with ethyl acetate (20 mL) and concentrated to give the crude material which was then purified by column chromatography (SiO_2, hexane) to provide **3a**.

Representative example of Table 1: (3,5-Dimethylbenzyl)(phenyl)selane (entry 7, 3a).



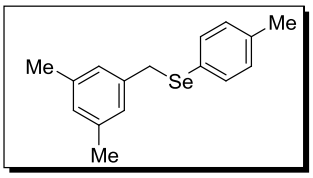
The title compound was prepared following the general procedure for Table 1, using diphenyl diselenide (157 mg, 0.5 mmol), mesitylene (1.0 mL) and DTBP (5.0 mmol), which on purification by column chromatography (SiO_2, hexane), provided **3a** as a colorless oil (187 mg, 68% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 2.25 (s, 6 H), 4.05 (s, 2 H), 6.80-6.83 (m, 3 H), 7.24-7.26 (m, 3 H), 7.45-7.48 (m, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.2, 32.2, 126.6, 127.1, 128.6, 128.9, 130.8, 133.4, 137.9, 138.2;

HRMS-EI calcd. for $C_{15}H_{16}Se$: 276.0417, found: 276.0424.

3. General procedure for Table 2

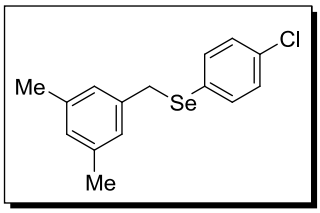
A vial sealed equipped with a magnetic stir bar was charged with diselenide (0.5 mmol), methyl arene (1.0 mL) and DTBP (5.0 mmol), and the vial was sealed with a cap containing a PTFE septum and the reaction vessel was heated at 120 ℃ in an oil bath. After stirring at this temperature for 24 h, the reaction mixture was cooled to room temperature and diluted with ethyl acetate (20 mL). The resulting solution was directly filtered through a pad of celite then washed with ethyl acetate (20 mL) and concentrated to give the crude material which was then purified by column chromatography (SiO_2, hexane) to provide **3**.

(3,5-Dimethylbenzyl)(p-tolyl)selane (3b) (Table 2, entry 1):



The title compound was prepared following the general procedure for Table 2, using 1,2-di-*p*-tolyldiselane (170 mg, 0.5 mmol), mesitylene (1.0 mL) and DTBP (5.0 mmol), which on purification by column chromatography (SiO_2, hexane), provided **3b** as a colorless oil (171 mg, 59% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 2.24 (s, 6 H), 2.32 (s, 3 H), 4.00 (s, 2 H), 6.81-6.83 (m, 3 H), 7.05 (d, J = 7.6 Hz, 2 H), 7.35 (d, J = 7.6 Hz, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.1, 21.2, 32.6, 126.6, 126.9, 128.5, 129.7, 133.9, 137.2, 137.9, 138.4; HRMS-EI calcd. for $C_{16}H_{18}Se$: 290.0574, found: 290.0580.

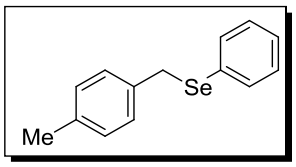
(4-Chlorophenyl)(3,5-dimethylbenzyl)selane (3c) (Table 2, entry 2):



The title compound was prepared following the general procedure for Table 2, using 1,2-bis(4-chlorophenyl)diselane (191 mg, 0.5 mmol), mesitylene (1.0 mL) and DTBP (5.0 mmol), which on purification by column chromatography (SiO_2, hexane),

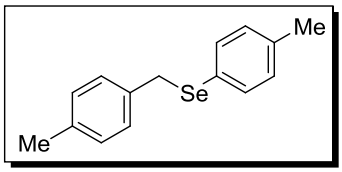
provided **3c** as a colorless oil (188 mg, 61% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 2.25 (s, 6 H), 4.01 (s, 2 H), 6.80 (s, 2 H), 6.84 (s, 1 H), 7.19 (dd, J = 2.0 & 6.4 Hz, 2 H), 7.35 (dd, J = 2.0 & 6.4 Hz, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.1, 32.5, 126.6, 128.7, 128.7, 129.0, 133.5, 134.9, 137.8, 138.0; HRMS-EI calcd. for $C_{15}H_{15}ClSe$: 310.0027, found: 310.0035.

(4-Methylbenzyl)(phenyl)selane (3d) (Table 2, entry 3):[1a]



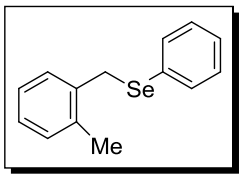
The title compound was prepared following the general procedure for Table 2, using diphenyl diselenide (157 mg, 0.5 mmol), *p*-xylene (1.0 mL) and DTBP (5.0 mmol),which on purification by column chromatography (SiO_2, hexane), provided **3d** as a colorless oil (164 mg, 63% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 2.31 (s, 3 H), 4.09 (s, 2 H), 7.05 (d, J = 8.0 Hz, 2 H), 7.11 (d, J = 8.0 Hz, 2 H), 7.23-7.25 (m, 3 H), 7.45-7.47 (m, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.1, 31.9, 127.1, 128.7, 128.9, 129.1, 130.7, 133.3, 135.4, 136.5.

(4-Methylbenzyl)(p-tolyl)selane (3e) (Table 2, entry 4):



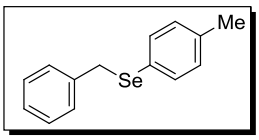
The title compound was prepared following the general procedure for Table 2, using 1,2-di-*p*-tolyldiselane (170 mg, 0.5 mmol), *p*-xylene (1.0 mL) and DTBP (5.0 mmol),which on purification by column chromatography (SiO_2, hexane), provided **3e** as a colorless oil (157 mg, 57% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 2.31 (s, 3 H), 2.32 (s, 3 H), 4.04 (s, 2 H), 7.05-7.10 (m, 6 H), 7.35 (d, J = 8.0 Hz, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.1, 32.3, 126.8, 128.7, 129.1, 129.8, 133.8, 135.7, 136.4, 137.2; HRMS-EI calcd. for $C_{15}H_{16}Se$: 276.0417, found: 276.0414.

(2-Methylbenzyl)(phenyl)selane (3f) (Table 2, entry 5):[1a]



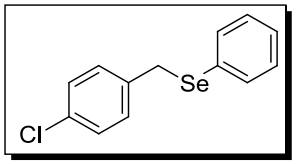
The title compound was prepared following the general procedure for Table 2, using diphenyl diselenide (157 mg, 0.5 mmol), *o*-xylene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to provide **3f** as a colorless oil (170 mg, 65% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 2.35 (s, 3 H), 4.10 (s, 2 H), 7.02-7.06 (m, 2 H), 7.11-7.20 (m, 2 H), 7.22-7.25 (m, 3 H), 7.44-7.47 (m, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 19.2, 30.5, 125.9, 127.2, 127.3, 128.9, 129.7, 130.4, 133.8, 136.2, 136.4.

Benzyl(p-tolyl)selane (3g) (Table 2, entry 6):[1b]



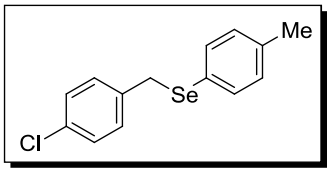
The title compound was prepared following the general procedure for Table 2, using 1,2-di-*p*-tolyldiselane (170 mg, 0.5 mmol), toluene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to provide **3g** as a colorless oil (127 mg, 49% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 2.32 (s, 3 H), 4.06 (s, 2 H), 7.34 (d, J = 8.0 Hz, 2 H), 7.17-7.24 (m, 5 H), 7.33 (d, J = 8.0 Hz, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.1, 32.5, 126.5, 126.7, 128.4, 128.8, 129.8, 134.0, 137.4, 138.9.

(4-Chlorobenzyl)(phenyl)selane (3h) (Table 2, entry 7):[1a]



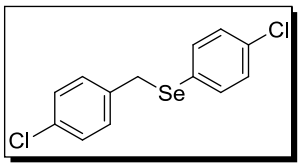
The title compound was prepared following the general procedure for Table 2, using diphenyl diselenide (157 mg, 0.5 mmol), 1-chloro-4-methylbenzene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to provide **3h** as a yellow solid (135 mg, 48% yield). M.P.:52-54 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 4.03 (s, 2 H), 7.08 (d, J = 8.0 Hz, 2 H), 7.19-7.28 (m, 5 H), 7.41-7.43 (m, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 31.4, 127.6, 128.5, 129.0, 129.2, 130.1, 132.5, 133.9, 137.3.

(4-Chlorobenzyl)(p-tolyl)selane (3i) (Table 2, entry 8):



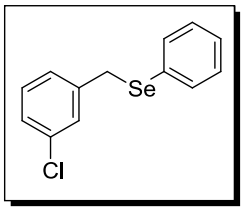
The title compound was prepared following the general procedure for Table 2, using 1,2-di-*p*-tolyldiselane (170 mg, 0.5 mmol), 1-chloro-4-methylbenzene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to provide **3i** as a yellow solid (165 mg, 56% yield). M.P.:66-68 ^oC; ^1H NMR (400 MHz, $CDCl_3$): δ 2.32 (s, 3 H), 3.98 (s, 2 H), 7.03-7.08 (m, 4 H), 7.17 (d, J = 8.0 Hz, 2 H), 7.31 (d, J = 8.0 Hz, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.1, 31.7, 125.9, 128.4, 129.8, 130.0, 132.4, 134.3, 137.6, 137.7; HRMS-EI calcd. for $C_{14}H_{13}ClSe$: 295.9871, found: 295.9862.

(4-Chlorobenzyl)(4-chlorophenyl)selane (3j) (Table 2, entry 9):



The title compound was prepared following the general procedure for Table 2, using 1,2-bis(4-chlorophenyl)diselane (191 mg, 0.5 mmol), 1-chloro-4-methylbenzene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to provide **3j** as a white yellow solid (186 mg, 59% yield). M.P.:52-54 ^oC; ^1H NMR (400 MHz, $CDCl_3$): δ 4.00 (s, 2 H), 7.06 (d, J = 8.0 Hz, 2 H), 7.19-7.21 (m, 4 H), 7.32 (d, J = 8.0 Hz, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 31.7, 128.5, 128.6, 128.9, 129.2, 130.1, 134.0, 135.4, 137.0; HRMS-EI calcd. for $C_{13}H_{10}Cl_2Se$: 315.9325, found: 315.9315

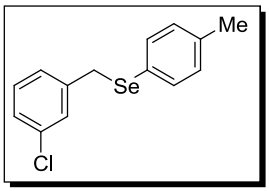
(3-Chlorobenzyl)(phenyl)selane (3k) (Table 2, entry 10):



The title compound was prepared following the general procedure for Table 2, using diphenyl diselenide (157 mg, 0.5 mmol), 1-chloro-3-methylbenzene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to

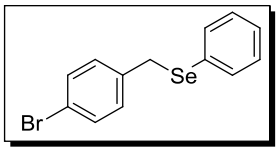
provide **3k** as a colorless oil (180 mg, 64% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 4.01 (s, 2 H), 7.02-7.03 (m, 1 H), 7.11-7.16 (m, 3 H), 7.21-7.28 (m, 3 H), 7.41-7.44 (m, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 31.5, 126.9, 126.9, 127.6, 128.9, 129.0, 129.5, 129.6, 133.9, 134.0, 140.8; HRMS-EI calcd. for $C_{13}H_{11}ClSe$: 281.9714, found: 281.9711.

(3-Chlorobenzyl)(p-tolyl)selane (3l) (Table 2, entry 11):



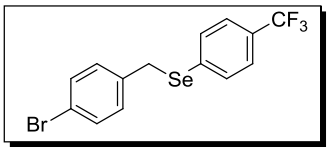
The title compound was prepared following the general procedure for Table 2, using 1,2-di-*p*-tolyldiselane (170 mg, 0.5 mmol), 1-chloro-3-methylbenzene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to provide **3l** as a yellow oil (183 mg, 62% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 2.36 (s, 3 H), 3.98 (s, 2 H), 7.01-7.07 (m, 3 H), 7.12-7.16 (m, 3 H), 7.31-7.33 (m, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.1, 31.8, 125.8, 126.9, 126.9, 128.9, 129.5, 129.8, 134.0, 134.4, 137.8, 141.0; HRMS-EI calcd. for $C_{14}H_{13}ClSe$: 295.9871, found: 295.9874.

(4-Bromobenzyl)(phenyl)selane (3m) (Table 2, entry 12):



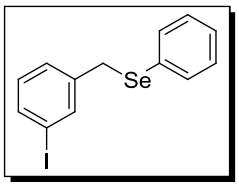
The title compound was prepared following the general procedure for Table 2, using diphenyl diselenide (157 mg, 0.5 mmol), 1-bromo-4-methylbenzene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to provide **3m** as a yellow solid (166 mg, 51% yield). M.P.:56-58 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 4.10 (s, 2 H), 7.02 (d, J = 8.0 Hz, 2 H), 7.23-7.25 (m, 3 H), 7.33 (d, J = 8.0 Hz, 2 H), 7.42 (d, J = 7.2 Hz, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 31.4, 120.6, 127.5, 129.0, 129.7, 130.4, 131.4, 133.8, 137.8; HRMS-EI calcd. for $C_{13}H_{11}BrSe$: 325.9209, found: 325.9201.

(4-Bromobenzyl)(4-(trifluoromethyl)phenyl)selane (3n) (Table 2, entry 13):



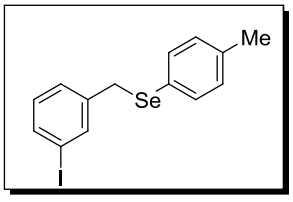
The title compound was prepared following the general procedure for Table 2, using 1,2-bis(4-(trifluoromethyl)phenyl)diselane (224 mg, 0.5 mmol), 1-bromo-4-methyl benzene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to provide **3n** as a yellow solid (161 mg, 41% yield). M.P.:75-77 ^oC; ^1H NMR (400 MHz, $CDCl_3$): δ 4.09 (s, 2 H), 7.09 (d, J = 9.6 Hz, 2 H), 7.38 (d, J = 8.4 Hz, 2 H), 7.46-7.51 (m, 4 H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 31.1, 121.0, 125.4, 125.7, 125.8, 130.5, 131.7, 132.7, 135.3, 136.9; ^{19}F NMR (376 MHz, $CDCl_3$): δ -64.15 (s); HRMS-EI calcd. for $C_{14}H_{10}BrF_3Se$: 393.9083, found: 393.9077.

(3-Iodobenzyl)(phenyl)selane (3o) (Table 2, entry 14):



The title compound was prepared following the general procedure for Table 2, using diphenyl diselenide (157 mg, 0.5 mmol), 1-iodo-3-methylbenzene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to provide **3o** as a yellow oil (201 mg, 54% yield). ^1H NMR (400 MHz, $CDCl_3$): δ 3.97 (s, 2 H), 6.94 (t, J = 7.8 Hz, 1 H), 7.10 (d, J = 7.6 Hz, 1 H), 7.22-7.27 (m, 3 H), 7.40-7.51 (m, 4 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 31.3, 94.1, 127.7, 128.0, 129.0, 129.6, 130.0, 134.0, 135.7, 137.7, 141.1; HRMS-EI calcd. for $C_{13}H_{11}ISe$: 373.9071, found: 373.9067.

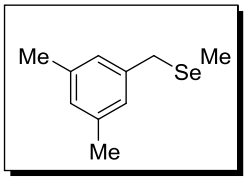
(3-Iodobenzyl)(p-tolyl)selane (3p) (Table 2, entry 15):



The title compound was prepared following the general procedure for Table 2, using 1,2-di-*p*-tolyldiselane (170 mg, 0.5 mmol), 1-iodo-3-methylbenzene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to provide **3p** as a yellow oil (201 mg, 52% yield). ^1H NMR (400 MHz, $CDCl_3$): δ 2.33

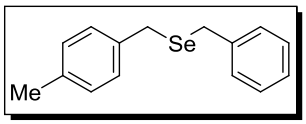
(s, 3 H), 3.92 (s, 2 H), 6.94 (t, *J* = 8.0 Hz, 1 H), 7.05-7.11 (m, 3 H), 7.30 (dd, *J* = 2.0, 6.8 Hz, 2 H), 7.41 (s, 1 H), 7.50 (d, *J* = 8.0 Hz, 1 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.1, 31.7, 94.0, 125.7, 128.0, 129.8, 130.0, 134.5, 135.7, 137.6, 137.8, 141.3; HRMS-EI calcd. for $C_{14}H_{13}ISe$: 387.9227, found: 387.9229.

(3,5-Dimethylbenzyl)(methyl)selane (3q) (Table 2, entry 16):



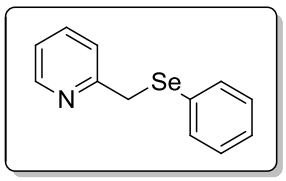
The title compound was prepared following the general procedure for Table 2, using 1,2-dimethyldiselane (94.0 mg, 0.5 mmol), mesitylene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to provide **3q** as a colorless oil (138 mg, 65% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 1.91 (s, 3 H), 2.28 (s, 6 H), 3.66 (s, 2H), 6.84 (s, 1 H), 6.88 (s, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 4.3, 21.2. 28.3, 126.5, 128.3, 137.8, 138.9; HRMS-EI calcd. for $C_{10}H_{14}Se$: 214.0261, found: 214.0262.

Benzyl(4-methylbenzyl)selane (3r) (Table 2, entry 17):



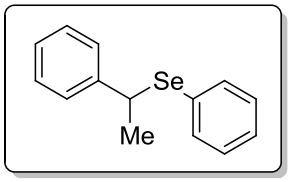
The title compound was prepared following the general procedure for Table 2, using 1,2-dibenzyldiselane (170.0 mg, 0.5 mmol), p-xylene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to provide **3r** as a colorless oil (159 mg, 58% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 2.31 (s, 3 H), 4.32 (s, 2 H), 4.34 (s, 2H), 7.09 (d, *J* = 8.0 Hz, 1 H), 7.21-7.30 (m. 2H), 7.32-7.46 (m. 3H), 7.53-7.7.61 (m, 1H), 7.86-7.92 (m, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.1, 28.9, 29.1, 127.0, 127.2, 128.6, 128.8, 128.9, 129.0, 129.3, 133.6; HRMS-EI calcd. for $C_{10}H_{14}Se$: 214.0261, found: 214.0262.

2-{(Phenylselanyl)methyl}pyridine (3s) (Table 2, entry 18):[3a]



The title compound was prepared following the general procedure for Table 2, using diphenyl diselenide (157 mg, 0.5 mmol), 2-methylpyridine (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, EtOAc/hexane : 1/9) to provide **3s** as a yellow oil (104 mg, 42% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 4.22 (s, 2H), 7.08-7.10 (m. 2H), 7.21-7.23 (m. 3H), 7.46-7.51 (m, 3H), 8.50 (d, J = 4.4 Hz, 1 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 33.7, 121.5, 122.9, 127.2, 128.8, 129.7, 133.4, 136.3, 149.2, 158.6.

Phenyl(1-phenylethyl)selane (3t) (Table 2, entry 19):[3b]

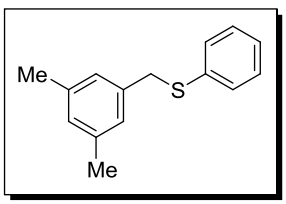


The title compound was prepared following the general procedure for Table 2, using diphenyl diselenide (157 mg, 0.5 mmol), ethyl benzene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to provide **3t** as a colorless oil (161 mg, 62% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 1.73 (d, J = 6.8 Hz, 3H), 4.44 (q, J = 6.8 Hz, 1H), 7.16-7.25 (m. 8H), 7.41-7.43 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 22.1, 42.4, 126.8, 127.1, 128.2, 128.4, 128.7, 129.7, 135.4, 143.5

4. General procedure for Eq. 1

A vial sealed equipped with a magnetic stir bar was charged with disulfide (0.5 mmol), arene (1.0 mL) and DTBP (5.0 mmol) and heated at 120 ℃ in an oil bath. After stirring at this temperature for 24 h, the reaction mixture was cooled to room temperature and diluted with ethyl acetate (20 mL). The resulting solution was directly filtered through a pad of celite then washed with ethyl acetate (20 mL) and concentrated to give the crude material which was then purified by column chromatography (SiO_2, ethyl acetate/hexane; 1/99) to yield **5** as colorless oil (41 mg, 18%) & **6a** as white solid (89.5 mg, 37%).

(3,5-Dimethylbenzyl)(phenyl)sulfane (5)

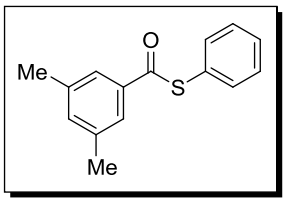


^{1}H NMR (400 MHz, $CDCl_3$): δ 2.26 (s, 6 H), 4.05 (s, 2 H), 6.87 (s, 1 H), 6.91 (s, 2 H), 7.17-7.32 (s, 6 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.2, 38.9, 126.1, 126.6, 128.8, 128.9, 129.4, 137.0, 138.0; HRMS-EI calcd. for $C_{15}H_{16}S$: 228.0973, found: 228.0964.

5. General procedure for Table 3

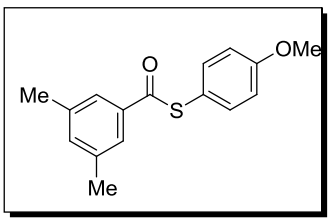
A Schlenk tube equipped with a magnetic stir bar was charged with disulfide (0.5 mmol), arene (1.0 mL) and DTBP (5.0 mmol) under a nitrogen-filled balloon and heated at 110 ℃ in an oil bath. After stirring at this temperature for 36 h, the reaction mixture was cooled to room temperature and diluted with ethyl acetate (20 mL). The resulting solution was directly filtered through a pad of celite then washed with ethyl acetate (20 mL) and concentrated to give the crude material which was then purified by column chromatography (SiO_2, ethyl acetate/hexane; 1/99) to yield **6**.

S-Phenyl 3,5-dimethylbenzothioate (6a): (Table 3, entry 1):



The title compound was prepared following the general procedure for Table 3, using diphenyl disulfide (109 mg, 0.5 mmol), mesitylene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, ethyl acetate/hexane; 1/99) to provide **6a** as a yellow oil (157 mg, 65% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 2.37 (s, 6 H), 7.43-7.45 (m, 4 H), 7.49-7.52 (m, 2 H), 7.63 (s, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.2, 125.1, 127.6, 129.1, 129.3, 135.0, 135.3, 136.7, 138.4, 190.2; HRMS-EI calcd. for $C_{15}H_{14}OS$: 242.0765, found: 242.0761.

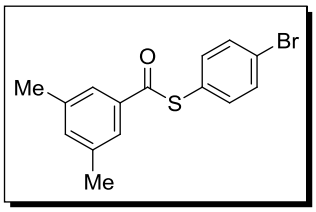
S-4-Methoxyphenyl 3,5-dimethylbenzothioate (6b) (Table 3, entry 2):



The title compound was prepared following the general procedure for Table 3, using 1,2-bis(4-methoxyphenyl)disulfane (139 mg, 0.5 mmol), mesitylene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2,ethyl

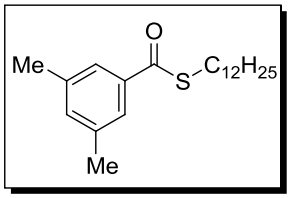
acetate/hexane; 5/95) to provide **6b** as a white solid (158 mg, 58% yield). M.P.:95-96 ^{o}C ^{1}H NMR (400 MHz, $CDCl_3$): δ 2.38 (s, 6 H), 3.84 (s, 3 H), 7.68 (dd, J = 2.4 & 6.8 Hz, 2 H), 7.21 (s, 1 H), 7.40 (dd, J = 2.4 & 6.8 Hz, 2 H), 7.63 (s, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.2, 55.3, 114.9, 118.2, 125.1, 136.6, 136.7, 138.4, 160.7, 191.2; HRMS-EI calcd. for $C_{16}H_{16}O_2S$: 272.3620, found: 272.0872.

S-(4-Bromophenyl) 3,5-dimethylbenzothioate (6c) (Table 3, entry 3):



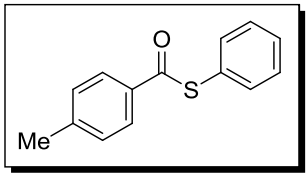
The title compound was prepared following the general procedure for Table 3, using 1,2-bis(4-bromophenyl)disulfane (188 mg, 0.5 mmol), mesitylene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, ethyl acetate/hexane; 1/99) to provide **6c** as a yellow solid (212 mg, 66% yield). M.P.:109-110 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 2.34 (s, 6 H), 7.23 (s, 1 H), 7.35 (d, J = 7.6 Hz, 2 H), 7.56 (dd, J = 1.6, 6.8 Hz, 2 H), 7.61 (s, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.2, 124.1, 125.2, 126.8, 132.3, 135.5, 136.4, 138.5, 189.6; HRMS-EI calcd. for $C_{15}H_{13}BrOS$: 319.9870, found: 319.9875.

S-*n*-Dodecyl 3,5-dimethylbenzothioate (6d) (Table 3, entry 4):



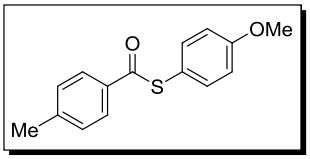
The title compound was prepared following the general procedure for Table 3, using 1,2-didodecyldisulfane (270 mg, 0.5 mmol), mesitylene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to provide **6d** as a colorless oil (227 mg, 68% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 0.88 (t, J = 6.8 Hz, 3 H), 1.26-1.43 (m, 20 H), 1.61-1.67 (m, 2 H), 2.36 (s, 6 H), 3.05 (t, J = 7.4 Hz, 2 H), 7.18 (s, 1 H), 7.58 (s, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 14.1, 21.2, 22.7, 28.9, 29.0, 29.2, 29.3, 29.5, 29.6, 29.6, 31.9, 124.9, 134.8, 137.4, 138.2, 192.4; HRMS-EI calcd. for $C_{21}H_{34}OS$: 334.2330, found: 334.2339.

S-Phenyl 4-methylbenzothioate (6e) (Table 3, entry 5):[2a]



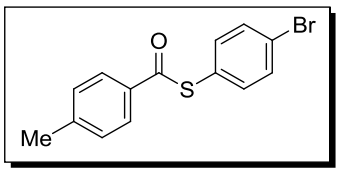
The title compound was prepared following the general procedure for Table 3, using diphenyl disulfide (109 mg, 0.5 mmol), *p*-xylene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, ethyl acetate/hexane; 1/99) to provide **6e** as a white solid (139 mg, 61% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 2.42 (s, 3 H), 7.27 (d, J = 8.0 Hz, 2 H), 7.44-7.45 (m, 3 H), 7.50-7.52 (m, 2 H), 7.93 (d, J = 8.0 Hz, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.7, 127.5, 129.2, 129.4, 134.1, 135.1, 144.5, 189.6.

S-(4-Methoxyphenyl) 4-methylbenzothioate (6f) (Table 3, entry 6):[2a]



The title compound was prepared following the general procedure for Table 3, using 1,2-bis(4-methoxyphenyl)disulfane (139 mg, 0.5 mmol), *p*-xylene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, ethyl acetate/hexane; 5/95) to provide **6f** as a white solid (152 mg, 59% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 2.42 (s, 3 H), 3.84 (s, 3 H), 6.98 (d, J = 8.0 Hz, 2 H), 7.27 (d, J =8.4 Hz, 2 H), 7.41 (d, J = 8.4 Hz, 2 H), 7.92 (d, J = 8.0 Hz, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.7, 55.3, 114.9, 118.1, 127.5, 129.3, 134.1, 136.6, 144.4, 160.7, 190.6. .

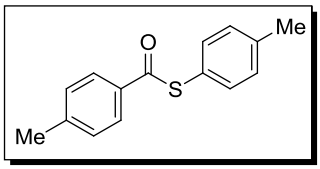
S-4-Bromophenyl 4-methylbenzothioate (6g) (Table 3, entry 7):



The title compound was prepared following the general procedure for Table 3, using 1,2-bis(4-bromophenyl)disulfane (188 mg, 0.5 mmol), *p*-xylene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, ethyl acetate/hexane; 1/99) to provide **6g** as a white solid (190 mg, 62% yield). M.P.:121-122 ^{o}C ^{1}H NMR (400 MHz, $CDCl_3$): δ 2.41 (s, 3 H), 7.26 (d, J = 8.0 Hz, 2 H), 7.35 (dd, J = 2.0 & 6.4

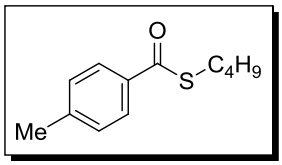
Hz, 2 H), 7.56 (dd, J = 2.0 Hz, 6.4 Hz, 2 H), 7.90 (d, J = 8.0 Hz, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.7, 124.1, 126.7, 127.5, 129.4, 132.3, 133.7, 136.5, 144.8, 188.9; HRMS-EI calcd. for $C_{14}H_{11}BrOS$: 305.9714, found: 305.9718.

S-(*p*-Tolyl) 4-methylbenzothioate (6h) (Table 3, entry 8) [2b]



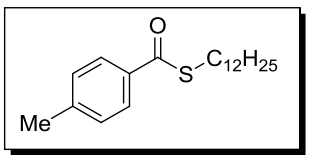
The title compound was prepared following the general procedure for Table 3, using 1,2-di-*p*-tolyldisulfane (123 mg, 0.5 mmol), *p*-xylene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, ethyl acetate/hexane; 1/99) to provide **6h** as a yellow solid (148 mg, 61% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 2.42 (s, 3 H), 2.44 (s, 3 H), 7.23-7.31 (m, 4 H), 7.38 (d, J = 8.0 Hz, 2 H), 7.92 (d, J = 8.0 Hz, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.3, 21.7, 121.4, 123.9, 128.5, 129.4, 130.1, 134.2, 135.0, 139.7, 144.4, 190.1.

S-*n*-Butyl 4-methylbenzothioate (6i) (Table 3, entry 9):[2a]



The title compound was prepared following the general procedure for Table 3, using 1,2-dibutyldisulfane (89 mg, 0.5 mmol), *p*-xylene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to provide **6i** as a colorless oil (129 mg, 62% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 0.94 (t, J = 7.2 Hz, 3 H), 1.41-1.47 (m, 2 H), 1.62-1.66 (m, 2 H), 2.38 (s, 3 H), 3.05 (t, J = 7.2 Hz, 2 H), 7.21 (d, J = 8.0 Hz, 2 H), 7.86 (d, J = 8.0 Hz, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 13.5, 21.5, 22.0, 28.5, 31.6, 127.1, 129.1, 134.6, 143.9, 191.6.

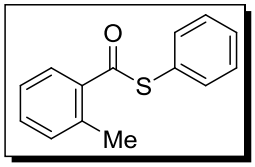
S-*n*-Dodecyl 4-methylbenzothioate (6j) (Table 3, entry 10):[2a]



The title compound was prepared following the general procedure for Table 3, using 1,2-didodecyldisulfane (270 mg, 0.5 mmol), *p*-xylene (1.0 mL) and DTBP (5.0 mmol),

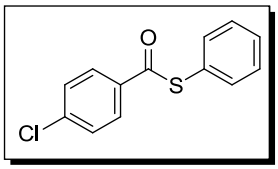
then purified by column chromatography (SiO_2, hexane) to provide **6j** as a colorless oil (208 mg, 65% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 0.88 (t, J = 5.8 Hz, 3 H), 1.23-1.42 (m, 18 H), 1.60-1.68 (m, 2 H), 2.40 (s, 3 H), 3.05 (t, J = 7.2 Hz, 2 H), 7.24 (d, J = 8.0 Hz, 2 H), 7.87 (d, J = 8.0 Hz, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 14.1, 29.0, 29.2, 29.3, 29.5, 29.6, 29.6, 31.9, 127.2, 129.2, 134.8, 144.0, 191.8.

S-Phenyl 2-methylbenzothioate (6k) (Table 3, entry 11):[2a]



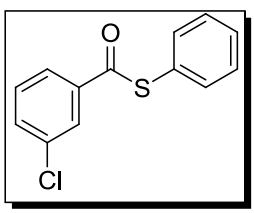
The title compound was prepared following the general procedure for Table 3, using diphenyl disulfide (109 mg, 0.5 mmol), *o*-xylene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, ethyl acetate/hexane; 1/99) to provide **6k** as a colorless oil (132 mg, 58% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 2.48 (s, 3 H), 7.12-7.34 (m, 3 H), 7.37-7.46 (m, 3 H), 7.46-7.52 (m, 2 H), 7.93 (d, J = 7.6 Hz, 1 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 20.8, 125.8, 128.1, 128.5, 129.2, 129.3, 131.7, 131.9, 134.8, 136.6, 137.3, 192.0.

S-Phenyl 4-chlorobenzothioate (6l) (Table 3, entry 12)[2a]



The title compound was prepared following the general procedure for Table 3, using diphenyl disulfide (109 mg, 0.5 mmol), 1-chloro-4-methylbenzene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, ethyl acetate/hexane; 1/99) to provide **6l** as a yellow solid (151 mg, 61% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.42 -7.51 (m, 7 H), 7.94-7.96 (m, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 126.8, 128.7, 129.0, 129.2, 129.6, 134.9, 135.0, 140.0, 188.9.

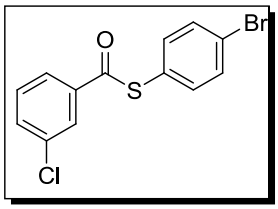
S-phenyl 3-chlorobenzothioate (6m) (Table 3, entry 13):[2c]



The title compound was prepared following the general procedure for Table 3, using

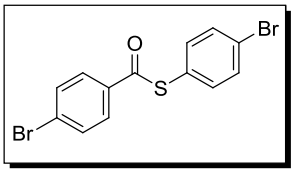
diphenyl disulfide (109 mg, 0.5 mmol), 1-chloro-3-methylbenzene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, ethyl acetate/hexane; 1/99) to provide **6m** as a yellow oil (154 mg, 62% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.37-7.57 (m, 6 H), 7.89-7.91 (m, 1 H), 7.98 (t, J = 1.8 Hz, 1 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 125.5, 126.7, 127.4, 127.8, 129.3, 129.7, 130.0, 133.5, 135.0, 138.1, 189.0.

S-4-bromophenyl 3-chlorobenzothioate (6n) (Table 3, entry 14):



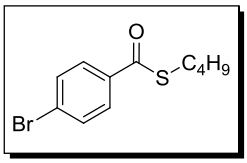
The title compound was prepared following the general procedure for Table 3, using 1,2-bis(4-bromophenyl)disulfane (188 mg, 0.5 mmol), 1-chloro-3-methylbenzene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, ethyl acetate/hexane; 1/99) to provide **6n** as a white solid (206 mg, 63% yield). M.P.:100-102 ^{o}C ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36 (d, J = 8.4 Hz, 2 H), 7.44 (t, J = 8.0 Hz, 1 H), 7.59 (d, J = 8.4 Hz, 3 H), 7.89 (d, J = 7.6 Hz, 1 H), 7.97 (s, 1 H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 124.5, 125.6, 125.9, 127.5, 130.1, 132.6, 133.7, 135.1, 136.4, 137.8, 188.4; HRMS-EI calcd. for $C_{13}H_8BrClOS$: 325.9168, found: 325.9174.

S-4-bromophenyl 4-bromobenzothioate (6o) (Table 3, entry15):



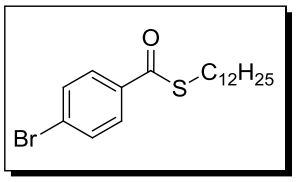
The title compound was prepared following the general procedure for Table 3, using 1,2-bis(4-bromophenyl)disulfane (188 mg, 0.5 mmol), 1-bromo-4-methylbenzene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, ethyl acetate/hexane; 1/99) to provide **6o** as a white solid (249 mg, 67% yield). M.P.:146-147 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.35 (d, J = 8.4 Hz, 2 H), 7.58 (d, J = 8.4 Hz, 2 H), 7.62 (d, J = 8.4 Hz, 2 H), 7.86 (d, J= 8.4 Hz, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 124.4, 126.0, 129.0, 129.0, 132.1, 132.5, 135.1, 136.4, 188.5; HRMS-EI calcd. for $C_{13}H_8Br_2OS$: 369.8663, found: 369.8671.

S-(*n*-Butyl) 4-bromobenzothioate (6p) (Table 3, entry 16):



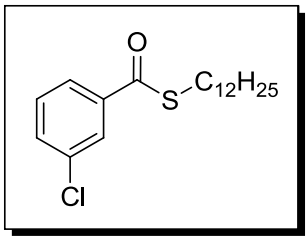
The title compound was prepared following the general procedure for Table 3, using 1,2-dibutyldisulfane (89 mg, 0.5 mmol), 1-bromo-4-methylbenzene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to provide **6p** as a colorless oil (175 mg, 64% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 0.95 (t, J = 7.2 Hz, 3 H), 1.42-1.48 (m, 2 H), 1.62-1.68 (m, 2 H), 3.08 (t, J = 7.2 Hz, 2 H), 7.59 (dd, J = 2.0, 8.4 Hz, 2 H), 7.83 (dd, J = 2.0, 8.4 Hz, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 13.6, 22.0, 28.9, 31.5, 128.2, 128.6, 131.8, 136.1, 192.8; HRMS-EI calcd. for $C_{11}H_{13}BrOS$: 271.9870, found: 271.9863.

S-(*n*-Dodecyl) 4-bromobenzothioate (6q) (Table 3, entry 17):[2a]



The title compound was prepared following the general procedure for Table 3, using 1,2-didodecyldisulfane (270 mg, 0.5 mmol), 1-bromo-4-methylbenzene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to provide **6q** as a white solid (258 mg, 67% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 0.88 (t, J = 6.4 Hz, 3 H), 1.26-1.59 (m, 18 H), 1.63-1.68 (m, 2 H), 3.07 (t, J = 7.2 Hz, 2 H), 7.58 (d, J = 6.8 Hz, 2 H), 7.83 (d, J = 8.0 Hz, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 14.1, 22.7, 28.8, 28.9, 29.1, 29.2, 29.3, 29.5, 30.0, 30.0, 32.0, 44.2, 128.2, 128.6, 131.8, 136.1, 191.2.

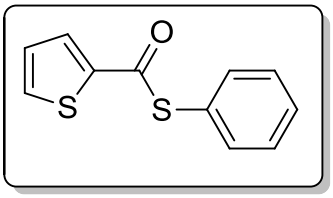
S-(*n*-Dodecyl) 3-chlorobenzothioate (6r) (Table 3, entry 18):



The title compound was prepared following the general procedure for Table 3, using 1,2-didodecyldisulfane (270 mg, 0.5 mmol), 1-chloro-3-methylbenzene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to

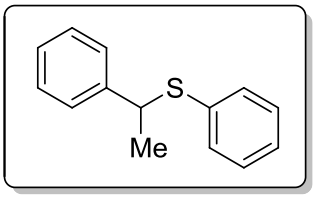
provide **6r** as a colorless oil (221 mg, 65% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 0.88 (t, J = 6.8 Hz, 3 H), 1.26-1.42 (m, 18 H), 1.59-1.69 (m, 2 H), 3.07 (t, *J* = 7.2 Hz, 2 H), 7.39 (t, *J* = 7.8 Hz, 1 H), 7.53 (dd, *J* = 2 Hz, 7.2 Hz, 1 H), 7.83-7.86 (m, 1 H), 7.94 (s, 1 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 14.1, 22.7, 26.5, 29.0, 29.1, 29.3, 29.3, 29.4, 29.4, 29.6, 29.6, 31.9, 125.3, 127.2, 129.8, 133.1, 134.9, 138.8, 191.0; HRMS-EI calcd. for $C_{19}H_{29}ClOS$: 340.1628, found:340.1622.

S-Phenyl thiophene-2-carbothioate (6s) (Table 3, entry 19)[3c]



The title compound was prepared following the general procedure for Table 3, using diphenyl disulfide (109 mg, 0.5 mmol), 2-methylthiophene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to provide **6s** as a colorless oil (123 mg, 56% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.14-7.17 (m, 1 H), 7.25-7.53 (m, 5 H), 7.66 (dd, *J* = 1.2 & 5.2 Hz, 1 H), 7.90 (dd, *J* = 1.2 & 4.8 Hz, 1 H), ^{13}C NMR (100 MHz, $CDCl_3$): δ = 126.9, 128.0, 129.2, 129.6, 131.6, 133.2, 135.0, 141.4, 182.0.

Phenyl(1-phenylethyl)sulfane (6t) (Table 3, entry 20)[3b]



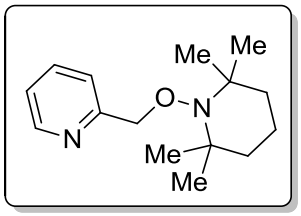
The title compound was prepared following the general procedure for Table 3, using diphenyl disulfide (109 mg, 0.5 mmol), ethyl benzene (1.0 mL) and DTBP (5.0 mmol), then purified by column chromatography (SiO_2, hexane) to provide **6t** as a colorless oil (112 mg, 51% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ 1.61 (d, *J* = 7.2 Hz, 3 H), 4.32 (q, *J* = 7.2 Hz, 1 H), 7.15-7.29 (m, 10 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 22.2, 47.9, 127.06, 127.08, 127.2, 128.3, 128.6, 132.4, 135.0, 143.1.

6. General Procedure for Eq. 3

A vial sealed equipped with a magnetic stir bar was charged with TEMPO (1.0 mmol, 156 mg), 2-methylpyridine (1.0 mL) and DTBP (5.0 mmol), and the vial was sealed

with a cap containing a PTFE septum and the reaction vessel was heated at 120 ℃ in an oil bath. After stirring at this temperature for 24 h, the reaction mixture was cooled to room temperature and diluted with ethyl acetate (20 mL). The resulting solution was directly filtered through a pad of celite then washed with ethyl acetate (20 mL) and concentrated to give the crude material which was then purified by column chromatography (SiO_2, hexane/EtOAc : 1/1) to provide **7** as colorless liquid in (64 mg, 26%) yield along with unreacted TEMPO.

2-[{(2,2,6,6-tetramethylpiperidin-1-yl)oxy}methyl]pyridine (7)



^{1}H NMR (400 MHz, $CDCl_3$): δ 1.16-1.55 (m, 18 H), 4.99 (s, 2 H), 1.59-1.69 (m, 2 H), 7.14-7.17 (m, 1 H), 7.52 (d, J = 8.0 Hz, 1 H), 7.66-7.71 (m, 1 H), 8.52-8.54 (m, 1 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 17.0, 20.2, 32.8, 39.6, 59.9, 79.6, 121.0, 121.9, 136.3, 148.8, 158.5; ; HRMS-EI calcd. for $C_{15}H_{24}N_2O$: 248.1889, found: 248.1883.

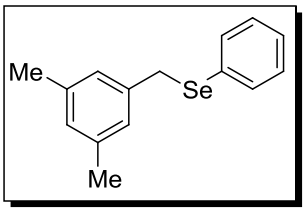
7. References:

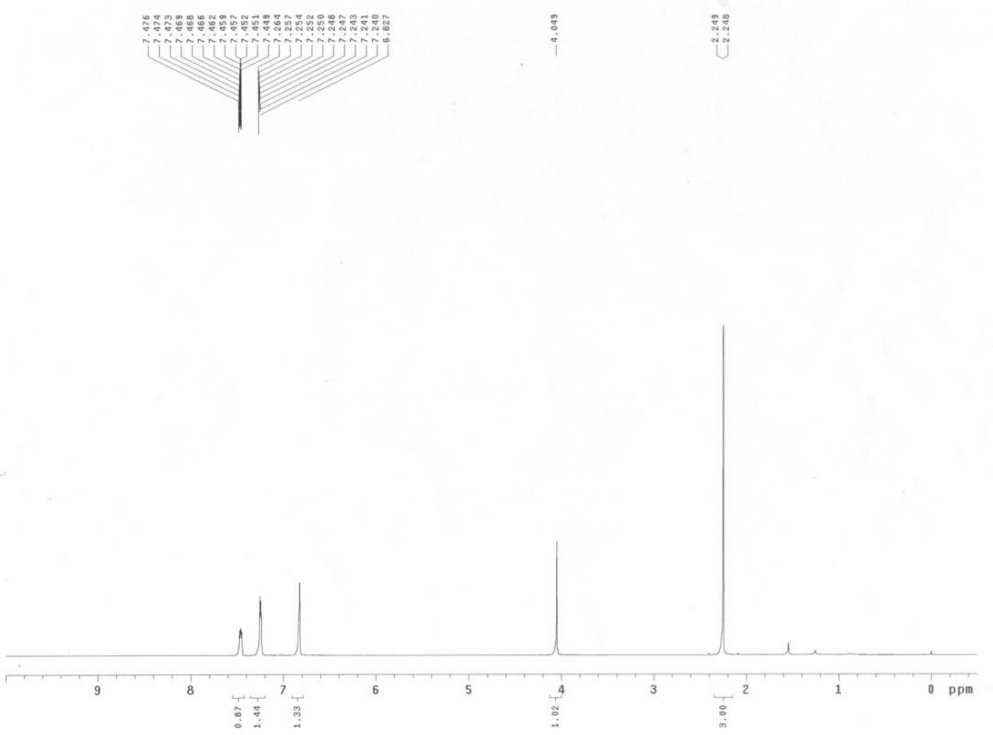
1. (a) S. Narayanaperumal, E. E. Alberto, F. M. Andrade, E. J. Lenardao , P. S. Taube and A. L. Braga, *Org. Biomol. Chem.*, 2009, **7**, 4647-4650; (b) S. Narayanaperumal, E. E. Alberto, K. Gul, O. E. D. Rodrigues and A. L. Braga, *J. Org. Chem.,* 2010, **75**, 3886-3889.

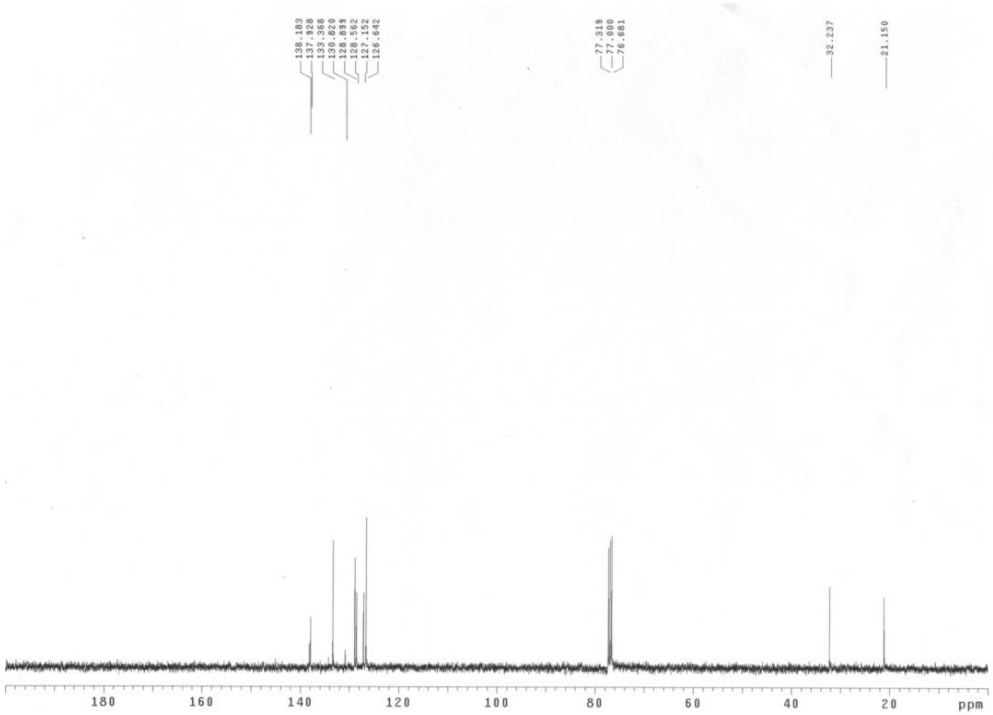
2. (a) J-W. Zeng, Y-C. Liu, P-A. Hsiech, Y-T. Huang, C-L. Yi, S. S. Badsara and C.-F. Lee, *Green Chem.,* 2014, **16**, 2644-2652; (b) J. B. Azeredo, M. Godoi, R. S. Schwab, G. V. Botteselle and A. L. Braga, *Eur. J. Org. Chem.,* 2013, **23**, 5188-5194; (c) X. Zhu, Y. Shi, H. Mao, Y. Cheng and C. Zhu, *Adv. Synth. Catal.*, 2013, **355**, 3558-3562.

3. (a) R. C. Jones, A. J. Cantya, M. G. Gardiner, B. W. Skelton, V-A. Tolhurst and A. H. White, *Inorganica Chimica Acta.,* 2010, **363**, 77–87. (b) B. C. Ranu and T. Mandal, *J. Org. Chem.* 2004, **69**, 5793-5795. (c) J.-W. Zeng, Y.-C. Liu, P.-A. Hsiech, Y.-T. Huang, C.-L. Yi, S. S. Badsara and C.-F. Lee, *Green Chem.,* 2014, **16**, 2644-2652.

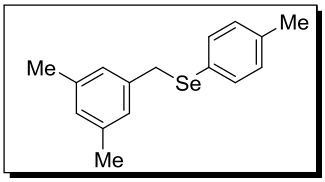
(3,5-Dimethylbenzyl)(phenyl)selane (3a)

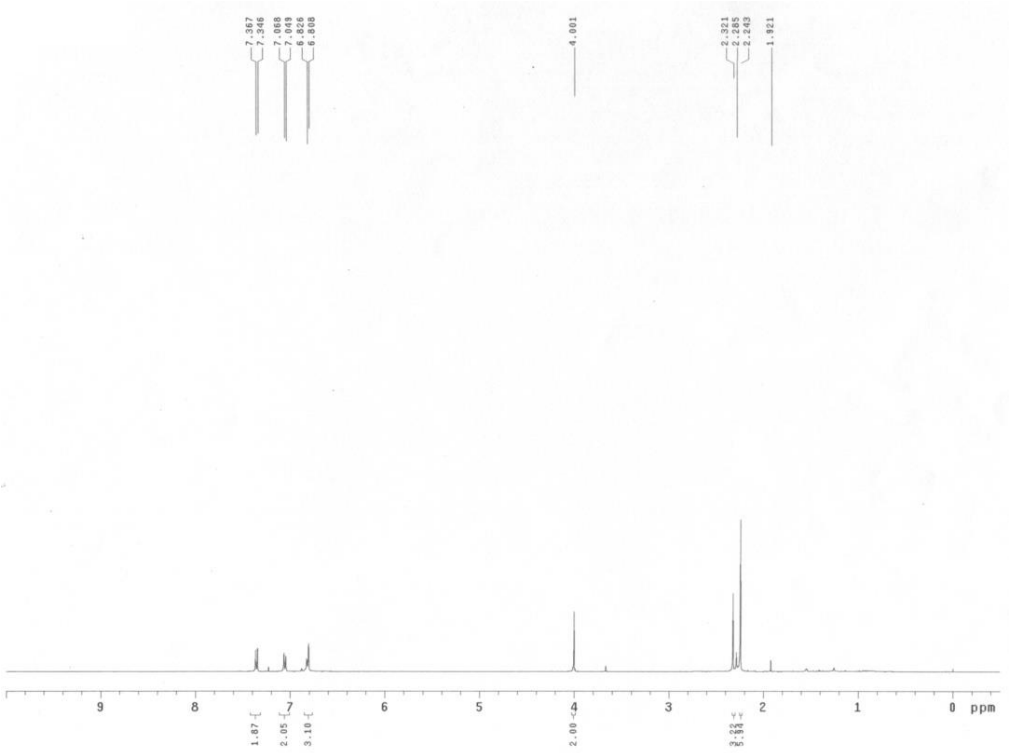


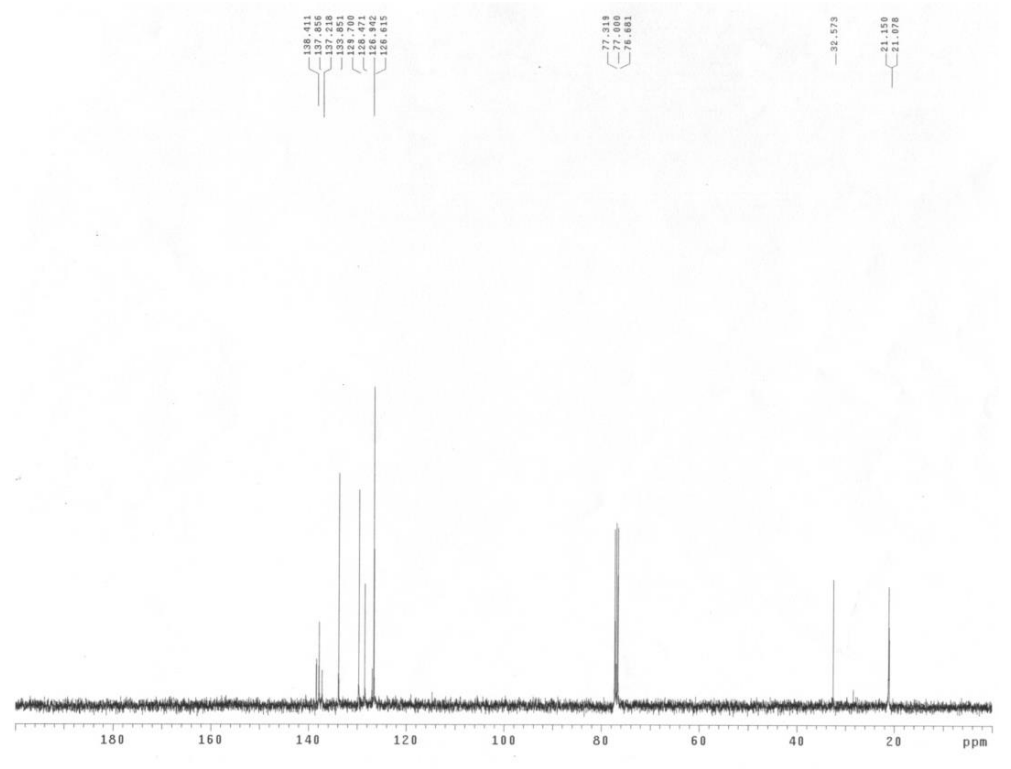




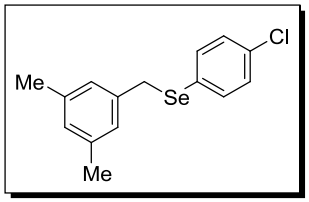
(3,5-Dimethylbenzyl)(p-tolyl)selane (3b)

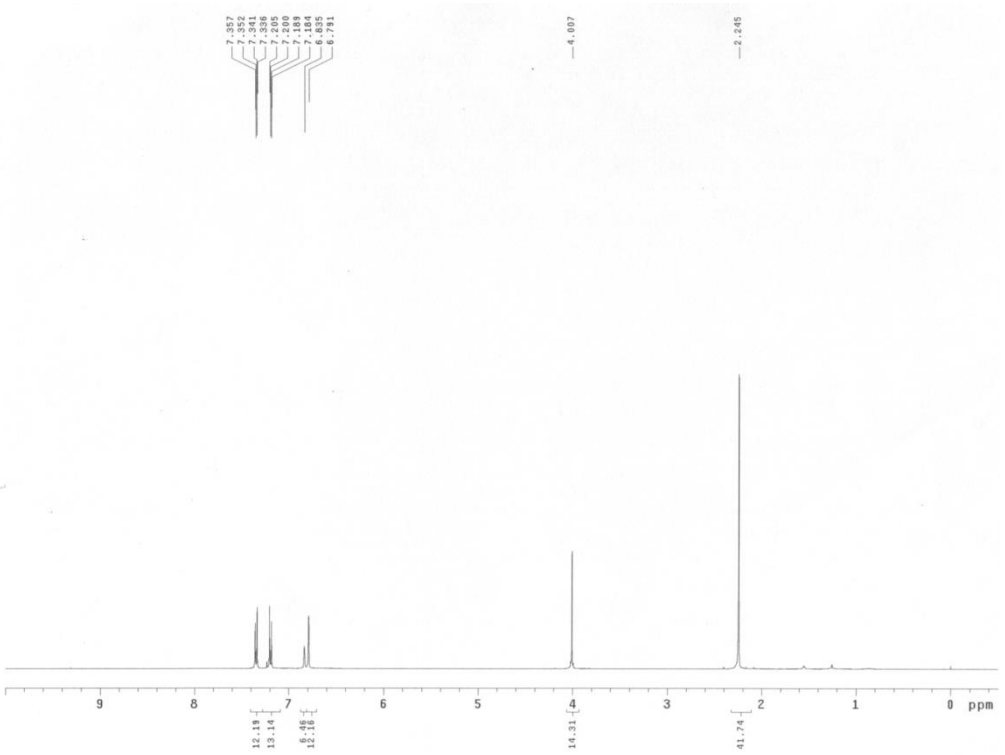


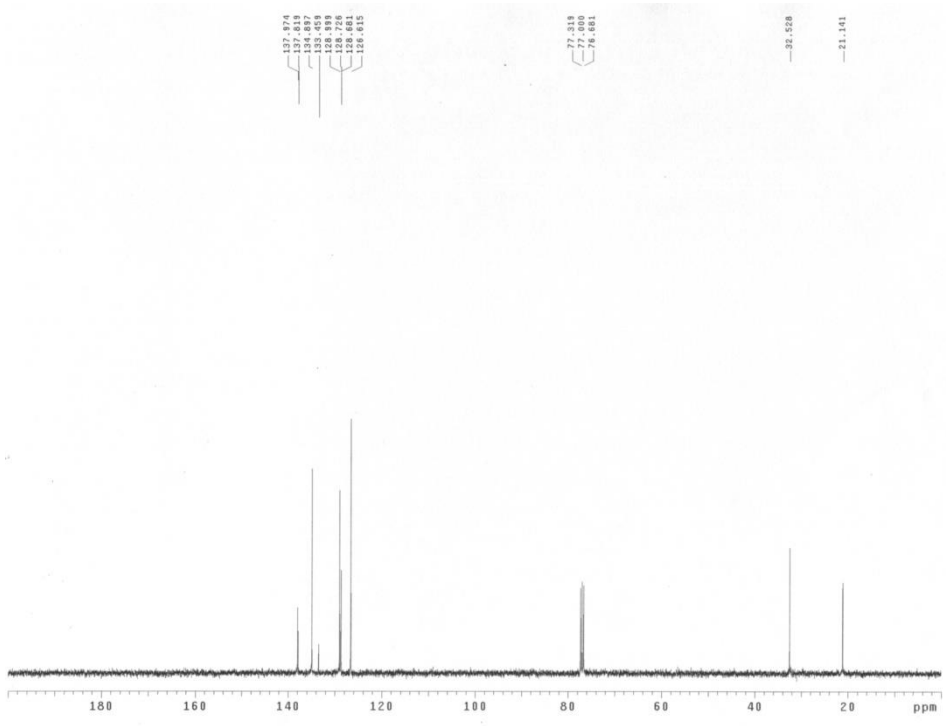




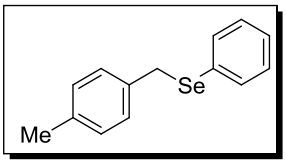
(4-Chlorophenyl)(3,5-dimethylbenzyl)selane (3c)

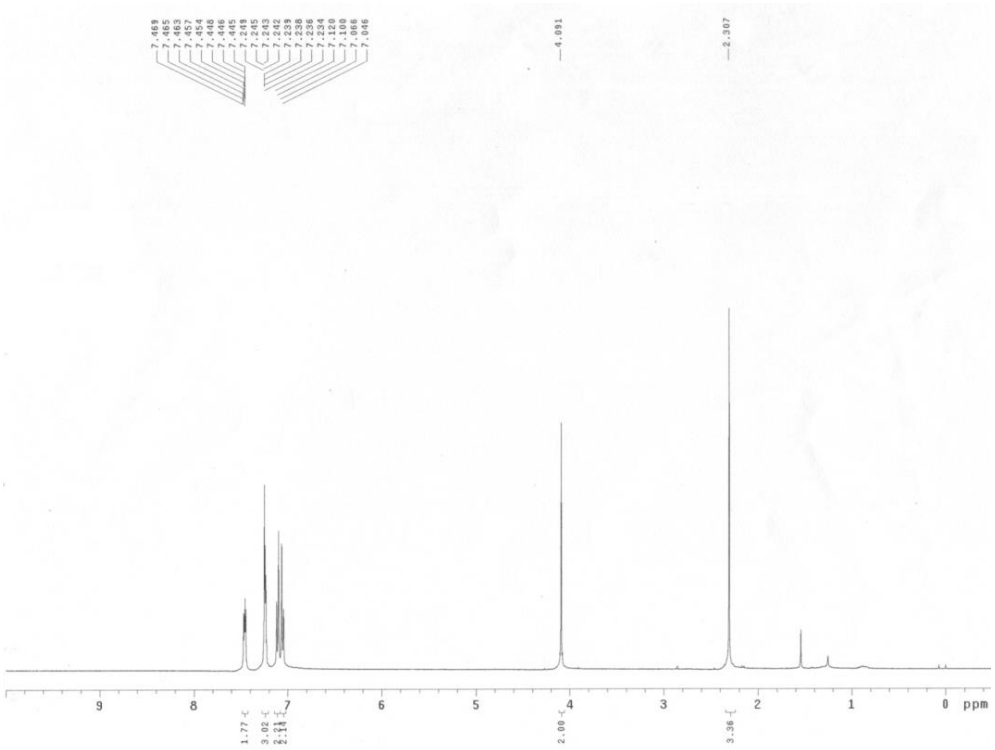


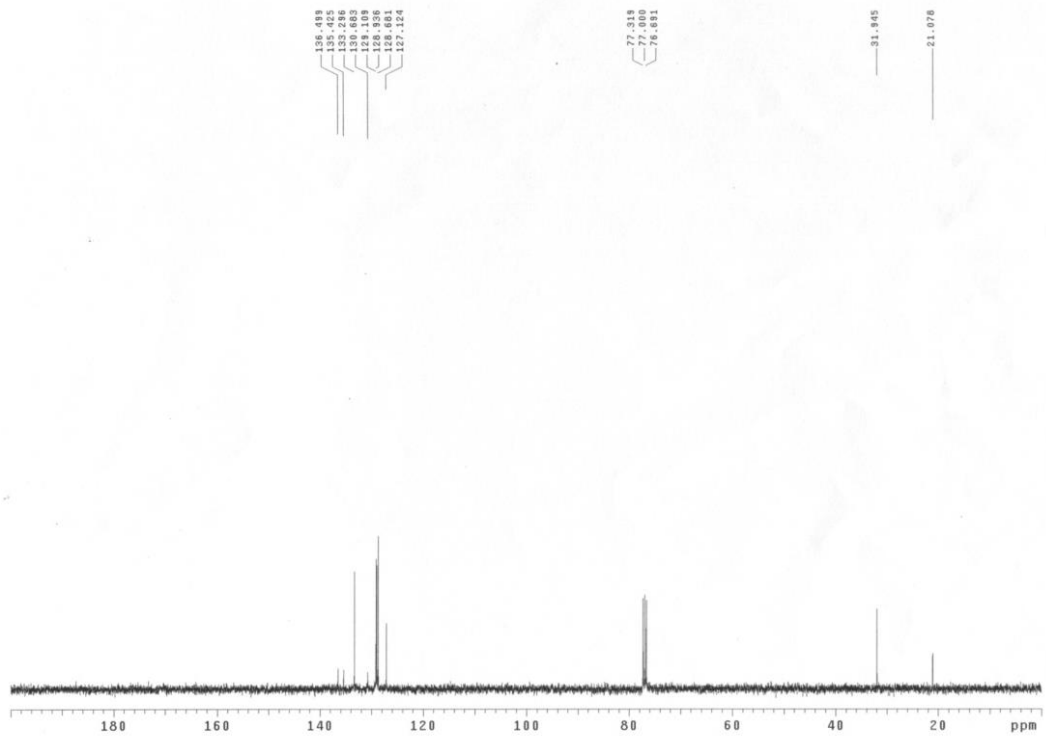




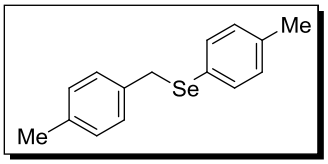
(4-Methylbenzyl)(phenyl)selane (3d)

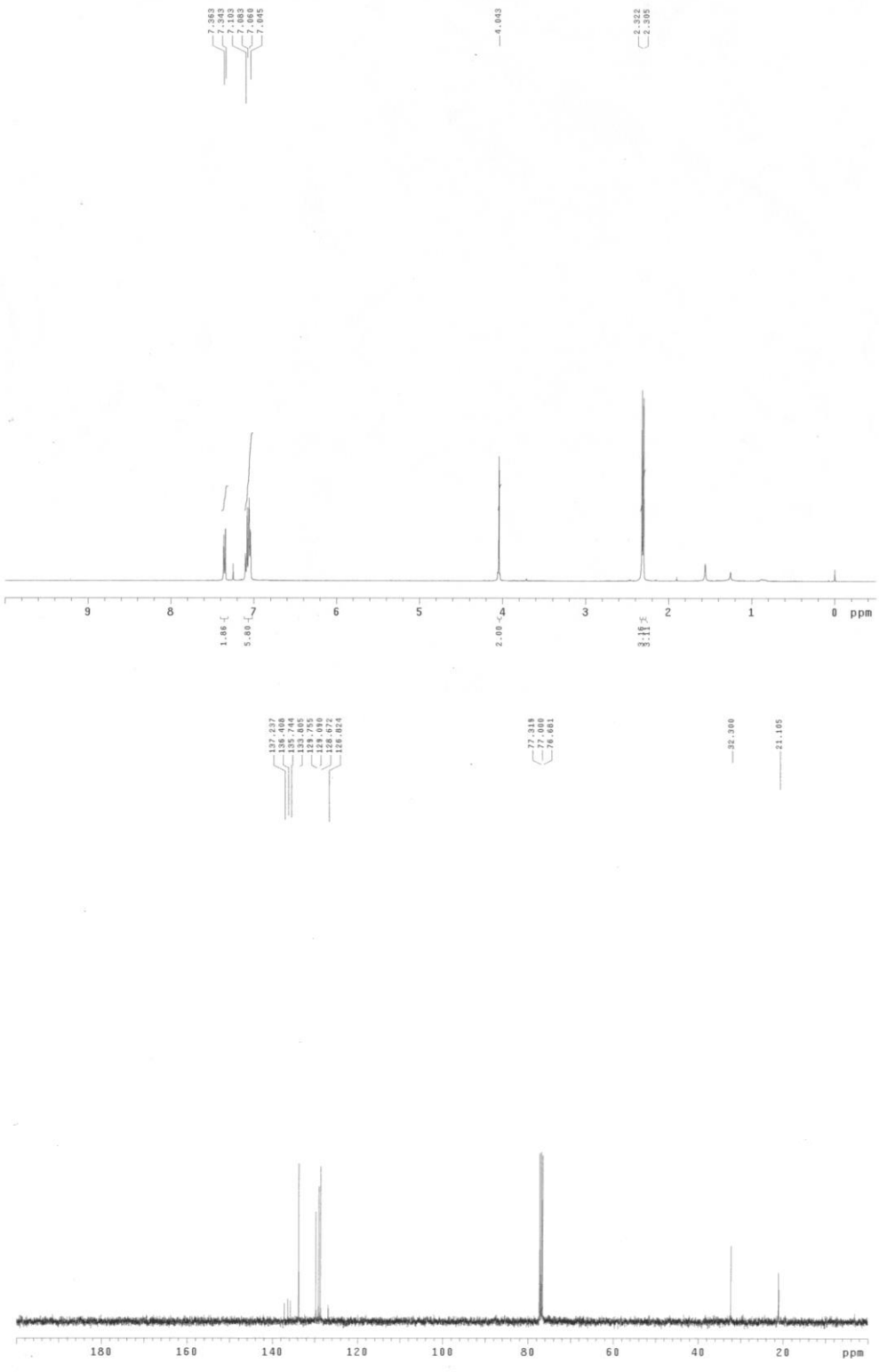




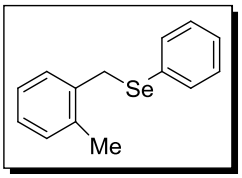


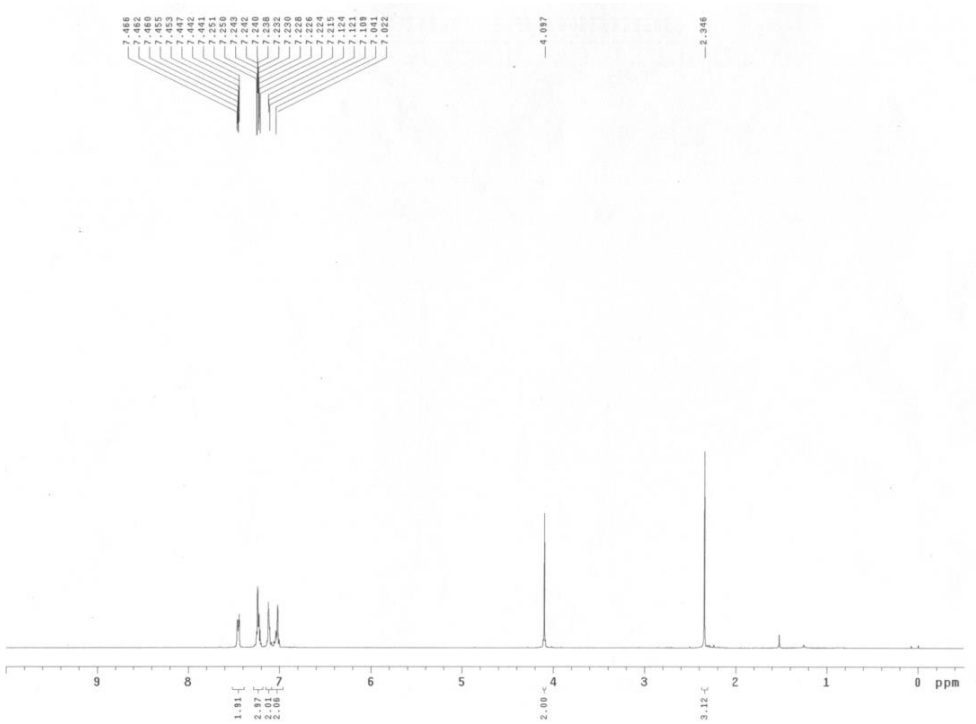
(4-Methylbenzyl)(p-tolyl)selane (3e)

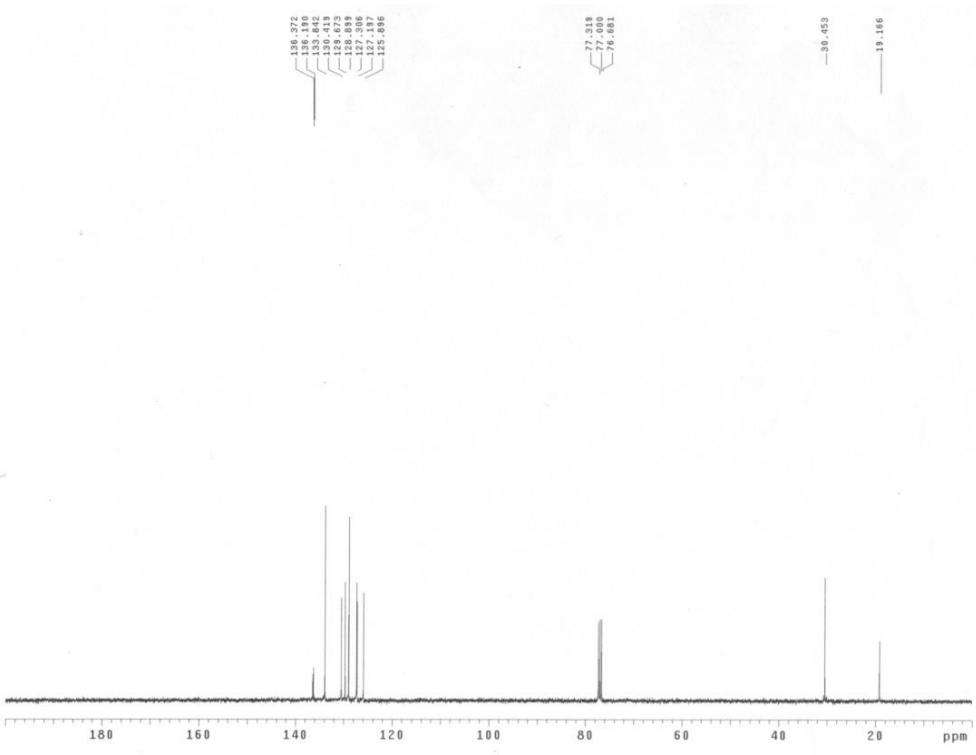




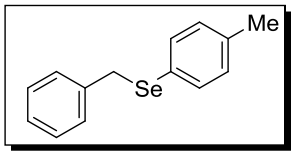
(2-Methylbenzyl)(phenyl)selane (3f)

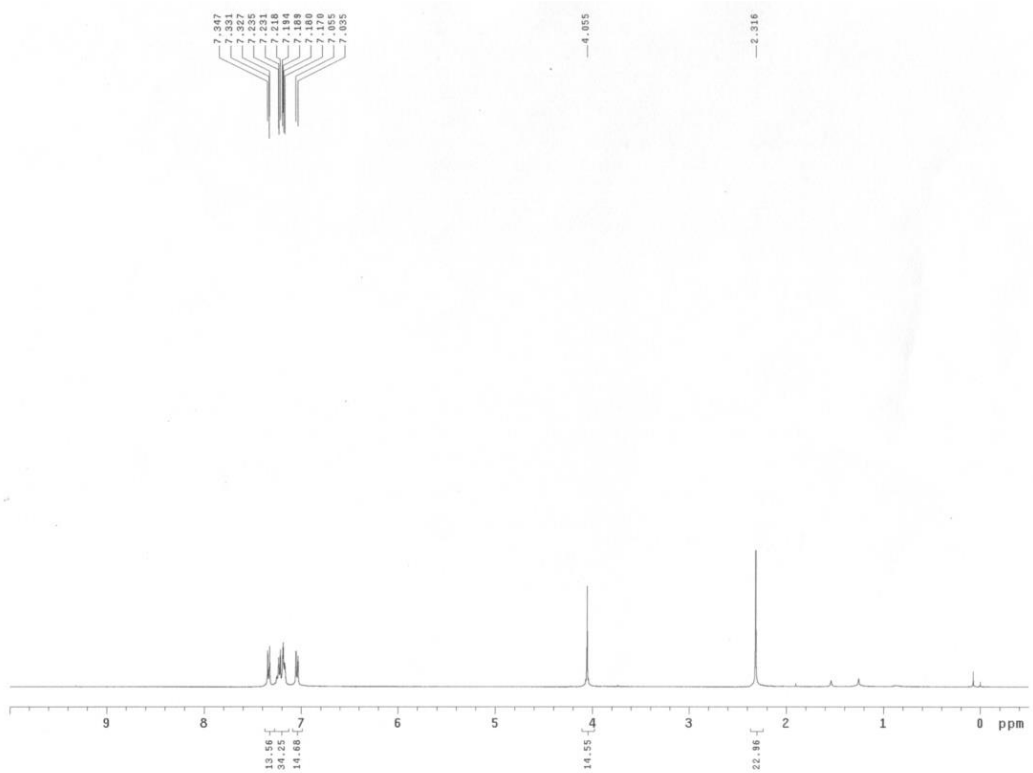


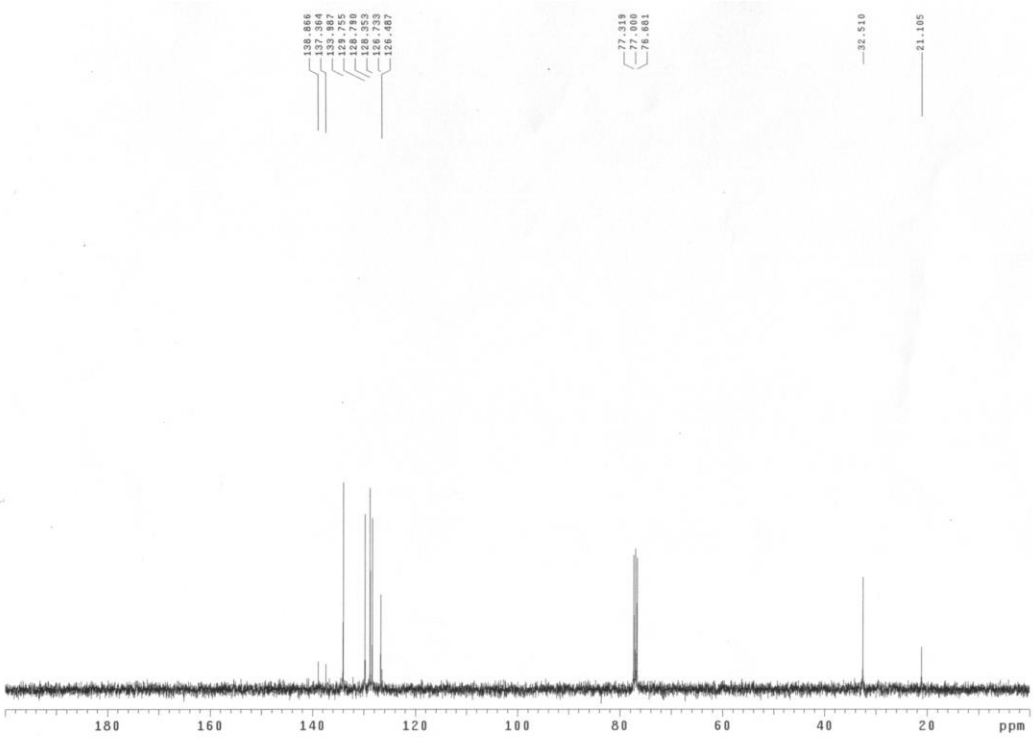




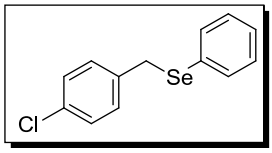
Benzyl(p-tolyl)selane (3g)

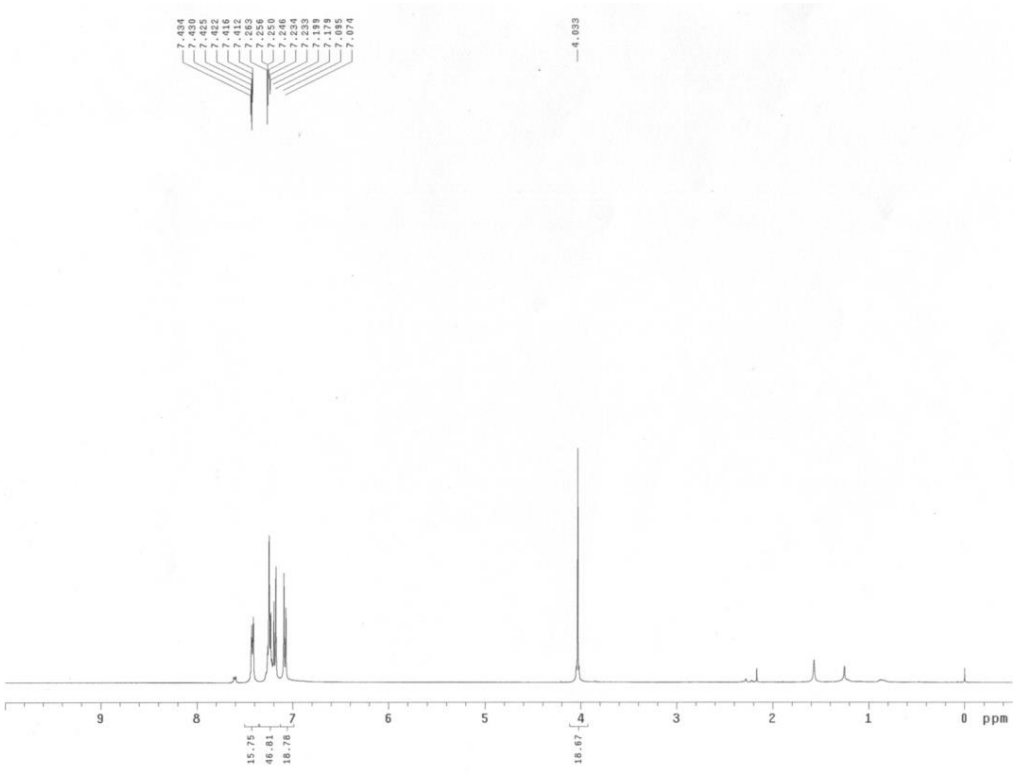


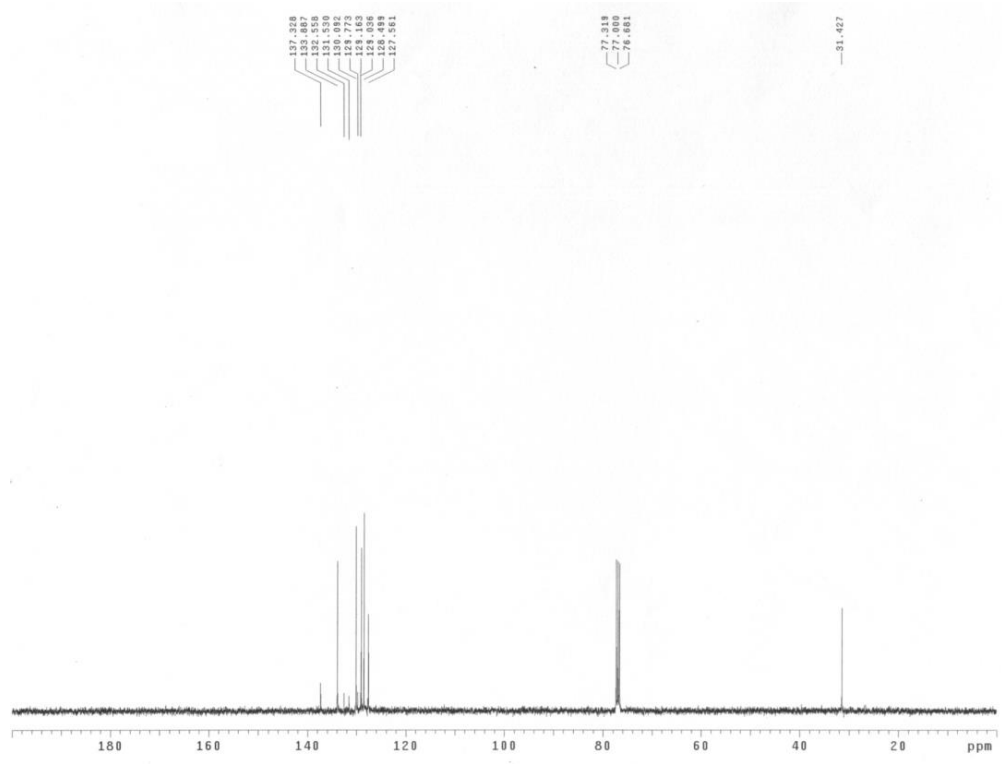




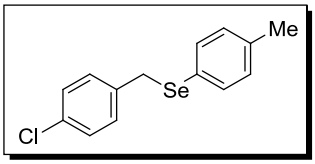
(4-Chlorobenzyl)(phenyl)selane (3h)

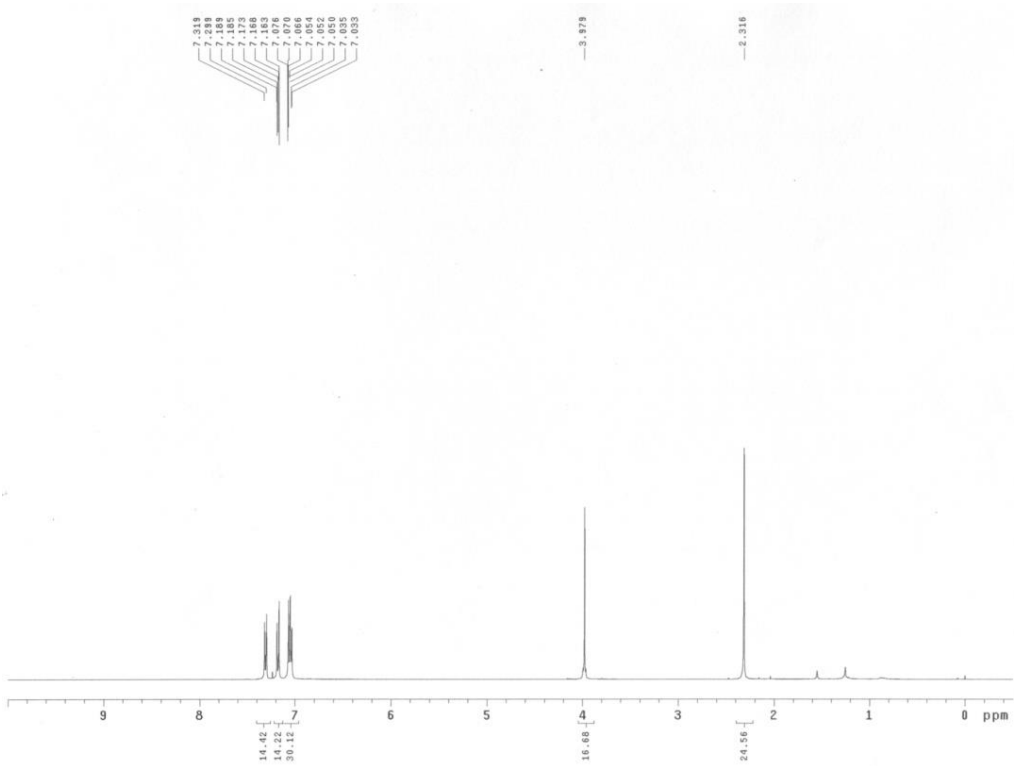


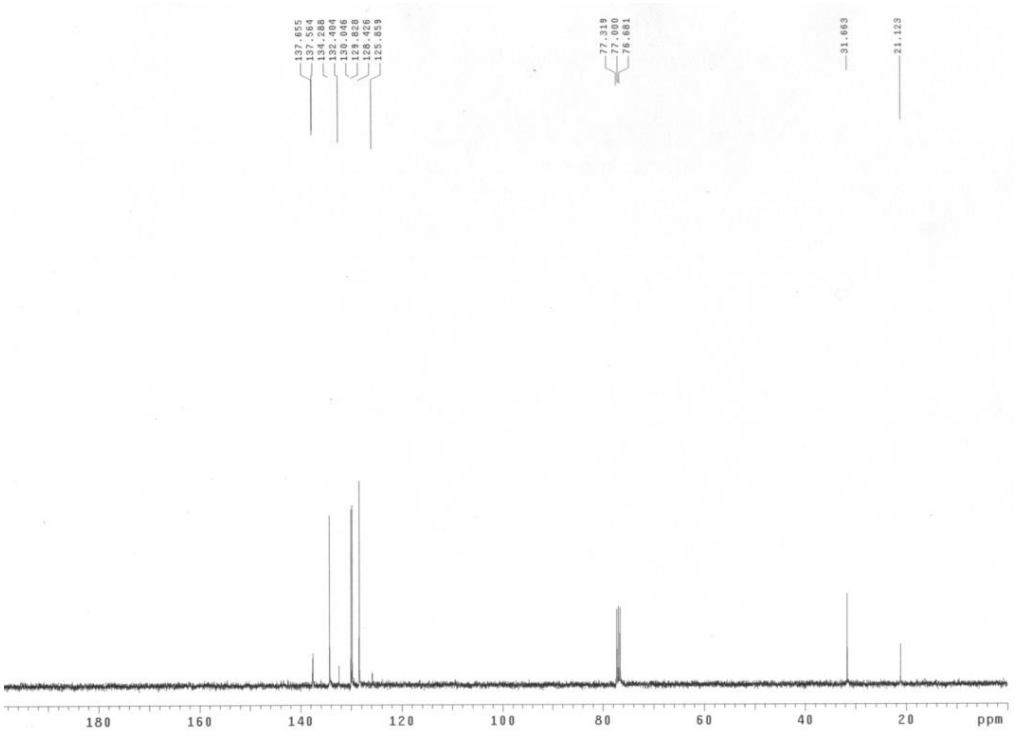




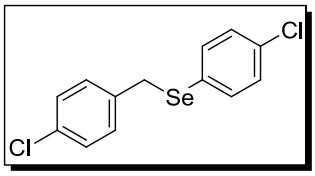
(4-Chlorobenzyl)(p-tolyl)selane (3i)

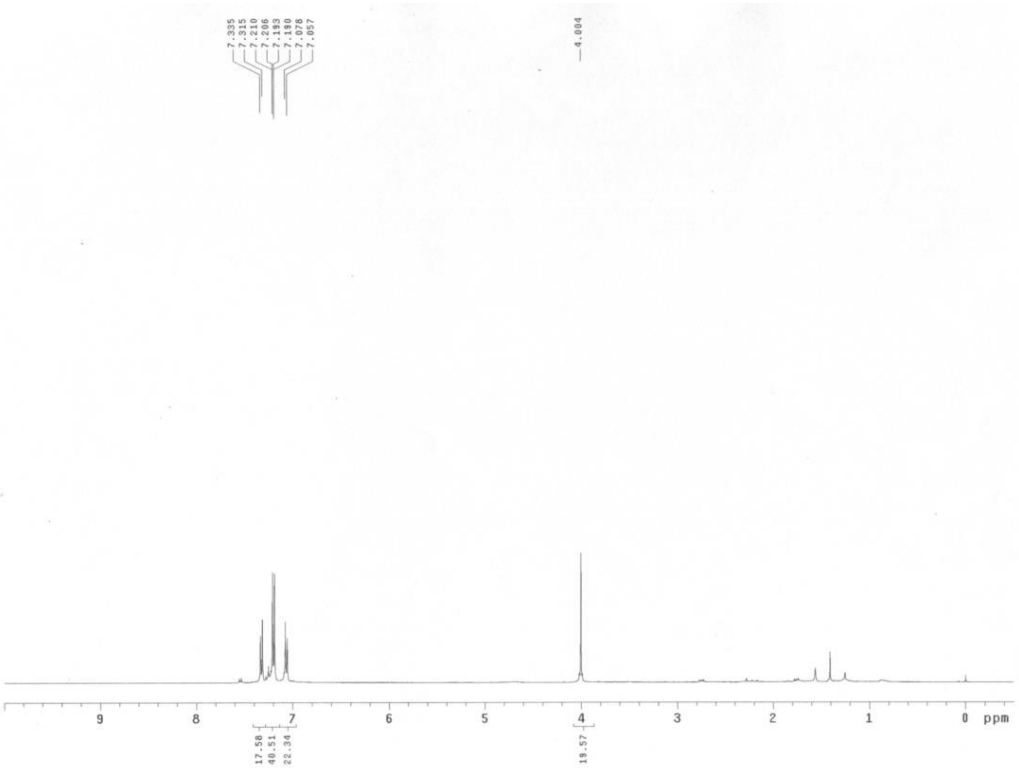


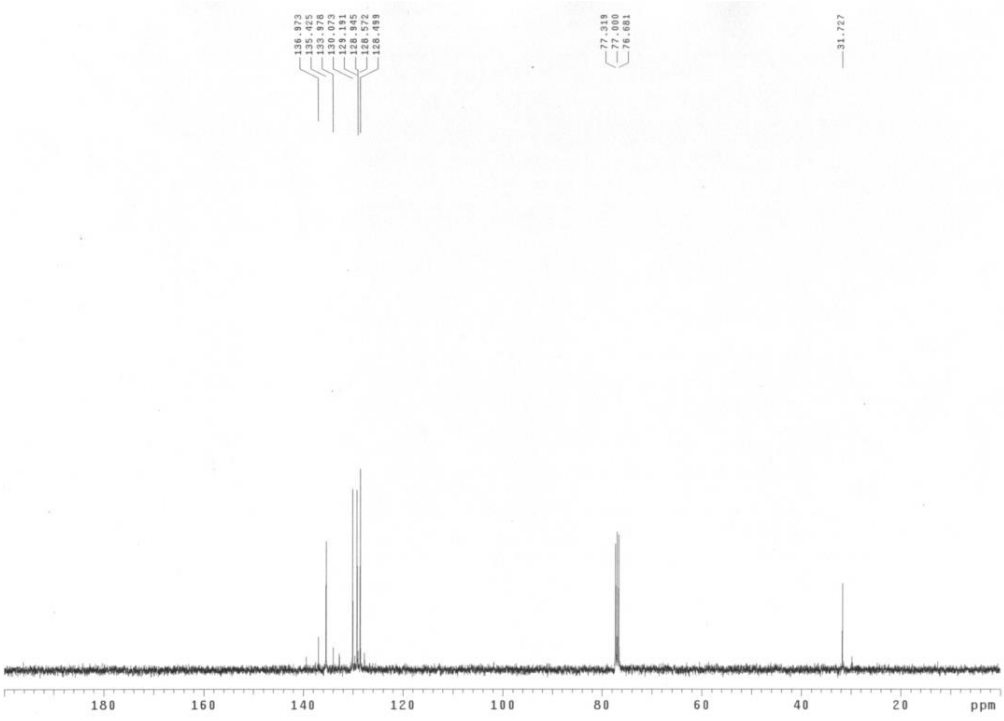




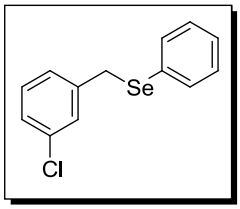
(4-Chlorobenzyl)(4-chlorophenyl)selane (3j)

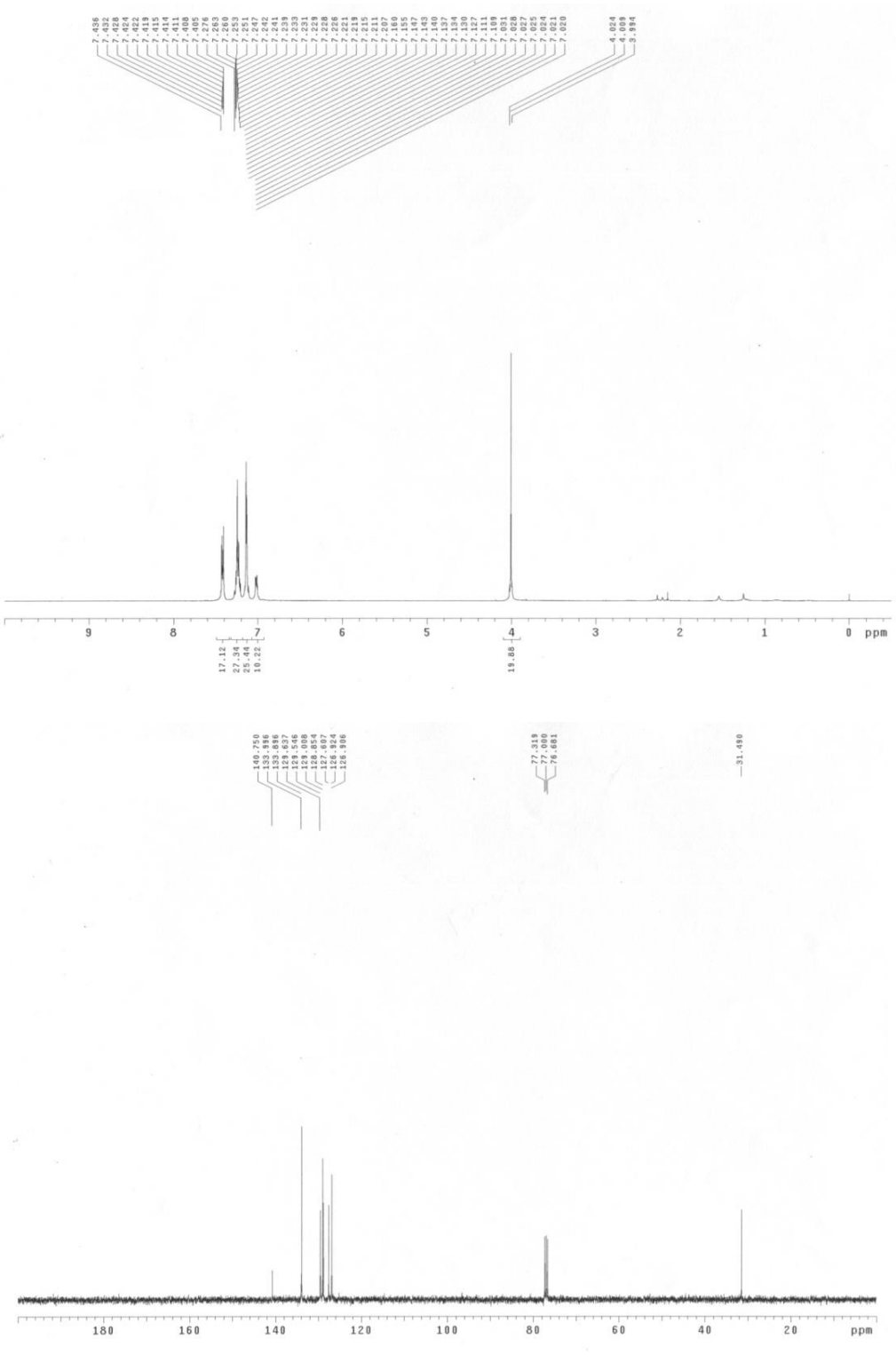




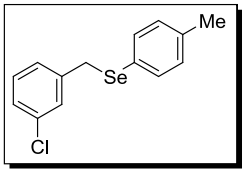


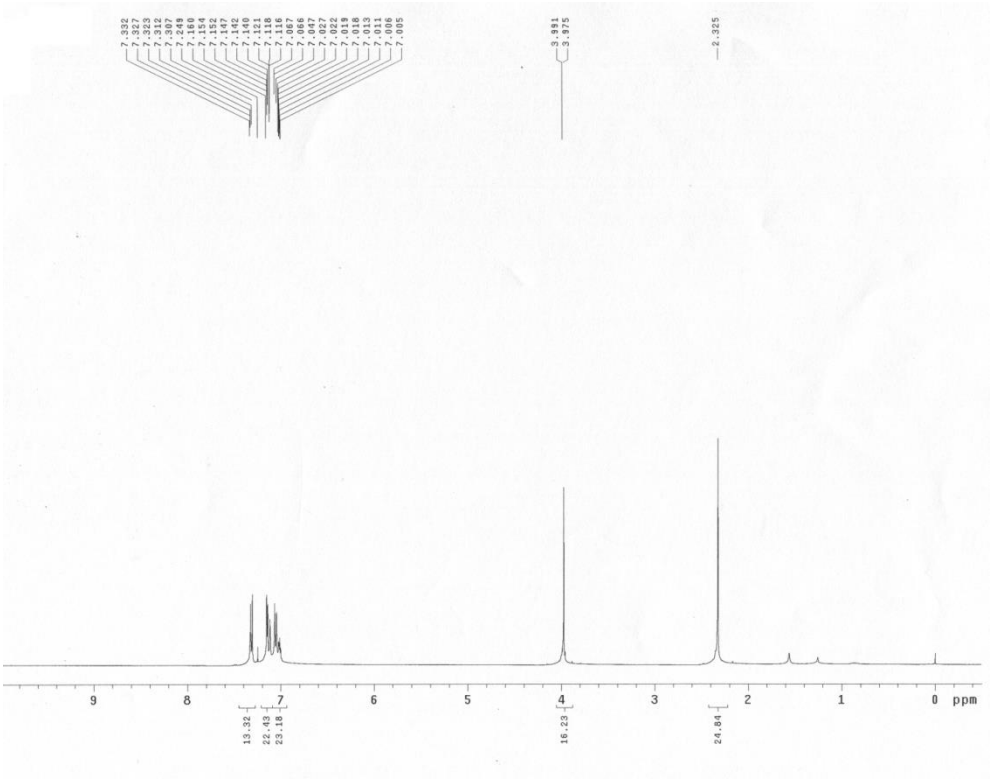
(3-Chlorobenzyl)(phenyl)selane (3k)

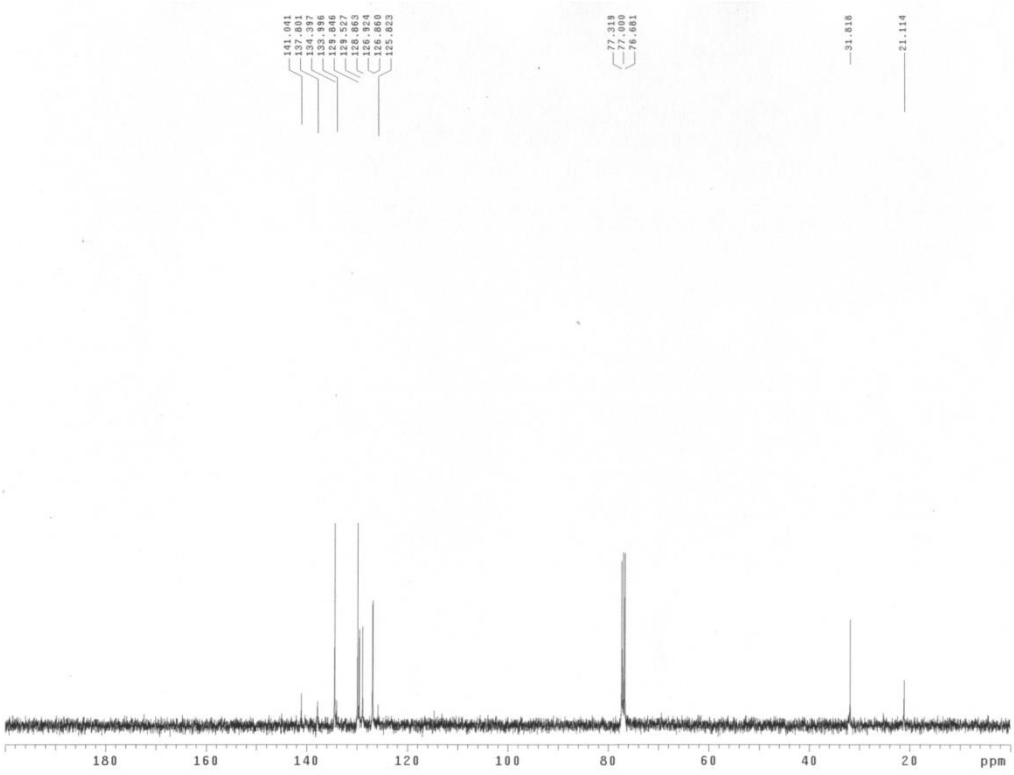




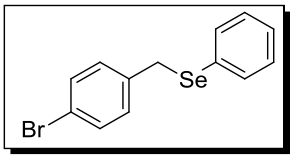
(3-Chlorobenzyl)(p-tolyl)selane (3l)

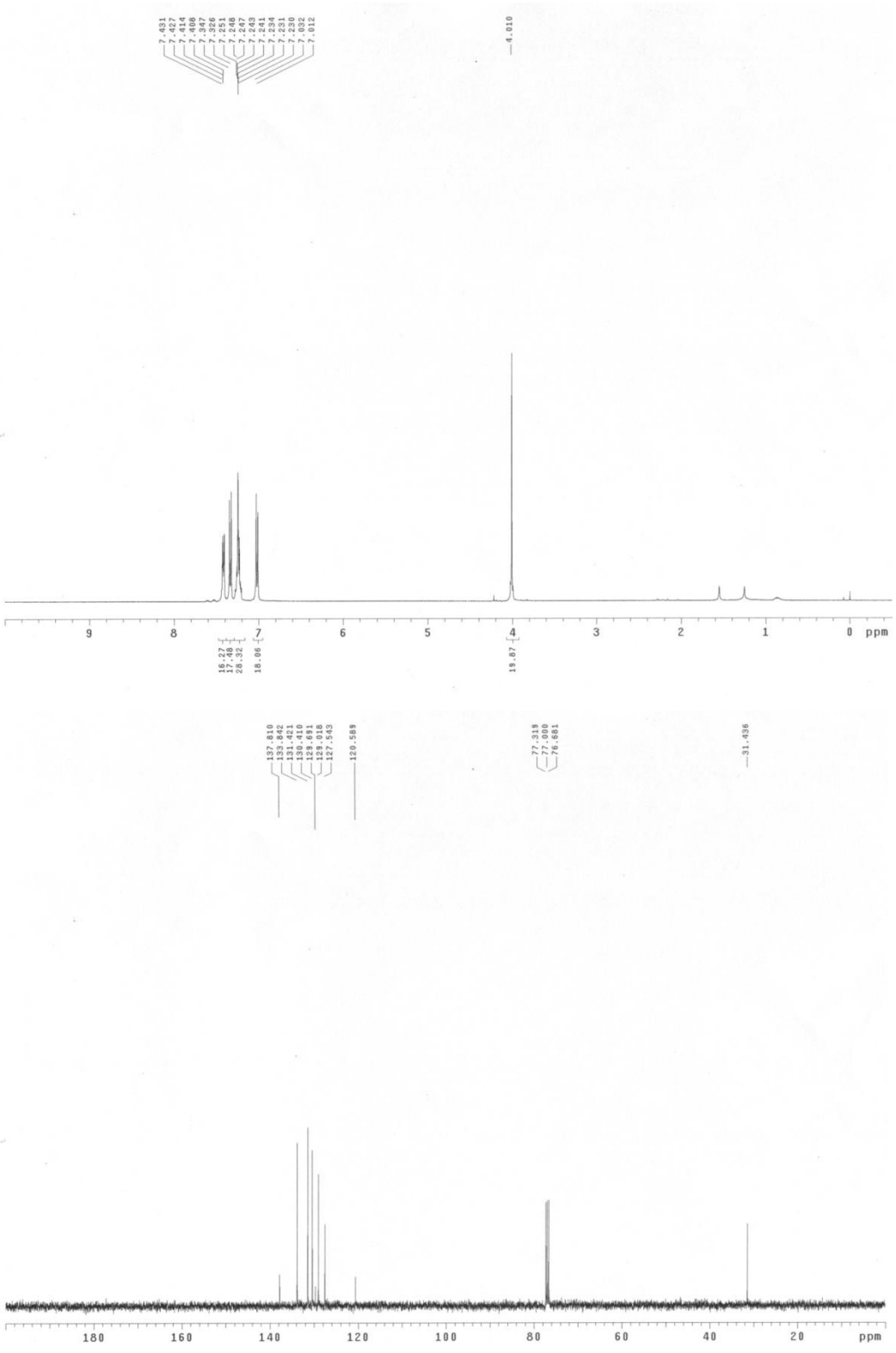




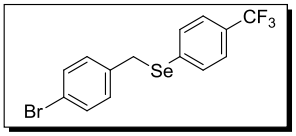


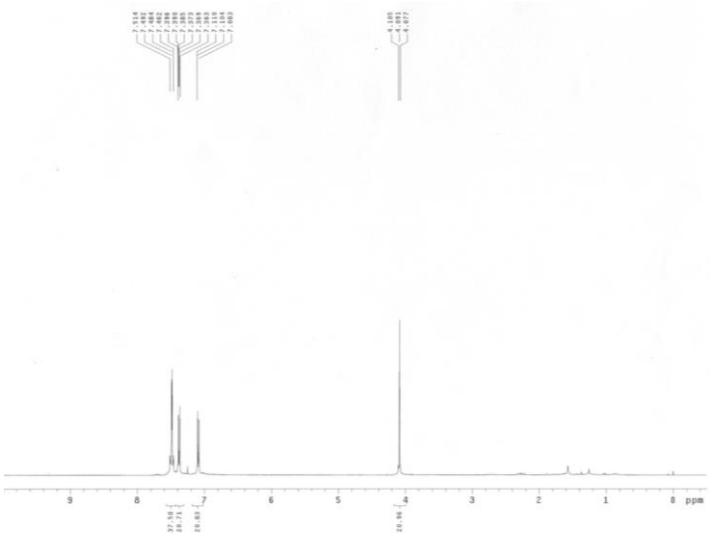
(4-Bromobenzyl)(phenyl)selane (3m)

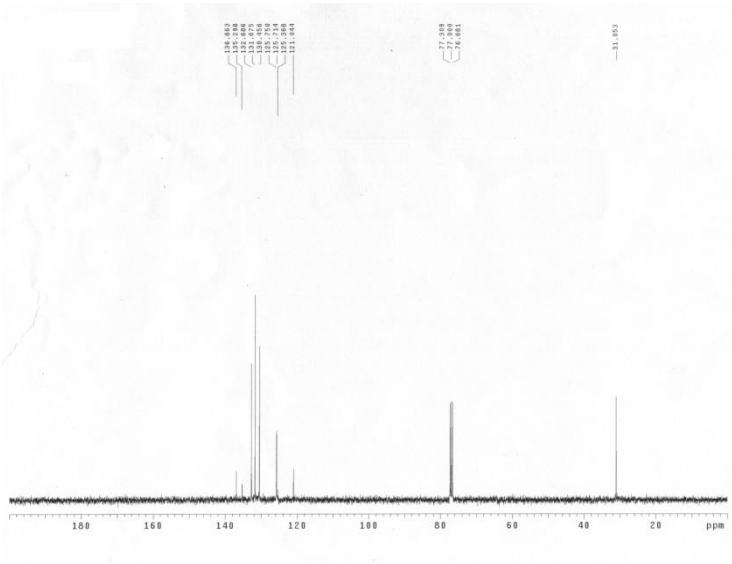


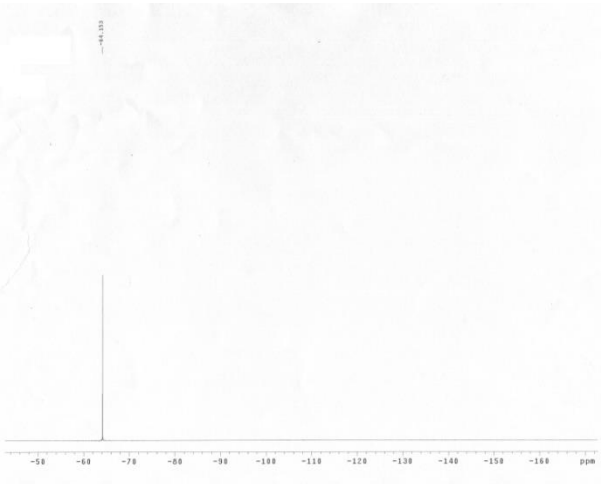


(4-Bromobenzyl)(4-(trifluoromethyl)phenyl)selane (3n)

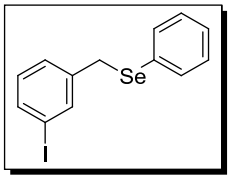


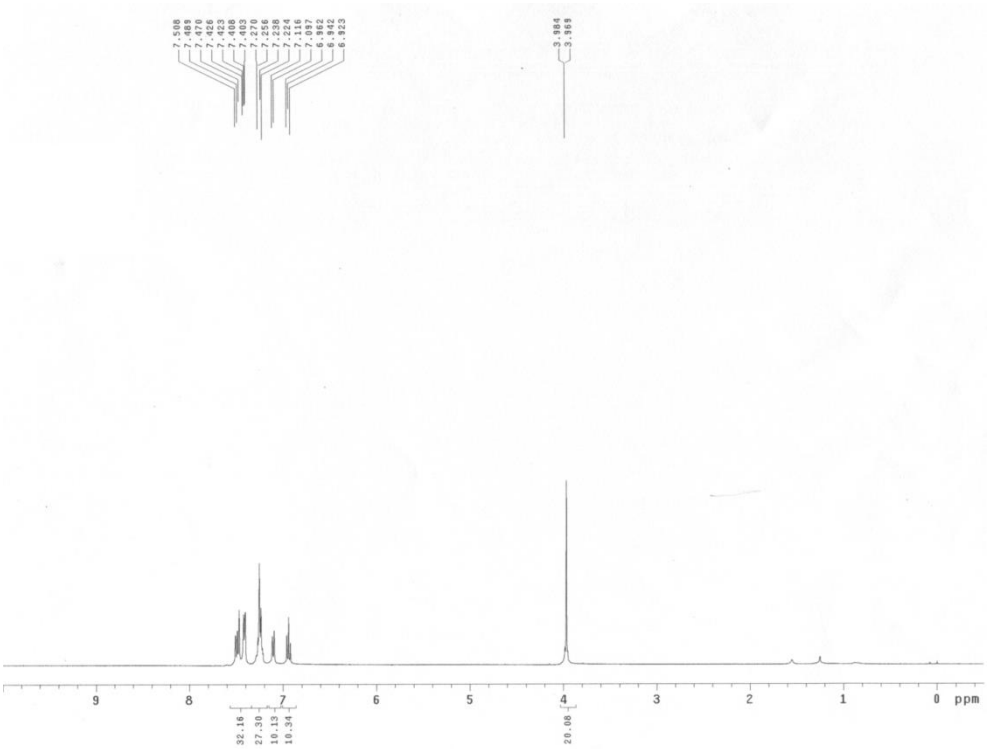


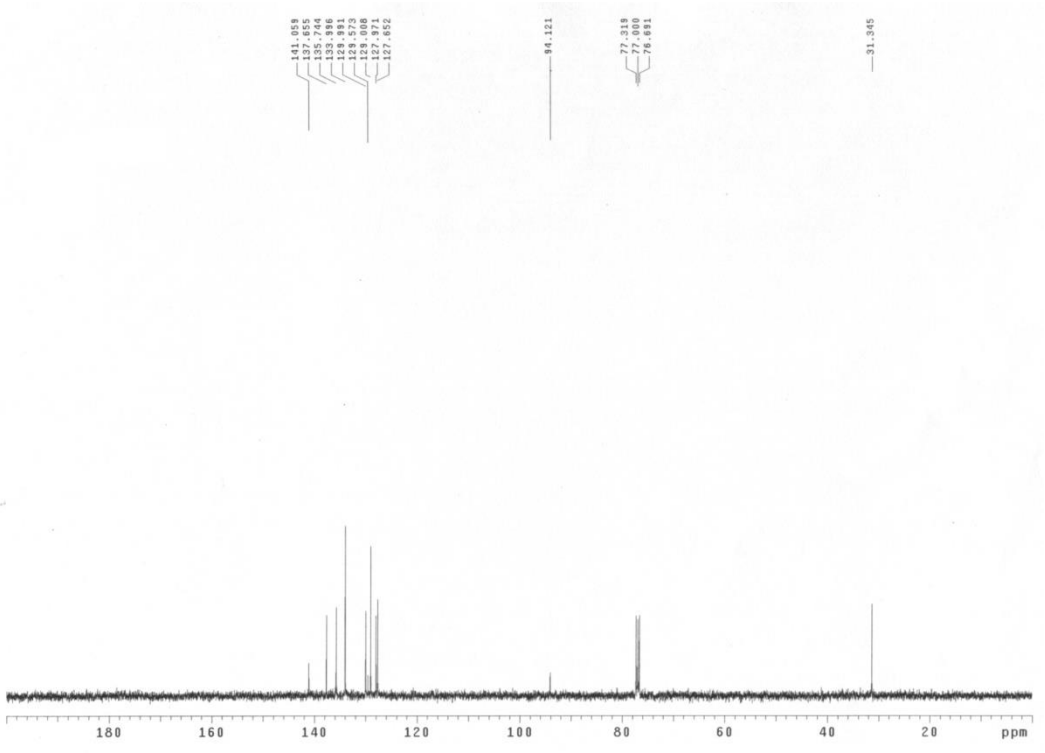




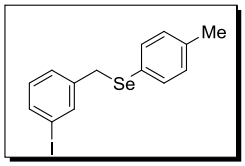
(3-Iodobenzyl)(phenyl)selane (3o)

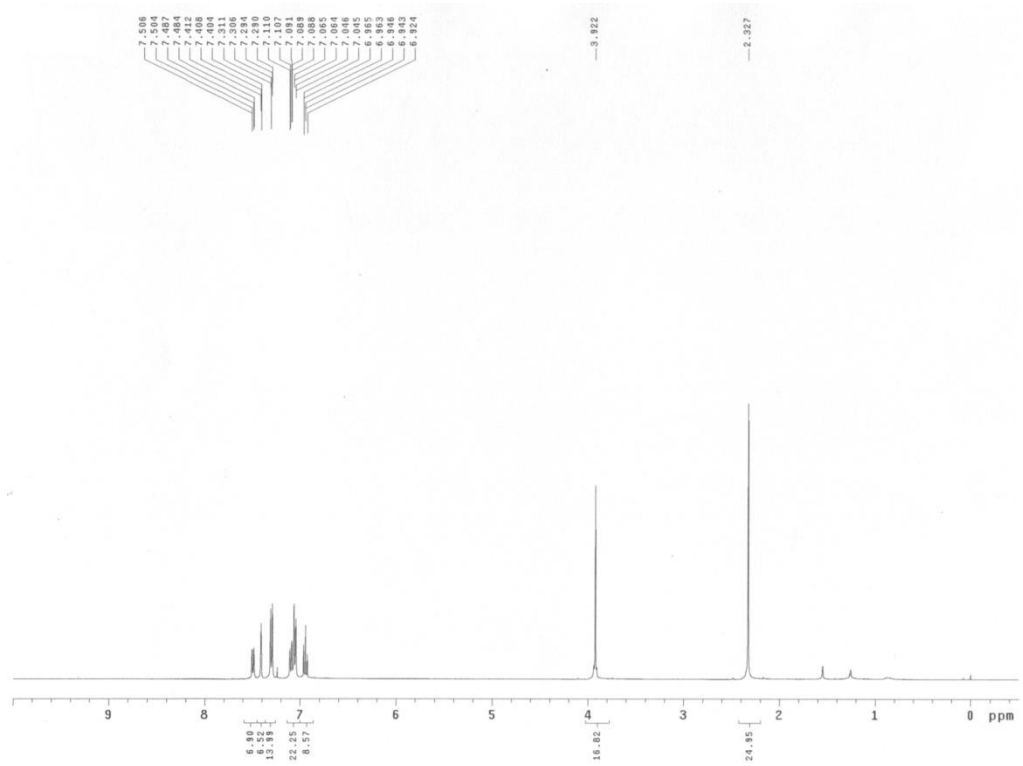


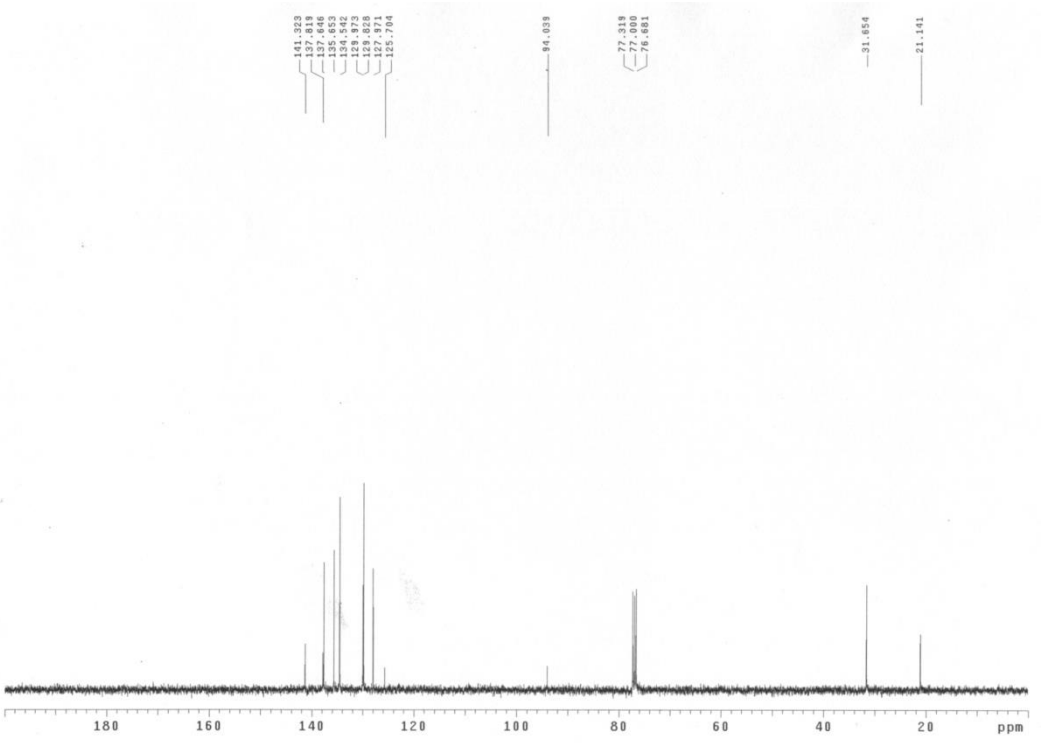




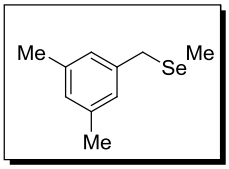
(3-Iodobenzyl)(p-tolyl)selane (3p)

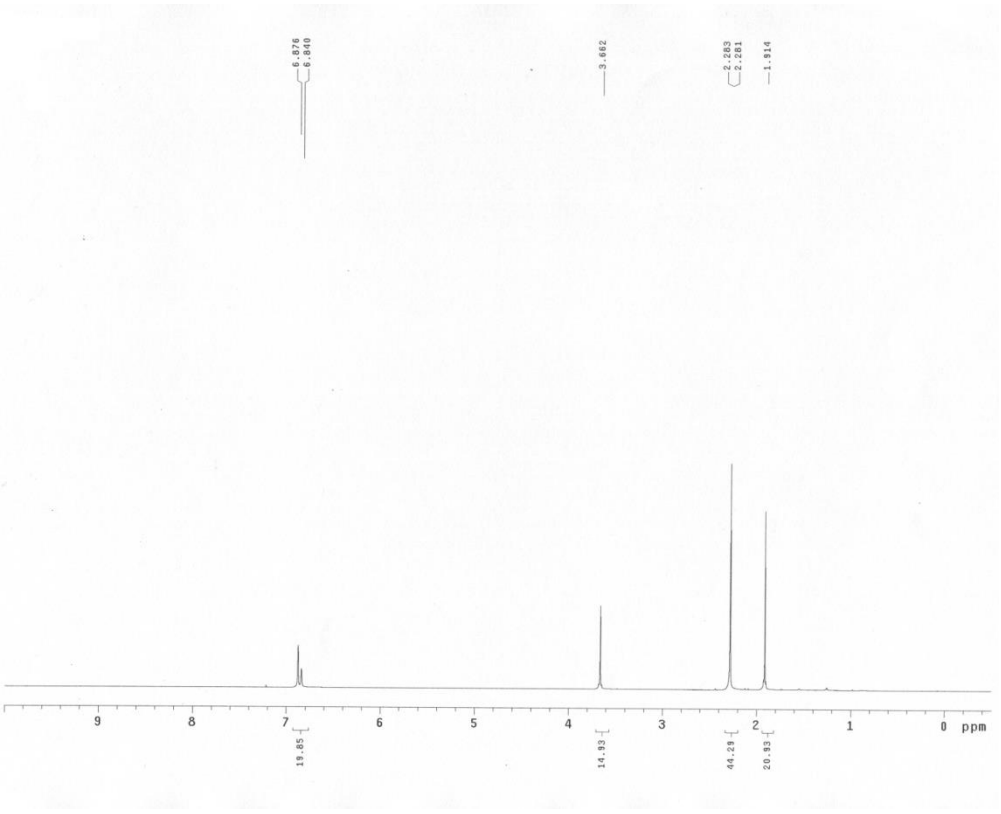


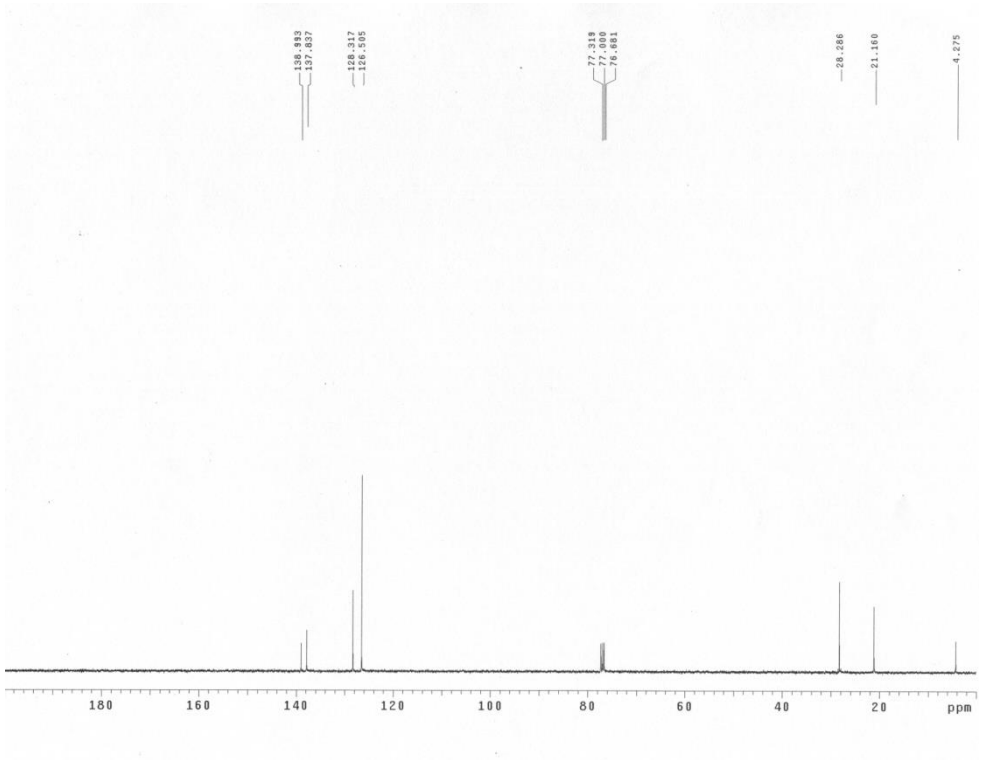




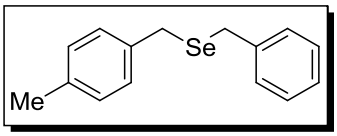
(3,5-Dimethylbenzyl)(methyl)selane (3q)

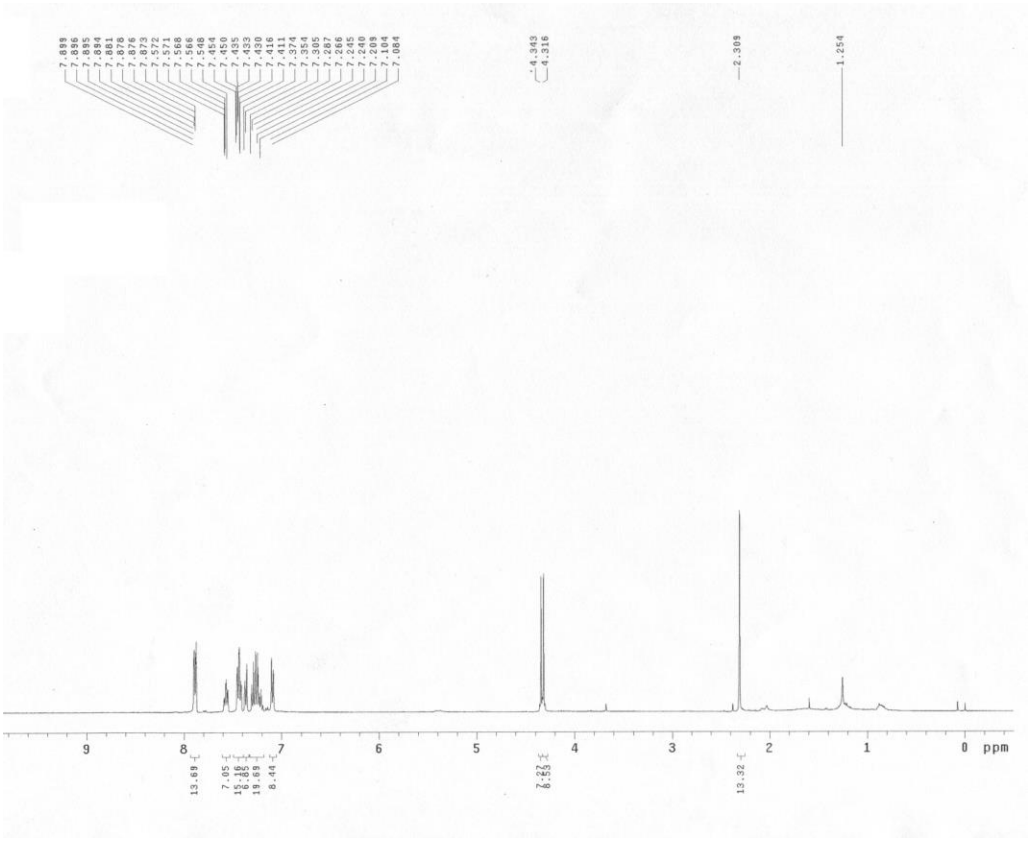


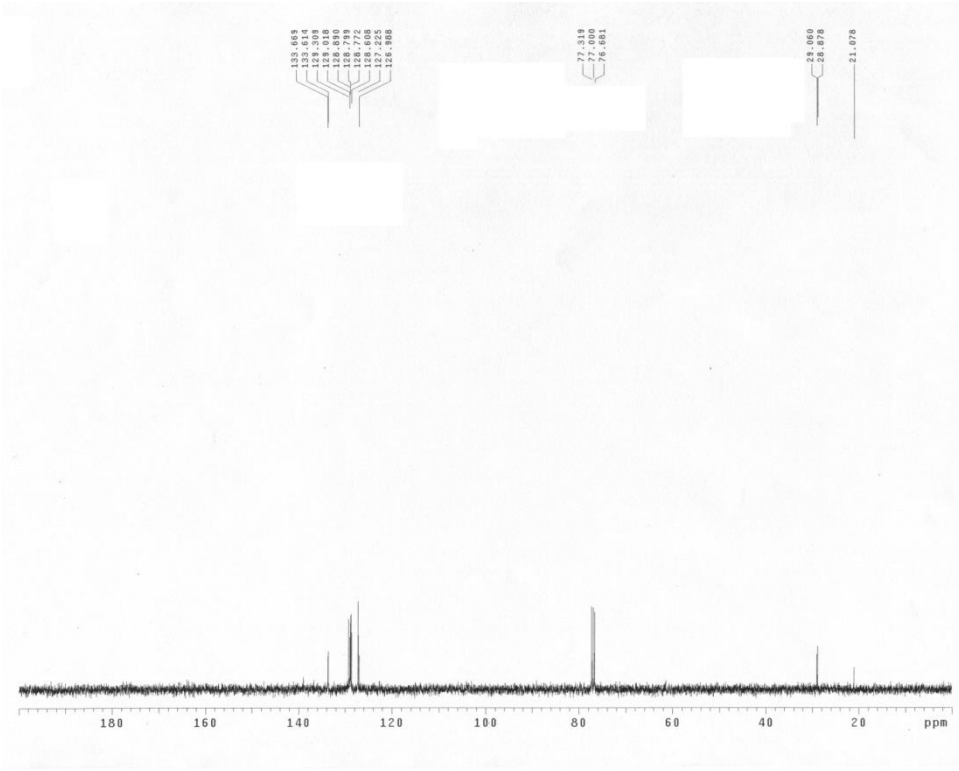




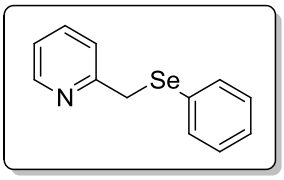
Benzyl(4-methylbenzyl)selane (3r)

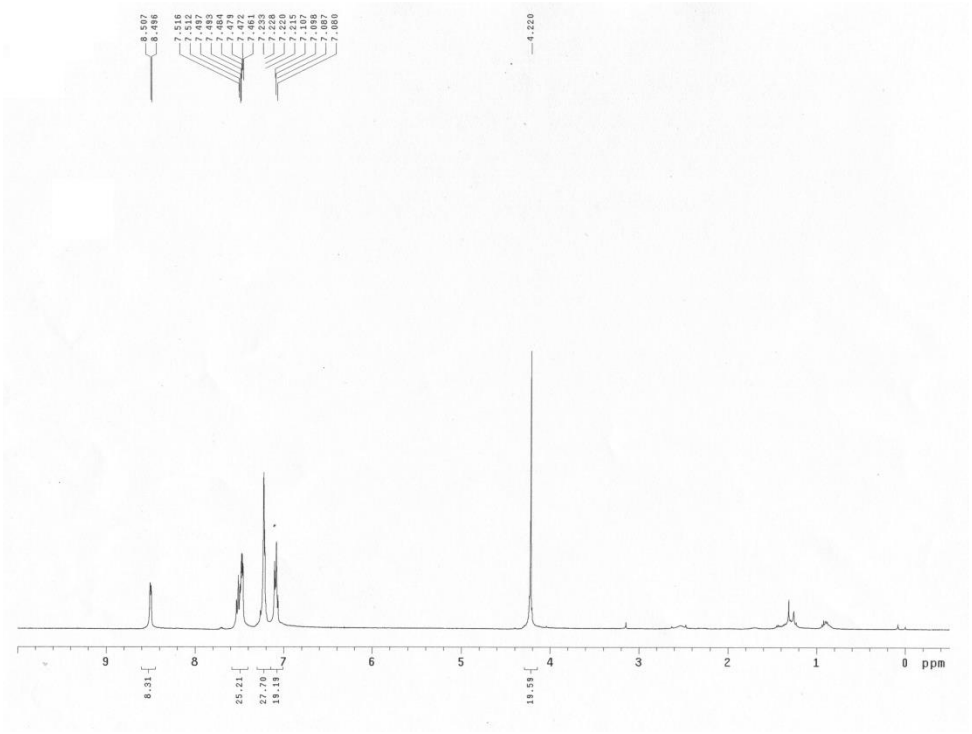


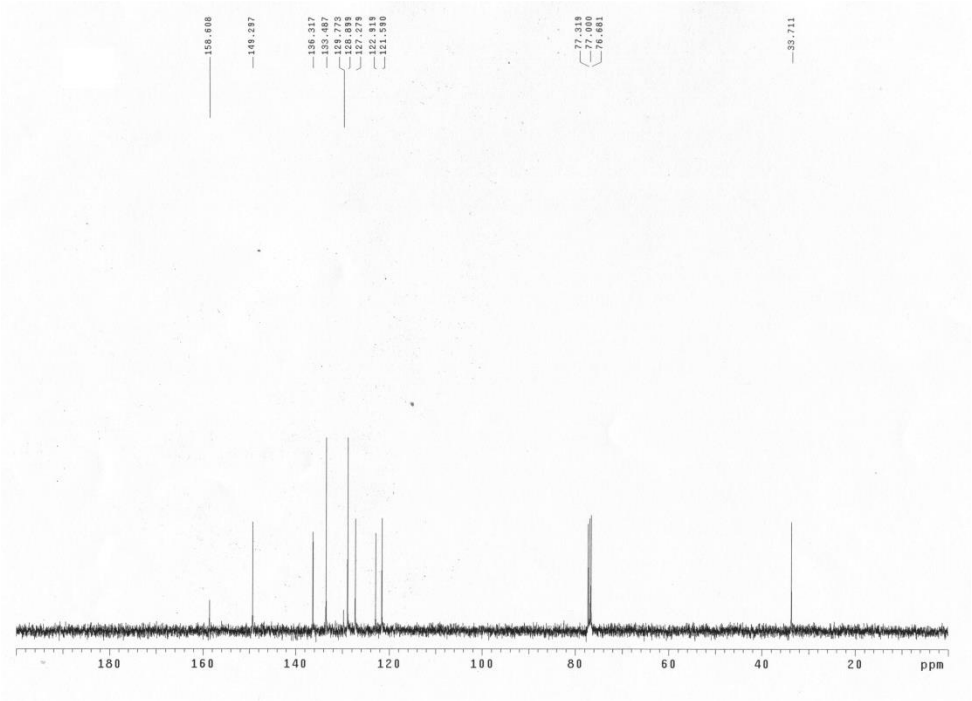




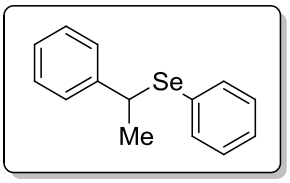
2-{(Phenylselanyl)methyl}pyridine (3s)

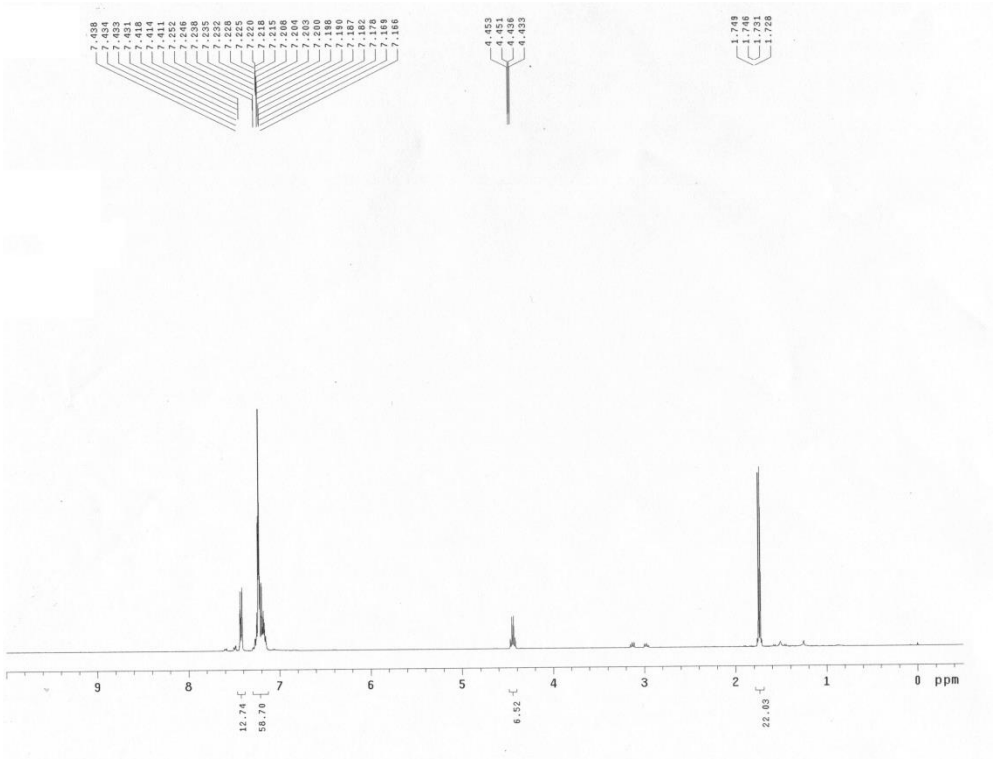


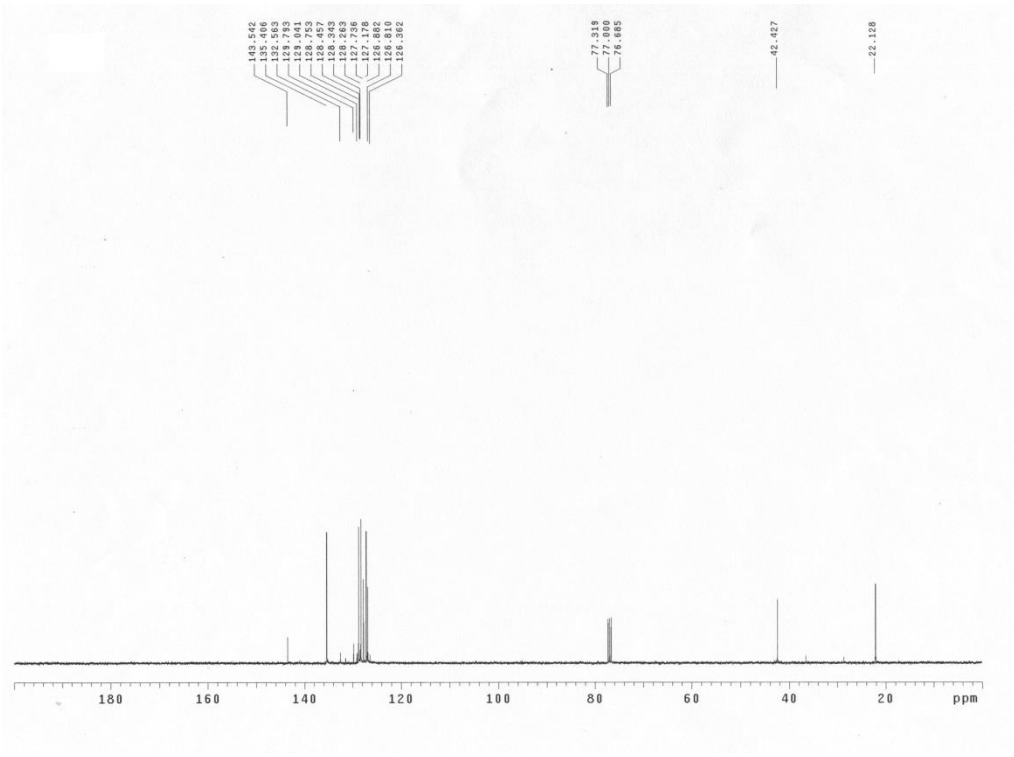




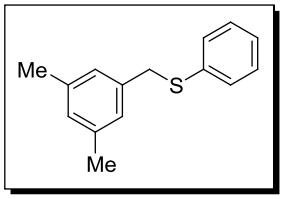
Phenyl(1-phenylethyl)selane (3t)

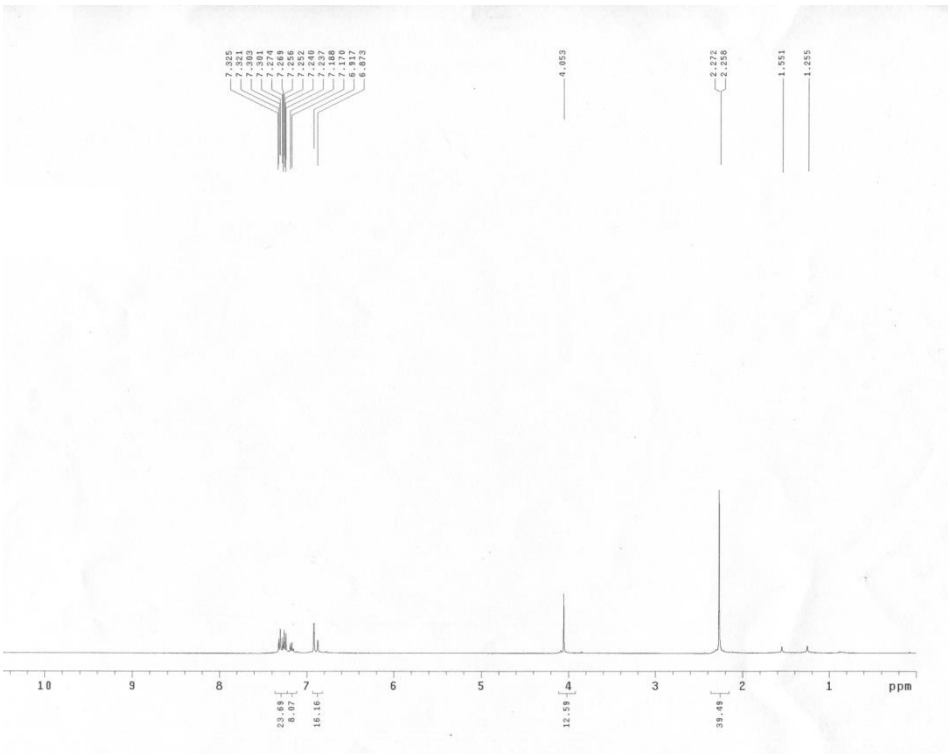


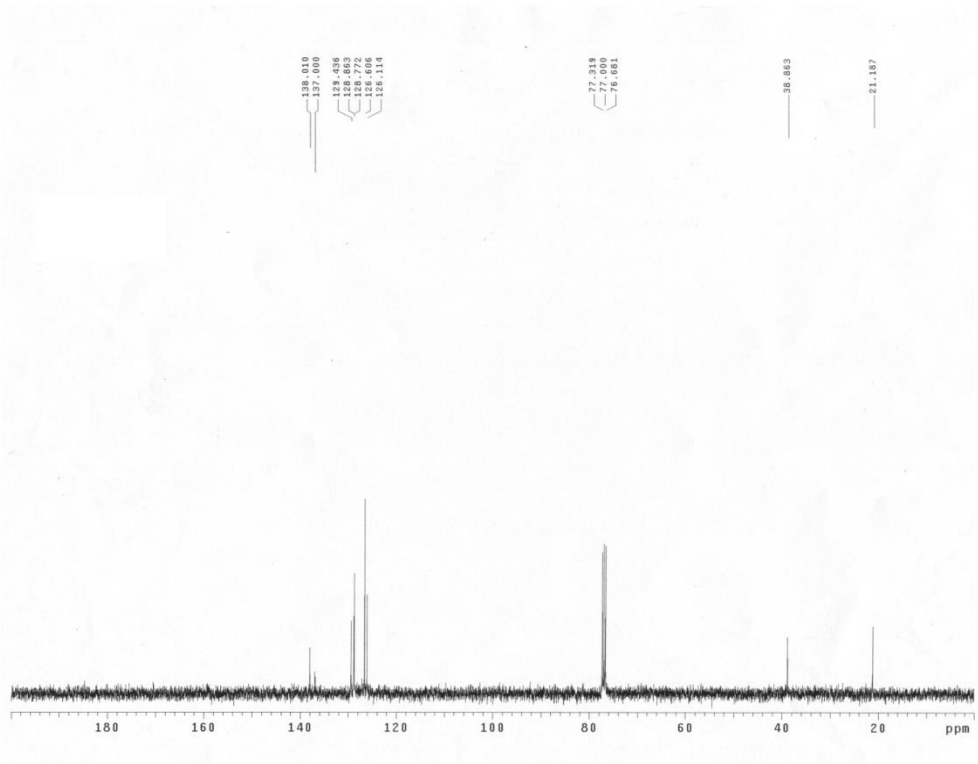




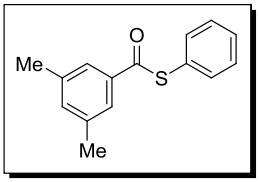
(3,5-Dimethylbenzyl)(phenyl)sulfane (5)

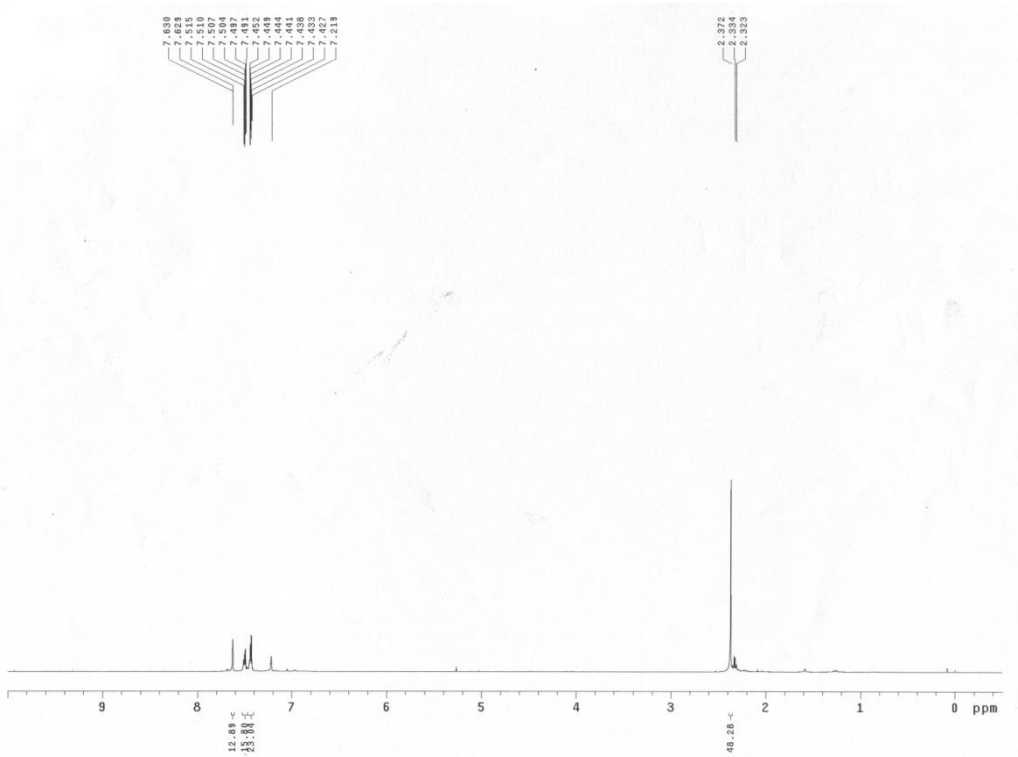


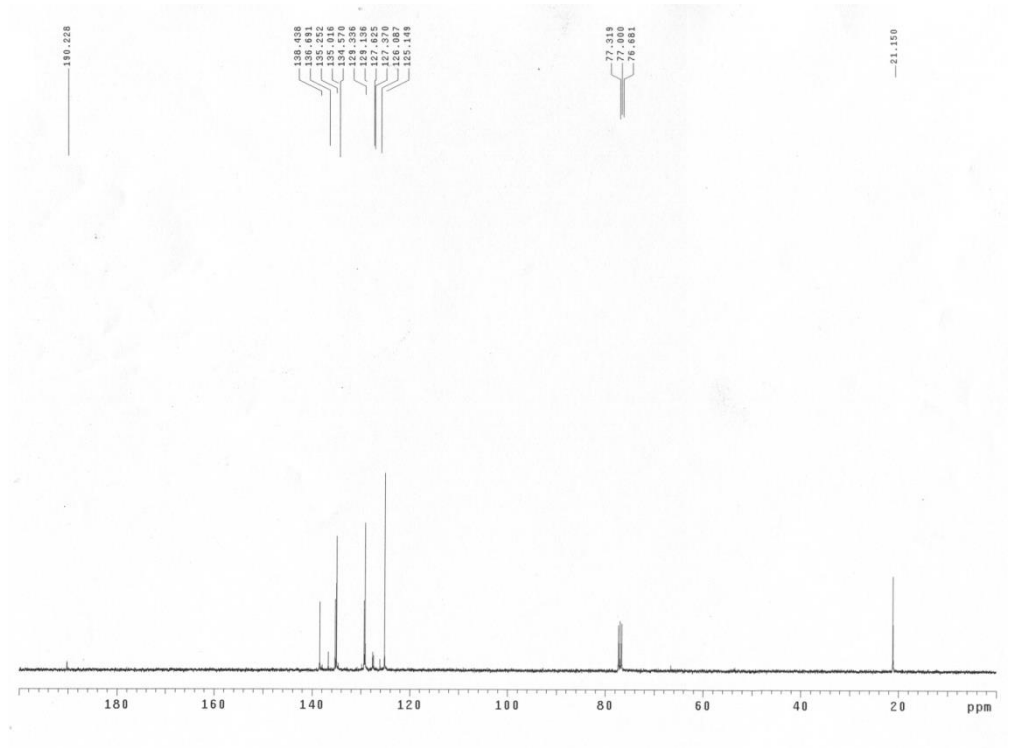




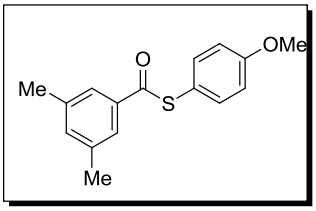
S-Phenyl 3,5-dimethylbenzothioate (6a)

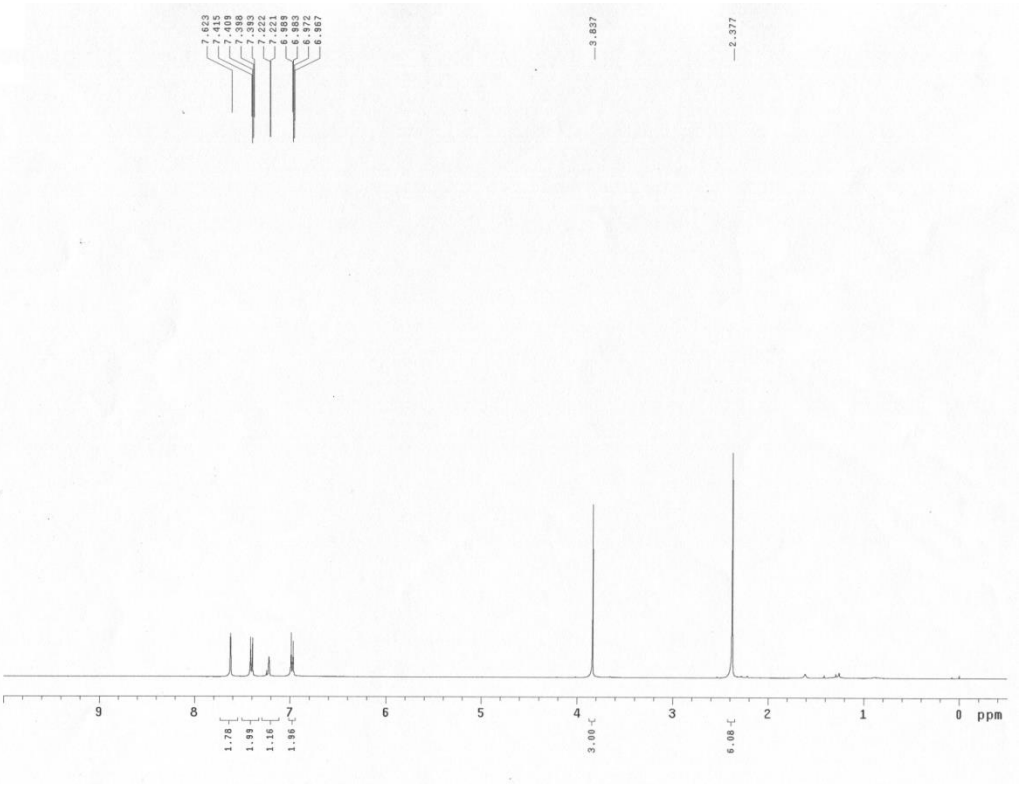


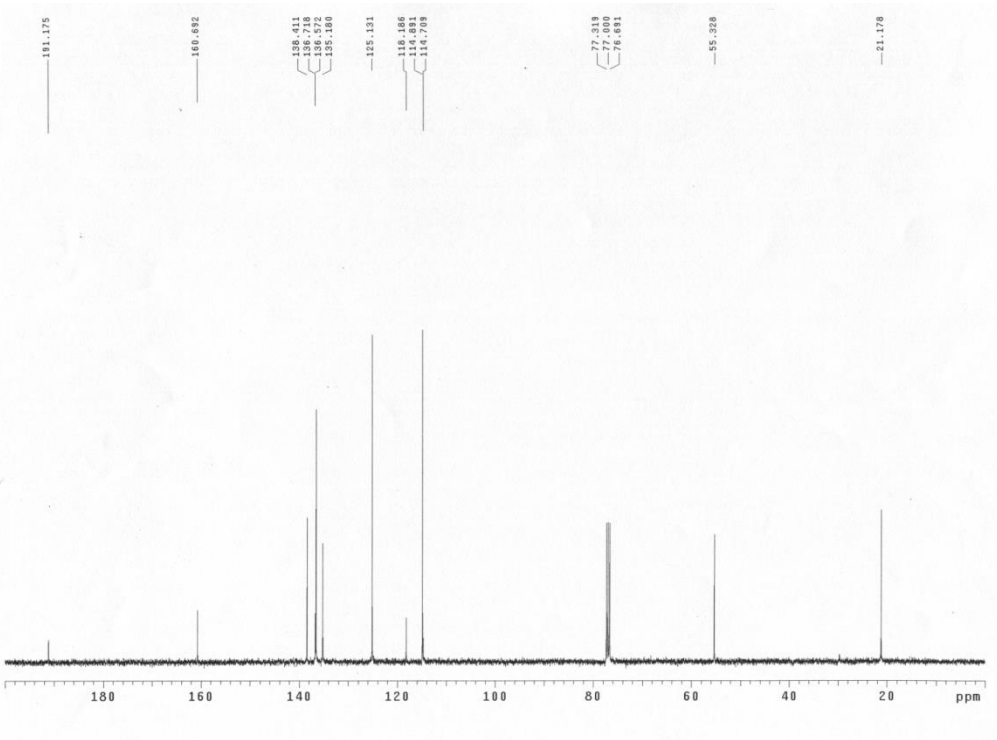




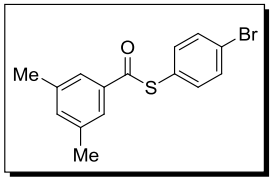
S-4-Methoxyphenyl 3,5-dimethylbenzothioate (6b)

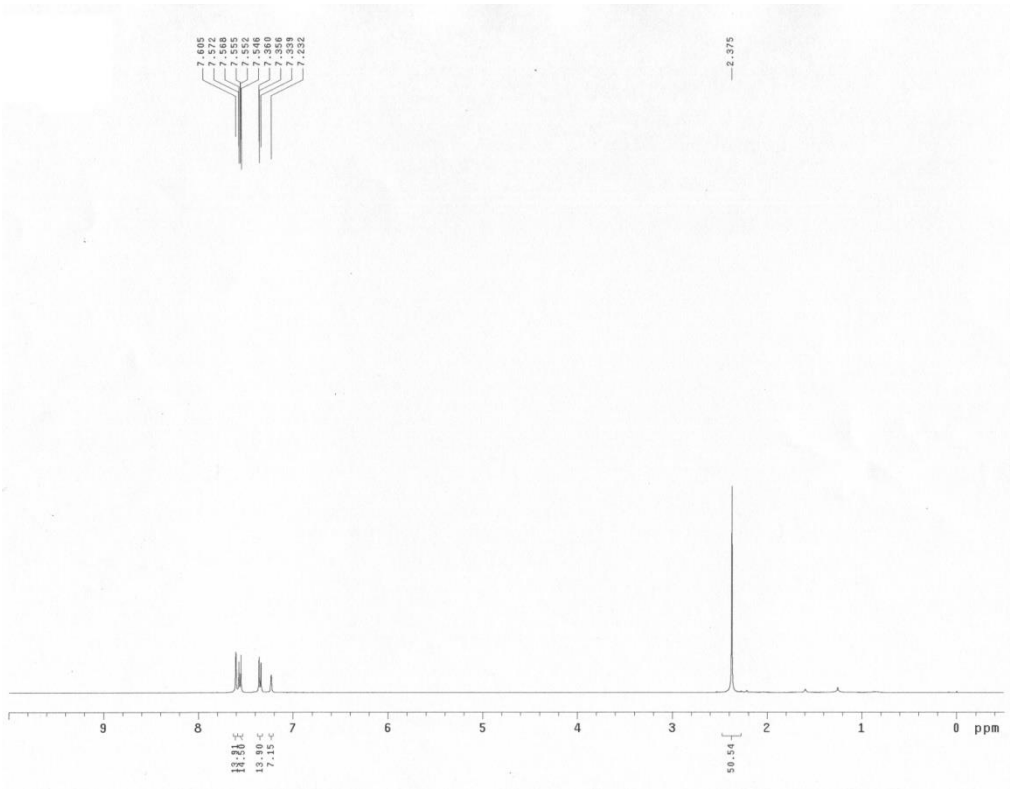


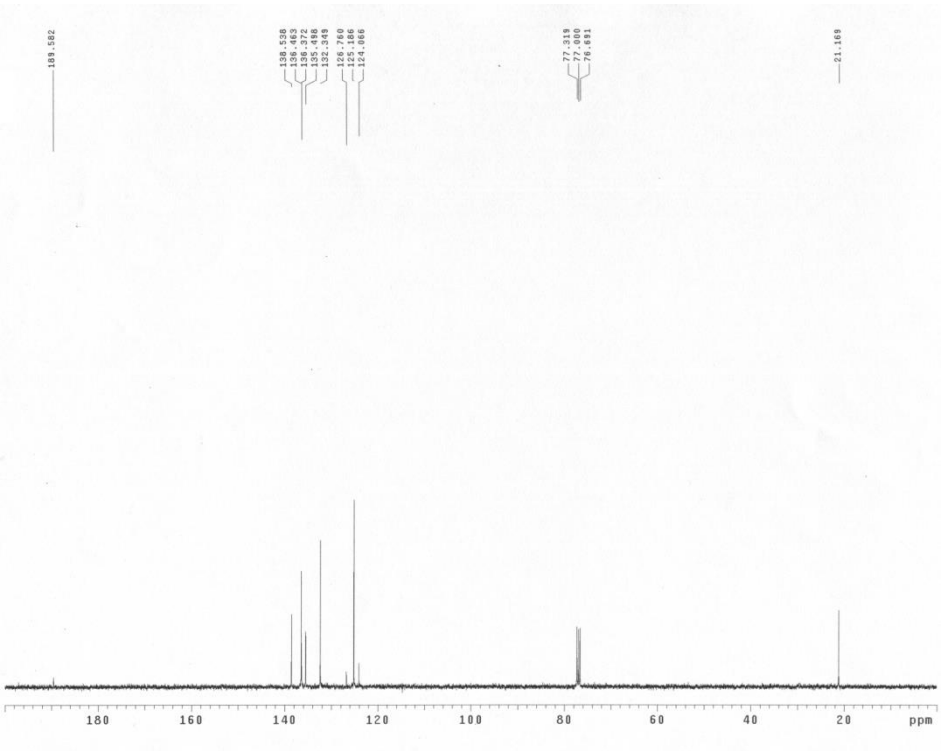




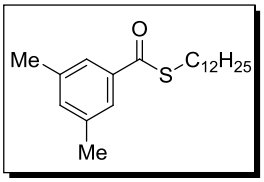
S-4-Bromophenyl 3,5-dimethylbenzothioate (6c)

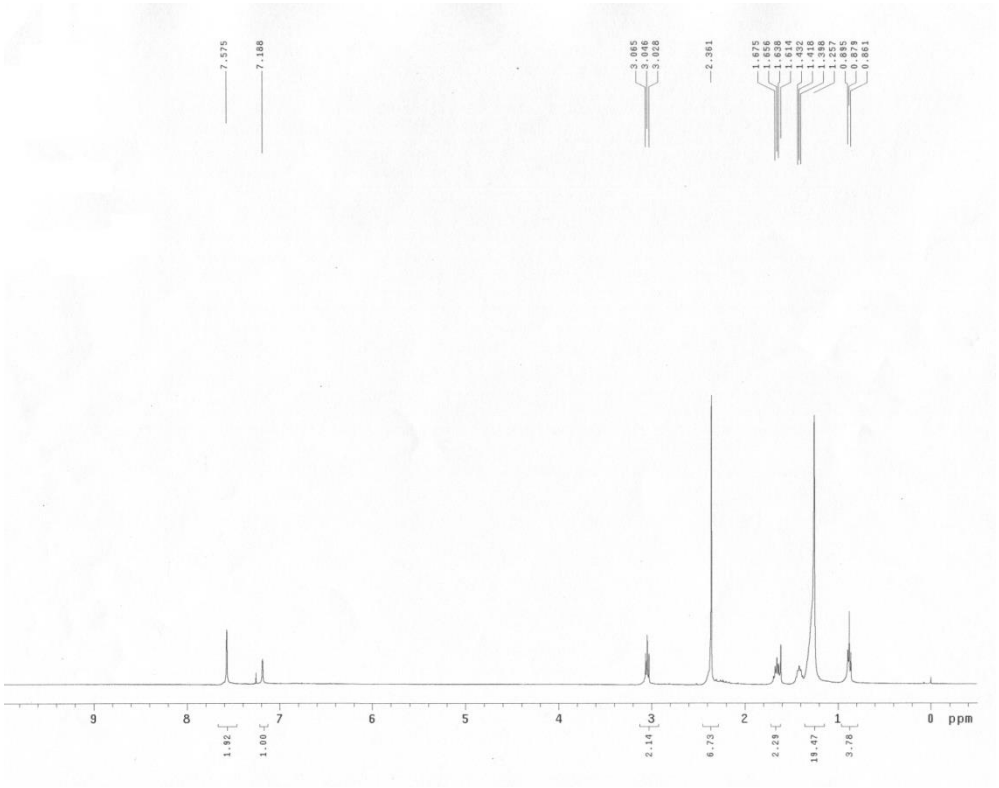


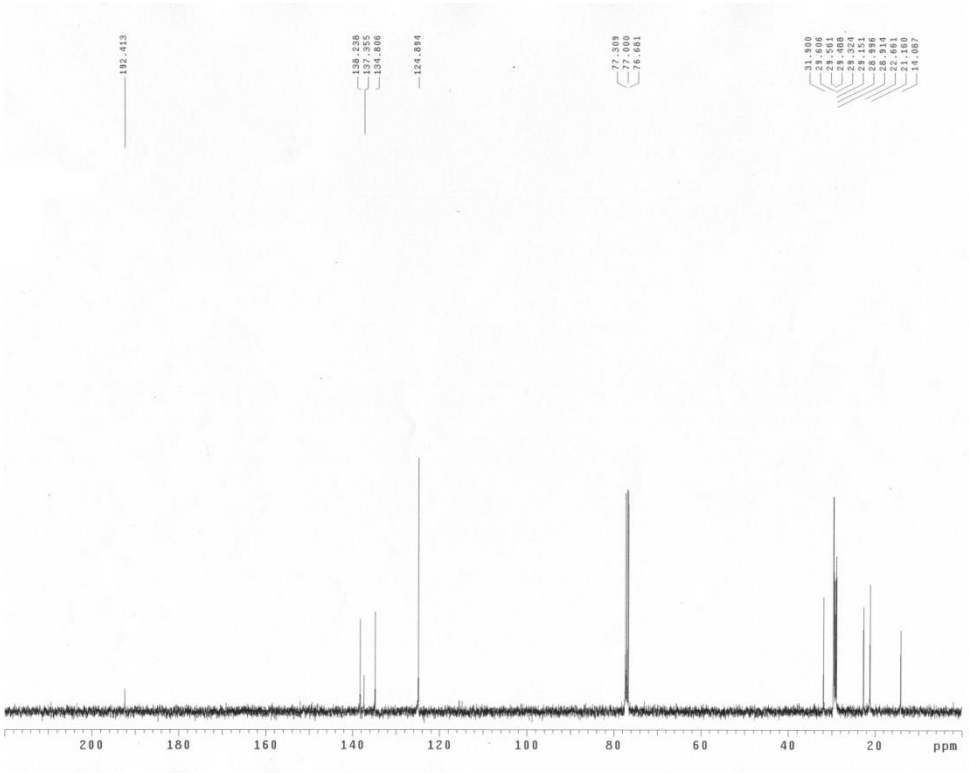




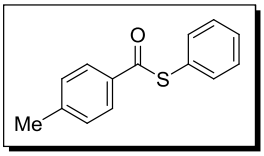
S-*n*-Dodecyl 3,5-dimethylbenzothioate (6d)

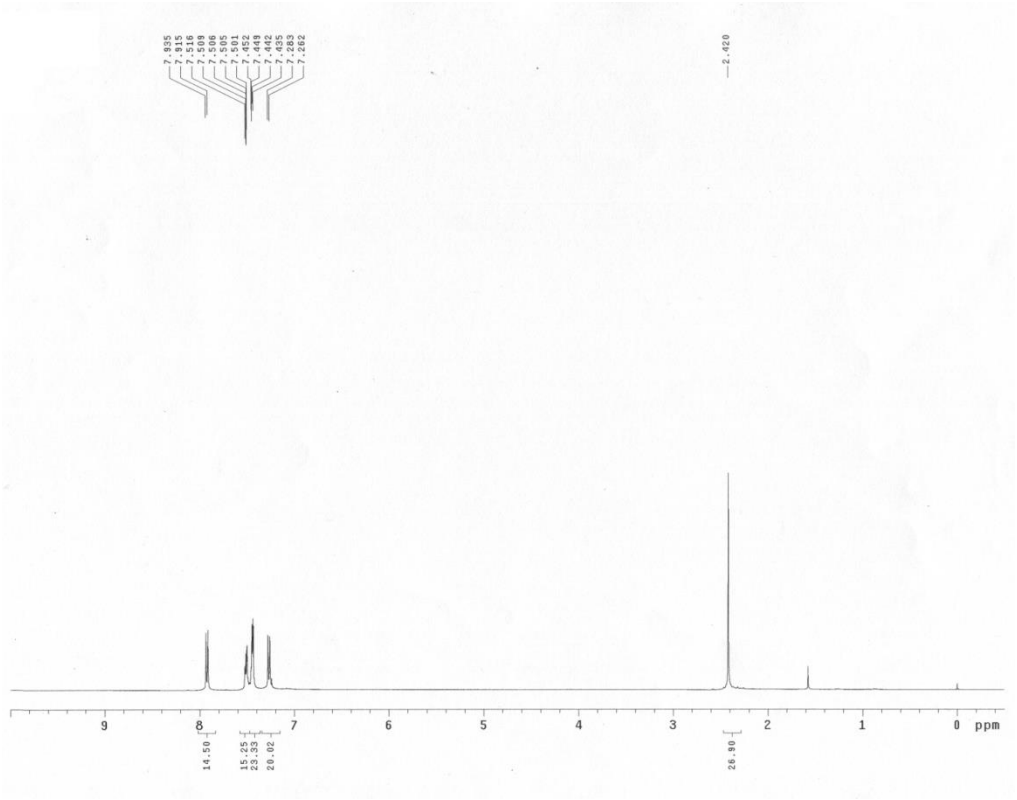


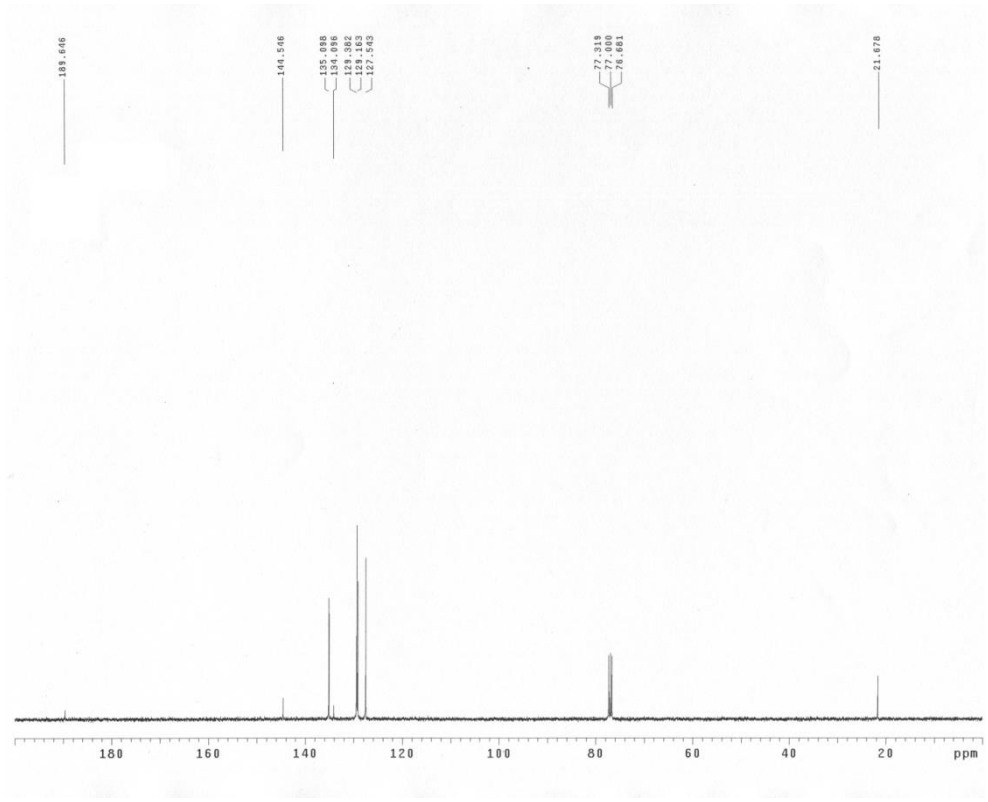




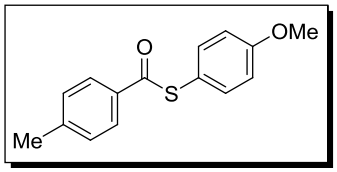
S-Phenyl 4-methylbenzothioate (6e)

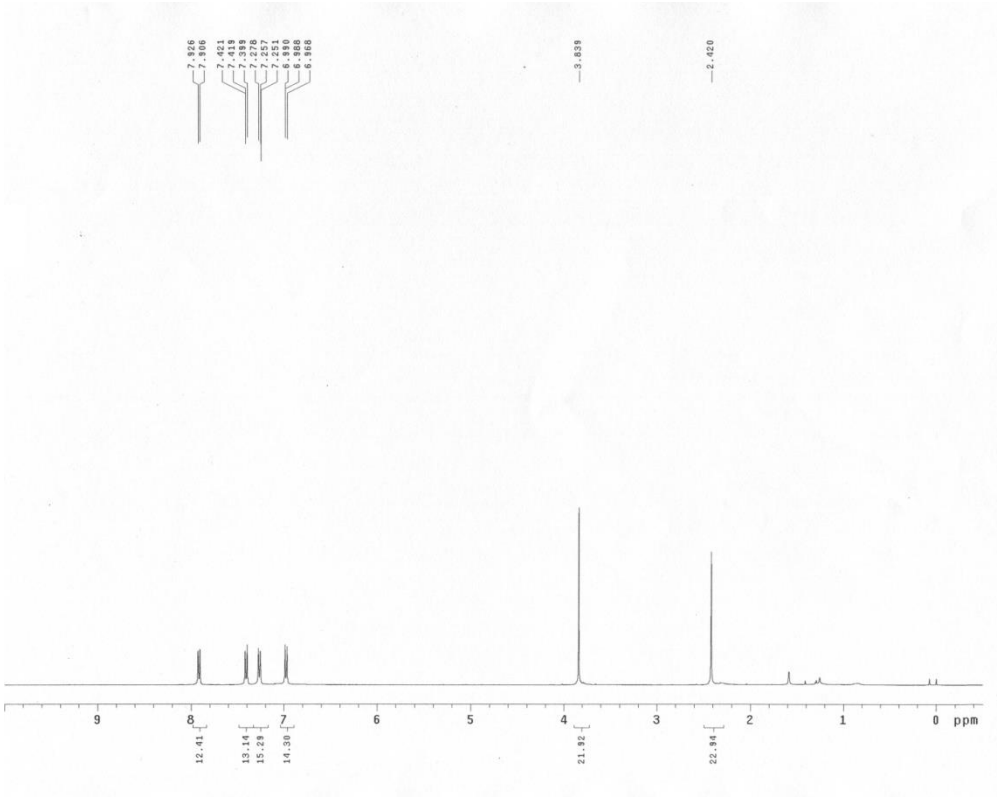


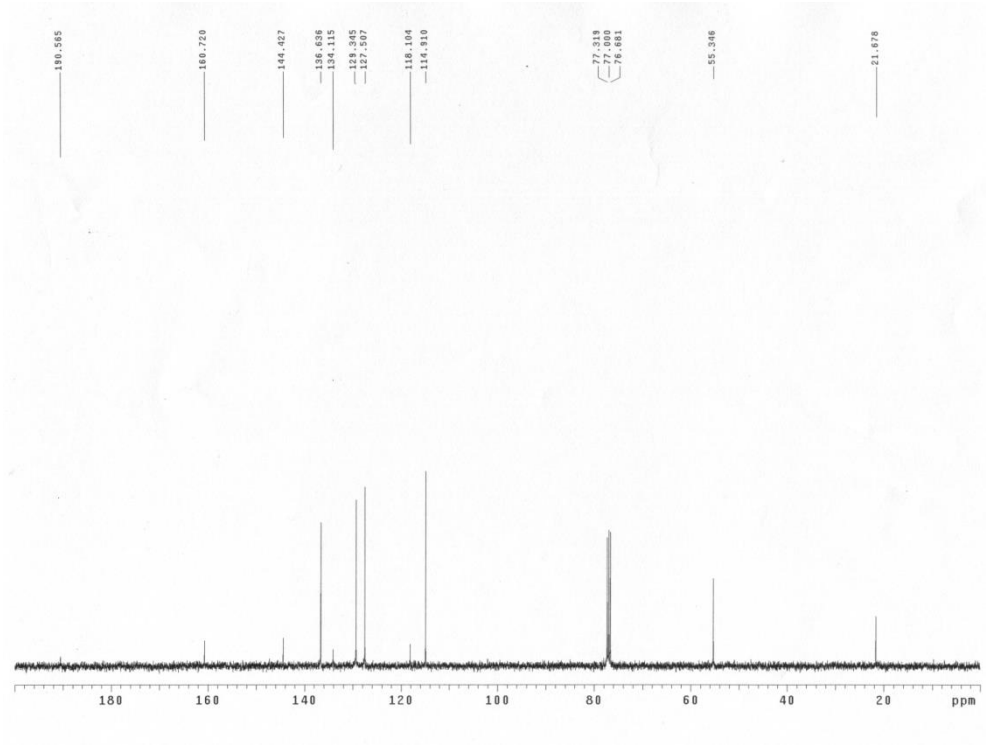




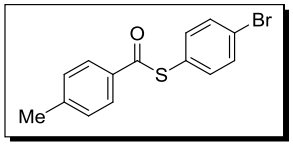
S-4-Methoxyphenyl 4-methylbenzothioate (6f)

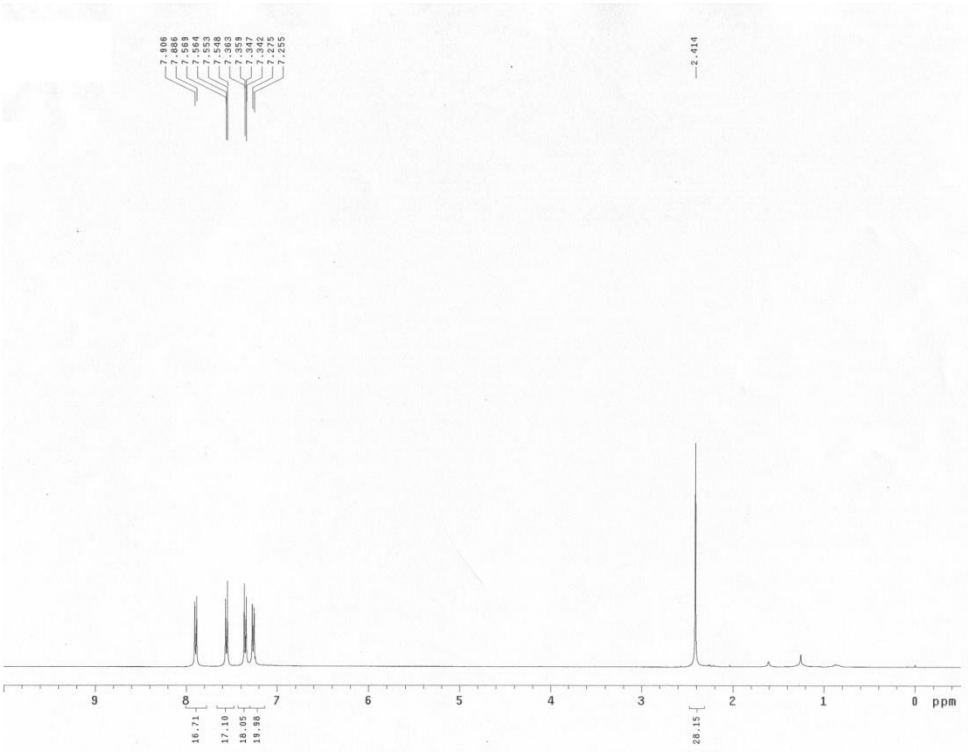


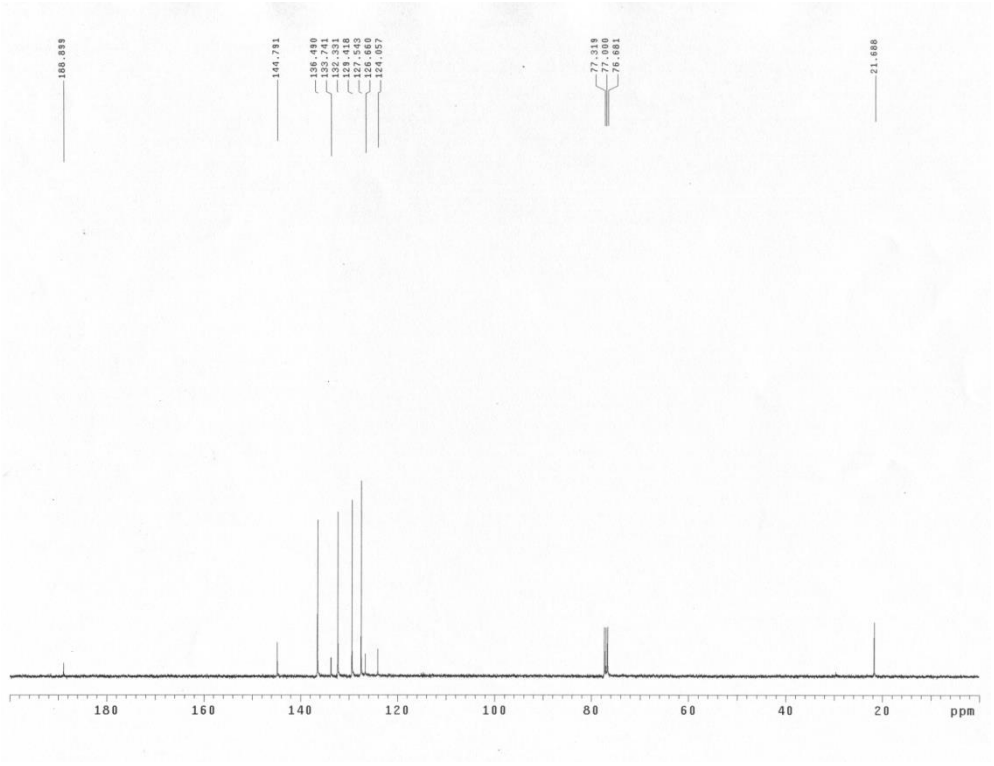




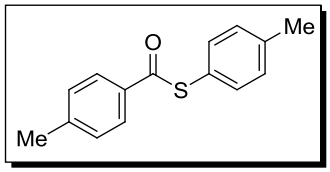
S-4-Bromophenyl 4-methylbenzothioate (6g)

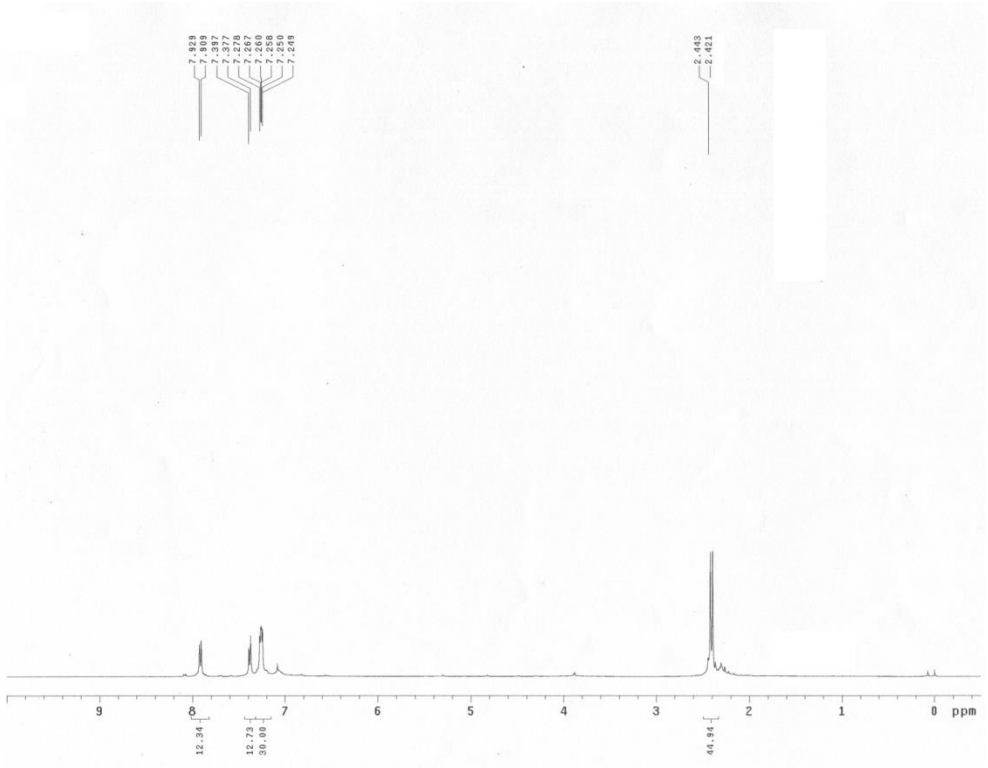


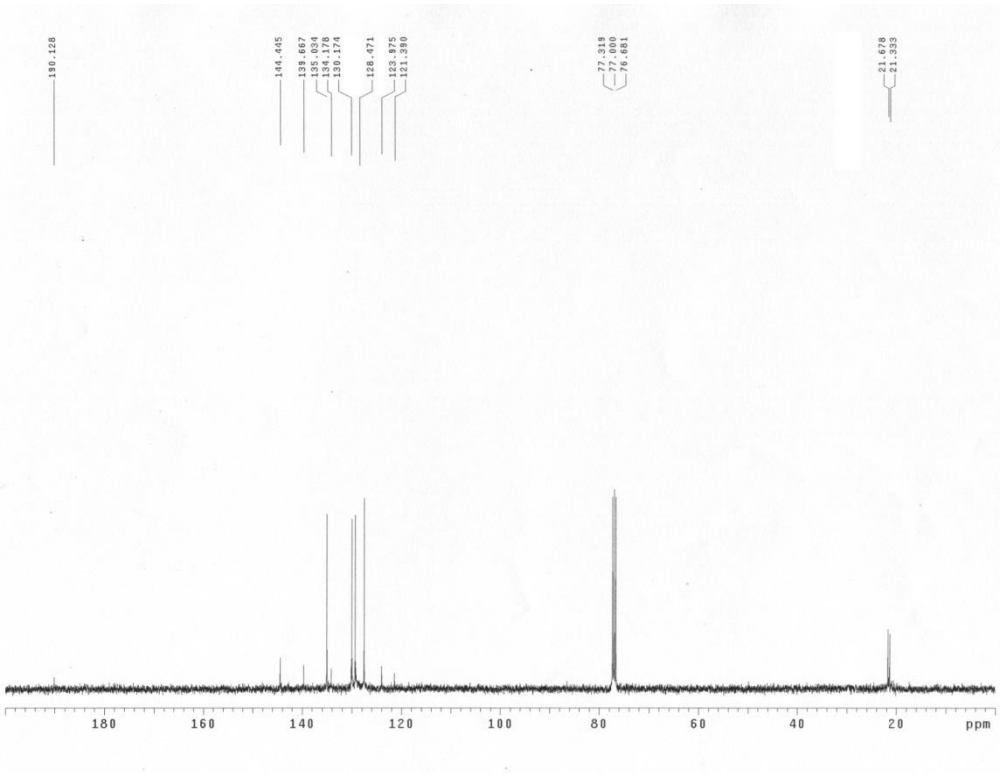




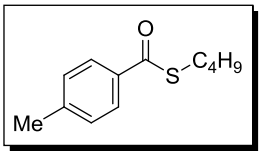
S-*p*-Tolyl 4-methylbenzothioate (6h)

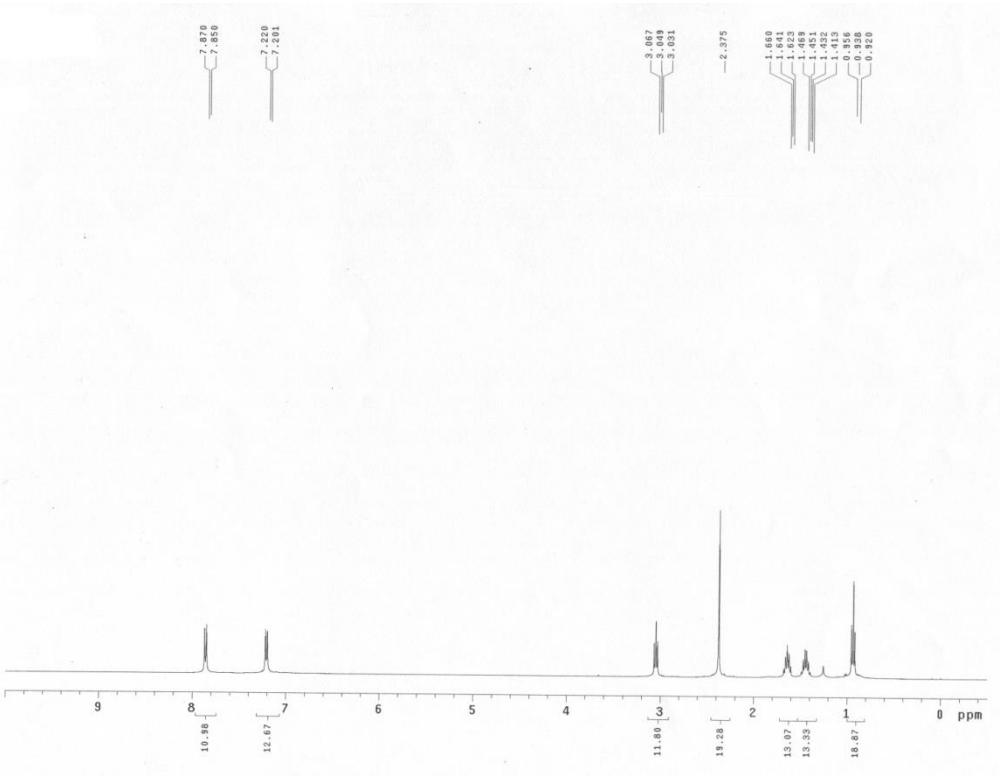


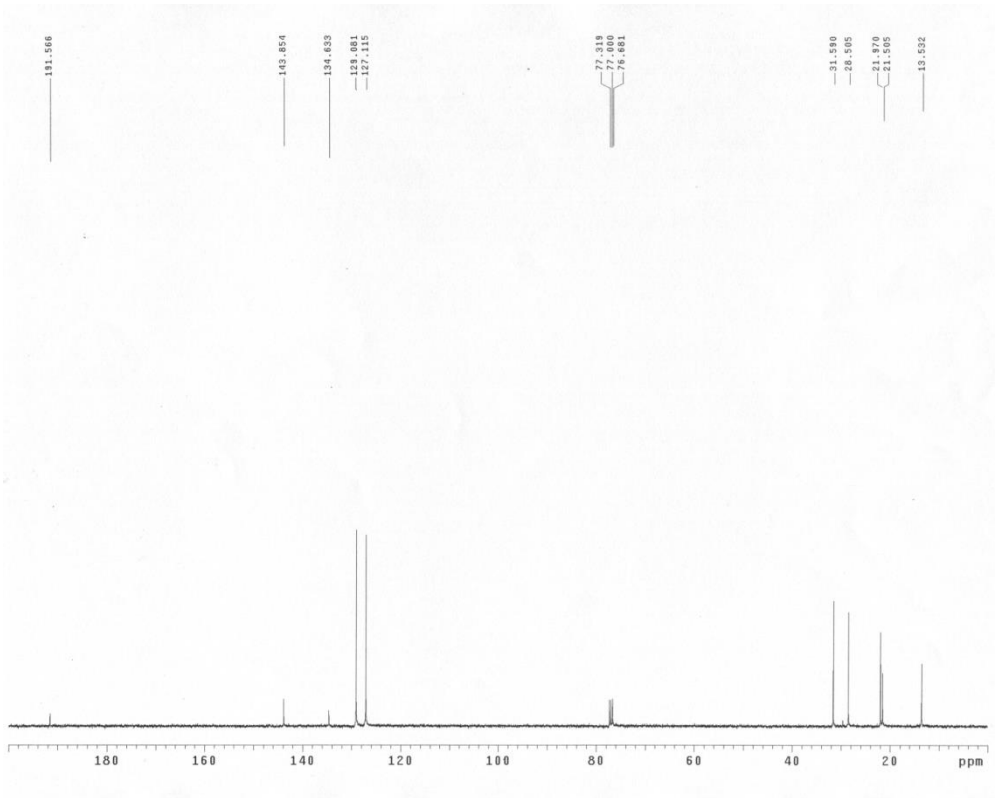




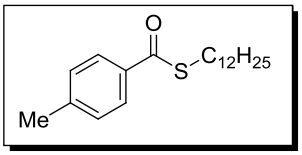
S-*n*-Butyl 4-methylbenzothioate (6i)

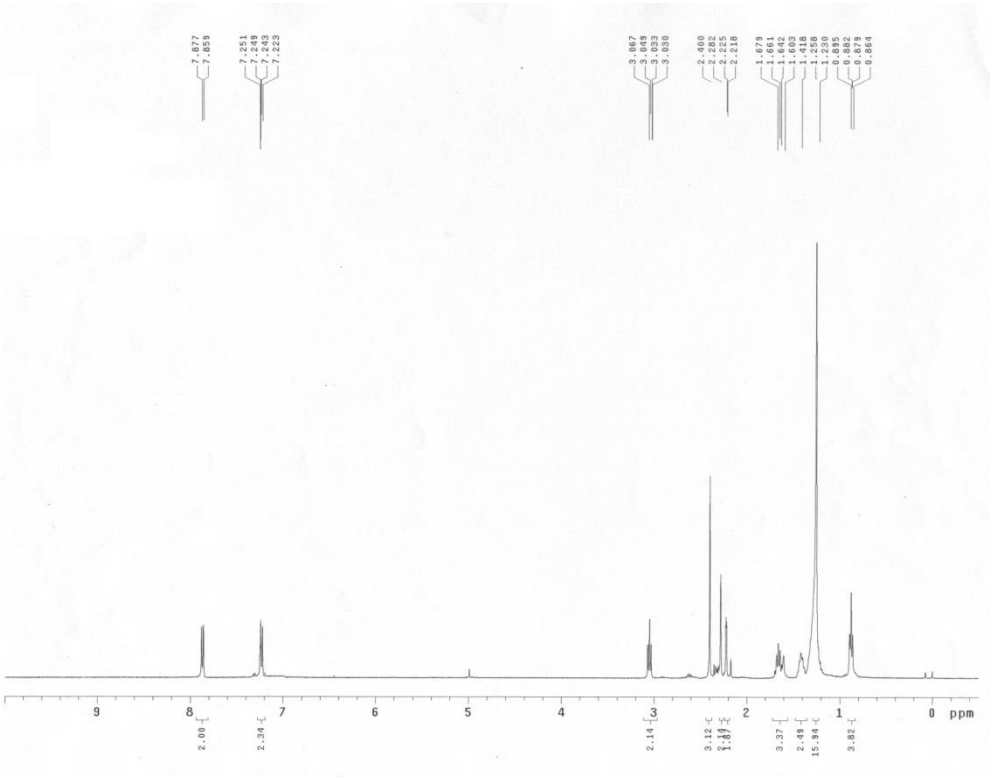


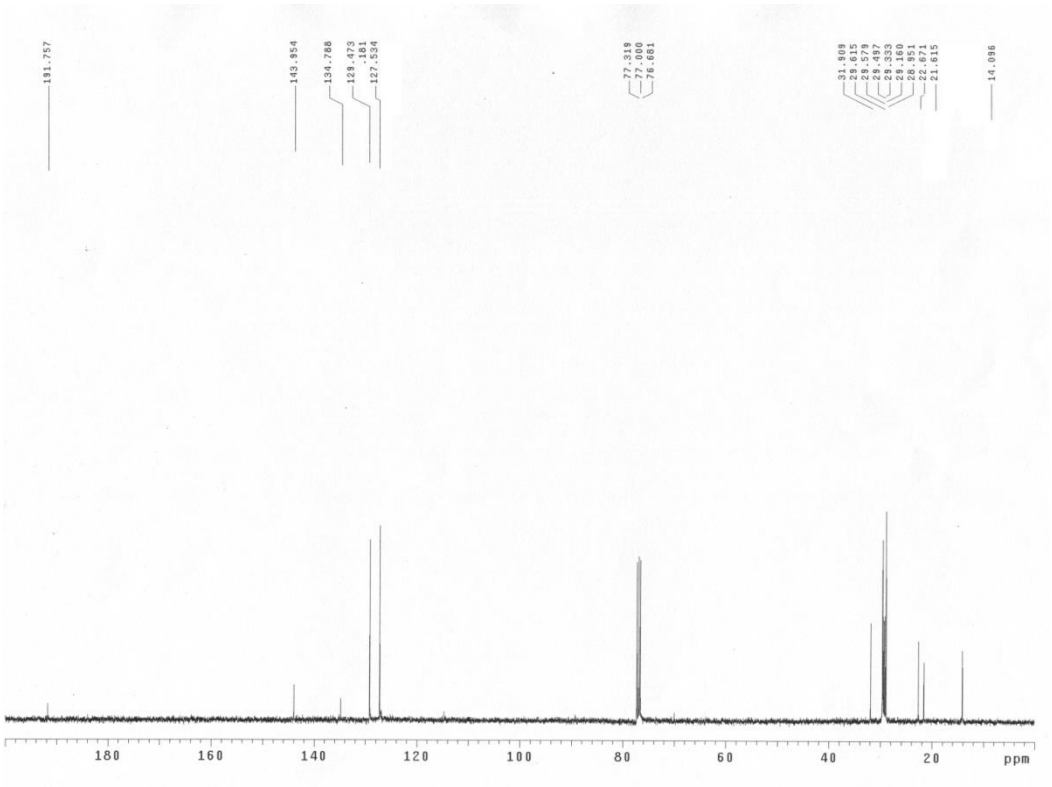




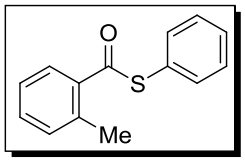
S-*n*-Dodecyl 4-methylbenzothioate (6j)

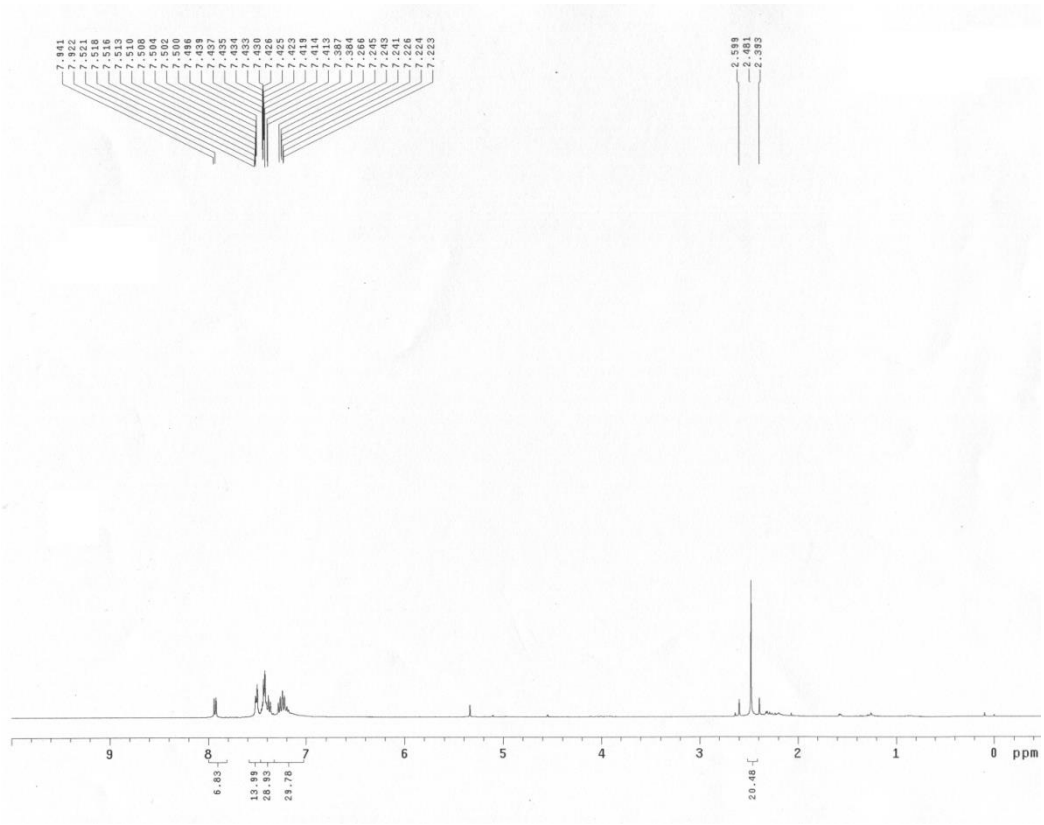


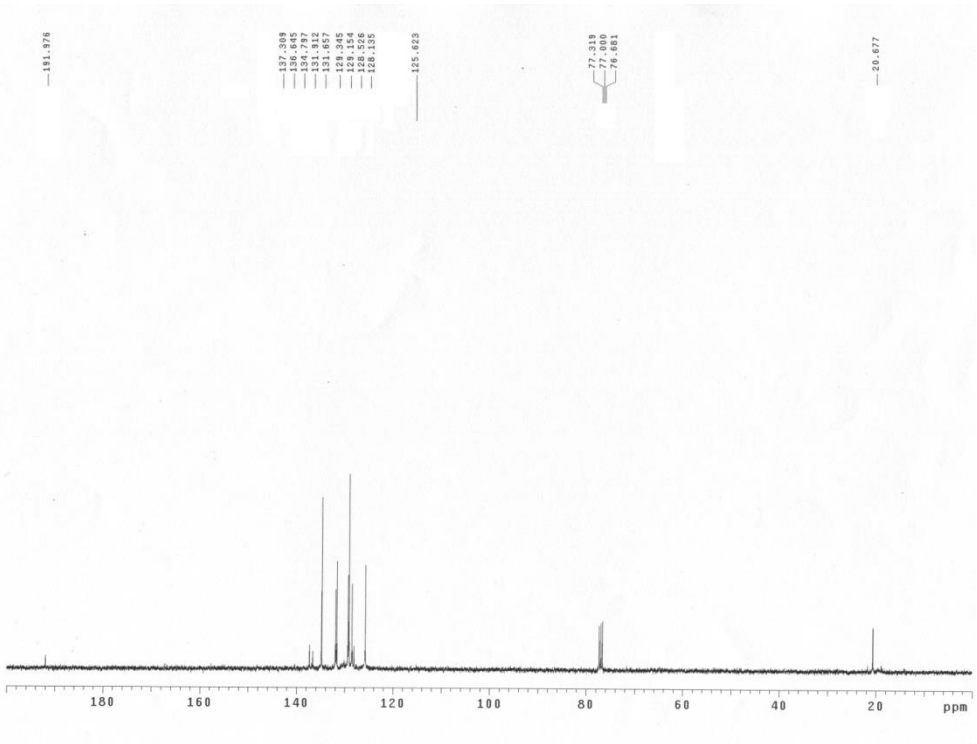




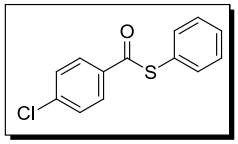
S-Phenyl 2-methylbenzothioate (6k)

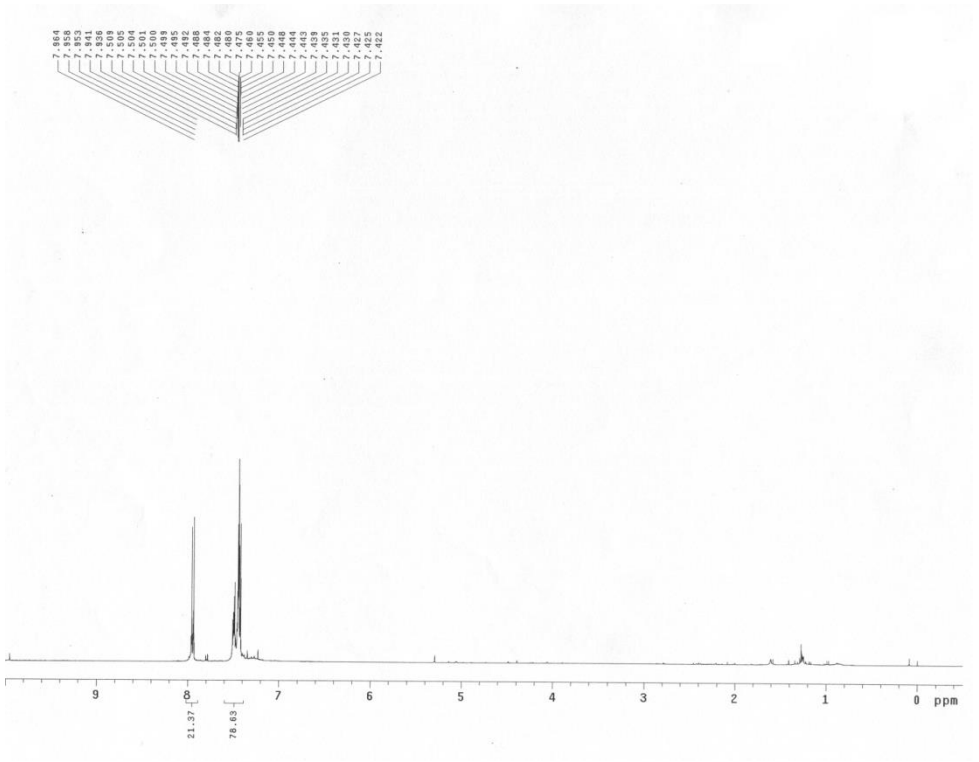


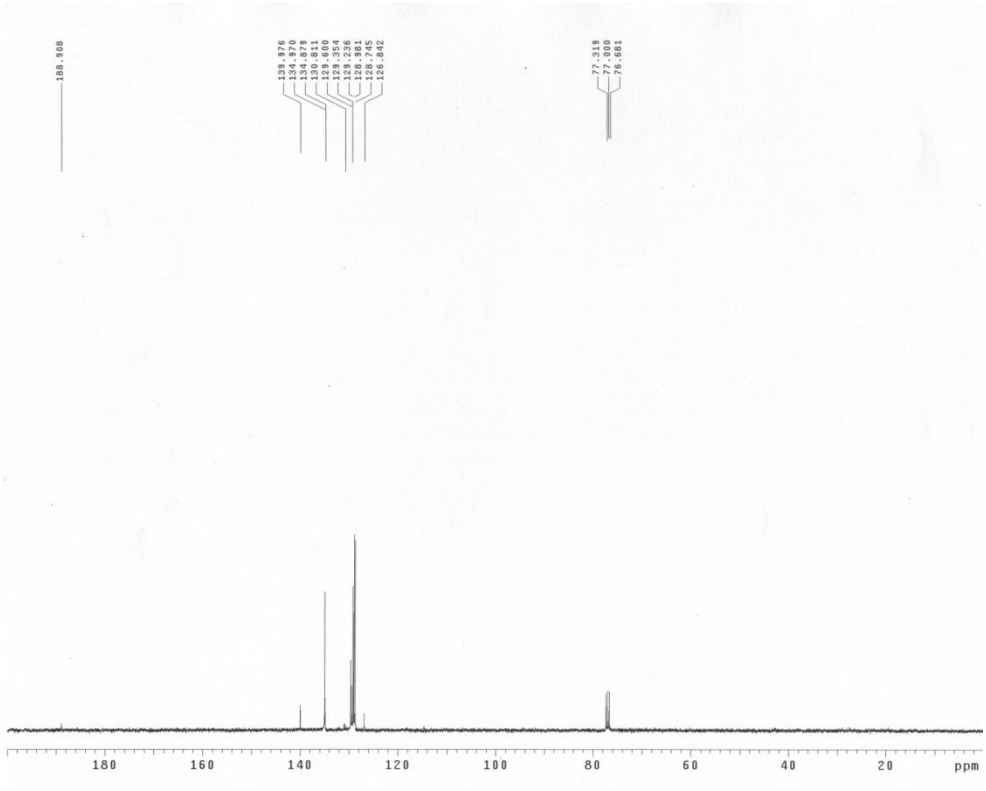




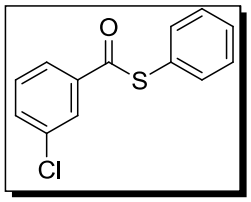
S-phenyl 4-chlorobenzothioate (6l)

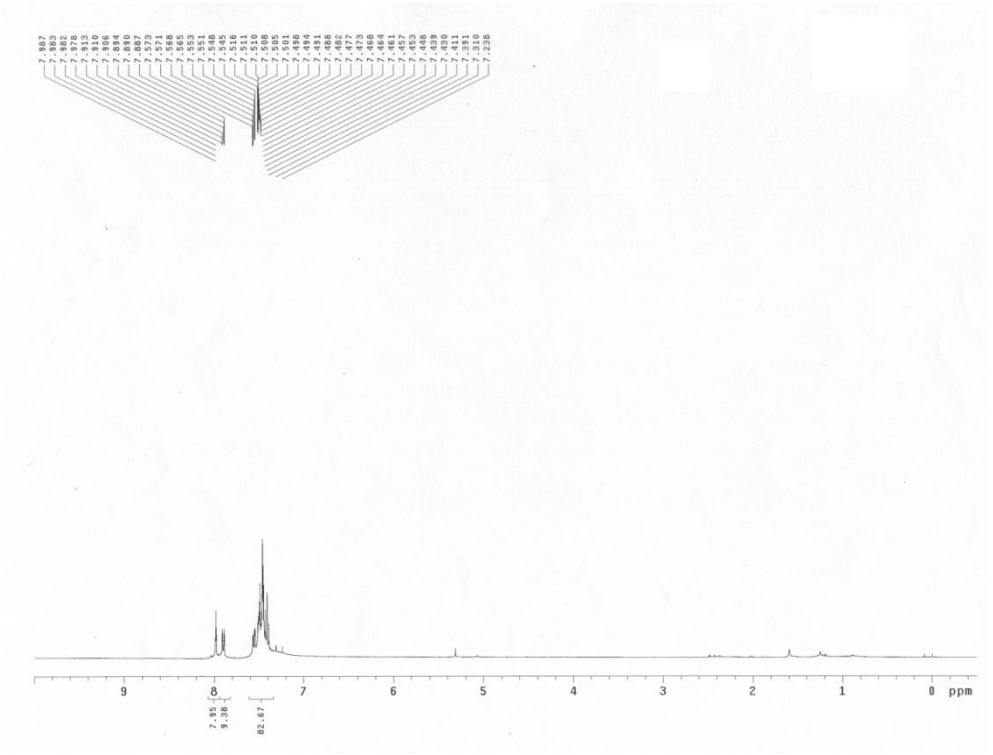


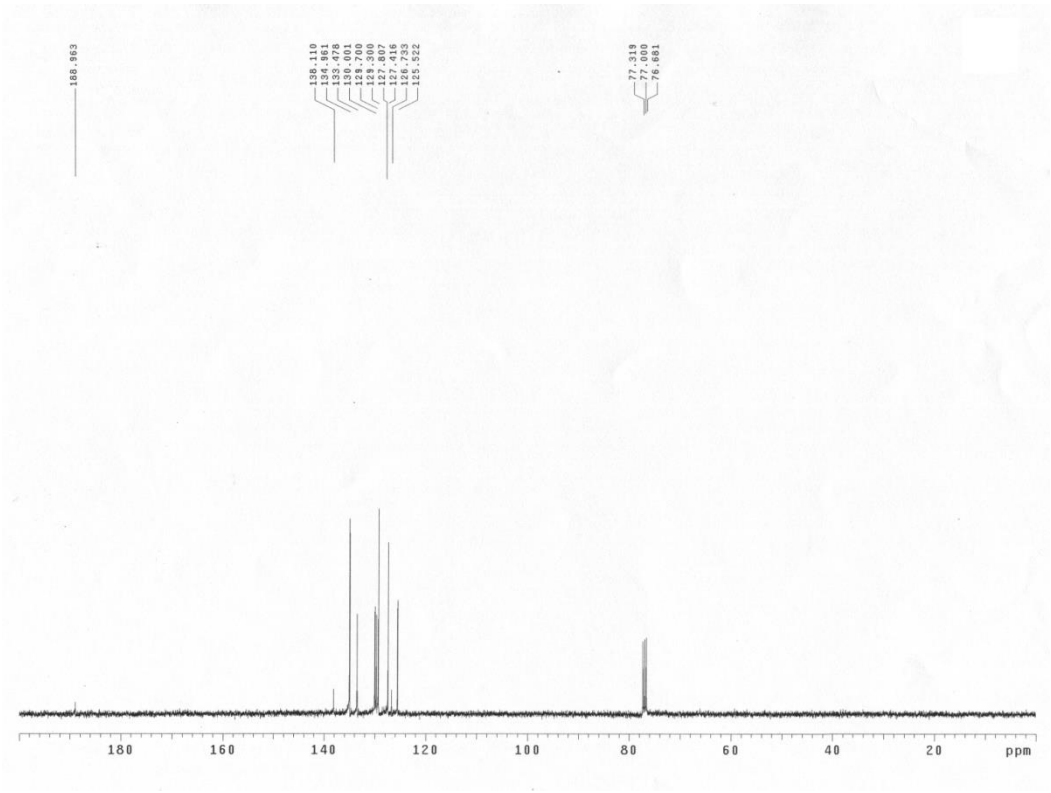




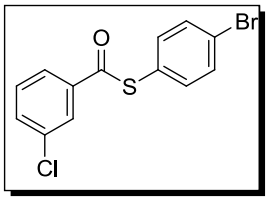
S-phenyl 3-chlorobenzothioate (6m)

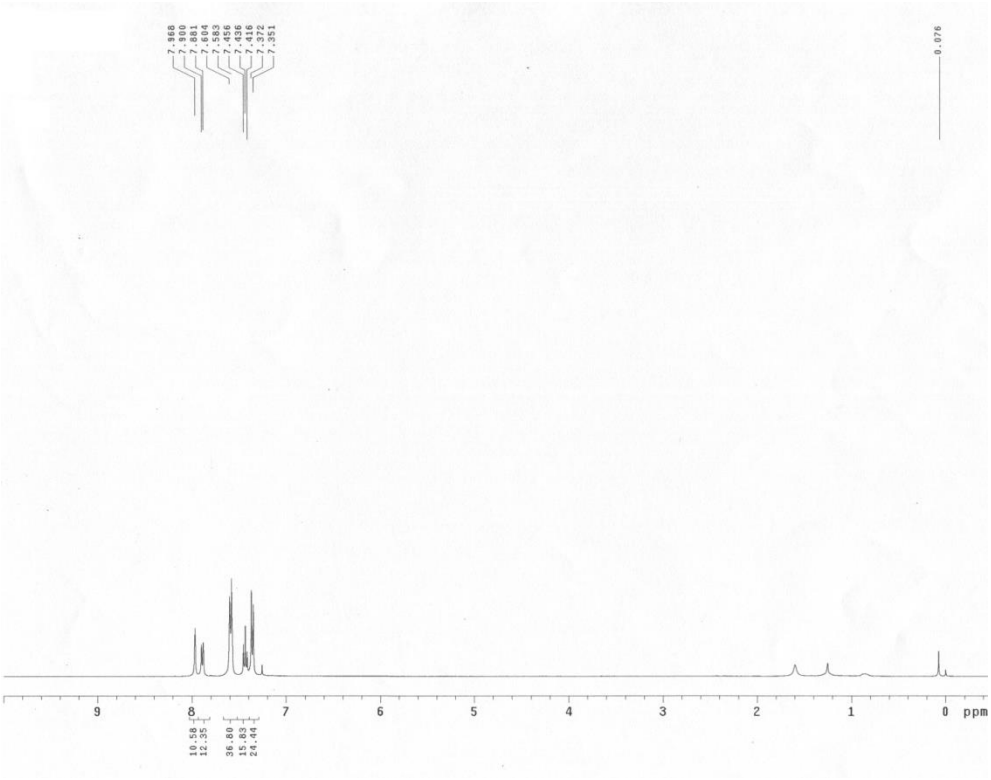


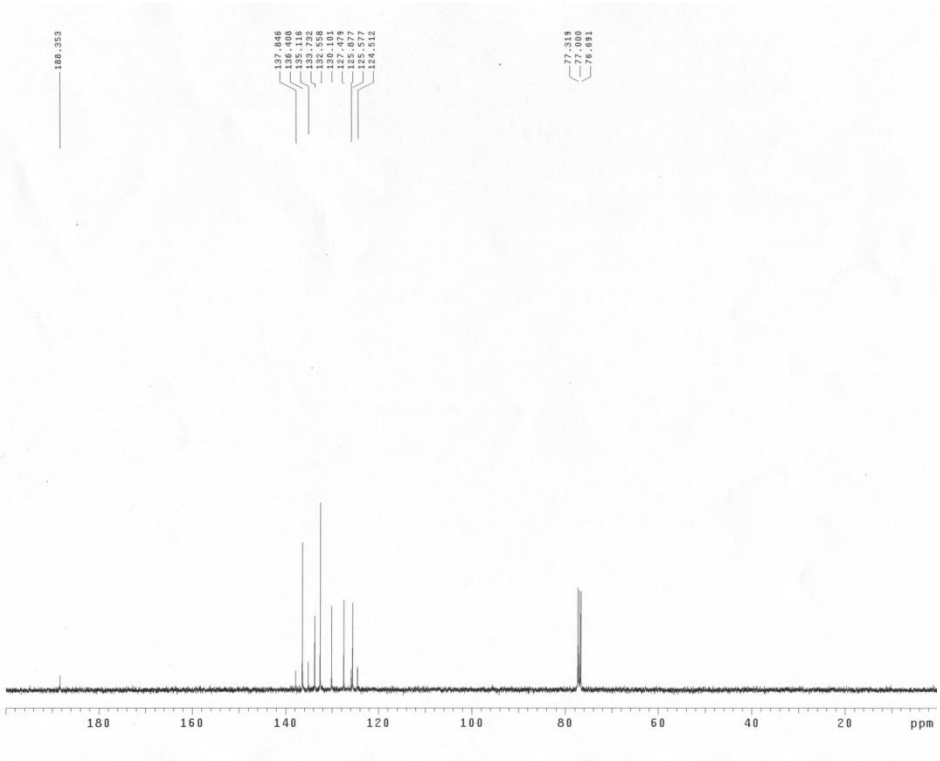




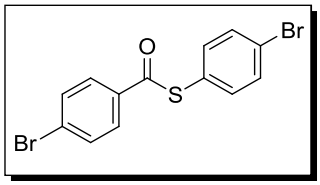
S-4-bromophenyl 3-chlorobenzothioate (6n)

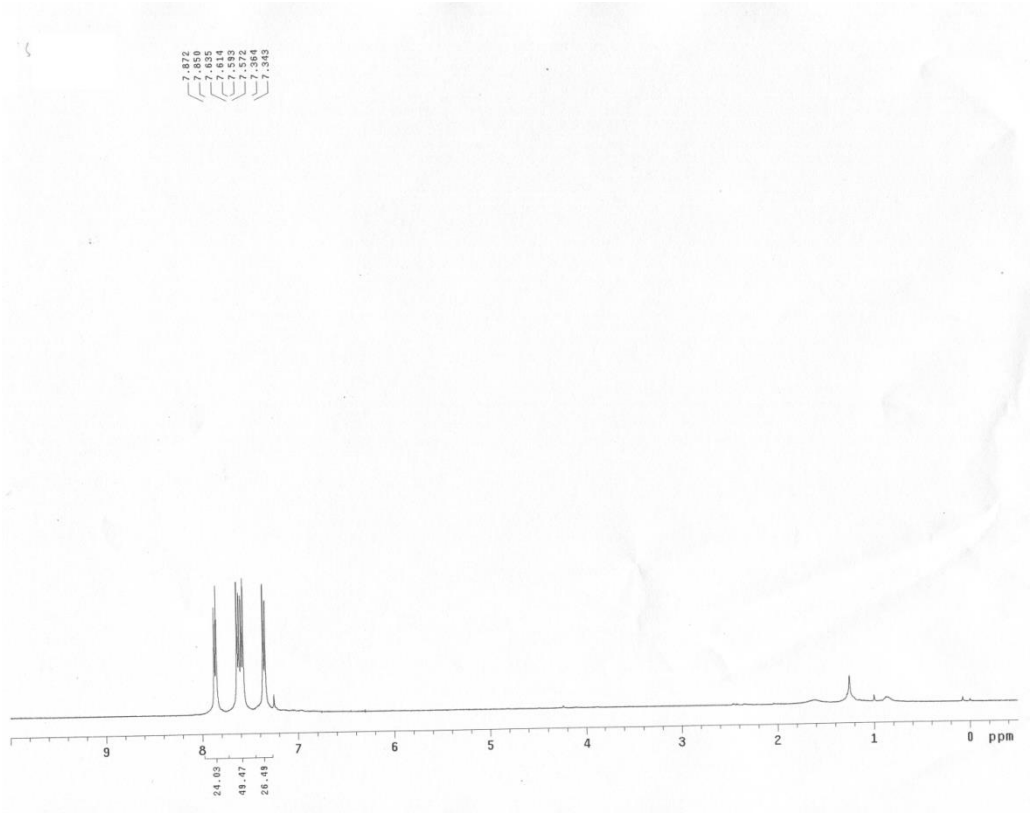


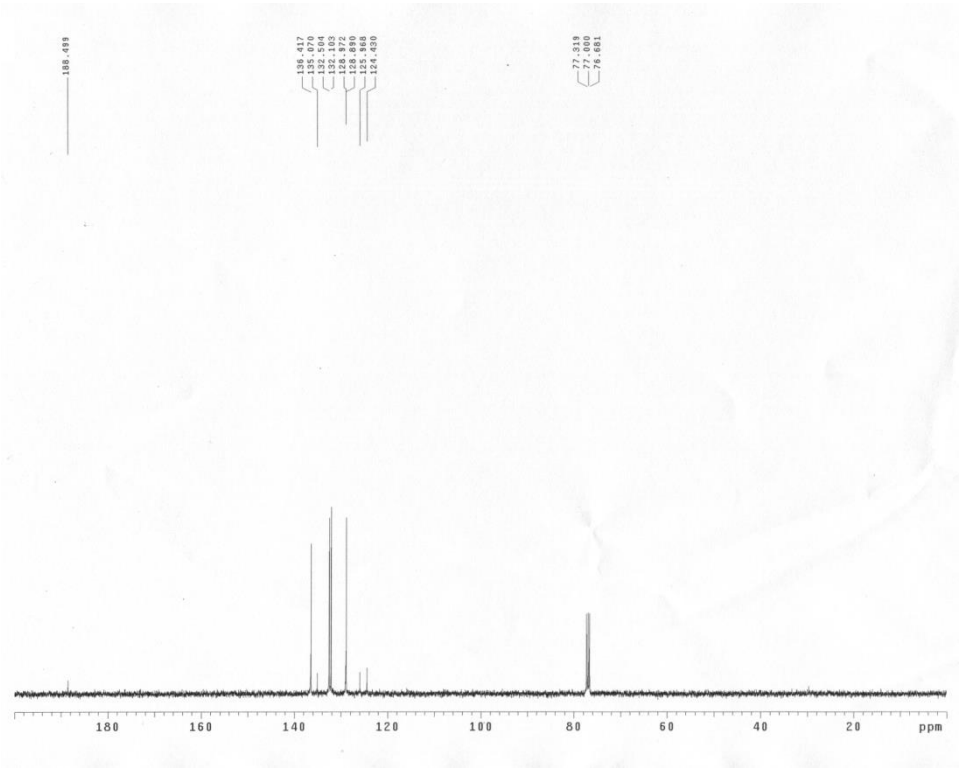




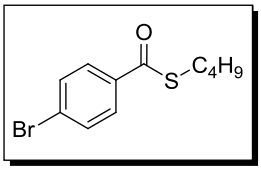
S-4-bromophenyl 4-bromobenzothioate (6o)

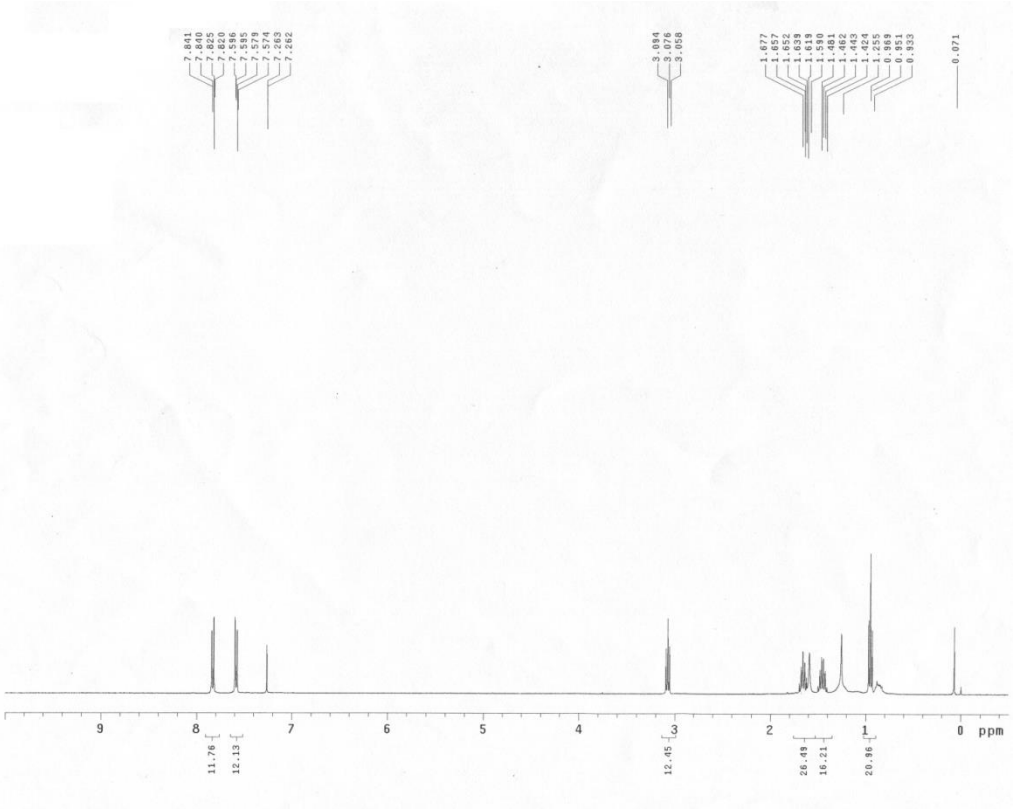


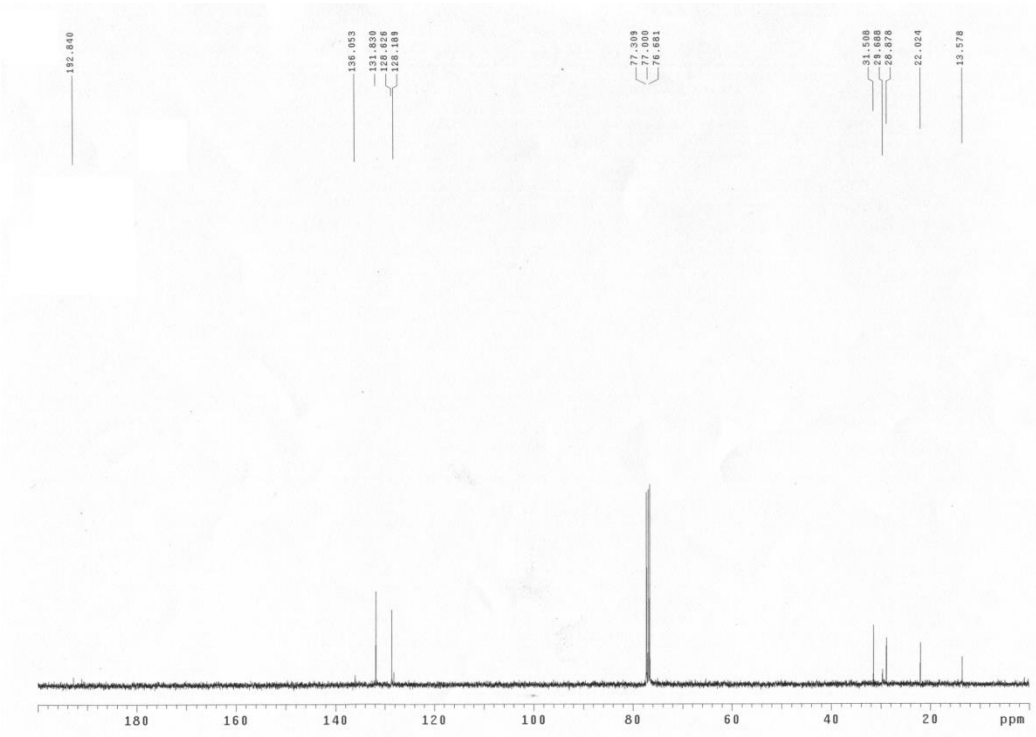




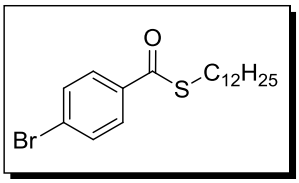
S-(*n*-Butyl) 4-bromobenzothioate (6p)

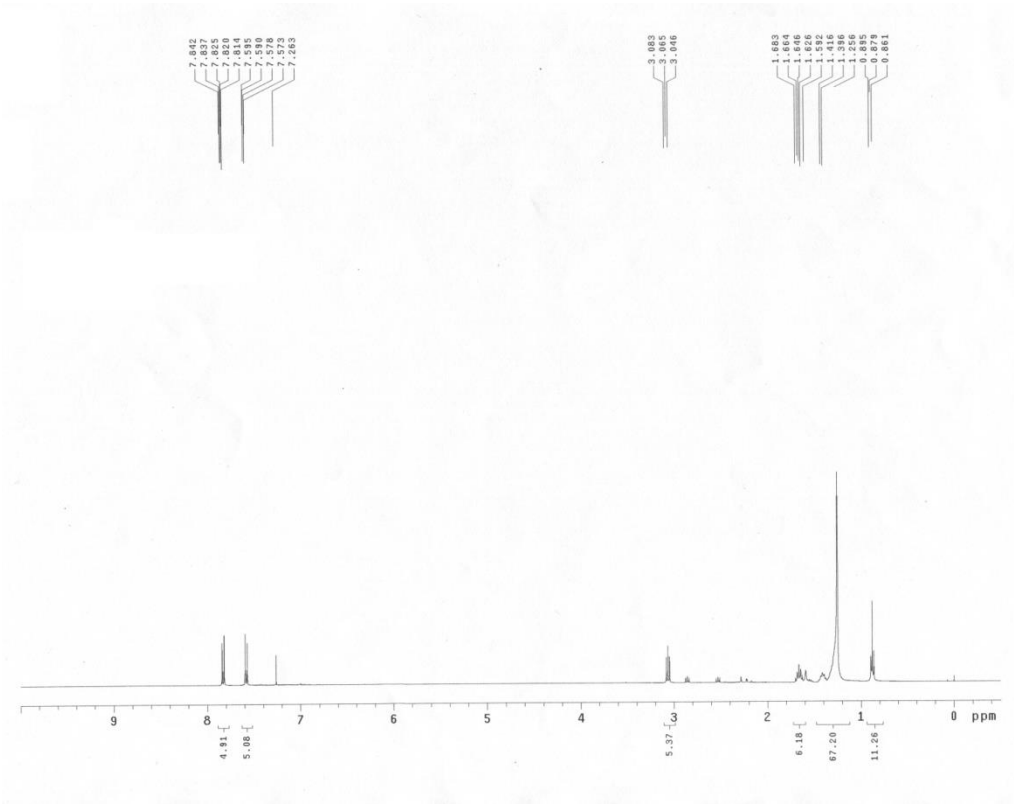


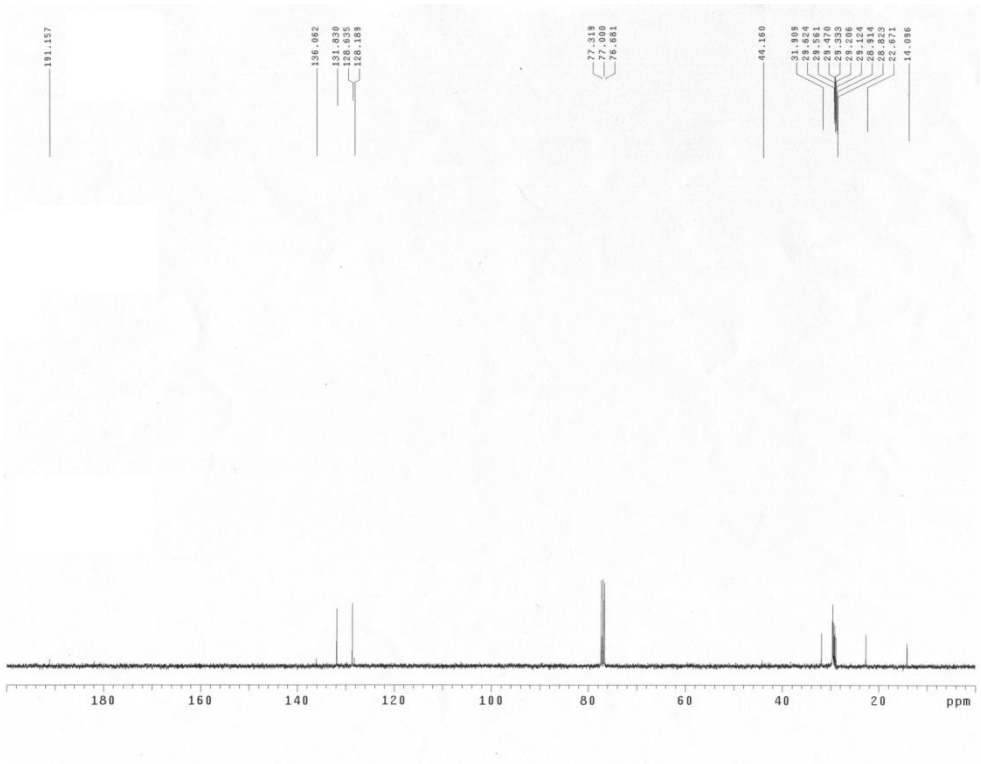




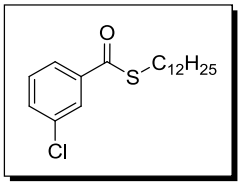
S-(*n*-Dodecyl) 4-bromobenzothioate (6q)

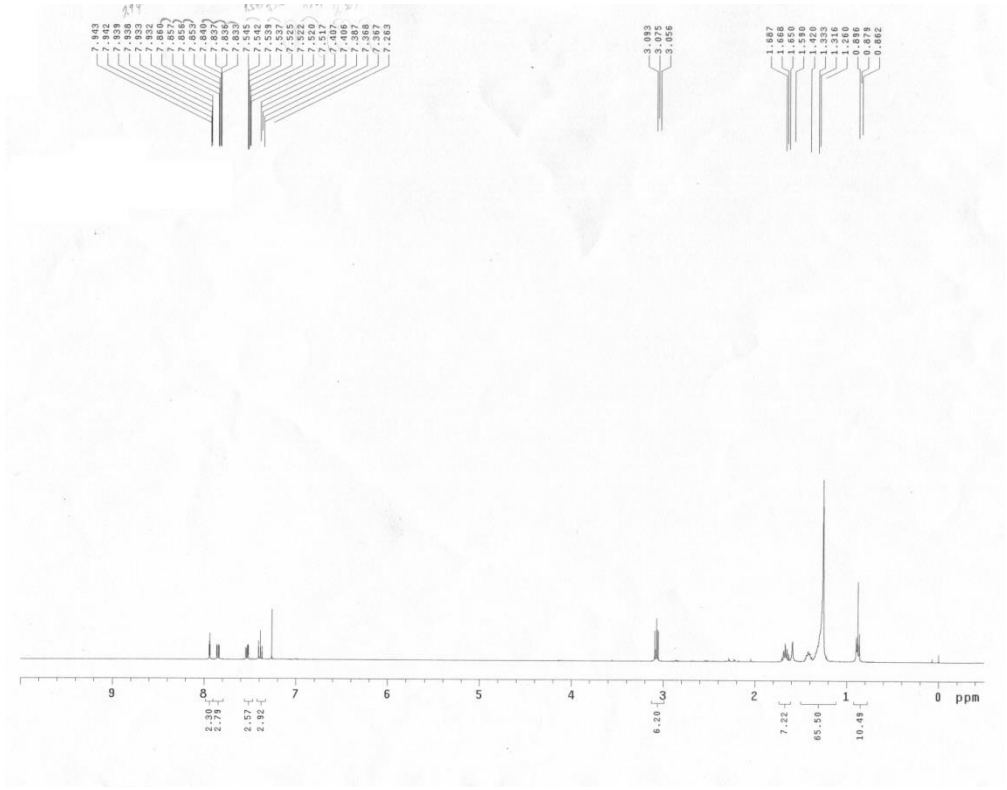


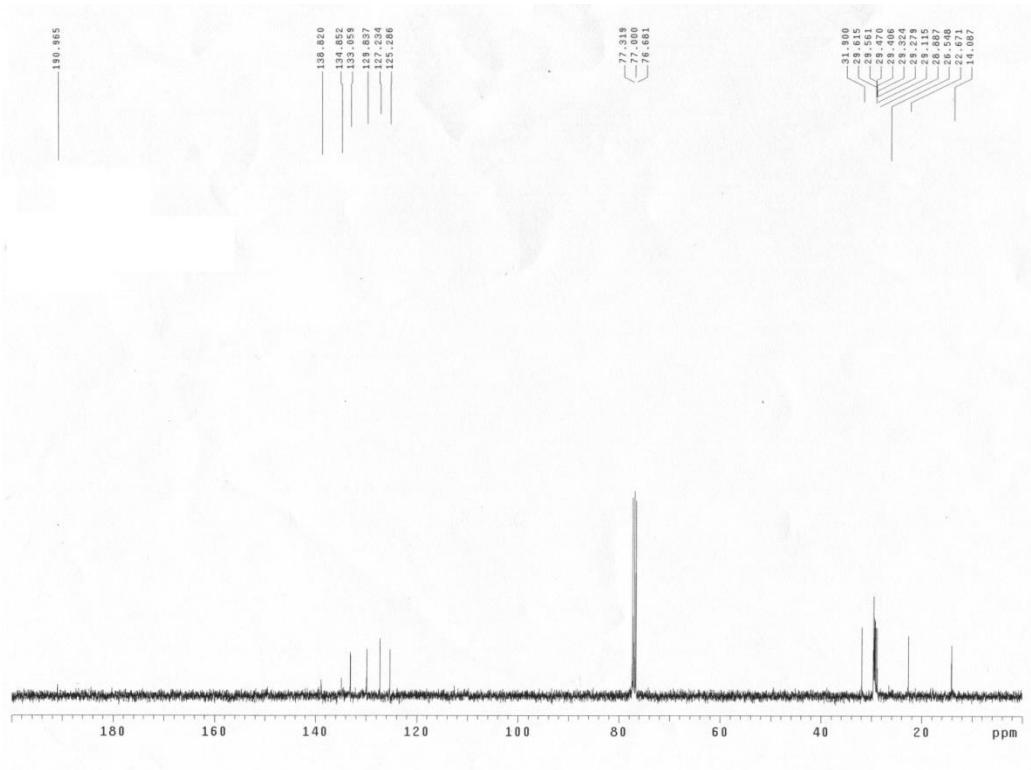




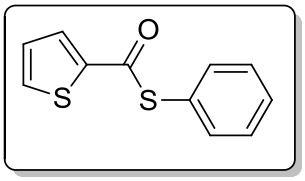
S-(*n*-Dodecyl) 3-chlorobenzothioate (6r)

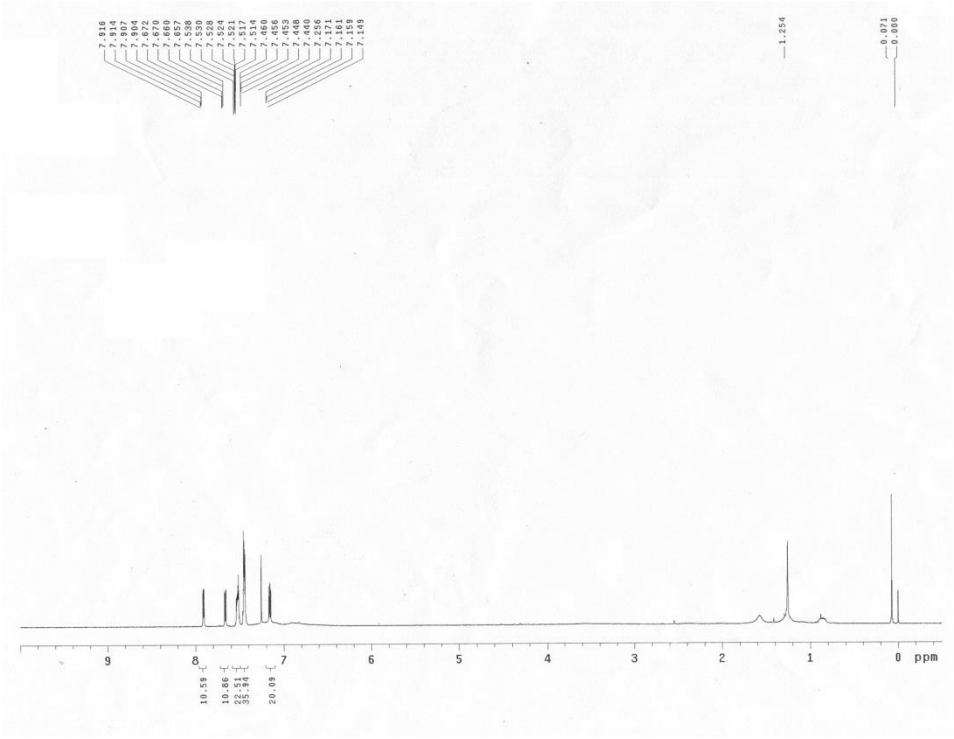


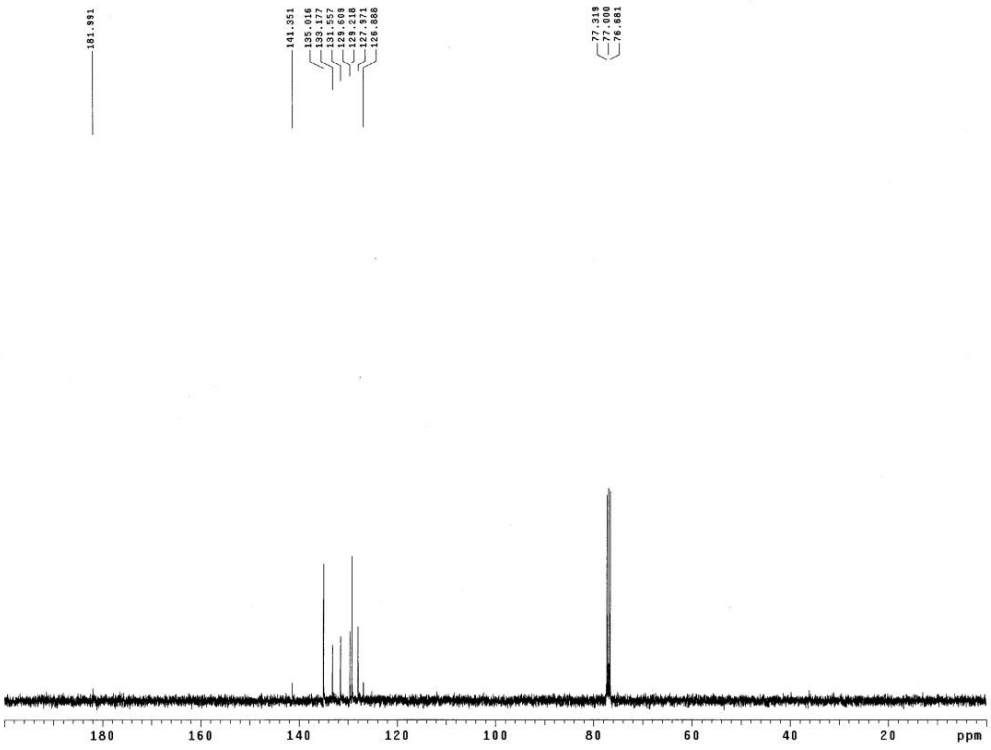




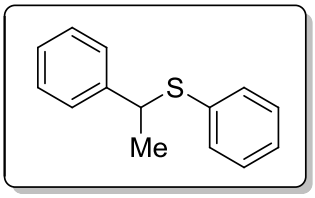
S-Phenyl thiophene-2-carbothioate (6s)

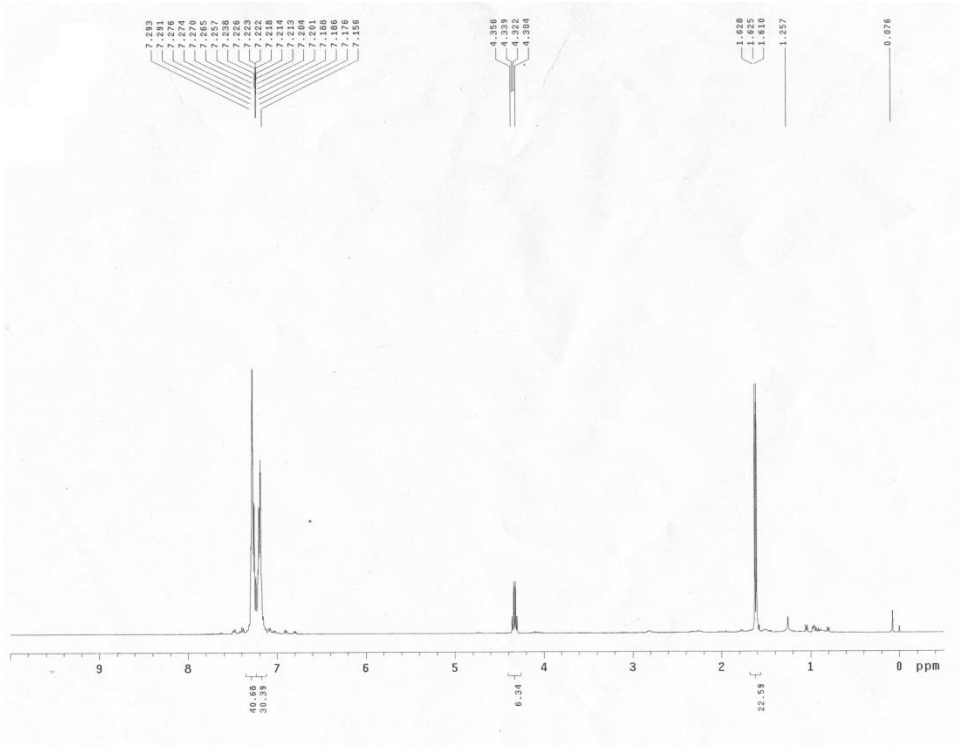


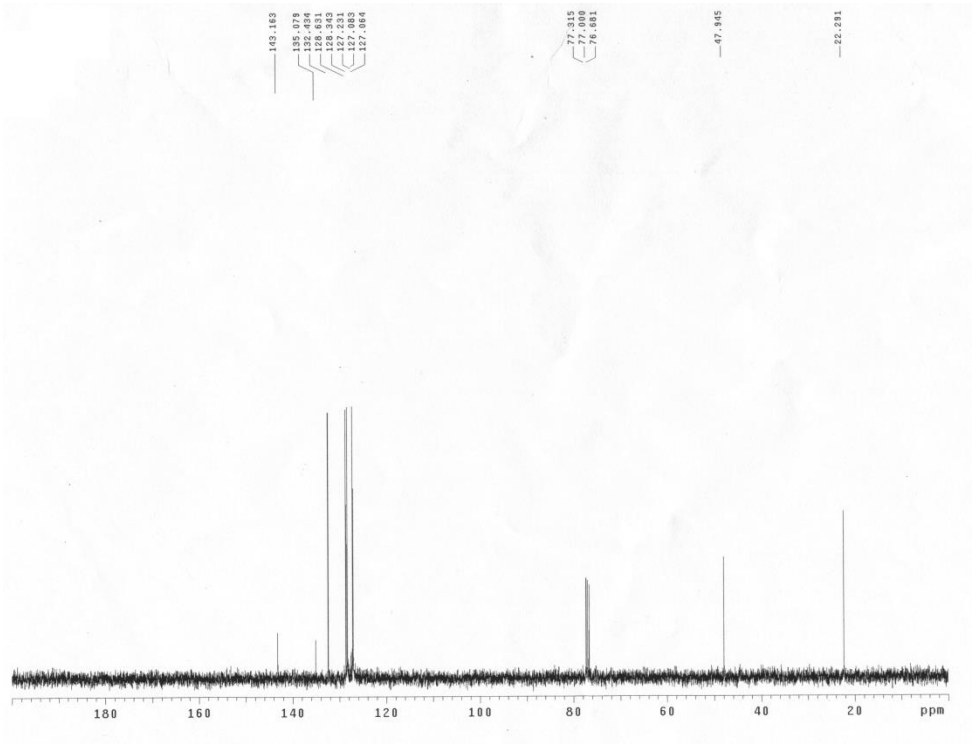




Phenyl(1-phenylethyl)sulfane (6t)







2-[{(2,2,6,6-tetramethylpiperidin-1-yl)oxy}methyl]pyridine (7)