Supporting Information

Metal Triflates-mediated Coupling of Allylgermanes with Thiols: A Facile Route to Thiogermanes

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CONTENT

1. Preparation of (2-methylallyl)germanes

1.1. Preparation of (2-methylallyl)triethylgermane

In two-necked round bottom flask (100 mL) equipped with condenser, THF (15 mL) and 2.84 g of chlorotriethylgermane (14.5 mmol) were placed. Next, 22 mL of 1M solution of 2-methylallyl magnesium chloride was added. The system was stirred by 3 hours in inert atmosphere (Ar). After that, the solvent was evaporated. The reaction mixture was extracted with hexane. Next, hexane was evaporated and the crude product was distilled under reduced pressure to obtain 3 g of (2-methylallyl)triethylgermane (Yield = 95%).

1.2. Preparation of (2-methylallyl)tributylgermane

In two-necked round bottom flask (100 mL) equipped with condenser, THF (15 mL) and 2.03 g of chlorotributylgermane (7.25 mmol) were placed. Next, 11 mL of 1M solution of 2-methylallyl magnesium chloride was added. The system was stirred by 3 hours in inert atmosphere (Ar). After that, the solvent was evaporated. The reaction mixture was extracted with hexane. Next, hexane was evaporated and the crude product was distilled under reduced pressure to obtain 2 g of (2-methylallyl)tributylgermane (Yield = 92%).

1.3. Preparation of di(2-methylallyl)diethylgermane

In two-necked round bottom flask (100 mL) equipped with condenser, THF (15 mL) and 2 g of dichlorodiethylgermane (9.95 mmol) were placed. Next, 30 mL of 1M solution of 2-methylallyl magnesium chloride was added. The system was stirred by 3 hours in inert atmosphere (Ar). After that, the solvent was evaporated. The reaction mixture was extracted with hexane. Next, hexane was evaporated and the crude product was distilled under reduced pressure to obtain 2.1 g of di(2-methylallyl)diethylgermane (Yield = 87.5%).

2. Characterization data of 2-methylallylgermanes

2.1. (2-Methylallyl)triethylgermane

(2-Methylallyl)triethylgermane was obtained as a colorless liquid in 95% yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.65-0.84 (m, 6H), 1.02 (t, *J* = 7.9 Hz, 9H), 1.54 (s, 3H), 1.61-1.75 (m, 2H), 4.60-4.81 (m, 2H). **^{13}C NMR** (101 MHz, C_6D_6): δ (ppm) = 4.3, 8.8, 22.9, 24.7, 108.0, 144.2.
MS (EI) m/z (rel.int.): 187(100%, $(M\text{-}C_2H_5)^+$), 159 (25), 131 (15), 103 (20), 75 (5).

2.2. (2-Methylallyl)tributylgermane

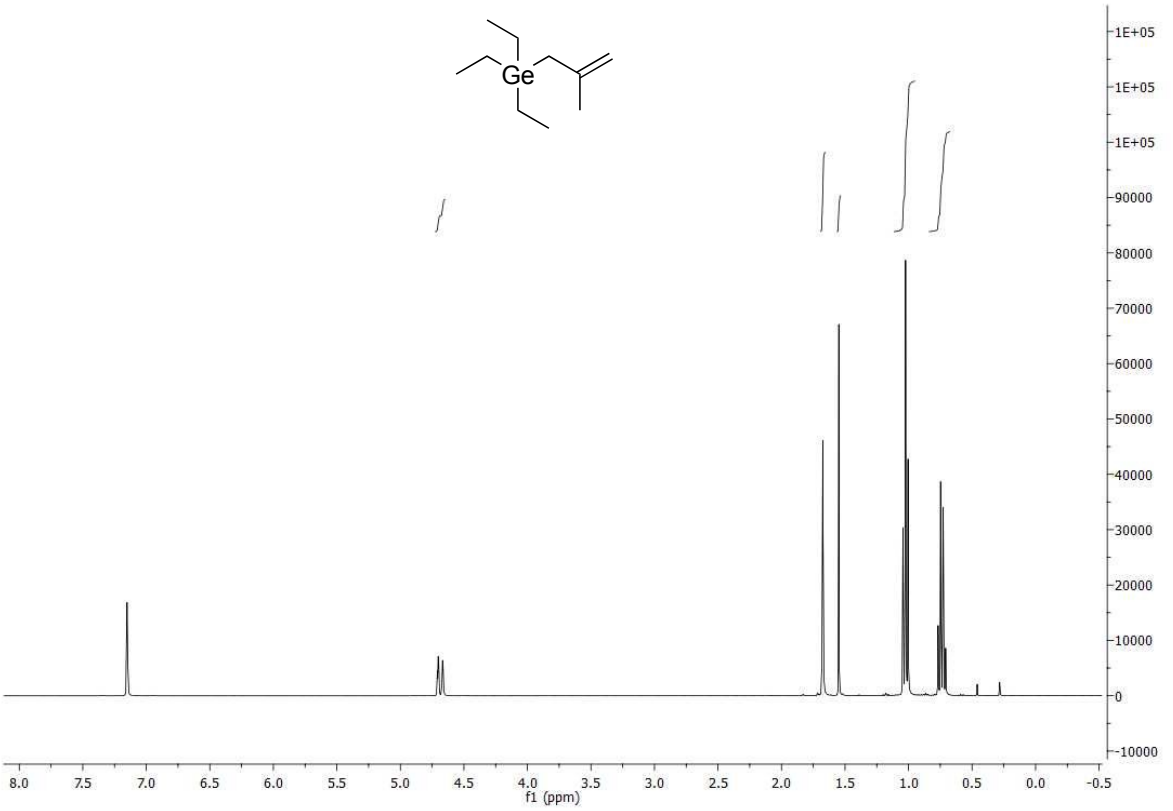
(2-Methylallyl)tributylgermane was obtained as a colorless liquid in 92% yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.78-0.87 (m, 6H), 0.93 (t, *J* = 7.1 Hz, 8H), 1.29-1.46 (m, 11H), 1.54 (s, 3H), 1.71-1.76 (m, 4H), 4.69-4.76 (m, 2H). **^{13}C NMR** (101 MHz, C_6D_6): δ (ppm) = 12.9, 13.6, 24.0, 24.8, 26.7, 27.5, 108.1, 144.3.
MS (EI) m/z (rel.int.): 243(50%, $(M\text{-}C_4H_9)^+$), 189 (100), 133 (90), 103 (20), 89 (15), 55 (25).

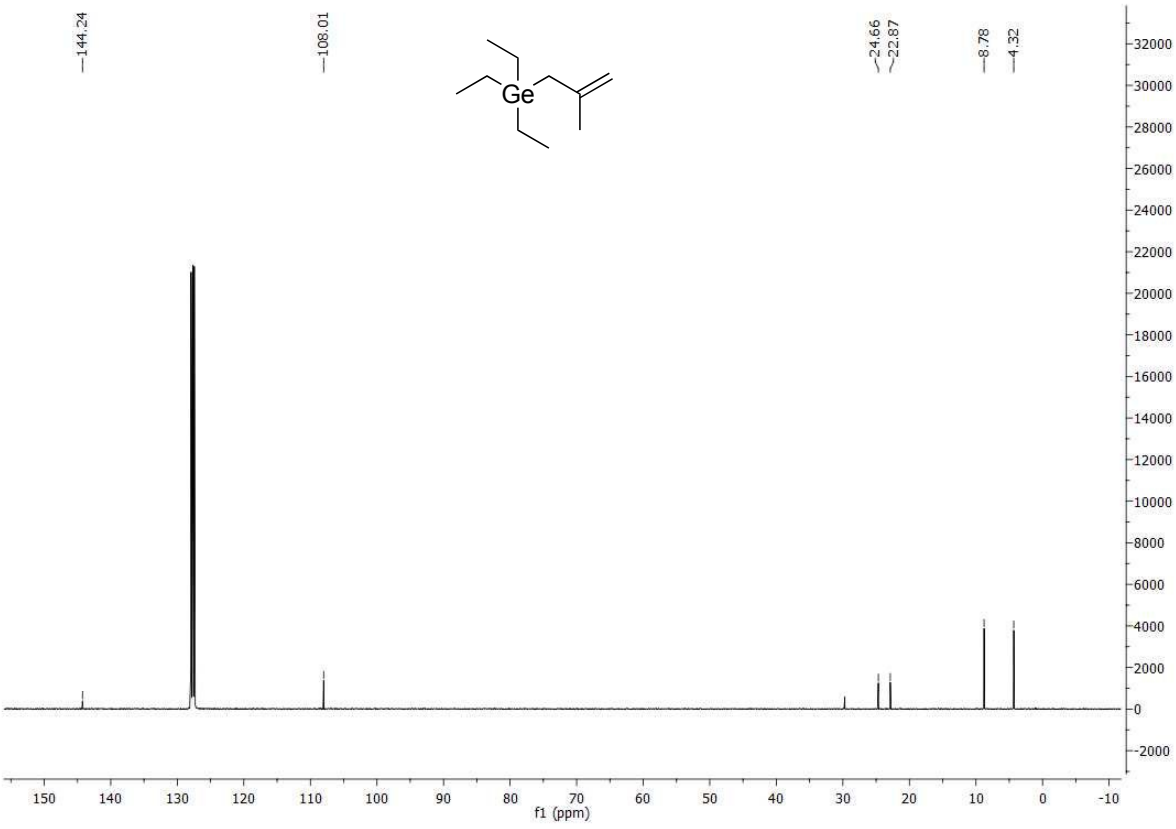
2.3. Di(2-methylallyl)diethylgermane

Di(2-methylallyl)diethylgermane was obtained as a colorless liquid in 87.5% yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.71-0.83 (m, 4H), 0.98-1.07 (m, 6H), 1.63-1.69 (m, 6H), 1.71 (d, *J* = 0.9 Hz, 4H), 4.57-4.82 (m, 4H). **^{13}C NMR** (101 MHz, C_6D_6): δ (ppm) = 5.3, 8.7, 23.5, 24.7, 108.6, 143.9.
MS (EI) m/z (rel.int.): 213 (15%, $(M\text{-}C_2H_5)^+$), 187 (100), 157 (10), 129 (15), 103 (30).

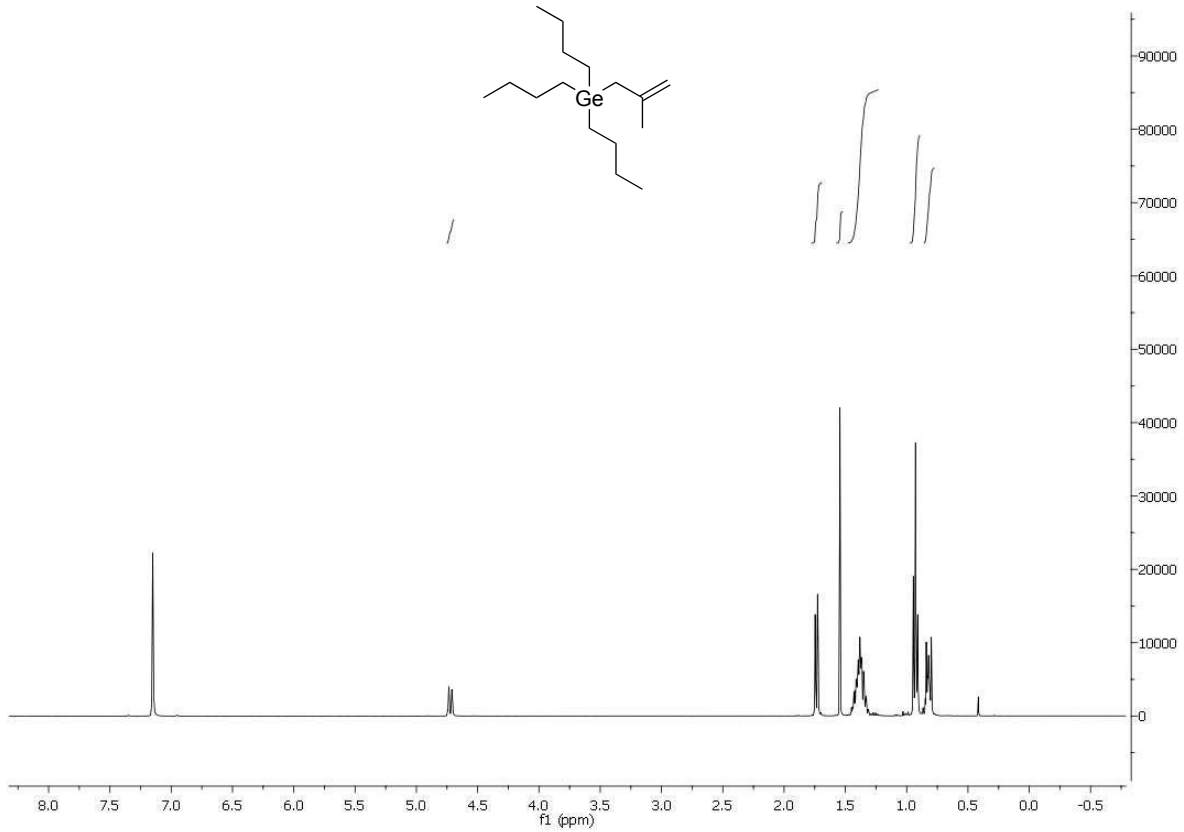
3. Copies of ^{1}H and ^{13}C NMR spectra of (2-methylallyl)germanes

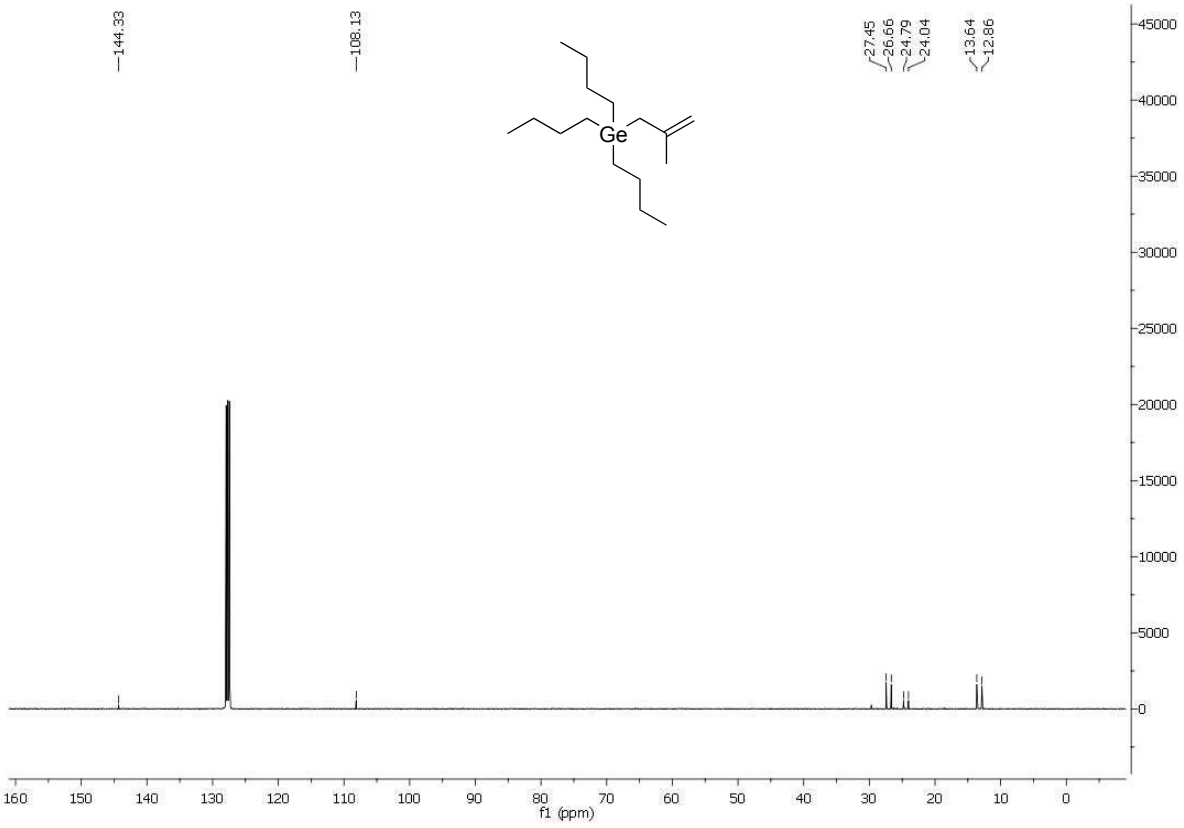
3.1. *(2-methylallyl)triethylgermane*



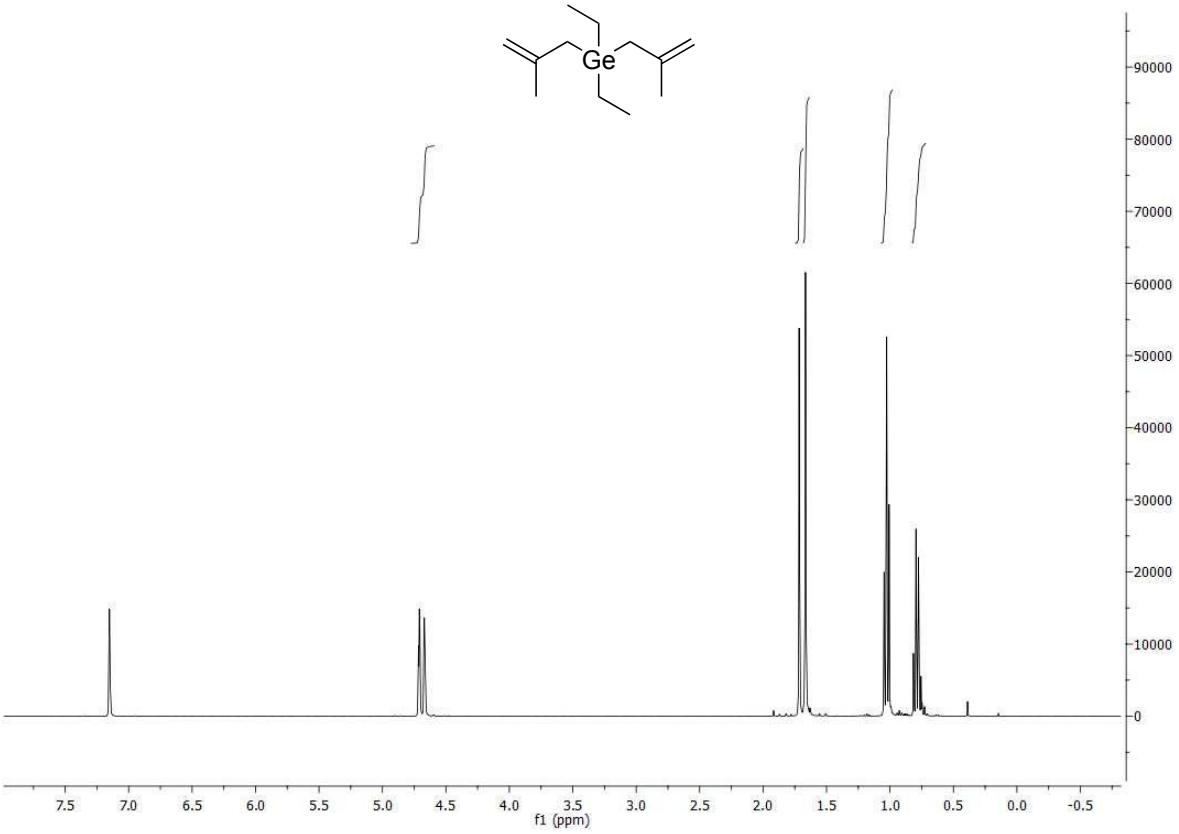


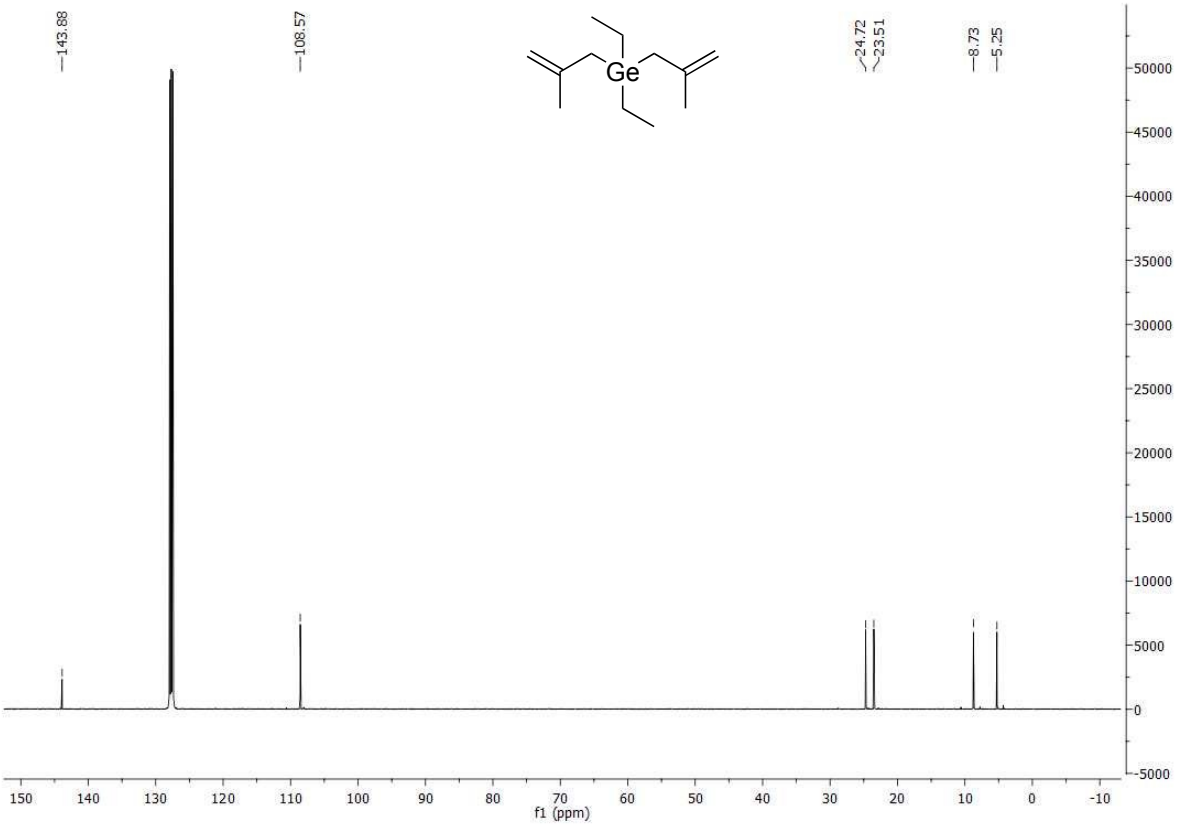
3.2. *(2-methylallyl)tributylgermane*





3.3. Di(2-methylallyl)diethylgermane





4. Characterization data of products

*4.1. Triethyl[(p-chlorophenyl)thio]germane (**1**)*

The product **1** was obtained as a colorless liquid in 91 % yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.74-0.83 (m, 6H), 0.89-1.02 (m, 9H), 6.89-6.94 (m, 2H), 7.20-7.25 (m, 2H). **^{13}C NMR** (101 MHz, C_6D_6): δ (ppm) = 7.5, 8.4, 128.6, 132.4, 132.5, 136.3.
MS (EI) m/z (rel. int.): 304 (10% M^+), 275 (100, $(M-C_2H_5)^+$), 247 (15), 217 (10), 161 (20), 133 (25), 105 (15).
HRMS calcd for $C_{13}H_{19}ClGeS[(M-C_2H_5)^+]$: 274.97165, found: 274.97147

*4.2. Triethyl(cyclohexylthio)germane (**2**)*

The product **2** was obtained as a colorless liquid in 93 % yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.89-0.97 (m, 6H), 1.05-1.12 (m, 9H), 1.13-1.27 (m, 3H), 1.35-1.44 (m, 1H), 1.46-1.59 (m, 2H), 1.63-1.76 (m, 2H), 1.95-2.06 (m, 2H), 2.69-2.81 (m, 1H). **^{13}C NMR** (101 MHz, C_6D_6): δ (ppm) = 7.7, 8.7, 25.5, 26.3, 38.3, 40.1.
MS (EI) m/z (rel. int.): 247 (100%, $(M-C_2H_5)^+$), 161 (30), 137 (20), 105 (15), 55 (30).
HRMS calcd for $C_{12}H_{26}GeS$: 276.09671, found: 276.09492

*4.3. Triethyl[(p-methoxyphenyl)thio]germane (**3**)*

The product **3** was obtained as a colorless liquid in 95 % yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.83-0.94 (m, 6H), 1.03 (t, J = 7.8 Hz, 9H), 3.22 (s, 3H), 6.60-6.65 (m, 2H), 7.42-7.49 (m, 2H). **^{13}C NMR** (101 MHz, C_6D_6): δ (ppm) = 7.4, 8.5, 54.4, 114.3, 114.6, 123.6, 132.3, 136.4, 158.9.
MS (EI) m/z (rel. int.): 300 (30% M^+), 271 (100 $(M-C_2H_5)^+$), 256 (10), 213 (15), 133 (25), 109 (40), 77 (20).
HRMS calcd for $C_{13}H_{22}GeOS$: 300.06030, found: 300.06127

*4.4. 3,3,9,9-Tetraethyl-4,8-dithia-3,9-digermaundecane (**4**)*

The product **4** was obtained as a colorless liquid in 90 % yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.87-0.95 (m, 6H), 1.07 (t, J = 7.7 Hz, 9H), 1.94 (p, J = 6.9 Hz, 2H), 2.64 (t, J = 6.9 Hz, 4H). **^{13}C NMR** (101 MHz, C_6D_6): δ (ppm) 7.2, 8.6, 25.0, 37.0.
MS (EI) m/z (rel. int.): 426 (2% M^+), 397 (100, $(M-C_2H_5)^+$), 235 (55), 209 (20), 161 (45), 133 (60), 103 (40).
HRMS calcd for $C_{15}H_{36}Ge_2S_2$: 426.06909, found: 426.07191

*4.5. Triethyl(phenylthio)germane (**5**)*

The product **5** was obtained as a colorless liquid in 92 % yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.81-0.90 (m, 6H), 0.95-1.03 (m, 9H), 6.90-7.02 (m, 3H), 7.49-7.56 (m, 2H). **^{13}C NMR** (101 MHz, C_6D_6): δ (ppm) = 7.5, 8.4, 126.2, 128.5, 133.9, 135.1.
MS (EI) m/z (rel. int.): 267 (10% M^+), 241 (100 $(M-C_2H_5)^+$), 213 (100), 183 (12), 159 (17), 133 (15), 103 (10), 77 (25).
HRMS calcd for $C_{12}H_{20}GeS$: 270.04974, found: 270.05082

*4.6. Triethyl[(3-methylbutyl)thio]germane (**6**)*

The product **6** was obtained as a colorless liquid in 91 % yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.83 (d, *J* = 6.6 Hz, 6H), 0.87-0.96 (m, 6H), 1.03-1.14 (m, 9H), 1.47-1.57 (m, 2H), 1.65-1.79 (m, 1H), 2.46-2.54 (m, 2H).
^{13}C NMR (101 MHz, C_6D_6): δ (ppm) = 7.2, 8.6, 22.0, 24.3, 27.0, 42.8.
MS (EI) m/z (rel. int.): 235 (100%, $(M\text{-}C_2H_5)^+$), 149 (40), 133 (25), 103 (20), 71 (15).
HRMS calcd for $C_{11}H_{26}GeS$: 264.09671, found: 264.09721

*4.7. Triethyl[(p-fluorophenyl)thio]germane (**7**)*

The product **7** was obtained as a colorless liquid in 93 % yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.76-0.85 (m, 6H), 0.92-1.03 (m, 9H), 6.58-6.68 (m, 2H), 7.23-7.33 (m, 2H). **^{13}C NMR** (101 MHz, C_6D_6): δ (ppm) = 7.6, 8.4, 115.5 (d, *J* = 21.6 Hz), 128.6 (d, *J* = 3.4 Hz), 136.7 (d, *J* = 7.8 Hz), 162.0 (d, *J* = 245.6Hz).
MS (EI) m/z (rel. int.): 288 (10% M^+), 259 (100, $(M\text{-}C_2H_5)^+$), 231 (25), 201 (15), 161 (15), 133 (30), 103 (20), 75 (15).
HRMS calcd for $C_{12}H_{19}FGeS$: 288.04034, found: 288.04110

*4.8. Triethyl[(o-fluorophenyl)thio]germane (**8**)*

The product **8** was obtained as a colorless liquid in 92 % yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.84-0.93 (m, 6H), 0.95-1.04 (m, 9H), 6.54-6.68 (m, 1H), 6.69-6.82 (m, 2H), 7.39-7.50 (m, 1H). **^{13}C NMR** (101 MHz, C_6D_6): δ (ppm) = 7.8, 8.3, 115.5 (d, *J* = 24 Hz), 121.0 (d, *J* = 19.9 Hz), 123.8 (d, *J* = 3.9 Hz), 128.2 (d, *J* = 7.6 Hz), 137.8, 163.7 (d, *J* = 243.6 Hz).
MS (EI) m/z (rel. int.): 259 (100%, $(M\text{-}C_2H_5)^+$), 231 (15), 183 (10), 133 (5), 105 (12), 93 (7).
HRMS calcd for $C_{12}H_{19}FGeS$: 288.04034, found: 288.03954

*4.9. Triethyl[(3-methylphenyl)thio]germane (**9**)*

The product **9** was obtained as a colorless liquid in 95 % yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.85-0.95 (m, 6H), 0.97-1.09 (m, 9H), 2.03 (s, 3H), 6.80 (d, *J* = 7.6 Hz, 1H), 6.95 (t, *J* = 7.6 Hz, 1H), 7.39 (d, *J* = 7.7 Hz, 1H), 7.42 (s, 1H). **^{13}C NMR** (101 MHz, C_6D_6): δ (ppm) = 7.6, 8.5, 20.8, 127.0, 128.3, 132.2, 133.5, 135.8, 138.0.
MS (EI) m/z (rel. int.): 284 (5% M^+), 255 (100, $(M\text{-}C_2H_5)^+$), 227 (5), 197 (10), 133 (15), 103 (10), 91 (25), 65 (10).
HRMS calcd for $C_{13}H_{22}GeS$: 284.06540, found: 284.06594

*4.10. Triethyl(benzylthio)germane (**10**)*

The product **10** was obtained as a colorless liquid in 92 % yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.78-0.87 (m, 6H), 1.01 (t, *J* = 7.8 Hz, 9H), 3.61 (s, 2H), 7.00-7.06 (m, 1H), 7.07-7.14 (m, 2H), 7.28-7.36 (m, 2H).
^{13}C NMR (101 MHz, C_6D_6): δ (ppm) = 7.2, 8.6, 30.6, 126.6, 128.2, 128.5, 141.7.
MS (EI) m/z (rel. int.): 283 (3%, M^+), 255 (100, $(M\text{-}C_2H_5)^+$), 159 (7), 133 (3), 103 (5), 91 (30).
HRMS calcd for $C_{13}H_{22}GeS$: 284.06540, found: 284.06687

*4.11. Tributyl(benzylthio)germane (**11**)*

The product **11** was obtained as a colorless liquid in 89 % yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.84-0.91 (m, 9H), 0.91-1.00 (m, 6H), 1.24-1.36 (m, 6H), 1.38-1.49 (m, 6H), 3.68 (s, 2H), 6.99-7.05 (m, 1H), 7.09-7.14 (m, 2H), 7.33-7.38 (m, 2H). **^{13}C NMR** (101 MHz, C_6D_6): δ (ppm) = 13.6, 15.6, 26.2, 27.1, 30.9, 126.5, 128.2, 128.6, 141.8.
MS (EI) m/z (rel. int.): 311 (75%, $(M\text{-}C_4H_9)^+$), 255 (100), 199 (20), 189 (15), 91 (90), 65 (20).
HRMS calcd for $C_{19}H_{34}GeS$: 368.15930, found: 368.16106

*4.12. Tributyl(phenylthio)germane (**12**)*

The product **12** was obtained as a colorless liquid in 94 % yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.86 (t, *J* = 7.3 Hz, 9H), 0.96-1.03 (m, 6H), 1.21-1.34 (m, 6H), 1.39-1.50 (m, 6H), 6.91-7.03 (m, 3H), 7.54-7.61 (m, 2H). **^{13}C NMR** (101 MHz, C_6D_6): δ (ppm) = 13.5, 16.0, 26.1, 26.9, 126.2, 128.5, 134.1, 135.2.
MS (EI) m/z (rel. int.): 297 (100%, $(M\text{-}C_4H_9)^+$), 241 (30), 189 (60), 131 (20), 79 (95).
HRMS calcd for $C_{18}H_{32}GeS$: 354.14365, found: 354.14305

*4.13. Tributyl(cyclohexylthio)germane (**13**)*

The product **13** was obtained as a colorless liquid in 91 % yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.91 (t, *J* = 7.3 Hz, 9H), 1.01-1.09 (m, 6H), 1.12-1.27 (m, 3H), 1.30-1.37 (m, 6H), 1.38-1.52 (m, 1H), 1.47-1.56 (m, 6H), 1.57-1.62 (m, 2H), 1.65-1.75 (m, 2H), 1.99-2.09 (m, 2H), 2.77-2.88 (m, 1H). **^{13}C NMR** (101 MHz, C_6D_6): δ (ppm) = 13.6, 16.2, 25.5, 26.3, 26.5, 27.2, 38.3, 40.3.
MS (EI) m/z (rel. int.): 361 (5%, M^+) 303 (100, $(M\text{-}C_4H_9)^+$), 247 (20), 189 (25), 165 (35), 131 (20), 55 (45).
HRMS calcd for $C_{18}H_{38}GeS$: 360.19061, found: 360.19160

*4.14. Tributyl[(p-methoxyphenyl)thio]germane (**14**)*

The product **14** was obtained as a colorless liquid in 88 % yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.88-0.91 (m, 9H), 0.93-1.04 (m, 6H), 1.25-1.37 (m, 6H), 1.38-1.52 (m, 6H), 3.21 (s, 3H), 6.62-6.69 (m, 2H), 7.46-7.54 (m, 2H). **^{13}C NMR** (101 MHz, C_6D_6): δ (ppm) = 13.6, 15.9, 26.2, 27.0, 54.4, 114.3, 123.9, 136.5, 158.9.
MS (EI) m/z (rel. int.): 384 (90%, M^+) 327 (100, $(M\text{-}C_4H_9)^+$), 271 (60), 189 (50), 131 (40), 109 (90), 57 (60).
HRMS calcd for $C_{19}H_{34}GeOS$: 384.15421, found: 384.15459

*4.15. Diethyl-di[(3-methylbutyl)thio]germane (**15**)*

The product **15** was obtained as a colorless liquid in 90 % yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.79-0.89 (m, 12H), 1.02-1.13 (m, 6H), 1.14-1.20 (m, 4H), 1.53-1.61 (m, 4H), 1.62-1.79 (m, 2H), 2.65-2.80 (m, 4H). **^{13}C NMR** (101 MHz, C_6D_6): δ (ppm) = 8.7, 12.3, 25.5, 26.2, 37.8, 41.4.
MS (EI) m/z (rel. int.): 309 (100%, $(M\text{-}C_2H_5)^+$), 236 (30), 205 (10), 167 (3), 149 (3), 135 (3), 107 (5), 71 (5).
HRMS calcd for $C_{14}H_{32}GeS_2$: 338.11572, found: 338.11740

*4.16. Diethyl-bis(tert-butylthio)germane (**16**)*

The product **16** was obtained as a colorless liquid in 88 % yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 1.11-1.16 (m, 4H), 1.17-1.22 (m, 6H), 1.47 (s, 18H).
^{13}C NMR (101 MHz, C_6D_6): δ (ppm) = 8.7, 14.6, 35.3, 45.5.
MS (EI) m/z (rel. int.): 295 (2%, $(M\text{-}CH_3)^+$), 219 (5), 197 (15), 169 (100), 135 (7), 107 (5), 57 (20).
HRMS calcd for $C_{12}H_{28}GeS_2$: 310.08441, found: 310.08495

*4.17. Diethyl-bis(n-butylthio)germane (**17**)*

The product **17** was obtained as a colorless liquid in 93 % yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.91 (t, J = 7.4 Hz, 6H), 1.09-1.19 (m, 4H), 1.18-1.27 (m, 6H), 1.38-1.53 (m, 4H) 1.61-1.75 (m, 4H), 2.62-2.84 (m, 4H).
^{13}C NMR (101 MHz, C_6D_6): δ (ppm) = 8.7, 11.6, 13.5, 21.9, 27.1, 35.3.
MS (EI) m/z (rel. int.): 281 (100%, $(M\text{-}C_2H_5)^+$), 221 (30), 167 (2), 135 (5), 105 (5), 57 (5).
HRMS calcd for $C_{12}H_{28}GeS_2$: 310.08441, found: 310.08299

*4.18. Diethyl-bis(cyclohexylthio)germane (**18**)*

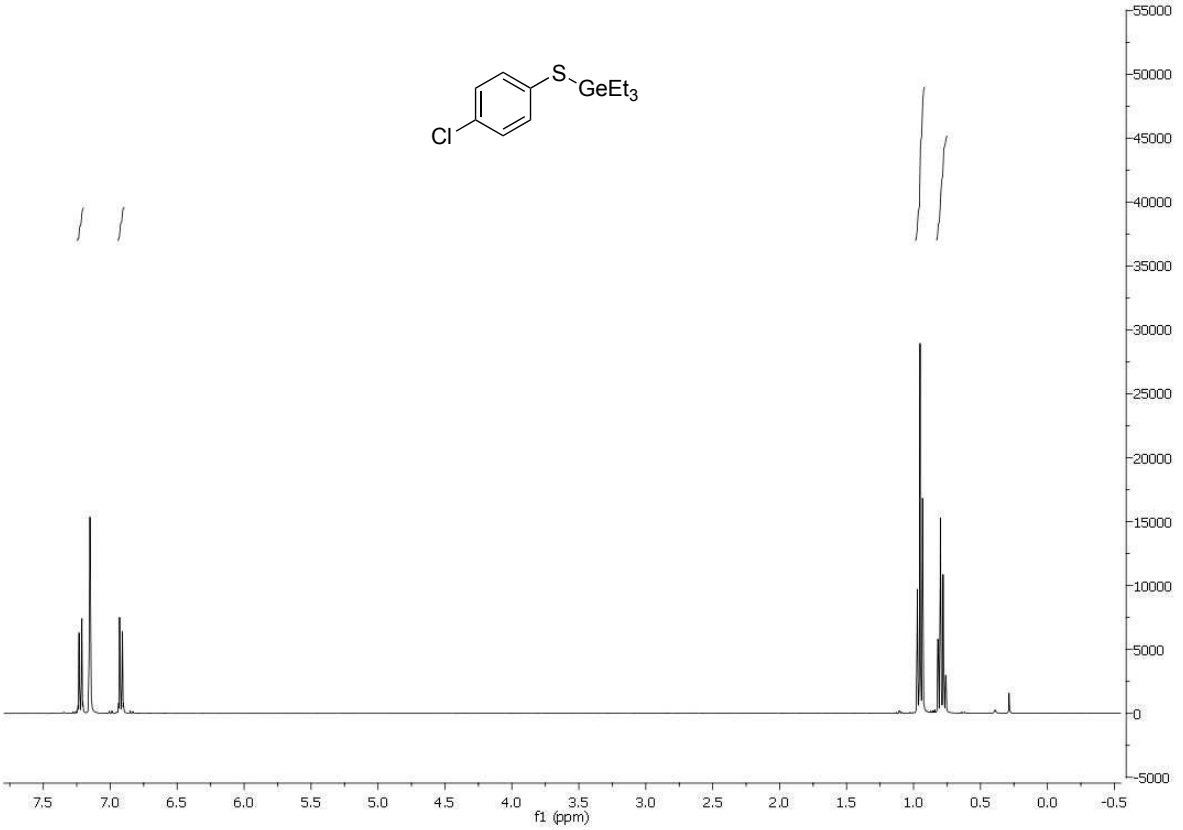
The product **18** was obtained as a colorless liquid in 89 % yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 1.07-1.15 (m, 6H), 1.16-1.19 (m, 4H), 1.20-1.31 (m, 6H), 1.33-1.44 (m, 2H), 1.50-1.62 (m, 4H), 1.63-1.73 (m, 4H), 2.02-2.17 (m, 4H), 3.02-3.18 (m, 2H).
^{13}C NMR (101 MHz, C_6D_6): δ (ppm) = 8.7, 12.3, 25.5, 26.2, 37.8, 41.4.
MS (EI) m/z (rel. int.): 333 (100%, $(M\text{-}C_2H_5)^+$), 251 (40), 167 (15), 135 (5), 107 (5), 83 (5), 55 (35).
HRMS calcd for $C_{16}H_{32}GeS_2$: 362.11572, found: 362.11434

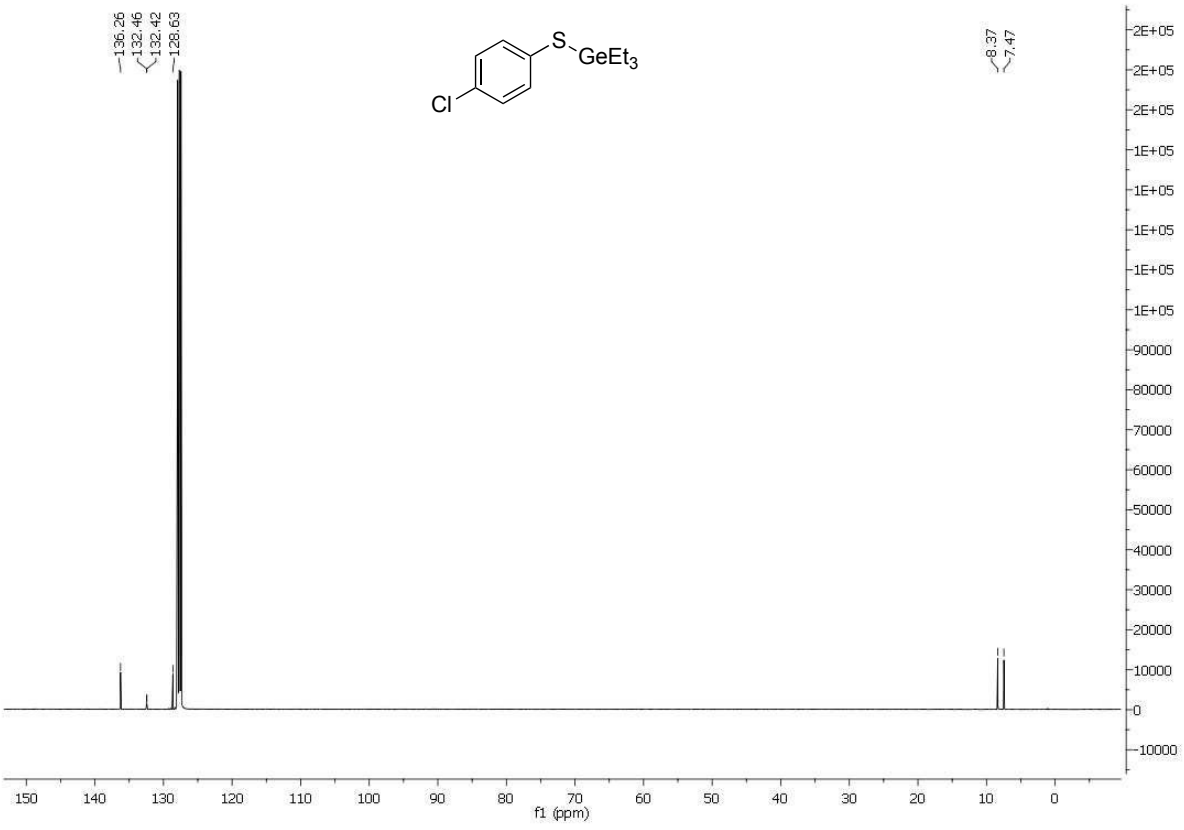
*4.19. Diethyl-bis[(p-fluorophenyl)thio]germane (**19**)*

The product **19** was obtained as a colorless liquid in 85 % yield. **^{1}H NMR** (400 MHz, C_6D_6): δ (ppm) = 0.77-0.99 (m, 10H), 6.47-6.58 (m, 1H), 6.59-6.66 (m, 3H), 7.05-7.12 (m, 1H), 7.30-7.36 (m, 3H). **^{13}C NMR** (101 MHz, C_6D_6): δ (ppm) = 8.2, 11.4, 115.8 (d, J = 21.8 Hz), 136.8 (d, J = 8.0 Hz), 161.3 (d, J = 12.3 Hz), 163.7 (d, J = 13.2 Hz).
MS (EI) m/z (rel. int.): 357 (10%, $(M\text{-}C_2H_5)^+$), 259 (100), 229 (15), 201 (5), 127 (10), 83 (7).
HRMS calcd for $C_{16}H_{18}F_2GeS_2$: 386.00299, found: 386.00200.

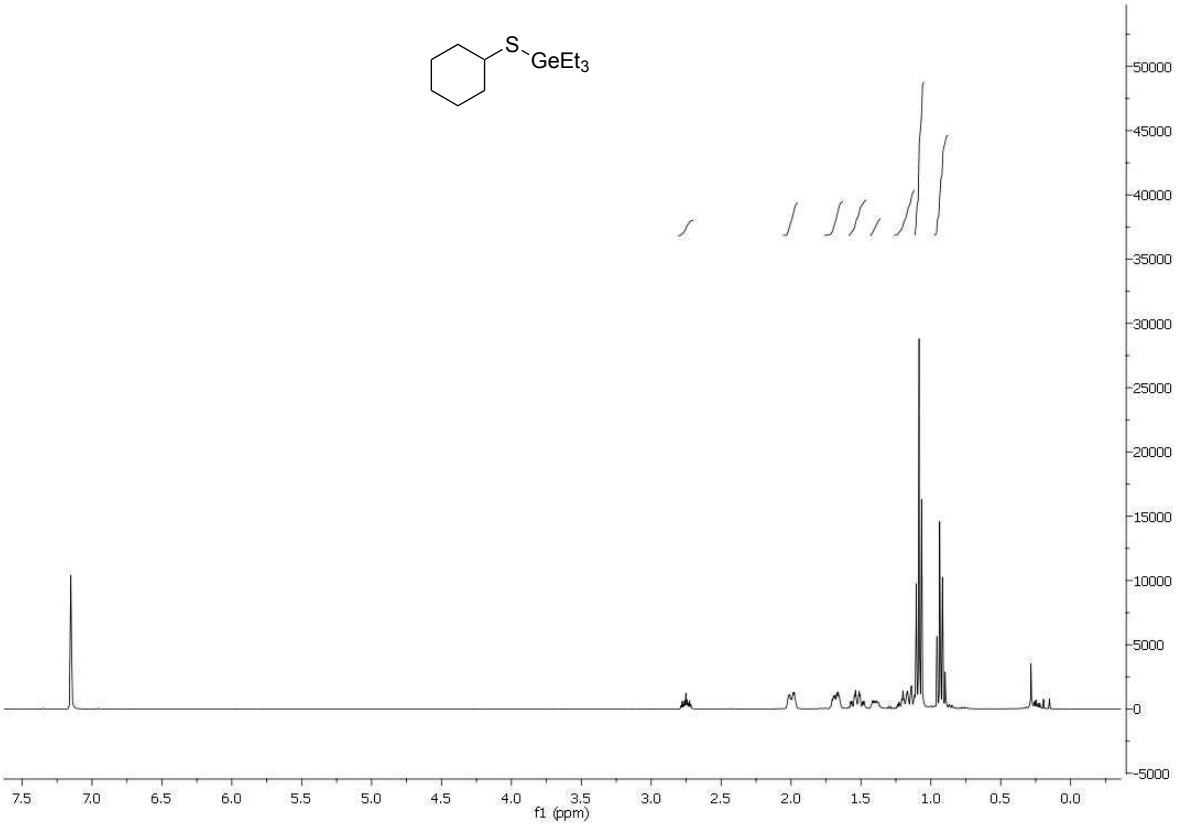
5. Copies of ^{1}H and ^{13}C NMR spectra of products

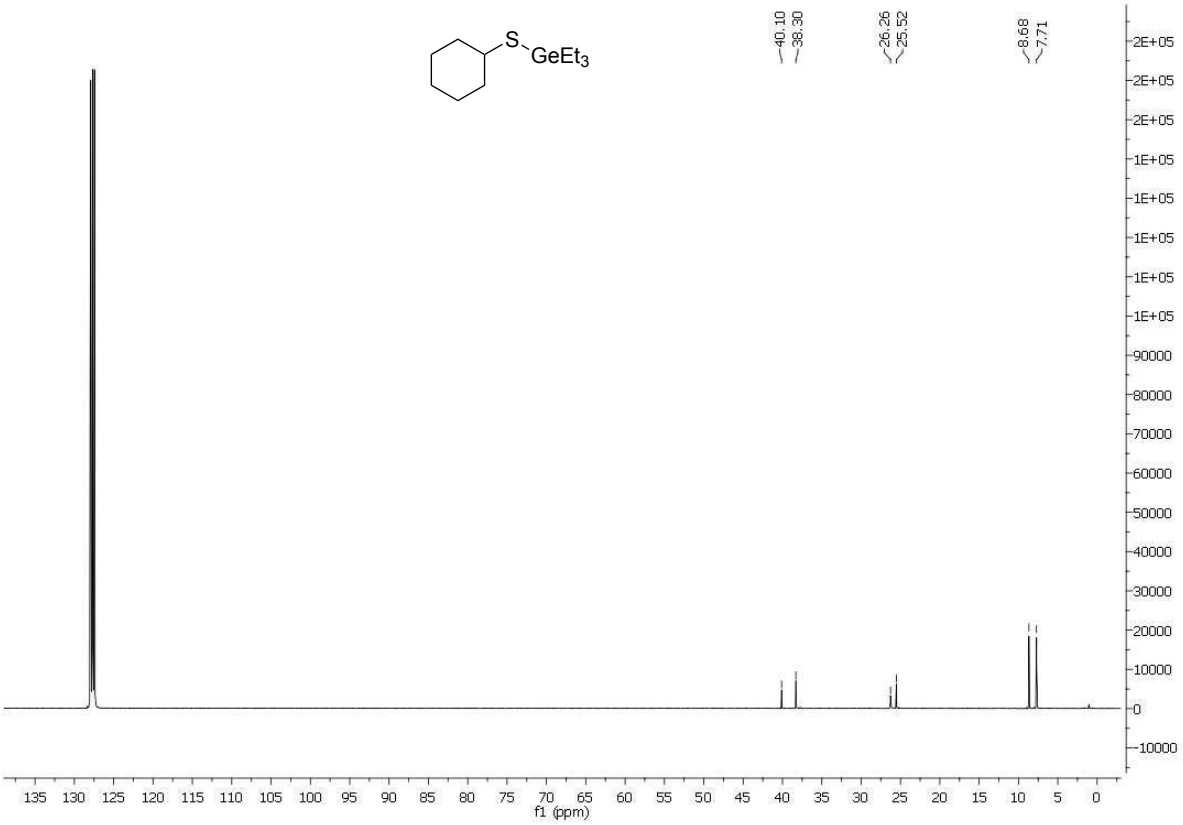
*5.1. Triethyl[(p-chlorophenyl)thio]germane (**1**)*



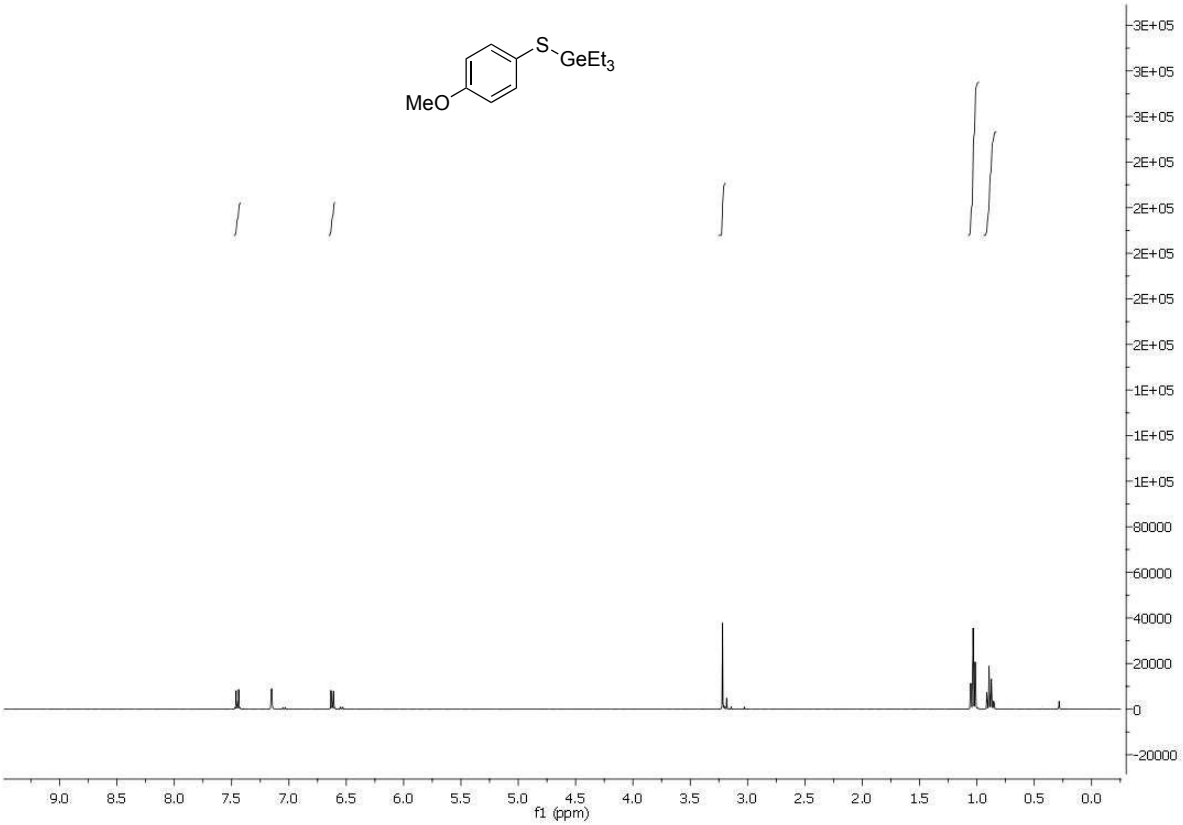


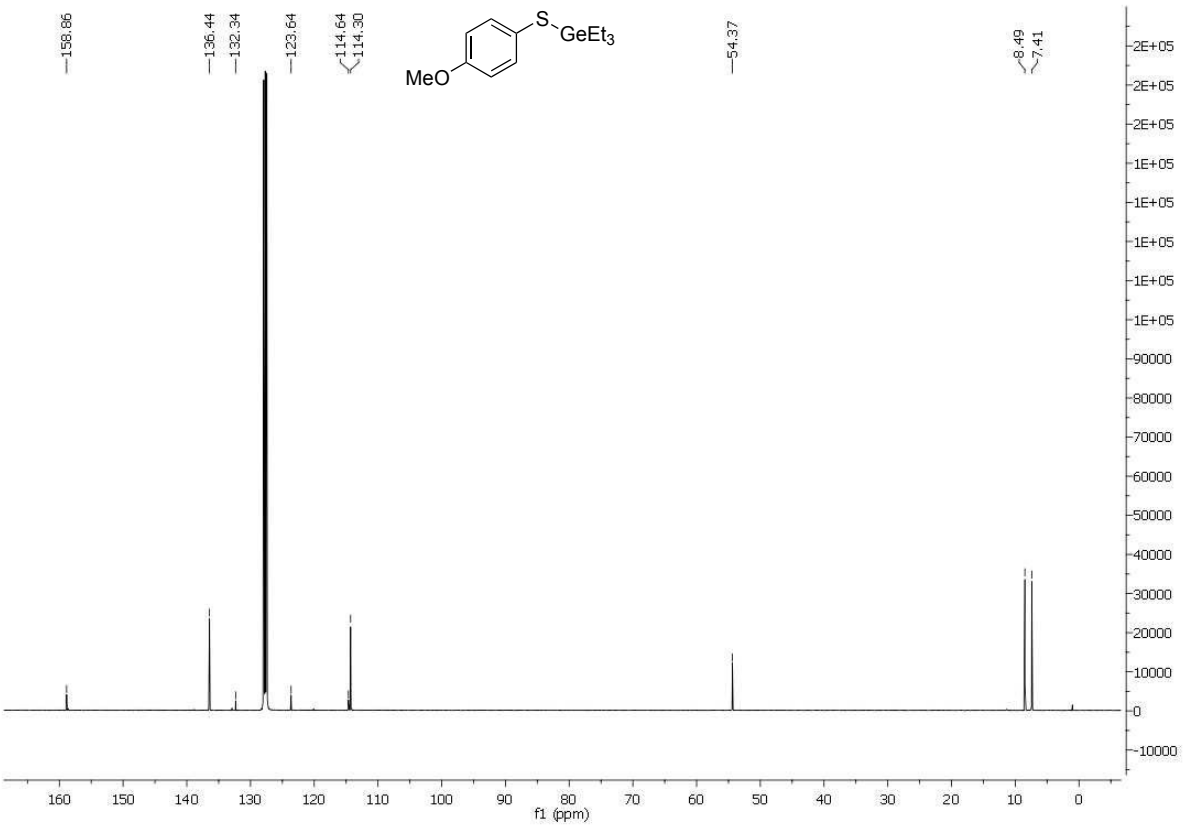
5.2. *Triethyl(cyclohexylthio)germane (**2**)*



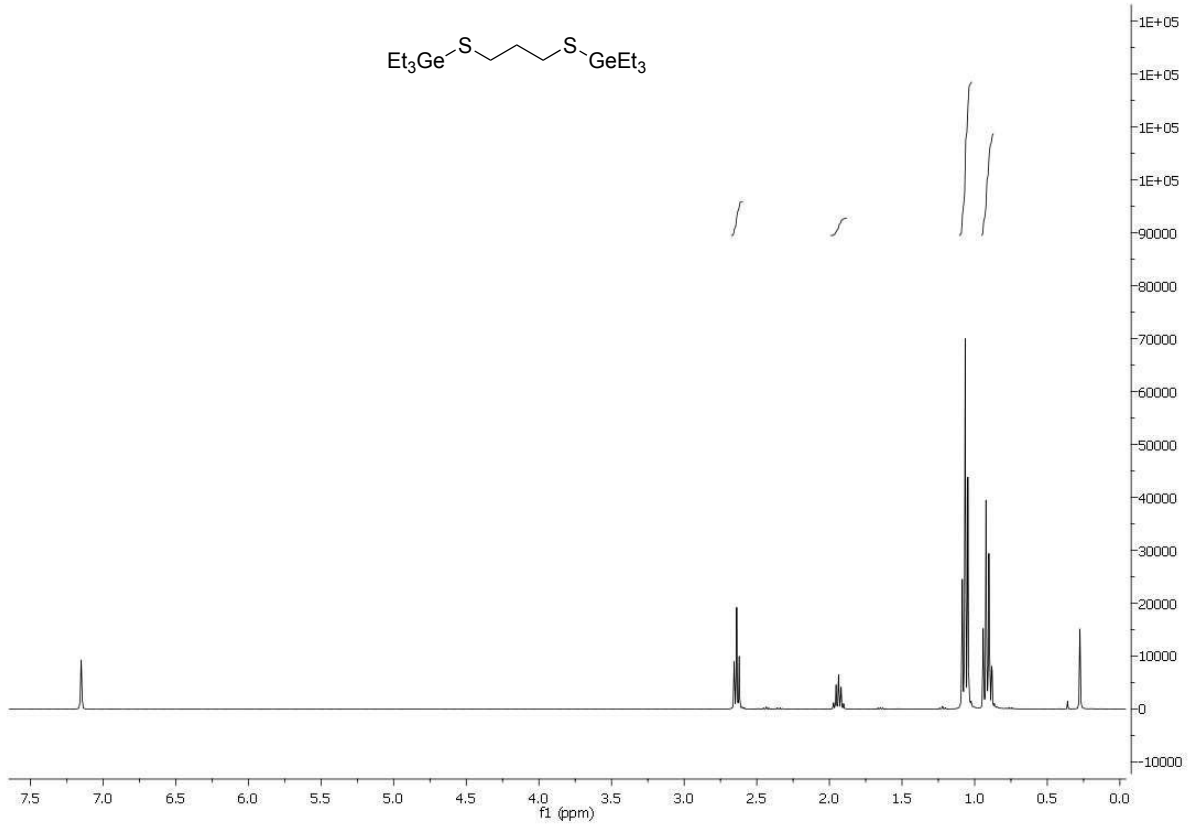


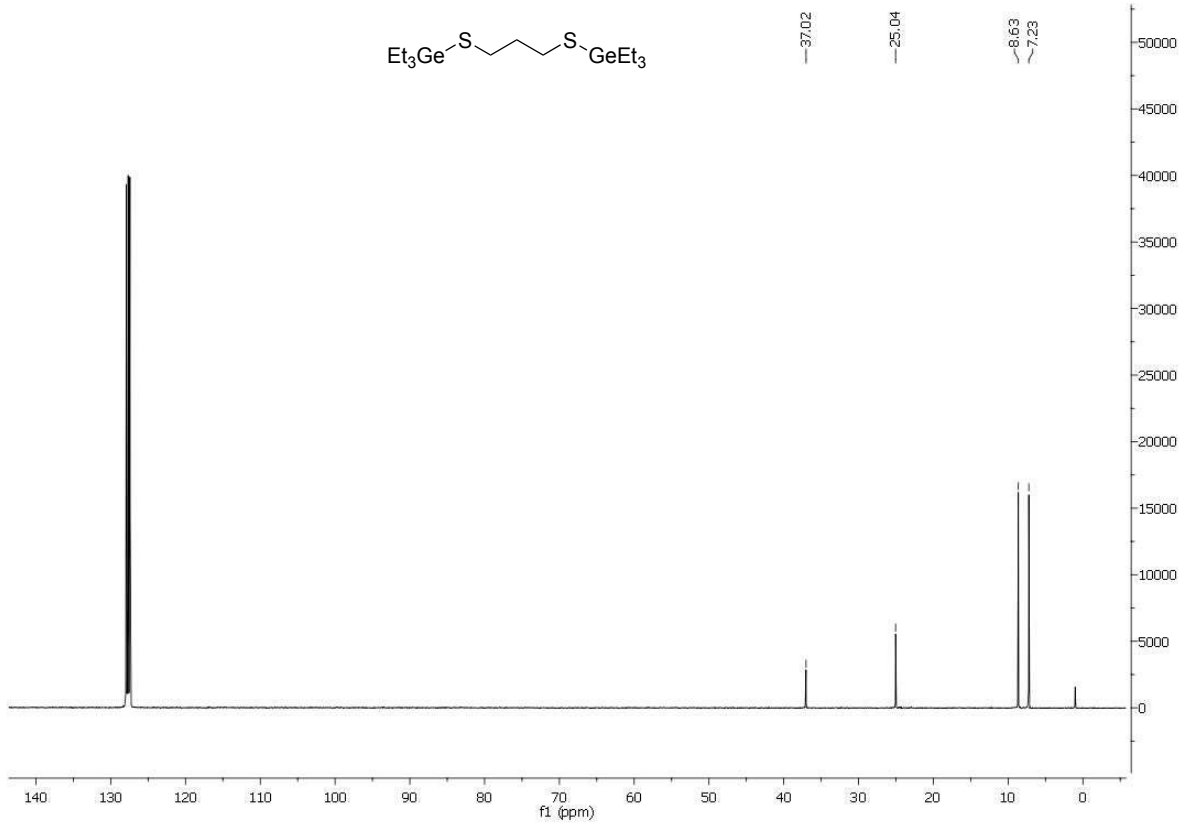
5.3. *Triethyl[(p-methoxyphenyl)thio]germane (**3**)*



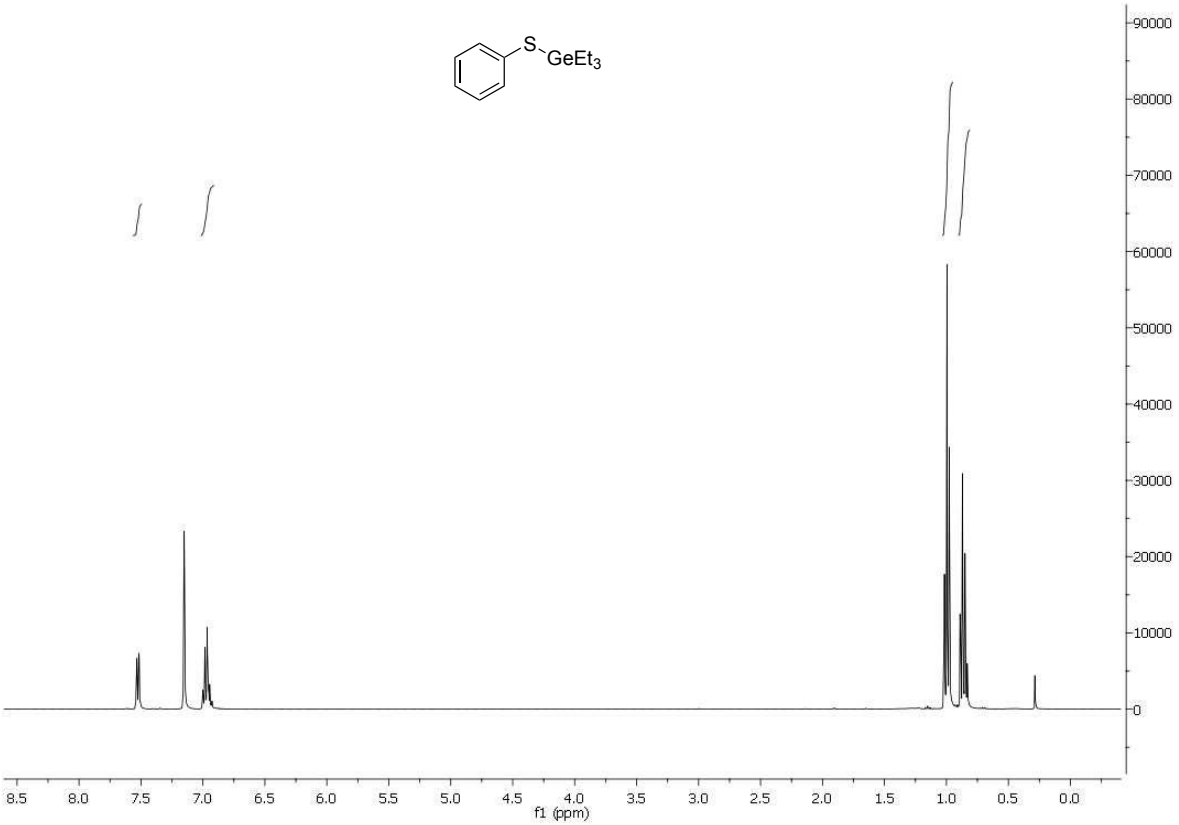


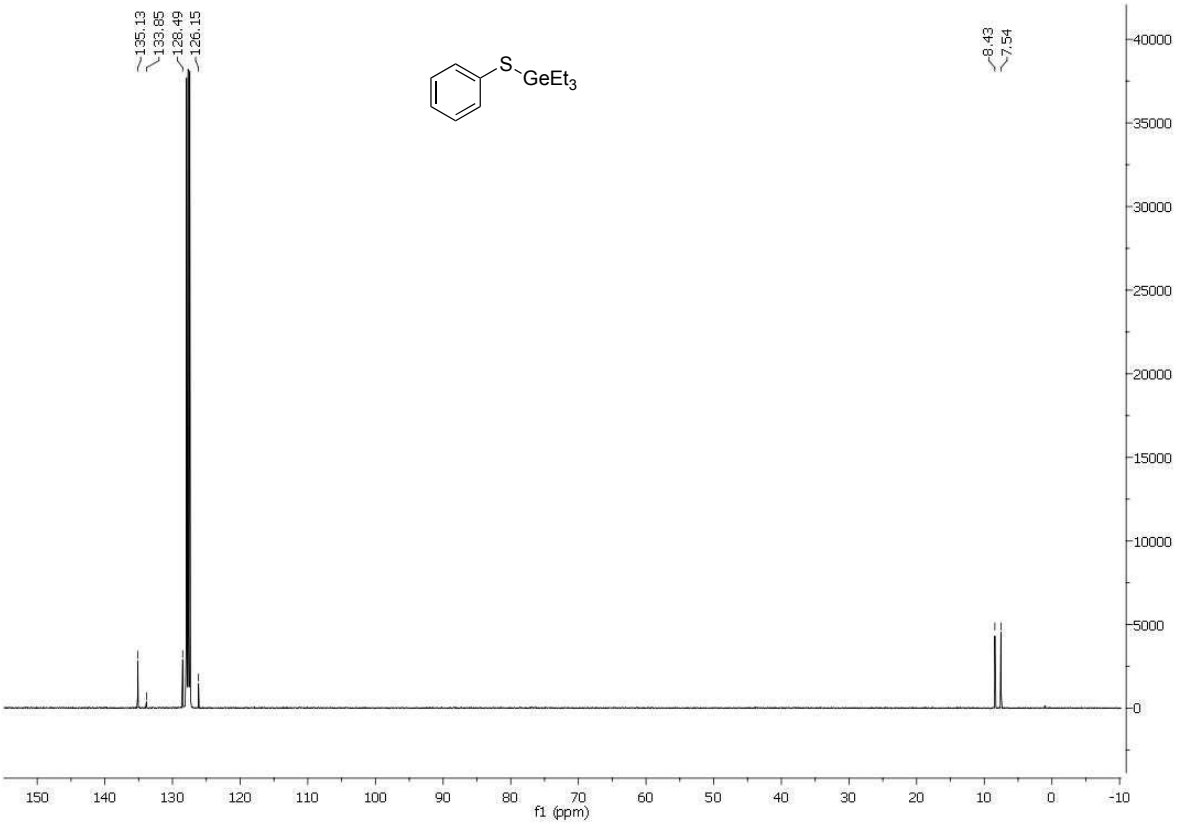
5.4. *3,3,9,9-tetraethyl-4,8-dithia-3,9-digermaundecane* (***4***)



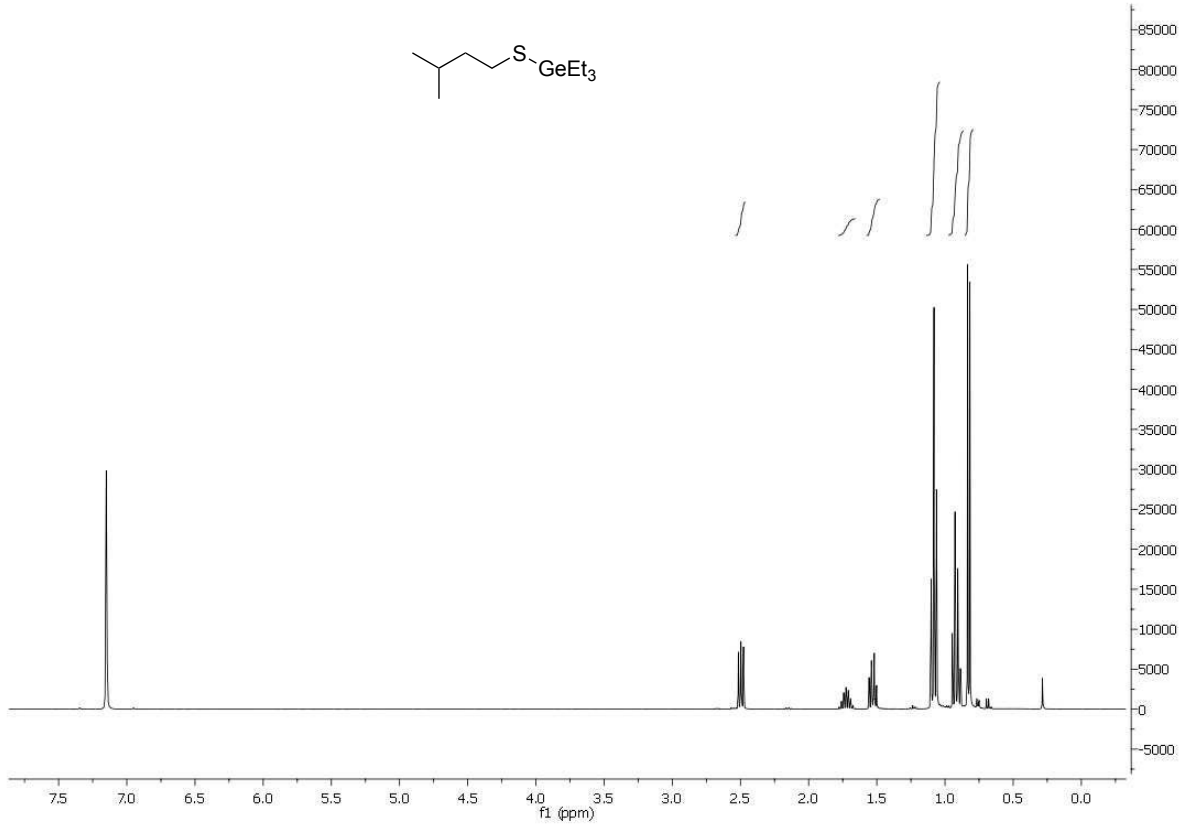


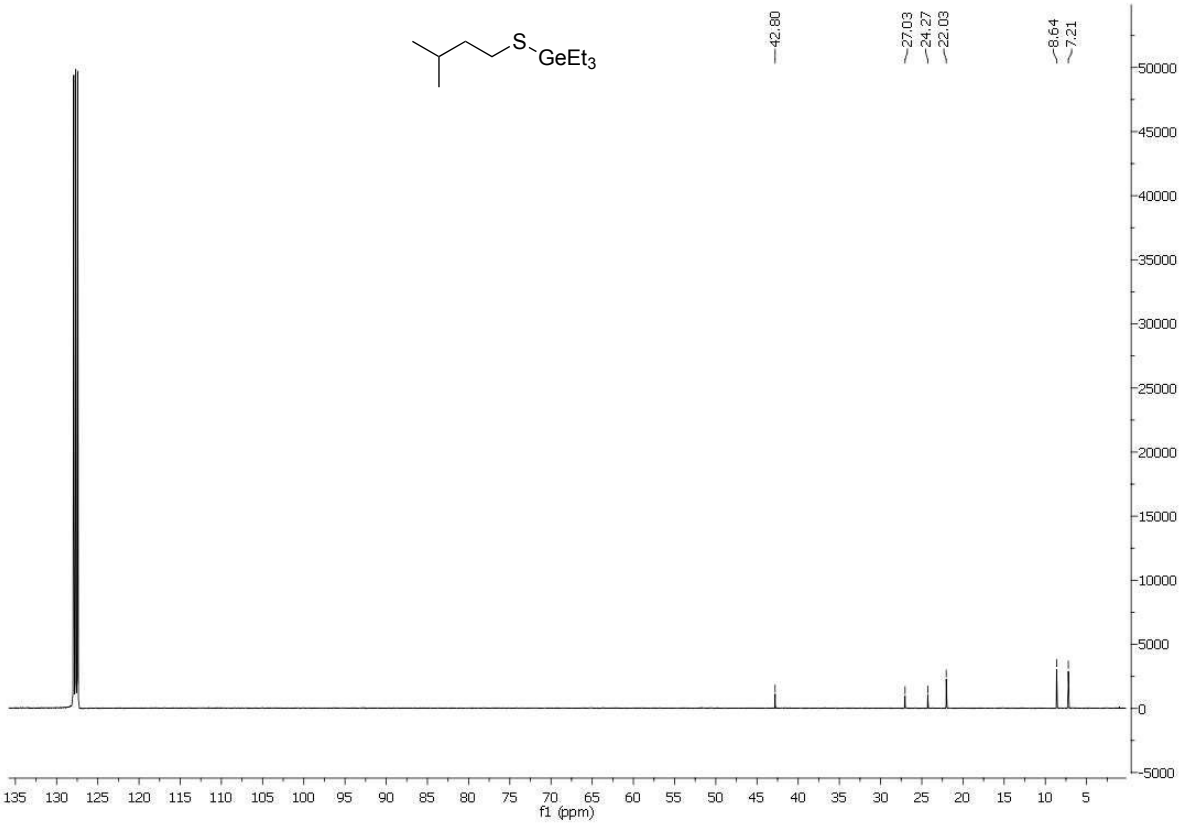
5.5. *Triethyl(phenylthio)germane (**5**)*



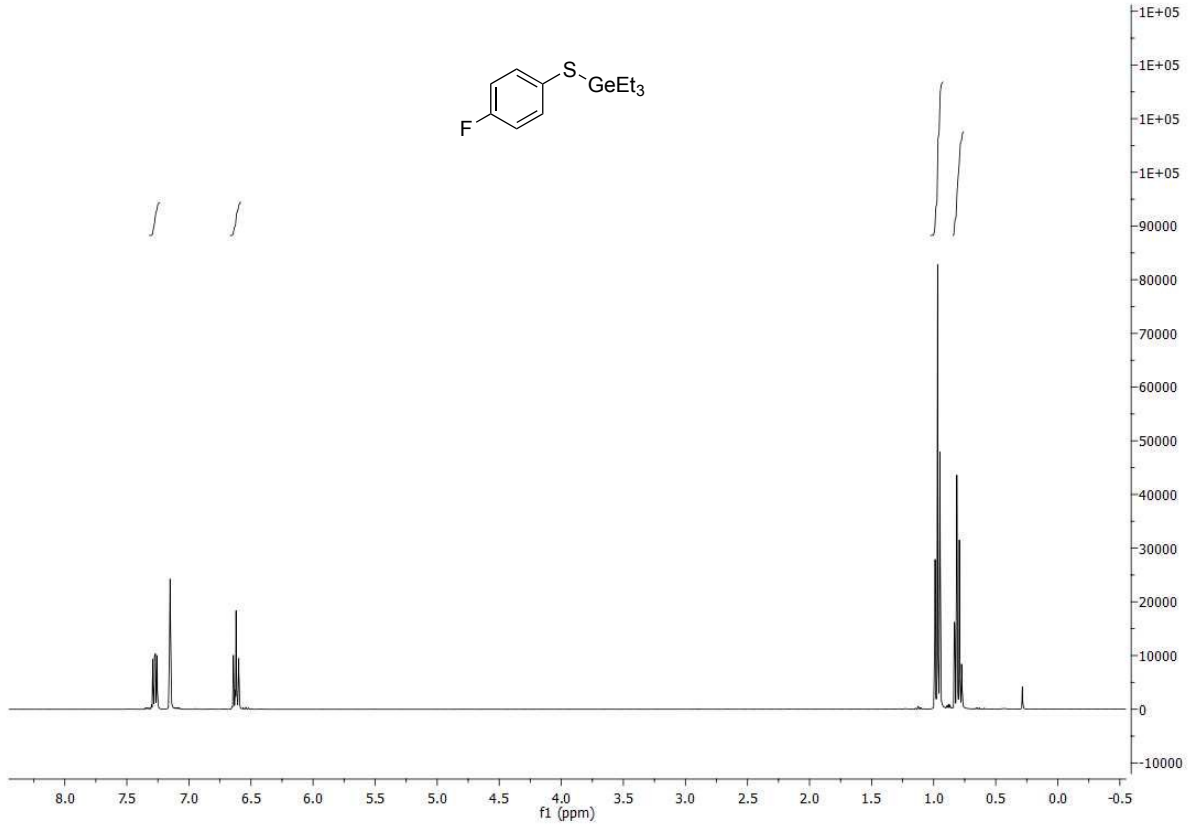


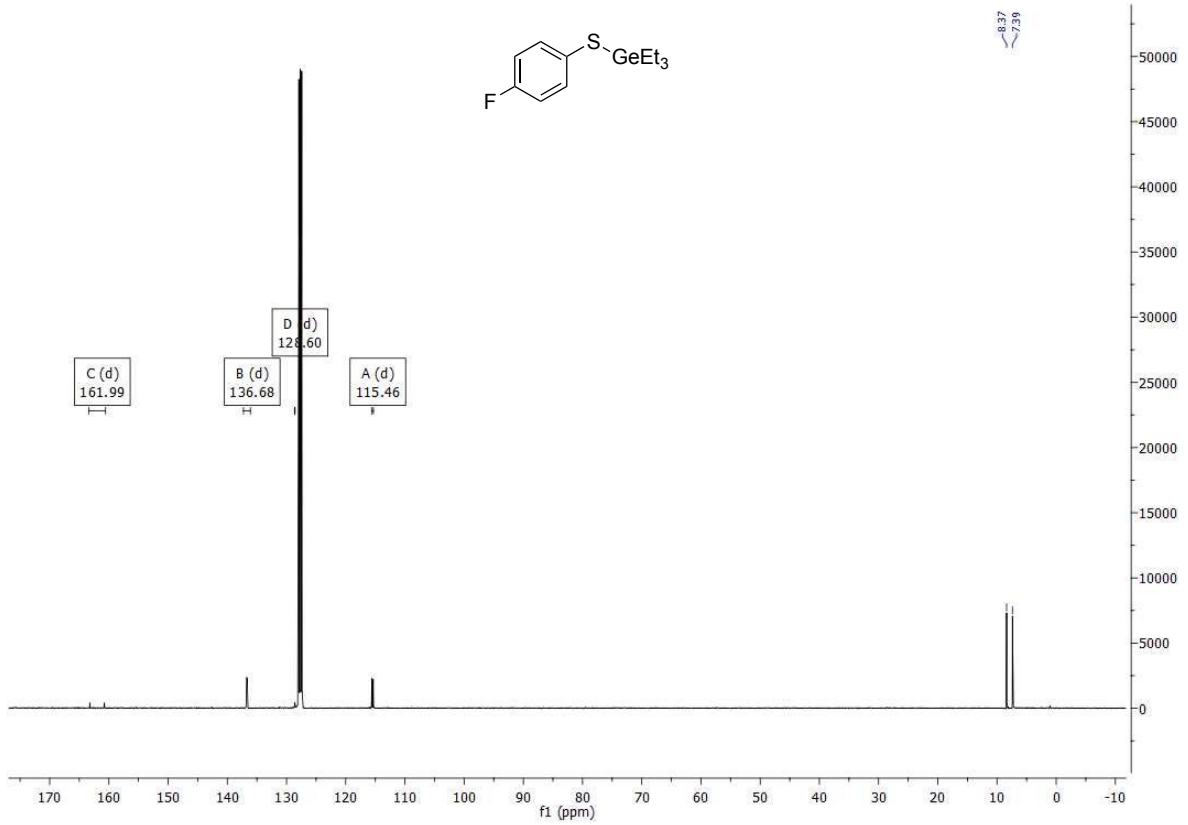
5.6. *Triethyl[(3-methylbutyl)thio]germane (**6**)*



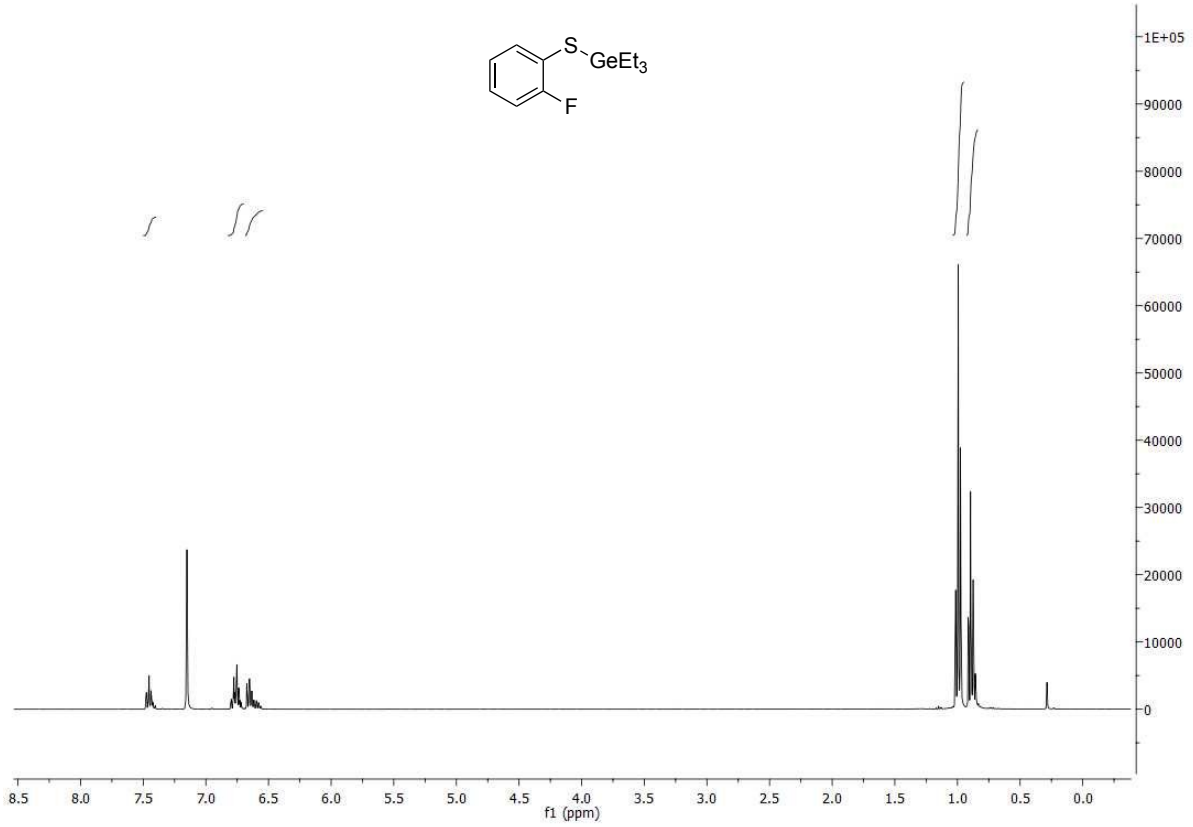


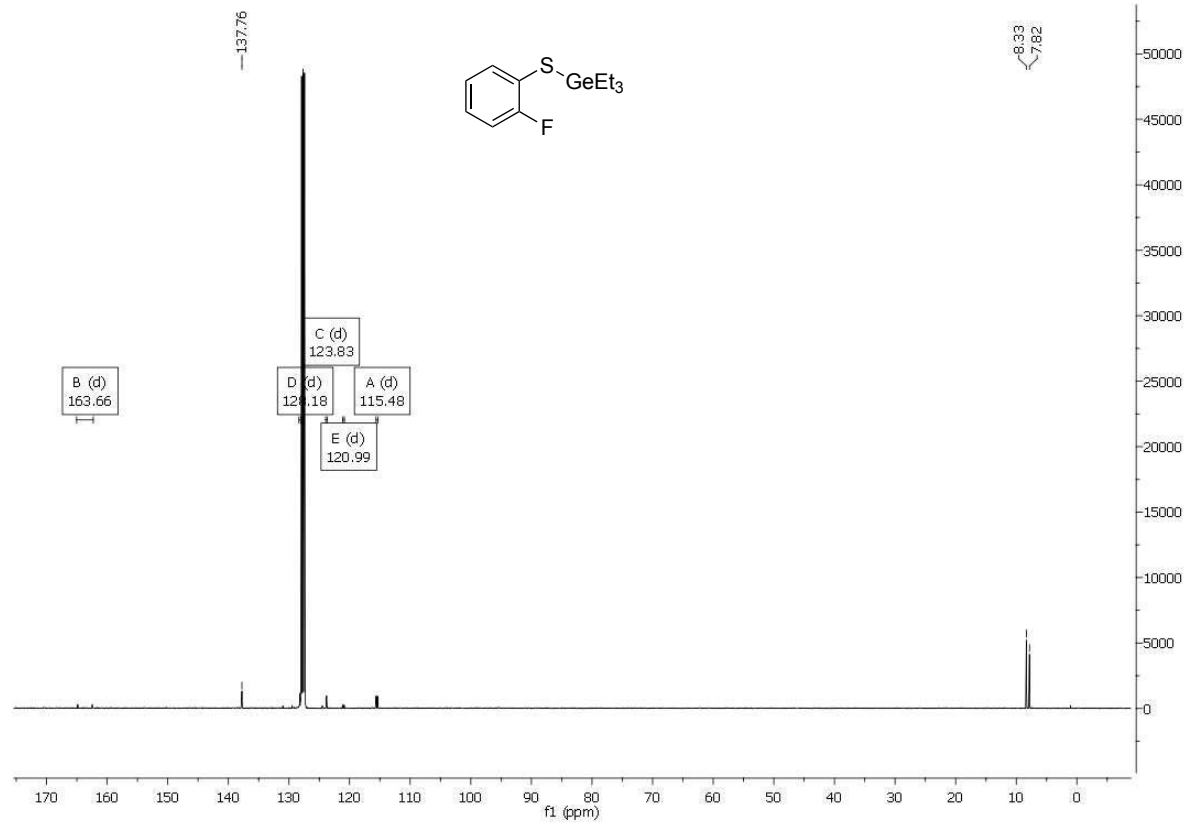
5.7. *Triethyl[(p-fluorophenyl)thio]germane (7)*



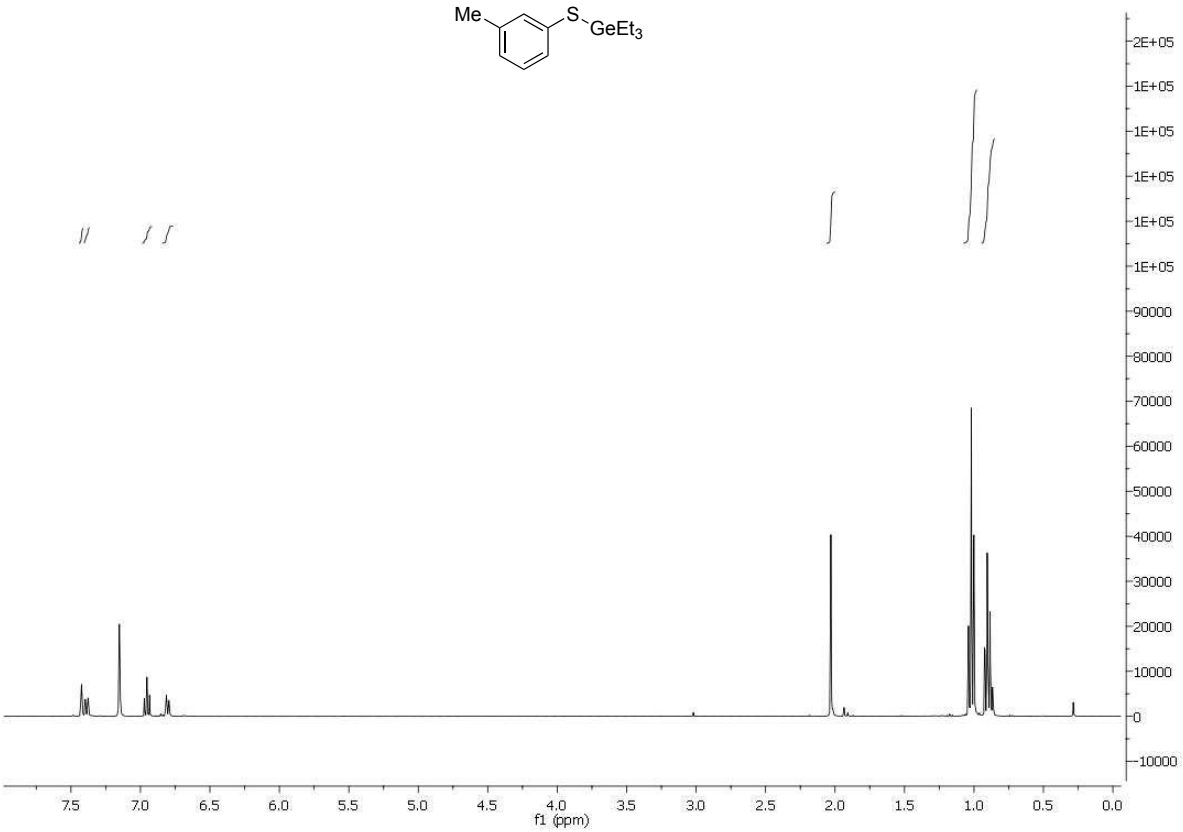


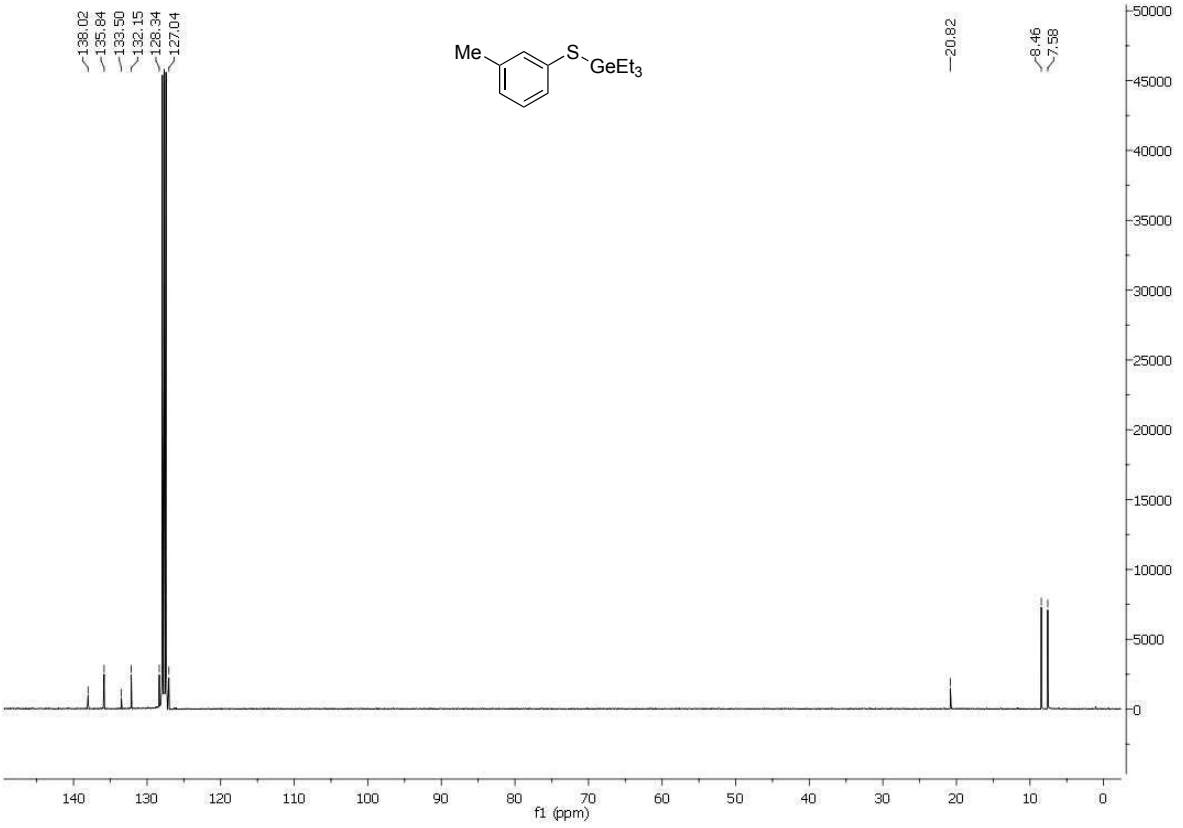
5.8. *Triethyl[(o-fluorophenyl)thio]germane (**8**)*



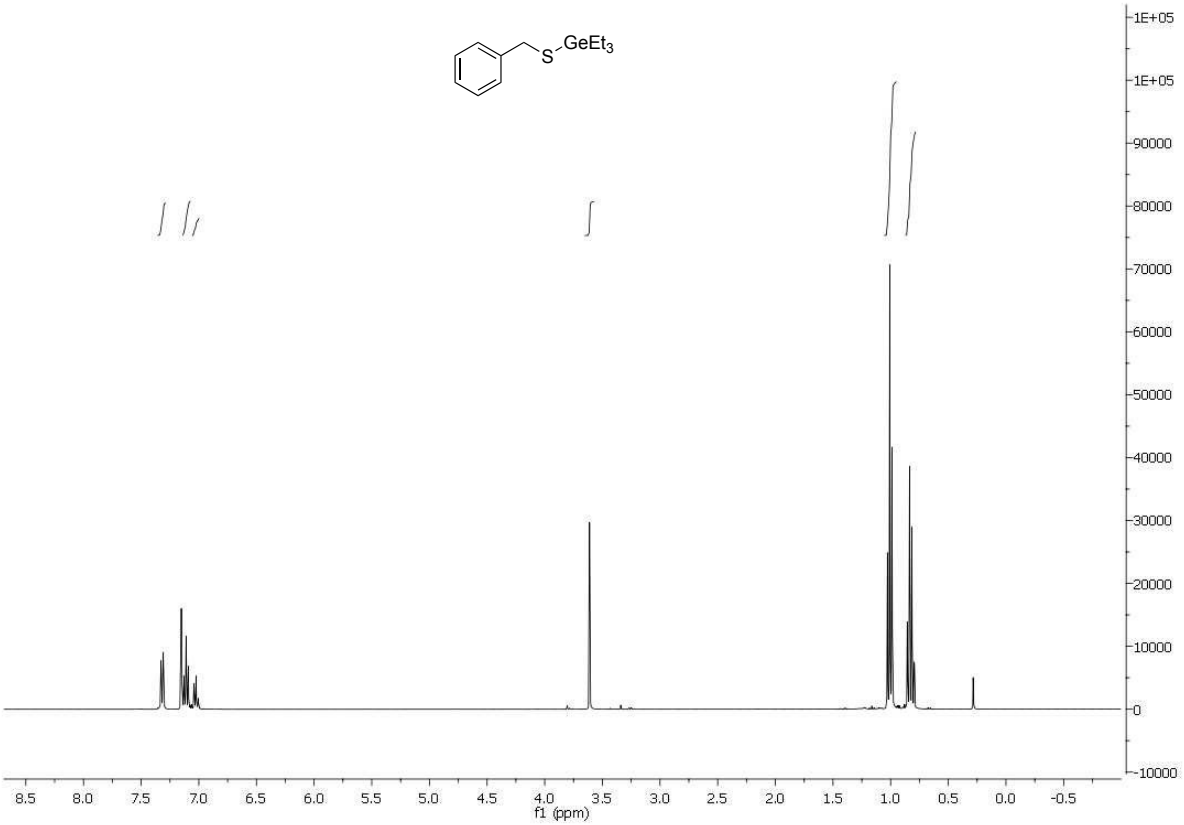


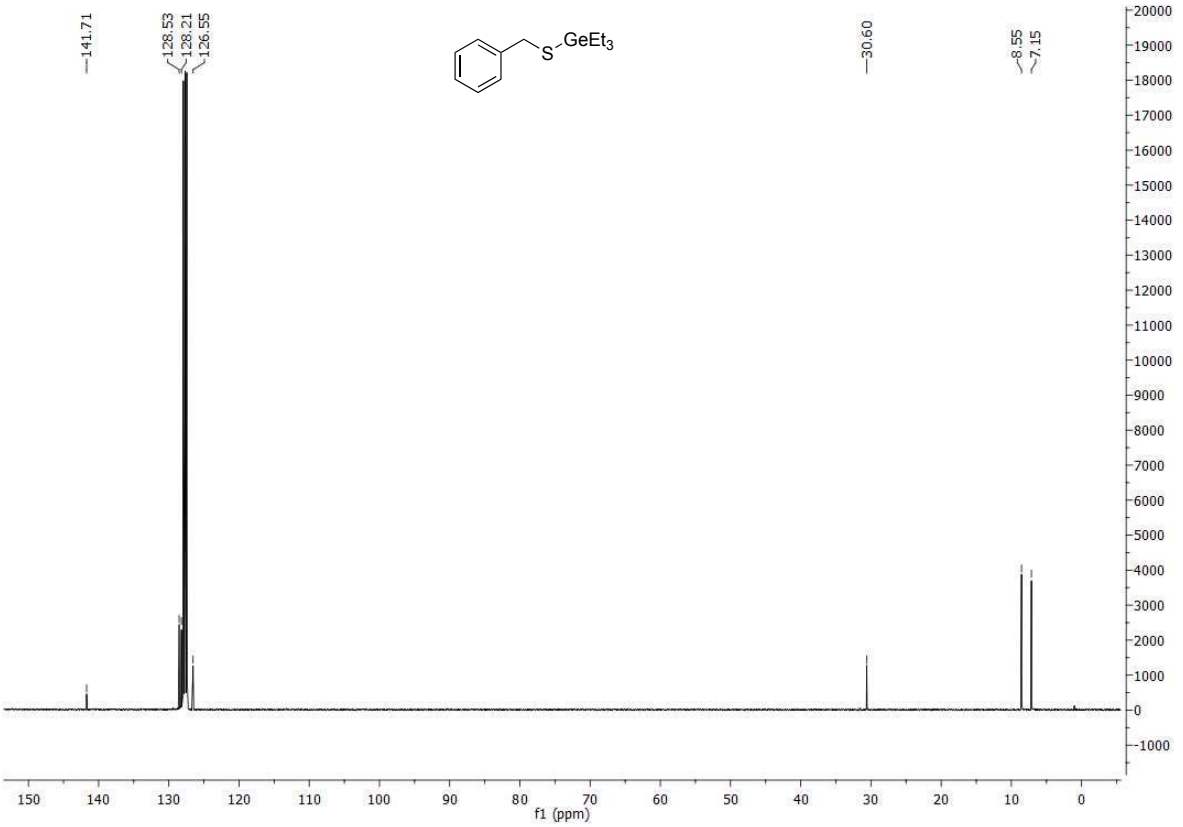
5.9. *Triethyl[(3-methylphenyl)thio]germane (**9**)*



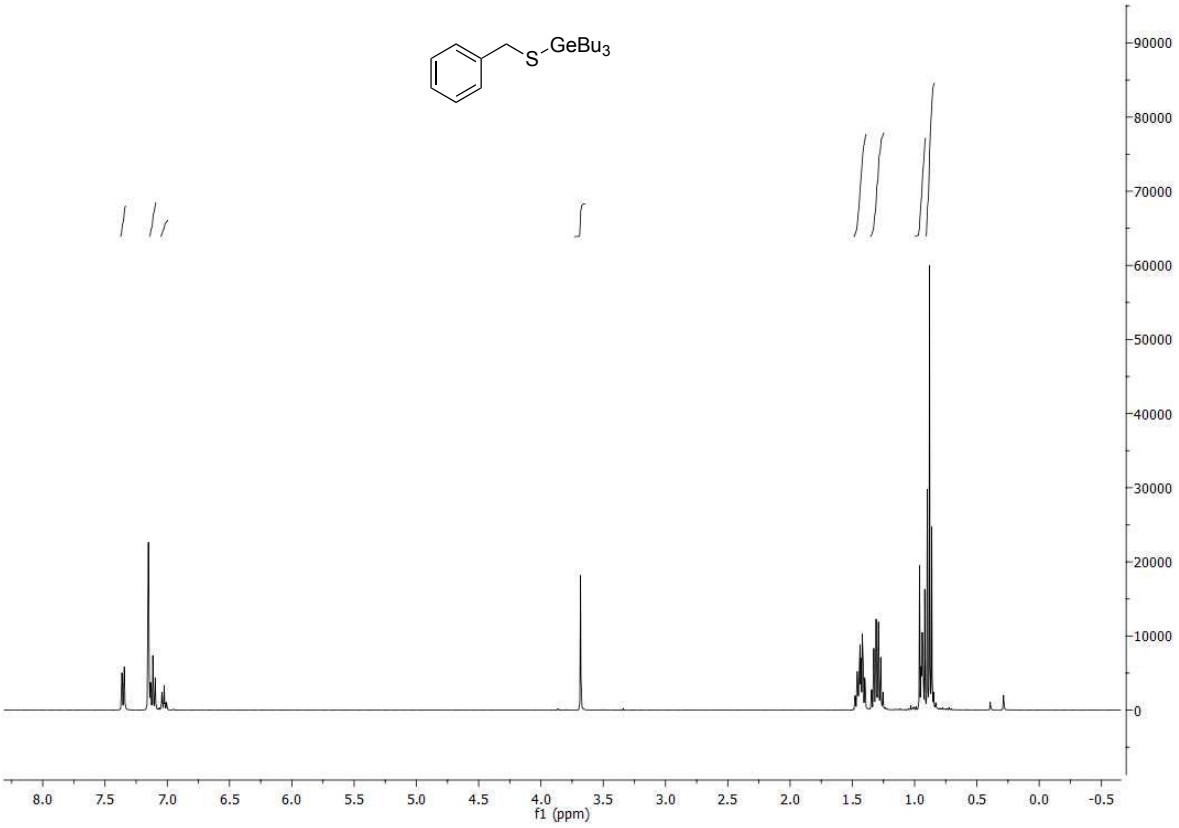


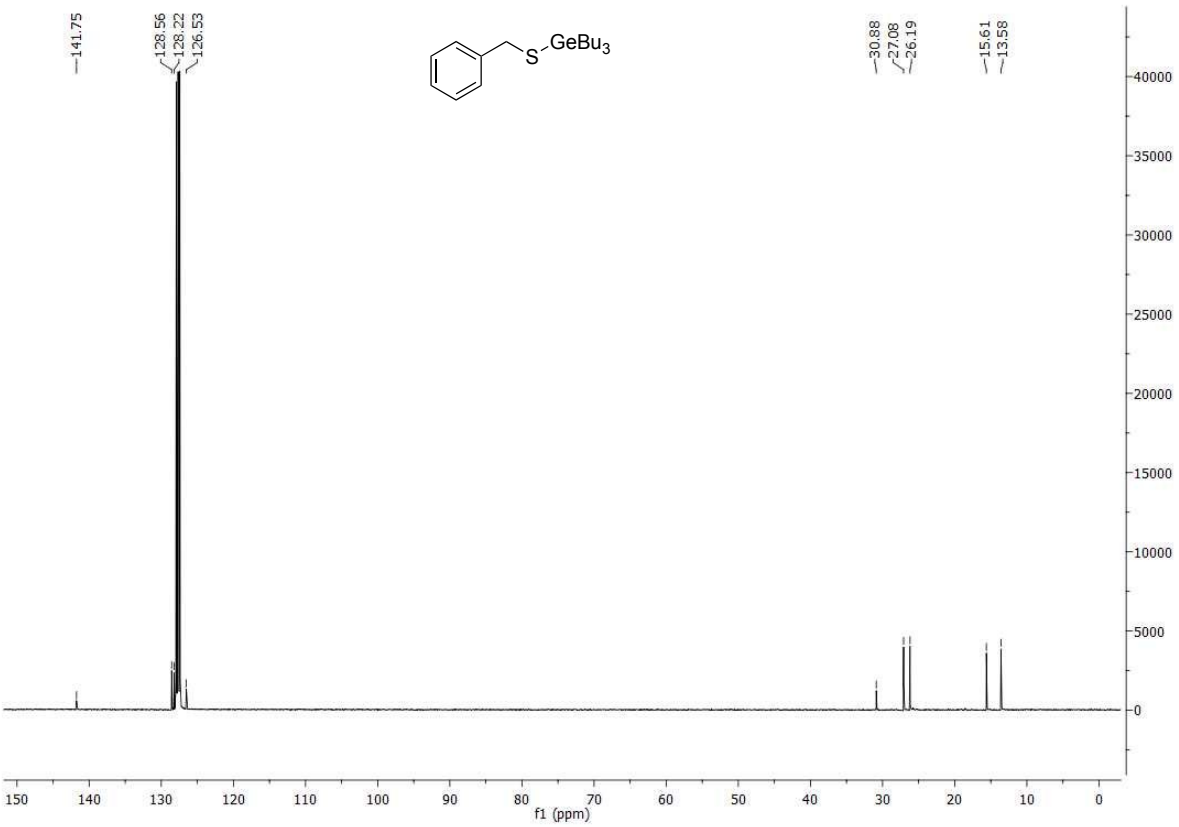
5.10. *Triethyl(benzylthio)germane (**10**)*



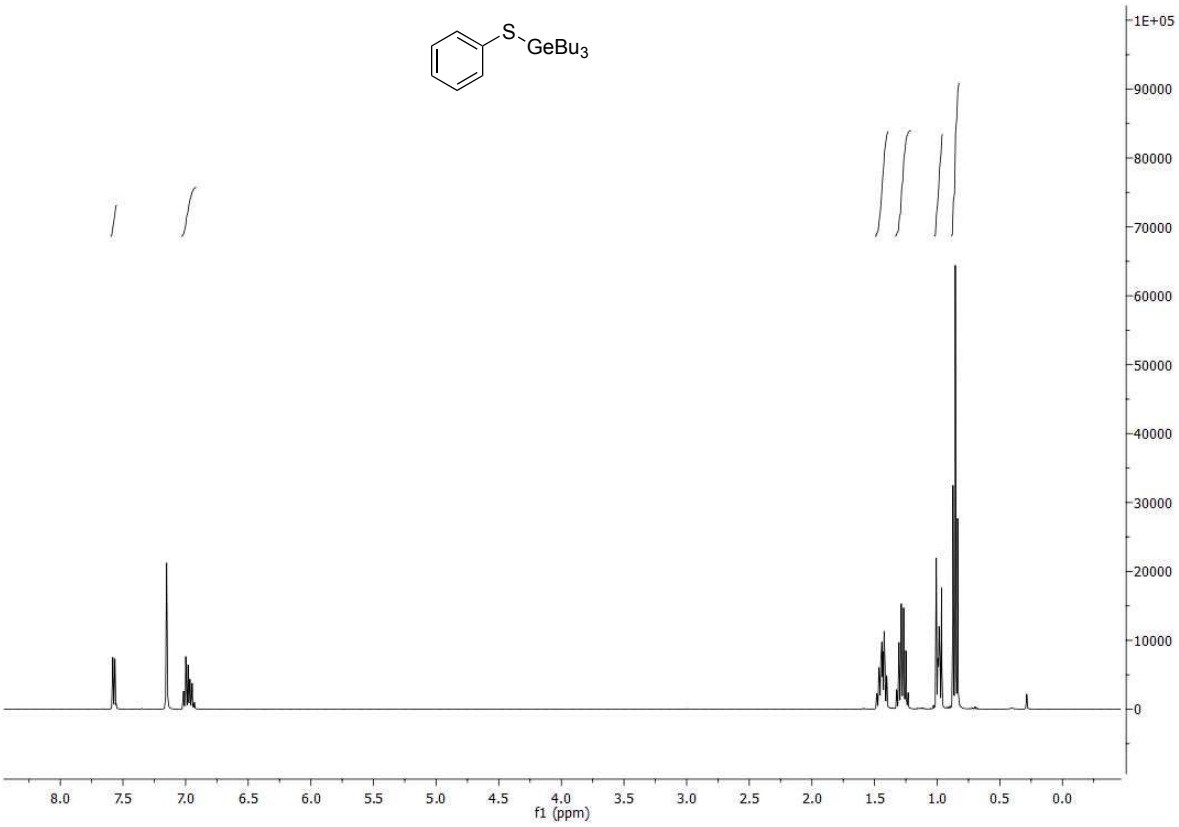


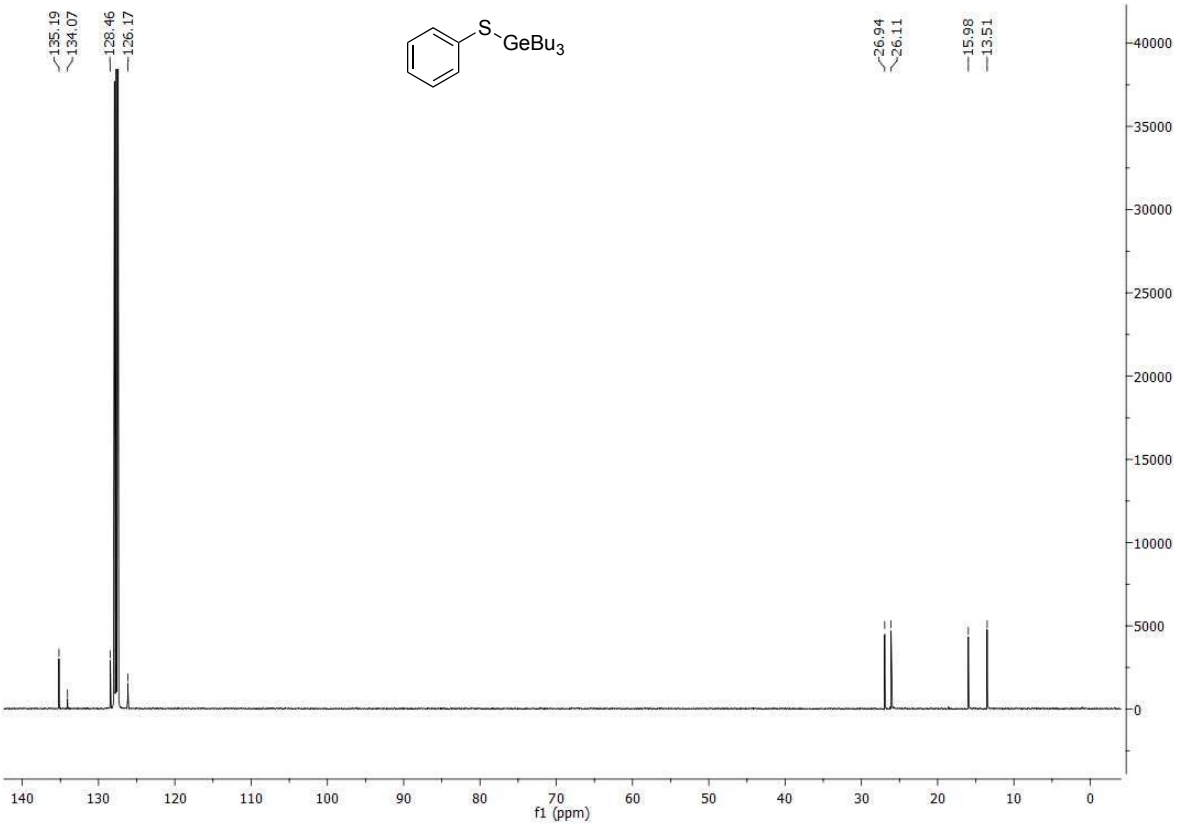
5.11. *Tributyl(benzylthio)germane* ***(11)***



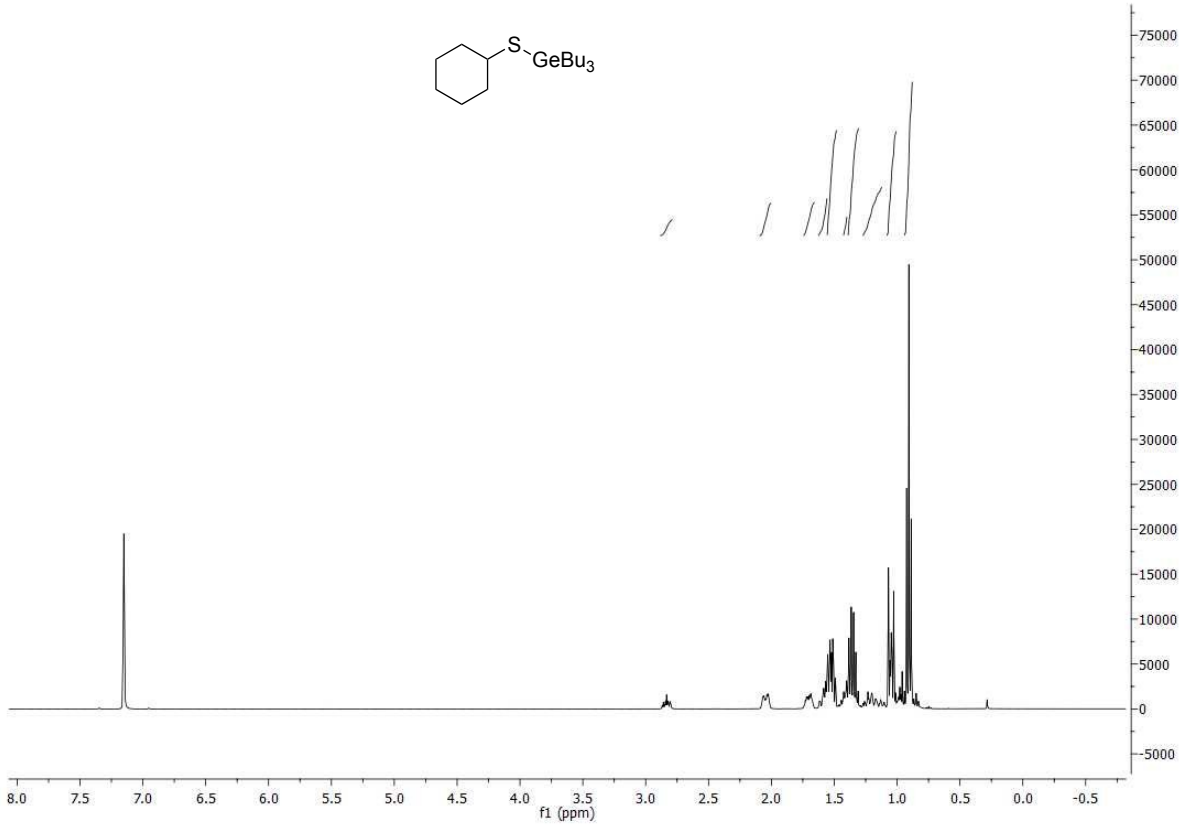


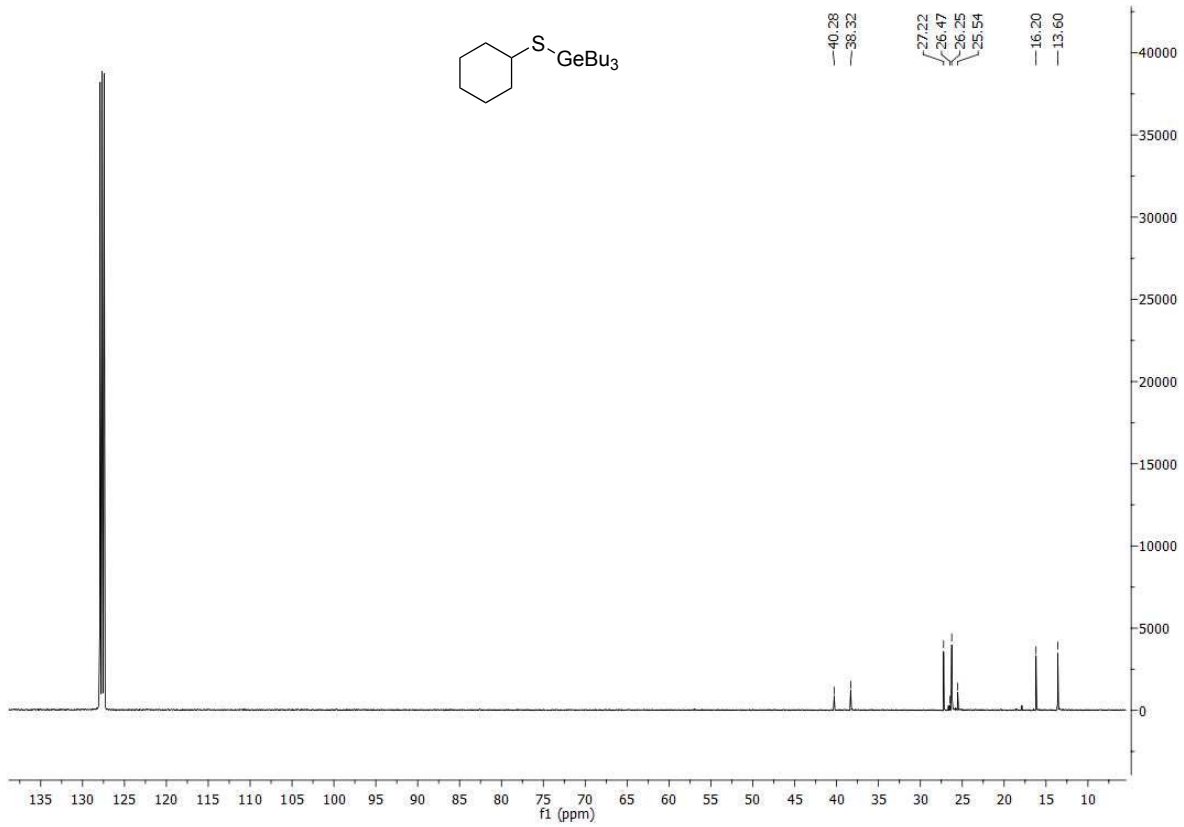
5.12. *Tributyl(phenylthio)germane (**12**)*



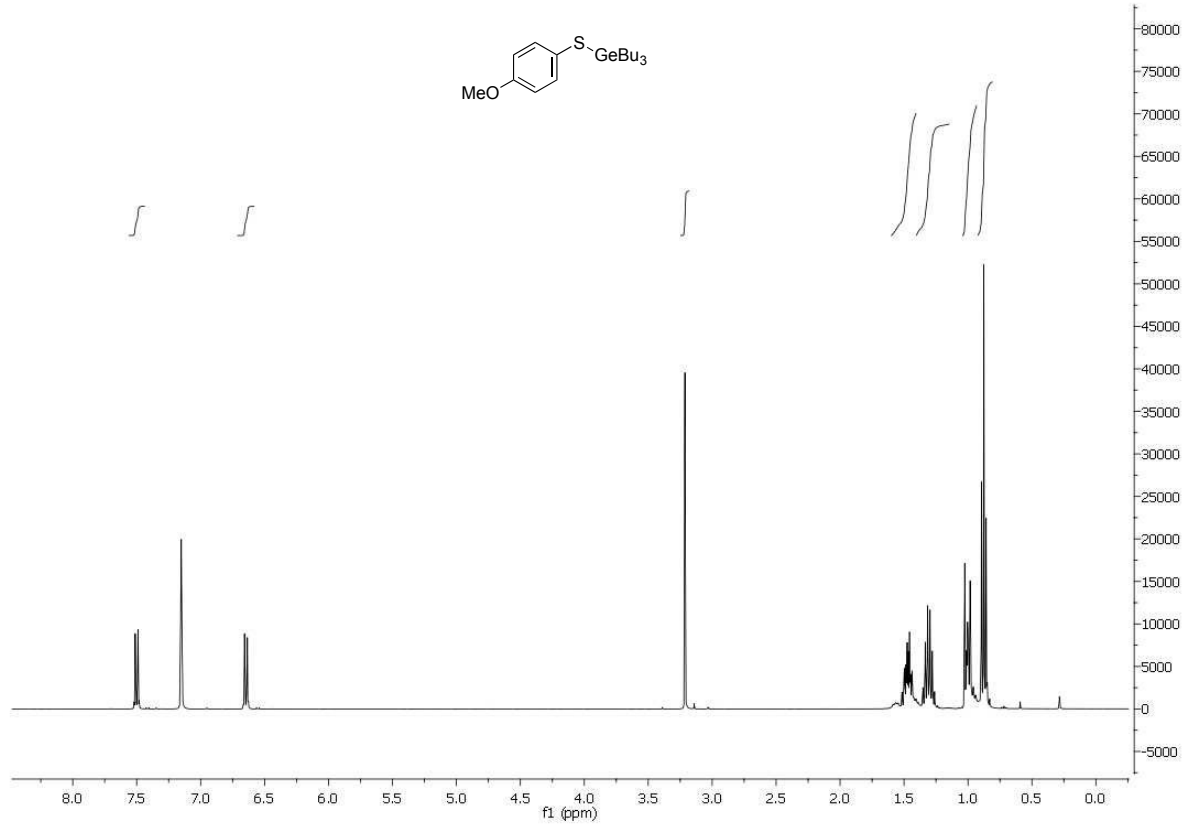


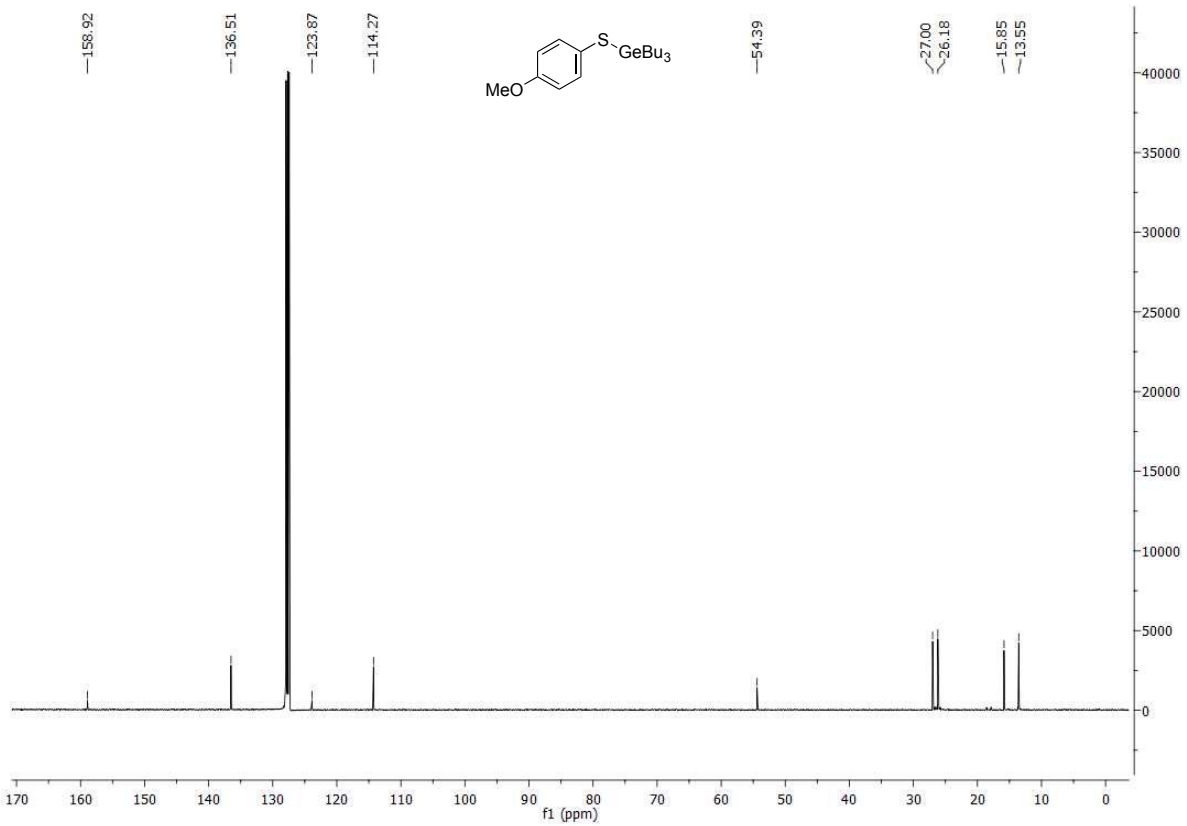
5.13. *Tributyl(cyclohexylthio)germane (**13**)*



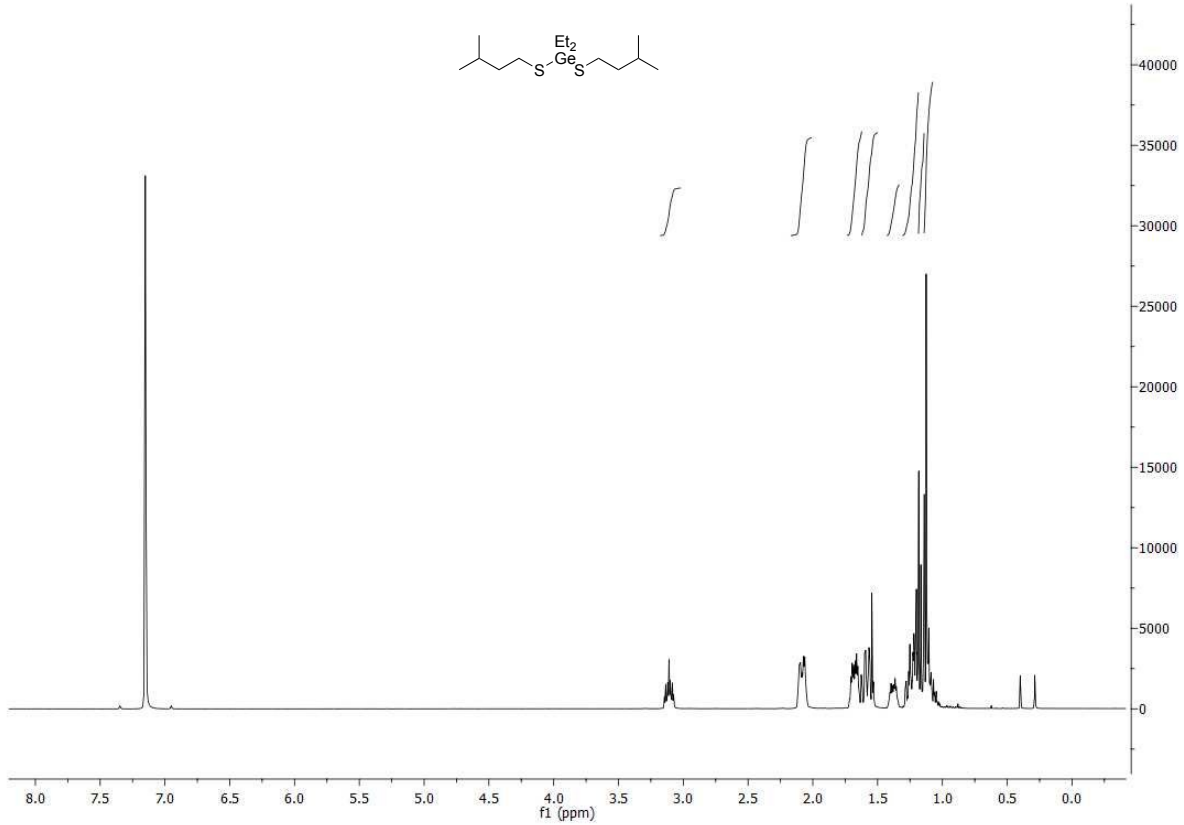


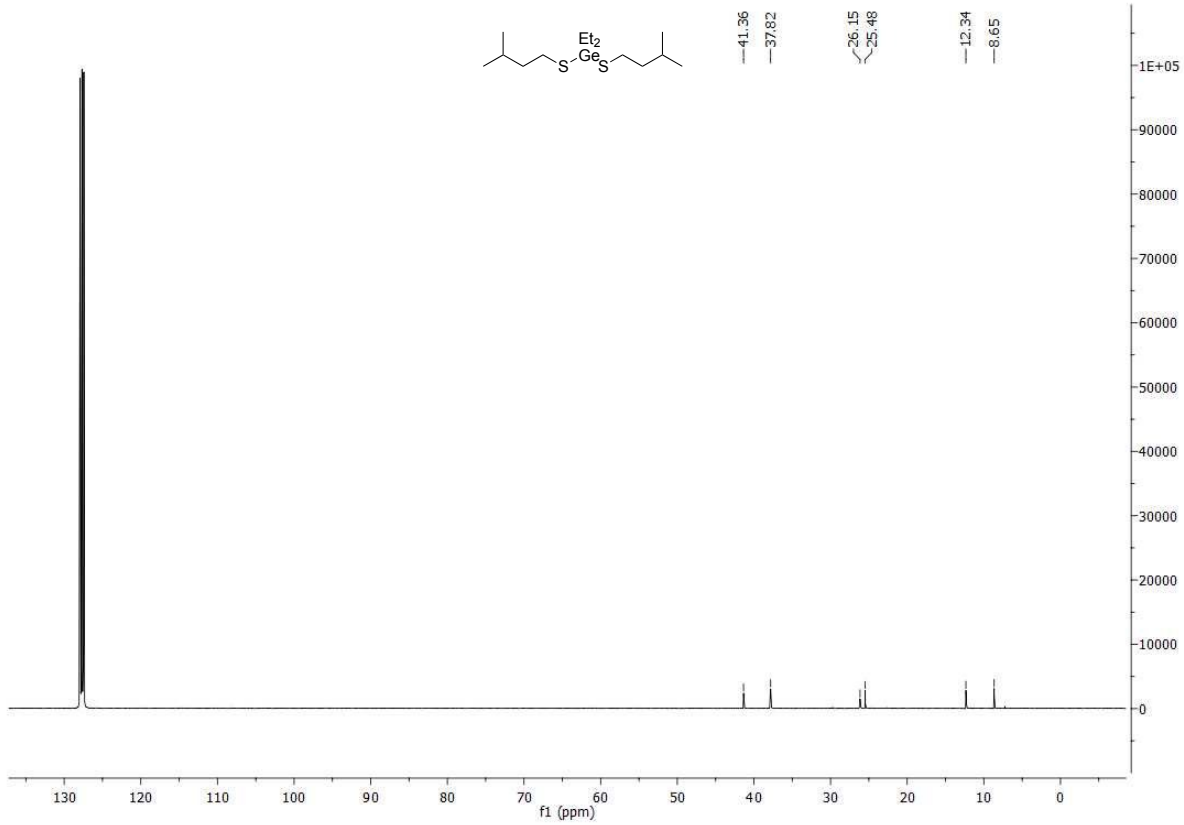
5.14. *Tributyl[(p-methoxyphenyl)thio]germane (**14**)*



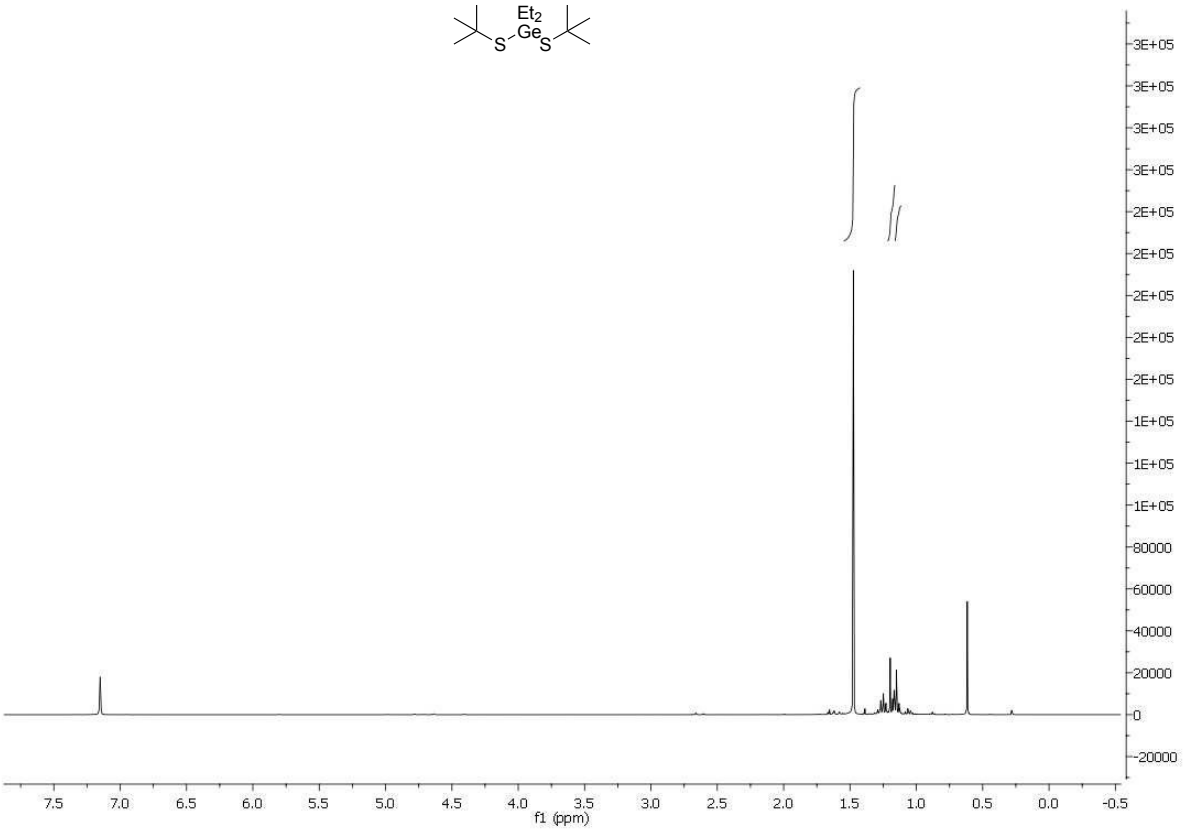


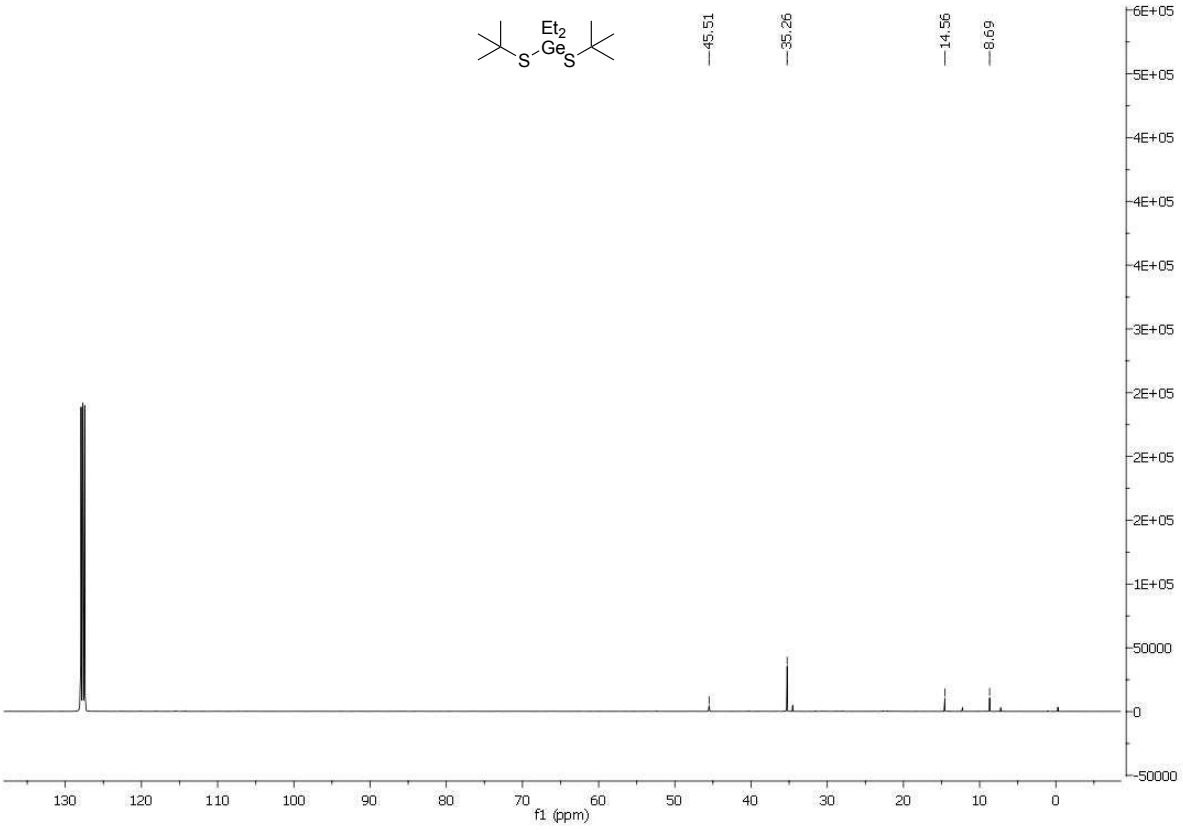
5.15. *Diethyl-bis[(3-methylbutyl)thio]germane (**15**)*



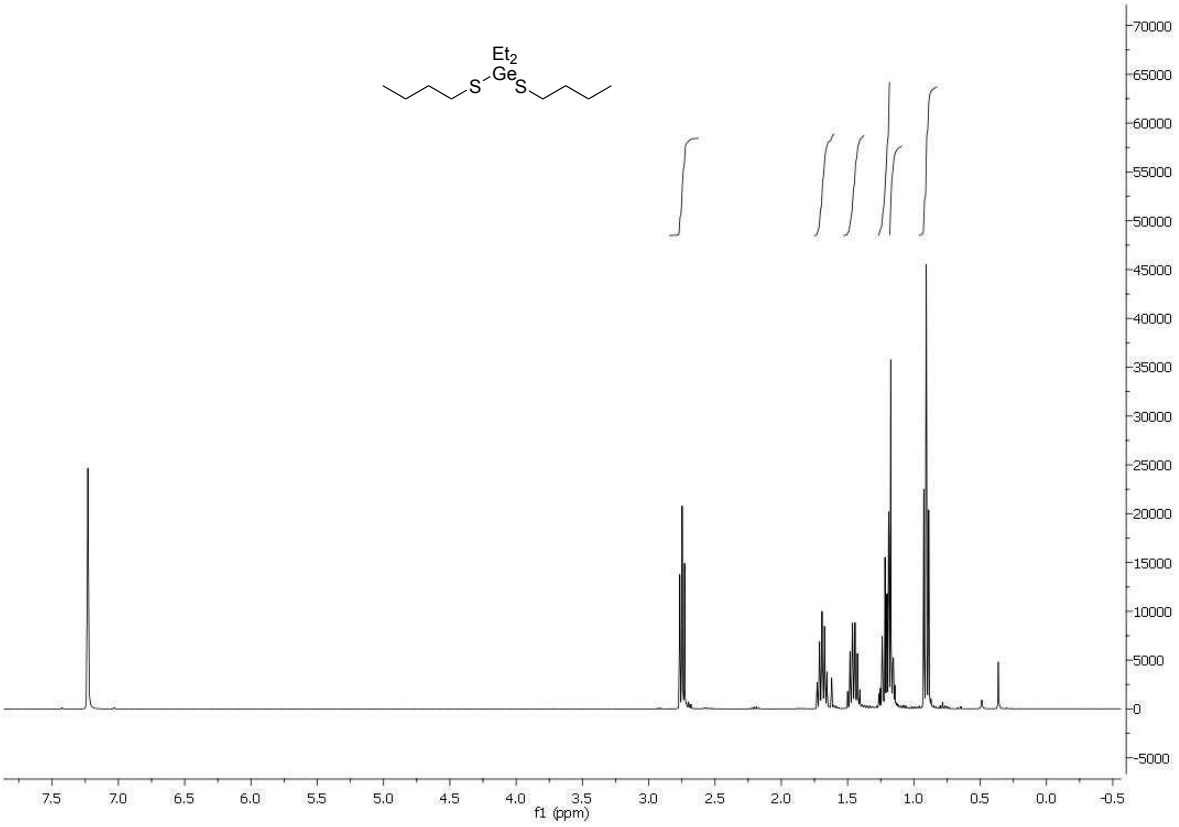


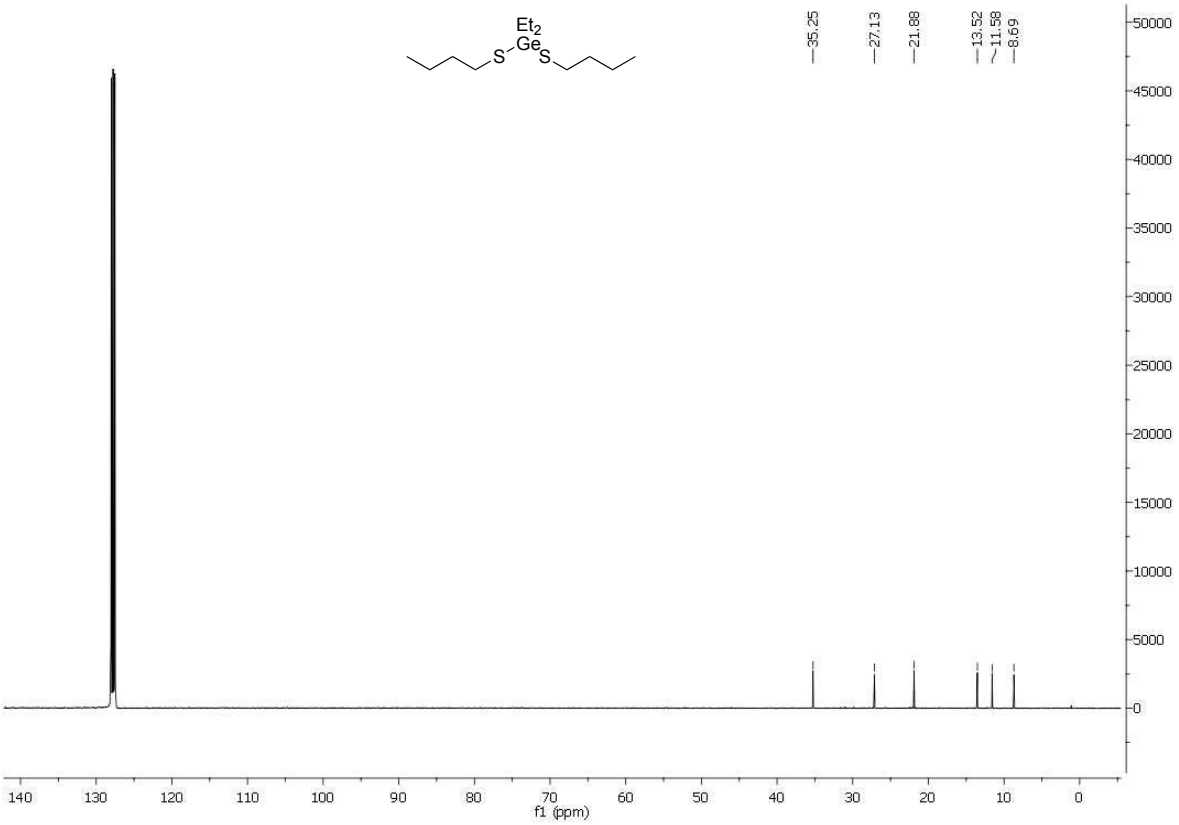
5.16. *Diethyl-bis(tert-butylthio)germane (**16**)*



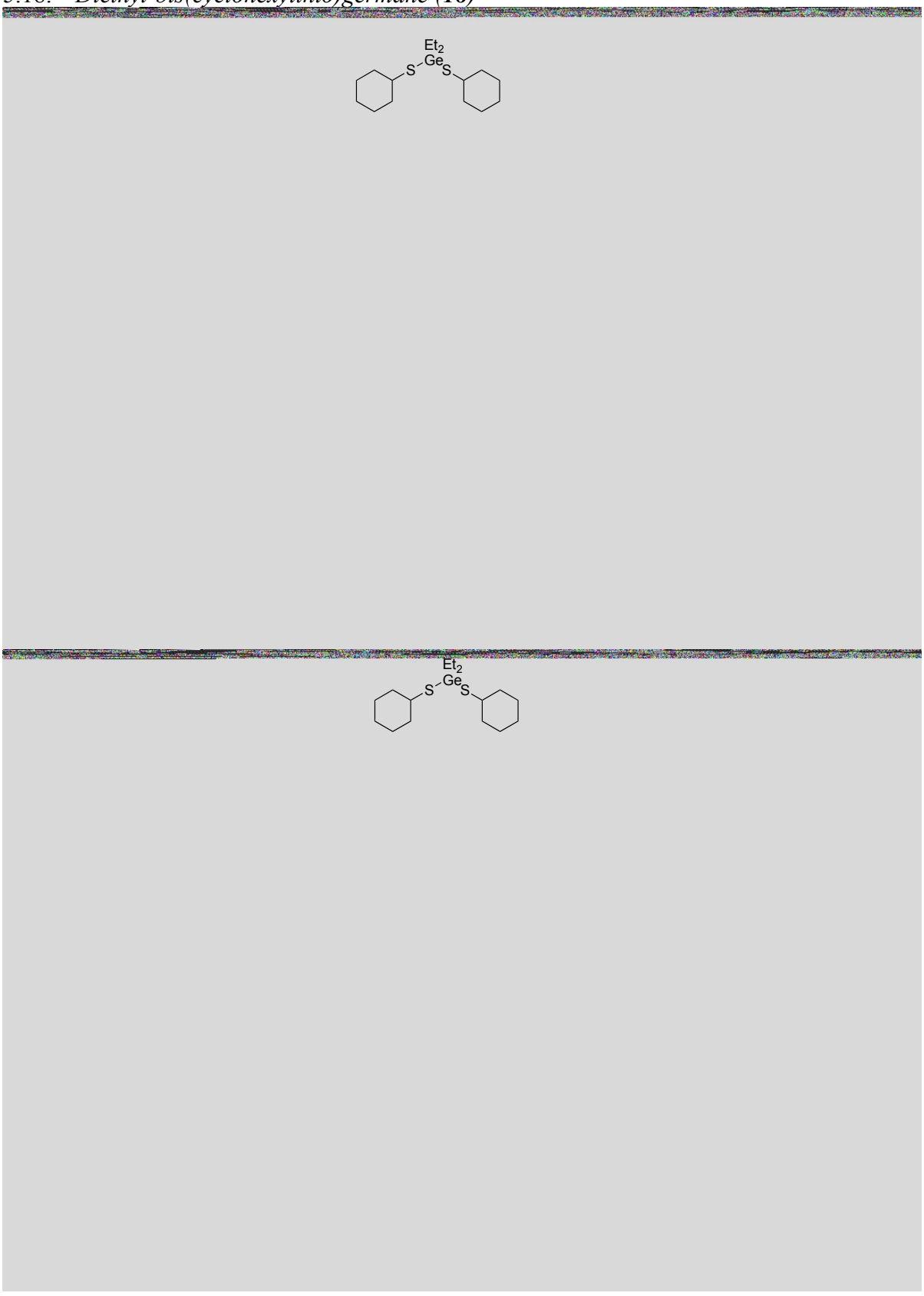


5.17. *Diethyl-bis(n-butylthio)germane (**17**)*





5.18. *Diethyl-bis(cyclohexylthio)germane (**18**)*



5.19. *Diethyl-bis[(p-fluorophenyl)thio]germane (**19**)*