Supplementary Information for

Copper-catalyzed distannylation of alkynes

Hiroto Yoshida, Ayako Shinke and Ken Takaki*

Department of Applied Chemistry, Graduate School of Engineering, Hiroshima University, Higashi-Hiroshima 739-8527, Japan

Contents

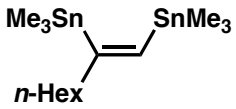
General remarks.

All manipulations of oxygen- and moisture-sensitive materials were conducted with a standard Schlenk technique under a purified argon atmosphere. Nuclear magnetic resonance spectra were taken on a Varian 400-MR (^{1}H, 400 MHz; ^{13}C, 100 MHz) spectrometer or a Varian System 500 (^{1}H, 500 MHz; ^{13}C, 125 MHz; ^{119}Sn, 186 MHz) spectrometer using residual chloroform (^{1}H, δ = 7.26) or $CDCl_3$ (^{13}C, δ = 77.0) as an internal standard, and tetramethyltin (^{119}Sn, δ = 0) as an external standard. ^{1}H NMR data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, br = broad), coupling constants (Hz), integration. High-resolution mass spectra (ESI or APCI/FTMS) were obtained with Thermo Fisher Scientific LTQ Orbitrap XL spectrometer. Preparative recycling gel permeation chromatography was performed with JAI LC-908 or JAI LC-9201 equipped with JAI GEL-1H and -2H columns (chloroform or toluene as an eluent). Column chromatography was carried out using Merck Aluminium oxide 90 (activity IV). Hexamethyldistannane (**2**)[1] and tris(triphenylphosphine)copper acetate[2] were synthesized according to literature procedures. Alkynes were purified prior to use by distillation. DMF was distilled from calcium hydride and stored over activated molecular sieves 4A.

Cu-catalyzed distannylation of alkynes: a general procedure.

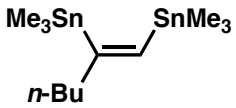
A Schlenk tube equipped with a magnetic stirring bar was charged with Cs_2CO_3 (0.060 mmol) before flame-drying under vacuum. To this were added $Cu(OAc)(PPh_3)_3$ (6.0 μmol) and DMF (0.2 mL), and the resulting mixture was stirred at room temperature for 1 h. Then tetramethyldistannane (0.30 mmol) and an alkyne (0.45 mmol) were added, and the resulting mixture was stirred at 60 °C for the period as specified in Table 2. The mixture was diluted with ethyl acetate and filtered through a Celite plug. The organic solution was washed twice with water and dried over $MgSO_4$. Evaporation of the solvent followed by preparative recycling gel permeation chromatography (chloroform or toluene as an eluent) or alumina-column chromatography (hexane as an eluent) gave the corresponding product.

(*Z*)-Oct-1-ene-1,2-diylbis(trimethylstannane) (3a)



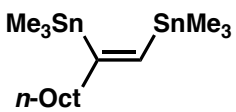
Isolated in 80% yield as a colorless oil: ^{1}H NMR ($CDCl_3$) δ 0.16 (s, $^2J_{Sn-H}$ = 53.0 Hz, 9H), 0.17 (s, $^2J_{Sn-H}$ = 51.5 Hz, 9H), 0.89 (t, *J* = 5.3 Hz, 3H), 1.27 (m, 4H), 2.33 (t, $^3J_{Sn-H}$ = 52.0 Hz, *J* = 7.5 Hz, 2H), 6.61 (s, $^3J^{119}_{Sn-H}$ = 203.4 Hz, $^3J^{117}_{Sn-H}$ = 194.3 Hz, $^2J_{Sn-H}$ = 88.9 Hz, 1H); ^{13}C NMR ($CDCl_3$) δ -7.71, -7.47, 14.09, 22.62, 28.88, 29.88, 31.72, 47.67, 142.47, 169.16; ^{119}Sn NMR ($CDCl_3$) δ -63.48, -50.93; HRMS Calcd for $C_{13}H_{29}Sn_2$: $[M\text{-}Me]^-$, 425.03077. Found: *m*/*z* 425.03107.

(*Z*)-Hex-1-ene-1,2-diylbis(trimethylstannane) (3b)



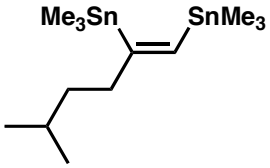
Isolated in 80% yield as a colorless oil: ^{1}H NMR ($CDCl_3$) δ 0.16 (s, $^2J_{Sn-H}$ = 52.8 Hz, 9H), 0.17 (s, $^2J_{Sn-H}$ = 51.5 Hz, 9H), 0.90 (t, *J* = 7.2 Hz, 3H), 1.32 (m, 4H), 2.34 (t, $^3J_{Sn-H}$ = 50.6 Hz, *J* = 6.4 Hz, 2H), 6.61 (s, $^3J^{119}_{Sn-H}$ = 202.7 Hz, $^3J^{117}_{Sn-H}$ = 193.7 Hz, $^2J_{Sn-H}$ = 88.2 Hz, 1H); ^{13}C NMR ($CDCl_3$) δ -7.69, -7.47, 14.00, 22.27, 32.10, 47.35, 142.51, 169.21; ^{119}Sn NMR ($CDCl_3$) δ -63.55, -50.90; HRMS Calcd for $C_{11}H_{25}Sn_2$: $[M\text{-}Me]^-$, 396.99947. Found: *m*/*z* 397.00031.

(*Z*)-Dec-1-ene-1,2-diylbis(trimethylstannane) (3c)



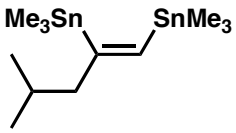
Isolated in 90% yield as a colorless oil: ^{1}H NMR ($CDCl_3$) δ 0.16 (s, $^{2}J_{Sn\text{-}H}$ = 53.4 Hz, 9H), 0.18 (s, $^{2}J_{Sn\text{-}H}$ = 52.3 Hz, 9H), 0.89 (t, J = 7.0 Hz, 3H), 1.23–1.37 (m, 8H), 2.33 (t, $^{3}J_{Sn\text{-}H}$ = 51.1 Hz, J = 6.7 Hz, 2H), 6.61 (s, $^{3}J^{119}_{Sn\text{-}H}$ = 203.1 Hz, $^{3}J^{117}_{Sn\text{-}H}$ = 194.2 Hz, $^{2}J_{Sn\text{-}H}$ = 89.6 Hz, 1H); ^{13}C NMR ($CDCl_3$) δ -7.70, -7.47, 14.12, 22.67, 29.19, 29.27, 31.87, 29.91, 29.44, 47.66, 142.46, 169.27; ^{119}Sn NMR ($CDCl_3$) δ -63.50, -50.93; HRMS Calcd for $C_{15}H_{33}Sn_2$: $[M\text{-}Me]^-$, 453.06207. Found: *m/z* 453.06271.

(*Z*)-(5-Methylhex-1-ene-1,2-diyl)bis(trimethylstannane) (3d)



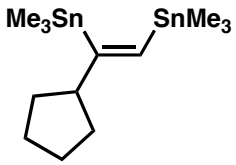
Isolated in 85% yield as a colorless oil: ^{1}H NMR ($CDCl_3$) δ 0.16 (s, $^{2}J^{119}_{Sn\text{-}H}$ = 53.8 Hz, $^{2}J^{117}_{Sn\text{-}H}$ = 51.7 Hz, 9H), 0.17 (s, $J^{119}_{Sn\text{-}H}$ = 52.5 Hz, $^{3}J^{117}_{Sn\text{-}H}$ = 50.3 Hz, 9H), 0.88 (d, J = 6.7 Hz, 6H), 1.22 (q, J = 6.7 Hz, 2H), 1.53 (nonet, J = 6.7 Hz, 1H), 2.25-2.40 (m, 2H), 6.62 (t, $^{3}J^{119}_{Sn\text{-}H}$ = 202.7 Hz, $^{3}J^{117}_{Sn\text{-}H}$ = 193.6 Hz, $^{2}J^{119}_{Sn\text{-}H}$ = 89.8 Hz, $^{2}J^{117}_{Sn\text{-}H}$ = 86.1 Hz, J = 1.2 Hz); ^{13}C NMR ($CDCl_3$) δ -7.70, -7.41, 22.60, 27.75, 39.33, 45.58, 142.37, 169.39; ^{119}Sn NMR ($CDCl_3$) δ -63.41, -50.60; HRMS Calcd for $C_{12}H_{27}Sn_2$: $[M\text{-}Me]^-$, 411.01512. Found: *m/z* 411.01593.

(*Z*)-(4-Methylpent-1-ene-1,2-diyl)bis(trimethylstannane) (3e)



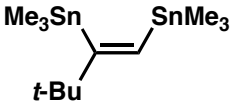
Isolated in 62% yield as a colorless oil: ^{1}H NMR ($CDCl_3$) δ 0.14 (s, $^{2}J_{Sn\text{-}H}$ = 52.9 Hz, 9H), 0.14 (s, $^{2}J_{Sn\text{-}H}$ = 51.5 Hz, 9H), 0.13 (d, J = 6.6 Hz, 6H), 1.55 (nonet, J = 6.6 Hz, 2H), 2.19 (dd, $^{3}J_{Sn\text{-}H}$ = 53.9 Hz, J = 7.4, 1.2 Hz, 2H), 6.52 (t, $^{3}J^{119}_{Sn\text{-}H}$ = 203.4 Hz, $^{3}J^{117}_{Sn\text{-}H}$ = 194.4 Hz, $^{2}J^{119}_{Sn\text{-}H}$ = 91.1 Hz, $^{2}J^{117}_{Sn\text{-}H}$ = 87.3 Hz, J = 1.2 Hz, 1H); ^{13}C NMR ($CDCl_3$) δ -7.70, -7.43, 22.19, 27.69, 57.52, 143.90, 168.37; ^{119}Sn NMR ($CDCl_3$) δ -64.50, -50.93; HRMS Calcd for $C_{11}H_{25}Sn_2$: $[M\text{-}Me]^-$, 396.99947. Found: *m/z* 397.00095.

(*Z*)-(1-Cyclopentylethene-1,2-diyl)bis(trimethylstannane) (3f)



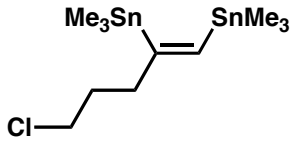
Isolated in 78% yield as a colorless oil: ^{1}H NMR ($CDCl_3$) δ 0.16 (s, $^{2}J_{^{119}Sn\text{-}H}$ = 53.8 Hz, $^{2}J_{^{117}Sn\text{-}H}$ = 51.5 Hz, 9H), 0.18 (s, $^{2}J_{^{119}Sn\text{-}H}$ = 52.1 Hz, $^{2}J_{^{117}Sn\text{-}H}$ = 50.0 Hz, 9H), 1.33–1.78 (m, 8H), 2.57–2.73 (m, 1H), 6.63 (d, $^{3}J_{^{119}Sn\text{-}H}$ = 210.0 Hz, $^{3}J_{^{117}Sn\text{-}H}$ = 200.1 Hz, $^{2}J_{Sn\text{-}H}$ = 88.2 Hz, *J* = 1.3 Hz, 1H); ^{13}C NMR ($CDCl_3$) δ -7.38, -6.66, 32.13, 24.88, 55.93, 138.80, 172.21; ^{119}Sn NMR ($CDCl_3$) δ -61.72, -53.93; HRMS Calcd for $C_{12}H_{25}Sn_2$: [M-Me]$^{-}$, 408.99947. Found: *m*/*z* 408.99896.

(*Z*)-(3,3-Dimethylbut-1-ene-1,2-diyl)bis(trimethylstannane) (3g)



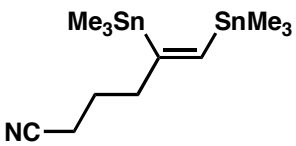
Isolated in 10% yield as a colorless oil: ^{1}H NMR ($CDCl_3$) δ 0.17 (s, $^{2}J_{Sn\text{-}H}$ = 52.8 Hz, 9H), 0.21 (s, $^{2}J_{Sn\text{-}H}$ = 50.3 Hz, 9H), 1.06 (s, 9H), 6.56 (s, $^{3}J_{^{119}Sn\text{-}H}$ = 218.7 Hz, $^{3}J_{^{117}Sn\text{-}H}$ = 209.0 Hz, $^{2}J_{Sn\text{-}H}$ = 69.6 Hz, 1H); ^{13}C NMR ($CDCl_3$) δ -6.87, -4.59, 30.02, 135.85, 178.85; ^{119}Sn NMR ($CDCl_3$) δ -60.50, -57.91; HRMS Calcd for $C_{11}H_{25}Sn_2$: [M-Me]$^{-}$, 396.99947. Found: *m*/*z* 396.99942.

(*Z*)-(5-Chloropent-1-ene-1,2-diyl)bis(trimethylstannane) (3h)



Isolated in 76% yield as a yellow oil: ^{1}H NMR ($CDCl_3$) δ 0.16 (s, $^{2}J_{^{119}Sn\text{-}H}$ = 54.3 Hz, $^{2}J_{^{117}Sn\text{-}H}$ = 51.6 Hz, 9H), 0.18 (s, $^{2}J_{^{119}Sn\text{-}H}$ = 53.0 Hz, $^{2}J_{^{117}Sn\text{-}H}$ = 50.1 Hz, 9H), 1.82 (quint, *J* = 6.6 Hz, 2H), 2.48 (t, $^{3}J_{Sn\text{-}H}$ = 48.2 Hz, *J* = 7.7 Hz, 2H), 3.50 (t, *J* = 7.0 Hz, 2H), 6.67 (s, $^{3}J_{^{119}Sn\text{-}H}$ = 195.4 Hz, $^{3}J_{^{117}Sn\text{-}H}$ = 189.6 Hz, $^{2}J_{Sn\text{-}H}$ = 84.5 Hz, 1H); ^{13}C NMR ($CDCl_3$) δ -7.70, -7.50, 32.45, 44.15, 44.36, 144.75, 166.61; ^{119}Sn NMR ($CDCl_3$) δ -62.44, -49.22; HRMS Calcd for $C_{10}H_{22}ClSn_2$: [M-Me]$^{-}$, 416.94485. Found: *m*/*z* 416.94467.

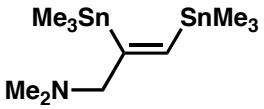
(*Z*)-5,6-Bis(trimethylstannyl)hex-5-enenitrile (3i)



Isolated in 51% yield as a brown oil: ^{1}H NMR ($CDCl_3$) δ 0.17 (s, $^{2}J_{^{119}Sn\text{-}H}$ = 54.0 Hz, $^{2}J_{^{117}Sn\text{-}H}$ = 52.1 Hz, 9H), 0.19 (s, $^{2}J_{^{119}Sn\text{-}H}$ = 52.9 Hz, $^{2}J_{^{117}Sn\text{-}H}$ = 50.5 Hz, 9H), 1.72 (quint, *J* = 7.4 Hz, 2H), 2.30 (t, *J* = 7.4 Hz, 2H), 2.38–2.55 (m, 2H), 6.69 (s, $^{3}J_{^{119}Sn\text{-}H}$ = 194.1 Hz, $^{3}J_{^{117}Sn\text{-}H}$ = 185.8 Hz, $^{2}J_{^{119}Sn\text{-}H}$ = 83.3 Hz, $^{2}J_{^{117}Sn\text{-}H}$ = 80.8 Hz, 1H); ^{13}C NMR ($CDCl_3$) δ -7.69, -7.50,

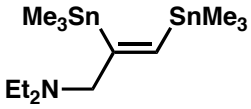
16.29, 25.00, 45.69, 119.67, 146.03, 165.67; ^{119}Sn NMR ($CDCl_3$) δ -61.85, -48.64; HRMS Calcd for $C_{11}H_{22}NSn_2$: [M-Me]$^-$, 407.97907. Found: *m/z* 407.98001.

(*Z*)-*N*,*N*-Dimethyl-2,3-bis(trimethylstannyl)prop-2-en-1-amine (3j)



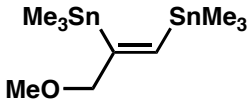
Isolated in 54% yield as a colorless oil: ^{1}H NMR ($CDCl_3$) δ 0.13 (s, $^2J_{^{119}Sn\text{-}H}$ = 53.5 Hz, $^2J_{^{117}Sn\text{-}H}$ = 51.6 Hz, 9H), 0.17 (s, $^2J_{^{119}Sn\text{-}H}$ = 54.1 Hz, $^2J_{^{117}Sn\text{-}H}$ = 52.1 Hz, 9H), 2.12 (s, 6H), 3.01 (d, $^3J_{Sn\text{-}H}$ = 48.1 Hz, *J* = 1.4 Hz, 2H), 6.73 (t, $^3J_{^{119}Sn\text{-}H}$ = 201.3 Hz, $^3J_{^{117}Sn\text{-}H}$ = 192.4 Hz, $^2J_{^{119}Sn\text{-}H}$ = 90.5 Hz, $^2J_{^{117}Sn\text{-}H}$ = 87.1 Hz, *J* = 1.4 Hz, 1H); ^{13}C NMR ($CDCl_3$) δ -7.71, -7.23, 45.03, 75.52, 142.83, 169.79; ^{119}Sn NMR ($CDCl_3$) δ -62.24, -54.24; HRMS Calcd for $C_{10}H_{24}NSn_2$: [M-Me]$^-$, 397.99472. Found: *m/z* 397.99518.

(*Z*)-*N*,*N*-Diethyl-2,3-bis(trimethylstannyl)prop-2-en-1-amine (3k)



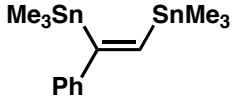
Isolated in 54% yield as a colorless oil: ^{1}H NMR ($CDCl_3$) δ 0.18 (s, $^2J_{Sn\text{-}H}$ = 53.2 Hz, 18H), 3.29 (s, 3H), 4.02 (s, $^3J_{Sn\text{-}H}$ = 39.3 Hz, 2H), 6.89 (s, $^3J_{^{119}Sn\text{-}H}$ = 190.3 Hz, $^3J_{^{117}Sn\text{-}H}$ = 183.1 Hz, $^2J_{Sn\text{-}H}$ = 84.1 Hz, 1H); ^{13}C NMR ($CDCl_3$) δ -7.61, -7.13, 10.50, 44.92, 70.14, 142.75, 169.83; ^{119}Sn NMR ($CDCl_3$) δ -63.05, -55.94; HRMS Calcd for $C_{12}H_{28}NSn_2$: [M-Me]$^-$, 426.02602. Found: *m/z* 426.02637.

(*Z*)-(3-Methoxyprop-1-ene-1,2-diyl)bis(trimethylstannane) (3l)



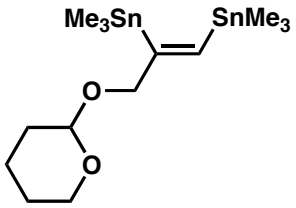
Isolated in 41% yield as a colorless oil: ^{1}H NMR ($CDCl_3$) δ 0.17 (s, $^2J_{Sn\text{-}H}$ = 52.8 Hz, 9H), 0.21 (s, $^2J_{Sn\text{-}H}$ = 50.3 Hz, 9H), 1.06 (s, 9H), 6.56 (s, $^3J_{^{119}Sn\text{-}H}$ = 218.7 Hz, $^3J_{^{117}Sn\text{-}H}$ = 209.0 Hz, $^2J_{Sn\text{-}H}$ = 69.6 Hz, 1H); ^{13}C NMR ($CDCl_3$) δ -7.78, -7.68, 57.66, 84.37, 144.71, 165.17; ^{119}Sn NMR ($CDCl_3$) δ -59.42, -48.53; ^{119}Sn NMR ($CDCl_3$) δ -62.24, -54.24; HRMS Calcd for $C_9H_{21}OSn_2$: [M-Me]$^-$, 384.96309. Found: *m/z* 384.96249.

(*Z*)-(1-Phenylethene-1,2-diyl)bis(trimethylstannane) (3m)



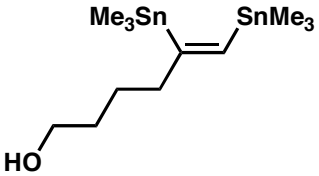
Isolated in 64% yield as a yellow oil: ^{1}H NMR ($CDCl_3$) δ 0.19 (s, $^{2}J_{^{119}Sn\text{-}H}$ = 53.4 Hz, $^{2}J_{^{117}Sn\text{-}H}$ = 51.1 Hz, 9H), 0.24 (s, $^{2}J_{^{119}Sn\text{-}H}$ = 54.5 Hz, $^{2}J_{^{117}Sn\text{-}H}$ = 52.0 Hz, 9H), 6.95 (s, $^{3}J_{^{119}Sn\text{-}H}$ = 188.1 Hz, $^{3}J_{^{117}Sn\text{-}H}$ = 179.9 Hz, $^{2}J_{^{119}Sn\text{-}H}$ = 82.7 Hz, $^{2}J_{^{117}Sn\text{-}H}$ = 79.0 Hz, 1H), 7.02–7.03 (m, 2H), 7.13–7.18 (m, 1H), 7.24–7.30 (m, 2H); ^{13}C NMR ($CDCl_3$) δ -7.47, -6.70, 125.79, 125.85, 128.07, 148.97, 150.30, 168.43; ^{119}Sn NMR ($CDCl_3$) δ -58.47, -44.84; HRMS Calcd for $C_{13}H_{21}Sn_2$: $[M\text{-}Me]^-$, 416.96817. Found: *m/z* 416.96741.

(*Z*)-(3-((Tetrahydro-2H-pyran-2-yl)oxy)prop-1-ene-1,2-diyl)bis(trimethylstannane) (3n)



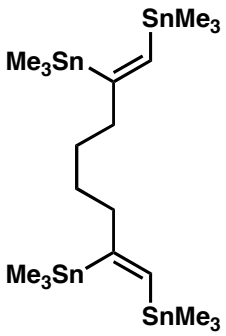
Isolated in 58% yield as a yellow green oil: ^{1}H NMR ($CDCl_3$) δ 0.18 (s, $^{2}J_{Sn\text{-}H}$ = 53.2 Hz, 9H), 0.18 (s, $^{2}J_{Sn\text{-}H}$ = 52.9 Hz, 9H), 1.47–1.65 (m, 4H), 1.66–1.75 (m, 1H), 1.70 (tt, *J* = 13.1, 3.3 Hz, 1H), 3.47–3.54 (m, 1H), 3.86 (ddd, *J* = 11.8, 8.7, 3.0 Hz, 1H), 4.06 (dd, $^{3}J_{^{119}Sn\text{-}H}$ = 34.2 Hz, *J* = 12.1, 1.6 Hz, 1H), 4.36 (dd, $^{3}J_{^{119}Sn\text{-}H}$ = 39.6 Hz, *J* = 12.0, 1.6 Hz, 1H), 4.62 (t, *J* = 3.3 Hz, 1H), 6.69 (t, $^{3}J_{^{119}Sn\text{-}H}$ = 192.6 Hz, $^{3}J_{^{117}Sn\text{-}H}$ = 184.1 Hz, $^{2}J_{^{119}Sn\text{-}H}$ = 85.2 Hz, $^{2}J_{^{117}Sn\text{-}H}$ = 81.7 Hz, *J* = 1.4 Hz, 1H); ^{13}C NMR ($CDCl_3$) δ -7.65, 7.50, 19.29, 25.42, 25.45, 30.55, 61.93, 78.74, 97.81, 144.00, 164.75; ^{119}Sn NMR ($CDCl_3$) δ -59.66, -46.49; HRMS Calcd for $C_{14}H_{30}O_2NaSn_2$: $[M+Na]^-$, 493.01820. Found: *m/z* 493.01810.

(*Z*)-5,6-Bis(trimethylstannyl)hex-5-en-1-ol (3o)



Isolated in 13% yield as a colorless oil: ^{1}H NMR ($CDCl_3$) δ 0.15 (s, $^{2}J_{Sn\text{-}H}$ = 52.8 Hz, 9H), 0.17 (s, $^{2}J_{Sn\text{-}H}$ = 51.5 Hz, 9H), 1.22 (t, *J* = 4.2 Hz, 1H), 1.41 (quint, *J* = 7.3 Hz, 2H), 1.55 (quint, *J* = 7.3 Hz, 2H), 2.35 (t, $^{3}J_{Sn\text{-}H}$ = 50.1, *J* = 7.6 Hz, 2H), 3.64 (q, *J* = 5.4 Hz, 2H), 6.62 (s, $^{3}J_{^{119}Sn\text{-}H}$ = 199.8 Hz, $^{3}J_{^{117}Sn\text{-}H}$ = 193.7 Hz, $^{2}J_{Sn\text{-}H}$ = 86.6 Hz, 1H); ^{13}C NMR ($CDCl_3$) δ -7.72, -7.49, 25.82, 32.23, 47.21, 62.84, 143.22, 168.51; ^{119}Sn NMR ($CDCl_3$) δ -63.09, -50.40; HRMS Calcd for $C_{11}H_{25}OSn_2$: $[M\text{-}Me]^-$, 412.99439. Found: *m/z* 412.99545.

(1*Z*,7*Z*)-Octa-1,7-diene-1,2,7,8-tetrayltetrakis(trimethylstannane) (3p)

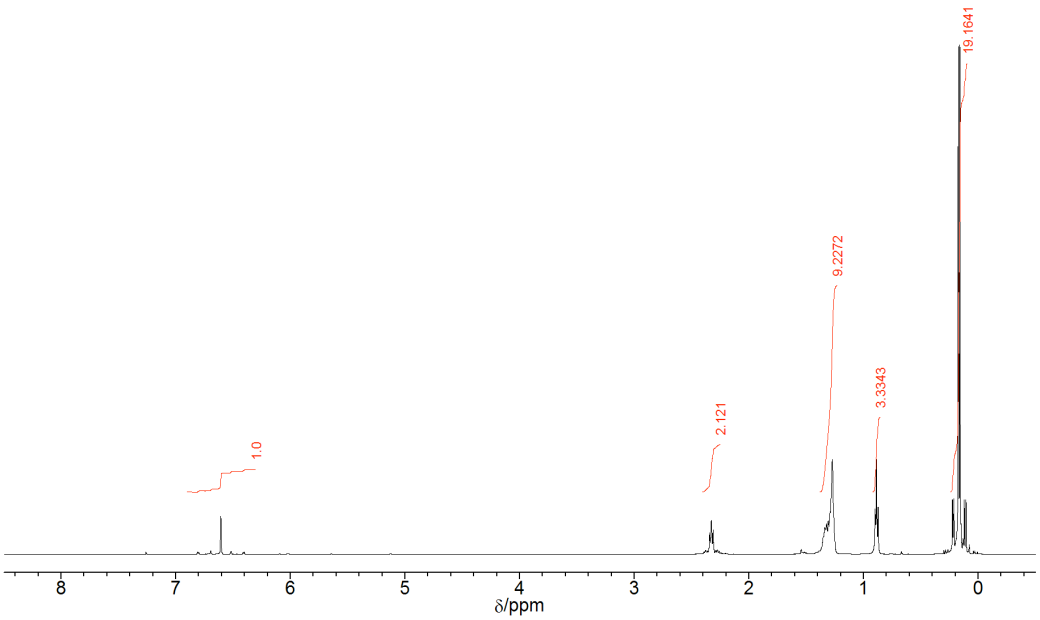


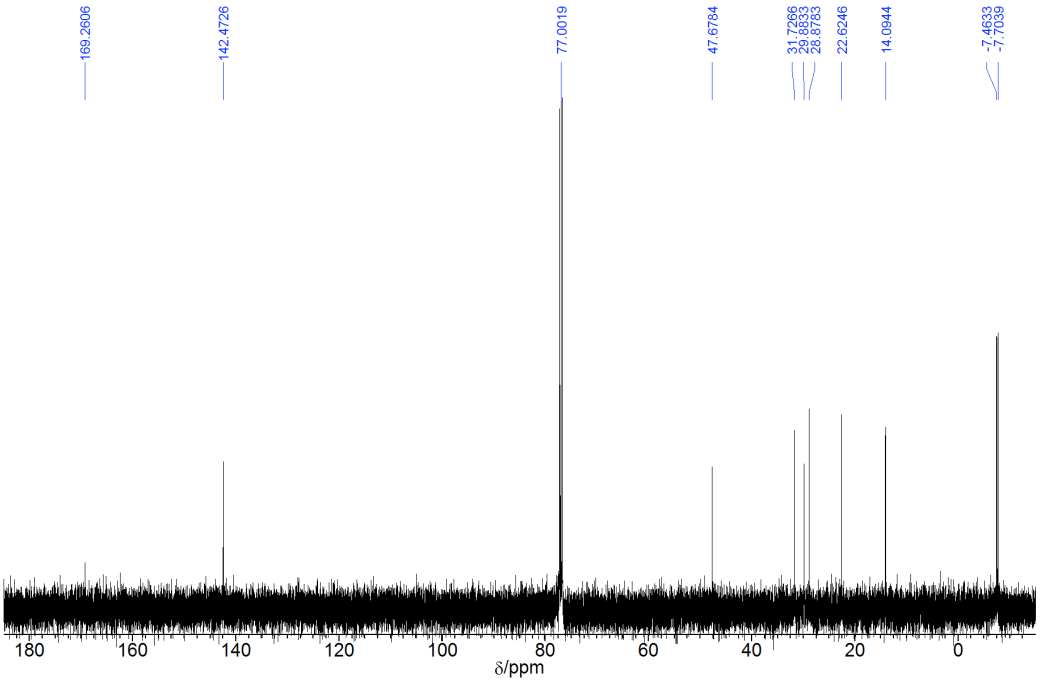
Isolated in 66% yield as a colorless oil: ^{1}H NMR ($CDCl_3$) δ 0.15 (s, $^{2}J_{^{119}Sn\text{-}H}$ = 54.1 Hz, $^{2}J_{^{117}Sn\text{-}H}$ = 51.7 Hz, 18H), 0.16 (s, $^{2}J_{^{119}Sn\text{-}H}$ = 52.7 Hz, $^{2}J_{^{117}Sn\text{-}H}$ = 50.3 Hz, 18H), 1.33 (quint, J = 3.5 Hz, 4H), 2.33 (t, $^{3}J_{Sn\text{-}H}$ = 50.7 Hz, J = 6.2 Hz, 4H), 6.60 (s, $^{3}J_{^{119}Sn\text{-}H}$ = 202.2 Hz, $^{3}J_{^{117}Sn\text{-}H}$ = 193.3 Hz, $^{2}J_{^{119}Sn\text{-}H}$ = 89.7 Hz, $^{2}J_{^{117}Sn\text{-}H}$ = 86.2 Hz, 2H); ^{13}C NMR ($CDCl_3$) δ -7.68, -7.41, 29.45, 47.44, 142.84, 168.91; ^{119}Sn NMR ($CDCl_3$) δ -63.33, -50.65; HRMS Calcd for $C_{19}H_{43}Sn_4$: $[M\text{-}Me]^-$, 750.94472. Found: m/z 750.94637.

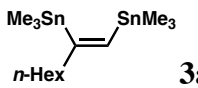
References

1 G. F. Smith, H. G. Kuivila, R. Simon and L. Sultan, *J. Am. Chem. Soc.*, 1981, **103**, 833.

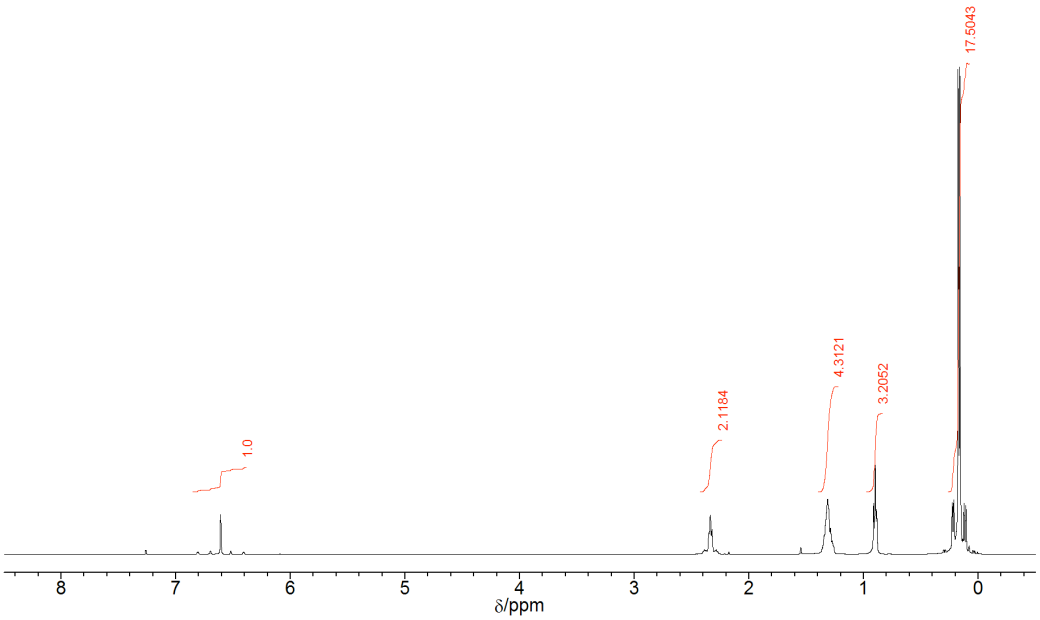
2 B. Hammond, F. H. Jardine and A. G. Vohra, *J. Inorg. Nucl. Chem.*, 1971, **33**, 1017.

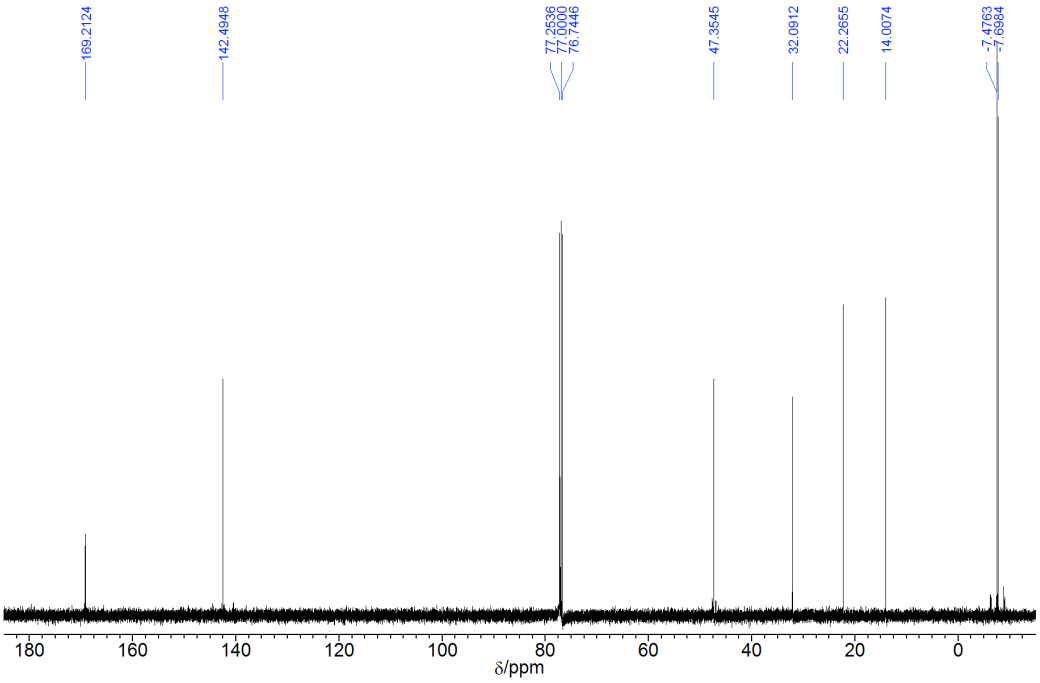

19.1641
9.2272
3.3343
2.121
1.0
8
7
6
5
4
3
2
1
0
δ/ppm

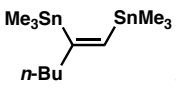

169.2606
142.4726
77.0019
47.6784
31.7366
29.8833
28.8783
22.6246
14.0944
-7.4633
-7.7039
180
160
140
120
100
80
60
40
20
0
δ/ppm


Me3Sn
SnMe3
n-Hex

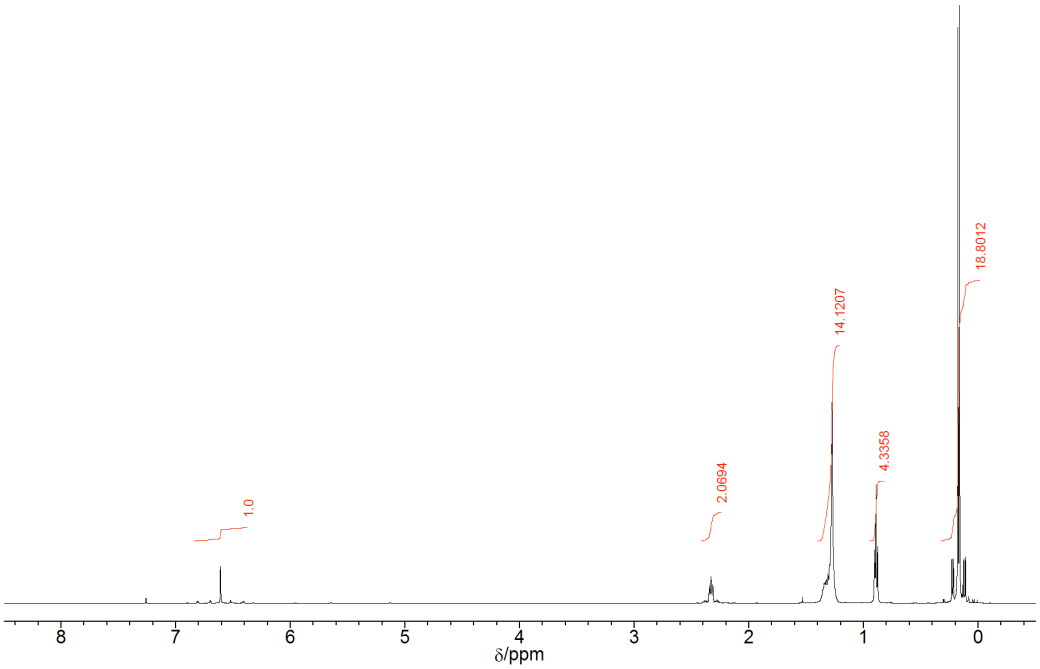
3a

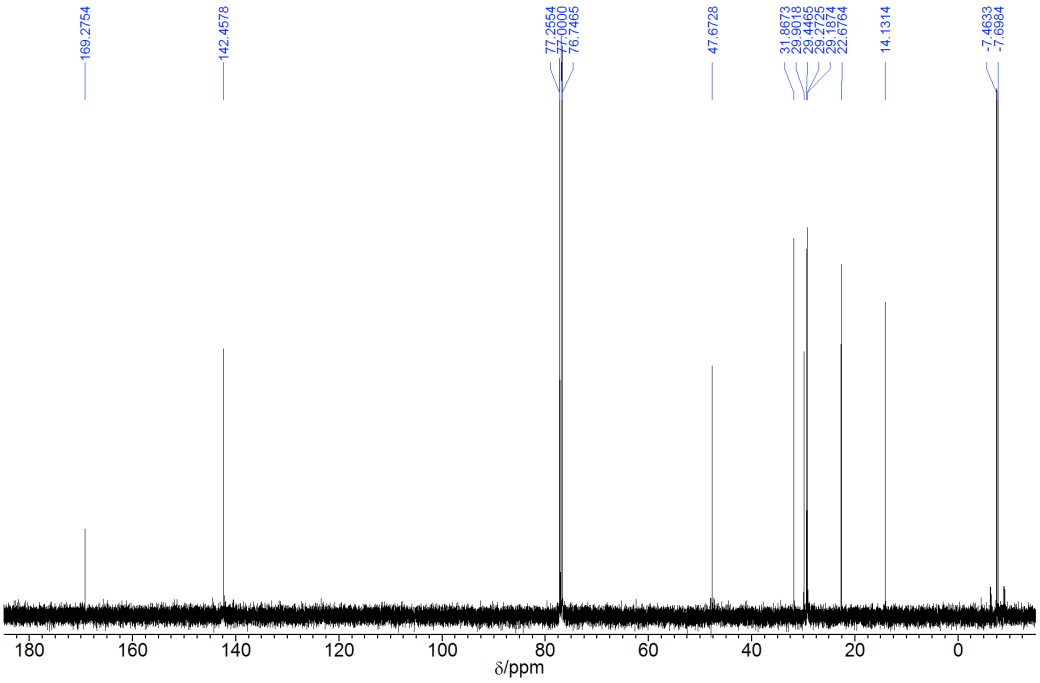

17.5043
4.3121
3.2052
2.1184
1.0
8
7
6
5
4
3
2
1
0
δ/ppm

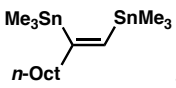

169.2124
142.4948
77.2536
77.0000
76.7446
47.3545
32.0912
22.2655
14.0074
-7.4763
-7.6984
180
160
140
120
100
80
60
40
20
0
δ/ppm


Me3Sn
SnMe3
n-Bu

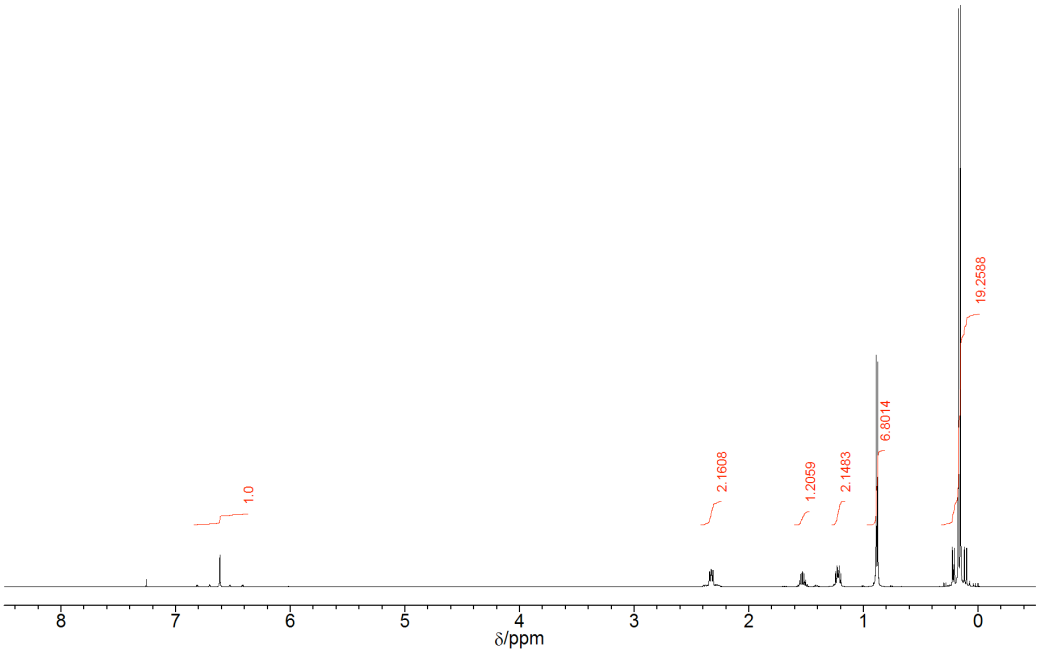
3b

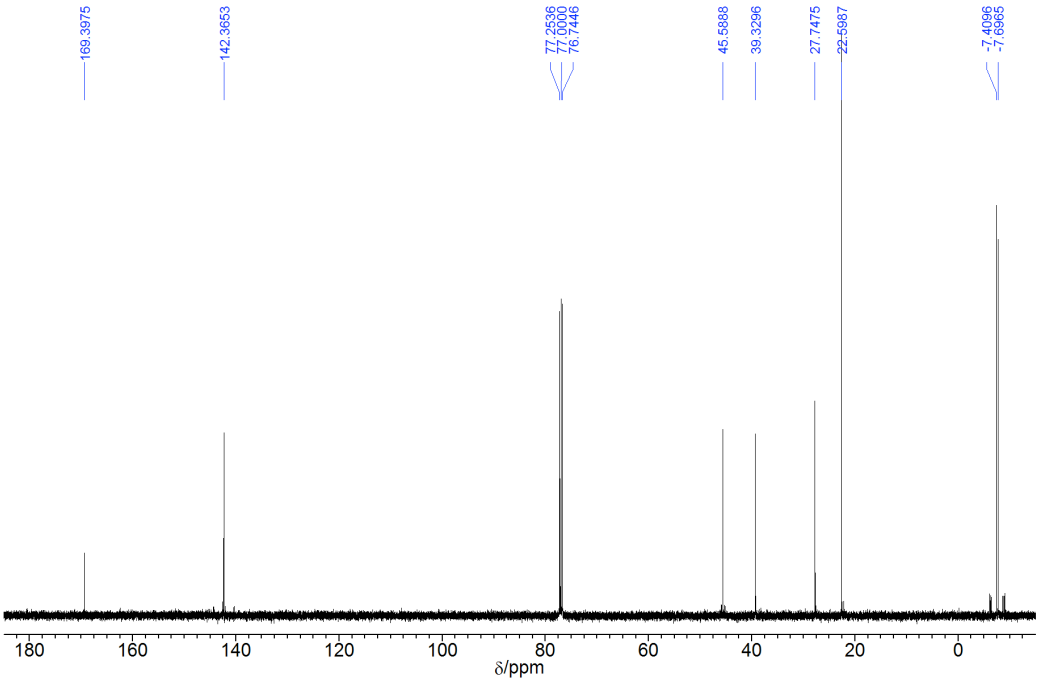

1.0
2.0694
14.1207
4.3358
18.8012
δ/ppm

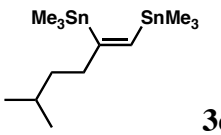

169.2754
142.4578
77.2554
77.0000
76.7465
47.6728
31.8673
29.9018
29.4456
29.1874
22.6764
14.1314
-7.4633
-7.6984
δ/ppm


Me3Sn
SnMe3
n-Oct

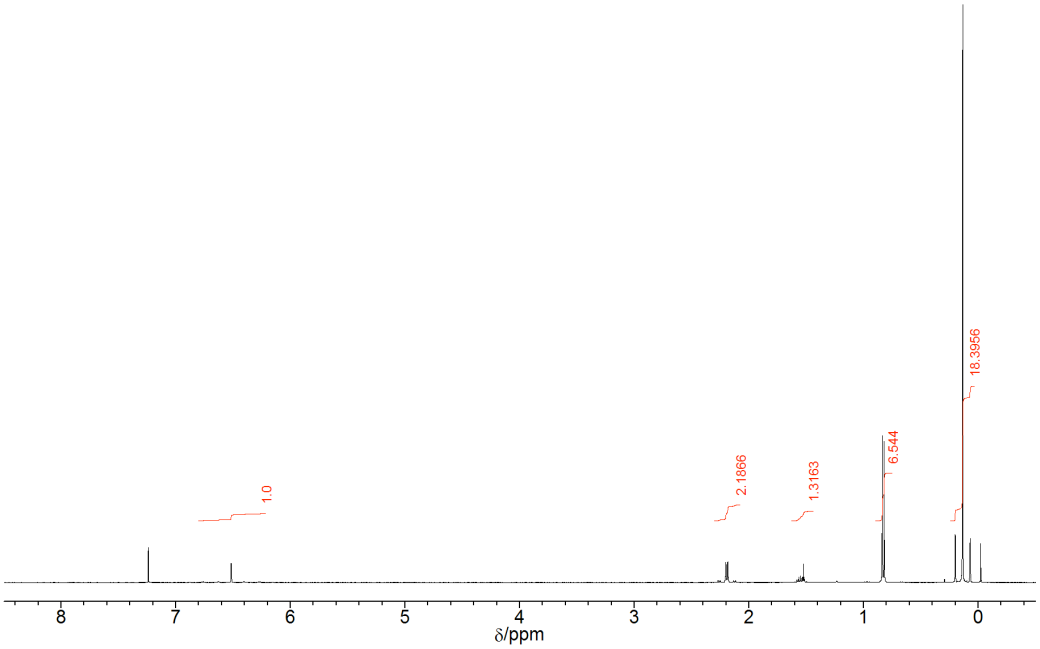
3c

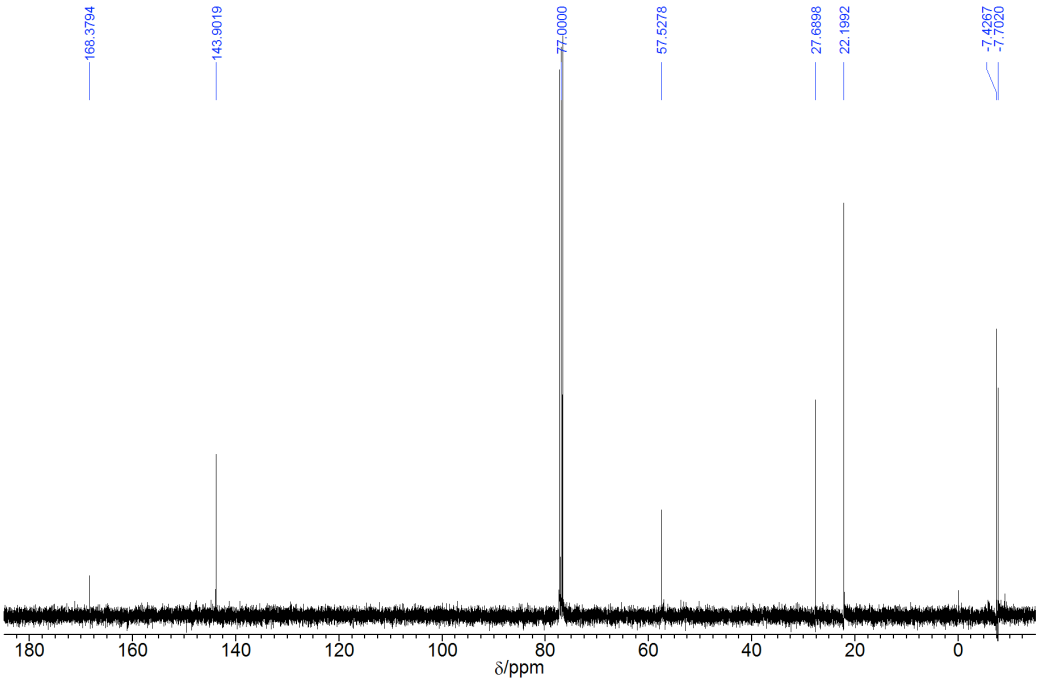


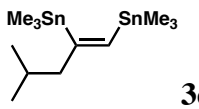




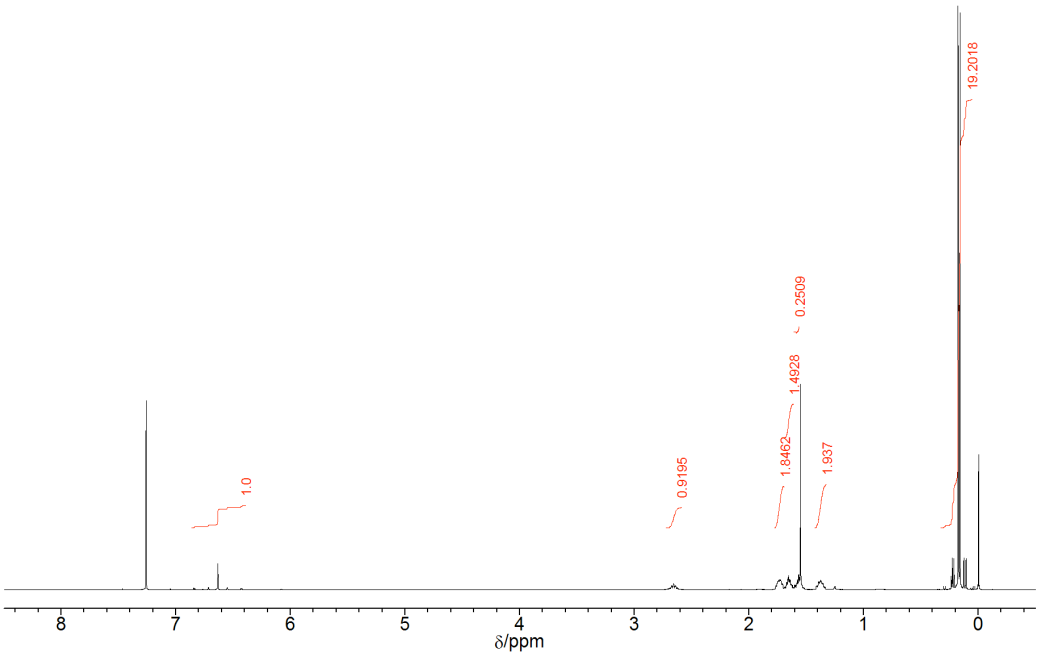
3d

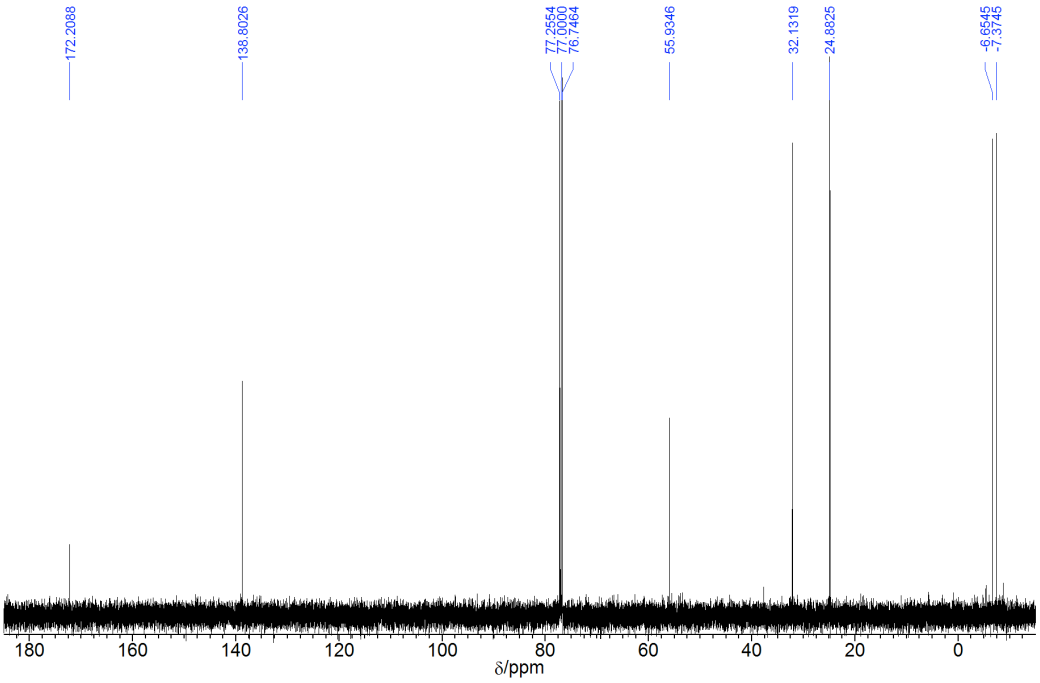

1.0
2.1866
1.3163
6.544
18.3956
8
7
6
5
4
3
2
1
0
δ/ppm

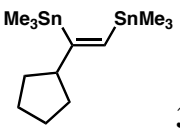

168.3794
143.9019
77.0000
57.5278
27.6898
22.1992
-7.4267
-7.7020
180
160
140
120
100
80
60
40
20
0
δ/ppm


Me3Sn
SnMe3

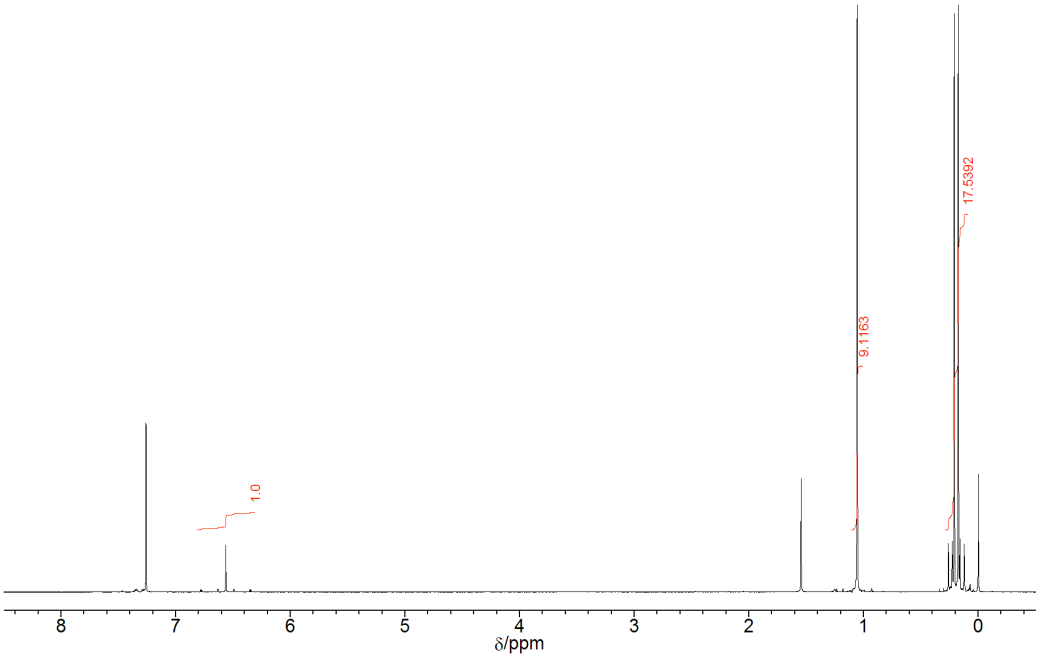
3e

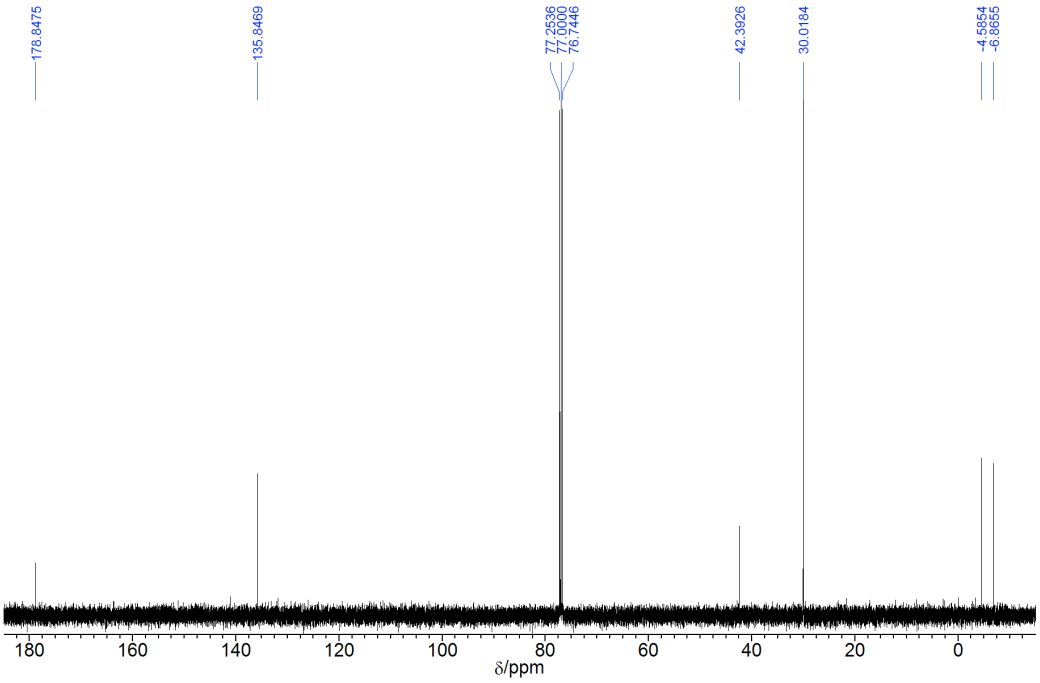

1.0
0.9195
1.8462
1.4928
0.2509
1.937
19.2018
δ/ppm

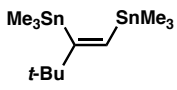

172.2088
138.8026
77.2554
77.0000
76.7464
55.9346
32.1319
24.8825
-6.6545
-7.3745
δ/ppm


Me3Sn
SnMe3

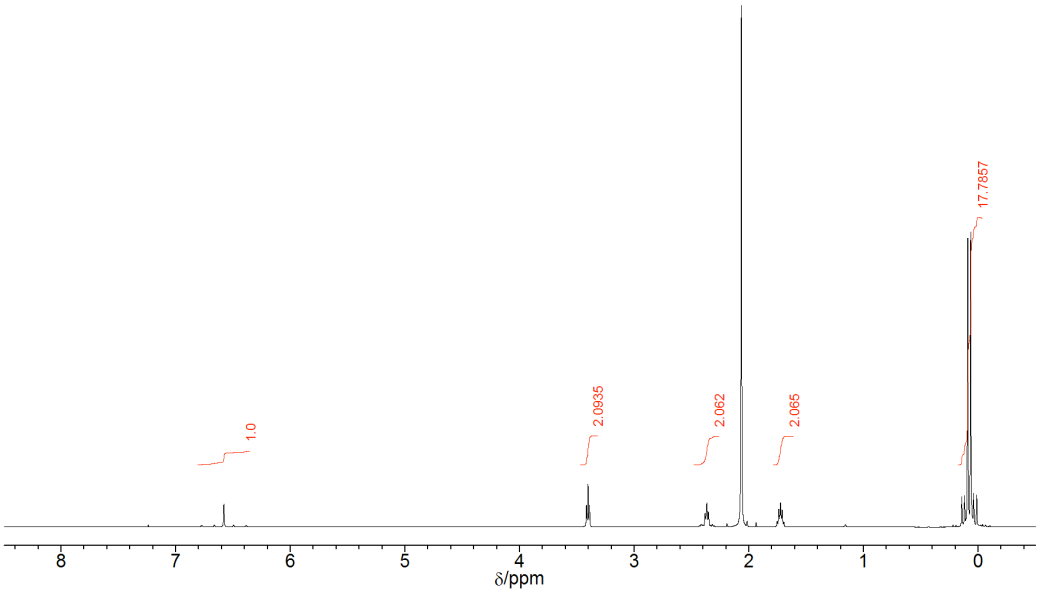
3f

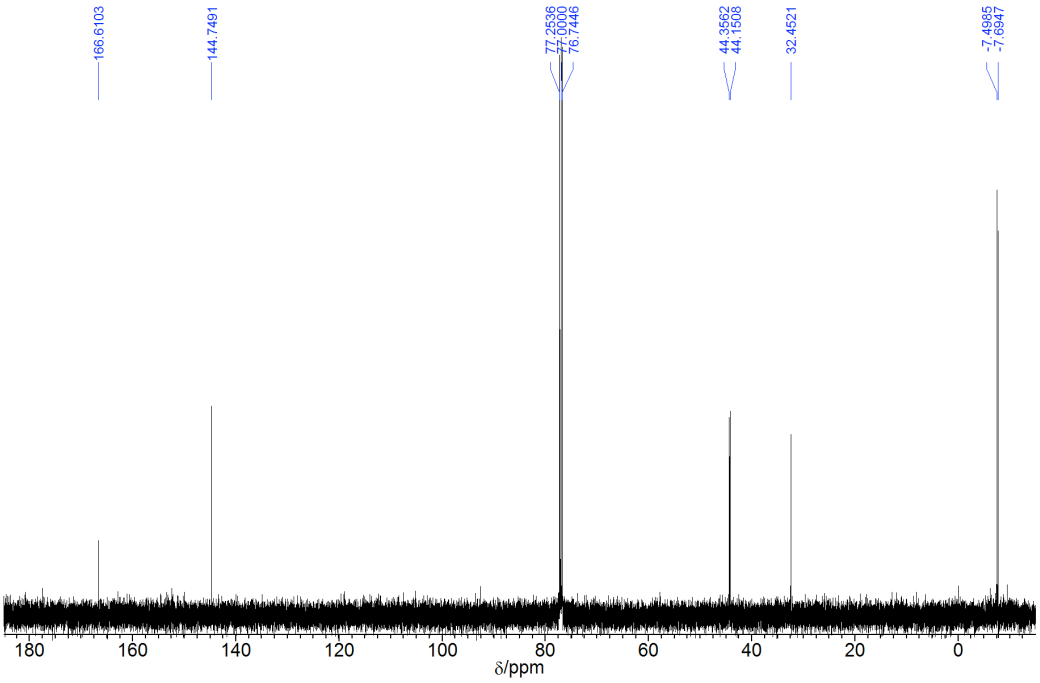

1.0
9.1163
17.5392
8
7
6
5
4
3
2
1
0
δ/ppm

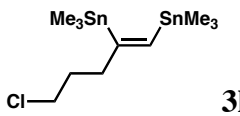

178.8475
135.8469
77.2536
77.0000
76.7446
42.3926
30.0184
-4.5854
-6.8655
180
160
140
120
100
80
60
40
20
0
δ/ppm


Me3Sn
SnMe3
t-Bu

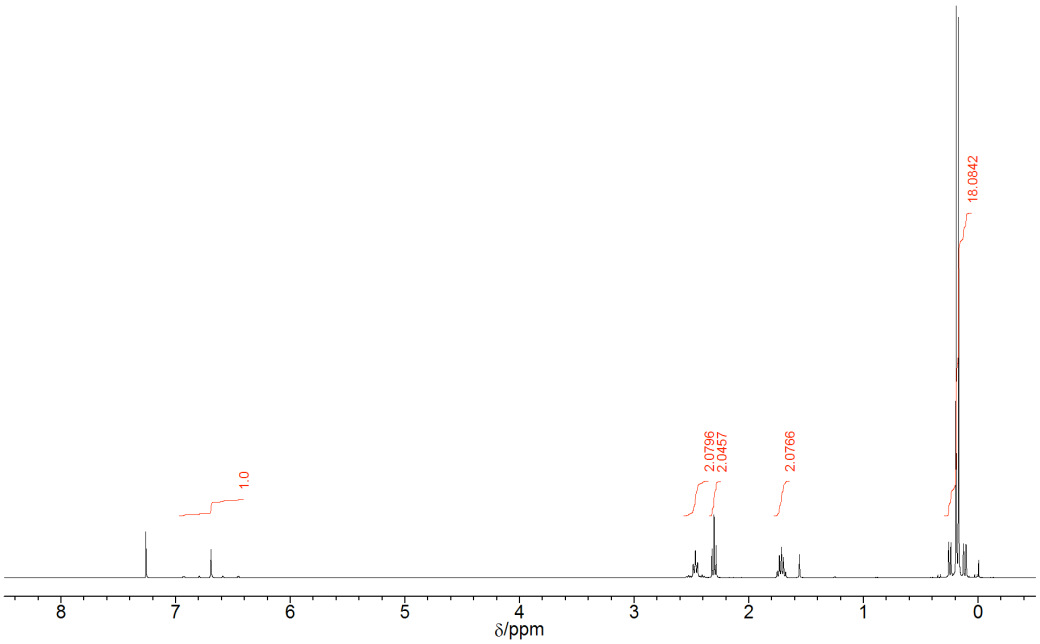
3g

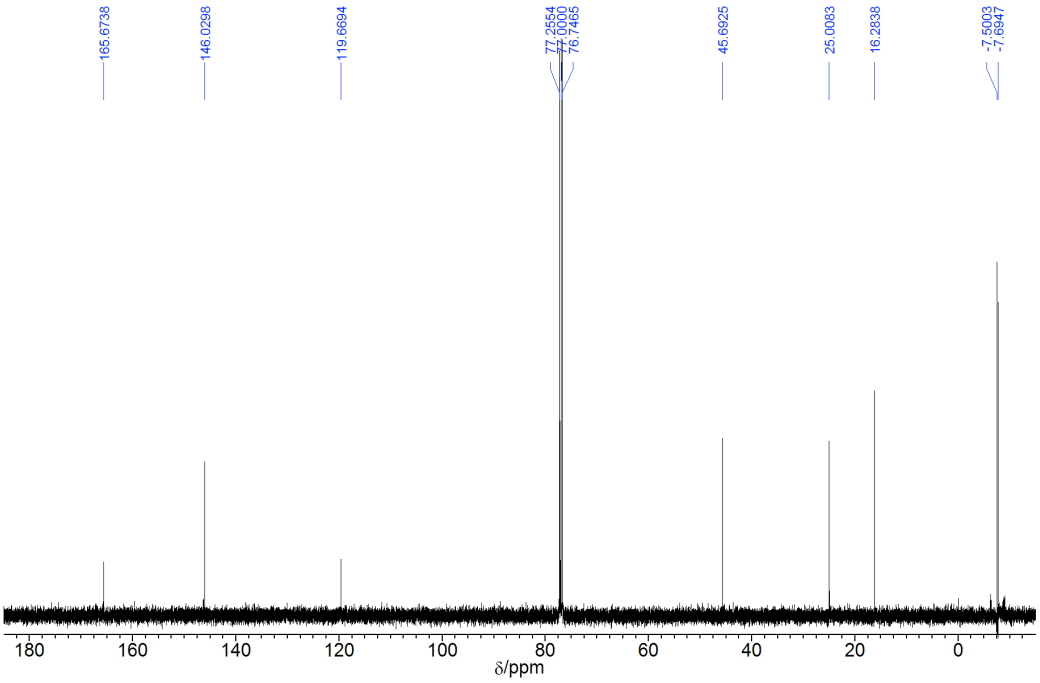

1.0
2.0935
2.062
2.065
17.7857
δ/ppm

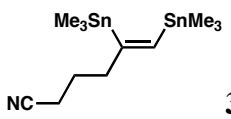

166.6103
144.7491
77.2536
77.0000
76.7446
44.3562
44.1508
32.4521
-7.4985
-7.6947
δ/ppm


Me3Sn
SnMe3
Cl

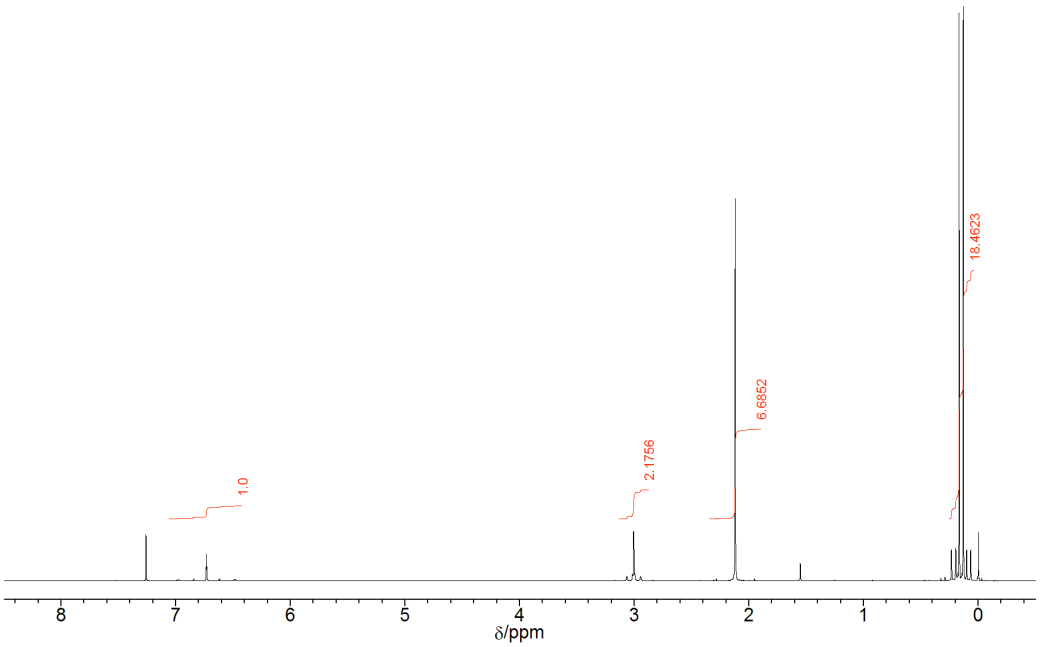
3h

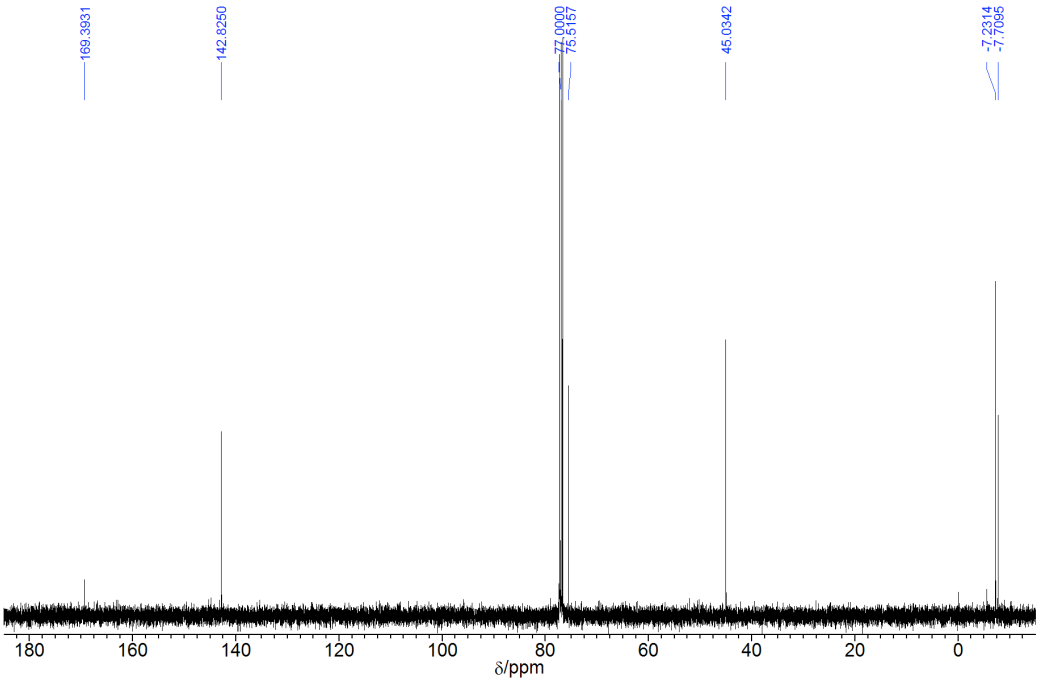


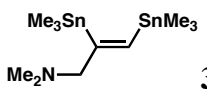




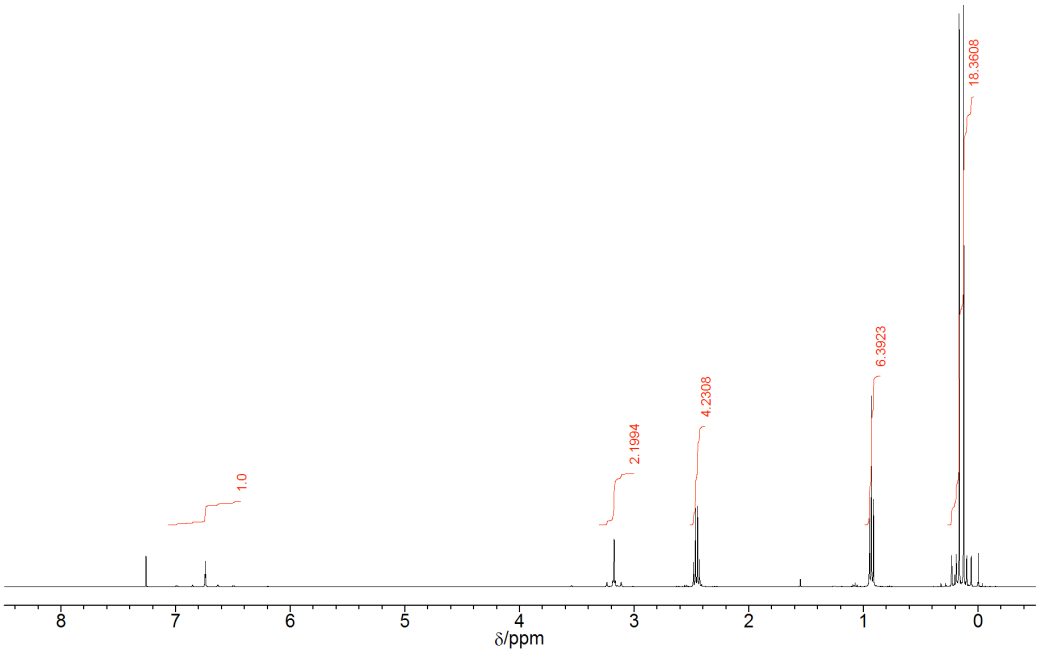
3i

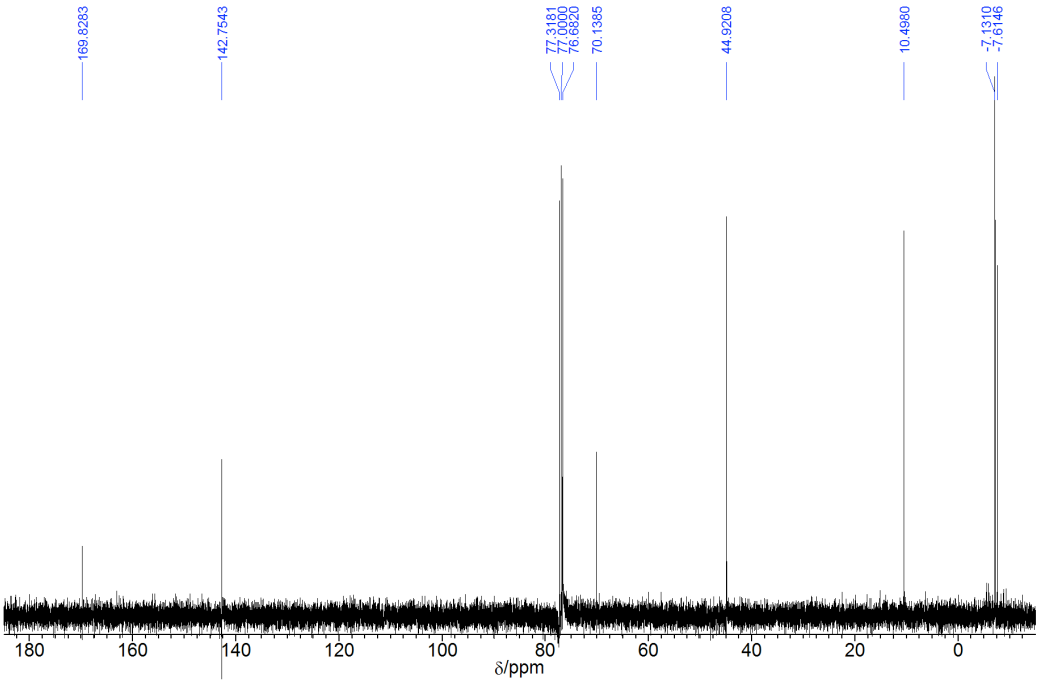

1.0
2.1756
6.6852
18.4623
8
7
6
5
4
3
2
1
0
δ/ppm

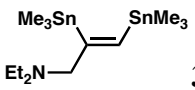

169.3931
142.8250
77.0000
75.5157
45.0342
-7.2314
-7.7095
180
160
140
120
100
80
60
40
20
0
δ/ppm


Me3Sn
SnMe3
Me2N

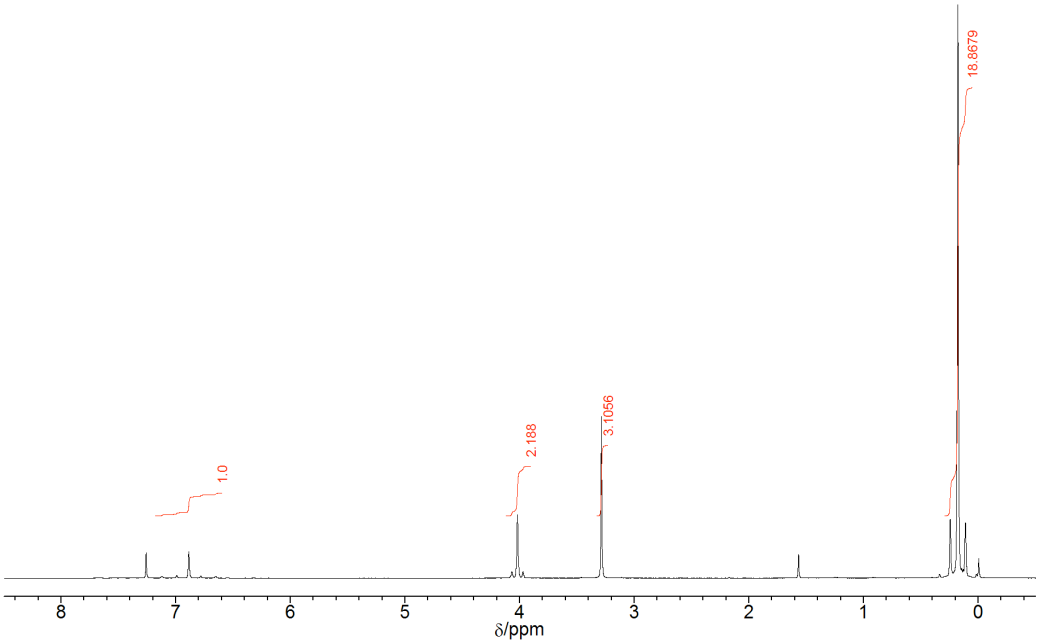
3j

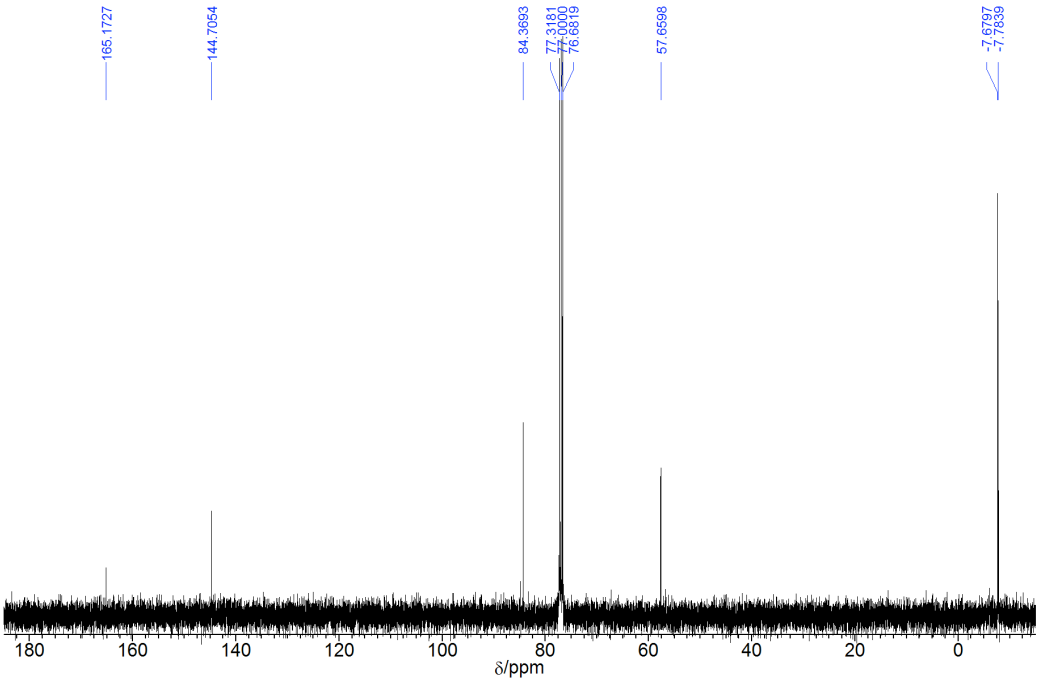

1.0
2.1994
4.2308
6.3923
18.3608
δ/ppm

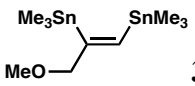

169.8283
142.7543
77.3181
77.0000
76.6820
70.1385
44.9208
10.4980
-7.1310
-7.6146
δ/ppm


Me3Sn
SnMe3
Et2N

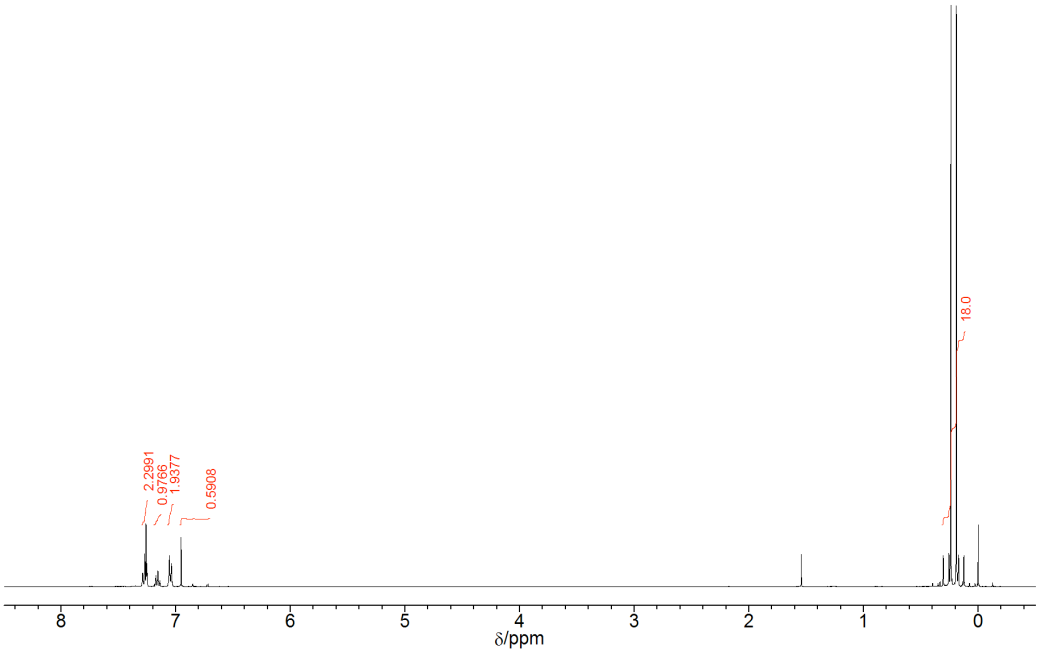
3k

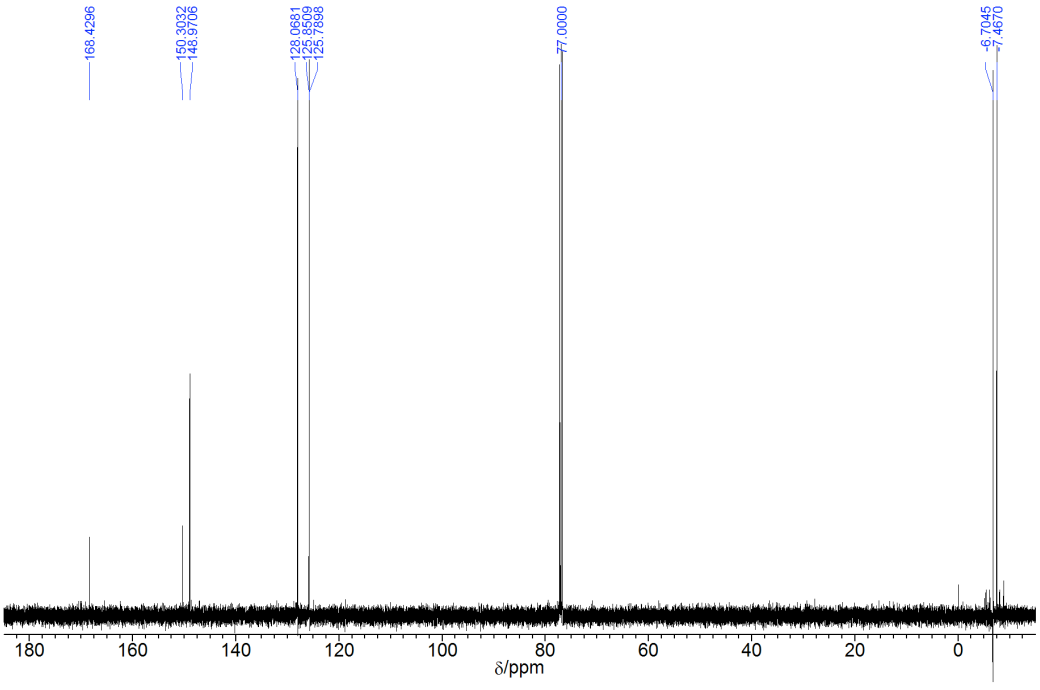

18.8679
3.1056
2.188
1.0
8
7
6
5
4
3
2
1
0
δ/ppm

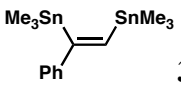

165.1727
144.7054
84.3693
77.3181
77.0000
76.6819
57.6598
-7.6797
-7.7839
180
160
140
120
100
80
60
40
20
0
δ/ppm


Me3Sn
SnMe3
MeO

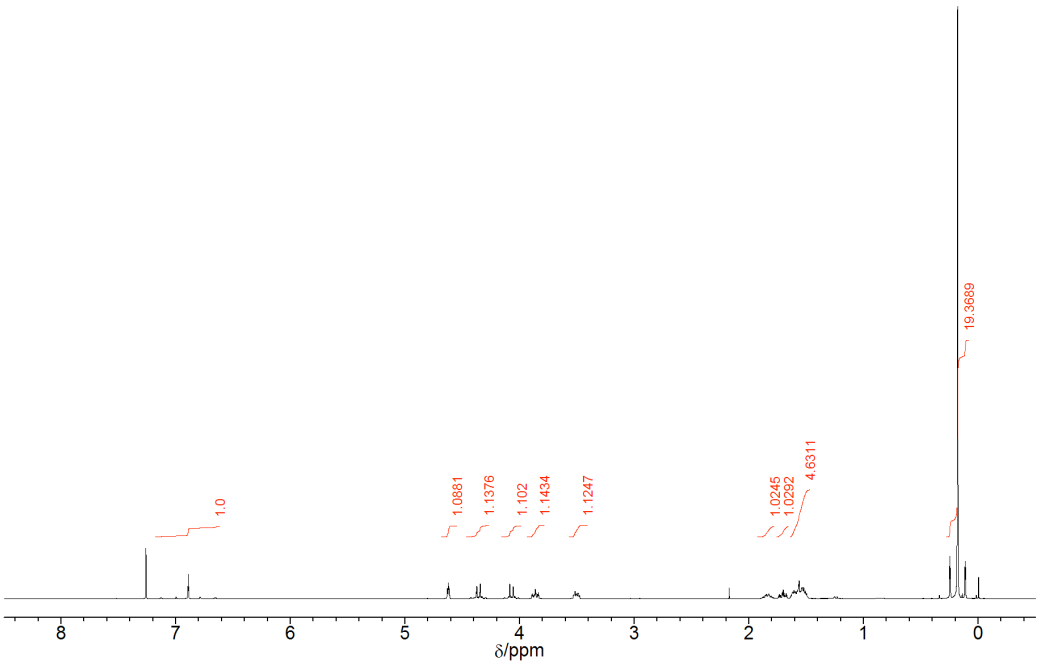
3l

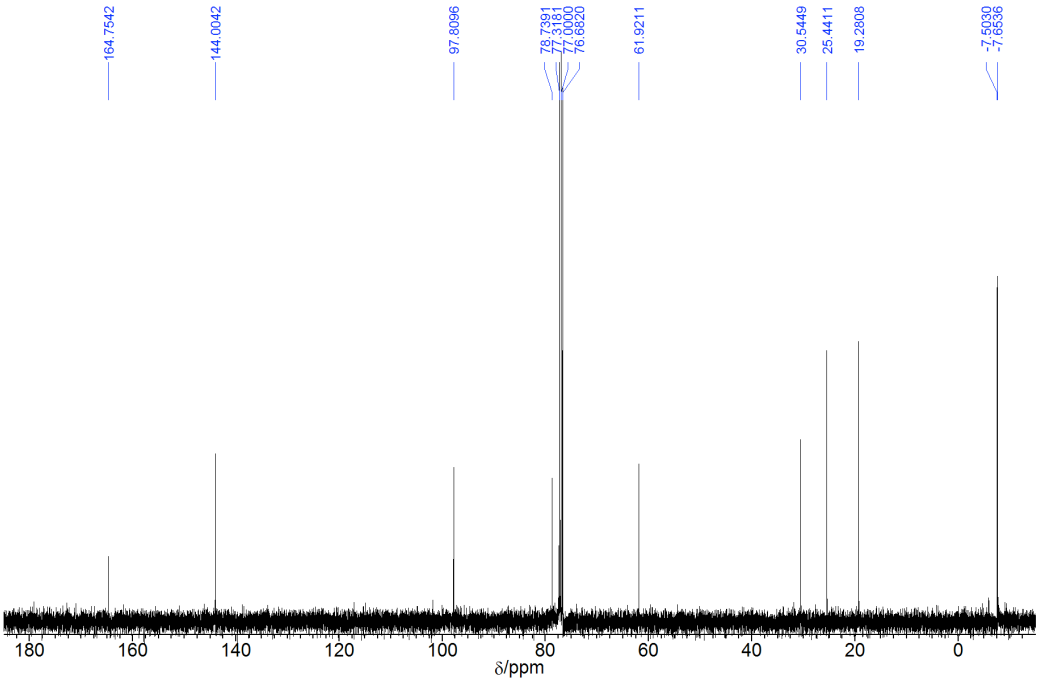

2.2991
0.9765
1.9377
0.5908
18.0
δ/ppm

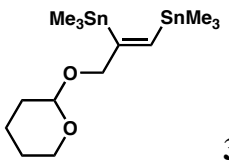

168.4296
150.3032
148.9706
128.0681
125.8509
125.7898
77.0000
-6.7045
-7.4670
δ/ppm


Me3Sn
SnMe3
Ph

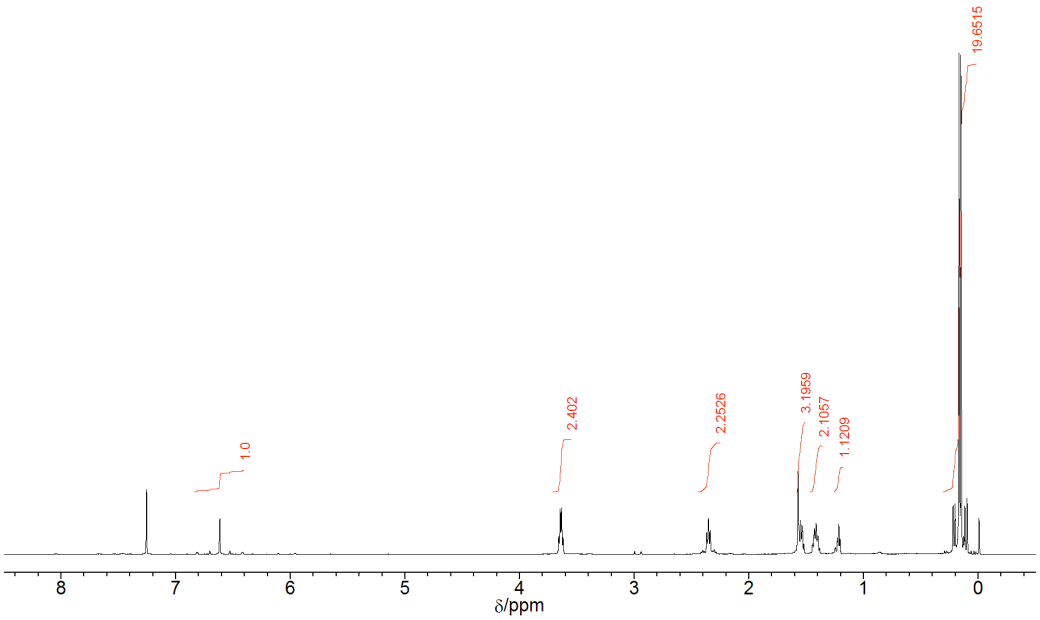
3m

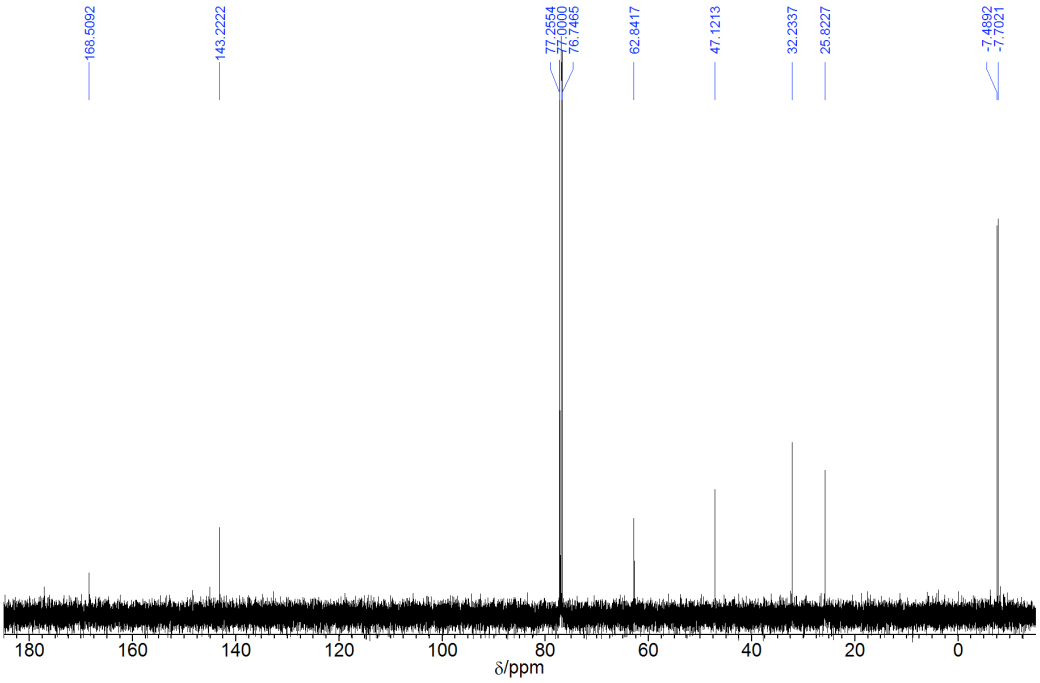

1.0
1.0881
1.1376
1.102
1.1434
1.1247
1.0245
1.0292
4.6311
19.3689
δ/ppm

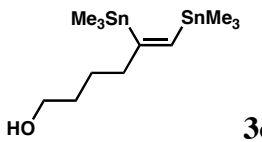

164.7542
144.0042
97.8096
78.7391
77.3181
77.0000
76.6820
61.9211
30.5449
25.4411
19.2808
-7.5030
-7.6536
δ/ppm


Me3Sn
SnMe3
O
O

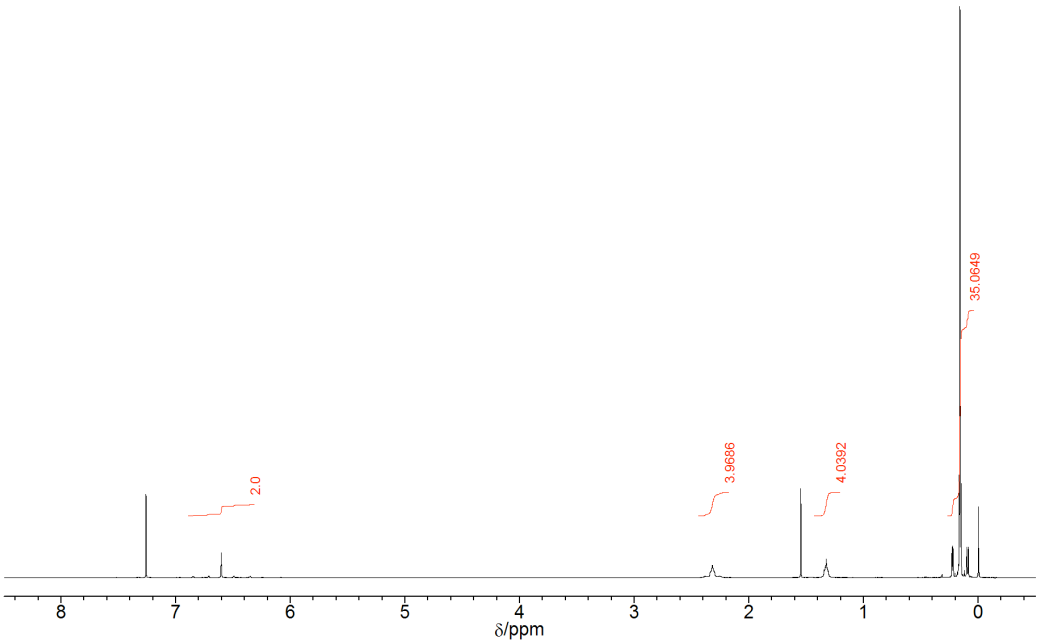
3n

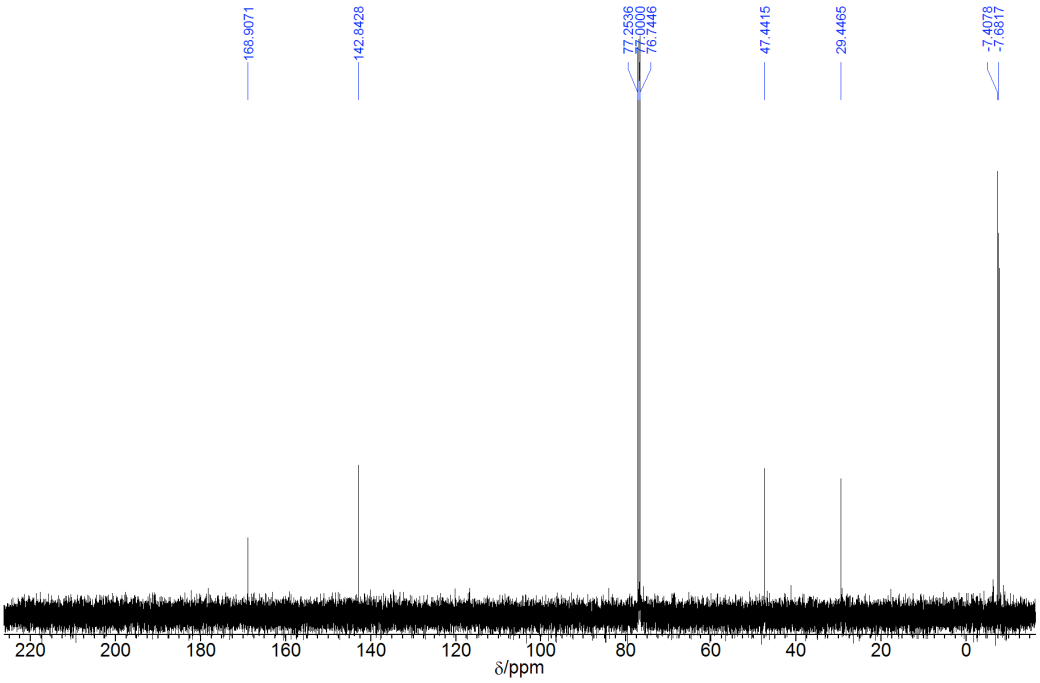


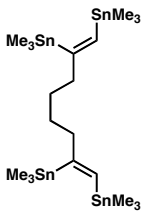




3o







3p