Preparation of chitosan/cellulose composite copper catalyst for green synthesis in the construction of C-Si bond in aqueous phase

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Dedicated to the 80th anniversary celebration of Hubei Engineering University

1. Different raw material ratios of chitosan/cellulose composite microsphere

In order to prepare cross-linked-chitosan-cellulose composite microbeads with good morphology, three different ratios of chitosan and cellulose were prepared according to the procedure of 2.3.1 Preparation of the support material. As a result, while the mass ratios of chitosan and cellulose were 2:1 could obtain better morphology of **CC@Cu**, while 1:1 and 3:1 were unable to form a complete sphere.

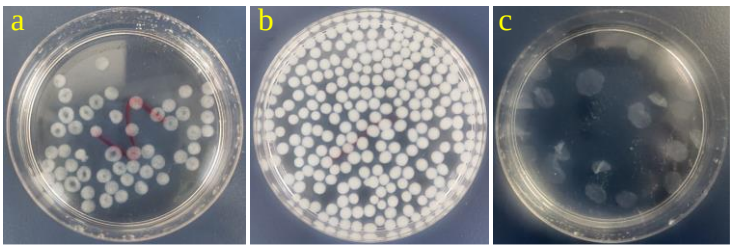
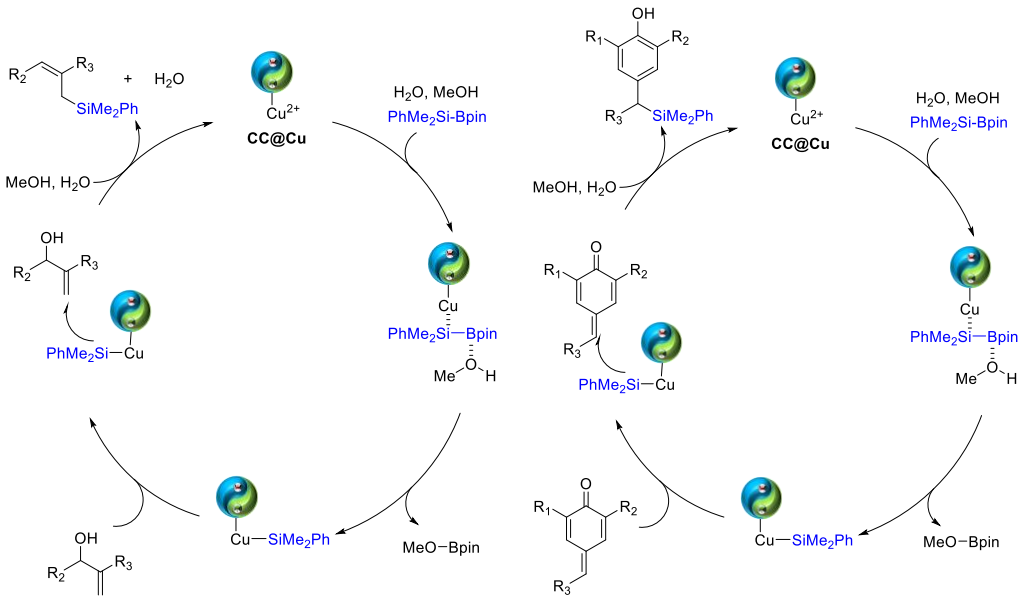


Fig S1. (a)chitosan **:** cellulose =1:1; (b)chitosan **:** cellulose =2:1; (c)chitosan **:** cellulose =3:1;

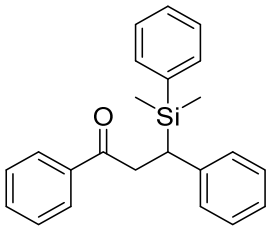
2. Proposed mechanism for the reaction of MBH alcohols and quinones



3. Characterization data for products

Most of adducts are literature-known and obtained characterization data for these compounds is in full agreement with reported data.

3-(Dimethyl(phenyl)silyl)-1,3-diphenylpropan-1-one 3a

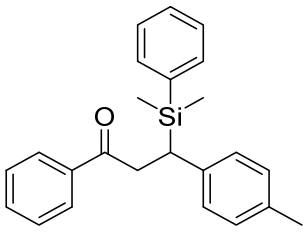


White solid

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.76 – 7.73 (m, 2H), 7.48 – 7.44 (m, 1H), 7.42 – 7.39 (m, 2H), 7.36 – 7.28 (m, 5H), 7.15 – 7.11 (m, 2H), 7.08 – 7.02 (m, 1H), 6.95 – 6.93 (m, 2H), 3.49 (dd, *J* = 17.1, 10.2 Hz, 1H), 3.19 – 3.05 (m, 2H), 0.26 (s, 3H), 0.20 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 199.1, 142.4, 137.1, 136.9, 134.2, 132.8, 129.4, 128.5, 128.1, 128.0, 127.8, 127.7, 124.8, 39.0, 31.1, – 3.8, – 5.1.

3-(Dimethyl(phenyl)silyl)-1-phenyl-3-(*p*-tolyl)propan-1-one 3b

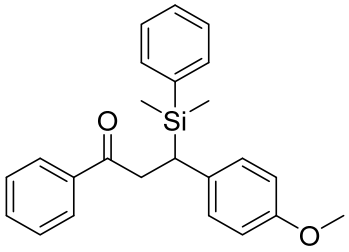


Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.79 (d, *J* = 7.6 Hz, 2H), 7.52 – 7.46 (m, 3H), 7.40 – 7.33 (m, 5H), 7.00 (d, *J* =7.8 Hz, 2H), 6.89 (d, *J* = 7.7 Hz, 2H), 3.49 (dd, *J*= 17.0, 10.4 Hz, 1H), 3.21 – 3.04 (m, 2H), 2.27 (s, 3H), 0.30 (s, 3H), 0.23 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 199.2, 139.1, 137.10, 137.05, 134.2, 134.1, 132.8, 129.3, 128.9, 128.5, 128.0, 127.8, 127.6, 39.0, 30.6, 21.0, – 3.7, – 5.2.

3-(Dimethyl(phenyl)silyl)-3-(4-methoxyphenyl)-1-phenylpropan-1-one 3c

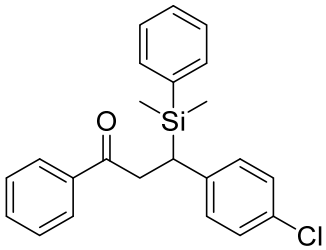


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.80 – 7.78 (m, 2H), 7.52 – 7.45 (m, 3H), 7.41 – 7.33 (m, 5H), 6.93 – 6.88 (m, 2H), 6.75 – 6.72 (m, 2H), 3.75 (s, 3H), 3.46 (dd, *J* = 17.0, 10.5 Hz, 1H), 3.21 – 3.01 (m, 2H), 0.30 (s, 3H), 0.24 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 199.4, 157.0, 137.1, 137.0, 134.21, 134.19, 132.8, 129.3, 128.6, 128.5, 128.0, 127.8, 113.6, 55.2, 39.2, 30.1, – 3.8, – 5.2.

3-(4-Chlorophenyl)-3-(dimethyl(phenyl)silyl)-1-phenylpropan-1-one 3d

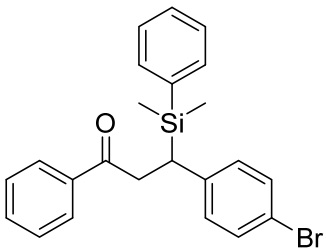


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.80 – 7.78 (m, 2H), 7.54 – 7.50 (m, 1H), 7.45 – 7.34 (m, 7H), 7.15 – 7.13 (m, 2H), 6.90 – 6.88 (m, 2H), 3.48 (dd, *J* = 17.2, 10.6 Hz, 1H), 3.23 – 3.08 (m, 2H), 0.30 (s, 3H), 0.26 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 198.8, 141.0, 136.9, 136.3, 134.2, 133.0, 130.4, 129.5, 128.9, 128.6, 128.2, 127.94, 127.90, 38.7, 30.7, – 4.0, – 5.2.

3-(4-Dromophenyl)-3-(dimethyl(phenyl)silyl)-1-phenylpropan-1-one 3e



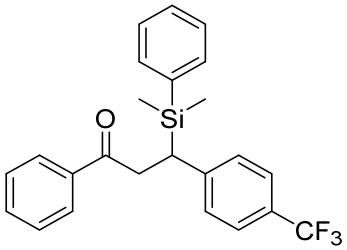
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.79 – 7.77 (m, 2H), 7.54 – 7.49 (m, 1H), 7.44 – 7.33 (m, 7H), 7.28 – 7.26 (m, 2H), 6.85 – 6.81 (m, 2H), 3.46 (dd, *J* = 17.2, 10.6 Hz, 1H), 3.22 – 3.03 (m, 2H), 0.30 (s, 3H), 0.25 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 198.7, 141.6, 136.9, 136.3, 134.2, 133.0, 131.1, 129.5, 129.3, 128.5, 127.9, 127.9, 118.4, 38.7, 30.8, – 4.0, – 5.2.

HRMS (ESI$^+$) calcd for $C_{23}H_{23}BrOSiNa$ $[M+Na]^+$: 445.0590; found 445.0594.

3-(Dimethyl(phenyl)silyl)-1-phenyl-3-(4-(trifluoromethyl)phenyl)propan-1-one 3f



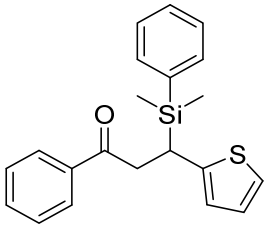
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.82 – 7.80 (m, 2H), 7.55 – 7.51 (m, 1H), 7.44 – 7.34 (m, 9H), 7.08 (d, *J* = 8 Hz, 2H), 3.56 (dd, *J* = 17.4, 10.5 Hz, 1H), 3.28 – 3.18 (m, 2H), 0.32 (s, 3H), 0.27 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 198.5, 147.0, 136.8, 136.0, 134.1, 133.1, 129.6, 128.6, 128.0, 127.9, 127.7, 127.1, 126.8, 125.8, 125.10, 125.06, 125.03, 124.99, 123.1, 38.5, 31.5, – 4.0, – 5.2.

HRMS (ESI$^+$) calcd for $C_{23}H_{23}F_3OSiNa$ $[M+Na]^+$: 435.1364; found 435.1362.

3-(Dimethyl(phenyl)silyl)-1-phenyl-3-(thiophen-2-yl)propan-1-one 3g



Brown oil

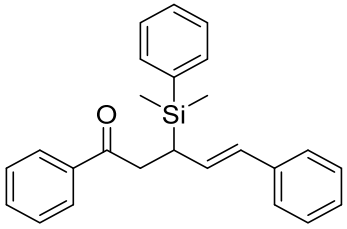
^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.81 – 7.79 (m, 2H), 7.53 – 7.48 (m, 3H), 7.41

– 7.33 (m, 5H), 6.97 – 6.96 (m, 1H), 6.85 – 6.83 (m, 1H), 6.60 – 6.59 (m, 1H), 3.48 – 3.41 (m, 2H), 3.20 – 3.12 (m, 1H), 0.39 (s, 3H), 0.31 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 198.6, 146.0, 137.0, 136.6, 134.1, 132.9, 129.5, 128.5, 128.0, 127.9, 126.7, 123.1, 121.5, 40.6, 26.2, – 3.8, – 5.1.

HRMS (ESI$^+$) calcd for $C_{21}H_{22}OSSiNa$ $[M+Na]^+$: 373.1060; found 373.1053.

(*E*)-3-(dimethyl(phenyl)silyl)-1,5-diphenylpent-4-en-1-one 3h

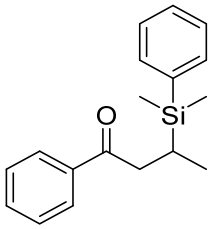


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.62 – 7.59 (m, 2H), 7.35 – 7.29 (m, 3H), 7.22 – 7.16 (m, 5H), 7.06 – 7.00 (m, 4H), 6.96 – 6.92 (m, 1H), 5.99 – 5.88 (m, 2H), 2.94 – 2.81 (m, 2H), 2.49 – 2.43 (m,1H), 0.18 (s, 3H), 0.17 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 199.5, 138.0, 137.0, 136.8, 134.1, 132.9, 130.7, 129.4, 128.6, 128.4, 128.3, 128.1, 127.9, 126.5, 125.8, 38.2, 29.2, – 4.1, – 5.0.

3-(Dimethyl(phenyl)silyl)-1-phenylbutan-1-one 3i

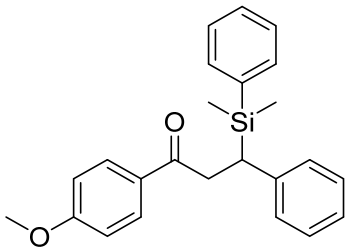


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.83 – 7.81 (m, 2H), 7.55 – 7.51 (m, 3H), 7.43 – 7.37 (m ,5H), 3.02 (dd, *J* = 15.8, 3.3 Hz, 1H), 2.68 – 2.61 (m, 1H), 1.63 – 1.59 (m, 1H), 0.98 (d, *J*=7.3 Hz, 3H), 0.33 (s, 3H), 0.32 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 200.7, 137.6, 137.1, 134.0, 132.8, 129.2, 128.5, 128.1, 127.9, 40.7, 15.9, 14.6, – 4.7, – 5.4.

3-(Dimethyl(phenyl)silyl)-1-(4-methoxyphenyl)-3-phenylpropan-1-one 3j

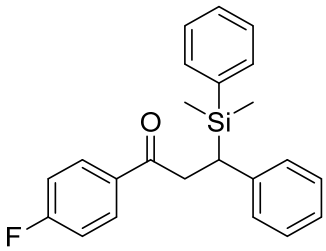


Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.83 – 7.77 (m, 2H), 7.46 – 7.44 (m, 2H), 7.39 – 7.33 (m, 3H), 7.19 – 7.15 (m, 2H), 7.08 – 7.04 (m, 1H), 7.00 – 6.97 (m, 2H), 6.88 – 6.84 (m,2H), 3.84 (s, 3H), 3.49 (dd, *J* = 16.6, 10.0 Hz, 1H), 3.18 – 3.09 (m, 2H), 0.30 (s, 3H), 0.24 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 197.6, 163.2, 142.5, 136.9, 134.2, 130.3, 130.2, 129.3, 128.1, 127.8, 127.7, 124.8, 113.6, 55.5, 38.5, 31.2, – 3.8, – 5.1.

3-(Dimethyl(phenyl)silyl)-1-(4-fluorophenyl)-3-phenylpropan-1-one 3k



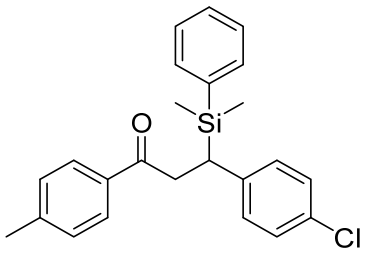
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.82 – 7.79 (m, 2H), 7.46 – 7.33 (m, 5H), 7.21 – 7.17 (m, 2H), 7.10 – 6.98 (m, 5H), 3.49 (dd, *J* = 17.0, 10.3 Hz, 1H), 3.20 – 3.06 (m, 2H), 0.31 (s, 3H), 0.25 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 197.6, 166.8, 164.3, 142.2, 136.8, 134.2, 133.5, 133.4, 130.6, 130.5, 129.4, 128.2, 127.8, 127.7, 124.9, 115.6, 115.4, 38.9, 31.2, – 3.8, – 5.4.

HRMS (ESI^{+}) calcd for $C_{23}H_{23}FOSiNa$ $[M+Na]^{+}$: 385.1401; found 385.1394.

3-(4-Chlorophenyl)-3-(dimethyl(phenyl)silyl)-1-(*p*-tolyl)propan-1-one 3l



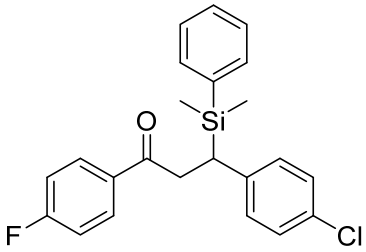
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.70 – 7.68 (m, 2H), 7.44 – 7.33 (m, 5H), 7.20 – 7.18 (m, 2H), 7.14 – 7.10 (m, 2H), 6.90 – 6.86 (m, 2H), 3.44 (dd, *J* = 16.9, 10.4 Hz, 1H), 3.19 – 3.04 (m, 2H), 2.38 (s, 3H), 0.29 (s, 3H), 0.23 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 198.4, 143.8, 141.1, 136.4, 134.4, 134.2, 130.3, 129.5, 129.2, 128.9, 128.2, 128.1, 127.9, 38.5, 30.8, 21.7, – 4.0, – 5.2.

HRMS (ESI^{+}) calcd for $C_{24}H_{25}ClOSiNa$ $[M+Na]^{+}$: 415.1260; found 415.1255.

3-(4-Chlorophenyl)-3-(dimethyl(phenyl)silyl)-1-(4-fluorophenyl)propan-1-one 3m

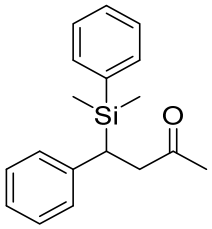


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.82 – 7.78 (m, 2H), 7.44 – 7.33 (m, 5H), 7.15 – 7.12 (m ,2H), 7.08 – 7.03 (m, 2H), 6.95 – 6.86 (m, 2H), 3.42 (dd, *J* = 17.1, 10.6 Hz, 1H), 3.18 – 3.02 (m, 2H), 0.29 (s, 3H), 0.25 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 197.2, 166.9, 164.3, 140.9, 136.3, 134.1, 133.30, 133.28, 130.6, 130.51, 130.46, 129.5, 128.8, 128.3, 127.9, 115.7, 115.5, 38.7, 30.8, – 4.0, – 5.3.

4-(Dimethyl(phenyl)silyl)-4-phenylbutan-2-one 3n

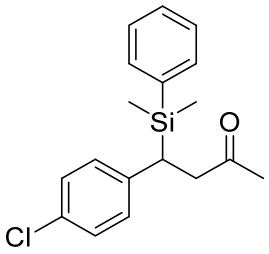


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.42 – 7.32 (m, 5H), 7.22 – 7.17 (m, 2H), 7.11 – 7.06 (m, 1H),6.95 – 6.93 (m, 2H), 2.96 – 2.87 (m, 2H), 2.68 – 2.59 (m, 1H), 1.95 (s, 3H), 0.24 (s, 3H), 0.22 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 208.3, 142.0, 136.6, 134.2, 129.4, 128.2, 127.8, 127.6, 124.9, 44.0, 31.4, 30.0, – 4.0, – 5.4.

4-(4-Chlorophenyl)-4-(dimethyl(phenyl)silyl)butan-2-one 3o



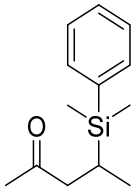
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.42 – 7.32 (m, 5H), 7.17 – 7.13 (m, 2H), 6.86 – 6.82 (m, 2H), 2.90 – 2.82 (m, 2H), 2.87 – 2.60 (m, 1H), 1.96 (s, 3H), 0.23 (s, 3H), 0.22 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 207.7, 140.7, 136.1, 134.1, 130.5, 129.5, 128.8, 128.3, 127.9, 43.8, 30.9, 30.1, – 4.2, – 5.3.

HRMS (ESI^{+}) calcd for $C_{18}H_{21}ClOSiNa$ $[M+Na]^{+}$: 339.0944; found 339.0942.

4-(Dimethyl(phenyl)silyl)pentan-2-one 3p

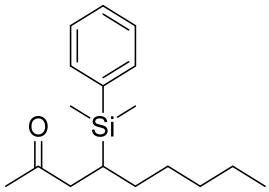


Pale yellow liquid

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.51 – 7.48 (m, 2H), 7.38 – 7.35 (m, 3H), 2.44 – 2.39 (m, 1H), 2.21 – 2.14 (m, 1H), 2.07 (s, 3H), 1.54 – 1.45 (m, 1H), 0.93 (d, *J* = 7.3 Hz, 3H), 0.28 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 209.5, 137.5, 133.9, 129.1, 127.8, 45.9, 30.0, 15.2, 14.5, – 4.8, – 5.3.

4-(Dimethyl(phenyl)silyl)nonan-2-one 3q

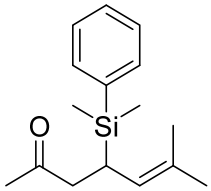


Yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.52 – 7.48 (m, 2H), 7.38 – 7.33 (m, 3H), 2.43 – 2.28 (m, 2H), 2.03 (s, 3H), 1.53 – 1.44 (m, 2H), 1.26 – 1.15 (m, 7H), 0.85 – 0.81 (m, 3H), 0.28 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 209.3, 138.2, 133.9, 129.0, 127.8, 44.6, 32.1, 30.5, 29.9, 28.9, 22.5, 20.3, 14.1, – 3.8, – 4.3.

4-(Dimethyl(phenyl)silyl)-6-methylhept-5-en-2-one 3r

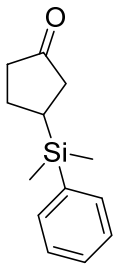


Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.49 – 7.47 (m, 2H), 7.38 – 7.32 (m, 3H), 4.85 – 4.81 (m, 1H), 2.46 – 2.25 (m, 3H), 2.01 (s, 3H), 1.67 (s, 3H), 1.50 (s, 3H), 0.28 (s, 3H), 0.26 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 209.7, 137.2, 134.0, 130.8, 129.2, 127.7, 123.8, 44.4, 29.6, 25.9, 24.9, 18.1, – 4.4, – 5.4.

3-(Dimethyl(phenyl)silyl)cyclopentan-1-one 3s

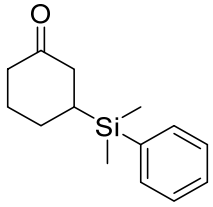


Pale yellow liquid

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.52 – 7.49 (m, 2H), 7.42 – 7.34 (m, 3H), 2.31 – 2.20 (m, 2H), 2.16 – 2.05 (m, 2H), 1.93 – 1.85 (m, 1H), 1.74 – 1.50 (m, 2H), 0.33 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 221.3, 137.0, 133.9, 129.4, 128.0, 40.2, 39.4, 25.0, 24.0, – 4.89, – 4.94.

3-(Dimethyl(phenyl)silyl)cyclohexan-1-one 3t

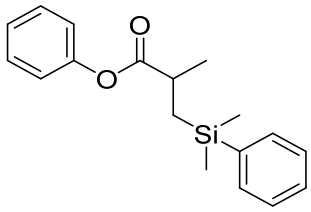


Pale yellow liquid

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.48 – 7.46 (m, 2H), 7.38 – 7.34 (m, 3H), 2.39 – 2.10 (m, 5H), 1.83 – 1.61 (m, 2H), 1.47 – 1.25 (m, 2H), 0.30 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 212.8, 136.6, 133.9, 129.3, 127.9, 42.4, 41.9, 29.8, 27.7, 26.1, – 5.3, – 5.4.

Phenyl 3-(dimethyl(phenyl)silyl)-2-methylpropanoate 3u



Colorless oil

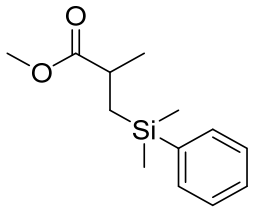
^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.59 – 7.56 (m, 2H), 7.41 – 7.35 (m, 5H), 7.24

– 7.20 (m, 1H), 7.01 – 6.98 (m, 2H), 2.82 – 2.76 (m, 1H), 1.50 – 1.44 (m, 1H), 1.32 (d, *J* = 12.3 Hz, 3H), 1.09 – 1.03 (m, 1H), 0.39 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 178.4, 153.2, 141.0, 136.0, 131.7, 131.5, 130.3, 128.02, 123.8, 38.3, 27.4, 23.0, 0.1, 0.0.

HRMS (ESI$^+$) calcd for $C_{18}H_{22}O_2Si$ [M+Na]$^+$: 321.1283; found 321.1281.

Methyl 3-(dimethyl(phenyl)silyl)-2-methylpropanoate 3v

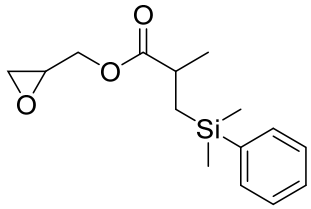


Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.51 – 7.49 (m, 2H), 7.36 – 7.34 (m, 3H), 3.54 (s, 3H), 2.58 – 2.49 (m ,1H), 1.28 – 1.22 (m, 1H), 1.15 (d, *J* = 6.8 Hz, 3H), 0.94 (dd, *J* = 7.0, 14.9 Hz, 1H), 0.29 (d, *J* = 2.5 Hz, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 177.9, 138.7, 133.6, 129.0, 127.8, 51.5, 35.5, 20.9, 20.7, – 2.5, – 2.6.

Oxiran-2-ylmethyl 3-(dimethyl(phenyl)silyl)-2-methylpropanoate 3w



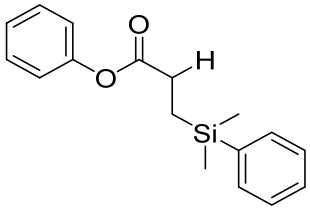
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.52 – 7.49 (m, 2H), 7.37 – 7.34 (m, 3H), 4.29 – 4.20 (m, 1H), 3.80 – 3.71 (m, 1H), 3.16 – 3.11 (m, 1H), 2.83 – 2.81 (m, 1H), 2.61 – 2.55 (m, 2H), 1.33 – 1.27 (m, 1H), 1.17 (d, *J* = 7.0 Hz, 3H), 0.96 – 0.91 (m, 1H), 0.32 – 0.28 (m, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 179.6, 141.0, 136.0, 131.5, 130.2, 67.3, 51.8, 47.1, 38.0, 23.2, 0.0, – 0.1.

HRMS (ESI$^+$) calcd for $C_{15}H_{22}O_3Si$ [M+Na]$^+$: 301.1226; found 301.1230.

Phenyl 3-(dimethyl(phenyl)silyl)propanoate 3x



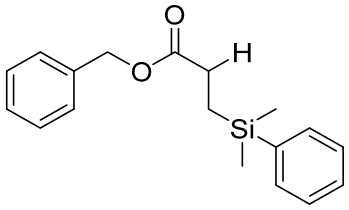
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.57 – 7.54 (m, 2H), 7.41 – 7.35 (m, 5H), 7.24 – 7.20 (m, 1H), 7.05 – 7.03 (m, 2H), 2.56 – 2.52 (m, 2H), 1.25 – 1.21 (m, 2H), 0.69 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 173.5, 150.8, 138.0, 133.7, 129.4, 129.3, 128.0, 125.7, 121.5, 29.1, 10.9, – 3.2.

HRMS (ESI$^+$) calcd for $C_{17}H_{20}O_2Si$ [M+Na]$^+$: 307.1121; found 307.1125.

Benzyl 3-(dimethyl(phenyl)silyl)propanoate 3y

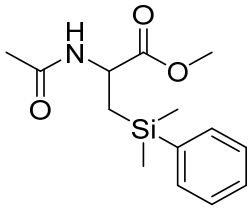


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.50 – 7.48 (m, 2H), 7.36 – 7.33 (m, 8H), 5.06 (s, 2H), 2.35 – 2.31 (m, 2H), 1.13 – 1.09 (m, 2H), 0.28 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 174.8, 138.1, 136.0, 133.6, 129.1, 128.6, 128.3, 128.2, 127.9, 66.3, 28.9, 25.0, 10.8, – 3.3.

Methyl 2-acetamido-3-(dimethyl(phenyl)silyl)propanoate 3z

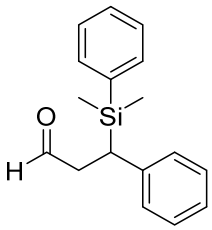


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.50 – 7.48 (m, 2H), 7.39 – 7.36 (m, 3H), 5.64 – 5.62 (m, 1H), 4.64 – 4.58 (m, 1H), 3.57 (s, 3H), 1.72 (m, 3H), 1.42 – 1.36 (m, 1H), 1.26 – 1.20 (m, 1H), 0.35 (s, 3H), 0.32 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 174.0, 169.5, 138.1, 133.5, 129.4, 128.1, 52.2, 49.3, 22.9, 20.2, – 2.8, – 3.2.

3-(Dimethyl(phenyl)silyl)-3-phenylpropanal 3A

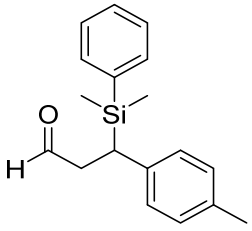


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 9.54 – 9.53 (m, 1H), 7.42 – 7.33 (m, 5H), 7.23 – 7.19 (m, 2H), 7.13 – 7.09 (m, 1H), 6.96 – 6.94 (m, 2H), 2.91 – 2.83 (m, 2H), 2.67 – 2.59 (m, 1H), 0.27 (d, *J* = 11.4 Hz, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 202.7, 141.1, 136.2, 134.1, 129.5, 128.3, 127.9, 127.7, 125.2, 43.5, 30.1, – 4.2, – 5.5.

3-(Dimethyl(phenyl)silyl)-3-(*p*-tolyl)propanal 3B



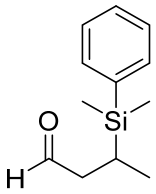
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 9.53 – 9.52 (m, 1H), 7.42 – 7.33 (m, 5H), 7.04

– 7.01 (m, 2H), 6.86 – 6.83 (m, 2H), 2.87 – 2.79 (m, 2H), 2.63 – 2.57 (m, 1H), 2.29 (s, 3H), 0.26 (d, *J* = 11.4 Hz, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 202.9, 137.8, 136.4, 134.6, 134.1, 129.5, 129.1, 127.9, 127.5, 43.5, 29.6, 21.0, – 4.1, – 5.6.

3-(Dimethyl(phenyl)silyl)butanal 3C

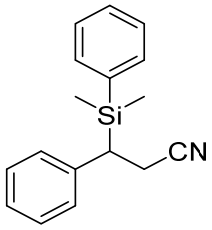


Pale yellow liquid

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 9.67 – 9.66 (m, 1H), 7.51 – 7.48 (m, 2H), 7.40 – 7.34 (m, 3H), 2.45 – 2.40 (m, 1H), 2.19 – 2.11 (m, 1H), 1.53 – 1.47 (m, 1H), 0.99 (d, *J* = 7.4 Hz, 3H), 0.30 (d, *J* = 2.2 Hz, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 203.5, 137.0, 133.9, 129.3, 127.9, 45.9, 14.6, 13.8, – 4.9, – 5.4.

3-(Dimethyl(phenyl)silyl)-3-phenylpropanenitrile 3D

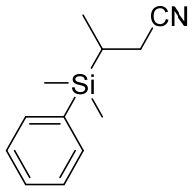


Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.43 – 7.37 (m, 6H), 7.28 – 7.27 (m, 1H), 7.20 – 7.16 (m, 1H), 6.97 – 6.94 (m, 2H), 2.67 – 2.60 (m, 3H), 0.28 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 139.7, 135.2, 134.1, 129.9, 128.6, 128.1, 127.4, 126.0, 119.7, 33.0, 18.9, – 4.0, – 5.5.

3-(Dimethyl(phenyl)silyl)butanenitrile 3E

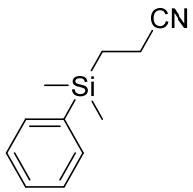


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.49 – 7.47 (m, 2H), 7.42 – 7.37 (m, 3H), 2.42 – 2.37 (m, 1H), 2.11 – 2.04 (m, 1H), 1.27 – 1.23 (m, 1H), 1.17 – 1.15 (m, 3H), 0.35 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 135.9, 133.8, 129.6, 128.1, 119.9, 20.5, 17.3, 14.5, – 4.9, – 5.6.

3-(Dimethyl(phenyl)silyl)propanenitrile 3F

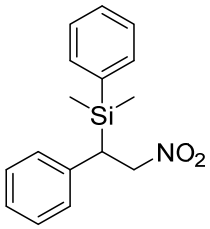


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.50 – 7.47 (m, 2H), 7.41 – 7.37 (m, 3H), 2.29 – 2.25 (m, 2H), 1.17 – 1.13 (m, 2H), 0.36 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 136.6, 133.5, 129.6, 128.2, 121.2, 12.2, 12.0, – 3.5.

Dimethyl(2-nitro-1-phenylethyl)(phenyl)silane 3G

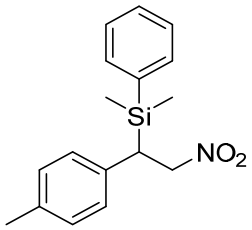


Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.45 – 7.36 (m, 5H), 7.25 – 7.22 (m, 2H), 7.18 – 7.14 (m, 1H), 6.99 – 6.97 (m, 2H), 4.86 (t, *J* = 13.4 Hz, 1H), 4.52 (dd, *J* = 13.6, 3.8 Hz, 1H), 3.28 – 3.24 (m, 1H), 0.30 (s, 3H), 0.28 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 137.5, 134.9, 133.9, 130.0, 128.6, 128.2, 127.3, 126.1, 77.1, 36.1, – 3.9, – 5.4.

Dimethyl(2-nitro-1-(*p*-tolyl)ethyl)(phenyl)silane 3H

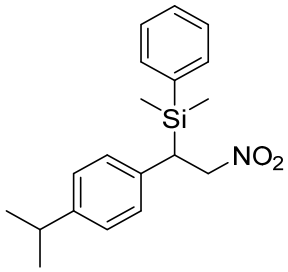


Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.46 – 7.37 (m, 5H), 7.10 – 7.04 (m, 2H), 6.89 – 6.86 (m, 2H), 4.83 (t, *J* = 13.5 Hz, 1H), 4.50 (dd, *J* = 13.5, 3.8 Hz, 1H), 3.26 – 3.20 (m, 1H), 2.29 (m, 3H), 0.30 (s, 3H), 0.28 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 135.6, 135.1, 134.3, 134.0, 130.0, 129.3, 128.2, 127.2, 77.1, 35.7, 21.0, – 3.9, – 5.5.

(1-(4-Isopropylphenyl)-2-nitroethyl)dimethyl(phenyl)silane 3I



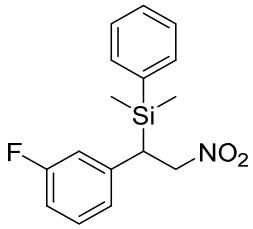
Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.45 – 7.36 (m, 5H), 7.10 – 7.07 (m, 2H), 6.92 – 6.88 (m, 2H), 4.84 (t, *J* = 13.5 Hz, 1H), 4.49 (dd, *J* = 13.6, 3.8 Hz, 1H), 3.27 – 3.21 (m, 1H), 2.88 – 2.81 (m, 1H), 1.22 (d, *J* = 7.0 Hz, 6H), 0.30 (s, 3H), 0.27 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 146.5, 135.2, 134.5, 133.9, 130.0, 128.2, 127.2, 126.6, 77.1, 35.6, 33.6, 24.0, – 3.8, – 5.5.

HRMS (ESI^{+}) calcd for $C_{19}H_{25}NO_2SiNa$ $[M+Na]^{+}$: 350.1548; found 350.1547.

(1-(3-Fluorophenyl)-2-nitroethyl)dimethyl(phenyl)silane 3J



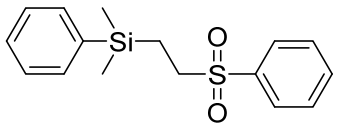
Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.46 – 7.39 (m, 5H), 7.23 – 7.18 (m, 1H), 6.88 – 6.83 (m, 1H), 6.77 – 6.74 (m ,1H), 6.69 – 6.65 (m, 1H), 4.81 (t, *J* = 13.6 Hz, 1H), 4.52 (dd, *J* = 13.8, 3.7 Hz, 1H), 3.30 – 3.24 (m, 1H), 0.32 (d, *J* = 2.0 Hz, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 164.1, 161.7, 140.4, 140.3, 134.3, 133.9, 130.2, 130.1, 130.0, 128.3, 122.93, 122.90, 114.4, 114.1, 113.2, 113.0, 76.6, 36.14, 36.12, – 4.0, – 5.4.

HRMS (ESI^{+}) calcd for $C_{16}H_{18}FNO_2SiNa$ $[M+Na]^{+}$: 326.0981; found 326.0983.

Dimethyl(phenyl)(2-(phenylsulfonyl)ethyl)silane 3K

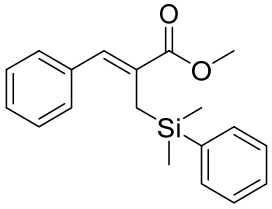


White solid

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.74 – 7.72 (m, 2H), 7.54 – 7.48 (m, 1H), 7.46 – 7.40 (m, 2H), 7.28 – 7.21 (m, 5H), 2.85 – 2.81 (m, 2H), 1.05 – 1.01 (m, 2H), 0.15 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 138.6, 136.5, 133.6, 133.4, 129.6, 129.2, 128.2, 128.1, 52.5, 8.5, – 3.4.

Methyl (*Z*)-2-((dimethyl(phenyl)silyl)methyl)-3-phenylacrylate 5a

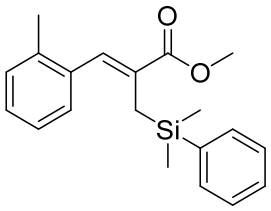


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.56 (s, 1H), 7.49 – 7.46 (m, 2H), 7.37 – 7.27 (m, 8H), 3.71 (s, 3H), 2.41 (s, 2H), 0.27 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 169.3, 138.6, 136.3, 135.7, 133.6, 130.9, 129.09, 129.05, 128.3, 127.8, 127.7, 51.9, 17.4, – 2.6.

Methyl (*Z*)-2-((dimethyl(phenyl)silyl)methyl)-3-(*o*-tolyl)acrylate 5b



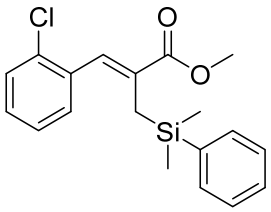
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.50 (s, 1H), 7.32 – 7.29 (m, 2H), 7.25 – 7.18 (m, 3H), 7.12 – 7.09 (m, 2H), 7.06 – 7.00 (m, 2H), 3.64 (s, 3H), 2.18 (s, 2H), 2.14 (s, 3H), 0.13 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 169.1, 138.6, 136.6, 135.6, 135.3, 133.5, 131.4, 130.1, 128.9, 128.4, 127.8, 127.7, 125.5, 51.8, 19.9, 17.0, – 2.6.

HRMS (ESI^{+}) calcd for $C_{23}H_{23}BrOSiNa$ $[M+Na]^{+}$: 347.1434; found 347.1438.

Methyl (*Z*)-3-(2-chlorophenyl)-2-((dimethyl(phenyl)silyl)methyl)acrylate 5c



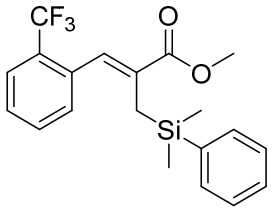
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.56 (s, 1H), 7.42 – 7.27 (m, 6H), 7.22 – 7.11 (m, 3H), 3.71 (s, 3H), 2.26 (s, 2H), 0.20 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 168.7, 138.4, 135.0, 134.0, 133.5, 132.9, 132.8, 129.9, 129.6, 129.01, 128.97, 127.7, 126.4, 52.0, 17.3, – 2.8.

HRMS (ESI^{+}) calcd for $C_{23}H_{23}BrOSiNa$ $[M+Na]^{+}$: 367.0885; found 367.0892.

Methyl (*Z*)-2-((dimethyl(phenyl)silyl)methyl)-3-(2-(trifluoromethyl)phenyl)acrylate 5d



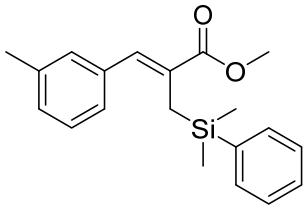
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.69 (s, 1H), 7.67 – 7.64 (m, 1H), 7.42 – 7.28 (m, 7H), 7.20 – 7.17 (m, 1H), 3.73 (s, 3H), 2.21 (s, 2H), 0.22 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 168.6, 138.5, 135.04, 135.02, 133.5, 132.2, 131.4, 130.2, 129.0, 128.7, 128.4, 127.7, 127.6, 126.1, 126.1, 126.01, 125.96, 125.3, 122.6, 52.1, 17.6, – 2.7.

HRMS (ESI^{+}) calcd for $C_{23}H_{23}BrOSiNa$ $[M+Na]^{+}$: 401.1152; found 401.1155.

Methyl (*Z*)-2-((dimethyl(phenyl)silyl)methyl)-3-(*m*-tolyl)acrylate 5e

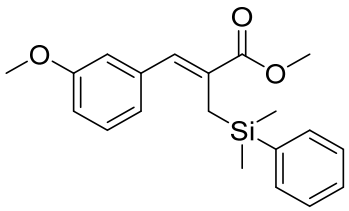


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.51 (s, 1H), 7.47 – 7.45 (m, 2H), 7.36 – 7.29 (m, 3H), 7.23 – 7.19 (m, 1H), 6.89 – 6.87 (m, 1H), 6.82 – 6.79 (m, 2H), 3.73 (s, 3H), 3.68 (s, 3H), 2.41 (s, 2H), 0.26 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 171.7, 162.0, 141.1, 140.2, 138.0, 136.1, 133.7, 131.8, 131.5, 130.2, 124.0, 116.9, 116.1, 57.7, 54.4, 20.0, 0.0.

Methyl (*Z*)-2-((dimethyl(phenyl)silyl)methyl)-3-(3-methoxyphenyl)acrylate 5f



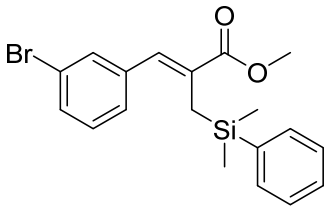
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.52 (s, 1H), 7.49 – 7.46 (m, 2H), 7.39 – 7.29 (m, 3H), 7.20 – 7.16 (m, 1H), 7.09 – 7.05 (m, 3H), 3.70 (s, 3H), 2.39 (s, 2H), 2.25 (s, 3H), 0.27 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 171.9, 141.2, 140.4, 138.6, 138.3, 136.1, 133.1, 132.2, 131.5, 131.1, 130.7, 130.2, 128.8, 54.4, 23.8, 20.0, 0.0.

HRMS (ESI^{+}) calcd for $C_{23}H_{23}BrOSiNa$ [M+Na]$^{+}$: 363.1380; found 363.1387.

Methyl (*Z*)-3-(3-bromophenyl)-2-((dimethyl(phenyl)silyl)methyl)acrylate 5g



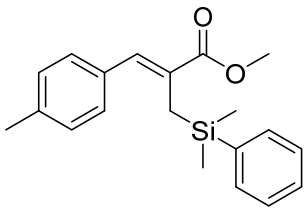
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.46 – 7.42 (m, 3H), 7.39 – 7.29 (m, 5H), 7.15 – 7.11 (m, 2H), 3.70 (s, 3H), 2.53 (s, 2H), 0.27 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 168.9, 138.4, 138.1, 133.8, 133.6, 132.4, 131.7, 130.7, 129.8, 129.2, 127.8, 127.6, 122.4, 52.0, 17.8, – 2.6.

HRMS (ESI^{+}) calcd for $C_{23}H_{23}BrOSiNa$ [M+Na]$^{+}$: 411.0386; found 411.0386.

Methyl (*Z*)-2-((dimethyl(phenyl)silyl)methyl)-3-(*p*-tolyl)acrylate 5h

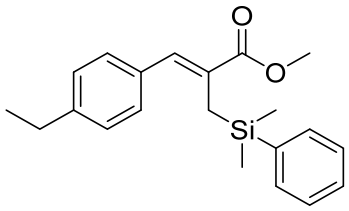


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.53 (s, 1H), 7.49 – 7.47 (m, 2H), 7.38 – 7.31 (m, 3H), 7.20 – 7.18 (m, 2H), 7.10 – 7.08 (m, 2H), 3.68 (s, 3H), 2.41 (s, 2H), 2.34 (s, 3H), 0.27 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 169.5, 138.8, 137.9, 135.7, 133.6, 133.4, 130.0, 129.2, 129.1, 129.0, 127.7, 51.9, 21.3, 17.5, – 2.5.

Methyl (*Z*)-2-((dimethyl(phenyl)silyl)methyl)-3-(4-ethylphenyl)acrylate 5i



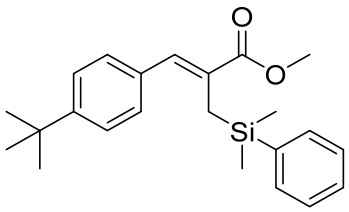
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.54 (s, 1H), 7.51 – 7.47 (m, 2H), 7.38 – 7.31 (m, 3H), 7.24 – 7.22 (m, 2H), 7.14 – 7.12 (m, 2H), 3.70 (s, 3H), 2.68 (dd, *J* = 15.2, 7.6 Hz, 2H), 2.42 (s, 2H), 1.27 (t, *J* = 7.6 Hz, 3H), 0.28 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 169.5, 144.2, 138.8, 135.8, 133.61, 133.59, 130.0, 129.3, 129.0, 127.8, 127.7, 51.9, 28.7, 17.5, 15.4, – 2.5.

HRMS (ESI^{+}) calcd for $C_{23}H_{23}BrOSiNa$ $[M+Na]^{+}$: 361.1594; found 361.1594.

Methyl (*Z*)-3-(4-(*tert*-butyl)phenyl)-2-((dimethyl(phenyl)silyl)methyl)acrylate 5j



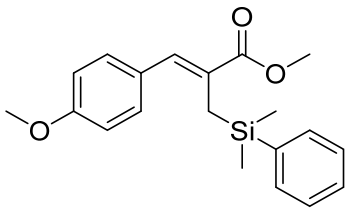
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.50 (s, 1H), 7.46 – 7.44 (m, 2H), 7.32 – 7.26 (m, 5H), 7.23 – 7.20 (m, 2H), 3.65 (s, 3H), 2.39 (s, 2H), 1.29 (s, 9H), 0.25 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 172.0, 153.5, 141.3, 138.1, 136.1, 135.8, 132.5, 131.53, 131.47, 130.2, 127.7, 54.3, 37.1, 33.7, 19.9, 0.0.

HRMS (ESI^{+}) calcd for $C_{23}H_{23}BrOSiNa$ $[M+Na]^{+}$: 389.1902; found 389.1907.

Methyl (*Z*)-2-((dimethyl(phenyl)silyl)methyl)-3-(4-methoxyphenyl)acrylate 5k

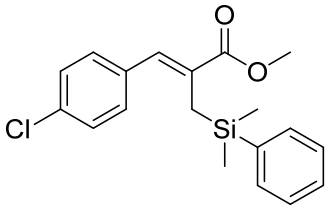


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.45 – 7.42 (m, 3H), 7.30 – 7.27 (m, 3H), 7.21 – 7.19 (m, 2H), 6.76 – 6.74 (m, 2H), 3.75 (s, 3H), 3.62 (s, 3H), 2.35 (s, 2H), 0.21 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 169.6, 159.3, 138.8, 135.4, 133.6, 130.8, 129.0, 128.8, 128.7, 127.8, 113.8, 55.3, 51.9, 17.4, –2.5.

Methyl (*Z*)-3-(4-chlorophenyl)-2-((dimethyl(phenyl)silyl)methyl)acrylate 5l

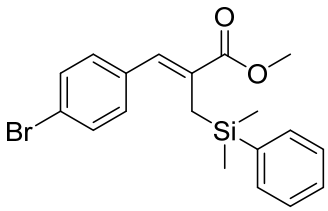


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.46 (s, 1H), 7.45 – 7.42 (m, 2H), 7.38 – 7.30 (m, 3H), 7.24 – 7.20 (m, 2H), 7.16 – 7.12 (m, 2H), 3.70 (s, 3H), 2.35 (s, 2H), 0.26 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 169.1, 138.3, 134.7, 134.2, 133.5, 131.6, 130.3, 129.2, 128.5, 127.8, 52.0, 17.7, – 2.6.

Methyl (*Z*)-3-(4-bromophenyl)-2-((dimethyl(phenyl)silyl)methyl)acrylate 5m

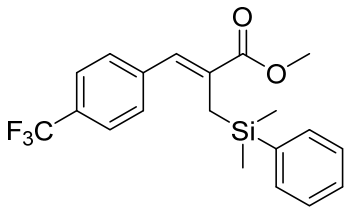


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.44 – 7.42 (m, 3H), 7.39 – 7.30 (m, 5H), 7.08 – 7.06 (m, 2H), 3.70 (s, 3H), 2.35 (s, 2H), 0.26 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 169.1, 138.3, 135.1, 134.2, 133.5, 131.7, 131.5, 130.6, 129.2, 127.8, 121.8, 52.0, 17.7, –2.6.

Methyl (*Z*)-2-((dimethyl(phenyl)silyl)methyl)-3-(4-(trifluoromethyl)phenyl)acrylate 5n



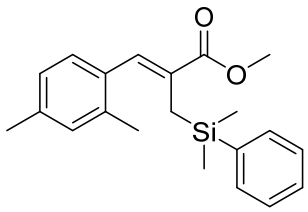
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.48 – 7.46 (m, 3H), 7.39 – 7.36 (m, 2H), 7.32 – 7.24 (m, 5H), 3.70 (s, 3H), 2.34 (s, 2H), 0.24 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 168.8, 139.9, 138.0, 133.8, 133.5, 133.1, 129.6, 129.2, 129.1, 127.8, 125.4, 125.3, 125.23, 125.19, 125.2, 122.7, 52.1, 17.8, – 2.7.

HRMS (ESI$^+$) calcd for $C_{23}H_{23}BrOSiNa$ $[M+Na]^+$: 401.1152; found 401.1155.

Methyl (*Z*)-2-((dimethyl(phenyl)silyl)methyl)-3-(2,4-dimethylphenyl)acrylate 5o



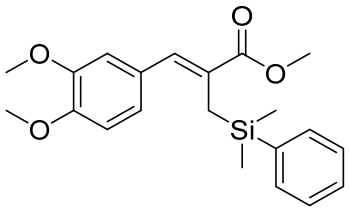
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.56 (s, 1H), 7.41 – 7.38 (m, 2H), 7.36 – 7.28 (m, 3H), 7.03 – 7.00 (m, 2H), 6.92 – 6.89 (m, 1H), 3.70 (s, 3H), 2.32 (s, 3H), 2.26 (s, 2H), 2.19 (s, 3H), 0.21 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 169.2, 138.8, 137.6, 136.6, 135.3, 133.6, 132.6, 130.9, 130.8, 128.9, 128.3, 127.7, 126.2, 51.8, 21.2, 19.9, 17.0, – 2.6.

HRMS (ESI$^+$) calcd for $C_{23}H_{23}BrOSiNa$ $[M+Na]^+$: 361.1589; found 361.1594.

Methyl (*Z*)-3-(3,4-dimethoxyphenyl)-2-((dimethyl(phenyl)silyl)methyl)acrylate 5p



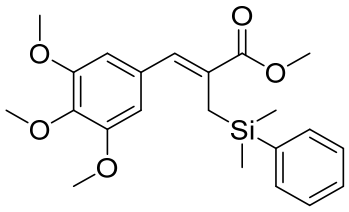
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.50 – 7.46 (m, 3H), 7.36 – 7.29 (m, 3H), 6.93 – 6.90 (m, 1H), 6.82 – 6.76 (m, 2H), 3.88 (s, 3H), 3.72 (s, 3H), 3.69 (s, 3H), 2.44 (s, 2H), 0.28 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 171.9, 151.3, 151.0, 141.2, 138.0, 136.0, 131.49, 131.46, 131.4, 130.2, 124.9, 114.8, 113.2, 58.3, 58.2, 54.3, 19.9, 0.0.

HRMS (ESI$^+$) calcd for $C_{23}H_{23}BrOSiNa$ $[M+Na]^+$: 393.1491; found 393.1493.

Methyl (*Z*)-2-((dimethyl(phenyl)silyl)methyl)-3-(3,4,5-trimethoxyphenyl)acrylate 5q



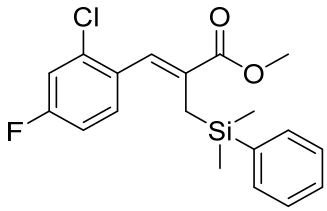
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.47 – 7.44 (m, 3H), 7.33 – 7.28 (m, 3H), 6.50 (s, 2H), 3.84 (s, 3H), 3.70 (s, 3H), 3.69 (s, 6H), 2.45 (s, 2H), 0.29 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 171.6, 155.3, 141.0, 140.2, 138.0, 135.9, 134.1, 132.6, 131.4, 130.1, 108.8, 63.2, 58.4, 54.3, 19.9, 0.0.

HRMS (ESI$^+$) calcd for $C_{23}H_{23}BrOSiNa$ $[M+Na]^+$: 423.1598; found 423.1598.

Methyl (*Z*)-3-(2-chloro-4-fluorophenyl)-2-((dimethyl(phenyl)silyl)methyl)acrylate 5r



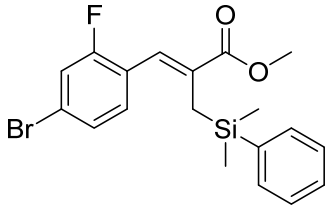
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.48 (s, 1H), 7.41 – 7.28 (m, 5H), 7.12 – 7.06 (m, 2H), 6.85 – 6.80 (m, 1H), 3.71 (s, 3H), 2.23 (s, 2H), 0.22 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 168.6, 163.0, 160.5, 138.2, 134.8, 134.7, 133.5, 133.0, 131.8, 131.1, 131.0, 130.9, 130.8, 129.1, 127.8, 117.1, 116.9, 113.9, 113.7, 52.1, 17.5, – 2.8.

HRMS (ESI^{+}) calcd for $C_{23}H_{23}BrOSiNa$ [M+Na]$^{+}$: 385.0789; found 385.0797.

Methyl (*Z*)-3-(4-bromo-2-fluorophenyl)-2-((dimethyl(phenyl)silyl)methyl)acrylate 5s



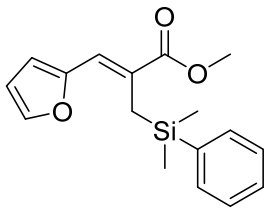
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.40 – 7.37 (m, 3H), 7.34 – 7.28 (m, 3H), 7.20 – 7.17 (m, 1H), 7.12 – 7.09 (m, 1H), 7.02 – 6.96 (m, 1H), 3.71 (s, 3H), 2.27 (s, 2H), 0.24 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 168.5, 161.0, 158.5, 138.1, 133.9, 133.5, 130.73, 130.70, 129.1, 127.8, 127.1, 127.1, 123.4, 123.3, 121.9, 121.8, 119.4, 119.2, 52.1, 18.1, – 2.8.

HRMS (ESI^{+}) calcd for $C_{23}H_{23}BrOSiNa$ [M+Na]$^{+}$: 429.0288; found 429.0292.

Methyl (*Z*)-2-((dimethyl(phenyl)silyl)methyl)-3-(furan-2-yl)acrylate 5t



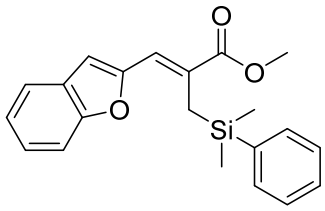
Brown oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.54 – 7.52 (m, 2H), 7.42 – 7.41 (m, 1H), 7.34 – 7.33 (m, 3H), 7.28 (s, 1H), 6.47 – 6.42 (m, 2H), 3.64 (s, 3H), 2.60 (s, 2H), 0.25 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 169.1, 152.3, 143.2, 139.0, 133.6, 128.9, 127.6, 127.2, 122.3, 114.2, 111.8, 51.9, 18.5, – 3.0.

HRMS (ESI^{+}) calcd for $C_{23}H_{23}BrOSiNa$ $[M+Na]^{+}$: 323.1070; found 323.1074.

Methyl (*Z*)-3-(benzofuran-2-yl)-2-((dimethyl(phenyl)silyl)methyl)acrylate 5u

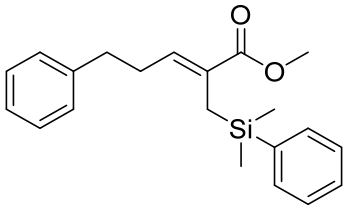


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.44 – 7.39 (m, 3H), 7.25 – 7.22 (m, 2H), 7.20 – 7.14 (m, 4H), 7.11 (m, 1H), 6.64 (s, 1H), 3.55 (s, 3H), 2.64 (s, 2H), 0.15 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 168.8, 155.1, 154.0, 138.8, 133.6, 130.9, 129.0, 128.1, 127.7, 125.5, 123.2, 122.2, 121.3, 111.2, 110.5, 52.1, 19.3, -2.9.

Methyl (*Z*)-2-((dimethyl(phenyl)silyl)methyl)-5-phenylpent-2-enoate 5v



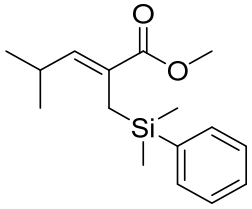
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.48 – 7.46 (m, 2H), 7.33 – 7.29 (m, 3H), 7.24

– 7.21 (m, 2H), 7.18 – 7.14 (m, 1H), 7.01 – 7.05 (m, 2H), 6.63 (t, *J* = 7.2 Hz, 1H), 3.59 (s, 3H), 2.60 (t, *J* = 7.8 Hz, 2H), 2.23 (dd, *J* = 15.6, 7.6 Hz, 2H), 1.98 (s, 2H), 0.25 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 168.6, 141.3, 138.7, 138.2, 133.6, 129.8, 129.1, 128.4, 128.3, 127.8, 127.7, 126.0, 51.6, 34.8, 30.8, 17.2, – 2.8.

Methyl (*Z*)-2-((dimethyl(phenyl)silyl)methyl)-4-methylpent-2-enoate 5w



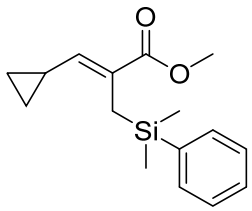
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.52 – 7.50 (m, 2H), 7.35 – 7.34 (m, 3H), 6.41 (d, *J* = 10.2 Hz, 1H), 3.61 (s, 3H), 2.41 – 2.30 (m, 1H), 2.01 (s, 2H), 0.88 (d, *J* = 6.6 Hz, 6H), 0.28 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 169.0, 146.1, 138.8, 133.6, 129.0, 127.7, 126.8, 51.5, 28.1, 21.9, 16.7, – 2.9.

HRMS (ESI^{+}) calcd for $C_{23}H_{23}BrOSiNa$ $[M+Na]^{+}$: 299.1431; found 299.1438.

Methyl (*Z*)-3-cyclopropyl-2-((dimethyl(phenyl)silyl)methyl)acrylate 5x



Colorless oil

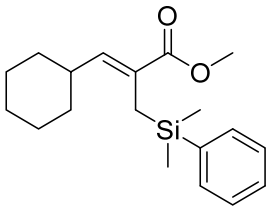
^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.55 – 7.53 (m, 2H), 7.36 – 7.34 (m, 3H), 6.04 (d, *J* = 10.6 Hz, 1H), 3.60 (s, 3H), 2.14 (s, 2H), 1.40 – 1.31 (m, 1H), 0.81 – 0.79 (m, 2H), 0.53 – 0.49 (m, 2H), 0.32 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 168.5, 144.5, 139.0, 133.7, 129.0, 127.7,

126.7, 51.5, 16.7, 12.3, 8.5, – 2.9.

HRMS (ESI$^+$) calcd for $C_{23}H_{23}BrOSiNa$ [M+Na]$^+$: 297.1279; found 297.1281.

Methyl (*Z*)-3-cyclohexyl-2-((dimethyl(phenyl)silyl)methyl)acrylate 5y



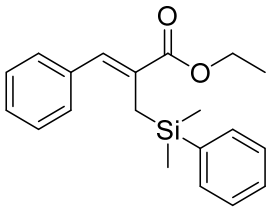
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.53 – 7.50 (m, 2H), 7.36 – 7.33 (m, 3H), 6.42 (d, *J* = 10.1 Hz, 1H), 3.62 (s, 3H), 2.05 – 1.93 (m, 3H), 1.66 – 1.60 (m, 4H), 1.28 – 1.23 (m, 1H), 1.16 – 0.96 (m, 5H), 0.28 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 169.1, 144.6, 138.8, 133.6, 129.0, 127.7, 127.0, 51.5, 38.0, 31.9, 25.9, 25.6, 16.8, – 2.9.

HRMS (ESI$^+$) calcd for $C_{23}H_{23}BrOSiNa$ [M+Na]$^+$: 339.1750; found 339.1751.

Ethyl (*Z*)-2-((dimethyl(phenyl)silyl)methyl)-3-phenylacrylate 5z



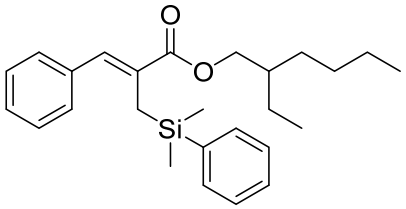
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.41 (s, 1H), 7.33 – 7.31 (m, 2H), 7.21 – 7.18 (m, 3H), 7.15 – 7.10 (m, 5H), 4.05 (dd, *J* = 14.2, 7.1 Hz, 2H), 2.26 (s, 2H), 1.17 – 1.12 (m, 3H), 0.12 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 171.3, 141.2, 138.9, 137.9, 136.1, 133.7, 131.6, 131.5, 130.8, 130.2, 63.4, 27.5, 19.8, 16.7, 0.0.

HRMS (ESI$^+$) calcd for $C_{23}H_{23}BrOSiNa$ [M+Na]$^+$: 347.1440; found 347.1438.

2-Ethylhexyl (*Z*)-2-((dimethyl(phenyl)silyl)methyl)-3-phenylacrylate 5A



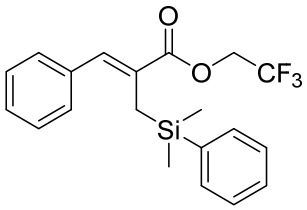
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.43 (s, 1H), 7.37 – 7.35 (m, 2H), 7.24 – 7.13 (m, 8H), 3.95 – 3.93 (m, 2H), 2.31 (s, 2H), 1.54 – 1.51 (m, 1H), 1.32 – 1.20 (m, 8H), 0.84 – 0.80 (m. 6H), 0.15 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 169.0, 138.7, 136.4, 135.2, 133.6, 131.4, 129.11, 129.06, 128.3, 127.8, 67.4, 38.8, 30.6, 29.0, 23.9, 23.1, 17.4, 14.2, 11.1, – 2.5.

HRMS (ESI^{+}) calcd for $C_{23}H_{23}BrOSiNa$ [M+Na]$^{+}$: 431.2382; found 431.2377.

2,2,2-Trifluoroethyl (*Z*)-2-((dimethyl(phenyl)silyl)methyl)-3-phenylacrylate 5B



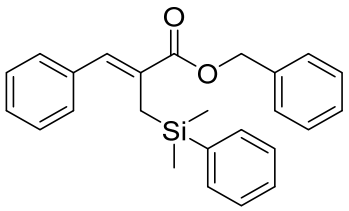
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.61 (s, 1H), 7.47 – 7.44 (m, 2H), 7.38 – 7.29 (m, 8H), 4.47 (dd, *J* = 17.2, 8.5 Hz, 2H), 2.43 (s, 2H), 0.26 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 167.1, 138.2, 137.6, 135.7, 133.6, 129.4, 129.22, 129.19, 128.4, 128.3, 127.8, 124.5, 121.8, 61.3, 60.9, 60.6, 60.2, 17.5, – 2.7.

HRMS (ESI^{+}) calcd for $C_{23}H_{23}BrOSiNa$ [M+Na]$^{+}$: 401.1150; found 401.1155.

Benzyl (*Z*)-2-((dimethyl(phenyl)silyl)methyl)-3-phenylacrylate 5C



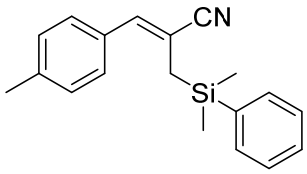
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.56 (s, 1H), 7.41 – 7.32 (m, 7H), 7.31 – 7.26 (m, 3H), 7.24 – 7.20 (m, 5H), 5.11 (s, 2H), 2.39 (s, 2H), 0.18 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 168.7, 138.6, 136.3, 136.1, 135.9, 133.6, 131.0, 129.14, 129.08, 128.6, 128.36, 128.35, 128.2, 127.9, 127.8, 66.7, 17.4, – 2.5.

HRMS (ESI^{+}) calcd for $C_{23}H_{23}BrOSiNa$ $[M+Na]^{+}$: 409.1593; found 409.1594.

(*Z*)-2-((dimethyl(phenyl)silyl)methyl)-3-(*p*-tolyl)acrylonitrile 5D



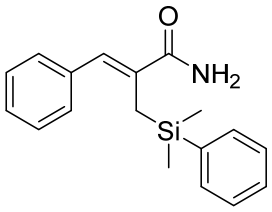
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.54 – 7.48 (m, 4H), 7.41 – 7.38 (m, 3H), 7.19 – 7.04 (m, 2H), 6.54 (s, 1H), 2.36 (s, 3H), 2.06 (s, 2H), 0.46 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 141.8, 139.6, 136.9, 133.7, 131.5, 129.6, 129.4, 128.1, 128.0, 119.9, 107.0, 26.2, 21.4, – 3.4

HRMS (ESI^{+}) calcd for $C_{19}H_{22}NSi$ $[M+H]^{+}$: 292.1522; found 292.1523.

(*Z*)-2-((dimethyl(phenyl)silyl)methyl)-3-phenylacrylamide 5E



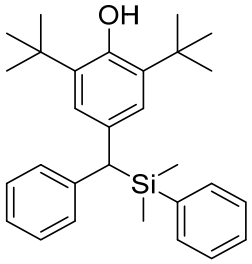
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.41 – 7.38 (m, 2H), 7.29 – 7.11 (m, 8H), 7.00 (s, 1H), 5.56 (s, 2H), 2.23 (s, 2H), 0.23 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 175.1, 140.8, 138.6, 137.7, 136.1, 133.1, 131.8, 131.3, 130.9, 130.4, 130.1, 20.5, 0.0.

HRMS (ESI^{+}) calcd for $C_{18}H_{21}NOSiNa$ $[M+Na]^{+}$: 318.1290; found 318.1291.

2,6-Di-*tert*-butyl-4-((dimethyl(phenyl)silyl)(phenyl)methyl)phenol 7a

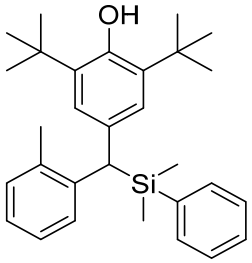


Yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.35 – 7.28 (m, 2H), 7.25 – 7.19 (m, 5H), 7.16 – 7.08 (m, 3H), 6.86 (s, 2H), 4.93 (s, 1H), 3.62 (s, 1H), 1.33 (s, 18H), 0.27 (s, 3H), 0.25 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 151.3, 143.1, 137.9, 135.2, 134.5, 132.3, 129.0, 128.9, 128.2, 127.5, 125.4, 125.0, 45.5, 34.3, 30.4, – 3.0, – 3.4.

2,6-Di-*tert*-butyl-4-((dimethyl(phenyl)silyl)(*o*-tolyl)methyl)phenol 7b

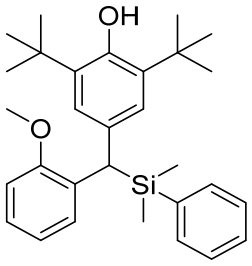


Yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.38 – 7.31 (m, 1H), 7.30 – 7.28 (m, 5H), 7.15 – 7.03 (m, 3H), 6.82 (s, 2H), 4.93 (s, 1H), 3.84 (s, 1H), 2.27 (s, 3H), 1.33 (s, 18H), 0.33 (s, 3H), 0.29 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 151.1, 141.5, 138.4, 136.6, 135.1, 134.5, 131.9, 130.5, 129.4, 128.9, 127.5, 125.5, 125.4, 125.2, 40.1, 34.3, 30.3, 20.6, – 2.5, – 3.5.

2,6-Di-*tert*-butyl-4-((dimethyl(phenyl)silyl)(2-methoxyphenyl)methyl)phenol 7c

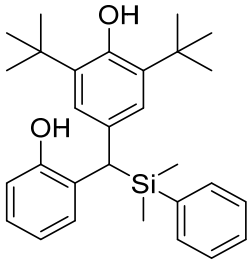


Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.36 – 7.32 (m, 1H), 7.31 – 7.28 (m, 4H), 7.24 – 7.21 (m, 1H), 7.15 – 7.11 (m ,1H), 6.92 (s, 2H), 6.89 – 6.81 (m, 2H), 4.93 (s, 1H), 4.20 (s, 1H), 3.72 (s, 3H), 1.36 (s, 18H), 0.28 (s, 3H), 0.25 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 156.7, 151.1, 139.1, 135.0, 134.4, 132.5, 131.7, 130.2, 128.7, 127.3, 126.0, 125.7, 120.2, 110.4, 55.1, 36.6, 34.3, 30.4, – 2.8, – 3.4.

2,6-Di-*tert*-butyl-4-((dimethyl(phenyl)silyl)(2-hydroxyphenyl)methyl)phenol 7d



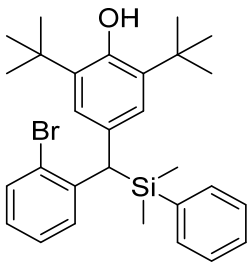
Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.39 – 7.35 (m, 1H), 7.34 – 7.28 (m, 5H), 7.10 – 7.06 (m, 1H), 6.90 – 6.86 (m ,1H), 6.84 (s, 2H), 6.80 – 6.77 (m, 1H), 5.00 (s, 1H), 4.81 (s, 1H), 3.95 (s, 1H), 1.33 (s, 18H), 0.38 (s, 3H), 0.35 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 153.8, 151.6, 138.2, 135.5, 134.4, 131.1, 130.6, 129.2, 129.0, 127.6, 126.7, 125.5, 120.5, 116.1, 37.0, 34.3, 30.3, – 2.6, – 3.5.

HRMS (ESI^{+}) calcd for $C_{29}H_{39}O_2Si$ $[M+H]^{+}$: 447.1719; found 447.2716.

4-((2-Bromophenyl)(dimethyl(phenyl)silyl)methyl)-2,6-di-*tert*-butylphenol 7e

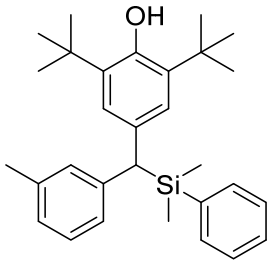


Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.55 – 7.53 (m, 1H), 7.37 – 7.27 (m, 6H), 7.20 – 7.16 (m, 1H), 6.99 – 6.95 (m ,1H), 6.87 (s, 2H), 4.95 (s, 1H), 4.35 (s, 1H), 1.32 (s, 18H), 0.32 (s, 3H), 0.26 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 151.4, 142.6, 137.7, 135.2, 134.6, 133.0, 131.3, 130.4, 129.1, 127.6, 127.0, 126.6, 126.1, 125.6, 43.0, 34.3, 30.3, – 2.7, – 3.8.

2,6-Di-*tert*-butyl-4-((dimethyl(phenyl)silyl)(*m*-tolyl)methyl)phenol 7f

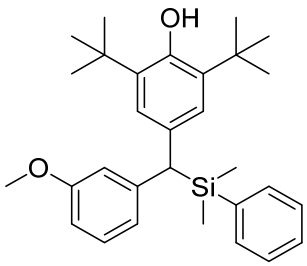


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.33 – 7.29 (m, 1H), 7.25 – 7.20 (m, 4H), 7.10 – 7.08 (m, 1H), 6.95 – 6.89 (m, 3H), 6.82 (s, 2H), 4.89 (s, 1H), 3.53 (s, 1H), 2.23 (s, 3H), 1.30 (s, 18H), 0.24 (s, 3H), 0.21 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 151.3, 142.8, 138.0, 137.5, 135.2, 134.5, 132.3, 130.0, 128.9, 127.9, 127.4, 125.8, 125.7, 125.3, 45.4, 34.3, 30.3, 21.6, – 3.1, – 3.5.

2,6-Di-*tert*-butyl-4-((dimethyl(phenyl)silyl)(3-methoxyphenyl)methyl)phenol 7g

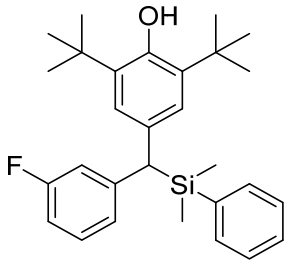


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.39 – 7.34 (m, 1H), 7.33 – 7.28 (m, 4H), 7.18 – 7.14 (m, 1H), 6.91 (s, 2H), 6.80 – 6.78 (m ,1H), 6.72 – 6.69 (m, 2H), 4.98 (s, 1H), 3.70 (s, 3H), 3.64 (s, 1H), 1.38 (s, 18H), 0.31 (s, 3H), 0.30 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 159.3, 151.4, 144.6, 137.9, 135.3, 134.6, 132.1, 129.02, 129.00, 127.5, 125.4, 121.4, 114.1, 111.0, 55.0, 45.7, 34.4, 30.4, – 3.1, – 3.3.

2,6-Di-*tert*-butyl-4-((dimethyl(phenyl)silyl)(3-fluorophenyl)methyl)phenol 7h



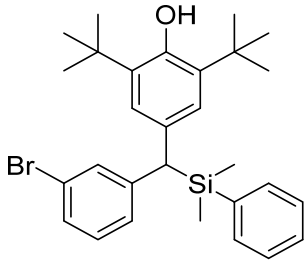
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.33 – 7.29 (m, 1H), 7.25 – 7.19 (m, 4H), 7.15 – 7.10 (m, 1H), 6.88 – 6.85 (m, 1H), 6.81 – 6.74 (m, 4H), 4.94 (s, 1H), 3.58 (s, 1H), 1.30 (s, 18H), 0.24 (s, 3H), 0.22 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 161.5, 151.5, 145.9, 145.8, 137.4, 135.4, 134.4, 131.6, 129.4, 129.3, 129.1, 127.6, 125.5, 124.5, 124.4, 115.6, 115.4, 111.9, 111.7, 45.5, 45.4, 34.3, 30.3, – 3.2, – 3.4.

HRMS (ESI^{+}) calcd for $C_{29}H_{38}FOSi$ $[M+H]^{+}$: 449.2676; found 449.2672.

4-((3-Bromophenyl)(dimethyl(phenyl)silyl)methyl)-2,6-di-*tert*-butylphenol 3i



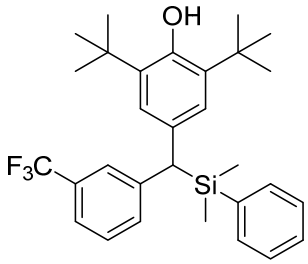
Yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.33 – 7.29 (m, 1H), 7.25 – 7.24 (m, 1H), 7.22 – 7.17 (m, 5H), 7.05 – 6.99 (m, 2H), 6.78 (s, 2H), 4.88 (s, 1H), 3.56 (s, 1H), 1.23 (s, 18H), 0.16 (s, 3H), 0.15 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 151.5, 145.5, 137.2, 135.4, 134.5, 131.9, 131.5, 129.6, 129.2, 128.0, 127.6, 127.2, 125.4, 122.2, 45.3, 34.3, 30.3, – 3.2, – 3.5.

HRMS (ESI^{+}) calcd for $C_{29}H_{38}BrOSi$ $[M+H]^{+}$: 509.1875; found 509.1871.

2,6-Di-*tert*-butyl-4-((dimethyl(phenyl)silyl)(3-(trifluoromethyl)phenyl)methyl)phenol 3j

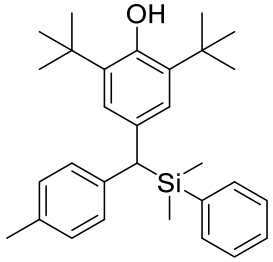


Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.27 – 7.22 (m, 3H), 7.20 – 7.15 (m, 4H), 7.12 – 7.09 (m, 2H), 6.74 (s, 2H), 4.93 (s, 1H), 3.52 (s, 1H), 1.29 (s, 18H), 0.23 (s, 3H), 0.21 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 151.6, 144.0, 137.0, 135.5, 134.5, 132.0, 131.3, 129.3, 128.5, 127.6, 125.5, 125.4, 125.3, 121.79, 121.75, 45.6, 34.4, 30.3, – 3.4, – 3.5.

2,6-Di-*tert*-butyl-4-((dimethyl(phenyl)silyl)(*p*-tolyl)methyl)phenol 7k



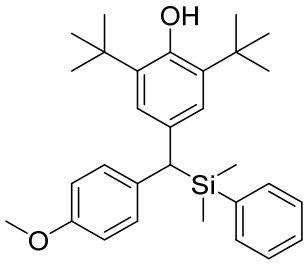
Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.33 – 7.28 (m, 1H), 7.25 – 7.21 (m, 4H), 7.03

– 6.99 (m, 4H), 6.81 (s, 2H), 4.89 (s, 1H), 3.54 (s, 1H), 2.26 (s, 3H), 1.30 (s, 18H), 0.23 (s, 3H), 0.21 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 151.2, 139.9, 138.1, 135.1, 134.5, 134.3, 132.5, 128.9, 128.84, 128.79, 127.4, 125.3, 45.0, 34.3, 30.3, 21.0, – 3.0, – 3.4.

2,6-Di-*tert*-butyl-4-((dimethyl(phenyl)silyl)(4-methoxyphenyl)methyl)phenol 7l

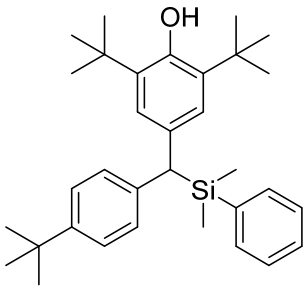


Yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.35 – 7.31 (m, 1H), 7.28 – 7.23 (m, 4H), 7.08 – 7.05 (m, 2H), 6.83 (s, 2H), 6.79 – 6.76 (m, 2H), 4.92 (s, 1H), 3.77 (s, 3H), 3.56 (s, 1H), 1.33 (s, 18H), 0.26 (s, 3H), 0.24 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 157.1, 151.2, 138.1, 135.2, 135.2, 134.5, 132.7, 129.9, 128.9, 127.5, 125.2, 113.6, 55.2, 44.3, 34.3, 30.3, – 3.0, – 3.4.

2,6-Di-*tert*-butyl-4-((4-(*tert*-butyl)phenyl)(dimethyl(phenyl)silyl)methyl)phenol 7m



Pale yellow oil

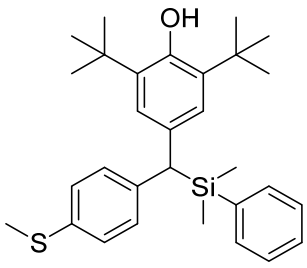
^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.35 – 7.29 (m, 1H), 7.25 – 7.20 (m, 6H), 7.08 – 7.06 (m, 2H), 6.84 (s, 2H), 4.90 (s, 1H), 3.55 (s, 1H), 1.32 (s, 18H), 1.27 (s, 9H), 0.26 (s, 3H), 0.23 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 151.3, 147.6, 139.8, 138.1, 135.1, 134.5,

132.5, 128.9, 128.4, 127.4, 125.4, 125.0, 45.2, 34.30, 34.28, 31.5, 30.4, – 3.1, – 3.3.

HRMS (ESI$^+$) calcd for $C_{33}H_{47}OSi$ $[M+H]^+$: 487.3396; found 487.3396.

2,6-Di-*tert*-butyl-4-((dimethyl(phenyl)silyl)(4-(methylthio)phenyl)methyl)phenol 7n



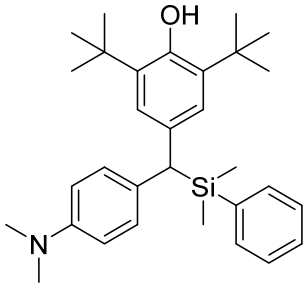
Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.38 – 7.29 (m, 5H), 7.19 – 7.10 (m, 4H), 6.88 (s, 2H), 4.99 (s, 1H), 3.62 (s, 1H), 2.49 (s, 3H), 1.38 (s, 18H), 0.31 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 151.4, 140.3, 137.8, 135.3, 134.5, 134.1, 132.1, 129.4, 129.0, 127.5, 126.9, 125.4, 45.0, 34.3, 30.3, 16.3, – 3.1, – 3.4.

HRMS (ESI$^+$) calcd for $C_{30}H_{41}OSSi$ $[M+H]^+$: 477.2647; found 477.2652.

2,6-Di-*tert*-butyl-4-((dimethyl(phenyl)silyl)(4-(dimethylamino)phenyl)methyl)phenol 7o



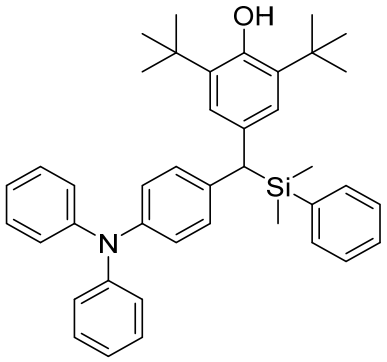
Orange oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.34 – 7.31 (m, 1H), 7.26 – 7.25 (m, 4H), 7.05 – 7.01 (m, 2H), 6.82 (s, 2H), 6.67 – 6.63 (m, 2H), 4.89 (s, 1H), 3.50 (s, 1H), 2.89 (s, 6H), 1.31 (s, 18H), 0.25 (s, 3H), 0.23 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 151.1, 148.4, 138.4, 135.0, 134.6, 133.0, 131.4, 129.6, 128.8, 127.4, 125.2, 113.0, 44.1, 41.0, 34.3, 30.3, – 2.9, – 3.4.

HRMS (ESI$^+$) calcd for $C_{31}H_{44}NOSi$ $[M+H]^+$: 474.3192; found 474.3189.

2,6-Di-*tert*-butyl-4-((dimethyl(phenyl)silyl)(4-(diphenylamino)phenyl)methyl)phenol 7p



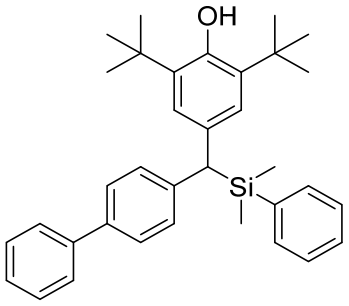
Orange oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.35 – 7.29 (m, 2H), 7.25 – 7.19 (m, 7H), 7.06 – 7.02 (m, 6H), 6.99 – 6.94 (m, 4H), 6.86 (s, 2H), 4.95 (s, 1H), 3.57 (s, 1H), 1.34 (s, 18H), 0.29 (s, 3H), 0.26 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 151.3, 148.0, 137.9, 137.8, 135.2, 134.5, 132.4, 129.6, 129.1, 128.9, 127.4, 125.3, 124.7, 123.6, 122.1, 44.9, 34.3, 30.3, – 3.2, – 3.4.

HRMS (ESI$^+$) calcd for $C_{41}H_{48}NOSi$ $[M+H]^+$: 598.3505; found 598.3508.

4-([1,1'-Biphenyl]-4-yl(dimethyl(phenyl)silyl)methyl)-2,6-di-*tert*-butylphenol 7q



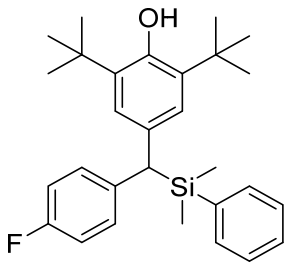
Yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.54 – 7.51 (m, 2H), 7.42 – 7.33 (m, 4H), 7.31 – 7.27 (m, 1H), 7.25 – 7.13 (m, 7H), 6.83 (s, 2H), 4.89 (s, 1H), 3.60 (s, 1H), 1.28 (s, 18H), 0.24 (s, 3H), 0.22 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 151.4, 142.3, 141.1, 137.8, 137.6, 135.3, 134.6, 132.2, 129.2, 129.0, 128.7, 127.5, 126.9, 126.9, 126.8, 125.5, 45.3, 34.3, 30.4, – 3.1, – 3.3.

HRMS (ESI$^+$) calcd for $C_{35}H_{42}OSiNa$ [M+Na]$^+$: 529.2903; found 529.2904.

2,6-Di-*tert*-butyl-4-((dimethyl(phenyl)silyl)(4-fluorophenyl)methyl)phenol 7r



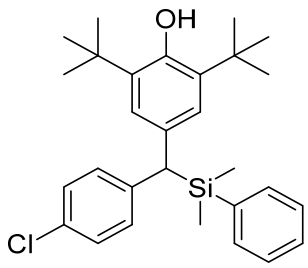
Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.30 – 7.26 (m, 1H), 7.23 – 7.16 (m, 4H), 7.04 – 7.00 (m, 2H), 6.86 – 6.82 (m, 2H), 6.77 (s, 2H), 4.90 (s, 1H), 3.54 (s, 1H), 1.28 (s, 18H), 0.20 (s, 3H), 0.19 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 159.6, 151.4, 138.8, 138.7, 137.6, 135.4, 134.5, 132.2, 130.2, 130.1, 129.1, 127.6, 125.3, 115.0, 114.8, 44.5, 34.4, 30.3, – 3.1, – 3.4.

HRMS (ESI$^+$) calcd for $C_{29}H_{38}FOSi$ [M+H]$^+$: 449.2676; found 449.2674.

2,6-Di-*tert*-butyl-4-((4-chlorophenyl)(dimethyl(phenyl)silyl)methyl)phenol 7s



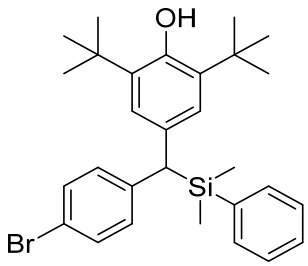
Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.26 – 7.22 (m, 1H), 7.19 – 7.11 (m, 4H), 7.08 – 7.05 (m, 2H), 6.94 – 6.92 (m, 2H), 6.72 (s, 2H), 4.56 (s, 1H), 3.48 (s, 1H), 1.23 (s, 18H), 0.15 (s, 3H), 0.14 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 151.5, 141.7, 137.4, 135.4, 134.5, 131.8, 130.6, 130.1, 129.1, 128.2, 127.6, 125.4, 44.9, 34.3, 30.3, – 3.2, – 3.4.

HRMS (ESI$^+$) calcd for $C_{29}H_{38}ClOSi$ $[M+H]^+$: 465.2380; found 465.2379.

4-((4-Bromophenyl)(dimethyl(phenyl)silyl)methyl)-2,6-di-*tert*-butylphenol 7t

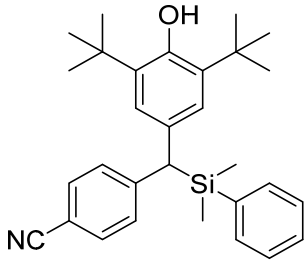


Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.36 – 7.32 (m, 2H), 7.31 – 7.21 (m, 5H), 6.99 – 6.97 (m, 2H), 6.82 (s, 2H), 4.96 (s, 1H), 3.87 (s, 1H), 1.32 (s, 18H), 0.25 (s, 3H), 0.24 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 151.5, 142.2, 137.4, 135.4, 134.5, 131.7, 131.1, 130.5, 129.1, 127.6, 125.4, 118.6, 44.9, 34.3, 30.3, – 3.2, – 3.4.

4-((3,5-Di-*tert*-butyl-4-hydroxyphenyl)(dimethyl(phenyl)silyl)methyl)benzonitrile 7u

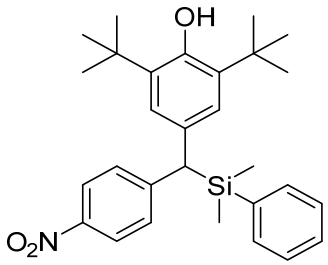


Yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.78 – 7.76 (m, 2H), 7.68 – 7.64 (m, 1H), 7.58 – 7.55 (m, 2H), 7.52 – 7.50 (m, 2H), 7.47 – 7.45 (m, 2H), 7.15 (s, 2H), 5.33 (s, 1H), 4.00 (s, 1H), 1.64 (s, 18H), 0.57 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 151.8, 149.3, 136.7, 135.7, 134.4, 131.9, 130.8, 129.4, 129.1, 127.7, 125.7, 119.4, 108.4, 46.4, 34.4, 30.3, – 3.2, – 3.5.

2,6-Di-*tert*-butyl-4-((dimethyl(phenyl)silyl)(4-nitrophenyl)methyl)phenol 7v



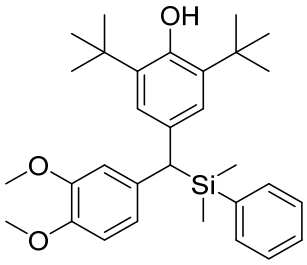
Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 8.07 – 8.04 (m, 2H), 7.39 – 7.35 (m, 1H), 7.31 – 7.27 (m, 2H), 7.23 – 7.18 (m, 4H), 6.89 (s, 2H), 5.04 (s, 1H), 3.77 (s, 1H), 1.35 (s, 18H), 0.29 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 151.9, 151.7, 145.4, 136.6, 135.8, 134.4, 129.5, 128.9, 127.7, 125.7, 123.4, 46.3, 34.4, 30.3, – 3.2, – 3.5.

HRMS (ESI^{+}) calcd for $C_{29}H_{38}NO_3Si$ $[M+H]^{+}$: 476.2621; found 476.2622.

2,6-Di-*tert*-butyl-4-((3,4-dimethoxyphenyl)(dimethyl(phenyl)silyl)methyl)phenol 7w



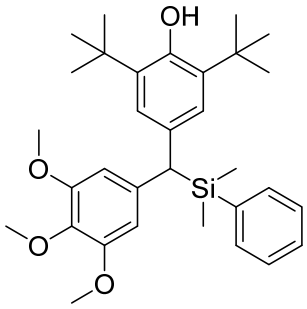
Pale yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.32 – 7.29 (m, 1H), 7.25 – 7.24 (m, 1H), 7.22 – 7.20 (m, 3H), 6.83 (s, 2H), 6.72 – 6.65 (m, 2H), 6.56 – 6.55 (m, 1H), 4.91 (s, 1H), 3.80 (s, 3H), 3.62 (s, 3H), 3.50 (s, 1H), 1.30 (s, 18H), 0.21 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 151.3, 148.2, 146.4, 137.9, 135.5, 135.2, 134.7, 132.4, 129.0, 127.5, 125.1, 120.7, 112.2, 110.9, 55.8, 55.4, 44.9, 34.3, 30.3, – 3.1, – 3.5.

HRMS (ESI$^+$) calcd for $C_{31}H_{43}O_3Si$ $[M+H]^+$: 491.2981; found 491.2976.

2,6-Di-*tert*-butyl-4-((dimethyl(phenyl)silyl)(3,4,5-trimethoxyphenyl)methyl)phenol 7x



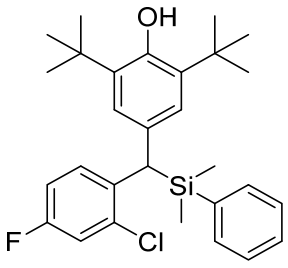
Yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.29 – 7.21 (m, 2H), 7.19 – 7.16 (m, 3H), 6.82 (s, 2H), 6.25 (m, 2H), 4.89 (s, 1H), 3.71 (s, 3H), 3.60 (s, 6H), 3.44 (s, 1H), 1.28 (s, 18H), 0.19 (s, 3H), 0.18 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 152.6, 151.4, 138.6, 137.7, 135.3, 134.8, 132.0, 129.1, 127.5, 125.1, 105.7, 60.9, 55.7, 46.0, 34.4, 30.3, – 3.2, – 3.4.

HRMS (ESI$^+$) calcd for $C_{32}H_{45}O_4Si$ $[M+H]^+$: 521.3087; found 521.3087.

2,6-Di-*tert*-butyl-4-((2-chloro-4-fluorophenyl)(dimethyl(phenyl)silyl)methyl)phenol 7y



Colorless oil

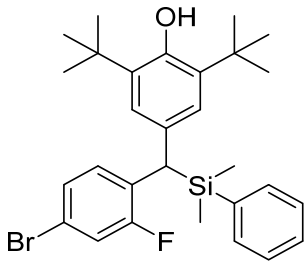
^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.43 – 7.40 (m, 1H), 7.38 – 7.35 (m, 4H), 7.30 – 7.26 (m, 1H), 7.18 – 7.15 (m, 1H), 6.96 – 6.91 (m, 1H), 6.89 (s, 2H), 5.04 (s, 1H), 4.33 (s, 1H), 1.39 (s, 18H), 0.37 (s, 3H), 0.33 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 161.3, 158.9, 151.5, 137.4, 136.9, 136.9, 135.3, 134.8, 134.5, 131.2, 131.1, 131.0, 129.2, 127.6, 125.5, 116.9, 116.7, 113.7, 113.5,

39.3, 34.3, 30.3, – 2.8, – 3.7.

HRMS (ESI$^+$) calcd for $C_{29}H_{37}FClOSi$ $[M+H]^+$: 483.2286; found 483.2289.

4-((4-Bromo-2-fluorophenyl)(dimethyl(phenyl)silyl)methyl)-2,6-di-*tert*-butylphenol 7z



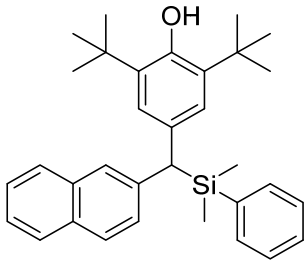
Yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.37 – 7.32 (m, 1H), 7.29 – 7.28 (m, 4H), 7.15 – 7.11 (m, 3H), 6.92 (s, 2H), 4.94 (s, 1H), 4.39 (s, 1H), 1.35 (s, 18H), 0.21 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 154.4, 151.2, 138.1, 138.0, 135.2, 134.4, 132.0, 131.2, 128.9, 127.4, 126.1, 125.1, 123.8, 118.8, 36.7, 34.3, 30.3, 26.8, 24.3, – 3.0, – 4.0.

HRMS (ESI$^+$) calcd for $C_{29}H_{37}FBrOSi$ $[M+H]^+$: 527.1781; found 527.1777.

2,6-Di-*tert*-butyl-4-((dimethyl(phenyl)silyl)(naphthalen-2-yl)methyl)phenol 7A

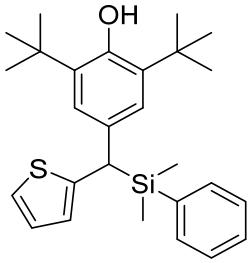


Yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.80 – 7.78 (m, 1H), 7.73 – 7.69 (m, 2H), 7.60 (s, 1H), 7.45 – 7.36 (m, 3H), 7.35 – 7.29 (m, 5H), 6.95 (s, 2H), 4.97 (s, 1H), 3.82 (s, 1H), 1.36 (s, 18H), 0.32 (s, 3H), 0.30 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 151.4, 140.7, 137.9, 135.3, 134.6, 133.6, 132.2, 131.5, 129.1, 128.3, 127.54, 127.52, 127.48, 126.8, 125.7, 125.5, 124.8, 45.6, 34.3, 30.3, – 3.0, – 3.3.

2,6-Di-*tert*-butyl-4-((dimethyl(phenyl)silyl)(thiophen-2-yl)methyl)phenol 7B

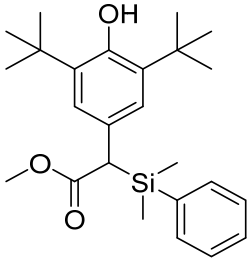


Yellow oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.22 – 7.18 (m, 1H), 7.13 – 7.08 (m, 4H), 6.90 – 6.89 (m, 1H), 6.76 -6.74 (m, 1H), 6.70 (s, 2H), 6.60 (s, 1H), 4.81 (s, 1H), 3.74 (s, 1H), 1.20 (s, 18H), 0.15 (s, 3H), 0.14 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 151.4, 146.0, 137.0, 135.2, 134.5, 131.5, 129.1, 127.4, 126.6, 124.8, 124.1, 122.1, 40.2, 34.3, 30.3, – 3.7, – 4.1.

Methyl 2-(3,5-di-*tert*-butyl-4-hydroxyphenyl)-2-(dimethyl(phenyl)silyl)acetate 7C

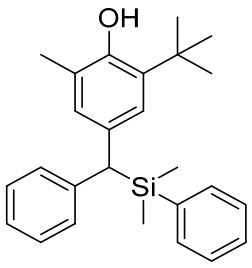


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.38 – 7.33 (m, 1H), 7.32 – 7.28 (m, 4H), 6.93 (s, 2H), 4.99 (s, 1H), 3.59 (s, 3H), 3.49 (s, 1H), 1.34 (s, 18H), 0.34 (s, 3H), 0.33 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 173.7, 151.7, 135.8, 135.2, 134.1, 129.4, 127.6, 125.8, 125.0, 51.3, 45.3, 34.2, 30.3, – 4.3, – 4.4.

2-(*tert*-Butyl)-4-((dimethyl(phenyl)silyl)(phenyl)methyl)-6-methylphenol 7D

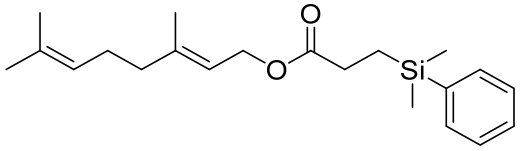


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.37 – 7.31 (m, 1H), 7.30 – 7.28 (m, 4H), 7.23 – 7.19 (m, 2H), 7.14 – 7.09 (m, 3H), 6.85 (s, 1H), 6.75 (s, 1H), 4.54 (s, 1H), 3.62 (s, 1H), 2.13 (s, 3H), 1.31 (s, 9H), 0.30 (s, 3H), 0.28 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 150.3, 143.0, 137.9, 135.0, 134.6, 133.2, 129.1, 129.0, 128.8, 128.2, 127.5, 126.0, 125.0, 122.7, 45.0, 34.6, 29.8, 16.2, – 3.1, – 3.2.

(*E*)-3,7-dimethylocta-2,6-dien-1-yl 3-(dimethyl(phenyl)-l4-sulfanyl)propanoate 9a



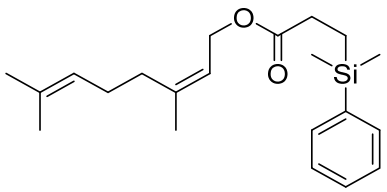
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.51 – 7.49 (m, 2H), 7.37 – 7.36 (m, 3H), 5.34 – 5.30 (m, 1H), 5.10 – 5.07 (m, 1H), 4.57 – 4.55 (m, 2H), 2.31 – 2.27 (m, 2H), 2.09 – 2.04 (m, 4H), 1.70 – 1.68 (m, 6H), 1.60 (s, 3H), 1.12 – 1.08 (m, 2H), 0.29 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 175.0, 142.2, 138.2, 133.6, 131.8, 129.1, 127.9, 123.8, 118.3, 61.4, 39.6, 28.9, 26.3, 25.7, 17.7, 16.5, 10.9, – 3.3.

HRMS (ESI^{+}) calcd for $C_{21}H_{33}O_2Si$ $[M+H]^{+}$: 345.2250; found 345.2248.

(*Z*)-3,7-dimethylocta-2,6-dien-1-yl 3-(dimethyl(phenyl)silyl)propanoate 9b



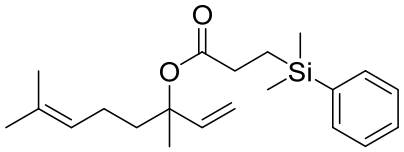
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.51 – 7.49 (m, 2H), 7.37 – 7.33 (m, 3H), 5.35 – 5.32 (m, 1H), 5.11 – 5.07 (m, 1H), 4.54 – 4.52 (m, 2H), 2.30 – 2.26 (m, 2H), 2.21 – 2.06 (m, 4H), 1.76 (s, 3H), 1.68 (s, 3H), 1.60 (s, 3H), 1.12 – 1.07 (m, 2H), 0.29 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 174.9, 142.6, 138.2, 133.6, 132.2, 129.1, 127.9, 123.6, 119.2, 61.1, 32.2, 28.9, 26.7, 25.7, 23.6, 17.7, 10.9, – 3.3.

HRMS (ESI^{+}) calcd for $C_{21}H_{32}O_2SiNa$ [M+Na]$^{+}$: 367.2069; found 367.2064.

3,7-Dimethylocta-1,6-dien-3-yl 3-(dimethyl(phenyl)silyl)propanoate 9c



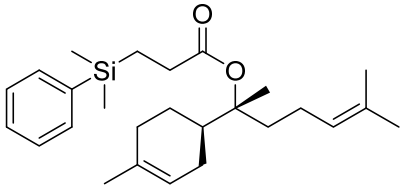
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.52 – 7.49 (m, 2H), 7.37 – 7.26 (m, 3H), 5.98 – 5.91 (m, 1H), 5.16 – 5.06 (m, 2H), 2.25 – 2.21 (m, 2H), 1.99 – 1.93 (m, 2H), 1.87 – 1.72 (m, 2H), 1.67 (s, 3H), 1.58 (s, 3H), 1.52 (s, 3H), 1.09 – 1.04 (m, 2H), 0.28 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 173.7, 141.9, 138.3, 133.6, 131.8, 129.1, 127.9, 123.9, 113.1, 82.7, 39.8, 29.8, 25.7, 23.6, 22.4, 17.6, 10.8, – 3.2.

HRMS (ESI^{+}) calcd for $C_{21}H_{32}O_2SiNa$ [M+Na]$^{+}$: 367.2069; found 367.2073.

(*R*)-6-methyl-2-((*R*)-4-methylcyclohex-3-en-1-yl)hept-5-en-2-yl 3-(dimethyl(phenyl)silyl)propanoate 9d



Colorless oil

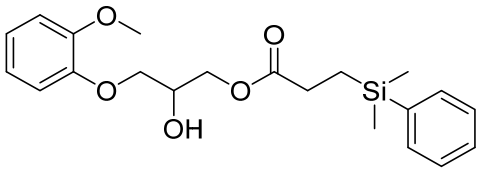
^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.52 – 7.49 (m, 2H), 7.37 – 7.26 (m, 3H), 5.35 – 5.31 (m, 1H), 5.11 – 5.08 (m, 2H), 4.57 – 4.52 (m, 2H), 2.30 – 2.25 (m, 2H), 2.12 – 2.03 (m, 7H), 1.76 – 1.58 (m, 11H), 1.43 – 138 (m, 1H), 1.27 – 1.23 (m, 1H), 1.11 – 1.07 (m, 2H), 0.29 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 174.9, 142.5, 138.2, 135.9, 133.6, 131.6,

129.1, 127.9, 124.3, 124.2, 119.2, 61.1, 32.4, 32.0, 28.9, 26.6, 26.4, 25.8, 23.6, 23.4, 17.7, 10.9, – 3.3.

HRMS (ESI$^+$) calcd for $C_{26}H_{41}O_2Si$ [M+H]$^+$: 413.2876; found 413.2873.

2-Hydroxy-3-(2-methoxyphenoxy)propyl 3-(dimethyl(phenyl)silyl)propanoate 9e



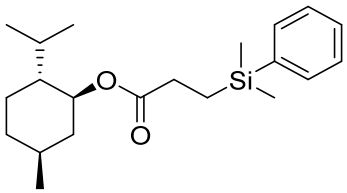
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.50 – 7.48 (m, 2H), 7.37 – 7.35 (m, 3H), 7.01 – 6.88 (m, 4H), 4.25 – 4.18 (m, 3H), 4.09 – 3.97 (m, 2H), 3.85 (s, 3H), 2.34 – 3.00 (m, 2H), 1.11 – 1.07 (m, 2H), 0.29 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 175.0, 150.0, 147.9, 138.0, 133.6, 129.2, 127.9, 122.6, 121.1, 115.8, 112.0, 71.5, 68.5, 65.2, 55.8, 28.7, 10.8, – 3.3.

HRMS (ESI$^+$) calcd for $C_{21}H_{29}O_5Si$ [M+H]$^+$: 389.1784; found 389.1783.

(1*S*,2*R*,5*S*)-2-isopropyl-5-methylcyclohexyl 3-(dimethyl(phenyl)silyl)propanoate 9f



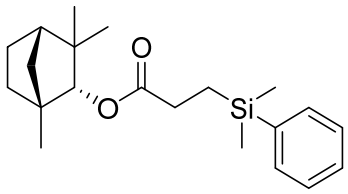
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.52 – 7.49 (m, 2H), 7.38 – 7.35 (m, 3H), 4.69 – 4.62 (m, 1H), 2.27 – 2.22 (m, 2H), 1.97 – 1.80 (m, 2H), 1.69 – 1.30 (m, 7H), 1.60 (s, 2H), 1.10 – 1.05 (m, 2H), 0.89 – 0.87 (m, 6H), 0.75 (d, *J* = 7 Hz, 3H), 0.29 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 174.6, 138.3, 133.6, 129.1, 127.9, 74.0, 47.0, 40.9, 34.3, 31.4, 29.2, 26.2, 23.4, 22.1, 20.8, 16.3, 10.9, – 3.24, – 3.27.

HRMS (ESI$^+$) calcd for $C_{21}H_{34}O_2SiNa$ [M+Na]$^+$: 369.2226; found 369.2227.

(1*R*,2*R*,4*S*)-1,3,3-trimethylbicyclo[2.2.1]heptan-2-yl 3-(dimethyl(phenyl)silyl)propanoate 9g



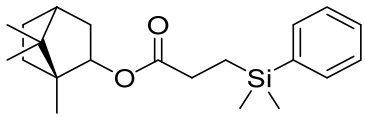
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.54 – 7.50 (m, 2H), 7.40 – 7.32 (m, 3H), 4.35 (s, 1H), 2.32 – 2.28 (m, 2H), 1.75 – 1.55 (m, 5H), 1.48 – 1.40 (m, 1H), 1.19 – 1.13 (m, 3H), 1.10 (s, 3H), 1.02 (s, 3H), 0.75 (s, 3H), 0.30 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 175.5, 138.3, 133.6, 129.1, 127.9, 86.0, 48.34, 48.25, 41.4, 39.5, 29.7, 28.9, 26.6, 25.9, 20.2, 19.5, 11.0, – 3.23, – 3.24.

HRMS (ESI^{+}) calcd for $C_{21}H_{33}O_2Si$ $[M+H]^{+}$: 345.2250; found 345.2250.

(1*S*)-1,7,7-trimethylbicyclo[2.2.1]heptan-2-yl 3-(dimethyl(phenyl)silyl)propanoate 9h



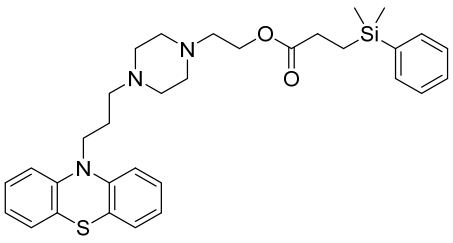
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.51 – 7.49 (m, 2H), 7.37 – 7.35 (m, 3H), 4.65 – 4.62 (m, 1H), 2.26 – 2.22 (m, 2H), 1.81 – 1.50 (m, 6H), 1.10 – 1.06 (m, 3H), 0.96 (s, 3H), 0.86 – 0.82 (m, 6H), 0.29 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 174.5, 138.3, 133.6, 129.1, 127.9, 80.9, 48.7, 46.9, 45.0, 38.8, 33.8, 29.2, 27.1, 20.2, 20.0, 11.5, 10.8, – 3.2, – 3.3.

HRMS (ESI^{+}) calcd for $C_{21}H_{33}O_2Si$ $[M+H]^{+}$: 345.2250; found 345.2247.

2-(4-(3-(*10H*-phenothiazin-10-yl)propyl)piperazin-1-yl)ethyl 3-(dimethyl(phenyl)silyl)propanoate 9i



Colorless oil

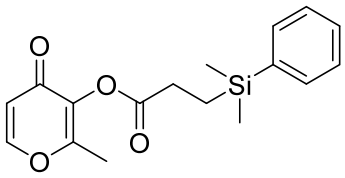
^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.51 – 7.48 (m, 2H), 7.39 – 7.35 (m, 4H), 7.17 – 7.11 (m, 2H), 7.02 – 6.84 (m, 5H), 4.15 (t, *J* = 6.0 Hz, 2H), 3.90 (t, *J* = 6.8 Hz, 2H), 2.59 – 2.44 (m, 12H), 2.30 – 2.25 (m, 2H), 1.95 – 1.92 (m, 2H), 1.10 – 1.05 (m, 2H), 0.29 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 174.8, 146.4, 144.4, 138.1, 133.5, 133.1, 133.0, 129.5, 129.1, 127.82, 127.80, 127.44, 127.35, 124.7, 123.4, 122.8, 122.2, 115.8, 115.7, 61.7, 56.5, 55.4, 53.2, 53.1, 45.3, 28.8, 24.1, 10.7, – 3.4.

HRMS (ESI^{+}) calcd for $C_{32}H_{42}N_3O_2SSi$ $[M+H]^{+}$: 560.2767; found 560.2769.

2-methyl-4-oxo-*4H*-pyran-3-yl 3-(dimethyl(phenyl)silyl)propanoate

9j



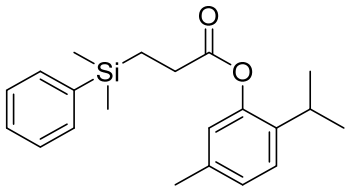
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.66 – 7.64 (m, 1H), 7.53 – 7.50 (m, 2H), 7.38 – 7.37 (m, 3H), 6.40 (d, *J* = 5.8 Hz, 1H), 2.60 – 2.55 (m, 2H), 2.21 (s, 3H), 1.24 – 1.19 (m, 2H), 0.33 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 172.1, 171.7, 159.0, 154.1, 138.7, 137.9, 133.6, 129.2, 128.0, 116.9, 28.4, 15.0, 10.9, – 3.3.

HRMS (ESI^{+}) calcd for $C_{18}H_{25}O_3Si$ $[M+H]^{+}$: 317.1573; found 317.1574.

2-Isopropyl-5-methylphenyl 3-(dimethyl(phenyl)silyl)propanoate 9k



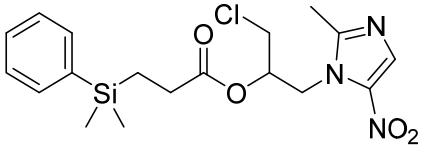
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.60 – 7.54 (m, 2H), 7.41 – 7.33 (m, 3H), 7.19 – 7.17 (m, 1H), 7.02 – 7.00 (m, 1H), 6.74 (s, 1H), 2.99 – 2.88 (m, 1H), 2.57 – 2.52 (m, 2H), 1.30 (s, 3H), 1.25 – 1.23 (m, 2H), 1.18 (d, *J* = 6.9 Hz, 6H), 0.36 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 173.7, 148.0, 138.0, 137.0, 136.5, 133.6, 129.2, 128.0, 127.1, 126.4, 122.7, 29.0, 27.0, 23.1, 20.9, 11.0, – 3.2.

HRMS (ESI$^+$) calcd for $C_{21}H_{28}O_2SiNa$ [M+Na]$^+$: 363.1756; found 363.1755.

1-Chloro-3-(2-methyl-5-nitro-1*H*-imidazol-1-yl)propan-2-yl 3-(dimethyl(phenyl)silyl)propanoate 9l



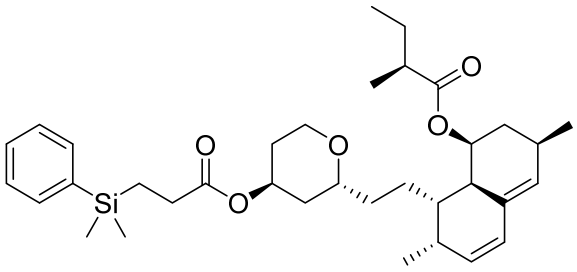
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.94 (s, 1H), 7.48 – 7.45 (m, 2H), 7.38 – 7.36 (m, 3H), 5.36 – 5.33 (m, 1H), 4.74 – 4.70 (m, 1H), 4.49 – 4.43 (m, 1H), 3.80 – 3.71 (m, 2H), 2.48 (s, 3H), 2.26 – 2.09 (m, 2H), 1.03 – 0.88 (m, 2H), 0.27 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 173.5, 151.0, 138.6, 137.6, 133.5, 133.2, 129.3, 128.0, 70.7, 47.1, 43.4, 28.6, 14.4, 10.7, – 3.37, – 3.43.

HRMS (ESI$^+$) calcd for $C_{18}H_{25}ClN_3O_4Si$ [M+H]$^+$: 410.1303; found 410.1307.

(1*S*,3*R*,7*S*,8*S*,8*aR*)-8-(2-((2*R*,4*S*)-4-((3-(dimethyl(phenyl)silyl)propanoyl)oxy)tetrahydro-2*H*-pyran-2-yl)ethyl)-3,7-dimethyl-1,2,3,7,8,8a-hexahydronaphthalen-1-yl (*S*)-2-methylbutanoate 9m



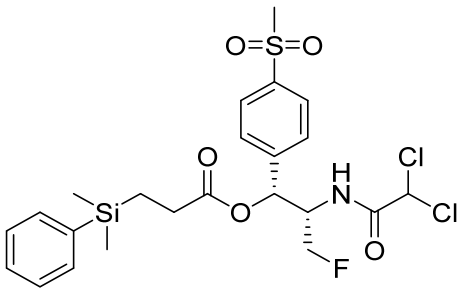
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.61 – 7.59 (m, 1H), 7.50 – 7.48 (m, 2H), 7.39 – 7.35 (m, 5H), 5.99 – 5.97 (m, 1H), 5.79 – 5.75 (m, 1H), 5.53 – 5.51 (m, 1H), 5.36 – 5.34 (m, 1H), 3.93 – 3.89 (m, 1H), 2.46 – 2.19 (m, 6H), 2.01 – 1.87 (m, 2H), 1.80 – 1.74 (m, 2H), 1.69 – 1.58 (m, 5H), 1.45 – 1.33 (m, 3H), 1.11 – 1.06 (m, 6H), 0.87 – 0.83 (m, 6H), 0.41 (s, 3H), 0.34 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 176.6, 173.9, 135.6, 133.9, 133.1, 133.0, 131.6, 129.7, 129.6, 128.3, 128.1, 127.9, 78.7, 67.8, 41.4, 37.2, 36.7, 32.7, 32.6, 30.7, 29.9, 28.6, 27.5, 26.9, 24.8, 22.8, 16.3, 15.1, 13.9, 11.7, – 5.4, – 5.5.

HRMS (ESI^{+}) calcd for $C_{35}H_{52}O_5SiNa$ $[M+Na]^{+}$: 603.3482; found 603.3485.

(1*R*,2*S*)-2-(2,2-dichloroacetamido)-3-fluoro-1-(4-(methylsulfonyl)phenyl)propyl 3-(dimethyl(phenyl)silyl)propanoate 9n



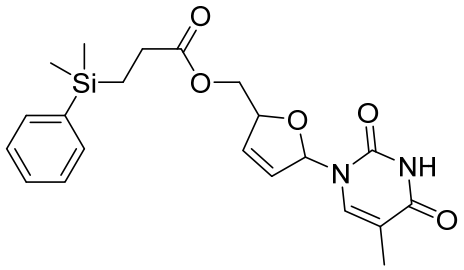
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.98 – 7.96 (m, 2H), 7.60 – 7.58 (m, 2H), 7.48 – 7.34 (m, 5H), 6.91 – 6.87 (m, 1H), 6.11 (d, *J* = 7.4 Hz, 1H), 5.88 (s, 1H), 4.53 – 4.18 (m, 3H), 3.06 (s, 3H), 2.36 – 2.31 (m, 2H), 1.07 (t, *J* = 8.7 Hz, 2H), 0.28 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 173.9, 164.2, 142.4, 141.2, 137.6, 133.5, 129.3, 128.1, 128.1, 128.0, 82.4, 80.7, 72.6, 66.0, 54.2, 54.0, 44.5, 28.8, 10.7, – 3.35, – 3.37.

HRMS (ESI$^+$) calcd for $C_{23}H_{28}Cl_2FNO_5SSiNa$ [M+Na]$^+$: 570.0716; found 570.0711.

(5-(5-Methyl-2,4-dioxo-3,4-dihydropyrimidin-1(2*H*)-yl)-2,5-dihydrofuran-2-yl)methyl 3-(dimethyl(phenyl)silyl)propanoate 9o



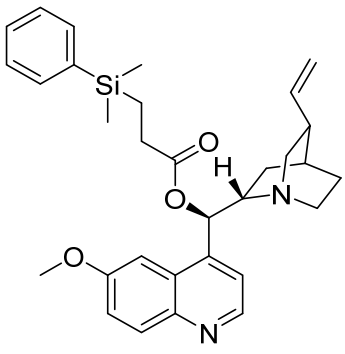
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 9.23 (s, 1H), 7.48 – 7.46 (m, 2H), 7.36 – 7.33 (m, 3H), 7.15 (s, 1H), 7.00 – 6.98 (m, 1H), 6.23 – 6.21 (m, 1H), 5.88 – 5.85 (m, 1H), 5.00 – 4.99 (m, 1H), 4.38 – 4.33 (m, 1H), 4.18 – 4.15 (m, 1H), 2.30 – 2.26 (m, 2H), 1.80 (s, 3H), 1.11 – 1.07 (m, 2H), 0.28 (s, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 174.5, 163.8, 150.8, 137.7, 135.4, 133.5, 133.1, 129.3, 128.0, 127.4, 111.2, 89.7, 84.3, 64.8, 28.7, 12.6, 10.7, – 3.27, – 3.30.

HRMS (ESI$^+$) calcd for $C_{21}H_{26}N_2O_5SiNa$ [M+Na]$^+$: 437.1509; found 437.1513.

(*R*)-(6-methoxyquinolin-4-yl)((1*S*,2*S*,4*S*,5*R*)-5-vinylquinuclidin-2-yl)methyl 3-(dimethyl(phenyl)silyl)propanoate 9p



Colorless oil

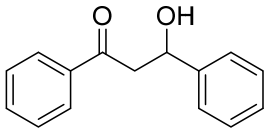
^{1}H NMR (400 MHz, Chloroform-*d*); δ = 8.73 (d, *J* = 4.6 Hz, 1H), 8.02 (d, *J* = 9.2 Hz, 1H), 7.48 – 7.44 (m, 3H), 7.38 – 7.26 (m, 5H), 6.48 (s, 1H), 5.87 – 5.79 (m, 1H), 5.04 – 4.99 (m, 2H), 3.94 (s, 3H), 3.38 – 3.33 (m, 1H), 3.07 – 3.01 (m, 2H), 2.65 – 2.58 (m,

2H), 2.35 – 2.26 (m, 3H), 1.89 – 1.84 (m, 2H), 1.54 – 1.47 (m, 3H), 1.08 – 1.04 (m, 2H), 0.26 (d, *J* = 4.3 Hz, 6H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 174.0, 157.9, 147.5, 144.8, 143.6, 141.7, 137.8, 133.5, 131.8, 129.2, 127.9, 127.1, 121.9, 119.0, 114.6, 101.5, 59.1, 56.5, 55.7, 42.4, 29.0, 27.5, 10.7, – 3.30, – 3.32.

HRMS (ESI$^+$) calcd for $C_{31}H_{39}N_2O_3Si$ $[M+H]^+$: 515.2730; found 515.2733.

3-Hydroxy-1,3-diphenylpropan-1-one 10

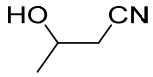


Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 7.97 – 7.95 (m, 2H), 7.61 – 7.57 (m, 1H), 7.49 – 7.43 (m, 4H), 7.41 – 7.37 (m, 2H), 7.33 – 7.29 (m, 1H), 5.37 – 5.34 (m, 1H), 3.71 (br, 1H), 3.39 – 3.37(m, 2H).

^{13}C NMR (100 MHz, Chloroform-*d*); δ = 200.2, 143.0, 136.5, 133.7, 128.8, 128.6, 128.2, 127.7, 125.8, 70.0, 47.5.

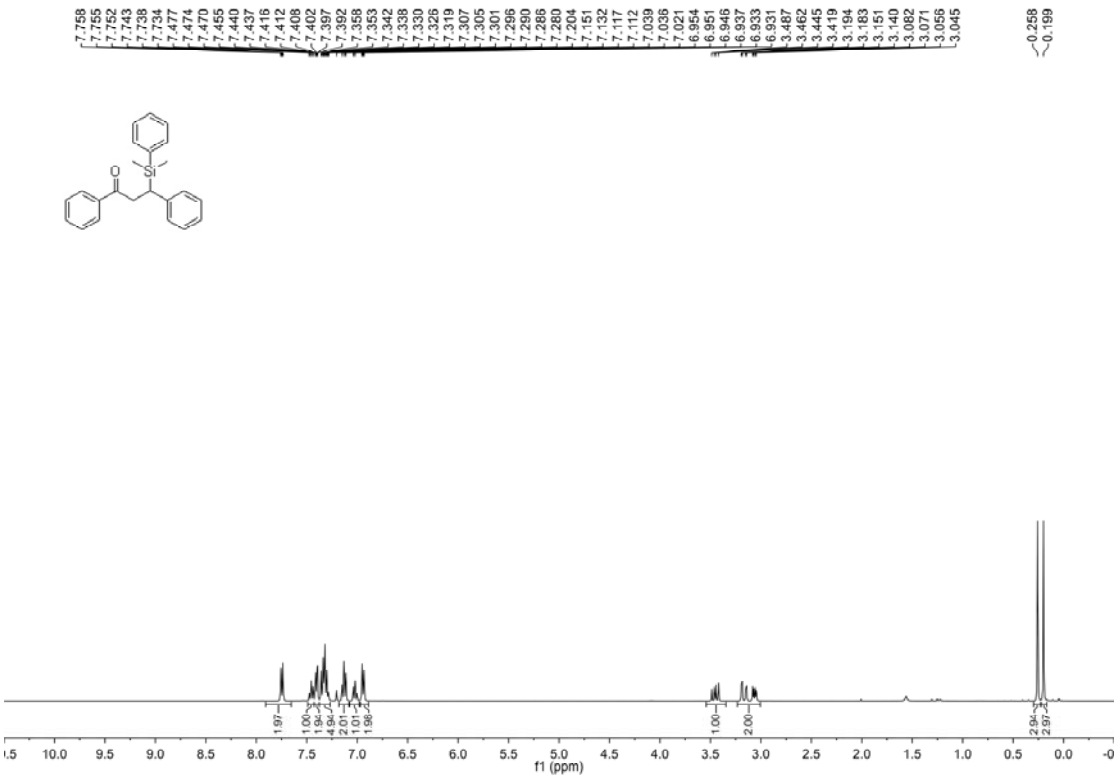
3-Hydroxybutanenitrile 11



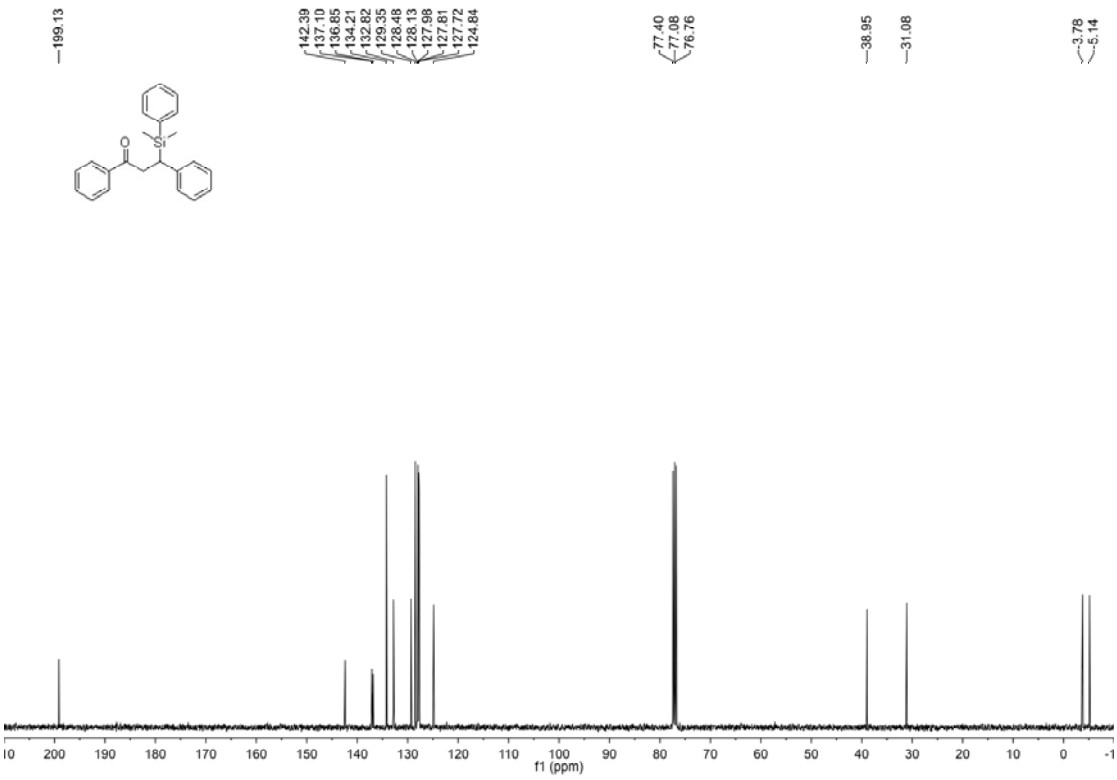
Colorless oil

^{1}H NMR (400 MHz, Chloroform-*d*); δ = 4.19 – 4.16 (m, 1H), 2.57 – 2.48 (m, 2H), 1.94 (br, 1H), 1.38 (d, J = 4.2 Hz, 3H).

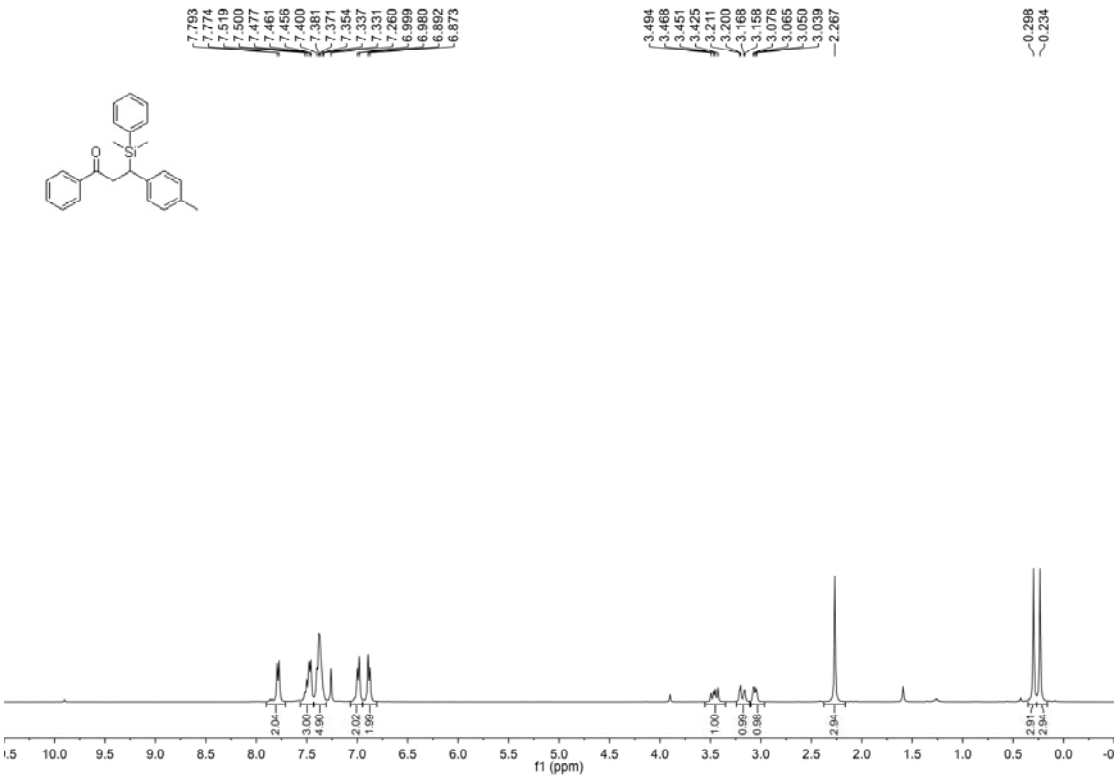
^{13}C NMR (100 MHz, Chloroform-*d*); δ = 99.9, 64.2, 27.5, 22.8.



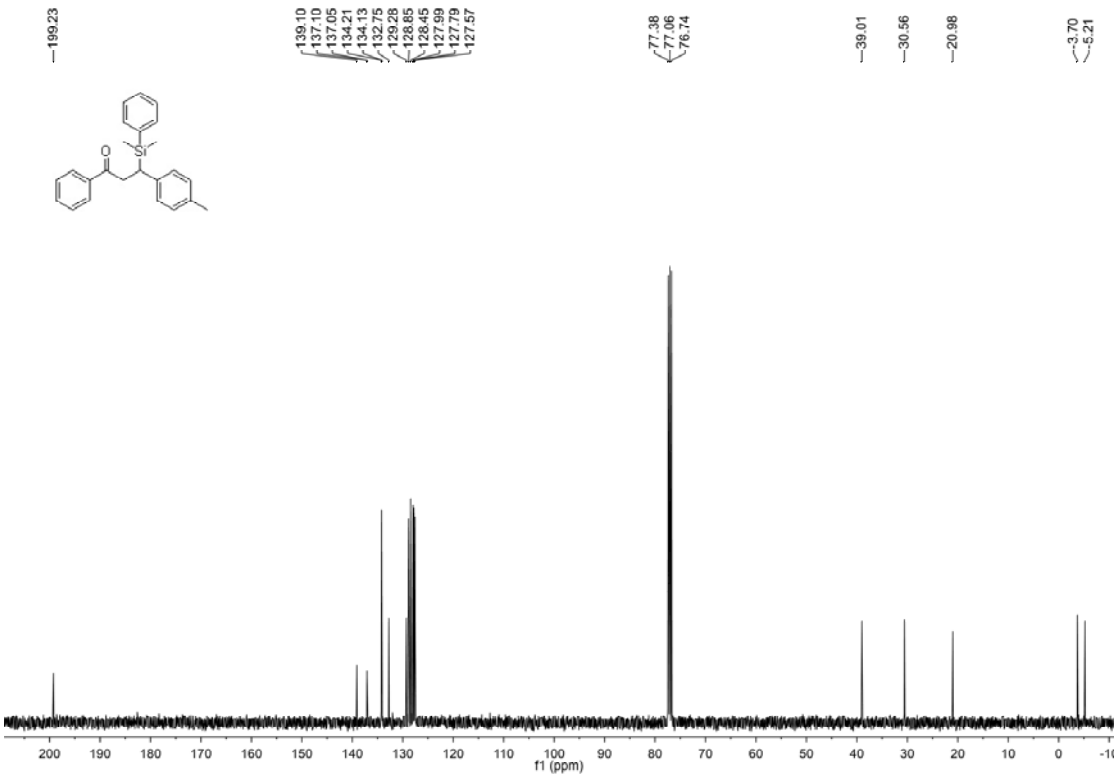
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3a**



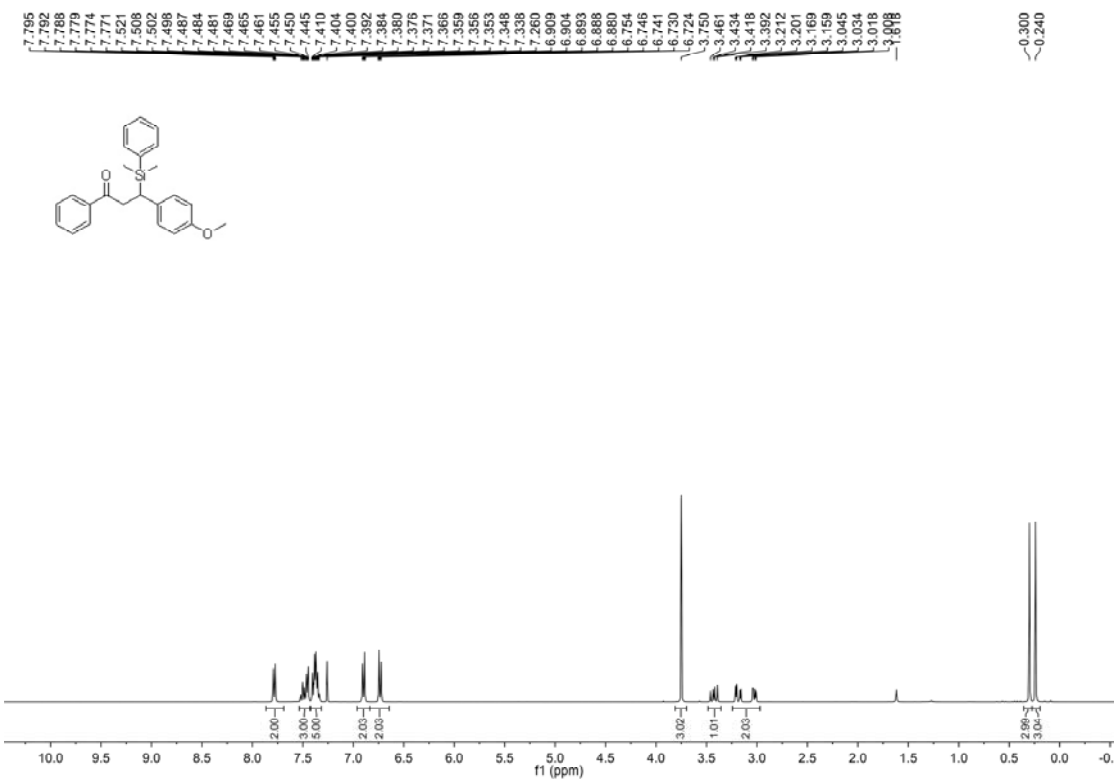
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **3a**



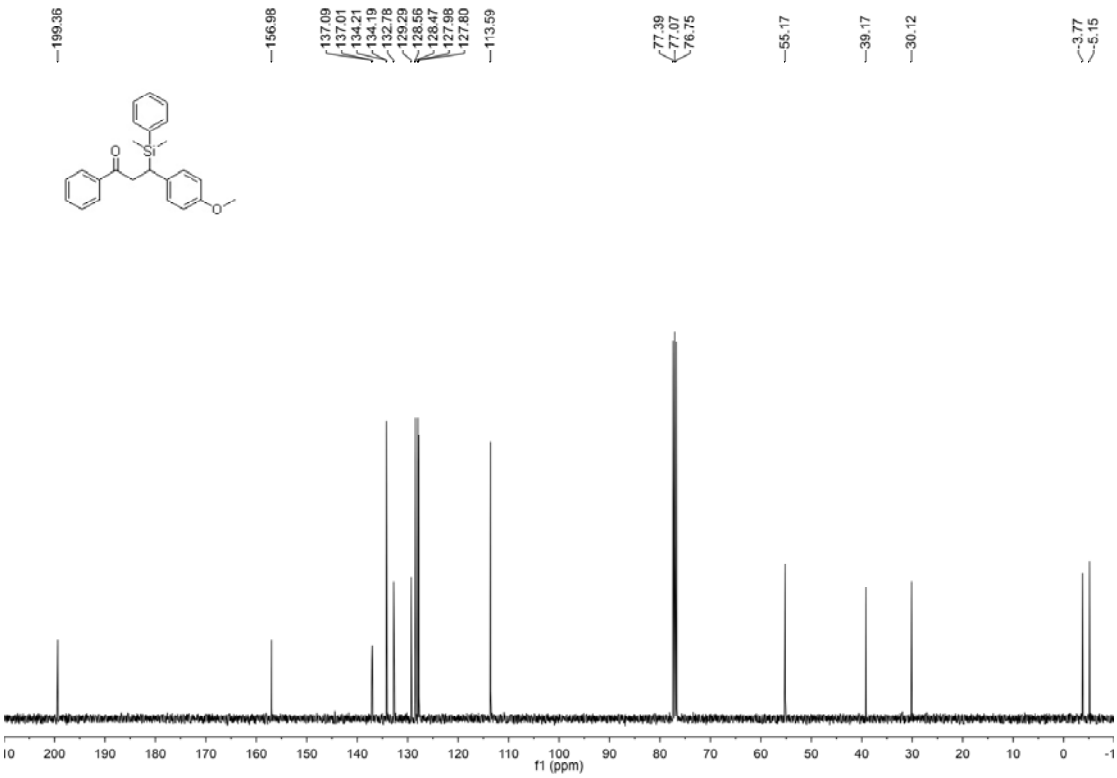
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3b**



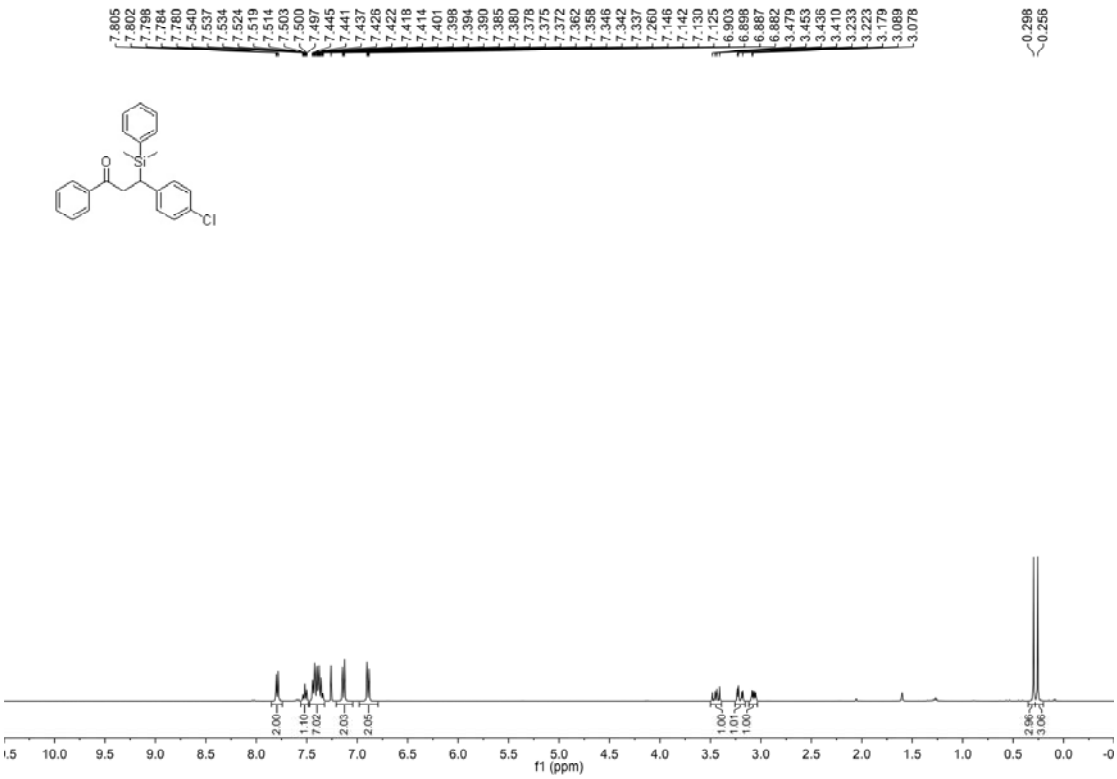
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3b**



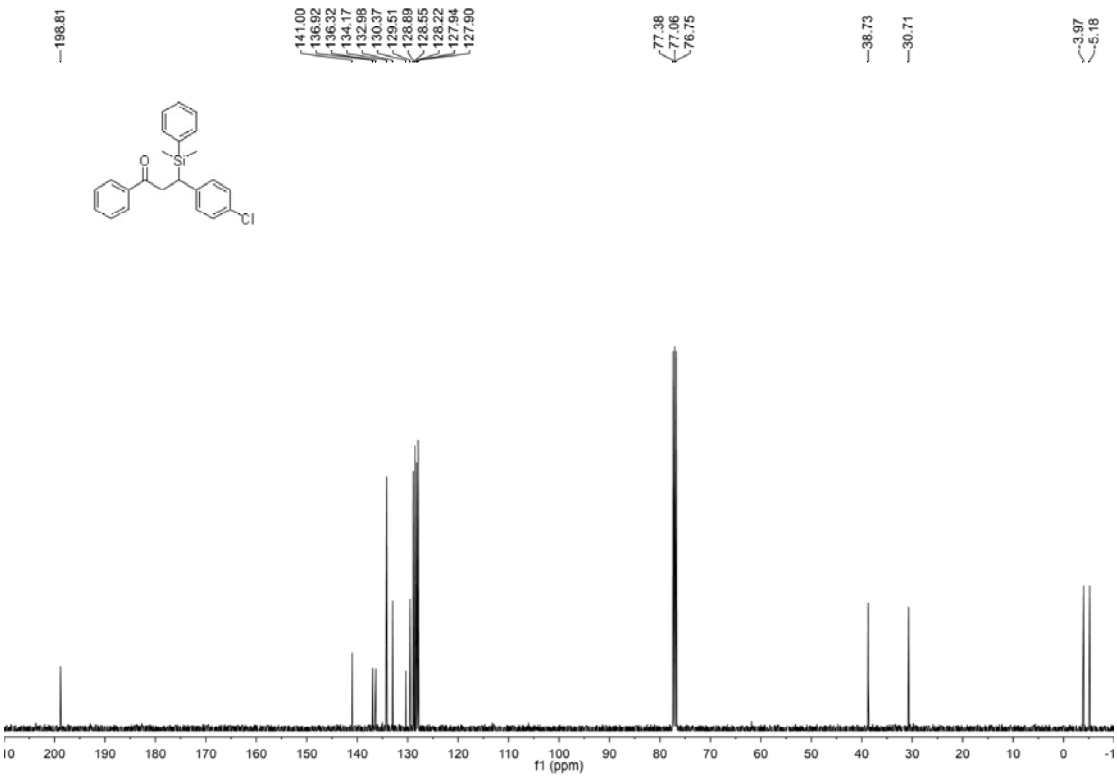
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3c**



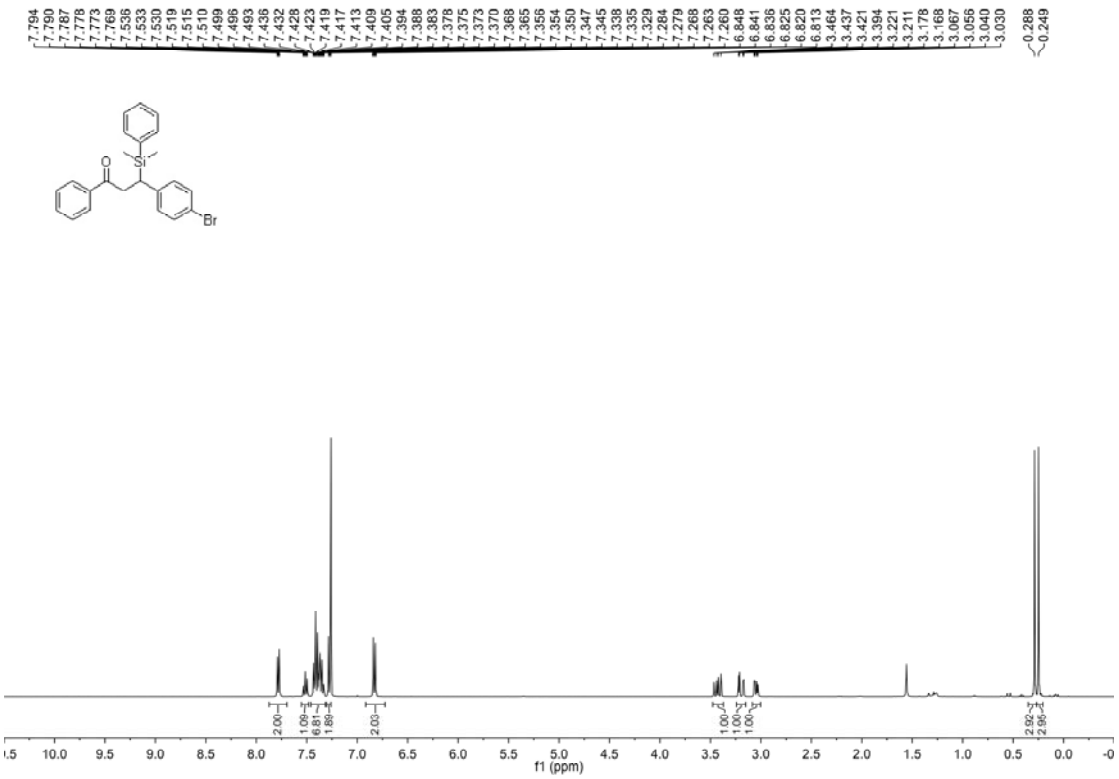
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3c**



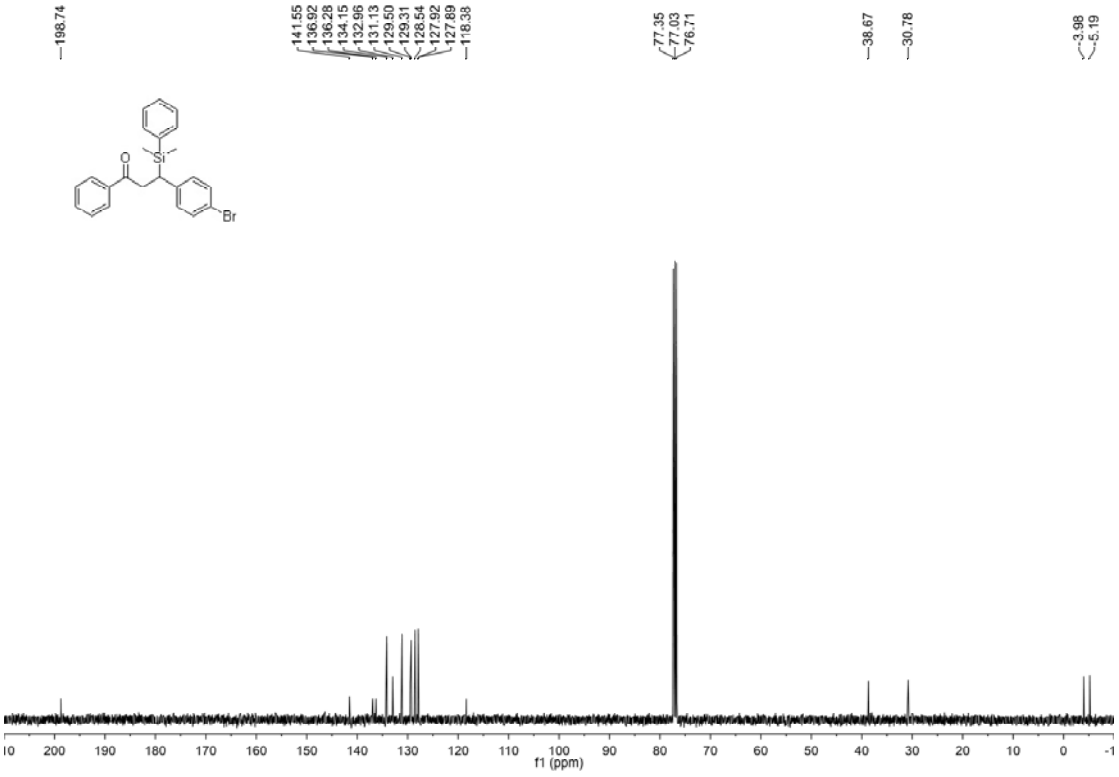
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3d**



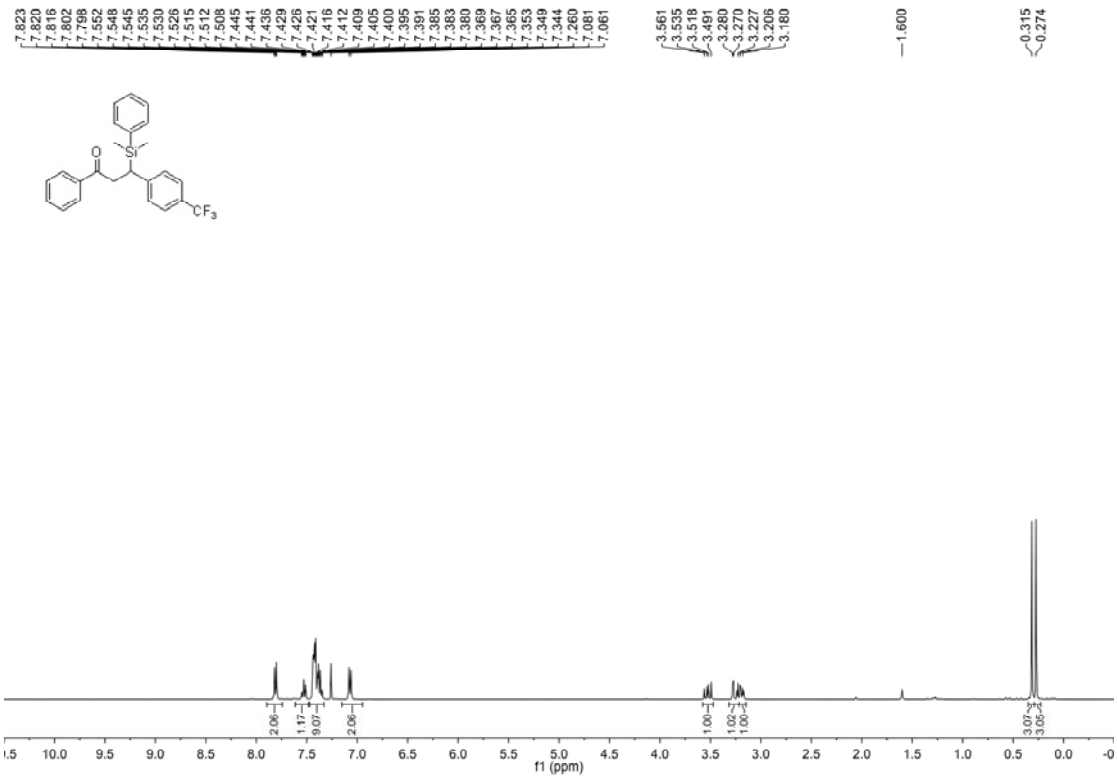
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3d**



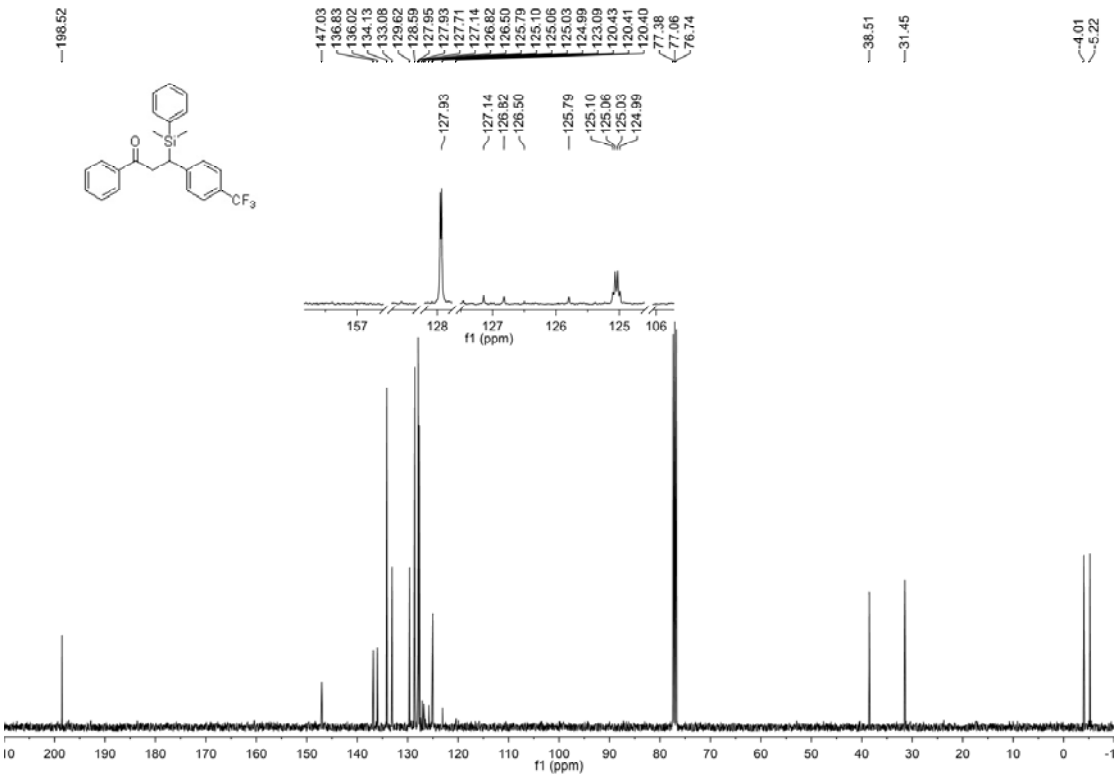
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3e**



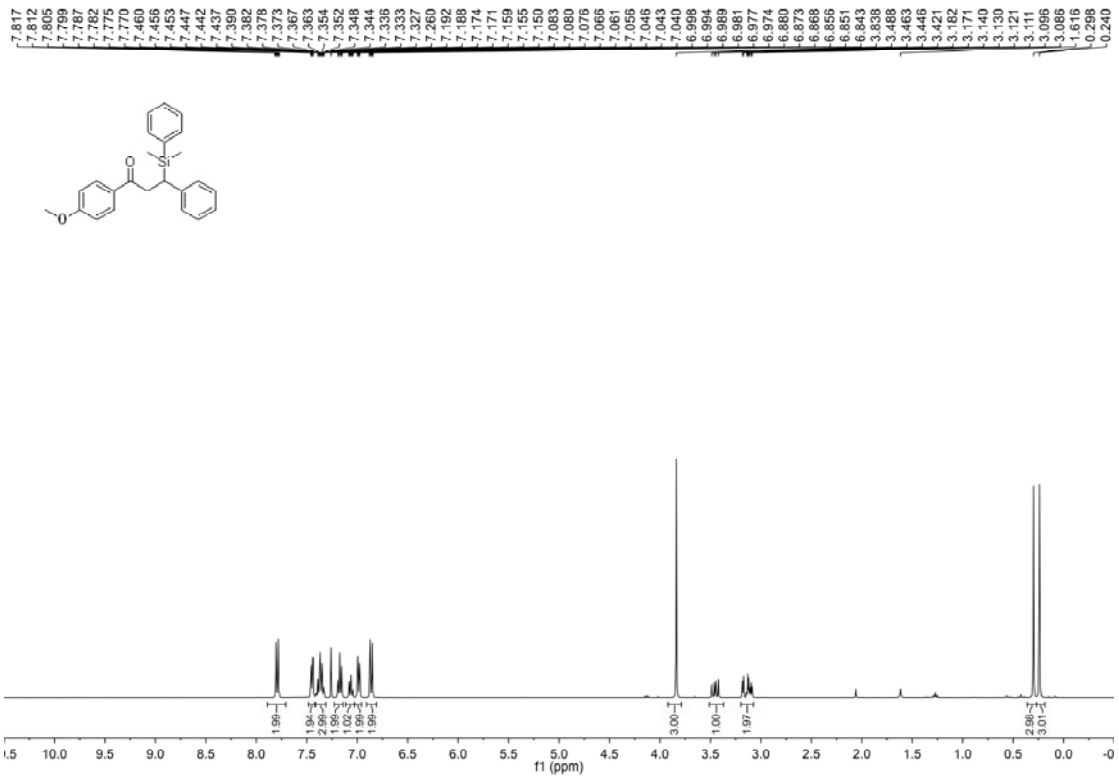
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3e**



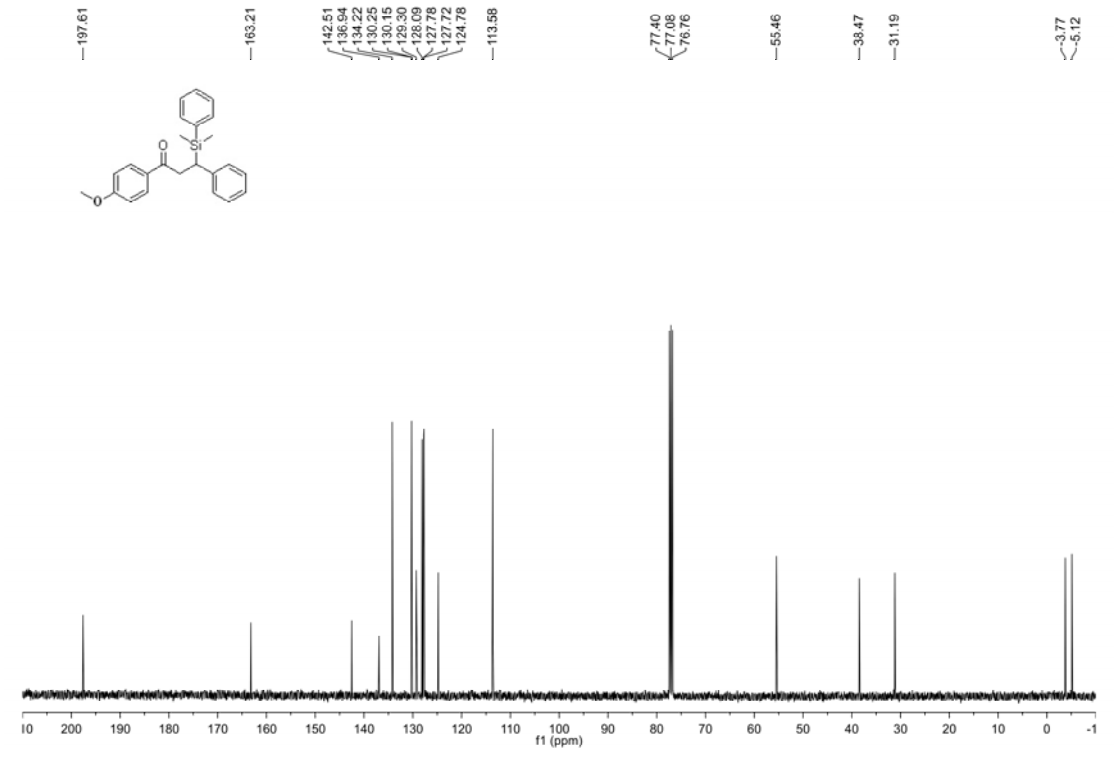
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3f**



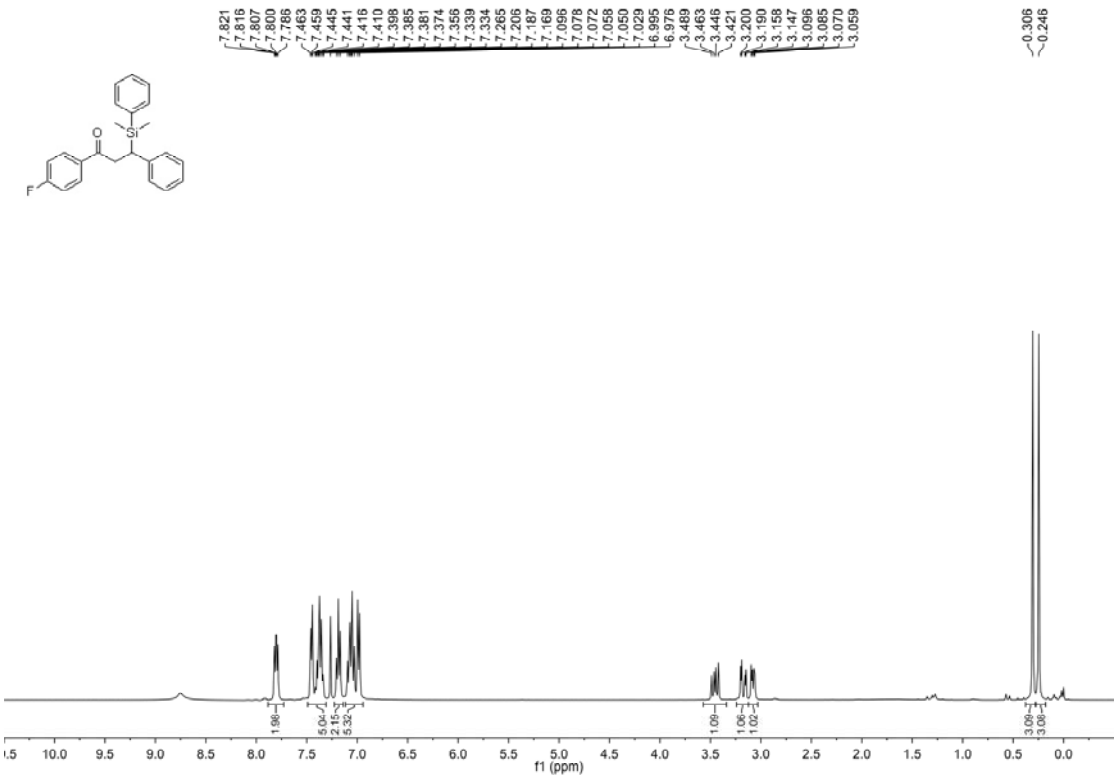
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **3f**



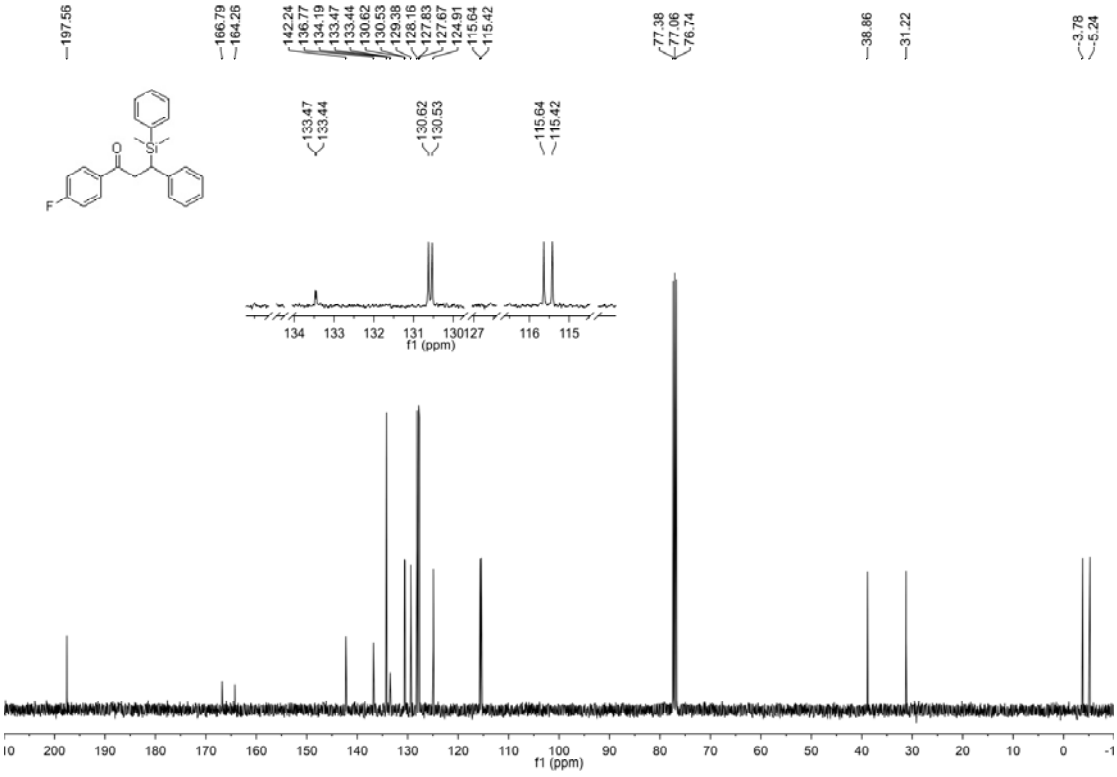
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3g**



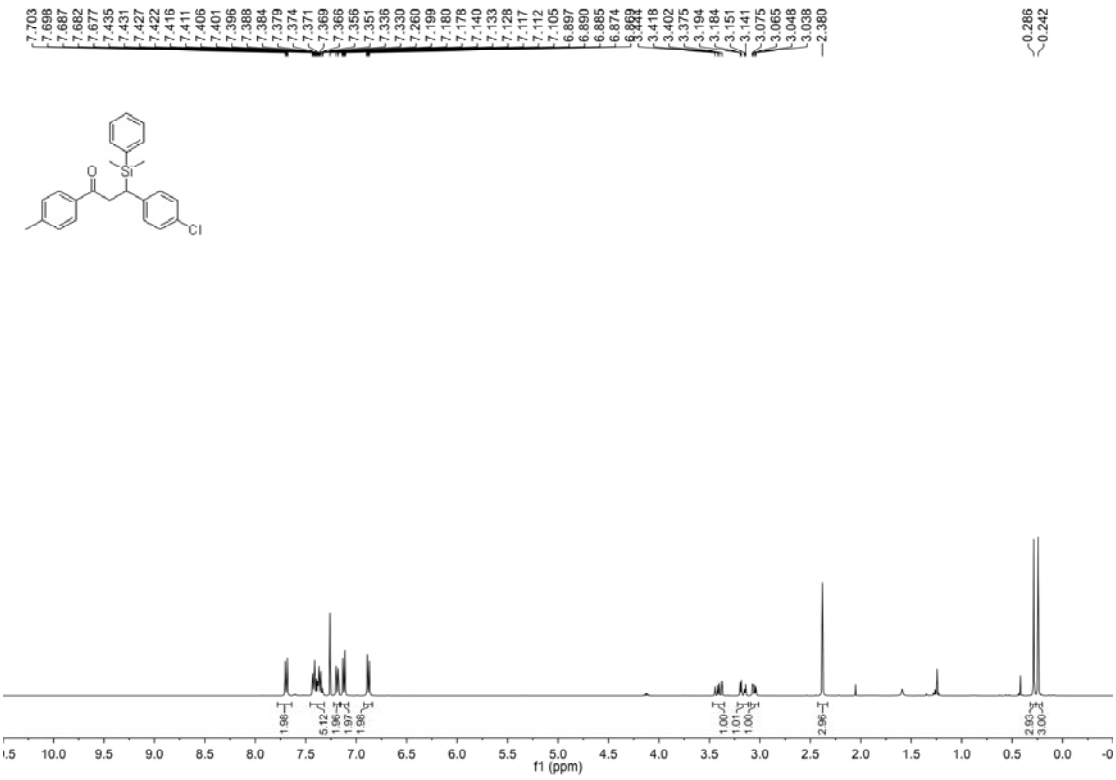
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3g**



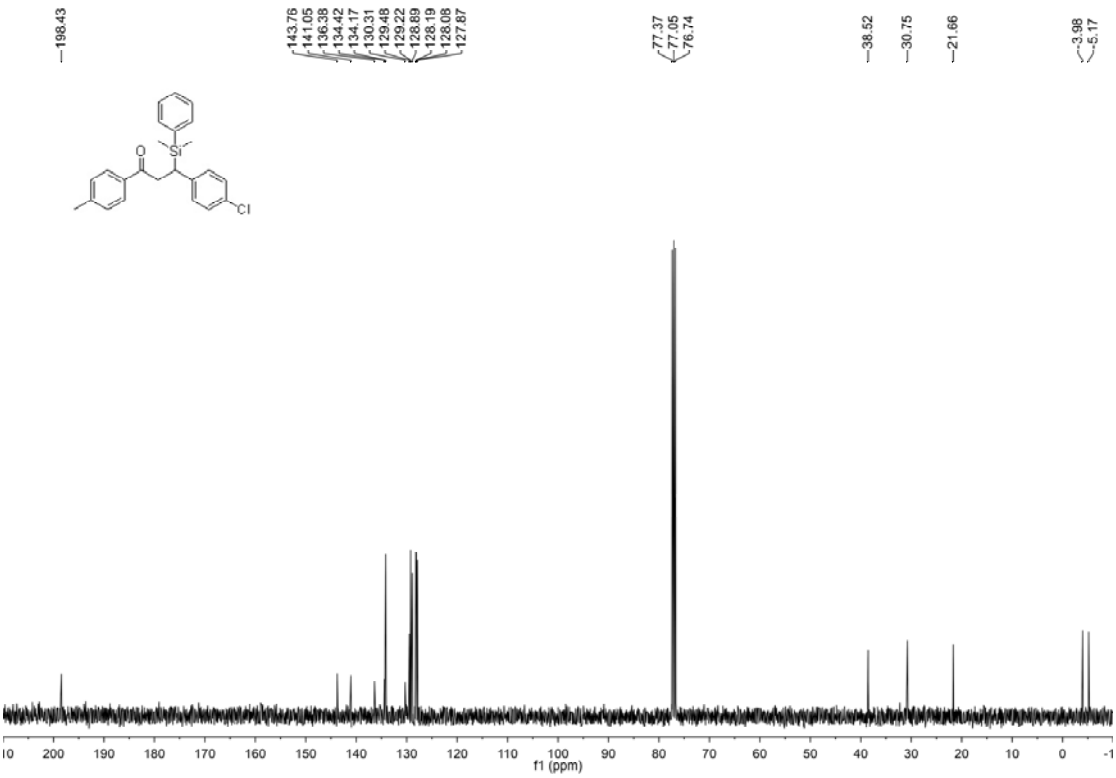
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3h**



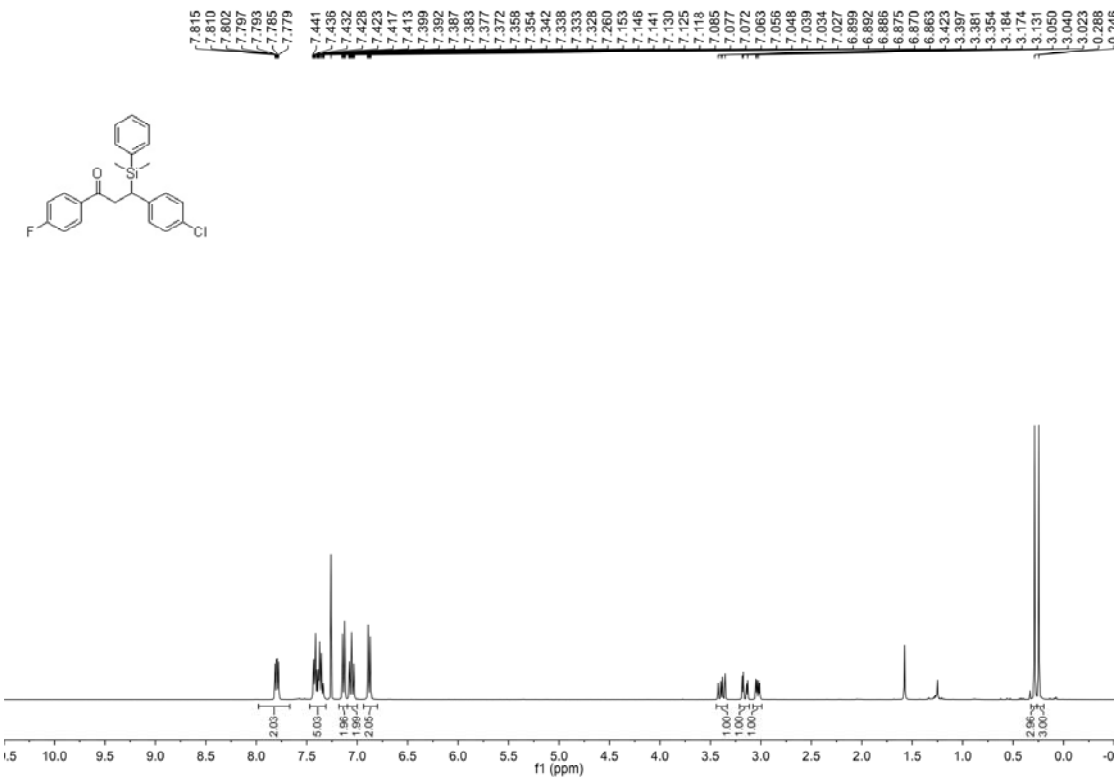
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3h**



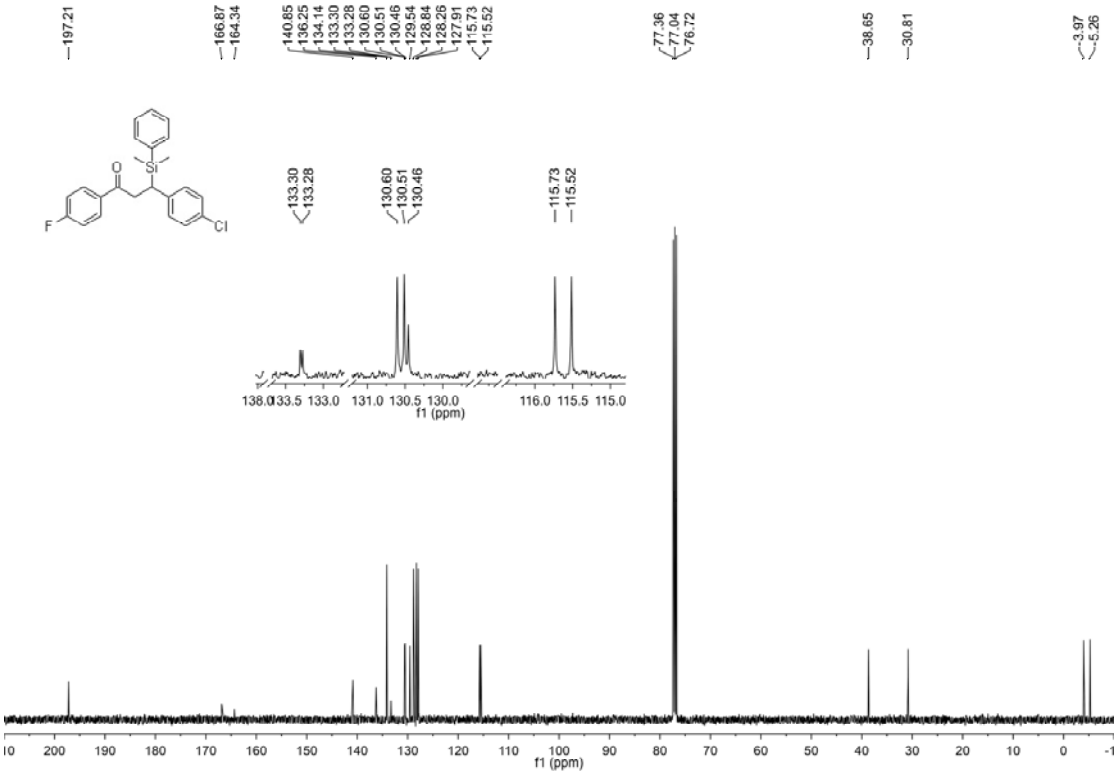
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3i**



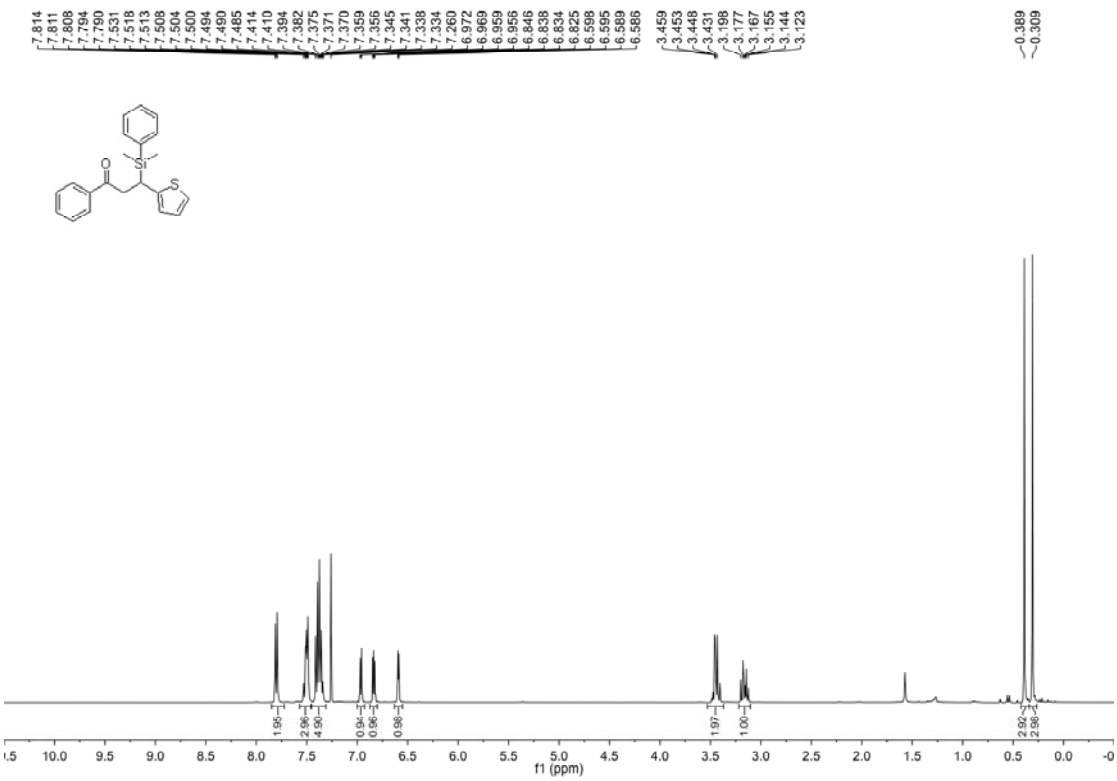
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3i**



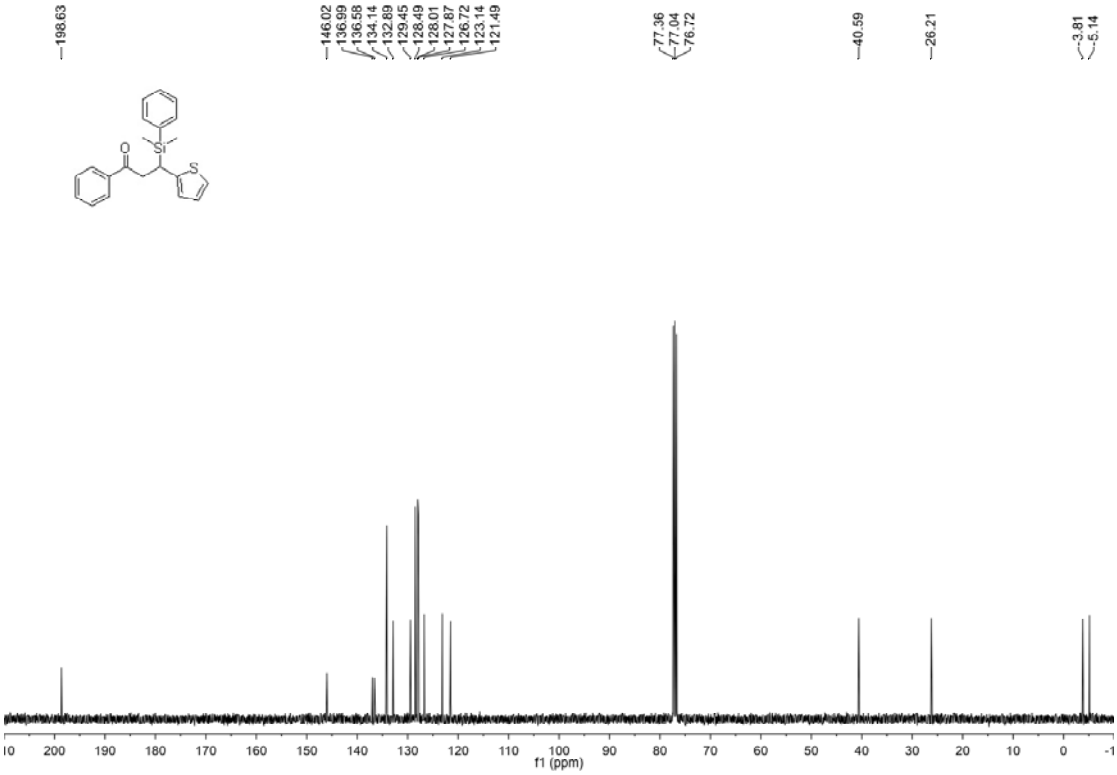
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3j**



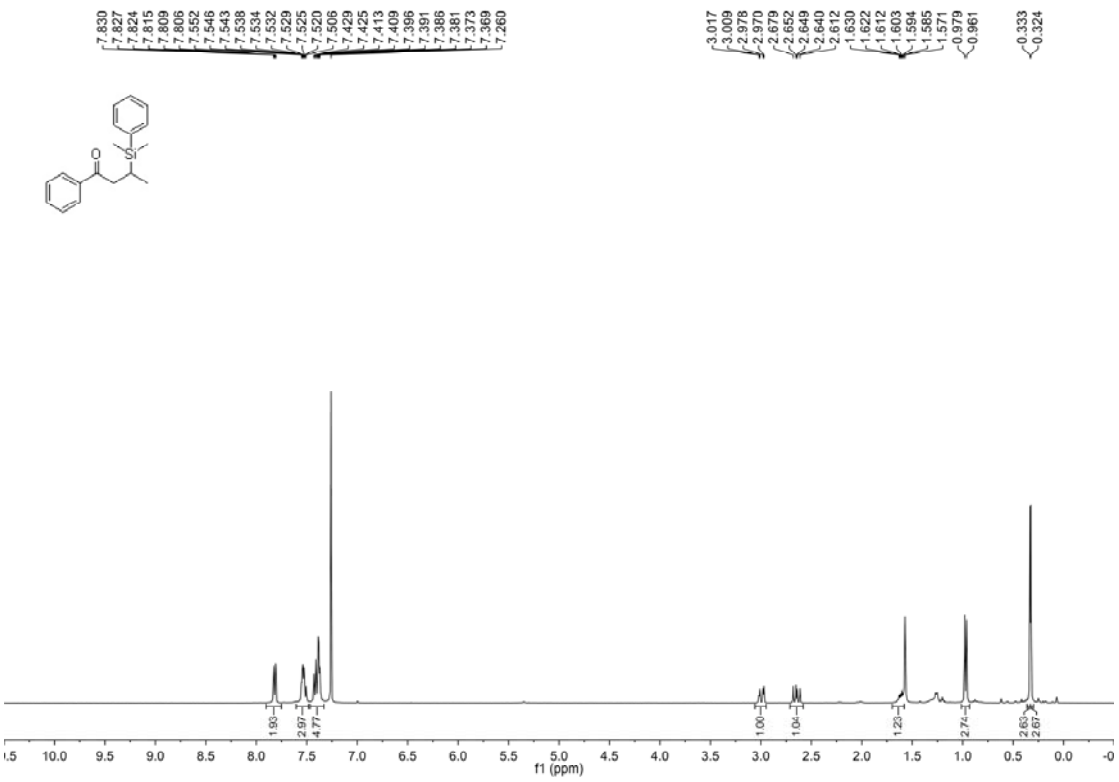
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **3j**



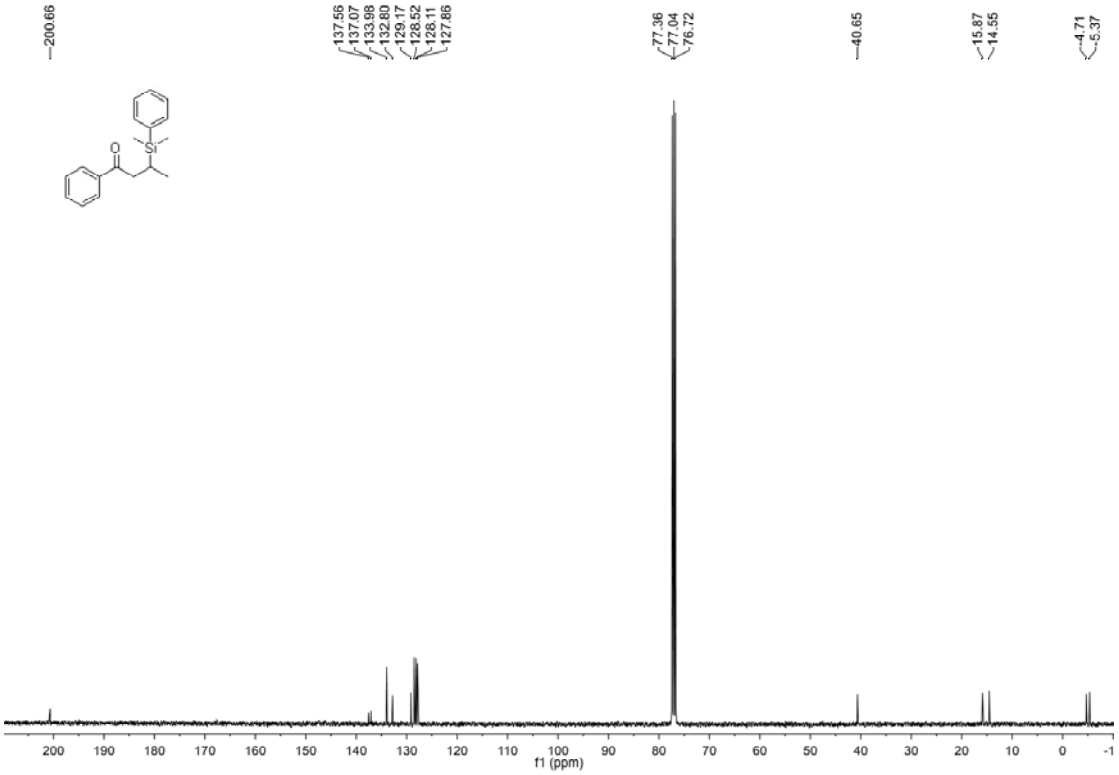
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3k**



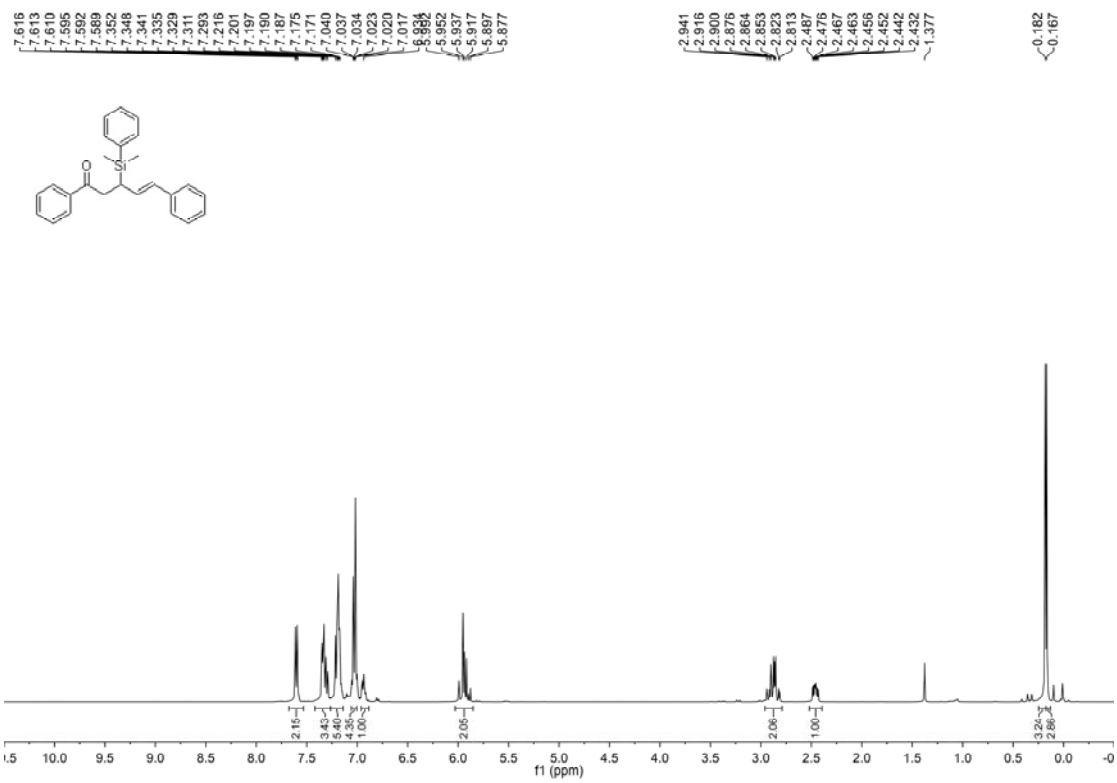
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **3k**



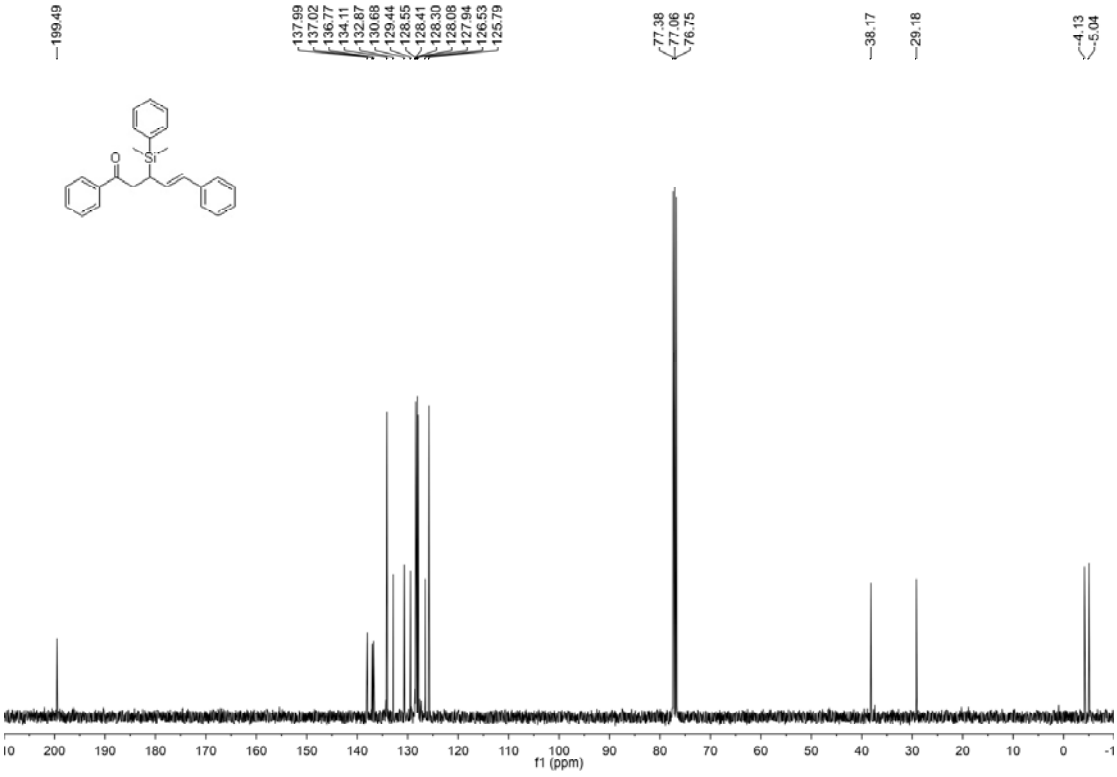
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3l**



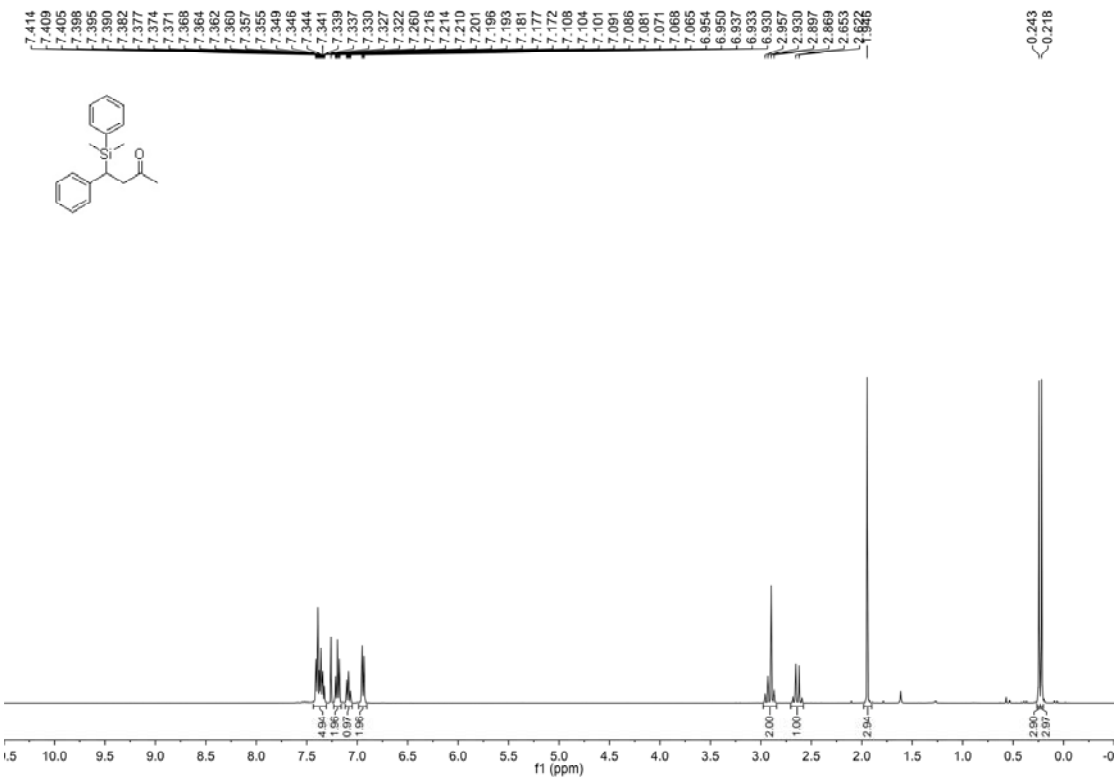
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **3l**



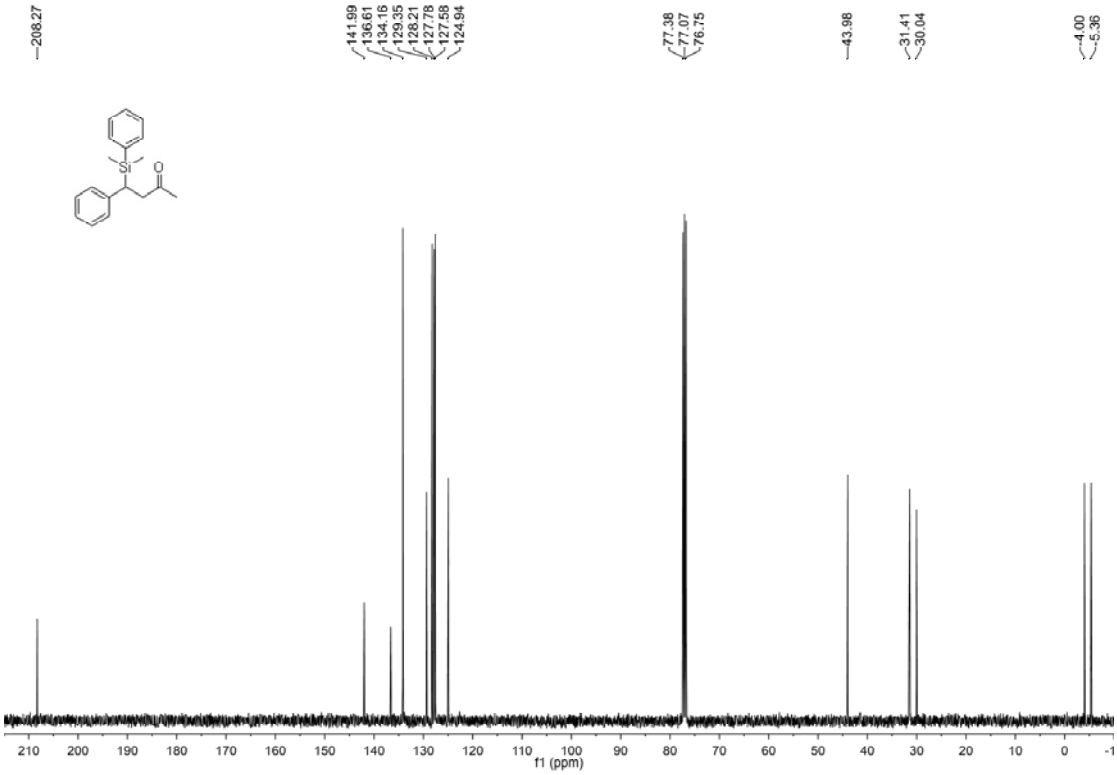
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3m**



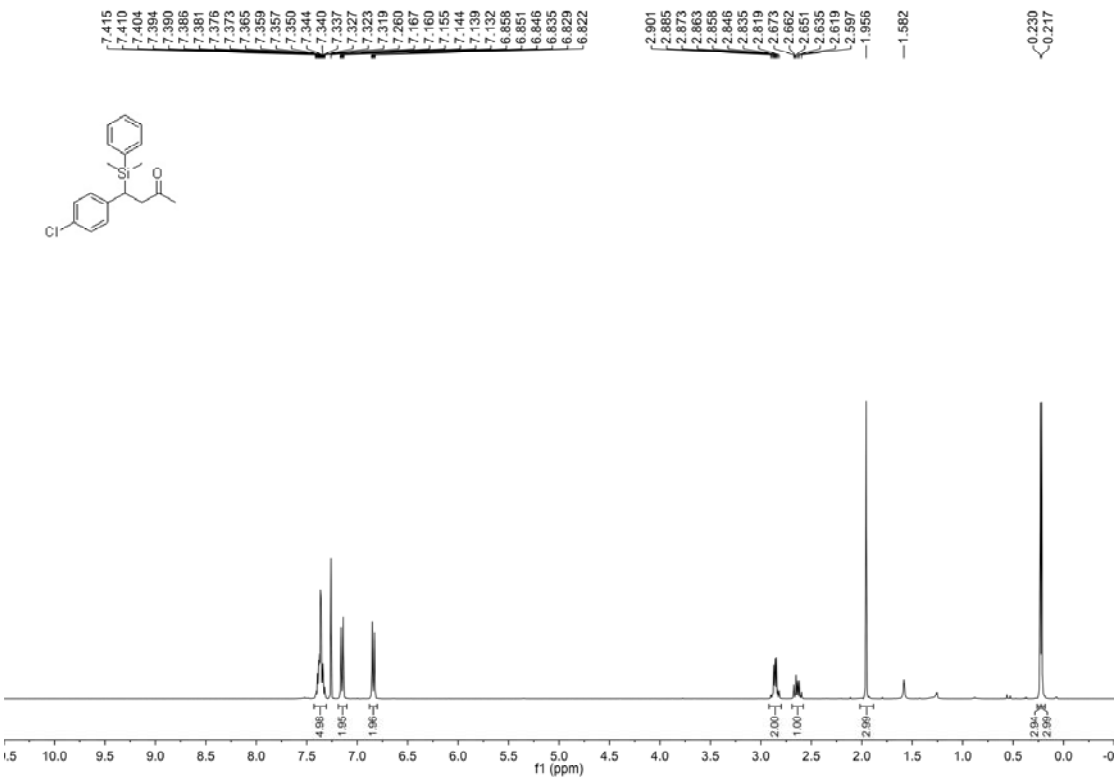
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3m**



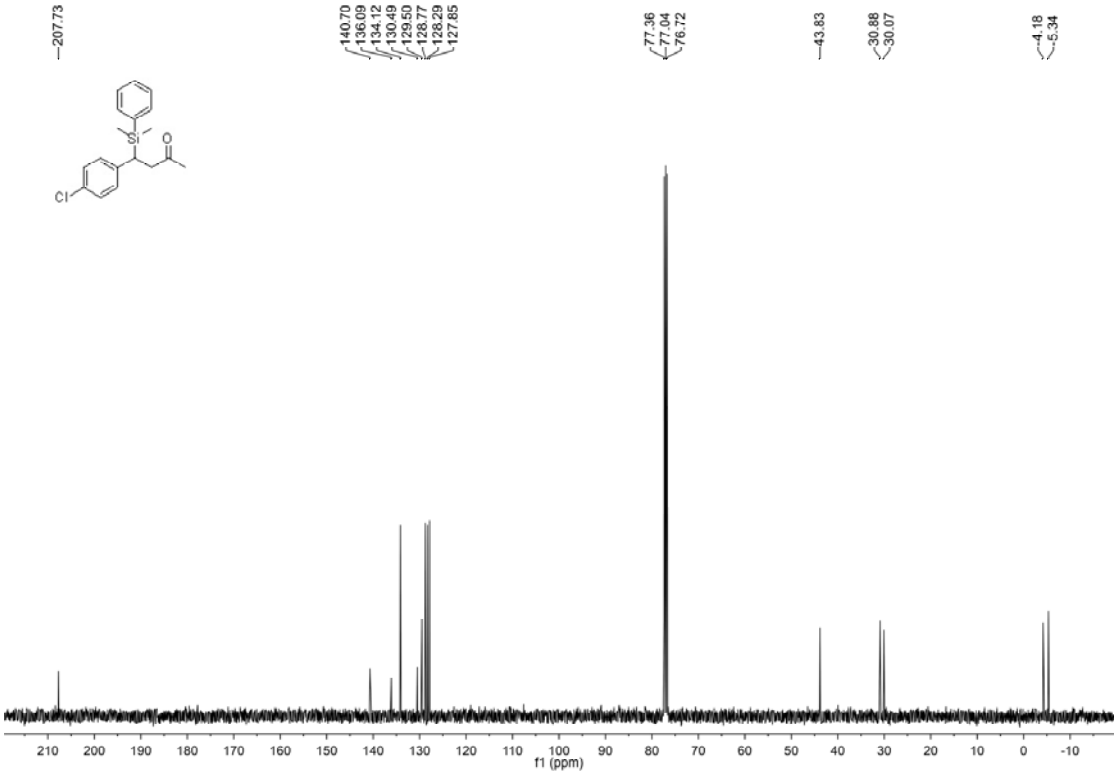
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3n**



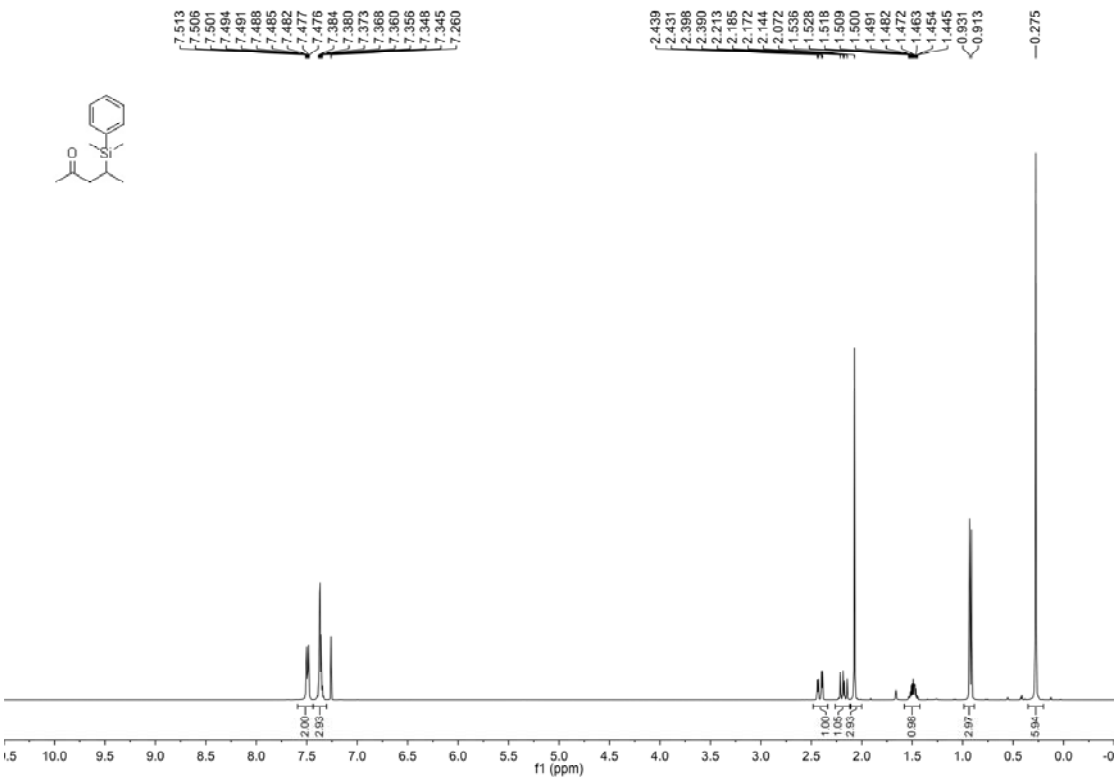
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3n**



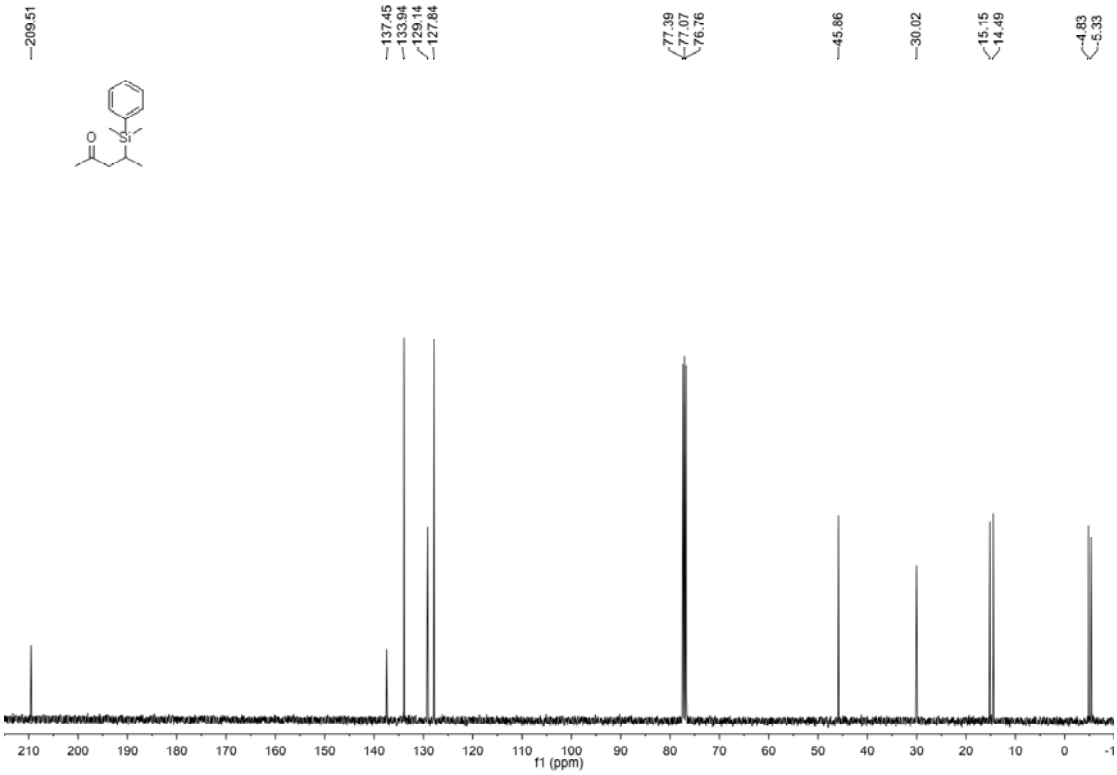
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3o**



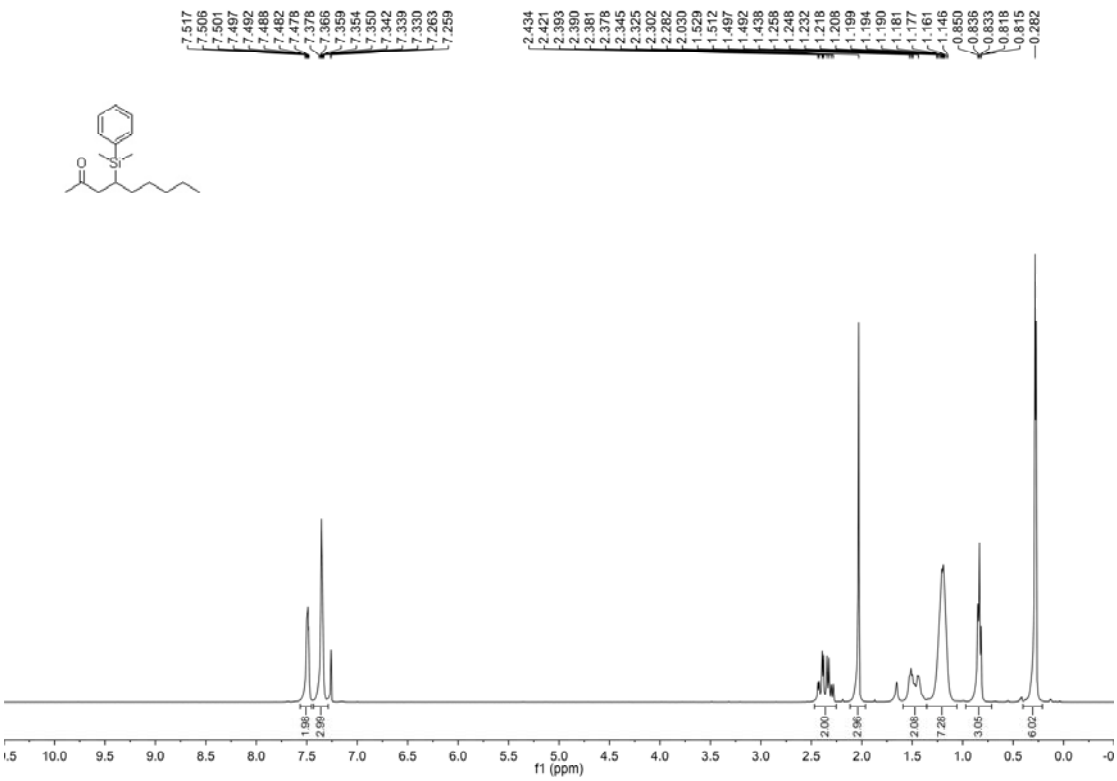
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3o**



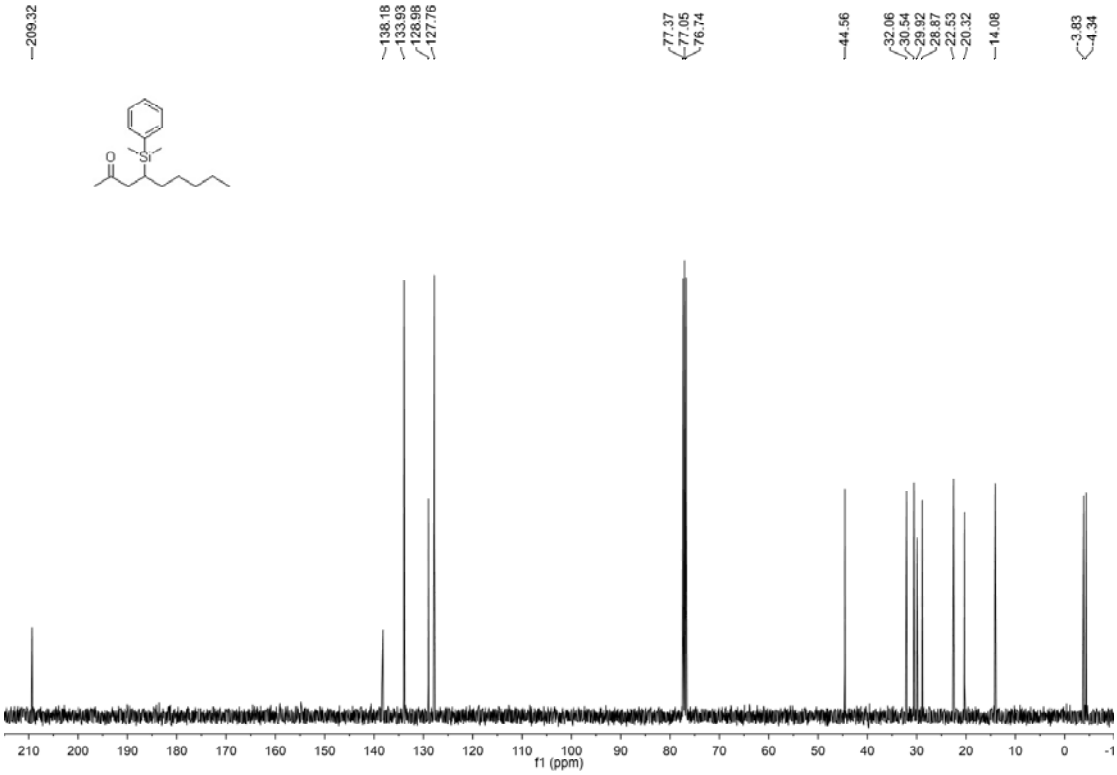
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3p**



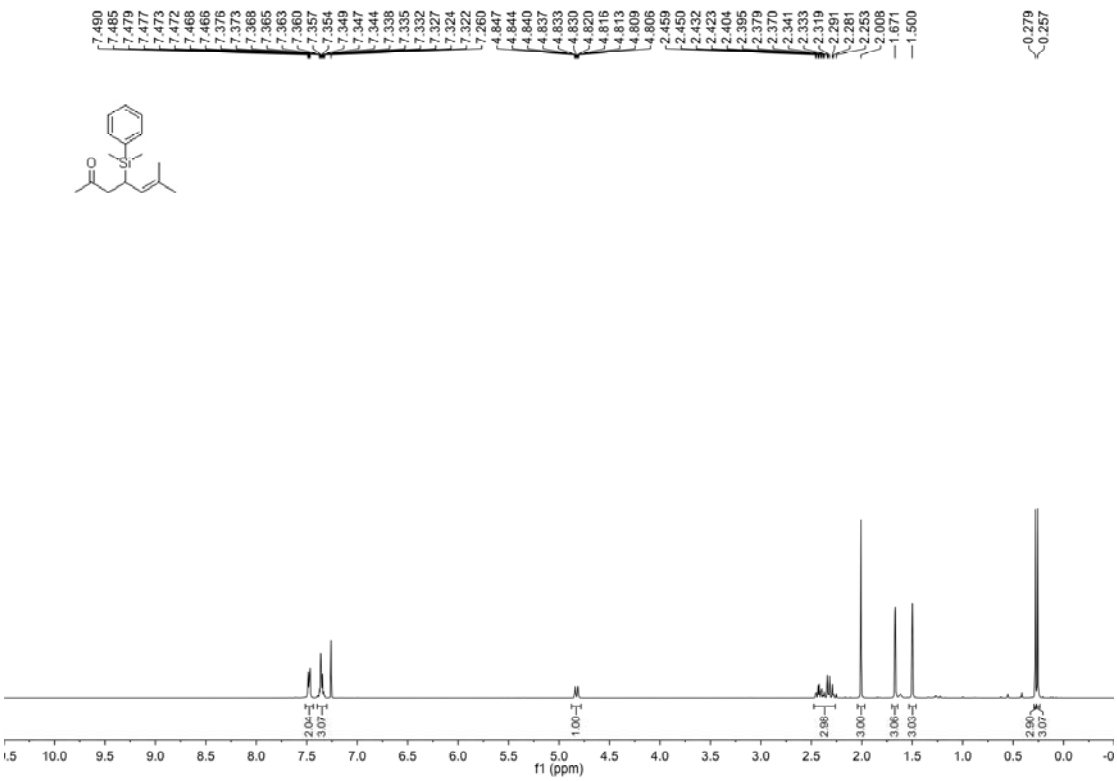
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3p**



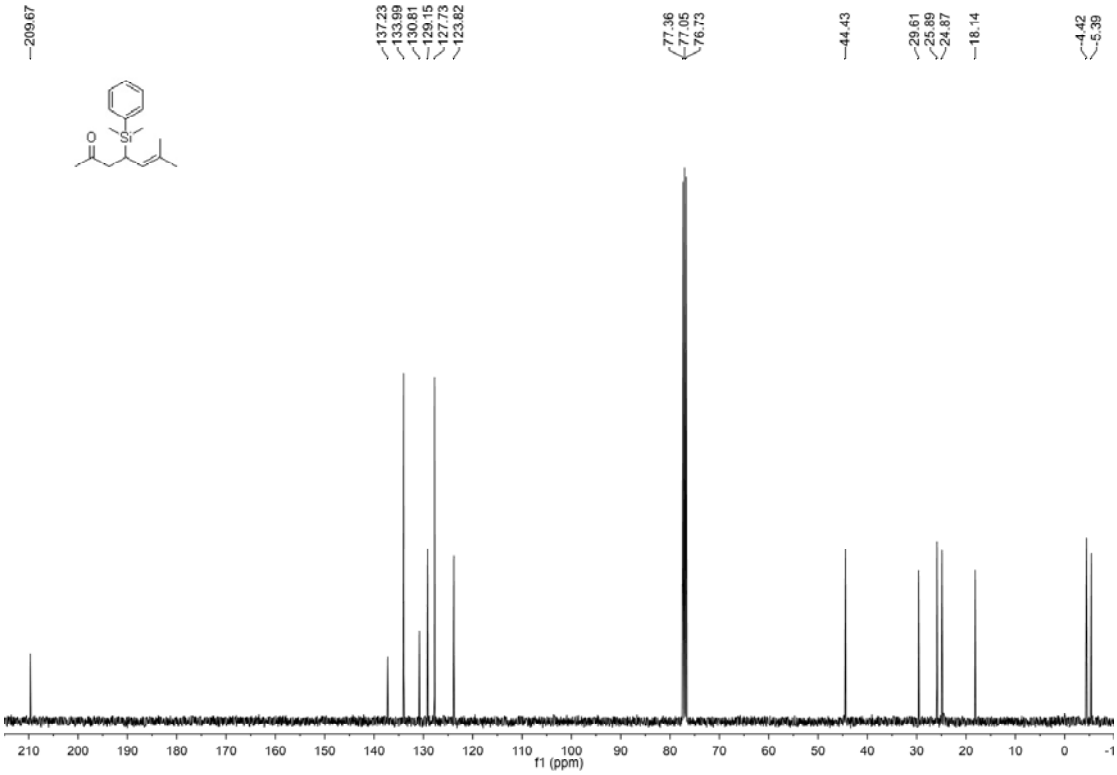
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3q**



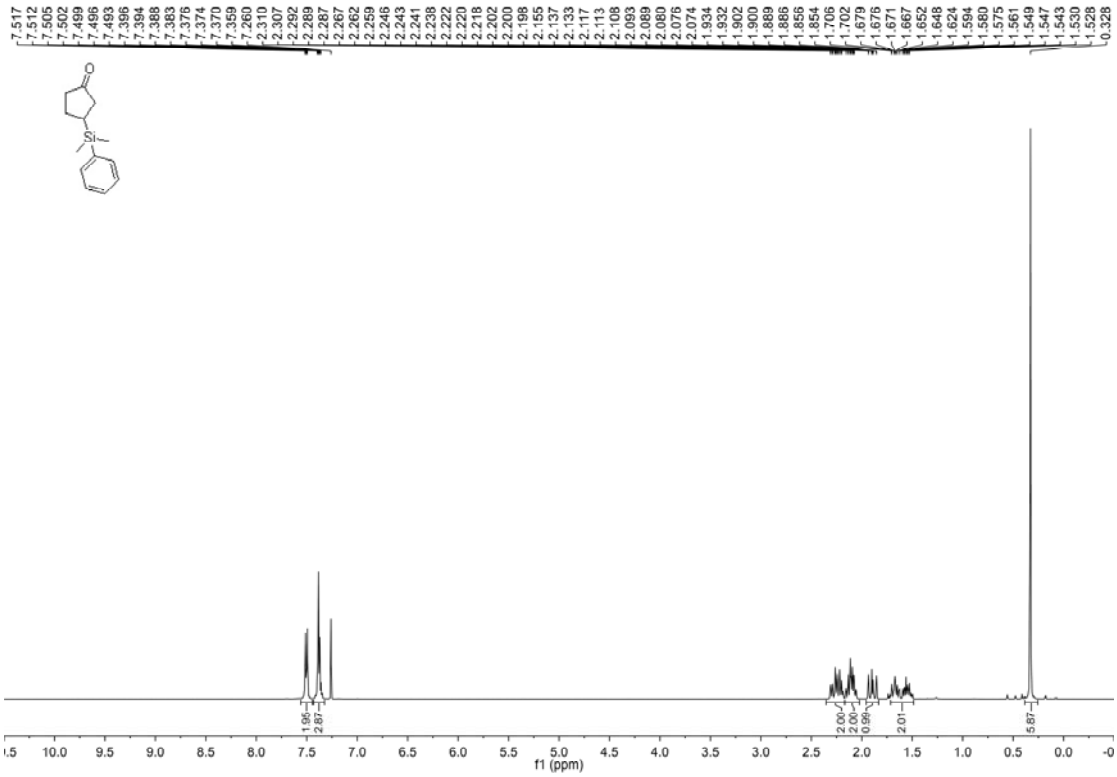
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3q**



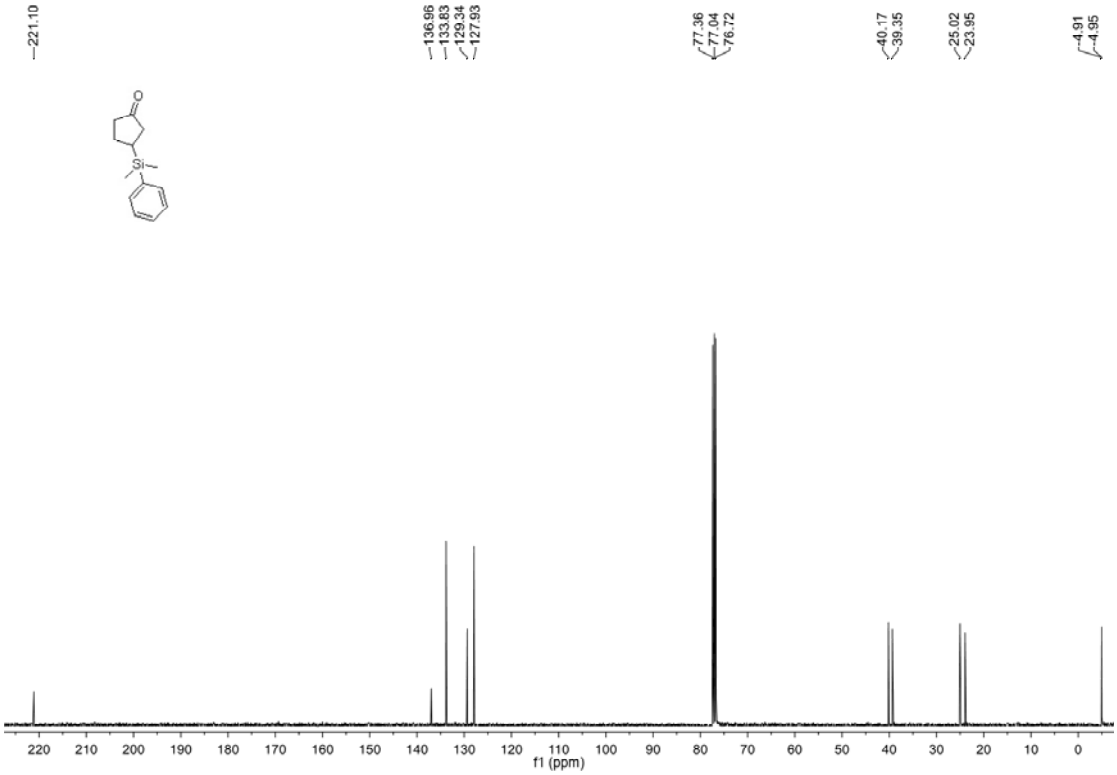
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3r**



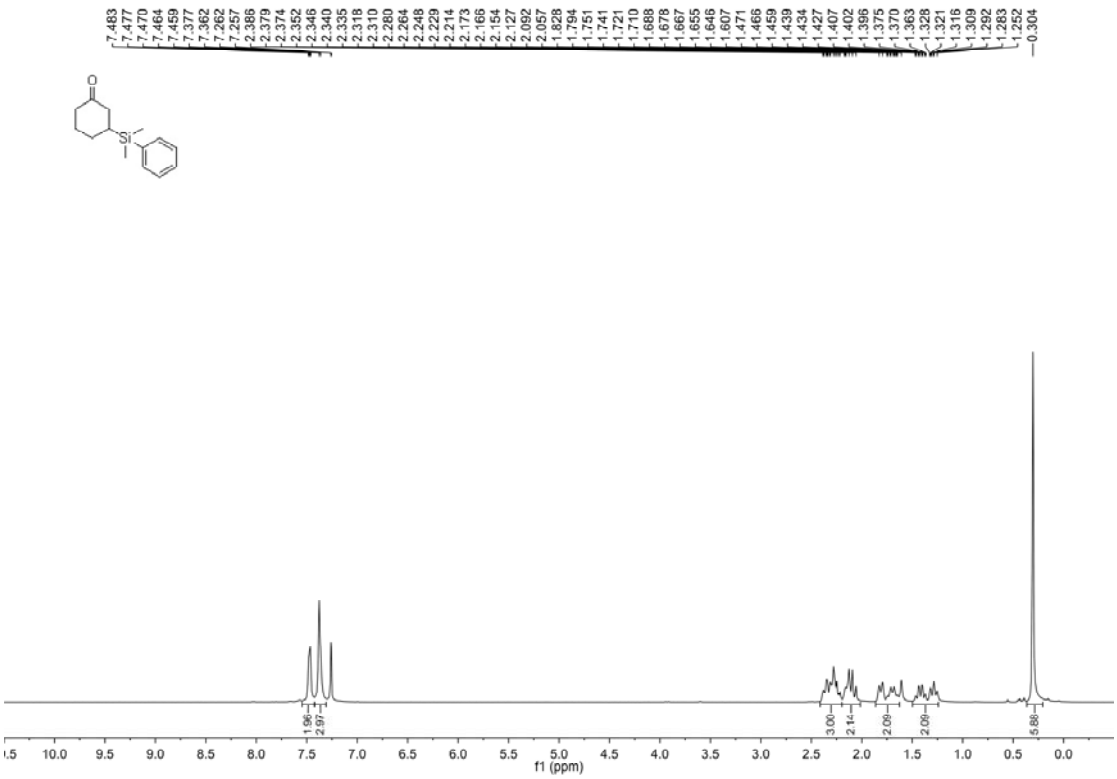
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3r**



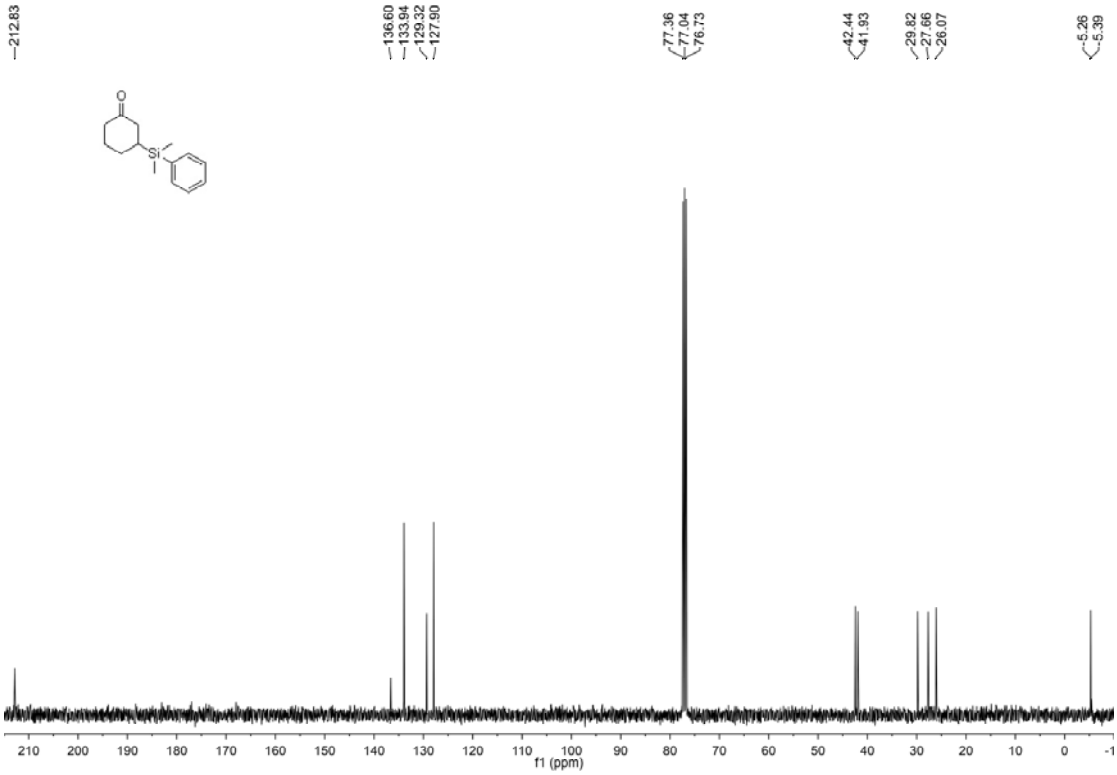
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3s**



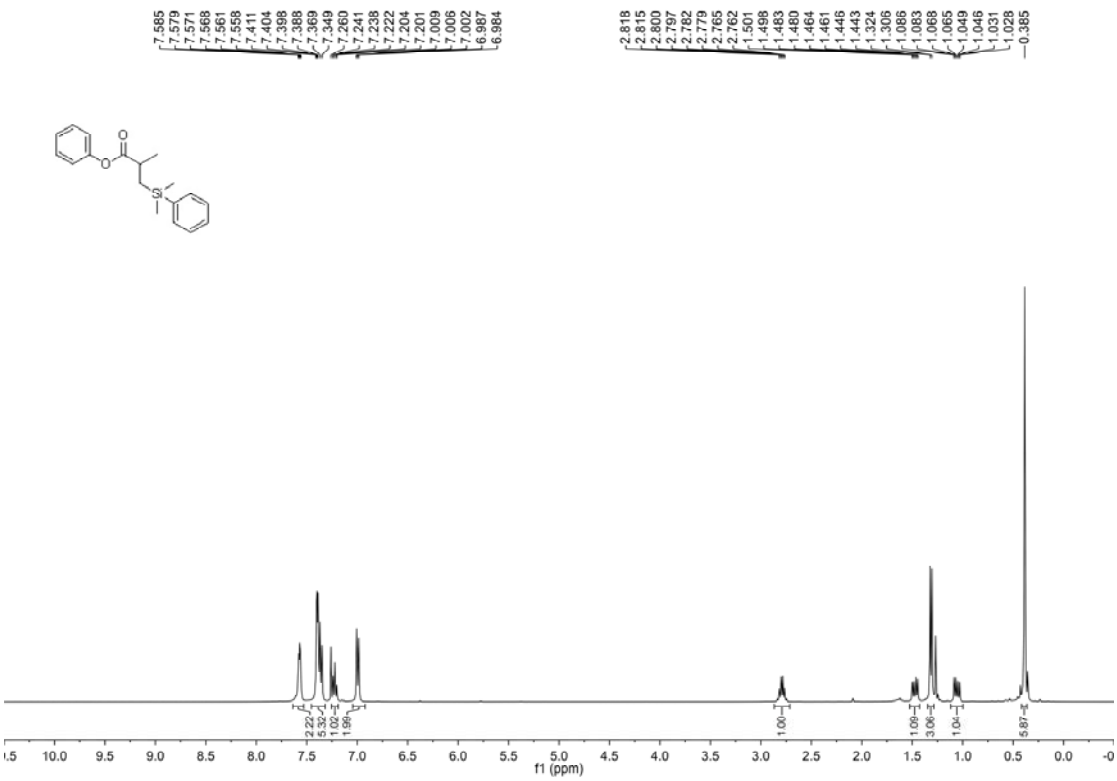
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3s**



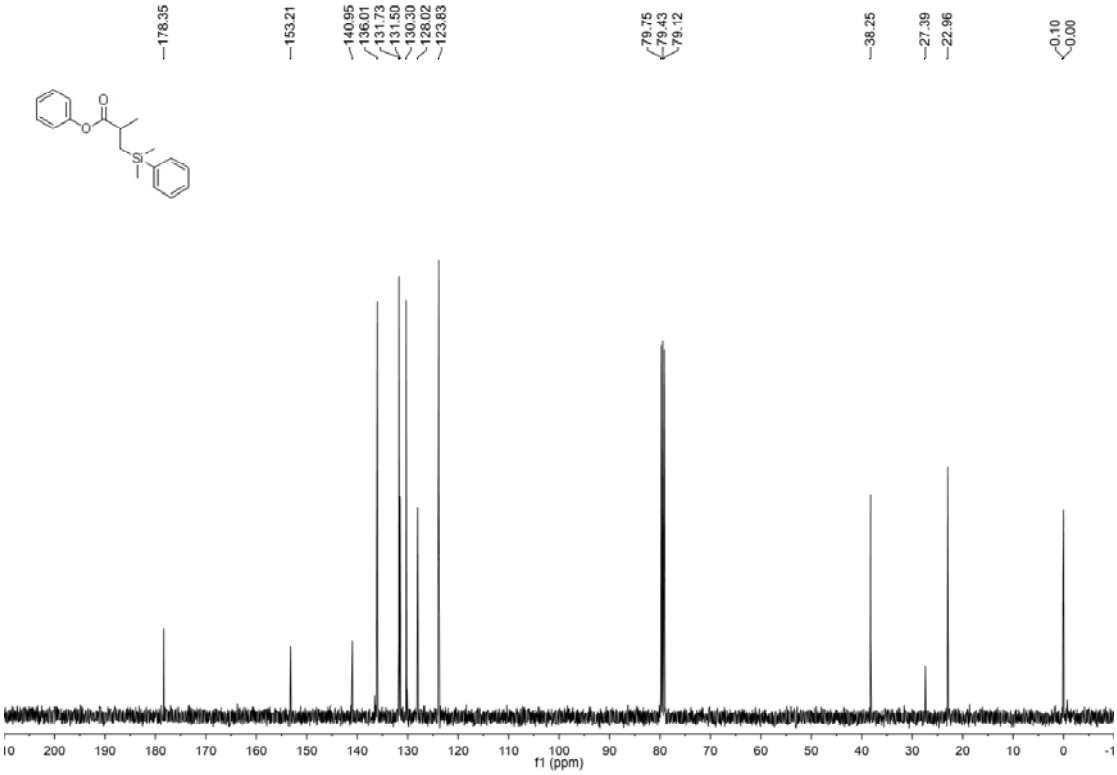
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3t**



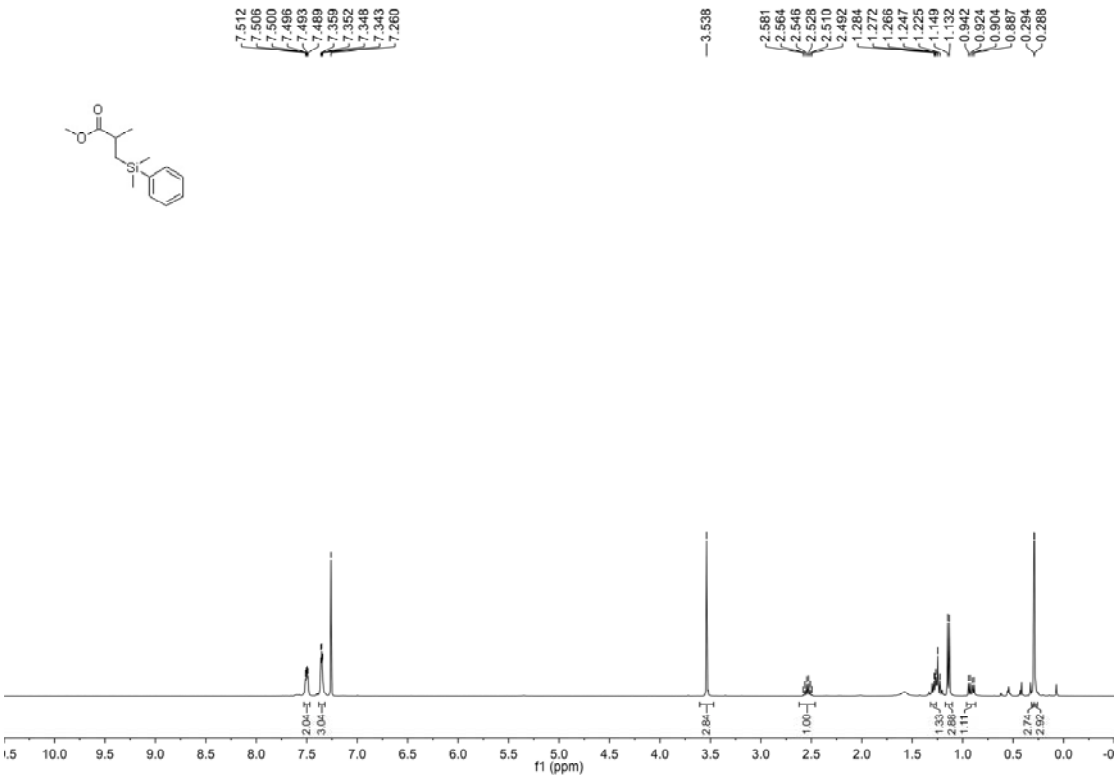
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3t**



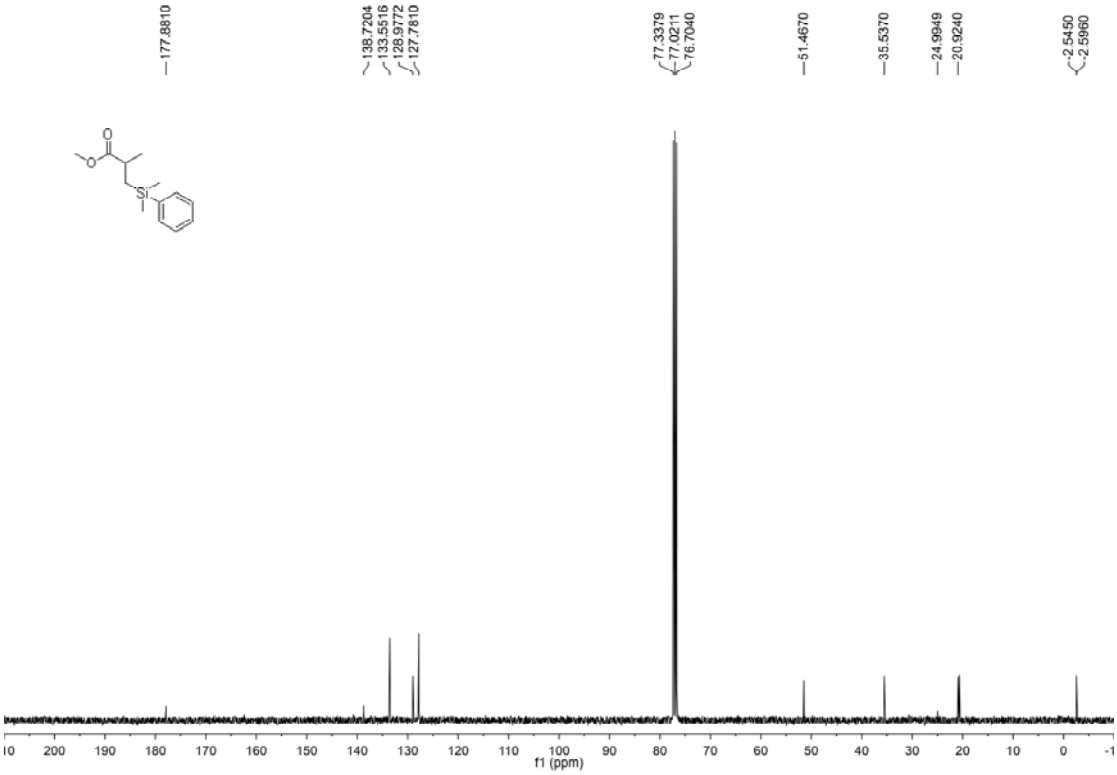
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3u**



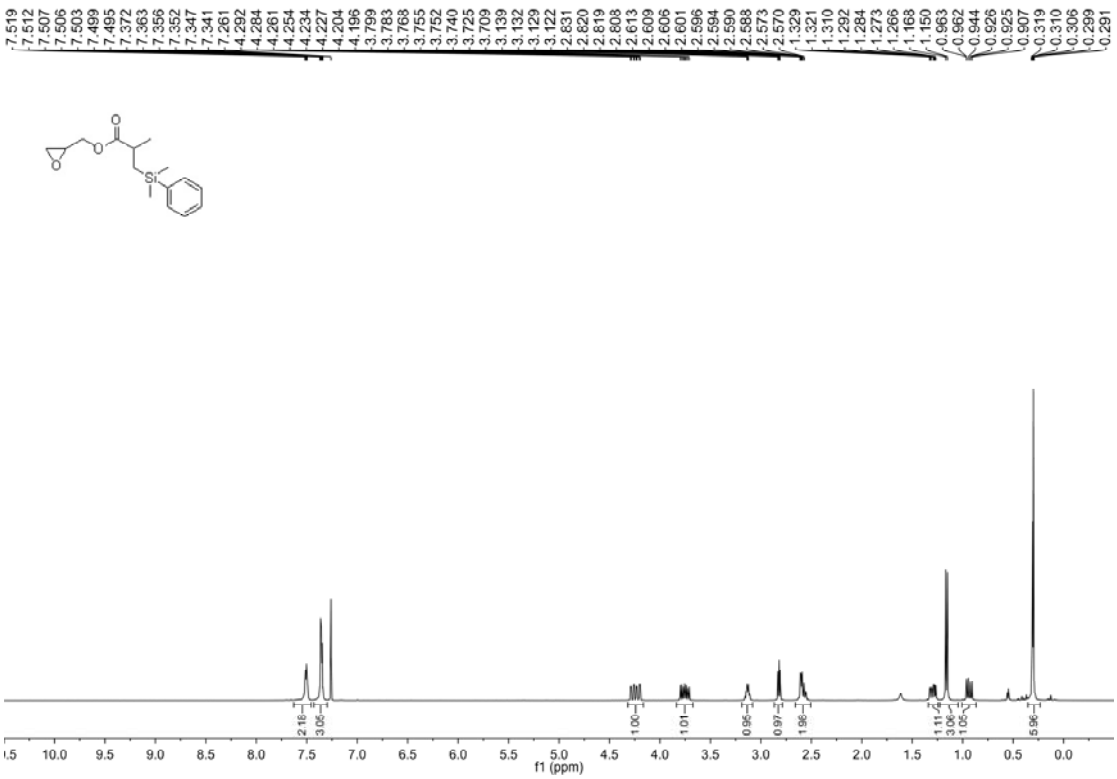
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3u**



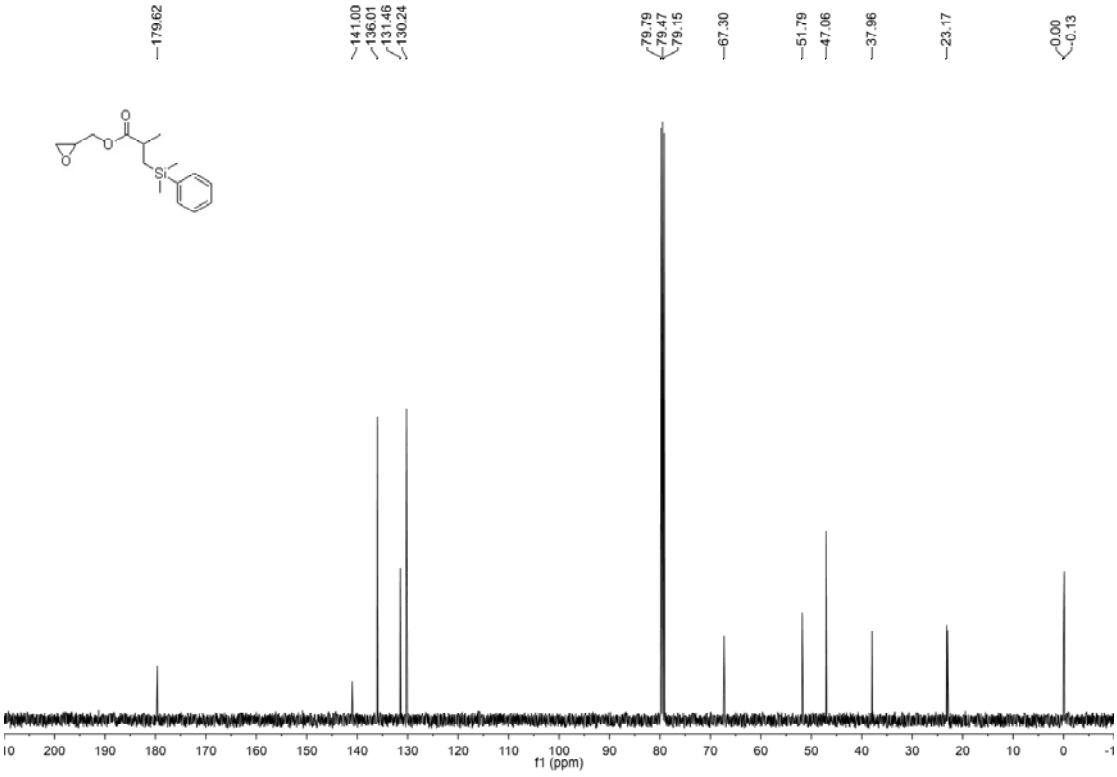
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3v**



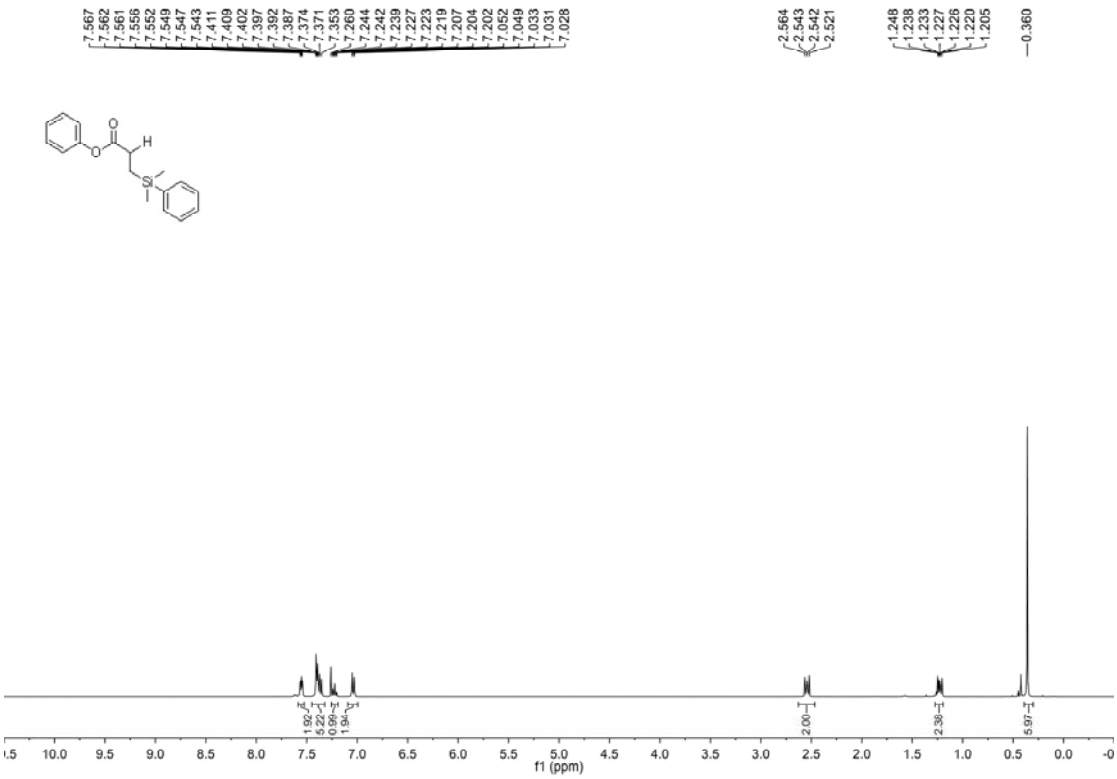
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3v**



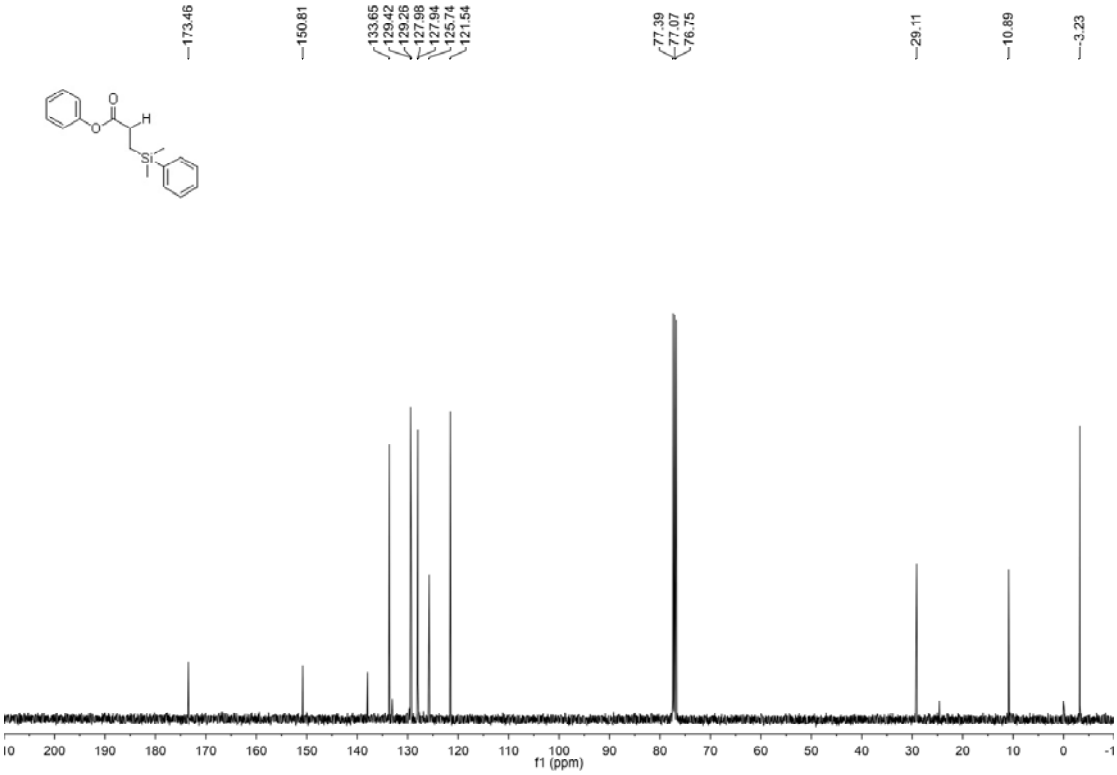
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3w**



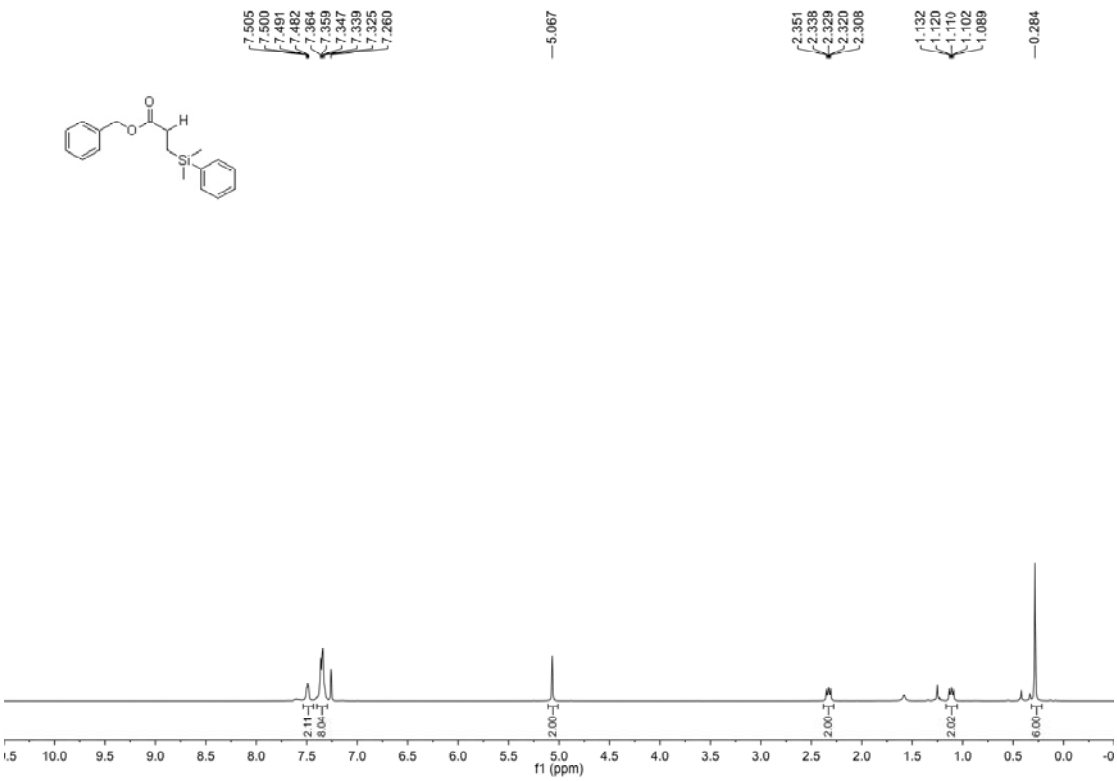
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3w**



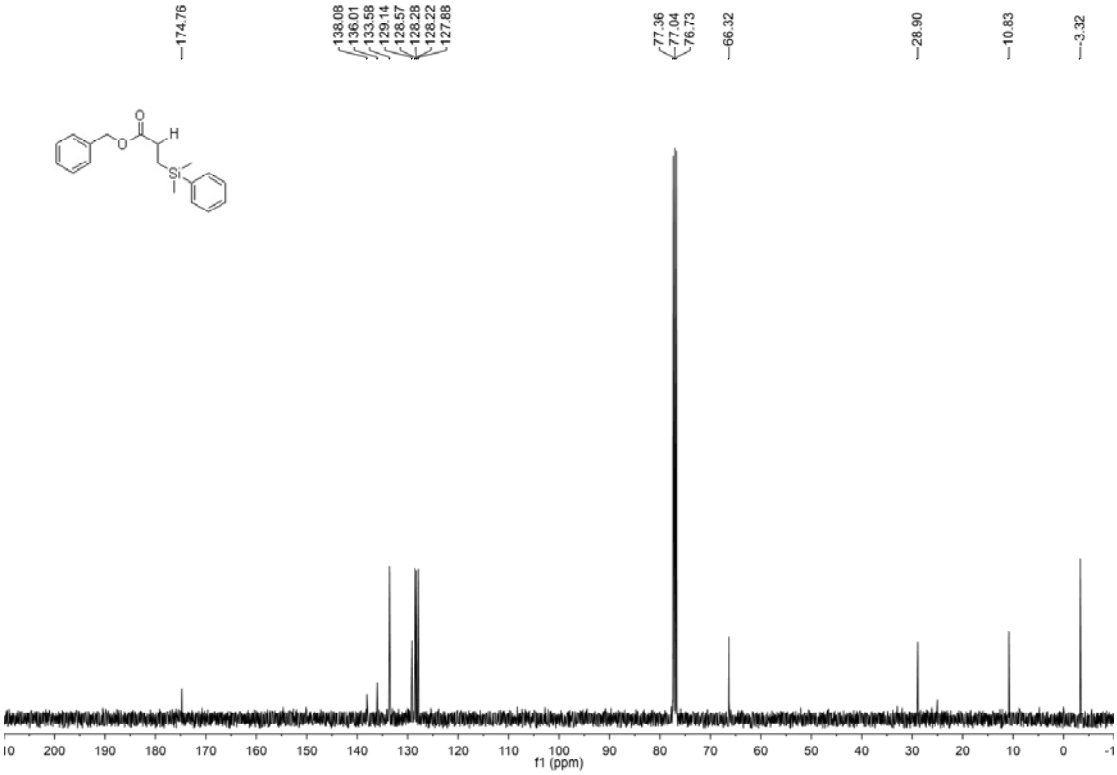
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3x**



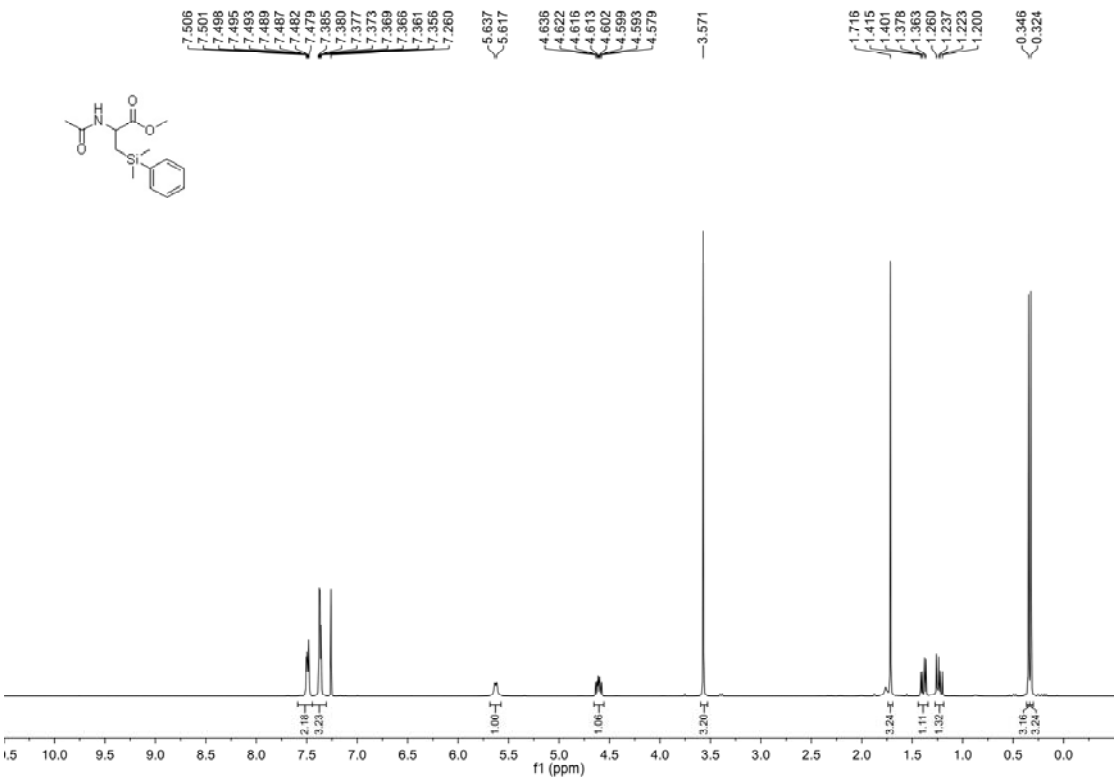
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3x**



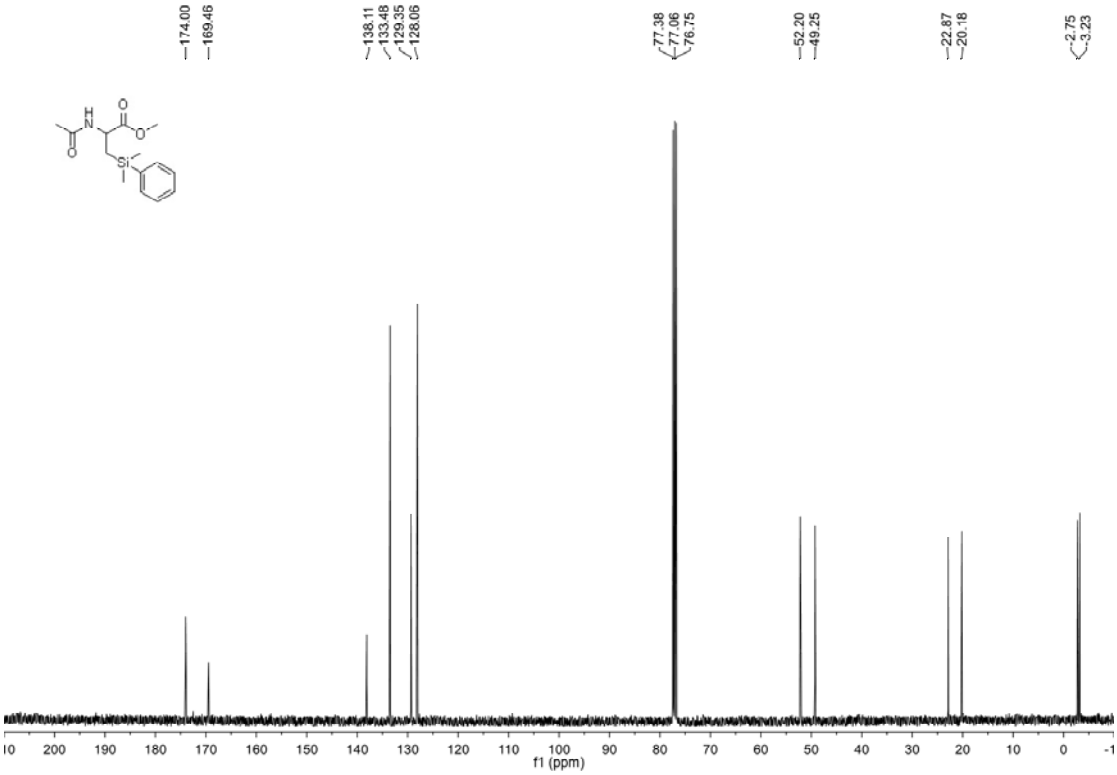
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3y**



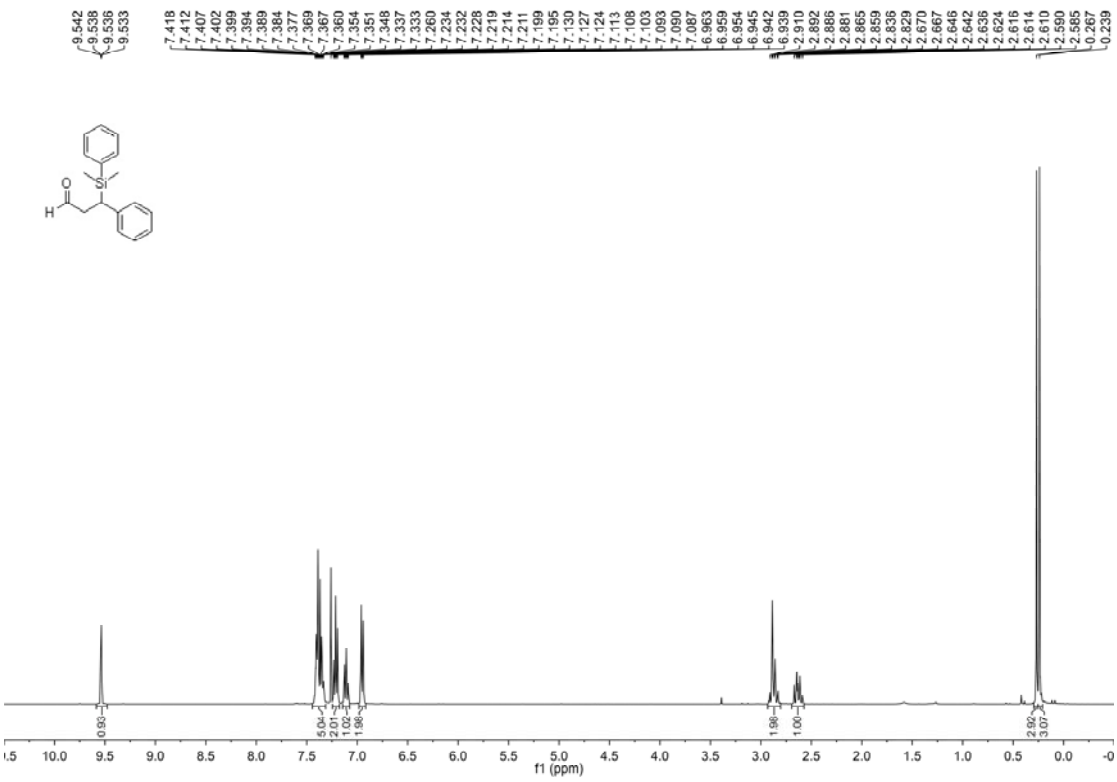
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3y**



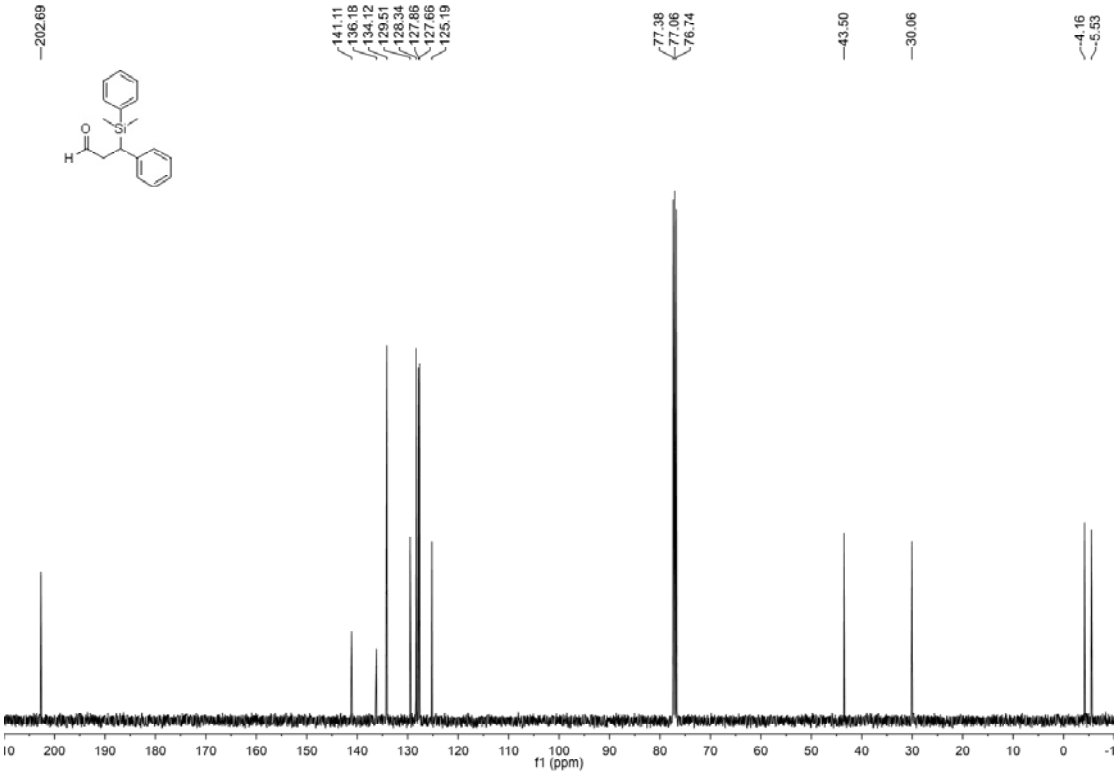
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3z**



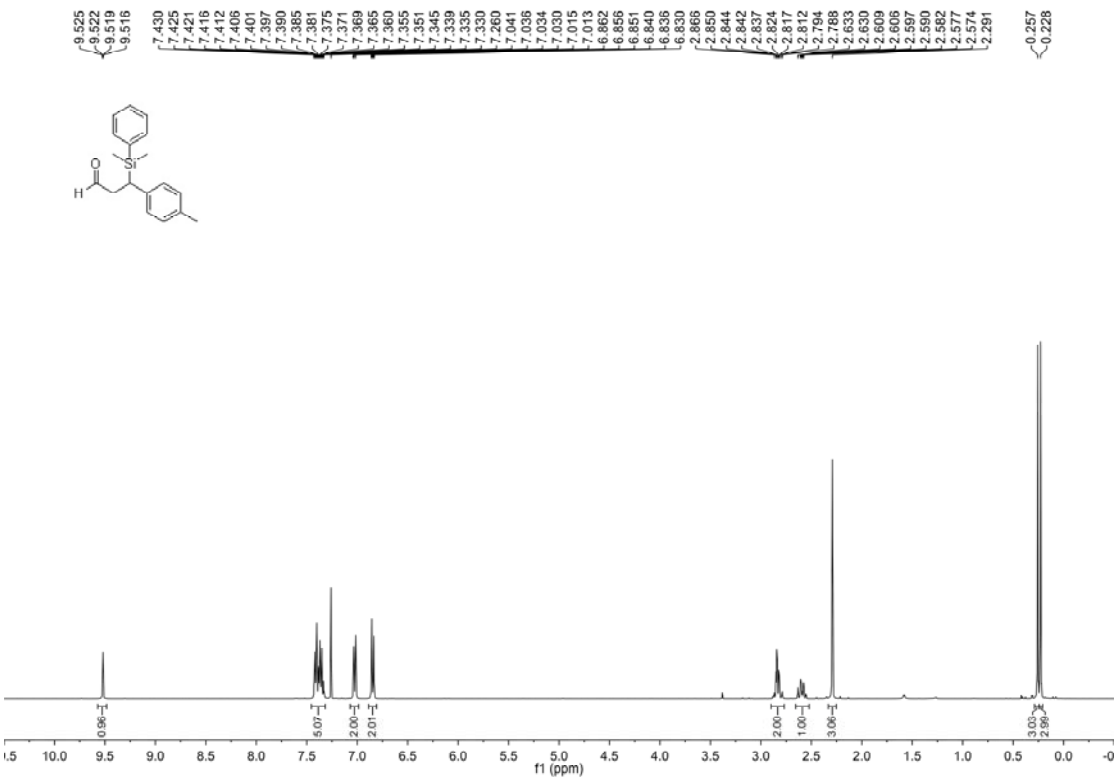
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3z**



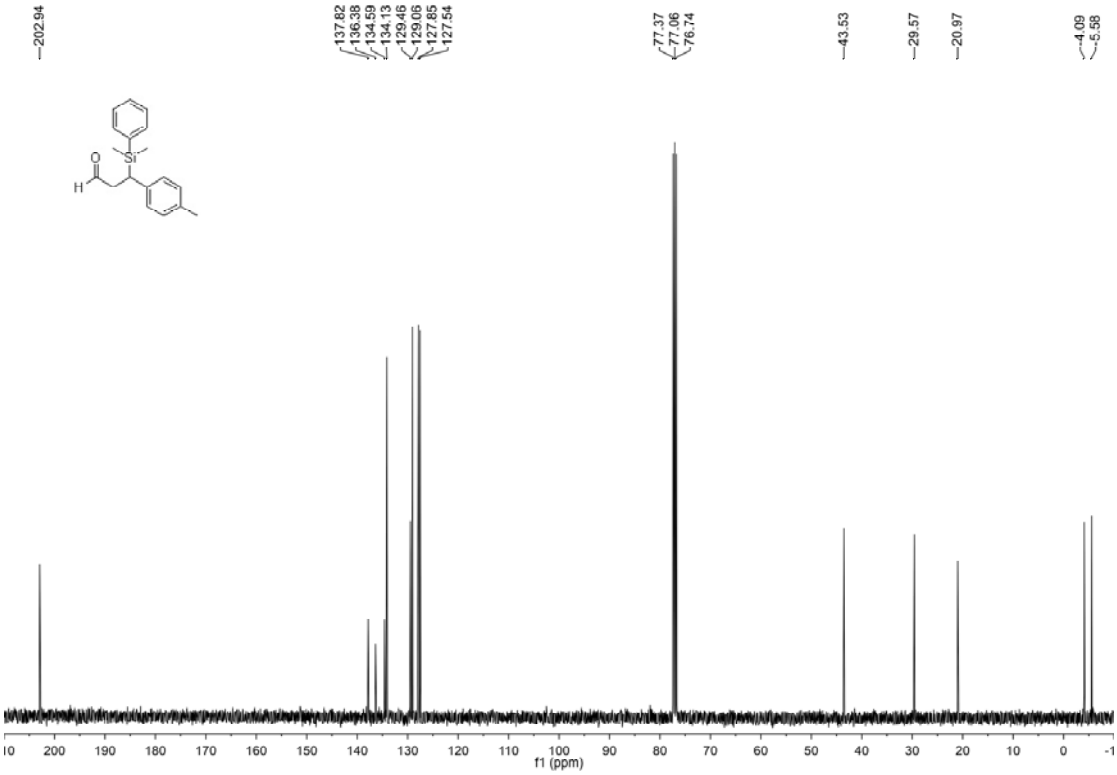
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3A**



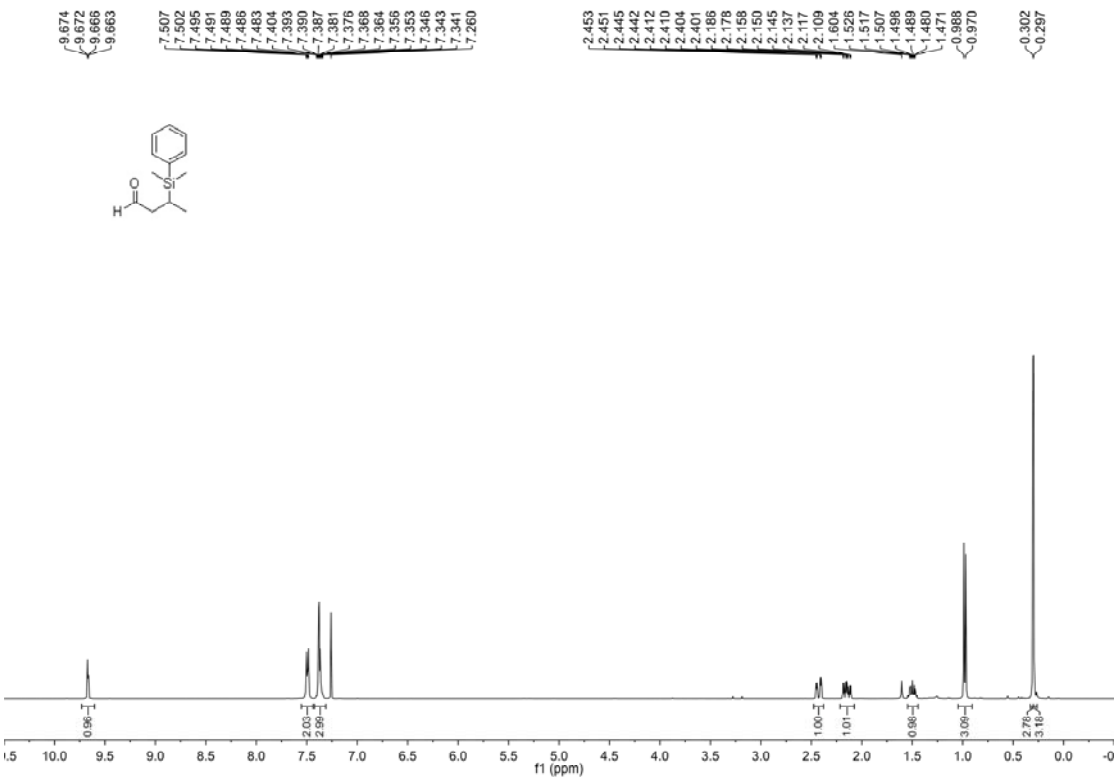
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3A**



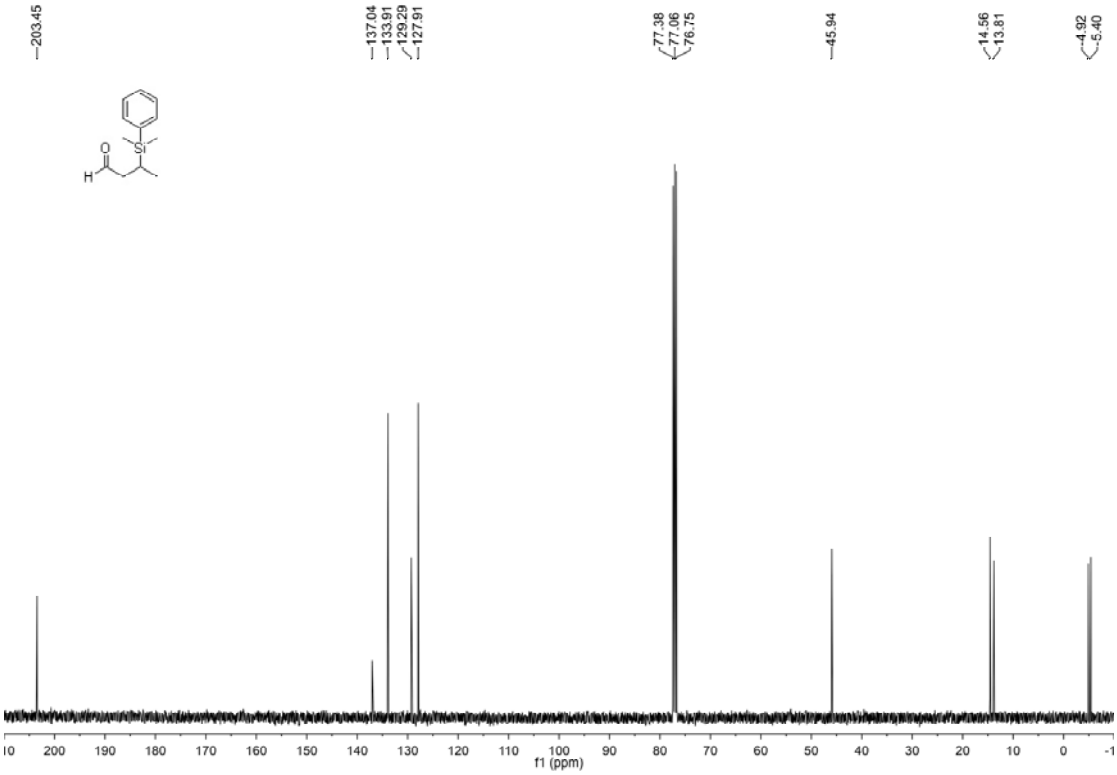
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3B**



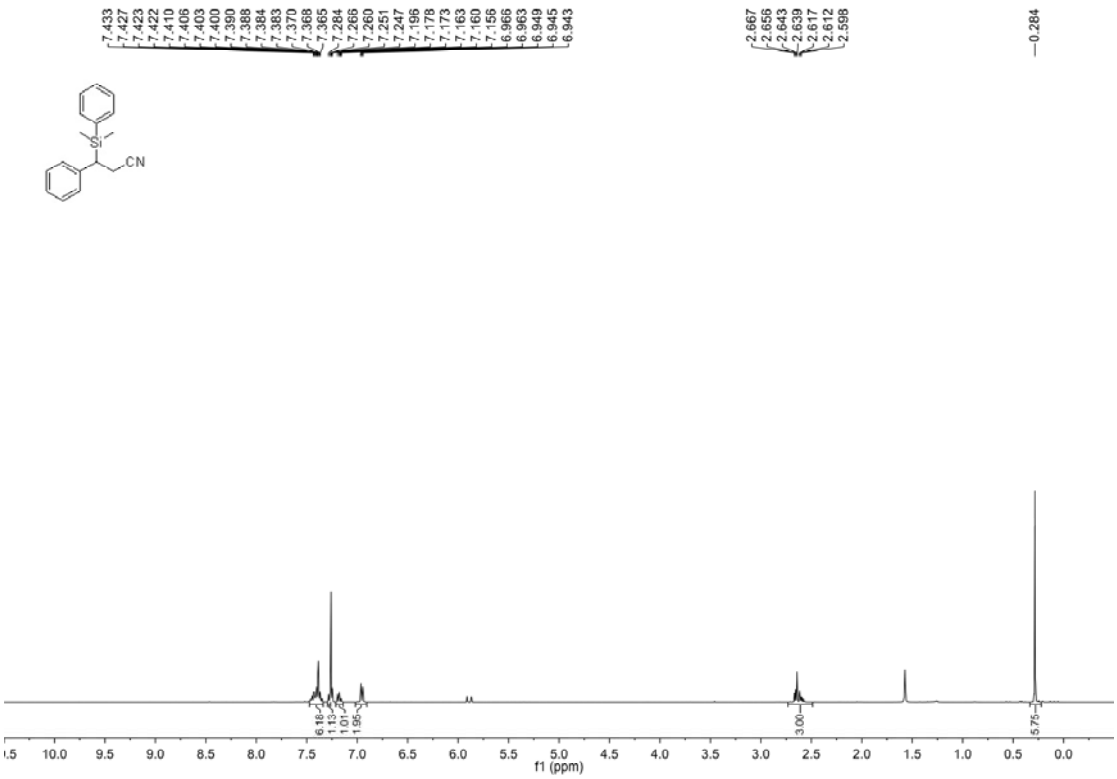
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3B**



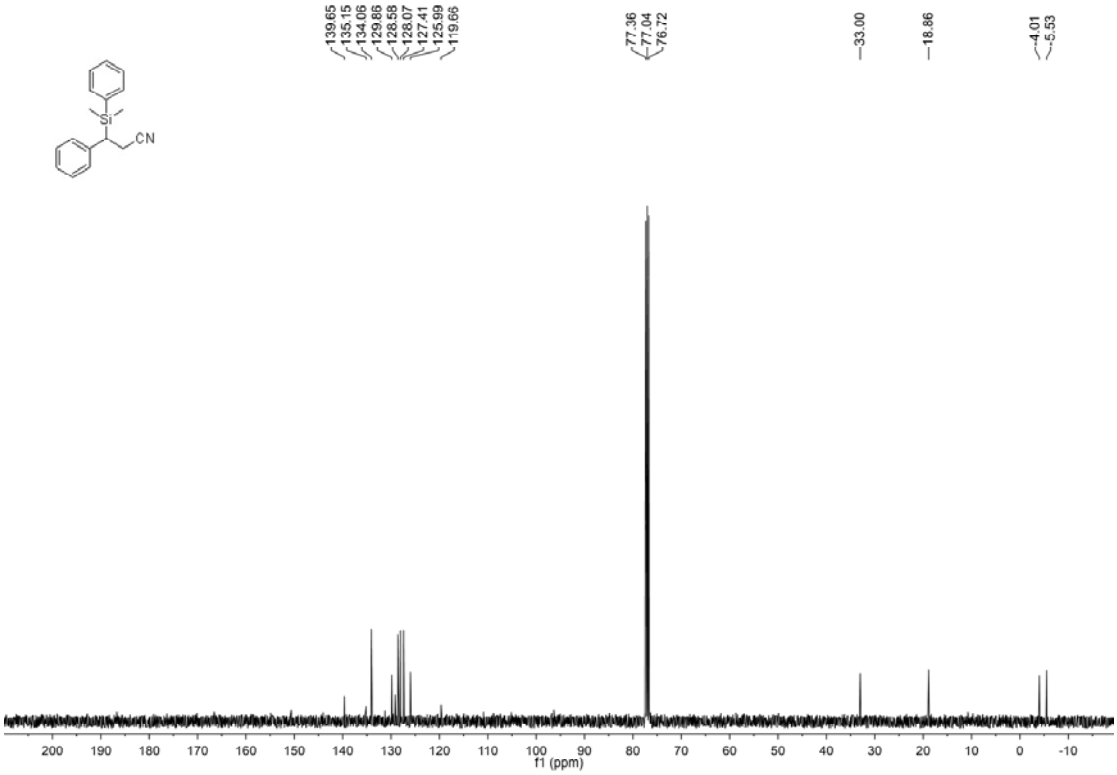
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3C**



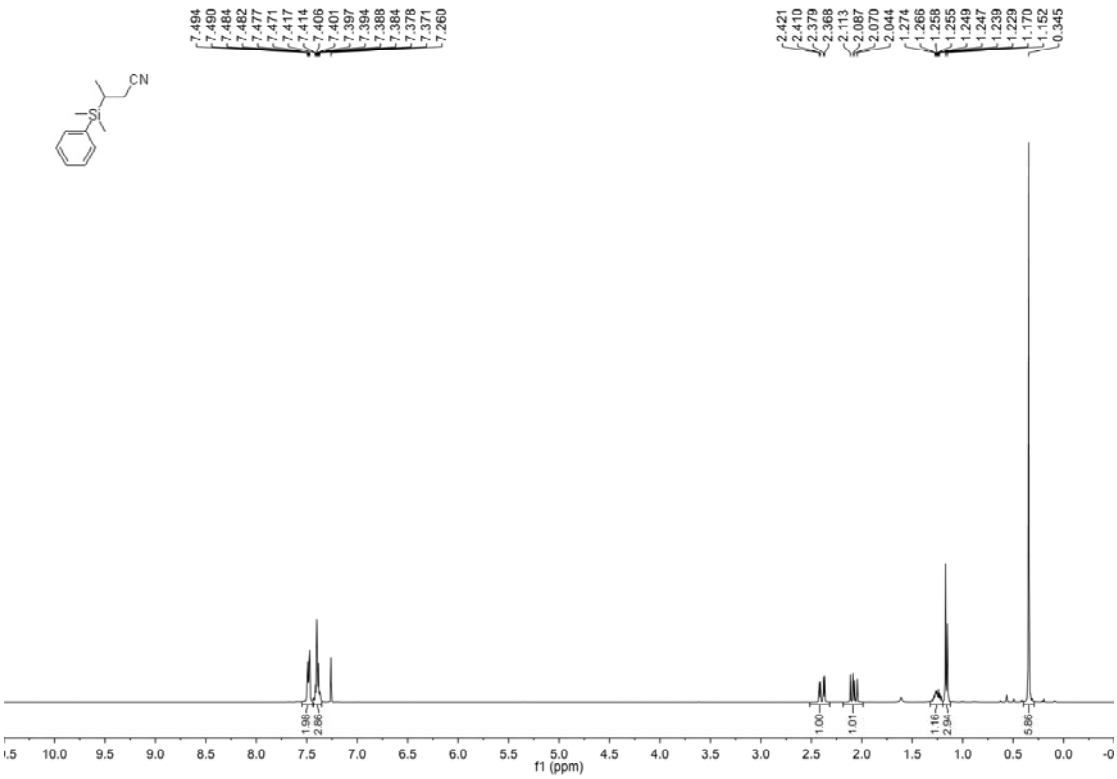
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3C**



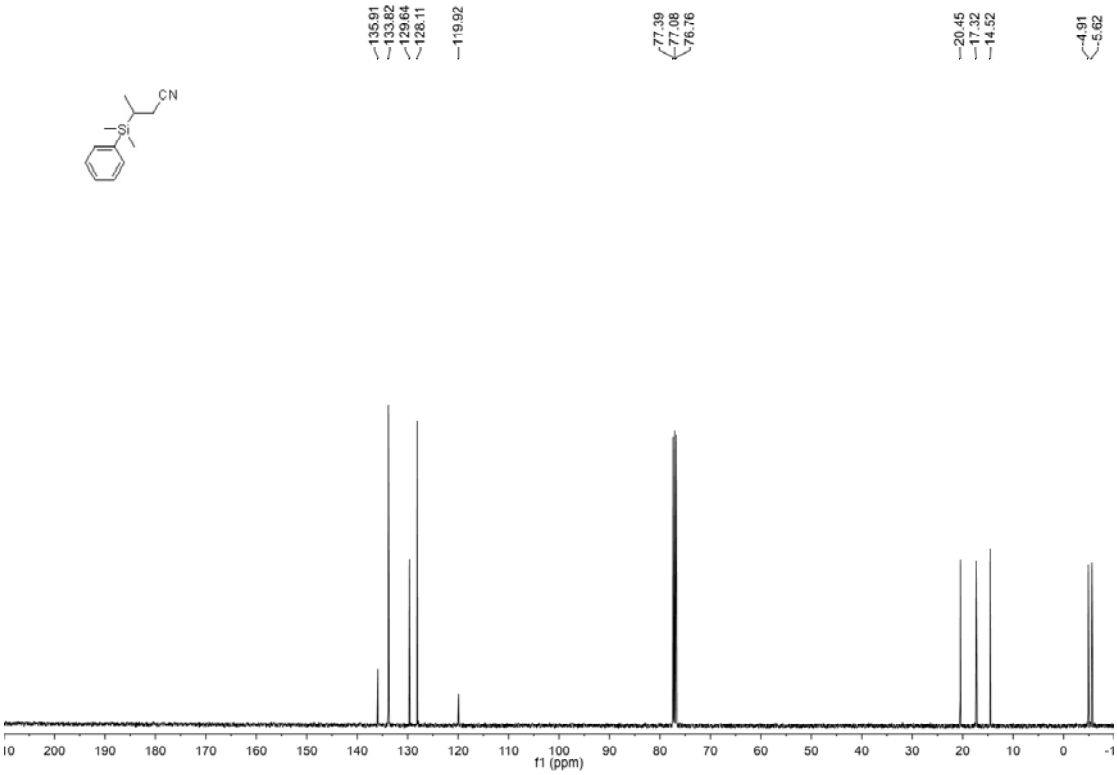
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3D**



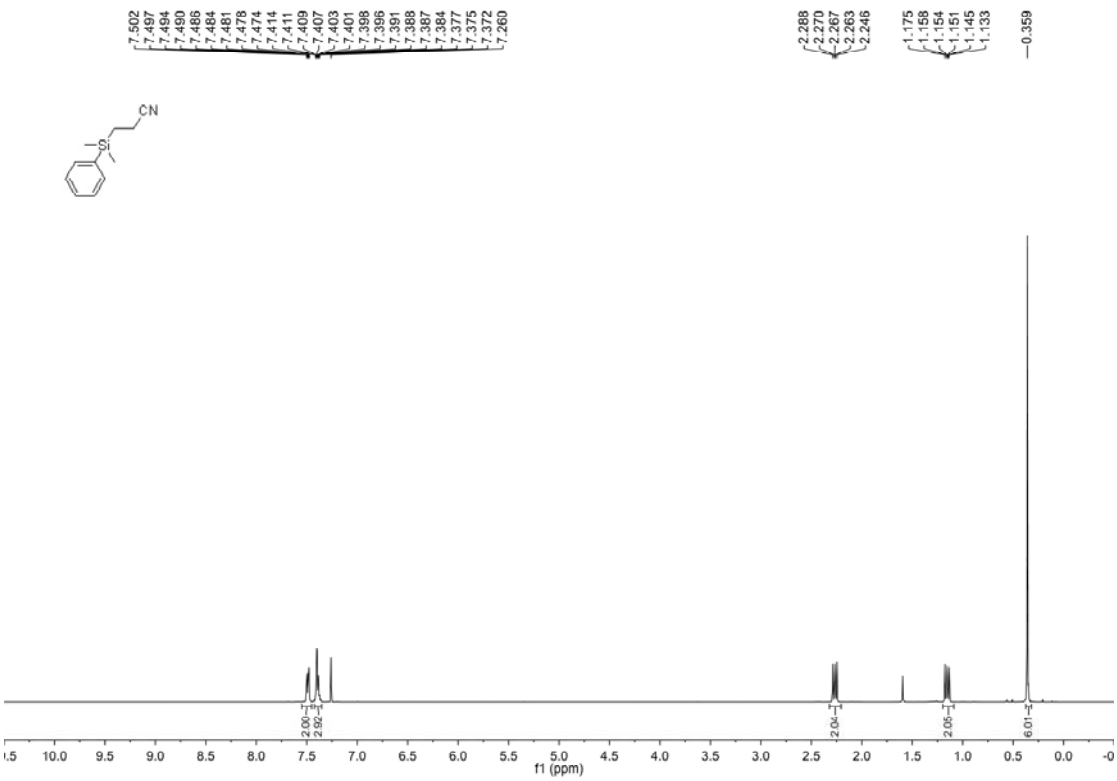
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3D**



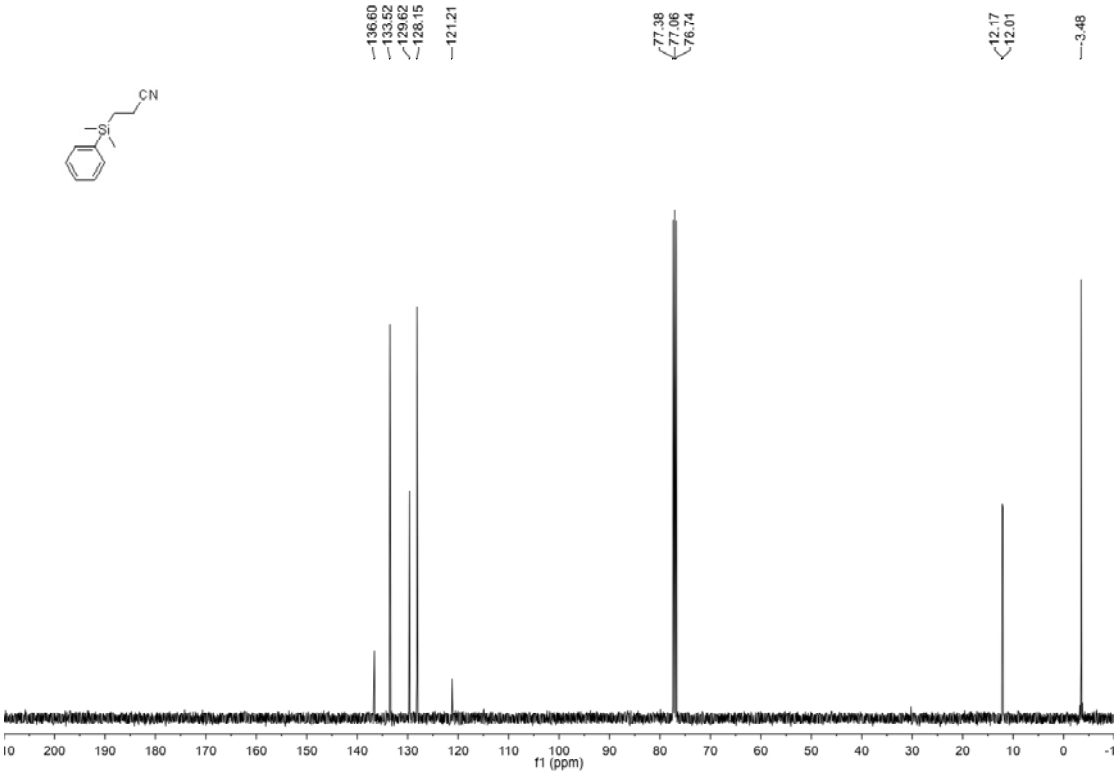
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3E**



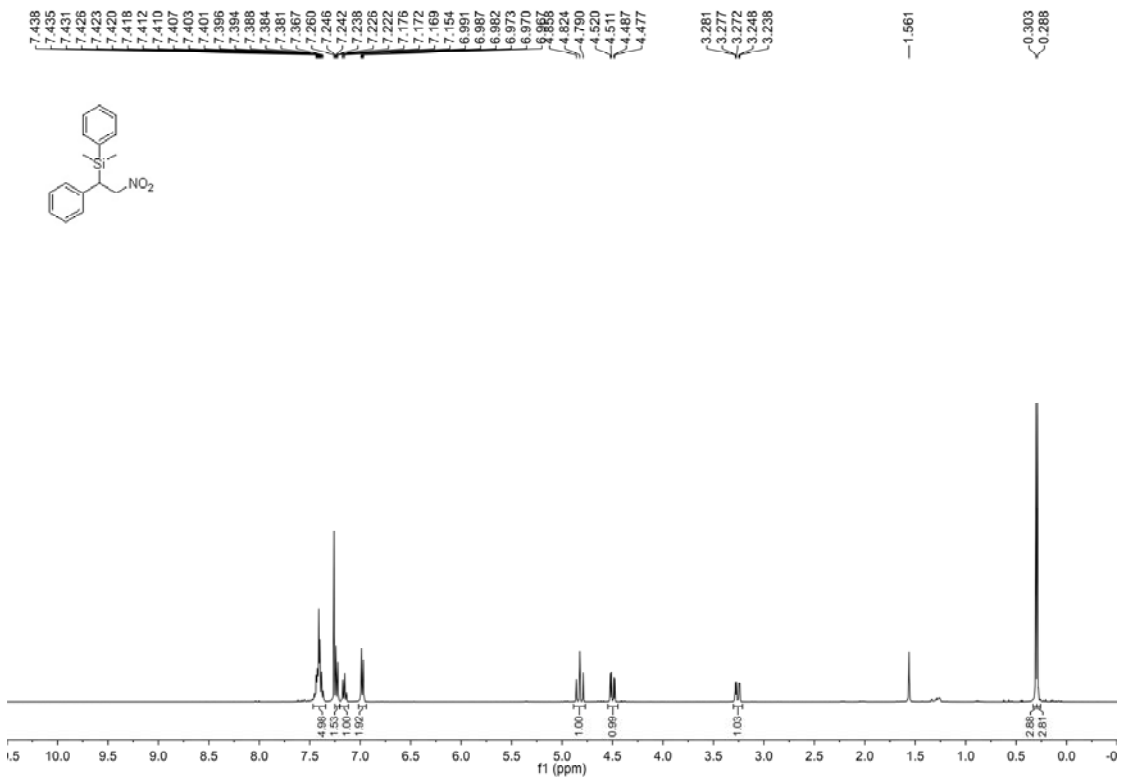
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3E**



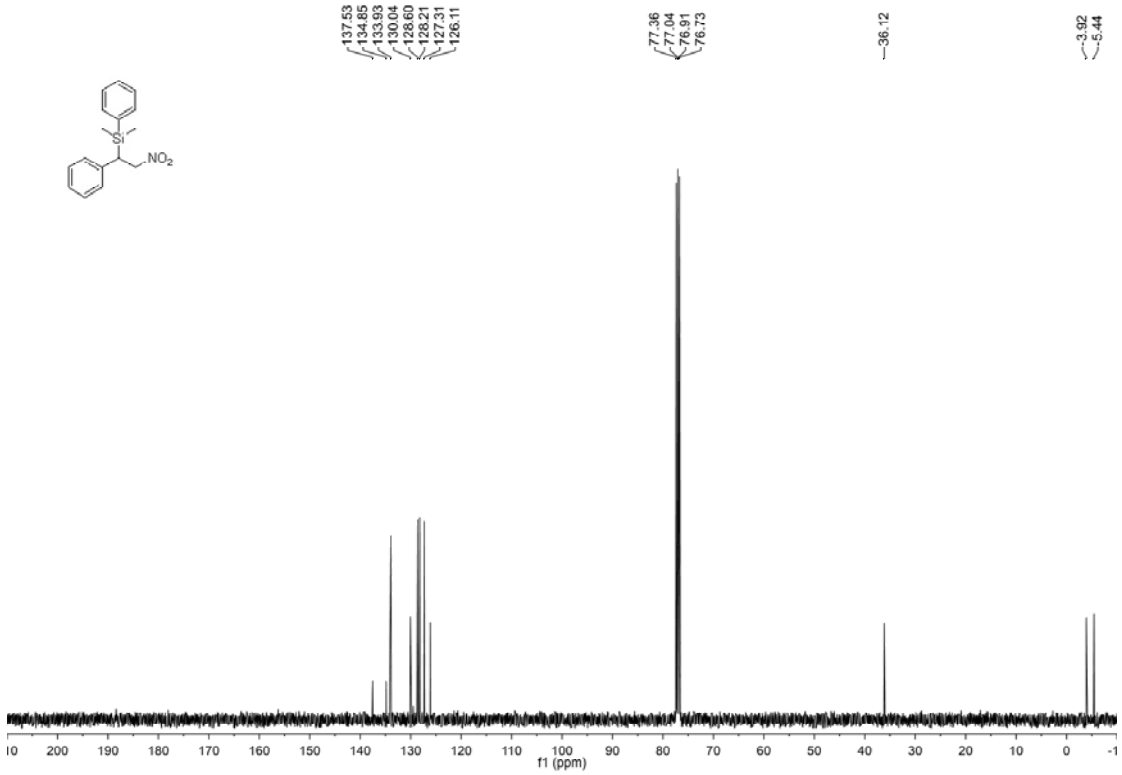
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3F**



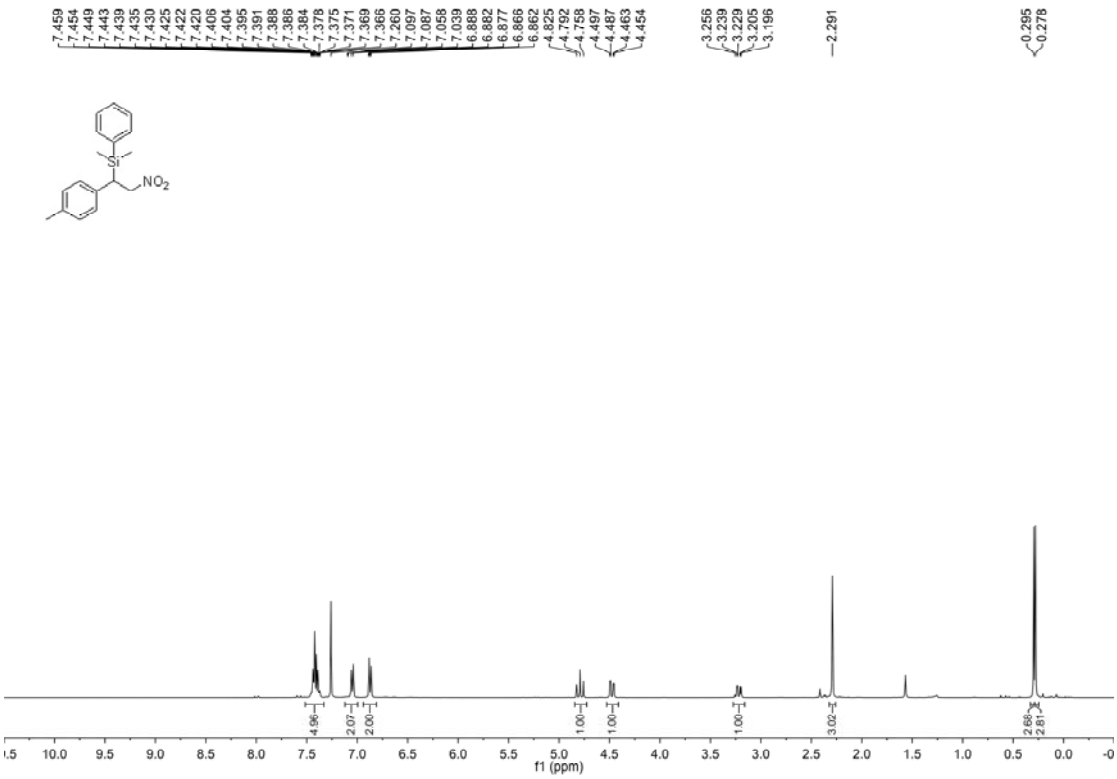
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3F**



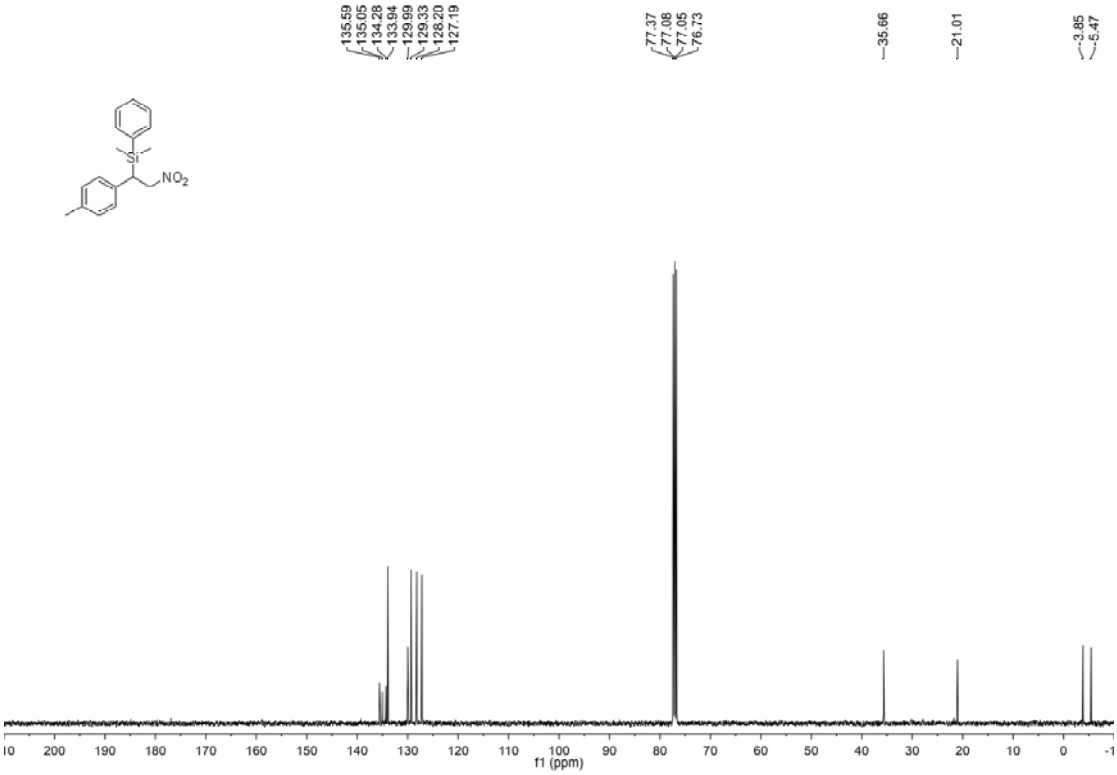
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3G**



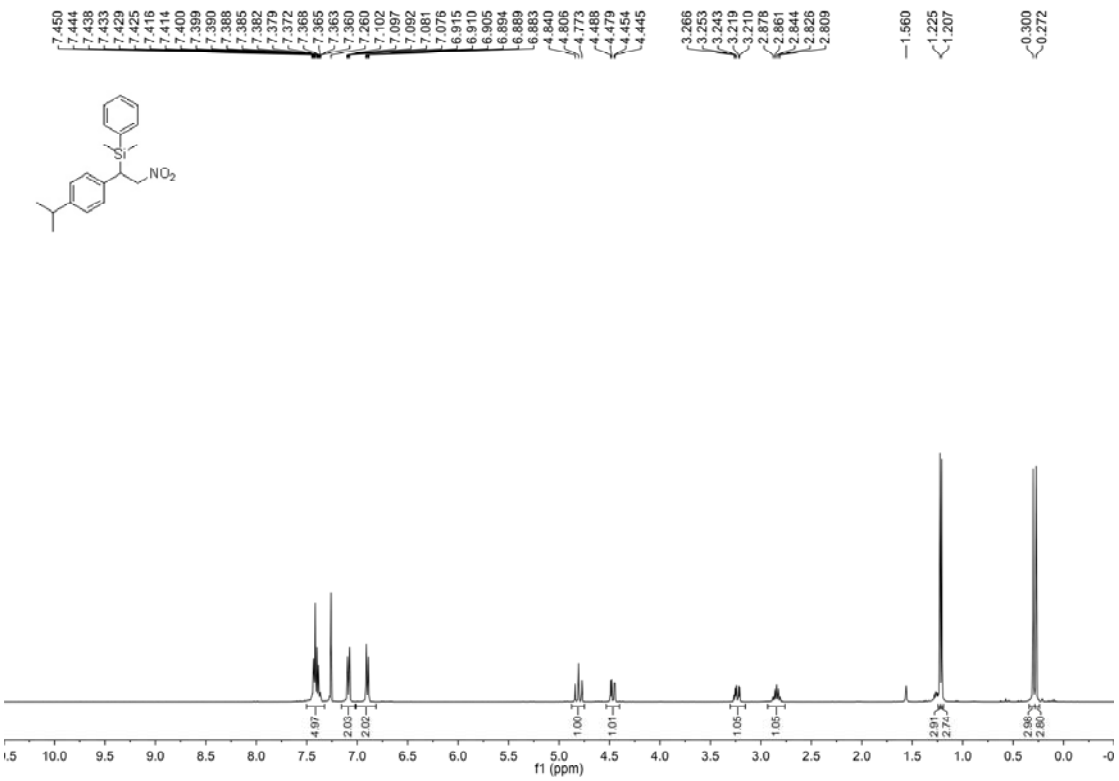
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3G**



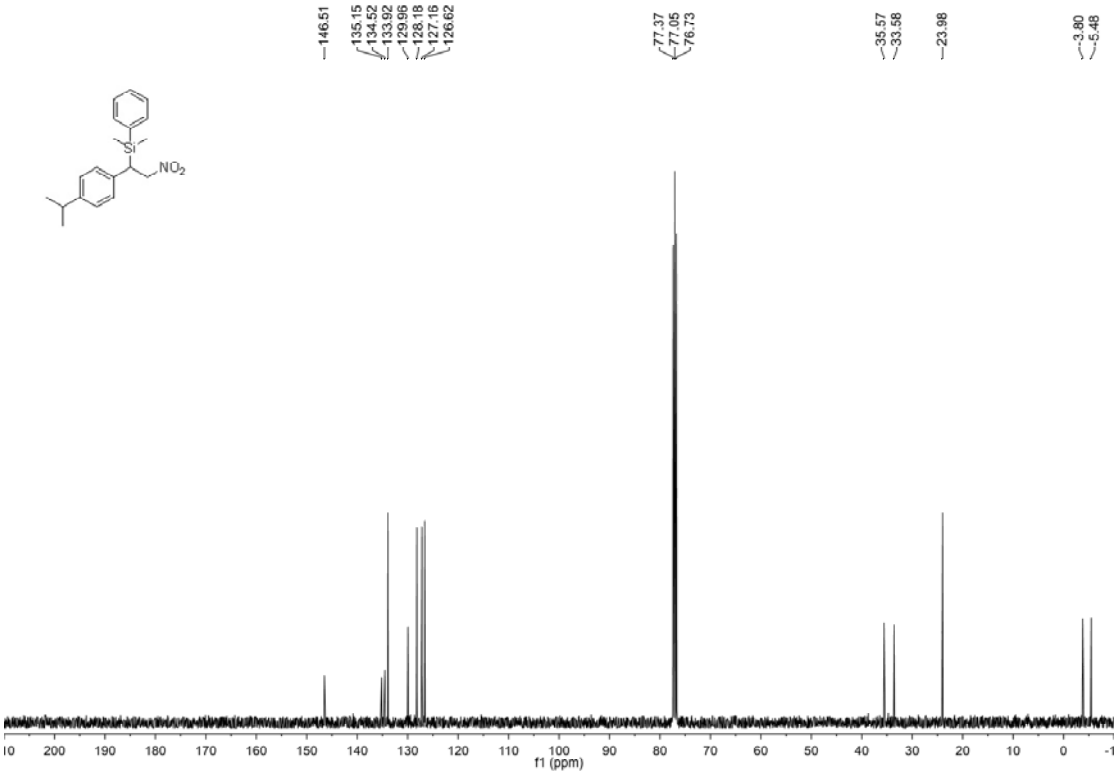
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3H**



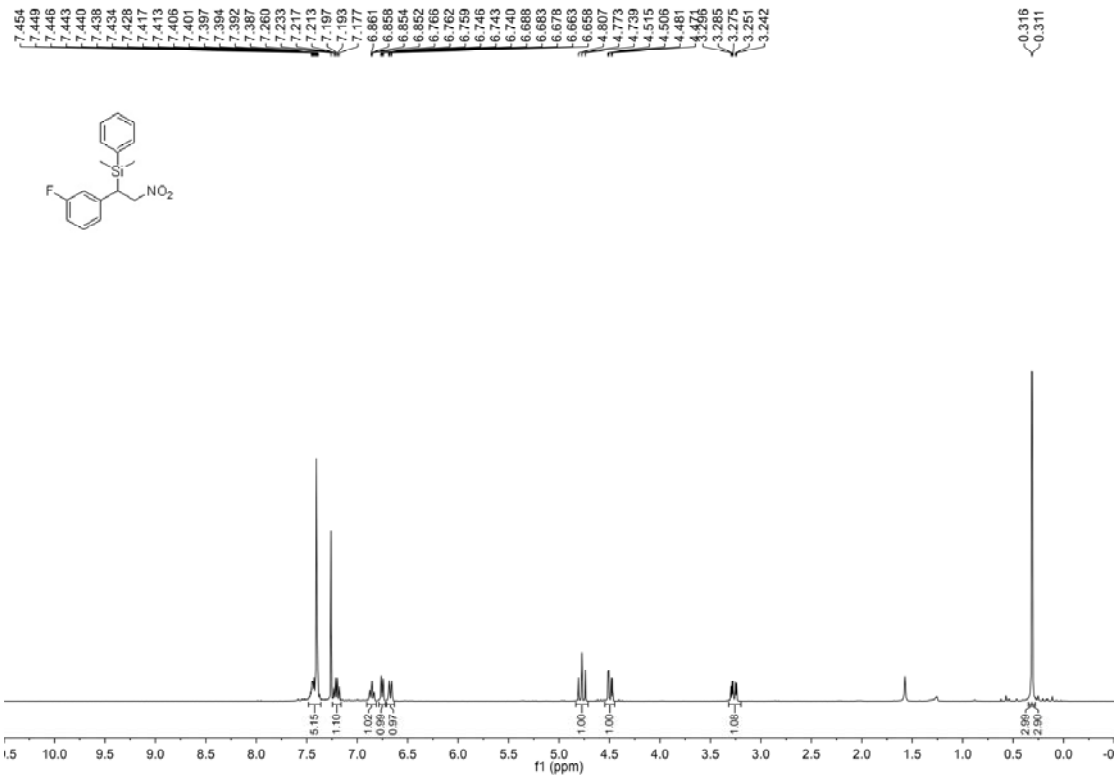
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3H**



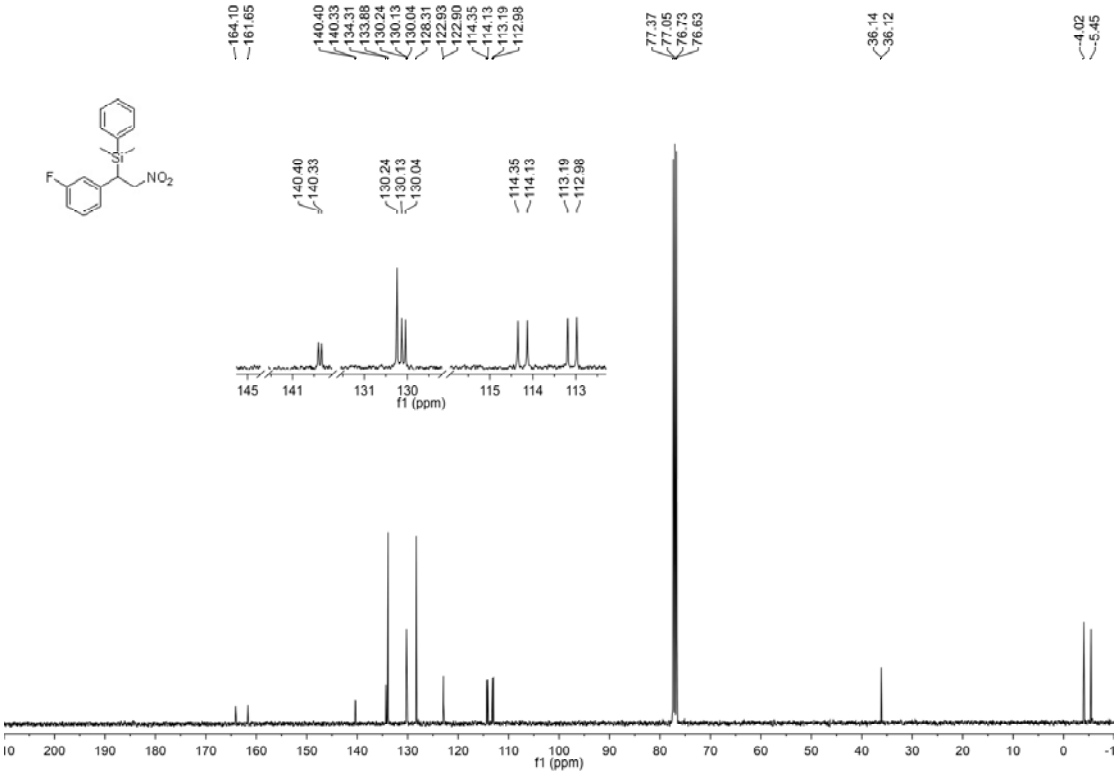
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3I**



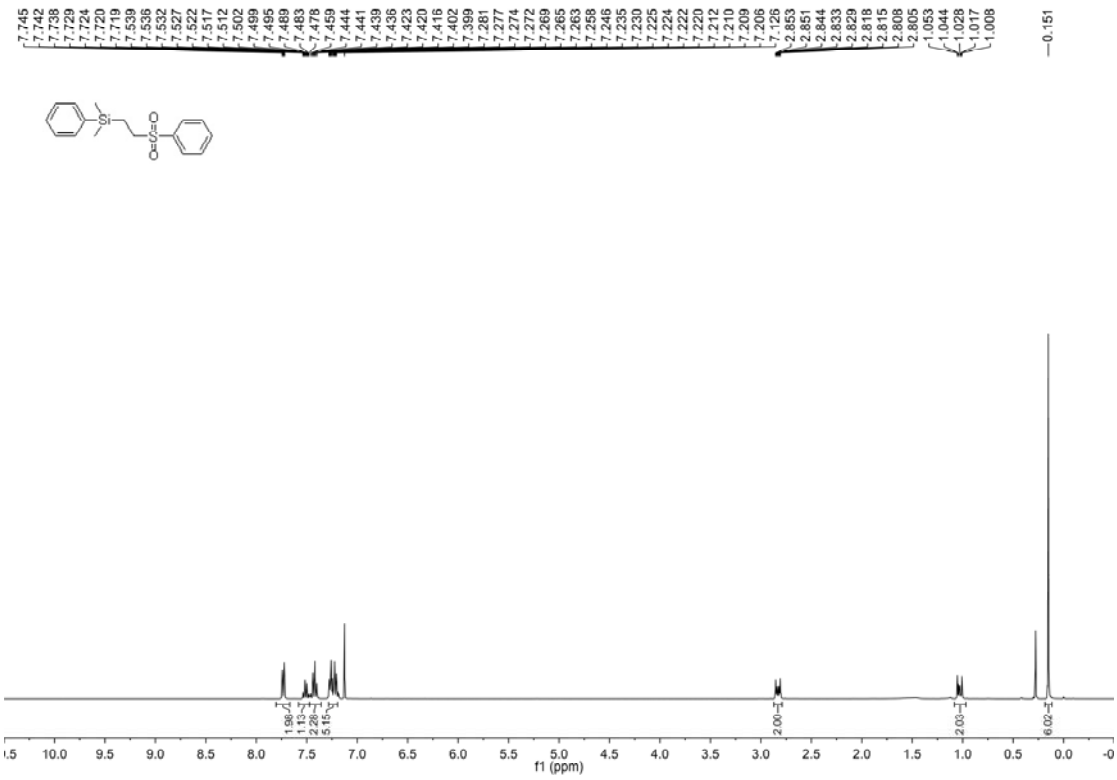
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **3I**



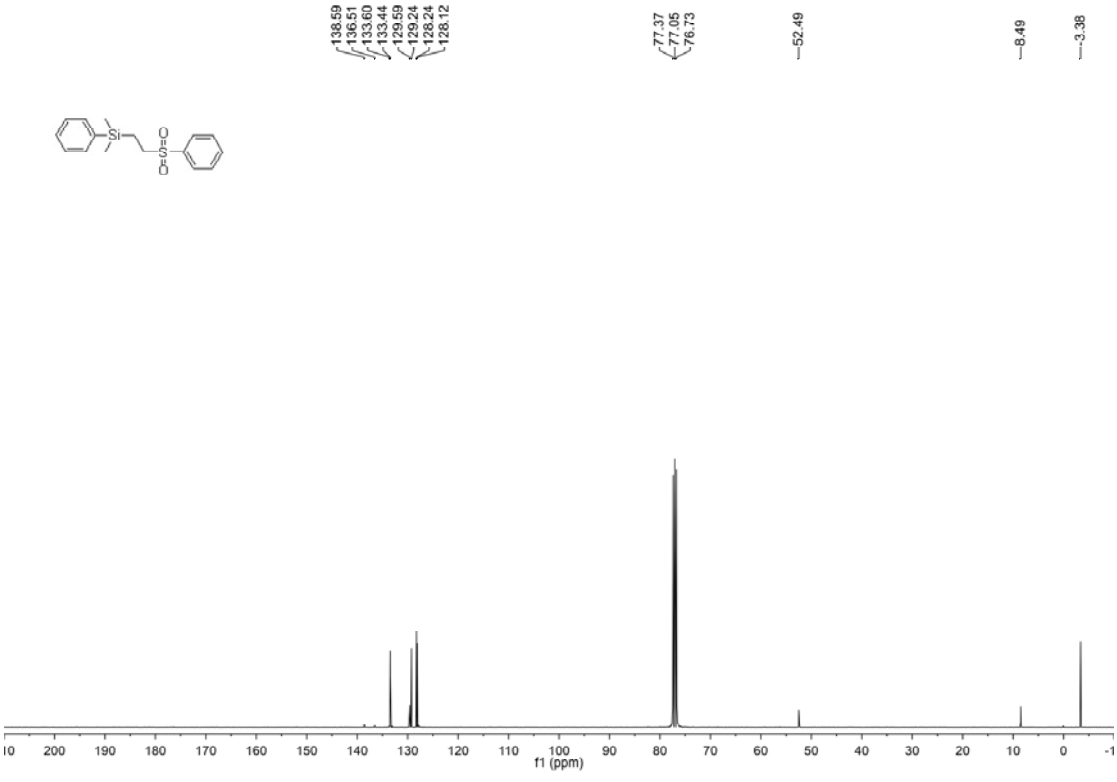
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3J**



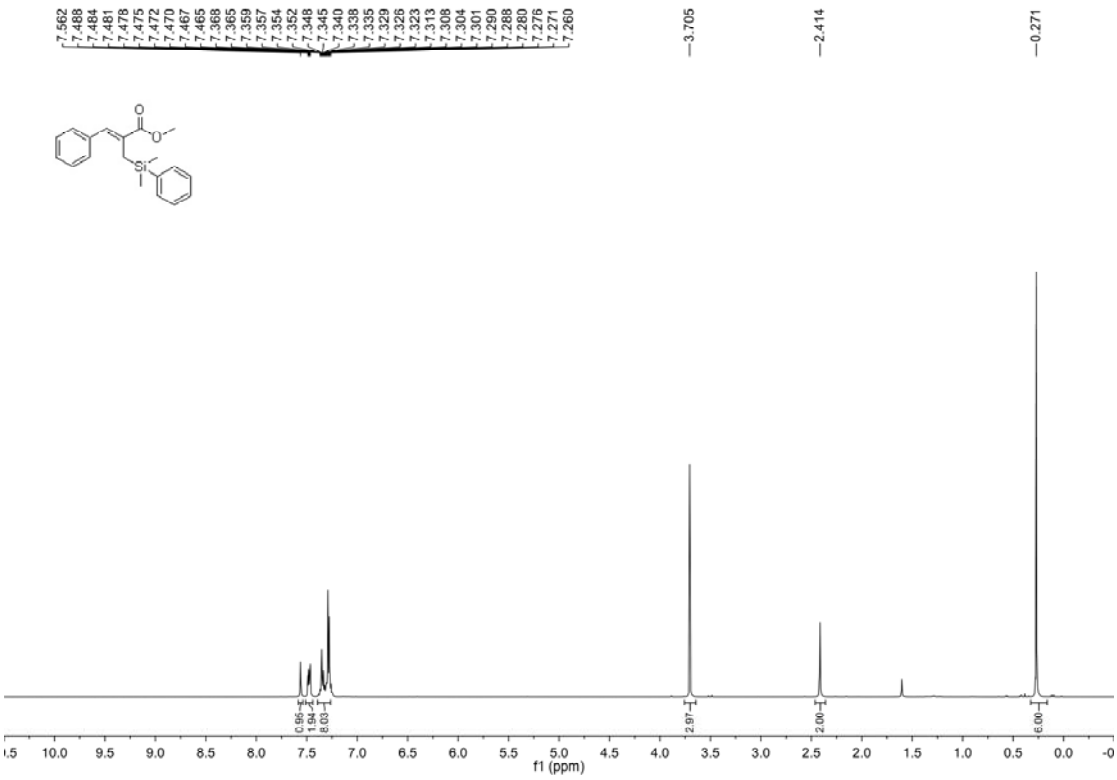
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3J**



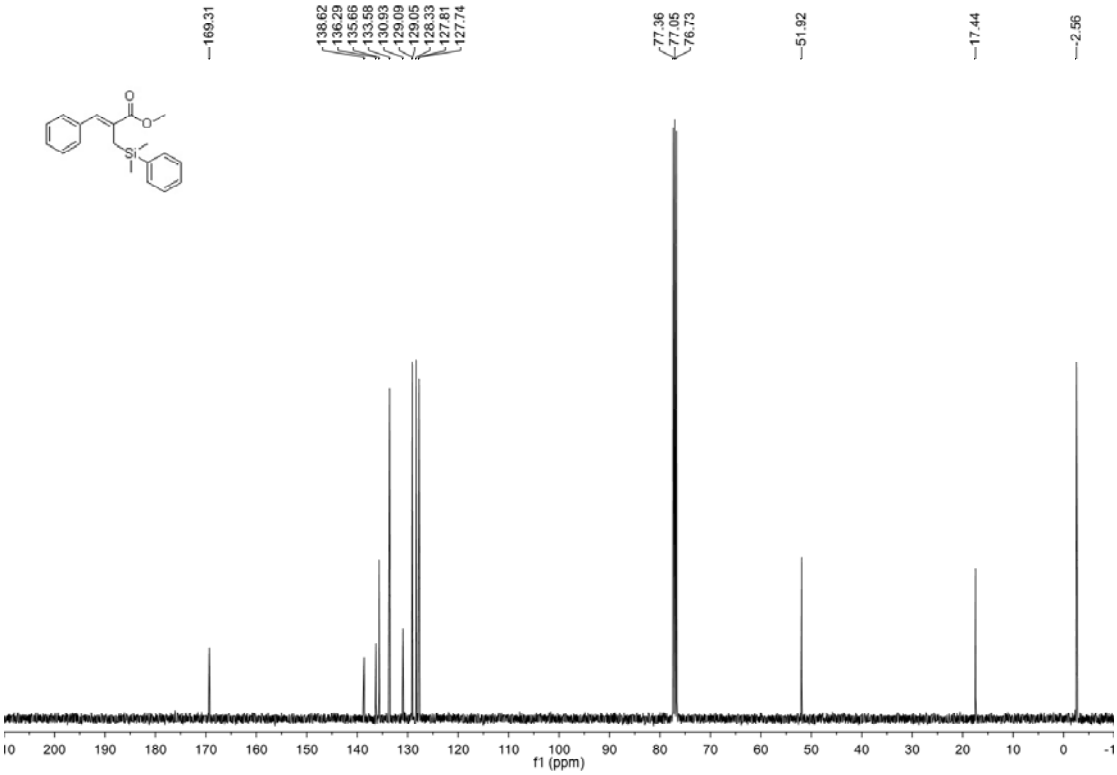
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3K**



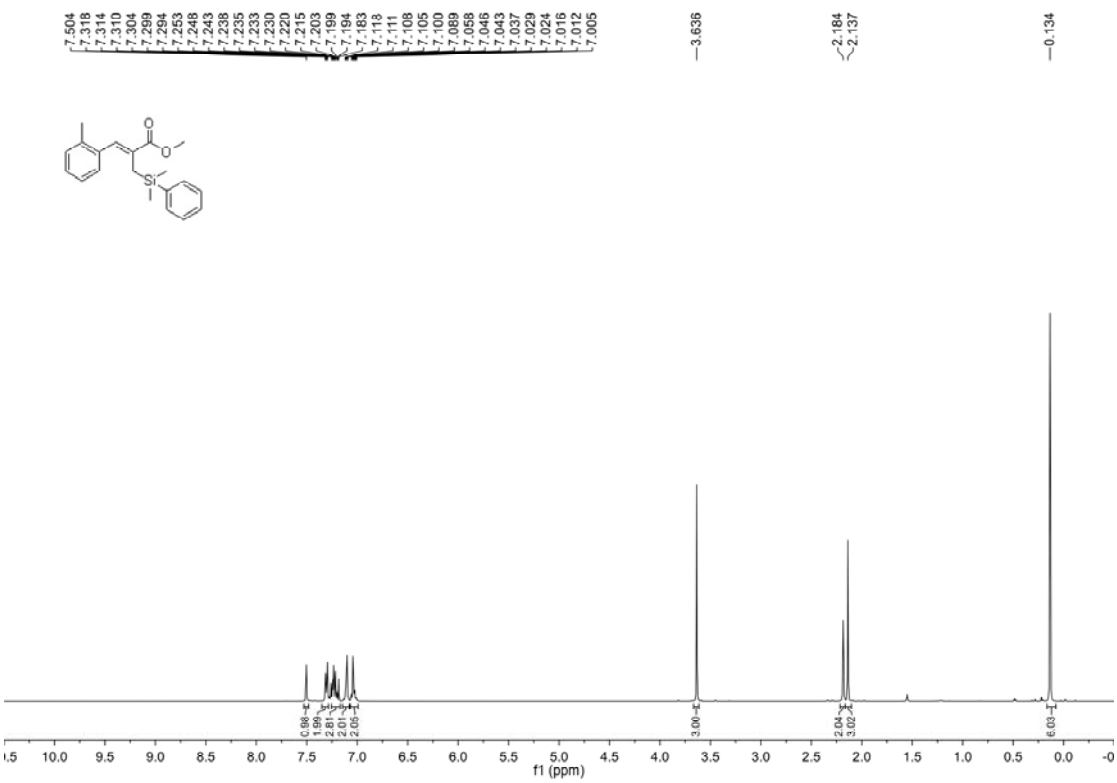
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **3K**



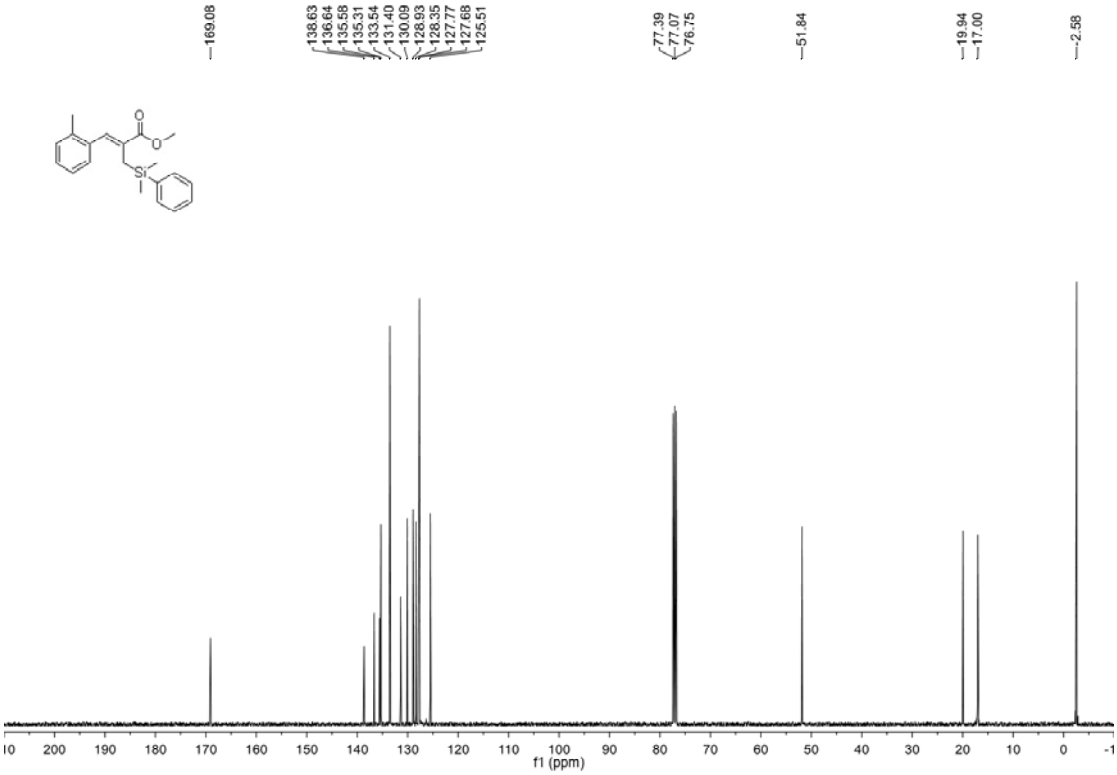
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5a**



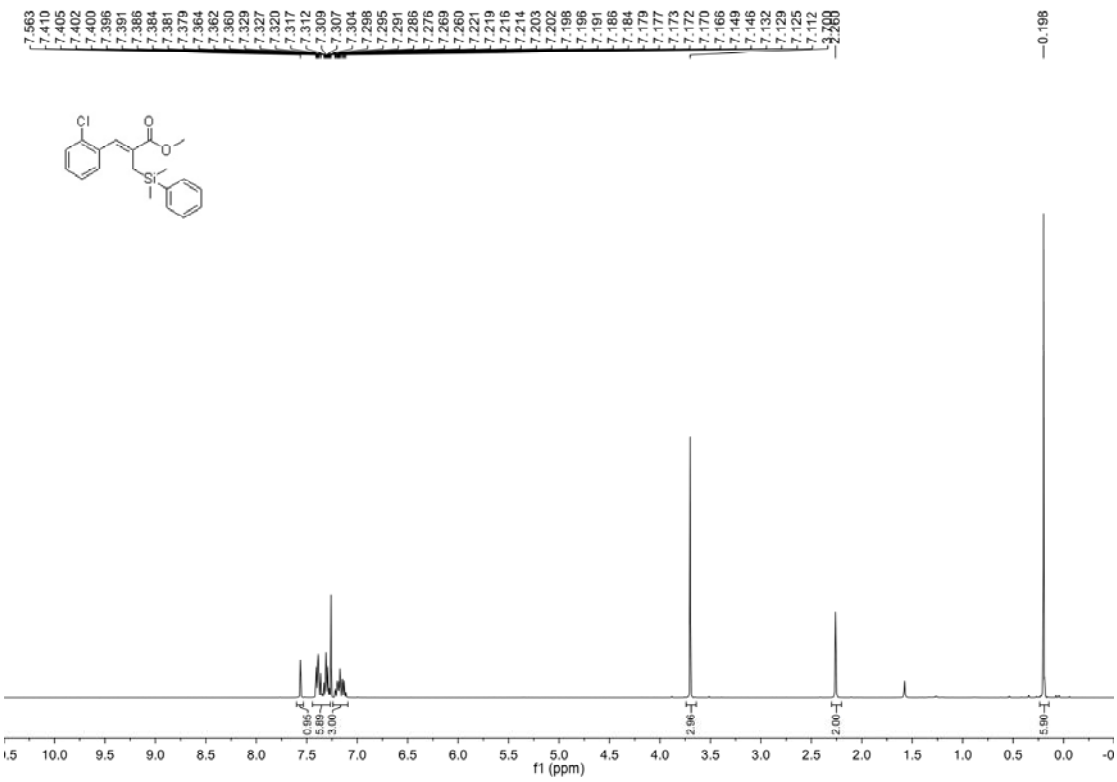
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5a**



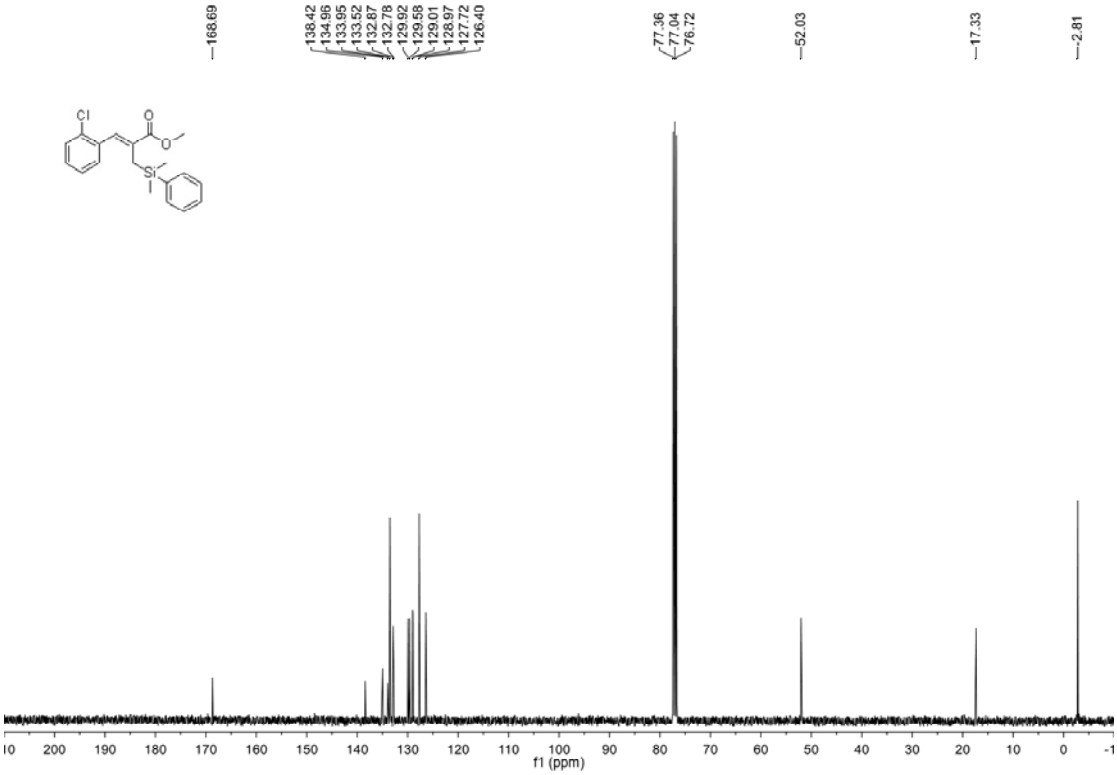
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5b**



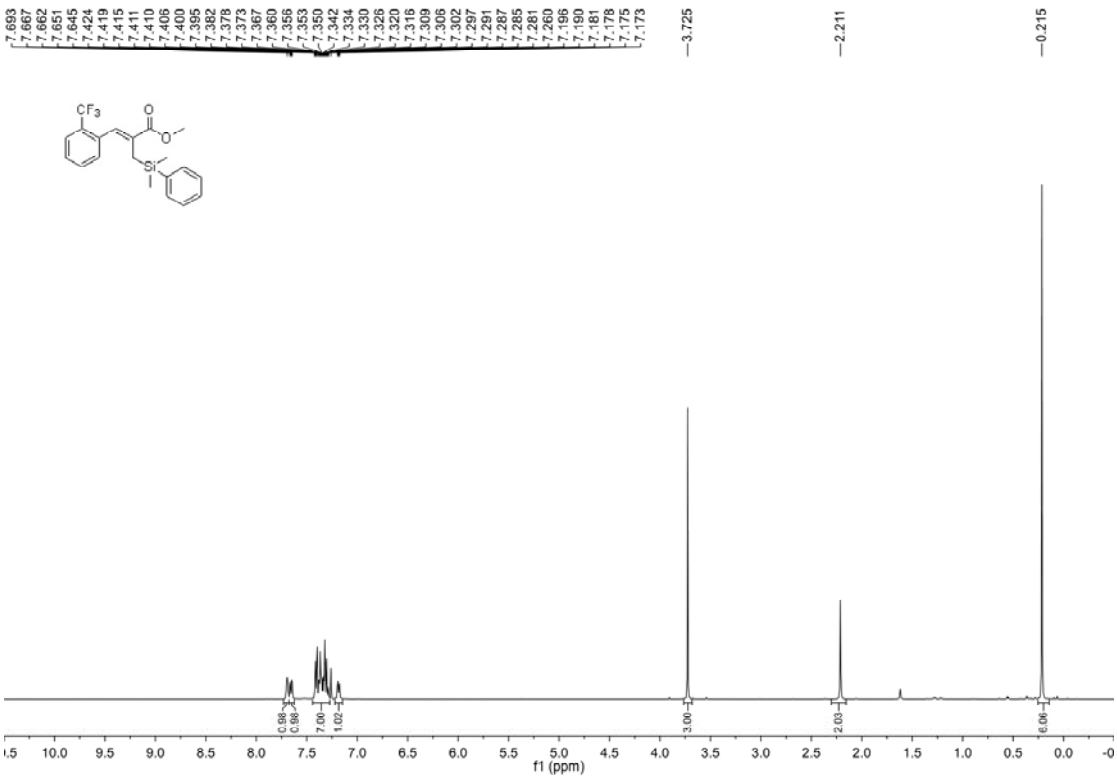
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5b**



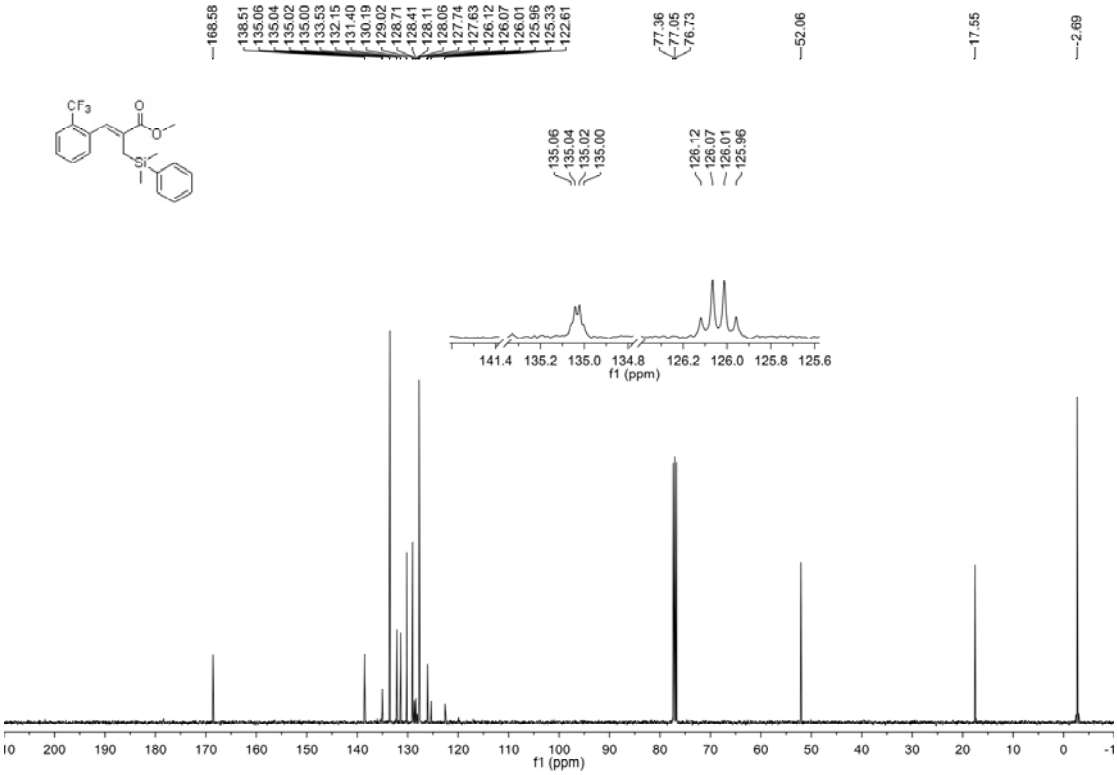
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5c**



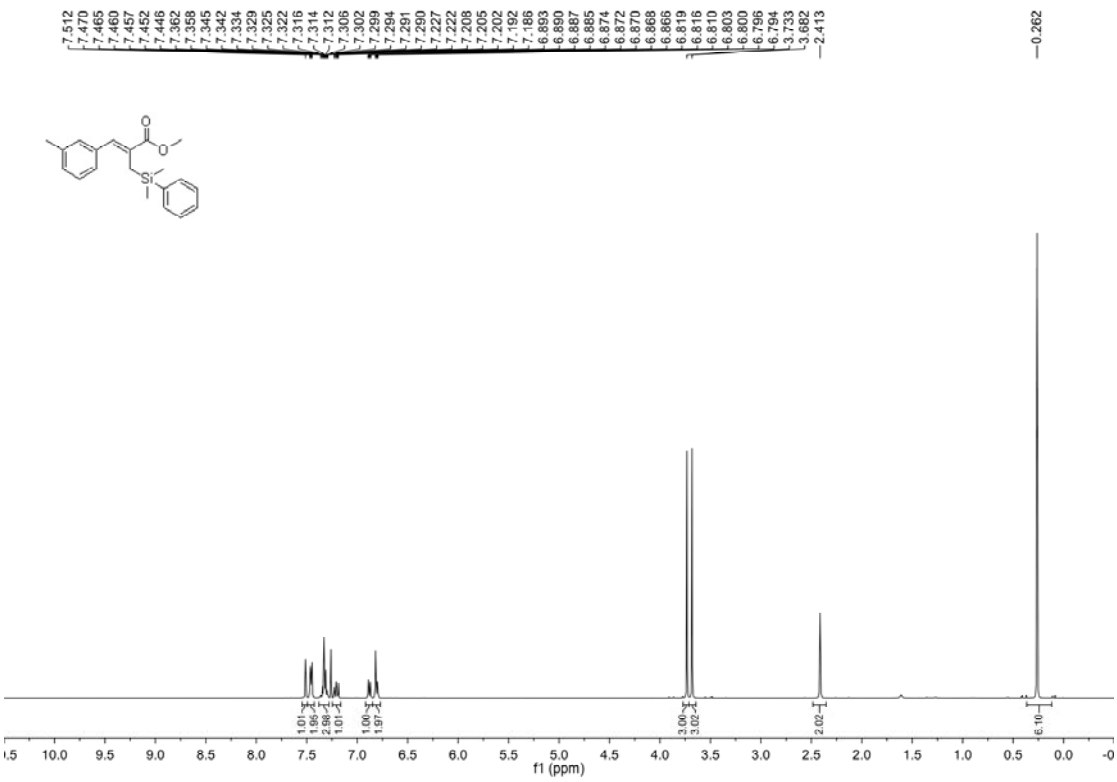
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5c**



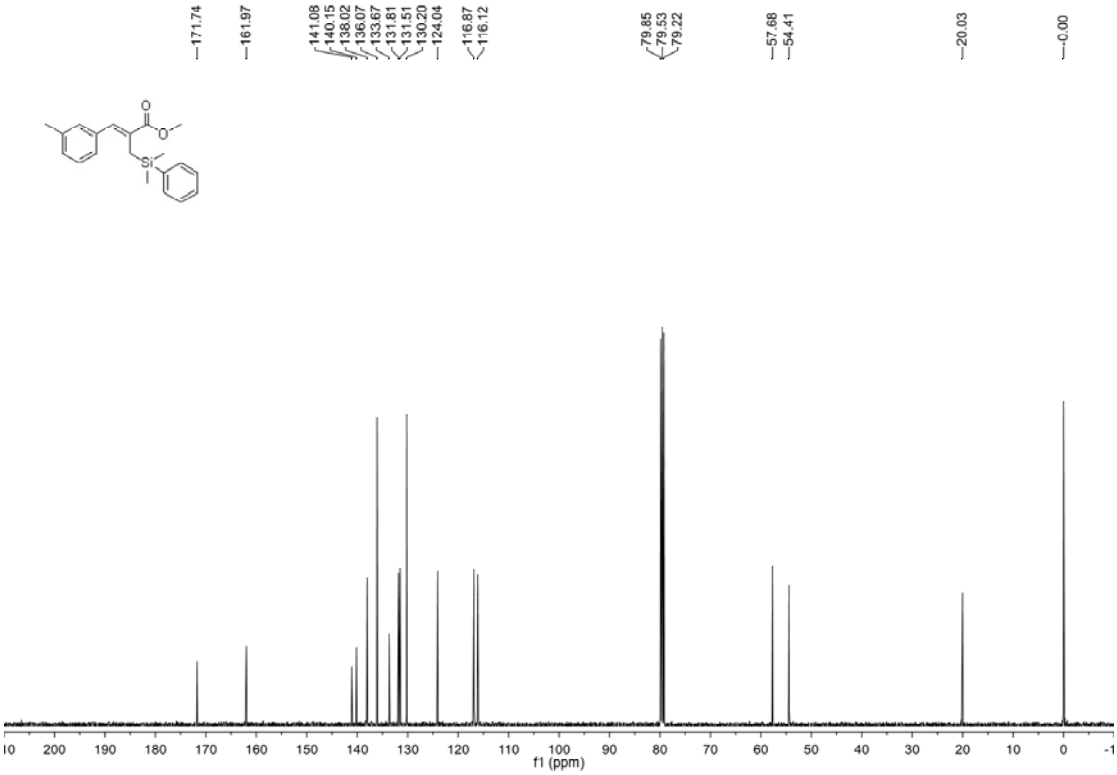
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5d**



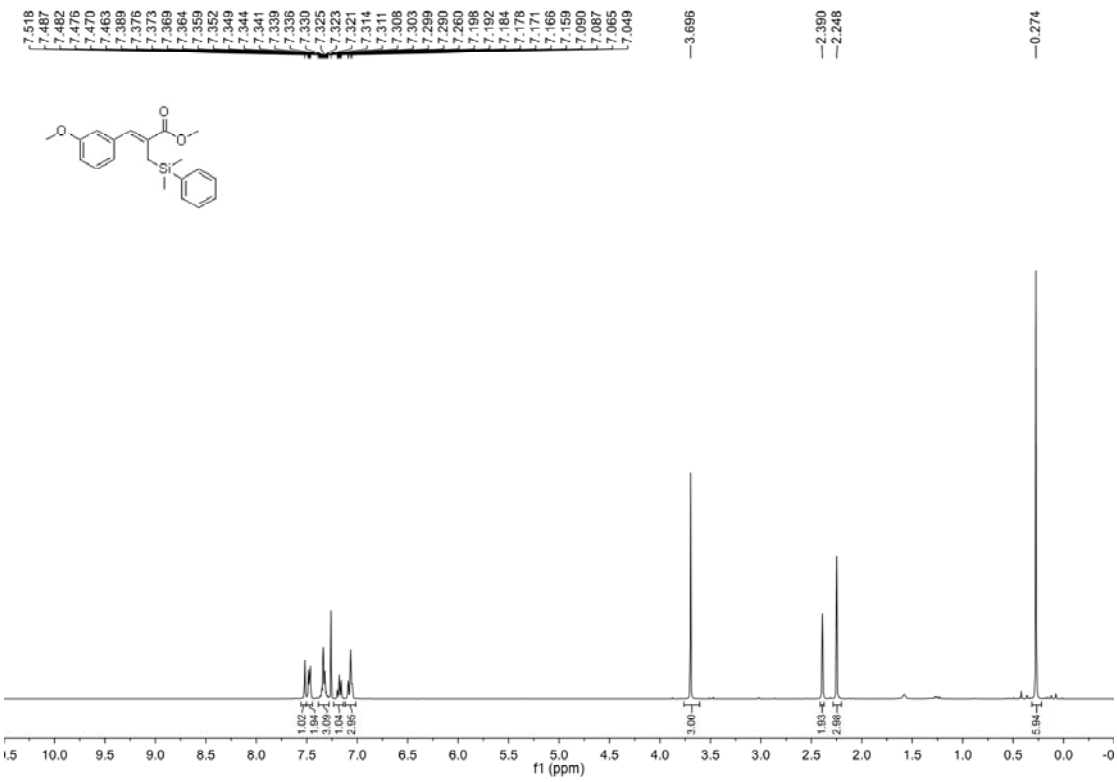
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **5d**



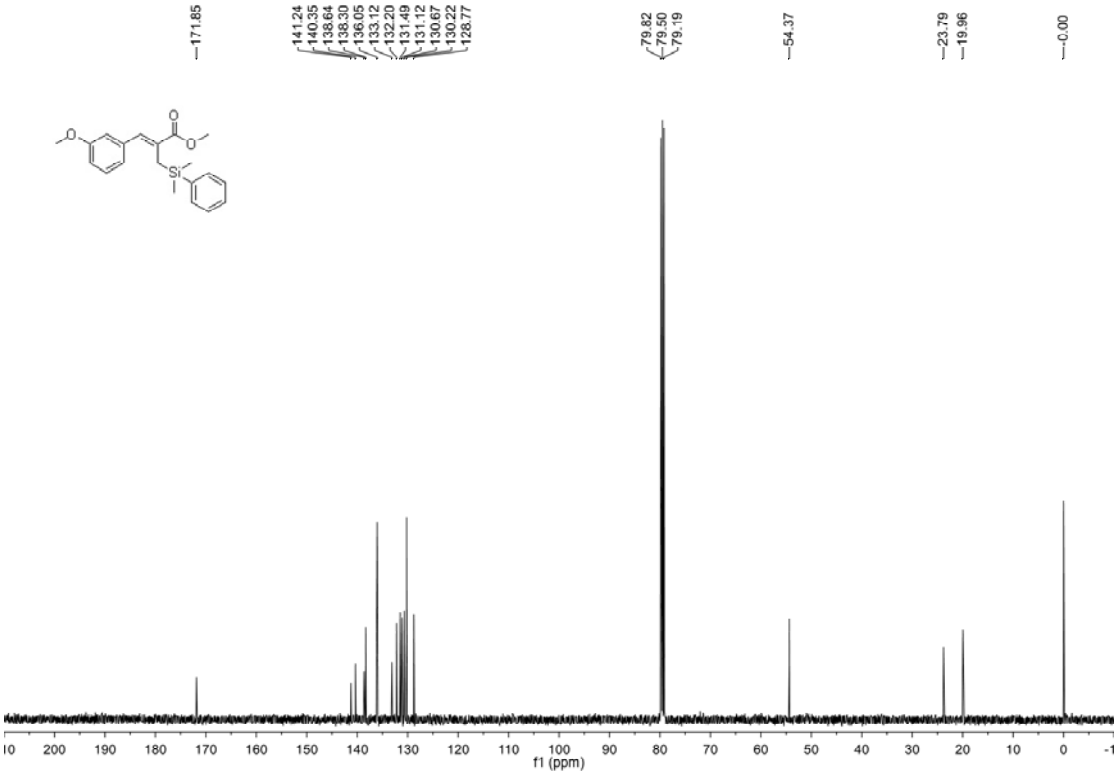
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5e**



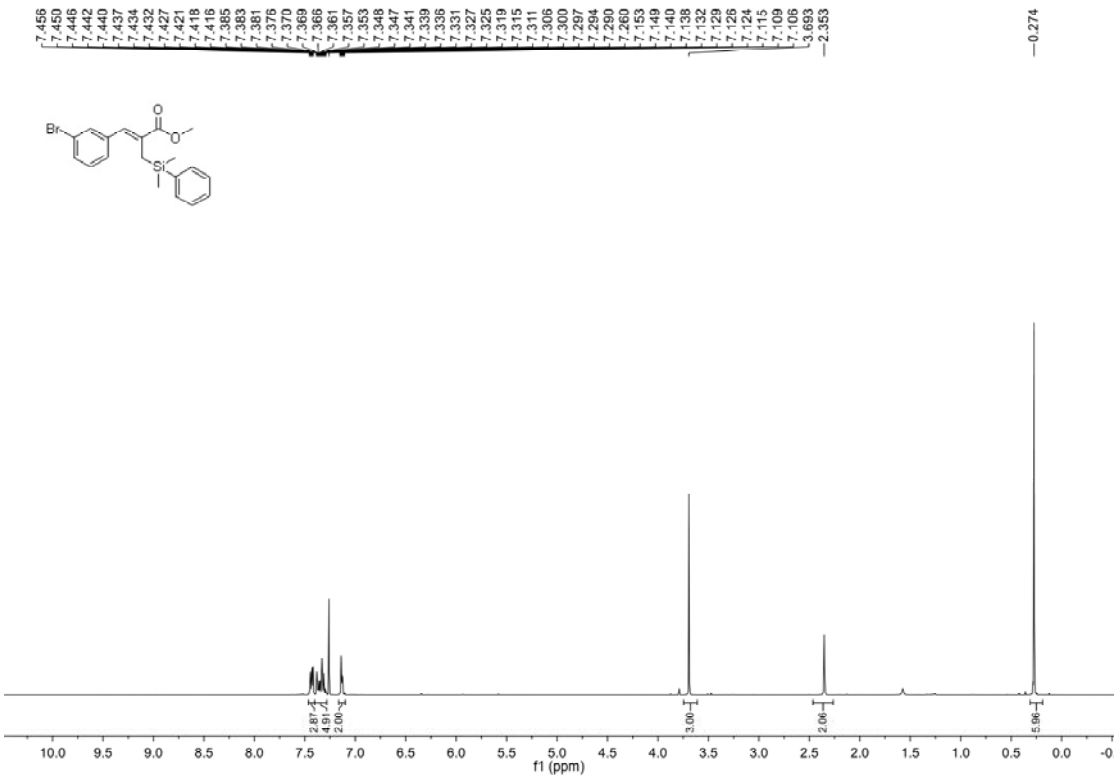
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5e**



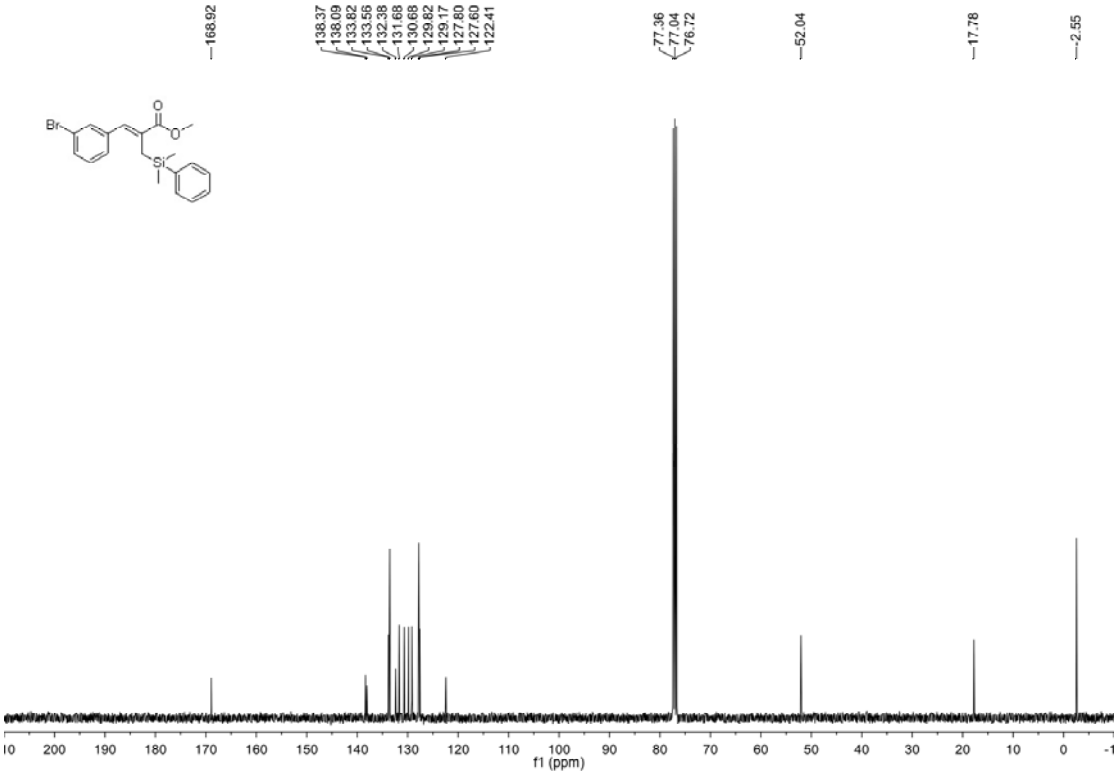
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5f**



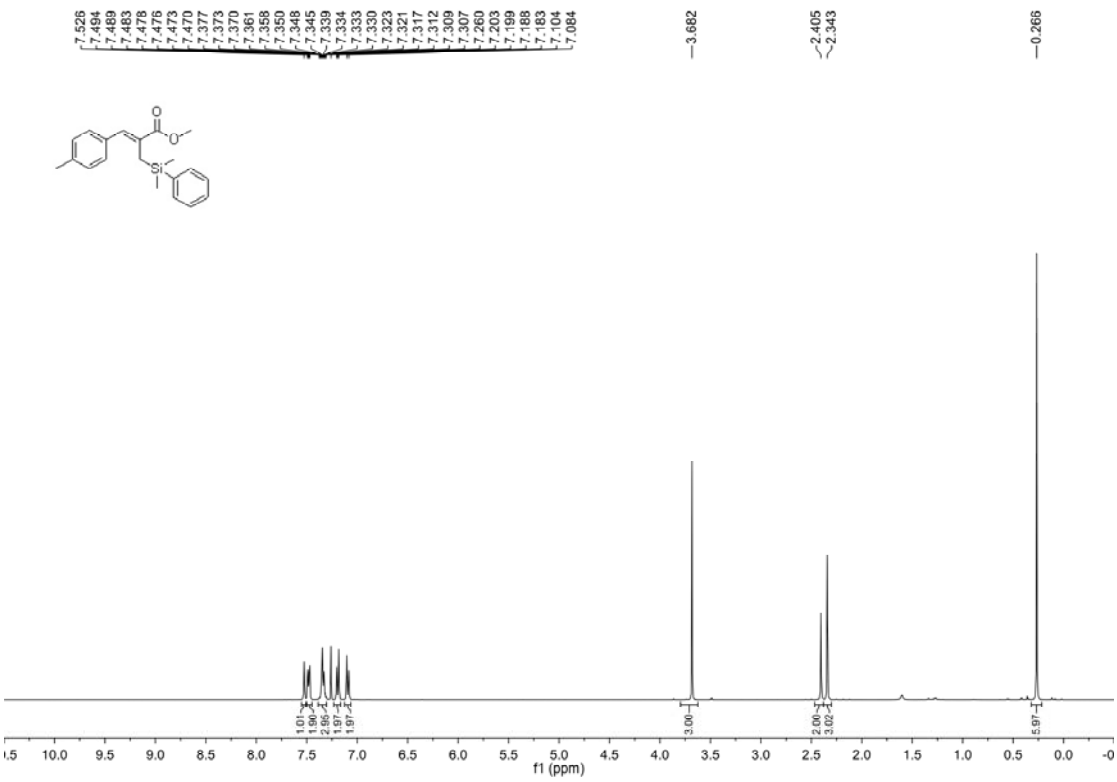
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **5f**



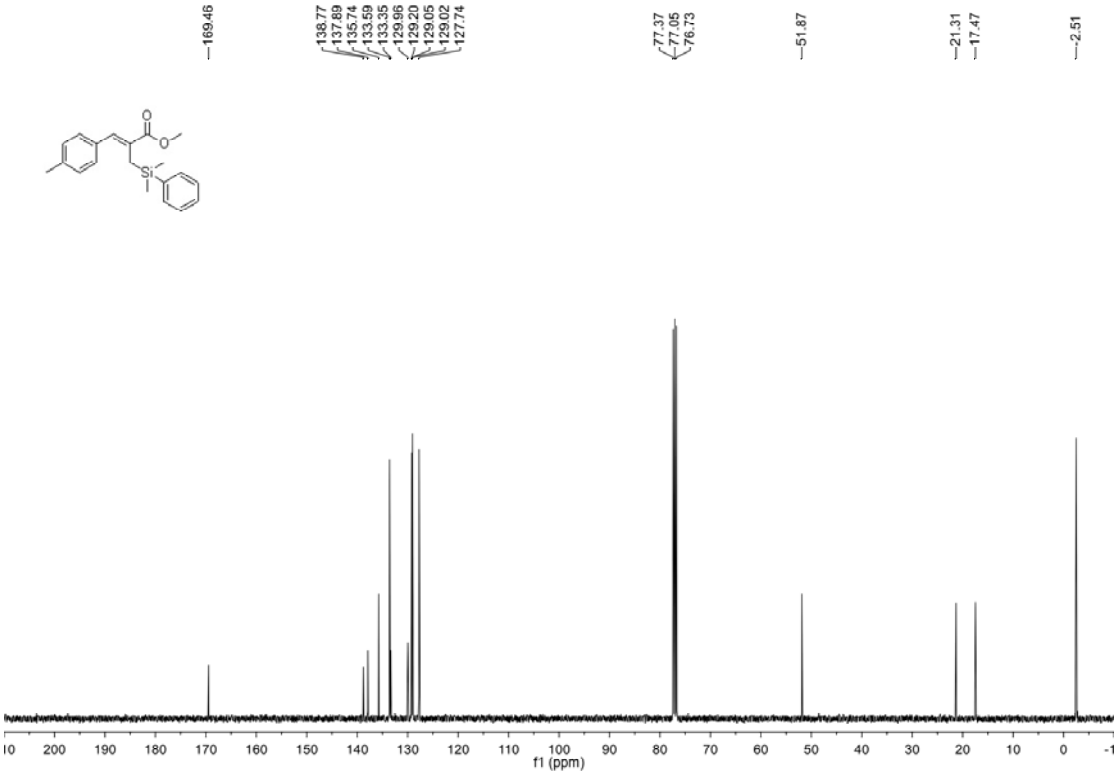
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5g**



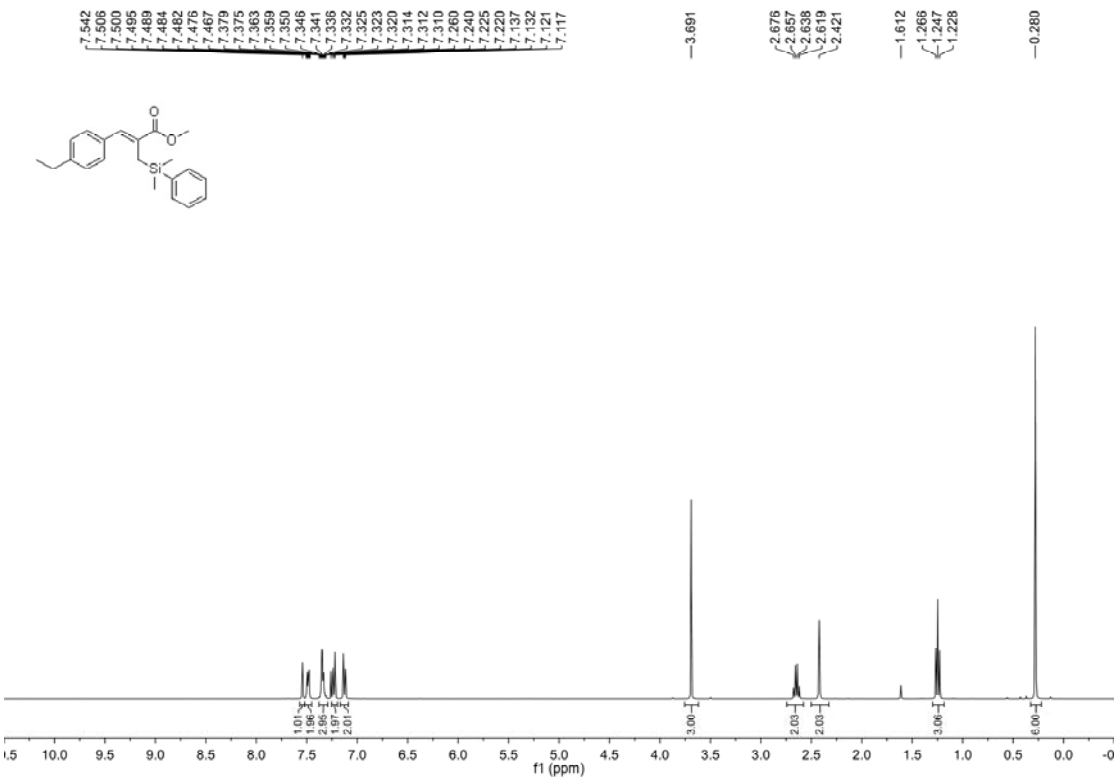
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **5g**



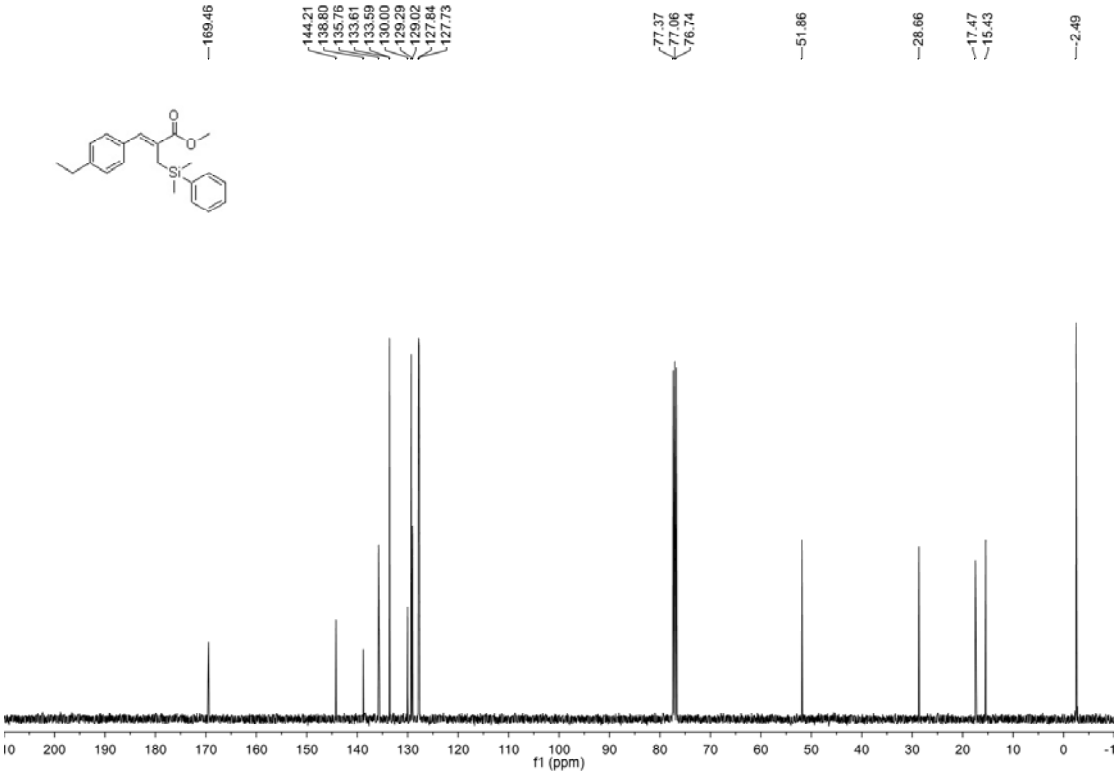
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5h**



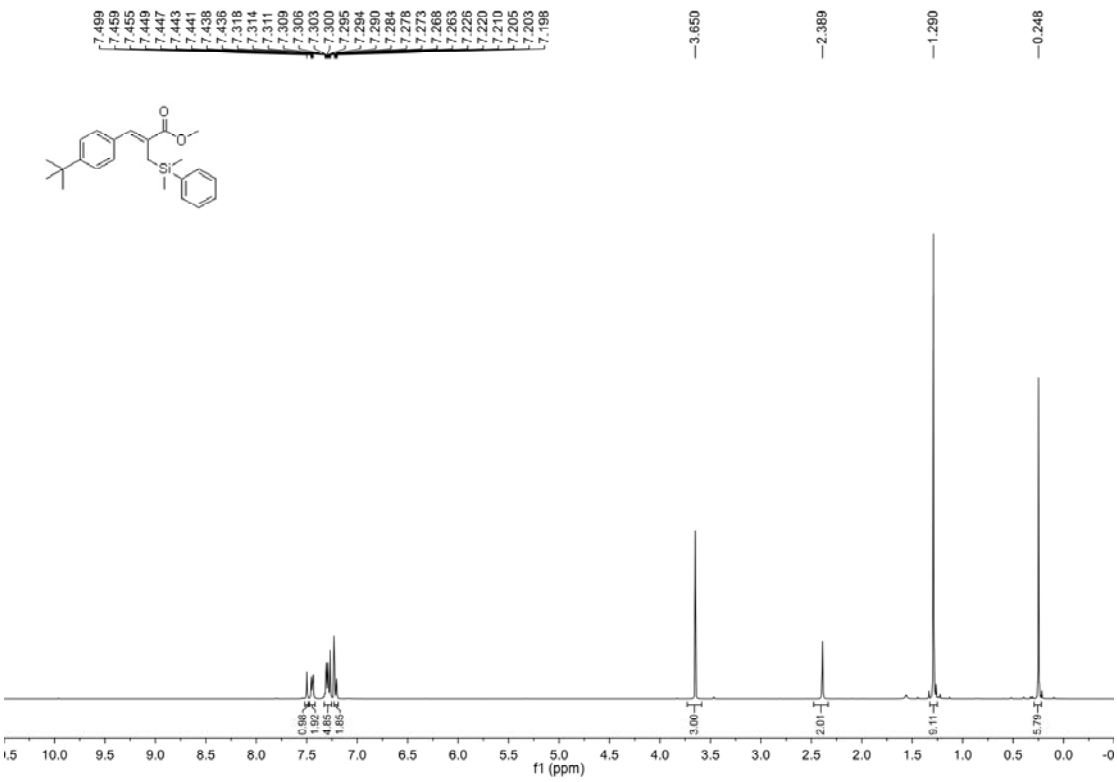
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **5h**



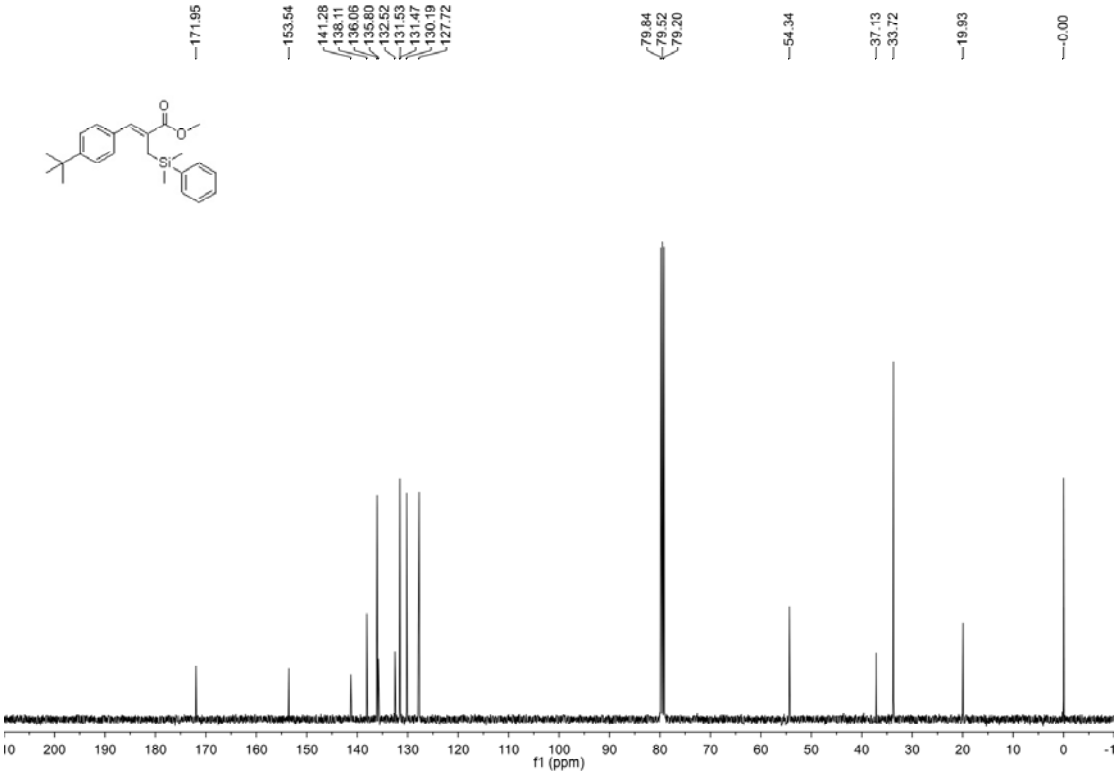
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5i**



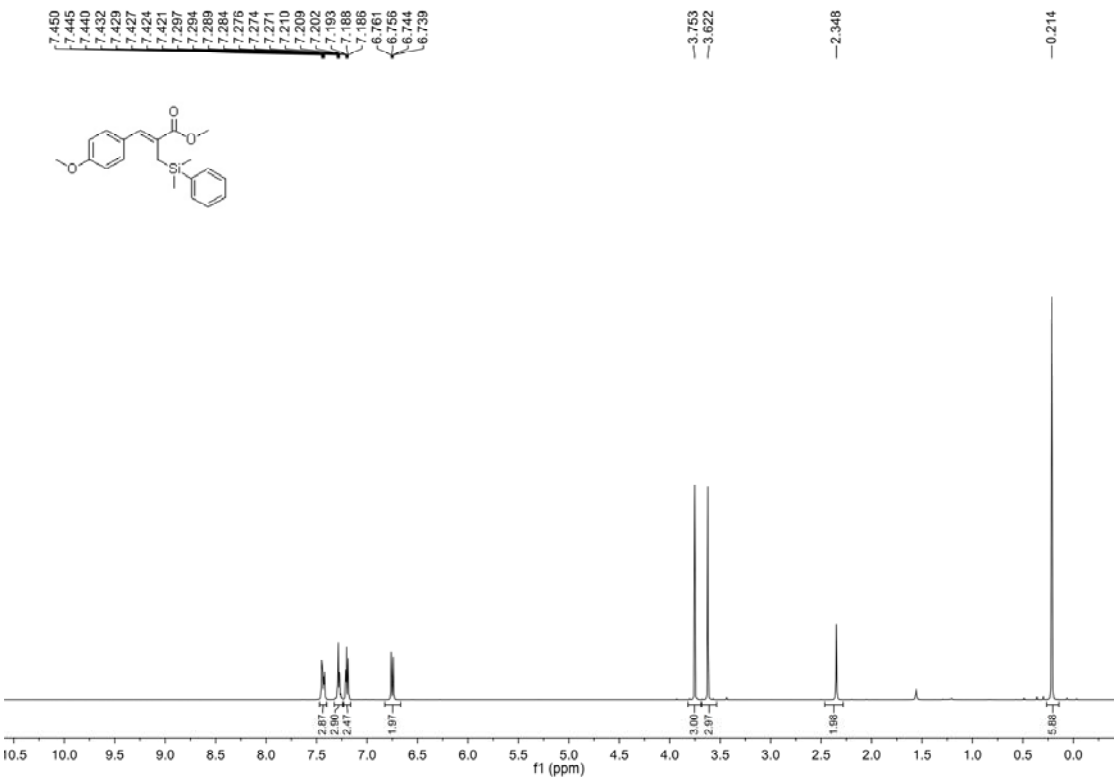
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **5i**



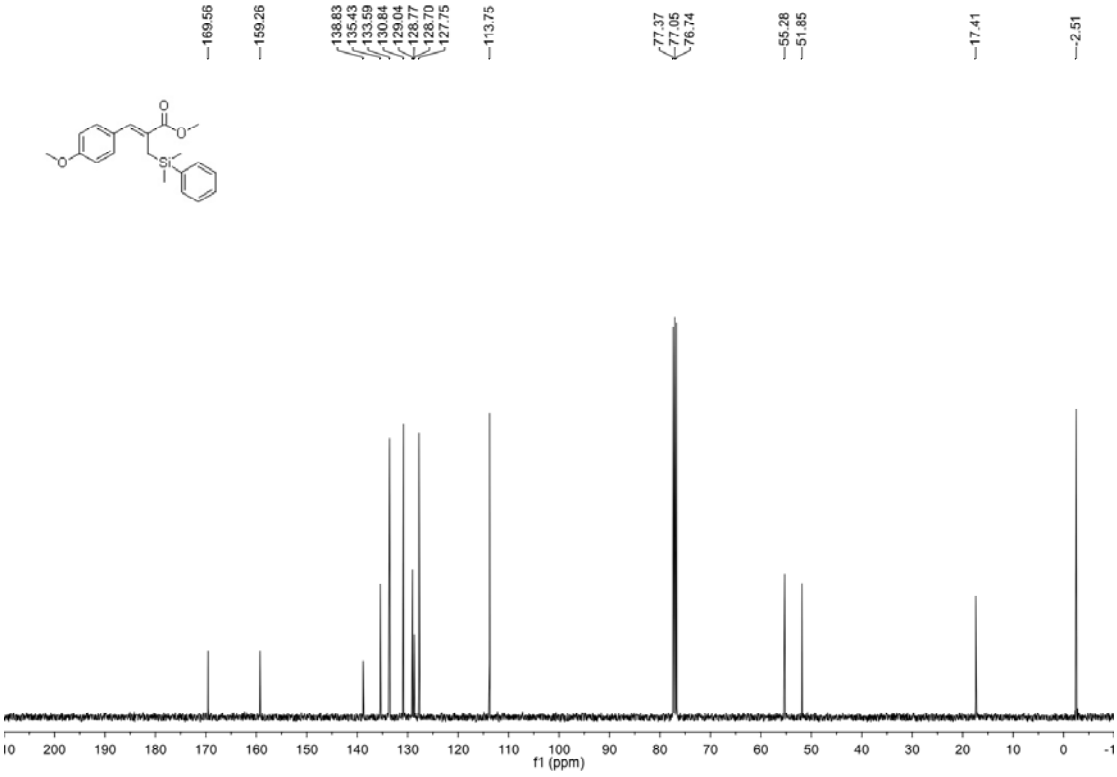
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5j**



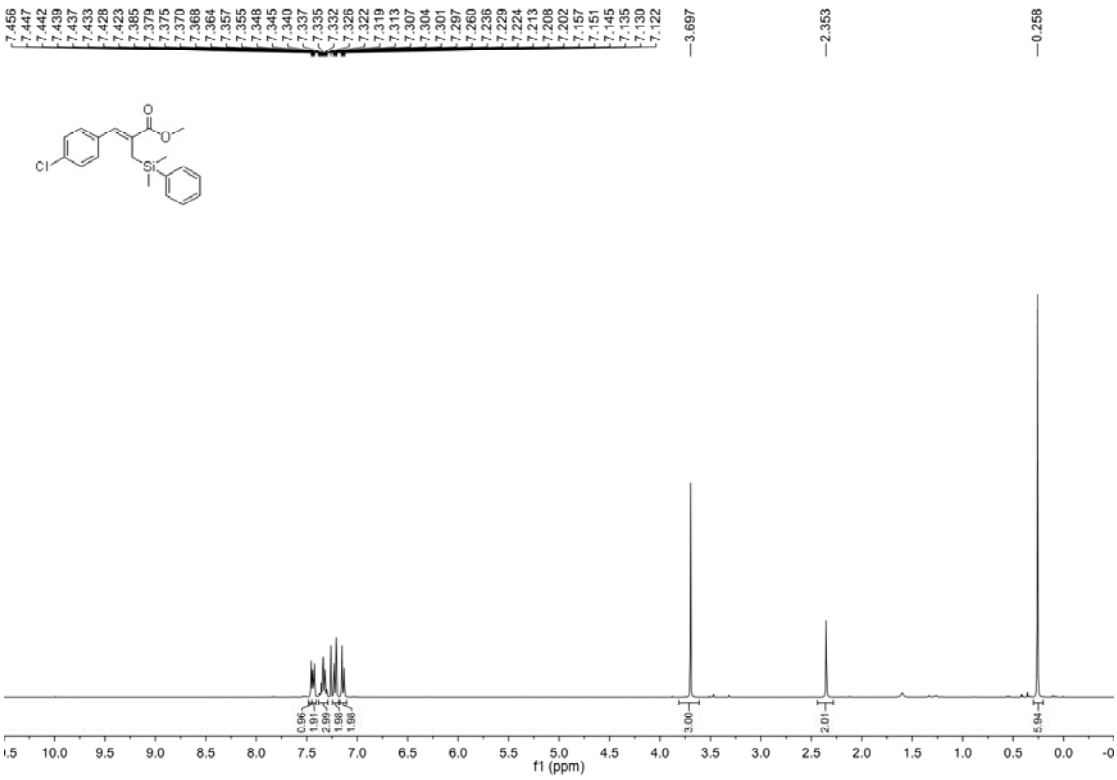
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **5j**



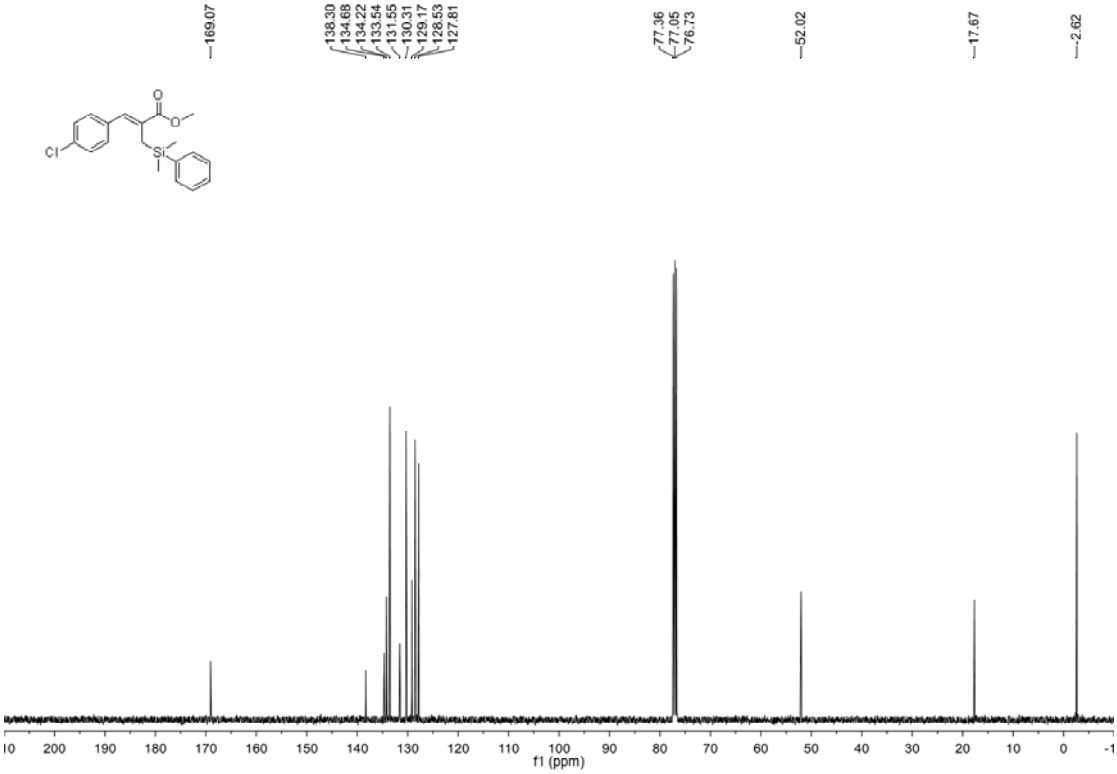
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5k**



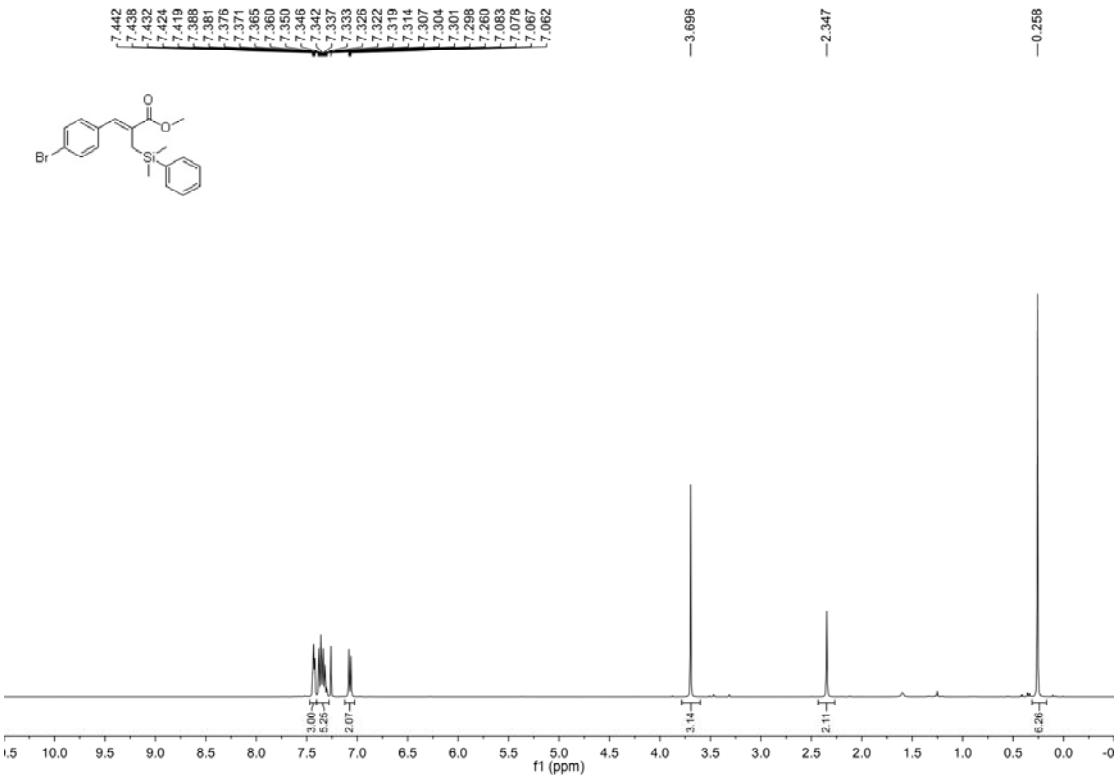
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5k**



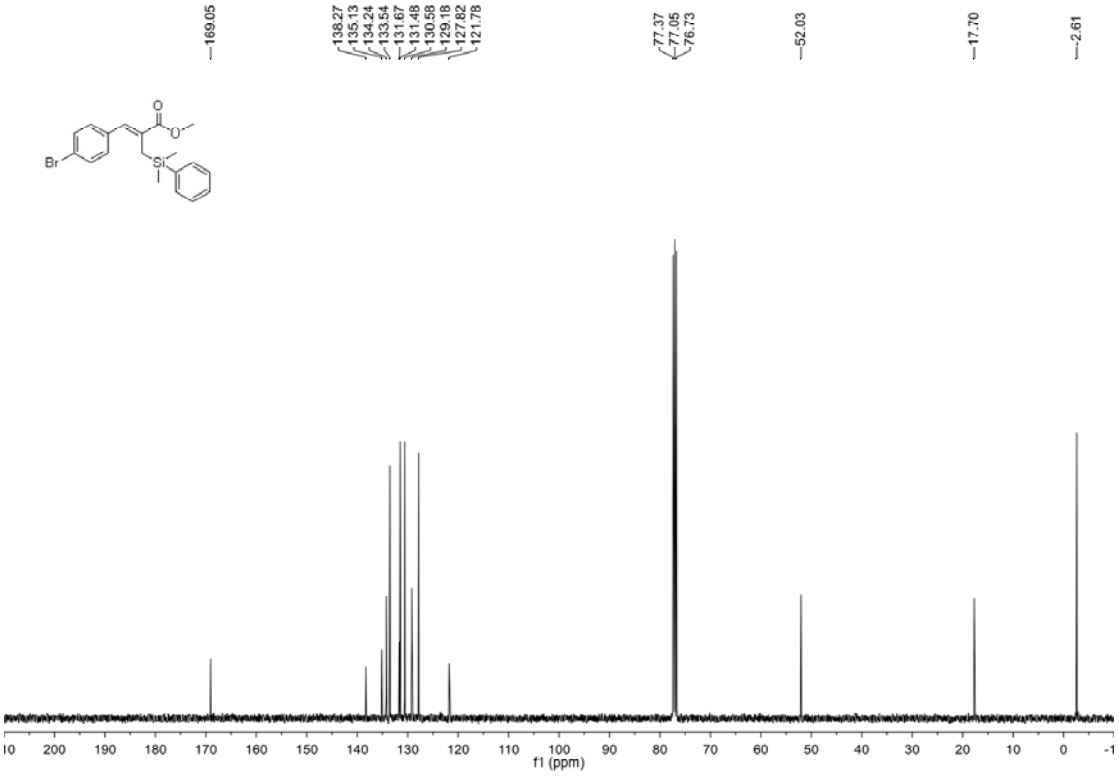
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5l**



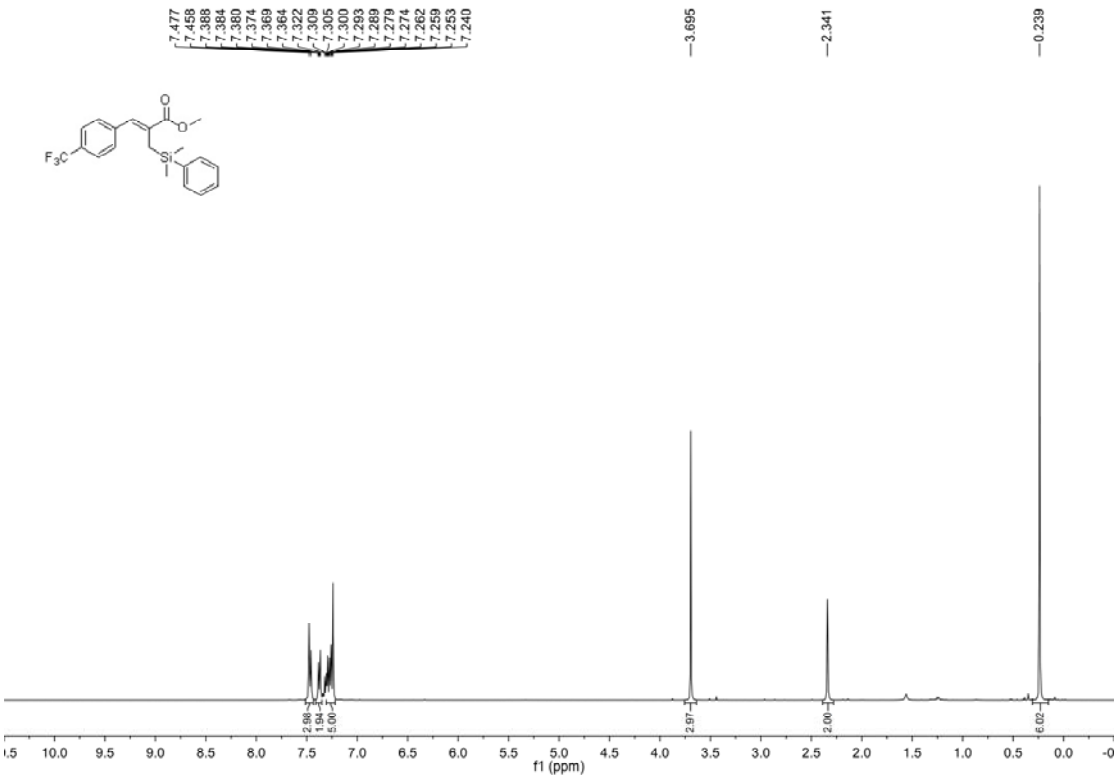
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **5l**



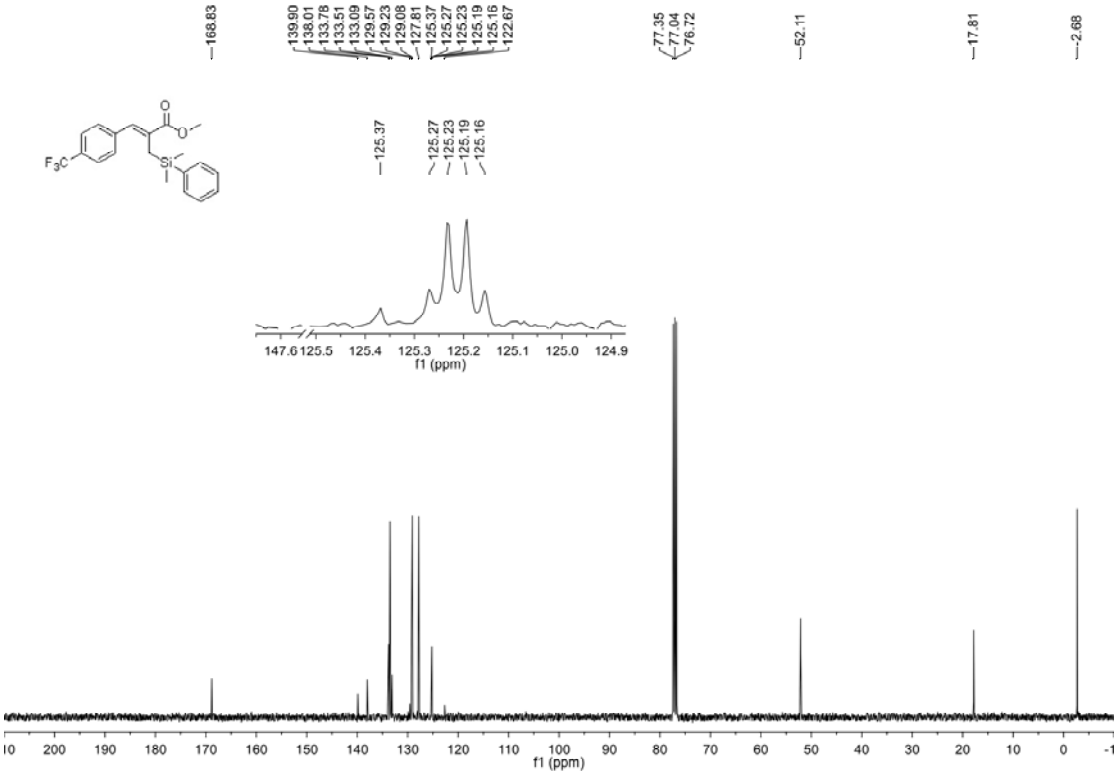
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5m**



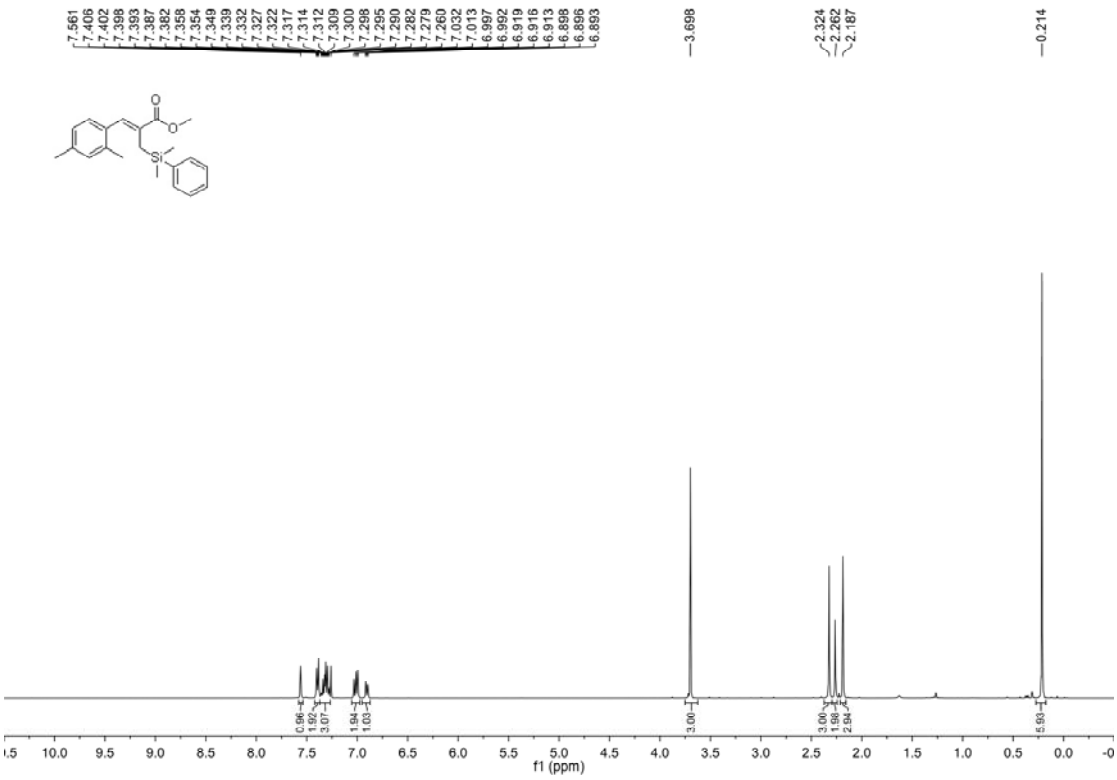
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5m**



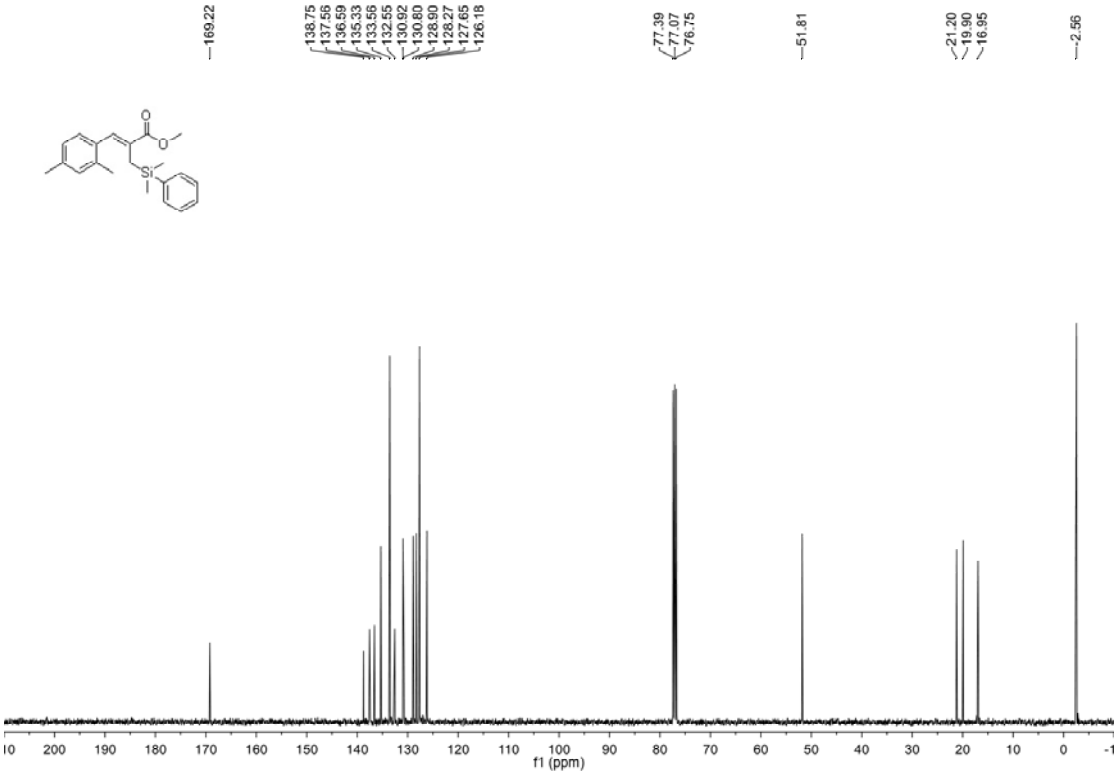
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5n**



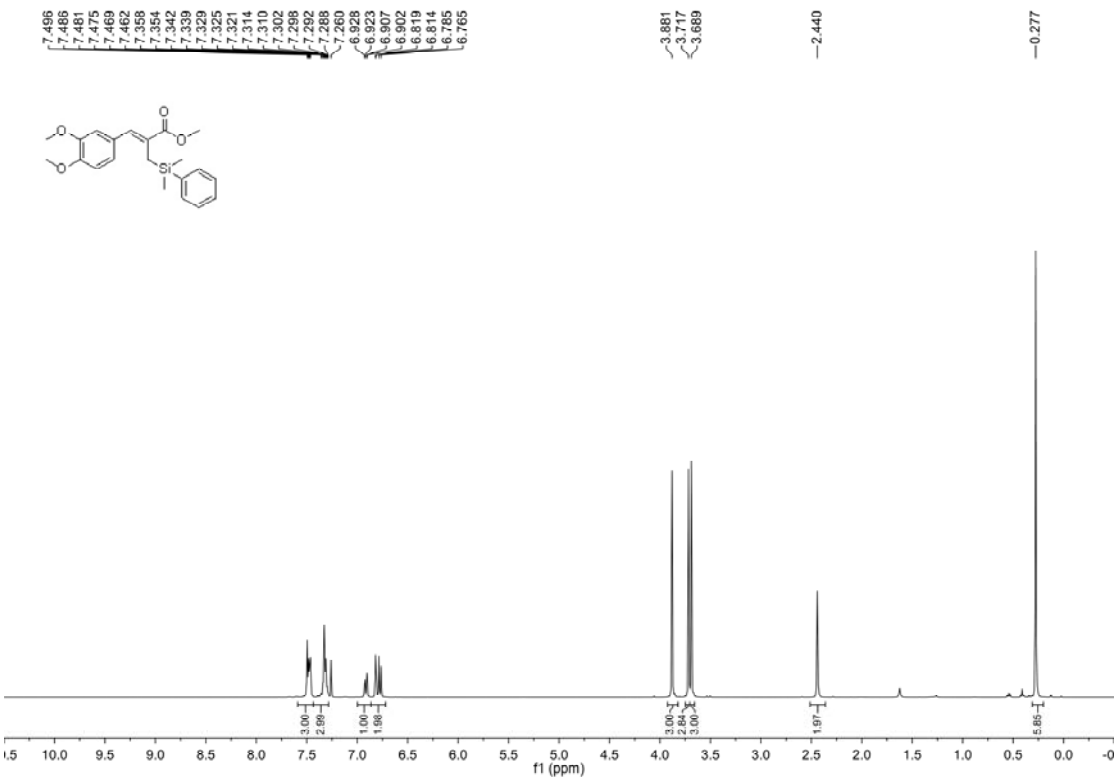
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5n**



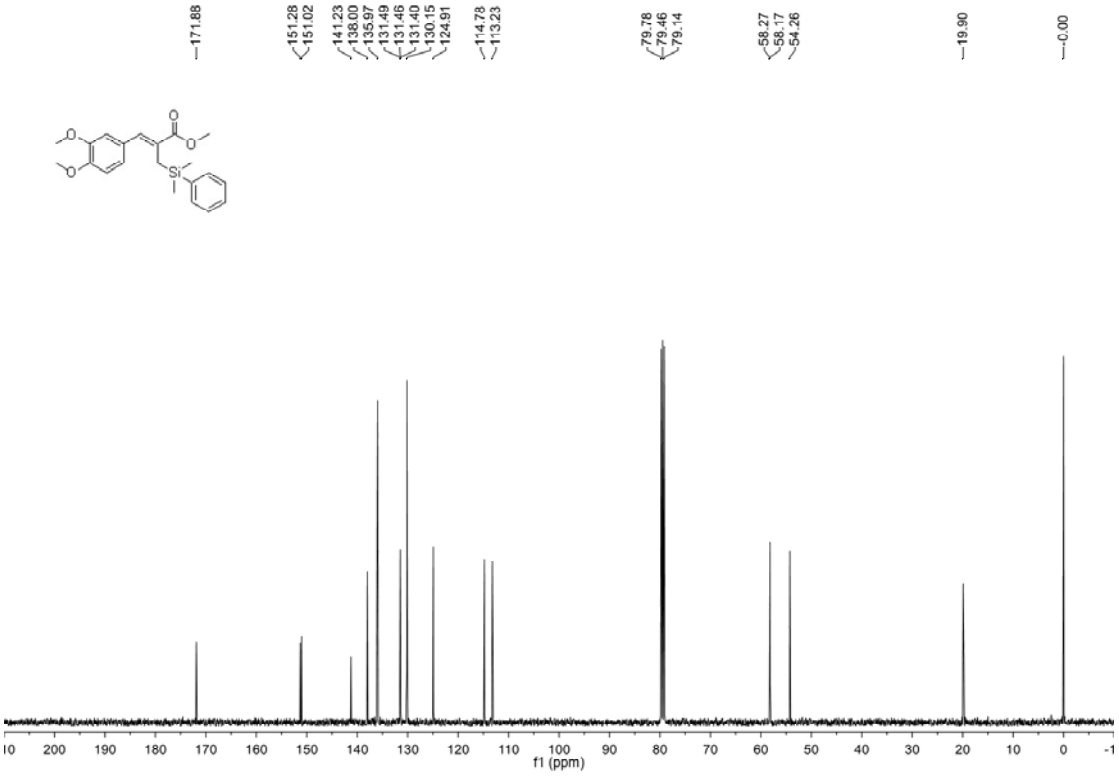
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5o**



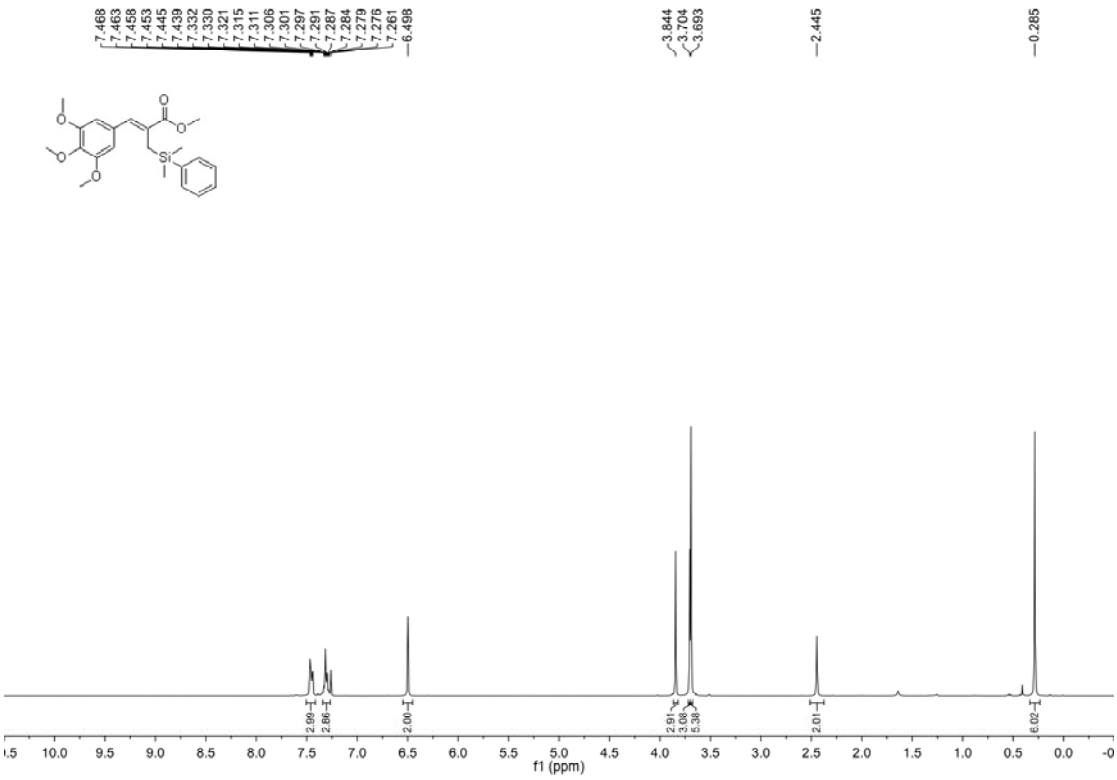
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5o**



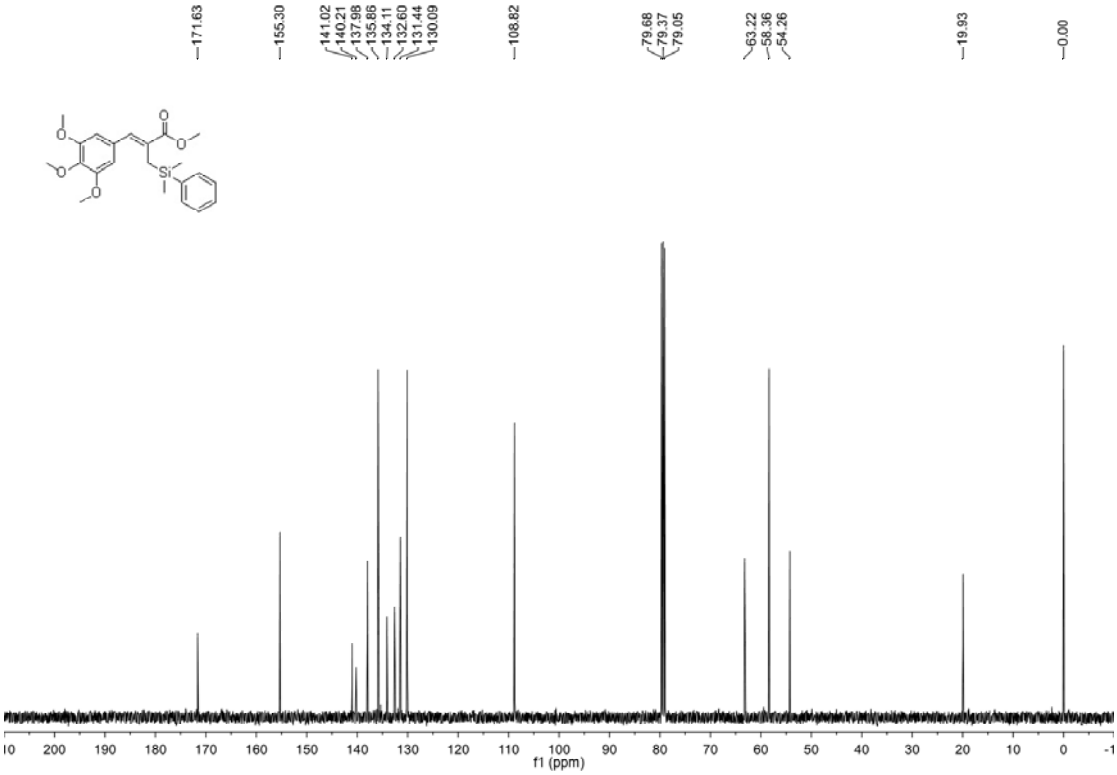
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5p**



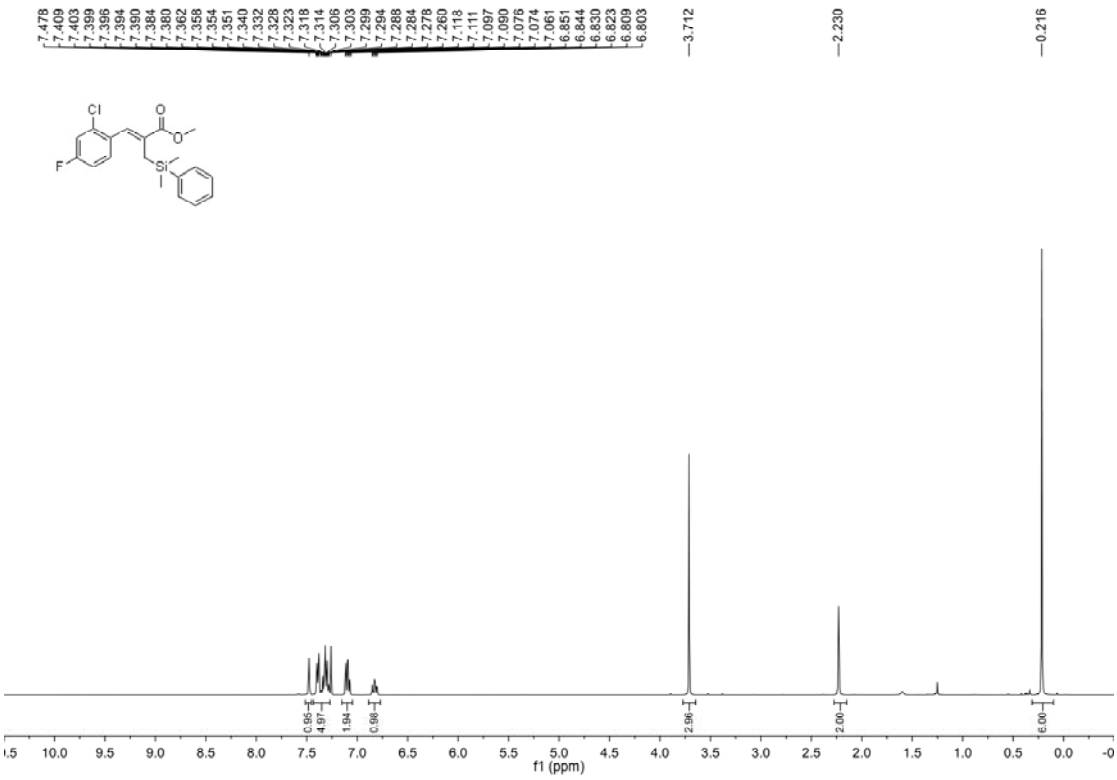
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5p**



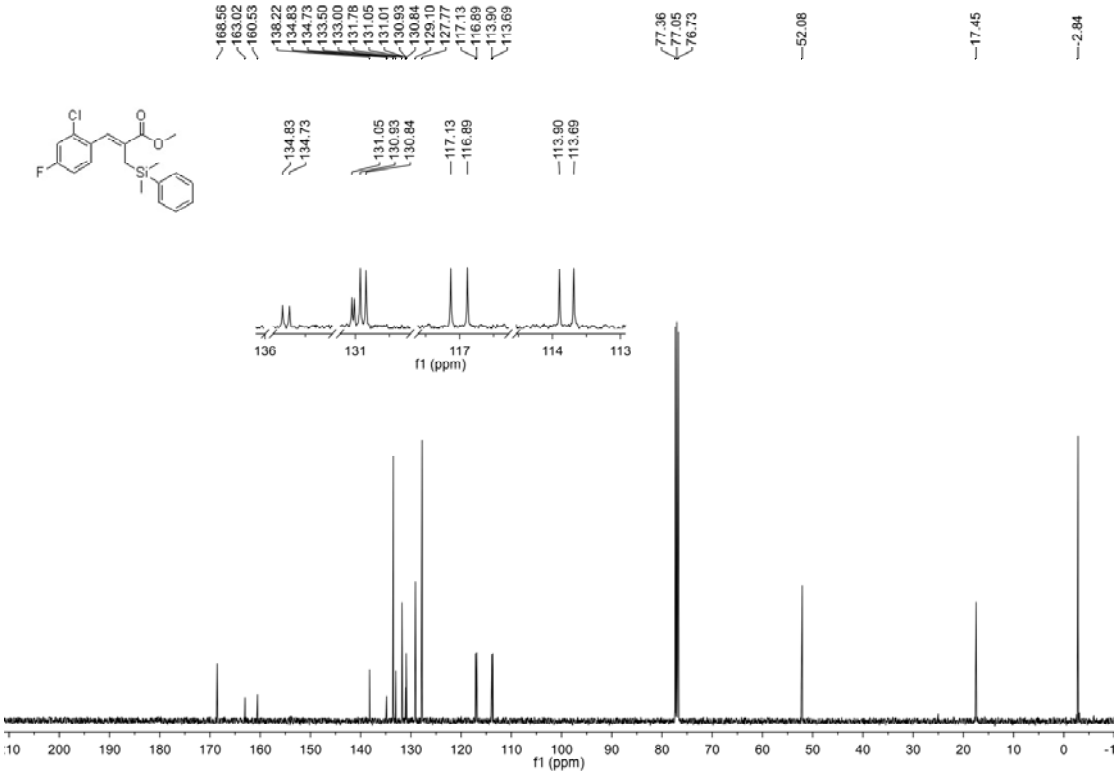
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5q**



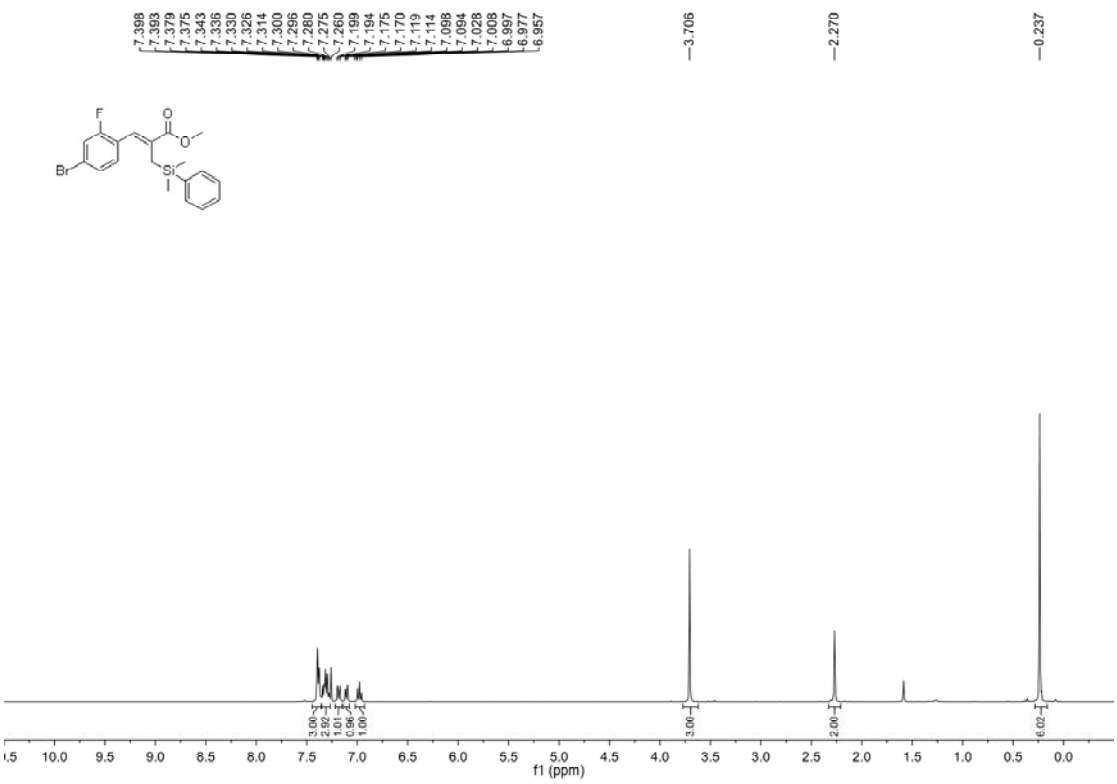
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5q**



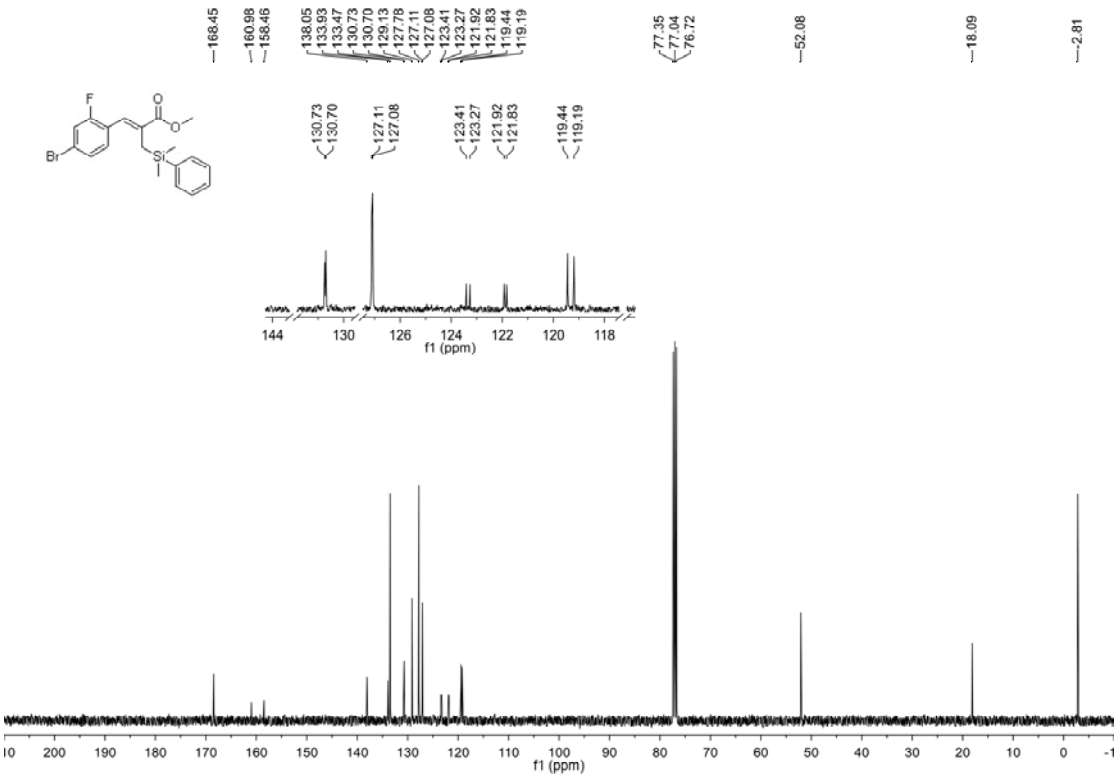
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5r**



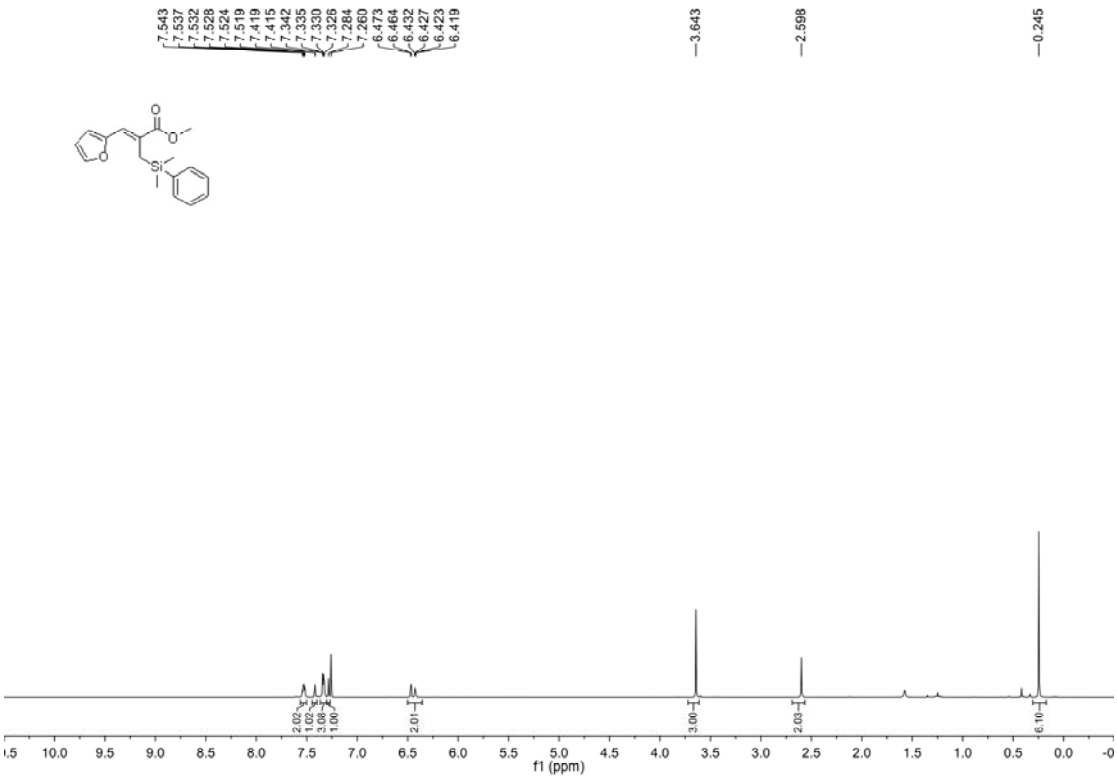
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **5r**



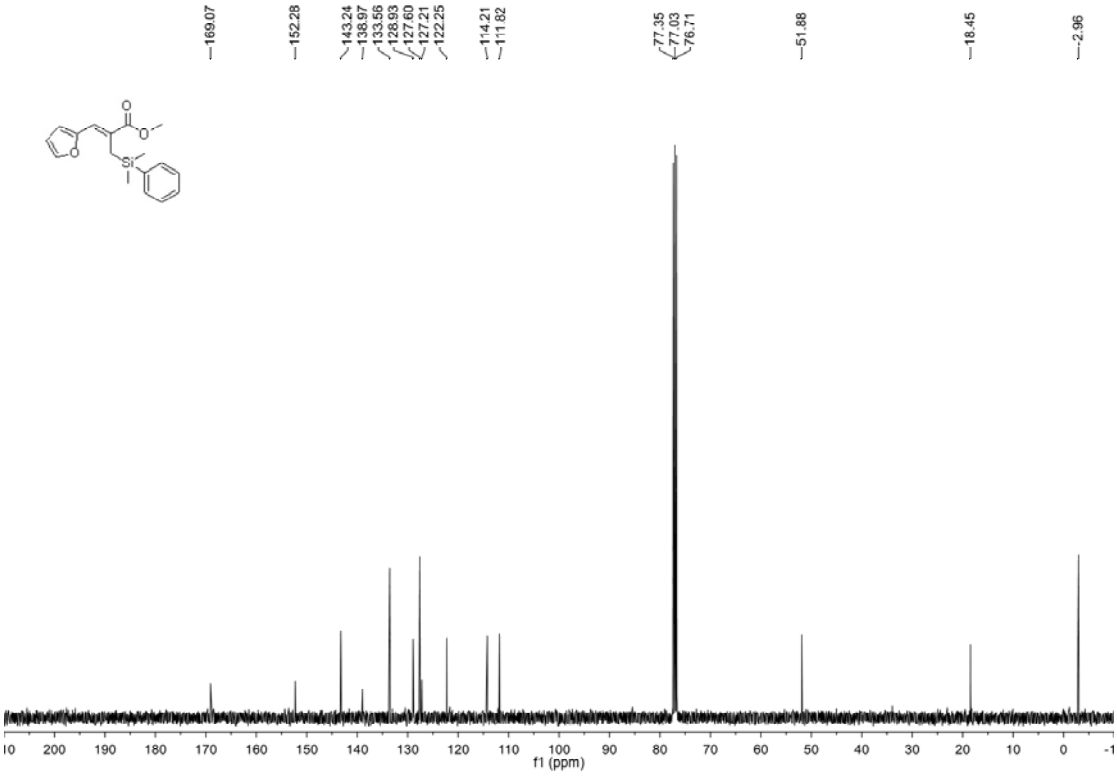
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5s**



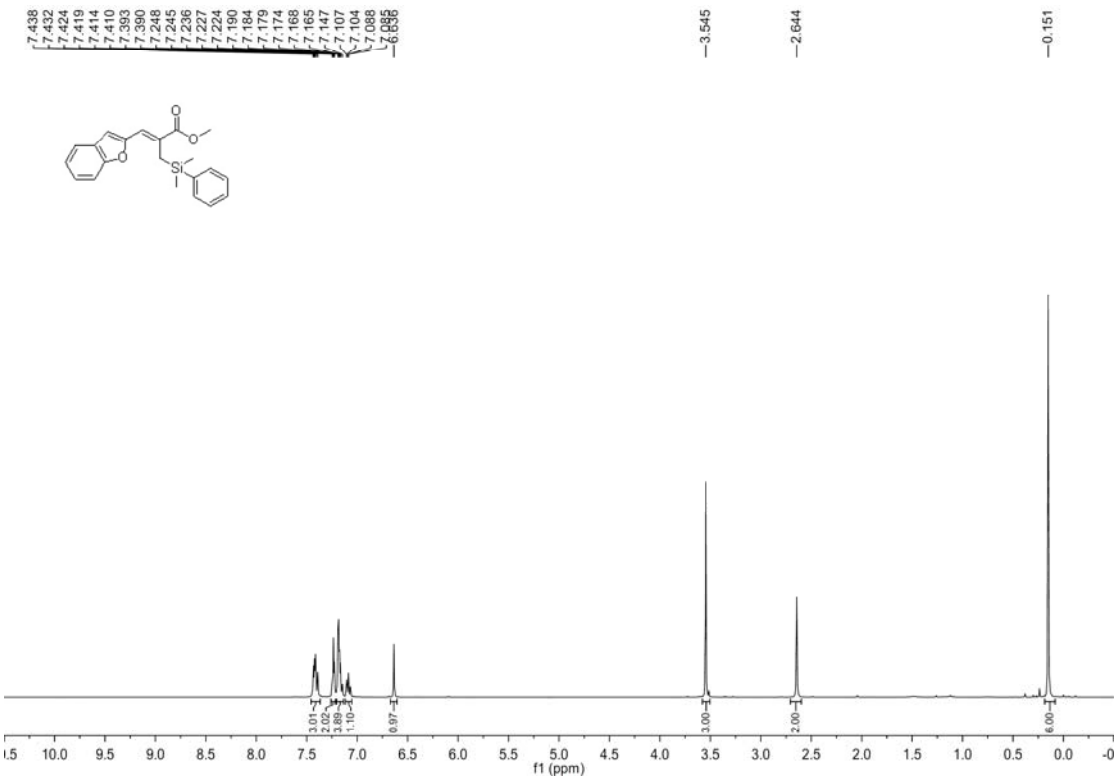
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **5s**



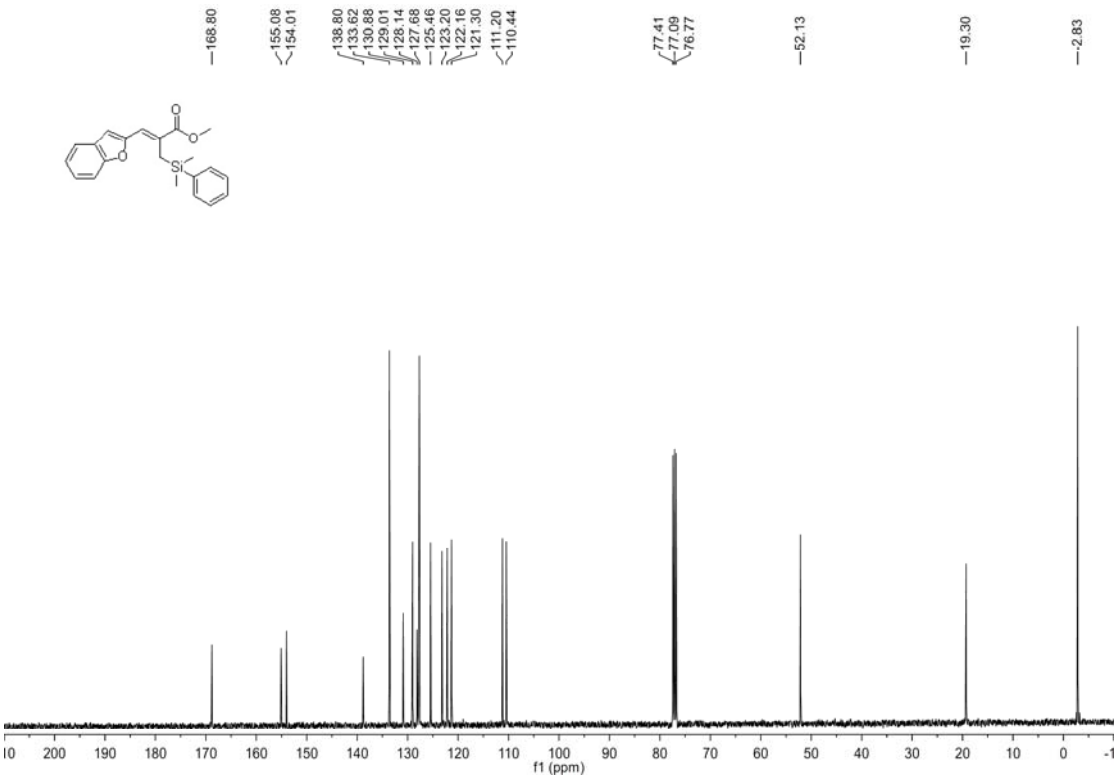
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5t**



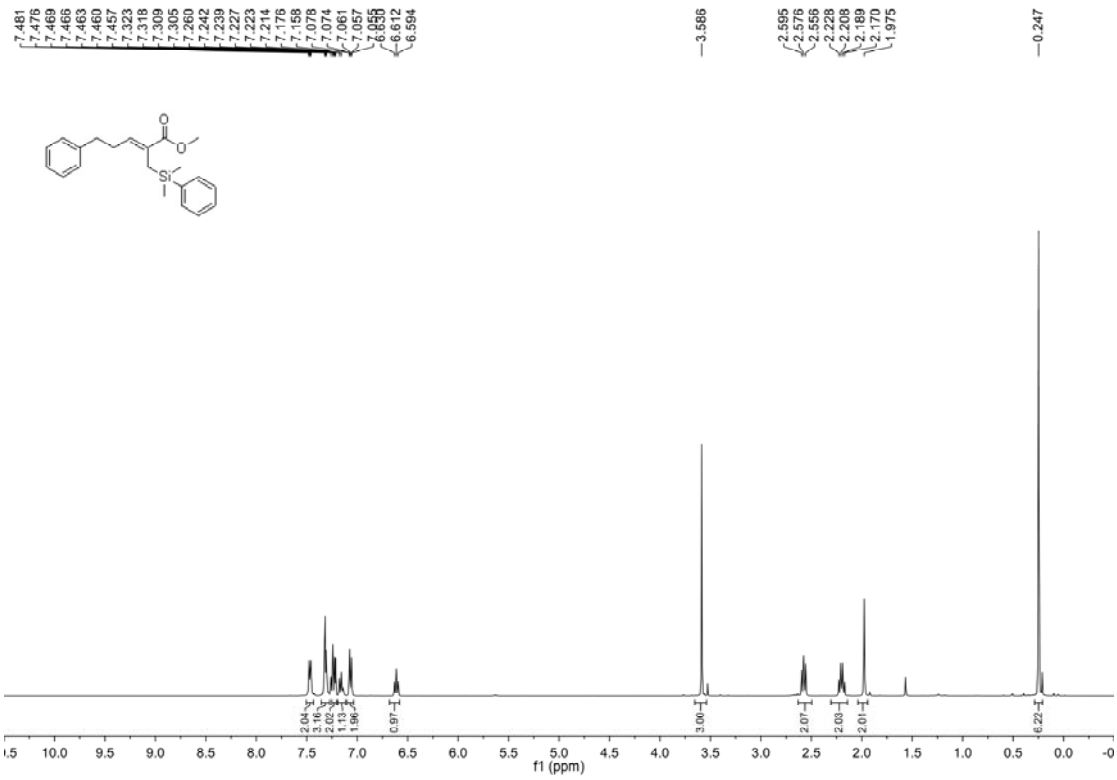
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5t**



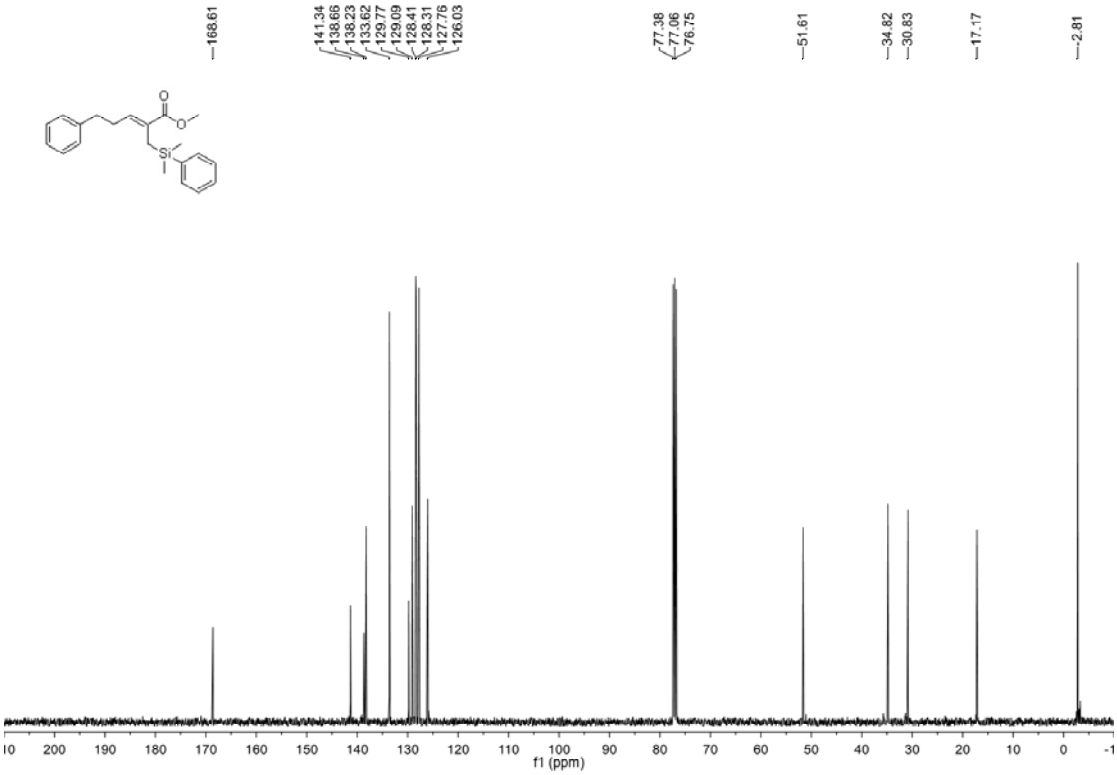
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5u**



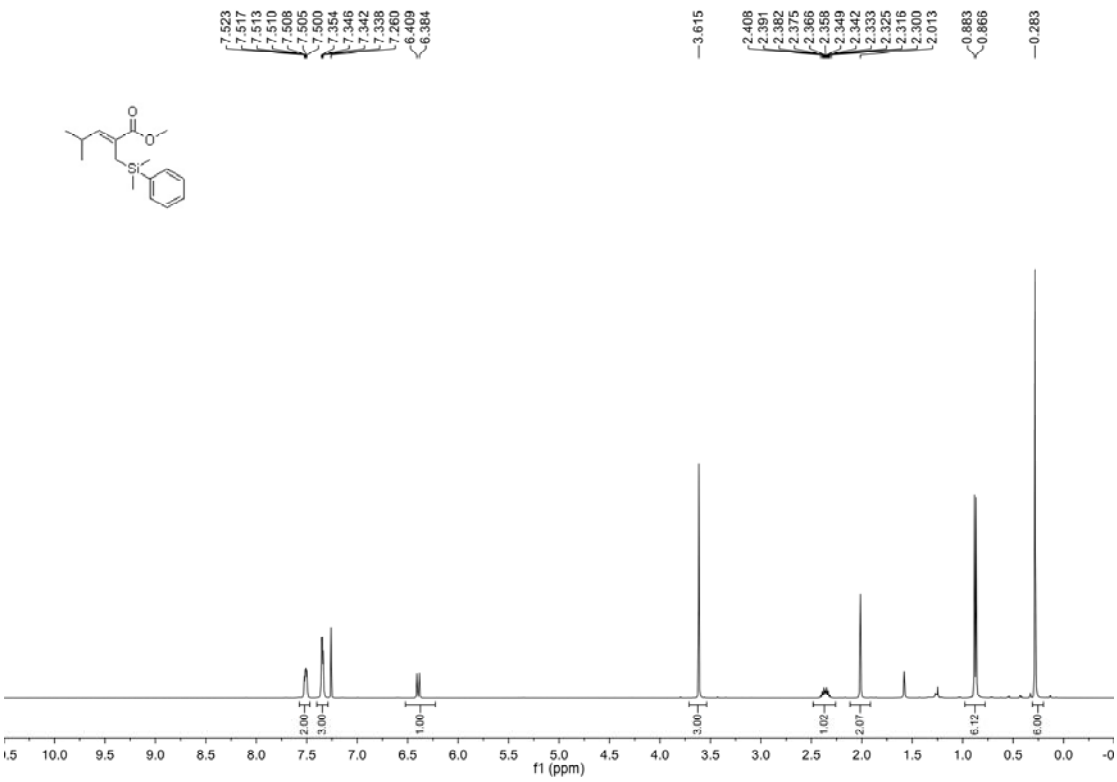
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5u**



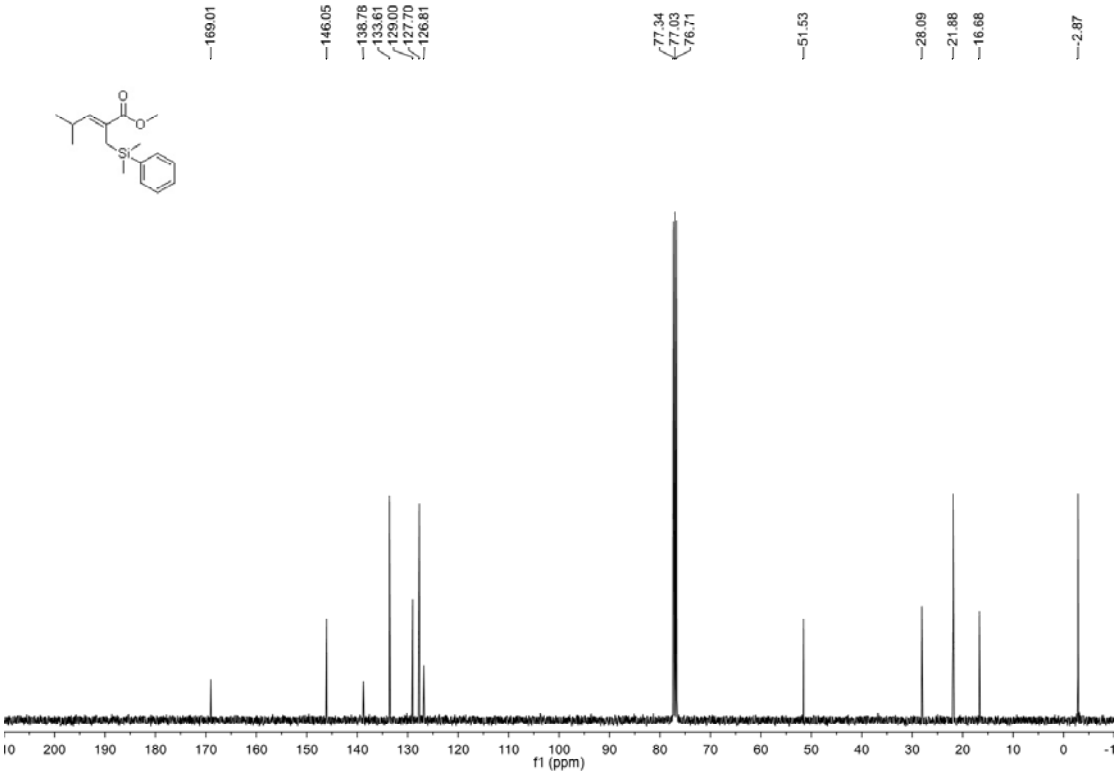
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5v**



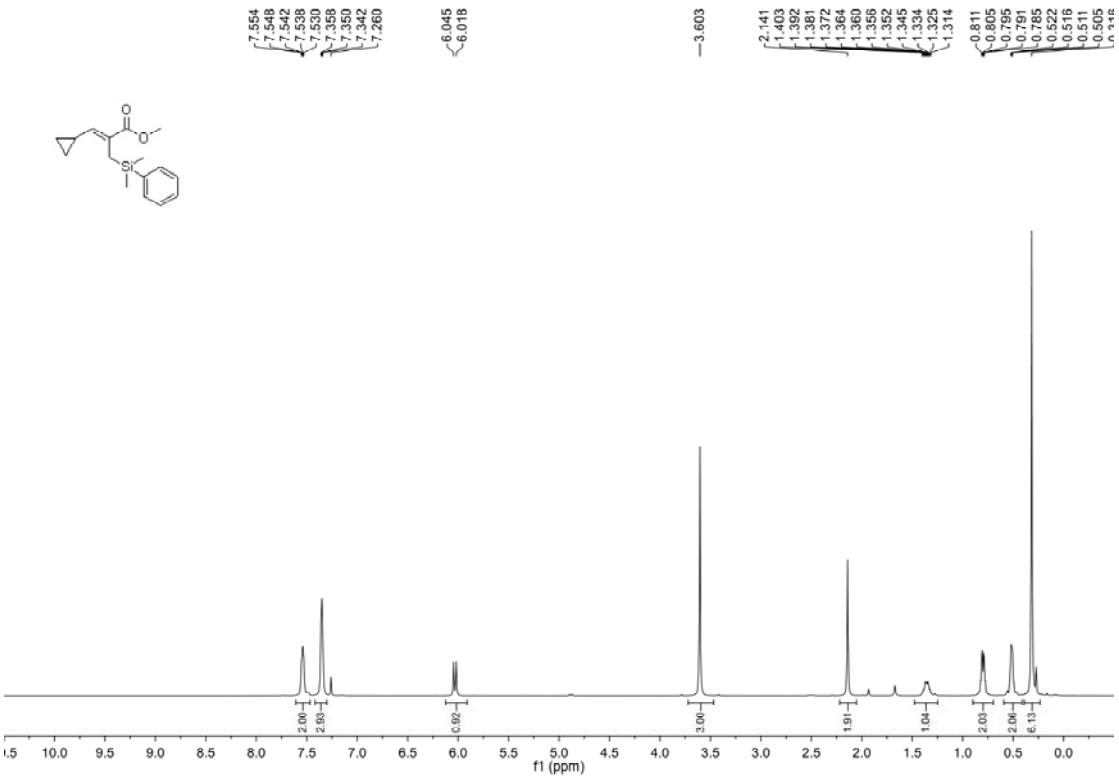
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5v**



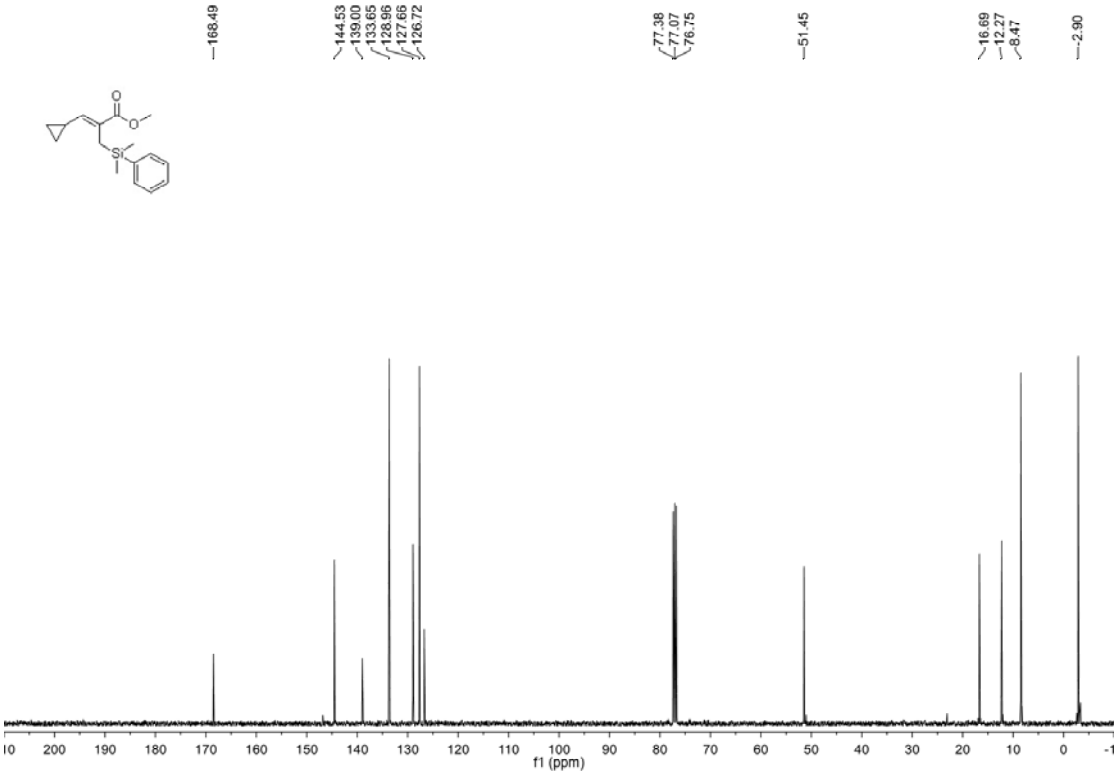
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5w**



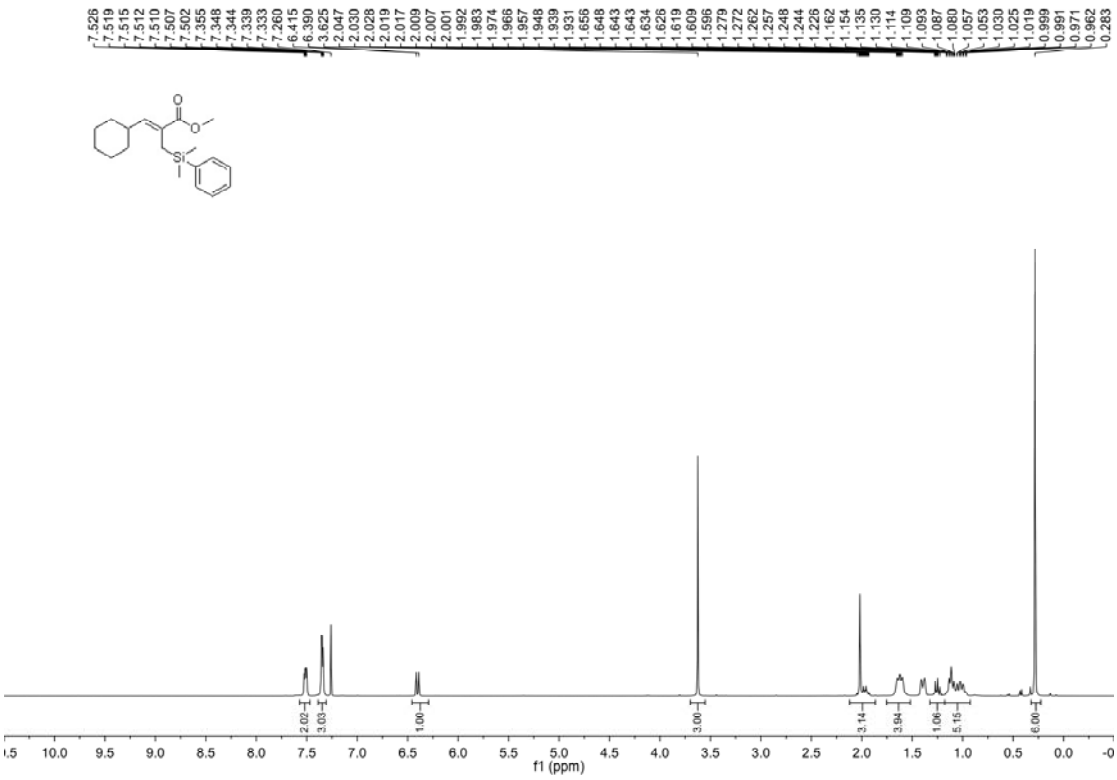
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **5w**



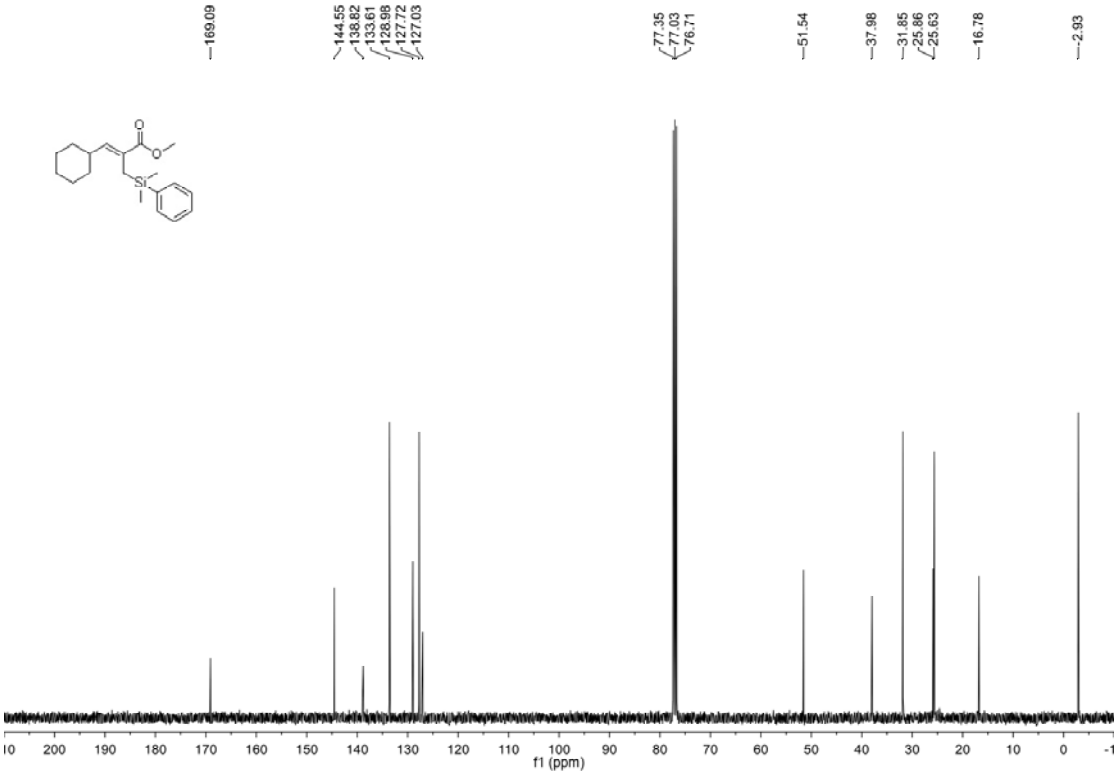
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5x**



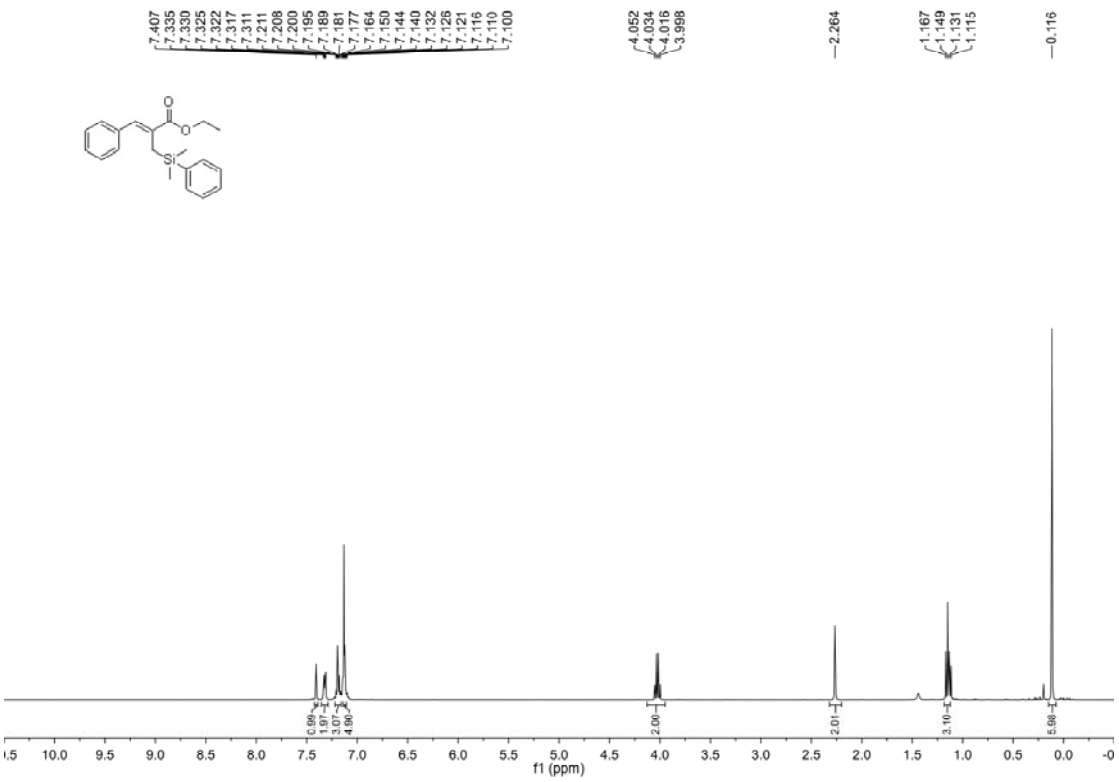
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5x**



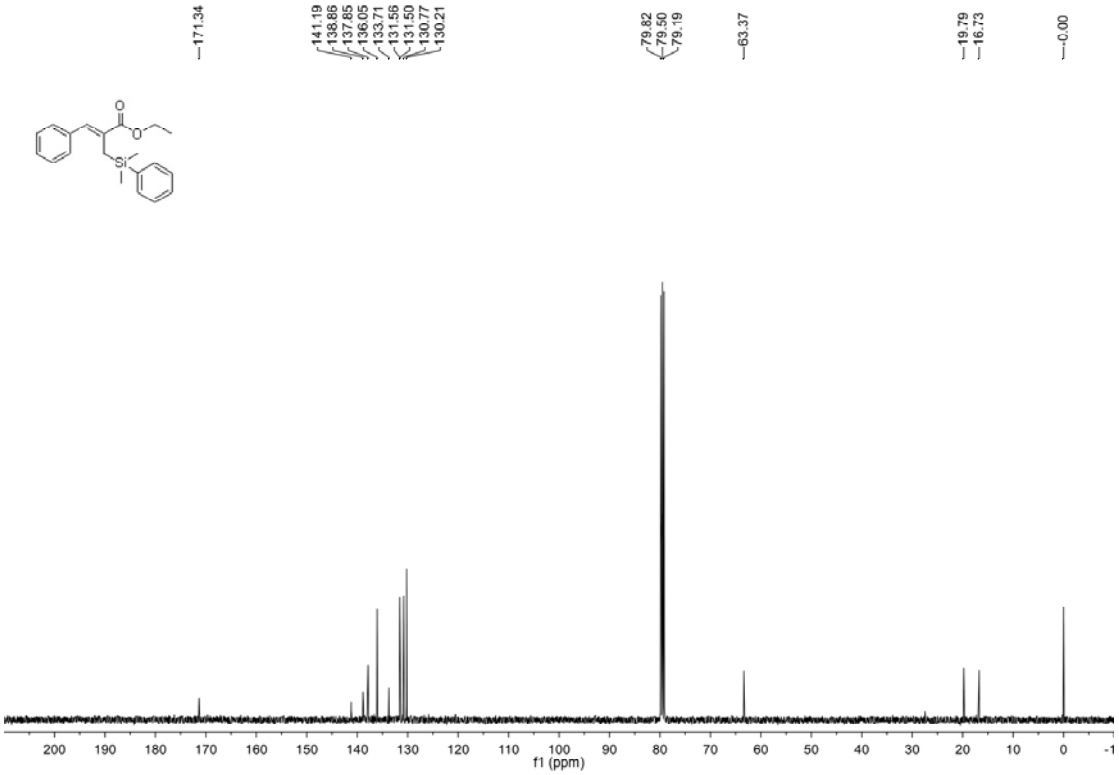
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5y**



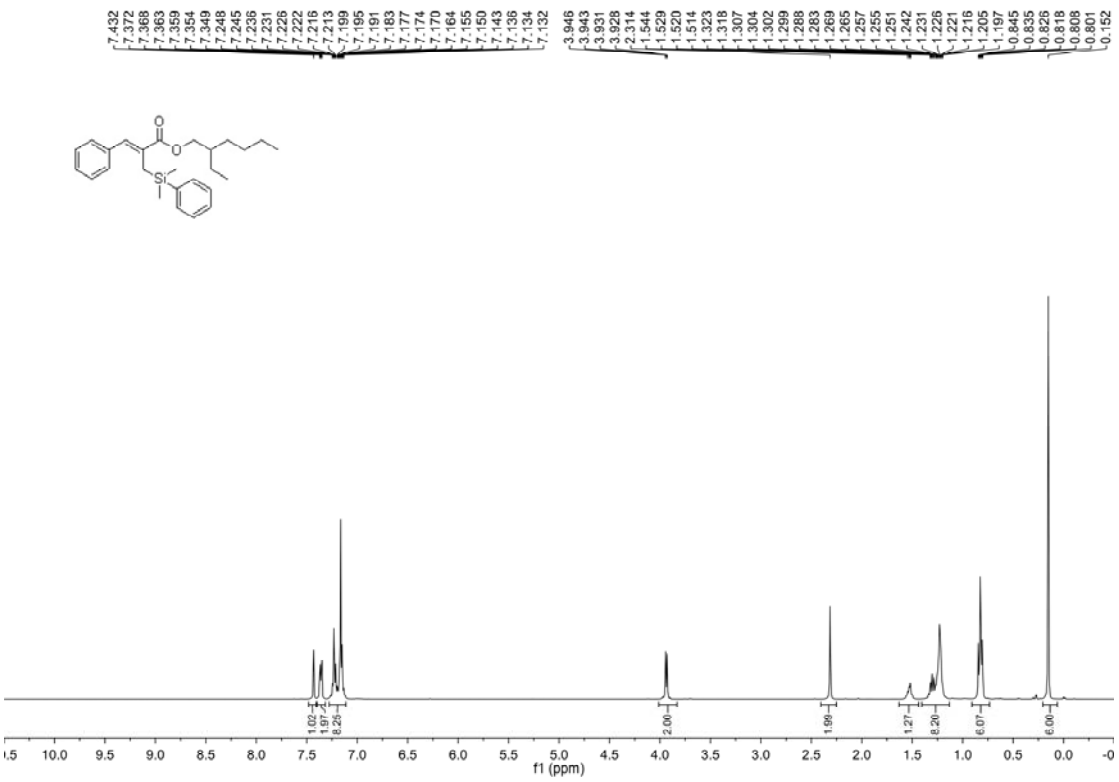
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5y**



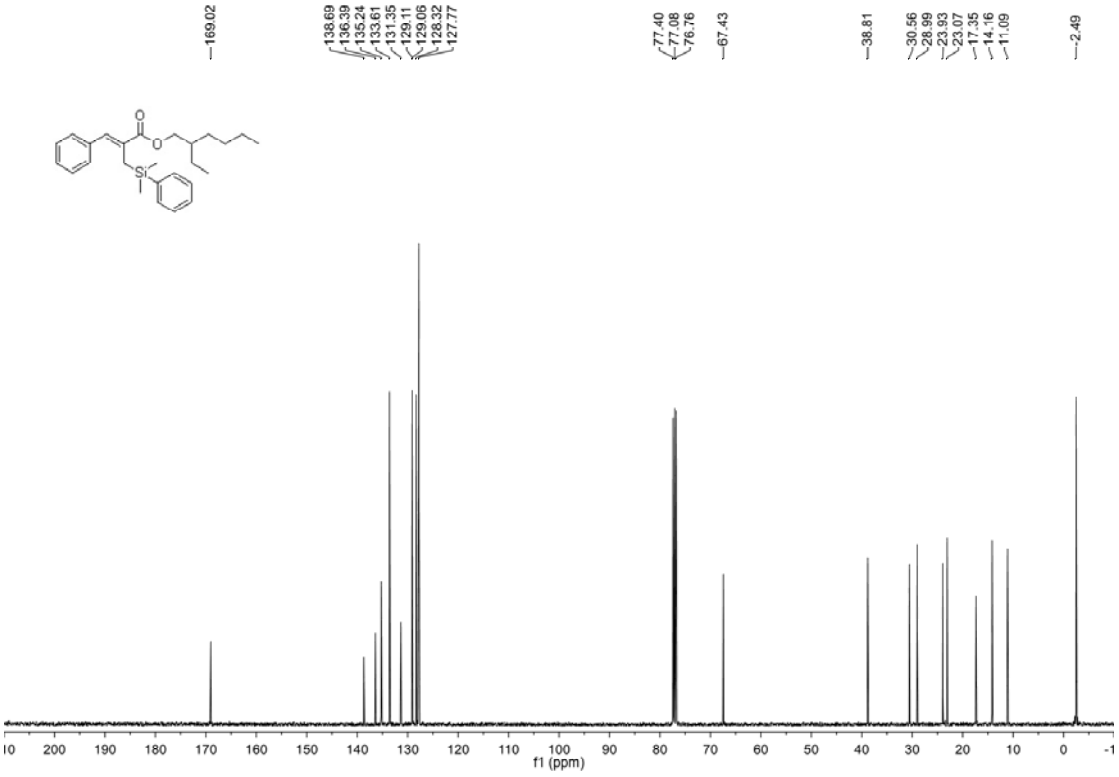
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5z**



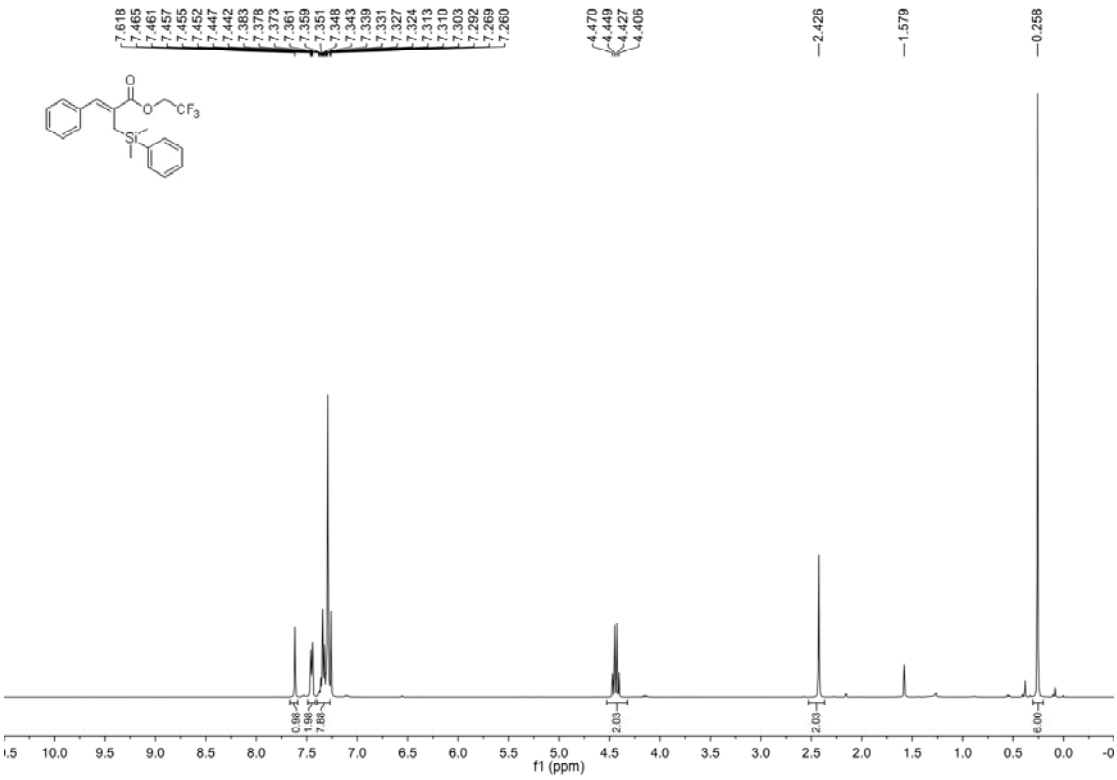
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5z**



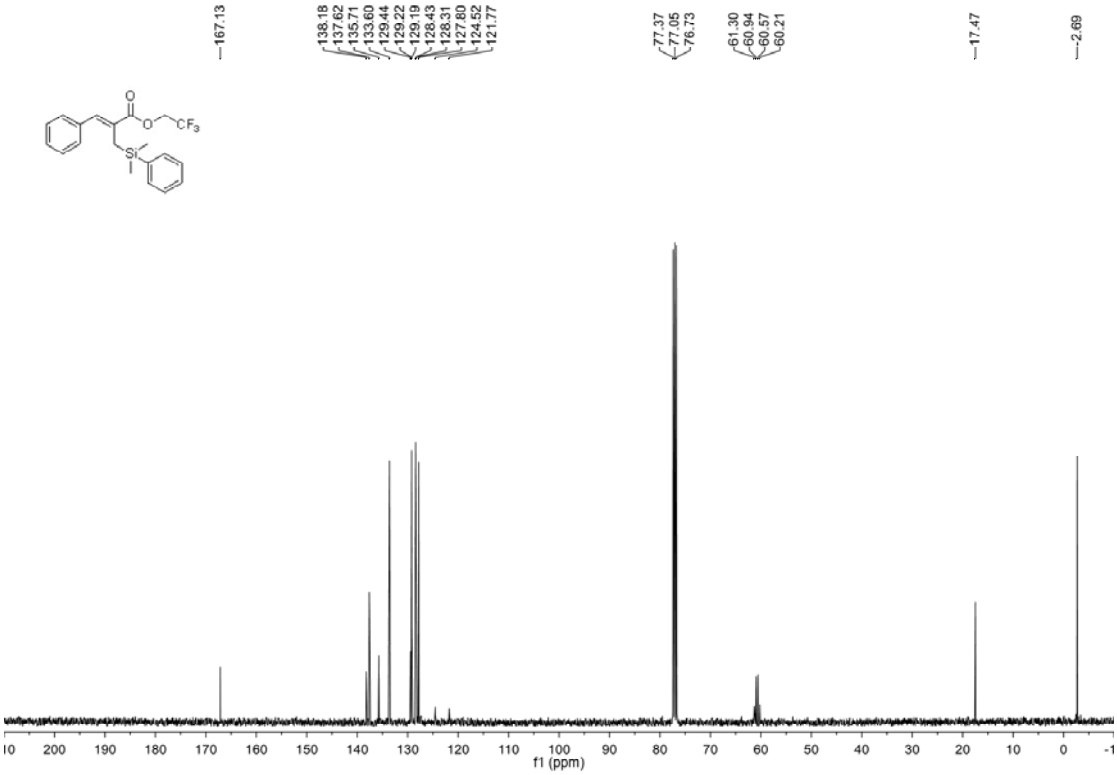
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5A**



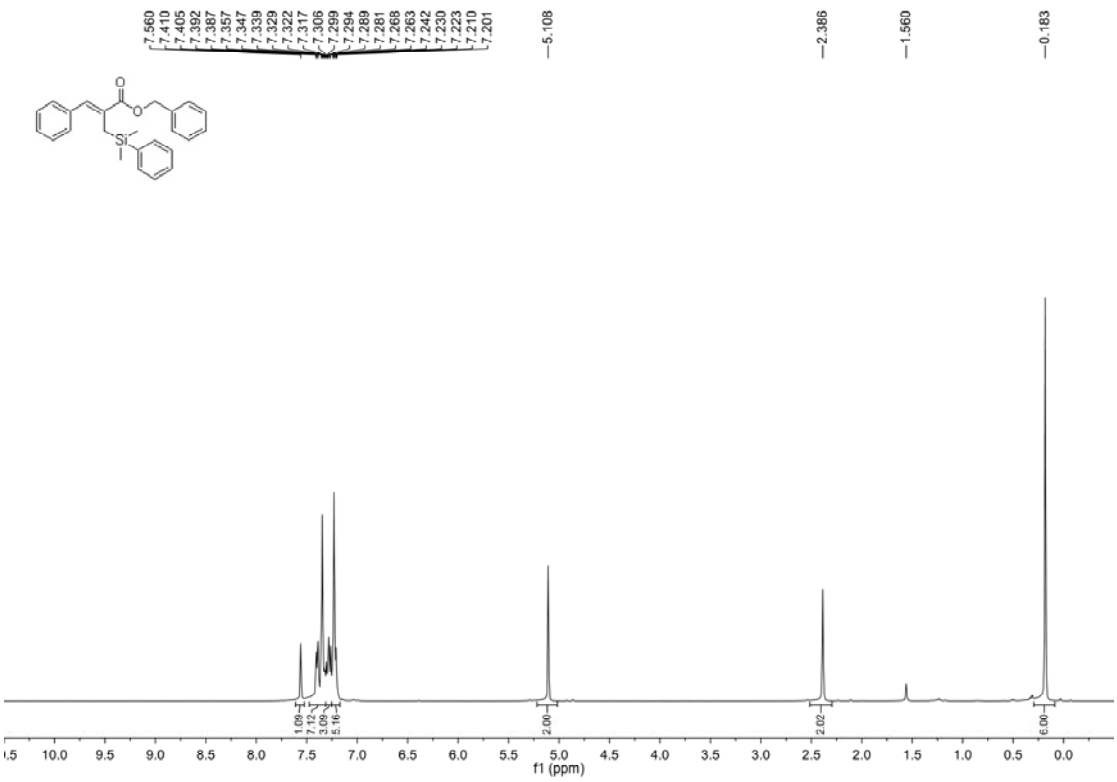
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5A**



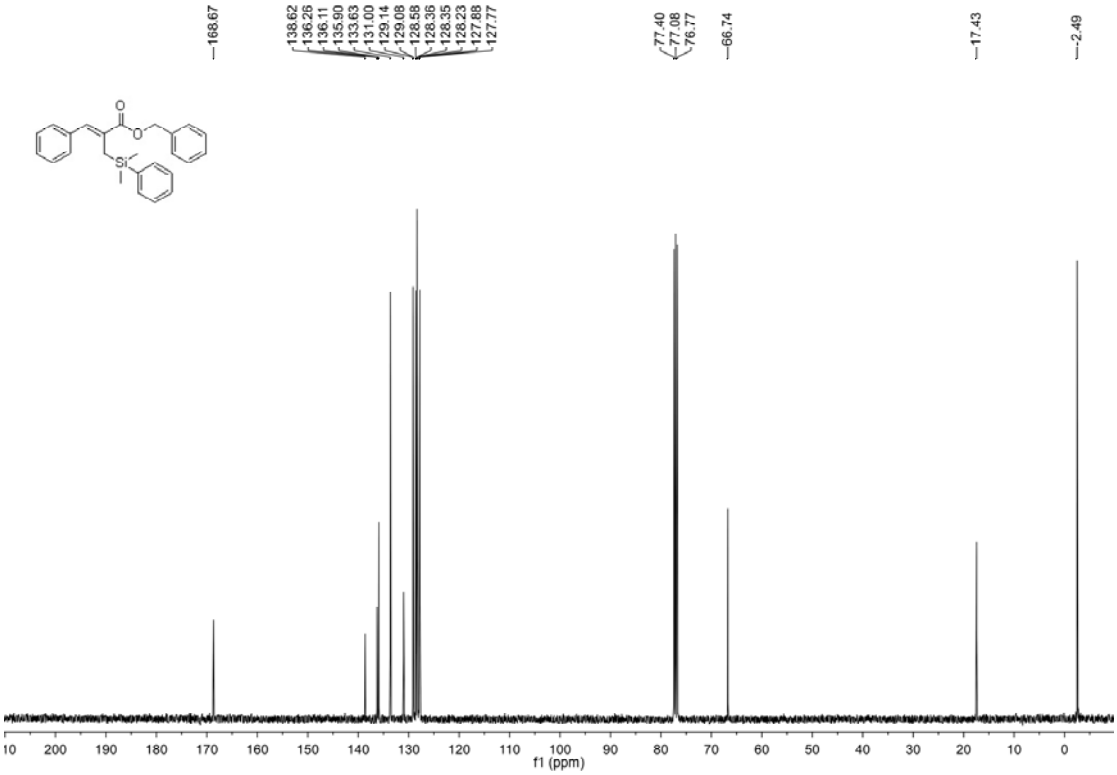
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5C**



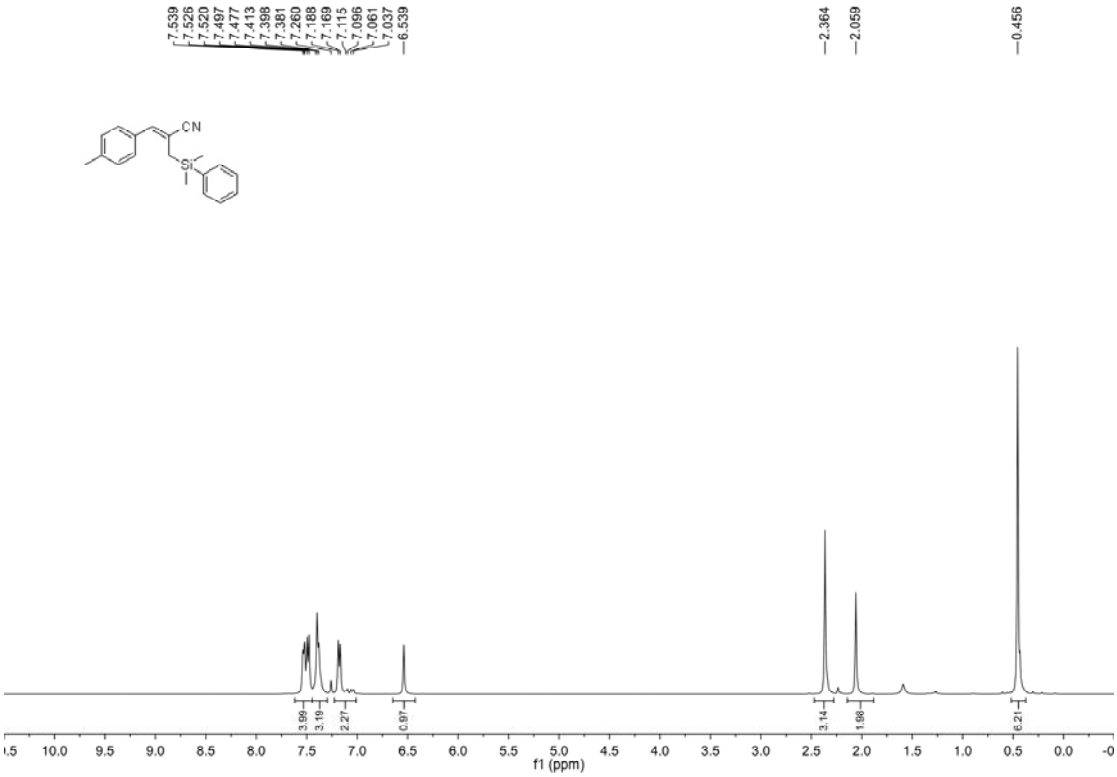
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5C**



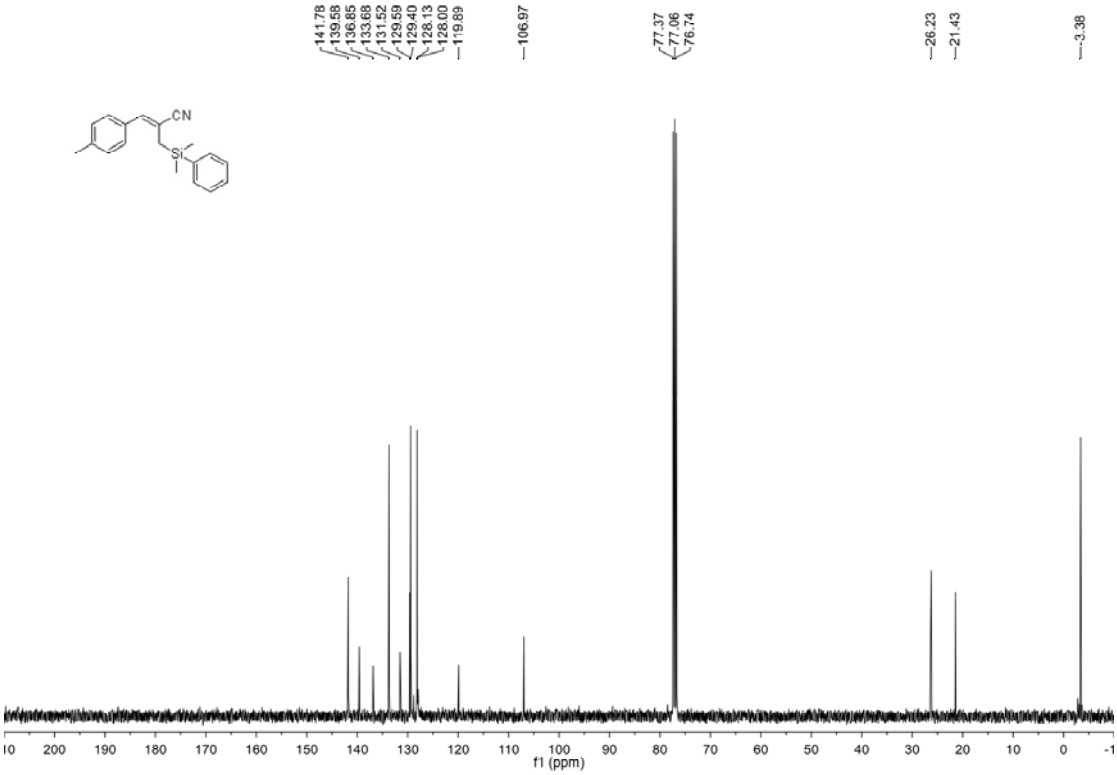
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5C**



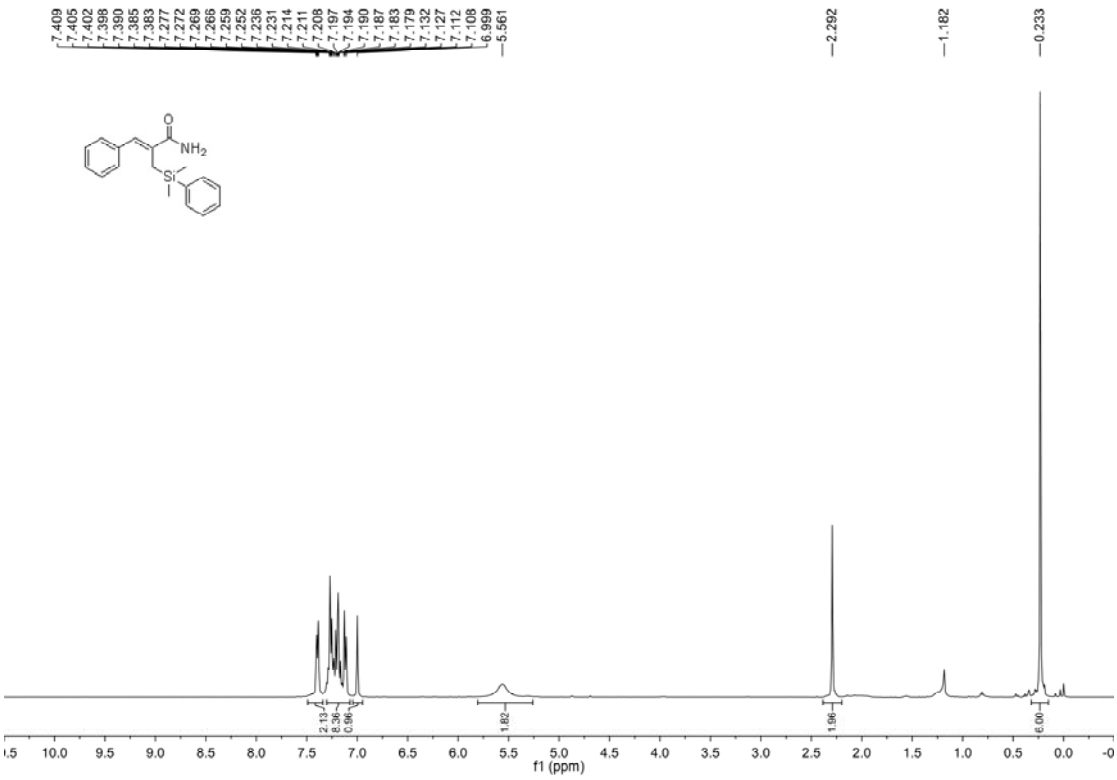
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5C**



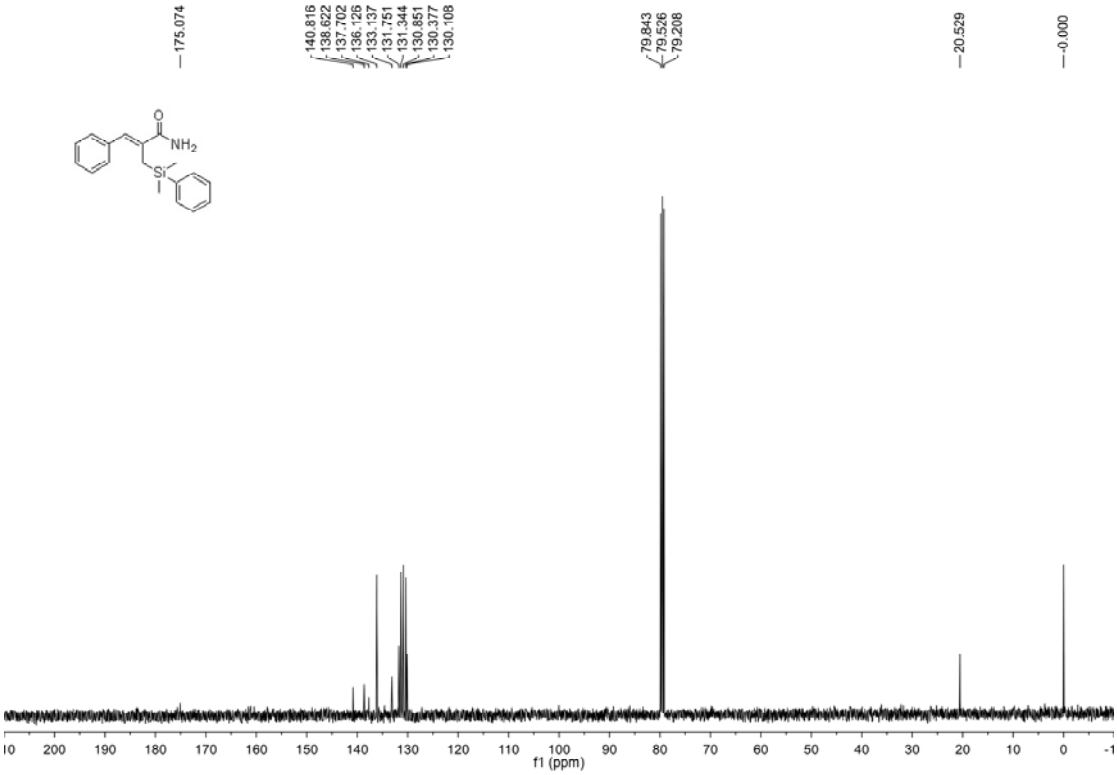
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5D**



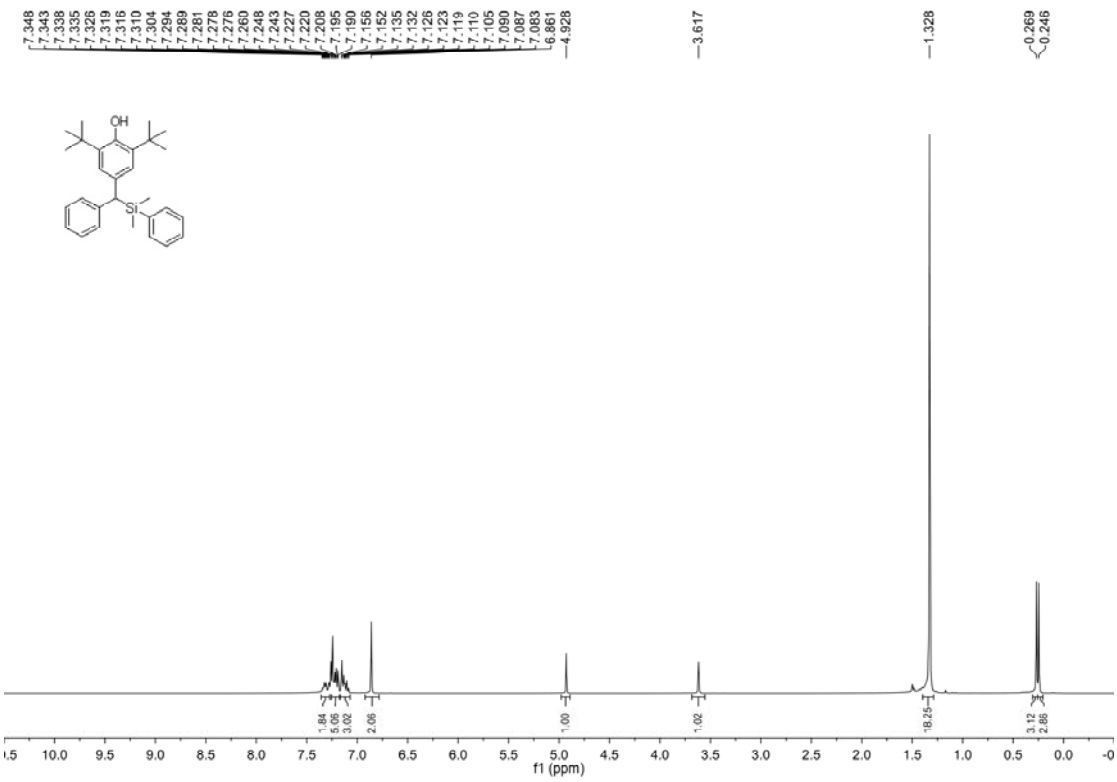
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5D**



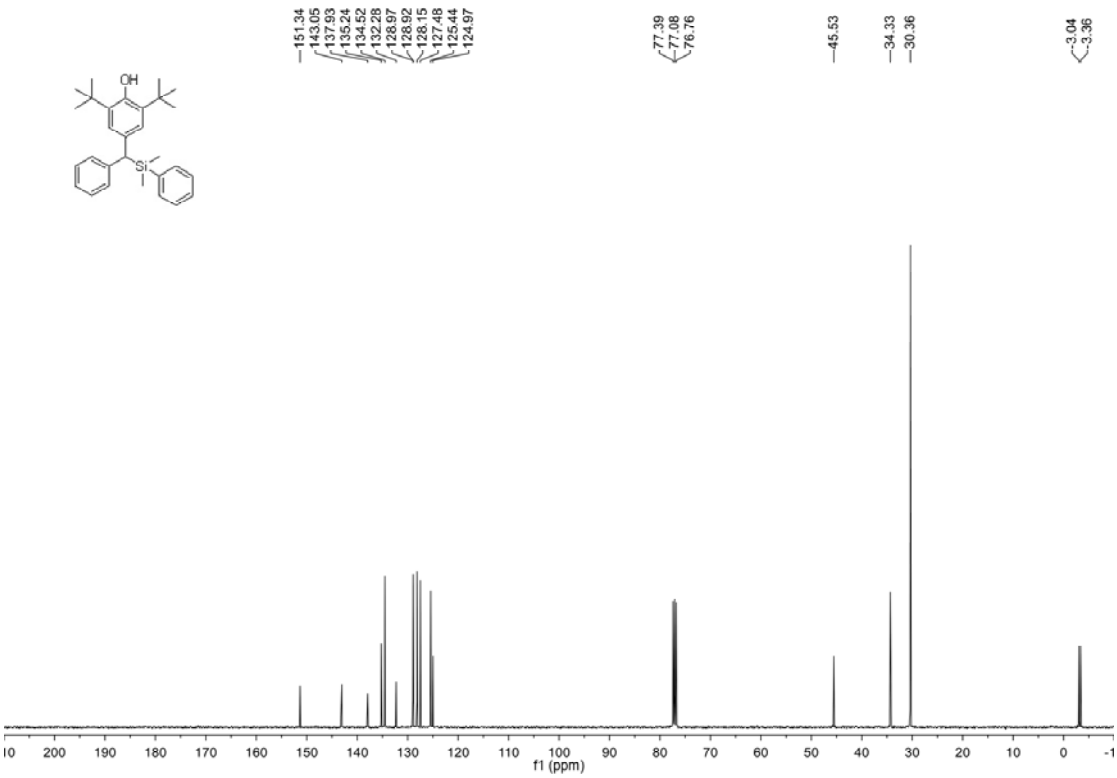
^{1}H NMR (400 MHz, $CDCl_3$) of compound **5E**



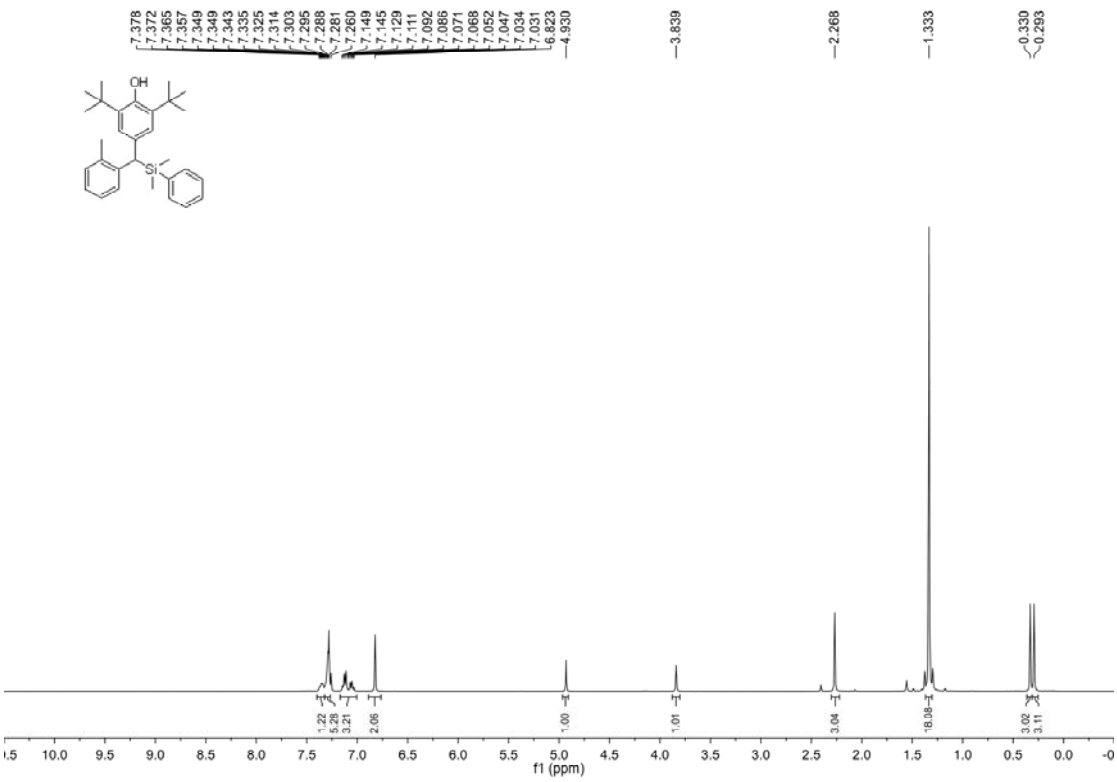
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **5E**



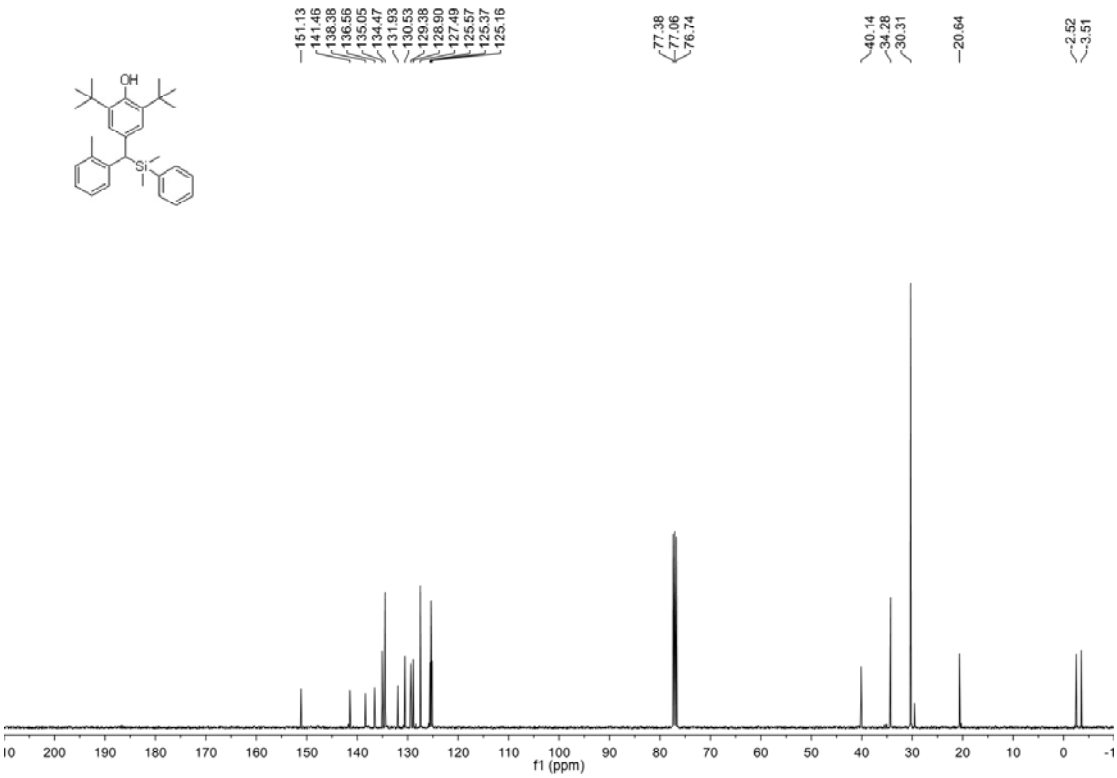
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7a**



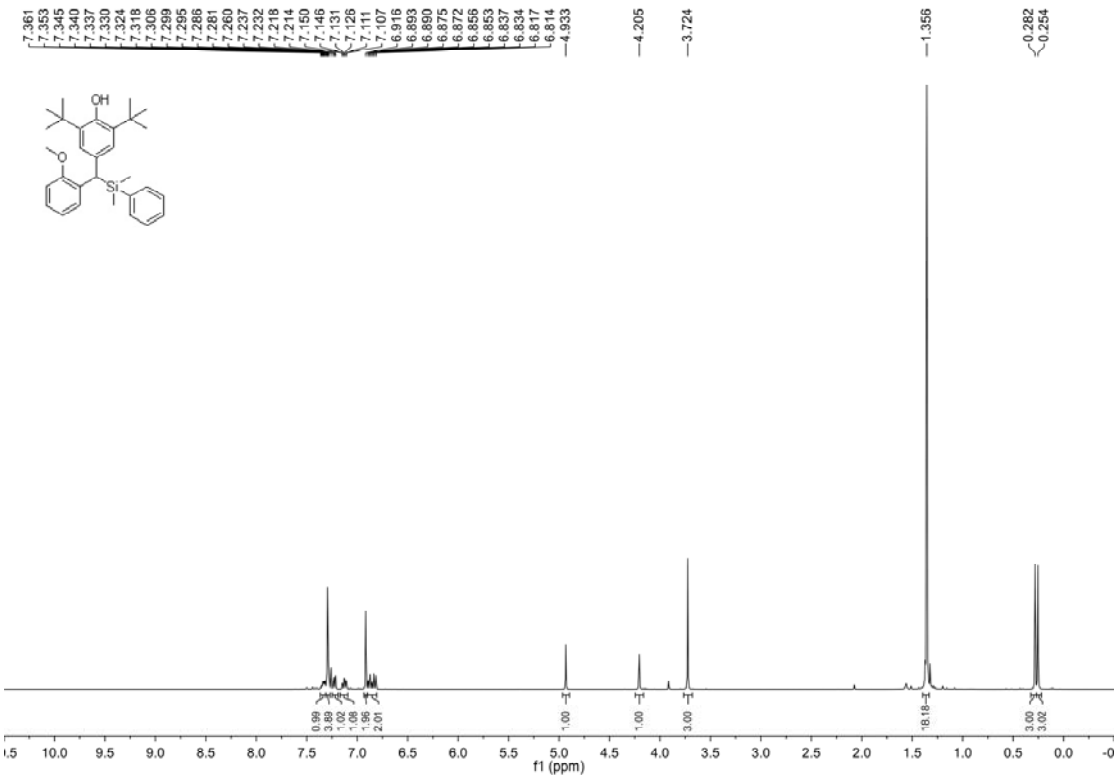
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7a**



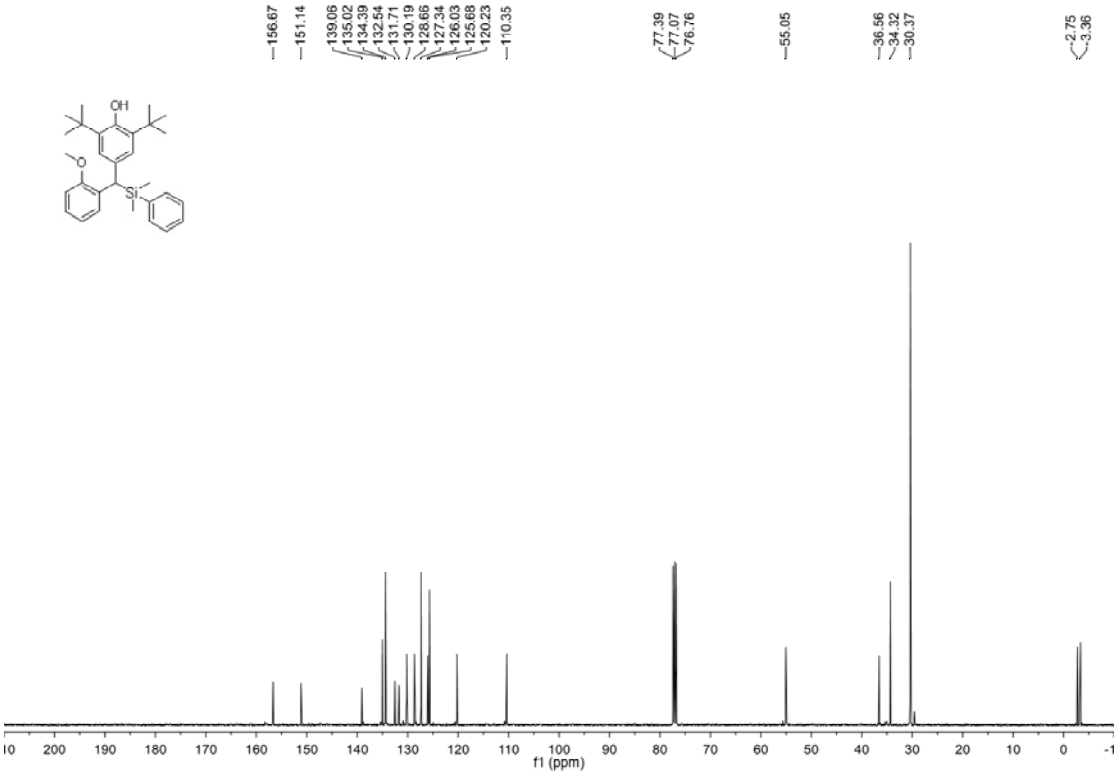
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7b**



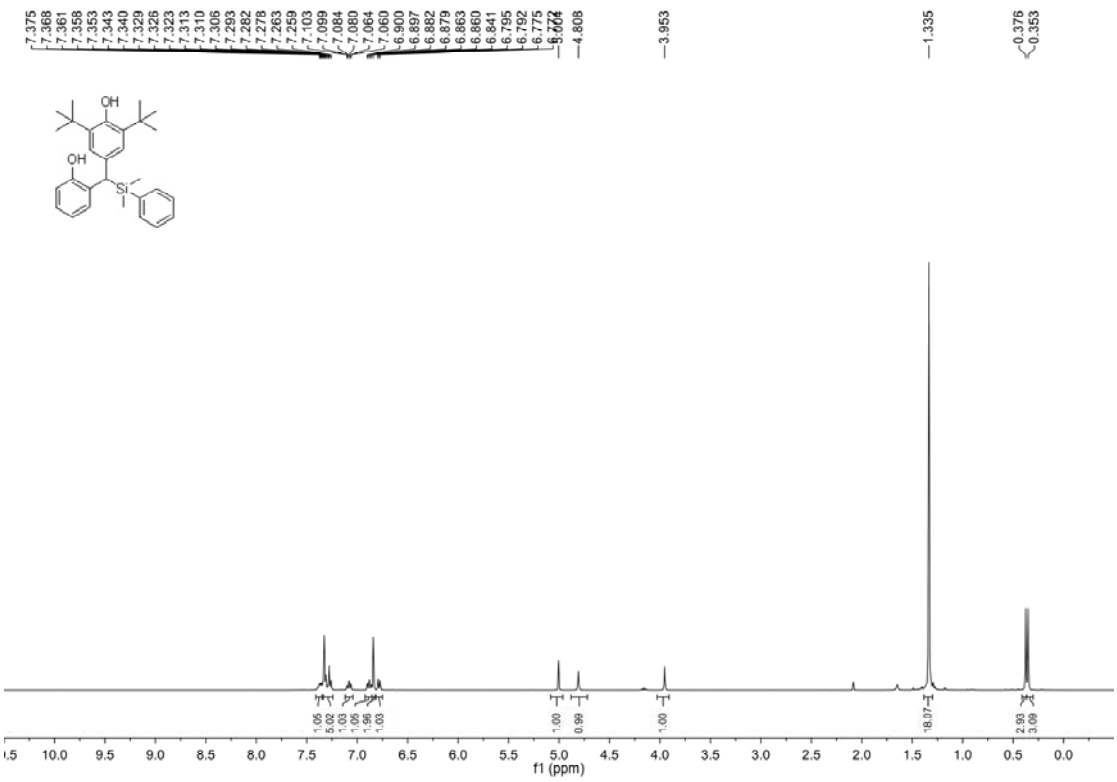
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7b**



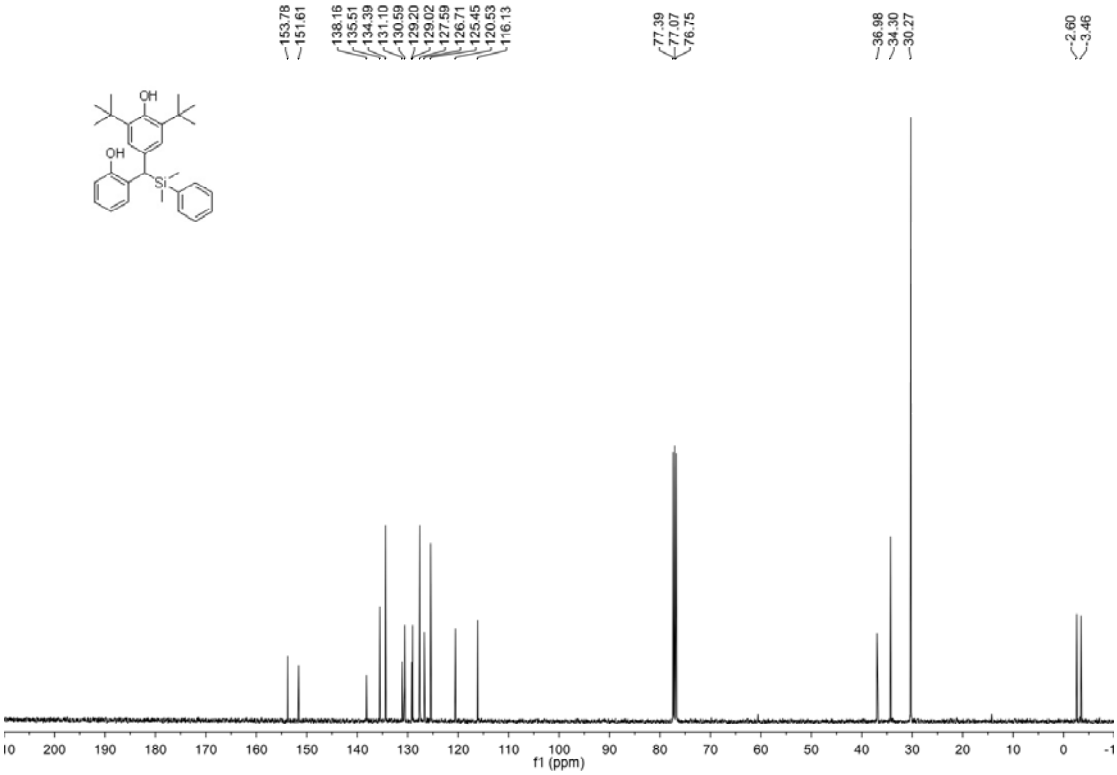
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7c**



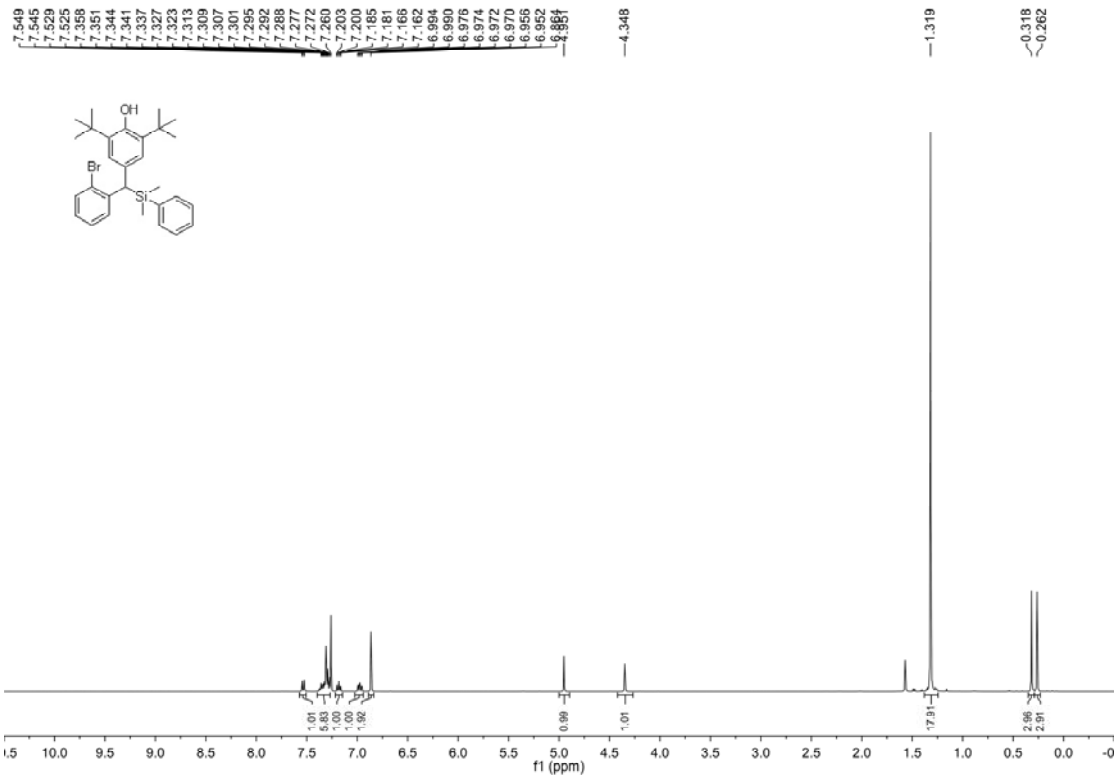
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7c**



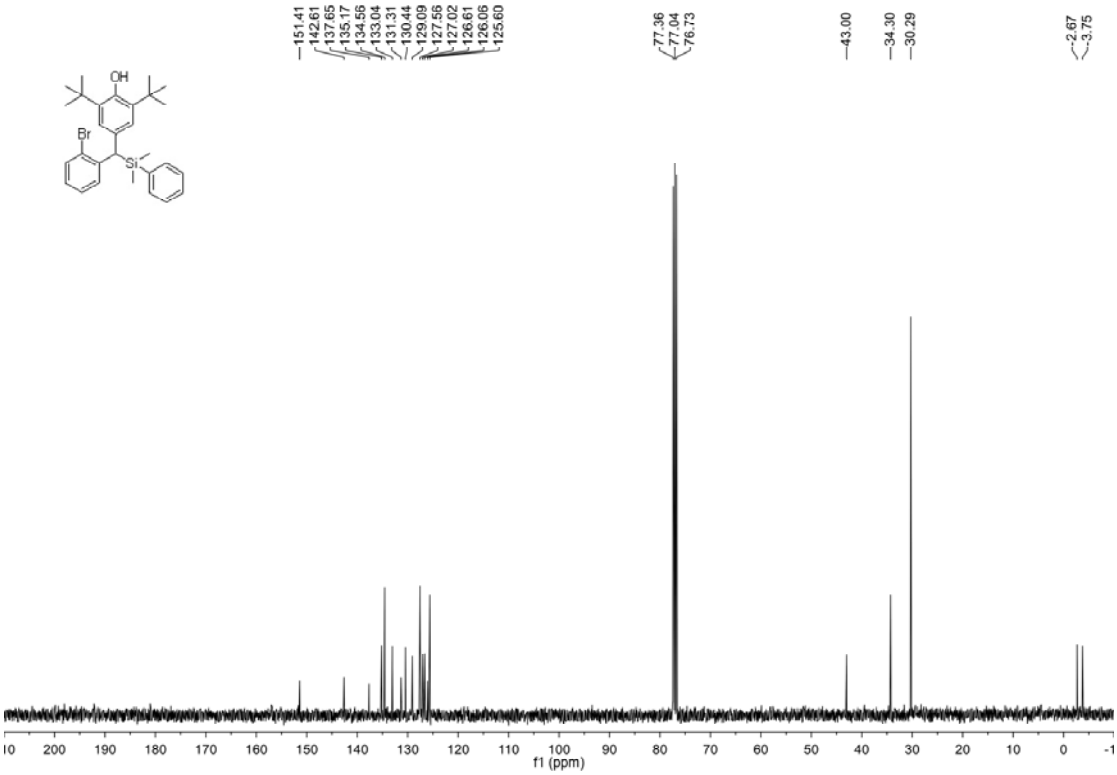
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7d**



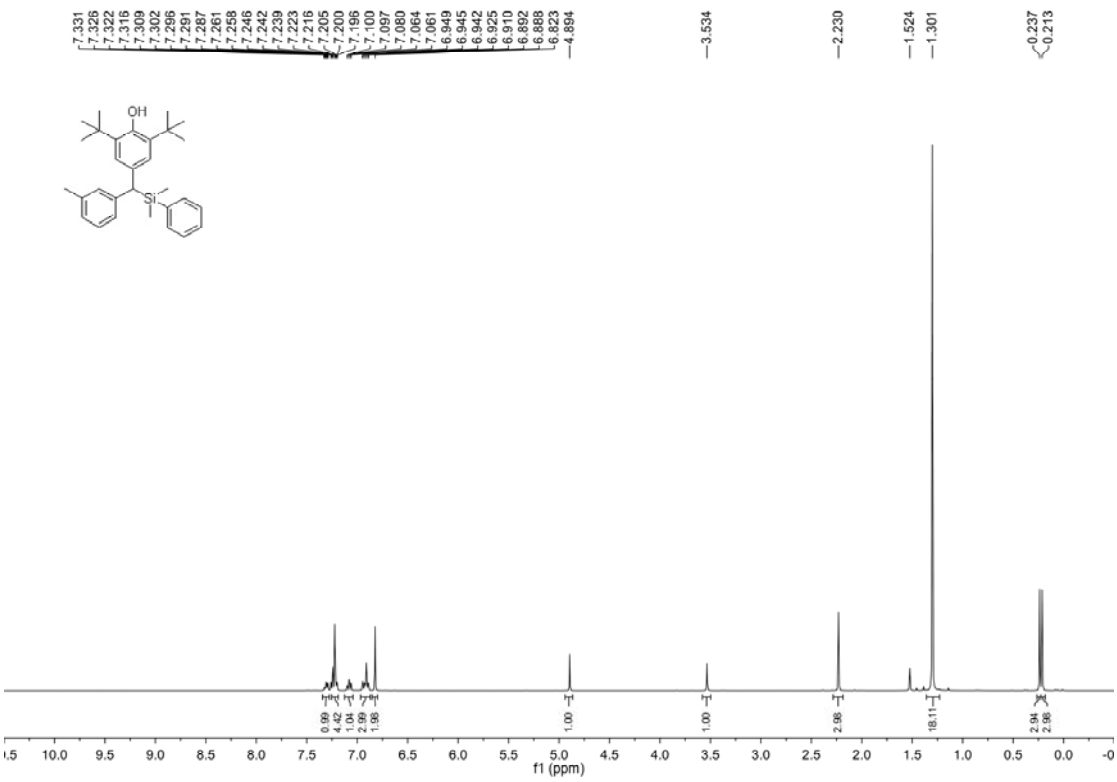
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7d**



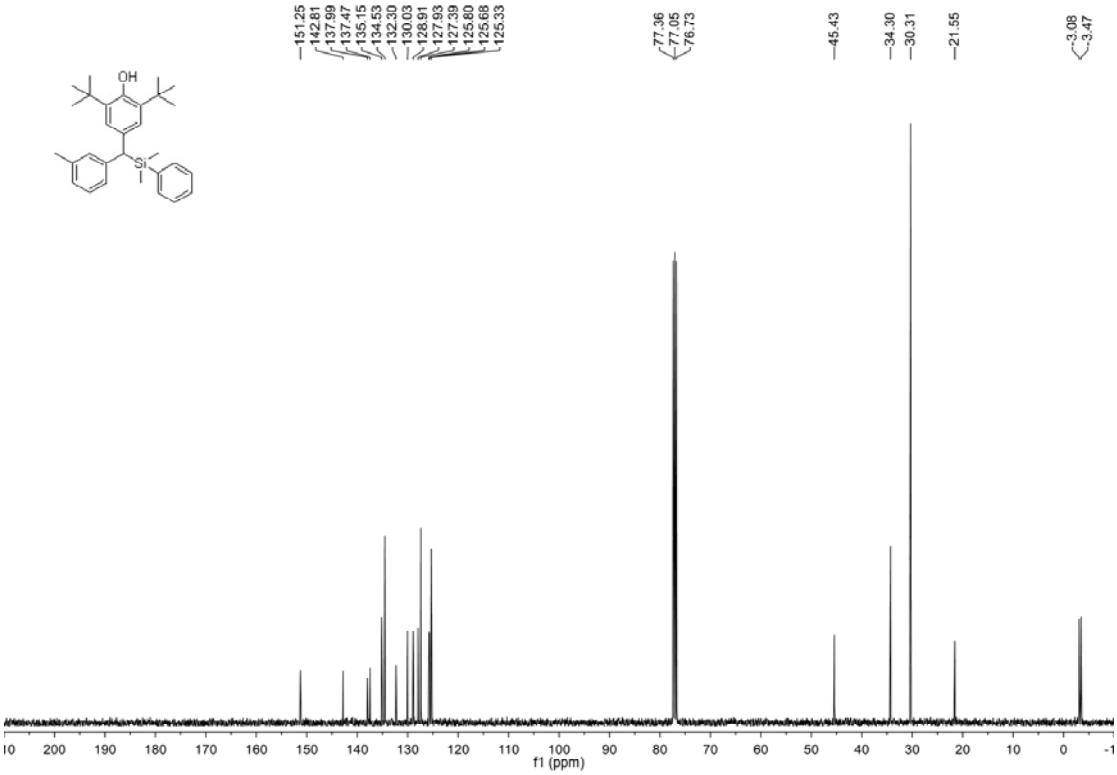
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7e**



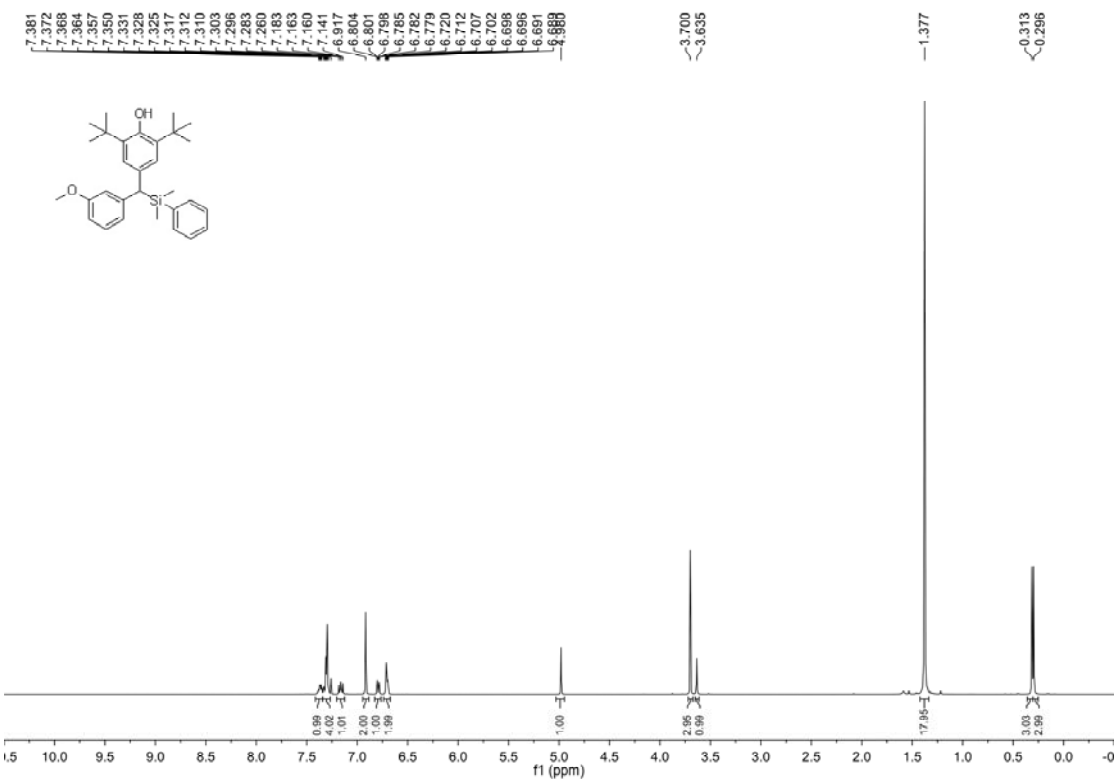
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7e**



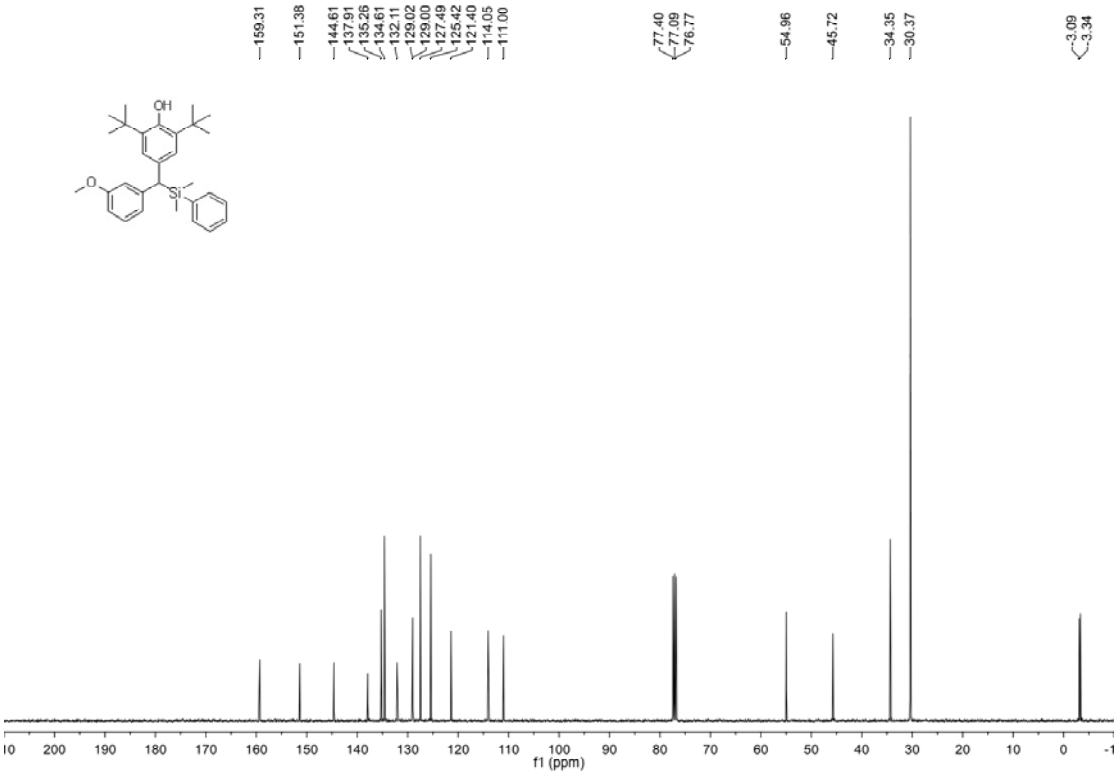
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7f**



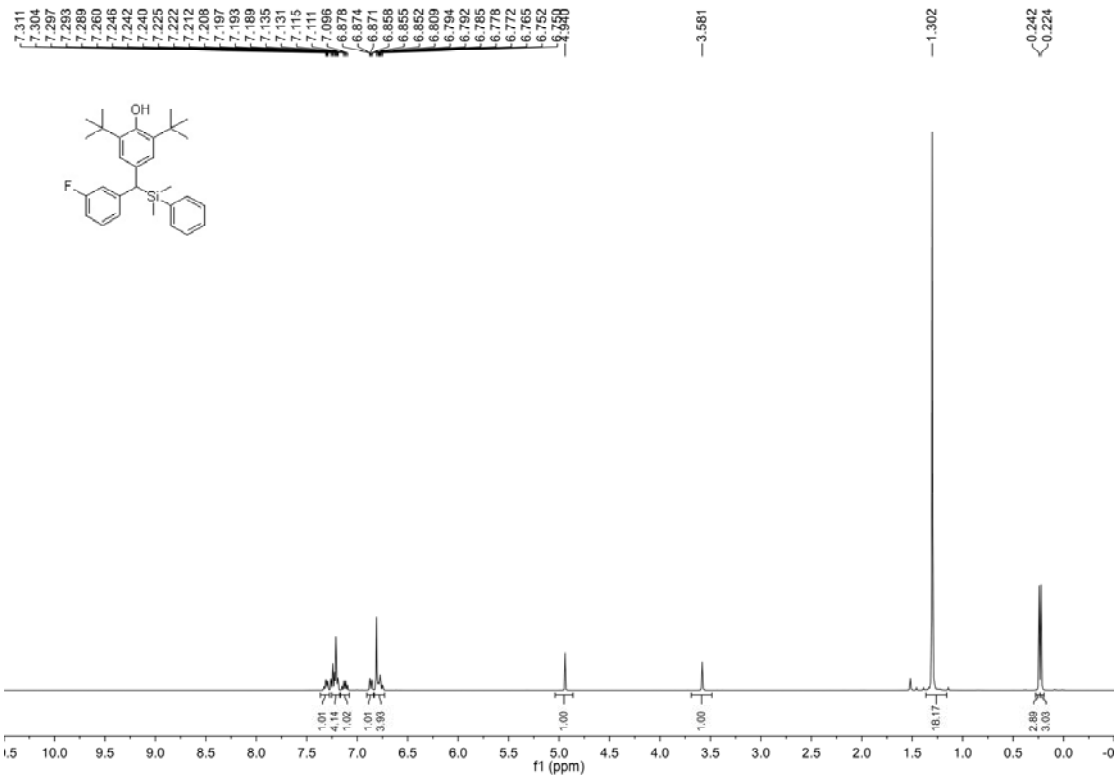
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7f**



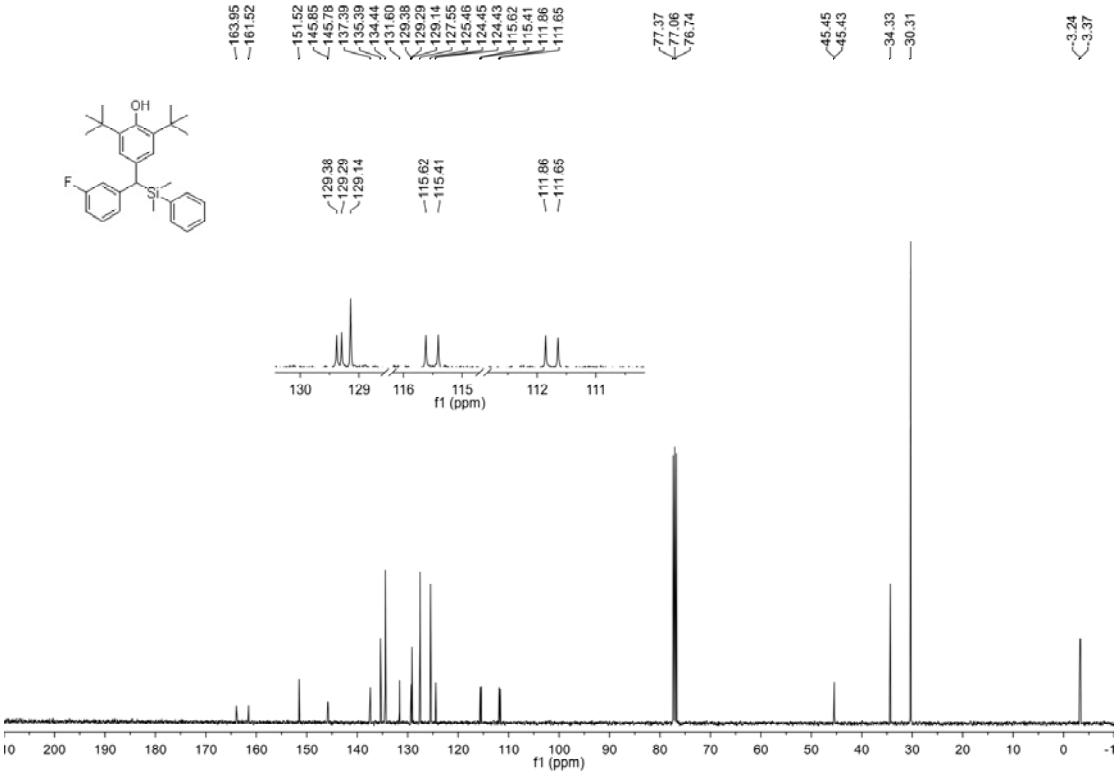
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7g**



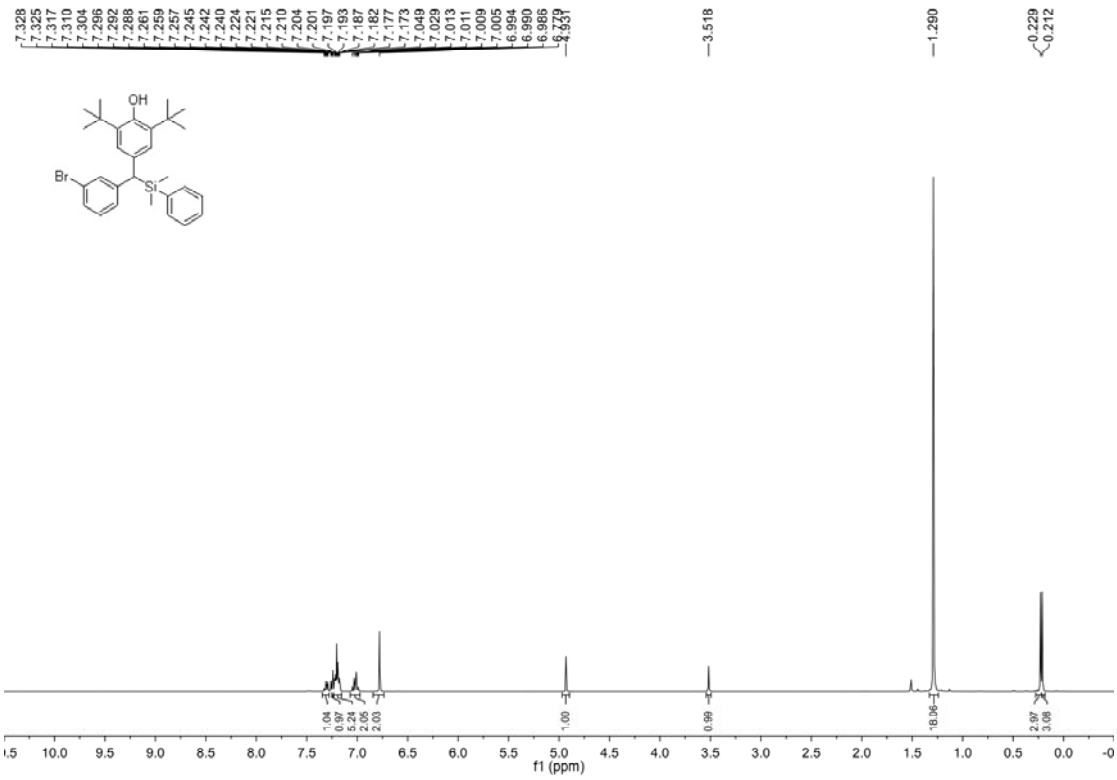
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7g**



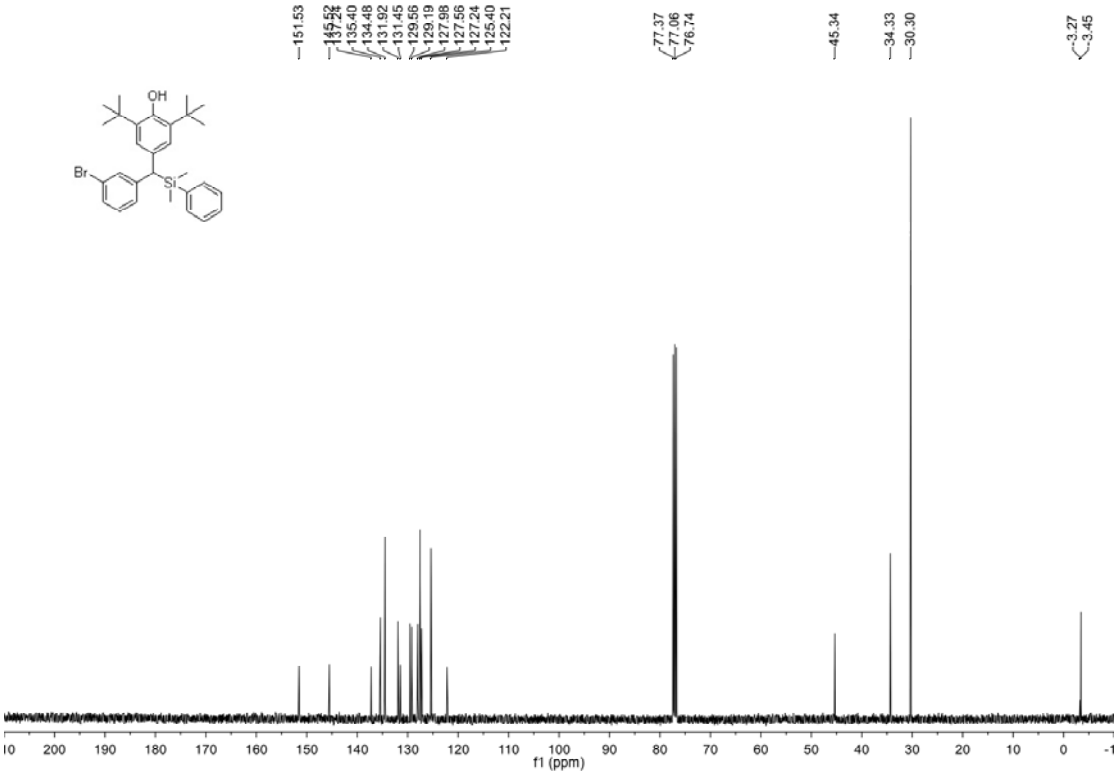
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7h**



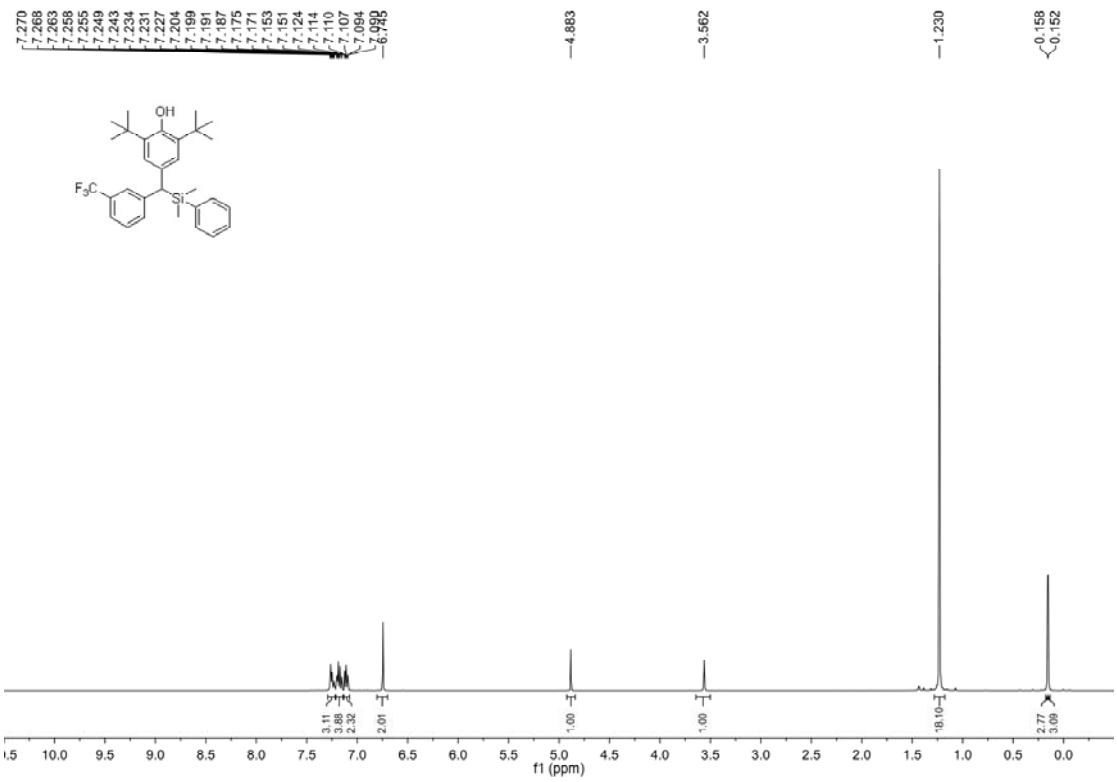
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7h**



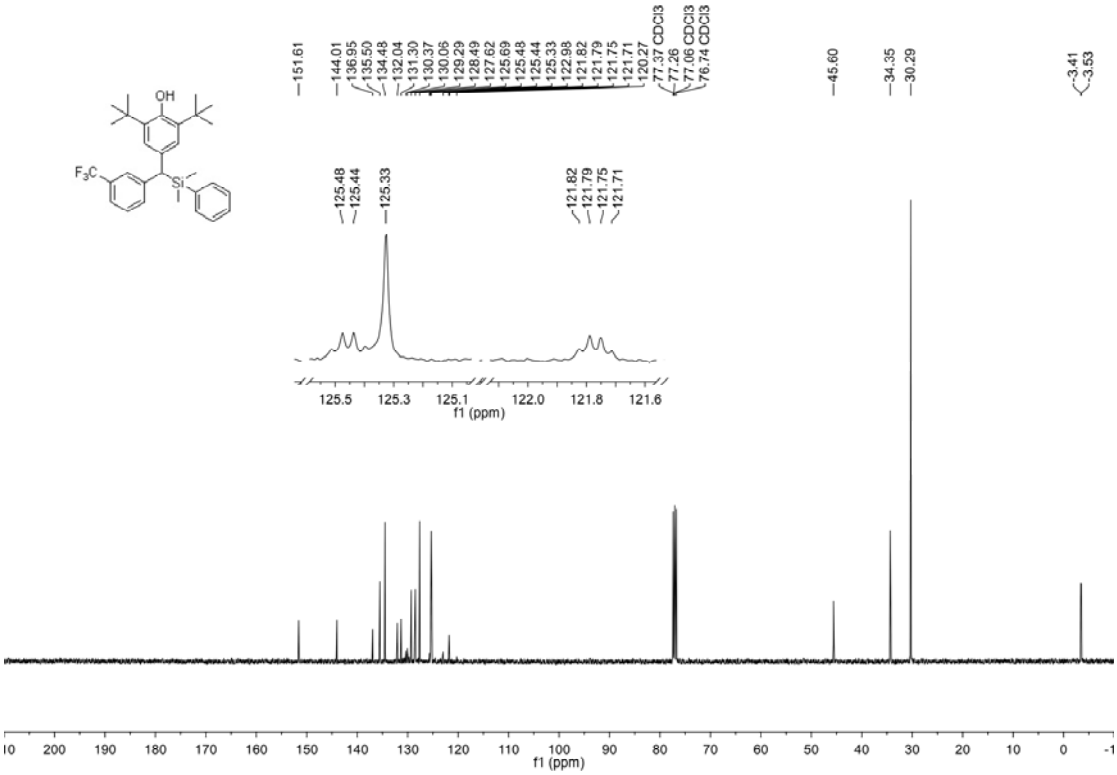
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7i**



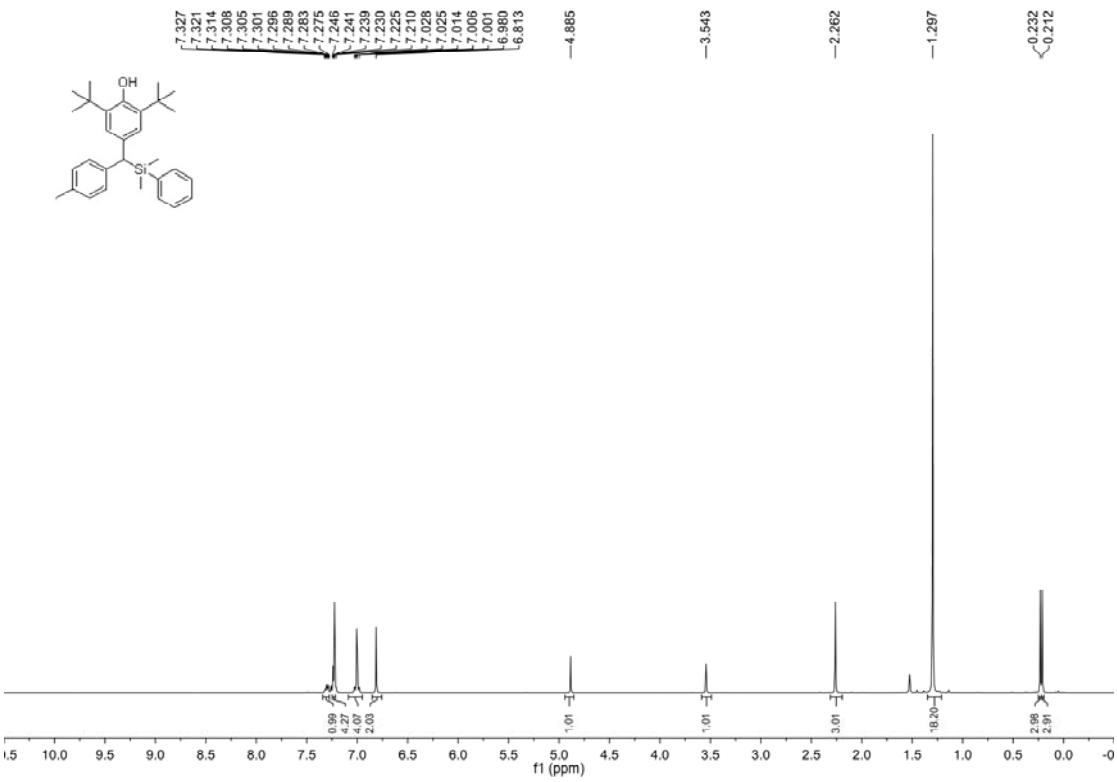
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7i**



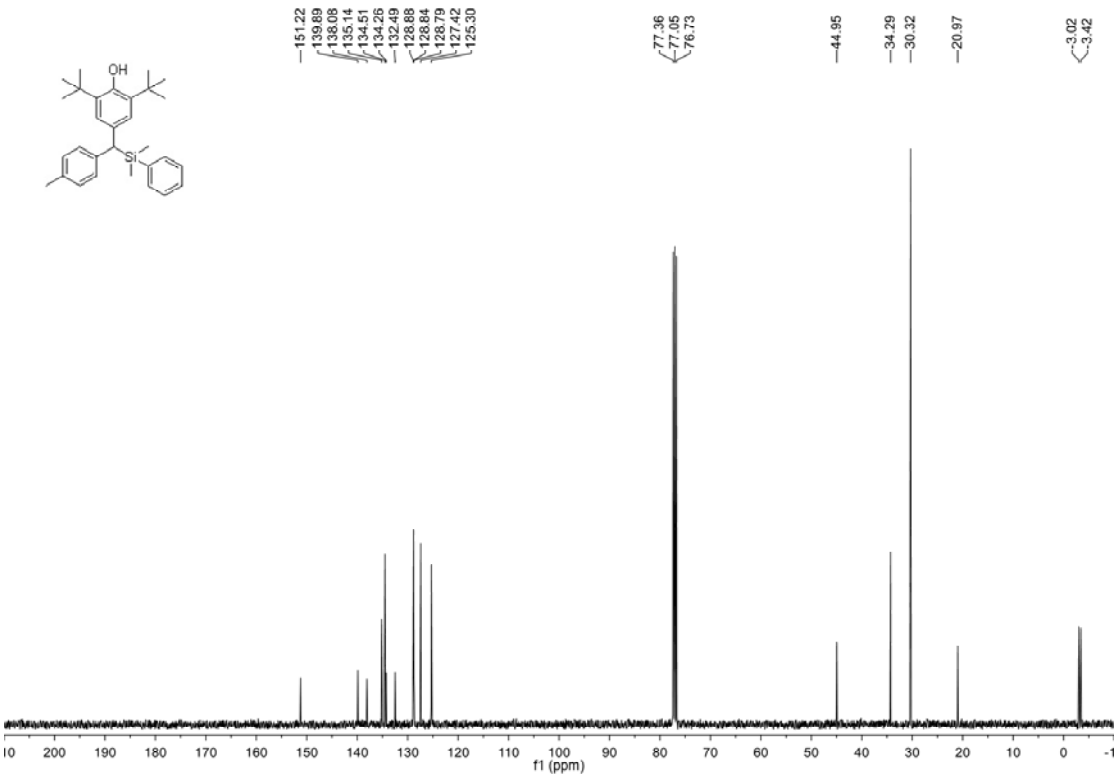
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7j**



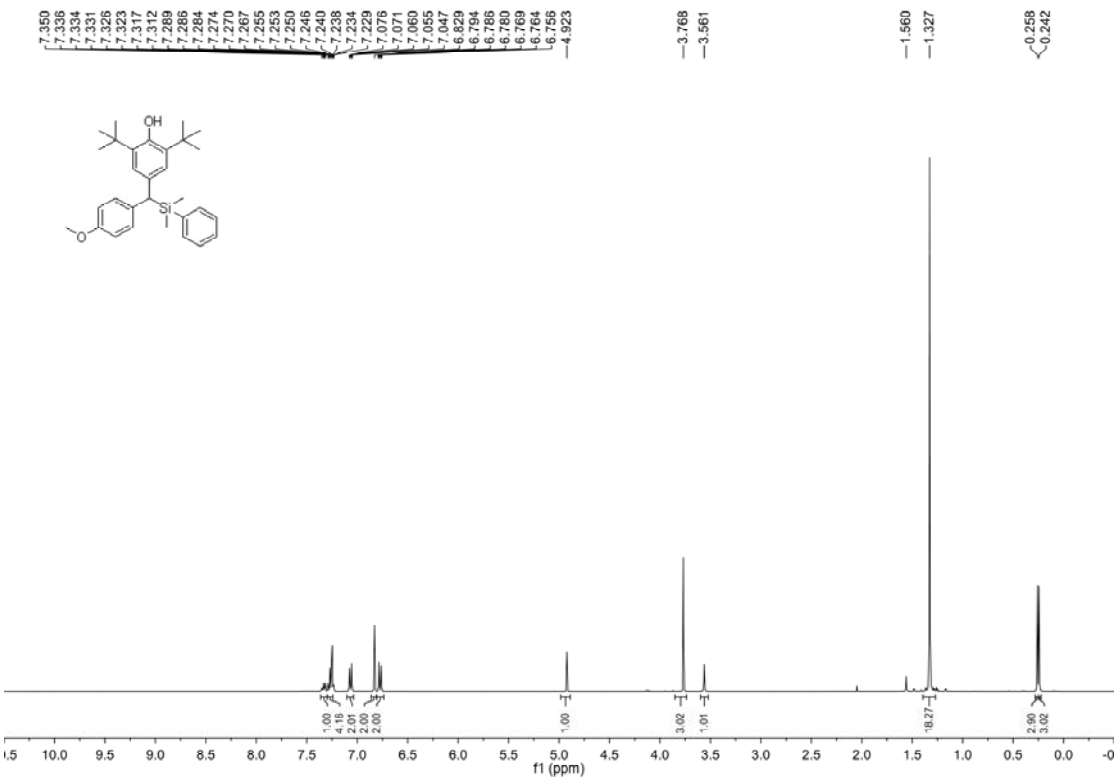
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7j**



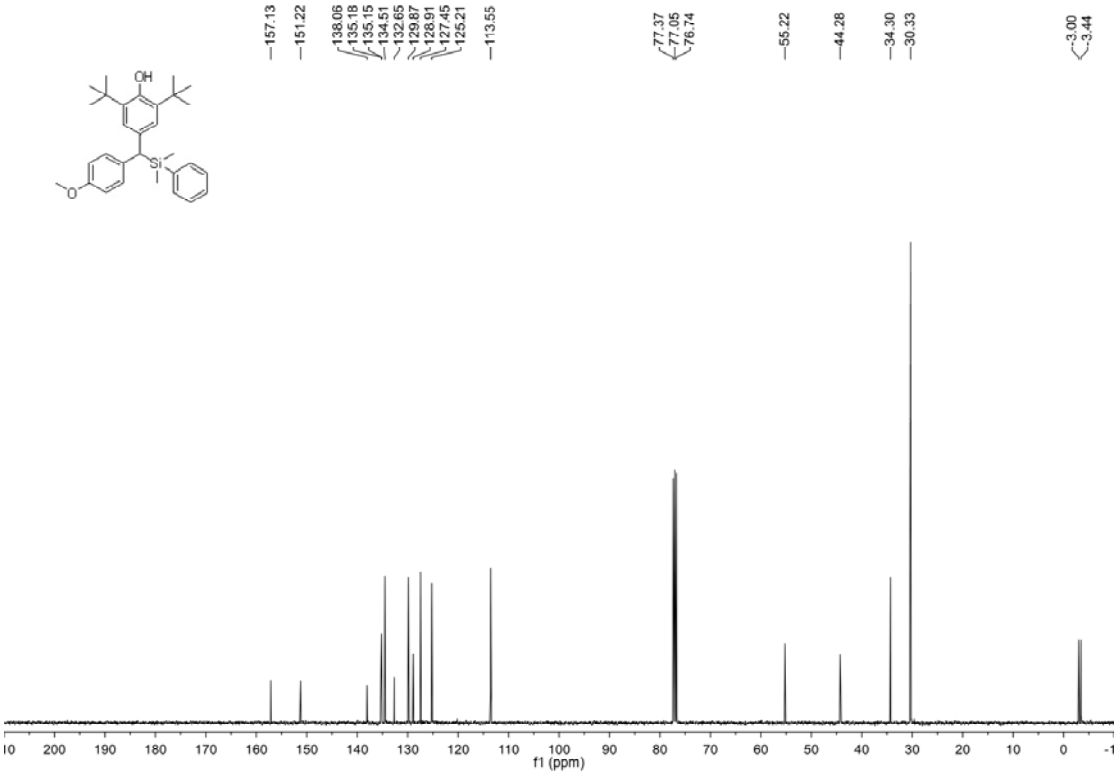
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7k**



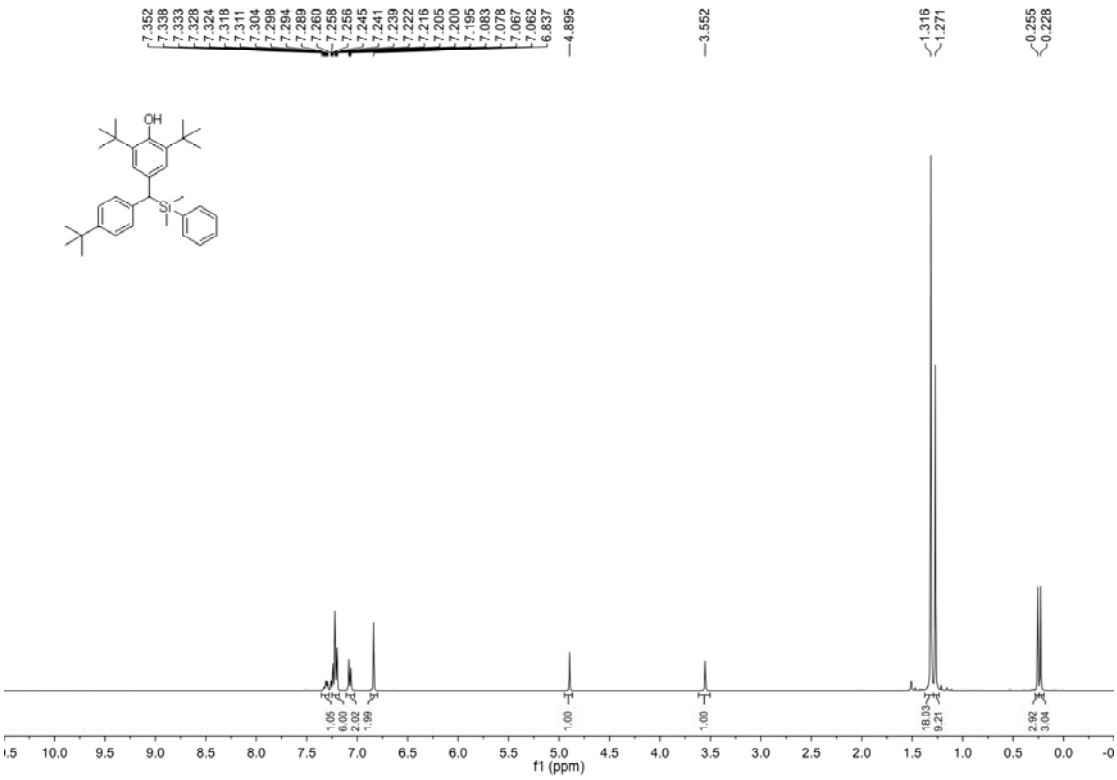
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7k**



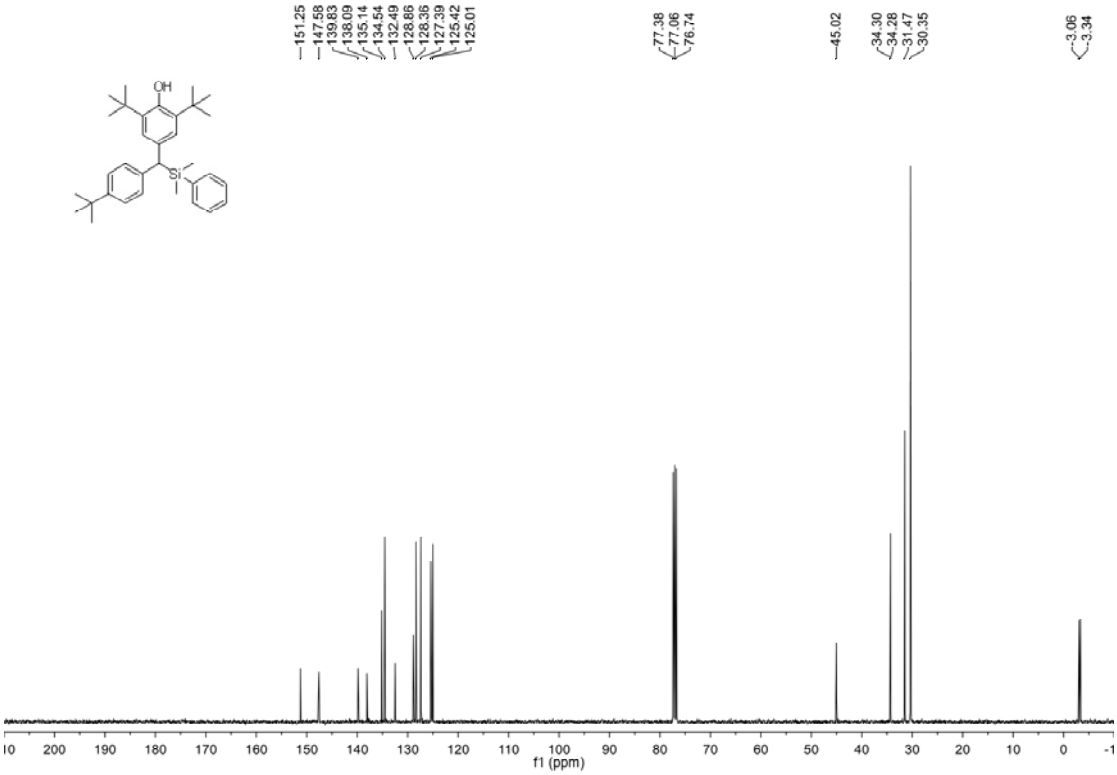
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7l**



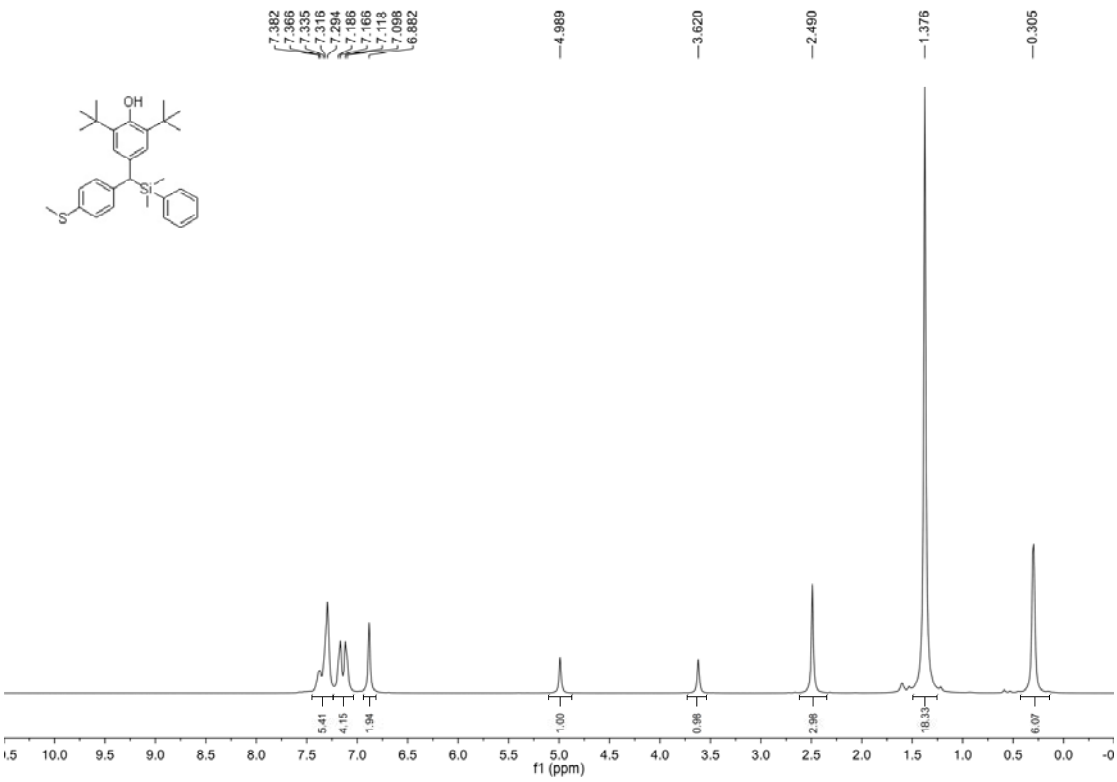
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7l**



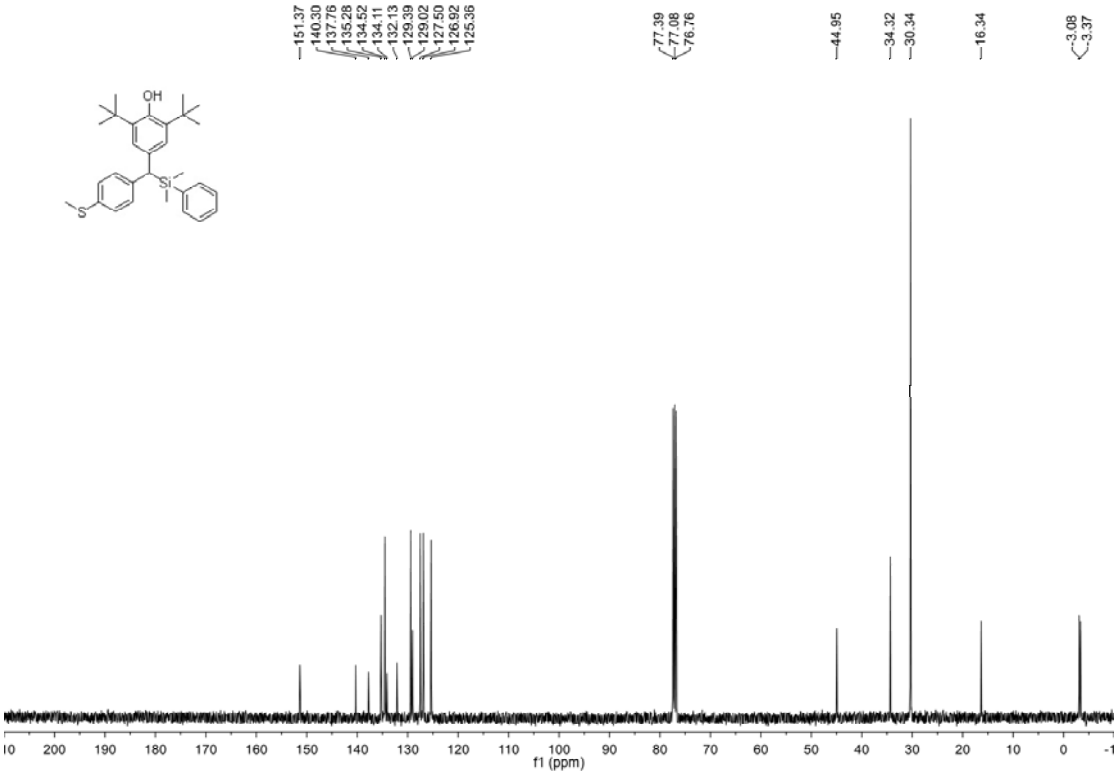
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7m**



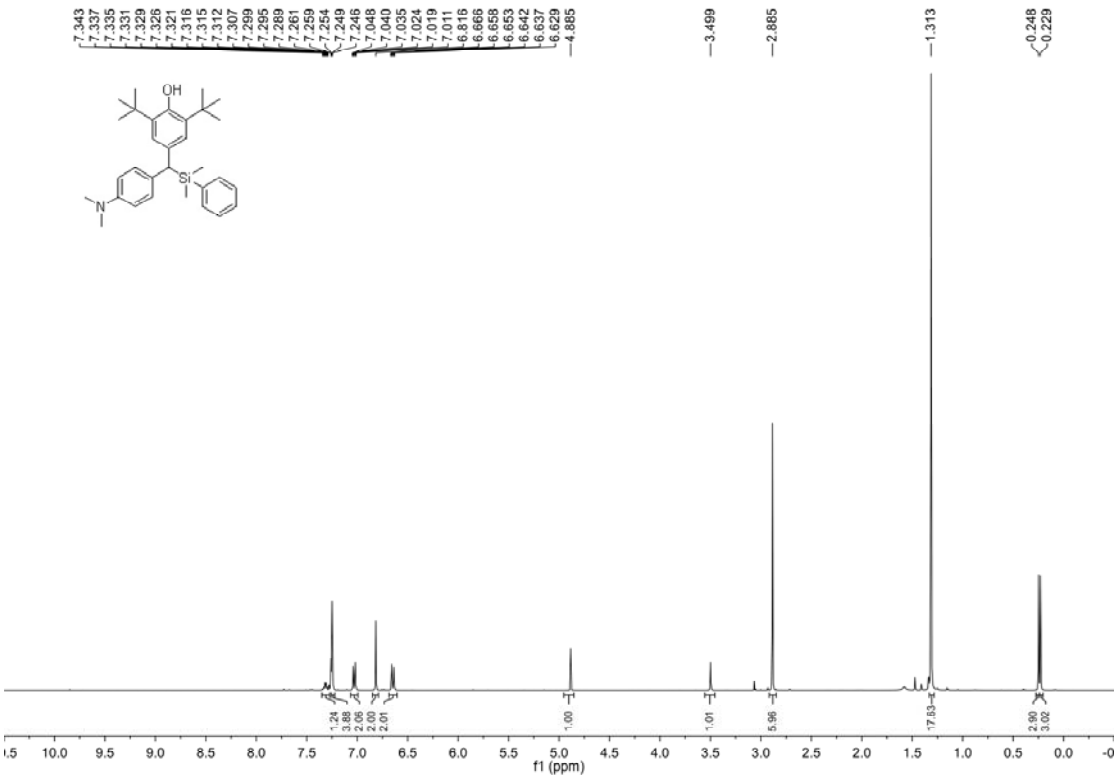
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7m**



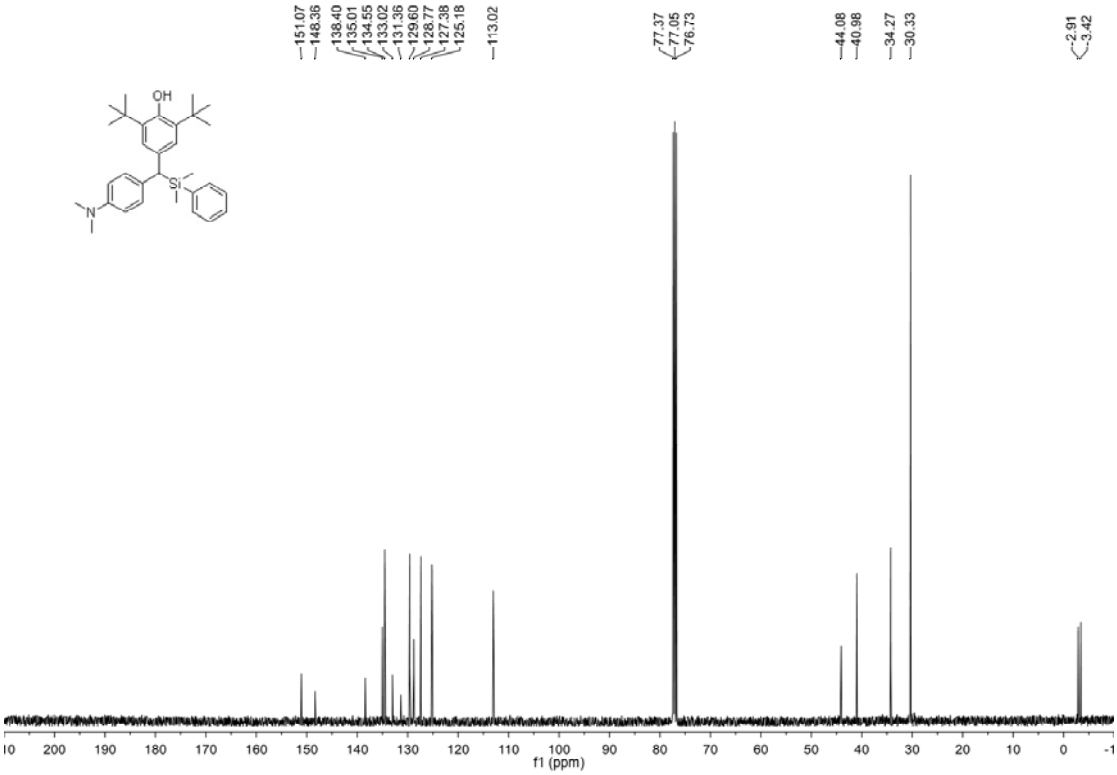
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7n**



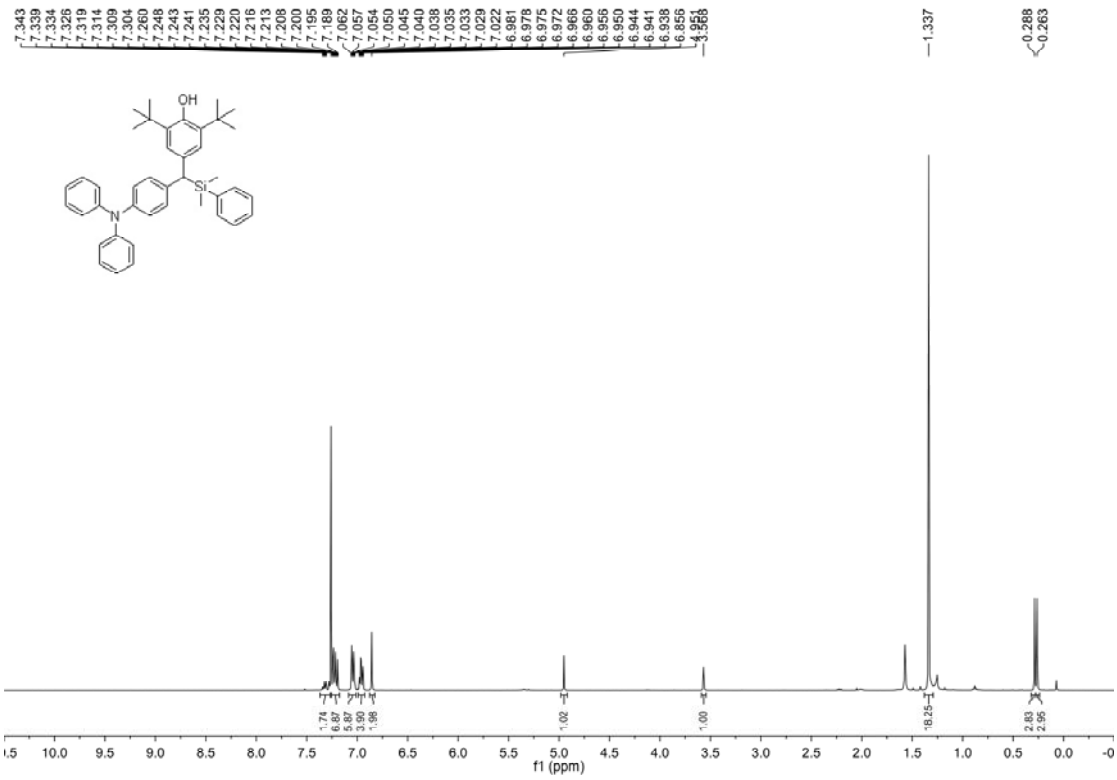
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **7n**



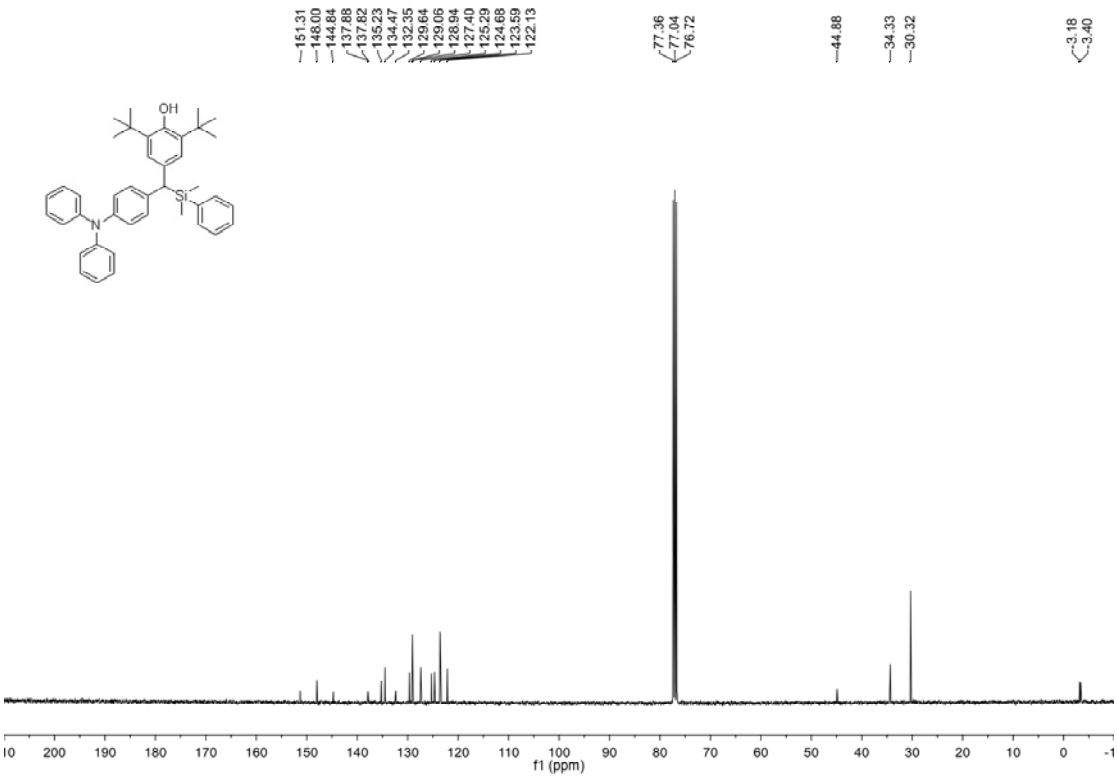
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7o**



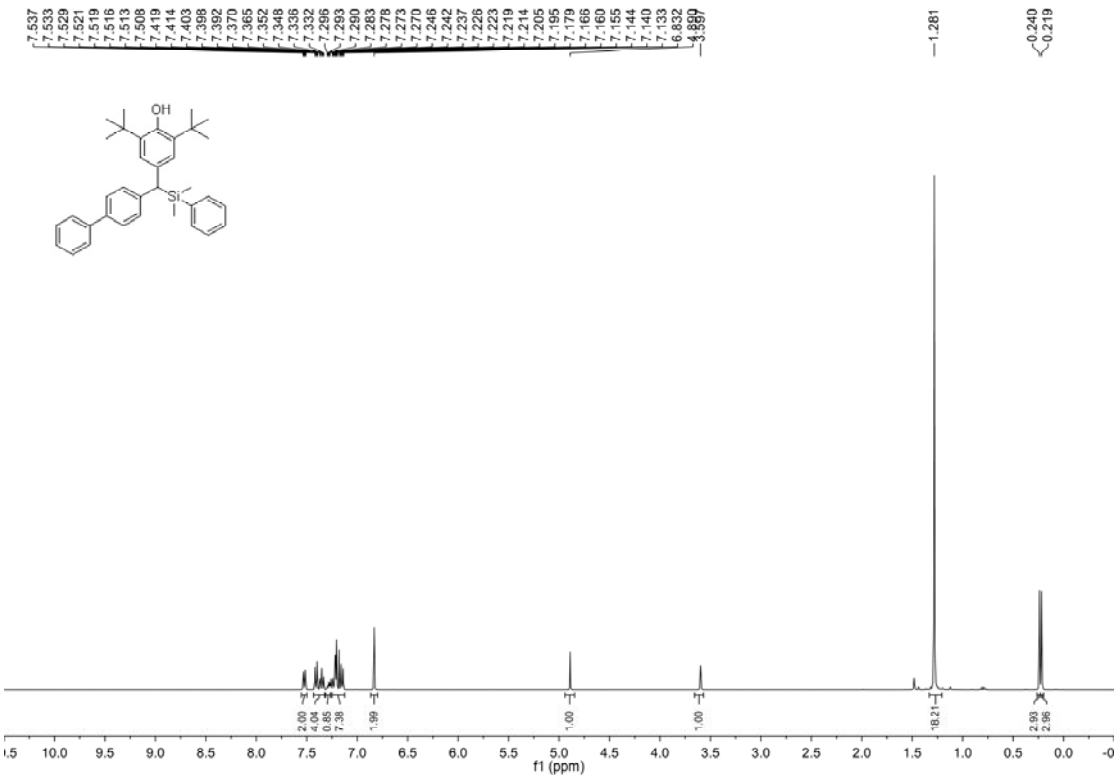
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7o**



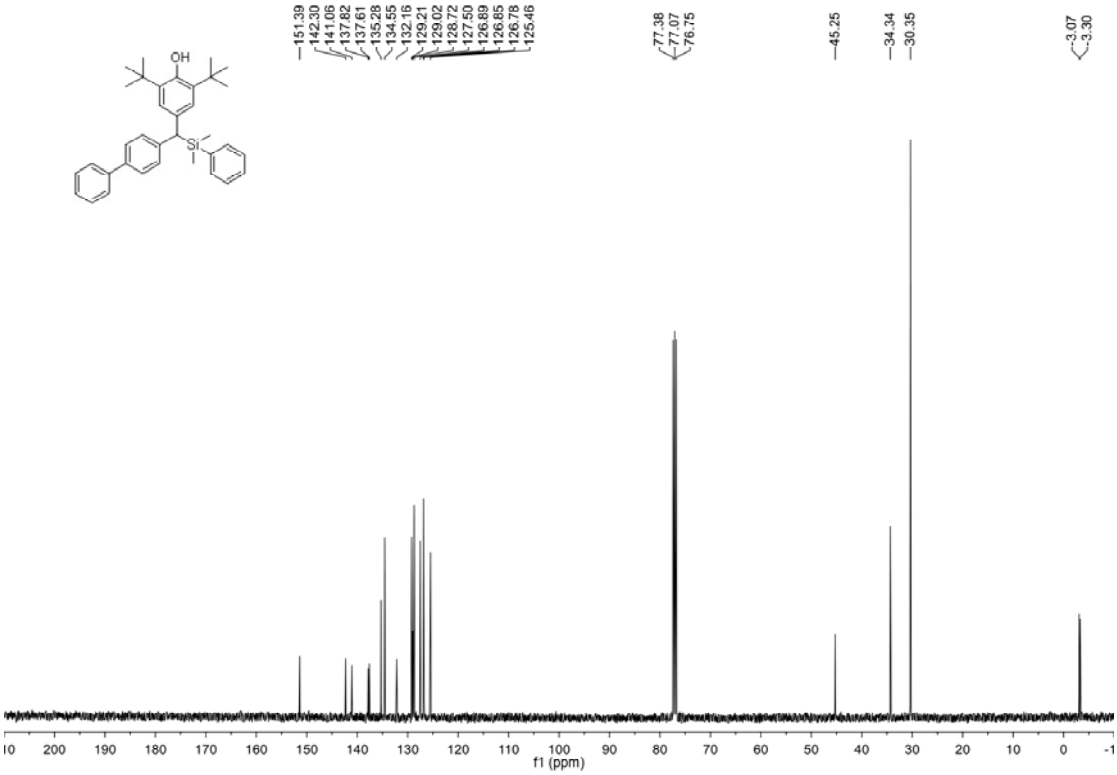
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7p**



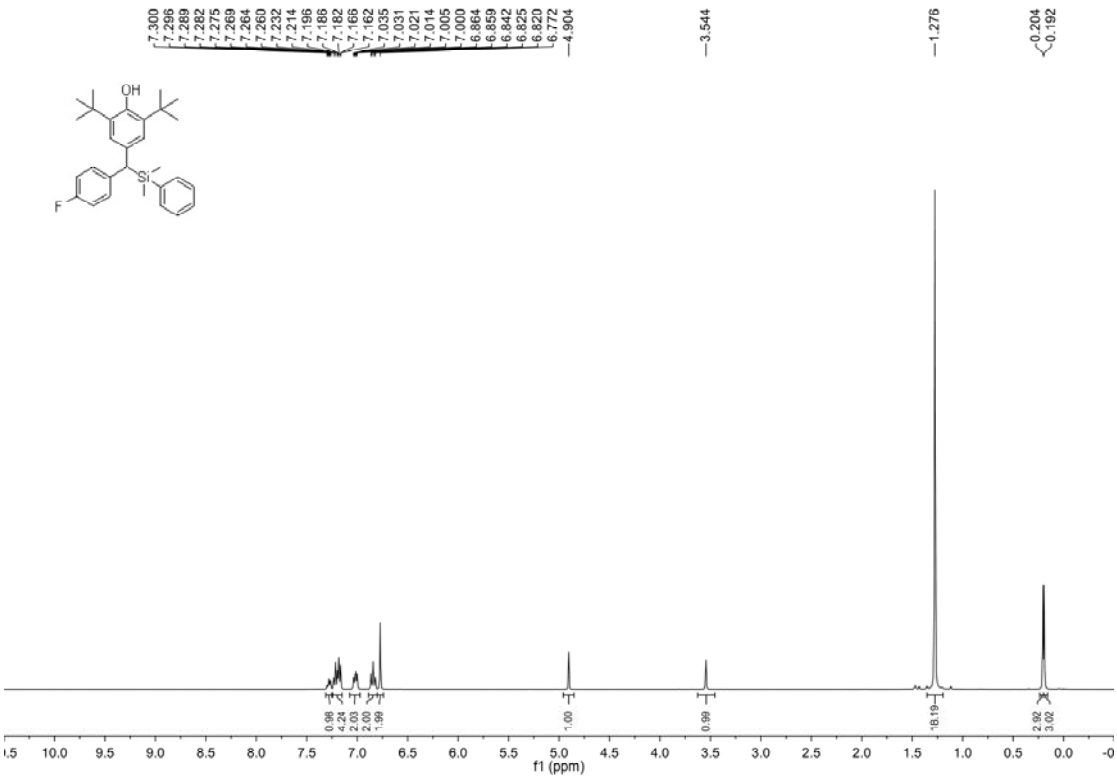
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7p**



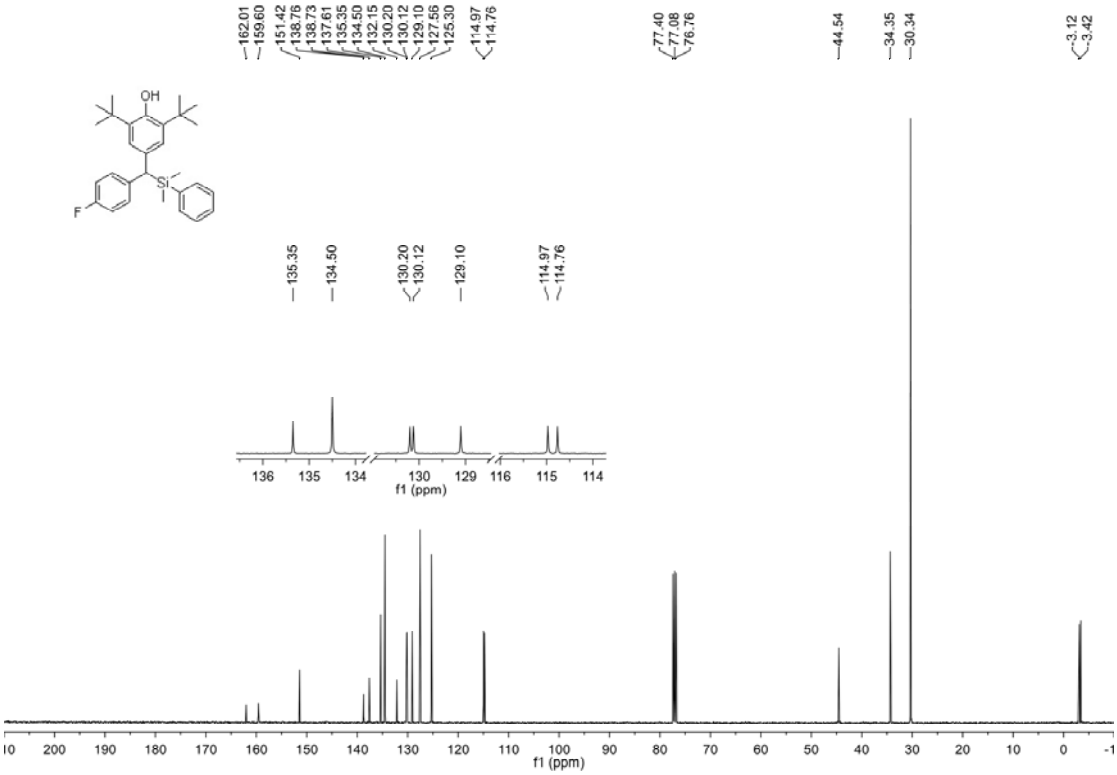
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7q**



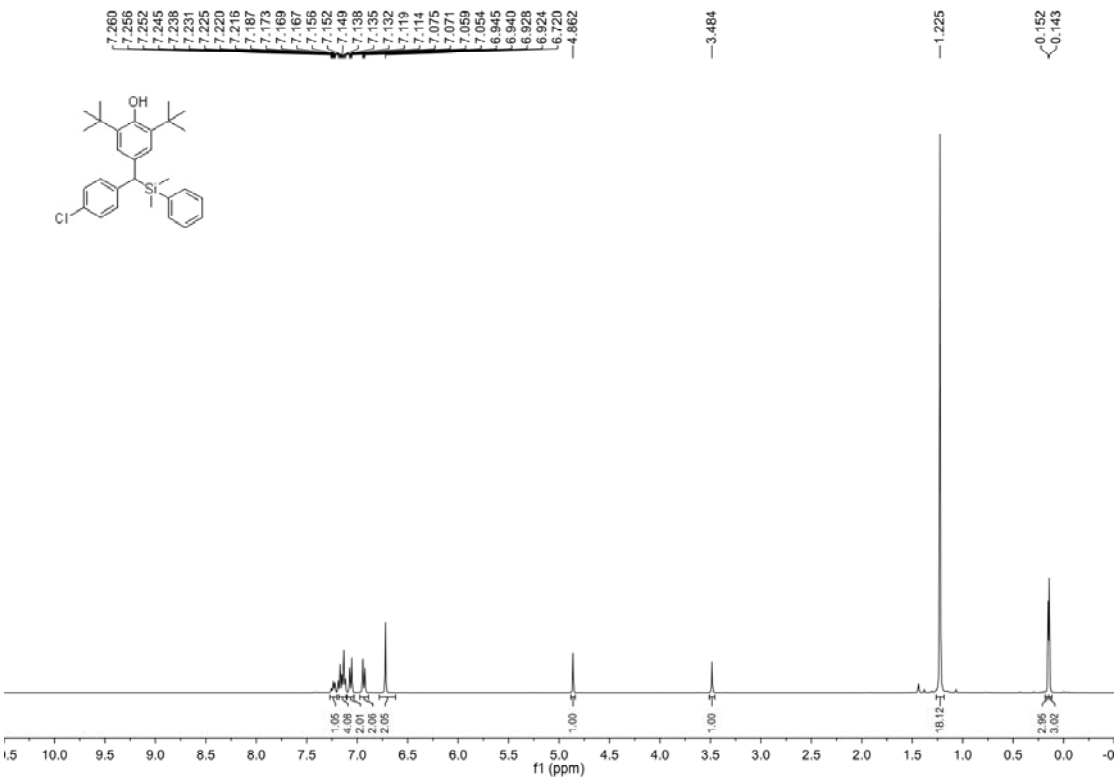
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7q**



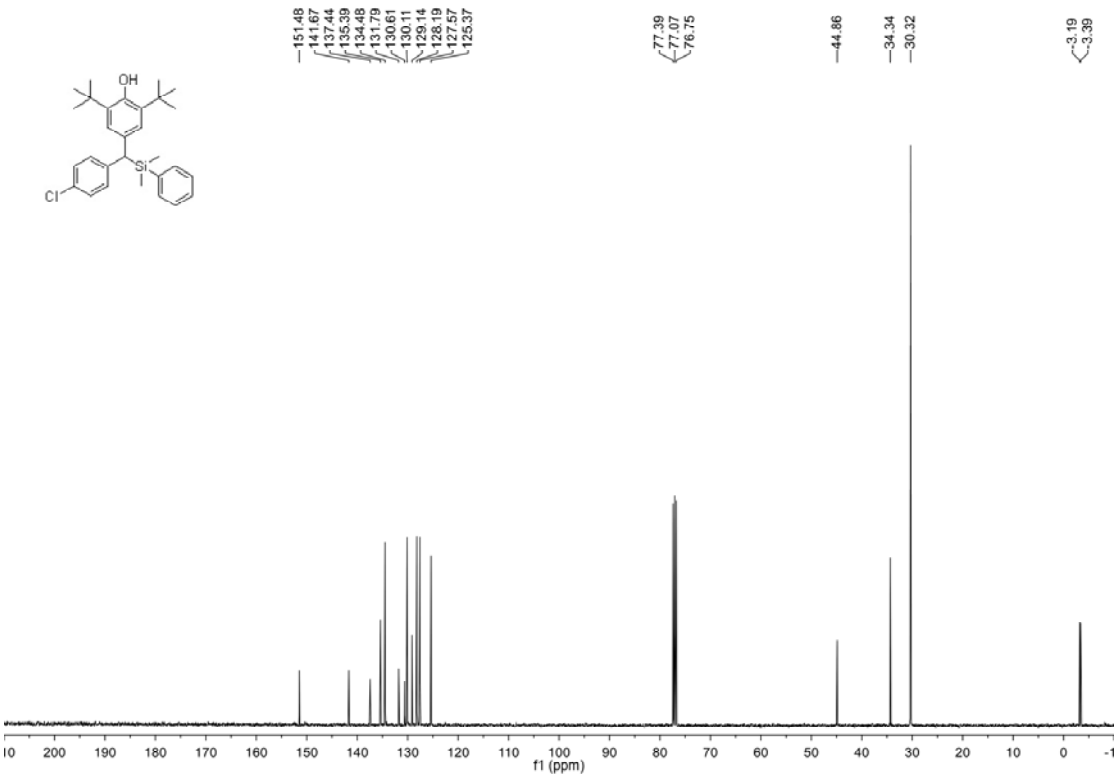
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7r**



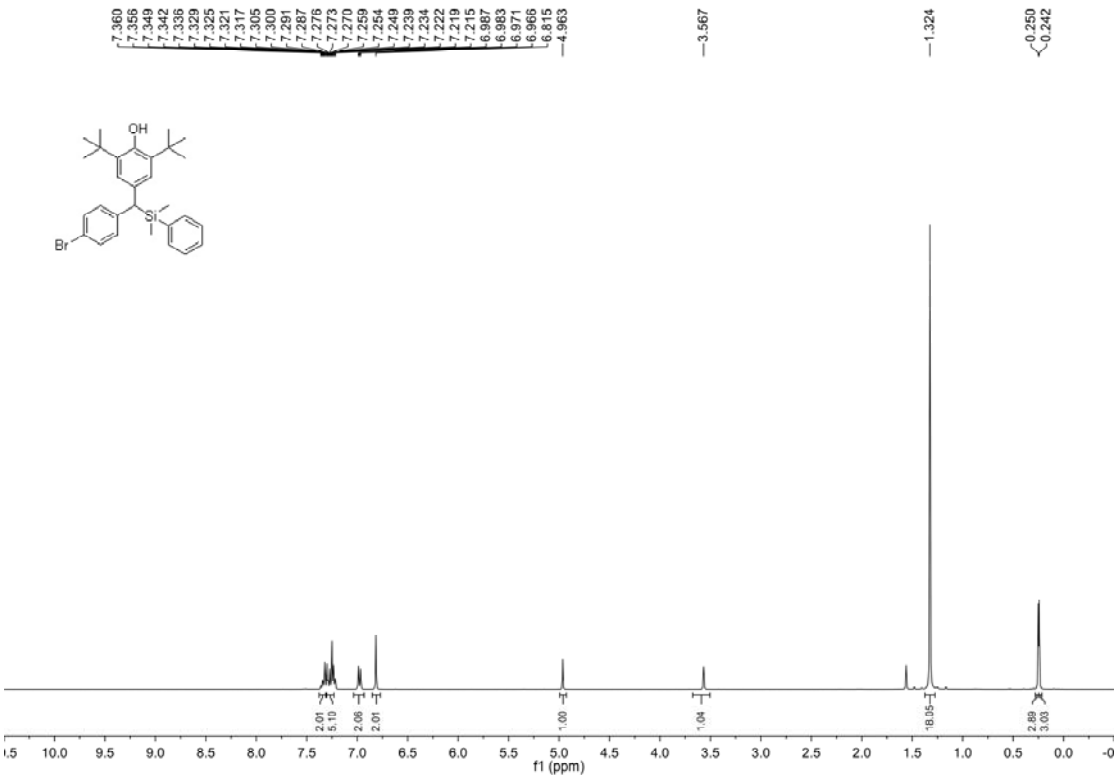
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **7r**



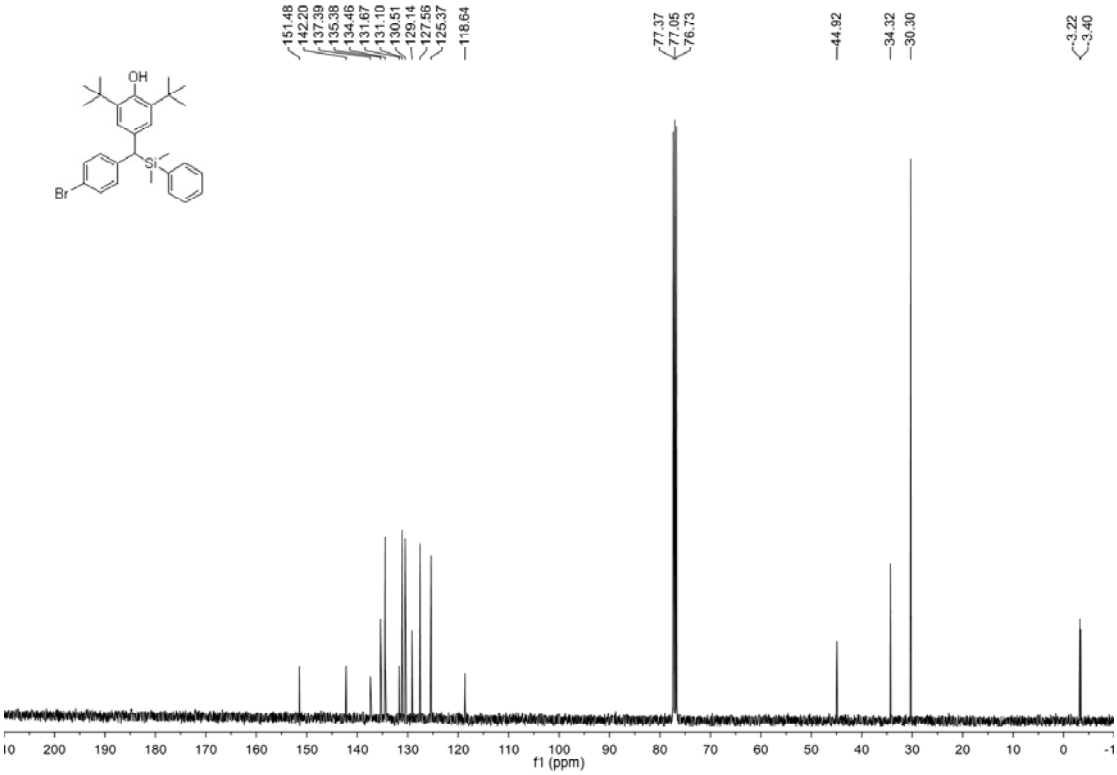
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7s**



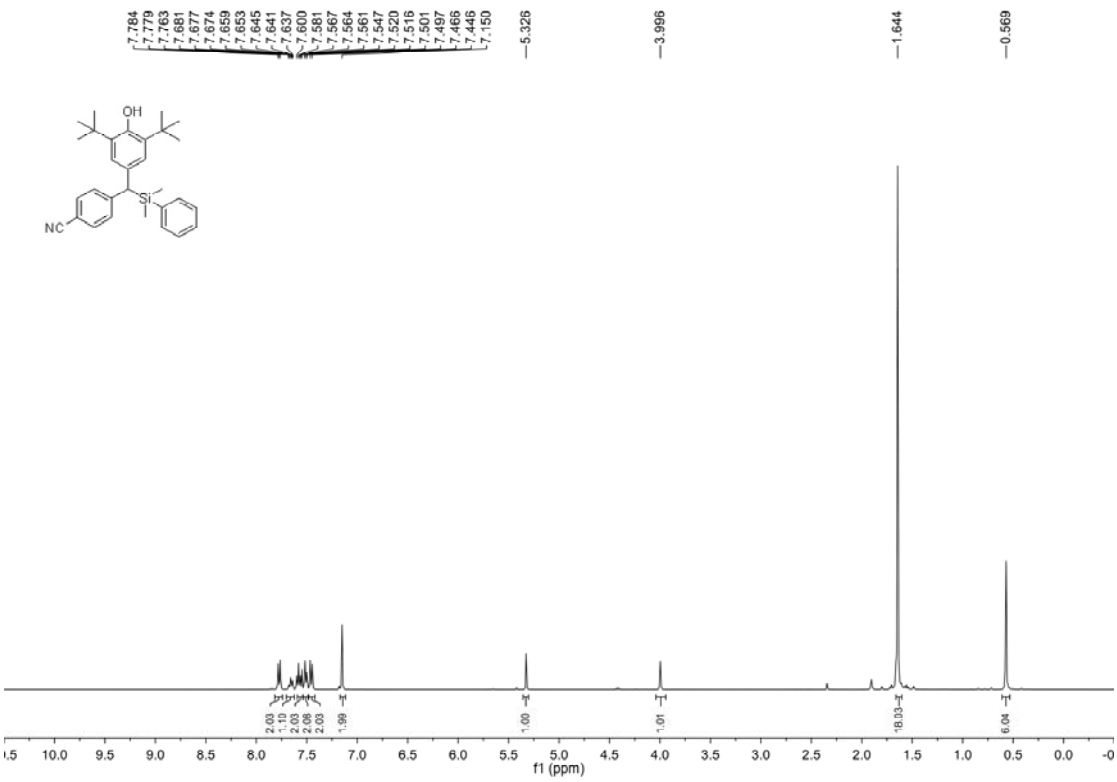
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **7s**



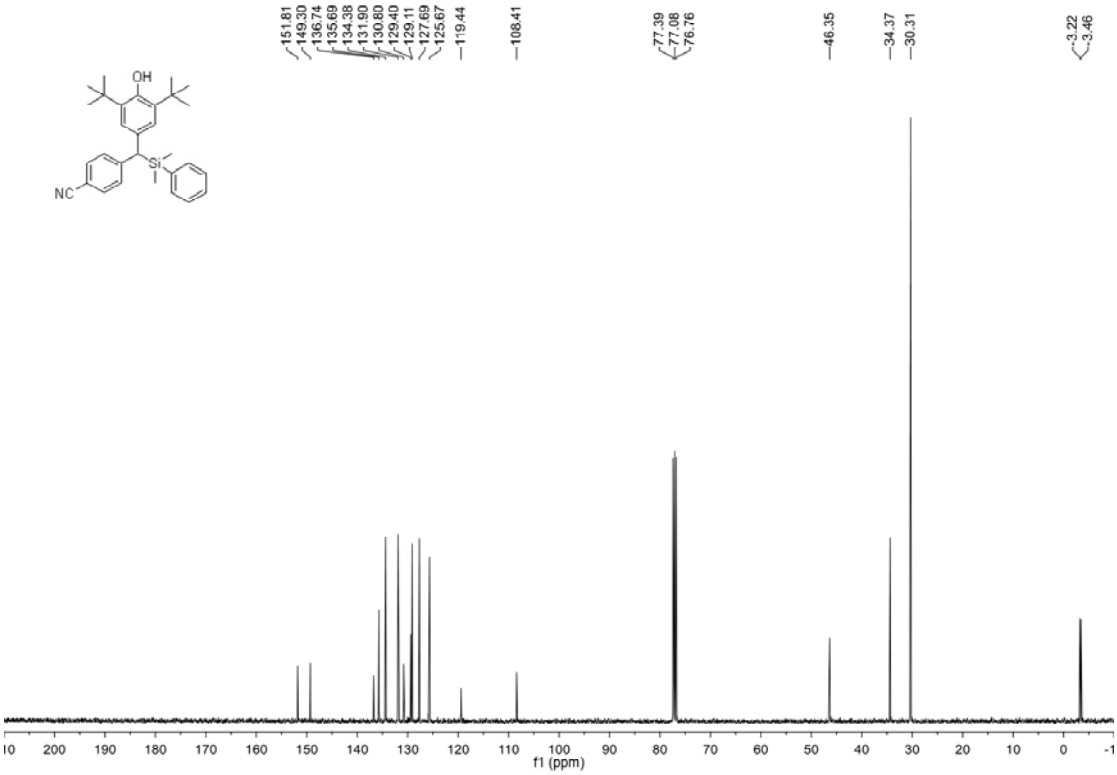
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7t**



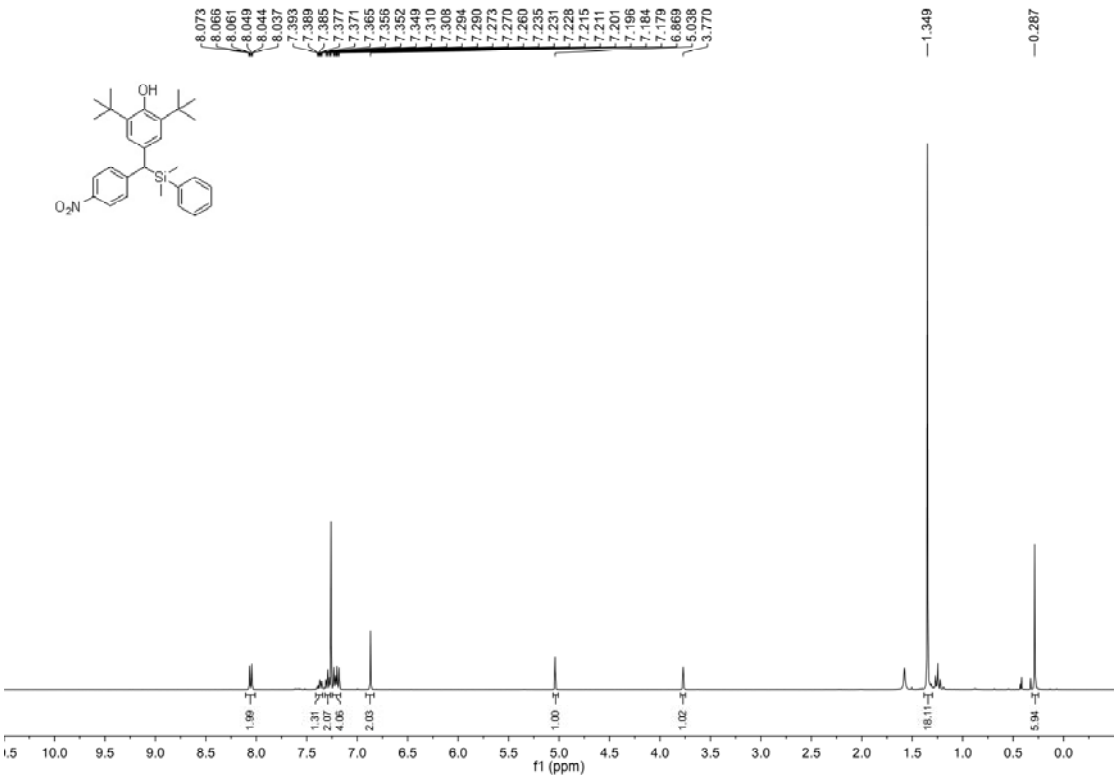
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7t**



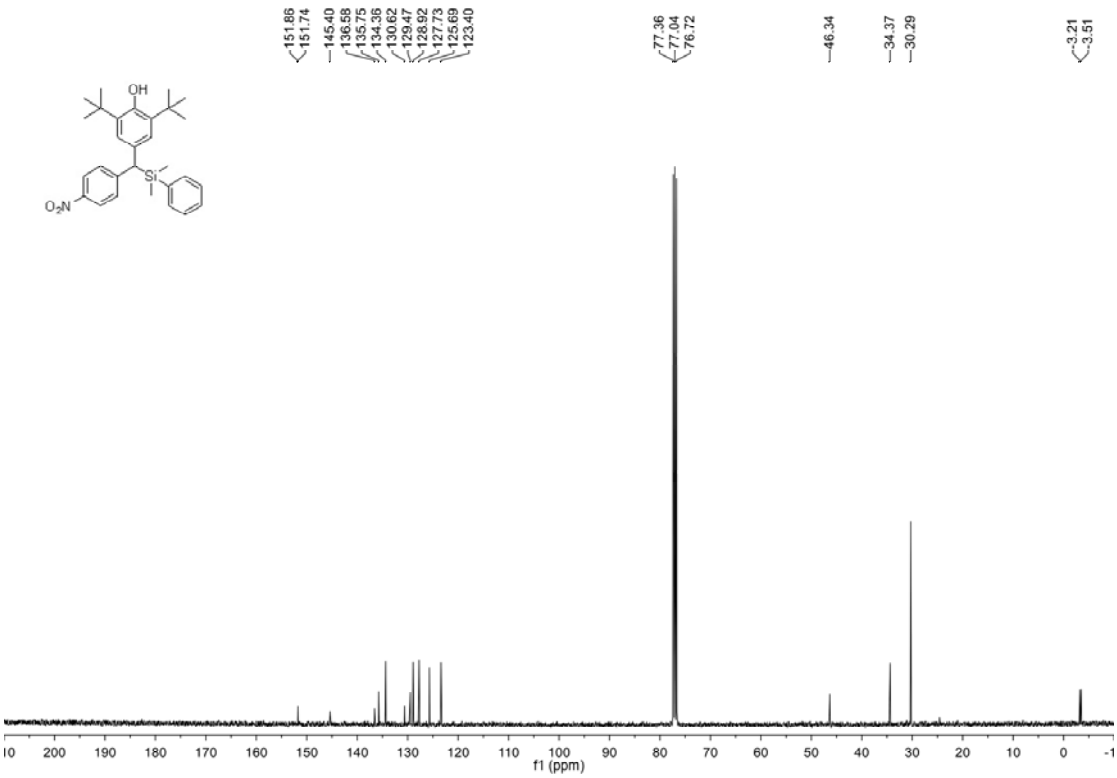
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7u**



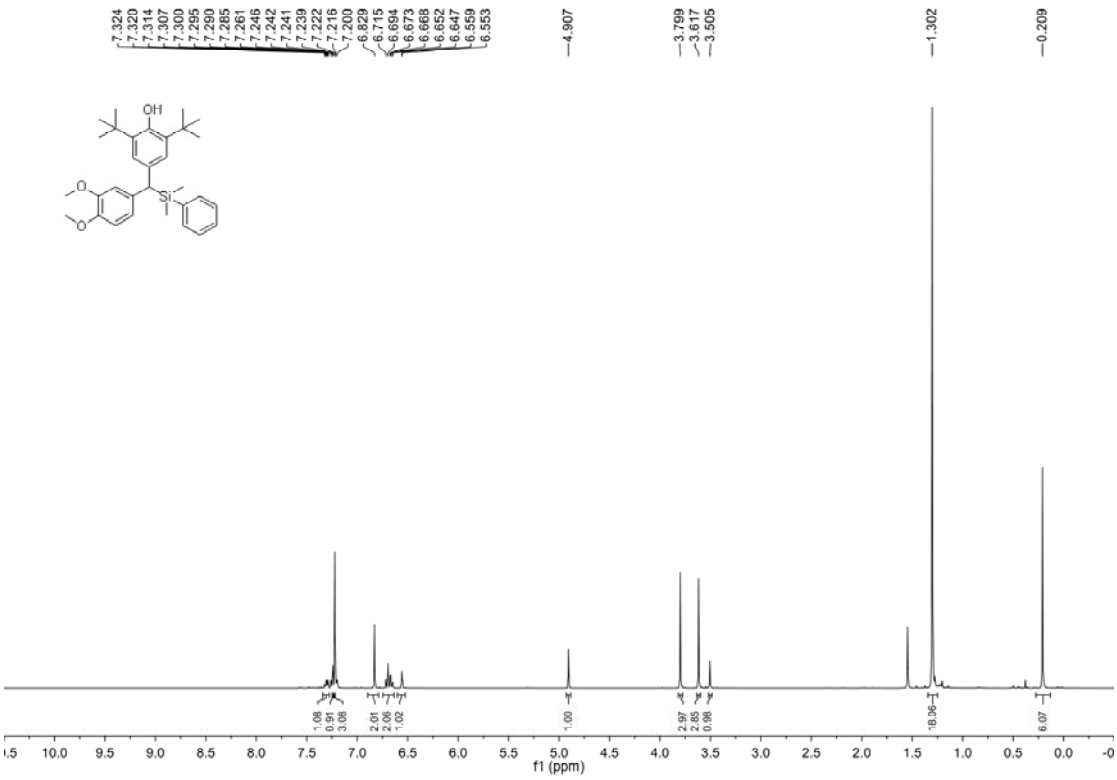
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7u**



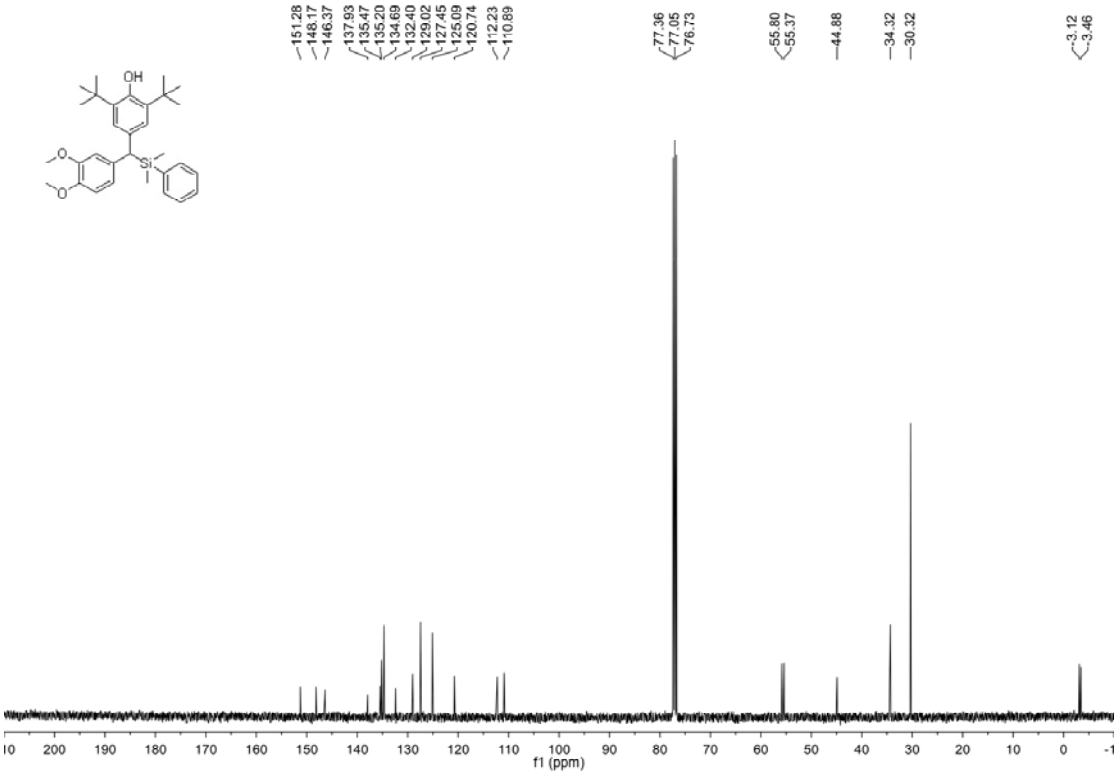
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7v**



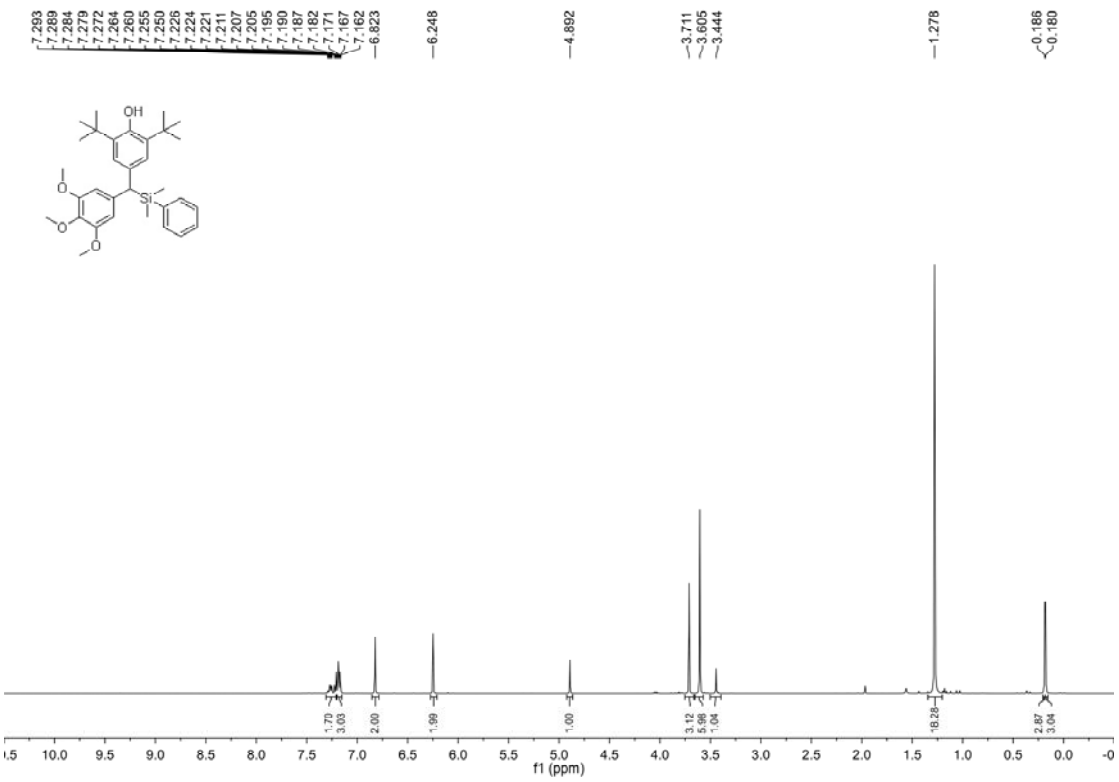
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7v**



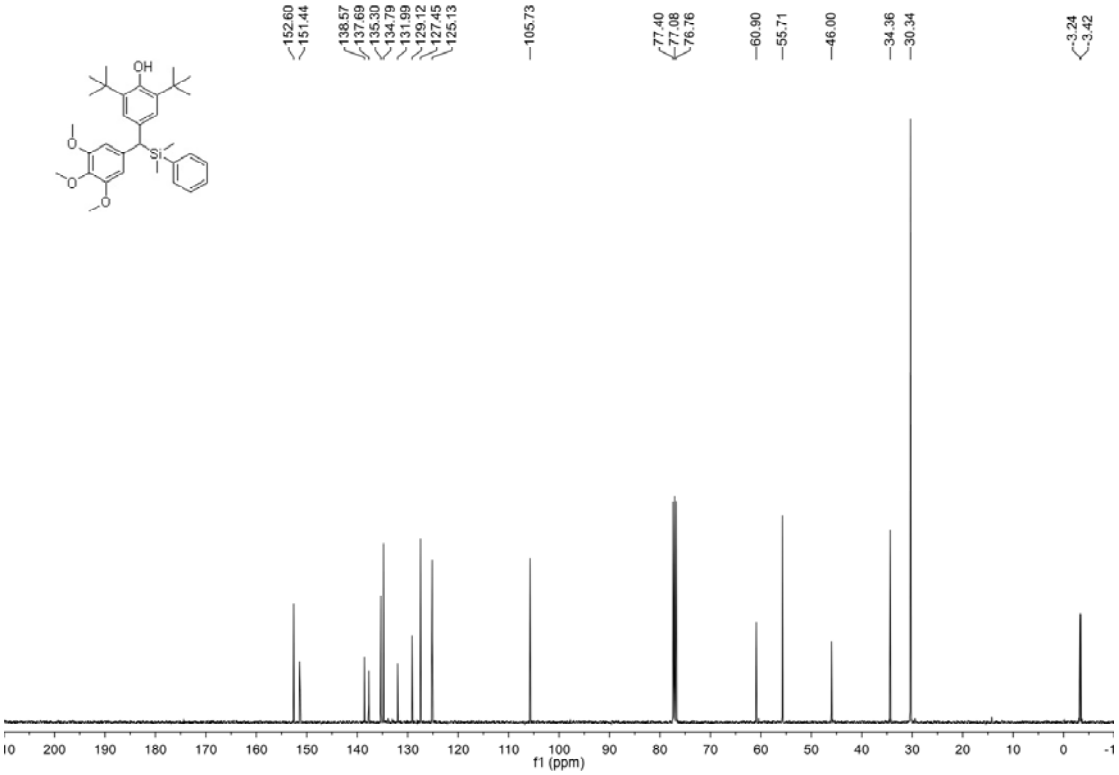
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7w**



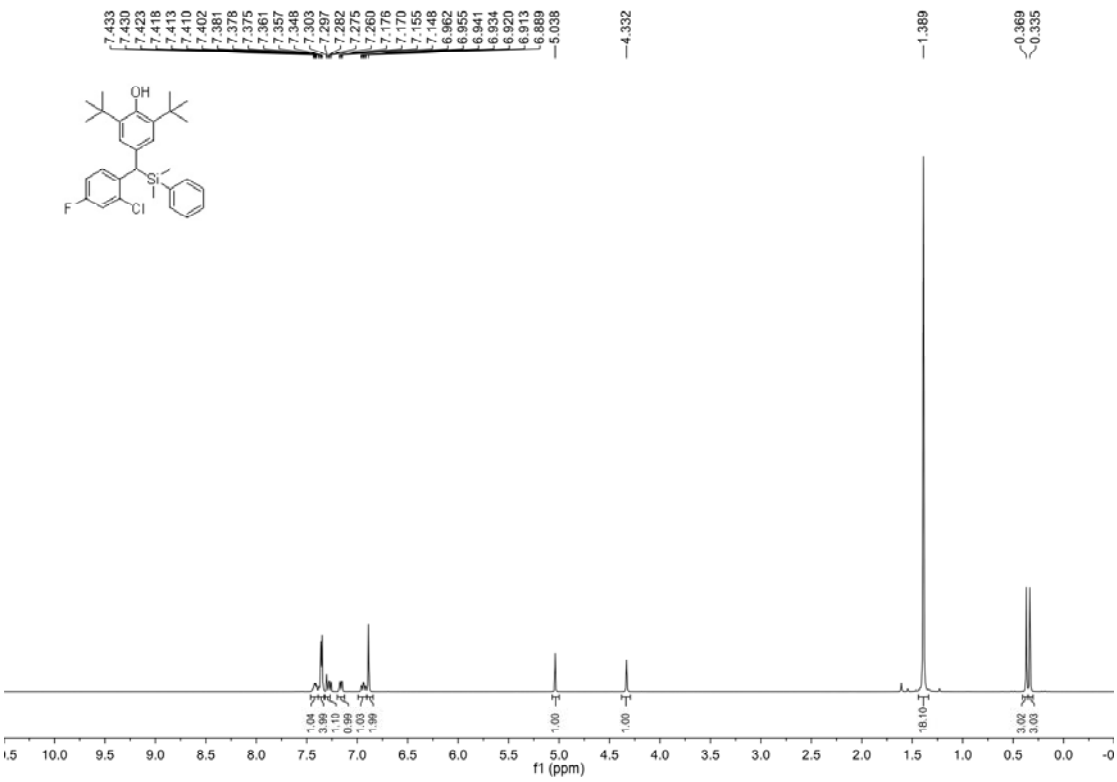
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7w**



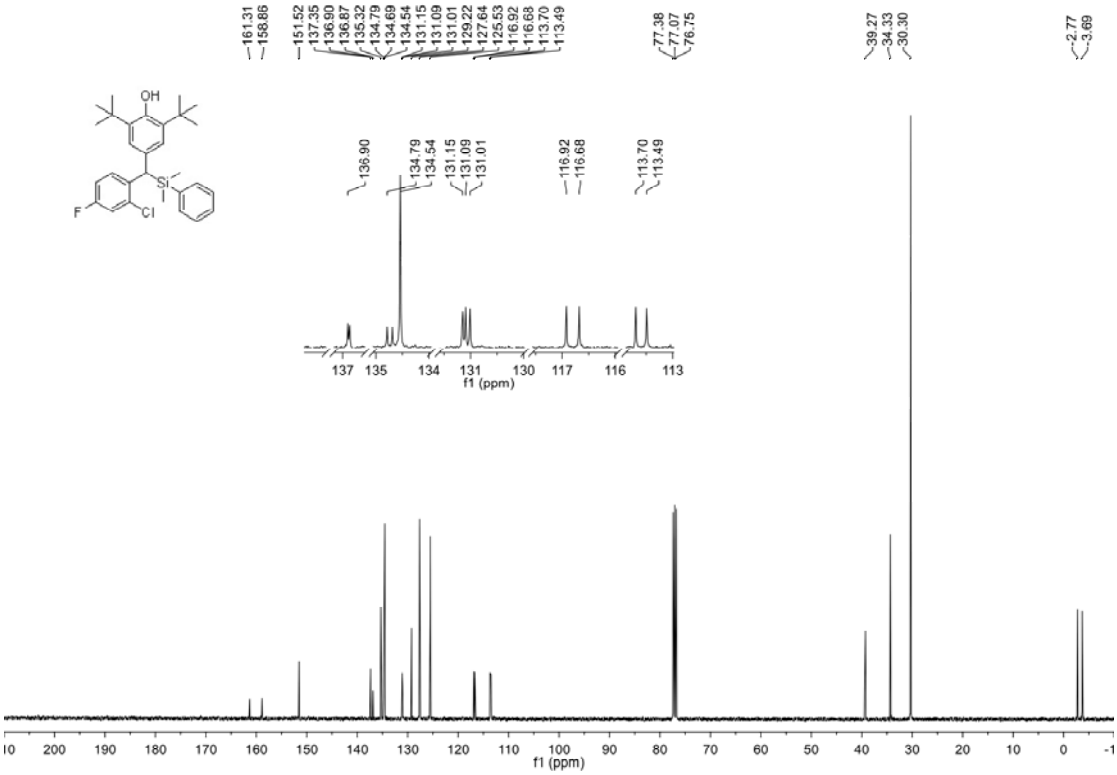
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7x**



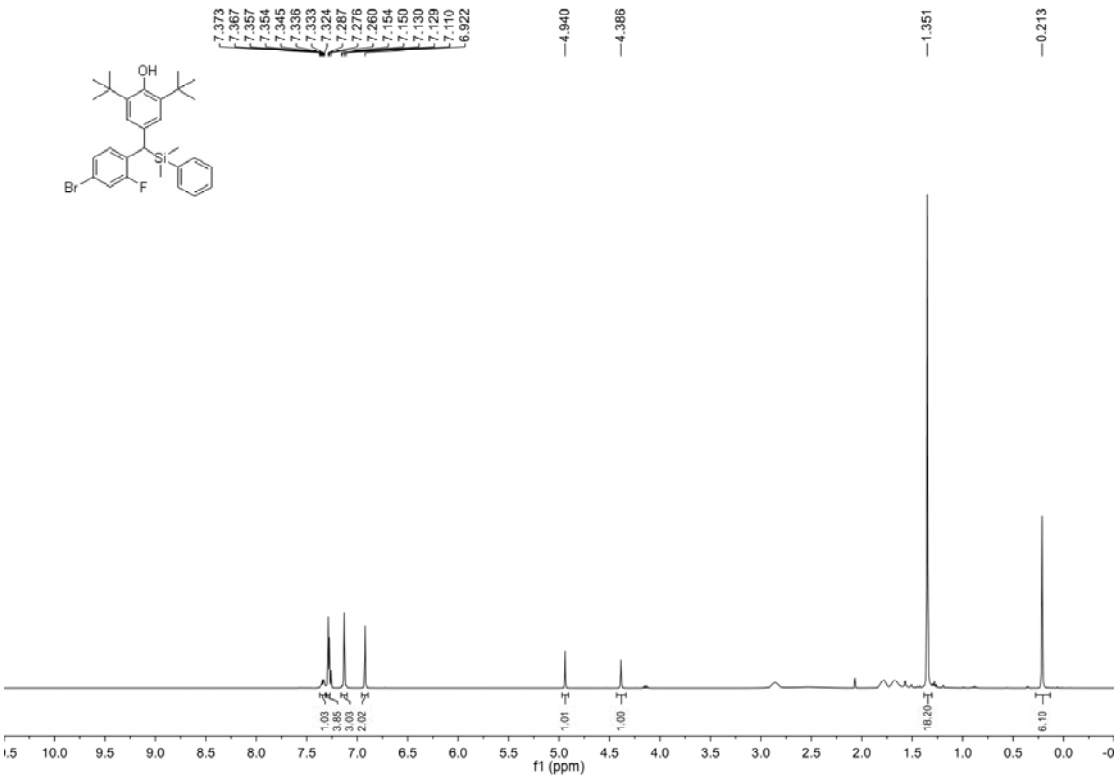
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7x**



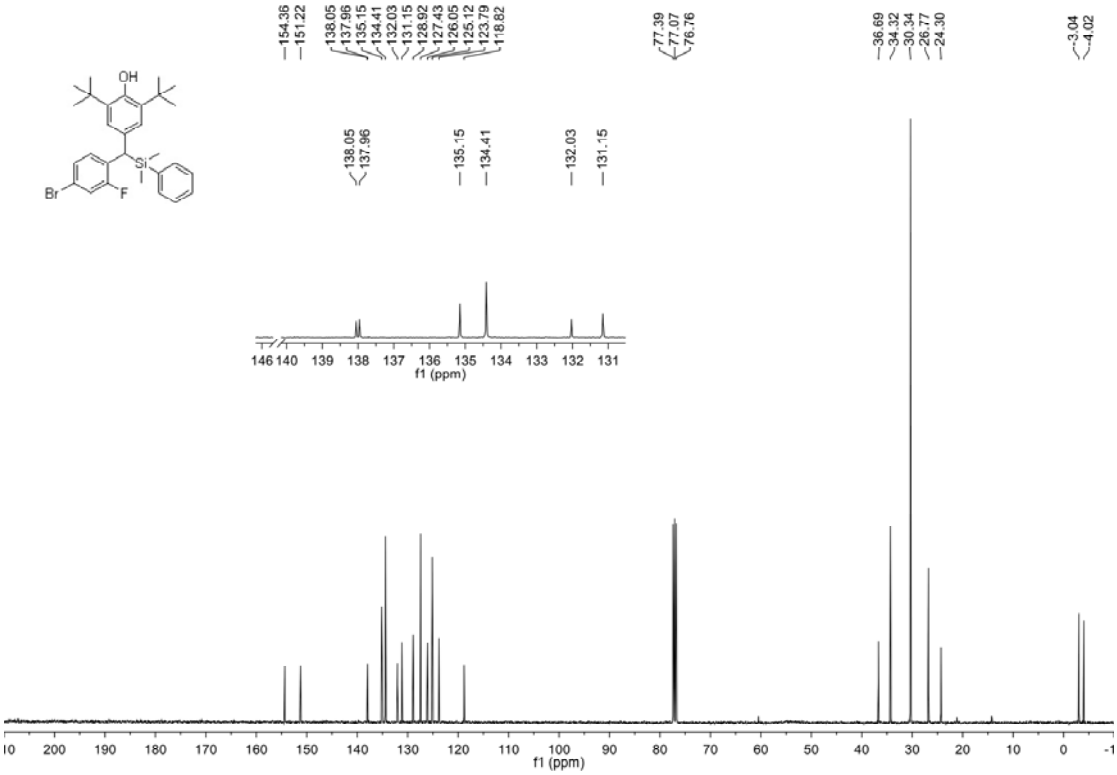
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7y**



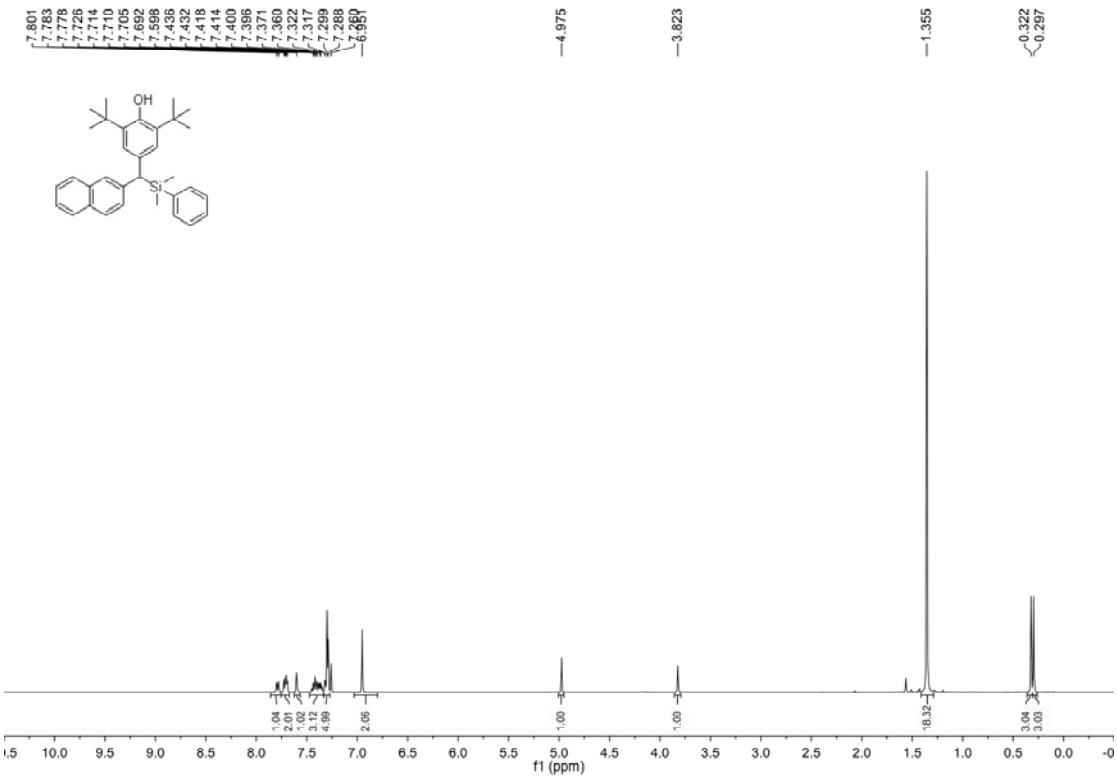
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7y**



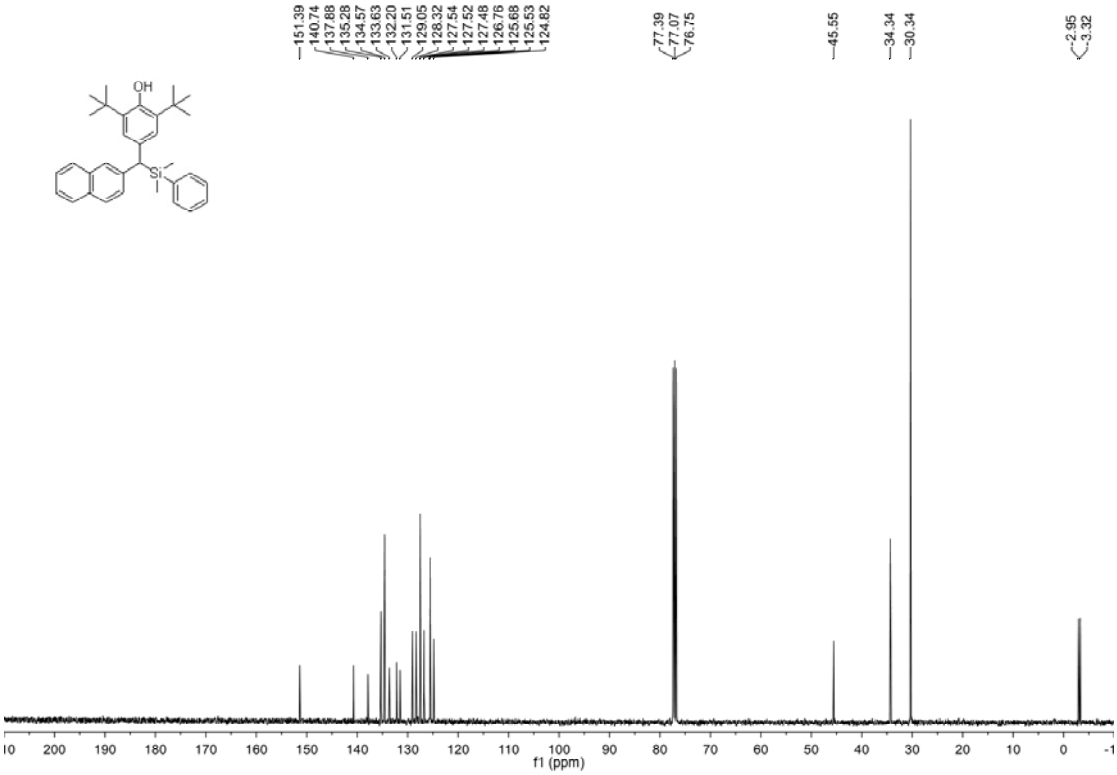
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7z**



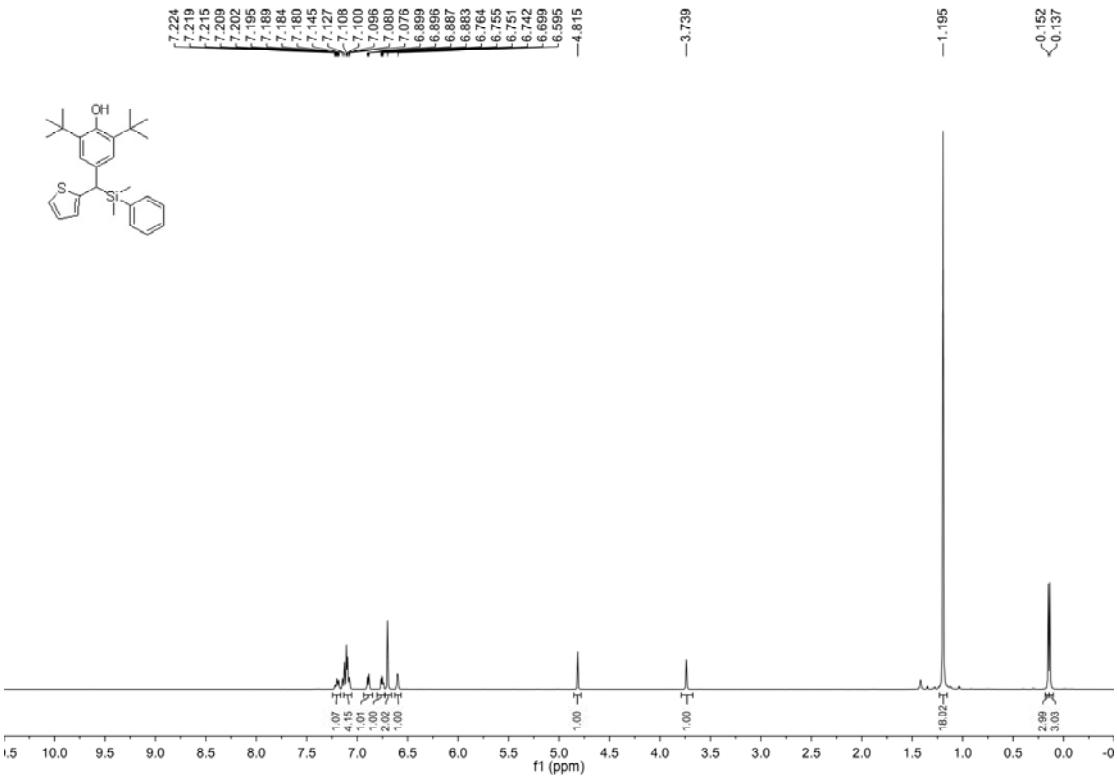
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7z**



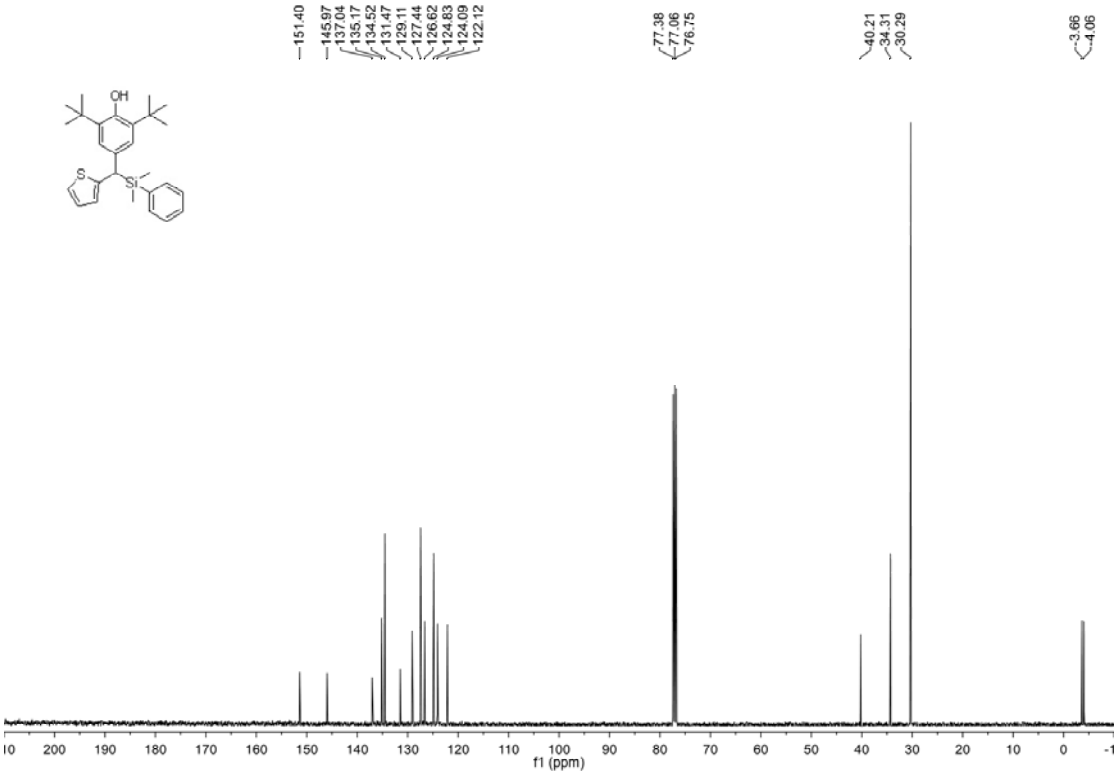
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7A**



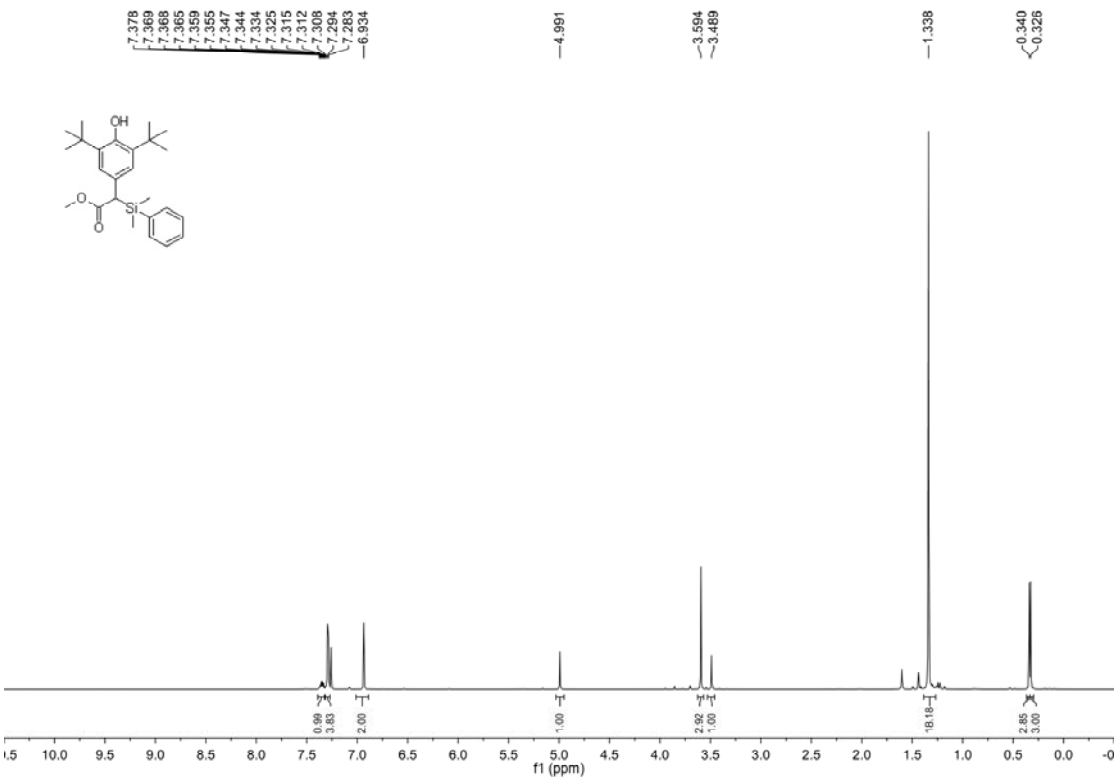
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7A**



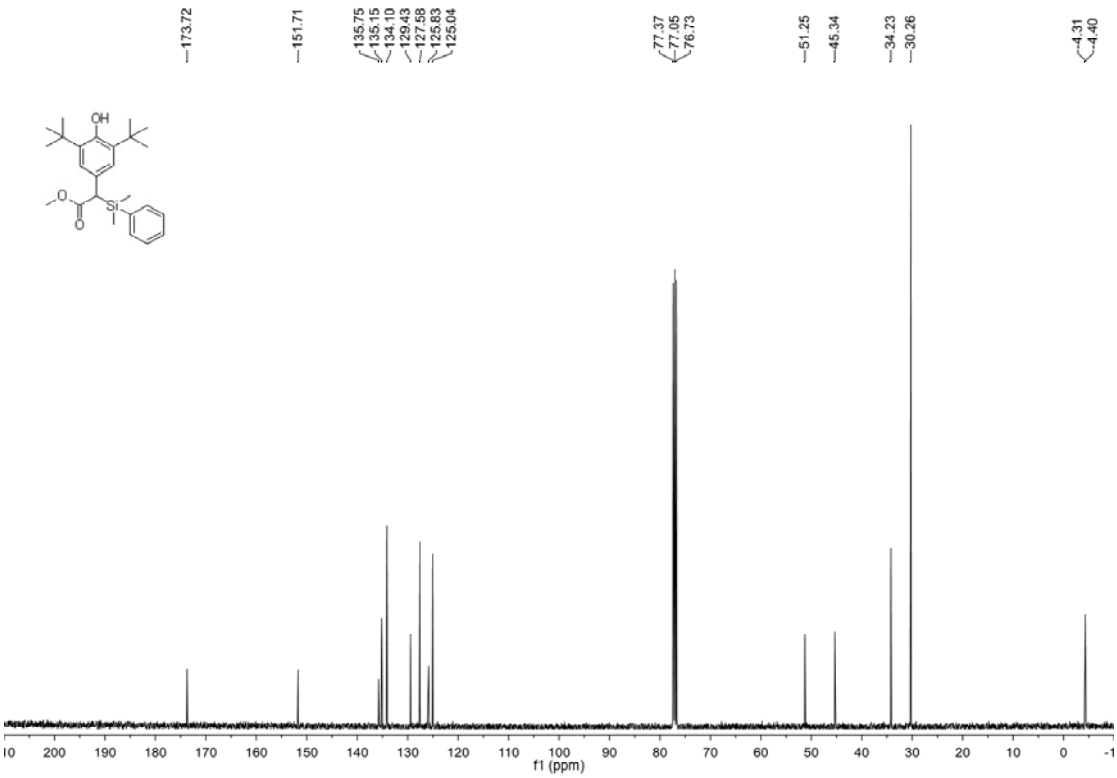
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7B**



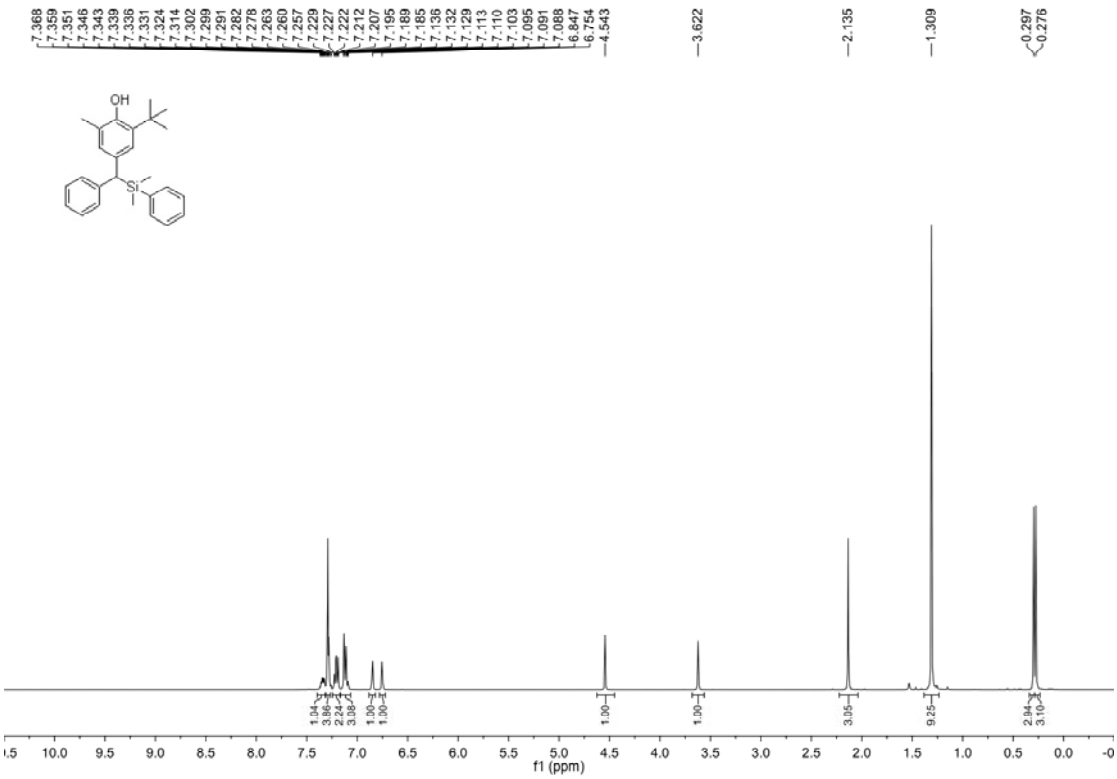
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7B**



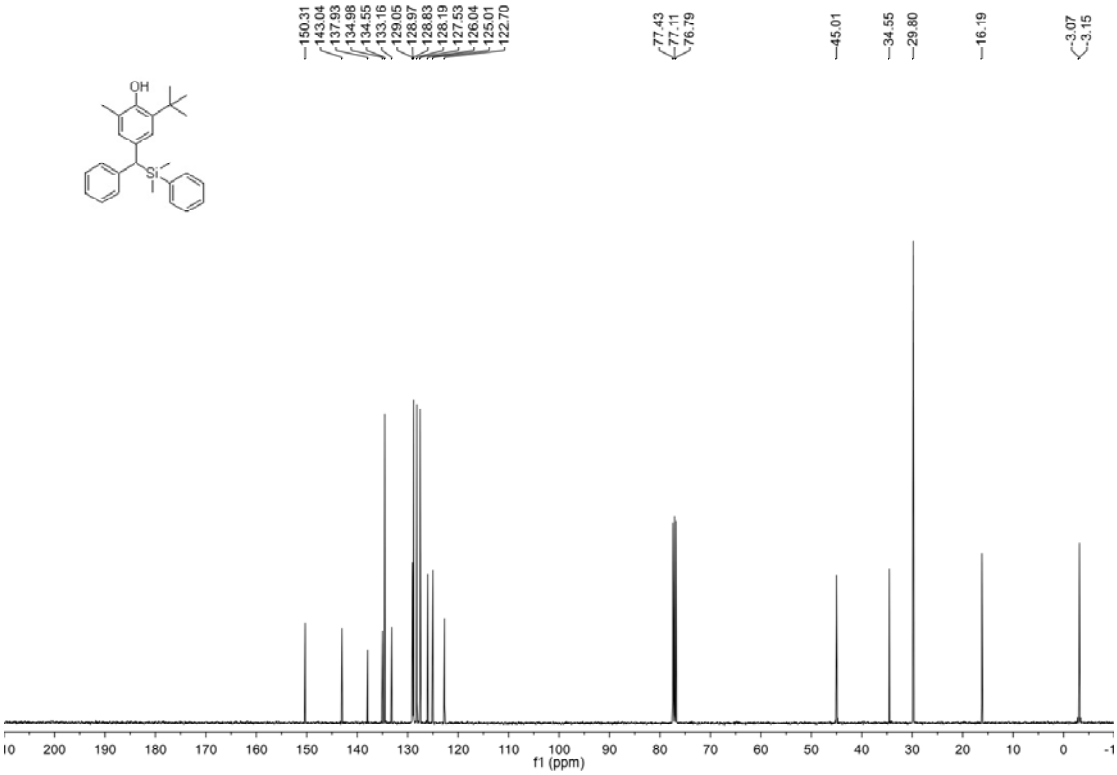
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7C**



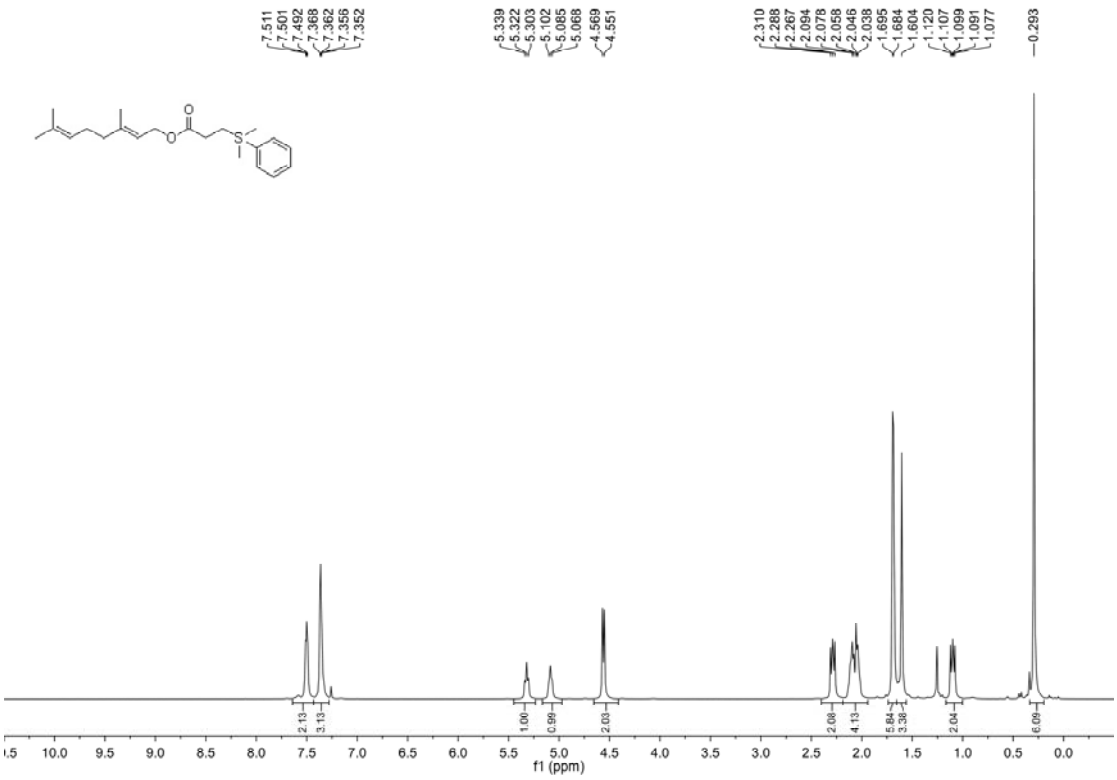
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7C**



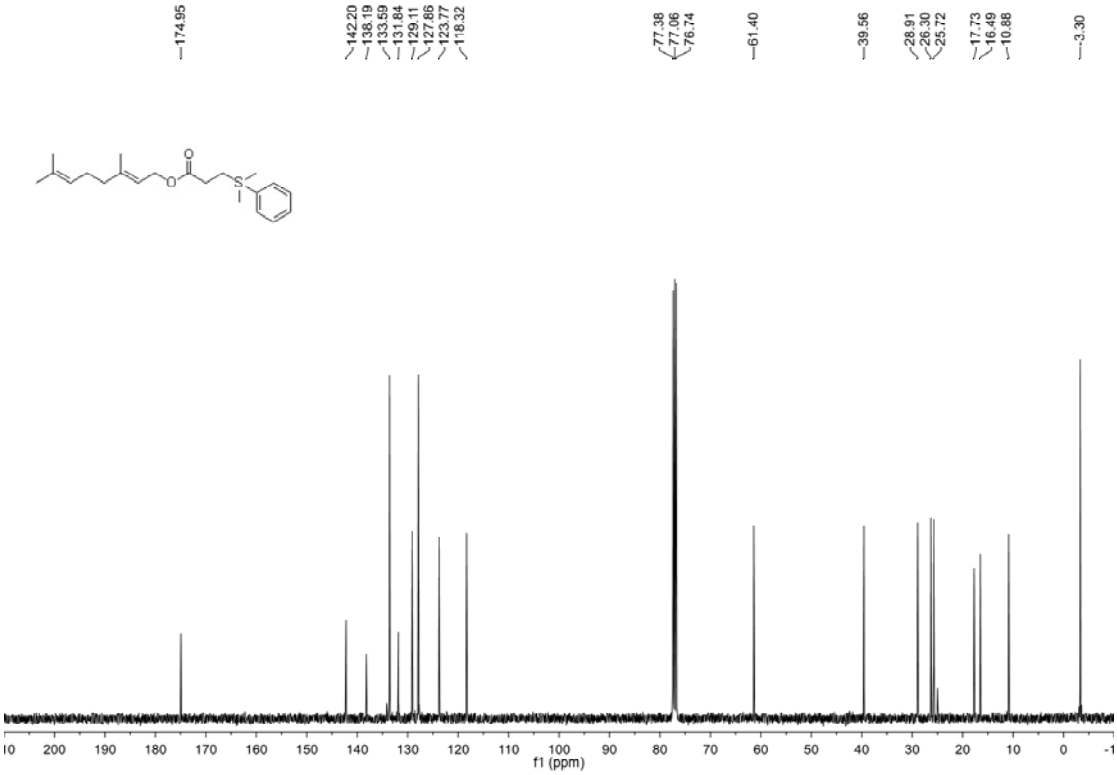
^{1}H NMR (400 MHz, $CDCl_3$) of compound **7D**



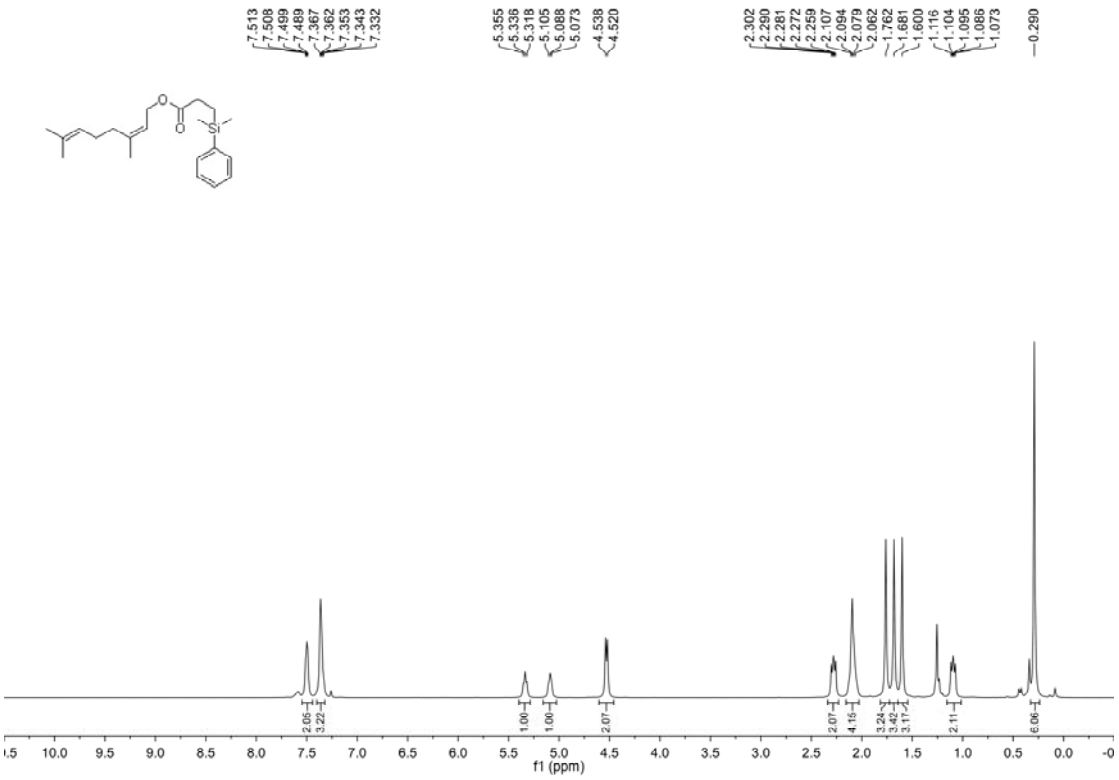
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **7D**



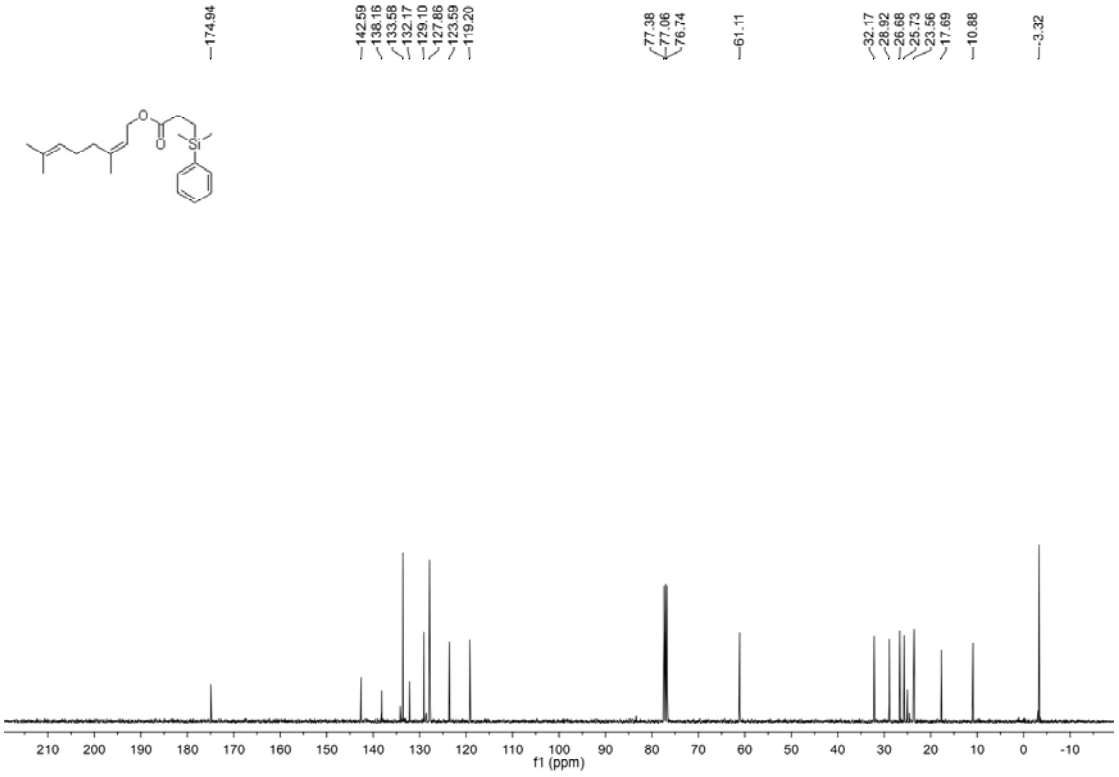
^{1}H NMR (400 MHz, $CDCl_3$) of compound **9a**



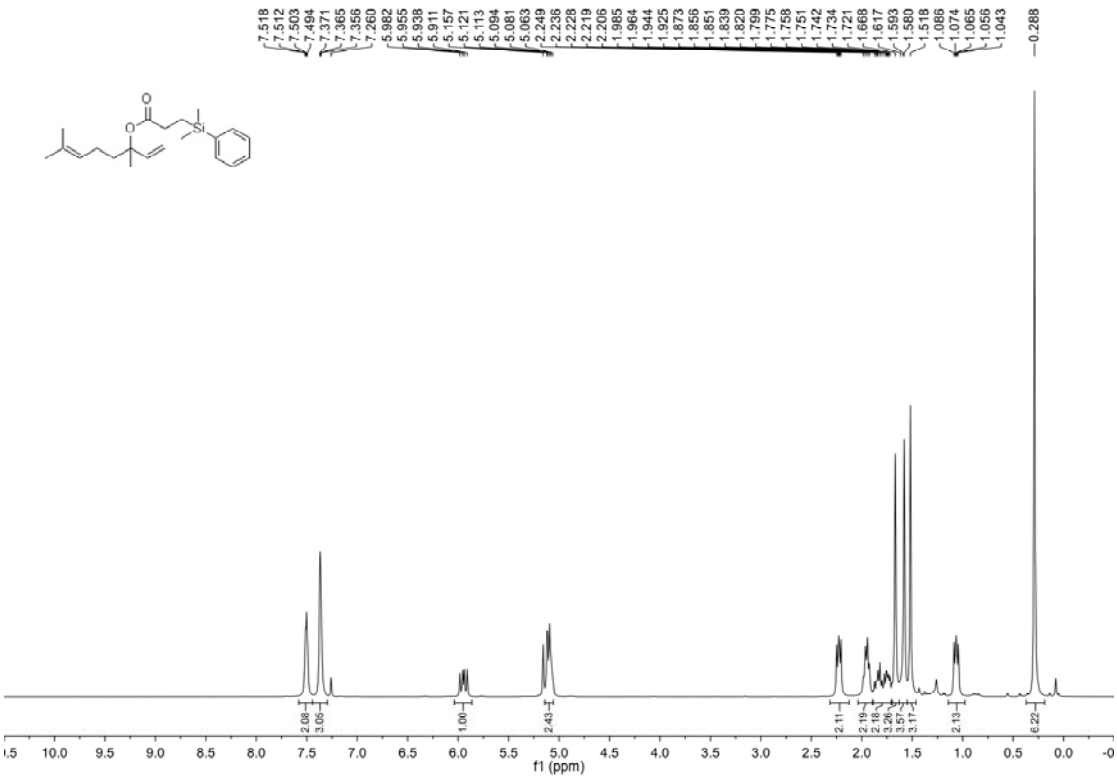
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **9a**



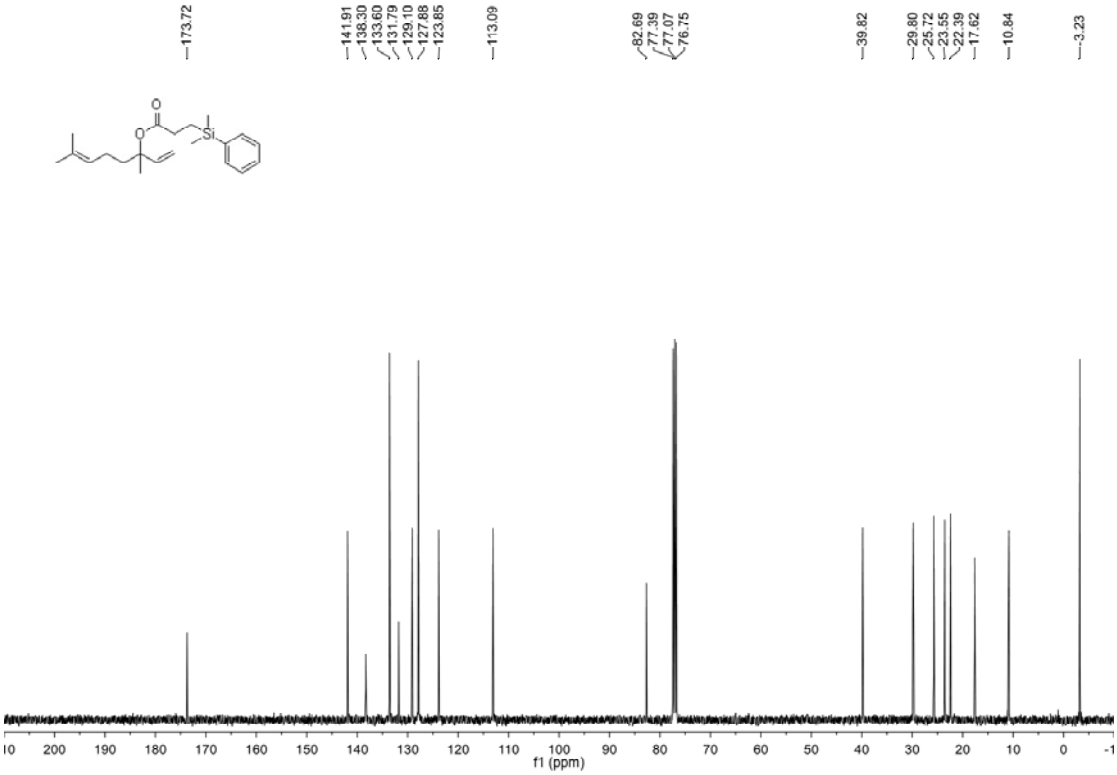
^{1}H NMR (400 MHz, $CDCl_3$) of compound **9b**



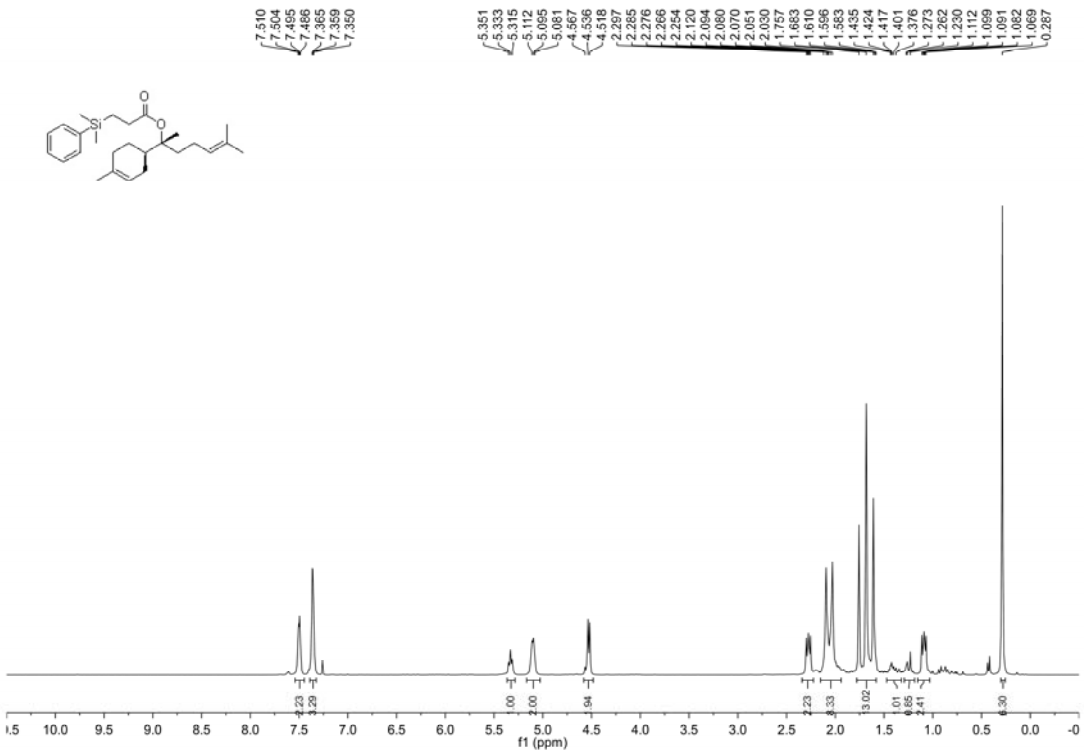
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **9b**



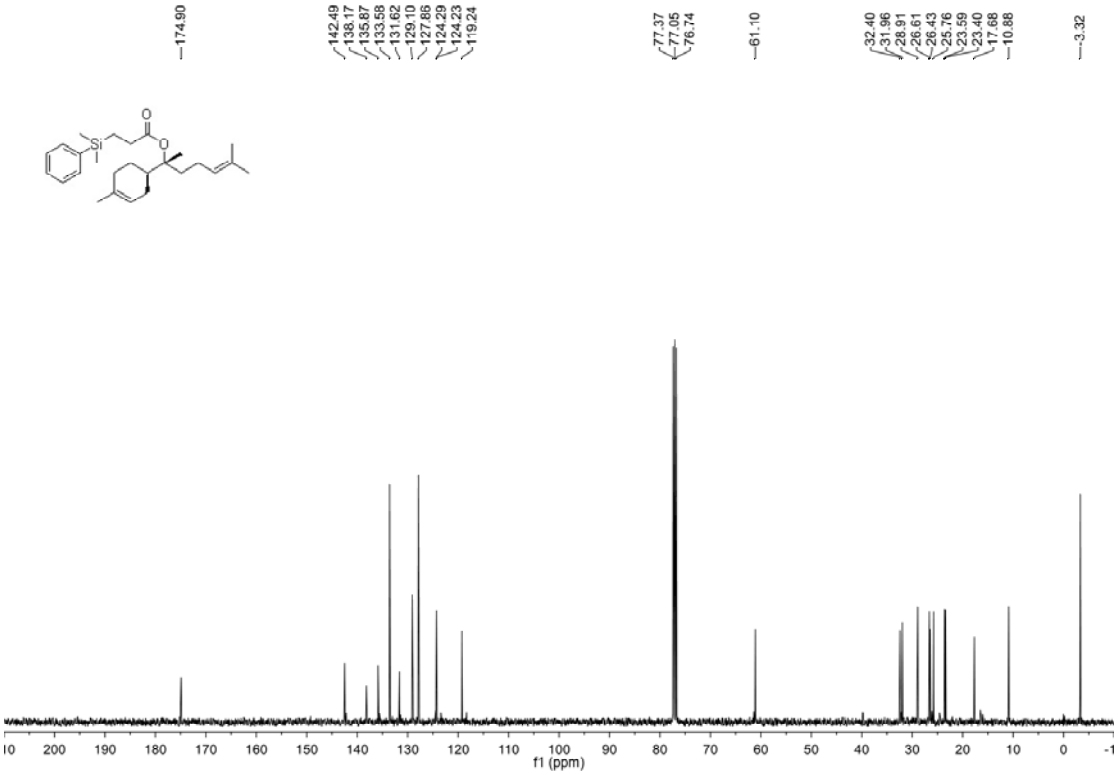
^{1}H NMR (400 MHz, $CDCl_3$) of compound **9c**



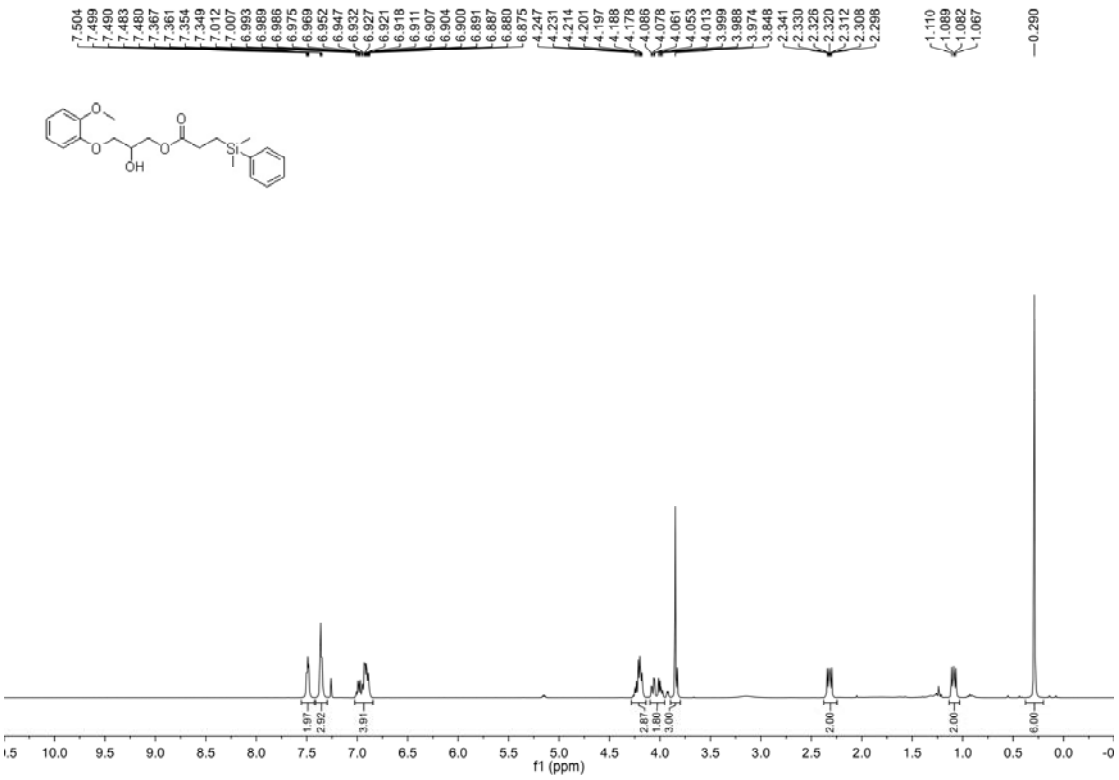
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **9c**



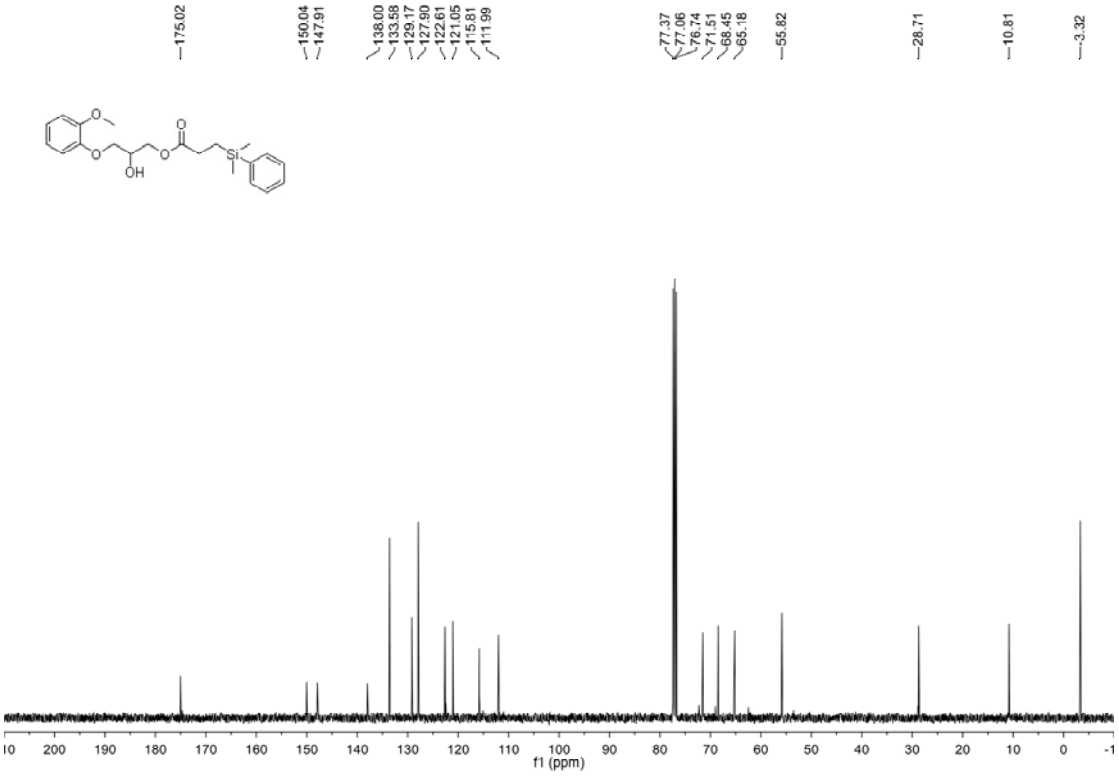
^{1}H NMR (400 MHz, $CDCl_3$) of compound **9d**



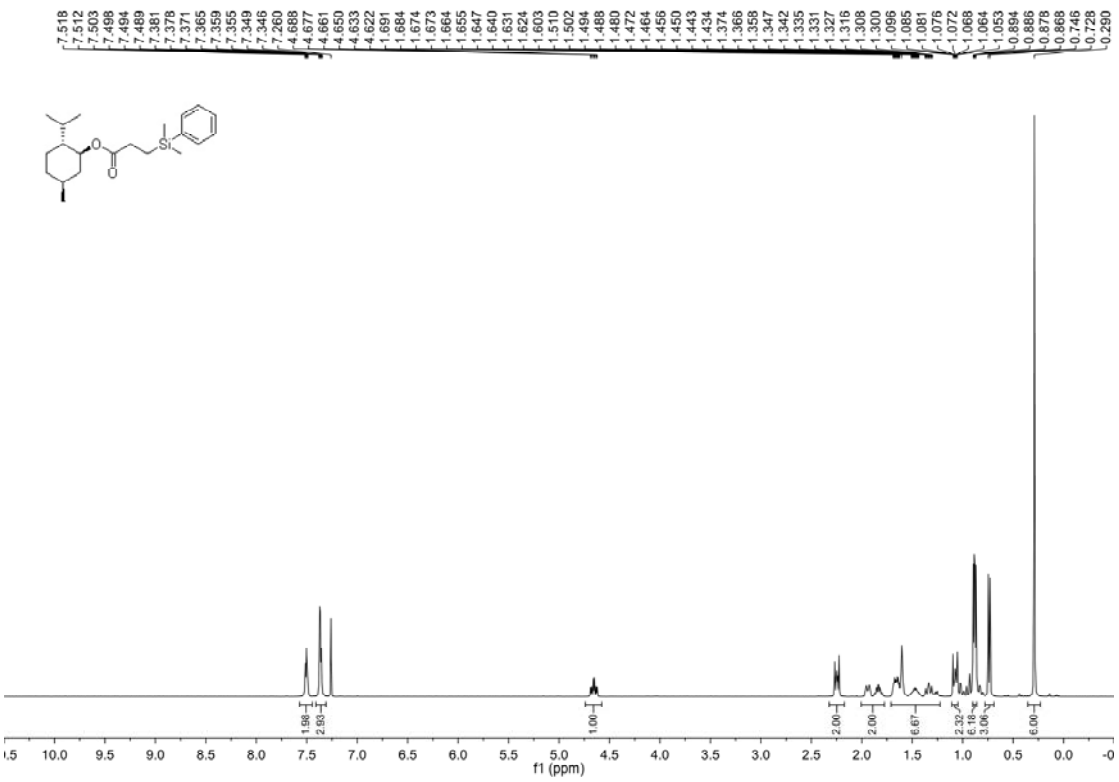
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **9d**



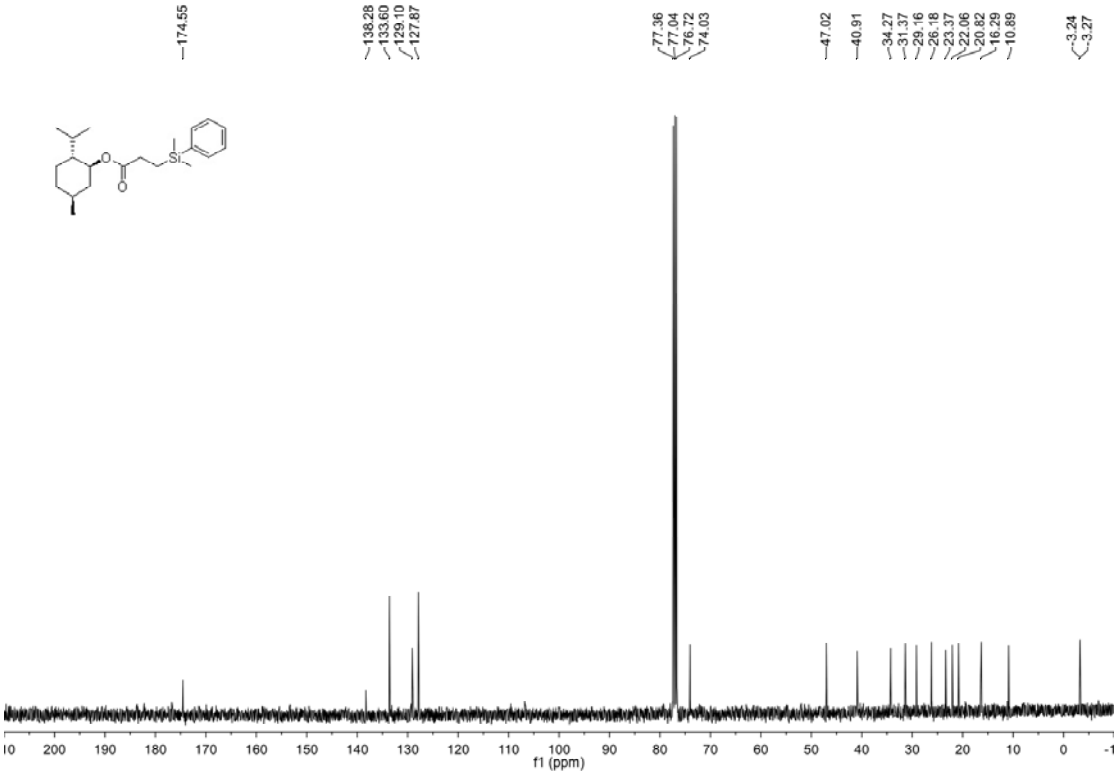
^{1}H NMR (400 MHz, $CDCl_3$) of compound **9e**



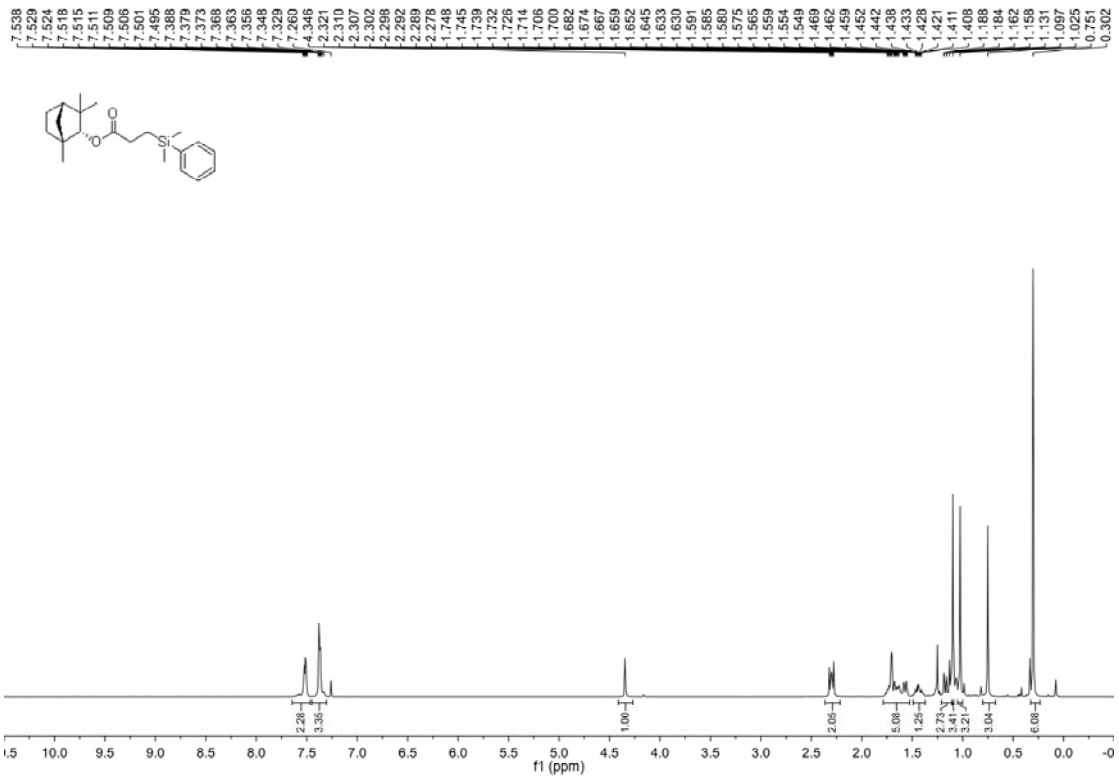
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **9e**



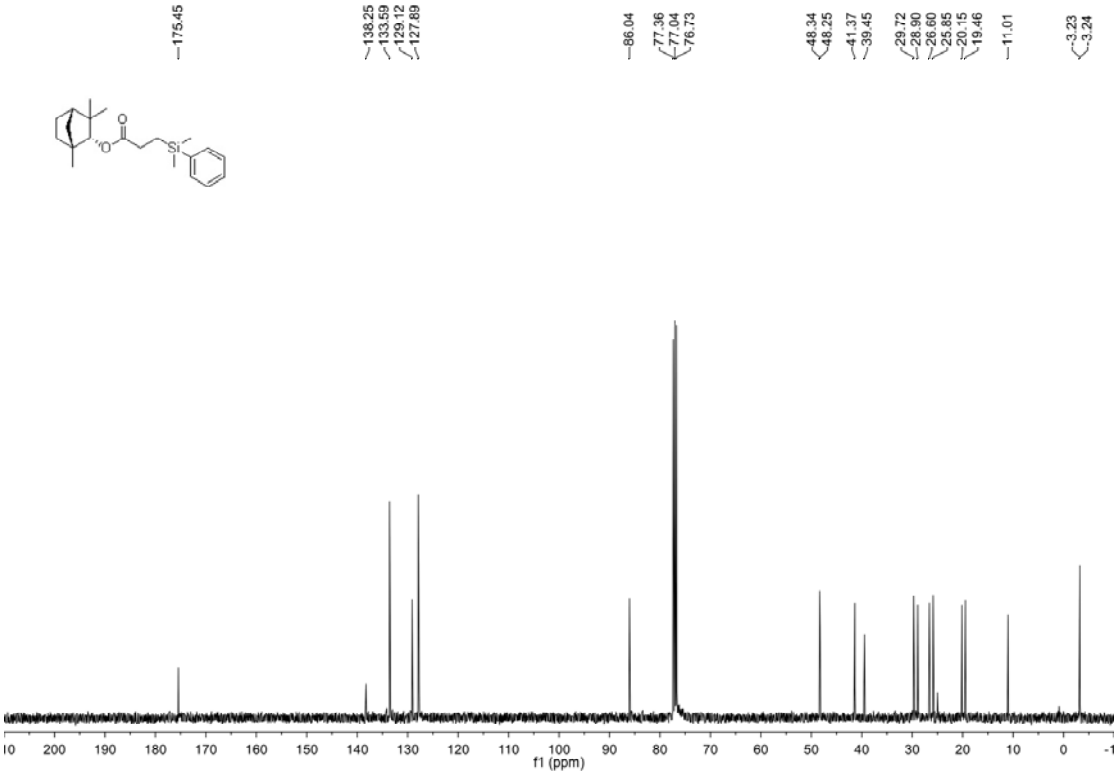
^{1}H NMR (400 MHz, $CDCl_3$) of compound **9f**



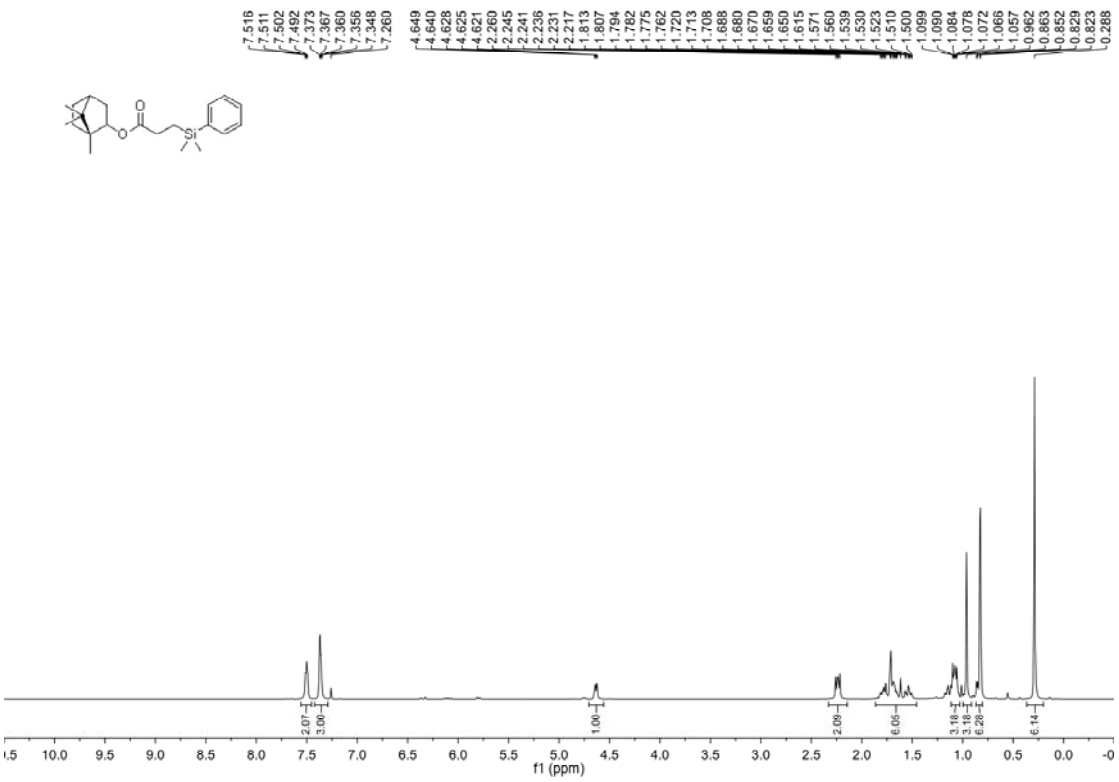
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **9f**



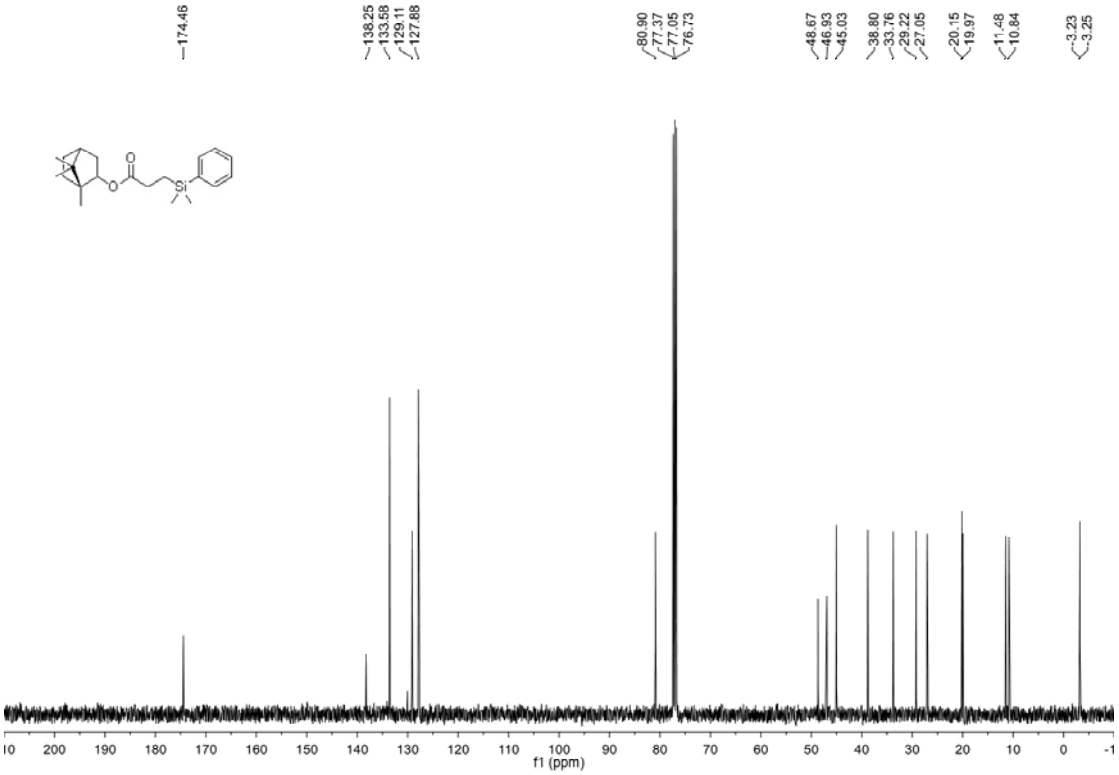
^{1}H NMR (400 MHz, $CDCl_3$) of compound **9g**



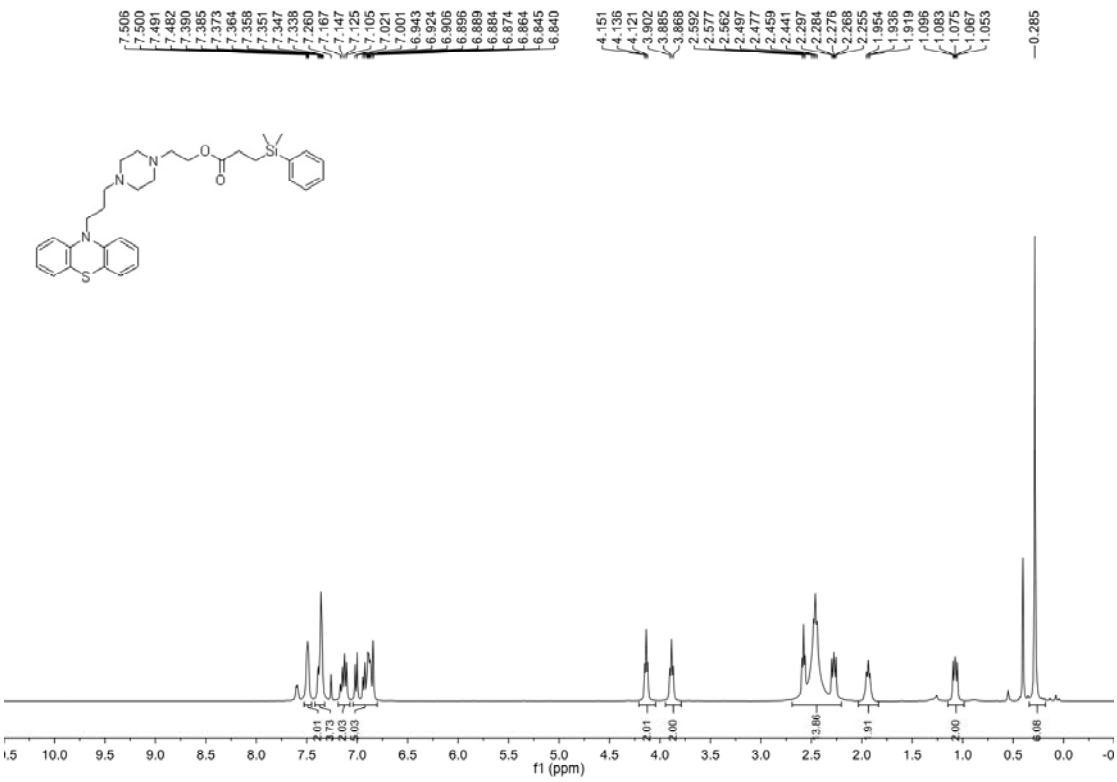
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **9g**



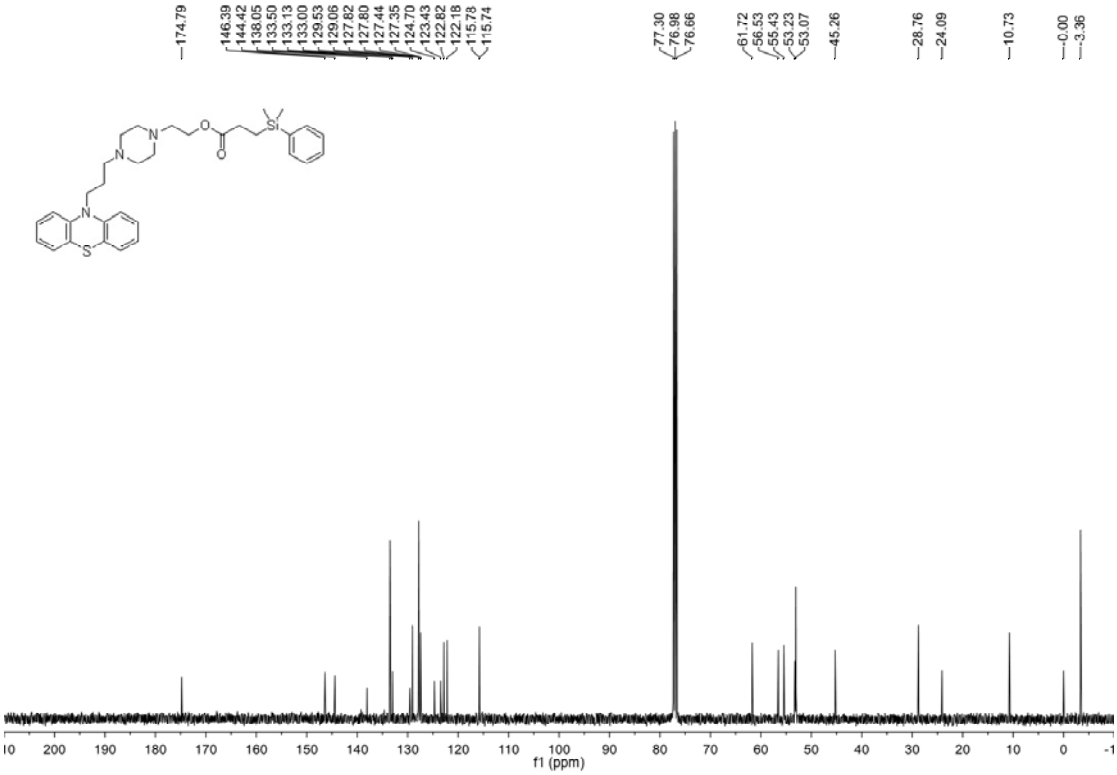
^{1}H NMR (400 MHz, $CDCl_3$) of compound **9h**



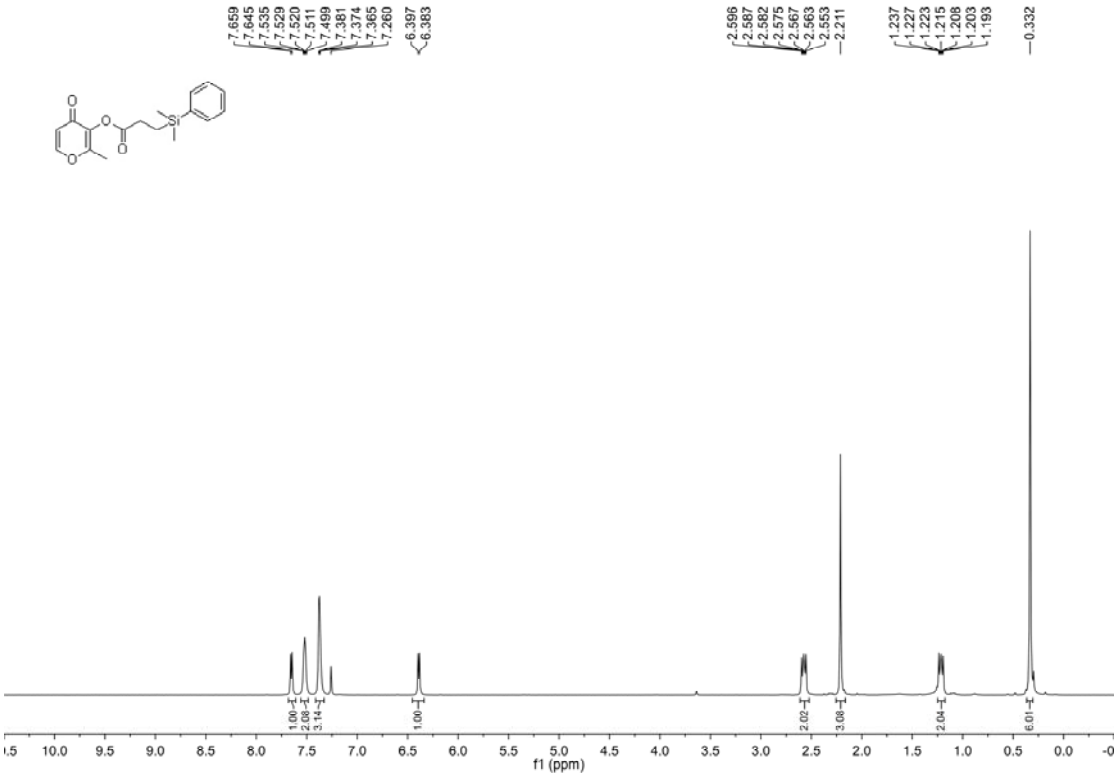
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **9h**



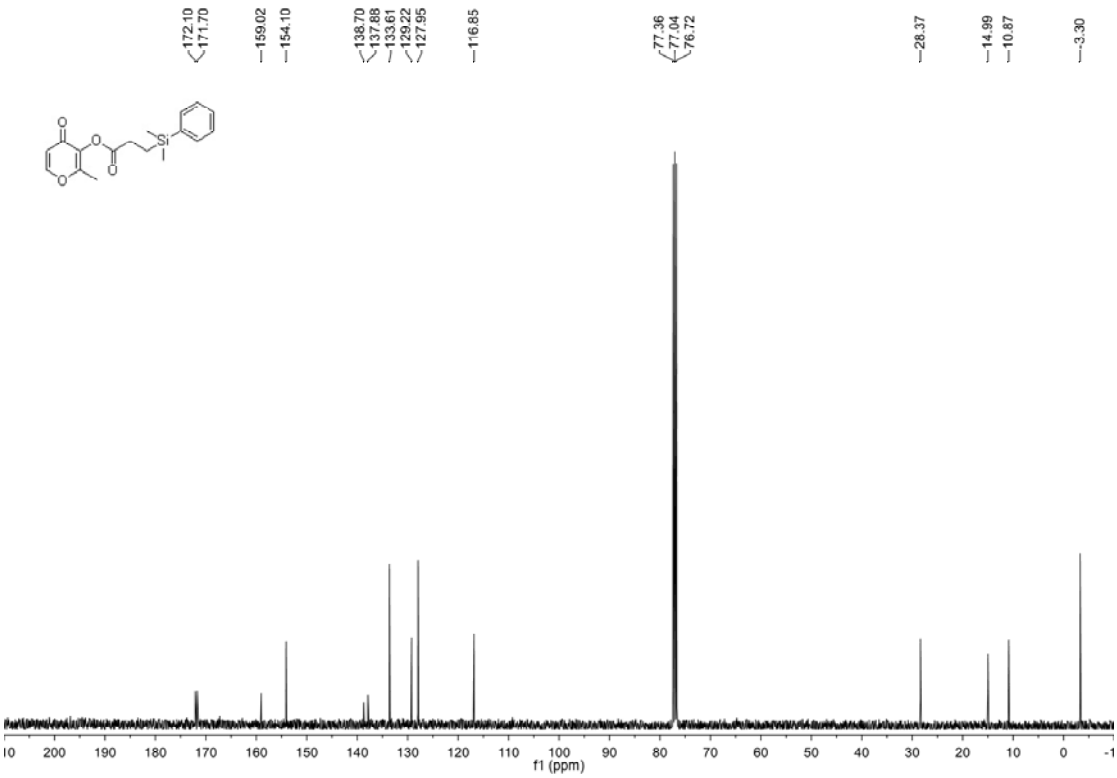
^{1}H NMR (400 MHz, $CDCl_3$) of compound **9i**



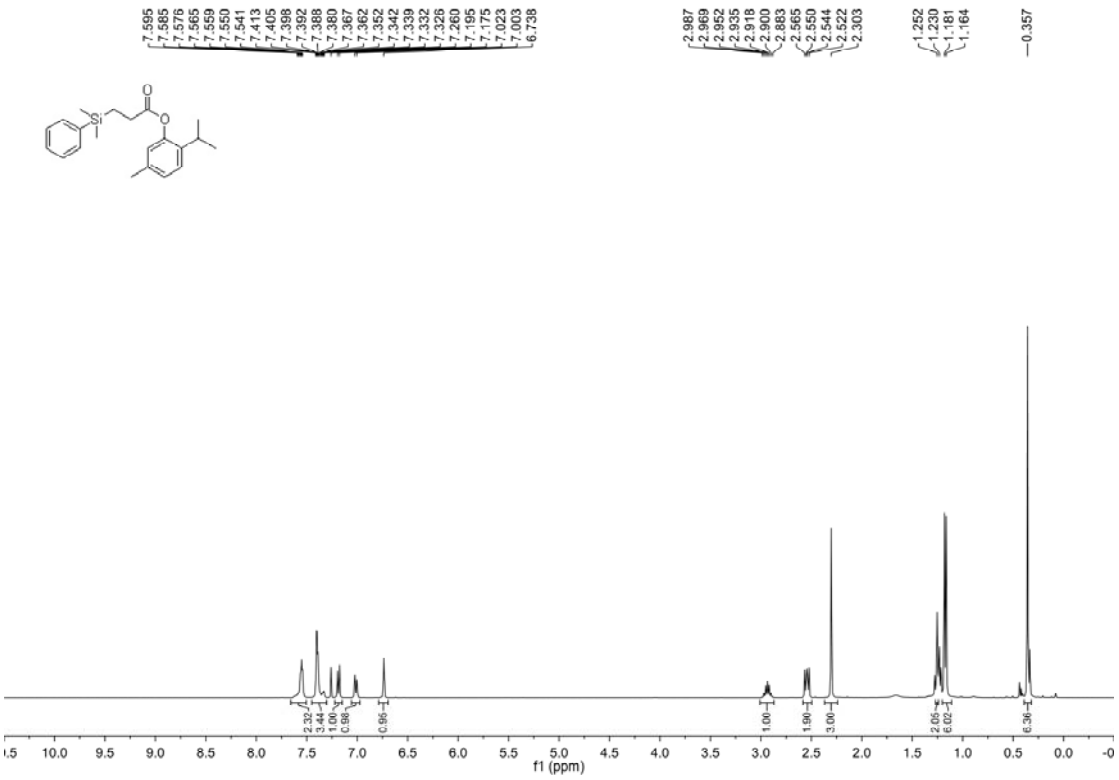
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **9i**



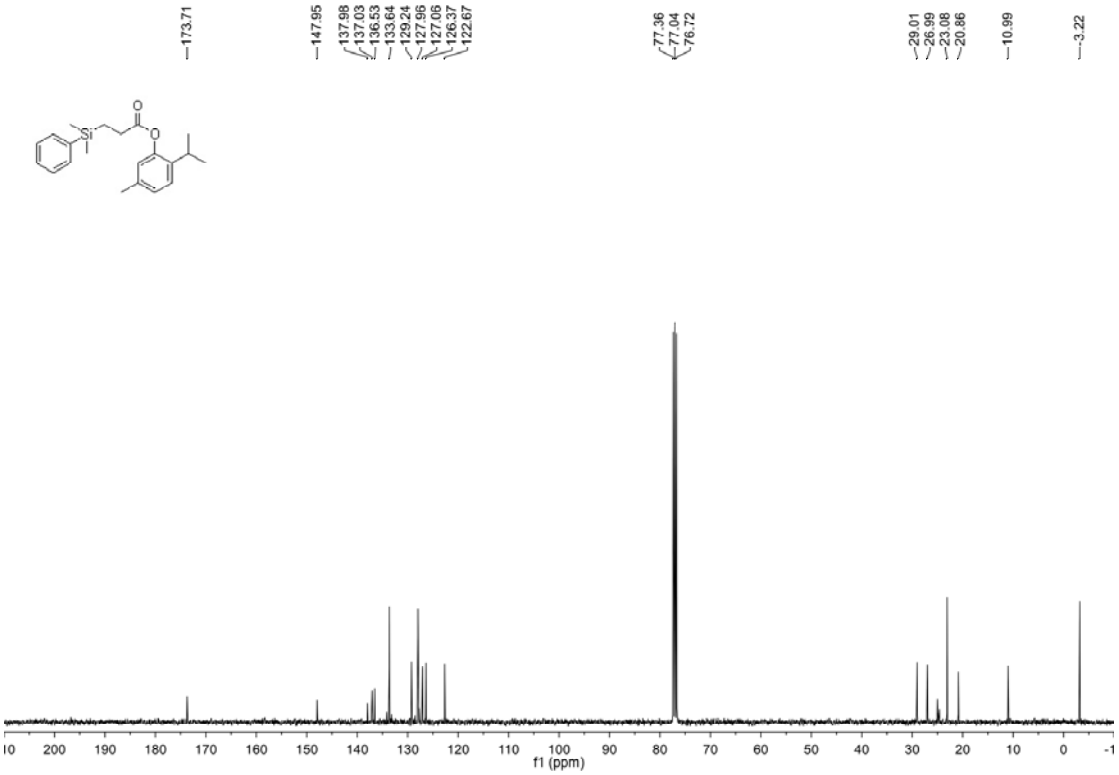
^{1}H NMR (400 MHz, $CDCl_3$) of compound **9j**



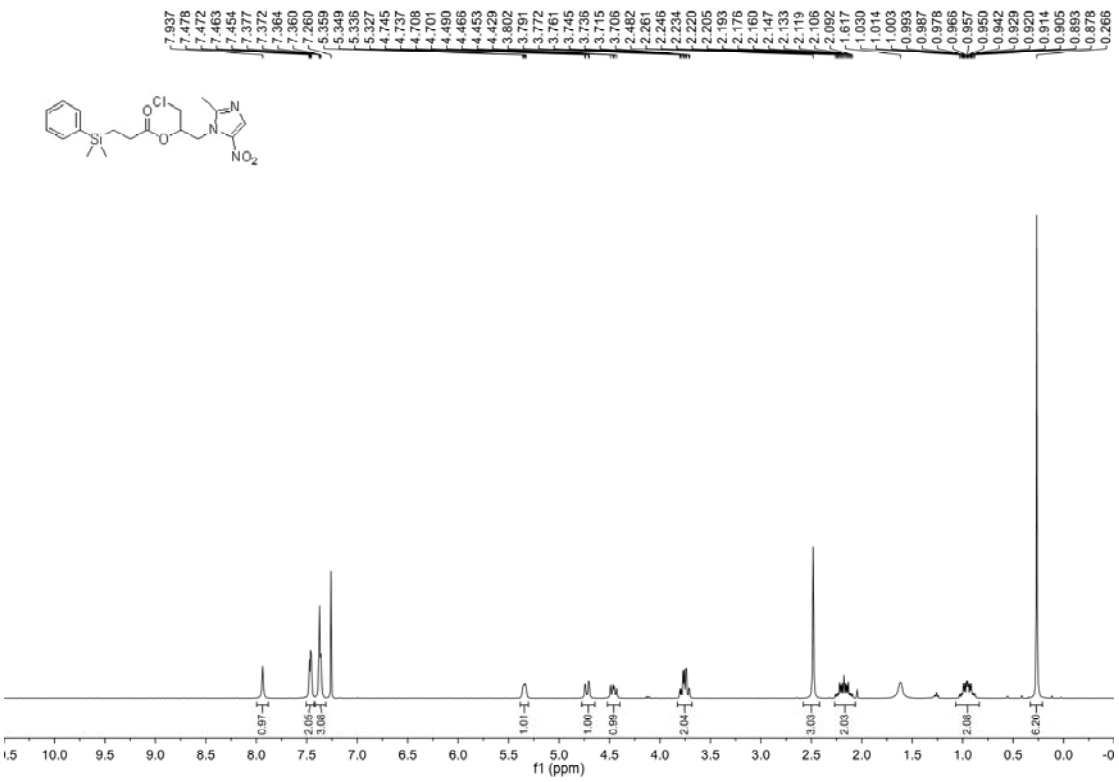
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **9j**



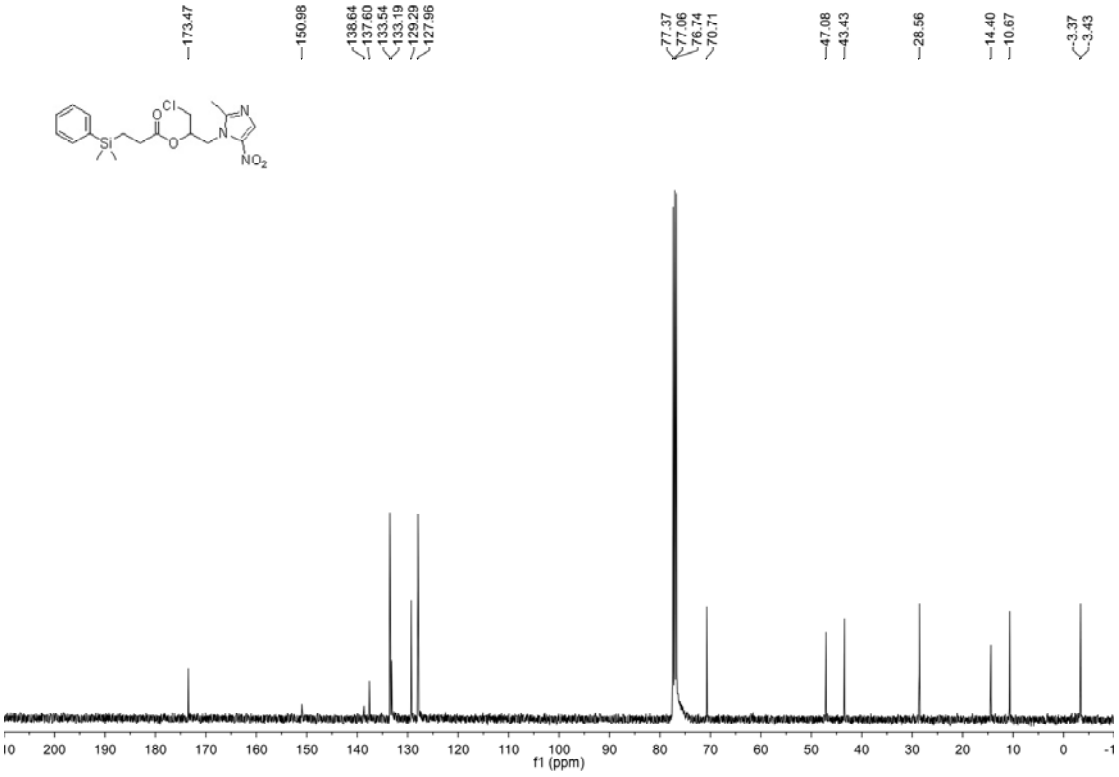
^{1}H NMR (400 MHz, $CDCl_3$) of compound **9k**



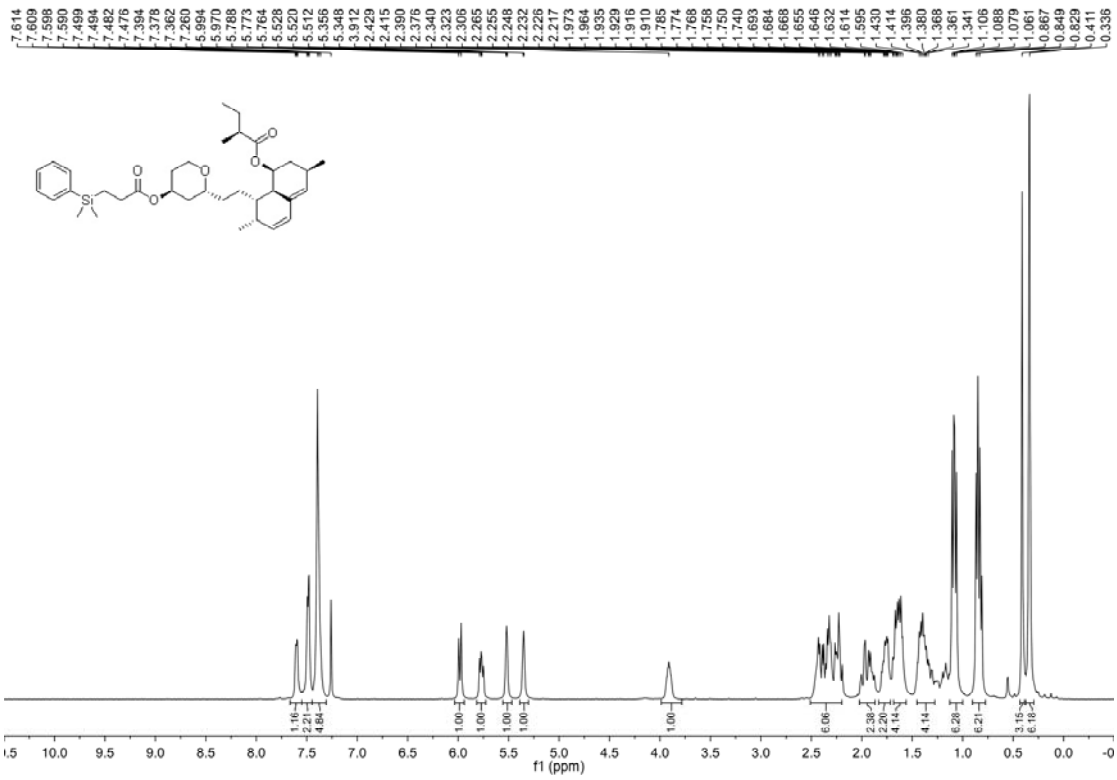
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **9k**



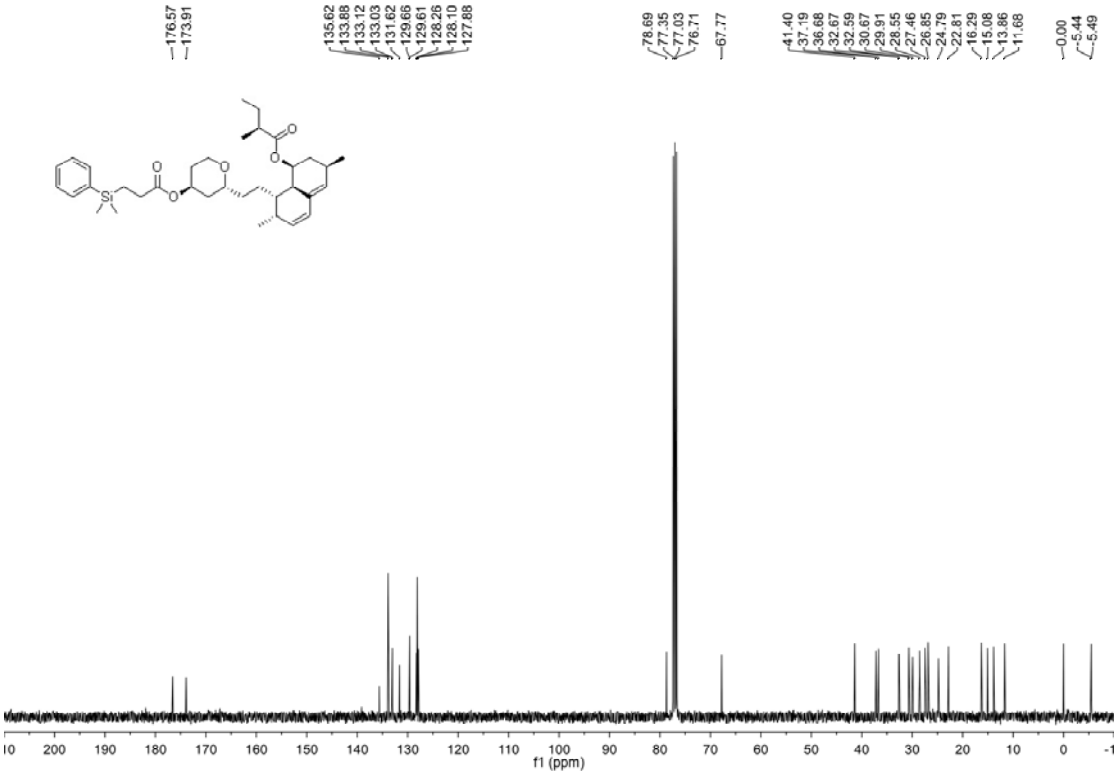
^{1}H NMR (400 MHz, $CDCl_3$) of compound **9l**



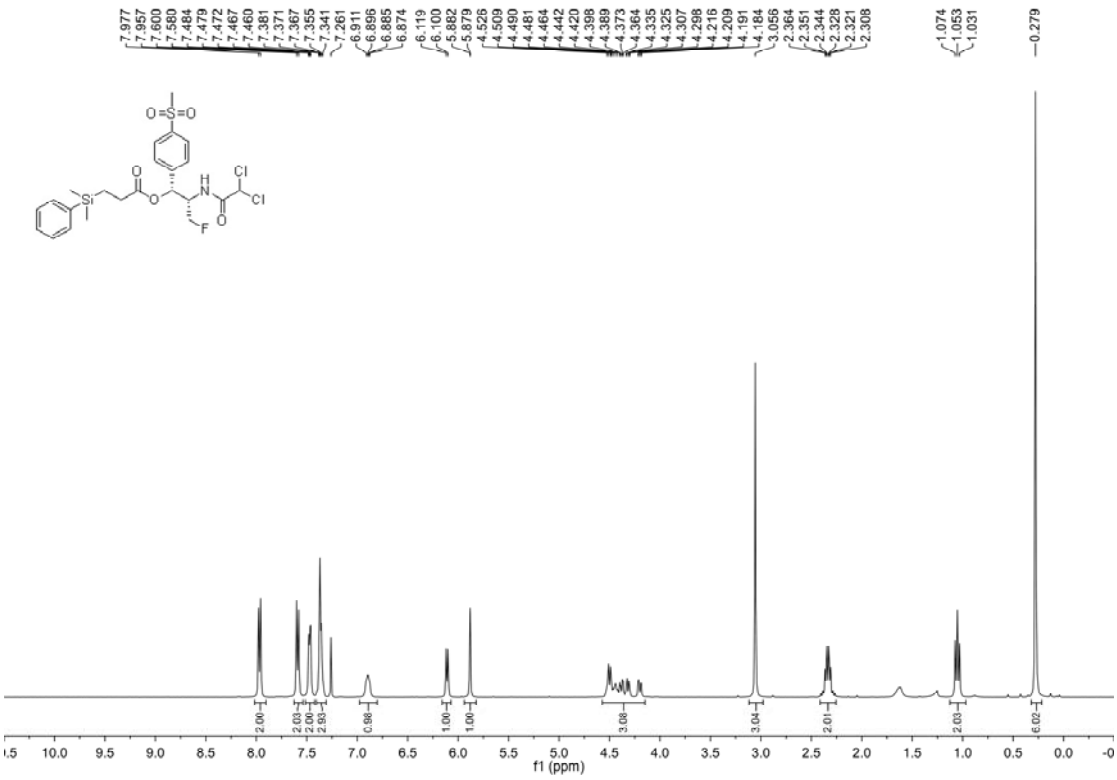
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **9l**



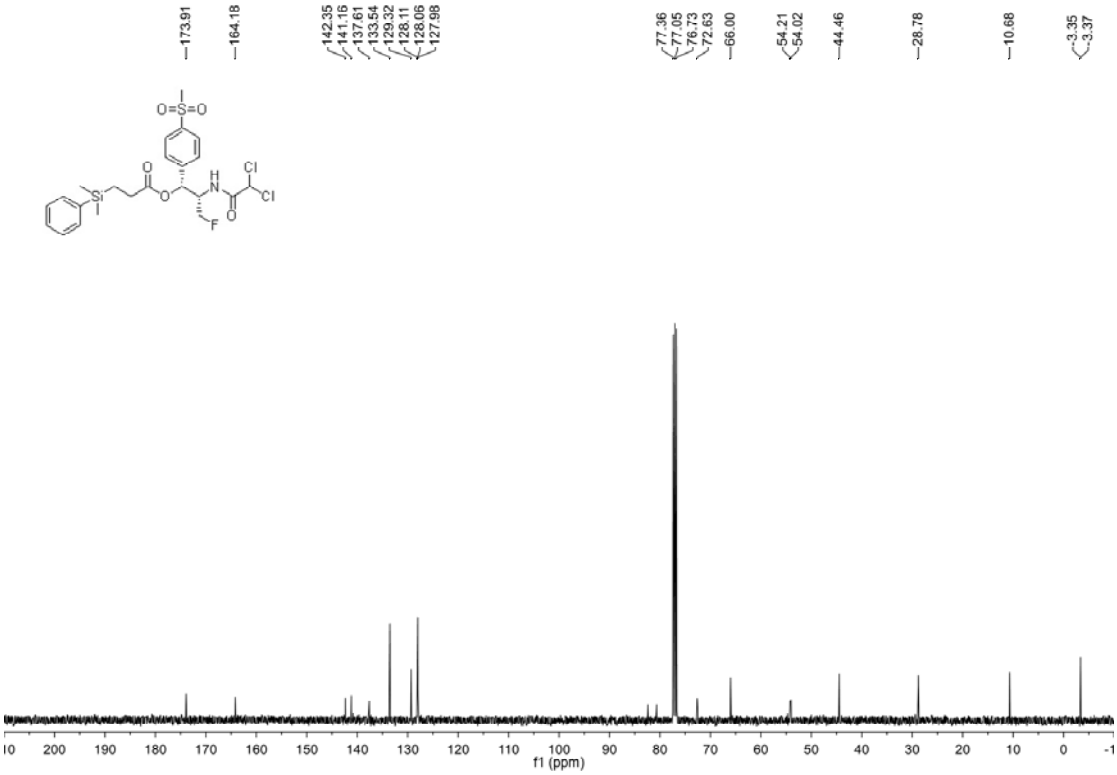
^{1}H NMR (400 MHz, $CDCl_3$) of compound **9m**



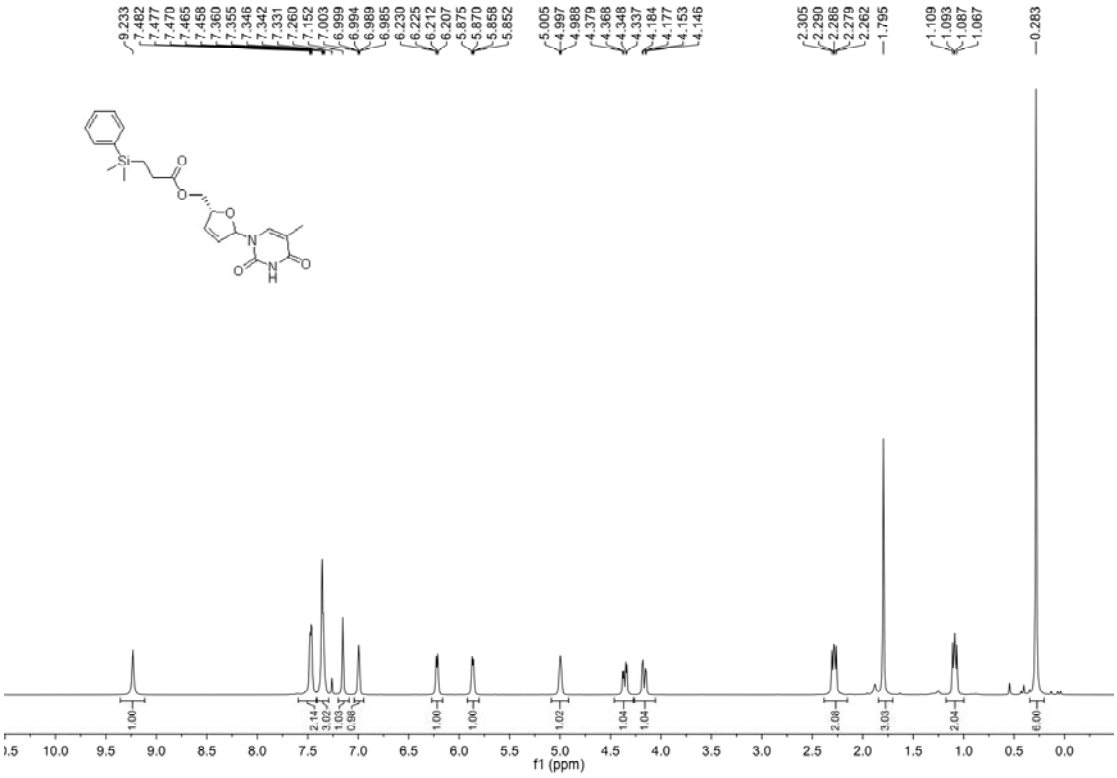
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **9m**



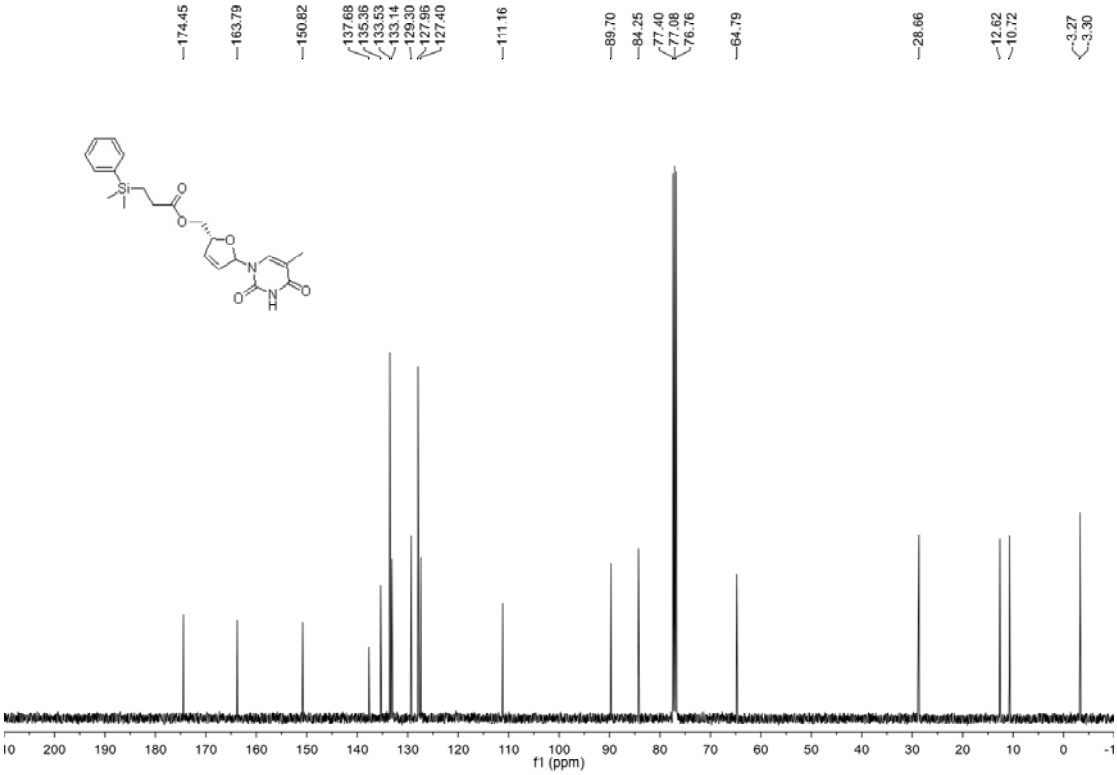
^{1}H NMR (400 MHz, $CDCl_3$) of compound **9n**



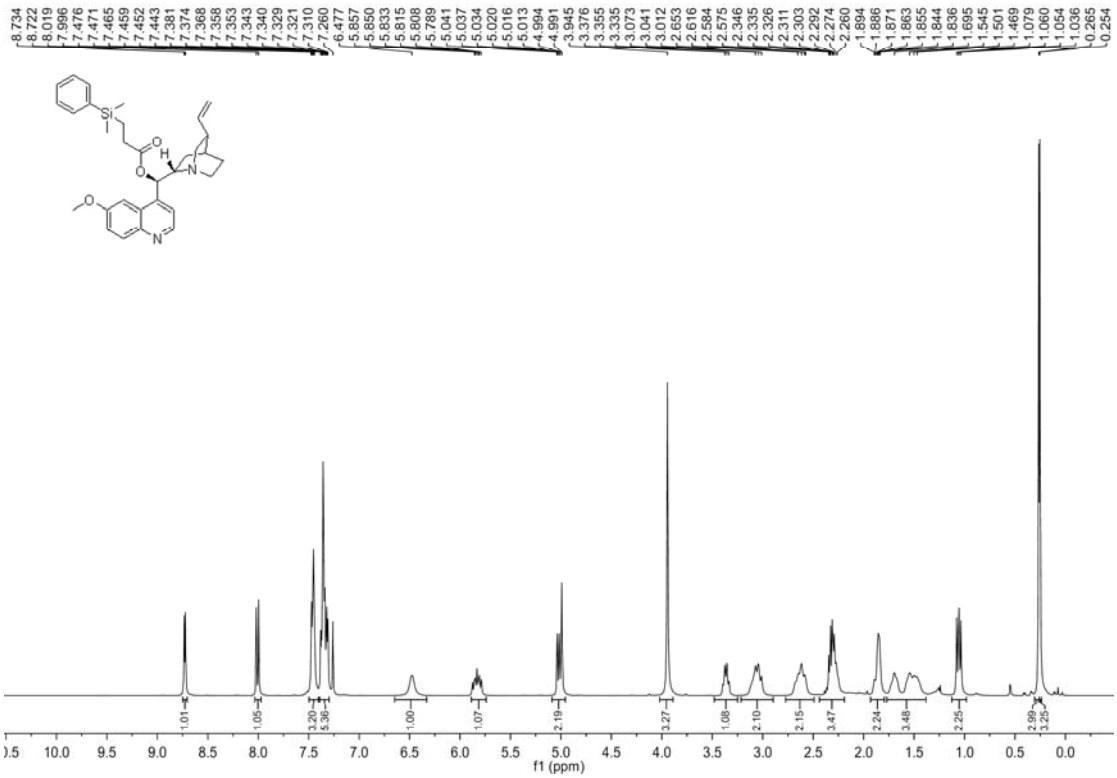
^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) of compound **9n**



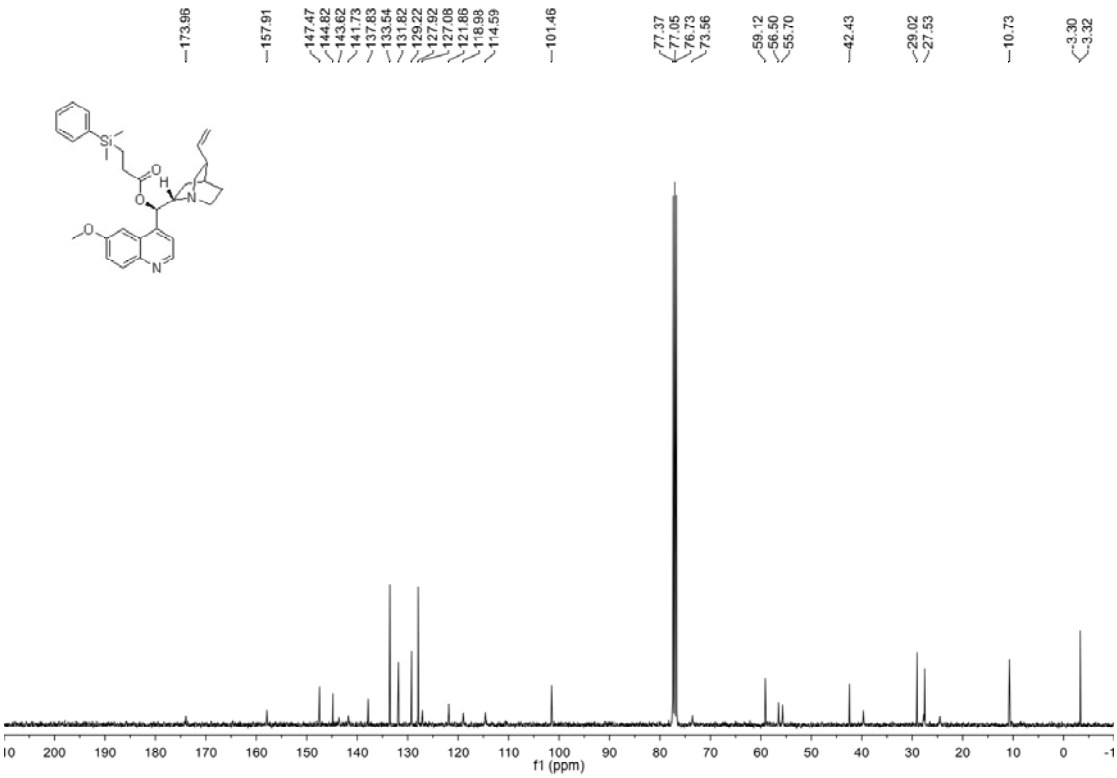
^{1}H NMR (400 MHz, $CDCl_3$) of compound **9o**



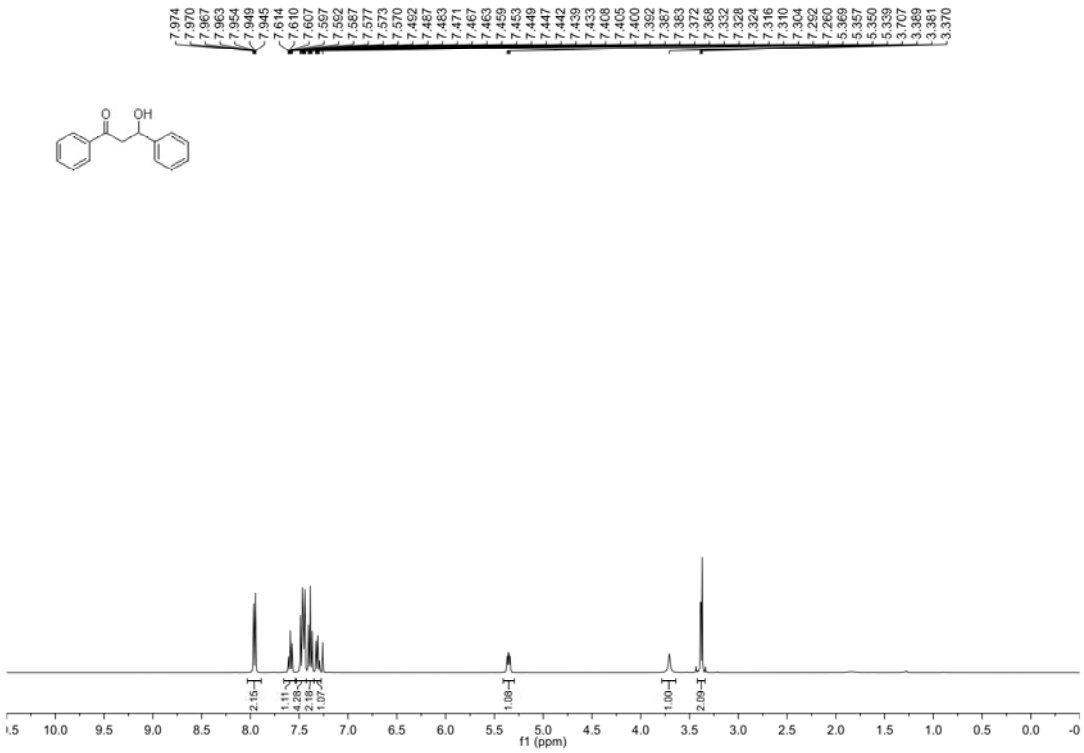
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **9o**



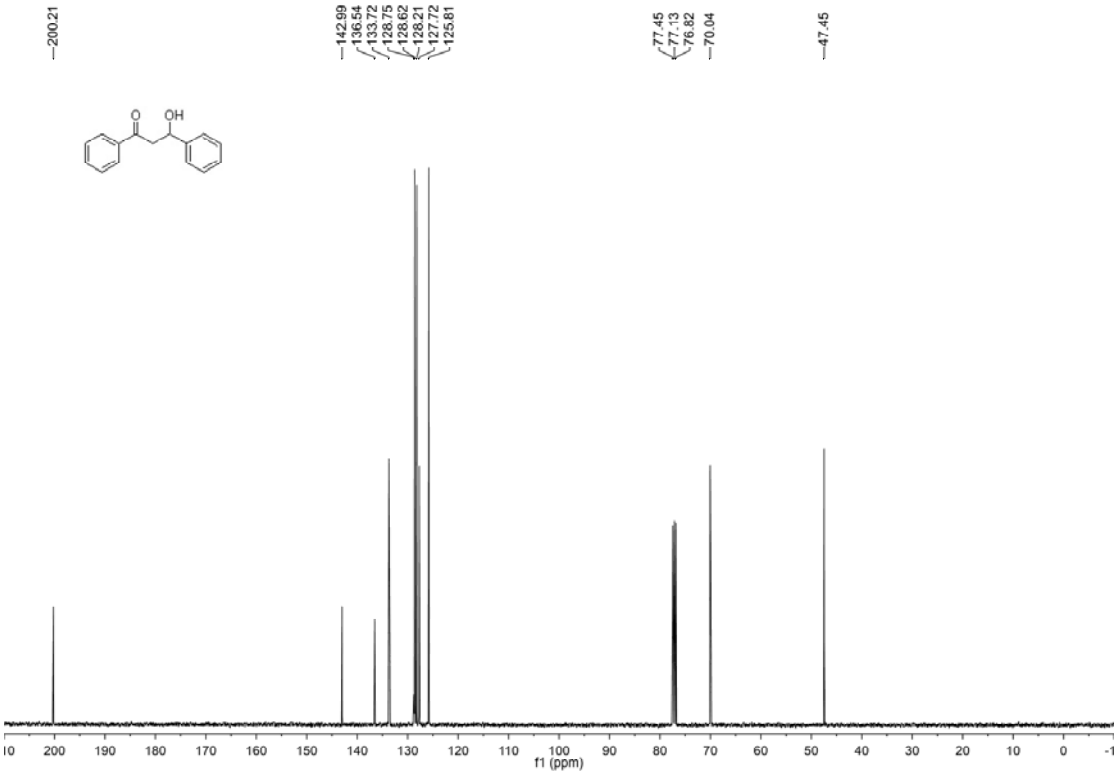
^{1}H NMR (400 MHz, $CDCl_3$) of compound **9p**



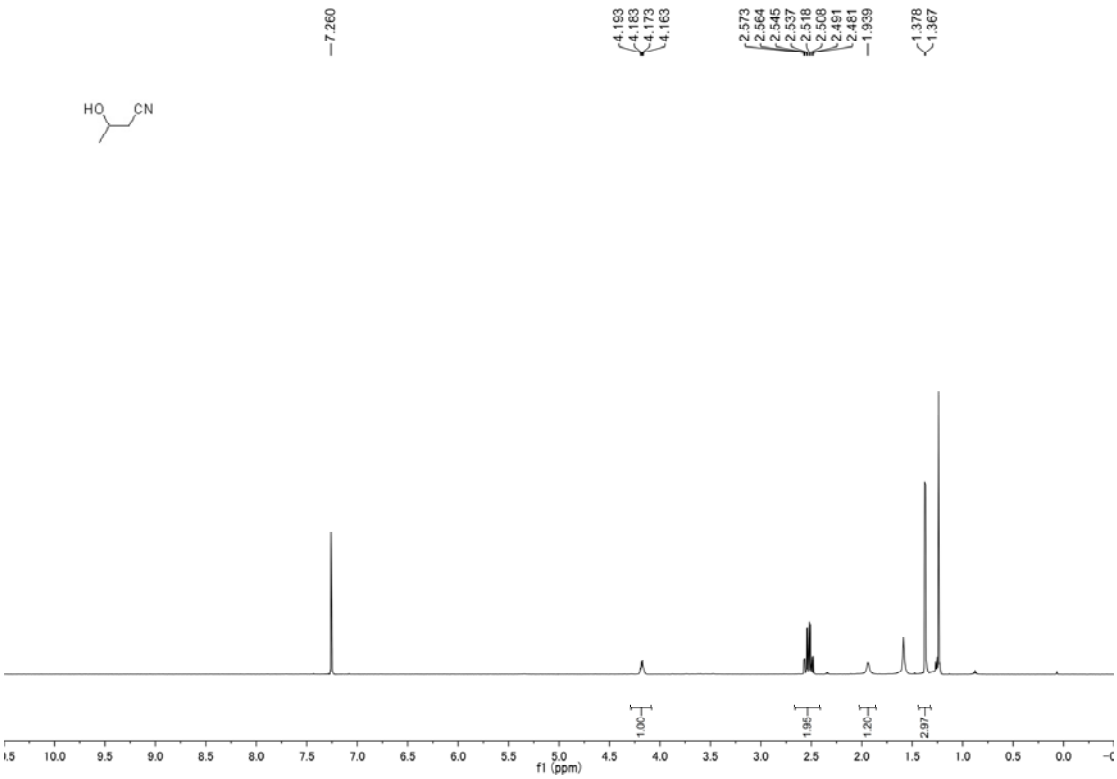
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **9p**



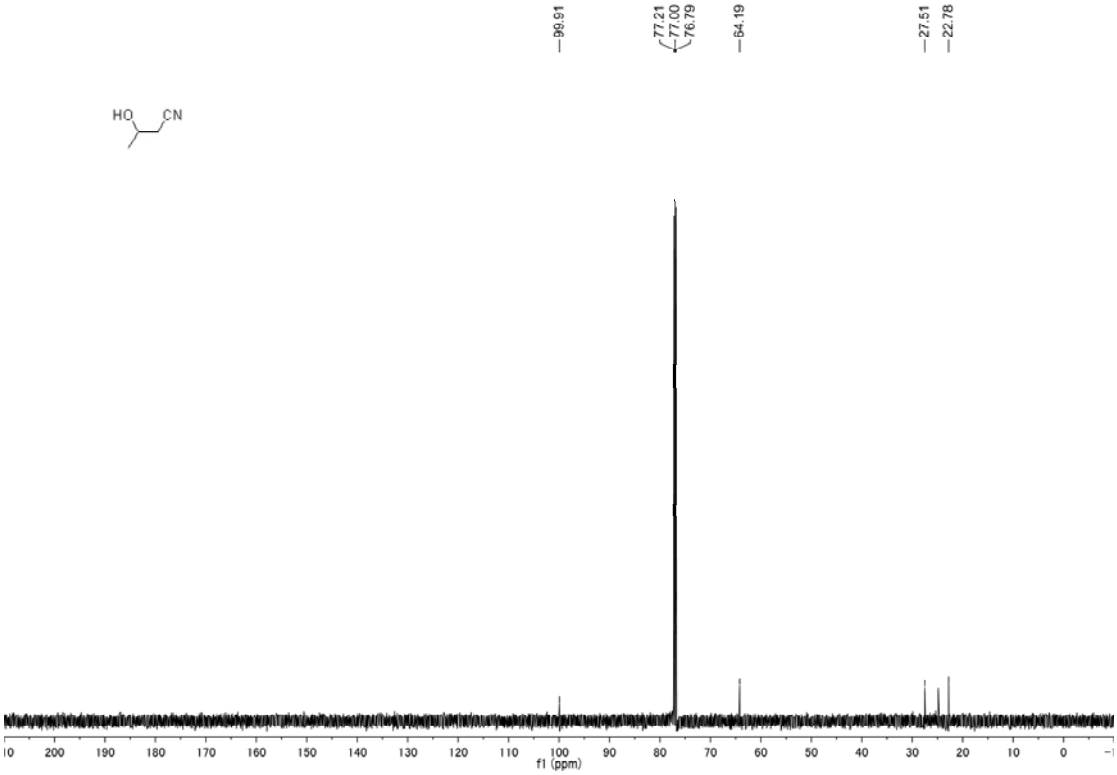
^{1}H NMR (400 MHz, $CDCl_3$) of compound **10**



$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **10**



^{1}H NMR (400 MHz, $CDCl_3$) of compound **11**



$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of compound **11**