Supporting information

Electrochemically Driven Silicon–Carbon Bond Cleavage of Silacyclobutanes: A Transition Metal-Free Approach

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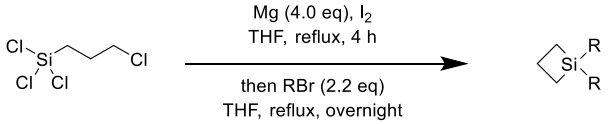
1. General Information

All reagents were purchased from Macklin, Sigma-Aldrich, Adamas-beta, and Energy Chemical of the highest purity grade and used without further purification, unless otherwise indicated. Analytical thin-layer chromatography (TLC) was performed on hexane, visualized by irradiation with UV light. For column chromatography, 300-400 mesh silica gel was used. ^{1}H-NMR and^{13}C-NMR were recorded on a BRUKER 600 MHz spectrometer in $CDCl_3$. ^{19}F-NMR spectra were recorded at BRUKER 400 MHz spectrometer in $CDCl_3$. The residual solvent peak was used as an internal reference: proton ($CDCl_3$ δ 7.26) and carbon ($CDCl_3$ δ 77.16). Data were reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, p = pentet, dd = double doublet, dt = double triplet, m = multiplet), coupling constants (*J*) are in Hertz (Hz). HRMS spectra were recorded on a Xevo G2-XS QTof (Waters Corporation) using electrospray ionization. DC power supply MT-152D was used for all experiments.

2. Experimental Procedures

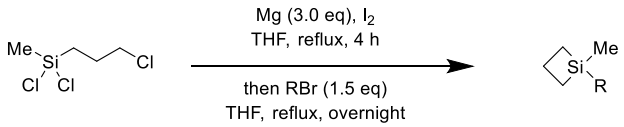
2.1 Preparation of Silacyclobutanes (SCBs)

Preparation of 1a- 1i



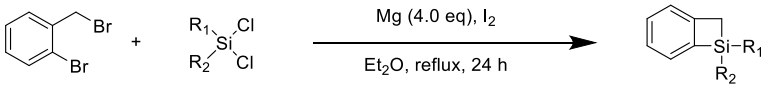
To the suspension of magnesium (40 mmol, 4.0 equiv.) and a grain of I_2 in dry THF (50 mL) was added a small amount (about 20 drops) solution of the 3-chloropropyltrichlorosilane (10 mmol, 1.0 equiv.) in THF (20 mL) by syringe at ambient temperature under argon. The reaction was initiated and heated to reflux with addition the rest of the 3-chloropropyltrichlorosilane solution dropwise over 1 h. The resulting mixture was refluxed for additional 4 h before addition of a solution of RBr (22 mmol, 2.2 equiv.) in THF (40 mL) dropwise over 3 h. The resulting mixture was refluxed overnight. The reaction was cooled to room temperature before quenching with aq. HCl (15 mL, 2 M). The mixture was extracted with n-hexane (3 × 50 mL). The combined organic layers were dried over Na_2SO_4, filtered, and evaporated under reduced pressure. The crude residue was purified by column chromatography on silica gel to afford the silacyclobutanes.

Preparation of 1j- 1y, 1ab



To the suspension of magnesium (30 mmol, 3.0 equiv.) and a grain of I_2 in dry THF (50 mL) was added a small amount (about 20 drops) solution of the 3-chloropropylmethyldichlorosilane (10 mmol, 1.0 equiv.) in THF (20 mL) by syringe at ambient temperature under argon. The reaction was initiated and heated to reflux with addition the rest of the THF solution of 3-chloropropylmethyldichlorosilane dropwise over 1 h. The resulting mixture was refluxed for additional 4 h before addition of a solution of the RBr (15 mmol, 1.5 equiv.) in THF (40 mL) dropwise over 3 h. The resulting mixture was refluxed overnight. The reaction was cooled to room temperature before quenching with aq. HCl (15 mL, 2 M). The mixture was extracted with n-hexane (3 × 50 mL). The combined organic layers were dried over Na_2SO_4, filtered, and evaporated under reduced pressure. The crude residue was purified by column chromatography on silica gel to afford the silacyclobutanes.

Preparation of 1z and 1aa

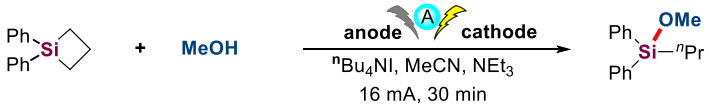


To a suspension of magnesium (1.92 g, 80 mmol) and a grain of I_2 in dry Et_2O (2.0 mL), the 2-bromobenzyl bromide solution (2-bromobenzyl bromide (5.0 g, 20 mmol) dissolved in 20.0 mL Et_2O) and dichlorodialkylsilane or dichlorodiarylsilane were added dropwise simultaneously. Then the reaction mixture was refluxed for 24 h. After cooling to room temperature, the reaction was quenched with water and extracted with Et_2O (3×30 mL). The combined organic phase was washed with water and brine, and dried over anhydrous Na_2SO_4. After removal of the solvent under reduced pressure, the residue was purified by silica gel flash column chromatography to afford the corresponding benzosilacyclobutanes.

All silacyclobutanes are known compounds and were prepared according to reported procedures. [1-12]

2.2 Experimental Optimization

Table S1. Screening of electrode [a]

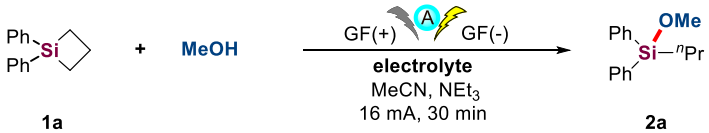


1a **2a**

Entry	Electrode	Yield（%） [b]
1	**GF (+) | GF (-)**	**89**
2	Mg (+) | GF (-)	70
3	Zn (+) | GF (-)	Trace
4	Cu (+) | GF (-)	62
5	GF (+) | Pt (-)	79
6	Pt (+) | Pt (-)	66
7	SST (+) | Pt (-)	68
8	carbon cloth (+) | carbon cloth (-)	69

[a] Unless otherwise noted, the conditions were as follows: **electrode**, constant current = 16 mA, **1a** (0.2 mmol), MeOH (0.4 mL), MeCN (4.0 mL), NEt_3 (0.5 equiv.), $^nBu_4NI$ (1.0 equiv.), room temperature, 30 min, undivided cell, N_2. [b] yield of isolated product.

Table S2. Screening of electrolyte [a]

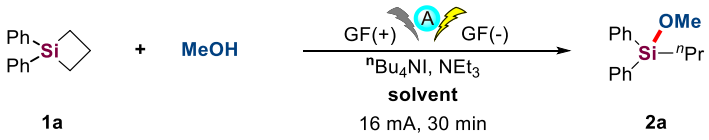


1a **2a**

Entry	Electrolyte	Yield（%） [b]
1	$^nBu_4NBF_4$	64
2	$^nBu_4NCl$	Trace
3	$^nBu_4NBr$	45
4	$^nBu_4NOAc$	Trace

[a] Unless otherwise noted, the conditions were as follows: graphite felt anode (10 mm × 15 mm × 0.3 mm), graphite felt cathode (10 mm × 15 mm × 0.3 mm), constant current = 16 mA, **1a** (0.2 mmol), MeOH (0.4 mL), MeCN (4.0 mL), NEt_3 (0.5 equiv.), **electrolyte** (1.0 equiv.), room temperature, 30 min, undivided cell, N_2. [b] yield of isolated product.

Table S3. Screening of solvent [a]

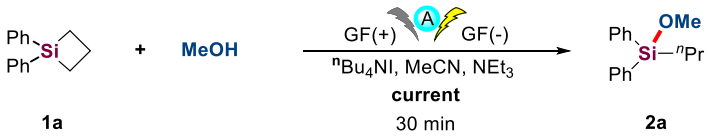


1a 2a

Entry	Solvent	Yield（%） [b]
1	DMSO	36
2	DMF	58
3	DMA	54
4	THF	66
5	NMP	47
6	MeOH	Trace

[a] Unless otherwise noted, the conditions were as follows: graphite felt anode (10 mm × 15 mm × 0.3 mm), graphite felt cathode (10 mm × 15 mm × 0.3 mm), constant current = 16 mA, **1a** (0.2 mmol), MeOH (0.4 mL), **solvent** (4.0 mL), NEt_3 (0.5 equiv.), $^{n}Bu_4NI$ (1.0 equiv.), room temperature, 30 min, undivided cell, N_2. [b] yield of isolated product.

Table S4. Screening of current [a]

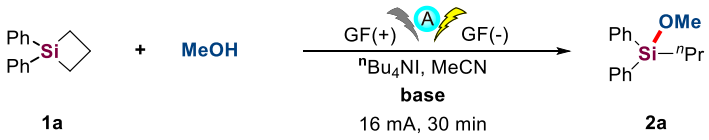


1a 2a

Entry	Current	Yield（%） [b]
1	8 mA	60
2	12 mA	66
3	No electricity	N.R.

[a] Unless otherwise noted, the conditions were as follows: graphite felt anode (10 mm × 15 mm × 0.3 mm), graphite felt cathode (10 mm × 15 mm × 0.3 mm), **constant current**, **1a** (0.2 mmol), MeOH (0.4 mL), MeCN (4.0 mL), NEt_3 (0.5 equiv.), $^{n}Bu_4NI$ (1.0 equiv.), room temperature, 30 min, undivided cell, N_2. [b] yield of isolated product. N. R. = no reaction.

Table S5. Screening of base [a]



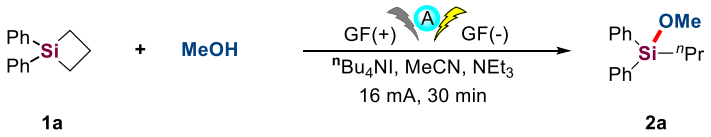
1a 2a

Entry	Base	Yield（%） [b]
1	w/o NEt_3	83
2	$CsCO_3$	40
3	DABCO	66
4	DBU	41

[a] Unless otherwise noted, the conditions were as follows: graphite felt anode (10 mm × 15 mm × 0.3 mm), graphite felt cathode (10 mm × 15 mm × 0.3 mm), constant current = 16 mA, **1a** (0.2 mmol), MeOH (0.4 mL), MeCN (4.0 mL), **base** (0.5 equiv.), $^{n}Bu_4NI$ (1.0 equiv.), room temperature, 30 min, undivided cell, N_2. [b] yield of isolated product.

3. General procedure for the synthesis of products

3.1 Synthesis of silicon ether by electrochemically induced Si-C bond fracture in silicon ring



1a **2a**

Under N_2 atmosphere, 1,1-diphenylsiletane **1a** (44.8 mg. 0.2 mmol), MeOH (0.4 mL), NEt_3 (0.5 equiv.), ^{n}Bu$_4$NI (1.0 equiv.) and MeCN (4.0 mL) were added in a boiling flask-2-neck (10.0 mL). The flask was equipped with graphite felt (10 mm × 15 mm × 0.3 mm) as anode and graphite felt (10 mm × 15 mm × 0.3 mm) as cathode. Then the reaction mixture was stirred and electrolyzed at a constant current of 16 mA for 30 min. When the reaction was finished, the mixture extracted with EtOAc (3 x 10 mL) and the combined organics were washed with H_2O (10 mL), brine (10 mL) and dried over Na_2SO_4. Part of the organics was concentrated and the crude residue was purified by preparative TLC on silica gel to afford the product.

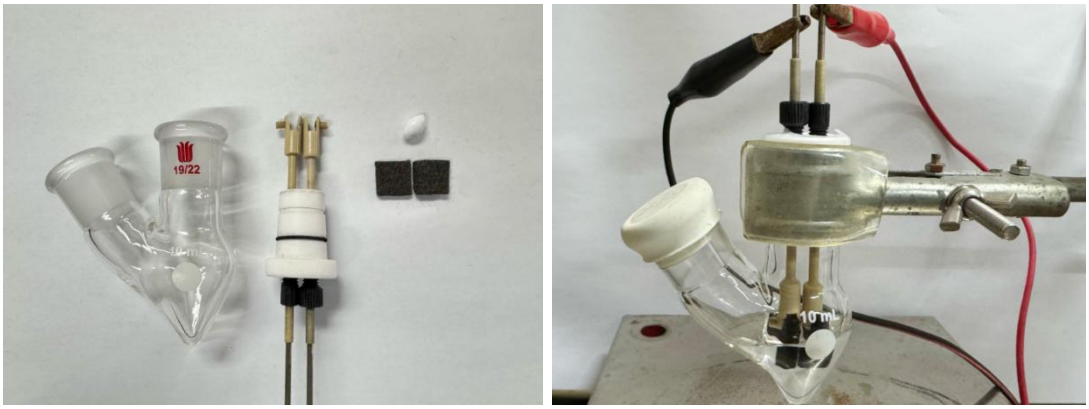
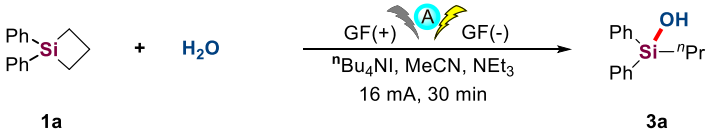


Figure S1. Electrolysis setup for the small scale experiment.

3.2 Synthesis of silanol by electrochemically induced Si-C bond fracture in silicon ring

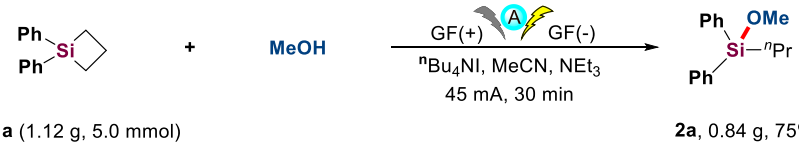


1a **3a**

Under N_2 atmosphere, 1,1-diphenylsiletane **1a** (44.8 mg. 0.2 mmol), H_2O (0.4 mL), NEt_3 (0.5 equiv.), ^{n}Bu$_4$NI (1.0 equiv.) and MeCN (4.0 mL) were added in a boiling flask-2-neck (10.0 mL). The flask was equipped with graphite felt (10 mm × 15 mm × 0.3 mm) as anode and graphite felt (10 mm × 15 mm × 0.3 mm) as cathode. Then the reaction mixture was stirred and electrolyzed at a constant current of 16 mA for 30 min. When the reaction was finished, the mixture extracted with EtOAc (3 x 10 mL) and the combined organics were washed with H_2O (10 mL), brine (10 mL) and dried over Na_2SO_4. Part of the organics was concentrated and the crude residue was purified by preparative TLC on silica gel to afford the product.

3.3 Gram-scale synthesis

3.3.1 Gram-scale synthesis of alkoxysilane 2



1a (1.12 g, 5.0 mmol) **2a**, 0.84 g, 75%

Under N_2 atmosphere, 1,1-diphenylsiletane **1a** (1.12g. 5 mmol), MeOH (1.2 mL), NEt_3 (50.0 μL) and MeCN (20.0 mL) were added in a bottle (50.0 mL). The bottle was equipped with graphite felt (40 mm × 40 mm × 0.3 mm) as anode and graphite felt (40 mm × 40 mm × 0.3 mm) as cathode. Then the reaction mixture was stirred and electrolyzed at a constant current of 45 mA for 30 min. When the reaction was finished, the mixture extracted with EtOAc (3 x 10 mL) and the combined organics were washed with H_2O (10 mL), brine (10 mL) and dried over Na_2SO_4. Part of the organics was concentrated and the crude residue was purified by column chromatography on silica gel (*n*-hexane/EtOAc = 40: 1, v/v) to afford the product **2a**.

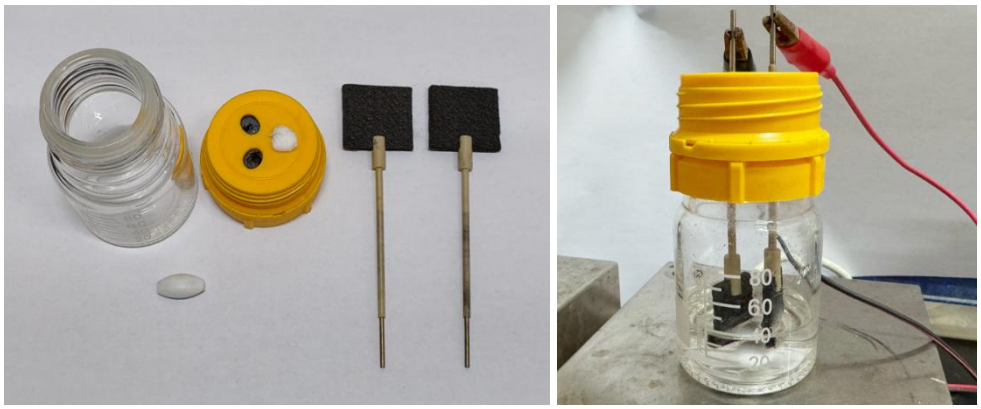
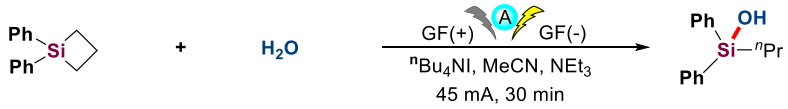


Figure S2. Electrolysis setup for the gram scale experiment.

3.3.2 Gram-scale synthesis of silanol 32

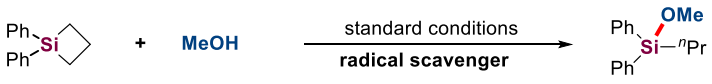


1a (1.12 g, 5.0 mmol) **3a**, 0.96 g, 85%

Under N_2 atmosphere, 1,1-diphenylsiletane **1a** (1.12g. 5 mmol), H_2O (1.2 mL), NEt_3 (50.0 μL) and MeCN (20.0 mL) were added in a bottle (50.0 mL). The bottle was equipped with graphite felt (40 mm ×40 mm × 0.3 mm) as anode and graphite felt (40 mm ×40 mm × 0.3 mm) as cathode. Then the reaction mixture was stirred and electrolyzed at a constant current of 45 mA for 30 min. When the reaction was finished, the mixture extracted with EtOAc (3 x 10 mL) and the combined organics were washed with H_2O (10 mL), brine (10 mL) and dried over Na_2SO_4. Part of the organics was concentrated and the crude residue was purified by column chromatography on silica gel (*n*-hexane/EtOAc = 10: 1, v/v) to afford the product **3a**.

4. Mechanistic studies

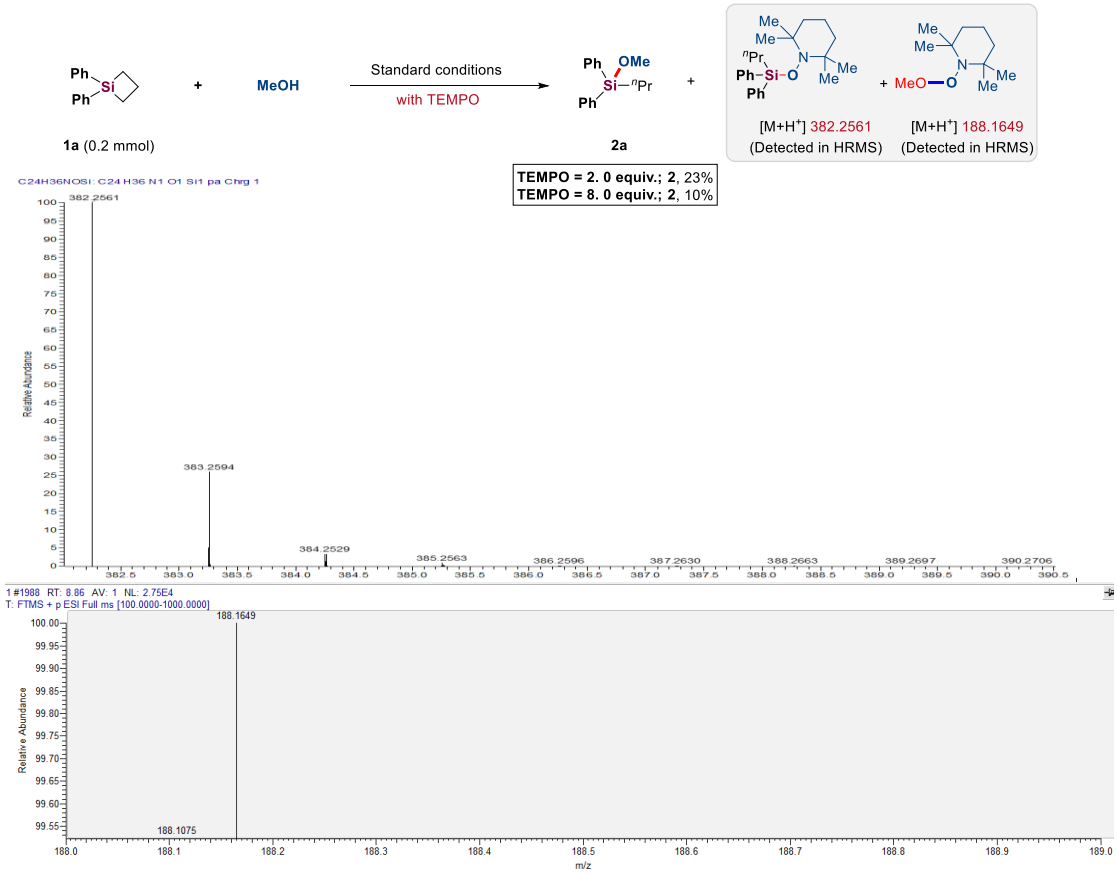
4.1 radical trapping experiments [a]



1a **2a**

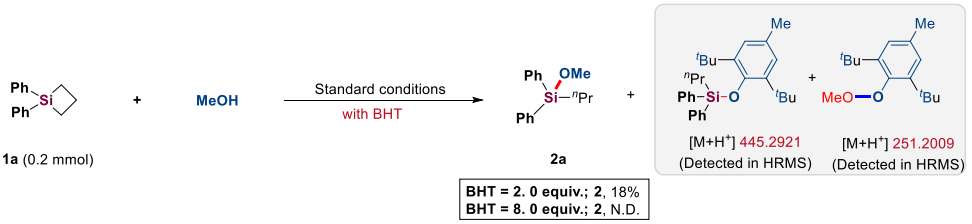
Entry	Radical scavenger	Yield（%）[b]
1	none	88
2	TEMPO (2.0 equiv.)	23
3	TEMPO (8.0 equiv.)	10
4	BHT (2.0 equiv.)	18
5	BHT (8.0 equiv.)	N.D.

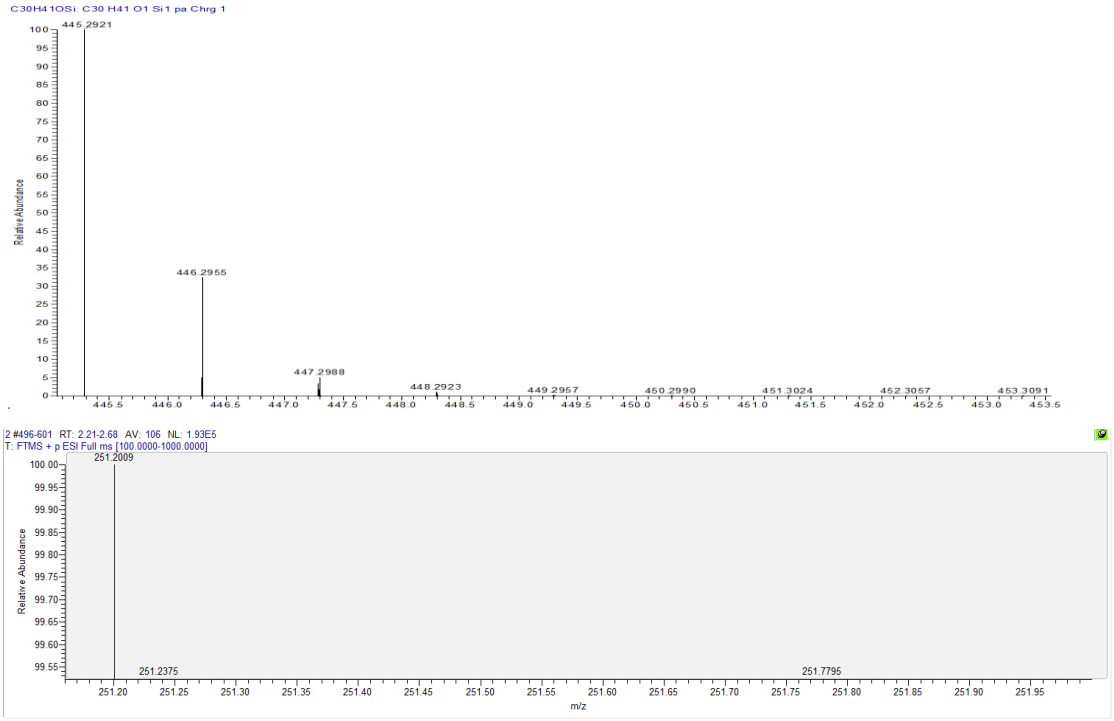
[a] Standard reaction conditions: graphite felt anode (10 mm × 15 mm × 0.3 mm), graphite felt cathode (10 mm × 15 mm × 0.3 mm), constant current = 16 mA, **1a** (0.2 mmol), MeOH (0.4 mL), MeCN (4.0 mL), NEt_3 (0.5 equiv.), $^nBu_4NI$ (1.0 equiv.), room temperature, 30 min, undivided cell, N_2. [b] yield of isolated product. N. D. = not detected.



An undivided cell (10 mL pearbottle) was equipped with a magnet stirrer (3 mm x 5 mm), graphite felt (10 mm × 15 mm × 0.3 mm) as cathode, and graphite felt (10 mm × 15 mm × 0.3 mm) as anode, and then evacuated and re-filled with nitrogen gas for 3 cycles. The electrolyte $^nBu_4NI$ (73.9 mg, 0.2 mmol, 1.0 equiv.), MeCN (4.0 mL), followed by the addition of the substrate **1a** (44.8 mg, 0.2 mmol), MeOH (0.4 mL), a solution of NEt_3 (0.5 equiv.) and 2,2,6,6-tetramethylpiperidine-1-oxyl (TEMPO). The reaction mixture was then stirred (1000 rpm) and electrolyzed at a constant current of 16 mA flow for 30 min at room temperature. The aqueous layer extracted with EtOAc (3 x 10 mL) and the combined organics were washed with H_2O (10 mL), brine (10 mL) and dried over Na_2SO_4.

When TEMPO was introduced into the model reactions, the desired 1,1-diphenylsiletane was isolated in 23% yield after column chromatography separation. Then the TEMPO was improving to 8.0 equiv. at the standard condition the yield of **2a** reduced from 23% to 10%. These results suggest the involvement of radical process in this transformation. The TEMPO-adduct was detected by HRMS (ESI, m/z), calculated for $[C_{24}H_{35}NOSi + H]^+$: 382.2561; Found: 382.2561; calculated for $[C_{10}H_{22}NO_2Si + H]^+$: 188.1645; Found: 188.1649.

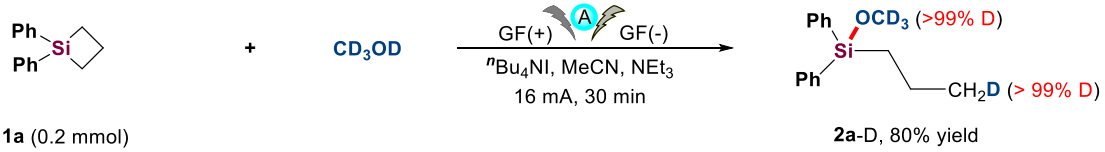




An undivided cell (10 mL pearbottle) was equipped with a magnet stirrer (3 mm x 5 mm), graphite felt (10 mm × 15 mm × 0.3 mm) as cathode, and graphite felt (10 mm × 15 mm × 0.3 mm) as anode, and then evacuated and re-filled with nitrogen gas for 3 cycles. The electrolyte $^{n}Bu_4NI$ (73.9 mg, 0.2 mmol, 1.0 equiv.), MeCN (4.0 mL), followed by the addition of the substrate **1a** (44.8 mg, 0.2 mmol), MeOH (0.4 mL), a solution of NEt_3 (0.5 equiv.) and 2,6-Di-tert-butyl-4-methylphenol (BHT). The reaction mixture was then stirred (1000 rpm) and electrolyzed at a constant current of 16 mA flow for 30 min at room temperature. The aqueous layer extracted with EtOAc (3 x 10 mL) and the combined organics were washed with H_2O (10 mL), brine (10 mL) and dried over Na_2SO_4.

When BHT was introduced into the model reactions, the desired 1,1-diphenylsiletane was isolated in 18% yield after column chromatography separation. Then the BHT was improving to 8.0 equiv. at the standard condition the yield of **2a** reduced from 18% to no product was detected. These results suggest the involvement of radical process in this transformation. The BHT-adduct was detected by HRMS (ESI, m/z), calculated for $[C_{30}H_{40}OSi + H]^+$: 445.2921; Found: 445.2921; calculated for $[C_{16}H_{27}O_2Si + H]^+$: 251.2006; Found: 251.2009.

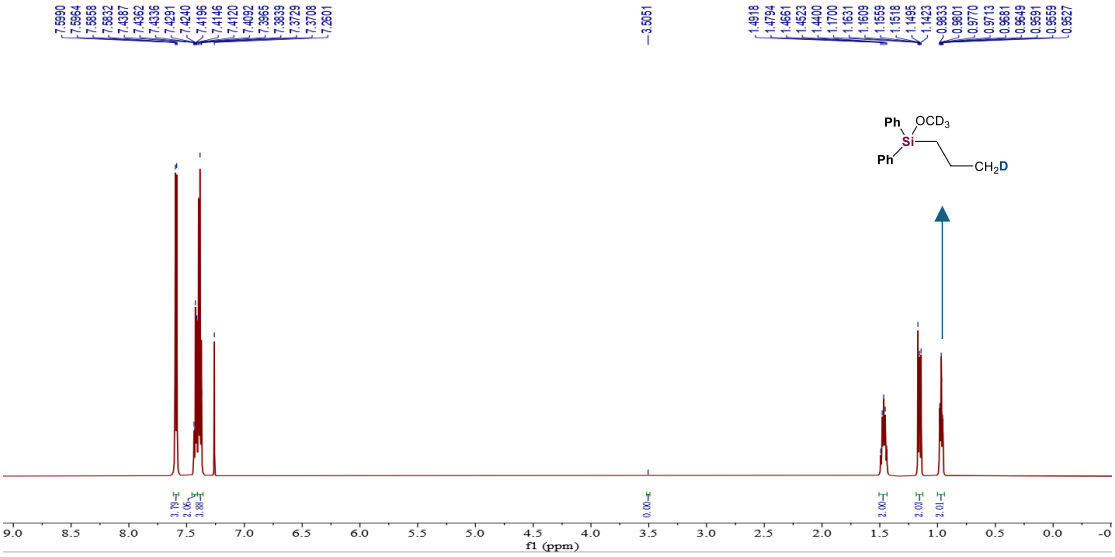
4.2 D-labeling experiments

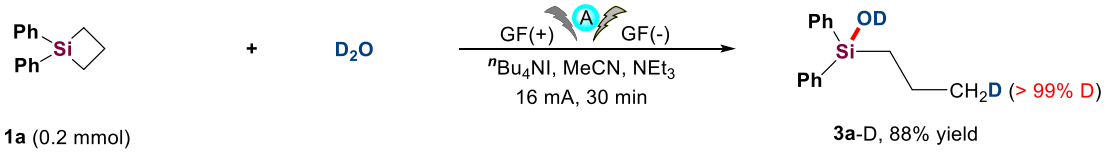


In an oven-dried undivided two-necked bottle (10 mL) equipped with a stir bar, 1,1-diphenylsiletane (**1a**) (44.8 mg, 0.2 mmol), and $^{n}Bu_4NI$ (1.0 equiv.) were combined and added. The bottle was equipped with graphite felt (10 mm × 15 mm × 0.3 mm) as the anode and graphite felt (10 mm × 15 mm × 0.3 mm) as the cathode and was then

charged with nitrogen. Under the protection of N_2, CD_3OD (0.8 mL) and MeCN (8.0 mL) were injected respectively into the tubes via syringes. The reaction mixture was stirred and electrolyzed at a constant current of 16 mA at 25°C for 30 min. The aqueous layer extracted with EtOAc (3 x 10 mL) and the combined organics were washed with H_2O (10 mL), brine (10 mL) and dried over Na_2SO_4. The volatile was removed under reduced pressure and the crude residue was purified by preparative TLC on silica gel using *n*-Hexane/EtOAc (40: 1, v/v) as the eluent to afford the desired product (isolated yield: 80%).

The ^1H NMR spectrums were provided as below picture.



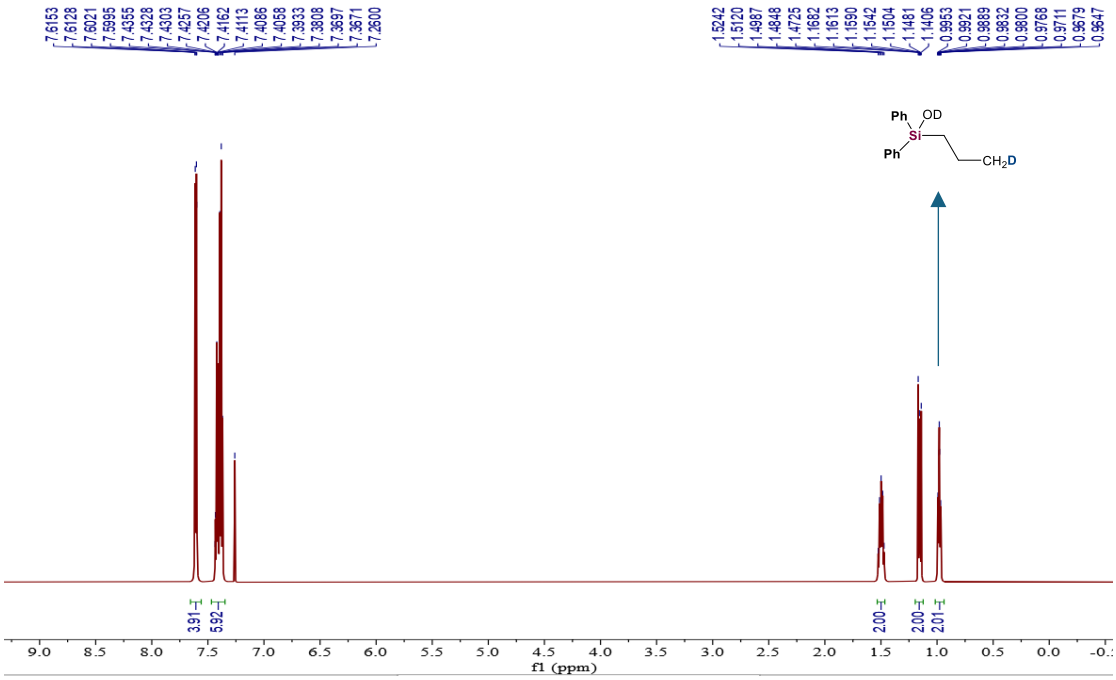


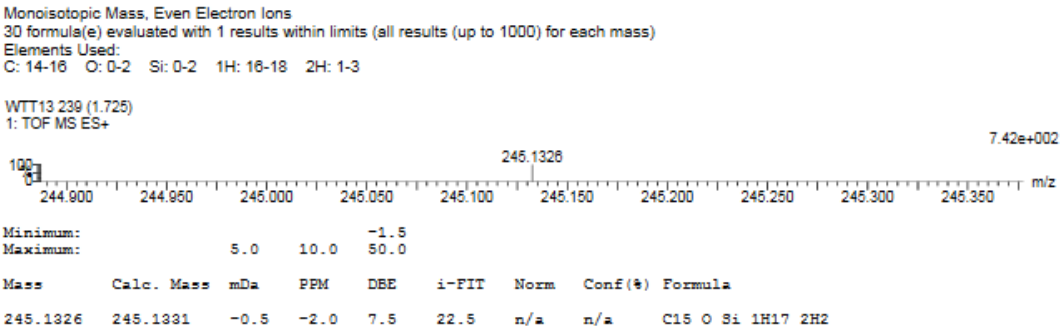
1a (0.2 mmol)

3a-D, 88% yield

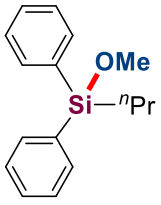
In an oven-dried undivided two-necked bottle (10 mL) equipped with a stir bar, 1,1-diphenylsiletane (**1a**) (44.8 mg, 0.2 mmol), and $^nBu_4NI$ (1.0 equiv.) were combined and added. The bottle was equipped with graphite felt (10 mm × 15 mm × 0.3 mm) as the anode and graphite felt (10 mm × 15 mm × 0.3 mm) as the cathode and was then charged with nitrogen. Under the protection of N_2, D_2O (0.8 mL) and MeCN (8.0 mL) were injected respectively into the tubes via syringes. The reaction mixture was stirred and electrolyzed at a constant current of 16 mA at 25°C for 30 min. The aqueous layer extracted with EtOAc (3 x 10 mL) and the combined organics were washed with H_2O (10 mL), brine (10 mL) and dried over Na_2SO_4. The volatile was removed under reduced pressure and the crude residue was purified by preparative TLC on silica gel using *n*-Hexane/EtOAc (10: 1, v/v) as the eluent to afford the desired product (isolated yield: 88%). The **3a-D** was detected by HRMS (ESI, m/z), calculated for $[C_{15}H_{16}D_2OSi + H]^+$: 245.1325; Found: 245.1326.

The ^{1}H NMR spectrums were provided as below picture.

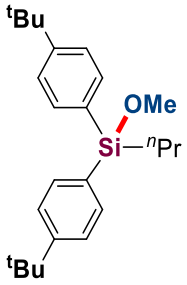




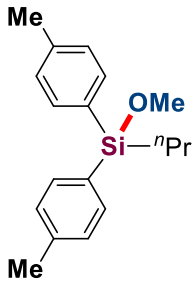
5. Characterization



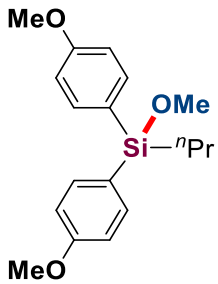
methoxydiphenyl(propyl)silane (2a). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 45.6 mg, 89%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.60 (dd, *J* = 7.9, 1.5 Hz, 4H), 7.46-7.41 (m, 2H), 7.41-7.38 (m, 4H), 3.55 (s, 3H), 1.52-1.45 (m, 2H), 1.19-1.15 (m, 2H), 1.00 (t, *J* = 7.3 Hz, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 135.03, 134.80, 129.94, 127.98, 51.50, 18.31, 16.75, 16.19.; **HRMS** (ESI): calculated for $C_{16}H_{21}OSi^+$ $[M+H]^+$: 257.1356; found: 257.1358.



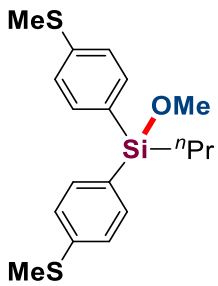
bis(4-(tert-butyl)phenyl)(methoxy)(propyl)silane (2b). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 63.4 mg, 82%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.54 (d, *J* = 8.2 Hz, 4H), 7.41 (d, *J* = 8.2 Hz, 4H), 3.54 (s, 3H), 1.52-1.46 (m, 2H), 1.33 (s, 18H), 1.15-1.12 (m, 2H), 0.99 (t, *J* = 7.3 Hz, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 152.75, 134.71, 131.70, 124.90, 51.52, 34.85, 31.38, 18.41, 16.85, 16.49.; **HRMS** (ESI): calculated for $C_{24}H_{37}OSi^+$ $[M+H]^+$: 369.2608; found: 369.2608.



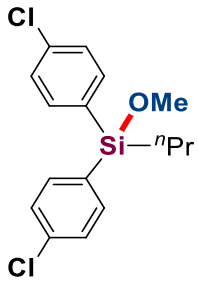
methoxy(propyl)di-p-tolylsilane (2c). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 30.1 mg, 53%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.49 (d, *J* = 7.8 Hz, 4H), 7.21 (d, *J* = 7.5 Hz, 4H), 3.52 (s, 3H), 2.37 (s, 6H), 1.49-1.42 (m, 2H), 1.14-1.11 (m, 2H), 0.98 (t, *J* = 7.3 Hz, 3H). **^{13}C NMR** (151 MHz, $CDCl_3$) δ 139.81, 134.90, 131.56, 128.81, 51.42, 21.71, 18.34, 16.81, 16.39.; **HRMS** (ESI): calculated for $C_{18}H_{25}OSi^+$ $[M+H]^+$: 285.1669; found: 285.1674.



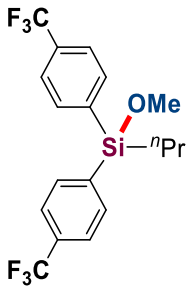
methoxybis(4-methoxyphenyl)(propyl)silane (2d). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 36.7 mg, 58%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.48 (d, *J* = 7.9 Hz, 4H), 7.21 (d, *J* = 8.1 Hz, 4H), 3.51 (s, 3H), 2.37 (s, 6H), 1.48-1.42 (m, 2H), 1.13-1.11 (m, 2H), 0.97 (t, *J* = 7.3 Hz, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 139.82, 134.90, 131.55, 128.80, 51.42, 21.71, 18.34, 16.80, 16.38.; **HRMS** (ESI): calculated for $C_{18}H_{25}O_3Si^+$ $[M+H]^+$: 317.1567; found: 317.1568.



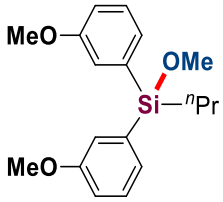
methoxybis(4-(methylthio)phenyl)(propyl)silane (2e). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 61.9 mg, 89%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.47 (d, *J* = 8.2 Hz, 4H), 7.25 (d, *J* = 8.0 Hz, 4H), 3.51 (s, 3H), 2.49 (s, 6H), 1.48-1.41 (m, 2H), 1.13-1.09 (m, 2H), 0.98 (t, *J* = 7.3 Hz, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 141.02, 135.16, 130.74, 125.52, 51.42, 18.28, 16.73, 16.18, 15.23.; **HRMS** (ESI): calculated for $C_{18}H_{25}OS_2Si^+$ $[M+H]^+$: 349.1111; found: 349.1111.



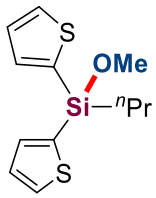
bis(4-chlorophenyl)(methoxy)(propyl)silane (2f). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 43.6 mg, 67%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.48 (d, *J* = 8.2 Hz, 4H), 7.37 (d, *J* = 8.2 Hz, 4H), 3.51 (s, 3H), 1.45- 1.40 (m, 2H), 1.14-1.11 (m, 2H), 0.98 (t, *J* = 7.2 Hz, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 136.59, 136.07, 132.96, 128.42, 51.49, 18.21, 16.64, 15.95.; **HRMS** (ESI): calculated for $C_{16}H_{19}Cl_2OSi^+$ $[M+H]^+$: 325.0577; found: 325.0577.



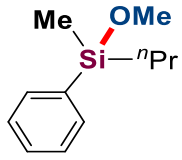
methoxy(propyl)bis(4-(trifluoromethyl)phenyl)silane (2g). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 48.6 mg, 62%. **^{1}H NMR** (600 MHz, Chloroform-*d*) δ 7.68 (d, *J* = 7.8 Hz, 4H), 7.64 (d, *J* = 7.9 Hz, 4H), 3.56 (s, 3H), 1.48-1.44 (m, 2H), 1.22-1.19 (m, 2H), 1.00 (t, *J* = 7.3 Hz, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 139.24, 134.97, 132.17 (q, *J* = 32.4 Hz), 124.72 (q, *J* = 3.9 Hz,), 124.26 (q, *J* = 272.6 Hz,), 51.65, 18.17, 16.57, 15.71.; **^{19}F NMR** (377 MHz, $CDCl_3$) δ -63.08; **HRMS** (ESI): calculated for $C_{18}H_{19}F_6OSi^+$ $[M+H]^+$: 393.1104; found: 393.1108.



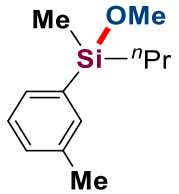
methoxybis(3-methoxyphenyl)(propyl)silane (2h). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 37.9 mg, 60%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.35-7.30 (m, 2H), 7.16 (d, *J* = 7.2 Hz, 2H), 7.13 (d, *J* = 2.6 Hz, 2H), 6.95 (ddd, *J* = 8.3, 2.8, 1.0 Hz, 2H), 3.80 (s, 6H), 3.54 (s, 3H), 1.50-1.42 (m, 2H), 1.16-1.11 (m, 2H), 0.98 (t, *J* = 7.3 Hz, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 159.17, 136.54, 129.24, 127.08, 120.07, 115.35, 55.27, 51.58, 18.32, 16.77, 16.21.; **HRMS** (ESI): calculated for $C_{18}H_{25}O_3Si^+$ $[M+H]^+$: 317.1567; found: 317.1569.



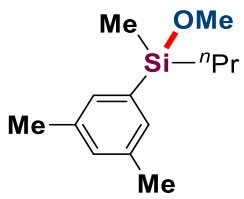
methoxy(propyl)di(thiophen-2-yl)silane (2i). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 39.1 mg, 73%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.71 (dd, *J* = 4.6, 0.9 Hz, 2H), 7.45 (dd, *J* = 3.4, 0.9 Hz, 2H), 7.25 (dd, *J* = 4.6, 3.4 Hz, 2H), 3.55 (s, 3H), 1.55-1.50 (m, 2H), 1.18-1.14 (m, 2H), 1.00 (t, *J* = 7.3 Hz, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 136.96, 133.77, 132.23, 128.38, 51.63, 18.42, 18.12, 16.68.; **HRMS** (ESI): calculated for $C_{12}H_{17}OS_2Si^+$ $[M+H]^+$: 269.0485; found: 269.0487.



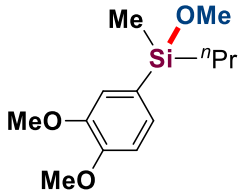
methoxy(methyl)(phenyl)(propyl)silane (2j). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 33.0 mg, 85%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.59-7.55 (m, 2H), 7.40 (t, *J* = 6.7 Hz, 3H), 3.46 (s, 3H), 1.43 (dq, *J* = 14.8, 7.5 Hz, 2H), 0.98 (t, *J* = 7.3 Hz, 3H), 0.93-0.81 (m, 2H), 0.38 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 137.07, 133.81, 129.70, 127.98, 50.94, 18.24, 17.51, 16.76, -4.12.; **HRMS** (ESI): calculated for $C_{11}H_{19}OSi^+$ $[M+H]^+$: 195.1200; found: 195.1200.



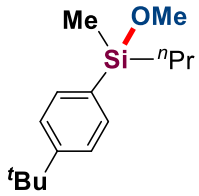
methoxy(methyl)(propyl)(m-tolyl)silane (2k). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 30.0 mg, 72%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.36 (d, *J* = 8.6 Hz, 2H), 7.28 (t, *J* = 7.4 Hz, 1H), 7.22 (d, *J* = 7.5 Hz, 1H), 3.46 (s, 3H), 2.37 (s, 3H), 1.45-1.40 (m, 2H), 0.98 (d, *J* = 7.3 Hz, 3H), 0.90-0.81 (m, 2H), 0.36 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 137.33, 136.92, 134.43, 130.84, 130.52, 127.90, 50.95, 21.69, 18.27, 17.54, 16.78, -4.09.; **HRMS** (ESI): calculated for $C_{12}H_{21}OSi^+$ $[M+H]^+$: 209.1356; found: 209.1357.



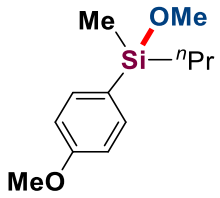
(3,5-dimethylphenyl)(methoxy)(methyl)(propyl)silane (2l). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 33.7 mg, 76%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.17 (s, 2H), 7.04 (s, 1H), 3.46 (s, 3H), 2.33 (s, 6H), 1.47-1.40 (m, 2H), 0.98 (t, *J* = 7.3 Hz, 3H), 0.90-0.80 (m, 2H), 0.36 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 137.28, 136.72, 131.48, 130.72, 50.95, 21.53, 18.29, 17.57, 16.80, -4.07.; **HRMS** (ESI): calculated for $C_{13}H_{23}OSi^+$ $[M+H]^+$: 223.1513; found: 223.1513.



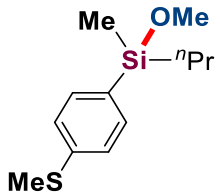
(3,4-dimethoxyphenyl)(methoxy)(methyl)(propyl)silane (2m). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 20/1) as a colorless oil. Isolated yield: 41.4 mg, 81%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.12 (dd, *J* = 7.8, 1.4 Hz, 1H), 7.04 (d, *J* = 1.4 Hz, 1H), 6.91 (d, *J* = 7.8 Hz, 1H), 3.90 (d, *J* = 10.3 Hz, 6H), 3.44 (s, 3H), 1.45-1.39 (m, 2H), 0.97 (t, *J* = 7.3 Hz, 3H), 0.89-0.79 (m, 2H), 0.36 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 150.51, 148.79, 128.48, 127.16, 116.00, 111.07, 56.01, 55.82, 50.88, 18.25, 17.62, 16.81, -4.04.; **HRMS** (ESI): calculated for $C_{13}H_{23}O_3Si^+$ $[M+H]^+$: 255.1411; found: 255.1406.



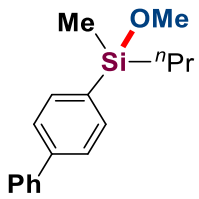
(4-(tert-butyl)phenyl)(methoxy)(methyl)(propyl)silane (2n). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 43.0 mg, 86%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.50 (d, *J* = 8.2 Hz, 2H), 7.41 (d, *J* = 8.2 Hz, 2H), 3.45 (s, 3H), 1.46-1.41 (m, 2H), 1.33 (s, 9H), 0.98 (t, *J* = 7.3 Hz, 3H), 0.89-0.82 (m, 2H), 0.36 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 152.66, 133.73, 133.51, 124.94, 50.95, 34.84, 31.37, 18.29, 17.59, 16.81, -4.05.; **HRMS** (ESI): calculated for $C_{15}H_{27}OSi^+$ $[M+H]^+$:251.1826; found: 251.1826.



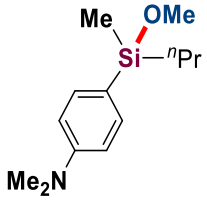
methoxy(4-methoxyphenyl)(methyl)(propyl)silane (2o). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 31.8 mg, 71%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.49 (d, *J* = 8.7 Hz, 2H), 6.93 (d, *J* = 8.6 Hz, 2H), 3.82 (s, 3H), 3.43 (s, 3H), 1.45-1.38 (m, 2H), 0.97 (t, *J* = 7.3 Hz, 3H), 0.89-0.79(m, 2H), 0.35 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 160.96, 135.38, 127.97, 113.73, 55.15, 50.84, 18.26, 17.61, 16.80, -4.02.; **HRMS** (ESI): calculated for $C_{12}H_{21}O_2Si^+$ $[M+H]^+$: 225.1305; found: 225.1301.



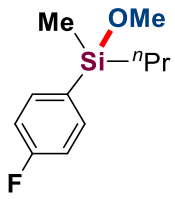
methoxy(methyl)(4-(methylthio)phenyl)(propyl)silane (2p). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 43.2 mg, 90%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.46 (d, *J* = 8.1 Hz, 2H), 7.26 (d, *J* = 8.1 Hz, 2H), 3.44 (s, 3H), 2.49 (s, 3H), 1.44-1.38 (m, 2H), 0.97 (t, *J* = 7.3 Hz, 3H), 0.89-0.79 (m, 2H), 0.35 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 140.59, 134.22, 132.92, 125.64, 50.90, 18.22, 17.51, 16.74, 15.34, -4.11.; **HRMS** (ESI): calculated for $C_{12}H_{21}OSSi^+$ $[M+H]^+$: 241.1077; found: 241.1077.



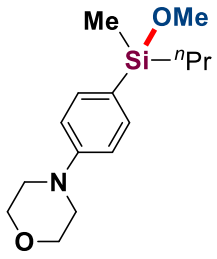
[1,1'-biphenyl]-4-yl(methoxy)(methyl)(propyl)silane (2q). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 49.1 mg, 91%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.68-7.61 (m, 6H), 7.46 (t, *J* = 7.7 Hz, 2H), 7.37 (d, *J* = 7.3 Hz, 1H), 3.50 (s, 3H), 1.51-1.44 (m, 2H), 1.01 (td, *J* = 7.3, 2.9 Hz, 3H), 0.94-0.87 (m, 2H), 0.42 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 142.44, 141.18, 135.78, 134.34, 128.92, 127.59, 127.32, 126.74, 51.00, 18.27, 17.58, 16.79, -4.02.; **HRMS** (ESI): calculated for $C_{17}H_{23}OSi^+$ $[M+H]^+$: 271.1513; found: 271.1515.



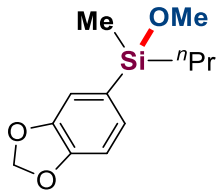
4-(methoxy(methyl)(propyl)silyl)-N,N-dimethylaniline (2r). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 20/1) as a colorless oil. Isolated yield: 30.3 mg, 64%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.44 (d, *J* = 8.4 Hz, 2H), 6.75 (d, *J* = 8.0 Hz, 2H), 3.42 (s, 3H), 2.98 (s, 6H), 1.46-1,39 (m, 2H), 0.97 (t, *J* = 7.3 Hz, 3H), 0.87-0.80 (m, 2H), 0.33 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 134.95, 111.76, 50.64, 40.15, 18.17, 17.53, 16.74, -4.17.; **HRMS** (ESI): calculated for $C_{13}H_{24}NOSi^+$ $[M+H]^+$: 238.1622; found: 238.1627.



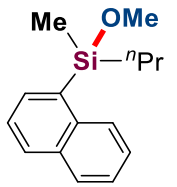
(4-fluorophenyl)(methoxy)(methyl)(propyl)silane (2s). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 17.0 mg, 40%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.53 (dd, *J* = 8.4, 6.3 Hz, 2H), 7.10-7.05 (m, 2H), 3.44 (s, 3H), 1.44-1.37 (m, 2H), 0.97 (t, *J* = 7.3 Hz, 3H), 0.89-0.81 (m, 2H), 0.36 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 164.17 (d, *J* = 248.8 Hz), 135.80 (d, *J* = 7.4 Hz), 132.63 (d, *J* = 3.8 Hz), 115.17 (d, *J* = 19.8 Hz), 50.90, 18.20, 17.56, 16.72, -4.02.; **^{19}F NMR** (377 MHz, $CDCl_3$) δ -111.12; **HRMS** (ESI): calculated for $C_{11}H_{18}FOSi^+$ $[M+H]^+$: 213.1105; found: 213.1104.



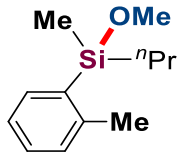
4-(4-(methoxy(methyl)(propyl)silyl)phenyl)morpholine (2t). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 10/1) as a colorless oil. Isolated yield: 33.5 mg, 60%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.47 (d, *J* = 8.6 Hz, 2H), 6.92 (d, *J* = 8.1 Hz, 2H), 3.86 (d, *J* = 4.9 Hz, 4H), 3.42 (s, 3H), 3.21 (d, *J* = 5.0 Hz, 4H), 1.45-1.38 (m, 2H), 0.97 (t, *J* = 7.3 Hz, 3H), 0.88-0.80 (m, 2H), 0.34 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 134.98, 114.67, 66.84, 50.69, 48.62, 18.14, 17.46, 16.68, -4.20.; **HRMS** (ESI): calculated for $C_{15}H_{26}NO_2Si^+$ $[M+H]^+$: 280.1727; found: 280.1727.



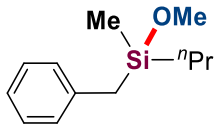
benzo[d][1,3]dioxol-5-yl(methoxy)(methyl)(propyl)silane (2u). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 43.3 mg, 91%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.04 (dd, *J* = 7.6, 1.1 Hz, 1H), 7.01 (s, 1H), 6.86 (d, *J* = 7.6 Hz, 1H), 5.95 (s, 2H), 3.43 (s, 3H), 1.44-1.37 (m, 2H), 0.97 (t, *J* = 7.3 Hz, 3H), 0.87-0.79 (m, 2H), 0.33 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 148.96, 147.59, 130.12, 128.03, 113.11, 108.78, 100.71, 50.87, 18.23, 17.61, 16.77, -4.00.; **HRMS** (ESI): calculated for $C_{12}H_{19}O_4Si^+$ $[M+H]^+$: 239.1098; found: 239.1093.



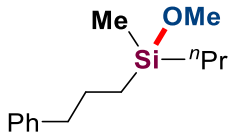
methoxy(methyl)(naphthalen-1-yl)(propyl)silane (2v). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 40.5 mg, 83%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 8.31 (d, *J* = 8.6 Hz, 1H), 7.92-7.85 (m, 2H), 7.73 (dd, *J* = 6.8, 1.3 Hz, 1H), 7.55-7.46 (m, 3H), 3.47 (s, 3H), 1.50-1.40 (m, 2H), 1.11-1.00 (m, 2H), 0.97 (t, *J* = 7.3 Hz, 3H), 0.55 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 137.22, 135.16, 134.27, 133.42, 130.52, 128.99, 128.21, 126.24, 125.66, 125.63, 125.14, 50.86, 18.62, 18.24, 16.97, -2.93.; **HRMS** (ESI): calculated for $C_{15}H_{21}OSi^+$ $[M+H]^+$:245.1356; found: 245.1354.



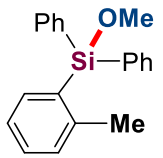
methoxy(methyl)(propyl)(o-tolyl)silane (2w). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 26.2 mg, 63%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.49 (d, *J* = 7.3 Hz, 1H), 7.29 (td, *J* = 7.5, 1.5 Hz, 1H), 7.18 (t, *J* = 8.0 Hz, 2H), 3.44 (s, 3H), 2.48 (s, 3H), 1.45-1.37 (m, 2H), 0.97 (t, *J* = 7.3 Hz, 3H), 0.94- 0.86 (m, 2H), 0.41 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 143.92, 135.52, 135.04, 130.02, 129.88, 124.98, 50.70, 22.56, 18.26, 18.20, 16.90, -3.09.; **HRMS** (ESI): calculated for $C_{12}H_{21}OSi^+$ $[M+H]^+$: 209.1356; found: 209.1360.



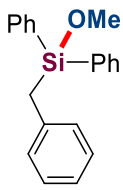
benzyl(methoxy)(methyl)(propyl)silane (2x). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 21.6 mg, 52%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.22 (t, *J* = 7.7 Hz, 2H), 7.10-7.05 (m, 3H), 3.42 (s, 3H), 2.23-2.13 (m, 2H), 1.42-1.33 (m, 2H), 0.95 (t, *J* = 7.3 Hz, 3H), 0.67- 0.54 (m, 2H), 0.06 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 139.24, 128.49, 128.42, 124.31, 50.89, 25.14, 18.24, 16.85, 16.70, -4.52.; **HRMS** (ESI): calculated for $C_{12}H_{21}OSi^+$ $[M+H]^+$: 209.1356; found: 209.1356.



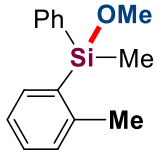
methoxy(methyl)(3-phenylpropyl)(propyl)silane (2y). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 40.1 mg, 85%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.25-7.19 (m, 2H), 7.10-7.05 (m, 3H), 3.42 (s, 3H), 2.23-2.13 (m, 2H), 1.41-1.34 (m, 2H), 0.95 (t, *J* = 7.3 Hz, 3H), 0.66-0.55 (m, 2H), 0.06 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 142.66, 128.63, 128.37, 125.80, 50.60, 39.87, 25.39, 18.32, 17.31, 16.80, 14.67, -4.26.; **HRMS** (ESI): calculated for $C_{14}H_{25}OSi^+$ $[M+H]^+$: 237.1669; found: 237.1669.



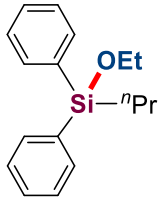
methoxydiphenyl(o-tolyl)silane (2z). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 40.1 mg, 66%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.62 (dd, *J* = 8.0, 1.4 Hz, 4H), 7.54 (dd, *J* = 7.4, 1.5 Hz, 1H), 7.45 (t, *J* = 7.4 Hz, 2H), 7.41-7.35 (m, 5H), 7.21-7.18 (m, 2H), 3.64 (s, 3H), 2.30 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 145.02, 136.95, 135.48, 134.51, 132.65, 130.50, 130.23, 130.06, 128.06, 125.01, 51.92, 23.24.; **HRMS** (ESI): calculated for $C_{20}H_{21}OSi^+$ $[M+H]^+$: 305.1356; found: 305.1355.



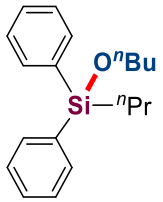
benzyl(methoxy)diphenylsilane (2z'). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 17.0 mg, 28%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.50 (dd, *J* = 8.0, 1.4 Hz, 4H), 7.42 (t, *J* = 7.4 Hz, 2H), 7.38-7.32 (m, 5H), 7.13 (t, *J* = 7.5 Hz, 2H), 6.97 (d, *J* = 6.5 Hz, 2H), 3.52 (s, 3H), 2.71 (s, 2H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 137.71, 135.02, 134.04, 130.13, 129.18, 128.25, 127.96, 124.62, 51.83, 23.88.; **HRMS** (ESI): calculated for $C_{20}H_{21}OSi^+$ $[M+H]^+$: 305.1356; found: 305.1355.



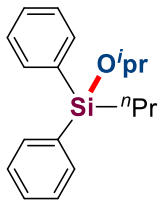
methoxy(methyl)(phenyl)(o-tolyl)silane (2aa). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 38.7 mg, 80%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.60-7.53 (m, 3H), 7.44-7.39 (m, 1H), 7.39-7.35 (m, 2H), 7.33 (td, *J* = 7.5, 1.5 Hz, 1H), 7.24-7.19 (m, 1H), 7.17 (d, *J* = 7.6 Hz, 1H), 3.54 (s, 3H), 2.33 (s, 3H), 0.68 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 144.30, 136.53, 135.73, 134.29, 130.28, 130.10, 129.85, 128.04, 125.04, 51.15, 22.83, -2.70.; **HRMS** (ESI): calculated for $C_{15}H_{19}OSi^+$ $[M+H]^+$: 243.1200; found: 243.1199.



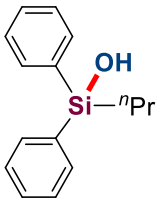
ethoxydiphenyl(propyl)silane (2ab). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 35.1 mg, 65. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.62-7.57 (m, 4H), 7.43-7.36 (m, 6H), 3.77 (q, *J* = 7.0 Hz, 2H), 1.47 (dd, *J* = 16.5, 7.3 Hz, 2H), 1.21 (t, *J* = 6.9 Hz, 3H), 1.17-1.13 (m, 2H), 0.98 (t, *J* = 7.3 Hz, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 135.60, 134.81, 129.82, 127.92, 59.36, 18.54, 18.36, 16.83, 16.65.; **HRMS** (ESI): calculated for $C_{17}H_{23}OSi^+$ $[M+H]^+$: 271.1513; found: 271.1514.



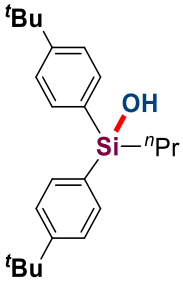
butoxydiphenyl(propyl)silane (2ac). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 28.1 mg, 47%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.59 (dd, *J* = 7.9, 1.4 Hz, 4H), 7.42-7.35 (m, 6H), 3.68 (t, *J* = 6.6 Hz, 2H), 1.58 (s, 2H), 1.54 (dd, *J* = 14.8, 6.8 Hz, 2H), 1.49-1.43 (m, 2H), 1.39-1.33 (m, 2H), 1.25 (t, *J* = 7.0 Hz, 2H), 1.16-1.13 (m, 2H), 0.98 (t, *J* = 7.3 Hz, 3H), 0.88 (t, *J* = 7.4 Hz, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 135.70, 134.82, 129.79, 127.89, 63.40, 34.89, 19.12, 18.37, 16.83, 16.56, 14.01.; **HRMS** (ESI): calculated for $C_{19}H_{27}OSi^+$ $[M+H]^+$: 299.1826; found: 299.1826.



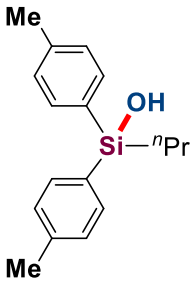
isopropoxydiphenyl(propyl)silane (2ad). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 40/1) as a colorless oil. Isolated yield: 42.0 mg, 74%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.64-7.57 (m, 4H), 7.42-7.34 (m, 6H), 4.08 (p, *J* = 6.1 Hz, 1H), 1.49-1.41 (m, 2H), 1.16 (d, *J* = 6.1 Hz, 8H), 0.98 (t, *J* = 7.3 Hz, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 136.18, 134.89, 129.71, 127.84, 65.89, 25.84, 18.46, 17.10, 16.91.; **HRMS** (ESI): calculated for $C_{18}H_{25}OSi^+$ $[M+H]^+$: 285.1669; found: 285.1663.



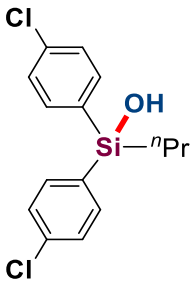
diphenyl(propyl)silanol (3a). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 10/1) as a colorless oil. Isolated yield: 45.0 mg, 93%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.61 (dd, *J* = 7.9, 1.4 Hz, 4H), 7.46-7.35 (m, 6H), 1.54-1.46 (m, 2H), 1.18-1.13 (m, 2H), 1.00 (t, *J* = 7.3 Hz, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 136.57, 134.31, 129.96, 128.03, 18.27, 17.80, 16.78.; **HRMS** (ESI): calculated for $C_{15}H_{19}OSi^+$ $[M+H]^+$: 243.1200; found: 243.1200.



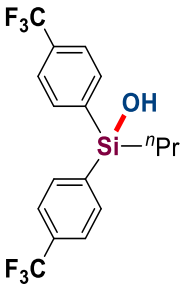
bis(4-(tert-butyl)phenyl)(propyl)silanol (3b). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 10/1) as a colorless oil. Isolated yield: 32.6 mg, 46%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.55 (d, *J* = 8.2 Hz, 4H), 7.41 (d, *J* = 8.2 Hz, 4H), 1.55-1.48 (m, 2H), 1.32 (s, 18H), 1.18-1.10 (m, 2H), 1.00 (t, *J* = 7.3 Hz, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 152.86, 134.23, 133.27, 124.97, 34.86, 31.36, 18.36, 18.01, 16.85.; **HRMS** (ESI): calculated for $C_{23}H_{35}OSi^+$ $[M+H]^+$: 355.2453; found: 355.2454.



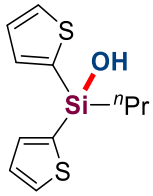
propyldi-p-tolylsilanol (3c). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 10/1) as a colorless oil. Isolated yield: 49.7 mg, 92%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.50 (d, *J* = 7.9 Hz, 4H), 7.21 (d, *J* = 7.6 Hz, 4H), 2.37 (s, 6H), 1.56-1.42 (m, 2H), 1.16-1.10 (m, 2H), 0.99 (t, *J* = 7.3 Hz, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 139.83, 134.38, 133.16, 128.82, 21.68, 18.30, 17.95, 16.83.; **HRMS** (ESI): calculated for $C_{17}H_{23}OSi^+$ $[M+H]^+$: 271.1513; found: 271.1516.



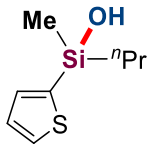
bis(4-chlorophenyl)(propyl)silanol (3d). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 10/1) as a colorless oil. Isolated yield: 47.1 mg, 76%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.49 (d, *J* = 8.3 Hz, 4H), 7.36 (d, *J* = 8.3 Hz, 4H), 1.50-1.42 (m, 2H), 1.14-1.08 (m, 2H), 0.99 (t, *J* = 7.3 Hz, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 136.60, 135.62, 134.38, 128.43, 18.18, 17.64, 16.67.; **HRMS** (ESI): calculated for $C_{15}H_{17}Cl_2OSi^+$ $[M+H]^+$:325.0577; found: 325.0577



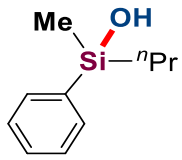
propylbis(4-(trifluoromethyl)phenyl)silanol (3e). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 10/1) as a colorless oil. Isolated yield: 46.1 mg, 61%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.71 (d, *J* = 7.8 Hz, 4H), 7.64 (d, *J* = 7.8 Hz, 4H), 1.52-1.50 (m, 2H), 1.21-1.17 (m, 2H), 1.01 (t, *J* = 7.3 Hz, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 140.56, 134.54, 132.20 (q, *J* = 32.2 Hz), 124.76 (q, *J* = 3.8 Hz), 124.18 (q, *J* = 272.4 Hz), 18.13, 17.43, 16.59.; **^{19}F NMR** (377 MHz, $CDCl_3$) δ -63.08; **HRMS** (ESI): calculated for $C_{17}H_{17}F_6OSi^+$ $[M+H]^+$: 379.0947; found: 379.0949.



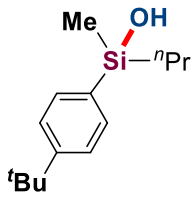
propyldi(thiophen-2-yl)silanol (3f). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 10/1) as a colorless oil. Isolated yield: 48.3 mg, 95%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.64 (d, *J* = 4.5 Hz, 1H), 7.37 (d, *J* = 3.2 Hz, 1H), 7.22 (t, *J* = 3.8 Hz, 1H), 1.51-1.46 (m, 2H), 1.00 (t, *J* = 7.3 Hz, 3H), 0.90 (dd, *J* = 10.1, 6.3 Hz, 2H), 0.45 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 136.56, 135.49, 132.15, 128.42, 19.74, 18.08, 16.67.; **HRMS** (ESI): calculated for $C_{11}H_{15}OS_2Si^+$ $[M+H]^+$: 255.0328; found: 255.0328.



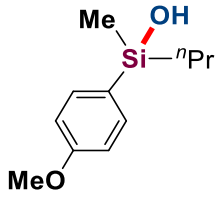
methyl(propyl)(thiophen-2-yl)silanol (3g). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 10/1) as a colorless oil. Isolated yield:31.2 mg, 84%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.64 (d, *J* = 4.5 Hz, 1H), 7.37 (dd, *J* = 3.2, 1.0 Hz, 1H), 7.22 (t, *J* = 3.8 Hz, 1H), 1.52-1.45 (m, 2H), 1.00 (t, *J* = 7.3 Hz, 3H), 0.90 (dd, *J* = 10.1, 6.3 Hz, 2H), 0.45 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 138.00, 134.90, 131.21, 128.32, 19.98, 18.12, 16.73, -0.43.; **HRMS** (ESI): calculated for $C_8H_{15}OSSi^+$ $[M+H]^+$: 187.0607; found: 187.0611.



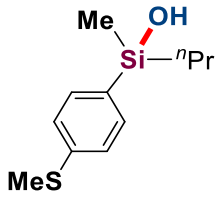
methyl(phenyl)(propyl)silanol (3h). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 10/1) as a colorless oil. Isolated yield:19.8 mg, 55%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.59 (dd, *J* = 7.4, 1.9 Hz, 2H), 7.44-7.34 (m, 3H), 1.48-1.41 (m, 2H), 0.98 (t, *J* = 7.3 Hz, 3H), 0.88-0.83 (m, 2H), 0.39 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 138.69, 133.37, 129.71, 128.01, 19.23, 18.21, 16.79, -1.45. ; **HRMS** (ESI): calculated for $C_{10}H_{17}OSi^+$ $[M+H]^+$: 181.1043; found: 181.1039.



(4-(tert-butyl)phenyl)(methyl)(propyl)silanol (3i). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 10/1) as a colorless oil. Isolated yield: 28.3 mg, 60%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.53 (d, *J* = 8.2 Hz, 2H), 7.42 (d, *J* = 8.1 Hz, 2H), 1.49-1.43 (m, 2H), 1.33 (s, 9H), 0.99 (t, *J* = 7.3 Hz, 3H), 0.87-0.83 (m, 2H), 0.38 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 152.75, 135.19, 133.33, 124.99, 34.84, 31.36, 19.27, 18.27, 16.83, -1.44.; **HRMS** (ESI): calculated for $C_{14}H_{25}OSi^+$ $[M+H]^+$: 237.1669; found: 237.1667.

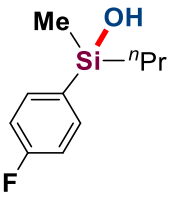


(4-methoxyphenyl)(methyl)(propyl)silanol (3j). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 10/1) as a colorless oil. Isolated yield: 34.4 mg, 82%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.51 (d, *J* = 8.4 Hz, 2H), 6.93 (d, *J* = 8.3 Hz, 2H), 3.82 (s, 3H), 1.46-1.40 (m, 2H), 0.98 (t, *J* = 7.3 Hz, 3H), 0.84 (dd, *J* = 10.0, 6.6 Hz, 2H), 0.37 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 160.95, 134.94, 129.68, 113.75, 55.18, 19.37, 18.23, 16.84, -1.35.; **HRMS** (ESI): calculated for $C_{11}H_{19}O_2Si^+$ $[M+H]^+$: 211.1149; found: 211.1149.

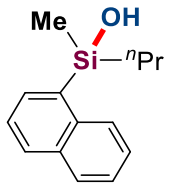


methyl(4-(methylthio)phenyl)(propyl)silanol (3k). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 10/1) as a colorless oil. Isolated yield: 21.7 mg, 48%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.48 (d, *J* = 8.2 Hz, 2H), 7.25 (d, *J* = 8.1 Hz, 2H), 2.49 (s, 3H), 1.46-1.39 (m, 2H), 0.97 (t, *J* = 7.3 Hz, 3H), 0.89-0.78 (m, 2H), 0.37 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$)

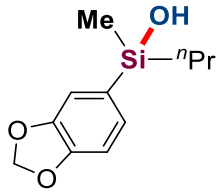
δ 140.60, 134.57, 133.80, 125.69, 19.25, 18.20, 16.79, 15.39, -1.42.; **HRMS** (ESI): calculated for $C_{11}H_{19}OSSi^+$ $[M+H]^+$: 227.0920; found: 227.0919.



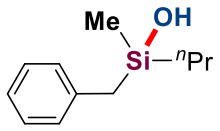
(4-fluorophenyl)(methyl)(propyl)silanol (3l). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 10/1) as a colorless oil. Isolated yield: 32.9 mg, 83%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.55 (dd, *J* = 8.4, 6.3 Hz, 2H), 7.07 (dd, *J* = 9.3, 8.6 Hz, 2H), 1.45-1.39 (m, 2H), 0.97 (t, *J* = 7.3 Hz, 3H), 0.87-0.80 (m, 2H), 0.38 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 164.14 (d, *J* = 248.9 Hz), 135.40 (d, *J* = 7.3 Hz), 134.22 (d, *J* = 3.8 Hz), 115.16 (d, *J* = 19.5 Hz), 19.31, 18.17, 16.84, 16.76, -1.33.; **^{19}F NMR** (377 MHz, $CDCl_3$) δ -111.15; **HRMS** (ESI): calculated for $C_{10}H_{16}FOSi^+$ $[M+H]^+$: 199.0949; found: 199.0953.



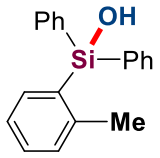
methyl(naphthalen-1-yl)(propyl)silanol (3m). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 10/1) as a colorless oil. Isolated yield:37.7 mg, 82%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 8.26 (d, *J* = 8.3 Hz, 1H), 7.90-7.86 (m, 2H), 7.78 (dd, *J* = 6.8, 1.3 Hz, 1H), 7.54-7.46 (m, 3H), 1.52-1.42 (m, 2H), 1.07-1.03 (m, 2H), 0.98 (t, *J* = 7.3 Hz, 3H), 0.57 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 136.89, 136.55, 133.61, 133.53, 130.46, 129.15, 128.26, 128.02, 126.11, 125.96, 125.64, 125.16, 20.28, 18.21, 17.01, -0.06.; **HRMS** (ESI): calculated for $C_{14}H_{19}OSi^+$ $[M+H]^+$: 231.1200; found: 231.1203.



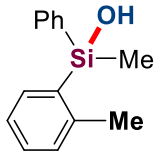
benzo[d][1,3]dioxol-5-yl(methyl)(propyl)silanol (3n). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 10/1) as a colorless oil. Isolated yield: 40.8 mg, 91%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.06 (d, *J* = 7.6 Hz, 1H), 7.03 (s, 1H), 6.86 (d, *J* = 7.6 Hz, 1H), 5.94 (s, 2H), 1.45-1.39 (m, 2H), 0.97 (t, *J* = 7.3 Hz, 3H), 0.84-0.79 (m, 2H), 0.35 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 148.92, 147.55, 131.78, 127.55, 112.76, 108.76, 100.70, 19.33, 18.19, 16.80, -1.34.; **HRMS** (ESI): calculated for $C_{11}H_{17}O_3Si^+$ $[M+H]^+$: 225.0941; found: 225.0943.



benzyl(methyl)(propyl)silanol (3o). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 10/1) as a colorless oil. Isolated yield: 24.1 mg, 62%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.24 (dd, *J* = 14.8, 7.1 Hz, 2H), 7.10 (t, *J* = 7.2 Hz, 1H), 7.06 (d, *J* = 7.4 Hz, 2H), 2.24-2.12 (m, 2H), 1.44-1.36 (m, 2H), 0.97 (t, *J* = 7.2 Hz, 3H), 0.62 (td, *J* = 7.7, 3.3 Hz, 2H), 0.11 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 139.16, 128.58, 128.33, 124.42, 26.87, 18.48, 18.21, 16.68, -2.11.; **HRMS** (ESI): calculated for $C_{11}H_{19}OSi^+$ $[M+H]^+$:195.1200; found: 195.1200.



diphenyl(o-tolyl)silanol (3p). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 10/1) as a colorless oil. Isolated yield: 53.4 mg, 92%. **^{1}H NMR** (600 MHz, $CDCl_3$) ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.65-7.59 (m, 4H), 7.49-7.43 (m, 3H), 7.41-7.36 (m, 5H), 7.22 (d, *J* = 7.6 Hz, 1H), 7.21-7.14 (m, 1H), 2.34 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 144.73, 136.72, 135.81, 135.02, 134.49, 133.67, 130.61, 130.22, 130.15, 128.95, 128.51, 128.12, 128.02, 125.03, 23.45.; **HRMS** (ESI): calculated for $C_{19}H_{19}OSi^+$ $[M+H]^+$: 291.1200; found: 291.1200.



methyl(phenyl)(o-tolyl)silanol (3q). The title compound was isolated through preparative TLC on silica gel (*n*-Hexane/EtOAc = 10/1) as a colorless oil. Isolated yield: 42.0 mg, 94%. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.62 (d, *J* = 7.3 Hz, 1H), 7.60-7.56 (m, 2H), 7.46-7.41 (m, 1H), 7.40-7.33 (m, 3H), 7.25-7.17 (m, 2H), 2.36 (s, 3H), 0.72 (s, 3H); **^{13}C NMR** (151 MHz, $CDCl_3$) δ 143.96, 137.94, 135.39, 135.31, 133.92, 130.34, 130.11, 129.92, 128.10, 125.11, 23.10, -0.24.; **HRMS** (ESI): calculated for $C_{14}H_{17}OSi^+$ $[M+H]^+$: 229.1043; found: 229.1046.

6. Reference

[1]. H. Chen, Y. Chen, X. Tang, S. Liu, R. Wang, T. Hu, L. Gao, Z. Song, *Angew. Chem. Int. Ed.* **2019**, *58*, 4695-4699; *Angew. Chem.* **2019**, *131*, 4743-4747.

[2]. X. Tang, Y. Zhang, Y. Tang, Y. Li, J. Zhou, D. Wang, L. Gao, Z. Su, Z. Song, *ACS. Catal.* **2022**, *12,* 5185-5196.

[3]. T. A. Su, J. R. Widawsky, H. Li, R. S. Klausen, J. L. Leighton, M. L. Steigerwald, L. Venkataraman, C. Nuckolls, *J. Am. Chem. Soc.* **2013**, *135*, 18331-18334.

[4]. C. J. Bradaric, W. J. Leigh, *Can. J. Chem.* **1997**, *75*, 1393-1402.

[5]. L. E. Gusel'nikov, V. V. Volkova, B. D. Lavrukhin, *J. Organomet. Chem.* **1995**, *492*, C4-C7.

[6]. X. Wang, S.-S. Huang, F.-J. Zhang, J.-L. Xie, Z. Li, Z. Xu, F. Ye, L.-W. Xu, *Org. Chem. Front.* **2021**, *8*, 6577-6584.

[7]. Z. J. Garlets, E. F. Hicks, J. Fu, E. A. Voight, H. M. L. Davies, *Org. Lett.* **2019**, *21*, 4910-4914.

[8]. N. V. Ushakov, V. M. Vdovin, *Bull. Acad. Sci. USSR, Div. Chem. Sci.* **1978**, *27*, 1475-1476.

[9]. J. D. Sunderhaus, H. Lam, G. B. Dudley, *Org. Lett.* **2003**, *5*, 4571-4573.

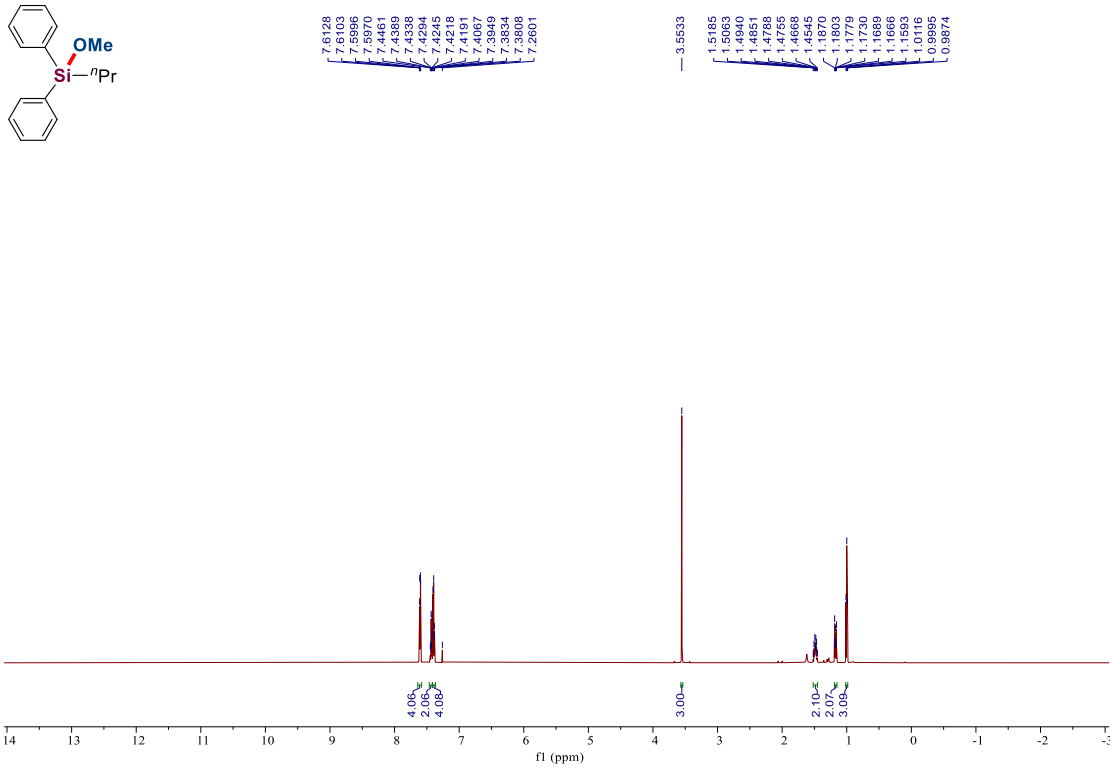
[10]. T. He, B. Li, L. Liu, W. Ma, W. He, *Chem. - Eur. J.* **2021**, *27*, 5648-5652.

[11]. W.-K. Zhu, H.-J. Zhu, X.-J. Fang, F. Ye, J. Cao, Z. Xu, L.-W. Xu, *Org. Lett.* **2023**, *25*, 7186-7191.

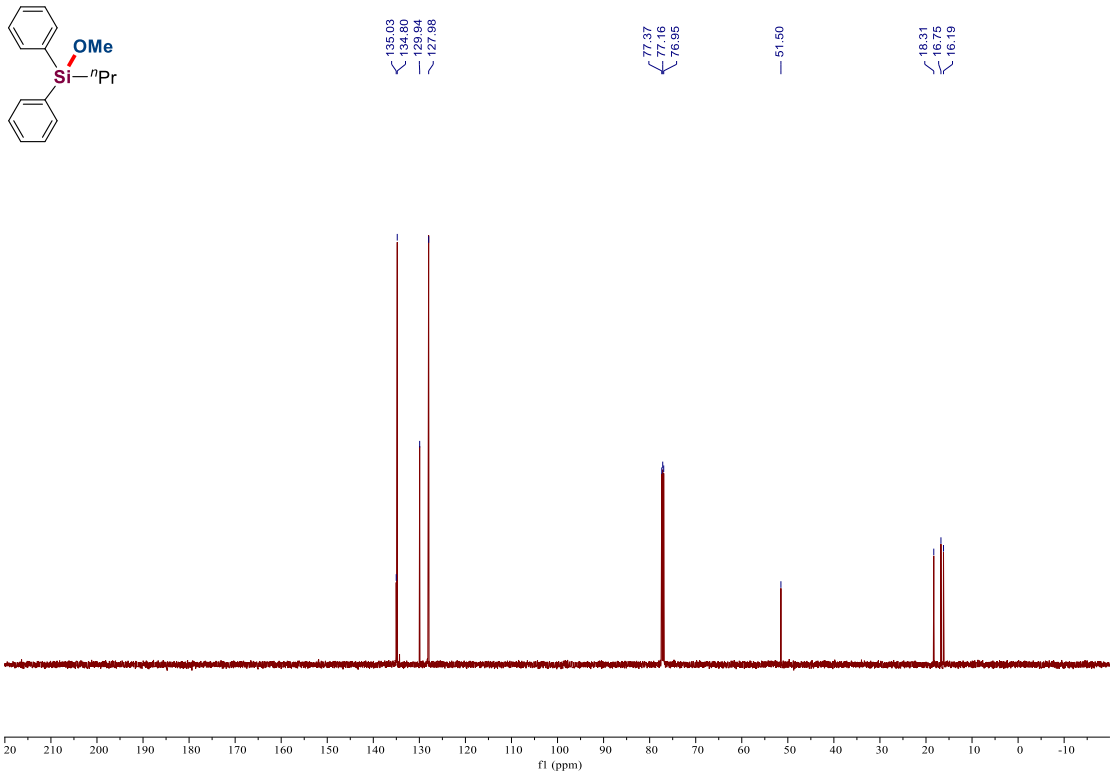
[12]. N. Ishida, S. Okumura, M. Murakami, *Chem. Lett.* **2018**, *47*, 570-572.

7. NMR Spectra

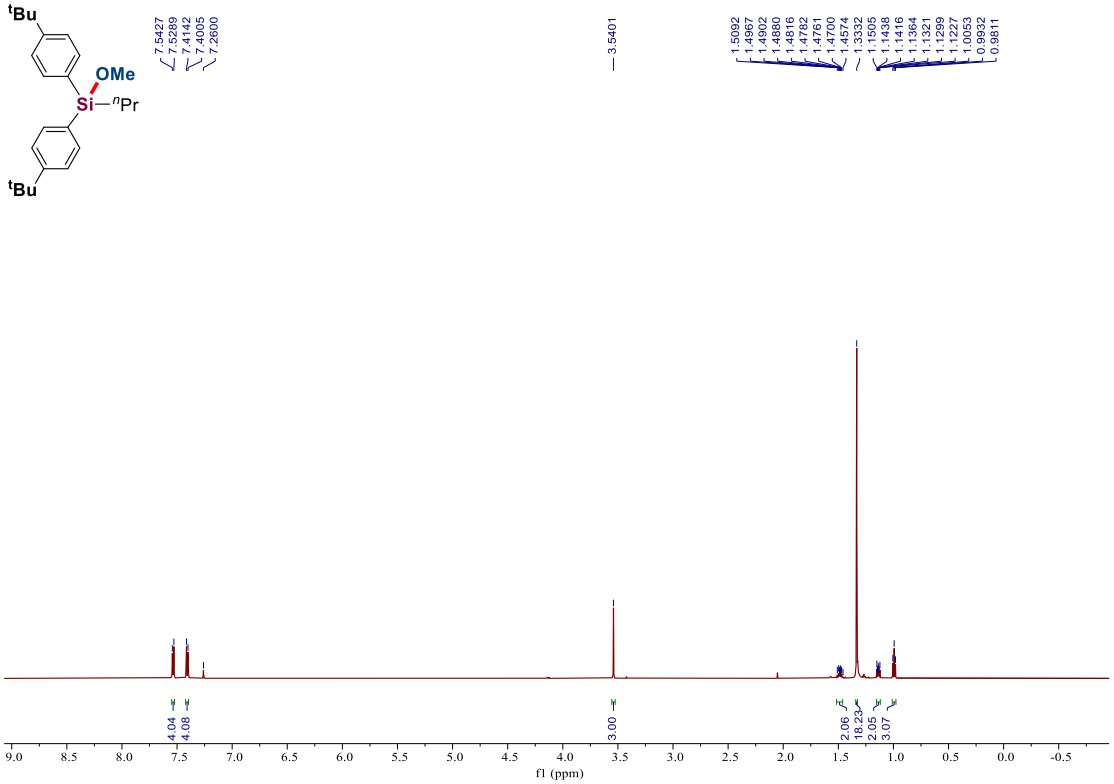
^{1}H NMR Spectra of **2a** (600 MHz, $CDCl_3$)



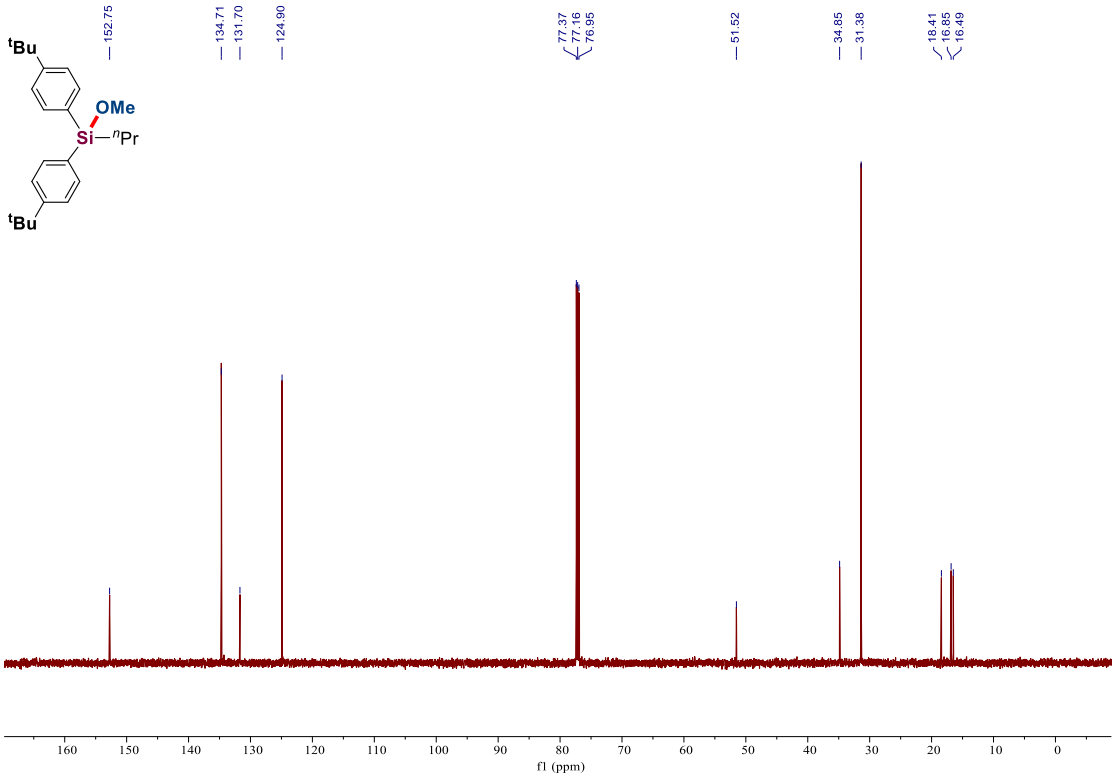
^{13}C NMR Spectra of **2a** (151 MHz, $CDCl_3$)



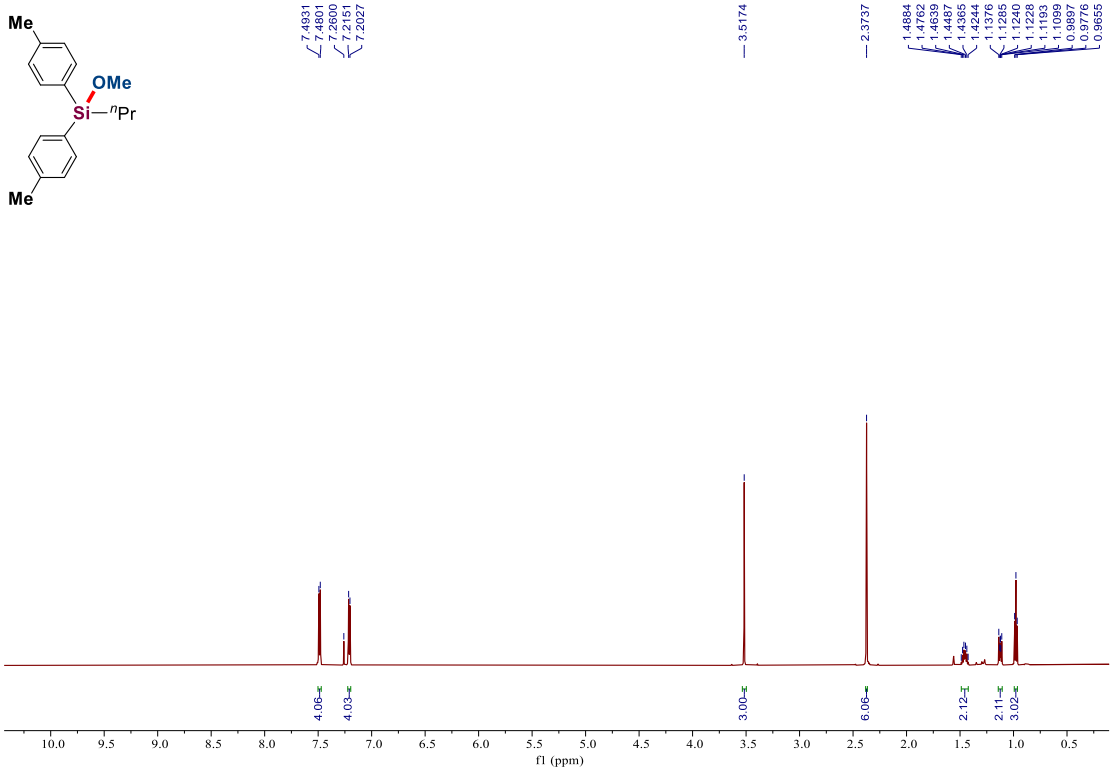
^{1}H NMR Spectra of **2b** (600 MHz, $CDCl_3$)



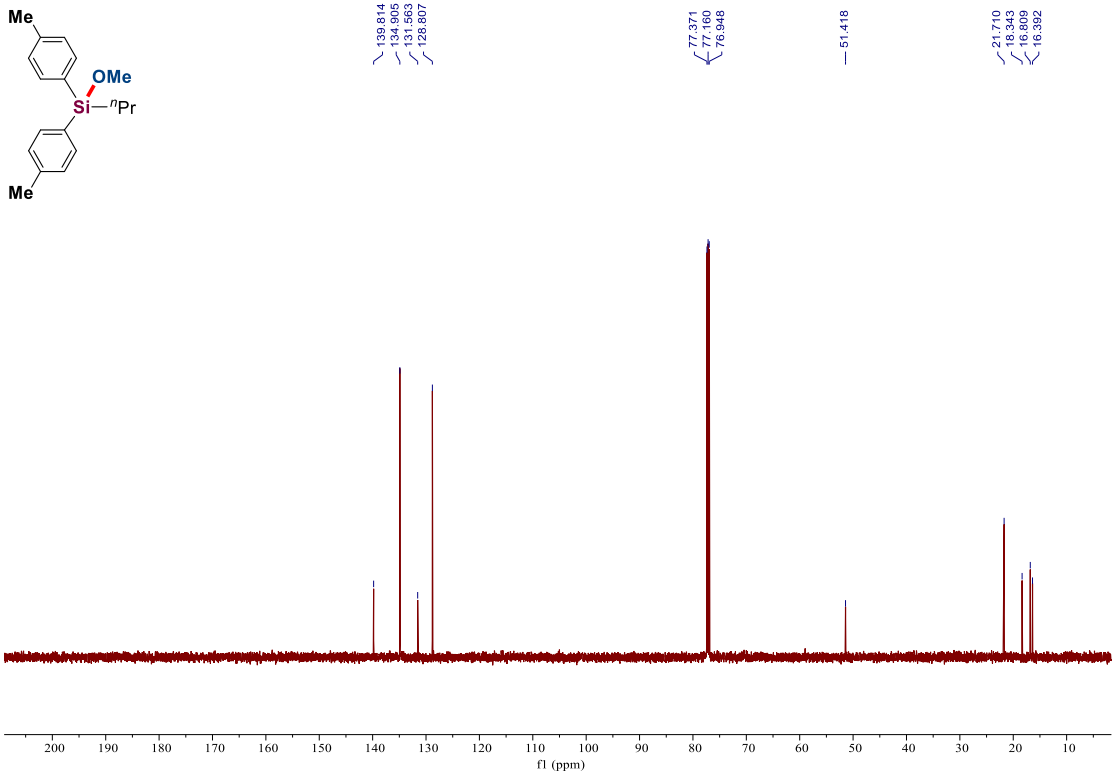
^{13}C NMR Spectra of **2b** (151 MHz, $CDCl_3$)



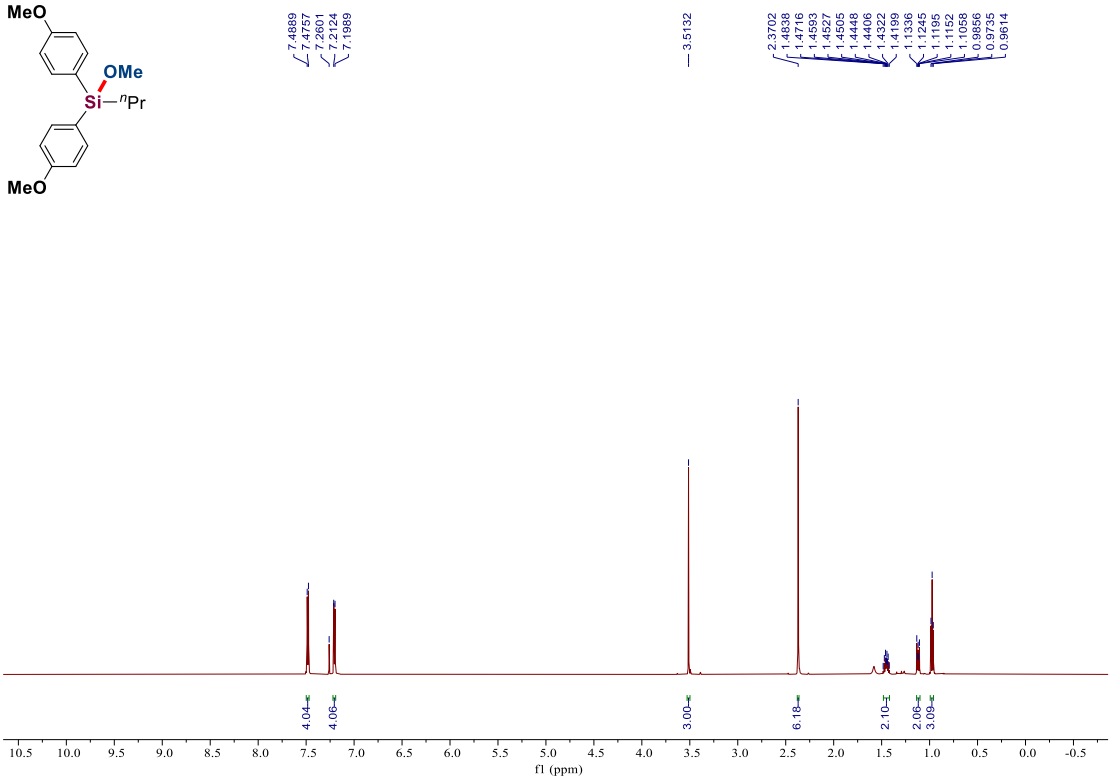
^{1}H NMR Spectra of **2c** (600 MHz, $CDCl_3$)



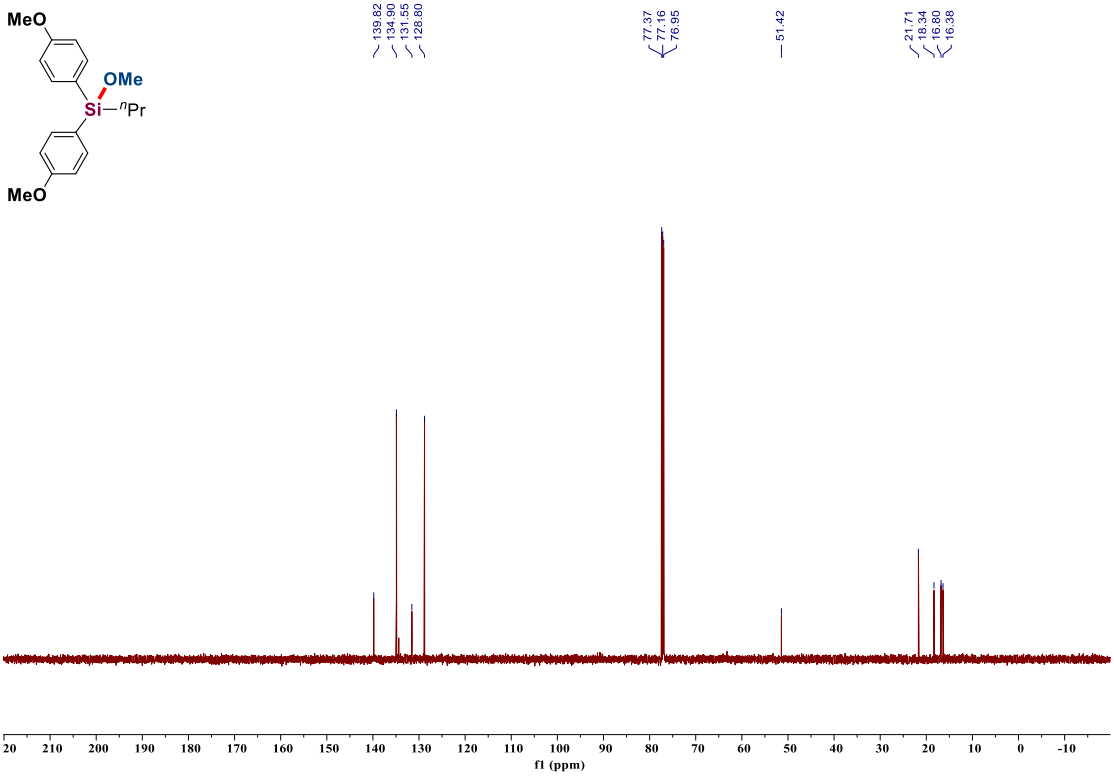
^{13}C NMR Spectra of **2c** (151 MHz, $CDCl_3$)



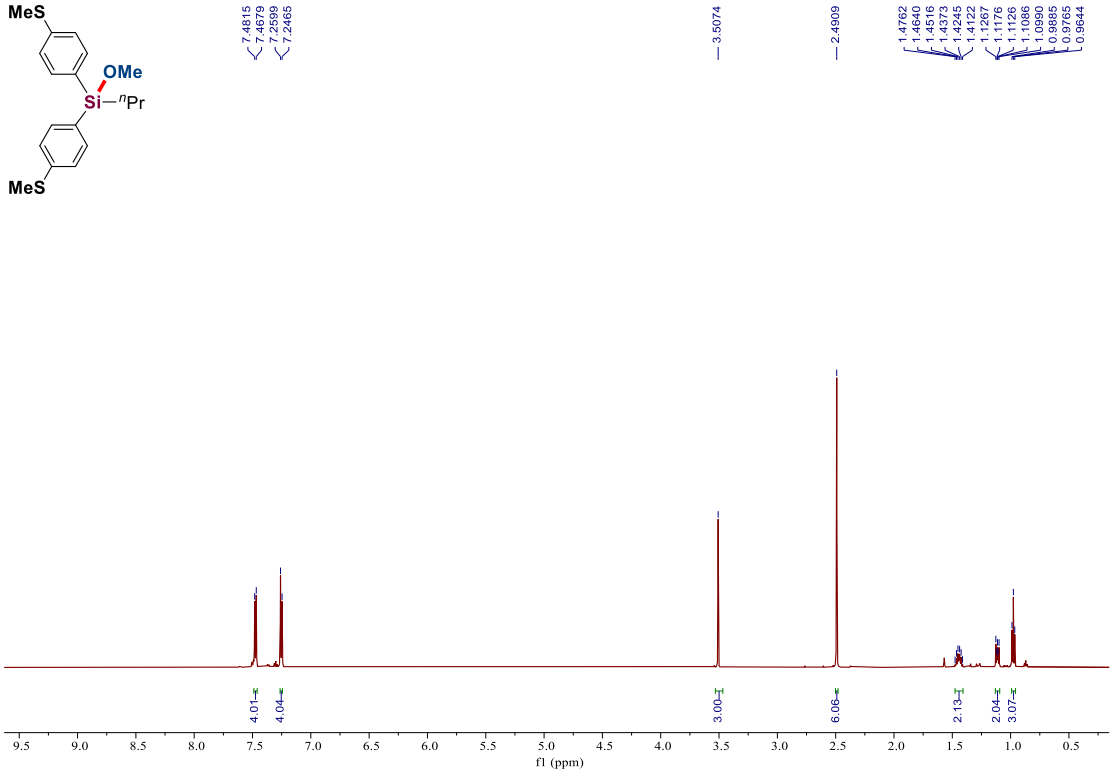
^{1}H NMR Spectra of **2d** (600 MHz, $CDCl_3$)



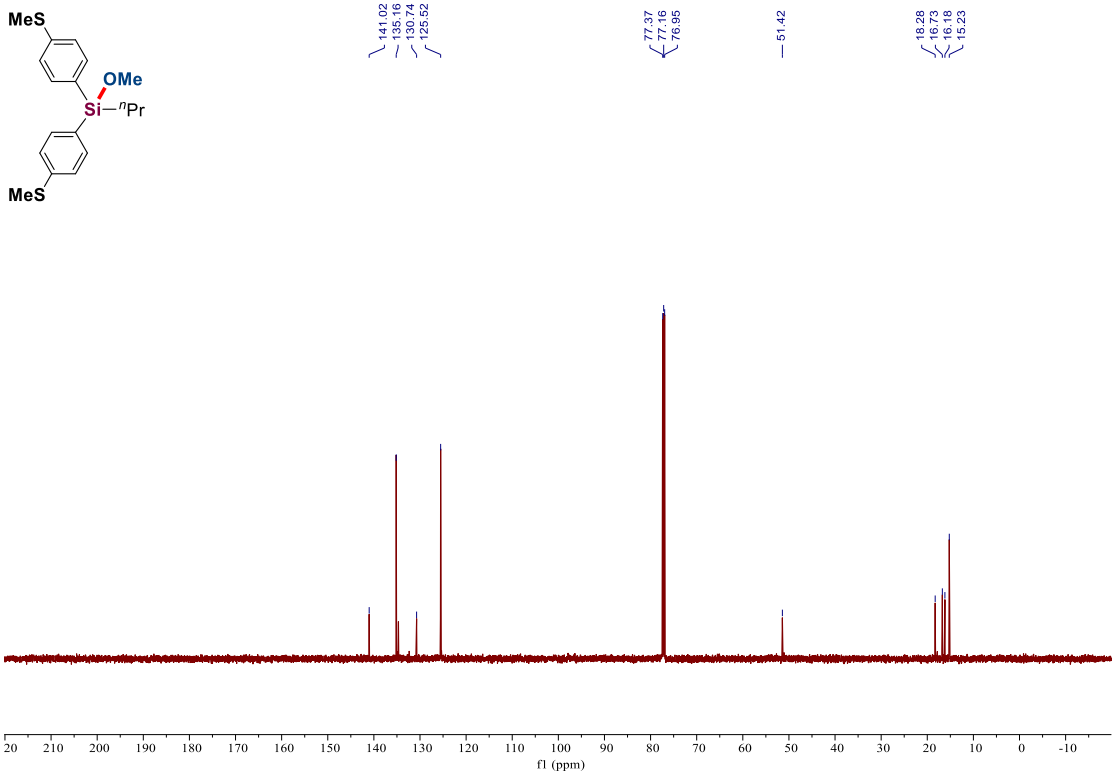
^{13}C NMR Spectra of **2d** (151 MHz, $CDCl_3$)



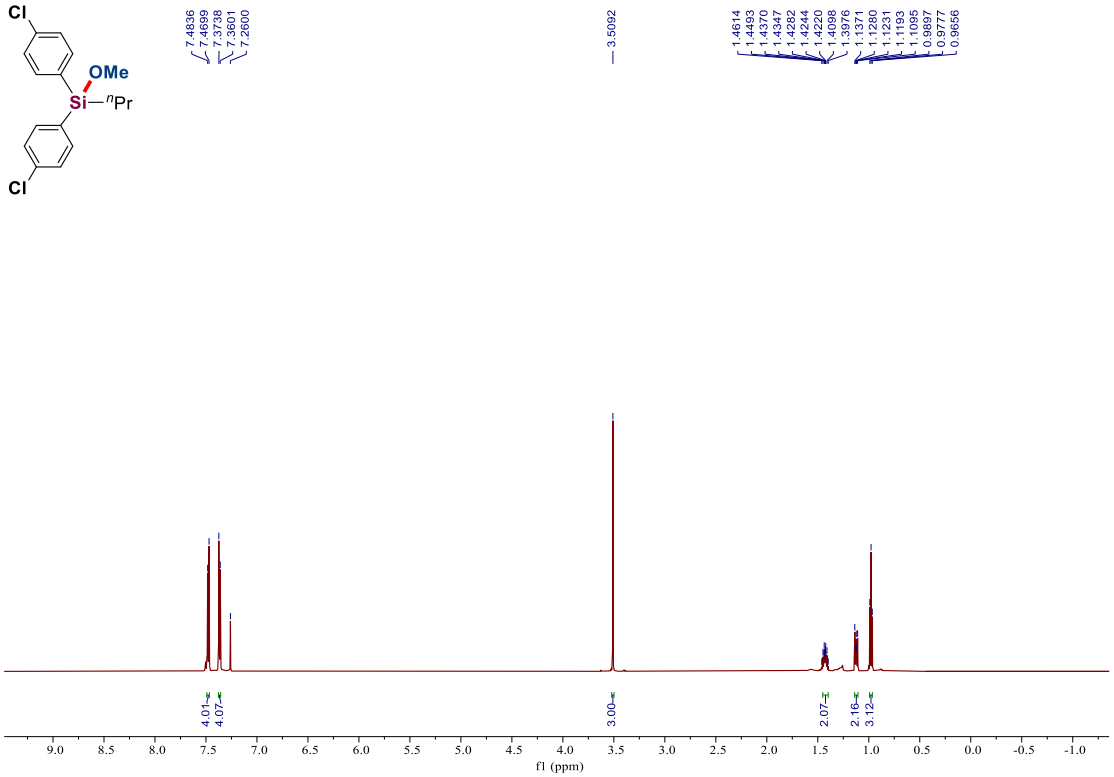
^{1}H NMR Spectra of **2e** (600 MHz, $CDCl_3$)



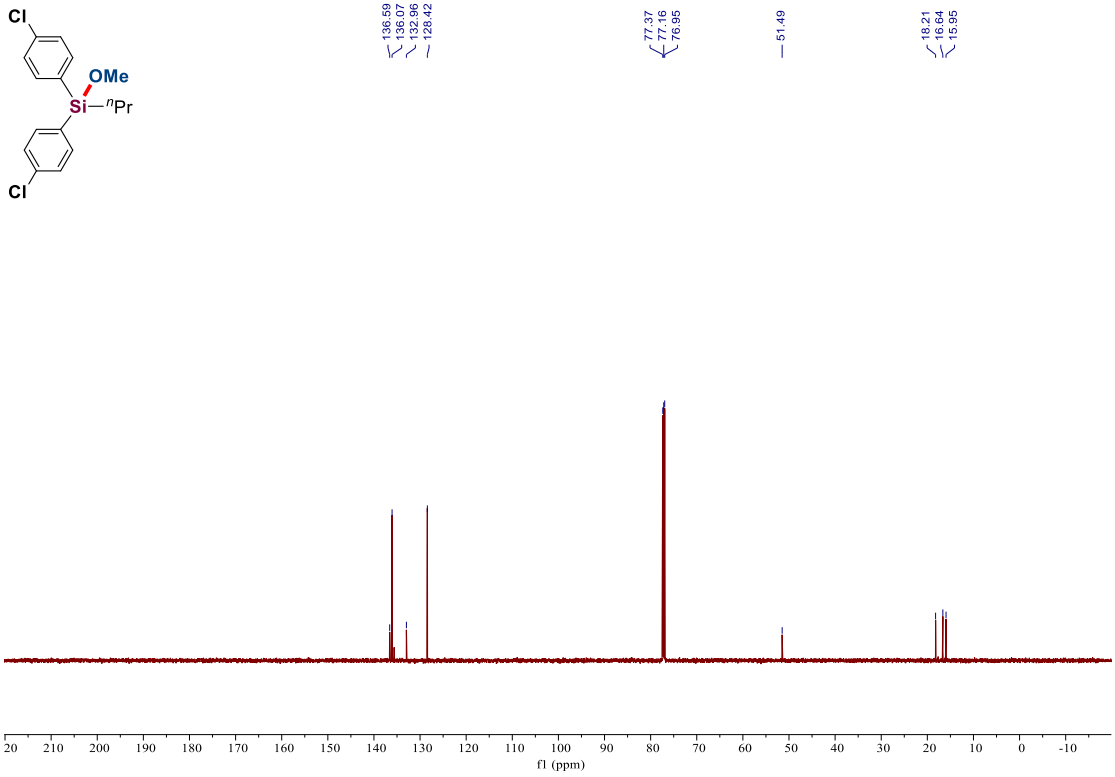
^{13}C NMR Spectra of **2e** (151 MHz, $CDCl_3$)



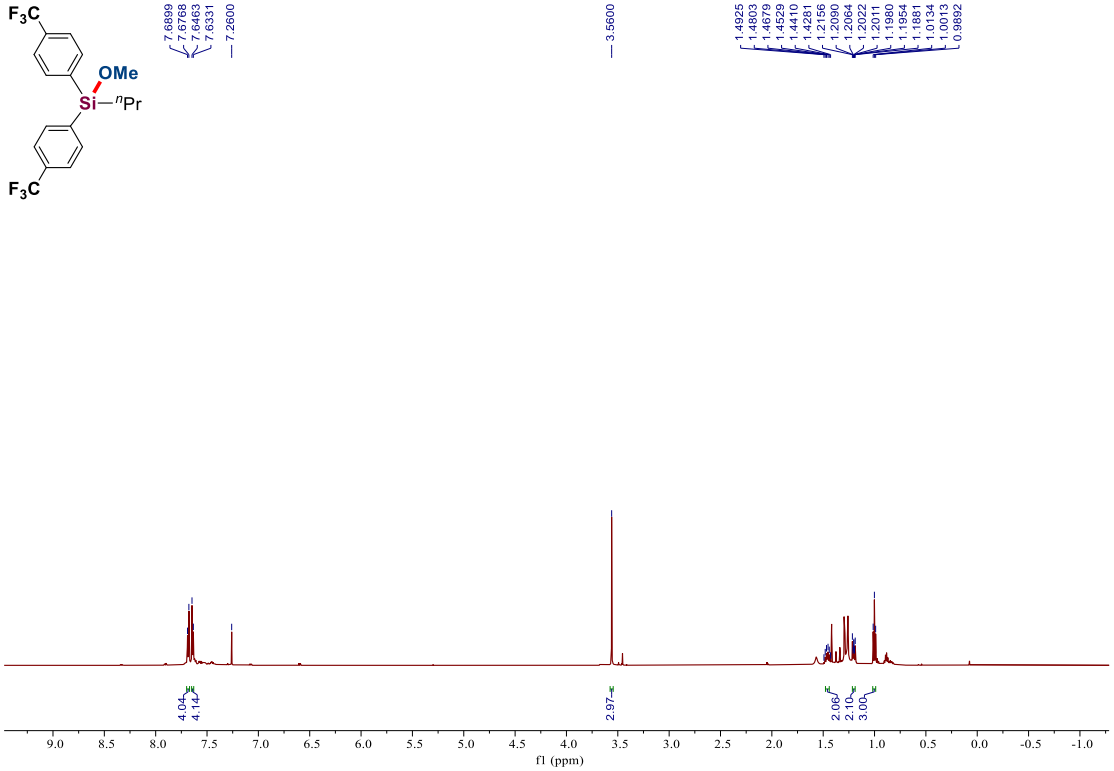
^{1}H NMR Spectra of **2f** (600 MHz, $CDCl_3$)



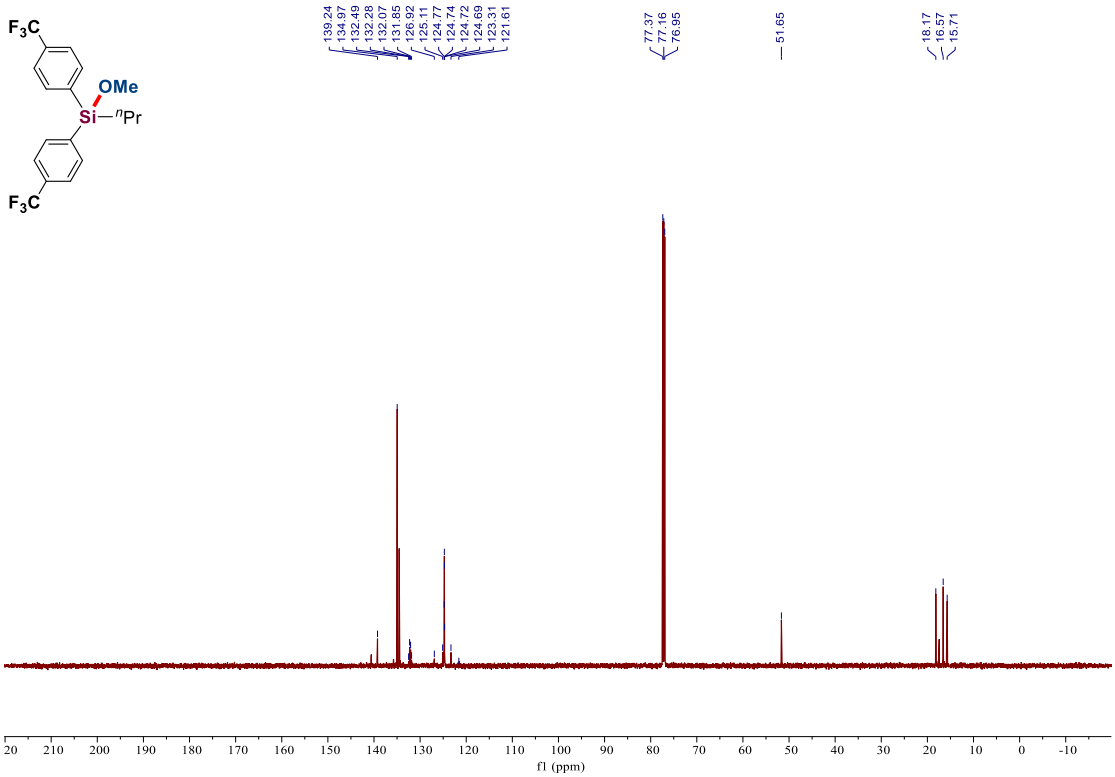
^{13}C NMR Spectra of **2f** (151 MHz, $CDCl_3$)



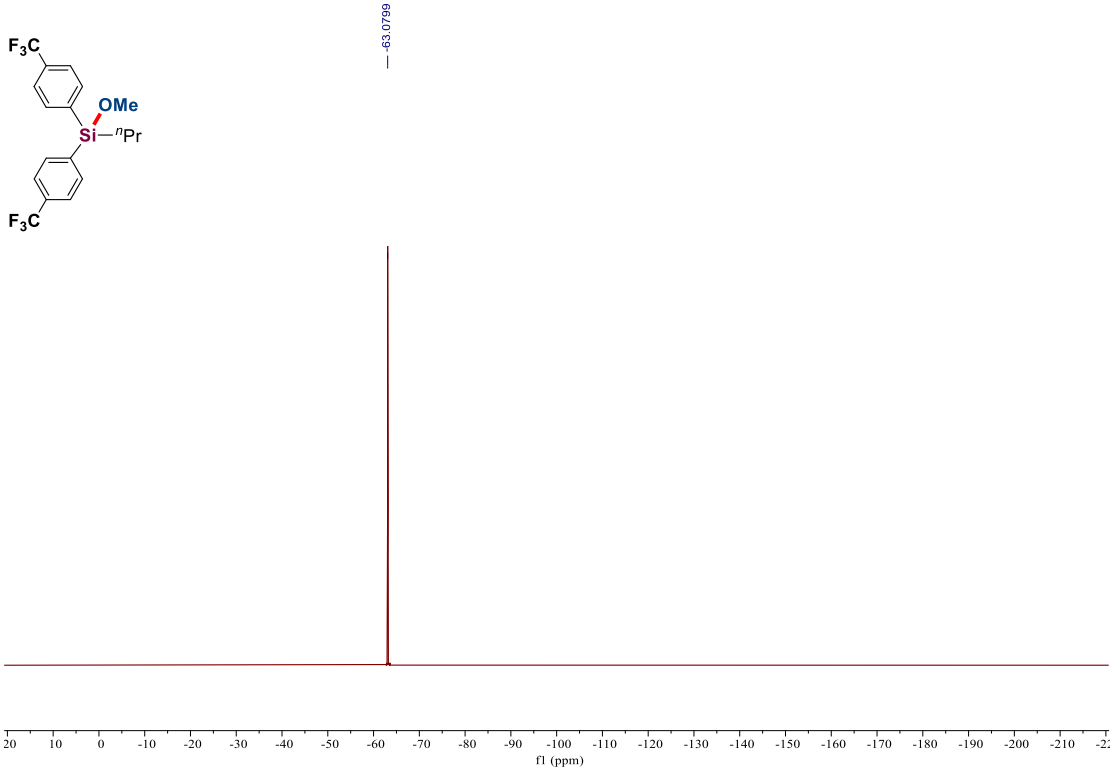
^{1}H NMR Spectra of **2g** (600 MHz, $CDCl_3$)



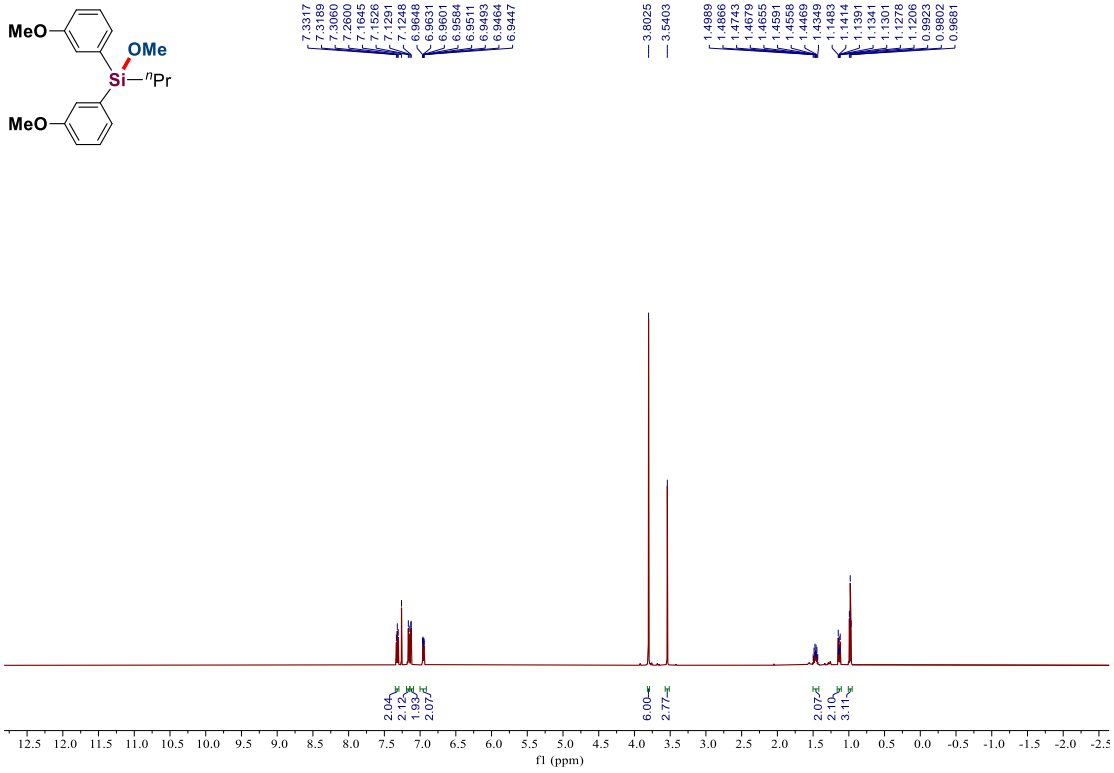
^{13}C NMR Spectra of **2g** (151 MHz, $CDCl_3$)



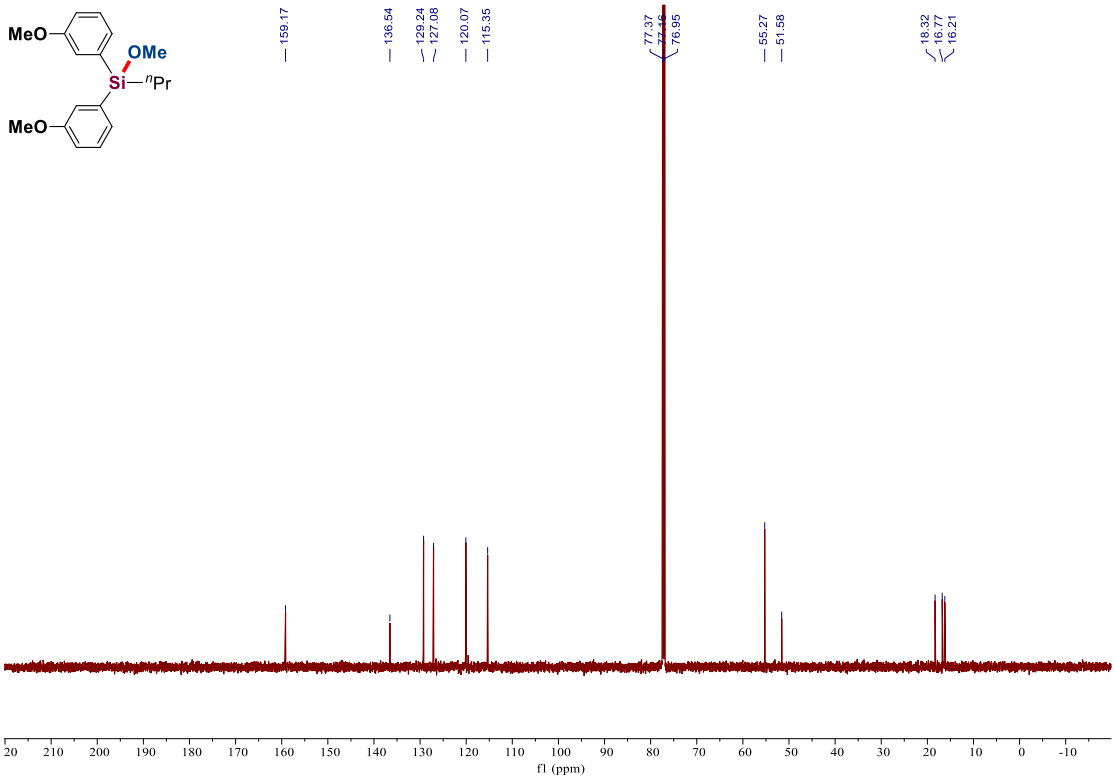
^{19}F NMR Spectra of **2g** (377 MHz, $CDCl_3$)



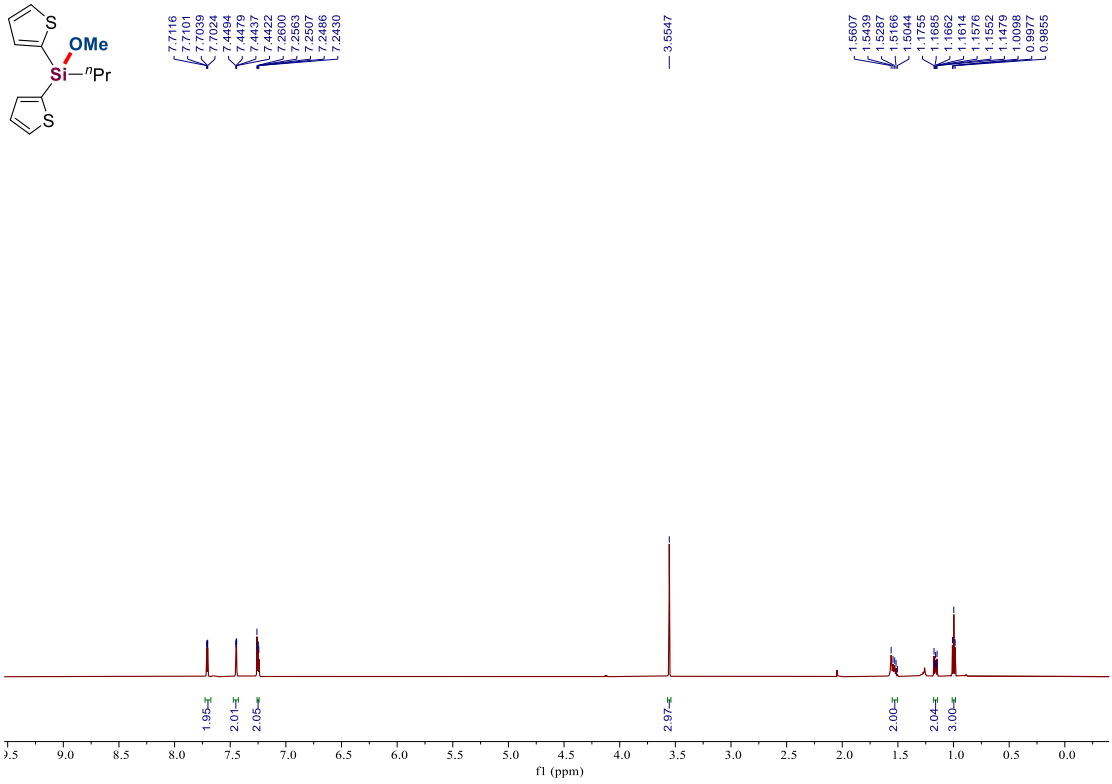
^{1}H NMR Spectra of **2h** (600 MHz, $CDCl_3$)



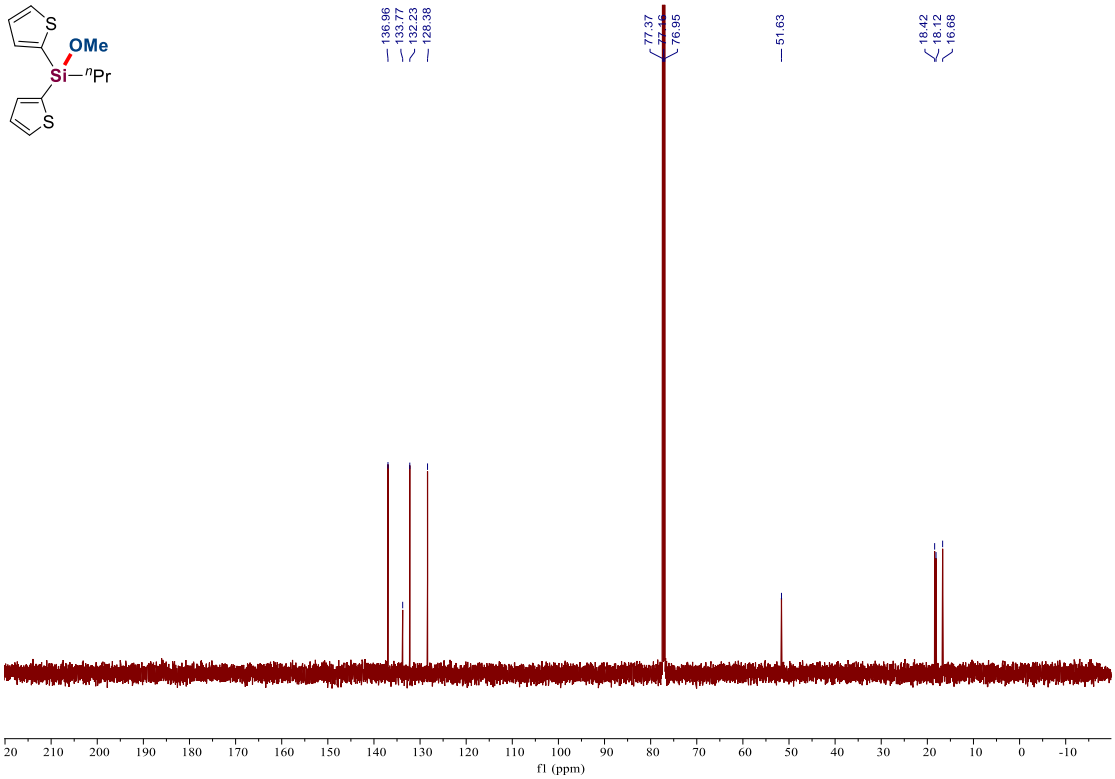
^{13}C NMR Spectra of **2h** (151 MHz, $CDCl_3$)



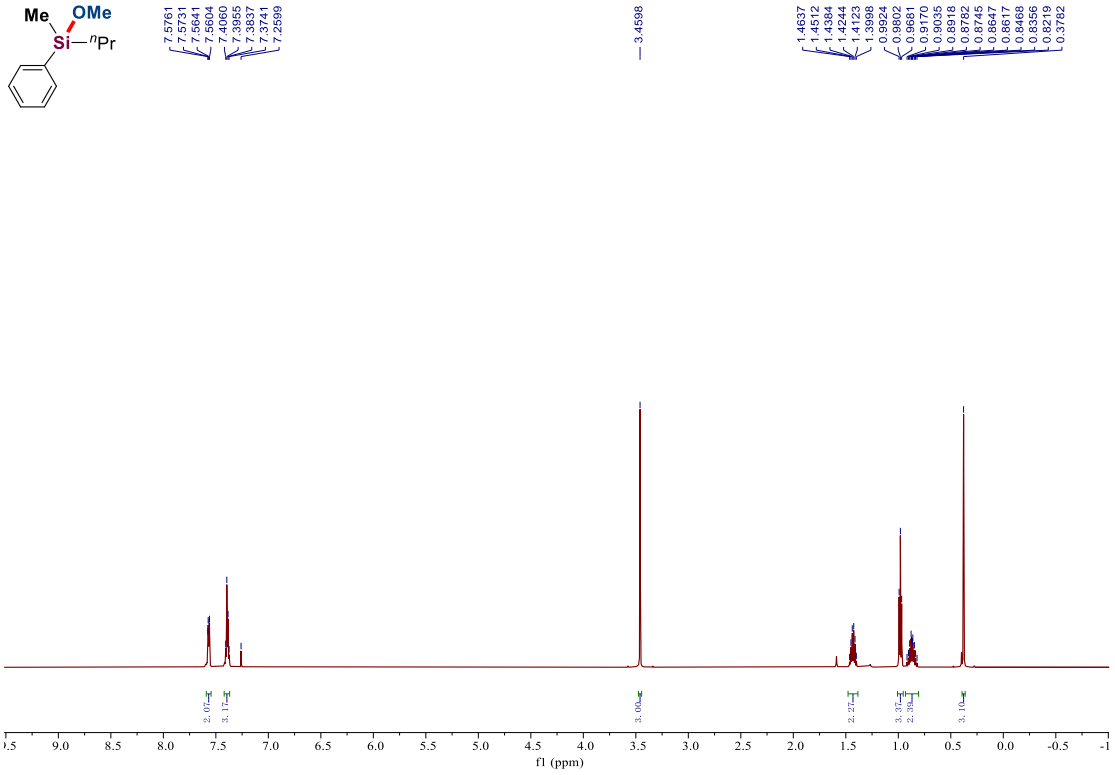
^{1}H NMR Spectra of **2i** (600 MHz, $CDCl_3$)



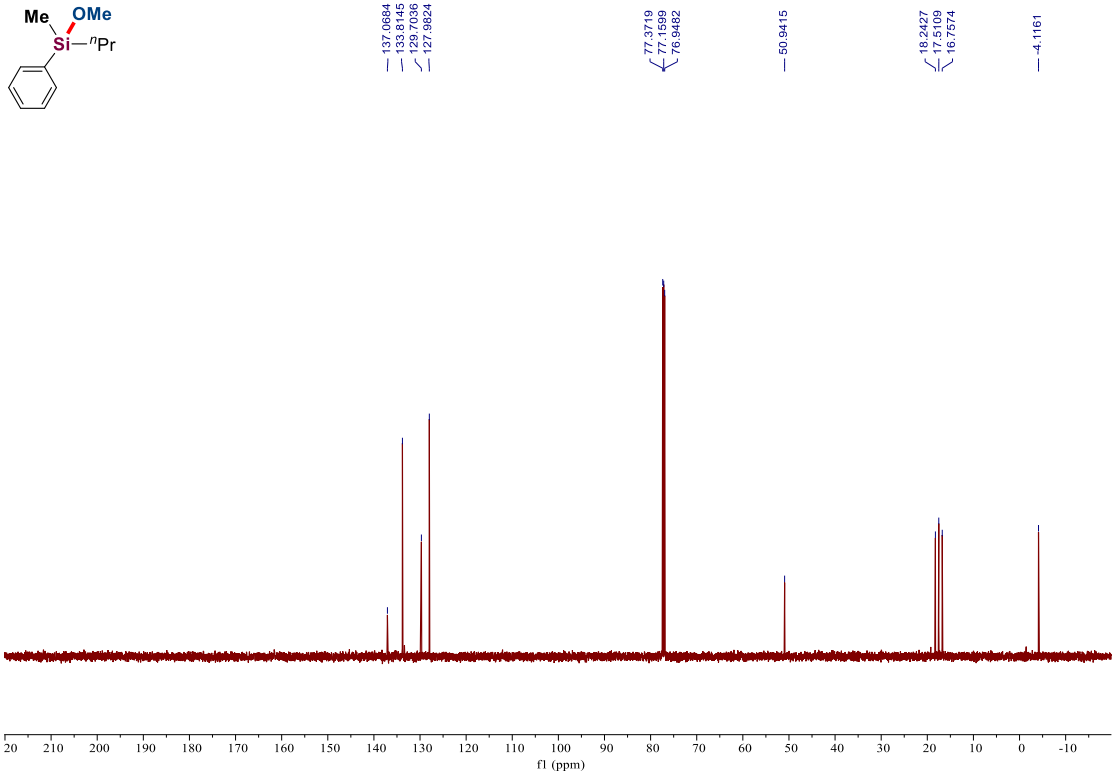
^{13}C NMR Spectra of **2i** (151 MHz, $CDCl_3$)



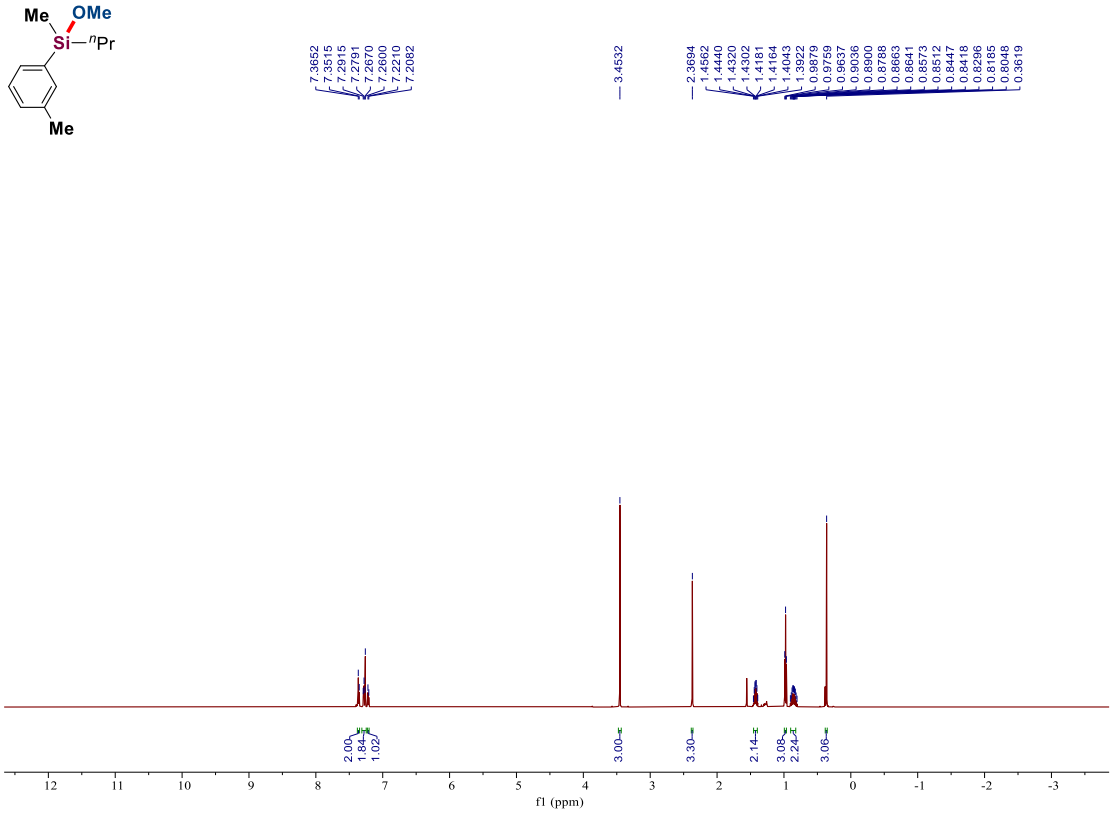
^{1}H NMR Spectra of **2j** (600 MHz, $CDCl_3$)



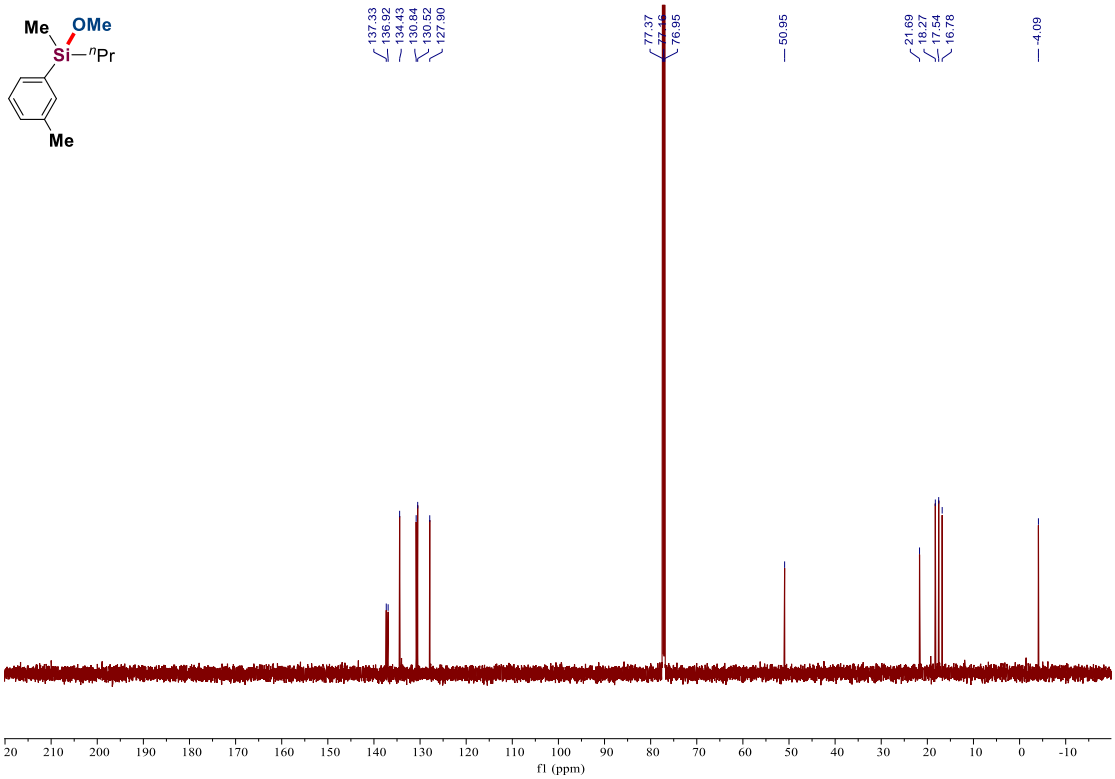
^{13}C NMR Spectra of **2j** (151 MHz, $CDCl_3$)



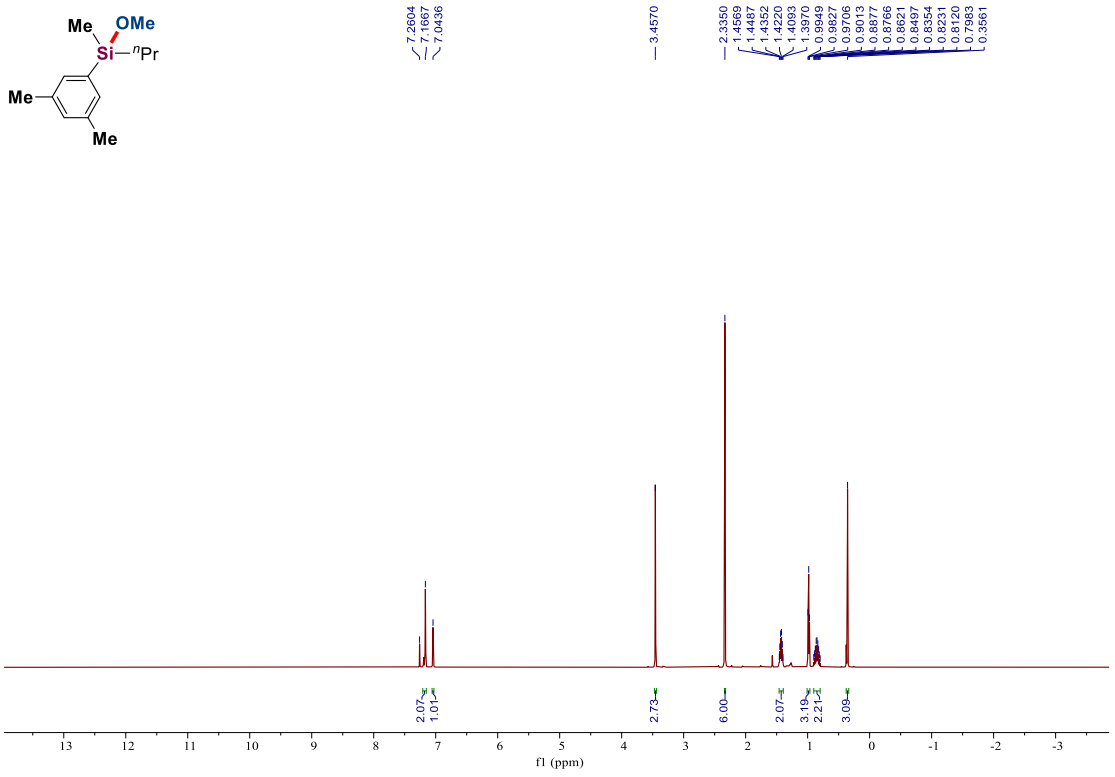
^{1}H NMR Spectra of **2k** (600 MHz, $CDCl_3$)



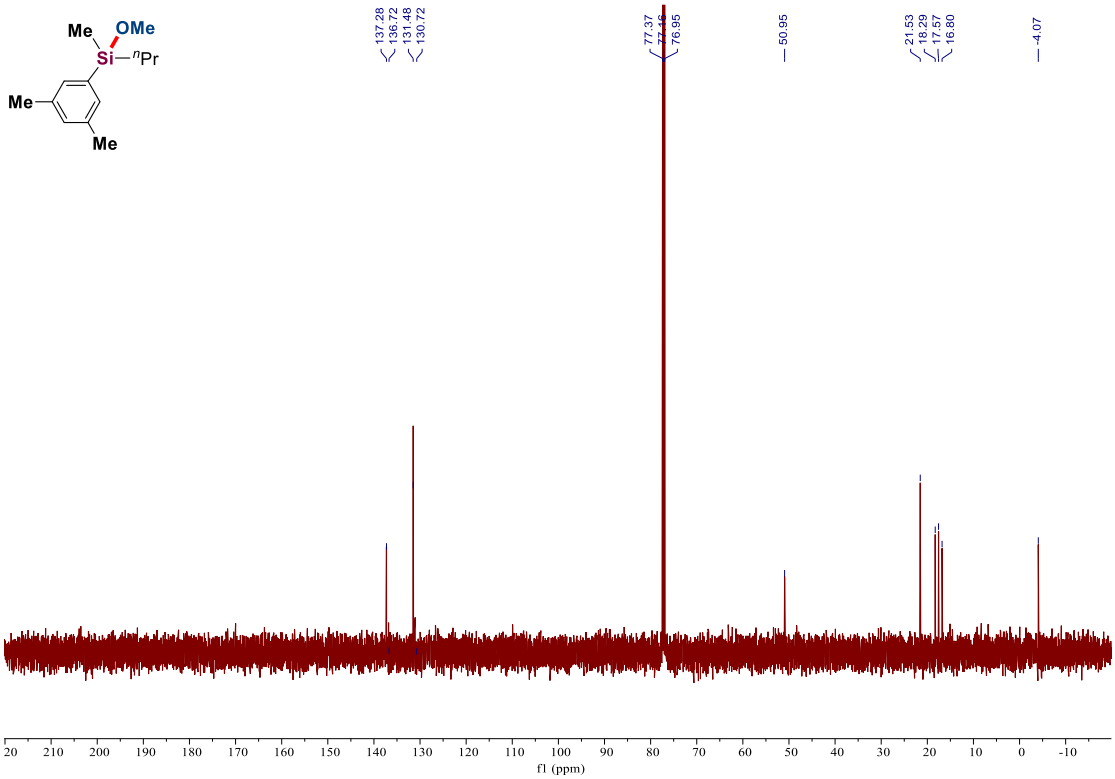
^{13}C NMR Spectra of **2k** (151 MHz, $CDCl_3$)



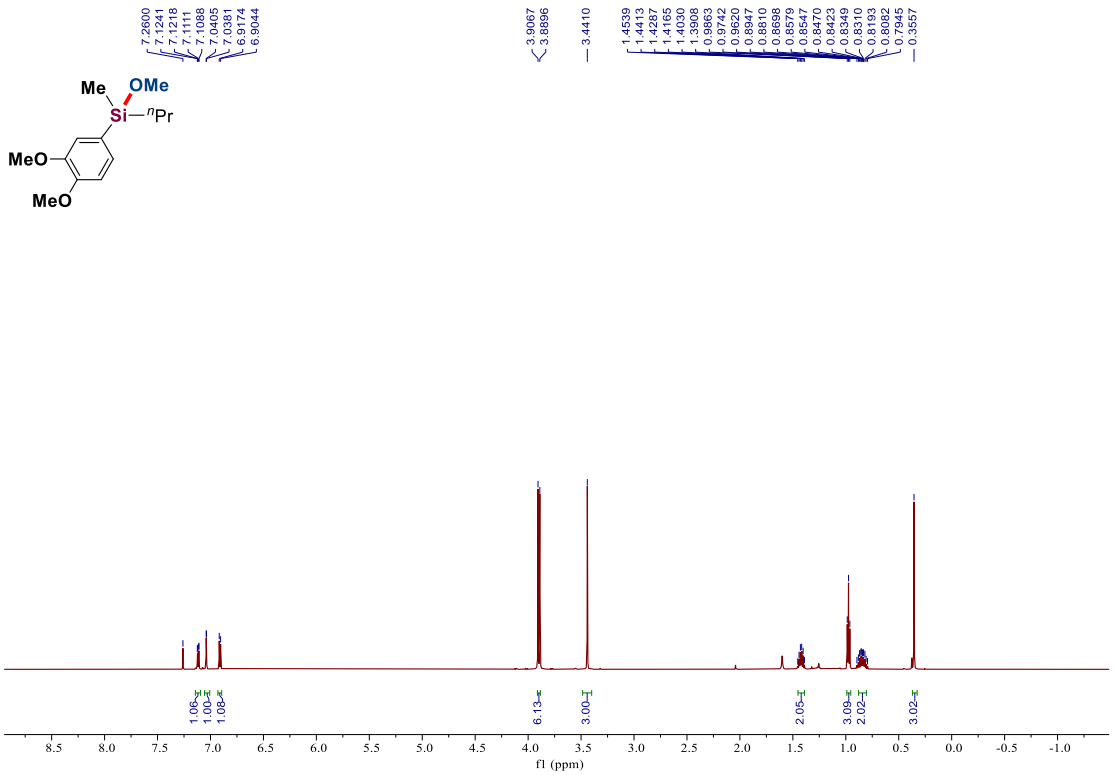
^{1}H NMR Spectra of **2l** (600 MHz, $CDCl_3$)



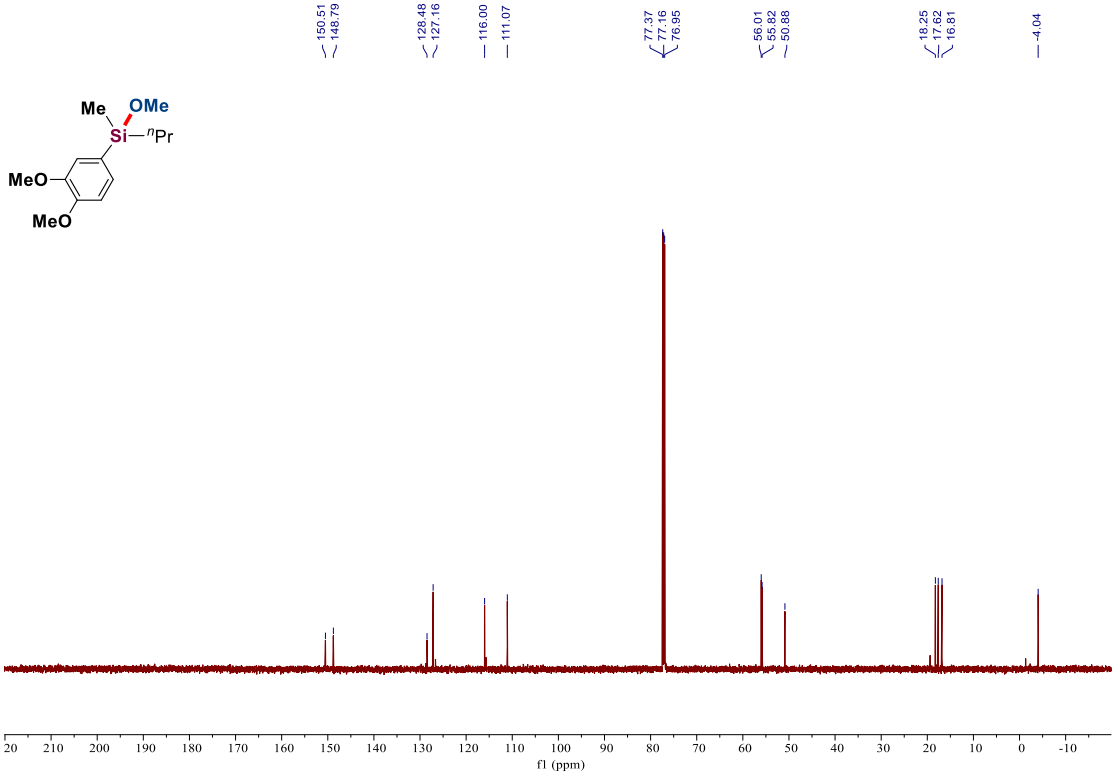
^{13}C NMR Spectra of **2l** (151 MHz, $CDCl_3$)



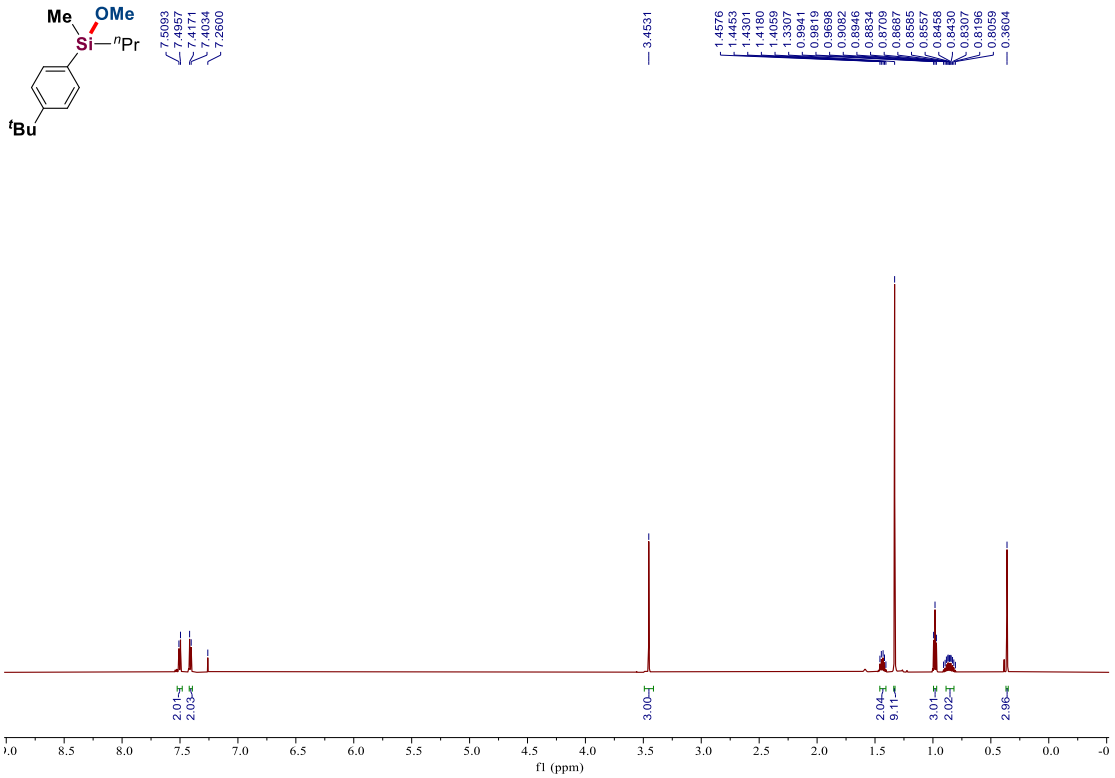
^{1}H NMR Spectra of **2m** (600 MHz, $CDCl_3$)



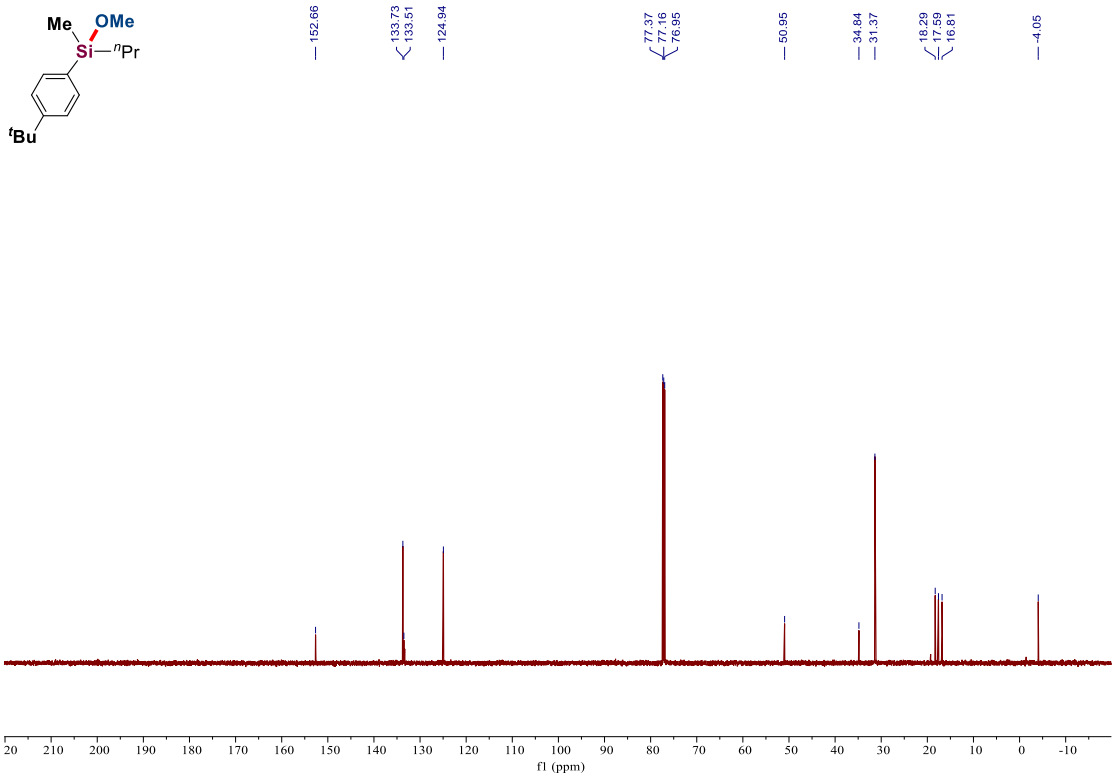
^{13}C NMR Spectra of **2m** (151 MHz, $CDCl_3$)



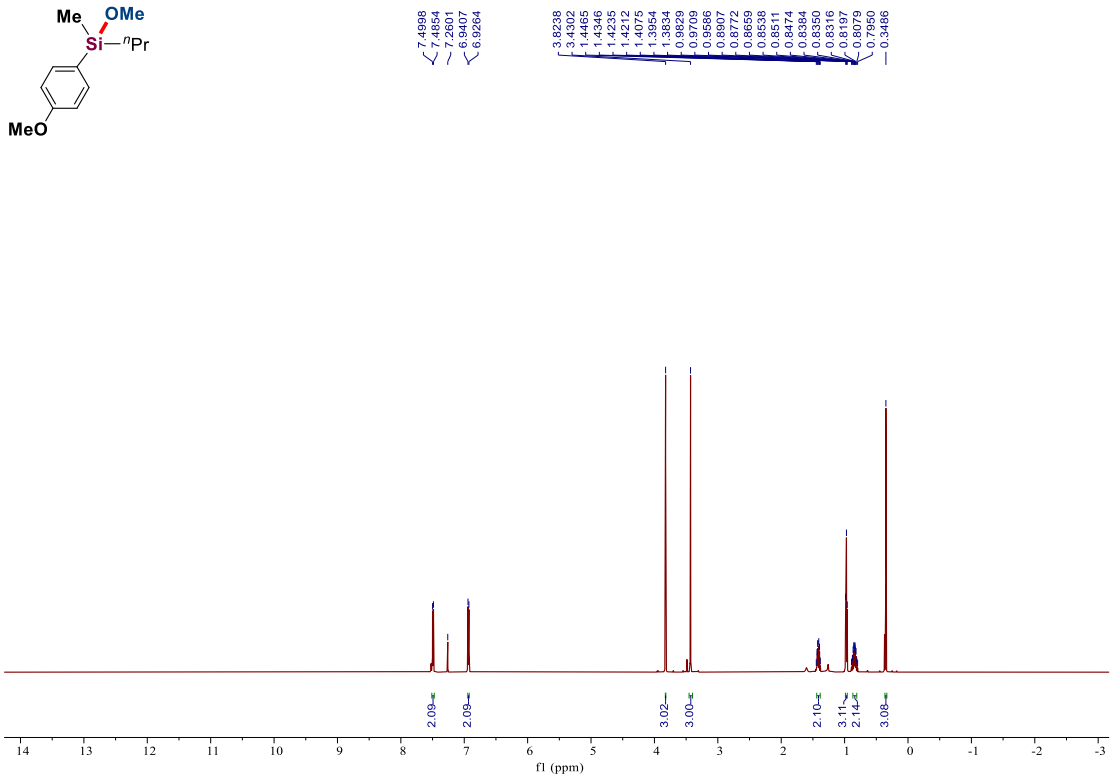
^{1}H NMR Spectra of **2n** (600 MHz, $CDCl_3$)



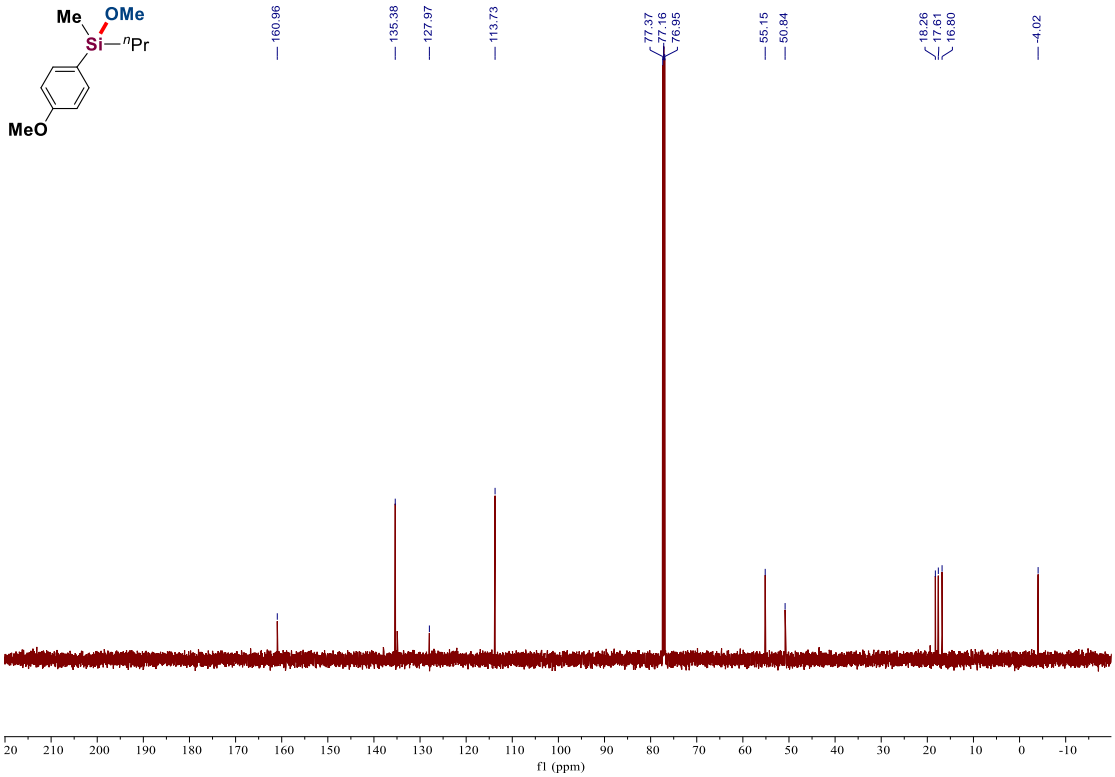
^{13}C NMR Spectra of **2n** (151 MHz, $CDCl_3$)



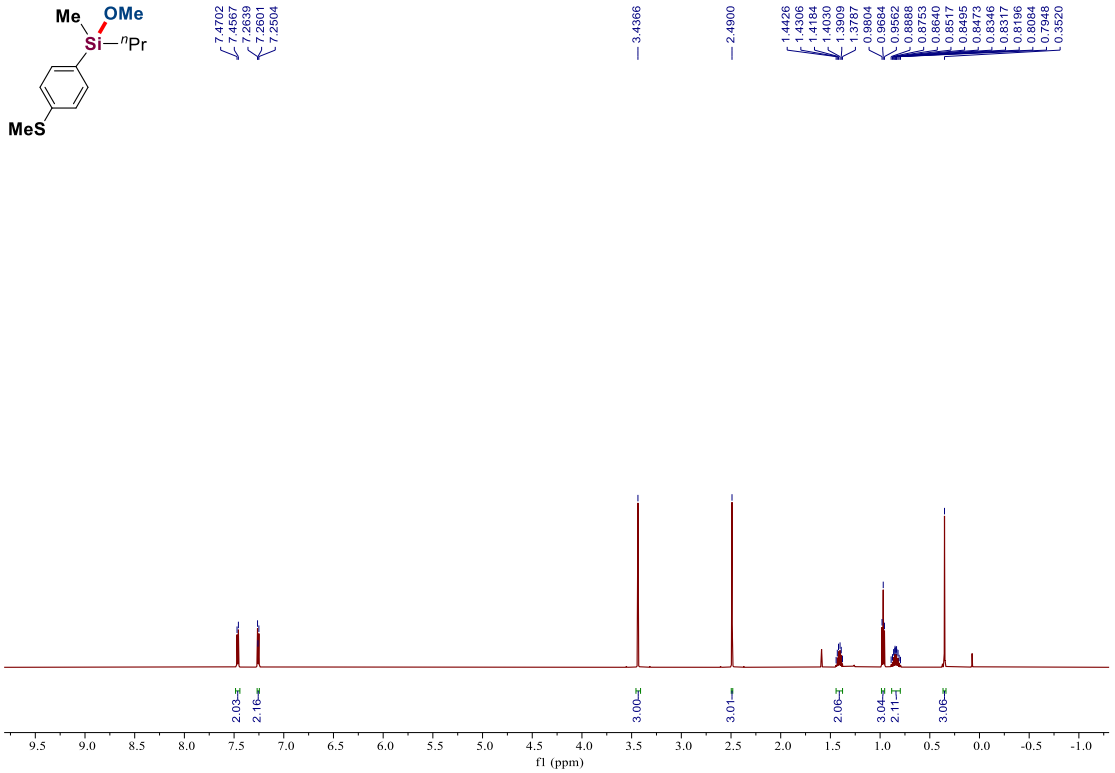
^{1}H NMR Spectra of **2o** (600 MHz, $CDCl_3$)



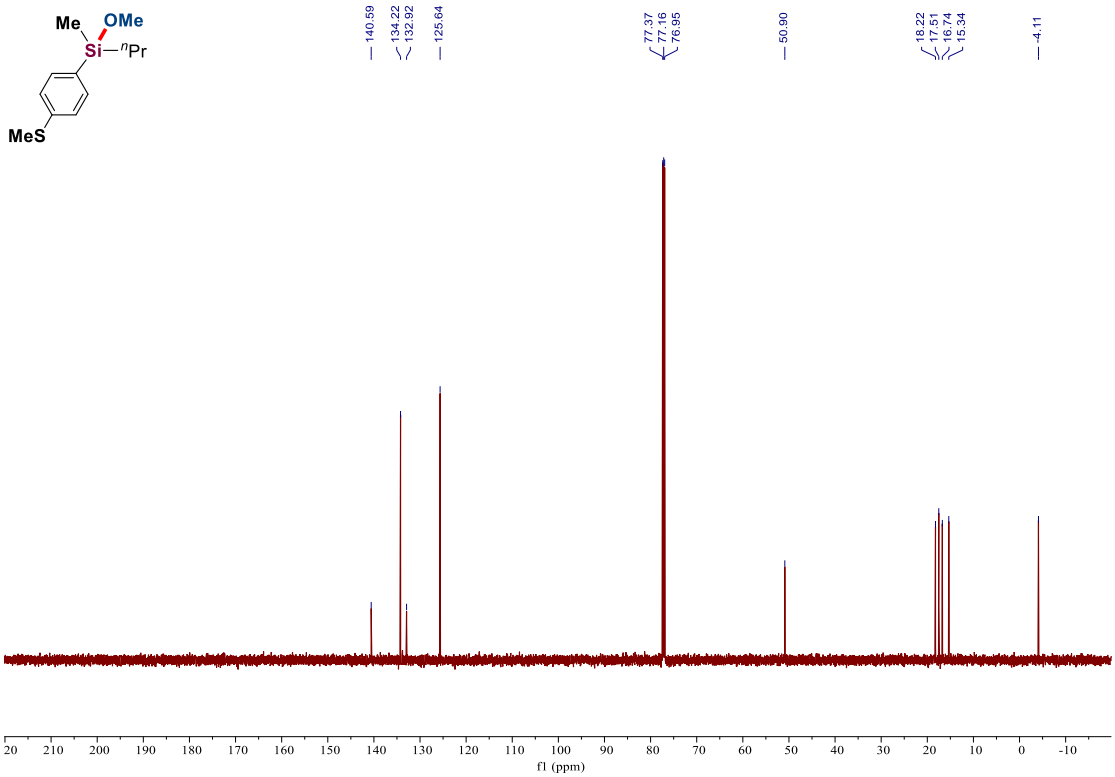
^{13}C NMR Spectra of **2o** (151 MHz, $CDCl_3$)



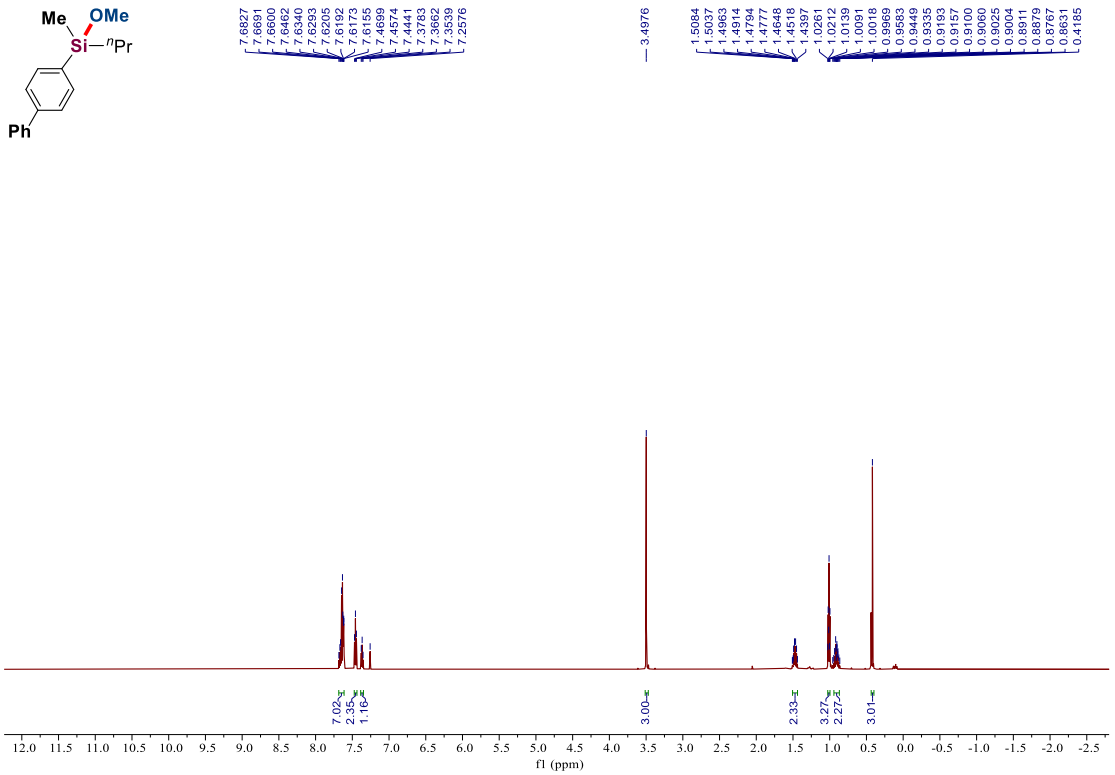
^{1}H NMR Spectra of **2p** (600 MHz, $CDCl_3$)



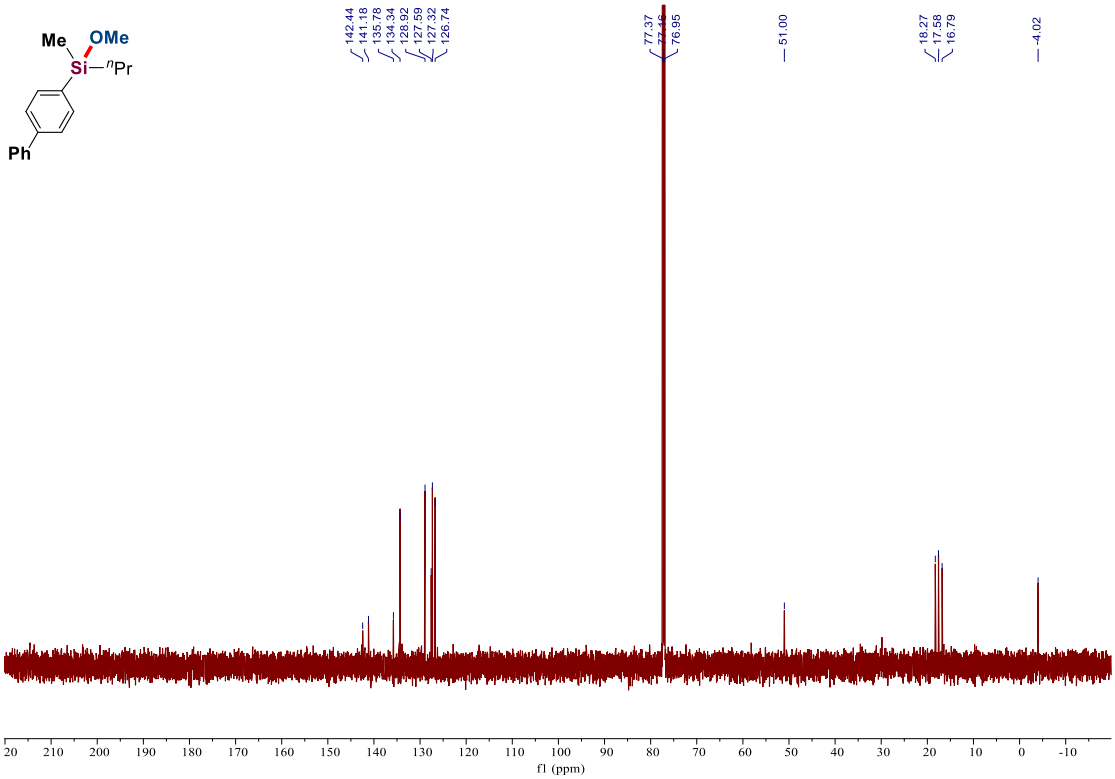
^{13}C NMR Spectra of **2p** (151 MHz, $CDCl_3$)



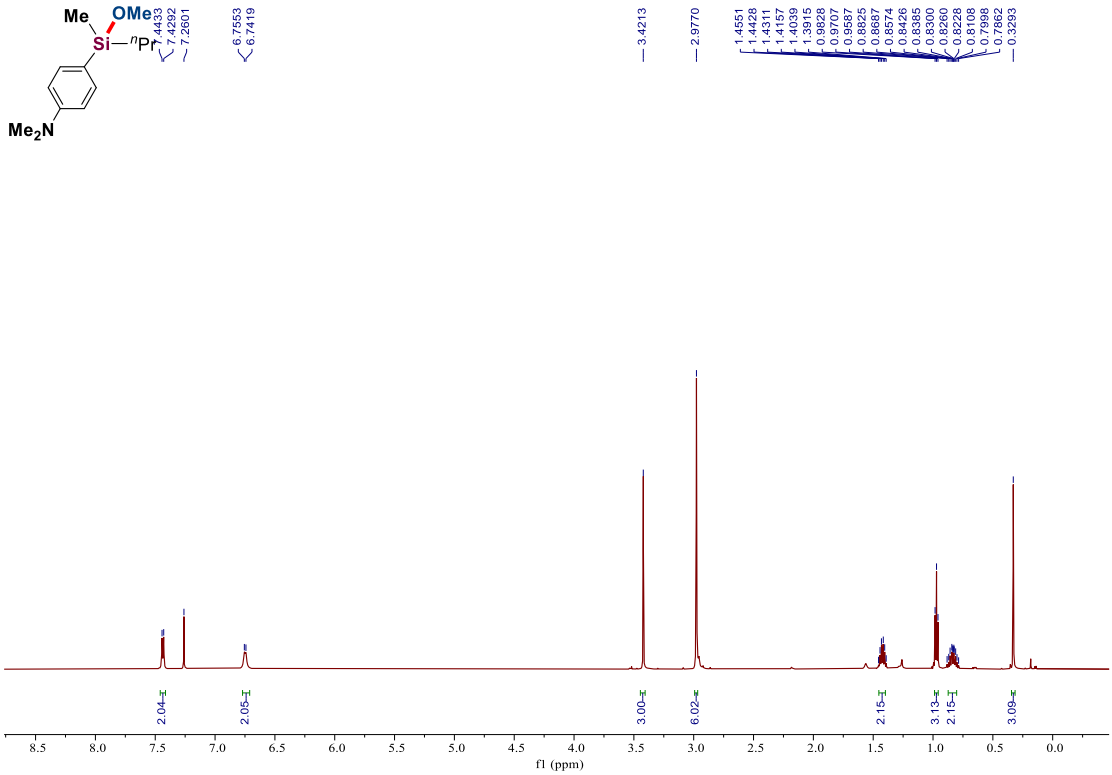
^{1}H NMR Spectra of **2q** (600 MHz, $CDCl_3$)



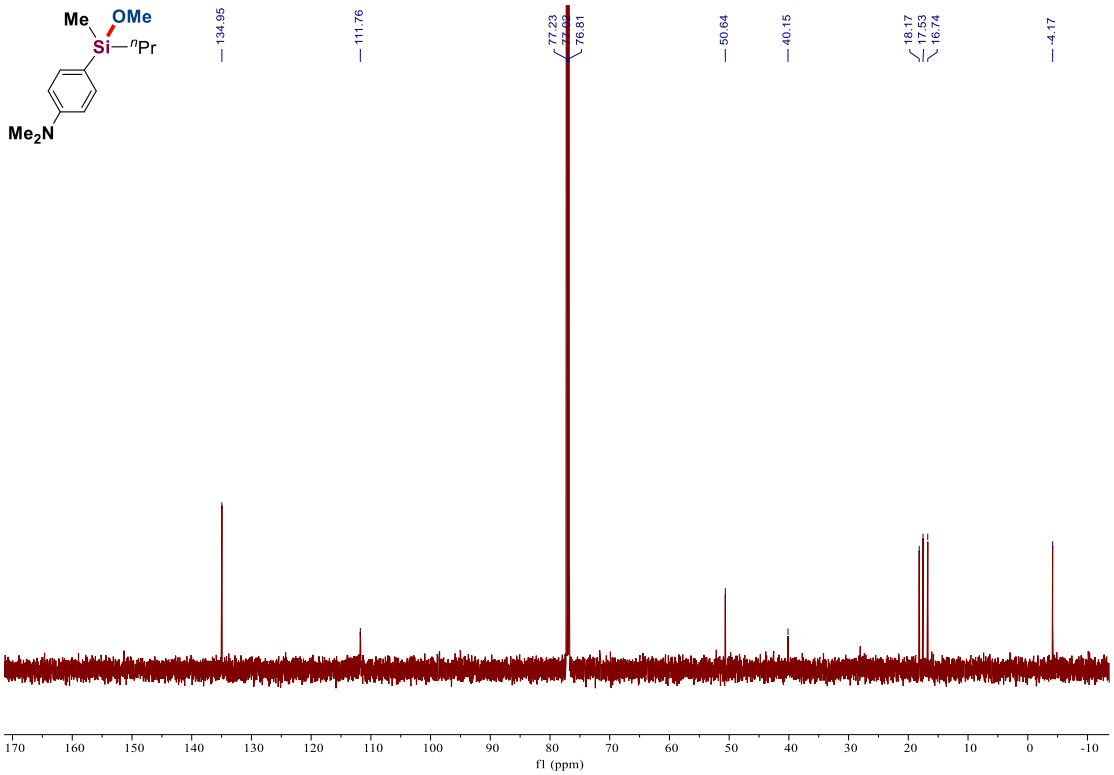
^{13}C NMR Spectra of **2q** (151 MHz, $CDCl_3$)



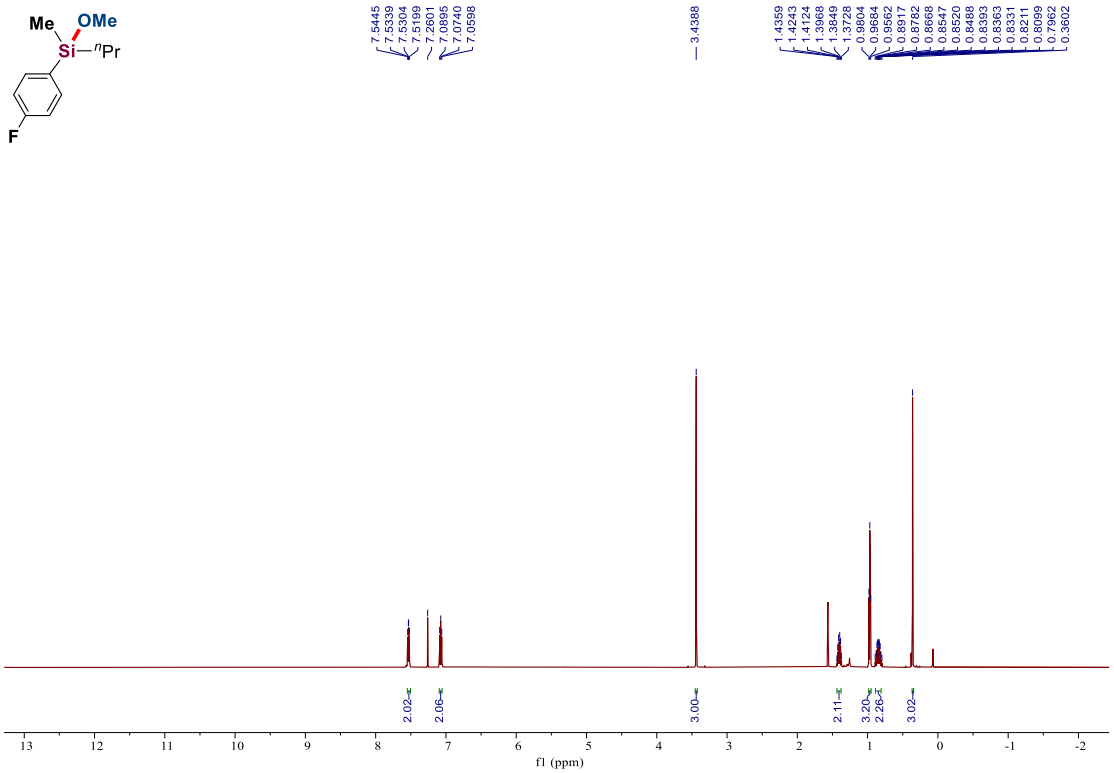
^{1}H NMR Spectra of **2r** (600 MHz, $CDCl_3$)



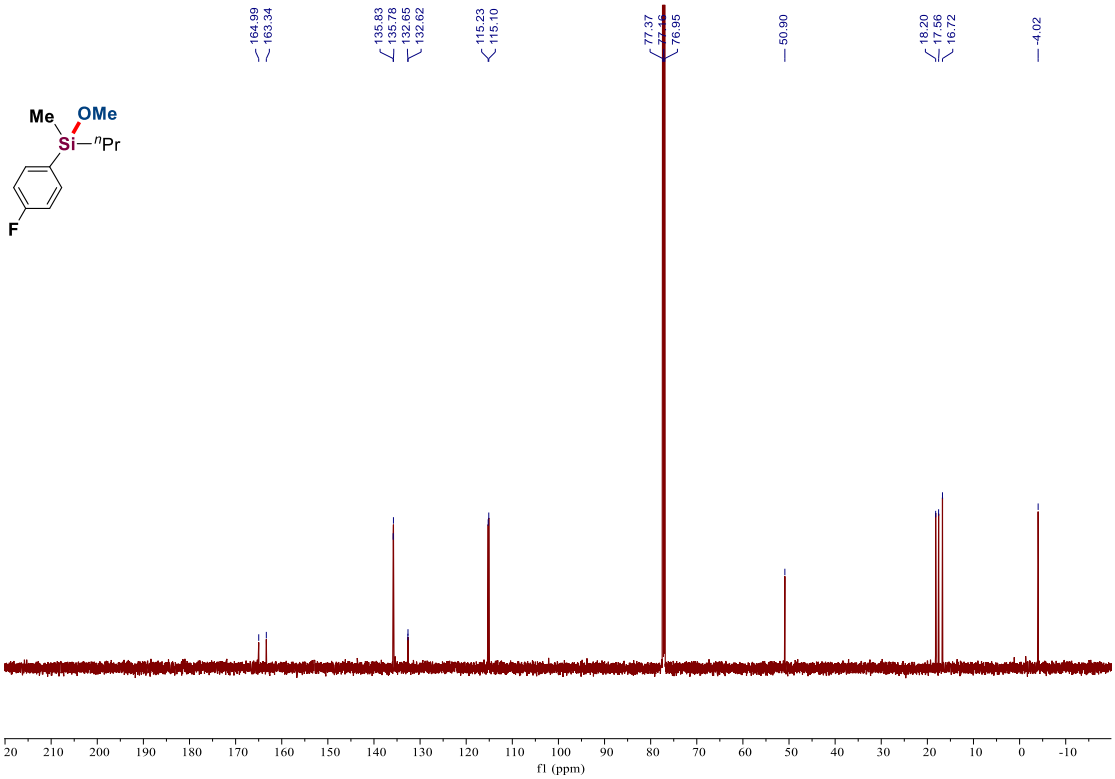
^{13}C NMR Spectra of **2r** (151 MHz, $CDCl_3$)



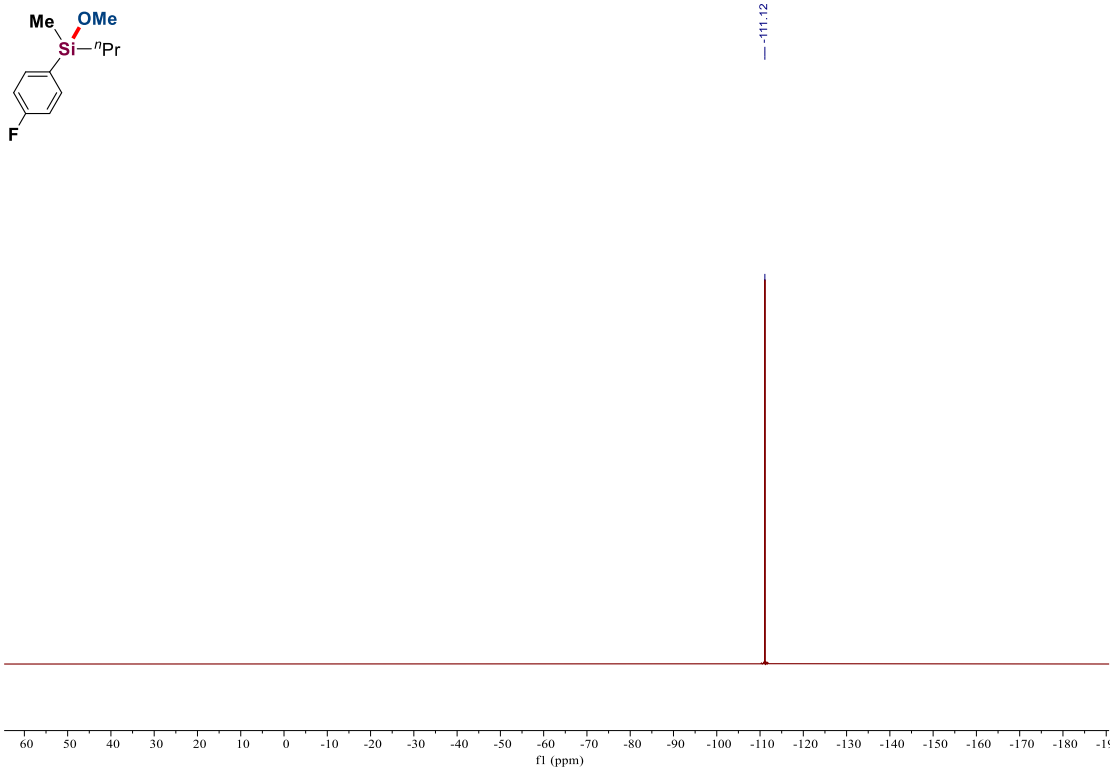
^{1}H NMR Spectra of **2s** (600 MHz, $CDCl_3$)



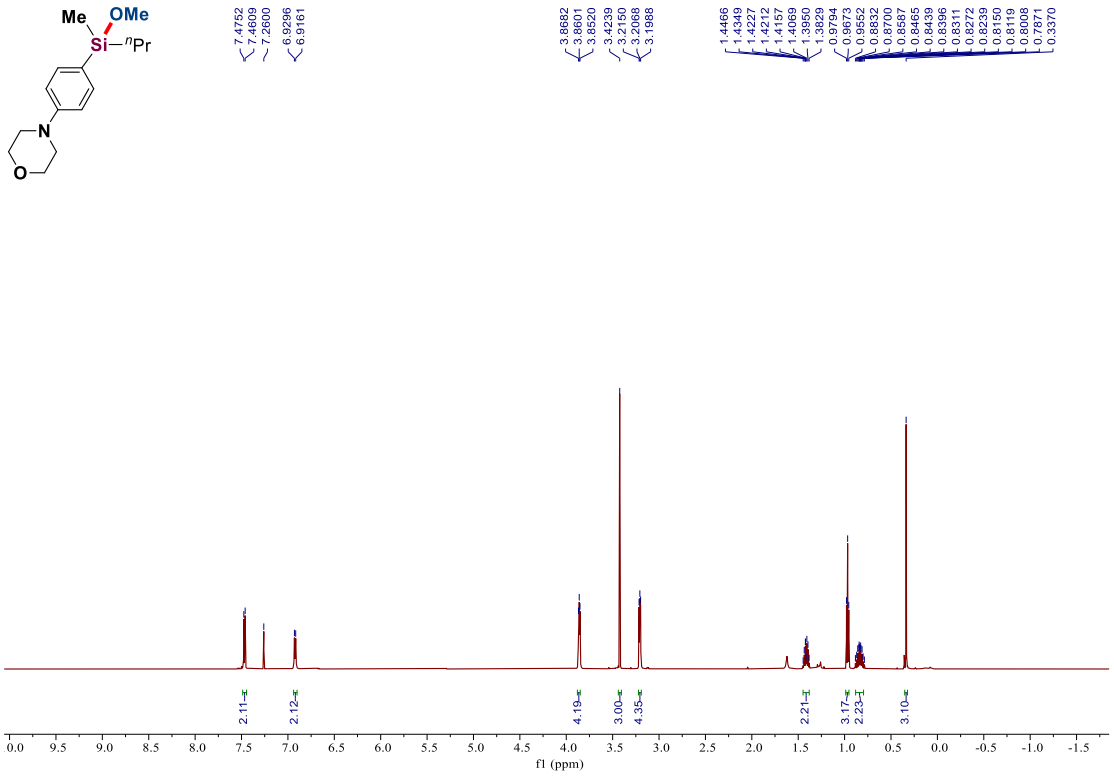
^{13}C NMR Spectra of **2s** (151 MHz, $CDCl_3$)



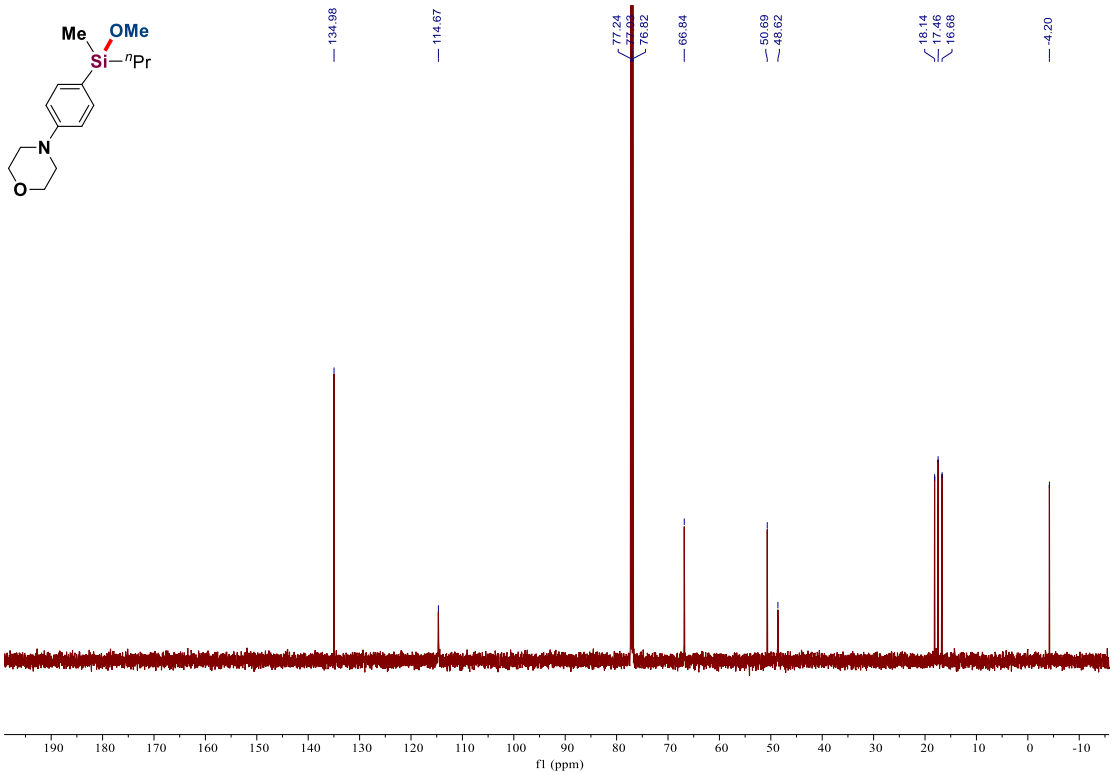
^{19}F NMR Spectra of **2s** (377 MHz, $CDCl_3$)



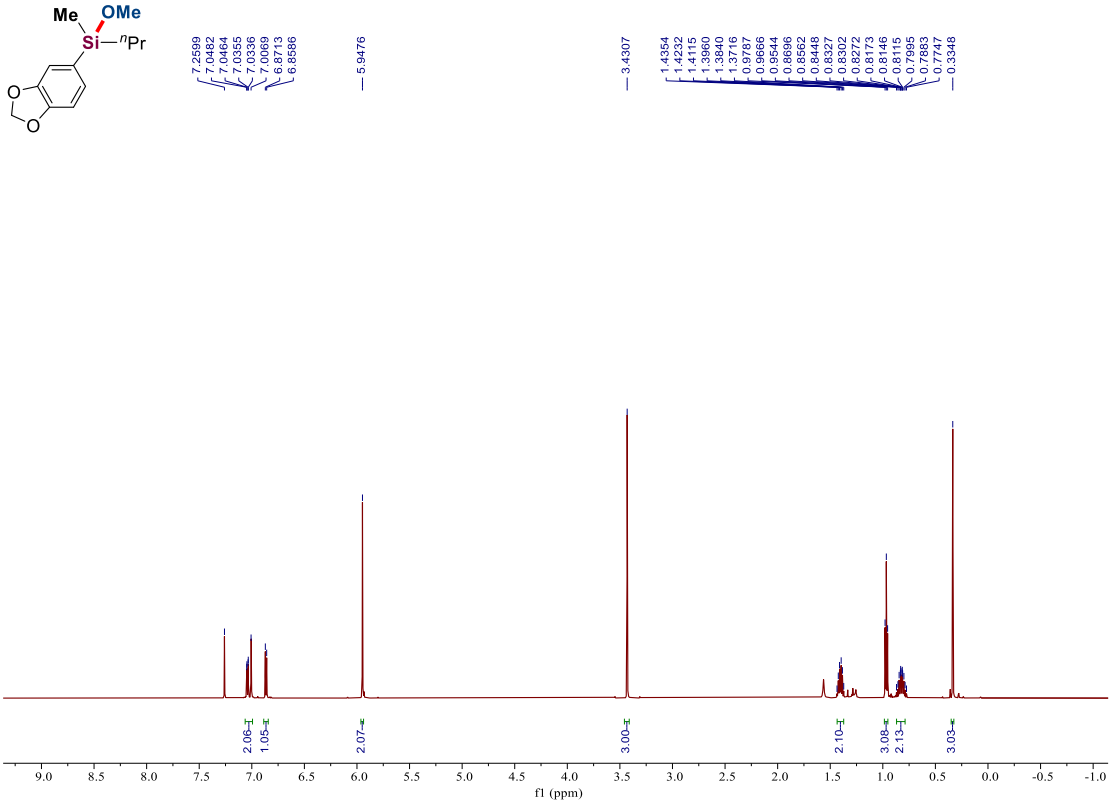
^{1}H NMR Spectra of **2t** (600 MHz, $CDCl_3$)



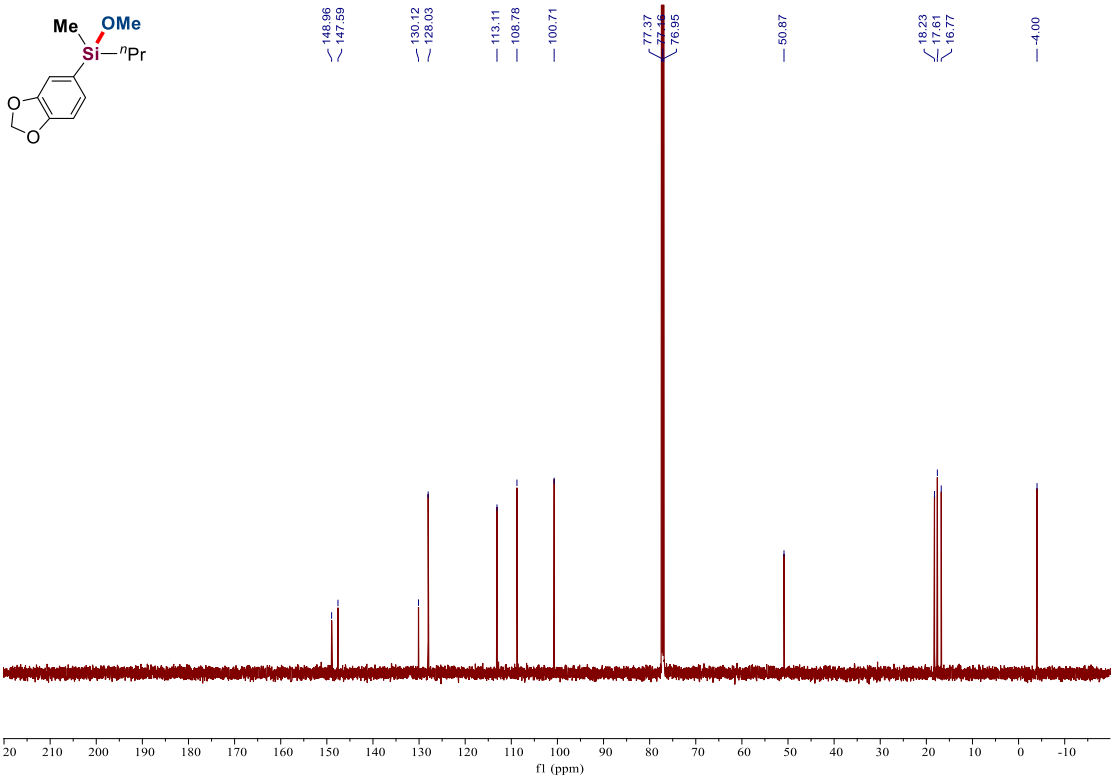
^{13}C NMR Spectra of **2t** (151 MHz, $CDCl_3$)



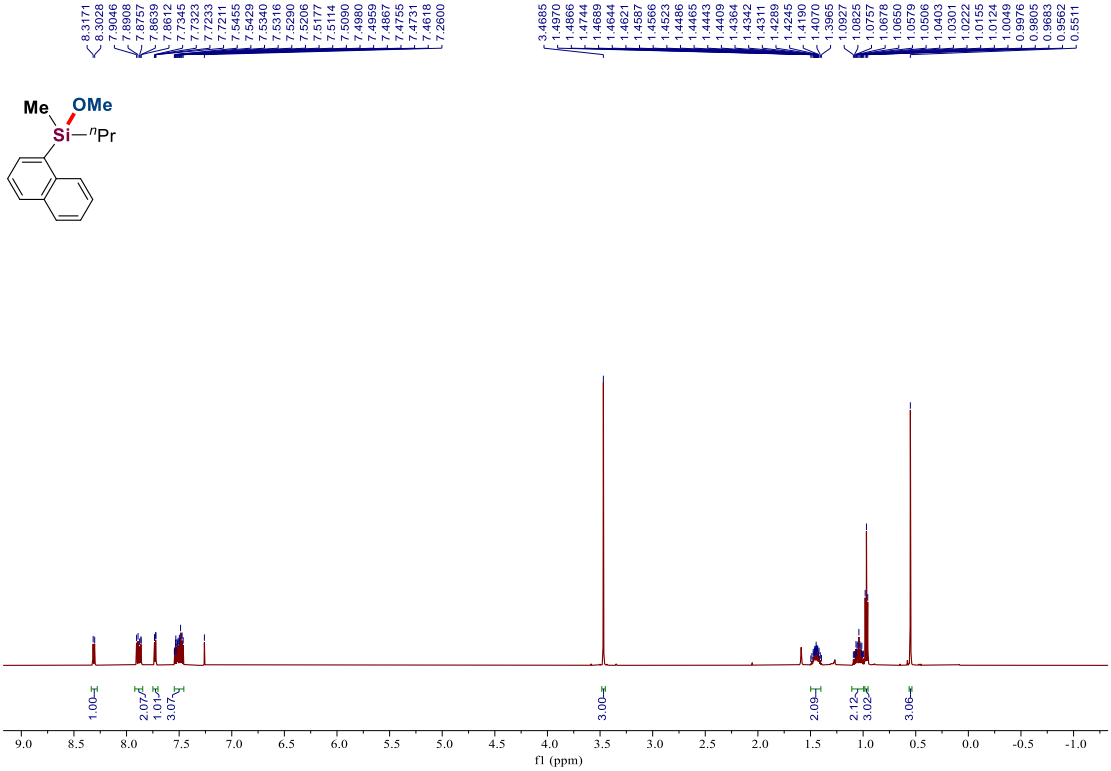
^{1}H NMR Spectra of **2u** (600 MHz, $CDCl_3$)



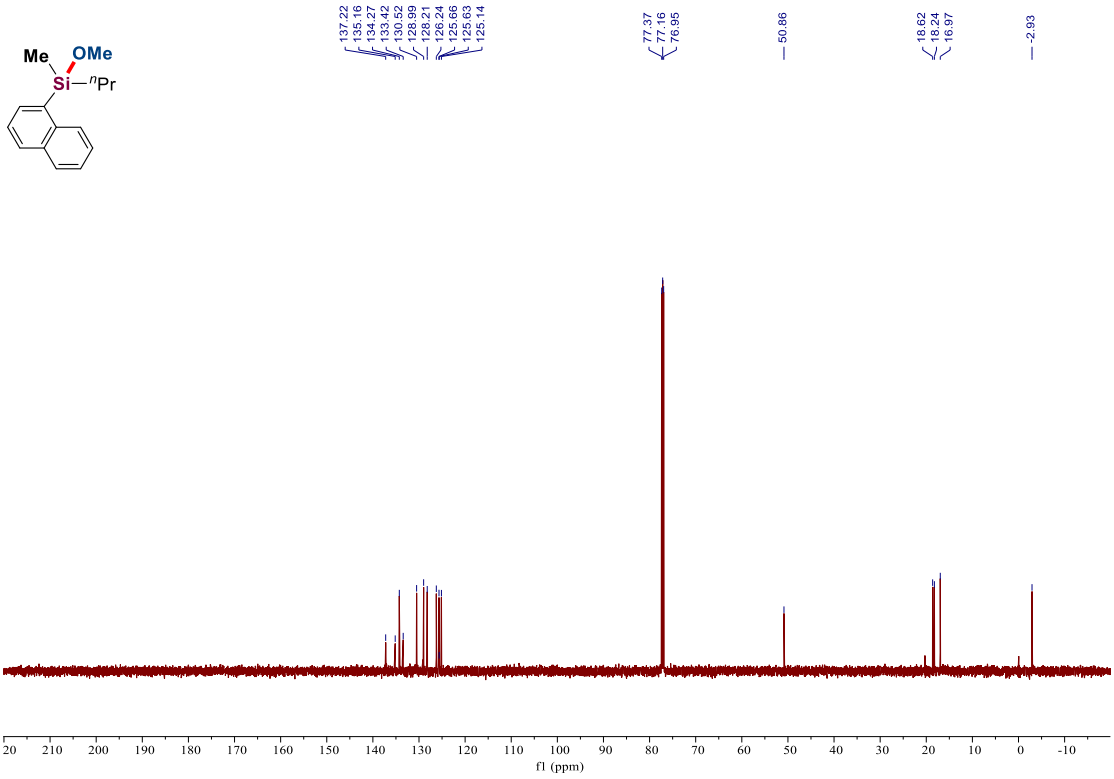
^{13}C NMR Spectra of **2u** (151 MHz, $CDCl_3$)



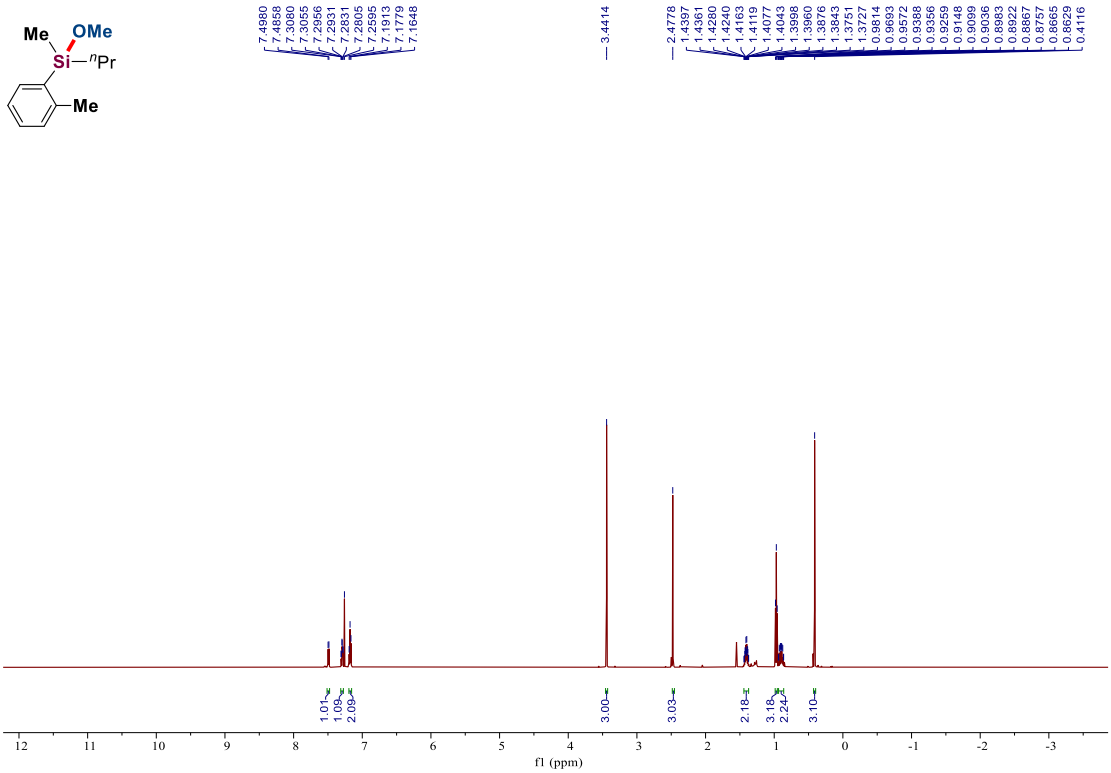
^{1}H NMR Spectra of **2v** (600 MHz, $CDCl_3$)



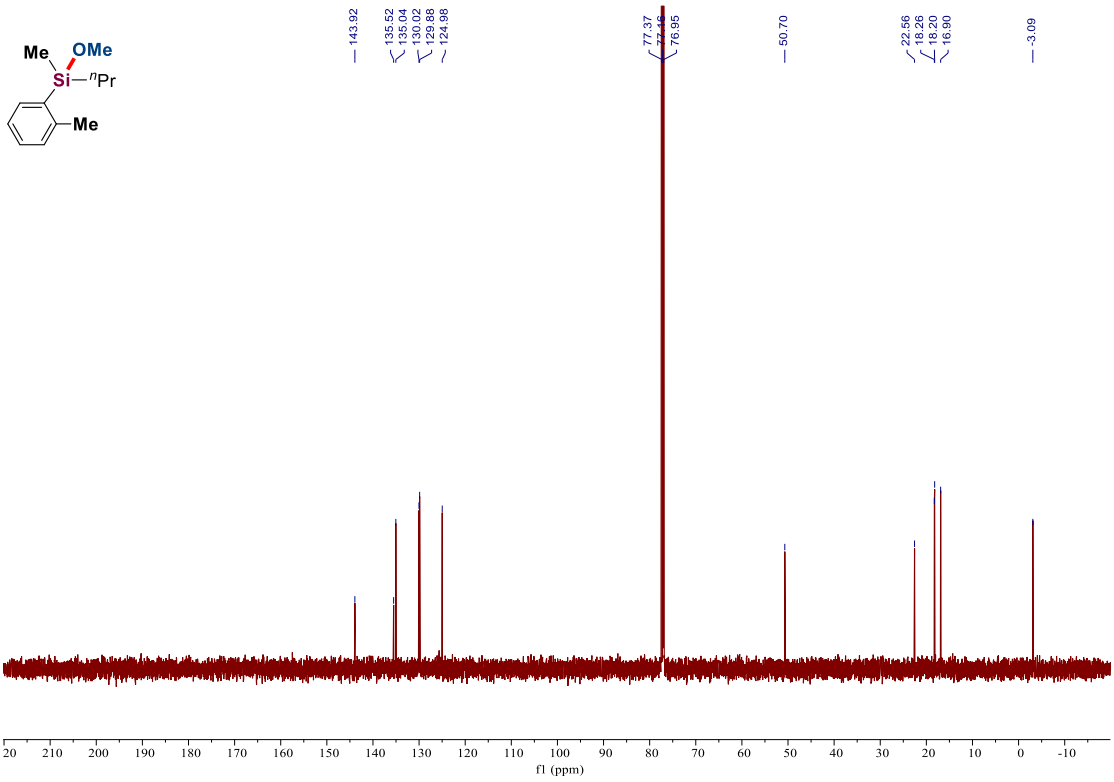
^{13}C NMR Spectra of **2v** (151 MHz, $CDCl_3$)



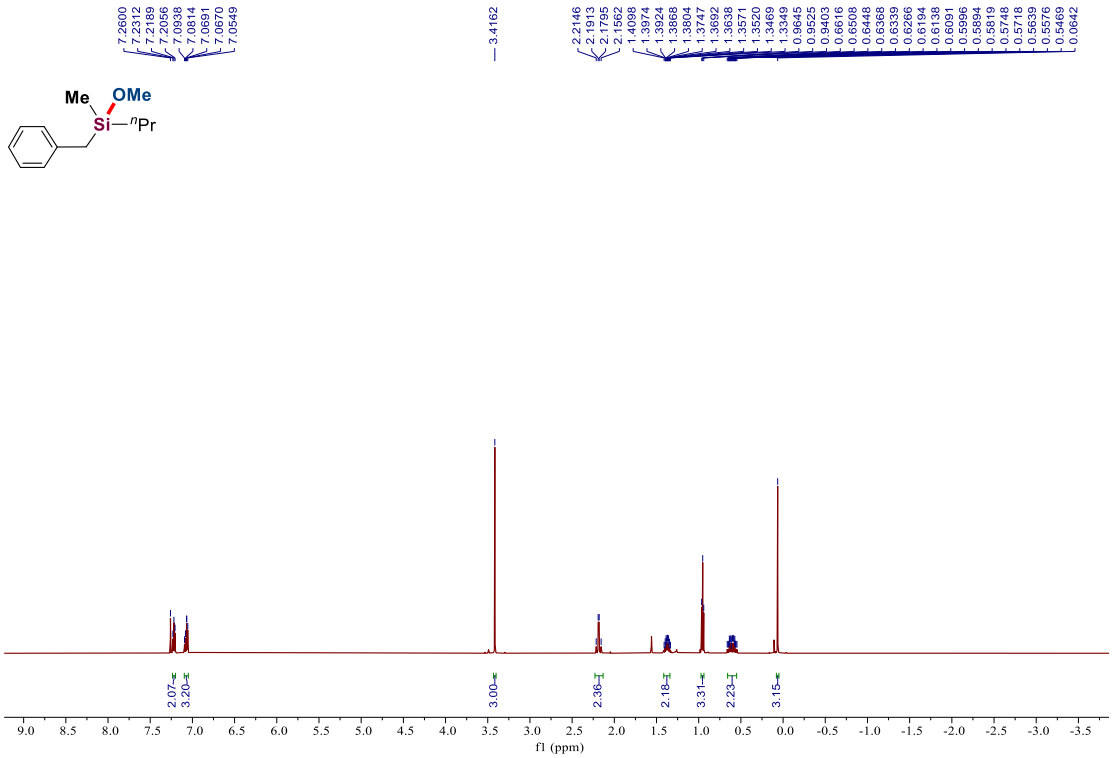
^{1}H NMR Spectra of **2w** (600 MHz, $CDCl_3$)



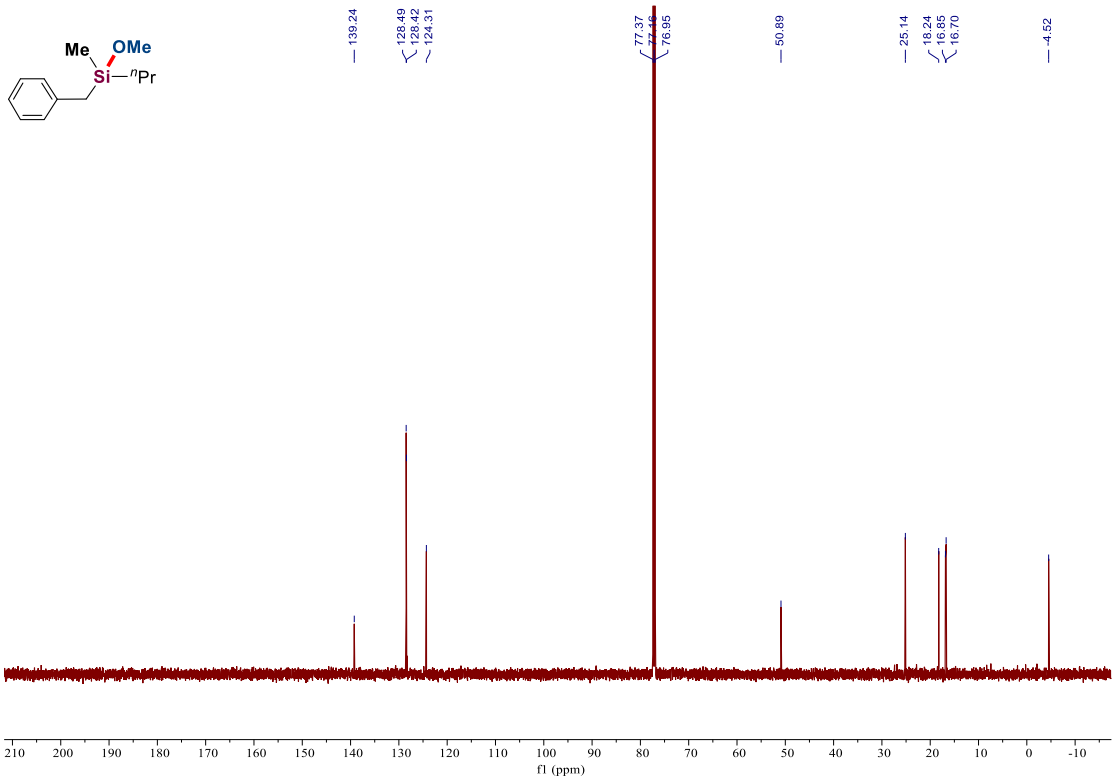
^{13}C NMR Spectra of **2w** (151 MHz, $CDCl_3$)



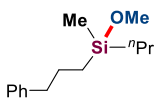
^{1}H NMR Spectra of **2x** (600 MHz, $CDCl_3$)



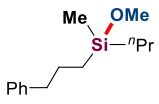
^{13}C NMR Spectra of **2x** (151 MHz, $CDCl_3$)



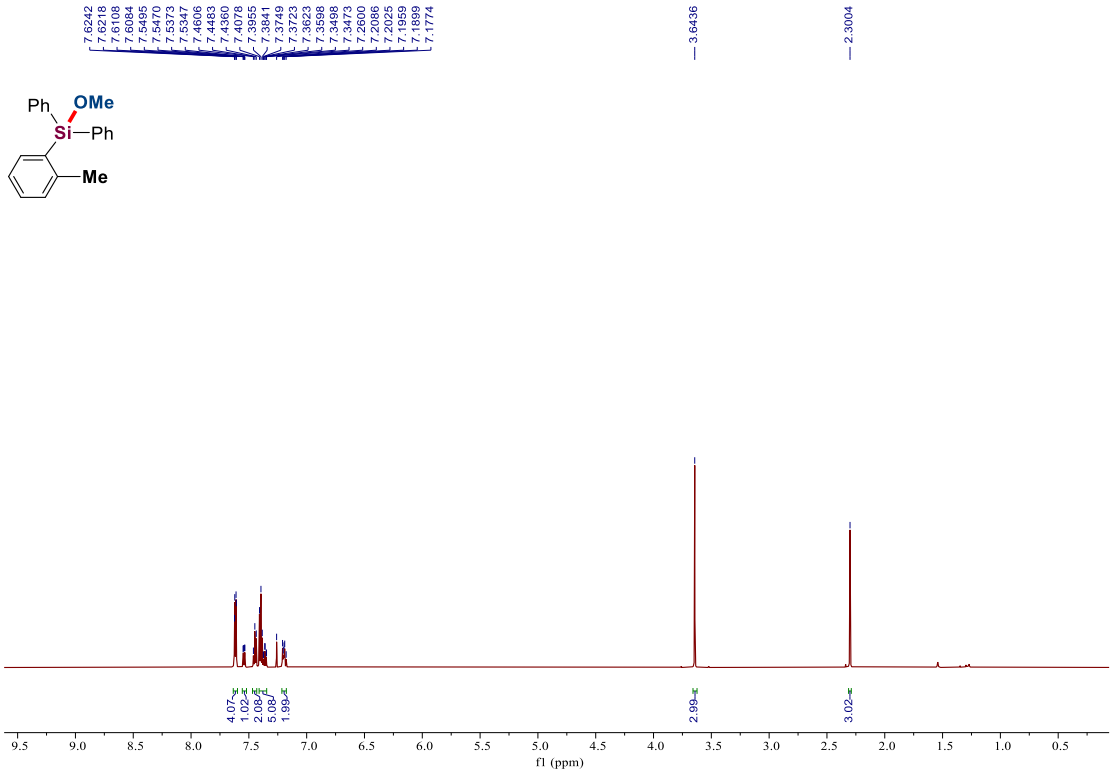
^{1}H NMR Spectra of **2y** (600 MHz, $CDCl_3$)



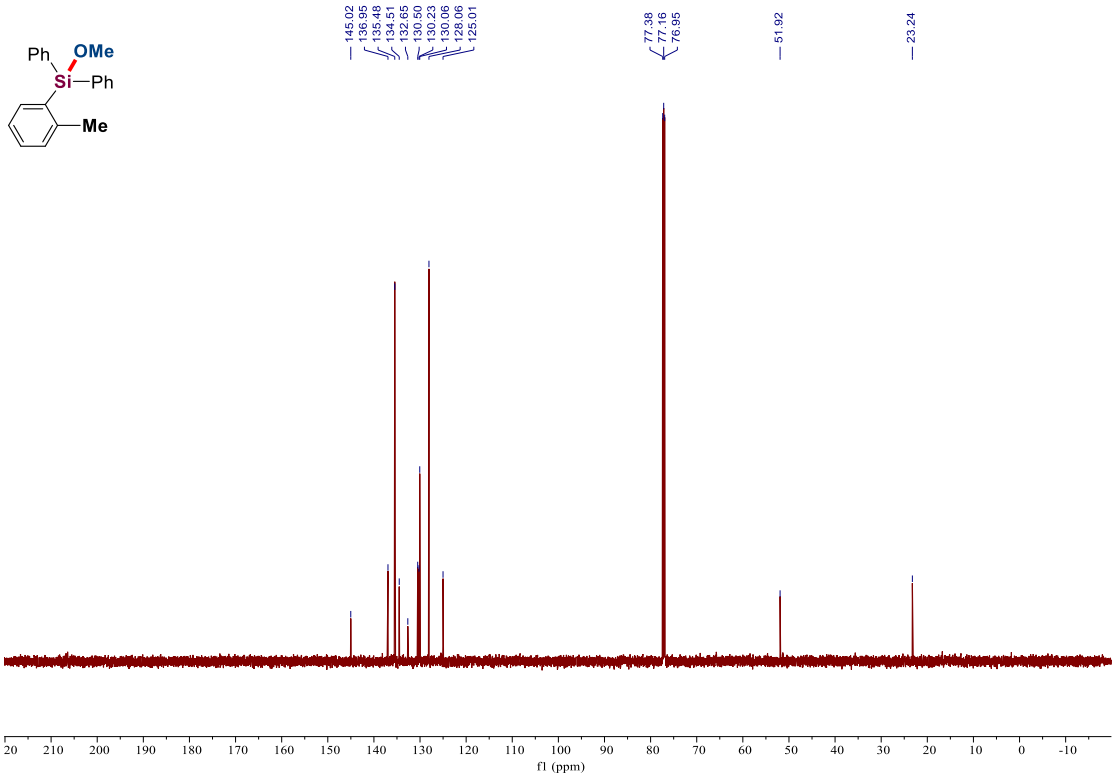
^{13}C NMR Spectra of **2y** (151 MHz, $CDCl_3$)



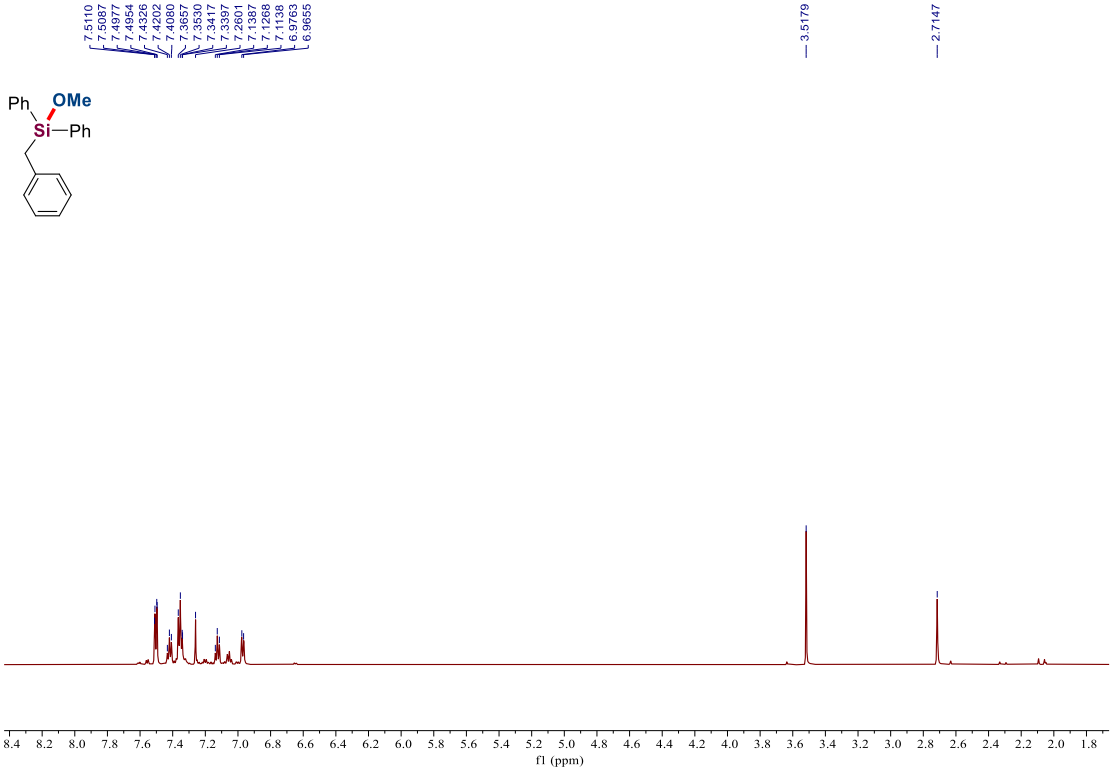
^{1}H NMR Spectra of **2z** (600 MHz, $CDCl_3$)



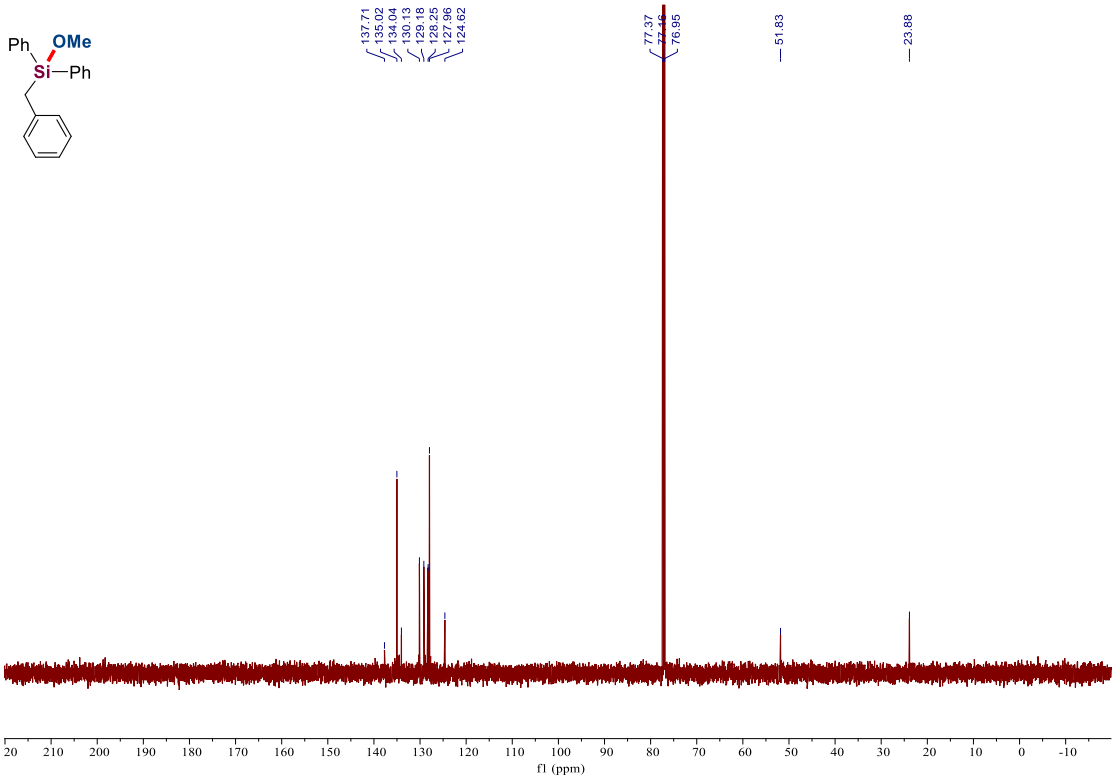
^{13}C NMR Spectra of **2z** (151 MHz, $CDCl_3$)



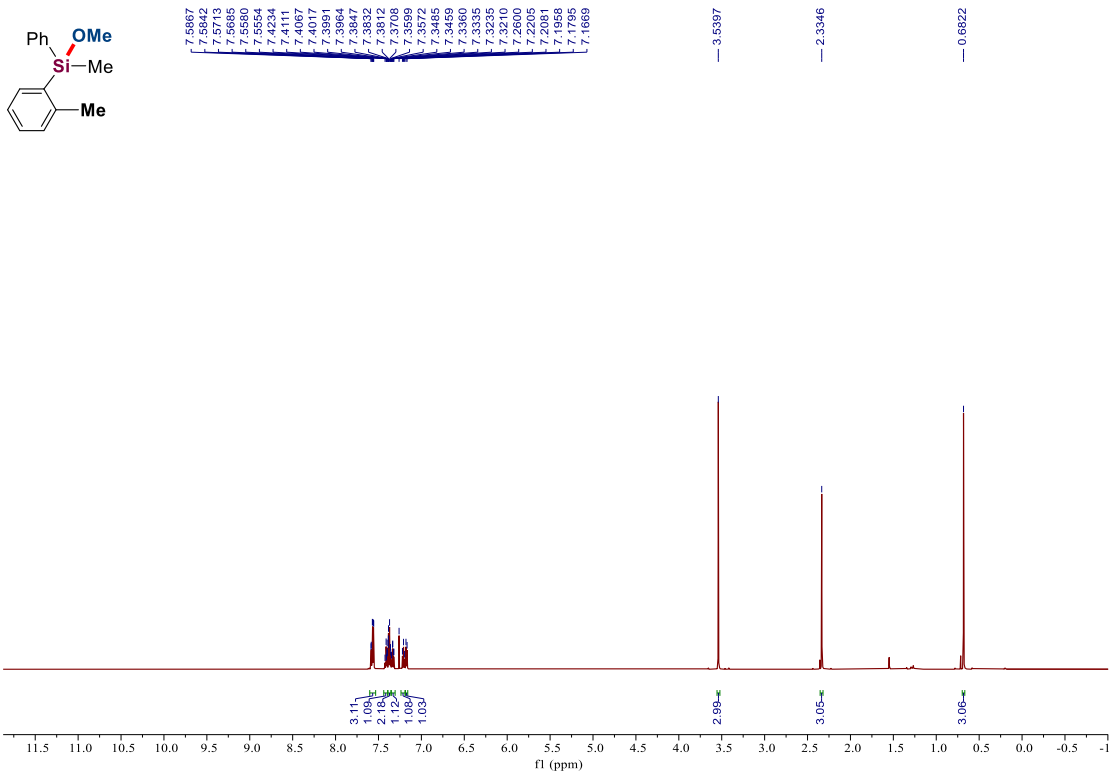
^{1}H NMR Spectra of **2z'** (600 MHz, $CDCl_3$)



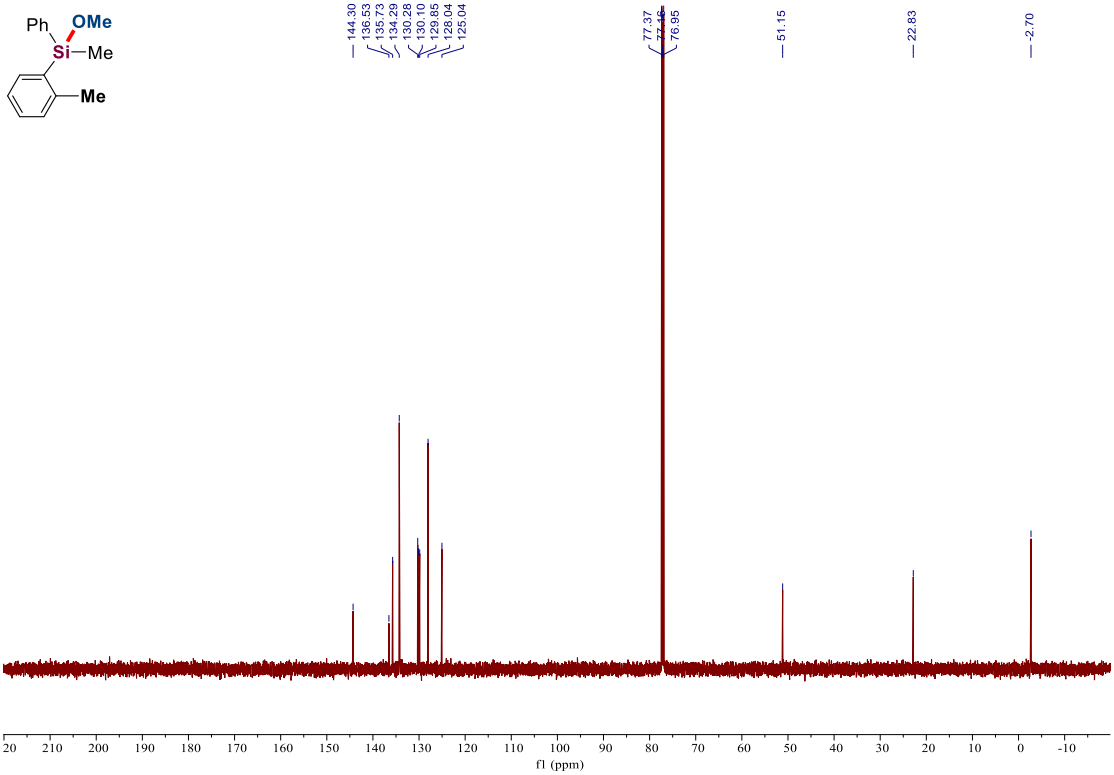
^{13}C NMR Spectra of **2z'** (151 MHz, $CDCl_3$)



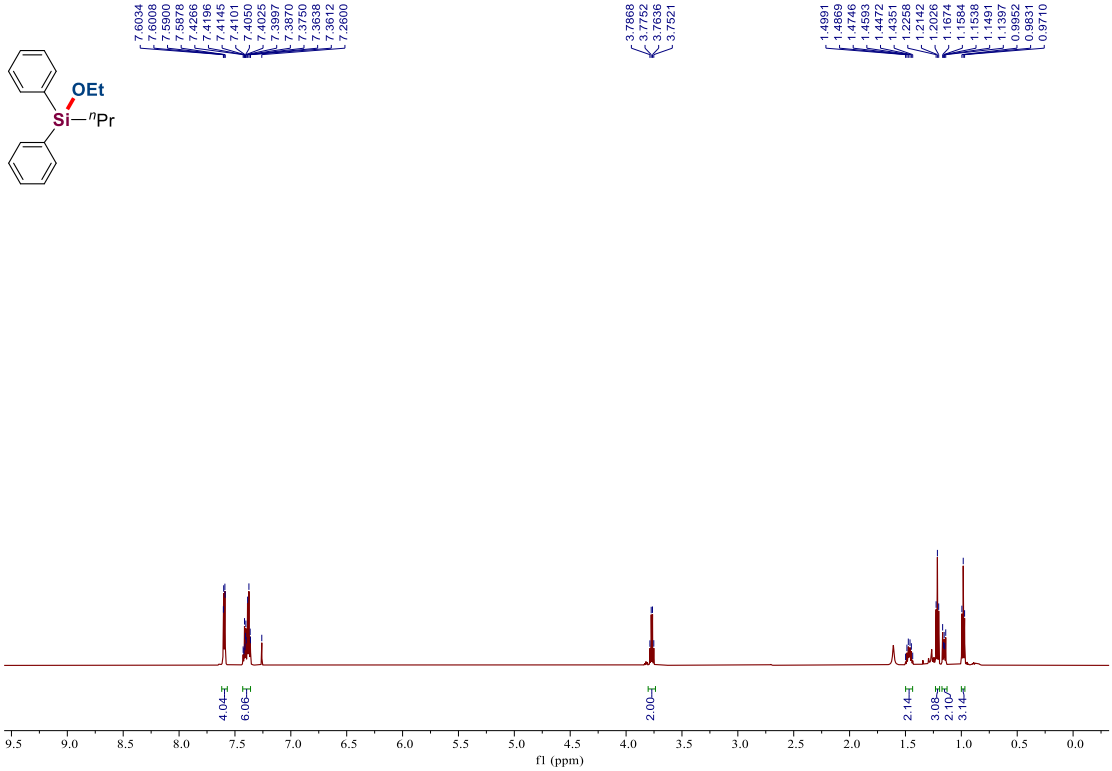
^{1}H NMR Spectra of **2aa** (600 MHz, $CDCl_3$)



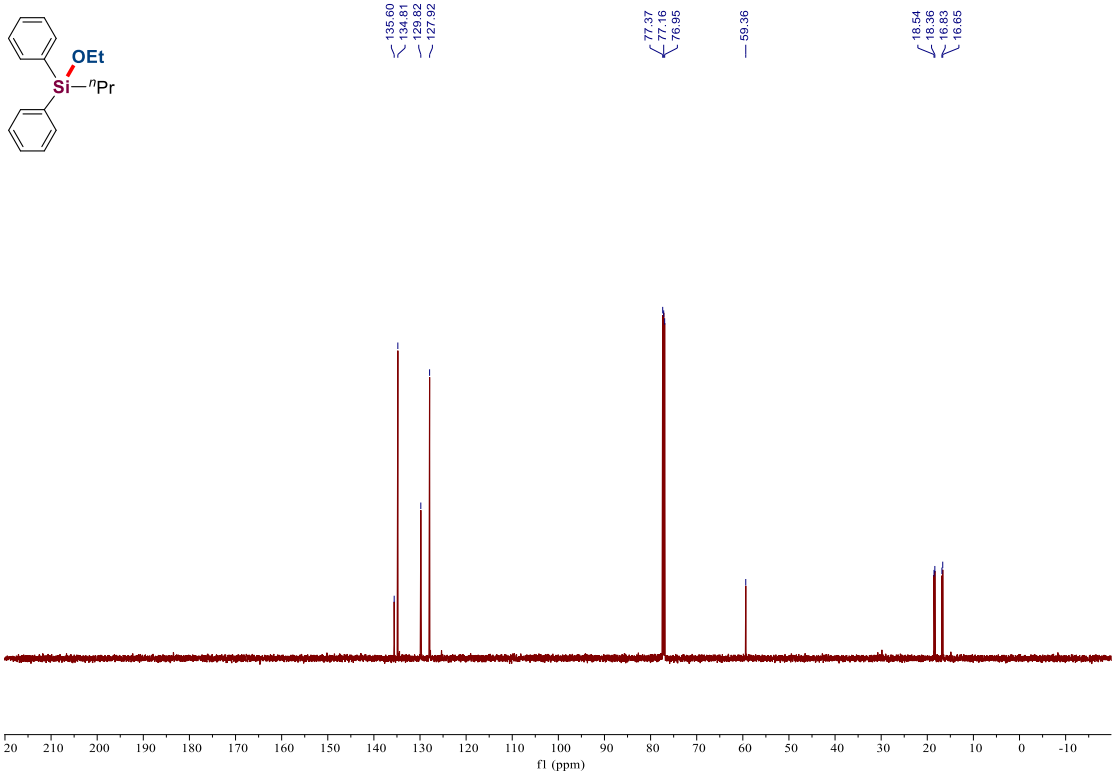
^{13}C NMR Spectra of **2aa** (151 MHz, $CDCl_3$)



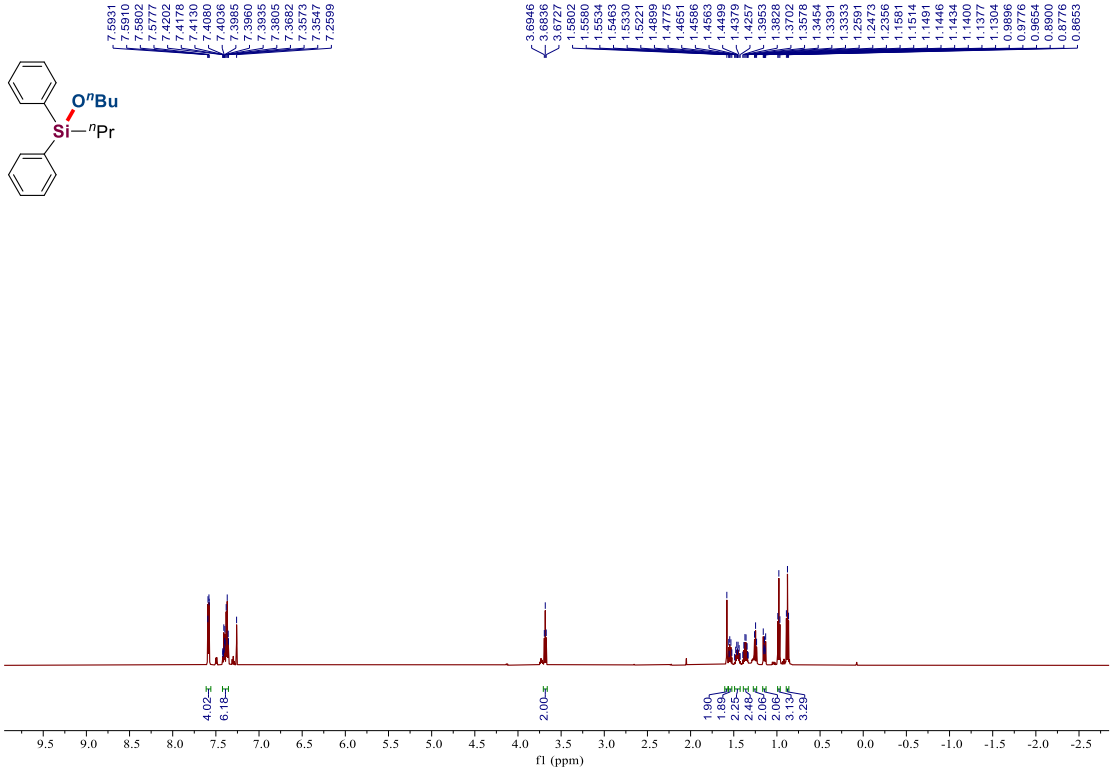
^{1}H NMR Spectra of **2ab** (600 MHz, $CDCl_3$)



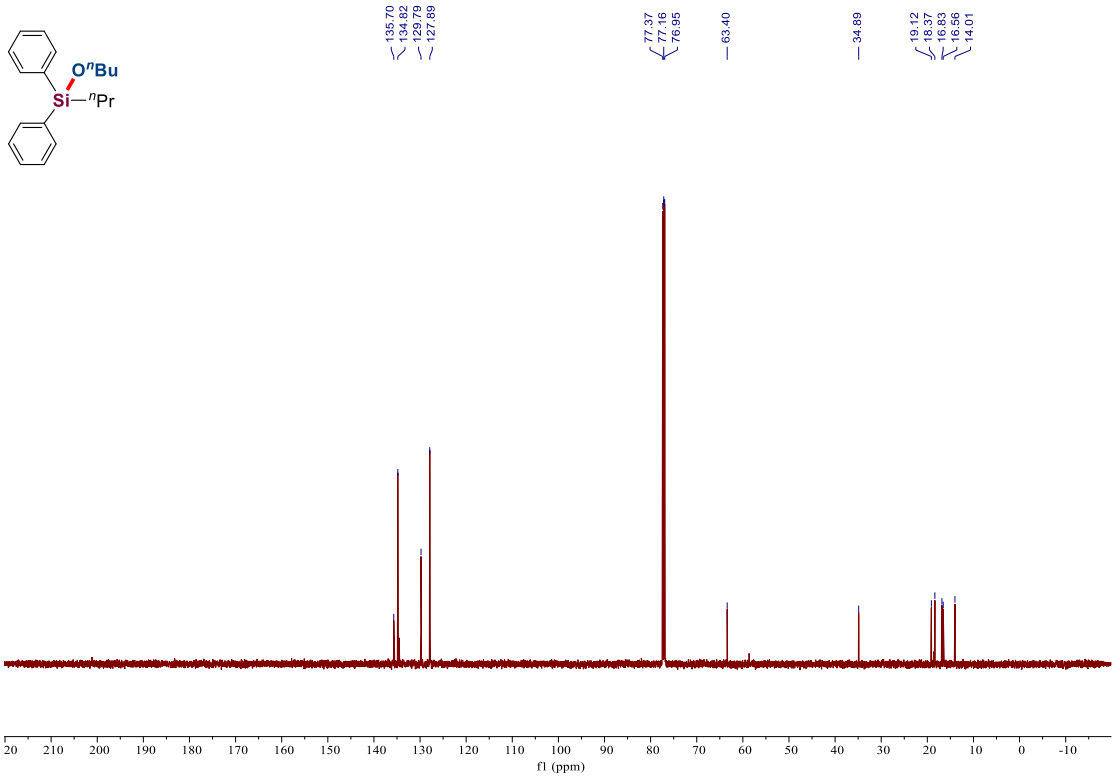
^{13}C NMR Spectra of **2ab** (151 MHz, $CDCl_3$)



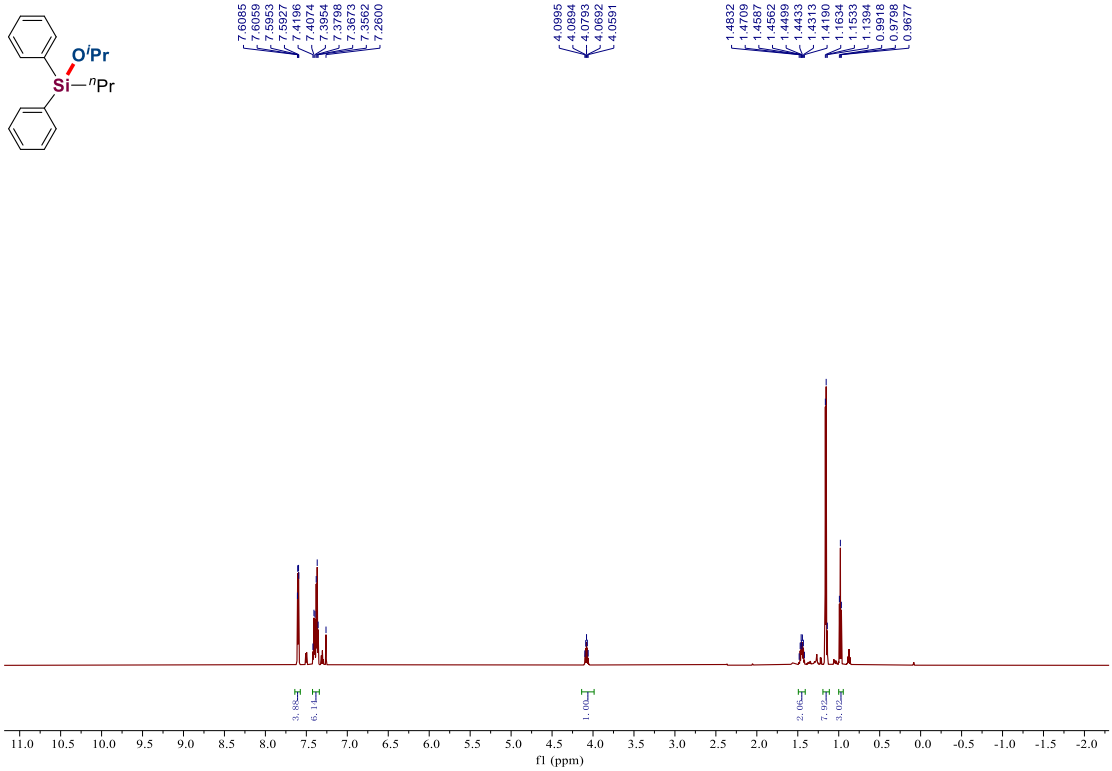
^{1}H NMR Spectra of **2ac** (600 MHz, $CDCl_3$)



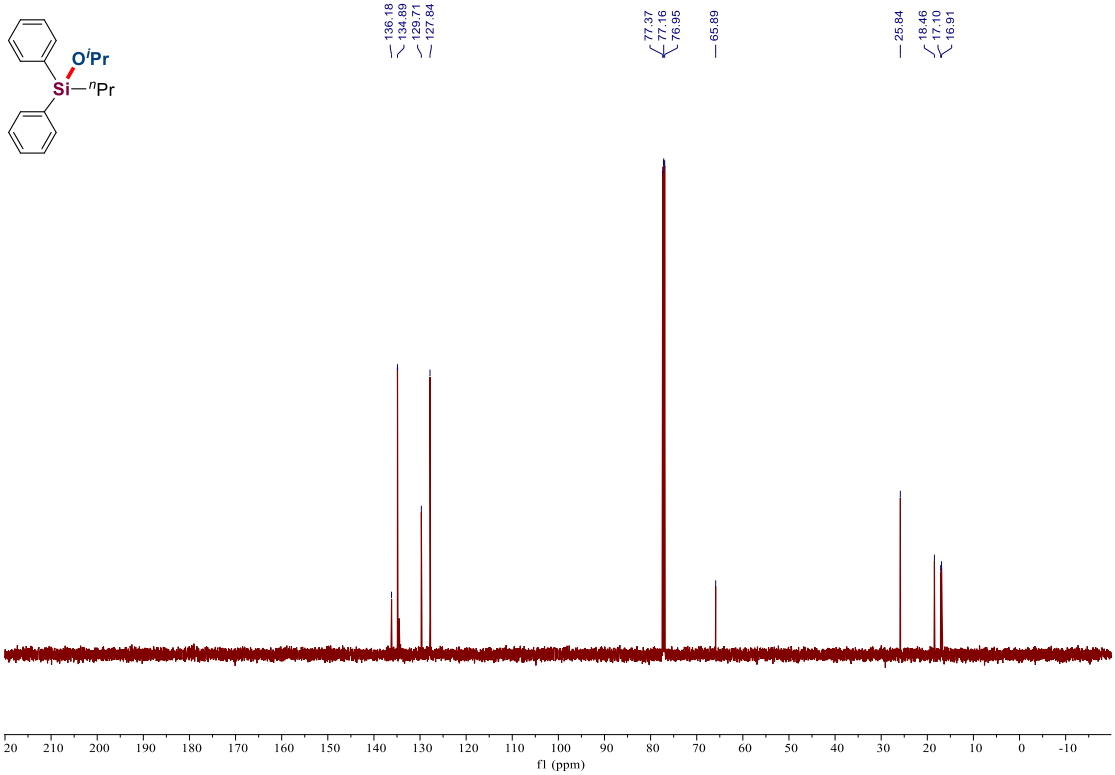
^{13}C NMR Spectra of **2ac** (151 MHz, $CDCl_3$)



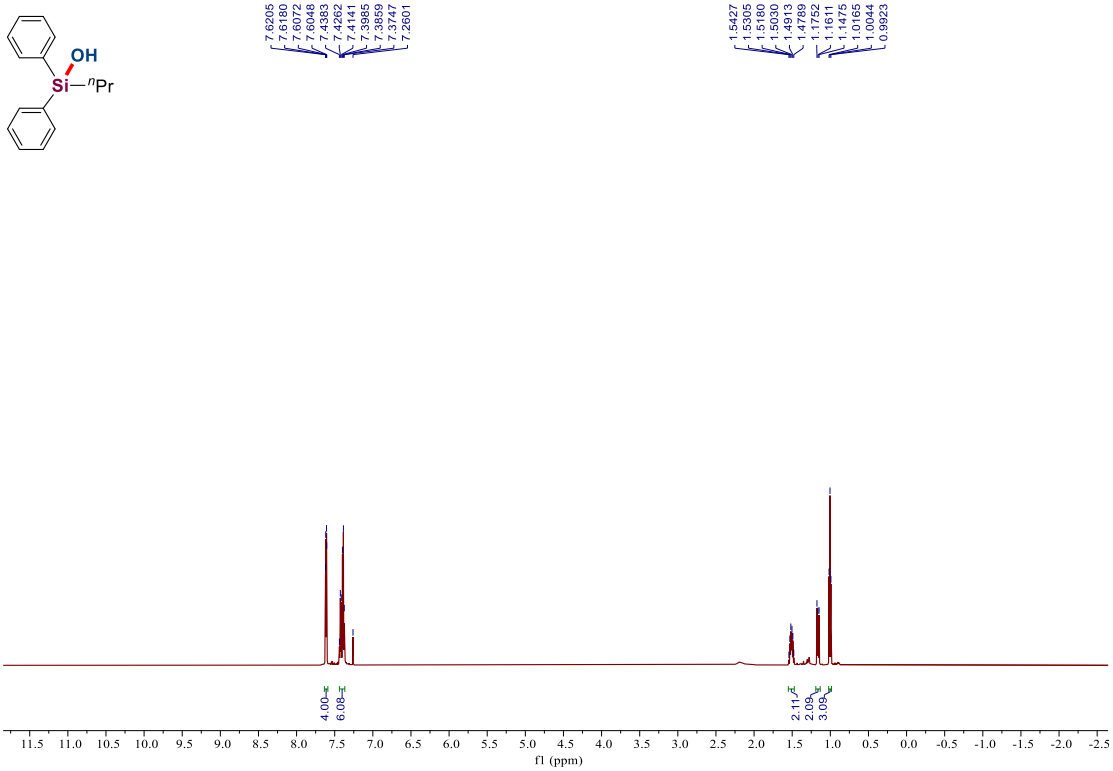
^{1}H NMR Spectra of **2ad** (600 MHz, $CDCl_3$)



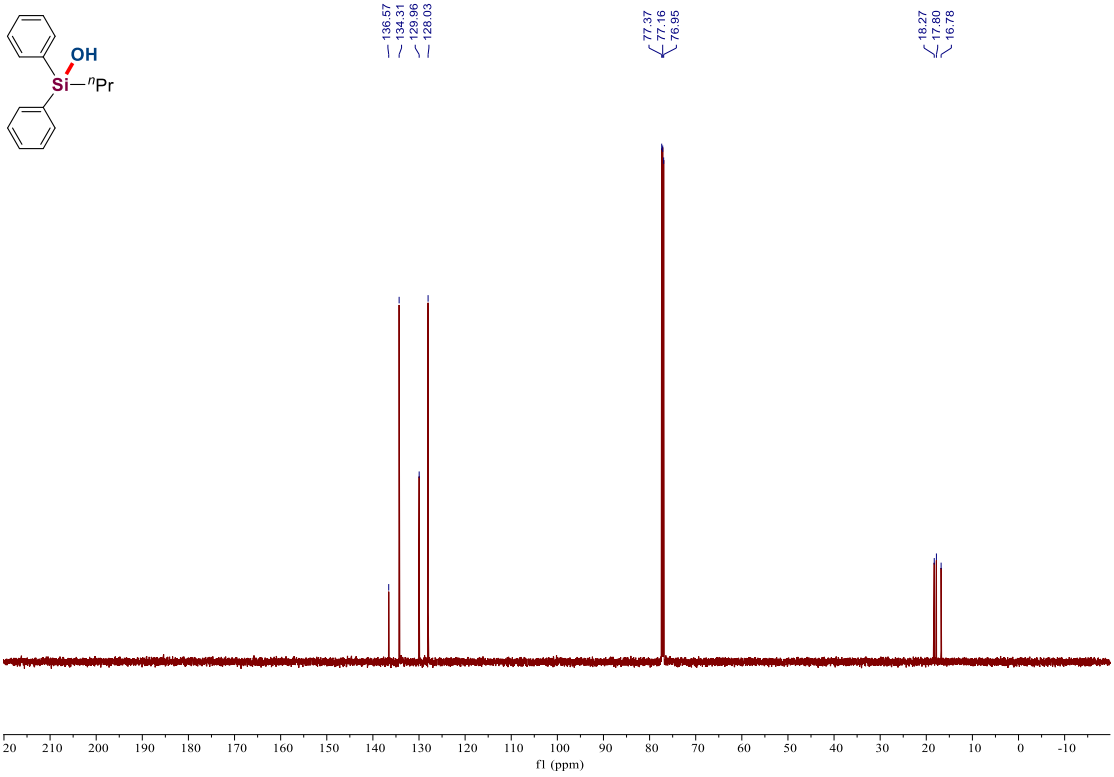
^{13}C NMR Spectra of **2ad** (151 MHz, $CDCl_3$)



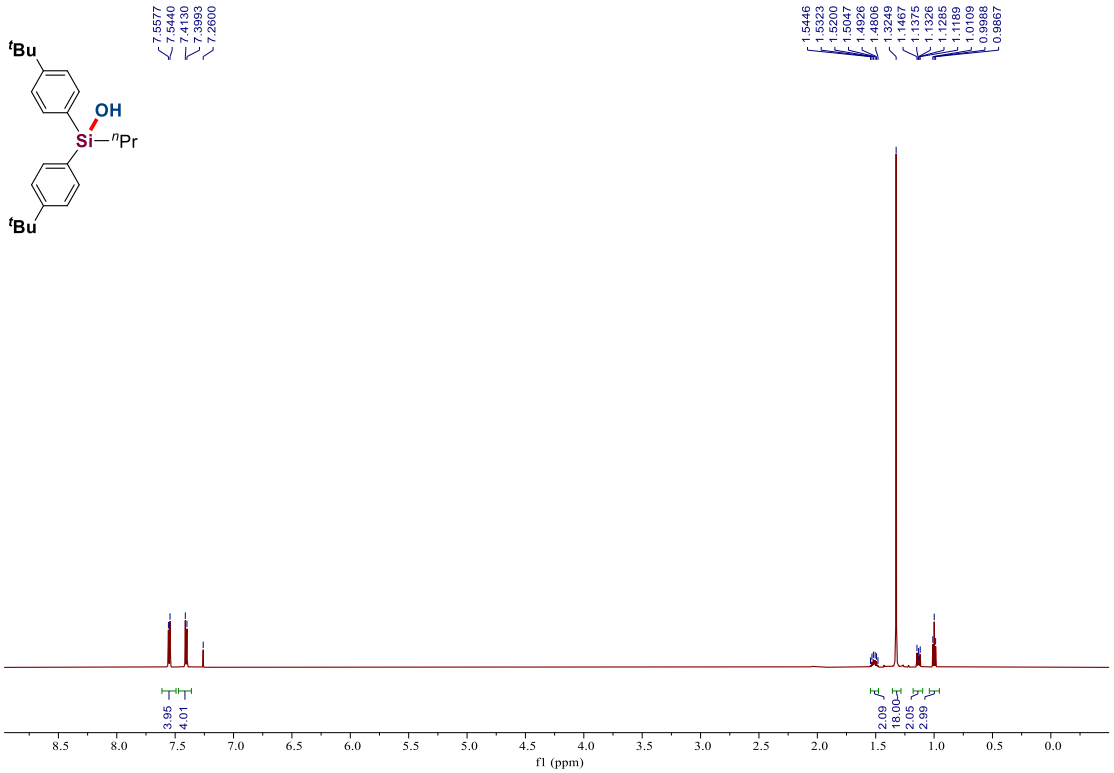
^{1}H NMR Spectra of **3a** (600 MHz, $CDCl_3$)



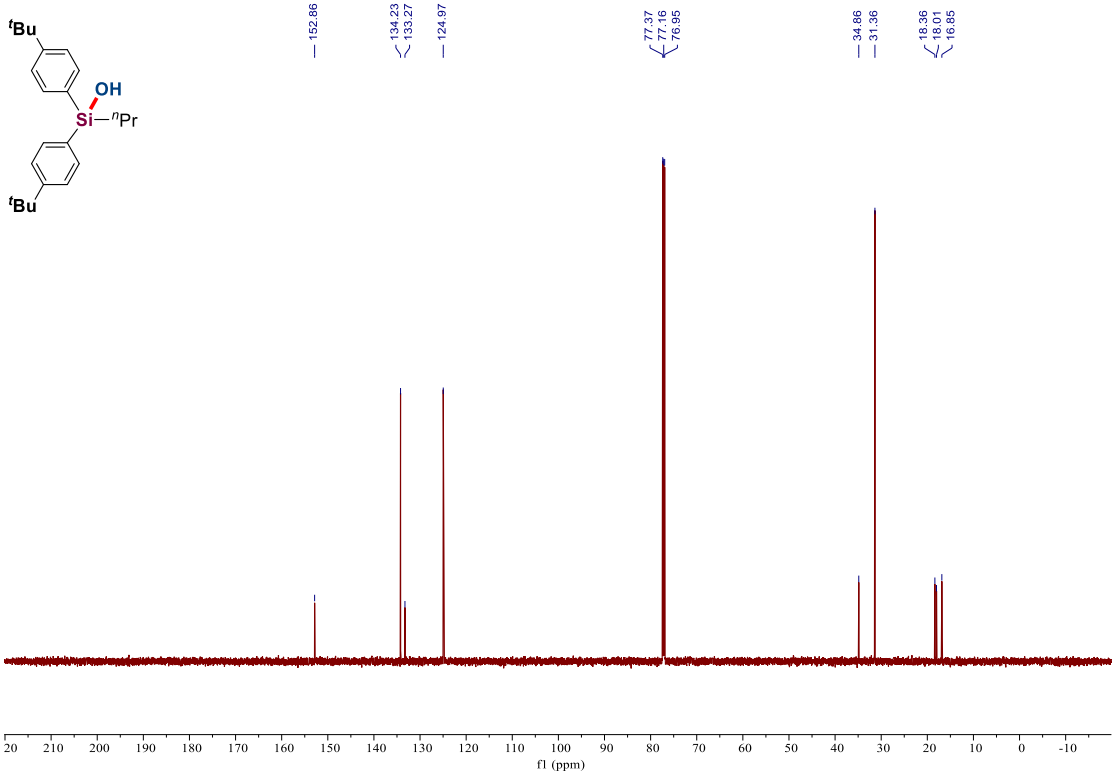
^{13}C NMR Spectra of **3a** (151 MHz, $CDCl_3$)



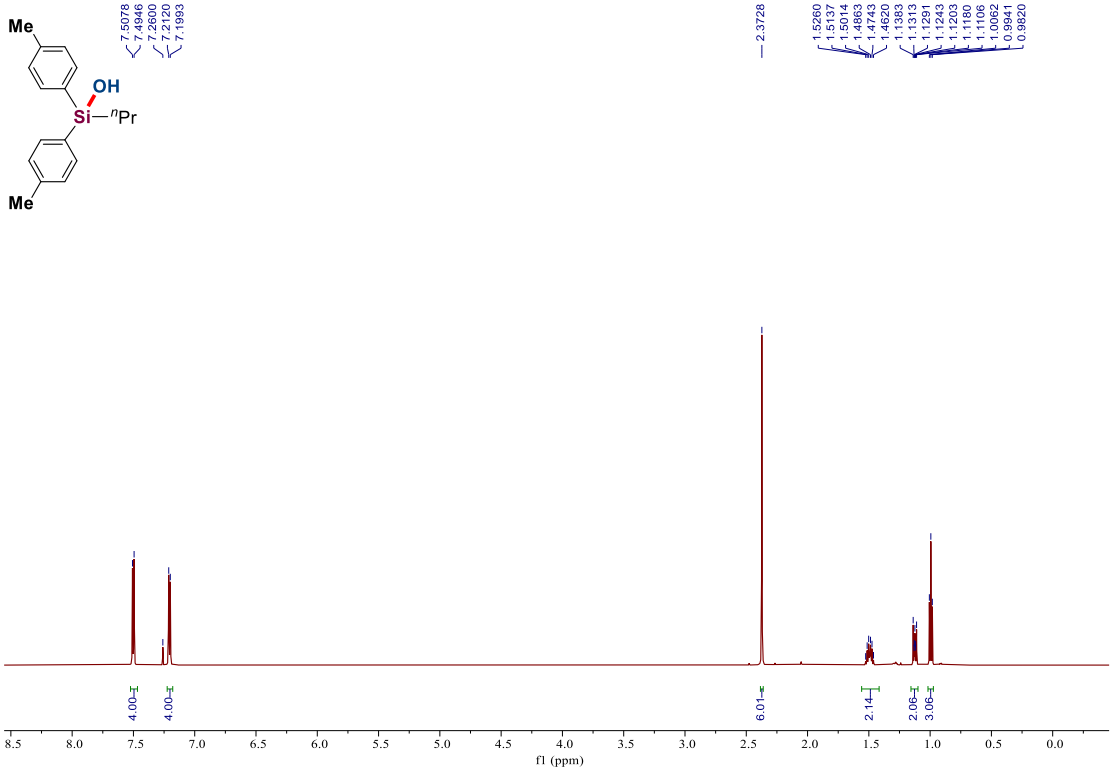
^{1}H NMR Spectra of **3b** (600 MHz, $CDCl_3$)



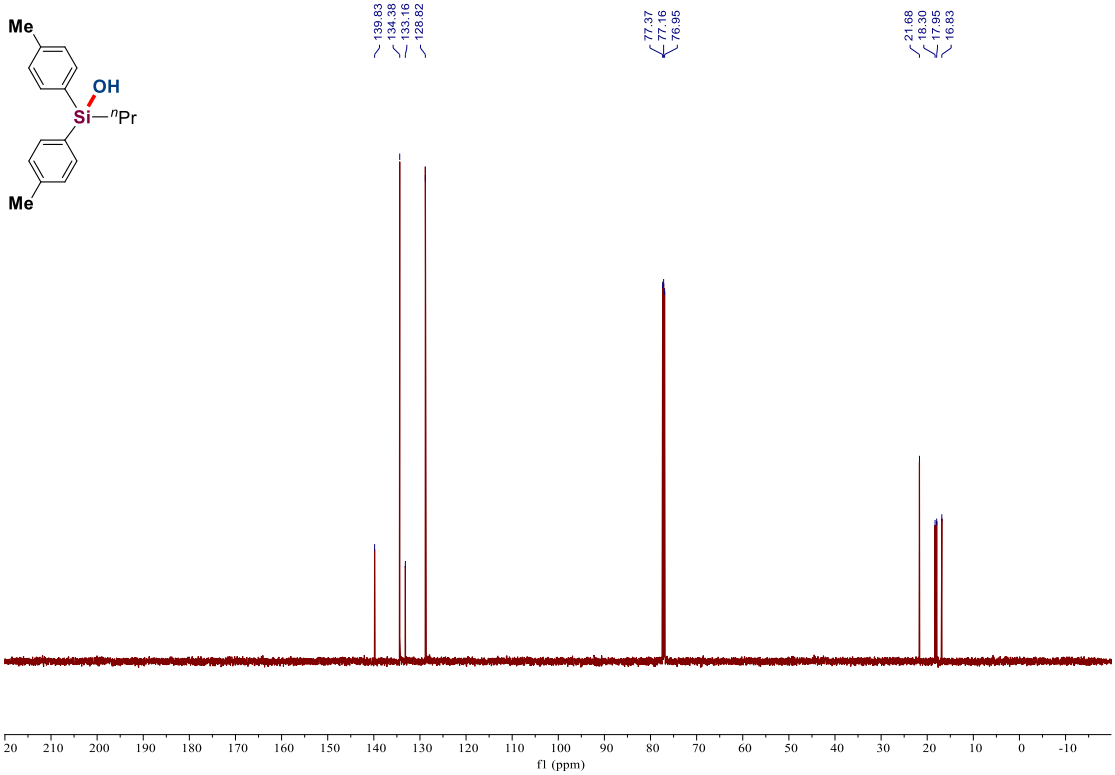
^{13}C NMR Spectra of **3b** (151 MHz, $CDCl_3$)



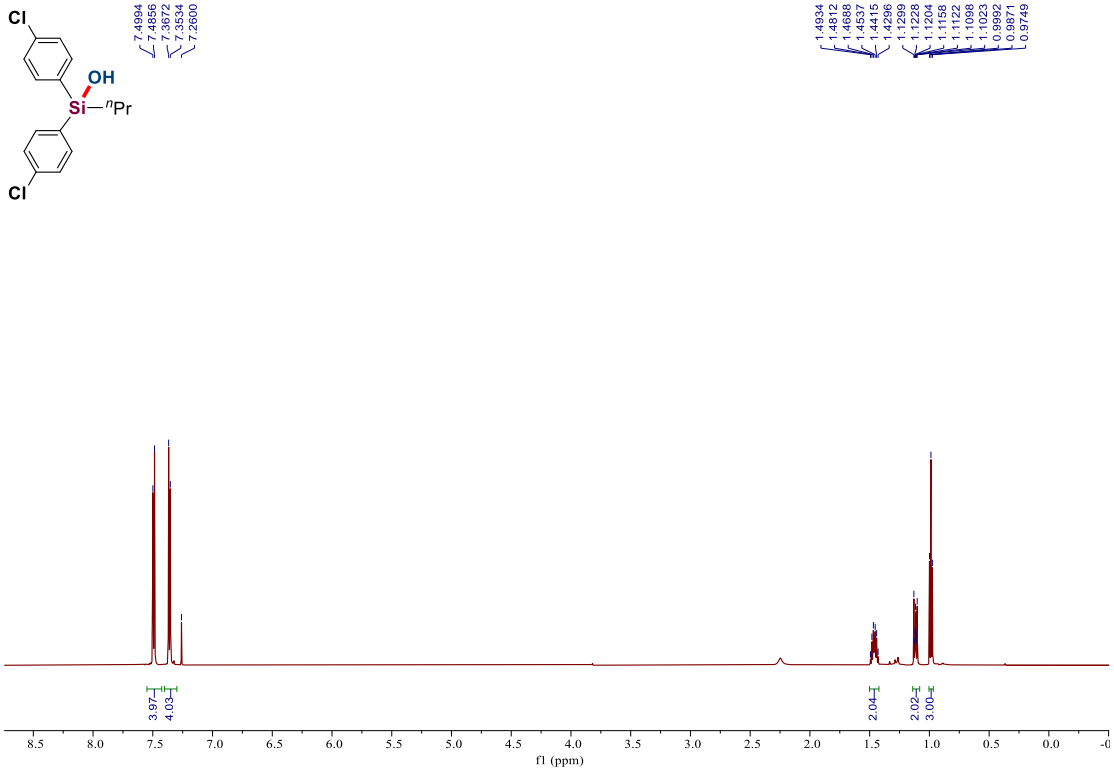
^{1}H NMR Spectra of **3c** (600 MHz, $CDCl_3$)



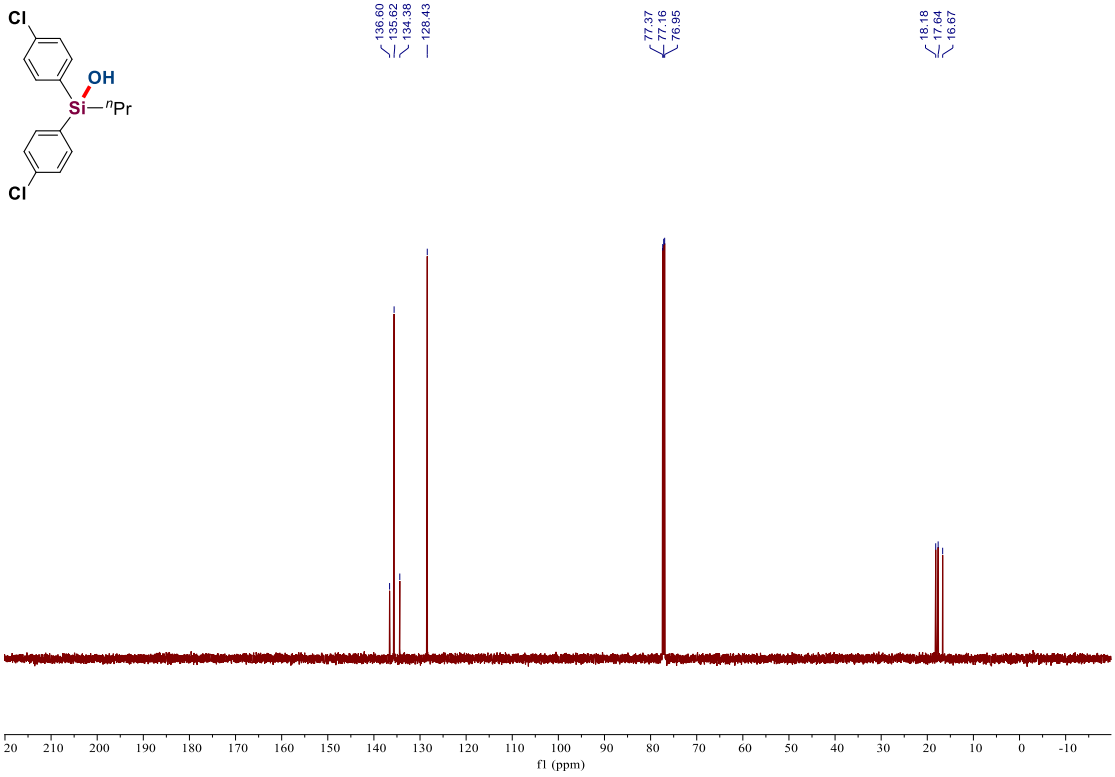
^{13}C NMR Spectra of **3c** (151 MHz, $CDCl_3$)



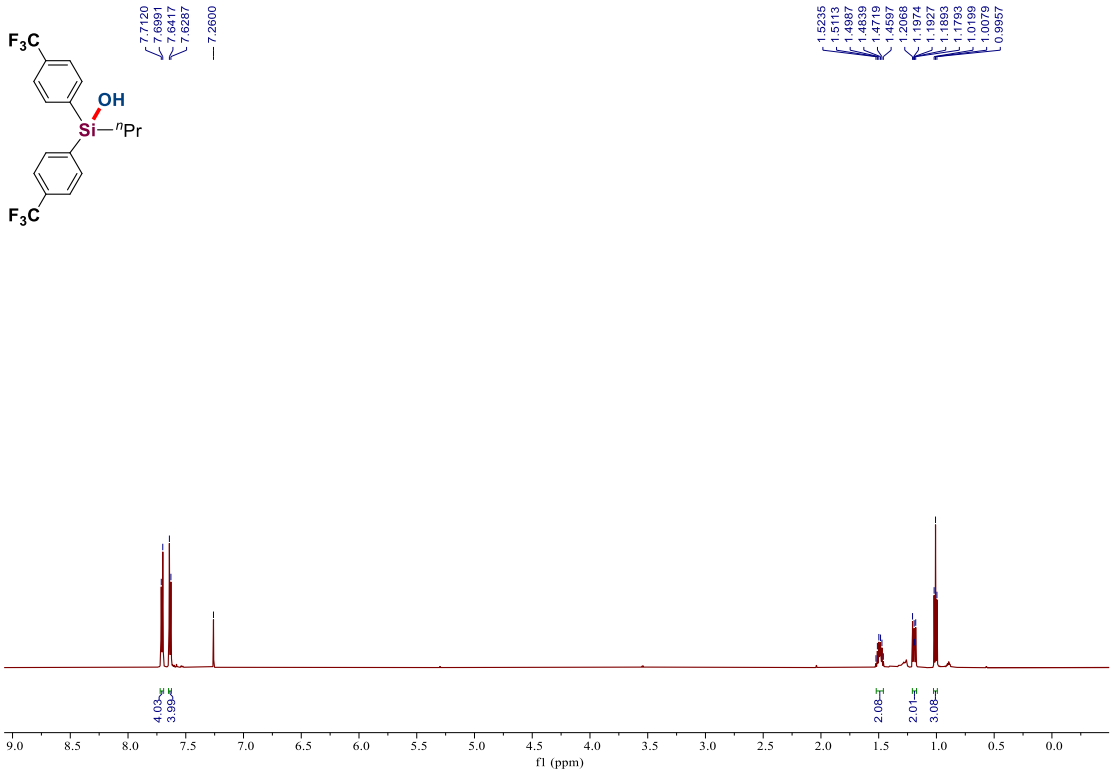
^{1}H NMR Spectra of **3d** (600 MHz, $CDCl_3$)



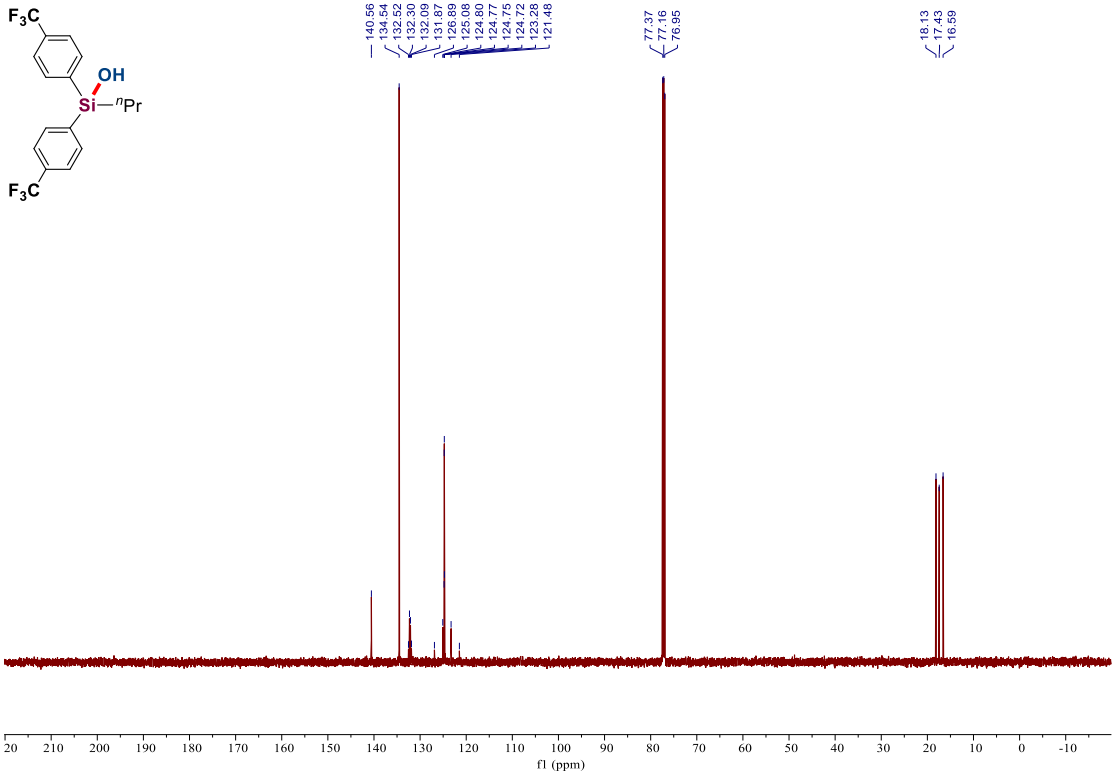
^{13}C NMR Spectra of **3d** (151 MHz, $CDCl_3$)



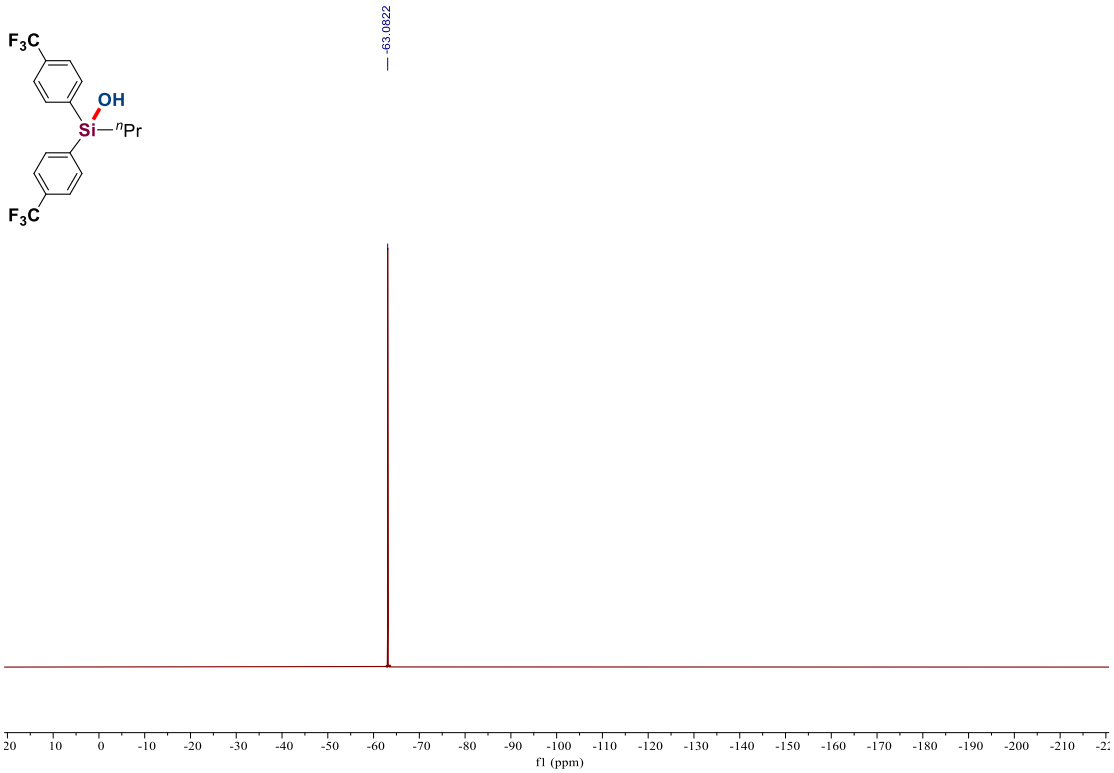
^{1}H NMR Spectra of **3e** (600 MHz, $CDCl_3$)



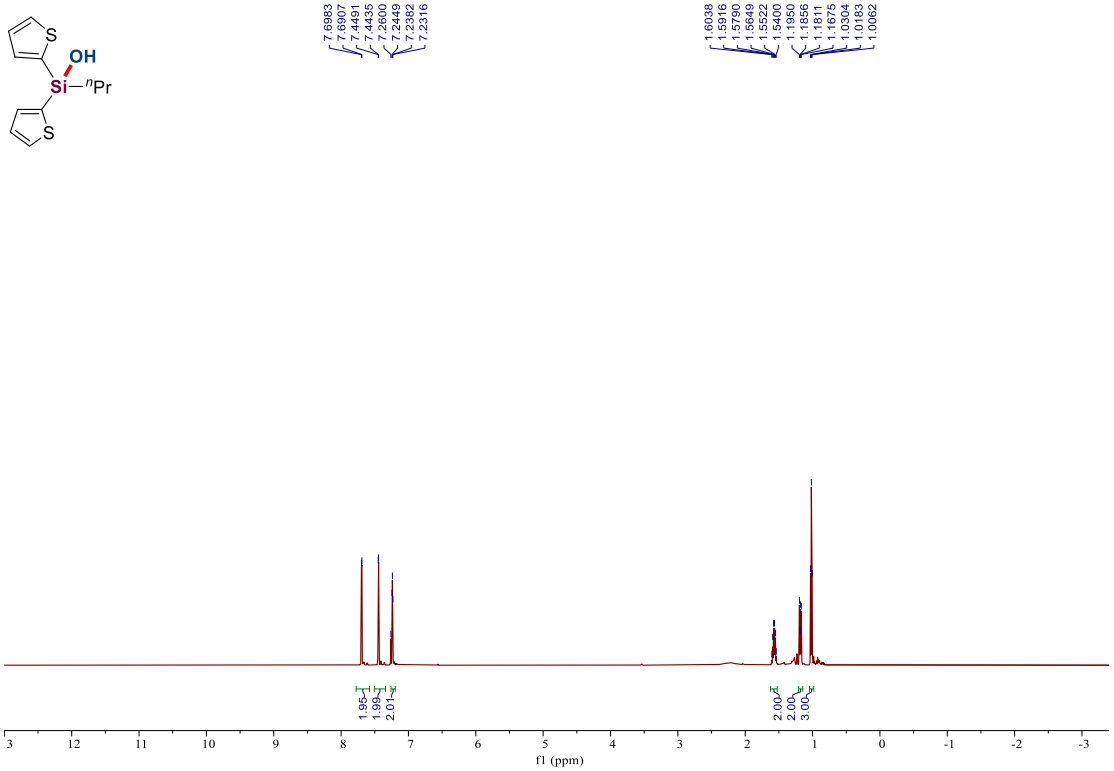
^{13}C NMR Spectra of **3e** (151 MHz, $CDCl_3$)



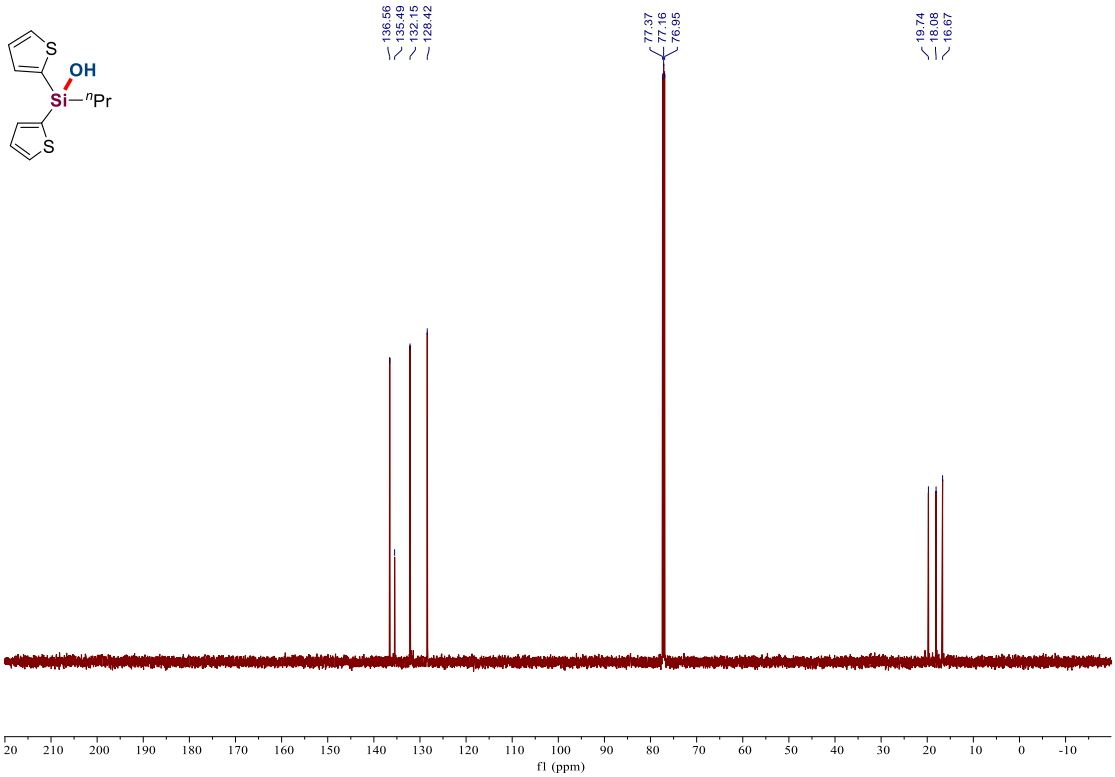
^{19}F NMR Spectra of **3e** (377 MHz, $CDCl_3$)



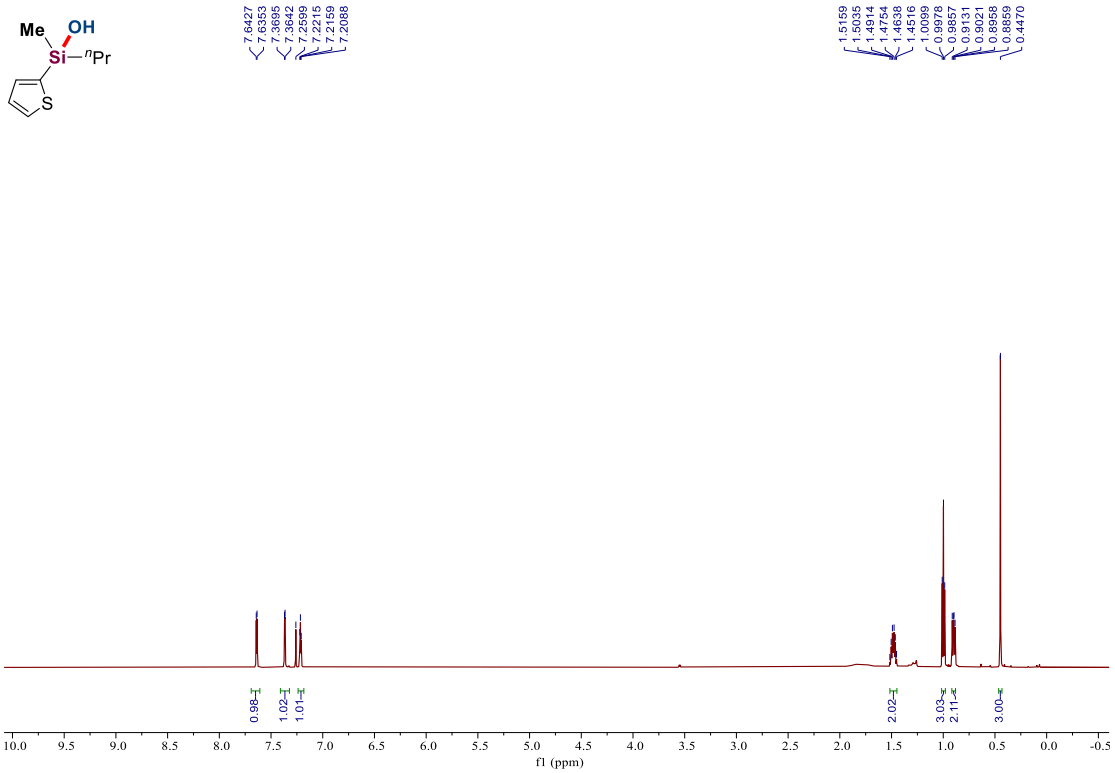
^{1}H NMR Spectra of **3f** (600 MHz, $CDCl_3$)



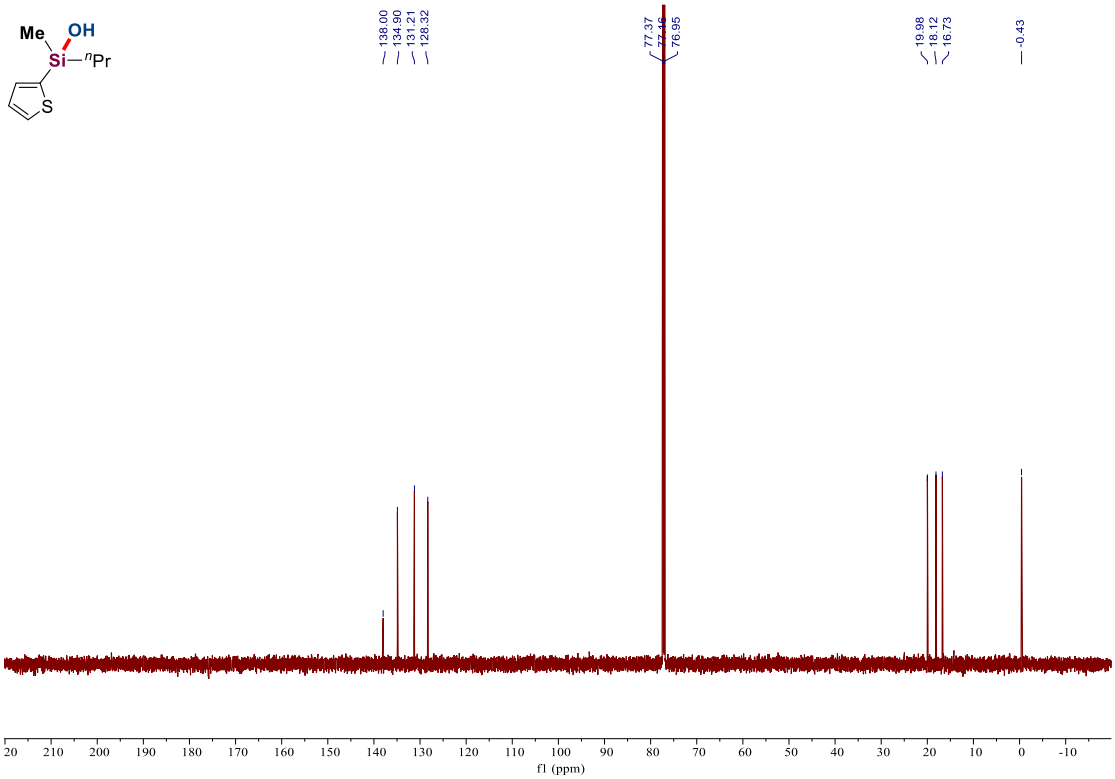
^{13}C NMR Spectra of **3f** (151 MHz, $CDCl_3$)



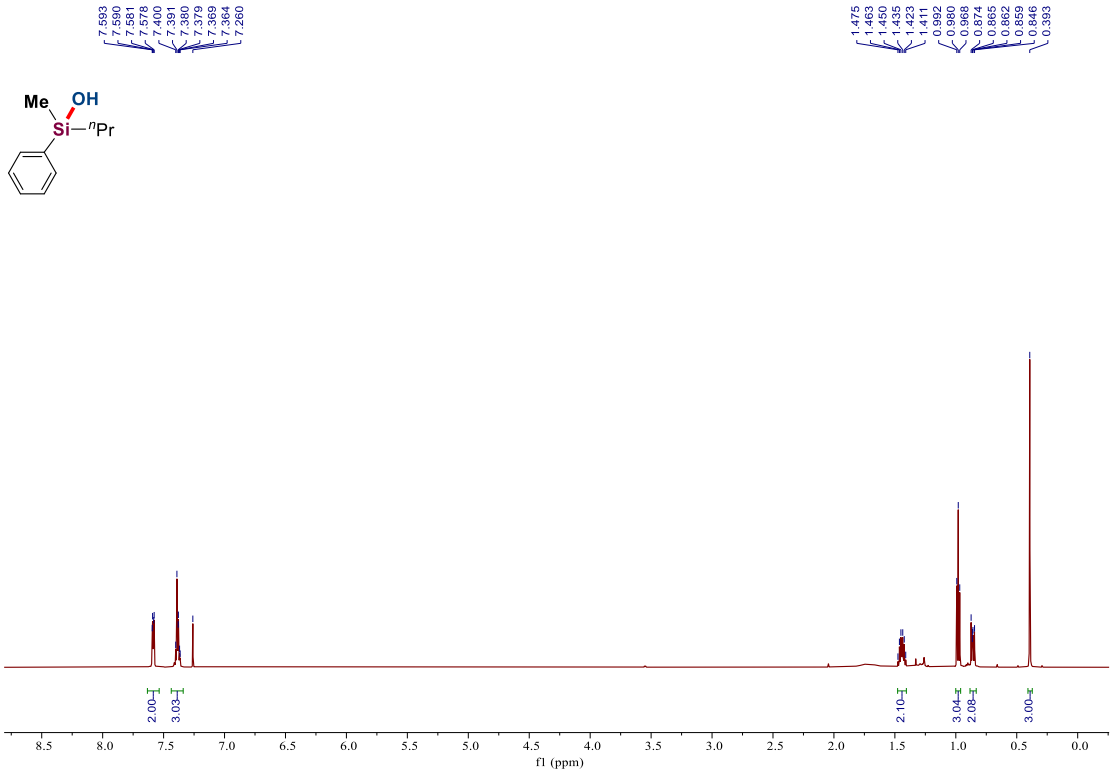
^{1}H NMR Spectra of **3g** (600 MHz, $CDCl_3$)



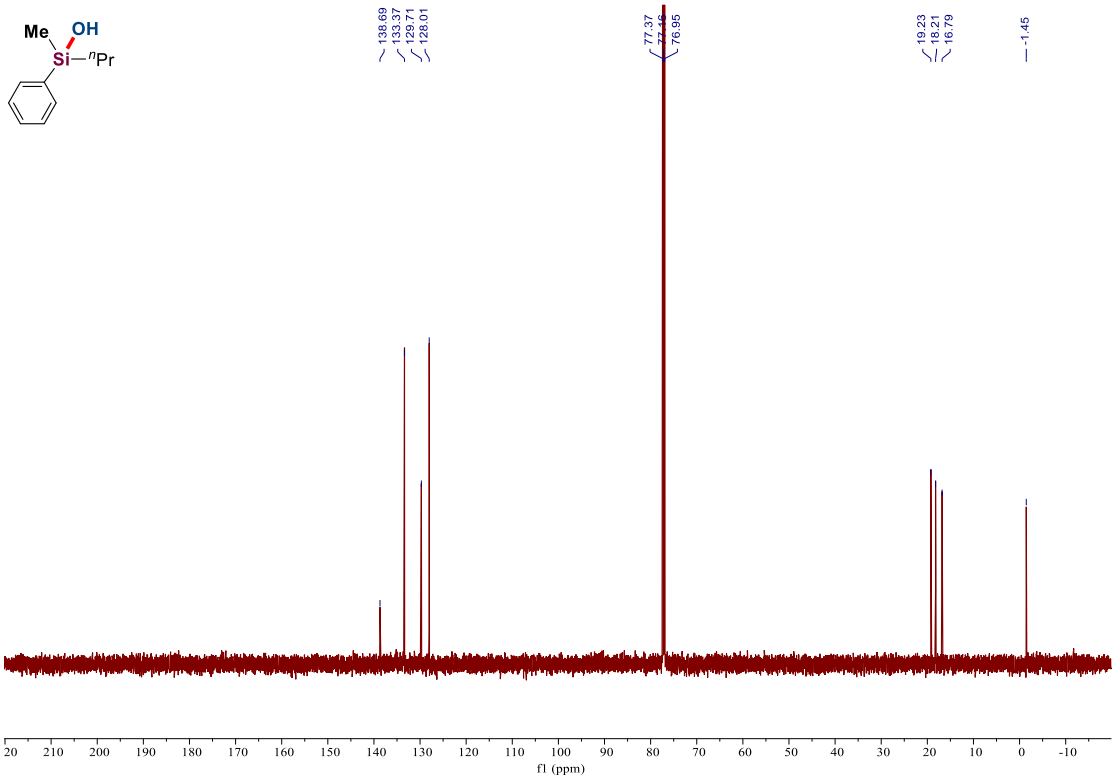
^{13}C NMR Spectra of **3g** (151 MHz, $CDCl_3$)



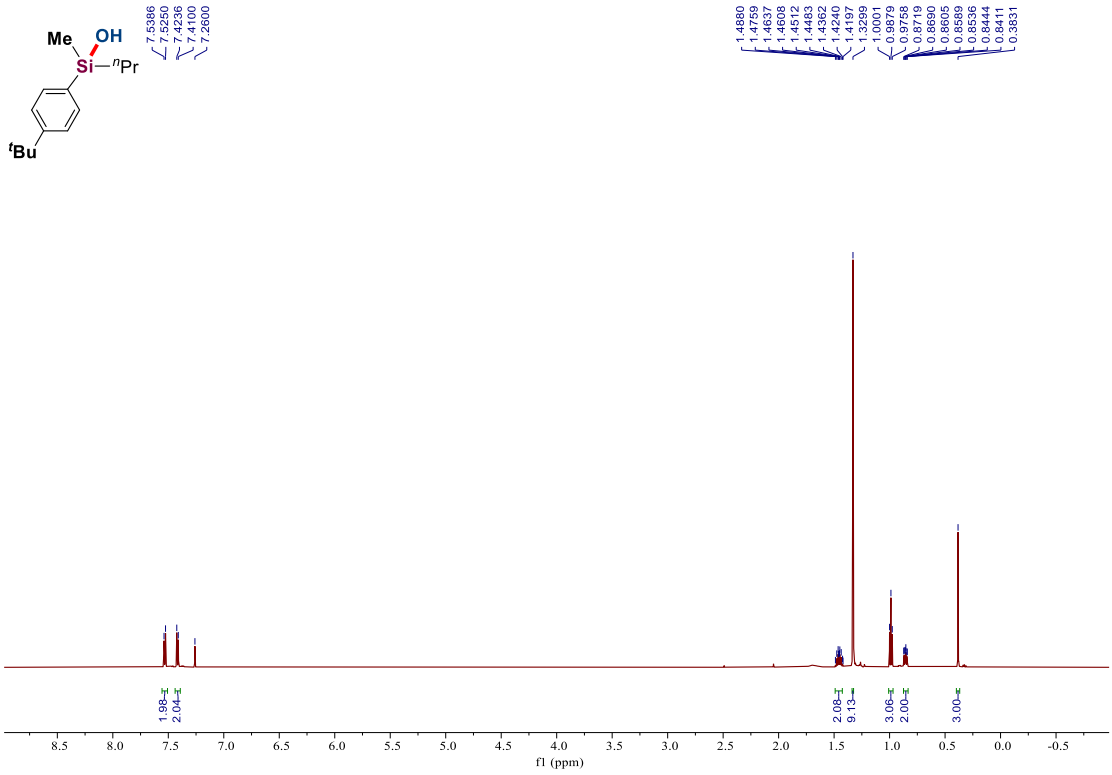
^{1}H NMR Spectra of **3h** (600 MHz, $CDCl_3$)



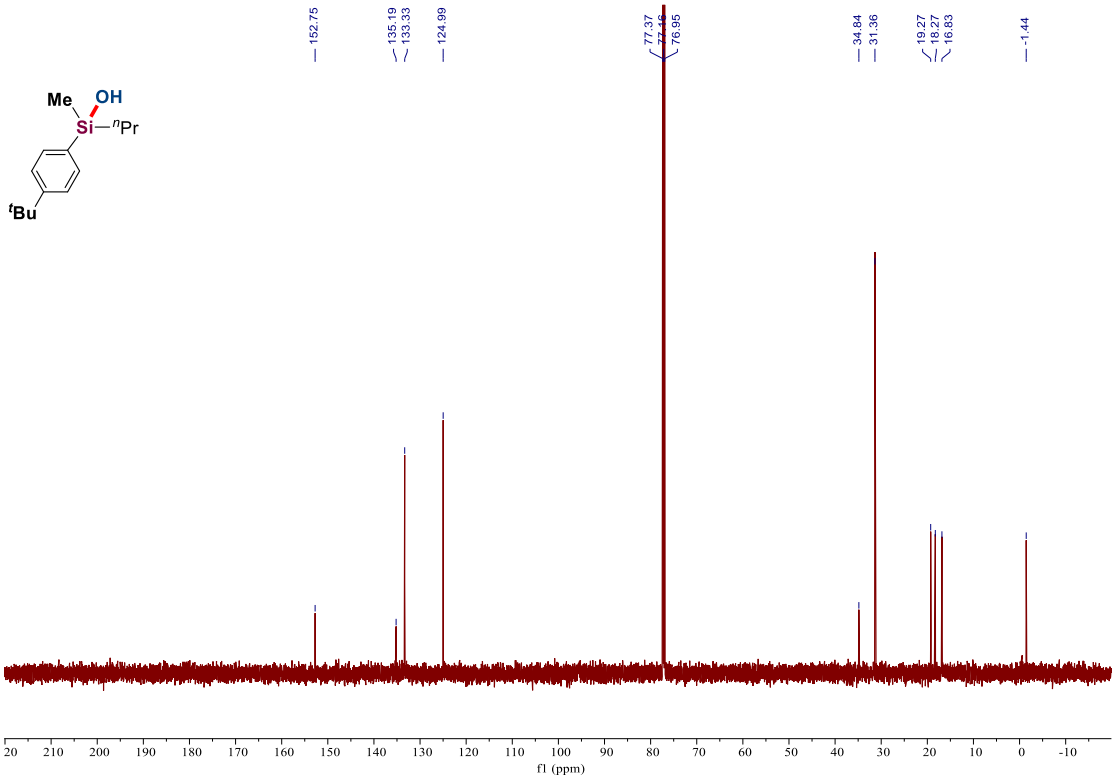
^{13}C NMR Spectra of **3h** (151 MHz, $CDCl_3$)



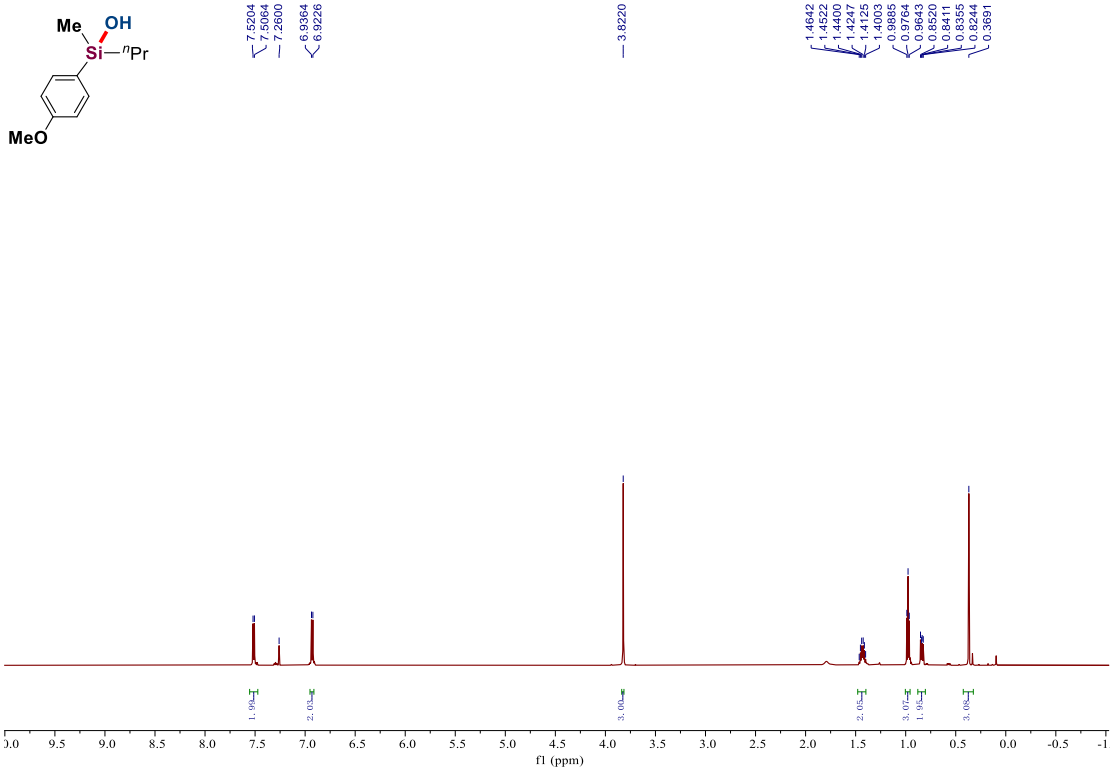
^{1}H NMR Spectra of **3i** (600 MHz, $CDCl_3$)



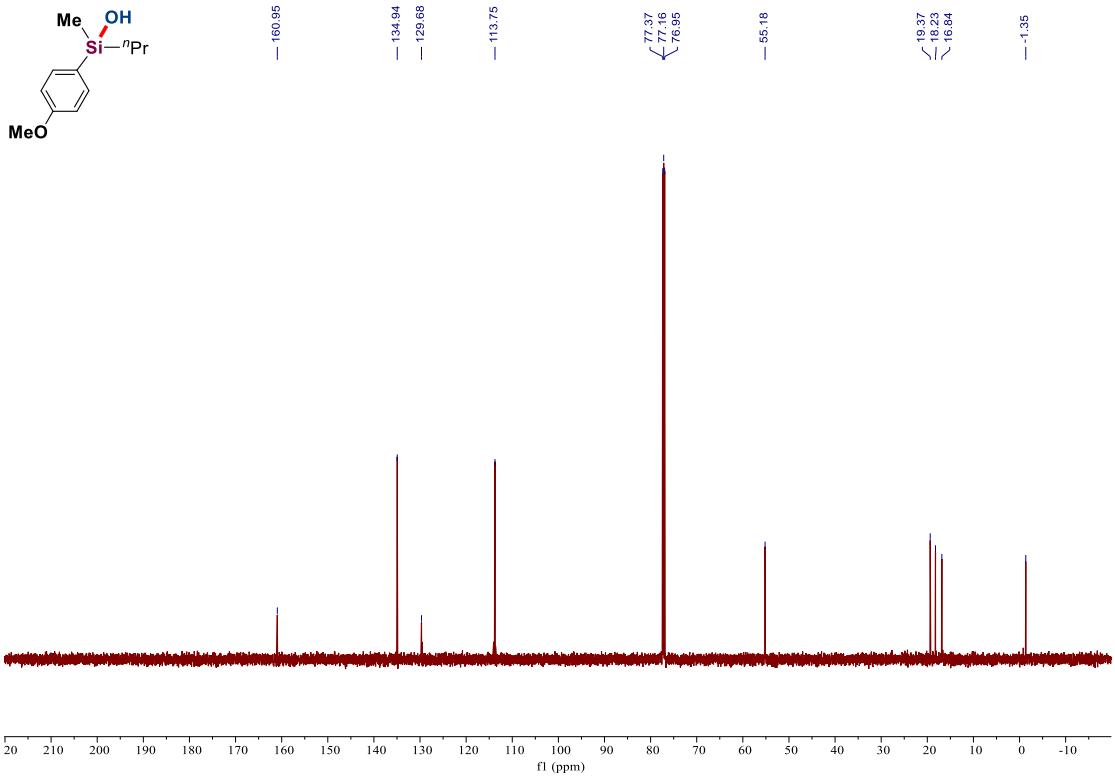
^{13}C NMR Spectra of **3i** (151 MHz, $CDCl_3$)



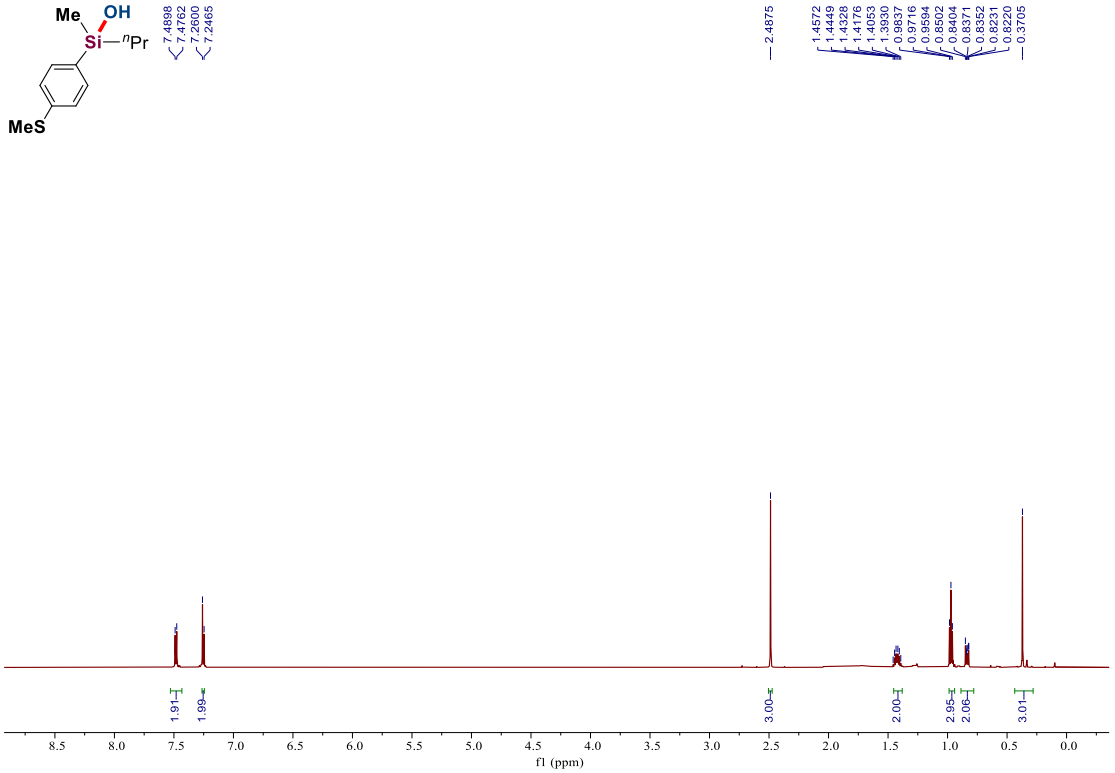
^{1}H NMR Spectra of **3j** (600 MHz, $CDCl_3$)



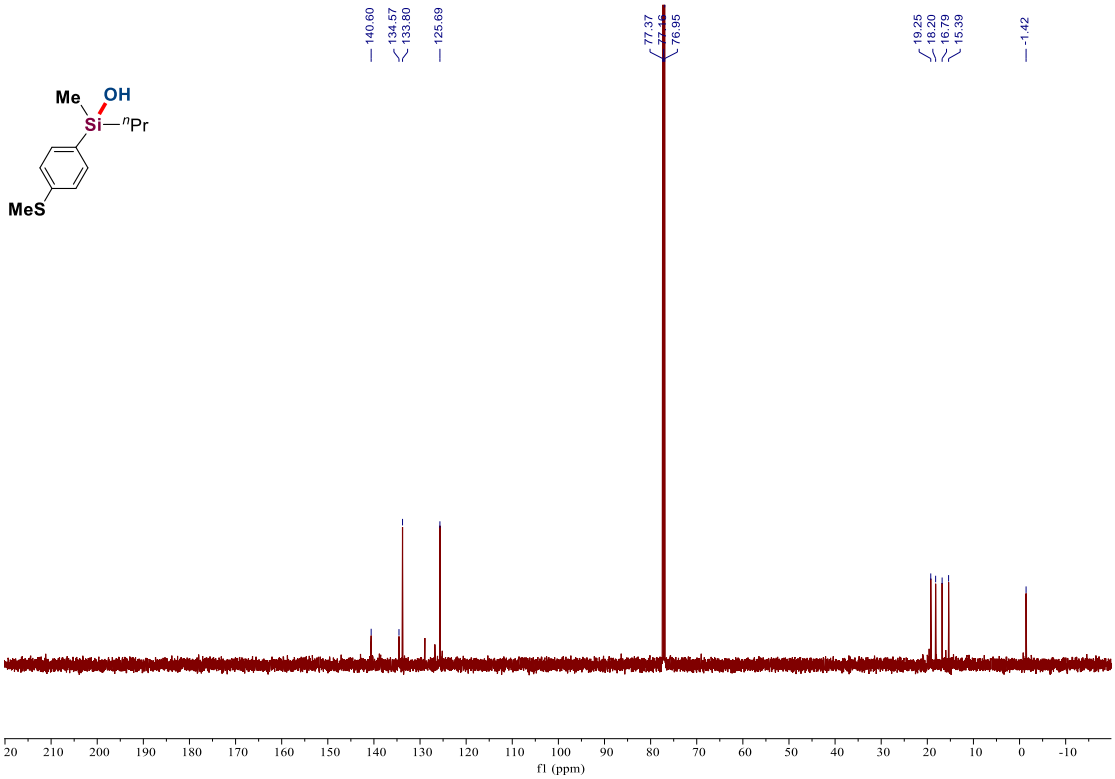
^{13}C NMR Spectra of **3j** (151 MHz, $CDCl_3$)



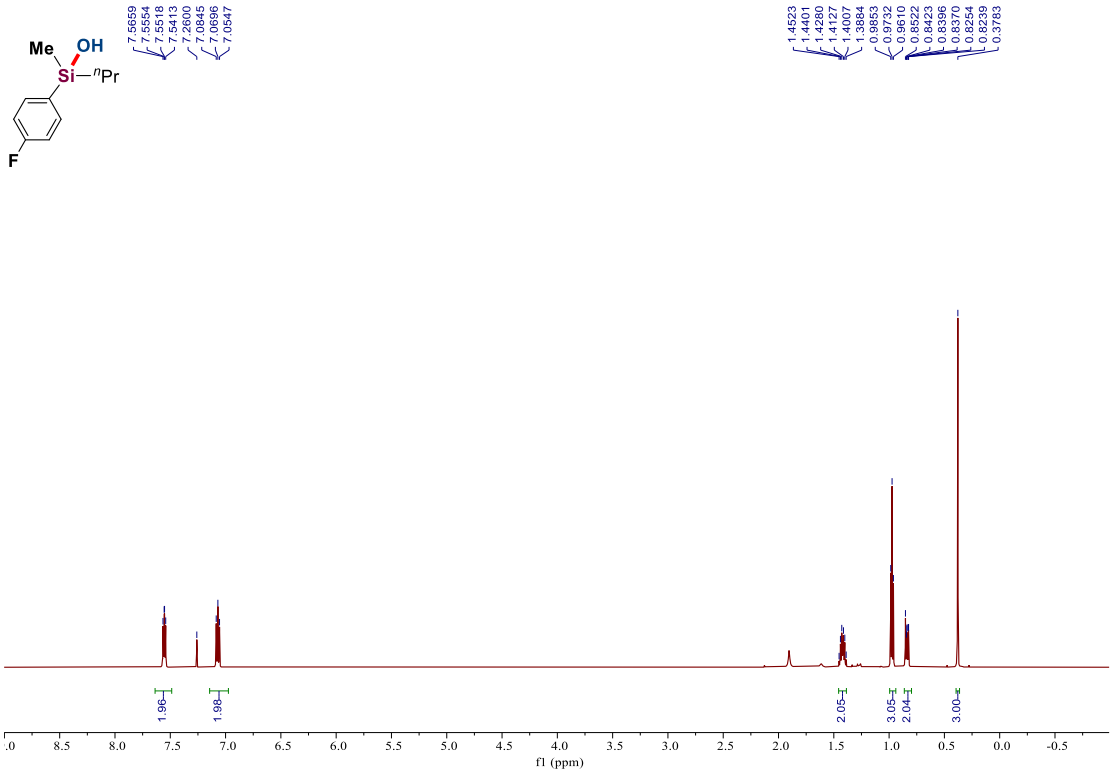
^{1}H NMR Spectra of **3k** (600 MHz, $CDCl_3$)



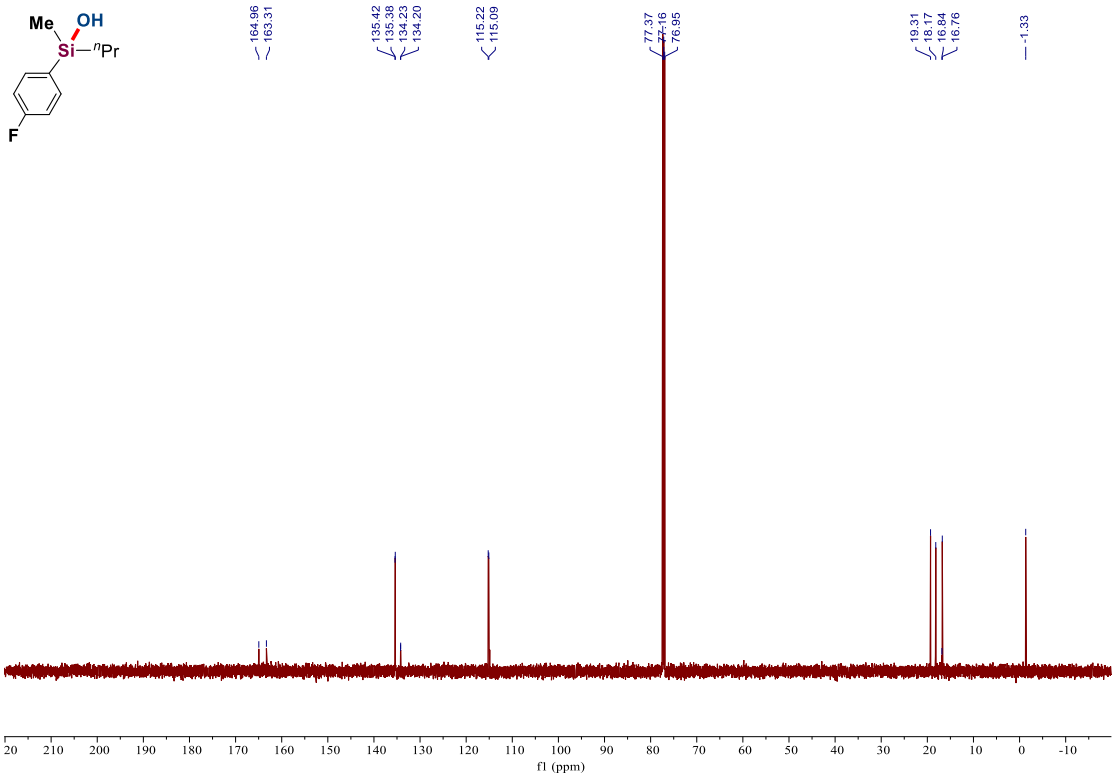
^{13}C NMR Spectra of **3k** (151 MHz, $CDCl_3$)



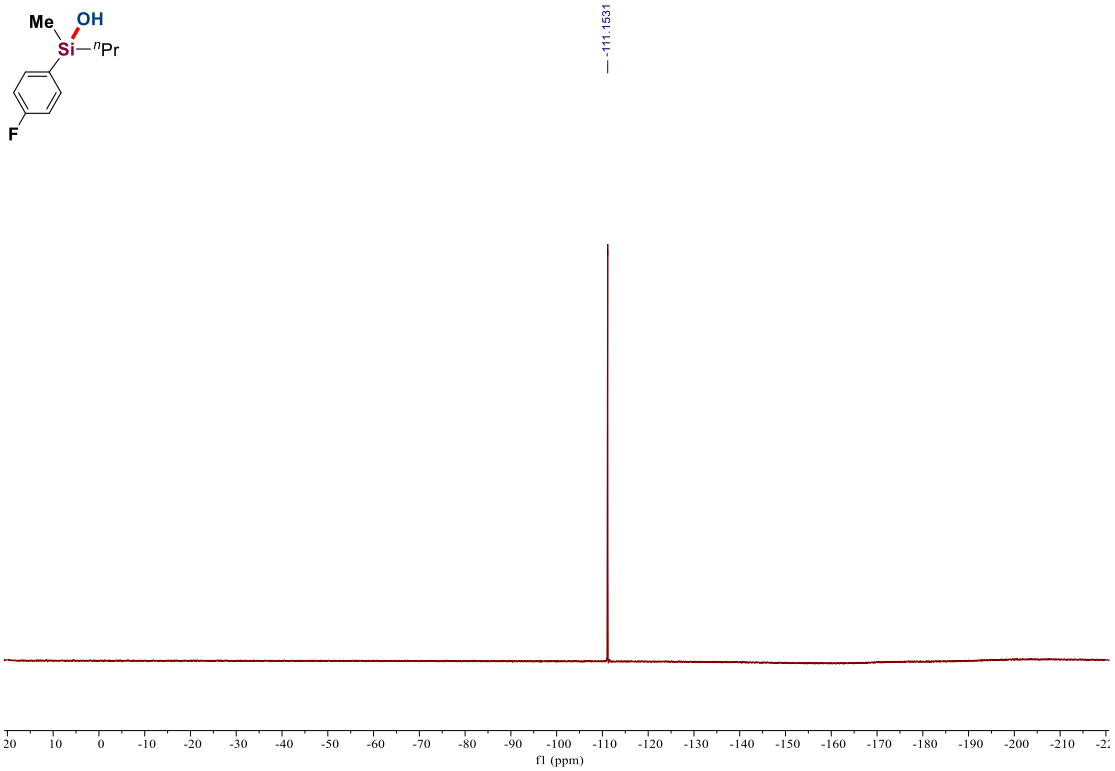
^{1}H NMR Spectra of **3l** (600 MHz, $CDCl_3$)



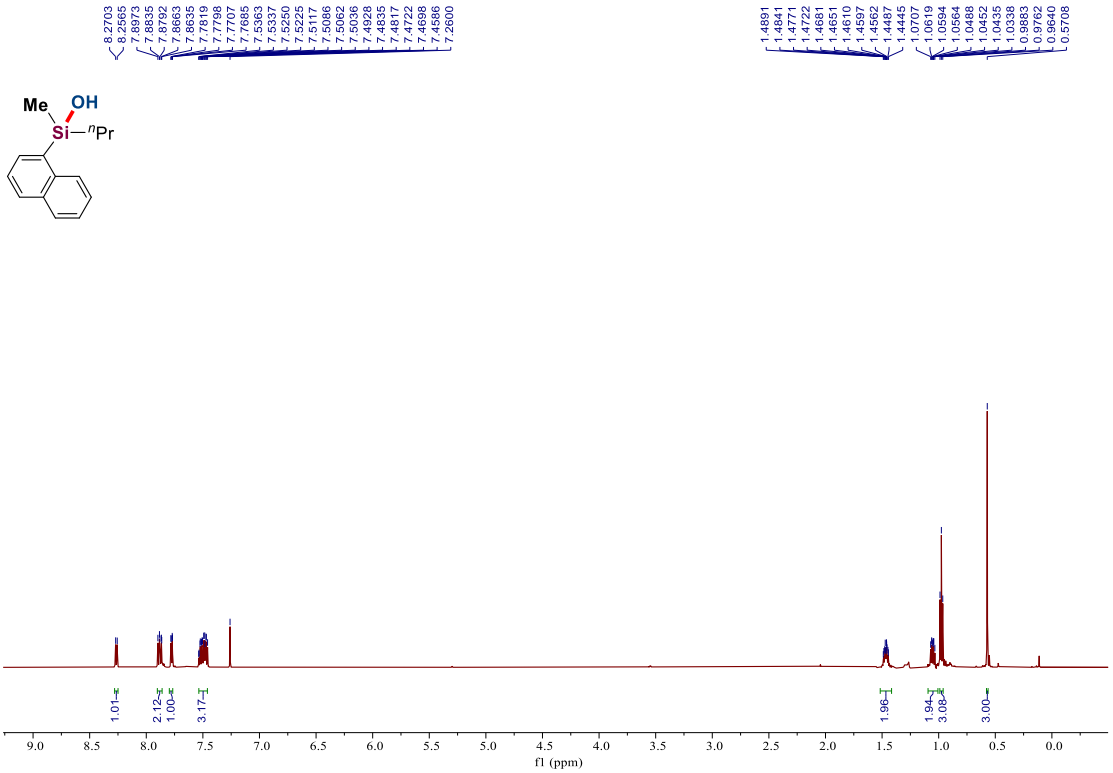
^{13}C NMR Spectra of **3l** (151 MHz, $CDCl_3$)



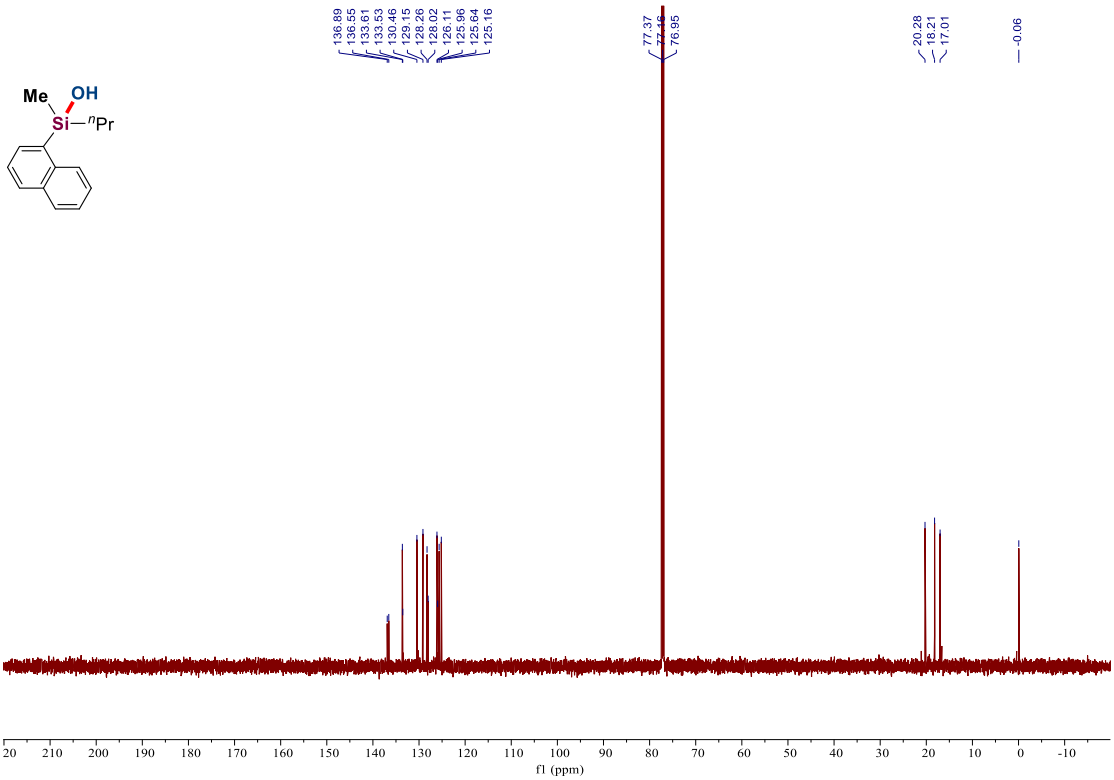
^{19}F NMR Spectra of **3l** (377 MHz, $CDCl_3$)



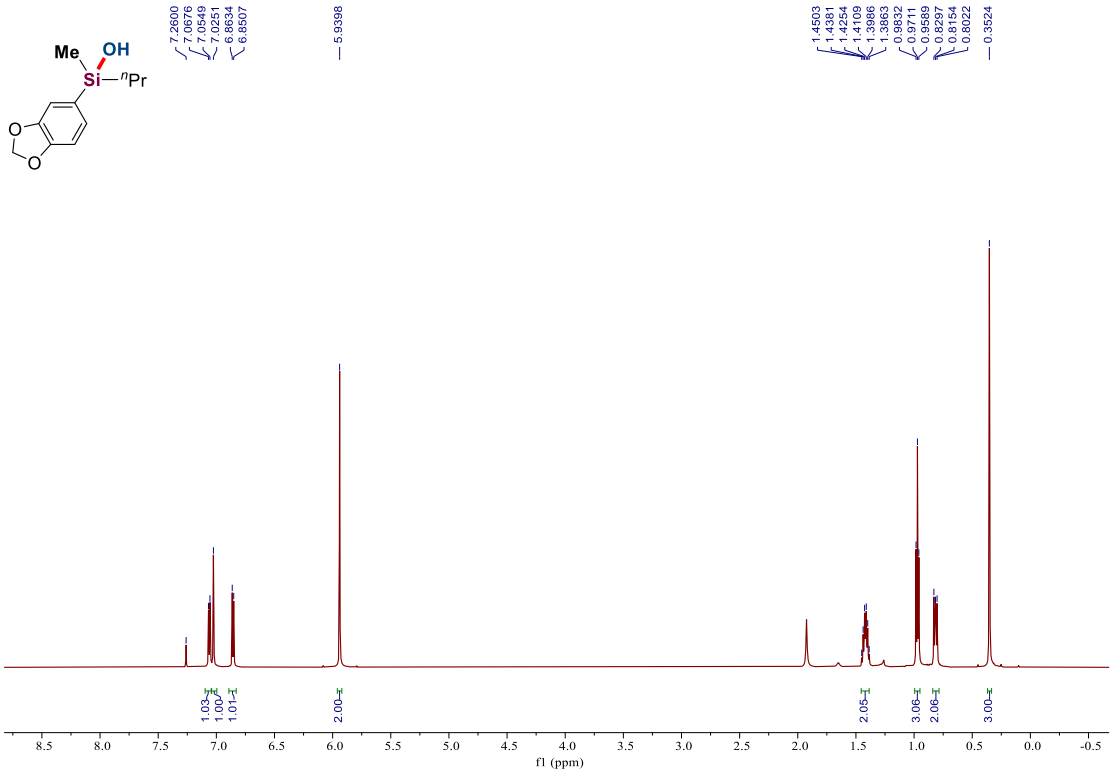
^{1}H NMR Spectra of **3m** (600 MHz, $CDCl_3$)



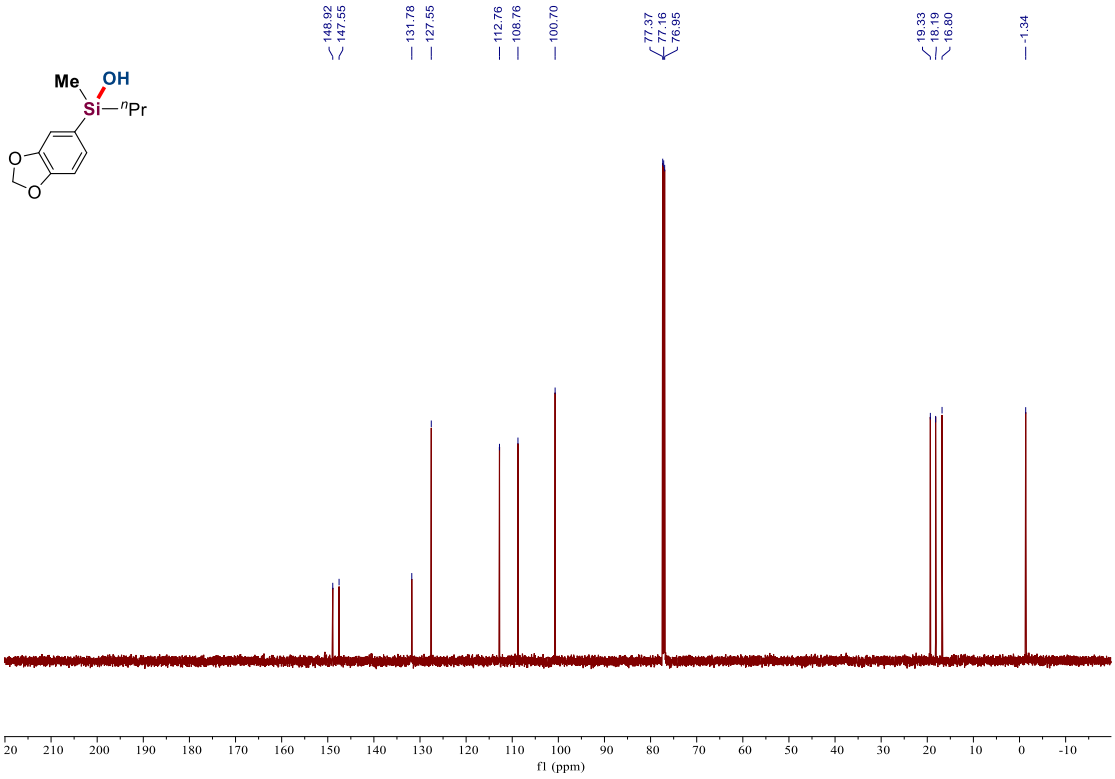
^{13}C NMR Spectra of **3m** (151 MHz, $CDCl_3$)



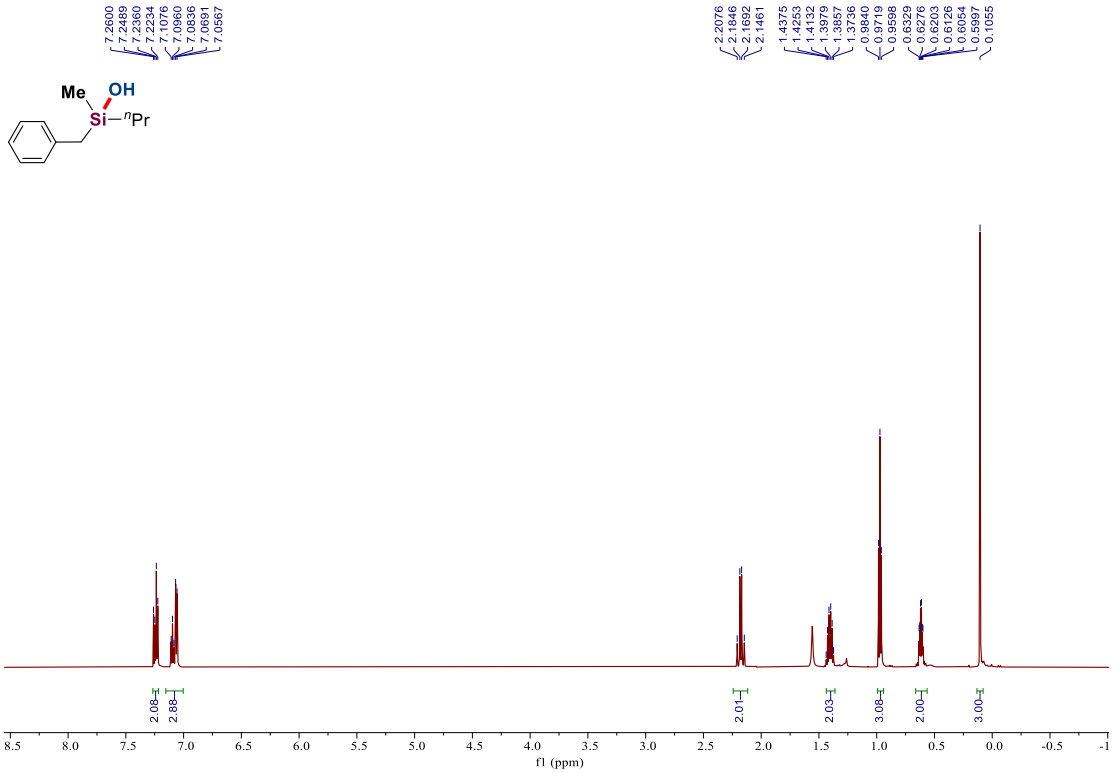
^{1}H NMR Spectra of **3n** (600 MHz, $CDCl_3$)



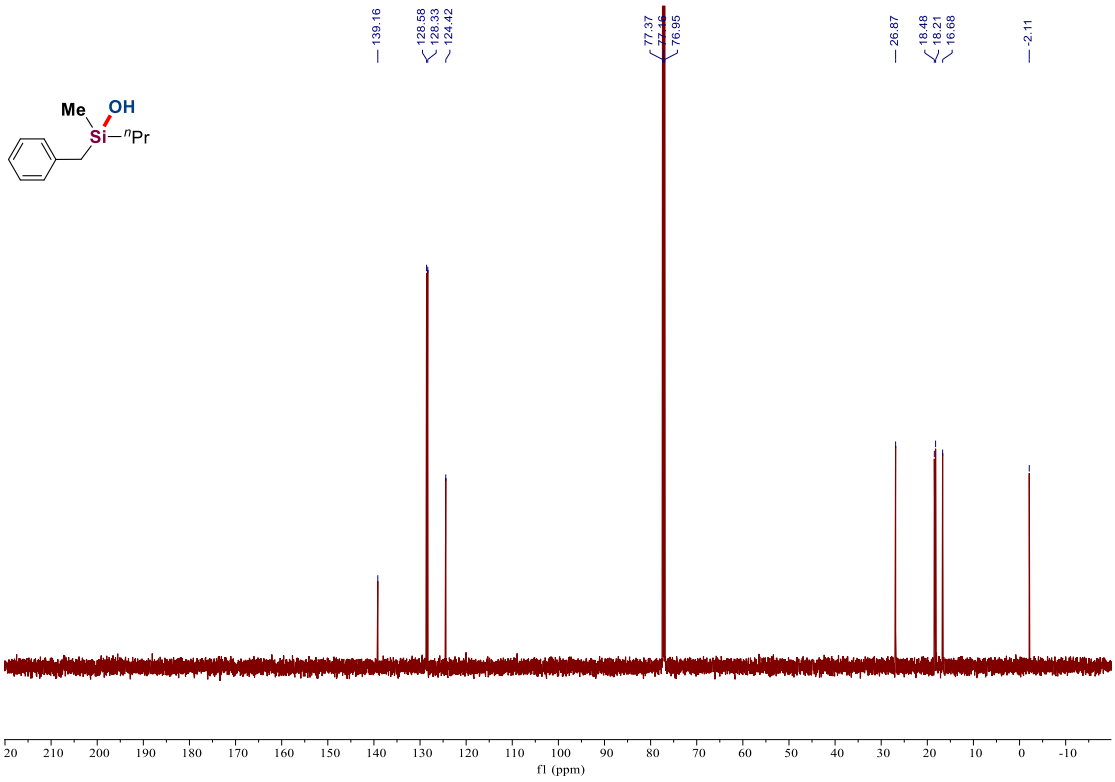
^{13}C NMR Spectra of **3n** (151 MHz, $CDCl_3$)



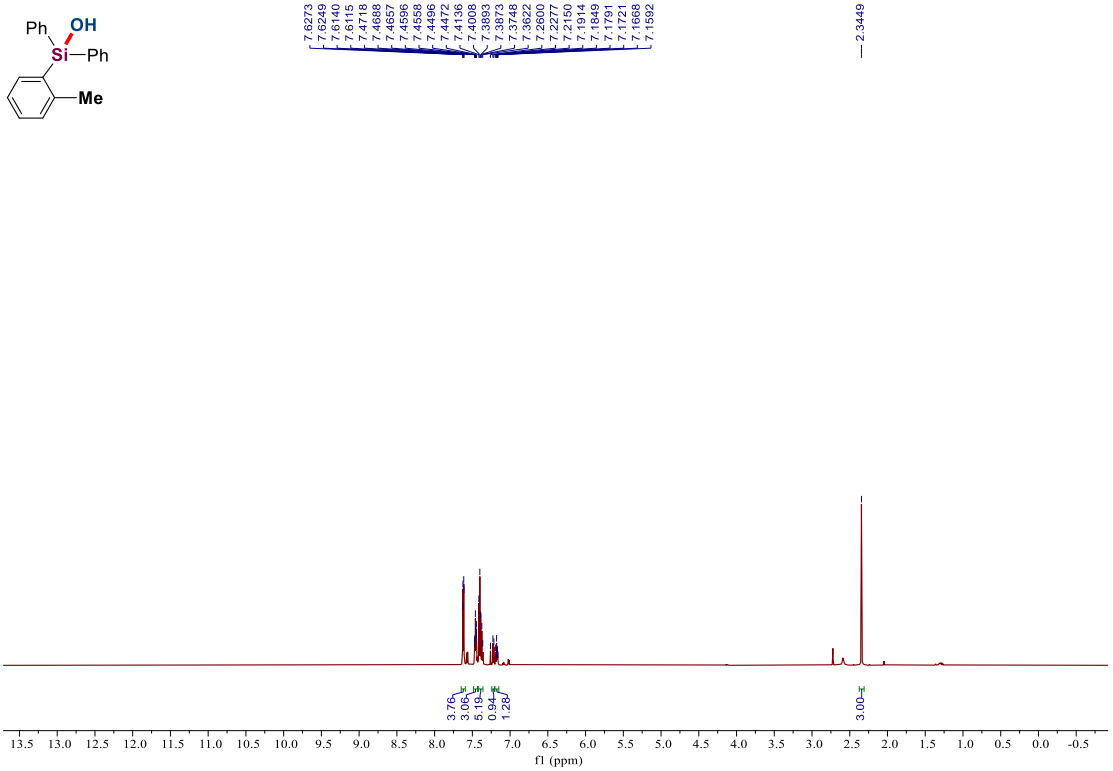
^{1}H NMR Spectra of **3o** (600 MHz, $CDCl_3$)



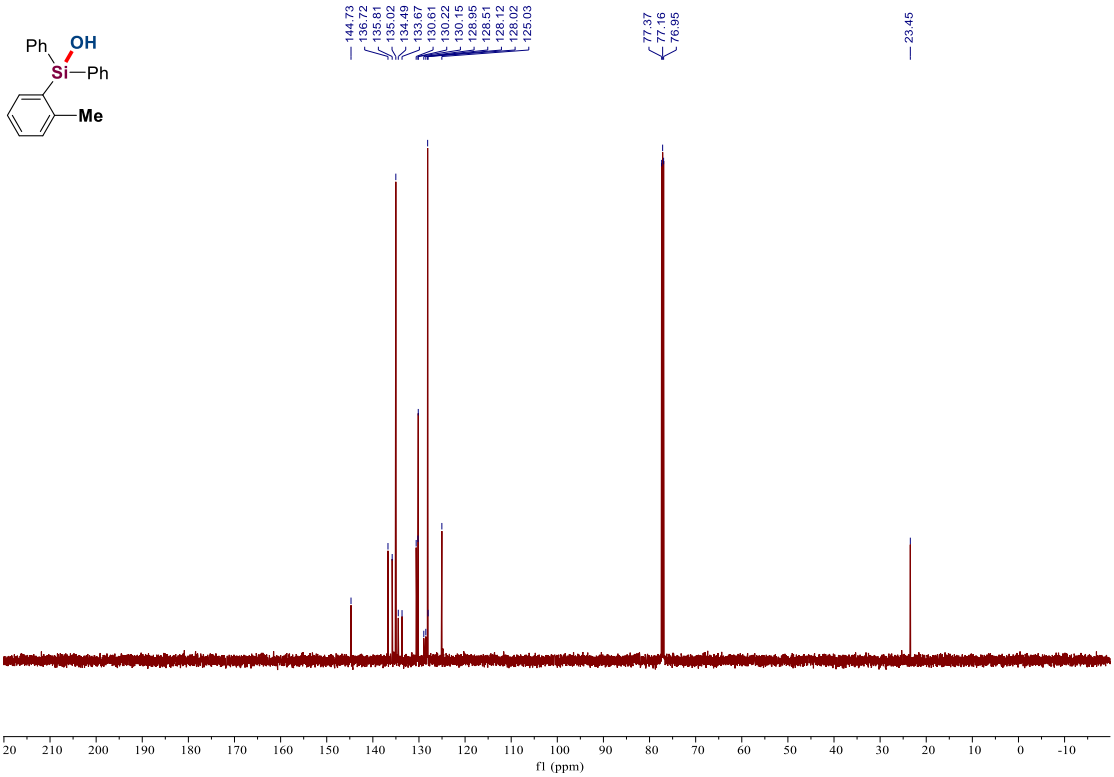
^{13}C NMR Spectra of **3o** (151 MHz, $CDCl_3$)



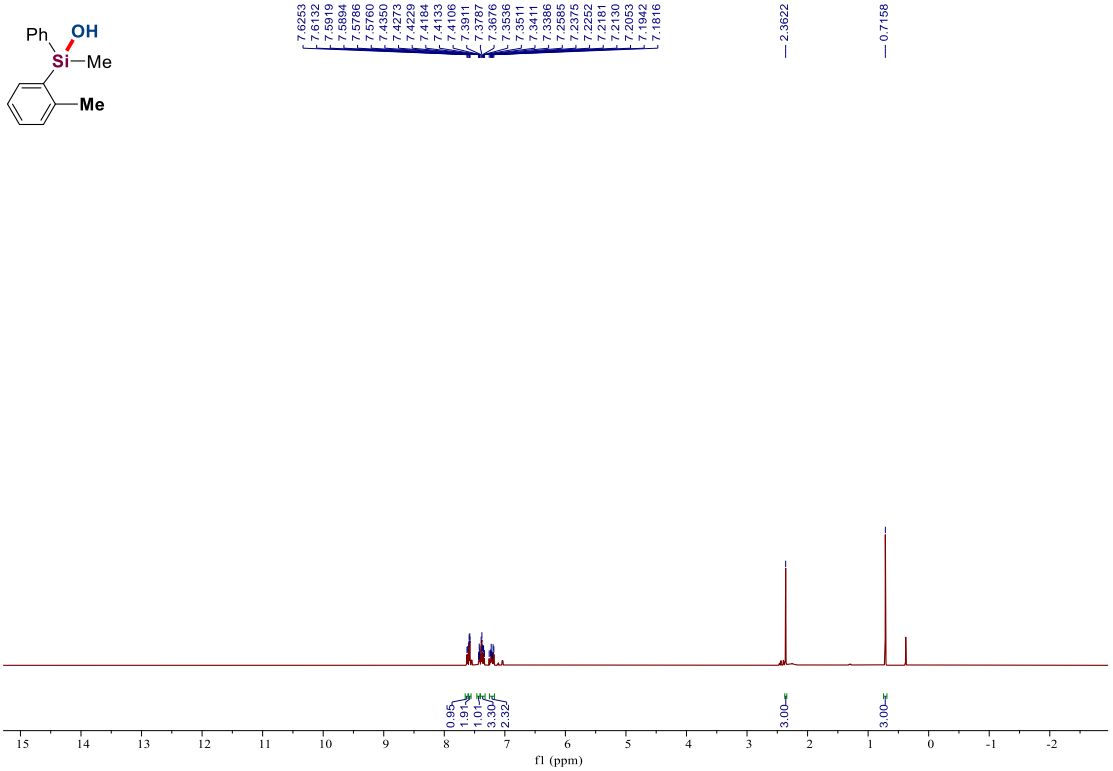
^{1}H NMR Spectra of **3p** (600 MHz, $CDCl_3$)



^{13}C NMR Spectra of **3p** (151 MHz, $CDCl_3$)



^{1}H NMR Spectra of **3q** (600 MHz, $CDCl_3$)



^{13}C NMR Spectra of **3q** (151 MHz, $CDCl_3$)