Electronic Supplementary Information

Tailoring stability, catalytic activity and selectivity of covalent metal-organic frameworks *via* steric modification of metal nodes

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Contents

1. Characterizations

All reagents and solvents were purchased from commercial sources and used as received without further purification. Powder X-ray diffraction (PXRD) data were collected on Rigaku Ultima IV diffractometer (40 kV, 40 mA, Cu Kα, λ = 1.5418 Å) from 1.5° to 30° with a step of 0.02° at a scan speed of 1° min^{-1}, and it was reduced to 2° min^{-1} for variable temperature powder X-ray diffraction (VT-PXRD) measurements. Thermogravimetric analysis was performed on a Mettler-Toledo (TGA/DSC1) thermal analyzer. Measurement was made under N_2 flow with a heating rate of 10 °C/min. The morphology characterizations were taken on TEM (FEI Talos F200X) and FESEM (Zeiss Ultra-55). Energy dispersive X-ray spectroscopy (EDS) analyses were performed on Zeiss Ultra-55. Fourier-transform infrared (FTIR) was recorded on Nicolet Avatar 360. X-ray photoelectron spectroscopy (XPS) experiments were performed by a Thermo ESCALAB 250XI system. GC-MS analysis was carried out on an Agilent 7890B GC analyzer. ^{1}H NMR (400 MHz) spectra were recorded on a Bruker AVANCE III HD 400 spectrometer using $CDCl_3$ (1 H, δ = 7.26) and CD_3CN (1 H, δ = 1.9) as deuterated solvent. ^{13}C NMR (100 MHz) spectra were conducted on a Bruker Avance 400 spectrometer using $CDCl_3$ (δ = 77) and CD_3CN (δ = 118.7) as deuterated solvent. The following abbreviations were used to explain the multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, dd = doublet of doublet, ddd = doublet of doublet of doublet, dt = doublet of triplet, m = multiplet, s br = single broad. Flash column chromatography was performed using Merck silica gel 60 with solvents. The solid-state ^{13}C CP/MAS NMR spectra were recorded on Bruker AVANCE III 600M. N_2 adsorption/desorption measurements were performed on Micromeritics ASAP 2020 Plus adsorption instrument.

2. Structural determination of Cu-CTC (2)

Single-crystal X-ray diffraction data for Cu-CTC (**2**) were collected *via* an Oxford Cryo stream system on a XtaLAB PRO MM007-DW diffractometer system equipped with a RA-Micro7HF-MR-DW(Cu/Mo) X-ray generator and Pilatus3R-200K-A detector (Rigaku, Japan, Cu Kα, λ = 1.54178 Å). The numerical absorption corrections were applied using the program of ABSCOR. The structures were solved using direct methods, which yielded the positions of all non-hydrogen atoms. These were refined first isotropically and then anisotropically. All the hydrogen atoms of the ligands were placed in calculated positions with fixed isotropic thermal parameters and included in the structure factor calculations in the final stage of full-matrix least-squares refinement. All calculations were performed using the SHELXTL system of computer programs.[1,2] Crystal data and structure refinement parameters are summarized in Tables S1. Containing the supplementary crystallographic data can be obtained free via www.ccdc.cam.ac.uk/data_request/cif.

Table S1. Crystal data and structure refinement for Cu-CTC (**2**)

	Cu-CTC (**2**)
Chemical formula	$C_{15}H_{24}Cu_3N_9$
FW	521.00
a, Å	7.5694(2)
b, Å	22.0064(4)
c, Å	11.5409(3)
α, deg	90
β, deg	97.069(2)
γ, deg	90
V, Å^3	1907.81(8)
space group	*C*2/*m*
Z	4
temp, K	100.00(10)
D_{calcd}, g cm^{-3}	1.814
μ, mm^{-1}	4.053
final *R* indices [$I > 2\sigma(I)$]	$R_1 = 0.0328$, $wR_2 = 0.0913$
final *R* indices (all data)	$R_1 = 0.0338$, $wR_2 = 0.0923$
CCDC number	2100102

3. PXRD of Cu-CTC (2)

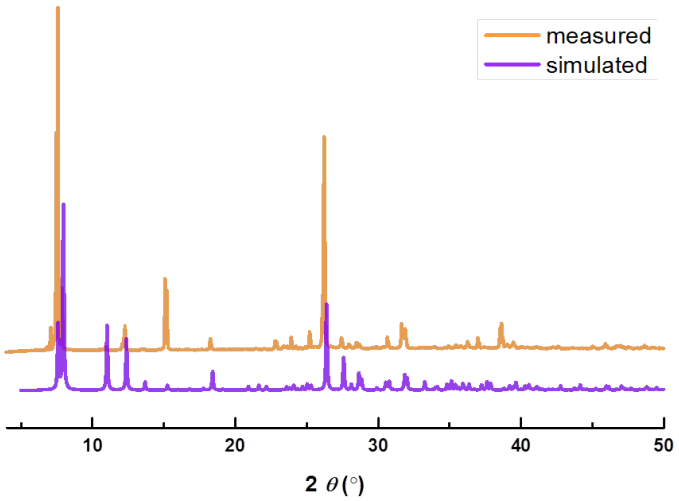


Fig. S1 PXRD pattern of Cu-CTC (**2**).

4. Solvent stability of Cu-CTC (1) and (2)

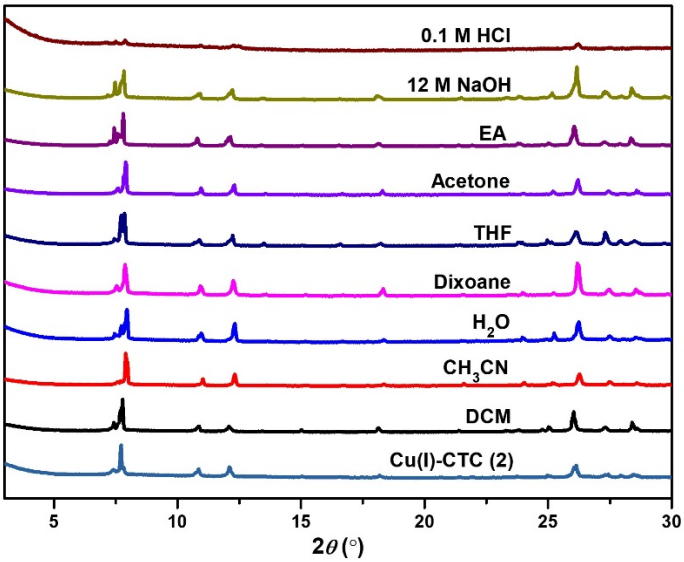


Fig. S2 Solvent stability of Cu-CTC (**2**).

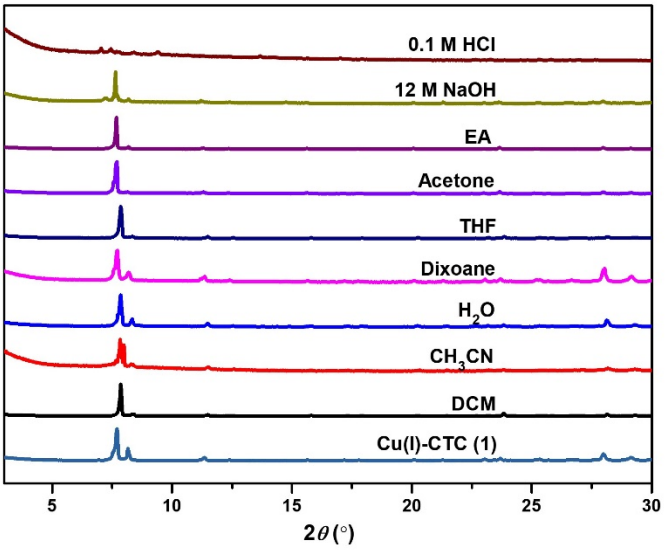


Fig. S3 Solvent stability of Cu-CTC (**1**).

5. TGA of Cu-CTC (1) and (2)

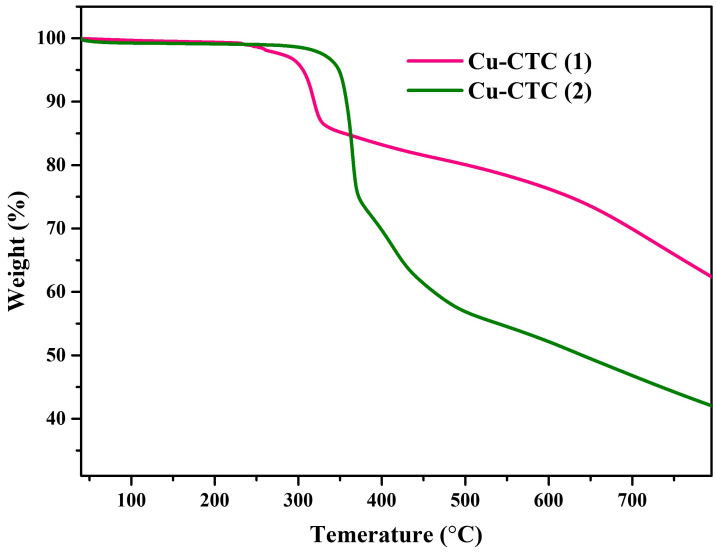


Fig. S4 TGA of Cu-CTC (**1**) and Cu-CTC (**2**).

6. Schematic illustration of constructing JNM-5

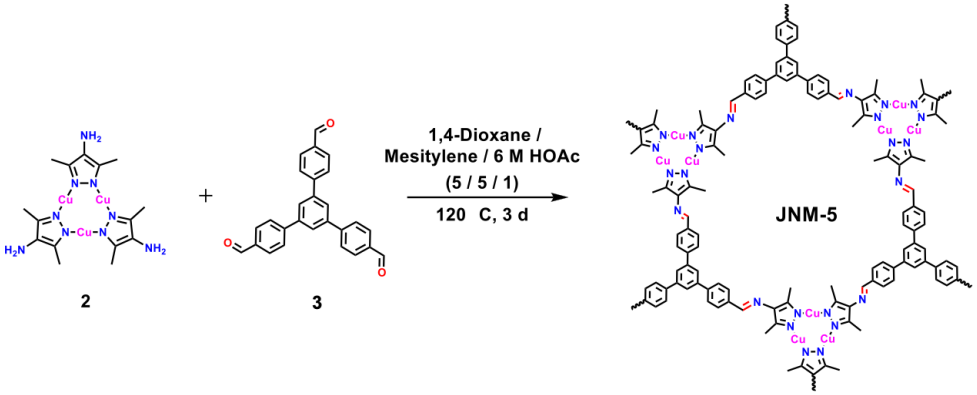


Fig. S5 Schematic illustration of constructing **JNM-5**.

7. PXRD pattern of Cu-CTU-based CMOFs through one-pot synthesis

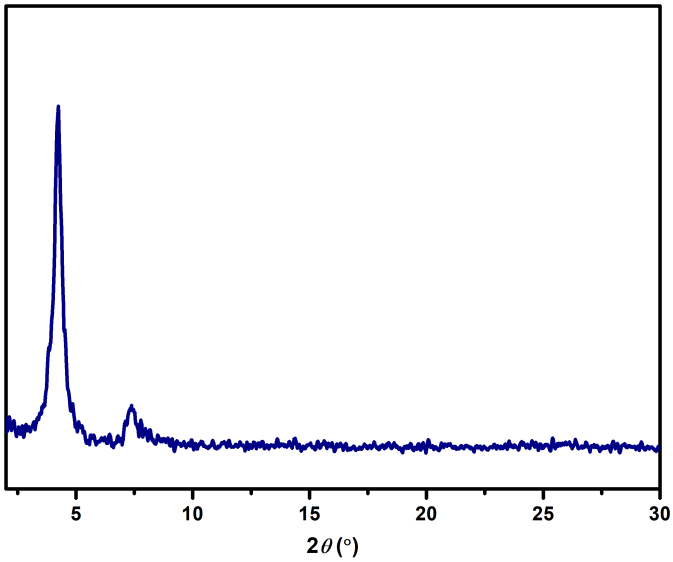


Fig. S6 PXRD pattern of Cu-CTU-based CMOFs through one-pot synthesis.

8. Fourier-transform infrared (FTIR) spectra

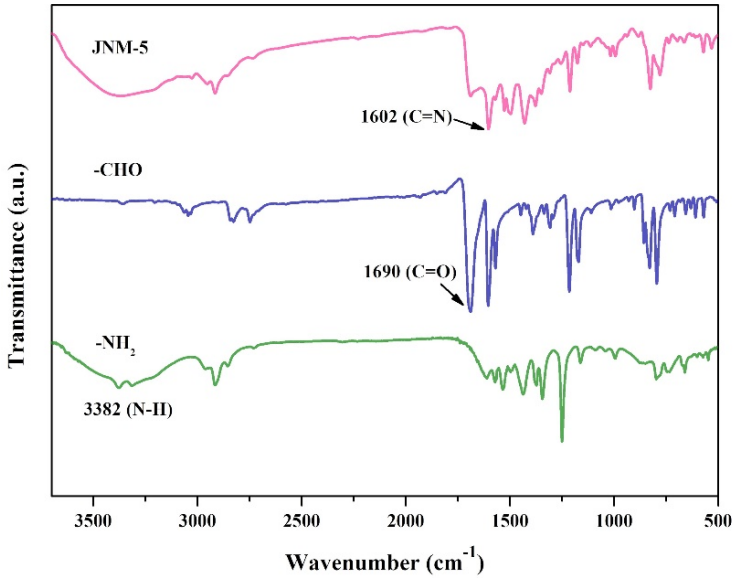


Fig. S7 FTIR spectra of monomers and **JNM-5**.

9. Solid-state ^{13}C CP/MAS NMR spectra

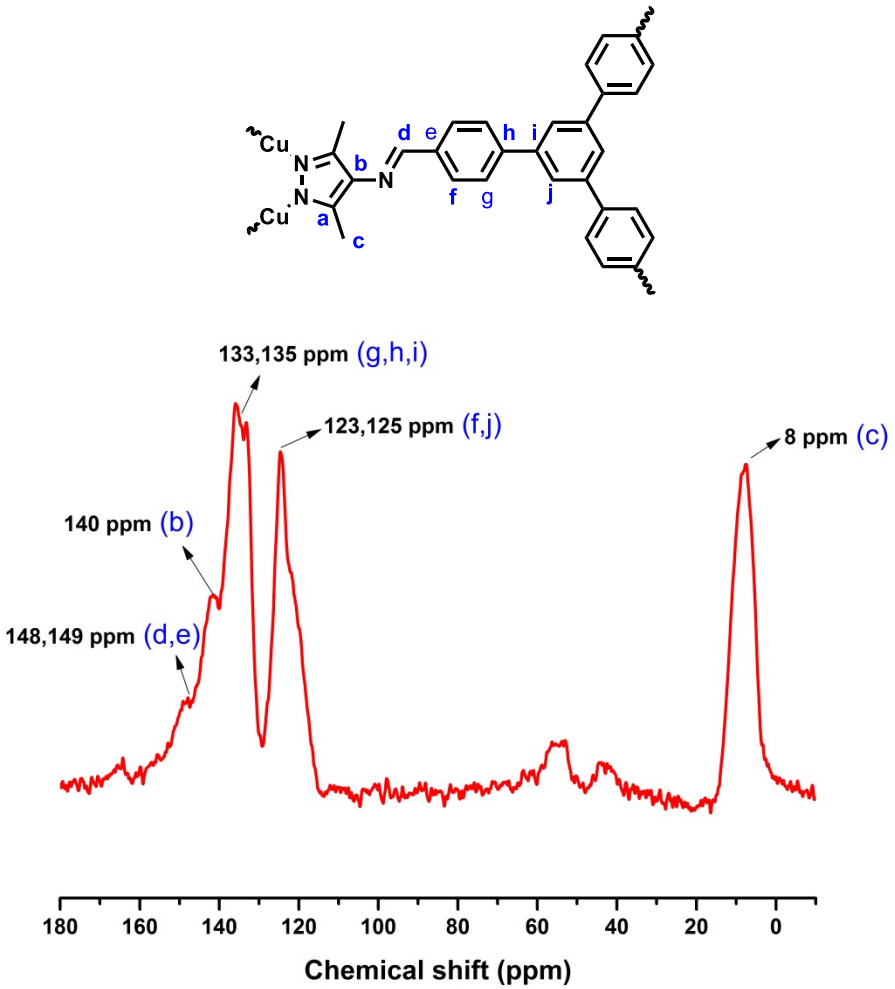


Fig. S8 Solid-state ^{13}C CP/MAS NMR spectra and peak assignments of **JNM-5**.

10. Scanning electron microscopy (SEM)

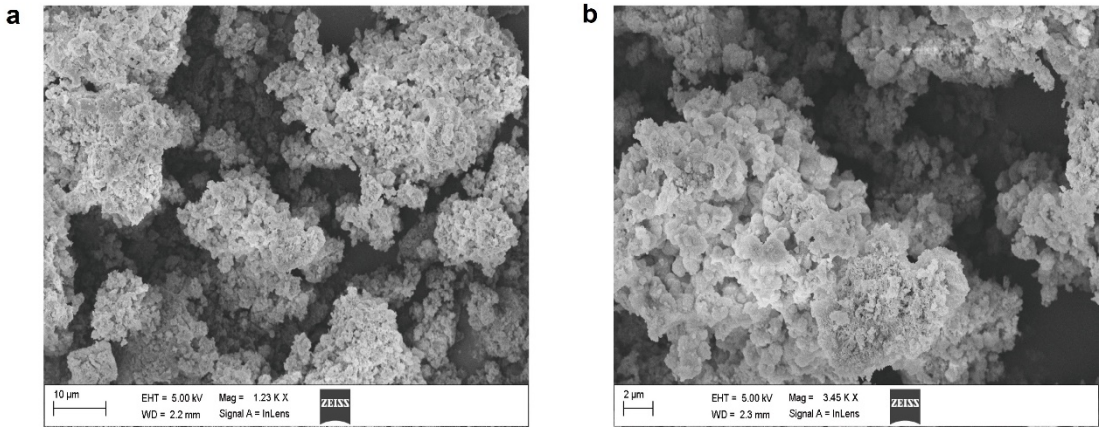


Fig. S9 SEM images of **JNM-5**.

11. Energy dispersive X-ray spectroscopy (EDS)

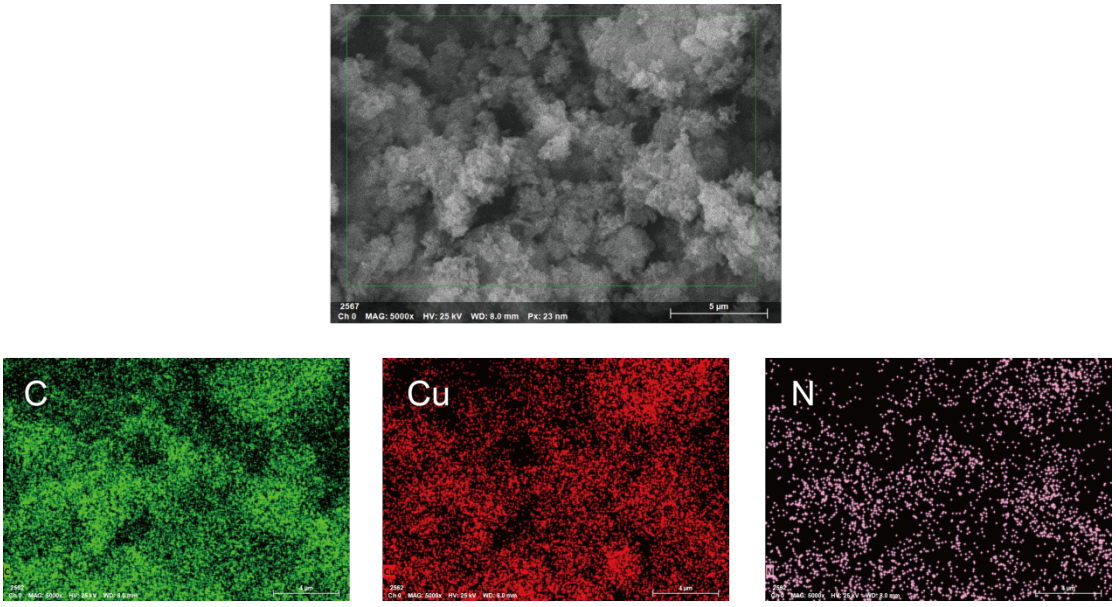


Fig. S10 EDS of **JNM-5** showing the uniform distribution of element C, Cu and N.

12. Structural simulation of JNM-5

Theoretical simulations of **JNM-5** were carried out in Accelrys Materials Studio 2019 software package. The relative total energies were calculated by molecular mechanics calculation using DMol^3 energy task, after which the simulated PXRD patterns were determined by the Reflex module. The Pawley refinement of the experimental PXRD was conducted with the Reflex module.[1, 2]

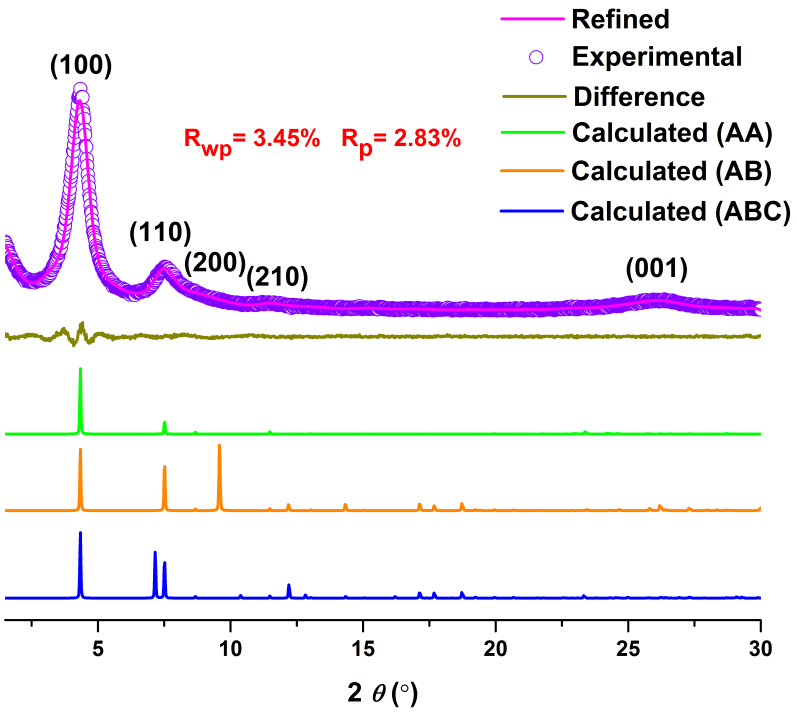


Fig. S11 PXRD patterns of **JNM-5** with the experimental profiles in violet, difference curve in dark yellow, and calculated profiles of AA (green), AB (orange) and ABC (bule) packing modes.

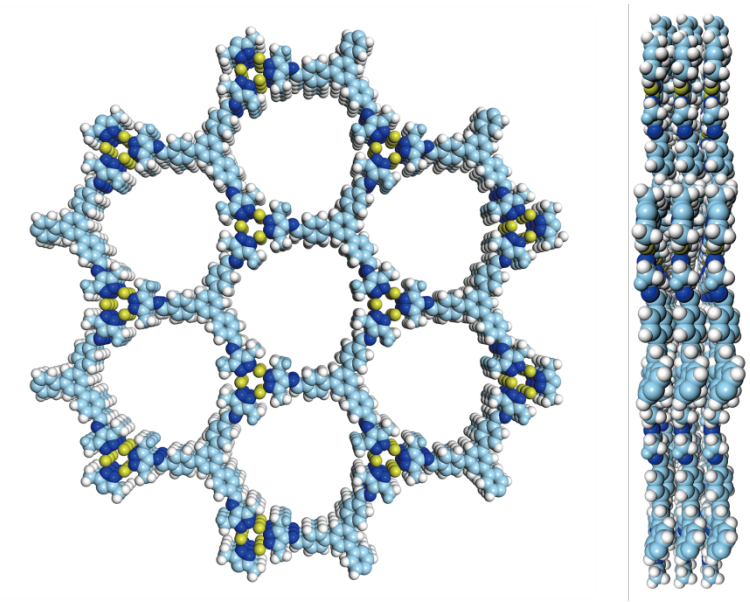


Fig. S12 Space-filling mode of **JNM-5** in AA stacking model viewed from (left) *c* axis and (right) *a* axis.

Table S2. Atomic coordinates of the AA-stacking mode of **JNM-5.**

Space group: *P*3 *a* = *b* = 23.53 Å, and *c* = 3.80 Å *α* =*β* = 90°, and *γ* = 120°			
	X	Y	Z
Cu1	0.57469	0.2858	-0.25684
C2	0.36165	0.73346	-0.55964
C3	0.39926	0.70464	-0.56035
C4	0.44976	0.84168	-0.38316
C5	0.3915	0.80395	-0.55249
C6	0.44709	0.93734	-0.52912
C7	0.47747	0.90756	-0.37419
C8	0.4725	0.63817	-0.71167
C9	0.51108	0.61093	-0.6972
C10	-0.00669	0.46788	-0.51444
C11	0.52679	0.37645	-0.29565
C12	0.61652	0.46817	-0.30421
C13	0.5509	0.44104	-0.33109
C14	0.45895	0.32565	0.68314
C15	0.66638	0.53662	0.69262
N16	0.62916	0.42082	-0.26165
N17	0.51349	0.47111	-0.36723

N18	-0.20957	0.42436	-0.25779
H19	0.45024	0.73401	-0.55923
H20	0.47336	0.82047	-0.24771
H21	0.52199	0.93499	-0.23903
H22	0.48947	0.68189	-0.85425
H23	0.55704	0.63489	-0.82166
H24	-0.02731	0.42197	-0.63678
H25	0.45346	0.27952	0.76532
H26	0.44203	0.32142	0.41472
H27	0.42958	0.33778	0.85002
H28	0.67535	0.55482	0.42504
H29	0.71133	0.54257	0.79926
H30	0.65118	0.56454	0.85127

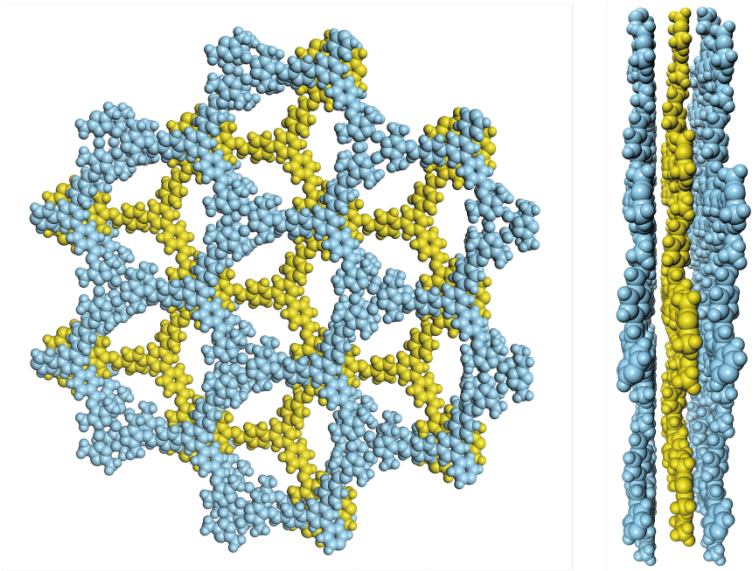


Fig. S13 Space-filling mode of **JNM-5** in AB stacking model viewed from (left) *c* axis and (right) *a* axis.

Table S3. Atomic coordinates of the AB-stacking mode of **JNM-5.**

Space group: *P*3 $a = b = 24.36$ Å, and $c = 10.26$ Å $\alpha = \beta = 90°$, and $\gamma = 120°$			
	X	Y	Z
Cu1	0.57469	0.2858	0.3423
Cu2	0.90802	0.95246	0.8423
C3	0.36165	0.73346	0.22807
C4	0.39926	0.70464	0.22781
C5	0.44976	0.84168	0.29465
C6	0.3915	0.80395	0.23077
C7	0.44709	0.93734	0.23958
C8	0.47747	0.90756	0.29803
C9	0.47249	0.63817	0.17072
C10	0.51107	0.61093	0.17618
C11	0.99331	0.46788	0.24512
C12	0.52679	0.37645	0.32766
C13	0.61652	0.46817	0.32442
C14	0.5509	0.44104	0.31428
C15	0.45895	0.32565	0.31966
C16	0.66638	0.53662	0.32322
C17	0.69498	0.40013	0.72807

C18	0.73259	0.37131	0.72781
C19	0.7831	0.50835	0.79465
C20	0.72484	0.47062	0.73077
C21	0.78043	0.604	0.73958
C22	0.8108	0.57423	0.79803
C23	0.80583	0.30484	0.67072
C24	0.84441	0.27759	0.67618
C25	0.32665	0.13455	0.74512
C26	0.86012	0.04312	0.82766
C27	0.94986	0.13484	0.82442
C28	0.88423	0.10771	0.81428
C29	0.79228	0.99232	0.81966
C30	0.99972	0.20328	0.82322
N31	0.62916	0.42082	0.34048
N32	0.51349	0.47111	0.30065
N33	0.79043	0.42436	0.34194
N34	0.96249	0.08748	0.84048
N35	0.84682	0.13778	0.80065
N36	0.12376	0.09103	0.84194
H37	0.48947	0.68189	0.11693
H38	0.45346	0.27952	0.35069
H39	0.44203	0.32141	0.2184
H40	0.42958	0.33779	0.38261
H41	0.67535	0.55482	0.22228
H42	0.71133	0.54257	0.36345
H43	0.65118	0.56454	0.38307
H44	0.45024	0.73401	0.22823
H45	0.47336	0.82047	0.34575
H46	0.52199	0.93499	0.34902
H47	0.55703	0.63489	0.12922
H48	0.97269	0.42197	0.19896
H49	0.8228	0.34856	0.61693
H50	0.7868	0.94619	0.85069
H51	0.77536	0.98807	0.7184
H52	0.76291	0.00445	0.88261
H53	0.00868	0.22149	0.72228
H54	0.04467	0.20924	0.86345
H55	0.98452	0.23121	0.88307
H56	0.78357	0.40068	0.72823
H57	0.8067	0.48714	0.84575
H58	0.85533	0.60166	0.84902
H59	0.89037	0.30156	0.62922
H60	0.30602	0.08864	0.69896

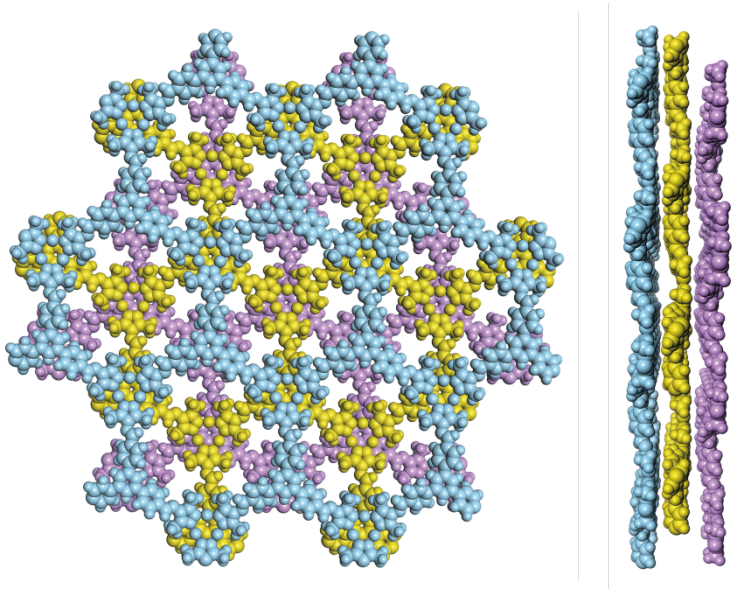


Fig. S14 Space-filling mode of **JNM-5** in ABC stacking model viewed from (left) *c* axis and (right) *a* axis.

Table S4. Atomic coordinates of the ABC-stacking mode of **JNM-5.**

Space group: *R*3 *a* = *b* = 24.36 Å, and *c* = 15.39 Å *α* =*β* = 90°, and *γ* = 120°			
	X	Y	Z
Cu1	-0.57469	-0.2858	0.2282
C2	-0.36165	-0.73346	0.15205
C3	-0.39926	-0.70464	0.15187
C4	-0.44976	-0.84168	0.19643
C5	-0.3915	-0.80395	0.15385
C6	-0.44709	-0.93734	0.15972
C7	-0.47747	-0.90756	0.19869
C8	-0.47249	-0.63817	0.11381
C9	-0.51107	-0.61093	0.11745
C10	-0.99331	-0.46788	0.16341
C11	-0.52679	-0.37645	0.21844
C12	-0.61652	-0.46817	0.21628
C13	-0.5509	-0.44104	0.20952
C14	-0.45895	-0.32565	0.21311
C15	-0.66638	-0.53662	0.21548
N16	-0.62916	-0.42082	0.22699
N17	-0.51349	-0.47111	0.20043

N18	-0.79043	-0.42436	0.22796
H19	-0.48947	-0.68189	0.07795
H20	-0.45346	-0.27952	0.23379
H21	-0.44203	-0.32141	0.1456
H22	-0.42958	-0.33779	0.25507
H23	-0.67535	-0.55482	0.14818
H24	-0.71133	-0.54257	0.2423
H25	-0.65118	-0.56454	0.25538
H26	-0.45024	-0.73401	0.15215
H27	-0.47336	-0.82047	0.2305
H28	-0.52199	-0.93499	0.23268
H29	-0.55703	-0.63489	0.08615
H30	-0.97269	-0.42197	0.13264

13. Transmission electron microscopy (TEM)

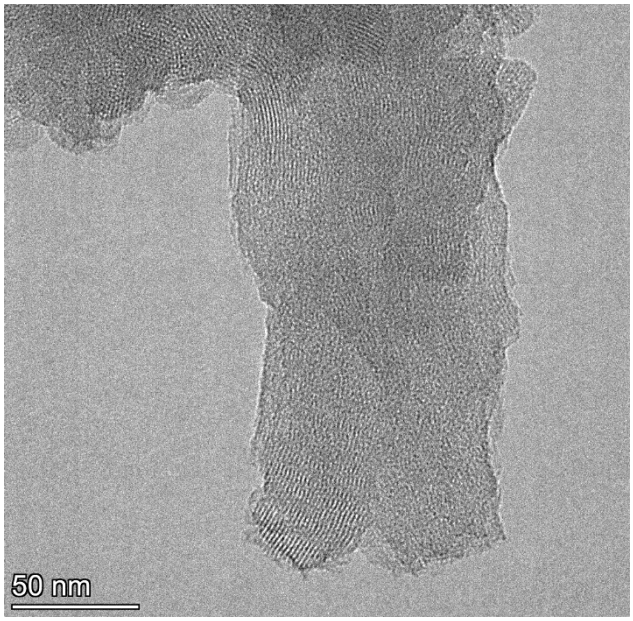


Fig. S15 TEM images of **JNM-5**.

14. PXRD of JNMs

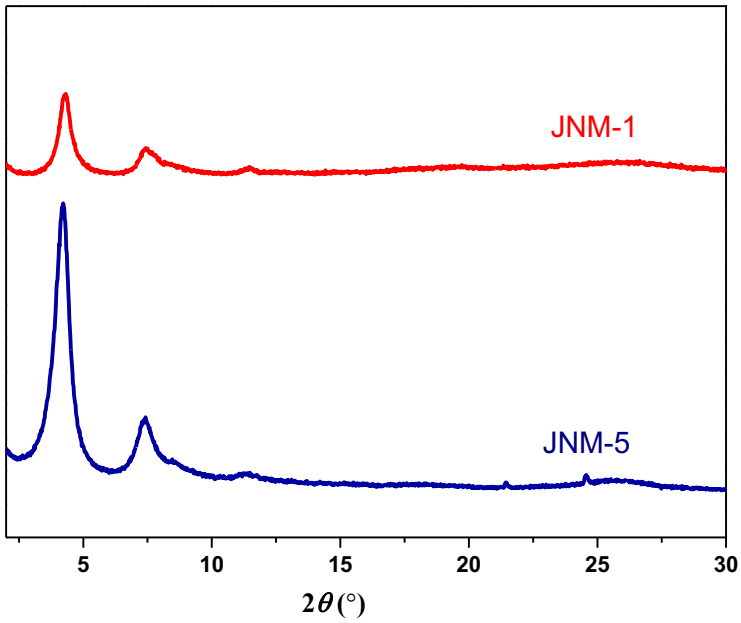


Fig. S16 PXRD of (bottom) **JNM-5** and (top) **JNM-1**.

15. PXRD of JNM-5 after 3 months and 6 months in air

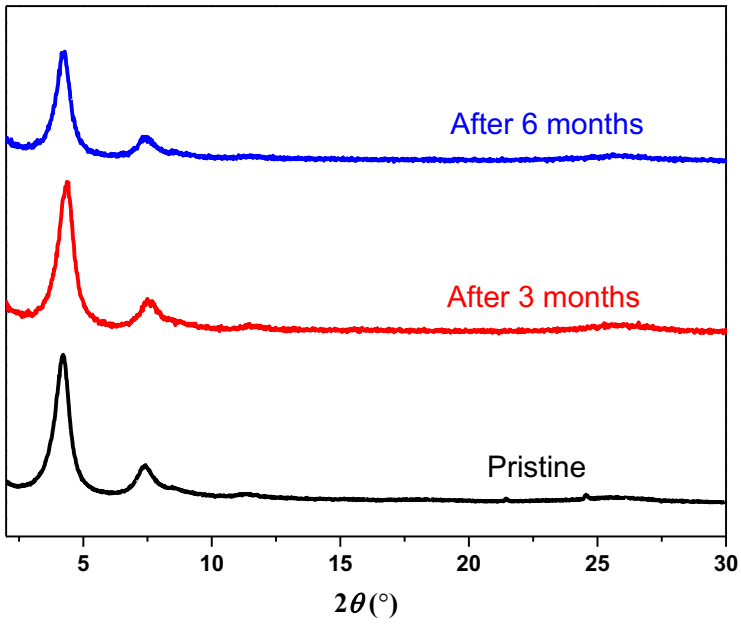


Fig. S17 PXRD of **JNM-5** after exposing 3 months and 6 months in air.

16. PXRD of JNMs in boiling water

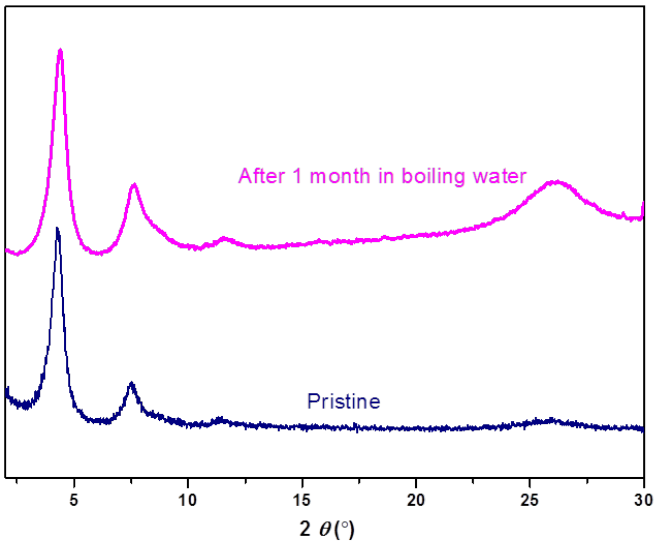


Fig. S18 PXRD of **JNM-5** after immesing in boiling water for one month.

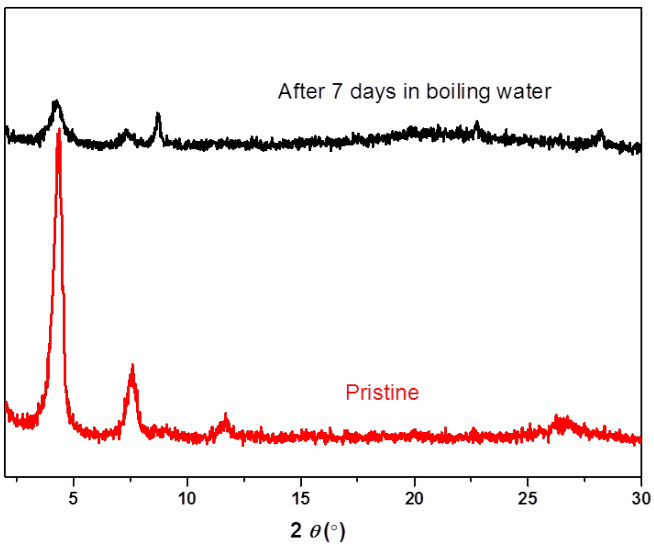


Fig. S19 PXRD of **JNM-1** after immesing in boiling water for one week.

17. X-ray Photoeletron Spectroscopy (XPS)

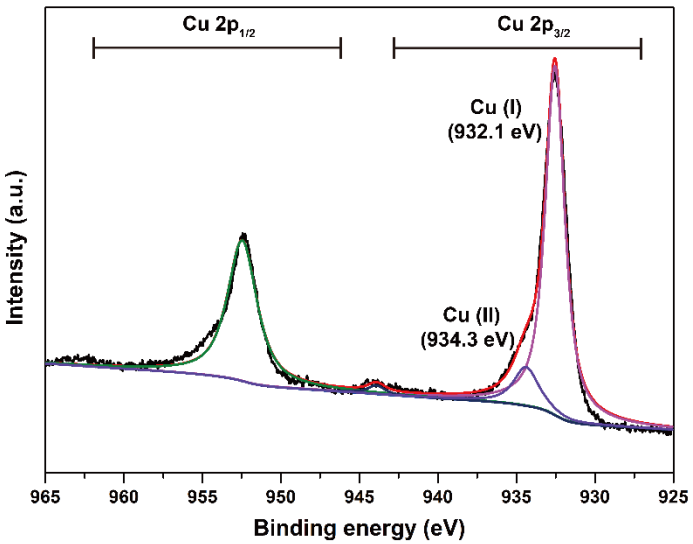


Fig. S20 XPS of **JNM-5** after exposing one month in boiling water.

18. The palladium-free sonogashira coupling reactions of JNM-5

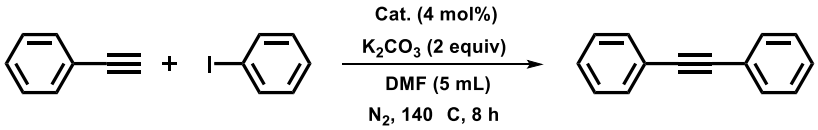


Fig. S21 The palladium-free sonogashira coupling reactions using **JNMs** as catalyst and the yield of **JNM-5** is 52%, which are lower than that of **JNM-1**(99%). (Reaction conditions: phenylacetylene 0.5 mmol, iodobenzene (1.2 equiv), K_2CO_3 (2 equiv); DMF (5 mL), N_2 atmosphere, and reaction time is 8 h.)

19. The catalysis performance of Cu-CTC (1) and Cu-CTC (2)

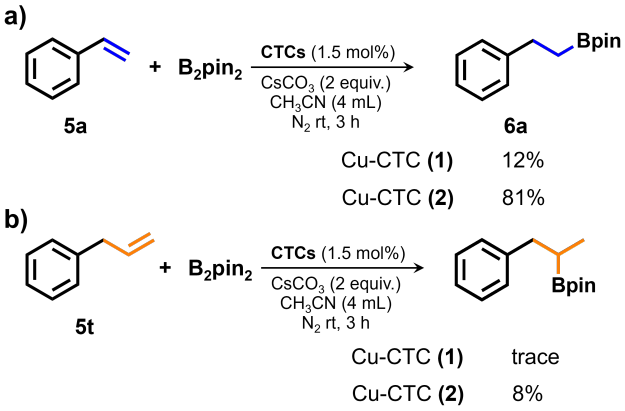


Fig. S22 The catalysis performance of Cu-CTC (**1**) and Cu-CTC (**2**).

20. Gram-scale hydroboration reaction of styrene

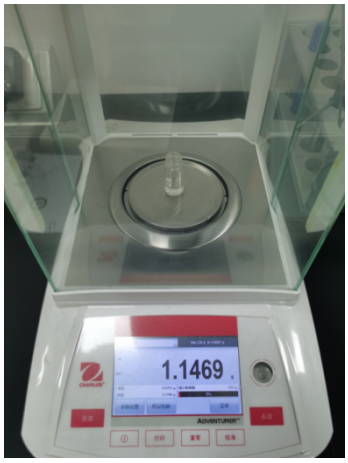


Fig. S23 The hydroboration product of gram-scale reaction of **6a** using low loading of **JNM-5**.

A solution of styrene (**5a**) (690 μL, 6 mmol), B_2pin_2 (3.05 g, 12 mmol), Cs_2CO_3 (3.91 g, 12 mmol), **JNM-5** (3 mg, 6.9×10^{-4} mmol) in CH_3CN (AR) (48 mL) were added into a vial. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. The conversion of **5a** was monitored by GC-MS. After the reaction completed, the hydroboration product **6a** was isolated following the general procedure.

21. The catalytic kinetics for the hydroboration reactions of styrene

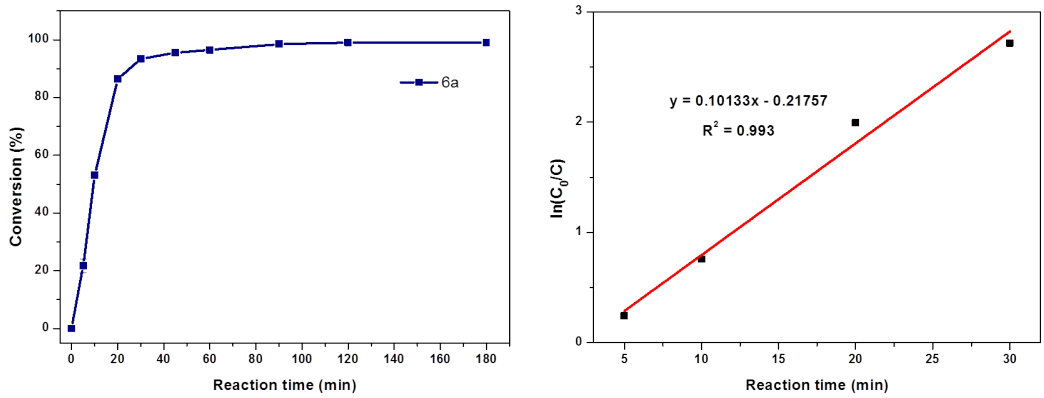


Fig. S24 The plots of conversion *versus* reaction time for **JNM-1.**

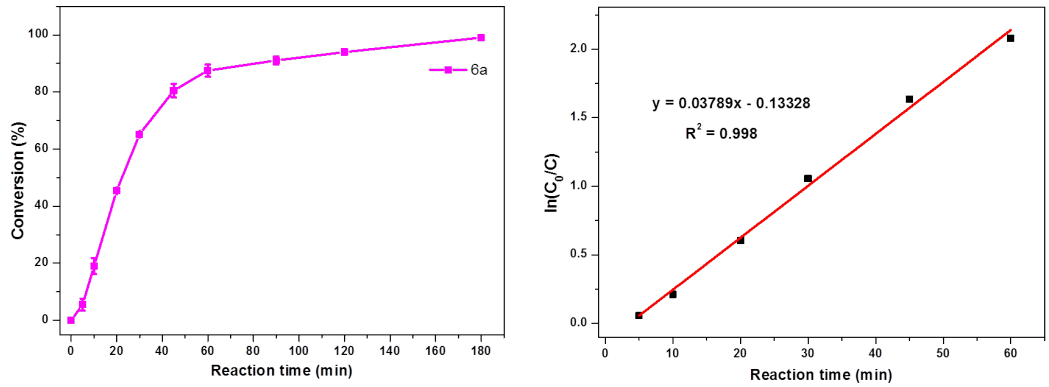


Fig. S25 The plots of conversion *versus* reaction time for **JNM-5.**

22. XPS of JNMs after catalytic cycles

The catalytic recyclability of **JNMs** catalyst was studied detailedly after five cycles. After each catalytic run, the catalyst was separated by centrifuging the mixture, and washed in DCM for 1h. And then it was dried in vacuum at 100 °C for 1 h and used for the next run.

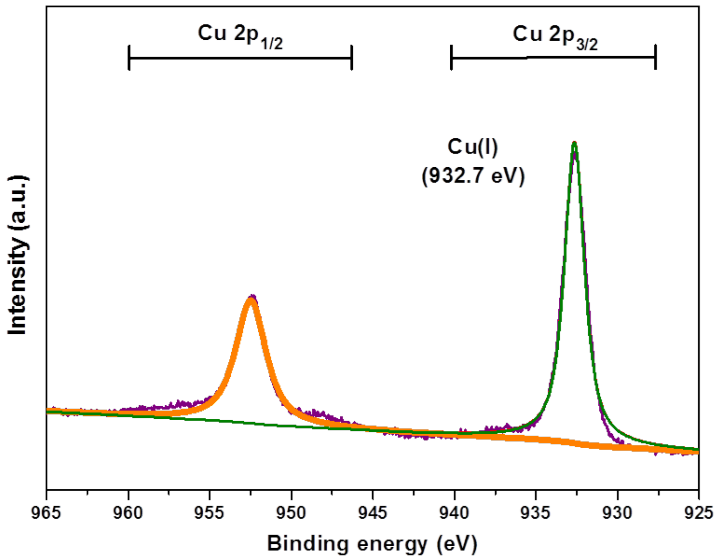


Fig. S26 XPS for **JNM-5** after catalyst reaction.

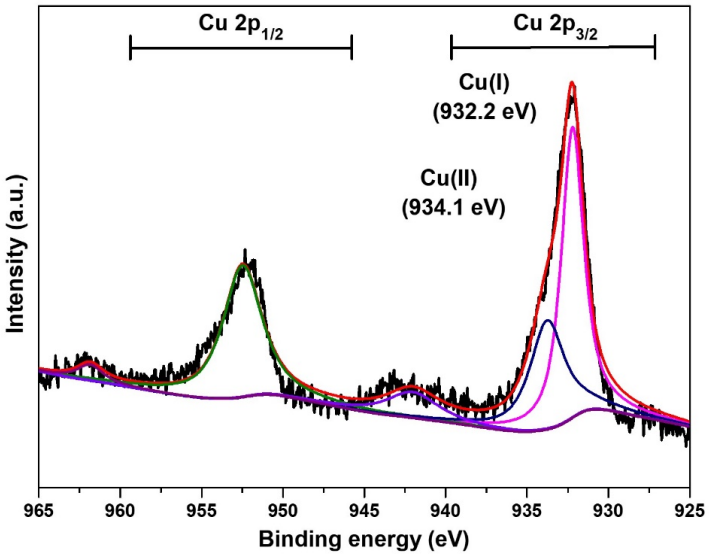


Fig. S27 XPS for **JNM-1** after catalyst reaction.

23. Reaction mechanisms

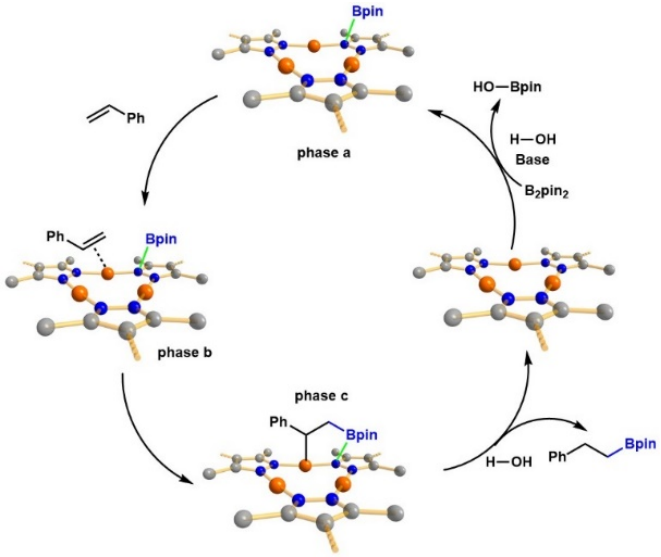


Fig. S28 Proposed reaction mechanisms for the hydroborylation of styrene in the presence of **JNM-5**.

24. The catalytic kinetics for the hydroboration reactions of allylbenzene

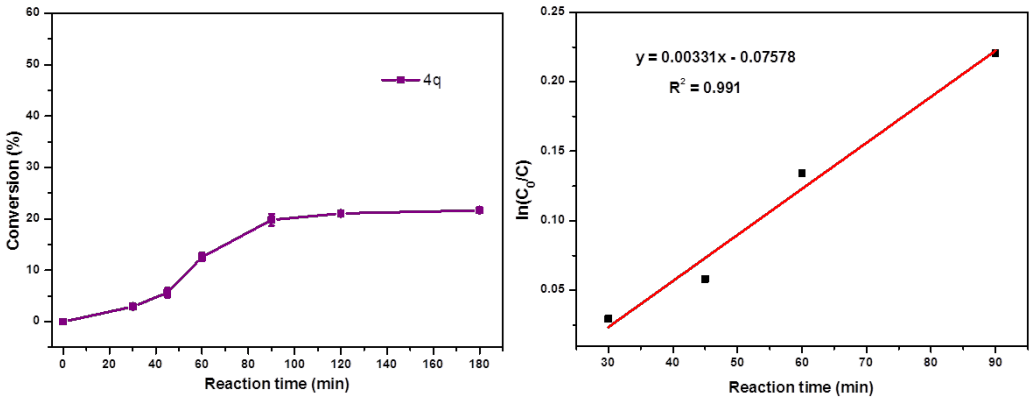


Fig. S29 The plots of conversion *versus* reaction time for **JNM-5.**

25. The competition experiment

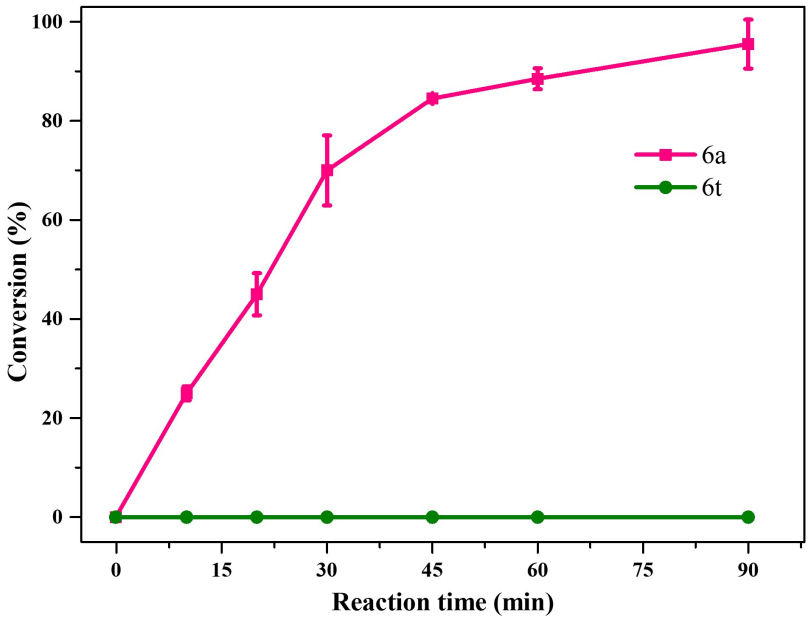


Fig. S30 The plots of conversion *versus* reaction time for **JNM-5.**

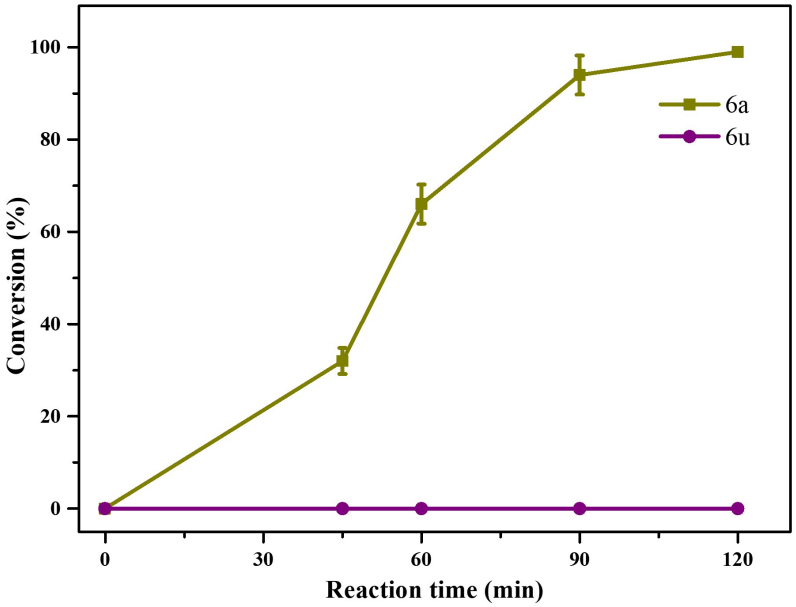


Fig. S31 The plots of conversion *versus* reaction time for **JNM-5.**

26. Comparison of yield and TOF for JNM-5 with existing catalysts

Table S5. Comparison of yield and TOF for **JNM-5** with existing catalysts for the hydroboration of styrene.

Catalyst	Condition	Yield	TOF / h^{-1}	Reference
$Cu(OH)_x$-Fe_3O_4	60 °C, Ar, 96 h	99%	0.41	3
Cu_2O	rt, air, 18 h	92%	0.51	4
$FeCl_2$	65 °C, air, 12 h	92%	7.6	5
CuCl	40 °C, air, 10 h	90%	0.9	6
$Cu(OTf)_2$	50 °C, air, 3 h	98%	6.5	7
Cu-PC-1	rt, 405 nm LED, Ar,	97%	5.5	8
$Ni(cod)_2$	75 °C, N_2, 10 h	91%	4.5	9
CoO/Pd- Fe_3O_4	60 °C, air, 12 h	67%	5.5	10
$(^{t\text{Bu}}PNN)CoCl_2$	rt, air, 3 h	77%	51.3	11
$(^{DIPP}CCC)CoN_2$	rt, air, 1 h	88%	35.3	12
MOF-P-Co	23 °C, air, 20 h	89%	3.2	13
AgOAc	120 °C, Ar, 12 h	83%	0.34	14
$AgSbF_6$	60 °C, air, 24 h	84%	2.3	15
$[Ir(cod)Cl]_2$	rt, air, 24 h	97%	1.3	16
$[Ru(p\text{-cymene})Cl_2]$	rt, air, 24 h	98%	81.6	17
$RuH_2(H_2)_2(PCy_3)_2$	rt, air, 3 h	87%	29	18
JNM-5	rt, N_2, 3 h	93%	394	**This work**

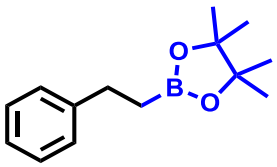
27. Comparison of substrate selectivity

Table S6. Comparison of selectivity for **JNM-5** with previous works for the hydroboration of styrene and allylbenzene.

Catalyst	Condition	Styrene (Yield)	Allylbenzene (Yield)	Reference
CuCl	40 °C, air, 10 h	90%	80%	6
Cu-PC-1	rt, 405 nm LED, Ar, 7 h	97%	71%	8
MOF-P-Co	23 °C, air, 20 h	89%	80%	13
Fe-DOPA-Cu	rt, air, 24 h	89%	80%	19
($^{i\text{Pr}}$PNN)$CoCl_2$	25 °C, air, 1 h	92%	86%	20
Cp_2TiCl_2	100 °C, air, 8 h	92%	84%	21
Mn complexe	60 °C, air, 24 h	99%	99%	22
CeOH-BTC	80 °C, air, 18 h	79%	90%	23
$Sc(OTf)_3$	100 °C, air, 24 h	70%	95%	24
JNM-5	rt, N_2, 3 h	93%	trace	**This work**

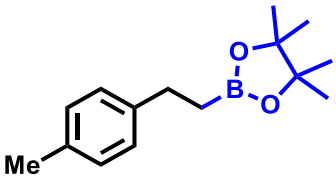
28. ^{1}H and ^{13}C NMR spectra for new compounds

4,4,5,5-tetramethyl-2-phenethyl-1,3,2-dioxaborolane (**6a**)



^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.20 (2H, t, *J* = 8.0 Hz), 1.27 (12H, s), 2.81 (2H, t, *J* = 8.0 Hz), 7.18-7.32 (5H, m); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 24.7, 29.9, 83.0, 125.4, 127.9, 128.1, 144.3.

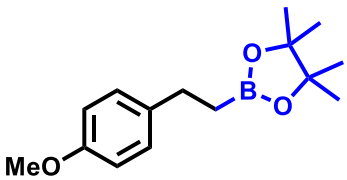
4,4,5,5-tetramethyl-2-(4-methylphenethyl)-1,3,2-dioxaborolane (**6b**)



According to the general procedure, a solution of **5b** (62.7 μL, 0.5 mmol), B_2pin_2 (254.2 mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100 : 1) to afford product **6b** (93.7 mg, 0.395 mmol) in 79% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.14 (2H, t, *J* = 8.0 Hz), 1.25 (12H, s), 2.32 (3H, s), 2.73 (2H, t, *J* = 8.0 Hz), 7.07-7.14 (4H, m); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 20.9, 24.8, 29.5, 83.0, 127.8, 128.8, 134.8, 144.3.

2-(4-methoxyphenethyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (**6c**)

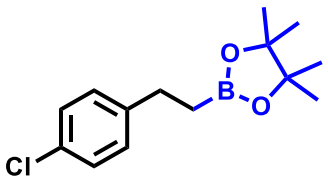


According to the general procedure, a solution of **5c** (67.5 μL, 0.5 mmol), B_2pin_2

(254.2 mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100 : 1) to afford product **6c** (61.6 mg, 0.235 mmol) in 51% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.11 (2H, t, *J* = 8.0 Hz), 1.22 (12H, s), 2.69 (2H, t, *J* = 8.0 Hz), 3.77 (3H, s), 6.81 (2H, d, *J* = 8.0 Hz), 7.13 (2H, d, *J* = 8.0 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 24.8, 29.0, 55.2, 83.0, 113.6, 128.8, 136.5, 157.5.

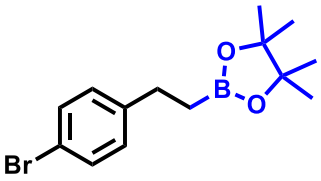
2-(4-chlorophenethyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (**6d**)



According to the general procedure, a solution of **5d** (60.0 μL, 0.5 mmol), B_2pin_2 (254.2 mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100 : 1) to afford product **6d** (119.8 mg, 0.450 mmol) in 92% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.11 (2H, t, *J* = 8.0 Hz), 1.21 (12H, s), 2.71 (2H, t, *J* = 8.0 Hz), 7.13 (2H, d, *J* = 8.0 Hz), 7.21 (2H, d, *J* = 8.0 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 24.7, 29.3, 55.2, 83.1, 128.2, 129.3, 133.1, 142.7.

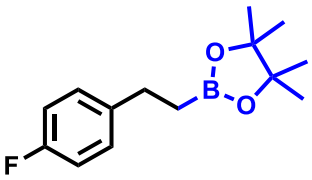
2-(4-bromophenethyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (**6e**)



According to the general procedure, a solution of **5e** (65.0 μL, 0.5 mmol), B_2pin_2 (254.2 mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100 : 1) to afford product **6e** (128.1 mg, 0.413 mmol) in 83% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.11 (2H, t, *J* = 8.0 Hz), 1.21 (12H, s), 2.69 (2H, t, *J* = 8.0 Hz), 7.08 (2H, d, *J* = 8.0 Hz), 7.36 (2H, d, *J* = 8.0 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 24.8, 29.4, 55.2, 83.2, 119.2, 129.8, 131.2, 143.3.

2-(4-fluorophenethyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (**6f**)

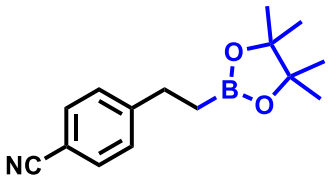


According to the general procedure, a solution of **5f** (59.8 μL, 0.5 mmol), B_2pin_2 (254.2 mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100 : 1) to afford product **6f** (112.6 mg, 0.450 mmol) in 90% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.11 (2H, t, *J* = 8.0 Hz), 1.20 (12H, s), 2.71 (2H, t, *J* = 8.0 Hz), 6.90-6.95 (2H, m), 7.14-717 (2H, m); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 24.7, 29.1, 83.1, 114.6, 114.7 (d, *J* = 21 Hz), 129.2 (d, *J* = 8 Hz), 139.9 (d, *J* = 3 Hz),

161.0 (d, J = 241 Hz).

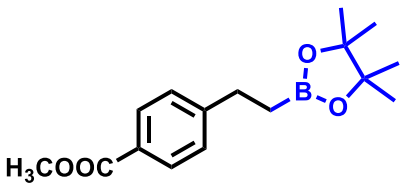
4-(2-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)ethyl)benzonitrile (**6g**)



According to the general procedure, a solution of **5g** (60.0 μL, 0.5 mmol), B_2pin_2 (254.2 mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 20 : 1) to afford product **6g** (119.2 mg, 0.464 mmol) in 93% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.13 (2H, t, J = 8.0 Hz), 1.20 (12H, s), 2.79 (2H, t, J = 8.0 Hz), 7.30 (2H, d, J = 8.0 Hz), 7.54 (2H, d, J = 8.0 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 24.8, 30.1, 83.3, 109.4, 119.2, 128.8, 132.0, 150.0.

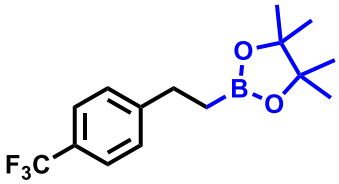
methyl 4-(2-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)ethyl)benzoate (**6h**)



According to the general procedure, a solution of **5h** (81.1 mg, 0.5 mmol), B_2pin_2 (254.2 mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 50 : 1) to afford product **6h** (118.9 mg, 0.410 mmol) in 81% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.15 (2H, t, *J* = 8.0 Hz), 1.21 (12H, s), 2.80 (2H, t, *J* = 8.0 Hz), 3.89 (3H, s), 7.27 (2H, d, *J* = 8.0 Hz), 7.93 (2H, d, *J* = 8.0 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 24.8, 30.0, 51.9, 83.2, 127.5, 128.1, 129.6, 159.0, 167.3.

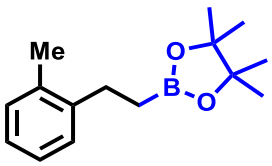
4,4,5,5-tetramethyl-2-(4-(trifluoromethyl)phenethyl)-1,3,2-dioxaborolane (**6i**)



According to the general procedure, a solution of **5i** (75 μL, 0.5 mmol), B_2pin_2 (254.2 mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100 : 1) to afford product **6i** (139.5 mg, 0.465 mmol) in 93% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.15 (2H, t, *J* = 8.0 Hz), 1.22 (12H, s), 2.80 (2H, t, *J* = 8.0 Hz), 7.32 (2H, d, *J* = 8.0 Hz), 7.51 (2H, d, *J* = 8.0 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 12.7, 24.8, 29.8, 83.2, 125.1 (q, *J* = 4 Hz), 128.3, 148.5.

4,4,5,5-tetramethyl-2-(2-methylphenethyl)-1,3,2-dioxaborolane (**6j**)

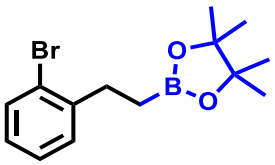


According to the general procedure, a solution of **5j** (63.0 μL, 0.5 mmol), B_2pin_2 (254.2 mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether :

ethyl acetate = 30 : 1) to afford product **6j** (108.2 mg, 0.439 mmol) in 88% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.16 (2H, t, *J* = 8.0 Hz), 1.28 (12H, s), 2.37 (3H, s), 2.77 (2H, t, *J* = 8.0 Hz), 7.12-7.25 (4H, m); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 19.2, 24.8, 27.1, 83.0, 125.6, 125.8, 128.0, 129.9, 135.7, 142.4.

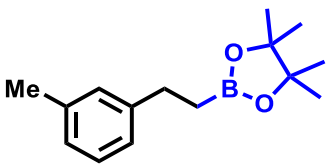
2-(2-bromophenethyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (**6k**)



According to the general procedure, a solution of **5k** (64.5 μL, 0.5 mmol), B_2pin_2 (254.2 mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100 : 1) to afford product **6k** (129.5 mg, 0.417 mmol) in 84% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.17 (2H, t, *J* = 8.0 Hz), 1.26 (12H, s), 2.87 (2H, t, *J* = 8.0 Hz), 7.03-7.06 (1H, m), 7.21-7.25 (1H, m), 7.29-7.31 (1H, m), 7.51-7.53 (1H, m); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 24.8, 30.4, 83.1, 124.3, 127.2, 127.3, 129.7, 132.6, 143.5.

4,4,5,5-tetramethyl-2-(3-methylphenethyl)-1,3,2-dioxaborolane (**6l**)

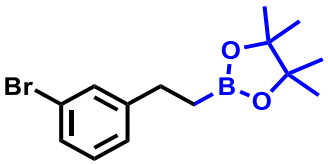


According to the general procedure, a solution of **5l** (65.0 μL, 0.5 mmol), B_2pin_2 (254.2 mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under

N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100 : 1) to afford product **6l** (99.6 mg, 0.405 mmol) in 81% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.14 (2H, t, *J* = 8.0 Hz), 1.23 (12H, s), 2.33 (3H, s), 2.72 (2H, t, *J* = 8.0 Hz), 6.97-7.05 (3H, m), 7.16 (1H, t, *J* = 8.0 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 21.4, 24.8, 29.8, 83.0, 125.0, 126.2, 128.1, 128.8, 137.6, 144.4.

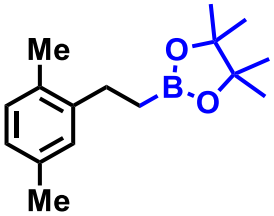
2-(3-bromophenethyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (**6m**)



According to the general procedure, a solution of **5m** (67.0 μL, 0.5 mmol), B_2pin_2 (254.2 mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100 : 1) to afford product **6m** (125.1 mg, 0.403 mmol) in 81% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.14 (2H, t, *J* = 8.0 Hz), 1.24 (12H, s), 2.74 (2H, t, *J* = 8.0 Hz), 7.11-7.16 (2H, m), 7.29-7.32 (1H, m), 7.40 (1H, s); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 24.8, 29.6, 83.2, 122.2, 126.7, 128.6, 129.7, 131.2, 146.7.

2-(2,5-dimethylphenethyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (**6n**)

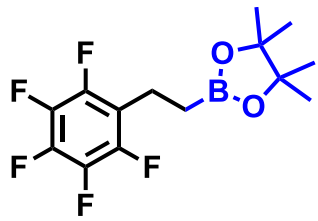


According to the general procedure, a solution of **5n** (73 μL, 0.5 mmol), B_2pin_2 (254.2

mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100 : 1) to afford product **6n** (110.5 mg, 0.425 mmol) in 85% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.10 (2H, t, *J* = 8.0 Hz), 1.25 (12H, s), 2.28 (3H, s), 2.30 (3H, s), 2.70 (2H, t, *J* = 8.0 Hz), 6.90 (2H, d, *J* = 4.8 Hz), 7.02 (2H, d, *J* = 4.8 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 18.7, 21.0, 24.8, 27.2, 83.0, 126.2, 128.9, 129.8, 132.5, 135.1, 142.3.

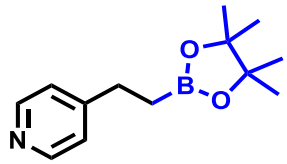
4,4,5,5-tetramethyl-2-(2-(perfluorophenyl)ethyl)-1,3,2-dioxaborolane (**6o**)



According to the general procedure, a solution of **5o** (68 μL, 0.5 mmol), B_2pin_2 (254.2 mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100 : 1) to afford product **6o** (146.5 mg, 0.455 mmol) in 91% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.09 (2H, t, *J* = 8.0 Hz), 1.23 (12H, s), 2.78 (2H, t, *J* = 8.0 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 16.9, 24.8, 83.4.

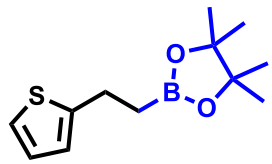
4-(2-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)ethyl)pyridine (**6p**)



According to the general procedure, a solution of **5p** (53.0 μL, 0.5 mmol), B_2pin_2 (254.2 mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 1 : 1) to afford product **6p** (92.1 mg, 0.395 mmol) in 79% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.13 (2H, t, *J* = 8.0 Hz), 1.20 (12H, s), 2.73 (2H, t, *J* = 8.0 Hz), 7.13 (2H, d, *J* = 4.8 Hz), 8.46 (2H, d, *J* = 4.8 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 24.7, 29.2, 83.2, 123.6, 148.9, 153.6.

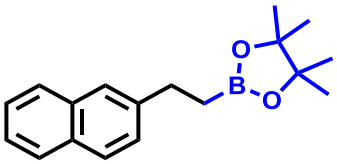
4,4,5,5-tetramethyl-2-(2-(thiophen-2-yl)ethyl)-1,3,2-dioxaborolane (**6q**)



According to the general procedure, a solution of **5q** (52.0 μL, 0.5 mmol), B_2pin_2 (254.2 mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100 : 1) to afford product **6q** (111.6 mg, 0.468 mmol) in 90% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.20-1.23 (15H, m), 2.96 (2H, t, *J* = 8.0 Hz), 6.80-6.81 (1H, m), 6.88-6.89 (1H, m), 7.07-7.08 (1H, m); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 24.3, 24.8, 83.2, 122.6, 123.4, 126.5, 147.7.

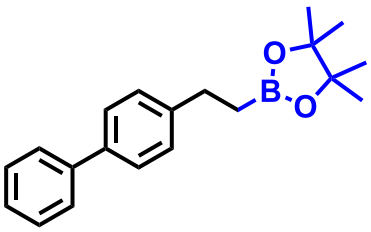
4,4,5,5-tetramethyl-2-(2-(naphthalen-2-yl)ethyl)-1,3,2-dioxaborolane (**6r**)



According to the general procedure, a solution of **5r** (77.1 mg, 0.5 mmol), B_2pin_2 (254.2 mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 20 : 1) to afford product **6r** (132.8 mg, 0.471 mmol) in 94% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.22 (12H, s), 1.26 (2H, t, *J* = 8.0 Hz), 2.92 (2H, t, *J* = 8.0 Hz), 7.36-7.45 (3H, m), 7.65 (1H, s), 7.74-7.80 (3H, m); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 24.8, 30.1, 83.1, 124.9, 125.6, 125.7, 127.3, 127.4, 127.5, 127.7, 131.9, 133.6, 142.0.

2-(2-([1,1'-biphenyl]-4-yl)ethyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (**6s**)

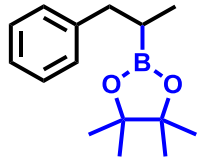


According to the general procedure, a solution of **5s** (90.1 mg, 0.5 mmol), B_2pin_2 (254.2 mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100 : 1) to afford product **6s** (146.3 mg, 0.475 mmol) in 95% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.21 (2H, t, *J* = 8.0 Hz), 1.26 (12H, s), 2.82 (2H, t, *J* = 8.0 Hz), 7.31-7.36 (3H, m), 7.44 (2H, t, *J* = 8.0 Hz), 7.51 (2H, d, *J* = 8.0 Hz),

7.59-7.62 (2H, m); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 24.8, 29.6, 83.1, 126.9, 126.9, 127.0, 128.4, 128.6, 138.4, 141.2, 143.5.

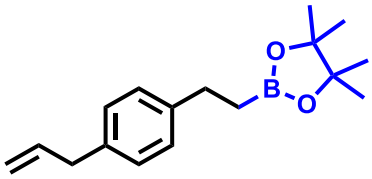
4,4,5,5-tetramethyl-2-(1-phenylpropan-2-yl)-1,3,2-dioxaborolane (**6t**)



According to the general procedure, a solution of **5t** (66 μL, 0.5 mmol), B_2pin_2 (254.2 mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100 : 1) to afford product **6t** (25.8 mg, 0.105 mmol) in 21% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.02 (3H, t, *J* = 8.0 Hz), 1.24 (12H, d, *J* = 8.0 Hz), 1.43 (1H, t, *J* = 8.0 Hz), 2.56-2.63 (1H, m), 2.82-2.89 (1H, m), 7.18-7.32 (5H, m); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 15.1, 24.6, 82.9, 125.5, 127.9, 128.8, 142.2.

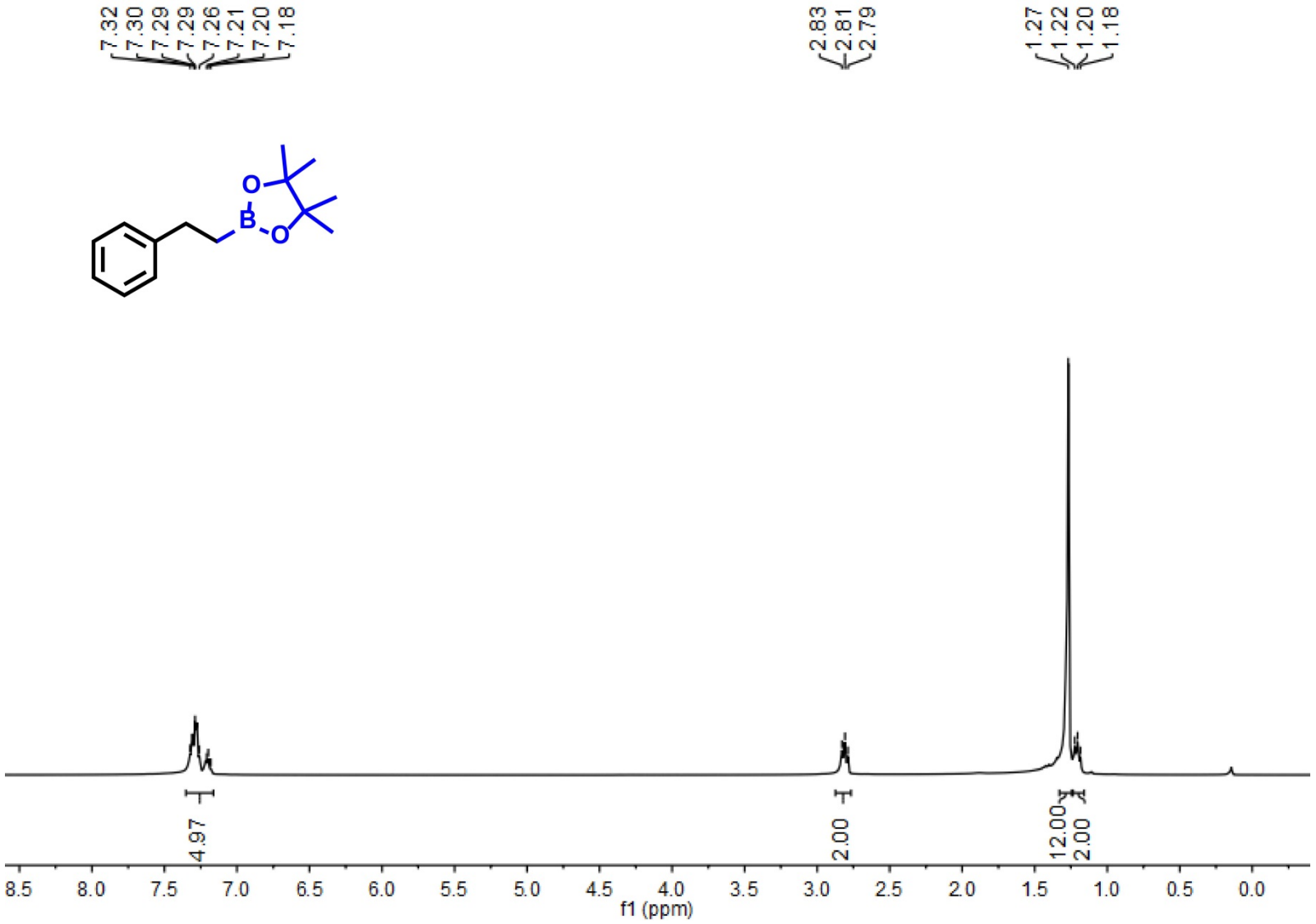
2-(4-allylphenethyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (**6v**)



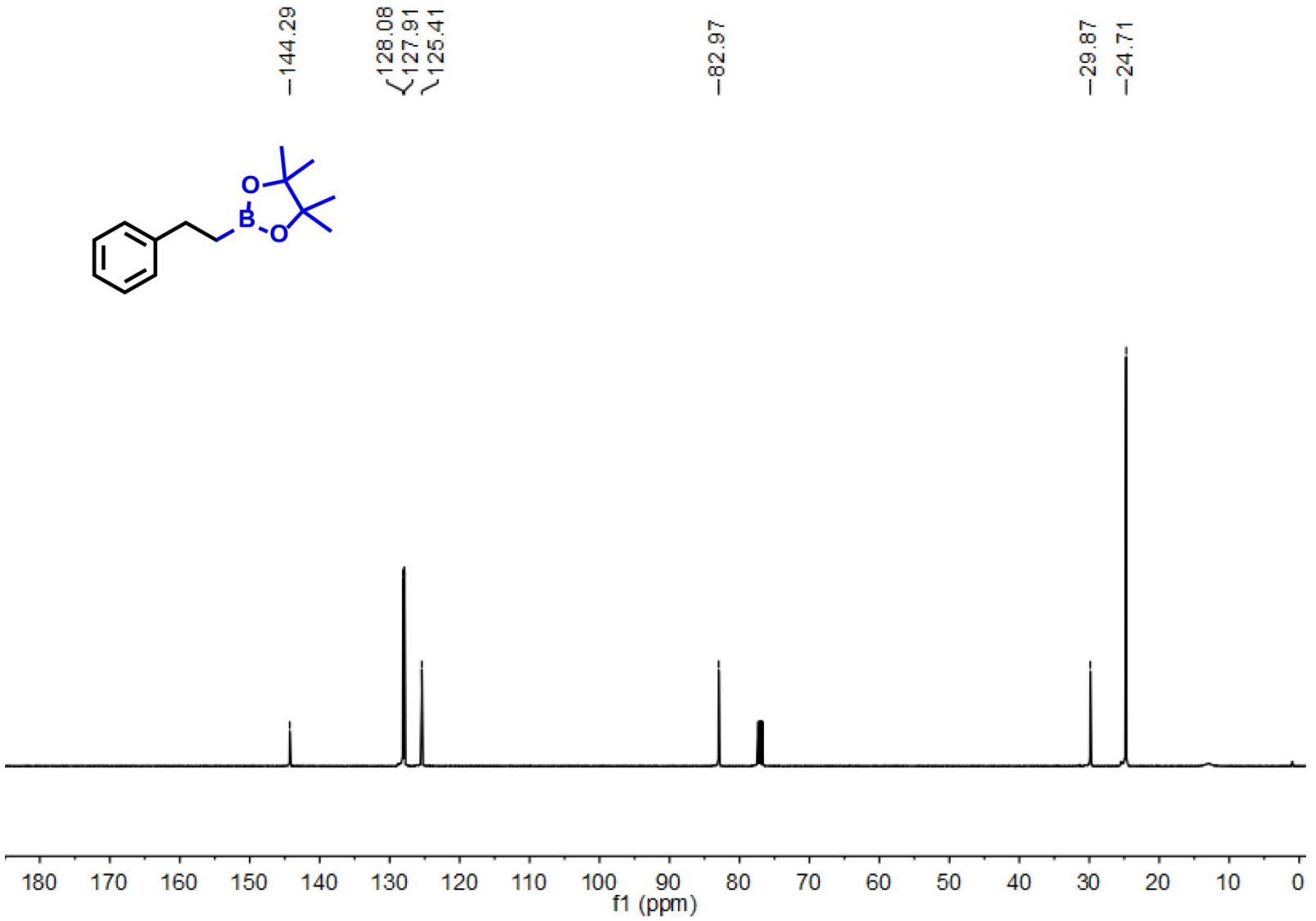
According to the general procedure, a solution of **5v**[5] (90.5 mg, 0.5 mmol), B_2pin_2 (254.2 mg, 1.0 mmol), Cs_2CO_3 (325.8 mg, 1.0 mmol), JNM-5 (6.4 mg, 0.0075 mmol) in CH_3CN (4 mL) were added into a 10 mL Purex tube. The mixture was stirred under N_2 atmosphere for 3 h at room temperature. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100 : 1) to afford product **6v** (247 mg, 0.455 mmol) in 91% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 1.12 (2H, t, *J* = 8.0 Hz), 1.22 (12H, s), 2.71 (2H, t, *J* = 8.0 Hz), 3.34 (2H, d, *J* = 8 Hz), 5.02-5.08 (2H, m), 5.90-6.01 (1H, m), 7.11 (4H, dd, *J* = 8 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 24.8, 29.5, 39.8, 83.1, 115.5, 128.0, 128.4, 137,1, 137.8, 142.2.

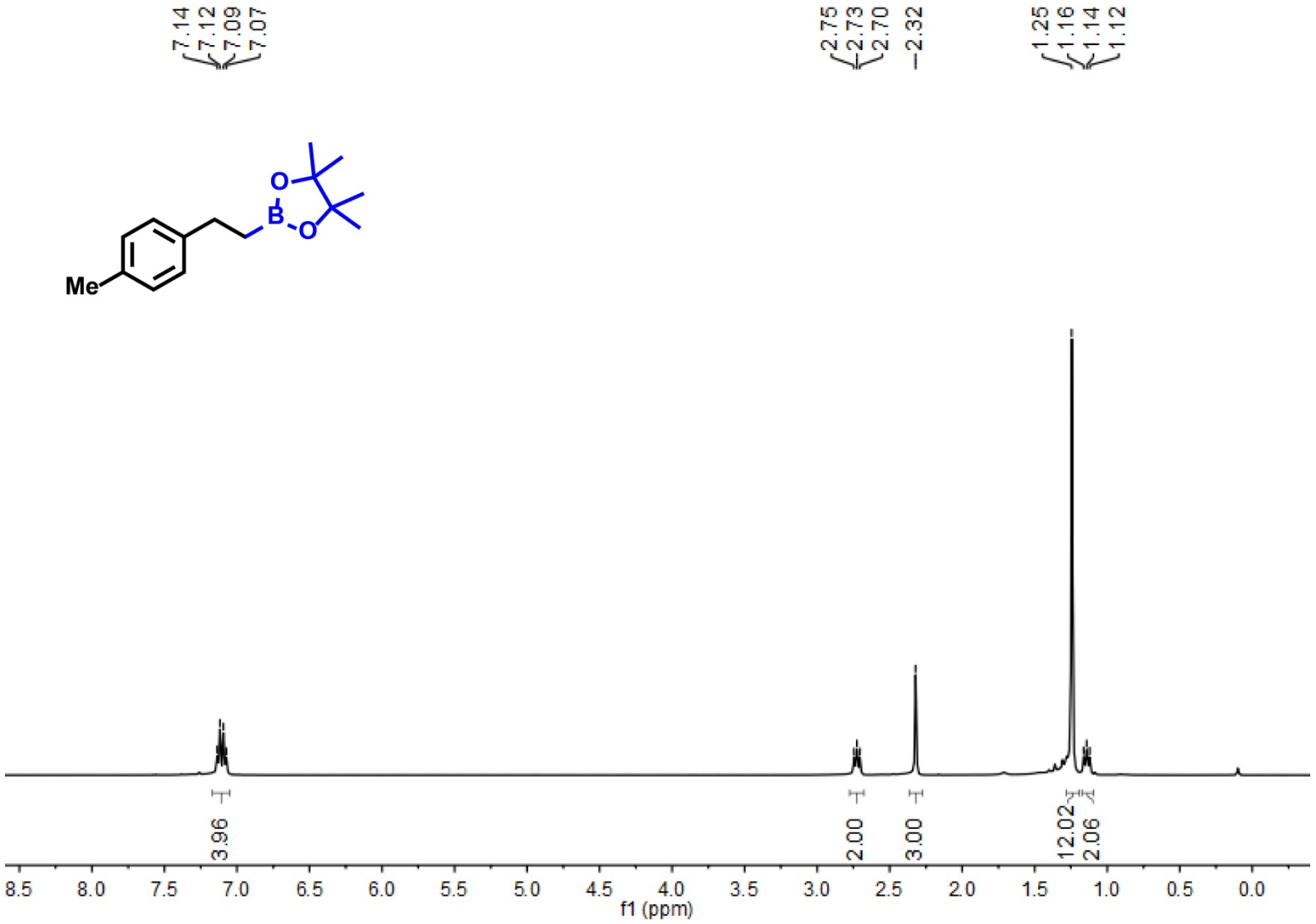
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6a**



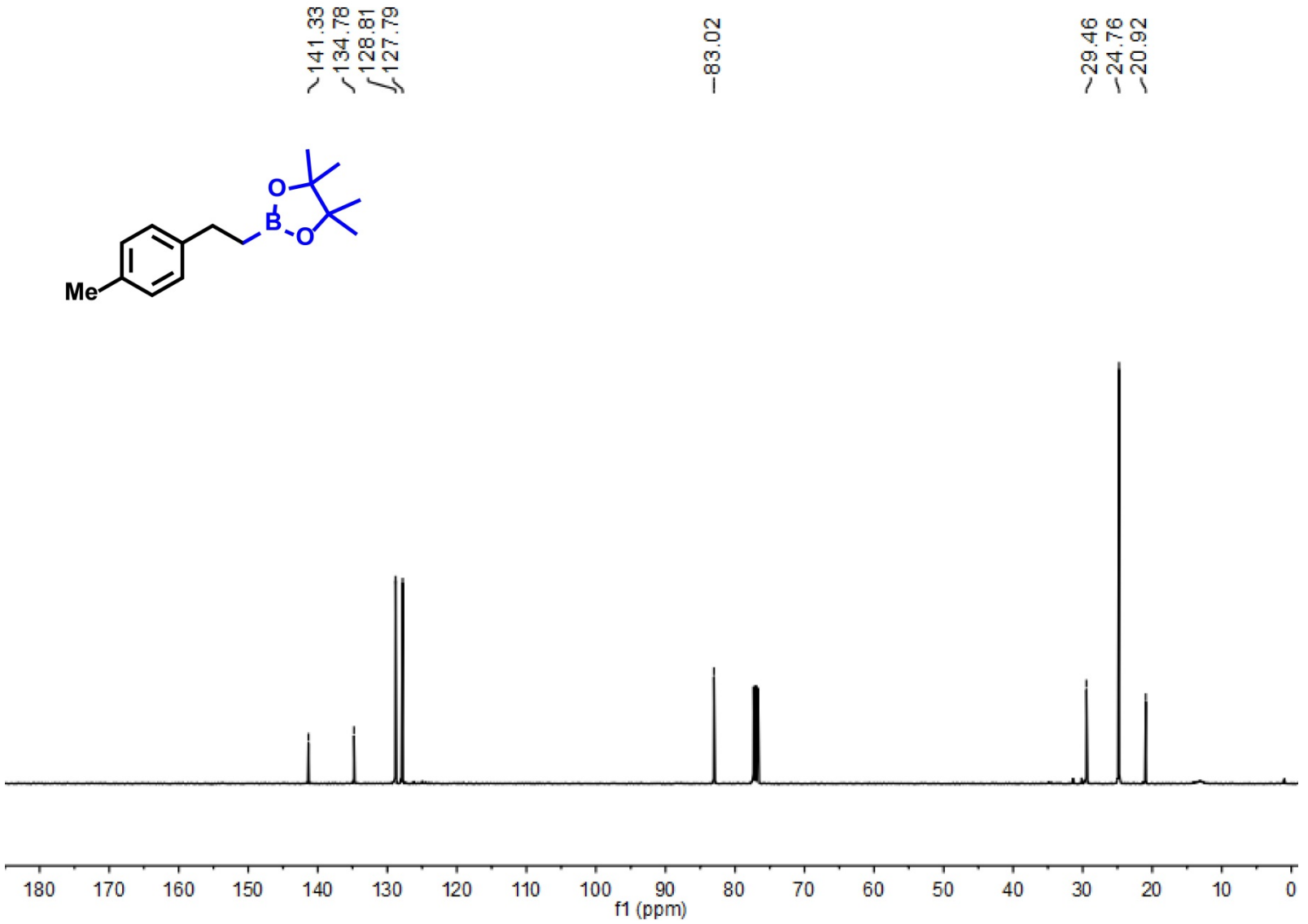
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6a**



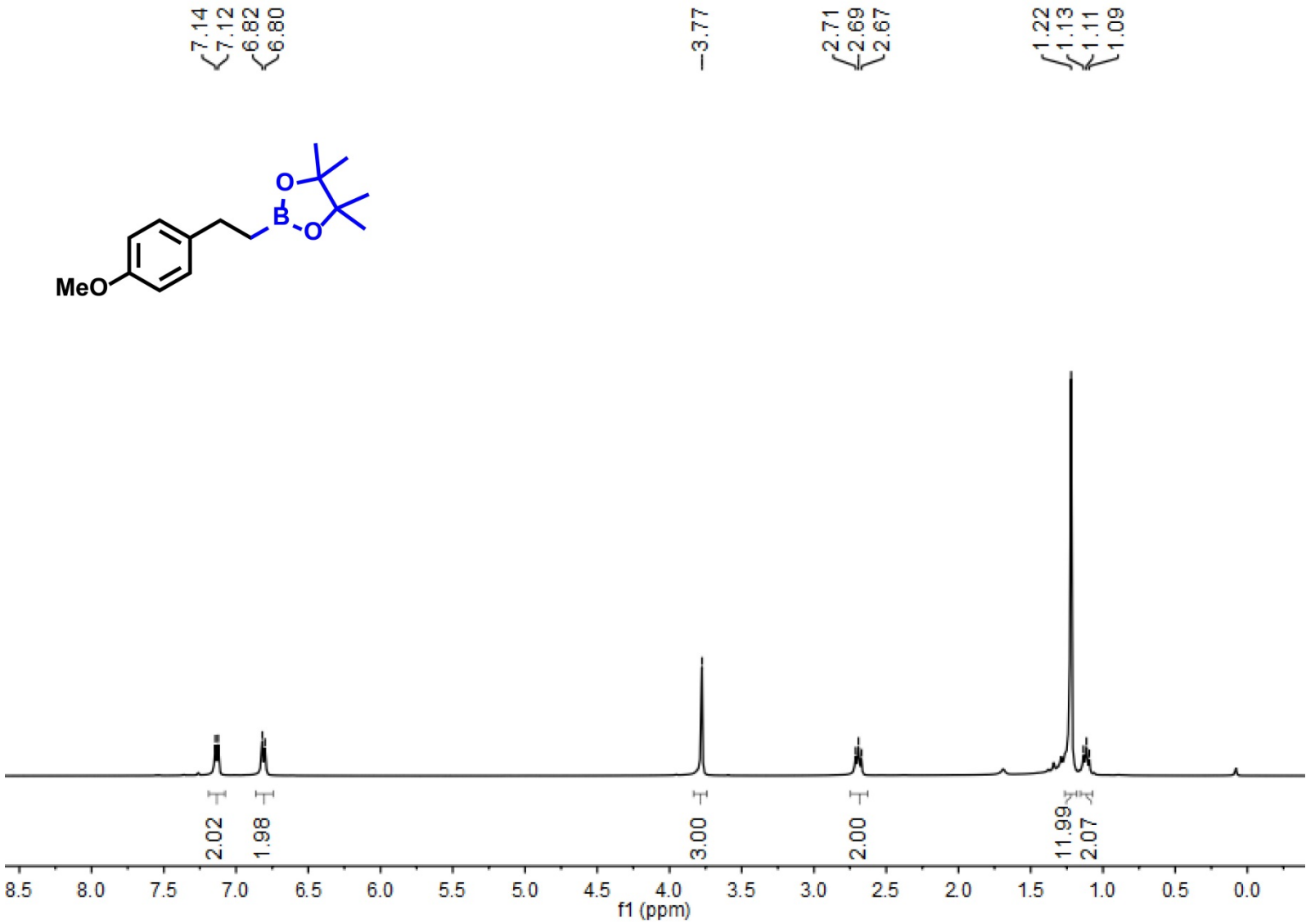
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6b**



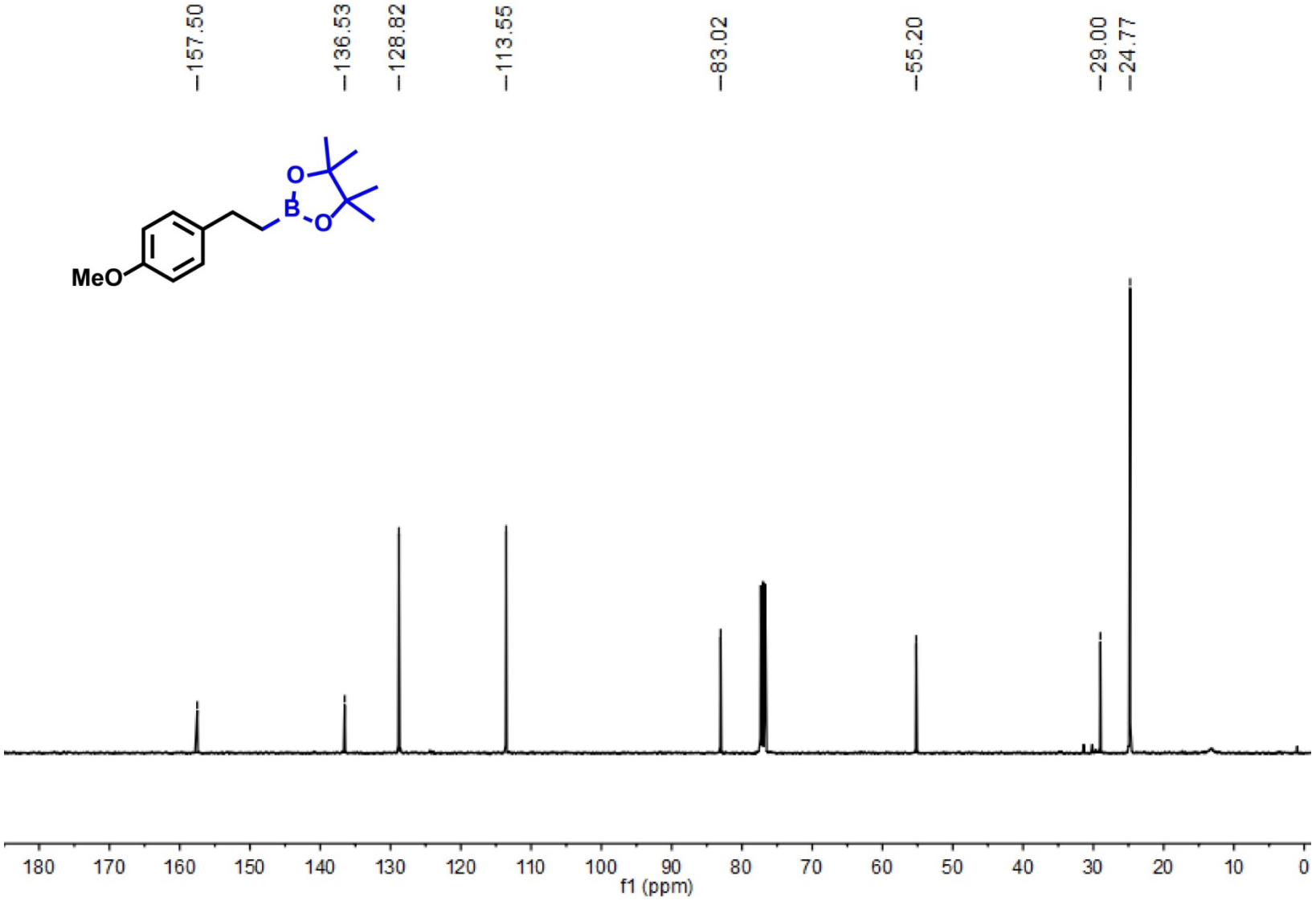
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6b**



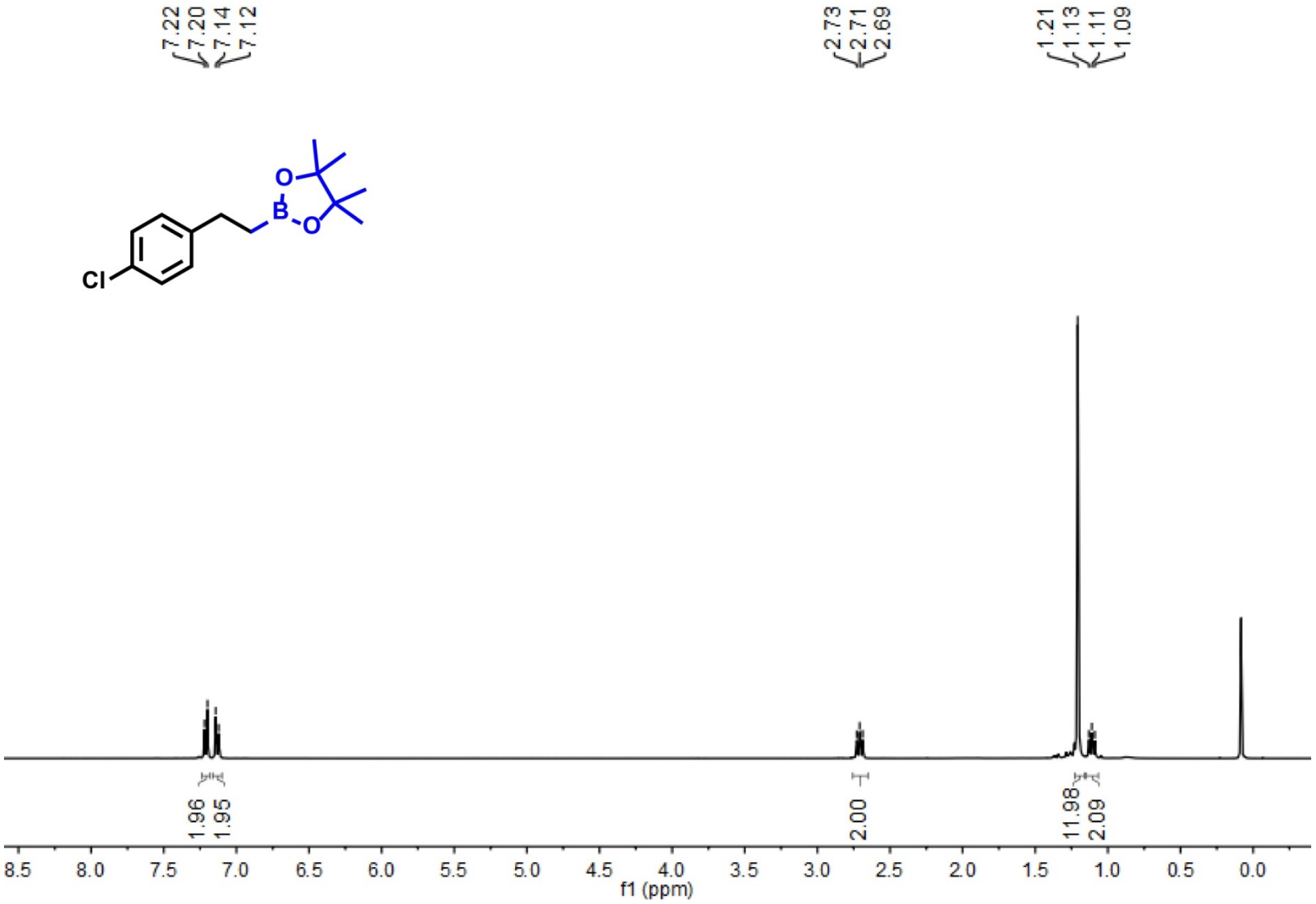
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6c**



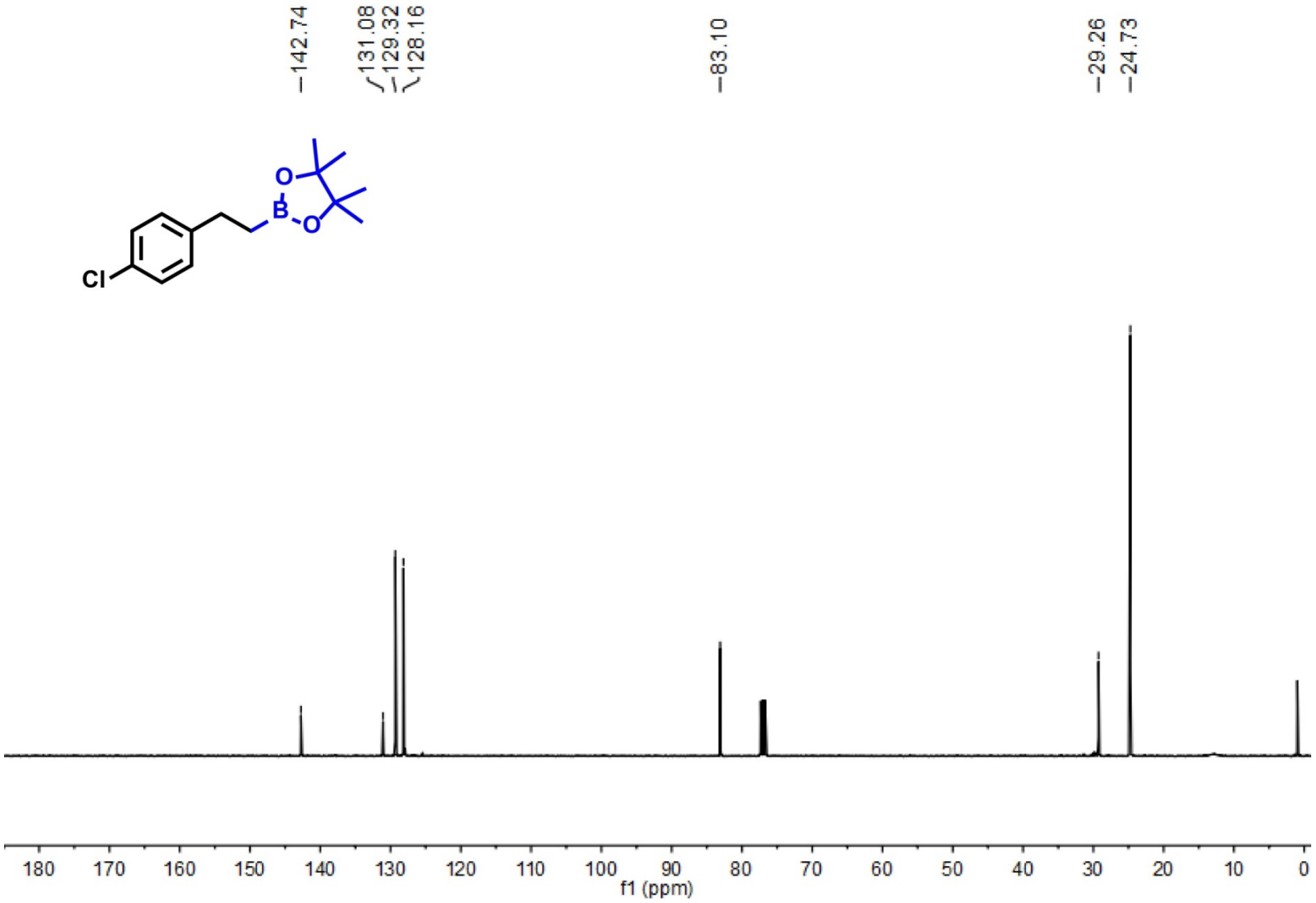
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6c**



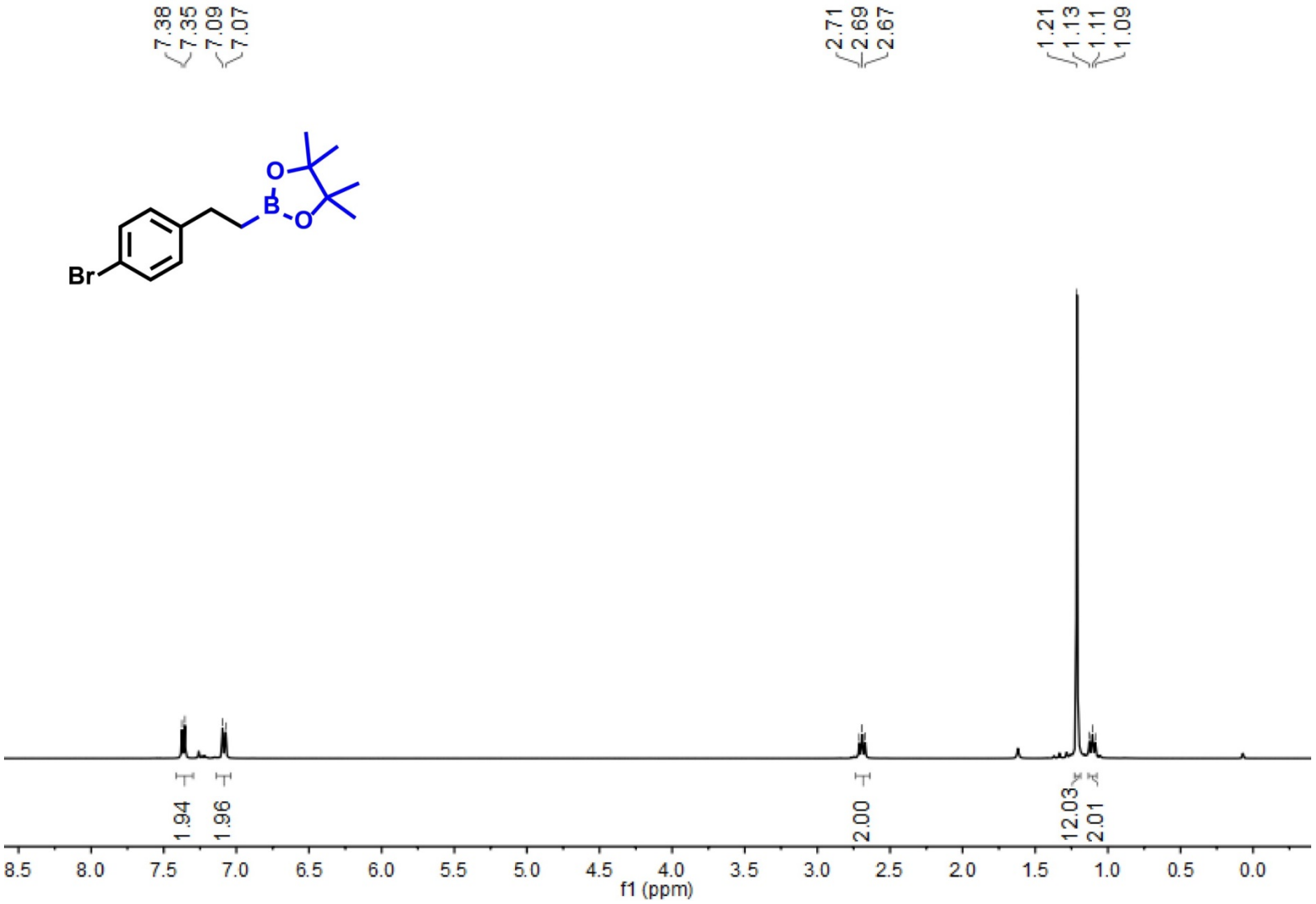
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6d**



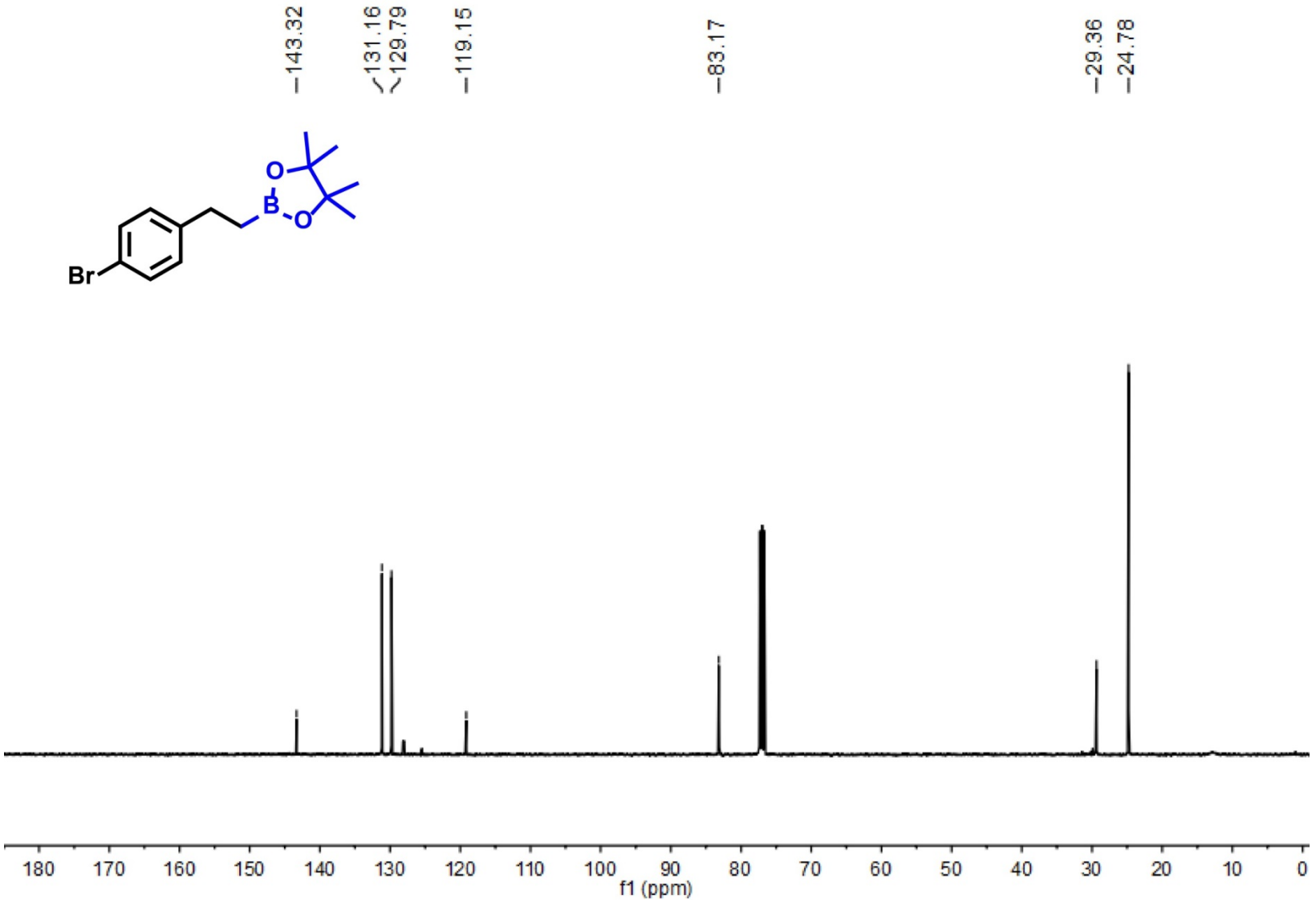
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6d**



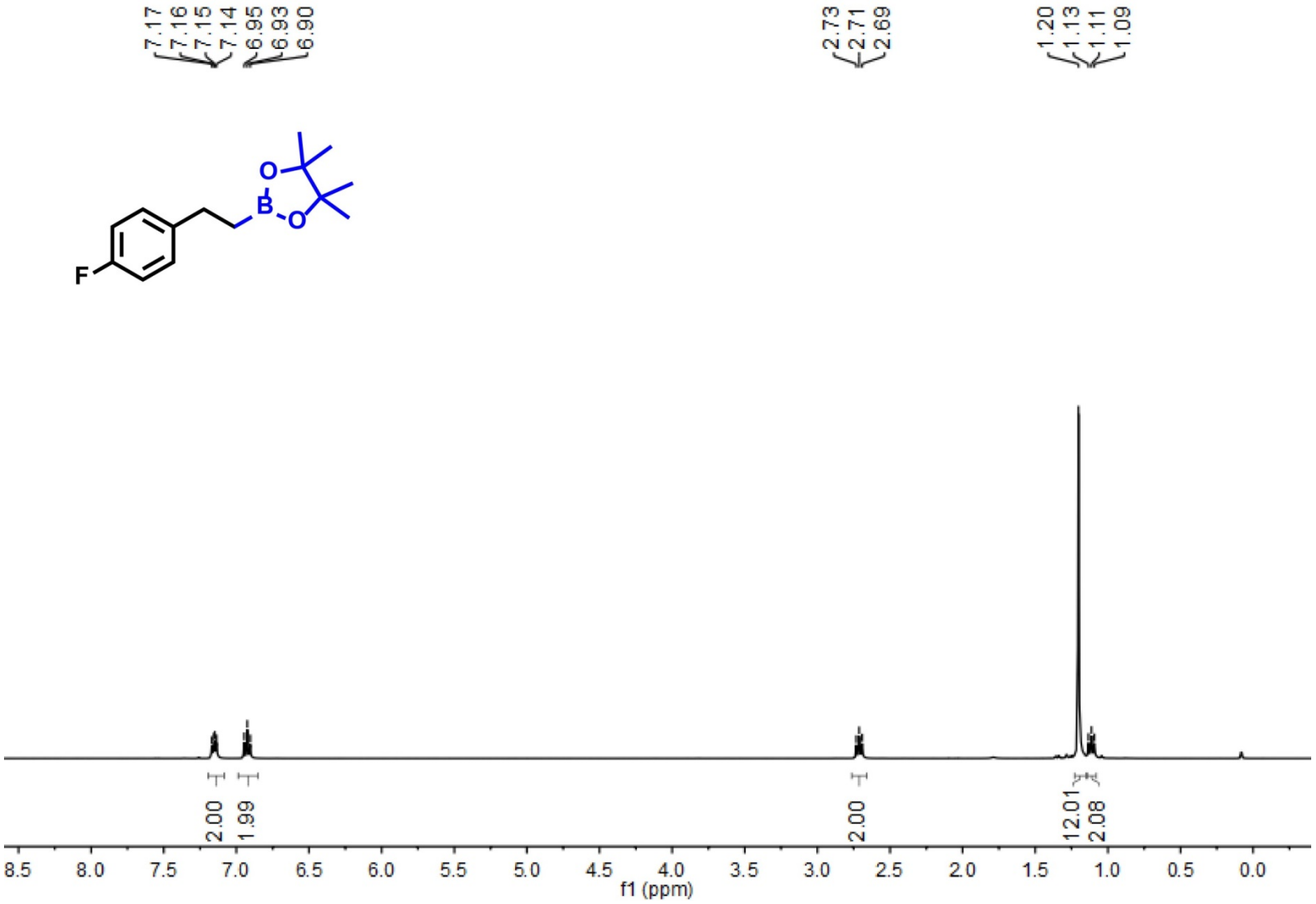
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6e**



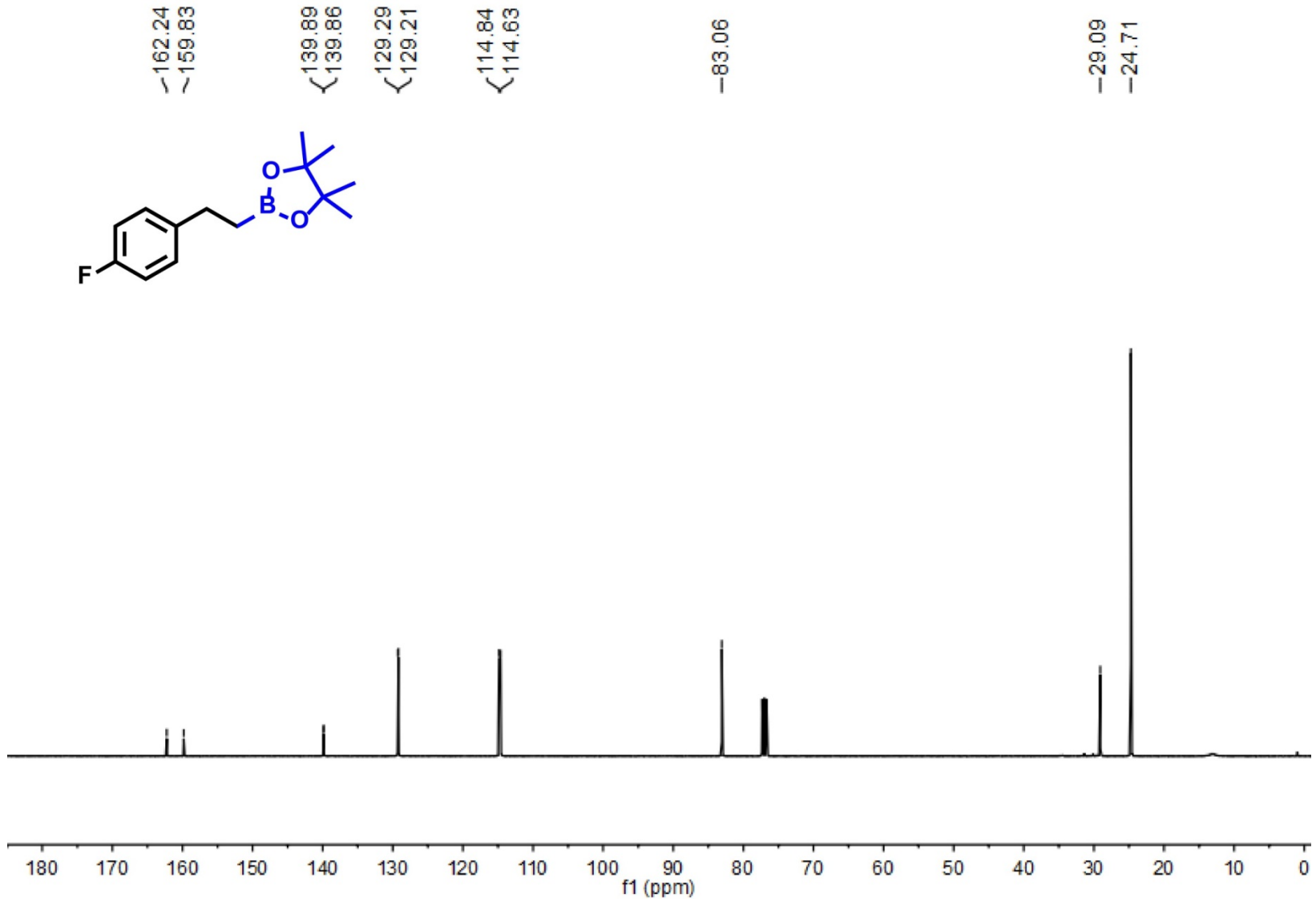
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6e**



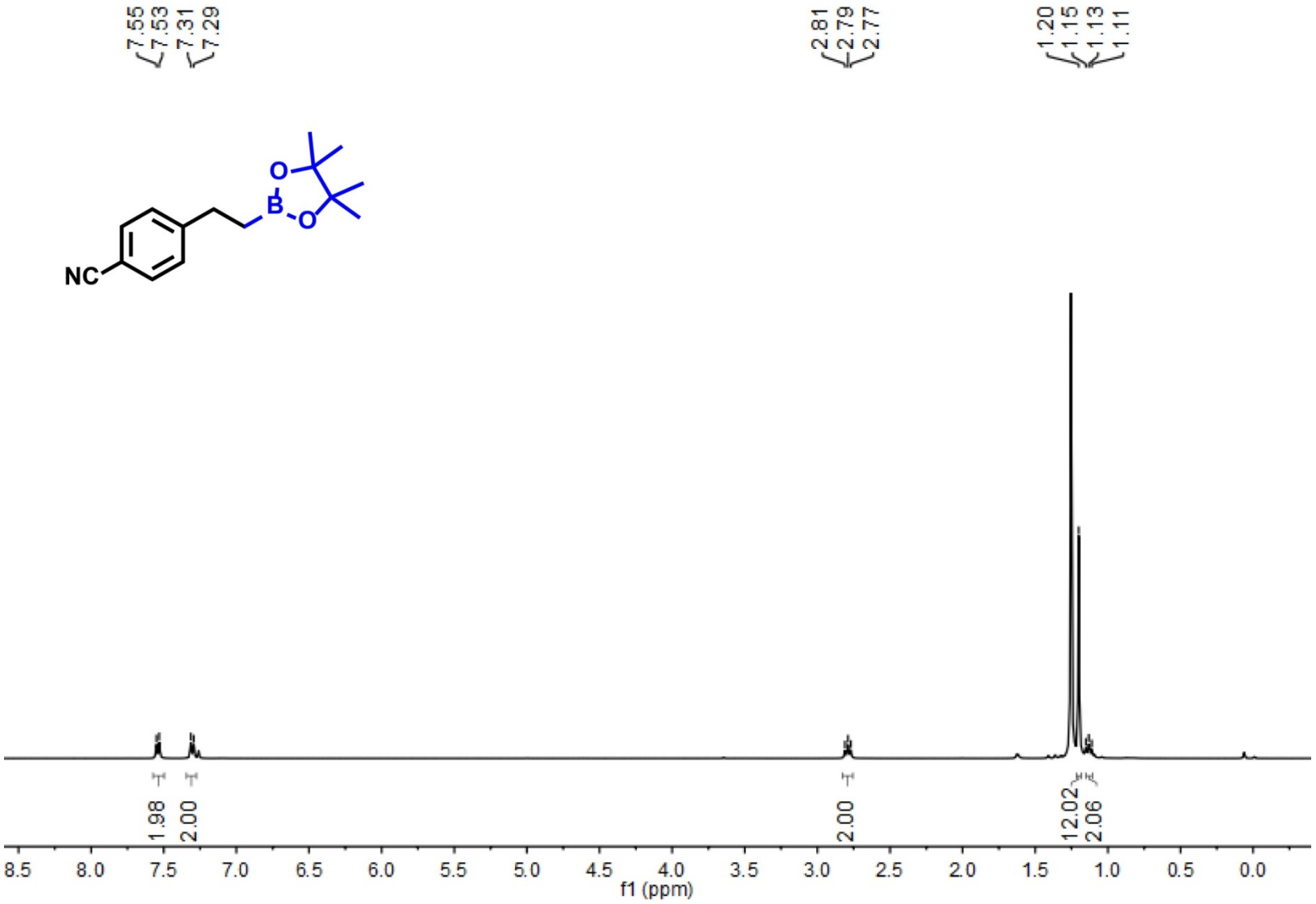
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6f**



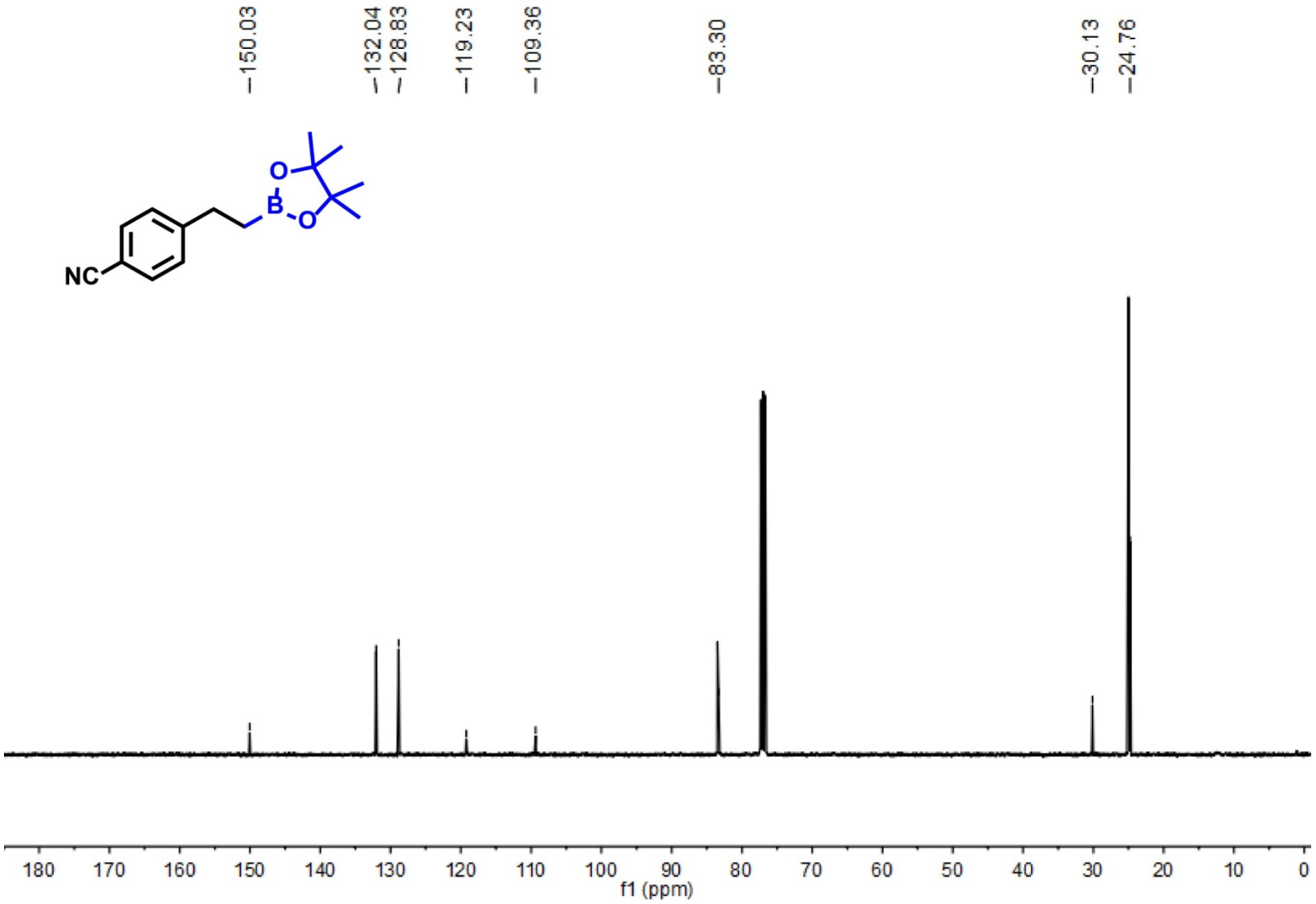
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6f**



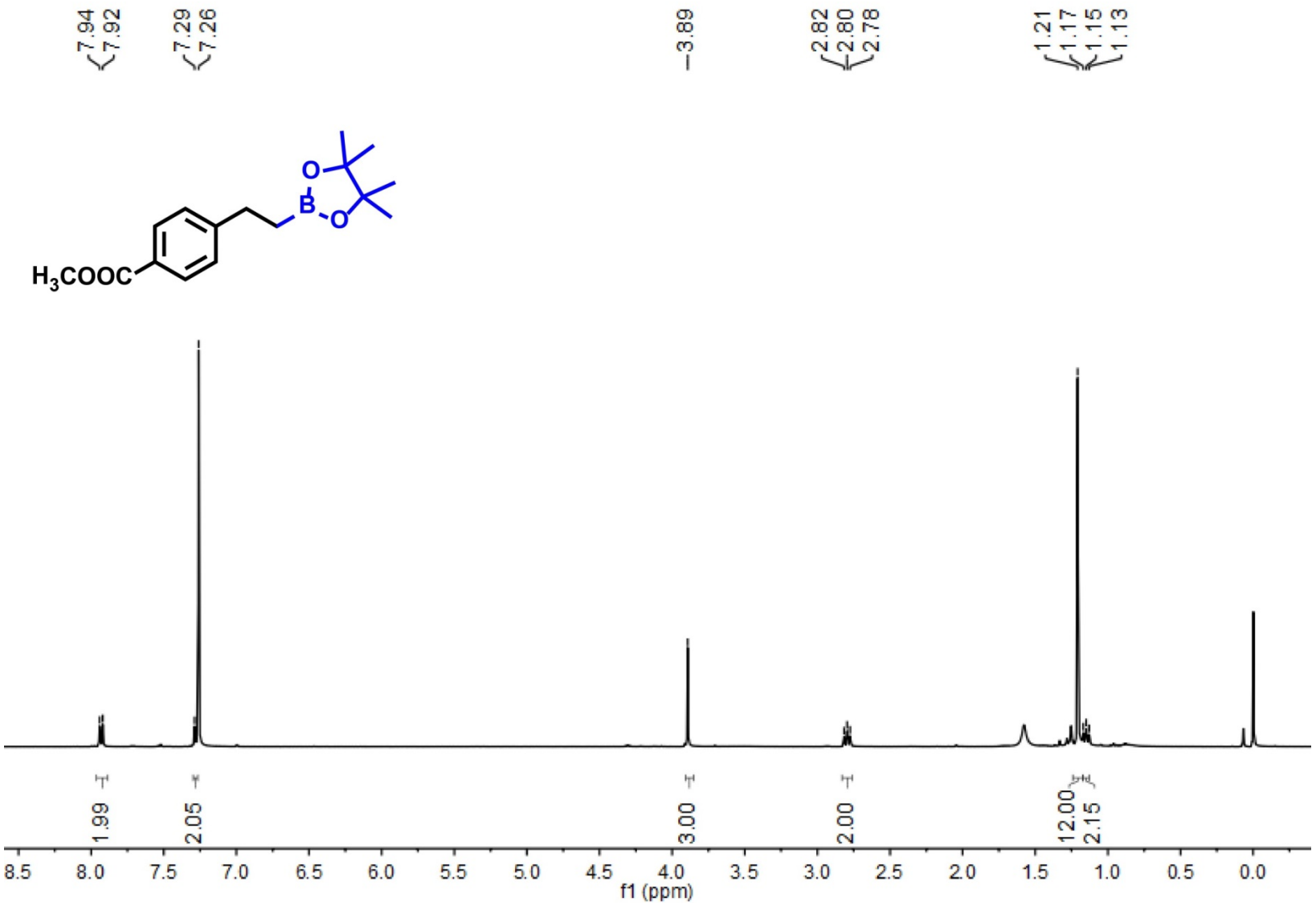
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6g**



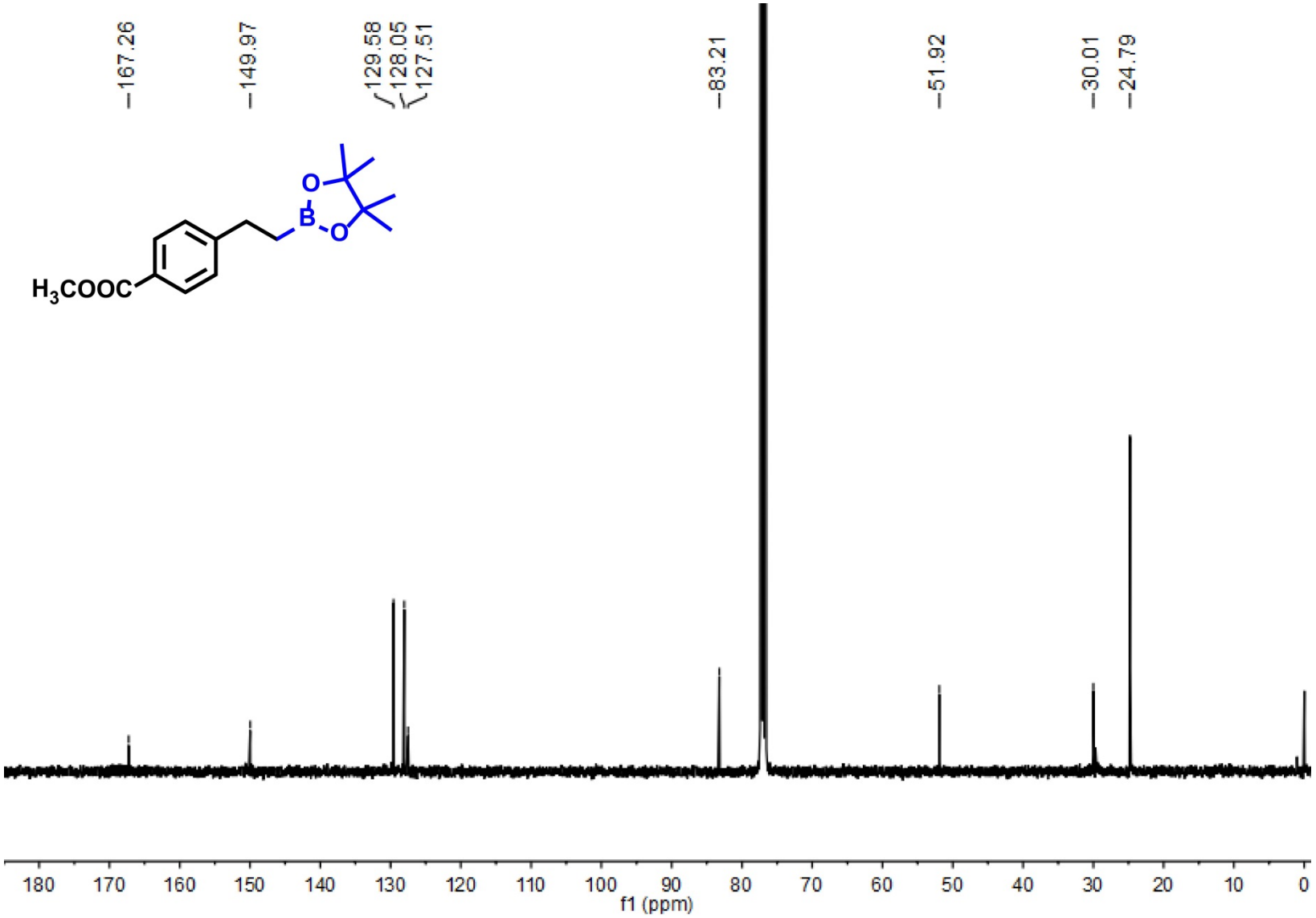
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6g**



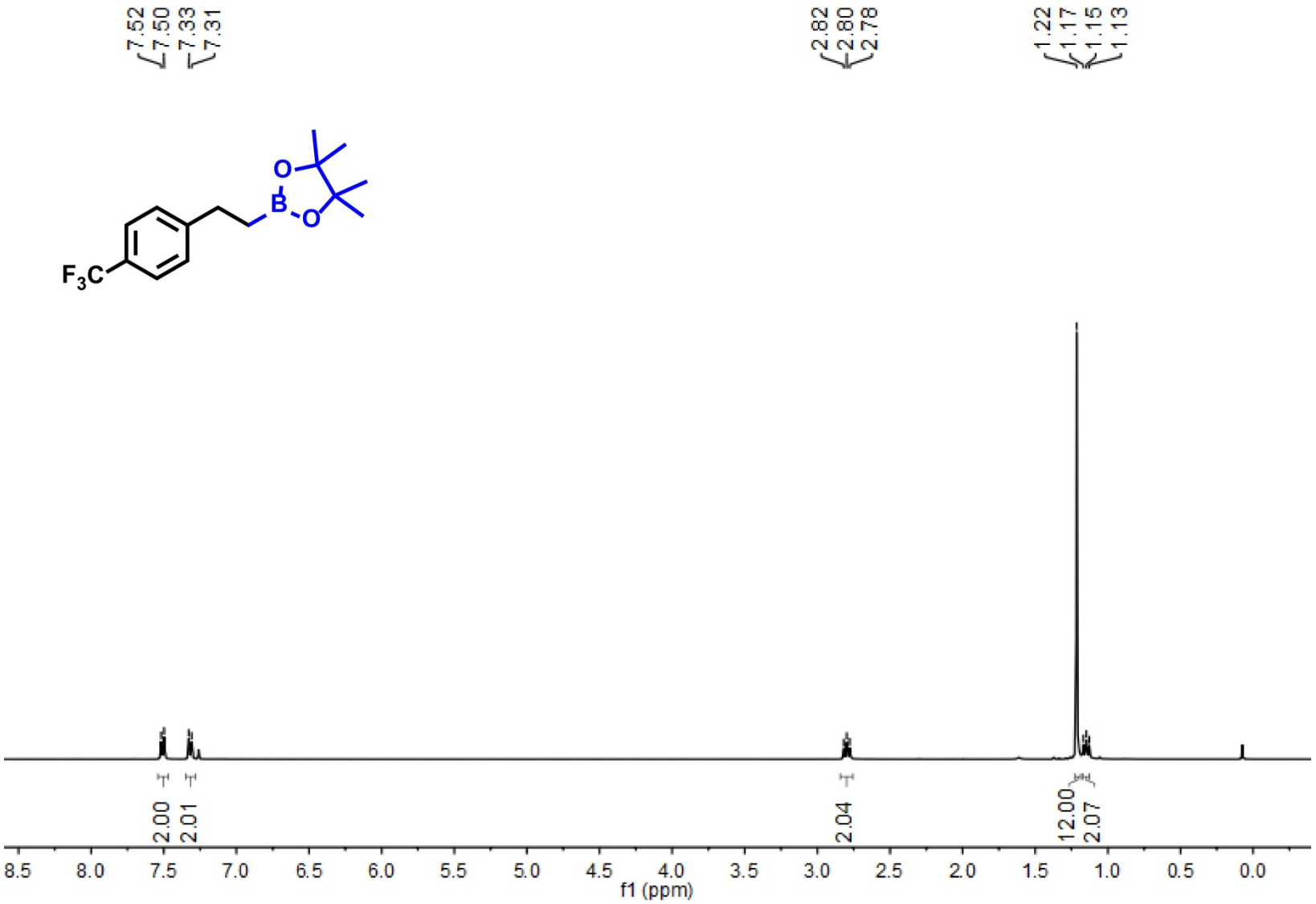
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6h**



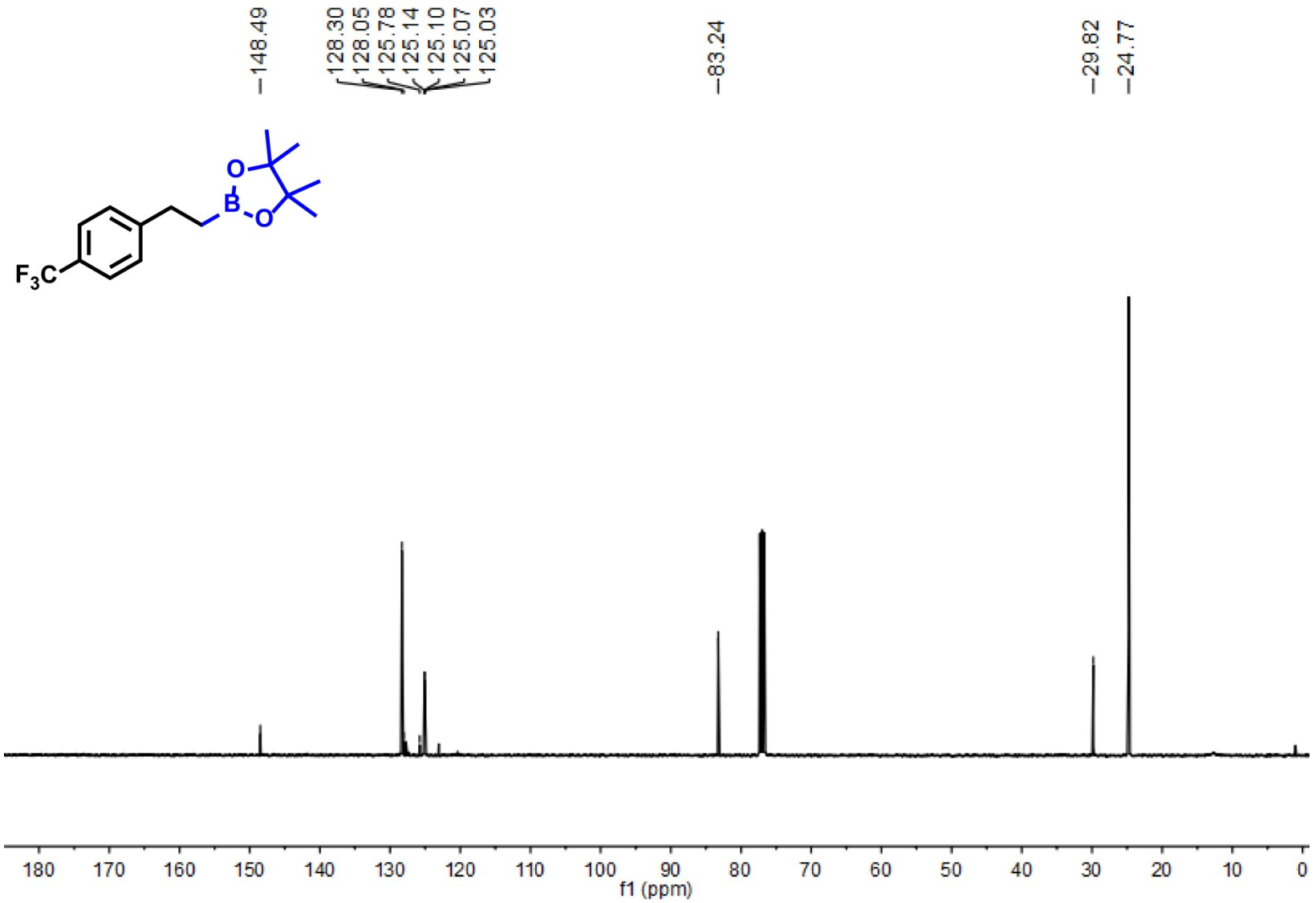
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6h**



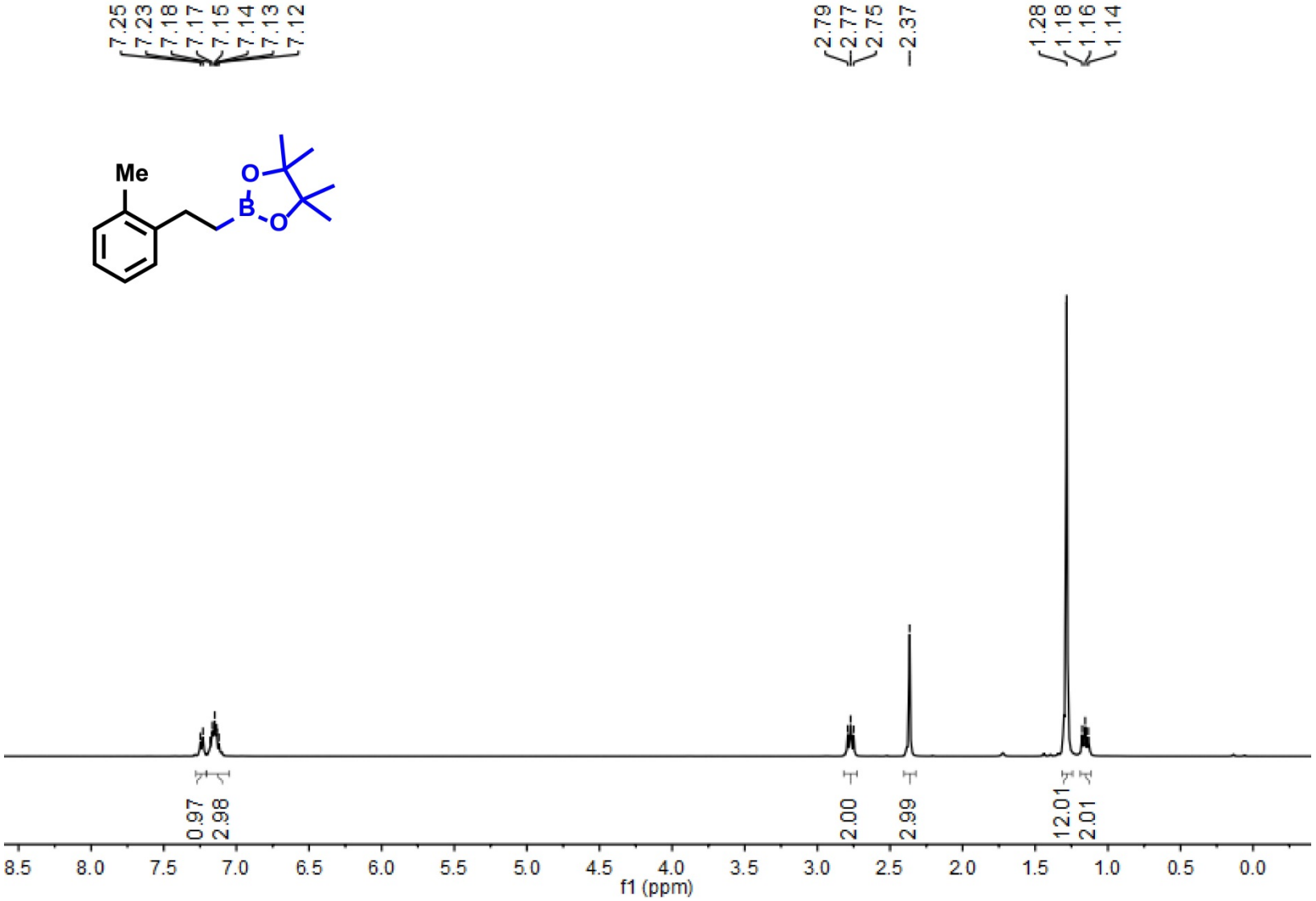
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6i**



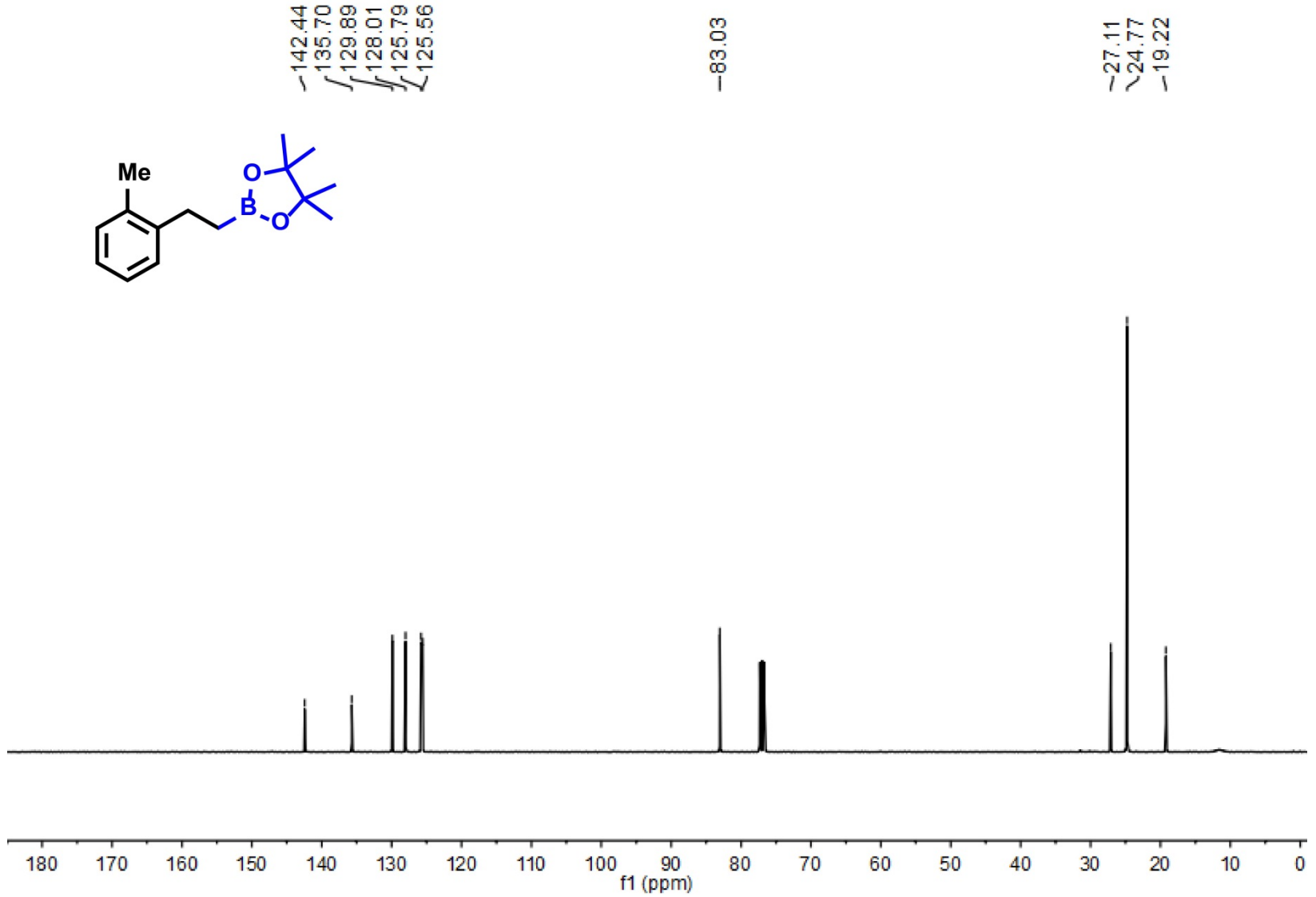
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6i**



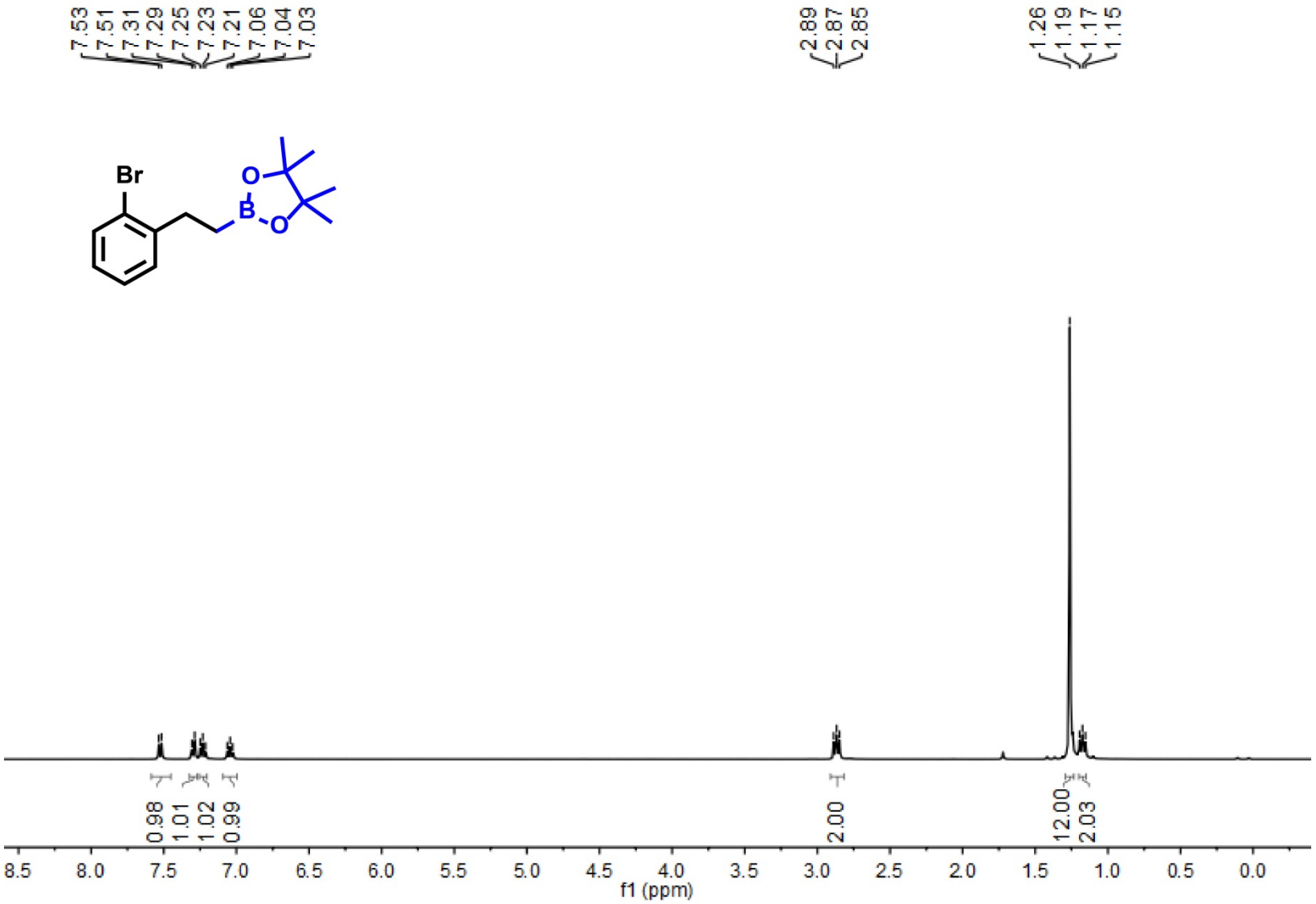
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6j**



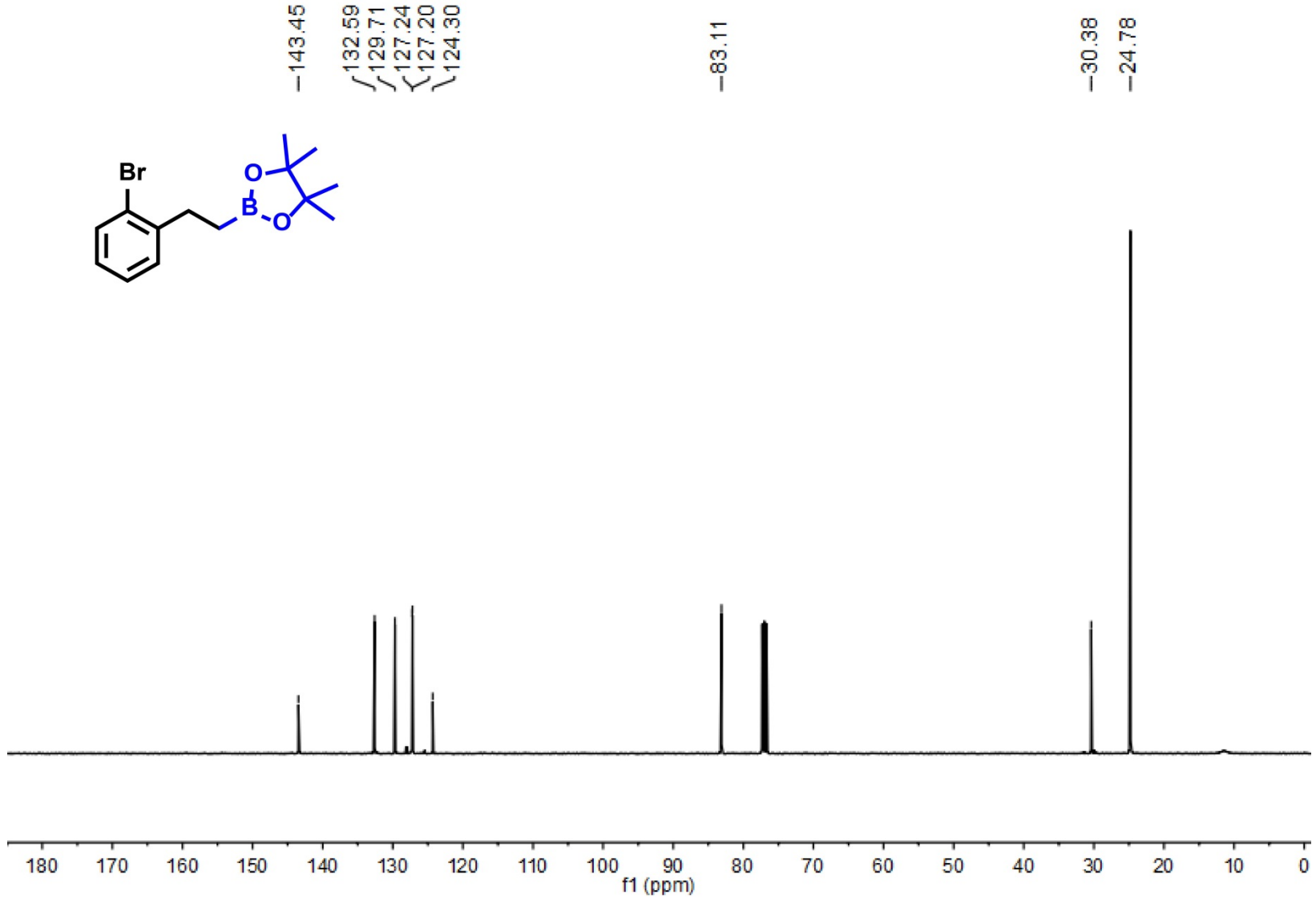
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6j**



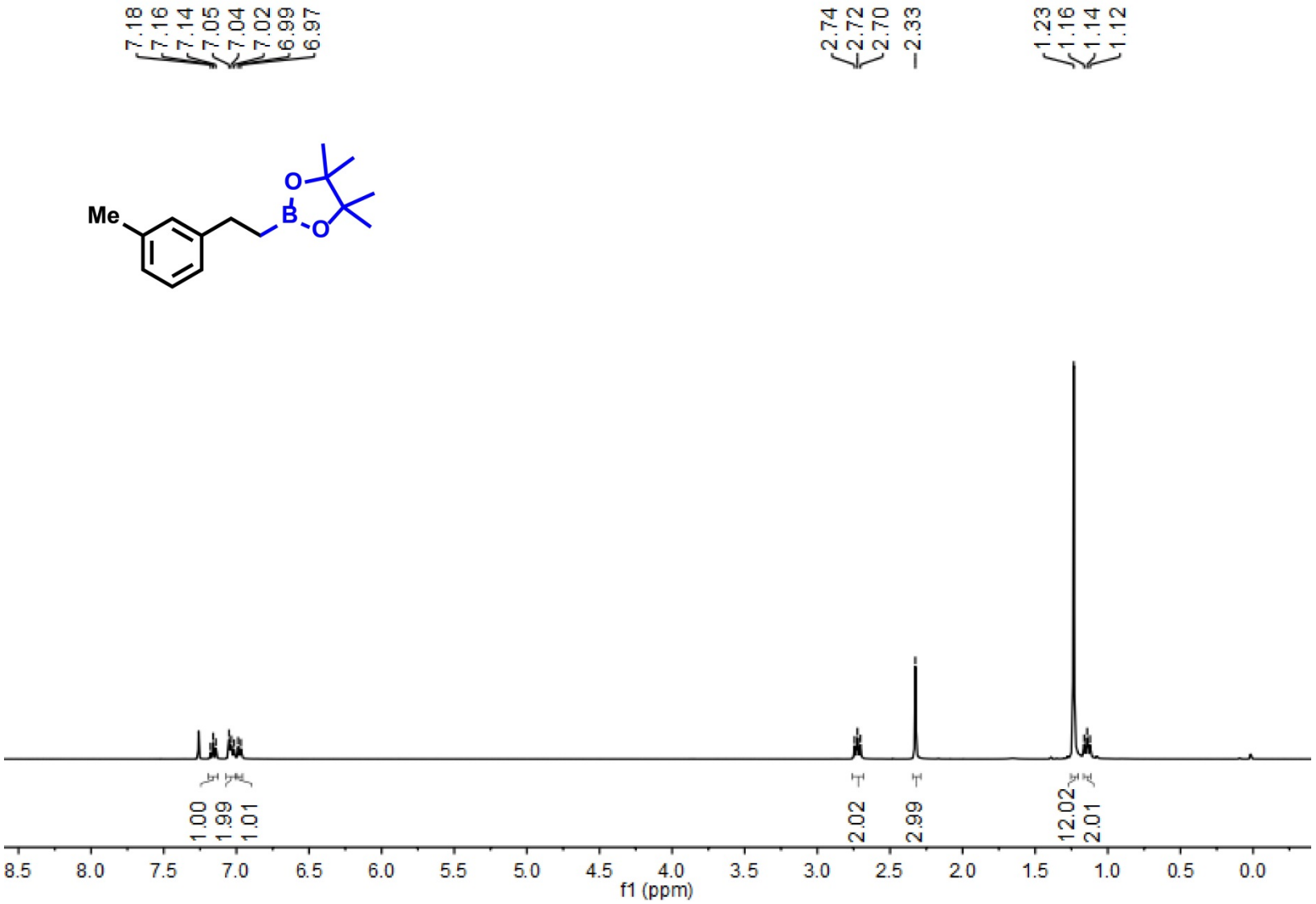
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6k**



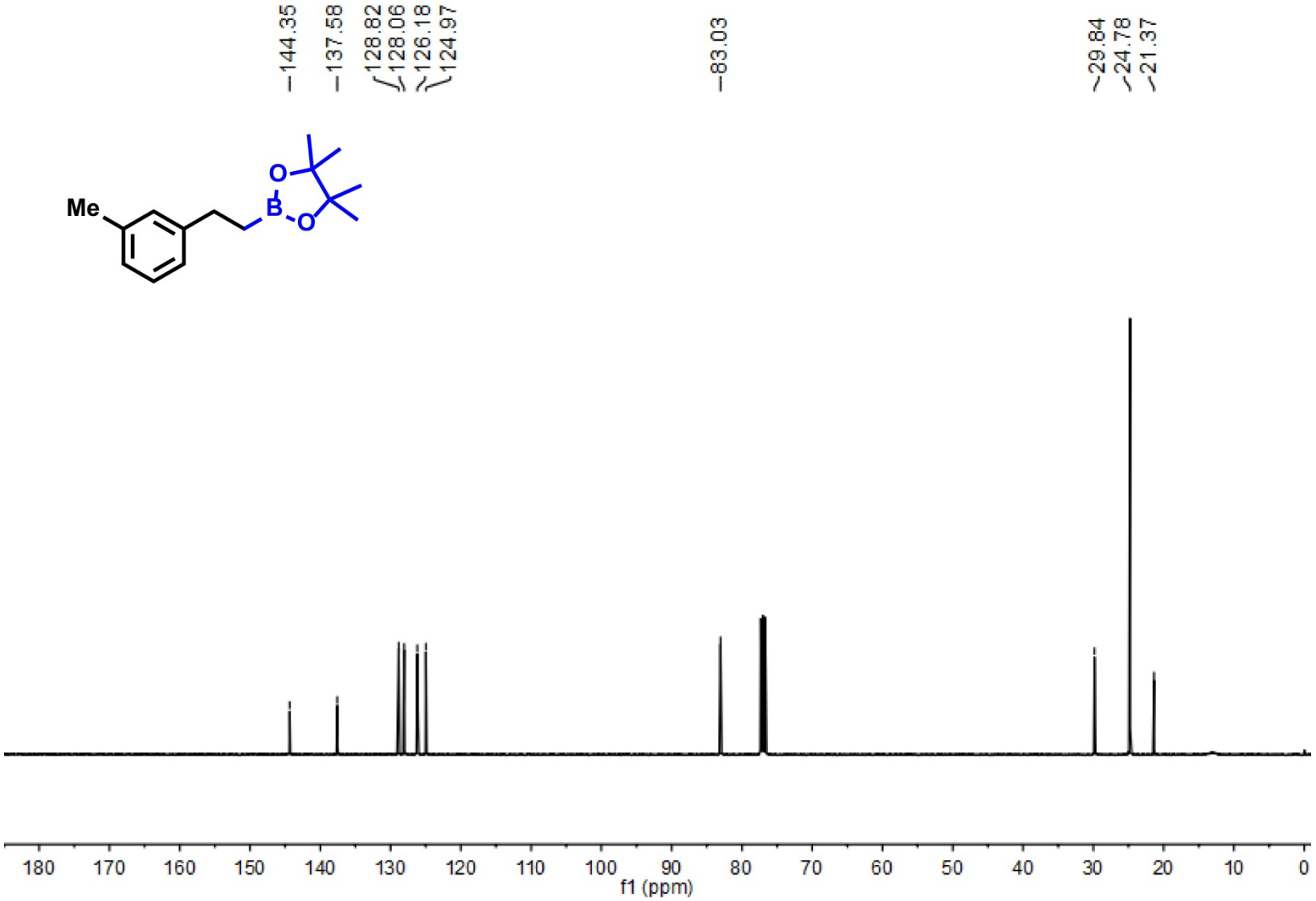
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6k**



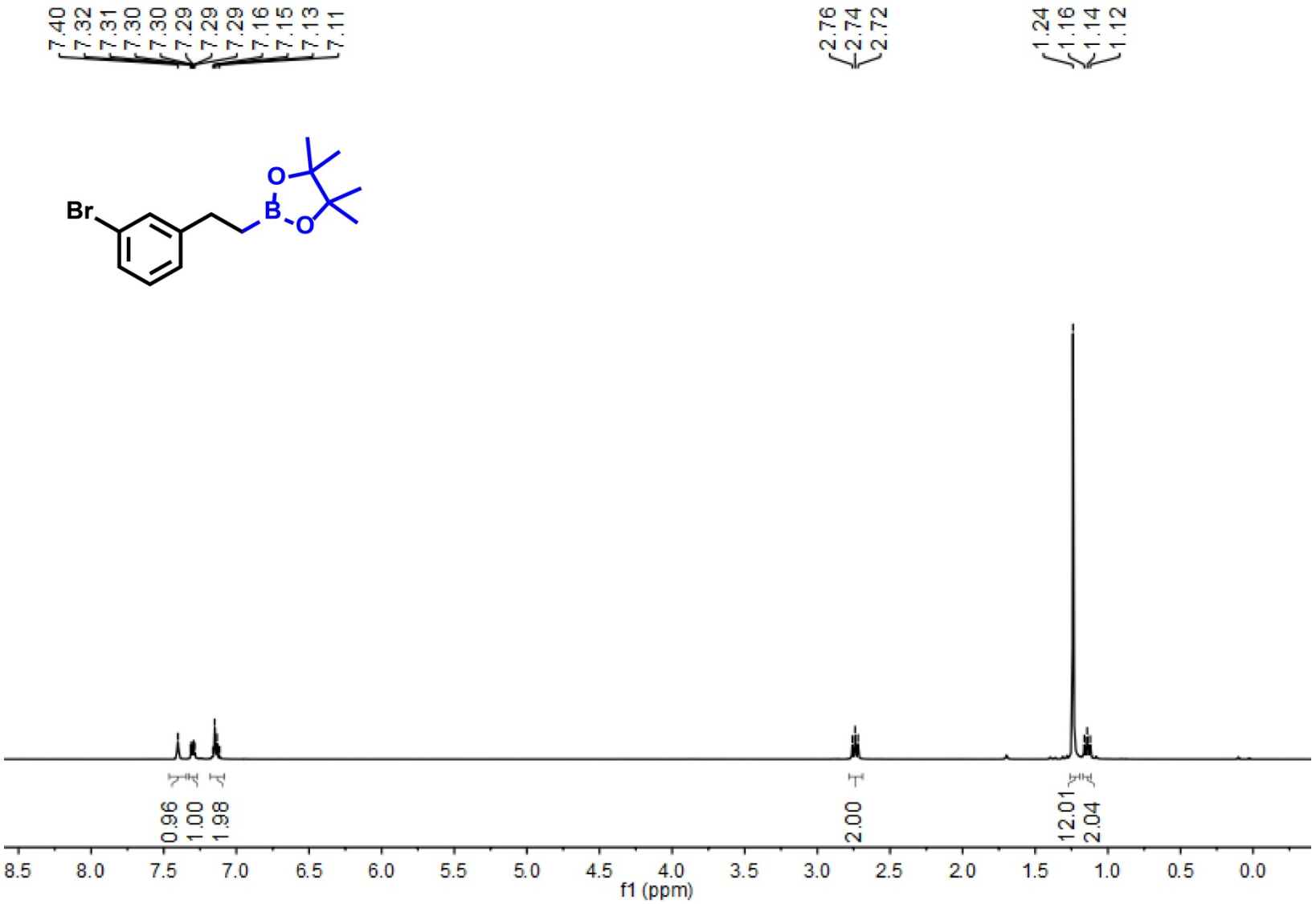
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6l**



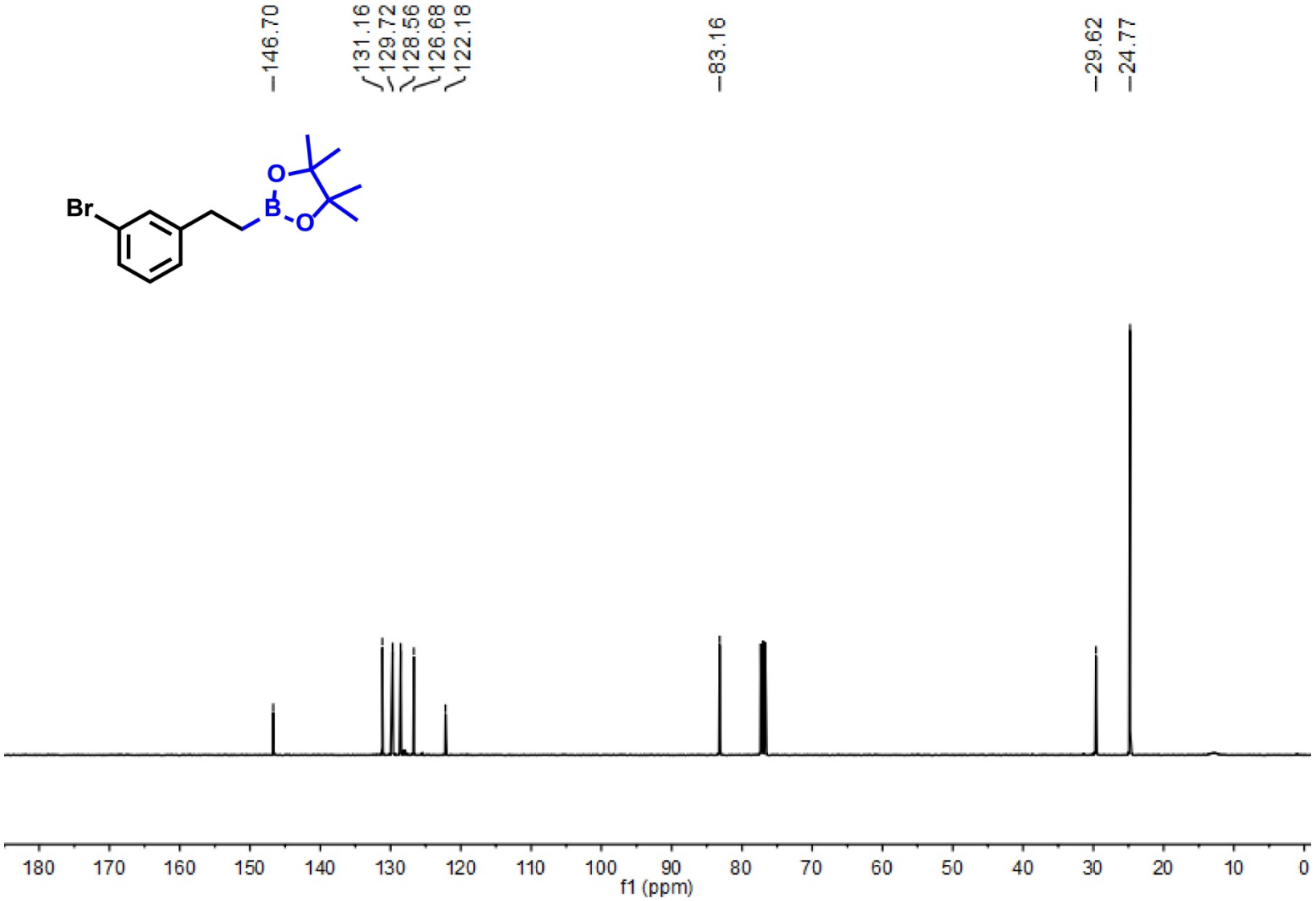
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6l**



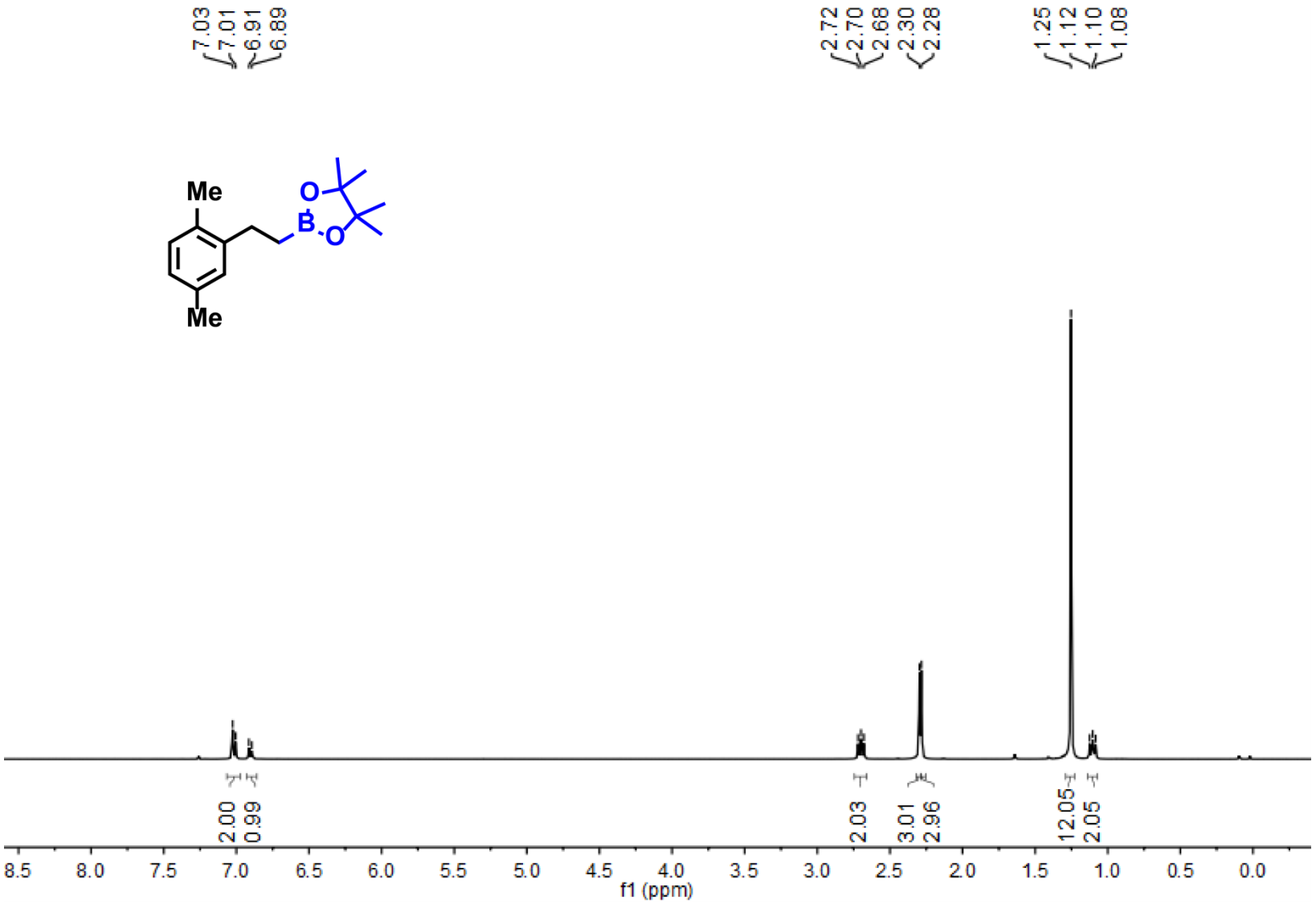
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6m**



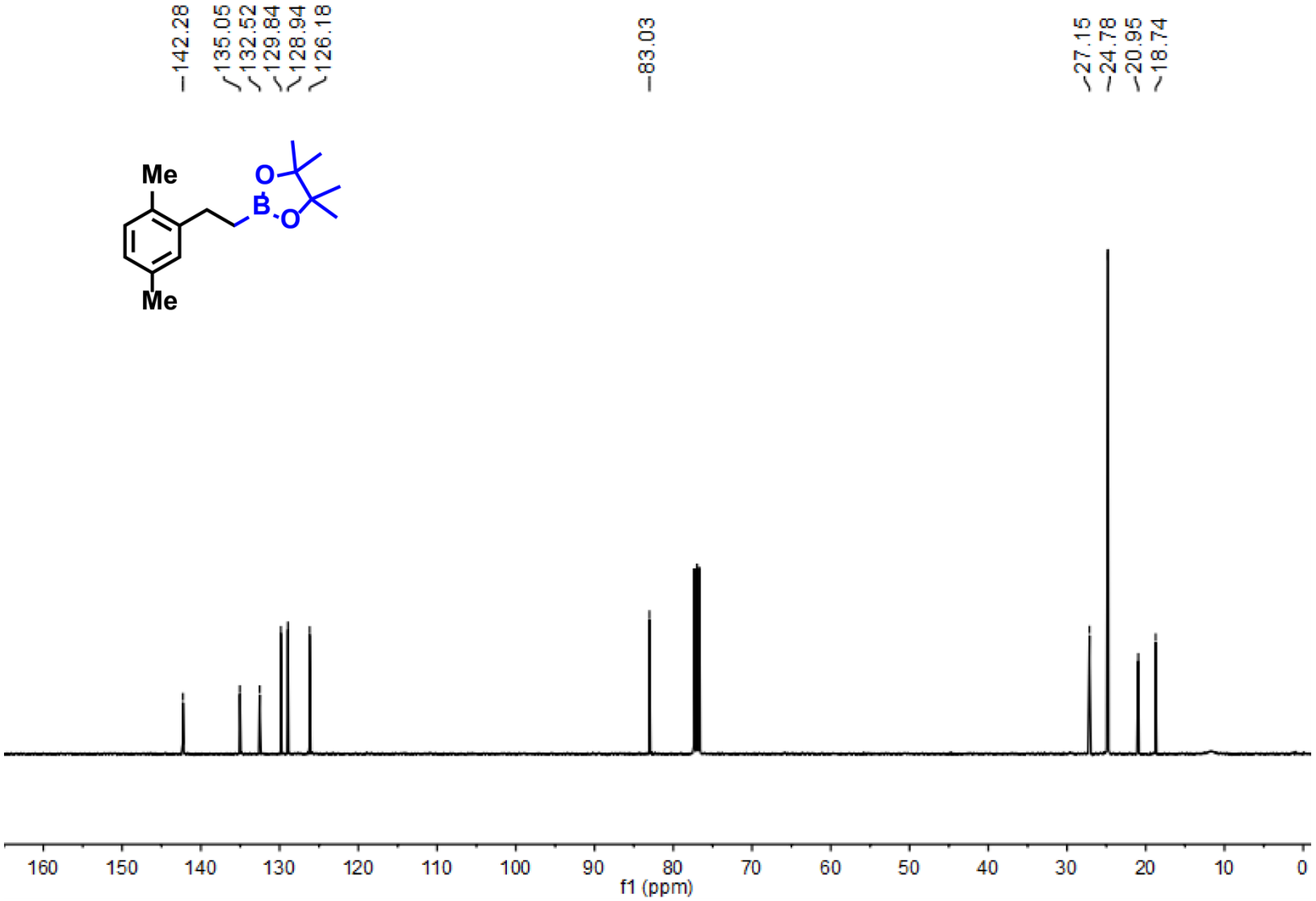
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6m**



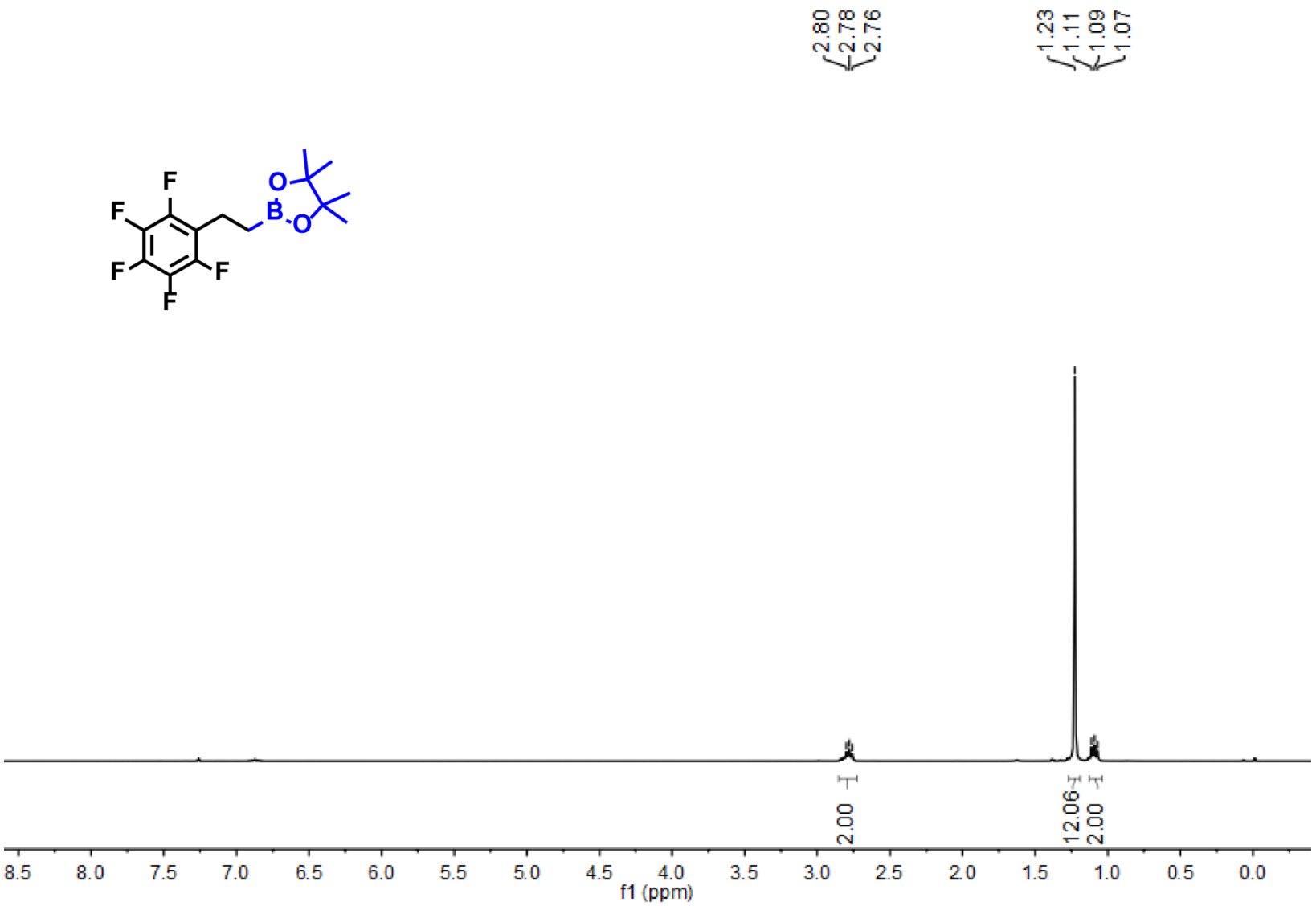
NMR (400 MHz, $CDCl_3$) spectrum of **6n**



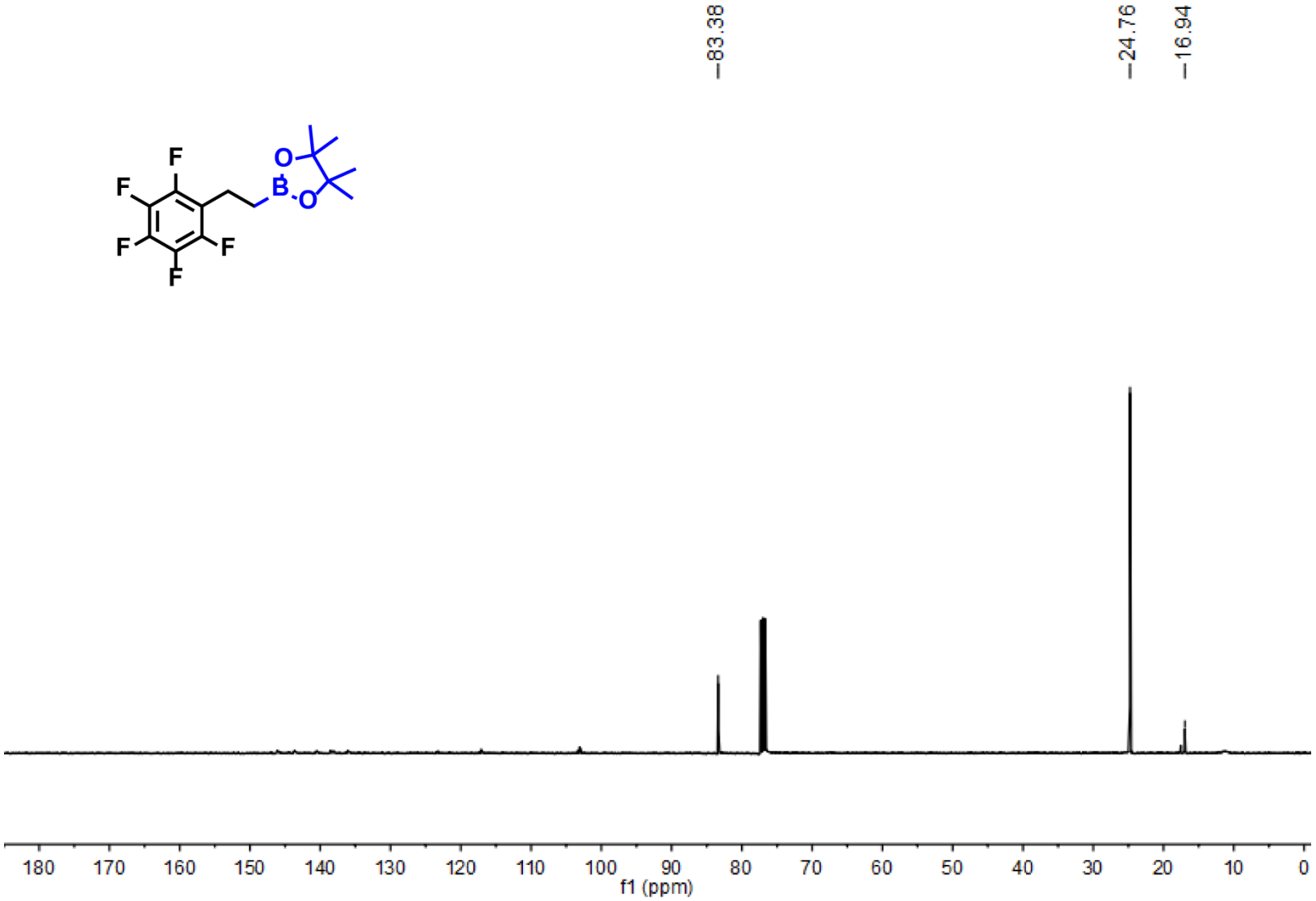
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6n**



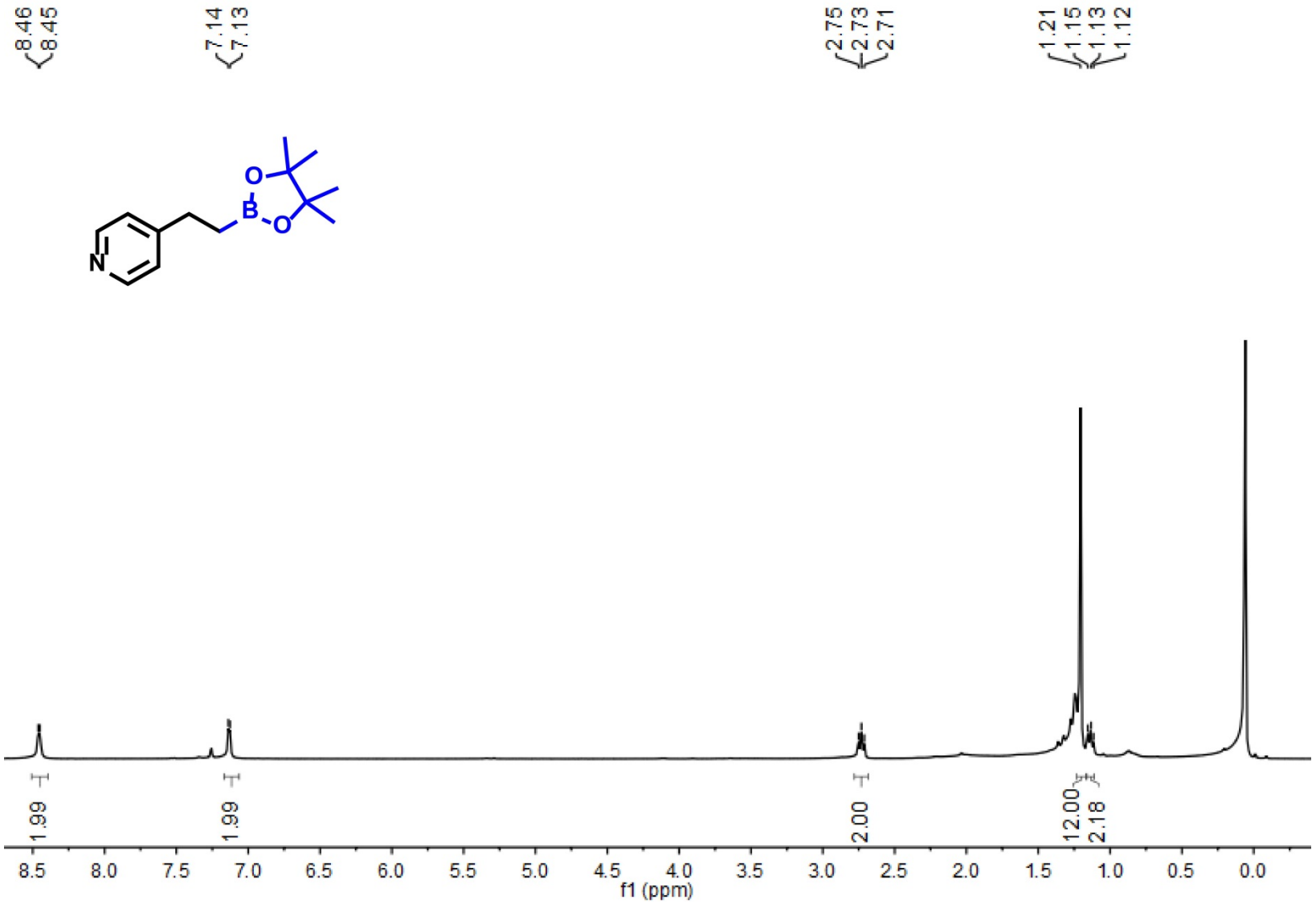
NMR (400 MHz, $CDCl_3$) spectrum of **6o**



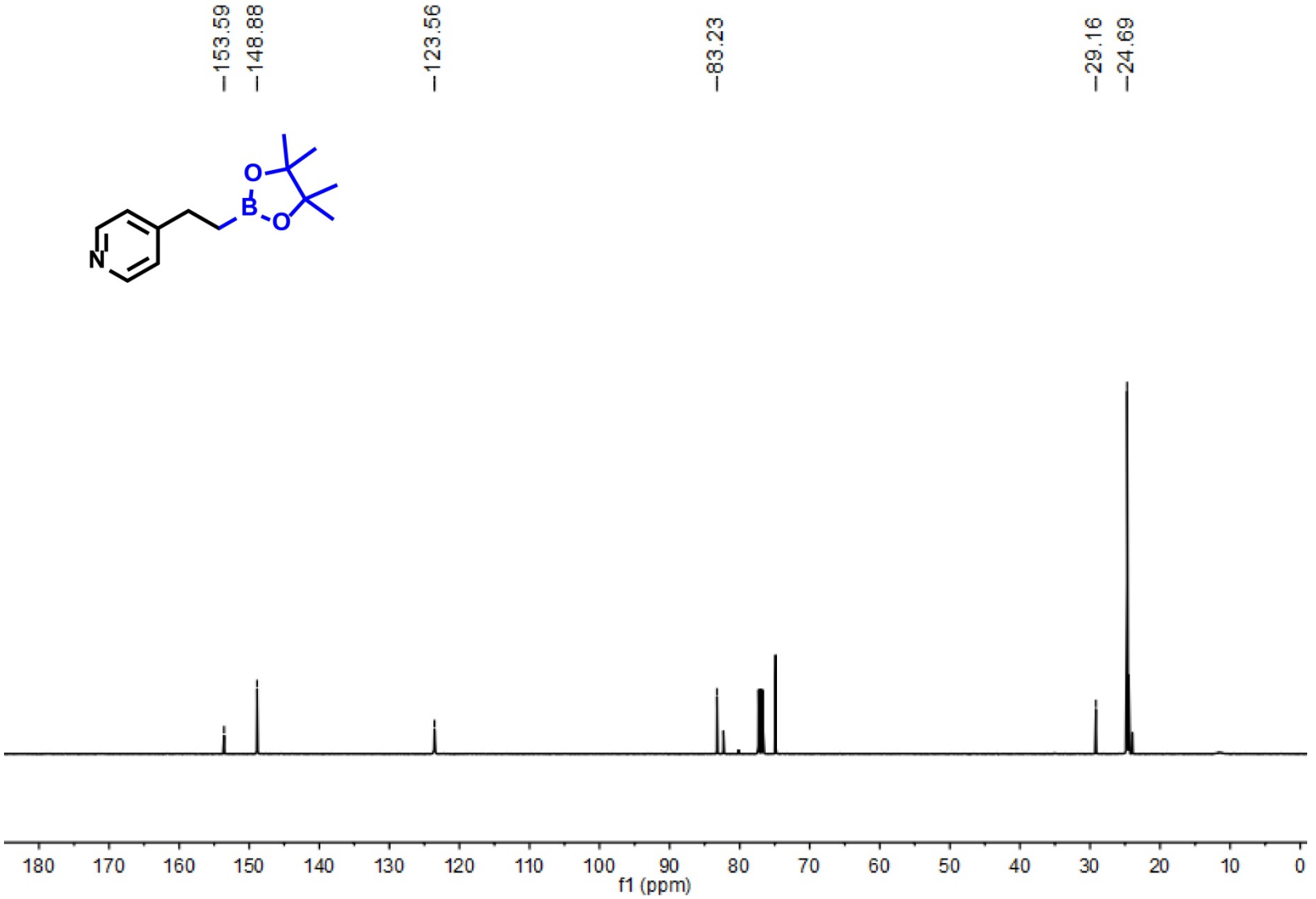
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6o**



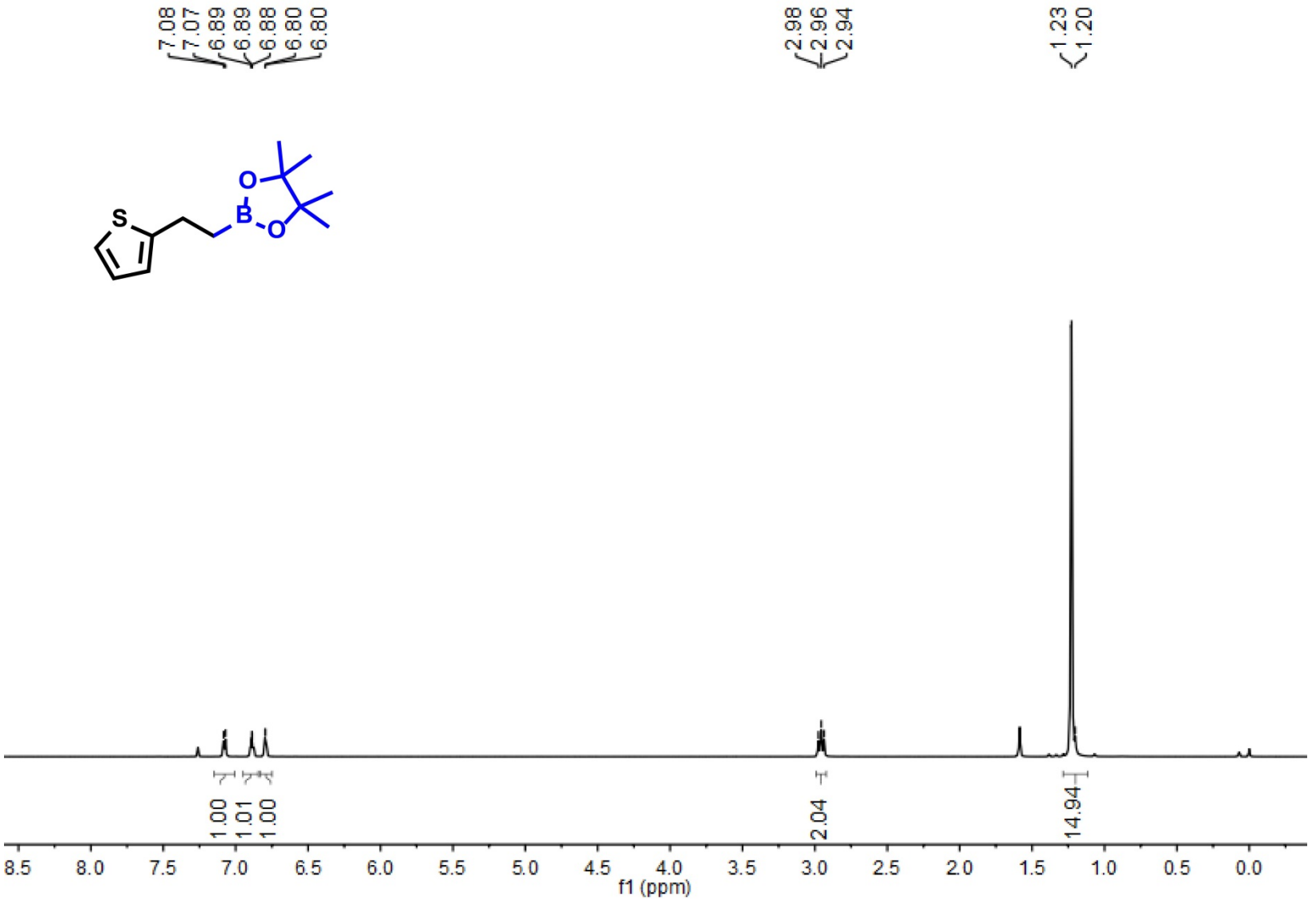
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6p**



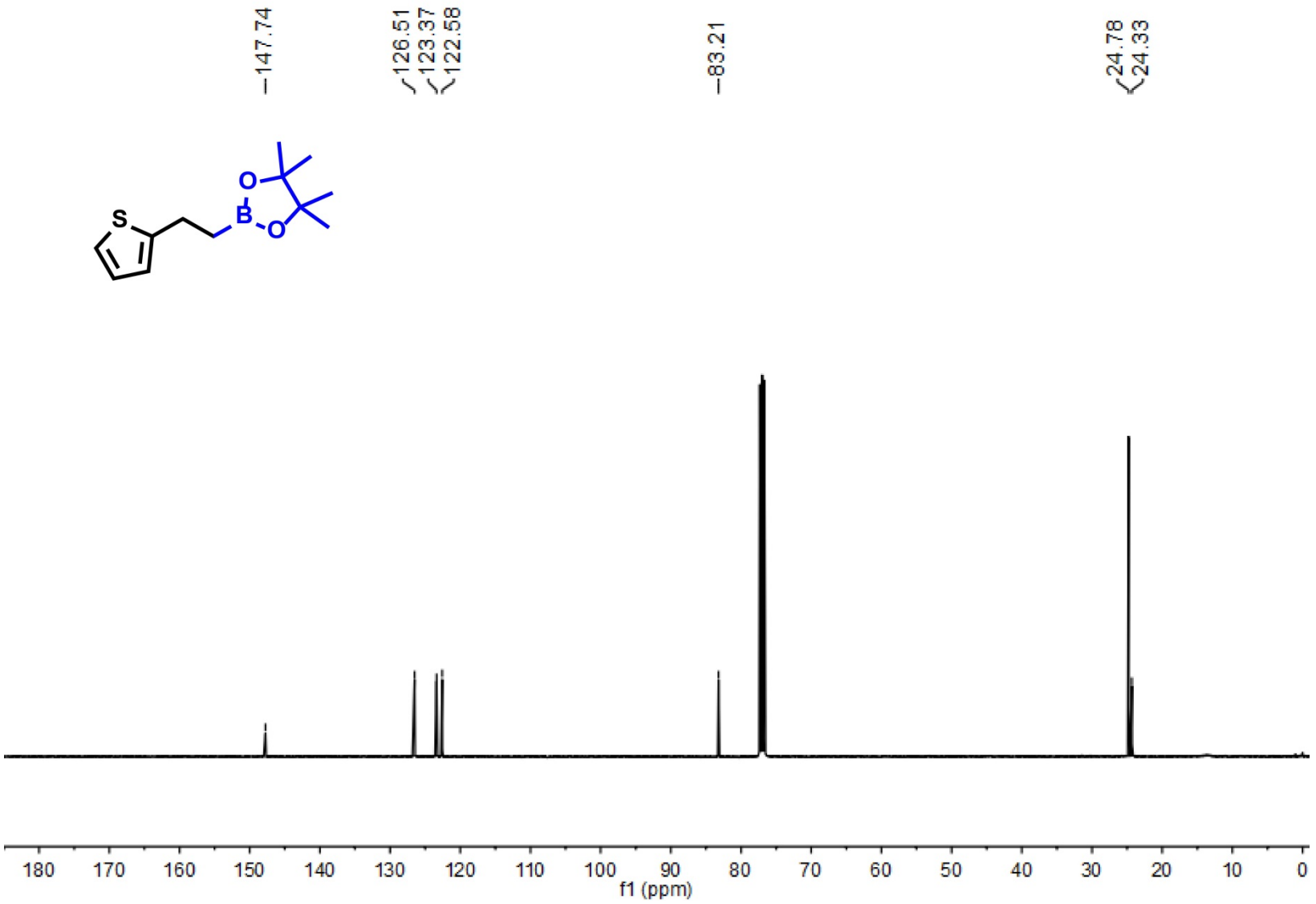
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6p**



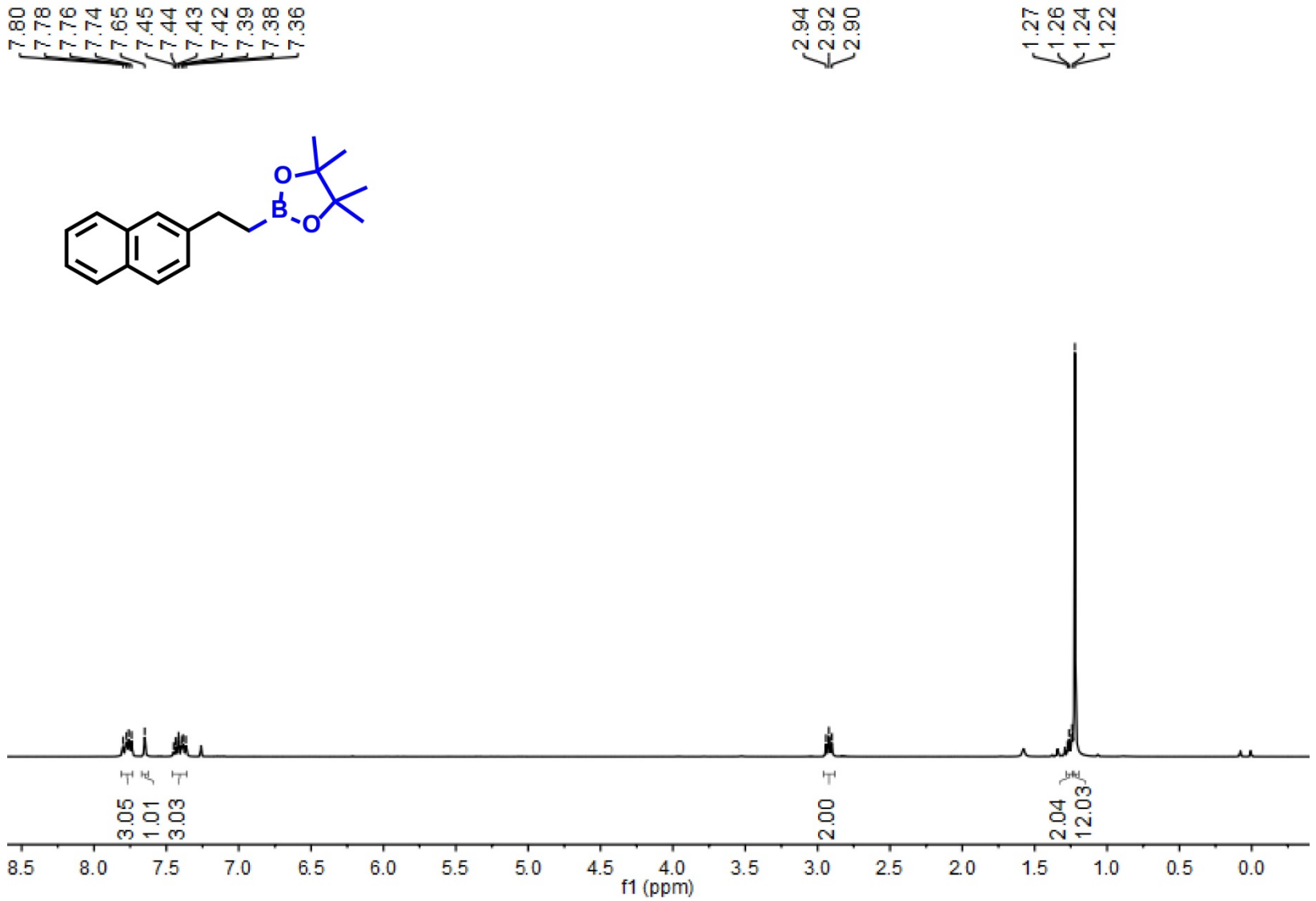
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6q**



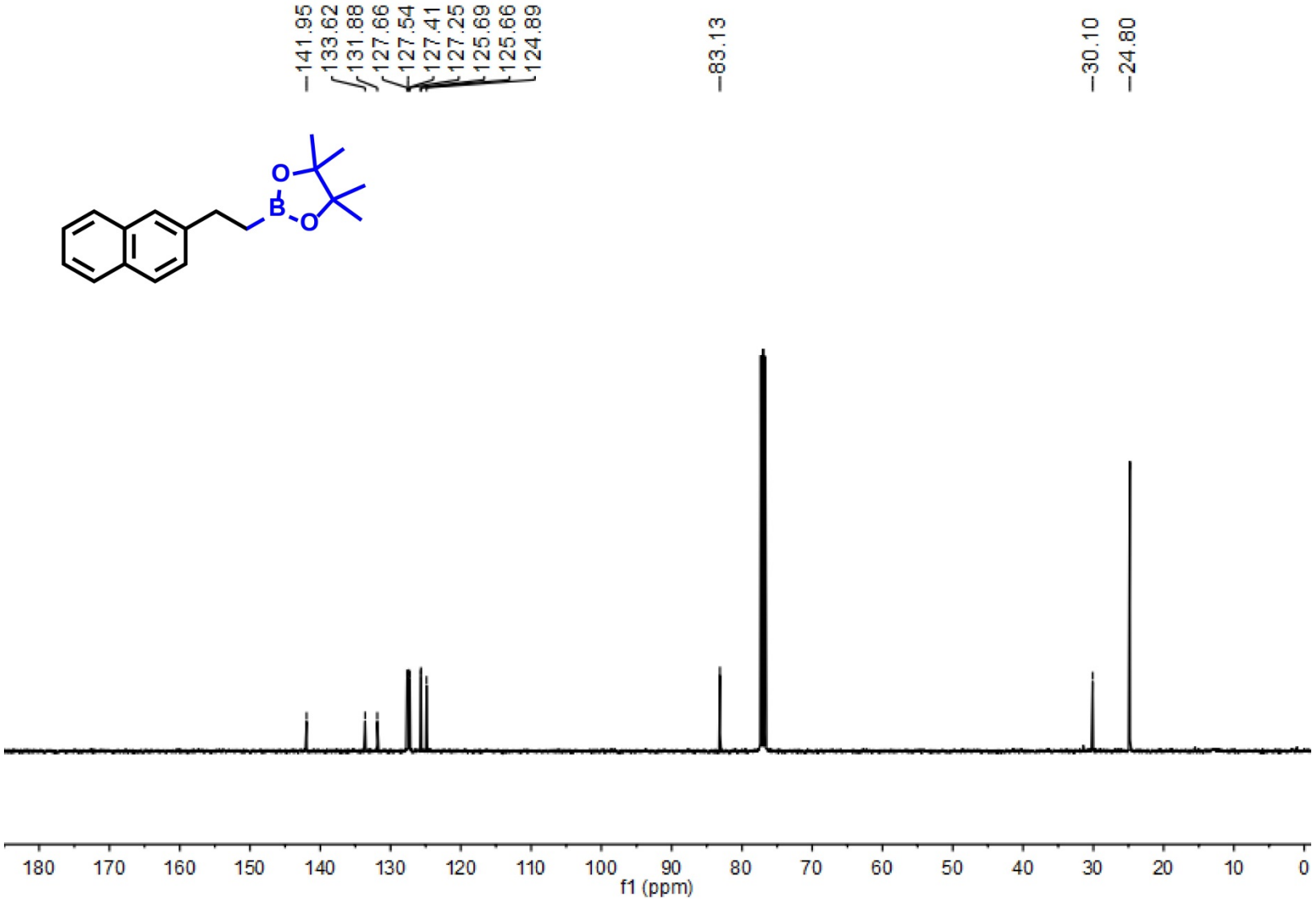
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6q**



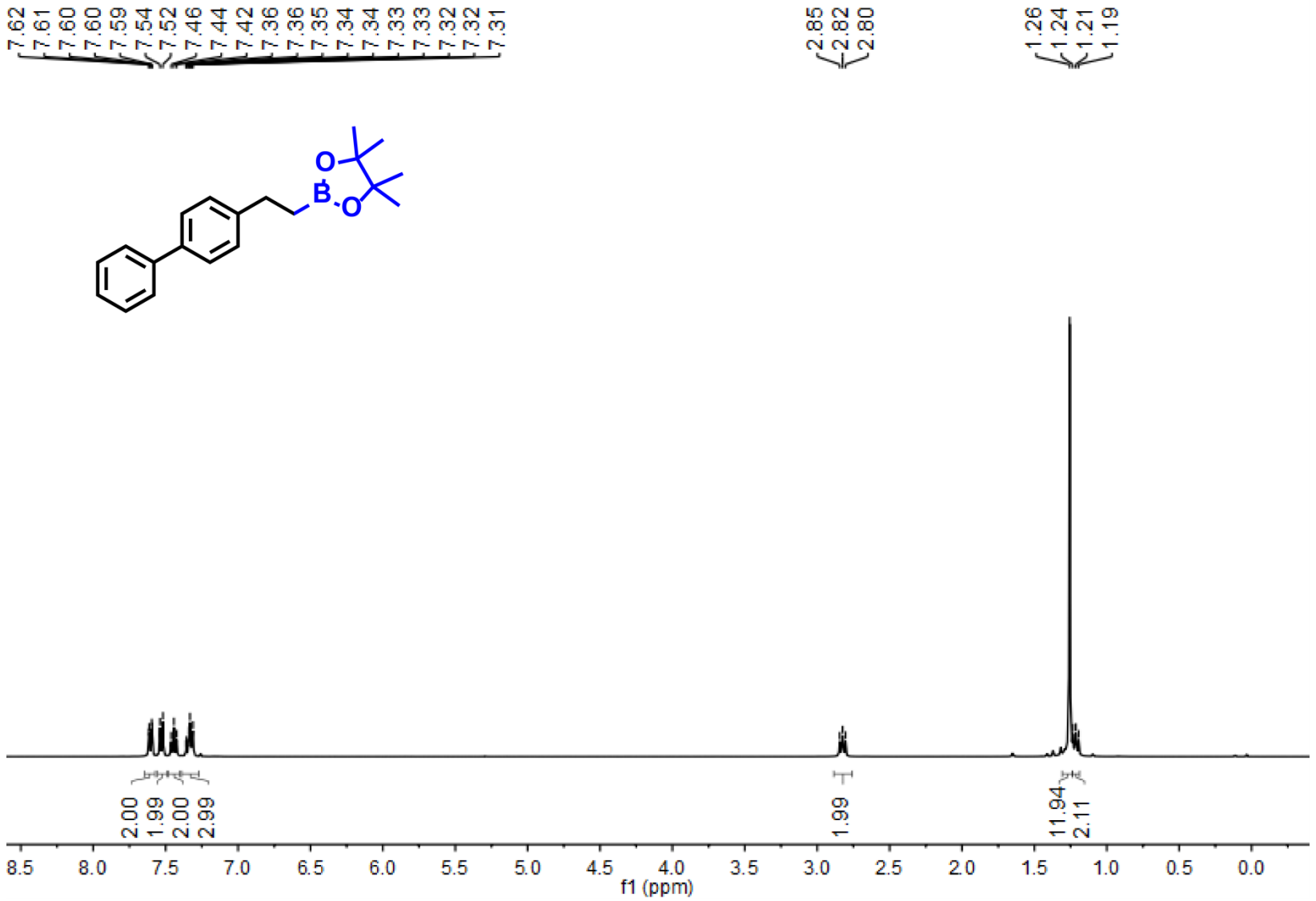
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6r**



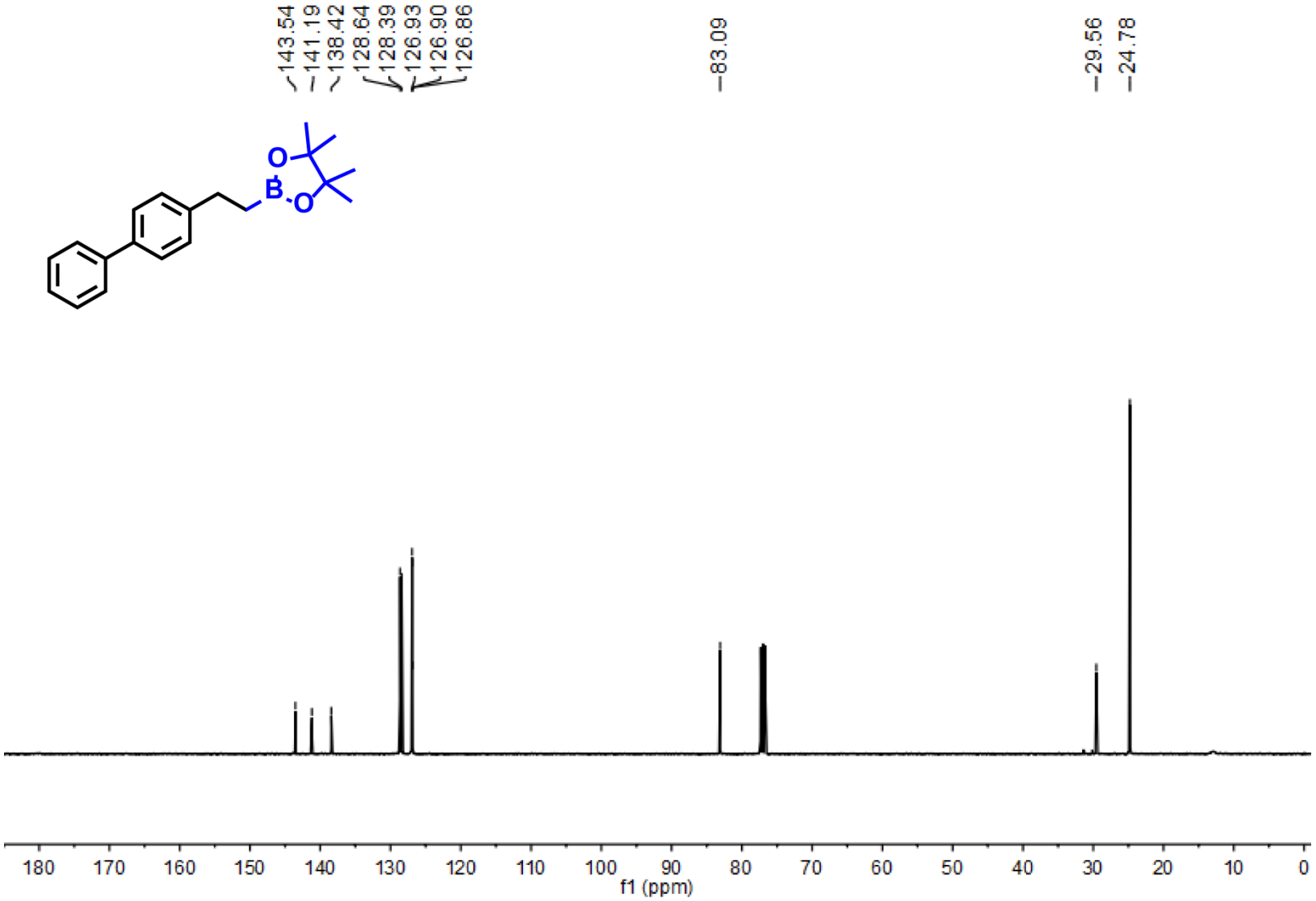
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6r**



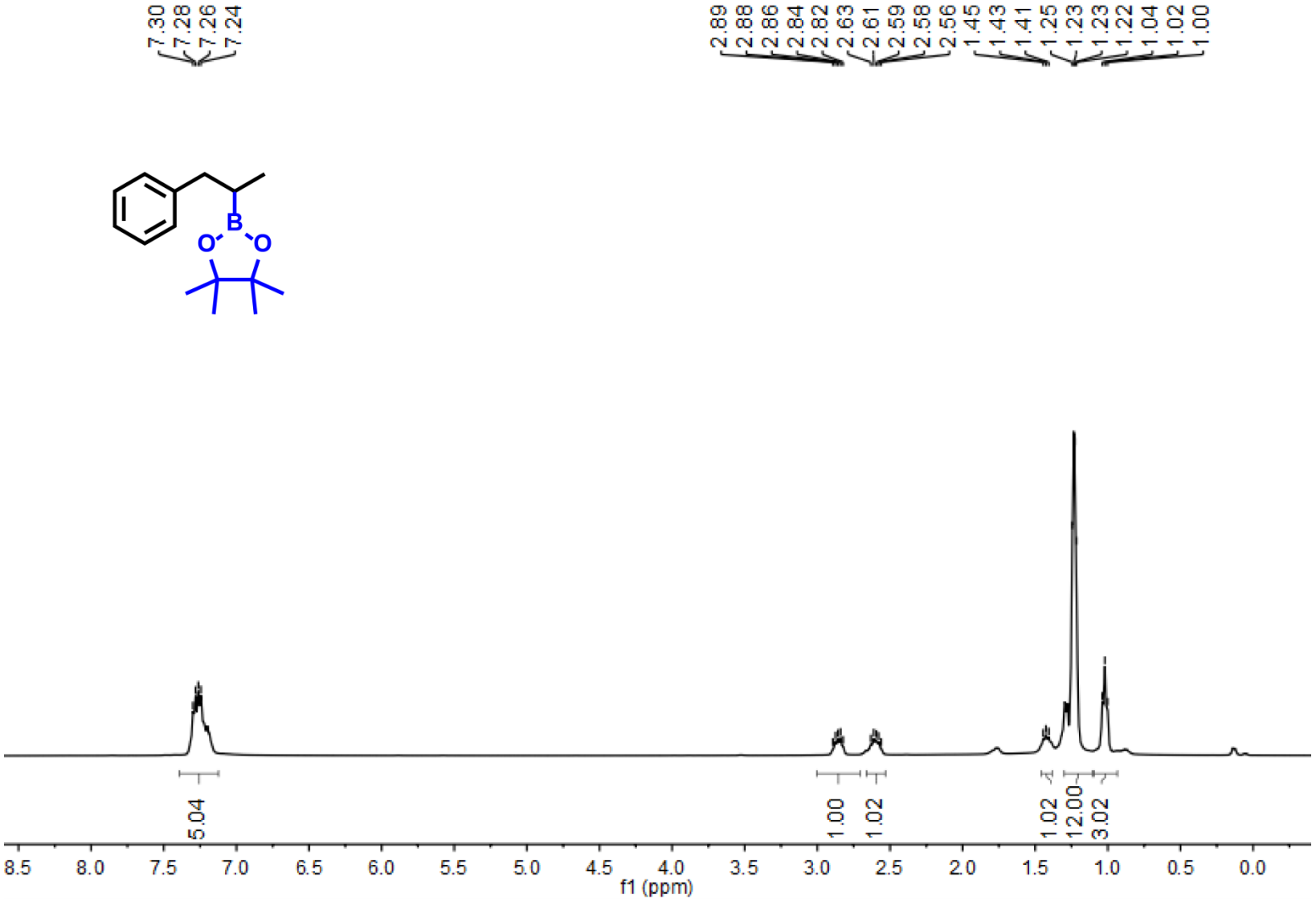
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6s**



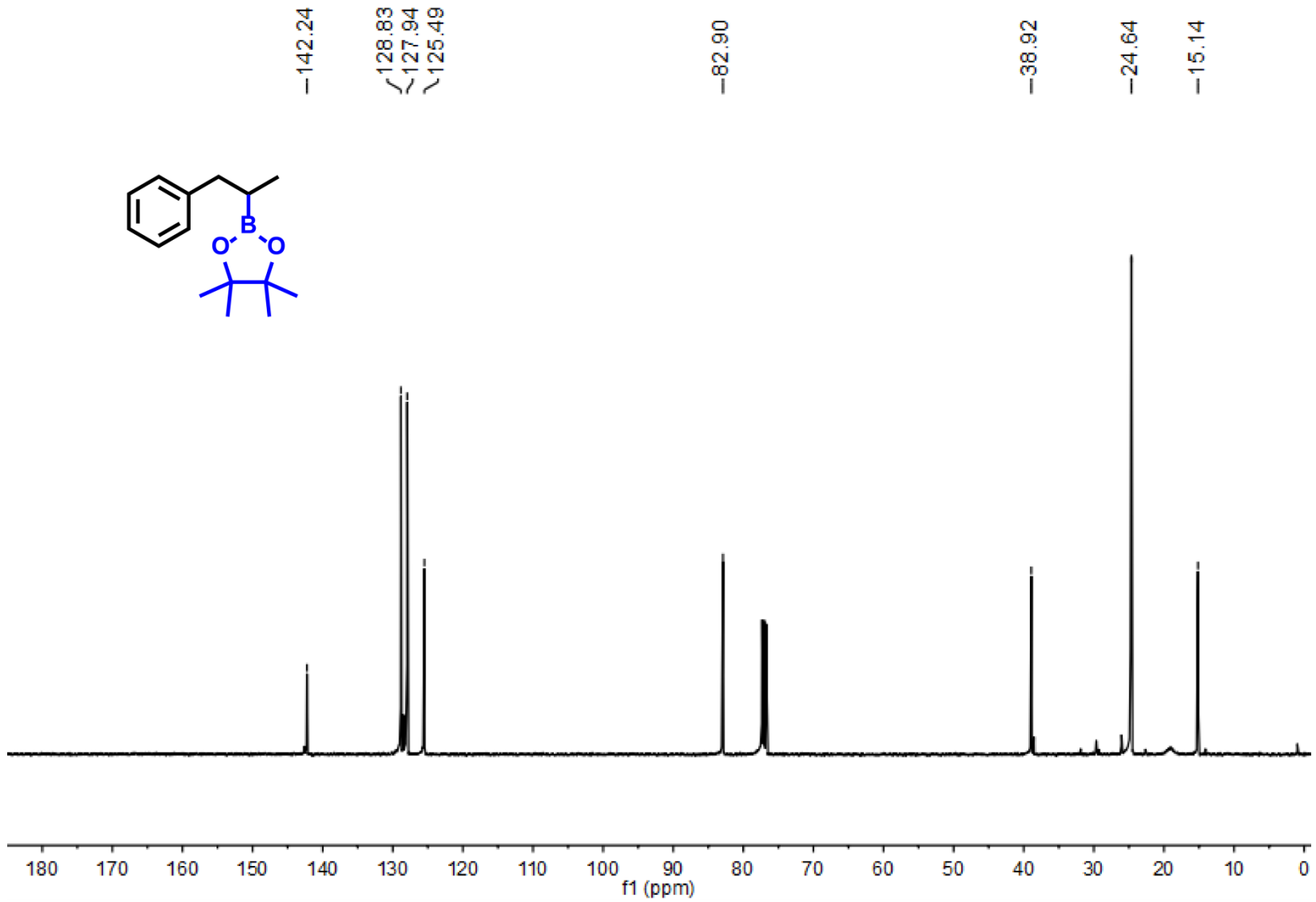
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6s**



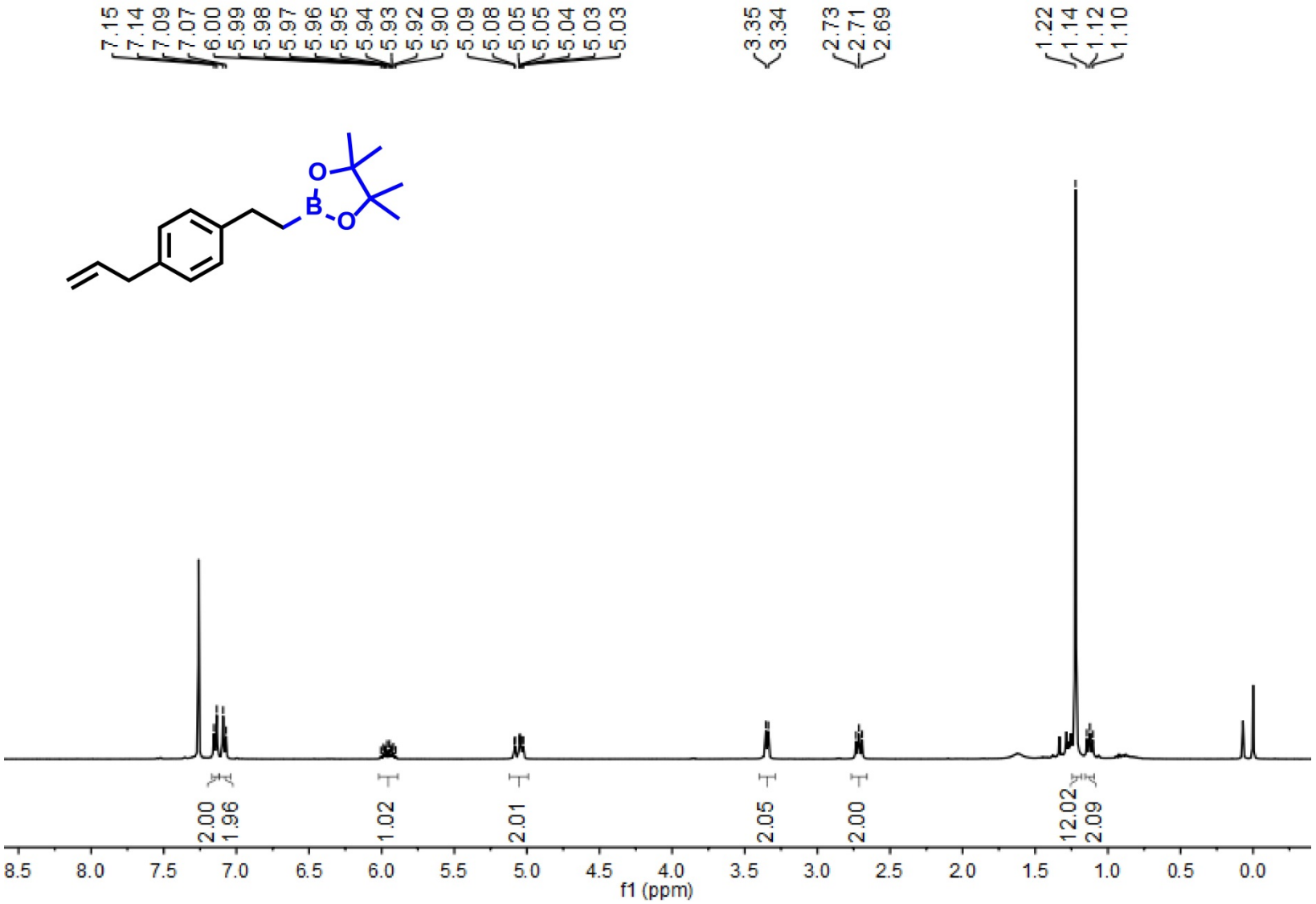
NMR (400 MHz, $CDCl_3$) spectrum of **6t**



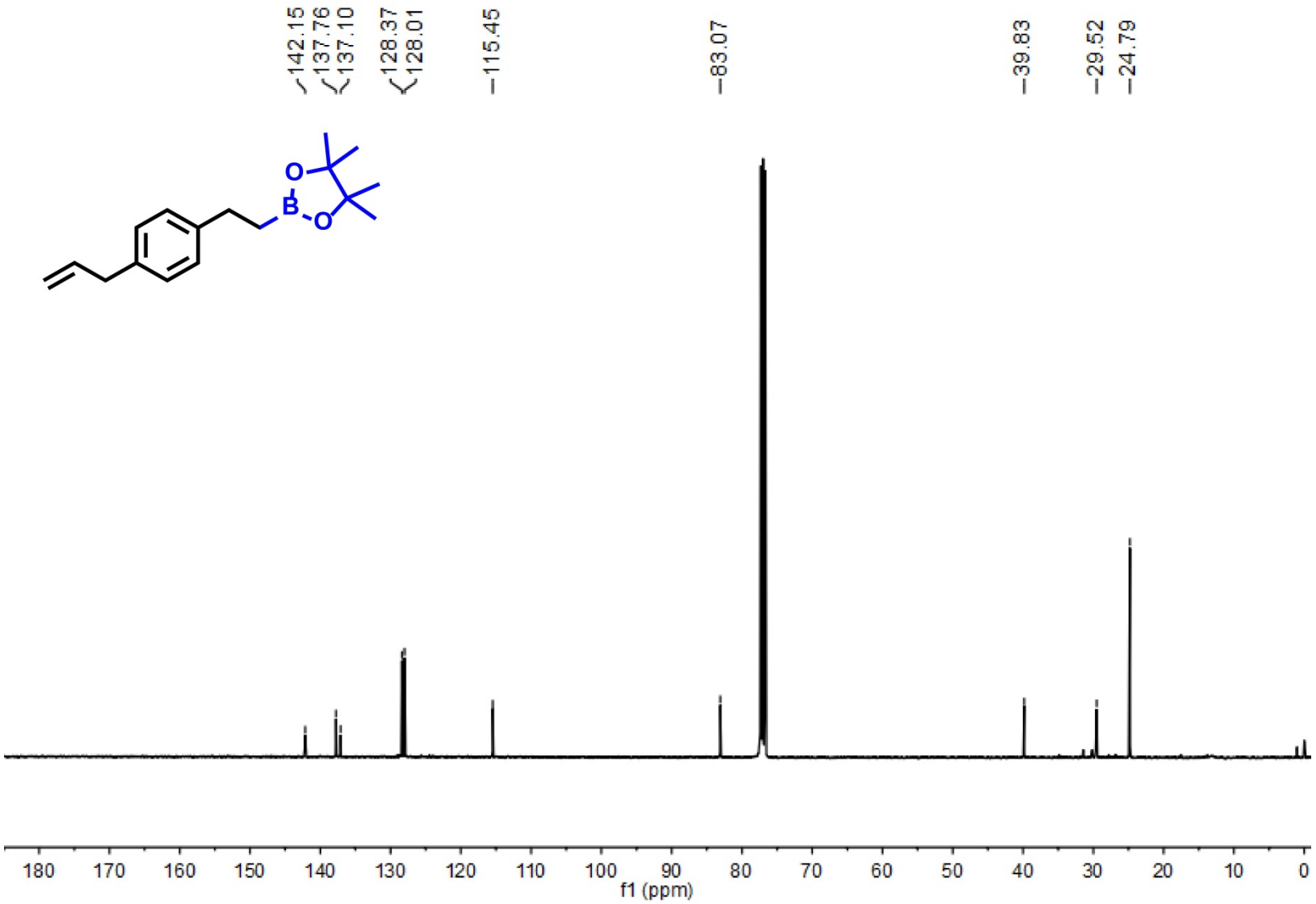
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6t**



NMR (400 MHz, $CDCl_3$) spectrum of **6v**



^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6v**



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