Supplementary Information for

Cu/Cd-Cocatalysed cascade reaction for constructing the nitrogen-tethered 1,6-enynes enabled by 1,5-hydride transfer

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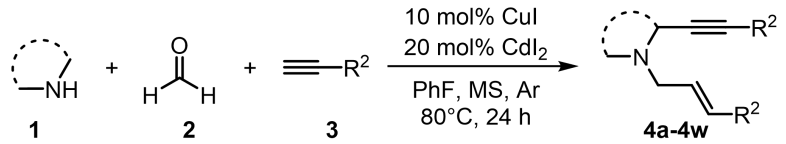
General information

Unless otherwise noted, all commercial reagents were used directly as purchased. Thin-layer chromatography (TLC) was performed, and visualization of the compounds was accomplished with UV light (254 nm) or iodine. Products were purified by flash chromatography on silica gel (100-200 mesh). The solvent was removed under reduced pressure, and the residue was purified by column chromatography on silica gel and eluted with petroleum/ethyl acetate to afford the desired product .^{1}H NMR, ^{13}C NMR and ^{19}F spectra were recorded in $CDCl_3$ operating at 400 MHz and 101 MHz, respectively. Proton chemical shifts are reported relative to the residual proton signals of the deuterated solvent $CDCl_3$ (7.29 ppm). Carbon chemical shifts were internally referenced to the deuterated solvent signals in $CDCl_3$ (77.10 ppm). Chemical shifts are reported in δ (parts per million) values. Coupling constants *J* are reported in Hz. Proton coupling patterns were described as singlet (s), doublet (d), triplet (t), and multiple (m). High-resolution mass spectrometry (HRMS) data were measured on an MS mass spectrometer.

General procedure for the synthesis of 4

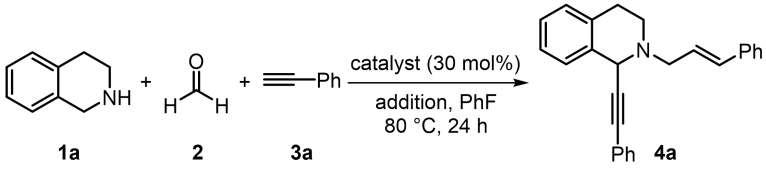


1 2 3 4a-4w

A vial tube was equipped with a magnetic stir bar and charged with amine **1** (0.25 mmol), 37% formaldehyde solution **2** (0.60 mmol), terminal alkyne **3** (0.45 mmol), CuI/CdI_2 (10 mol%/20 mol%), molecular sieve (120 mg) in fluorobenzene (1.0 mL) under argon. Then, the tube stirred at 80 °C for 24 h (monitored by TLC). After cooling to room temperature, the solid was removed by filtration of the reaction mixture through a pad of celite. The filtrate was washed with DCM. The crude product was purified by flash column chromatography on silica gel (PE:EA=10:1-PE) to afford the desired products **4a-4w** in 38%-90% yield.

Optimization of the reaction conditions

Table S1. Evaluation of catalysts and additions.[a]



1a 2 3a 4a

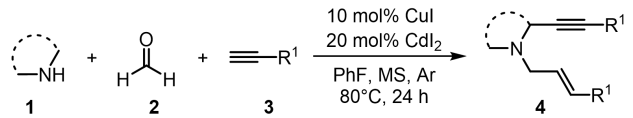
Entry	Catalyst	Additive	Yield (%)
1	CuI	/	32
2	CuBr	/	13
3	CuCl	/	Trace
4	$ZnCl_2$	/	Trace
5	CdI_2	/	40
6	$CdBr_2$	/	35
7 [b]	CdI_2	/	50
8 [b]	CdI_2	$MgSO_4$	55
9 [b]	CdI_2	Na_2SO_4	56

[a] Reaction conditions: the mixture of **1a** (0.25 mmol), **2** (0.60 mmol), **3a** (0.45 mmol), catalyst (30 mol%) and fluorobenzene (1 mL) were heated in a sealed tube at 80 °C for 24 h. Isolated yield. [b] reacted in a closed vial tube under argon.

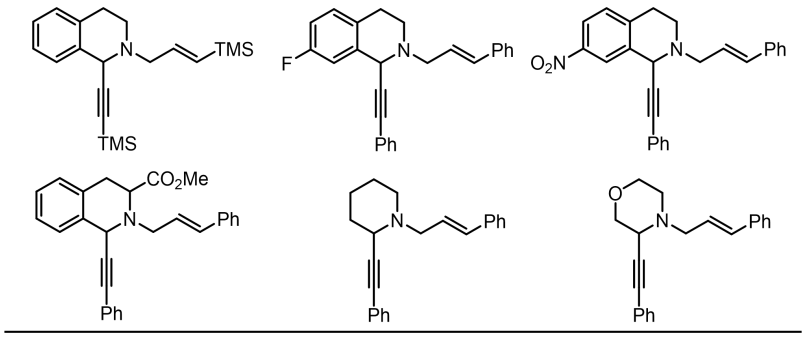
Failed amines and alkynes

We tried to change the alkynes and amines. However, when we use the ethynyltrimethylsilane, piperidine, morpholine, and so on, all of them can't produce the target product (Table S2).

Table S2. Failed substrate[a].



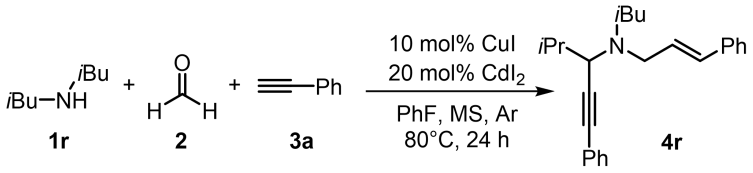
1 2 3 4



[a] Performed on 0.25 mmol scale. Reaction conditions: See Table 1, entry 13.

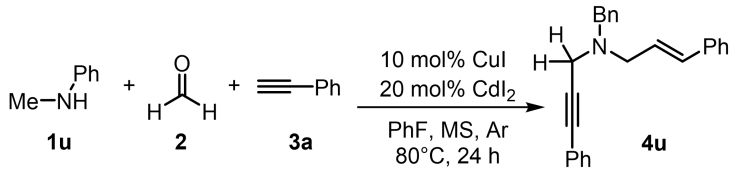
Scalability and transformation

2 mmol Scale-up reaction for the synthesis of 4r



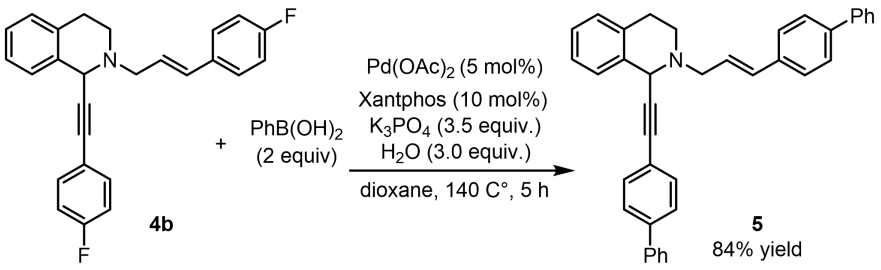
A vial tube was equipped with a magnetic stir bar and charged with amine **1r** (2 mmol, 258.3 mg), 37% formaldehyde solution **2** (5.6 mmol, 392 mg), terminal alkyne **3a** (3.6 mmol, 367.4 mg), CuI/CdI_2 (10 mol%/20 mol%, 32 mg/128 mg), molecular sieve (120 mg) in fluorobenzene (5.0 mL) under argon. Then, the tube stirred at 80 °C for 24 h (monitored by TLC). After cooling to room temperature, the solid was removed by filtration of the reaction mixture through a pad of celite. The filtrate was washed with DCM. The crude product was purified by flash column chromatography on silica gel (PE) to afford the desired products **4s** in 88% yield.

2 mmol Scale-up reaction for the synthesis of 4u



A vial tube was equipped with a magnetic stir bar and charged with amine **1u** (2 mmol, 258.3 mg), 37% formaldehyde solution **2** (5.6 mmol, 392 mg), terminal alkyne **3a** (3.6 mmol, 367.4 mg), CuI/CdI_2 (10 mol%/20 mol%, 32 mg/128 mg), molecular sieve (120 mg) in fluorobenzene (5.0 mL) under argon. Then, the tube stirred at 80 °C for 24 h (monitored by TLC). After cooling to room temperature, the solid was removed by filtration of the reaction mixture through a pad of celite. The filtrate was washed with DCM. The crude product was purified by flash column chromatography on silica gel (PE:EA=25:1) to afford the desired products **4v** in 53% yield.

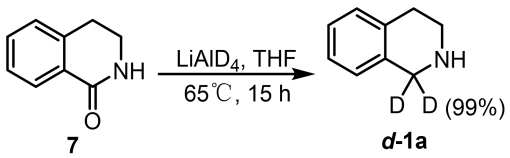
Synthesis of 5



To a dry Schlenk tube with a polytetrafluoroethylene plug was added K_3PO_4 (1.75 mmol, 383.3 mg). Then added $Pd(OAc)_2$ (0.025 mmol, 5.8 mg), Xantphos (0.05 mmol, 30 mg), phenylboronic acid (1 mmol, 124.4 mg), and dioxane (0.5 mL) were added sequentially under Ar atmosphere. After being stirred for 5 min at room temperature, **4b** (0.5 mmol, 192.6 mg), dioxane (0.5 mL) and 27.0 μL of H_2O (1.5 mmol, 27.0 mg) were added. The resulting mixture was heated at 140 ℃ for 5 h. After cooling to room temperature, the solid was removed by filtration of the reaction mixture through a pad of celite. The filtrate was washed with DCM. The crude product was purified by flash column chromatography on silica gel and eluted ethyl acetate and petroleum ether (PE:EA=80:1) to afford the desired product **5** (84%, 210 mg).

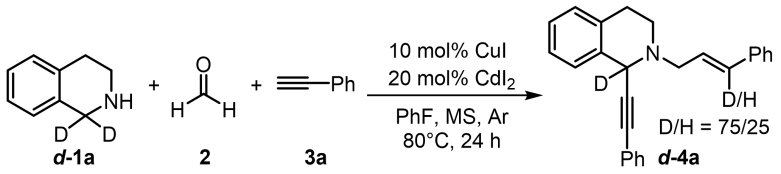
Control experiments

Synthesis of *d*-1a



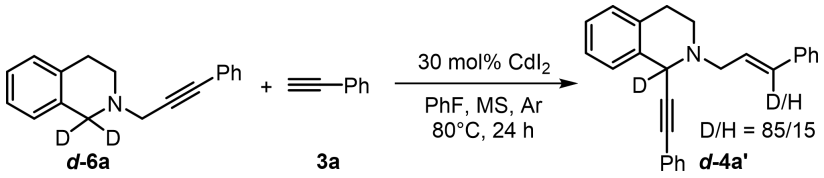
A three neck-flask was equipped with a magnetic stir bar and inject the solution of the corresponding 3,4-dihydroisoquinolin-1(2H)-one **7** (1 mmol, 147.1 mg) in dry THF (1 M) to a suspension of $LiAlD_4$ (2.2 mmol, 92.4 mg) in dry THF (3.3 M) in three neck-flask at 0 °C under nitrogen. The reaction mixture was heated to reflux for 15 h. After cooling to 0 °C, followed by the addition slowly of water (5 mL) and 30% NaOH (4 mL). The mixture was extracted with Et_2O and the organic phase was washed with brine, dried over anhydrous Na_2SO_4 and concentrated. The product ***d*-1a** is used in the next step without further purification (90% yield, 121.6 mg).

Synthesis of *d*-4a



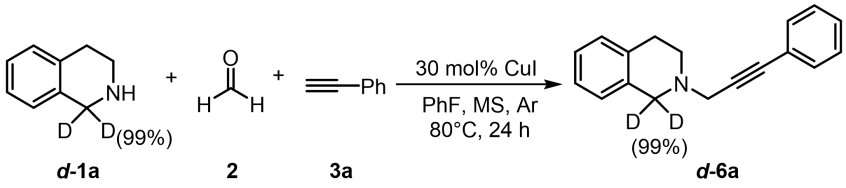
A vial tube was equipped with a magnetic stir bar and charged with amine ***d*-1a** (0.25 mmol, 34 mg), 37% formaldehyde solution **2** (0.60 mmol, 49 mg), terminal alkyne **3a** (0.45 mmol, 46 mg), CuI/CdI_2 (10 mol%/20 mol%, 4 mg/16 mg), molecular sieve (120 mg) in fluorobenzene (1.0 mL) under argon. Then, the tube stirred at 80 °C for 24 h (monitored by TLC). After cooling to room temperature, the solid was removed by filtration of the reaction mixture through a pad of celite. The filtrate was washed with DCM. The crude product was purified by flash column chromatography on silica gel (PE:EA=25:1) to afford the desired product ***d*-4a**(82% yield, 64.8 mg).

Synthesis of *d*-4a'



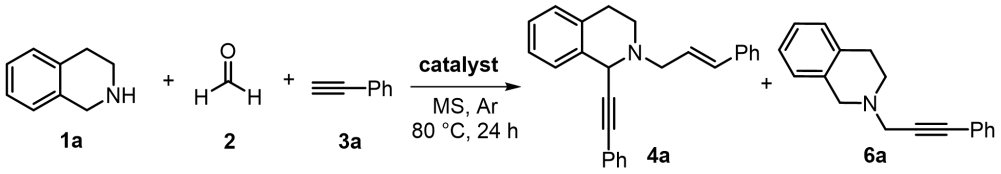
A vial tube was equipped with a magnetic stir bar and charged with amine ***d*-6a** (0.25 mmol, 62 mg), terminal alkyne **3a** (0.225 mmol, 23 mg), CdI_2 (30 mol%, 25 mg), molecular sieve (120 mg) in fluorobenzene (1.0 mL) under argon. Then, the tube stirred at 80 °C for 24 h (monitored by TLC). After cooling to room temperature, the solid was removed by filtration of the reaction mixture through a pad of celite. The filtrate was washed with DCM. The crude product was purified by flash column chromatography on silica gel (PE:EA=25:1) to afford the desired product ***d*-4a'**(89% yield, 71 mg)

Synthesis of *d*-6a



A vial tube was equipped with a magnetic stir bar and charged with amine ***d*-1a** (0.25 mmol, 34 mg), 37% formaldehyde solution **2** (0.60 mmol, 49 mg), terminal alkyne 3a (0.45 mmol, 46 mg), CuI (30 mol%, 15 mg), molecular sieve (120 mg) in fluorobenzene (1.0 mL) under argon. Then, the tube stirred at 80 °C for 24 h (monitored by TLC). After cooling to room temperature, the solid was removed by filtration of the reaction mixture through a pad of celite. The filtrate was washed with DCM. The crude product was purified by flash column chromatography on silica gel (PE:EA=25:1) to afford the desired product ***d*-6a** (70%, 39.2 mg).

Synthesis of 4a and 6a



1a 2 3a 4a 6a

Using 10 mol% CuI, 20 mol% CdI_2:

A vial tube was equipped with a magnetic stir bar and charged with amine **1a** (0.25 mmol, 33 mg), 37% formaldehyde solution **2** (0.60 mmol, 49 mg), terminal alkyne **3a** (0.45 mmol, 46 mg), CuI/CdI_2 (10 mol%/20 mol%, 4 mg/16 mg), molecular sieve (120 mg) in fluorobenzene (1.0 mL) under argon. Then, the tube stirred at 80 °C for 24 h (monitored by TLC). After cooling to room temperature, the solid was removed by filtration of the reaction mixture through a pad of celite. The filtrate was washed with DCM. The crude product was purified by flash column chromatography on silica gel (PE:EA=25:1) to afford the desired product **4a** (86%, 67.6 mg).

Using 10 mol% CuI :

A vial tube was equipped with a magnetic stir bar and charged with amine **1a** (0.25 mmol, 33 mg), 37% formaldehyde solution **2** (0.70 mmol, 49 mg), terminal alkyne **3a** (0.45 mmol, 46 mg), CuI (10 mol%, 4 mg), molecular sieve (120 mg) in fluorobenzene (1.0 mL) under argon. Then, the tube stirred at 80 °C for 24 h (monitored by TLC). After cooling to room temperature, the solid was removed by filtration of the reaction mixture through a pad of celite. The filtrate was washed with DCM. The crude product was purified by flash column chromatography on silica gel

(PE:EA=25:1) to afford the desired product **4a** (8%, 6.1 mg) and **6a** (31%, 17.2 mg).

Using 30 mol% CuI:

A vial tube was equipped with a magnetic stir bar and charged with amine **1a** (0.25 mmol, 33 mg), 37% formaldehyde solution **2** (0.70 mmol, 49 mg), terminal alkyne **3a** (0.45 mmol, 46 mg), CuI (30 mol%, 15 mg), molecular sieve (120 mg) in fluorobenzene (1.0 mL) under argon. Then, the tube stirred at 80 °C for 24 h (monitored by TLC). After cooling to room temperature, the solid was removed by filtration of the reaction mixture through a pad of celite. The filtrate was washed with DCM. The crude product was purified by flash column chromatography on silica gel (PE:EA=25:1) to afford the desired product **4a** (18%, 60.5 mg) and **6a** (71%, 40 mg).

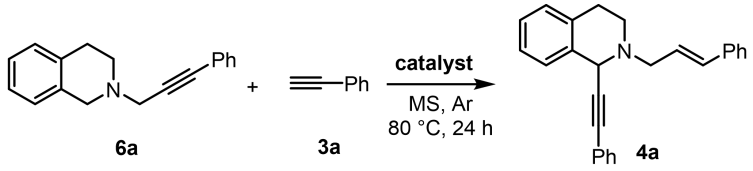
Using 20 mol% CdI_2 :

A vial tube was equipped with a magnetic stir bar and charged with amine **1a** (0.25 mmol, 33 mg), 37% formaldehyde solution **2** (0.70 mmol, 49 mg), terminal alkyne **3a** (0.45 mmol, 46 mg), CdI_2 (20 mol%, 16 mg), molecular sieve (120 mg) in fluorobenzene (1.0 mL) under argon. Then, the tube stirred at 80 °C for 24 h (monitored by TLC). After cooling to room temperature, the solid was removed by filtration of the reaction mixture through a pad of celite. The filtrate was washed with DCM. The crude product was purified by flash column chromatography on silica gel (PE:EA=25:1) to afford the desired product **4a** (60%, 45.4 mg) and **6a** (10%, 5.6 mg).

Using 30 mol% CdI_2:

A vial tube was equipped with a magnetic stir bar and charged with amine **1a** (0.25 mmol, 33 mg), 37% formaldehyde solution **2** (0.70 mmol, 49 mg), terminal alkyne **3a** (0.45 mmol, 46 mg), CdI_2 (30 mol%, 25 mg), molecular sieve (120 mg) in fluorobenzene (1.0 mL) under argon. Then, the tube stirred at 80 °C for 24 h (monitored by TLC). After cooling to room temperature, the solid was removed by filtration of the reaction mixture through a pad of celite. The filtrate was washed with DCM. The crude product was purified by flash column chromatography on silica gel (PE:EA=25:1) to afford the desired product **4a** (67%, 50.7 mg) and **6a** (3%, 1.7 mg).

Synthesis of 4a



Using 10 mol% CuI/20 mol% CdI_2:

A vial tube was equipped with a magnetic stir bar and charged with propargylamine **6a** (0.25 mmol, 61.8 mg), terminal alkyne **3a** (0.225 mmol, 23 mg), CuI/CdI_2 (10 mol%/20 mol% 4 mg/16 mg), molecular sieve (120 mg) in fluorobenzene (1.0 mL) under argon. Then, the tube stirred at 80 °C for 24 h (monitored by TLC). After cooling to room temperature, the solid was removed by filtration of the reaction mixture through a pad of celite. The filtrate was washed with DCM. The crude product was purified by flash column chromatography on silica gel (PE:EA=25:1) to afford the desired product **4a** (85%, 64.3 mg), and **6a** in 7% recovery.

Using 10 mol% CuI:

A vial tube was equipped with a magnetic stir bar and charged with propargylamine **6a** (0.25 mmol, 61.8 mg), terminal alkyne **3a** (0.225 mmol, 23 mg), CuI (10 mol%, 4 mg), molecular sieve (120 mg) in fluorobenzene (1.0 mL) under argon. Then, the tube stirred at 80 °C for 24 h (monitored by TLC). After cooling to room temperature, the solid was removed by filtration of the reaction mixture through a pad of celite. The filtrate was washed with DCM. The crude product was purified by flash column chromatography on silica gel (PE:EA=25:1) to afford the desired product **4a**(9%, 6.8 mg) and **6a** in 89% recovery.

Using 30 mol% CuI:

A vial tube was equipped with a magnetic stir bar and charged with propargylamine **6a** (0.25 mmol, 61.8 mg), terminal alkyne **3a** (0.225 mmol, 23 mg), CuI (30 mol%, 15 mg), molecular sieve (120 mg) in fluorobenzene (1.0 mL) under argon. Then, the tube stirred at 80 °C for 24 h (monitored by TLC). After cooling to room temperature, the solid was removed by filtration of the reaction mixture through a pad of celite. The filtrate was washed with DCM. The crude product was purified by flash column

chromatography on silica gel (PE:EA=25:1) to afford the desired product **4a** (17%, 57.1 mg)and **6a** in 73% recovery.

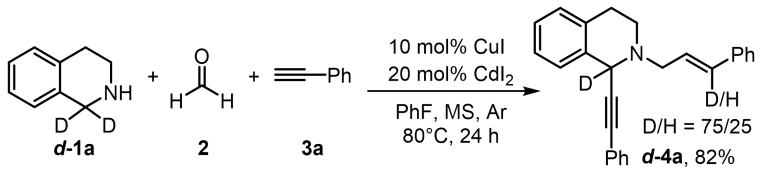
Using 20 mol% CdI_2:

A vial tube was equipped with a magnetic stir bar and charged with propargylamine **6a** (0.25 mmol, 61.8 mg), terminal alkyne **3a** (0.225 mmol 23 mg), CdI_2 (20 mol%, 16 mg), molecular sieve (120 mg) in fluorobenzene (1.0 mL) under argon. Then, the tube stirred at 80 °C for 24 h (monitored by TLC). After cooling to room temperature, the solid was removed by filtration of the reaction mixture through a pad of celite. The filtrate was washed with DCM. The crude product was purified by flash column chromatography on silica gel (PE:EA=25:1) to afford the desired product **4a** (88%, 66.6 mg) and **6a** in 5% recovery.

Using 30 mol% CdI_2:

A vial tube was equipped with a magnetic stir bar and charged with propargylamine **6a** (0.25 mmol, 61.8 mg), terminal alkyne **3a** (0.225 mmol, 23 mg), CdI_2 (30 mol%, 25 mg), molecular sieve (120 mg) in fluorobenzene (1.0 mL) under argon. Then, the tube stirred at 80 °C for 24 h (monitored by TLC). After cooling to room temperature, the solid was removed by filtration of the reaction mixture through a pad of celite. The filtrate was washed with DCM. The crude product was purified by flash column chromatography on silica gel (PE:EA=25:1) to afford the desired product **4a** in (92%, 69.6 mg).

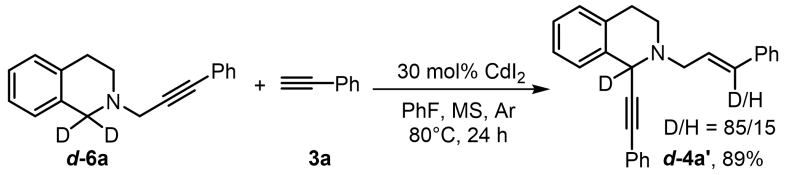
Synthesis of *d*-4a



A vial tube was equipped with a magnetic stir bar and charged with amine ***d*-1a** (0.25 mmol, 33.8 mg), 37% formaldehyde solution **2** (0.70 mmol, 49 mg), terminal alkyne **3a** (0.45 mmol, 46 mg), CuI/CdI_2 (10 mol%/20 mol%, 4 mg/16 mg), molecular sieve (120 mg) in fluorobenzene (1.0 mL) under argon. Then, the tube stirred at 80 °C for

24 h (monitored by TLC). After cooling to room temperature, the solid was removed by filtration of the reaction mixture through a pad of celite. The filtrate was washed with DCM. The crude product was purified by flash column chromatography on silica gel (PE:EA=25:1) to afford the desired product ***d*-4a** (82%, 65 mg).

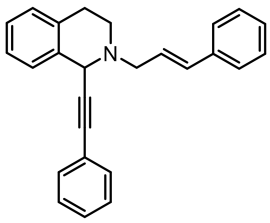
Synthesis of *d*-4a'



A vial tube was equipped with a magnetic stir bar and charged with propargylamine ***d*-6a** (0.25 mmol, 62.3 mg), terminal alkyne **3a** (0.225 mmol, 23 mg), CdI_2 (30 mol%, 25 mg), molecular sieve (120 mg) in fluorobenzene (1.0 mL) under argon. Then, the tube stirred at 80 °C for 24 h (monitored by TLC). After cooling to room temperature, the solid was removed by filtration of the reaction mixture through a pad of celite. The filtrate was washed with DCM. The crude product was purified by flash column chromatography on silica gel (PE:EA=25:1) to afford the desired product ***d*-4a'** (89% 70.5 mg).

Characterization data

2-Cinnamyl-1-(phenylethynyl)-1,2,3,4-tetrahydroisoquinoline **(4a)**



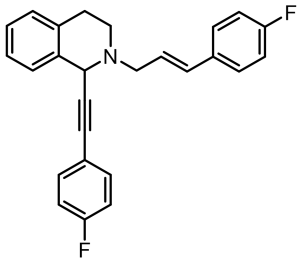
Purified by silica gel column chromatography (PE:EA=25:1) afforded **4a** (67.6 mg, 86% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.50-7.44 (m, 4H), 7.39-7.32 (m, 6H), 7.31-7.28 (m, 1H), 7.24-7.15 (m, 3H), 6.74 (d, *J* = 15.8 Hz, 1H), 6.47-6.37 (m, 1H), 4.98 (s, 1H), 3.62 (d, *J* = 6.8 Hz, 2H), 3.17-3.04 (m, 2H), 2.98-2.83 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-d) δ 137.1, 135.4, 133.9, 133.4, 131.8, 129.1, 128.6, 128.3, 128.1, 127.9, 127.6, 127.1, 126.7, 126.5, 125.9, 123.2, 87.3, 86.9, 57.8, 54.7, 45.8, 28.9.

HRMS m/z (ESI-TOF): Calculated for $C_{26}H_{24}N([M+H]^+)$ 350.1903, found 350.1894.

(E)-2-(3-(4-fluorophenyl)allyl)-1-((4-fluorophenyl)ethynyl)-1,2,3,4-tetrahydroisoquinoline (**4b**)



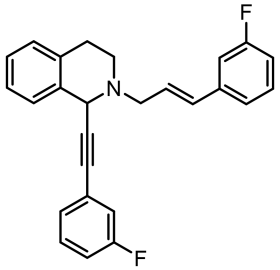
Purified by silica gel column chromatography (PE:EA=20:1) afforded **4b** (71.1 mg, 82% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.49-7.43 (m, 4H), 7.40-7.35 (m, 1H), 7.26-7.19 (m, 3H), 7.10-7.03 (m, 4H), 6.72 (d, *J* = 15.8 Hz, 1H), 6.45-6.27 (m, 1H), 5.00 (s, 1H), 3.72-3.54 (m, 2H), 3.20-3.08 (m, 2H), 3.02-2.86 (m, 2H).

^{19}F NMR (376 MHz, Chloroform-d) δ -111.1, -114.3.

^{13}C NMR (101 MHz, Chloroform-d) δ 163.4 (d, $J_{(C-F)}$ = 10.6 Hz), 161.4 (d, $J_{(C-F)}$ = 8.3 Hz), 135.2, 133.9, 133.7 (d, $J_{(C-F)}$ = 8.3 Hz), 133.2 (d, $J_{(C-F)}$ = 3.2 Hz), 132.2, 129.1, 128.0 (d, $J_{(C-F)}$ = 7.9 Hz), 127.8, 127.2, 126.5 (d, $J_{(C-F)}$ = 2.1 Hz), 126.0, 119.3, 119.3, 115.6 (d, $J_{(C-F)}$ = 2.1 Hz), 115.5 (d, $J_{(C-F)}$ = 2.4 Hz), 86.9, 85.8, 57.7, 54.6, 45.8, 28.8.

(E)-2-(3-(3-fluorophenyl)allyl)-1-((3-fluorophenyl)ethynyl)-1,2,3,4-tetrahydroisoquinoline (**4c**)



Purified by silica gel column chromatography (PE:EA=20:1) afforded **4c** (70.8 mg, 81% yield) as yellow oil.

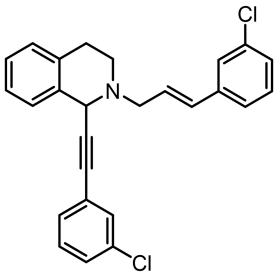
^{1}H NMR (400 MHz, Chloroform-d) δ 7.34-7.27 (m, 3H), 7.27-7.23 (m, 2H), 7.22 (d, *J* = 2.9 Hz, 2H), 7.19-7.13 (m, 3H), 7.06-7.01 (m, 1H), 7.00-6.94 (m, 1H), 6.69 (d, *J* = 15.8 Hz, 1H), 6.45-6.37 (m, 1H), 4.95 (s, 1H), 3.59 (d, *J* = 6.5 Hz, 2H), 3.13-3.05 (m, 2H), 2.97-2.84 (m, 2H).

^{19}F NMR (376 MHz, Chloroform-d) δ -112.9, -113.3.

^{13}C NMR (101 MHz, Chloroform-d) δ 163.2 (d, $J_{(C-F)}$ = 245.4 Hz), 162.4 (d, $J_{(C-F)}$ = 246.5 Hz), 139.4 (d, $J_{(C-F)}$ = 7.6 Hz), 135.0, 133.9, 132.2 (d, $J_{(C-F)}$ = 2.4 Hz), 130.1 (d, $J_{(C-F)}$ = 8.4 Hz), 129.9 (d, $J_{(C-F)}$ = 8.6 Hz), 129.2, 128.2, 127.8 (d, $J_{(C-F)}$ = 9.8 Hz), 127.7, 127.3, 126.1, 125.0 (d, $J_{(C-F)}$ = 9.4 Hz), 122.3 (d, $J_{(C-F)}$ = 2.8 Hz), 118.6 (d, $J_{(C-F)}$ = 22.8 Hz), 115.5 (d, $J_{(C-F)}$ = 21.2 Hz), 114.4 (d, $J_{(C-F)}$ = 21.3 Hz), 113.0 (d, $J_{(C-F)}$ = 21.8 Hz), 88.3, 85.8 (d, $J_{(C-F)}$ = 3.3 Hz), 57.6, 54.6, 45.8, 28.8.

HRMS m/z (ESI-TOF): Calculated for $C_{26}H_{22}F_2N$ ($[M+H]^+$) 386.1715, found 386.1709.

(E)-2-(3-(3-chlorophenyl)allyl)-1-((3-chlorophenyl)ethynyl)-1,2,3,4-tetrahydroisoquinoline (**4d**)



Purified by silica gel column chromatography (PE:EA=20:1) afforded **4d** (74.1 mg, 79% yield) as yellow oil.

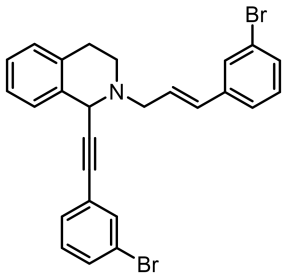
^{1}H NMR (400 MHz, Chloroform-d) δ 7.46-7.42 (m, 2H), 7.37-7.32 (m, 2H), 7.31-7.28 (m, 3H), 7.27-7.24 (m, 2H), 7.23-7.21 (m, 2H), 7.19-7.16 (m, 1H), 6.66 (d, *J* = 14.4 Hz, 1H), 6.46-6.37 (m, 1H), 4.95 (s, 1H), 3.59 (d, *J* = 6.7 Hz, 2H), 3.14-3.06 (m, 2H), 2.97-2.83 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-d) δ 138.8, 134.8, 134.6, 134.1, 133.8, 132.0, 131.7, 129.9, 129.8, 129.5, 129.1, 128.4, 128.2, 127.7, 127.5, 127.2, 126.5, 126.0, 124.8, 124.6, 88.6, 85.6, 57.6, 54.6, 45.8, 28.8.

HRMS m/z (ESI-TOF): Calculated for $C_{26}H_{22}Cl_2N$ ($[M+H]^+$) 418.1124, found

418.1118.

(E)-2-(3-(3-bromophenyl)allyl)-1-((3-bromophenyl)ethynyl)-1,2,3,4-tetrahydroisoquinoline (**4e**)



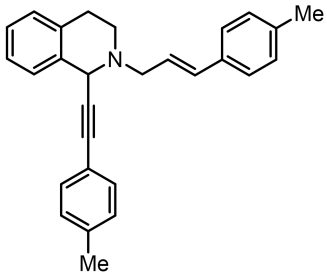
Purified by silica gel column chromatography (PE:EA=20:1) afforded **4e** (94.3 mg, 83% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.60 (d, *J* = 7.1 Hz, 2H), 7.47-7.31 (m, 5H), 7.24-7.16 (m, 5H), 6.64 (d, *J* = 15.8 Hz, 1H), 6.44-6.35 (m, 1H), 4.94 (s, 1H), 3.57 (d, *J* = 8.1 Hz, 2H), 3.12-3.04 (m, 2H), 2.96-2.82 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-d) δ 139.1, 134.9, 134.5, 133.8, 131.9, 131.3, 130.4, 130.3, 130.1, 129.7, 129.4, 129.1, 128.3, 127.7, 127.2, 126.0, 125.1, 125.0, 122.8, 122.1, 88.7, 85.5, 57.6, 54.6, 45.8, 28.8.

HRMS m/z (ESI-TOF): Calculated for $C_{26}H_{22}Br_2N$ ($[M+H]^+$) 506.0114, found 506.0114.

(E)-2-(3-(p-tolyl)allyl)-1-(p-tolylethynyl)-1,2,3,4-tetrahydroisoquinoline (**4f**)



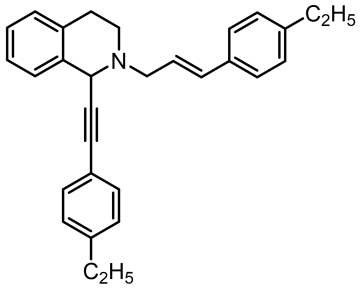
Purified by silica gel column chromatography (PE:EA=20:1) afforded **4f** (67.9 mg, 80% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.28-7.18 (m, 5H), 7.10-6.99 (m, 7H), 6.57 (d, *J* = 15.8 Hz, 1H), 6.35-6.09 (m, 1H), 4.84 (s, 1H), 3.57-3.37 (m, 2H), 3.04-2.91 (m, 2H), 2.84-2.67 (m, 2H), 2.25 (d, *J* = 2.9 Hz, 6H).

^{13}C NMR (101 MHz, Chloroform-d) δ 138.2, 137.4, 135.5, 134.3, 133.9, 133.3, 131.7, 129.3, 129.0, 129.0, 127.9, 127.0, 126.4, 125.9, 125.6, 120.2, 86.9, 86.5, 57.9, 54.6, 45.7, 28.9, 21.5, 21.3.

HRMS m/z (ESI-TOF): Calculated for $C_{28}H_{28}N$ ($[M+H]^+$) 378.2216, found 378.2209.

(E)-2-(3-(4-ethylphenyl)allyl)-1-((4-ethylphenyl)ethynyl)-1,2,3,4-tetrahydroisoquinoline (**4g**)



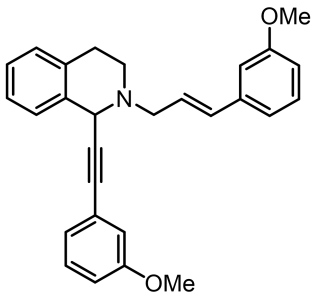
Purified by silica gel column chromatography (PE:EA=20:1) afforded **4g** (71.1 mg, 78% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.45-7.39 (m, 4H), 7.38-7.34 (m, 1H), 7.25-7.16 (m, 7H), 6.78-6.67 (m, 1H), 6.52-6.29 (m, 1H), 4.99 (s, 1H), 3.71-3.50 (m, 2H), 3.19-3.06 (m, 2H), 2.98-2.86 (m, 2H), 2.73-2.66 (m, 4H), 1.32-1.26 (m, 6H).

^{13}C NMR (101 MHz, Chloroform-d) δ 144.5, 143.8, 135.5, 134.6, 133.9, 133.3, 131.8, 129.0, 128.2, 127.9, 127.8, 127.0, 126.5, 125.9, 125.7, 120.4, 87.0, 86.6, 57.9, 54.7, 45.7, 28.9, 28.8, 28.7, 15.7, 15.5.

HRMS m/z (ESI-TOF): Calculated for $C_{30}H_{32}N$ ($[M+H]^+$) 406.2529, found 406.2528.

(E)-2-(3-(3-methoxyphenyl)allyl)-1-((3-methoxyphenyl)ethynyl)-1,2,3,4-tetrahydroisoquinoline (**4h**)



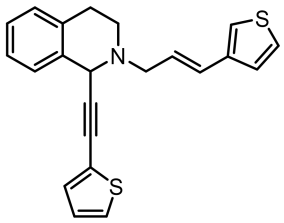
Purified by silica gel column chromatography (PE:EA=20:1) afforded **4h** (69.1 mg, 75% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.49 (d, *J* = 9.3 Hz, 1H), 7.40-7.33 (m, 2H), 7.25-7.10 (m, 5H), 7.04 (d, *J* = 16.0 Hz, 1H), 6.86 (t, *J* = 7.6 Hz, 4H), 6.47-6.34 (m, 1H), 4.99 (s, 1H), 3.85 (d, *J* = 15.0 Hz, 6H), 3.72-3.53 (m, 2H), 3.17-2.99 (m, 2H), 2.96-2.80 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-d) δ 137.0, 133.1, 131.6, 129.7, 129.6, 128.7, 128.4, 128.4, 128.4, 128.2, 122.6, 89.3, 83.6, 66.8, 58.3, 41.8, 38.9, 31.5, 30.2, 29.7.

HRMS m/z (ESI-TOF): Calculated for $C_{28}H_{28}NO_2$ ($[M+H]^+$) 410.2115, found 410.2125.

(E)-1-(thiophen-2-ylethynyl)-2-(3-(thiophen-3-yl)allyl)-1,2,3,4-tetrahydroisoquinoline (**4i**)



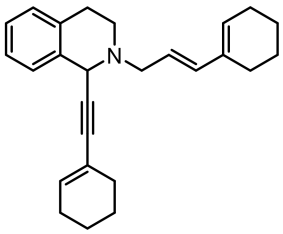
Purified by silica gel column chromatography (PE:EA=30:1) afforded **4i** (67.4 mg, 83% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.46 (d, *J* = 3.0 Hz, 1H), 7.37-7.30 (m, 3H), 7.29-7.27 (m, 1H), 7.26-7.21 (m, 3H), 7.20-7.18 (m, 1H), 7.16 (d, *J* = 5.0 Hz, 1H), 6.76 (d, *J* = 15.8 Hz, 1H), 6.31-6.24 (m, 1H), 4.98 (s, 1H), 3.58 (t, *J* = 6.1 Hz, 2H), 3.17-3.07 (m, 2H), 2.97-2.87 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-d) δ 139.8, 135.3, 133.9, 130.2, 129.1, 128.6, 127.9, 127.6, 127.1, 126.6, 126.2, 126.0, 125.2, 125.2, 122.2, 122.0, 86.9, 81.9, 57.7, 54.7, 45.8, 28.9.

HRMS m/z (ESI-TOF): Calculated for $C_{22}H_{20}NS_2$ ($[M+H]^+$) 362.1032, found 362.1023.

(E)-2-(3-(cyclohex-1-en-1-yl)allyl)-1-(cyclohex-1-en-1-ylethynyl)-1,2,3,4-tetrahydroi soquinoline (**4j**)



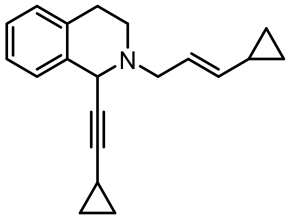
Purified by silica gel column chromatography (PE:EA=15:1) afforded **4j** (63.5 mg, 79% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.26-7.19 (m, 1H), 7.19-7.04 (m, 3H), 6.28 (d, J = 15.7 Hz, 1H), 6.06 (t, J = 4.0 Hz, 1H), 5.81-5.55 (m, 2H), 4.76 (s, 1H), 3.43-3.27 (m, 2H), 3.03-2.91 (m, 2H), 2.84-2.72 (m, 2H), 2.21-2.02 (m, 8H), 1.68 (s, 2H), 1.64-1.51 (m, 6H).

^{13}C NMR (101 MHz, Chloroform-d) δ 137.1, 136.0, 135.5, 134.4, 133.8, 129.2, 128.9, 127.8, 126.8, 125.8, 122.3, 120.5, 88.5, 84.3, 57.7, 54.5, 45.5, 29.5, 28.8, 25.9, 25.6, 24.6, 22.6, 22.5, 22.3, 21.5.

HRMS m/z (ESI-TOF): Calculated for $C_{26}H_{32}N$ ($[M+H]^+$) 358.2529, found 358.2519.

(E)-2-(3-cyclopropylallyl)-1-(3-cyclopropylprop-1-yn-1-yl)-1,2,3,4-tetrahydroisoquinoline (**4k**)



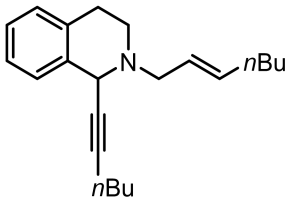
Purified by silica gel column chromatography (PE:EA=30:1) afforded **4k** (55.7 mg, 85% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.16-6.97 (m, 4H), 5.58-5.48 (m, 1H), 5.21-5.11 (m, 1H), 4.51 (s, 1H), 3.20-3.06 (m, 2H), 2.90-2.79 (m, 2H), 2.72-2.61 (m, 2H), 1.38-1.29 (m, 1H), 1.18-1.09 (m, 1H), 0.66-0.51 (m, 6H), 0.34-0.27 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-d) δ 138.7, 136.4, 134.1, 129.2, 128.0, 127.1, 126.1, 124.4, 90.4, 73.3, 57.6, 54.4, 45.5, 29.1, 13.9, 8.8, 7.16, 7.08.

HRMS m/z (ESI-TOF): Calculated for $C_{20}H_{24}N$ ($[M+H]^+$) 278.1903, found 278.1898.

(E)-2-(hept-2-en-1-yl)-1-(hex-1-yn-1-yl)-1,2,3,4-tetrahydroisoquinoline (**4l**)



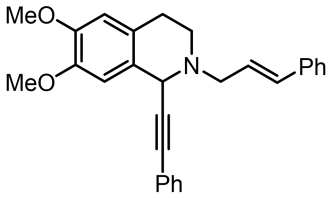
Purified by silica gel column chromatography (PE:EA=45:1) afforded **4l** (55.7 mg, 80% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.15-7.12 (m, 1H), 7.06-7.01 (m, 2H), 7.01-6.96 (m, 1H), 5.67-5.59 (m, 1H), 5.50-5.42 (m, 1H), 4.53 (s, 1H), 3.22-3.12 (m, 2H), 2.89-2.81 (m, 2H), 2.72-2.62 (m, 2H), 2.13-2.09 (m, 2H), 2.02-1.96 (m, 2H), 1.42-1.34 (m, 3H), 1.33 (s, 5H), 0.87-0.78 (m, 6H).

^{13}C NMR (101 MHz, Chloroform-d) δ 136.3, 134.9, 133.8, 128.9, 127.7, 126.7, 126.5, 125.7, 86.9, 57.4, 54.1, 45.3, 32.1, 31.5, 31.1, 28.9, 22.3, 22.0, 18.6, 14.0, 13.6.

HRMS m/z (ESI-TOF): Calculated for $C_{22}H_{32}N$ ($[M+H]^+$) 310.2529, found 310.2520.

2-Cinnamyl-6,7-dimethoxy-1-(phenylethynyl)-1,2,3,4-tetrahydroisoquinoline (**4m**)



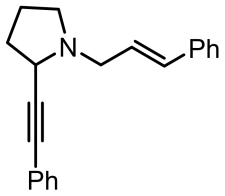
Purified by silica gel column chromatography (PE:EA=10:1) afforded **4m** (82.9 mg, 90% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.39-7.32 (m, 4H), 7.27-7.20 (m, 5H), 7.17 (d, *J* = 3.2 Hz, 1H), 6.70 (s, 1H), 6.62 (d, *J* = 15.8 Hz, 1H), 6.53 (s, 1H), 6.36-6.25 (m, 1H), 4.78 (s, 1H), 3.77 (d, *J* = 1.5 Hz, 6H), 3.48 (d, *J* = 6.3 Hz, 2H), 3.04-2.86 (m, 2H), 2.84-2.75 (m, 1H), 2.72-2.64 (m, 1H).

^{13}C NMR (101 MHz, Chloroform-d) δ 148.2, 147.4, 136.9, 133.5, 131.8, 128.6, 128.3, 128.1, 127.6, 127.1, 126.5, 126.4, 125.8, 123.1, 111.3, 110.3, 87.2, 86.8, 57.7, 56.0, 55.8, 54.0, 45.8, 28.7.

HRMS m/z (ESI-TOF): Calculated for $C_{28}H_{28}NO_2$ ($[M+H]^+$) 410.2115, found 410.2108.

1-Cinnamyl-2-(phenylethynyl)pyrrolidine (**4n**)

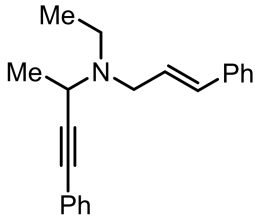


Purified by silica gel column chromatography (PE:EA=25:1) afforded **4n** (38.1 mg, 59% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.39-7.27 (m, 4H), 7.25-7.18 (m, 5H), 7.18-7.12 (m, 1H), 6.52 (d, *J* = 16.0 Hz, 1H), 6.36-6.25 (m, 1H), 3.66-3.53 (m, 2H), 3.22-3.14 (m, 1H), 2.89-2.80 (m, 1H), 2.55-2.45 (m, 1H), 2.20-2.08 (m, 1H), 2.02-1.85 (m, 2H), 1.81-1.72 (m, 1H).

^{13}C NMR (101 MHz, Chloroform-d) δ 137.2, 132.4, 131.8, 128.5, 128.2, 128.0, 127.4, 127.4, 126.4, 123.3, 88.7, 84.8, 55.6, 54.8, 51.9, 31.8, 22.1.

N-cinnamyl-N-ethyl-4-phenylbut-3-yn-2-amine (**4o**)



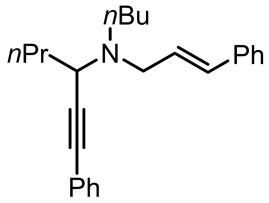
Purified by silica gel column chromatography (PE:EA=120:1) afforded **4o** (47.5 mg, 73% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.40-7.35 (m, 2H), 7.34-7.29 (m, 2H), 7.28-7.19 (m, 5H), 7.18-7.13 (m, 1H), 6.53 (d, *J* = 15.9 Hz, 1H), 6.28-6.17 (m, 1H), 3.59 (s, 2H), 3.29 (d, *J* = 6.9 Hz, 2H), 2.68-2.56 (m, 2H), 1.73 (s, 1H), 1.18 (s, 1H), 1.08 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-d) δ 137.0, 133.0, 131.7, 128.5, 128.2, 128.0, 127.5, 127.0, 126.3, 123.3, 85.4, 84.2, 56.2, 47.3, 41.9, 12.7, 1.0.

HRMS m/z (ESI-TOF): Calculated for $C_{21}H_{24}N$ ($[M+H]^+$) 290.1903, found 290.1904

N-butyl-N-cinnamyl-1-phenylhex-1-yn-3-amine (**4p)**



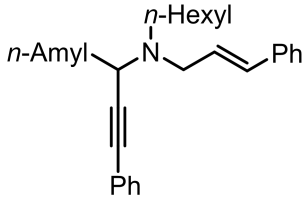
Purified by silica gel column chromatography (PE:EA=150:1) afforded **4p** (55.9 mg, 72% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.40-7.34 (m, 2H), 7.33-7.27 (m, 2H), 7.26-7.19 (m, 5H), 7.14 (t, *J* = 7.3 Hz, 1H), 6.50 (d, *J* = 15.9 Hz, 1H), 6.32-5.98 (m, 1H), 3.69 (t, *J* = 7.5 Hz, 1H), 3.51-3.33 (m, 1H), 3.24-3.03 (m, 1H), 2.64-2.53 (m, 1H), 2.46-2.35 (m, 1H), 1.68-1.59 (m, 2H), 1.53-1.38 (m, 4H), 1.31-1.23 (m, 2H), 0.91-0.82 (m, 6H).

^{13}C NMR (101 MHz, Chloroform-d) δ 137.3, 131.9, 131.8, 128.5, 128.3, 127.8, 127.3, 126.3, 123.6, 54.1, 53.6, 50.7, 36.2, 30.5, 30.3, 29.7, 20.7, 20.0, 14.2, 13.9, 1.1.

HRMS m/z (ESI-TOF): Calculated for $C_{25}H_{32}N$ ($[M+H]^+$) 346.2529, found 346.2519

N-cinnamyl-N-hexyl-1-phenyloct-1-yn-3-amine (**4q**)



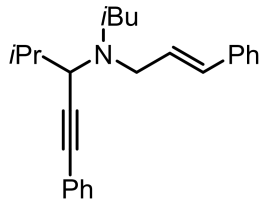
Purified by silica gel column chromatography (PE:EA=150:1) afforded **4q** (67.7 mg, 75% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.39-7.33 (m, 2H), 7.30 (d, *J* = 7.2 Hz, 3H), 7.26-7.18 (m, 5H), 7.17-7.12 (m, 1H), 6.49 (d, *J* = 15.9 Hz, 1H), 6.29-6.10 (m, 1H), 3.64 (t, *J* = 7.5 Hz, 1H), 3.45-3.35 (m, 1H), 3.19-3.05 (m, 1H), 2.61-2.52 (m, 1H), 2.44-2.33 (m, 1H), 1.65 (s, 1H), 1.49-1.36 (m, 4H), 1.29-1.17 (m, 11H), 0.84-0.78 (m, 6H).

^{13}C NMR (101 MHz, Chloroform-d) δ 137.4, 131.9, 131.8, 128.8, 128.5, 128.2, 127.8, 127.2, 126.3, 123.7, 88.9, 84.9, 54.1, 53.8, 51.0, 34.1, 31.9, 31.6, 29.7, 28.4, 27.2, 26.5, 22.7, 22.7, 14.1.

HRMS m/z (ESI-TOF): Calculated for $C_{29}H_{40}N$ ($[M+H]^+$) 402.3156, found 402.3146.

N-cinnamyl-N-isobutyl-4-methyl-1-phenylpent-1-yn-3-amine (**4r**)



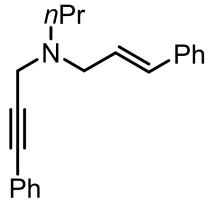
Purified by silica gel column chromatography (PE) afforded **4r** (72.2 mg, 93% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.52 (d, *J* = 7.9 Hz, 2H), 7.44 (d, *J* = 7.7 Hz, 2H), 7.39-7.32 (m, 5H), 7.28 (t, *J* = 7.3 Hz, 1H), 6.62 (d, *J* = 15.9 Hz, 1H), 6.38-6.25 (m, 1H), 3.53-3.48 (m, 1H), 3.26 (d, *J* = 10.2 Hz, 1H), 3.21-3.15 (m, 1H), 2.48-2.43 (m, 1H), 2.33-2.27 (m, 1H), 1.98-1.92 (m, 1H), 1.87-1.80 (m, 1H), 1.18-1.12 (m, 6H), 1.02 (d, *J* = 6.4 Hz, 3H), 0.95 (d, *J* = 6.6 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-d) δ 137.5, 131.8, 131.4, 129.4, 128.6, 128.3, 127.7, 127.2, 126.3, 123.8, 88.3, 85.5, 61.4, 59.6, 54.1, 31.2, 26.5, 21.2, 21.0, 20.9, 20.3.

HRMS m/z (ESI-TOF): Calculated for $C_{25}H_{32}N$ ($[M+H]^+$) 346.2529, found 346.2519.

(E)-N-isopropyl-3-phenyl-N-(3-phenylprop-2-yn-1-yl)prop-2-en-1-amine (**4s**)



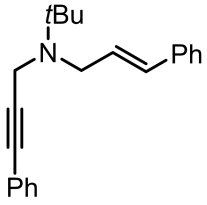
Purified by silica gel column chromatography (PE:EA=25:1) afforded **4s** (44.2 mg, 68% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.38-7.29 (m, 4H), 7.26-7.19 (m, 5H), 7.18-7.14 (m, 1H), 6.53 (d, *J* = 15.8 Hz, 1H), 6.27-6.19 (m, 1H), 3.58 (s, 2H), 3.36 (d, *J* = 6.8 Hz, 2H), 3.09-2.99 (m, 1H), 1.10 (d, *J* = 6.5 Hz, 6H).

^{13}C NMR (101 MHz, Chloroform-d) δ 171.2, 137.1, 132.6, 131.7, 128.6, 128.3, 127.9, 127.4, 126.4, 123.5, 86.2, 84.7, 60.4, 52.4, 51.3, 39.7, 21.1, 19.8, 14.2.

HRMS m/z (ESI-TOF): Calculated for $C_{21}H_{24}N$ ($[M+H]^+$) 290.1903, found 290.1899

(E)-N-(tert-butyl)-3-phenyl-N-(3-phenylprop-2-yn-1-yl)prop-2-en-1-amine (**4t**)



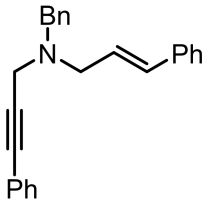
Purified by silica gel column chromatography (PE:EA=60:1) afforded **4t** (48.4 mg, 71% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.39-7.29 (m, 4H), 7.26-7.18 (m, 5H), 7.14 (t, *J* = 7.3 Hz, 1H), 6.55 (d, *J* = 15.8 Hz, 1H), 6.31-6.13 (m, 1H), 3.69 (s, 2H), 3.46 (d, *J* = 6.7 Hz, 2H), 1.21 (s, 9H).

^{13}C NMR (101 MHz, Chloroform-d) δ 137.3, 132.1, 131.5, 128.9, 128.5, 128.3, 127.8, 127.3, 126.4, 123.7, 55.2, 49.5, 37.3, 29.9, 27.8.

HRMS m/z (ESI-TOF): Calculated for $C_{22}H_{26}N$ ($[M+H]^+$) 304.2060, found 304.2056.

(E)-N-benzyl-3-phenyl-N-(3-phenylprop-2-yn-1-yl)prop-2-en-1-amine (**4u**)



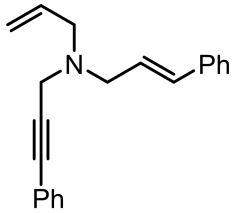
Purified by silica gel column chromatography (PE:EA=25:1) afforded **4u** (42.5 mg, 56% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.44-7.38 (m, 2H), 7.36-7.30 (m, 4H), 7.28 (d, *J* = 1.1 Hz, 1H), 7.27-7.24 (m, 4H), 7.23 (d, *J* = 1.7 Hz, 1H), 7.21 (d, *J* = 1.6 Hz, 1H), 7.20-7.13 (m, 2H), 6.56 (d, *J* = 15.9 Hz, 1H), 6.30-6.21 (m, 1H), 3.70 (s, 2H), 3.50 (s, 2H), 3.34 (d, *J* = 6.7 Hz, 2H).

^{13}C NMR (101 MHz, Chloroform-d) Chloroform-d) δ 138.6, 137.1, 133.1, 131.9, 131.8, 129.3, 128.6, 128.5, 128.4, 128.3, 128.2, 128.1, 127.5, 127.2, 126.4, 123.4, 85.9, 84.4, 57.7, 56.2, 42.3.

HRMS m/z (ESI-TOF): Calculated for $C_{25}H_{24}N$ ($[M+H]^+$) 338.1903, found 338.1895.

(E)-N-allyl-3-phenyl-N-(3-phenylprop-2-yn-1-yl)prop-2-en-1-amine (**4v**)



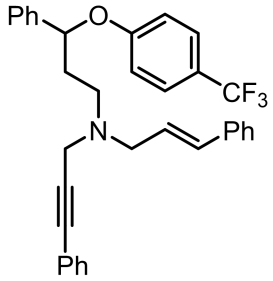
Purified by silica gel column chromatography (PE:EA=30:1) afforded **4v** (24.6 mg, 38% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.43-7.35 (m, 2H), 7.35-7.29 (m, 2H), 7.28-7.19 (m, 5H), 7.18-7.12 (m, 1H), 6.54 (d, *J* = 15.9 Hz, 1H), 6.30-6.12 (m, 1H), 5.93-5.68 (m, 1H), 5.30-5.05 (m, 2H), 3.58 (s, 2H), 3.44-3.00 (m, 4H).

^{13}C NMR (101 MHz, Chloroform-d) δ 137.0, 135.3, 133.3, 131.8, 128.6, 128.3, 128.1, 127.5, 126.4, 123.3, 118.4, 85.6, 84.3, 56.7, 55.9, 42.4, 1.1.

HRMS m/z (ESI-TOF): Calculated for $C_{21}H_{22}N$ ($[M+H]^+$) 288.1747, found 288.1744

(E)-3-phenyl-N-(3-phenyl-3-(4-(trifluoromethyl)phenoxy)propyl)-N-(3-phenylprop-2-yn-1-yl)prop-2-en-1-amine (**4w**)



Purified by silica gel column chromatography (PE:EA=5:1) afforded **4w** (73 mg, 62% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.47-7.39 (m, 6H), 7.37 (d, *J* = 1.8 Hz, 2H), 7.35 (d, *J* = 1.6 Hz, 4H), 7.34 (d, *J* = 1.4 Hz, 3H), 7.30-7.24 (m, 2H), 6.93 (d, *J* = 8.6 Hz, 2H), 6.61 (d, *J* = 15.8 Hz, 1H), 6.33-6.15 (m, 1H), 5.47-5.35 (m, 1H), 3.72 (s, 2H), 3.41 (d, *J* = 6.7 Hz, 2H), 3.00-2.69 (m, 2H), 2.34-2.24 (m, 1H), 2.15-2.06 (m, 1H).

122.3 (d, $J_{(C-F)}$ = 2.8 Hz)

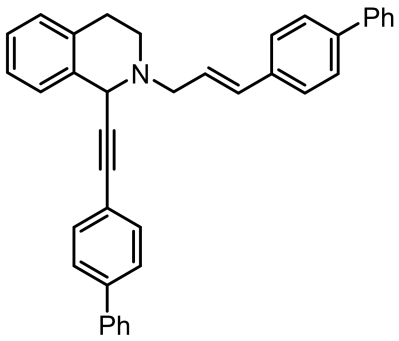
^{19}F NMR (376 MHz, Chloroform-d) δ -61.4.

^{13}C NMR (101 MHz, Chloroform-d) δ 160.7, 141.2, 136.9, 133.1, 131.8, 128.8, 128.6, 128.3, 128.1, 127.8, 127.6, 127.0, 126.9-126.6 (q, $J_{(C-F)}$ = 30.3 Hz), 126.4, 125.9, 123.3-122.3 (q, $J_{(C-F)}$ = 101 Hz) 115.8, 85.6, 84.3, 78.2, 77.4, 77.1, 76.8, 56.8, 49.1,

42.8, 36.7, 29.8.

HRMS m/z (ESI-TOF): Calculated for $C_{34}H_{31}F_3NO$ ($[M+H]^+$) 526.2352, found 526.2346.

(E)-2-(3-([1,1'-biphenyl]-4-yl)allyl)-1-([1,1'-biphenyl]-4-ylethynyl)-1,2,3,4-tetrahydro isoquinoline (**5**)



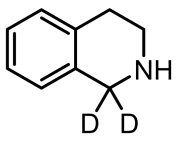
Purified by silica gel column chromatography (PE:EA=5:1) afforded **5** (105.1 mg, 84% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.68-7.56 (m, 6H), 7.56-7.48 (m, 6H), 7.44 (t, *J* = 7.6 Hz, 4H), 7.39-7.30 (m, 3H), 7.24-7.10 (m, 3H), 6.75 (d, *J* = 15.9 Hz, 1H), 6.54-6.31 (m, 1H), 4.98 (s, 1H), 3.62 (d, *J* = 7.1 Hz, 2H), 3.18-3.02 (m, 2H), 3.00-2.79 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-d) δ 139.8, 139.6, 139.3, 135.0, 134.1, 132.8, 131.9, 131.2, 128.0, 127.8, 127.7, 126.8, 126.5, 126.2, 126.0, 125.9, 125.9, 125.8, 125.8, 125.6, 124.9, 121.0, 86.9, 85.7, 56.8, 53.6, 44.7, 28.7, 27.8.

HRMS m/z (ESI-TOF): Calculated for $C_{38}H_{32}N$ ($[M+H]^+$) 502.2529, found 502.2523.

1,2,3,4-tetrahydroisoquinoline-1,1-d_2 (***d*-1a**)

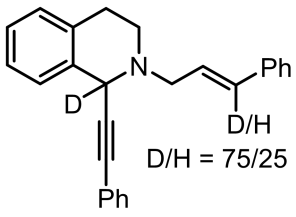


Purified by silica gel column chromatography (EA) afforded ***d*-1a** (121.6 mg, 90% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.07-7.01 (m, 2H), 7.01-6.94 (m, 1H), 6.93-6.86 (m, 1H), 3.03 (t, *J* = 6.0 Hz, 2H), 2.69 (t, *J* = 6.0 Hz, 2H), 2.07 (s, 1H).

^{13}C NMR (101 MHz, Chloroform-d) δ 135.7, 134.8, 129.3, 126.3, 126.1, 125.8, 43.8, 29.1.

(E)-2-(3-phenylallyl-3-d)-1-(phenylethynyl)-1,2,3,4-tetrahydroisoquinoline-1-d (***d*-4a**)



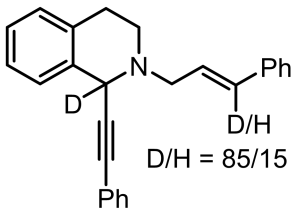
Purified by silica gel column chromatography (PE:EA=15:1) afforded ***d*-4a** (64.8 mg, 82% yield) as yellow oil.

^{1}H NMR (400 MHz, Chloroform-d) δ 7.45-7.40 (m, 4H), 7.36-7.28 (m, 6H), 7.25-7.10 (m, 4H), 6.43-6.32 (m, 1H), 3.57 (d, *J* = 6.9 Hz, 2H), 3.16-3.00 (m, 2H), 2.97-2.78 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-d) δ 137.0, 135.3, 133.9, 131.8, 129.1, 128.7, 128.3, 128.1, 127.8, 127.6, 127.1, 126.6, 126.4, 125.9, 123.2, 87.2, 86.9, 57.7, 45.7, 29.8, 28.9, 1.1.

HRMS m/z (ESI-TOF): Calculated for $C_{26}H_{22}D_2N$ ($[M+H]^+$) 352.2029, found 352.2025.

(E)-2-(3-phenylallyl-3-d)-1-(phenylethynyl)-1,2,3,4-tetrahydroisoquinoline-1-d (***d*-4a'**)



Purified by silica gel column chromatography (PE:EA=15:1) afforded ***d*-4a'** (70.5 mg, 89% yield) as yellow oil.

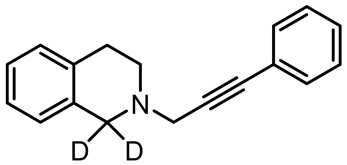
^{1}H NMR (400 MHz, Chloroform-d) δ 7.38-7.31 (m, 4H), 7.28-7.19 (m, 6H), 7.18-7.15 (m, 1H), 7.11-7.03 (m, 3H), 6.36-6.22 (m, 1H), 3.49 (d, *J* = 6.8 Hz, 2H), 3.06-2.92 (m, 2H), 2.89-2.69 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-d) δ 137.0, 135.3, 133.9, 131.8, 129.1, 128.7, 128.3,

128.1, 127.8, 127.6, 127.1, 126.6, 126.4, 125.9, 123.2, 87.2, 86.9, 57.7, 45.7, 29.8, 28.9, 1.1.

HRMS m/z (ESI-TOF): Calculated for $C_{26}H_{22}D_2N$ ($[M+H]^+$) 352.2029, found 352.2031.

2-(3-phenylprop-2-yn-1-yl)-1,2,3,4-tetrahydroisoquinoline-1,1-d_2 (***d*-6a**)



Purified by silica gel column chromatography (PE:EA=15:1) afforded ***d*-6a** (40 mg, 71% yield) as yellow oil.

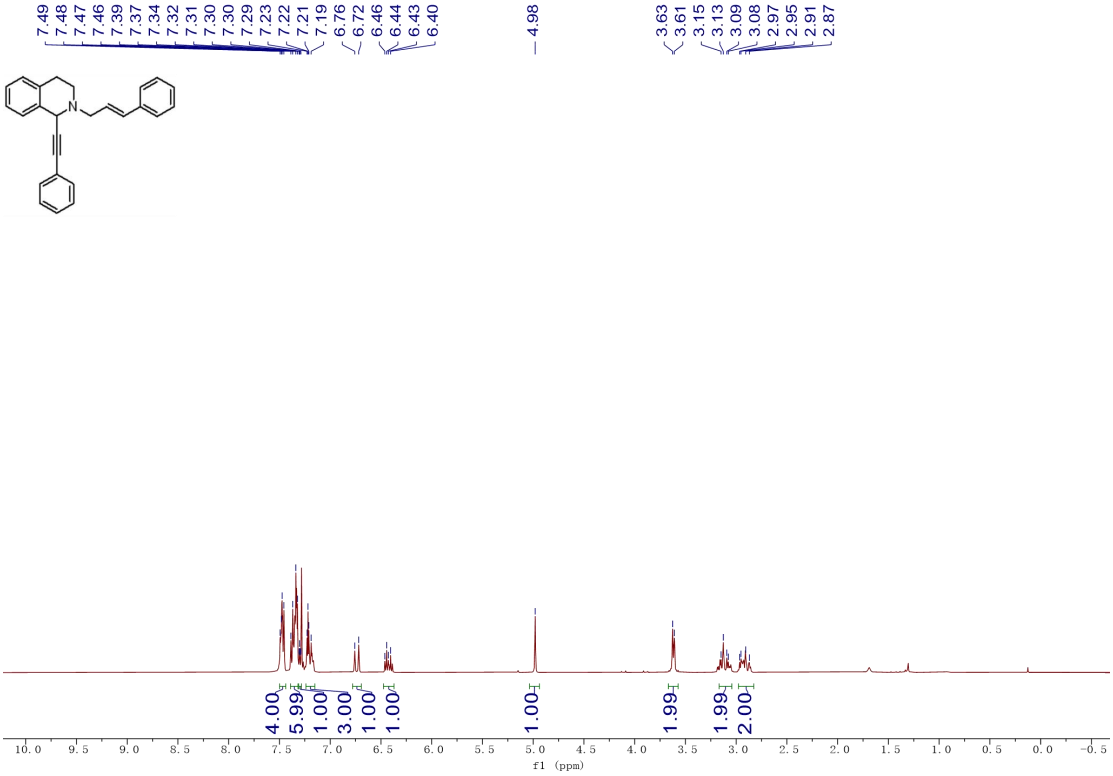
^{1}H NMR (400 MHz, Chloroform-d) δ 7.47-7.40 (m, 2H), 7.31-7.24 (m, 3H), 7.12 (d, *J* = 5.2 Hz, 3H), 7.07-7.02 (m, 1H), 3.72 (s, 2H), 2.98-2.94 (m, 2H), 2.90 (t, *J* = 5.4 Hz, 2H).

^{13}C NMR (101 MHz, Chloroform-d) δ 134.5, 133.9, 131.8, 128.7, 128.3, 128.2, 126.7, 126.2, 125.7, 123.2, 85.5, 84.5, 53.8, 49.9, 47.6, 29.3.

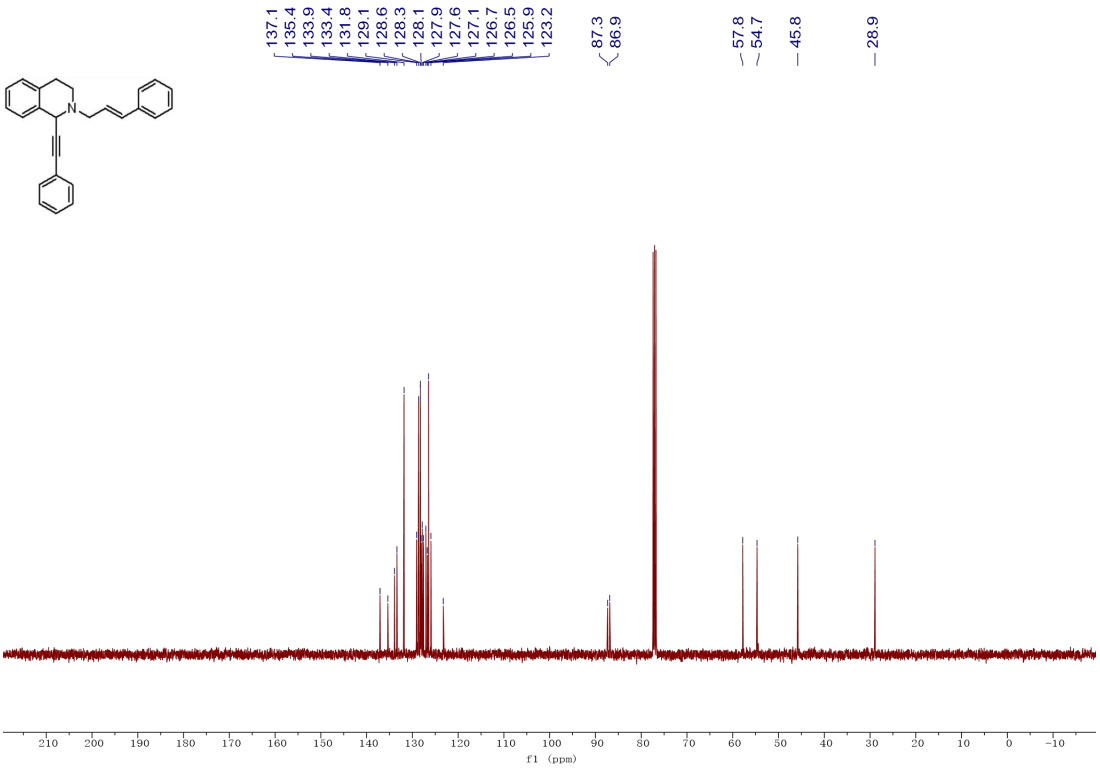
HRMS m/z (ESI-TOF): Calculated for $C_{18}H_{16}D_2N$ ($[M+H]^+$) 250.1559, found 250.1559.

^{1}H NMR, ^{19}F NMR and^{13}C NMR spectra

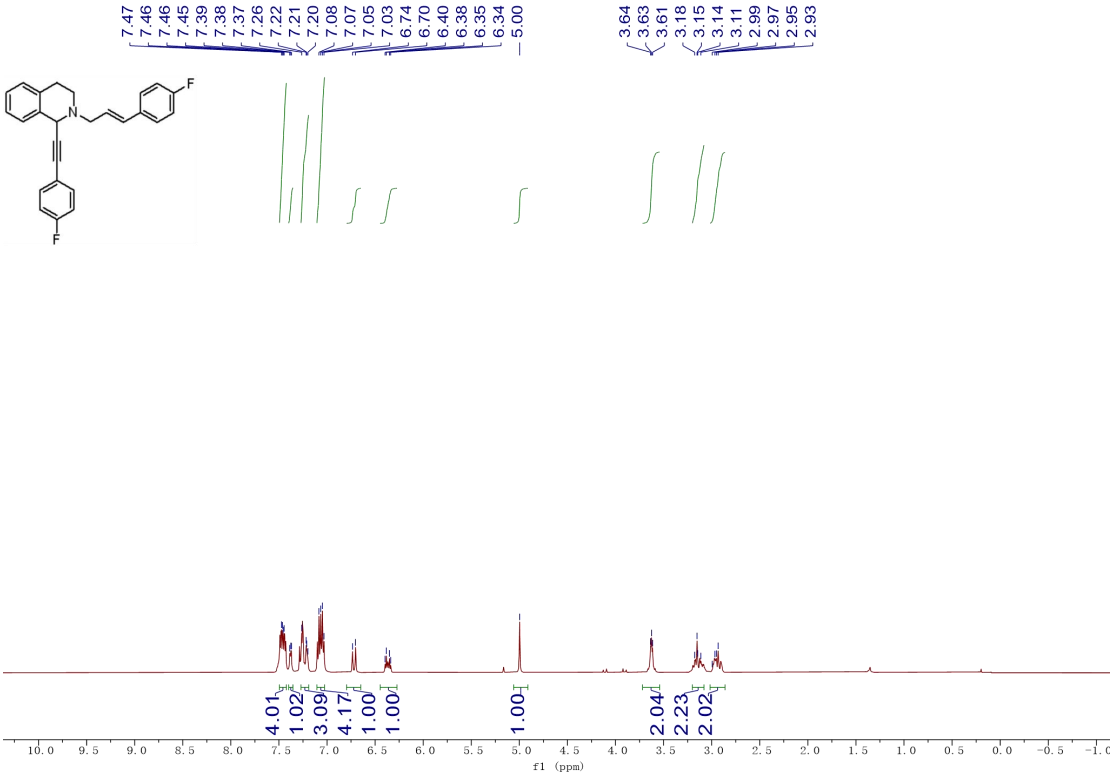
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4a**



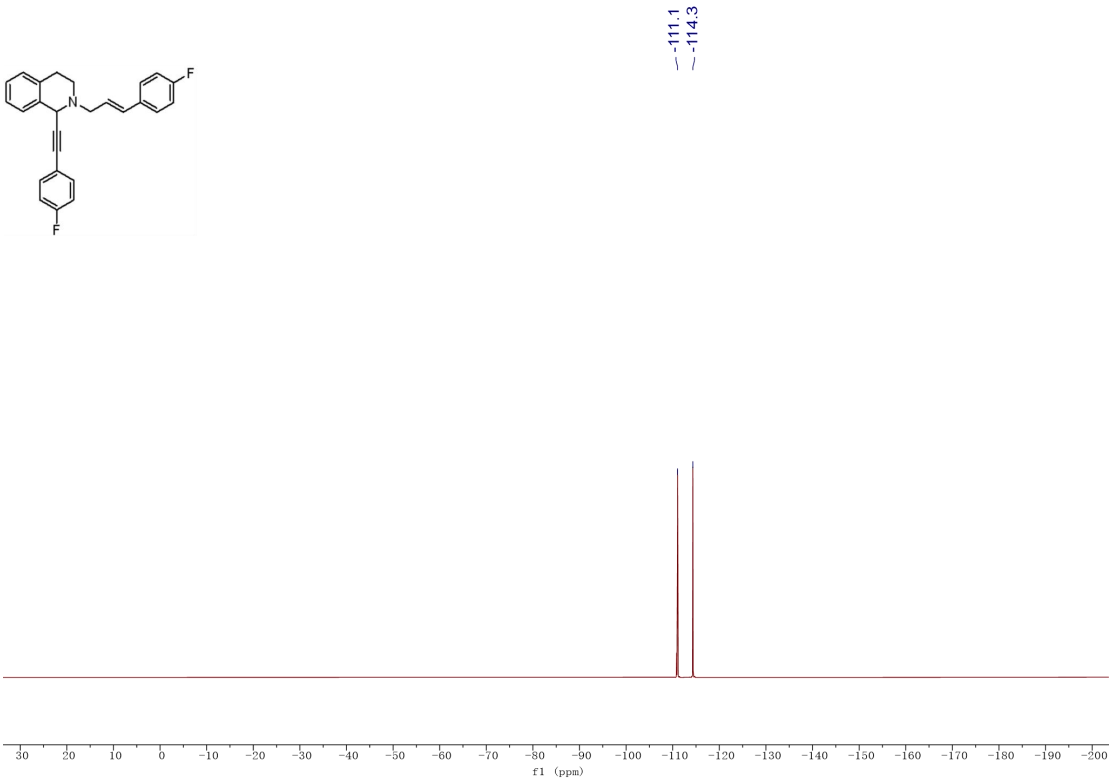
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4a**



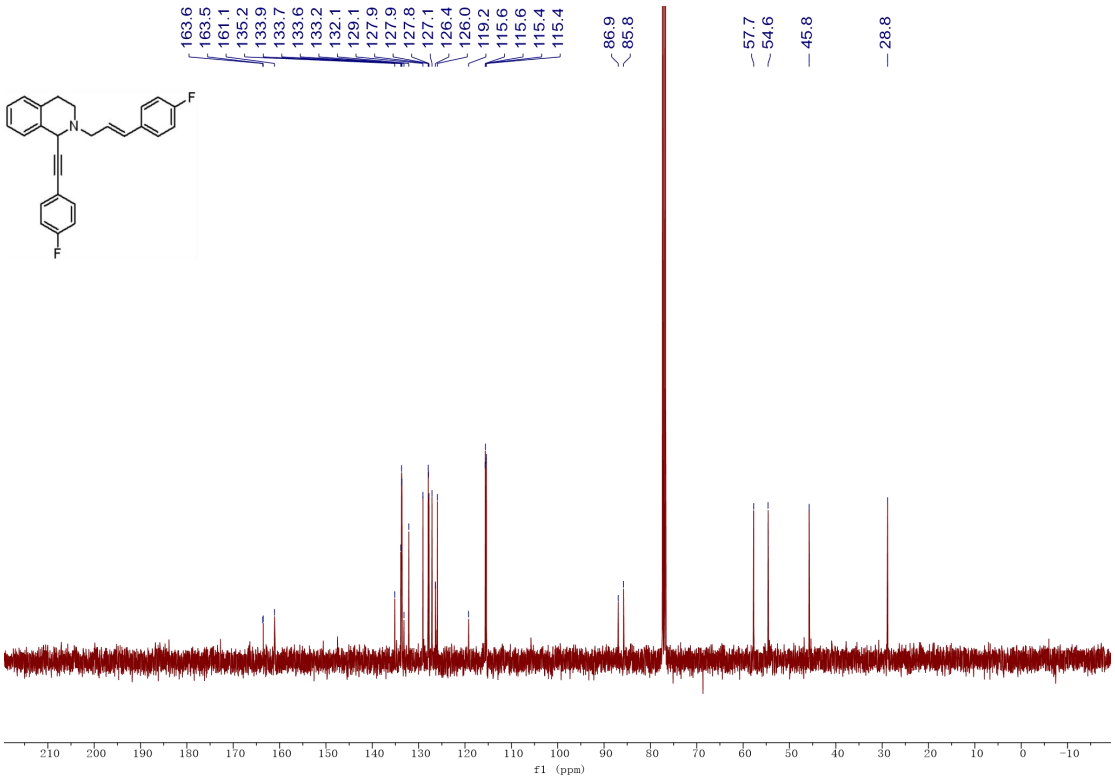
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4b**



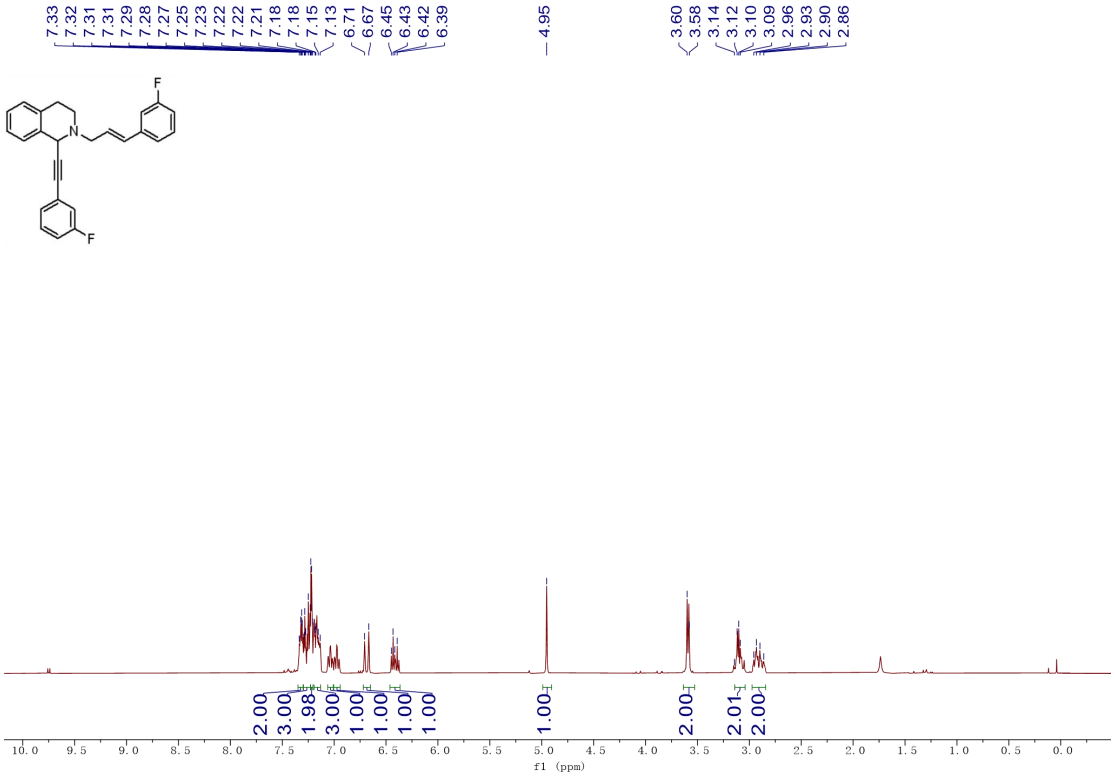
^{19}F NMR (376 MHz, Chloroform-d) Spectrum of compound **4b**



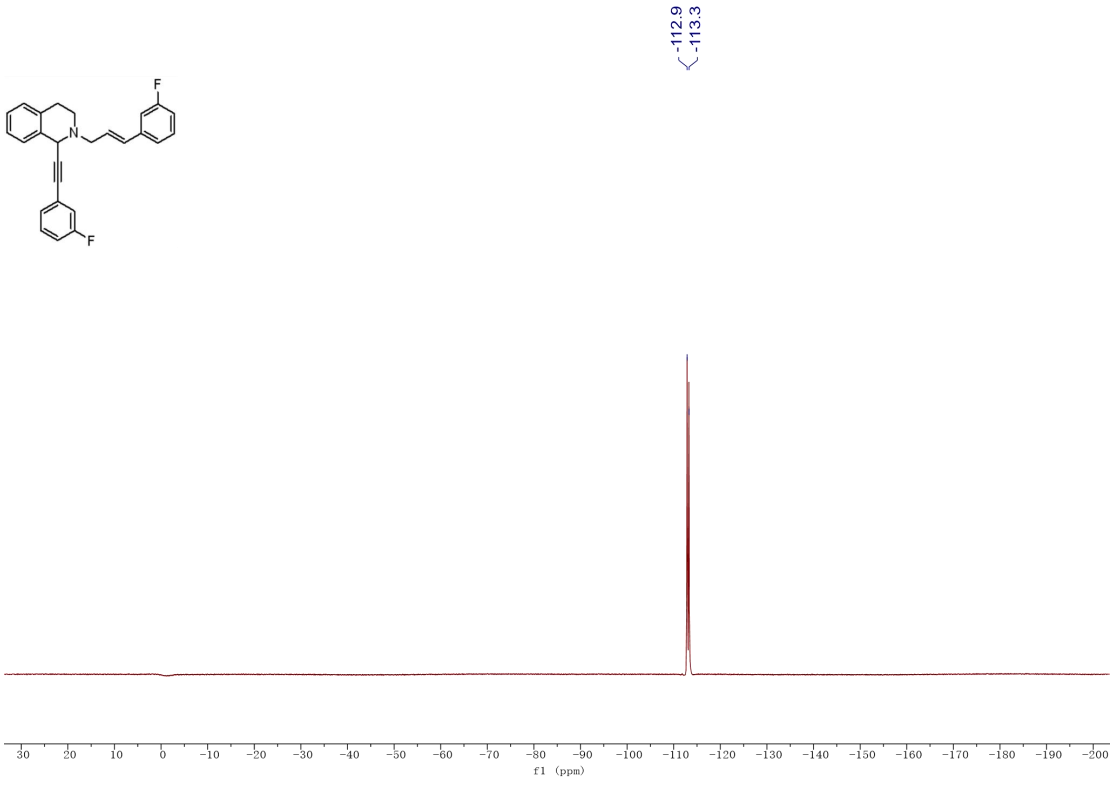
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4b**



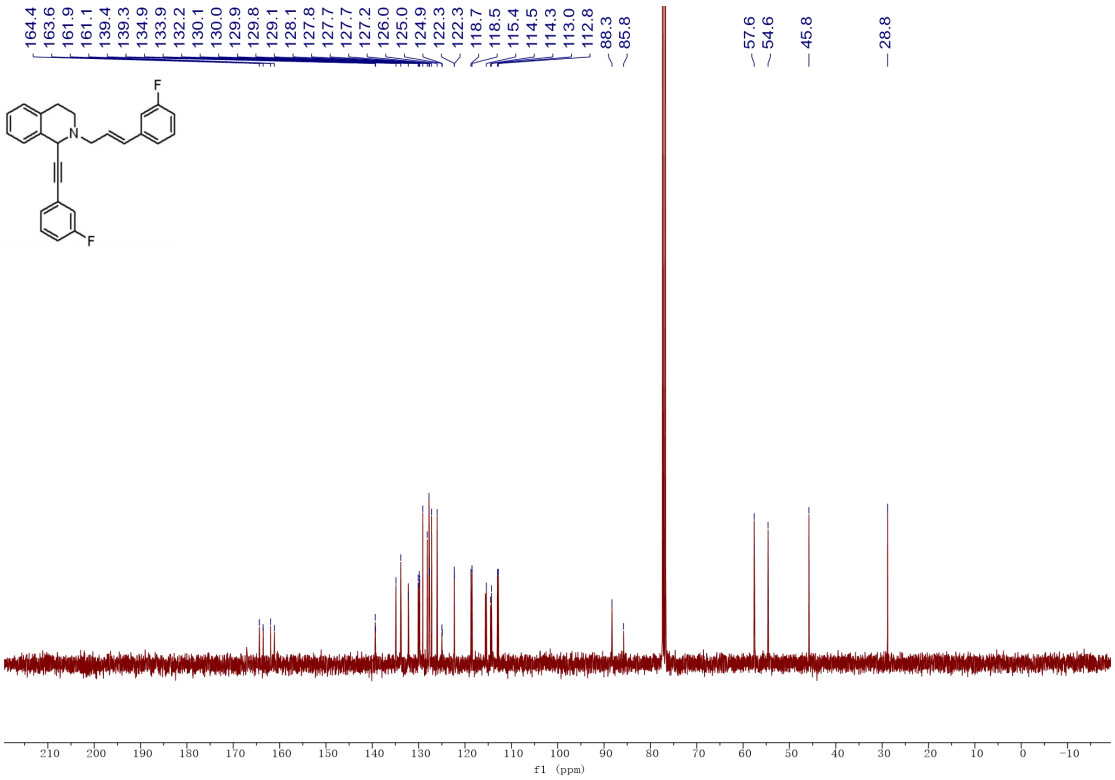
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4c**



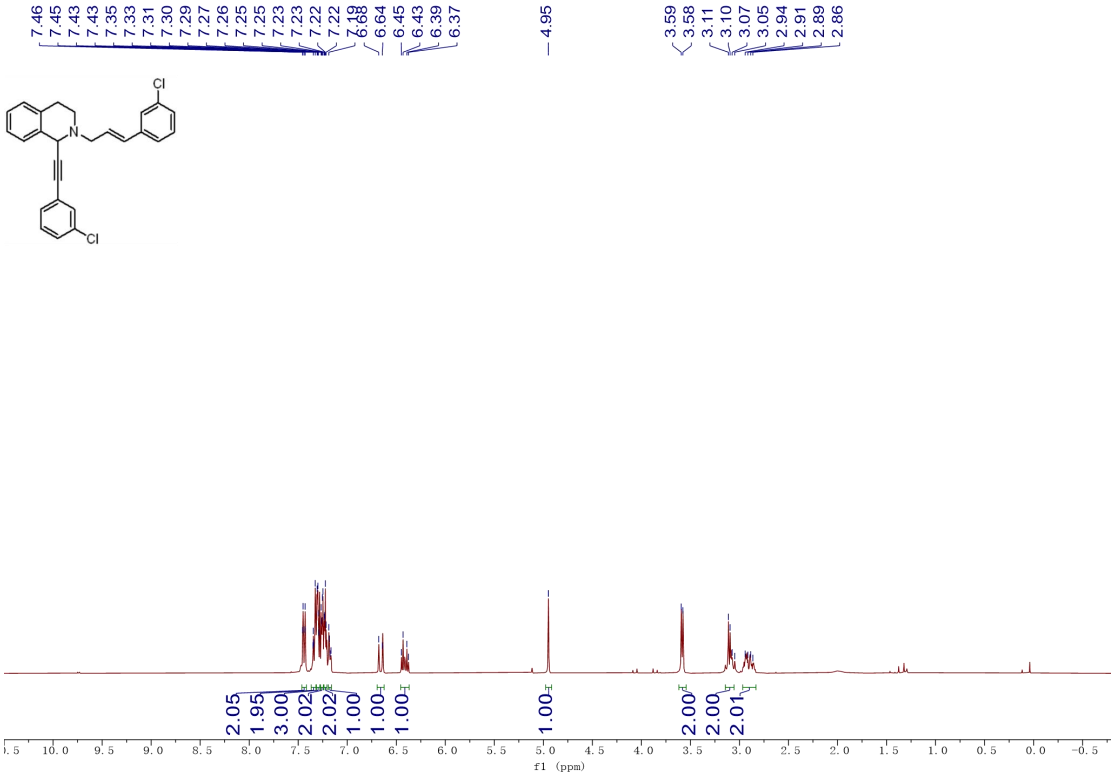
^{19}F NMR (376 MHz, Chloroform-d) Spectrum of compound **4c**



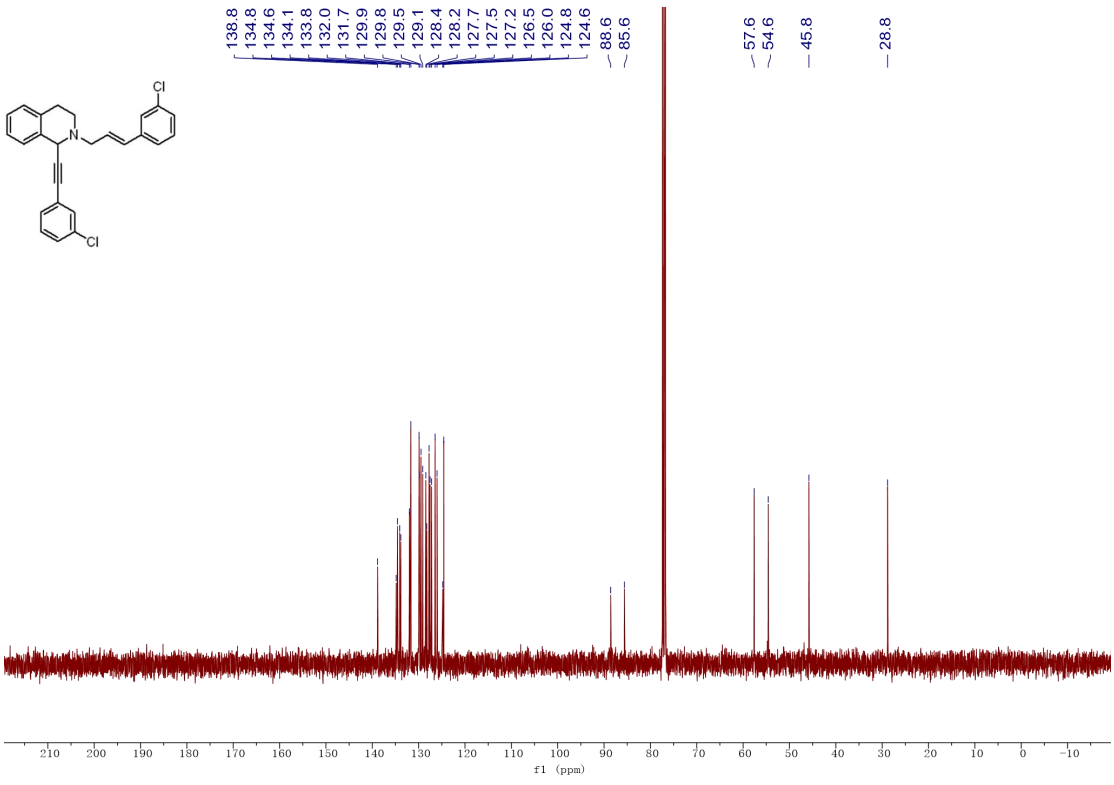
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4c**



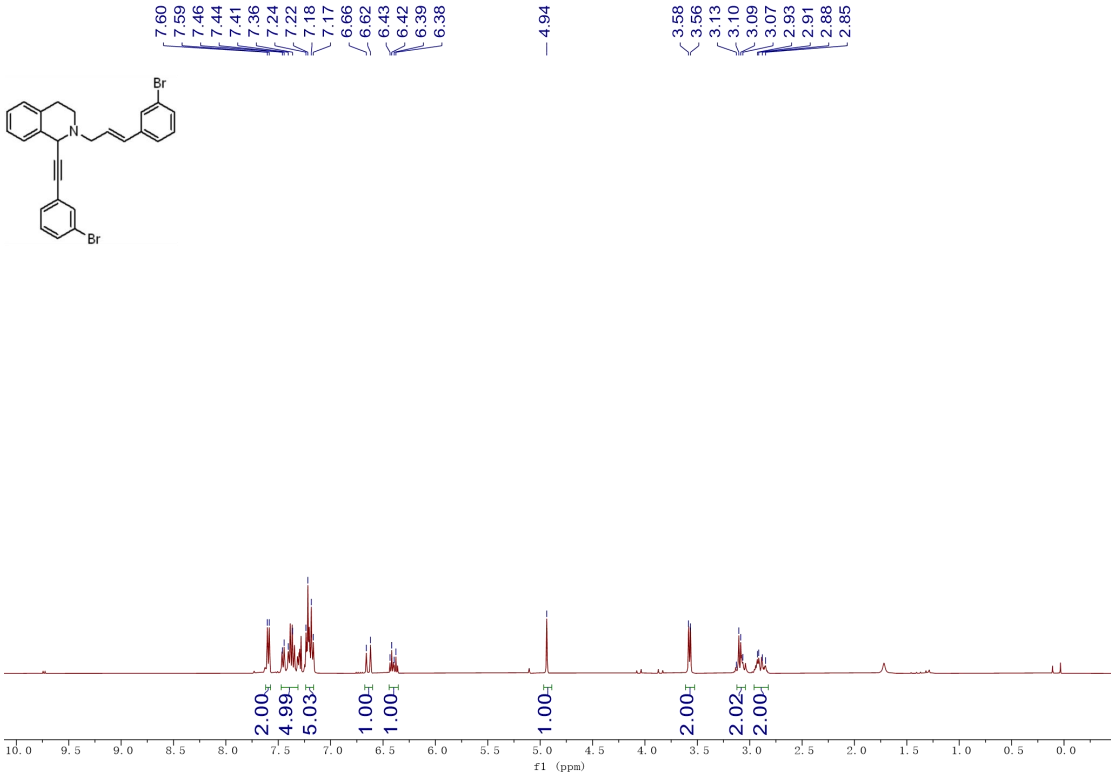
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4d**



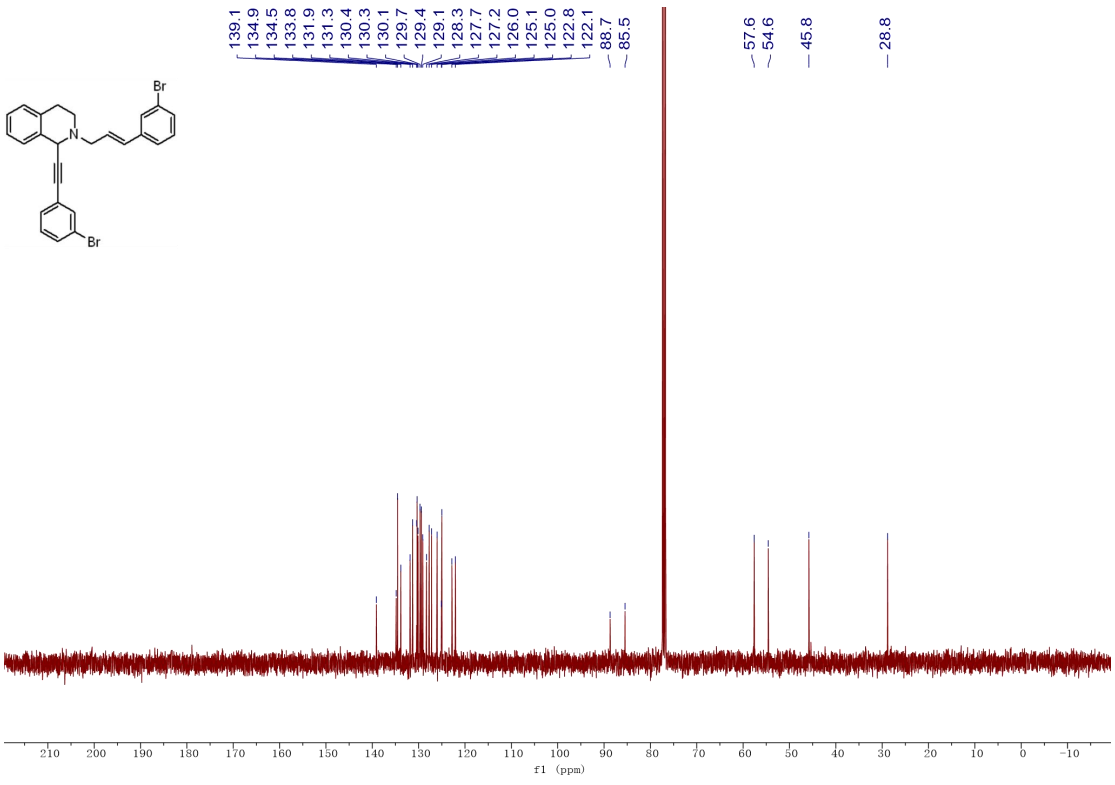
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4d**



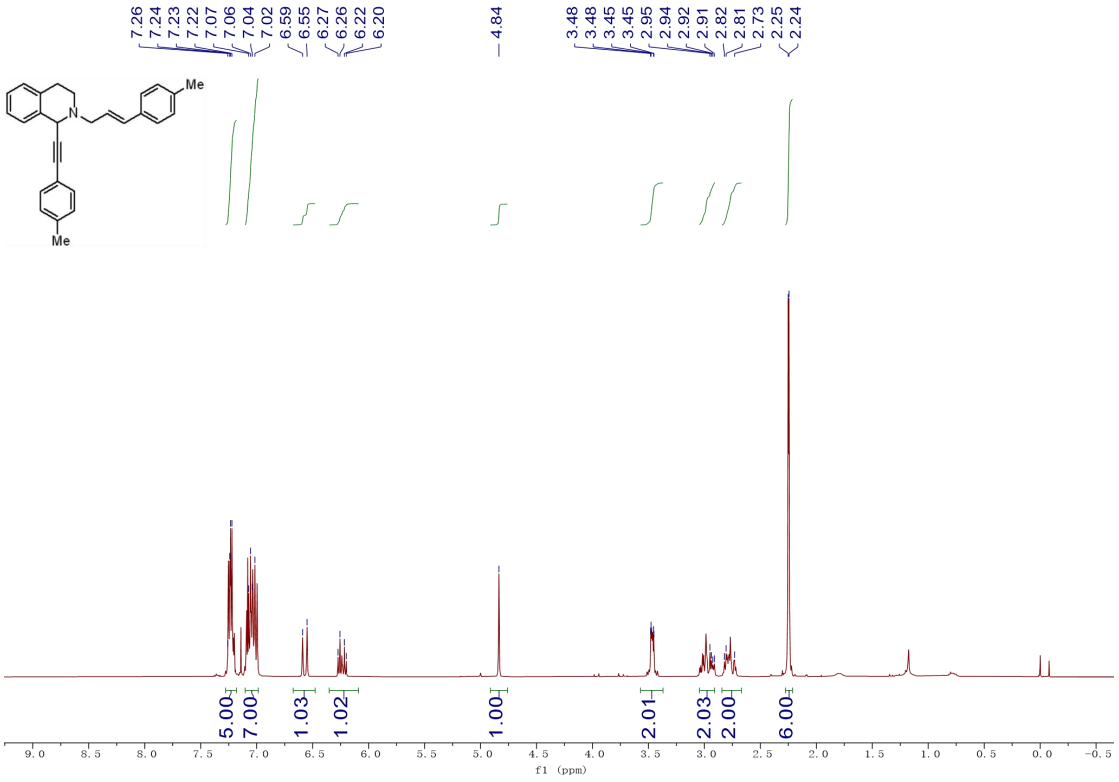
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4e**



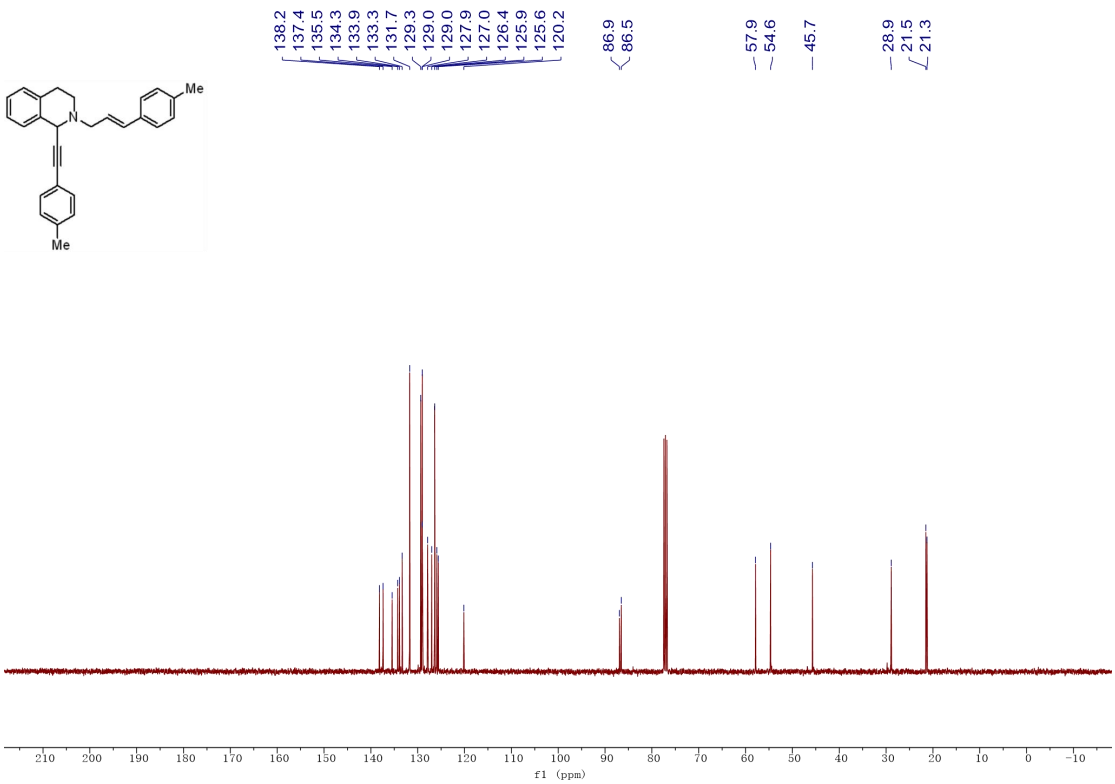
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4e**



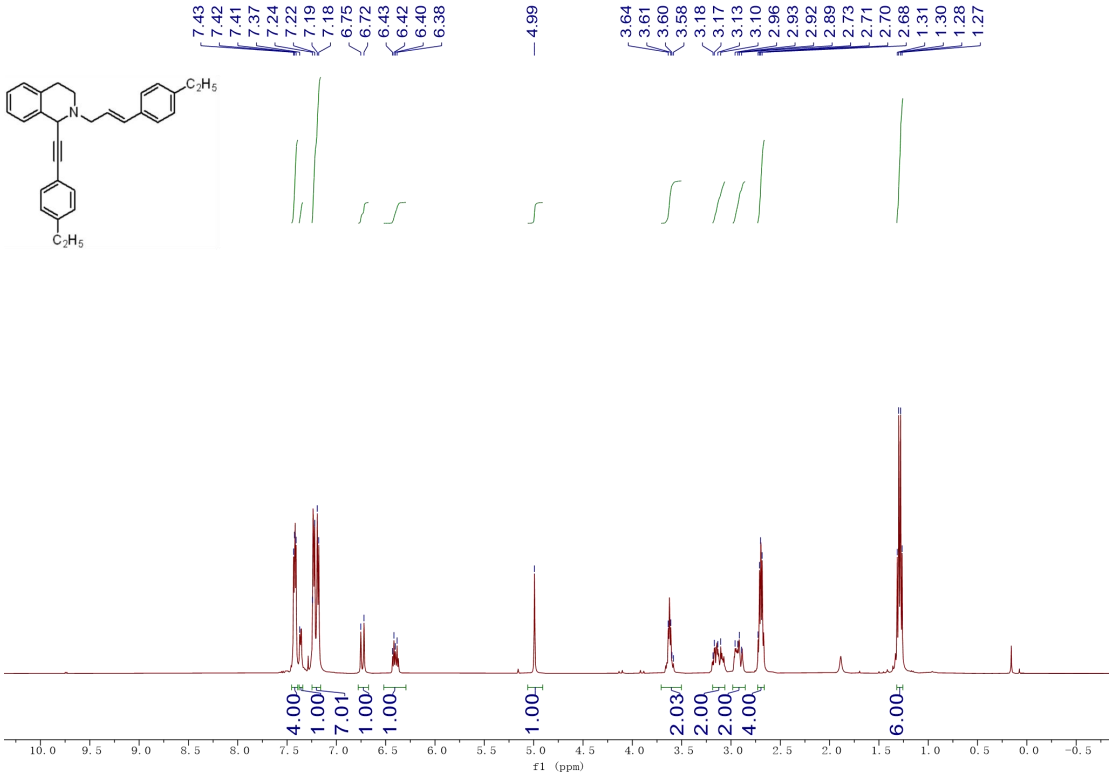
[1]H NMR (400 MHz, Chloroform-d) Spectrum of compound **4f**



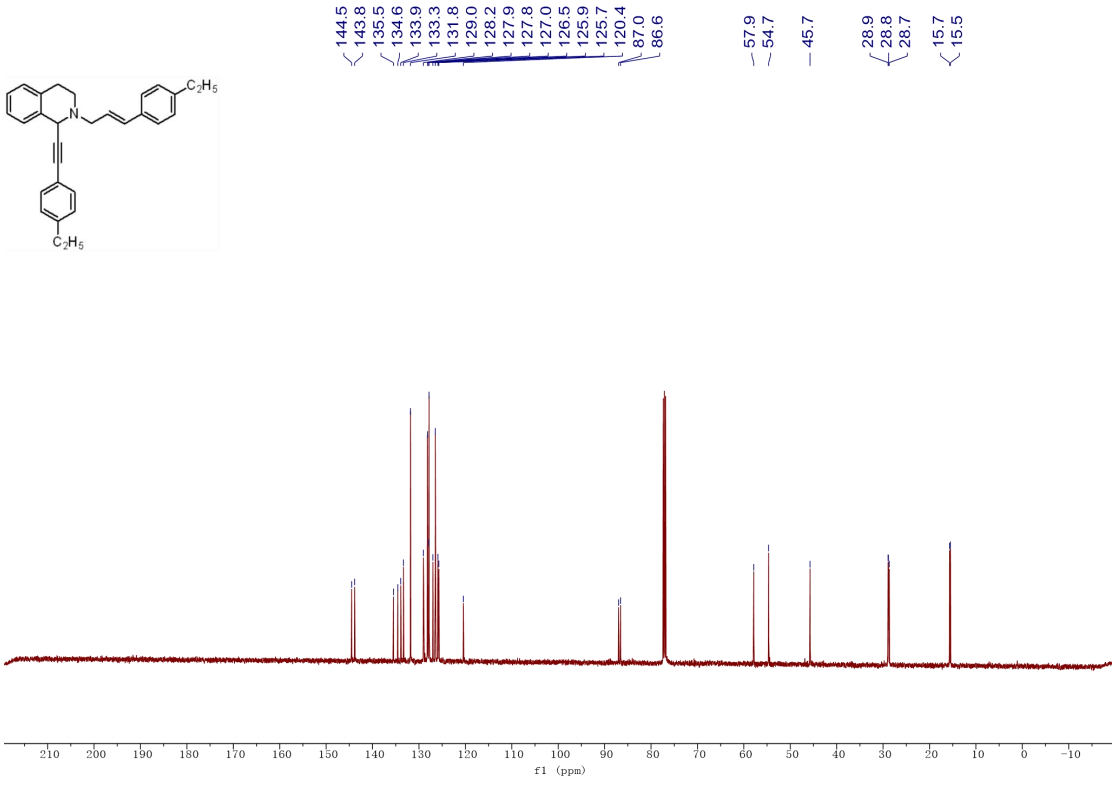
[13]C NMR (101 MHz, Chloroform-d) Spectrum of compound **4f**



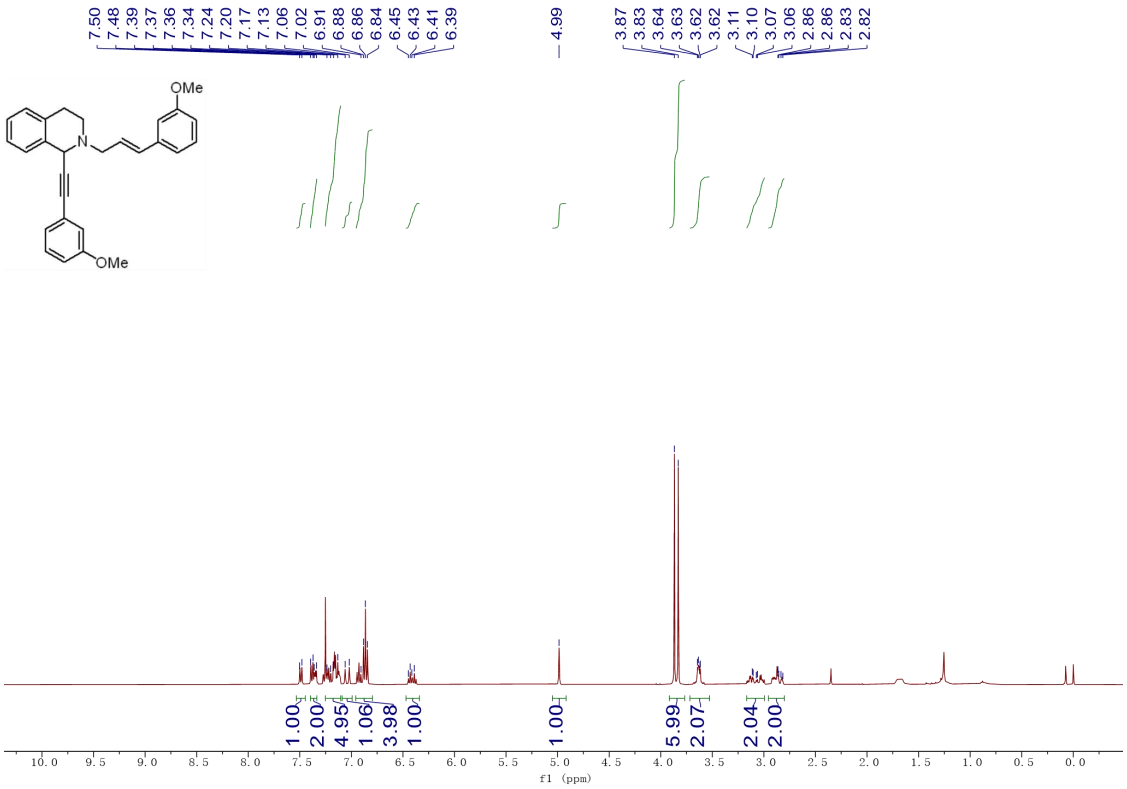
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4g**



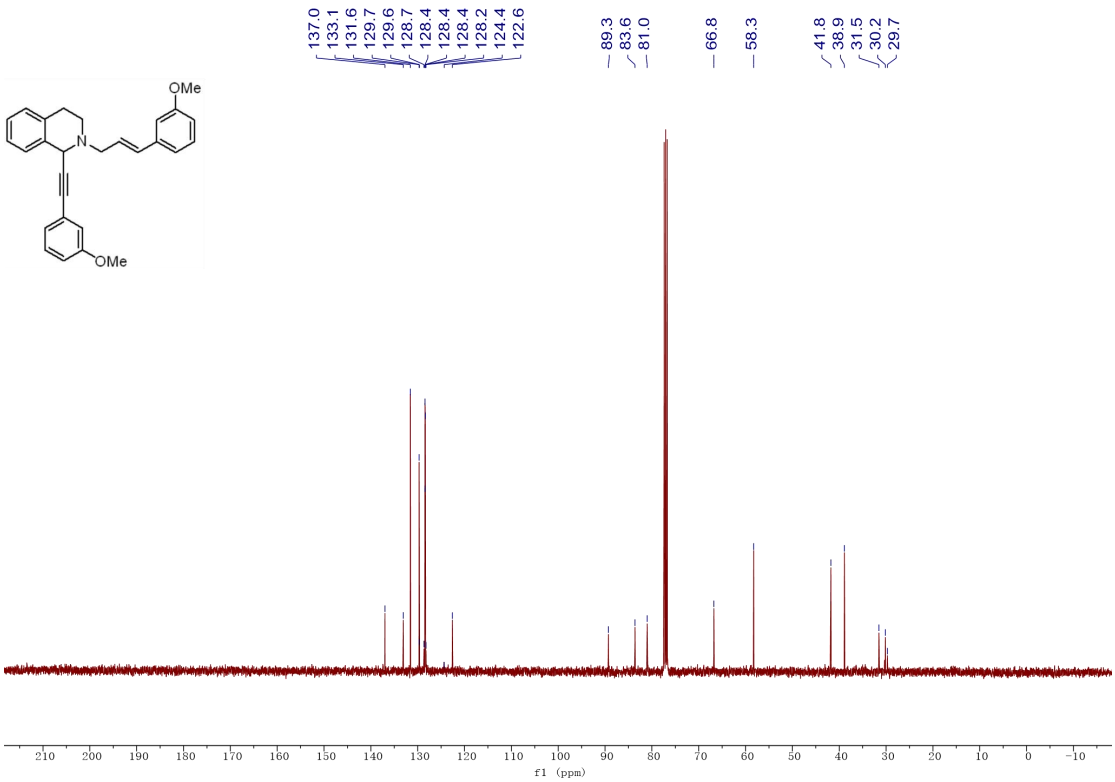
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4g**



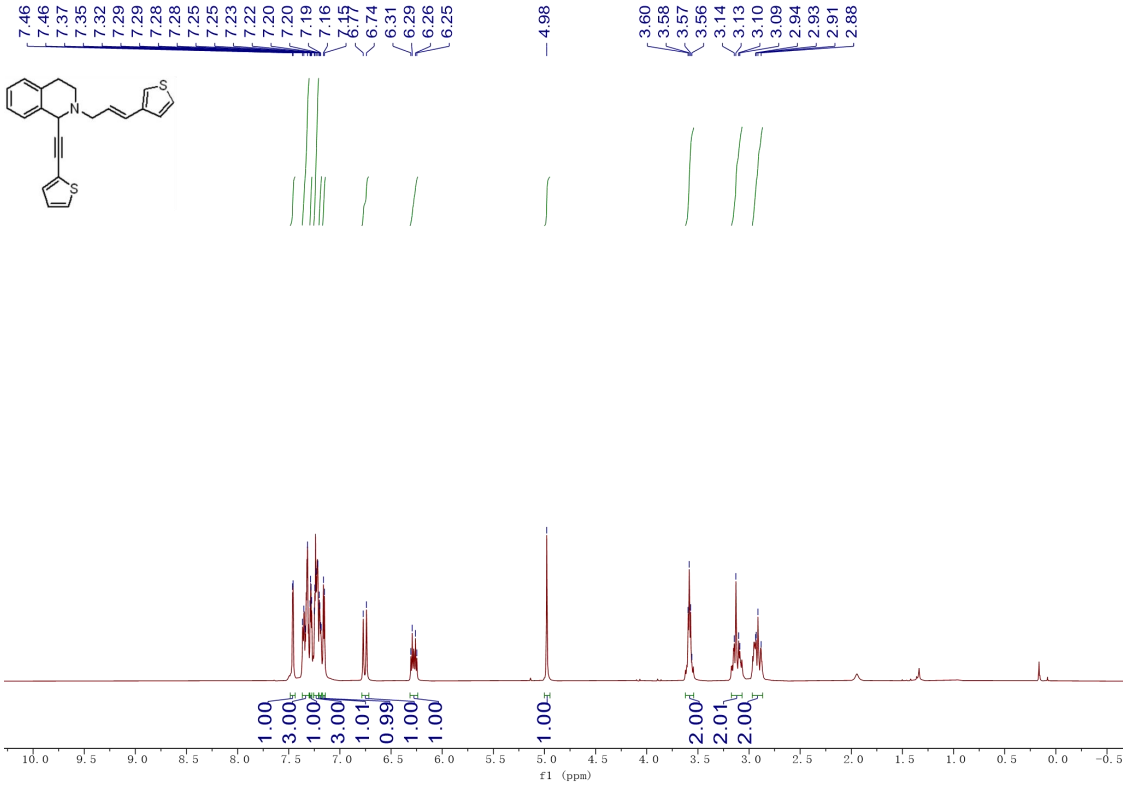
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4h**



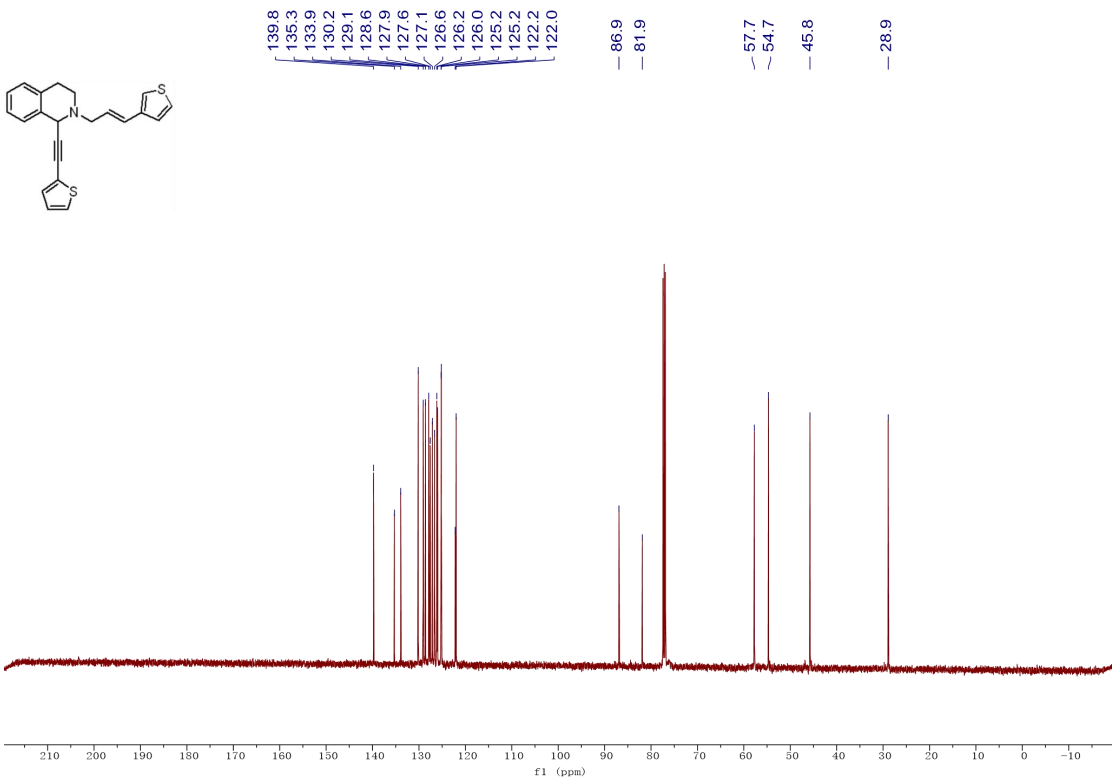
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4h**



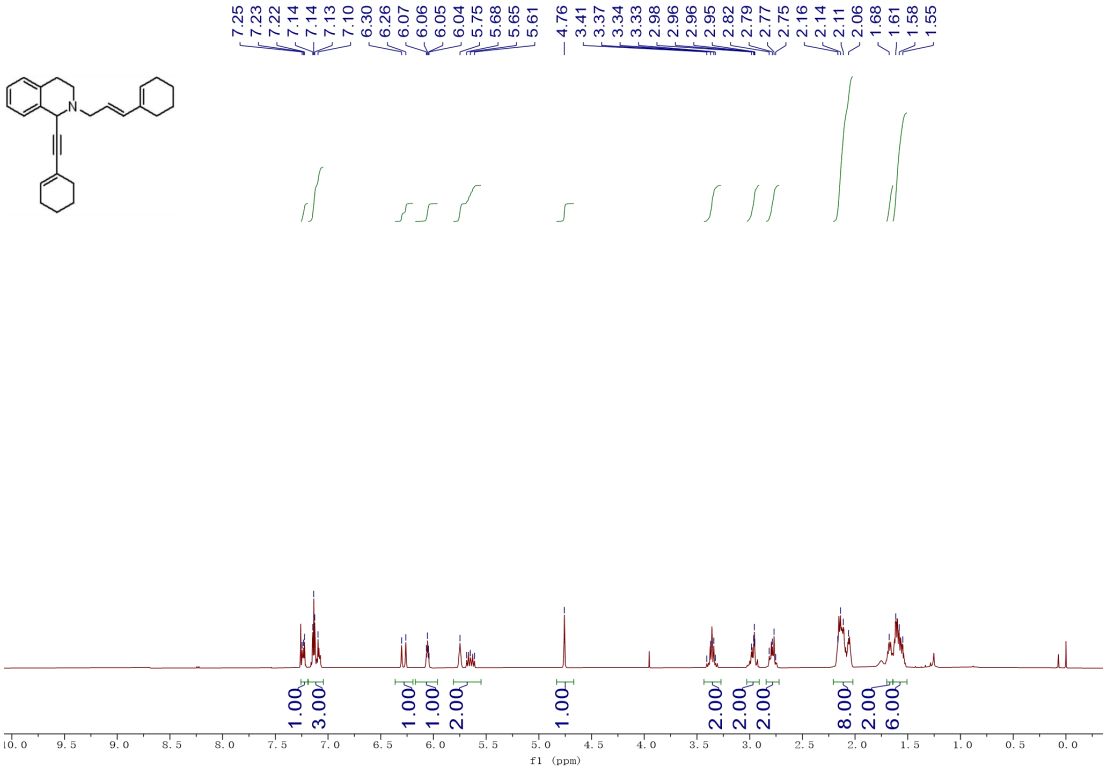
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4i**



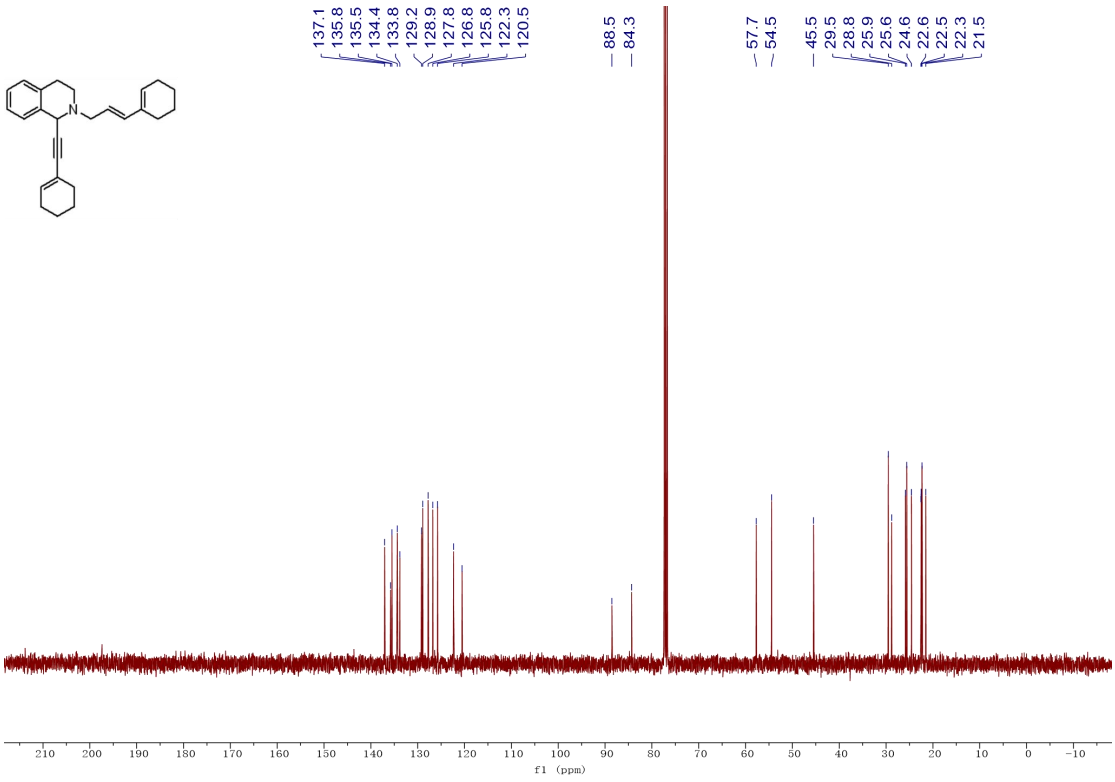
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4i**



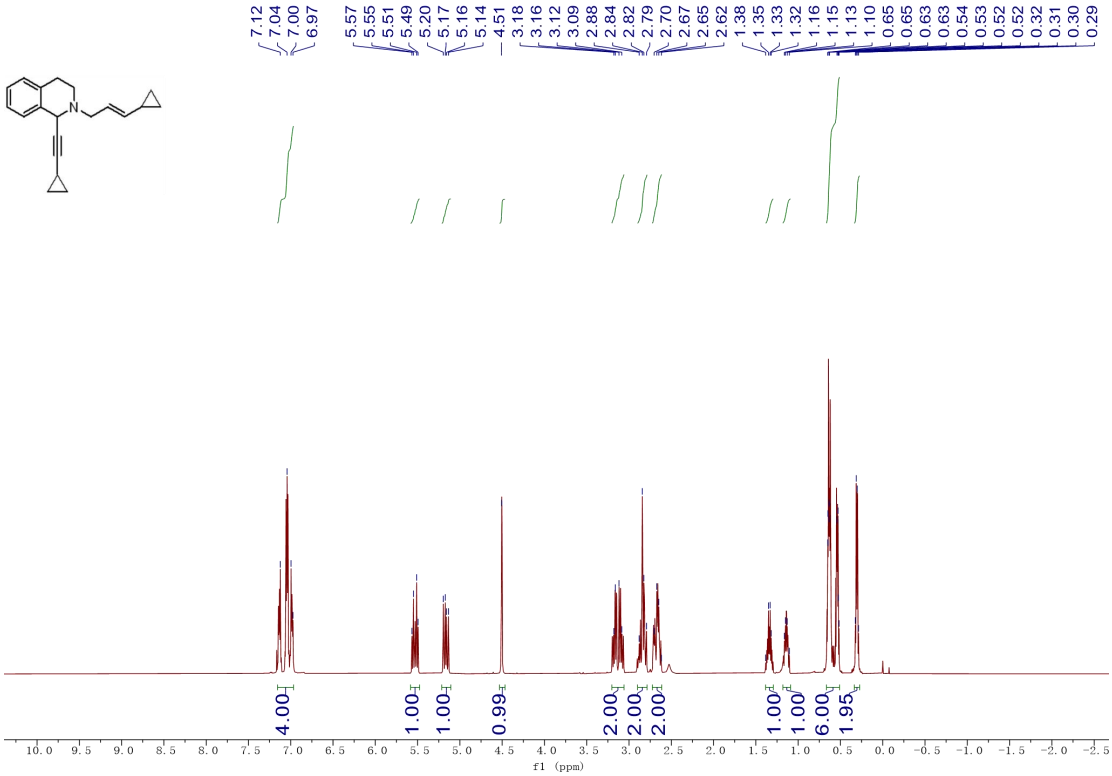
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4j**



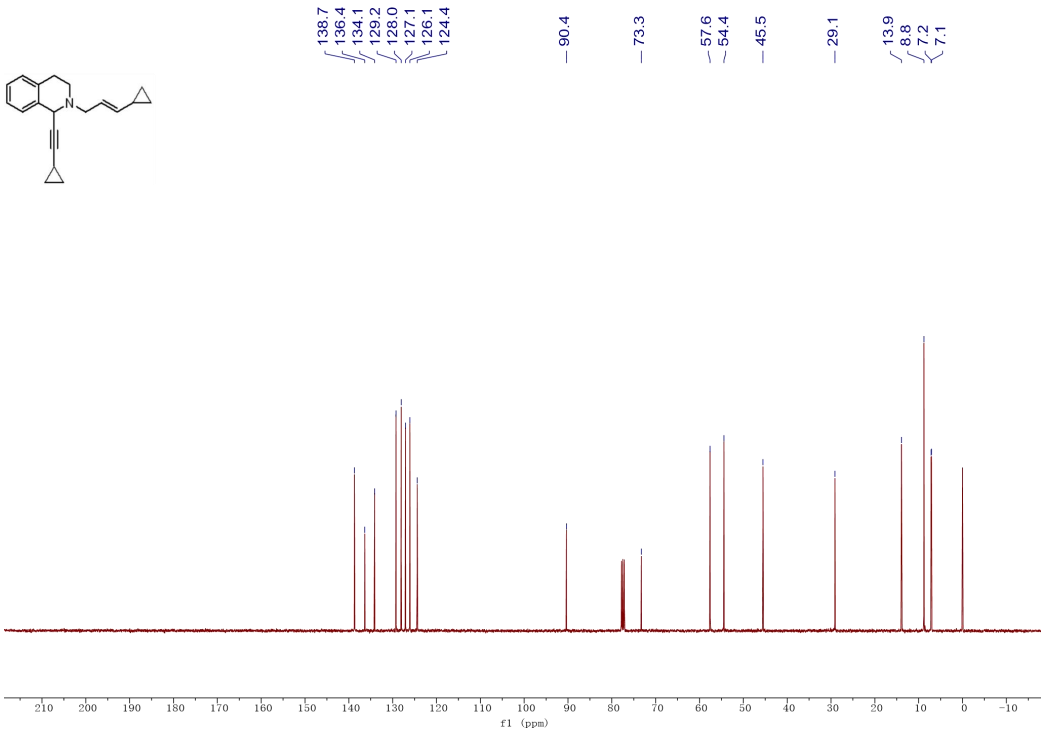
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4j**



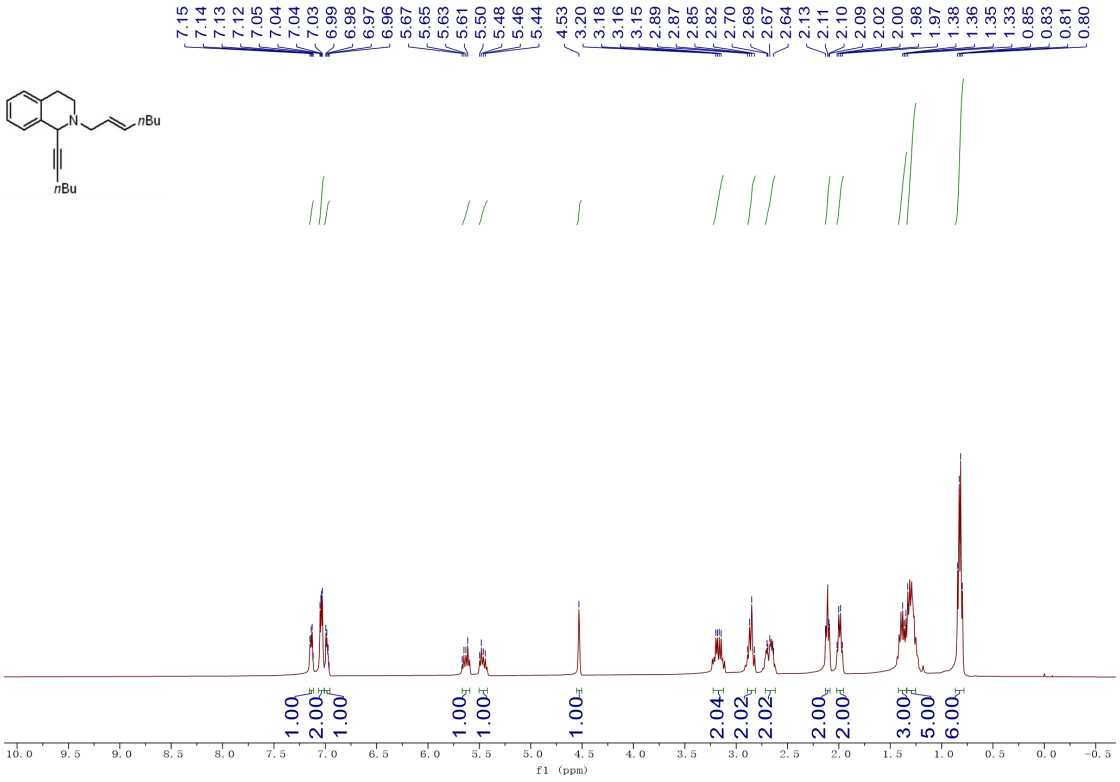
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4k**



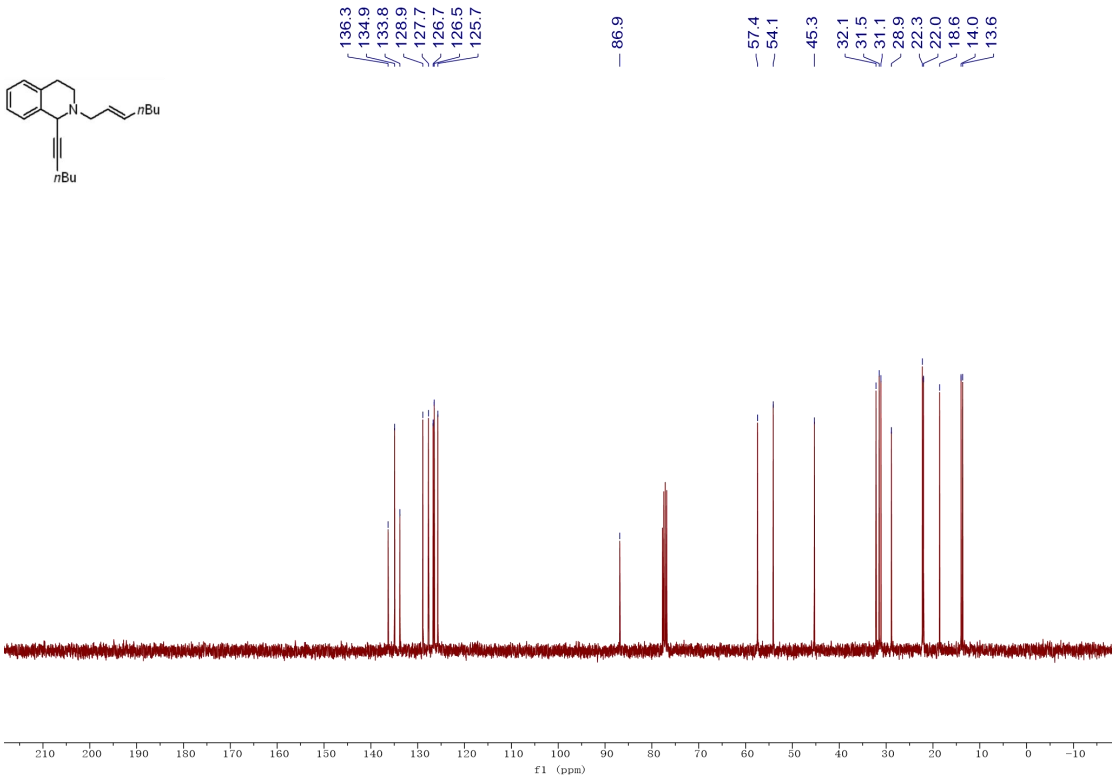
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4k**



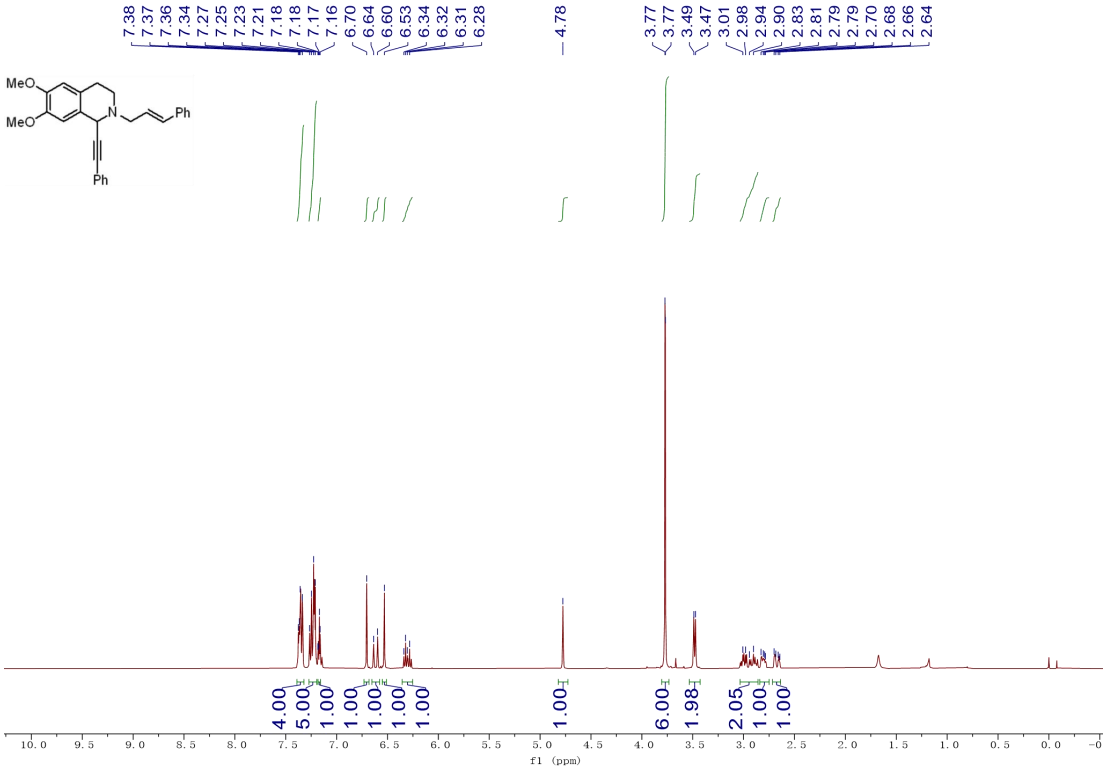
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4l**



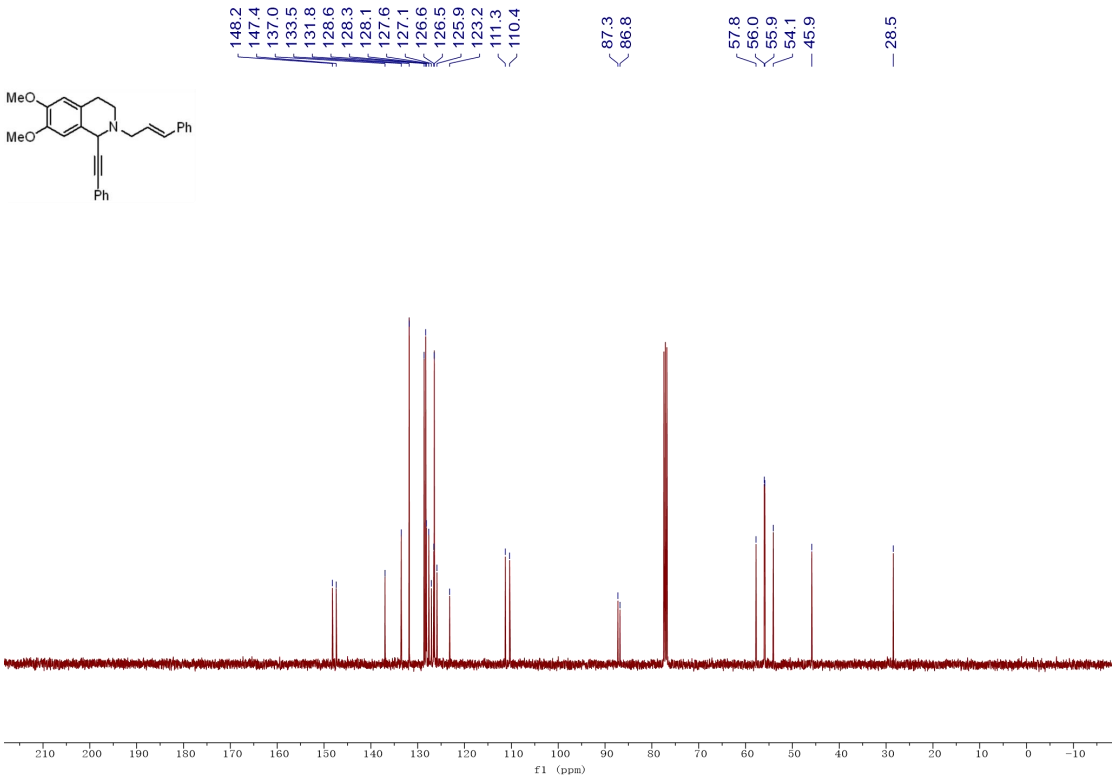
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4l**



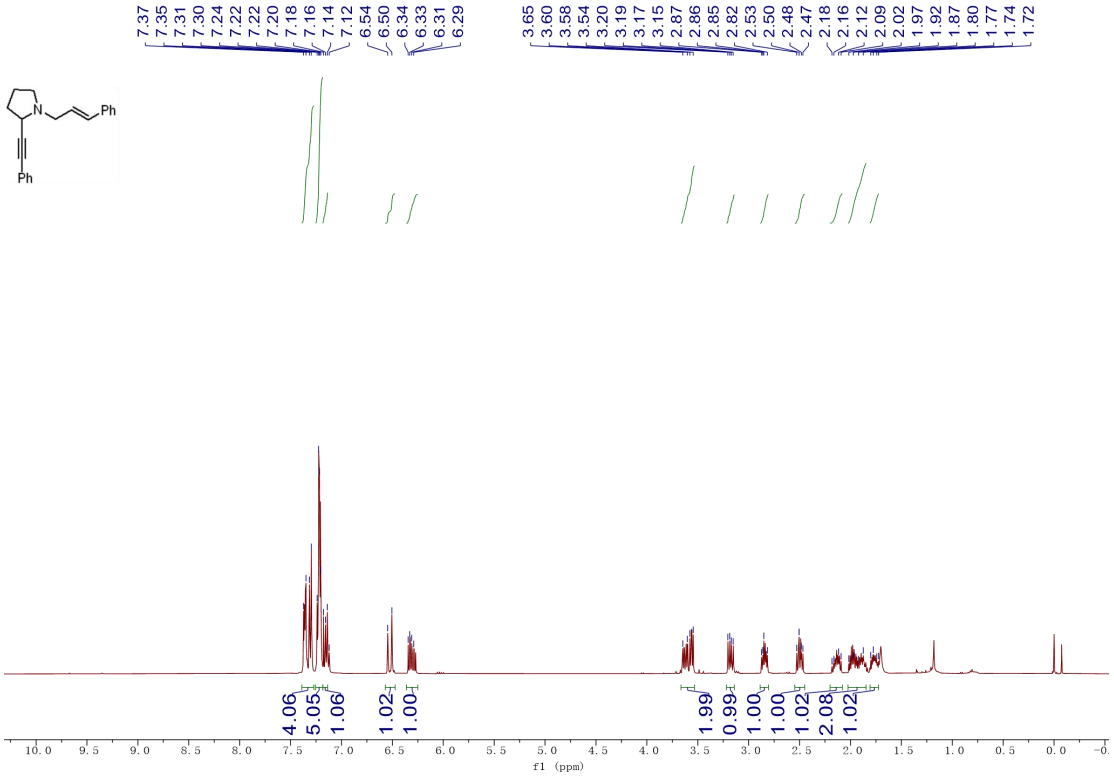
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4m**



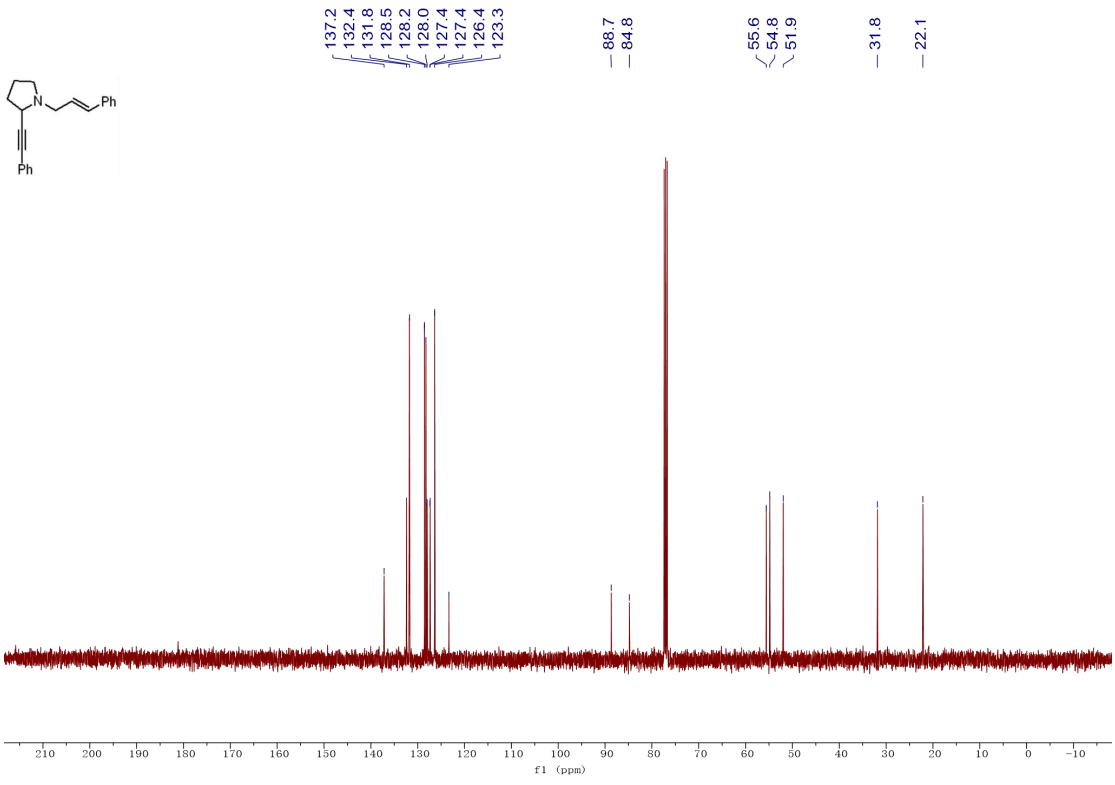
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4m**



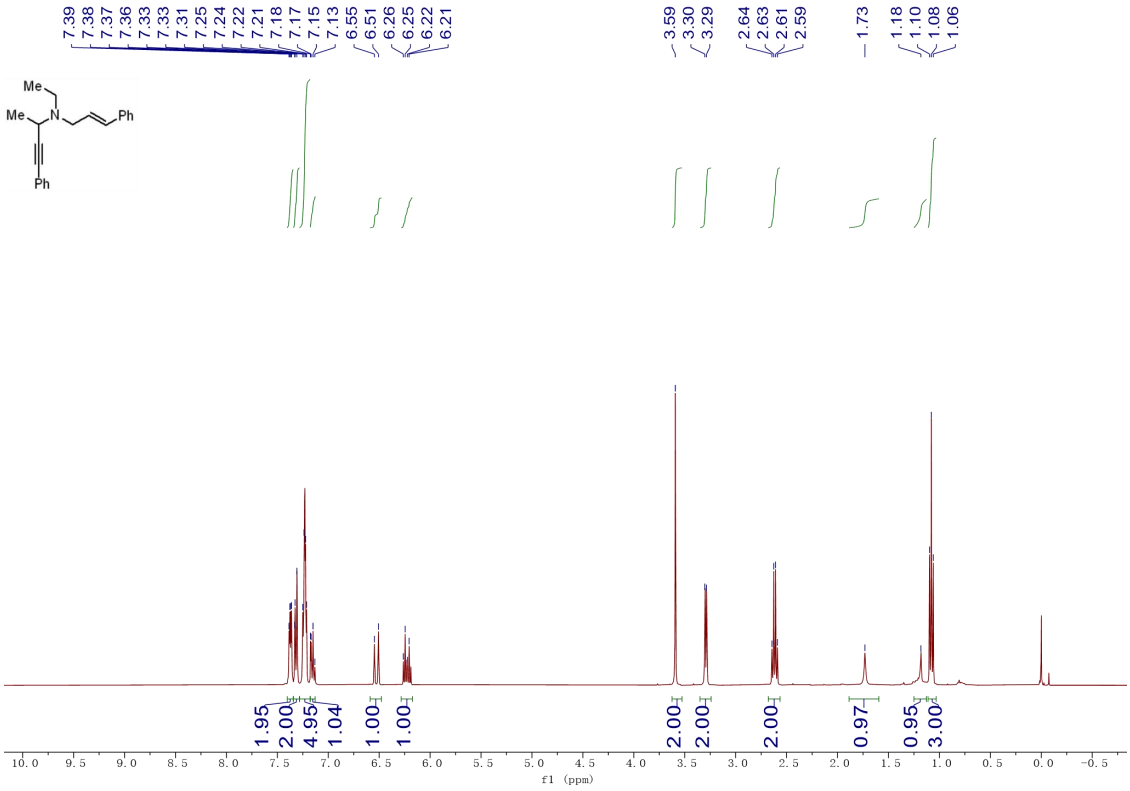
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4n**



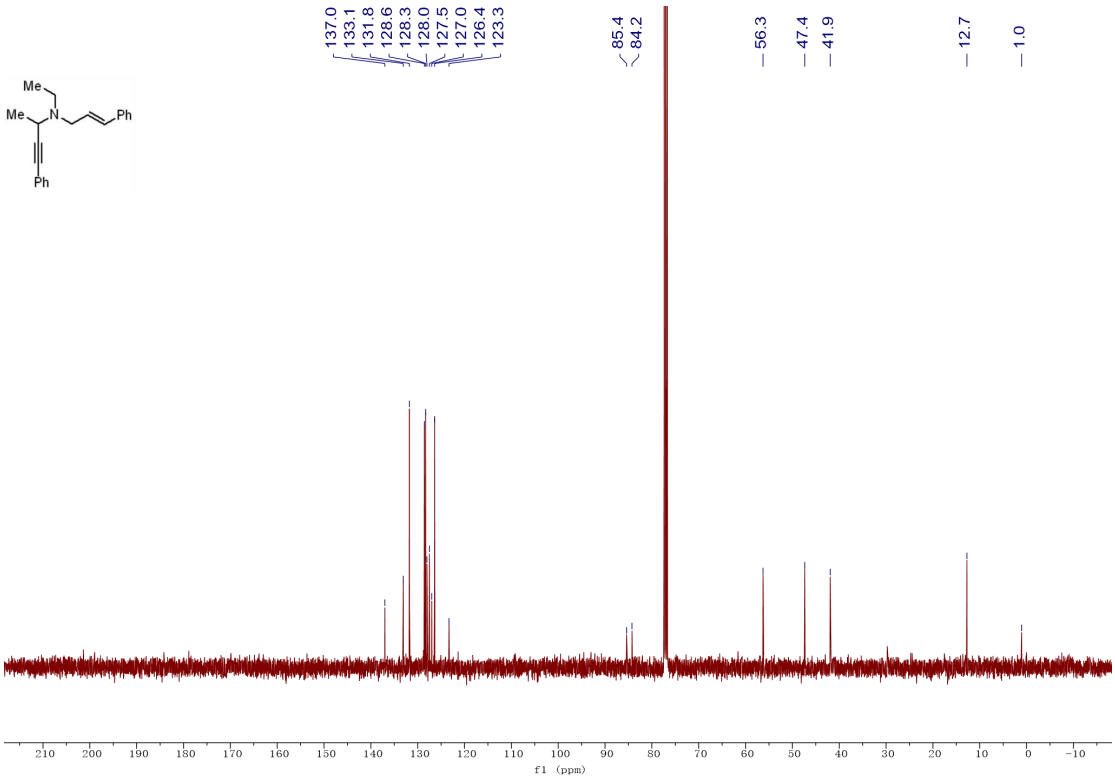
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4n**



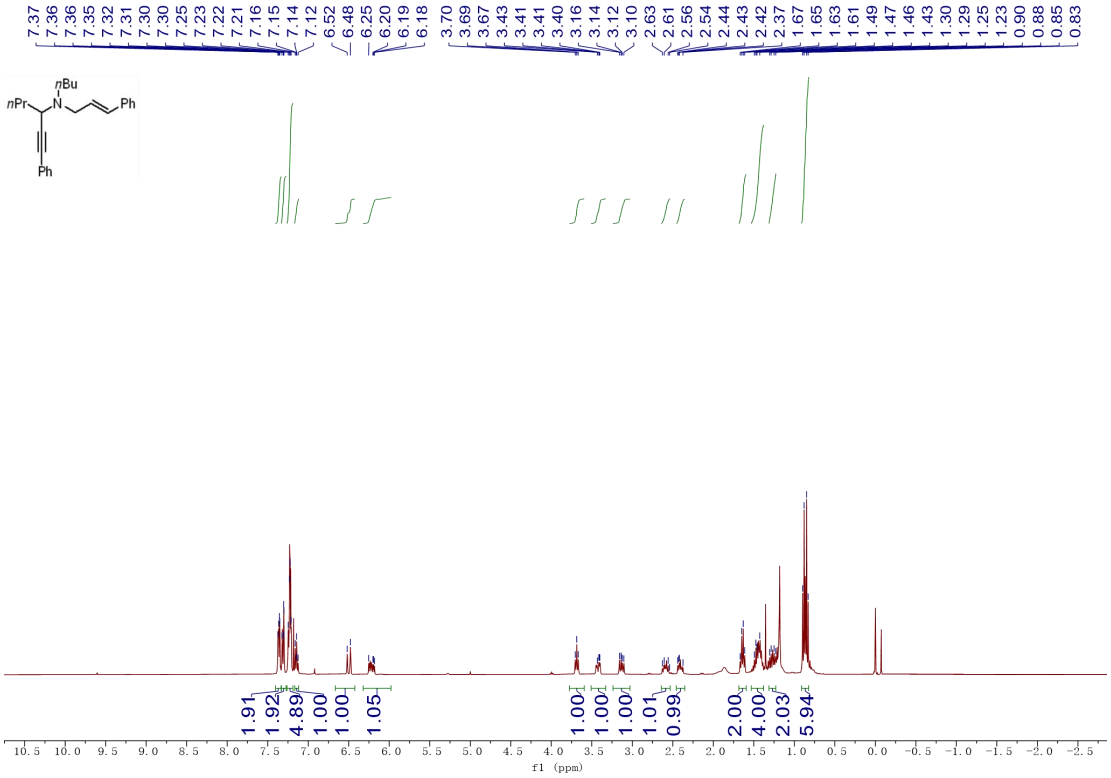
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4o**



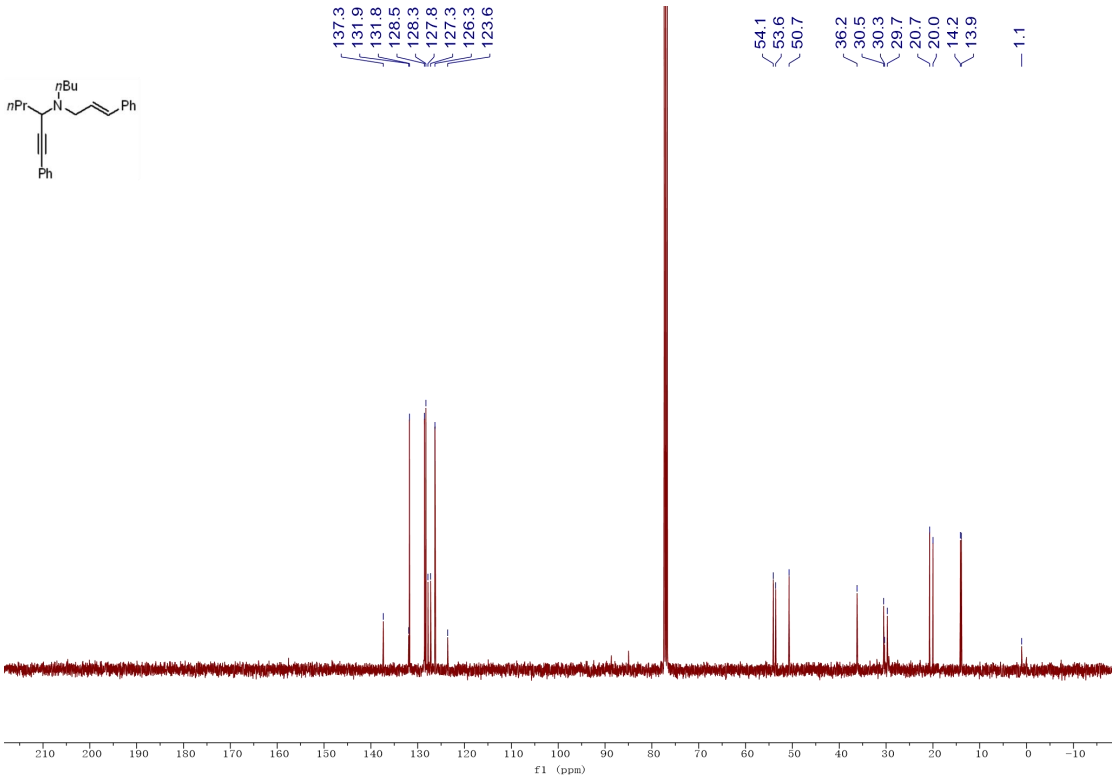
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4o**



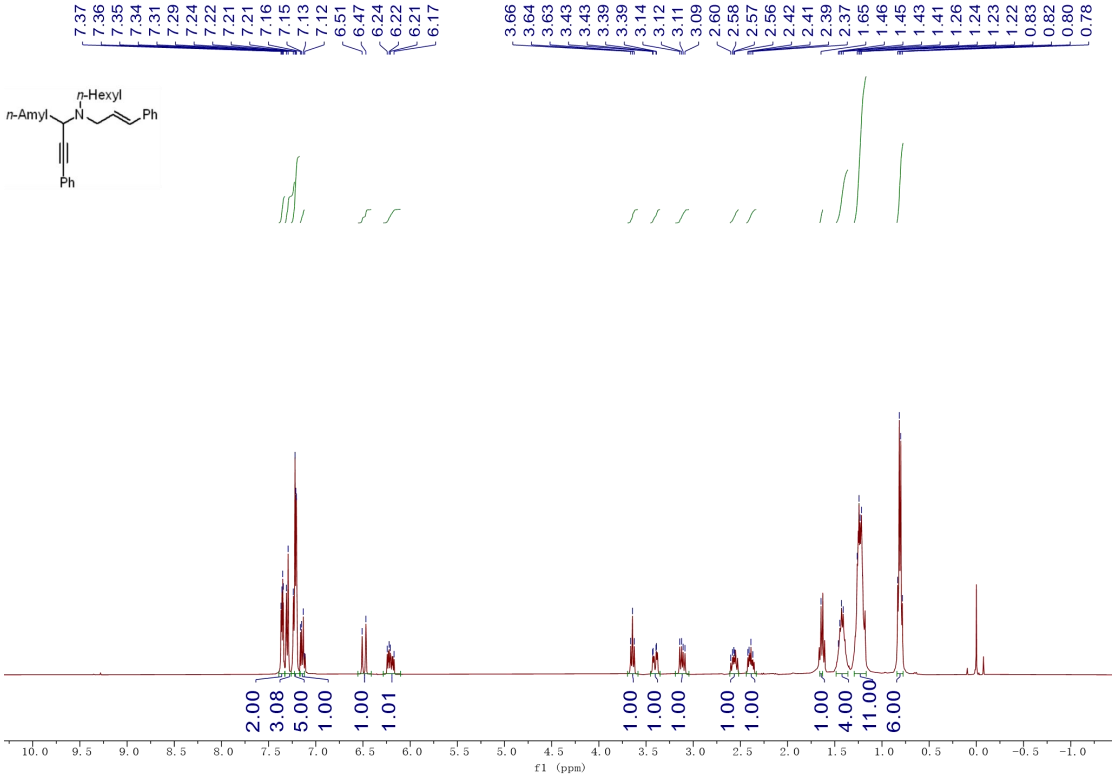
[1]H NMR (400 MHz, Chloroform-d) Spectrum of compound **4p**



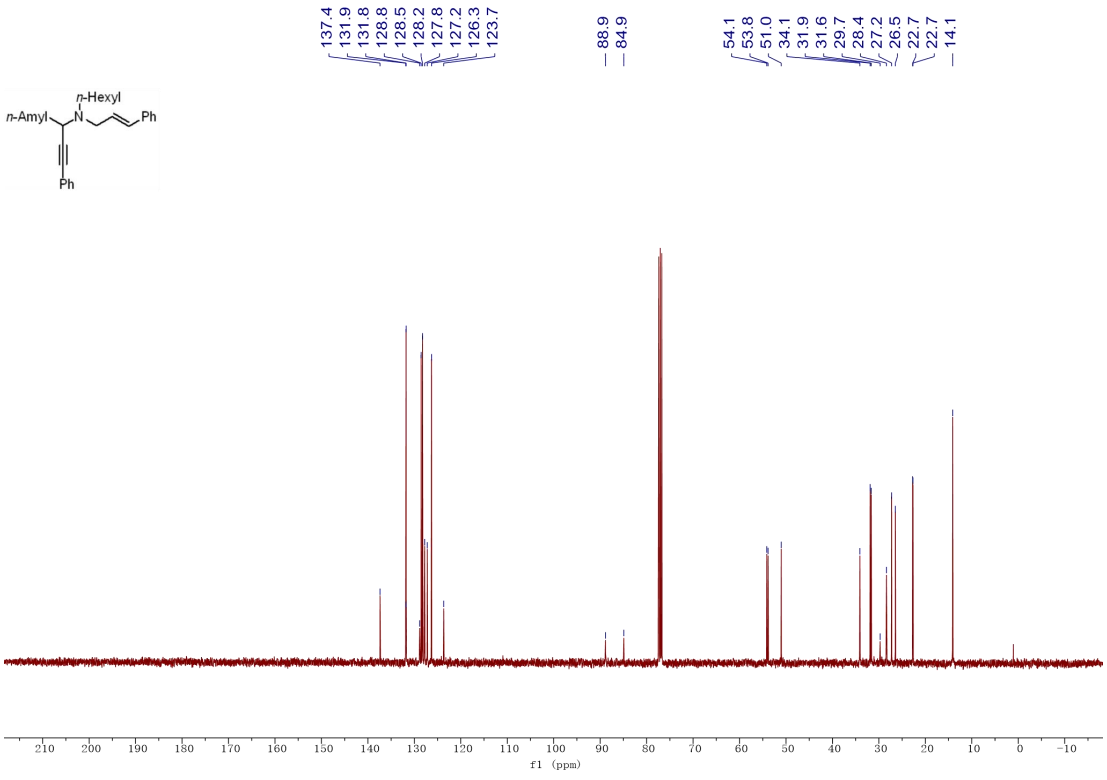
[13]C NMR (101 MHz, Chloroform-d) Spectrum of compound **4p**



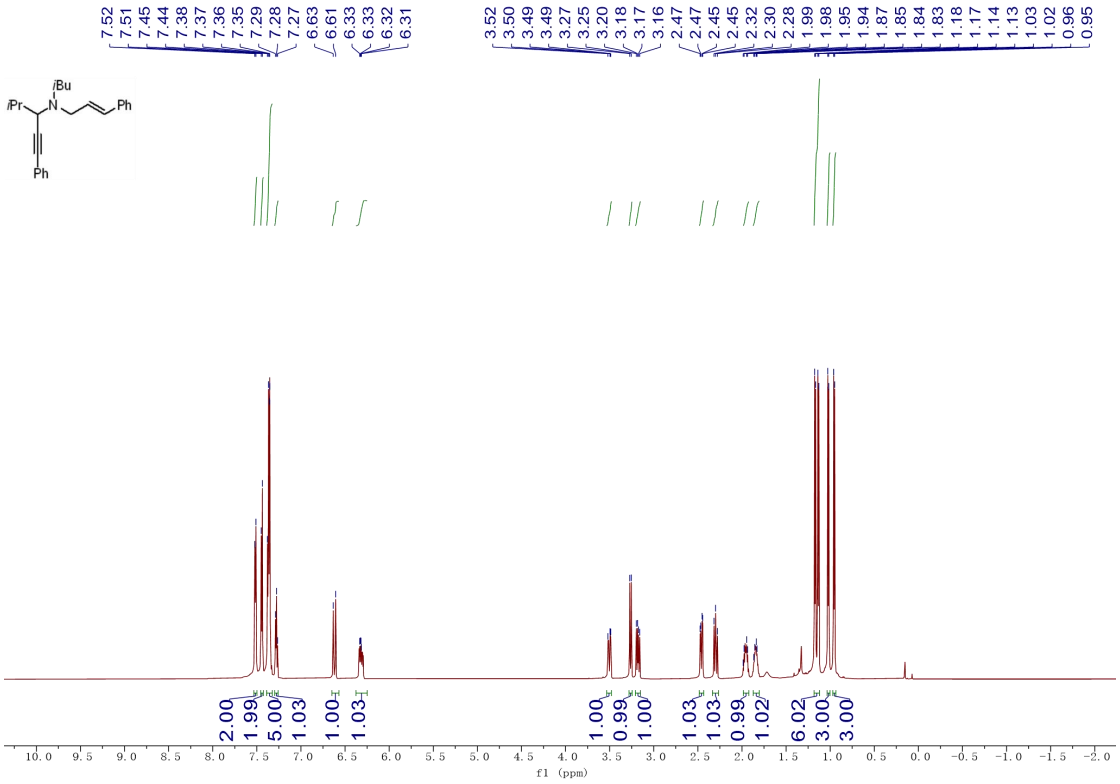
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4q**



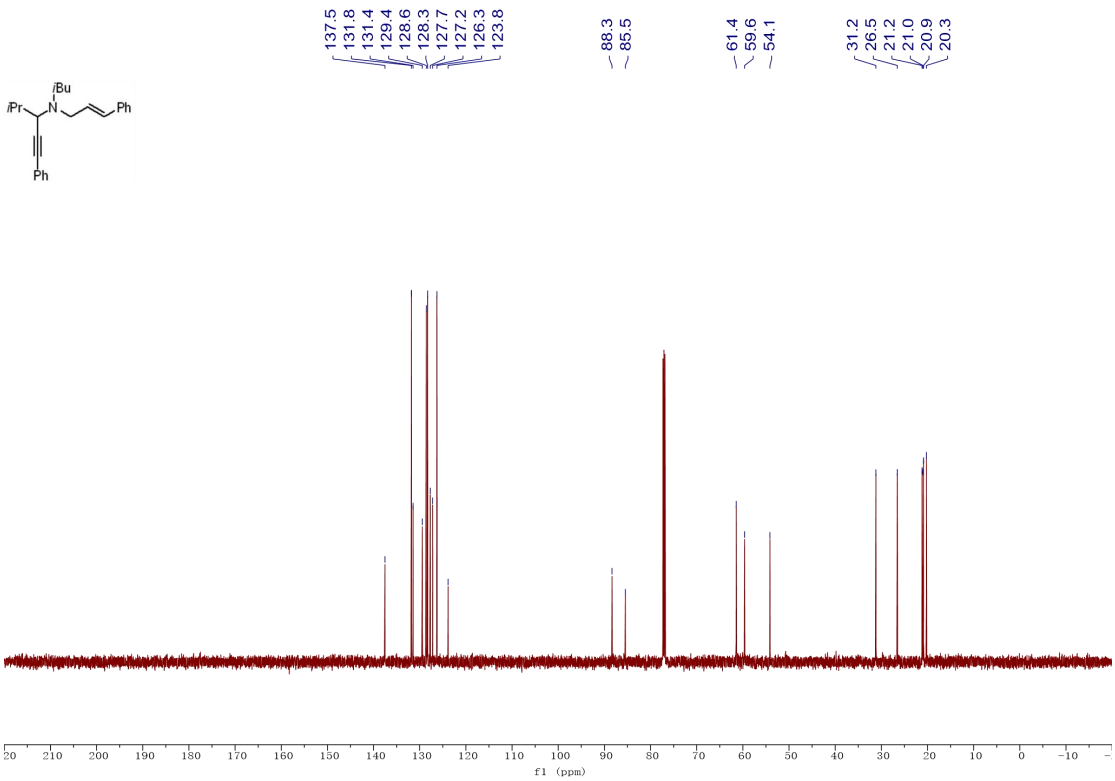
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4q**



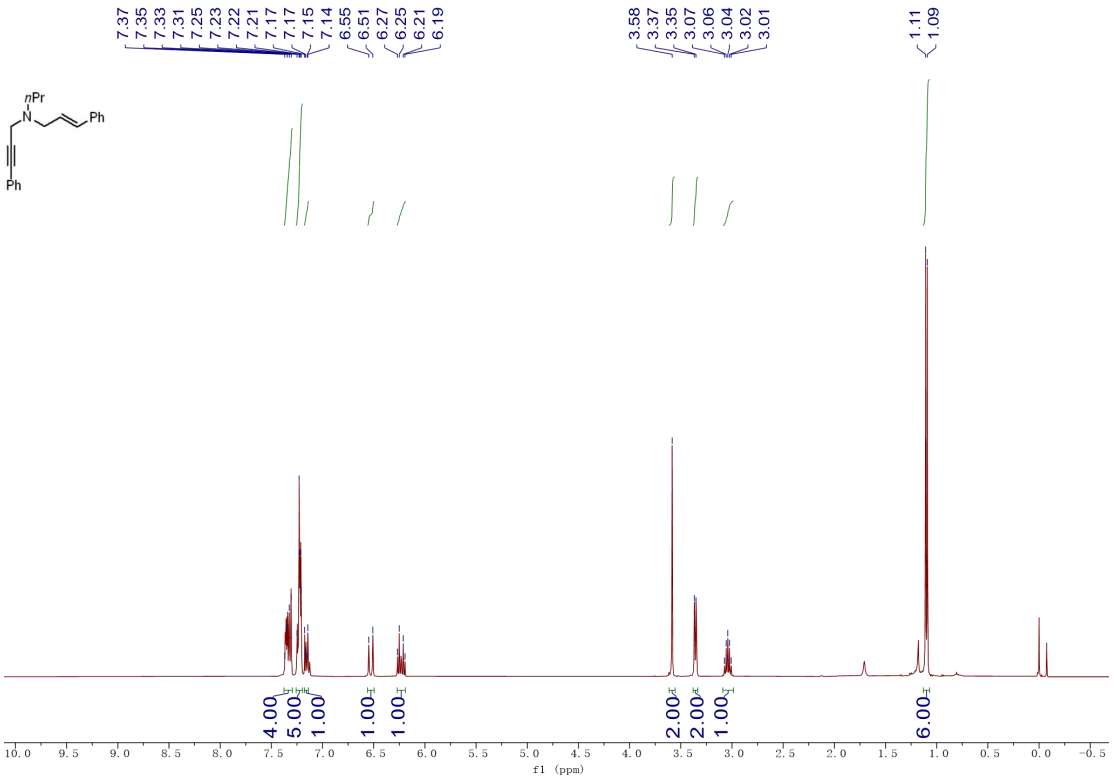
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4r**



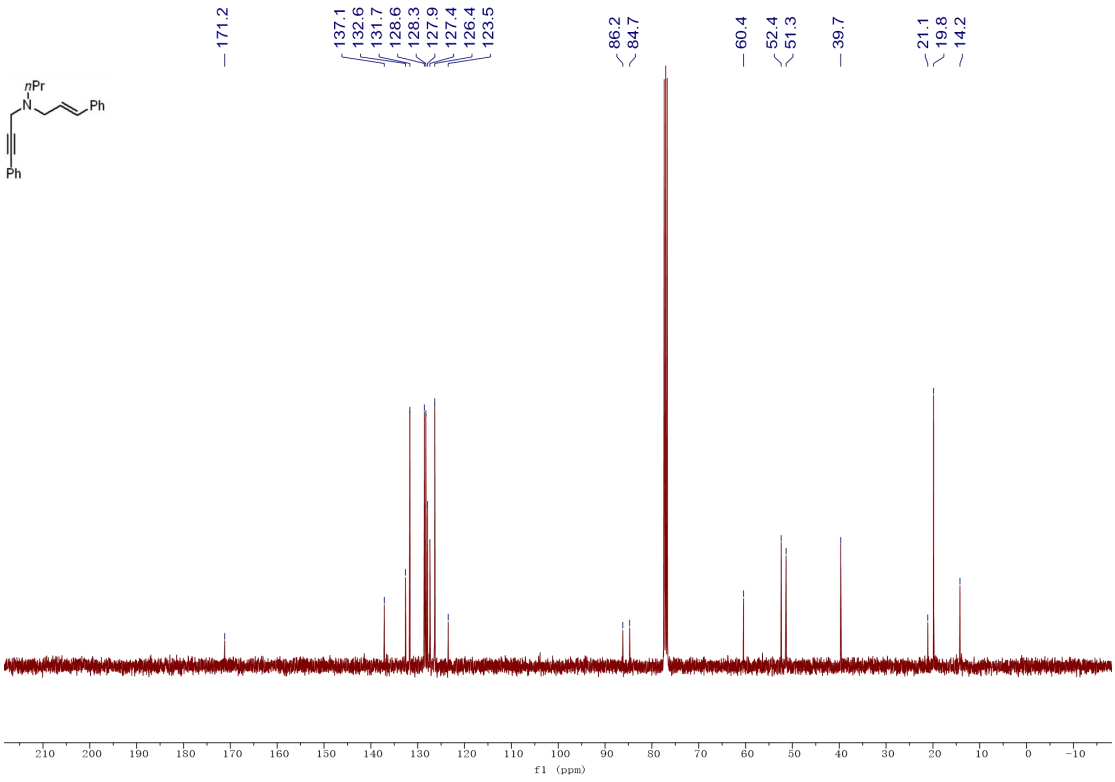
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4r**



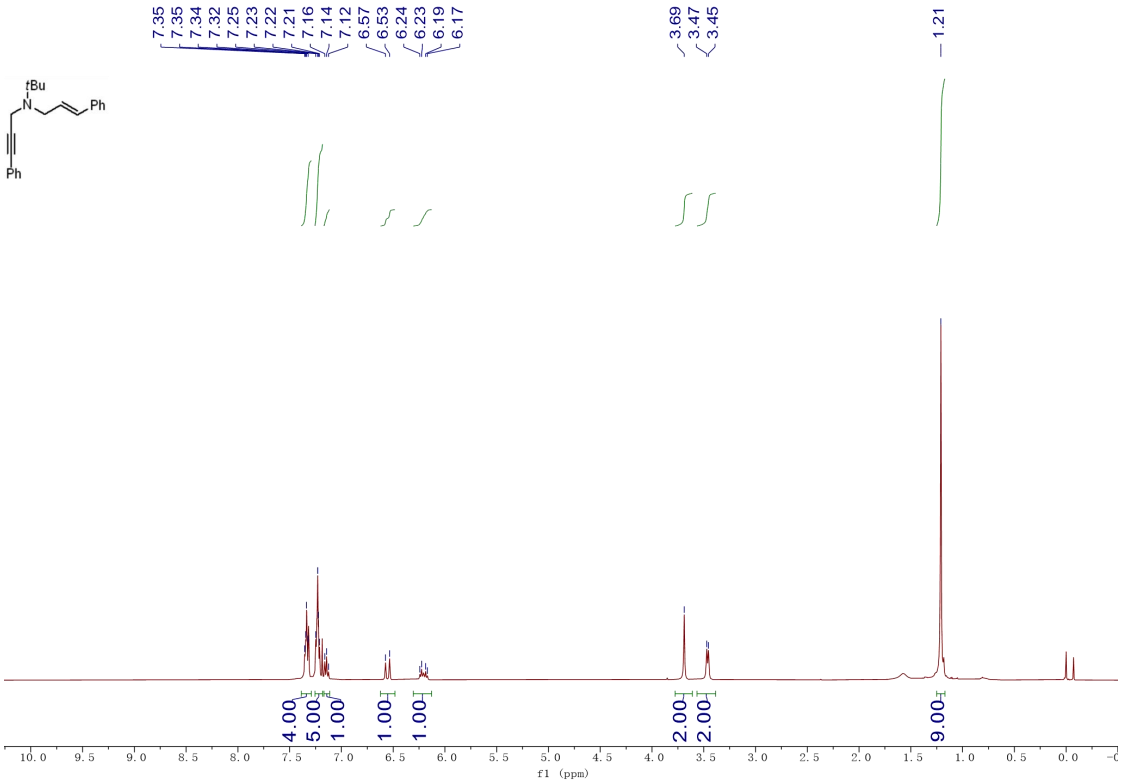
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4s**



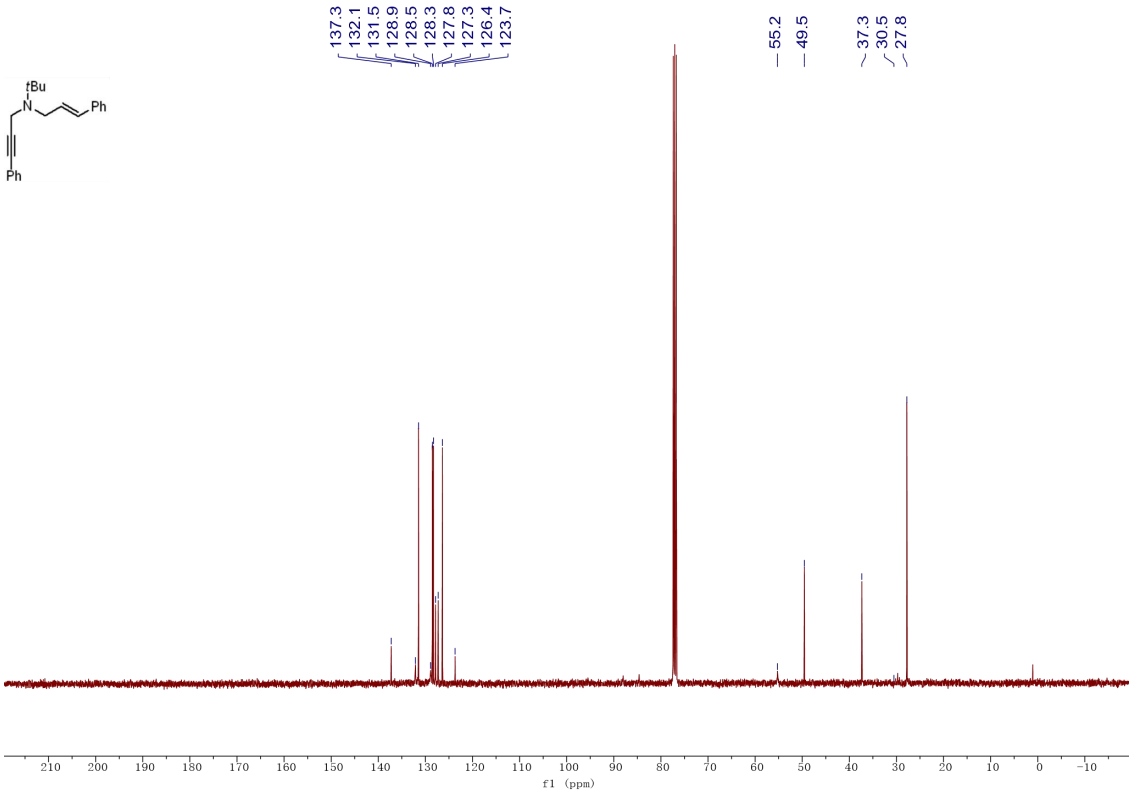
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4s**



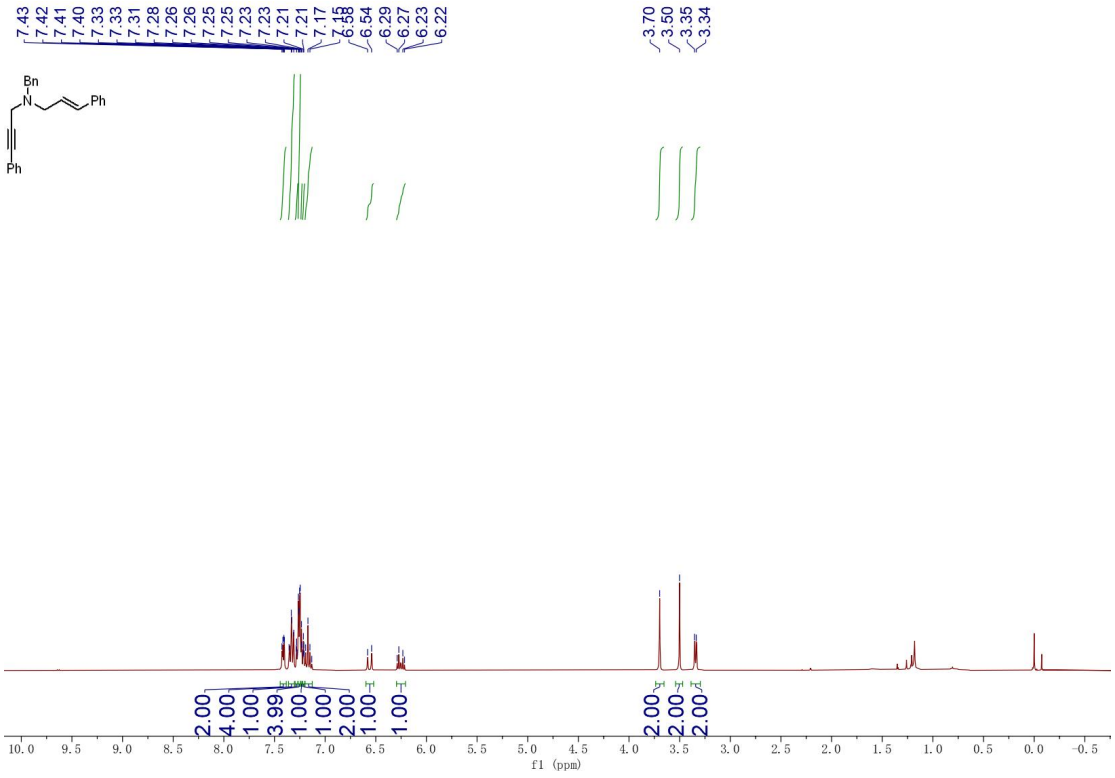
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4t**



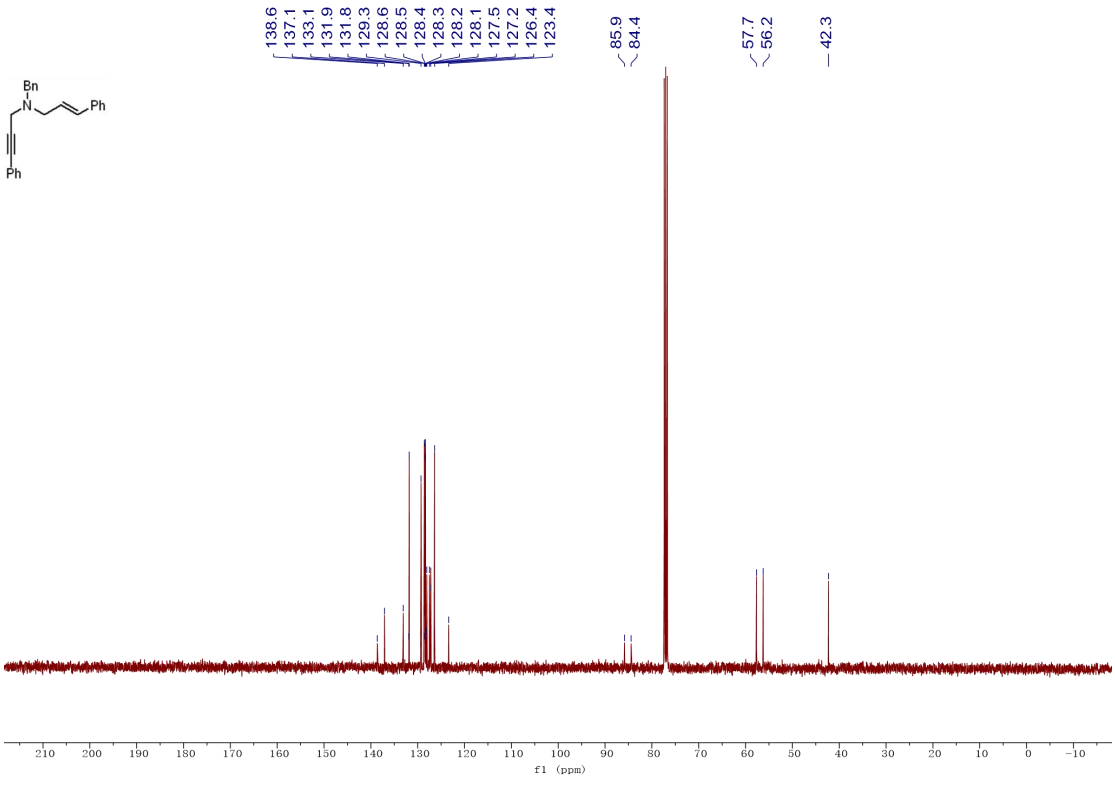
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4t**



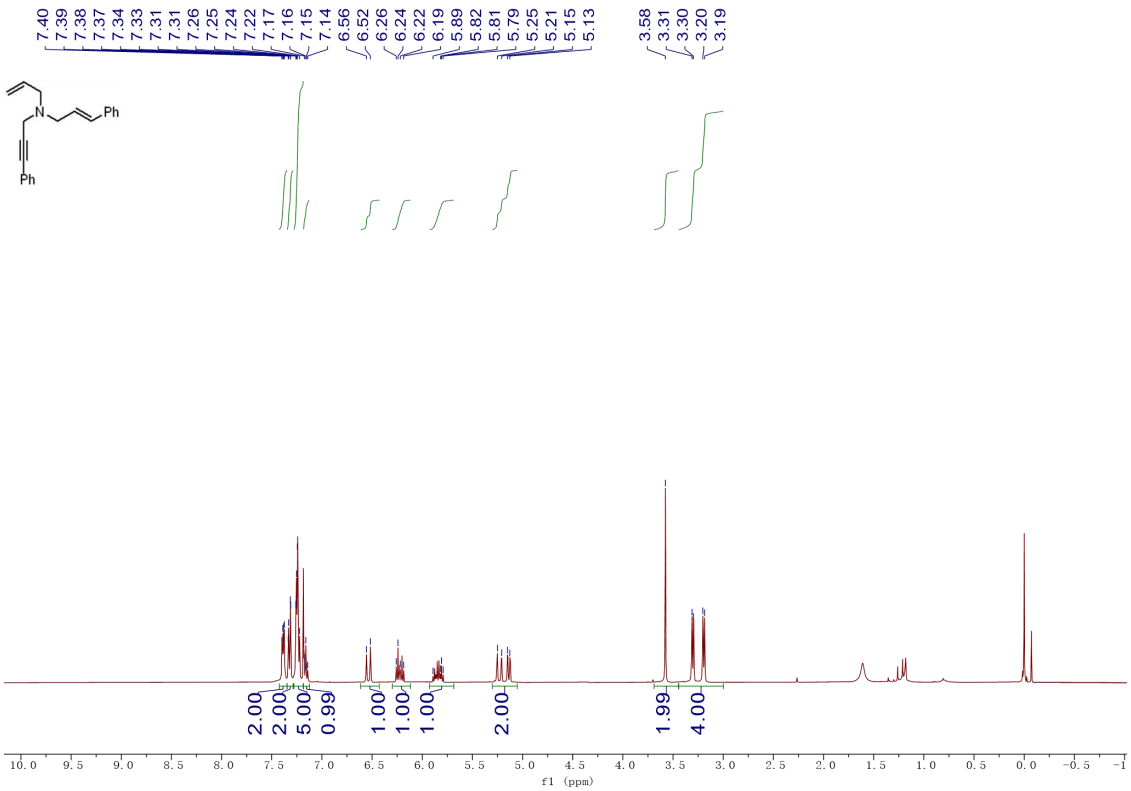
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4u**



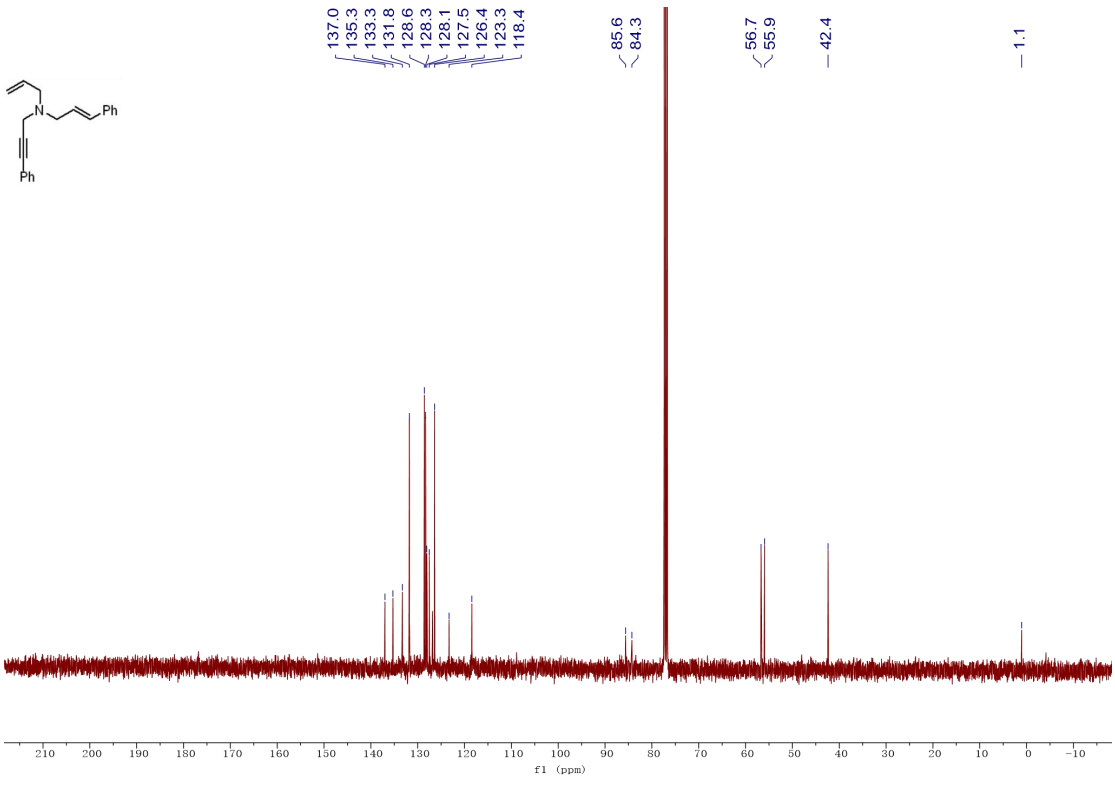
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4u**



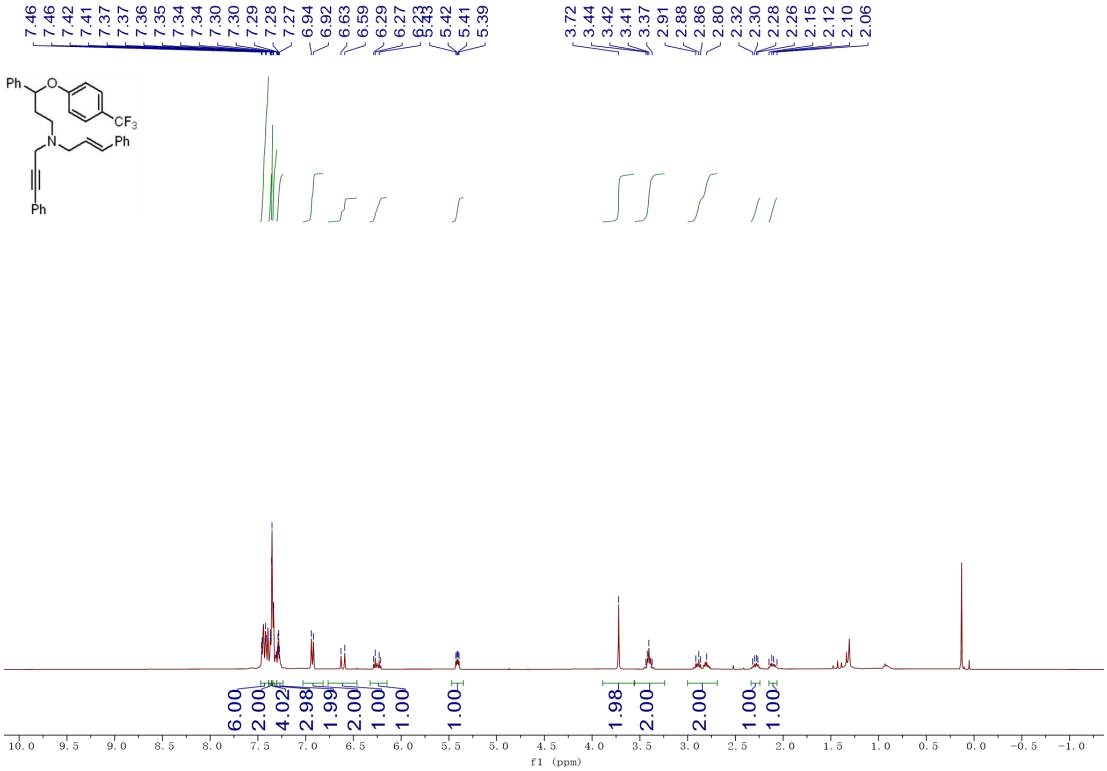
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4v**



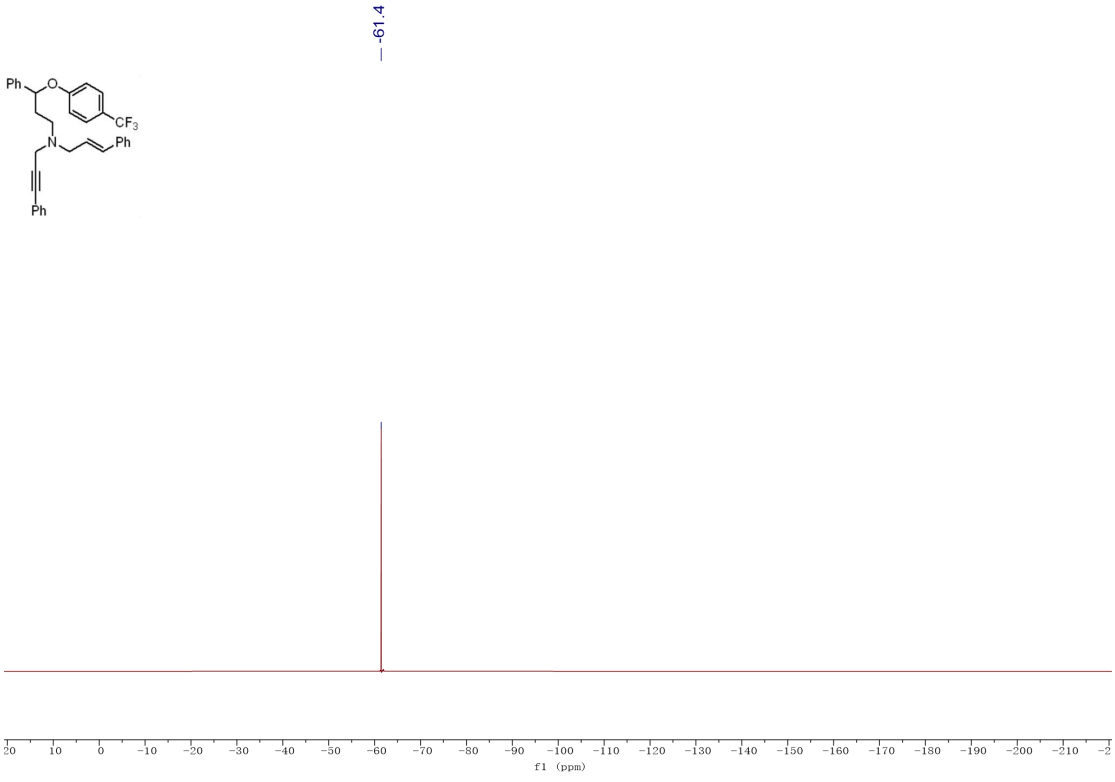
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4v**



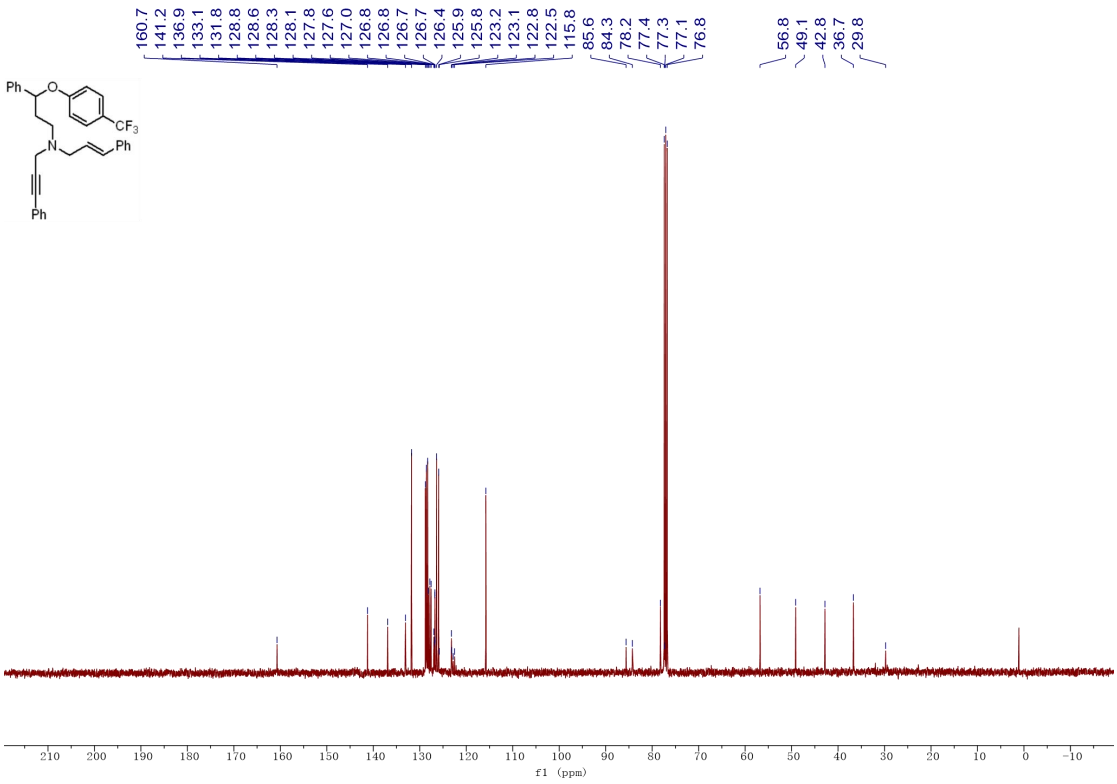
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **4w**



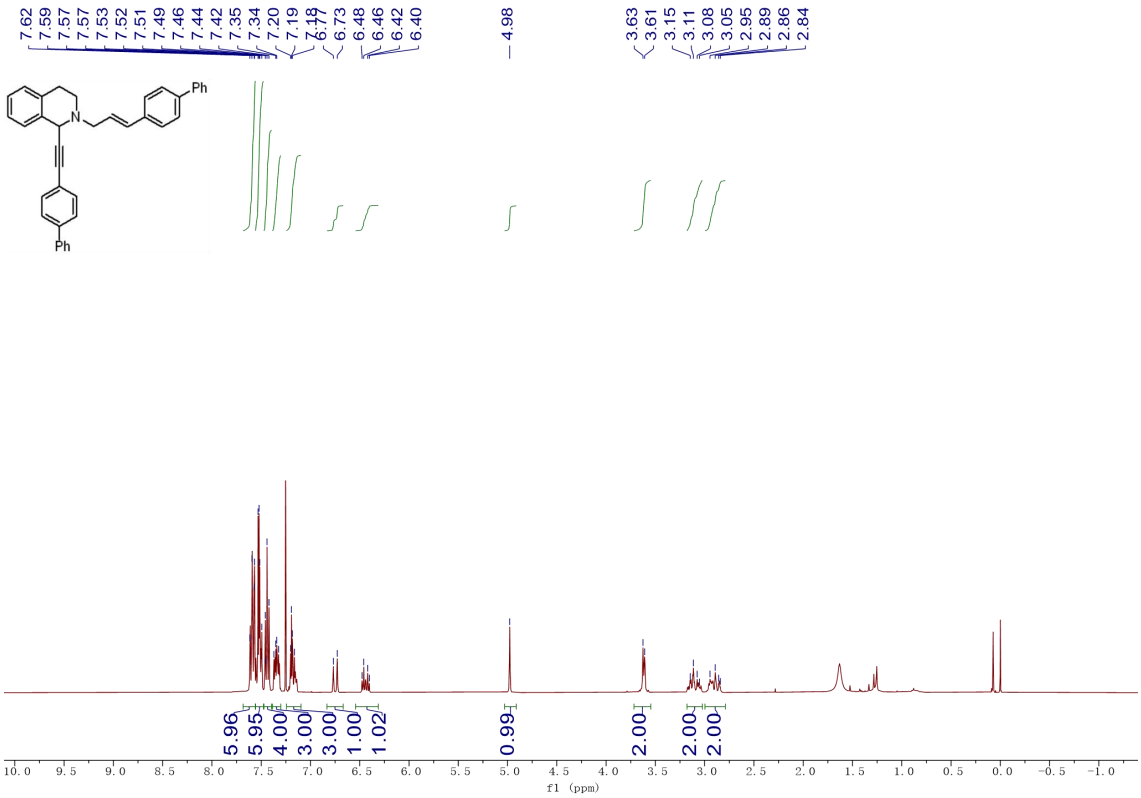
^{19}F NMR (376 MHz, Chloroform-d) Spectrum of compound **4w**



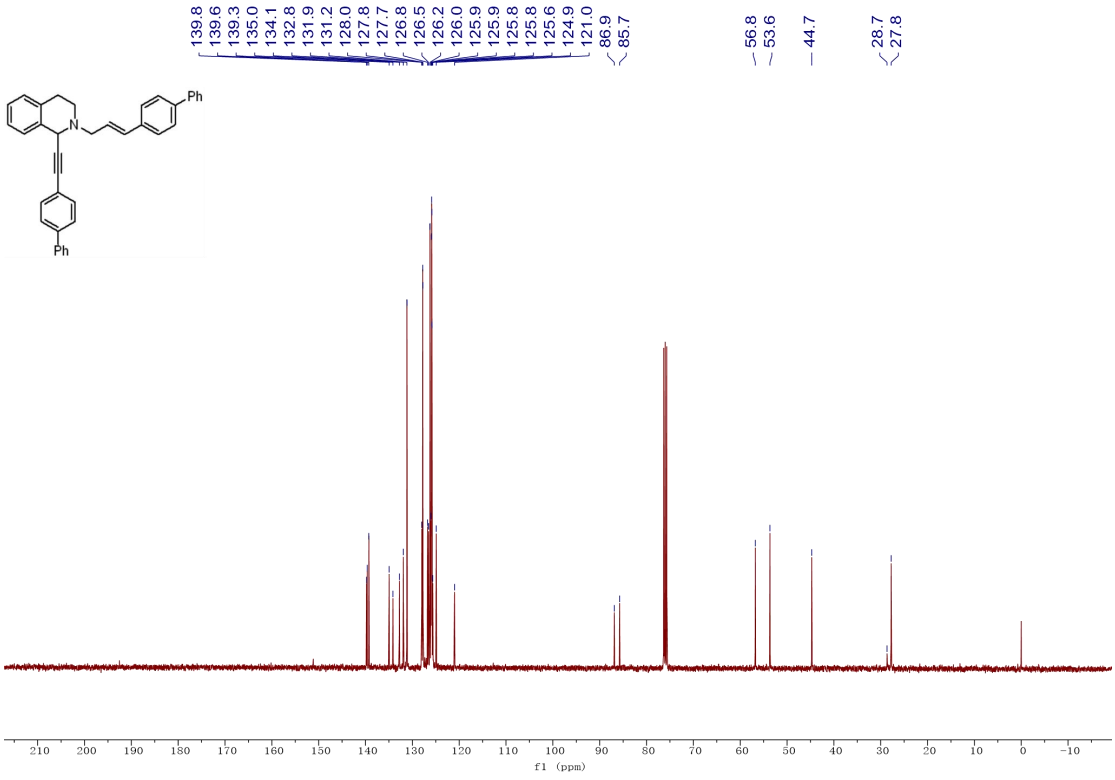
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **4w**



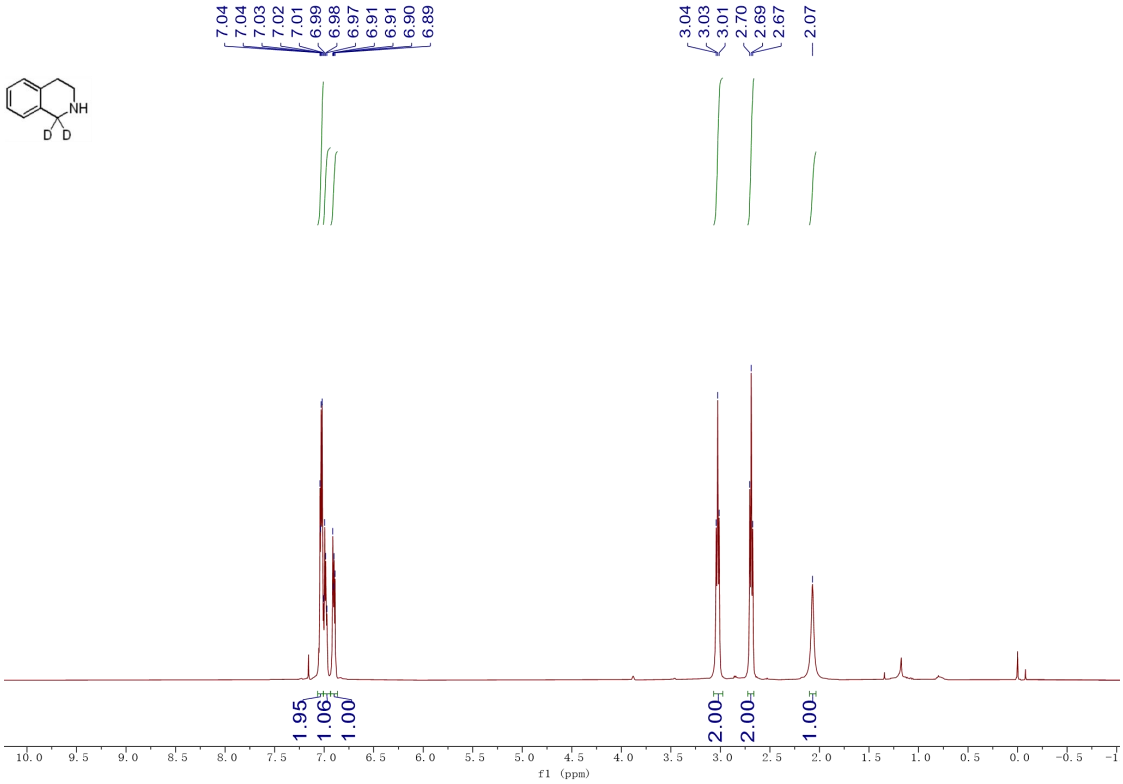
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound **5**



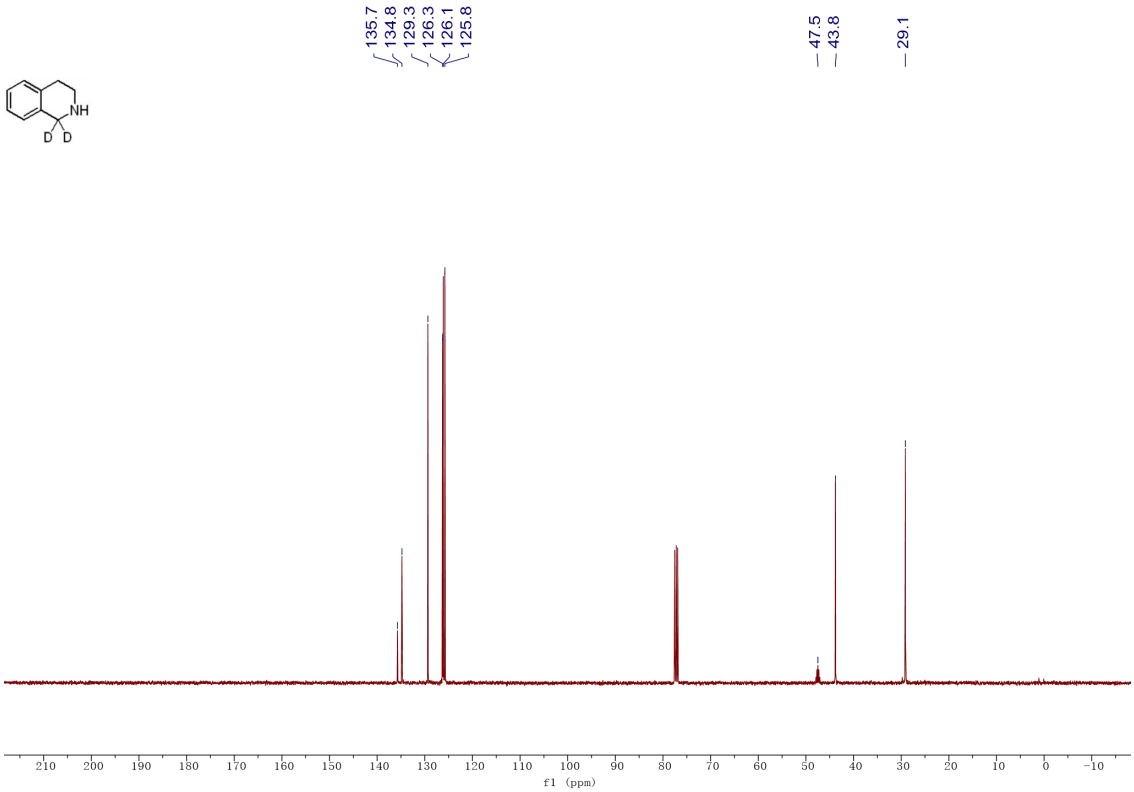
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound **5**



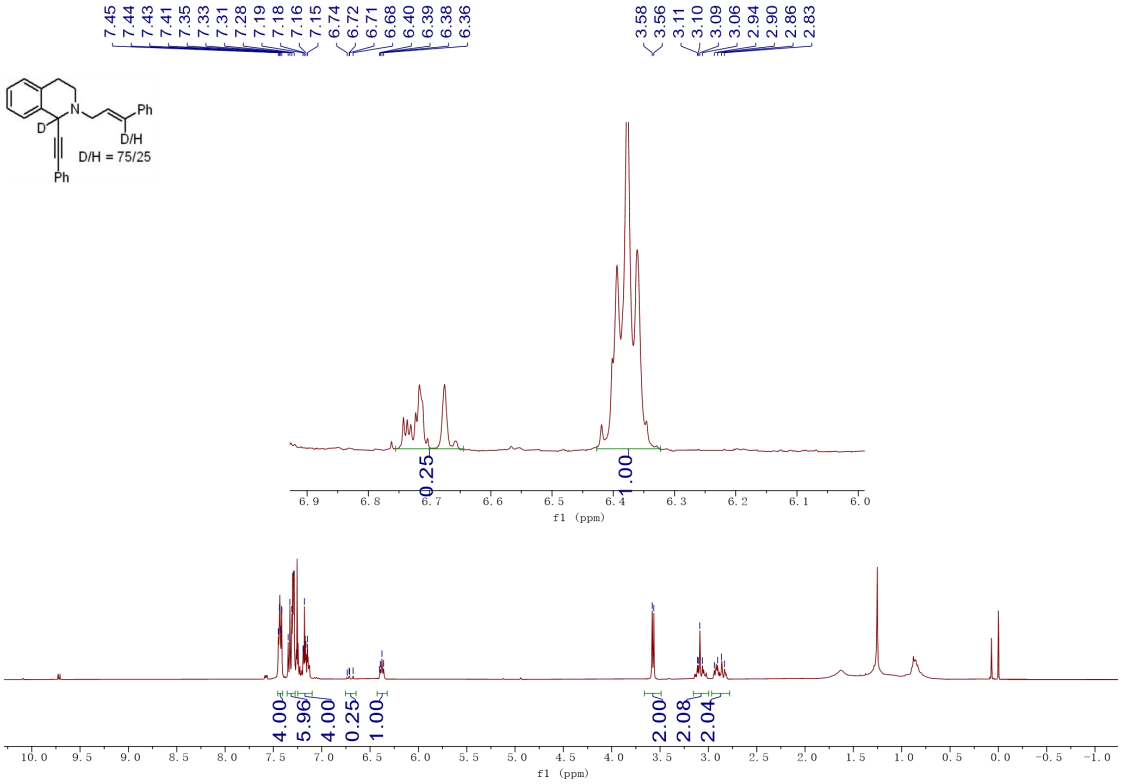
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound ***d*-1a**



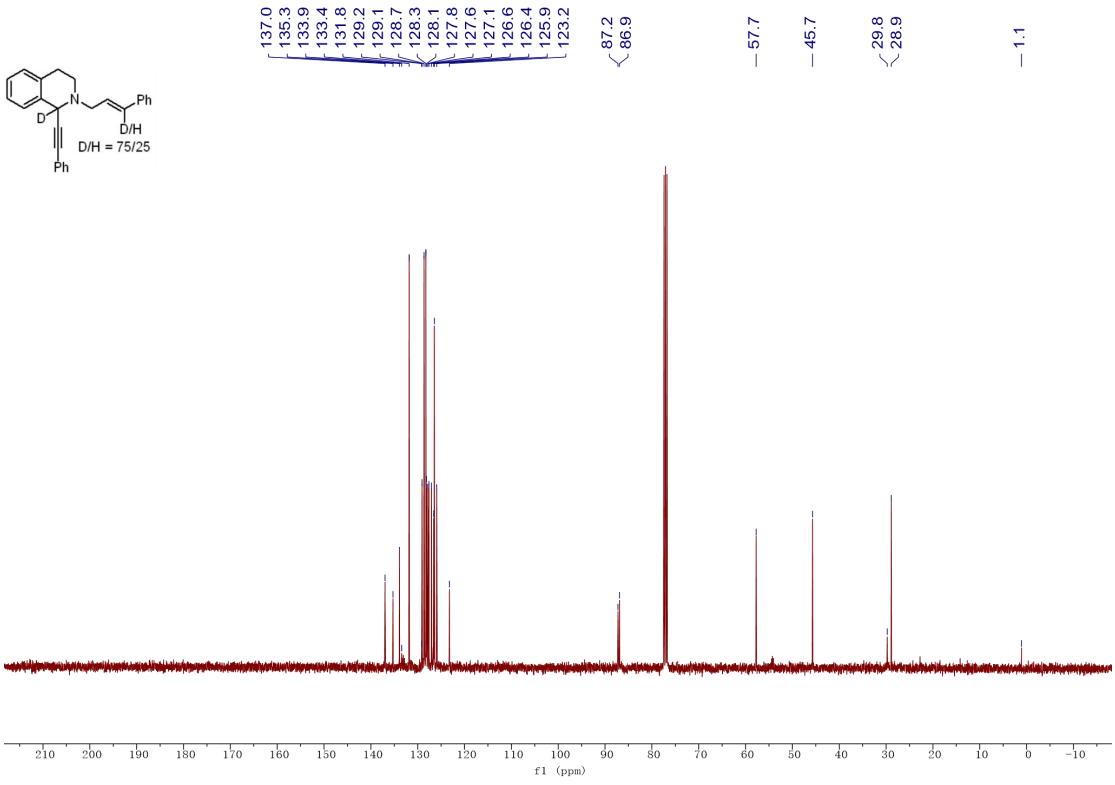
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound ***d*-1a**



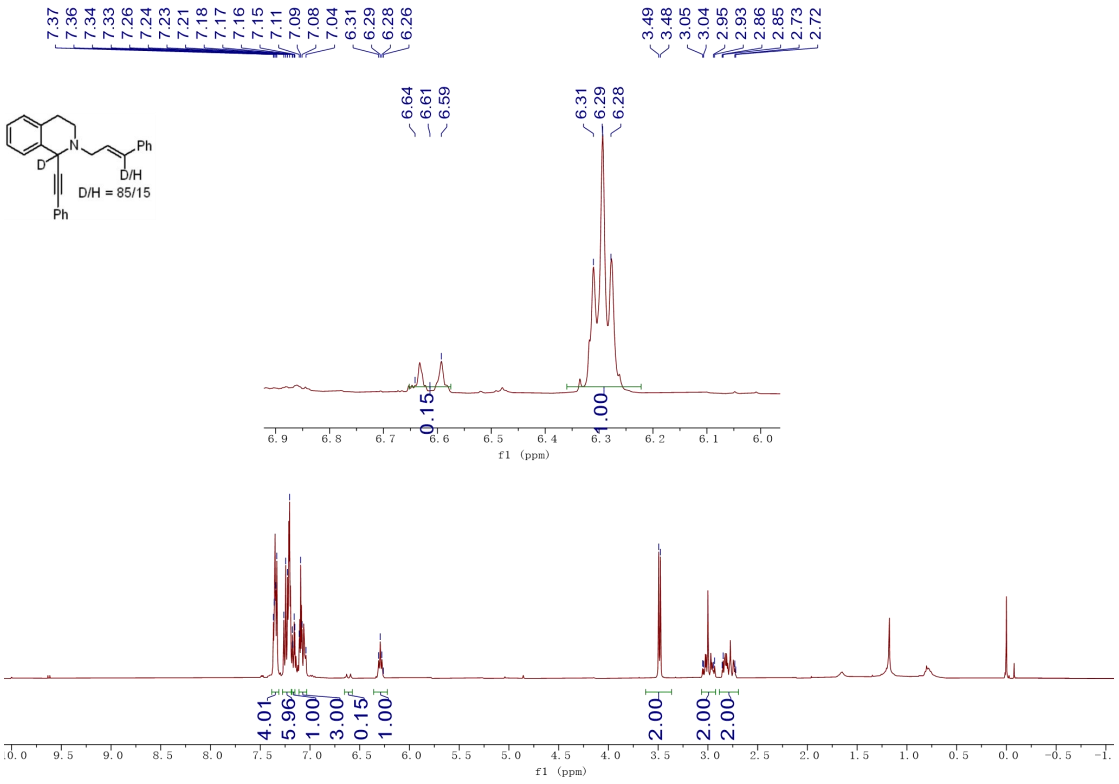
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound ***d*-4a**



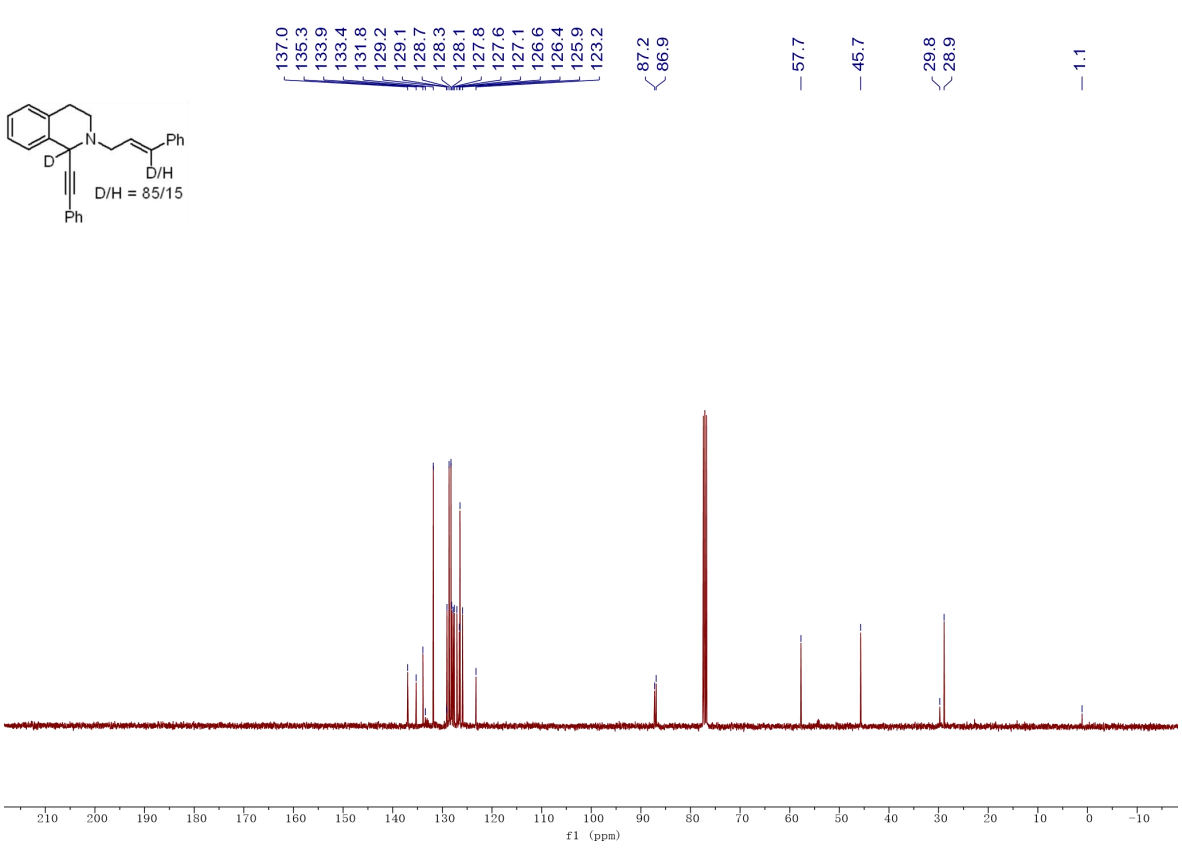
^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound ***d*-4a**



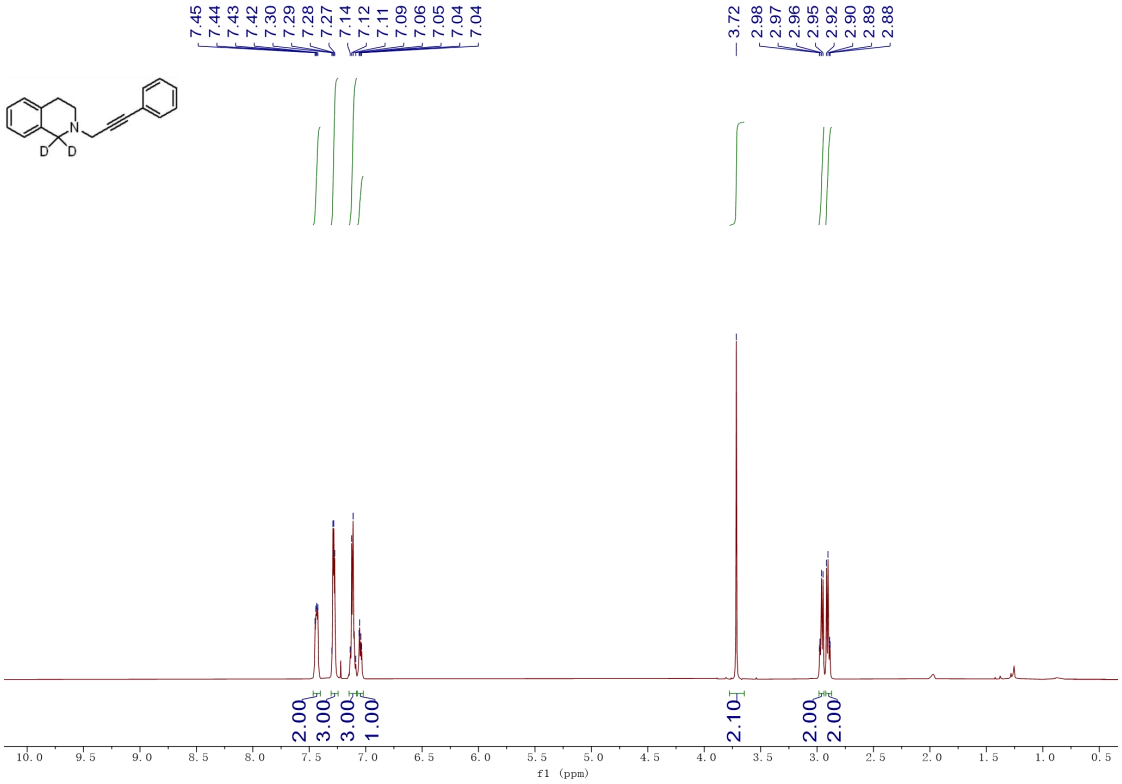
^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound ***d*-4a'**



^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound ***d*-4a'**



^{1}H NMR (400 MHz, Chloroform-d) Spectrum of compound ***d*-6a**



^{13}C NMR (101 MHz, Chloroform-d) Spectrum of compound ***d*-6a**