Supporting Information

Metal-Free Synthesis of (*E*)-Monofluoroenamine from 1-Sulfonyl-1,2,3-Triazole and $Et_2O{\cdot}BF_3$ via Stereospecific Fluorination of α-Diazoimine

Ze-Feng Xu, Haican Dai, Lihong Shan, and Chuan-Ying Li*

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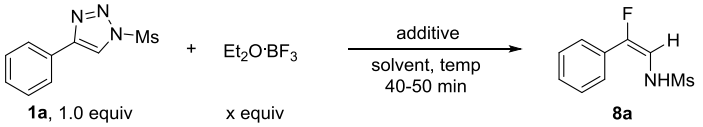
1. General comments

Analytical thin layer chromatography (TLC) was performed using Silica Gel HSGF254 pre-coated plates. Flash column chromatography was performed using 200 - 300 Mesh Silica Gel. Proton nuclear magnetic resonance (^{1}H-NMR) spectra were recorded using Brucker Avance IIDMX 400MHz spectrometers. Chemical shift (δ) is reported in parts per million (ppm) downfield relative to tetramethylsilane (TMS, 0.00 ppm) or $CDCl_3$ (7.26 ppm). Coupling constants (*J*) are reported in Hz. Multiplicities are reported using the following abbreviations: s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet; br, broad; Carbon-13 nuclear magnetic resonance (^{13}C-NMR) spectra were recorded using a Brucker Avance II DMX 400 spectrometer at 100 MHz. Chemical shift is reported in ppm relative to the carbon resonance of $CDCl_3$ (77.00 ppm). High resolution mass spectra (HRMS) were obtained by Center for Instrumental Analysis of Zhejiang Sci-Tech University and a Waters TOFMS GCT Premier instrument for HRMS. The results are reported as m/e (relative ratio). Accurate masses are reported for the molecular ion (M^+) or a suitable fragment ion.

2. Detailed optimization of reaction conditions

Table S1 Optimization of Reaction Conditions.[a]



entry	x	Additive (equiv)	solvent	temp (^{o}C)	yield (%)[b]
1	1.0	--	DCE	rt	44
2	1.0	--	DCE	reflux	54
3	0.5	--	DCE	reflux	52
4	1.5	--	DCE	reflux	59
5	2.0	--	DCE	reflux	55
6	1.5	--	$CHCl_3$	reflux	36
7	1.5	--	DCM	reflux	47
8	1.5	--	toluene	90	20
9	1.5	--	dioxane	90	0
10	1.5	--	TCE	90	46
11	1.5	H_2O (1.0)	DCE	reflux	28
12	1.5	TsOH (1.0)	DCE	reflux	0
13	1.5	NH_4Cl (1.0)	DCE	reflux	49
14[d]	1.5	--	DCE	reflux	68
15[d,e]	1.5	AcOH (1.0)	DCE	reflux	51
16[d,e]	1.5	TFA (1.0)	DCE	reflux	68
17[d,e]	1.5	TsOH (1.0)	DCE	reflux	60
18[d,e]	1.5	TfOH (1.0)	DCE	reflux	0
19[d]	1.5	$PhB(OH)_2$ (0.5)	DCE	reflux	71
20[d]	1.5	HBF_4 (1.0)	DCE	reflux	20
21[d]	1.5	pyridine·HF (1.0)	DCE	reflux	0
22[d]	1.5	TsONa (1.0)	DCE	reflux	0
23[d]	1.5	Ph_3P (1.0)	DCE	reflux	20
24[d]	1.5	Ph_2S (1.0)	DCE	reflux	45
25[d]	1.5	TBAF·$3H_2O$ (1.0)	DCE	reflux	51
26[d]	1.5	TBAF·$3H_2O$ (0.3)	DCE	reflux	70
27[d]	1.5	TBAF·$3H_2O$ (0.2)	DCE	reflux	80(71[c])
28[d]	1.5	TBAF·$3H_2O$ (0.1)	DCE	reflux	75
29	1.5	TBAF·$3H_2O$ (0.2)	DCE	reflux	78
30[f]	1.5	TBAF·$3H_2O$ (0.2)	DCE	reflux	--(70[c])

[a] General reaction conditions: **1a** (44.6 mg, 0.2 mmol), $Et_2O·BF_3$, additive, solvent (2.0-2.5 mL), N_2 atmosphere. [b] Determined by ^{1}H NMR with 1,3,5-trimethoxylbenzene as the internal standard. [c] Isolated yield. [d] 4 Å molecular sieve was added. [e] The additive was added after disappearance of 1a. [f] The reaction was carried out in 1.0 mmol scale. Ms = methylsulfonyl, Ts = tosyl, AcO = acetate, TFA = trifluoroacetic acid, TfOH = triflic acid, TBAF = tetrabutylammonium fluoride, DCE = 1,2-dichloroethane, DCM = dichloromethane, TCE = 1,1,2-trichloroethane.

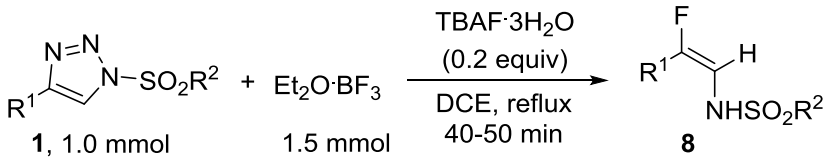
Detailed optimization of reaction conditions was displayed above in Table S1. Elevating the temperature from rt to reflux promoted the yield of **8a** to 54% in the presence of 1.0 equiv $Et_2O·BF_3$ in DCE (entries 1-2); dosage of $Et_2O·BF_3$ influenced the yield of the product slightly (entries 3-5) and 1.5 equiv should be the best (59%, entry 4). DCE was proved to be the most efficient solvent (entries 6-10). Several hydrogen sources were added to the reaction to

promote the formation of the desired product, however, giving no positive results (entries 11-13). Interestingly, 4 Å molecular sieves could improve the yield to 68% (entry 14). Accordingly, many other additives were tested along with the addition of 4 Å molecular sieves; for instance, most of protonic acids tested in this work displayed negative effect (entries 15-18) except for $PhB(OH)_2$ which led to the formation of **8a** in a slightly increased yield (71%, entry 19); however, no further improvement was achieved by using other boronic acids. HBF_4 and pyridine·HF were introduced to the reactions respectively attempting to provide both fluorine and hydrogen, but very poor yields were obtained (entries 20-21). According to Sander and co-workers, migration of F from boron to diazo-linked carbon was reversible (Costa, P.; Mieres-Perez, J.; Ozkan, N.; Sander, W. *Angew. Chem., Int. Ed.* **2017**, *56*, 1760.), and in hence, Lewis bases were utilized in the purpose of coordinating with the newly formed -BF_2 group to stop F migrating back to boron (entries 22-28). Fortunately, 0.2 equiv of TBAF·$3H_2O$ could increase the yield of the desired product to 80% (71% isolated yield, entry 27). Surprisingly, in the presence of TBAF·$3H_2O$, 4 Å molecular sieves was not necessary (78%, entry 29) and furthermore, when the reaction was carried in a larger scale (1.0 mmol), the yield of **8a** was also reserved (70% isolated yield, entry 30). Eventually, conditions of entry 30 were selected as the optimal conditions utilized in further examination of substrate scope.

3 Evaluation of other 1-sulfonyl-1,2,3-triazoles

Several other triazoles were also tested under the standard conditions, and the results were summarized in the following Table S2.

Table S2 Evaluation of other 1-sulfonyl-1,2,3-triazoles.[a]



entry	**1**	R^1	R^2	**8**	yield (%)[b]	note
1	**1z**	Ph	*p*-$MeOC_6H_4$	**8z**	0	decomposed
2	**1aa**	*p*-MeO-C_6H_4	Me	**8aa**	0	decomposed
3	**1ab**	*p*-O_2N-C_6H_4	Me	**8ab**	0	decomposed
4	**1ac**	*p*-F_3C-C_6H_4	Me	**8ac**	trace	decomposed
5	**1ad**	*o*-NC-C_6H_4	Me	**8ad**	8	
6[c]	**1ae**	*n*Bu	*p*-MeC_6H_4	**8ae**	0	decomposed

[a] The reactions were carried out under standard conditions in 1.0 mmol scale. [b] Isolated yield. [c] The reaction time was 4 h.

Alkoxy group was not compatible at all in the reaction. When **1z** and **1aa** was treated under standard conditions, no desired products were monitored or isolated and the starting materials were decomposed very fast (entries 1-2).

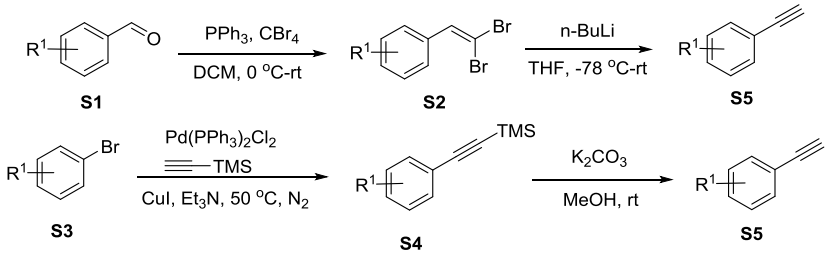
For strong electron-withdrawing groups, a complicated mixture was obtained when *p*-NO_2 substituted **1ab**

was used (entry 3). Trace amount of *p*-CF_3 substituted **8ac** was detected from the ^{1}H NMR of the reaction mixture (entry 4), and *o*-cyano **8ad** was isolated in only 8% yield after twice flash column chromatograph and then recrystallization (entry 5).

Triazole **1ae** was not reactive under the standard conditions as 4-aryl triazoles, and after 4 h, it was decomposed without any desired **8ae** generated (entry 6).

4. Synthetic procedures and spectra data of 1-sulfonyl-1,2,3–triazoles

4.1 General procedures for preparation of S5



4.1.1 Synthesis of polysubstituted (2,2-dibromovinyl)benzenes (S2) [1]

General Procedure: To a solution of **S1** (10 mmol) and CBr_4 (6.63 g, 20 mmol) in CH_2Cl_2 (10 mL) was added the solution of PPh_3 (10.48 g, 40 mmol) in CH_2Cl_2 (10 mL) via cannula at 0 °C. After stirring for 30 min, the solvent was removed under reduced pressure. The residue was purified by flash column chromatography on silica gel (PE) to afford **S2**.

4.1.2 Synthesis of polysubstituted trimethyl(phenylethynyl)silane (S4) [1]

General Procedure: Under a nitrogen atmosphere, to a triethylamine solution (20 mL) of $Pd(PPh_3)_2Cl_2$ (213 mg, 0.3 mmol) and CuI (190 mg, 1.0 mmol) was added **S3** (10.0 mmol) and stirred for 10 min, then trimethylsilylacetylene (1.80 mL, 12.0 mmol) was added dropwise over 30 min. The resulting suspension was allowed to be stirred for 4.0 h at 50 ^{o}C. After completion of the reaction, the mixture was filtered through a short celite bed and concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel (PE) to afford compound **S4**.

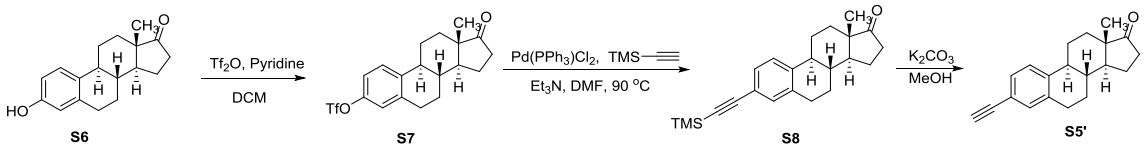
4.1.3 Synthesis of polysubstituted-ethynylbenzene (S5) [1]

General Procedure 1: To a solution of **S2** (10 mmol) in THF (10 mL) *n*-BuLi (20 mmol, 8.3 mL, 2.4 M in hexane) was added dropwise at –78 °C. After stirring for 4.0 h, MeOH (8 mL) was added and the mixture was stirred for an additional 1.0 h, then the reaction was quenched with saturated aqueous NH_4Cl solution at 0 °C, and the aqueous phase

was extracted with Et_2O. The combined organic extracts were dried over Na_2SO_4, filtered, and concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel (PE) to afford **S5.**

General Procedure 2: To polysubstituted-trimethyl(phenylethynyl)silane **S4** (5 mmol) a solution of K_2CO_3 (0.276 g, 2 mmol) in 10 mL MeOH was added and the mixture was stirred at room temperature, until TLC analysis showed that **S4** was completely consumed. The reaction mixture was filtered through a short plug of silica gel. The filtration was concentrated and then purified by flash chromatography to give the corresponding product **S5**.

4.2 Synthesis of S5'



4.2.1 Synthesis of S7 [2]

To a solution of **S6** (2.7 g, 10.0 mmol) and pyridine (1.62 mL, 20.0 mmol) in 20 mL dry DCM was added Tf_2O (2.0 mL, 12.0 mmol) dropwise at 0 ^oC. After that, the mixture was warmed to rt, and stirred overnight. The mixture was then quenched with HCl (10%) and extracted with CH_2Cl_2, washed with saturated $NaHCO_3$ and saturated brine. The organic layer was dried over anhydrous Na_2SO_4 and filtered. The filtrate was concentrated under reduced pressure, and the crude product was purified by flash column chromatography on silica gel to give the corresponding product **S7.**

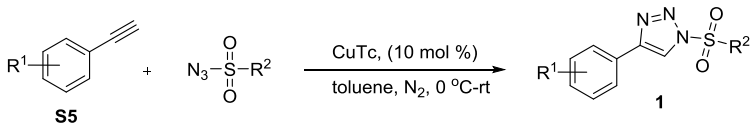
4.2.2 Synthesis of S8 [3]

A mixture of **S7** (1.61 g, 4.0 mmol), ethynyltrimethylsilane (0.79 mL, 5.6 mmol), triethylamine (3.0 mL), and $Pd(PPh_3)_2Cl_2$ (84 mg, 0.12 mmol) in 15 mL DMF was stirred at 90 °C for 4 h under nitrogen. The reaction mixture was then diluted with water, extracted with 1:1 petroleum ether/ether, washed with water until neutral, and dried (Na_2SO_4), after filtration the filtrate was evaporated. Chromatography of the residue on silica gel provided the corresponding product **S8.**

4.2.3 Synthesis of S5'

To **S8** (1.16 g, 3.3 mmol) a solution of K_2CO_3 (0.52 g, 4.95 mmol) in 10 mL MeOH was added and the mixture was stirred at room temperature, until TLC analysis showed that **S4** was completely consumed. The reaction mixture was filtered through a short plug of silica gel. The filtration was concentrated and then purified by flash chromatography to give the corresponding product **S5'** (726.5 mg, overall 54% yield from **S6**).

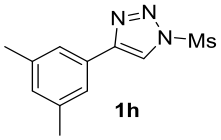
4.3 General procedure for synthesis of 1-sulfonyl-1,2,3-triazoles



Under a nitrogen atmosphere, dry toluenewas added to a flask charged with copper (I) thiophene-2-carboxylate (CuTC, 0.1 equiv in regards to alkyne) and the alkyne (1 equiv, 0.33 M). The reaction mixture was cooled in an ice-water bath. Subsequently, the sulfonyl azide (1.2 equiv) was added slowly as the limiting reagent to avoid a run-away exotherm, and the reaction mixture was allowed to warm to room temperature and stirred until TLC analysis showed that alkyne was completely consumed. The reaction mixture filtered through a short plug of silica gel. The filtrate was concentrated and then purified by flash chromatography with PE/EtOAc (3:1) as eluent to give the corresponding product **1**.

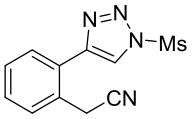
1a-e and **1ae** were reported in ref 4, **1f**, **1k**, **1m** and **1r** were reported in ref 5, **1g** was reported in ref 6, **1i** was reported in ref 7, **1l** and **1z** was reported in ref 8, **1o** and **1s** were reported in ref 9, **1t** was reported in ref 10, and **1x** was reported in ref 11, **1aa-ac** were reported in ref 12.

The corresponding alkynes of **1h**, **1v** and **1w** were synthesized through **S4** from **S3**, and the corresponding alkynes of **1j**, **1n**, **1p**, **1q** and **1u** were synthesized through **S2** from **S1**, **1y** was prepared from **S5'**.



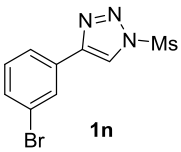
1h

4-(3,5-dimethylphenyl)-1-(methylsulfonyl)-1H-1,2,3-triazole (1h): white solid, yield: 80%, m.p.: 89-91 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.30 (s, 1H), 7.49 (s, 2H), 7.06 (s, 1H), 3.58 (s, 3H), 2.39 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 147.7, 138.7, 131.0, 128.4, 123.9, 118.9, 42.7, 21.3. HRMS (ESI) calcd for $C_{11}H_{14}N_3O_2S^+$ 252.0801, found 252.0804.



1j

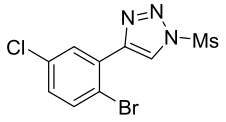
2-(2-(1-(methylsulfonyl)-1H-1,2,3-triazol-4-yl)phenyl)acetonitrile (1j): white solid, yield: 83%, m.p.: 135-137 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.32 (s, 1H), 7.62 (d, J = 7.5 Hz, 1H), 7.57 – 7.43 (m, 3H), 4.19 (s, 2H), 3.63 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 146.4, 130.2, 130.1, 129.9, 128.83, 128.76, 127.6, 121.5, 117.8, 42.8, 22.9. HRMS (ESI) calcd for $C_{11}H_{11}N_4O_2S^+$ 263.0597, found 263.0602.



1n

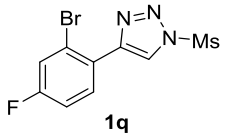
4-(3-bromophenyl)-1-(methylsulfonyl)-1H-1,2,3-triazole (1n): white solid, yield: 68%, m.p.: 102-104 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.35 (s, 1H), 8.01 (s, 1H), 7.77 (d, J = 7.7 Hz, 1H), 7.54 – 7.50 (m, 1H), 7.32 (t, J = 7.9 Hz, 1H),

3.60 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 146.0, 132.2, 130.64, 130.59, 129.1, 124.7, 123.1, 119.6, 42.8. HRMS (ESI) calcd for $C_9H_9BrN_3O_2S^+$ 301.9593, found 301.9609.



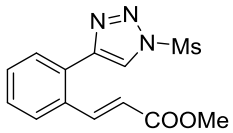
1p

4-(2-bromo-5-chlorophenyl)-1-(methylsulfonyl)-1H-1,2,3-triazole (1p): white solid, yield: 27%, m.p.: 115-117 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.83 (s, 1H), 8.20 – 8.12 (m, 1H), 7.66 – 7.61 (m, 1H), 7.30 – 7.23 (m, 1H), 3.63 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 143.9, 134.9, 134.1, 130.8, 130.5, 130.3, 122.5, 119.1, 42.8. HRMS (ESI) calcd for $C_9H_8BrClN_3O_2S^+$ 335.9204, found 335.9207.



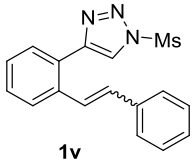
1q

4-(2-bromo-4-fluorophenyl)-1-(methylsulfonyl)-1H-1,2,3-triazole (1q): white solid, yield: 30%, m.p.: 101-103 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.75 (s, 1H), 8.13 (dd, *J* = 8.8, 6.0 Hz, 1H), 7.46 (dd, *J* = 8.2, 2.6 Hz, 1H), 7.21 (td, *J* = 8.8, 8.2, 2.6 Hz, 1H), 3.63 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.4 (d, *J* = 254.3 Hz), 144.3, 132.1 (d, *J* = 8.7 Hz), 125.9 (d, *J* = 3.6 Hz), 122.0, 121.7 (d, *J* = 9.5 Hz), 121.0 (d, *J* = 24.8 Hz), 115.4 (d, *J* = 21.3 Hz), 42.8. HRMS (ESI) calcd for $C_9H_8BrFN_3O_2S^+$ 319.9499, found 319.9505.



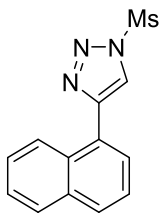
1u

methyl (E)-3-(2-(1-(methylsulfonyl)-1H-1,2,3-triazol-4-yl)phenyl)acrylate (1u): white solid, yield: 67%, m.p.: 114-116 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.19 (s, 1H), 7.98 (d, *J* = 16.0 Hz, 1H), 7.78 (d, *J* = 7.1 Hz, 1H), 7.72 (d, *J* = 7.1 Hz, 1H), 7.55 – 7.45 (m, 2H), 6.48 (d, *J* = 16.0 Hz, 1H), 3.83 (s, 3H), 3.65 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.0, 145.6, 142.5, 133.3, 130.2, 130.0, 129.6, 128.6, 127.4, 122.1, 120.9, 51.9, 42.8. HRMS (ESI) calcd for $C_{13}H_{14}N_3O_4S^+$ 308.0700, found 308.0706.



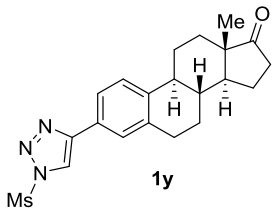
1v

1-(methylsulfonyl)-4-(2-styrylphenyl)-1H-1,2,3-triazole (1v): yellow oil, yield: 60%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.34 8.20 (1H), 8.12 – 8.10 7.78 – 7.73 (2H), 7.53 – 7.35 (m, 6H), 7.32 – 7.30 (m, 1H), 7.19 – 7.08 6.73 – 6.72 (2H), 3.59 3.53 (3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 146.5, 137.1, 136.5, 131.9, 129.7, 129.6, 128.8, 128.1, 127.9, 127.2, 126. 9, 126.8, 126.5, 121.8, 42.7. HRMS (ESI) calcd for $C_{17}H_{16}N_3O_2S^+$ 326.0958, found 326.0960.



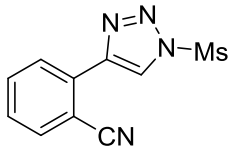
1w

1-(methylsulfonyl)-4-(naphthalen-1-yl)-1H-1,2,3-triazole (1w): white solid, yield: 46%, m.p.: 116-118 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.40 (s, 1H), 8.30 – 8.23 (m, 1H), 8.00 – 7.89 (m, 2H), 7.78 (d, *J* = 7.0 Hz, 1H), 7.60 – 7.55 (m, 3H), 3.67 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 146.6, 133.8, 130.9, 130.0, 128.7, 127.9, 127.2, 126.4, 126.0, 125.3, 124.8, 121.9, 42.8. HRMS (ESI) calcd for $C_{13}H_{12}N_3O_2S^+$ 274.0645, found 274.0651.



1y

(8R,9S,13S,14S)-13-methyl-3-(1-(methylsulfonyl)-1H-1,2,3-triazol-4-yl)-6,7,8,9,11,12,13,14,15,16-decahydro-17H-cyclopenta[a]phenanthren-17-one (1y): yellow solid, yield: 53%, m.p.: 155-157 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.30 (s, 1H), 7.67 (s, 1H), 7.63 (d, *J* = 8.1 Hz, 1H), 7.41 (d, *J* = 8.1 Hz, 1H), 3.59 (s, 3H), 3.01 (dd, *J* = 10.1, 4.6 Hz, 2H), 2.62 – 2.43 (m, 2H), 2.42 – 2.26 (m, 1H), 2.24 – 1.91 (m, 4H), 1.73 – 1.39 (m, 6H), 0.95 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 220.8, 147.5, 141.2, 137.4, 126.7, 126.14, 126.06, 123.5, 118.6, 50.5, 48.0, 44.5, 42.7, 38.0, 35.9, 31.6, 29.4, 26.4, 25.7, 21.6, 13.9. HRMS (ESI) calcd for $C_{21}H_{26}N_3O_3S^+$ 400.1689, found 400.1698.

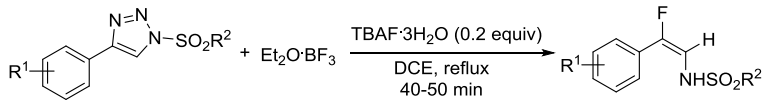


1ad

2-(1-(methylsulfonyl)-1H-1,2,3-triazol-4-yl)benzonitrile (1ad): yellow oil, yiled: 80%; ^{1}H NMR (400 MHz, DMSO-d6) δ 9.21 (s, 1H), 8.11 (d, *J* = 7.8 Hz, 1H), 8.01 (d, *J* = 7.8 Hz, 1H), 7.86 (t, *J* = 7.7 Hz, 1H), 7.65 (t, *J* = 7.7 Hz, 1H), 3.98 (s, 3H). ^{13}C NMR (100 MHz, DMSO-d6) δ 143.7, 134.9, 134.3, 131.9, 130.1, 129.4, 123.9, 118.6, 109.4, 42.9. HRMS (ESI) calcd for $C_{10}H_9N_4O_2S^+$ 249.0441, found 249.0443.

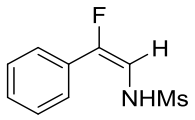
5. Reaction scope

Procedure for the preparation of 8



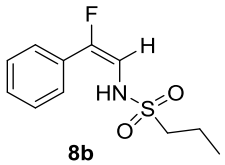
1, 1.0 mmol 1.5 mmol **8**

General procedure: Under a nitrogen atmosphere, a solution of $Et_2O{\cdot}BF_3$ (0.19 mL, 1.5 mmol) in DCE (4.0 mL) was added to a reaction flask charged with $TBAF{\cdot}3H_2O$ (50.5 mg, 0.2 mmol) and a stirring bar, and then the solution of 1-sulfonyl-1,2,3-triazoles (**1**, 1.0 mmol) in DCE (4.0 mL) was added. The reaction mixture was stirred at reflux for 40-50 min, then was cooled to room temperature and filtered through a short plug of silica gel. The filtrate was concentrated and the residue was purified by flash chromatography with PE/EtOAc (4:1) as eluent to give the corresponding product **8**.



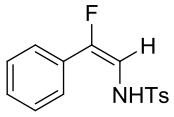
8a

(*E*)-N-(2-fluoro-2-phenylvinyl)methanesulfonamide (8a): yellow oil, 149.0 mg, yield: 70%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.46 – 7.33 (m, 5H), 6.59 (d, *J* = 10.7 Hz, 1H), 6.47 (dd, *J* = 25.4, 10.7 Hz, 1H), 3.13 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 147.1 (d, *J* = 240.7 Hz), 130.2 (d, *J* = 24.8 Hz), 128.72 (d, *J* = 2.0 Hz), 128.65, 122.8 (d, *J* = 6.7 Hz), 104.0 (d, *J* = 13.9 Hz), 41.1. HRMS (ESI) calcd for $C_9H_{11}FNO_2S^+$ 216.0489, found 216.0497.



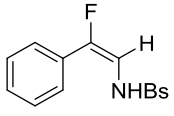
8b

(*E*)-N-(2-fluoro-2-phenylvinyl)propane-1-sulfonamide (8b): yellow oil, 166.2 mg, yield: 68%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44 (d, *J* = 7.7 Hz, 2H), 7.37 (t, *J* = 7.5 Hz, 2H), 7.32 (d, *J* = 7.1 Hz, 1H), 7.02 (d, *J* = 10.2 Hz, 1H), 6.49 (dd, *J* = 26.3, 10.2 Hz, 1H), 3.19 (t, *J* = 7.5 Hz, 2H), 1.97 – 1.87 (m, 2H), 1.09 (t, *J* = 7.5 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 146.5 (d, *J* = 240.0 Hz), 130.4 (d, *J* = 24.7 Hz), 128.7, 128.4, 122.7 (d, *J* = 6.6 Hz), 104.5 (d, *J* = 13.6 Hz), 55.5, 17.3, 12.9. HRMS (ESI) calcd for $C_{11}H_{15}FNO_2S^+$ 244.0802, found 244.0809.



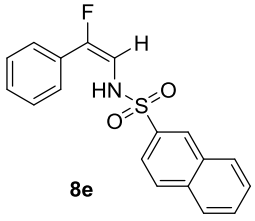
8c

(*E*)-N-(2-fluoro-2-phenylvinyl)-4-methylbenzenesulfonamide (8c): yellow oil, 168.0 mg, yield: 58%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 (d, *J* = 8.3 Hz, 2H), 7.37 – 7.25 (m, 7H), 6.70 (d, *J* = 9.4 Hz, 1H), 6.45 (dd, *J* = 25.7, 9.4 Hz, 1H), 2.41 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 147.1 (d, *J* = 240.5 Hz), 144.2, 136.7, 130.3 (d, *J* = 24.8 Hz), 130.0, 128.6 (d, *J* = 1.8 Hz), 128.5, 126.8, 122.8 (d, *J* = 6.6 Hz), 104.2 (d, *J* = 13.9 Hz), 21.6. HRMS (ESI) calcd for $C_{15}H_{15}FNO_2S^+$ 292.0802, found 292.0791.



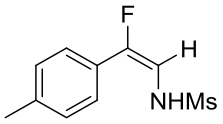
8d

(*E*)-4-bromo-N-(2-fluoro-2-phenylvinyl)benzenesulfonamide (8d): yellow solid, 243.4 mg, yield: 69%, m.p.: 94-96 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 (d, *J* = 8.6 Hz, 2H), 7.65 (d, *J* = 8.6 Hz, 2H), 7.39 – 7.27 (m, 5H), 6.81 (d, *J* = 10.6 Hz, 1H), 6.43 (dd, *J* = 25.6, 10.6 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 147.6 (d, *J* = 241.7 Hz), 138.6, 132.7, 130.0 (d, *J* = 24.6 Hz), 128.8, 128.7, 128.4, 128.3, 122.9 (d, *J* = 6.5 Hz), 103.6 (d, *J* = 14.0 Hz). HRMS (ESI) calcd for $C_{14}H_{12}BrFNO_2S^+$ 355.9751, found 355.9763.



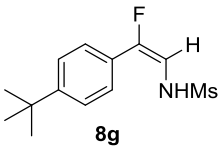
8e

(*E*)-N-(2-fluoro-2-phenylvinyl)naphthalene-2-sulfonamide (8e): yellow oil, 157.0 mg, yield: 48%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.51 (s, 1H), 7.98 (d, *J* = 8.0 Hz, 2H), 7.90 (t, *J* = 8.0 Hz, 2H), 7.68 – 7.60 (m, 2H), 7.42 – 7.28 (m, 5H), 6.94 (d, *J* = 10.4 Hz, 1H), 6.55 (dd, *J* = 25.7, 10.4 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 147.2 (d, *J* = 240.7 Hz), 136.5, 135.0, 132.1, 130.3, 129.8, 129.4, 129.1, 128.6 (d, *J* = 1.8 Hz), 128.5, 128.3 (d, *J* = 4.2 Hz), 128.0, 127.7, 122.8 (d, *J* = 6.6 Hz), 121.8, 104.1 (d, *J* = 14.1 Hz). HRMS (ESI) calcd for $C_{18}H_{15}FNO_2S^+$ 328.0802, found 328.0811.



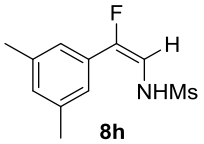
8f

(*E*)-N-(2-fluoro-2-(p-tolyl)vinyl)methanesulfonamide (8f): yellow oil, 140.1 mg, yield: 62%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.33 (d, *J* = 8.1 Hz, 2H), 7.19 (d, *J* = 8.1 Hz, 2H), 6.67 (d, *J* = 10.4 Hz, 1H), 6.40 (dd, *J* = 25.9, 10.4 Hz, 1H), 3.11 (s, 3H), 2.38 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 147.5 (d, *J* = 241.9 Hz), 138.7, 129.4, 127.4 (d, *J* = 25.8 Hz), 122.9 (d, *J* = 6.5 Hz), 103.2 (d, *J* = 14.2 Hz), 40.9, 21.3. HRMS (ESI) calcd for $C_{10}H_{12}FNNaO_2S^+$ 252.0465, found 252.0480.



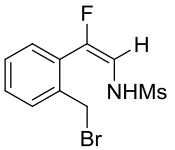
8g

(*E*)-N-(2-(4-(tert-butyl)phenyl)-2-fluorovinyl)methanesulfonamide (8g): yellow oil, 145.4 mg yield: 54%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44 – 7.36 (m, 4H), 6.82 (d, *J* = 10.3 Hz, 1H), 6.43 (dd, *J* = 26.0, 10.3 Hz, 1H), 3.13 (s, 3H), 1.34 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.0, 147.5 (d, *J* = 240.9 Hz), 127.3 (d, *J* = 24.9 Hz), 125. 7 (d, *J* = 1.8 Hz), 122.7 (d, *J* = 6.5 Hz), 103.3 (d, *J* = 14.1 Hz), 40.9, 34.7, 31.2. HRMS (ESI) calcd for $C_{13}H_{18}FNNaO_2S^+$ 294.0934, found 294.0933.



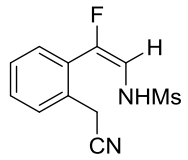
8h

(*E*)-N-(2-(3,5-dimethylphenyl)-2-fluorovinyl)methanesulfonamide (8h): yellow oil, 134.0 mg, yield: 55%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.07 (s, 2H), 7.02 – 6.92 (m, 2H), 6.45 (dd, *J* = 26.2, 9.4 Hz, 1H), 3.13 (s, 3H), 2.33 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 147.4 (d, *J* = 241.6 Hz), 138.3, 130.4, 130.1 (d, *J* = 24.4 Hz), 120.7 (d, *J* = 6.5 Hz), 103.7 (d, *J* = 14.1 Hz), 40.9, 21.3. HRMS (ESI) calcd for $C_{11}H_{14}FNNaO_2S^+$ 266.0621, found 266.0617.



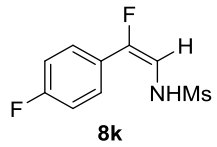
8i

(*E*)-N-(2-(2-(bromomethyl)phenyl)-2-fluorovinyl)methanesulfonamide (8i): yellow oil, 177.6 mg, yield: 59%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.48 – 7.30 (m, 4H), 7.18 (d, *J* = 10.6 Hz, 1H), 6.37 (dd, *J* = 25.5, 10.6 Hz, 1H), 4.62 (s, 2H), 3.17 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 146.1 (d, *J* = 244.2 Hz), 135.5, 131.4, 130.1, 129.8 (d, *J* = 22.4 Hz), 129.0, 128.9, 108.0 (d, *J* = 14.4 Hz), 41.3, 31.8. HRMS (ESI) calcd for $C_{10}H_{11}BrFNNaO_2S^+$ 329.9570, found 329.9576.



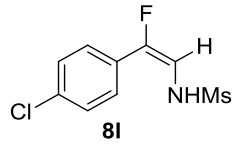
8j

(*E*)-N-(2-(2-(cyanomethyl)phenyl)-2-fluorovinyl)methanesulfonamide (8j): yellow oil, 139.8 mg, yield: 55%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.48 – 7.39 (m, 2H), 7.38 – 7.32 (m, 2H), 7.24 (d, *J* = 10.7 Hz, 1H), 6.23 (dd, *J* = 25.7, 10.7 Hz, 1H), 3.83 (s, 2H), 3.14 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.9 (d, *J* = 243.5 Hz), 130.4, 129.8, 129.6 (d, *J* = 22.5 Hz), 129.0 (d, *J* = 4.9 Hz), 128.6, 128.5, 117.5, 108.4 (d, *J* = 14.1 Hz), 41.3, 22.5. HRMS (ESI) calcd for $C_{11}H_{12}FN_2O_2S^+$ 255.0598, found 255.0600.



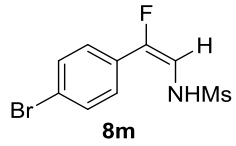
8k

(*E*)-N-(2-fluoro-2-(4-fluorophenyl)vinyl)methanesulfonamide (8k): yellow oil, 153.7 mg, yield: 66%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 (dd, *J* = 8.8, 5.2 Hz, 2H), 7.07 (t, *J* = 8.8 Hz, 2H), 6.89 (d, *J* = 8.9 Hz, 1H), 6.41 (dd, *J* = 26.0, 8.9 Hz, 1H), 3.14 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.8 (d, *J* = 249.0 Hz), 146.4 (d, *J* = 240.6 Hz), 126.4 (dd, *J* = 25.7, 3.5 Hz), 124.9 (dd, *J* = 8.1, 6.6 Hz), 115.9 (dd, *J* = 22.1, 1.7 Hz), 103.8 (dd, *J* = 14.1, 1.7 Hz), 41.1. HRMS (ESI) calcd for $C_9H_{10}F_2NO_2S^+$ 234.0395, found 234.0396.



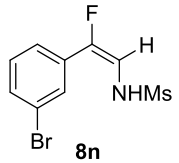
8l

(*E*)-N-(2-(4-chlorophenyl)-2-fluorovinyl)methanesulfonamide (8l): yellow oil, 168.6 mg, yield: 68%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 – 7.30 (m, 4H), 6.97 (d, *J* = 10.1 Hz, 1H), 6.47 (dd, *J* = 26.0, 10.1 Hz, 1H), 3.14 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 146.0 (d, *J* = 240.1 Hz), 134.4, 129.0, 128.7 (d, *J* = 25.6 Hz), 124.1 (d, *J* = 6.4 Hz), 104.5 (d, *J* = 14.0 Hz), 41.23. HRMS (ESI) calcd for $C_9H_{10}ClFNO_2S^+$ 250.0099, found 250.0127.



8m

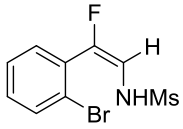
(*E*)-N-(2-(4-bromophenyl)-2-fluorovinyl)methanesulfonamide (8m): yellow oil, 217.0 mg, yield: 74%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.49 (d, *J* = 8.5 Hz, 2H), 7.28 (d, *J* = 8.5 Hz, 2H), 7.08 (d, *J* = 10.4 Hz 1H), 6.50 (dd, *J* = 26.1, 10.4 Hz, 1H), 3.14 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.9 (d, *J* = 240.0 Hz), 131.9, 129.4, 124.3 (d, *J* = 6.2 Hz), 122.4, 104.7 (d, *J* = 13.6 Hz), 41.3. HRMS (ESI) calcd for $C_9H_{10}BrFNO_2S^+$ 293.9594, found 293.9592.



8n

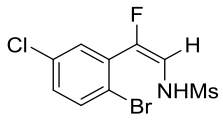
(*E*)-N-(2-(3-bromophenyl)-2-fluorovinyl)methanesulfonamide (8n): yellow oil, 226.1 mg, yield: 77%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56 (s, 1H), 7.42 (d, *J* = 7.8 Hz, 1H), 7.34 (d, *J* = 7.8 Hz, 1H), 7.26 – 7.18 (m, 2H), 6.51 (dd, *J* = 26.1, 10.7 Hz, 1H), 3.16 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.2 (d, *J* = 240.4 Hz), 132.3 (d, *J* = 24.8 Hz), 131.4,

130.3 (d, *J* = 2.1 Hz), 125.7 (d, *J* = 7.0 Hz), 122.9 (d, *J* = 2.1 Hz), 121.2 (d, *J* = 6.5 Hz), 105.3 (d, *J* = 13.2 Hz), 41.4. HRMS (ESI) calcd for $C_9H_{10}BrFNO_2S^+$ 293.9594, found 293.9604.



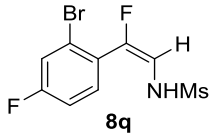
8o

(*E*)-N-(2-(2-bromophenyl)-2-fluorovinyl)methanesulfonamide (8o): yellow oil, 250.0 mg, yield: 85%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 (d, *J* = 7.9 Hz, 1H), 7.46 (dd, *J* = 7.9, 1.3 Hz, 1H), 7.37 (t, *J* = 7.6 Hz, 1H), 7.25 (t, *J* = 7.6 Hz, 1H), 6.61 (d, *J* = 11.4 Hz, 1H), 6.53 (dd, *J* = 24.4, 11.4 Hz, 1H), 3.16 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.0 (d, *J* = 242.2 Hz), 133.8, 131.2 (d, *J* = 23.5 Hz), 130.5, 129.9 (d, *J* = 5.4 Hz), 127.5, 121.1 (d, *J* = 1.6 Hz), 109.1 (d, *J* = 13.9 Hz), 41.2. HRMS (ESI) calcd for $C_9H_{10}BrFNO_2S^+$ 293.9594, found 293.9604.



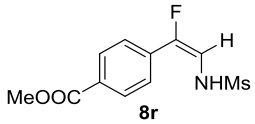
8p

(*E*)-N-(2-(2-bromo-5-chlorophenyl)-2-fluorovinyl)methanesulfonamide (8p): white solid, 256.2 mg, m.p.: 132-134 °C, yield: 78%; ^{1}H NMR (400 MHz, DMSO-d6) δ 10.14 (d, *J* = 10.2 Hz, 1H), 7.70 (d, *J* = 8.6 Hz, 1H), 7.63 (d, *J* = 2.5 Hz, 1H), 7.38 (dd, *J* = 8.6, 2.5 Hz, 1H), 6.51 (dd, *J* = 28.3, 10.2 Hz, 1H), 3.16 (s, 3H). ^{13}C NMR (100 MHz, DMSO-d6) δ 141.7 (d, *J* = 241.0 Hz), 135.6, 133. 8 (d, *J* = 23.2 Hz), 133.1, 130.7, 130.0, 119.2, 111.6 (d, *J* = 12.3 Hz), 41.5. HRMS (ESI) calcd for $C_9H_9BrClFNO_2S^+$ 327.9204, found 327.9210.



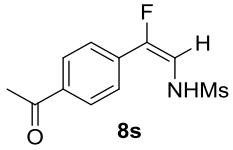
8q

(*E*)-N-(2-(2-bromo-4-fluorophenyl)-2-fluorovinyl)methanesulfonamide (8q): yellow oil, 237.3 mg, yield: 76%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.46 – 7.35 (m, 2H), 7.11 – 6.98 (m, 2H), 6.43 (dd, *J* = 25.3, 10.7 Hz, 1H), 3.16 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.4 (d, *J* = 255.4 Hz), 144.3 (d, *J* = 242.4 Hz), 131.4 (dd, *J* = 8.8, 4.8 Hz), 127.6 (dd, *J* = 24.3, 3.7 Hz), 122.1 (d, *J* = 9.8 Hz), 121.1 (d, *J* = 24.8 Hz), 114.9 (d, *J* = 21.4 Hz), 109.0 (d, *J* = 14.3 Hz), 41.2. HRMS (ESI) calcd for $C_9H_9BrF_2NO_2S^+$ 311.9500, found 311.9511.



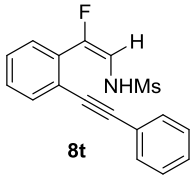
8r

methyl (*E*)-4-(1-fluoro-2-(methylsulfonamido)vinyl)benzoate (8r): white solid, 138.1 mg, yield: 51%, m.p.: 127-129 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.04 (d, *J* = 8.3 Hz, 2H), 7.48 (d, *J* = 8.3 Hz, 2H), 7.05 (d, *J* = 10.5 Hz, 1H), 6.63 (dd, *J* = 25.8, 10.5 Hz, 1H), 3.94 (s, 3H), 3.16 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.5, 145.5 (d, *J* = 239.5 Hz), 130.0 (d, *J* = 2.1 Hz), 129.8 (d, *J* = 20.8 Hz), 125.1, 122.3 (d, *J* = 6.8 Hz), 106.3 (d, *J* = 13.5 Hz), 52.3, 41.6. HRMS (ESI) calcd for $C_{11}H_{13}FNO_4S^+$ 274.0544, found 274.0542.



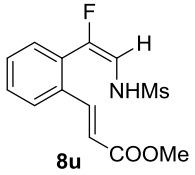
8s

(*E*)-N-(2-(4-acetylphenyl)-2-fluorovinyl)methanesulfonamide (8s): yellow oil, 72.4 mg, yield: 28%; ^{1}H NMR (400 MHz, DMSO-d6) δ 10.20 (d, *J* = 10.0 Hz, 1H), 7.94 (d, *J* = 8.2 Hz, 2H), 7.62 (d, *J* = 8.2 Hz, 2H), 6.90 (dd, *J* = 29.3, 10.0 Hz, 1H), 3.18 (s, 3H), 2.57 (s, 3H). ^{13}C NMR (100 MHz, DMSO-d6) δ 197.5, 143.5 (d, *J* = 236.8 Hz), 135.9, 135.7 (d, *J* = 24.0 Hz), 129.1 (d, *J* = 1.8 Hz), 122.4 (d, *J* = 6.8 Hz), 109.1 (d, *J* = 12.5 Hz), 41.4, 27.1. HRMS (ESI) calcd for $C_{11}H_{13}FNO_3S^+$ 258.0595, found 258.0603.



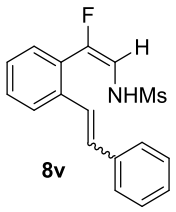
8t

(*E*)-N-(2-fluoro-2-(2-(phenylethynyl)phenyl)vinyl)methanesulfonamide (8t): yellow oil,239.6 mg, yield: 76%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.69 – 7.60 (m, 3H), 7.55 (d, *J* = 7.9 Hz, 1H), 7.52 – 7.35 (m, 5H), 7.35 – 7.27 (m, 1H), 7.07 – 6.93 (m, 1H), 3.07 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 144.9 (d, *J* = 237.2 Hz), 134.1, 131.7, 130. 9 (d, *J* = 23.7 Hz), 128. 9, 128.5, 127.9, 125.1, 125.0, 122.5, 118.0 (d, *J* = 4.7 Hz), 108.7 (d, *J* = 13.3 Hz), 95.6, 88.3, 41.1. HRMS (ESI) calcd for $C_{17}H_{15}FNO_2S^+$ 316.0802, found 316.0796.



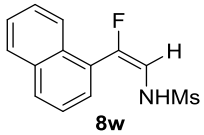
8u

methyl (*E*)-3-(2-((E)-1-fluoro-2-(methylsulfonamido)vinyl)phenyl)acrylate (8u): yellow oil, 194.4 mg, yield: 65%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (dd, *J* = 15.9, 2.4 Hz, 1H), 7.63 – 7.54 (m, 1H), 7.46 – 7.37 (m, 3H), 7.27 (d, *J* = 11.0 Hz, 1H), 6.39 (d, *J* = 15.9 Hz, 1H), 6.08 (dd, *J* = 25.4, 11.0 Hz, 1H).3.82 (s, 3H), 3.19 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.2, 144.7 (d, *J* = 243.5 Hz), 142.6, 132.7, 130.5 (d, *J* = 22.6 Hz), 129.9, 129.6, 128.3 (d, *J* = 4.3 Hz), 127.4, 120.0, 109.5 (d, *J* = 14.0 Hz), 51.9, 41.1. HRMS (ESI) calcd for $C_{13}H_{15}FNO_4S^+$ 300.0700, found 300.0710.



8v

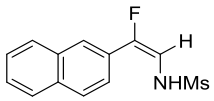
N-((1*E*)-2-fluoro-2-(2-styrylphenyl)vinyl)methanesulfonamide (8v): yellow oil, 113.8 mg, yield: 37%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 – 7.48 (m, 3H), 7.47 – 7.36 (m, 3H), 7.36 – 7.28 (m, 2H), 7.28 – 7.02 (m, 2H), 6.93 – 6.64 (m, 2H), 6.48 – 6.14 (m, 1H), 3.12 3.05 (3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 146.5 (d, *J* = 243.6 Hz), 146.3 (d, *J* = 242.4 Hz), 137.1, 136.3 (d, *J* = 8.3 Hz), 135.1, 131.3, 130.4, 129.7, 129.0, 128.9, 128.8, 128.4 (d, *J* = 4.8 Hz), 128.2, 128.1, 127.6, 127.5 (d, *J* = 6.1 Hz), 126.7, 126.6, 126.4 (d, *J* = 2.2 Hz), 108.4 (d, *J* = 14.8 Hz), 108.1 (d, *J* = 13.9 Hz), 41.1, 41.0. HRMS (ESI) calcd for $C_{17}H_{17}FNO_2S^+$ 318.0959, found 318.0959.



8w

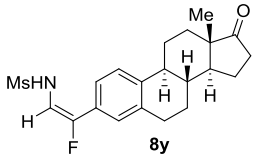
(*E*)-N-(2-fluoro-2-(naphthalen-1-yl)vinyl)methanesulfonamide (8w): yellow oil, 119.4 mg, yield: 49%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (d, *J* = 7.5 Hz, 1H), 7.91 (t, *J* = 7.1 Hz, 2H), 7.61 – 7.52 (m, 3H), 7.46 (t, *J* = 7.5 Hz, 1H),

6.92 (d, *J* = 10.3 Hz, 1H), 6.32 (dd, *J* = 24.7, 10.3 Hz, 1H), 3.19 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 147.7 (d, *J* = 245.6 Hz), 133.6, 130.9, 130.6, 128.6, 127.7 (d, *J* = 21.8 Hz), 127.2 (d, *J* = 4.8 Hz), 127.0, 126.4, 125.12, 125.06 (d, *J* = 2.2 Hz), 107.8 (d, *J* = 15.1 Hz), 41.2. HRMS (ESI) calcd for $C_{13}H_{12}FNNaO_2S^+$ 288.0465, found 288.0468.



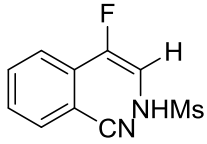
8x

(*E*)-N-(2-fluoro-2-(naphthalen-2-yl)vinyl)methanesulfonamide (8x): yellow oil, 82.0 mg, yield: 31%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (s, 1H), 7.86 – 7.79 (m, 3H), 7.54 – 7.45 (m, 3H), 6.90 (d, *J* = 10.5 Hz, 1H), 6.62 (dd, *J* = 25.9, 10.5 Hz, 1H), 3.17 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 147.1 (d, *J* = 240.2 Hz), 133.1, 128.62, 128.60, 128.3, 127.8, 127.4 (d, *J* = 24.3 Hz), 126.9, 126.6, 122.0 (d, *J* = 6.9 Hz), 120.2 (d, *J* = 6.5 Hz), 104.6 (d, *J* = 13.7 Hz), 41.2. HRMS (ESI) calcd for $C_{13}H_{13}FNO_2S^+$ 266.0646, found 266.0632.



8y

N-((*E*)-2-fluoro-2-((8R,9S,13S,14S)-13-methyl-17-oxo-7,8,9,11,12,13,14,15,16,17-decahydro-6H-cyclopenta[a]phenanthren-3-yl)vinyl)methanesulfonamide (8y): yellow oil, 160.3 mg, yield: 53%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.29 (d, *J* = 8.3 Hz, 1H), 7.21 (d, *J* = 8.3 Hz, 1H), 7.17 (s, 1H), 7.05 – 6.81 (m, 1H), 6.41 (dd, *J* = 26.2, 10.1 Hz, 1H), 3.12 (s, 3H), 2.96 – 2.86 (m, 2H), 2.60 – 1.92 (m, 8H), 1.71 – 1.42 (m, 5H), 0.93 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 221.2, 147.2 (d, *J* = 241.1 Hz), 140.6, 137.0, 127.7 (d, *J* = 24.6 Hz), 125.8, 123.4 (d, *J* = 6.4 Hz), 120.4 (d, *J* = 6.4 Hz), 103.5 (d, *J* = 14.0 Hz), 50.4, 48.0, 44.4, 41.0, 38.0, 35.9, 31.5, 29.4, 26.3, 25.6, 21.6, 13.8. HRMS (ESI) calcd for $C_{21}H_{27}FNO_3S^+$ 392.1690, found 392.1676.

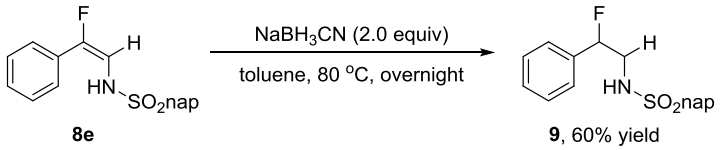


8ad

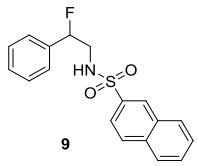
(*E*)-N-(2-(2-cyanophenyl)-2-fluorovinyl)methanesulfonamide (8ad): white solid, 17.3 mg, yield: 8%, m.p.: 128-130 °C; ^{1}H NMR (400 MHz, DMSO-d6) δ 10.37 (d, *J* = 10.2 Hz, 1H), 7.91 (d, *J* = 7.8 Hz, 1H), 7.75 (d, *J* = 4.0 Hz, 2H), 7.57 – 7.50 (m, 1H), 6.87 (dd, *J* = 28.9, 10.2 Hz, 1H), 3.20 (s, 3H). ^{13}C NMR (100 MHz, DMSO-d6) δ 141.5 (d, *J* = 238.2 Hz), 134.9, 134.1 (d, *J* = 22.9 Hz), 133.9, 129.1, 126.4 (d, *J* = 5.5 Hz), 118.6, 111.3 (d, *J* = 11.8 Hz), 106.7, 41.6. HRMS (ESI) calcd for $C_{10}H_{10}FN_2O_2S^+$ 241.0442, found 241.0445.

6. Procedure for derivation of products

6.1 Synthesis of N-(2-fluoro-2-phenylethyl)naphthalene-2-sulfonamide (9)[13]

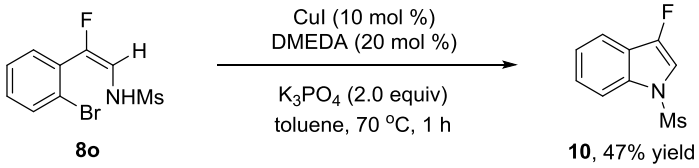


(*E*)-N-(2-fluoro-2-phenylvinyl)naphthalene-2-sulfonamide **(8e)** (0.30 mmol, 100 mg) was dissolved in toluene (2.0 mL) and added to an oven-dried tube equipped with $NaBH_3CN$ (0.60 mmol, 36.9 mg) and a stir bar. The reaction mixture was stirred overnight at 80 °C. Then the reaction mixture was filtered through a short plug of silica gel. The filtrate was concentrated and the residue was purified by flash chromatography with PE/EtOAc (8:1) as eluent to give the corresponding product **9** (60.5 mg, 60%) as a yellow oil**.**

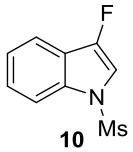


N-(2-fluoro-2-phenylethyl)naphthalene-2-sulfonamide (9): yellow oil, 60.5 mg, yield: 60%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.47 (s, 1H), 8.01 – 7.90 (m, 3H), 7.86 (d, *J* = 8.7 Hz, 1H), 7.69 – 7.61 (m, 2H), 7.37 – 7.30 (m, 3H), 7.27 – 7.21 (m, 2H), 5.54 (ddd, *J* = 48.0, 8.2, 3.2 Hz, 1H), 5.34 – 5.19 (m, 1H), 3.58 – 3.26 (m, 2H). ^{13}C NMR (100 MHz, DMSO-d6) δ 136.7, 136.3 (d, *J* = 19.4 Hz), 134. 9, 132.2, 129.7, 129.3, 129.1, 129.0, 128.7 (d, *J* = 2.7 Hz), 128.4, 127.9, 127.7, 125.5 (d, *J* = 6.9 Hz), 122.2, 92.8 (d, *J* = 174.0 Hz), 48.7 (d, *J* = 25.2 Hz). HRMS (ESI) calcd for $C_{18}H_{17}FNO_2S^+$ 330.0959, found 330.0956.

6.2 Synthesis of 3-fluoro-1-(methylsulfonyl)-1H-indole (10)[13]



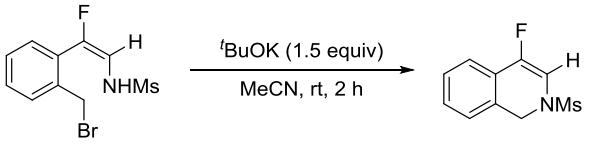
To a solution of **8o** (146 mg, 0.50 mmol) in toluene (4.0 mL), CuI (9.5 mg, 0.05 mmol), N,N'- dimethylethylene -1,2-diamine (DMEDA, 88.0 mg, 0.1 mmol) and K_3PO_4 (212 mg, 1.0 mmol) were added and the reaction mixture was stirred at 70 °C for 1 h. After evaporation of the solvent, the corresponding product **10** (49.0 mg, 47%) was purified by silica gel column chromatography using PE/EtOAc (10:1) as eluent.



10

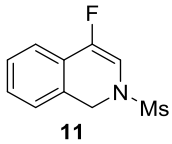
3-fluoro-1-(methylsulfonyl)-1H-indole (10): yellow oil, 49.0 mg, yield: 47%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (d, *J* = 9.3 Hz, 1H), 7.67 (d, *J* = 7.6 Hz, 1H), 7.48 – 7.43 (m, 1H), 7.39 (t, *J* = 7.6 Hz, 1H), 7.26 (d, *J* = 2.9 Hz, 1H), 3.07 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 148.7 (d, *J* = 255.6 Hz), 132.8 (d, *J* = 5.1 Hz), 126.3, 124.0, 121.5 (d, *J* = 19.2 Hz), 118.0 (d, *J* = 2.6 Hz), 113.6, 108.6 (d, *J* = 28.9 Hz), 40.2. HRMS (ESI) calcd for $C_9H_9FNO_2S^+$ 214.0333, found 214.0324.

6.3 Synthesis of 4-fluoro-2-(methylsulfonyl)-1,2-dihydroisoquinoline (11)[14]



8i **11**, 54% yield

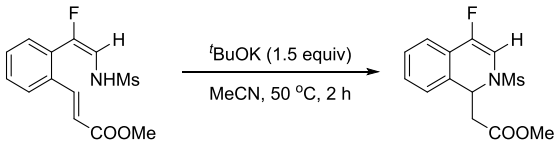
A solution of **8i** (120 mg, 0.40 mmol), *t*-BuOK (67.2 mg, 0.6 mmol) in MeCN (2 mL) was stirred at room temperature for 2 h. After the reaction completed (checked by TLC), the mixture was concentrated under vacuum and filtered through a plug of silica gel. The solvent was removed in vacuum and the residue was purified by column chromatography on silica gel (PE/EtOAc=10:1) to give pure product **11**(48.0 mg, 54%).



11

4-fluoro-2-(methylsulfonyl)-1,2-dihydroisoquinoline (11): yellow oil, 48.2 mg, yield: 54%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.45 – 7.34 (m, 3H), 7.24 – 7.17 (m, 1H), 6.62 (d, *J* = 5.6 Hz, 1H), 4.77 (s, 2H), 2.75 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.3(d, *J* = 247.0 Hz), 129.8, 128.7 (d, *J* = 5.7 Hz), 128.4, 125.9 (d, *J* = 23.6 Hz), 125.4, 120.0, 110.1 (d, *J* = 39.6 Hz), 47.9, 37.7. HRMS (ESI) calcd for $C_{10}H_{11}FNO_2S^+$ 228.0489, found 228.0500.

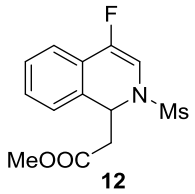
6.4 Synthesis of methyl 2-(4-fluoro-2-(methylsulfonyl)-1,2-dihydroisoquinolin -1-yl) acetate (12)[14]



8u **12**, 48% yield

A solution of **8u** (81.0 mg, 0.27 mmol), *t*-BuOK (44.8 mg, 0.40 mmol) in MeCN (2 mL) was stirred at room temperature for 2 h. After the reaction completed (checked by TLC), the mixture was concentrated under vacuum and

filtered through a plug of silica gel. The solvent was removed in vacuum and the residue was purified by column chromatography on silica gel (PE/EtOAc=10:1) to give pure product **12** (39.0 mg, 48%).



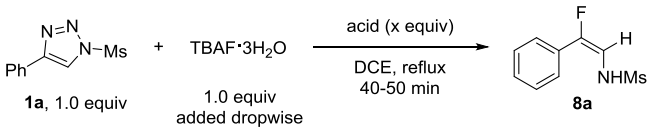
12

methyl 2-(4-fluoro-2-(methylsulfonyl)-1,2-dihydroisoquinolin-1-yl)acetate (12): yellow oil, 39.0 mg, yield: 48%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.49 (d, *J* = 6.9 Hz, 1H), 7.45 – 7.36 (m, 2H), 7.33 – 7.27 (m, 1H), 6.54 (d, *J* = 5.2 Hz, 1H), 5.57 (t, *J* = 7.3 Hz, 1H), 3.69 (s, 3H), 2.84 (dd, *J* = 15.0, 7.3 Hz, 1H), 2.70 (s, 3H), 2.69 – 2.63 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 169.8, 152.0 (d, *J* = 248.3 Hz), 131.5 (d, *J* = 5.6 Hz), 130.0, 128.8, 126.0 (d, *J* = 2.8 Hz), 124.1 (d, *J* = 23.0 Hz), 120.6 (d, *J* = 3.3 Hz), 107.3 (d, *J* = 39.3 Hz), 54.5, 52.0, 40.6, 38.3. HRMS (ESI) calcd for $C_{13}H_{15}FNO_4S^+$ 300.0700, found 300.0699.

7. Protonic acid catalyzed/mediated reaction

We used protonic acid to catalyze the reaction with TBAF as the fluoride source, no **8a** was obtained. The results were summarized as follows:

Table S3 Protonic Acid Catalyzed/Mediated Reaction.



1a, 1.0 equiv

1.0 equiv added dropwise

8a

entry	acid	x	yield of **8a** (%)	note
1	HBF_4	1.0	0	desulfonylation
2	TsOH	1.0	0	desulfonylation
3	HBF_4	0.2	0	desulfonylation
4	TsOH	0.2	0	desulfonylation

Thus, under strong acidic conditions, desulfonylation was the major reaction. Since it is difficult to mimic the reaction condition without adding $Et_2O{\cdot}BF_3$, and we do not know the exact amount of protonic acid under the optimized conditions, the mechanism of path c in the manuscript cannot be excluded at this stage. However, on the basis of the above experiments, we thought the participation of $Et_2O{\cdot}BF_3$ in the activation of triazole is necessary.

8. References

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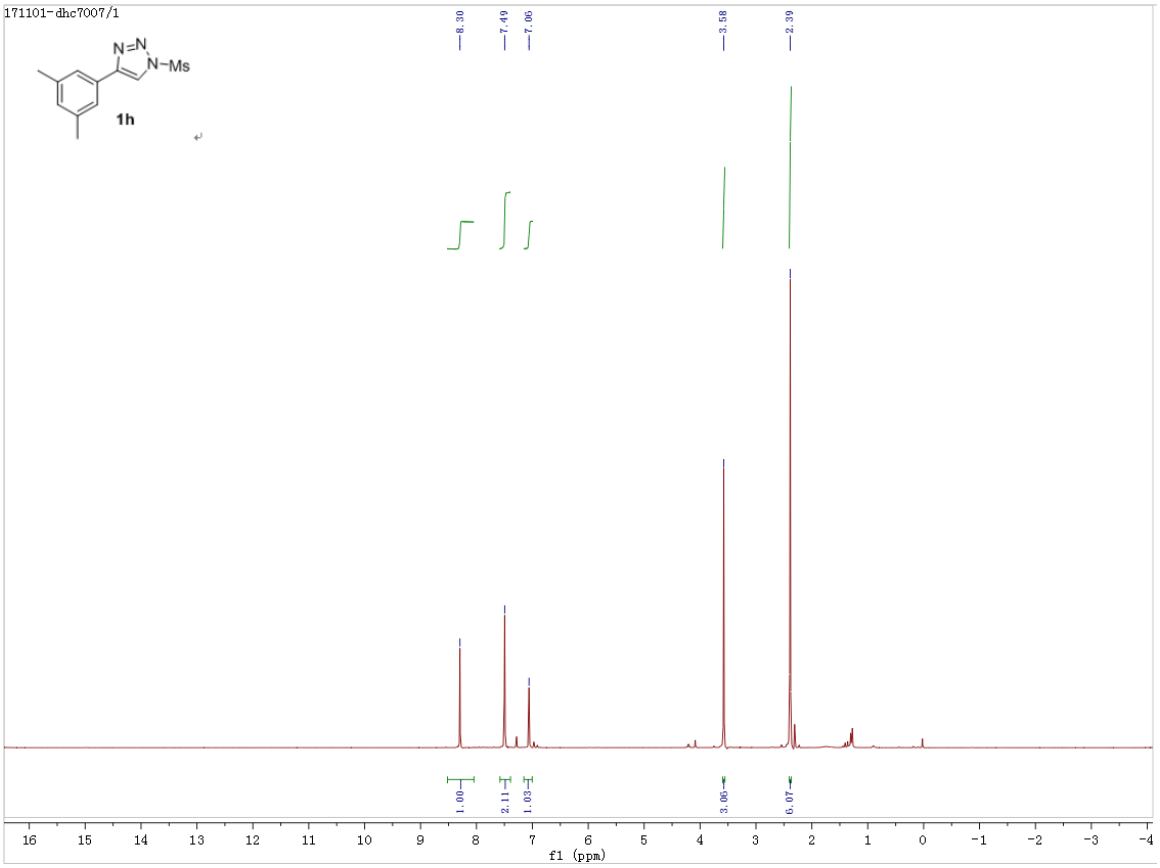
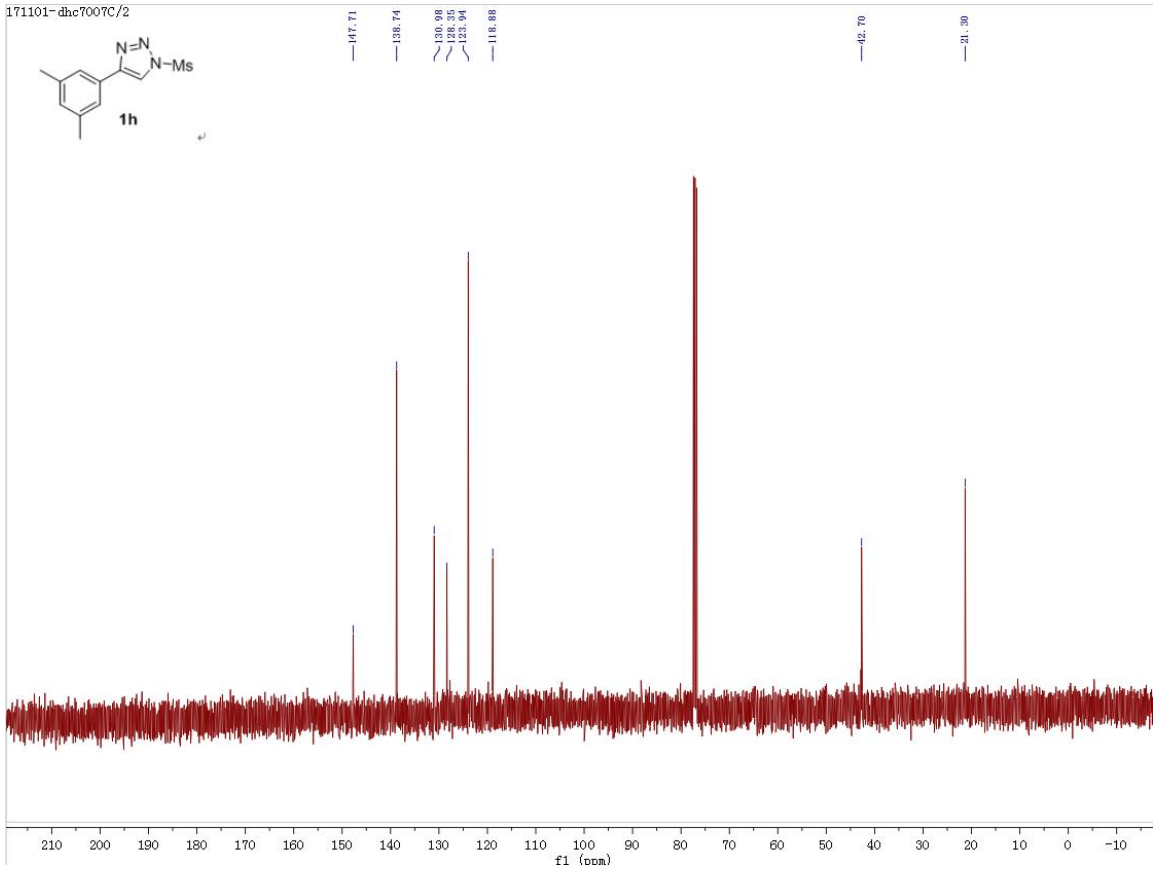
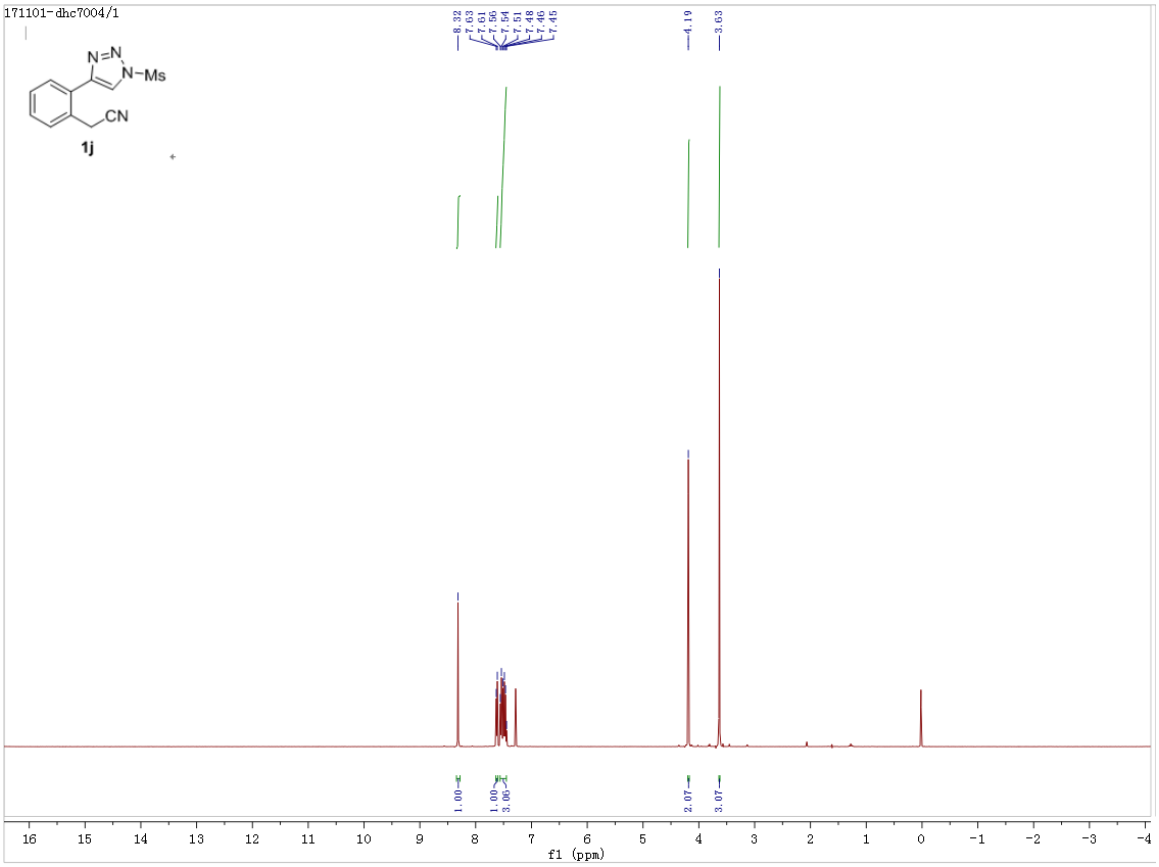
9. ^{1}H and ^{13}C NMR spectra for new compounds



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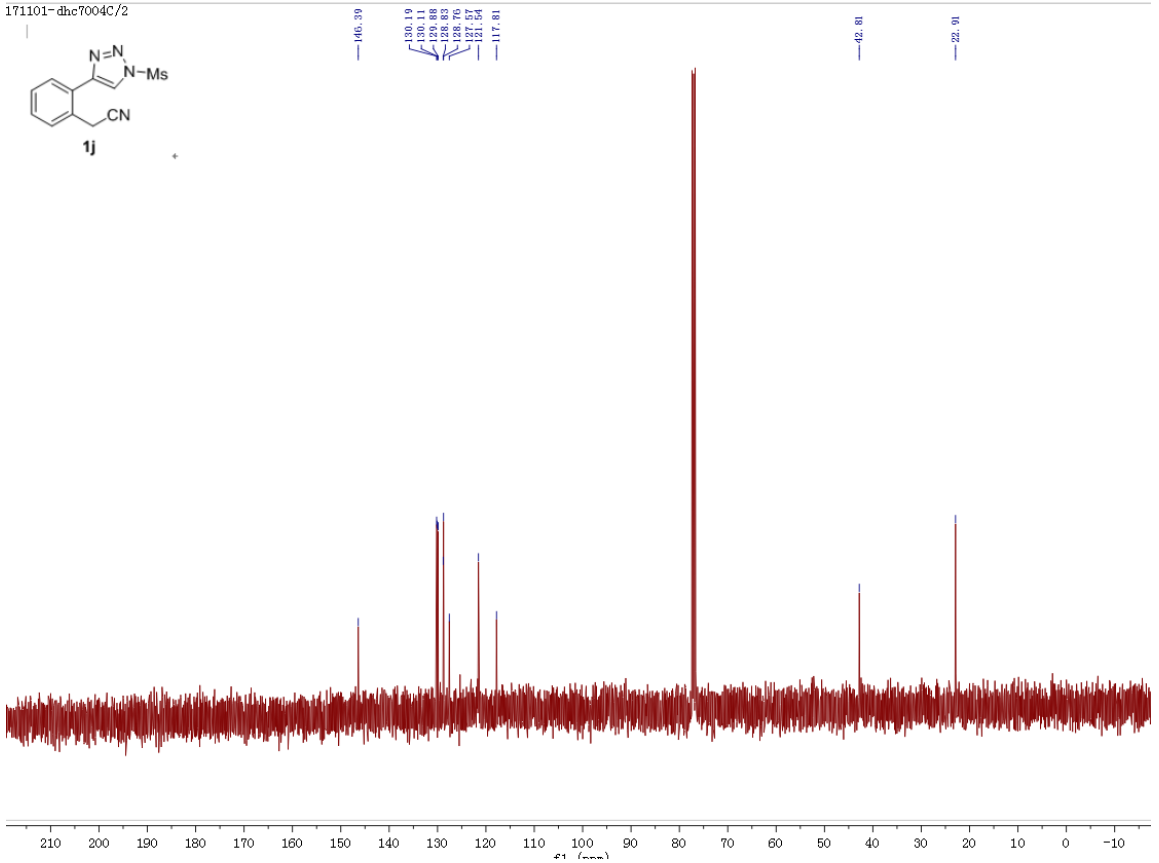
7.46
7.46
4.19
3.63
N=N
N-Ms
CN
1j
1.00
1.00
3.06
2.07
3.07
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4
f1 (ppm)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121.54
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22.91
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N-Ms
CN
1j
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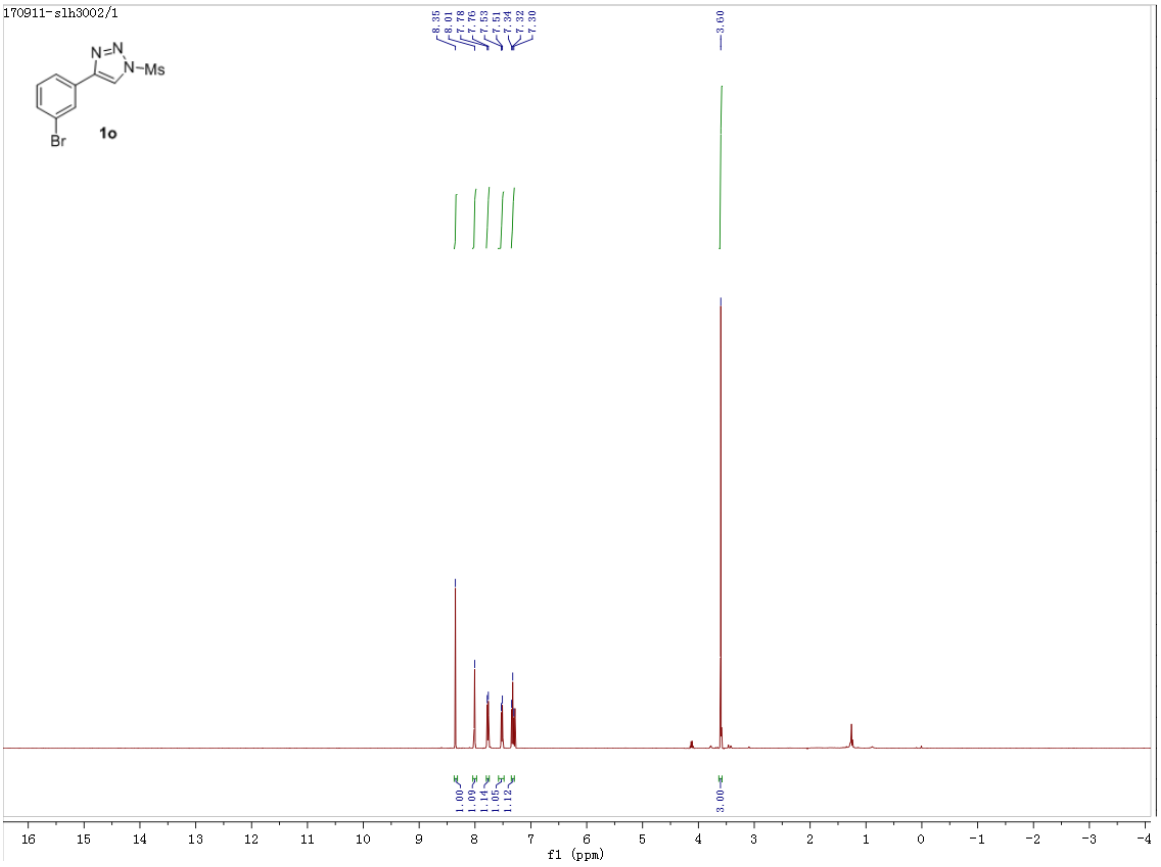
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1.00
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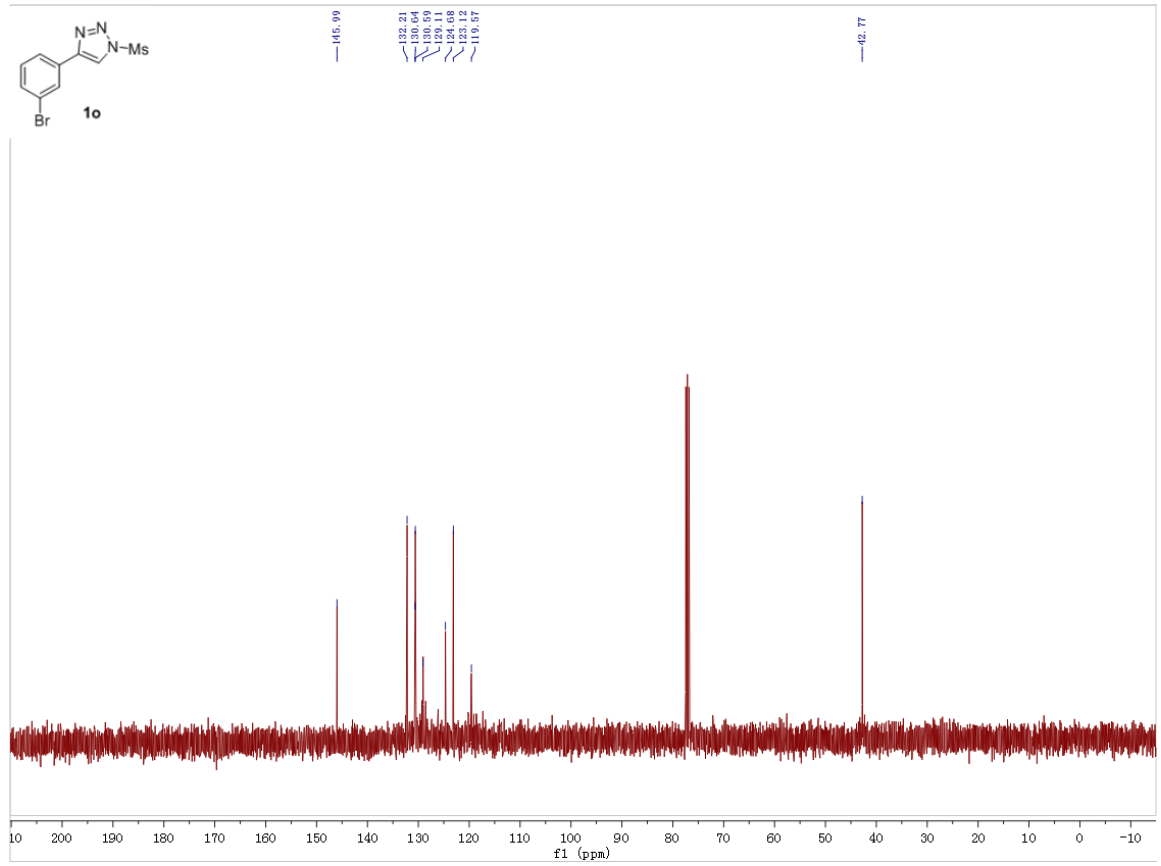
1.05
1.12
3.00
f1 (ppm)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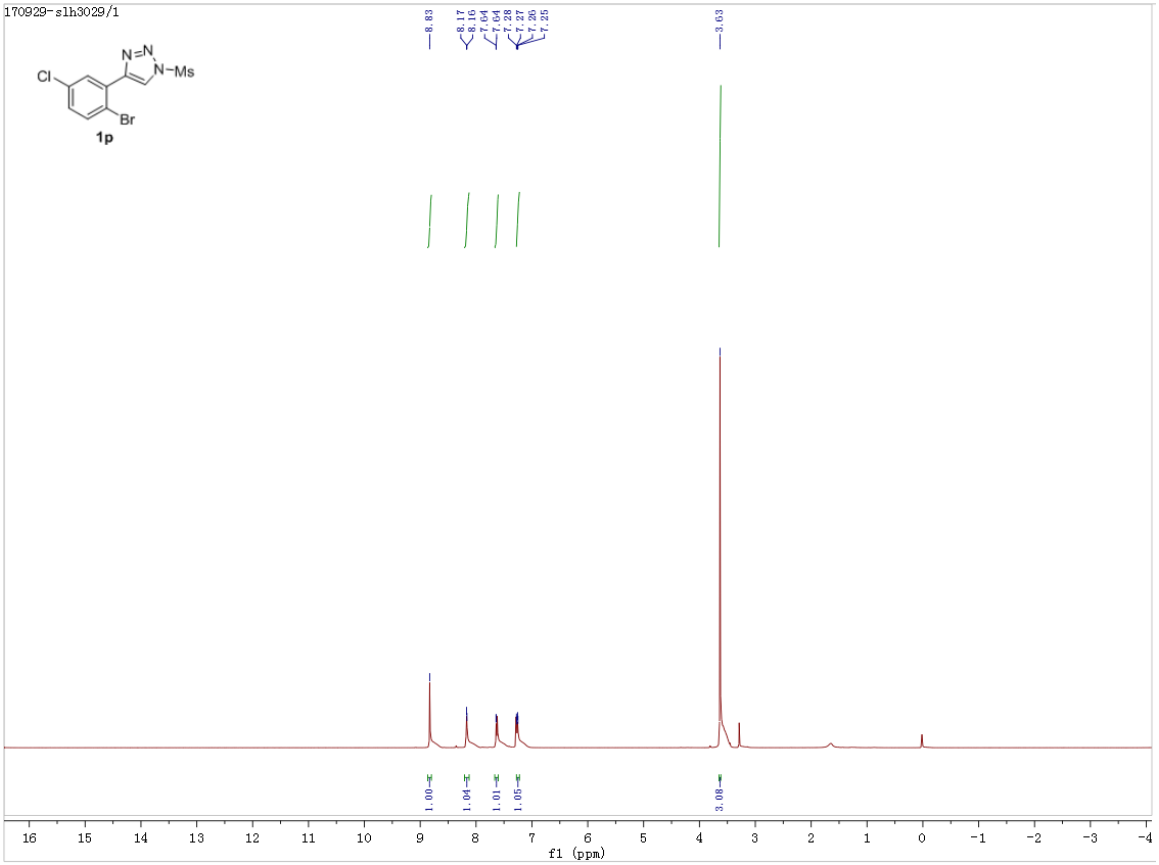
f1 (ppm)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1.01
1.05
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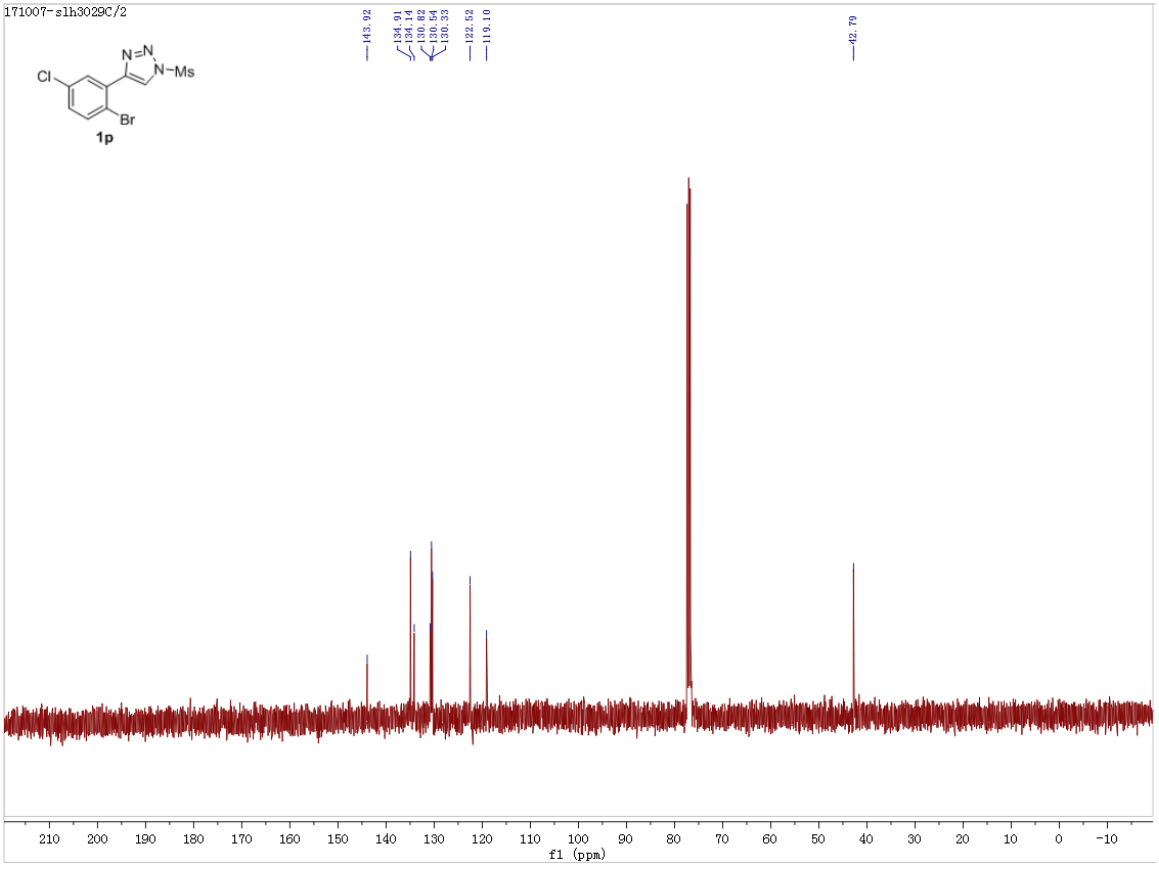
1p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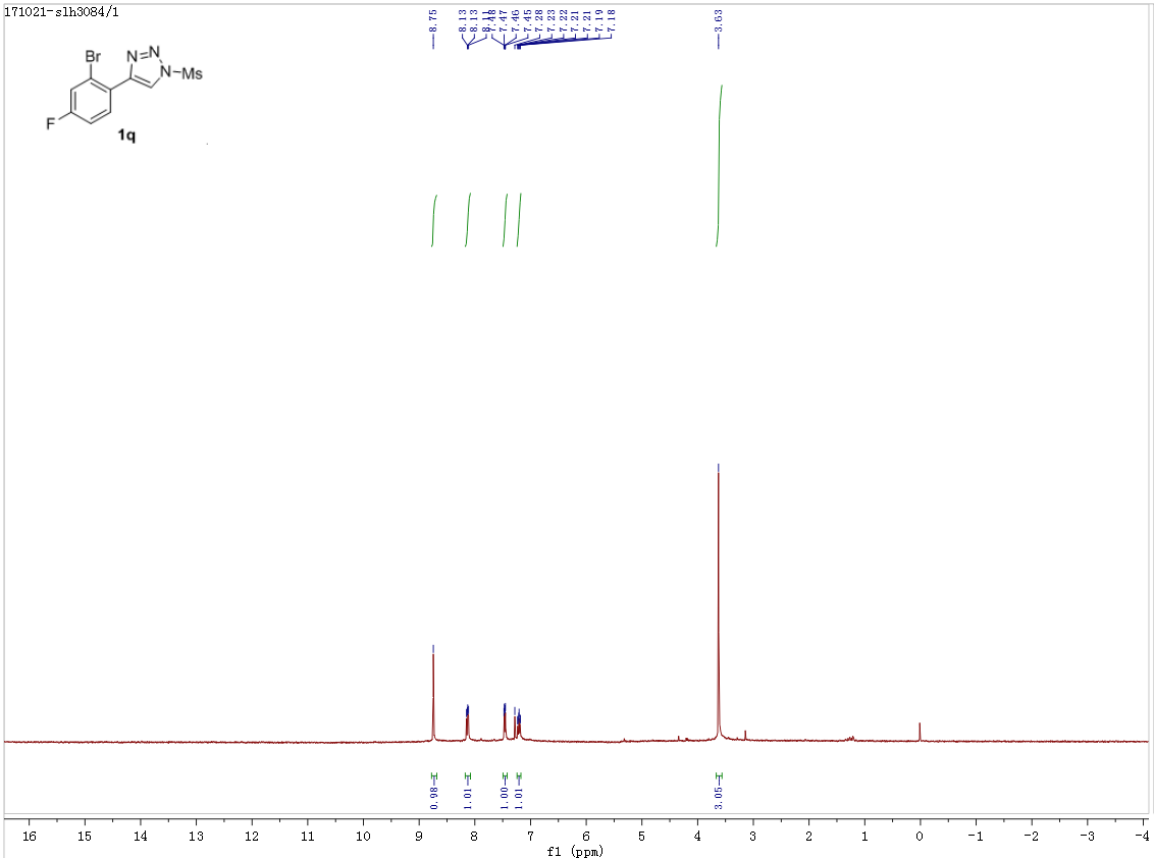
1p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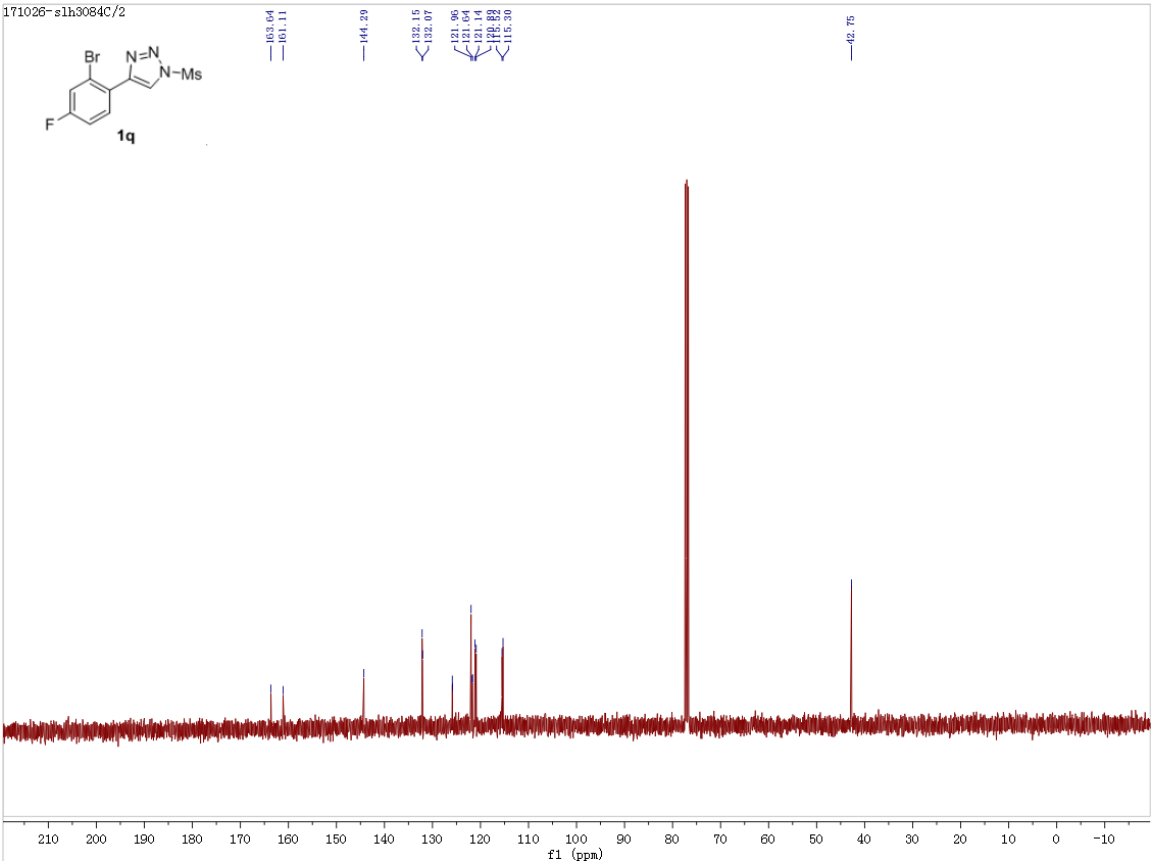
f1 (ppm)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F
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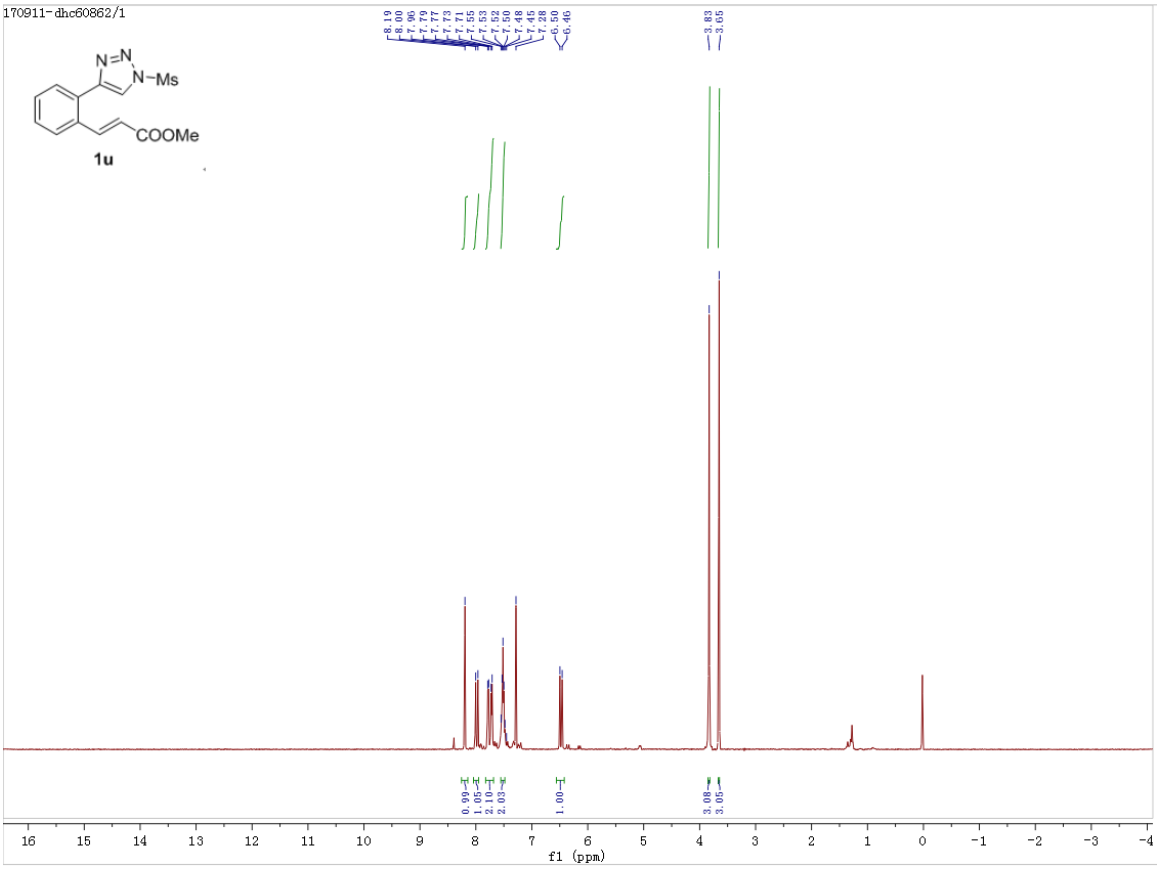
121.14
115.30
42.75
f1 (ppm)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COOMe
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7.71
7.55
7.53
7.52
7.50
7.48
7.45
7.38
7.30
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2.10
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1.00
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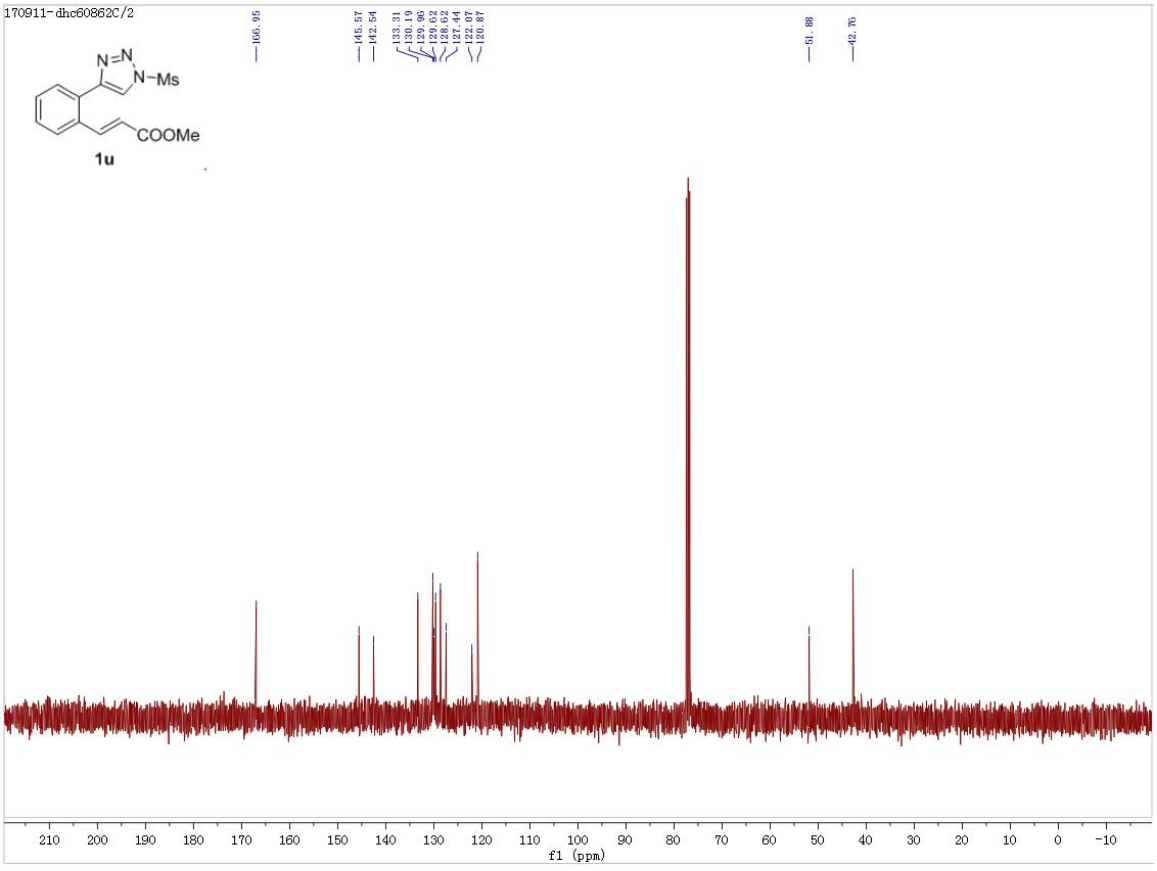
f1 (ppm)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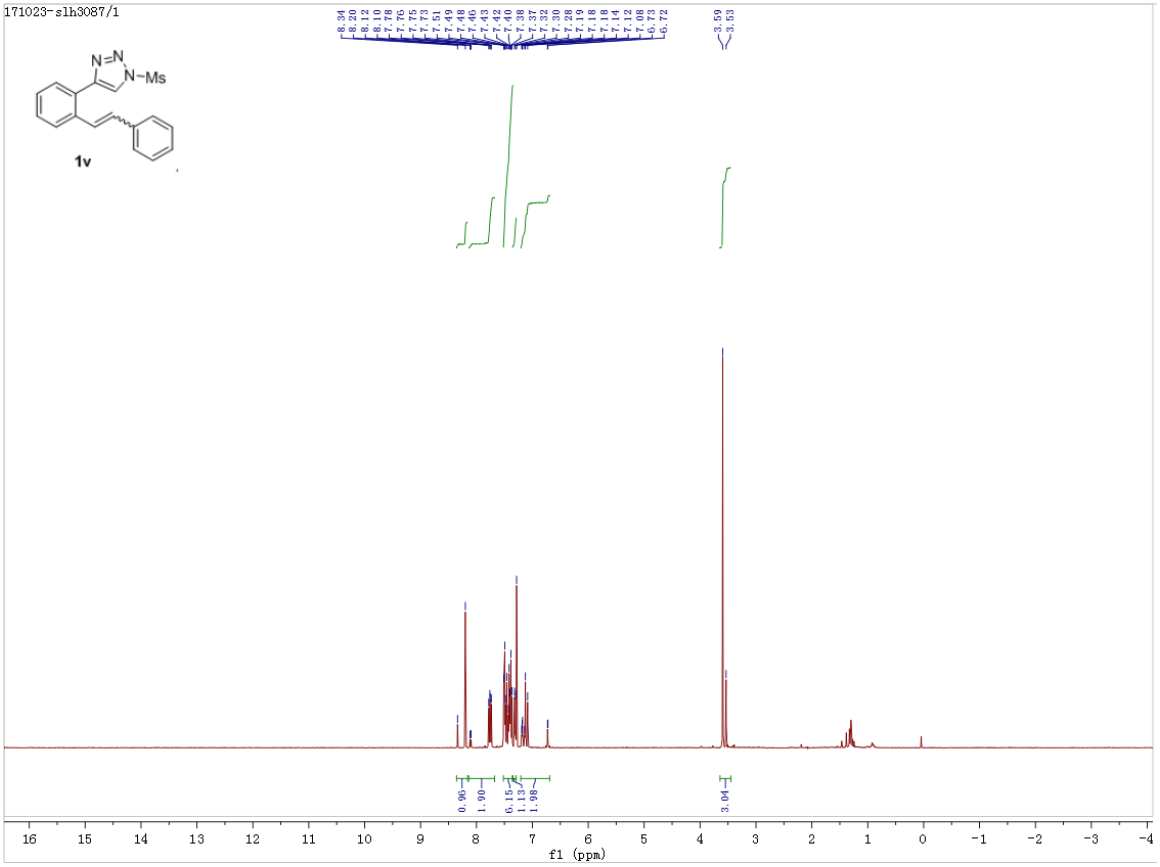
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7.46
7.45
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7.40
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7.37
7.32
7.30
7.28
7.19
7.18
7.14
7.12
7.08
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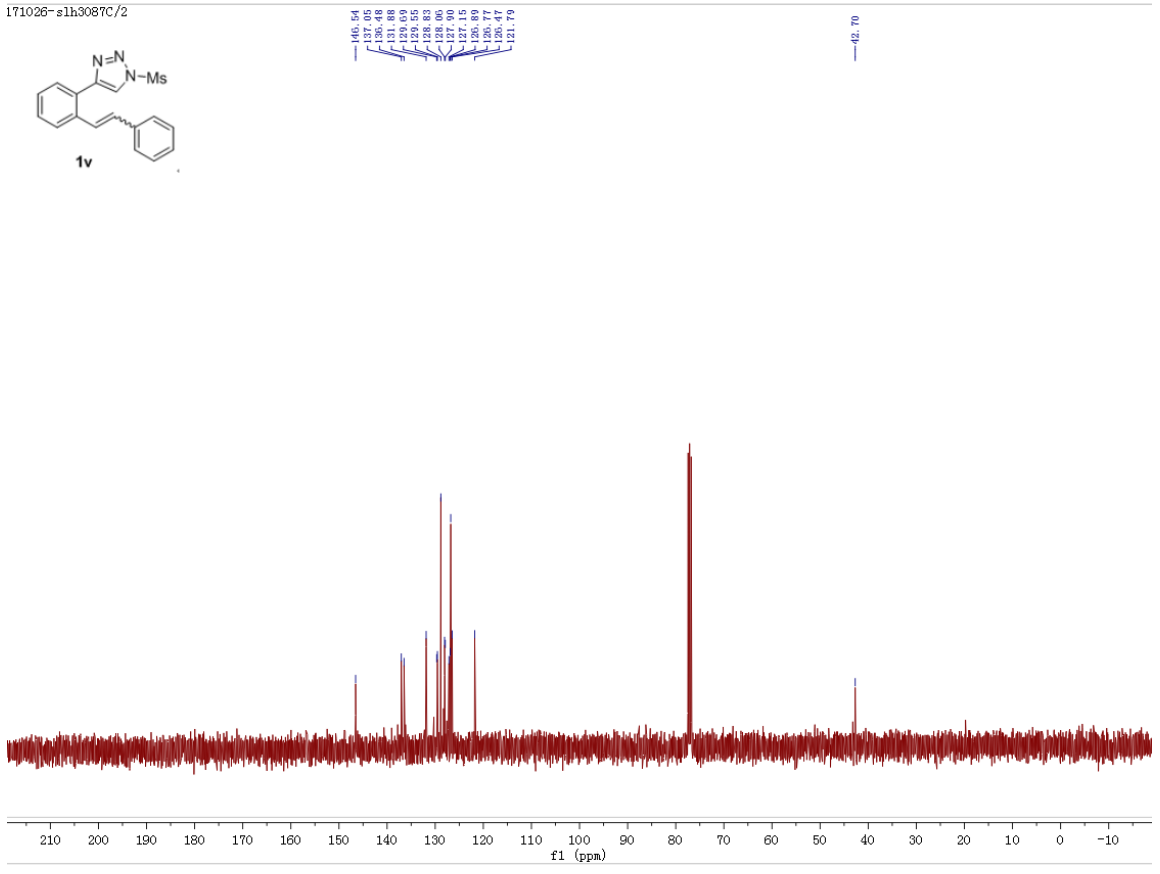
f1 (ppm)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127.90
127.15
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121.79
42.70
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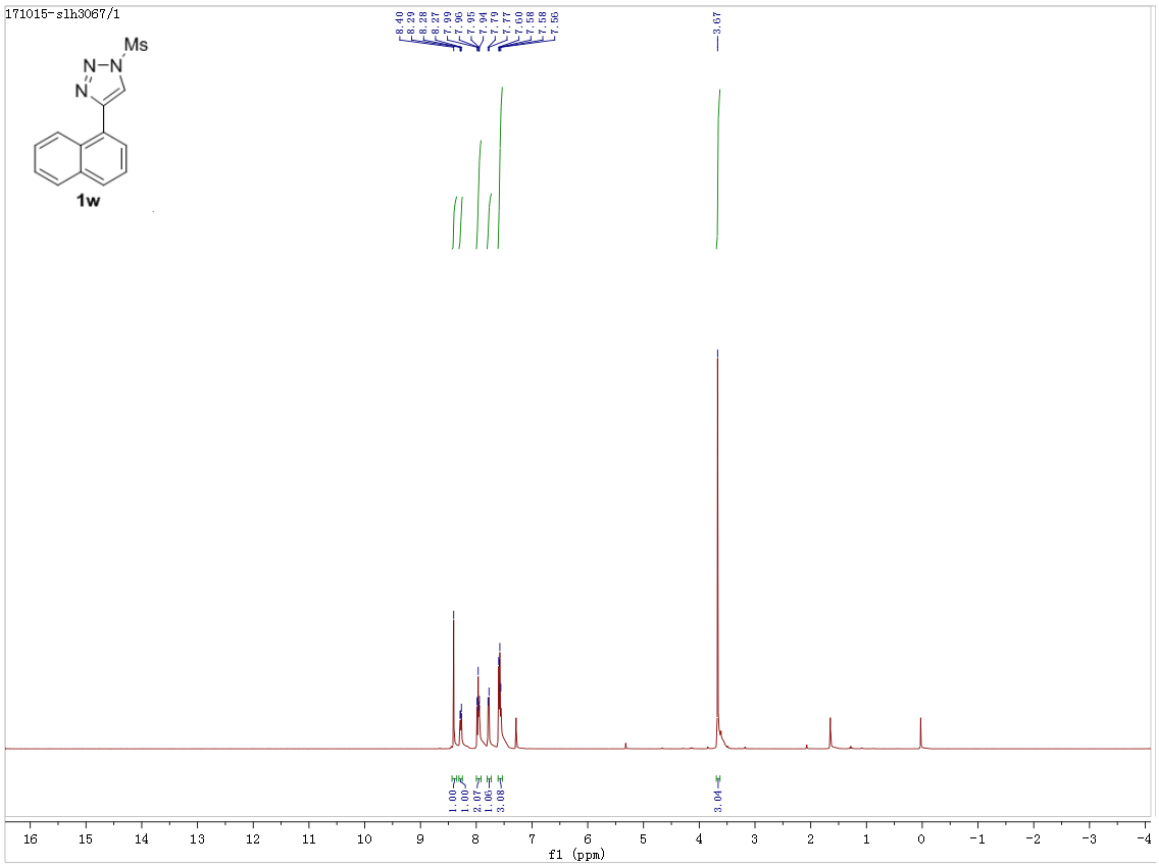
f1 (ppm)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7.77
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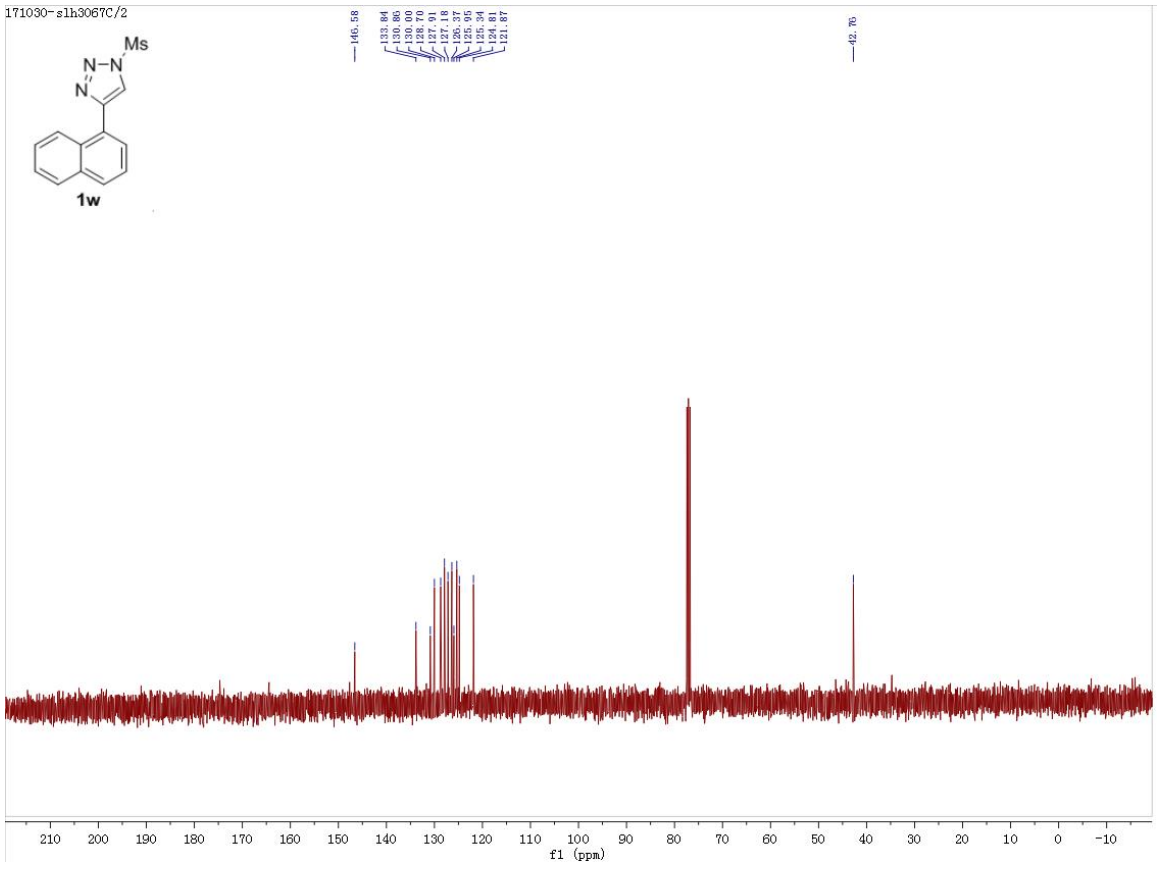
1.06
3.08
3.04
f1 (ppm)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124.81
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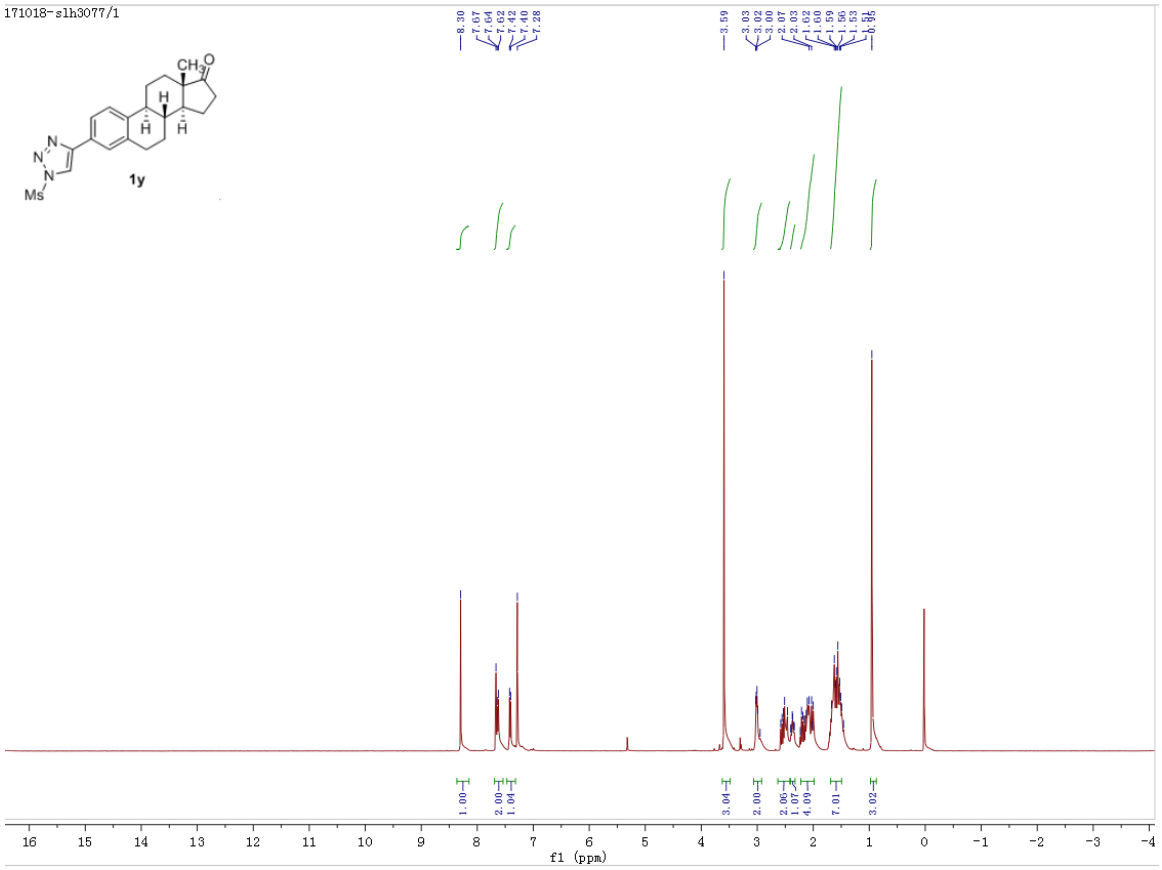
f1 (ppm)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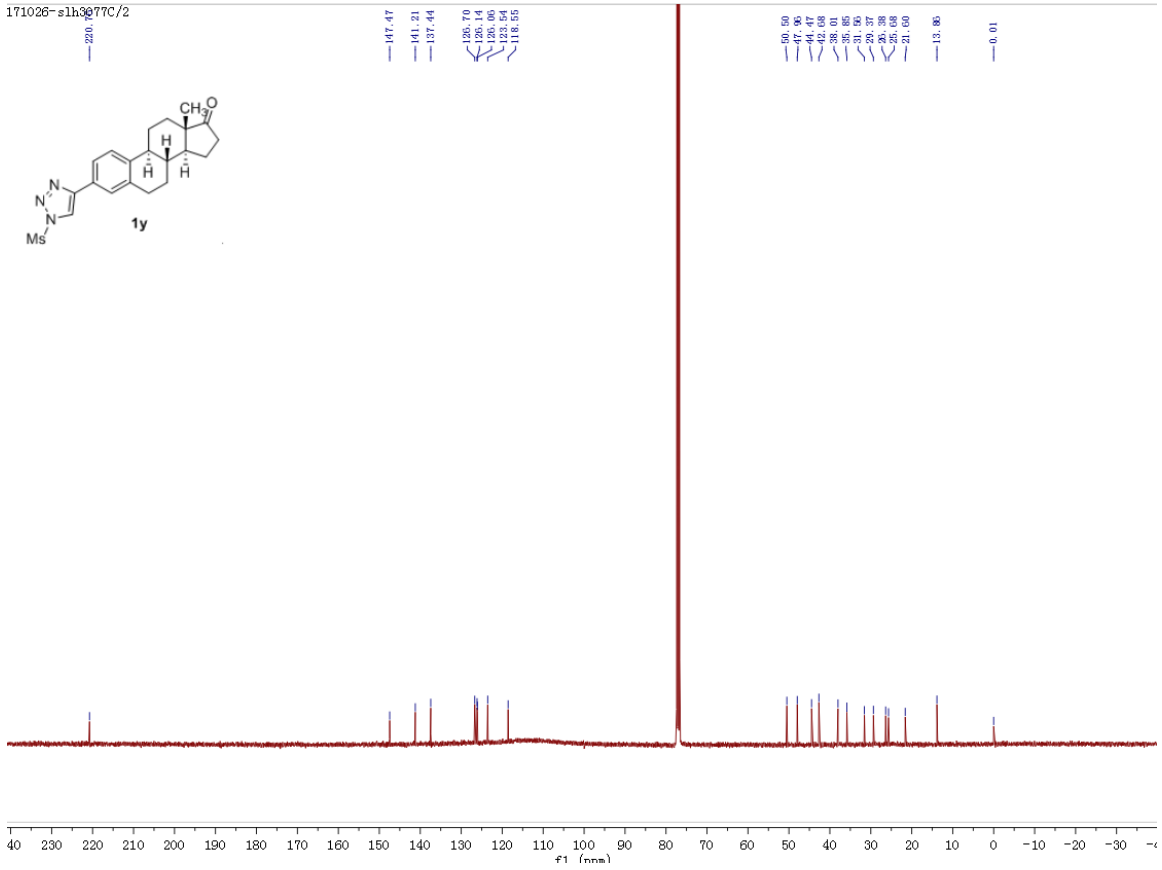
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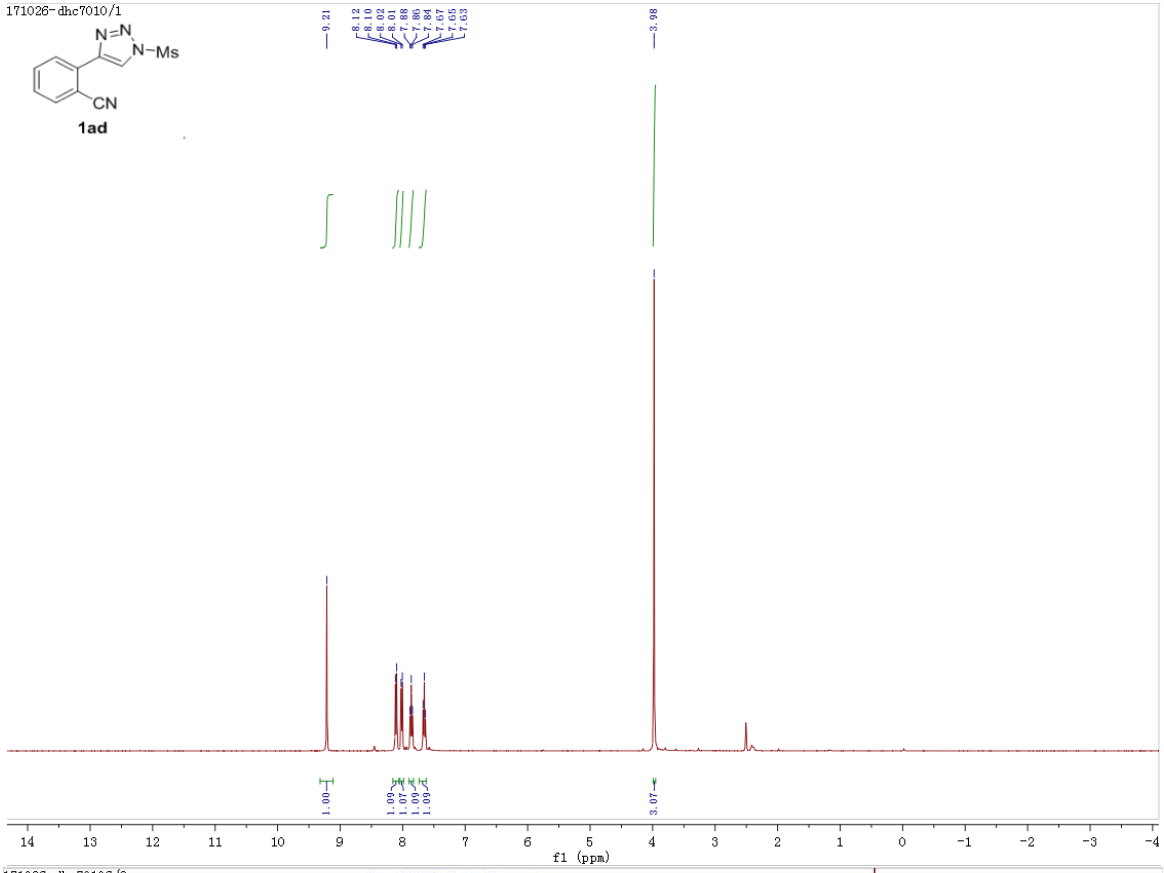
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7.67
7.65
7.63
3.98
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1.09
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1.09
1.09
3.07
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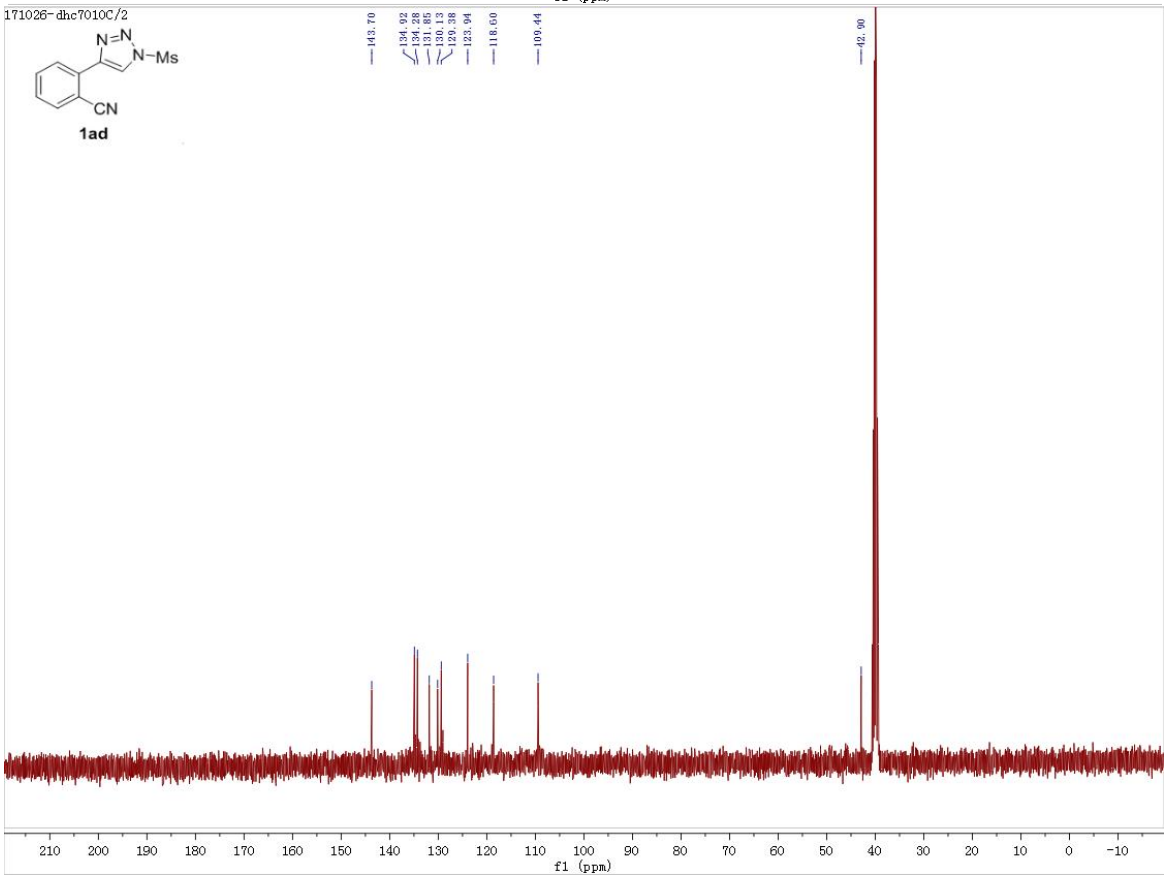
f1 (ppm)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CN
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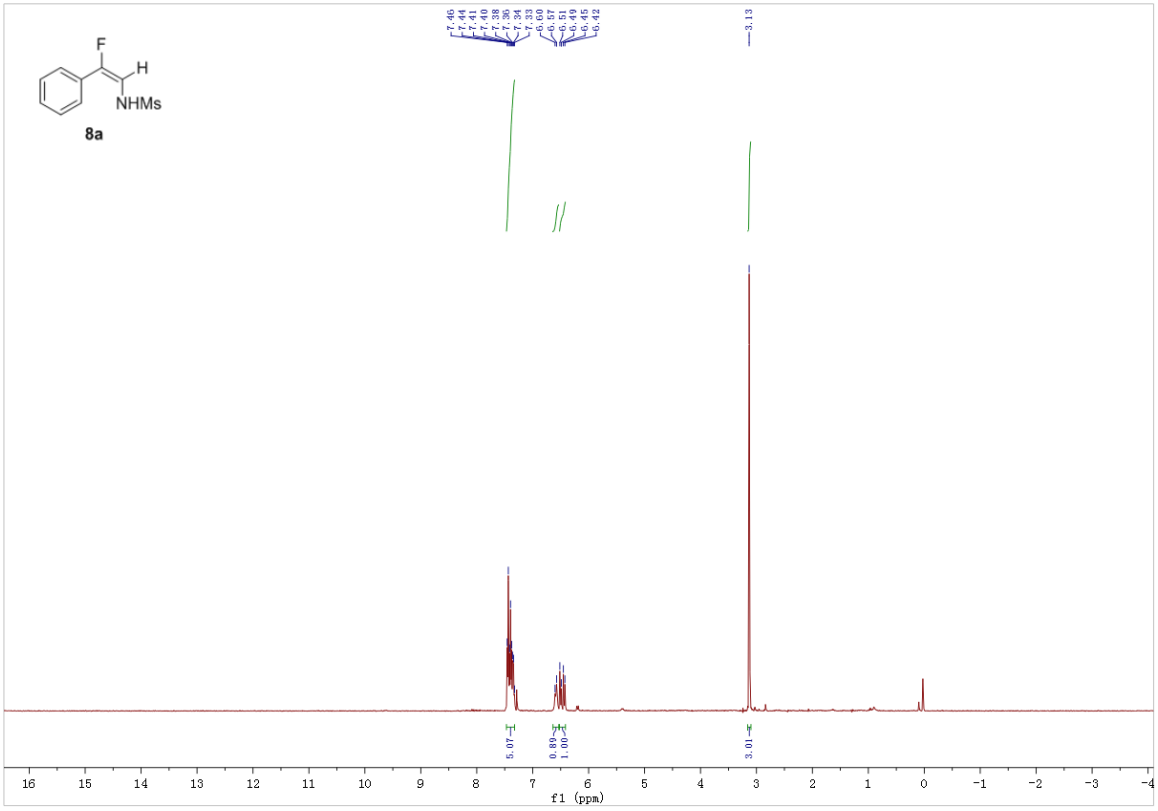
f1 (ppm)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H
NHMs
8a
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7.33
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6.57
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6.49
6.45
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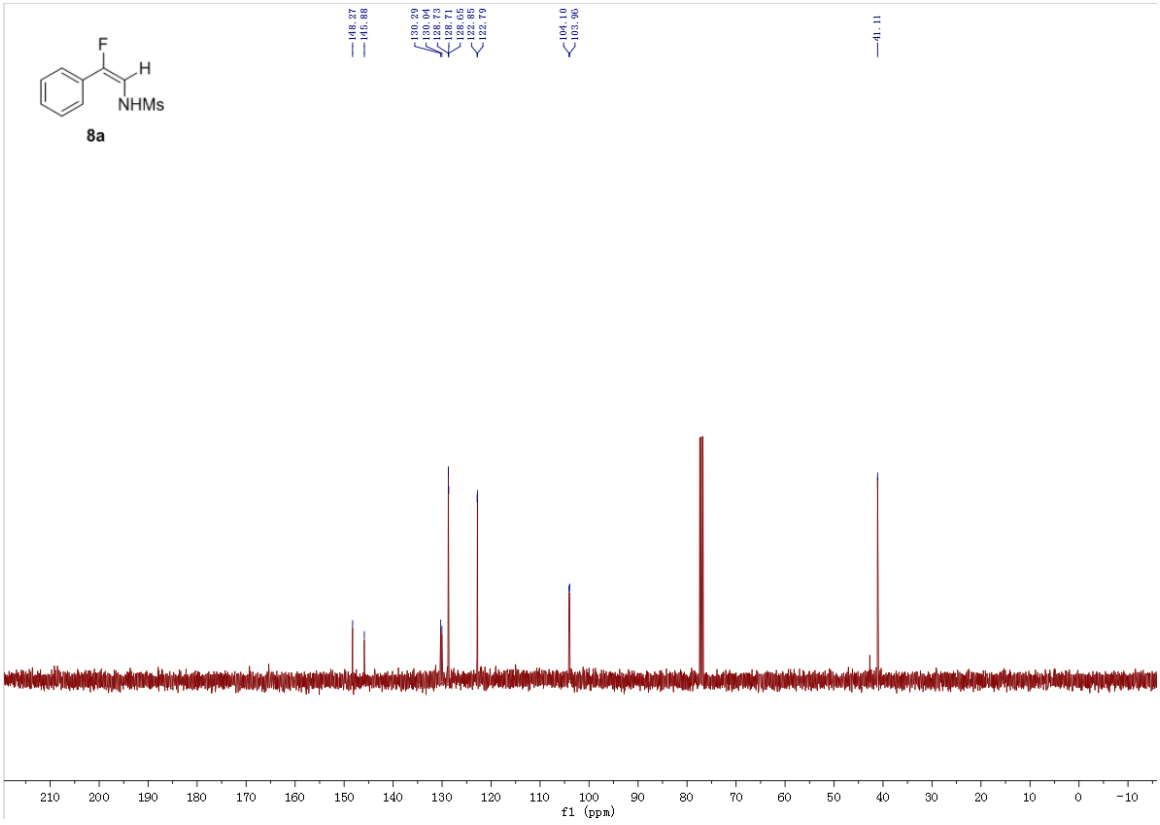
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H
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122.85
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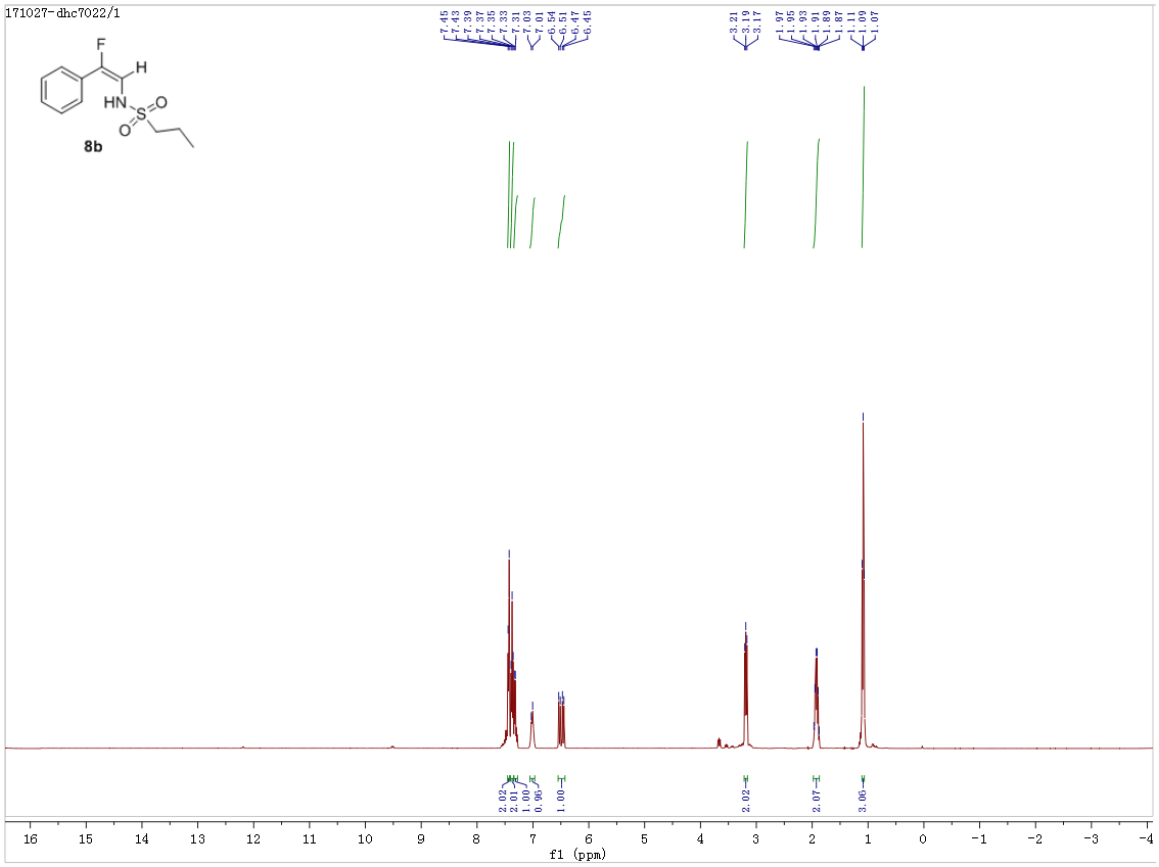
104.10
103.96
41.11
f1 (ppm)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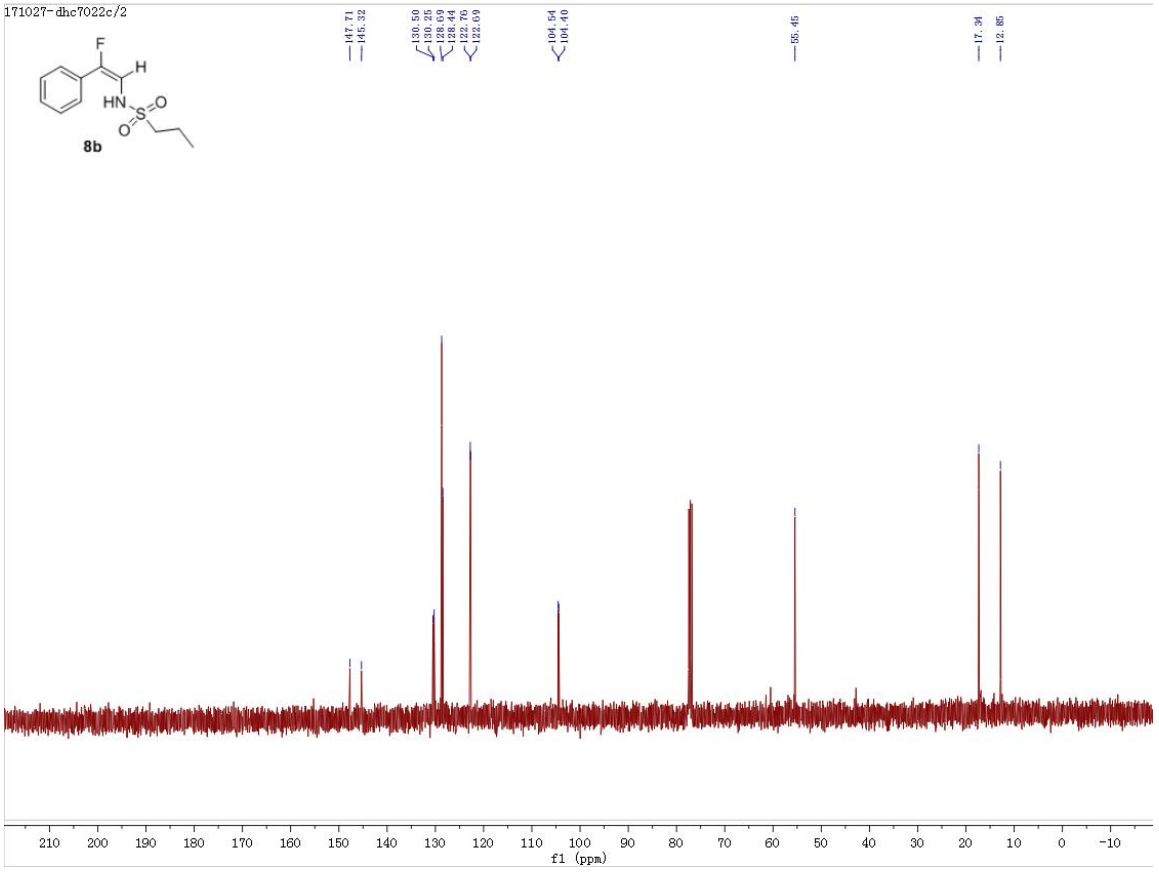
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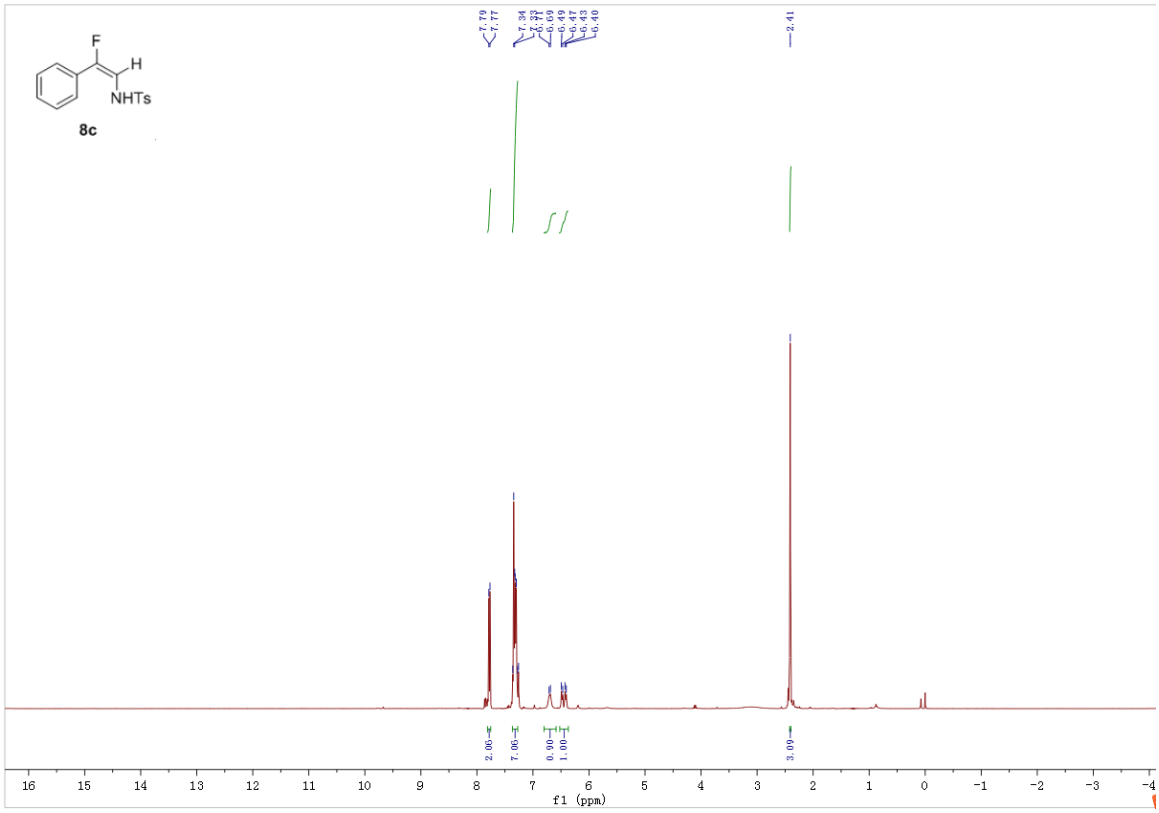
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H
NHTs
8c
7.79
7.77
7.34
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2.41
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1.10
3.09
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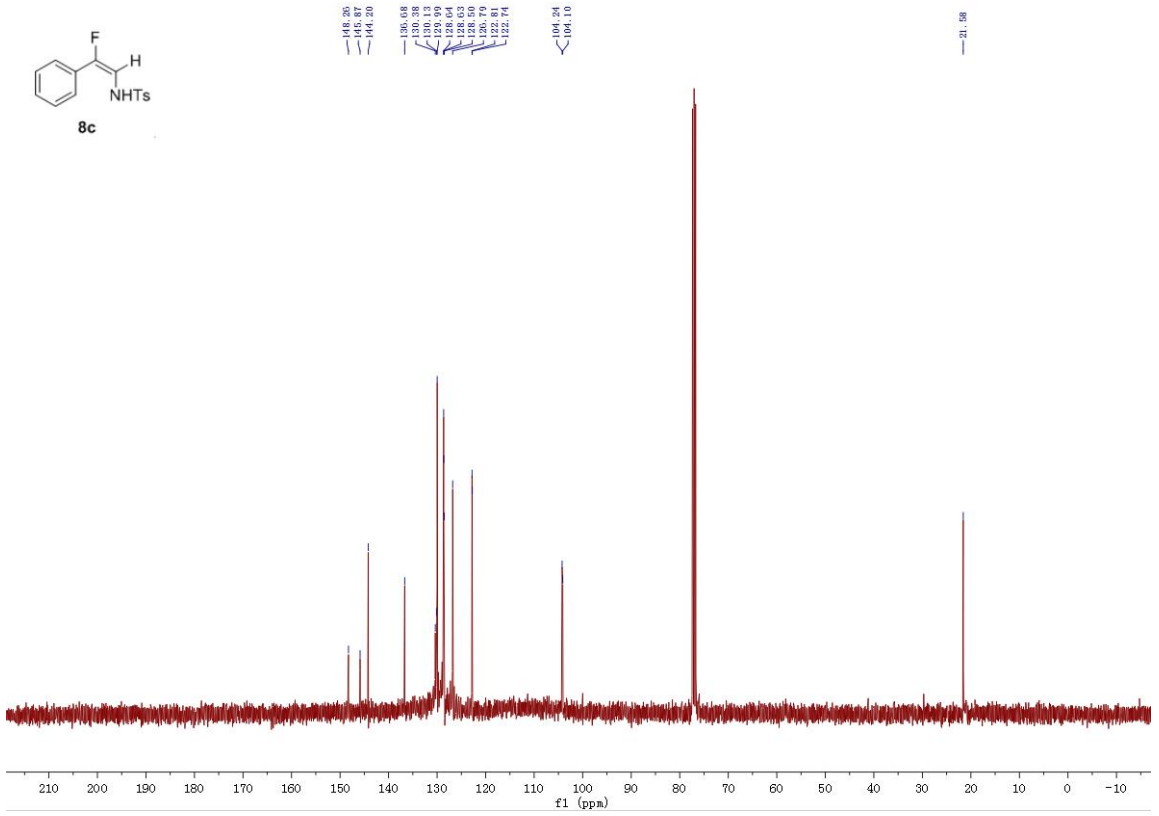
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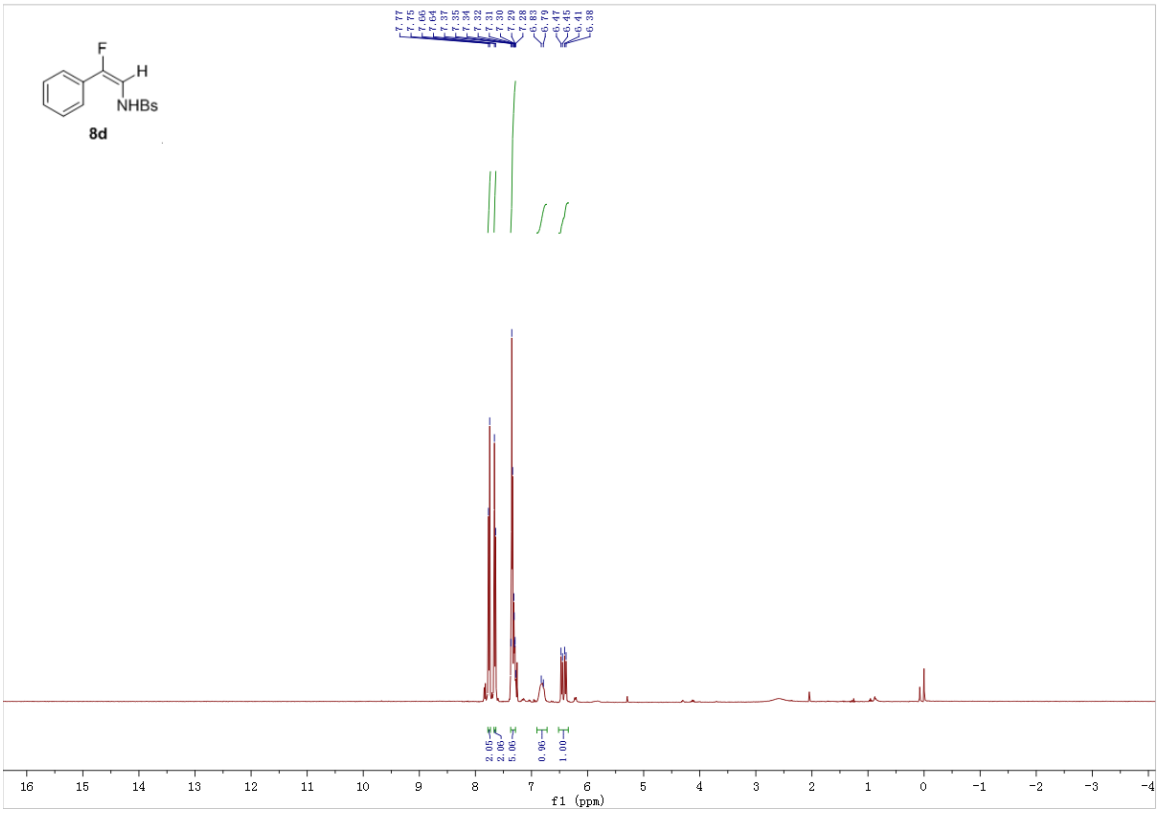
21.58
f1 (ppm)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7.34
7.32
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7.30
7.29
7.28
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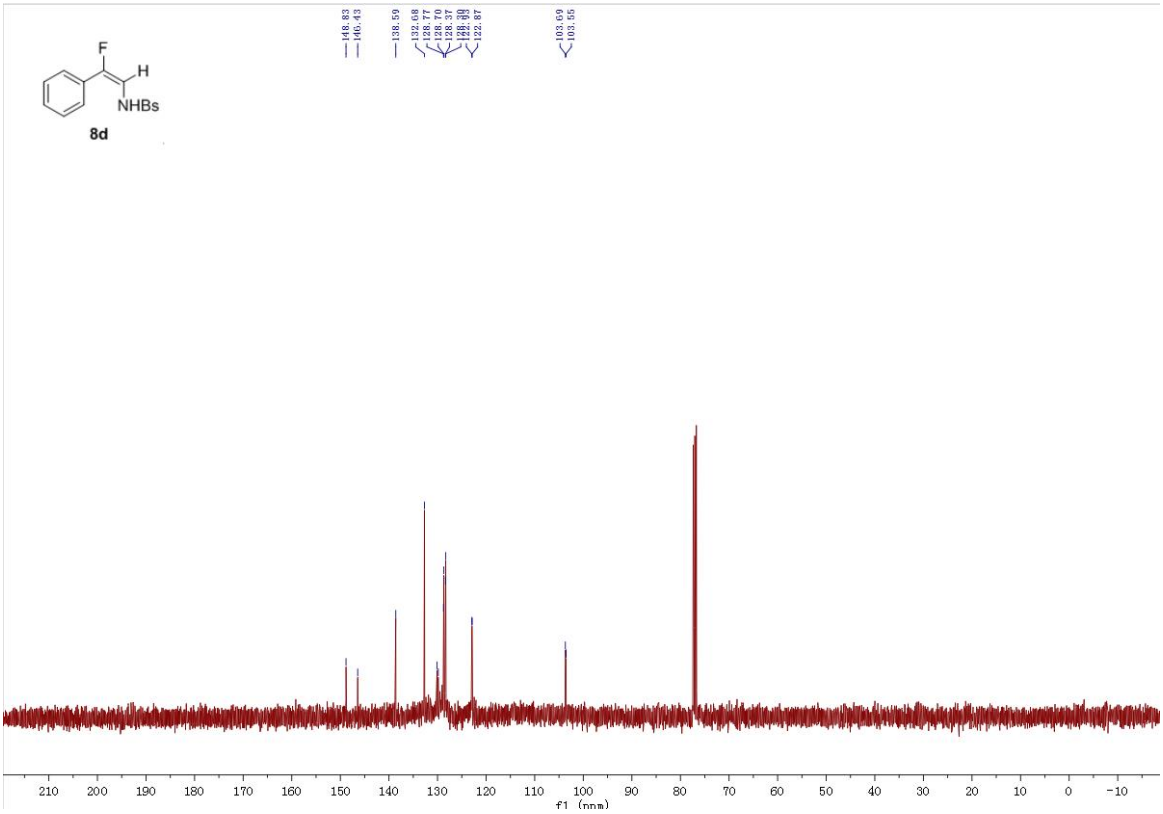
1.00
f1 (ppm)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128.37
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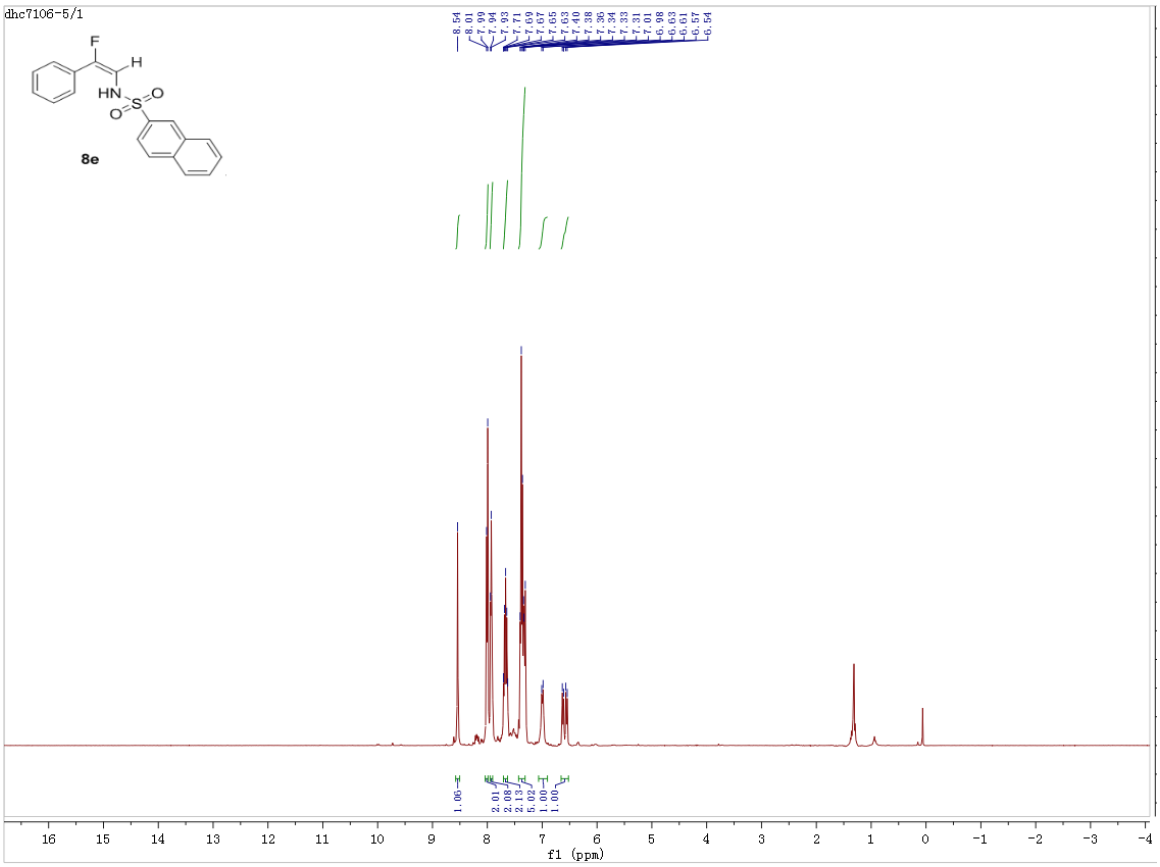
103.55
f1 (ppm)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H
HN
S
O
O
8e
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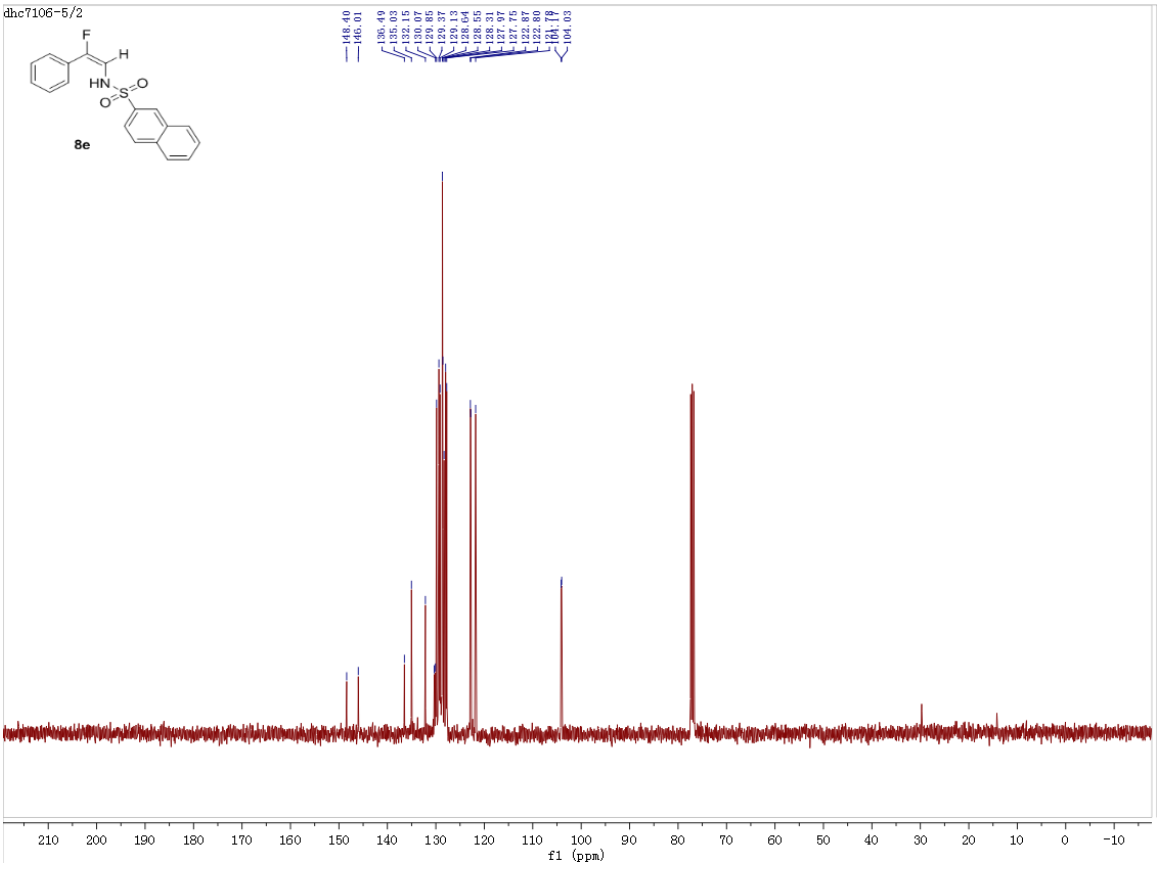
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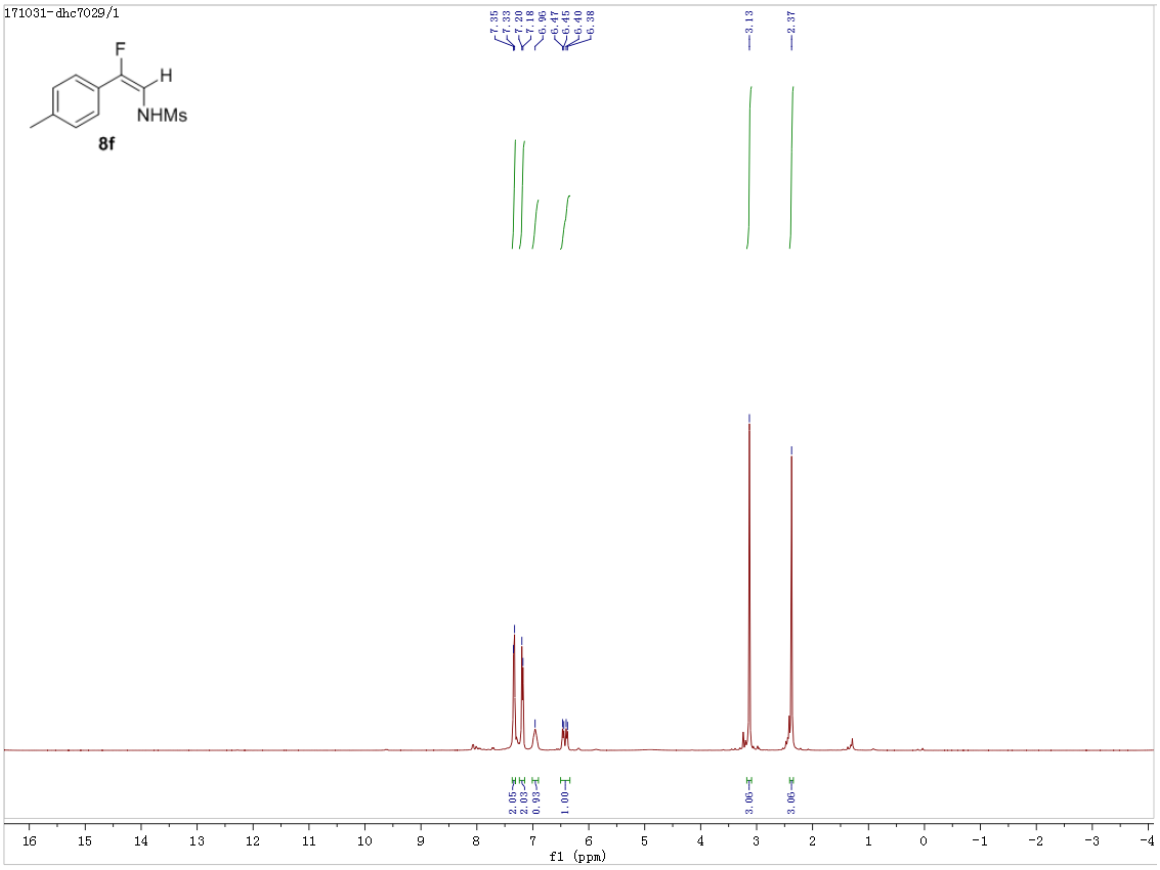
H
HN
S
O
O
8e
f1 (ppm)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H
NHMs
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7.33
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7.18
6.46
6.45
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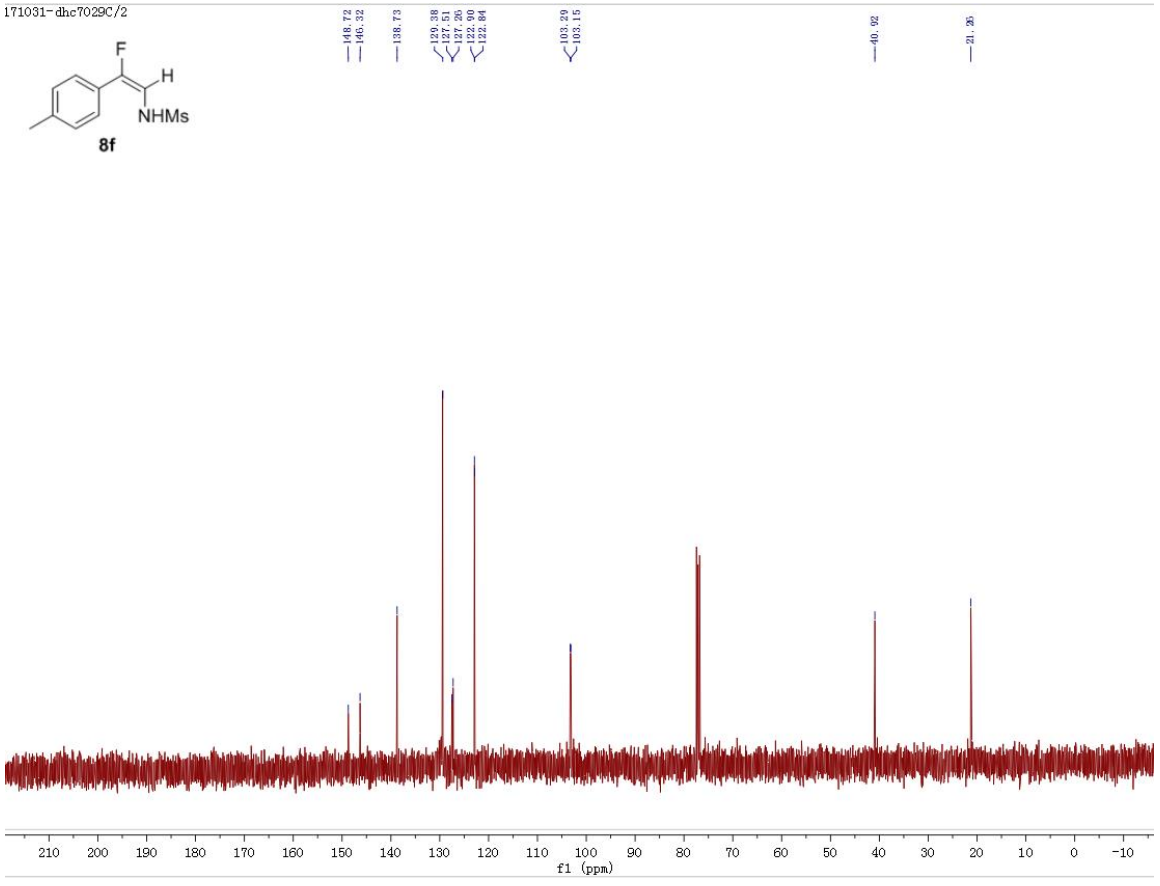
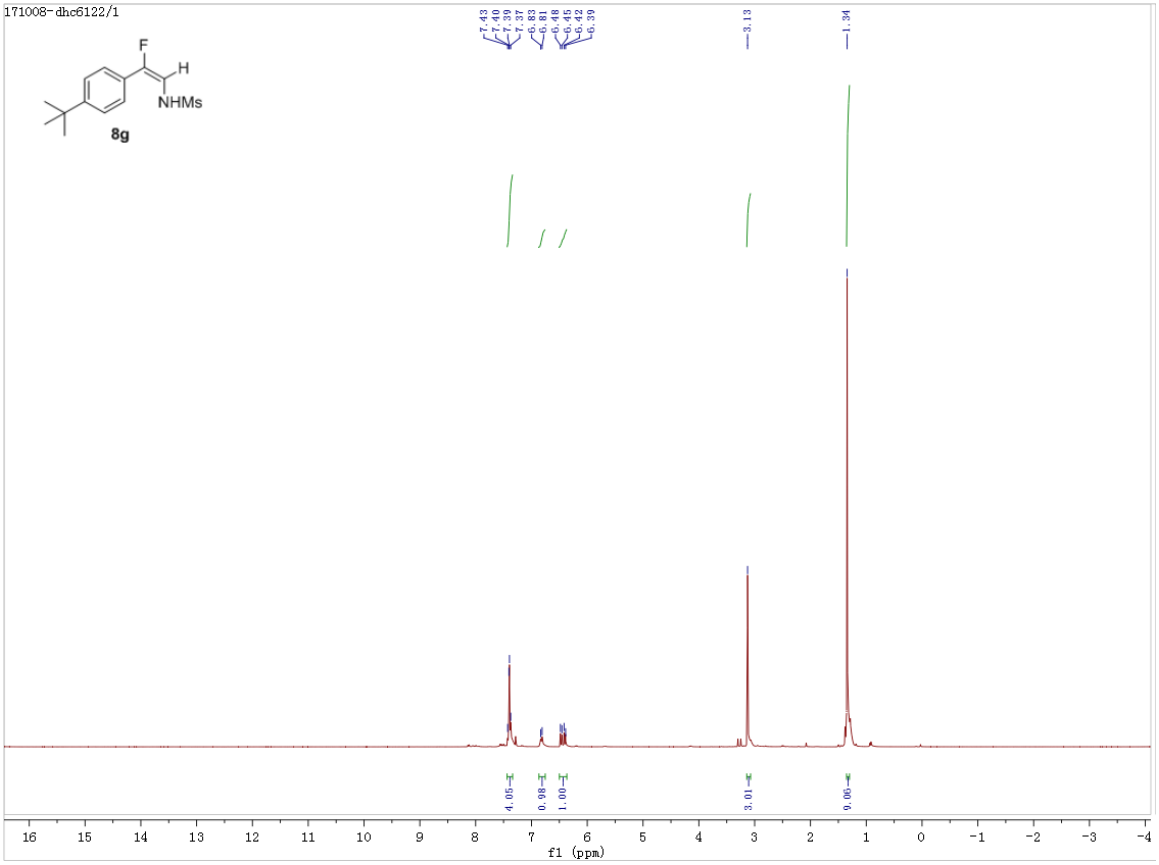
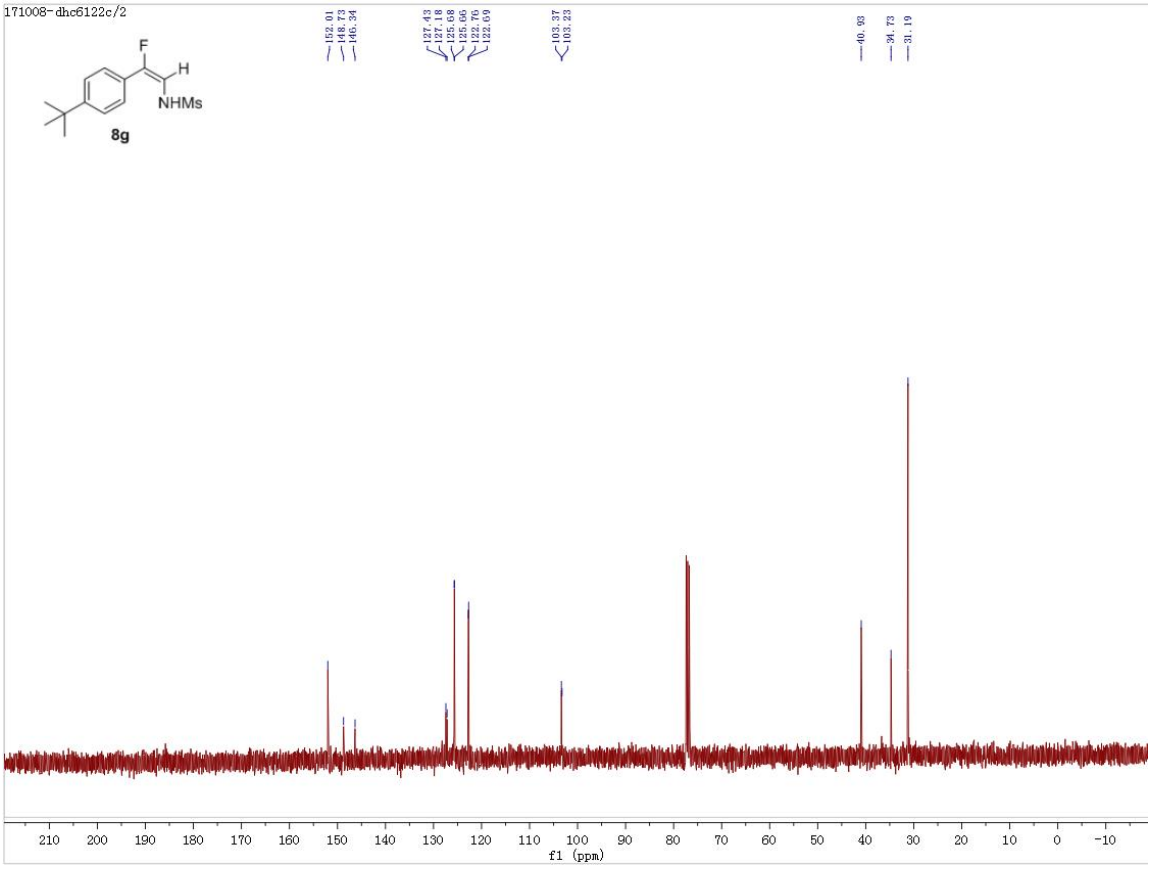
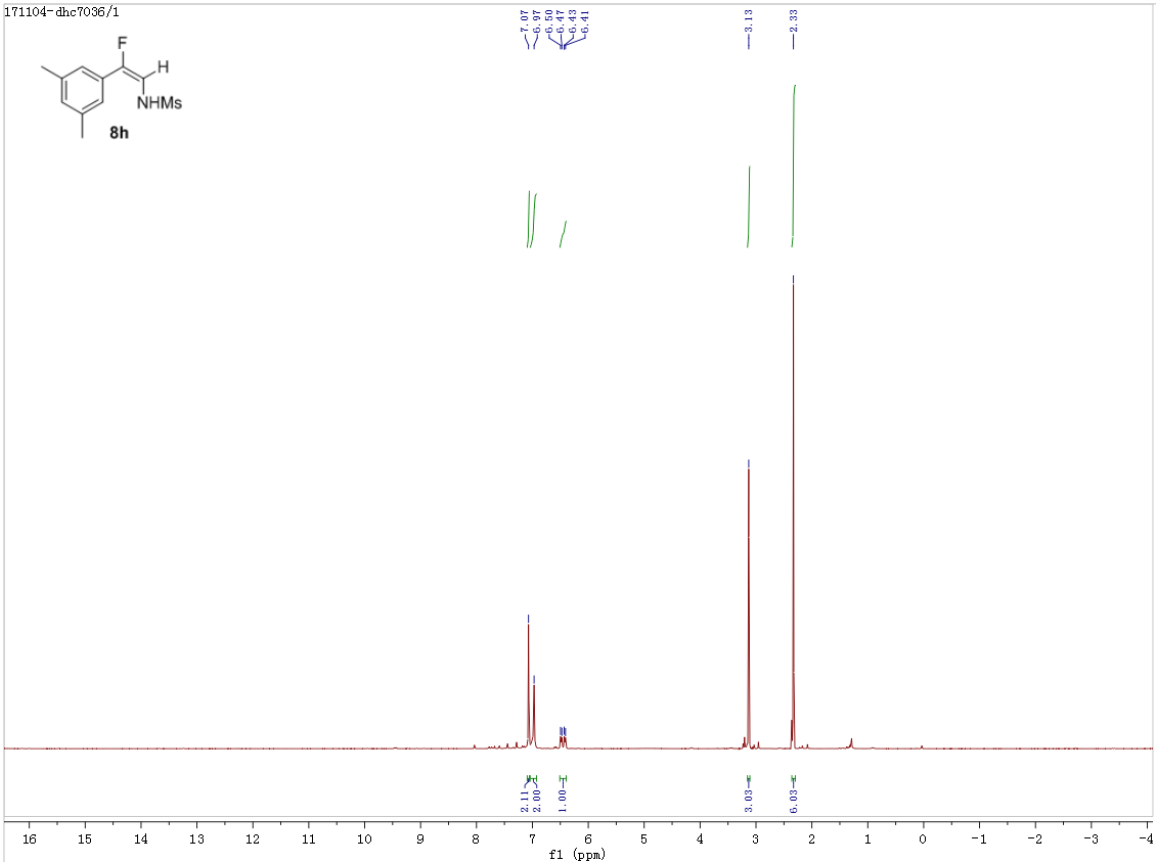
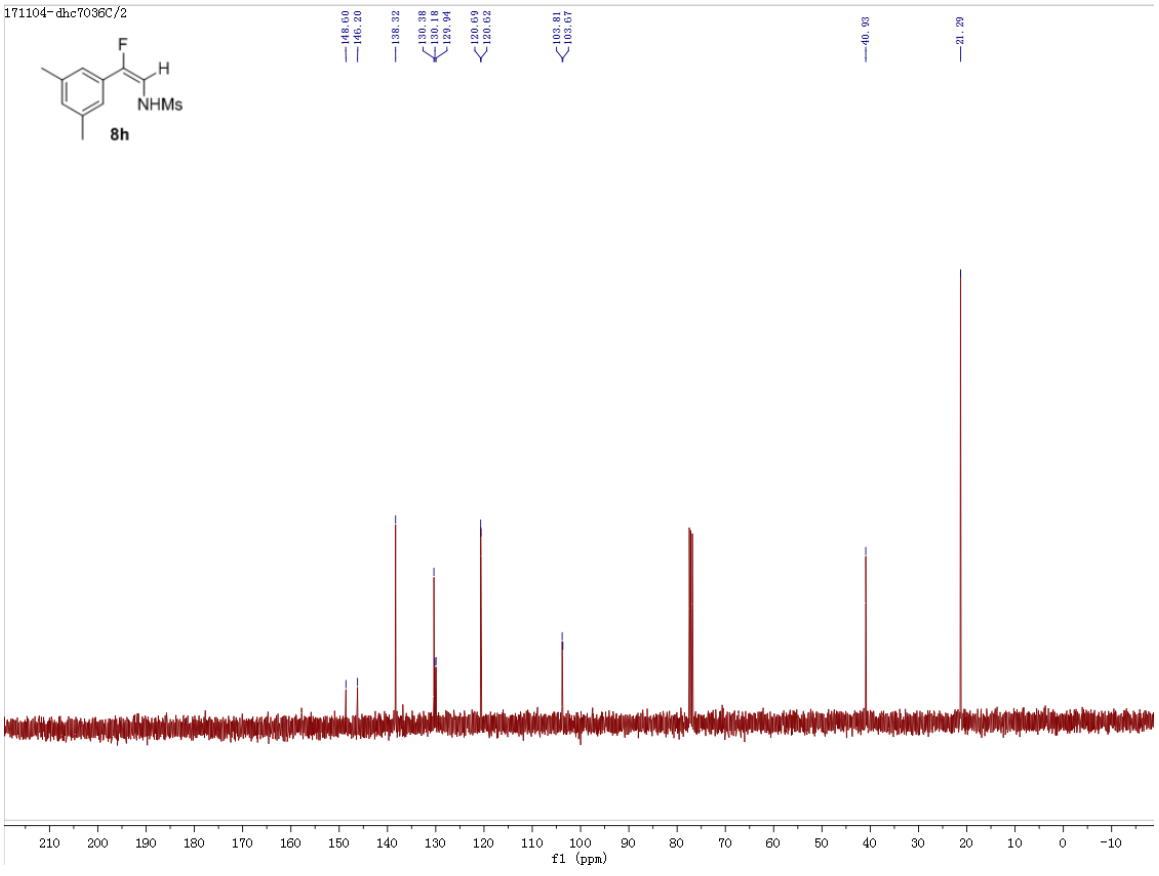
3.13
2.37
2.05
2.03
0.93
1.00
3.00
3.00
f1 (ppm)

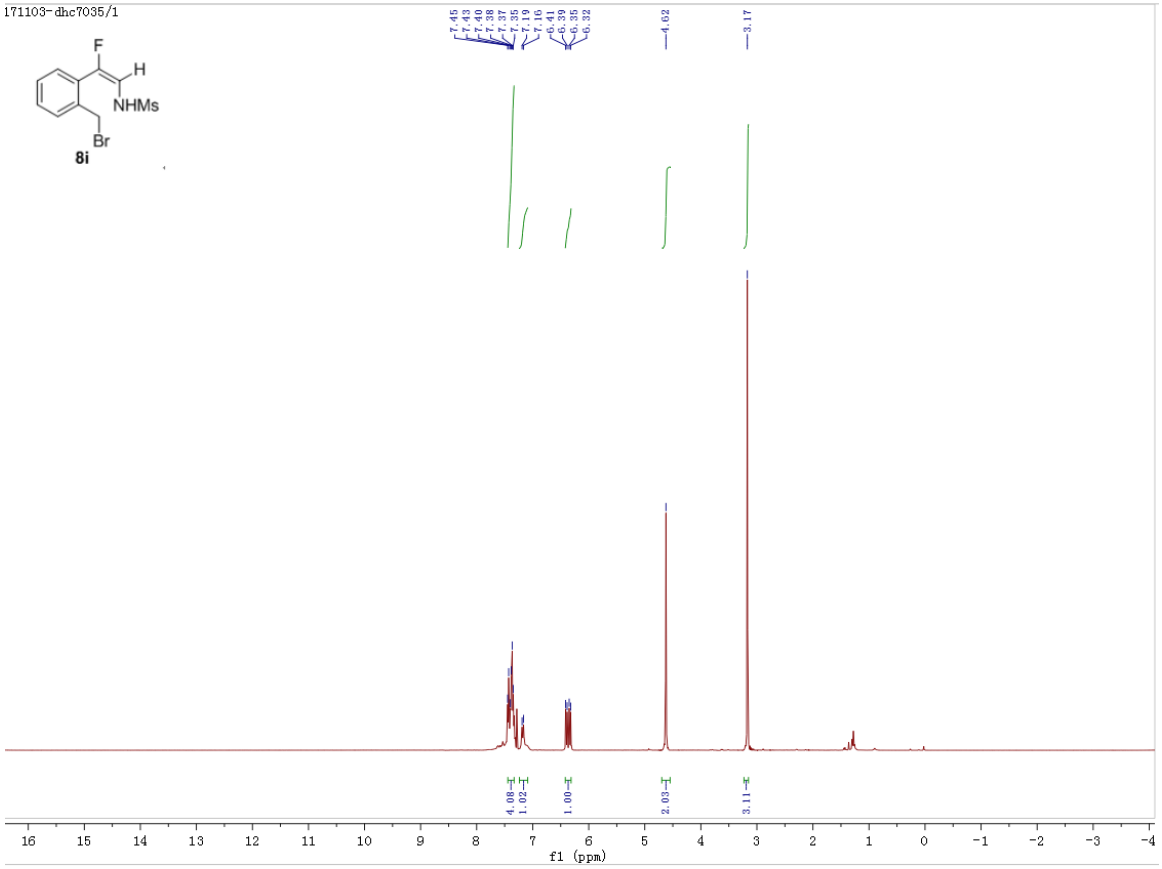

171031-dhc7029C/2
F
H
NHMs
8f
148.72
146.32
138.73
129.38
127.51
127.35
122.80
122.84
103.29
103.15
40.92
21.25
f1 (ppm)

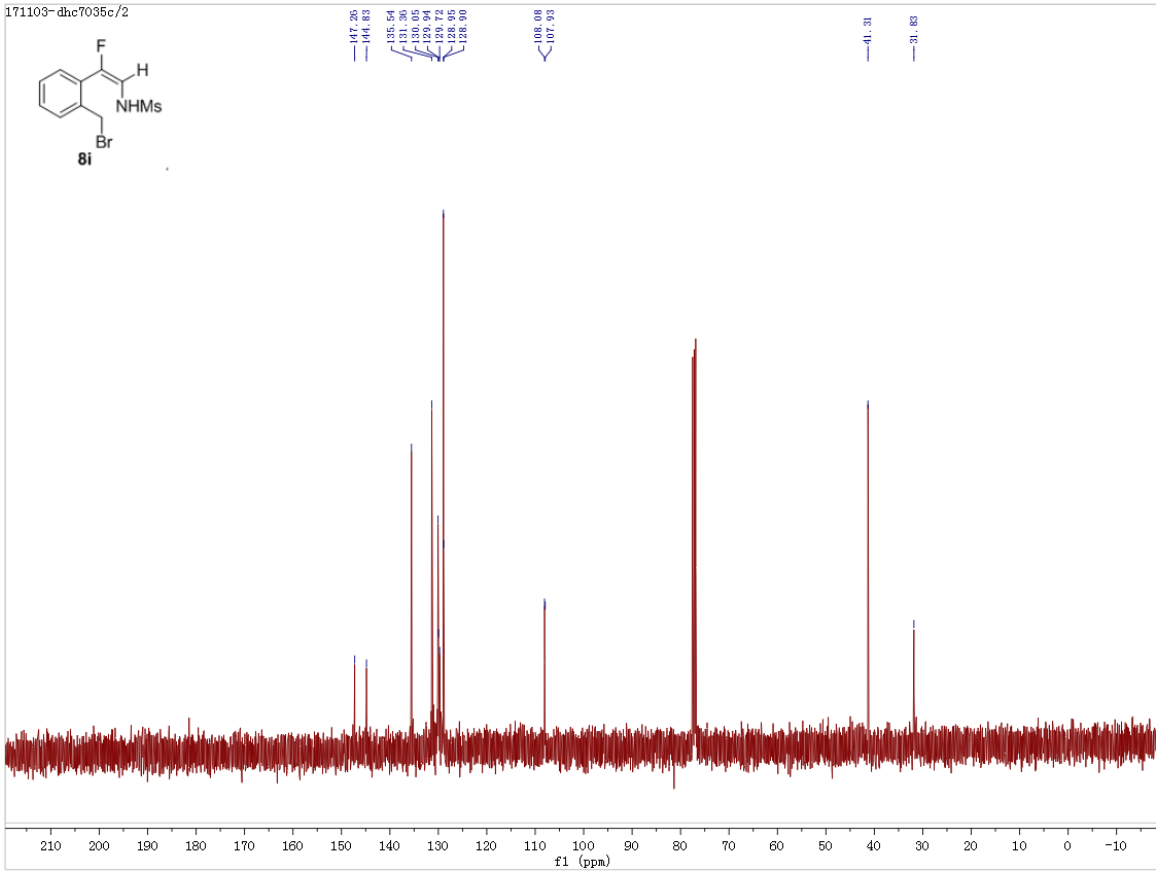

171008-dhc6122/1
F
H
NHMs
8g
7.43
7.40
7.39
7.37
6.83
6.81
6.48
6.45
6.42
6.39
3.13
1.34
4.05
0.98
1.00
3.01
9.06
f1 (ppm)

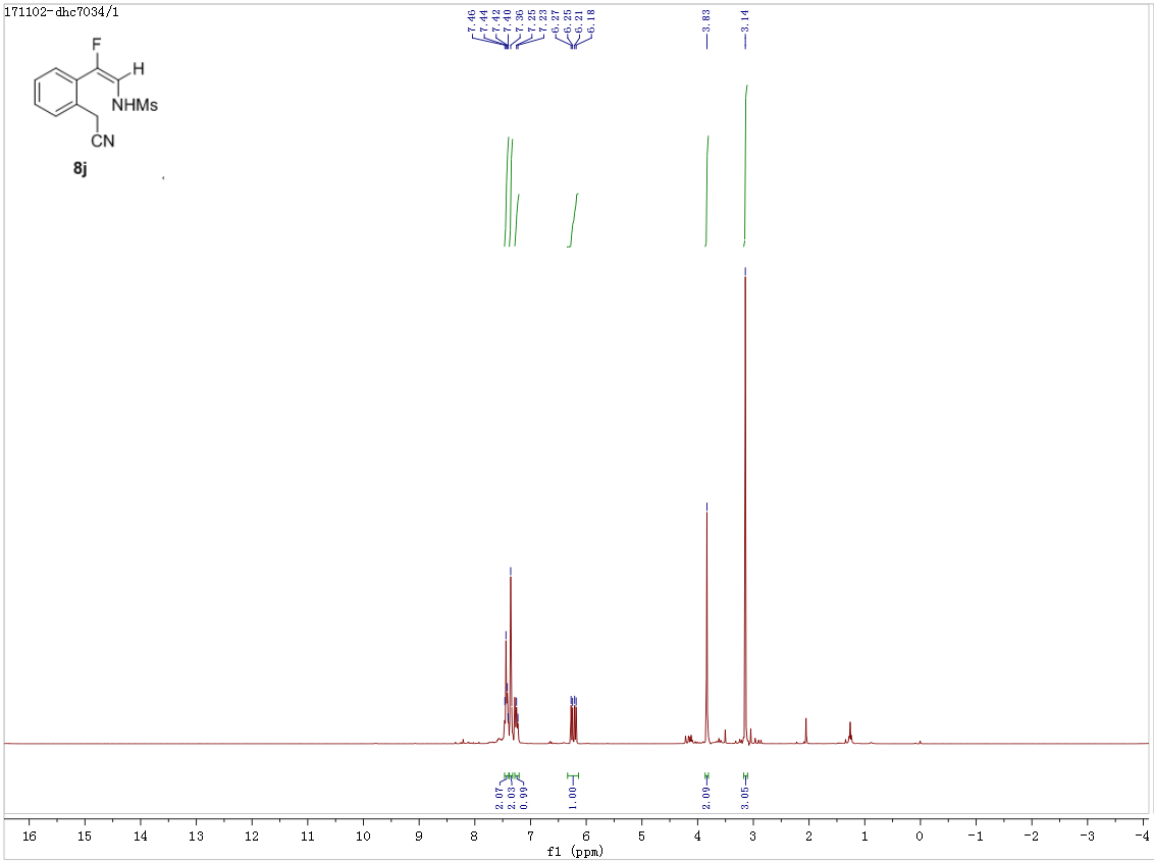

171008-dhc6122c/2
F
H
NHMs
8g
152.01
148.73
146.34
127.43
127.18
125.68
125.66
122.76
122.69
103.37
103.23
40.93
34.73
31.19
f1 (ppm)

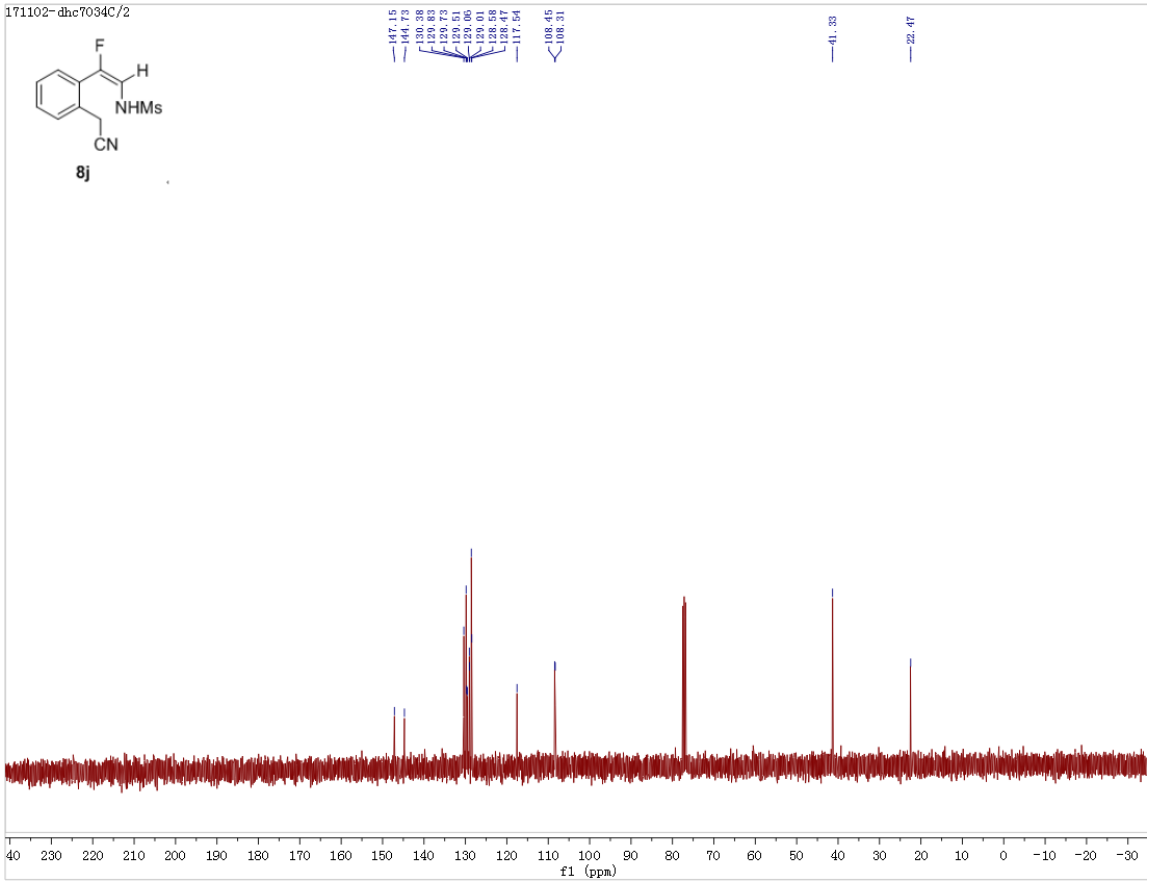

171104-dhc7036/1
F
H
NHMs
8h
7.07
6.97
6.50
6.47
6.43
6.41
3.13
2.33
2.11
2.00
1.00
3.03
6.03
f1 (ppm)

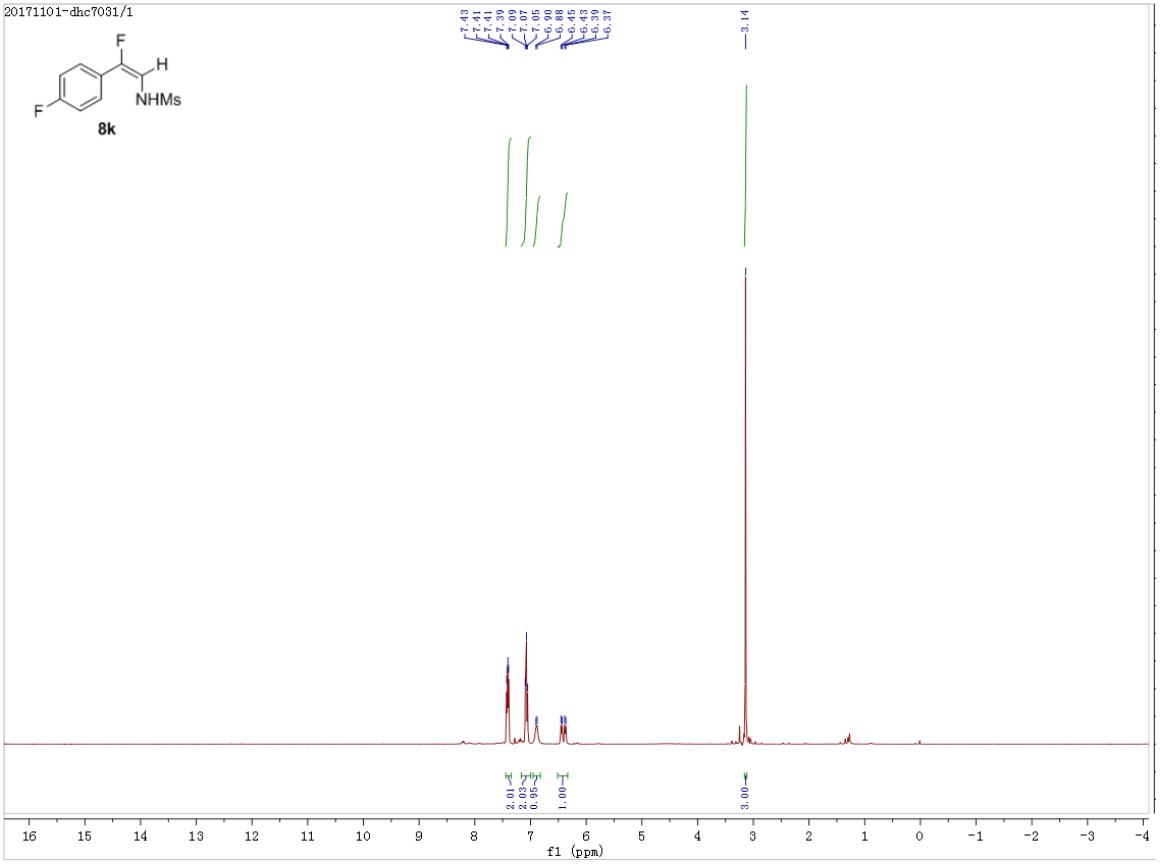

171104-dhc7036C/2
F
H
NHMs
8h
148.60
146.20
138.32
130.38
130.18
129.94
120.69
120.62
103.81
103.67
40.93
21.29
f1 (ppm)

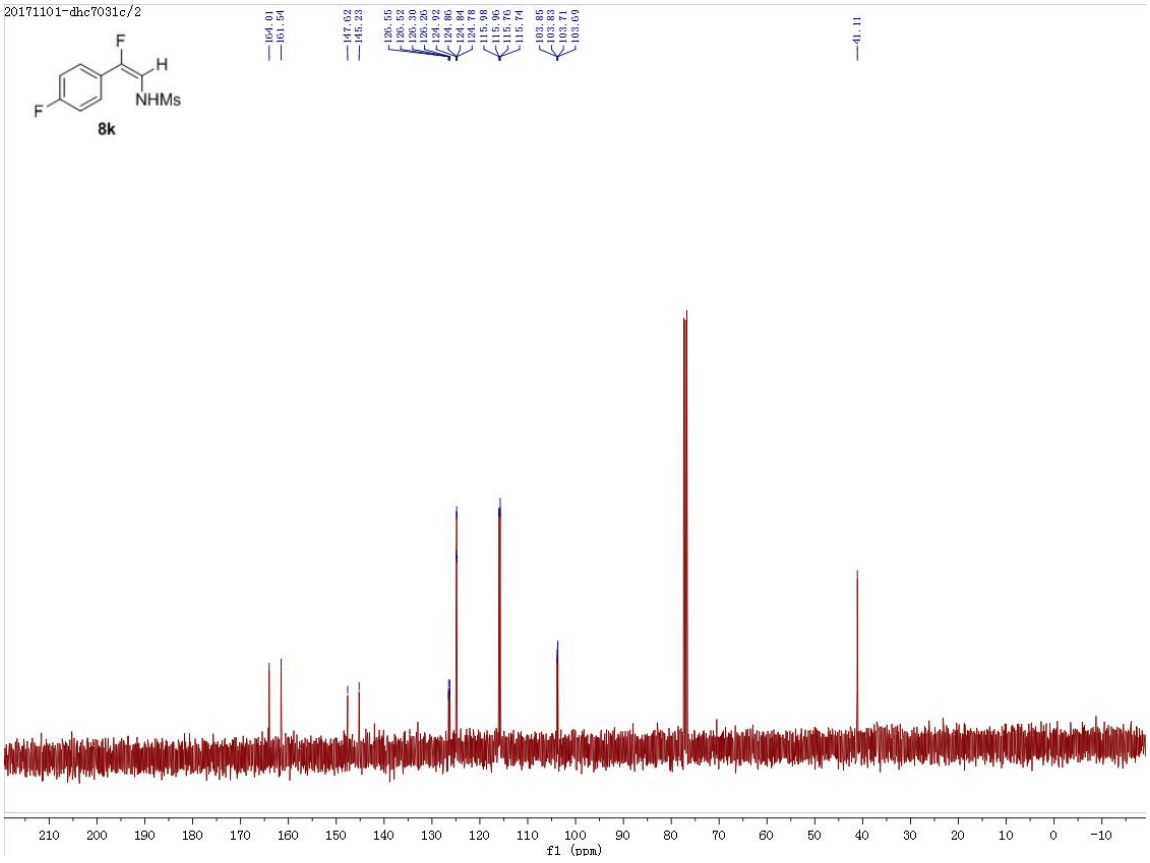

171103-dhc7035/1
F
H
NHMs
Br
8i
7.45
7.43
7.40
7.38
7.37
7.35
7.19
7.16
6.41
6.39
6.35
6.32
4.62
3.17
4.08
1.02
1.00
2.03
3.11
f1 (ppm)

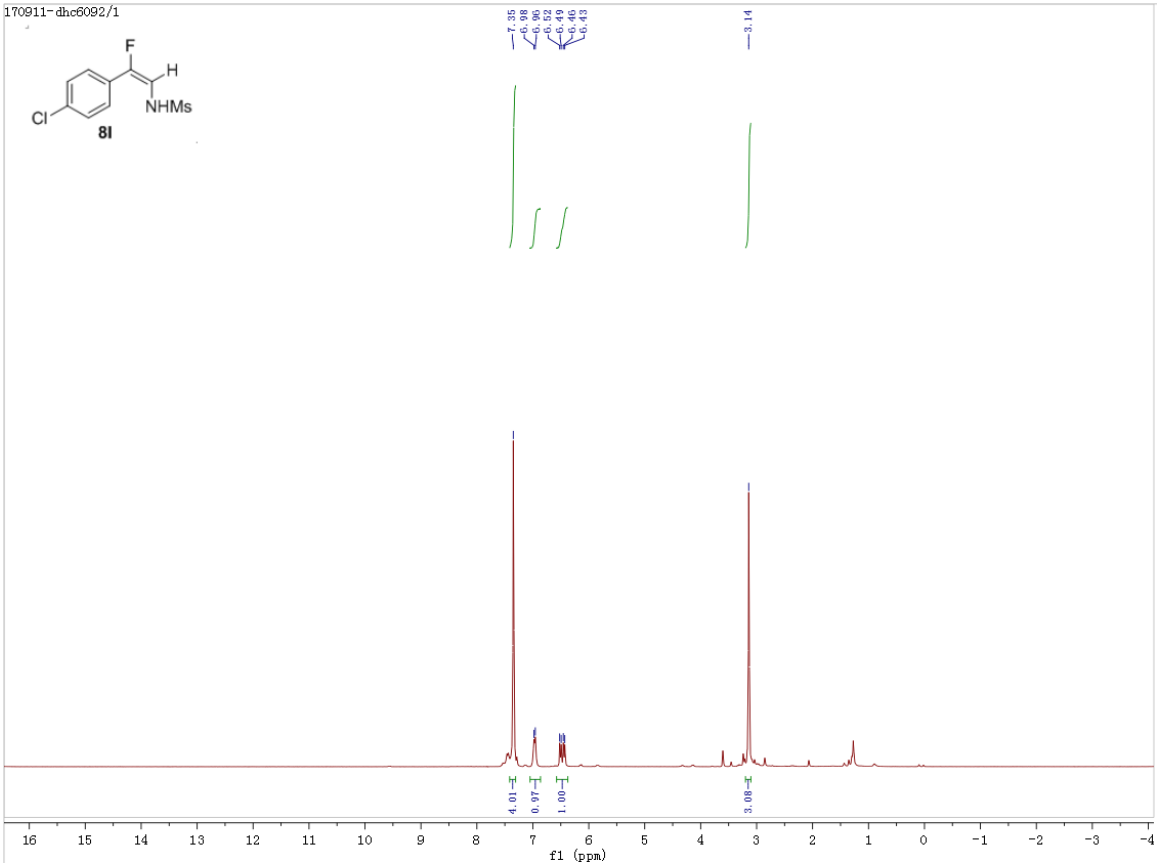

171103-dhc7035c/2
F
H
NHMs
Br
8i
147.25
144.83
135.54
131.36
130.65
130.04
129.72
128.95
128.90
108.08
107.93
41.31
31.83
f1 (ppm)

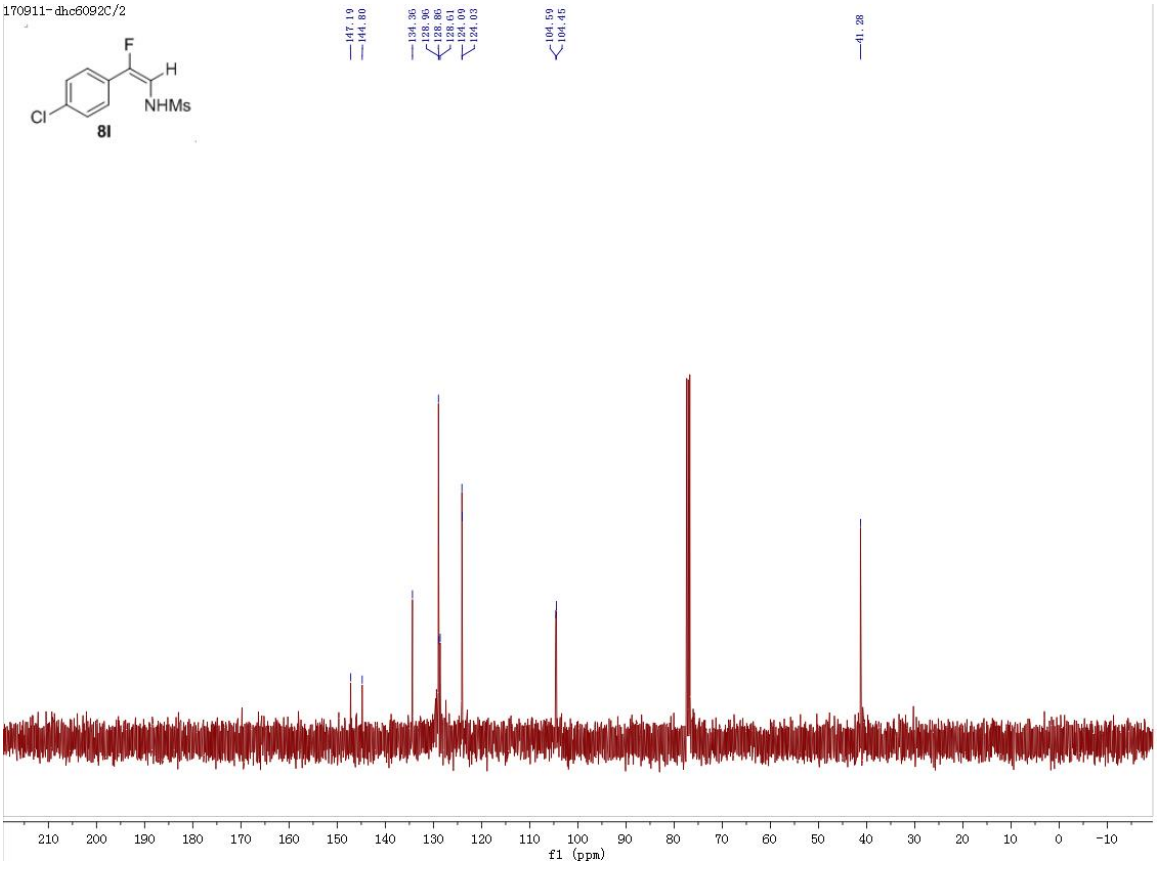

171102-dhc7034/1
F
H
NHMs
CN
8j
7.46
7.44
7.42
7.40
7.36
7.25
7.23
6.27
6.25
6.21
6.18
3.83
3.14
2.07
2.03
0.99
1.00
2.09
3.05
f1 (ppm)

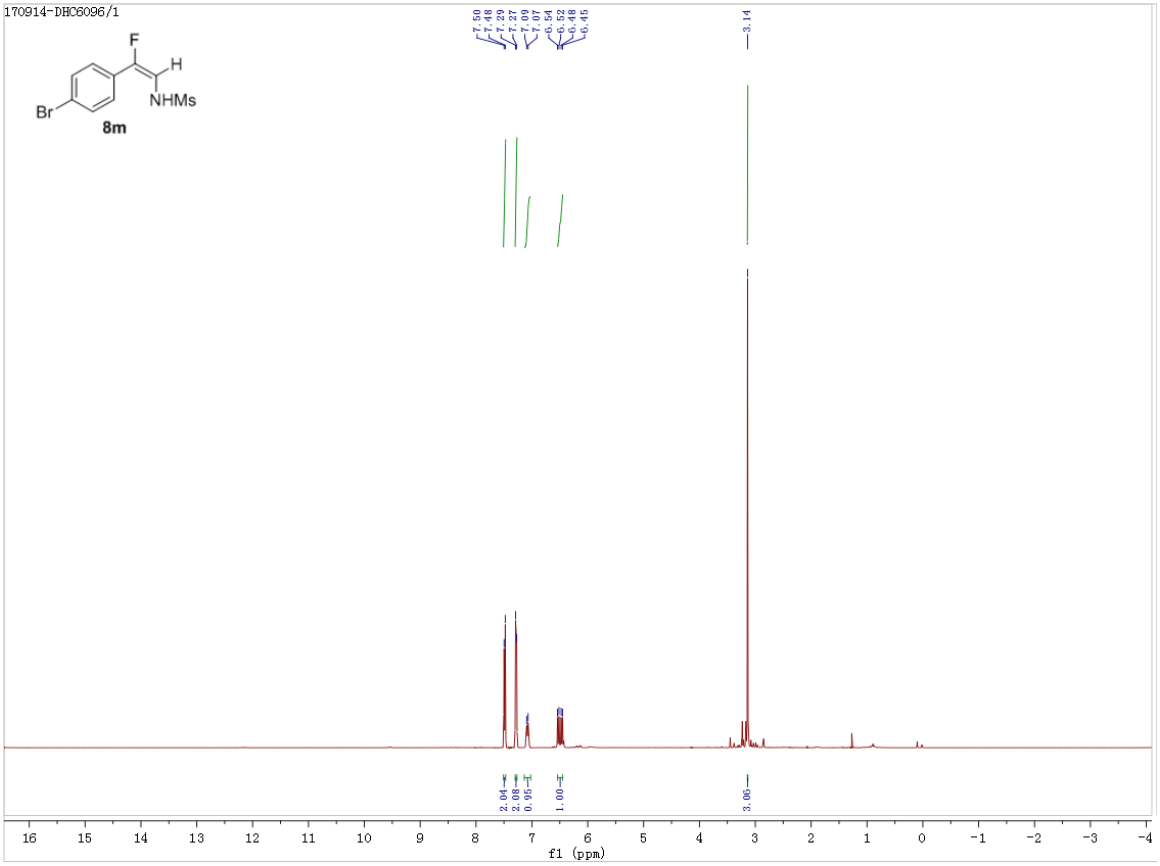

171102-dhc7034C/2
F
H
NHMs
CN
8j
147.15
144.73
130.38
120.83
120.73
120.51
120.06
129.01
128.58
128.47
117.54
108.45
108.31
41.33
22.47
f1 (ppm)

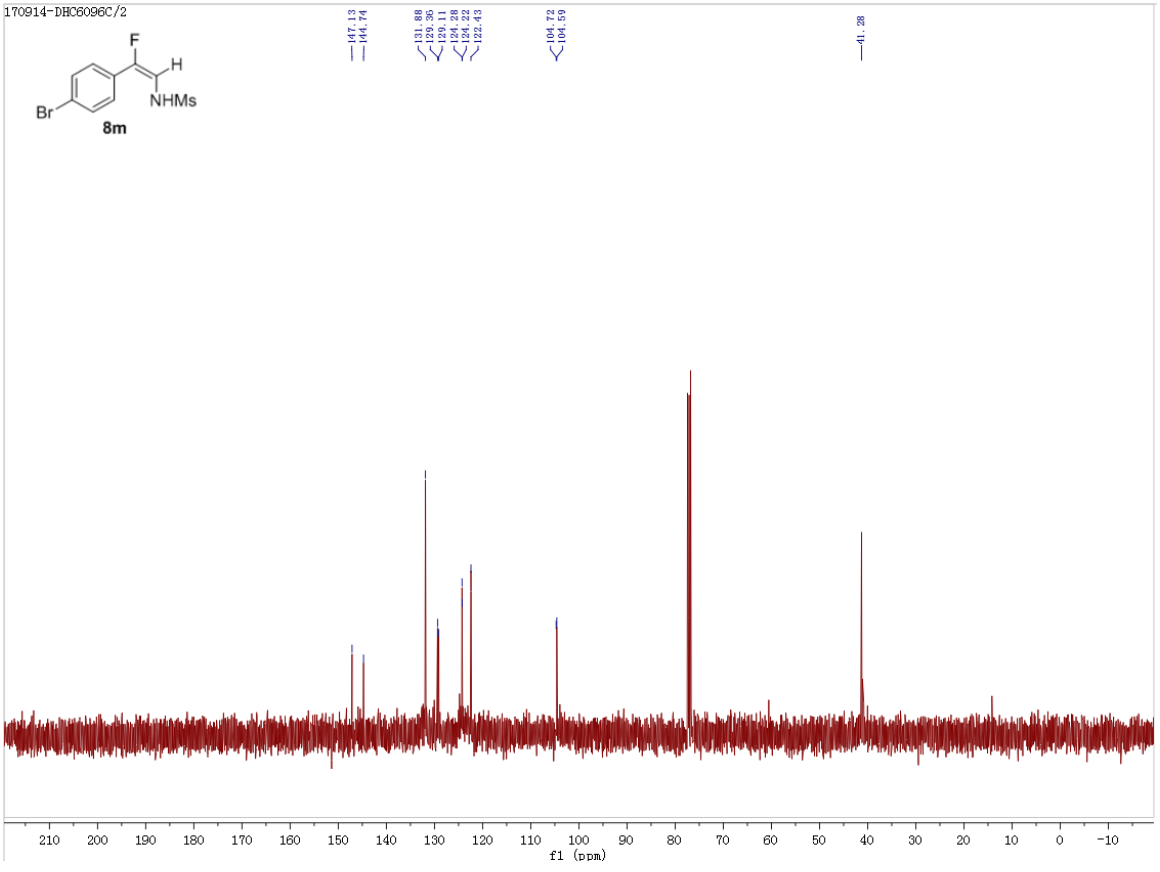

20171101-dhc7031/1
F
H
NHMs
F
8k
7.43
7.41
7.41
7.39
7.09
7.07
7.05
6.90
6.88
6.45
6.43
6.39
6.37
3.14
2.01
2.03
0.95
1.00
3.00
f1 (ppm)

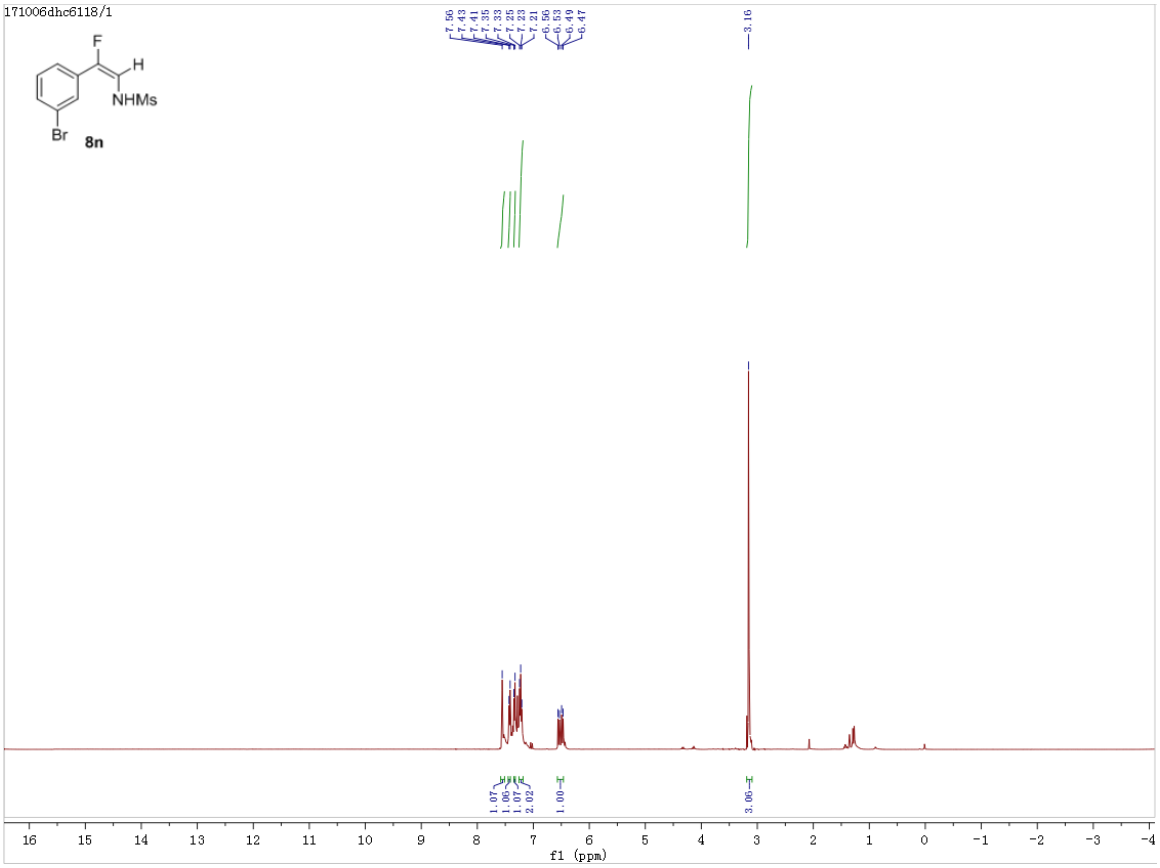

20171101-dhc7031c/2
F
H
NHMs
F
8k
164.01
161.54
147.62
145.23
126.55
126.52
126.30
126.28
124.92
124.86
124.84
124.78
115.98
115.96
115.76
115.74
103.85
103.83
103.71
103.69
41.11
f1 (ppm)

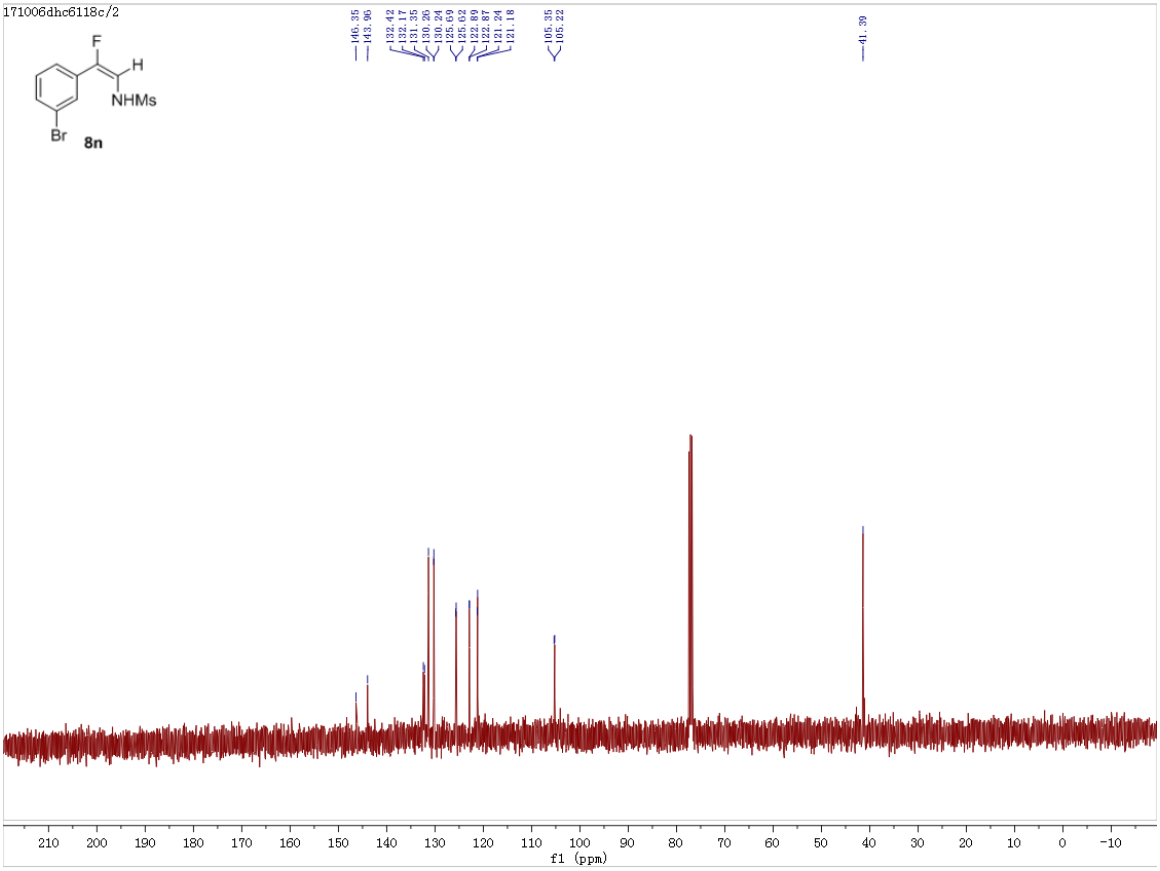

170911-dhc6092/1
F
H
Cl
NHMs
8l
7.35
6.98
6.96
6.52
6.49
6.46
6.43
3.14
4.01
0.97
1.00
3.08
f1 (ppm)

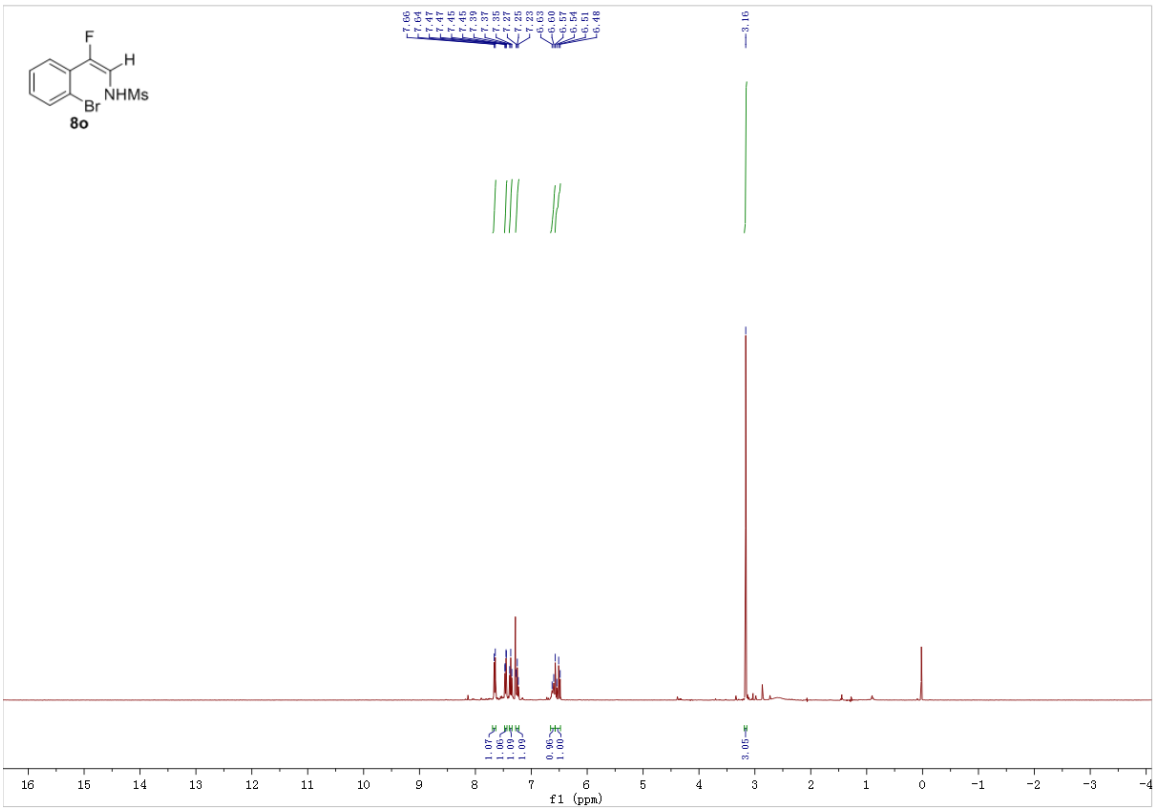

170911-dhc6092C/2
F
H
Cl
NHMs
8l
147.19
144.80
134.36
128.96
128.86
128.61
124.09
124.03
104.59
104.45
41.28
f1 (ppm)

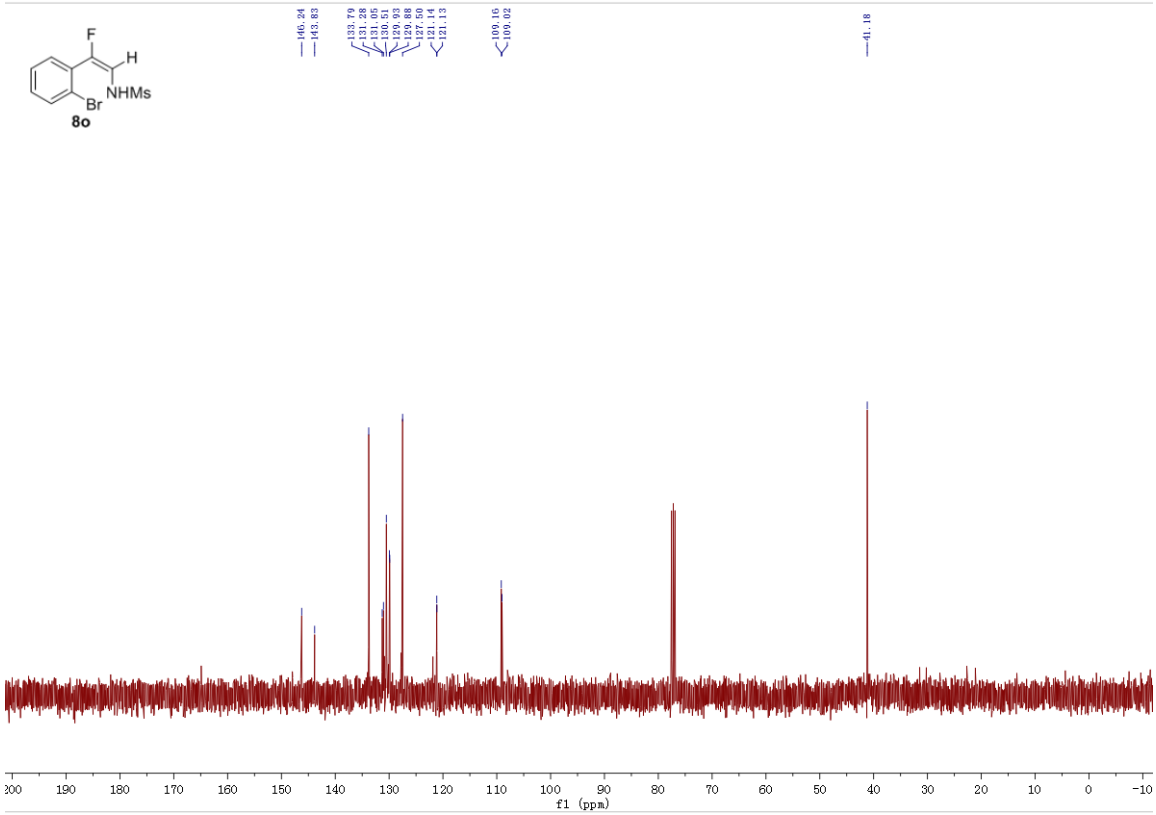

170914-DHC6096/1
F
H
NHMs
Br
8m
7.50
7.48
7.29
7.27
7.09
7.07
6.54
6.52
6.48
6.45
3.14
2.04
2.08
0.95
1.00
3.06
f1 (ppm)

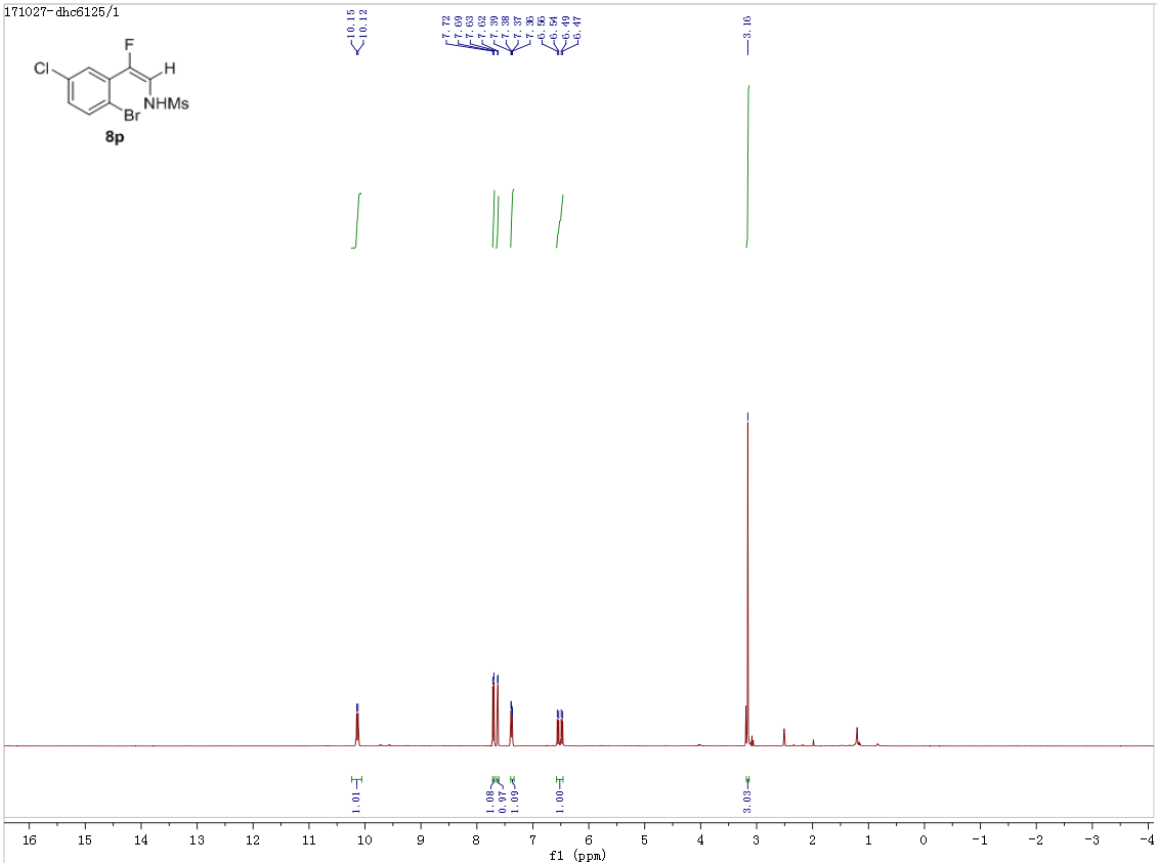

170914-DHC6096C/2
F
H
NHMs
Br
8m
147.13
144.74
131.88
130.95
129.11
124.28
124.22
122.43
104.72
104.59
41.28
f1 (ppm)

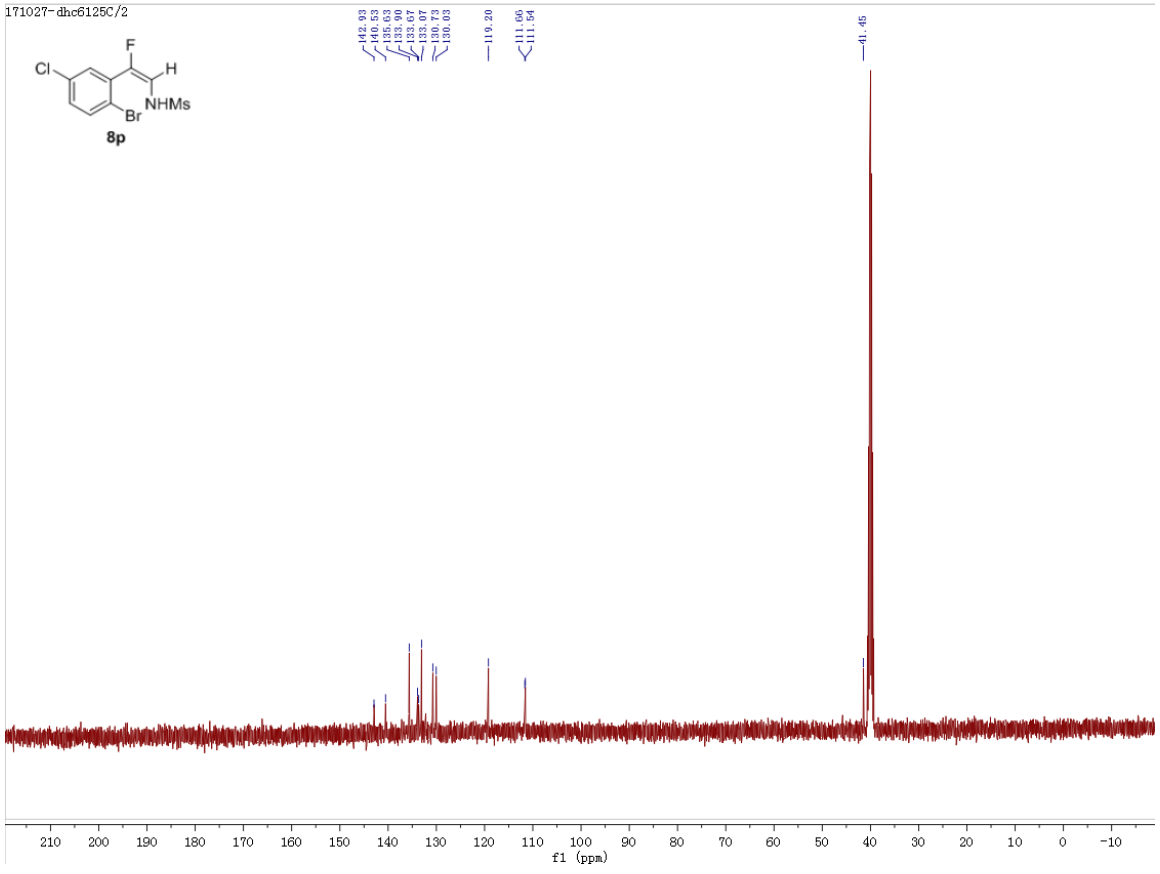

171006dhc6118/1
F
H
NHMs
Br
8n
7.56
7.43
7.41
7.35
7.33
7.25
7.23
7.21
6.56
6.53
6.49
6.47
3.16
1.07
1.06
1.07
2.02
1.00
3.06
f1 (ppm)

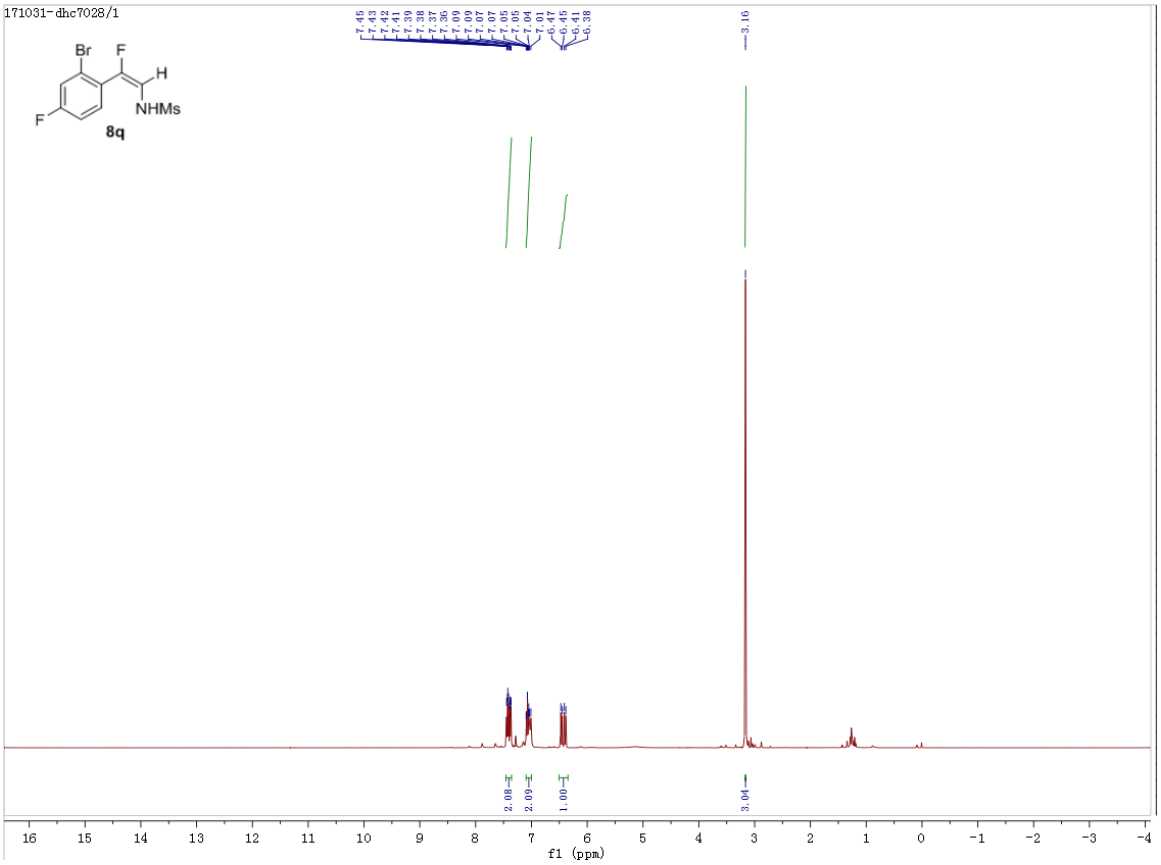

171006dhc6118c/2
F
H
NHMs
Br
8n
146.35
143.96
132.42
132.17
131.35
130.26
130.24
125.69
125.62
122.89
122.87
121.94
121.18
105.35
105.22
41.39
f1 (ppm)

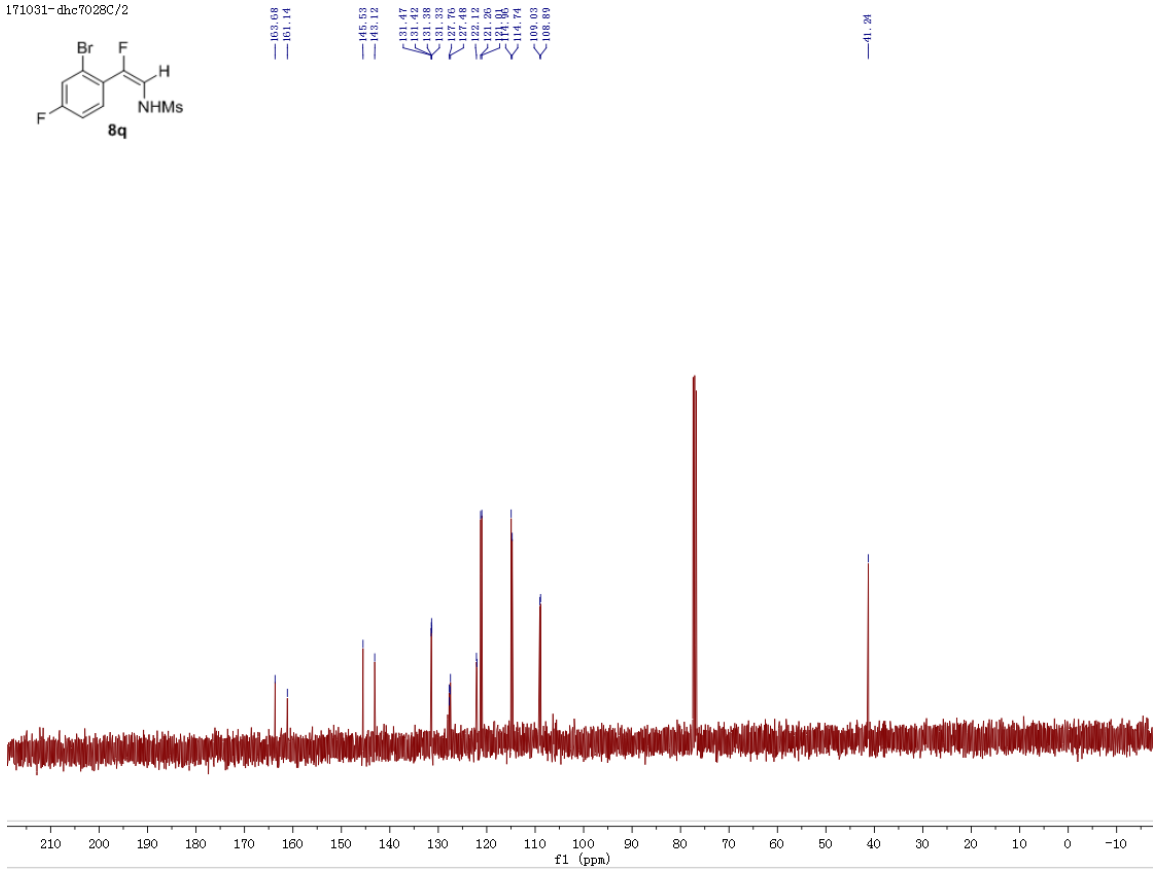

F
H
NHMs
Br
8o
7.66
7.64
7.47
7.45
7.39
7.37
7.35
7.27
7.25
7.23
6.60
6.57
6.54
6.51
6.48
3.16
1.07
1.05
1.09
1.09
0.96
1.00
3.05
f1 (ppm)

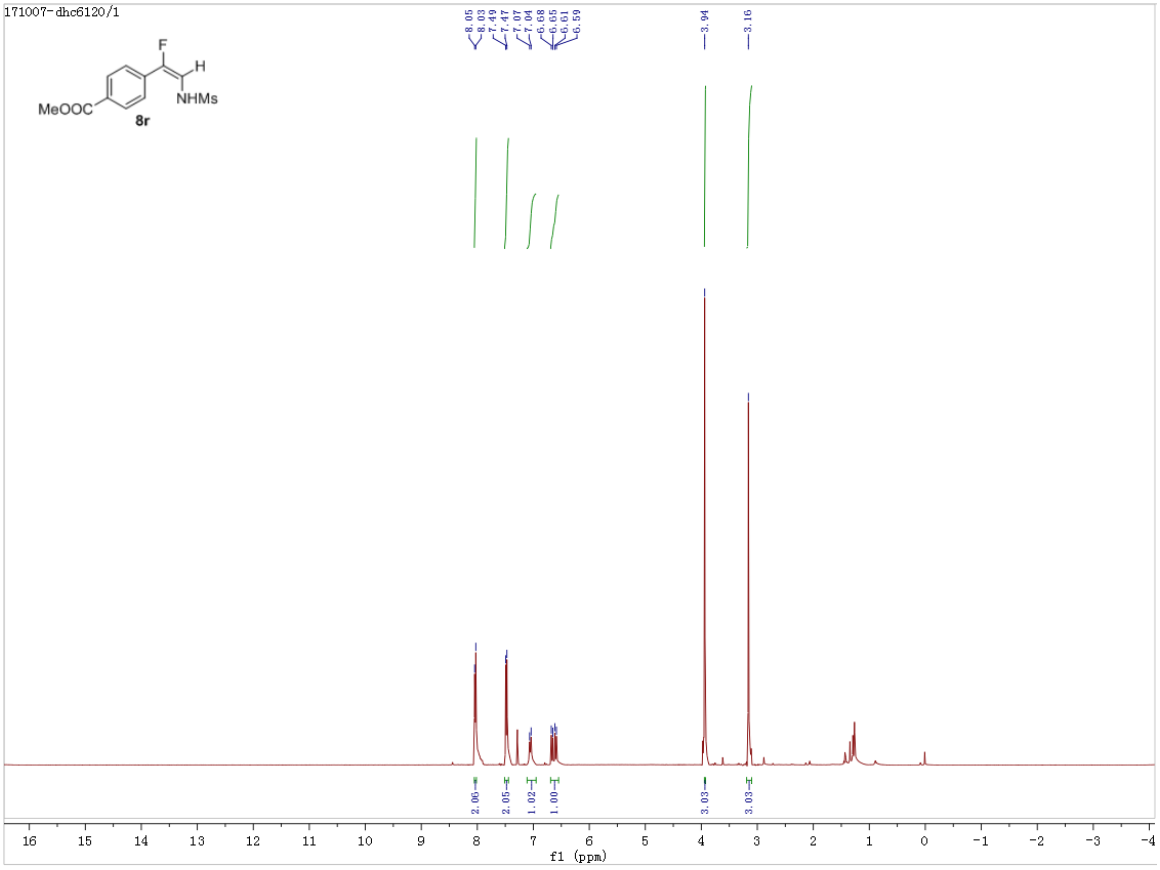

F
H
NHMs
Br
8o
146.24
143.83
133.79
131.28
131.05
130.51
129.93
129.88
127.50
121.14
121.13
109.16
109.02
41.18
f1 (ppm)

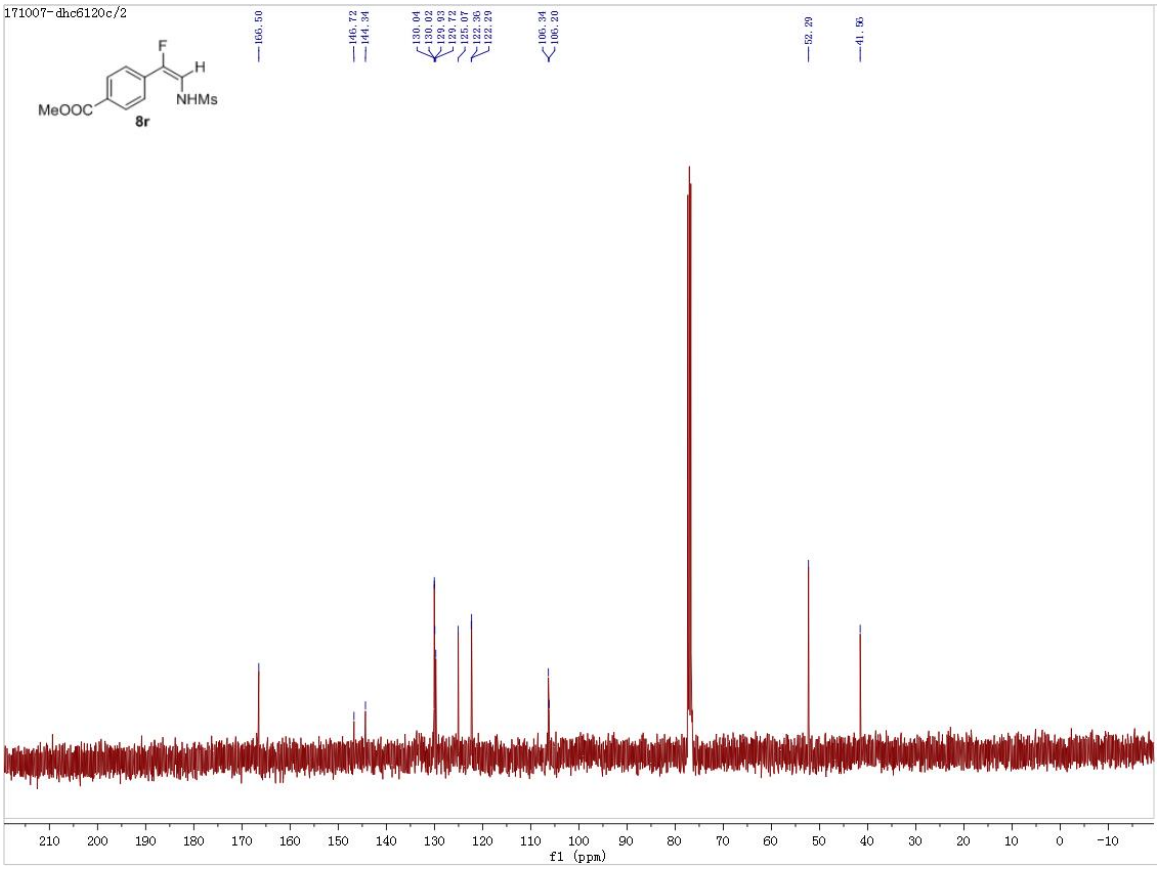

171027-dhc6125/1
F
H
Cl
NHMs
Br
8p
10.15
10.12
7.72
7.69
7.65
7.62
7.39
7.38
7.37
7.35
6.54
6.49
6.47
3.16
1.01
1.08
0.97
1.09
1.00
3.03
f1 (ppm)

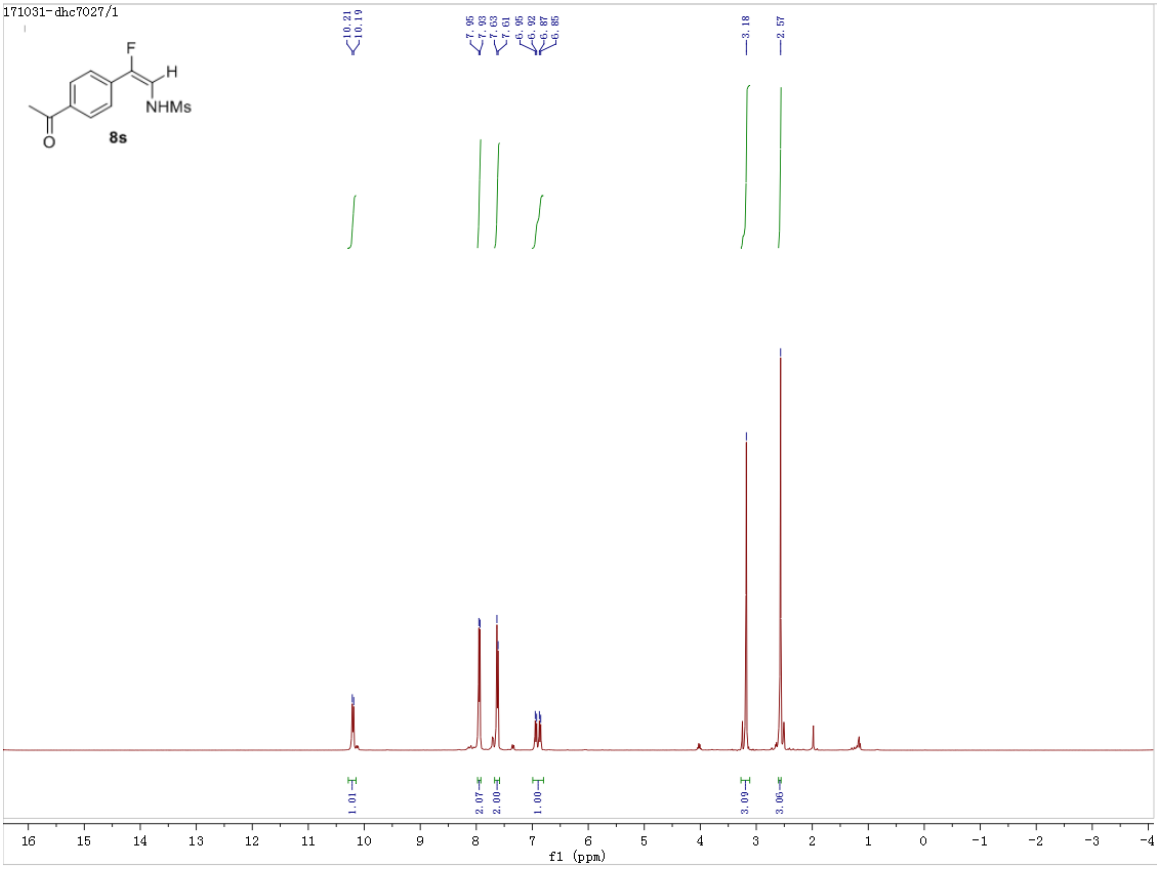

171027-dhc6125C/2
F
H
Cl
NHMs
Br
8p
142.93
140.53
135.63
133.90
133.67
133.07
130.73
130.03
119.20
111.66
111.54
41.45
f1 (ppm)

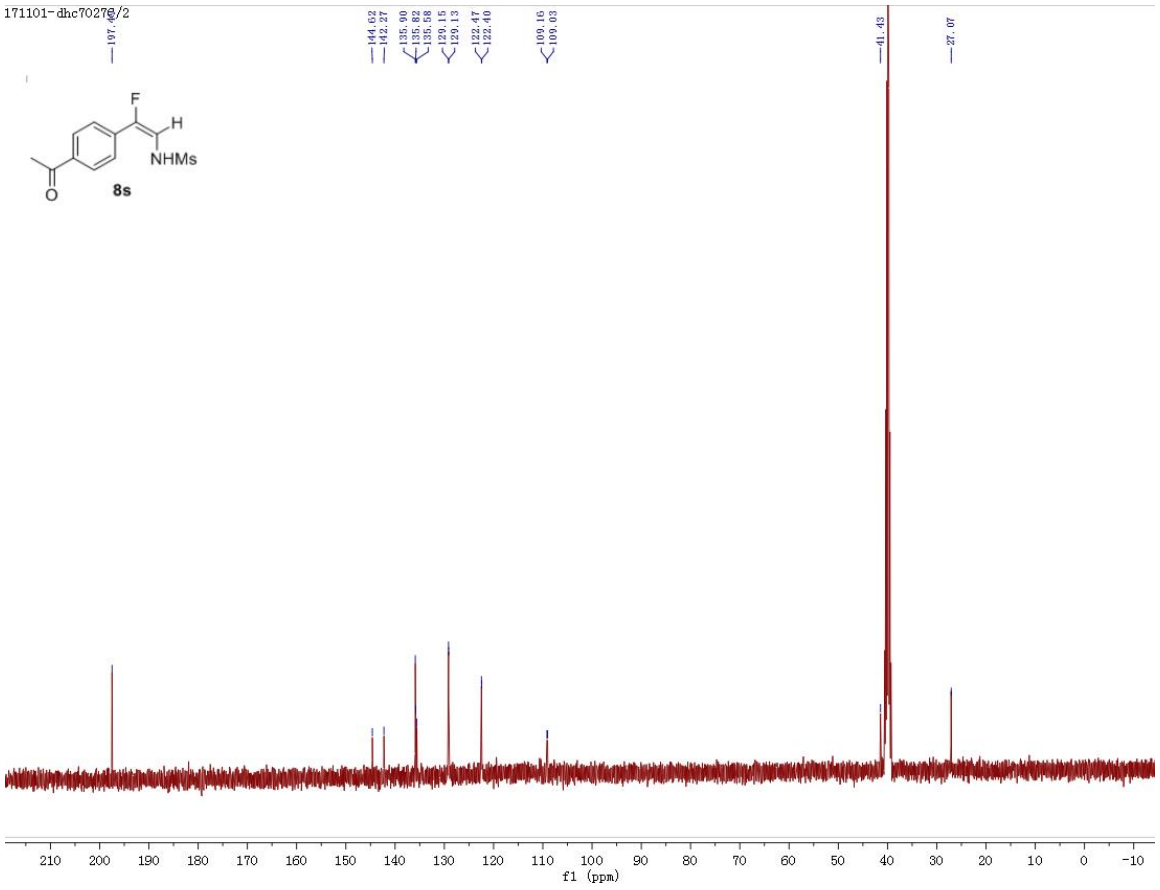

171031-dhc7028/1
Br
F
H
NHMs
F
8q
7.45
7.43
7.42
7.41
7.39
7.38
7.37
7.36
7.09
7.07
7.07
7.05
7.05
7.04
7.01
6.47
6.45
6.41
6.38
3.16
2.08
2.09
1.00
3.04
f1 (ppm)

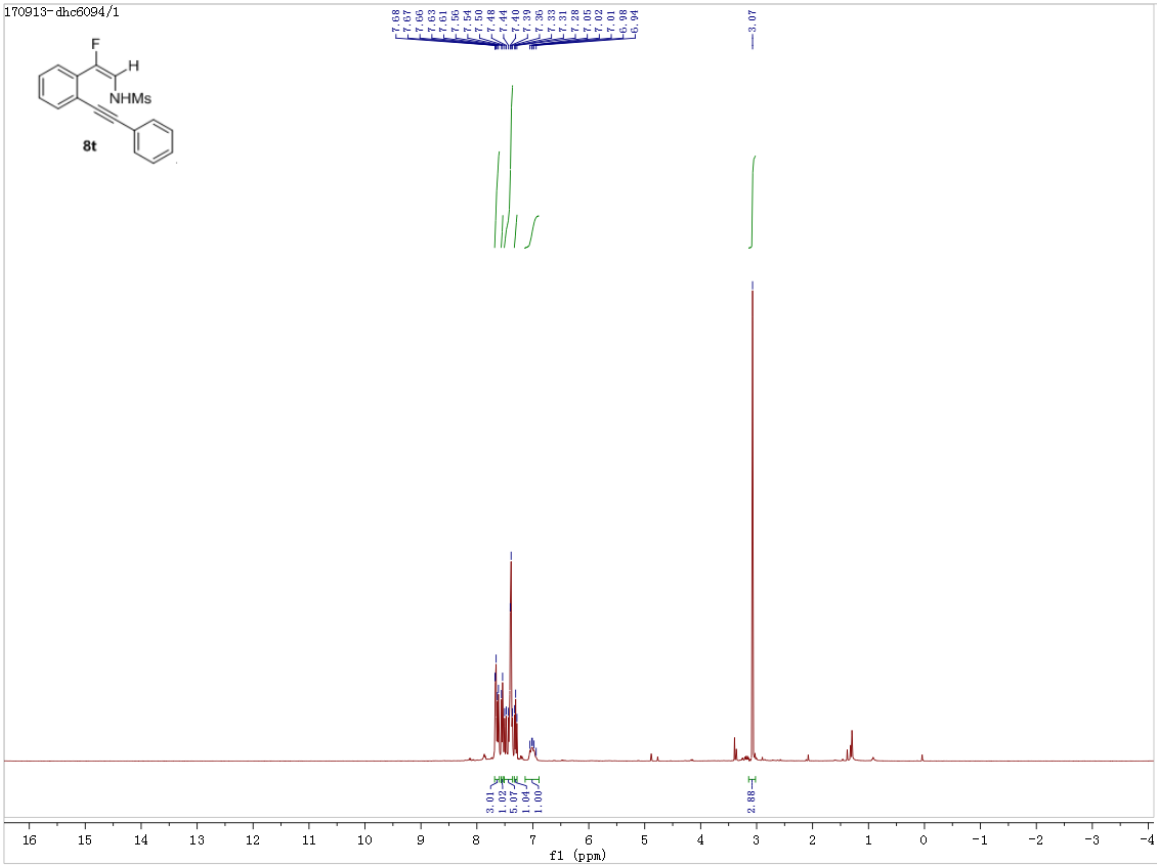

171031-dhc7028C/2
Br
F
H
NHMs
F
8q
163.68
161.14
145.53
143.12
131.47
131.42
131.38
131.33
127.76
127.48
122.12
121.26
121.21
114.96
114.74
109.03
108.89
41.24
f1 (ppm)

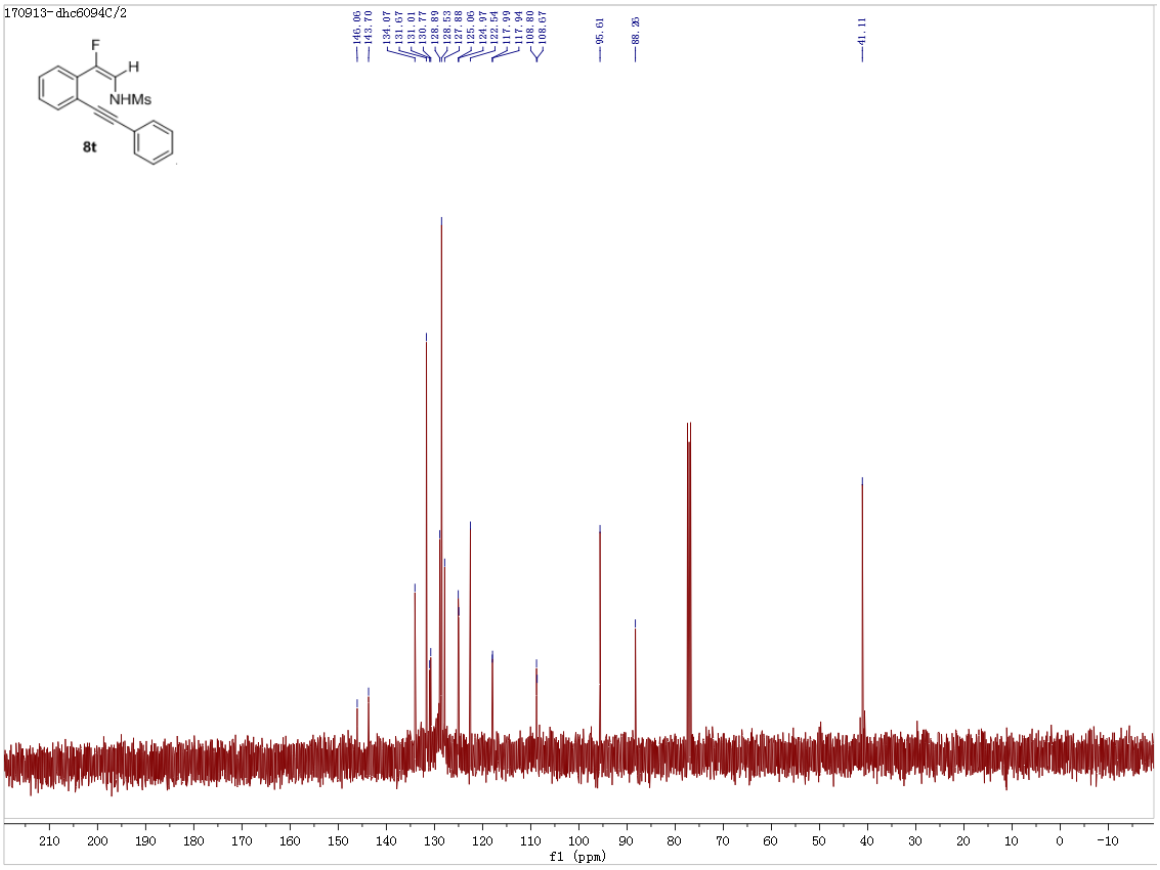

171007-dhc6120/1
F
H
NHMs
MeOOC
8r
8.05
8.03
7.49
7.47
7.07
7.04
6.68
6.65
6.61
6.59
3.94
3.16
2.06
2.05
1.02
1.00
3.03
3.03
f1 (ppm)

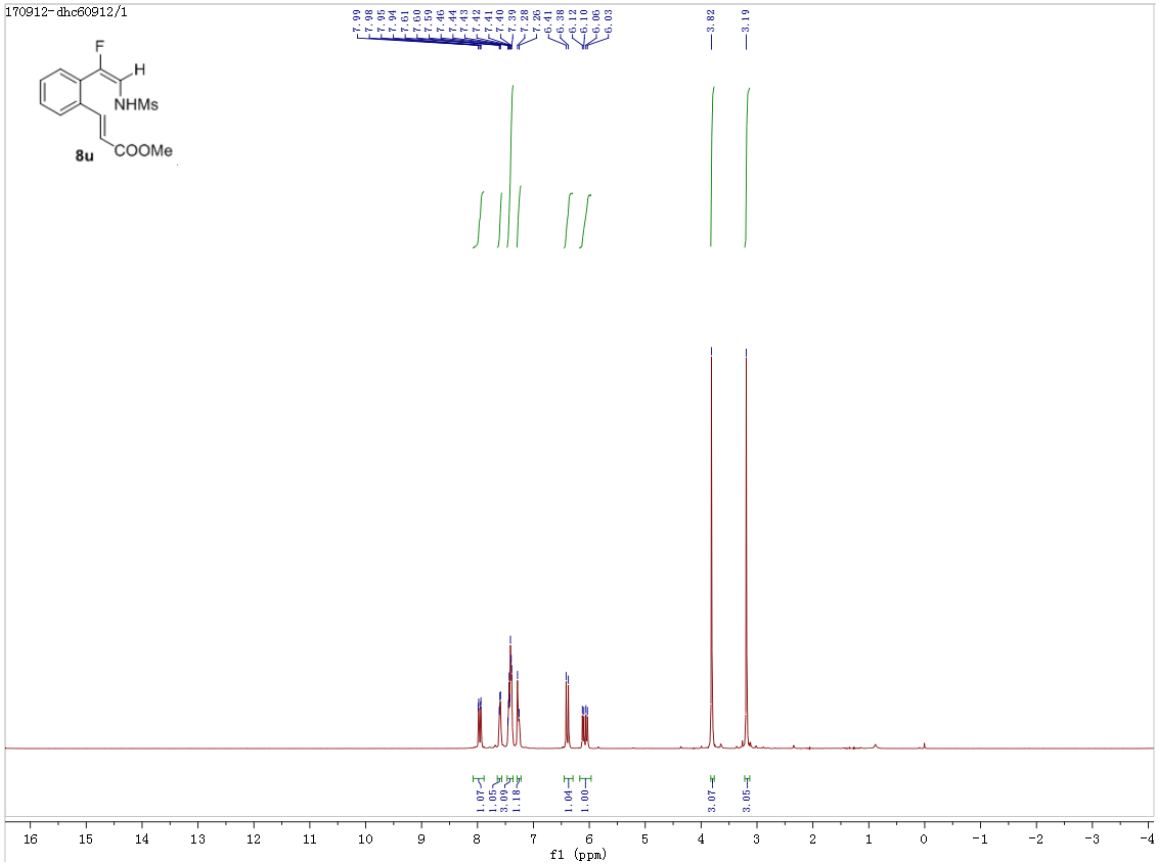

171007-dhc6120c/2
F
H
NHMs
MeOOC
8r
166.50
146.72
144.34
130.04
130.02
129.93
129.72
125.07
122.35
122.29
106.34
106.20
52.29
41.66
f1 (ppm)


171031-dhc7027/1
F
H
NHMs
O
8s
10.01
10.19
7.95
7.93
7.63
7.61
6.95
6.92
6.87
6.85
3.18
2.57
1.01
2.07
2.00
1.00
3.09
3.06
f1 (ppm)


171101-dhc7027e/2
197.40
144.62
142.27
135.90
135.82
135.58
129.15
129.13
122.47
122.40
109.16
109.03
41.43
27.07
F
H
NHMs
O
8s
f1 (ppm)


170913-dhc6094/1
F
H
NHMs
8t
7.68
7.67
7.66
7.63
7.61
7.56
7.54
7.50
7.48
7.44
7.40
7.39
7.36
7.33
7.31
7.28
7.05
7.02
7.01
6.98
6.94
3.07
3.01
1.02
5.07
1.04
1.00
2.88
f1 (ppm)


170913-dhc6094C/2
F
H
NHMs
8t
146.06
143.70
134.07
131.67
131.01
130.77
128.89
128.53
127.88
125.06
124.97
122.54
117.99
117.94
108.80
108.07
95.61
88.26
41.11
f1 (ppm)


170912-dhc60912/1
F
H
NHMs
COOMe
8u
7.99
7.98
7.95
7.94
7.61
7.60
7.59
7.46
7.44
7.43
7.42
7.41
7.40
7.39
7.28
7.25
6.41
6.38
6.12
6.10
6.06
6.03
3.82
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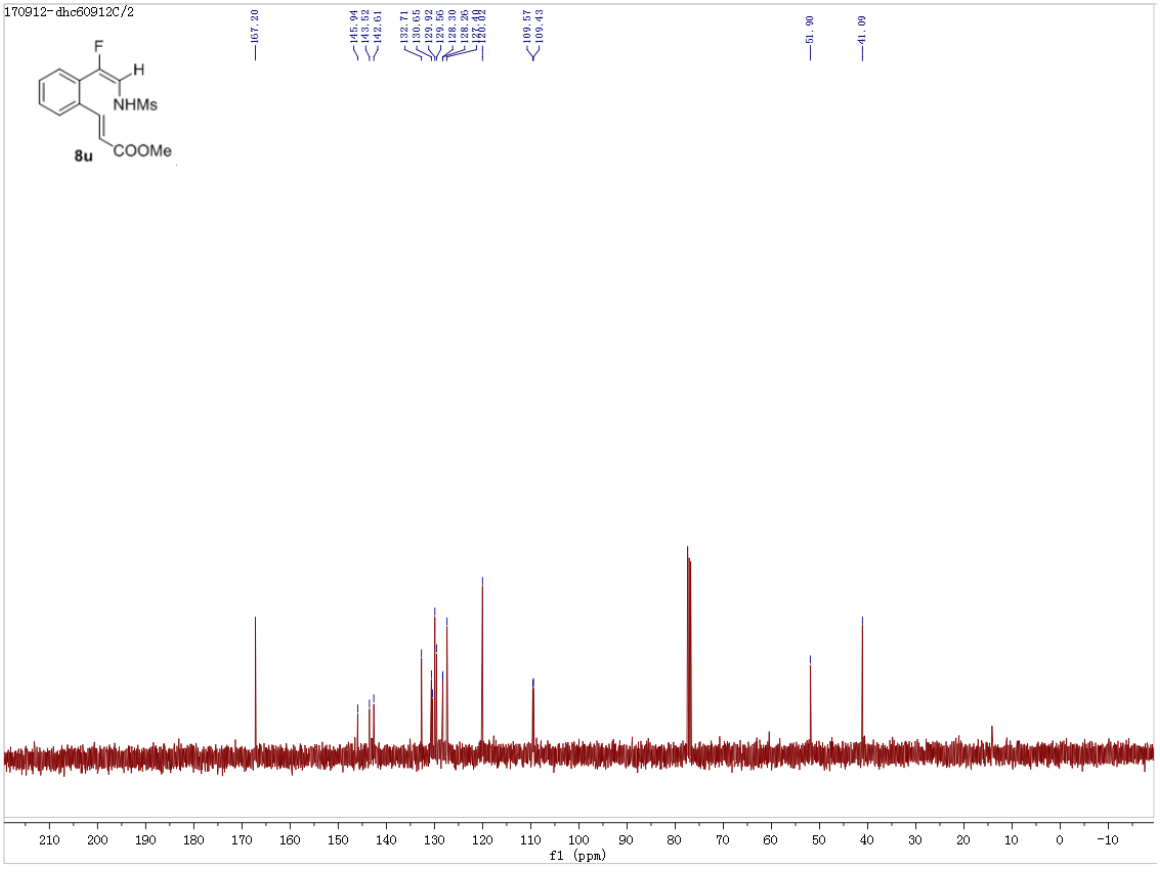
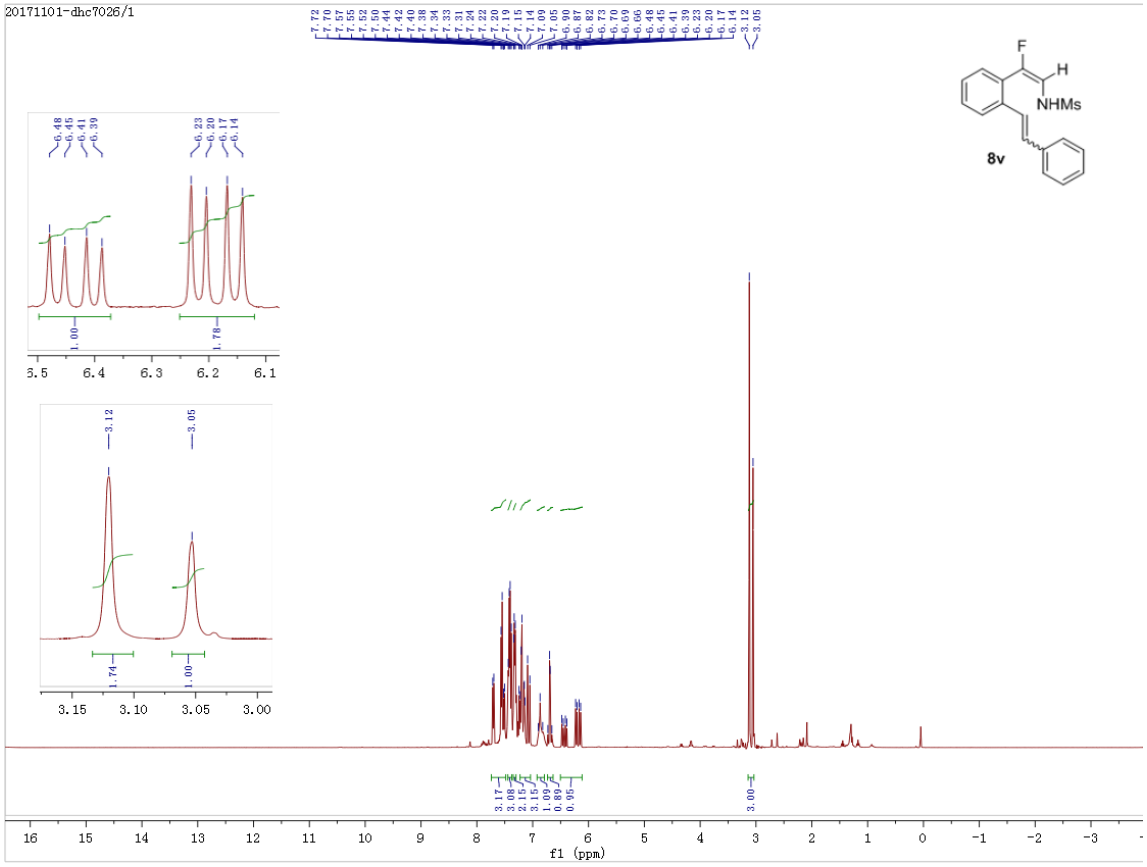
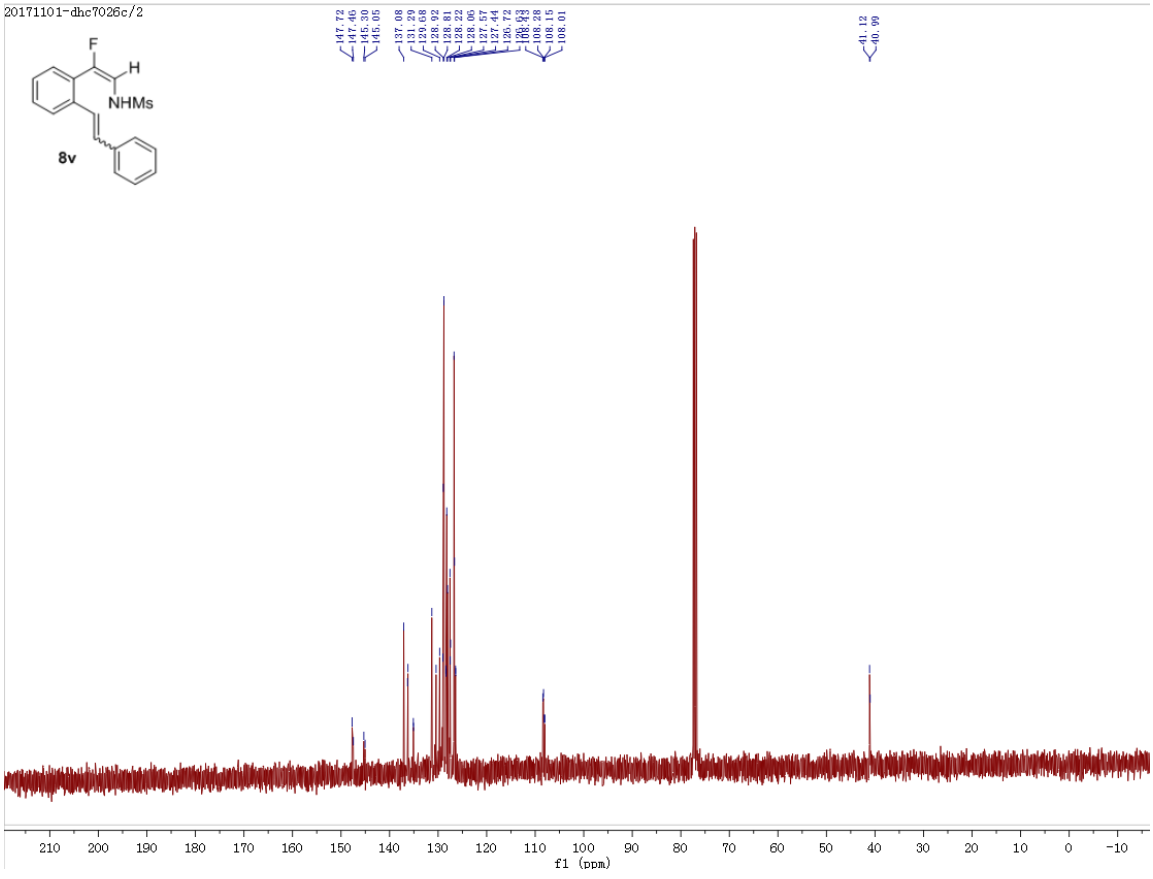
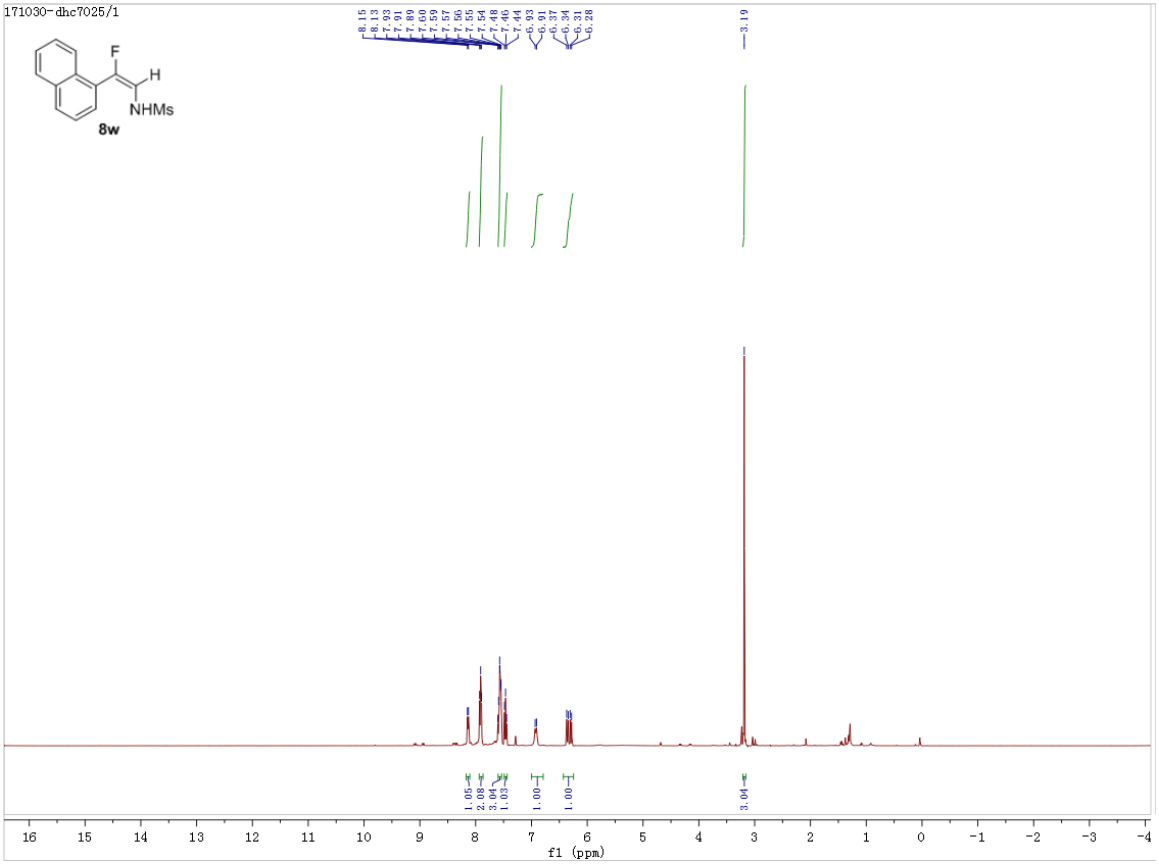
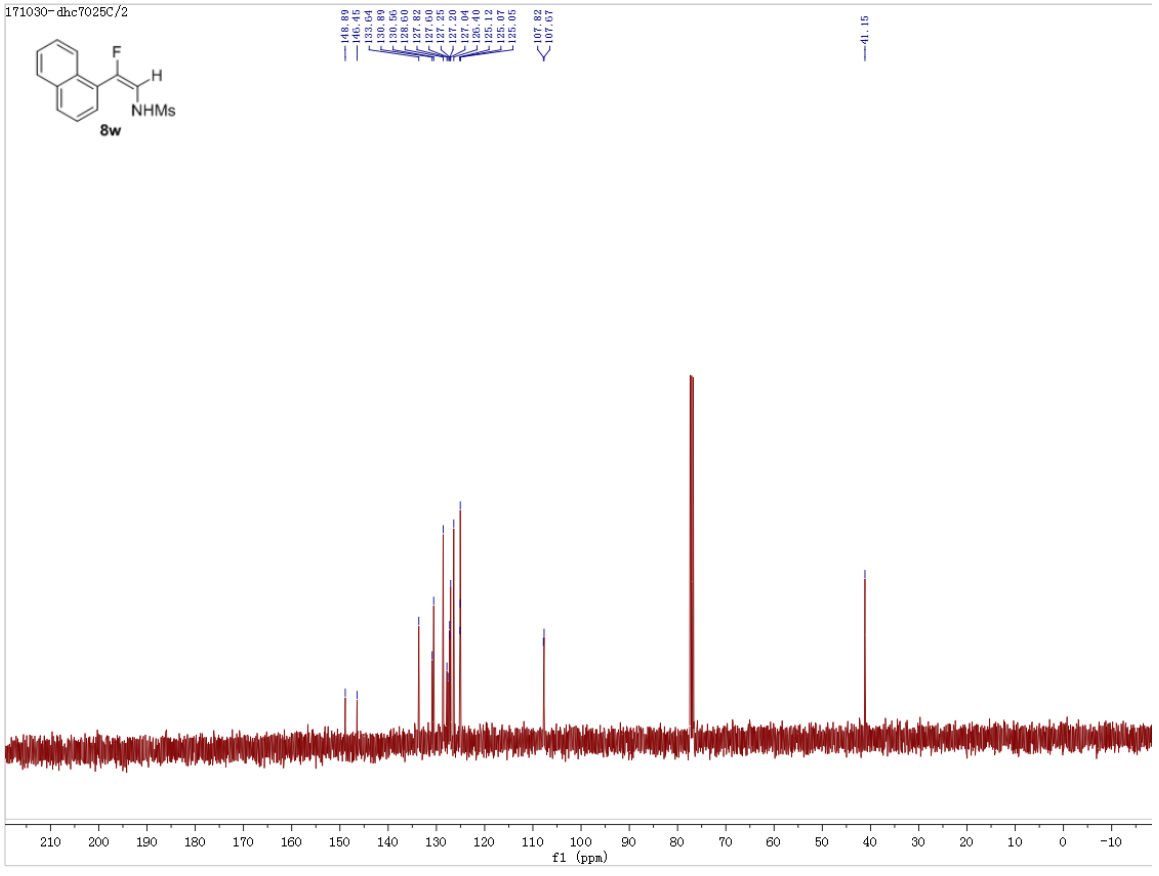
1.07
1.05
3.09
1.18
1.04
1.00
3.07
3.05
f1 (ppm)

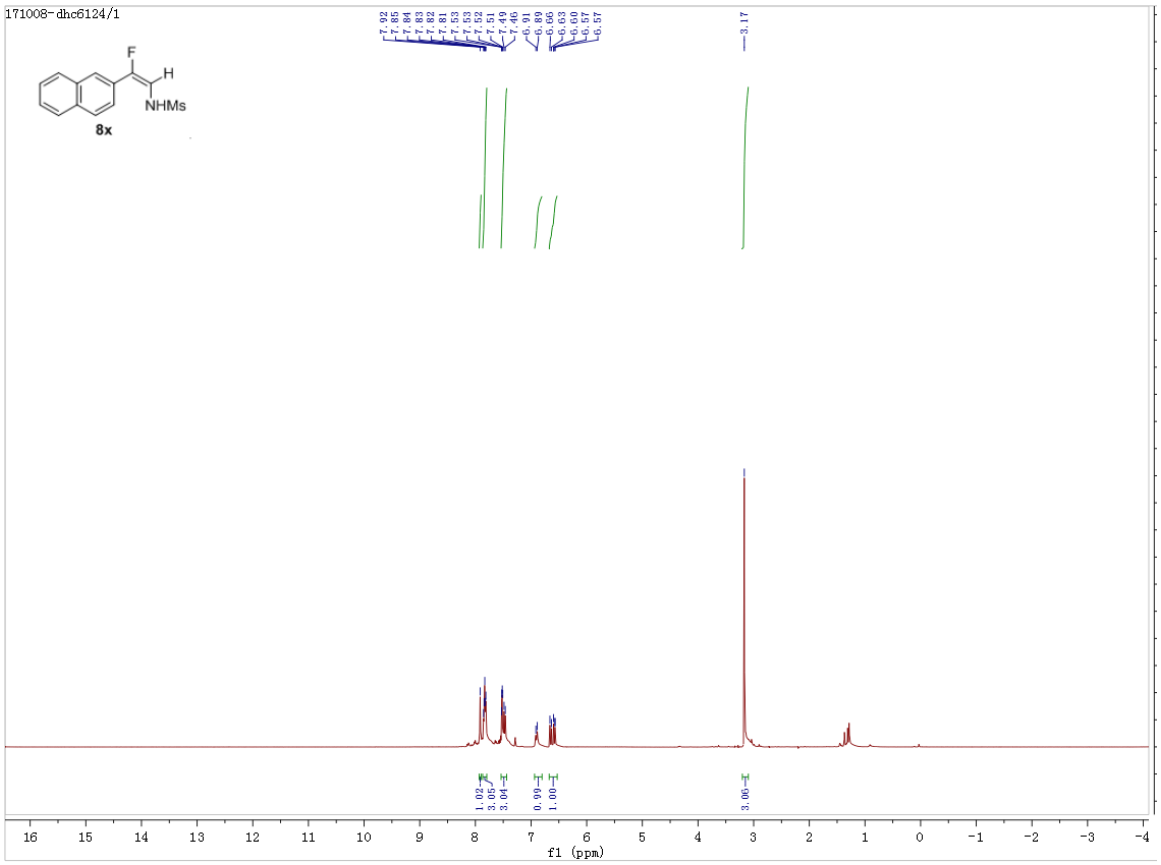

170912-dhc60912C/2
F
H
NHMs
COOMe
8u
167.20
145.94
143.52
142.61
132.71
130.65
129.92
129.56
128.30
128.26
125.49
125.04
109.57
109.43
51.90
41.09
f1 (ppm)

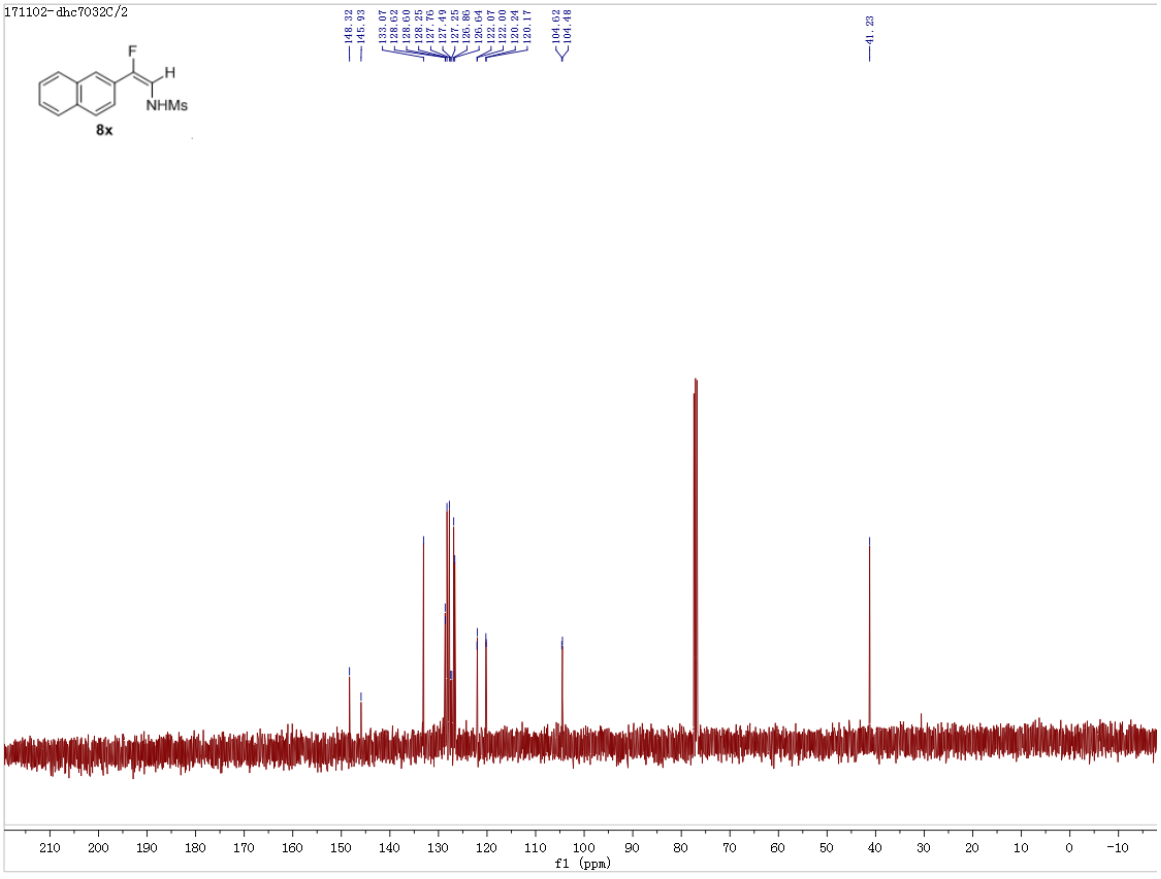

20171101-dhc7026/1
F
H
NHMs
8v
f1 (ppm)

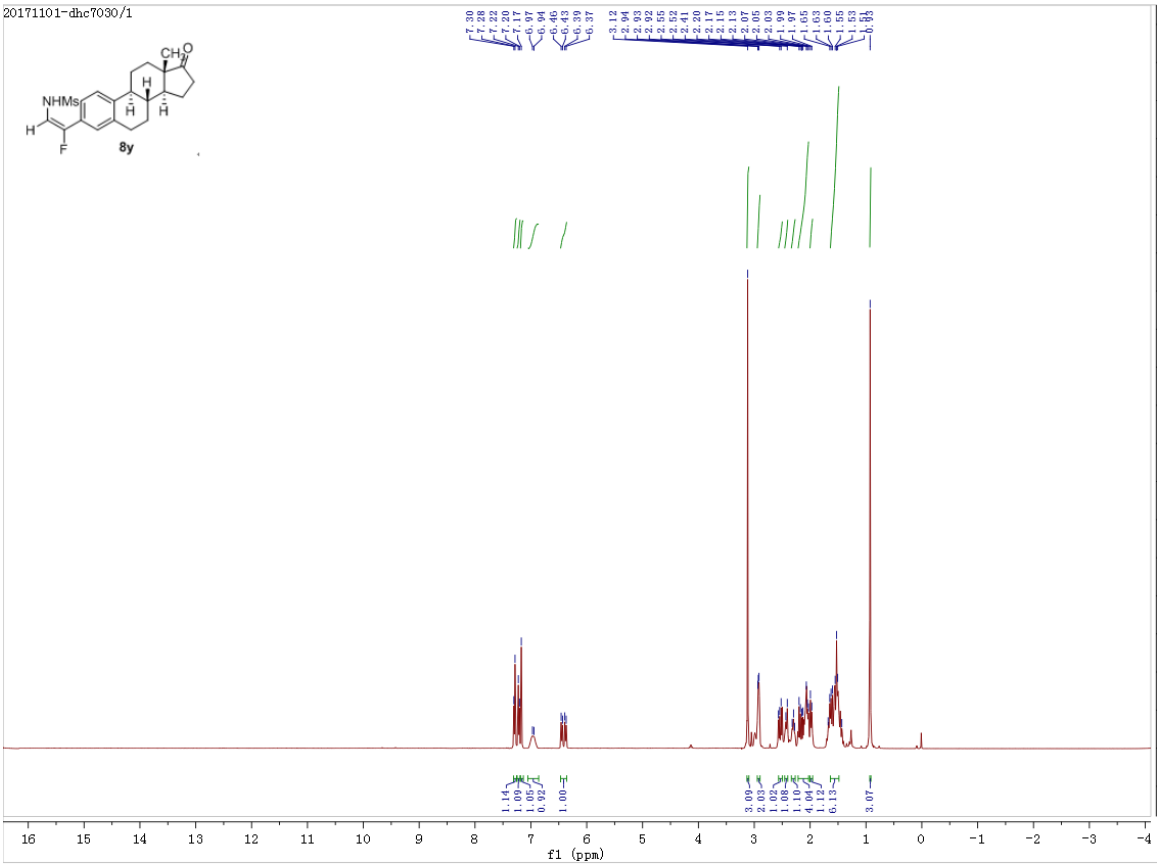

20171101-dhc7026c/2
F
H
NHMs
8v
f1 (ppm)

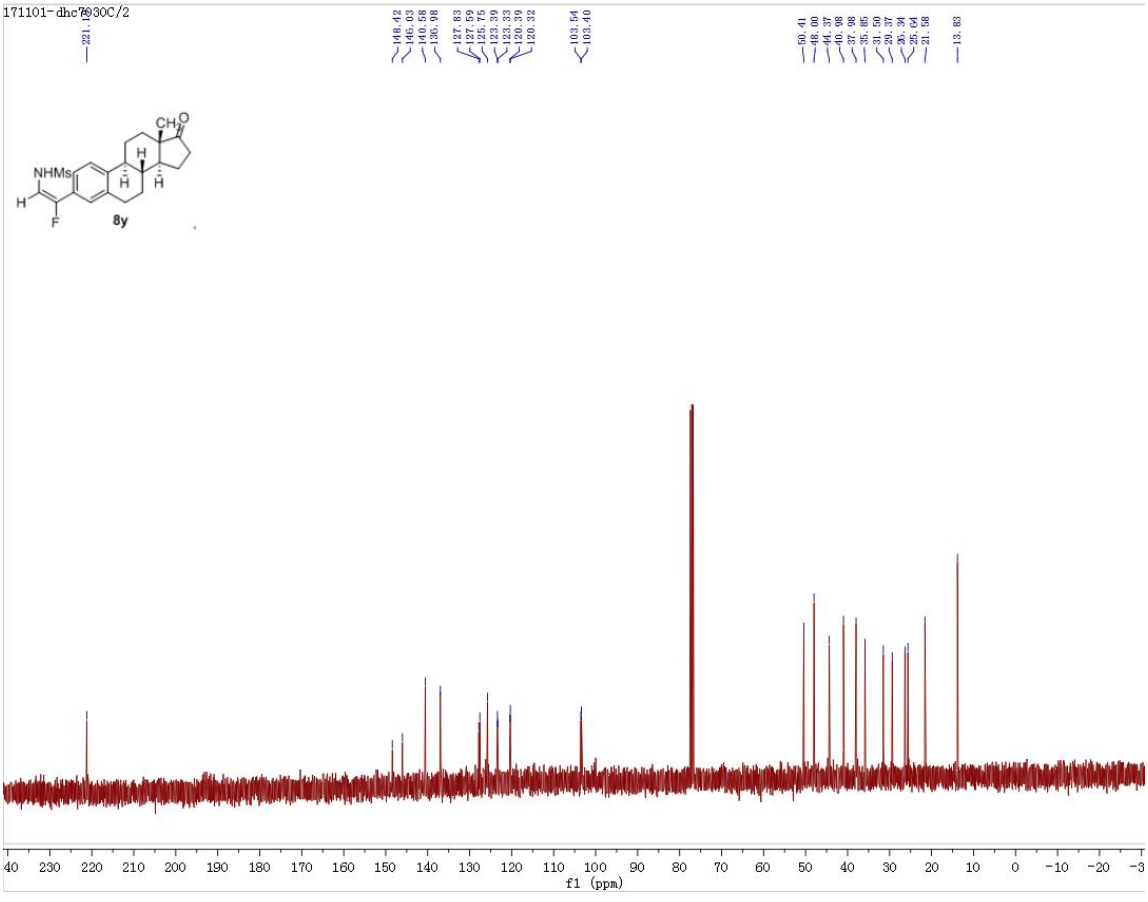

171030-dhc7025/1
F
H
NHMs
8w
8.15
8.13
7.93
7.91
7.89
7.60
7.59
7.57
7.56
7.55
7.54
7.48
7.46
7.44
6.93
6.91
6.37
6.34
6.31
6.28
3.19
1.05
2.08
3.04
1.03
1.00
1.00
3.04
f1 (ppm)

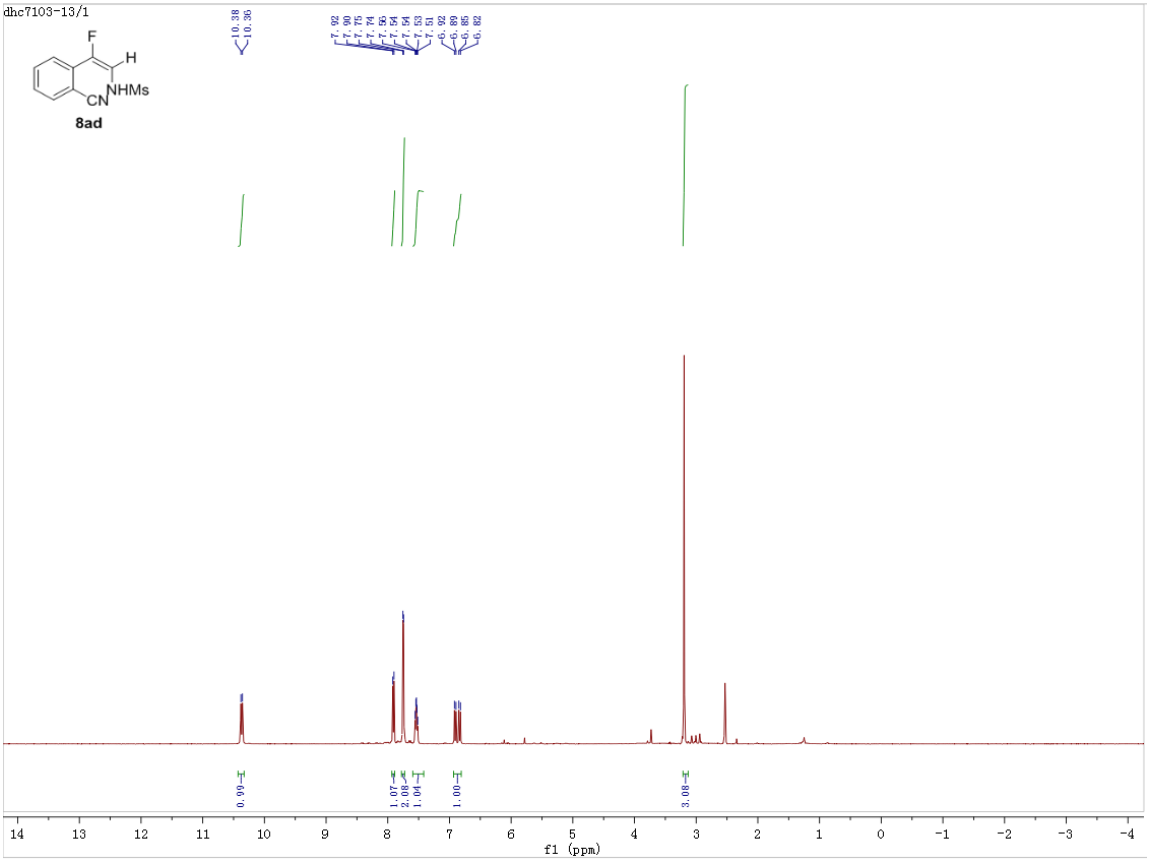

171030-dhc7025C/2
F
H
NHMs
8w
148.89
146.45
133.54
130.89
130.56
128.60
127.82
127.50
127.25
127.20
127.04
126.40
125.12
125.07
125.05
107.82
107.67
41.15
f1 (ppm)

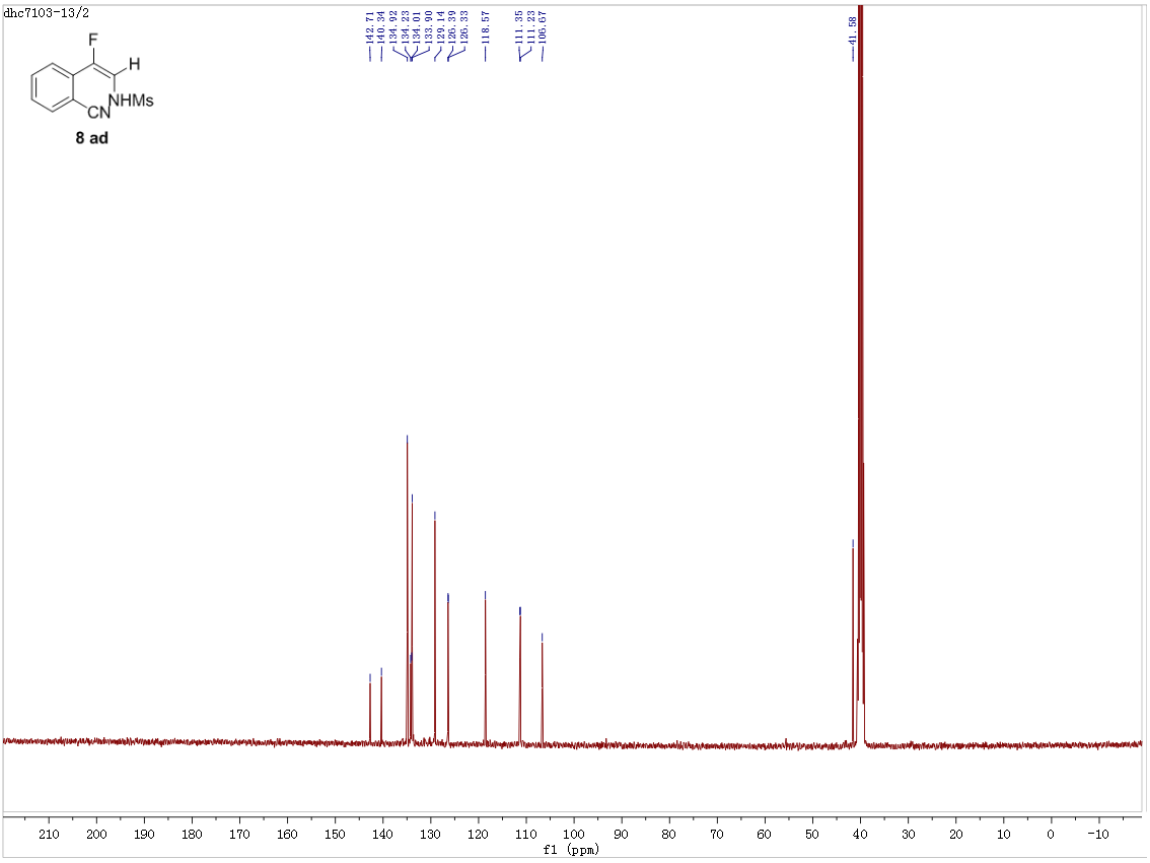

171008-dhc6124/1
F
H
NHMs
8x
7.92
7.85
7.84
7.83
7.82
7.81
7.53
7.53
7.52
7.51
7.49
7.46
6.91
6.89
6.66
6.63
5.60
5.57
5.57
3.17
1.02
3.05
3.04
0.99
1.00
3.06
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4
f1 (ppm)

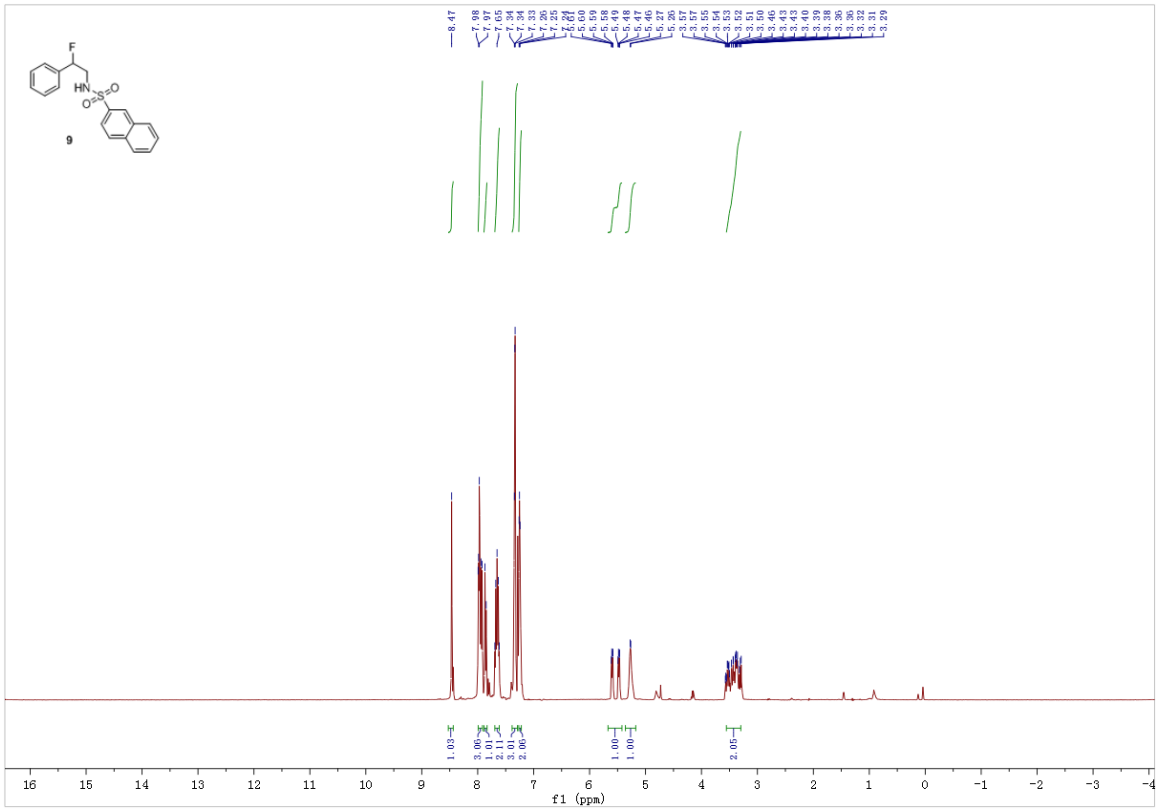

171102-dhc7032C/2
F
H
NHMs
8x
148.32
145.93
133.07
128.62
128.60
128.25
127.76
127.49
127.25
126.86
126.64
122.07
122.00
120.24
120.17
104.62
104.48
41.23
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

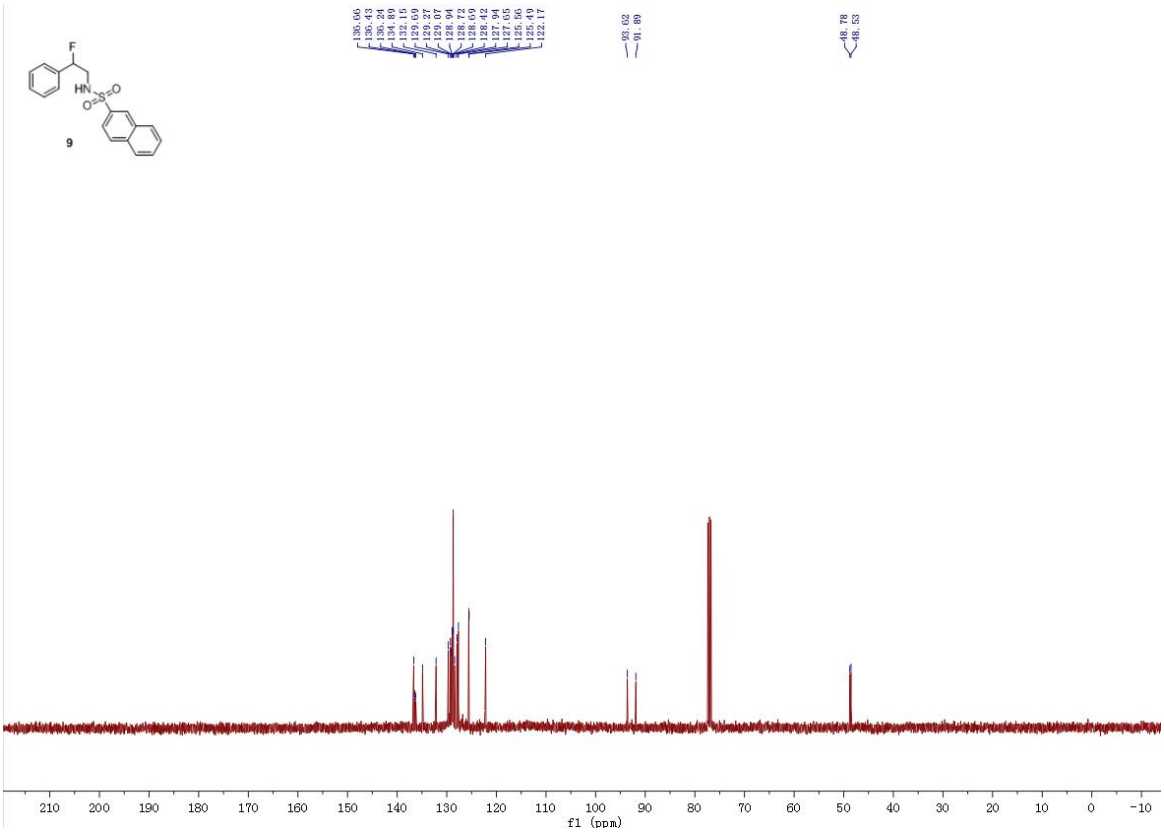

20171101-dhc7030/1
NHMs
H
F
8y
f1 (ppm)

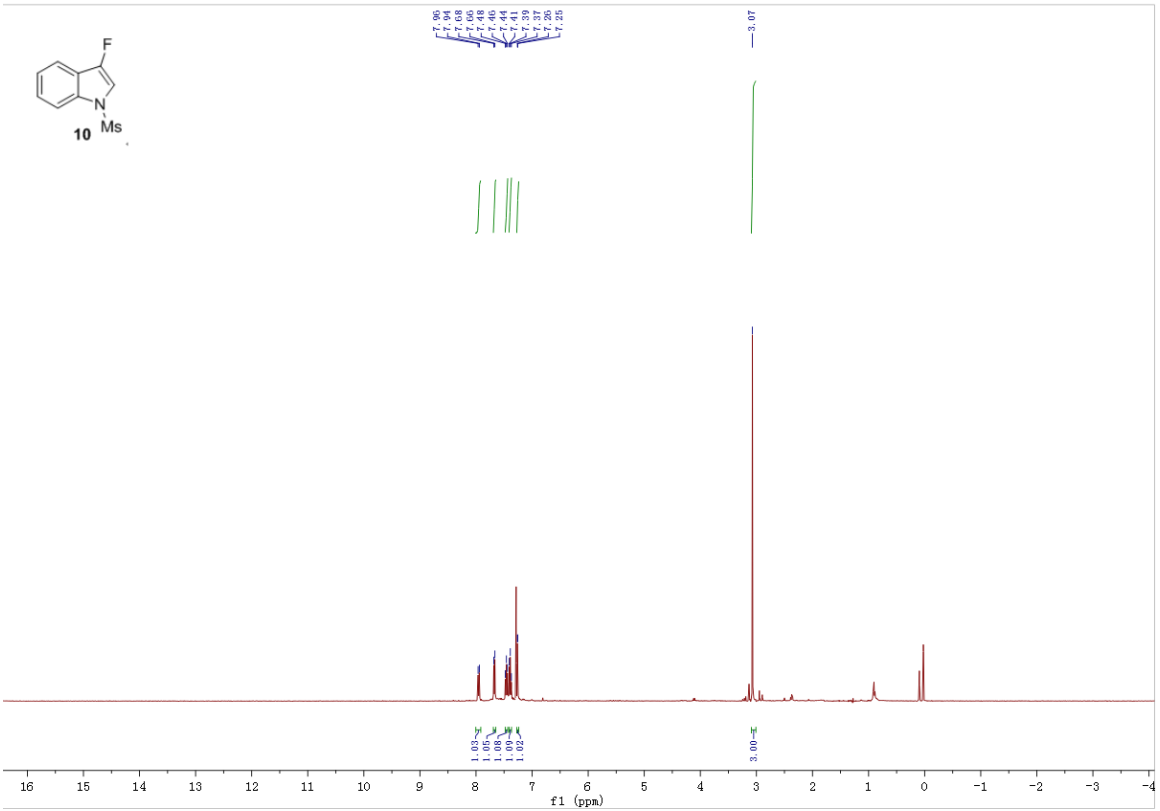

171101-dhc7030C/2
NHMs
H
F
8y
f1 (ppm)

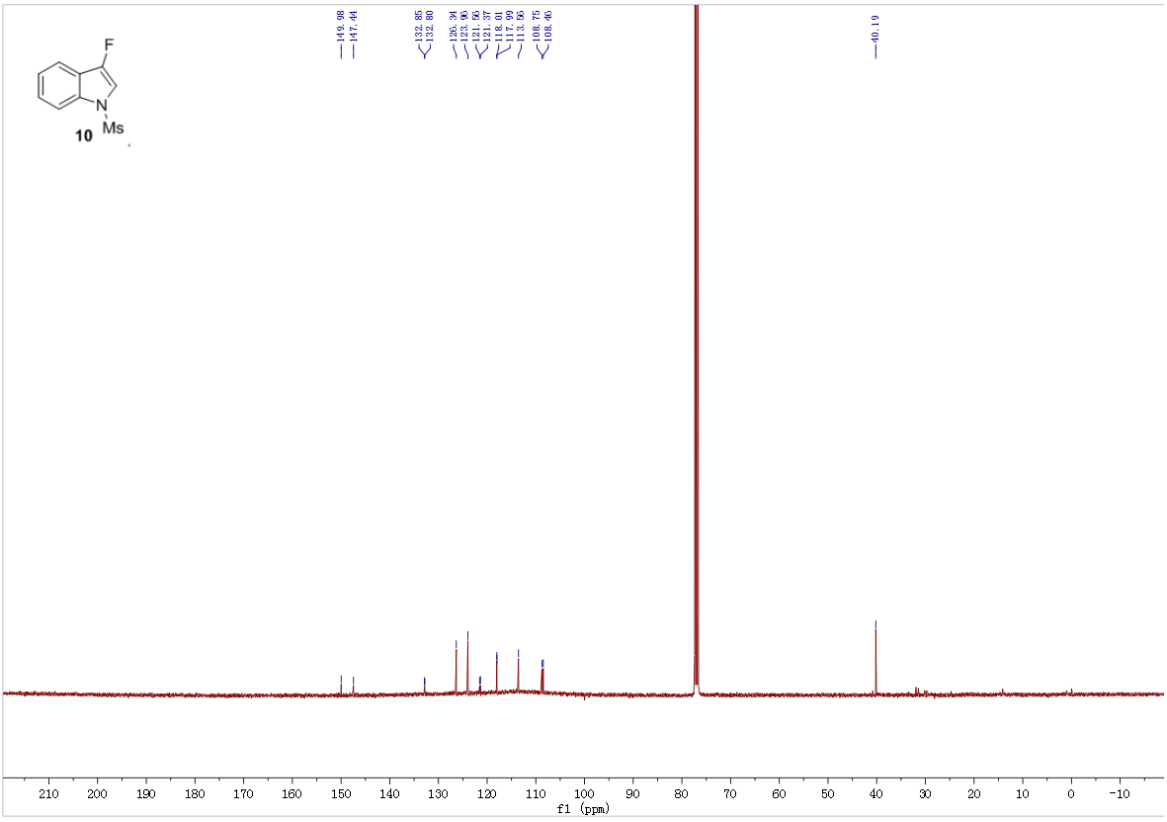

dhc7103-13/1
F
H
NHMs
CN
8ad
10.38
10.36
7.92
7.90
7.75
7.74
7.55
7.54
7.54
7.53
7.51
6.92
6.89
6.85
6.82
0.99
1.07
2.08
1.04
1.00
3.08
f1 (ppm)

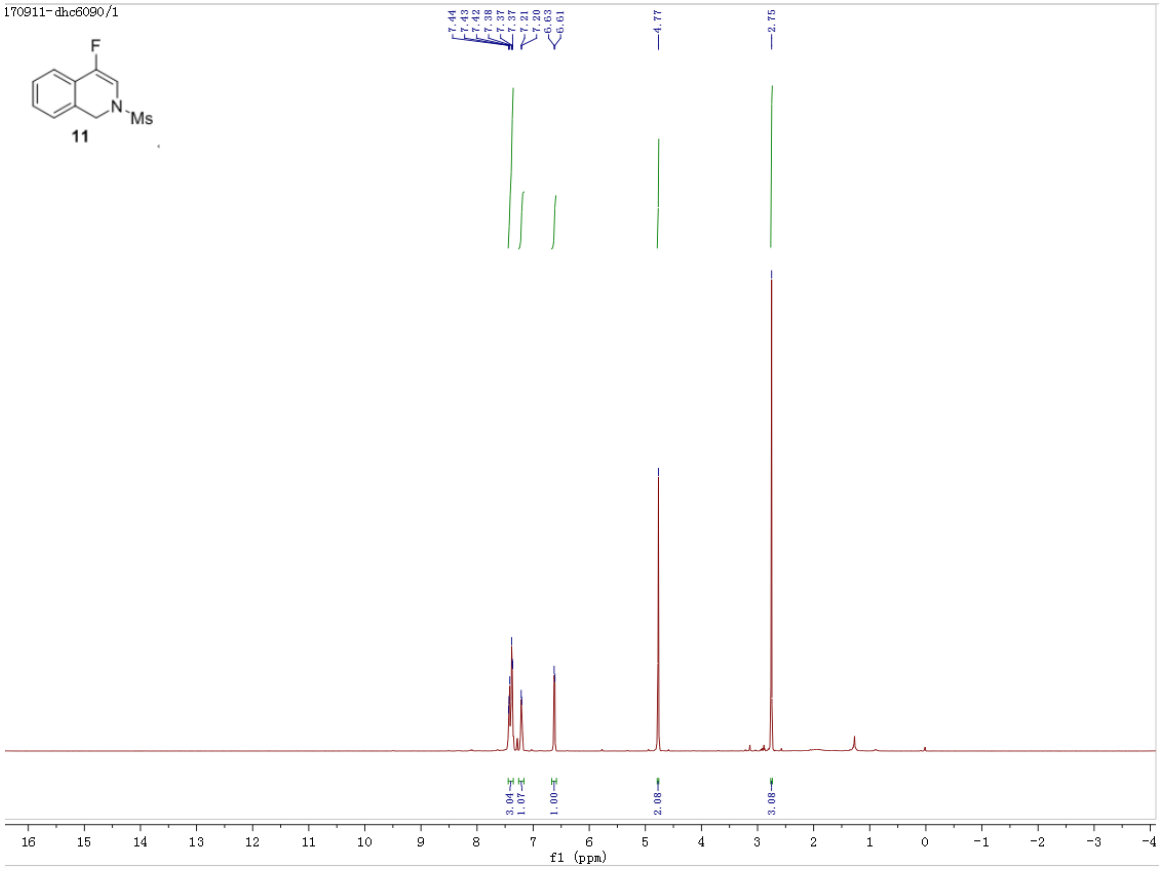

dhc7103-13/2
F
H
NHMs
CN
8 ad
142.71
140.34
134.92
134.23
134.01
133.90
129.14
128.39
126.33
118.57
111.35
111.23
106.67
41.58
f1 (ppm)

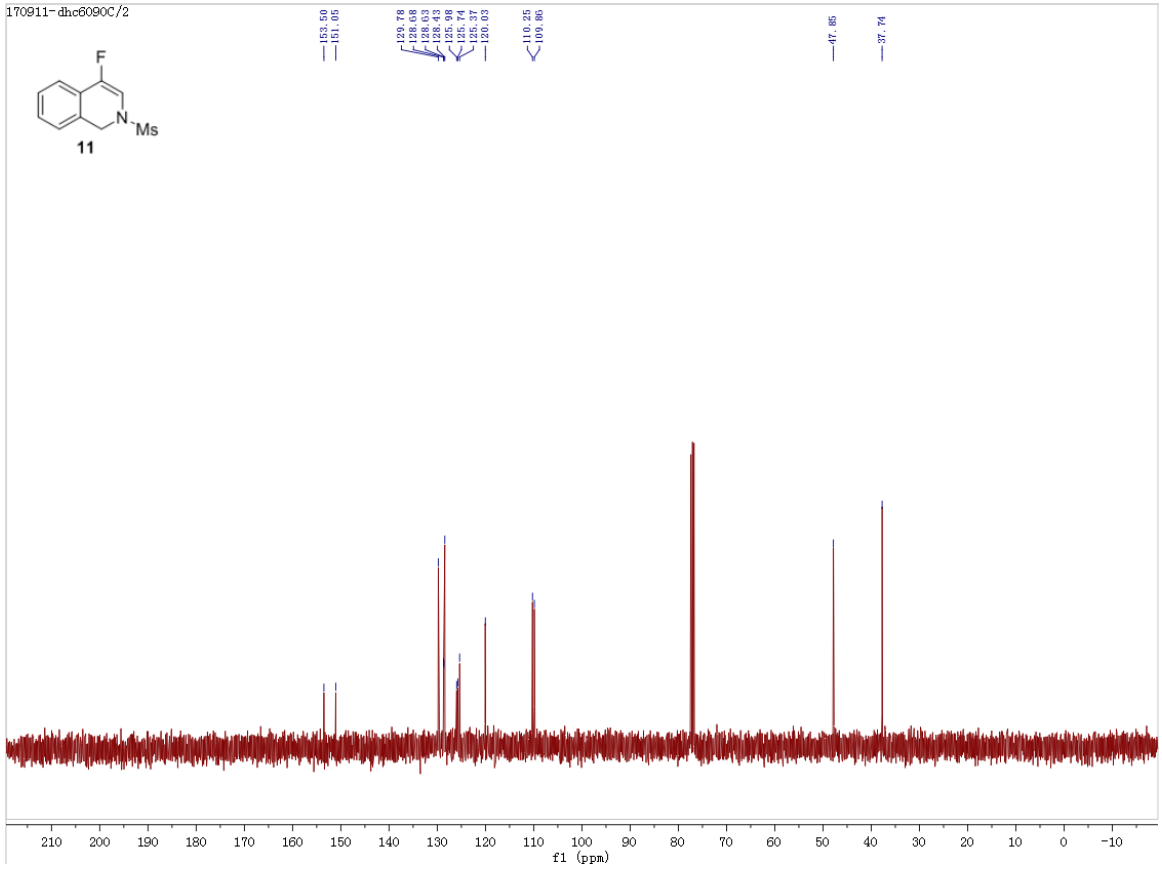

F
HN
O
S
O
9
8.47
7.98
7.97
7.65
7.34
7.33
7.25
7.24
5.60
5.59
5.58
5.49
5.48
5.47
5.46
5.27
5.26
3.57
3.56
3.55
3.54
3.53
3.52
3.51
3.50
3.46
3.43
3.42
3.40
3.39
3.38
3.36
3.35
3.32
3.31
3.29
1.03
3.06
1.01
2.01
2.00
1.00
1.00
2.05
f1 (ppm)

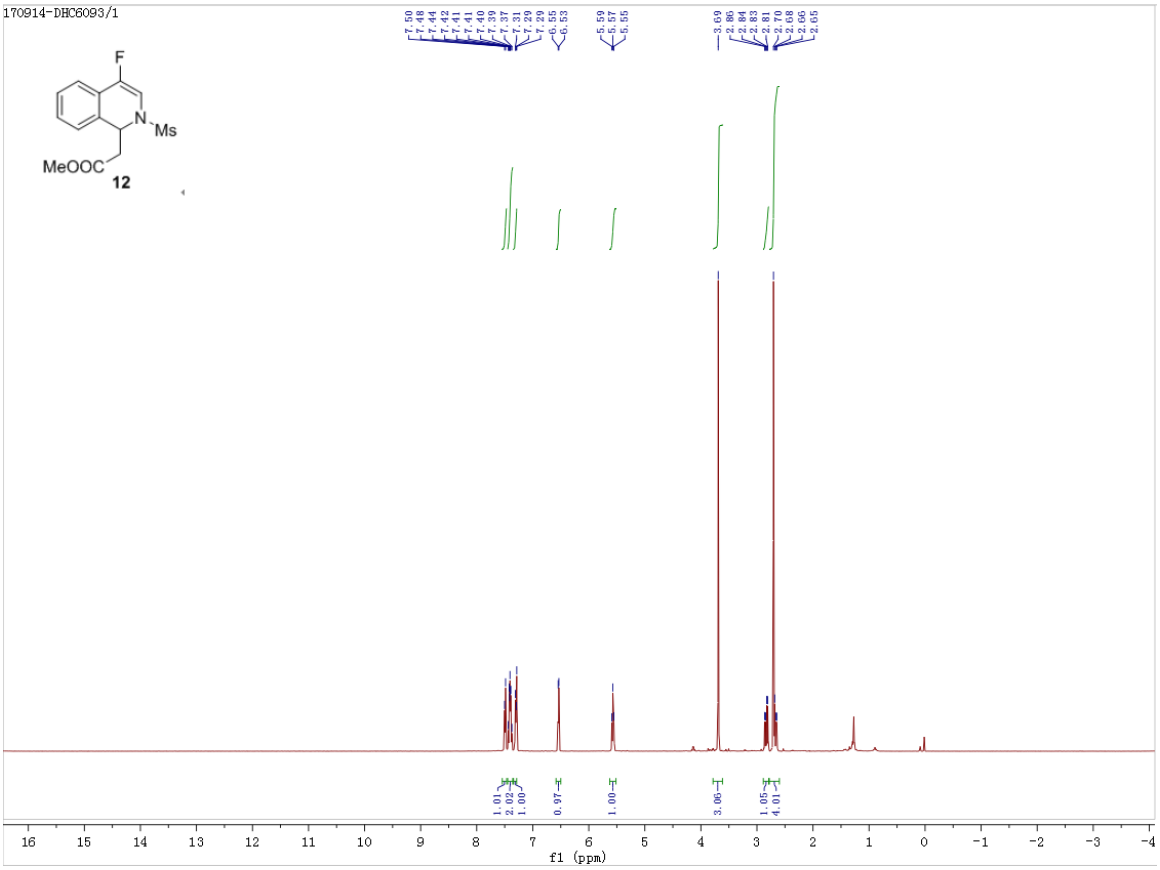

F
HN
O
S
O
9
136.66
136.43
136.24
134.69
133.15
129.59
129.27
129.07
128.94
128.72
128.66
128.42
127.94
127.65
125.56
125.49
122.17
93.62
91.89
48.78
48.53
f1 (ppm)

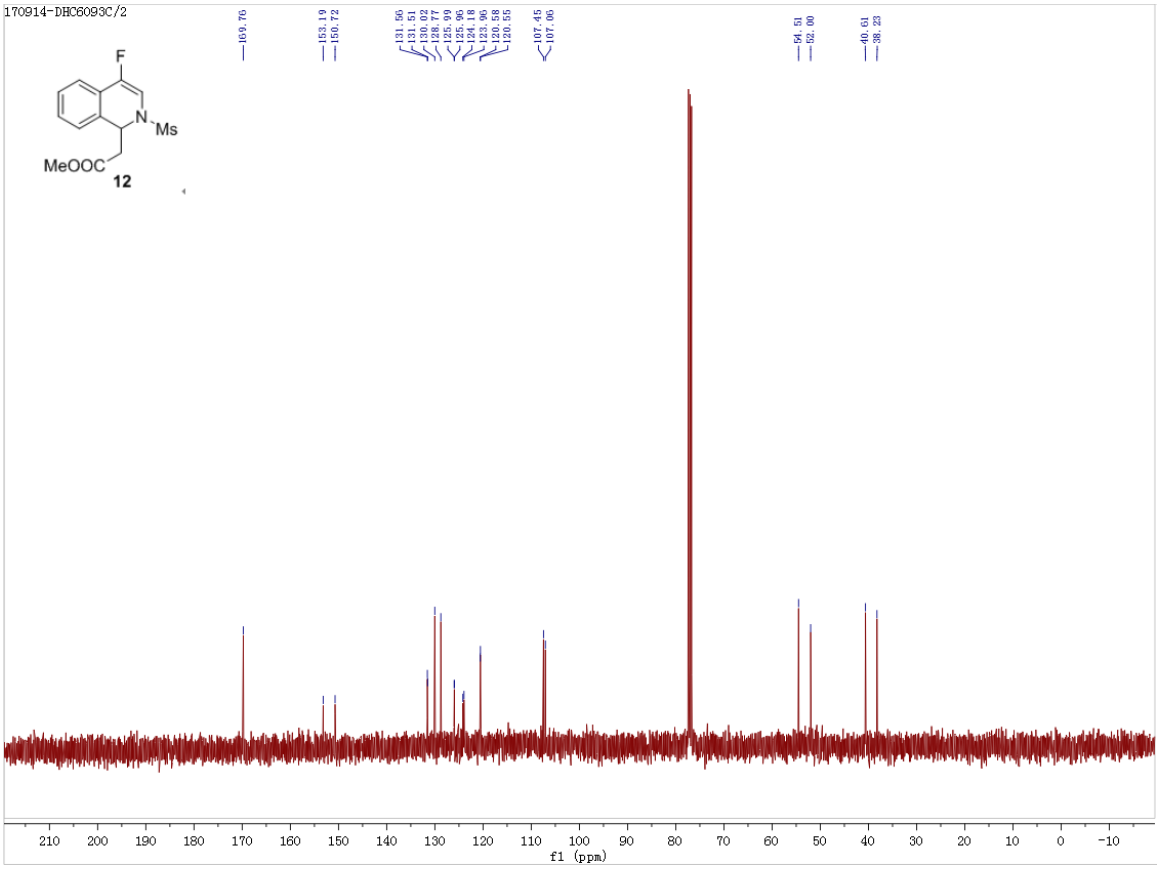

F
N
Ms
10
7.96
7.94
7.68
7.66
7.48
7.46
7.44
7.41
7.39
7.37
7.25
3.07
1.03
1.05
1.00
1.09
1.02
3.00
f1 (ppm)


F
N
Ms
10
149.98
147.44
133.85
133.80
120.34
123.96
121.95
121.57
118.01
117.99
113.95
108.75
108.46
40.19
f1 (ppm)


170911-dhc6090/1
F
N
Ms
11
7.44
7.43
7.42
7.38
7.37
7.37
7.21
7.20
6.63
6.61
4.77
2.75
3.04
1.07
1.00
2.08
3.08
f1 (ppm)


170911-dhc6090C/2
F
N
Ms
11
153.59
151.05
129.78
128.68
128.63
128.43
125.98
125.74
125.37
120.03
110.25
109.86
47.85
37.74
f1 (ppm)


170914-DHC6093/1
F
N
Ms
MeOOC
12
7.50
7.48
7.44
7.42
7.41
7.41
7.40
7.39
7.37
7.31
7.30
7.29
6.55
6.53
5.59
5.57
5.56
3.69
2.86
2.84
2.83
2.81
2.70
2.68
2.66
2.65
1.01
2.02
1.00
0.97
1.00
3.06
1.05
4.01
f1 (ppm)


170914-DHC6093C/2
F
N
Ms
MeOOC
12
169.76
153.19
150.72
131.56
131.51
130.02
128.77
125.99
125.96
124.18
123.96
120.58
120.55
107.45
107.06
54.51
52.00
40.61
38.23
f1 (ppm)