Supporting Information

For

Remote Azidation of C(sp^3)-H Bonds to Synthesize δ-Azido Sulfonamides *via* Iron-catalyzed Radical Relay

Kang-Jie Bian, ‡ Cheng-Yu Wang, ‡ Yu-Ling Huang, Yi-Hao Xu and Xi-Sheng Wang *

Hefei National Laboratory for Physical Sciences at the Microscale and Department of Chemistry,

Center for Excellence in Molecular Synthesis of CAS,

University of Science and Technology of China,

96 Jinzhai Road, Hefei, Anhui 230026, China

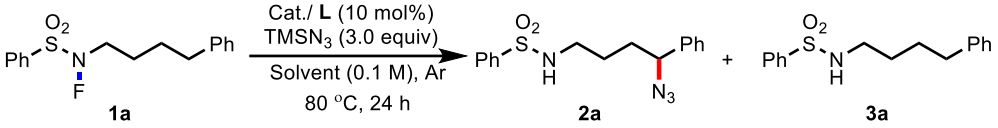
Tabel of Contents

I. General Information:

NMR spectra were recorded on Bruker-400 and Bruker-500 (400 MHz for ^{1}H (Bruker-400); 500 MHz for ^{1}H (Bruker-500), 126 MHz for ^{13}C (Bruker-500), and 376 MHz for ^{19}F (Bruker-400)) instruments internally referenced to $SiMe_4$ signal. High resolution mass spectra were recorded on P-SIMS-Gly of Bruker Daltonics Inc. using ESI-TOF (electrospray ionization-time of flight) or Micromass GCT using EI (electron impact). Catalyst, $TMSN_3$, and solvent were purchased from J&K etc. and used as received.

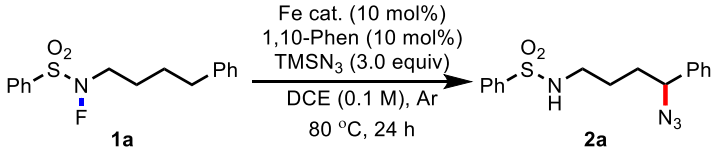
II. Optimization of conditions

Catalyst screening



Entry	Cat.	2a[b]	3a[b]
1	$Cu(MeCN)_4PF_6$	75%	21%
2	CuCN	78%	15%
3	CuSCN	84%	20%
4	CuI	N.D.	~50%
5	$Cu(OAc)_2$	77%	14%
6	$Cu(OTf)_2$	trace	trace

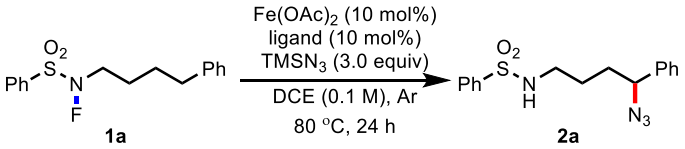
[a] Reaction conditions: **1a** (0.1 mmol. 1.0 equiv), Cu cat. (10 mol%), 1,10-Phen (12 mol%), $TMSN_3$ (3.0 equiv), DCE (0.1 M), Ar, 80 °C, 24 h.
[b] Yields detected by crude ^1H NMR with CH_2Br_2 as internal standard.

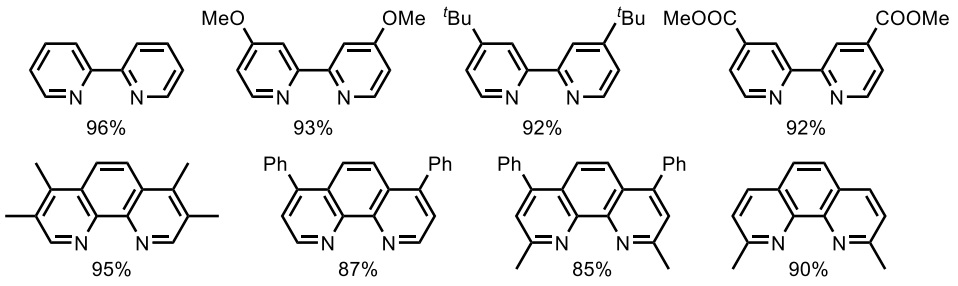


Entry	Fe cat.	2a[b]
1	FeF_2	57%
2	$FeCl_2$	38%
3	$Fe(OTf)_2$	85%
4	$Fe(acac)_3$	91%

[a] Reaction conditions: **1a** (0.1 mmol. 1.0 equiv), Fe cat. (10 mol%), 1,10-Phen (10 mol%), $TMSN_3$ (3.0 equiv), DCE (0.1 M), Ar, 80 °C, 24 h.
[b] Yields detected by crude ^1H NMR with CH_2Br_2 as internal standard.

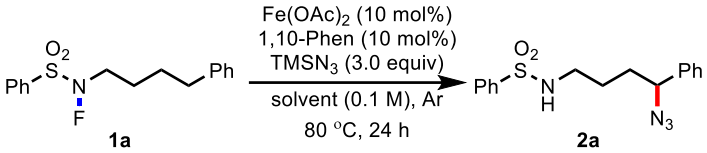
Ligand screening





[a] Reaction conditions: **1a** (0.1 mmol. 1.0 equiv), $Fe(OAc)_2$ (10 mol%), ligand (10 mol%), $TMSN_3$ (3.0 equiv), DCE (0.1 M), Ar, 80 °C, 24 h.
[b] Yields detected by crude ^1H NMR with CH_2Br_2 as internal standard.

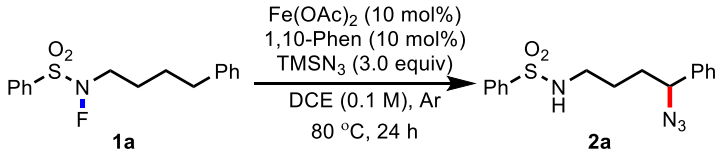
Solvent screening



Entry	solvent	2a[b]
1	MeCN	89%
2	DCE	99% (94%)[c]
3	1,4-dioxane	81%
4	PhCl	87%
5	$PhCF_3$	85%

[a] Reaction conditions: **1a** (0.1 mmol. 1.0 equiv), $Fe(OAc)_2$ (10 mol%), 1,10-Phen (10 mol%), $TMSN_3$ (3.0 equiv), solvent (0.1 M), Ar, 80 °C, 24 h.
[b] Yields detected by crude ^1H NMR with CH_2Br_2 as internal standard.
[c] Isolated yields.

Other Variables



Entry	deviation from standard condition	2a[b]
1	$TMSN_3$ (2.0 equiv)	81%
2	60 ℃	93%
3	w/o Fe/L	0%
4	w/o L	56%
5	under air	29%

[a] Reaction conditions: **1a** (0.1 mmol. 1.0 equiv), $Fe(OAc)_2$ (10 mol%), 1,10-Phen (10 mol%), $TMSN_3$ (3.0 equiv), DCE (0.1 M), Ar, 80 °C, 24 h.
[b] Yields detected by crude ^1H NMR with CH_2Br_2 as internal standard.

III. Experimental procedures and data

Synthesis of Products

General Procedure A – Iron-catalyzed Remote Azidation

$Fe(OAc)_2$ (1.7 mg, 0.01 mmol), 1,10-phenanthroline (1.8mg, 0.01mmol) were combined in a 25 mL oven-dried sealed tube. The vessel was evacuated and backfilled with N_2 (repeated for 3 times), after that, substrate **1** (0.1 mmol), $TMSN_3$ (0.3 mmol, 3.0 equiv) and DCE (1.0 mL) were then added via syringe under N_2. The tube was sealed with a Teflon lined cap and moved into a preheated oil bath at 80 °C for 24 h. The reaction mixture was then cooled to room temperature, diluted with EtOAc (10 mL) and filtered through a pad of celite. The filtrate was concentrated, and the residue was then purified by flash column chromatography to give **2a**-**2x**.

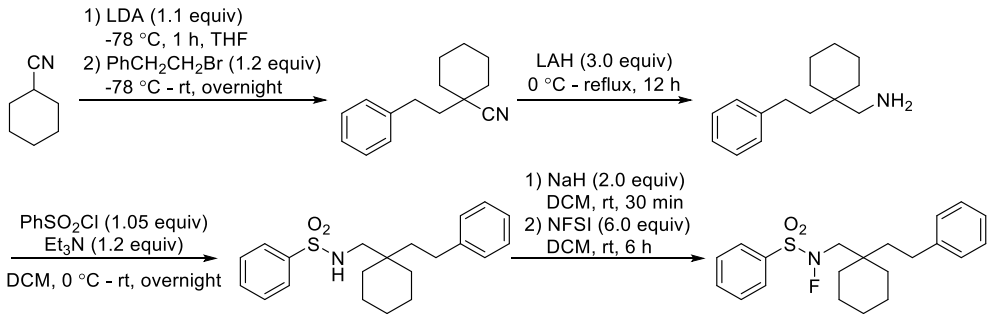
General Procedure B – Derivatization-Click Reaction[2]

CuI (2 equiv) was added in a 25 mL oven-dried sealed tube. The vessel was evacuated and backfilled with N_2 (repeated for 3 times), after that, product **2a** (0.1 mmol) dissolved in CH_3CN (0.05 M), DIPEA (3 equiv), phenylacetylene (1.1 equiv) were then added via syringe under N_2. The tube was sealed with a Teflon lined cap and moved into a preheated oil bath at RT for 2h. The reaction mixture was then cooled to room temperature, diluted with EtOAc (10 mL) and filtered through a pad of celite. The filtrate was concentrated, and the residue was then purified by flash column chromatography to give **4**.

Synthesis of Starting Materials

All known starting materials were synthesized through the method reported in Ref. S1

General Procedure C (for the synthesis of 1g, 1h)



Step 1 : To solution of cyclohexanecarbonitrile (1.0 equiv) in THF (0.25 M) was added LDA (1.1 equiv) dropwise under -78 °C and the mixture was allowed to stir for 1 h at room temperature. The solution was cooled to -78 °C again and added with (2-bromoethyl)benzene (1.2 equiv). Then, the mixture was warmed to room temperature and stirred overnight. Until completion, the reaction was quenched with saturated NH_4Cl (aq). The reaction mixture was then cooled to room

temperature, extracted with DCM three times. The combined organic layer was washed with brine, dried over anhydrous Na_2SO_4 and concentrated. The residue was then purified by column chromatography to afford the product.

Step 2 : To a mixture of LAH (3.0 equiv) dispersed in THF (0.25 M) was added the solution the product (1.0 equiv) obtained from step 1 under 0 ^oC and the mixture then transferred to oil bath and refluxed overnight. Until completion, the mixture was quenched with water and 10% NaOH (aq) in sequence and the slurry was added with anhydrous Na_2SO_4 and filtered over a pad of celite. The filtrate was collected and concentrated under vaccum to afford the crude product which can be used directly without further purification.

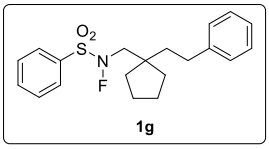
Step 3 : To a solution of amine (1.0 equiv) obtained in step 2 and Et_3N (1.2 equiv) in DCM (0.2 M) was slowly added with benzenesulfonyl chloride (1.05 equiv) under 0 ^oC. The mixture was allowed to warm to room temperature and stirred overnight. . Until completion, the reaction was diluted with DCM and the organic layer was washed with aqueous HCl (1N) and brine in sequence; the organic layer was dried over anhydrous Na_2SO_4 and concentrated. The residue was then purified by column chromatography to afford the product.

Step 4 : To a stirred suspension of NaH (6 mmol, 60 wt% in mineral oil) in anhydrous CH_2Cl_2 (24 mL) in a 100 mL round-bottomed flask was slowly added a solution of sulfonamide obtained in step 3 (3 mmol) in anhydrous CH_2Cl_2 (6 mL) at room temperature under an N_2 atmosphere. After the mixture was stirred for 30 min, N-fluorobenzenesulfonimide (NFSI, 5.67 g, 18 mmol) was added in one portion and allowed to stir for another 6 h. Until completion, the reaction was quenched by the addition of water. The mixture was extracted with DCM (3×30 mL) and the organic layers were combined, washed with brine, and dried over anhydrous Na_2SO_4. The crude mixture was filtered through celite and concentrated. The resulting residue was purified by column chromatography on silica gel with a gradient eluent of petroleum ether and ethyl acetate.

Analytical data for compounds

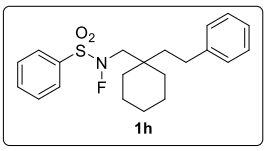
1. Substrates:

Most substrates data were reported in previous work[1]. New substrates are shown as follow:



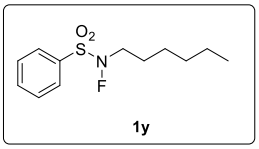
1g

N-fluoro-N-((1-phenethylcyclopentyl)methyl)benzenesulfonamide was prepared following general procedure C and was purified by column chromatography with petroleum ether and ethyl acetate (PE/EA = 19:1) to afford the product **1g** (68% yield) as light yellow oil. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.97 (d, *J* = 7.6 Hz, 2H), 7.75 (t, *J* = 7.5 Hz, 1H), 7.63 (t, *J* = 7.8 Hz, 2H), 7.27 (d, *J* = 7.8 Hz, 2H), 7.17 (d, *J* = 6.8 Hz, 3H), 3.30 (s, 1H), 3.19 (s, 1H), 2.64 – 2.45 (m, 2H), 1.82 – 1.74 (m, 2H), 1.71 – 1.51 (m, 8H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 142.83, 134.96, 132.79, 129.94, 129.45, 128.49, 128.49, 125.83, 59.44 (d, *J* = 10.6 Hz), 46.12, 39.99, 36.32, 31.09, 24.46. ^{19}F NMR (376 MHz, Chloroform-*d*) δ -40.78 (t, *J* = 44.0 Hz). HRMS (ESI) (*m/z*): $[M+Na]^+$ calcd. for $C_{20}H_{24}NO_2SFNa$: 384.1404, found: 384.1414.



1h

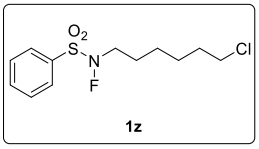
N-fluoro-N-((1-phenethylcyclohexyl)methyl)benzenesulfonamide was prepared following general procedure C and was purified by column chromatography with petroleum ether and ethyl acetate (PE/EA = 19:1) to afford the product **1h** (64% yield) as light yellow oil.. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.98 (d, *J* = 7.7 Hz, 2H), 7.75 (t, *J* = 7.5 Hz, 1H), 7.63 (t, *J* = 7.8 Hz, 2H), 7.26 (d, *J* = 7.0 Hz, 2H), 7.18 (d, *J* = 7.5 Hz, 3H), 3.30 (s, 1H), 3.19 (s, 1H), 2.61 – 2.37 (m, 2H), 1.86 – 1.66 (m, 2H), 1.50 – 1.36 (m, 10H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 143.03, 134.95, 132.88, 129.92, 129.45, 128.55, 128.49, 125.81, 59.49 (d, *J* = 9.9 Hz), 38.22, 36.77, 34.13, 29.39, 26.08, 21.43. ^{19}F NMR (376 MHz, Chloroform-*d*) δ -36.19 (t, *J* = 42.6 Hz). HRMS (ESI) (*m/z*): $[M+Na]^+$ calcd. for $C_{21}H_{26}NO_2SFNa$: 398.1560, found: 398.1569.



1y

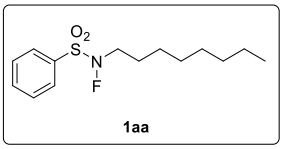
N-fluoro-N-hexylbenzenesulfonamide was prepared following general procedure C and was purified by column chromatography with petroleum ether and ethyl acetate (PE/EA = 19:1) to afford the product **1y** (68% yield) as light yellow oil. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.95 (d, *J* = 7.6 Hz, 2H), 7.75 (t, *J* = 7.5 Hz, 1H), 7.62 (t, *J* = 7.6 Hz, 2H), 3.27 (t, *J* = 7.0 Hz, 1H), 3.17 (t, *J* = 6.9 Hz, 1H), 1.71 (p, *J* = 7.2 Hz, 2H), 1.48 – 1.28 (m, 6H), 0.88 (t, *J* = 6.0 Hz, 3H). ^{13}C NMR (101 MHz,

$CDCl_3$) δ 134.99, 132.21, 130.08, 129.41, 53.82 (d, *J* = 12.7 Hz), 31.40, 26.37, 22.58, 14.10. ^{19}F NMR (376 MHz, Chloroform-*d*) δ -50.06 (t, *J* = 40.7 Hz). HRMS (ESI) (*m/z*): $[M+Na]^+$ calcd. for $C_{12}H_{18}NO_2SFNa$: 282.0934, found: 282.0941.



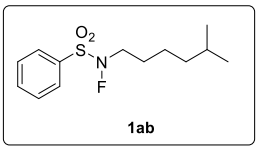
1z

N-(6-chlorohexyl)-N-fluorobenzenesulfonamide was prepared following general procedure C and was purified by column chromatography with petroleum ether and ethyl acetate (PE/EA = 19:1) to afford the product **1z** (69% yield) as light yellow oil. ^1H NMR (400 MHz, Chloroform-*d*) δ 7.95 (d, *J* = 7.6 Hz, 2H), 7.75 (t, *J* = 7.5 Hz, 1H), 7.63 (t, *J* = 7.8 Hz, 2H), 3.53 (t, *J* = 6.6 Hz, 2H), 3.29 (t, *J* = 6.9 Hz, 1H), 3.19 (t, *J* = 6.9 Hz, 1H), 1.82 – 1.70 (m, 4H), 1.54 – 1.40 (m, 4H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 135.05, 132.17, 130.08, 129.44, 53.59 (d, *J* = 12.6 Hz), 44.99, 32.44, 26.48, 26.26, 25.98. ^{19}F NMR (376 MHz, Chloroform-*d*) δ -49.90 (t, *J* = 40.4 Hz). HRMS (ESI) (*m/z*): $[M+Na]^+$ calcd. for $C_{12}H_{17}NO_2SFClNa$: 316.0545, found: 316.0549.



1aa

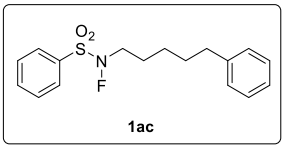
N-fluoro-N-octylbenzenesulfonamide was prepared following general procedure C and was purified by column chromatography with petroleum ether and ethyl acetate (PE/EA = 19:1) to afford the product **1aa** (69% yield) as light yellow oil. ^1H NMR (400 MHz, Chloroform-*d*) δ 7.95 (d, *J* = 7.4 Hz, 2H), 7.75 (t, *J* = 7.5 Hz, 1H), 7.62 (t, *J* = 7.8 Hz, 2H), 3.27 (t, *J* = 7.0 Hz, 1H), 3.17 (t, *J* = 7.0 Hz, 1H), 1.71 (p, *J* = 7.3 Hz, 2H), 1.44 – 1.35 (m, 2H), 1.33-1.23 (m, 8H), 0.87 (t, *J* = 6.8 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 134.98, 130.09, 129.41, 53.81 (d, *J* = 12.5 Hz), 31.85, 29.19, 26.70, 26.42, 22.74, 14.21. ^{19}F NMR (376 MHz, Chloroform-*d*) δ -49.99 (t, *J* = 40.6 Hz). HRMS (ESI) (*m/z*): $[M+Na]^+$ calcd. for $C_{14}H_{22}NO_2SFNa$: 310.1247, found: 310.1254.



1ab

N-fluoro-N-(5-methylhexyl)benzenesulfonamide was prepared following general procedure C and was purified by column chromatography with petroleum ether and ethyl acetate (PE/EA = 19:1) to afford the product **1ab** (66% yield) as light yellow oil. ^1H NMR (400 MHz, Chloroform-*d*) δ 7.96 (d, *J* = 7.7 Hz, 2H), 7.75 (t, *J* = 7.5 Hz, 1H), 7.63 (t, *J* = 7.8 Hz, 2H), 3.27 (t, *J* = 7.0 Hz, 1H), 3.17 (t, *J* = 7.0 Hz, 1H), 1.70 (p, *J* = 7.4 Hz, 2H), 1.56 – 1.50 (m, 1H), 1.40 (q, *J* = 7.9 Hz, 2H), 1.23 – 1.15 (m, 2H), 0.86 (d, *J* = 6.6 Hz, 6H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 134.99, 132.22, 130.09, 129.42, 53.87

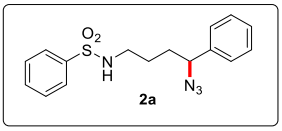
(d, *J* = 12.4 Hz), 38.51, 27.96, 26.66, 24.52, 22.65. ^{19}F NMR (376 MHz, Chloroform-*d*) δ -50.04 (t, *J* = 40.6 Hz). HRMS (ESI) (*m/z*): $[M+Na]^+$ calcd. for $C_{13}H_{20}NO_2SFNa$: 296.1091, found: 296.1094.



1ac

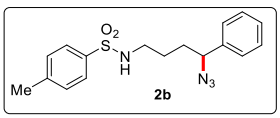
N-fluoro-N-(5-phenylpentyl)benzenesulfonamide was prepared following general procedure C and was purified by column chromatography with petroleum ether and ethyl acetate (PE/EA = 19:1) to afford the product **1ac** (66% yield) as light yellow oil. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.98 – 7.91 (m, 2H), 7.74 (t, *J* = 7.5 Hz, 1H), 7.61 (t, *J* = 7.9 Hz, 2H), 7.29-7.27 (m, 2H), 7.21 – 7.13 (m, 3H), 3.26 (t, *J* = 7.0 Hz, 1H), 3.18 (t, *J* = 7.0 Hz, 1H), 2.70 – 2.56 (m, 2H), 1.75 (p, *J* = 7.3 Hz, 2H), 1.64 (p, *J* = 7.7 Hz, 2H), 1.44 (p, *J* = 7.7, 7.2 Hz, 2H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 142.24, 134.87, 132.13, 129.95, 129.29, 128.39, 128.34, 125.78, 53.54 (d, *J* = 12.5 Hz), 35.68, 30.90, 26.19. ^{19}F NMR (376 MHz, Chloroform-d) δ -49.88 (t, *J* = 40.6 Hz). HRMS (ESI) (m/z): $[M+Na]^+$ calcd. for $C_{17}H_{20}NO_2SFNa$: 344.1091, found: 344.1102.

2. Products:



2a

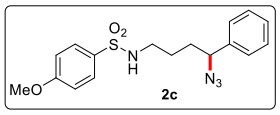
N-(4-azido-4-phenylbutyl)benzenesulfonamide was prepared following general procedure A the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2a** (92% yield) as a light yellow liquid. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.88 – 7.81 (m, 2H), 7.61 – 7.55 (m, 1H), 7.53 – 7.48 (m, 2H), 7.39 – 7.30 (m, 3H), 7.25 – 7.21 (m, 2H), 4.60 (t, *J* = 6.2 Hz, 1H), 4.37 (dd, *J* = 7.9, 6.3 Hz, 1H), 2.97 (qd, *J* = 6.7, 3.3 Hz, 2H), 1.85 – 1.68 (m, 2H), 1.60 – 1.53 (m, 1H), 1.50 – 1.43 (m, 1H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 139.82, 139.15, 132.73, 129.18, 128.90, 128.43, 127.01, 126.80, 65.70, 42.74, 33.13, 26.36. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{16}H_{19}N_2O_2S$: 303.1162, found: 303.1161.



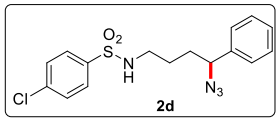
2b

N-(4-azido-4-phenylbutyl)-4-methylbenzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2b** (95% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.78 – 7.69 (m, 2H), 7.38 – 7.26 (m, 5H), 7.25 – 7.19 (m, 2H), 4.78 (t, *J* = 6.2 Hz, 1H), 4.35 (dd, *J* = 7.9, 6.4 Hz, 1H), 2.93 (qd, *J* = 6.8, 1.9 Hz, 2H), 2.42 (s, 3H), 1.81 – 1.66 (m, 2H), 1.62 – 1.40 (m, 2H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 143.43, 139.13, 136.74, 129.69, 128.78, 128.30, 127.00, 126.73, 65.63, 42.60,

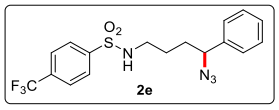
33.02, 26.22, 21.47. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{17}H_{21}N_2O_2S$: 317.1318, found: 317.1331.



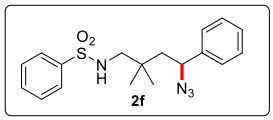
N-(4-azido-4-phenylbutyl)-4-methoxybenzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 5:1) to afford the product **2c** (85% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.81 – 7.74 (m, 2H), 7.39 – 7.28 (m, 3H), 7.25 – 7.19 (m, 2H), 6.99 – 6.92 (m, 2H), 4.75 (t, *J* = 6.2 Hz, 1H), 4.36 (dd, *J* = 7.8, 6.4 Hz, 1H), 3.86 (s, 3H), 2.92 (qd, *J* = 6.7, 1.6 Hz, 2H), 1.82 – 1.67 (m, 2H), 1.62 – 1.39 (m, 2H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 162.83, 139.12, 129.11, 128.78, 128.30, 126.73, 114.22, 65.63, 55.56, 42.57, 33.04, 26.19. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{17}H_{21}N_2O_3S$: 333.1268, found: 333.1265.



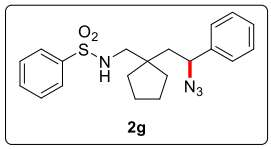
N-(4-azido-4-phenylbutyl)-4-chlorobenzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2d** (84% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.83 – 7.71 (m, 2H), 7.51 – 7.43 (m, 2H), 7.41 – 7.29 (m, 3H), 7.25 – 7.20 (m, 2H), 4.81 (t, *J* =5.2 Hz, 1H), 4.38 (dd, *J* = 7.8, 6.3 Hz, 1H), 2.95 (q, *J* = 5.7 Hz, 2H), 1.83 – 1.68 (m, 2H), 1.63 – 1.40 (m, 2H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 139.17, 139.03, 138.33, 129.42, 128.85, 128.42, 128.40, 126.71, 65.61, 42.69, 33.06, 26.27. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{16}H_{18}N_2O_2SCl$: 337.0773, found: 337.0792.



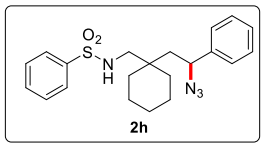
N-(4-azido-4-phenylbutyl)-4-(trifluoromethyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2e** (95% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.05 – 7.93 (m, 2H), 7.85 – 7.72 (m, 2H), 7.43 – 7.29 (m, 3H), 7.25 – 7.18 (m, 2H), 4.97 (t, *J* = 6.3 Hz, 1H), 4.38 (dd, *J* = 7.9, 6.2 Hz, 1H), 3.12 – 2.89 (m, 2H), 1.85 – 1.67 (m, 2H), 1.65 – 1.41 (m, 2H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 143.44, 139.00, 134.38 (q, *J* =33.1 Hz), 128.86, 128.43, 127.47, 126.70, 126.31 (q, *J* = 3.7Hz), 123.26 (q, *J* = 272.9 Hz), 65.60, 42.76, 33.04, 26.32. ^{19}F NMR (376 MHz, Chloroform-*d*) δ -63.09. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{17}H_{18}N_2O_2SF_3$: 371.1036, found: 371.1036.



N-(4-azido-2,2-dimethyl-4-phenylbutyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2f** (94% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.92 – 7.78 (m, 2H), 7.60 – 7.54 (m, 1H), 7.54 – 7.47 (m, 2H), 7.39 – 7.29 (m3H), 7.28 – 7.23 (m, 2H), 5.09 (t, *J* = 7.2 Hz, 1H), 4.47 (dd, *J* = 9.7, 3.3 Hz, 1H), 2.81 – 2.66 (m, 2H), 1.81 (dd, *J* = 14.9, 9.7 Hz, 1H), 1.51 (dd, *J* = 14.9, 3.4 Hz, 1H), 0.95 (s, 3H), 0.94 (s, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 140.18, 139.82, 132.53, 129.07, 128.95, 128.39, 126.87, 126.66, 62.79, 52.30, 45.00, 33.92, 26.48, 25.23. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{18}H_{23}N_2O_2S$: 331.1475, found: 331.1485.

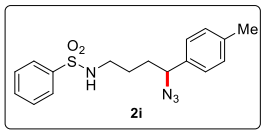


N-((1-(2-azido-2-phenylethyl)cyclopentyl)methyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2g** (94% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.92 – 7.82 (m, 2H), 7.61 – 7.56 (m, 1H), 7.55 – 7.49 (m, 2H), 7.40 – 7.29 (m, 3H), 7.28 – 7.22 (m, 2H), 5.20 – 5.04 (m, 1H), 4.44 (dd, *J* = 9.8, 2.9 Hz, 1H), 2.87 – 2.75 (m, 2H), 1.95 – 1.88 (m, 1H), 1.72 – 1.52 (m, 6H), 1.41 – 1.31 (m, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 140.19, 139.74, 132.55, 129.09, 128.99, 128.42, 126.88, 126.61, 63.83, 49.07, 45.66, 43.97, 36.92, 35.81, 24.29, 24.15. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{20}H_{25}N_2O_2S$: 357.1632, found: 357.1614.

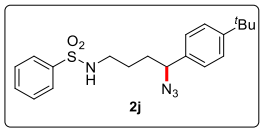


N-((1-(2-azido-2-phenylethyl)cyclohexyl)methyl)benzenesulfonamide was prepared following general procedure and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2h** (88% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.91 – 7.84 (m, 2H), 7.61 – 7.49 (m, 3H), 7.41 – 7.29 (m, 3H), 7.27 (d, *J* = 1.7 Hz, 1H), 7.25 (q, *J* = 2.5, 2.0 Hz, 1H), 5.08 (dd, *J* = 9.3, 5.2 Hz, 1H), 4.50 (dd, *J* = 10.0, 2.7 Hz, 1H), 3.00 (dd, *J* = 12.8, 9.4 Hz, 1H), 2.75 (dd, *J* = 12.8, 5.2 Hz, 1H), 1.77 (dd, *J* = 15.3, 10.0 Hz, 1H), 1.57 (dd, *J* = 15.3, 2.6 Hz, 1H), 1.49 – 1.21 (m, 10H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 140.54, 140.01, 132.65, 129.23, 129.16, 128.55, 127.03, 126.71, 62.20, 48.80, 42.93, 36.12, 34.77, 33.68, 26.06, 21.33, 21.11. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{21}H_{27}N_2O_2S$:

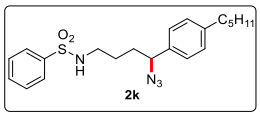
371.1788, found: 371.1736.



N-(4-azido-4-(p-tolyl)butyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2i** (85% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.90 – 7.78 (m, 2H), 7.61 – 7.54 (m, 1H), 7.50 (ddt, *J* = 8.3, 6.8, 1.4 Hz, 2H), 7.20 – 7.07 (m, 4H), 4.79 (t, *J* = 6.2 Hz, 1H), 4.32 (dd, *J* = 7.8, 6.5 Hz, 1H), 2.95 (qd, *J* = 6.8, 1.5 Hz, 2H), 2.34 (s, 3H), 1.83 – 1.61 (m, 2H), 1.61 – 1.38 (m, 2H).^{13}C NMR (126 MHz, $CDCl_3$) δ 139.76, 138.13, 136.00, 132.63, 129.47, 129.10, 126.94, 126.68, 65.44, 42.67, 32.95, 26.30, 21.09. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{17}H_{21}N_2O_2S$: 317.1319, found: 317.1331.

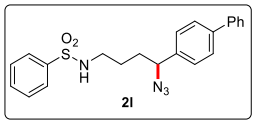


N-(4-azido-4-(4-(tert-butyl)phenyl)butyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2j** (93% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.90 – 7.81 (m, 2H), 7.60 – 7.54 (m, 1H), 7.53 – 7.48 (m, 2H), 7.40 – 7.33 (m, 2H), 7.18 – 7.12 (m, 2H), 4.80 (s, 1H), 4.33 (dd, *J* = 7.9, 6.3 Hz, 1H), 3.06 – 2.86 (m, 2H), 1.84 – 1.64 (m, 2H), 1.63 – 1.38 (m, 2H), 1.31 (s, 9H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 151.25, 139.77, 136.05, 132.63, 129.10, 126.95, 126.39, 125.67, 65.38, 42.69, 34.53, 32.99, 31.24, 26.32. HRMS (ESI) (*m/z*): $[M+Na]^+$ calcd. for $C_{20}H_{26}N_4O_2SNa$: 409.1669, found: 409.1656.



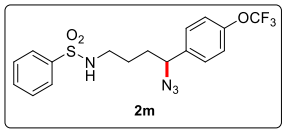
N-(4-azido-4-(4-pentylphenyl)butyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2k** (89% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.90 – 7.81 (m, 2H), 7.61 – 7.53 (m, 1H), 7.53 – 7.46 (m, 2H), 7.14 (q, *J* = 8.3 Hz, 4H), 4.85 (t, *J* = 6.2 Hz, 1H), 4.32 (dd, *J* = 7.9, 6.4 Hz, 1H), 3.07 – 2.85 (m, 2H), 2.67 – 2.50 (m, 2H), 1.84 – 1.51 (m, 5H), 1.50 – 1.40 (m, 1H), 1.35 – 1.25 (m, 4H), 0.89 (t, *J* = 6.9 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 143.31, 139.92, 136.39, 132.78, 129.25, 128.93, 127.10, 126.79, 65.64, 42.83, 35.70, 33.13, 31.62, 31.15, 26.46, 22.63, 14.14. HRMS (ESI)

(*m/z*): $[M+H-N_2]^+$ calcd. for $C_{21}H_{29}N_2O_2S$: 373.1945, found: 373.1950.



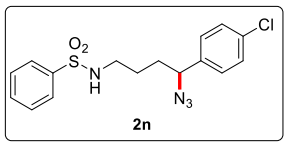
2l

N-(4-([1,1'-biphenyl]-4-yl)-4-azidobutyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 5:1) to afford the product **2l** (89% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.90 – 7.81 (m, 2H), 7.60 – 7.52 (m, 5H), 7.51 – 7.41 (m, 4H), 7.39 – 7.32 (m, 1H), 7.32 – 7.26 (m, 2H), 4.89 (t, *J* = 6.1 Hz, 1H), 4.40 (dd, *J* = 7.7, 6.5 Hz, 1H), 2.96 (qd, *J* = 6.7, 1.9 Hz, 2H), 1.88 – 1.70 (m, 2H), 1.65 – 1.41 (m, 2H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 141.34, 140.51, 139.90, 138.24, 132.80, 129.26, 128.95, 127.64, 127.34, 127.17, 127.09, 65.51, 42.81, 33.18, 26.41. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{22}H_{23}N_2O_2S$: 379.1475, found: 379.1466.



2m

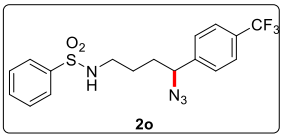
N-(4-azido-4-(4-(trifluoromethoxy)phenyl)butyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2m** (87% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.89 – 7.81 (m, 2H), 7.61 – 7.55 (m, 1H), 7.54 – 7.47 (m, 2H), 7.30 – 7.25 (m, 2H), 7.23 – 7.16 (m, 2H), 4.89 (t, *J* = 6.2 Hz, 1H), 4.41 (dd, *J* = 7.9, 6.2 Hz, 1H), 2.97 (qd, *J* = 6.7, 2.8 Hz, 2H), 1.83 – 1.65 (m, 2H), 1.60 – 1.42 (m, 2H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 148.94, 139.73, 137.99, 132.71, 129.14, 128.18, 126.93, 121.24, 120.37 (q, *J* = 257.79Hz), 64.82, 42.56, 33.18, 26.16. ^{19}F NMR (376 MHz, Chloroform-*d*) δ -57.83. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{17}H_{18}N_2O_3SF_3$: 387.0985, found: 387.0986.



2n

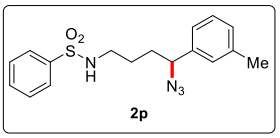
N-(4-azido-4-(4-chlorophenyl)butyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2n** (91% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.91 – 7.80 (m, 2H), 7.61 – 7.53 (m, 1H), 7.54 – 7.47 (m, 2H), 7.34 – 7.29 (m, 2H), 7.20 – 7.13 (m, 2H), 5.02 (t, *J* = 6.2 Hz, 1H), 4.36 (dd, *J* = 7.8, 6.3 Hz, 1H), 2.94 (qd, *J* = 6.7, 2.4 Hz, 2H), 1.84 – 1.59 (m, 2H), 1.62 – 1.37 (m, 2H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 139.68, 137.69, 134.04, 132.68, 129.12, 128.98, 128.10, 126.89, 64.87,

42.53, 33.00, 26.10. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{16}H_{18}N_2O_2SCl$: 337.0773, found: 337.0754.



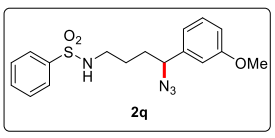
2o

N-(4-azido-4-(4-(trifluoromethyl)phenyl)butyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2o** (81% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.89 – 7.80 (m, 2H), 7.65 – 7.54 (m, 3H), 7.54 – 7.47 (m, 2H), 7.36 (d, *J* = 8.2 Hz, 2H), 4.93 (t, *J* = 6.0 Hz, 1H), 4.47 (dd, *J* = 7.7, 6.3 Hz, 1H), 2.97 (qd, *J* = 6.6, 3.1 Hz, 2H), 1.84 – 1.70 (m, 2H), 1.63 – 1.40 (m, 2H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 143.31, 139.71, 132.73, 130.45 (q, *J* = 32.6Hz), 129.15, 127.08, 126.91, 125.82 (q, *J* = 3.7 Hz), 123.86 (q, *J* = 272.1 Hz), 64.99, 42.52, 33.15, 26.07. ^{19}F NMR (376 MHz, Chloroform-*d*) δ -62.59. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{17}H_{18}N_2O_2SF_3$: 371.1036, found: 371.1036.



2p

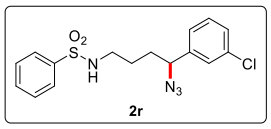
N-(4-azido-4-(m-tolyl)butyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2p** (95% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.91 – 7.76 (m, 2H), 7.62 – 7.44 (m, 3H), 7.23 (t, *J* = 7.6 Hz, 1H), 7.12 (d, *J* = 7.6 Hz, 1H), 7.07 – 6.98 (m, 2H), 4.85 (t, *J* = 6.2 Hz, 1H), 4.31 (dd, *J* = 7.9, 6.4 Hz, 1H), 2.95 (qd, *J* = 6.8, 1.5 Hz, 2H), 2.35 (s, 3H), 1.79 – 1.66 (m, 2H), 1.64 – 1.35 (m, 2H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 139.75, 139.03, 138.51, 132.63, 129.10, 128.66, 127.39, 126.93, 123.78, 65.68, 42.67, 33.02, 26.29, 21.40. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{17}H_{21}N_2O_2S$: 317.1319, found: 317.1331.



2q

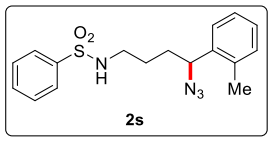
N-(4-azido-4-(3-methoxyphenyl)butyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 5:1) to afford the product **2q** (98% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.90 – 7.79 (m, 2H), 7.61 – 7.54 (m, 1H), 7.53 – 7.46 (m, 2H), 7.30 – 7.22 (m, 1H), 6.88 – 6.76 (m, 3H), 4.84 (t, *J* = 6.2 Hz, 1H), 4.33 (dd, *J* = 7.6, 6.5 Hz, 1H), 3.80 (s, 3H), 2.95 (qd, *J* = 6.8, 1.7 Hz, 2H), 1.81 – 1.63 (m, 2H), 1.62 – 1.38

(m, 2H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 160.01, 140.86, 139.89, 132.80, 130.00, 129.26, 127.08, 119.16, 113.78, 112.54, 65.72, 55.38, 42.80, 33.17, 26.39. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{17}H_{21}N_2O_3S$: 333.1268, found: 333.1302.



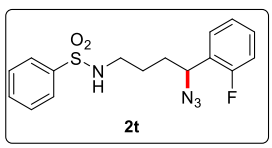
2r

N-(4-azido-4-(3-chlorophenyl)butyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2r** (91% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.90 – 7.82 (m, 2H), 7.62 – 7.55 (m, 1H), 7.51 (t, *J* = 7.5 Hz, 2H), 7.29 (dd, *J* = 3.8, 1.4 Hz, 2H), 7.22 (s, 1H), 7.17 – 7.08 (m, 1H), 4.91 (t, *J* = 6.2 Hz, 1H), 4.35 (dd, *J* = 7.6, 6.4 Hz, 1H), 2.96 (qd, *J* = 6.6, 2.2 Hz, 2H), 1.77 – 1.65 (m, 2H), 1.62 – 1.38 (m, 2H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 141.50, 139.86, 134.84, 132.87, 130.28, 129.29, 128.64, 127.08, 127.00, 125.07, 65.16, 42.72, 33.24, 26.28. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{16}H_{18}N_2O_2SCl$: 337.0773, found: 337.0792.



2s

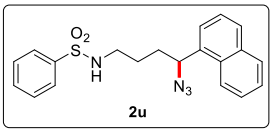
N-(4-azido-4-(o-tolyl)butyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2s** (89% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.90 – 7.80 (m, 2H), 7.62 – 7.53 (m, 1H), 7.53 – 7.46 (m, 2H), 7.23 (t, *J* = 7.6 Hz, 1H), 7.12 (d, *J* = 7.6 Hz, 1H), 7.05 – 6.99 (m, 2H), 4.85 (t, *J* = 6.2 Hz, 1H), 4.31 (dd, *J* = 7.9, 6.4 Hz, 1H), 2.95 (qd, *J* = 6.8, 1.5 Hz, 2H), 2.35 (s, 3H), 1.80 – 1.65 (m, 2H), 1.60 – 1.40 (m, 2H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 139.75, 139.03, 138.51, 132.63, 129.10, 128.66, 127.39, 126.93, 123.78, 65.68, 42.67, 33.02, 26.29, 21.40. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{17}H_{21}N_2O_2S$: 317.1319, found: 317.1331.



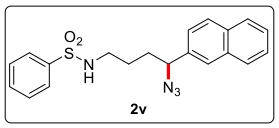
2t

N-(4-azido-4-(2-fluorophenyl)butyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2t** (92% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.90 – 7.82 (m, 2H), 7.62 – 7.55 (m, 1H), 7.51 (t, *J* = 7.5 Hz, 2H), 7.29 (dd, *J* = 3.8, 1.4 Hz, 2H), 7.22 (s, 1H), 7.17 – 7.08 (m, 1H),

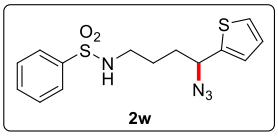
4.91 (t, *J* = 6.2 Hz, 1H), 4.35 (dd, *J* = 7.6, 6.4 Hz, 1H), 2.96 (qd, *J* = 6.6, 2.2 Hz, 2H), 1.75 – 1.65 (m, 2H), 1.62 – 1.38 (m, 2H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 160.01 (d, *J* = 246.8 Hz), 139.81, 132.73, 129.87 (d, *J* = 8.3 Hz), 129.18, 127.86 (d, *J* = 3.8 Hz), 127.01, 126.37 (d, *J* = 13.6 Hz), 124.68 (d, *J* = 3.6 Hz), 115.75 (d, *J* = 22.0 Hz), 58.83 (d, *J* = 2.2 Hz), 42.71, 32.14, 26.26. ^{19}F NMR (376 MHz, Chloroform-*d*) δ -118.59.HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{16}H_{18}N_2O_2SF$: 321.1068, found: 321.1074.



N-(4-azido-4-(naphthalen-1-yl)butyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2u** (87% yield) as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.01 (d, *J* = 8.2 Hz, 1H), 7.91 – 7.76 (m, 4H), 7.60 – 7.38 (m, 7H), 5.11 (t, *J* = 6.9 Hz, 1H), 5.00 (t, *J* = 6.1 Hz, 1H), 3.11 – 2.84 (m, 2H), 1.91 (q, *J* = 7.4 Hz, 2H), 1.65 – 1.45 (m, 2H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 139.84, 134.74, 134.11, 132.76, 130.65, 129.22, 129.20, 129.04, 127.06, 126.70, 126.02, 125.38, 124.50, 122.98, 62.52, 42.86, 32.43, 26.69. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{20}H_{21}N_2O_2S$: 353.1319, found: 353.1346.

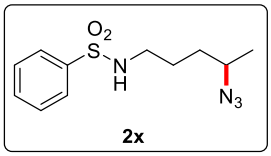


N-(4-azido-4-(naphthalen-2-yl)butyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2v** (92% yield) as a light yellow liquid. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.88 – 7.77 (m, 5H), 7.65 (s, 1H), 7.53 – 7.44 (m, 3H), 7.41 (t, *J* = 7.6 Hz, 2H), 7.32 (dd, *J* = 8.5, 1.5 Hz, 1H), 5.03 (t, *J* = 6.1 Hz, 1H), 4.50 (t, *J* = 7.1 Hz, 1H), 3.03 – 2.86 (m, 2H), 1.87 – 1.72 (m, 2H), 1.60 – 1.37 (m, 2H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 139.87, 136.59, 133.29, 133.22, 132.76, 129.22, 129.03, 128.12, 127.84, 127.04, 126.61, 126.48, 126.24, 124.28, 65.97, 42.79, 33.07, 26.39. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{20}H_{21}N_2O_2S$: 353.1319, found: 353.1346.



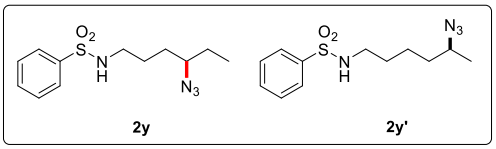
N-(4-azido-4-(thiophen-2-yl)butyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column

chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2w** (80% yield) as a light yellow liquid. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.86 (d, *J* = 7.4 Hz, 2H), 7.57 (t, *J* = 7.3 Hz, 1H), 7.50 (t, *J* = 7.6 Hz, 2H), 7.30 – 7.23 (m, 1H), 6.96 (d, *J* = 4.3 Hz, 2H), 5.13 (t, *J* = 6.0 Hz, 1H), 4.60 (t, *J* = 7.2 Hz, 1H), 2.96 (q, *J* = 6.6 Hz, 2H), 1.87 – 1.76 (m, 2H), 1.65 – 1.45 (m, 2H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 142.11, 139.86, 132.84, 129.29, 127.11, 126.93, 125.87, 125.74, 60.93, 42.69, 33.60, 26.48. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{14}H_{17}N_2O_2S_2$: 309.0726, found: 309.0753.



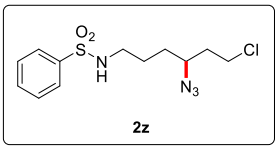
2x

N-(4-azidopentyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2x** (57% yield) as a light yellow liquid. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.94 – 7.85 (m, 2H), 7.63 – 7.56 (m, 1H), 7.56 – 7.50 (m, 2H), 5.08 (t, *J* = 5.9 Hz, 1H), 3.38 (h, *J* = 6.5 Hz, 1H), 2.97 (p, *J* = 6.4 Hz, 2H), 1.60 – 1.42 (m, 4H), 1.20 (d, *J* = 6.5 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 139.87, 132.75, 129.20, 127.04, 57.36, 42.86, 33.03, 26.20, 19.38. HRMS (ESI) (*m/z*): $[M+Na]^+$ calcd. for $C_{11}H_{16}N_4O_2SNa$: 291.0886, found: 291.0911.



2y **2y'**

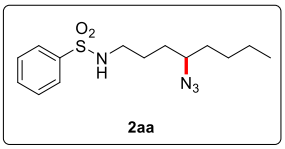
N-(4-azidohexyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2y** and **2y'** (74% yield) in the ratio higher than 10:1 as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.88 (d, *J* = 7.4 Hz, 2H), 7.79 – 7.42 (m, 3H), 5.01 (t, *J* = 6.0 Hz, 0.89H, **2y**), 4.96 (t, *J* = 6.0 Hz, 0.08H, **2y'**) 3.24 – 3.05 (m, 0.08H, **2y'**), 3.18 – 3.08 (m, 0.92H, **2y**), 2.97 (q, *J* = 6.5 Hz, 2H), 1.71 – 1.34 (m, 6H), 1.21 (d, *J* = 6.5 Hz, 0.24H, **2y'**), 0.94 (t, *J* = 7.4 Hz, 2.76H, **2y**). ^{13}C NMR (101 MHz, $CDCl_3$) δ 139.92, 132.81, 129.28, 127.11, 63.95, 57.80, 42.98, 35.65, 30.89, 29.78, 29.38, 27.42, 26.30, 23.11, 19.45, 10.50. HRMS (ESI) (*m/z*): $[M+Na]^+$ calcd. for $C_{12}H_{18}N_4O_2SNa$: 305.1043, found: 305.1048.



2z

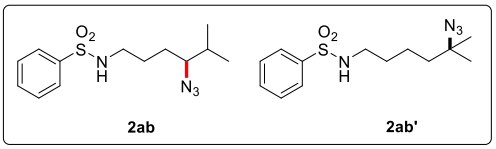
N-(4-azido-6-chlorohexyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with

petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the single product **2z** (50% yield) as a light yellow liquid. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.97 – 7.84 (m, 2H), 7.63 – 7.57 (m, 1H), 7.57 – 7.51 (m, 2H), 4.83 (t, *J* = 6.1 Hz, 1H), 3.66 – 3.58 (m, 2H), 3.52 (p, *J* = 6.9 Hz, 1H), 3.01 (q, *J* = 6.3 Hz, 2H), 1.86 (q, *J* = 6.3 Hz, 2H), 1.75 – 1.47 (m, 5H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 139.97, 132.92, 129.35, 127.14, 59.49, 42.92, 41.42, 37.15, 31.39, 26.28. HRMS (ESI) (*m/z*): $[M+Na]^+$ calcd. for $C_{12}H_{17}N_4O_2SClNa$: 339.0653, found: 339.0657.



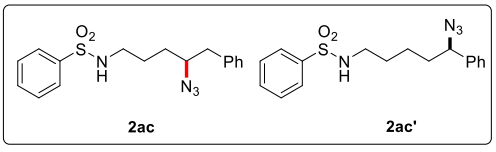
2aa

N-(4-azidooctyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2aa** in the regioselectivity higher than 10:1 (70% yield) as a light yellow liquid. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.88 (d, *J* = 8.1 Hz, 2H), 7.62 – 7.56 (m, 1H), 7.53 (t, *J* = 7.7 Hz, 2H), 4.89 (t, *J* = 6.0 Hz, 1H), 3.23 – 3.12 (m, 1H), 2.97 (p, *J* = 7.9, 7.2 Hz, 2H), 1.76 – 1.28 (m, 10H), 0.90 (t, *J* = 6.7 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 140.01, 132.81, 129.29, 127.13, 62.67, 62.55, 43.13, 43.03, 36.54, 34.12, 33.91, 31.36, 29.52, 28.23, 26.35, 23.20, 22.57, 19.40, 14.04, 13.95. HRMS (ESI) (*m/z*): $[M+Na]^+$ calcd. for $C_{14}H_{22}N_4O_2SNa$: 333.1356, found: 333.1361.



2ab **2ab'**

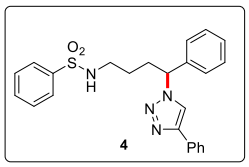
N-(4-azido-5-methylhexyl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2ab** and **2ab'** (63% yield) in the ratio of 2:1 as a light yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.89 (d, *J* = 7.5 Hz, 2H), 7.71 – 7.48 (m, 3H), 5.00 (t, *J* = 6.0 Hz, 0.64H, **2ab**), 4.94 (t, *J* = 6.0 Hz, 0.33H, **2ab'**), 3.04 – 2.99 (m, 0.63H, **2ab**), 3.00 – 2.93 (m, 2H), 1.85 – 1.25 (m, 6H), 1.20 (s, 2H, **2ab'**), 0.91 (t, *J* = 6.5 Hz, 4H, **2ab**). ^{13}C NMR (101 MHz, $CDCl_3$) δ 139.97, 139.93, 132.81, 132.76, 129.28, 129.25, 127.12, 68.82, 61.53, 43.12, 43.03, 40.93, 32.64, 29.84, 28.52, 26.76, 25.96, 21.33, 19.34, 18.10. HRMS (ESI) (*m/z*): $[M+Na]^+$ calcd. for $C_{13}H_{20}N_4O_2SNa$: 319.1199, found: 319.1203.



2ac **2ac'**

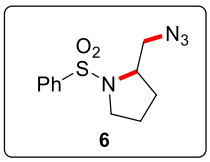
N-(4-azido-5-phenylpentyl)benzenesulfonamide and N-(5-azido-5-phenylpentyl)benzenesulfonamide were afforded following general procedure A and

the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **2ac** and **2ac'** (75% yield) in the ratio of 1:1.1 as a light yellow liquid. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.90 – 7.82 (m, 2H), 7.61 – 7.55 (m, 1H), 7.54 – 7.49 (m, 2H), 7.39 – 7.34 (m, 1H), 7.34 – 7.23 (m, 4H), 7.19 – 7.14 (m, 1H), 4.778-4.58 (m, 1H), 4.34 (dd, *J* = 7.82, 6.50 Hz, 0.526H, **2ac'**), 3.52-3.41 (m, 0.474H, **2ac**), 2.94 (dq, *J* = 20.1, 6.6 Hz, 2H), 2.78 (h, *J* = 7.5 Hz, 0.955H, **2ac**), 1.79 – 1.21 (m, 5.052H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 140.03, 140.01, 139.56, 137.47, 132.84, 132.79, 129.37, 129.30, 129.27, 128.96, 128.75, 128.45, 127.14, 126.99, 126.94, 66.22, 63.71, 43.06, 42.94, 41.04, 35.72, 31.01, 29.37, 26.43, 23.32. HRMS (ESI) (*m/z*): $[M+Na]^+$ calcd. for $C_{17}H_{20}N_4O_2SNa$: 367.1199, found: 367.1205



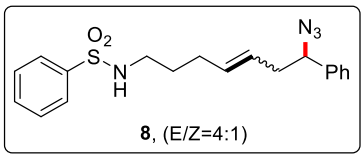
N-(4-phenyl-4-(4-phenyl-1H-1,2,3-triazol-1-yl)butyl)benzenesulfonamide was prepared following procedure B according to Ref. S2 and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 3:1) to afford the product **4** (74% yield) as white solid. ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.75 (s, 1H), 7.85 (d, *J* = 7.6 Hz, 2H), 7.76 (d, *J* = 7.4 Hz, 2H), 7.68 – 7.53 (m, 4H), 7.47 – 7.32 (m, 8H), 5.45 (dd, *J* = 9.2, 6.8 Hz 1H), 2.81 (q, *J* = 6.5 Hz, 2H), 2.43 – 2.35 (m, 1H), 2.28 – 2.17 (m, 1H), 1.37 – 1.25 (m, 2H). ^{13}C NMR (126 MHz, DMSO) δ 146.94, 140.96, 140.16, 132.78, 131.16, 129.65, 129.36, 129.25, 128.67, 128.37, 127.26, 126.84, 125.58, 120.74, 64.21, 42.41, 32.13, 26.56. HRMS (ESI) (*m/z*): $[M+H]^+$ calcd. for $C_{24}H_{25}N_4O_2S$: 433.1693, found: 433.1699. Melting point: 176 °C – 177 °C

Mechanistic Studies



6

2-(azidomethyl)-1-(phenylsulfonyl)pyrrolidine was prepared following general procedure A and the reaction mixture was purified by column chromatography with petroleum ether and ethyl acetate (PE/EA = 15:1) to afford the product **6** (37% yield) as a light yellow liquid. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.85 (d, *J* = 7.5 Hz, 2H), 7.63 (t, *J* = 7.3 Hz, 1H), 7.55 (t, *J* = 7.6 Hz, 2H), 3.73 (tt, *J* = 7.3, 3.6 Hz, 1H), 3.60 – 3.46 (m, 3H), 3.20 – 3.15 (m, 1H), 1.90 – 1.80 (m, 2H), 1.71 – 1.65 (m, 1H), 1.60 – 1.53 (m, 1H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 137.11, 133.09, 129.34, 127.66, 59.07, 55.32, 49.62, 29.44, 24.19. HRMS (ESI) (*m/z*): $[M+Na]^+$ calcd. for $C_{11}H_{14}N_4O_2SNa$: 287.0730, found: 287.0728.



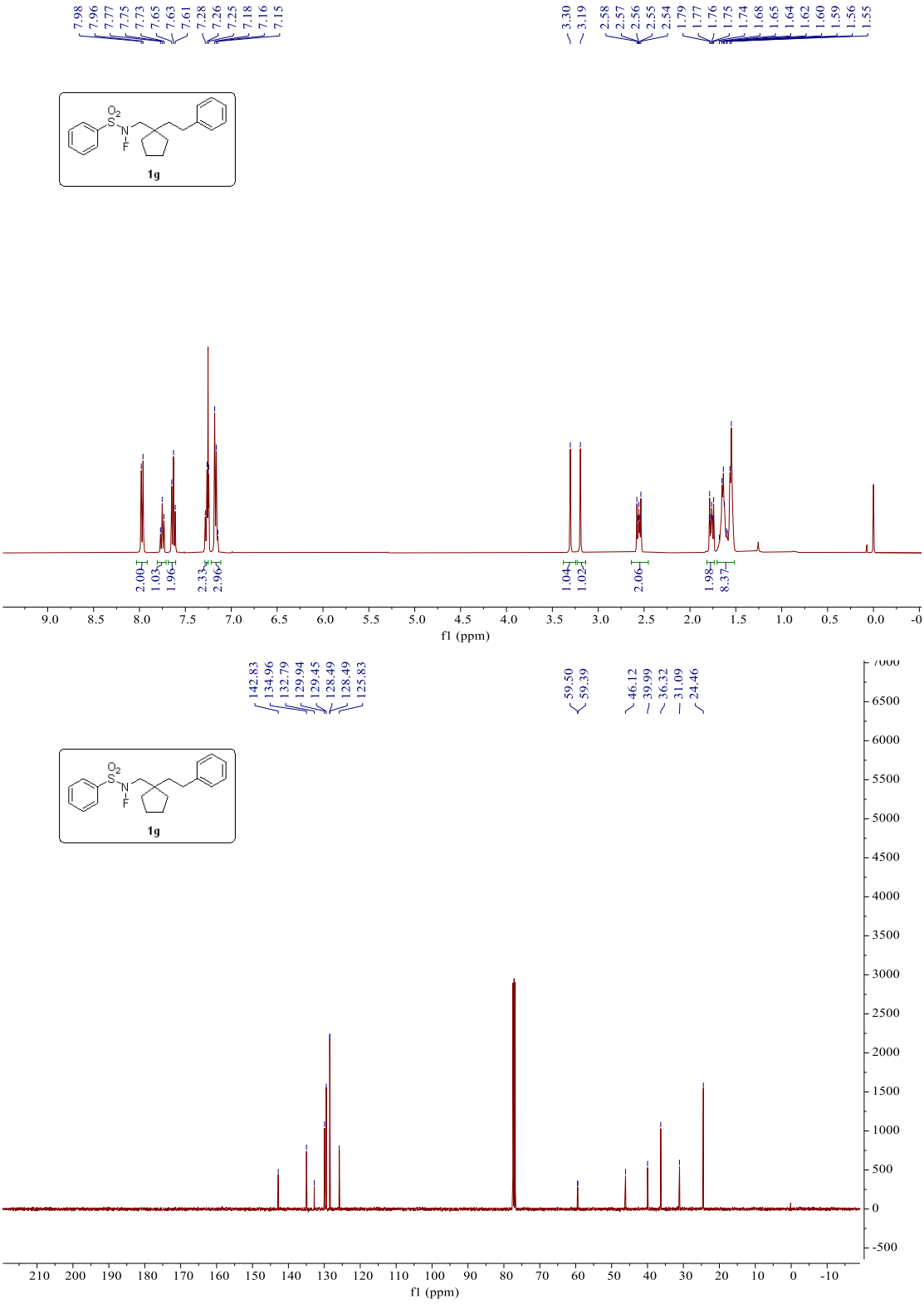
8, (E/Z=4:1)

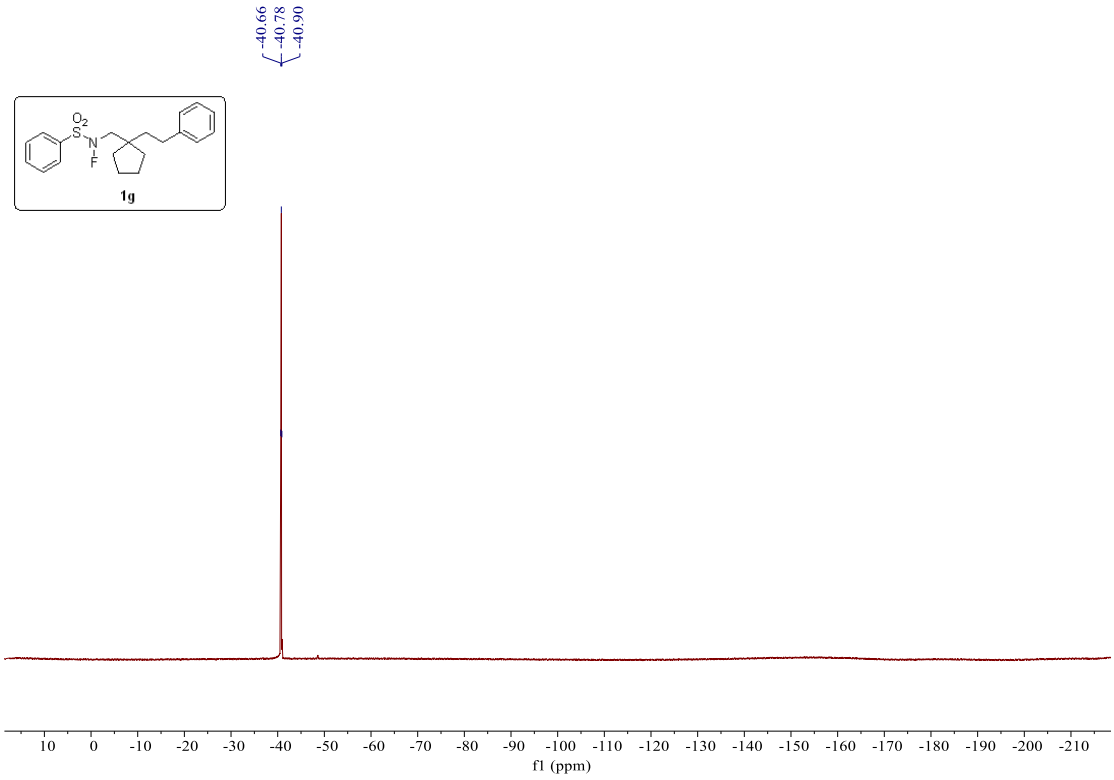
N-(7-azido-7-phenylhept-4-en-1-yl)benzenesulfonamide was prepared following general procedure A and the reaction mixture was purified by flash column chromatography with petroleum ether and ethyl acetate (PE/EA = 7:1) to afford the product **8** (82% yield, E/Z=4:1) as a light yellow liquid. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.91 – 7.83 (m, 2H), 7.58 (t, *J* = 7.3 Hz, 1H), 7.52 (t, *J* = 7.5 Hz, 2H), 7.39 – 7.33 (m, 2H), 7.34 – 7.25 (m, 3H), 5.44 – 5.27 (m, 2H), 4.71 – 4.62 (m, 1H), 4.48 – 4.40 (m, 1H), 2.91 (q, *J* = 6.6 Hz, 2H), 2.56 – 2.40 (m, 2H), 1.98 (q, *J* = 6.9 Hz, 2H), 1.55 – 1.37 (m, 2H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 140.14, 139.39, 132.85, 132.73, 129.23, 128.88, 128.85, 128.41, 128.35, 127.13, 127.11, 127.01, 126.99, 126.54, 66.13, 42.67, 39.59, 29.59, 29.12. HRMS (ESI) (*m/z*): $[M+H-N_2]^+$ calcd. for $C_{19}H_{23}N_2O_2S$: 343.1475, found: 343.1490.

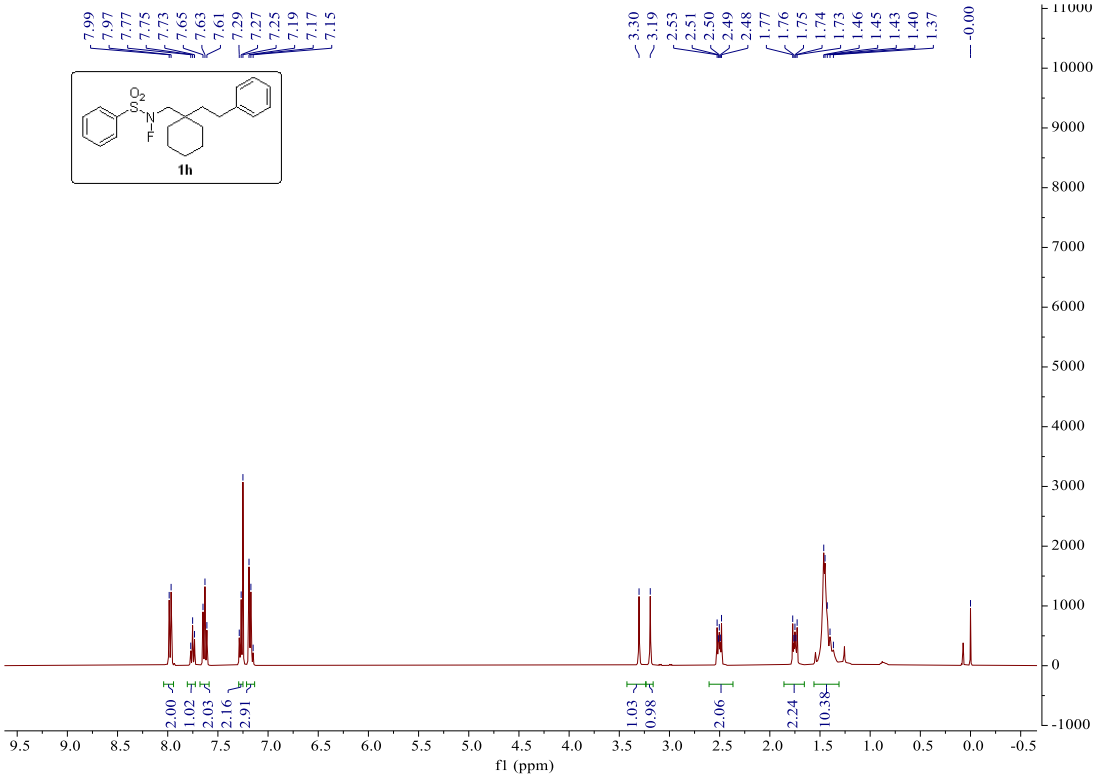
IV. References:

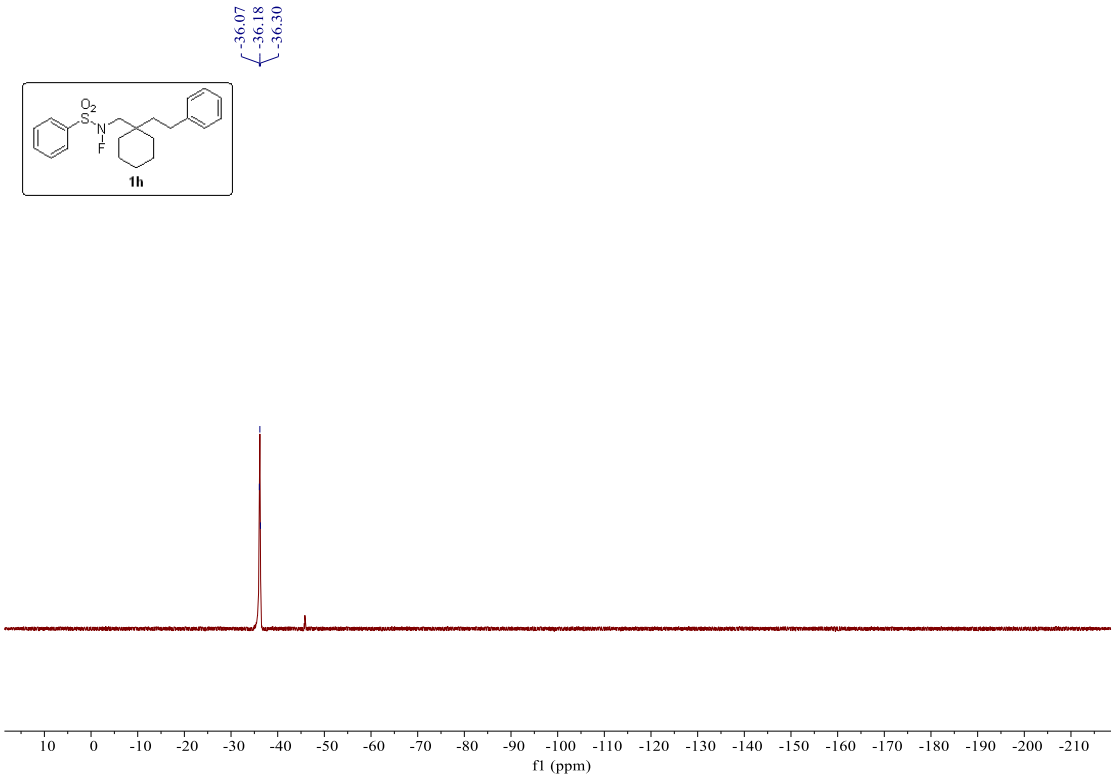
1. Wang, C.-Y.; Qin, Z.-Y.; Huang, Y.-L; Jin, R.-X.; Lan, Q.; Wang, X.-S. *iScience* 2019, **21**, 490.
2. Lu, M.-Z.; Wang, C.-Q.; Loh, T.-P. *Org. Lett.* 2015, **17**, 6110

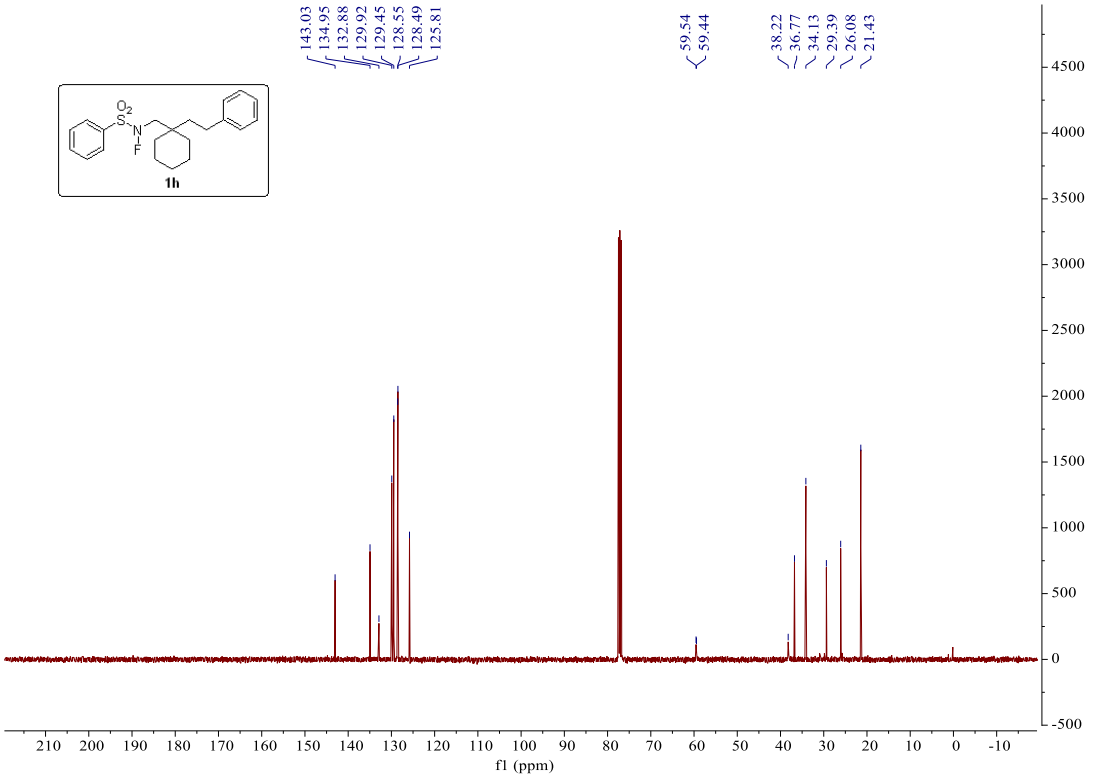
^{1}H, ^{19}F, and ^{13}C NMR Spectra

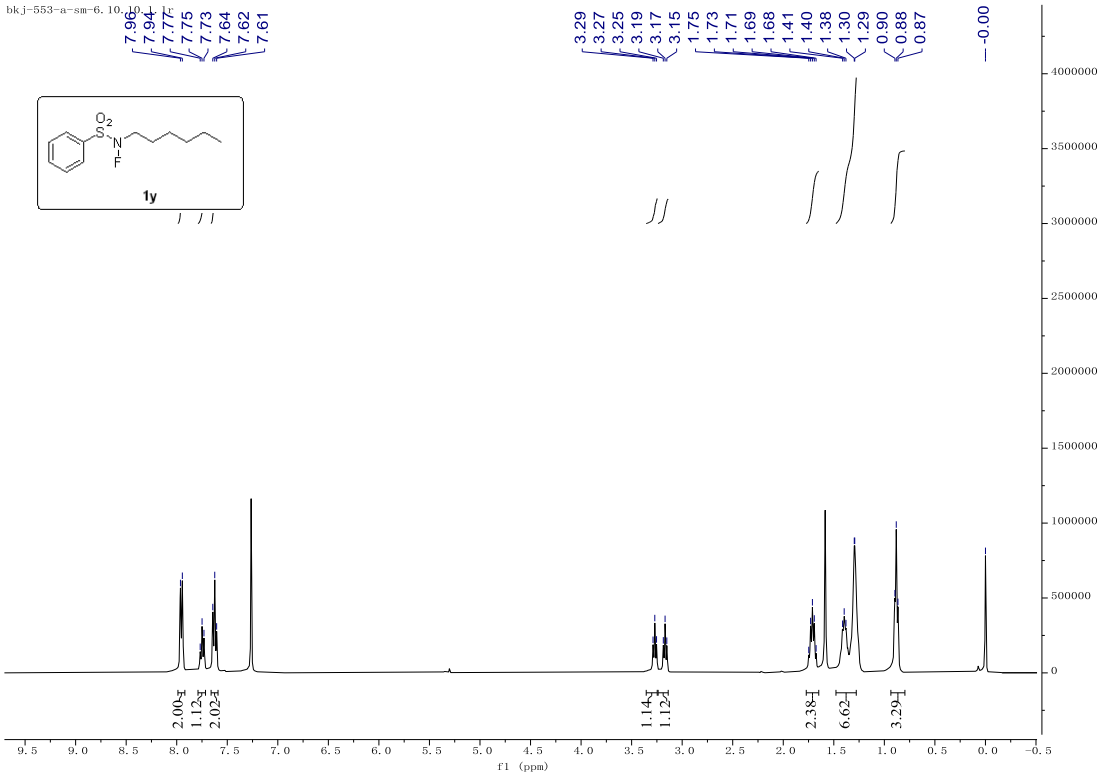


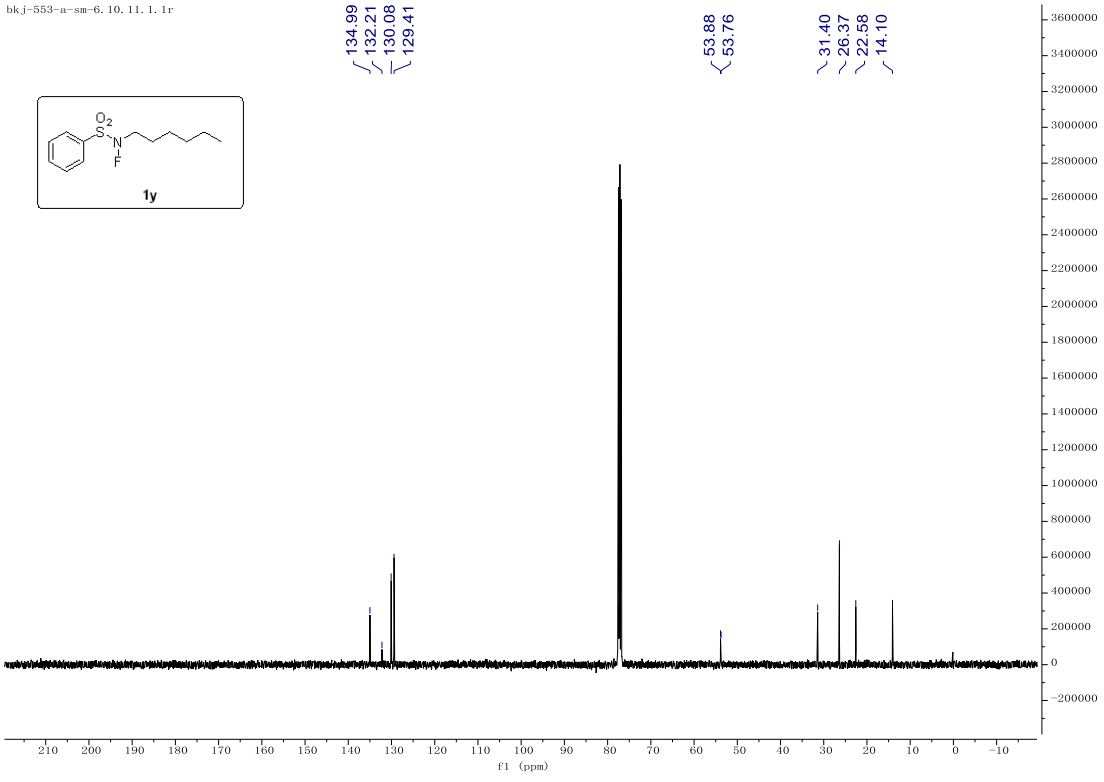

-40.66
-40.78
-40.90
1g
fl (ppm)

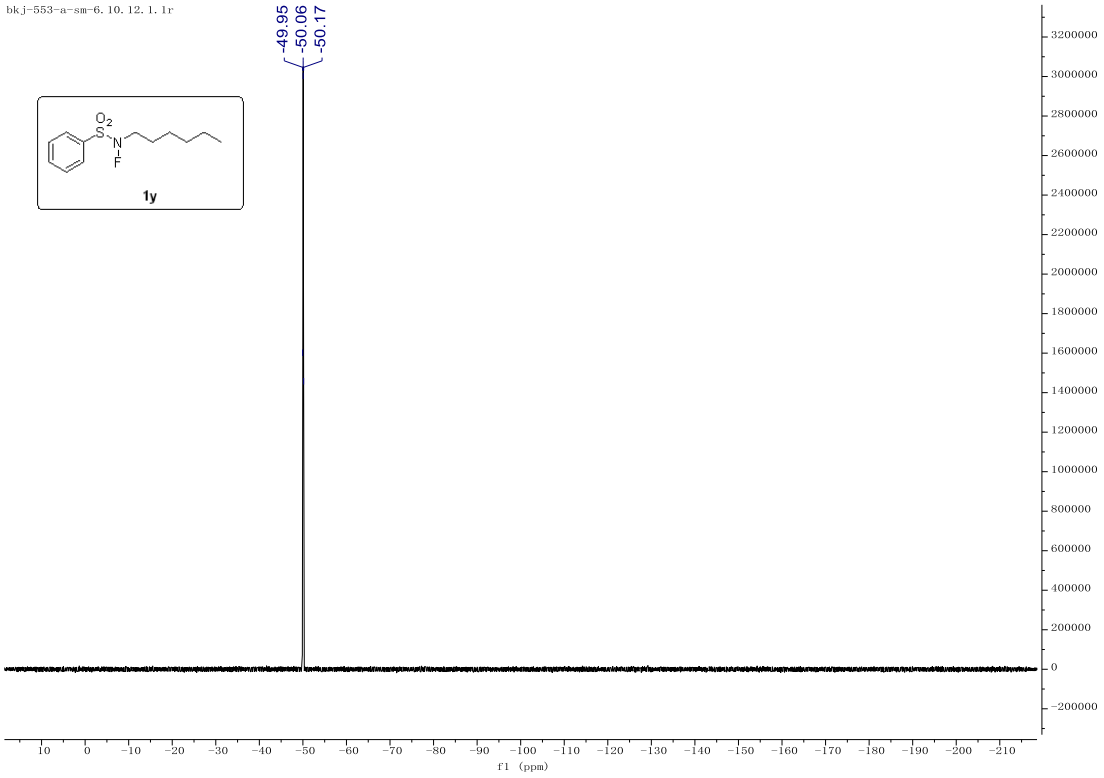

7.99
7.97
7.77
7.75
7.73
7.65
7.63
7.61
7.29
7.27
7.25
7.19
7.17
7.15
3.30
3.19
2.53
2.51
2.50
2.49
2.48
1.77
1.76
1.75
1.74
1.73
1.46
1.45
1.43
1.40
1.37
-0.00
1h
2.00
1.02
2.03
2.16
2.91
1.03
0.98
2.06
2.24
10.38
fl (ppm)

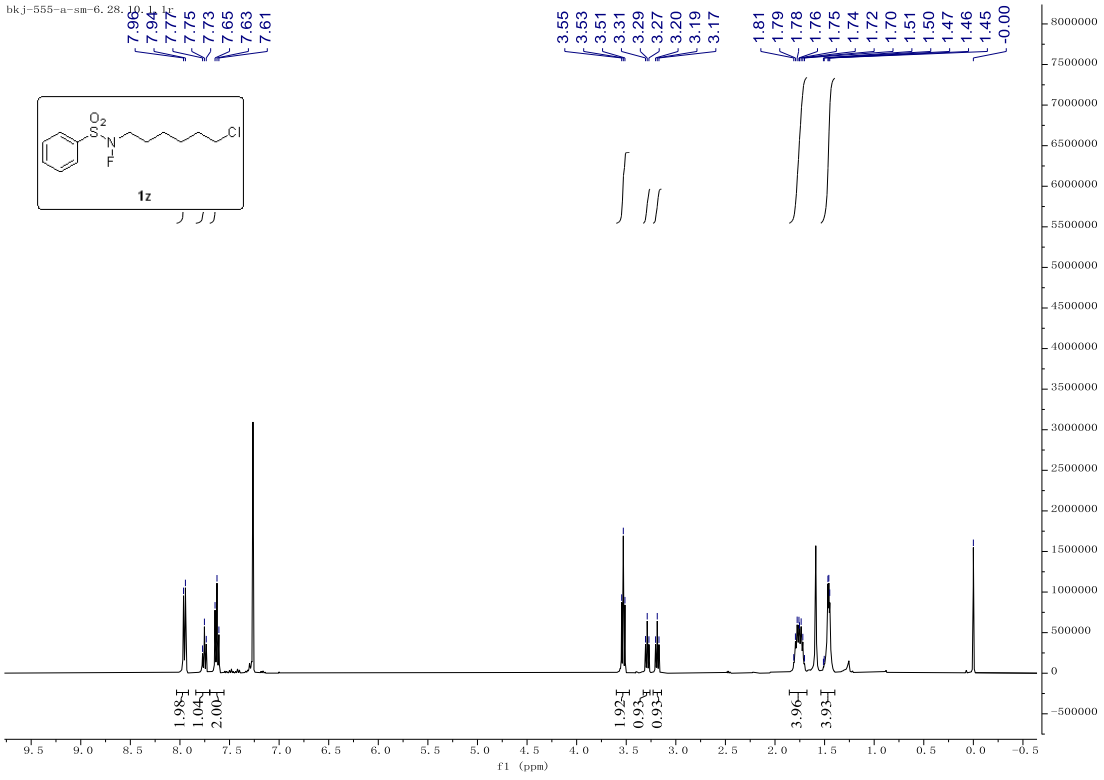

-36.07
-36.18
-36.30
1h
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

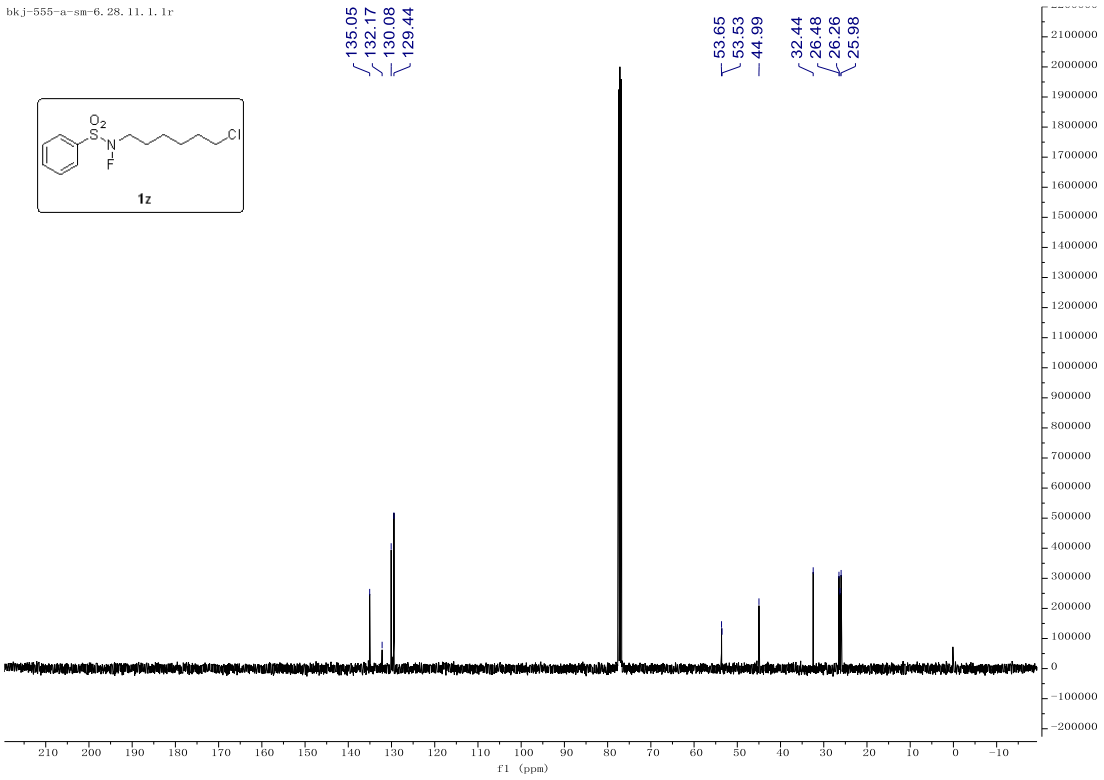

143.03
134.95
132.88
129.92
129.45
128.55
128.49
125.81
59.54
59.44
38.22
36.77
34.13
29.39
26.08
21.43
1h
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

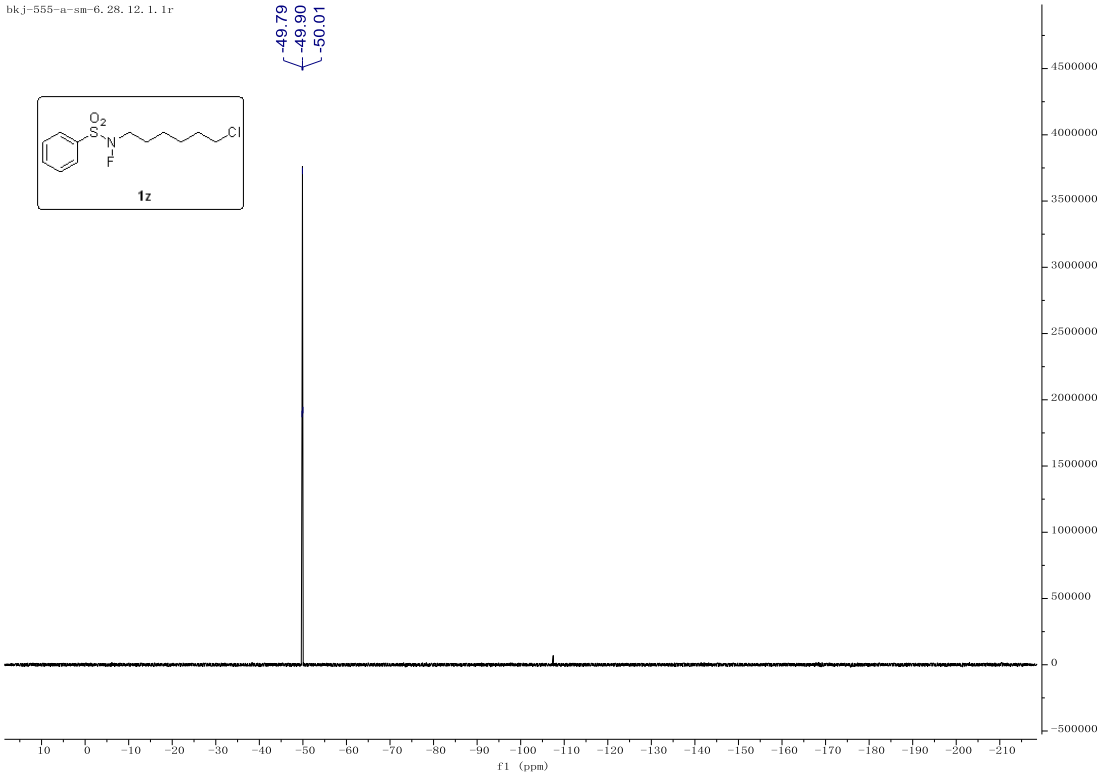

bkj-553-a-sm-6.10.10.1.1r
7.96
7.94
7.77
7.75
7.73
7.64
7.62
7.61
3.29
3.27
3.25
3.19
3.17
3.15
1.75
1.73
1.71
1.69
1.68
1.41
1.40
1.38
1.30
1.29
0.90
0.88
0.87
-0.00
1y
2.00
1.12
2.02
1.14
1.12
2.38
6.62
3.29
f1 (ppm)

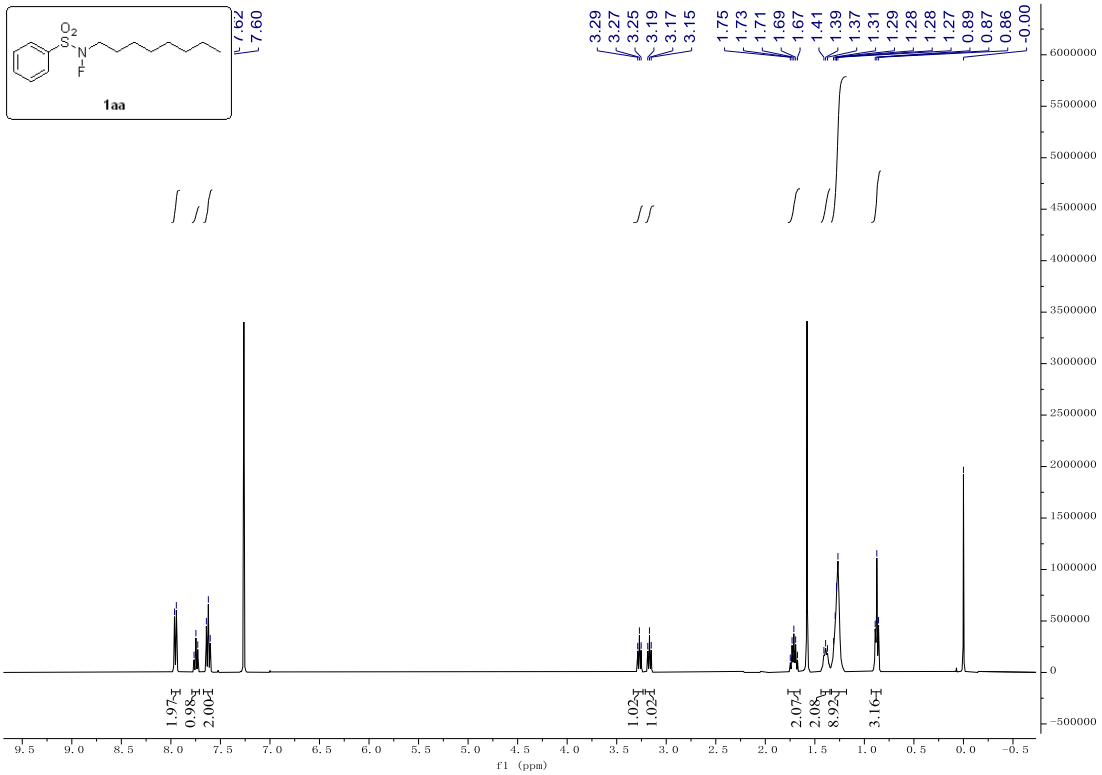

bkj-553-a-sm-6.10.11.1.1r
134.99
132.21
130.08
129.41
53.88
53.76
31.40
26.37
22.58
14.10
1y
f1 (ppm)

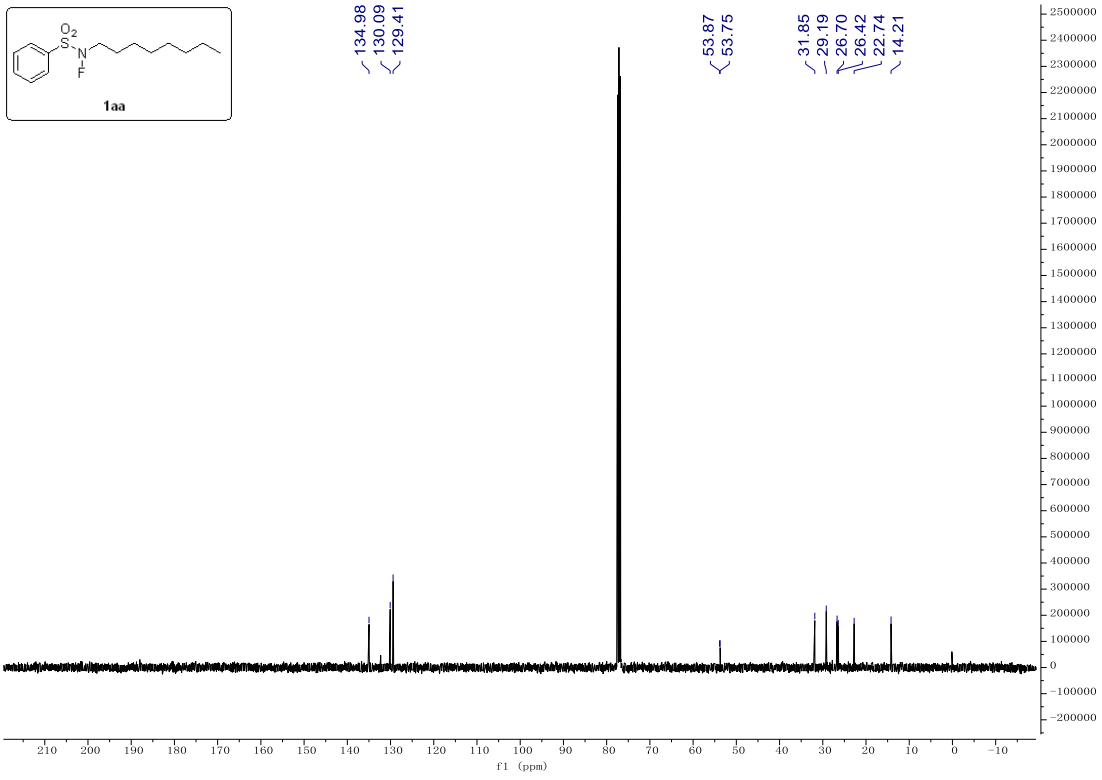

bkj-553-a-sm-6.10.12.1.1r
-49.95
-50.06
-50.17
1y
f1 (ppm)

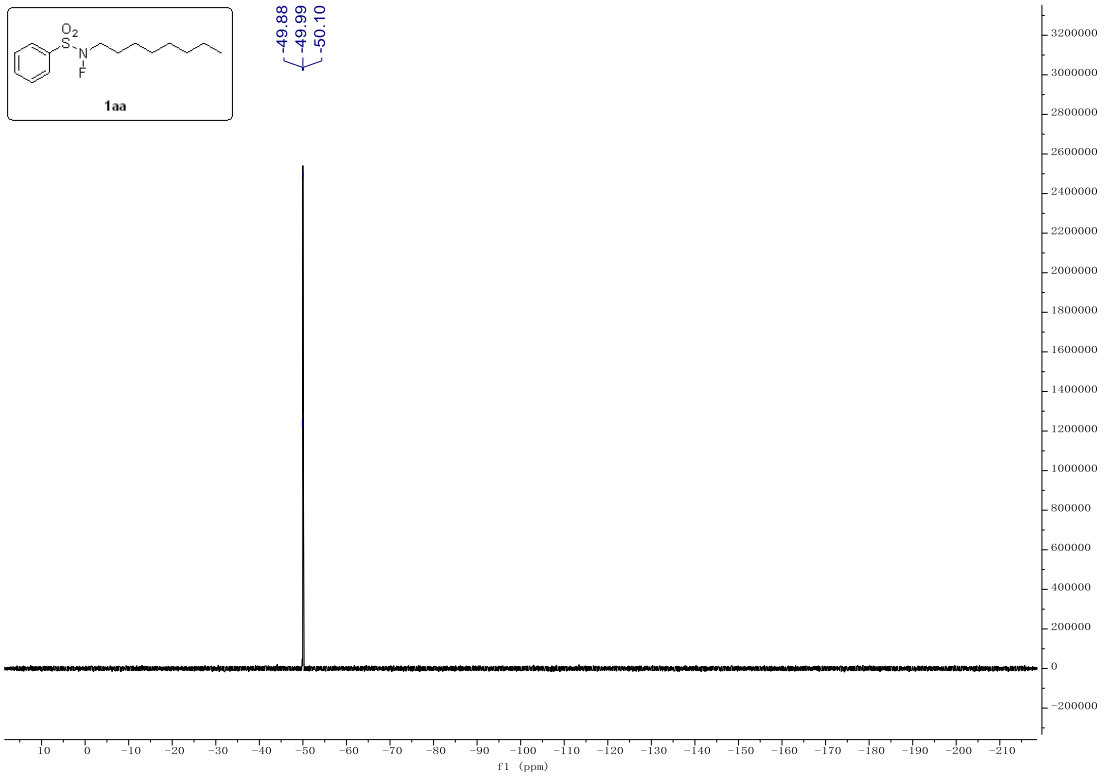

bkj-555-a-sm-6.28.10.1.1r
7.96
7.94
7.77
7.75
7.73
7.65
7.63
7.61
3.55
3.53
3.51
3.31
3.29
3.27
3.20
3.19
3.17
1.81
1.79
1.78
1.76
1.75
1.74
1.72
1.70
1.51
1.50
1.47
1.46
1.45
-0.00
1z
1.98
1.04
2.00
1.92
0.93
0.93
3.96
3.93
f1 (ppm)

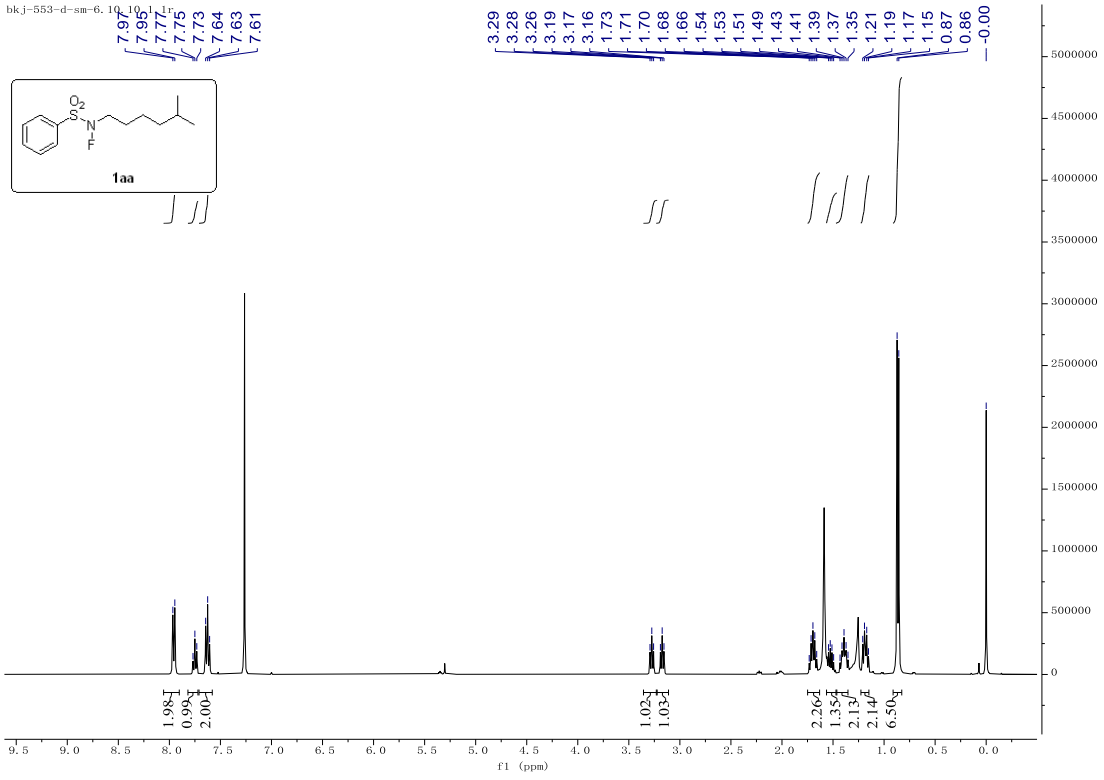

bkj-555-a-sm-6.28.11.1.1r
135.05
132.17
130.08
129.44
53.65
53.53
44.99
32.44
26.48
26.26
25.98
1z
f1 (ppm)

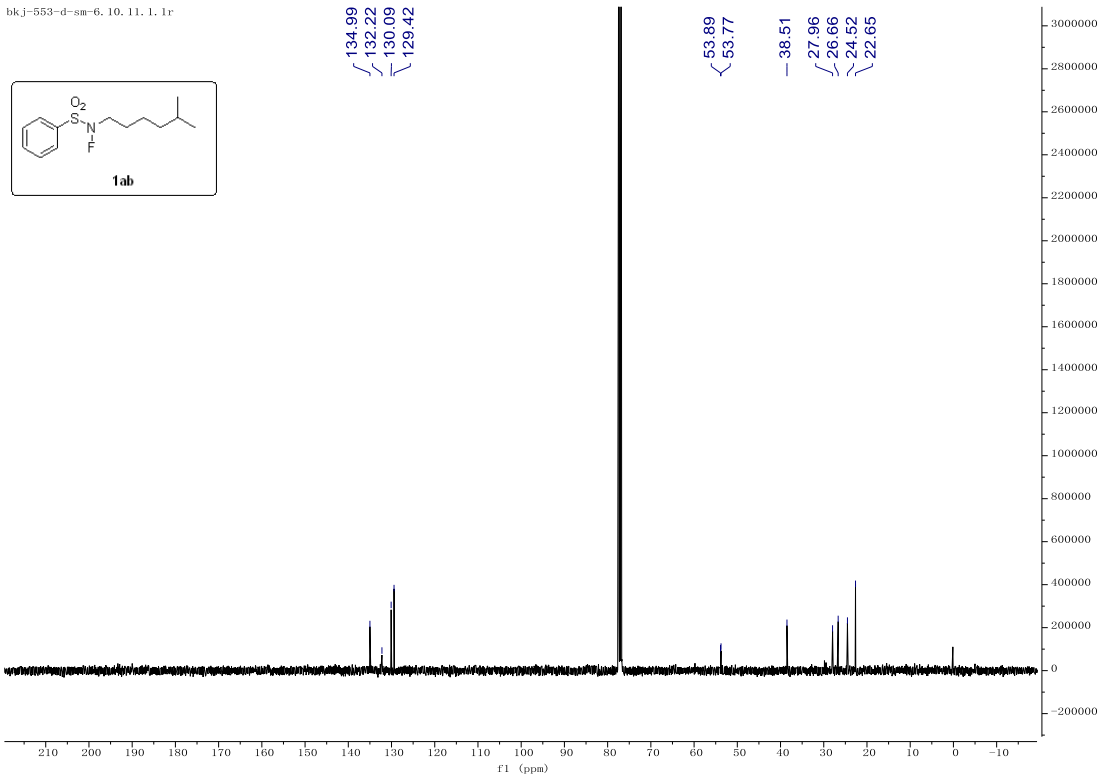

bkj-555-a-sm-6.28.12.1.1r
-49.79
-49.90
-50.01
1z
f1 (ppm)

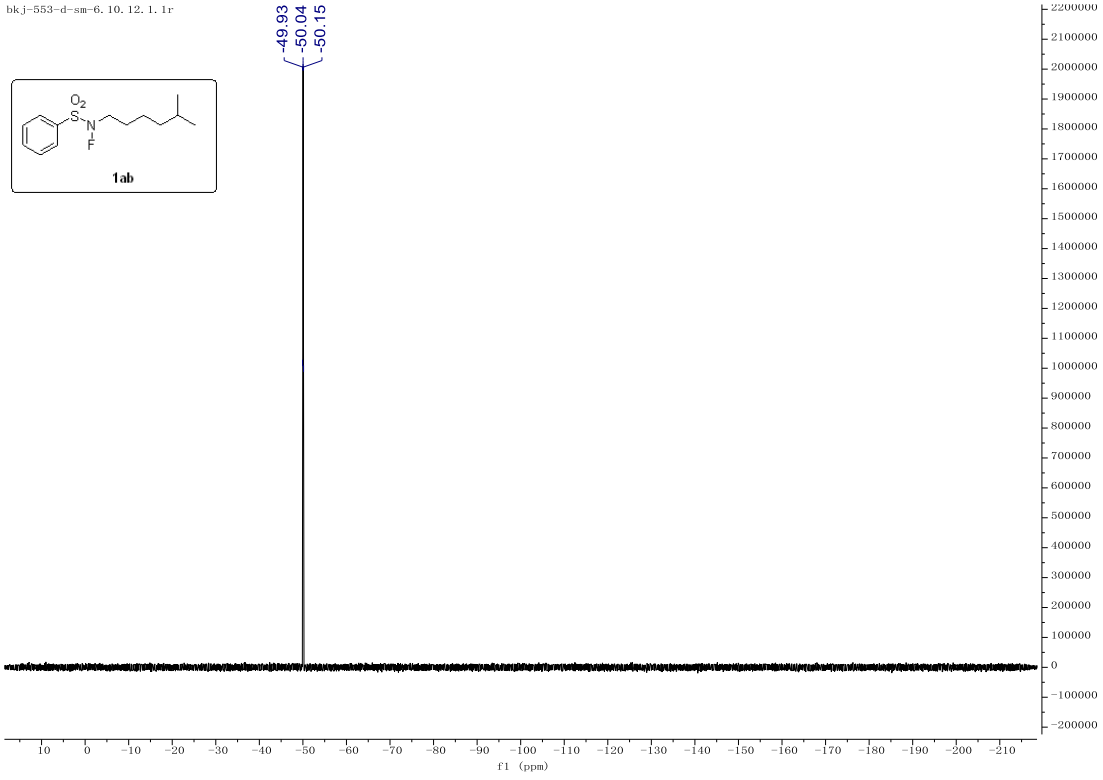

1aa
7.62
7.60
3.29
3.27
3.25
3.19
3.17
3.15
1.75
1.73
1.71
1.69
1.67
1.41
1.39
1.37
1.31
1.29
1.28
1.28
1.27
0.89
0.87
0.86
-0.00
1.97
0.98
2.00
1.02
1.02
2.07
2.08
8.92
3.16
f1 (ppm)

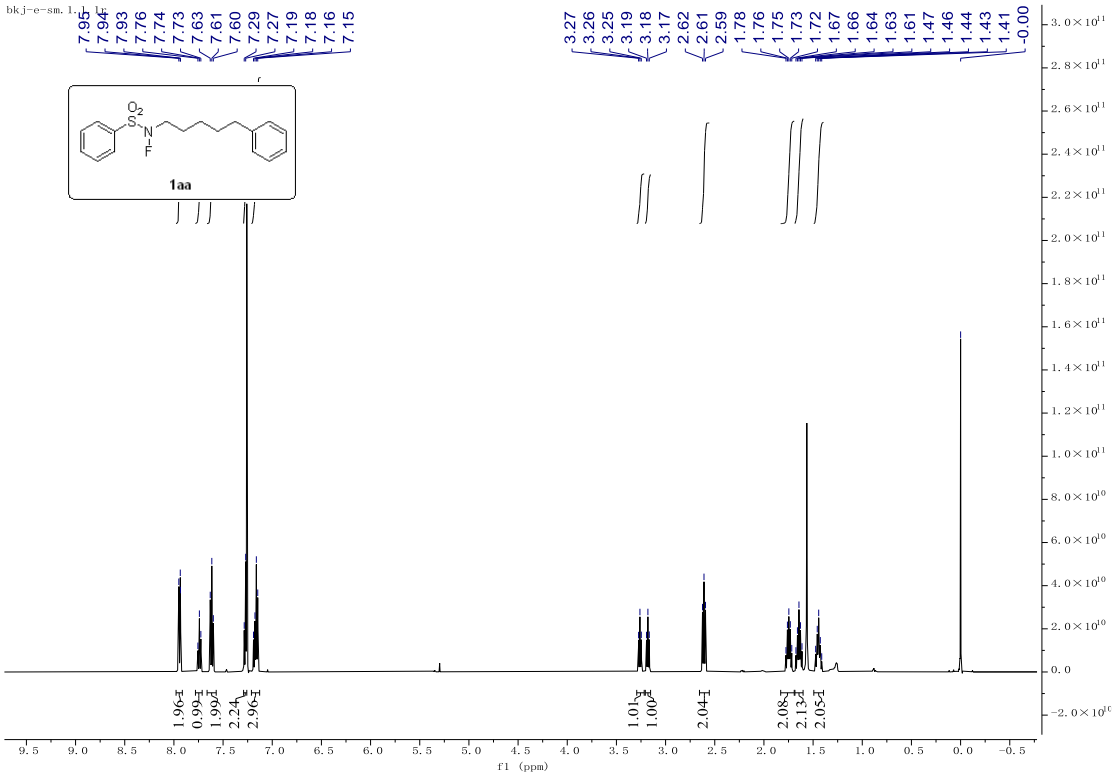

1aa
134.98
130.09
129.41
53.87
53.75
31.85
29.19
26.70
26.42
22.74
14.21
f1 (ppm)

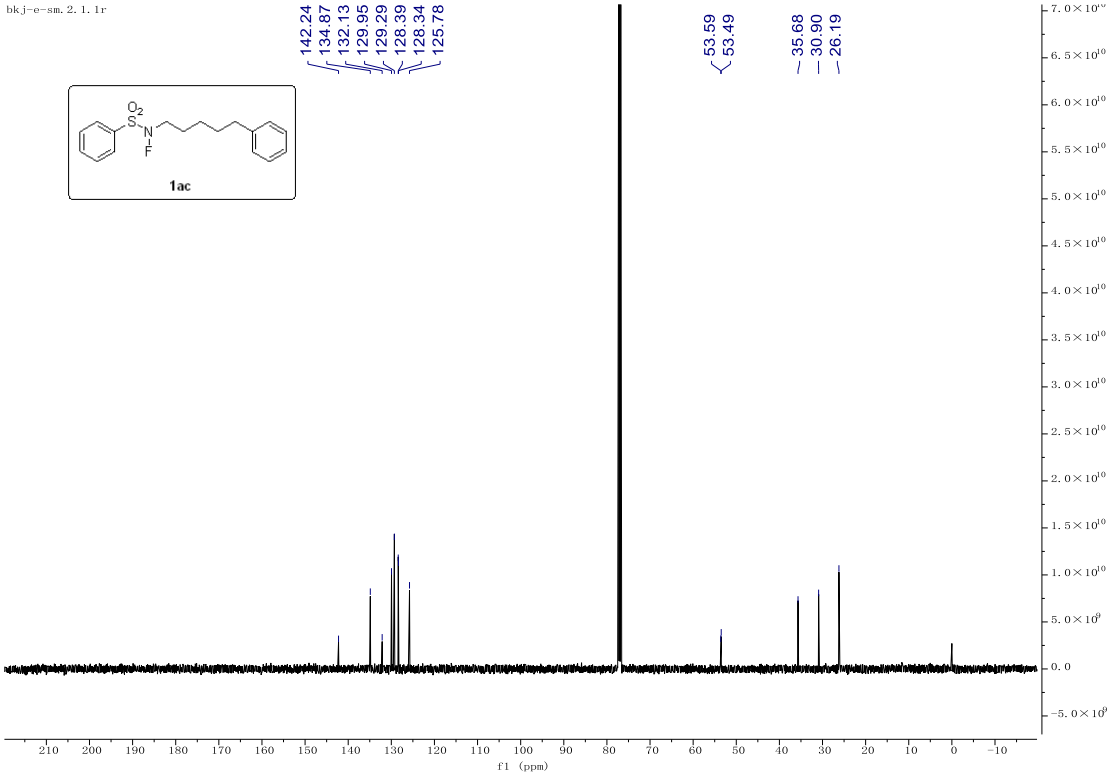

1aa
-49.88
-49.99
-50.10
f1 (ppm)

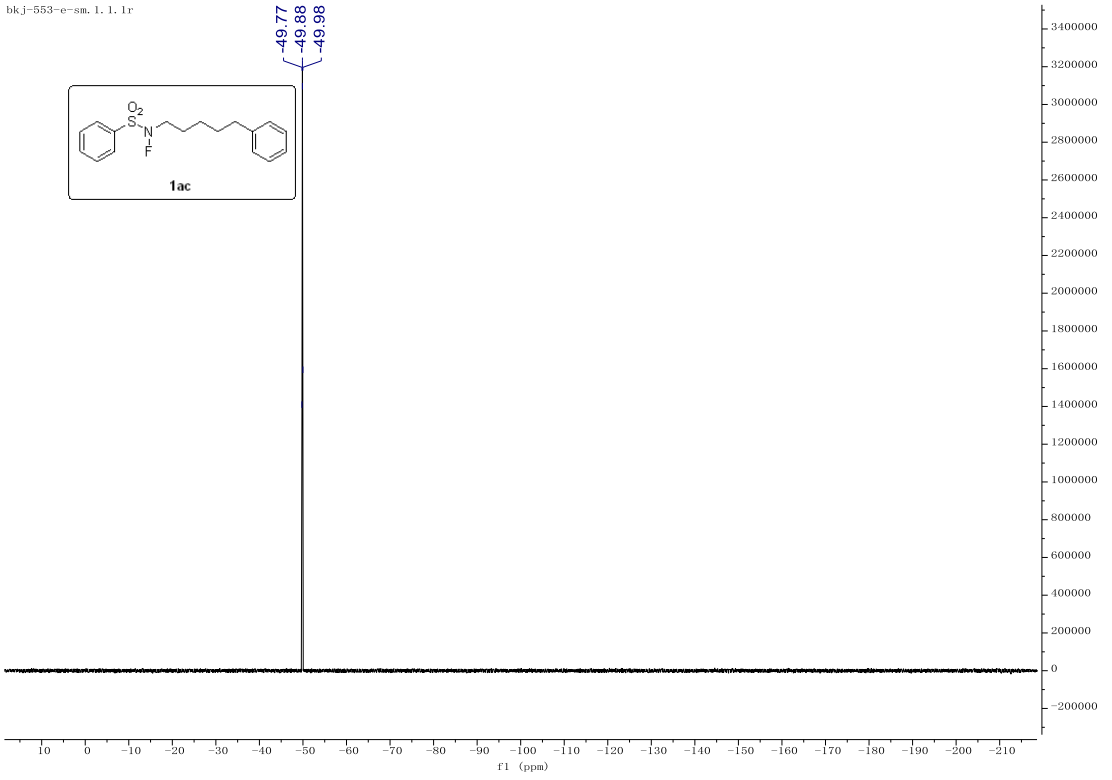

bkj-553-d-sm-6.10.10.1.r
7.97
7.95
7.77
7.75
7.73
7.64
7.63
7.61
3.29
3.28
3.26
3.19
3.17
3.16
1.73
1.71
1.70
1.68
1.66
1.54
1.53
1.51
1.49
1.43
1.41
1.39
1.37
1.35
1.21
1.19
1.17
1.15
0.87
0.86
-0.00
1aa
1.98
0.99
2.00
1.02
1.03
2.26
1.35
2.13
2.14
6.50
f1 (ppm)


bkj-553-d-sm-6.10.11.1.1r
134.99
132.22
130.09
129.42
53.89
53.77
38.51
27.96
26.66
24.52
22.65
1ab
f1 (ppm)

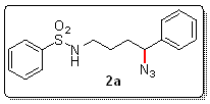

bkj-553-d-sm-6.10.12.1.1r
-49.93
-50.04
-50.15
1ab
f1 (ppm)

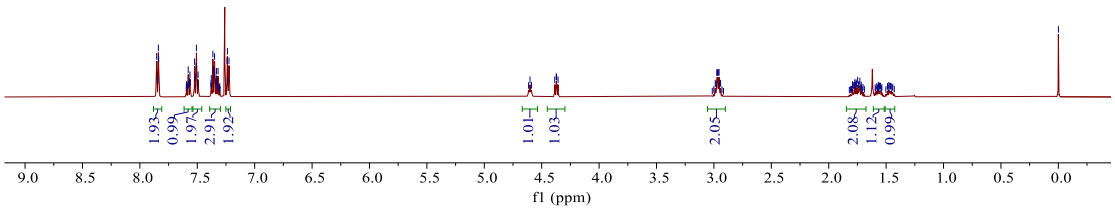

bkj-e-sm.1.1r
7.95
7.94
7.93
7.76
7.74
7.73
7.63
7.61
7.60
7.29
7.27
7.19
7.18
7.16
7.15
3.27
3.26
3.25
3.19
3.18
3.17
2.62
2.61
2.59
1.78
1.76
1.75
1.73
1.72
1.67
1.66
1.64
1.63
1.61
1.47
1.46
1.44
1.43
1.41
0.00
1aa
1.96
0.99
1.99
2.24
2.96
1.01
1.00
2.04
2.08
2.13
2.05
f1 (ppm)

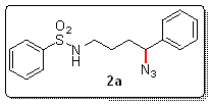

bkj-e-sm.2.1.1r
142.24
134.87
132.13
129.95
129.29
128.39
128.34
125.78
53.59
53.49
35.68
30.90
26.19
1ac
f1 (ppm)


bkj-553-e-sm.1.1.1r
-49.77
-49.88
-49.98
1ac
f1 (ppm)

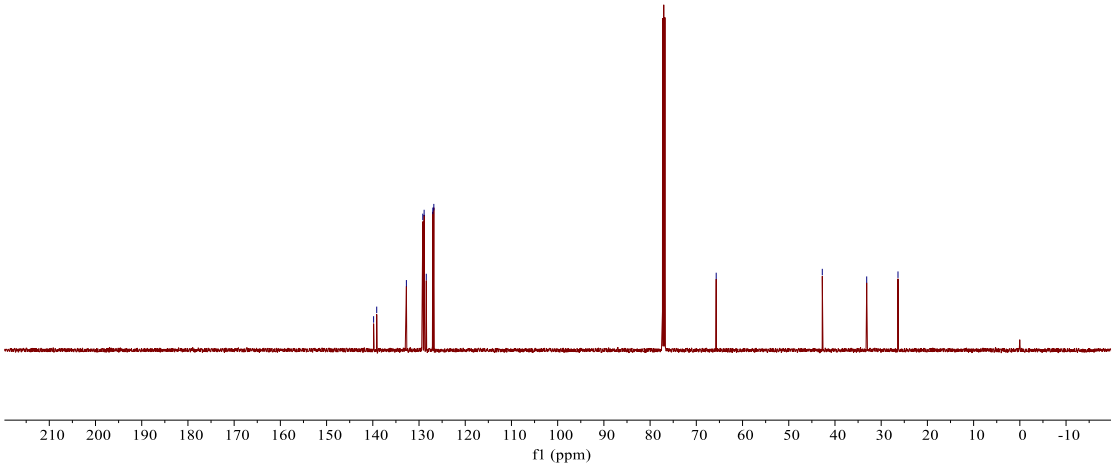

7.85
7.84
7.84
7.84
7.59
7.58
7.57
7.57
7.56
7.56
7.52
7.52
7.51
7.51
7.50
7.49
7.38
7.38
7.37
7.36
7.36
7.35
7.35
7.34
7.33
7.33
7.32
7.32
7.24
7.24
7.23
7.22
4.60
4.59
4.39
4.37
4.37
4.36
2.99
2.98
2.98
2.97
2.96
2.96
2.95
2.94
1.79
1.77
1.77
1.76
1.76
1.75
1.74
1.74
1.73
1.72
1.57
1.48
-0.00


2a

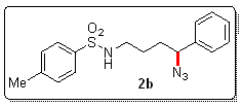

1.93
0.99
1.97
2.91
1.92
1.01
1.03
2.05
2.08
1.12
0.99
f1 (ppm)

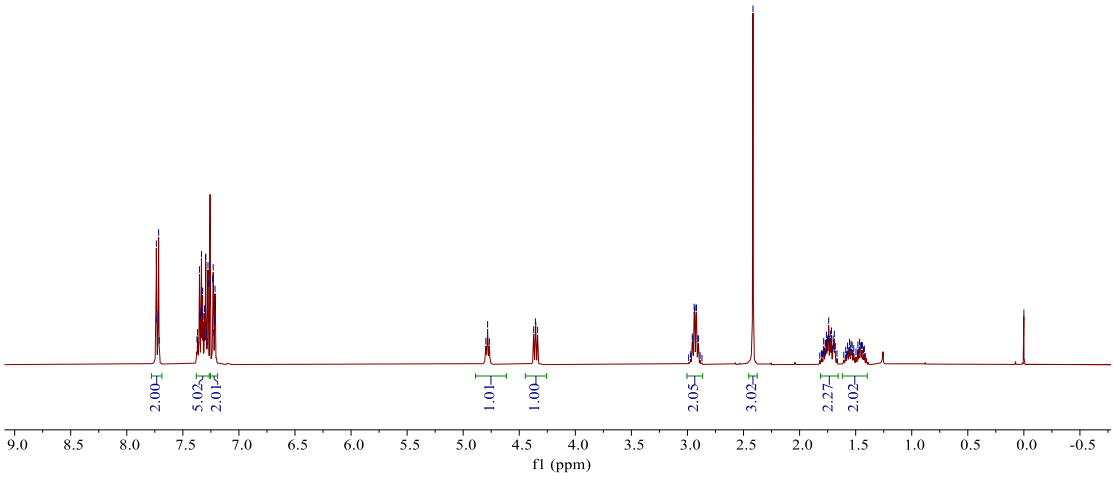

O2
S
N
H
N3
2a

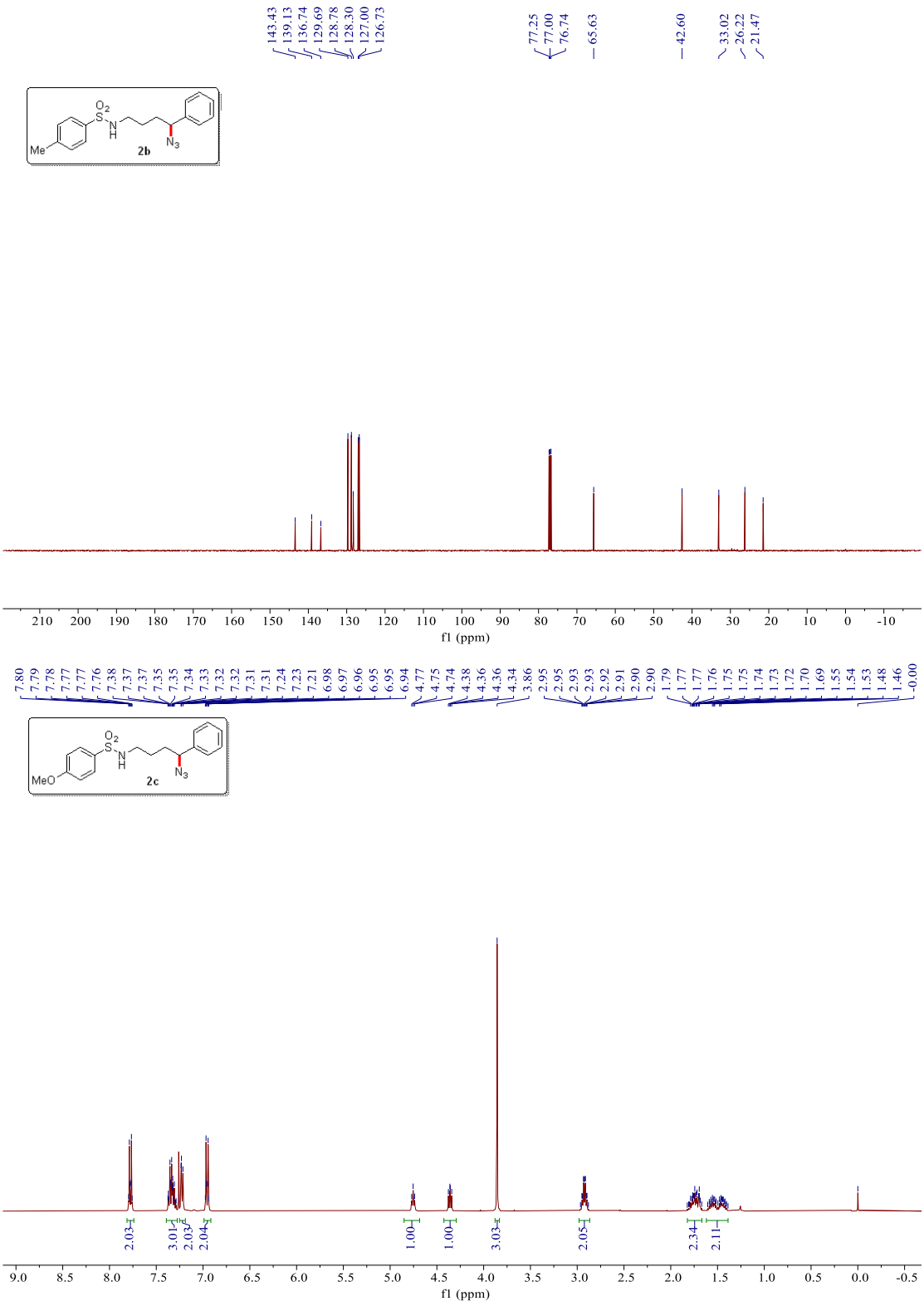

139.82
139.15
132.73
129.18
128.90
128.43
127.01
126.80
65.70
42.74
33.13
26.36

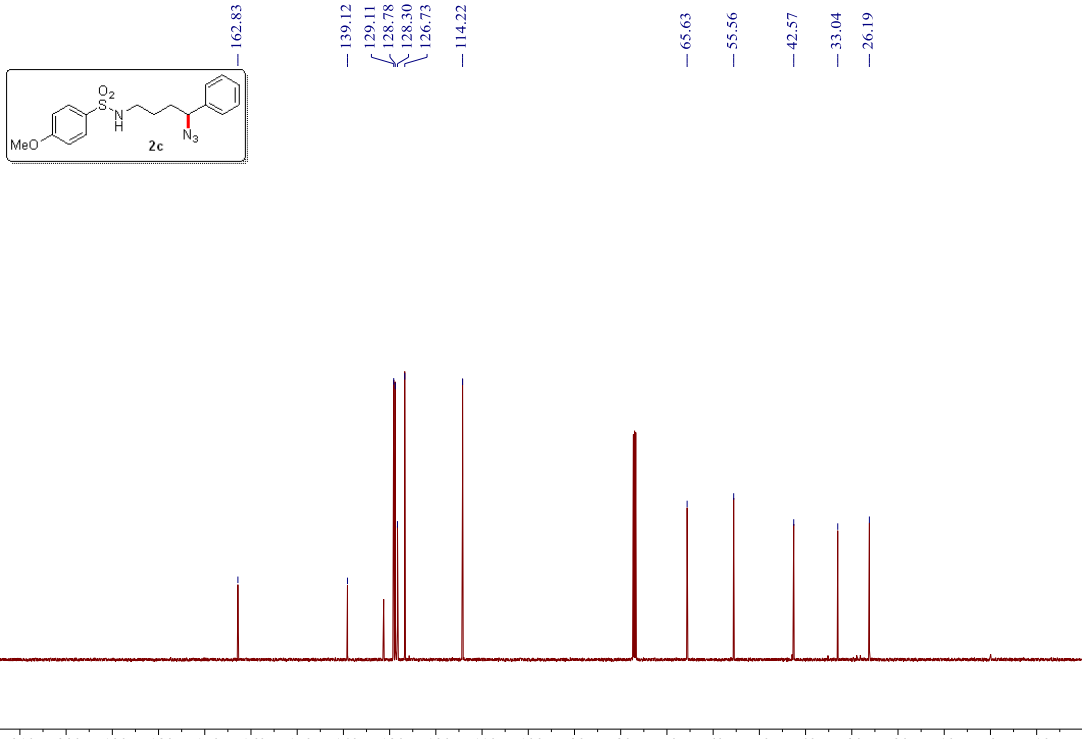

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.74
7.73
7.72
7.72
7.71
7.37
7.37
7.35
7.35
7.34
7.33
7.33
7.32
7.32
7.31
7.31
7.30
7.30
7.29
7.28
7.28
7.27
7.23
7.23
7.22
7.22
7.21
7.21
4.80
4.78
4.77
4.37
4.36
4.35
4.34
2.96
2.95
2.94
2.94
2.92
2.92
2.91
2.90
2.42
1.79
1.77
1.76
1.75
1.75
1.75
1.74
1.73
1.73
1.72
1.70
1.69
1.56
1.46
-0.00

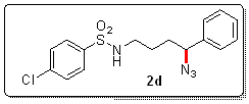

O2
S
N
H
N3
Me
2b

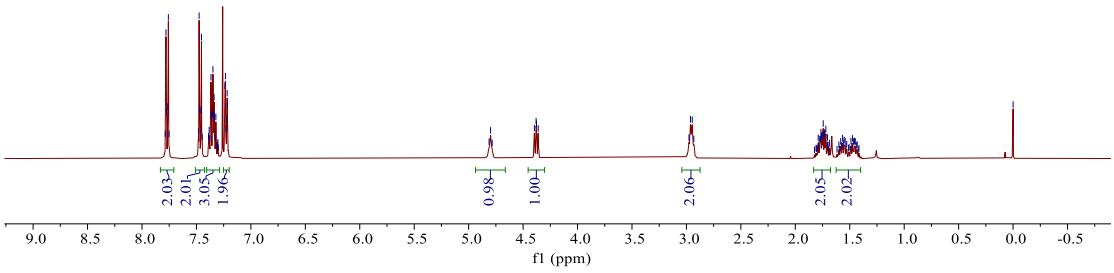

2.00
5.02
2.01
1.01
1.00
2.05
3.02
2.27
2.02
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

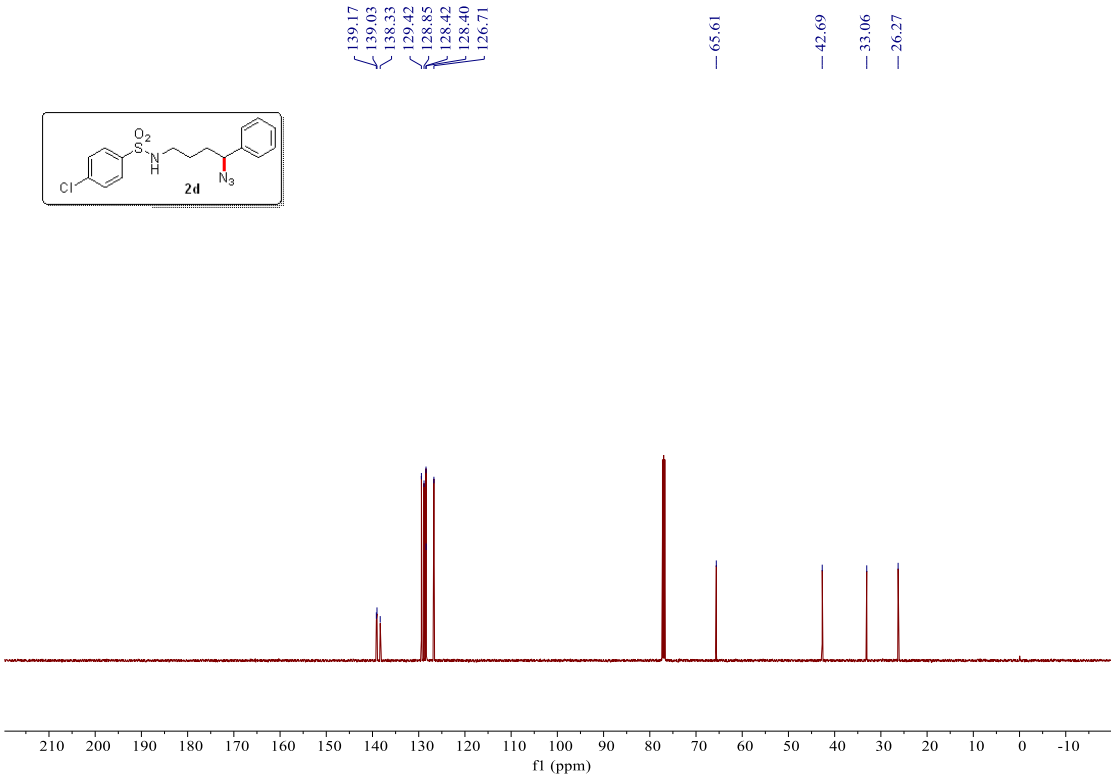

143.43
139.13
136.74
129.69
128.78
128.30
127.00
126.73
77.25
77.00
76.74
65.63
42.60
33.02
26.22
21.47
Me
2b
f1 (ppm)
7.80
7.79
7.78
7.77
7.77
7.76
7.38
7.37
7.37
7.35
7.35
7.34
7.33
7.32
7.32
7.31
7.31
7.24
7.23
7.21
6.98
6.97
6.96
6.95
6.94
4.77
4.75
4.74
4.38
4.36
4.36
4.34
3.86
2.95
2.95
2.93
2.93
2.92
2.91
2.90
2.90
1.79
1.77
1.77
1.76
1.75
1.75
1.74
1.73
1.72
1.70
1.69
1.55
1.54
1.53
1.48
1.46
-0.00
MeO
2c
2.03
3.01
2.03
2.04
1.00
1.00
3.03
2.05
2.34
2.11
f1 (ppm)

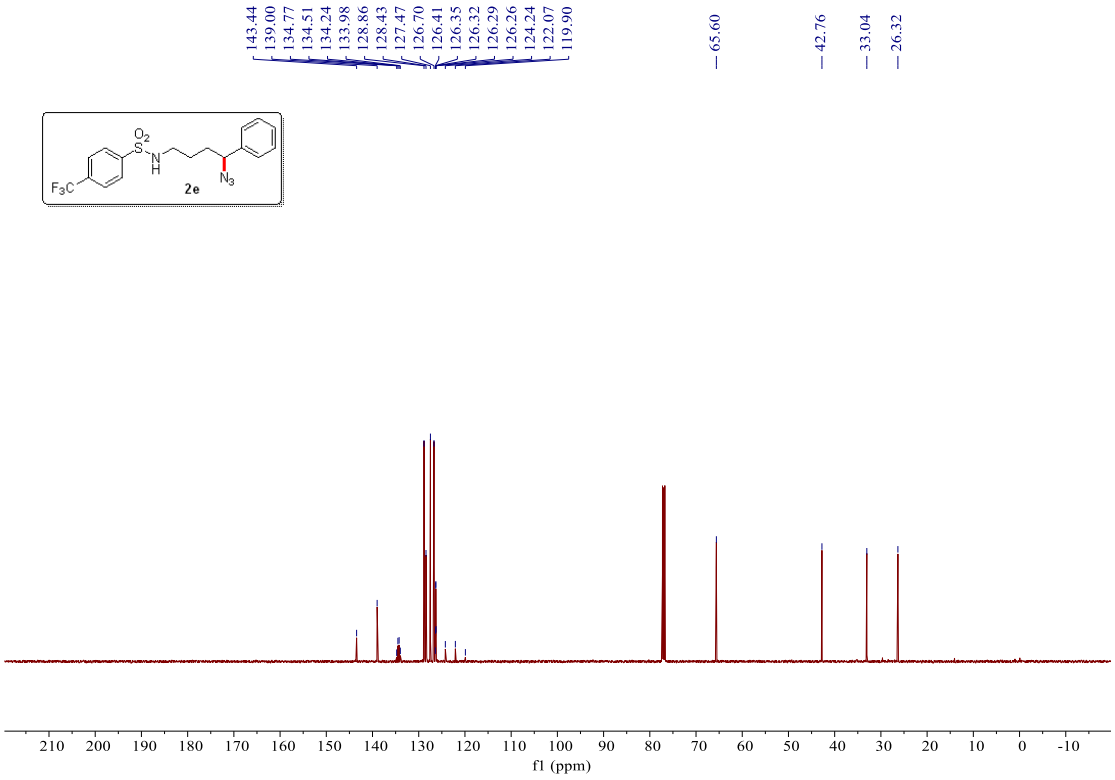

162.83
139.12
129.11
128.78
128.30
126.73
114.22
65.63
55.56
42.57
33.04
26.19
MeO
2c
f1 (ppm)

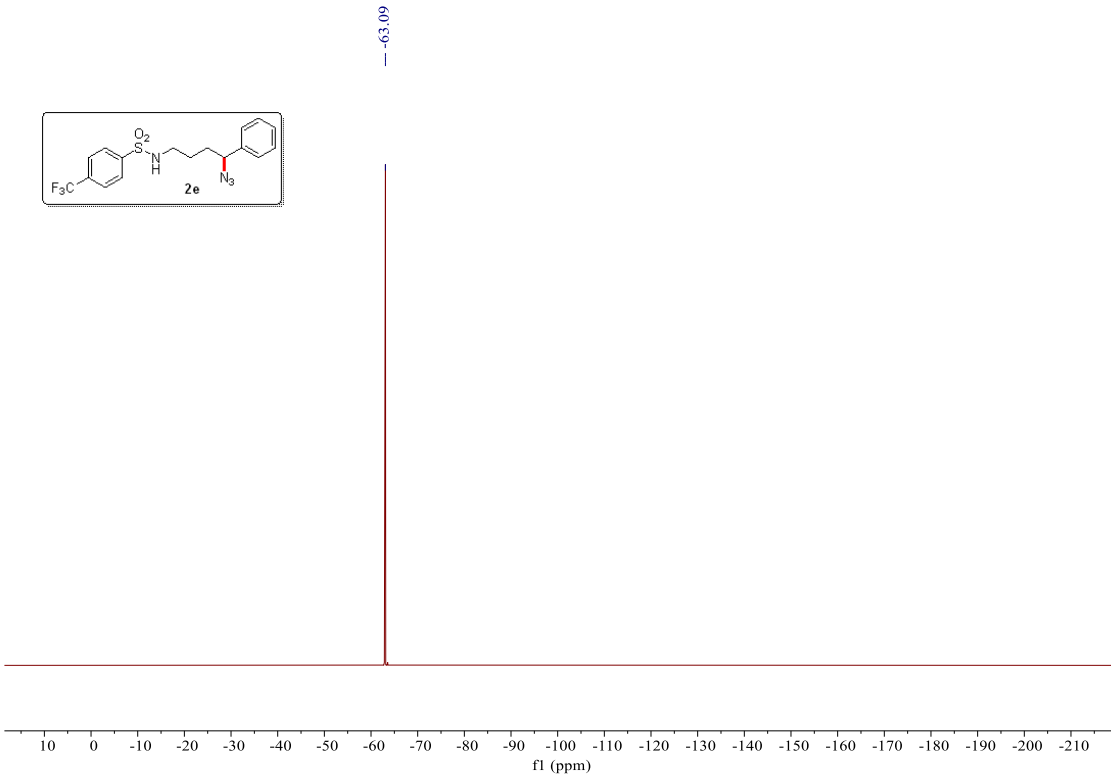

7.79
7.78
7.77
7.76
7.76
7.75
7.48
7.48
7.47
7.46
7.45
7.45
7.39
7.38
7.38
7.37
7.36
7.35
7.35
7.34
7.34
7.33
7.33
7.32
7.24
7.23
7.23
7.22
7.22
7.21
4.80
4.40
4.38
4.36
2.98
2.96
2.95
2.93
1.79
1.78
1.77
1.76
1.76
1.76
1.75
1.74
1.73
1.73
1.73
1.72
1.70
1.57
1.55
1.54
1.49
1.47
1.46
-0.00

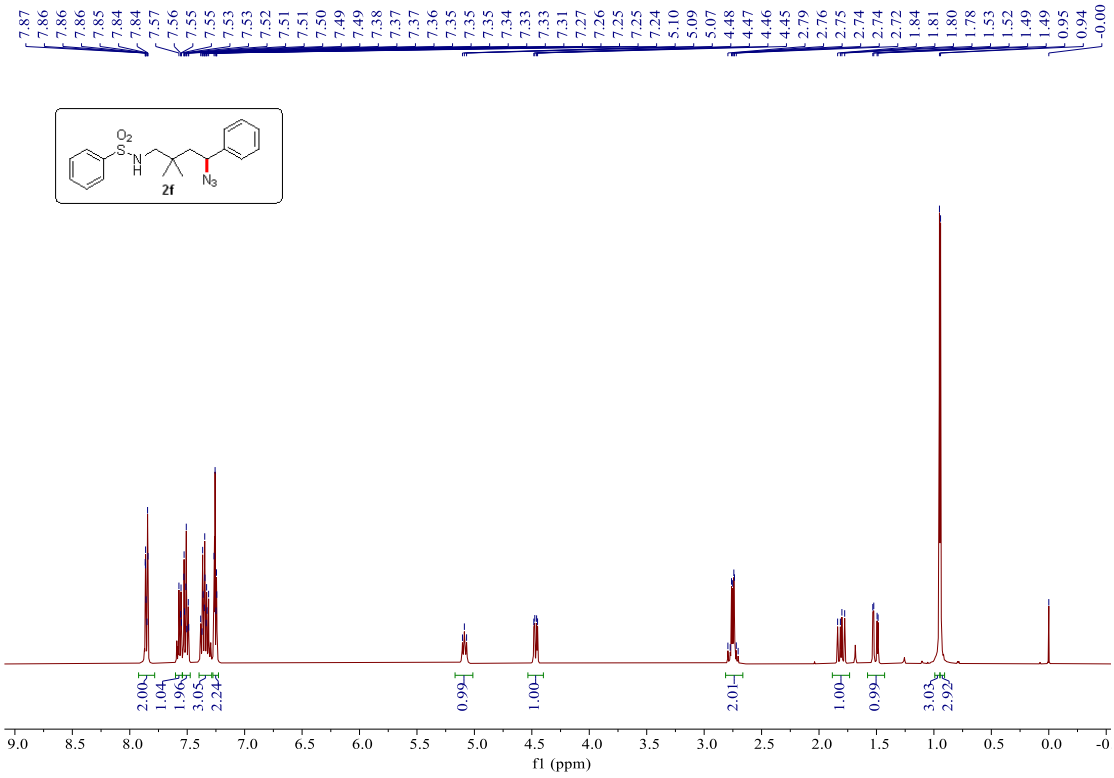

Cl
2d

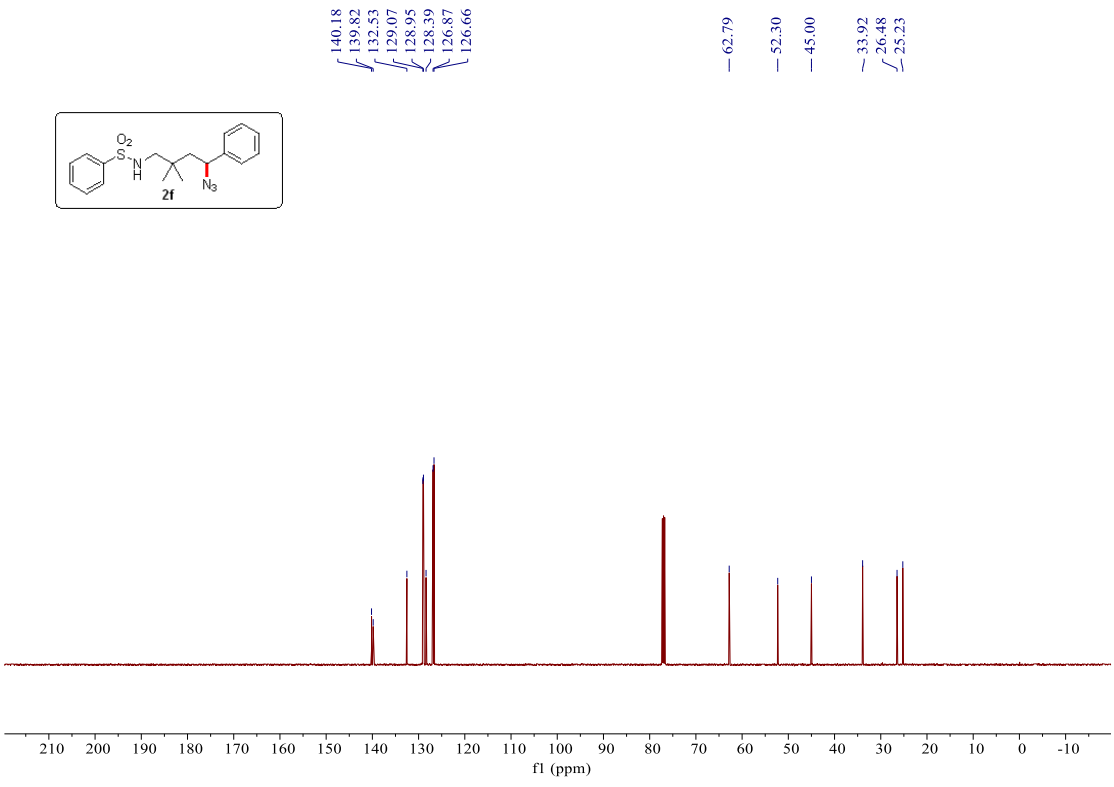

2.03
2.01
3.05
1.96
0.98
1.00
2.06
2.05
2.02
f1 (ppm)


139.17
139.03
138.33
129.42
128.85
128.42
128.40
126.71
65.61
42.69
33.06
26.27
2d
f1 (ppm)
7.98
7.96
7.77
7.77
7.75
7.38
7.37
7.37
7.36
7.36
7.35
7.35
7.34
7.34
7.34
7.34
7.34
7.33
7.33
7.32
7.31
7.31
7.26
7.24
7.23
7.22
7.22
7.21
4.40
4.38
4.36
3.01
3.01
2.99
2.97
2.96
2.96
1.80
1.78
1.78
1.77
1.76
1.76
1.75
1.74
1.74
1.73
1.73
1.72
1.71
1.60
1.58
1.57
1.56
1.50
1.49
1.47
-0.00
2e
2.05
2.04
3.16
1.85
0.99
1.00
2.06
2.32
2.10
f1 (ppm)

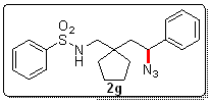

143.44
139.00
134.77
134.51
134.24
133.98
128.86
128.43
127.47
126.70
126.41
126.35
126.32
126.29
126.26
124.24
122.07
119.90
65.60
42.76
33.04
26.32
2e
f1 (ppm)

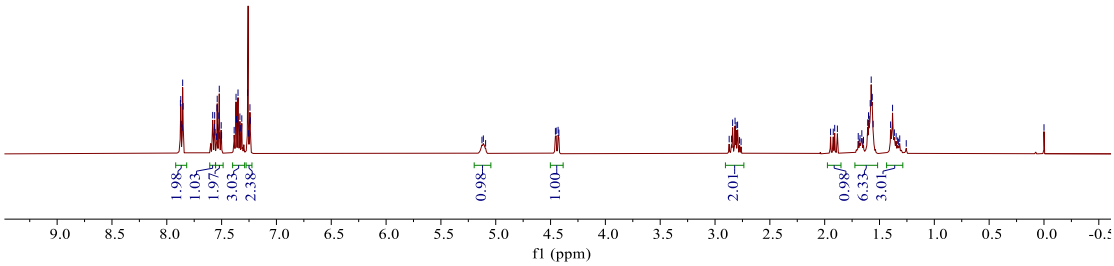

-63.09
2e
f1 (ppm)


7.87 7.86 7.86 7.86 7.85 7.84 7.84 7.57 7.56 7.55 7.55 7.53 7.53 7.52 7.51 7.51 7.50 7.49 7.49 7.38 7.37 7.37 7.36 7.35 7.35 7.35 7.34 7.33 7.33 7.31 7.27 7.26 7.25 7.25 7.24 5.10 5.09 5.07 4.48 4.47 4.46 4.45 2.79 2.76 2.75 2.74 2.74 2.72 1.84 1.81 1.80 1.78 1.53 1.52 1.49 1.49 0.95 0.94 -0.00
O2
S
N
H
N3
2f
2.00 1.04 1.96 3.05 2.24 0.99 1.00 2.01 1.00 0.99 3.03 2.92
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0
f1 (ppm)

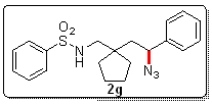

140.18 139.82 132.53 129.07 128.95 128.39 126.87 126.66
62.79 52.30 45.00 33.92 26.48 25.23
O2
S
N
H
N3
2f
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

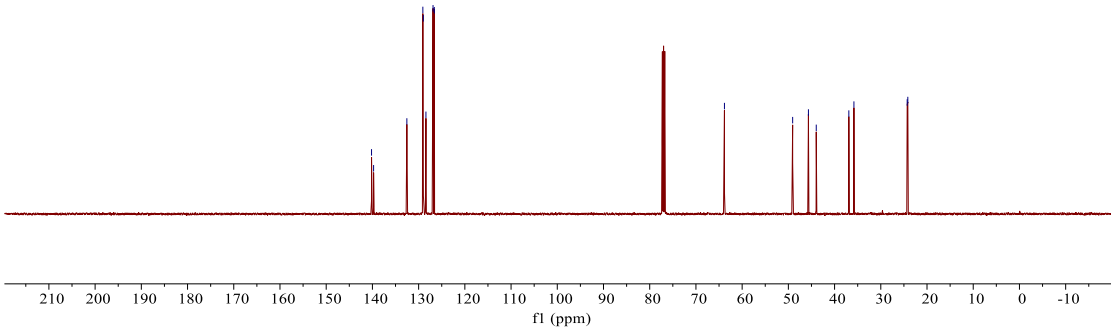

7.88
7.87
7.87
7.86
7.86
7.85
7.58
7.57
7.56
7.56
7.54
7.54
7.54
7.53
7.52
7.52
7.50
7.50
7.39
7.37
7.36
7.35
7.35
7.34
7.33
7.33
7.32
7.26
7.25
7.25
7.24
7.24
4.46
4.45
4.43
4.42
2.84
2.82
2.81
2.79
1.95
1.92
1.91
1.88
1.69
1.66
1.61
1.60
1.59
1.58
1.58
1.57
1.57
1.56
1.40
1.38
1.36
1.35
-0.00


O2
S
NH
N3
2g

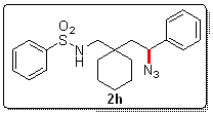

1.98
1.03
1.97
3.03
2.38
0.98
1.00
2.01
0.98
6.33
3.01
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

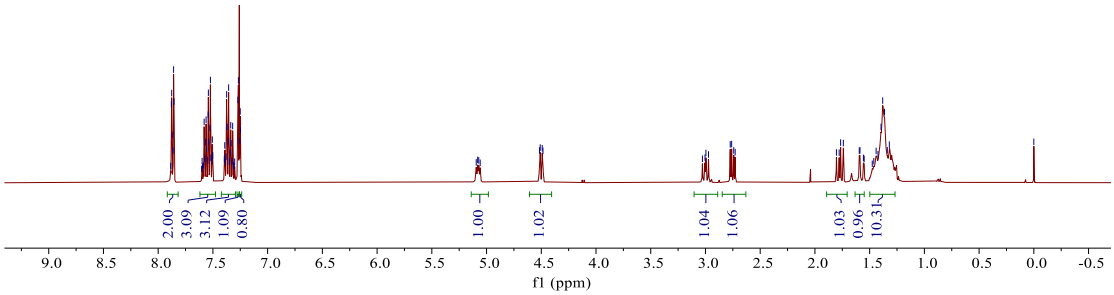

140.19
139.74
132.55
129.09
128.99
128.42
126.88
126.61
63.83
49.07
45.66
43.97
36.92
35.81
24.29
24.15


O2
S
NH
N3
2g

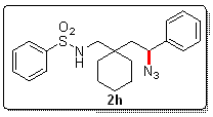

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

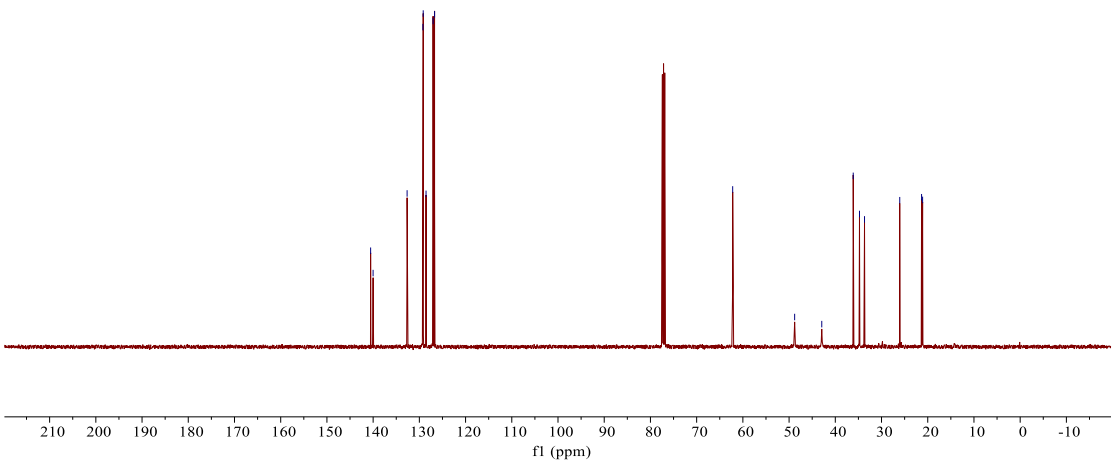

7.88
7.88
7.87
7.86
7.86
7.86
7.58
7.57
7.56
7.56
7.54
7.54
7.54
7.53
7.52
7.52
7.51
7.50
7.39
7.38
7.37
7.37
7.36
7.36
7.34
7.34
7.33
7.32
7.27
7.27
7.25
7.25
7.25
4.52
4.51
4.49
4.48
3.00
3.00
2.97
2.77
2.76
2.74
2.73
1.80
1.78
1.77
1.74
1.59
1.59
1.56
1.44
1.42
1.40
1.38
1.36
1.34
1.32
0.00


O2
S
N
H
N3
2h

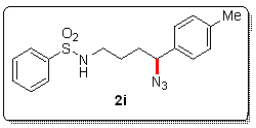

2.00
3.09
3.12
1.09
0.80
1.00
1.02
1.04
1.06
1.03
0.96
10.31
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

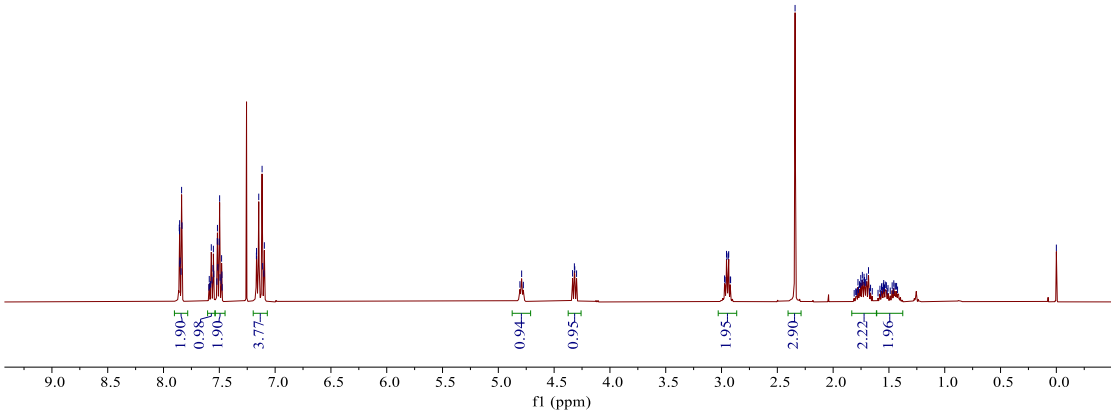

140.54
140.01
132.65
129.23
129.16
128.55
127.03
126.71
62.20
48.80
42.93
36.12
34.77
33.68
26.06
21.33
21.11


O2
S
N
H
N3
2h

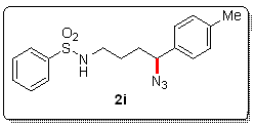

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

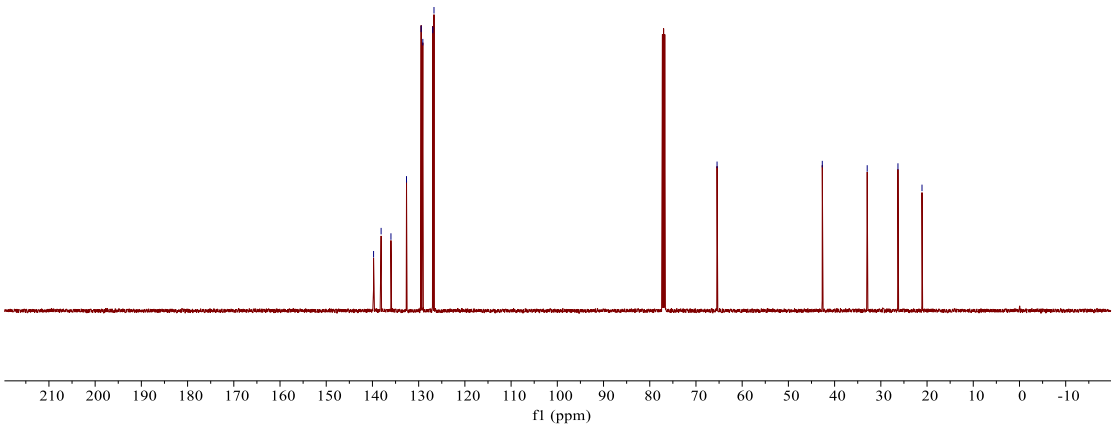

7.86
7.86
7.86
7.85
7.85
7.84
7.84
7.83
7.59
7.57
7.57
7.56
7.55
7.55
7.52
7.52
7.52
7.51
7.50
7.50
7.49
7.48
7.48
7.48
7.17
7.17
7.15
7.12
7.11
7.10
7.10
4.79
4.33
4.32
4.32
4.30
2.97
2.97
2.96
2.95
2.94
2.94
2.92
2.92
2.34
1.78
1.75
1.74
1.74
1.73
1.72
1.72
1.71
1.71
1.70
1.68
1.55
1.46
-0.00

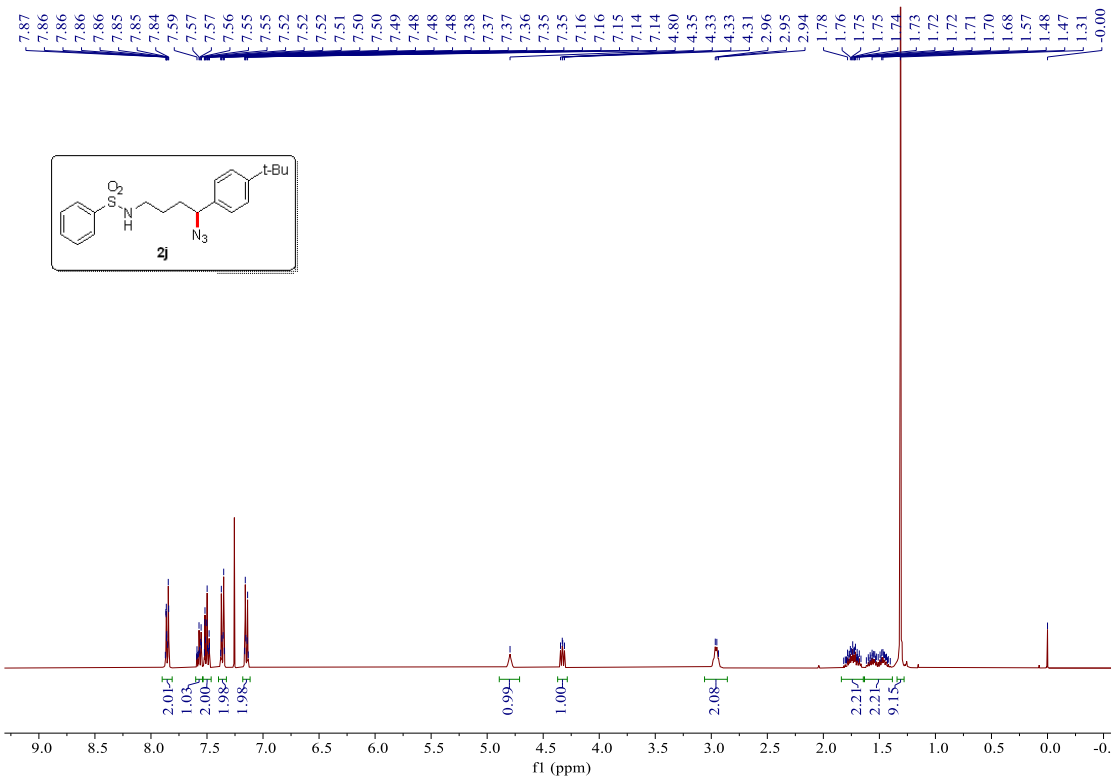

Me
O2
S
N
H
N3
2i

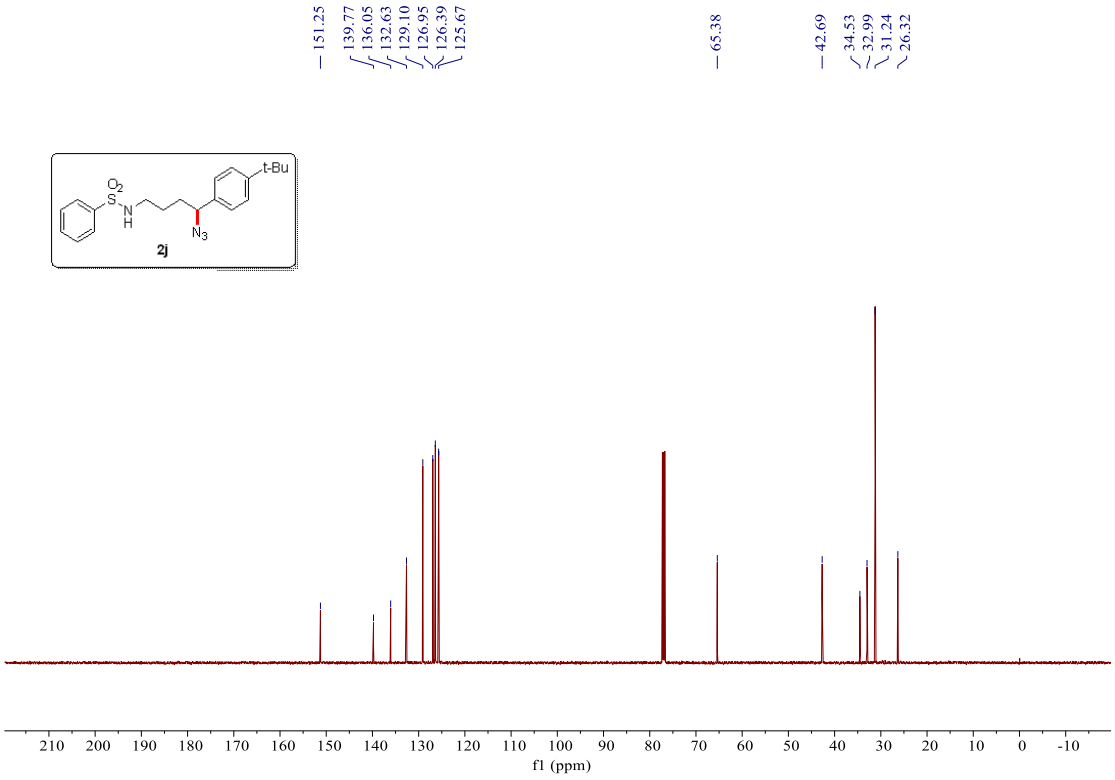

1.90
0.98
1.90
3.77
0.94
0.95
1.95
2.90
2.22
1.96
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


139.76
138.13
136.00
132.63
129.47
129.10
126.94
126.68
65.44
42.67
32.95
26.30
21.09

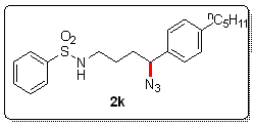

Me
O2
S
N
H
N3
2i

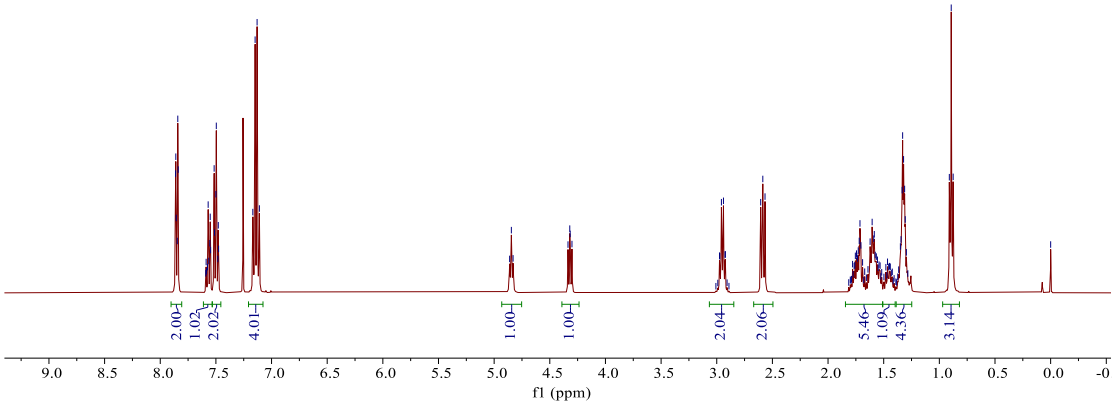

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


7.87 7.86 7.86 7.86 7.86 7.85 7.85 7.84 7.59 7.57 7.57 7.56 7.55 7.55 7.52 7.52 7.52 7.51 7.50 7.50 7.49 7.48 7.48 7.48 7.38 7.37 7.37 7.36 7.35 7.35 7.16 7.16 7.15 7.14 7.14 4.80 4.35 4.33 4.33 4.31 2.96 2.95 2.94 1.78 1.76 1.75 1.75 1.74 1.73 1.72 1.72 1.71 1.70 1.68 1.57 1.48 1.47 1.31 -0.00
t-Bu
O2
S
N
H
N3
2j
2.01 1.03 2.00 1.98 1.98 0.99 1.00 2.08 2.21 2.21 9.15
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.
f1 (ppm)

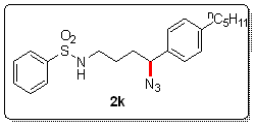

151.25 139.77 136.05 132.63 129.10 126.95 126.39 125.67 65.38 42.69 34.53 32.99 31.24 26.32
t-Bu
O2
S
N
H
N3
2j
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

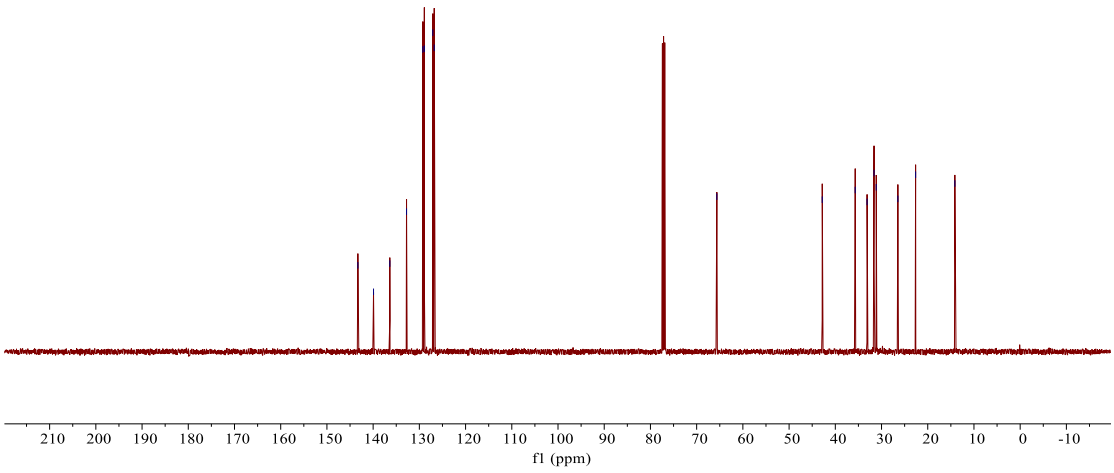

7.86
7.86
7.86
7.85
7.84
7.84
7.57
7.55
7.55
7.55
7.52
7.51
7.50
7.50
7.48
7.48
7.17
7.15
7.13
7.11
4.85
4.34
4.32
4.32
4.30
2.98
2.97
2.96
2.94
2.92
2.92
2.61
2.59
2.57
1.75
1.74
1.74
1.73
1.72
1.71
1.70
1.62
1.60
1.59
1.58
1.58
1.57
1.35
1.34
1.33
1.33
1.32
1.31
1.31
1.30
0.91
0.89
0.88
-0.00


O2
S
N
H
N3
nC5H11
2k

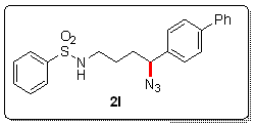

2.00
1.02
2.02
4.01
1.00
1.00
2.04
2.06
5.46
1.09
4.36
3.14
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0
f1 (ppm)

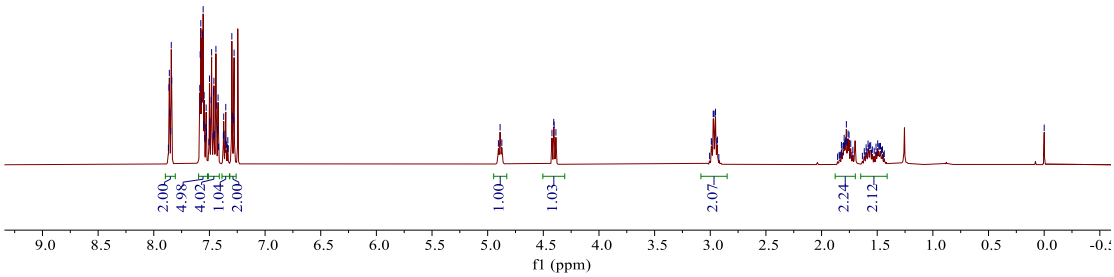

143.31
139.92
136.39
132.78
129.25
128.93
127.10
126.79
65.64
42.83
35.70
33.13
31.62
31.15
26.46
22.63
14.14


O2
S
N
H
N3
nC5H11
2k

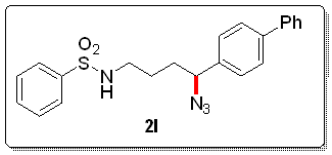

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

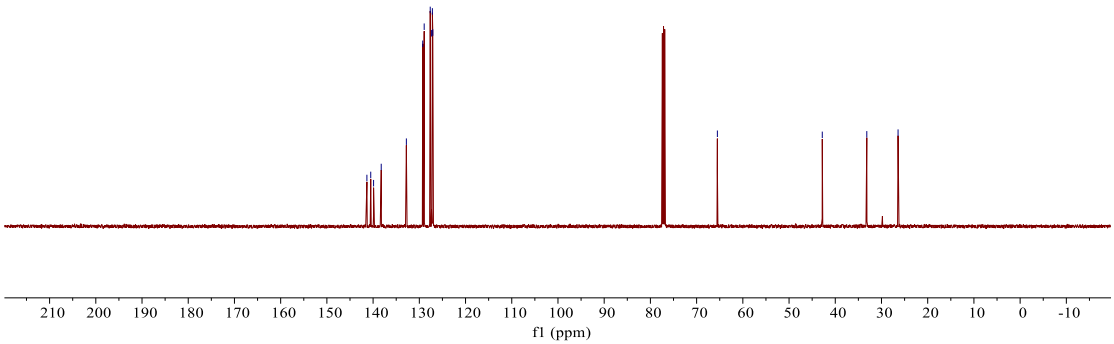

7.86
7.86
7.86
7.85
7.84
7.84
7.59
7.58
7.58
7.57
7.57
7.56
7.56
7.55
7.55
7.54
7.53
7.53
7.53
7.50
7.50
7.48
7.48
7.47
7.46
7.46
7.46
7.44
7.44
7.43
7.42
7.37
7.37
7.37
7.36
7.35
7.34
7.30
7.29
7.28
7.28
4.89
4.42
4.41
4.40
4.39
2.99
2.97
2.97
2.96
2.95
2.94
2.94
1.80
1.78
1.78
1.76
1.75
-0.00


O2
S
N
H
N3
Ph
2l

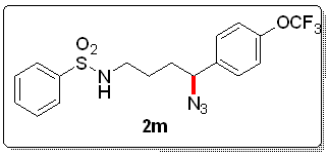

2.00
4.98
4.02
1.04
2.00
1.00
1.03
2.07
2.24
2.12
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

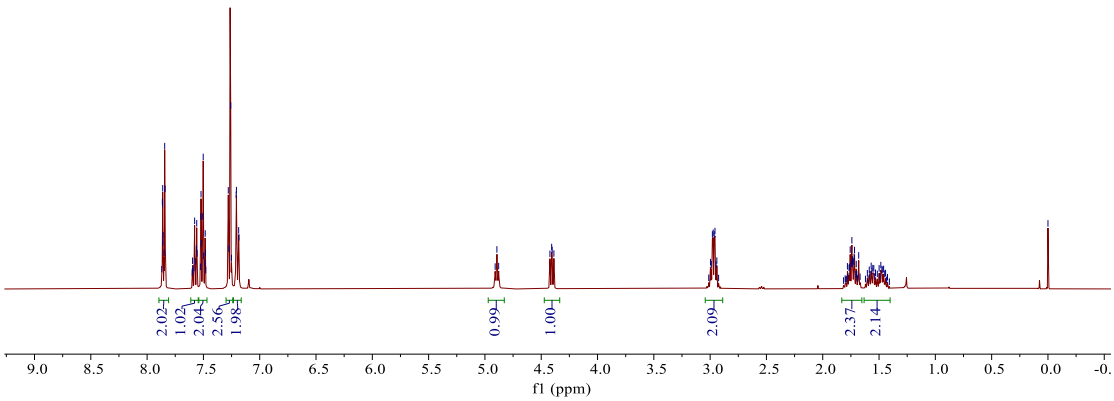

141.34
140.51
139.90
138.24
132.80
129.26
128.95
127.64
127.34
127.17
127.09
65.51
42.81
33.18
26.41


O2
S
N
H
N3
Ph
2l

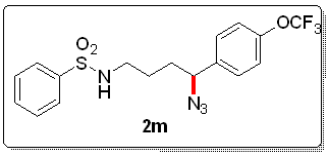

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

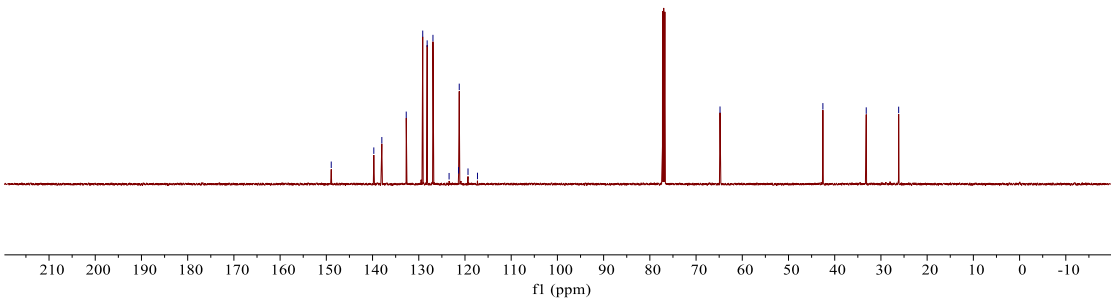

7.86
7.86
7.86
7.86
7.86
7.85
7.84
7.84
7.60
7.58
7.57
7.56
7.56
7.56
7.52
7.52
7.52
7.51
7.50
7.50
7.49
7.48
7.48
7.28
7.27
7.26
7.25
7.21
7.21
7.19
7.18
4.89
4.88
4.42
4.41
4.40
4.39
3.00
2.99
2.98
2.97
2.96
2.96
2.95
2.94
1.78
1.76
1.75
1.74
1.74
1.73
1.73
1.72
1.72
1.70
1.68
1.57
1.48
-0.00

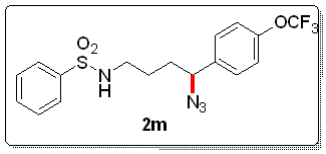

OCF3
O2
S
N
H
N3
2m


2.02
1.02
2.04
2.56
1.98
0.99
1.00
2.09
2.37
2.14
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


148.94
139.73
137.99
132.71
129.14
128.18
126.93
123.44
121.39
121.24
119.35
117.30
64.82
42.56
33.18
26.16


OCF3
O2
S
N
H
N3
2m

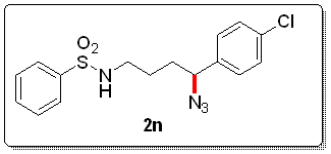

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


OCF3
O2
S
N
H
N3

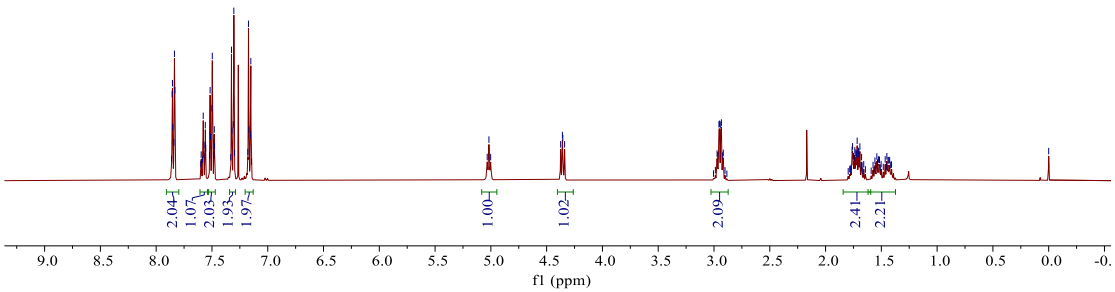
2m

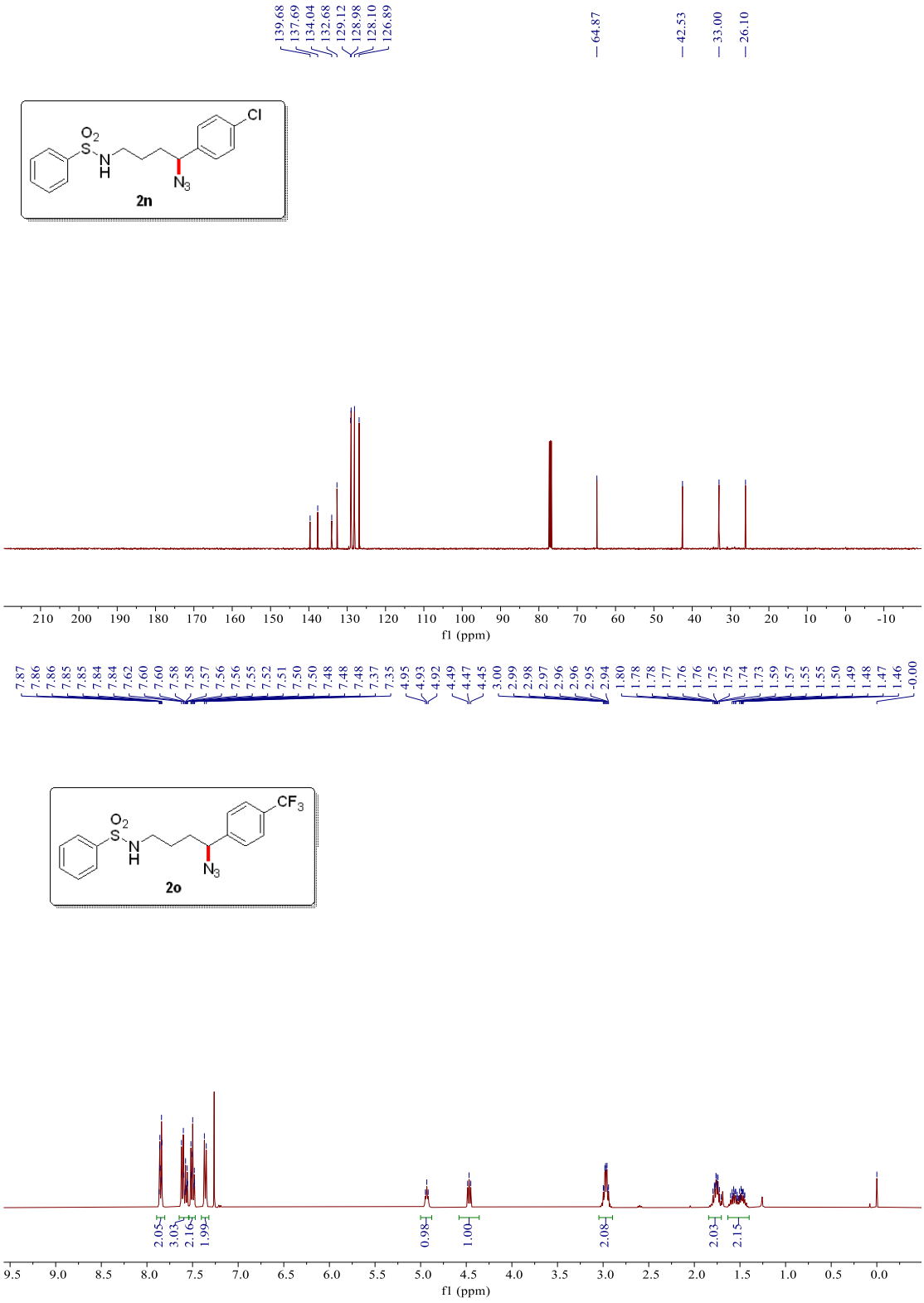
-57.83
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

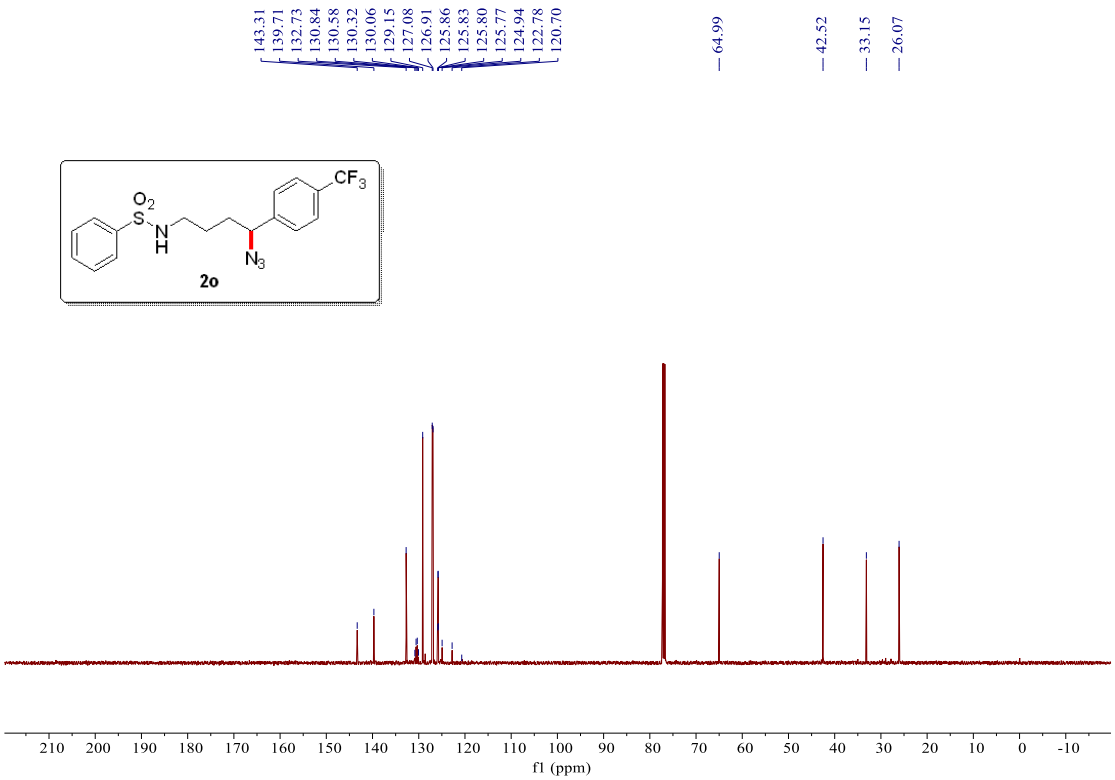
7.86 7.85 7.85 7.84 7.84 7.83 7.60 7.58 7.57 7.56 7.56 7.56 7.52 7.52 7.51 7.50 7.50 7.48 7.48 7.48 7.33 7.32 7.31 7.30 7.30 7.18 7.17 7.17 7.16 7.15 5.03 5.02 4.37 4.36 4.36 4.34 2.97 2.97 2.96 2.95 2.94 2.93 2.92 2.92 1.76 1.76 1.75 1.74 1.73 1.72 1.72 1.71 1.70 1.70 1.69 1.68 1.54 1.45 -0.00

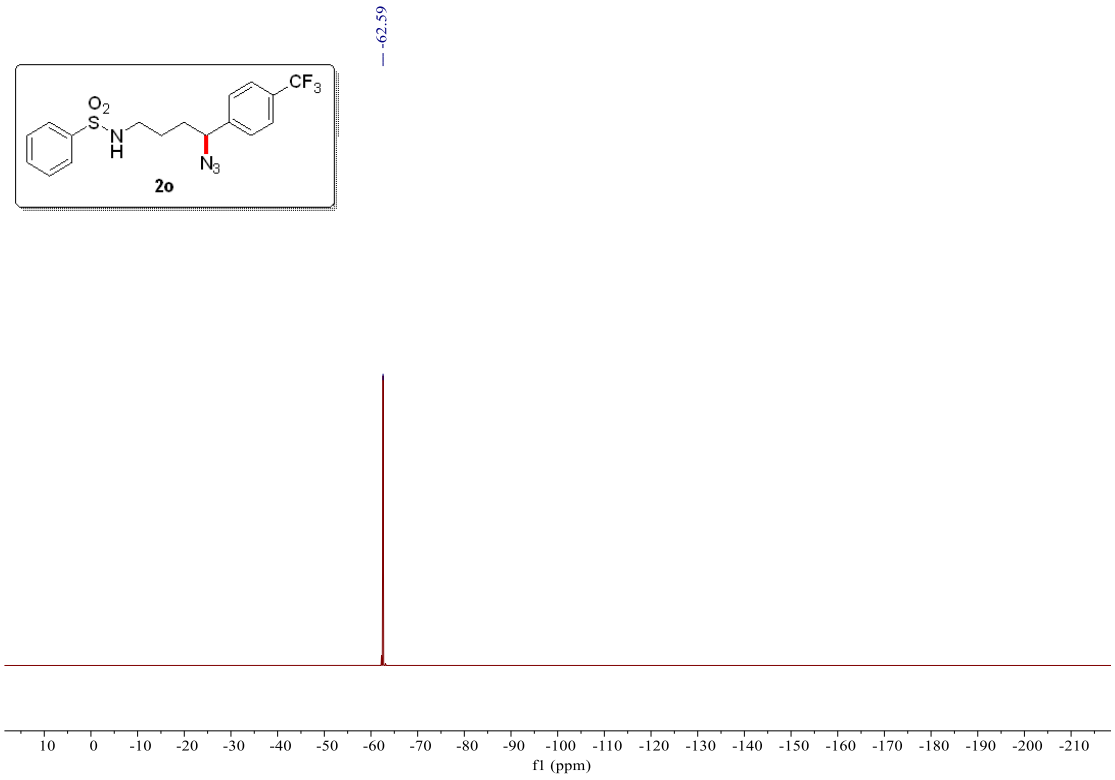

Cl
O2
S
N
H
N3

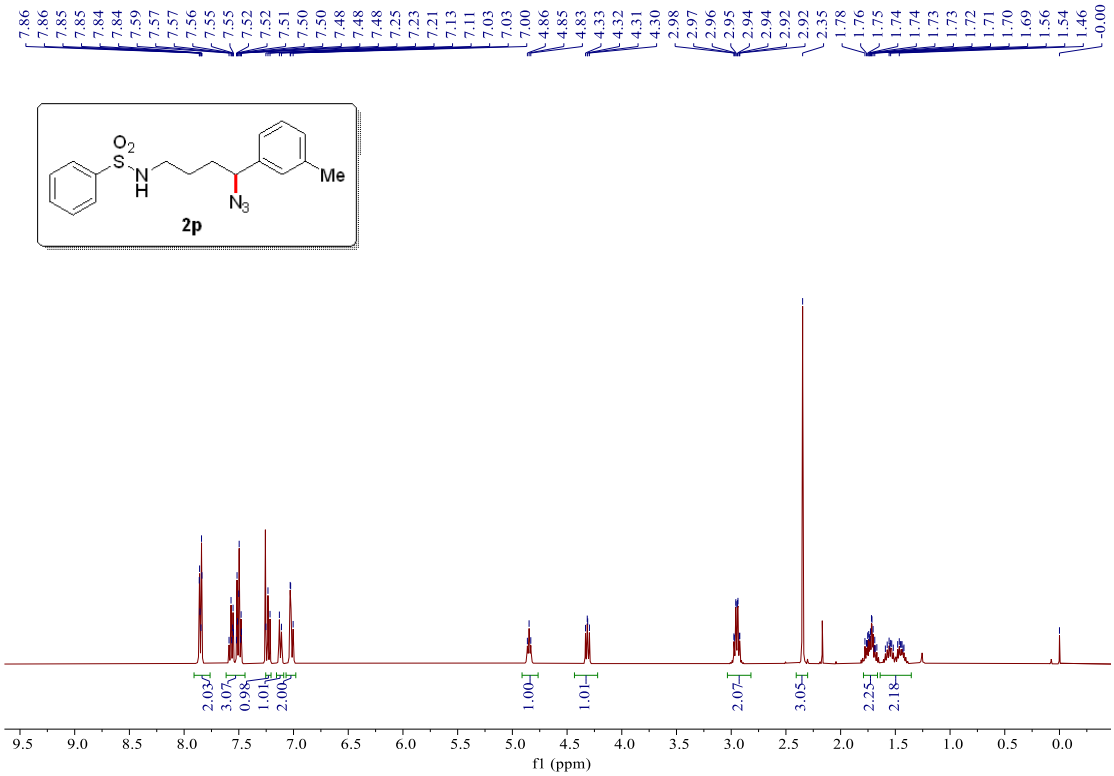
2n

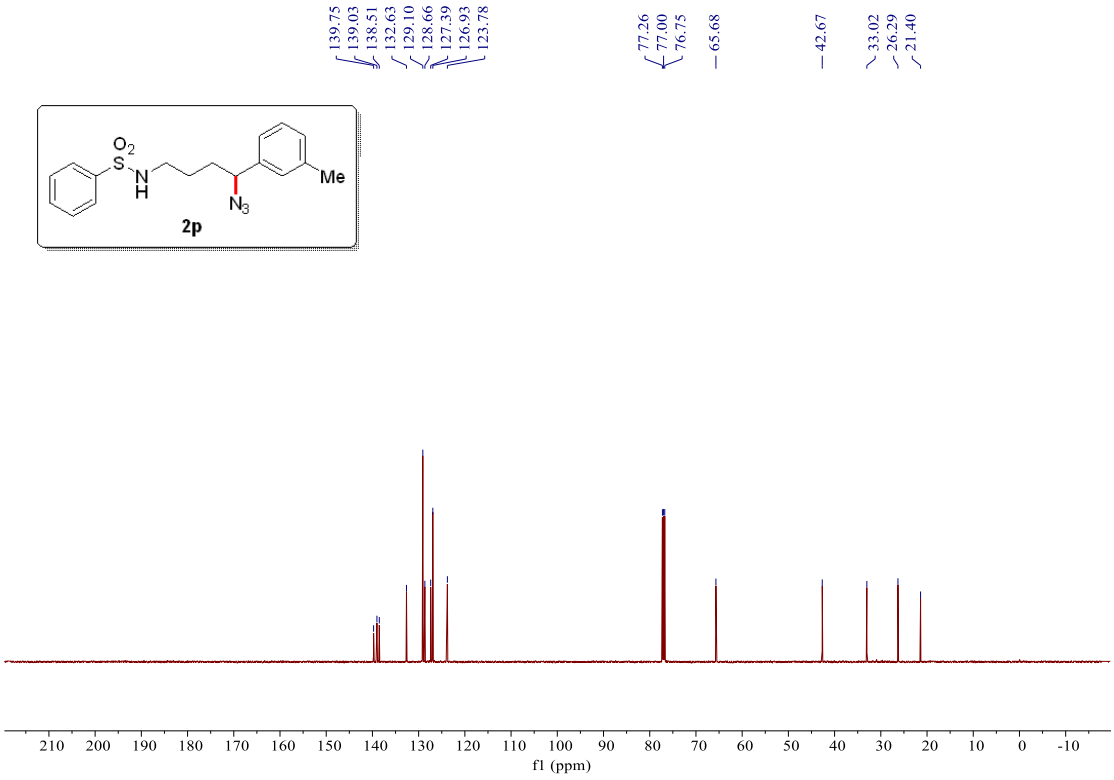

2.04 1.07 2.03 1.93 1.97 1.00 1.02 2.09 2.41 2.21
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.
f1 (ppm)

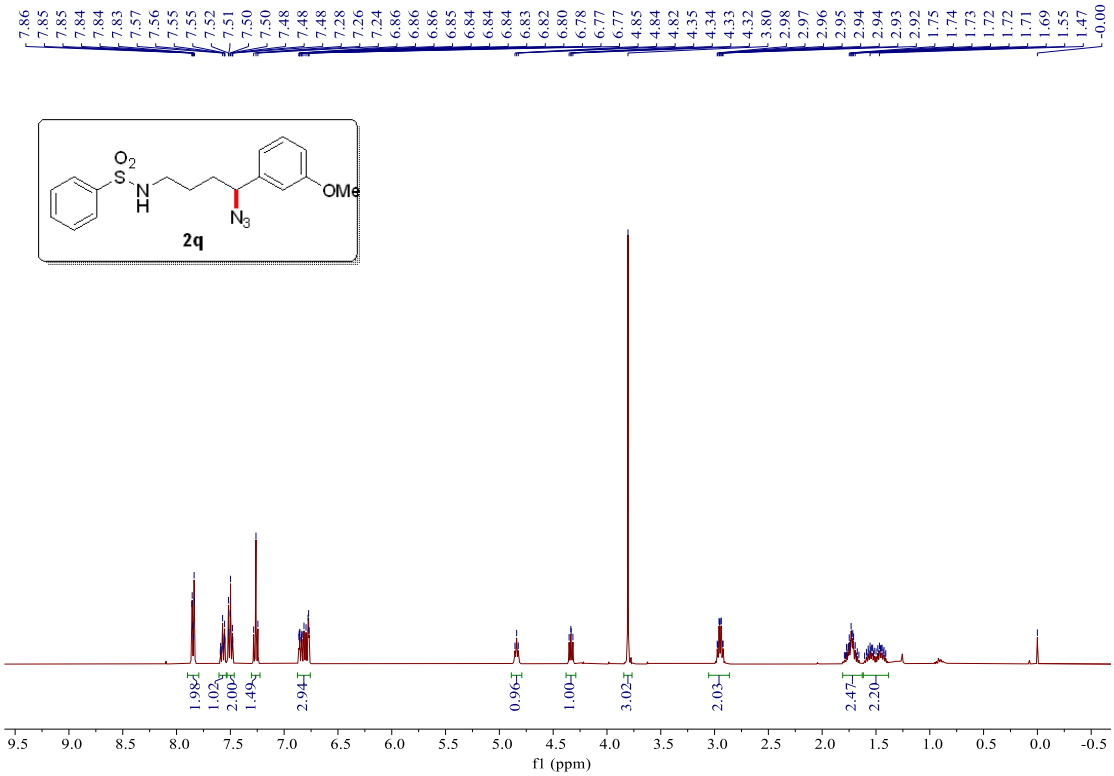

139.68
137.69
134.04
132.68
129.12
128.98
128.10
126.89
64.87
42.53
33.00
26.10
Cl
O2
S
N
H
N3
2n
f1 (ppm)
7.87
7.86
7.86
7.85
7.85
7.84
7.84
7.62
7.60
7.60
7.58
7.58
7.57
7.56
7.56
7.55
7.52
7.51
7.50
7.50
7.48
7.48
7.48
7.37
7.35
4.95
4.93
4.92
4.49
4.47
4.45
3.00
2.99
2.98
2.97
2.96
2.96
2.95
2.94
1.80
1.78
1.78
1.77
1.76
1.76
1.75
1.75
1.74
1.73
1.59
1.57
1.55
1.55
1.50
1.49
1.48
1.47
1.46
-0.00
CF3
O2
S
N
H
N3
2o
2.05
3.03
2.16
1.99
0.98
1.00
2.08
2.03
2.15
f1 (ppm)

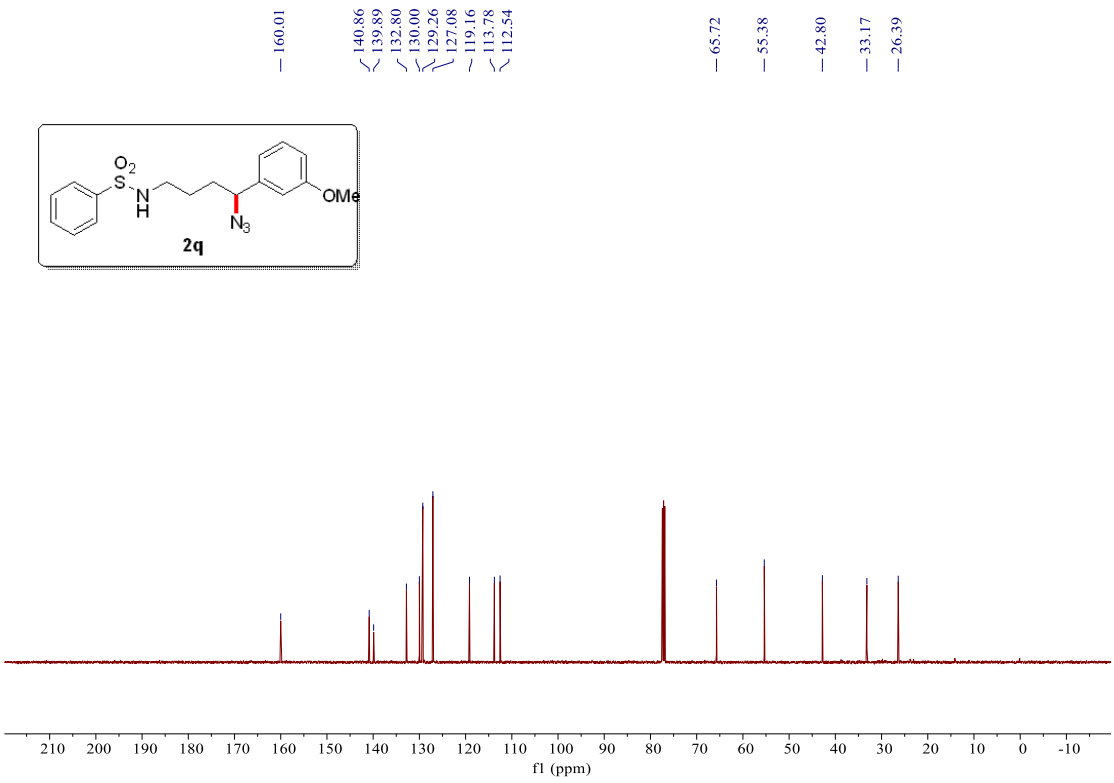

143.31
139.71
132.73
130.84
130.58
130.32
130.06
129.15
127.08
126.91
125.86
125.83
125.80
125.77
124.94
122.78
120.70
64.99
42.52
33.15
26.07
CF3
O2
S
N
H
N3
2o
f1 (ppm)

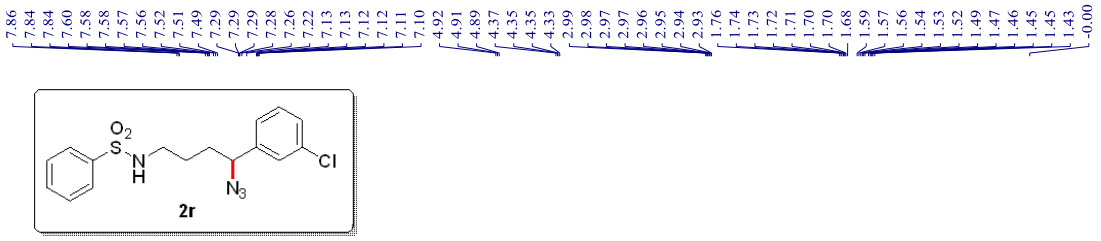

-62.59
CF3
O2
S
N
H
N3
2o
f1 (ppm)


7.86 7.86 7.85 7.85 7.84 7.84 7.59 7.57 7.57 7.56 7.55 7.55 7.52 7.52 7.51 7.50 7.50 7.48 7.48 7.48 7.25 7.23 7.21 7.13 7.11 7.03 7.03 7.00 4.86 4.85 4.83 4.33 4.32 4.31 4.30 2.98 2.97 2.96 2.95 2.94 2.94 2.92 2.92 2.35 1.78 1.76 1.75 1.74 1.74 1.73 1.73 1.72 1.71 1.70 1.69 1.56 1.54 1.46 -0.00
O2
S
N
H
Me
N3
2p
2.03 3.07 0.98 1.01 2.00 1.00 1.01 2.07 3.05 2.25 2.18
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

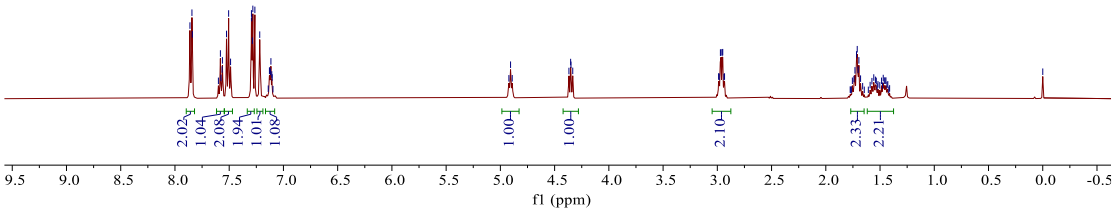

139.75 139.03 138.51 132.63 129.10 128.66 127.39 126.93 123.78
77.26 77.00 76.75
65.68
42.67
33.02 26.29 21.40
O2
S
N
H
Me
N3
2p
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.86 7.85 7.85 7.84 7.84 7.84 7.83 7.57 7.56 7.55 7.55 7.52 7.51 7.50 7.50 7.48 7.48 7.48 7.28 7.26 7.24 6.86 6.86 6.86 6.85 6.84 6.84 6.84 6.83 6.82 6.80 6.78 6.77 6.77 4.85 4.84 4.82 4.35 4.34 4.33 4.32 3.80 2.98 2.97 2.96 2.95 2.94 2.94 2.93 2.92 1.75 1.74 1.73 1.72 1.72 1.71 1.69 1.55 1.47 -0.00
O2
S
N
H
N3
OMe
2q
1.98 1.02 2.00 1.49 2.94 0.96 1.00 3.02 2.03 2.47 2.20
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

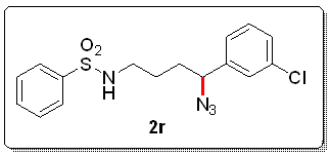

160.01 140.86 139.89 132.80 130.00 129.26 127.08 119.16 113.78 112.54 65.72 55.38 42.80 33.17 26.39
O2
S
N
H
N3
OMe
2q
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

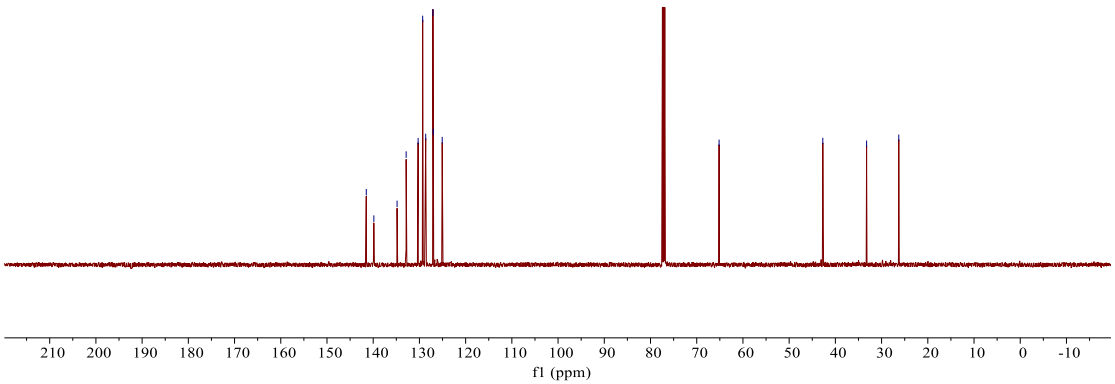

7.86
7.84
7.84
7.60
7.58
7.58
7.57
7.56
7.52
7.51
7.49
7.29
7.29
7.29
7.28
7.26
7.22
7.13
7.13
7.12
7.12
7.11
7.10
4.92
4.91
4.89
4.37
4.35
4.35
4.33
2.99
2.98
2.97
2.97
2.96
2.95
2.94
2.93
1.76
1.74
1.73
1.72
1.71
1.70
1.70
1.68
1.59
1.57
1.56
1.54
1.53
1.52
1.49
1.47
1.46
1.45
1.45
1.43
-0.00

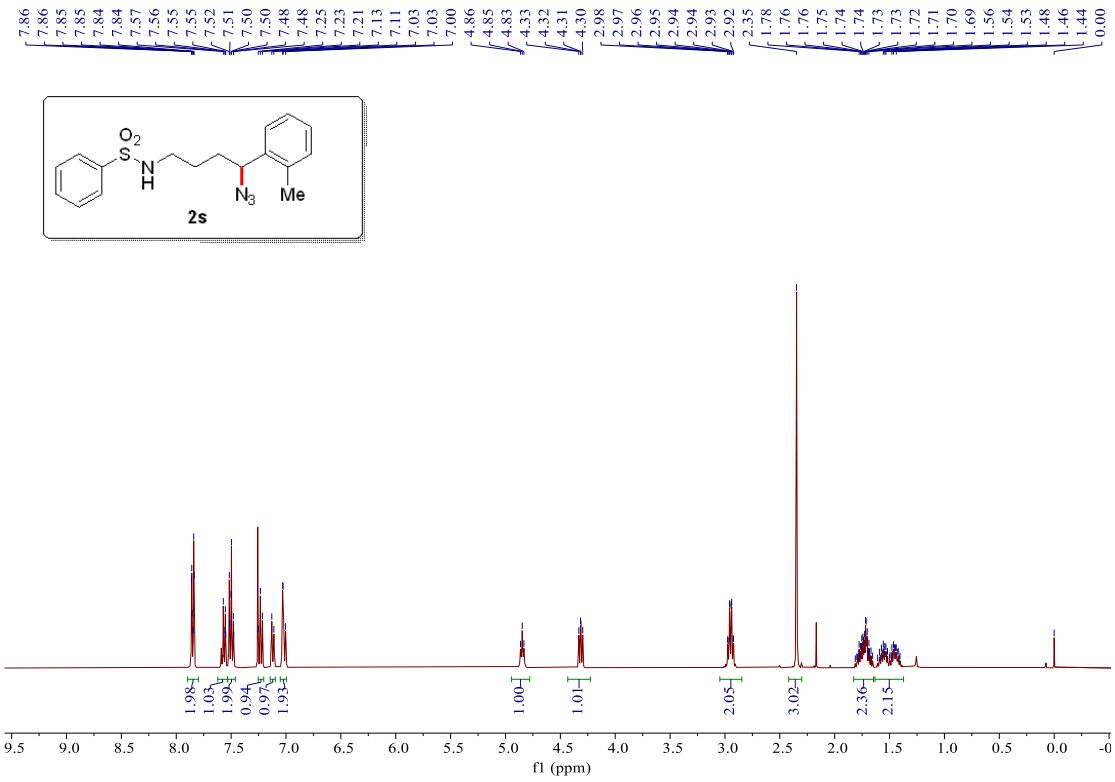
O2
S
N
H
N3
Cl
2r

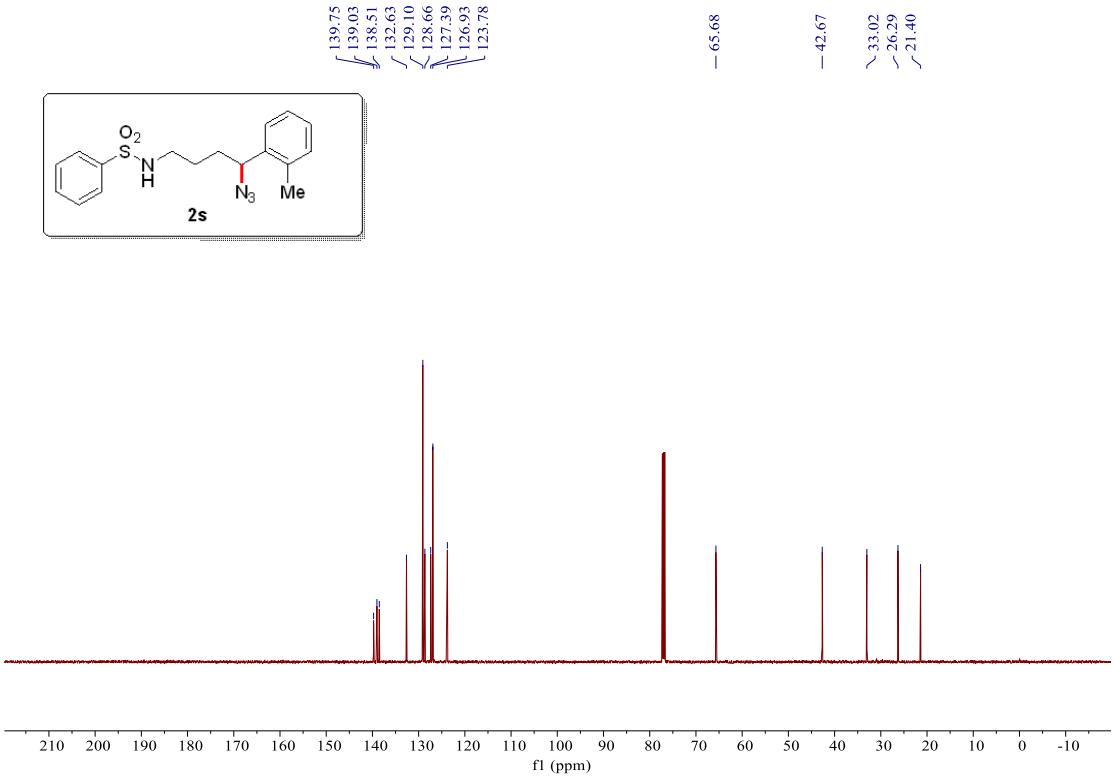

2.02
1.04
2.08
1.94
1.01
1.08
1.00
1.00
2.10
2.33
2.21
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


141.50
139.86
134.84
132.87
130.28
129.29
128.64
127.08
127.00
125.07
65.16
42.72
33.24
26.28

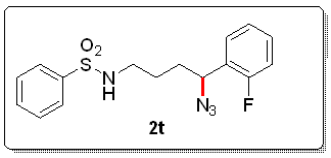

O2
S
N
H
N3
Cl
2r

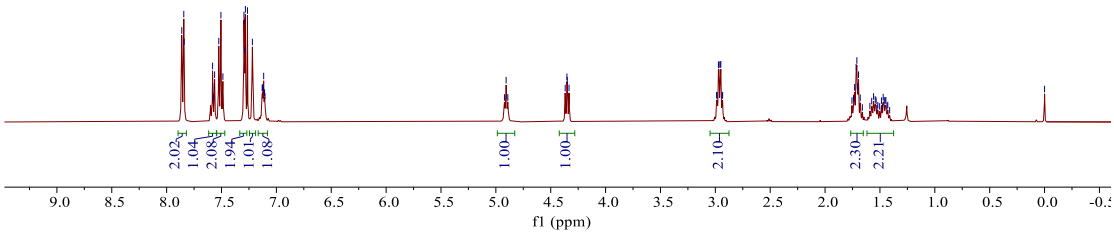

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


7.86 7.86 7.85 7.85 7.84 7.84 7.57 7.56 7.55 7.55 7.52 7.51 7.50 7.50 7.48 7.48 7.25 7.23 7.21 7.13 7.11 7.03 7.03 7.00 4.86 4.85 4.83 4.33 4.32 4.31 4.30 2.98 2.97 2.96 2.95 2.94 2.94 2.93 2.92 2.35 1.78 1.76 1.76 1.75 1.74 1.74 1.73 1.73 1.72 1.71 1.70 1.69 1.56 1.54 1.53 1.48 1.46 1.44 0.00
O2
S
N
H
N3
Me
2s
1.98 1.03 1.99 0.94 0.97 1.93 1.00 1.01 2.05 3.02 2.36 2.15
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

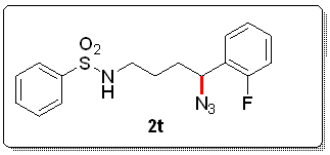

139.75 139.03 138.51 132.63 129.10 128.66 127.39 126.93 123.78
65.68
42.67
33.02 26.29 21.40
O2
S
N
H
N3
Me
2s
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

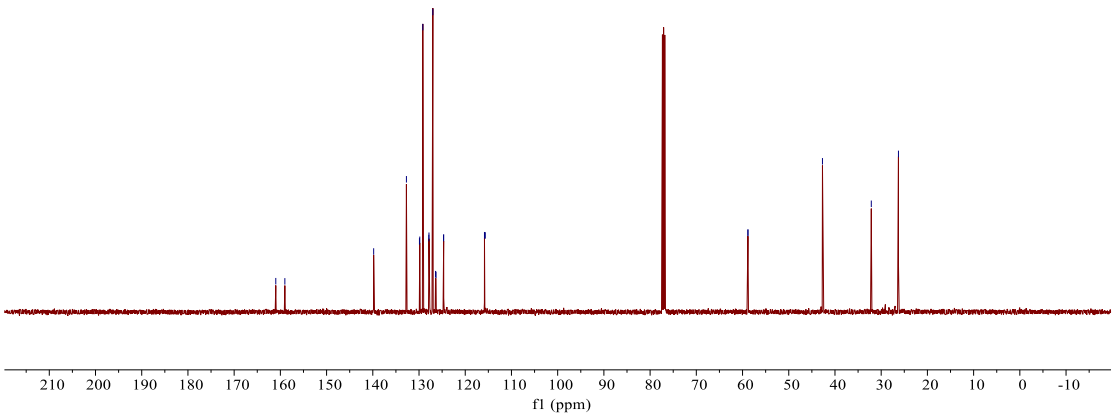

7.86
7.84
7.84
7.58
7.58
7.57
7.56
7.52
7.51
7.49
7.30
7.29
7.29
7.28
7.26
7.22
7.13
7.13
7.12
7.12
7.11
7.10
4.92
4.91
4.89
4.37
4.35
4.35
4.33
2.99
2.98
2.97
2.97
2.96
2.95
2.94
2.93
1.76
1.74
1.73
1.72
1.71
1.70
1.70
1.68
1.59
1.58
1.56
1.54
1.53
1.52
1.49
1.47
1.46
1.45
1.45
1.44
1.43
-0.00

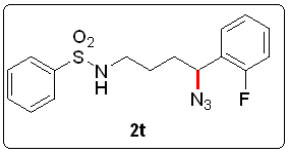

O2
S
N
H
N3
F
2t


2.02
1.04
2.08
1.94
1.01
1.08
1.00
1.00
2.10
2.30
2.21
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


160.99
159.03
139.81
132.73
129.90
129.84
129.18
127.88
127.85
127.01
126.43
126.32
124.69
124.67
115.84
115.66
58.84
58.82
42.71
32.14
26.26


O2
S
N
H
N3
F
2t

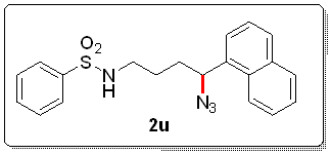

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


O2
S
N
H
N3
F

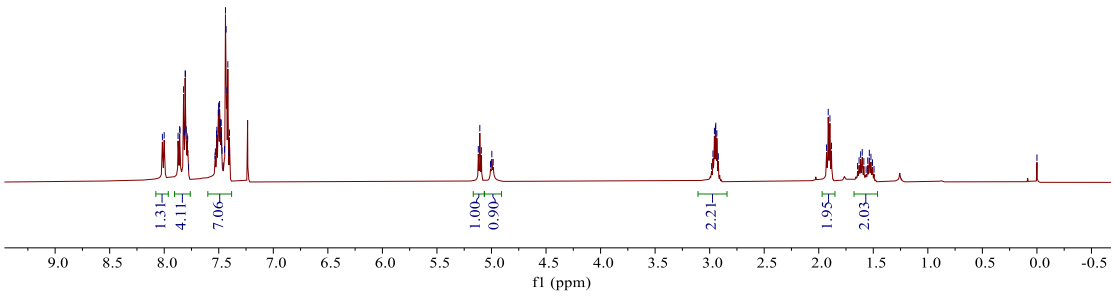
2t

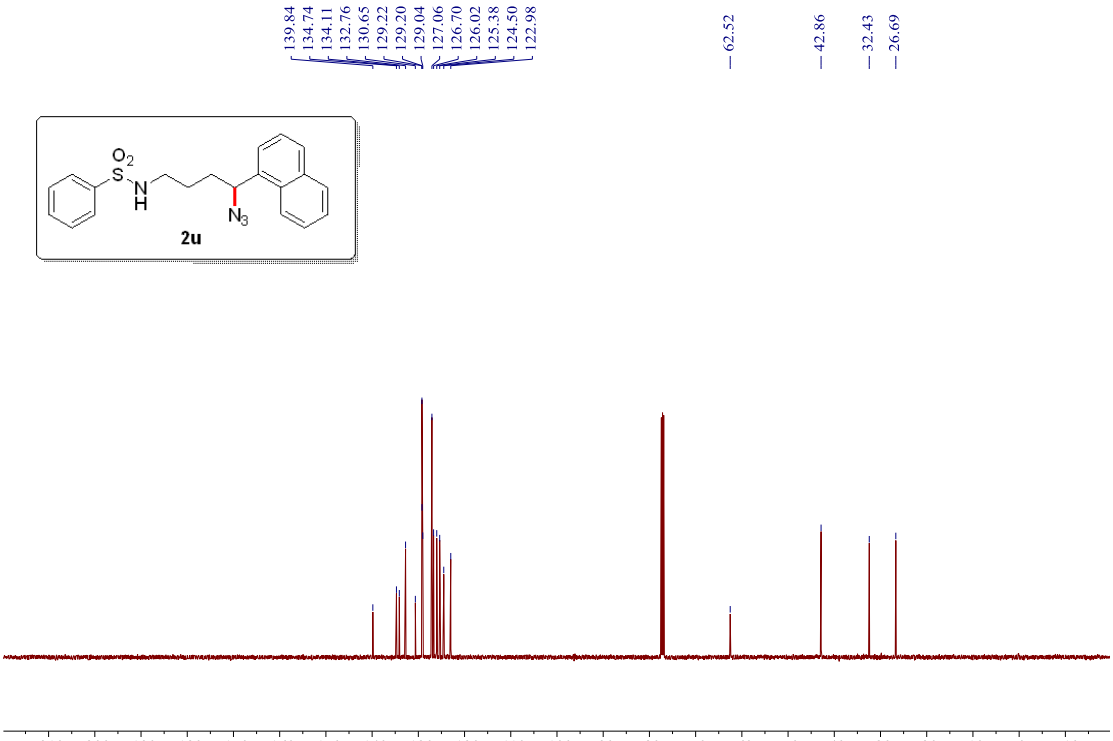
-118.59
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

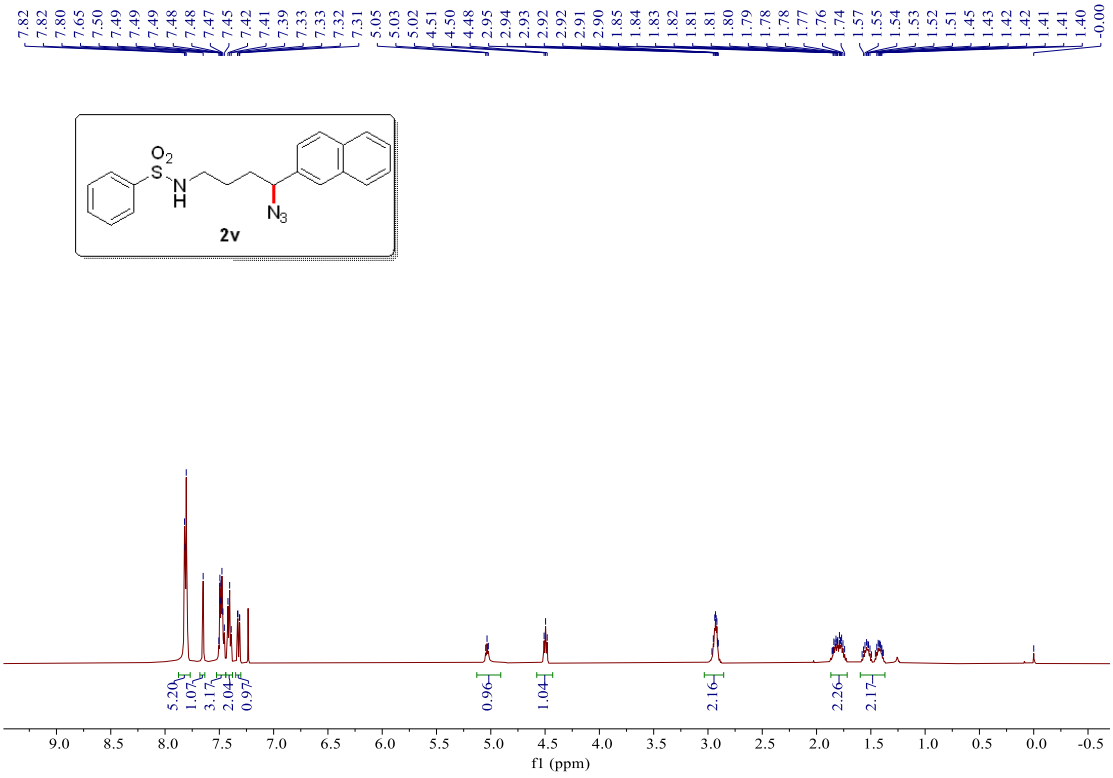
8.02 8.00 7.87 7.86 7.86 7.82 7.81 7.81 7.81 7.80 7.79 7.79 7.53 7.53 7.52 7.52 7.51 7.50 7.50 7.50 7.49 7.49 7.49 7.48 7.48 7.48 7.48 7.47 7.47 7.45 7.44 7.43 7.43 7.42 7.41 7.40 5.12 5.11 5.09 5.00 4.98 2.97 2.96 2.95 2.94 2.93 2.92 1.93 1.91 1.90 1.88 1.63 1.62 1.60 1.59 1.55 1.54 1.52 -0.00

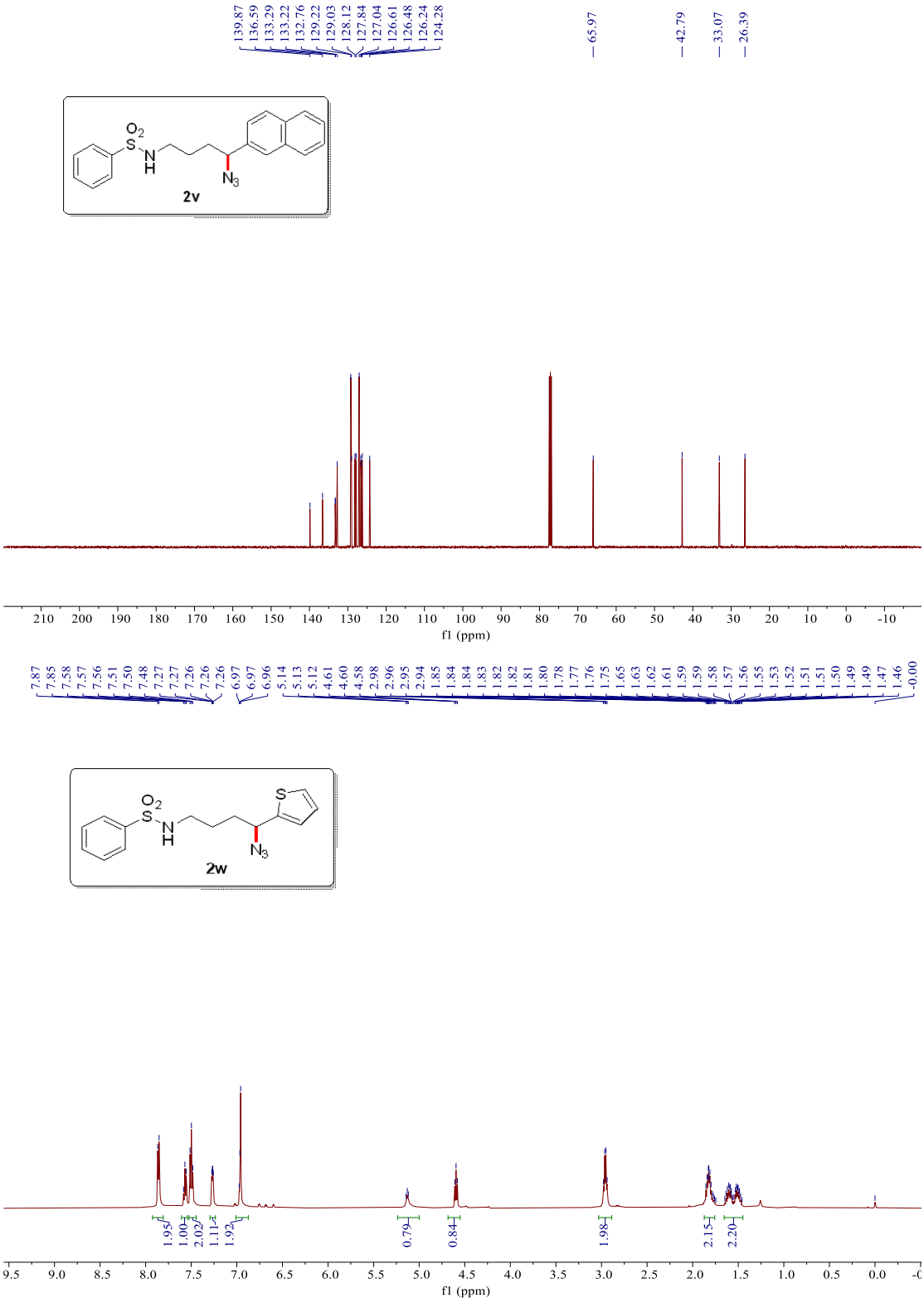

O2
S
N
H
N3

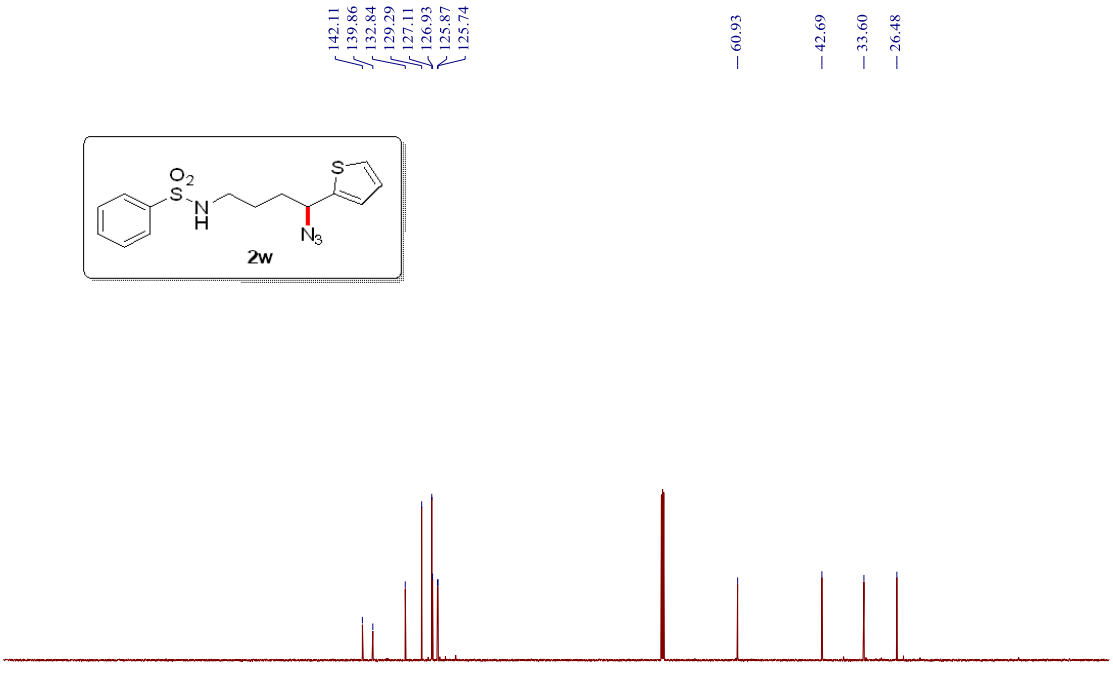
2u

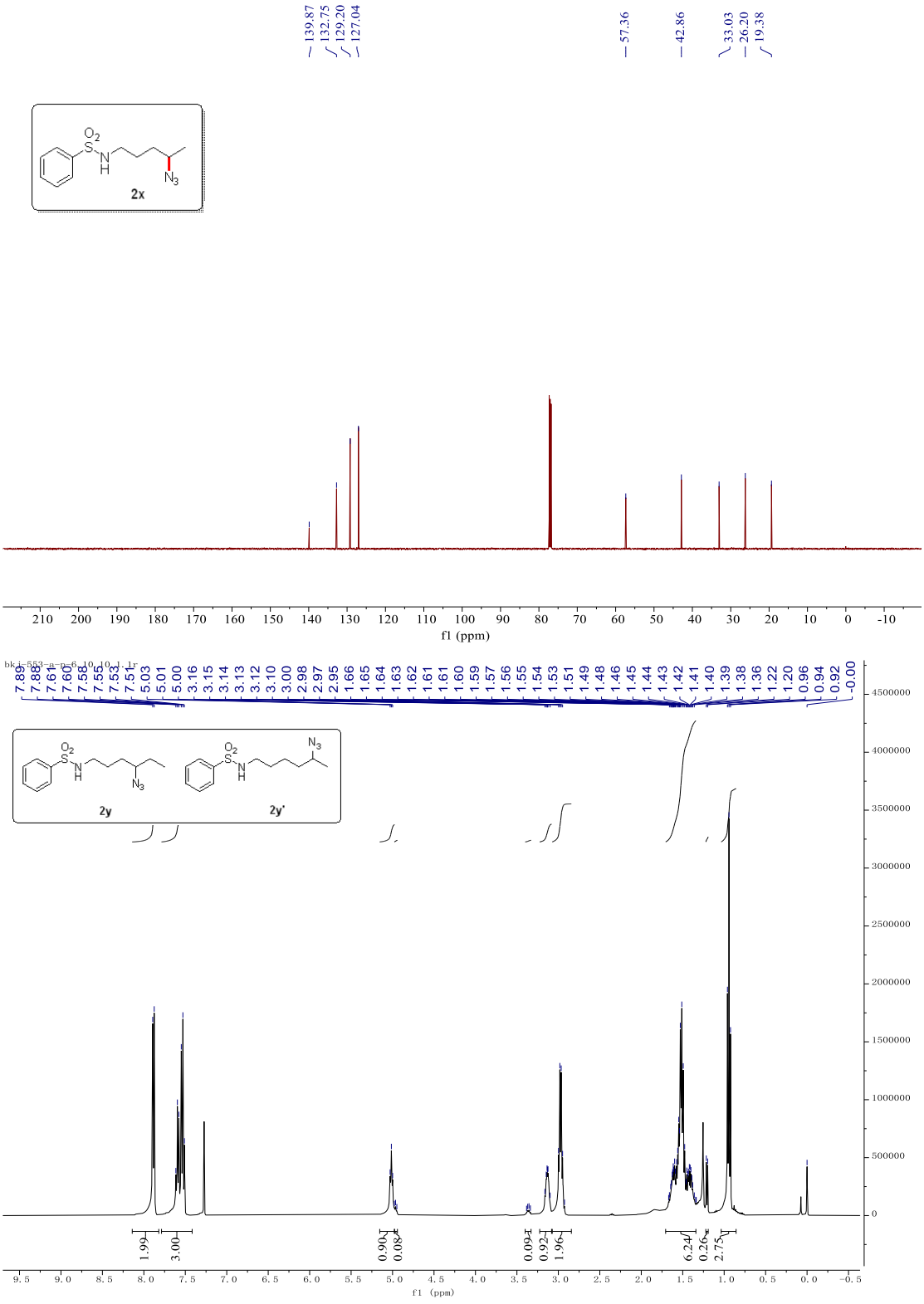

1.31
4.11
7.06
1.00
0.90
2.21
1.95
2.03
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

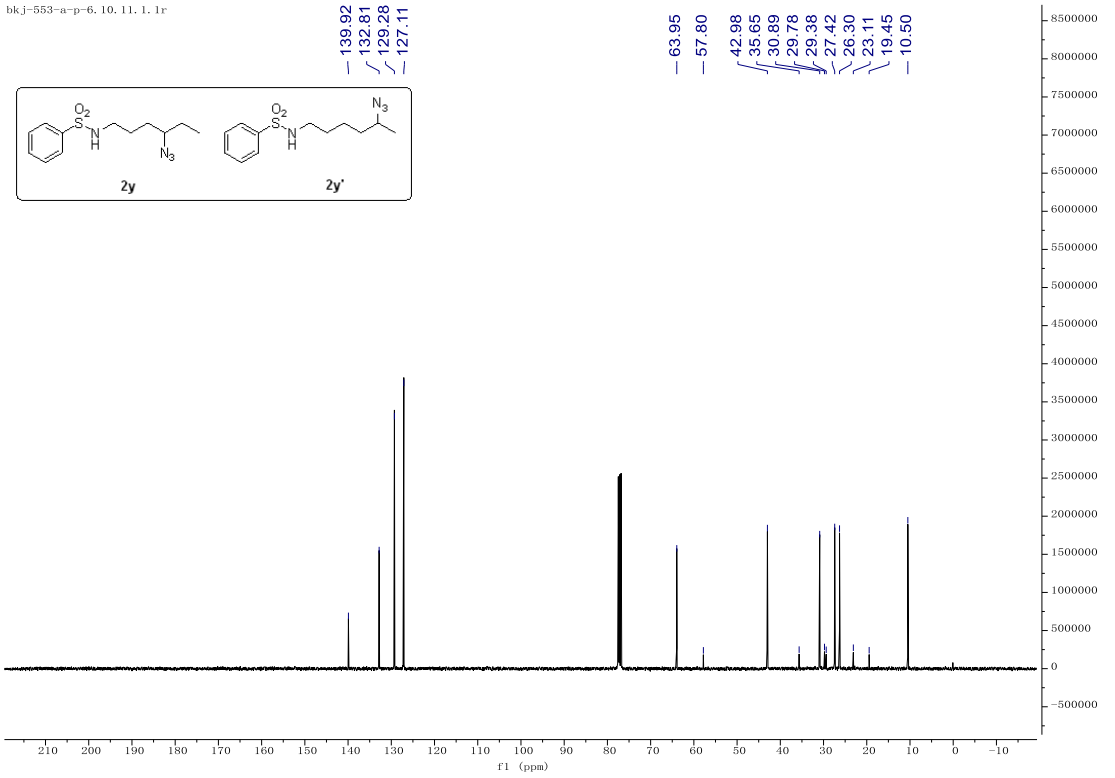

139.84
134.74
134.11
132.76
130.65
129.22
129.20
129.04
127.06
126.70
126.02
125.38
124.50
122.98
62.52
42.86
32.43
26.69
O2
S
N
H
N3
2u
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

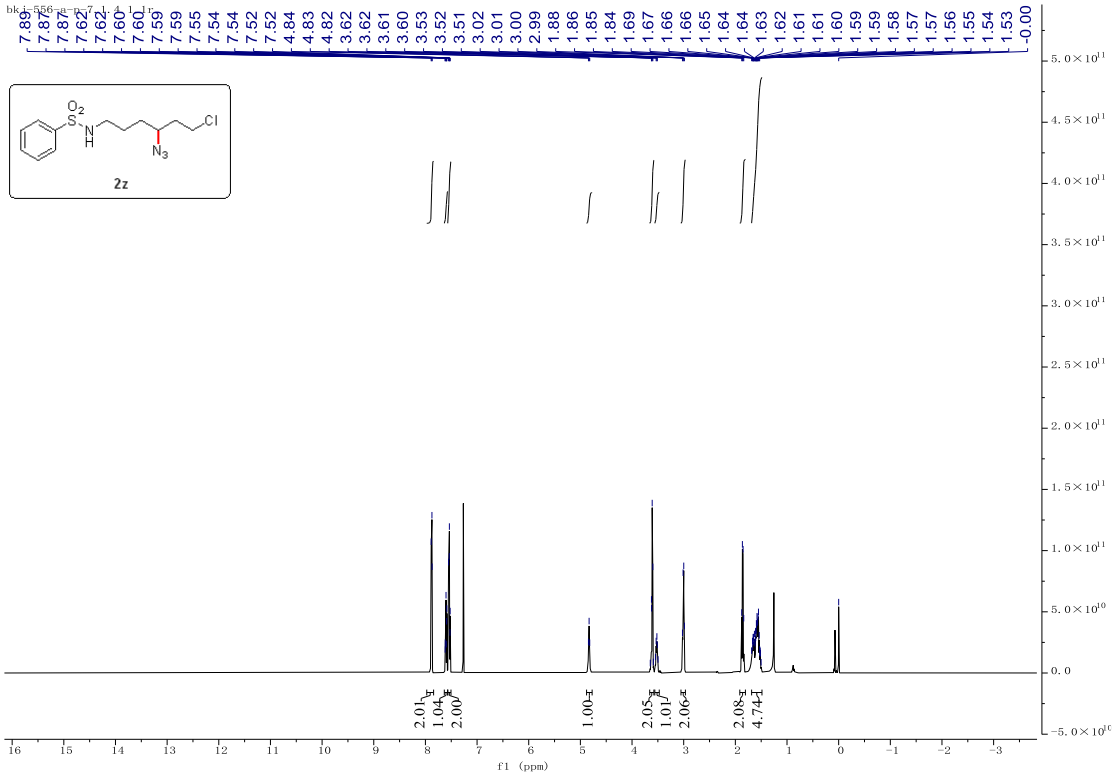

7.82
7.82
7.80
7.65
7.50
7.49
7.49
7.49
7.48
7.48
7.47
7.45
7.42
7.41
7.39
7.33
7.33
7.32
7.31
5.05
5.03
5.02
4.51
4.50
4.48
2.95
2.94
2.93
2.92
2.92
2.91
2.90
1.85
1.84
1.83
1.82
1.81
1.81
1.80
1.79
1.78
1.78
1.77
1.76
1.74
1.57
1.55
1.54
1.53
1.52
1.51
1.45
1.43
1.42
1.42
1.41
1.41
1.40
-0.00
O2
S
N
H
N3
2v
5.20
1.07
3.17
2.04
0.97
0.96
1.04
2.16
2.26
2.17
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

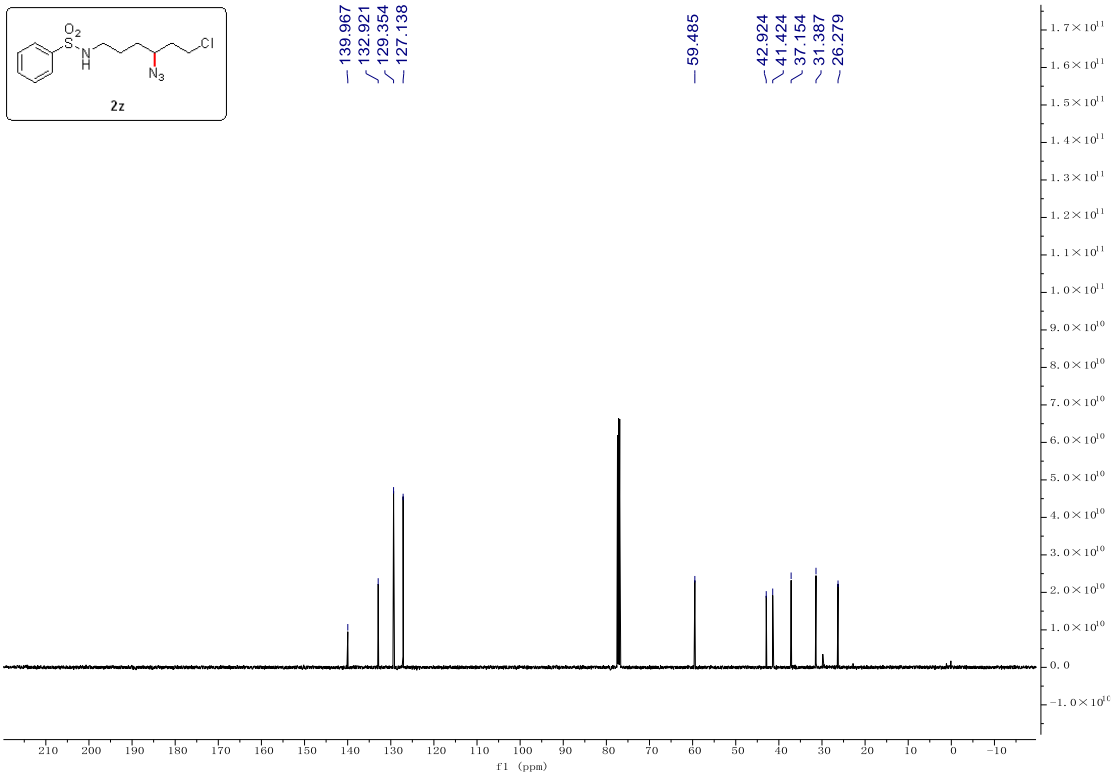

139.87
136.59
133.29
133.22
132.76
129.22
129.03
128.12
127.84
127.04
126.61
126.48
126.24
124.28
65.97
42.79
33.07
26.39
O2
S
N
H
N3
2v
f1 (ppm)
7.87
7.85
7.58
7.57
7.56
7.51
7.50
7.48
7.27
7.27
7.26
7.26
7.26
6.97
6.96
5.14
5.13
5.12
4.61
4.60
4.58
2.98
2.96
2.95
2.94
1.85
1.84
1.84
1.83
1.82
1.82
1.81
1.80
1.78
1.77
1.76
1.75
1.65
1.63
1.62
1.61
1.59
1.59
1.58
1.57
1.56
1.55
1.53
1.52
1.51
1.51
1.50
1.49
1.49
1.47
1.46
-0.00
O2
S
N
H
S
N3
2w
1.95
1.00
2.02
1.11
1.92
0.79
0.84
1.98
2.15
2.20
f1 (ppm)

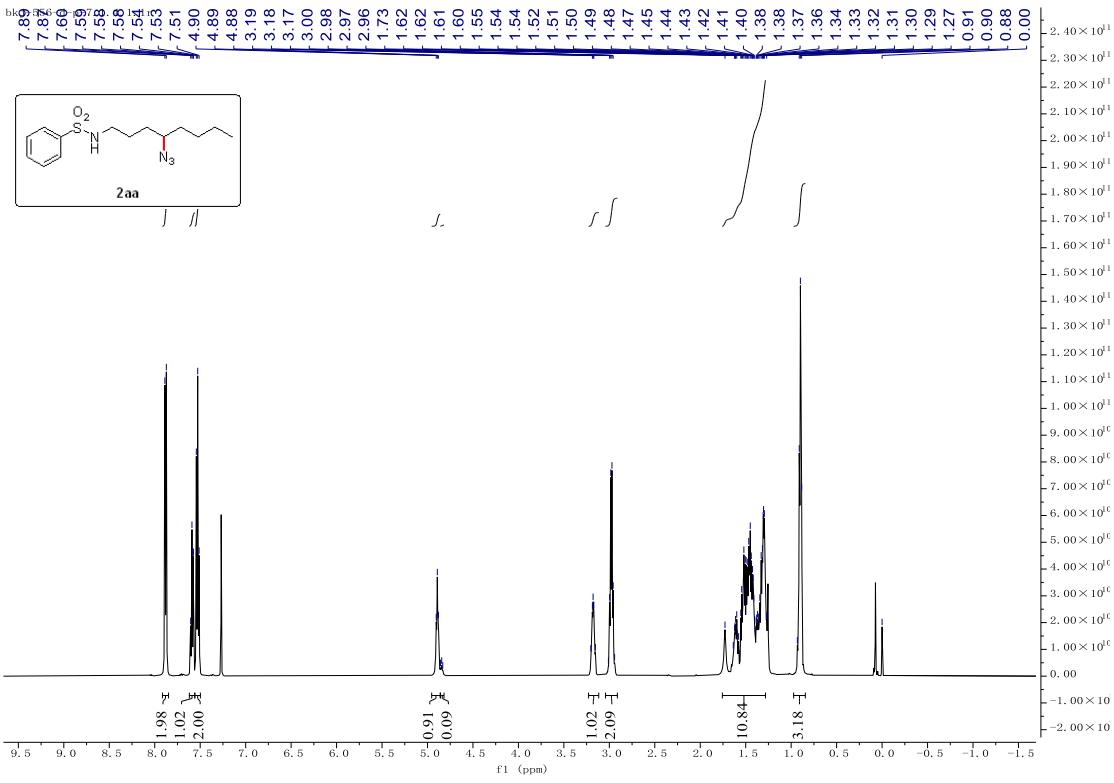

142.11
139.86
132.84
129.29
127.11
126.93
125.87
125.74
60.93
42.69
33.60
26.48
2w
f1 (ppm)
7.89
7.88
7.87
7.61
7.59
7.59
7.58
7.58
7.54
7.53
7.53
7.52
7.51
5.10
5.08
5.07
3.40
3.39
3.37
3.36
2.99
2.98
2.97
2.95
2.94
1.61
1.61
1.60
1.59
1.59
1.58
1.57
1.57
1.56
1.54
1.54
1.53
1.52
1.52
1.51
1.50
1.50
1.49
1.48
1.48
1.47
1.46
1.45
1.45
1.45
1.44
1.43
1.43
1.42
1.42
1.41
1.21
1.20
-0.00
2x
2.09
1.15
2.00
0.97
1.09
2.19
4.25
3.09
f1 (ppm)

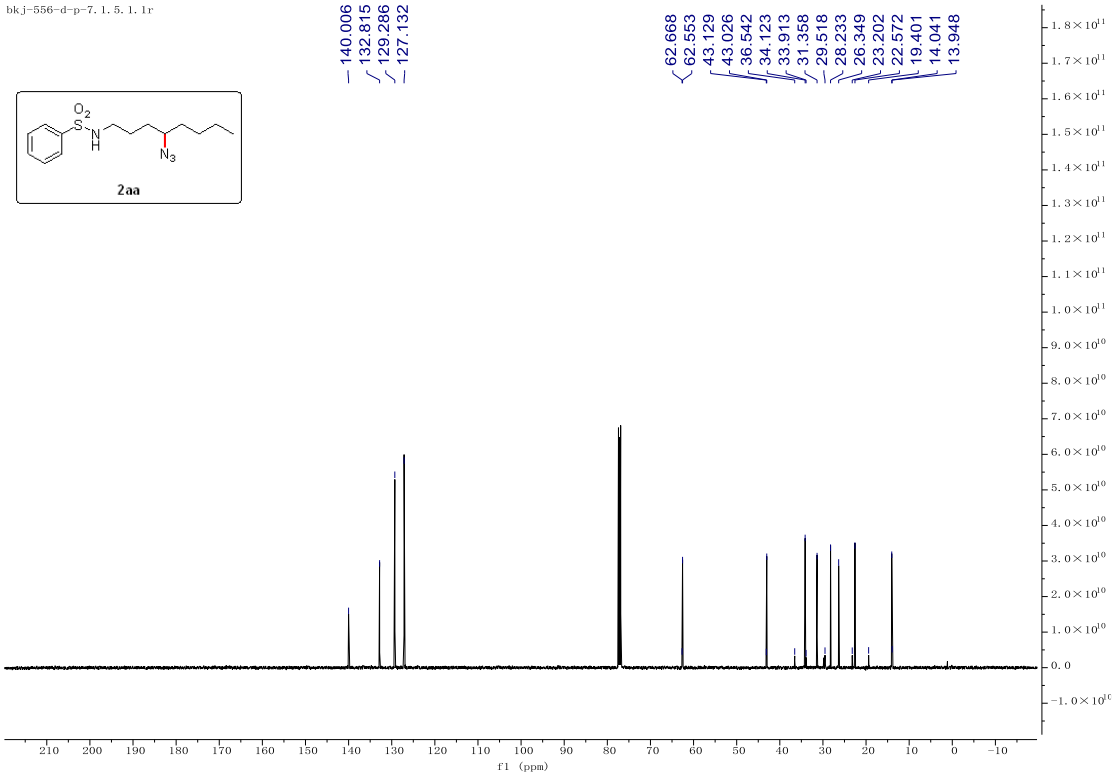

139.87
132.75
129.20
127.04
57.36
42.86
33.03
26.20
19.38
2x
f1 (ppm)
2y
2y'
f1 (ppm)

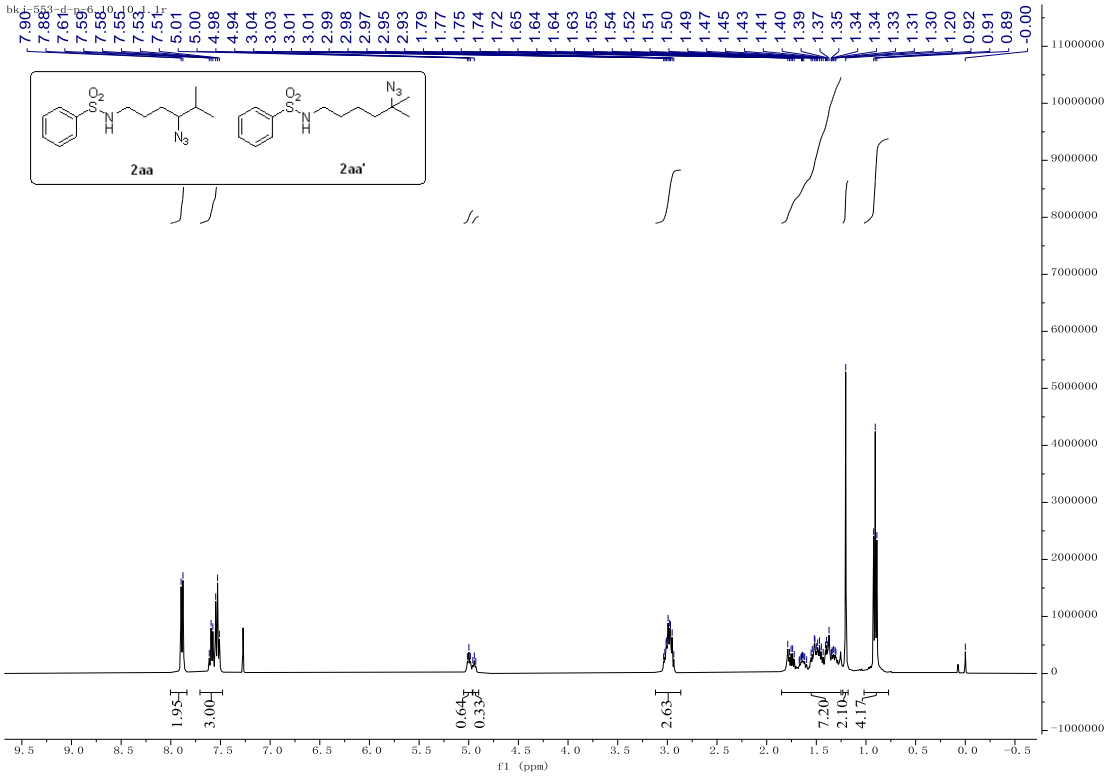

bkj-553-a-p-6.10.11.1.1r
139.92
132.81
129.28
127.11
63.95
57.80
42.98
35.65
30.89
29.78
29.38
27.42
26.30
23.11
19.45
10.50
2y
2y'
f1 (ppm)

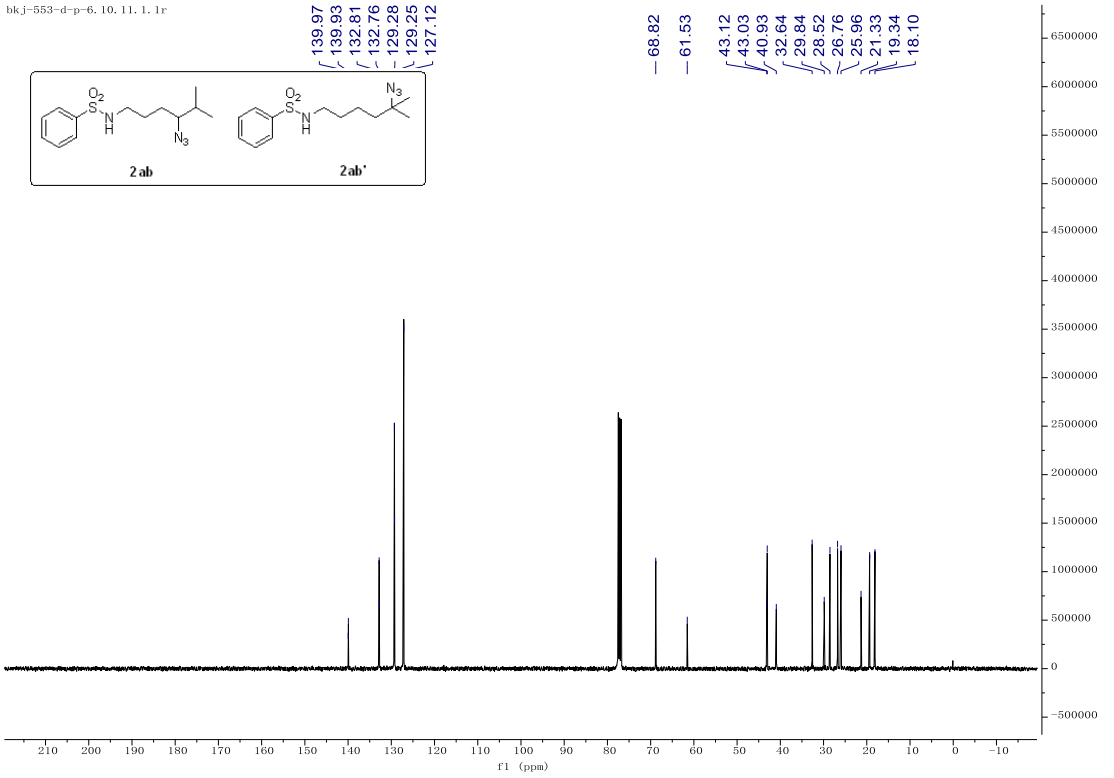

7.89
7.87
7.87
7.62
7.60
7.60
7.59
7.59
7.55
7.54
7.54
7.52
7.52
4.84
4.83
4.82
3.62
3.62
3.61
3.60
3.53
3.52
3.51
3.02
3.01
3.00
2.99
1.88
1.86
1.85
1.84
1.69
1.67
1.66
1.66
1.65
1.64
1.64
1.63
1.62
1.61
1.61
1.60
1.59
1.59
1.58
1.57
1.57
1.56
1.55
1.54
1.53
0.00
2z
2.01
1.04
2.00
1.00
2.05
1.01
2.06
2.08
4.74
f1 (ppm)

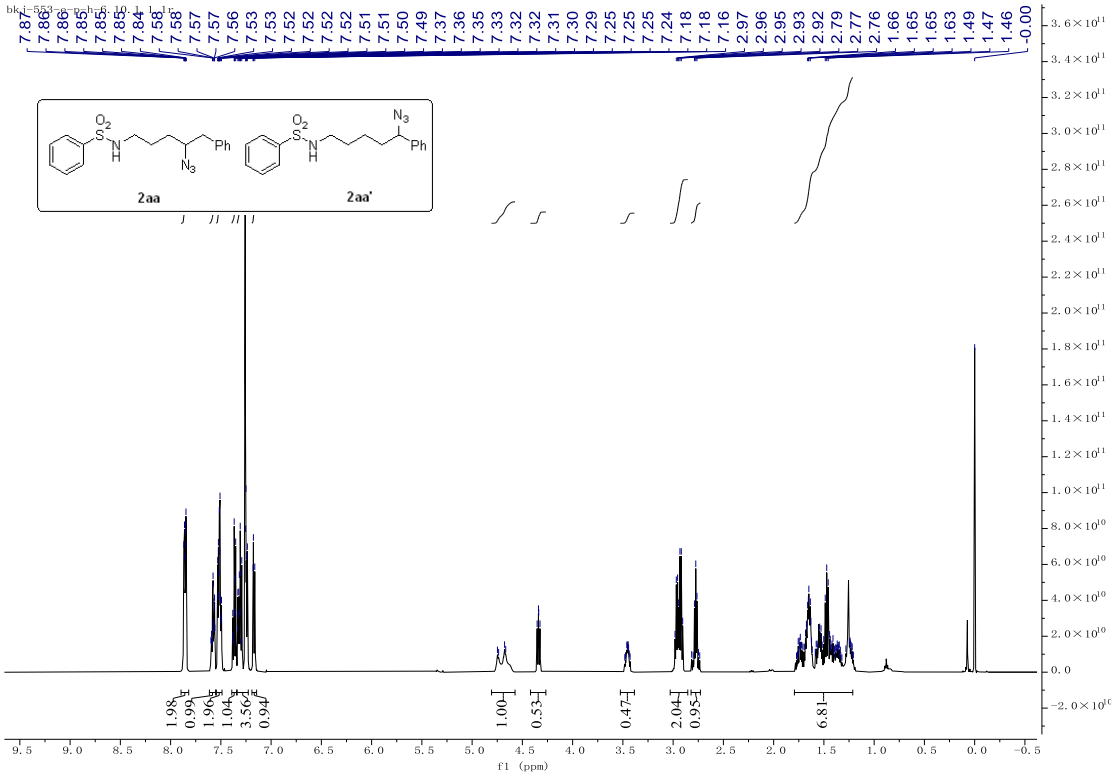

2z
139.967
132.921
129.354
127.138
59.485
42.924
41.424
37.154
31.387
26.279
f1 (ppm)

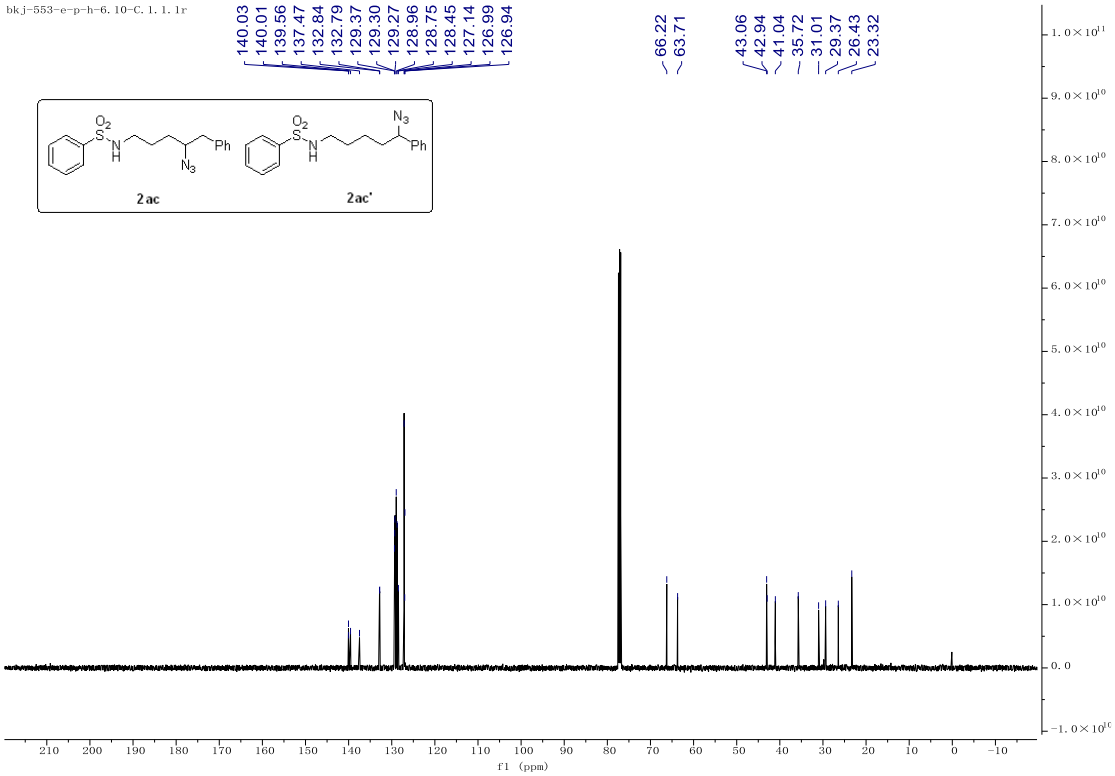

2aa
7.89
7.87
7.60
7.59
7.58
7.54
7.53
7.51
4.90
4.89
4.88
3.19
3.18
3.17
3.00
2.98
2.97
2.96
1.73
1.62
1.61
1.60
1.55
1.54
1.52
1.51
1.50
1.49
1.48
1.47
1.45
1.44
1.43
1.42
1.41
1.40
1.38
1.37
1.36
1.34
1.33
1.32
1.31
1.30
1.29
1.27
0.91
0.90
0.88
0.00
1.98
1.02
2.00
0.91
0.09
1.02
2.09
10.84
3.18
f1 (ppm)

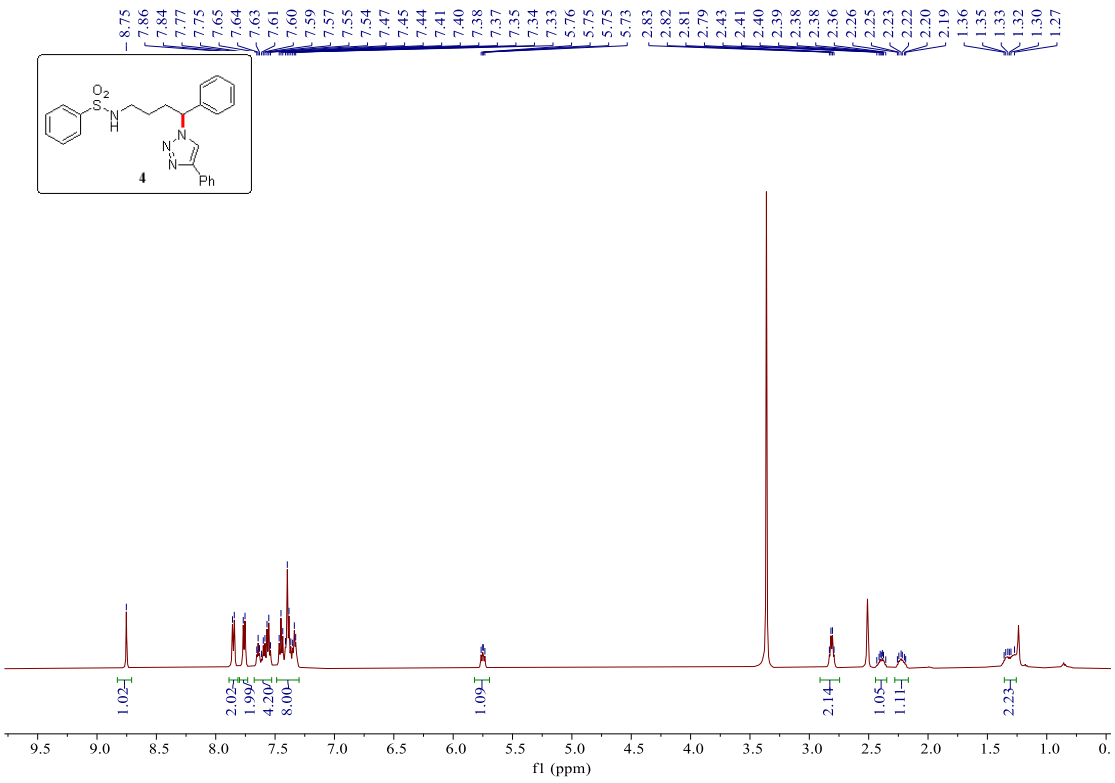

bkj-556-d-p-7.1.5.1.1r
140.006
132.815
129.286
127.132
62.668
62.553
43.129
43.026
36.542
34.123
33.913
31.358
29.518
28.233
26.349
23.202
22.572
19.401
14.041
13.948
2aa
f1 (ppm)

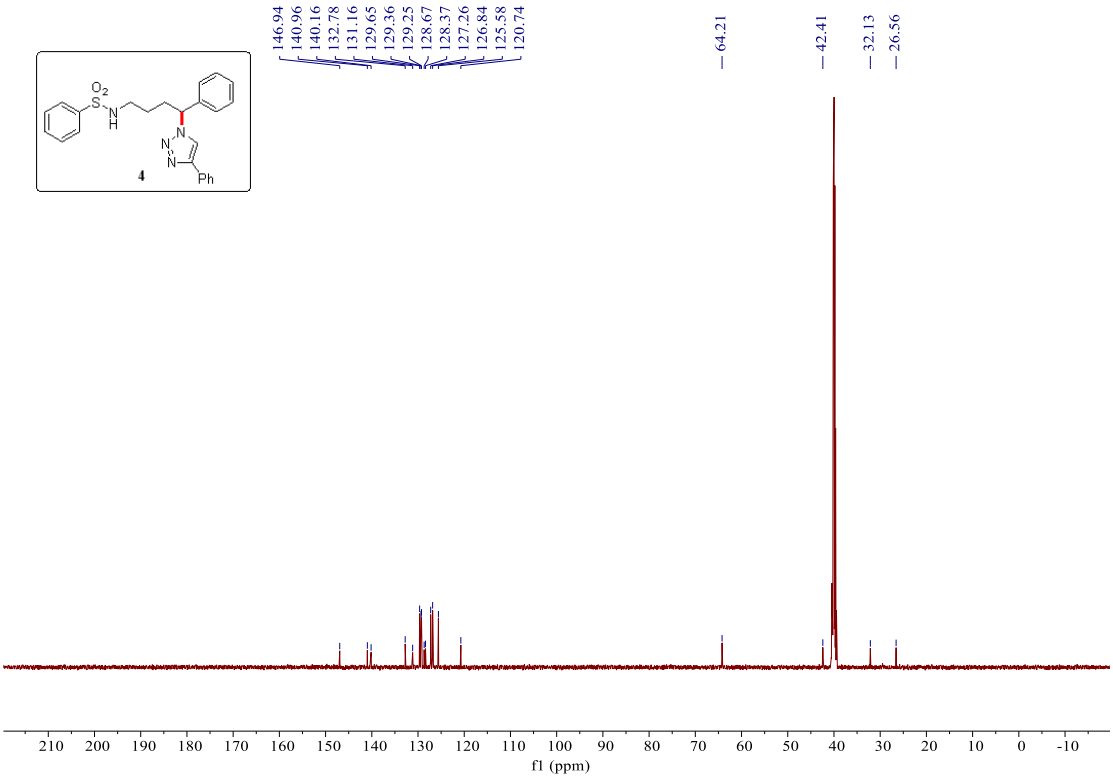

7.90
7.88
7.61
7.59
7.58
7.56
7.55
7.53
7.51
5.01
5.00
4.98
4.94
3.04
3.03
3.01
3.01
2.99
2.98
2.97
2.95
2.93
1.79
1.77
1.75
1.74
1.72
1.65
1.64
1.64
1.63
1.55
1.54
1.52
1.51
1.50
1.49
1.47
1.45
1.43
1.41
1.40
1.39
1.37
1.35
1.34
1.34
1.33
1.31
1.30
1.20
0.92
0.91
0.89
-0.00
2aa
2aa'
1.95
3.00
0.64
0.33
2.63
7.20
2.10
4.17
f1 (ppm)


bkj-553-d-p-6.10.11.1.1r
139.97
139.93
132.81
132.76
129.28
129.25
127.12
68.82
61.53
43.12
43.03
40.93
32.64
29.84
28.52
26.76
25.96
21.33
19.34
18.10
2ab
2ab'
f1 (ppm)

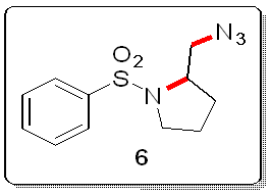

7.87
7.86
7.86
7.85
7.85
7.84
7.58
7.58
7.57
7.57
7.56
7.53
7.53
7.52
7.52
7.52
7.52
7.51
7.51
7.50
7.49
7.37
7.36
7.35
7.33
7.32
7.32
7.31
7.30
7.29
7.25
7.25
7.25
7.24
7.18
7.18
7.16
2.97
2.96
2.95
2.93
2.92
2.79
2.77
2.76
1.66
1.65
1.65
1.63
1.49
1.47
1.46
0.00
2aa
2aa'
1.98
0.99
1.96
1.04
3.56
0.94
1.00
0.53
0.47
2.04
0.95
6.81
f1 (ppm)

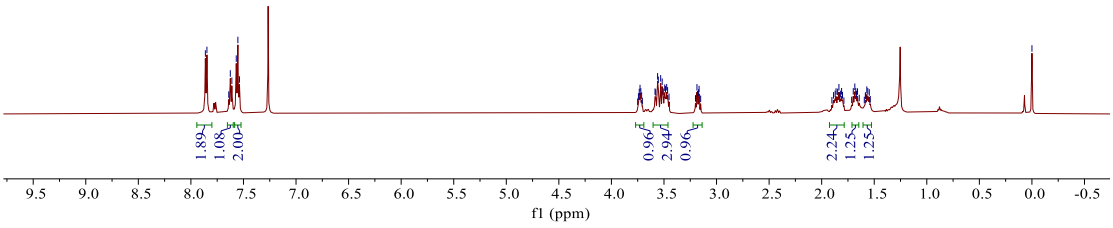

bkj-553-e-p-h-6.10-C.1.1.1r
140.03
140.01
139.56
137.47
132.84
132.79
129.37
129.30
129.27
128.96
128.75
128.45
127.14
126.99
126.94
66.22
63.71
43.06
42.94
41.04
35.72
31.01
29.37
26.43
23.32
2ac
2ac'
f1 (ppm)

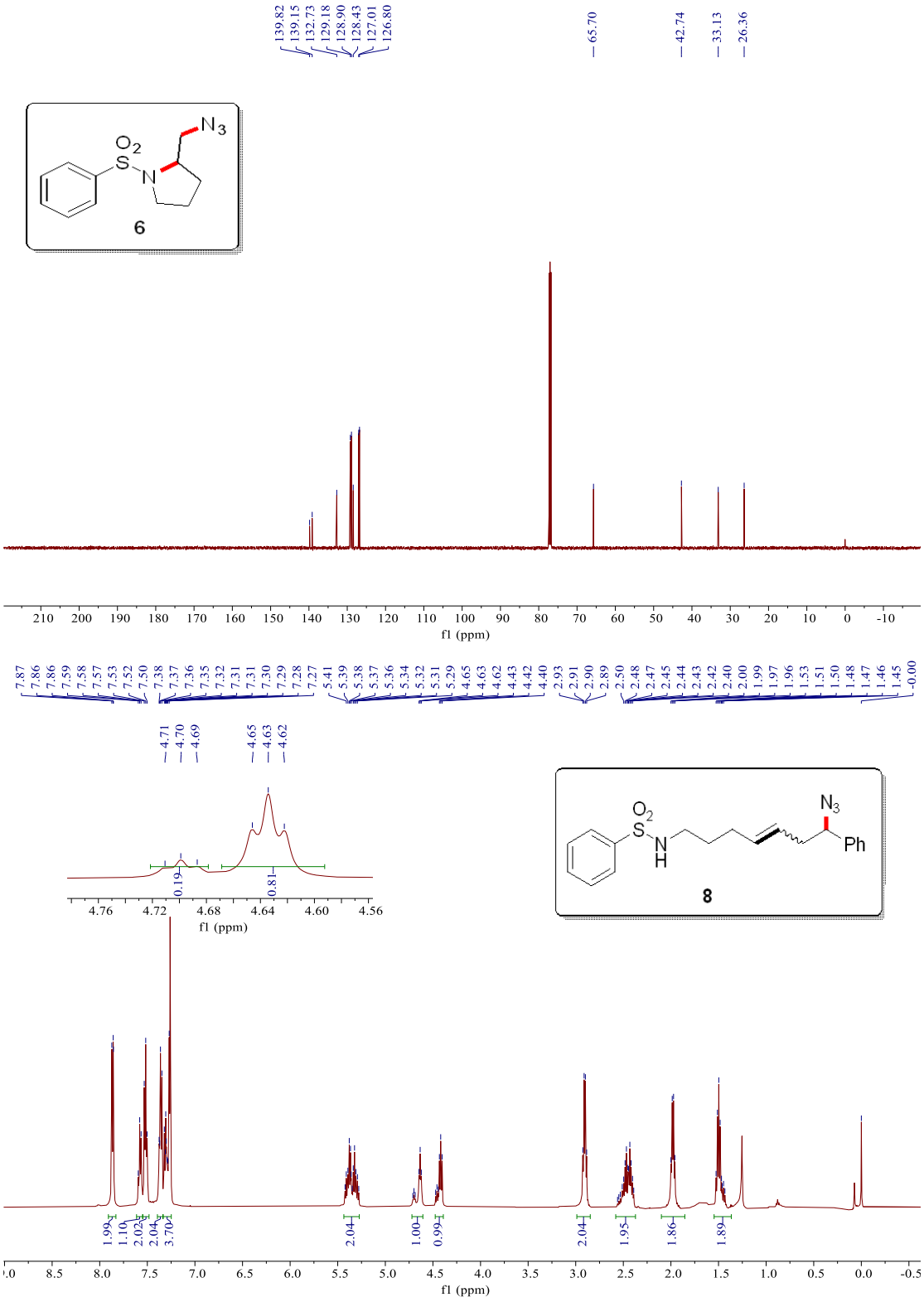

8.75
7.86
7.84
7.77
7.75
7.65
7.64
7.63
7.61
7.60
7.59
7.57
7.55
7.54
7.47
7.45
7.44
7.41
7.40
7.38
7.37
7.35
7.34
7.33
5.76
5.75
5.75
5.73
2.83
2.82
2.81
2.79
2.43
2.41
2.40
2.39
2.38
2.38
2.36
2.26
2.25
2.23
2.22
2.20
2.19
1.36
1.35
1.33
1.32
1.30
1.27
4
1.02
2.02
1.99
4.20
8.00
1.09
2.14
1.05
1.11
2.23
f1 (ppm)


146.94
140.96
140.16
132.78
131.16
129.65
129.36
129.25
128.67
128.37
127.26
126.84
125.58
120.74
64.21
42.41
32.13
26.56
4
Ph
f1 (ppm)

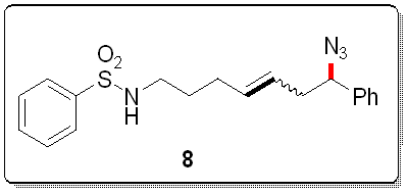

7.86
7.85
7.64
7.63
7.61
7.57
7.55
7.54
3.75
3.74
3.74
3.73
3.72
3.71
3.71
3.59
3.58
3.56
3.55
3.53
3.52
3.51
3.49
3.49
3.47
3.47
3.45
3.20
3.19
3.18
3.17
3.17
3.15
1.90
1.89
1.87
1.86
1.85
1.84
1.83
1.82
1.81
1.80
1.79
1.71
1.70
1.68
1.68
1.67
1.66
1.64
1.59
1.58
1.58
1.57
1.56
1.55
1.54
-0.00


N3
O2
S
N
6

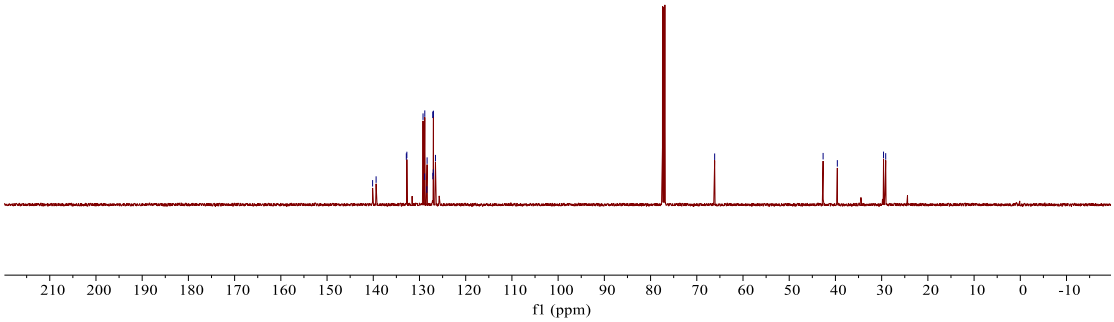

1.89
1.08
2.00
0.96
2.94
0.96
2.24
1.25
1.25
f1 (ppm)


139.82
139.15
132.73
129.18
128.90
128.43
127.01
126.80
65.70
42.74
33.13
26.36
O2
S
N
N3
6
fl (ppm)
7.87
7.86
7.86
7.59
7.58
7.57
7.53
7.52
7.50
7.38
7.37
7.36
7.35
7.32
7.31
7.31
7.30
7.29
7.28
7.27
5.41
5.39
5.38
5.37
5.36
5.34
5.32
5.31
5.29
4.65
4.63
4.62
4.43
4.42
4.40
2.93
2.91
2.90
2.89
2.50
2.48
2.47
2.45
2.44
2.43
2.42
2.40
2.00
1.99
1.97
1.96
1.53
1.51
1.50
1.48
1.47
1.46
1.45
-0.00
4.71
4.70
4.69
4.65
4.63
4.62
0.19
0.81
fl (ppm)
O2
S
N
H
N3
Ph
8
1.99
1.10
2.02
2.04
3.70
2.04
1.00
0.99
2.04
1.95
1.86
1.89
fl (ppm)


140.14
139.39
132.85
132.73
129.23
128.88
128.85
128.41
128.35
127.13
127.11
127.01
126.99
126.54
66.13
42.67
39.59
29.59
29.12


O2
S
N
H
N3
Ph

8


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)