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SUPPORTING INFORMATION

Facile Synthesis of Diverse Hetero Polyaromatic Hydrocarbons (PAHs) via Styryl Diels-Alder Reaction of Conjugated Diynes

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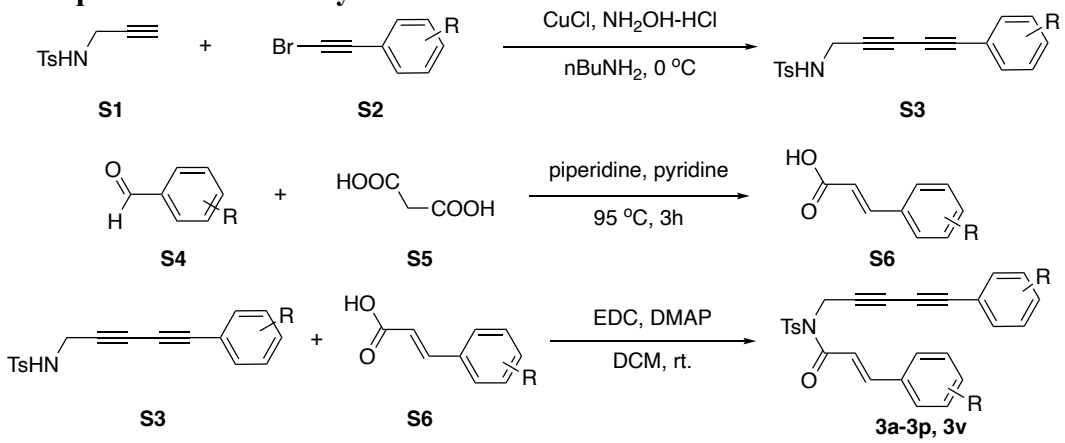
I. General Methods and Materials

All of the reactions dealing with air and/or moisture-sensitive compounds were carried out under an atmosphere of argon using oven/flame-dried glassware and standard syringe/septa techniques. Unless otherwise noted, all commercial reagents and solvents were obtained from the commercial provider and used without further purification. ^{1}H NMR, ^{13}C NMR, and ^{19}F NMR spectra were recorded on Bruker Avance NEO-600 MHz and NEO-400 MHz spectrometers. Chemical shifts were reported relative to internal tetramethylsilane (δ 0.00 ppm) or $CDCl_3$ (δ 7.26 ppm) for ^{1}H and $CDCl_3$ (δ 77.00 ppm) for ^{13}C. Flash column chromatography was performed on 230-430 mesh silica gel. Analytical thin layer chromatography was performed with precoated glass baked plates (250μ) and visualized by fluorescence and by charring after treatment with potassium permanganate stain. Chirality determination was measured in Agilent 1260 infinity HPLC system. HRMS were recorded on Agilent 6320 TOF MS/Agilent 1200 HPLC spectrometer and an Agilent 7890 GC-MS QTOF 7200 and 6540 LC/QTOF spectrometer in the mass-spec facility in the University of South Florida.

II. General Procedures

2.1 General procedure for the synthesis of 3a-3v



Method A: Synthesis of diynes S3

To a round bottom flask with CuCl (1.1 equiv.) add 30% (v/v) $nBuNH_2$ (0.25 M) aqueous solution at 0 °C. Fill flask with argon and add $NH_2OH{\cdot}HCl$ until the blue color disappeared. Refill flask with argon again. A solution of terminal alkyne **S1 (**1 equiv.) in DCM (1 M) (was then added, followed by the slow addition of a solution of bromoalkyne **S2** (2 equiv.) in DCM (1 M) over 5 minutes. The reaction mixture was stirred until terminal alkyne disappear on TLC, quenched with saturated aqueous NH_4Cl and extracted with EtOAc for three times. The combined organic layers were washed with brine, dried over Na_2SO_4, and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel to give the desired product.

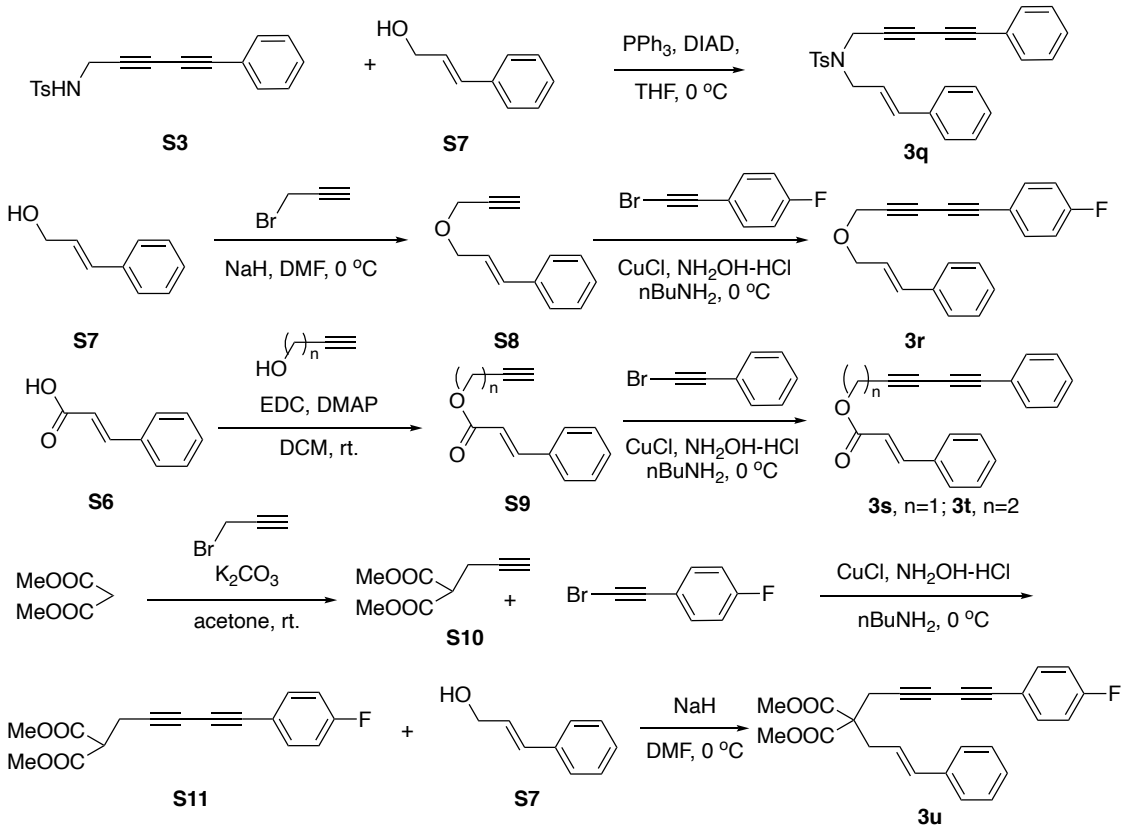
Method B: Synthesis of cinnamic acid S6

To a solution of aryl formaldehyde **S4** (1.0 equiv) and malonic acid **S5** (1.2 equiv) in dry pyridine (0.1 M) was added slowly of piperidine (0.05 equiv.) at room temperature. Then warm the mixture to 95°C for 3h. The solvent was then poured into a beaker with 1M cold hydrochloric

acid, and the crude products were collected by filtration. Products are further dried by lyophilizer.

Method C: Synthesis of 3a-3v

To a round bottom flask with diynes **S3** (1 equiv.), cinnamic acid **S6** (1.5 equiv.), 4-dimethylaminopyridine (0.1 equiv.) in anhydrous DCM at room temperature add EDC (2 equiv,) slowly. Track the reaction by TLC. The reaction was quenched with water and extracted with EtOAc for three times. The solvent was then removed under reduced pressure, and the crude product was purified by column chromatography on silica gel to afford the desired products **3a-3v**.



Method C: Synthesis of 3q

To a solution of amide **S3** (1.0 equiv.), PPh_3 (2.0 equiv.), cinnamic alcohol **S7** (2.0 equiv.) in anhydrous THF (0.1 M) under argon at 0 °C was added slowly of DIAD (2.2 equiv.). Then warm the mixture to room temperature for 3h. The solvent was then removed under reduced pressure, and the crude product was purified by column chromatography on silica gel to afford the desired product **3q**.

Method D: Synthesis of 3r

To a round bottom flask with **S7** (1 equiv.), propargyl bromide (1.2 equiv.) in anhydrous DMF at 0 °C add NaH (1.2 equiv, 60 % dispersion in mineral oil) slowly. After stirring for 30 min, the reaction solution was warmed up the room temperature for 4 h. The reaction was quenched with water and extracted with EtOAc for three times. The solvent was then removed under reduced pressure, and the crude product was purified by column chromatography on silica gel to afford the desired product **S8**. Treat **S8** with **method A** to produce the desired product **3r**.

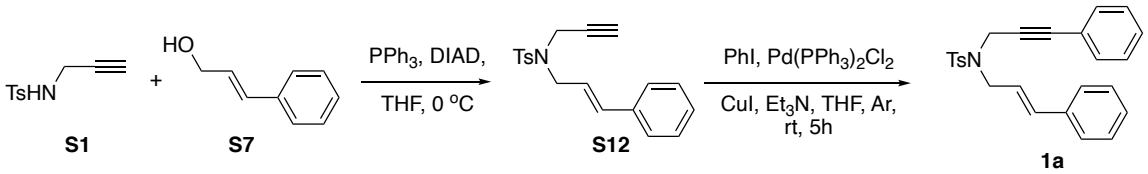
Method E: Synthesis of 3s and 3t

To a round bottom flask with alcohol (1 equiv.), cinnamic acid **S6** (1.5 equiv.), 4-dimethylaminopyridine (0.1 equiv.) in anhydrous DCM at room temperature add EDC (2 equiv,) slowly. Track the reaction by TLC. The reaction was quenched with water and extracted with EtOAc for three times. The solvent was then removed under reduced pressure, and the crude product was purified by column chromatography on silica gel to afford the desired products **S9**. Treat **S9** with **method A** to produce the desired product **3s** and **3t**.

Method F: Synthesis of 3u

To a round bottom flask with dimethyl malonate (1 equiv.), propargyl bromide (1.2 equiv.) in anhydrous acetone at room temperature add Ka_2CO_3 (5 equiv.). After stirring for 12 h, the reaction was quenched with water and extracted with EtOAc for three times. The solvent was then removed under reduced pressure, and the crude product was purified by column chromatography on silica gel to afford the desired product **S10**. Treat **S10** with **method A** to produce the desired product **S11**. Then treat **S11** with **method C** to produce the desired product **3u.**

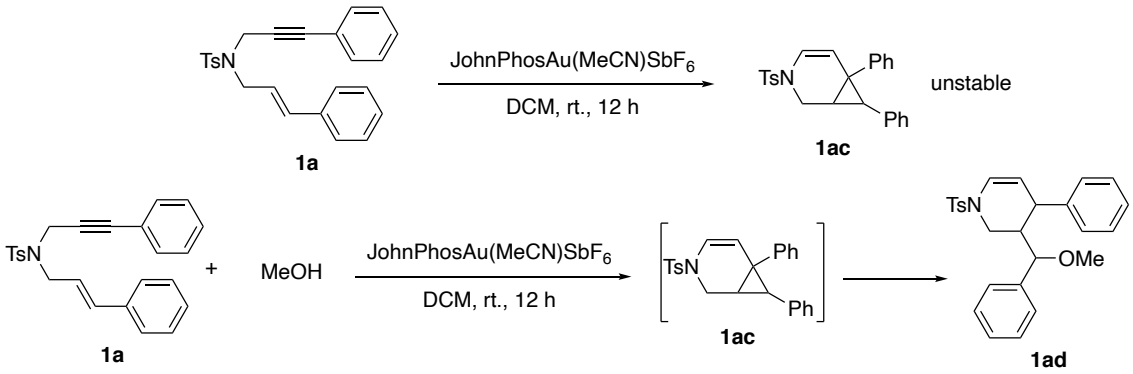
2.2 Procedure for 1a



To a solution of amide **S1** (1.0 equiv.), PPh_3 (2.0 equiv.), cinnamic alcohol **S7** (2.0 equiv.) in anhydrous THF (0.1 M) under argon at 0 °C was added slowly of DIAD (2.2 equiv.). Then warm the mixture to room temperature for 3h. The solvent was then removed under reduced pressure, and the crude product was purified by column chromatography on silica gel to afford the desired product **S12**.

To a solution of amide **S12** (1.0 equiv.), $Pd(PPh_3)_2Cl_2$ (0.1 equiv.), CuI (0.05 equiv.) in anhydrous THF under argon at 0 °C was added Et_3N (5 equiv.), followed adding PhI (1.5 equiv.). Then sir the mixture at room temperature for 3h. The solvent was then removed under reduced pressure, and the crude product was purified by column chromatography on silica gel to afford the desired product **1a**.

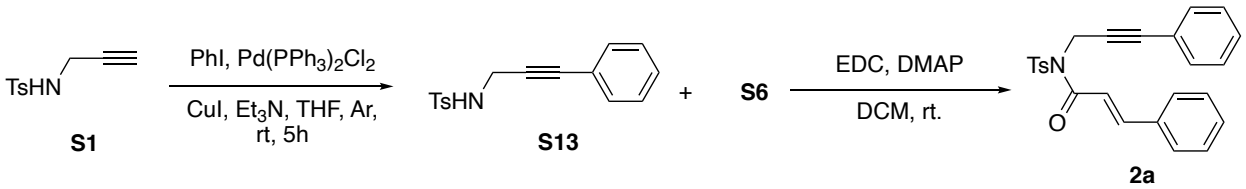
2.3 Procedure for 1ac(1ad)



To a solution of amide **1a** (1.0 equiv in anhydrous DCM (0.1 M) at room temperature was added JohnPhosAu(MeCN)SbF_6 (0.1 equiv.). After 12 h, the reaction is messy because of the

decomposition of **1ac**. The product **1ac** is not stable and easily decompose during separation. We use MeOH as nucleophile trapping **1ac** to produce product **1ad**. To a solution of amide **1a** (1.0 equiv.) and MeOH (10 equiv.) in anhydrous DCM (0.1 M) at room temperature was added JohnPhosAu(MeCN)SbF_6 (0.1 equiv.). The solvent was then removed under reduced pressure, and the crude product was purified by column chromatography on silica gel to afford the desired product **1ad**.

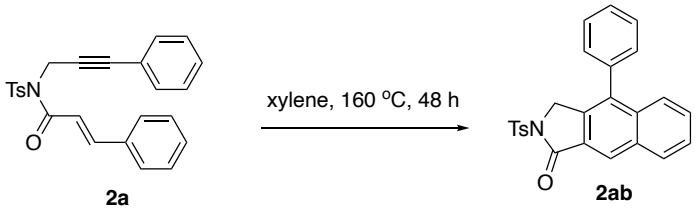
2.4 Procedure for 2a



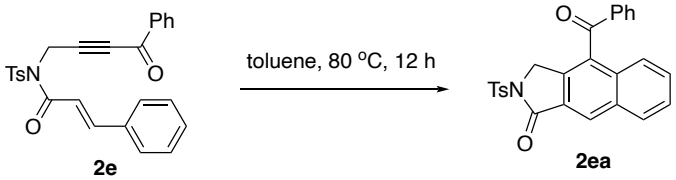
To a solution of amide **S1** (1.0 equiv.), $Pd(PPh_3)_2Cl_2$ (0.1 equiv.), CuI (0.05 equiv.) in anhydrous THF under argon at 0 °C was added Et_3N (5 equiv.), followed adding PhI (1.5 equiv.). Then sir the mixture at room temperature for 3h. The solvent was then removed under reduced pressure, and the crude product was purified by column chromatography on silica gel to afford the desired product **S13**.

To a round bottom flask with amine **S13** (1 equiv.), cinnamic acid **S6** (1.5 equiv.), 4-dimethylaminopyridine (0.1 equiv.) in anhydrous DCM at room temperature add EDC (2 equiv,) slowly. Track the reaction by TLC. The reaction was quenched with water and extracted with EtOAc for three times. The solvent was then removed under reduced pressure, and the crude product was purified by column chromatography on silica gel to afford the desired product **2a**.

2.5 Procedure for 2ab,2ea

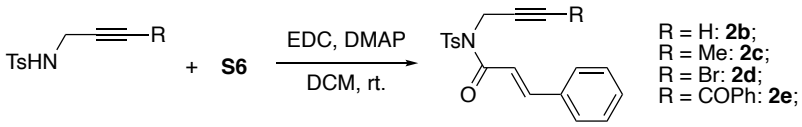


The resulting mixture of **2a** (0.2mmol) in xylene (10 mL) in a 20 mL vail was heated under 160 °C for 48 h in dark. Track the reaction by TLC. The solvent was then removed under reduced pressure, and the crude product was purified by column chromatography on silica gel to afford the desired product **2ab**.



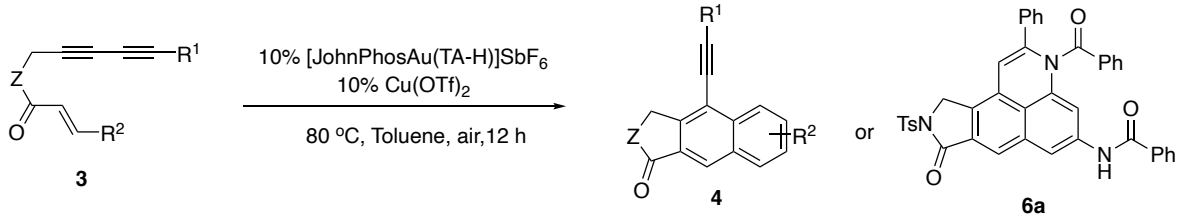
The resulting mixture of **2e** (0.2mmol) in toluene (10 mL) in a 20 mL vail was heated under 80 °C for 12 h dark. The solvent was then removed under reduced pressure, and the crude product was purified by column chromatography on silica gel to afford the desired product **2ea** with 58% conversion and 53% yield.

2.6 Procedure for 2b-2e



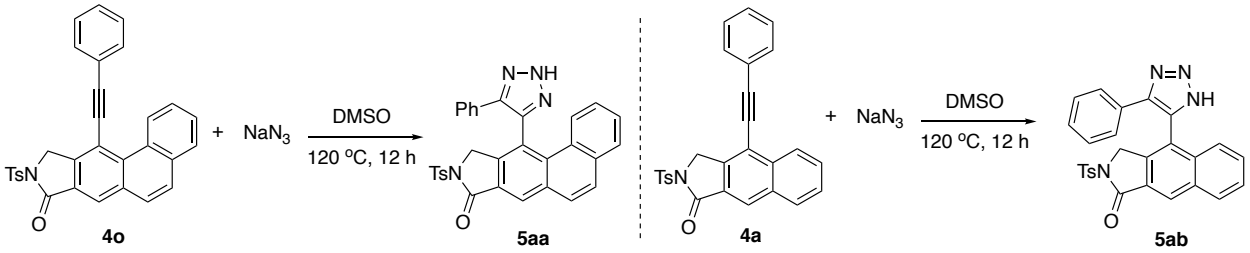
To a round bottom flask with amine (1 equiv.), cinnamic acid **S6** (1.5 equiv.), 4-dimethylaminopyridine (0.1 equiv.) in anhydrous DCM at room temperature add EDC (2 equiv,) slowly. Track the reaction by TLC. The reaction was quenched with water and extracted with EtOAc for three times. The solvent was then removed under reduced pressure, and the crude product was purified by column chromatography on silica gel to afford the desired product **2b-2e**.

2.7 General procedure for the synthesis of 4a-4s and 6a



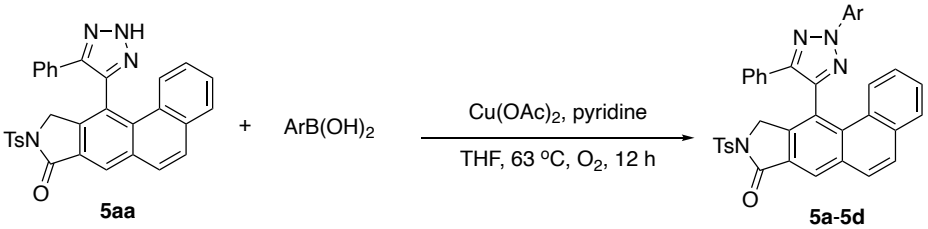
To a 20 mL vail with **3** (0.2mmol) in toluene (10 mL) was added 10% JohnPhosAu(TA-H)SbF_6 (17 mg), 10% $Cu(OTf)_2$ (7.2mg) subsequently. The resulting mixture was heated under 80 °C for 12 h in air under dark. Track the reaction by TLC. The solvent was then removed under reduced pressure, and the crude product was purified by column chromatography on silica gel to afford the desired product **4a-4s** or **6a**.

2.8 Procedure for the synthesis of 5aa and 5ab



To a round bottom flask with **4o** or **4a** (1 equiv.) in DMSO (0.1 M) was added NaN_3 (2 equiv.) slowly at room temperature. Then warm the mixture to 120°C and stir for 12h. The reaction was quenched with water and extracted with EtOAc for three times. The solvent was then removed under reduced pressure, and the crude product was purified by column chromatography on silica gel to afford the desired product **5aa** or **5ab**. Both **5aa** and **5ab** have poor solubility in $CDCl_3$, *d*6-DMSO. We used $CDCl_3$:CD_3OD (10:1) as solvent for NMR.

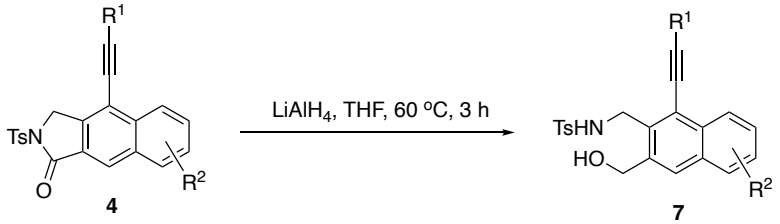
2.9 Procedure for the synthesis of 5a-5d



To a round bottom flask successively added triazole **5aa** (1 equiv.), arylboronic acid (2 equiv.), THF (0.1M), pyridine (2 equiv.) and $Cu(OAc)_2$ (0.1 equiv.) at room temperature. The bottle was

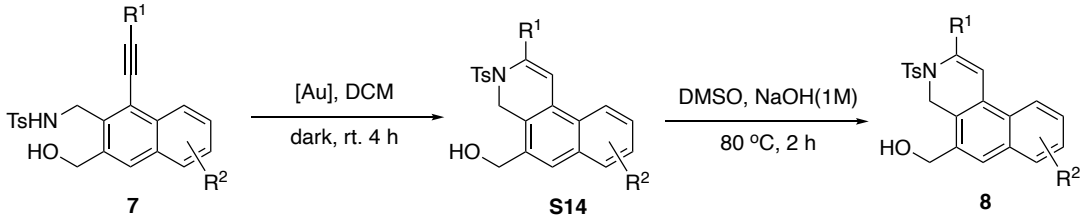
equipped with an oxygen balloon above. Then warm the mixture to 63°C and stir for 12h. Track the reaction by TLC. The solvent was then removed under reduced pressure, and the crude product was purified by column chromatography on silica gel to afford the desired products **5a-5d**.

2.10 Procedure for the synthesis of 7a-7d



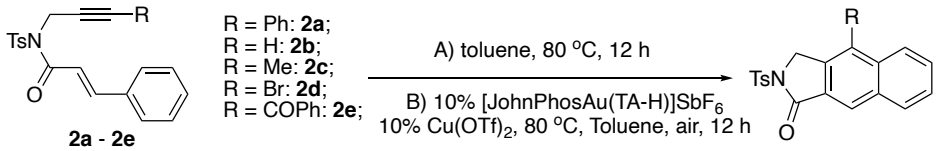
To a round bottom flask with **4** (1 equiv.) in dry THF (0.1 M) was added $LiAlH_4$ (2 equiv.) slowly at room temperature. Then warm the mixture to 60°C and stir for 3h. Track the reaction by TLC. The reaction was quenched with water and extracted with EtOAc for three times. The solvent was then removed under reduced pressure, and the crude product was purified by column chromatography on silica gel to afford the desired products **7a-7d**.

2.11 Procedure for the synthesis of 8a-8d



To a round bottom flask with **7a, 7b, 7d** (1 equiv.) in DCM (0.1 M) was added JohnPhosAu(MeCN)SbF_6 (0.1 equiv.) at room temperature in dark. (**7c** was added PPh_3AuNTf_2) at room temperature in dark). Then stir the mixture for 4 h. The solvent was then removed under reduced pressure to get products **S14**. Without purification, to the flask with S10 was added DMSO and NaOH (1M aq., 3 equiv.) at room temperature. Then warm the mixture to 80°C and stir for 2 h. Track the reaction by TLC. The reaction was quenched with water and extracted with EtOAc for three times. The solvent was then removed under reduced pressure, and the crude product was purified by column chromatography on silica gel to afford the desired products **8a-8d**.

2.11 Procedure for the 2a-2e ISDDA reaction



Condition A: The resulting mixture of **2a-2e** (0.2mmol) in toluene (10 mL) in a 20 mL vail was heated under 80 °C for 12 h dark. **2a-2d** have no conversion. **2e** afford the desired product **2ea** with 58% conversion and 53% yield.

Condition B: To a 20 mL vail with **2a-2e** (0.2mmol) in toluene (10 mL) was added 10% JohnPhosAu(TA-H)SbF_6 (17 mg), 10% $Cu(OTf)_2$ (7.2mg) subsequently. The resulting mixture

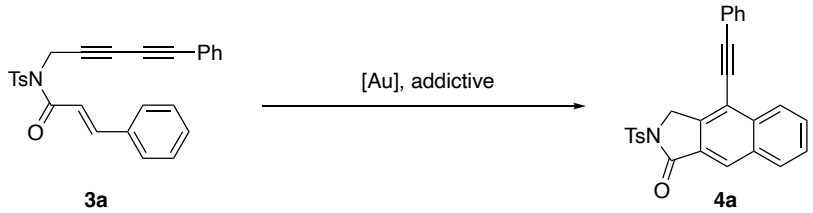
was heated under 80 °C for 12 h in air under dark. **2a** have no conversion. **2b** and **2c** starting materials decomposed and no clear products are identified. For **2d**, head-to-head coupling products are detected as literature reported.[1] **2e** afford the desired product **2ea** with 100% conversion and 40% yield.

Reference

1 M. Kreuzahler and G. Haberhauer, Cyclopropenylmethyl Cation: A Concealed Intermediate in Gold(I)-Catalyzed Reactions, *Angew. Chem. Int. Ed.*, 2020, **59**, 17739-17749.

III. Condition Optimization

3.1 Optimization condition table[a][b]



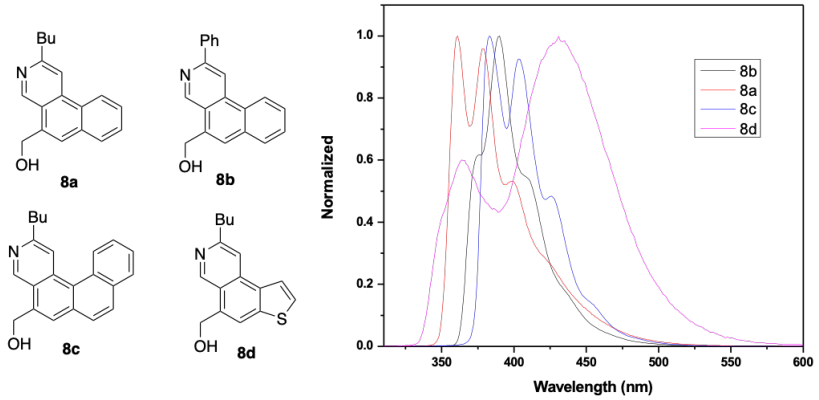
3a **4a**

Entry	Au Catalyst (10%)	Additive (10%)	Temp. (°C)	Solvents	Yield (%) 2a
1	-	-	80	toluene	55
2	JohnPhos(TA-H)AuSbF$_6$	-	80	toluene	84
3	JohnPhos(TA-H)AuSbF$_6$	Cu(OTf)$_2$	80	toluene	95
4	JohnPhos(TA-H)AuSbF$_6$	Ga(OTf)$_3$	80	toluene	14
6	JohnPhos(TA-H)AuSbF$_6$	Zn(OTf)$_2$	80	toluene	77
7	JohnPhos(TA-H)AuSbF$_6$	Fe(OTf)$_3$	80	toluene	5
8	JohnPhos(TA-H)AuSbF$_6$	CuCl	80	toluene	77
9	JohnPhos(TA-H)AuSbF$_6$	CuCl$_2$	80	toluene	80
10	JohnPhos(TA-H)AuSbF$_6$	Cu(OAc)$_2$	80	toluene	72
11	JohnPhos(TA-H)AuSbF$_6$	Cu(acac)$_2$	80	toluene	65
12	JohnPhos(TA-H)AuSbF$_6$	CuSO$_4$	80	toluene	89
13	JohnPhos(TA-H)AuSbF$_6$	CuOTf	80	toluene	84
14	JohnPhos(TA-H)AuSbF$_6$	CuI	80	toluene	84
15	PPh$_3$AuNTf$_2$	-	80	toluene	69
16	PPh$_3$AuCl	AgSbF$_6$	80	toluene	34
17	PPh$_3$(TA-H)AuSbF$_6$	-	80	toluene	75
18	IPrAuNTf$_2$	-	80	toluene	51
19	JohnPhosAuCl	AgSbF$_6$	80	toluene	60
20	XPhos(TA-H)AuSbF$_6$	-	80	toluene	68
21	-	Ga(OTf)$_3$	80	toluene	22
22	-	Cu(OTf)$_2$	80	toluene	46
23	-	Zn(OTf)$_2$	80	toluene	52
24	-	CuSO$_4$	80	toluene	54
25	-	AgSbF$_6$	80	toluene	48
26	JohnphosAuNTf$_2$	-	80	toluene	76
27	XphosAuNTf$_2$	-	80	toluene	65
28	JohnPhos(MeCN)AuSbF$_6$	-	80	toluene	17
29	JohnPhos(2,4-NO2-TA)AuSbF$_6$	-	80	toluene	77
30	5% JohnPhos(TA-H)AuSbF$_6$	5% Cu(OTf)$_2$	80	toluene	75
31	JohnPhos(TA-H)AuSbF$_6$	Cu(OTf)$_2$	80	MeCN	50
32	JohnPhos(TA-H)AuSbF$_6$	Cu(OTf)$_2$	80	DCE	24
33	JohnPhos(TA-H)AuSbF$_6$	Cu(OTf)$_2$	80	DMSO	60
34	JohnPhos(TA-H)AuSbF$_6$	Cu(OTf)$_2$	80	DMF	67
35	JohnPhos(TA-H)AuSbF$_6$	Cu(OTf)$_2$	rt.	toluene	0
36	JohnPhos(TA-H)AuSbF$_6$	Cu(OTf)$_2$	60	toluene	26(conv.30%)
37	JohnPhos(TA-H)AuSbF$_6$	Cu(OTf)$_2$(under light)	80	toluene	88
38	JohnPhos(TA-H)AuSbF$_6$	Cu(OTf)$_2$(under argon)	80	toluene	27

[a]Standard reaction conditions: to a solution of **3a** (0.2mmol) in toluene (10 mL), 10% JohnPhosAu(TA-H)SbF$_6$ (17 mg), 10% Cu(OTf)$_2$ (7.2mg) was added subsequently. The resulting mixture was heated under 80 °C for 12 h in air under dark. [b]isolated yields

IV. Optical Properties

Fluorescence detection Procedures: A series of stock solution of compound **8a-8d** (10^{-5} mol/L) was prepared by dissolving the corresponding amount of compound powder in DCE, which was stored in the dark. For fluorescence detection, 5mL stock solutions were used. The fluorescence spectra of mixed solutions were recorded with the corresponding excitation wavelength at room temperature (298 K).



Name	λ^{ex} (nm)	λ^{em}(nm)	$\Delta\lambda$(nm)
8a	254	360&379	125
8c	286	384&406	120
8d	248	366&432	184
8b	287	370	83

V. ORTEP Drawing of the Crystal Structure

X-ray diffraction data were measured on Bruker D8 Venture PHOTON II CMOS diffractometer equipped with a Cu Kα INCOATEC ImuS micro-focus source (λ = 1.54178 Å). Indexing was performed using APEX4 [1] (Difference Vectors method). Data integration and reduction were performed using SaintPlus [2]. Absorption correction was performed by multi-scan method implemented in SADABS [3]. Space group was determined using XPREP implemented in APEX3 [1]. Structure was solved using SHELXT [4] and refined using SHELXL-2018/3 [5] (full-matrix least-squares on F2) through OLEX2 interface program [6]. Ellipsoid plot was done with Platon [7]. **5ab**, **6a:** Hydrogen atoms of -NH groups were found from difference Fourier map and was freely refined.**6a:** Disordered chloroform molecule were refined with restraints. All remaining hydrogen atoms were refined using riding model. Data and refinement conditions are shown in **Tables S1 - S4**.

[1] Bruker (2022). APEX4. Bruker AXS LLC, Madison, Wisconsin, USA.
[2] Bruker SAINT. Bruker AXS LLC, Madison, Wisconsin, USA.
[3] Krause, L., Herbst-Irmer, R., Sheldrick, G. M., Stalke, D. (2015).
"Comparison of silver and molybdenum microfocus X-ray sources for single-crystal structure determination" J. Appl. Cryst. 48, 3-10.
[4] Sheldrick, G. M. (2015). "SHELXT - Integrated space-group and crystal-structure determination", Acta Cryst. A71, 3-8.
[5] Sheldrick, G. M. (2015) "Crystal structure refinement with SHELXL",
Acta Cryst., C71, 3-8
[6] Dolomanov, O.V.; Bourhis, L.J.; Gildea, R.J.; Howard, J.A.K.; Puschmann, H., OLEX2: A complete structure solution, refinement and analysis program (2009). J. Appl. Cryst., 42, 339-341
[7] A.L.Spek, The Program PLATON is designed as a Multipurpose Crystallographic Tool.
1980-2021 A.L.Spek, Utrecht University, Utrecht, The Netherlands. Acta Cryst. 2020, E76, 1-11

Table S1 Crystal data and structure refinement for 4j.	
Identification code	4j
Empirical formula	$C_{27}H_{17}BrFNO_3S$
Formula weight	534.39
Temperature/K	100.00
Crystal system	monoclinic
Space group	$P2_1/n$
a/Å	7.9493(2)
b/Å	24.1157(5)
c/Å	11.4002(2)
α/°	90
β/°	91.3000(10)
γ/°	90
Volume/Å^3	2184.89(8)
Z	4
ρ_{calc}g/cm^3	1.625
μ/mm^{-1}	3.806
F(000)	1080.0
Crystal size/mm^3	0.2 × 0.05 × 0.03
Radiation	CuKα (λ = 1.54178)
2Θ range for data collection/°	7.332 to 159.172
Index ranges	$-9 \le h \le 10$, $-30 \le k \le 30$, $-14 \le l \le 13$
Reflections collected	52092
Independent reflections	4705 [R_{int} = 0.0530, R_{sigma} = 0.0201]
Data/restraints/parameters	4705/0/308
Goodness-of-fit on F^2	1.057
Final R indexes [I>=2σ (I)]	R_1 = 0.0290, wR_2 = 0.0702
Final R indexes [all data]	R_1 = 0.0339, wR_2 = 0.0733
Largest diff. peak/hole / e Å^{-3}	0.33/-0.48

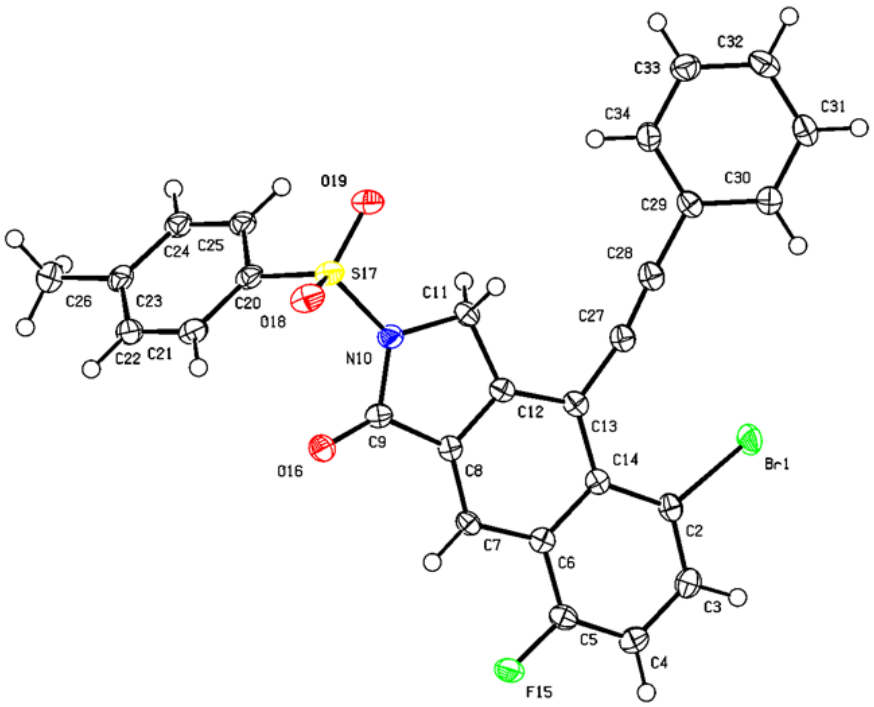


Figure S1. Ellipsoid plot of **4j**. Anisotropic displacement parameters were drawn at 50% probability level.
CCDC: 2161060

Table S2 Crystal data and structure refinement for 4s.	
Identification code	4s
Empirical formula	$C_{20}H_{12}O_2$
Formula weight	284.30
Temperature/K	100.00
Crystal system	monoclinic
Space group	$P2_1/c$
a/Å	16.0281(2)
b/Å	5.29640(10)
c/Å	16.7488(2)
α/°	90
β/°	99.9850(10)
γ/°	90
Volume/Å^3	1400.29(4)
Z	4
ρ_{calc}g/cm^3	1.349
μ/mm^{-1}	0.690
F(000)	592.0
Crystal size/mm^3	0.26 × 0.07 × 0.03
Radiation	CuKα (λ = 1.54178)
2Θ range for data collection/°	5.598 to 160.1
Index ranges	$-20 \leq h \leq 20$, $-6 \leq k \leq 6$, $-21 \leq l \leq 21$
Reflections collected	26828
Independent reflections	3037 [R_{int} = 0.0426, R_{sigma} = 0.0206]
Data/restraints/parameters	3037/0/199
Goodness-of-fit on F^2	1.056
Final R indexes [I>=2σ (I)]	R_1 = 0.0359, wR_2 = 0.0946
Final R indexes [all data]	R_1 = 0.0402, wR_2 = 0.0989
Largest diff. peak/hole / e Å^{-3}	0.20/-0.24

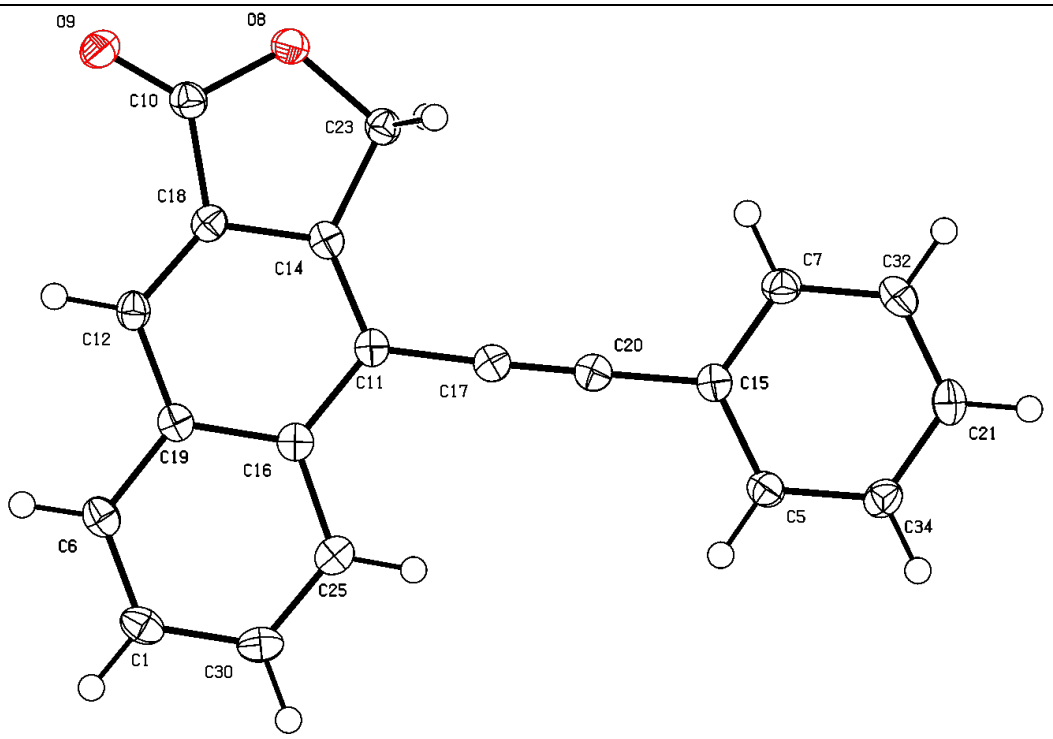


Figure S2. Ellipsoid plot of **4s**. Anisotropic displacement parameters were drawn at 50% probability level.
CCDC: 2161061

Table S3 Crystal data and structure refinement for 5ab.	
Identification code	5ab
Empirical formula	$C_{27}H_{20}N_4O_3S$
Formula weight	480.53
Temperature/K	296.00
Crystal system	monoclinic
Space group	$P2_1/c$
a/Å	9.2159(2)
b/Å	24.1709(5)
c/Å	21.1041(4)
α/°	90
β/°	101.4372(7)
γ/°	90
Volume/Å^3	4607.73(16)
Z	8
ρ_{calc}g/cm^3	1.385
μ/mm^{-1}	1.565
F(000)	2000.0
Crystal size/mm^3	0.19 × 0.16 × 0.04
Radiation	CuKα (λ = 1.54178)
2Θ range for data collection/°	5.624 to 160.73
Index ranges	$-11 \leq h \leq 11$, $-29 \leq k \leq 30$, $-26 \leq l \leq 26$
Reflections collected	99565
Independent reflections	10021 [R_{int} = 0.0503, R_{sigma} = 0.0250]
Data/restraints/parameters	10021/0/641
Goodness-of-fit on F^2	1.044
Final R indexes [I>=2σ (I)]	R_1 = 0.0430, wR_2 = 0.1153
Final R indexes [all data]	R_1 = 0.0522, wR_2 = 0.1242
Largest diff. peak/hole / e Å^{-3}	0.31/-0.48

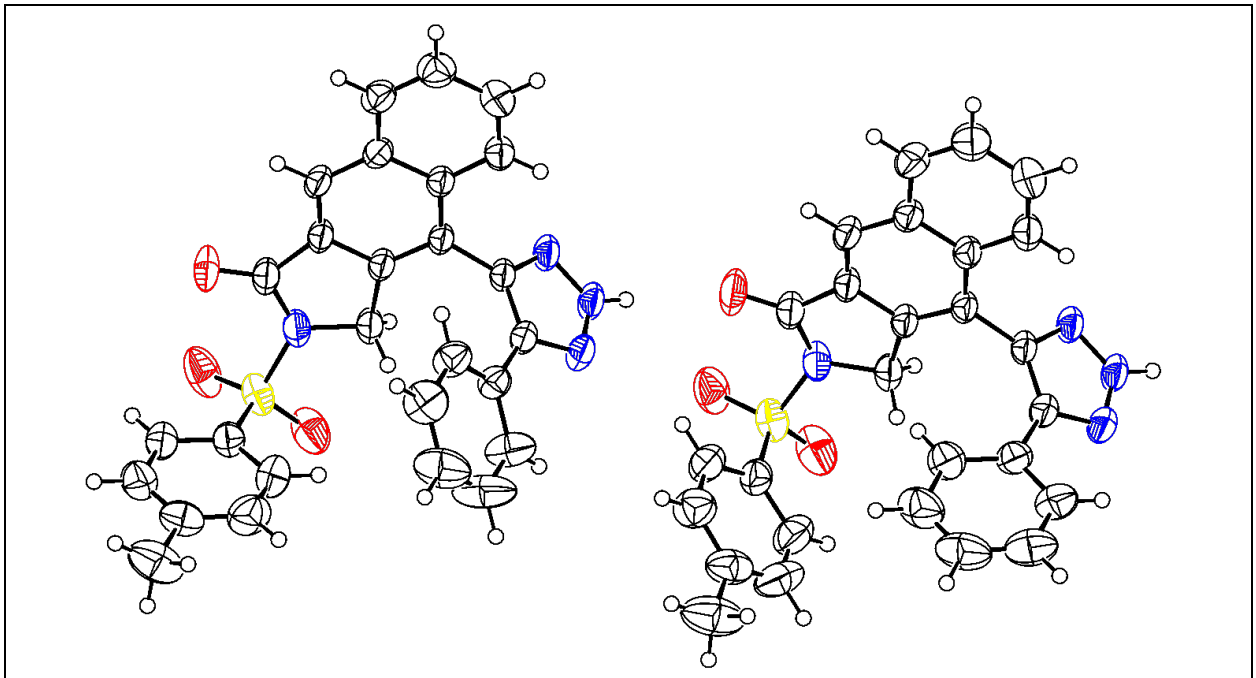


Figure S3. Ellipsoid plot of **5ab**. Anisotropic displacement parameters were drawn at 50% probability level.
CCDC: 2161059

Table S4 Crystal data and structure refinement for 6a.	
Identification code	6a
Empirical formula	$C_{45.91}H_{38.84}Cl_{1.83}N_3O_7S$
Moiety formula	$C_{41}H_{29}N_3O_5S$, $C_4H_8O_2$, 0.916(CH_2Cl_2)
Formula weight	841.72
Temperature/K	100.00
Crystal system	triclinic
Space group	P-1
a/Å	10.6653(3)
b/Å	12.1532(3)
c/Å	16.9707(5)
α/°	70.450(1)
β/°	89.007(1)
γ/°	74.967(1)
Volume/Å^3	1996.1(1)
Z	2
ρ_{calc}g/cm^3	1.400
μ/mm^{-1}	2.327
F(000)	877.0
Crystal size/mm^3	0.2 × 0.13 × 0.03
Radiation	CuKα (λ = 1.54178)
2Θ range for data collection/°	5.542 to 158.934
Index ranges	$-13 \leq h \leq 12$, $-15 \leq k \leq 15$, $-21 \leq l \leq 21$
Reflections collected	40341
Independent reflections	8344 [R_{int} = 0.0364, R_{sigma} = 0.0240]
Data/restraints/parameters	8344/10/568
Goodness-of-fit on F^2	1.045
Final R indexes [I>=2σ (I)]	R_1 = 0.0367, wR_2 = 0.0946
Final R indexes [all data]	R_1 = 0.0402, wR_2 = 0.0977
Largest diff. peak/hole / e Å^{-3}	0.45/-0.48

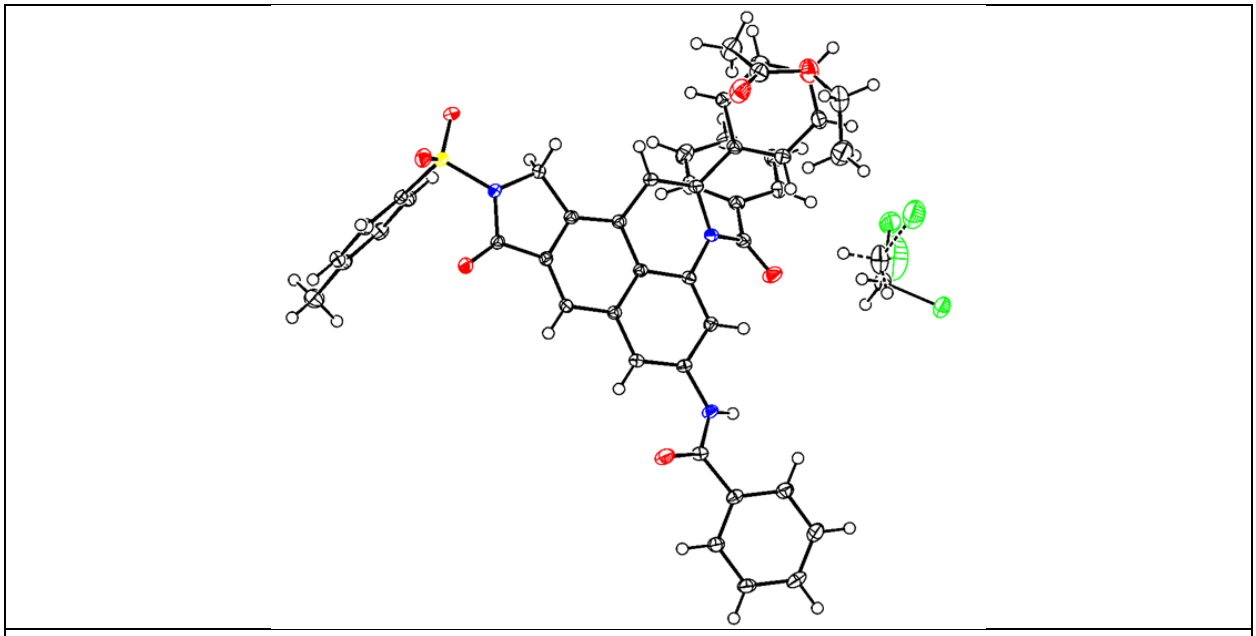
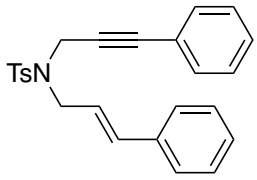


Figure S4. Ellipsoid plot of **6a**. Anisotropic displacement parameters were drawn at 50% probability level. Chloroform molecule is disordered.
CCDC: 2161058

VI. Compound Characterization



1a

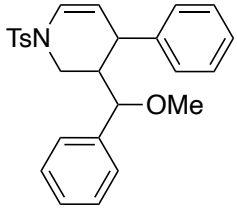
***N*-cinnamyl-4-methyl-*N*-(3-phenylprop-2-yn-1-yl)benzenesulfonamide**

1a was prepared following the Procedure 2.2 and purified by column chromatography (Hexane: Ethyl acetate = 10:1) in 75% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 7.80 (dd, *J* = 8.4, 1.8 Hz, 2H), 7.36-7.23 (m, 10H), 7.09-7.07 (m, 2H), 6.61 (d, *J* = 15.8 Hz, 1H), 6.16 (dt, *J* = 15.8, 6.8 Hz, 1H), 4.34 (s, 2H), 4.06-4.05 (m, 2H), 2.35 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 143.5, 136.17, 136.03, 134.9, 131.5, 129.6, 128.6, 128.4, 128.14, 128.06, 127.87, 126.6, 123.1, 122.2, 85.8, 81.8, 48.9, 36.9, 21.4

HRMS m/z (ESI) calcd. for C25H24NO2S+ $(M+H)^+$ 402.1523, found 402.1540



1ad

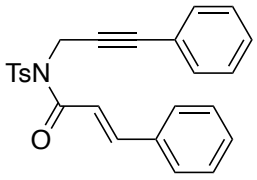
3-(methoxy(phenyl)methyl)-4-phenyl-1-tosyl-1,2,3,4-tetrahydropyridine

1ad was prepared following the Procedure 2.3 and purified by column chromatography (Hexane: Ethyl acetate = 10:1) in 85% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 7.72 (d, *J* = 8.3 Hz, 2H), 7.34 (d, *J* = 7.9 Hz, 2H), 7.03-6.98 (m, 8H), 6.83-6.81 (m, 2H), 5.68 (t, *J* = 3.3 Hz, 1H), 4.31 (d, *J* = 7.4 Hz, 1H), 4.02 (td, *J* = 11.4, 3.7 Hz, 2H), 3.52 (dt, *J* = 16.9, 2.6 Hz, 1H), 3.12 (s, 4H), 2.77 (dd, *J* = 11.2, 3.6 Hz, 1H), 2.44 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 143.6, 141.0, 139.0, 138.5, 133.2, 129.7, 127.78, 127.73, 127.4, 126.4, 126.2, 122.8, 83.2, 57.0, 45.6, 44.74, 44.58, 21.5

HRMS m/z (ESI) calcd. for C26H28NO3S+ $(M+H)^+$ 434.1785, found 434.1785

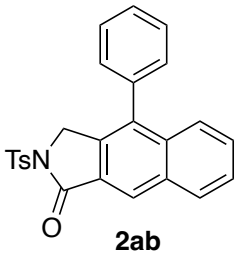


2a

***N*-(3-phenylprop-2-yn-1-yl)-*N*-tosylcinnamamide**

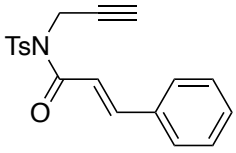
2a was prepared following the Procedure 2.4 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 83% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 7.98 (d, *J* = 8.4 Hz, 2H), 7.71 (d, *J* = 15.4 Hz, 1H), 7.52-7.51 (m, 2H), 7.40-7.37 (m, 3H), 7.34 (dt, *J* = 6.1, 1.9 Hz, 2H), 7.32-7.27 (m, 4H), 4.98 (s, 2H), 2.37 (s, 3H).
^{13}C NMR (151 MHz; CDCl3): δ 165.3, 146.6, 145.0, 136.7, 134.4, 131.8, 130.7, 129.7, 129.0, 128.59, 128.40, 128.24, 128.0, 122.3, 117.6, 84.3, 83.8, 36.3, 21.6
HRMS m/z (ESI) calcd. for C25H22NO3S+ $(M+H)^+$ 416.1315, found 416.1311



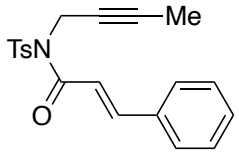
2ab

4-phenyl-2-tosyl-2,3-dihydro-1*H*-benzo[*f*]isoindol-1-one
2ab was prepared following the General Procedure 2.5 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 45% yield as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 8.40 (s, 1H), 8.03 (d, *J* = 8.3 Hz, 3H), 7.72 (d, *J* = 8.2 Hz, 1H), 7.58-7.52 (m, 5H), 7.34 (t, *J* = 8.5 Hz, 4H), 4.80 (s, 2H), 2.42 (s, 3H).
^{13}C NMR (151 MHz; CDCl3): δ 166.2, 145.2, 135.8, 135.41, 135.37, 134.9, 133.36, 133.30, 130.0, 129.8, 129.4, 129.1, 128.8, 128.5, 128.2, 127.4, 126.7, 126.0, 125.6, 49.6, 21.7
HRMS m/z (ESI) calcd. for C25H20NO3S+ $(M+H)^+$ 414.1159, found 414.1182



2b

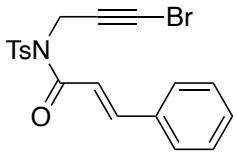
***N*-(prop-2-yn-1-yl)-*N*-tosylcinnamamide**
2b was prepared following the General Procedure 2.6 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 92% yield as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 7.93-7.92 (m, 2H), 7.69 (d, *J* = 15.4 Hz, 1H), 7.50-7.48 (m, 2H), 7.39 (td, *J* = 3.9, 2.5 Hz, 3H), 7.29 (q, *J* = 12.1 Hz, 3H), 4.75 (d, *J* = 2.4 Hz, 2H), 2.40 (s, 3H), 2.31 (t, *J* = 2.4 Hz, 1H).
^{13}C NMR ((151 MHz; CDCl3): δ 165.2, 146.7, 145.2, 136.5, 134.3, 130.8, 129.8, 129.0, 128.4, 127.9, 117.4, 78.4, 72.6, 35.4, 21.7
HRMS m/z (ESI) calcd. for C19H18NO3S+ $(M+H)^+$ 340.1002, found 340.0989



2c

***N*-(but-2-yn-1-yl)-*N*-tosylcinnamamide**
2c was prepared following the General Procedure 2.6 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 83% yield as white solid.

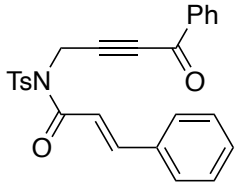
^{1}H NMR (600 MHz; $CDCl_3$): δ 7.93 (d, *J* = 8.4 Hz, 2H), 7.68 (d, *J* = 15.4 Hz, 1H), 7.50 (dd, *J* = 6.5, 3.0 Hz, 2H), 7.39 (dt, *J* = 5.3, 2.8 Hz, 3H), 7.30 (d, *J* = 8.4 Hz, 2H), 7.26 (s, 1H), 4.70 (q, *J* = 2.3 Hz, 2H), 2.41 (s, 3H), 1.79 (t, *J* = 2.3 Hz, 3H).
^{13}C NMR (151 MHz; CDCl3): δ 165.4, 146.4, 144.9, 136.7, 134.4, 130.7, 129.6, 128.9, 128.4, 128.0, 117.6, 80.7, 73.8, 36.1, 21.6, 3.6
HRMS m/z (ESI) calcd. for C20H20NO3S+ $(M+H)^+$ 354.1159, found 354.1179



2d

***N*-(3-bromoprop-2-yn-1-yl)-*N*-tosylcinnamamide**

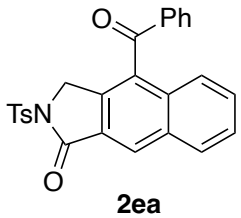
2d was prepared following the General Procedure 2.6 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 75% yield as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 7.88 (d, *J* = 8.4 Hz, 2H), 7.69 (d, *J* = 15.4 Hz, 1H), 7.52-7.50 (m, 2H), 7.40 (dquintet, *J* = 5.0, 2.5 Hz, 3H), 7.36 (d, *J* = 15.4 Hz, 1H), 7.32 (d, *J* = 8.2 Hz, 2H), 4.75 (s, 2H), 2.41 (s, 3H).
^{13}C NMR (151 MHz; CDCl3): δ 165.2, 146.8, 145.2, 136.4, 134.3, 130.8, 129.8, 129.0, 128.4, 127.8, 117.4, 74.7, 44.6, 36.5, 21.7
HRMS m/z (ESI) calcd. for C19H17BrNO3S+ $(M+H)^+$ 418.0108, found 418.0105



2e

***N*-(4-oxo-4-phenylbut-2-yn-1-yl)-*N*-tosylcinnamamide**

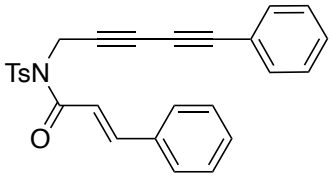
2e was prepared following the General Procedure 2.6 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 85% yield as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 8.02-8.01 (m, 2H), 7.94-7.92 (m, 2H), 7.73 (d, *J* = 15.5 Hz, 1H), 7.61-7.58 (m, 1H), 7.54-7.53 (m, 2H), 7.46-7.41 (m, 6H), 7.28-7.26 (m, 2H), 5.01 (s, 2H), 2.33 (s, 3H).
^{13}C NMR (151 MHz; CDCl3): δ 177.1, 165.2, 147.1, 145.6, 136.29, 136.14, 134.28, 134.24, 130.9, 130.1, 129.6, 129.0, 128.59, 128.49, 127.8, 117.3, 88.6, 81.8, 35.7, 21.6
HRMS m/z (ESI) calcd. for C26H22NO4S+ $(M+H)^+$ 444.1265, found 444.1275



2ea

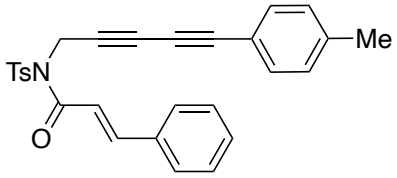
4-benzoyl-2-tosyl-2,3-dihydro-1*H*-benzo[*f*]isoindol-1-one

2ea was prepared following the General Procedure 2.5 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 53% yield (58% conversion) as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 8.50 (s, 1H), 8.06 (d, *J* = 8.1 Hz, 1H), 8.02 (d, *J* = 8.4 Hz, 2H), 7.80-7.78 (m, 2H), 7.70-7.66 (m, 2H), 7.59-7.55 (m, 2H), 7.49 (t, *J* = 7.8 Hz, 2H), 7.34 (d, *J* = 8.2 Hz, 2H), 4.88 (s, 2H), 2.42 (s, 3H).
^{13}C NMR (151 MHz; CDCl3): δ 196.3, 165.3, 145.5, 136.6, 135.1, 134.7, 133.5, 133.26, 133.06, 132.5, 130.3, 129.94, 129.82, 129.64, 129.2, 128.2, 128.0, 127.6, 127.3, 125.8, 49.0, 21.7
HRMS m/z (ESI) calcd. for C26H20NO4S+ $(M+H)^+$ 442.1108, found 442.1120



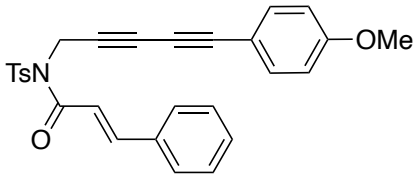
3a

***N*-(5-phenylpenta-2,4-diyn-1-yl)-*N*-tosylcinnamamide**
3a was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 84% yield as yellow solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 7.93 (d, *J* = 6.9 Hz, 2H), 7.71 (dd, *J* = 15.4, 0.9 Hz, 1H), 7.52 (dd, *J* = 5.2, 2.0 Hz, 2H), 7.47 (d, *J* = 8.1 Hz, 2H), 7.41-7.31 (m, 9H), 4.89 (d, *J* = 1.3 Hz, 2H), 2.39 (s, 3H).
^{13}C NMR (151 MHz; CDCl3): δ 165.2, 146.9, 145.4, 136.3, 134.3, 132.6, 130.9, 129.9, 129.5, 129.0, 128.5, 127.9, 121.3, 117.3, 77.9, 73.3, 69.1, 36.4, 21.7
HRMS m/z (ESI) calcd. for C27H22NO3S+ $(M+H)^+$ 440.1315, found 440.1313



3b

***N*-(5-(*p*-tolyl)penta-2,4-diyn-1-yl)-*N*-tosylcinnamamide**
3b was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 85% yield as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 7.92 (d, *J* = 8.4 Hz, 2H), 7.70 (d, *J* = 15.4 Hz, 1H), 7.52 (dd, *J* = 6.5, 2.9 Hz, 2H), 7.40 (dd, *J* = 5.1, 1.7 Hz, 3H), 7.35 (q, *J* = 11.5 Hz, 5H), 7.13 (d, *J* = 8.1 Hz, 2H), 4.88 (s, 2H), 2.39 (s, 3H), 2.36 (s, 3H).
^{13}C NMR (151 MHz; CDCl3): δ 165.2, 146.8, 145.3, 139.8, 136.4, 134.3, 132.6, 130.8, 129.9, 129.2, 129.0, 128.5, 127.9, 118.2, 117.4, 78.2, 76.7, 72.7, 69.3, 36.4, 21.68, 21.64
HRMS m/z (ESI) calcd. for C28H24NO3S+ $(M+H)^+$ 454.1472, found 454.1500



3c

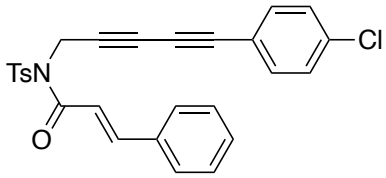
***N*-(5-(4-methoxyphenyl)penta-2,4-diyn-1-yl)-*N*-tosylcinnamamide**

3c was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 80% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 7.93-7.92 (m, 2H), 7.70 (d, *J* = 15.4 Hz, 1H), 7.52-7.51 (m, 2H), 7.43-7.40 (m, 5H), 7.35-7.32 (m, 3H), 6.85-6.83 (m, 2H), 4.88 (s, 2H), 3.82 (s, 3H), 2.39 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.2, 160.5, 146.8, 145.2, 136.4, 134.35, 134.28, 130.8, 129.9, 129.0, 128.5, 127.9, 117.4, 114.2, 113.2, 78.1, 76.4, 72.2, 69.4, 55.4, 36.4, 21.7

HRMS m/z (ESI) calcd. for C28H24NO4S+ $(M+H)^+$ 470.1421, found 470.1443



3d

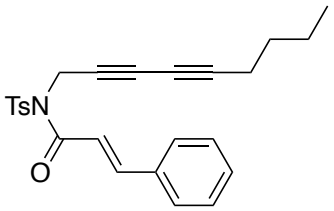
***N*-(5-(4-chlorophenyl)penta-2,4-diyn-1-yl)-*N*-tosylcinnamamide**

3d was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 82% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 7.92-7.90 (m, 2H), 7.71 (d, *J* = 15.4 Hz, 1H), 7.52 (dd, *J* = 7.2, 2.3 Hz, 2H), 7.42-7.39 (m, 5H), 7.37-7.29 (m, 5H), 4.88 (s, 2H), 2.40 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.2, 146.9, 145.3, 136.4, 135.6, 134.3, 133.8, 130.8, 129.9, 129.00, 128.88, 128.5, 127.8, 119.8, 117.3, 77.7, 76.6, 74.3, 68.8, 36.4, 21.7

HRMS m/z (ESI) calcd. for C27H21ClNO3S+ $(M+H)^+$ 474.0926, found 474.0949



3e

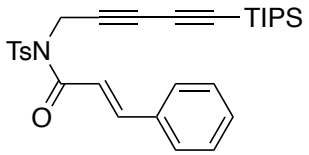
***N*-(nona-2,4-diyn-1-yl)-*N*-tosylcinnamamide**

3e was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 90% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 7.91 (d, *J* = 8.4 Hz, 2H), 7.68 (d, *J* = 15.4 Hz, 1H), 7.50 (dd, *J* = 7.1, 2.3 Hz, 2H), 7.40 (m, 3H), 7.31 (d, *J* = 8.1 Hz, 2H), 7.27 (d, *J* = 13.9 Hz, 1H), 4.79 (s, 2H), 2.41 (s, 3H), 2.26 (t, *J* = 7.0 Hz, 2H), 1.52-1.48 (m, 2H), 1.41 (ddd, *J* = 8.1, 7.0, 6.8 Hz, 2H), 0.91 (t, *J* = 7.3 Hz, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.2, 146.7, 145.1, 136.4, 134.3, 130.8, 129.8, 129.0, 128.4, 127.9, 117.4, 81.1, 70.0, 69.6, 64.5, 36.2, 30.1, 21.9, 21.7, 18.9, 13.5

HRMS m/z (ESI) calcd. for C25H26NO3S+ $(M+H)^+$ 420.1628, found 420.1627



3f

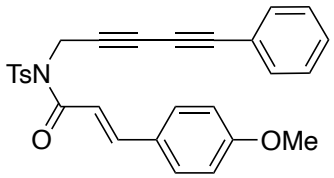
***N*-tosyl-*N*-(5-(triisopropylsilyl)penta-2,4-diyn-1-yl)cinnamamide**

3f was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 79% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 7.91 (d, *J* = 8.4 Hz, 2H), 7.70 (d, *J* = 15.4 Hz, 1H), 7.52 (dd, *J* = 7.2, 2.3 Hz, 2H), 7.41-7.36 (m, 4H), 7.31 (d, *J* = 8.1 Hz, 2H), 4.82 (s, 2H), 2.40 (s, 3H), 1.08 (s, 21H).

^{13}C NMR (151 MHz; CDCl3): δ 165.2, 146.9, 145.2, 136.3, 134.3, 130.8, 129.8, 129.0, 128.5, 127.9, 117.4, 88.9, 84.2, 71.1, 69.7, 36.1, 21.6, 18.5, 11.2

HRMS m/z (ESI) calcd. for C30H38NO3SSi+ $(M+H)^+$ 520.2337, found 520.2331



3g

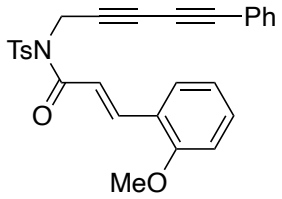
(*E*)-3-(4-methoxyphenyl)-*N*-(5-phenylpenta-2,4-diyn-1-yl)-*N*-tosylacrylamide

3g was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 76% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 7.92 (d, *J* = 8.4 Hz, 2H), 7.68 (d, *J* = 15.4 Hz, 1H), 7.48 (dd, *J* = 8.4, 1.4 Hz, 4H), 7.34-7.32 (m, 5H), 7.21 (d, *J* = 15.3 Hz, 1H), 6.91 (d, *J* = 8.8 Hz, 2H), 4.88 (s, 2H), 3.85 (s, 3H), 2.39 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.4, 161.9, 146.8, 145.2, 136.5, 132.6, 130.3, 129.8, 129.4, 128.4, 127.9, 127.1, 121.4, 114.7, 114.4, 77.8, 73.4, 72.5, 69.0, 55.4, 36.3, 21.7

HRMS m/z (ESI) calcd. for C28H24NO4S+ $(M+H)^+$ 470.1421, found 470.1392



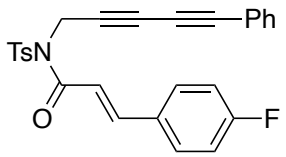
3h

(*E*)-3-(2-methoxyphenyl)-*N*-(5-phenylpenta-2,4-diyn-1-yl)-*N*-tosylacrylamide

3h was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 75% yield as colorless oil.

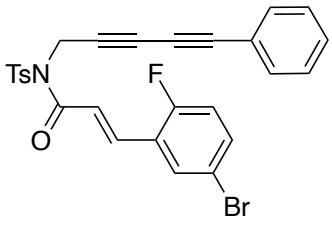
^{1}H NMR (600 MHz; $CDCl_3$): δ 7.98-7.93 (m, 3H), 7.51 (d, *J* = 15.5 Hz, 1H), 7.47 (t, *J* = 7.4 Hz, 3H), 7.37 (t, *J* = 7.5 Hz, 2H), 7.33-7.31 (m, 4H), 6.97 (t, *J* = 7.5 Hz, 1H), 6.92 (d, *J* = 8.3 Hz, 1H), 4.89 (s, 2H), 3.90 (s, 3H), 2.39 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.8, 158.9, 145.1, 142.8, 136.5, 132.6, 132.0, 130.2, 129.8, 129.4, 128.4, 128.0, 123.3, 121.4, 120.8, 118.0, 111.2, 77.8, 77.3, 73.4, 69.0, 55.5, 36.4, 21.7
HRMS m/z (ESI) calcd. for C28H24NO4S+ $(M+H)^+$ 470.1421, found 470.1439



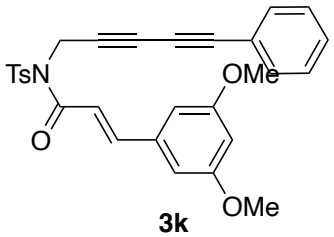
3i

(*E*)-3-(4-fluorophenyl)-*N*-(5-phenylpenta-2,4-diyn-1-yl)-*N*-tosylacrylamide
3i was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 92% yield as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 7.91 (d, *J* = 8.4 Hz, 2H), 7.67 (d, *J* = 15.4 Hz, 1H), 7.52-7.50 (m, 2H), 7.48-7.47 (m, 2H), 7.39-7.27 (m, 6H), 7.11-7.08 (m, 2H), 4.87 (s, 2H), 2.40 (s, 3H).
^{13}C NMR (151 MHz; CDCl3): δ 165.09, 164.31 (*J* = 252.5 Hz), 145.43 (*J* = 20.6 Hz), 136.3, 132.6, 130.61 (*J* = 3.6 Hz), 130.39 (*J* = 8.7 Hz), 129.9, 129.4, 128.5, 127.8, 121.3, 117.17 (*J* = 1.8 Hz), 116.28, 116.13, 77.9, 77.0, 73.3, 69.1, 36.4, 21.7
^{19}F NMR (564 MHz; CDCl3): δ -108.48
HRMS m/z (ESI) calcd. for C27H21FNO3S+ $(M+H)^+$ 458.1221, found 458.1221



3j

(*E*)-3-(5-bromo-2-fluorophenyl)-*N*-(5-phenylpenta-2,4-diyn-1-yl)-*N*-tosylacrylamide
3j was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 78% yield as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 7.93-7.92 (m, 2H), 7.68 (d, *J* = 15.6 Hz, 1H), 7.58 (dd, *J* = 6.4, 2.4 Hz, 1H), 7.47 (ddt, *J* = 8.4, 6.6, 1.7 Hz, 3H), 7.42 (d, *J* = 15.6 Hz, 1H), 7.38 (t, *J* = 7.5 Hz, 3H), 7.32 (td, *J* = 7.4, 1.3 Hz, 2H), 7.01 (dd, *J* = 10.0, 8.9 Hz, 1H), 4.89 (s, 2H), 2.42 (s, 3H).
^{13}C NMR (151 MHz; CDCl3): δ 164.7, 160.42 (d, *J* = 255.2 Hz), 145.5, 137.7, 136.2, 134.67 (d, *J* = 8.8 Hz), 132.6, 132.17 (d, *J* = 3.1 Hz), 130.0, 129.4, 128.5, 127.9, 124.43 (d, *J* = 13.0 Hz), 121.42 (d, *J* = 7.6 Hz), 121.28, 118.09 (d, *J* = 23.3 Hz), 117.10 (d, *J* = 3.2 Hz), 77.9, 73.2, 69.2, 36.4, 21.7
^{19}F NMR (564 MHz; CDCl3): δ -115.5
HRMS m/z (ESI) calcd. for C27H20BrFNO3S+ $(M+H)^+$ 536.0326, found 536.0309



3k

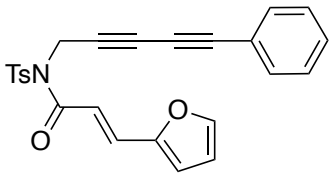
(*E*)-3-(3,5-dimethoxyphenyl)-*N*-(5-phenylpenta-2,4-diyn-1-yl)-*N*-tosylacrylamide

3k was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 83% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 7.94 (d, *J* = 8.4 Hz, 2H), 7.64 (d, *J* = 15.4 Hz, 1H), 7.51-7.49 (m, 2H), 7.40-7.31 (m, 6H), 6.67 (d, *J* = 2.2 Hz, 2H), 6.54 (t, *J* = 2.2 Hz, 1H), 4.90 (s, 2H), 3.84 (s, 6H), 2.43 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.1, 161.0, 146.8, 145.3, 136.35, 136.21, 132.6, 129.9, 129.4, 128.4, 127.9, 121.3, 118.0, 106.43, 106.37, 102.9, 77.9, 73.3, 69.1, 55.51, 55.46, 36.4, 21.7

HRMS m/z (ESI) calcd. for C29H26NO5S+ $(M+H)^+$ 500.1527, found 500.1520



3l

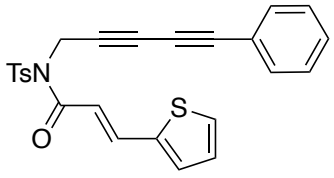
(*E*)-3-(furan-2-yl)-*N*-(5-phenylpenta-2,4-diyn-1-yl)-*N*-tosylacrylamide

3l was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 82% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 7.95 (d, *J* = 8.4 Hz, 2H), 7.53 (d, *J* = 1.3 Hz, 1H), 7.49-7.45 (m, 3H), 7.38-7.31 (m, 5H), 7.19 (d, *J* = 15.1 Hz, 1H), 6.65 (d, *J* = 3.4 Hz, 1H), 6.49 (dd, *J* = 3.4, 1.8 Hz, 1H), 4.89 (s, 2H), 2.41 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.1, 151.0, 145.40, 145.20, 136.3, 132.9, 132.6, 129.8, 129.4, 128.49, 128.45, 128.1, 121.3, 116.5, 114.5, 112.6, 77.8, 77.1, 73.3, 69.0, 36.3, 21.7

HRMS m/z (ESI) calcd. for C25H20NO4S+ $(M+H)^+$ 430.1108, found 430.1102



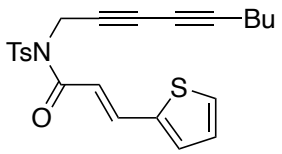
3m

(*E*)-*N*-(5-phenylpenta-2,4-diyn-1-yl)-3-(thiophen-2-yl)-*N*-tosylacrylamide

3m was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 85% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 7.94-7.93 (m, 2H), 7.80 (d, *J* = 15.1 Hz, 1H), 7.49-7.47 (m, 2H), 7.42 (d, *J* = 5.1 Hz, 1H), 7.37-7.31 (m, 5H), 7.27 (s, 1H), 7.12 (d, *J* = 15.1 Hz, 1H), 7.06 (dd, *J* = 5.1, 3.7 Hz, 1H), 4.89 (s, 2H), 2.40 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 164.9, 145.3, 139.7, 139.2, 136.4, 132.6, 132.1, 129.9, 129.40, 129.35, 128.44, 128.34, 127.9, 121.3, 116.0, 77.8, 77.1, 73.3, 69.0, 36.2, 21.7
HRMS m/z (ESI) calcd. for C25H20NO3S2+ $(M+H)^+$ 446.0880, found 446.0878



3n

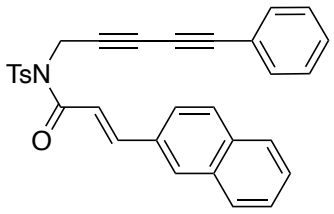
(*E*)-*N*-(nona-2,4-diyn-1-yl)-3-(thiophen-2-yl)-*N*-tosylacrylamide

3n was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 85% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 7.93-7.91 (m, 2H), 7.77 (d, *J* = 15.1 Hz, 1H), 7.42 (d, *J* = 5.1 Hz, 1H), 7.33 (d, *J* = 8.1 Hz, 2H), 7.25 (d, *J* = 3.6 Hz, 1H), 7.08-7.05 (m, 2H), 4.79 (s, 2H), 2.41 (s, 3H), 2.27 (t, *J* = 7.0 Hz, 2H), 1.52-1.48 (m, 2H), 1.42 (td, *J* = 8.2, 5.7 Hz, 2H), 0.92 (t, *J* = 7.3 Hz, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 164.8, 145.1, 139.7, 139.0, 136.4, 132.0, 129.8, 129.3, 128.3, 128.0, 116.0, 81.0, 70.1, 69.5, 64.5, 36.1, 30.1, 21.9, 21.7, 18.9, 13.5

HRMS m/z (ESI) calcd. for C23H24NO3S2+ $(M+H)^+$ 426.1193, found 426.1199



3o

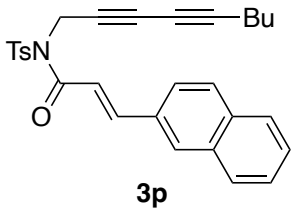
(*E*)-3-(naphthalen-2-yl)-*N*-(5-phenylpenta-2,4-diyn-1-yl)-*N*-tosylacrylamide

3o was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 10:1) in 73% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 7.95 (d, *J* = 8.4 Hz, 2H), 7.91 (s, 1H), 7.86 (q, *J* = 8.0 Hz, 4H), 7.66 (dd, *J* = 8.6, 1.3 Hz, 1H), 7.55-7.51 (m, 2H), 7.49-7.46 (m, 3H), 7.38-7.31 (m, 5H), 4.91 (s, 2H), 2.38 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.3, 147.0, 145.3, 136.4, 134.5, 133.2, 132.6, 131.8, 130.8, 129.9, 129.4, 128.85, 128.72, 128.4, 127.91, 127.81, 127.6, 126.9, 123.5, 121.3, 117.5, 77.9, 77.1, 73.3, 69.1, 36.4, 21.7.

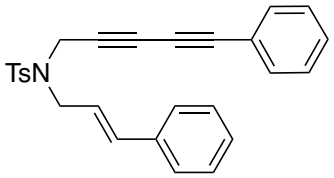
HRMS m/z (ESI) calcd. for C31H24NO3S+ $(M+H)^+$ 490.1471, found 490.1465



3p

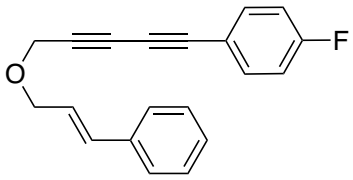
(*E*)-3-(naphthalen-2-yl)-*N*-(nona-2,4-diyn-1-yl)-*N*-tosylacrylamide

3p was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 10:1) in 83% yield as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 7.94 (d, *J* = 8.4 Hz, 2H), 7.90 (s, 1H), 7.85 (dt, *J* = 12.9, 8.1 Hz, 4H), 7.65 (dd, *J* = 8.6, 1.6 Hz, 1H), 7.55-7.51 (m, 2H), 7.41 (d, *J* = 15.4 Hz, 1H), 7.32 (d, *J* = 8.2 Hz, 2H), 4.82 (s, 2H), 2.40 (s, 3H), 2.27 (t, *J* = 7.0 Hz, 2H), 1.53-1.48 (m, 2H), 1.44-1.38 (m, 2H), 0.91 (t, *J* = 7.3 Hz, 3H).
^{13}C NMR (151 MHz; CDCl3): δ 165.2, 146.8, 145.2, 136.4, 134.4, 133.2, 131.8, 130.7, 129.8, 128.83, 128.71, 127.96, 127.81, 127.6, 126.9, 123.5, 117.4, 81.1, 70.0, 69.6, 64.5, 36.2, 30.1, 21.9, 21.7, 18.9, 13.5
HRMS m/z (ESI) calcd. for C29H28NO3S+ $(M+H)^+$ 470.1785, found 470.1807



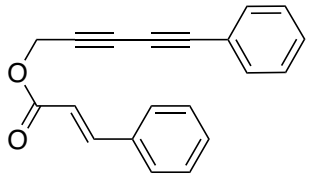
3q

***N*-cinnamyl-4-methyl-*N*-(5-phenylpenta-2,4-diyn-1-yl)benzenesulfonamide**
3q was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 10:1) in 86% yield as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 7.79-7.78 (m, 2H), 7.47-7.45 (m, 2H), 7.40-7.30 (m, 9H), 7.27 (t, *J* = 1.3 Hz, 1H), 6.60 (d, *J* = 15.8 Hz, 1H), 6.10 (dt, *J* = 15.8, 6.9 Hz, 1H), 4.26 (s, 2H), 4.00 (dd, *J* = 6.8, 0.7 Hz, 2H), 2.41 (s, 3H).
^{13}C NMR (151 MHz, $CDCl_3$): δ 143.9, 136.1, 135.6, 135.2, 132.5, 129.7, 129.4, 128.64, 128.49, 128.1, 127.8, 126.6, 122.8, 121.3, 77.4, 75.6, 73.1, 70.4, 49.1, 36.9, 21.6.
HRMS m/z (ESI) calcd. for C27H24NO2S+ $(M+H)^+$ 426.1522, found 426.1525



3r

1-(5-(cinnamyloxy)penta-1,3-diyn-1-yl)-4-fluorobenzene
3r was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 72% yield as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 7.50-7.47 (m, 2H), 7.40 (d, *J* = 7.4 Hz, 2H), 7.33-7.31 (m, 2H), 7.26-7.24 (m, 1H), 7.03-7.01 (m, 2H), 6.67 (d, *J* = 15.9 Hz, 1H), 6.28 (dt, *J* = 15.9, 6.2 Hz, 1H), 4.34 (s, 2H), 4.27 (dd, *J* = 6.2, 1.3 Hz, 2H).
^{13}C NMR (151 MHz, $CDCl_3$): δ 163.06 (d, *J* = 251.6 Hz), 136.5, 134.67 (d, *J* = 8.3 Hz), 133.7, 128.6, 127.9, 126.6, 124.9, 117.6, 115.88 (d, *J* = 22.0 Hz), 78.8, 73.2, 70.9, 70.4, 70.2, 57.7
^{19}F NMR (564 MHz, Chloroform-*d*) δ -108.4
HRMS m/z (ESI) calcd. for C20H16FO+ $(M+H)^+$ 291.1180, found 291.1188



3s

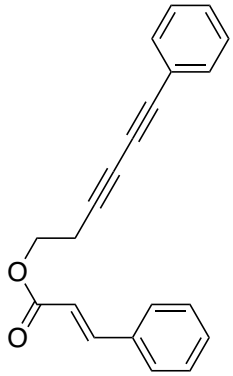
5-phenylpenta-2,4-diyn-1-yl cinnamate

3s was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 90% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 7.76 (d, *J* = 16.0 Hz, 1H), 7.54 (dd, *J* = 6.7, 2.9 Hz, 2H), 7.50-7.49 (m, 2H), 7.41-7.39 (m, 3H), 7.38-7.36 (m, 1H), 7.33-7.31 (m, 2H), 6.47 (d, *J* = 16.0 Hz, 1H), 4.96 (s, 2H).

^{13}C NMR (151 MHz; CDCl3): δ 166.0, 146.1, 134.2, 132.7, 130.6, 129.5, 129.0, 128.5, 128.2, 121.2, 116.9, 78.8, 76.3, 73.1, 71.3, 52.7

HRMS m/z (ESI) calcd. for C20H15O2+ $(M+H)^+$ 287.1067, found 287.1075



3t

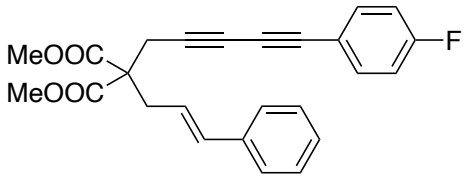
6-phenylhexa-3,5-diyn-1-yl cinnamate

3t was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 76% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 7.73 (d, *J* = 16.0 Hz, 1H), 7.55-7.53 (m, 2H), 7.48 (dd, *J* = 8.2, 1.3 Hz, 2H), 7.39 (t, *J* = 3.2 Hz, 3H), 7.35-7.29 (m, 3H), 6.47 (d, *J* = 16.0 Hz, 1H), 4.35 (t, *J* = 6.7 Hz, 2H), 2.79 (t, *J* = 6.7 Hz, 2H).

^{13}C NMR (151 MHz; CDCl3): δ 145.5, 134.3, 132.6, 130.4, 129.06, 128.91, 128.4, 128.2, 121.7, 117.6, 79.9, 75.5, 74.0, 66.6, 61.9, 20.3

HRMS m/z (ESI) calcd. for C21H17O2+ $(M+H)^+$ 301.1224, found 301.1220

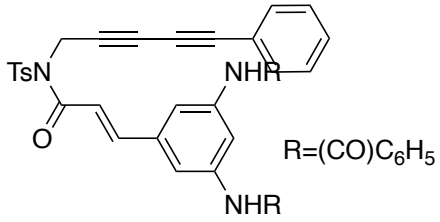


3u

dimethyl 2-cinnamyl-2-(5-(4-fluorophenyl)penta-2,4-diyn-1-yl)malonate

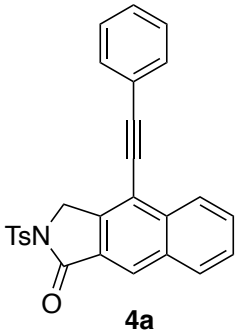
3u was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 78% yield as colorless oil.

^{1}H NMR (600 MHz; $CDCl_3$): δ 7.47 (ddd, *J* = 9.5, 5.1, 2.4 Hz, 2H), 7.35-7.34 (m, 2H), 7.31-7.28 (m, 2H), 7.24-7.21 (m, 1H), 7.01 (ddt, *J* = 8.7, 6.7, 2.2 Hz, 2H), 6.55 (d, *J* = 15.7 Hz, 1H), 6.02 (dt, *J* = 15.6, 7.7 Hz, 1H), 3.78 (s, 6H), 3.03 (s, 2H), 2.99 (dd, *J* = 7.7, 1.0 Hz, 2H).
^{13}C NMR (151 MHz; CDCl3): δ 169.9, 162.82 (*J* = 251.0 Hz), 136.9, 134.9, 134.63, 134.58, 128.5, 127.6, 126.4, 122.9, 115.82 (*J* = 21.8 Hz), 78.5, 74.6, 73.8, 68.0, 57.4, 53.0, 36.3, 24.2
^{19}F NMR (564 MHz; CDCl3): δ -108.82
HRMS m/z (ESI) calcd. for C25H22FO4+ $(M+H)^+$ 405.1497, found 405.1518



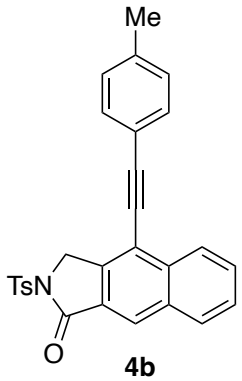
3v

(*E*)-*N*,*N*'-(5-(3-((4-methyl-*N*-(5-phenylpenta-2,4-diyn-1-yl)phenyl)sulfonamido)-3-oxoprop-1-en-1-yl)-1,3-phenylene)dibenzamide
3v was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 65% yield as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 8.18 (s, 3H), 7.98 (d, *J* = 8.4 Hz, 2H), 7.88-7.87 (m, 4H), 7.62 (d, *J* = 1.8 Hz, 2H), 7.54 (t, *J* = 7.4 Hz, 3H), 7.48-7.46 (m, 6H), 7.38-7.36 (m, 3H), 7.33-7.31 (m, 3H), 4.87 (s, 2H), 2.39 (s, 3H).
^{13}C NMR (151 MHz; CDCl3): δ 166.09, 166.07, 164.9, 145.8, 145.4, 139.2, 136.1, 135.7, 134.4, 132.6, 132.1, 130.1, 129.4, 128.8, 128.4, 128.0, 127.18, 127.14, 121.3, 118.5, 116.02, 115.99, 114.4, 77.9, 77.1, 73.3, 69.1, 36.3, 31.6, 21.7
HRMS m/z (ESI) calcd. for C41H32N3O5S+ $(M+H)^+$ 678.2058, found 678.2047



4a

4-(phenylethynyl)-2-tosyl-2,3-dihydro-1*H*-benzo[*f*]isoindol-1-one
4a was prepared following the General Procedure 2.7 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 90% yield as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 8.45 (d, *J* = 8.4 Hz, 1H), 8.30 (s, 1H), 8.09 (d, *J* = 8.4 Hz, 2H), 7.99 (d, *J* = 8.2 Hz, 1H), 7.72 (ddd, *J* = 8.3, 6.9, 1.3 Hz, 1H), 7.69-7.68 (m, 2H), 7.62-7.59 (m, 1H), 7.45 (dd, *J* = 6.4, 2.7 Hz, 3H), 7.36 (d, *J* = 8.2 Hz, 2H), 5.15 (s, 2H), 2.42 (s, 3H).
^{13}C NMR (151 MHz; CDCl3): δ 165.8, 145.4, 138.1, 135.7, 135.4, 132.8, 131.9, 130.3, 129.8, 129.6, 129.3, 128.7, 128.2, 127.6, 127.4, 126.04, 126.03, 122.3, 116.5, 100.9, 82.6, 49.9, 21.7
HRMS m/z (ESI) calcd. for C27H20NO3S+ $(M+H)^+$ 438.1159, found 438.1141



4b

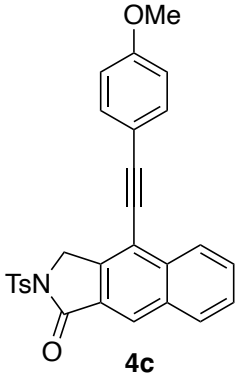
4-(*p*-tolylethynyl)-2-tosyl-2,3-dihydro-1*H*-benzo[*f*]isoindol-1-one

4b was prepared following the General Procedure 2.7 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 92% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 8.45 (d, *J* = 8.4 Hz, 1H), 8.29 (s, 1H), 8.09 (d, *J* = 8.3 Hz, 2H), 7.98 (d, *J* = 8.2 Hz, 1H), 7.71 (t, *J* = 7.6 Hz, 1H), 7.59 (dd, *J* = 17.8, 7.8 Hz, 3H), 7.35 (d, *J* = 8.2 Hz, 2H), 7.25 (d, *J* = 6.3 Hz, 2H), 5.15 (s, 2H), 2.43 (d, *J* = 9.2 Hz, 6H).

^{13}C NMR (151 MHz; CDCl3): δ 165.8, 145.3, 139.7, 137.9, 135.6, 135.4, 132.8, 131.8, 130.2, 129.8, 129.48, 129.40, 128.2, 127.6, 127.3, 126.1, 125.8, 119.2, 116.7, 101.2, 82.1, 49.9, 21.70, 21.66

HRMS m/z (ESI) calcd. for C28H22NO3S+ $(M+H)^+$ 452.1315, found 452.1301



4c

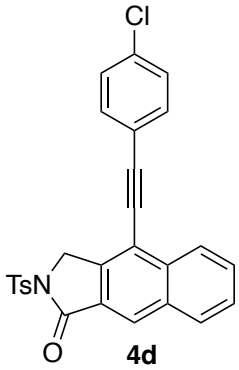
4-((4-methoxyphenyl)ethynyl)-2-tosyl-2,3-dihydro-1*H*-benzo[*f*]isoindol-1-one

4c was prepared following the General Procedure 2.7 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 89% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 8.44 (d, *J* = 8.4 Hz, 1H), 8.27 (s, 1H), 8.09 (d, *J* = 8.4 Hz, 2H), 7.97 (d, *J* = 8.2 Hz, 1H), 7.70 (ddd, *J* = 8.3, 7.0, 1.2 Hz, 1H), 7.62-7.58 (m, 3H), 7.35 (d, *J* = 8.3 Hz, 2H), 6.97-6.96 (m, 2H), 5.14 (s, 2H), 3.89 (s, 3H), 2.42 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.9, 160.4, 145.3, 137.7, 135.59, 135.41, 133.4, 132.8, 130.2, 129.8, 129.4, 128.2, 127.5, 127.3, 126.1, 125.6, 116.9, 114.3, 101.2, 81.5, 55.4, 50.0, 21.7

HRMS m/z (ESI) calcd. for C28H22NO4S+ $(M+H)^+$ 468.1265, found 468.1255



4d

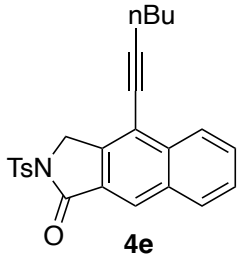
4-((4-chlorophenyl)ethynyl)-2-tosyl-2,3-dihydro-1*H*-benzo[*f*]isoindol-1-one

4d was prepared following the General Procedure 2.7 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 83% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 8.42 (d, *J* = 8.5 Hz, 1H), 8.32 (s, 1H), 8.09 (d, *J* = 8.3 Hz, 2H), 8.00 (dd, *J* = 8.0, 4.2 Hz, 1H), 7.73 (t, *J* = 7.6 Hz, 1H), 7.62 (t, *J* = 6.6 Hz, 3H), 7.43 (d, *J* = 8.2 Hz, 2H), 7.36 (d, *J* = 8.2 Hz, 2H), 5.15 (s, 2H), 2.42 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.7, 145.4, 138.2, 135.61, 135.47, 135.33, 133.1, 132.8, 130.4, 129.83, 129.68, 129.0, 128.2, 127.61, 127.43, 126.3, 125.9, 120.7, 116.1, 99.6, 83.6, 49.9, 21.7

HRMS m/z (ESI) calcd. for C27H19ClNO3S+ $(M+H)^+$ 472.0769, found 472.0797



4e

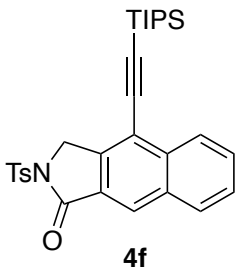
4-(hex-1-yn-1-yl)-2-tosyl-2,3-dihydro-1*H*-benzo[*f*]isoindol-1-one

4e was prepared following the General Procedure 2.7 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 78% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 8.35 (d, *J* = 8.3 Hz, 1H), 8.25 (s, 1H), 8.07 (d, *J* = 7.8 Hz, 2H), 7.95 (d, *J* = 8.1 Hz, 1H), 7.68 (t, *J* = 7.4 Hz, 1H), 7.57 (t, *J* = 7.2 Hz, 1H), 7.35 (d, *J* = 7.8 Hz, 2H), 5.06 (s, 2H), 2.65 (t, *J* = 6.9 Hz, 2H), 2.42 (s, 3H), 1.74 (q, *J* = 7.1 Hz, 2H), 1.60 (t, *J* = 7.6 Hz, 2H), 1.03 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.9, 145.3, 137.8, 136.0, 135.4, 132.8, 130.2, 129.8, 129.3, 128.2, 127.4, 127.1, 126.1, 125.2, 117.4, 102.8, 74.2, 50.0, 30.9, 22.2, 21.7, 19.6, 13.7

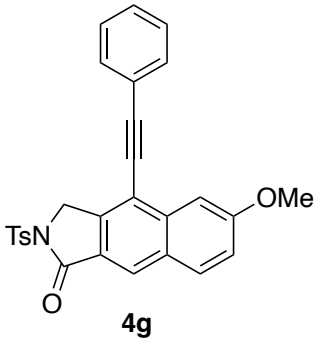
HRMS m/z (ESI) calcd. for C25H24NO3S+ $(M+H)^+$ 418.1472, found 418.1437



4f

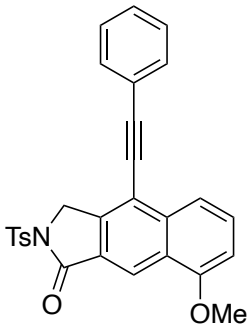
2-tosyl-4-((triisopropylsilyl)ethynyl)-2,3-dihydro-1*H*-benzo[*f*]isoindol-1-one

4f was prepared following the General Procedure 2.7 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 76% yield as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 8.41 (d, *J* = 8.4 Hz, 1H), 8.32 (s, 1H), 8.07 (d, *J* = 8.3 Hz, 2H), 7.99 (d, *J* = 8.2 Hz, 1H), 7.72 (dd, *J* = 8.2, 7.1 Hz, 1H), 7.60 (t, *J* = 7.5 Hz, 1H), 7.36 (d, *J* = 8.3 Hz, 2H), 5.08 (s, 2H), 2.42 (s, 3H), 1.23 (d, *J* = 5.4 Hz, 21H).
^{13}C NMR (151 MHz; CDCl3): δ 165.7, 145.3, 138.8, 135.9, 135.4, 132.8, 130.3, 129.79, 129.67, 128.3, 127.5, 127.3, 126.13, 126.00, 116.7, 103.9, 99.8, 50.0, 21.7, 18.8, 11.3
HRMS m/z (ESI) calcd. for C30H36NO3SSi+ $(M+H)^+$ 518.2180, found 518.2173



4g

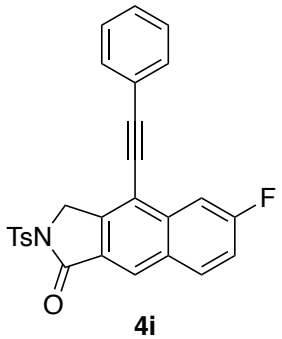
6-methoxy-4-(phenylethynyl)-2-tosyl-2,3-dihydro-1*H*-benzo[*f*]isoindol-1-one
4g was prepared following the General Procedure 2.7 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 82% yield as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 8.22 (s, 1H), 8.08 (d, *J* = 8.2 Hz, 2H), 7.87 (d, *J* = 9.0 Hz, 1H), 7.71 (s, 1H), 7.66 (d, *J* = 3.5 Hz, 2H), 7.45 (t, *J* = 2.5 Hz, 3H), 7.35 (d, *J* = 8.1 Hz, 2H), 7.25-7.24 (m, 1H), 5.13 (s, 2H), 4.01 (s, 3H), 2.42 (s, 3H).
^{13}C NMR (151 MHz; CDCl3): δ 165.9, 160.8, 145.2, 139.1, 137.8, 135.5, 131.85, 131.78, 129.8, 129.2, 128.7, 128.33, 128.20, 125.8, 125.4, 122.4, 120.4, 114.6, 104.2, 100.6, 82.8, 55.5, 49.9, 21.7
HRMS m/z (ESI) calcd. for C28H22NO4S+ $(M+H)^+$ 468.1264, found 468.1264



4h

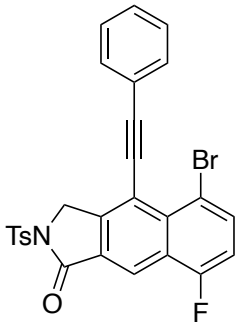
8-methoxy-4-(phenylethynyl)-2-tosyl-2,3-dihydro-1*H*-benzo[*f*]isoindol-1-one
4h was prepared following the General Procedure 2.7 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 75% yield as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 8.70 (s, 1H), 8.08 (d, *J* = 8.3 Hz, 2H), 7.93 (d, *J* = 8.5 Hz, 1H), 7.66 (dd, *J* = 6.5, 2.9 Hz, 2H), 7.58 (t, *J* = 8.1 Hz, 1H), 7.43 (t, *J* = 3.2 Hz, 3H), 7.35 (d, *J* = 8.3 Hz, 2H), 6.87 (d, *J* = 7.7 Hz, 1H), 5.09 (s, 2H), 4.00 (s, 3H), 2.41 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.9, 157.2, 145.3, 138.7, 136.7, 135.5, 131.8, 130.1, 129.8, 129.2, 128.6, 128.2, 126.4, 125.4, 122.4, 121.0, 117.8, 115.6, 105.0, 100.5, 82.9, 55.8, 49.9, 21.7
HRMS m/z (ESI) calcd. for C28H22NO4S+ $(M+H)^+$ 468.1264, found 468.1260



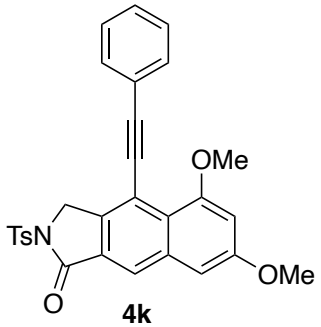
4i

6-fluoro-4-(phenylethynyl)-2-tosyl-2,3-dihydro-1*H*-benzo[*f*]isoindol-1-one
4i was prepared following the General Procedure 2.7 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 69% yield as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): 8.32 (s, 1H), 8.09-8.06 (m, 3H), 8.02 (dd, *J* = 9.0, 5.6 Hz, 1H), 7.68 (dt, *J* = 3.9, 2.7 Hz, 2H), 7.46 (t, *J* = 3.2 Hz, 3H), 7.40 (td, *J* = 8.5, 2.1 Hz, 1H), 7.36 (d, *J* = 8.2 Hz, 2H), 7.26 (s, 1H), 5.17 (s, 2H), 2.42 (s, 3H).
^{13}C NMR (151 MHz; CDCl3): δ 165.5, 163.00 (*J* = 252.8 Hz), 145.4, 139.1, 137.20 (*J* = 9.8 Hz), 135.3, 132.94 (*J* = 9.5 Hz), 131.9, 129.90, 129.84, 129.5, 128.7, 128.2, 127.29 (*J* = 2.9 Hz), 125.9, 122.0, 118.10 (*J* = 26.0 Hz), 116.06, 116.02, 110.01 (*J* = 22.8 Hz), 101.3, 82.0, 60.4, 49.9, 21.7
^{19}F NMR (564 MHz; CDCl3): δ -107.19
HRMS m/z (ESI) calcd. for C27H19FNO3S+ $(M+H)^+$ 456.1065, found 456.1058



4j

5-bromo-8-fluoro-4-(phenylethynyl)-2-tosyl-2,3-dihydro-1*H*-benzo[*f*]isoindol-1-one
4j was prepared following the General Procedure 2.7 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 86% yield as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 8.60 (s, 1H), 8.09 (d, *J* = 7.9 Hz, 2H), 7.92 (t, *J* = 6.7 Hz, 1H), 7.65 (s, 2H), 7.46 (s, 3H), 7.37 (d, *J* = 8.0 Hz, 2H), 7.11 (t, *J* = 8.7 Hz, 1H), 5.14 (s, 2H), 2.43 (s, 3H).
^{13}C NMR (151 MHz; CDCl3): δ 164.9, 145.6, 143.0, 135.88, 135.82, 135.1, 131.2, 129.9, 129.5, 128.7, 128.35, 128.30, 122.6, 119.33, 119.28, 115.02, 114.99, 111.50, 111.36, 106.6, 84.1, 50.7, 21.7
^{19}F NMR (564 MHz; CDCl3): δ -117.2
HRMS m/z (ESI) calcd. for C27H18BrFNO3S+ $(M+H)^+$ 534.0169, found 534.0169



4k

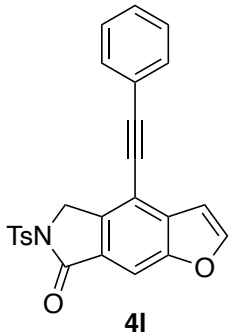
5,7-dimethoxy-4-(phenylethynyl)-2-tosyl-2,3-dihydro-1*H*-benzo[*f*]isoindol-1-one

4k was prepared following the General Procedure 2.7 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 74% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 8.08 (t, *J* = 4.2 Hz, 3H), 7.63 (dd, *J* = 7.7, 1.6 Hz, 2H), 7.45-7.42 (m, 3H), 7.36 (d, *J* = 8.2 Hz, 2H), 6.81 (d, *J* = 2.2 Hz, 1H), 6.66 (d, *J* = 2.2 Hz, 1H), 5.08 (s, 2H), 4.02 (s, 3H), 3.92 (s, 3H), 2.42 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 166.0, 158.7, 157.5, 145.3, 137.8, 136.1, 135.4, 131.7, 129.84, 129.80, 128.83, 128.64, 128.59, 128.24, 128.18, 124.1, 123.5, 123.3, 114.0, 101.7, 100.1, 99.6, 86.2, 55.9, 55.5, 50.3, 29.7, 21.7

HRMS m/z (ESI) calcd. for C29H24NO5S+ $(M+H)^+$ 498.1370, found 498.1370



4l

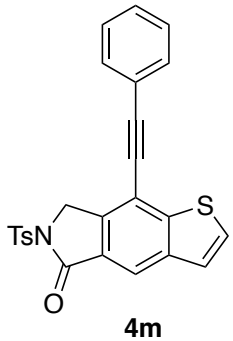
4-(phenylethynyl)-6-tosyl-5,6-dihydro-7*H*-furo[2,3-*f*]isoindol-7-one

4l was prepared following the General Procedure 2.7 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 55% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 8.07 (d, *J* = 8.0 Hz, 2H), 7.86 (d, *J* = 20.4 Hz, 2H), 7.62 (d, *J* = 3.5 Hz, 2H), 7.44 (s, 3H), 7.35 (d, *J* = 7.9 Hz, 2H), 7.06 (s, 1H), 5.06 (s, 2H), 2.42 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 166.0, 154.5, 149.4, 145.3, 137.4, 135.4, 134.9, 131.9, 129.8, 129.4, 128.6, 128.2, 127.0, 122.0, 111.4, 108.1, 106.6, 98.6, 82.1, 49.4, 21.7

HRMS m/z (ESI) calcd. for C25H18NO4S+ $(M+H)^+$ 428.0952, found 428.0934



4m

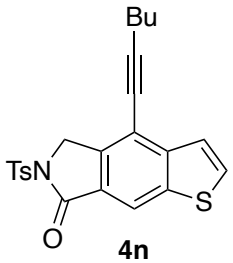
8-(phenylethynyl)-6-tosyl-6,7-dihydro-5*H*-thieno[2,3-*f*]isoindol-5-one

4m was prepared following the General Procedure 2.7 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 72% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 8.25 (s, 1H), 8.07 (d, *J* = 8.0 Hz, 2H), 7.76 (d, *J* = 5.3 Hz, 1H), 7.70 (d, *J* = 5.2 Hz, 1H), 7.64 (d, *J* = 2.6 Hz, 2H), 7.44 (s, 3H), 7.35 (d, *J* = 7.8 Hz, 2H), 5.09 (s, 2H), 2.42 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.7, 145.3, 144.5, 140.2, 138.4, 135.4, 132.4, 131.9, 129.8, 129.4, 128.6, 128.2, 126.7, 123.2, 122.1, 119.5, 113.7, 99.1, 82.7, 49.5, 21.7

HRMS m/z (ESI) calcd. for C25H18NO3S2+ $(M+H)^+$ 444.0723, found 444.0708



4n

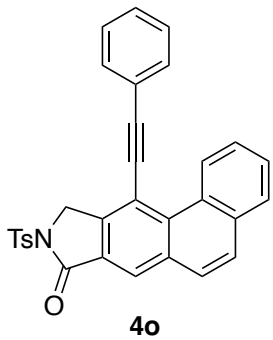
4-(hex-1-yn-1-yl)-6-tosyl-5,6-dihydro-7*H*-thieno[2,3-*f*]isoindol-7-one

4n was prepared following the General Procedure 2.7 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 81% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 8.19 (s, 1H), 8.05 (d, *J* = 8.2 Hz, 2H), 7.70 (d, *J* = 5.5 Hz, 1H), 7.58 (d, *J* = 5.5 Hz, 1H), 7.34 (d, *J* = 8.1 Hz, 2H), 4.98 (s, 2H), 2.59 (t, *J* = 7.1 Hz, 2H), 2.42 (s, 3H), 1.70 (quintet, *J* = 7.3 Hz, 2H), 1.57 (dt, *J* = 14.9, 7.4 Hz, 2H), 1.02 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.8, 145.2, 144.8, 140.0, 138.3, 135.5, 131.8, 129.8, 128.2, 126.5, 123.2, 118.7, 114.6, 101.0, 74.4, 49.6, 30.8, 22.1, 21.7, 19.5, 13.6

HRMS m/z (ESI) calcd. for C23H22NO3S2+ $(M+H)^+$ 424.1036, found 424.1036



4o

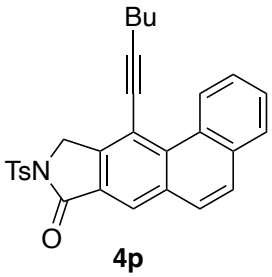
11-(phenylethynyl)-9-tosyl-9,10-dihydro-8*H*-naphtho[1,2-*f*]isoindol-8-one

4o was prepared following the General Procedure 2.7 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 75% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 10.36 (d, *J* = 4.9 Hz, 1H), 8.26 (s, 1H), 8.11 (d, *J* = 8.0 Hz, 2H), 7.93-7.93 (m, 1H), 7.80-7.71 (m, 5H), 7.50 (s, 3H), 7.36 (d, *J* = 8.0 Hz, 2H), 5.13 (s, 2H), 2.42 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.8, 145.3, 142.5, 135.5, 133.9, 133.3, 133.1, 131.6, 130.2, 129.8, 129.5, 128.93, 128.82, 128.73, 128.5, 128.2, 127.8, 127.4, 126.62, 126.56, 125.7, 122.5, 115.0, 102.3, 86.6, 50.7, 21.7

HRMS m/z (ESI) calcd. for C31H22NO3S+ $(M+H)^+$ 488.1315, found 488.1313



4p

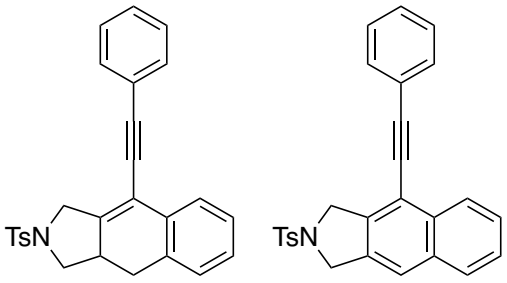
11-(hex-1-yn-1-yl)-9-tosyl-9,10-dihydro-8*H*-naphtho[1,2-*f*]isoindol-8-one

4p was prepared following the General Procedure 2.7 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 77% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 10.33 (d, *J* = 8.4 Hz, 1H), 8.15 (s, 1H), 8.09 (d, *J* = 8.4 Hz, 2H), 7.88 (d, *J* = 7.0 Hz, 1H), 7.73-7.63 (m, 4H), 7.36 (d, *J* = 8.3 Hz, 2H), 4.98 (s, 2H), 2.73 (t, *J* = 7.1 Hz, 2H), 2.41 (s, 3H), 1.81 (quintet, *J* = 7.4 Hz, 2H), 1.65 (q, *J* = 7.5 Hz, 2H), 1.07 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.9, 145.3, 142.5, 135.5, 133.6, 133.22, 133.06, 130.3, 129.8, 128.65, 128.57, 128.28, 128.20, 127.8, 127.2, 126.5, 126.2, 124.9, 115.8, 104.7, 78.2, 50.8, 30.6, 22.3, 21.7, 20.0, 13.7

HRMS m/z (ESI) calcd. for C29H26NO3S+ $(M+H)^+$ 468.1628, found 468.1629



4q **4qa**

4q: 9-(phenylethynyl)-2-tosyl-2,3,3a,4-tetrahydro-1*H*-benzo[*f*]isoindole

4qa: 4-(phenylethynyl)-2-tosyl-2,3-dihydro-1*H*-benzo[*f*]isoindole

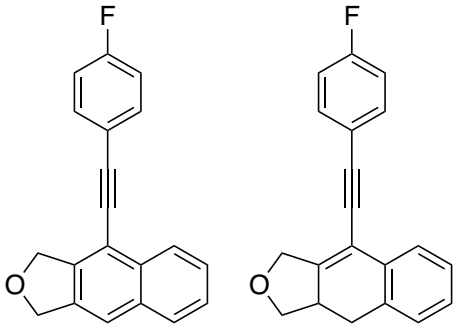
4q:4qa=1:1.2 was prepared following the General Procedure 2.7 and purified by column chromatography (Hexane: Ethyl acetate = 10:1) in 40% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 8.34 (d, *J* = 8.3 Hz, 1H), 7.84-7.82 (m, 2H), 7.79-7.77 (m, 2H), 7.65-7.63 (m, 2H), 7.60-7.48 (m, 5H), 7.45-7.41 (m, 3H), 7.39-7.32 (m, 5H), 7.25 (t, *J* = 5.5 Hz, 1H), 7.17 (td, *J* = 7.4, 1.1 Hz, 0.7H), 7.10 (d, *J* = 7.4 Hz, 0.7H), 4.90 (s, 2H), 4.79 (d, *J* = 0.7 Hz,

2H), 4.47 (dd, *J* = 16.9, 2.4 Hz, 0.7H), 4.12 (dd, *J* = 16.9, 3.3 Hz, 0.7H), 4.03 (dd, *J* = 9.2, 8.0 Hz, 0.7H), 3.12-3.08 (m, 0.7H), 2.87 (ddd, *J* = 10.9, 9.0, 8.2 Hz, 1.4H), 2.54 (t, *J* = 15.2 Hz, 0.7H), 2.43 (s, 2H), 2.39 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 146.5, 143.8, 138.4, 134.2, 133.5, 133.00, 132.92, 132.89, 132.73, 132.65, 131.76, 131.64, 129.91, 129.89, 128.9, 128.67, 128.54, 128.46, 128.2, 127.79, 127.76, 127.74, 127.67, 127.2, 126.9, 126.6, 125.8, 125.0, 122.80, 122.75, 121.6, 115.2, 114.2, 99.2, 96.3, 84.2, 83.7, 54.8, 53.76, 53.74, 51.6, 39.1, 31.7, 21.58, 21.52

HRMS m/z (ESI) calcd. for **4q**: C27H24NO2S+ $(M+H)^+$ 426.1523, found 426.1512; **4qa**: C27H22NO2S+ $(M+H)^+$ 424.1366, found 424.1371



4r **4ra**

4r: 4-((4-fluorophenyl)ethynyl)-1,3-dihydronaphtho[2,3-*c*]furan

4ra: 9-((4-fluorophenyl)ethynyl)-1,3,3a,4-tetrahydronaphtho[2,3-*c*]furan

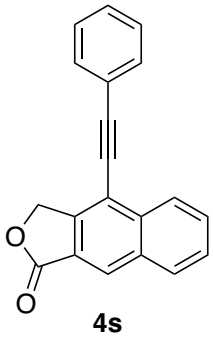
4r:4ra=7:1 was prepared following the General Procedure 2.7 and purified by column chromatography (Hexane: Ethyl acetate = 10:1) in 32% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 8.36 (d, *J* = 8.3 Hz, 1H), 7.84 (d, *J* = 8.1 Hz, 1H), 7.66 (s, 1H), 7.62-7.59 (m, 2H), 7.57 (ddd, *J* = 8.2, 6.9, 1.3 Hz, 1H), 7.51 (td, *J* = 7.5, 1.2 Hz, 1H), 7.11-7.09 (m, 2H), 5.37 (s, 2H), 5.28 (d, *J* = 1.0 Hz, 2H), 4.82 (dd, *J* = 16.1, 2.1 Hz,), 4.72 (d, *J* = 3.2 Hz,).

^{13}C NMR (151 MHz; CDCl3): δ 162.82 (*J* = 250.6 Hz), 141.9, 137.6, 133.62, 133.56, 133.2, 132.8, 128.4, 126.6, 126.3, 125.7, 119.9, 119.16 (*J* = 3.3 Hz), 115.90, 115.76, 113.1, 97.2, 84.4, 73.53, 73.47

^{19}F NMR (564 MHz; CDCl3): δ -110.2, -110.7

HRMS m/z (ESI) calcd. for **4r**: C20H14FO+ $(M+H)^+$ 289.1024, found 289.1017; **4ra**: C20H16FO+ $(M+H)^+$ 291.1180, found 291.1183

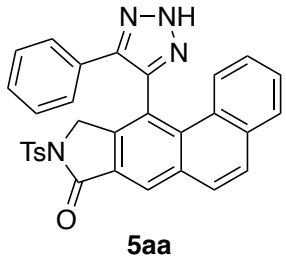


4s

4-(phenylethynyl)naphtho[2,3-*c*]furan-1(3*H*)-one

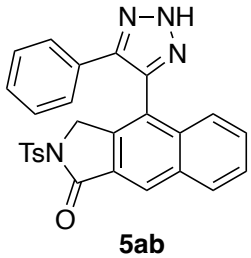
4s was prepared following the General Procedure 2.7 and purified by column chromatography (Hexane: Ethyl acetate = 5:1) in 75% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 8.51 (d, *J* = 8.5 Hz, 1H), 8.48 (s, 1H), 8.09 (d, *J* = 8.2 Hz, 1H), 7.78 (ddd, *J* = 8.3, 6.9, 1.3 Hz, 1H), 7.68-7.65 (m, 3H), 7.44 (dt, *J* = 4.5, 1.7 Hz, 3H), 5.60 (s, 2H).
^{13}C NMR (151 MHz; CDCl3): δ 170.7, 143.2, 135.8, 133.2, 131.8, 130.5, 129.8, 129.3, 128.6, 127.4, 127.1, 126.1, 123.3, 122.3, 115.3, 100.6, 82.6, 69.8
HRMS m/z (ESI) calcd. for C20H13O2+ $(M+H)^+$ 285.0911, found 285.0903



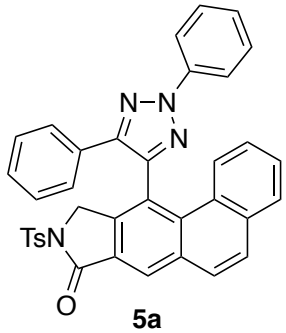
5aa

11-(5-phenyl-2*H*-1,2,3-triazol-4-yl)-9-tosyl-9,10-dihydro-8*H*-naphtho[1,2-*f*]isoindol-8-one
5aa was prepared following the General Procedure 2.8 and purified by column chromatography (DCM: MeOH = 20:1) in 92% yield as white solid.
^{1}H NMR (500 MHz; $CDCl_3$:CD_3OD (10:1)): δ 8.43 (s, 1H), 7.90-7.73 (m, 6H), 7.53 (t, *J* = 7.4 Hz, 1H), 7.34-7.11 (m, 8H), 4.68 (d, *J* = 16.2 Hz, 1H), 4.37 (d, *J* = 16.4 Hz, 1H), 2.39 (s, 3H).
^{13}C NMR δ (126 MHz; $CDCl_3$:CD_3OD (10:1)): δ 165.9, 145.4, 139.2, 134.9, 134.3, 133.95, 133.88, 129.7, 129.05, 128.93, 128.87, 128.80, 128.78, 128.69, 128.62, 128.0, 127.64, 127.50, 127.1, 126.70, 126.65, 126.3, 40.4, 21.6
HRMS m/z (ESI) calcd. for C31H23N4O3S+ $(M+H)^+$ 531.1486, found 531.1508



5ab

4-(5-phenyl-2*H*-1,2,3-triazol-4-yl)-2-tosyl-2,3-dihydro-1*H*-benzo[*f*]isoindol-1-one
5ab was prepared following the General Procedure 2.8 and purified by column chromatography (DCM: MeOH = 20:1) in 90% yield as white solid. **5ab** have poor solubility in $CDCl_3$ and *d*6-DMSO.
^{1}H NMR (500 MHz; $CDCl_3$:CD_3OD (10:1)): δ 8.47 (s, 1H), 8.05 (d, *J* = 8.0 Hz, 1H), 7.90 (d, *J* = 7.8 Hz, 2H), 7.69 (d, *J* = 8.2 Hz, 1H), 7.54 (dd, *J* = 19.6, 7.5 Hz, 2H), 7.31-7.19 (m, 7H), 4.69 (s, 2H), 2.41 (s, 3H).
^{13}C NMR (126 MHz; $CDCl_3$:CD_3OD): δ 166.0, 145.3, 135.5, 135.02, 134.92, 133.3, 130.2, 129.7, 129.5, 128.91, 128.72, 128.69, 128.0, 127.48, 127.30, 127.12, 126.5, 125.5, 21.6
HRMS m/z (ESI) calcd. for C27H21N4O3S+ $(M+H)^+$ 481.1329, found 481.1331



5a

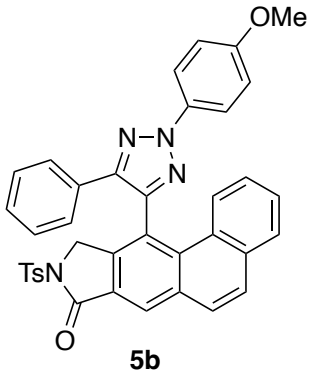
4-(2,5-diphenyl-2*H*-1,2,3-triazol-4-yl)-2-tosyl-2,3-dihydro-1*H*-benzo[*f*]isoindol-1-one

5a was prepared following the General Procedure 2.9 and purified by column chromatography (Hexane: Ethyl acetate = 3:1) in 92% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 8.48 (s, 1H), 8.24-8.23 (m, 2H), 7.94 (dd, *J* = 16.0, 8.6 Hz, 3H), 7.89-7.82 (m, 3H), 7.58-7.51 (m, 3H), 7.46-7.42 (m, 3H), 7.29-7.25 (m, 3H), 7.21 (t, *J* = 7.4 Hz, 1H), 7.13 (t, *J* = 7.7 Hz, 2H), 4.79 (d, *J* = 16.3 Hz, 1H), 4.49 (d, *J* = 16.4 Hz, 1H), 2.39 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.6, 146.0, 145.3, 143.7, 139.6, 139.3, 135.2, 134.3, 134.1, 133.8, 129.81, 129.75, 129.5, 129.27, 129.19, 129.04, 128.89, 128.18, 128.10, 128.08, 127.82, 127.76, 127.3, 126.8, 126.6, 126.3, 124.2, 119.0, 49.9, 21.7

HRMS m/z (ESI) calcd. for C37H27N4O3S+ $(M+H)^+$ 607.1799, found 607.1817



5b

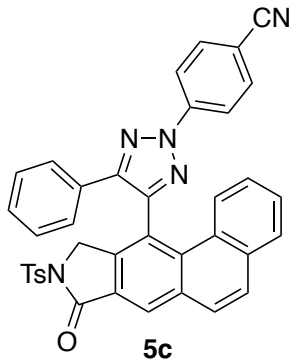
11-(2-(4-methoxyphenyl)-5-phenyl-2*H*-1,2,3-triazol-4-yl)-9-tosyl-9,10-dihydro-8*H*-naphtho[1,2-*f*]isoindol-8-one

5b was prepared following the General Procedure 2.9 and purified by column chromatography (Hexane: Ethyl acetate = 3:1) in 83% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 8.48 (s, 1H), 8.14 (d, *J* = 9.0 Hz, 2H), 7.96 (d, *J* = 8.7 Hz, 1H), 7.92 (d, *J* = 8.3 Hz, 2H), 7.89-7.82 (m, 3H), 7.52 (t, *J* = 7.4 Hz, 1H), 7.43 (d, *J* = 7.6 Hz, 2H), 7.29-7.24 (m, 3H), 7.21 (t, *J* = 7.3 Hz, 1H), 7.13 (t, *J* = 7.6 Hz, 2H), 7.06 (d, *J* = 9.0 Hz, 2H), 4.78 (d, *J* = 16.3 Hz, 1H), 4.48 (d, *J* = 16.4 Hz, 1H), 3.90 (s, 3H), 2.39 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.7, 159.5, 145.5, 145.3, 143.1, 139.3, 135.2, 134.4, 134.1, 133.9, 133.4, 129.85, 129.74, 129.4, 129.16, 129.02, 128.88, 128.17, 128.07, 127.79, 127.77, 127.2, 126.80, 126.63, 126.3, 124.4, 120.4, 114.5, 55.7, 50.0, 21.7

HRMS m/z (ESI) calcd. for C38H29N4O4S+ $(M+H)^+$ 637.1905, found 637.1917



5c

4-(4-(8-oxo-9-tosyl-9,10-dihydro-8*H*-naphtho[1,2-*f*]isoindol-11-yl)-5-phenyl-2*H*-1,2,3-triazol-2-yl)benzonitrile

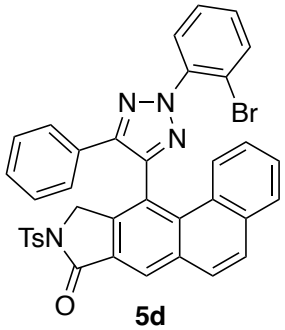
5c was prepared following the General Procedure 2.9 and purified by column chromatography (Hexane: Ethyl acetate = 3:1) in 77% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 8.51 (s, 1H), 8.36 (d, *J* = 8.8 Hz, 2H), 7.93 (d, *J* = 8.4 Hz, 2H), 7.90-7.84 (m, 6H), 7.53 (t, *J* = 7.4 Hz, 1H), 7.41-7.39 (m, 2H), 7.30 (d, *J* = 8.2 Hz, 2H), 7.27-7.23 (m, 2H), 7.14 (t, *J* = 7.8 Hz, 2H), 4.80 (d, *J* = 16.3 Hz, 1H), 4.47 (d, *J* = 16.3 Hz, 1H), 2.40 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.4, 147.4, 145.42, 145.30, 142.1, 139.1, 135.1, 134.4, 134.1, 133.71, 133.66, 129.77, 129.59, 129.56, 129.29, 129.18, 128.99, 128.6, 128.2, 127.91, 127.76, 127.58, 126.8, 126.44, 126.36, 123.5, 119.2, 118.2, 111.4, 49.8, 21.7

^{19}F NMR (564 MHz; CDCl3): δ -117.2

HRMS m/z (ESI) calcd. for $C_{38}H_{26}N_5O_3S^+$ $(M+H)^+$ 632.1751, found 632.1752



5d

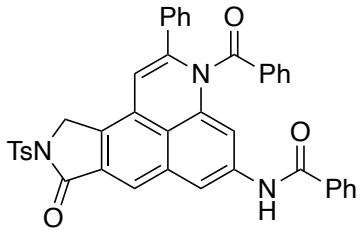
11-(2-(2-bromophenyl)-5-phenyl-2*H*-1,2,3-triazol-4-yl)-9-tosyl-9,10-dihydro-8*H*-naphtho[1,2-*f*]isoindol-8-one

5d was prepared following the General Procedure 2.9 and purified by column chromatography (Hexane: Ethyl acetate = 3:1) in 45% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 8.47 (s, 1H), 8.01 (d, *J* = 8.6 Hz, 1H), 7.93 (d, *J* = 8.2 Hz, 2H), 7.87-7.80 (m, 5H), 7.55 (dt, *J* = 17.2, 8.2 Hz, 2H), 7.44-7.39 (m, 3H), 7.30 (t, *J* = 10.3 Hz, 3H), 7.20 (t, *J* = 7.3 Hz, 1H), 7.11 (t, *J* = 7.6 Hz, 2H), 4.88 (d, *J* = 16.3 Hz, 1H), 4.55 (d, *J* = 16.3 Hz, 1H), 2.39 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 165.6, 146.2, 145.3, 143.8, 139.5, 139.3, 135.2, 134.36, 134.27, 134.03, 133.93, 131.1, 129.78, 129.73, 129.17, 129.08, 129.01, 128.90, 128.37, 128.20, 128.15, 128.12, 127.78, 127.71, 127.3, 126.90, 126.76, 126.4, 123.9, 119.0, 50.1, 21.7

HRMS m/z (ESI) calcd. for $C_{37}H_{26}BrN_4O_3S^+$ $(M+H)^+$ 685.0904, found 685.0899



6a

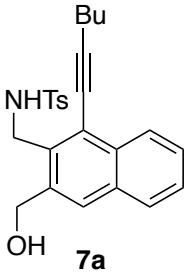
***N*-(3-benzoyl-8-oxo-2-phenyl-9-tosyl-3,8,9,10-tetrahydroisoindolo[4,5,6-*de*]quinolin-5-yl)benzamide**

6a was prepared following the General Procedure 2.1 and purified by column chromatography (Hexane: Ethyl acetate = 3:1) in 83% yield as red solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 8.30 (d, *J* = 1.6 Hz, 1H), 8.06 (d, *J* = 8.4 Hz, 2H), 8.03 (d, *J* = 1.7 Hz, 1H), 8.00 (s, 1H), 7.90 (d, *J* = 7.4 Hz, 2H), 7.85 (s, 1H), 7.57 (t, *J* = 7.3 Hz, 1H), 7.50 (t, *J* = 7.6 Hz, 2H), 7.42 (d, *J* = 7.4 Hz, 2H), 7.35 (d, *J* = 8.4 Hz, 2H), 7.31 (t, *J* = 7.4 Hz, 1H), 7.17-7.14 (m, 7H), 6.03 (s, 1H), 4.92 (s, 2H), 2.43 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 172.4, 166.04, 165.89, 145.3, 144.4, 138.7, 138.0, 137.4, 136.3, 135.37, 135.29, 134.6, 132.4, 132.1, 129.80, 129.77, 128.92, 128.86, 128.81, 128.75, 128.34, 128.23, 127.10, 126.98, 126.1, 125.6, 124.2, 121.0, 112.3, 107.3, 105.6, 48.5, 21.7

HRMS m/z (ESI) calcd. for $C41H32N3O5S^+$ $(M+H)^+$ 678.2058, found 678.2083



7a

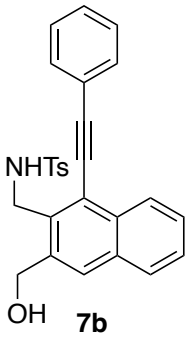
***N*-((1-(hex-1-yn-1-yl)-3-(hydroxymethyl)naphthalen-2-yl)methyl)-4-methylbenzenesulfonamide**

7a was prepared following the General Procedure 2.10 and purified by column chromatography (Hexane: Ethyl acetate = 3:1) in 82% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 8.21 (d, *J* = 8.2 Hz, 1H), 7.74 (dt, *J* = 17.3, 8.6 Hz, 4H), 7.54-7.47 (m, 2H), 7.19 (d, *J* = 8.1 Hz, 2H), 5.42 (t, *J* = 6.5 Hz, 1H), 4.84 (s, 2H), 4.57 (d, *J* = 6.6 Hz, 2H), 2.47 (t, *J* = 7.2 Hz, 2H), 2.33 (s, 3H), 1.64-1.59 (m, 3H), 1.49 (q, *J* = 7.5 Hz, 2H), 0.98 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 143.3, 136.7, 136.3, 134.6, 133.2, 132.5, 129.7, 129.4, 128.3, 128.0, 127.13, 127.01, 126.84, 126.45, 126.42, 122.9, 101.3, 76.2, 63.9, 43.5, 30.8, 22.2, 21.4, 19.5, 13.6

HRMS m/z (ESI) calcd. for $C25H26NO2S^+$ $(M-OH)^+$ 404.1679, found 404.1675



7b

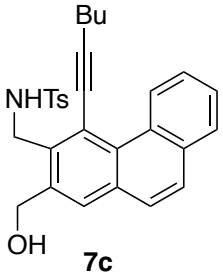
***N*-((3-(hydroxymethyl)-1-(phenylethynyl)naphthalen-2-yl)methyl)-4-methylbenzenesulfonamide**

7b was prepared following the General Procedure 2.10 and purified by column chromatography (Hexane: Ethyl acetate = 3:1) in 92% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 8.33 (d, *J* = 8.3 Hz, 1H), 7.82 (d, *J* = 5.2 Hz, 2H), 7.73 (d, *J* = 8.1 Hz, 2H), 7.57 (dt, *J* = 31.8, 7.4 Hz, 2H), 7.42 (ddd, *J* = 26.8, 14.0, 6.3 Hz, 5H), 7.11 (d, *J* = 8.0 Hz, 2H), 5.34 (s, 2H), 5.02 (t, *J* = 6.2 Hz, 1H), 4.66 (d, *J* = 6.4 Hz, 2H), 2.30 (s, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 170.6, 143.4, 136.5, 134.9, 133.1, 132.5, 132.3, 131.7, 130.5, 129.6, 129.0, 128.5, 128.3, 127.7, 127.27, 127.11, 126.3, 122.5, 122.2, 99.7, 84.7, 64.4, 43.5, 21.5, 21.1

HRMS m/z (ESI) calcd. for C27H22NO2S+ $(M\text{-}OH)^+$ 424.1366, found 424.1371



7c

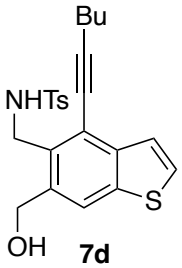
***N*-((4-(hex-1-yn-1-yl)-2-(hydroxymethyl)phenanthren-3-yl)methyl)-4-methylbenzenesulfonamide**

7c was prepared following the General Procedure 2.10 and purified by column chromatography (Hexane: Ethyl acetate = 3:1) in 83% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 10.18 (d, *J* = 8.4 Hz, 1H), 7.85 (dd, *J* = 7.7, 1.2 Hz, 1H), 7.73 (s, 1H), 7.69 (d, *J* = 8.3 Hz, 3H), 7.62-7.56 (m, 3H), 7.11 (d, *J* = 7.9 Hz, 2H), 5.49 (t, *J* = 6.7 Hz, 1H), 4.87 (s, 2H), 4.63 (d, *J* = 6.7 Hz, 2H), 2.59 (d, *J* = 1.4 Hz, 1H), 2.48 (t, *J* = 7.2 Hz, 2H), 2.19 (s, 3H), 1.66-1.63 (m, 2H), 1.54-1.50 (m, 2H), 0.99 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 143.3, 137.04, 137.00, 136.83, 133.2, 132.6, 130.3, 129.8, 129.4, 129.2, 128.4, 126.95, 126.90, 126.2, 125.6, 120.8, 102.6, 80.7, 63.5, 53.4, 43.4, 30.3, 22.3, 21.3, 19.8, 13.7

HRMS m/z (ESI) calcd. for C29H28NO2S+ $(M\text{-}OH)^+$ 454.1836, found 454.1830



7d

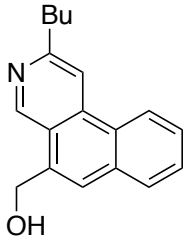
***N*-((4-(hex-1-yn-1-yl)-6-(hydroxymethyl)benzo[*b*]thiophen-5-yl)methyl)-4-methylbenzenesulfonamide**

7d was prepared following the General Procedure 2.10 and purified by column chromatography (Hexane: Ethyl acetate = 3:1) in 85% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 7.74 (s, 1H), 7.71 (d, *J* = 8.2 Hz, 2H), 7.45 (d, *J* = 5.4 Hz, 1H), 7.42-7.41 (m, 1H), 7.19 (d, *J* = 8.0 Hz, 2H), 4.78 (s, 2H), 4.49 (s, 2H), 2.43 (t, *J* = 7.1 Hz, 2H), 2.35 (s, 3H), 1.61-1.56 (m, 2H), 1.51-1.46 (m, 2H), 0.97 (t, *J* = 7.3 Hz, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 143.2, 141.0, 139.1, 136.7, 135.4, 132.5, 129.7, 129.4, 127.6, 127.1, 126.4, 123.8, 122.6, 119.9, 99.4, 76.6, 63.8, 43.0, 30.8, 22.2, 21.4, 19.4, 13.6

HRMS m/z (ESI) calcd. for C23H24NO2S2+ $(M\text{-}OH)^+$ 410.1243, found 410.1245



8a

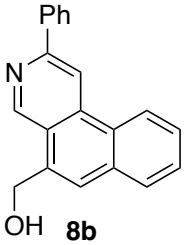
(2-butylbenzo[*f*]isoquinolin-5-yl)methanol

8a was prepared following the General Procedure 2.11 and purified by column chromatography (Hexane: Ethyl acetate = 2:1) in 63% yield as white solid.

^{1}H NMR (600 MHz; $CDCl_3$): δ 9.46 (s, 1H), 8.66-8.64 (m, 1H), 8.28 (s, 1H), 7.91-7.89 (m, 1H), 7.80 (s, 1H), 7.71-7.68 (m, 2H), 5.26 (d, *J* = 0.6 Hz, 2H), 3.04 (t, *J* = 7.8 Hz, 2H), 2.61 (s, 3H), 1.87-1.84 (m, 2H), 1.46 (dt, *J* = 14.9, 7.4 Hz, 2H), 0.99 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (151 MHz; CDCl3): δ 158.1, 147.6, 136.1, 134.0, 133.2, 128.80, 128.76, 128.5, 127.0, 125.9, 123.17, 123.05, 114.6, 63.0, 41.0, 38.3, 32.4, 22.6, 14.0

HRMS m/z (ESI) calcd. for C18H20NO+ $(M+H)^+$ 266.1540, found 266.1545

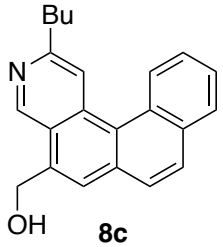


8b

(2-phenylbenzo[*f*]isoquinolin-5-yl)methanol

8b was prepared following the General Procedure 2.11 and purified by column chromatography (Hexane: Ethyl acetate = 2:1) in 72% yield as white solid.

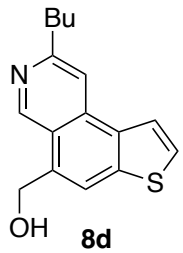
^{1}H NMR (600 MHz; $CDCl_3$): δ 9.58 (s, 1H), 8.79 (s, 1H), 8.70 (dd, *J* = 5.8, 3.4 Hz, 1H), 8.17 (d, *J* = 7.7 Hz, 2H), 7.89 (dd, *J* = 5.9, 3.2 Hz, 1H), 7.79 (s, 1H), 7.71 (dq, *J* = 6.1, 3.1 Hz, 2H), 7.55 (t, *J* = 7.5 Hz, 2H), 7.48-7.45 (m, 1H), 5.27 (s, 2H).
^{13}C NMR (151 MHz; CDCl3): δ 153.2, 148.1, 139.7, 136.2, 133.9, 133.3, 128.93, 128.91, 128.88, 128.81, 128.75, 127.24, 127.17, 126.6, 124.0, 123.0, 112.7, 63.0
HRMS m/z (ESI) calcd. for C20H16NO+ $(M+H)^+$ 286.1227, found 286.1286



8c

(2-butylnaphtho[1,2-f]isoquinolin-5-yl)methanol

8c was prepared following the General Procedure 2.11 and purified by column chromatography (Hexane: Ethyl acetate = 2:1) in 25% yield as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 9.55 (s, 1H), 8.91 (d, *J* = 8.4 Hz, 1H), 8.64 (s, 1H), 8.00 (d, *J* = 7.8 Hz, 1H), 7.92 (d, *J* = 8.5 Hz, 1H), 7.83 (s, 1H), 7.74 (d, *J* = 8.5 Hz, 1H), 7.69-7.67 (m, 1H), 7.63 (t, *J* = 7.3 Hz, 1H), 5.27 (s, 2H), 3.01 (t, *J* = 7.7 Hz, 2H), 1.82 (dt, *J* = 15.2, 7.6 Hz, 2H), 1.44 (dt, *J* = 14.9, 7.4 Hz, 2H), 0.97 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (151 MHz; CDCl3): δ 156.9, 147.9, 135.33, 135.25, 133.4, 132.9, 130.1, 129.6, 128.9, 127.0, 126.82, 126.67, 126.23, 126.18, 125.2, 124.1, 119.0, 62.3, 38.1, 32.3, 22.5, 14.0
HRMS m/z (ESI) calcd. for C22H22NO+ $(M+H)^+$ 316.1696, found 316.1749

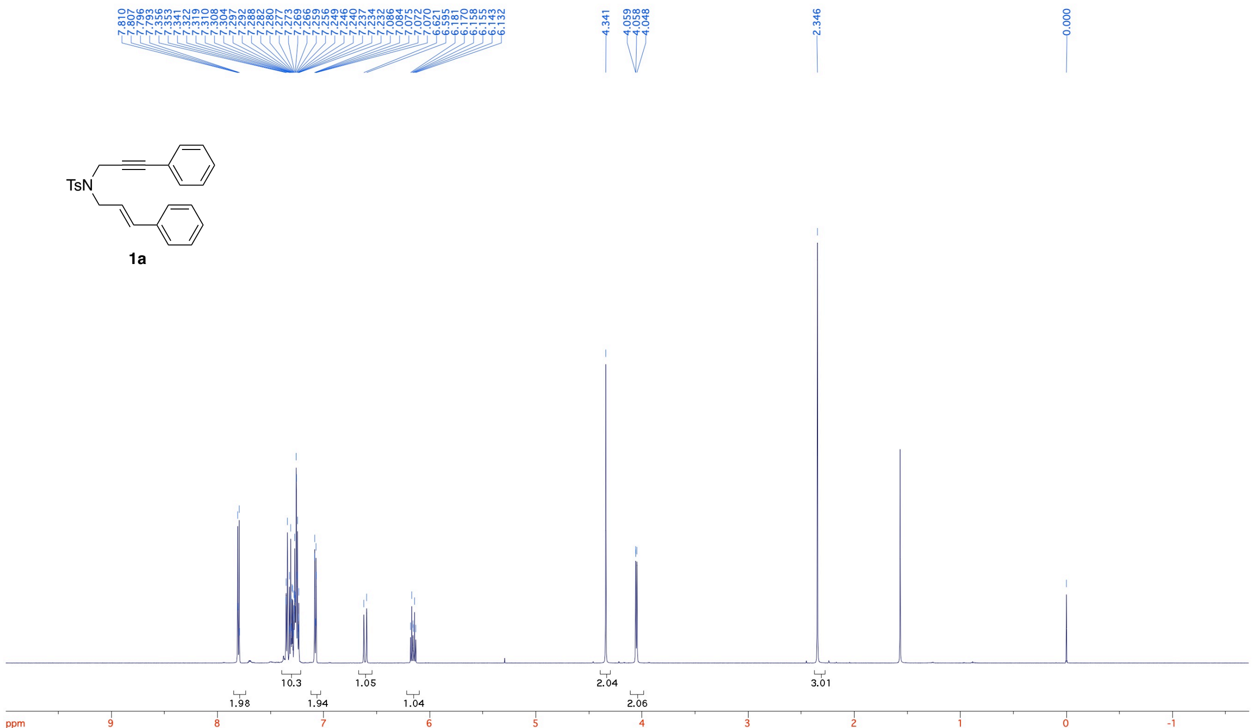


8d

(8-butylthieno[3,2-f]isoquinolin-5-yl)methanol

8d was prepared following the General Procedure 2.11 and purified by column chromatography (Hexane: Ethyl acetate = 2:1) in 55% yield as white solid.
^{1}H NMR (600 MHz; $CDCl_3$): δ 9.49 (s, 1H), 7.96 (s, 1H), 7.93 (d, *J* = 5.3 Hz, 1H), 7.89 (s, 1H), 7.61 (d, *J* = 5.3 Hz, 1H), 5.25 (s, 2H), 2.99 (t, *J* = 7.8 Hz, 2H), 1.82 (q, *J* = 7.7 Hz, 2H), 1.44 (q, *J* = 7.5 Hz, 2H), 0.97 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (151 MHz; CDCl3): δ 157.1, 148.3, 140.7, 134.0, 133.60, 133.54, 126.6, 122.2, 121.9, 120.0, 115.2, 62.7, 38.0, 32.3, 22.6, 14.0
HRMS m/z (ESI) calcd. for C16H18NOS+ $(M+H)^+$ 272.1104, found 272.1186

VII. NMR Spectra Data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4.341 4.059 4.058 4.048
2.346
0.000
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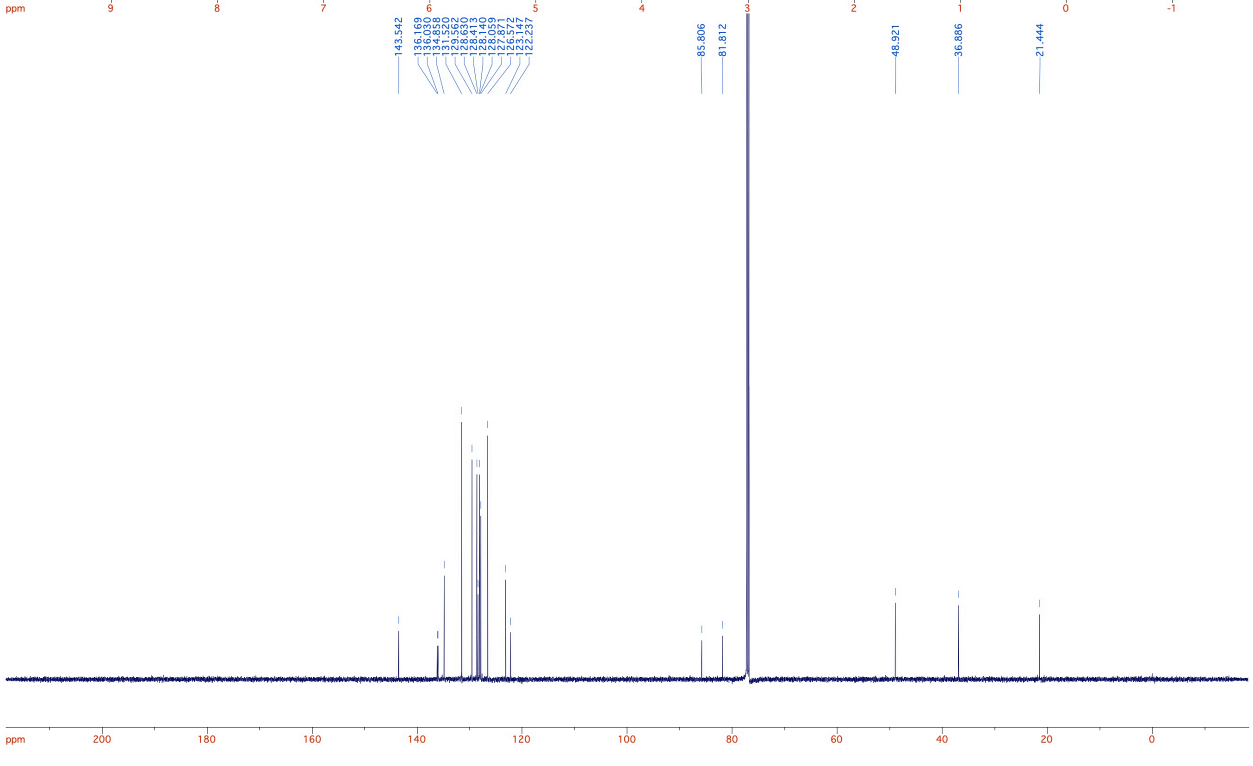
ppm 9 8 7 6 5 4 3 2 1 0 -1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85.806 81.812
48.921 36.886 21.444
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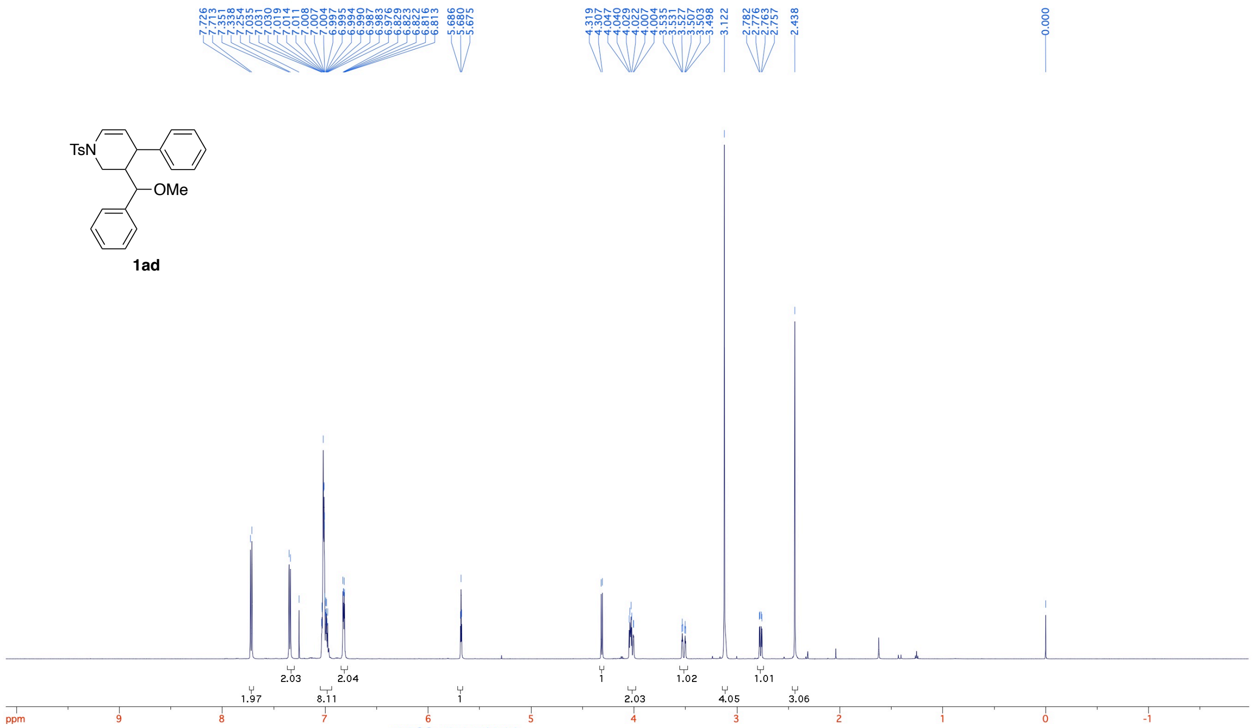
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4.319 4.307 4.047 4.040 4.029 4.022 4.007 4.004 3.535 3.531 3.527 3.507 3.503 3.498 3.122
2.782 2.776 2.763 2.757 2.438
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OMe
1ad
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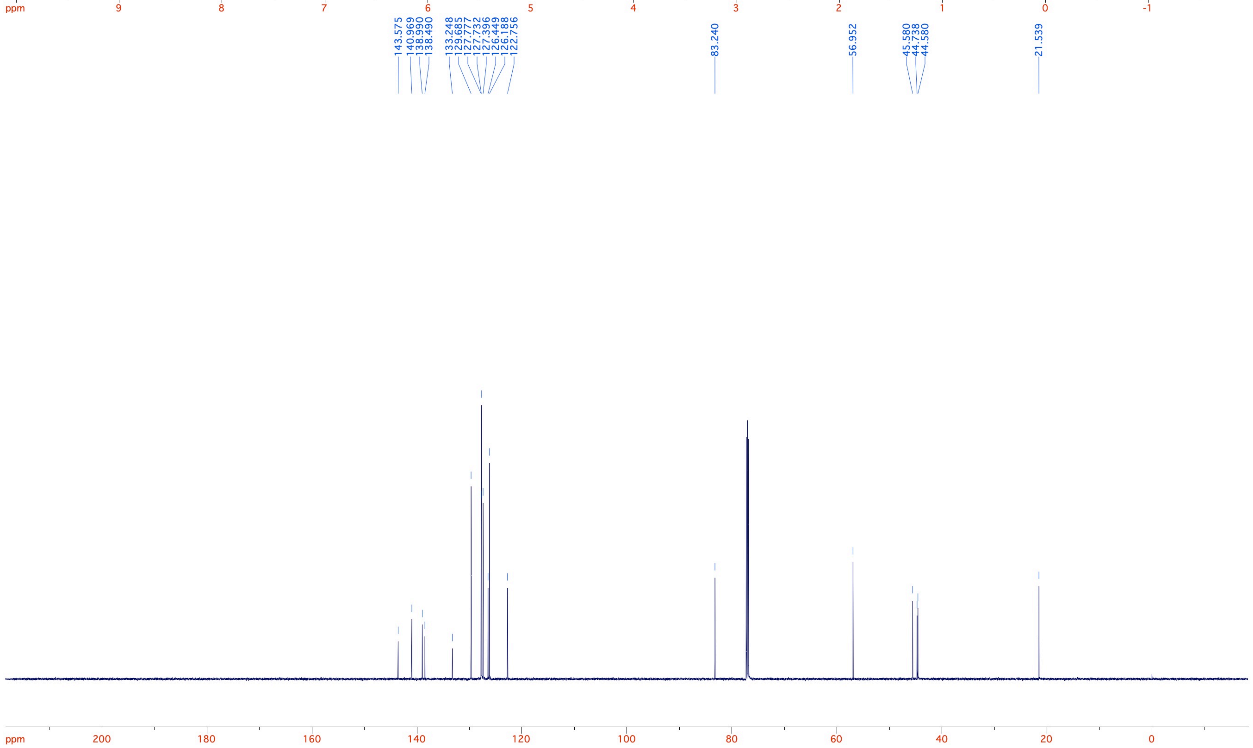
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56.952
45.580 44.738 44.580
21.539
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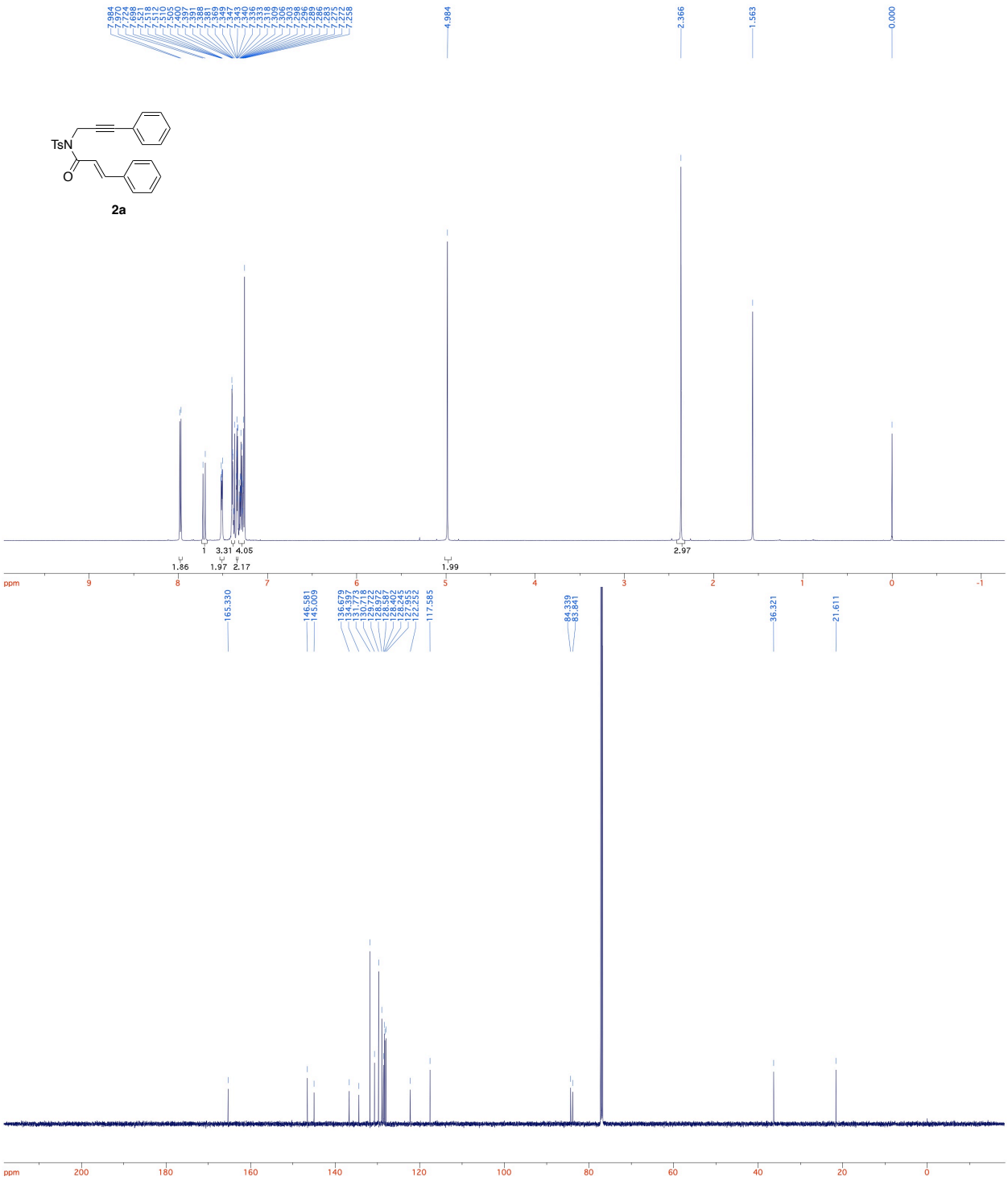
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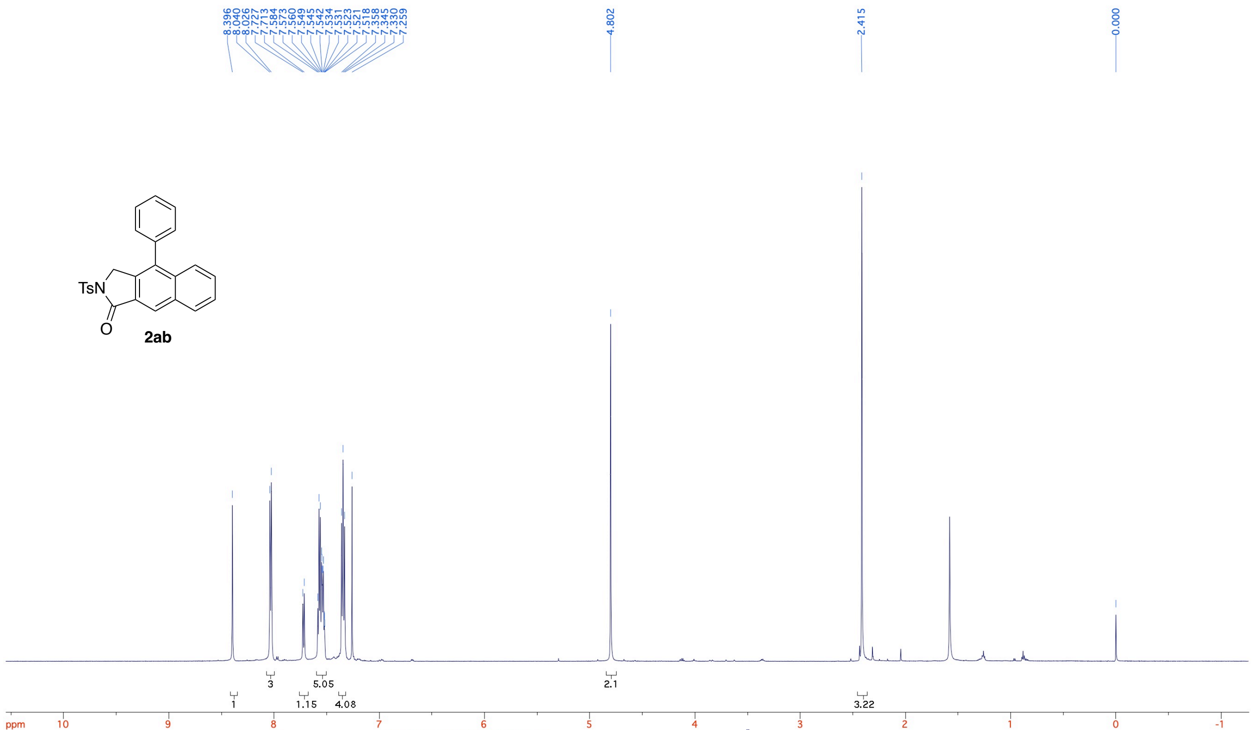
2ab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7.531
7.523
7.521
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7.259
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3.22
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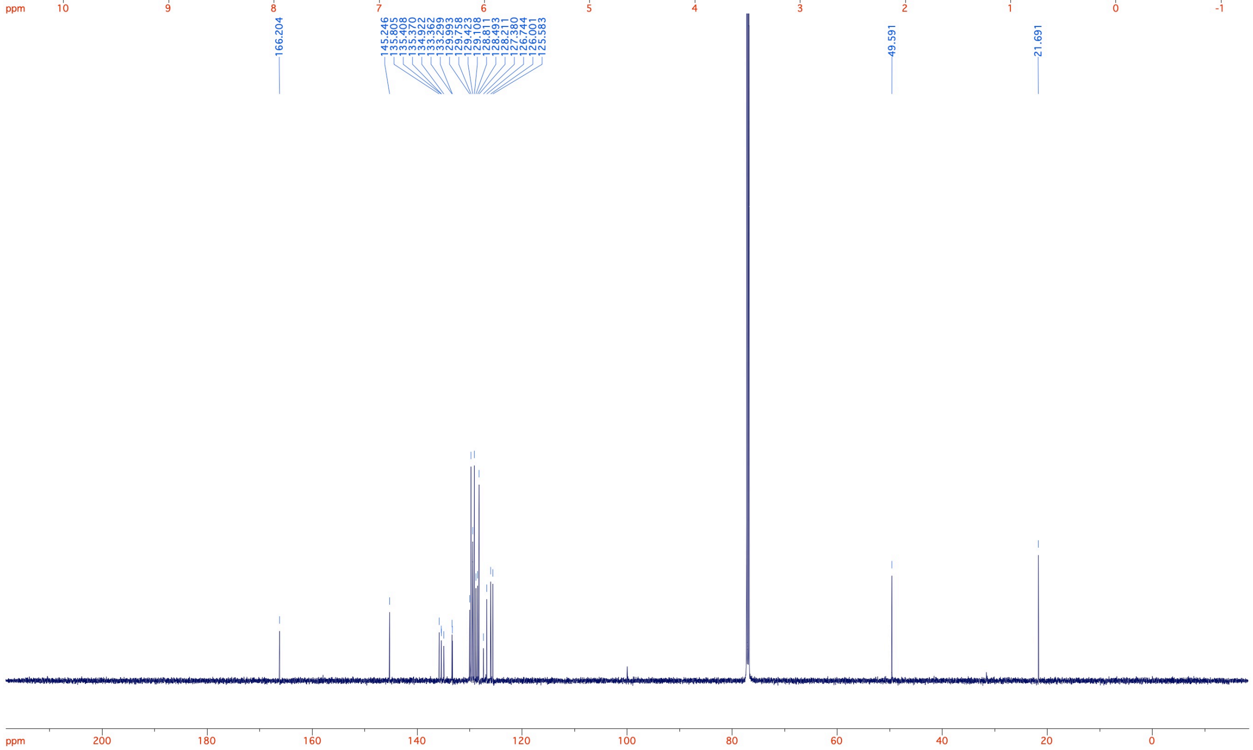
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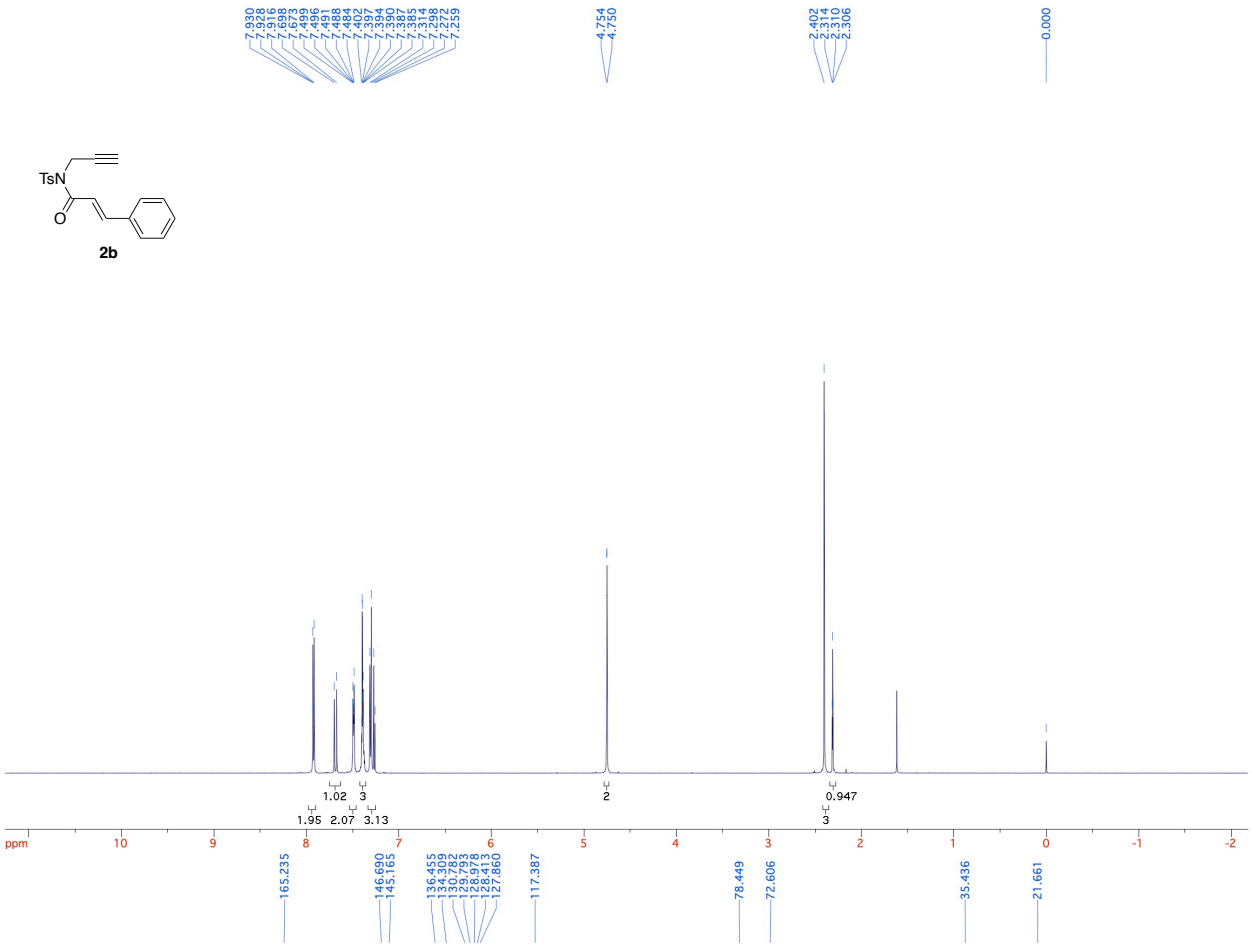
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7.390
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7.298
7.272
7.259
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4.750
2.402
2.314
2.310
2.306
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3
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2.07
3.13
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3
ppm
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8
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6
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2
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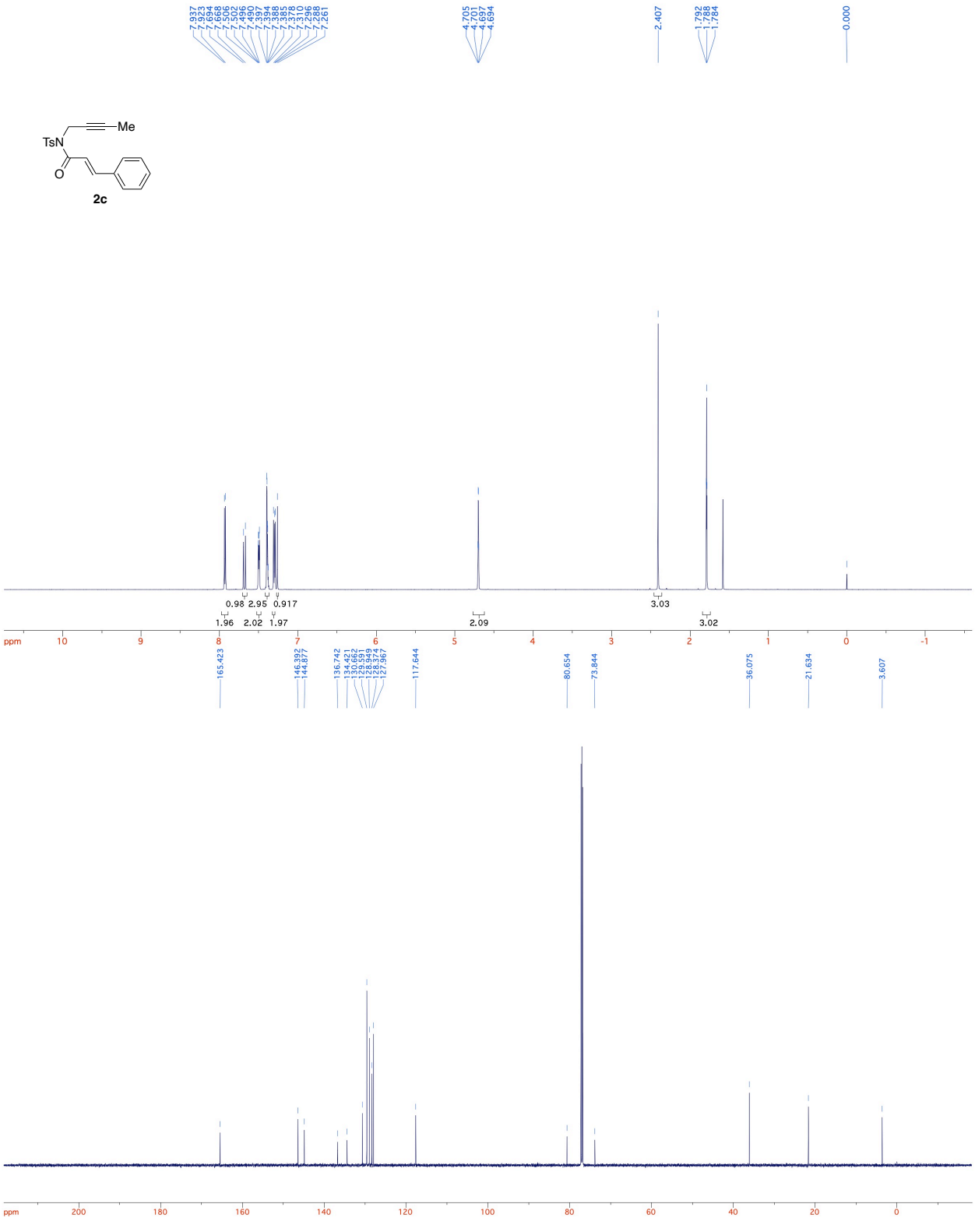
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4.701
4.697
4.694
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1.792
1.788
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TsN
O
2c
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1.96
2.02
1.97
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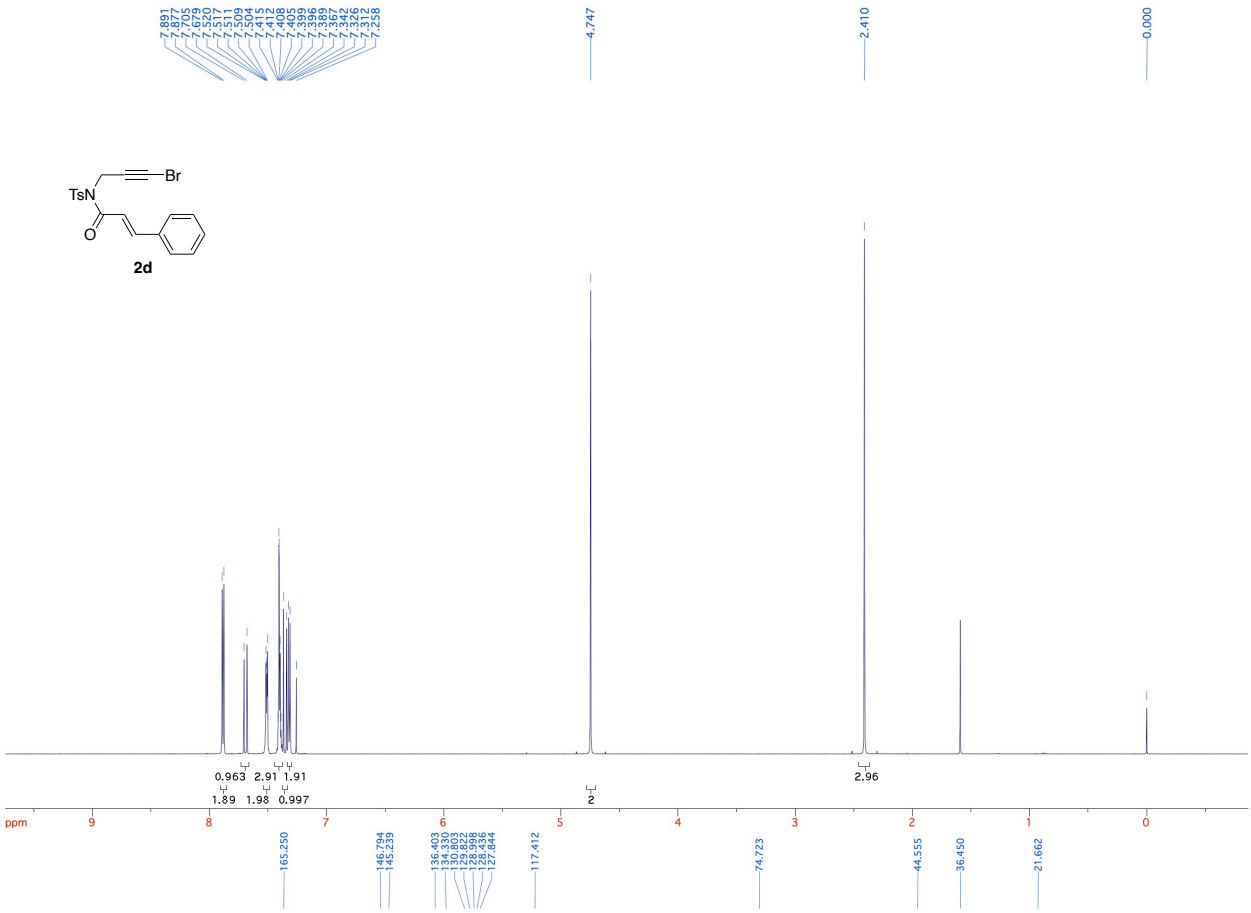
3.607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7.509
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7.415
7.408
7.405
7.399
7.396
7.389
7.367
7.342
7.326
7.317
7.258
4.747
2.410
0.000
Br
TsN
O
2d
0.963
2.91
1.91
1.89
1.98
0.997
2
2.96
ppm
9
8
7
6
5
4
3
2
1
0
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146.794
145.239
136.403
134.330
130.803
130.622
128.998
128.436
127.844
117.412
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36.450
21.662
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140
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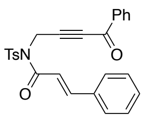
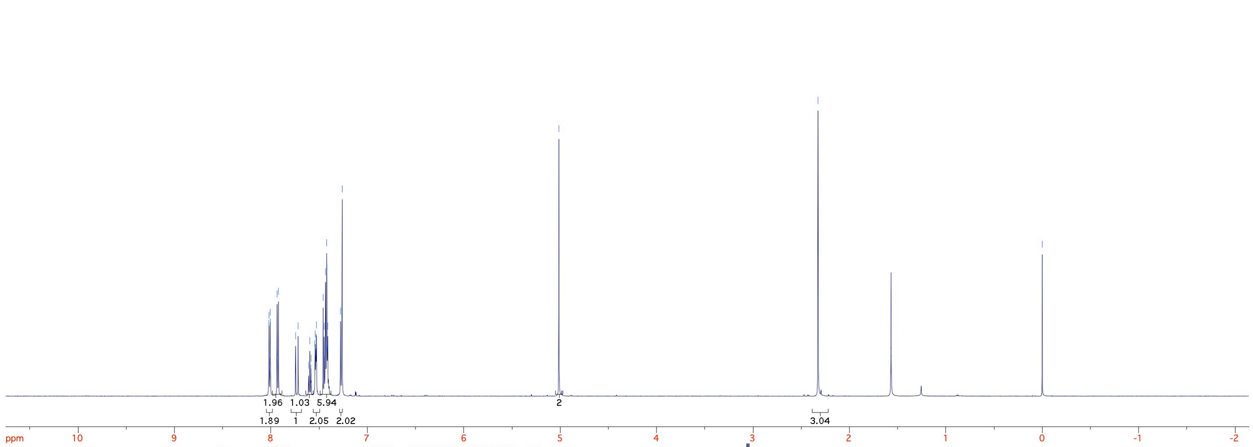

Ph
TsN
O
O

2e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7.933
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7.718
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7.596
7.586
7.584
7.543
7.540
7.535
7.532
7.528
7.458
7.448
7.445
7.437
7.432
7.427
7.422
7.420
7.415
7.410
7.277
7.264
7.263
7.260
5.013
2.326
0.000
1.96
1.89
1.03
1
2.05
5.94
2.02
2
3.04
ppm
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9
8
7
6
5
4
3
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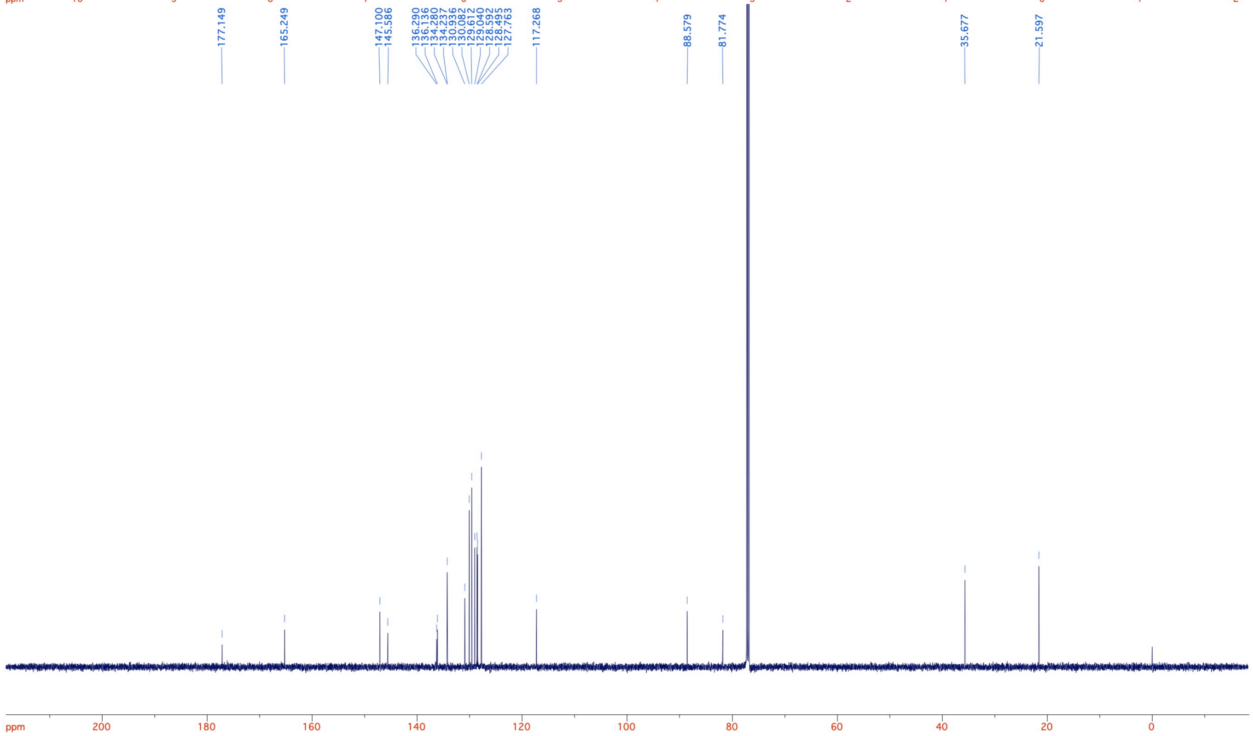
-2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136.136
134.280
134.257
130.936
130.082
129.612
129.040
128.592
128.495
127.763
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ppm
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160
140
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80
60
40
20
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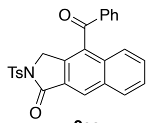
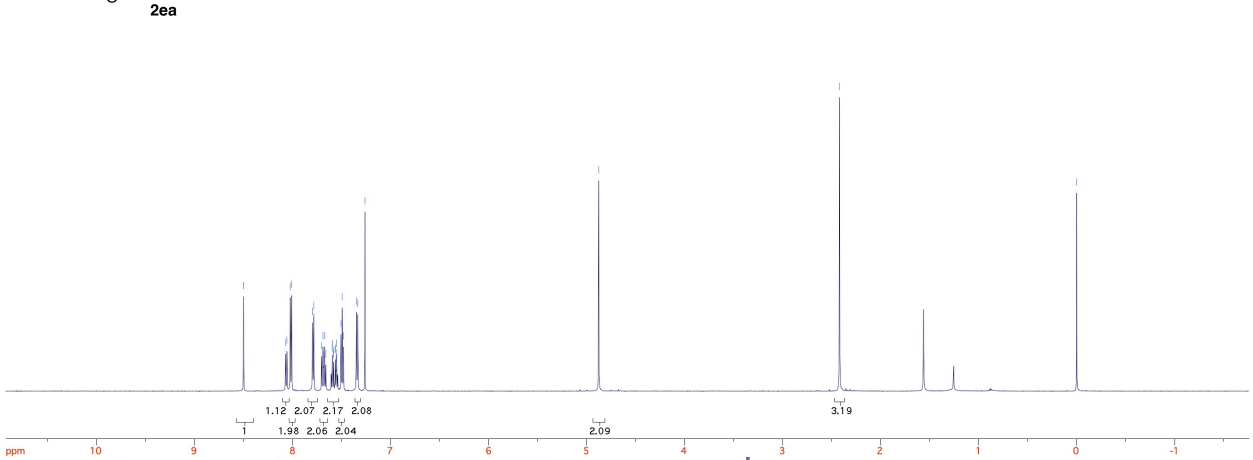


2ea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8.056
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7.783
7.781
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7.689
7.685
7.672
7.660
7.595
7.593
7.581
7.579
7.565
7.563
7.554
7.551
7.549
7.506
7.493
7.480
7.348
7.334
7.261
4.876
2.420
0.000
1.12
2.07
2.17
2.08
1
1.98
2.06
2.04
2.09
3.19
ppm
10
9
8
7
6
5
4
3
2
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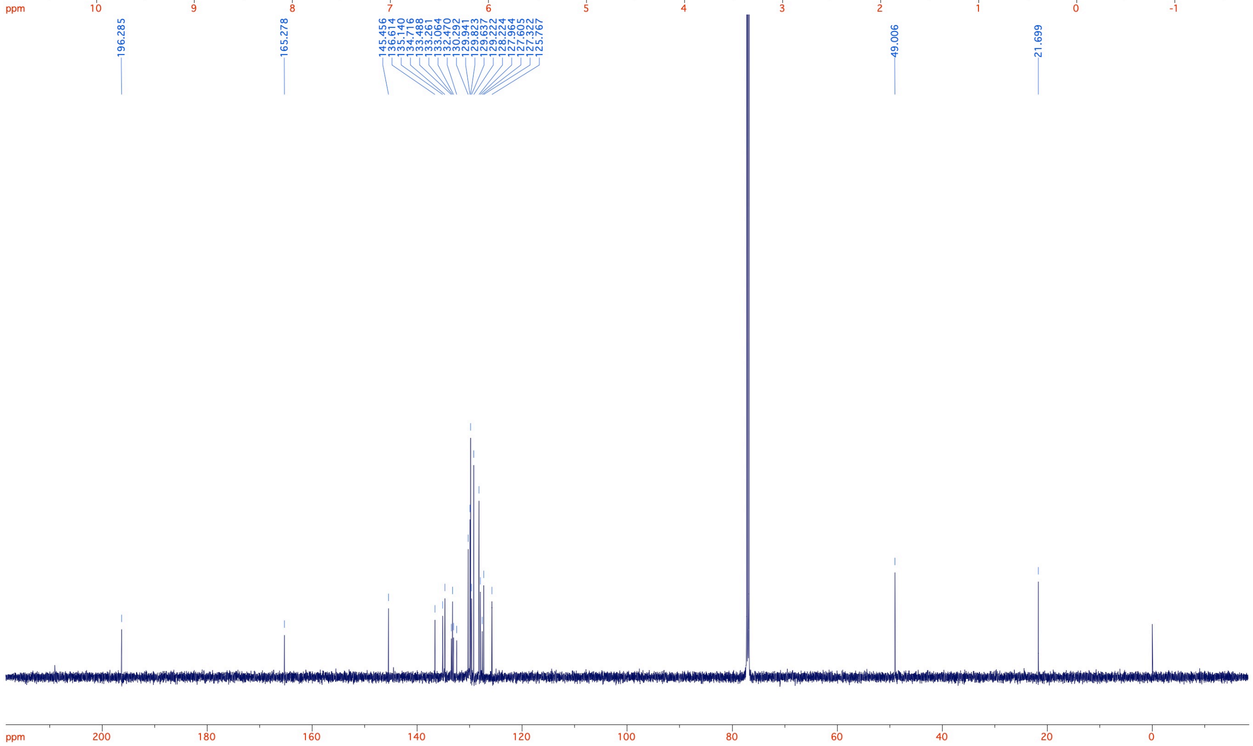
0
-1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133.488
133.261
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132.420
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129.941
129.823
129.637
129.222
128.224
127.964
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49.006
21.699
ppm
200
180
160
140
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20
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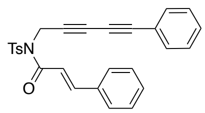
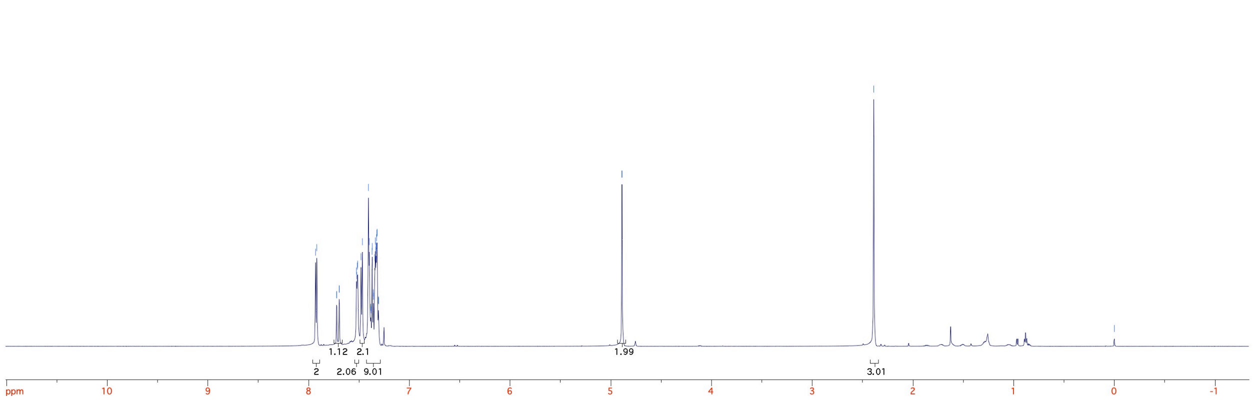

TsN
O

3a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7.526
7.523
7.517
7.514
7.480
7.467
7.407
7.398
7.383
7.381
7.371
7.369
7.358
7.356
7.348
7.343
7.338
7.333
7.331
7.330
7.326
7.323
7.320
7.308
7.305
4.891
4.888
2.390
0.000
2
1.12
2.06
2.1
9.01
1.99
3.01
ppm
10
9
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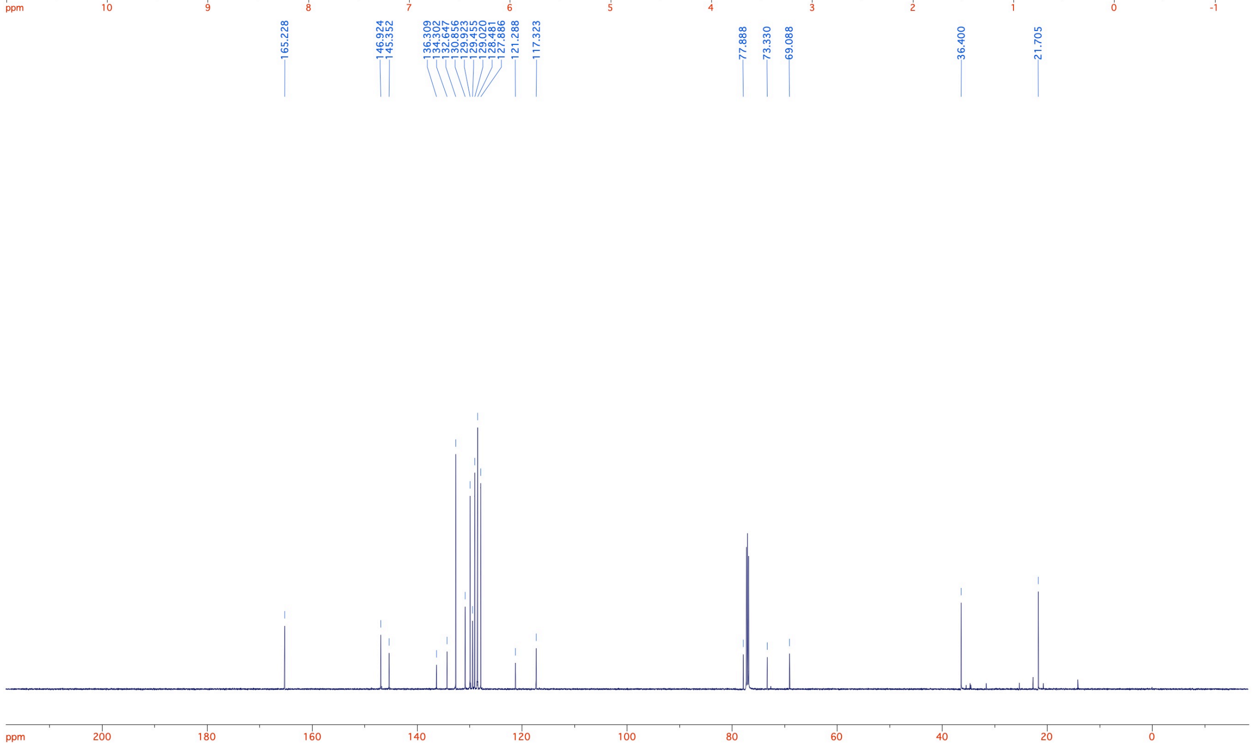
7
6
5
4
3
2
1
0
-1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145.352
136.309
134.302
132.647
130.856
129.923
129.435
129.020
128.481
127.886
121.288
117.323
77.888
73.330
69.088
36.400
21.705
ppm
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140
120
100
80
60
40
20
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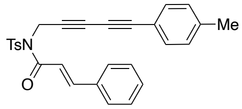
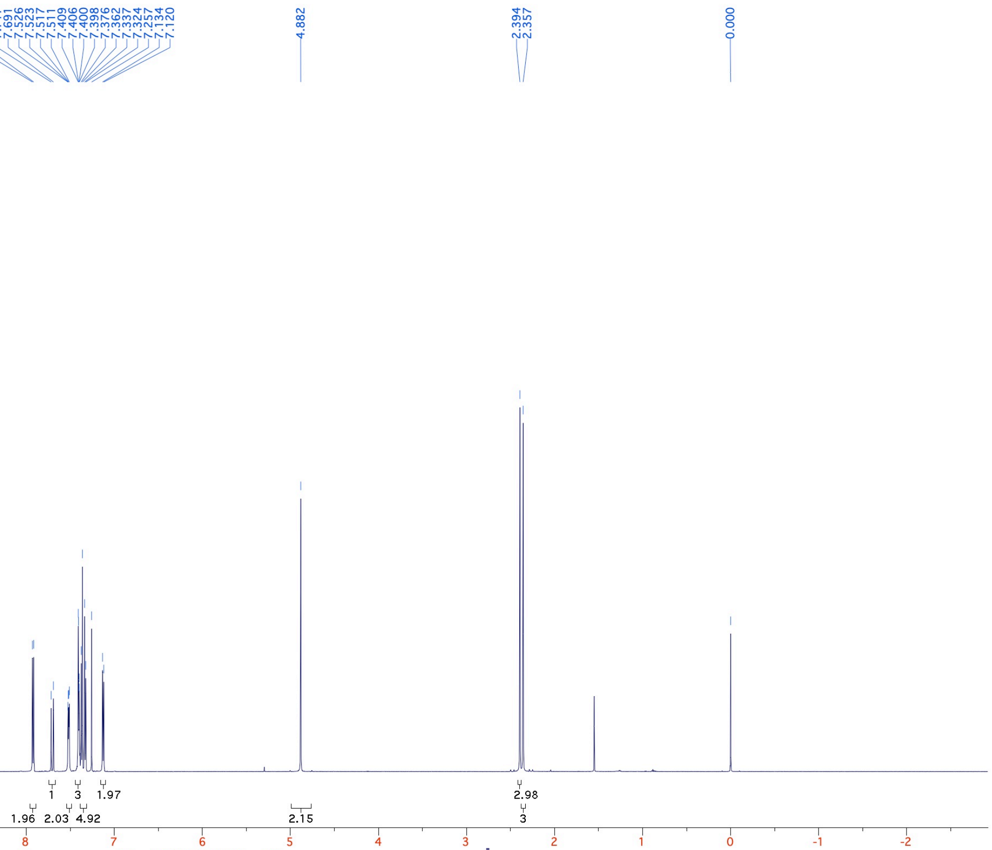

TsN
Me
O

3b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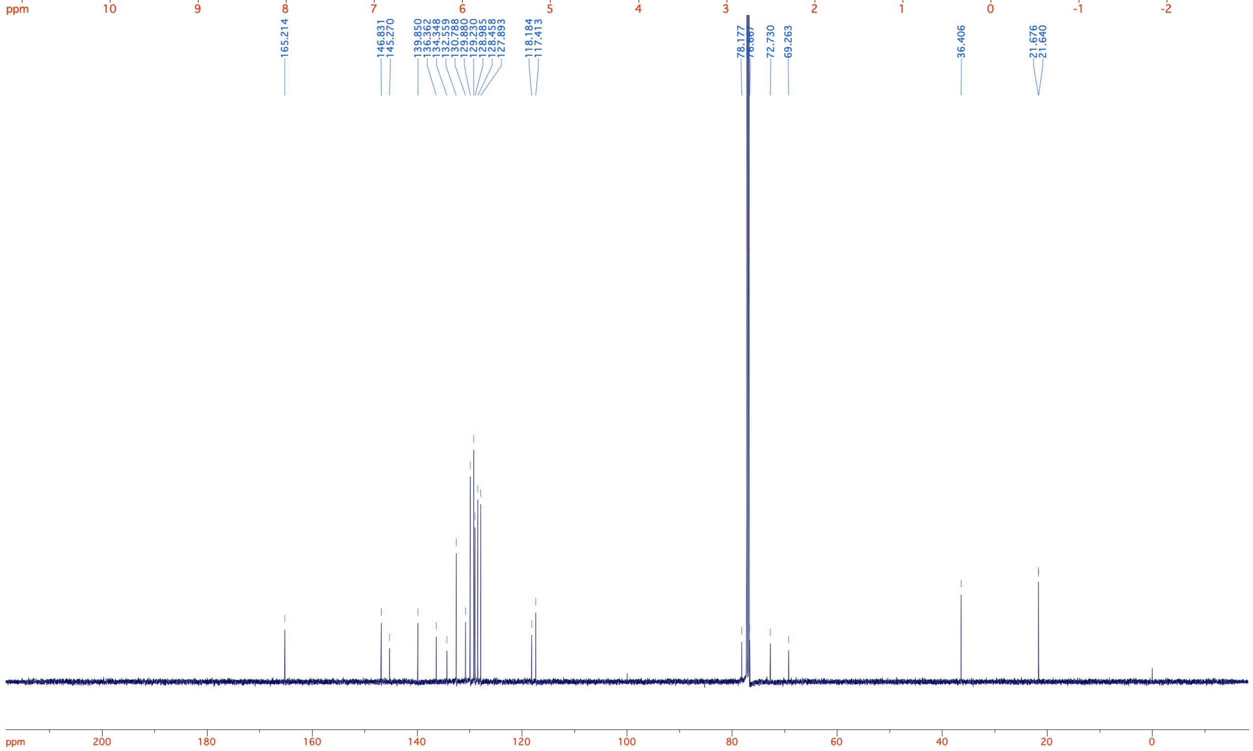
7.916
7.717
7.691
7.526
7.523
7.517
7.511
7.409
7.406
7.400
7.398
7.376
7.362
7.337
7.324
7.257
7.134
7.120
4.882
2.394
2.357
0.000
1
3
1.97
1.96
2.03
4.92
2.15
2.98
3
ppm
10
9
8
7
6
5
4
3
2
1
0
-1
-2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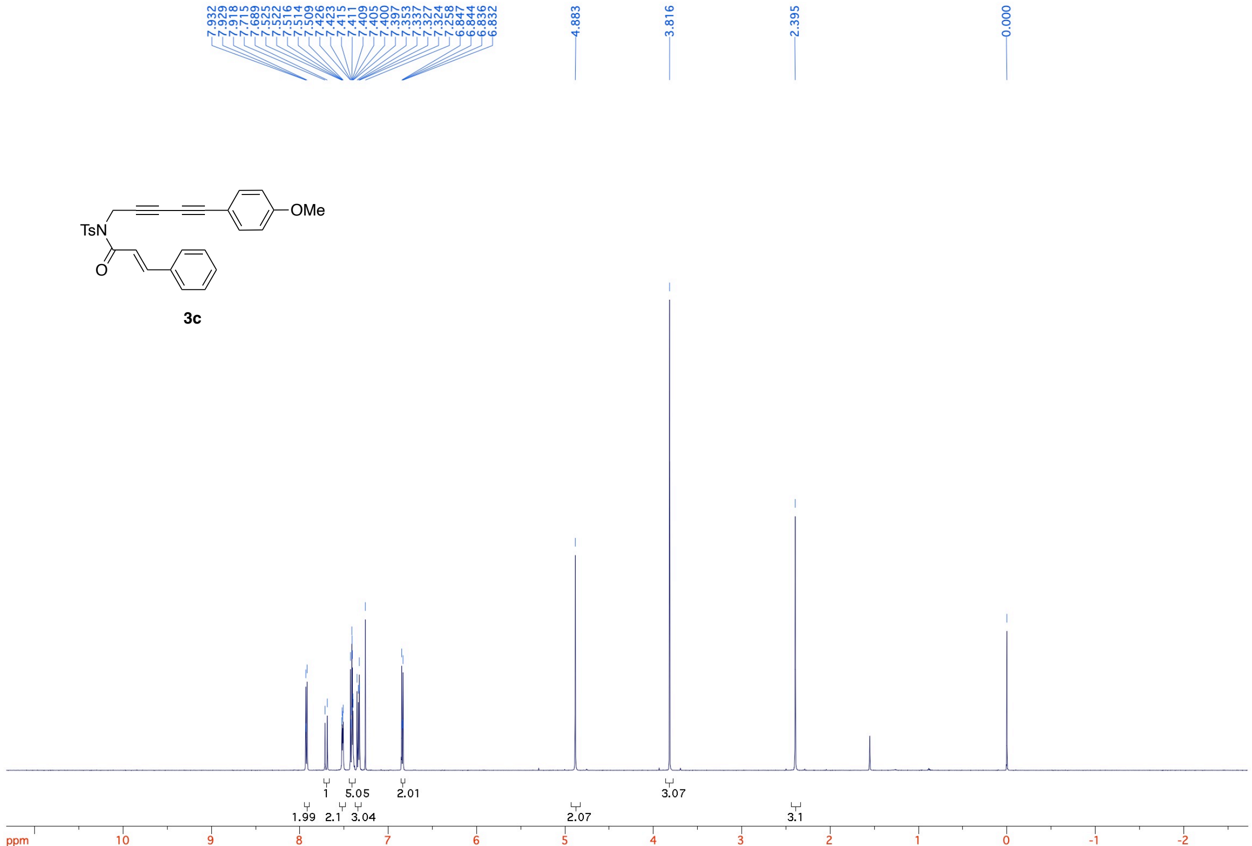
146.831
145.270
139.850
136.362
134.348
132.559
130.788
129.880
129.230
128.985
128.458
127.893
118.184
117.413
78.177
76.667
72.730
69.263
36.406
21.676
21.640
ppm
200
180
160
140
120
100
80
60
40
20
0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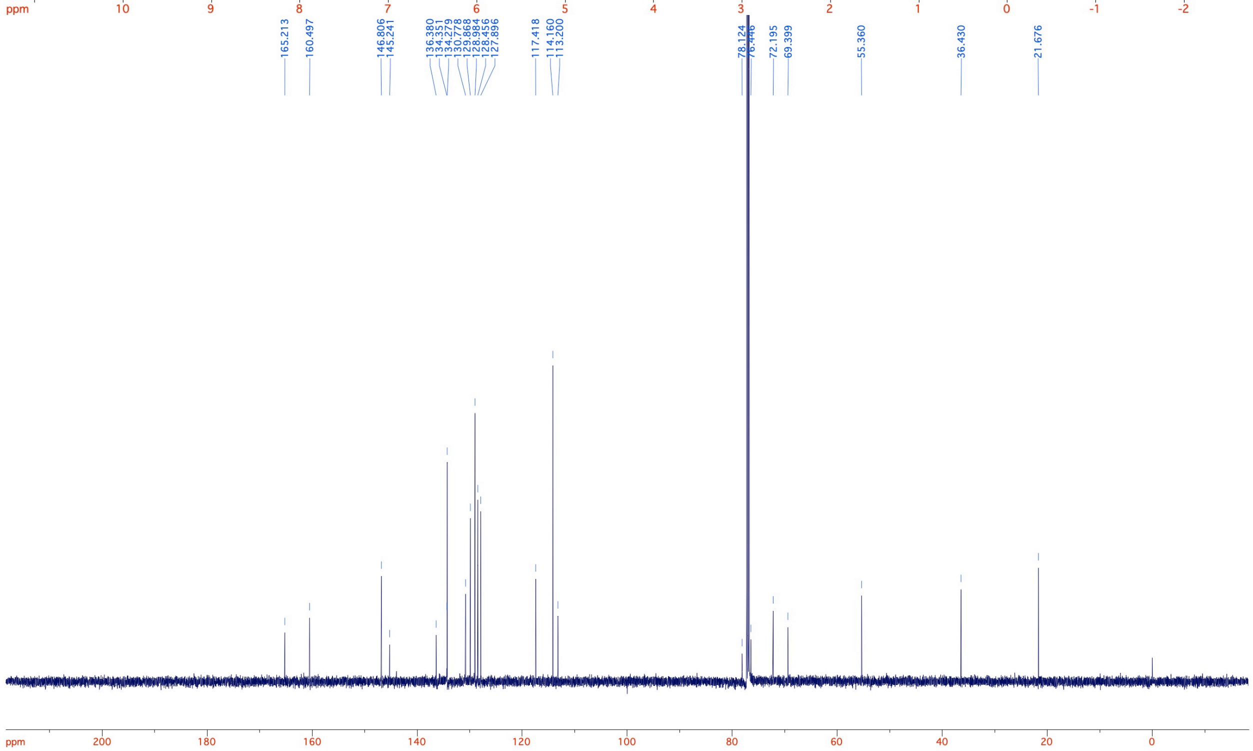
4.883
3.816
2.395
0.000
1.99 1 2.1 5.05 3.04 2.01 2.07 3.07 3.1
ppm 10 9 8 7 6 5 4 3 2 1 0 -1 -2
TsN
O
OMe

3c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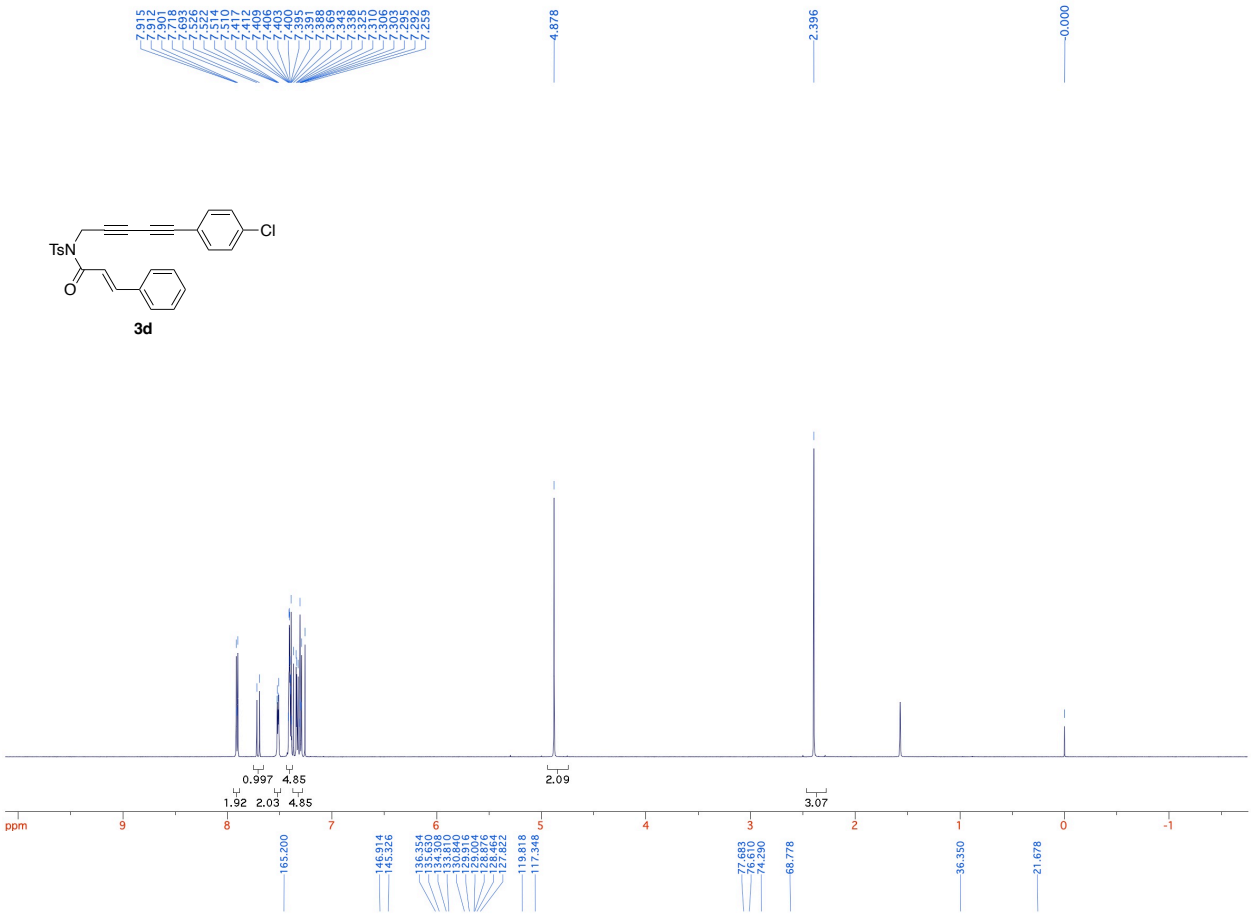
ppm 200 180 160 140 120 100 80 60 40 20 0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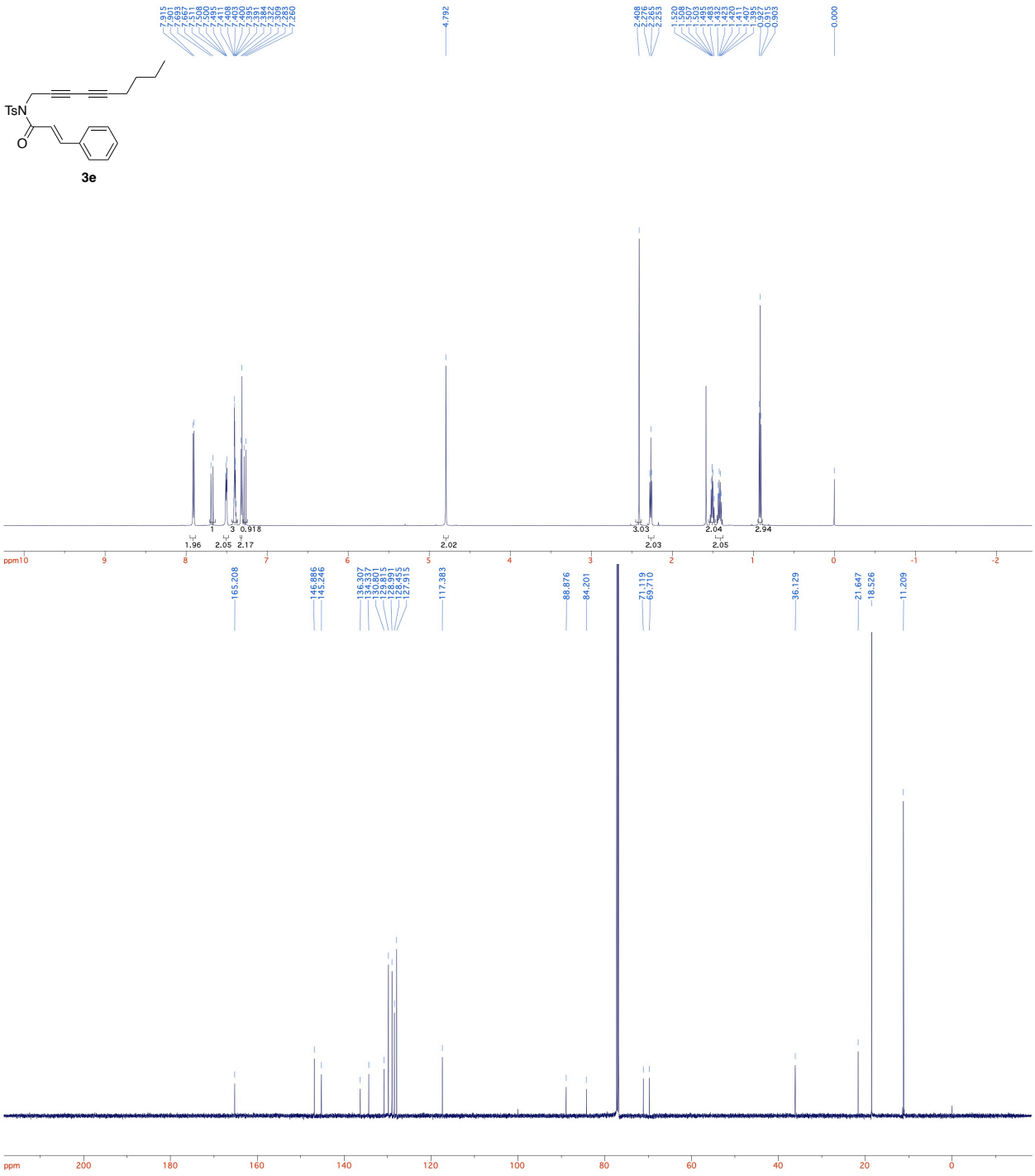
7.912
7.901
7.778
7.693
7.526
7.522
7.514
7.510
7.417
7.412
7.406
7.403
7.400
7.391
7.388
7.369
7.343
7.338
7.325
7.310
7.306
7.303
7.295
7.292
7.259
4.878
2.396
0.000
TsN
O
Cl
3d
0.997
4.85
2.09
1.92
2.03
4.85
3.07
ppm
165.200
146.914
145.326
136.354
135.630
134.010
133.811
130.840
130.315
129.004
128.876
128.464
127.822
119.818
117.348
77.683
76.610
74.290
68.778
36.350
21.678
ppm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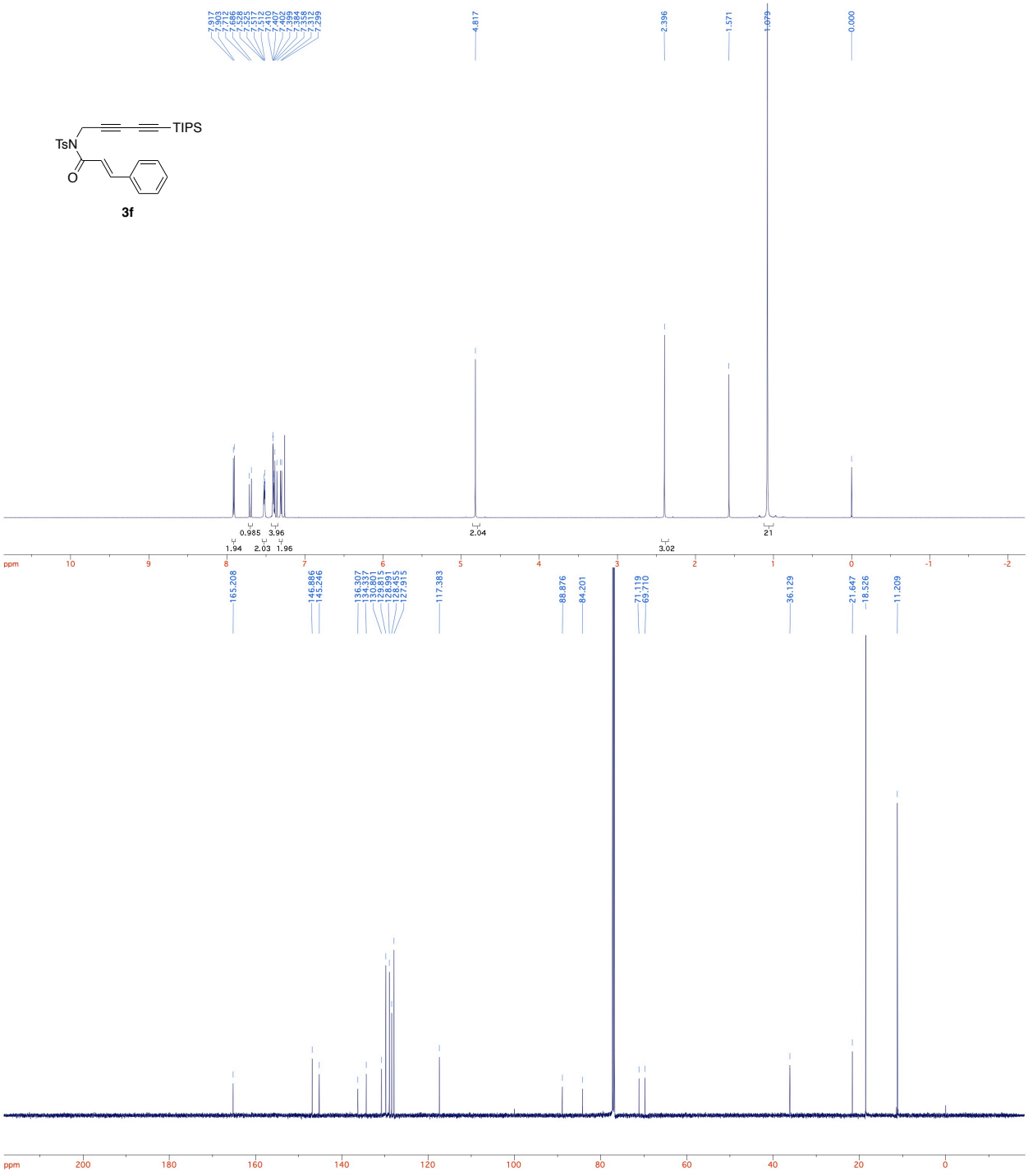
7.901
7.693
7.687
7.511
7.508
7.500
7.495
7.411
7.408
7.403
7.400
7.395
7.391
7.384
7.369
7.283
7.260
4.792
2.408
2.276
2.265
2.253
1.530
1.508
1.507
1.505
1.495
1.482
1.423
1.420
1.411
1.407
0.927
0.915
0.903
0.000
TsN
O
3e
1.96
2.05
2.17
1
3
0.918
2.02
3.03
2.03
2.04
2.05
2.94
ppm
165.208
146.886
145.246
136.307
134.337
130.801
130.651
128.991
128.455
127.915
117.383
88.876
84.201
71.119
69.710
36.129
21.647
18.526
11.209


TIPS
TsN
O
3f
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7.903
7.716
7.682
7.528
7.525
7.517
7.512
7.407
7.402
7.389
7.384
7.318
7.312
7.299
4.817
2.396
1.571
1.079
0.000
0.985
3.96
1.94
2.03
1.96
2.04
3.02
21
ppm
165.208
146.886
145.246
136.307
134.337
130.801
130.577
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117.383
88.876
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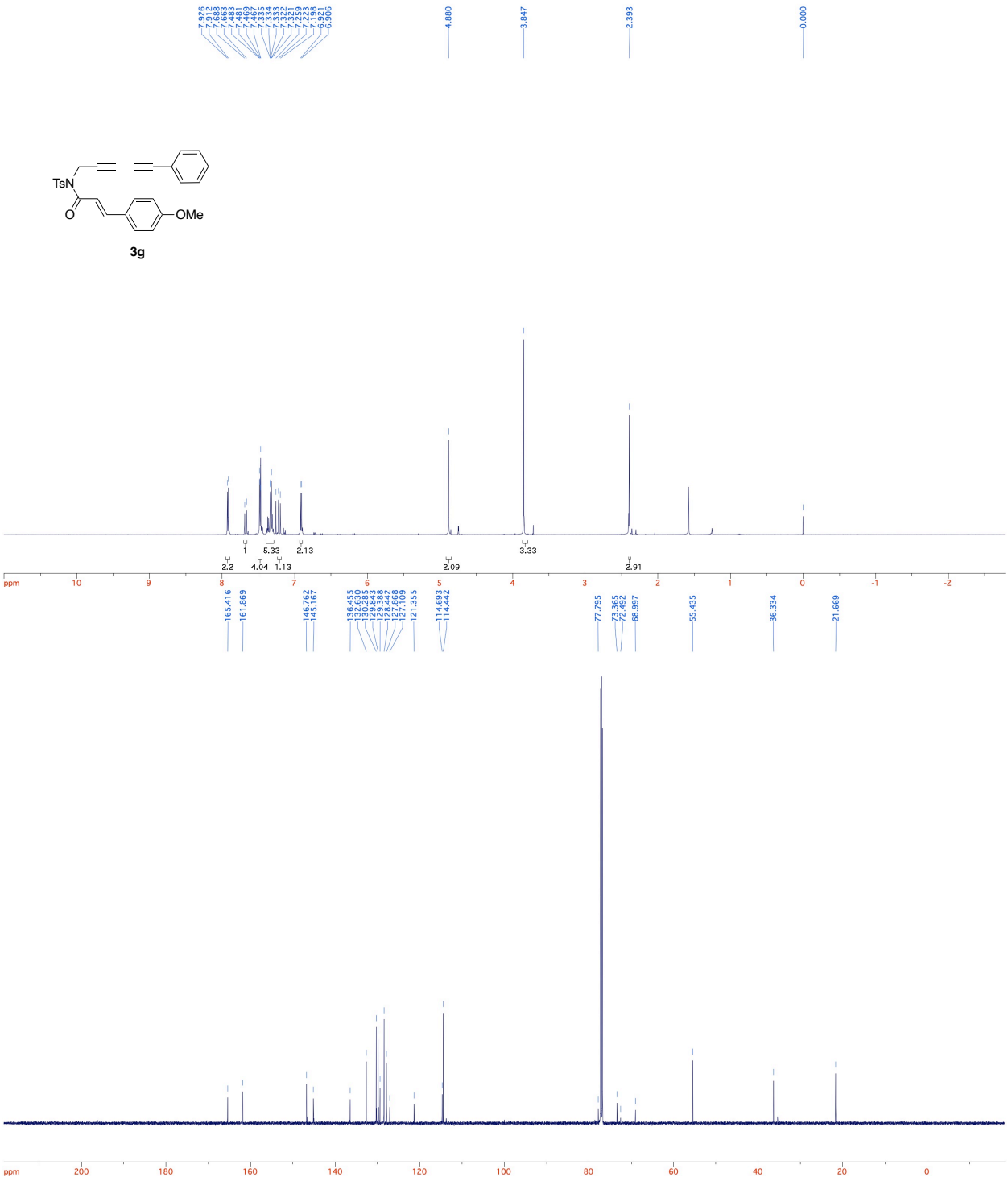
69.710
36.129
21.647
18.526
11.209
ppm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7.469
7.467
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7.334
7.333
7.322
7.321
7.259
7.198
6.921
6.906
4.880
3.847
2.393
0.000
TsN
O
OMe
3g
1
5.33
2.13
2.2
4.04
1.13
2.09
3.33
2.91
ppm
165.416
161.869
146.762
145.167
136.455
132.630
130.835
129.845
129.388
128.448
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127.109
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114.693
114.442
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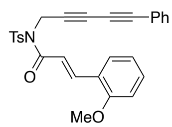
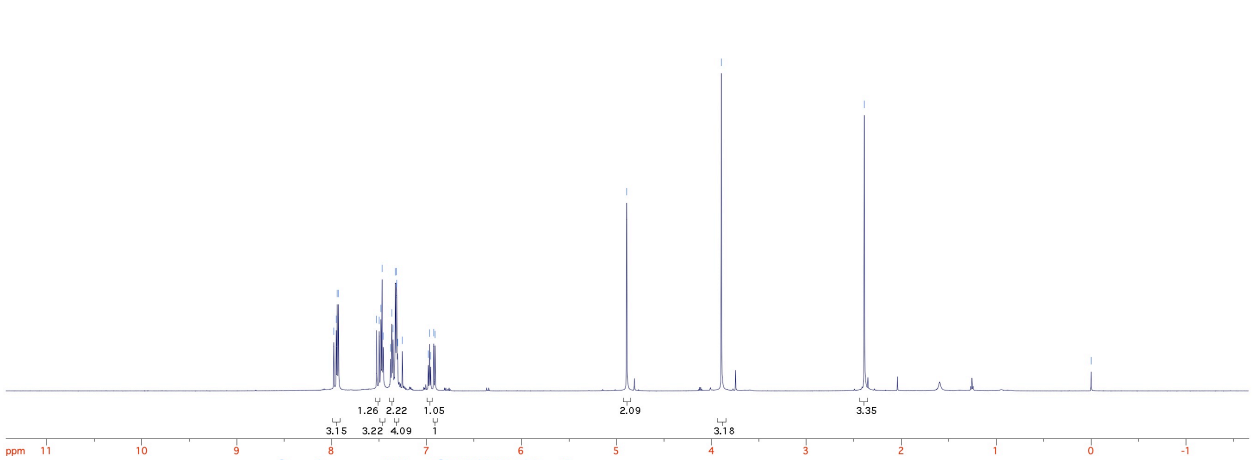
72.982
68.997
55.435
36.334
21.669


TsN
Ph
O
MeO

3h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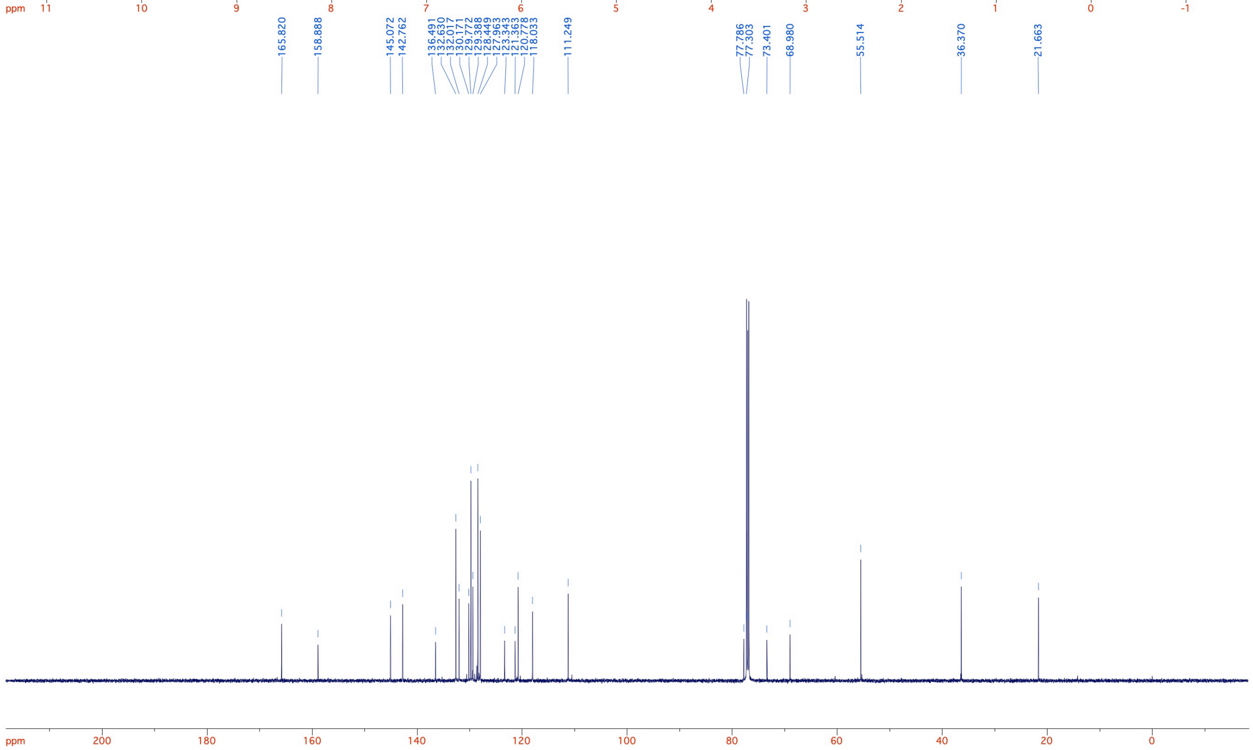
7.468
7.456
7.379
7.367
7.354
7.329
7.317
7.314
7.306
7.305
7.255
6.982
6.969
6.957
6.924
6.910
4.892
3.895
2.390
0.000
3.15
1.26
3.22
2.22
4.09
1.05
1
2.09
3.18
3.35
ppm
11
10
9
8
7
6
5
4
3
2
1
0
-1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128.449
127.963
123.343
121.363
120.778
118.033
111.249
77.786
77.303
73.401
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36.370
21.663
ppm
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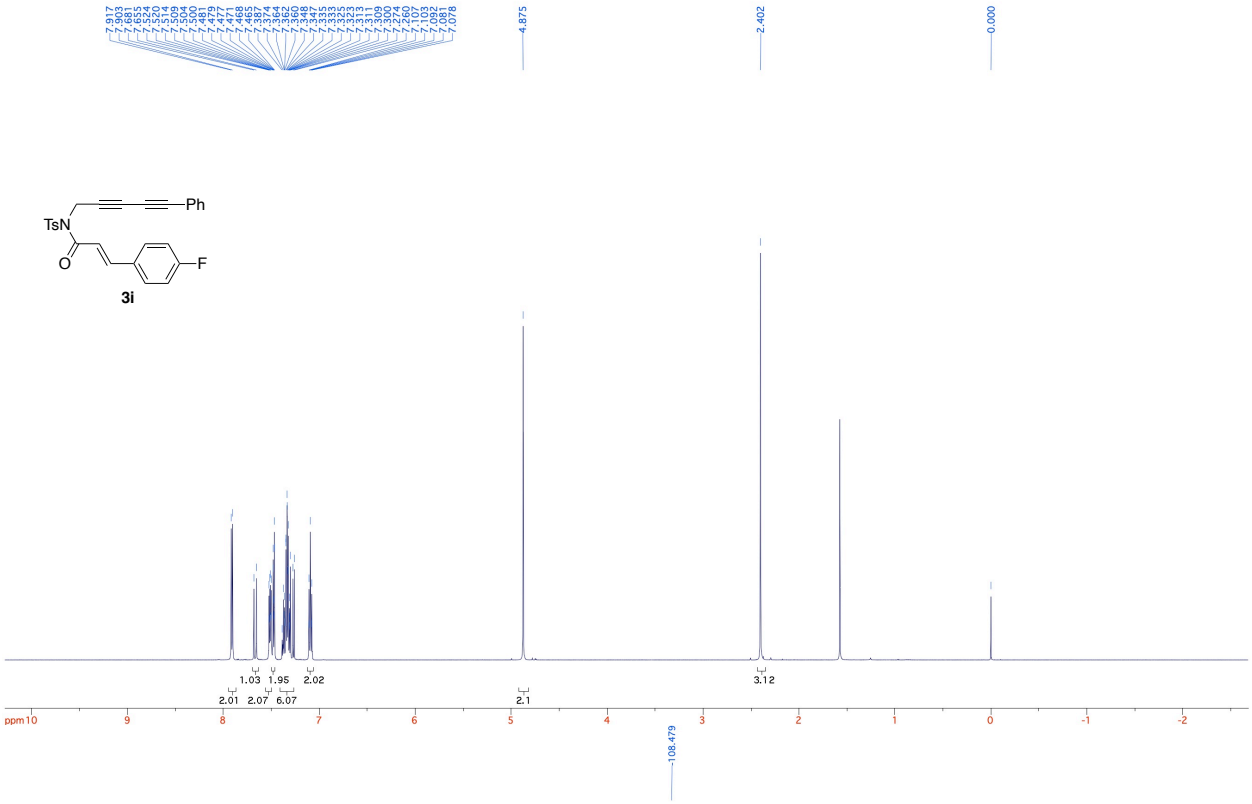
20
0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7.514
7.509
7.504
7.500
7.491
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7.477
7.471
7.468
7.465
7.397
7.394
7.362
7.360
7.348
7.347
7.340
7.333
7.325
7.323
7.313
7.311
7.309
7.300
7.274
7.264
7.107
7.103
7.093
7.081
7.078
4.875
2.402
0.000
Ph
TsN
O
F
3i
1.03
1.95
2.02
2.01
2.07
6.07
2.1
3.12
ppm
10
9
8
7
6
5
4
3
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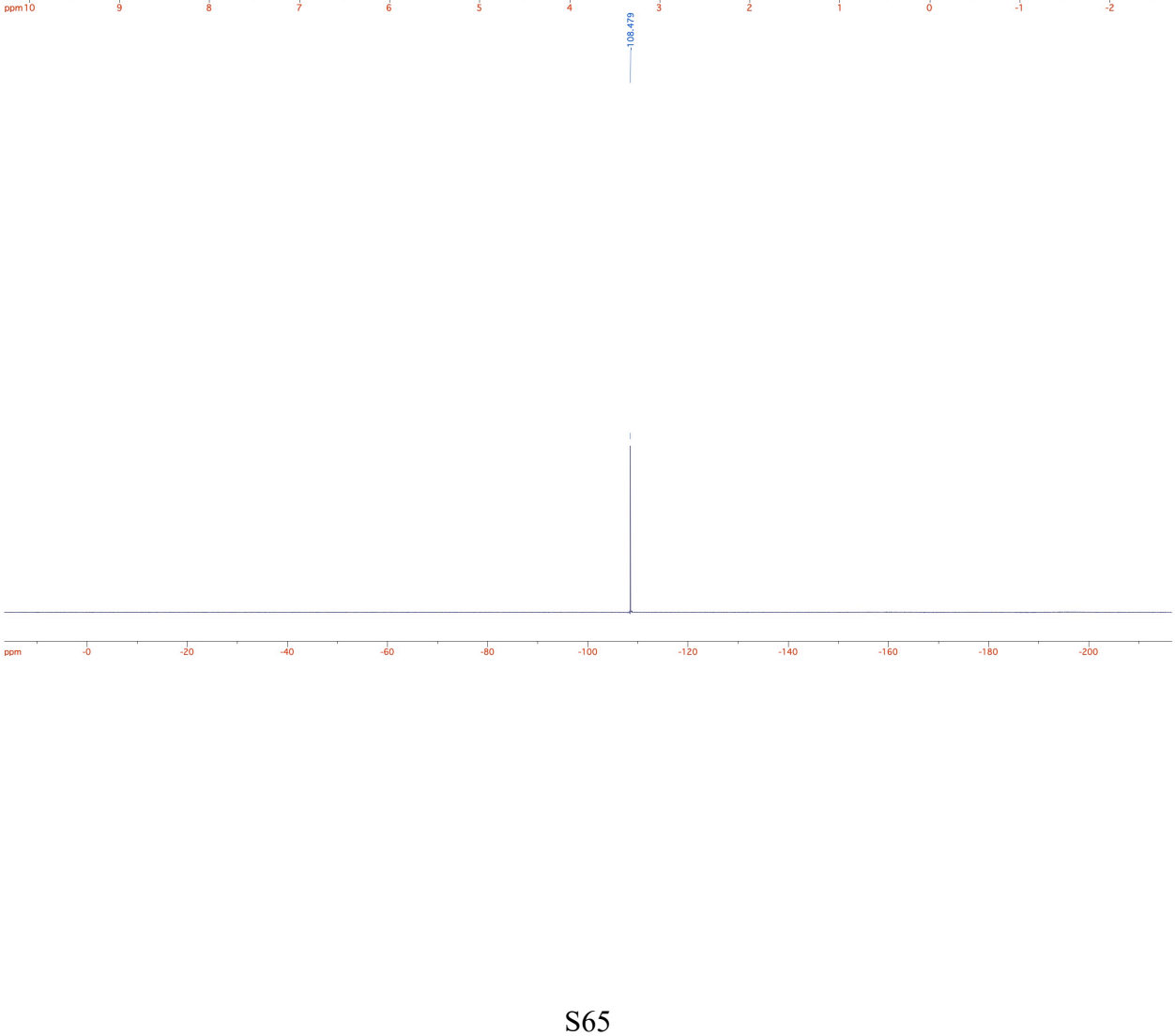
-2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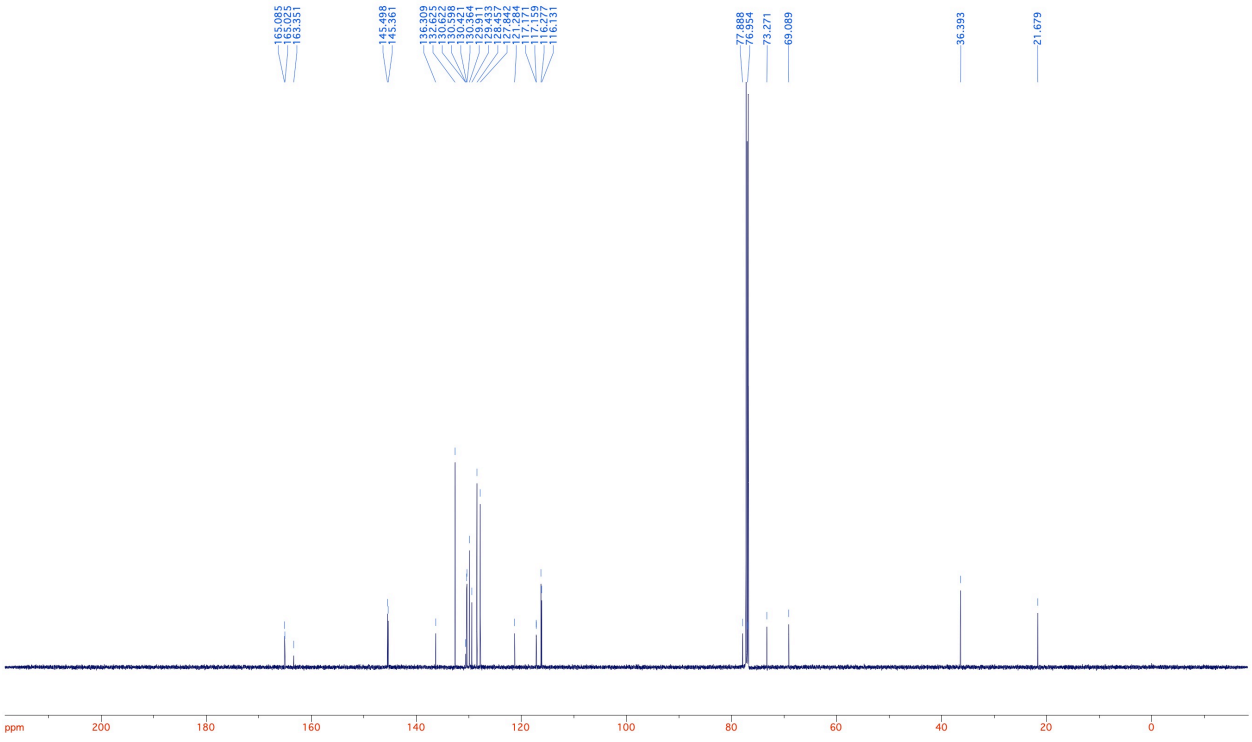
-160
-180
-200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130.421
130.364
130.311
129.433
129.457
129.382
121.284
117.171
117.079
116.277
116.131
77.888
76.954
73.271
69.089
36.393
21.679
ppm
200
180
160
140
120
100
80
60
40
20
0


7.934
7.931
7.920
7.698
7.697
7.584
7.580
7.574
7.570
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7.486
7.483
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7.464
7.461
7.457
7.431
7.405
7.388
7.376
7.363
7.337
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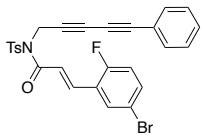
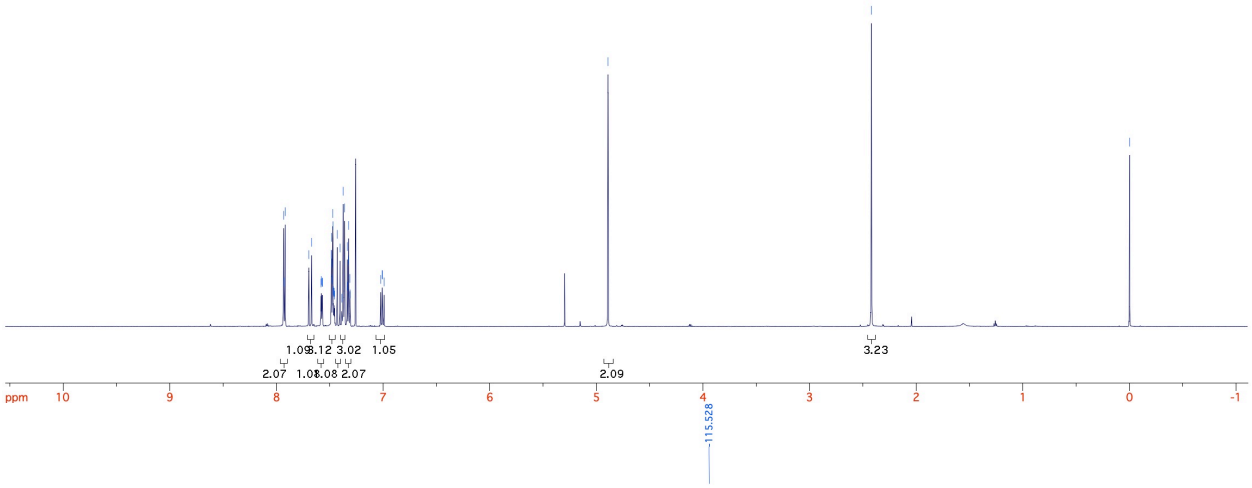

TsN
F
O
Br

3j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1.05
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1.08
1.08
2.07
2.09
3.23
ppm
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4
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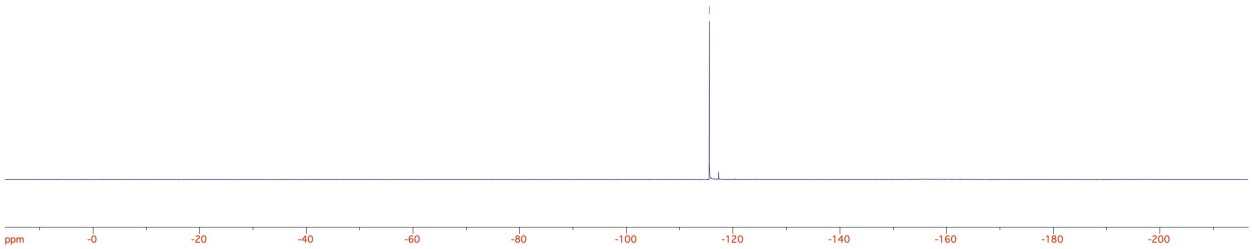
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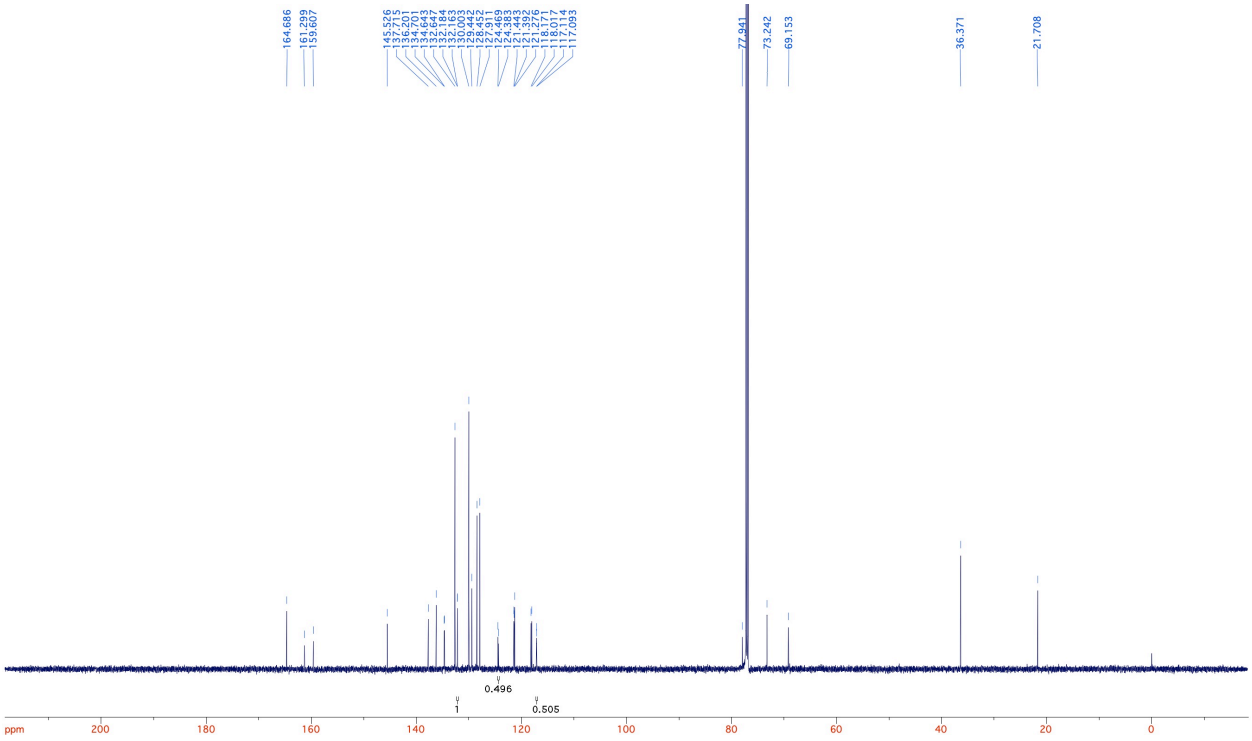
-60
-80
-100
-120
-140
-160
-180
-200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129.442
129.141
127.911
124.469
123.883
121.443
121.392
121.276
118.171
118.017
117.114
117.093
77.941
73.242
69.153
36.371
21.708
0.496
1
0.505
ppm
200
180
160
140
120
100
80
60
40
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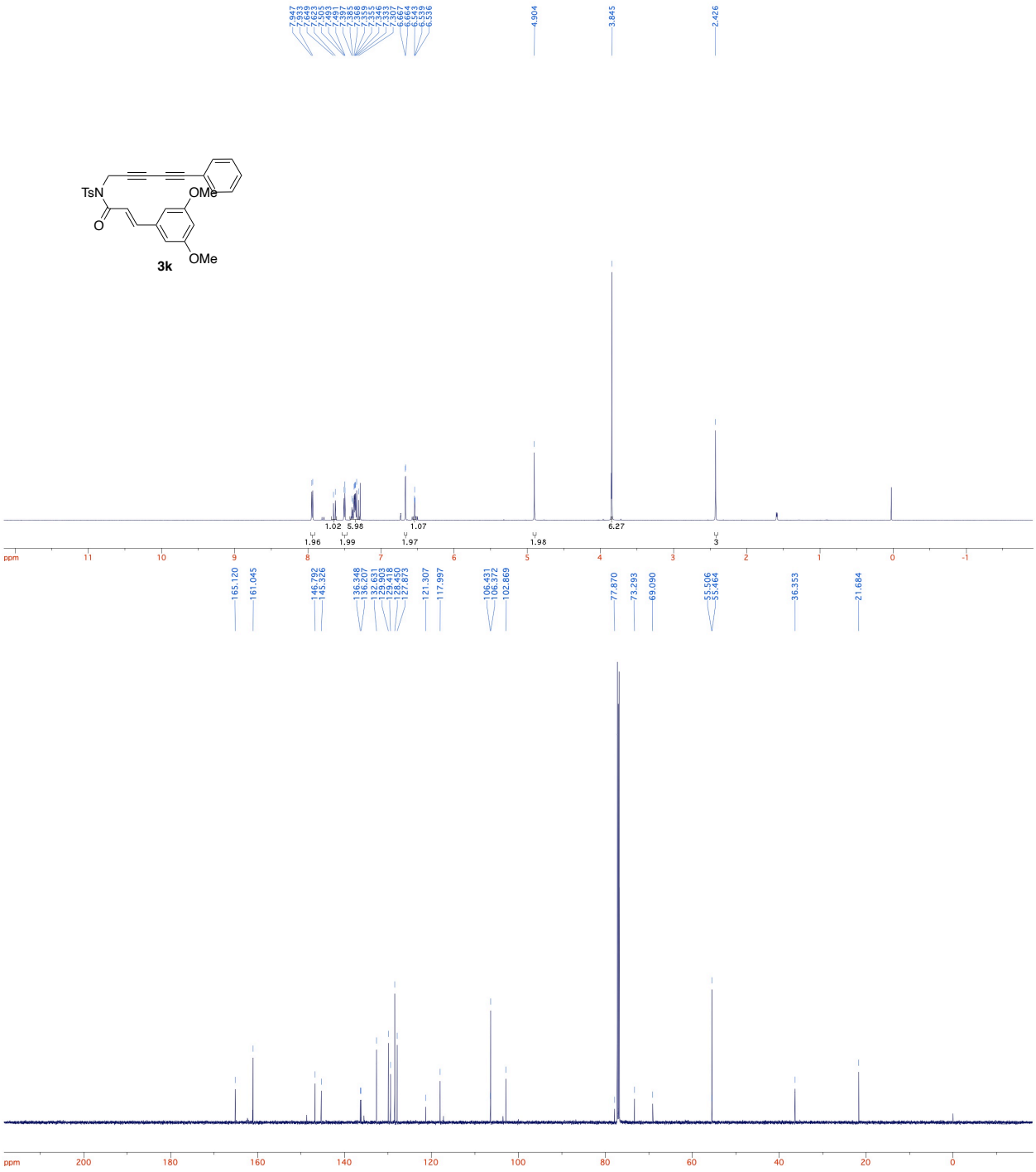
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7.303
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6.539
6.536
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3.845
2.426
TsN
O
OMe
OMe
3k
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1.07
6.27
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1.99
1.97
1.98
3
ppm
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135.631
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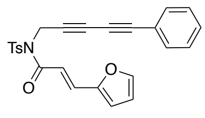
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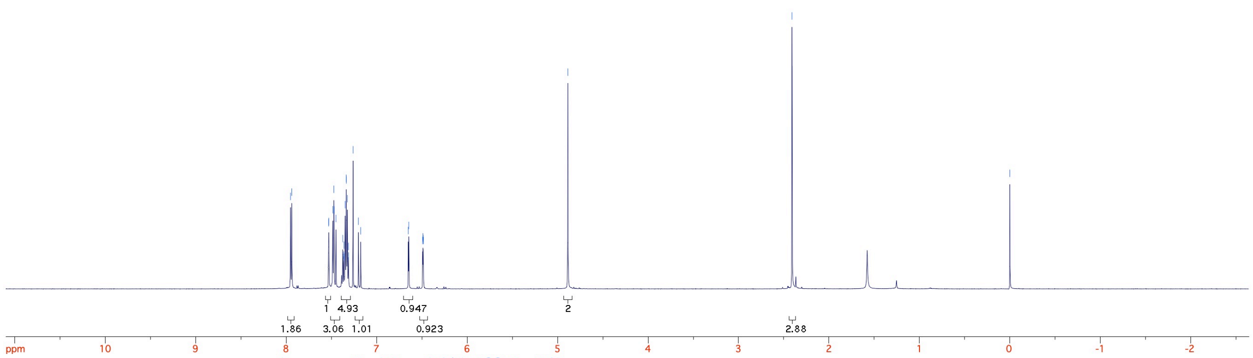
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7.203
7.178
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6.646
6.492
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6.487
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4.887
2.409
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3.06
4.93
1.01
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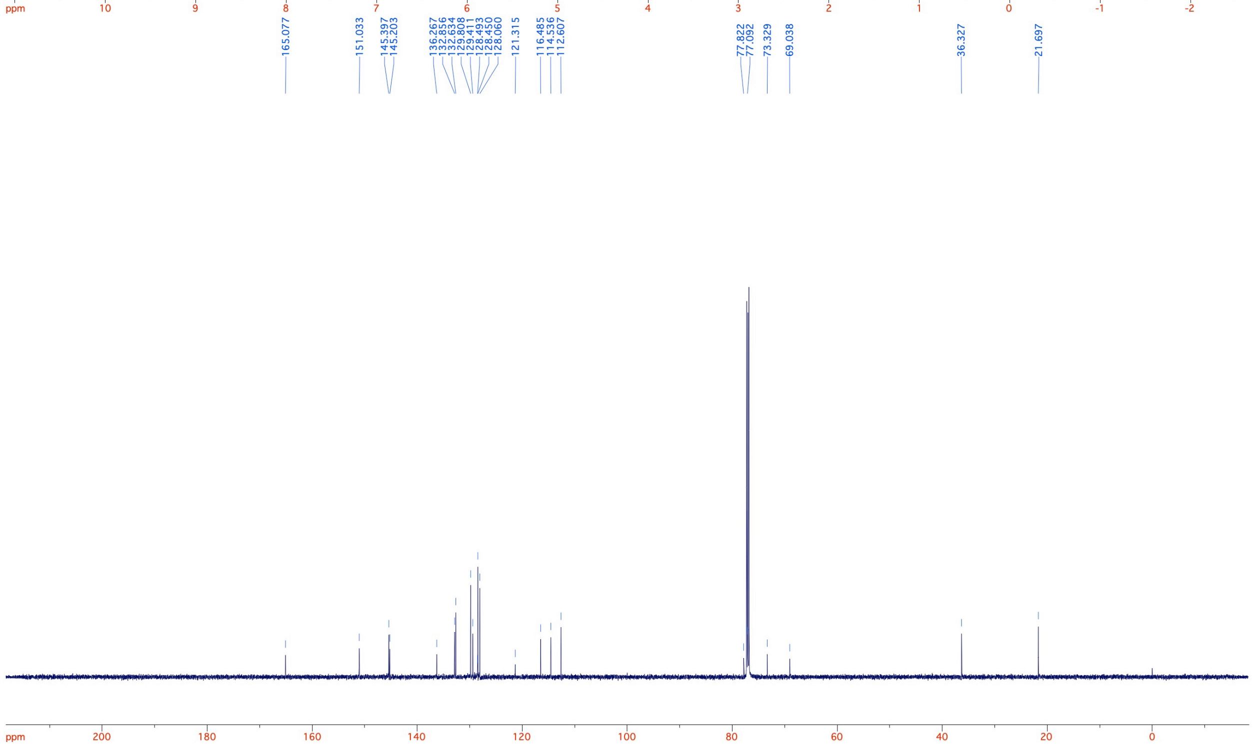
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114.536
112.607
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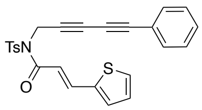
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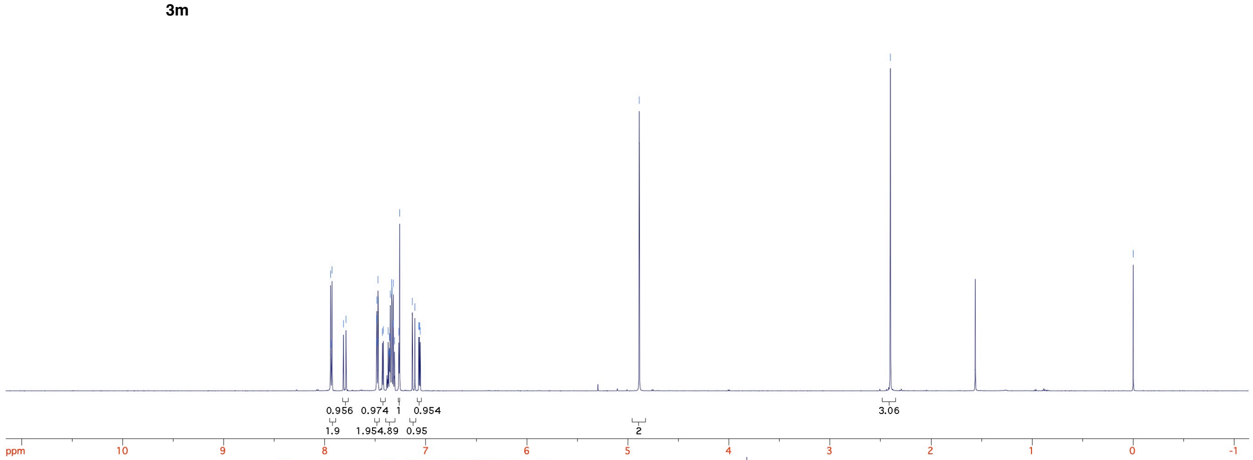
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7.336
7.334
7.324
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7.266
7.259
7.133
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7.063
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0.974
1
0.954
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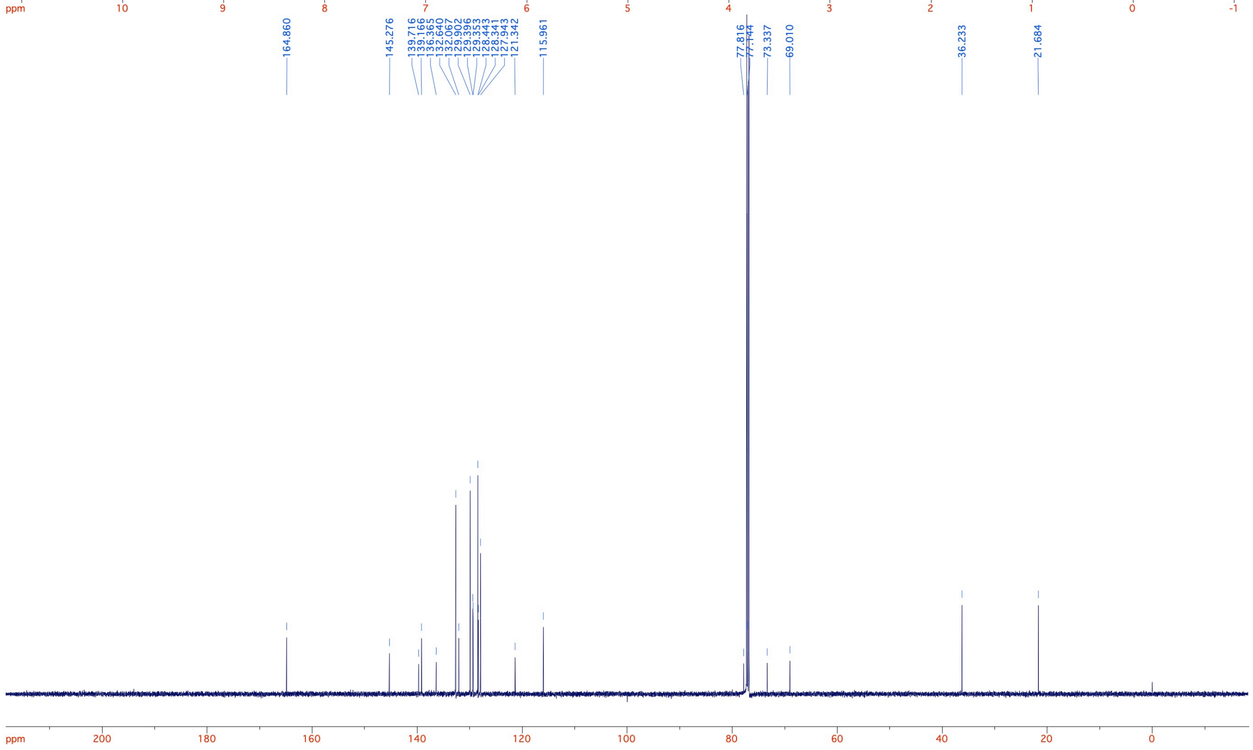
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121.342
115.961
77.816
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36.233
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ppm
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140
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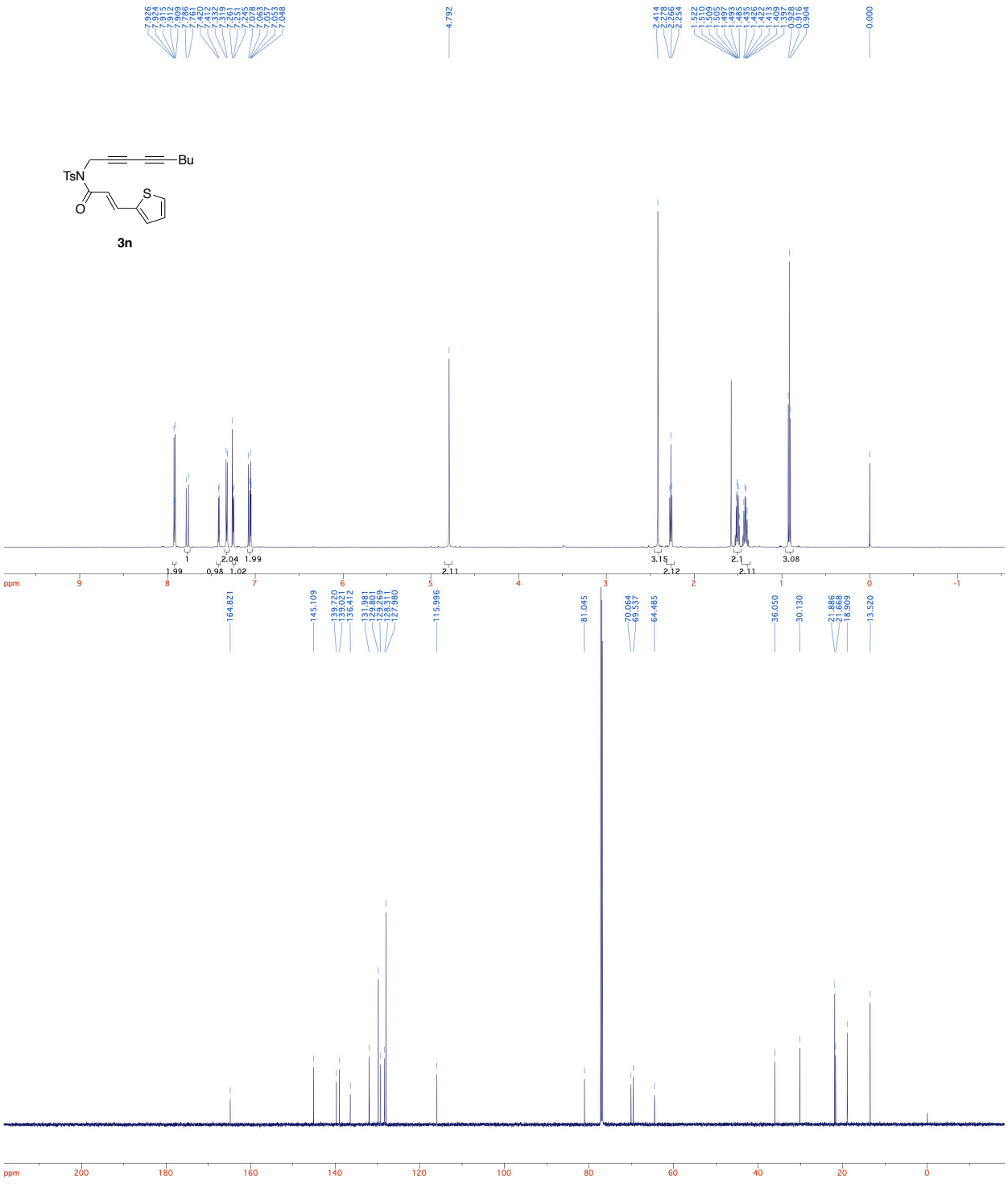
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7.251
7.245
7.078
7.068
7.057
7.048
4.792
2.414
2.278
2.266
2.254
1.522
1.510
1.509
1.505
1.497
1.493
1.485
1.455
1.426
1.422
1.413
1.409
1.397
1.328
0.916
0.904
0.000
TsN
O
S
Bu
3n
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1
2.04
1.99
0.98
1.02
2.11
3.15
2.12
2.1
2.11
3.08
ppm
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139.021
136.412
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129.269
128.131
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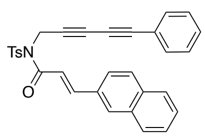
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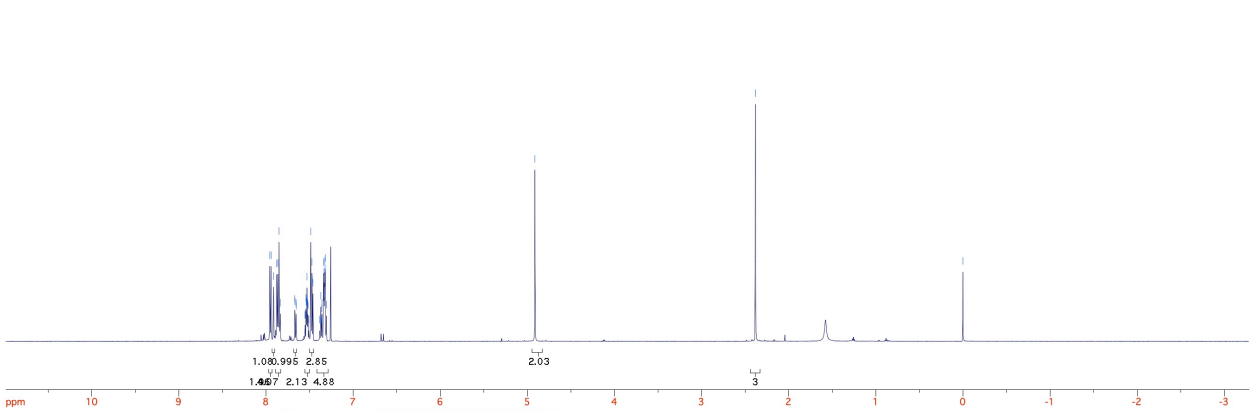
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7.552
7.550
7.540
7.538
7.533
7.529
7.525
7.520
7.518
7.508
7.486
7.472
7.470
7.461
7.382
7.374
7.370
7.366
7.359
7.357
7.339
7.333
7.329
7.325
7.321
7.320
7.307
4.913
2.382
0.000
1.08
0.995
2.85
2.03
1.46
4.07
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4.88
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ppm
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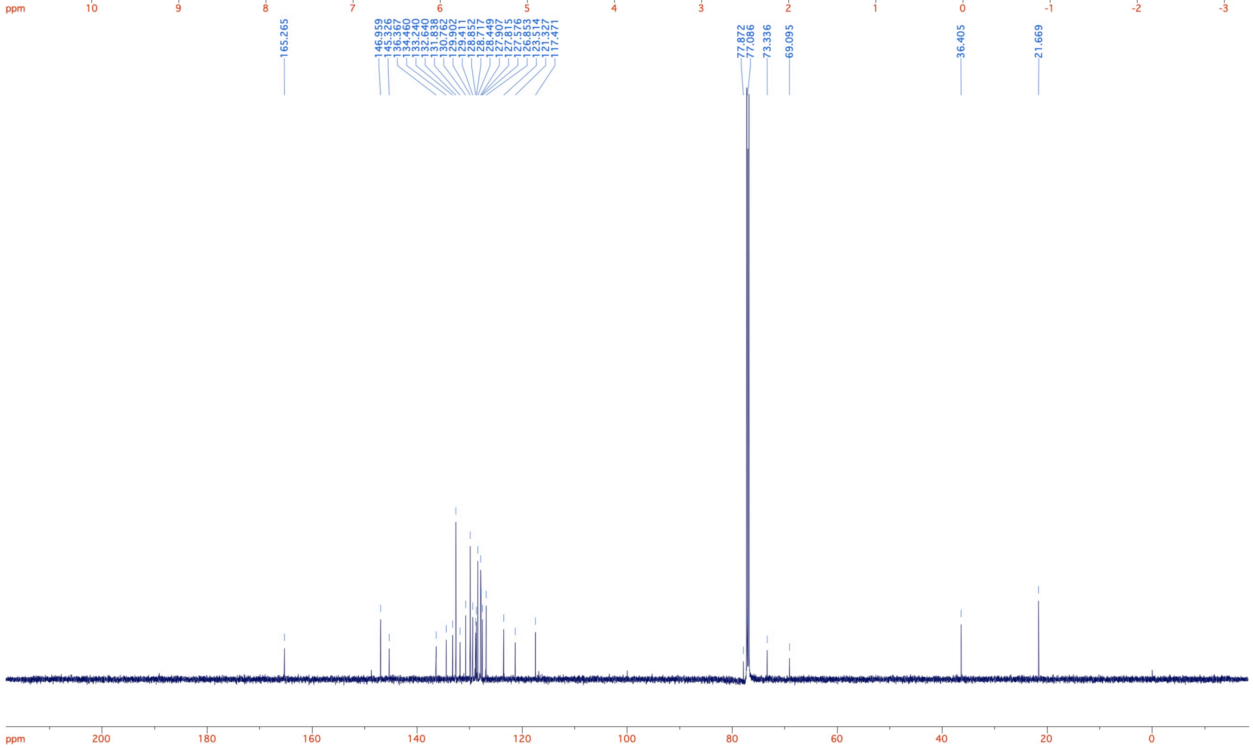
-3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129.411
128.852
128.717
128.449
127.907
127.815
127.576
126.853
123.514
121.327
117.471
77.872
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36.405
21.669
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60
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20
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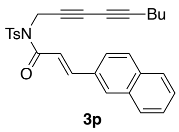

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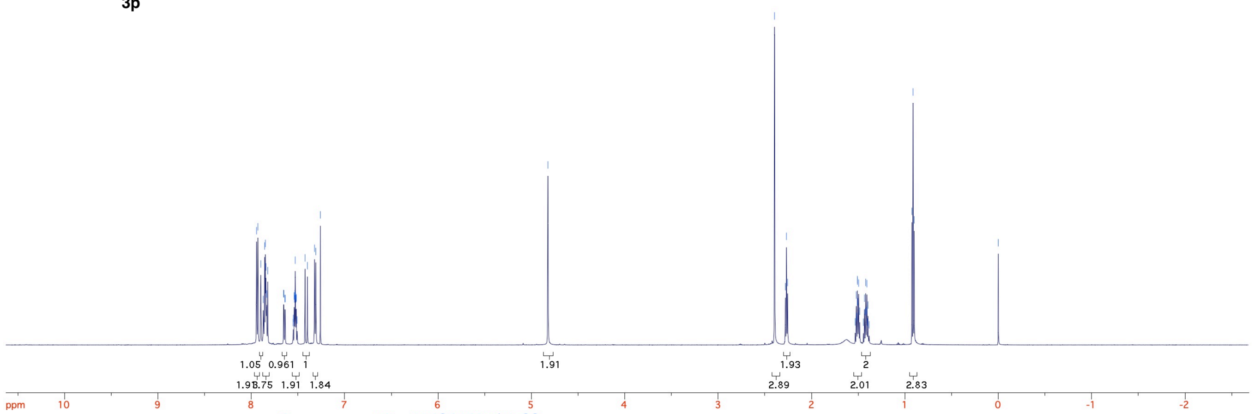

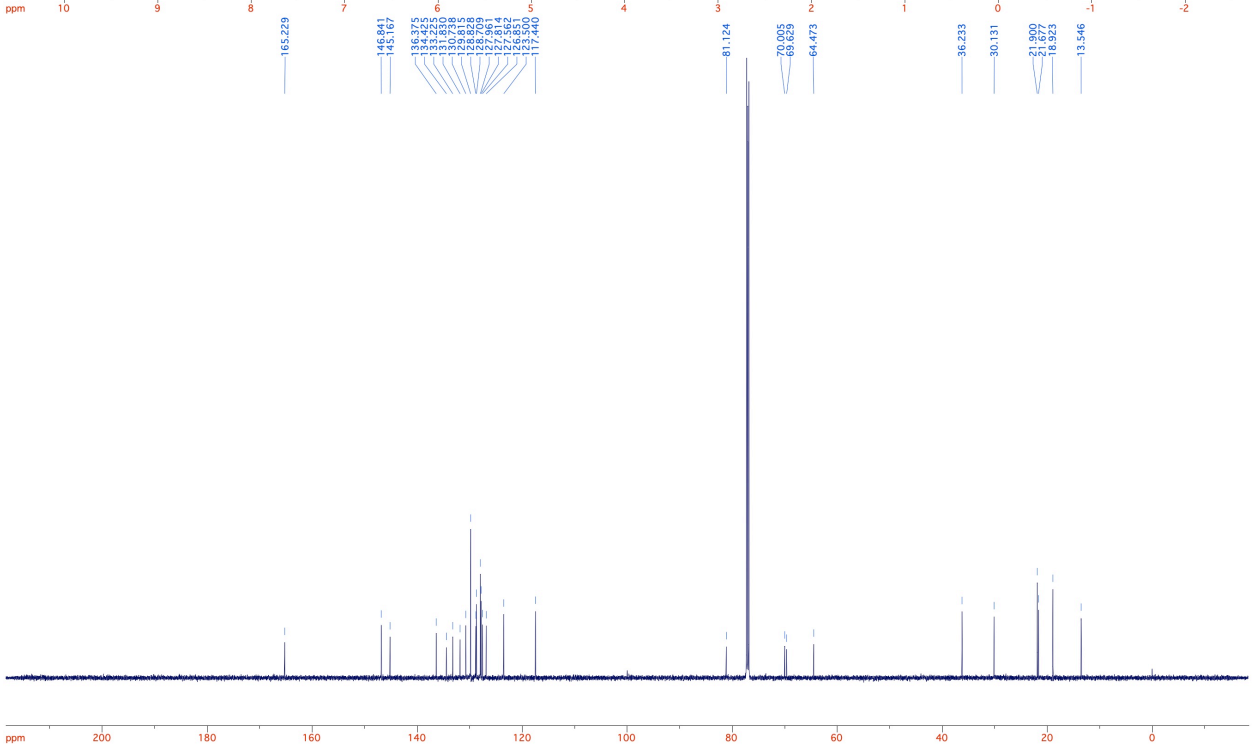

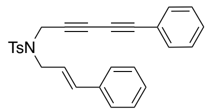
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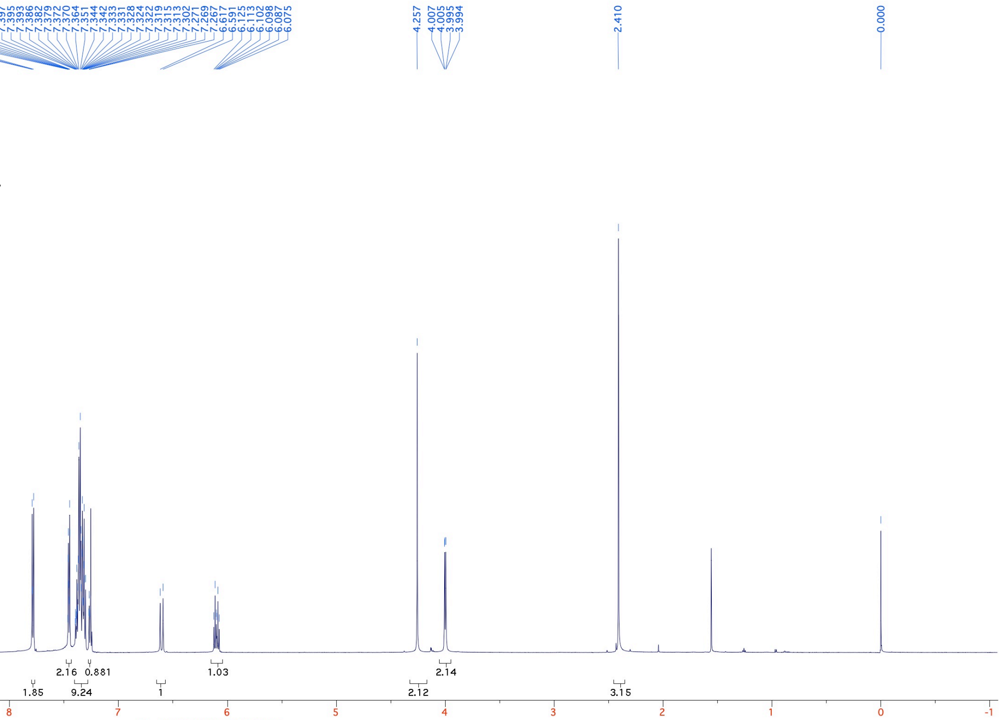
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7.393
7.386
7.382
7.379
7.372
7.370
7.364
7.351
7.344
7.342
7.333
7.331
7.328
7.324
7.322
7.319
7.315
7.313
7.302
7.271
7.269
7.267
6.617
6.591
6.125
6.113
6.102
6.098
6.087
6.075
4.257
4.007
4.005
3.995
3.994
2.410
0.000
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2.16
9.24
0.881
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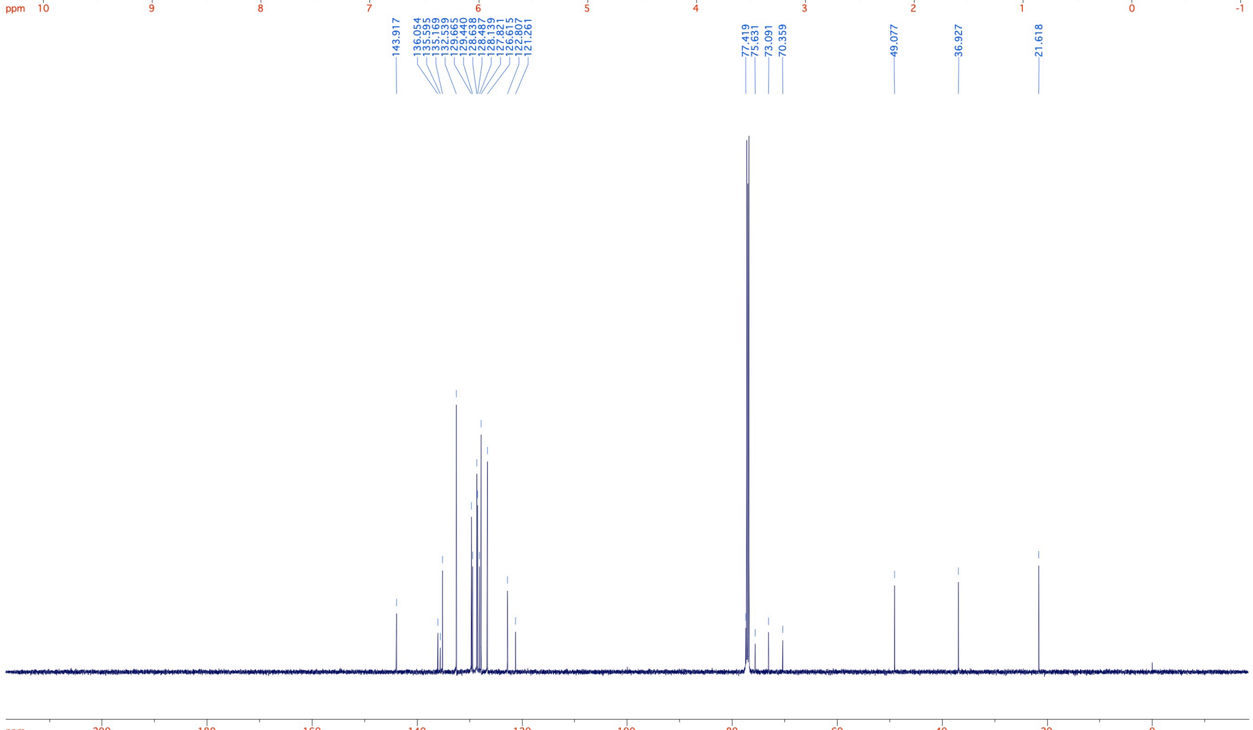
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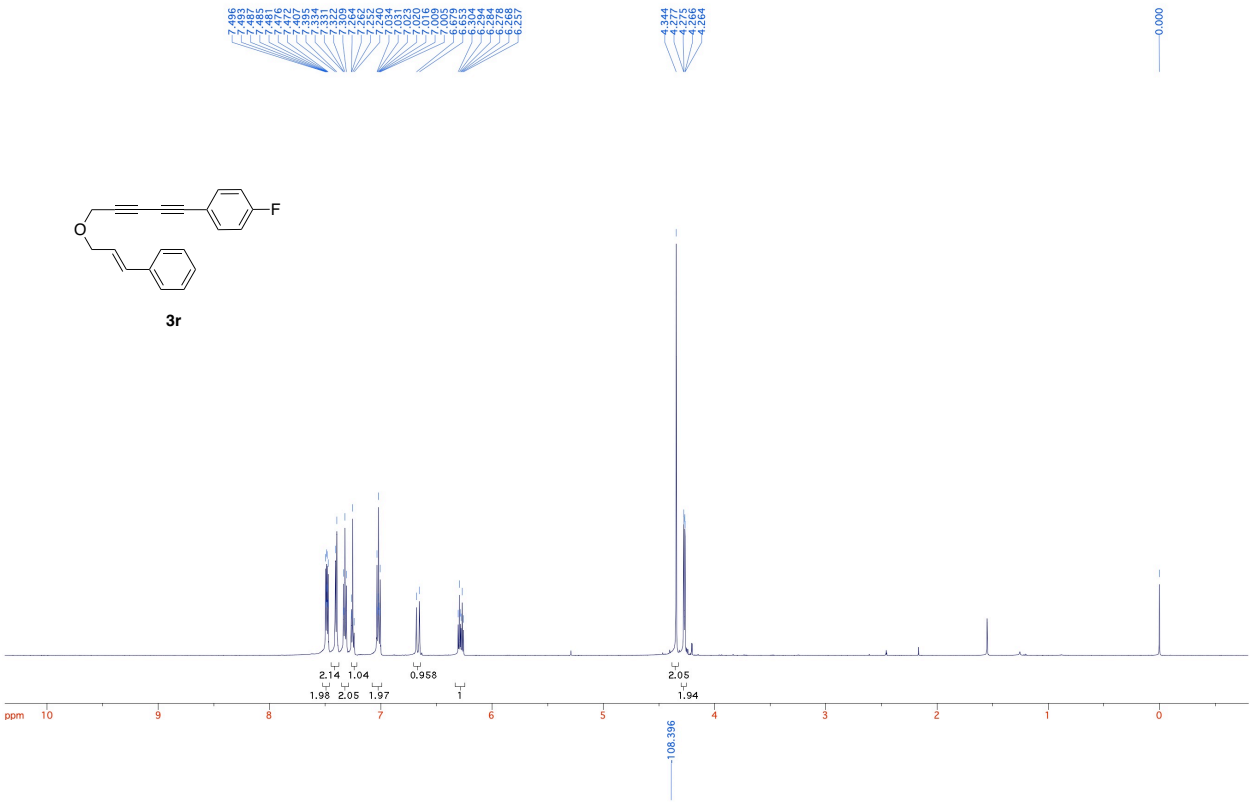
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7.250
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7.016
7.005
6.653
6.304
6.284
6.278
6.269
6.257
4.344
4.337
4.275
4.266
4.264
0.000
F
O
3r
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1.04
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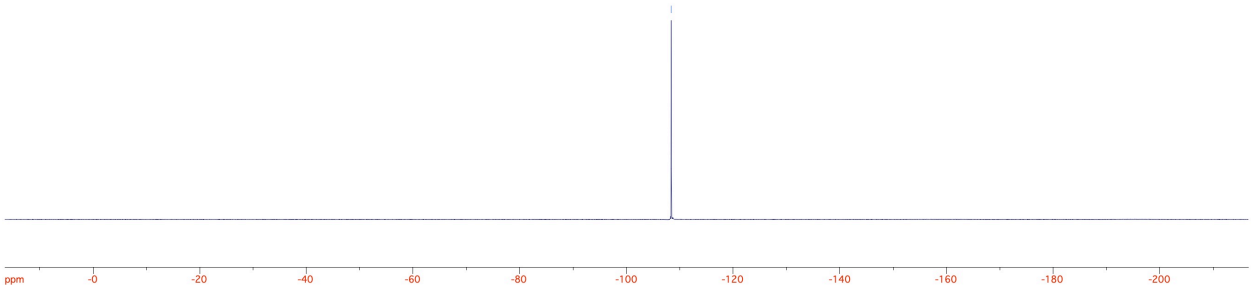
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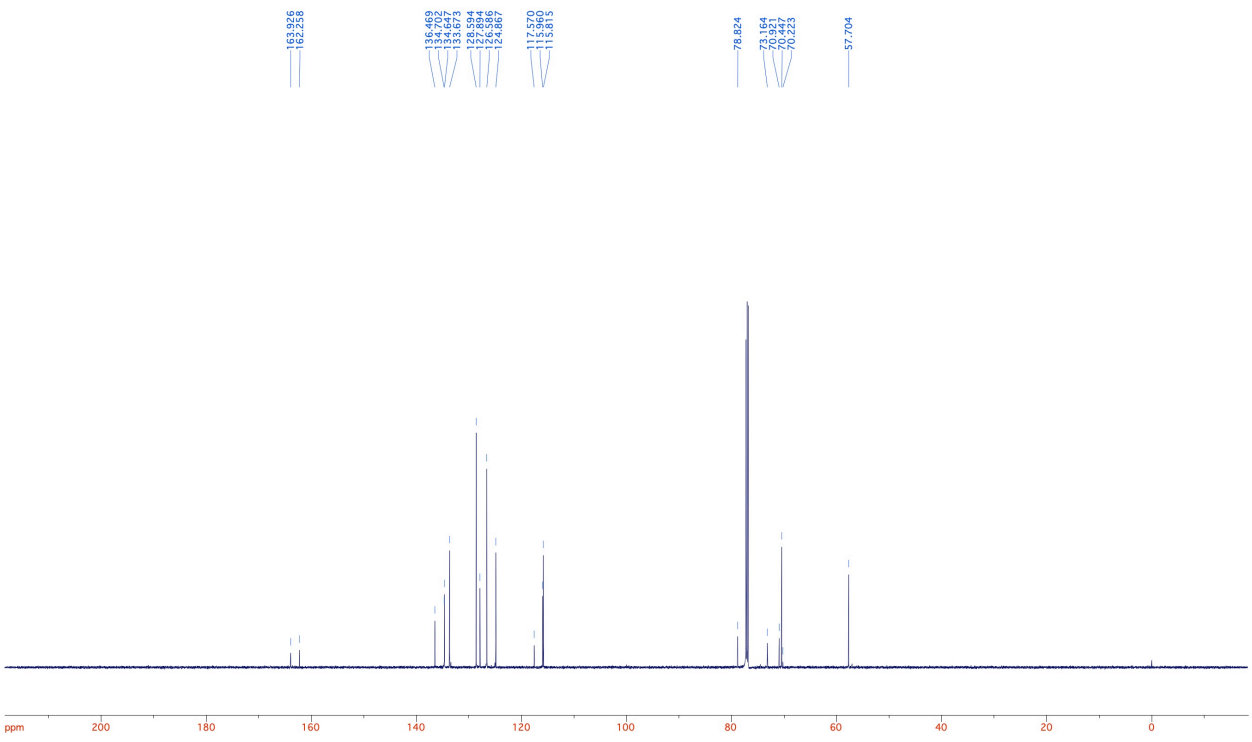
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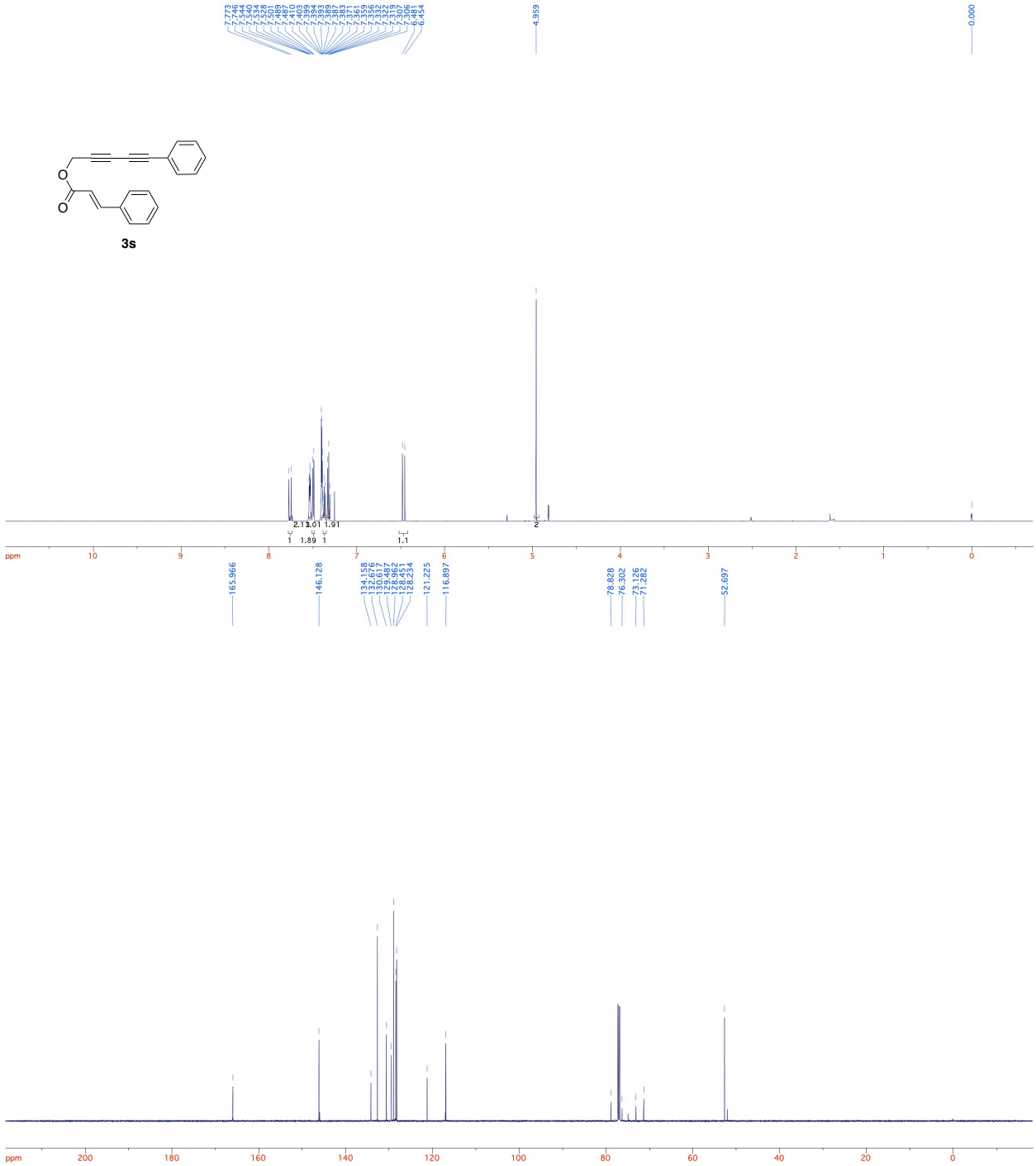
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7.387
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1
1.89
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1.1
2
ppm
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8
7
6
5
4
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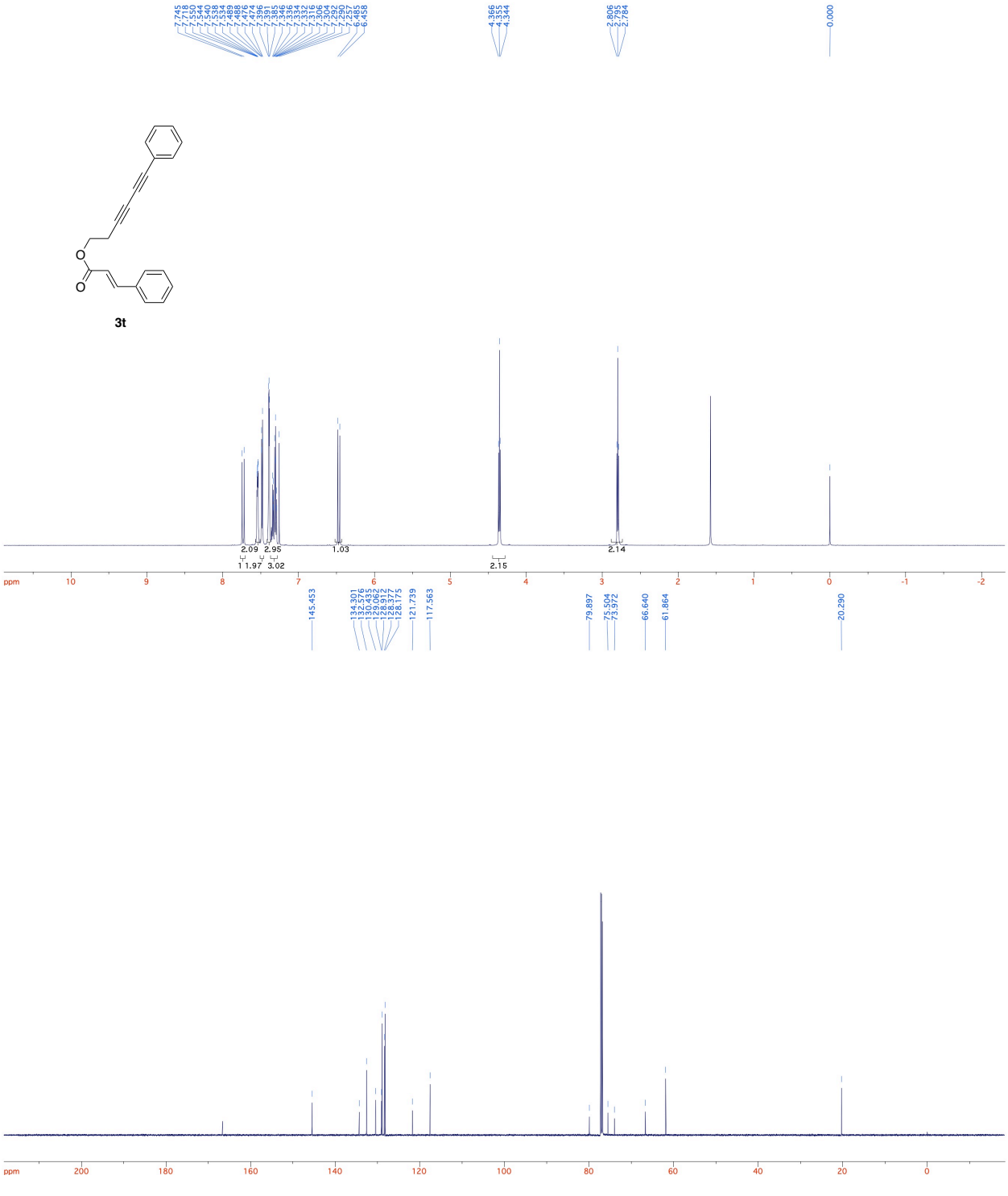
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7.292
7.290
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6.458
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4.355
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2.784
0.000
O
O
3t
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2.95
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1.03
2.15
2.14
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120
100
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20
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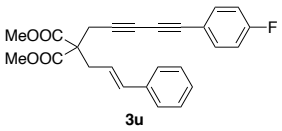
MeOOC
MeOOC
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3u

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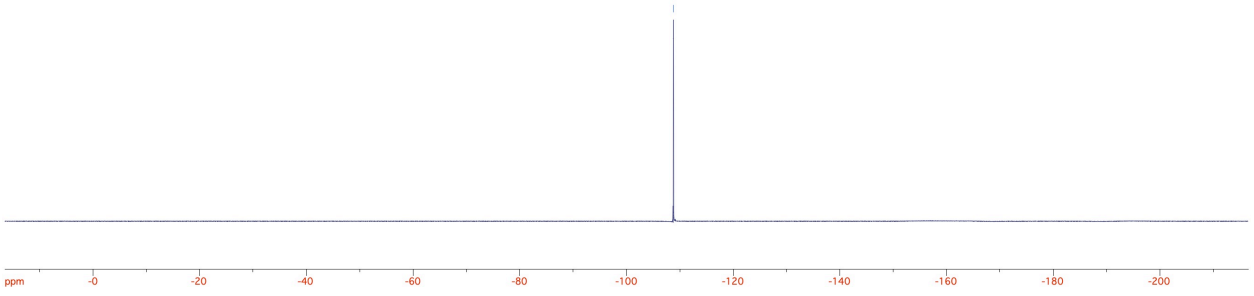
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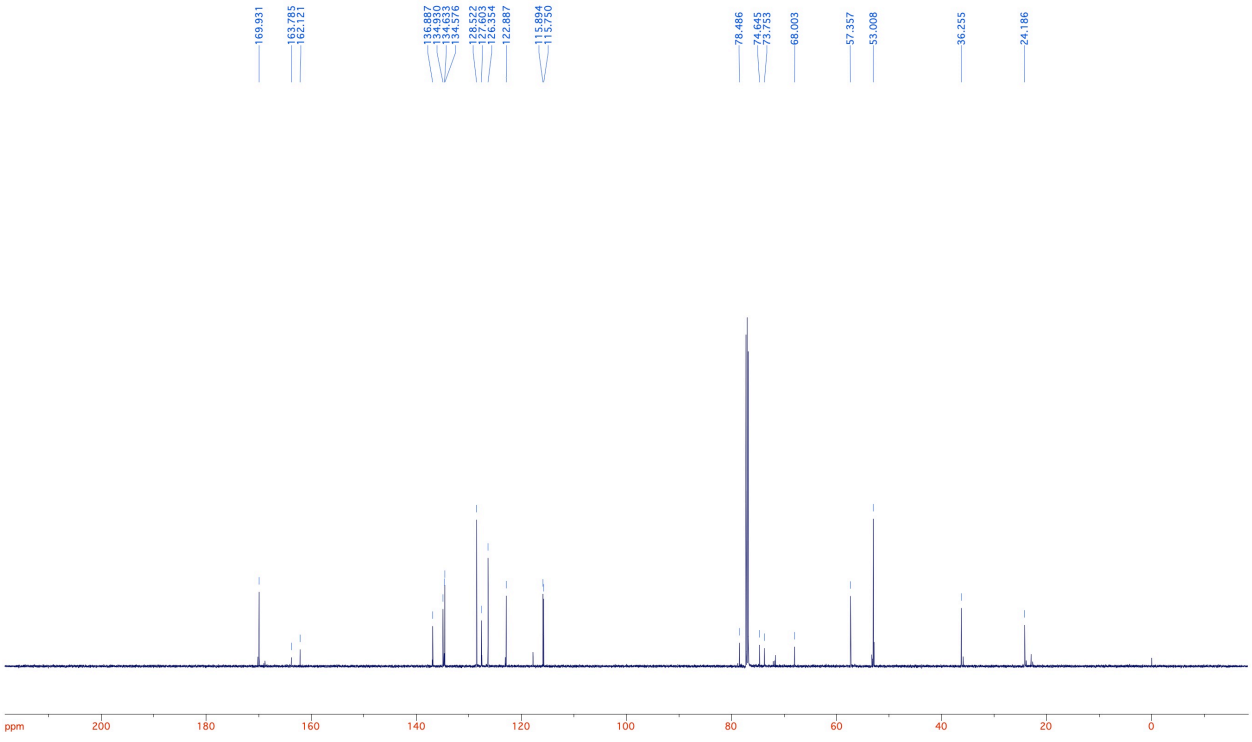
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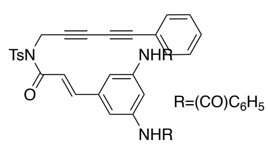
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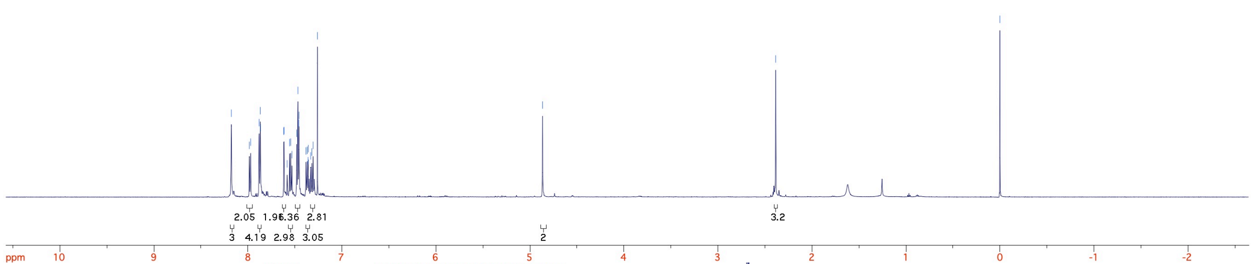
NHR
O
NHR
R=(CO)C$_6$H$_5$

3v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7.468
7.456
7.382
7.368
7.360
7.357
7.332
7.319
7.306
7.260
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1.96
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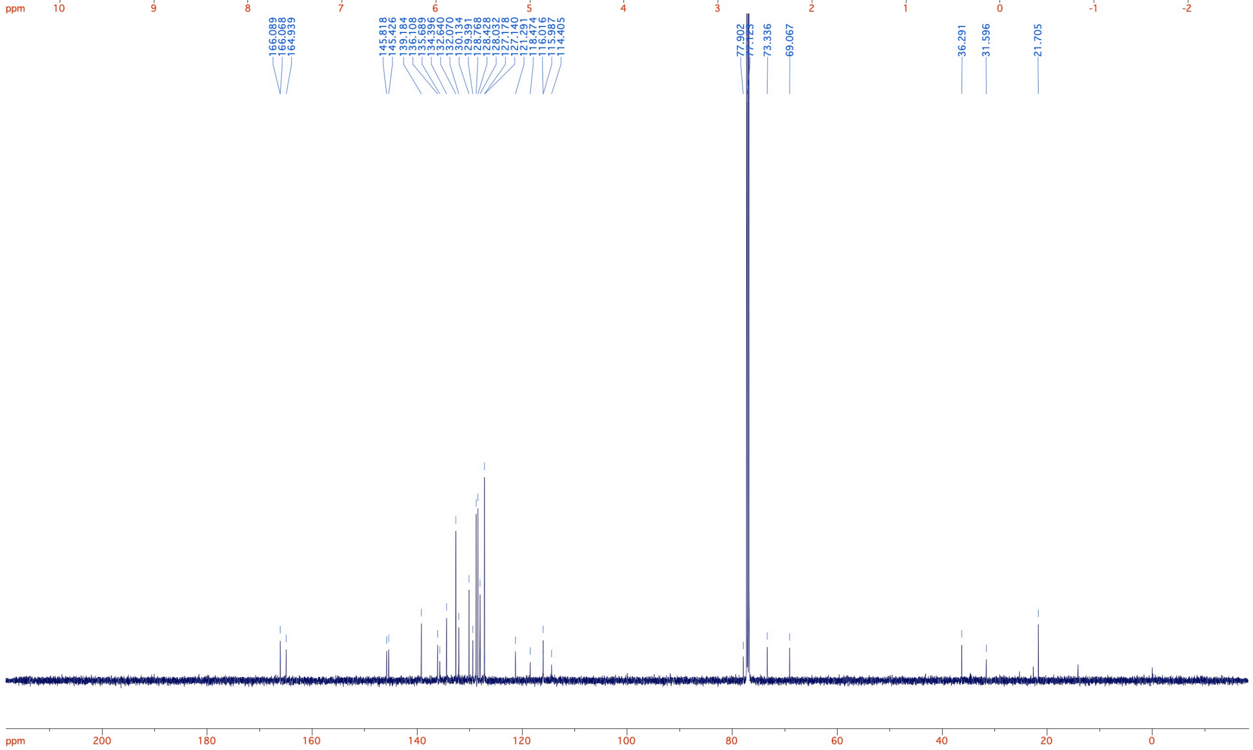
-2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115.987
114.405
77.902
77.123
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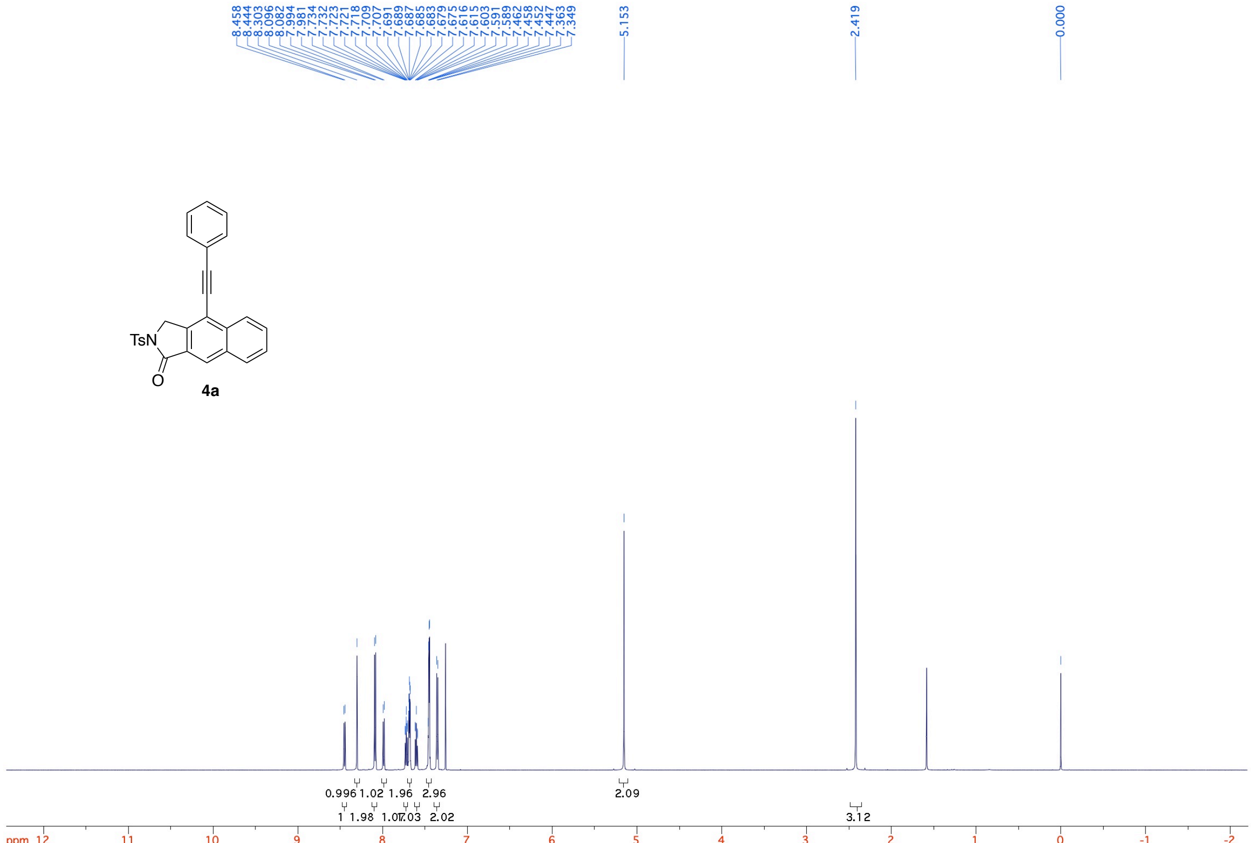
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2.96
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1.98
1.07
1.03
2.02
2.09
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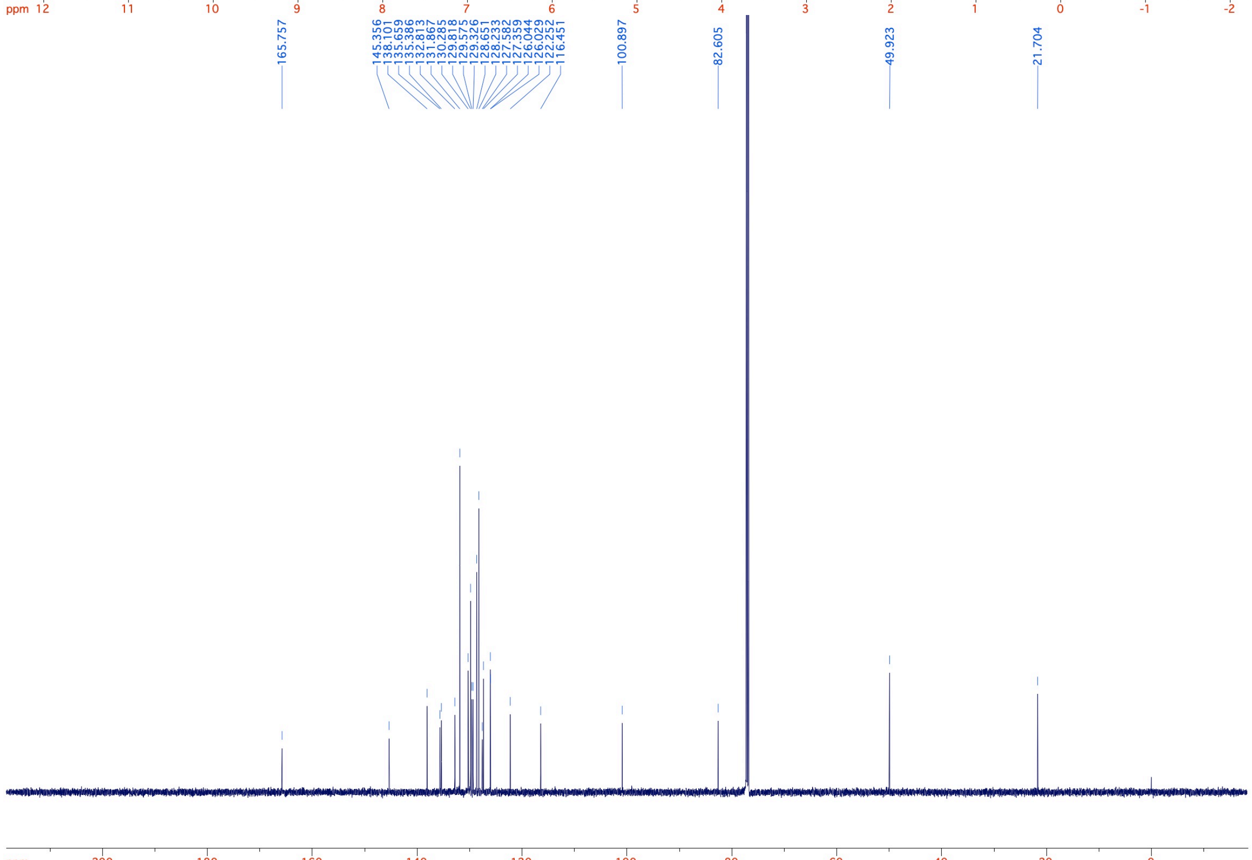
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128.233
127.582
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122.252
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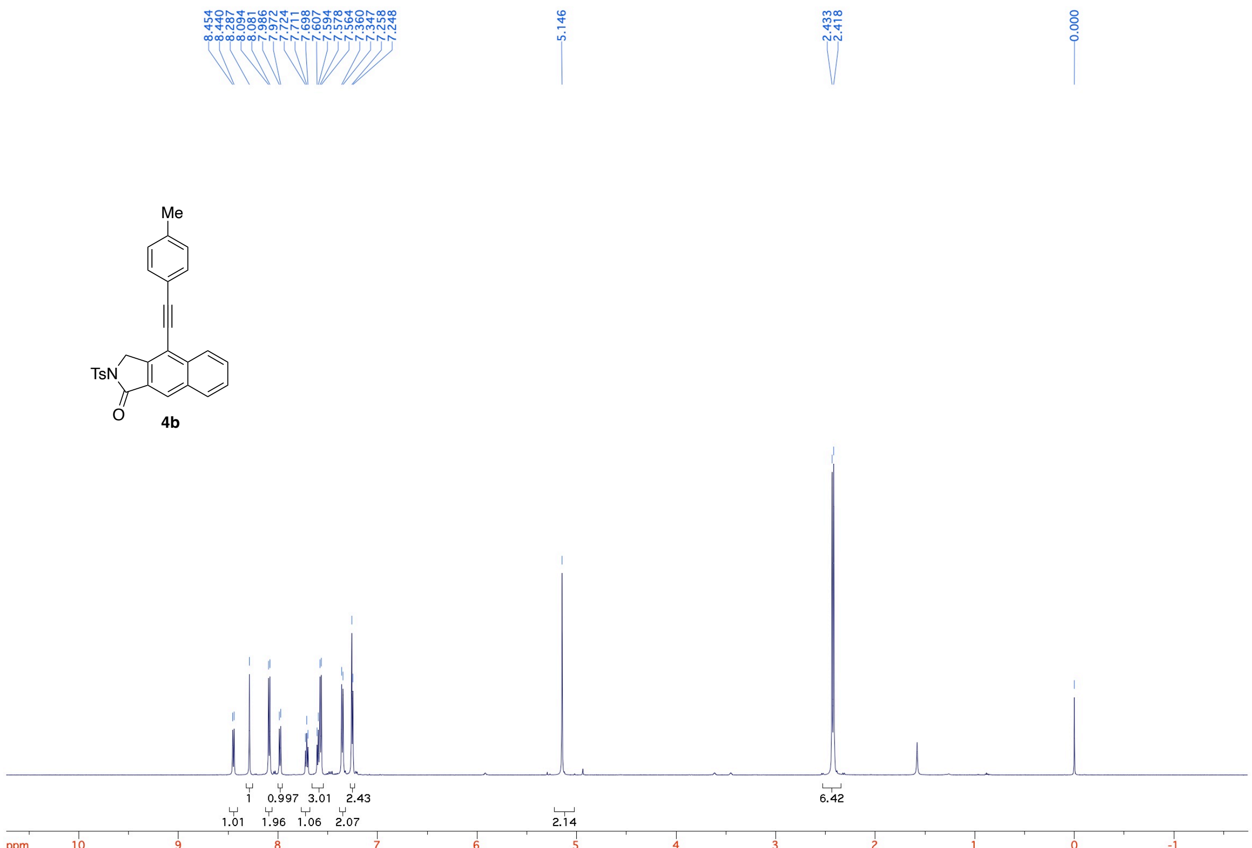
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TsN
O
4b
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7.698
7.607
7.594
7.578
7.564
7.360
7.347
7.258
7.248
5.146
2.433
2.418
0.000
1
1.01
0.997
1.96
3.01
1.06
2.43
2.07
2.14
6.42
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5
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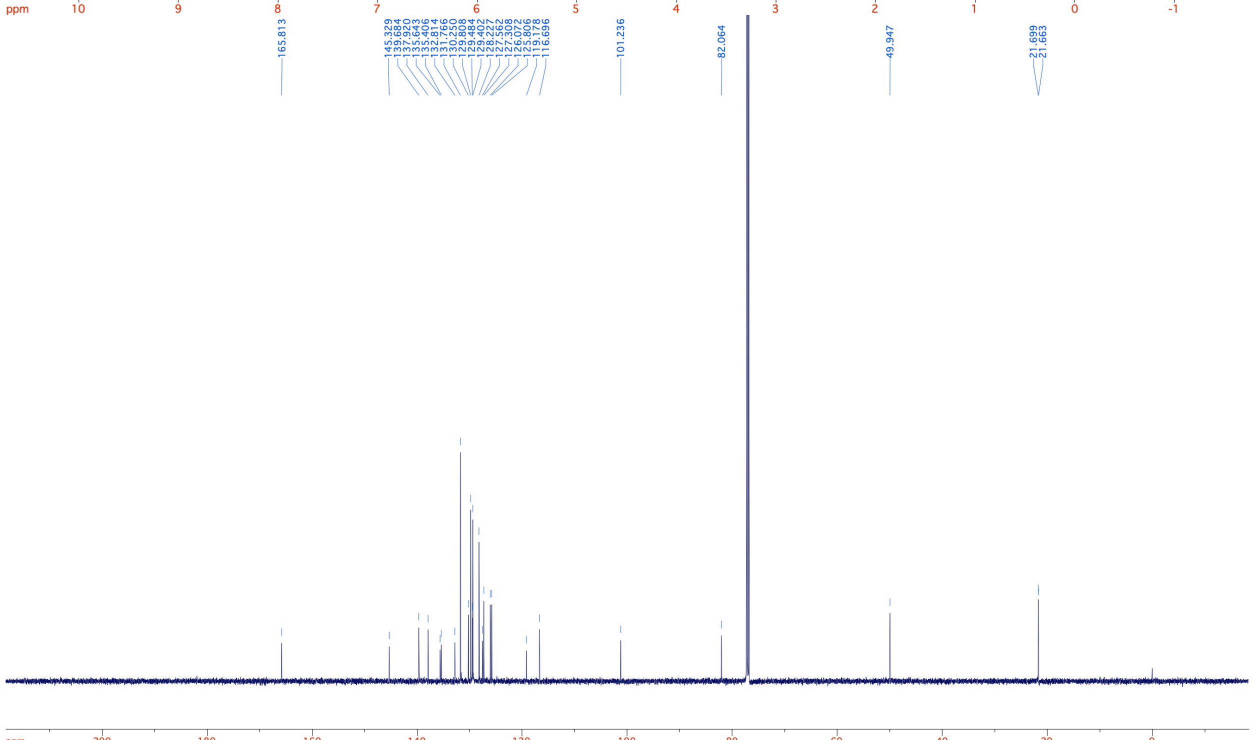
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128.227
127.562
127.308
126.072
125.806
119.178
116.696
101.236
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49.947
21.699
21.663
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140
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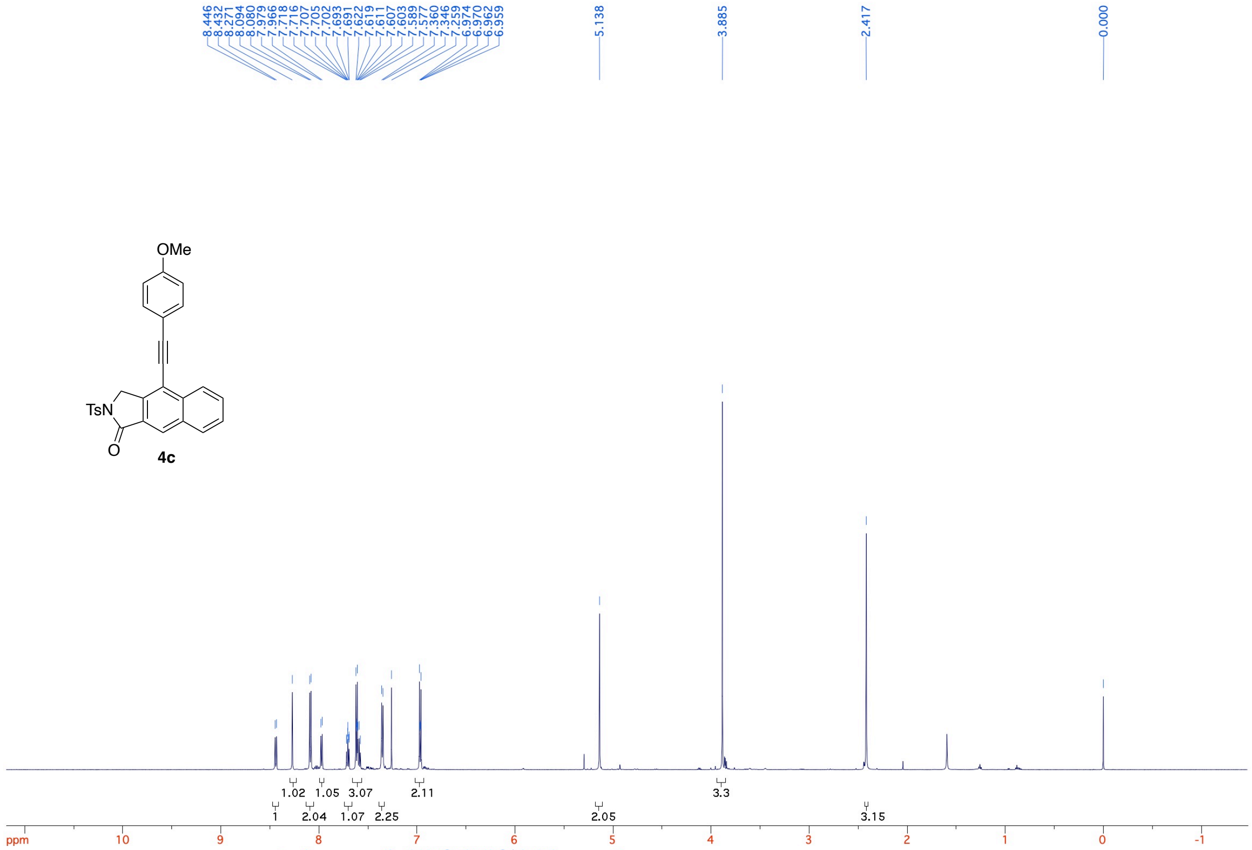
20
0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7.693
7.691
7.622
7.619
7.611
7.607
7.603
7.589
7.577
7.360
7.346
7.259
6.974
6.970
6.962
6.959
5.138
3.885
2.417
0.000
OMe
TsN
O
4c
1.02
1.05
3.07
2.11
3.3
1
2.04
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5
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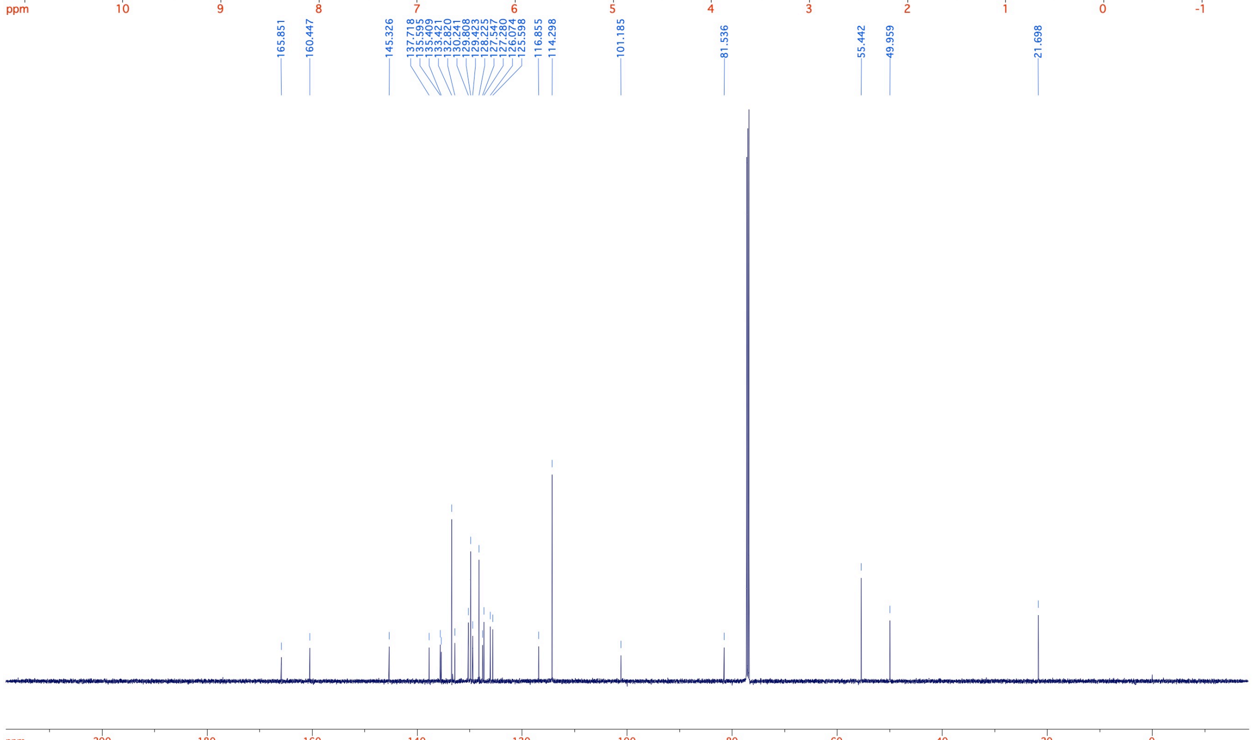
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127.547
127.280
126.074
125.598
116.855
114.298
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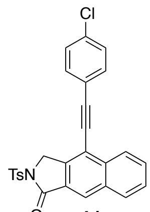
Cl
TsN
O

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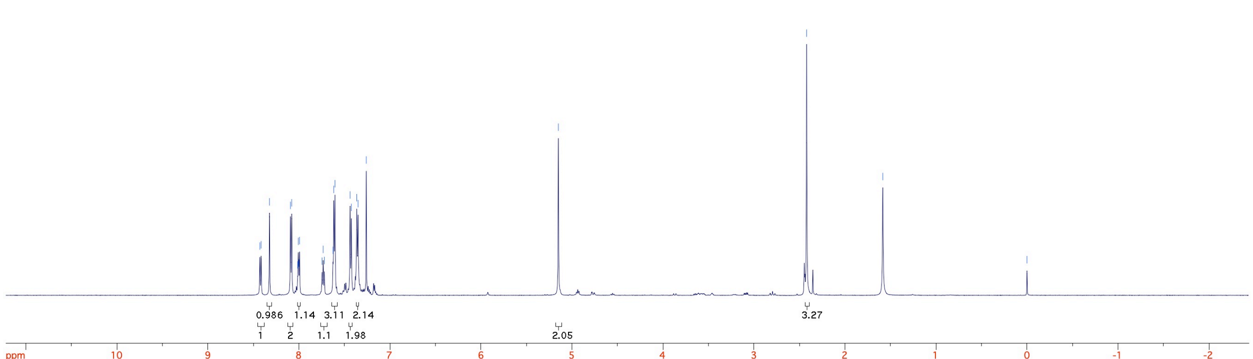
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8.001
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7.721
7.626
7.618
7.604
7.438
7.424
7.365
7.351
7.260
5.150
2.422
1.584
0.000
0.986
1.14
3.11
2.14
1
2
1.1
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ppm
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4
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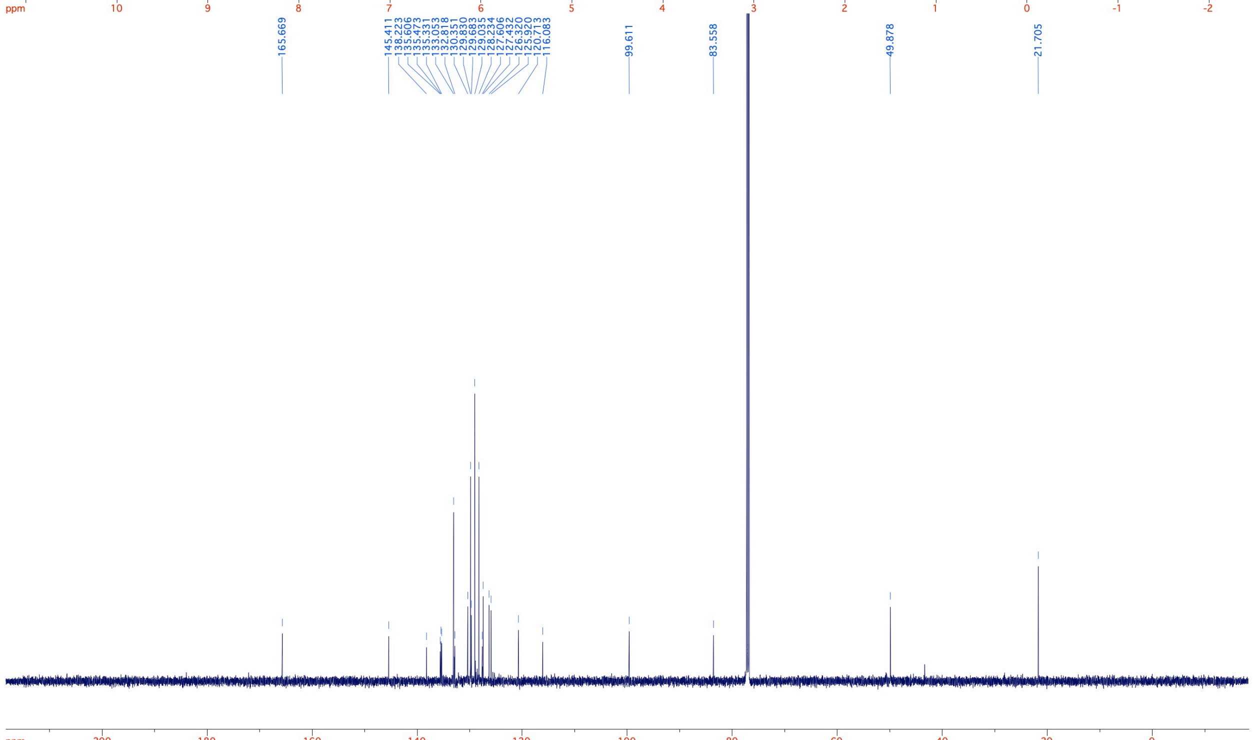
-2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128.234
127.606
127.432
126.320
125.920
120.713
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49.878
21.705
ppm
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140
120
100
80
60
40
20
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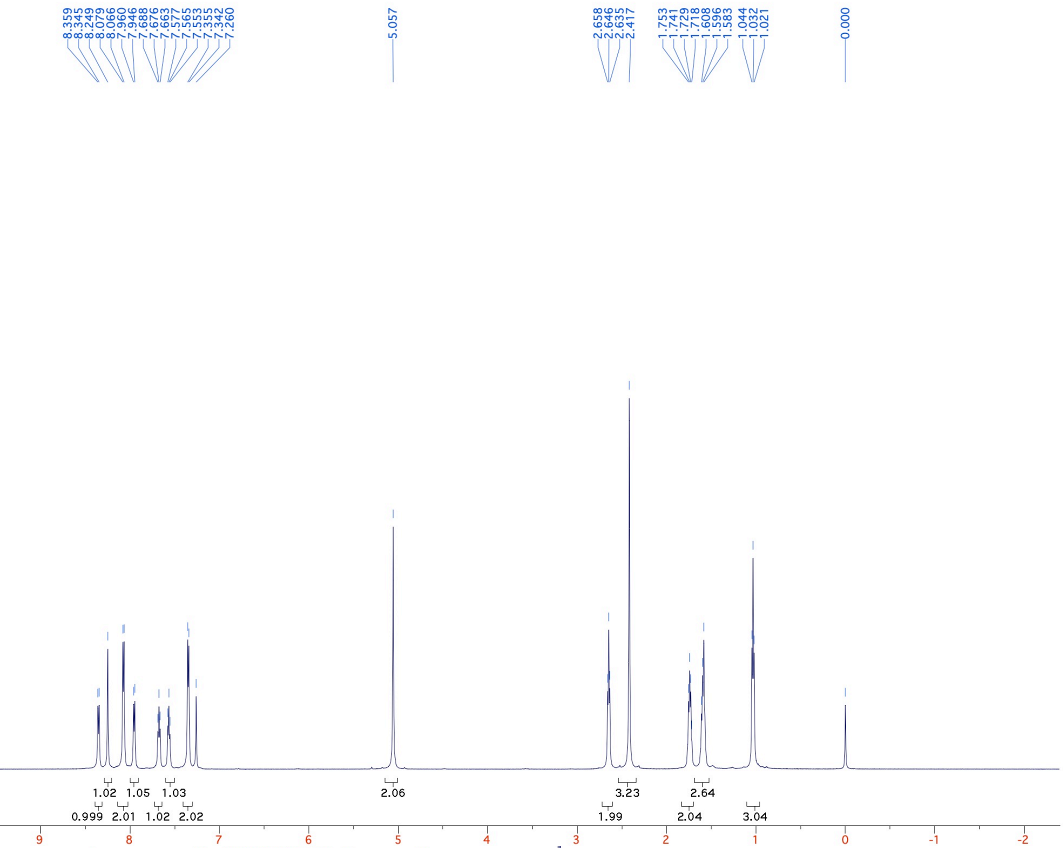
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7.946
7.688
7.676
7.663
7.577
7.565
7.553
7.355
7.342
7.260
5.057
2.658
2.646
2.635
2.417
1.753
1.741
1.729
1.718
1.608
1.596
1.583
1.044
1.032
1.021
0.000
1.02
1.05
1.03
2.06
3.23
2.64
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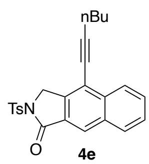
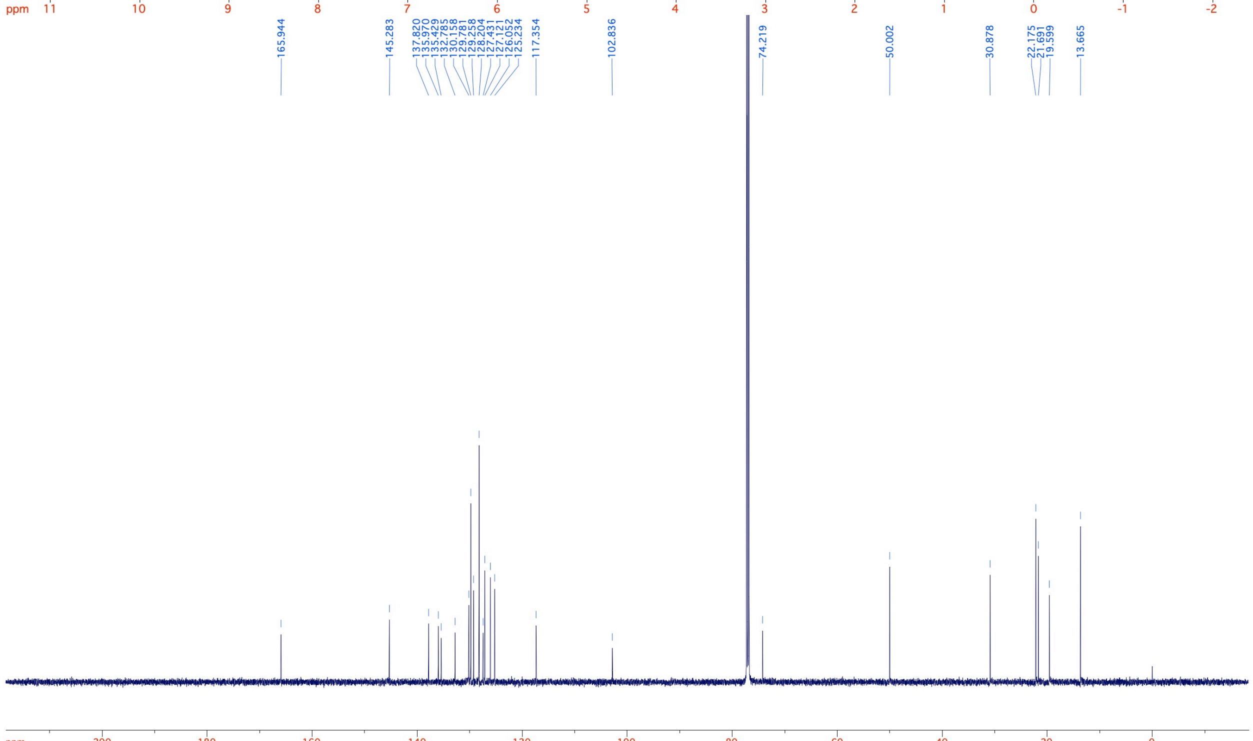
1.02
2.02
1.99
2.04
3.04
ppm


nBu
TsN
O

4e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129.781
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128.204
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127.121
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117.354
102.836
74.219
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22.175
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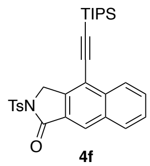
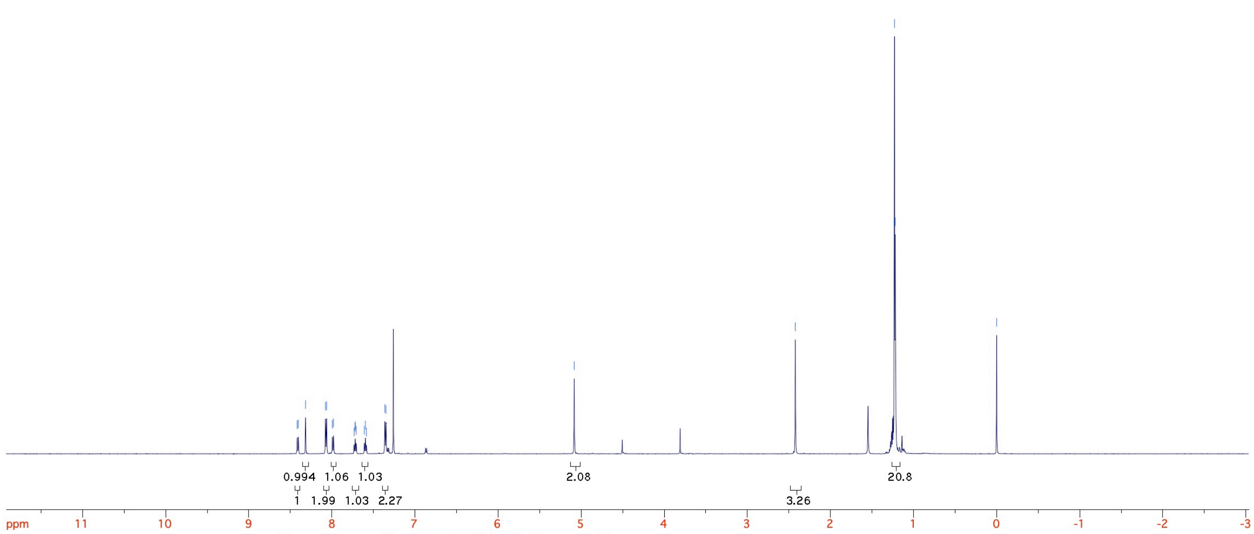
13.665
ppm


TIPS
TsN
O

4f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7.732
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7.719
7.707
7.609
7.596
7.584
7.363
7.349
5.083
2.423
1.229
1.220
0.000
0.994
1.06
1.03
2.08
20.8
1
1.99
1.03
2.27
3.26
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10
9
8
7
6
5
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3
2
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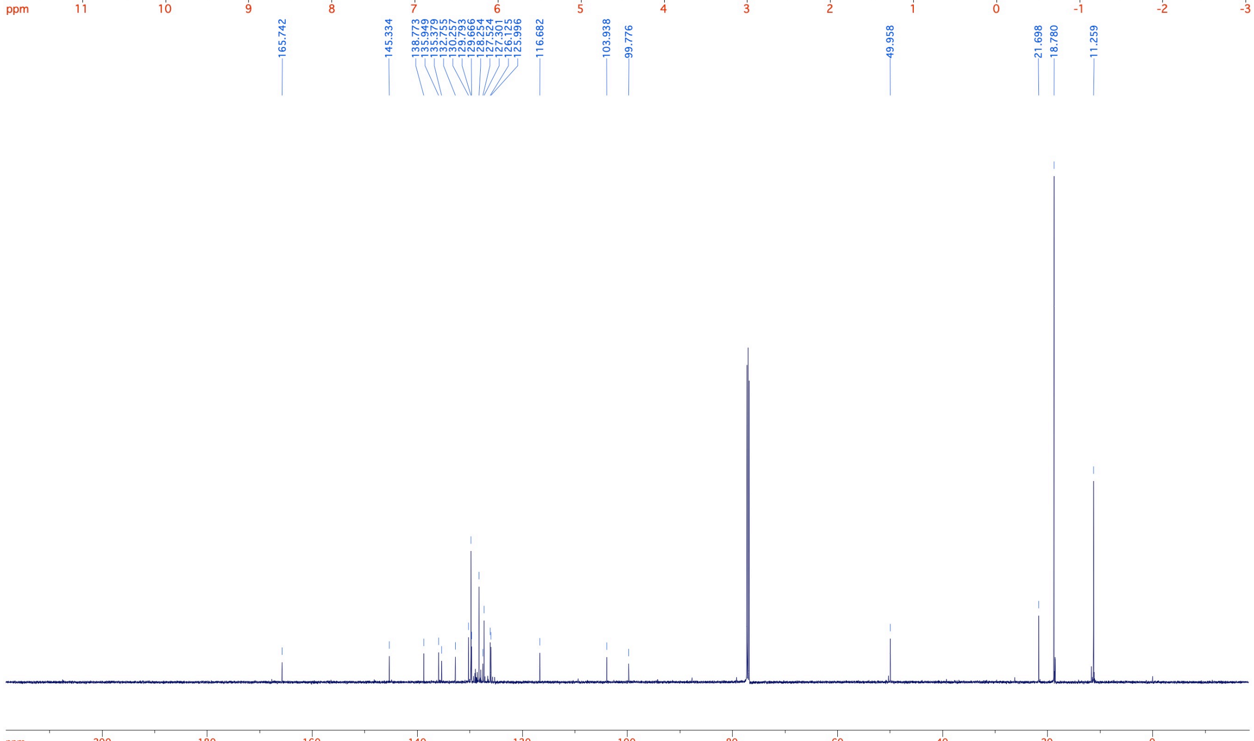
0
-1
-2
-3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129.793
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128.254
127.524
127.301
126.125
125.996
116.682
103.938
99.776
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18.780
11.259
ppm
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140
120
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80
60
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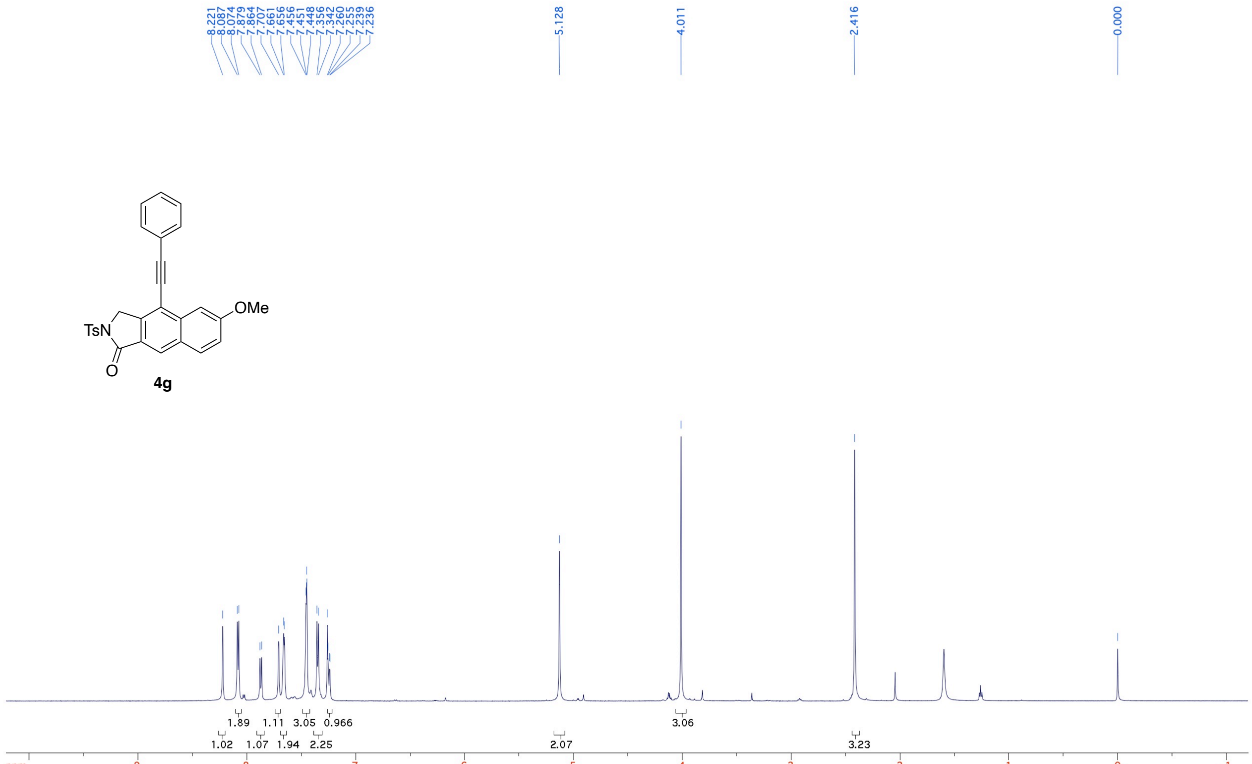
20
0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7.342
7.260
7.255
7.239
7.236
5.128
4.011
2.416
0.000
TsN
OMe
O
4g
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2.07
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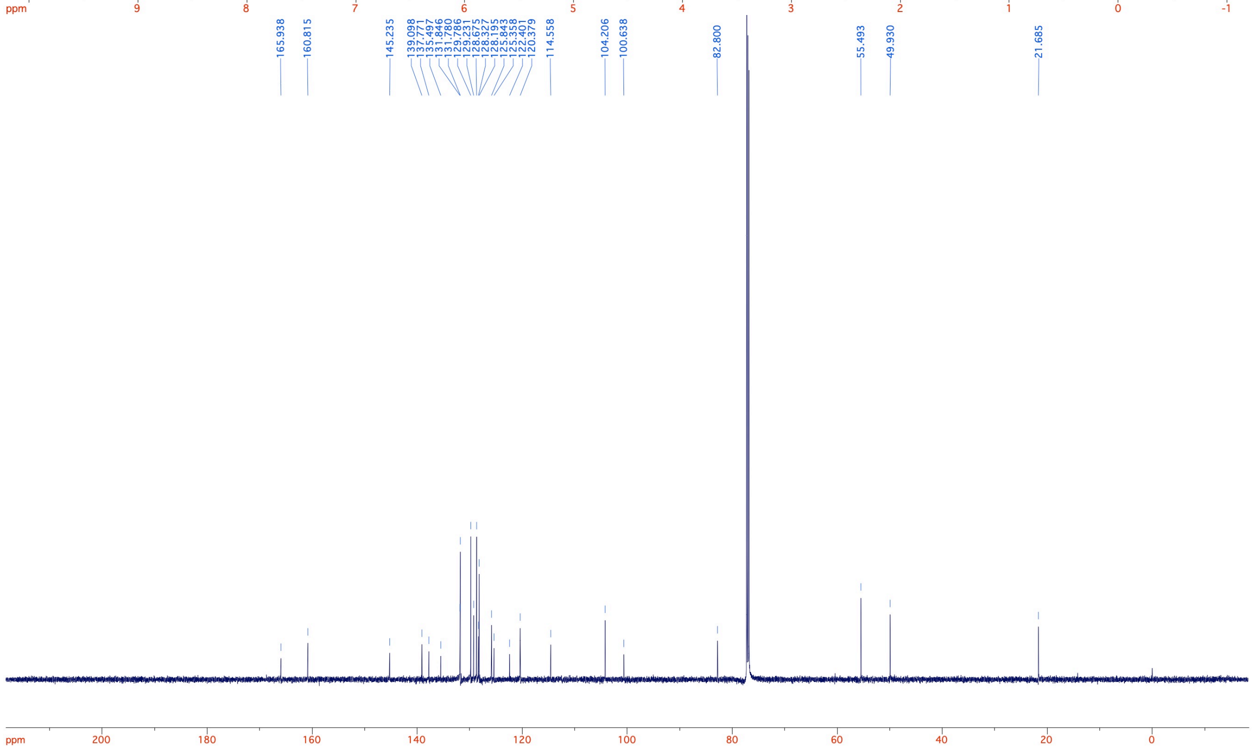
3.23
ppm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21.685
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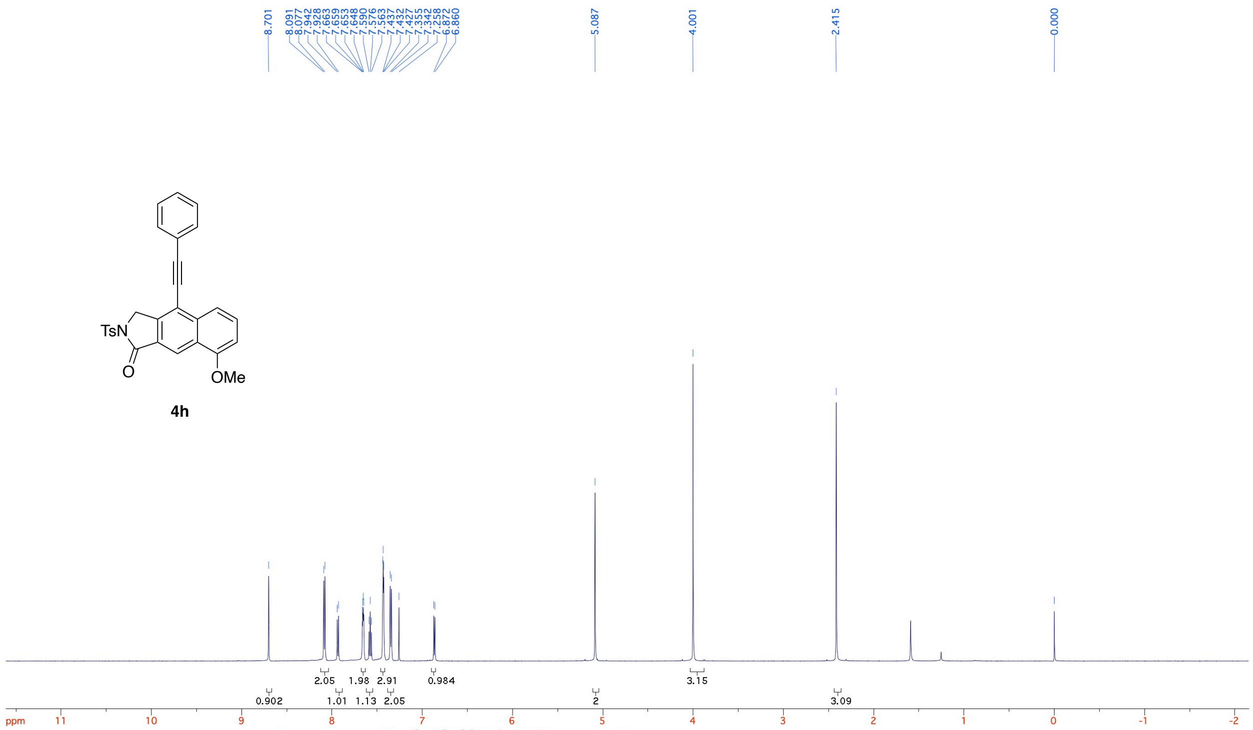
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O
OMe
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7.653
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7.576
7.563
7.437
7.432
7.427
7.355
7.342
7.258
6.872
6.860
5.087
4.001
2.415
0.000
2.05
1.98
2.91
0.984
3.15
0.902
1.01
1.13
2.05
2
3.09
ppm
11
10
9
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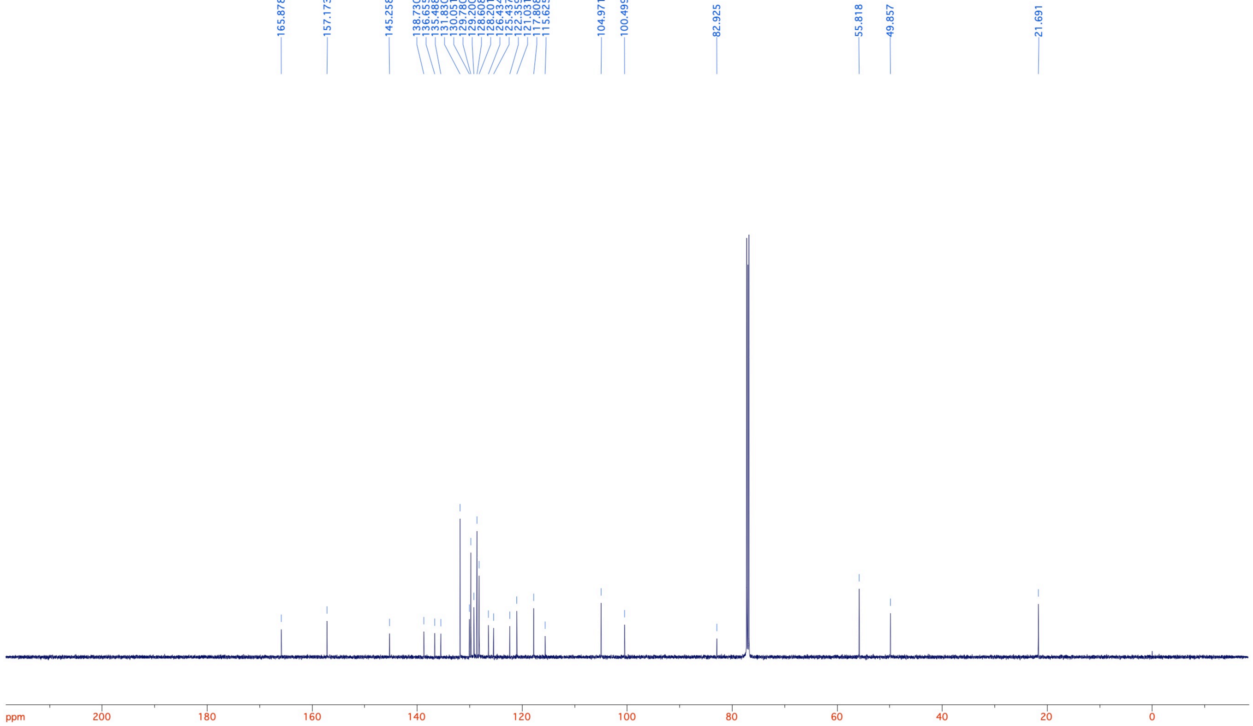
7
6
5
4
3
2
1
0
-1
-2

4h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126.434
125.437
122.359
121.031
117.808
115.625
104.971
100.499
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21.691
ppm
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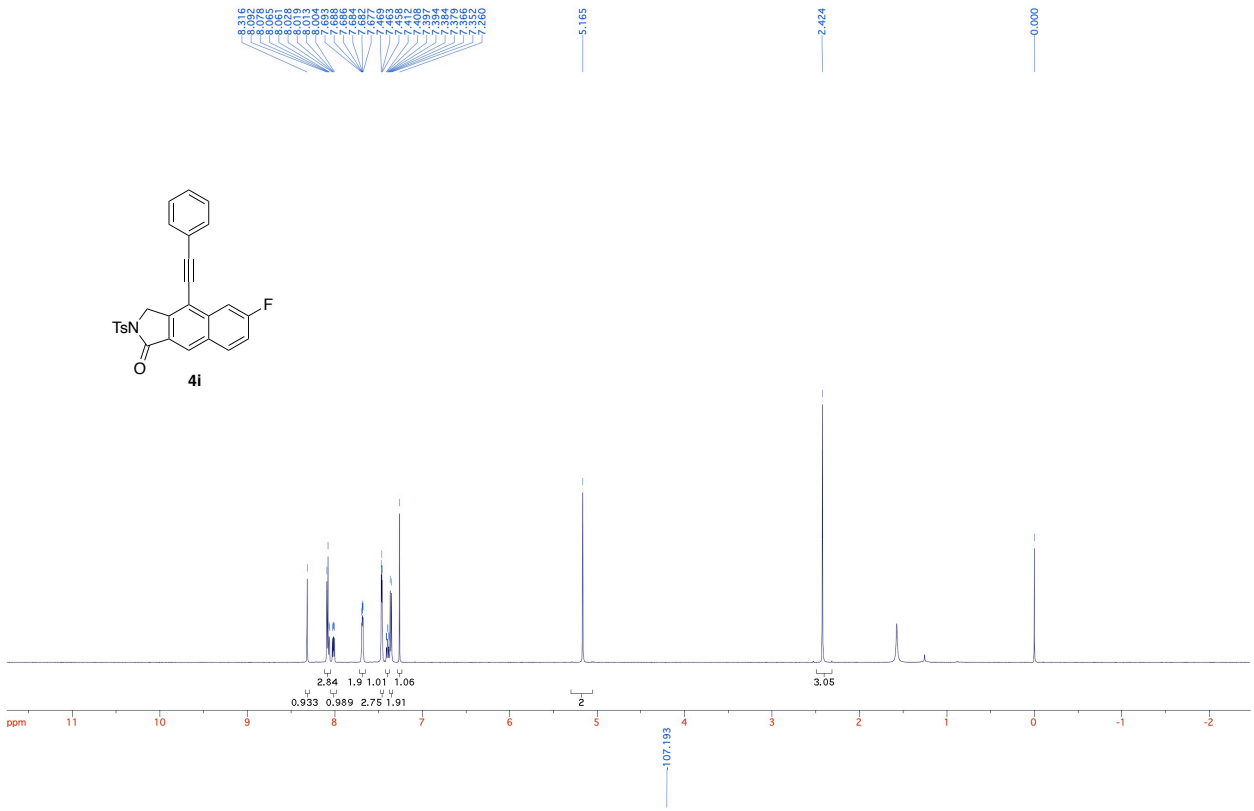
0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7.677
7.469
7.463
7.458
7.417
7.408
7.397
7.394
7.384
7.379
7.366
7.352
7.260
5.165
2.424
0.000
TsN
O
F
4i
2.84
1.9
1.01
1.06
0.933
0.989
2.75
1.91
2
3.05
ppm
11
10
9
8
7
6
5
4
3
2
1
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-2
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-80
-100
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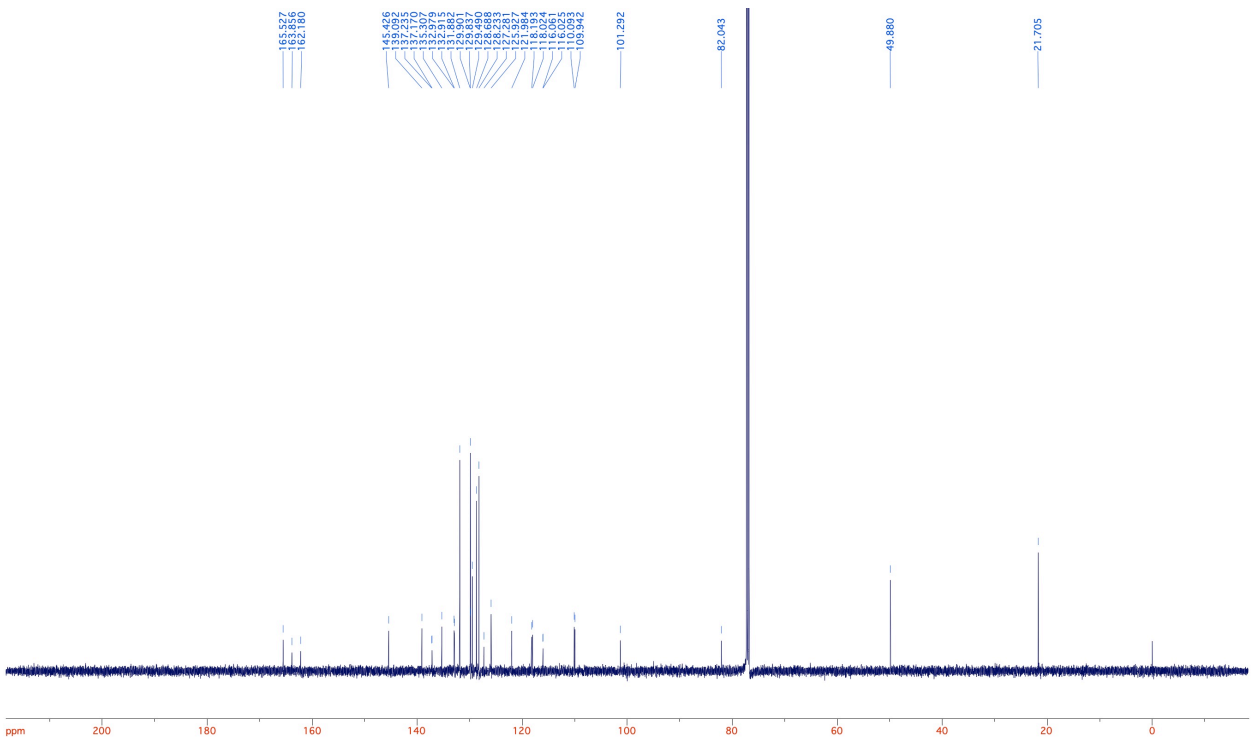
-140
-160
-180
-200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129.837
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128.233
127.281
125.927
121.984
118.193
118.024
116.061
116.025
110.093
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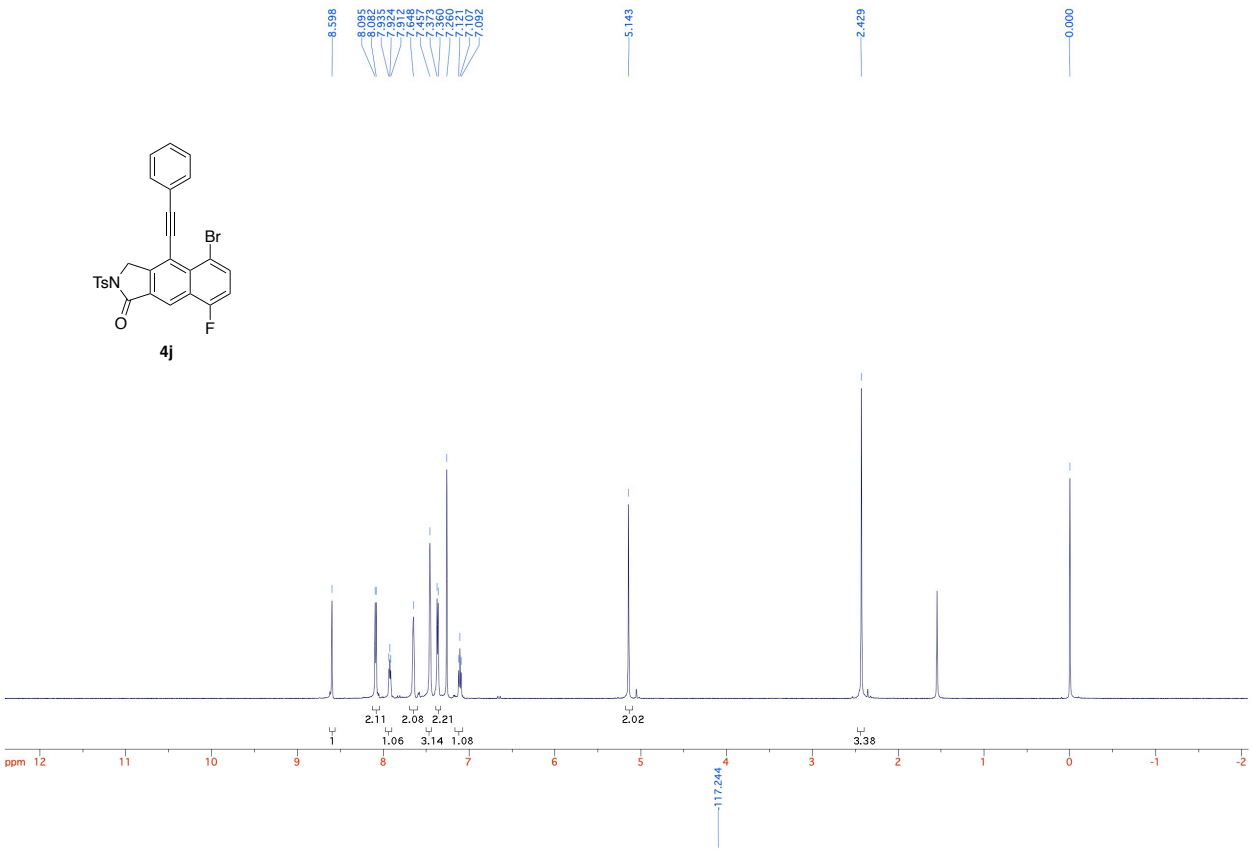
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7.107
7.092
5.143
2.429
0.000
Br
TsN
O
F
4j
2.11
2.08
2.21
2.02
1
1.06
3.14
1.08
3.38
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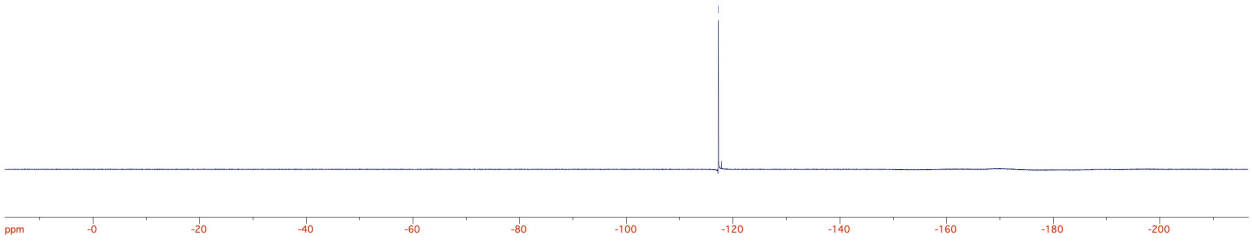
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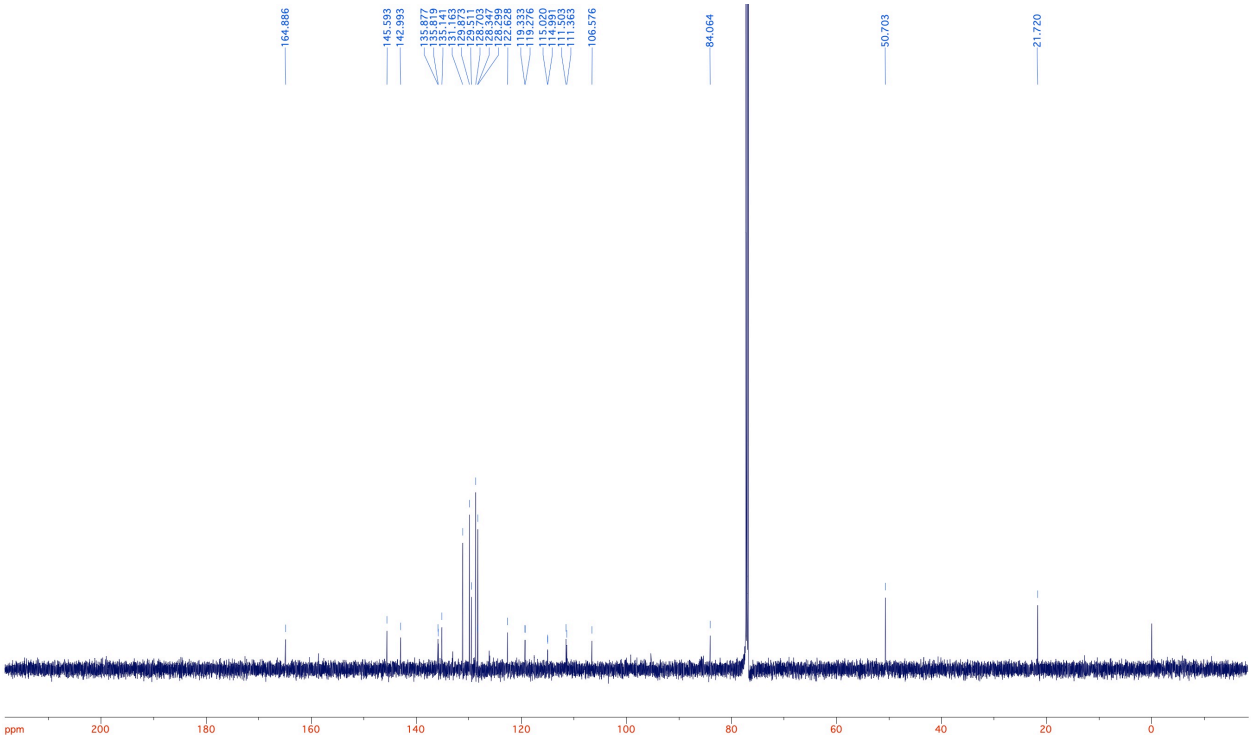
ppm -0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200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127.638
119.333
118.276
115.020
114.931
111.501
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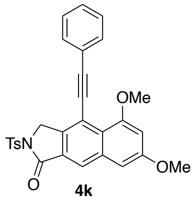
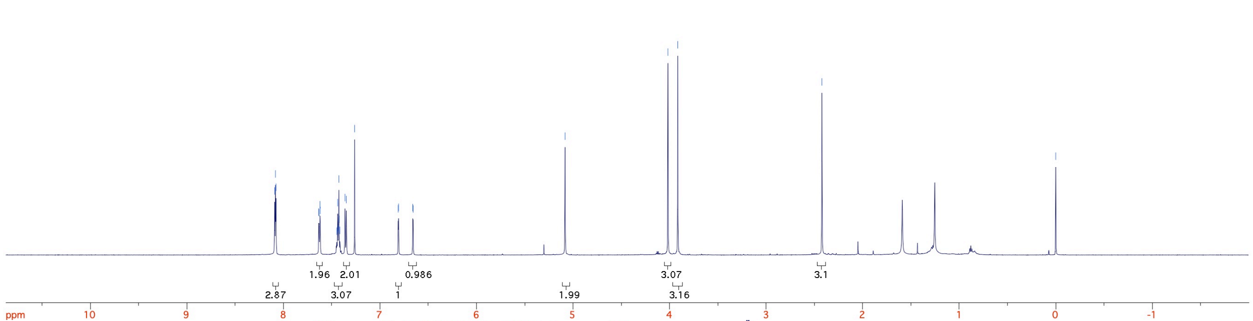

OMe
TsN
OMe
O

4k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7.415
7.362
7.348
7.262
6.811
6.807
6.660
6.656
5.083
4.017
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2.422
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1.96
2.01
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3.07
3.1
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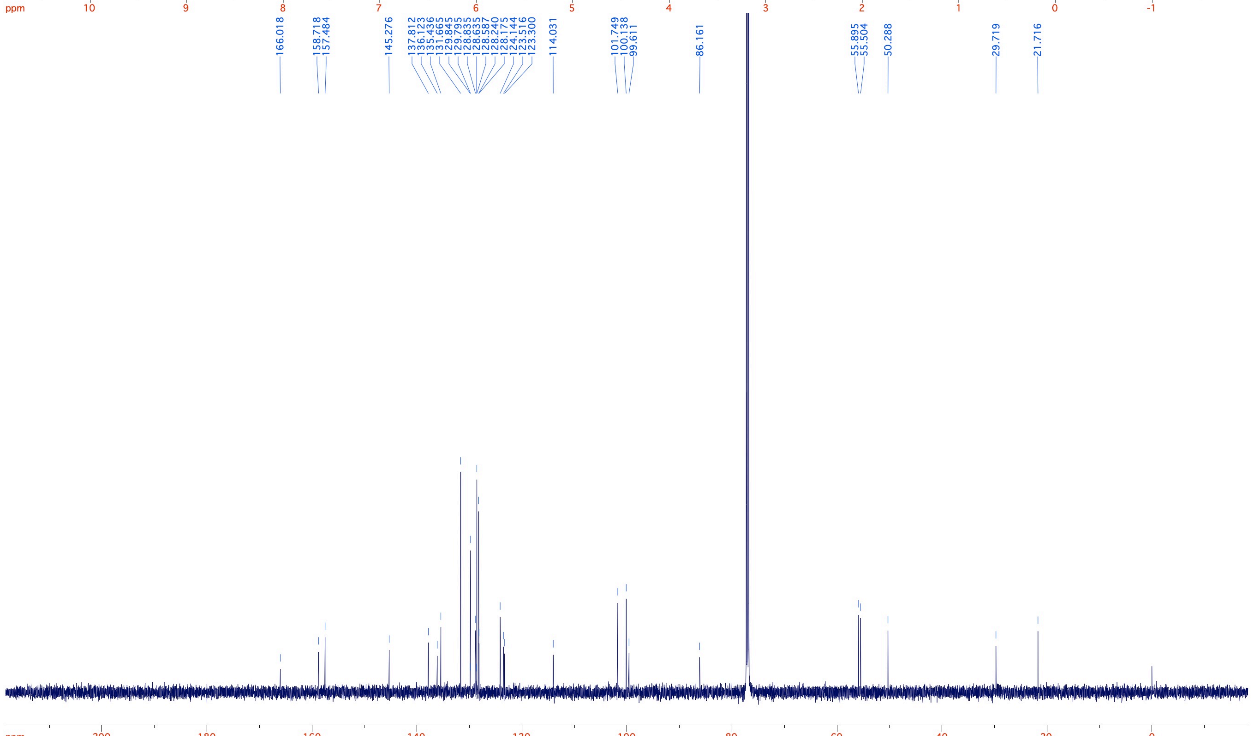
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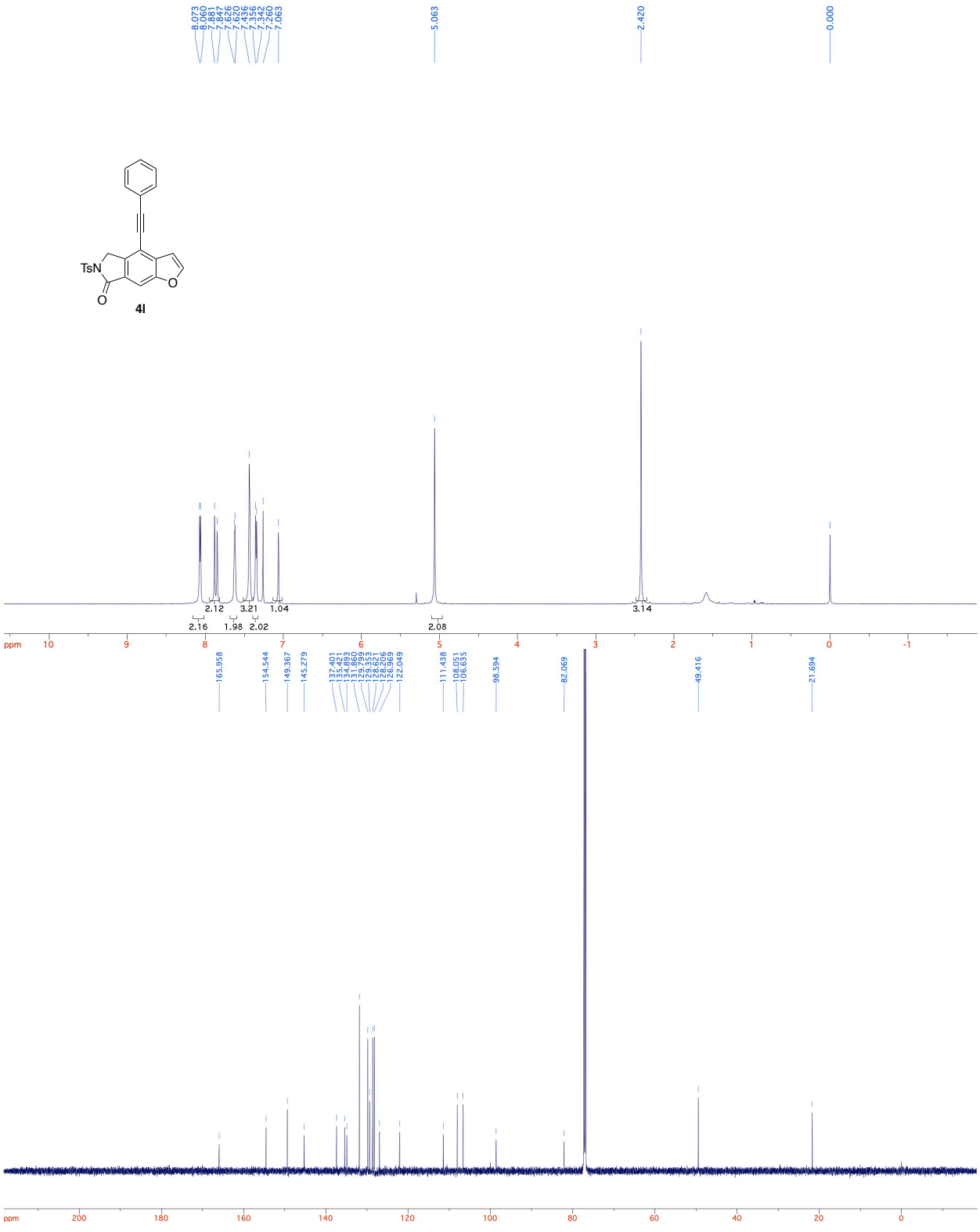
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7.260
7.063
5.063
2.420
0.000
TsN
O
O
4l
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3.21
1.04
3.14
2.16
1.98
2.02
2.08
ppm
10
9
8
7
6
5
4
3
2
1
0
-1
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137.401
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134.160
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108.051
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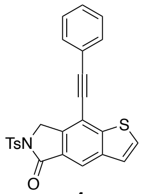
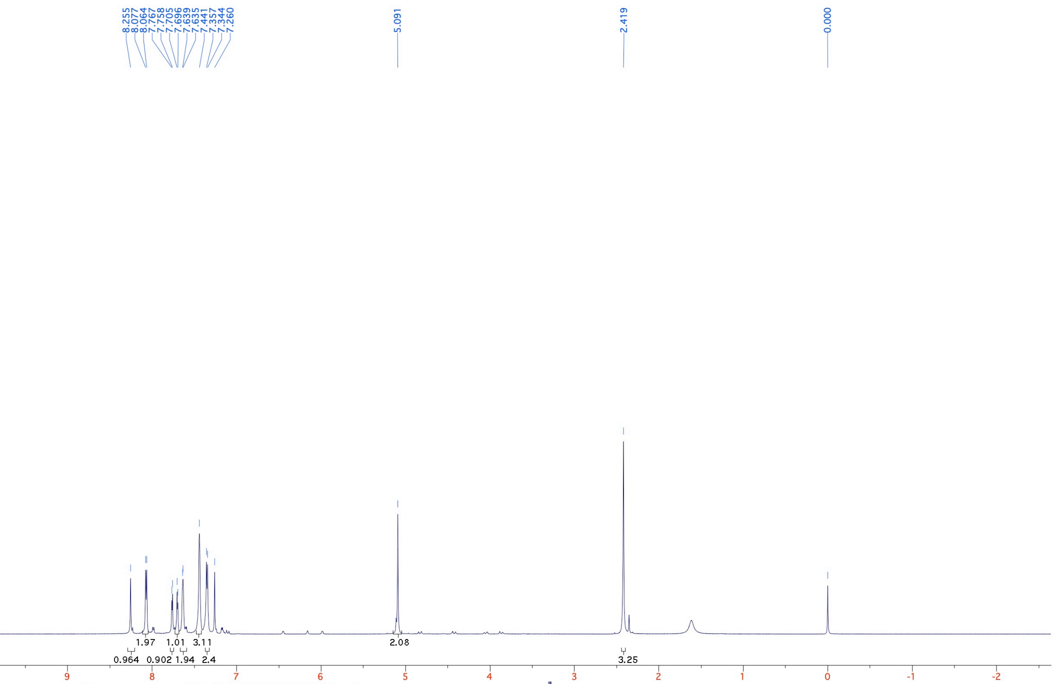

TsN
S
O

4m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7.260
5.091
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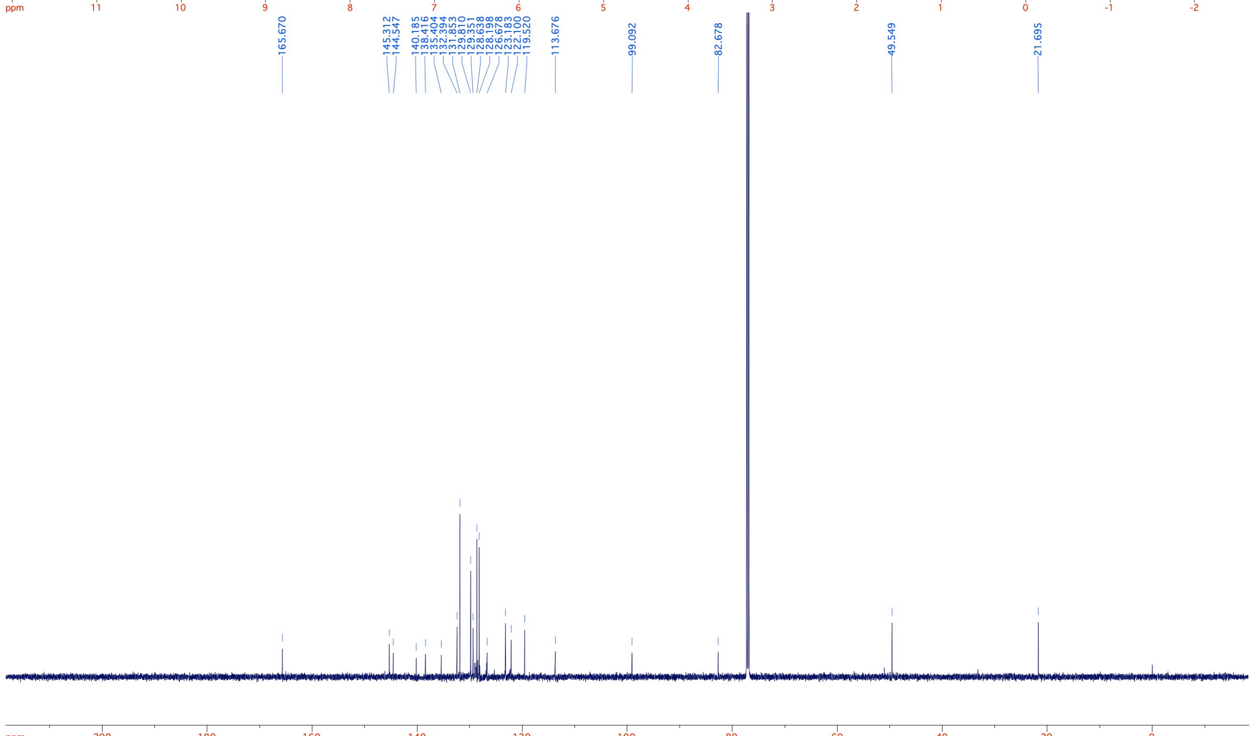
ppm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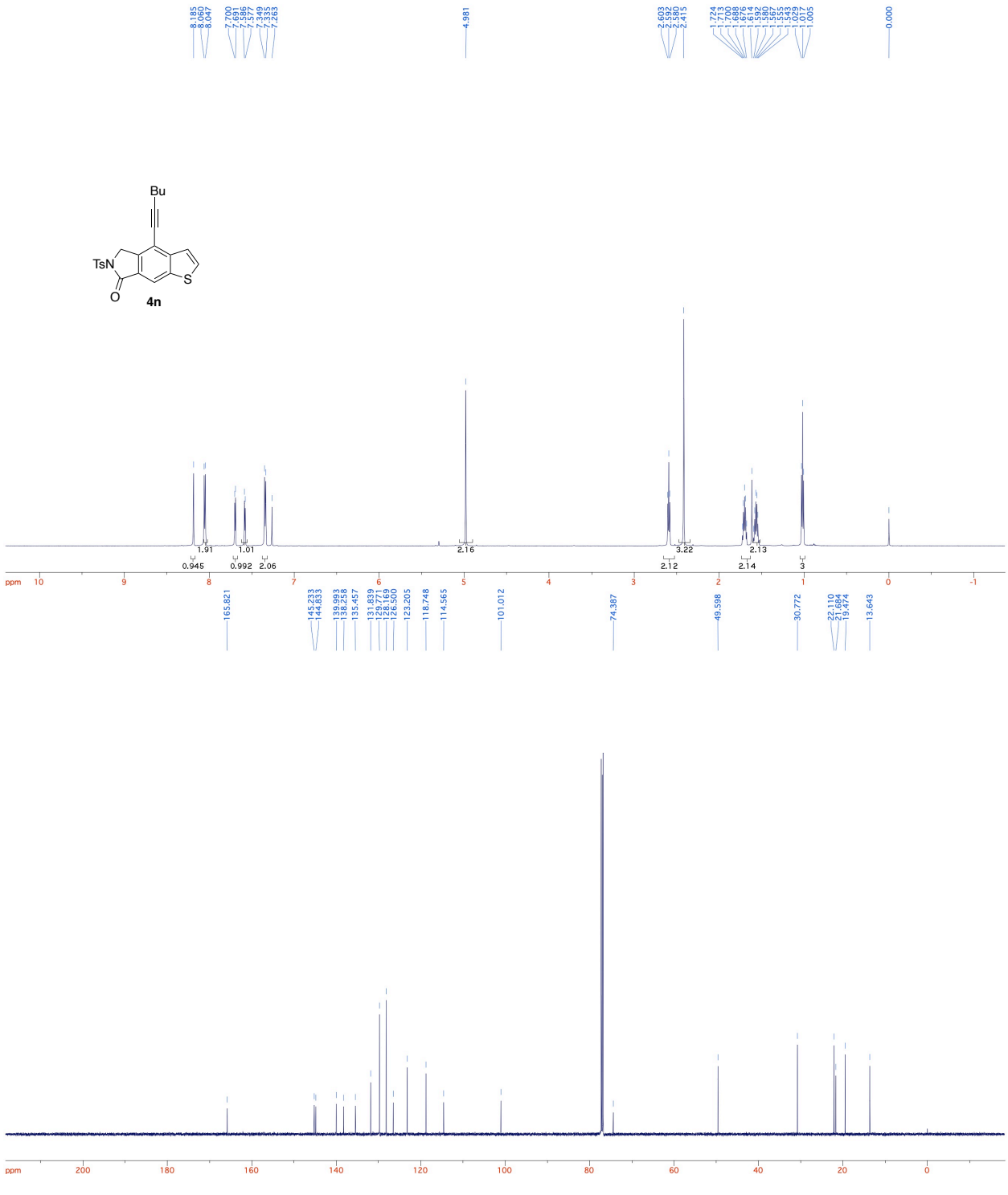
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2.592
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2.415
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1.713
1.700
1.688
1.676
1.614
1.592
1.580
1.567
1.555
1.543
1.029
1.017
1.005
0.000
Bu
TsN
O
S
4n
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1.01
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3.22
2.13
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0.992
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2.12
2.14
3
ppm
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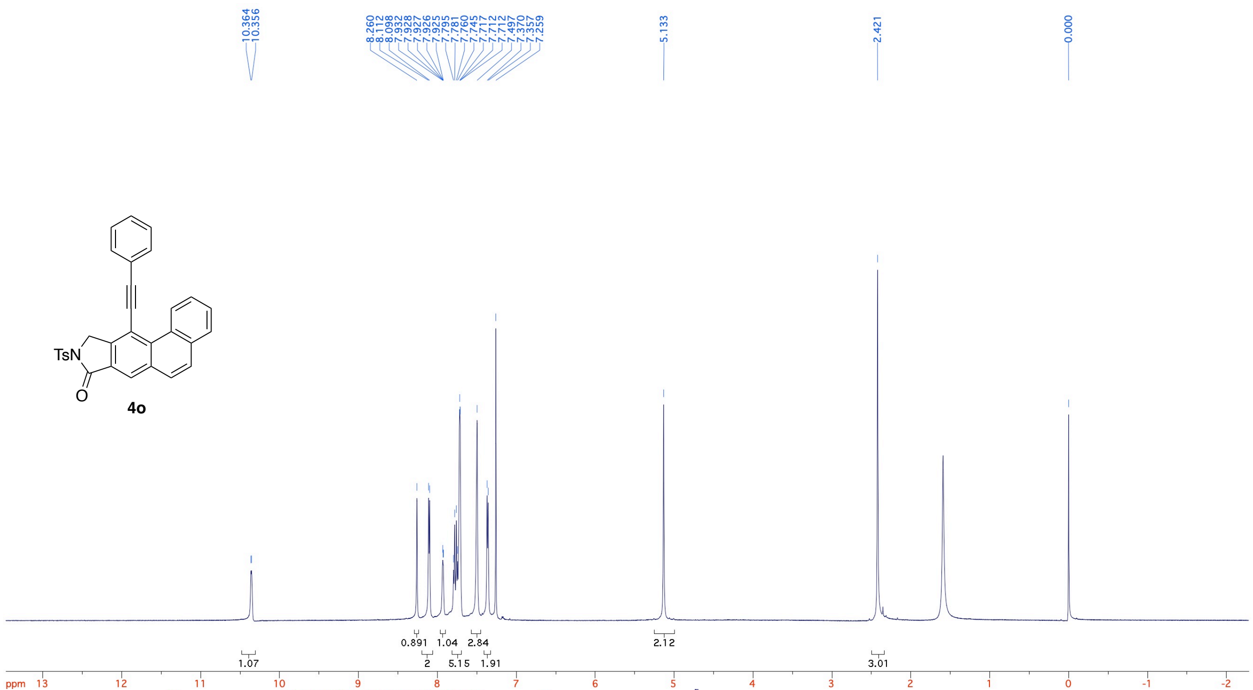
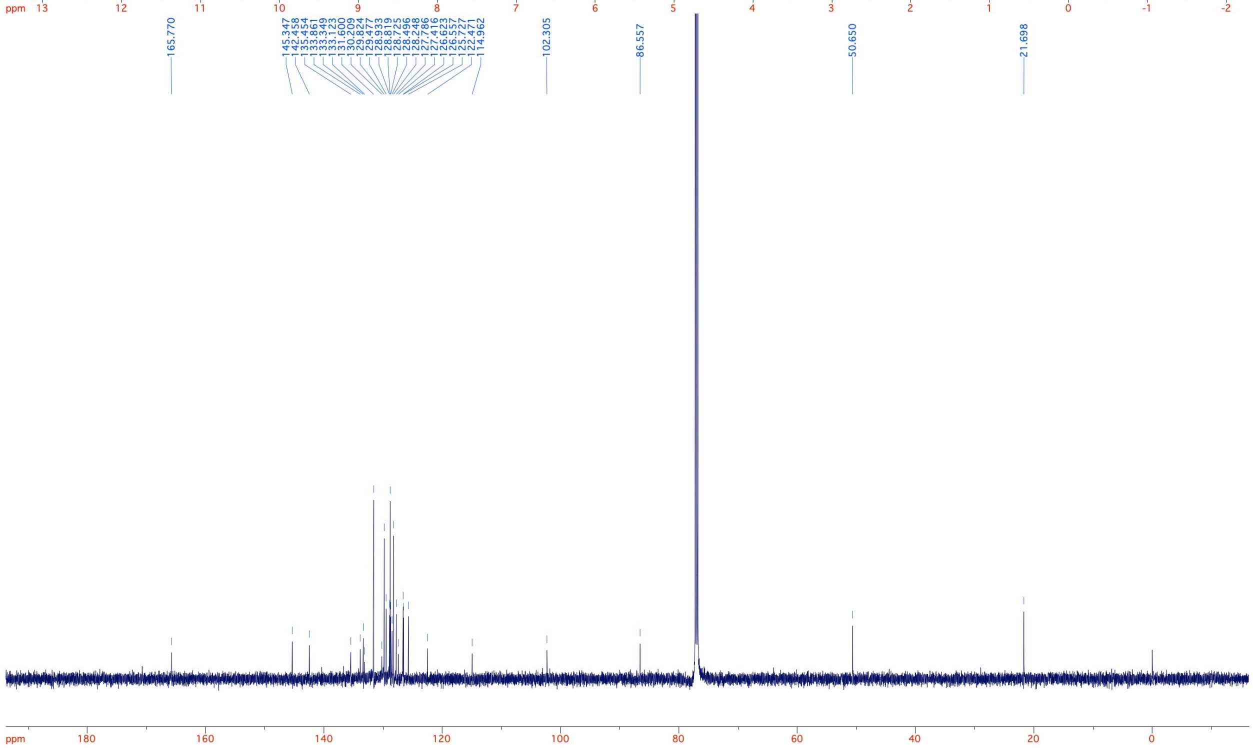
139.993
138.258
135.457
131.839
128.171
128.169
126.500
123.205
118.748
114.565
101.012
74.387
49.598
30.772
22.110
21.494
19.474
13.643

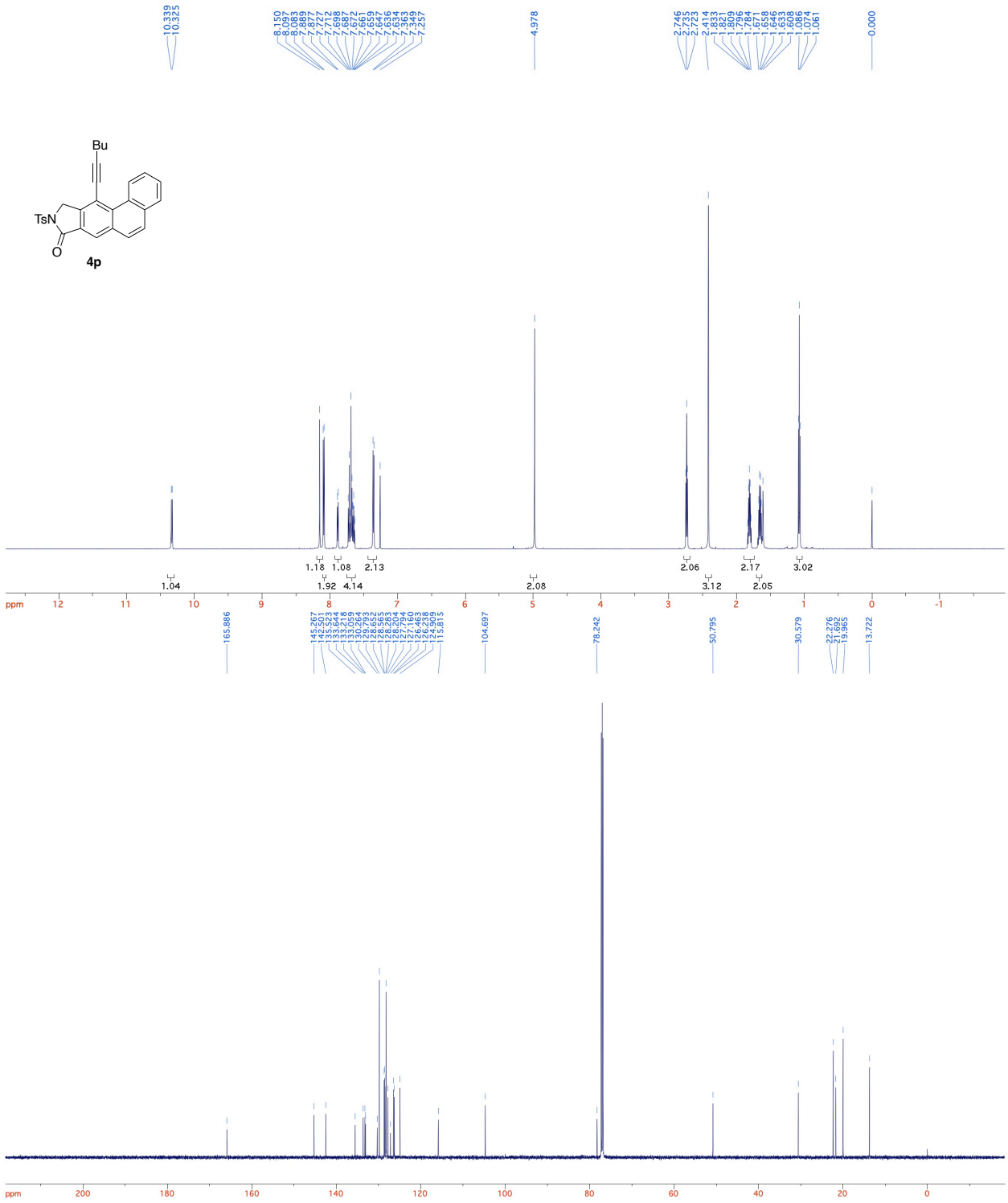
4o

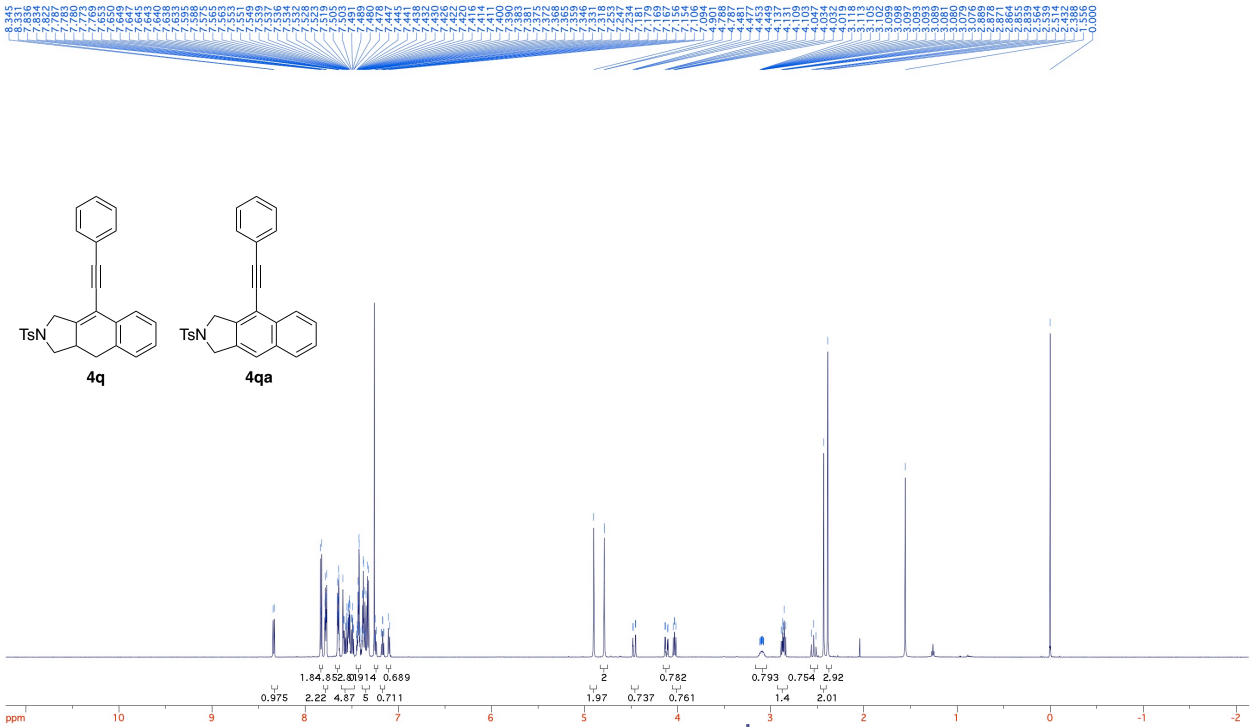


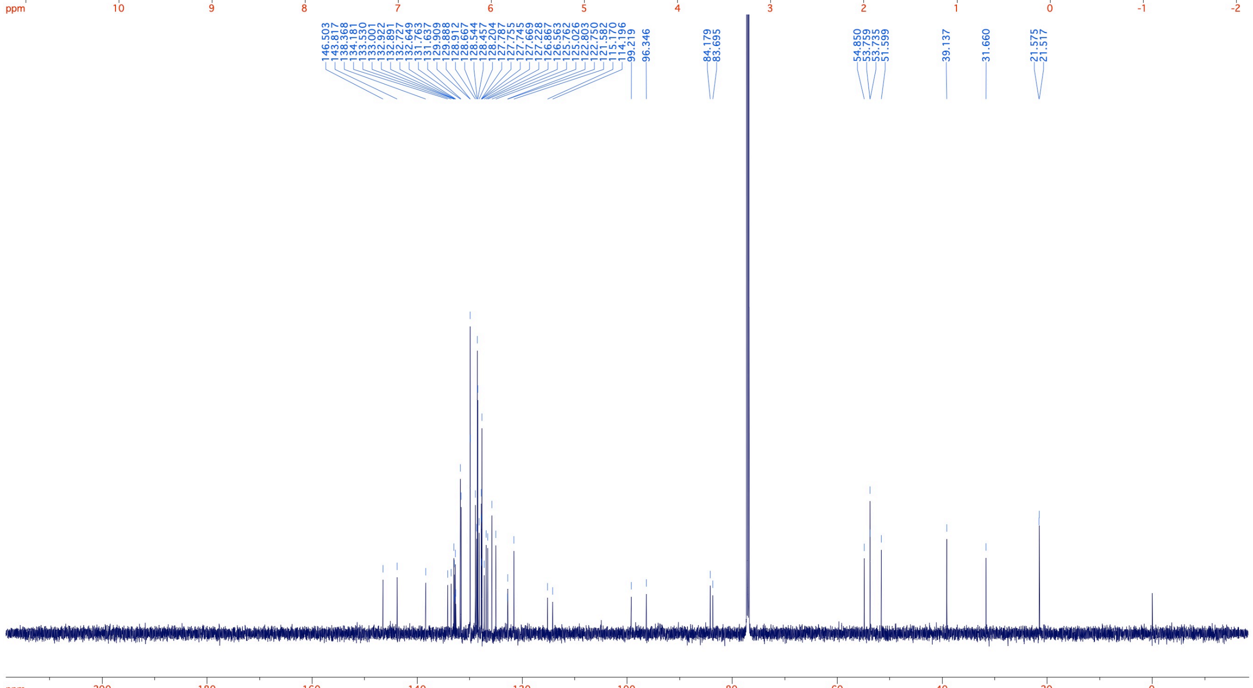
10.364
10.356
8.260
8.112
8.098
7.932
7.928
7.927
7.926
7.925
7.795
7.781
7.760
7.745
7.717
7.712
7.497
7.370
7.357
7.259
5.133
2.421
0.000
0.891
1.04
2.84
1.07
2
5.15
1.91
2.12
3.01
ppm 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2

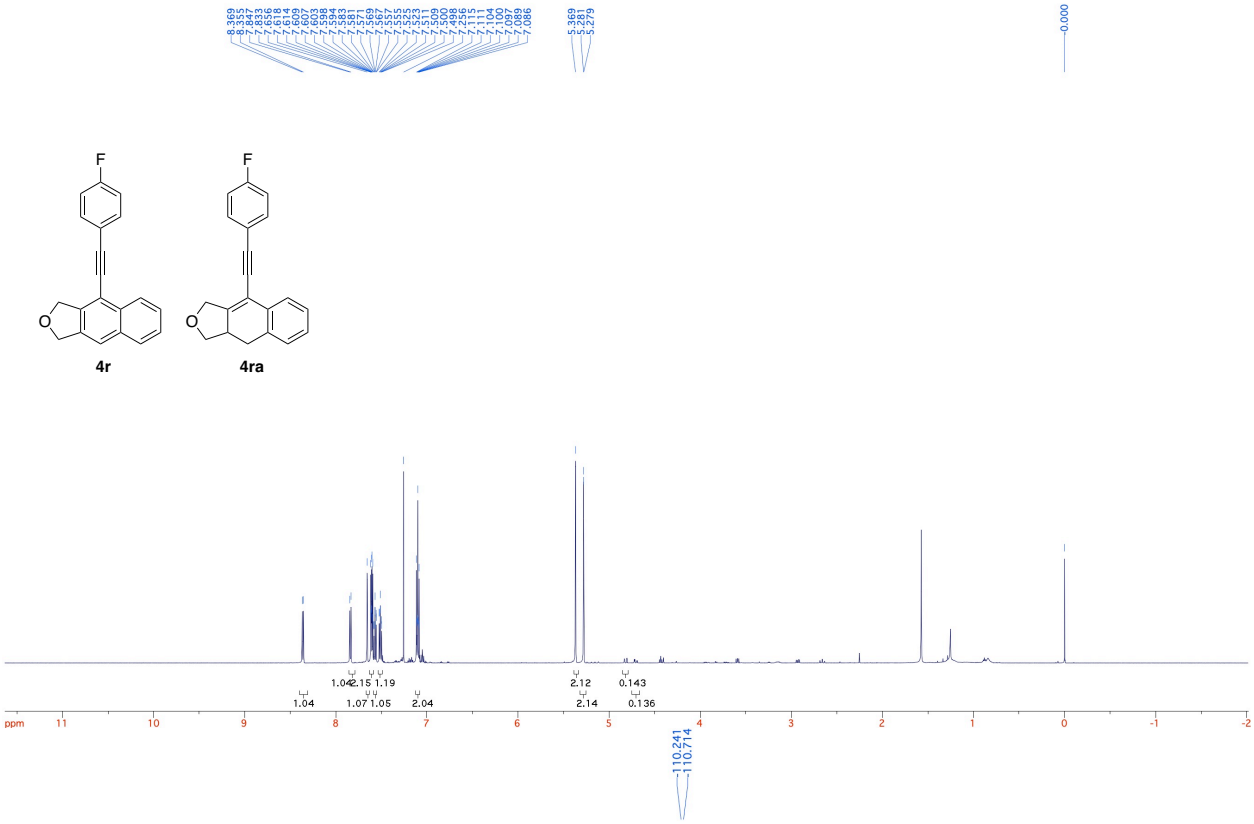


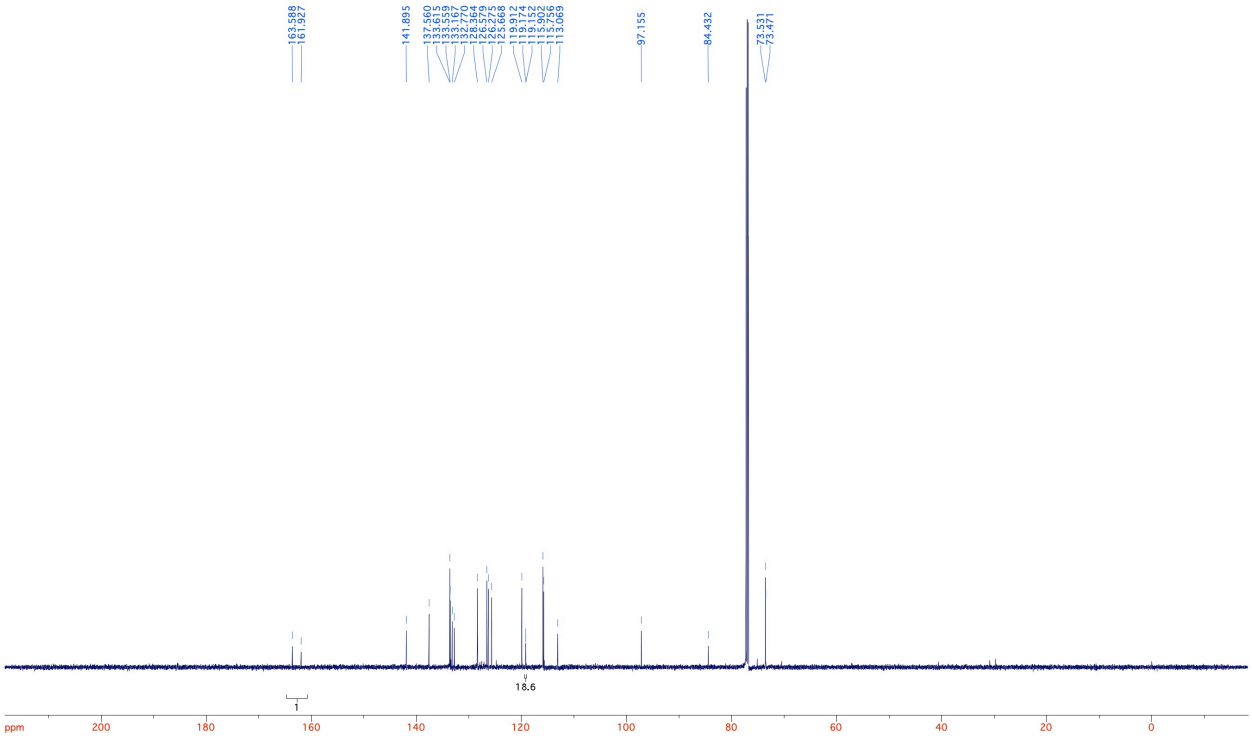
165.770
145.347
142.458
135.454
133.861
133.349
133.123
131.600
130.209
129.824
129.477
128.933
128.819
128.725
128.496
128.248
127.786
127.416
126.623
126.557
125.727
122.471
114.962
102.305
86.557
50.650
21.698
ppm 180 160 140 120 100 80 60 40 20 0

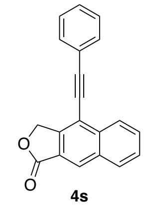

Bu
TsN
O
4p


4q
4qa
ppm

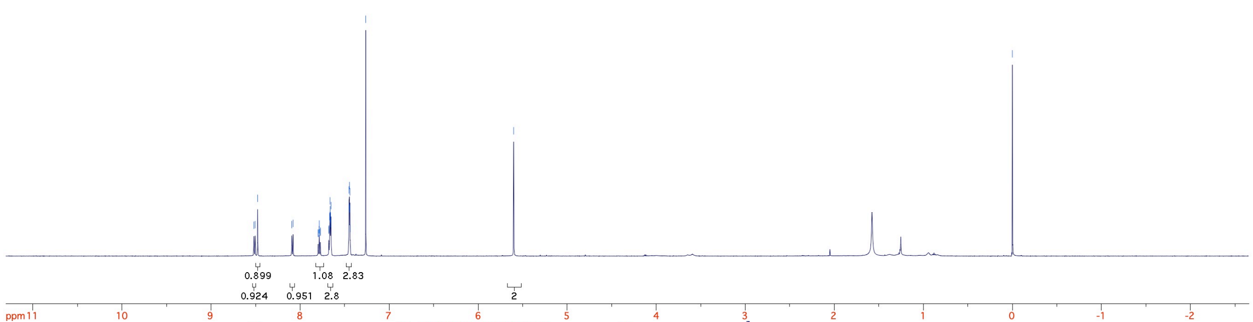

ppm

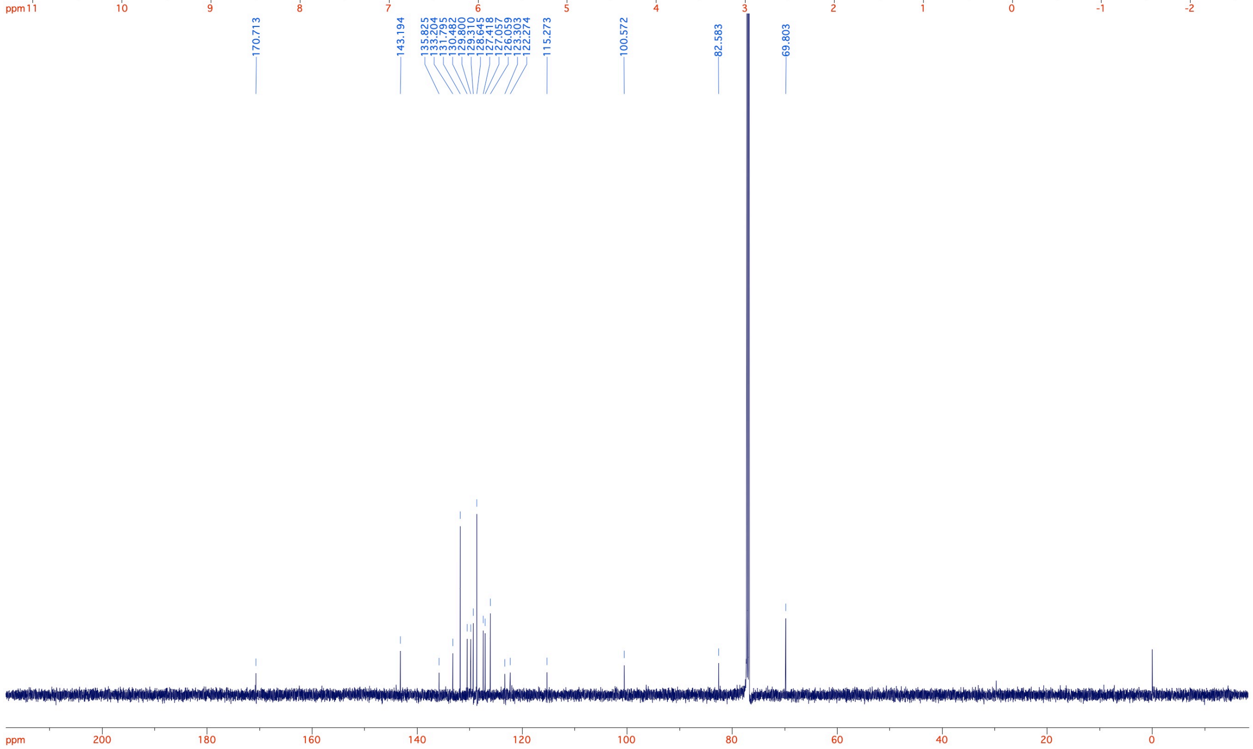

8.369
8.355
7.847
7.833
7.636
7.618
7.614
7.609
7.607
7.603
7.598
7.594
7.583
7.581
7.571
7.569
7.567
7.557
7.555
7.525
7.523
7.511
7.509
7.500
7.498
7.496
7.115
7.111
7.104
7.100
7.097
7.089
7.086
5.369
5.291
5.279
0.000
F
O
4r
F
O
4ra
1.04
2.15
1.19
1.04
1.07
1.05
2.04
2.12
0.143
2.14
0.136
ppm
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
110.241
110.714
ppm
-0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200

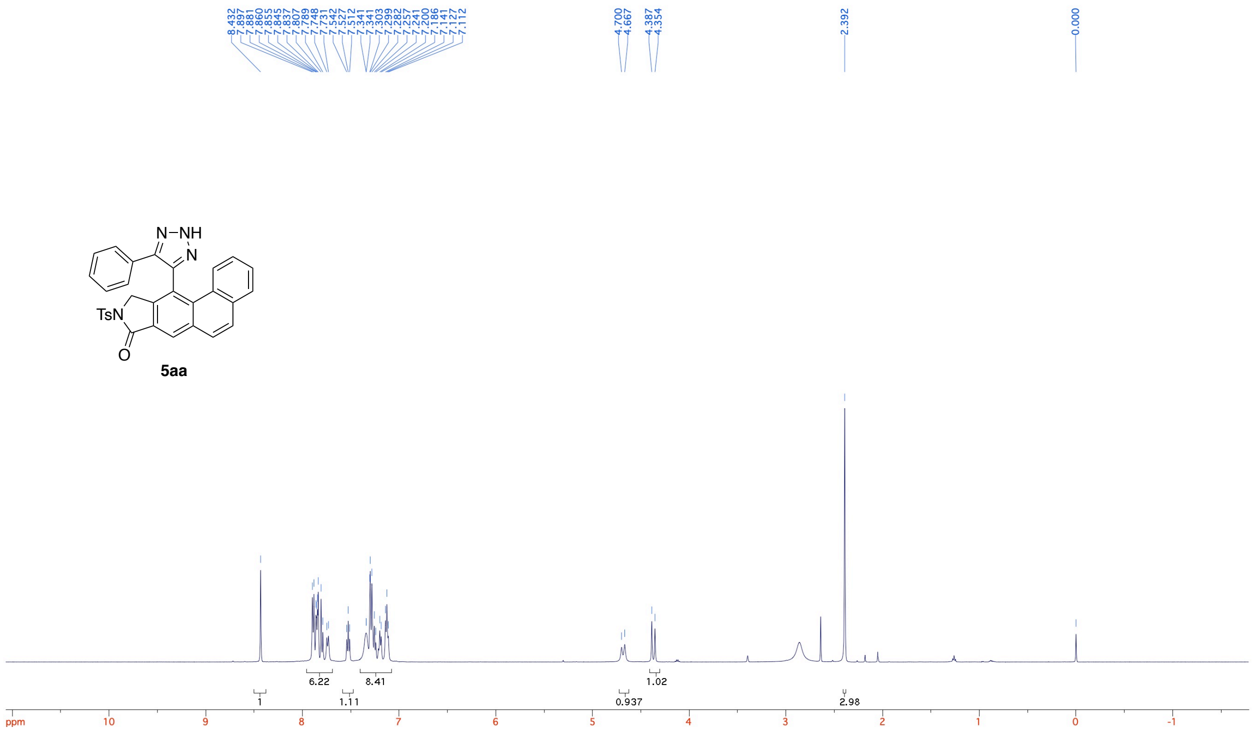

163.588
161.927
141.895
137.560
135.155
133.559
133.197
132.707
128.364
126.579
125.275
123.668
119.912
119.114
119.112
115.902
115.566
113.069
97.155
84.432
73.531
73.471
18.6
1
ppm
200
180
160
140
120
100
80
60
40
20
0



4s

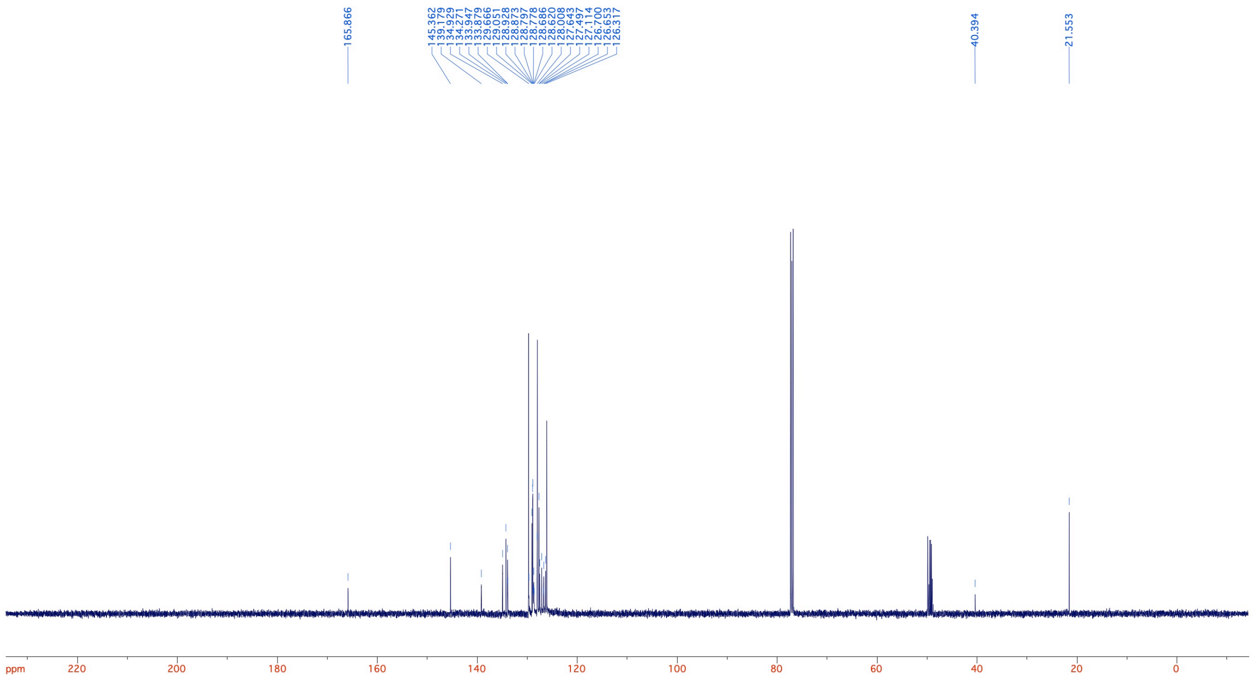

8.519
8.505
8.477
8.093
8.079
7.798
7.796
7.787
7.784
7.782
7.772
7.771
7.678
7.676
7.669
7.664
7.662
7.660
7.657
7.655
7.653
7.451
7.447
7.445
7.443
7.440
7.437
7.263
5.601
0.000
0.899
0.924
0.951
1.08
2.8
2.83
2
ppm 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2


170.713
143.194
135.825
133.204
131.795
130.482
129.800
129.310
128.645
127.418
127.057
126.059
123.303
122.274
115.273
100.572
82.583
69.803
ppm 200 180 160 140 120 100 80 60 40 20 0

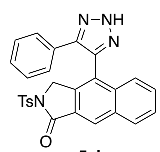


8.432
7.897
7.881
7.860
7.855
7.845
7.837
7.807
7.789
7.748
7.731
7.542
7.527
7.512
7.341
7.341
7.303
7.299
7.282
7.257
7.241
7.200
7.186
7.141
7.127
7.112
4.700
4.667
4.387
4.354
2.392
0.000
1
6.22
1.11
8.41
0.937
1.02
2.98
ppm
10
9
8
7
6
5
4
3
2
1
0
-1
N–NH
N
TsN
O

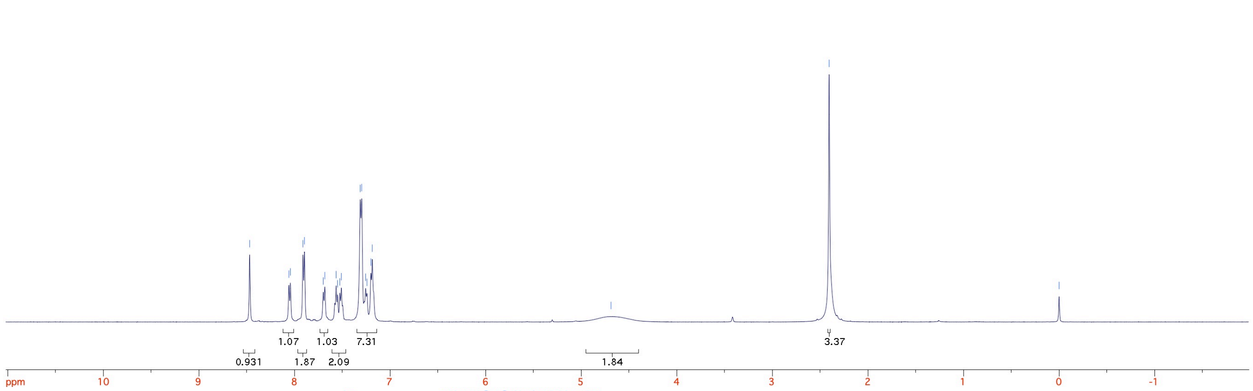
5aa

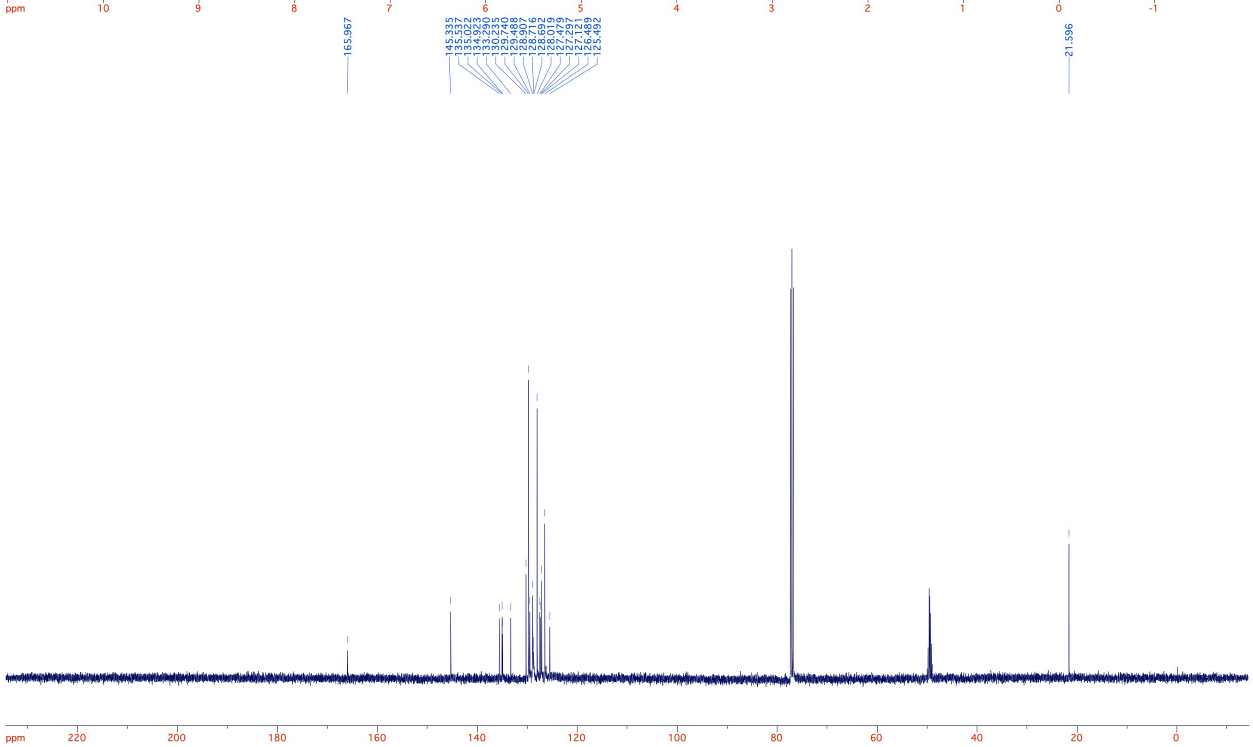


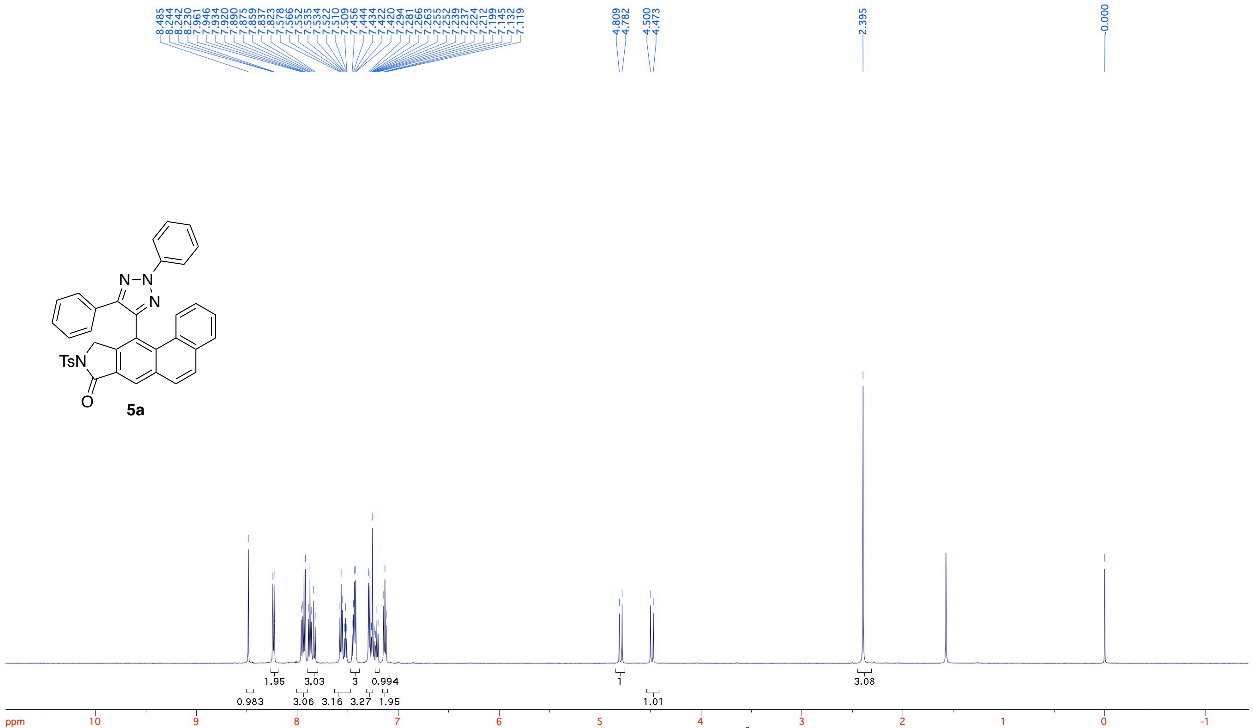
165.866
145.362
139.179
134.929
134.271
133.947
133.879
129.666
129.051
128.928
128.873
128.797
128.778
128.686
128.620
128.008
127.643
127.497
127.114
126.703
126.653
126.317
40.394
21.553
ppm
220
200
180
160
140
120
100
80
60
40
20
0

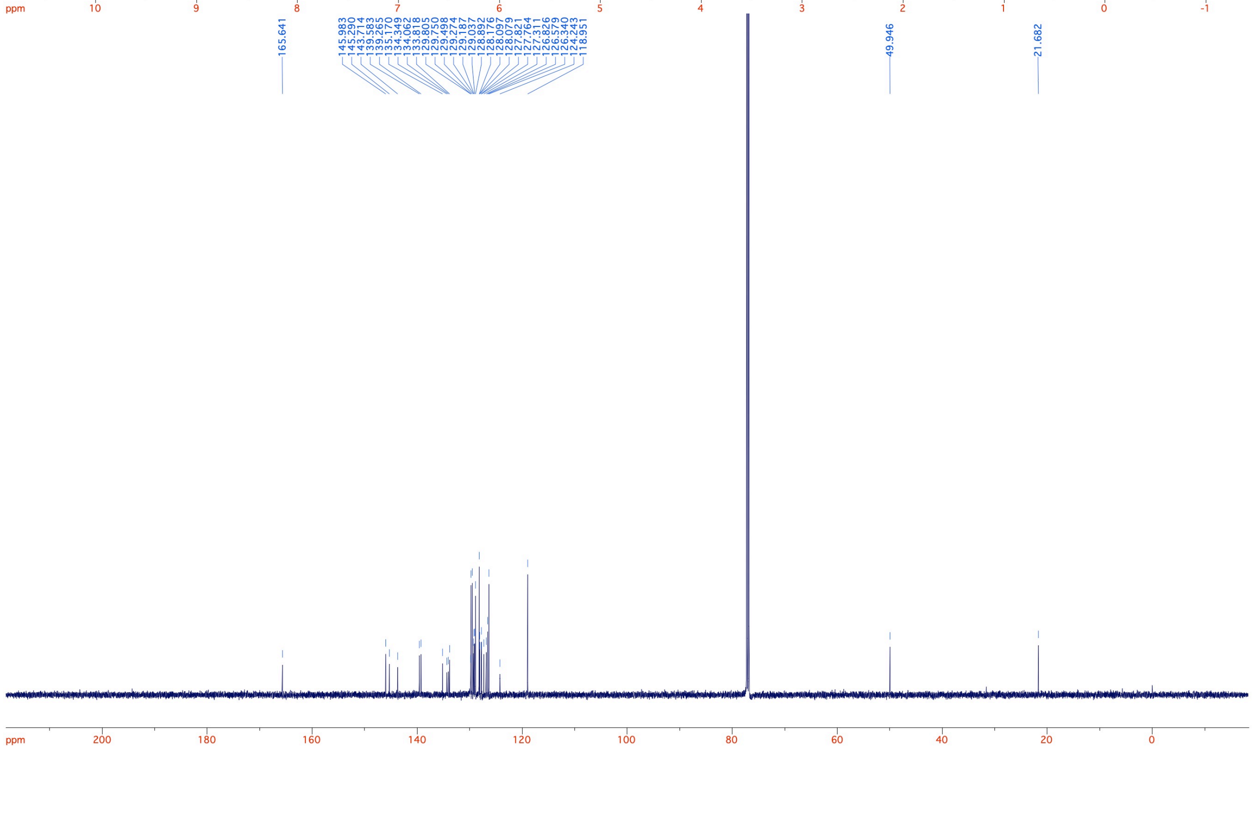

N–NH
N
TsN
O

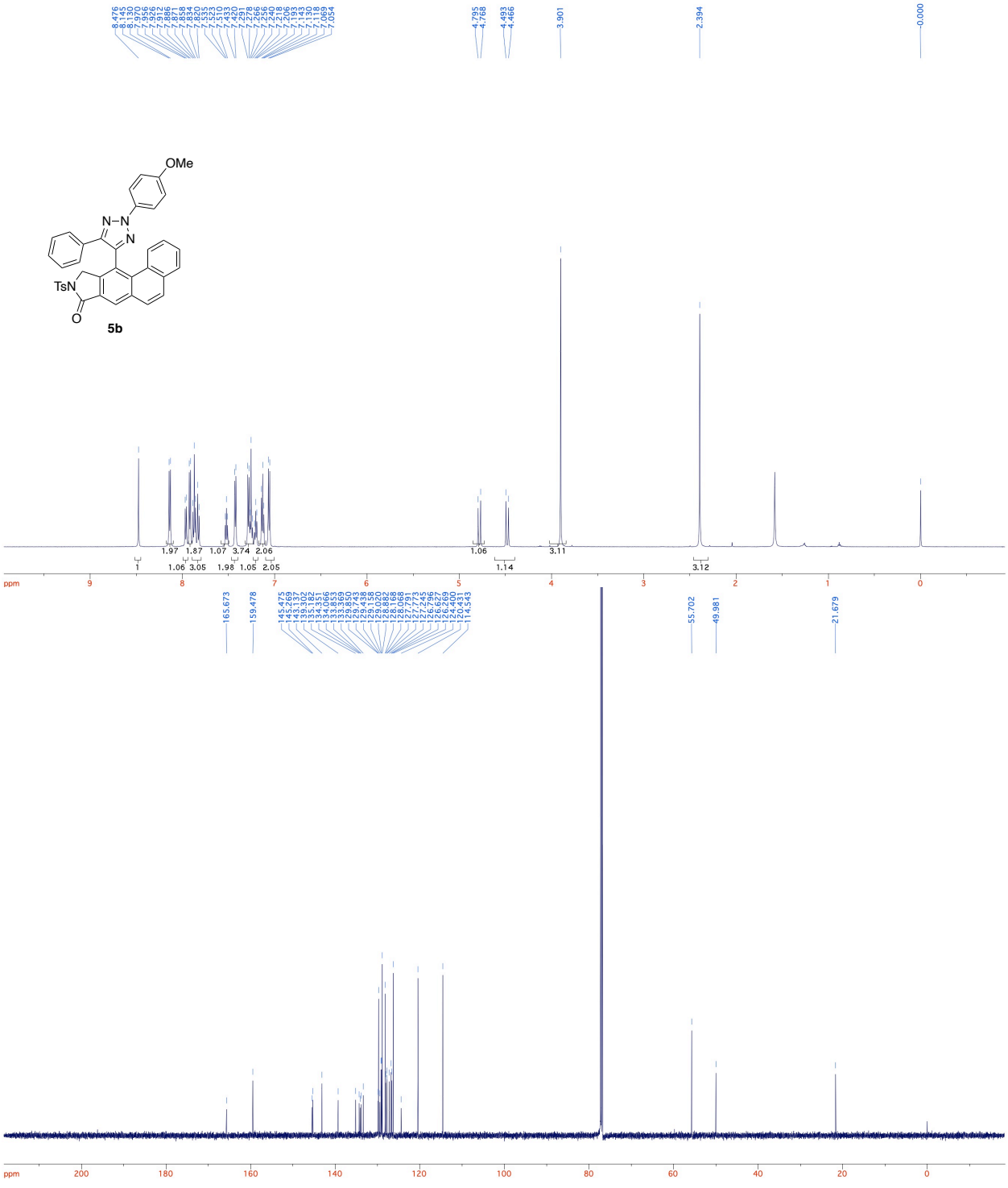
5ab

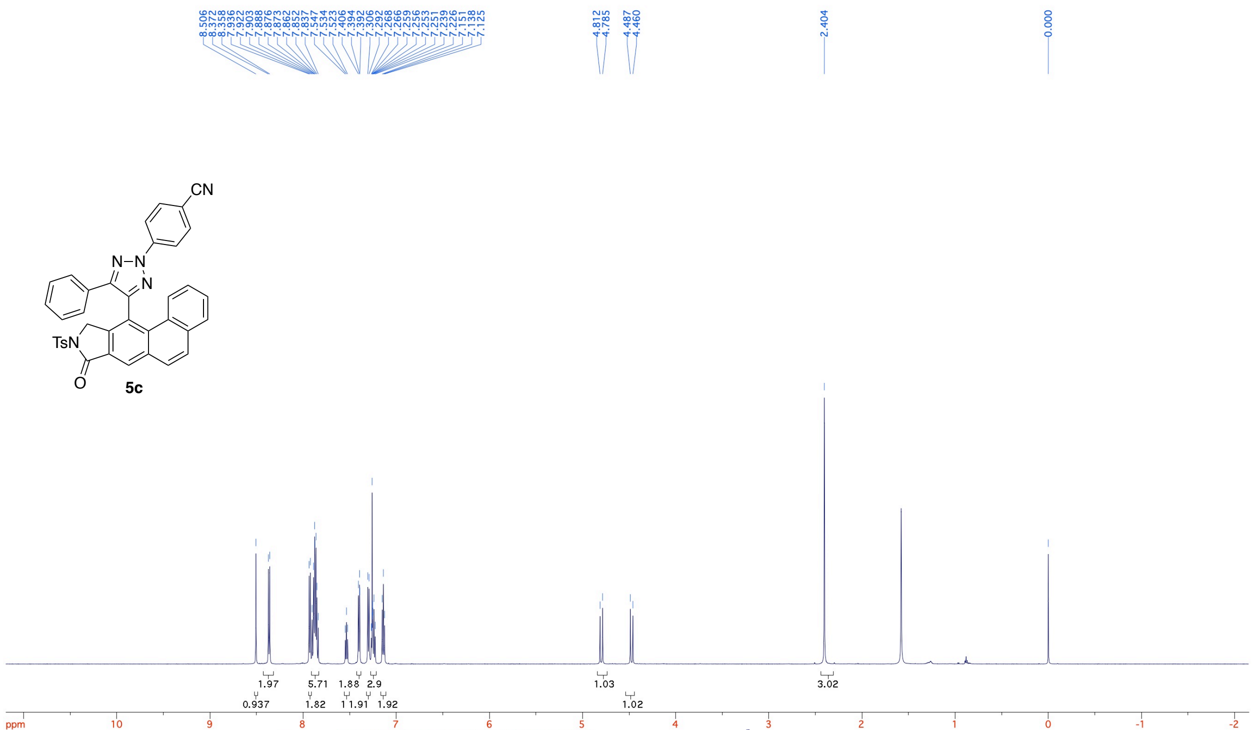

8.469
8.059
8.043
7.912
7.896
7.699
7.683
7.565
7.550
7.526
7.510
7.313
7.297
7.256
7.242
7.201
7.187
4.688
2.406
0.000
0.931
1.07
1.87
1.03
2.09
7.31
1.84
3.37
ppm
10
9
8
7
6
5
4
3
2
1
0
-1

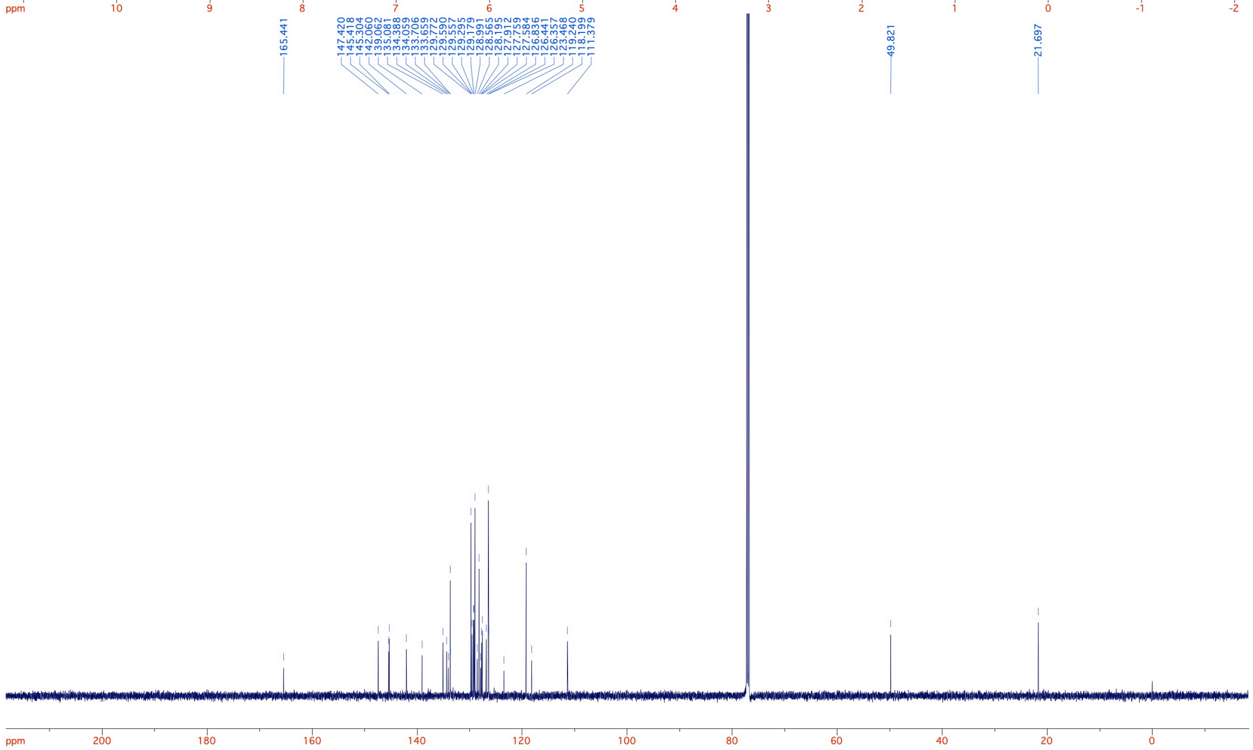

165.967
145.335
135.537
135.022
134.923
133.290
130.235
129.740
129.488
128.907
128.716
128.692
128.019
127.479
127.297
127.121
126.489
125.492
21.596
ppm
220
200
180
160
140
120
100
80
60
40
20
0


5a




OMe
N–N
N
TsN
O
5b
8.476
8.145
8.130
8.120
7.956
7.926
7.911
7.886
7.871
7.858
7.834
7.820
7.815
7.523
7.510
7.431
7.420
7.291
7.278
7.266
7.256
7.240
7.218
7.196
7.195
7.143
7.118
7.110
7.069
7.054
4.795
4.768
4.493
4.466
3.901
2.394
0.000
1.97
1.87
1.07
3.74
2.06
1.06
3.11
1
1.06
3.05
1.98
1.05
2.05
1.06
1.14
3.12
ppm
9
8
7
6
5
4
3
2
1
0
165.673
159.478
145.475
145.269
145.137
139.302
135.182
134.571
134.066
133.853
133.689
129.850
129.743
129.418
129.158
128.020
128.007
128.168
128.068
127.791
127.773
127.245
126.795
126.627
126.269
124.400
120.431
114.543
55.702
49.981
21.679
ppm
200
180
160
140
120
100
80
60
40
20
0


CN
N
N
N
TsN
O
5c
8.506
8.372
8.358
7.936
7.922
7.903
7.888
7.876
7.873
7.862
7.852
7.837
7.547
7.534
7.523
7.406
7.394
7.392
7.306
7.292
7.268
7.266
7.259
7.256
7.253
7.251
7.239
7.226
7.151
7.138
7.125
4.812
4.785
4.487
4.460
2.404
0.000
1.97
5.71
1.88
2.9
1.03
3.02
0.937
1.82
1
1.91
1.92
1.02
ppm
10
9
8
7
6
5
4
3
2
1
0
-1
-2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145.418
145.304
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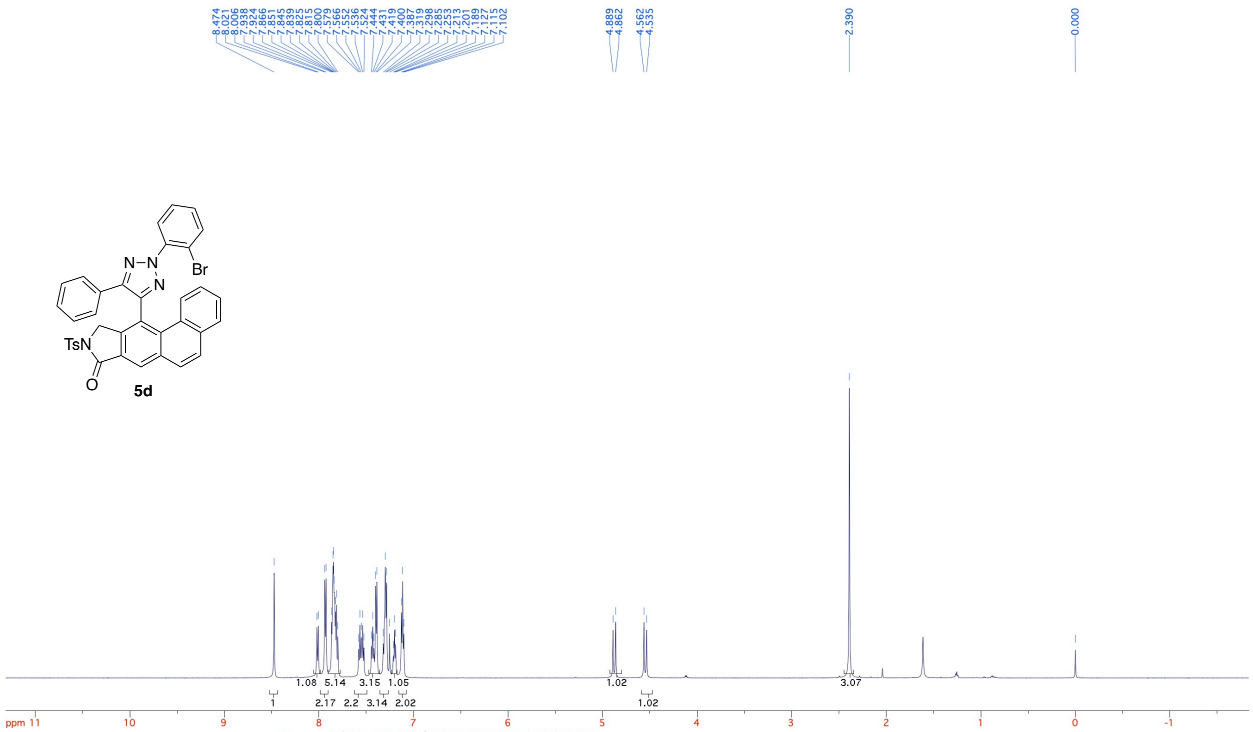
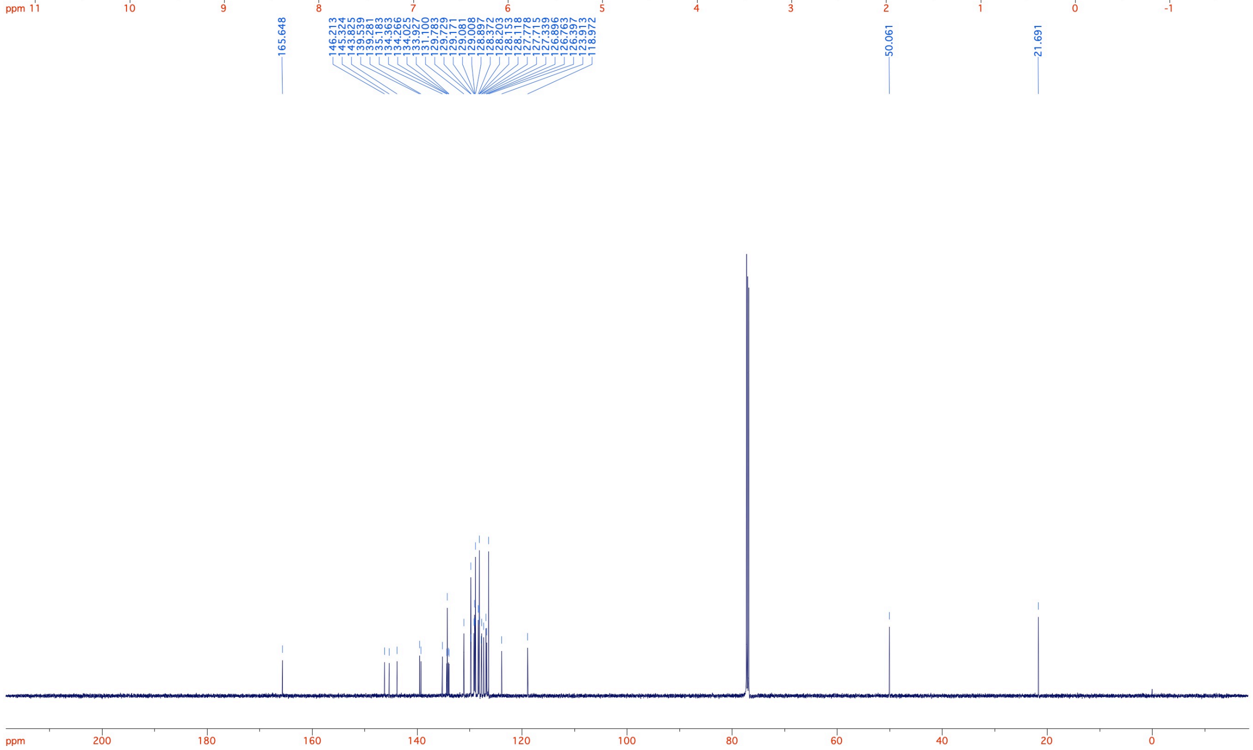
139.062
135.081
134.388
134.059
133.706
133.659
129.772
129.590
129.557
129.295
129.179
128.991
128.565
128.195
127.912
127.759
127.584
126.836
126.441
126.357
123.468
119.240
118.199
111.379
49.821
21.697
ppm
200
180
160
140
120
100
80
60
40
20
0



N
N
N
Br
TsN
O
5d
8.474
8.021
8.006
7.938
7.924
7.866
7.851
7.845
7.839
7.825
7.815
7.800
7.579
7.566
7.552
7.536
7.524
7.444
7.431
7.419
7.400
7.387
7.319
7.298
7.285
7.253
7.213
7.201
7.189
7.127
7.115
7.102
4.889
4.862
4.562
4.535
2.390
0.000
1.08
5.14
3.15
1.05
1.02
3.07
1
2.17
2.2
3.14
2.02
1.02
ppm 11
10
9
8
7
6
5
4
3
2
1
0
-1



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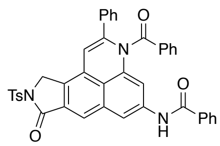
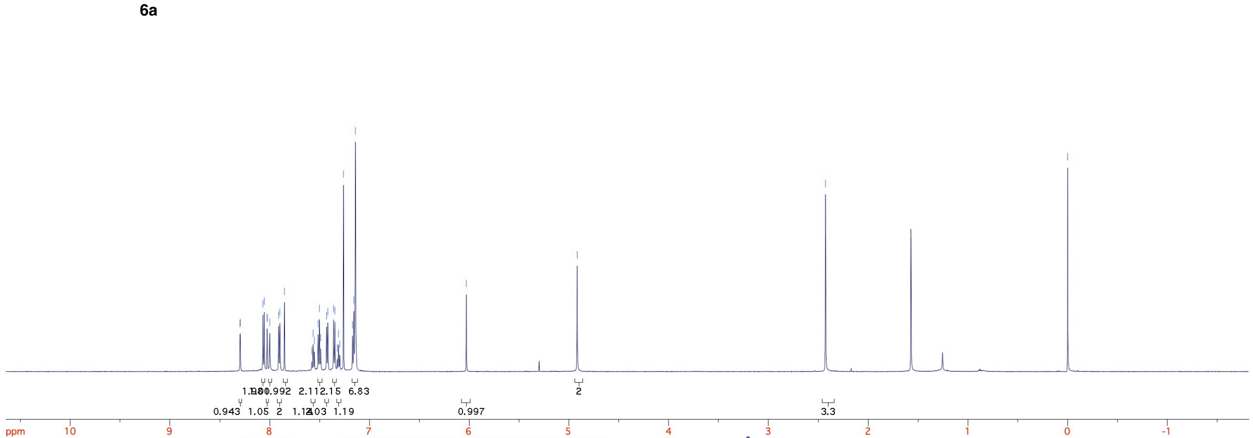
146.213
145.324
143.825
139.539
139.281
135.183
134.363
134.266
134.025
133.927
131.100
129.783
129.729
129.171
129.081
129.008
128.897
128.372
128.203
128.153
128.118
127.778
127.715
127.339
126.896
126.763
126.397
123.913
118.972
50.061
21.691
ppm
200
180
160
140
120
100
80
60
40
20
0


Ph
O
N
Ph
TsN
O
N
H
Ph
O

6a


8.298
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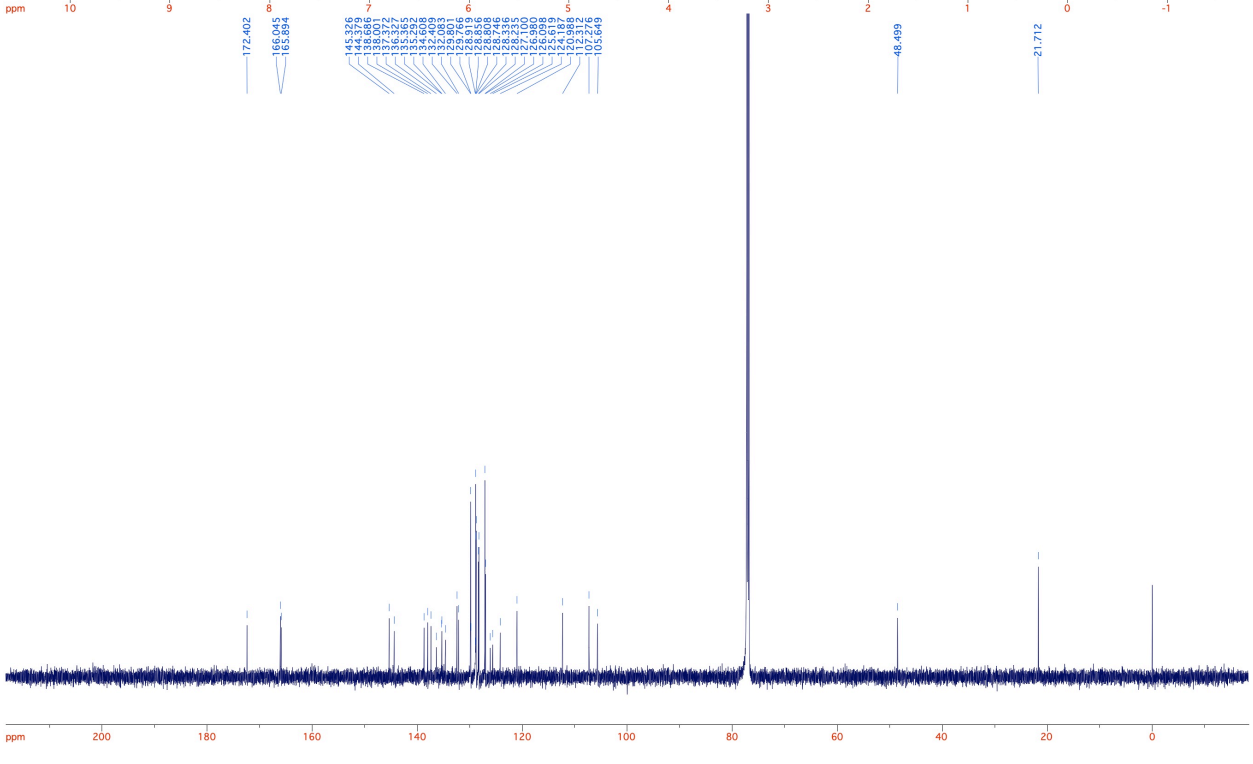
8.055
8.027
8.024
8.000
7.911
7.899
7.853
7.577
7.565
7.553
7.515
7.502
7.489
7.430
7.418
7.360
7.346
7.323
7.310
7.298
7.260
7.170
7.157
7.141
6.029
4.918
2.428
0.000
0.943
1.05
2
2.11
2.15
6.83
1.19
0.997
2
3.3
ppm
10
9
8
7
6
5
4
3
2
1
0
-1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137.372
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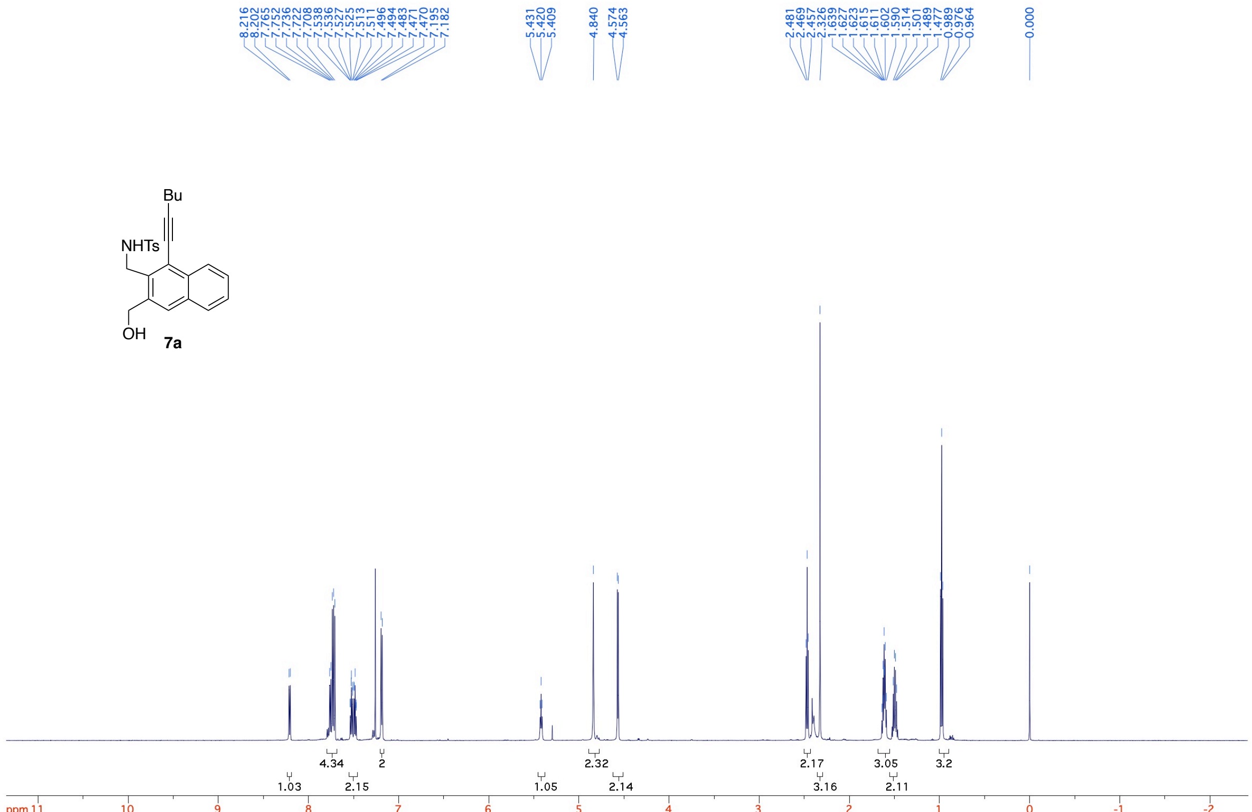
135.765
135.292
134.608
133.409
132.083
129.801
129.766
128.919
128.856
128.808
128.746
128.336
128.135
127.100
126.980
126.098
125.619
124.187
120.988
112.312
107.276
105.649
48.499
21.712
ppm
200
180
160
140
120
100
80
60
40
20
0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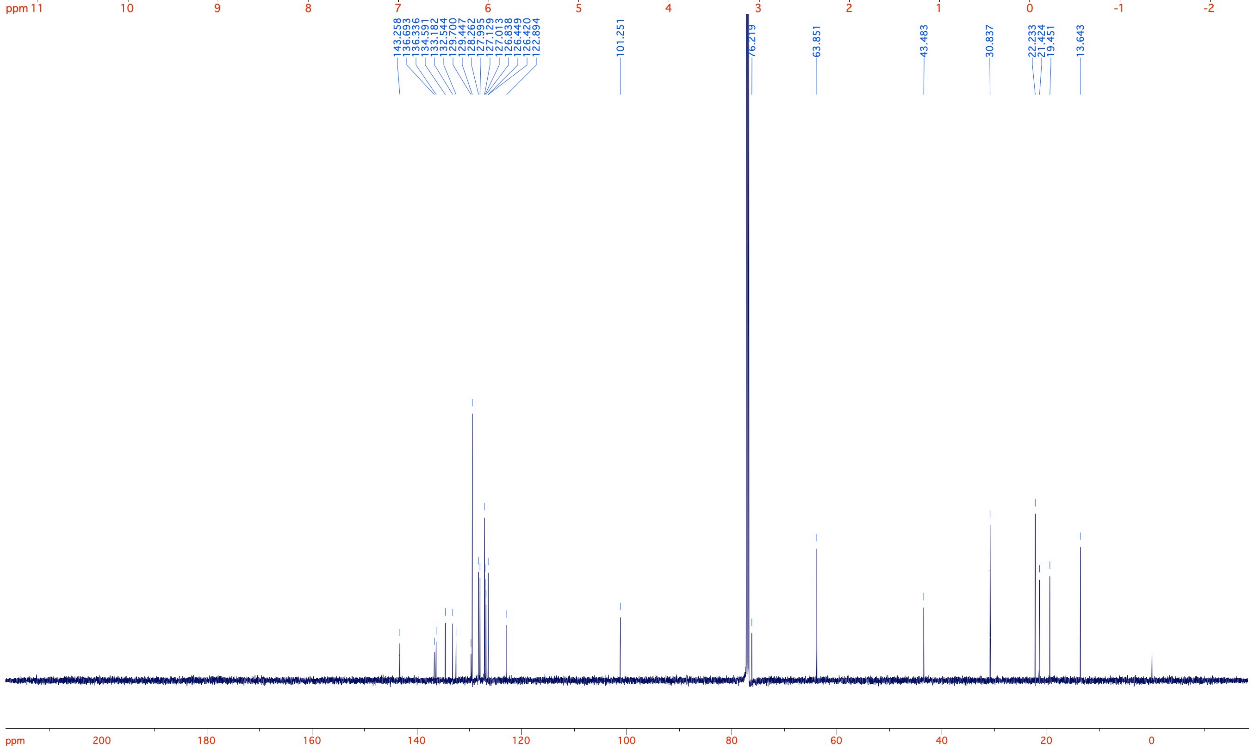
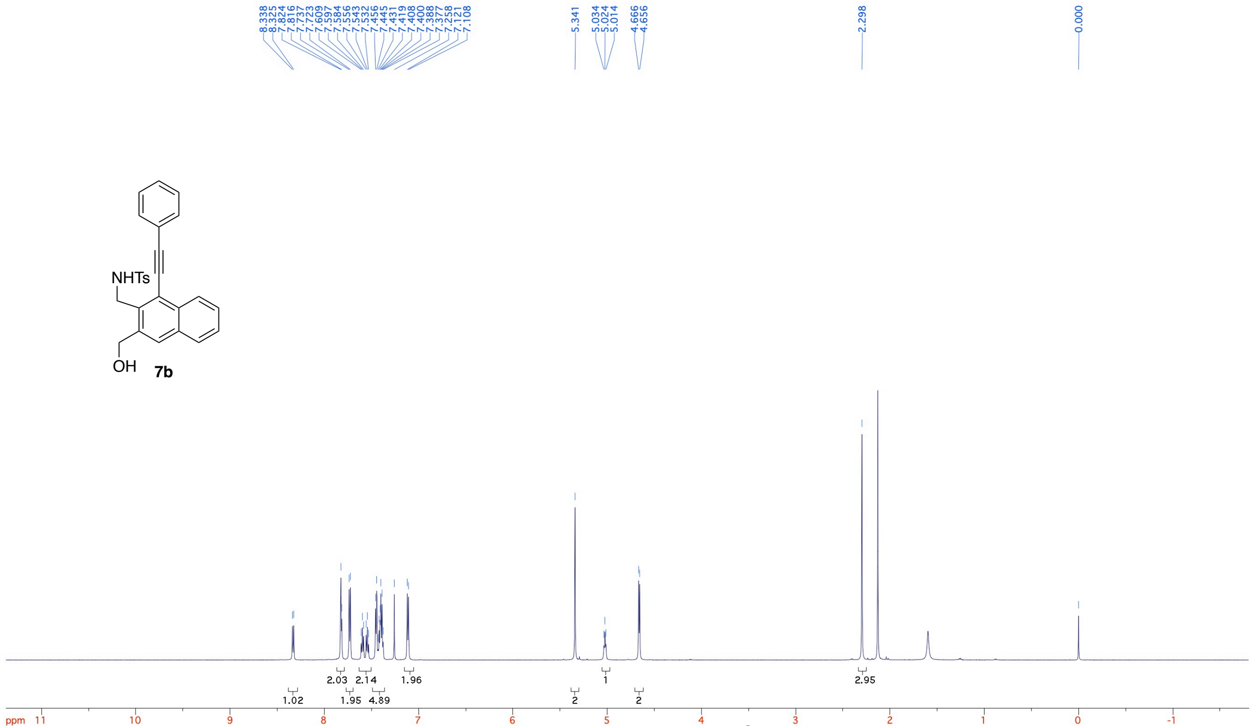
7.752
7.736
7.722
7.708
7.538
7.536
7.527
7.525
7.513
7.511
7.496
7.494
7.483
7.471
7.470
7.195
7.182
5.431
5.420
5.409
4.840
4.574
4.563
2.481
2.469
2.457
2.326
1.639
1.627
1.623
1.615
1.611
1.602
1.590
1.514
1.501
1.489
1.477
0.989
0.976
0.964
0.000
Bu
NHTs
OH
7a
1.03
4.34
2.15
2
1.05
2.32
2.14
2.17
3.16
3.05
2.11
3.2
ppm 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2


143.258
136.693
136.336
134.591
133.182
132.544
129.700
129.447
128.262
127.995
127.129
127.013
126.838
126.449
126.420
122.894
101.251
76.219
63.851
43.483
30.837
22.233
21.424
19.451
13.643
ppm 200 180 160 140 120 100 80 60 40 20 0


NHTs
OH
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7.816
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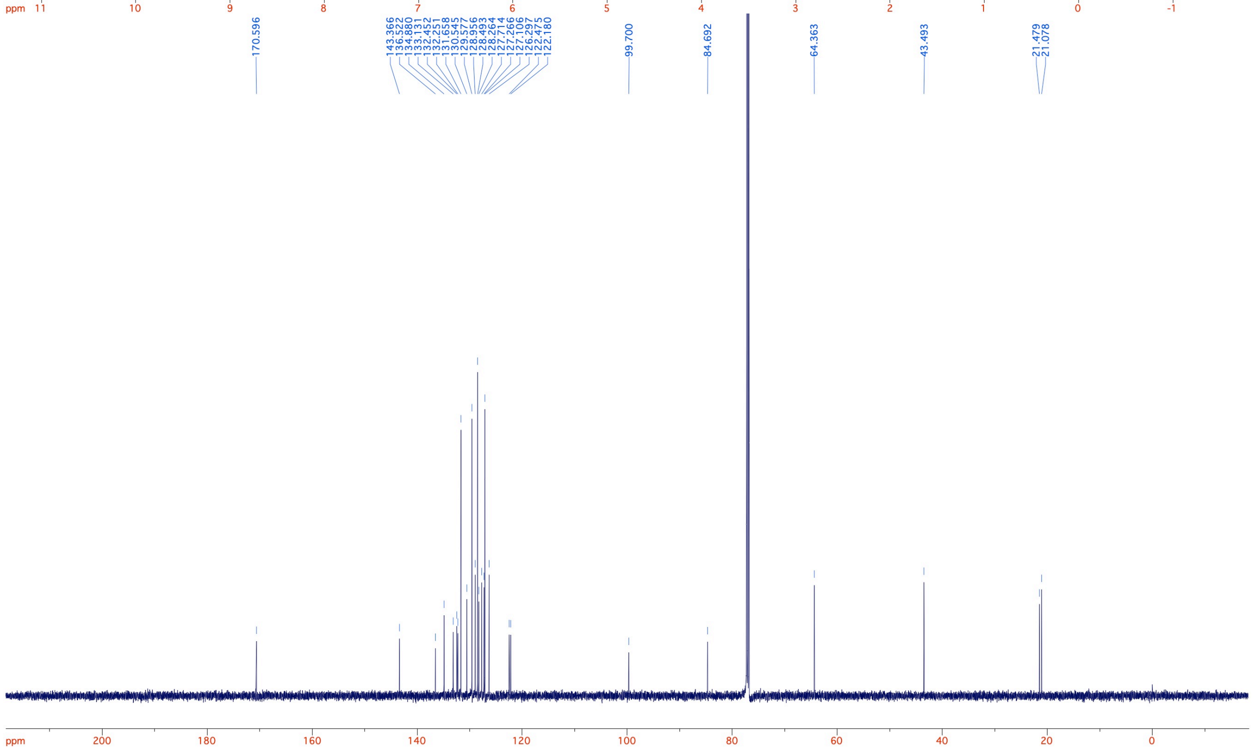
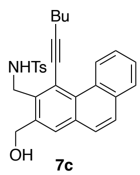
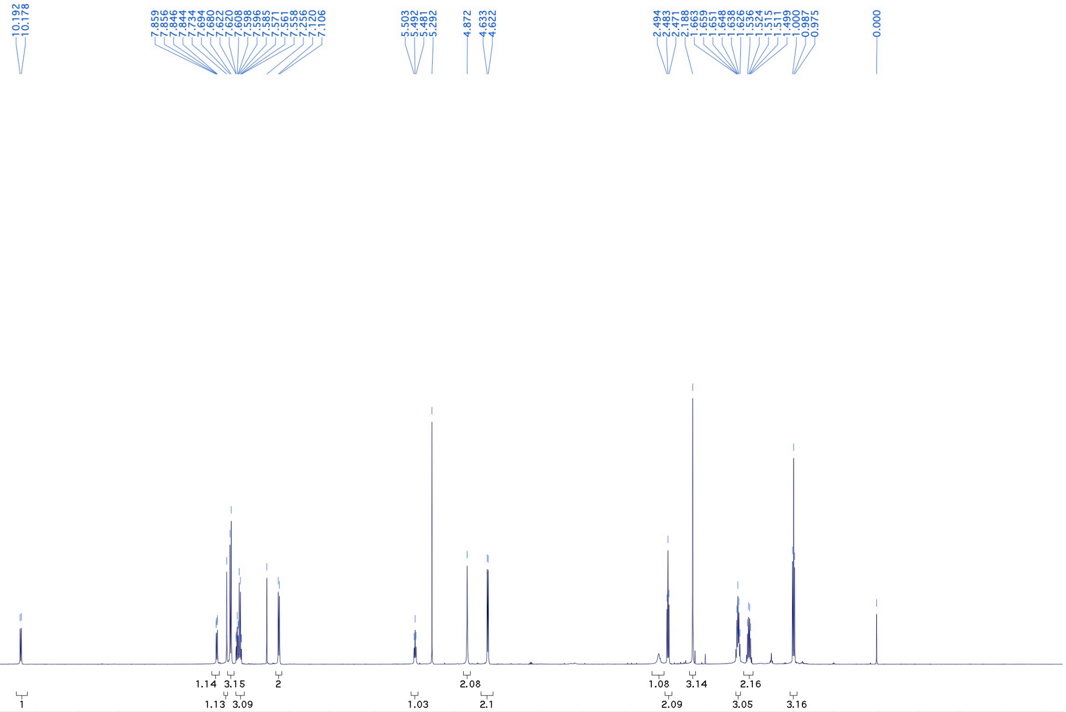
7.723
7.609
7.597
7.584
7.556
7.543
7.532
7.456
7.445
7.431
7.419
7.408
7.400
7.388
7.377
7.258
7.121
7.108
5.341
5.034
5.024
5.014
4.666
4.656
2.298
0.000
1.02
2.03
1.95
2.14
4.89
1.96
2
1
2
2.95
ppm 11 10 9 8 7 6 5 4 3 2 1 0 -1

7b


170.596
143.366
136.522
134.880
133.131
132.452
132.251
131.658
130.545
129.577
128.956
128.493
128.264
127.714
127.266
127.106
126.297
122.475
122.180
99.700
84.692
64.363
43.493
21.479
21.078
ppm 200 180 160 140 120 100 80 60 40 20 0


Bu
NHTs
OH

7c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10.178
7.859
7.856
7.846
7.844
7.734
7.694
7.680
7.622
7.620
7.608
7.598
7.596
7.585
7.571
7.561
7.558
7.256
7.120
7.106
5.503
5.492
5.481
5.292
4.872
4.633
4.622
2.494
2.483
2.471
2.188
1.663
1.659
1.651
1.648
1.638
1.626
1.536
1.524
1.515
1.511
1.499
1.000
0.987
0.975
0.000
1.14
3.15
2
1.13
3.09
1
1.03
2.08
2.1
1.08
3.14
2.16
2.09
3.05
3.16
ppm
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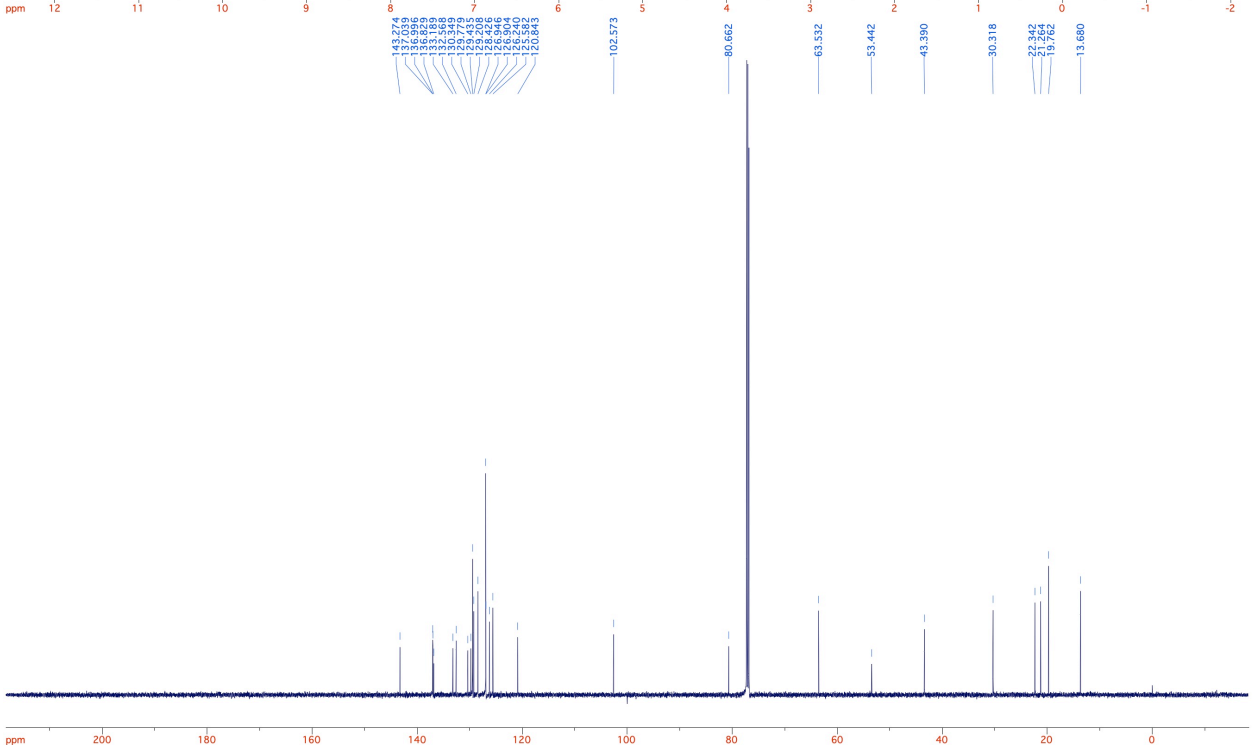
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2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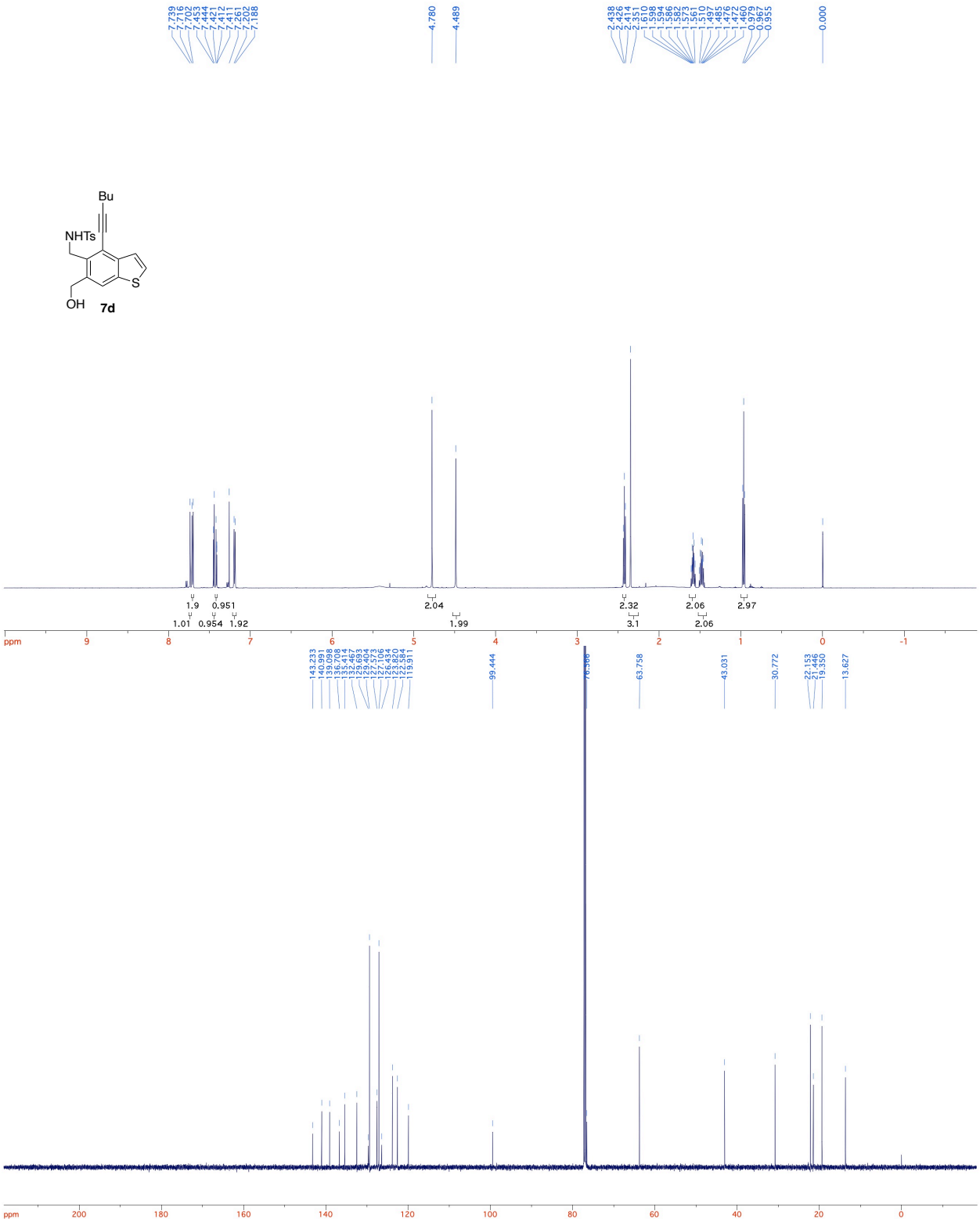
137.039
136.996
136.829
133.169
132.568
130.349
129.779
129.435
129.208
128.426
126.946
126.904
126.240
125.582
120.843
102.573
80.662
63.532
53.442
43.390
30.318
22.342
21.264
19.762
13.680
ppm
200
180
160
140
120
100
80
60
40
20
0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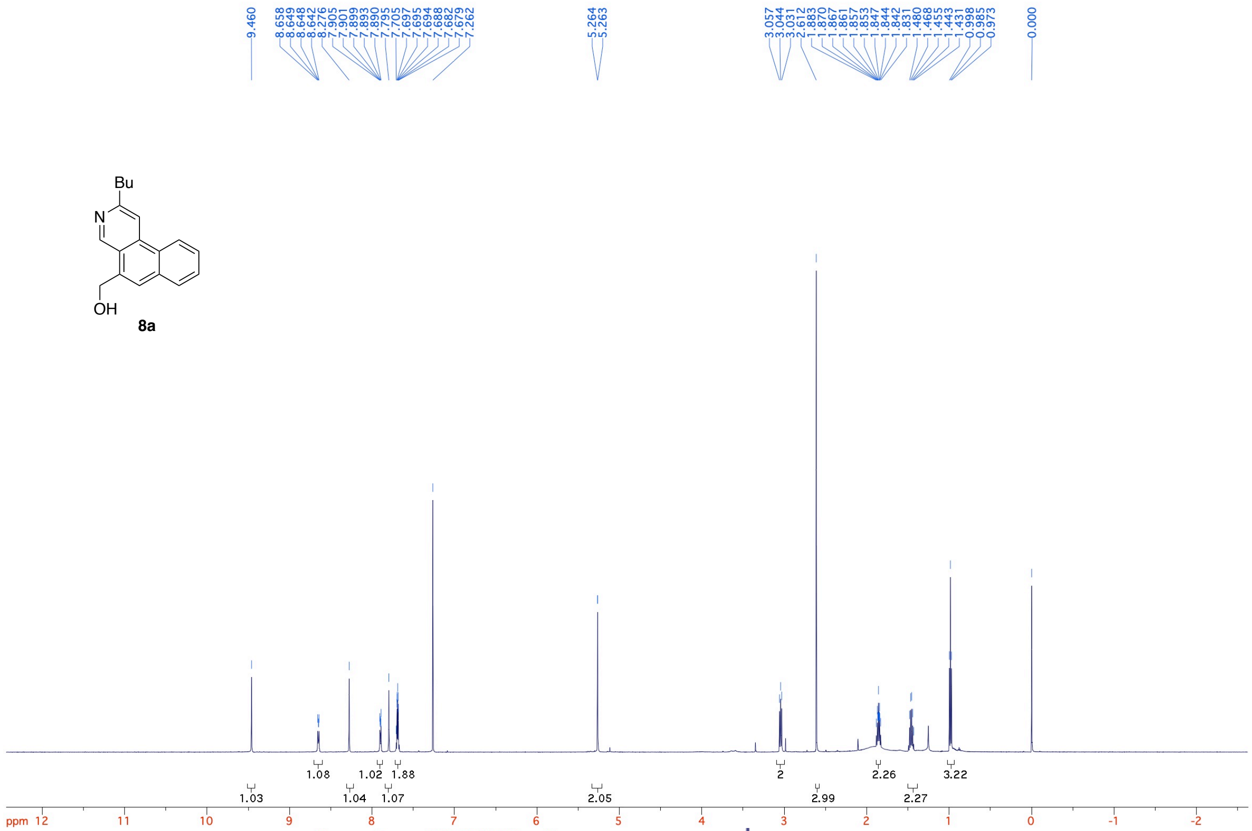
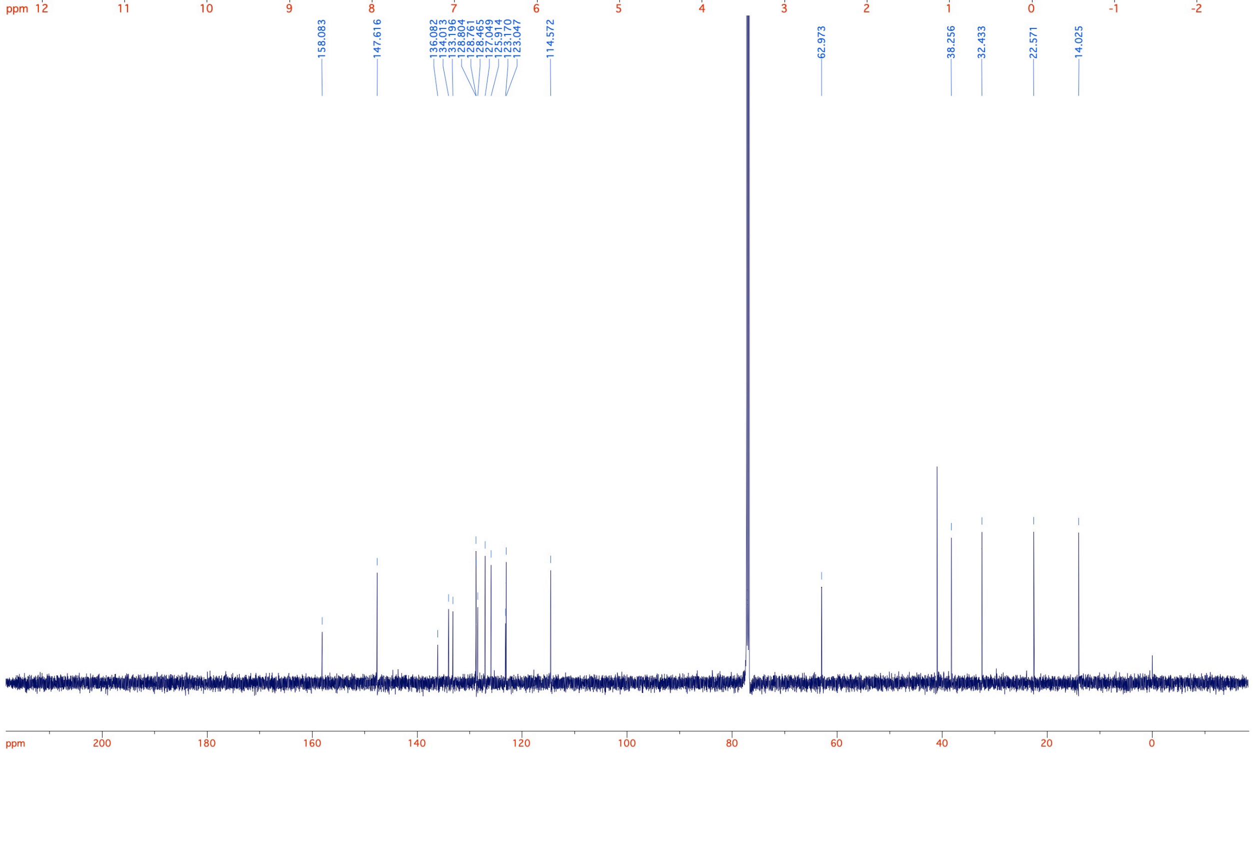
7.716
7.703
7.453
7.444
7.421
7.412
7.411
7.261
7.202
7.188
4.780
4.489
2.438
2.426
2.411
2.351
1.610
1.598
1.594
1.586
1.582
1.573
1.570
1.510
1.497
1.485
1.476
1.460
0.979
0.967
0.955
0.000
Bu
NHTs
S
OH
7d
1.9
0.951
2.04
2.32
2.06
2.97
1.01
0.954
1.92
1.99
3.1
2.06
ppm
9
8
7
6
5
4
3
2
1
0
-1
143.233
140.991
139.098
136.708
135.414
132.467
129.693
129.404
127.106
126.434
125.820
122.584
119.911
99.444
76.388
63.758
43.031
30.772
22.153
21.446
19.450
13.627
ppm
200
180
160
140
120
100
80
60
40
20
0


Bu
N
OH
8a
9.460
8.658
8.649
8.648
8.642
8.276
7.905
7.901
7.899
7.893
7.890
7.795
7.705
7.697
7.695
7.694
7.688
7.682
7.679
7.262
5.264
5.263
3.057
3.044
3.031
2.612
1.883
1.870
1.867
1.861
1.857
1.853
1.847
1.844
1.842
1.831
1.480
1.468
1.455
1.443
1.431
0.998
0.985
0.973
0.000
1.03
1.08
1.04
1.02
1.07
1.88
2.05
2
2.99
2.26
2.27
3.22
ppm 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2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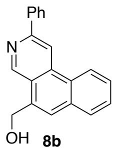
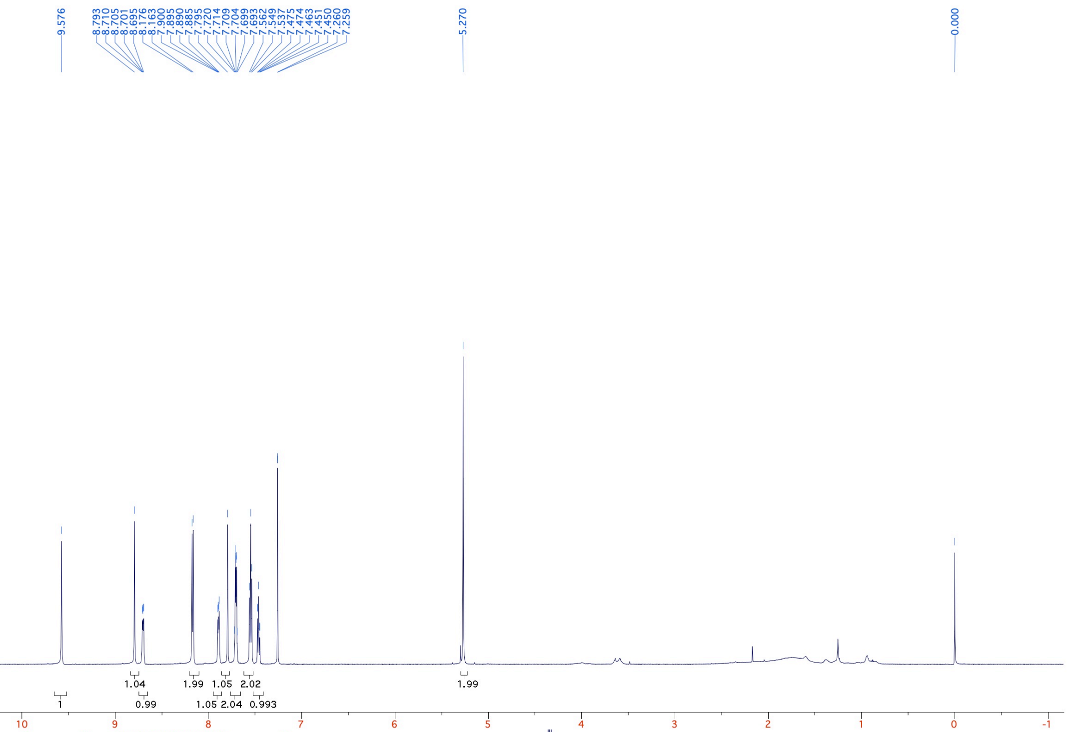
136.082
134.011
133.196
128.804
128.761
128.465
127.049
125.914
123.170
123.047
114.572
62.973
38.256
32.433
22.571
14.025
ppm 200 180 160 140 120 100 80 60 40 20 0

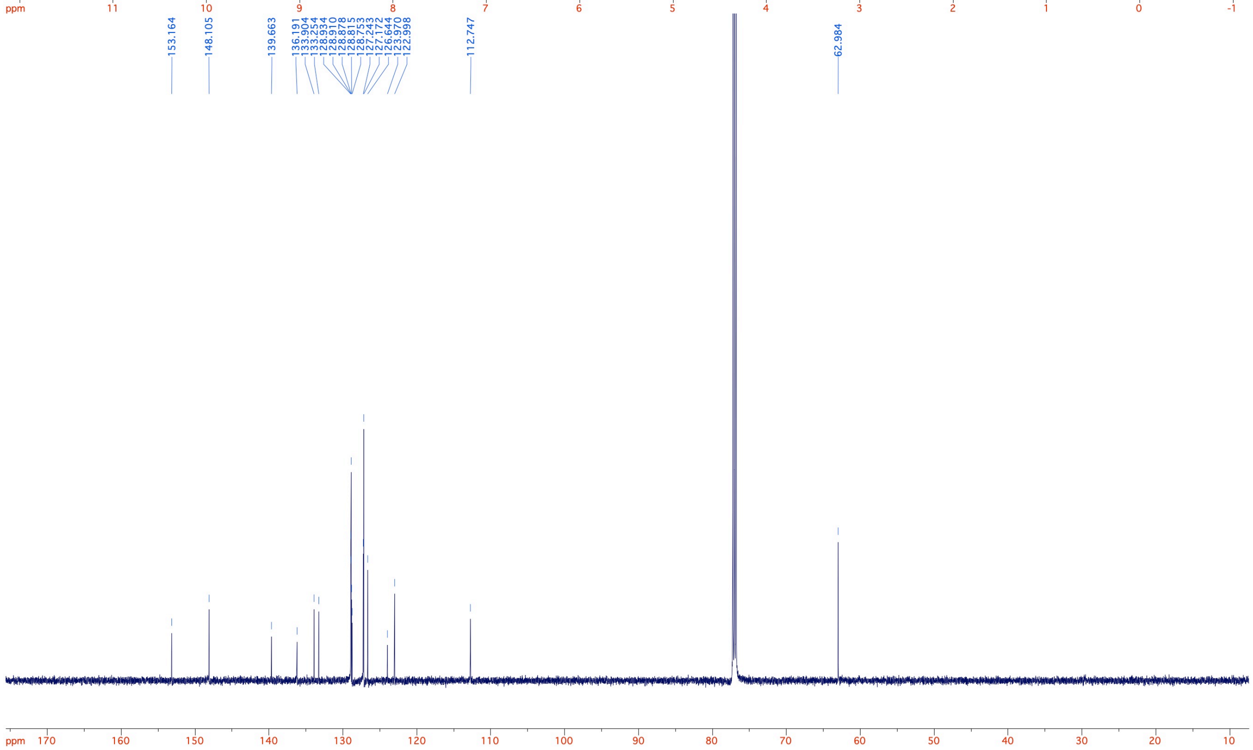


Ph
N
OH

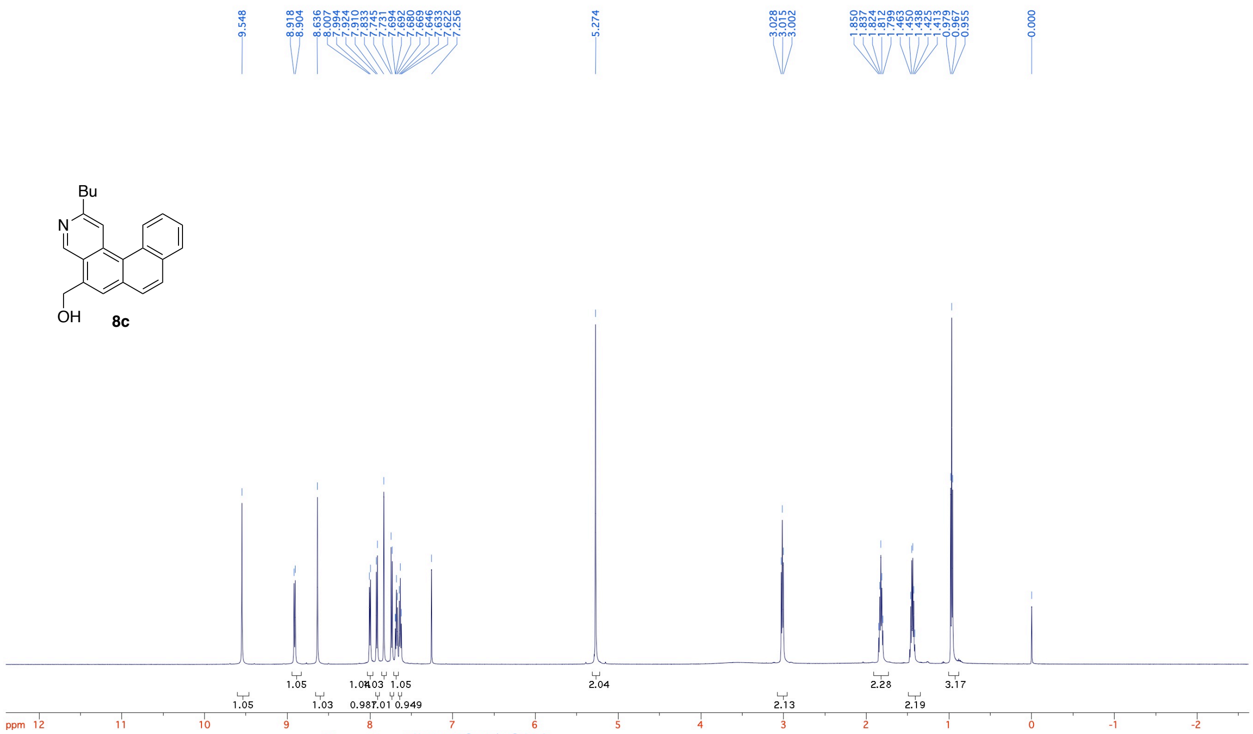
8b



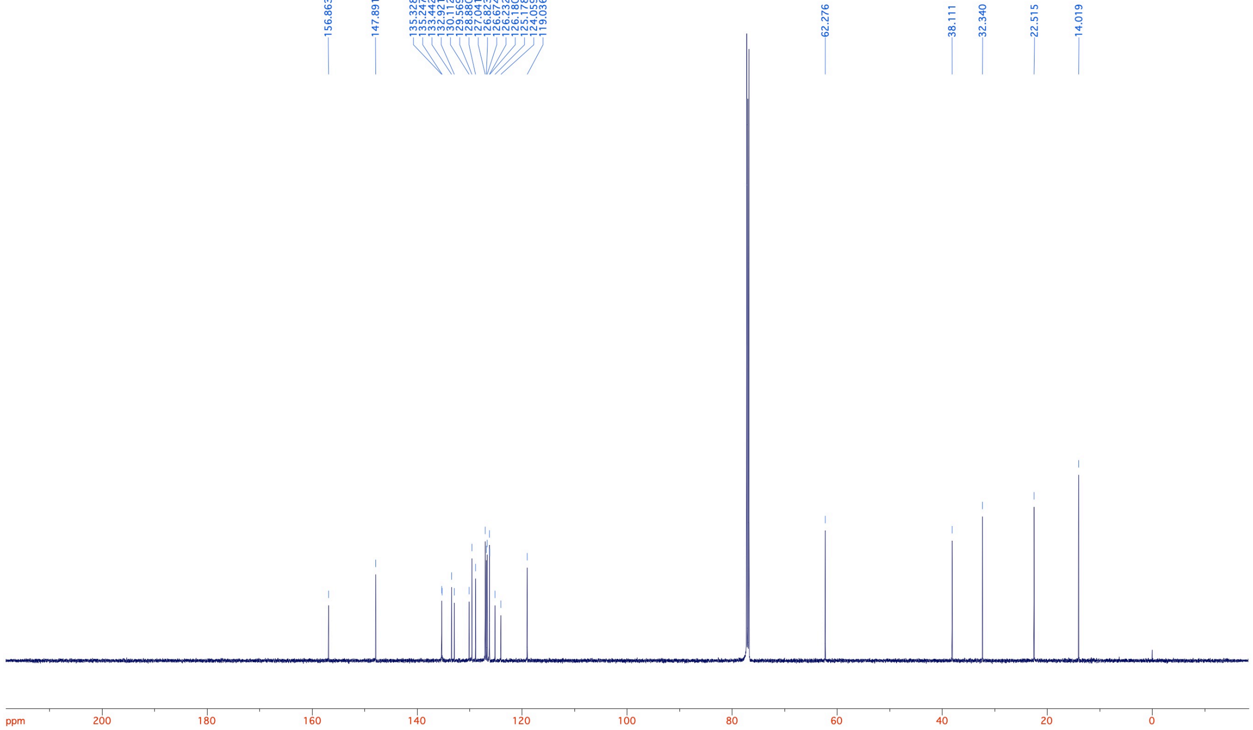
9.576
8.793
8.710
8.705
8.701
8.695
8.176
8.163
7.900
7.895
7.890
7.885
7.795
7.720
7.714
7.709
7.704
7.699
7.693
7.562
7.549
7.537
7.475
7.474
7.463
7.451
7.450
7.260
7.259
5.270
0.000
1
1.04
0.99
1.99
1.05
1.05
2.04
2.02
0.993
1.99
ppm
11
10
9
8
7
6
5
4
3
2
1
0
-1



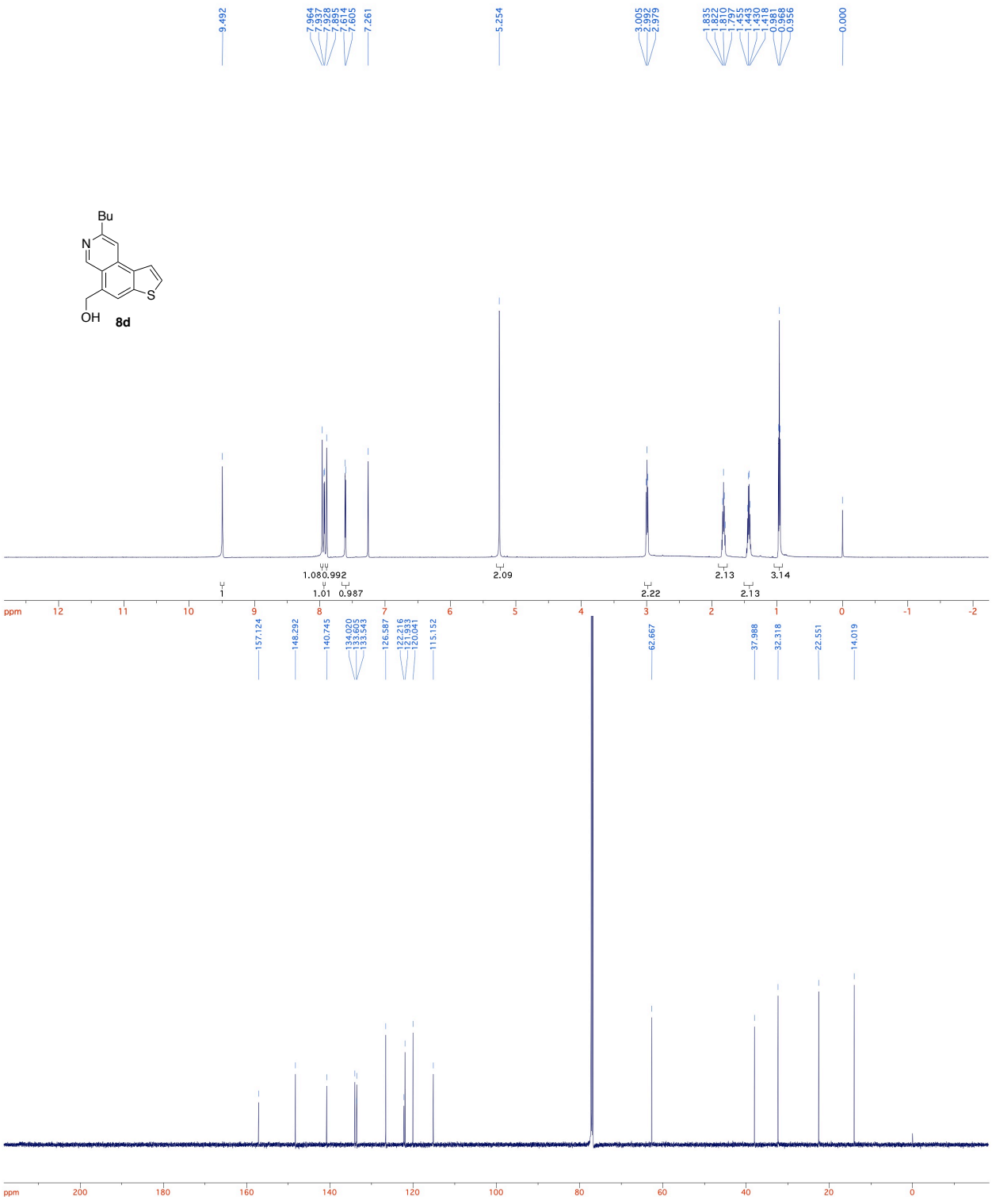
153.164
148.105
139.663
136.191
133.904
133.254
128.934
128.910
128.878
128.815
128.753
127.243
127.172
126.644
123.970
122.998
112.747
62.984
ppm
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10



9.548
8.918
8.904
8.636
8.007
7.994
7.924
7.910
7.813
7.745
7.731
7.694
7.692
7.680
7.669
7.646
7.633
7.622
7.256
5.274
3.028
3.015
3.002
1.850
1.837
1.824
1.812
1.799
1.463
1.450
1.438
1.425
1.413
0.979
0.967
0.955
0.000
Bu
N
OH
8c
1.05
1.05
1.03
1.04
1.03
1.05
0.98
1.01
0.949
2.04
2.13
2.28
2.19
3.17
ppm
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2



156.863
147.891
135.328
135.247
133.442
132.921
130.112
129.569
128.880
127.041
126.823
126.674
126.232
126.180
125.178
124.059
119.036
62.276
38.111
32.340
22.515
14.019
ppm
200
180
160
140
120
100
80
60
40
20
0


9.492
7.964
7.937
7.928
7.885
7.614
7.605
7.261
5.254
3.005
2.992
2.979
1.835
1.822
1.810
1.797
1.455
1.443
1.430
1.418
0.981
0.968
0.956
0.000
Bu
N
S
OH
8d
1.08
0.992
1.01
0.987
2.09
2.22
2.13
2.13
3.14
1
ppm
157.124
148.292
140.745
134.020
133.650
133.543
126.587
122.216
121.933
120.041
115.152
62.667
37.988
32.318
22.551
14.019