Supporting Information

One-pot relay catalysis: Divergent synthesis of furo[3,4-*b*]indoles and cyclopenta[*b*]indoles from 3-(2-aminophenyl)-1,4-enynols

Manisha, Seema Dhiman, Jopaul Mathew and S. S. V. Ramasastry *

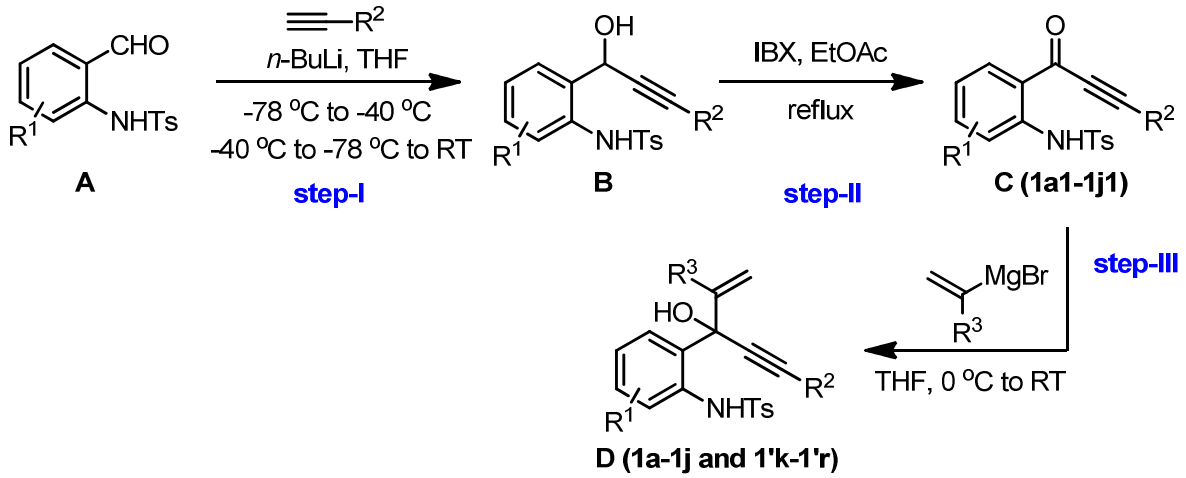
Organic Synthesis and Catalysis Lab, Department of Chemical Sciences, Indian Institute of Science Education and Research (IISER) Mohali, Sector 81, S A S Nagar, Manuali PO, Punjab 140 306, INDIA

E-mail: ramsastry@iisermohali.ac.in

General experimental methods: All the starting compounds and catalysts employed in this study were procured from Sigma-Aldrich and were used without further purification. For thin layer chromatography (TLC), silica aluminium foils with fluorescent indicator 254 nm (from Aldrich) were used and compounds were visualized by irradiation with UV light and/or by treatment with a solution of *p*-anisaldehyde (23 mL), conc. H_2SO_4 (35 mL), and acetic acid (10 mL) in ethanol (900 mL) followed by heating. Column chromatography was performed using SD Fine silica gel 100-200 mesh (approximately 15–20 g per 1 g of the crude product). Dry THF was obtained by distillation over sodium and stored over sodium wire. IR spectra were recorded on a Perkin–Elmer FT IR spectrometer as thin films or KBr pellet, as indicated, with ν_{max} in inverse centimetres. Melting points were recorded on a digital melting point apparatus Stuart SMP30 and were uncorrected. ^{1}H NMR and ^{13}C NMR spectra were recorded on a 400 MHz Bruker Biospin Avance III FT-NMR spectrometer. NMR shifts are reported as delta (δ) units in parts per million (ppm) and coupling constants (*J*) are reported in Hertz (Hz). The following abbreviations are utilized to describe peak patterns when appropriate: br=broad, s=singlet, d=doublet, t=triplet, q=quartet and m=multiplet. Proton chemical shifts are given in δ relative to tetramethylsilane (δ 0.00 ppm) in $CDCl_3$. Carbon chemical shifts are internally referenced to the deuterated solvent signals in $CDCl_3$ (δ 77.1 ppm). High-resolution mass spectra were recorded on a Waters QTOF mass spectrometer. Enantiomeric excess was determined by using Waters Chiral HPLC.

General procedure for the preparation of 3-(2-aminophenyl)pent-4-en-1-yn-3-ols (1a-1j and 1'k-1'r).

All the 3-(2-aminophenyl)pent-4-en-1-yn-3-ols (**1a-1j and 1'k-1'r**) employed in this study were prepared following a three-step protocol starting from 2-aminobenzaldehydes **A**.[1] *n*-Butyllithium mediated addition of alkynes to amino benzaldehydes **A** afforded ynols **B** which upon IBX oxidation generated the ynones **C**. Further addition of vinylmagnesium bromides to ynones **C** furnished 3-(2-aminophenyl)pent-4-en-1-yn-3-ols **D.**



Scheme 1S.General approach for the synthesis of 3-(2-aminophenyl)pent-4-en-1-yn-3-ols **1a-1j** and **1'k-1'r**.

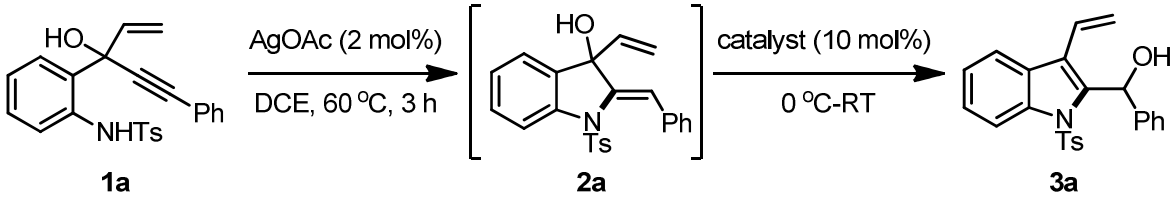
Representative procedure for step-I (Scheme 1S): To a stirred solution of the alkyne (2.2 equiv.) in anhydrous THF at −78 °C, was added *n*-butyllithium (2.0 M in cyclohexane solution, 2.2 equiv.) drop wise, and the resulting solution was allowed to stir at the same temperature for 10 min. The reaction was warmed to −40 °C. The resulting mixture was stirred at the same temperature for 1 h. After 1 h, reaction mixture was cooled to −78 °C. N-(2-formylphenyl)-4-methylbenzenesulfonamide **A** (1 mmol) was dissolved in THF (2 mL) and added to the reaction mixture drop wise at −78 °C and allowed to stir for 1 h at the same temperature. The reaction mixture was slowly warmed up to room temperature and stirred for a further 1 h. Upon completion, the reaction mixture was quenched by adding saturated aq. NH_4Cl (1 mL) and extracted with EtOAc. The combined organic layers were washed with brine, dried over anhydrous Na_2SO_4, and concentrated under reduced pressure. The residue was purified by silica gel column chromatography (20-30% EtOAc/hexane) to afford **B** in 80-90% yields.

[1]S. Dhiman, S. S. V. Ramasastry, *Chem. Commun*. **2015**, *51*, 557.

Representative procedure for step-II (Scheme 1S): Ynol **B** (1 mmol) was dissolved in EtOAc (5 mL), and IBX (1.5 mmol) was added. The resulting suspension was stirred at 75 °C until alcohol **B** disappeared as monitored by TLC. The reaction mixture was cooled to room temperature and filtered through celite pad. The residue was washed with ethyl acetate (3×2 mL). Organic extracts were combined and washed with saturated aq. $NaHCO_3$ solution to remove excess iodobenzoic acid. The combined organic layers were washed with brine, dried over anhydrous Na_2SO_4, and concentrated under reduced pressure. The residue was purified by silica gel column chromatography (20-30% EtOAc/hexane) to afford **C** in 75-85% yields.

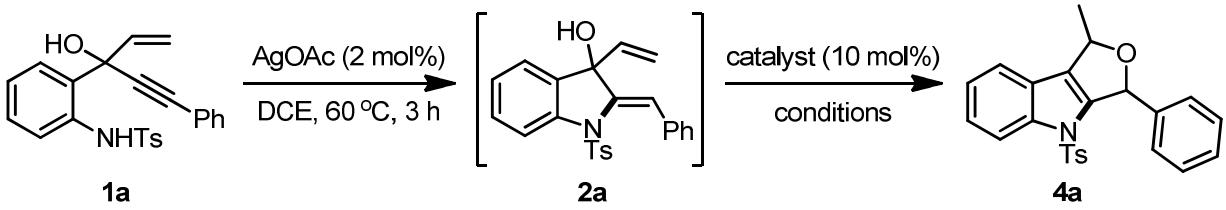
Representative procedure for step-III (Scheme 1S): An oven dried round bottom flask was charged with ynones **C** (1.0 mmol), 5 mL dry THF and placed at 0^oC. Vinylmagnesium bromide (2.0 *M* in THF, 3.5 mmol) was added drop wise at the same temperature and stirred for 1h. Upon completion, the reaction mixture was quenched by adding saturated aq. NH_4Cl (1 mL) and extracted with EtOAc. The combined organic layers were washed with brine, dried over anhydrous Na_2SO_4, and concentrated under reduced pressure. The residue was purified by silica gel column chromatography (10-20% EtOAc/hexane) to afford **D** in 84-97% yields.

Optimization of the reaction parameters (Table 1).



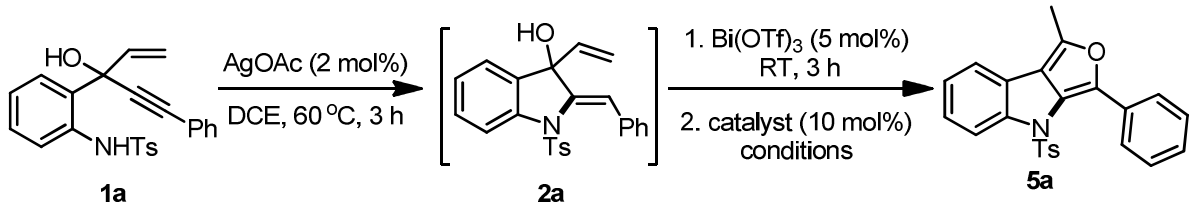
Scheme 2S. Optimization of reaction parameters.

Representative procedure for 3a (Table 1, entries 1-3): A 5 mL glass vial was charged with 3-(2-aminophenyl)-pent-4-en-1-yn-3-ol (0.1 mmol), AgOAc (2 mol%) in DCE solvent (1 mL) stirred at 60 °C. Upon disappearance of **1a**, catalyst (10 mol%) was introduced and continued stirring at 0°C to RT until intermediate **2a** disappeared. On complete formation of **3a,** the reaction mixture was quenched by adding saturated aq. $NaHCO_3$ (1 mL) and extracted with EtOAc (2 x 2 mL). The combined organic layers were washed with brine, dried over anhydrous Na_2SO_4, and concentrated under reduced pressure. The residue was purified by silica gel column chromatography (10-20% EtOAc/hexane) to afford **3a**.



Scheme 3S. Optimization of reaction parameters.

Representative procedure for 4a (Table 1, entries 4-12): A 5 mL glass vial was charged with 3-(2-aminophenyl)-pent-4-en-1-yn-3-ol (0.1 mmol), AgOAc (2 mol%) in DCE solvent (1 mL) stirred at 60 °C. Upon disappearance of **1a**, catalyst (10 mol%) in an appropriate solvent was introduced and continued stirring at appropriate temperature until intermediate **2a** disappeared. On complete formation of **4a**, the reaction mixture was quenched by adding saturated aq. $NaHCO_3$ (1 mL) and extracted with EtOAc (2 x 2 mL). The combined organic layers were washed with brine, dried over anhydrous Na_2SO_4, and concentrated under reduced pressure. The residue was purified by silica gel column chromatography (10-20% EtOAc/hexane) to afford **4a**.

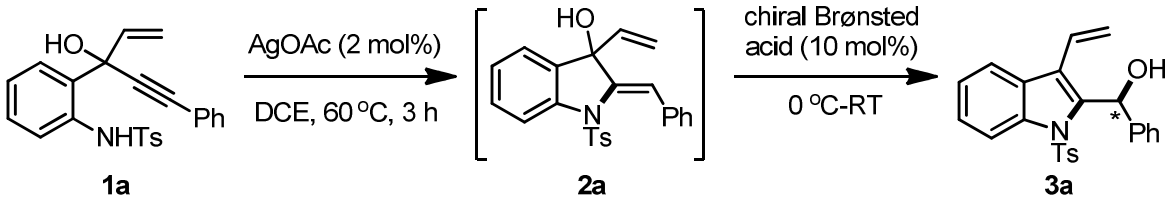


1a **2a** **5a**

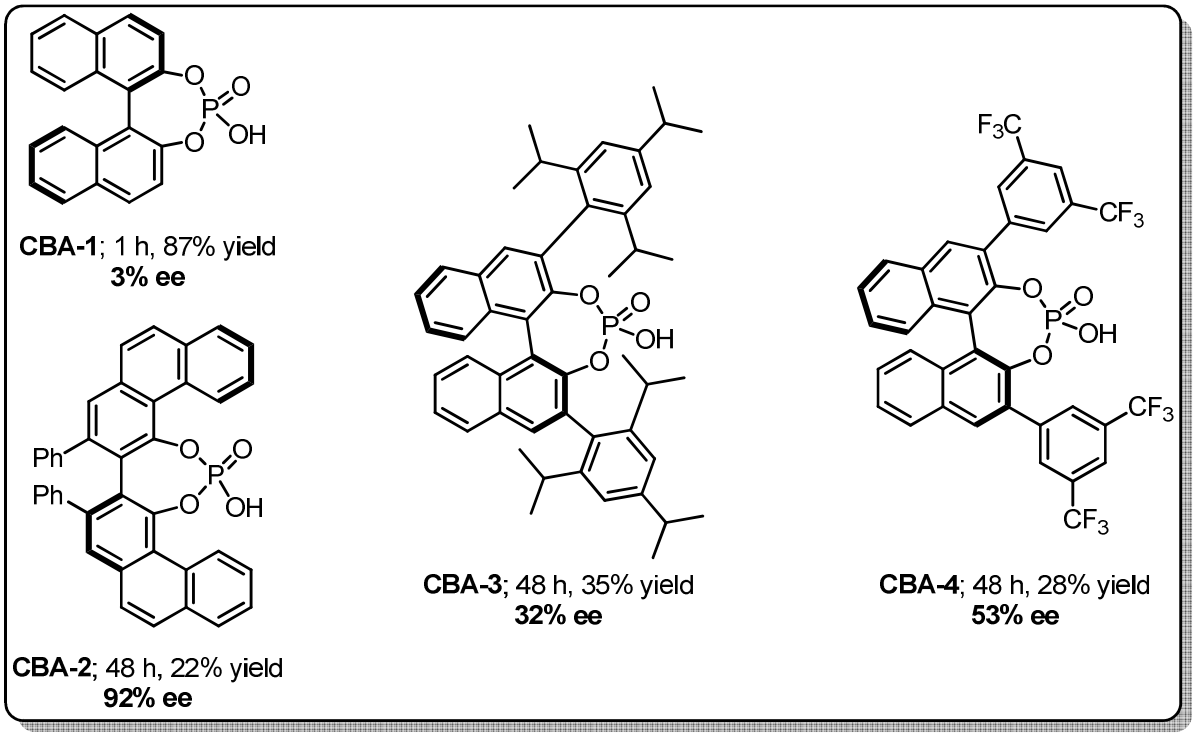
Scheme 4S. Optimization of reaction parameters.

Representative procedure for 5a (Table 1, entries 13-19): A 5 mL glass vial was charged with 3-(2-aminophenyl)-pent-4-en-1-yn-3-ol **1a** (0.1 mmol), AgOAc (2 mol%) in DCE solvent (1 mL) stirred at 60 ^{o}C. Upon disappearance of **1a**, $Bi(OTf)_3$ (5 mol%) was introduced and continued stirring at room temperature (see Table 1) until intermediate **2a** disappeared. Then, reaction mixture was quenched by adding saturated aq. $NaHCO_3$ (1 mL) and extracted with EtOAc (2 x 2 mL). The combined organic layers were washed with brine, dried over anhydrous Na_2SO_4, and concentrated under reduced pressure. The crude residue (crude **3a**) was further subjected to a palladium catalyst (10 mol%) in 1,2-dichloroethane with continuous stirring at an appropriate temperature. Upon disappearance of starting material (monitored by TLC), the volatiles were removed under reduced pressure and crude residue was purified by silica gel column chromatography (10-20% EtOAc/hexane) to afford **5a**.

General procedure for Scheme 2.



Scheme 5S. Optimization of reaction parameters.



Representative procedure for chiral 3a (Scheme 2): A 5 mL glass vial was charged with 3-(2-aminophenyl)-pent-4-en-1-yn-3-ol (0.1 mmol), AgOAc (2 mol%) in DCE solvent (1 mL) stirred at 60 ^{o}C. Upon disappearance of **1a**, chiral catalyst (10 mol%) was introduced and continued stirring at 0 ^{o}C-RT until the intermediate **2a** disappeared. Upon complete formation of **3a,** the reaction mixture was quenched by adding saturated aq. $NaHCO_3$ (1 mL) and extracted with EtOAc (2 x 2 mL). The combined organic layers were washed with brine, dried over anhydrous Na_2SO_4, and concentrated under reduced pressure. The residue was purified by silica gel column chromatography (10-20% EtOAc/hexane) to afford **3a**. The enantiomeric excess was determined by using chiral HPLC.

Empower 3

Vishnu

SAMPLE INFORMATION

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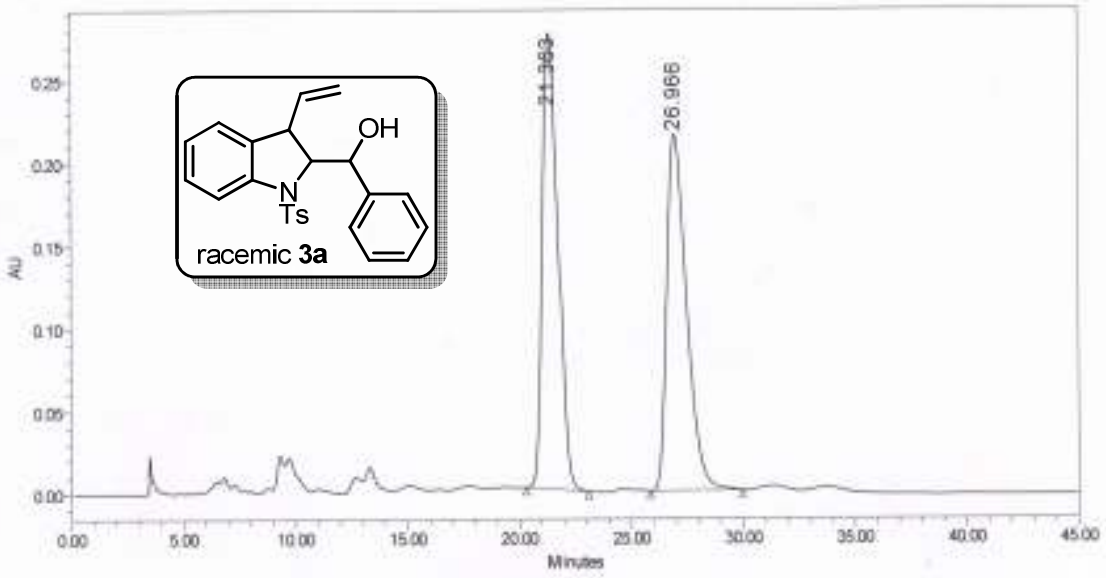
Injection #:	1	Processing Method:	ms0301
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	80.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	17-07-2015 18:51:22 IST		
Date Processed:	05-02-2016 23:31:12 IST		



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Report Method: Vishnu
Report Method Id 5245
Page: 1 of 1

Project Name: YR_01
Date Printed:
05-02-2016
23:34:59 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

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Injection #:	1	Processing Method:	ms0301vapp
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	80.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
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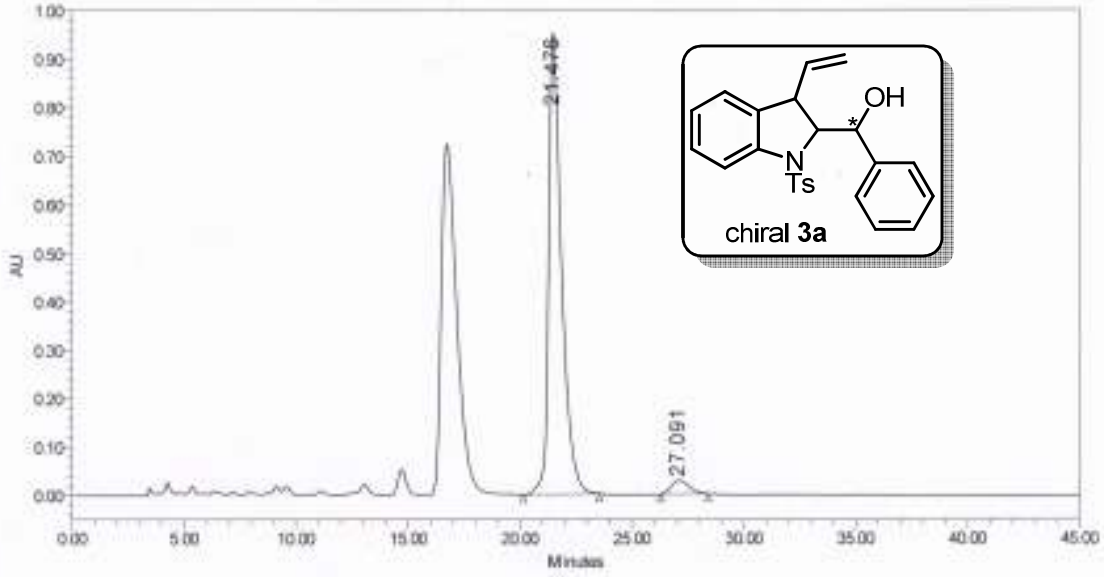

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Page: 1 of 1

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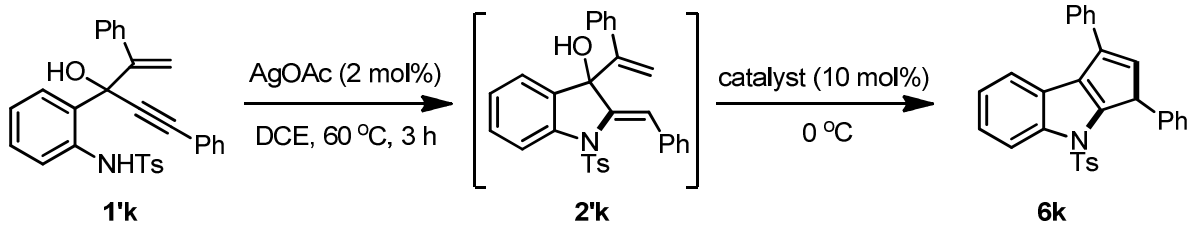
Analysis with CBA-2 (92% ee)

General procedure for Table 3.



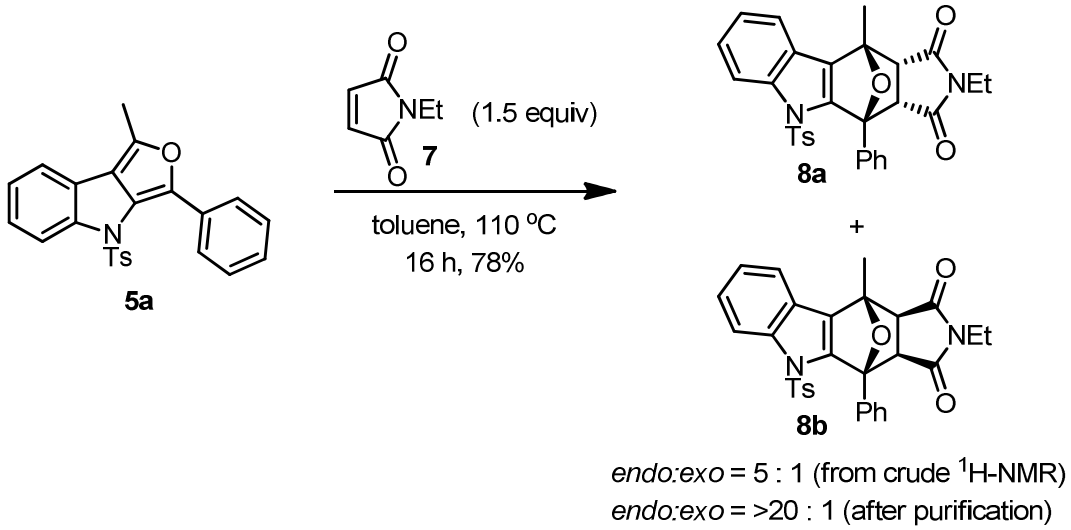
Scheme 6S. Optimization of reaction parameters.

Screening Table for compound 6k (Table 3).

Entry	Catalyst (10 mol%)	Time (min)	Yield (%)
1	$Sc(OTf)_3$	15	42
2	**CSA**	**30**	**80**
3	**PTSA**	**30**	**70**
4	$FeCl_3$	45	42
5	$AlCl_3$	35	65
6	$Pd(OAc)_2$	360	-
7	$Co(acac)_2$	360	-
8	AgOTf	40	55
9	**TfOH**	**20**	**68**
10	CF_3COOH	20	28
11	$ClCH_2COOH$	360	-
12	Amberlyst-15	180	56

Representative procedure for 6k (Scheme 6S, Table 3): A 5 mL glass vial was charged with 3-(2-aminophenyl)-pent-4-en-1-yn-3-ol **1'k** (0.1 mmol), AgOAc (2 mol%) in DCE solvent (1 mL) stirred at 60 °C. Upon disappearance of **1'k**, catalyst (10 mol%) was introduced and continued stirring at 0 °C until intermediate **2'k** disappeared. On complete formation of **6a**, the reaction mixture was quenched by adding saturated aq. $NaHCO_3$ (1 mL) and extracted with EtOAc (2 x 2 mL). The combined organic layers were washed with brine, dried over anhydrous Na_2SO_4, and concentrated under reduced pressure. The residue was purified by silica gel column chromatography (10-20% EtOAc/hexane) to afford **6k**.

General procedure for the Diels-Alder reaction (Scheme 4).[2]

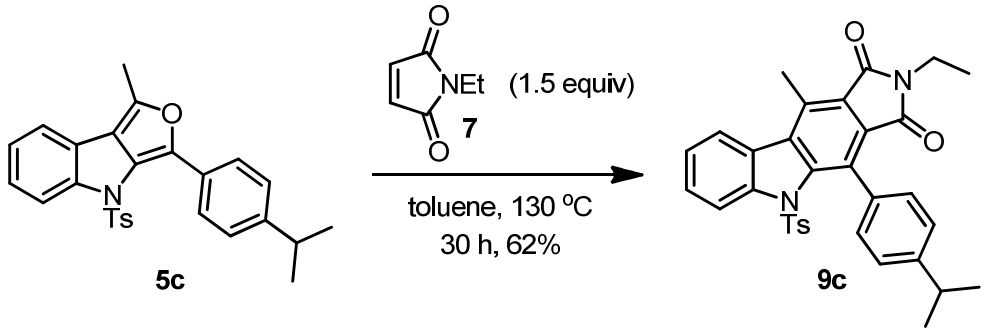


Scheme 7S. Diels-Alder reaction of the furoindole **5a** and N-ethyl maleimide **7**.

Representative procedure for 8a (Scheme 7S): An oven dried 10 mL round bottom flask was charged with furo[3,4-*b*]indole **5a** (0.1 mmol), N-ethyl maleimide (0.15 mmol) in toluene (1.5 mL) and stirred at 110 °C for 16 h. Upon disappearance of **5a** (monitored by TLC), the organic volatiles were removed under reduced pressure and crude residue was purified by silica gel column chromatography (10-20% EtOAc/hexane) to afford **8a** in 78% yield.

[2] (a) G. W**.** Gribble, M. G. Saulnier, M. P. Sibi and J. A. Obaza-Nutaitis, *J. Org. Chem.,* 1984, **49,** 4518; (b) G. W. Gribble, D. J. Keavy, D. A. Davis, M. G. Saulnier, B. Pelcman, T. C. Barden, M. P. Sibi, E. R. Olson and J. J. BelBruno, *J. Org. Chem.,* 1992, **57**, 5878;

General procedure for the Diels-Alder reaction (Scheme 5).[2]

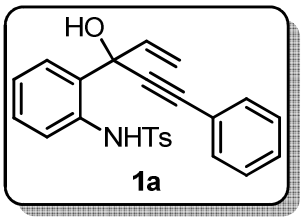


Scheme 8S. Diels-Alder reaction of the furoindole **5c** and N-ethyl maleimide **7**.

Representative procedure for 9c (Scheme 8S): An oven dried 5 mL round bottom flask was charged with furo[3,4-*b*]indole **5c** (0.1 mmol), N-ethyl maleimide (0.15 mmol) in toluene (1.5 mL) and stirred at 130 °C for 30 h. Upon disappearance of **5c** (monitored by TLC), the organic volatiles were removed under reduced pressure and crude residue was purified by silica gel column chromatography (10-20% EtOAc/hexane) to afford **9c** in 62% yield.

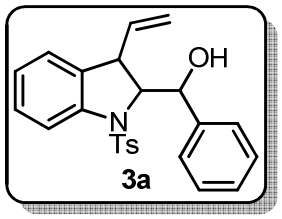
Spectroscopic data of all new compounds reported in this study

***N*-(2-(3-Hydroxy-5-phenylpent-1-en-4-yn-3-yl)phenyl)-4-methylbenzenesulfonamide (1a).**



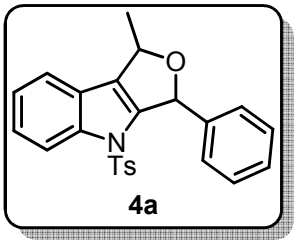
This compound was isolated as pale yellow oil. Following the general procedure (Scheme 1S), 80 mg of **1a1** afforded 76 mg of **1a** (88% yield). R_f = 0.5 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3432, 3250, 2226, 1599, 1493, 1336, 1159, 1092, 757. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.97 (s, 1H), 7.78 (d, *J* = 8.2 Hz, 2H), 7.64-7.62 (m, 2H), 7.51-7.49 (m, 2H), 7.41-7.33 (m, 3H), 7.28-7.24 (m, 1H), 7.17 (dd, *J* = 8.9 and 2.8 Hz, 2H), 7.05(t, *J* = 7.6 Hz, 1H), 6.02 (dd, *J* = 17.0 and 6.8 Hz, 1H), 5.56 (d, *J* = 17.0 Hz, 1H), 5.20 (d, *J* = 10.2 Hz, 1H), 3.40 (s, 1H), 2.35 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 143.7, 139.0, 136.9, 136.1, 131.8(2C), 129.5(2C), 129.4, 129.2, 129.0, 128.4(2C), 128.3, 127.4(2C), 123.4, 121.8, 119.6, 115.7, 89.0, 87.9, 74.6, 21.5. **HRMS (ESI):** *m/z* calcd for $C_{24}H_{21}NO_3SNa$ $(M+Na)^+$: 426.1140. Found: 426.1115.

Phenyl(1-tosyl-3-vinylindolin-2-yl)methanol (3a).



This compound was isolated as light brown oil. Following the general procedure (Scheme 2S), 50 mg of **1a** afforded 46 mg of **3a** (85% yield). R_f = 0.5 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3472, 3061, 2925, 1597, 1449, 1365, 1171, 1088, 748. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.11 (d, *J* = 8.0 Hz, 1H), 7.78-7.76 (m, 1H), 7.40-7.30 (m, 9H), 7.06 (d, *J* = 8.1 Hz, 2H), 6.84 (dd, *J* = 17.8 and 11.5 Hz, 1H), 6.59 (d, *J* = 10.6 Hz, 1H), 5.77 (dd, *J* = 17.8 and 1.4 Hz, 1H), 5.56 (dd, *J* = 11.5 and 1.4 Hz, 1H), 4.45 (d, *J* = 10.6 Hz, 1H), 2.32 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 145.0, 142.0, 137.8, 136.6, 135.1, 129.6(2C), 128.4, 128.3(2C), 127.4, 127.1, 126.8(2C), 125.8(2C), 125.5, 124.0, 122.6, 120.5, 120.1, 115.0, 68.2, 21.6. **HRMS (ESI):** *m/z* calcd for $C_{24}H_{21}NO_3SNa$ $(M+Na)^+$: 426.1140. Found: 426.1125.

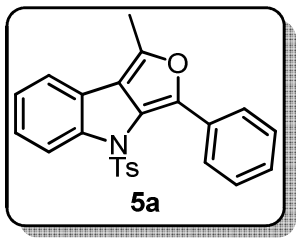
1-Methyl-3-phenyl-4-tosyl-3,4-dihydro-1*H*-furo[3,4-*b*]indole (4a).



This compound was isolated as light yellow oil. Following the general procedure (Scheme 3S), 40 mg of **1a** afforded 14 mg of **4a** (35% yield). R_f = 0.6 (Hexane/EtOAc = 4/1). **IR (thin film, neat):**

ν_{max}/cm^{-1} 3066, 2924, 2857, 1597, 1448, 1371, 1176, 1040, 758. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.97-8.01 (m, 2H), 7.29-7.40 (m, 7H), 7.07-7.12 (m, 2H), 6.99-7.03 (m, 2H), 6.35 (d, *J* = 2.8 Hz, 1H), 5.44-5.49 (m, 1H), 2.32 (s, 3H), 1.70 (d, *J* = 6.4 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 144.8, 140.8, 135.0, 129.6(2C), 129.0(2C), 128.6, 128.4(2C), 128.2, 128.1, 127.0(2C), 126.9, 124.4, 123.9, 123.6, 119.2, 114.6, 81.9, 75.7, 22.8, 21.5. **HRMS (ESI):** *m/z* calcd for $C_{24}H_{22}NO_3S$ $(M+H)^+$: 404.1320. Found: 404.1306.

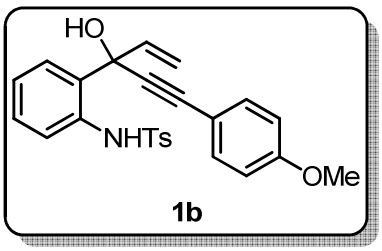
1-Methyl-3-phenyl-4-tosyl-4*H*-furo[3,4-*b*]indole (5a).



5a

This compound was isolated as light brown oil. Following the general procedure (Scheme 4S), 30 mg of **1a** afforded 15 mg of **5a** (50% yield). R_f = 0.8 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2928, 2850, 1740, 1375, 750. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.12 (d, *J* = 8.2 Hz, 1H), 7.86 (d, *J* = 7.2 Hz, 2H), 7.50-7.33 (m, 6H), 7.25 (d, *J* = 8.2 Hz, 2H), 7.00 (d, *J* = 8.2 Hz, 2H), 2.53 (s, 3H), 2.27 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 145.9, 144.4, 140.3, 136.8, 132.3, 130.2, 129.0(2C), 128.5, 128.0(2C), 127.9, 127.8(2C), 127.4(2C), 126.6, 125.3, 124.3, 120.9, 120.3, 118.5, 21.6, 13.7. **HRMS (ESI):** *m/z* calcd for $C_{24}H_{20}NO_3S$ $(M+H)^+$: 402.1163. Found: 402.1150.

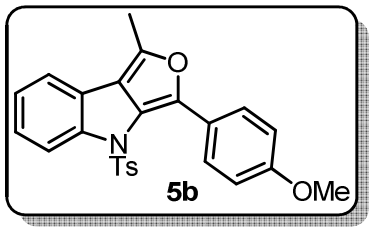
***N*-(2-(3-Hydroxy-5-(4-methoxyphenyl)pent-1-en-4-yn-3-yl)phenyl)-4-methylbenzenesulfonamide (1b).**



1b

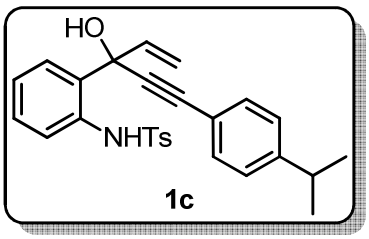
This compound was isolated as light brown oil. Following the general procedure (Scheme 1S), 80 mg of **1b1** afforded 77 mg of **1b** (97% yield). R_f = 0.1 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3441, 3252, 2932, 2225, 1742, 1605, 1510, 1251, 1160, 1091, 756. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.84 (s, 1H), 7.78 (d, *J* = 8.3 Hz, 2H), 7.64-7.59 (m, 2H), 7.44 (d, *J* = 9.1 Hz, 2H), 7.27-7.23 (m, 1H), 7.20 (d, *J* = 8.2 Hz, 2H), 7.04 (td, *J* = 7.6 and 1.0 Hz, 1H), 6.88 (d, *J* = 9.0 Hz, 2H), 6.00 (dd, *J* = 17.0 and 10.1 Hz, 1H), 5.54 (d, *J* = 16.9 Hz, 1H), 5.20 (d, *J* = 10.2 Hz, 1H), 3.84 (s, 3H), 3.00 (s, 1H), 2.37 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 160.1, 143.6, 139.0, 137.0, 136.0, 133.3(2C), 129.5(2C), 129.3, 129.2, 128.1, 127.4(2C), 123.3, 119.6, 115.5, 114.0(2C), 113.6, 89.1, 86.5, 74.6, 55.3, 21.5. **HRMS (ESI):** *m/z* calcd for $C_{25}H_{23}NO_4SNa$ $(M+Na)^+$: 456.1245. Found: 456.1228.

3-(4-Methoxyphenyl)-1-methyl-4-tosyl-4*H*-furo[3,4-*b*]indole (5b).



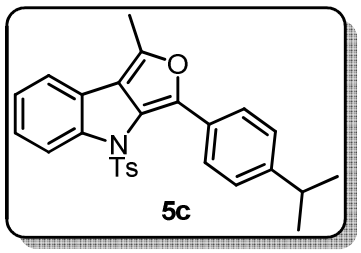
This compound was isolated as pale brown oil. Following the general procedure (Scheme 4S), 20 mg of **1b** afforded 11 mg of **5b** (54% yield). R_f = 0.4 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2924, 2855, 1669, 1599, 1371, 1258, 1176, 1090, 751.**^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.12 (d, *J* = 8.2 Hz, 1H), 7.78 (d, *J* = 8.8 Hz, 2H), 7.42 (d, *J* = 7.5 Hz, 1H), 7.37-7.32 (m, 1H), 7.26 (d, *J* = 8.2 Hz, 3H), 7.03-6.99 (m, 4H), 3.90 (s, 3H), 2.51 (s, 3H), 2.27 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 159.3, 145.9, 144.3, 139.6, 136.7, 132.4, 129.4(2C), 129.0(2C), 127.8, 127.4(2C), 126.5, 125.3, 124.4, 123.0, 120.9, 120.1, 118.4, 113.3(2C), 55.3, 21.6, 13.6. **HRMS (ESI):** *m/z* calcd for $C_{25}H_{22}NO_4S$ $(M+H)^+$: 432.1270. Found: 432.1254.

***N*-(2-(3-Hydroxy-5-(4-isopropylphenyl)pent-1-en-4-yn-3-yl)phenyl)-4-methylbenzenesulfonamide (1c).**



This compound was isolated as pale yellow oil. Following the general procedure (Scheme 1S), 70 mg of **1c1** afforded 63 mg of **1c** (84% yield). R_f = 0.3 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3446, 3243, 2962, 2928, 2225, 1672, 1495, 1336, 1160, 1092, 757. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.85 (s, 1H), 7.77 (d, *J* = 8.3 Hz, 2H), 7.63 (d,*J* = 8.4 Hz, 2H), 7.43 (d, *J* = 8.2 Hz, 2H), 7.27-7.21 (m, 3H), 7.18 (d, *J* = 8.1 Hz, 2H), 7.06-7.01 (m, 1H), 6.01 (dd, *J* = 17.0 and 10.2 Hz, 1H), 5.55 (d, *J* = 17.0 Hz, 1H), 5.20 (d, *J* = 10.2 Hz, 1H), 3.01 (s, 1H), 2.97-2.90 (m, 1H), 2.36 (s, 3H), 1.27 (s, 3H), 1.26 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 150.2, 143.6, 138.9, 136.9, 136.0, 131.8(2C), 129.5(2C), 129.4, 129.1, 128.2, 127.4(2C), 126.5(2C), 123.3, 119.6, 118.9, 115.6, 89.3, 87.1, 74.6, 34.1, 23.8(2C), 21.5. **HRMS (ESI):** *m/z* calcd for $C_{27}H_{27}NO_3SNa$ $(M+Na)^+$: 468.1609. Found: 468.1592.

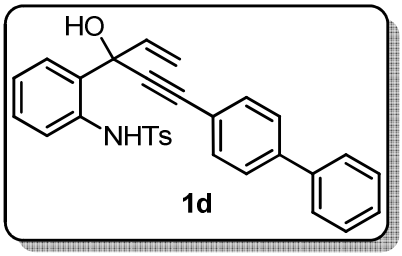
3-(4-Isopropylphenyl)-1-methyl-4-tosyl-4*H*-furo[3,4-*b*]indole (5c).



This compound was isolated as light brown oil. Following the general procedure (Scheme 4S), 30 mg of **1c** afforded 16 mg of **5c** (54% yield). R_f = 0.7 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2960, 2927, 1742, 1672, 1371, 1176, 1090, 752. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.11 (d, *J* = 8.2

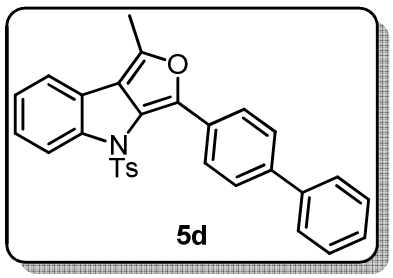
Hz, 1H), 7.79 (d, *J* = 8.2 Hz, 2H), 7.42 (d, *J* = 7.4 Hz, 1H), 7.36-7.33 (m, 3H), 7.29-7.23 (m, 3H), 6.99 (d, *J* = 8.2 Hz, 2H), 3.03-2.94 (m, 1H), 2.51 (s, 3H), 2.27 (s, 3H), 1.33 (d, *J* = 6.9 Hz, 6H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 148.5, 146.0, 144.3, 139.9, 137.1, 132.4, 129.0(2C), 128.1, 127.8(2C), 127.5(2C), 126.5, 125.9(2C), 125.3, 125.2, 124.4, 120.9, 120.2, 118.5, 34.0, 23.9(2C), 21.6, 13.7. **HRMS (ESI):** *m/z* calcd for $C_{27}H_{26}NO_3S$ $(M+H)^+$: 444.1633. Found: 444.1618.

_N_-(2-(5-([1,1'-Biphenyl]-4-yl)-3-hydroxypent-1-en-4-yn-3-yl)phenyl)-4-methylbenzenesulfonamide (1d).



This compound was isolated as light brown oil. Following the general procedure (Scheme 1S), 75 mg of **1d1** afforded 68 mg of **1d** (85% yield). R_f = 0.4 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3432, 3272, 2231, 1599, 1490, 1337, 1161, 1091, 764. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.95 (s, 1H), 7.79 (d, *J* = 8.3 Hz, 2H), 7.66-7.55 (m, 7H), 7.48 (t, *J* = 7.6 Hz, 2H), 7.41-7.38 (m, 1H), 7.29-7.25 (m, 1H), 7.19 (d, *J* = 8.3Hz, 2H), 7.08-7.04 (m, 1H), 6.04 (dd, *J* = 17.0 and 10.2 Hz, 1H), 5.58 (d, *J* = 17.0 Hz, 1H), 5.22 (d, *J* = 10.2 Hz, 1H), 3.01 (s, 1H), 3.39 (d, *J* = 5.3 Hz, 1H), 2.35 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 143.6, 141.7, 140.1, 138.9, 136.9, 136.0, 132.2(2C), 129.5(2C), 129.4, 129.1, 128.9(2C), 128.2, 127.8, 127.4(2C), 127.0(4C), 123.4, 120.6, 119.5, 115.7, 88.8, 88.5, 74.6, 21.5. **HRMS (ESI):** *m/z* calcd for $C_{30}H_{25}NO_3SNa$ $(M+Na)^+$: 259.0793. Found: 259.0778.

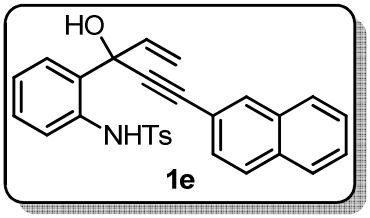
3-([1,1'-Biphenyl]-4-yl)-1-methyl-4-tosyl-4*H*-furo[3,4-*b*]indole (5d).



This compound was isolated as colourless solid. Following the general procedure (Scheme 4S), 20 mg of **1d** afforded 11 mg of **5d** (57% yield). M. P. = 175-176 ^oC. R_f = 0.7 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2919, 2859, 1763, 1375, 1260, 750. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.13 (d, *J* = 8.2 Hz, 1H), 7.96 (d, *J* = 8.4 Hz, 2H), 7.75-7.70 (m, 4H), 7.51-7.47 (m, 2H), 7.44 (d, *J* = 7.3 Hz, 1H), 7.40-7.34 (m, 2H), 7.30-7.28 (m, 3H), 7.01 (d, *J* = 8.2 Hz, 2H), 2.55 (s, 3H), 2.28 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 146.0, 144.4, 140.9, 140.4, 140.3, 136.8, 132.3, 129.2, 129.1(2C), 128.8(2C), 128.7, 128.1(2C), 127.5(2C), 127.3, 127.1(2C), 126.6, 126.5(2C), 125.4, 124.4, 121.0, 120.5,

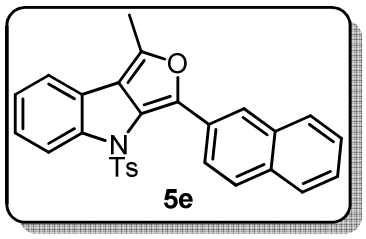
118.6, 21.6, 13.7. **HRMS (ESI):** *m/z* calcd for $C_{30}H_{24}NO_3S$ $(M+H)^+$: 478.1476. Found: 478.1459.

***N*-(2-(3-Hydroxy-5-(naphthalen-2-yl)pent-1-en-4-yn-3-yl)phenyl)-4-methylbenzenesulfonamide (1e).**



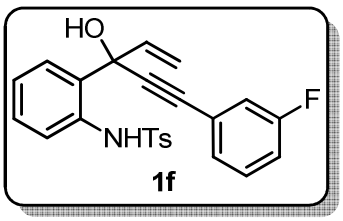
This compound was isolated as light brown oil. Following the general procedure (Scheme 1S), 60 mg of **1e1** afforded 60 mg of **1e** (94% yield). R_f = 0.4 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3430, 3244, 2923, 2231, 1598, 1497, 1337, 1159, 1091, 757. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.98 (s, 1H), 8.02 (s, 1H), 7.86-7.78 (m, 5H), 7.68 (dd, *J* = 7.9 and 1.4 Hz, 1H), 7.65 (dd, *J* = 8.2 and 0.8 Hz, 1H), 7.54-7.51 (m, 3H), 7.30-7.28 (m, 1H), 7.15 (d, *J* = 8.1 Hz, 2H), 7.09-7.05 (m, 1H), 6.06 (dd, *J* = 17.0 and 10.2 Hz, 1H), 5.60 (d, *J* = 17.0 Hz, 1H), 5.24 (d, *J* = 10.2 Hz, 1H), 3.40 (s, 1H), 2.31 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 143.7, 139.0, 137.0, 136.1, 133.1, 132.8, 132.0, 129.5(2C), 129.4, 129.2, 128.3, 128.2, 128.1, 127.86, 127.83, 127.47(2C), 127.1, 126.8, 123.4, 119.6, 119.0, 115.8, 89.3, 88.2, 74.7, 21.5. **HRMS (ESI):** *m/z* calcd for $C_{28}H_{23}NO_3SNa$ $(M+Na)^+$: 476.1296. Found: 476.1278.

1-Methyl-3-(naphthalen-2-yl)-4-tosyl-4*H*-furo[3,4-*b*]indole (5e).



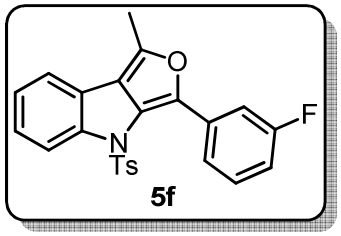
This compound was isolated as pale yellow solid. Following the general procedure (Scheme 4S), 20 mg of **1e** afforded 11 mg of **5e** (54% yield). M. P. = 139-140°C. R_f = 0.7 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2927, 1740, 1601, 1370, 1176, 796, 755. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.31 (s, 1H), 8.15 (d, *J* = 8.1 Hz, 1H), 8.02 (dd, *J* = 8.6 and 1.6 Hz, 1H), 7.98-7.92 (m, 2H), 7.53-7.50 (m, 2H), 7.46-7.44 (m, 1H), 7.40-7.35 (m, 2H), 7.30-7.28 (m, 1H), 7.24 (d, *J* = 8.3 Hz, 2H), 6.98 (d, *J* = 8.1 Hz, 2H), 2.57 (s, 3H), 2.26 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 146.1, 144.4, 140.6, 137.1, 133.1, 133.0, 132.3, 129.0(2C), 128.3, 127.9, 127.8, 127.7, 127.5(2C), 127.1, 126.3, 126.12(2C), 126.07, 125.4, 125.2, 124.5, 121.0, 120.6, 118.7, 21.6, 13.8. **HRMS (ESI):** *m/z* calcd for $C_{28}H_{22}NO_3S$ $(M+H)^+$: 452.1320. Found: 452.1304.

***N*-(2-(5-(3-Fluorophenyl)-3-hydroxypent-1-en-4-yn-3-yl)phenyl)-4-methylbenzenesulfonamide (1f).**



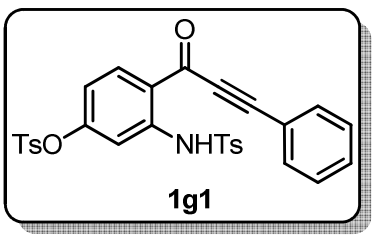
This compound was isolated as pale yellow oil. Following the general procedure (Scheme 1S), 60 mg of **1f1** afforded 61 mg of **1f** (95% yield). R_f= 0.5 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3434, 3235, 3070, 2927, 1709, 1582, 1494, 1373, 1159, 1091, 751. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.85 (s, 1H), 7.77 (d, *J* = 8.3 Hz, 2H), 7.62-7.57 (m, 2H), 7.33-7.24 (m, 3H), 7.20-7.16 (m, 3H), 7.12-7.03 (m, 2H), 6.02 (dd, *J* = 17.0 and 10.2 Hz, 1H), 5.55 (d, *J* = 16.9 Hz, 1H), 5.23 (d, *J* = 10.2 Hz, 1H), 3.22 (s, 1H), 2.36 (s, 3H). **^{19}F NMR (400 MHz, $CDCl_3$):** δ –112.47. **^{13}C NMR (100 MHz, $CDCl_3$):** δ 162.2 (d, *J* = 245.7 Hz, 1C), 143.7, 138.6, 137.0, 136.0, 130.0 (d, *J* = 8.1 Hz, 1C), 129.5(2C), 128.8, 128.1, 127.8, 127.6, 127.4(2C), 123.5 (d, *J* = 9.5 Hz, 1C), 123.4, 119.7, 118.6 (d, *J* = 22.6 Hz, 1C), 116.4, 115.9, 88.7, 87.6 (d, *J* = 3.7 Hz, 1C), 74.5, 21.5. **HRMS (ESI):** *m/z* calcd for $C_{24}H_{20}FNO_3SNa$ $(M+Na)^+$: 444.1045. Found: 444.1028.

3-(3-Fluorophenyl)-1-methyl-4-tosyl-4*H*-furo[3,4-*b*]indole (5f).



This compound was isolated as pale yellow oil. Following the general procedure (Scheme 4S), 20 mg of **1f** afforded 11 mg of **5f** (56% yield). R_f = 0.8 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3057, 2941, 1595, 1490, 1159, 756. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.12 (d, *J* = 8.2 Hz, 1H), 7.68 (d, *J* = 7.8 Hz, 1H), 7.55 (dt, *J* = 10.1 and 1.7 Hz, 1H), 7.46-7.40 (m, 2H), 7.38-7.34 (m, 1H), 7.29 (s, 1H), 7.25 (d, *J* = 8.4 Hz, 2H), 7.06 (dt, *J* = 8.5 and 2.5 Hz, 1H), 7.00 (d, *J* = 8.2 Hz, 2H), 2.53 (s, 3H), 2.28 (s, 3H). **^{19}F NMR (400 MHz, $CDCl_3$):** δ –113.90. **^{13}C NMR (100 MHz, $CDCl_3$):** δ 162.3 (d, *J* = 242.8 Hz, 1C), 145.9, 144.5, 140.7, 135.7, 135.5, 132.2, 132.1 (d, *J* = 8.8 Hz, 1C), 129.1 (d, *J* = 8.2 Hz, 1C), 129.0(2C), 127.4(2C), 126.6, 125.4, 124.2, 123.6, 120.9, 120.5, 118.6, 114.5 (d, *J* = 10.1 Hz, 1C), 114.4 (d, *J* = 12.0 Hz, 1C), 21.5, 13.6. **HRMS (ESI):** *m/z* calcd for $C_{24}H_{19}FNO_3S$ $(M+H)^+$: 420.1069. Found: 420.1055.

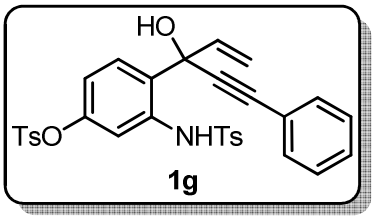
3-(4-Methylphenylsulfonamido)-4-(3-phenylpropioloyl)phenyl 4-methylbenzenesulfonate (1g1).



This compound was isolated as pale yellow solid. M. P. = 150-151 °C. R_f = 0.2 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2923, 2194, 1621, 1597, 1491, 1377, 1165, 1090, 795. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 11.16 (s, 1H),

7.94 (d, *J* = 2.8 Hz, 1H), 7.76 (d, *J* = 8.3 Hz, 2H), 7.69-7.63 (m, 6H), 7.58-7.55 (m, 1H), 7.50-7.47 (m, 2H), 7.29- 7.27 (m, 3H), 7.10 (dd, *J* = 9.1 and 2.8 Hz, 1H), 2.40 (s, 3H), 2.33 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 179.2, 146.0, 144.5, 144.0, 139.6, 136.1, 133.4(2C), 131.7, 131.6, 129.94(2C), 129.90(2C), 129.8, 128.9(2C), 128.6(2C), 128.0, 127.3(2C), 122.8, 119.6, 119.1, 96.4, 86.0, 21.64, 21.61. **HRMS (ESI):** *m/z* calcd for $C_{29}H_{23}NO_6S_2Na$ $(M+Na)^+$: 568.0864. Found: 568.0844.

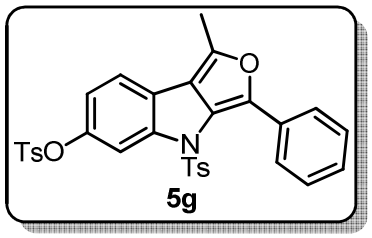
4-(3-Hydroxy-5-phenylpent-1-en-4-yn-3-yl)-3-(4-methylphenylsulfonamido)phenyl4-methylbenzenesulfonate (1g).



1g

This compound was isolated as light brown oil. Following the general procedure (Scheme 1S), 70 mg of **1g1** afforded 66 mg of **1g** (90% yield). R_f = 0.1 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3437, 3244, 2931, 2231, 1596, 1492, 1374, 1164, 1091, 757. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.88 (s, 1H), 7.72 (d, *J* = 8.3 Hz, 2H), 7.64 (d, *J* = 8.3 Hz, 2H), 7.52 (d, *J* = 9.0 Hz, 1H), 7.46-7.35 (m, 5H), 7.22-7.20 (m, 4H), 7.18 (s, 1H), 6.87 (dd, *J* = 8.9 and 2.8 Hz, 1H), 5.84 (dd, *J* = 16.9 and 10.1 Hz, 1H), 5.44 (d, *J* = 17.0 Hz, 1H), 5.15 (d, *J* = 10.2 Hz, 1H), 3.39 (s, 1H), 2.37 (s, 3H), 2.36 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 145.5, 144.8, 144.0, 138.2, 136.6, 135.0, 132.0, 131.8(2C), 130.6, 129.7(2C), 129.6(2C), 129.3, 128.54(2C), 128.48(2C), 127.4(2C), 123.2, 122.6, 121.4, 120.4, 116.2, 89.3, 86.9, 74.1, 21.7, 21.6. **HRMS (ESI):** *m/z* calcd for $C_{31}H_{27}NO_6S_2Na$ $(M+Na)^+$: 596.1177. Found: 596.1154.

1-Methyl-3-phenyl-4-tosyl-4*H*-furo[3,4-*b*]indol-6-yl 4-methylbenzenesulfonate (5g).

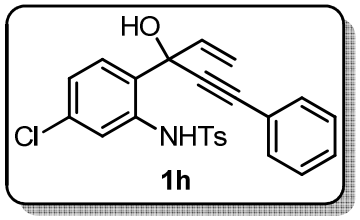


5g

This compound was isolated as pale yellow solid. Following the general procedure (Scheme 4S), 20 mg of **3g** afforded 10 mg of **5g** (53% yield). M. P. = 152-153 ^oC. R_f= 0.4 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2924, 2856, 1673, 1596, 1373, 1178, 763. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.96 (d, *J* = 9.0 Hz, 1H), 7.83-7.81 (m, 2H), 7.71 (d, *J* = 8.3 Hz, 2H), 7.50-7.46 (m, 2H), 7.40-7.36 (m, 1H), 7.35 (d, *J* = 8.0 Hz, 2H), 7.19 (d, *J* = 8.3 Hz, 2H), 7.17 (d, *J* = 2.4 Hz, 1H), 7.02 (d, *J* = 8.1 Hz, 2H), 6.75 (dd, *J* = 9.0 and 2.4 Hz, 1H), 2.50 (s, 3H), 2.48 (s, 3H), 2.31 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 147.0, 145.7, 144.8, 144.3, 141.1, 137.1, 132.0(2C), 129.9, 129.8(2C), 129.2(2C), 128.7, 128.6(2C), 128.1, 127.9(2C), 127.8(2C),

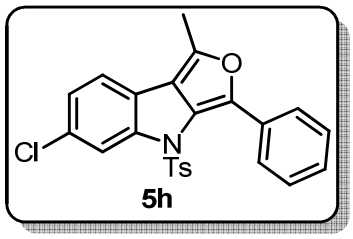
127.3(2C), 125.6, 120.2, 119.5, 119.0, 115.4, 21.8, 21.6, 13.7. **HRMS (ESI):** *m/z* calcd for $C_{31}H_{26}NO_6S_2$ $(M+H)^+$: 572.1202. Found: 572.1180.

***N*-(5-Chloro-2-(3-hydroxy-5-phenylpent-1-en-4-yn-3-yl)phenyl)-4-methylbenzenesulfonamide (1h).**



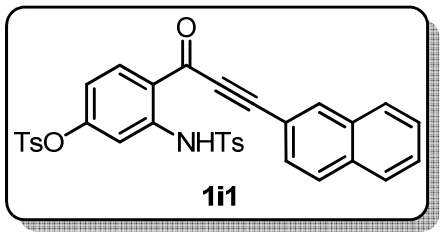
This compound was isolated as pale yellow oil. Following the general procedure (Scheme 1S), 60 mg of **1h1** afforded 54 mg of **1h** (85% yield). R_f = 0.4 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3441, 3272, 2199, 1599, 1491, 1336, 1159, 1091, 757. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.92 (s, 1H), 7.78 (d, *J* = 8.2 Hz, 2H), 7.66 (d, *J* = 2.0 Hz, 1H), 7.53 (d, *J* = 8.5 Hz, 1H), 7.50-7.48 (m, 2H), 7.41-7.37 (m, 3H), 7.21 (d, *J* = 8.2 Hz, 2H), 7.00 (dd, *J* = 8.4 and 2.0 Hz, 1H), 5.99 (dd, *J* = 17.0 and 10.2 Hz, 1H), 5.55 (d, *J* = 17.0 Hz, 1H), 5.23 (d, *J* = 10.2 Hz, 1H), 3.15 (s, 1H), 2.38 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 144.0, 138.6, 137.2, 136.5, 135.3, 131.8(2C), 129.7(2C), 129.3, 129.2, 128.5(2C), 127.5(2C), 127.4, 123.2, 121.5, 119.3, 116.2, 89.3, 87.4, 74.3, 21.6. **HRMS (ESI):** *m/z* calcd for $C_{24}H_{20}ClNO_3SNa$ $(M+Na)^+$: 460.0750. Found: 259.0730.

6-Chloro-1-methyl-3-phenyl-4-tosyl-4*H*-furo[3,4-*b*]indole (5h).



This compound was isolated as light brown oil. Following the general procedure (Scheme 4S), 20 mg of **1h** afforded 11 mg of **5h** (54% yield). R_f = 0.7 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3056, 2939, 1595, 1491, 1160, 757.**^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.15 (d, *J* = 1.8 Hz, 1H), 7.82 (d, *J* = 7.2 Hz, 2H), 7.50-7.47 (m, 2H), 7.41-7.37 (m, 1H), 7.34 (d, *J* = 8.2 Hz, 1H) 7.27 (d, *J* = 8.4 Hz, 2H), 7.24 (dd, *J* = 8.2 and 1.8 Hz, 1H), 7.04 (d,*J* = 8.0 Hz, 2H), 2.51 (s, 3H), 2.30 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 146.6, 144.7, 140.5, 136.8, 132.23, 132.19, 130.0, 129.3(2C), 128.09(2C), 128.08, 127.8(2C), 127.45, 127.4(2C), 125.6, 122.8, 121.4, 119.4, 118.7, 21.6, 13.7. **HRMS (ESI):** *m/z* calcd for $C_{24}H_{19}ClNO_3S$ $(M+H)^+$: 436.0774. Found: 436.0774.

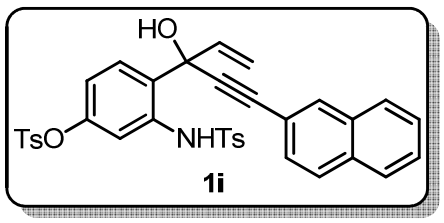
3-(4-Methylphenylsulfonamido)-4-(3-(naphthalen-2-yl)propioloyl)phenyl 4-methylbenzenesulfonate (1i1).



1i1

This compound was isolated as pale yellow solid. M. P. = 145-146 ^{o}C. R_f = 0.2 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3061, 2924, 2190, 1698, 1619, 1489, 1377, 1176, 1090, 795. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 11.20 (s, 1H), 8.23 (s, 1H), 8.02 (s, 1H), 7.94-7.92 (m, 3H), 7.78 (d, *J* = 7.8 Hz, 2H), 7.72-7.60 (m, 7H), 7.28 (t, *J* = 9.1 Hz, 3H), 7.13-7.11 (m, 1H), 2.40 (s, 3H), 2.26 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 179.11, 146.0, 144.5, 144.0, 139.6, 136.1, 135.2, 134.3, 132.6, 131.7, 129.93(2C), 129.90(2C), 129.7, 128.8, 128.6, 128.57(2C), 128.4, 128.2, 128.0, 127.96, 127.4, 127.3(2C), 123.0, 119.7, 116.2, 97.0, 86.4, 21.59(2C). **HRMS (ESI):** *m/z* calcd for $C_{33}H_{26}NO_6S_2$ $(M+H)^+$: 596.1202. Found: 596.1178.

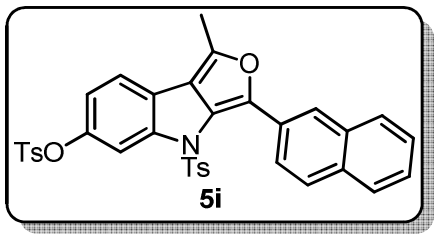
4-(3-Hydroxy-5-(naphthalen-2-yl)pent-1-en-4-yn-3-yl)-3-(4-methylphenylsulfonamido)phenyl 4-methylbenzenesulfonate (1i).



1i

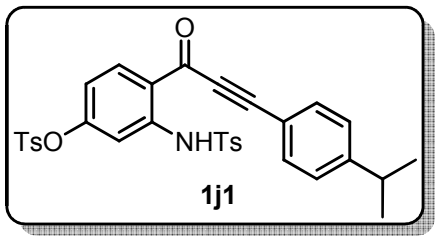
This compound was isolated as pale yellow oil. Following the general procedure (Scheme 1S), 70 mg of **1i1** afforded 67 mg of **1i** (92% yield). R_f = 0.2 (Hexane/EtOAc = 5/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3449, 3233, 2923, 2231, 1598, 1491, 1376, 1163, 795. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.87 (s, 1H), 7.99 (s, 1H), 7.88-7.83 (m, 3H), 7.73 (d, *J* = 8.3 Hz, 2H), 7.66 (d, *J* = 8.3 Hz, 2H), 7.57-7.54 (m, 3H), 7.48 (dd, *J* = 8.5 and 1.5 Hz, 1H), 7.28 (s, 1H), 7.19 (t, *J* = 8.6 Hz, 4H), 6.89 (dd, *J* = 9.0 and 2.8 Hz, 1H), 5.88 (dd, *J* = 17.0 and 10.2 Hz, 1H), 5.50 (d, *J* = 17.0 Hz, 1H), 5.19 (d, *J* = 10.2 Hz, 1H), 3.24 (s, 1H), 2.34 (s, 3H), 2.31 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 145.5, 144.9, 144.0, 138.2, 136.6, 135.0, 133.2, 132.8, 132.1, 132.0, 130.5, 129.7(2C), 129.6(2C), 128.5(2C), 128.2, 128.0, 127.89, 127.86, 127.4(2C), 127.3, 126.9, 123.2, 122.6, 120.4, 118.6, 116.3, 89.8, 87.1, 74.2, 21.6, 21.5. **HRMS (ESI):** *m/z* calcd for $C_{35}H_{29}NO_6S_2Na$ $(M+Na)^+$: 646.1334. Found: 646.1308.

1-Methyl-3-(naphthalen-2-yl)-4-tosyl-4*H*-furo[3,4-*b*]indol-6-yl 4-methylbenzenesulfonate (5i).



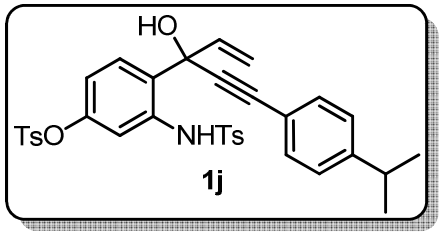
This compound was isolated as pale yellow solid. M. P. = 178-179 ^{o}C. Following the general procedure (Scheme 4S), 30 mg of **3i** afforded 15 mg of **5i** (51% yield). R_f = 0.4 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2927, 2856, 1673, 1596, 1373, 1179, 756. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.29 (s. 1H), 8.00-7.94 (m, 4H), 7.72 (d, *J* = 8.3 Hz, 2H), 7.54-7.51 (m, 2H), 7.36 (d, *J* = 8.2 Hz, 3H), 7.19-7.17 (m, 3H), 7.01 (d, *J* = 8.2 Hz, 2H), 6.76 (dd, *J* = 8.9 and 2.4 Hz, 1H), 2.52 (s, 3H), 2.51 (s, 3H), 2.30 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 147.1, 145.7, 144.8, 144.4, 141.4, 137.3, 133.0, 132.0, 131.9, 129.8(2C), 129.1(2C), 128.7(2C), 128.6, 128.3, 127.9, 127.8, 127.4(2C), 127.3, 127.2, 126.5, 126.24, 126.23, 126.0, 125.7, 120.3, 119.7, 119.2, 115.5, 21.8, 21.6, 13.8. **HRMS (ESI):** *m/z* calcd for $C_{35}H_{28}NO_6S_2$ $(M+H)^+$: 622.1358. Found: 622.1332.

4-(3-(4-Isopropylphenyl)propioloyl)-3-(4-methylphenylsulfonamido)phenyl 4-methylbenzenesulfonate (1j1).



This compound was isolated as pale yellow oil. R_f = 0.3 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2964, 2923, 2190, 1620, 1599, 1490, 1377, 1151, 1091, 795. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 11.21 (s, 1H), 7.91 (s, 1H), 7.75 (d, *J* = 8.0 Hz, 2H), 7.69-7.65 (m, 4H), 7.55 (d, *J* = 7.7 Hz, 2H), 7.32 (d, *J* = 7.8 Hz, 3H), 7.26-7.24 (m, 2H), 7.13-7.09 (m, 1H), 3.02-2.95 (m, 1H), 2.37 (s, 3H), 2.28 (s, 3H), 1.29 (d, *J* = 7.2 Hz, 6H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 179.3, 153.4, 146.0, 144.4, 143.9, 139.5, 136.2, 133.7(2C), 131.6, 129.94(2C), 129.87(2C), 129.6, 128.6(2C), 127.9, 127.3(2C), 127.1(2C), 123.0, 119.6, 116.3, 97.3, 86.0, 34.4, 23.7(2C), 21.62, 21.59. **HRMS (ESI):** *m/z* calcd for $C_{32}H_{30}NO_6S_2$ $(M+H)^+$: 588.1515. Found: 588.1485.

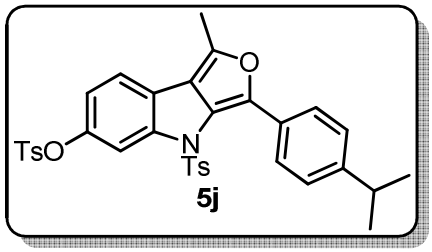
4-(3-Hydroxy-5-(4-isopropylphenyl)pent-1-en-4-yn-3-yl)-3-(4-methylphenylsulfonamido)phenyl 4-methylbenzenesulfonate (1j).



This compound was isolated as light brown oil. Following the general procedure (Scheme 1S), 70 mg of **1j1** afforded 62 mg of **1j** (84% yield). R_f = 0.3 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1}

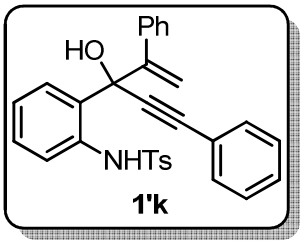
3449, 3251, 2961, 2227, 1598, 1493, 1375, 1164, 1091, 758. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.83 (s, 1H), 7.72 (d, *J* = 8.3 Hz, 2H), 7.65 (d, *J* = 8.9 Hz, 2H), 7.53 (d, *J* = 8.9 Hz, 1H), 7.38 (d, *J* = 8.2 Hz, 2H), 7.25-7.18 (m, 7H), 6.87 (dd, *J* = 9.0 and 2.8 Hz, 1H), 5.83(dd, *J* = 17.0 and 10.1 Hz, 1H), 5.44 (d, *J* = 17.0 Hz, 1H), 5.15 (d, *J* = 10.2 Hz, 1H), 3.11 (s, 1H), 2.99-2.92 (m, 1H), 2.38 (s, 3H), 2.36 (s, 3H), 1.28 (d, *J* = 6.9 Hz, 6H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 150.5, 145.5, 144.8, 143.9, 138.2, 136.6, 134.9, 132.0, 131.9(2C), 130.6, 129.7(2C), 129.6(2C), 128.5(2C), 127.4(2C), 126.6(2C), 123.2, 122.5, 120.0, 118.6, 116.1, 89.7, 86.1, 74.2, 34.2, 23.8(2C), 21.64, 21.55. **HRMS (ESI):** *m/z* calcd for $C_{34}H_{33}NO_6S_2Na$ $(M+Na)^+$: 638.1647. Found: 638.1620.

3-(4-Isopropylphenyl)-1-methyl-4-tosyl-4*H*-furo[3,4-*b*]indol-6-yl 4-methylbenzenesulfonate (5j).



This compound was isolated as light brown oil. Following the general procedure (Scheme 4S), 20 mg of **1j** afforded 11 mg of **5j** (56% yield). R_f = 0.2 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2960, 2926, 1597, 1463, 1375, 1179, 1091, 788. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.94 (d, *J* = 9.0 Hz, 1H), 7.73 (dd, *J* = 16.1 and 8.3 Hz, 4H), 7.36-7.33 (m, 4H), 7.21(d, *J* = 8.3 Hz, 2H), 7.15 (d, *J* = 2.4 Hz, 1H), 7.02 (d, *J* = 8.1 Hz, 2H), 6.74 (dd, *J* = 9.0 and 2.5 Hz, 1H), 3.03-2.96 (m, 1H), 2.50 (s, 3H), 2.46 (s, 3H), 2.31 (s, 3H), 1.33 (d, *J* = 6.9 Hz, 6H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 148.8, 147.0, 145.7, 144.7, 144.3, 140.8, 137.4, 132.04, 132.02, 129.79, 129.77(2C), 129.1(2C), 128.7(2C), 127.8(2C), 127.43(2C), 127.39, 126.0(2C), 125.7, 120.1, 119.4, 119.0, 115.4, 34.0, 24.0(2C), 21.8, 21.6, 13.7. **HRMS (ESI):** *m/z* calcd for $C_{34}H_{32}NO_6S_2$ $(M+H)^+$: 614.1671. Found: 614.1646.

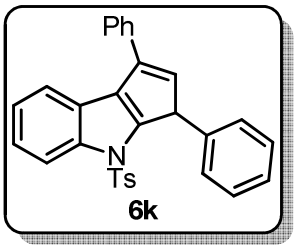
***N*-(2-(3-Hydroxy-2,5-diphenylpent-1-en-4-yn-3-yl)phenyl)-4-methylbenzenesulfonamide (1'k).**



This compound was isolated as pale yellow oil. Following the general procedure (Scheme 1S), 70 mg of **1a1** afforded 79 mg of **1'k** (88% yield). R_f = 0.3 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3431, 3271, 3059, 2199, 1599, 1492, 1337, 1159, 1091, 757. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.81 (s, 1H), 7.82 (d, *J* = 8.2 Hz, 2H), 7.65-7.60 (m, 2H), 7.47-7.45 (m, 2H), 7.40-7.34 (m, 4H), 7.28-7.22 (m, 4H),

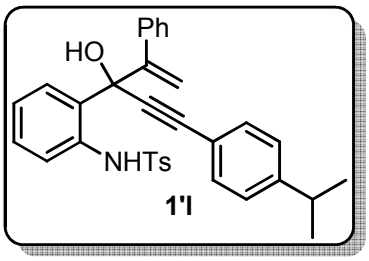
7.18 (s, 1H), 7.11(d, *J* = 7.2Hz, 2H), 6.98-6.94 (m, 1H), 5.54 (s, 1H), 5.26 (s, 1H), 3.32 (s, 1H), 2.35 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 149.6, 143.7, 138.4, 137.1, 136.2, 133.1, 131.7(2C), 129.8, 129.6, 129.5(2C), 129.1(2C), 128.5(2C), 128.3, 127.7, 127.68(2C), 127.6(2C), 122.9, 121.8, 119.2, 116.6, 89.6, 88.9, 76.7, 21.5. **HRMS (ESI):** *m/z* calcd for $C_{30}H_{25}NO_3SNa$ $(M+Na)^+$: 502.1453. Found: 502.1433.

1,3-Diphenyl-4-tosyl-3,4-dihydrocyclopenta[*b*]indole (6k).



This compound was isolated as light brown oil. Following the general procedure (Scheme 6S), 30 mg of **1'k** afforded 23 mg of **6k** (78% yield). R_f = 0.8 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3058, 2923, 2854, 1597, 1493, 1448, 1374, 1175, 1089, 750. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.08 (d, *J* = 8.3 Hz, 1H), 7.74-7.71 (m, 3H), 7.51-7.41 (m, 5H), 7.32-7.29 (m, 3H), 7.21-7.17 (m, 4H), 7.02 (d, *J* = 8.2 Hz, 2H), 6.36 (d, *J* = 1.6 Hz, 1H), 5.09 (d, *J* = 1.4 Hz, 1H), 2.31 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 150.0, 144.6, 140.0, 139.7, 136.2, 135.7, 135.3, 134.0, 129.6(2C), 129.0, 128.8(2C), 128.68, 128.62(2C), 128.5, 128.0, 127.4(2C), 127.03(2C), 127.0, 124.2, 123.8, 123.3, 120.4, 114.6, 52.5, 21.5. **HRMS (ESI):** *m/z* calcd for $C_{30}H_{24}NO_2S$ $(M+H)^+$: 462.1528. Found: 462.1511.

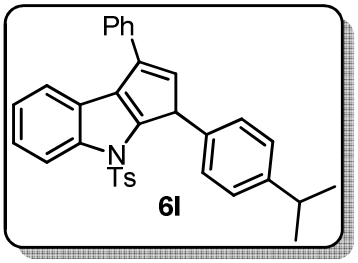
***N*-(2-(3-Hydroxy-5-(4-isopropylphenyl)-2-phenylpent-1-en-4-yn-3-yl)phenyl)-4-methylbenzenesulfonamide (1'l).**



This compound was isolated as pale yellow oil. Following the general procedure (Scheme 1S), 80 mg of **1c1** afforded 91 mg of **1'l** (91% yield). R_f = 0.5 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3441, 3266, 2959, 2924, 2226, 1600, 1493, 1338, 1160, 1092, 758. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.77 (s, 1H), 7.81 (d, *J* = 8.3 Hz, 2H), 7.65-7.60 (m, 2H), 7.40-7.38 (m, 2H), 7.28-7.24 (m, 3H), 7.22-7.18 (m, 5H), 7.13-7.10 (m, 2H), 6.95(dt, *J* = 7.7 and 1.2 Hz, 1H), 5.50 (s,1H), 5.24 (s,1H), 3.13 (d, *J* = 3.6 Hz, 1H), 2.97-2.90 (m, 1H), 2.35 (s, 3H), 1.28 (s, 3H), 1.26 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 150.3, 149.7, 143.7, 138.4, 137.1, 136.2, 131.7(2C), 129.8, 129.52, 129.50(2C), 129.1(2C), 128.4, 127.7, 127.68(2C), 127.6(2C), 126.6(2C), 122.9, 119.2, 119.0, 116.5, 89.9, 88.1, 82.6, 34.1,

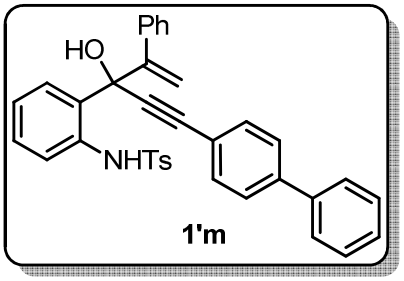
23.8(2C), 21.5. **HRMS (ESI):** *m/z* calcd for $C_{33}H_{31}NO_3SNa$ $(M+Na)^+$: 544.1922. Found: 544.1904.

3-(4-Isopropylphenyl)-1-phenyl-4-tosyl-3,4-dihydrocyclopenta[*b*]indole (6l).



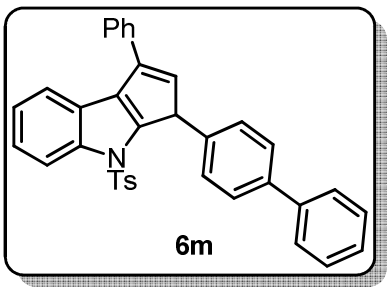
This compound was isolated as light brown oil. Following the general procedure (Scheme 6S), 30 mg of **1'l** afforded 25 mg of **6l** (88% yield). R_f = 0.9 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3459, 2970, 1740, 1369, 1217, 1160, 756. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.07(d, *J* = 8.3 Hz, 1H), 7.75-7.71 (m, 3H), 7.50-7.49 (m, 2H), 7.42-7.30 (m, 3H), 7.20-7.14(m, 6H), 7.01(d, *J* = 8.2 Hz, 2H), 6.36 (d, *J* = 1.9 Hz, 1H), 5.08 (d, *J* = 1.9 Hz, 1H), 2.99-2.92 (m, 1H), 2.30 (s, 3H), 1.32 (s, 3H), 1.30 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 150.1, 147.7, 144.5, 139.7, 139.6, 135.7, 135.4, 134.2, 133.2, 129.5(2C), 128.7(2C), 128.6(2C), 128.3, 127.9, 127.4(2C), 127.1(2C), 126.6(2C), 124.2, 123.6, 123.2, 120.3, 114.5, 52.2, 33.8, 24.2(2C), 21.5. **HRMS (ESI):** *m/z* calcd for $C_{33}H_{30}NO_2S$ $(M+H)^+$: 504.1997. Found: 504.1977.

***N*-(2-(5-([1,1'-Biphenyl]-4-yl)-3-hydroxy-2-phenylpent-1-en-4-yn-3-yl)phenyl)-4-methylbenzenesulfonamide (1'm).**



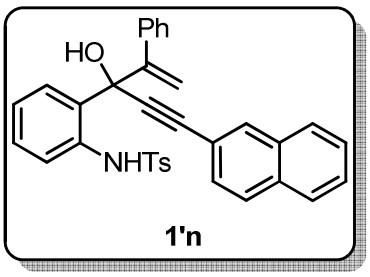
This compound was isolated as pale yellow oil. Following the general procedure (Scheme 1S), 70 mg of **1d1** afforded 76 mg of **1'm** (88% yield). R_f = 0.3 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3429, 3293, 3062, 2925, 2198, 1708, 1599, 1491, 1337, 1160, 1091, 764. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.80 (s, 1H), 7.83 (d, *J* = 8.2 Hz, 2H), 7.66-7.59 (m, 7H), 7.54-7.47 (m, 4H), 7.42-7.39 (m, 1H), 7.26-7.19 (m, 5H), 7.13 (d, *J* = 7.2 Hz, 2H), 6.98 (t, *J* = 7.6 Hz, 1H), 5.54 (s, 1H), 5.28 (s, 1H), 3.23 (s, 1H), 2.36 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 149.6, 143.7, 141.9, 140.1, 138.3, 137.1, 136.2, 132.1(2C), 129.8, 129.6, 129.5(2C), 129.1(2C), 128.9(2C), 128.3, 127.9, 127.8, 127.7(2C), 127.6(2C), 127.13(2C), 127.06(2C), 123.0, 120.6, 119.2, 116.7, 89.53, 89.46, 76.6, 21.5. **HRMS (ESI):** *m/z* calcd for $C_{36}H_{29}NO_3SNa$ $(M+Na)^+$: 578.1766. Found: 578.1743.

3-([1,1'-Biphenyl]-4-yl)-1-phenyl-4-tosyl-3,4-dihydrocyclopenta[*b*]indole (6m).



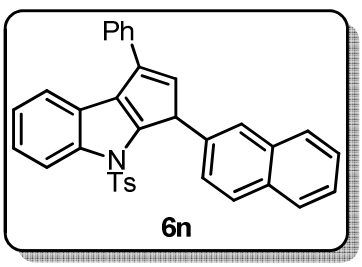
This compound was isolated as light brown oil. Following the general procedure (Scheme 6S), 30 mg of **1'm** afforded 20 mg of **6m** (68% yield). R_f = 0.8 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3059, 3029, 2924, 1598, 1486, 1449, 1372, 1174, 1009, 755. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.14 (d, *J* = 8.2 Hz, 1H), 7.77-7.75 (m, 3H), 7.64-7.62 (m, 2H), 7.53-7.47 (m, 7H), 7.43-7.36 (m, 4H), 7.25-7.23 (m, 3H), 6.97 (d, *J* = 8.2 Hz, 2H), 6.40 (d, *J* = 2.0 Hz, 1H), 5.15 (d, *J* = 1.9 Hz, 1H), 2.24 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 149.9, 144.5, 140.8, 140.1, 140.0, 139.8, 135.6, 135.5, 135.2, 133.8, 129.5(2C), 129.2(2C), 128.9(2C), 128.7(2C), 128.5, 128.0, 127.4(2C), 127.3, 127.2(2C), 127.0(2C), 126.9(2C), 124.2, 123.8, 123.4, 120.4, 114.6, 52.1, 21.5. **HRMS (ESI):** *m/z* calcd for $C_{36}H_{28}NO_2S$ $(M+H)^+$: 538.1841. Found: 538.1819.

_N_-(2-(3-Hydroxy-5-(naphthalen-2-yl)-2-phenylpent-1-en-4-yn-3-yl)phenyl)-4-methylbenzenesulfonamide (1'n).



This compound was isolated as pale yellow oil. Following the general procedure (Scheme 1S), 70 mg of **1e1** afforded 80 mg of **1'n** (92% yield). R_f = 0.3 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3437, 3291, 3058, 2925, 2229, 1598, 1583, 1493, 1337, 1160, 1091, 815, 749. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.82 (s, 1H), 7.99 (s, 1H), 7.87-7.82 (m, 5H), 7.67-7.65 (m, 2H), 7.55-7.53 (m, 2H), 7.49 (dd, *J* = 8.5 and 1.2 Hz, 1H), 7.25 (d, *J* = 7.7 Hz, 2H), 7.22-7.14 (m, 6H), 7.01-6.97 (m, 1H), 5.57 (s, 1H), 5.30 (s, 1H), 3.26 (s, 1H), 2.33 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 149.6, 143.7, 138.3, 137.1, 136.2, 133.1, 132.8, 131.9, 129.8, 129.6, 129.5(2C), 129.1(2C), 128.3, 128.2, 128.0, 127.78(2C), 127.82, 127.7(2C), 127.6(2C), 127.1, 126.8, 123.0, 119.2, 119.0, 116.8, 90.0, 89.1, 76.8, 21.5. **HRMS (ESI):** *m/z* calcd for $C_{34}H_{27}NO_3SNa$ $(M+Na)^+$: 552.1609. Found: 552.1593.

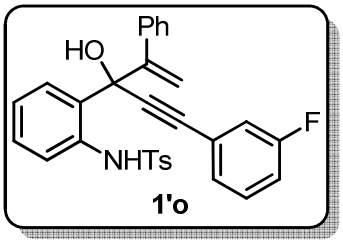
3-(Naphthalen-2-yl)-1-phenyl-4-tosyl-3,4-dihydrocyclopenta[*b*]indole (6n).



This compound was isolated as light brown oil. Following the general procedure (Scheme 6S), 30 mg of **1'n** afforded 20 mg of **6n** (69% yield). R_f = 0.8 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3054, 2924, 1735, 1598, 1448, 1372,

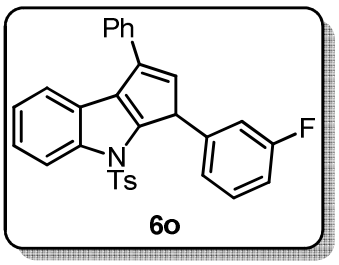
1175, 913, 747. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.16 (d, *J* = 8.2 Hz, 1H), 7.79-7.71 (m, 6H), 7.64 (d, *J* = 8.5 Hz, 1H), 7.52-7.47 (m, 5H), 7.43 (d, *J* = 7.4 Hz, 1H), 7.10-7.02 (m, 4H), 6.62 (d, *J* = 8.1 Hz, 2H), 6.40 (d, *J* = 2.0 Hz, 1H), 5.25 (d, *J* = 1.9 Hz, 1H), 2.15 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 150.0, 144.3, 140.1, 140.0, 135.4, 133.8, 133.7, 133.4, 132.8, 129.3(2C), 129.0, 128.7(2C), 128.5, 128.1, 128.0, 127.8, 127.7, 127.5, 127.4(2C), 126.6(2C), 126.4, 126.0, 125.7, 124.1, 123.8, 123.3, 120.4, 114.6, 52.5, 21.4. **HRMS (ESI):** *m/z* calcd for $C_{34}H_{26}NO_2S$ $(M+H)^+$: 512.1684. Found: 512.1663.

_N_-(2-(5-(3-Fluorophenyl)-3-hydroxy-2-phenylpent-1-en-4-yn-3-yl)phenyl)-4-methylbenzenesulfonamide (1'o).



This compound was isolated as pale yellow oil. Following the general procedure (Scheme 1S), 70 mg of **1f1** afforded 78 mg of **1'o** (88% yield). R_f = 0.3 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3432, 3281, 3066, 2928, 2203, 1737, 1582, 1492, 1338, 1159, 757. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.74 (s, 1H), 7.81 (d, *J* = 8.3 Hz, 2H), 7.64 (dd, *J* = 8.2 and 1.0 Hz, 1H), 7.57 (dd, *J* = 7.8 and 1.4 Hz, 1H),7.36-7.30 (m, 2H), 7.26-7.19 (m, 6H), 7.15-7.08 (m, 4H),6.97(dt, *J* = 7.7 and 1.1 Hz, 1H),5.53 (s,1H), 5.28 (s,1H), 3.20(s, 1H), 2.35 (s, 3H). **^{19}F NMR (400 MHz, $CDCl_3$):** δ −112.36. **^{13}C NMR (100 MHz, $CDCl_3$):** δ 162.3 (d, *J* = 245.5 Hz, 1C), 149.4, 143.8, 138.2, 137.1, 136.2, 130.1 (d, *J* = 8.5 Hz, 1C), 129.7(2C), 129.6(2C), 129.1(2C), 128.4, 128.1, 127.84, 127.76(2C), 127.61, 127.57(2C), 123.5 (d, *J* = 7.4 Hz, 1C), 123.0, 119.4, 118.5 (d, *J* = 22.7 Hz, 1C), 116.9, 116.5 (d, *J* = 20.9 Hz, 1C), 89.7, 88.2, 21.5. **HRMS (ESI):** *m/z* calcd for $C_{30}H_{24}FNO_3SNa$ $(M+Na)^+$: 520.1358. Found: 520.1337.

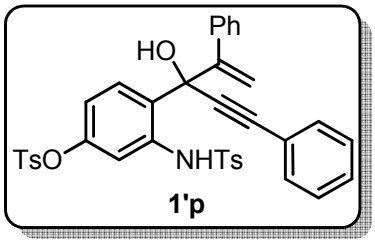
3-(3-Fluorophenyl)-1-phenyl-4-tosyl-3,4-dihydrocyclopenta[*b*]indole (6o).



This compound was isolated as light brown oil. Following the general procedure (Scheme 6S), 30 mg of **1'o** afforded 17 mg of **6o** (60% yield). R_f = 0.8 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3062, 2955, 2925, 1613, 1596, 1487, 1373, 1175, 793, 758. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.13 (d, *J* = 8.3 Hz, 1H), 7.74-7.72 (m, 3H), 7.52-7.48 (m, 3H), 7.44-7.34 (m, 4H), 7.27-7.26 (m, 1H), 7.08-7.05 (m, 3H), 7.00-6.96 (m, 1H), 6.79-6.76 (m, 1H), 6.33 (d, *J* = 2.0 Hz, 1H), 5.08 (d, *J* = 1.8 Hz, 1H), 2.33 (s, 3H). **^{19}F NMR (400 MHz, $CDCl_3$):** δ

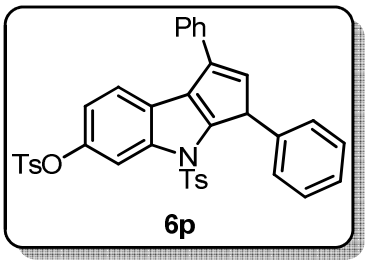
–113.2. **^{13}C NMR (100 MHz, $CDCl_3$):** δ 162.9 (d, *J* = 244.5 Hz, 1C), 149.1, 144.8, 140.3, 139.9, 138.9 (d, *J* = 7.3 Hz, 1C), 135.4 (d, *J* = 5.8 Hz, 1C), 133.3, 130.0 (d, *J* = 8.3 Hz, 1C), 129.6(2C), 129.0 (d, *J* = 6.4 Hz, 1C), 128.8, 128.7(2C), 128.1, 127.4(2C), 127.0, 126.8(2C), 124.7, 124.1 (d, *J* = 9.8 Hz, 1C), 123.5, 120.5, 115.1 (d, *J* = 21.6 Hz, 1C), 114.7, 113.9 (d, *J* = 21.1 Hz, 1C), 52.1, 21.5. **HRMS (ESI):** *m/z* calcd for $C_{30}H_{23}FNO_2S$ $(M+H)^+$: 480.1433. Found: 480.1415.

4-(3-Hydroxy-2,5-diphenylpent-1-en-4-yn-3-yl)-3-(4-methylphenylsulfonamido)phenyl 4-methylbenzenesulfonate (1'p).



This compound was isolated as pale yellow oil. Following the general procedure (Scheme 1S), 70 mg of **1g1** afforded 73 mg of **1'p** (87% yield). R_f = 0.1 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3445, 3291, 3056, 2923, 2229, 1734, 1598, 1492, 1375, 1338, 1195, 1091, 914, 758. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.74 (s, 1H), 7.76 (d, *J* = 8.2 Hz, 2H), 7.52 (d, *J* = 8.5 Hz, 3H), 7.43-7.38 (m, 6H), 7.25-7.19 (m, 5H), 7.13-7.07 (m, 4H), 6.83 (dd, *J* = 9.0and 2.8 Hz, 1H), 5.46 (s, 1H), 5.24 (s, 1H), 3.32 (s, 1H), 2.36 (s, 3H), 2.30 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 149.0, 145.3, 144.6, 144.1, 137.9, 136.7, 135.0, 132.0, 131.7(2C), 129.8, 129.7(2C), 129.6(2C), 129.3, 129.0(2C), 128.5(2C), 128.4(2C), 127.9, 127.8(2C), 127.5(2C), 123.8, 123.4, 121.4, 119.9, 117.0, 90.0, 87.9, 76.1, 21.6, 21.5. **HRMS (ESI):** *m/z* calcd for $C_{37}H_{31}NO_6S_2Na$ $(M+Na)^+$: 672.1490. Found: 672.1462.

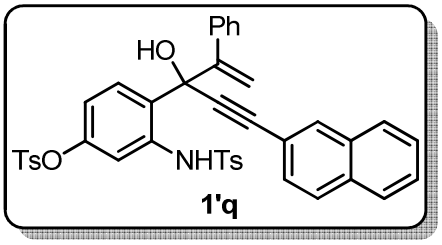
1,3-Diphenyl-4-tosyl-3,4-dihydrocyclopenta[*b*]indol-6-yl 4-methylbenzenesulfonate (6p).



This compound was isolated as light brown oil. Following the general procedure (Scheme 6S), 30 mg of **1'p** afforded 22 mg of **6p** (74% yield). R_f = 0.4 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3062, 2925, 1735, 1597, 1493, 1448, 1373, 1192, 1178, 1091, 909, 735. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.99 (d, *J* = 9.1 Hz, 1H), 7.72 (d, *J* = 8.3 Hz, 2H), 7.52-7.50 (m, 2H), 7.42-7.40 (m, 3H), 7.33-7.29 (m, 4H), 7.22-7.17 (m, 4H), 7.10 (d, *J* = 8.4 Hz, 2H), 7.03-7.00 (m, 3H), 6.34 (d, *J* = 1.9 Hz, 1H), 5.07 (d, *J* = 1.9 Hz, 1H), 2.46 (s, 3H), 2.33 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 151.6, 145.7, 145.4, 145.0, 139.4, 137.7, 135.6, 135.1, 135.0, 134.0, 132.3, 129.8, 129.7(2C), 128.8(2C), 128.73(2C), 128.71(2C), 128.7(2C), 128.6, 128.5, 128.1, 128.0,

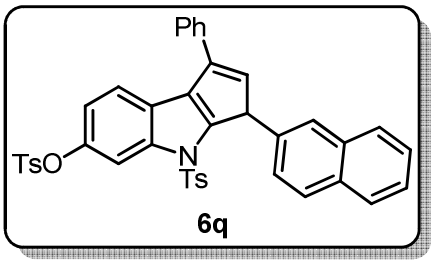
127.6, 127.2, 127.1(2C), 124.4, 118.2, 115.1, 114.0, 52.5, 21.8, 21.6. **HRMS (ESI):** *m/z* calcd for $C_{37}H_{30}NO_5S_2$ $(M+H)^+$: 632.1565. Found: 632.1575.

4-(3-Hydroxy-5-(naphthalen-2-yl)-2-phenylpent-1-en-4-yn-3-yl)-3-(4-methylphenylsulfonamido)phenyl 4-methylbenzenesulfonate (1'q).



This compound was isolated as pale yellow oil. Following the general procedure (Scheme 1S), 70 mg of **1i1** afforded 74 mg of **1'q** (90% yield). R_f = 0.1 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3437, 3273, 3062, 2926, 2194, 1735, 1597, 1493, 1374, 1194, 1091, 913, 748. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.74 (s, 1H), 7.95 (s, 1H), 7.86-7.84 (m, 3H), 7.77 (d, *J* = 8.3 Hz, 2H), 7.58-7.56 (m, 1H), 7.55-7.52 (m, 4H), 7.44 (dd, *J* = 8.4 and 1.5 Hz, 1H), 7.36 (d, *J* = 2.8 Hz, 1H),7.25-7.18 (m, 5H), 7.14-7.09 (m, 4H), 6.85 (dd, *J* = 8.9 and 2.8 Hz, 1H), 5.50 (s,1H), 5.28 (s,1H), 3.28 (s, 1H), 2.35 (s, 3H), 2.22 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 149.1, 145.3, 144.7, 144.1, 137.9, 136.7, 135.0, 133.2, 132.8, 132.1, 132.0, 129.9, 129.7, 129.66(2C), 129.6(2C), 129.0(2C), 128.6, 128.4(2C), 128.3, 128.0, 127.9(2C), 127.89, 127.87, 127.5(2C), 127.3, 126.9, 123.8, 123.4, 120.0, 118.5, 117.1, 90.4, 88.1, 31.0, 21.5. **HRMS (ESI):** *m/z* calcd for $C_{41}H_{33}NO_6S_2Na$ $(M+Na)^+$: 722.1647. Found: 722.1617.

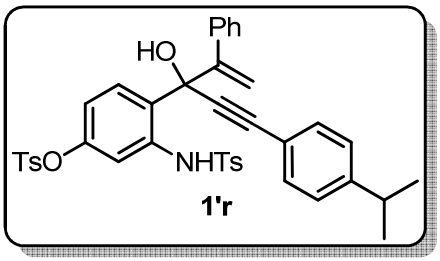
3-(Naphthalen-2-yl)-1-phenyl-4-tosyl-3,4-dihydrocyclopenta[*b*]indol-6-yl 4-methylbenzenesulfonate (6q).



This compound was isolated as light brown oil. Following the general procedure (Scheme 6S), 30 mg of **1'q** afforded 19 mg of **6q** (65% yield). R_f = 0.4 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3059, 2925, 2852, 1597, 1448, 1373, 1192, 1177, 1092, 745. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.05 (d, *J* = 9.1 Hz, 1H), 7.84-7.82 (m, 1H), 7.74 (d, *J* = 8.2 Hz, 2H), 7.69 (s, 1H), 7.64 (d, *J* = 8.2 Hz, 1H), 7.56-7.49 (m, 5H), 7.43-7.42 (m, 3H), 7.33 (d, *J* = 8.1 Hz, 2H), 7.06-7.00 (m, 3H), 6.95 (d, *J* = 8.2 Hz, 2H), 6.60 (d, *J* = 8.2 Hz, 2H), 6.37 (d, *J* = 1.5 Hz, 1H), 5.22 (d, *J* = 1.3 Hz, 1H), 2.47 (s, 3H), 2.15 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 151.6, 145.7, 145.4, 144.7, 139.6, 138.1, 135.09, 135.07, 133.82, 133.67, 132.81, 132.79, 132.3, 129.8(2C), 129.3(2C), 128.73(2C),

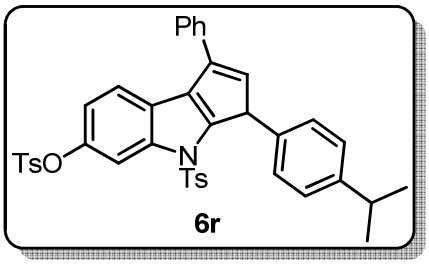
128.66(2C), 128.6, 128.2, 128.1, 128.0, 127.9, 127.5, 127.1(2C), 126.6(2C), 126.3, 126.2, 125.9, 124.3, 118.2, 115.2, 114.0, 52.5, 21.8, 21.4. **HRMS (ESI):** *m/z* calcd for $C_{41}H_{32}NO_5S_2$ $(M+H)^+$: 682.1722. Found: 682.1693.

4-(3-Hydroxy-5-(4-isopropylphenyl)-2-phenylpent-1-en-4-yn-3-yl)-3-(4-methylphenylsulfonamido)phenyl 4-methylbenzenesulfonate (1'r).



This compound was isolated as pale yellow oil. Following the general procedure (Scheme 1S), 70 mg of **1j1** afforded 70 mg of **1'r** (85% yield). R_f = 0.2 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3451, 3276, 2961, 2923, 2227, 1598, 1493, 1376, 1165, 1091, 793. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.73 (s, 1H), 7.76 (d, *J* = 8.2 Hz, 2H), 7.52 (d, *J* = 8.5 Hz, 4H), 7.34 (d, *J* = 8.1 Hz, 2H), 7.25-7.18 (m, 7H), 7.13-7.08 (m, 4H), 6.82 (dd, *J* = 8.9 and 2.8 Hz, 1H), 5.44 (s, 1H), 5.23 (s, 1H), 3.24 (s, 1H), 2.99-2.92 (m, 1H), 2.36 (s, 3H), 2.30 (s, 3H), 1.29 (d, *J* = 6.8 Hz, 6H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 150.5, 149.1, 145.3, 144.6, 144.0, 138.0, 136.7, 135.0, 132.0, 131.8(2C), 130.0, 129.7(2C), 129.6(2C), 129.0(2C), 128.4(2C), 127.9, 127.87(2C), 127.5(2C), 126.7(2C), 123.8, 123.3, 119.9, 118.6, 116.9, 90.3, 87.2, 76.1, 34.2, 23.8(2C), 21.6, 21.5. **HRMS (ESI):** *m/z* calcd for $C_{40}H_{37}NO_6S_2Na$ $(M+Na)^+$: 714.1960. Found: 714.1930.

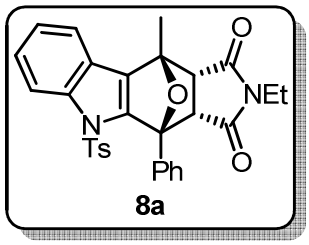
3-(4-Isopropylphenyl)-1-phenyl-4-tosyl-3,4-dihydrocyclopenta[*b*]indol-6-yl 4-methylbenzenesulfonate (6r).



This compound was isolated as light brown oil. Following the general procedure (Scheme 6S), 30 mg of **1'r** afforded 24 mg of **6r** (83% yield). R_f = 0.5 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2960, 2929, 1738, 1597, 1448, 1374, 1192, 1178, 1094, 741. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.96 (d, *J* = 9.0 Hz, 1H), 7.71 (d, *J* = 8.3 Hz, 2H), 7.52-7.49 (m, 2H), 7.42-7.40 (m, 3H), 7.32-7.30 (m, 2H), 7.20-7.14 (m, 3H), 7.10(d, *J* = 7.4 Hz, 4H), 7.02-6.98 (m, 3H), 6.33 (d, *J* = 1.9 Hz, 1H), 5.05(d, *J* = 1.9 Hz, 1H), 2.99-2.92 (m, 1H), 2.45 (s, 3H), 2.32 (s, 3H), 1.32 (s, 3H), 1.30 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 151.7, 147.9, 145.6, 145.3, 144.9, 139.2, 137.7, 135.2, 135.0, 134.2, 132.7, 132.3, 129.8, 129.7(2C), 129.6(2C), 128.8(2C), 128.72, 128.67(2C), 128.0,

127.8, 127.2(2C), 127.1(2C), 126.7(2C), 124.4, 118.1, 115.1, 113.9, 52.2, 33.8, 24.2(2C), 21.8, 21.6. **HRMS (ESI):** *m/z* calcd for $C_{40}H_{36}NO_5S_2$ $(M+H)^+$: 674.2038. Found: 674.2008.

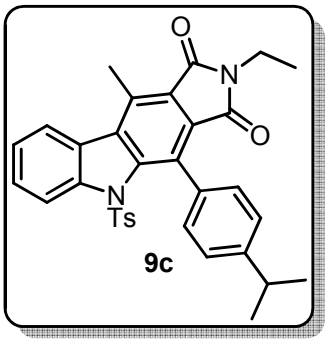
2-Ethyl-10-methyl-4-phenyl-5-tosyl-3a,4,10,10a-tetrahydro-4,10-epoxypyrrolo[3,4-*b*]carbazole-1,3(2*H*,5*H*)-dione (8a).



8a

This compound was isolated as colourless solid. M. P. = 160-161°C. Following the general procedure (Scheme 7S), 20 mg of **5a** afforded 20 mg of **8a** (78% yield). R_f = 0.4 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2916, 1769, 1701, 1385, 1351, 1180, 1091, 795, 669. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.09-8.03 (m, 3H), 7.58-7.52 (m, 4H), 7.36-7.30 (m, 2H), 7.22 (d, *J* = 8.3 Hz, 2H), 7.09 (d, *J* = 8.2 Hz, 2H), 4.15 (d, *J* = 7.6 Hz, 1H), 3.58 (d, *J* = 7.5 Hz, 1H), 2.90 (q, *J* = 7.2 Hz, 2H), 2.33 (s, 3H), 2.23 (s, 3H), 0.17 (t, *J* = 7.2 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 171.9, 171.1, 144.1, 144.0, 140.0, 135.1, 133.8, 132.0, 128.5(2C), 128.0(2C), 126.8(2C), 125.9(2C), 124.3, 123.1, 121.8, 119.0, 114.4, 91.7, 84.4, 54.43, 54.41, 32.3, 28.7, 20.5, 17.7, 10.4. **HRMS (ESI):** *m/z* calcd for $C_{30}H_{26}N_2O_5SNa$ $(M+Na)^+$: 549.1460. Found: 549.1440.

2-Ethyl-4-(4-isopropylphenyl)-10-methyl-5-tosylpyrrolo[3,4-*b*]carbazole-1,3(2*H*,5*H*)-dione (9c).

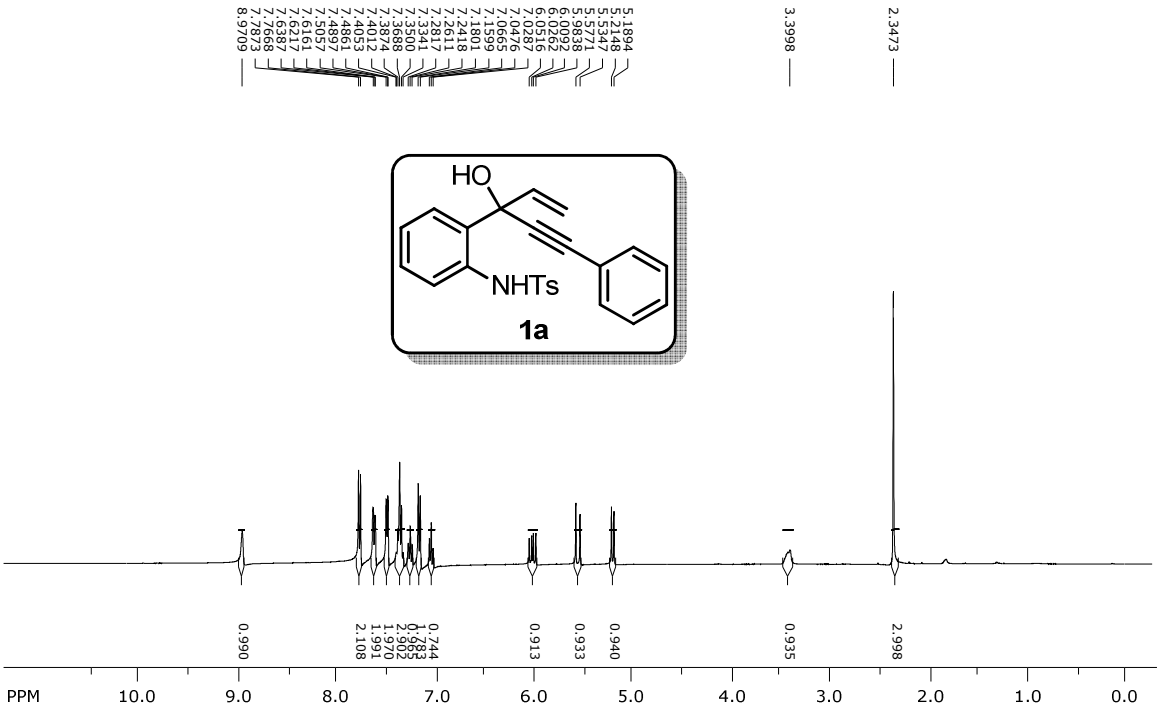


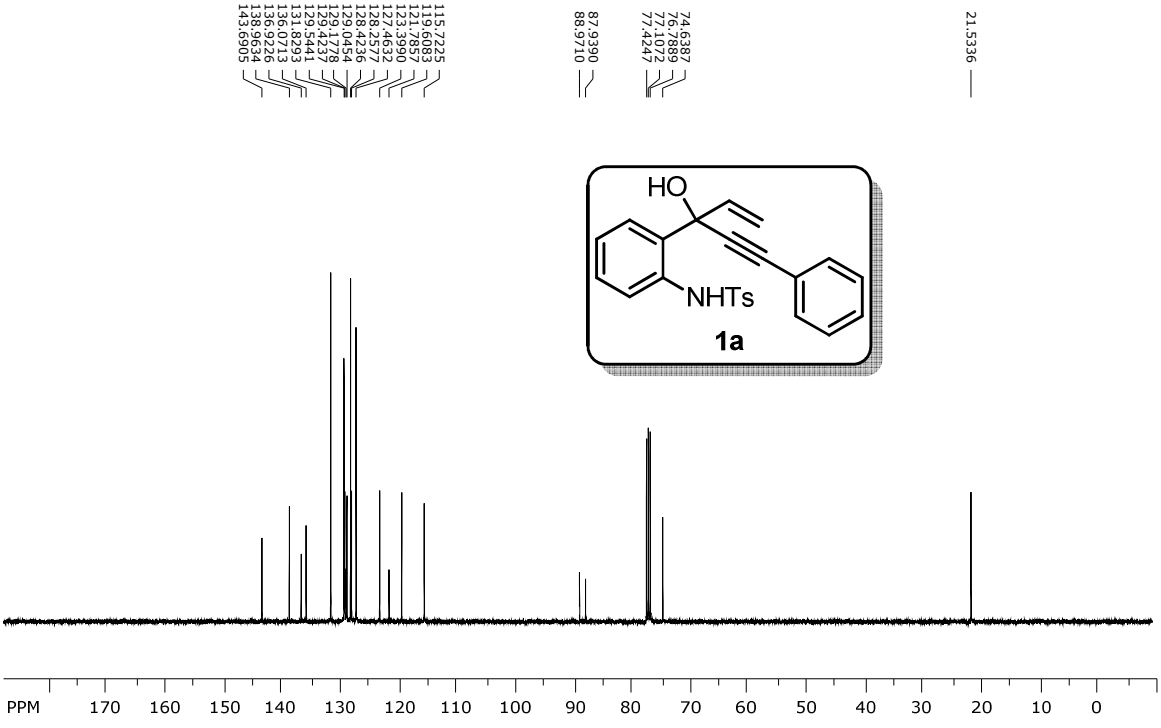
9c

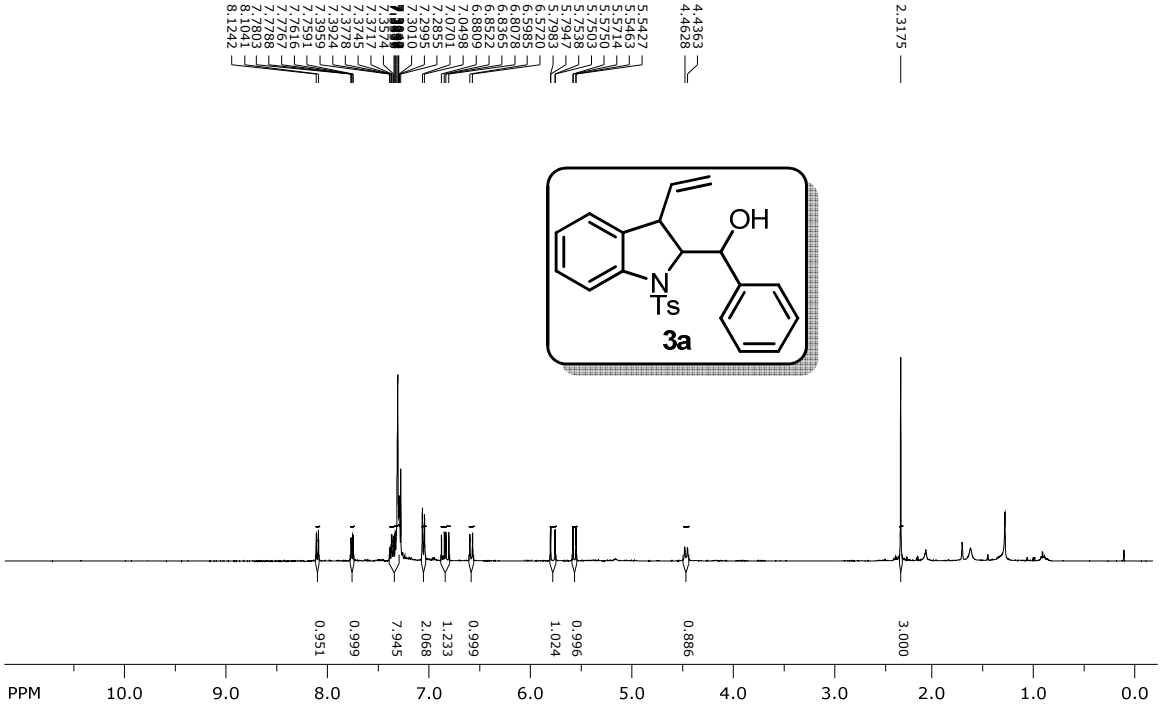
This compound was isolated as colourless solid. Following the general procedure (Scheme 8S), 40 mg of **5c** afforded 31 mg of **9c** (62% yield). M. P. = 228-229 °C. R_f = 0.6 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2961, 2870, 1762, 1704, 1450, 1400, 1362, 1176, 1093, 1051, 734. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.19 (d, *J* = 8.2 Hz, 1H), 8.11 (d, *J* = 8.0 Hz, 1H), 7.58-7.54 (m, 1H), 7.47-7.44 (m, 3H), 7.24 (d, *J* = 8.0 Hz, 2H), 7.08 (d, *J* = 8.1 Hz, 2H), 6.96 (d, *J* = 8.2 Hz, 2H), 3.71 (q, *J* = 7.1 Hz, 2H), 3.17 (s, 3H), 2.99 (hep, *J* = 6.7 Hz, 1H), 2.30 (s, 3H), 1.35 (d, *J* = 6.9 Hz, 6H), 1.26 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 168.7, 166.9, 148.4, 144.2, 142.9, 142.8, 134.6, 134.0, 132.5, 131.7, 131.4, 130.6(2C), 129.0(2C), 128.4, 128.1, 127.6, 126.8, 126.2(2C), 125.5, 125.2(2C), 123.2, 119.1, 33.8, 32.8, 23.9(2C), 21.5, 14.8, 13.9. **HRMS (ESI):** *m/z* calcd for $C_{33}H_{30}N_2O_4SNa$ $(M+Na)^+$: 573.1824. Found: 573.1811.

Copies of ^{1}H and ^{13}C-NMR spectra of all the new compounds reported in this study

(**Note**: In general, in a ^{1}H NMR spectrum recorded in $CDCl_3$, a peak at around δ 1.6 refers to moisture in the solvent/sample and a peak at about δ 1.2 refers to oil/grease present in the sample. In a ^{13}C NMR spectrum recorded in $CDCl_3$, a peak at about δ 29.7 usually represents oil/grease)



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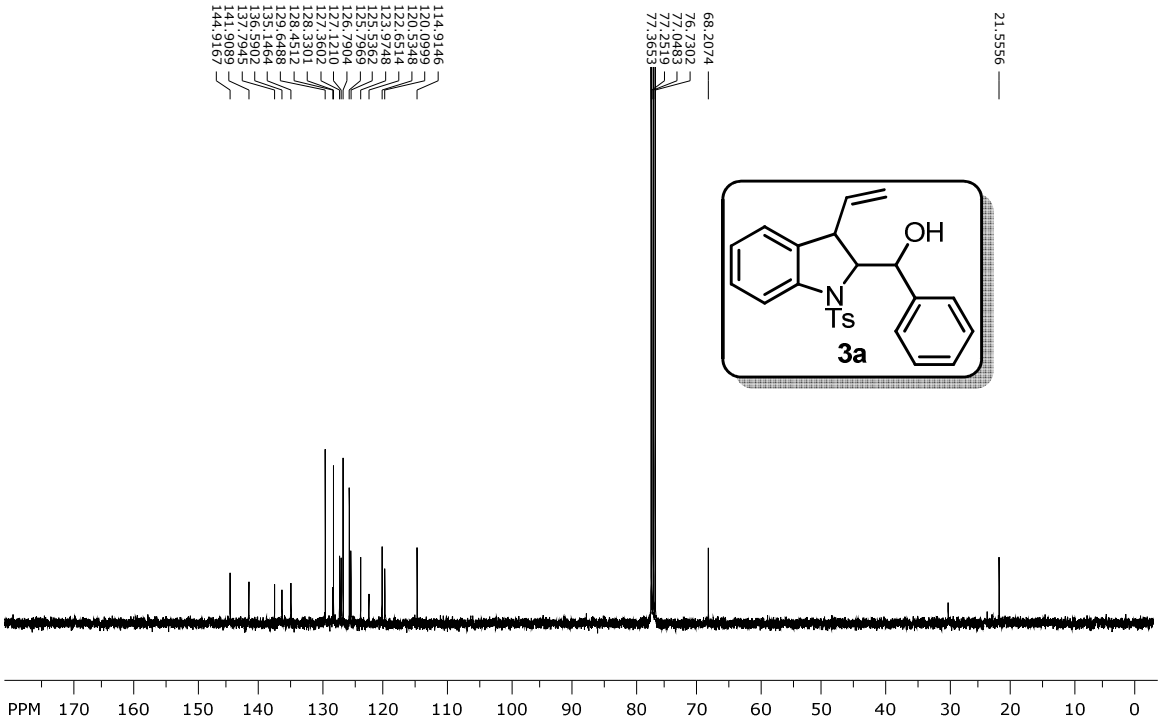
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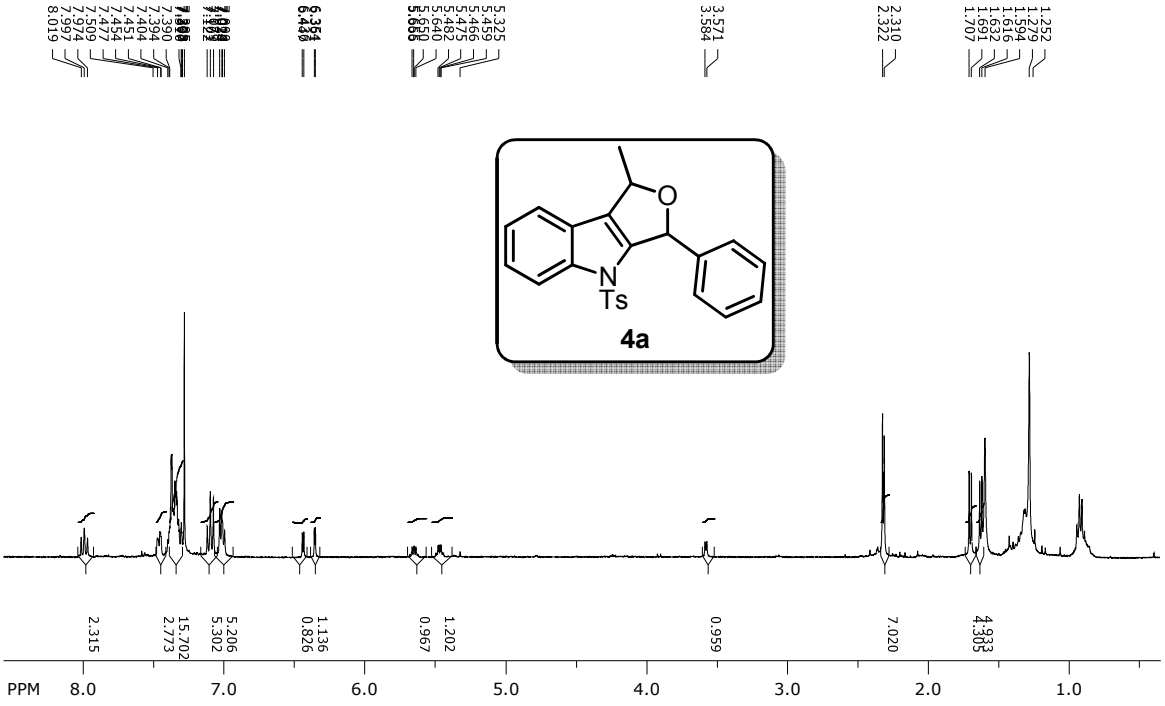

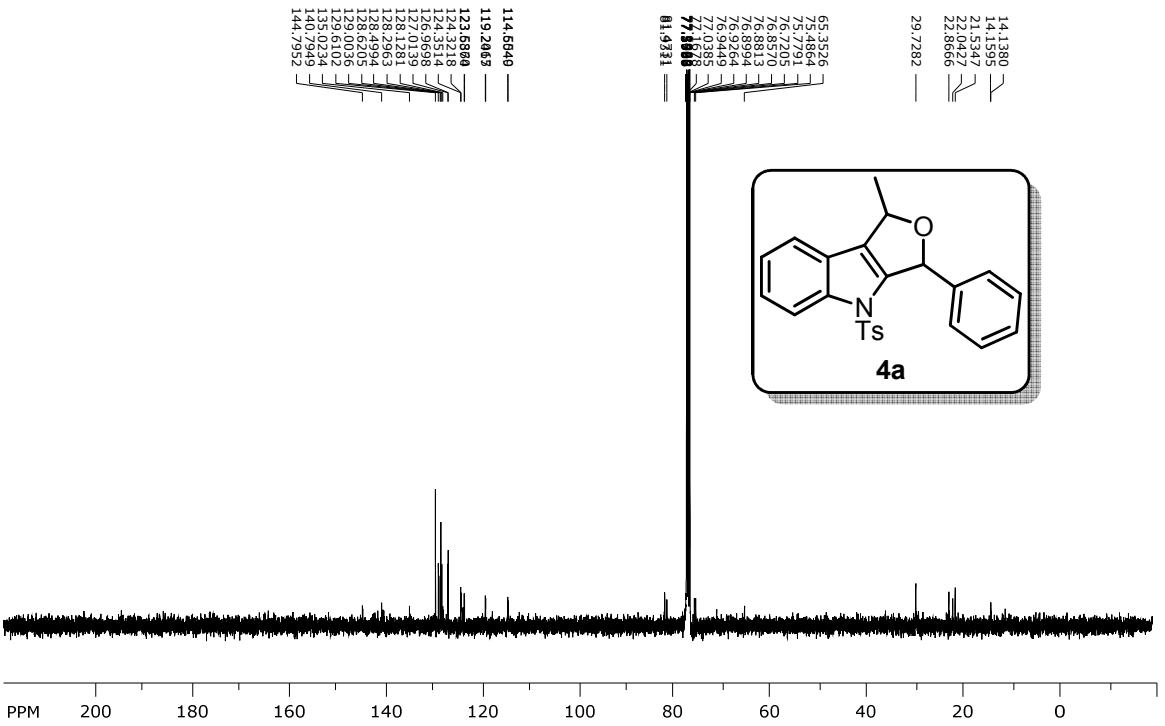

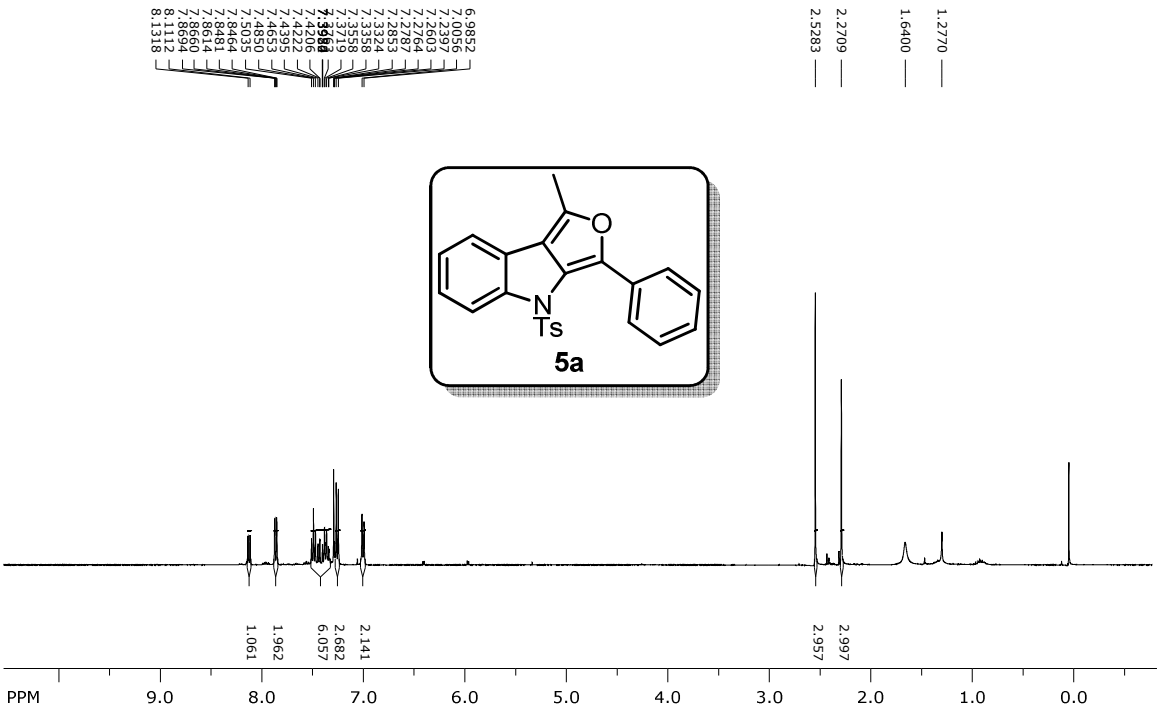
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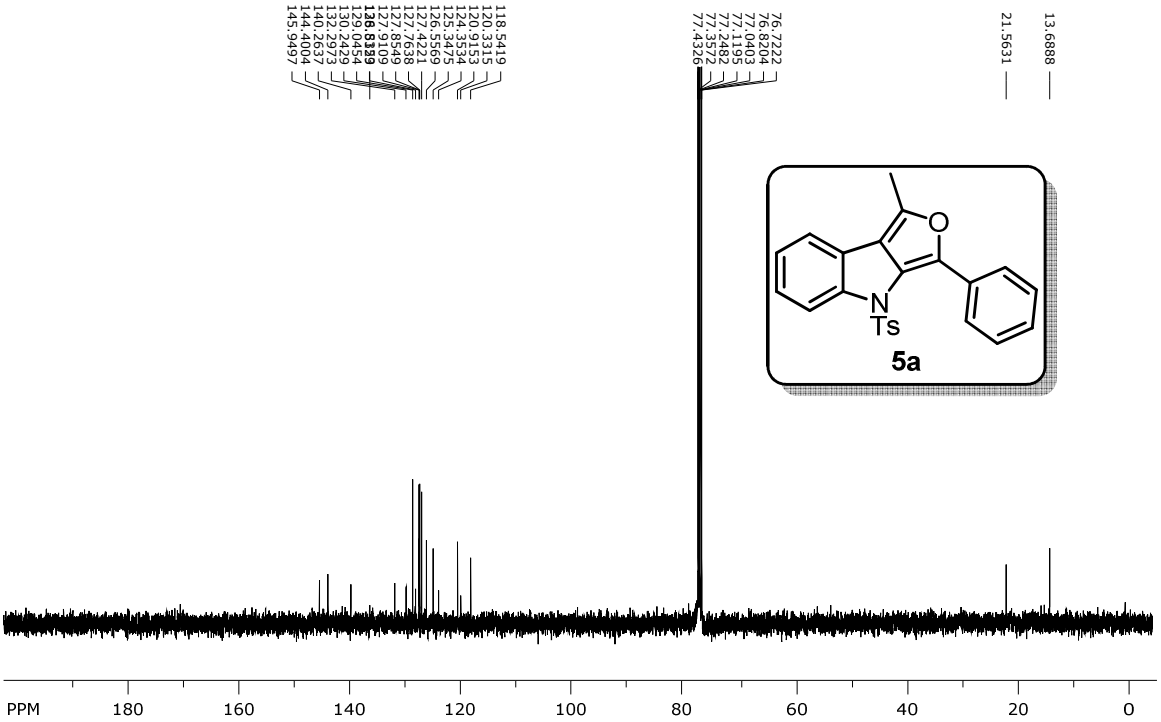
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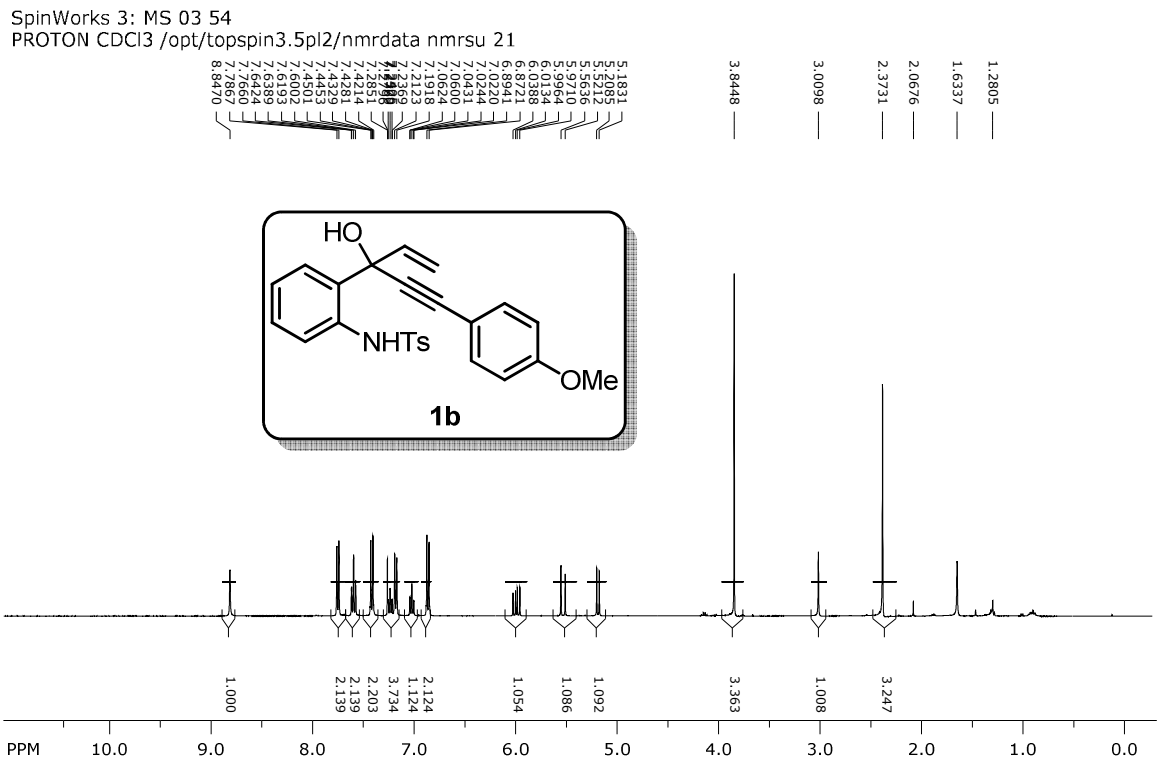
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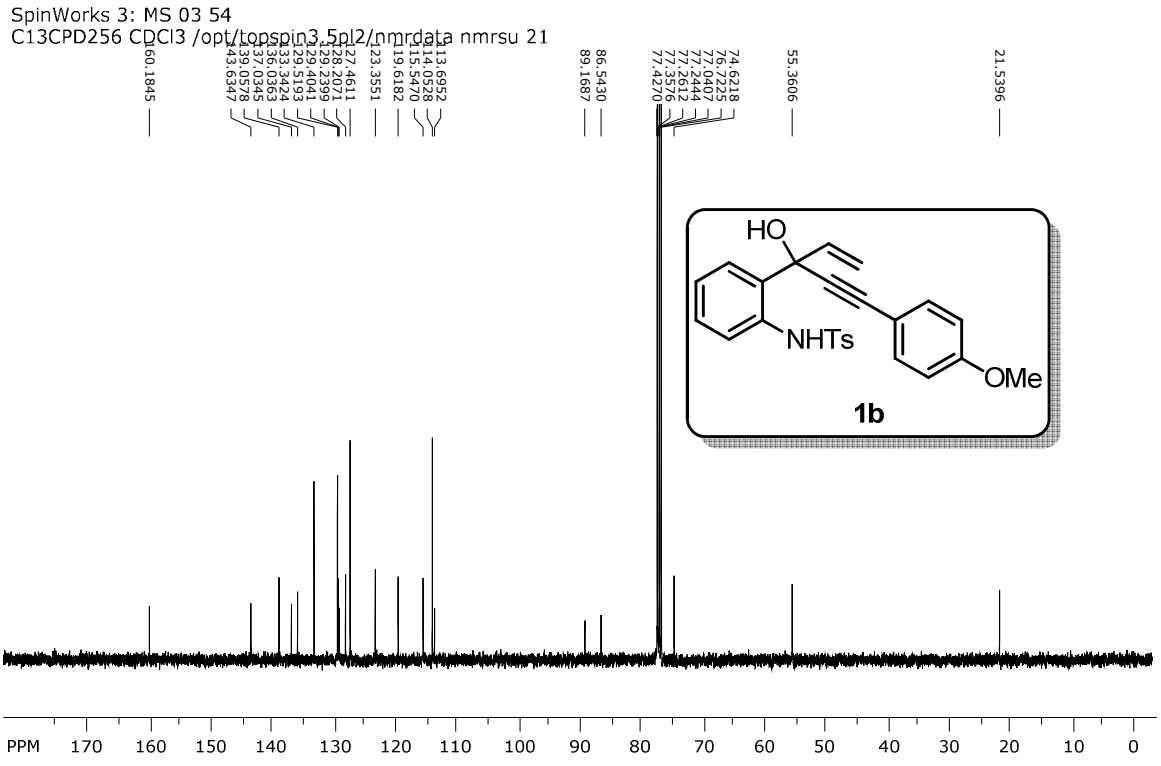
PPM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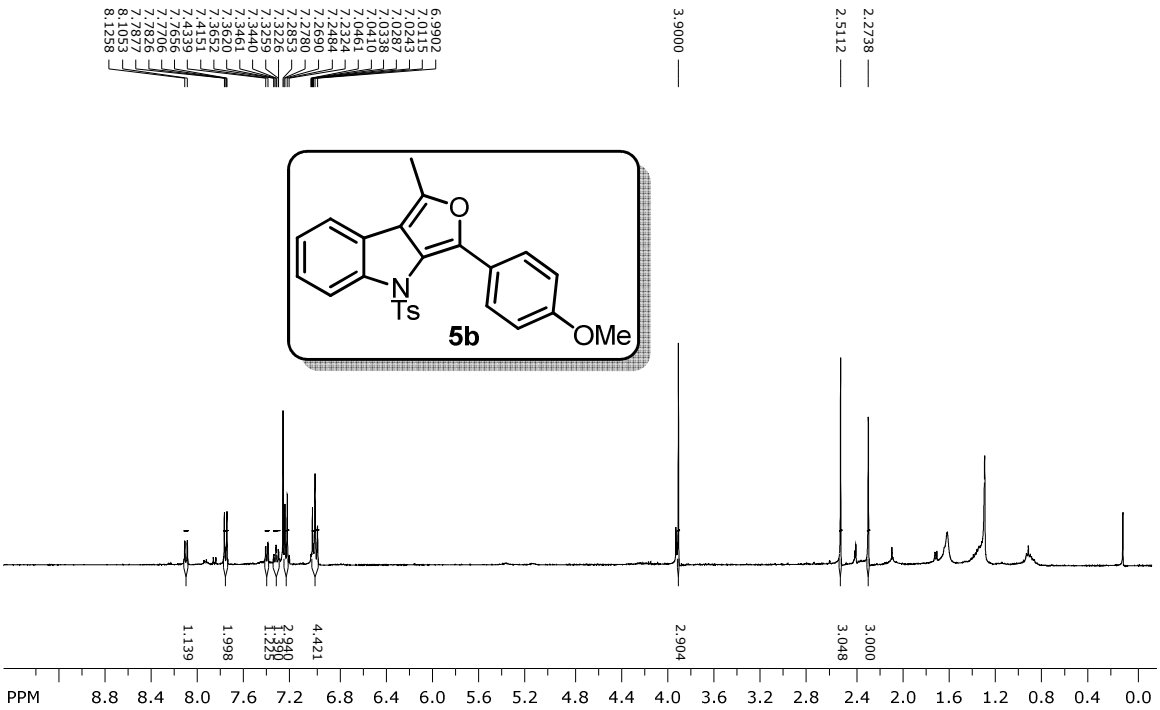
NHTs
OMe
1b
PPM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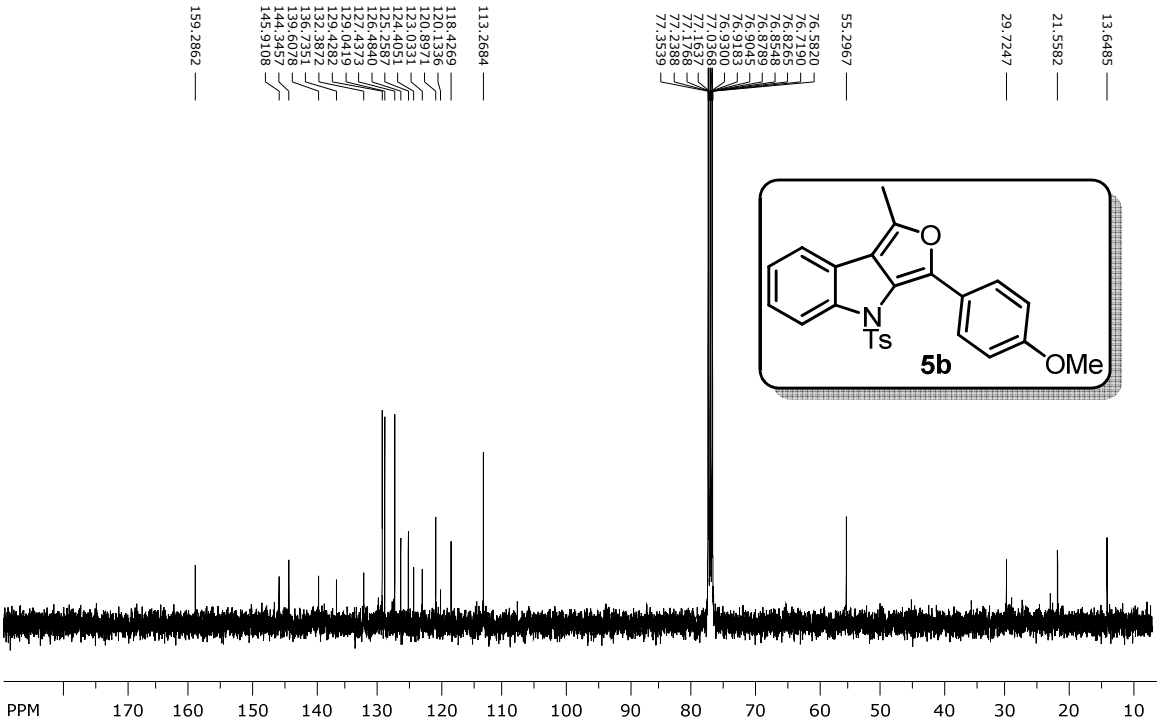
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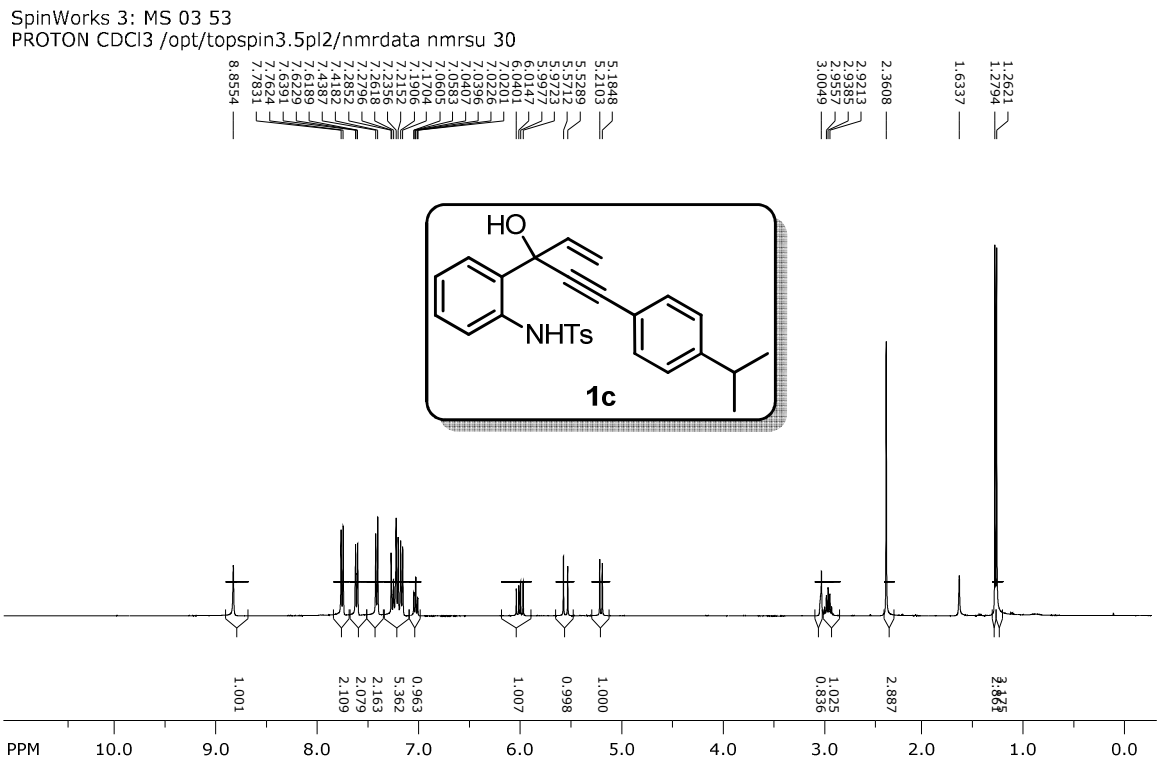
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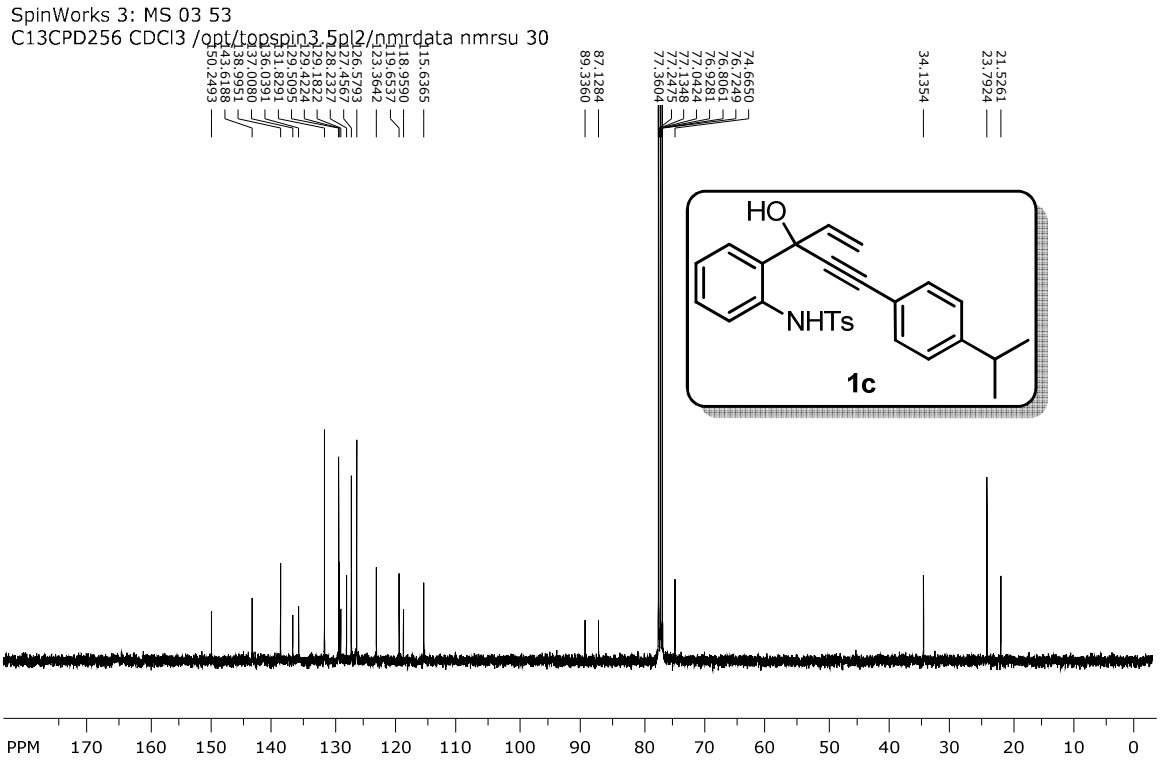
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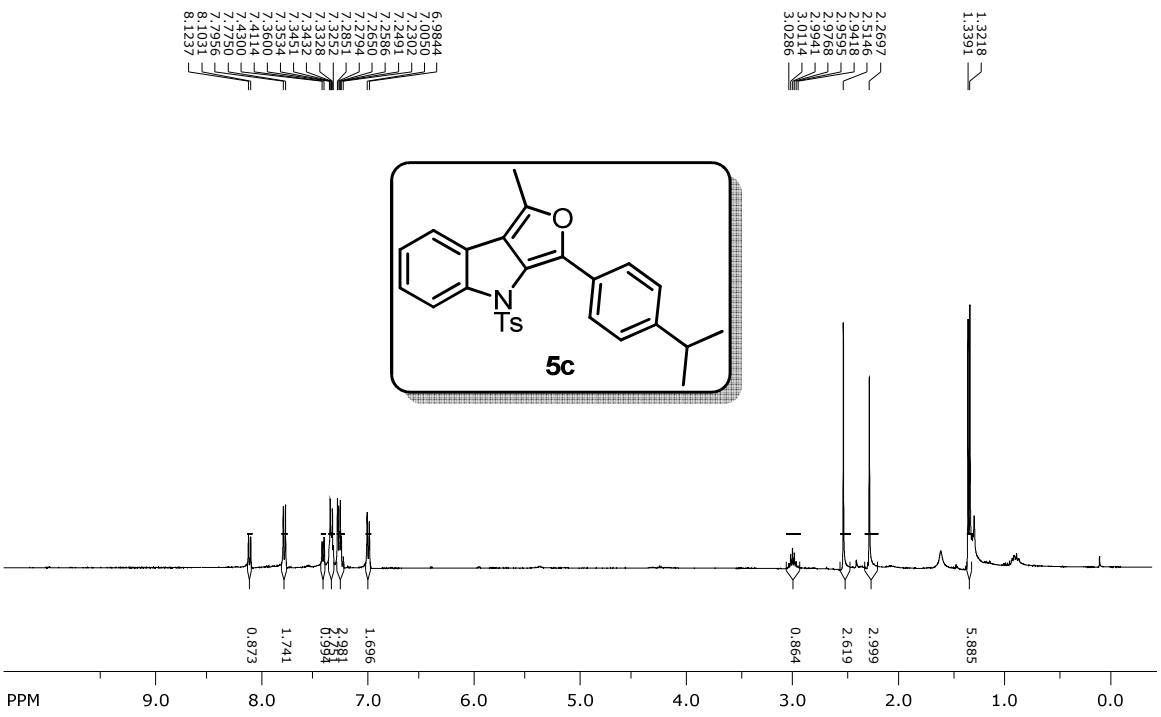
HO
NHTs
1c
PPM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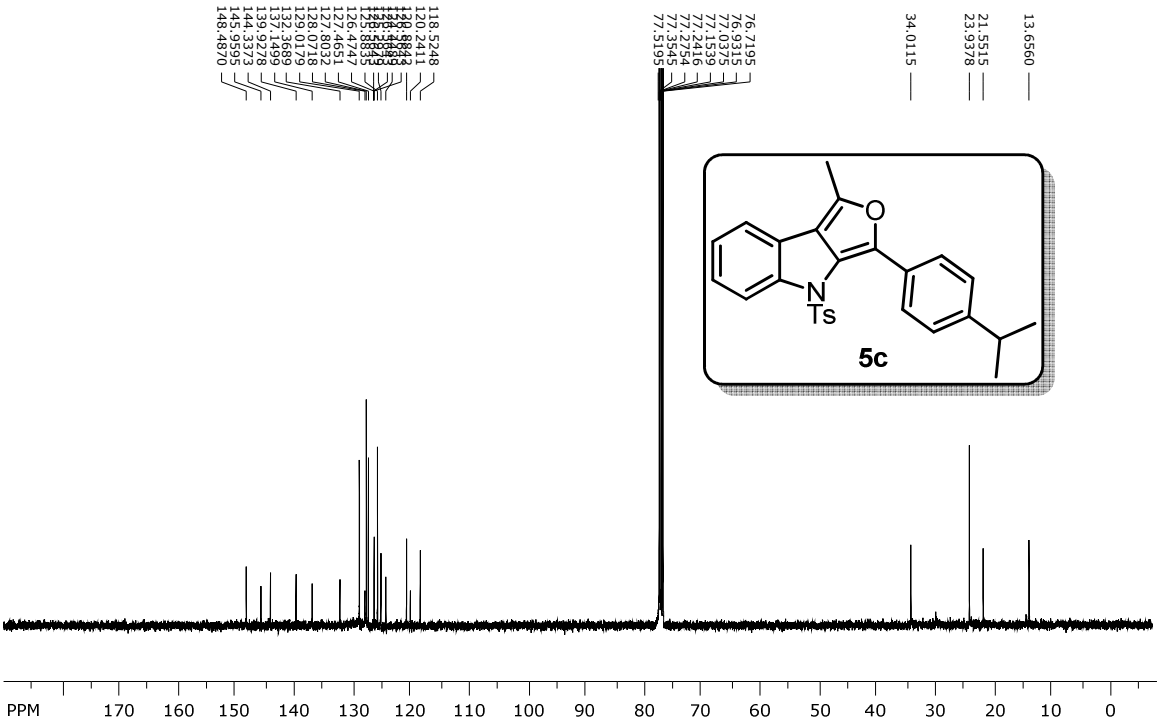
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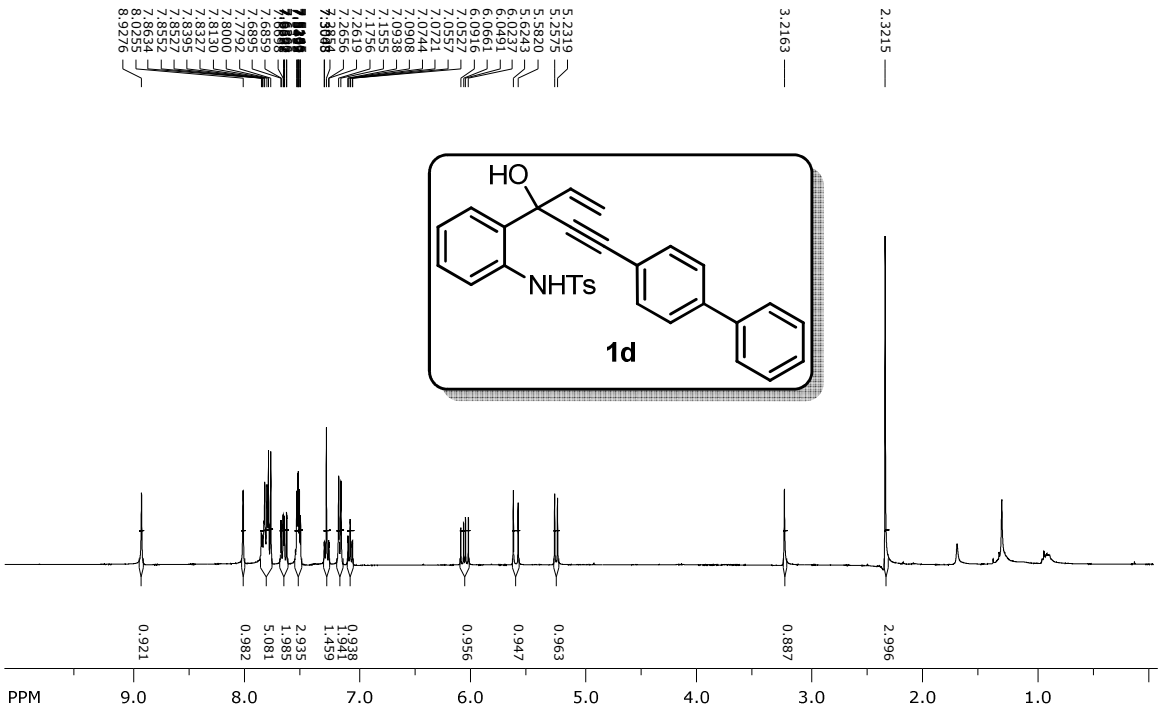

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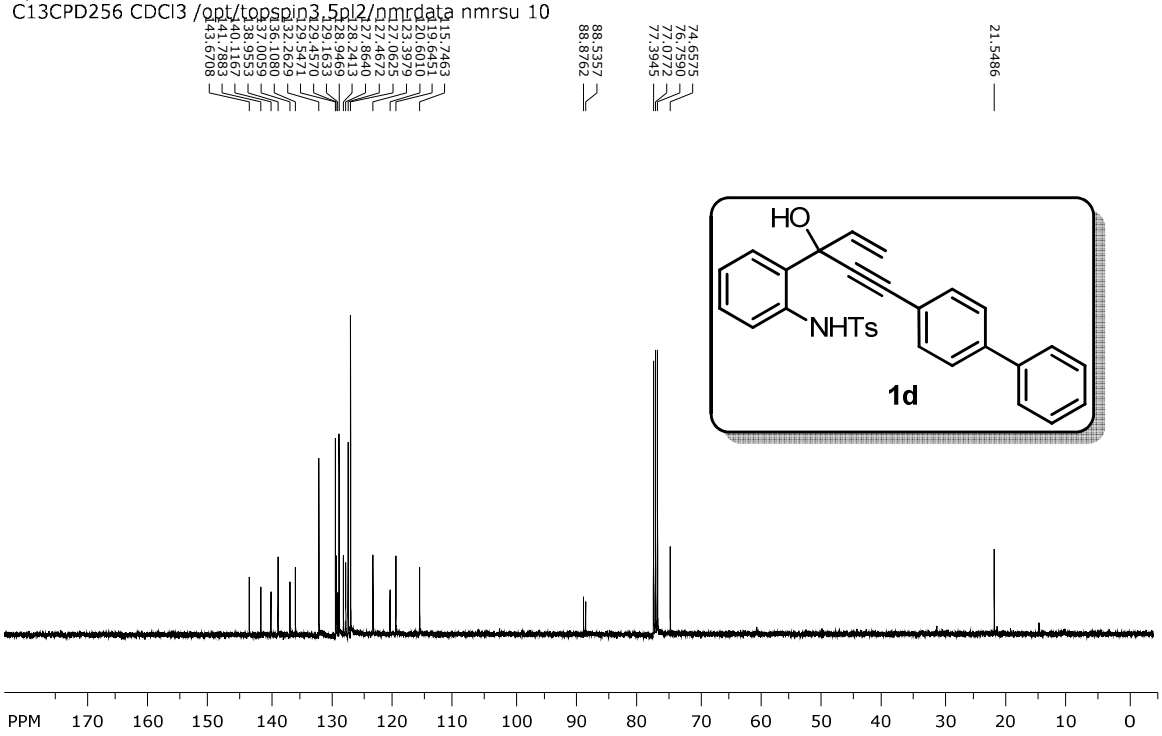

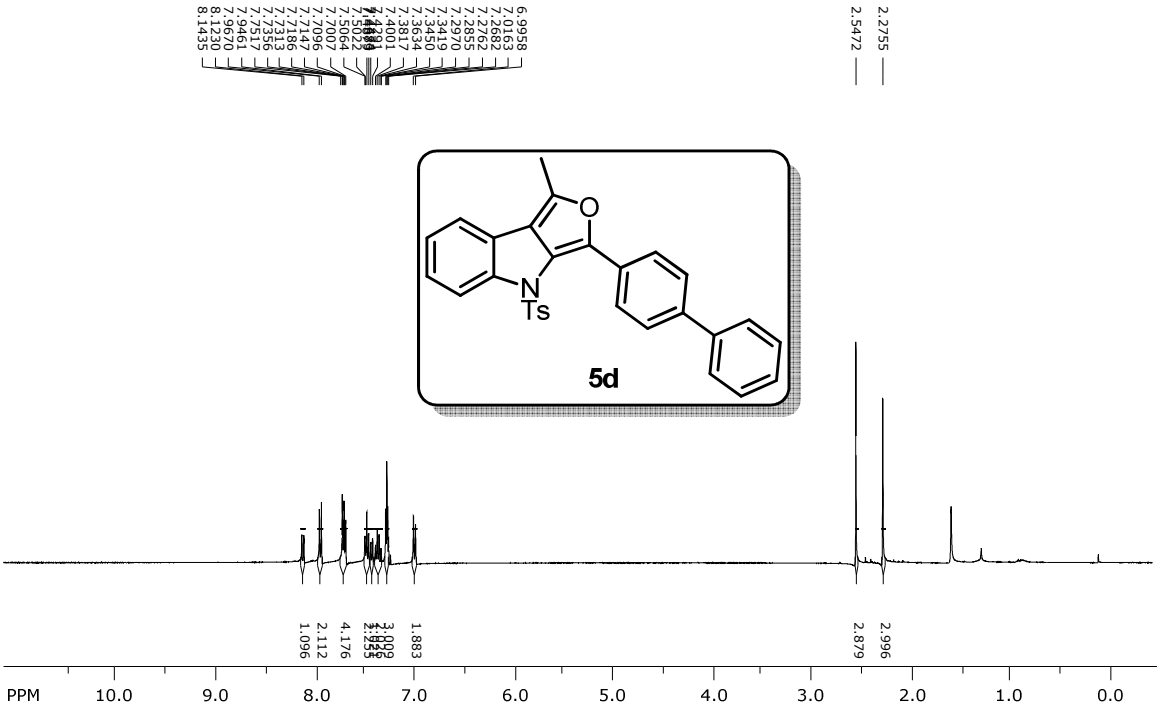
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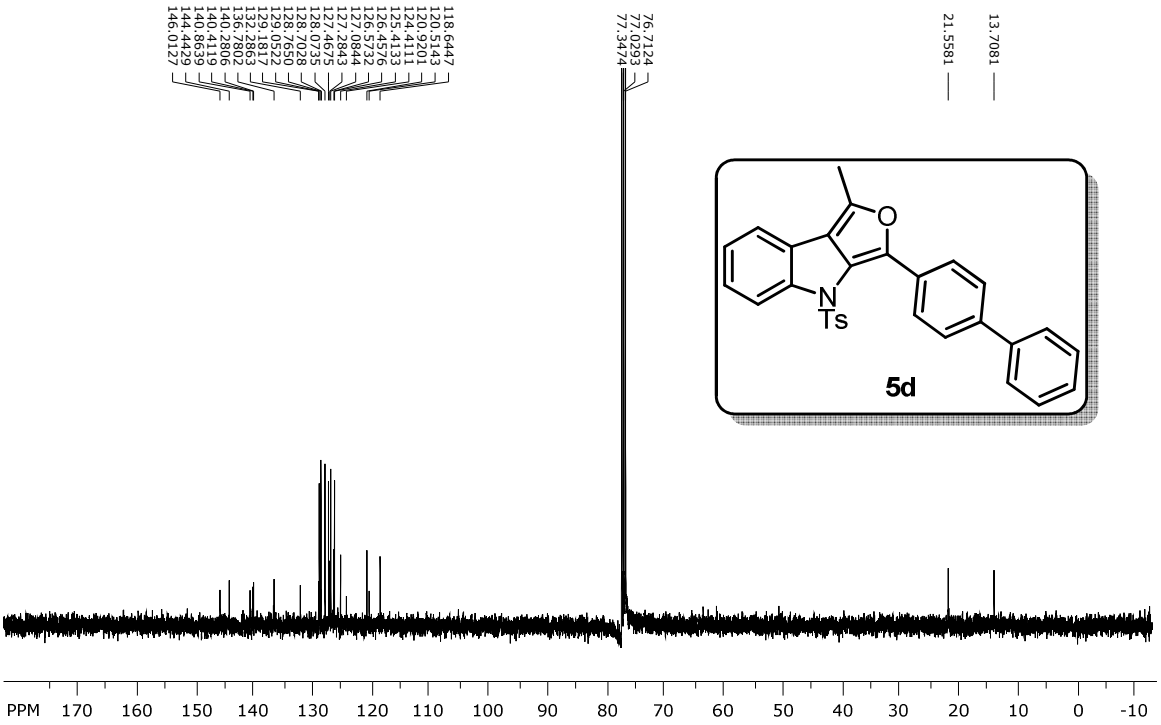
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128.7028
128.0735
127.4675
127.2843
127.0844
126.5732
126.4576
125.4133
124.4111
120.9201
120.5143
118.6447
77.3474
77.0293
76.7124
21.5581
13.7081
Ts
5d
PPM
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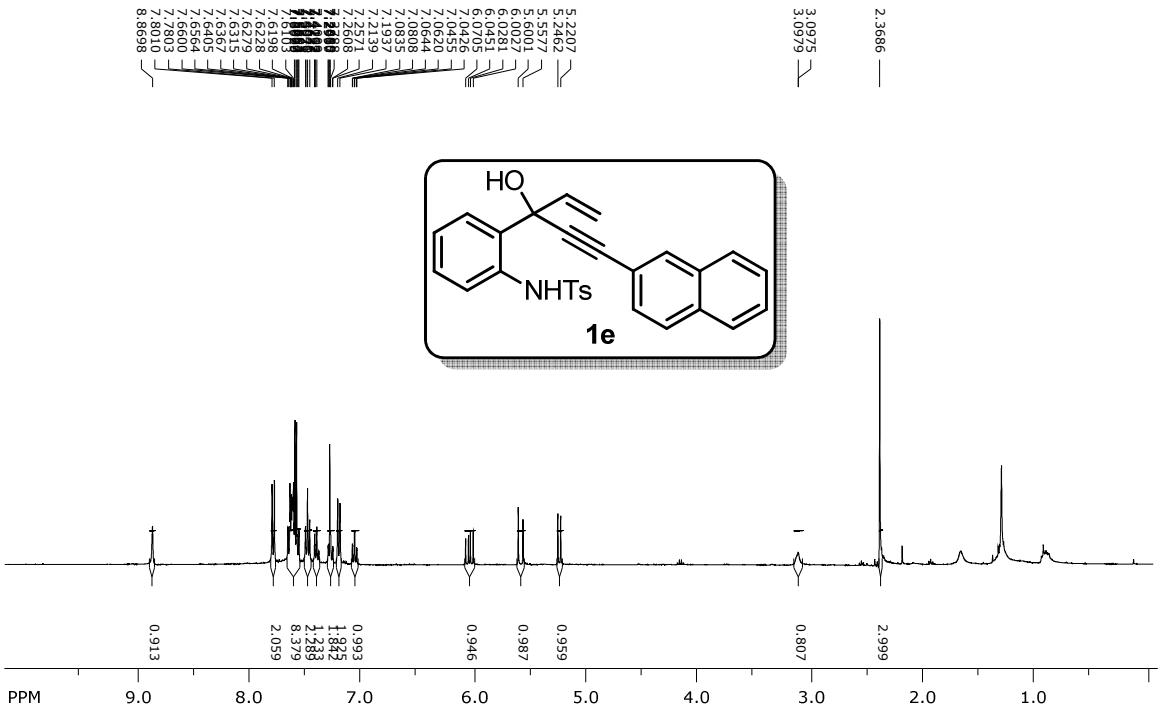
-10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7.6198
7.2608
7.2571
7.2139
7.1937
7.0835
7.0808
7.0644
7.0620
7.0426
6.0705
6.0451
6.0281
6.0027
5.6001
5.5577
5.2462
5.2207
3.0979
3.0975
2.3686
HO
NHTs
1e
0.913
2.059
8.379
1.925
1.842
0.993
0.946
0.987
0.959
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PPM
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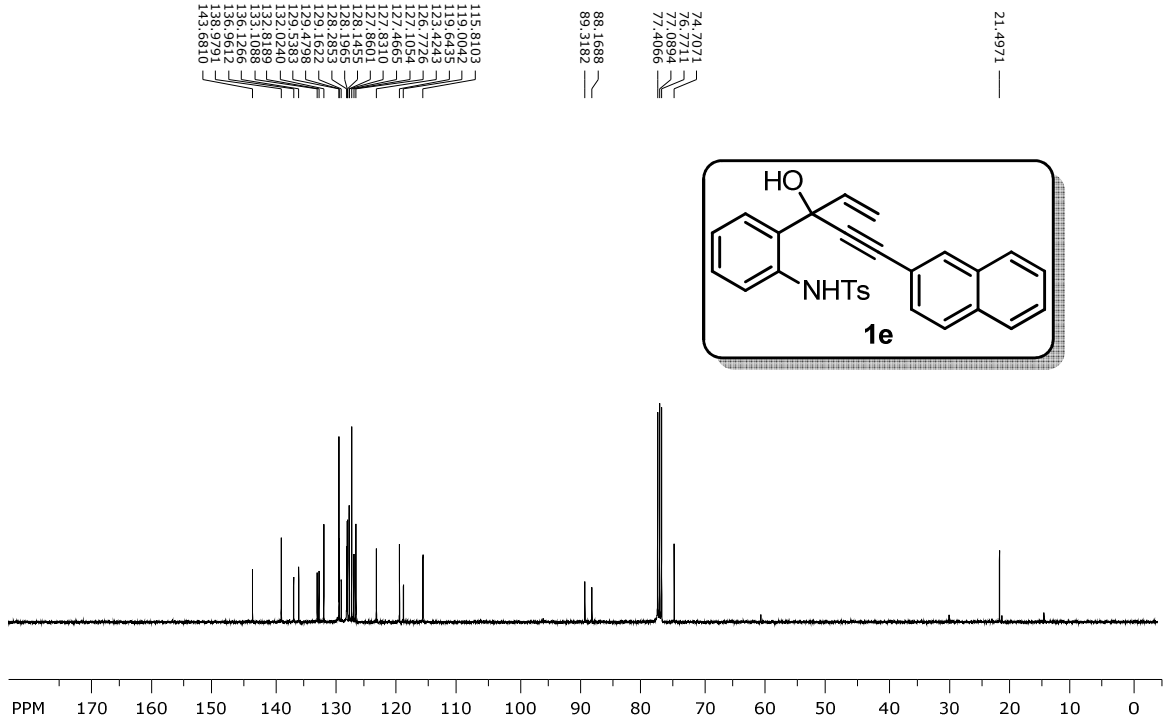
1.0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129.1622
128.2853
128.1965
128.1455
127.8601
127.8310
127.4665
127.1054
123.4243
119.6435
119.0042
115.8103
89.3182
88.1688
77.4066
76.7711
74.7071
21.4971
HO
NHTs
1e
PPM
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140
130
120
110
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70
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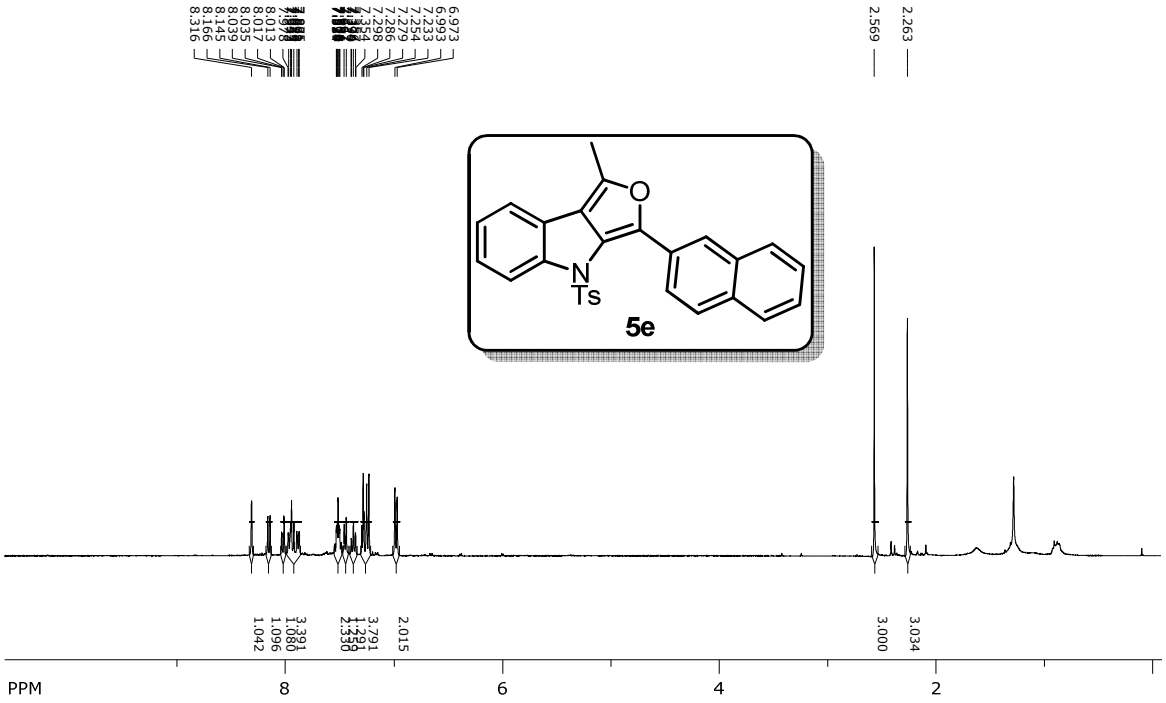
30
20
10
0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8.166
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8.035
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8.013
6.993
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7.254
7.279
7.286
7.298
2.569
2.263
Ts
5e
1.042
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1.291
3.791
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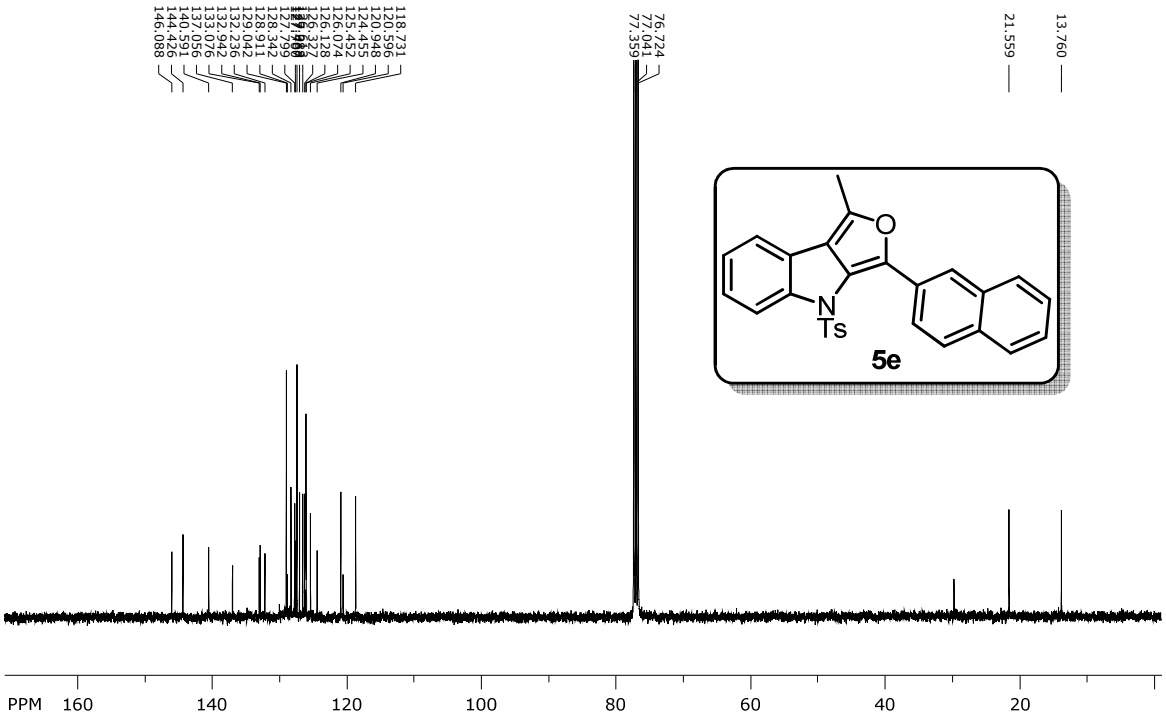
3.000
3.034
PPM
8
6
4
2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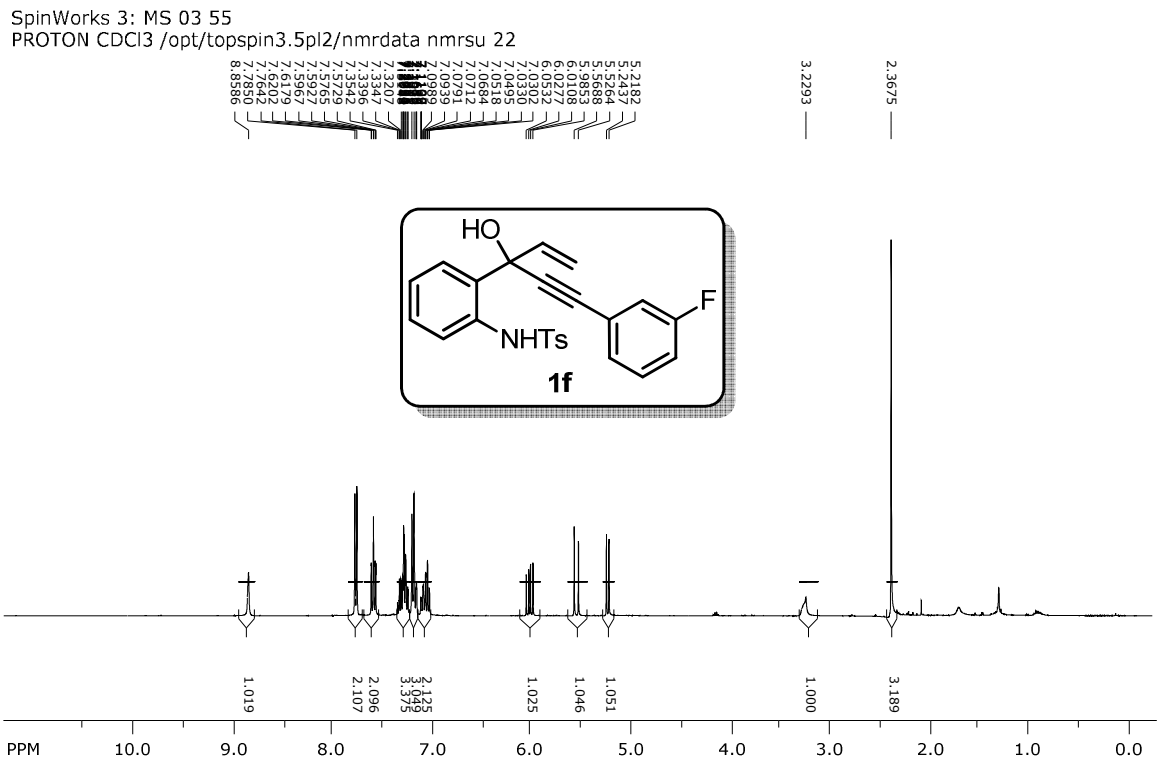
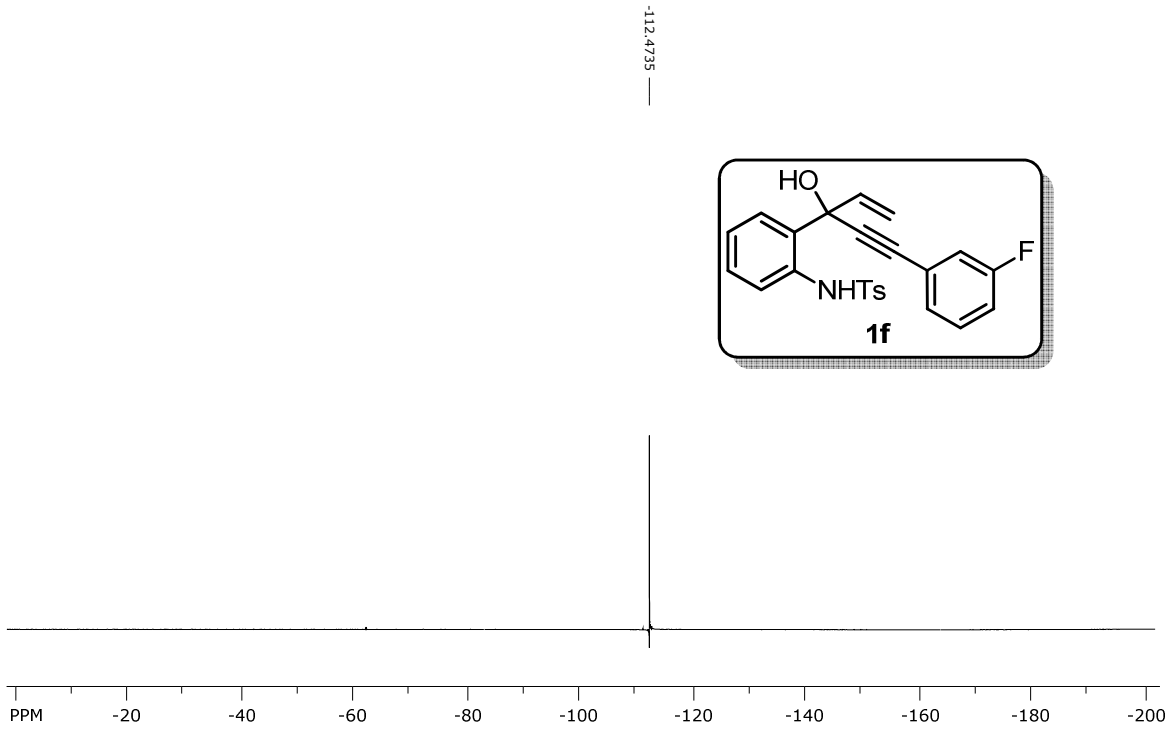
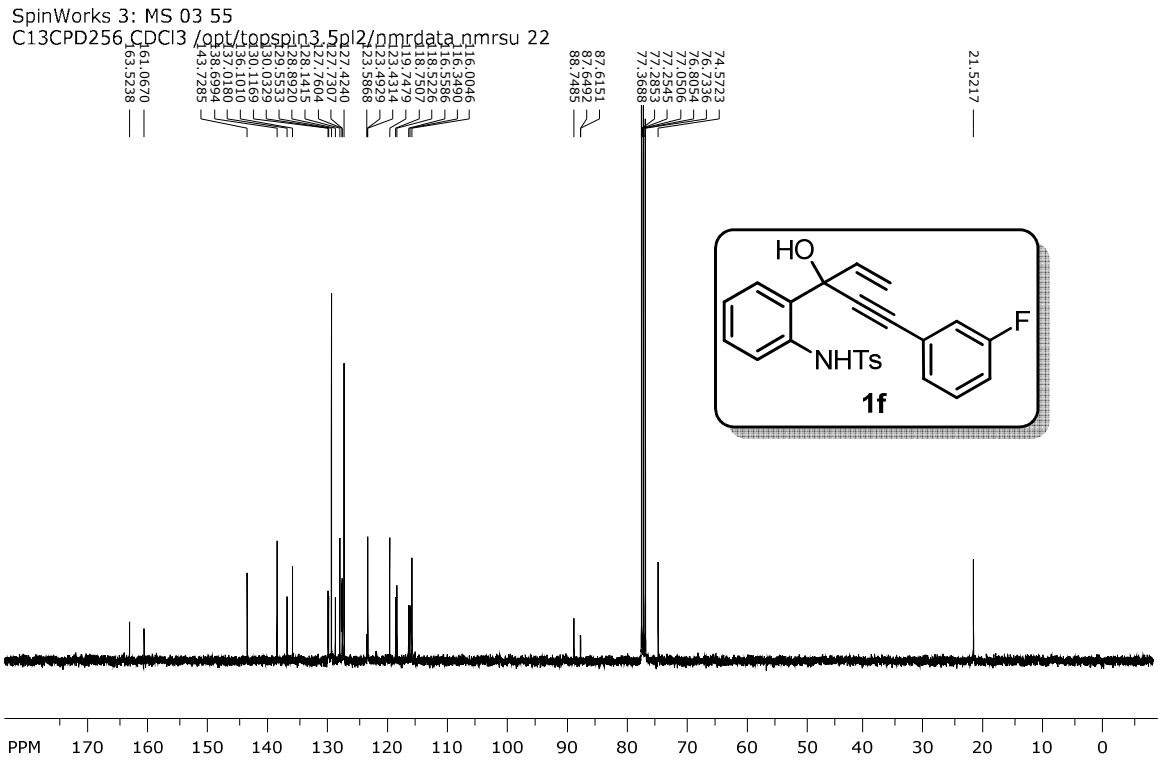
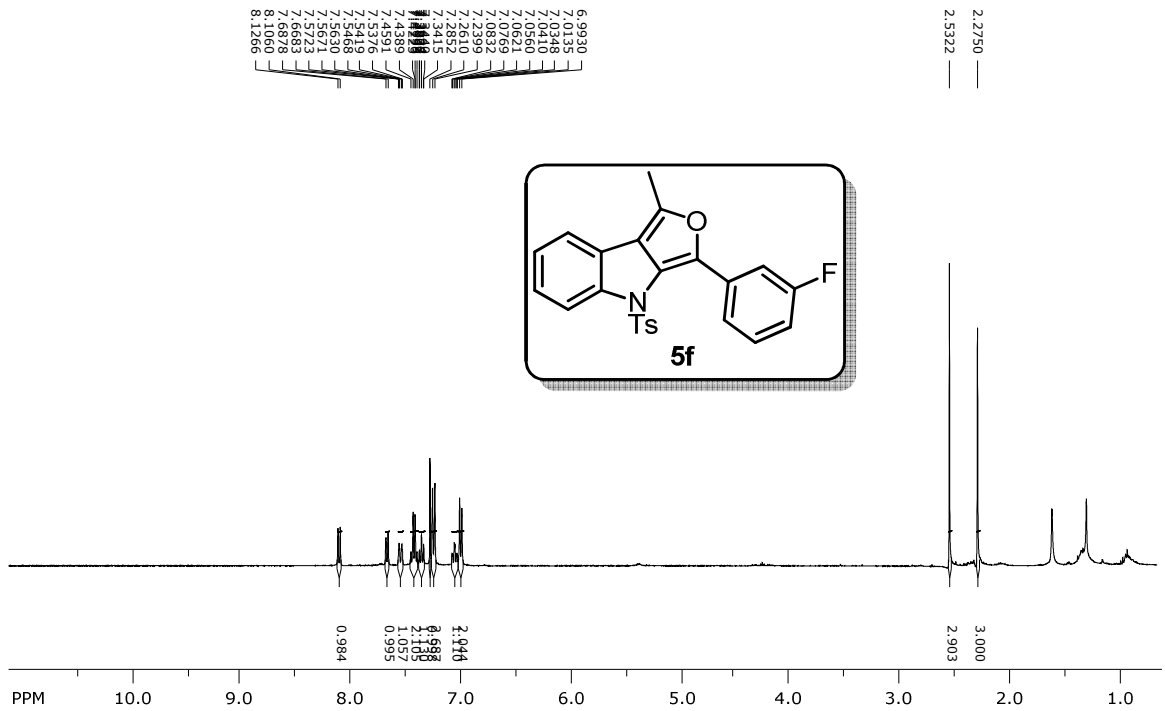
137.056
133.076
132.942
132.236
129.042
128.911
128.342
126.322
126.074
125.452
124.455
120.948
120.596
118.731
77.359
77.041
76.724
21.559
13.760
Ts
5e
PPM
160
140
120
100
80
60
40
20

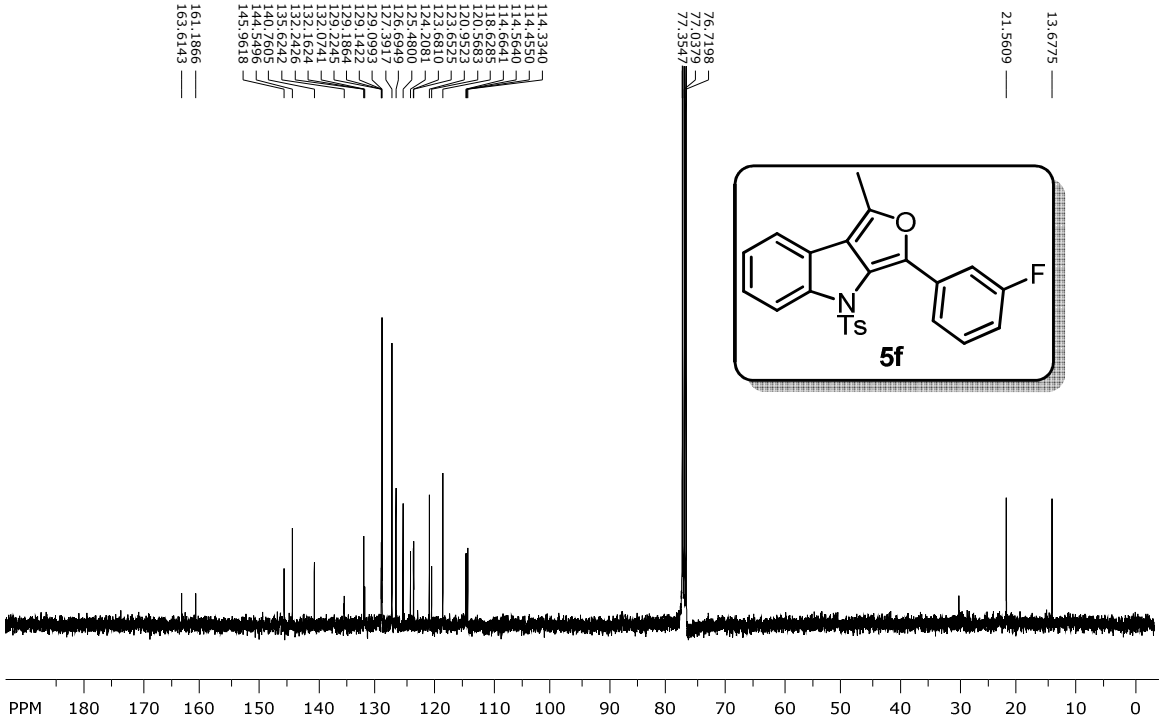

SpinWorks 3: MS 03 55
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 22
HO
F
NHTs
1f
PPM


HO
F
NHTs
1f
PPM

^{19}F-NMR of **1f**


SpinWorks 3: MS 03 55
C13CPD256.CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 22
HO
NHTs
F
1f
PPM


O
N
Ts
F
5f
PPM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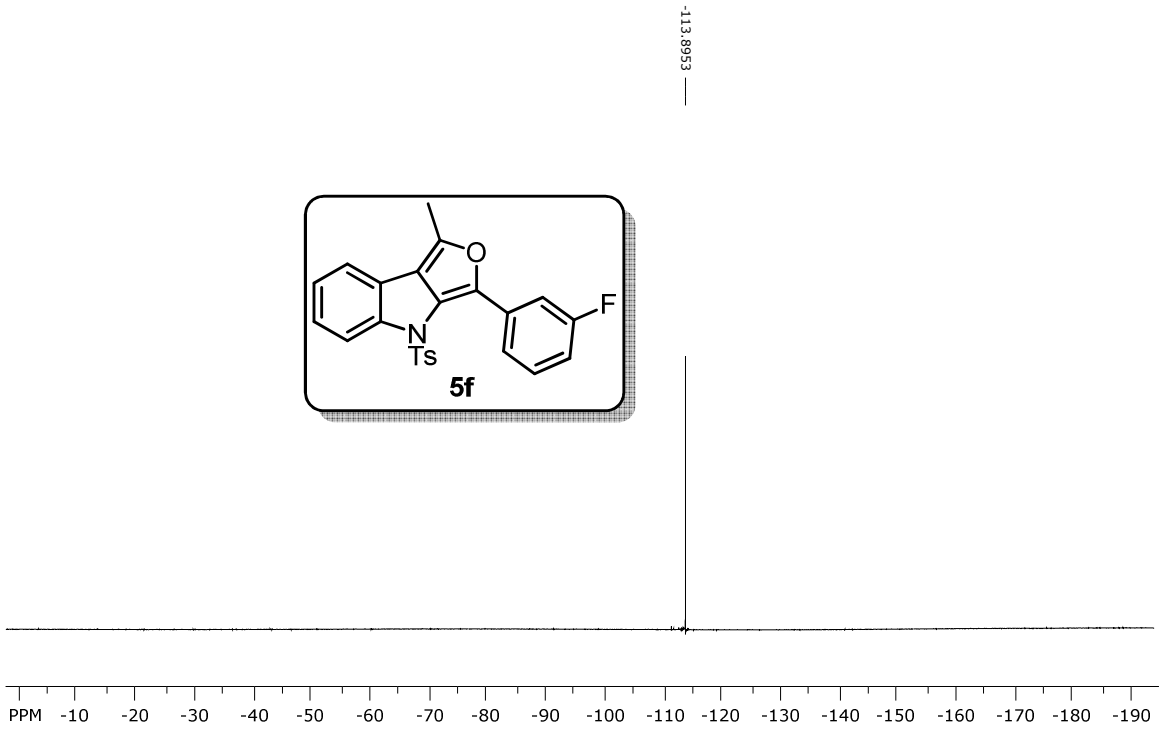
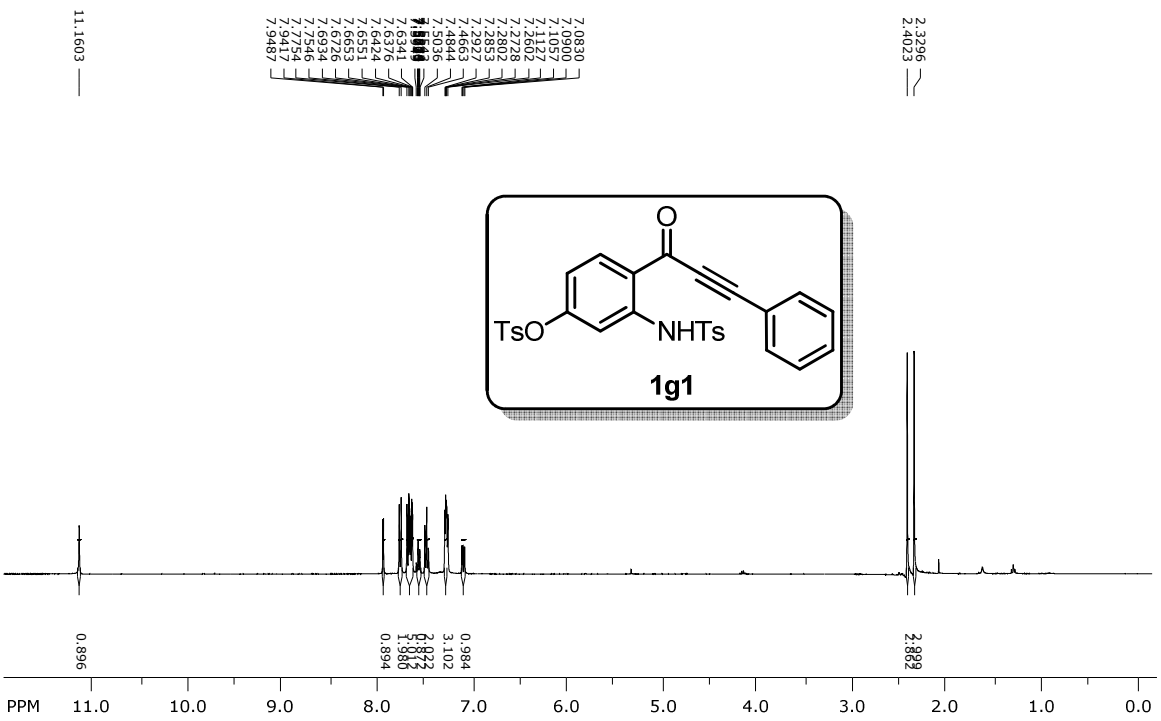
145.9618
144.5496
140.7605
135.6242
132.1626
132.0741
129.2245
129.1864
129.1422
129.0993
127.3917
126.6949
125.4800
124.2081
123.6810
123.6525
120.9523
120.5683
114.6641
114.5640
114.4550
114.3340
76.7198
77.0379
77.3547
21.5609
13.6775
O
F
N
Ts
5f
PPM 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0


-113.8953
O
F
N
Ts
5f
PPM -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190

^{19}F-NMR of **5f**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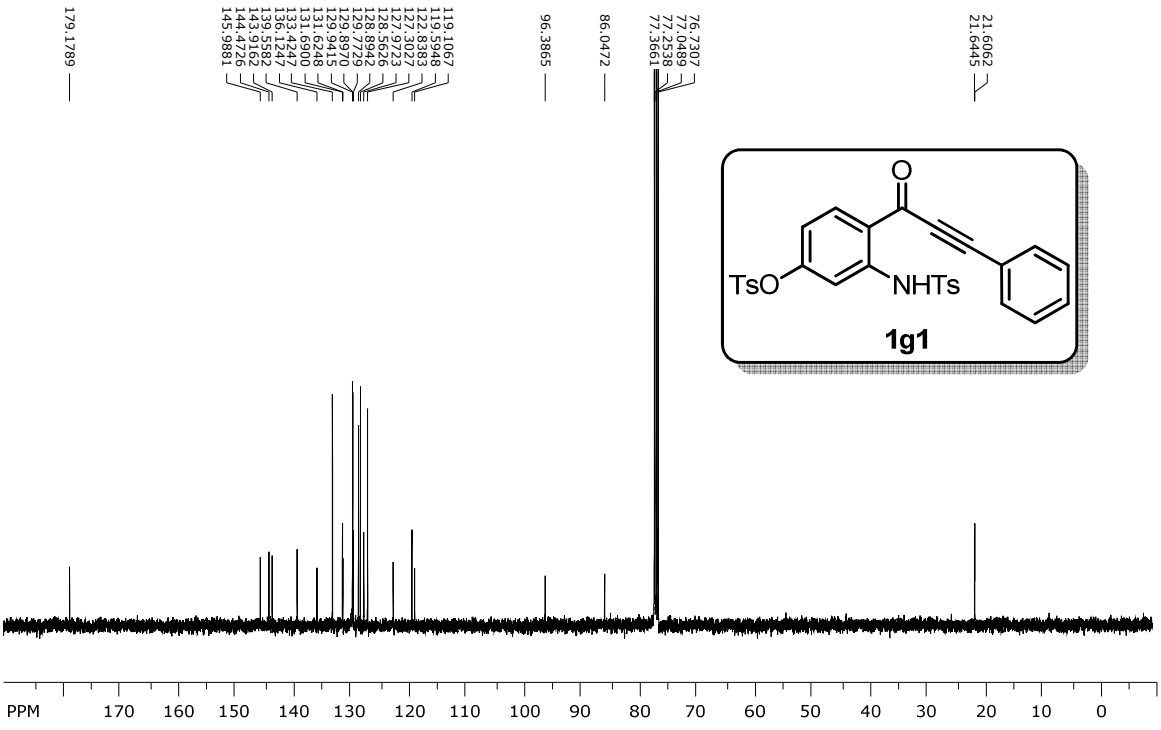
7.7754
7.7546
7.6934
7.6926
7.6553
7.6424
7.6376
7.6341
7.5036
7.4844
7.4663
7.2927
7.2853
7.2728
7.2602
7.1127
7.1057
7.0900
7.0830
2.4023
2.3296
TsO
NHTs
1g1
0.896
0.894
1.980
3.102
0.984
2.882
2.882
PPM
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0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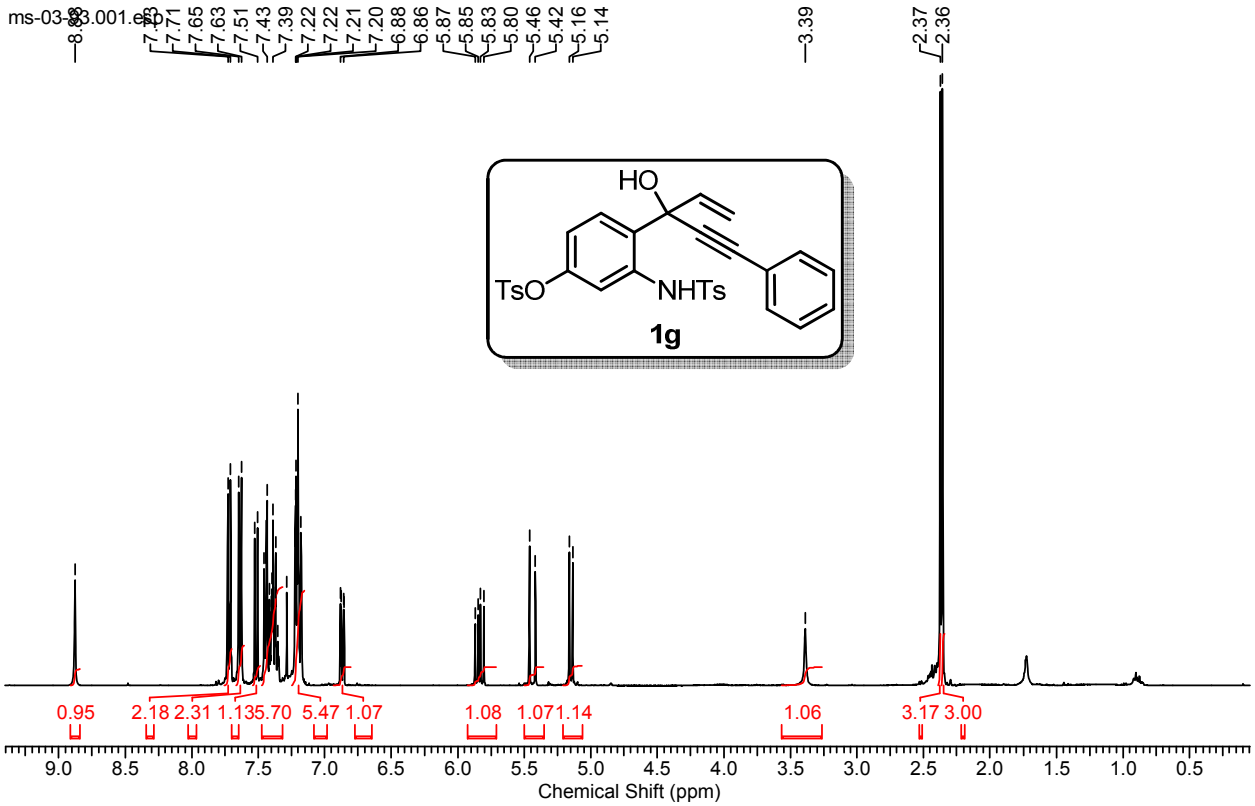
144.4726
143.9162
139.5582
136.1247
131.6900
131.6248
129.9415
129.8970
129.7729
128.8942
128.5626
127.9723
127.3027
122.8383
119.5948
119.1067
96.3865
86.0472
77.3661
77.2538
77.0489
76.7307
21.6445
21.6062
TsO
NHTs
1g1
PPM
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0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7.71
7.65
7.63
7.51
7.43
7.39
7.22
7.22
7.21
7.20
6.88
6.86
5.87
5.85
5.83
5.80
5.46
5.42
5.16
5.14
3.39
2.37
2.36
HO
TsO
NHTs
1g
0.95
2.18
2.31
1.13
5.70
5.47
1.07
1.08
1.07
1.14
1.06
3.17
3.00
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
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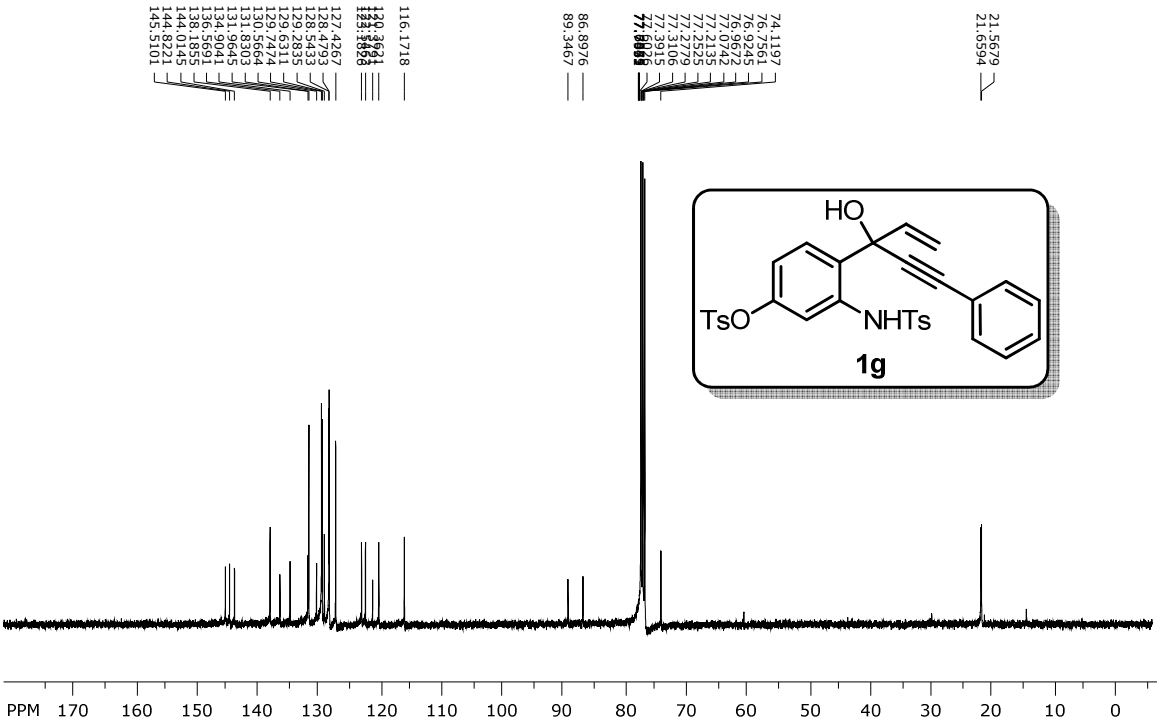
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)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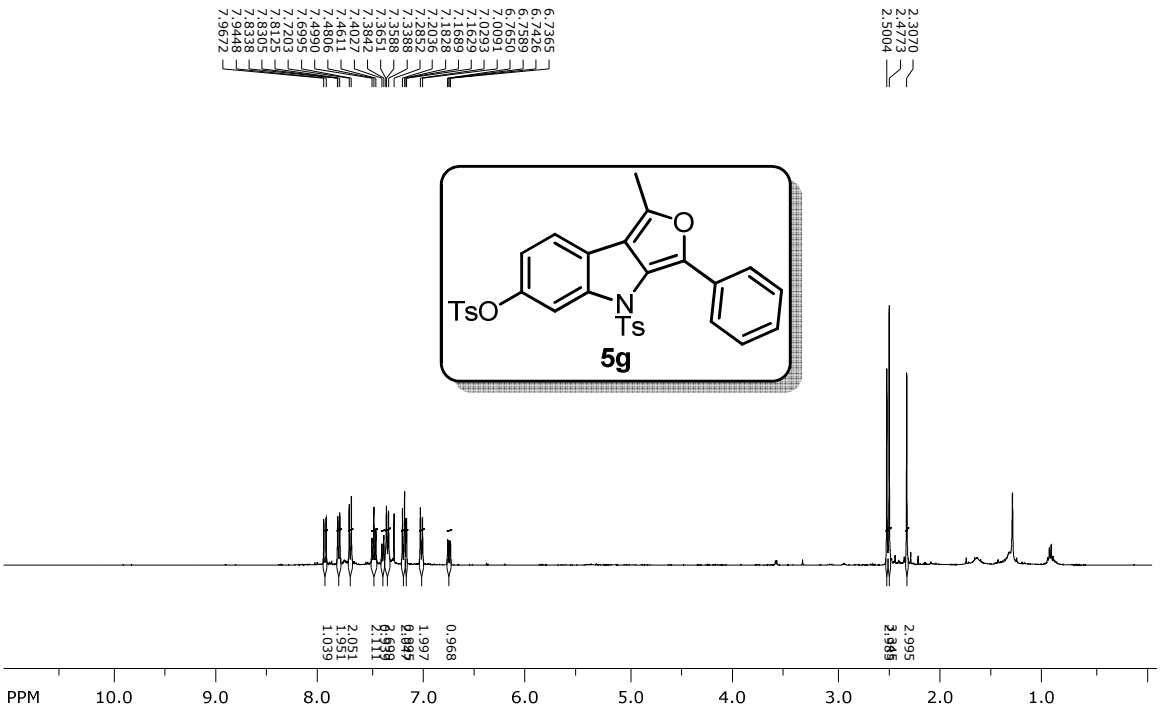
128.5433
128.4793
127.4267
116.1718
86.8976
89.3467
77.3915
77.3106
77.2375
77.2235
77.0742
76.9672
76.9245
76.7561
74.1197
21.5679
21.6594
HO
TsO
NHTs
1g
PPM
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


TsO
N
Ts
O
5g
PPM
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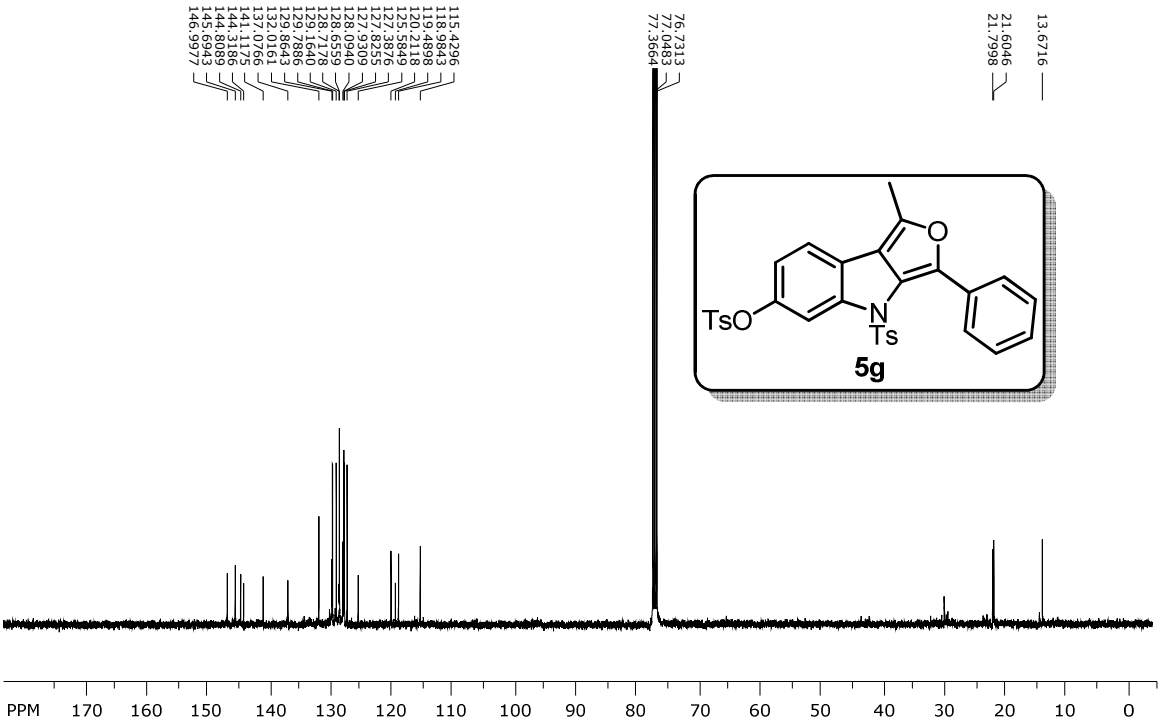
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0


TsO
N
Ts
O
5g
PPM
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160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
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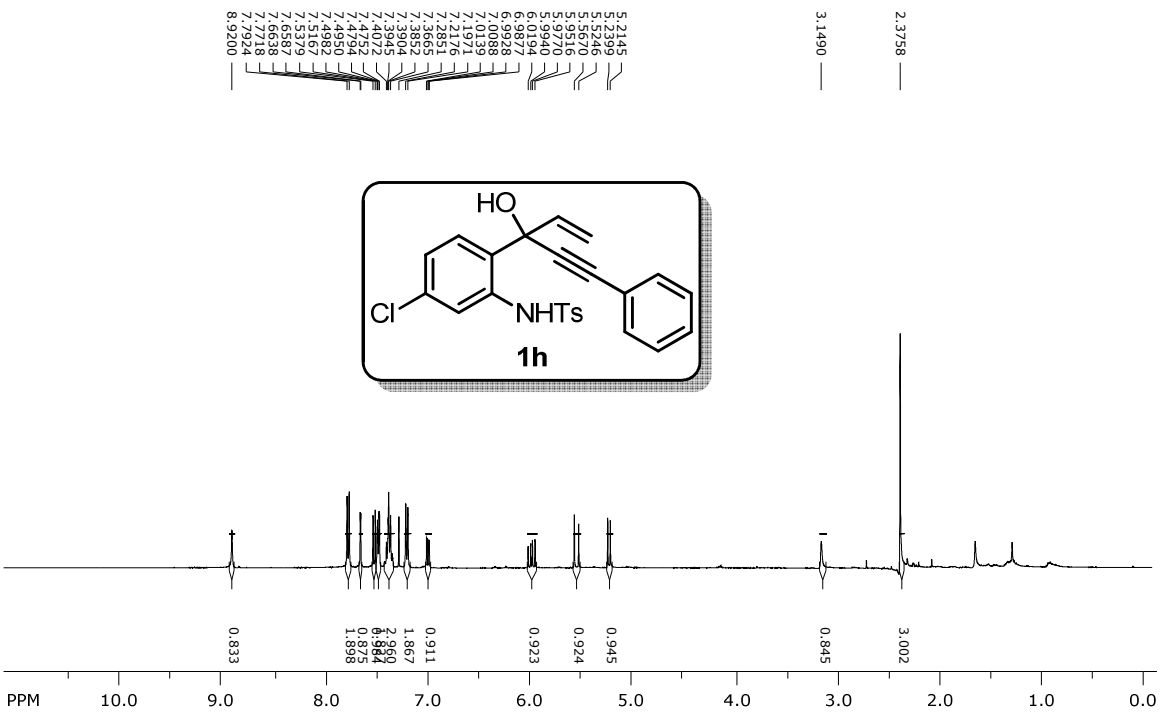
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7.6587
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7.4950
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7.4752
7.3904
7.3852
7.3665
7.2851
7.2176
7.1971
7.0139
7.0088
6.9928
6.9877
6.0194
5.9670
5.9516
5.5670
5.5246
5.2399
5.2145
3.1490
2.3758
HO
Cl
NHTs
1h
0.833
1.898
1.867
0.911
0.923
0.924
0.945
0.845
3.002
PPM
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4.0
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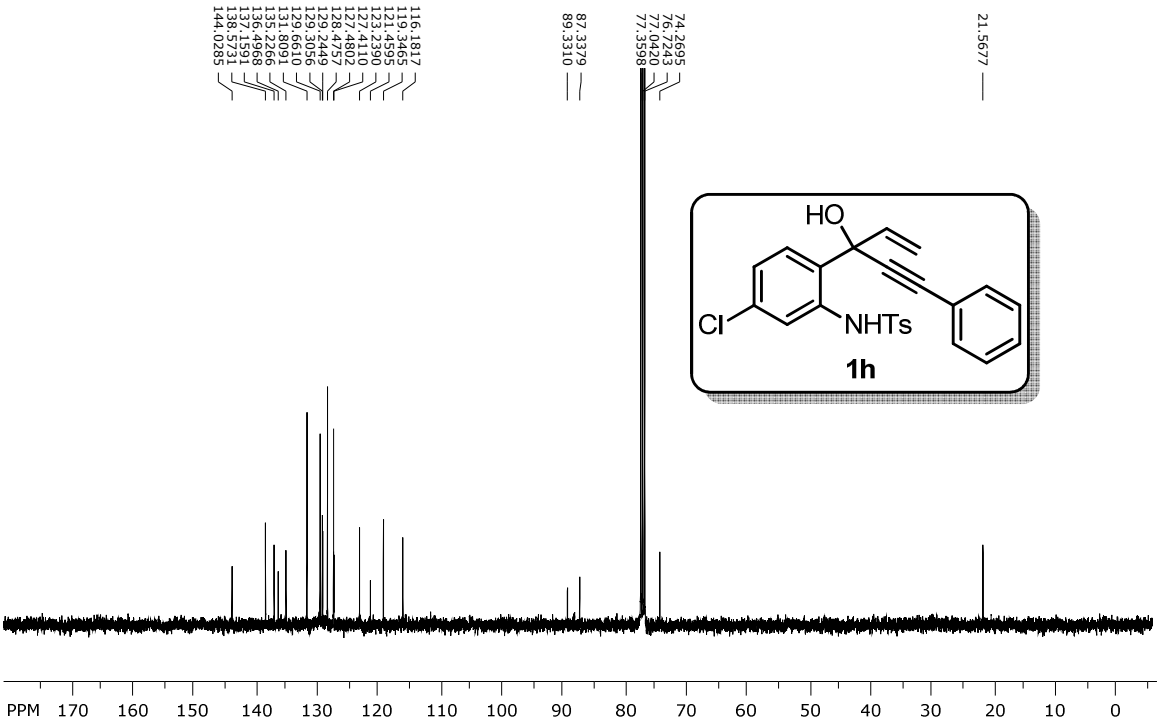
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129.2449
128.4757
127.4802
122.4190
121.4595
119.3465
116.1817
89.3310
87.3379
77.3598
77.0420
76.7243
74.2695
21.5677
HO
Cl
NHTs
1h
PPM
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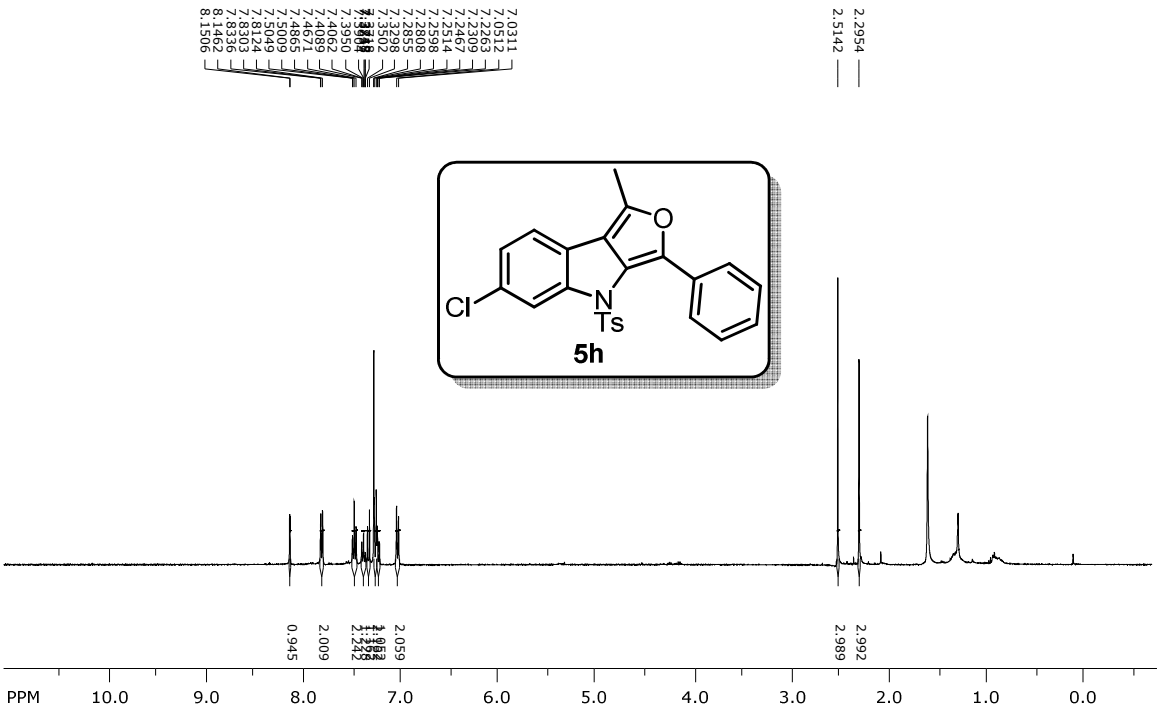
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0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7.3502
7.3298
7.2855
7.2808
7.2594
7.2567
7.2309
7.2263
7.0512
7.0311
2.5142
2.2954
Cl
N
Ts
O
5h
0.945
2.009
2.059
2.989
2.992
PPM
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9.0
8.0
7.0
6.0
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4.0
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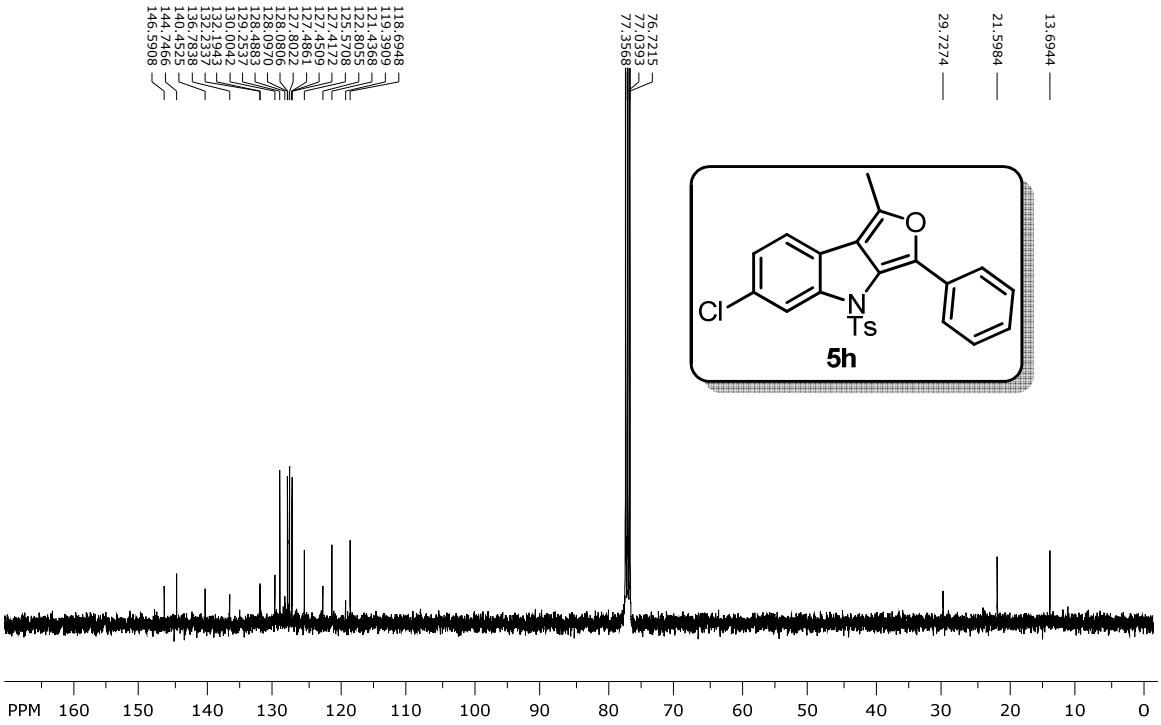
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119.3909
118.6948
77.3568
77.0393
76.7215
29.7274
21.5984
13.6944
Cl
N
Ts
O
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PPM
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150
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70
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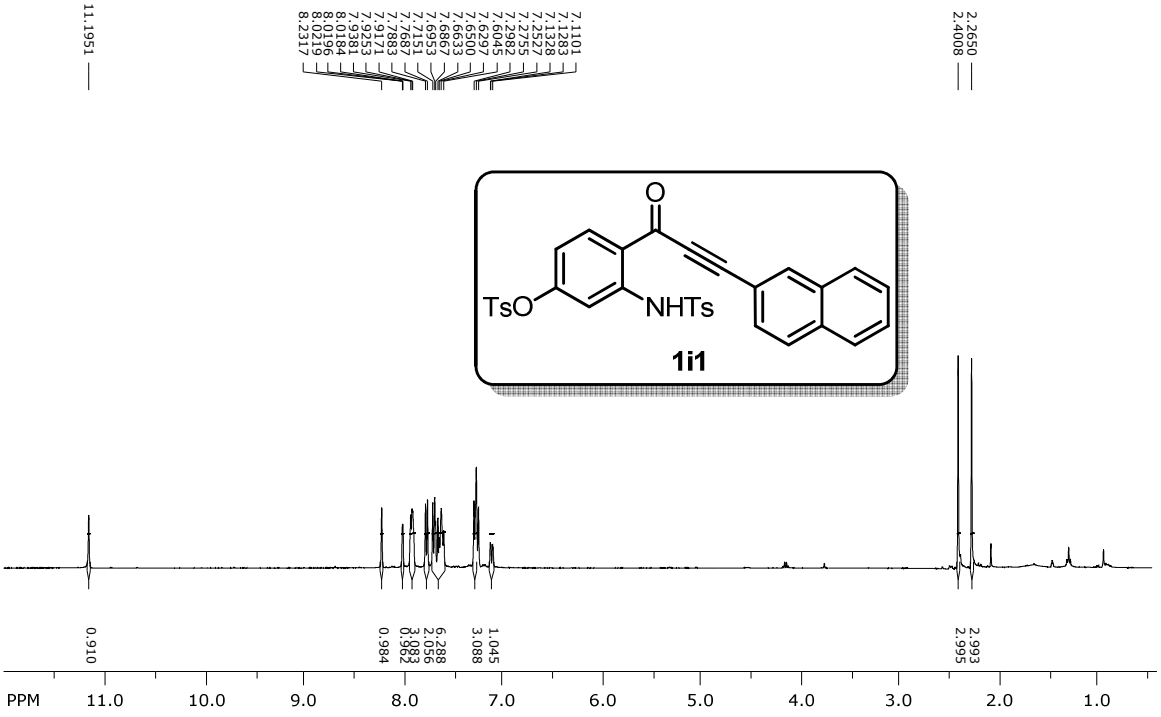
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7.6500
7.6297
7.6045
7.2982
7.2755
7.2527
7.1328
7.1283
7.1101
2.4008
2.2650
TsO
NHTs
1i1
0.910
0.984
0.982
0.983
2.056
6.288
3.088
1.045
2.995
2.993
PPM
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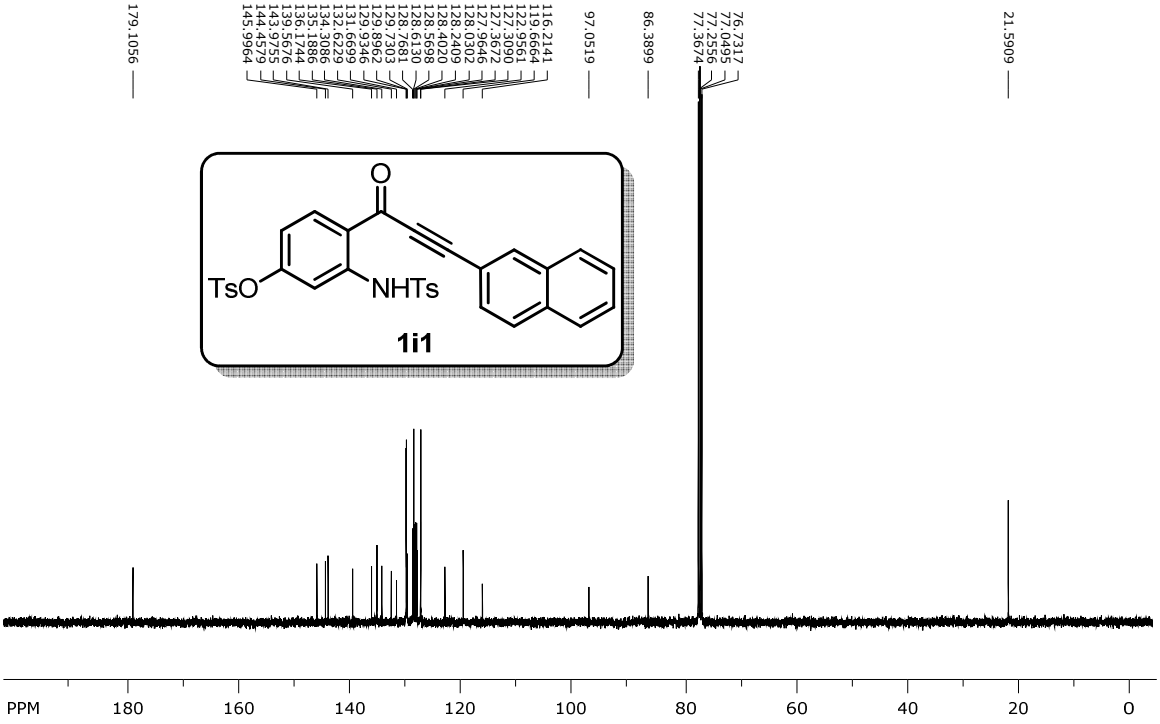
1.0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97.0519
86.3899
77.3674
77.2556
77.0495
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TsO
NHTs
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PPM
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140
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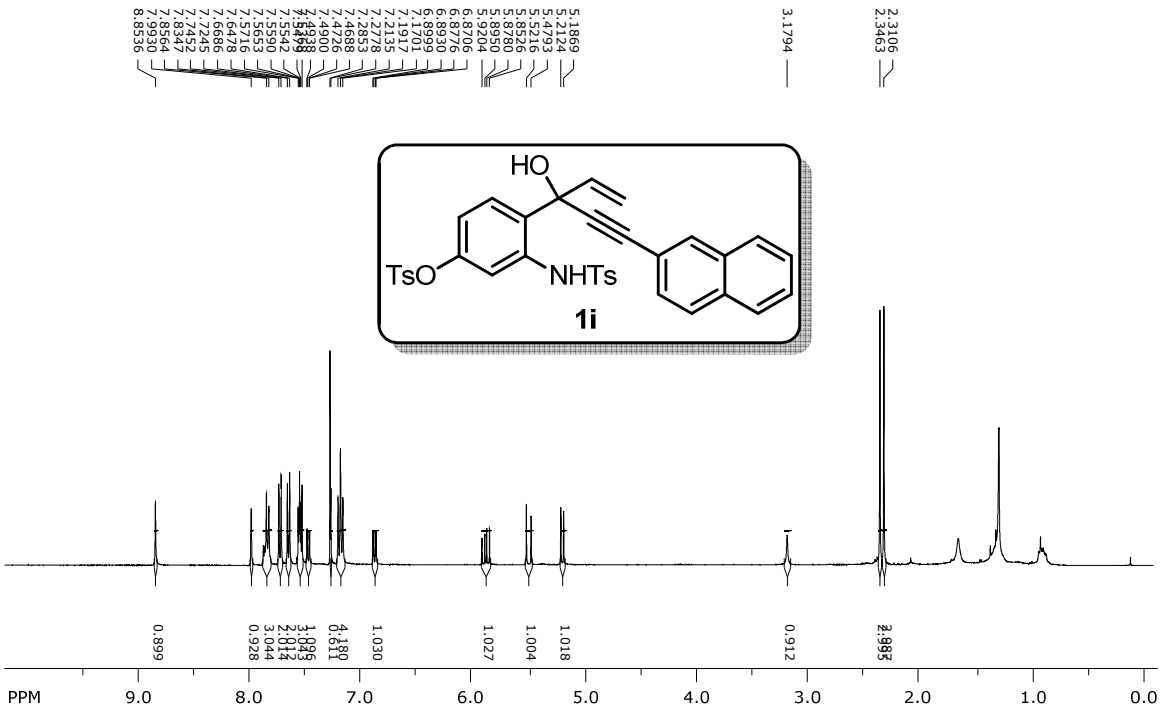
40
20
0


HO
TsO
NHTs
1i
PPM
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8.0
7.0
6.0
5.0
4.0
3.0
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1.0
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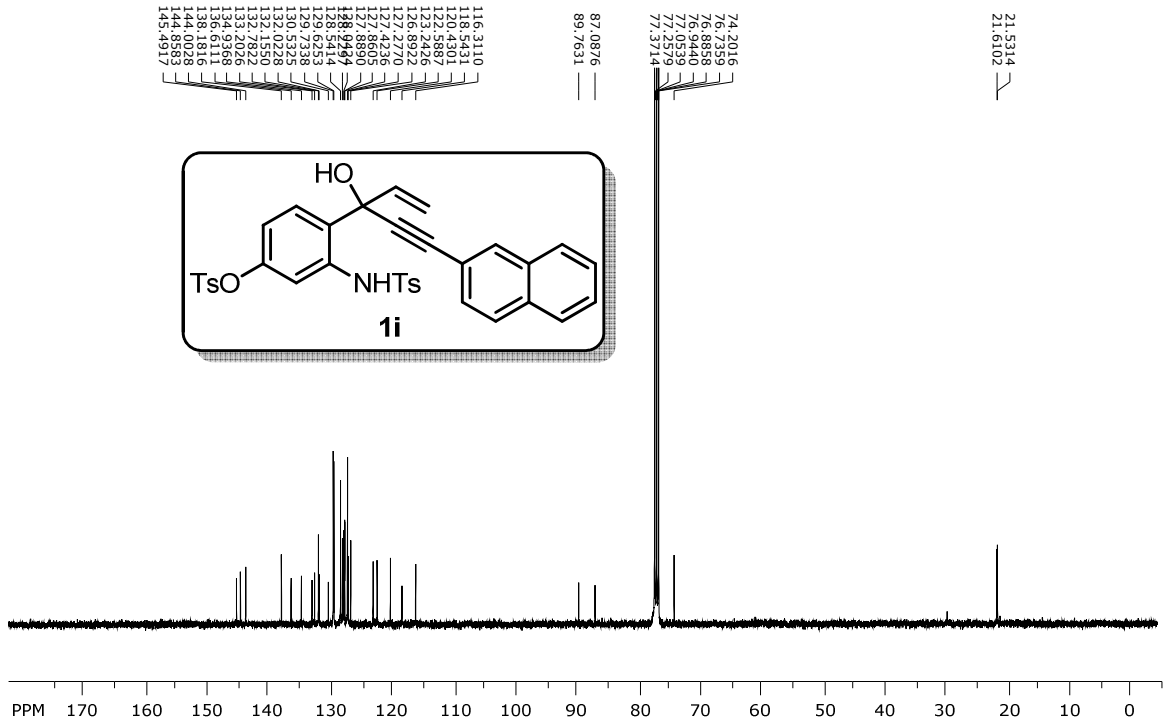
HO
TsO
NHTs
1i
PPM
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110
100
90
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70
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30
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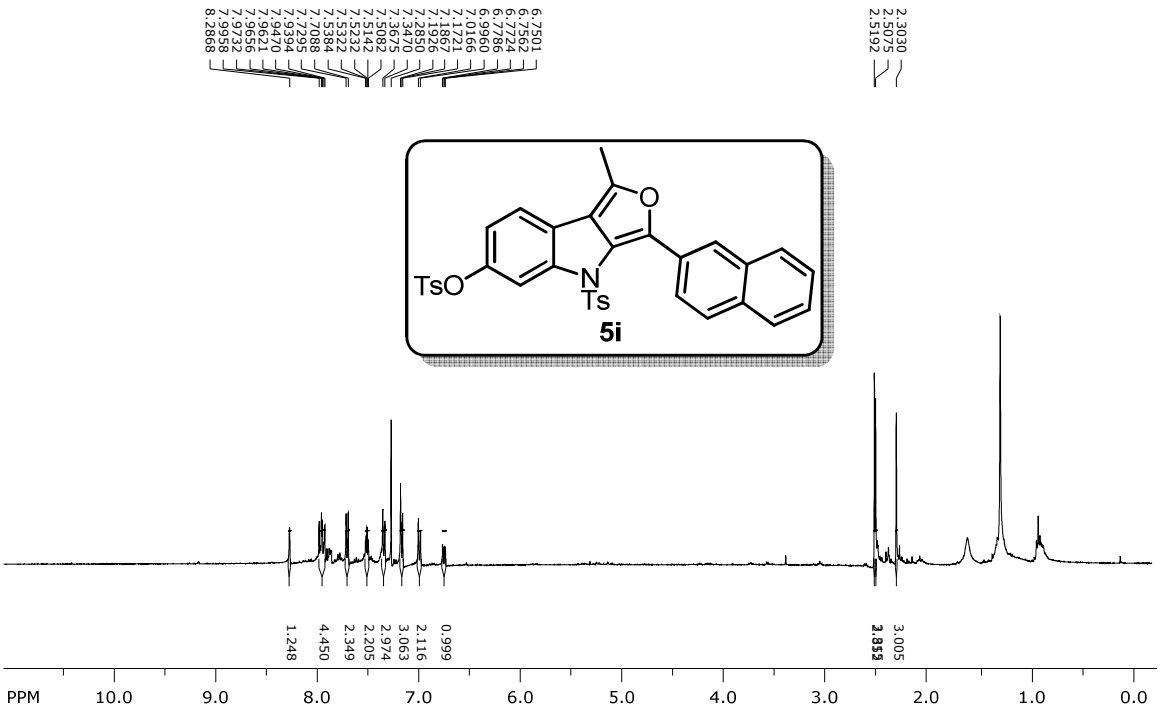
10
0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7.7295
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7.5384
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7.3675
7.3470
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7.1721
7.0166
6.9960
6.7786
6.7724
6.7562
6.7501
2.5192
2.5075
2.3030
TsO
N
Ts
O
5i
1.248
4.450
2.349
2.205
2.974
3.063
2.116
0.999
3.005
PPM
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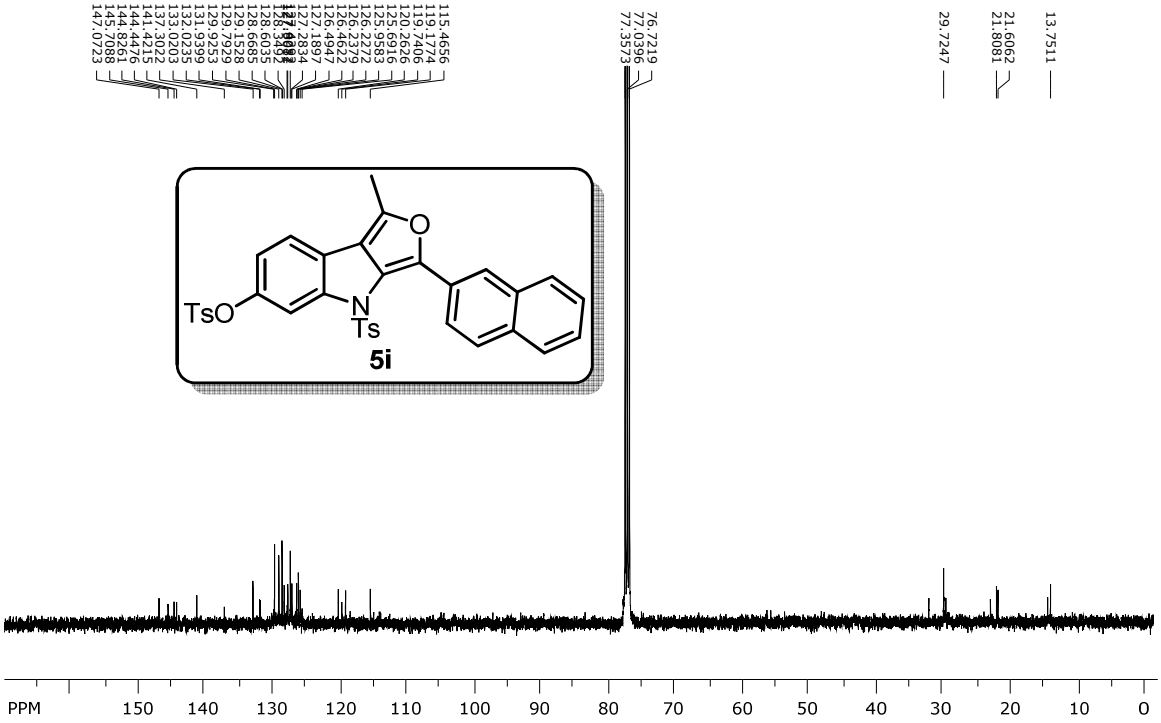
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0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127.1897
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126.2272
125.9583
125.6916
120.2626
119.7406
119.1774
115.4656
77.3573
77.0396
76.7219
29.7247
21.8081
21.6062
13.7511
TsO
N
Ts
O
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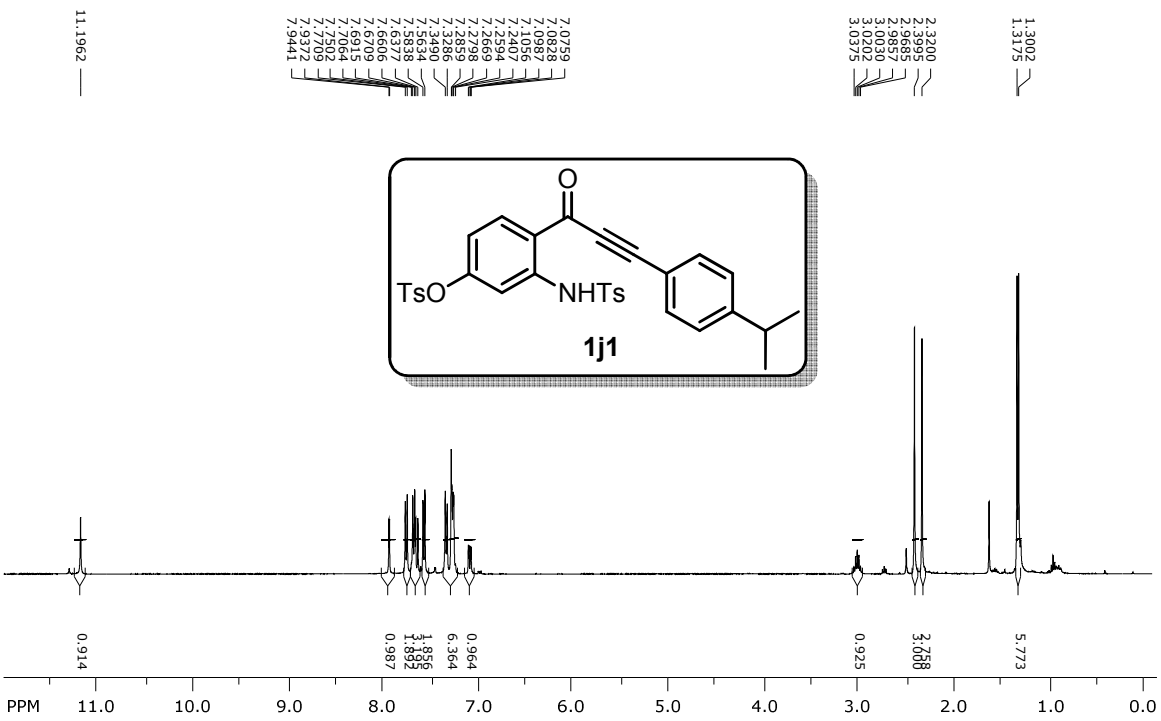
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NHTs
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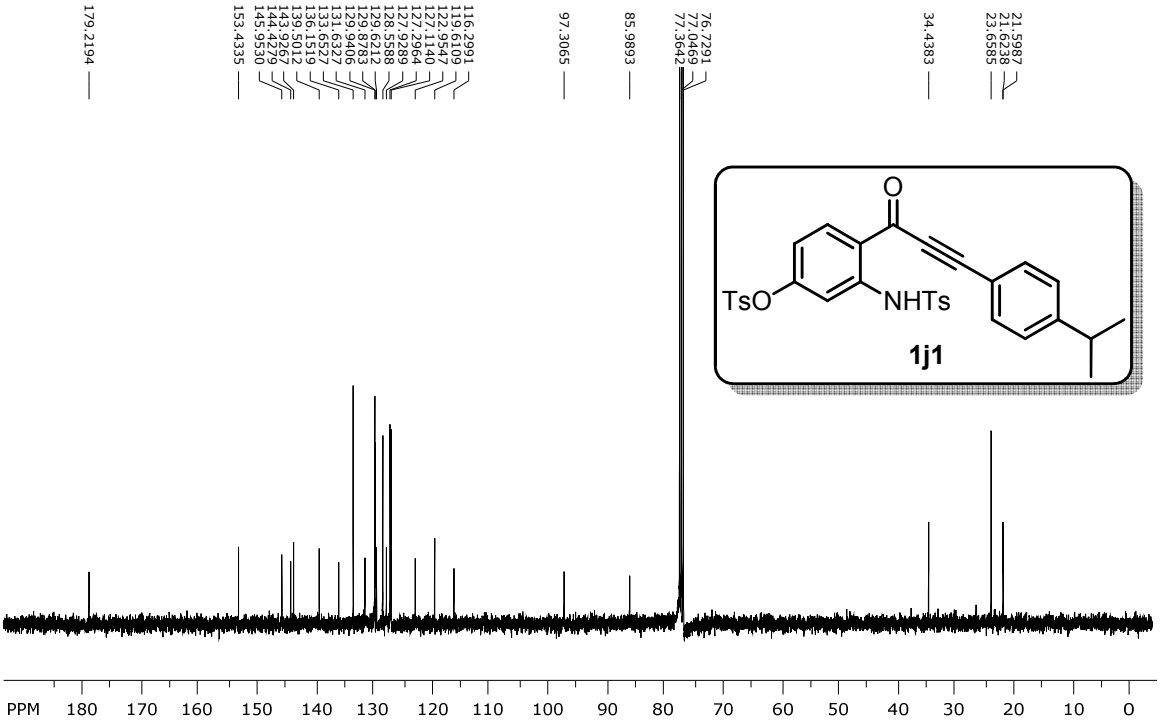
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TsO
NHTs
1j1
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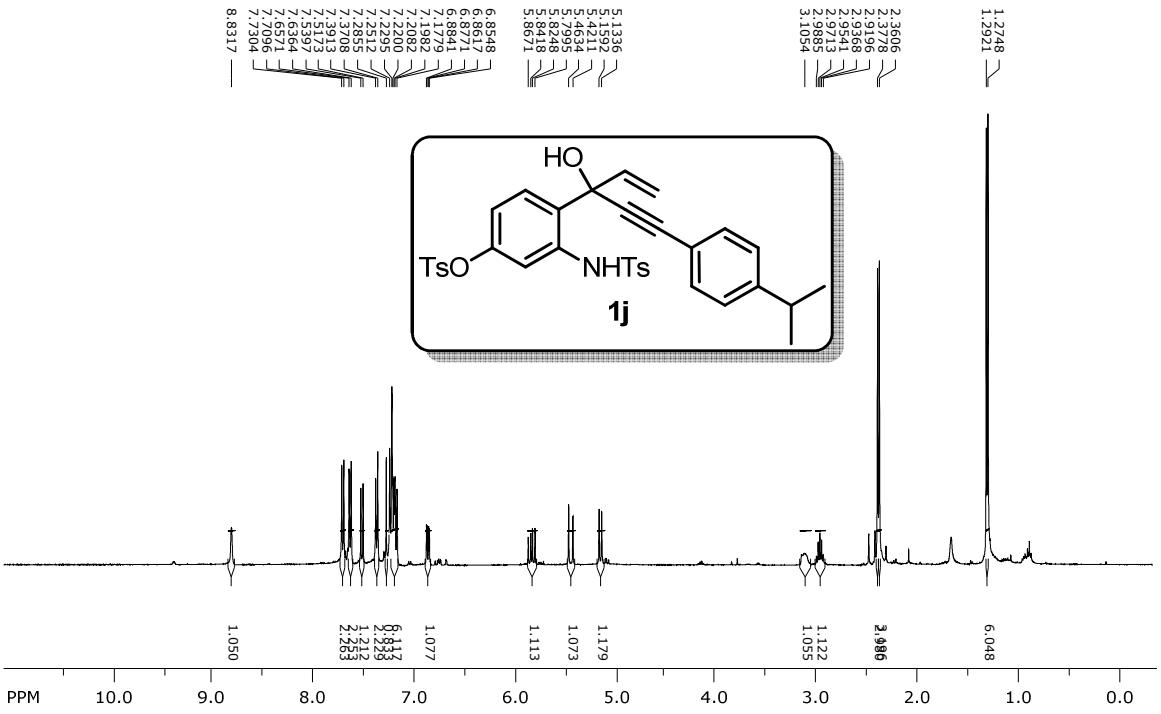
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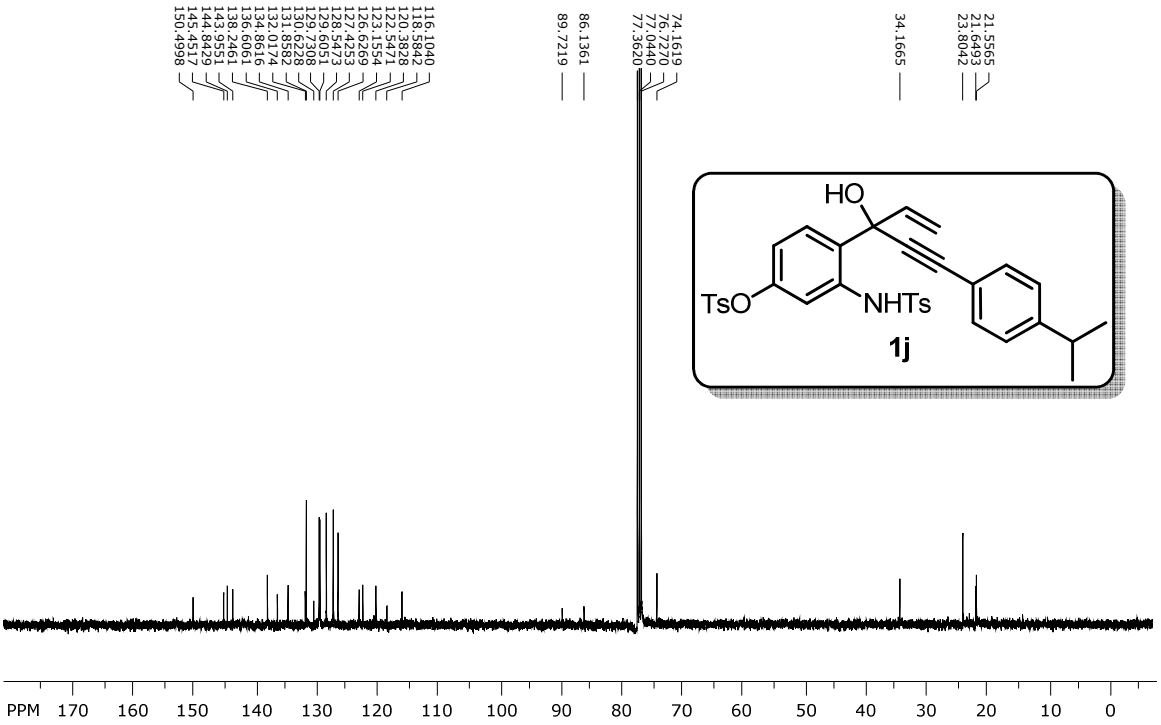
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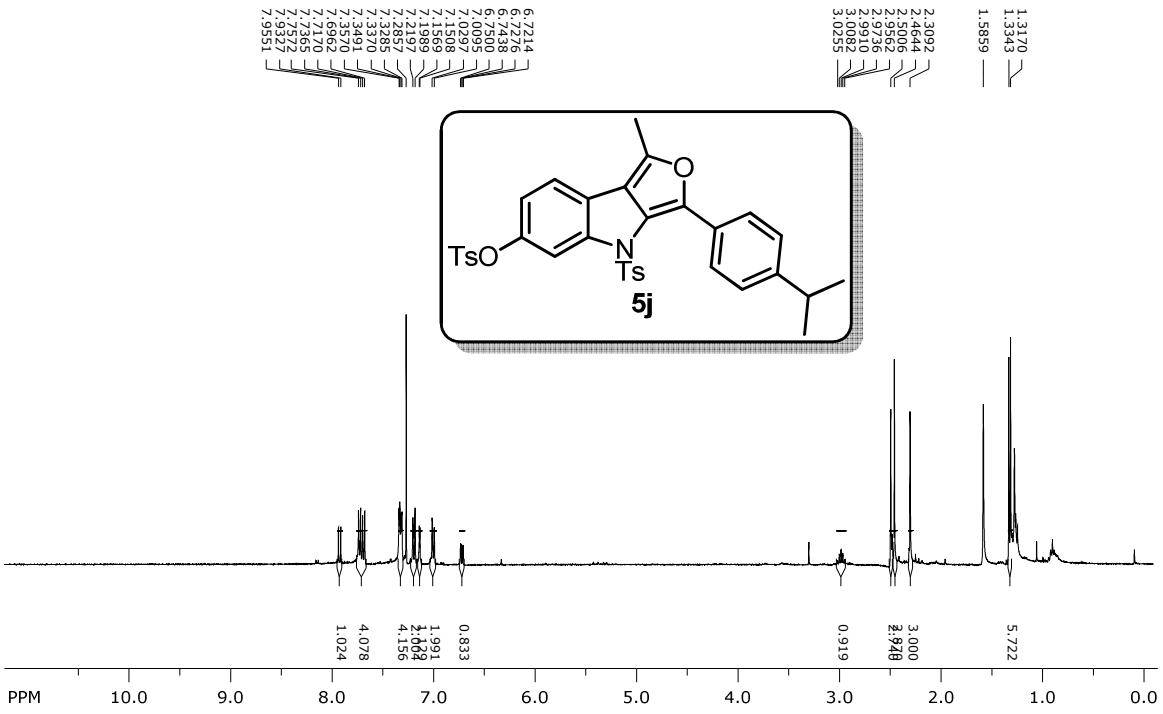
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7.2857
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7.0297
7.0095
6.7500
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3.0255
3.0082
2.9910
2.9736
2.9562
2.5006
2.4644
2.3092
1.5859
1.3343
1.3170
TsO
N
Ts
5j
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4.078
4.156
1.991
0.833
0.919
3.000
5.722
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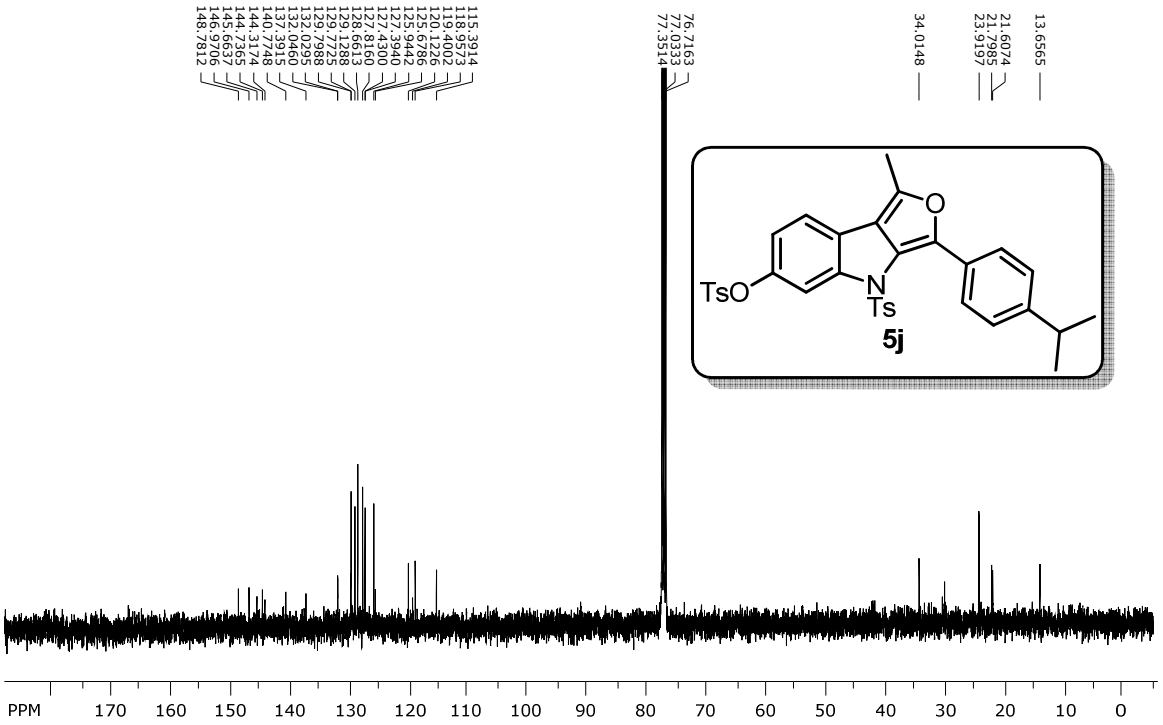
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N
Ts
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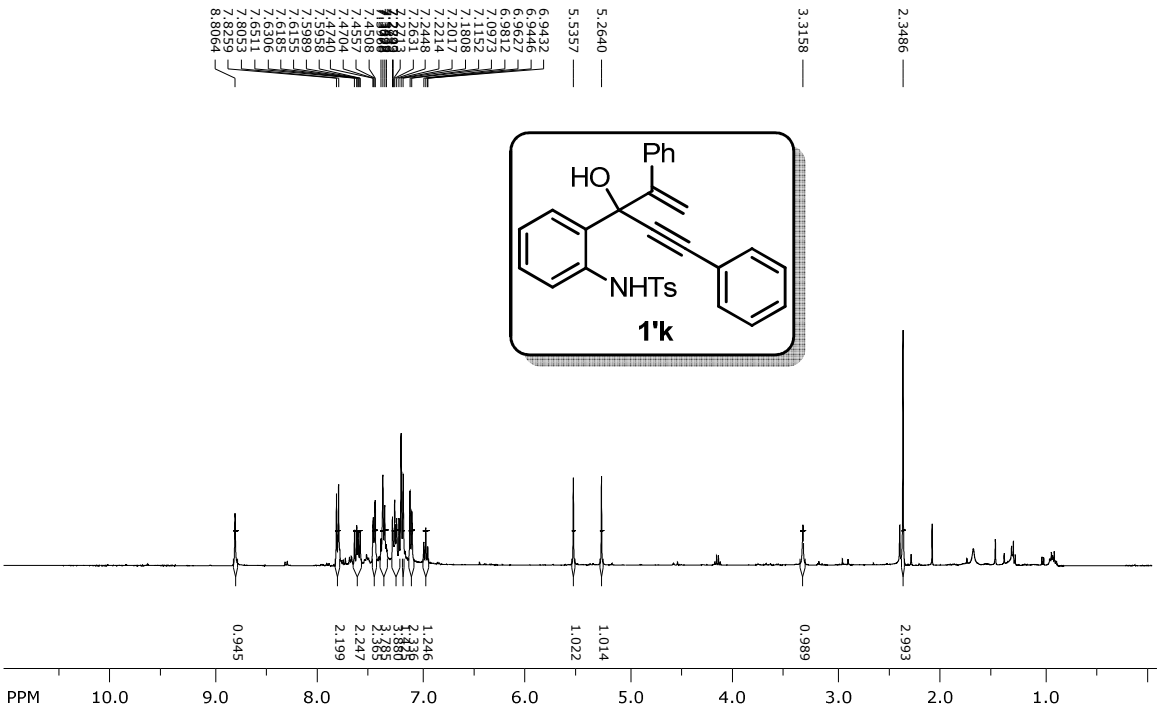
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7.2017
7.1808
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6.9432
5.5357
5.2640
3.3158
2.3486
Ph
HO
NHTs
1'k
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2.247
1.246
1.022
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0.989
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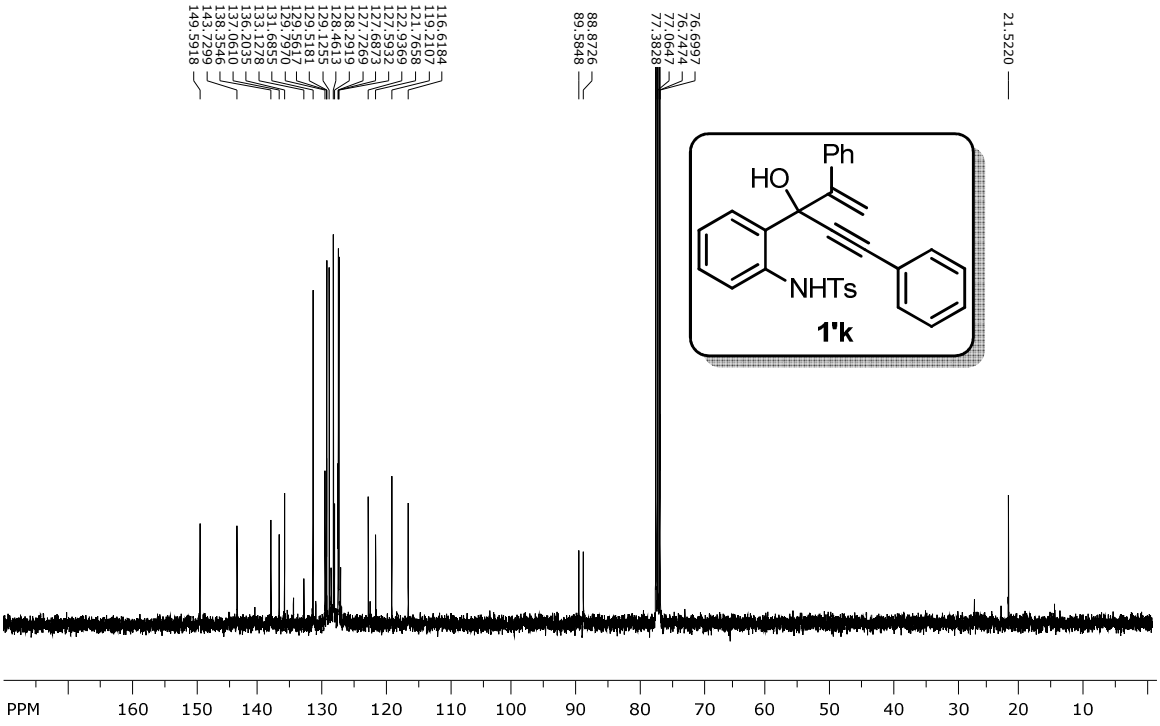
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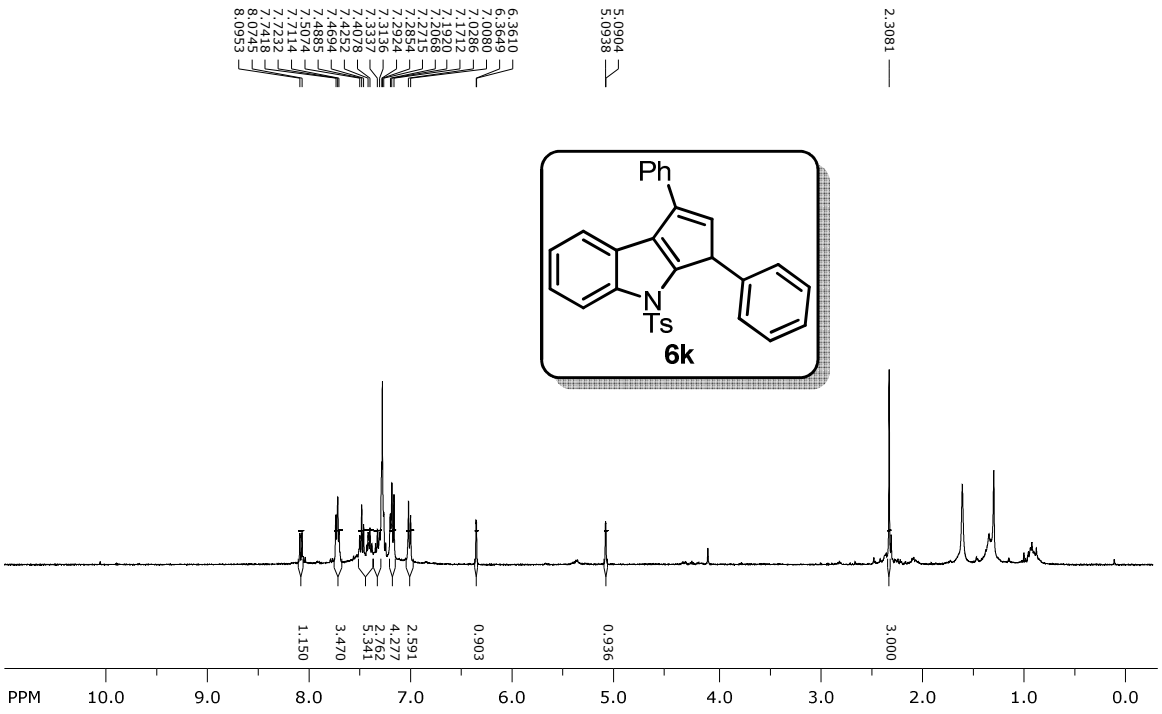
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7.2924
7.2653
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6.3610
5.0938
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Ph
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Ts
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3.000
PPM
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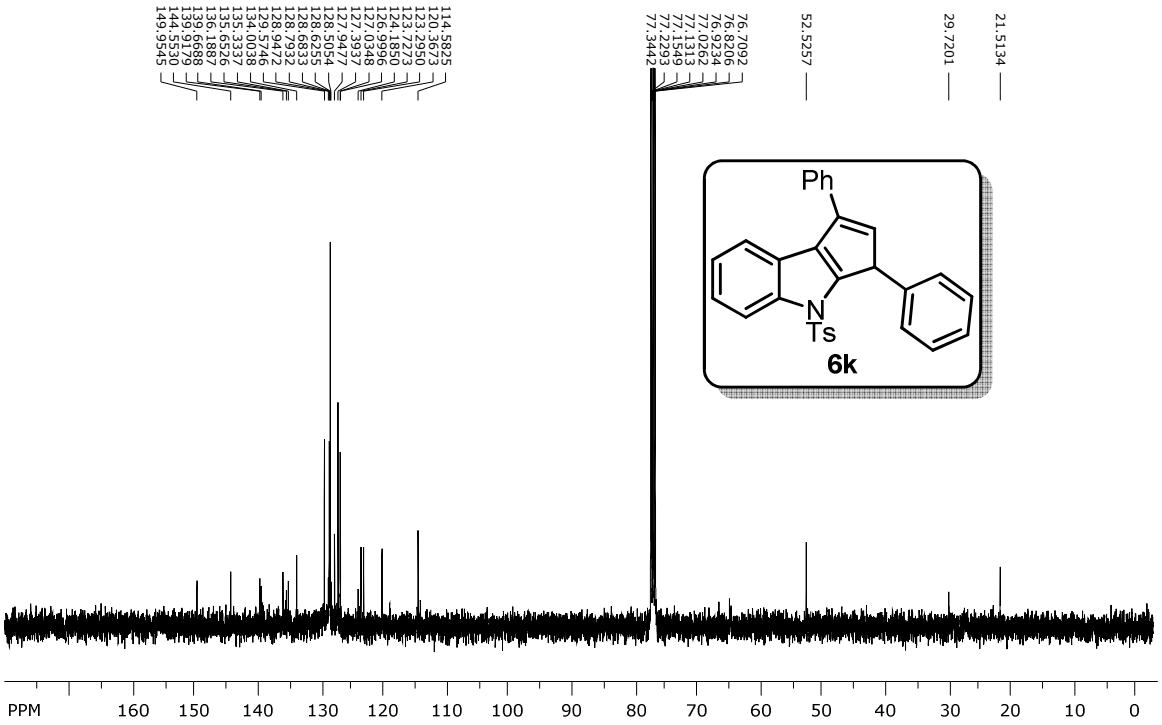
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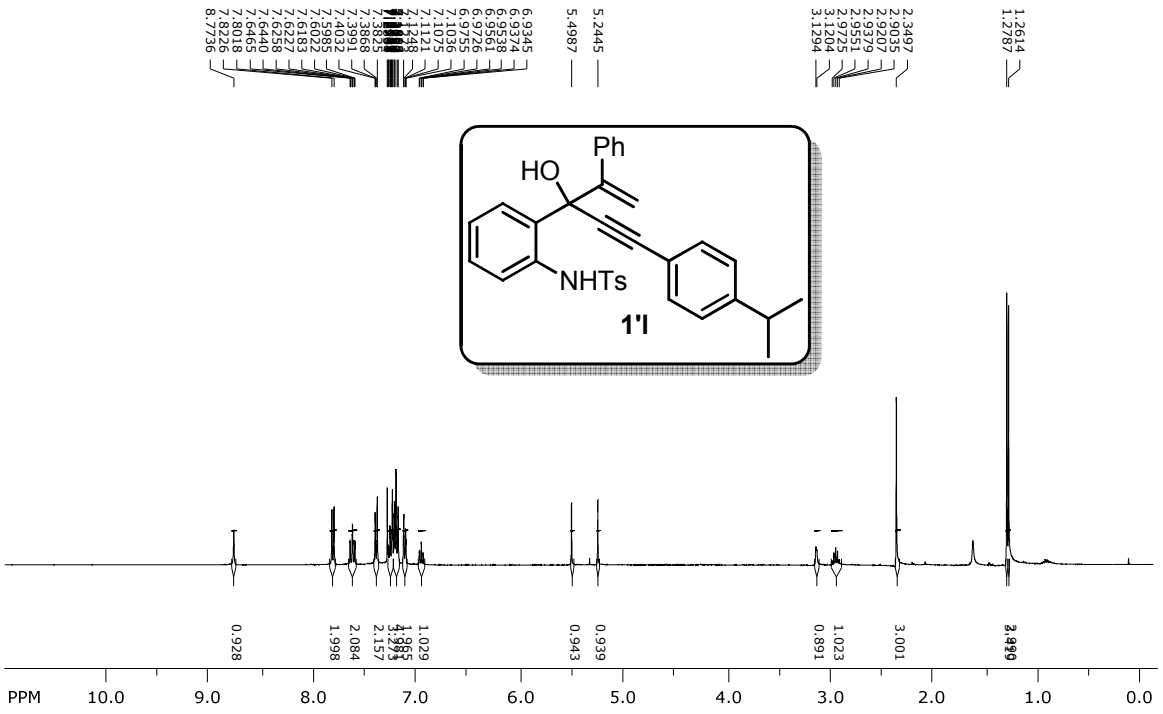
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NHTs
1'l
PPM
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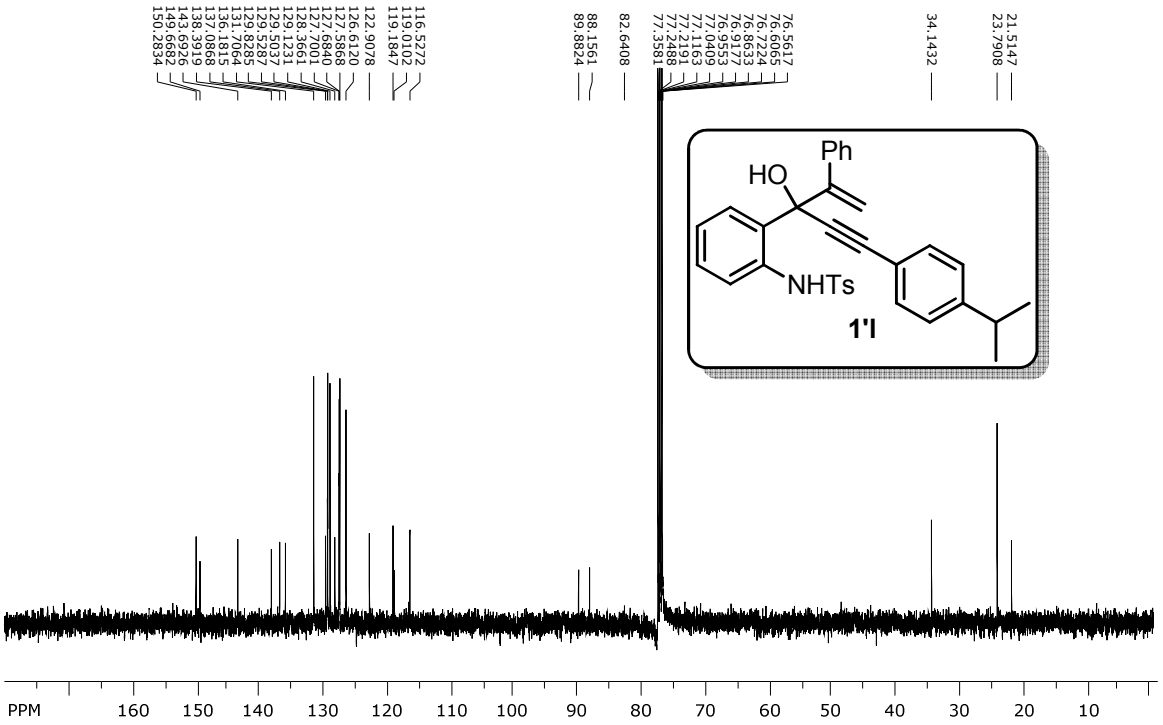
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NHTs
1'l
PPM
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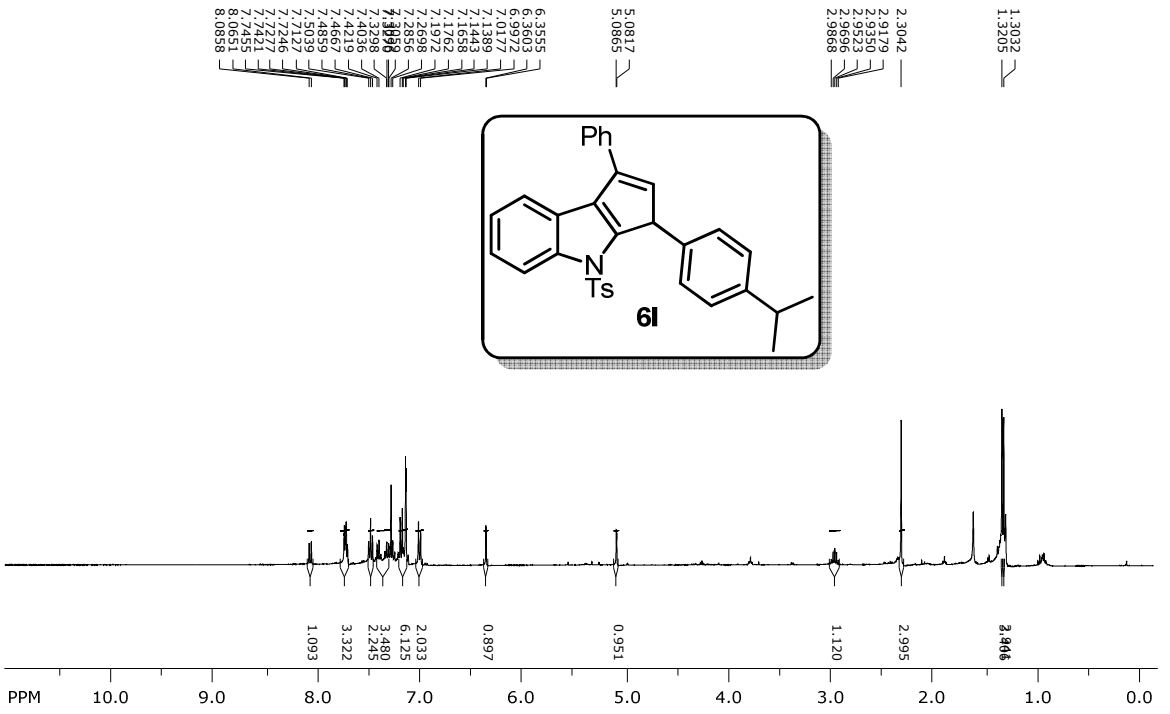
10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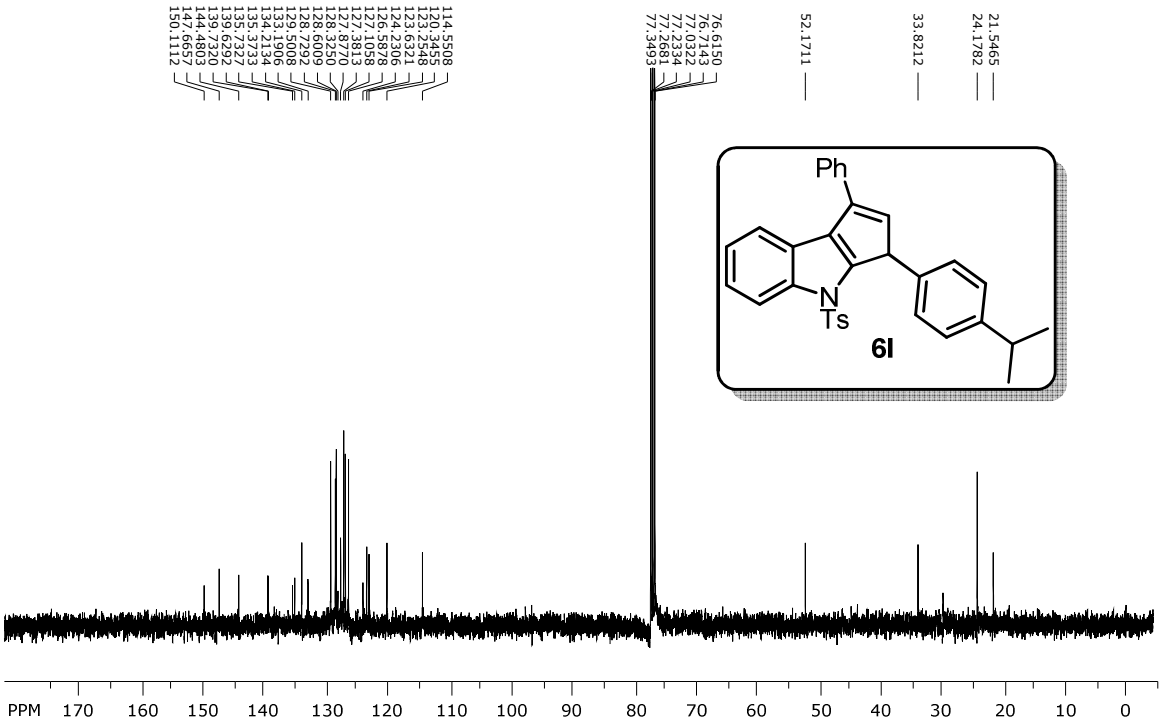
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77.2681
77.0322
76.7153
76.6150
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33.8212
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Ts
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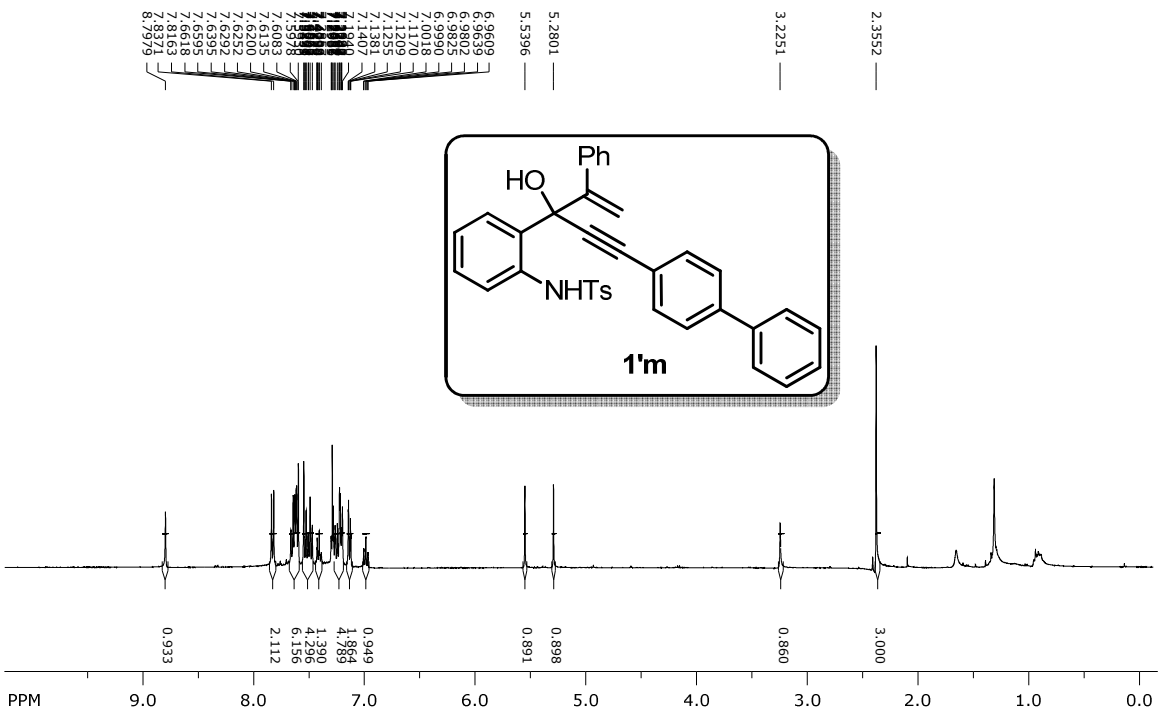
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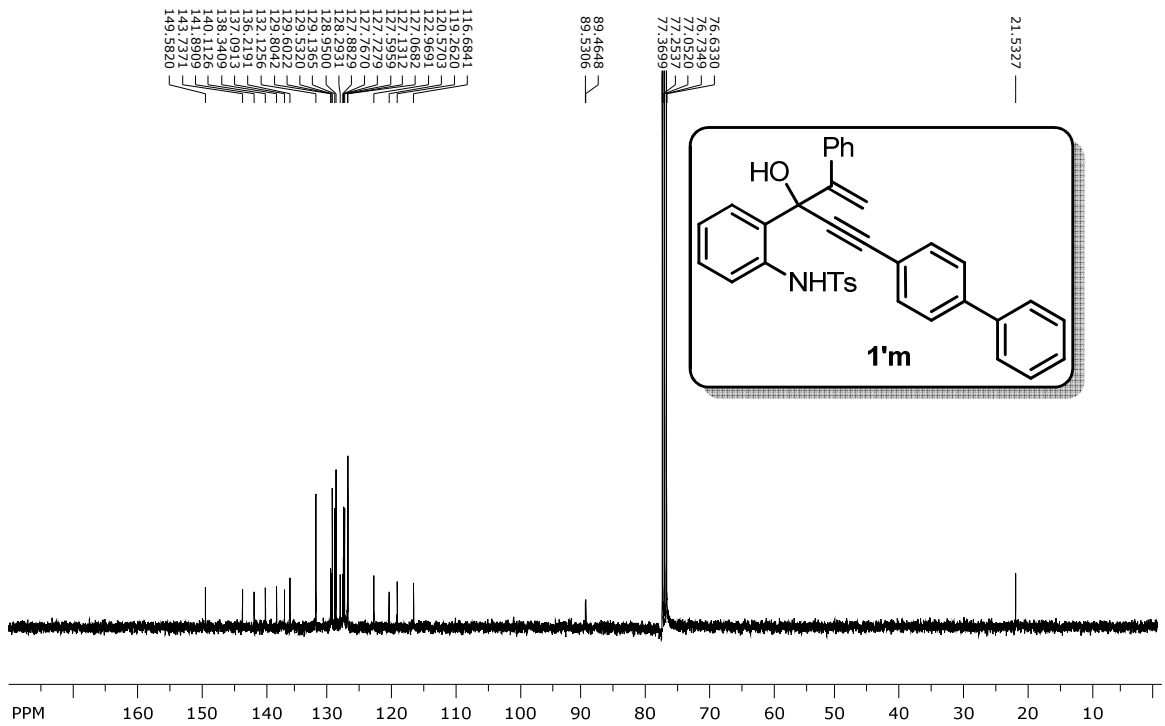
HO
NHTs
1'm
PPM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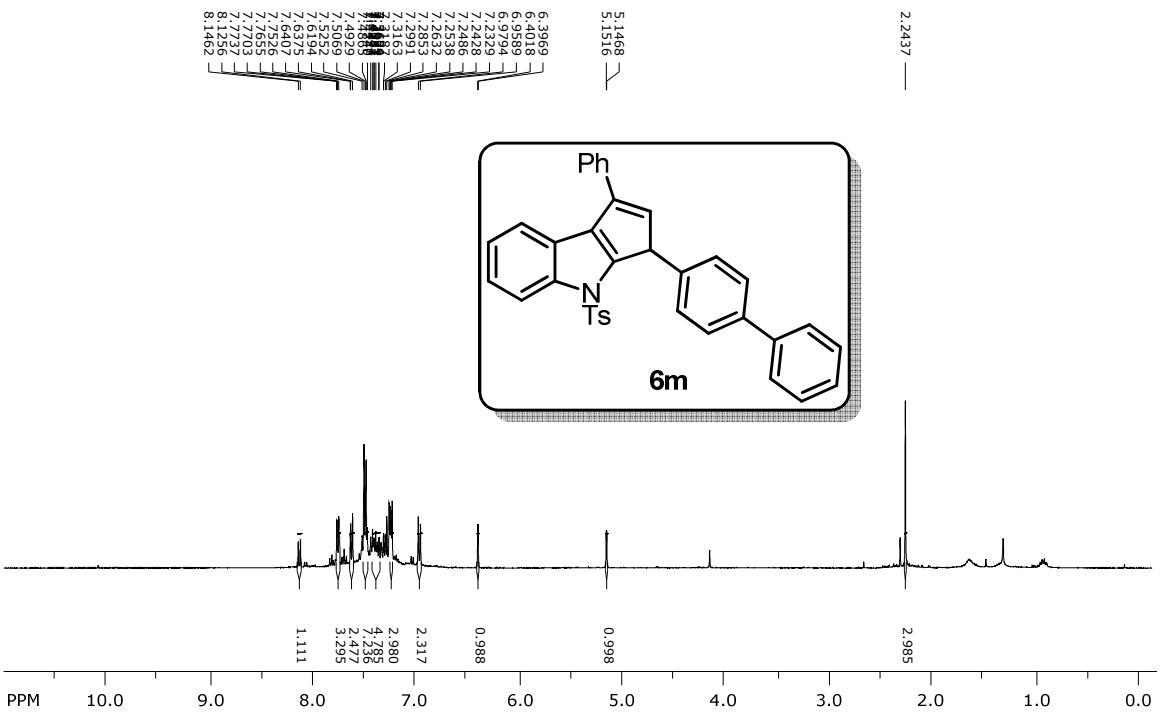
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7.2329
6.9994
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6.4018
6.3969
5.1516
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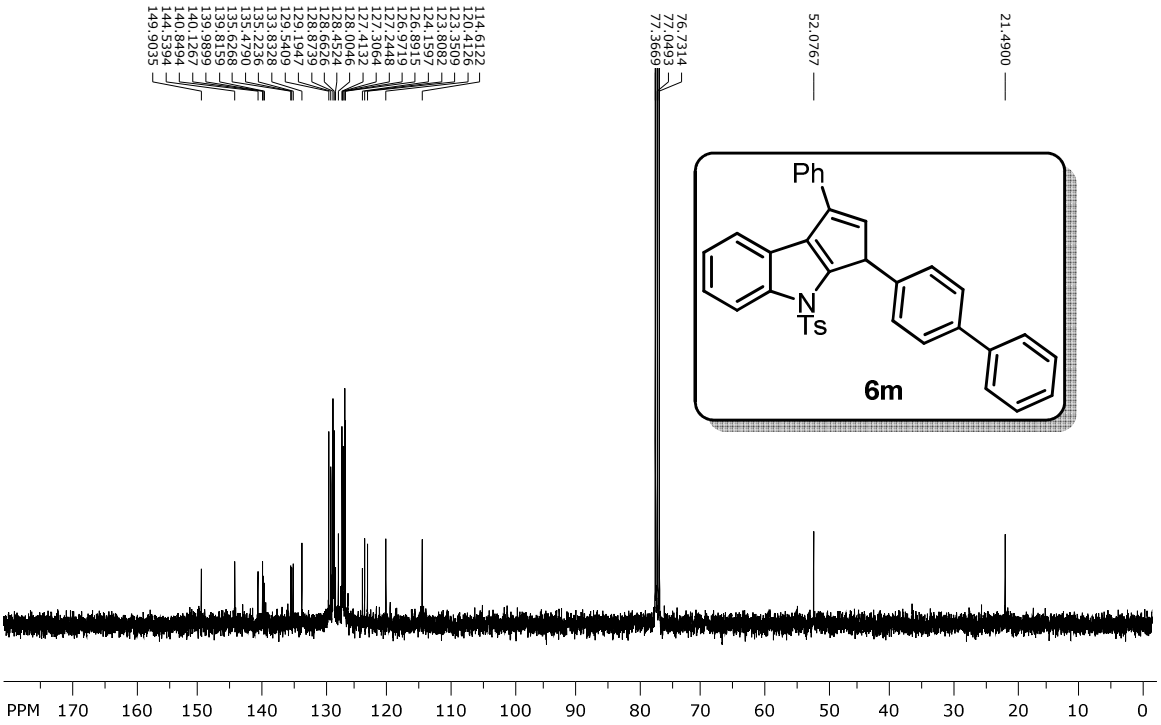
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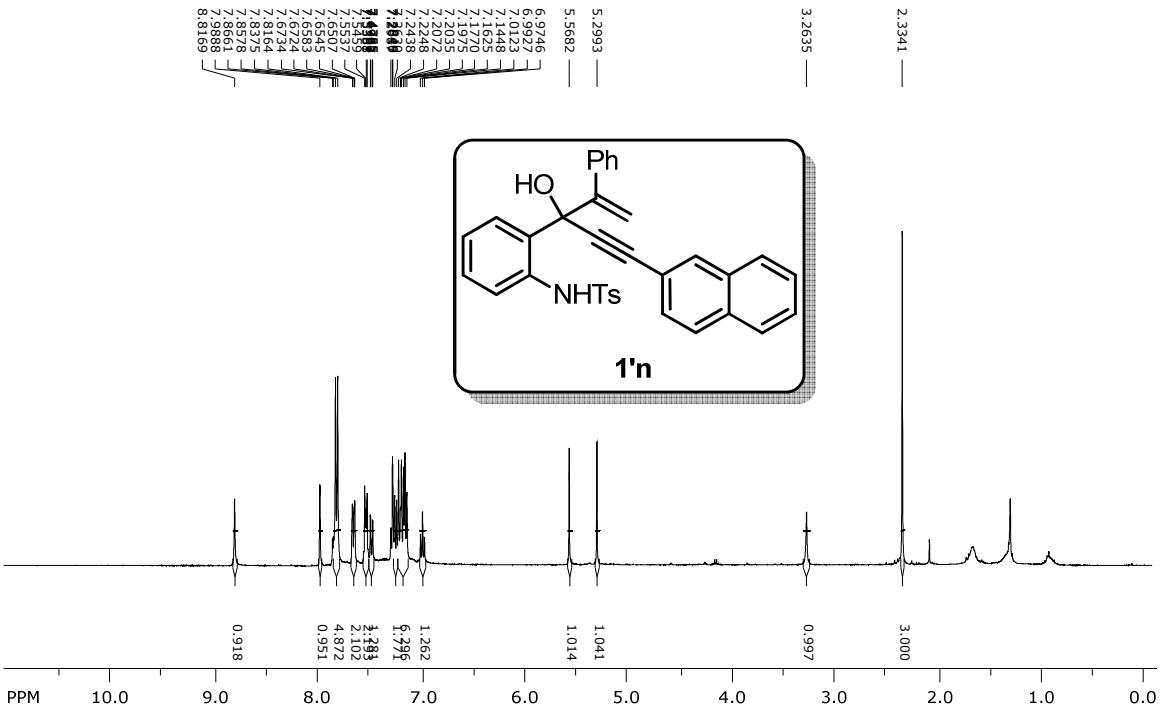
Ph
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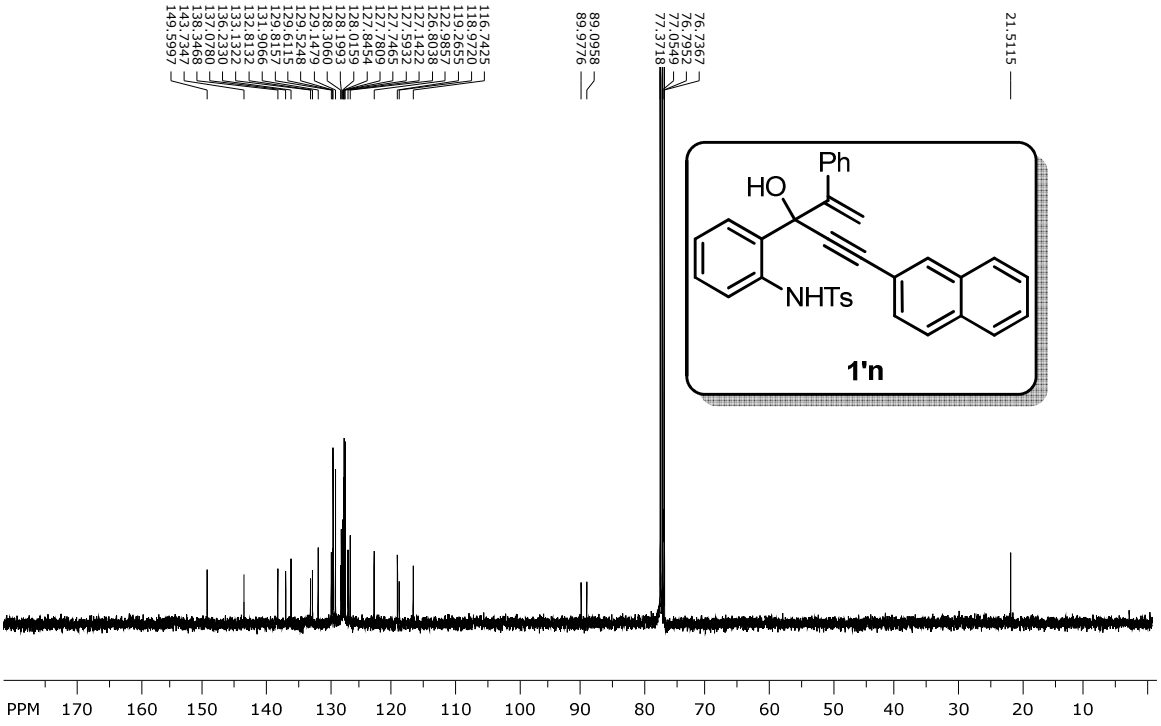
NHTs
1'n
PPM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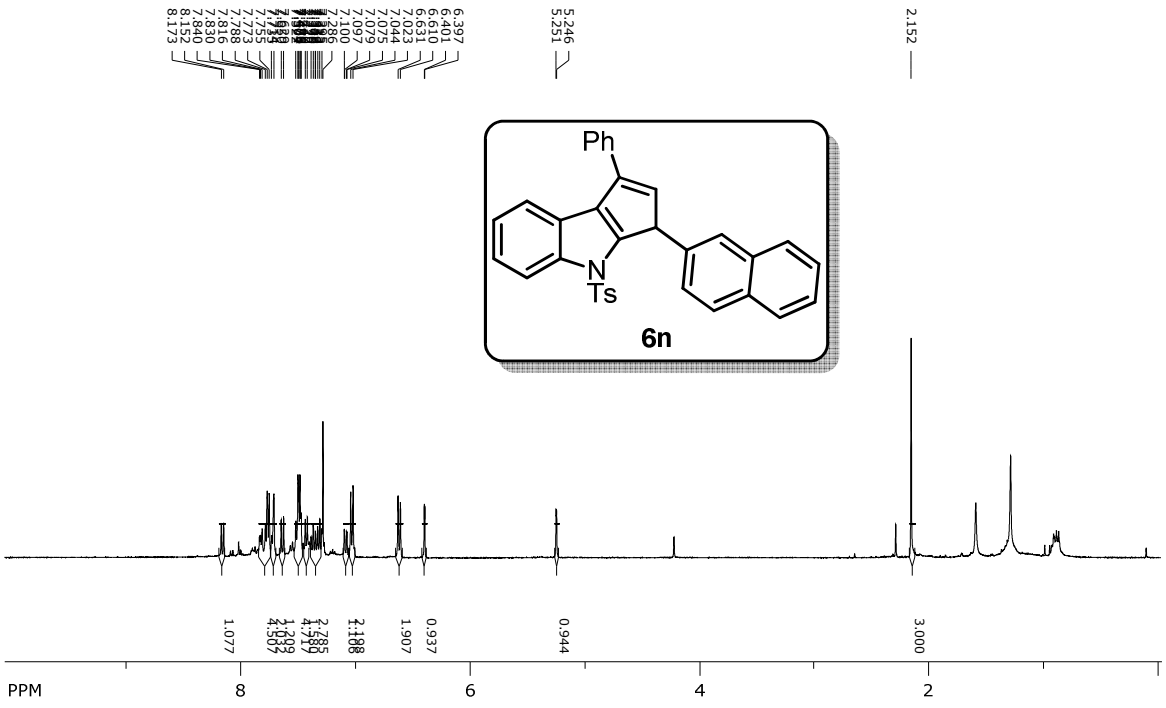
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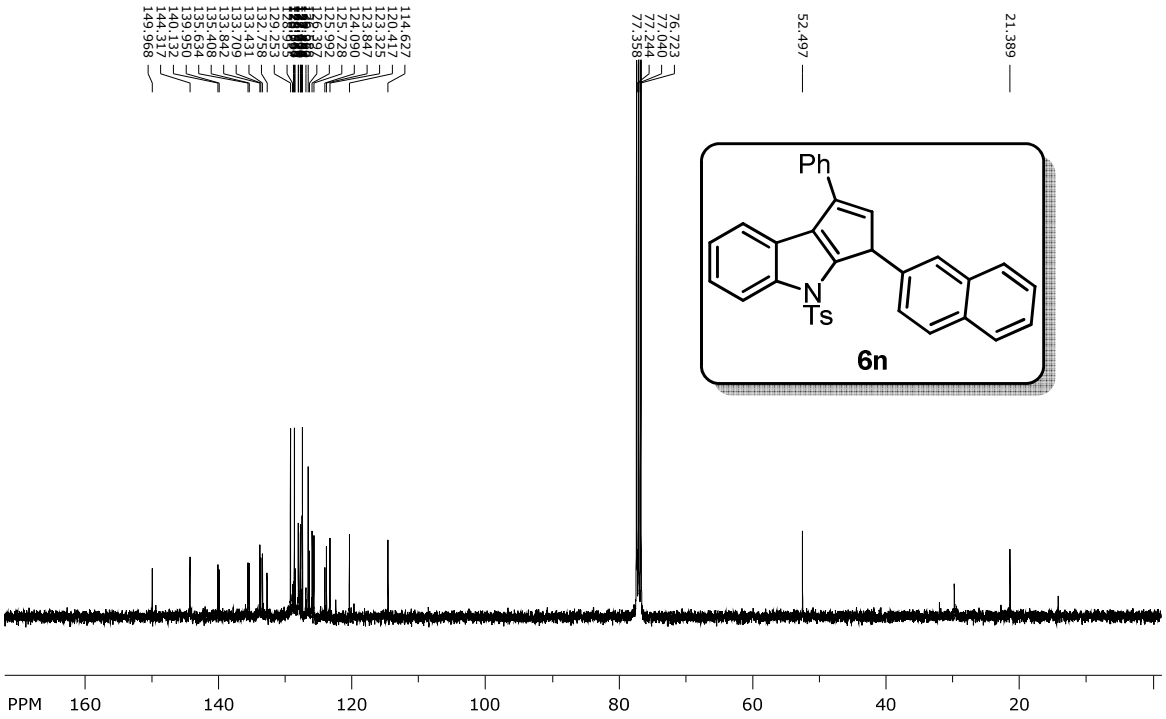
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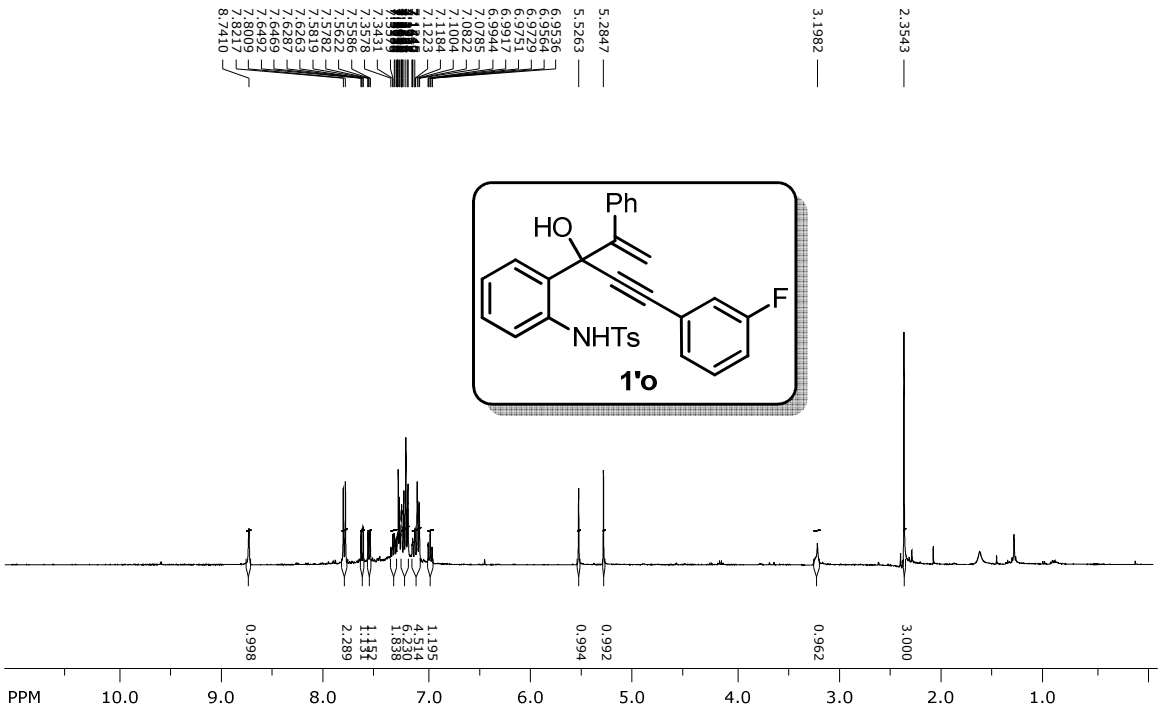
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5.2847
3.1982
2.3543
Ph
HO
F
NHTs
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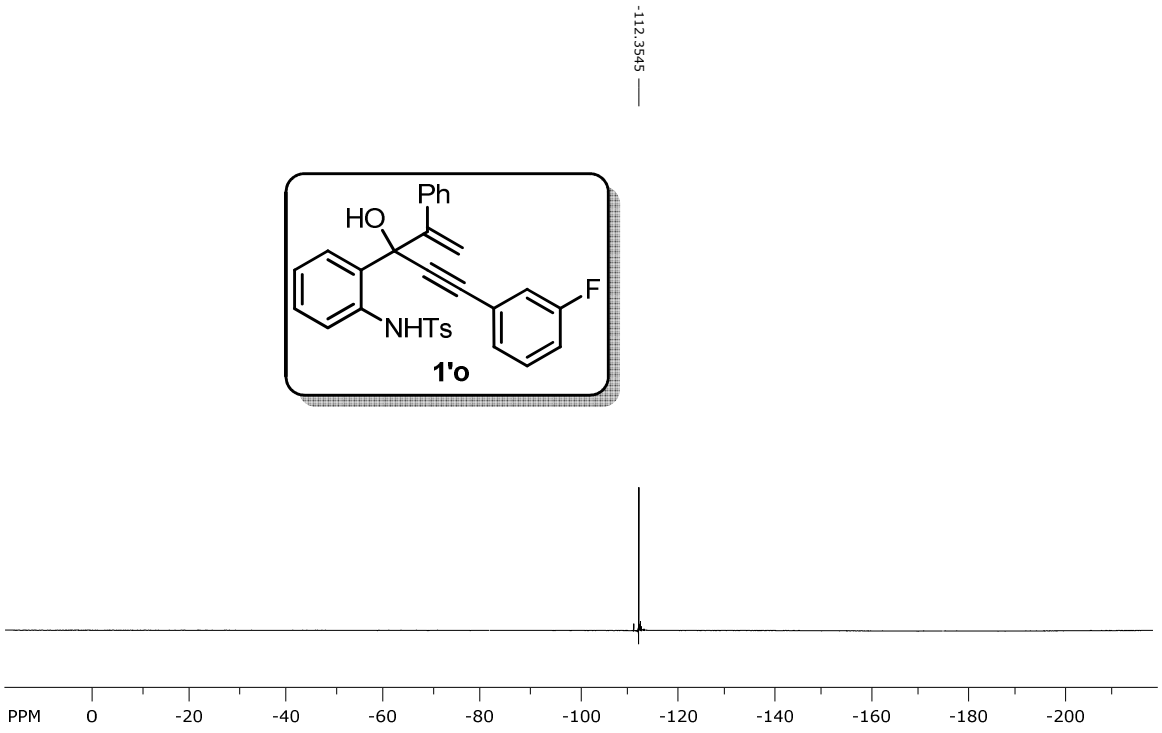
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PPM
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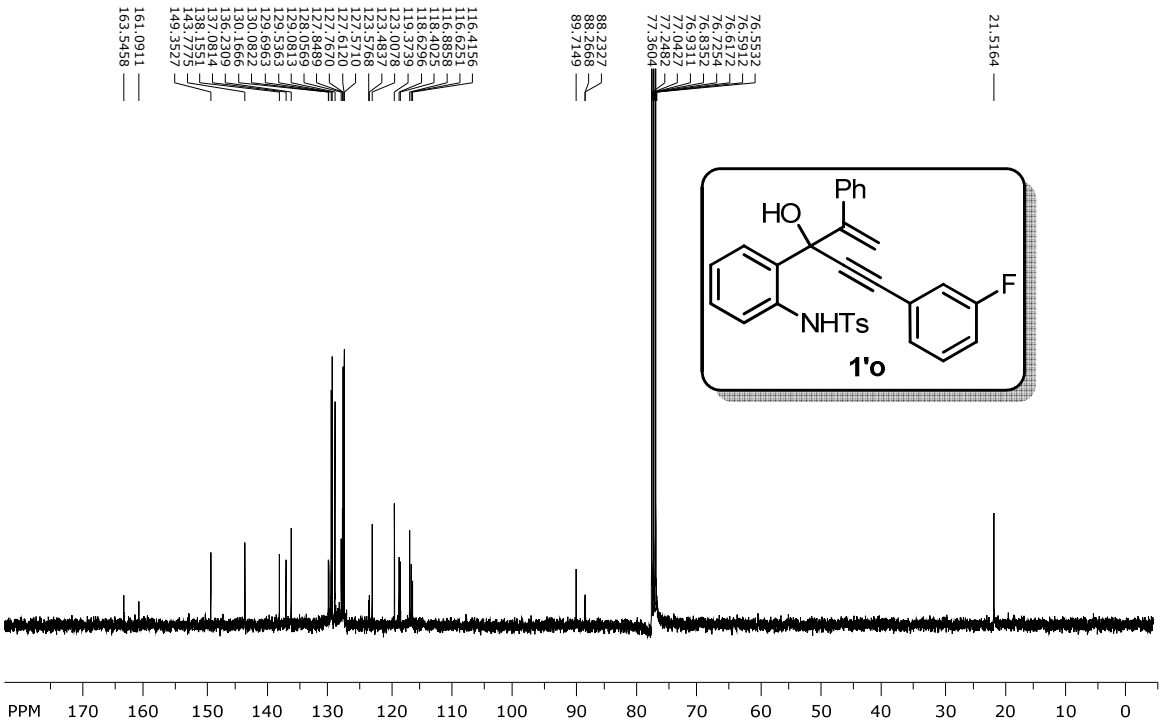
-100
-120
-140
-160
-180
-200

^{19}F-NMR of **1o**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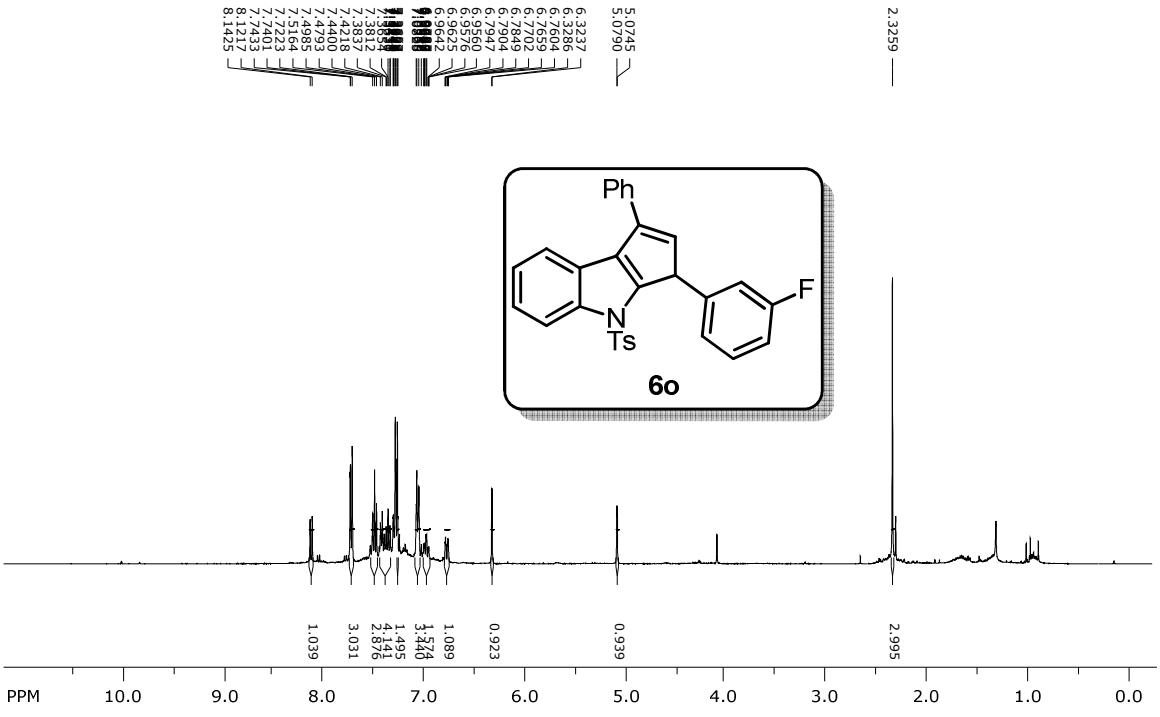
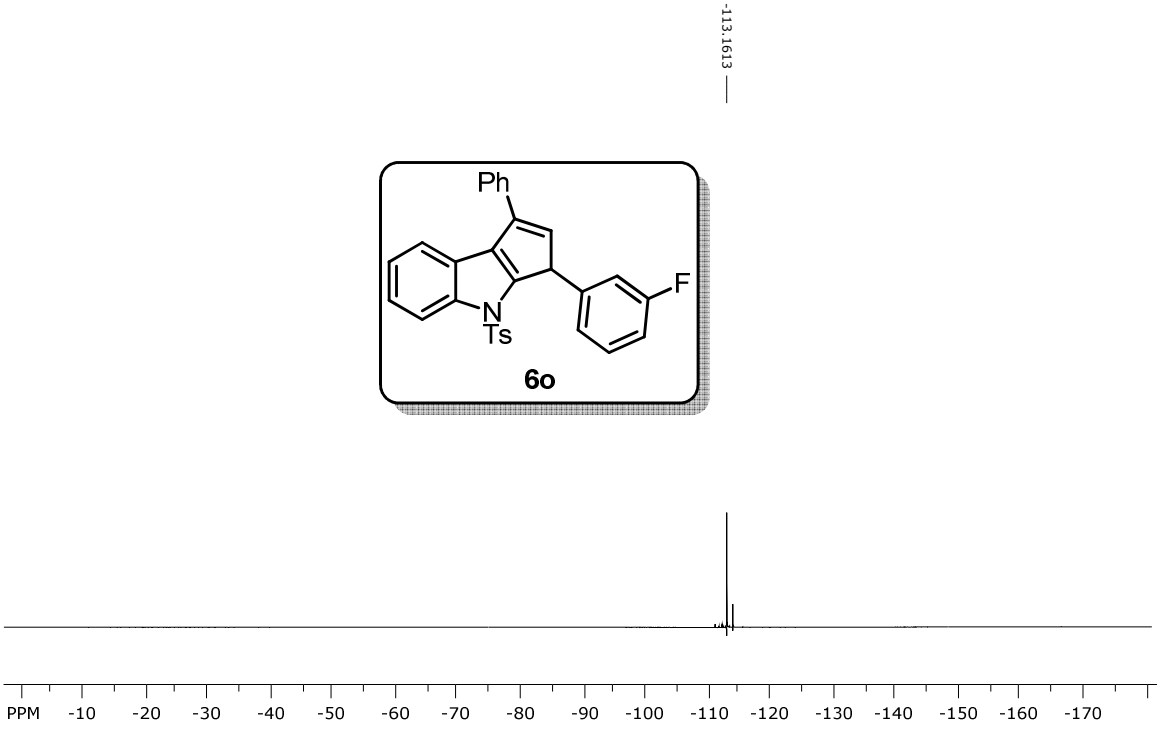
HO
F
NHTs
1'o
PPM


Ph
F
N
Ts
6o
PPM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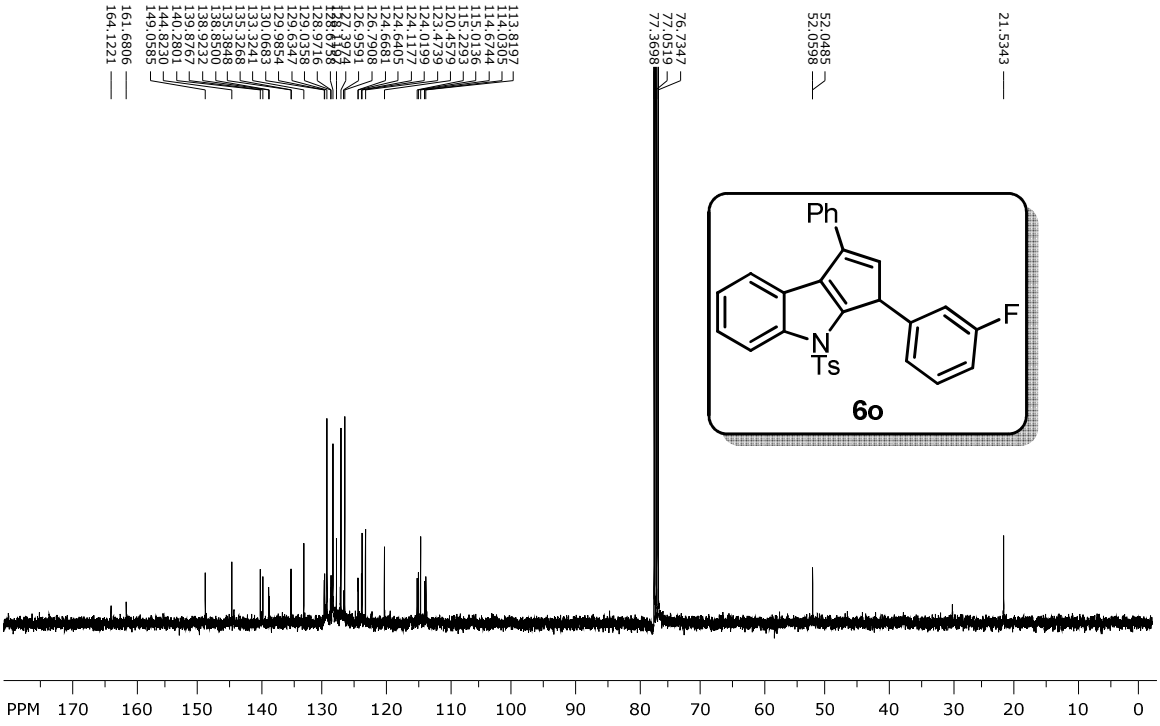
^{19}F-NMR of **6o**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Ph
F
N
Ts
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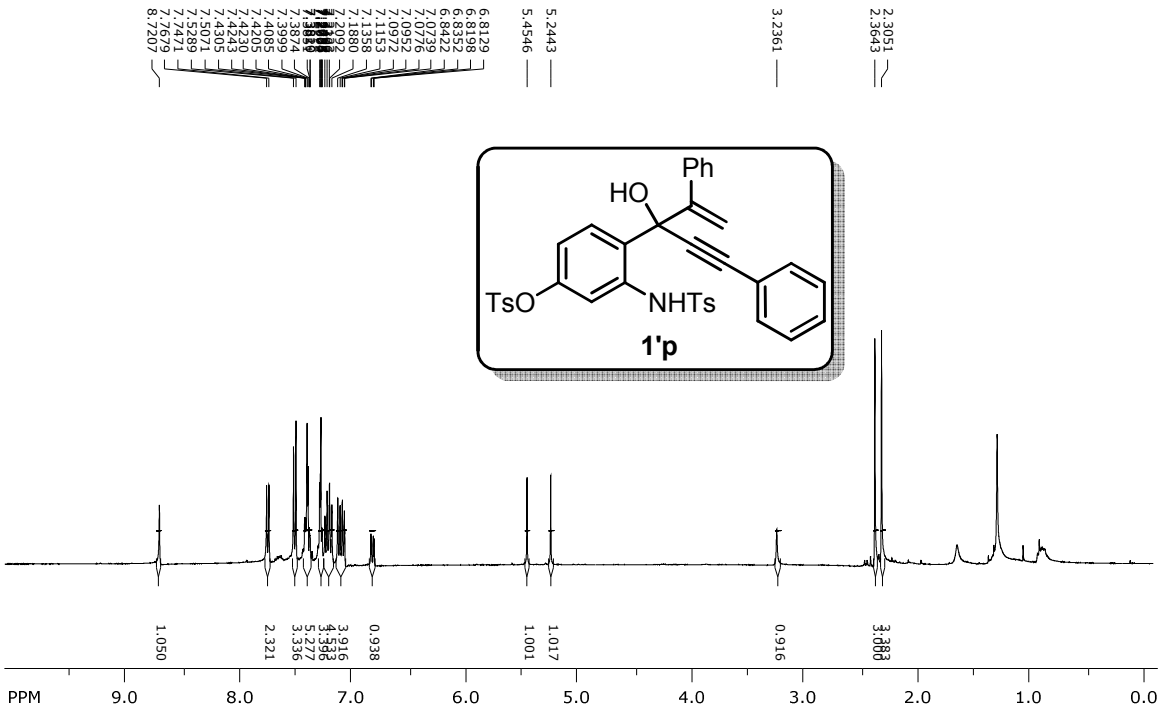
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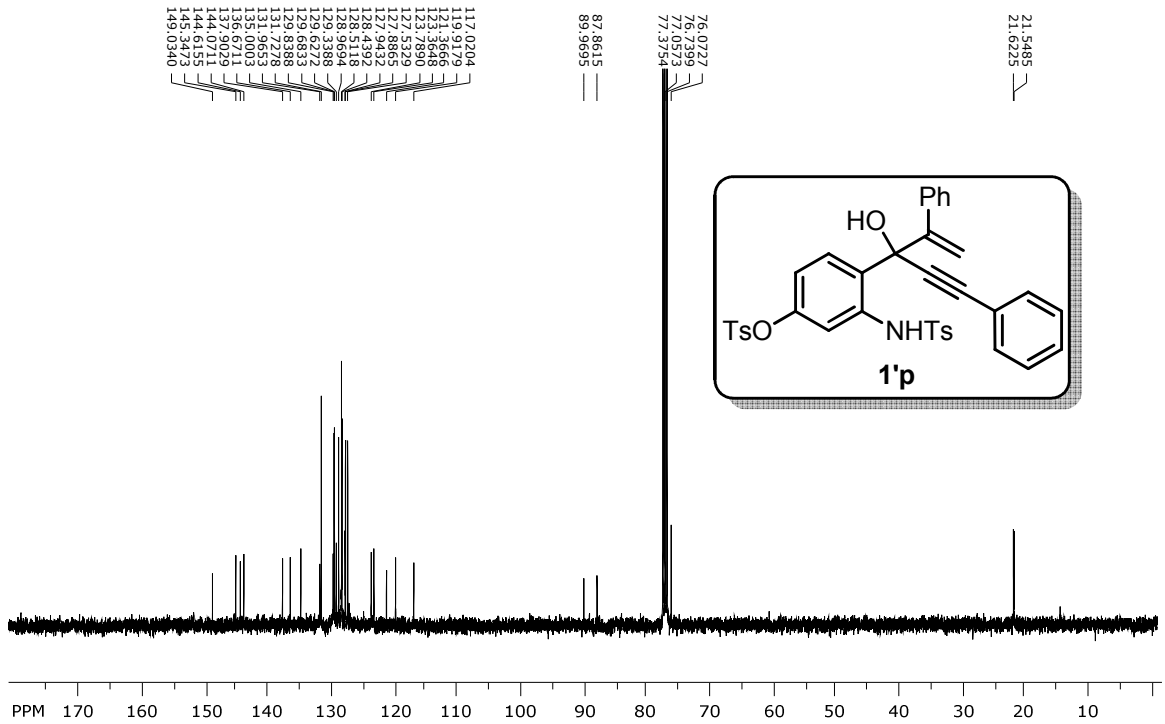
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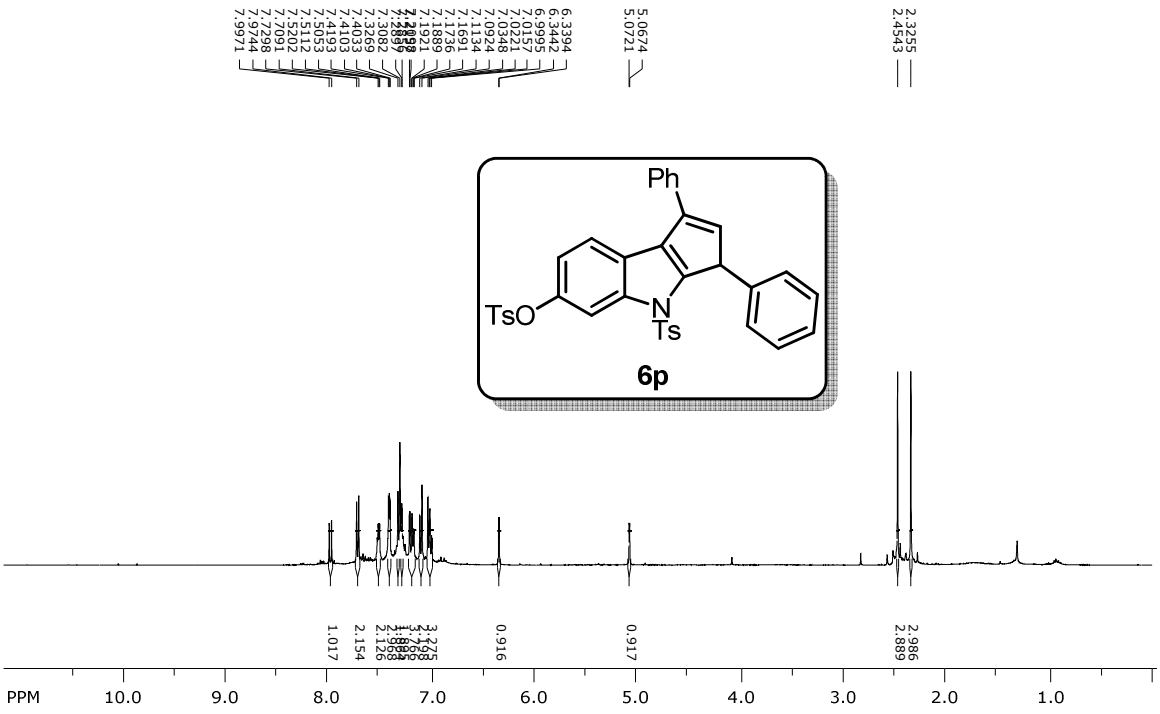
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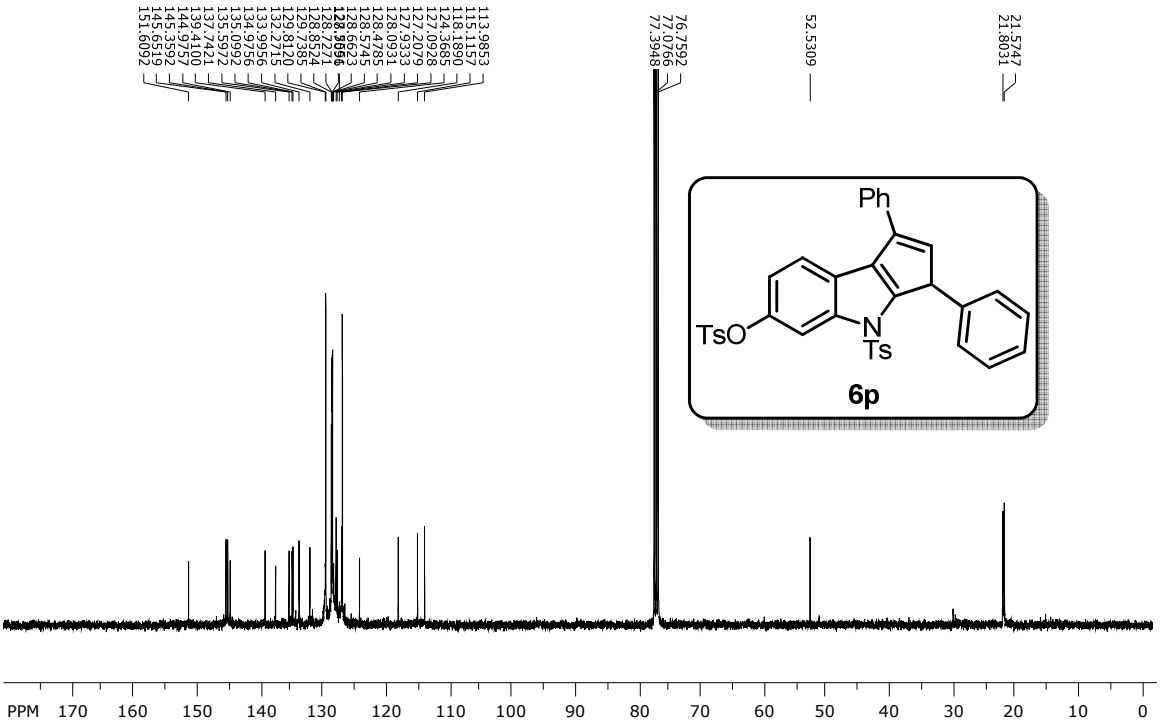
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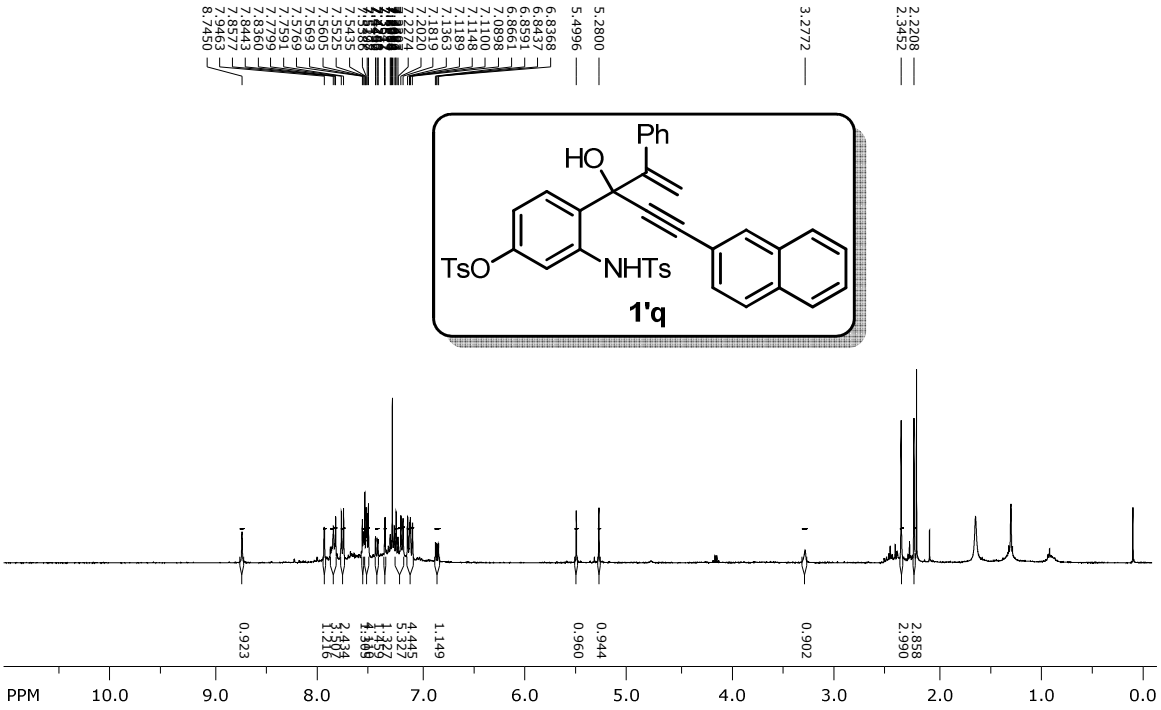
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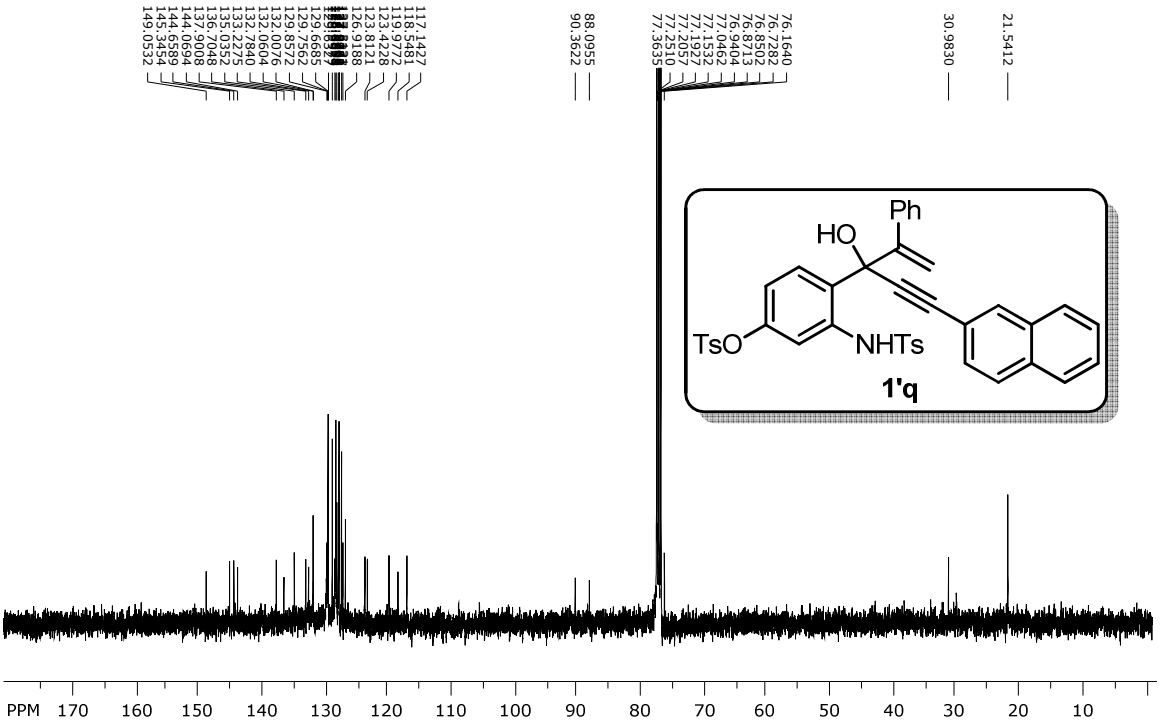
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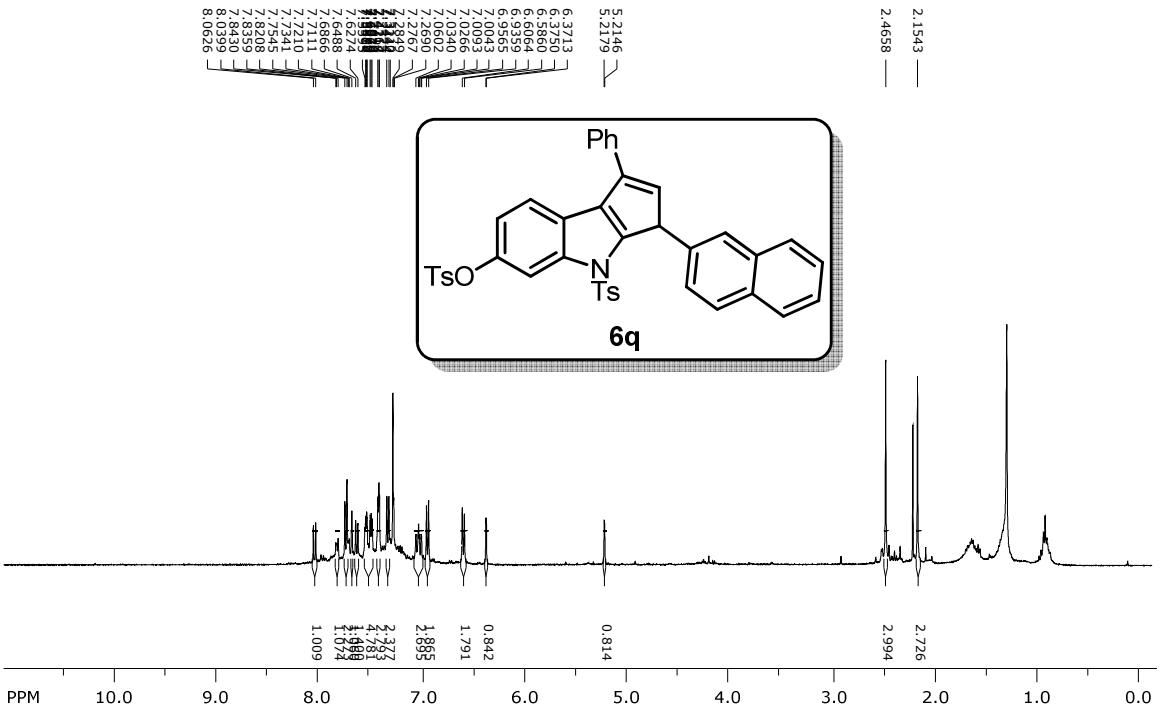
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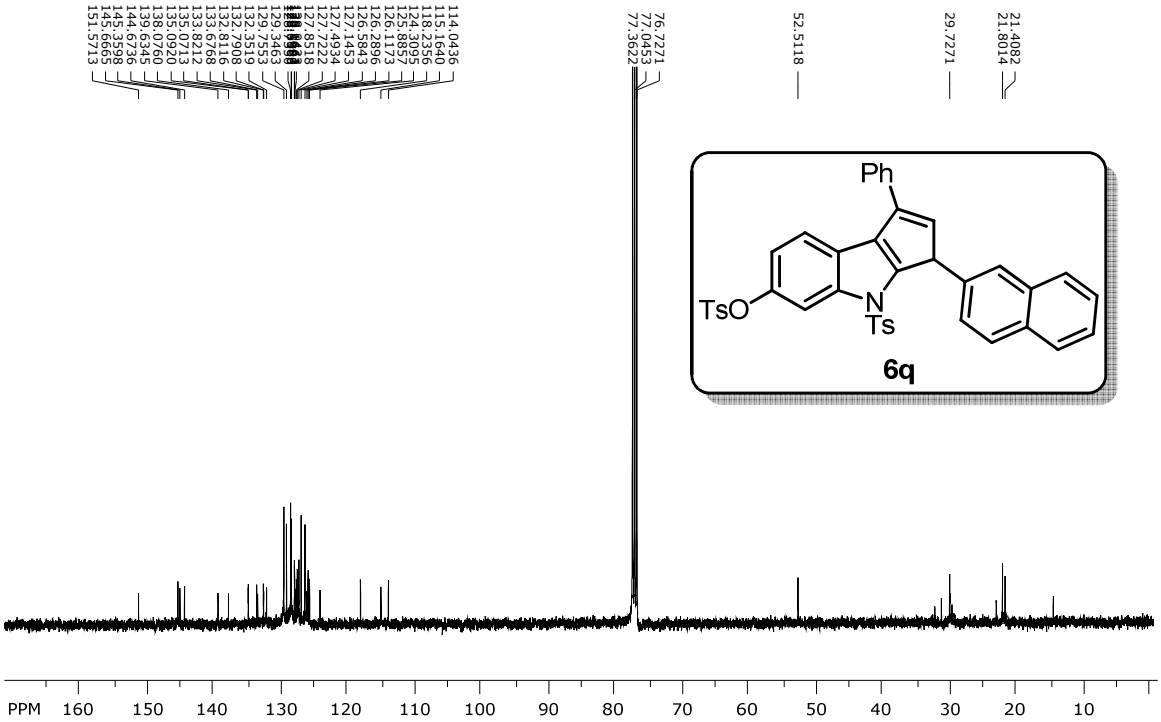
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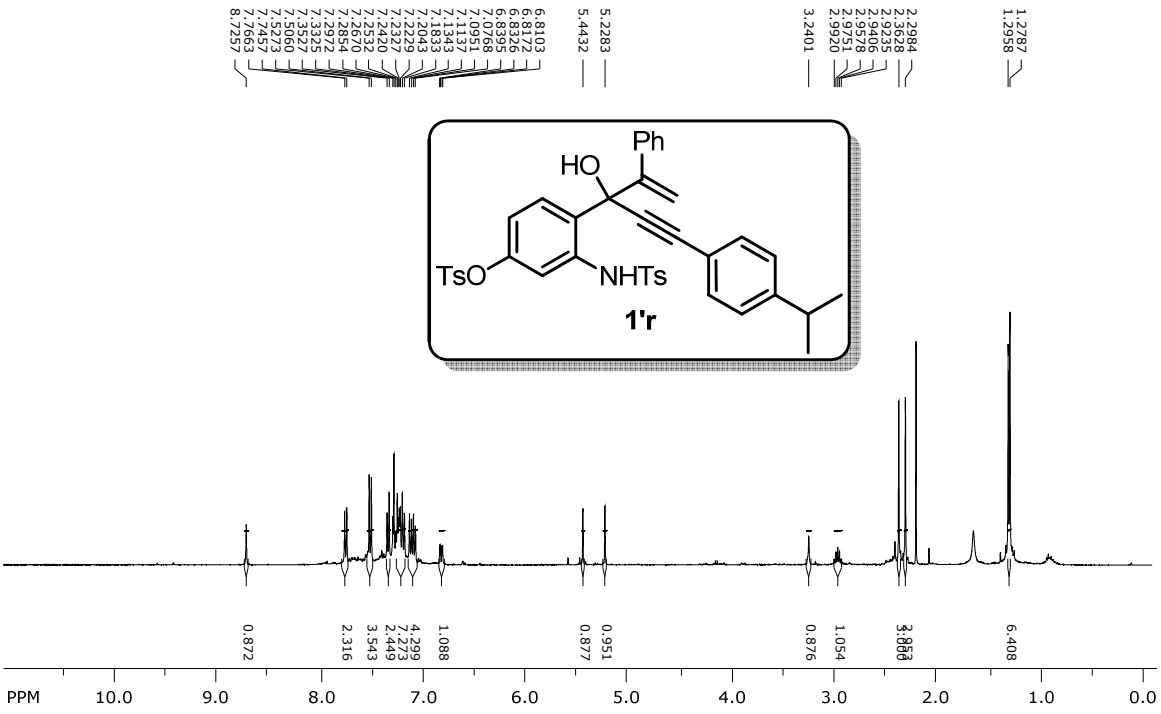
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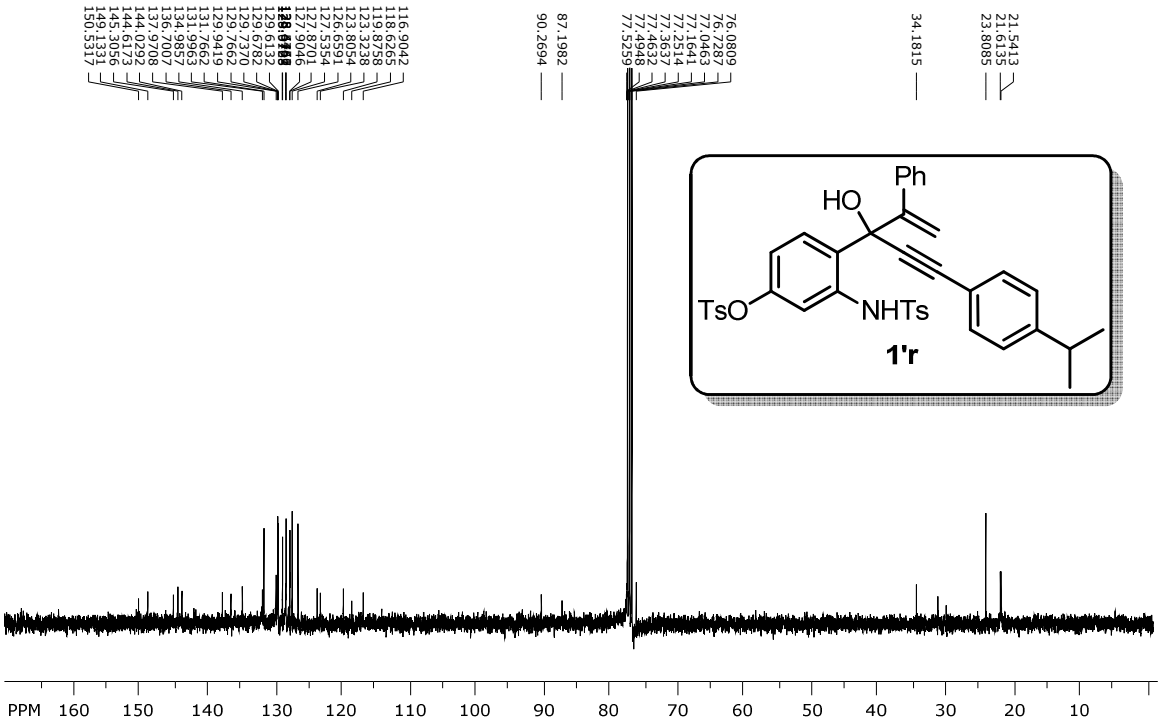
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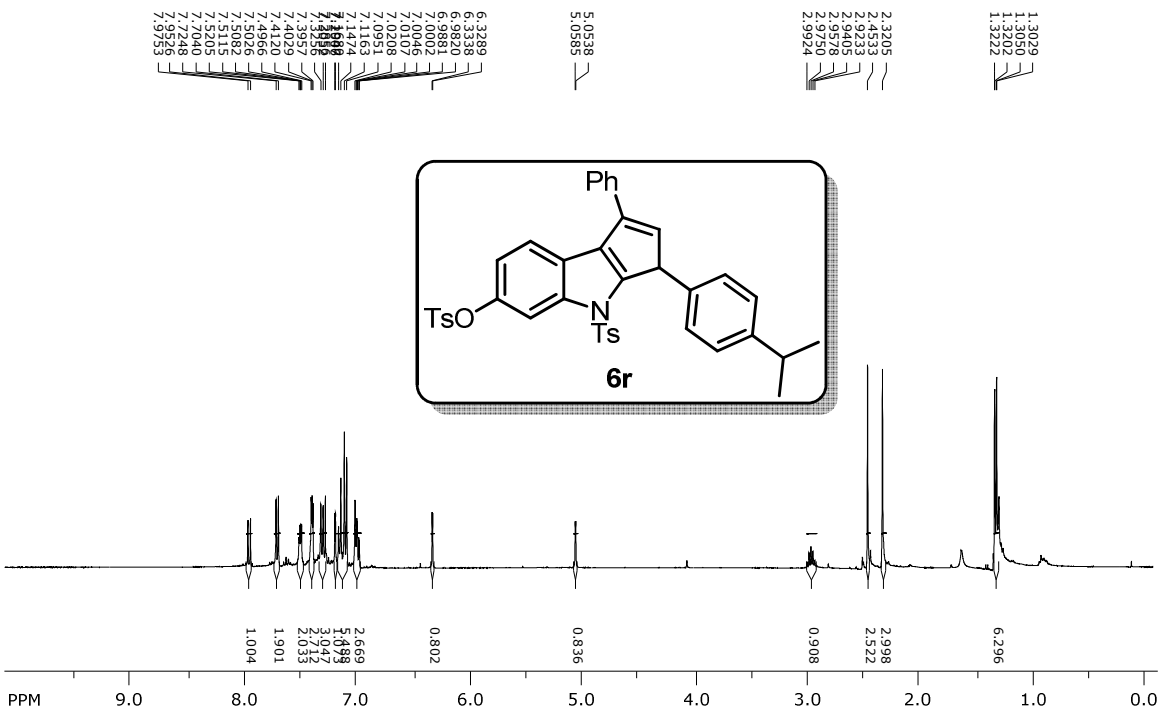
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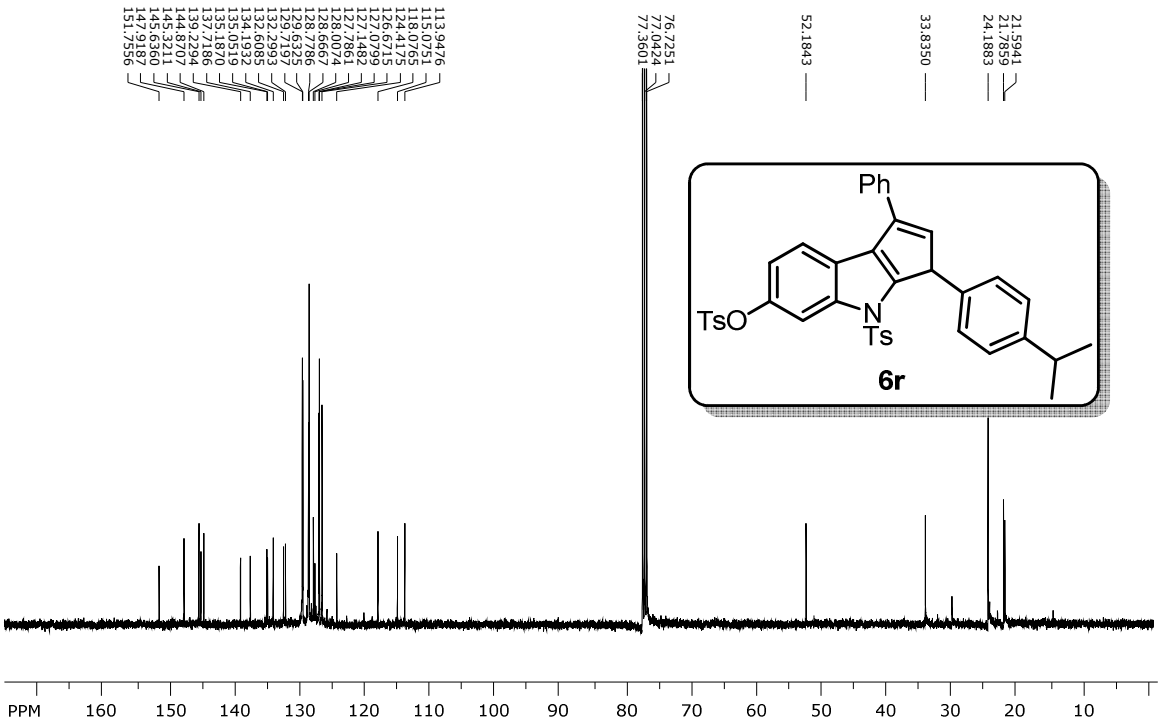
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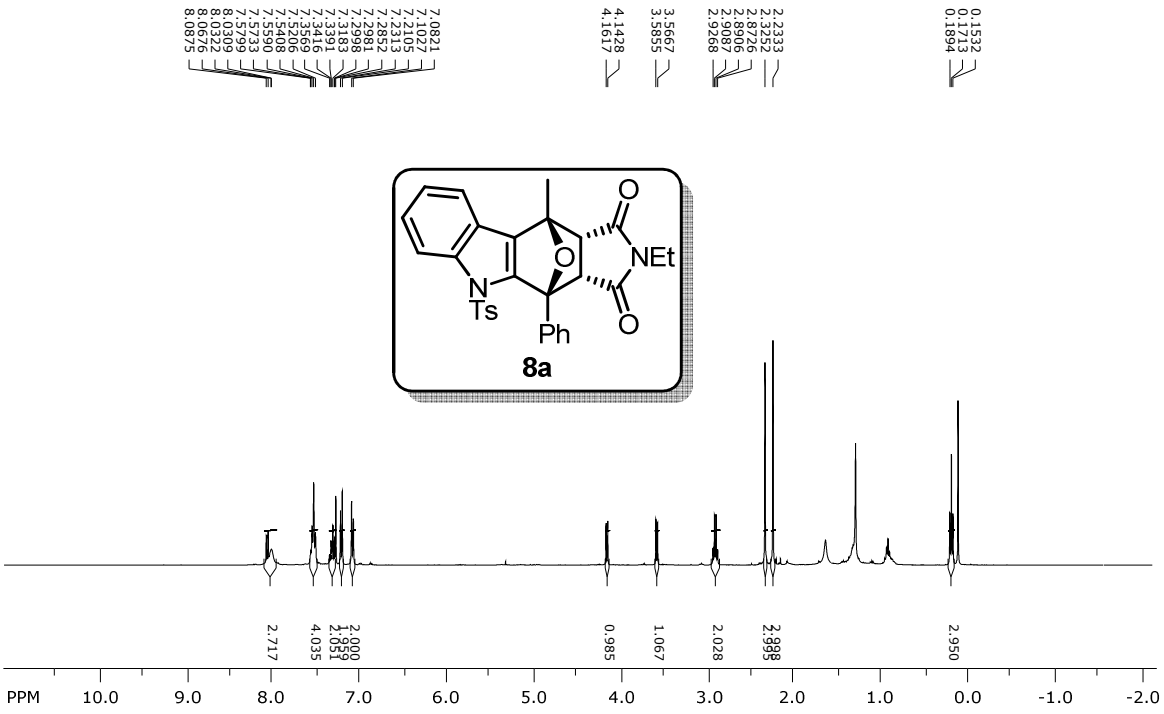
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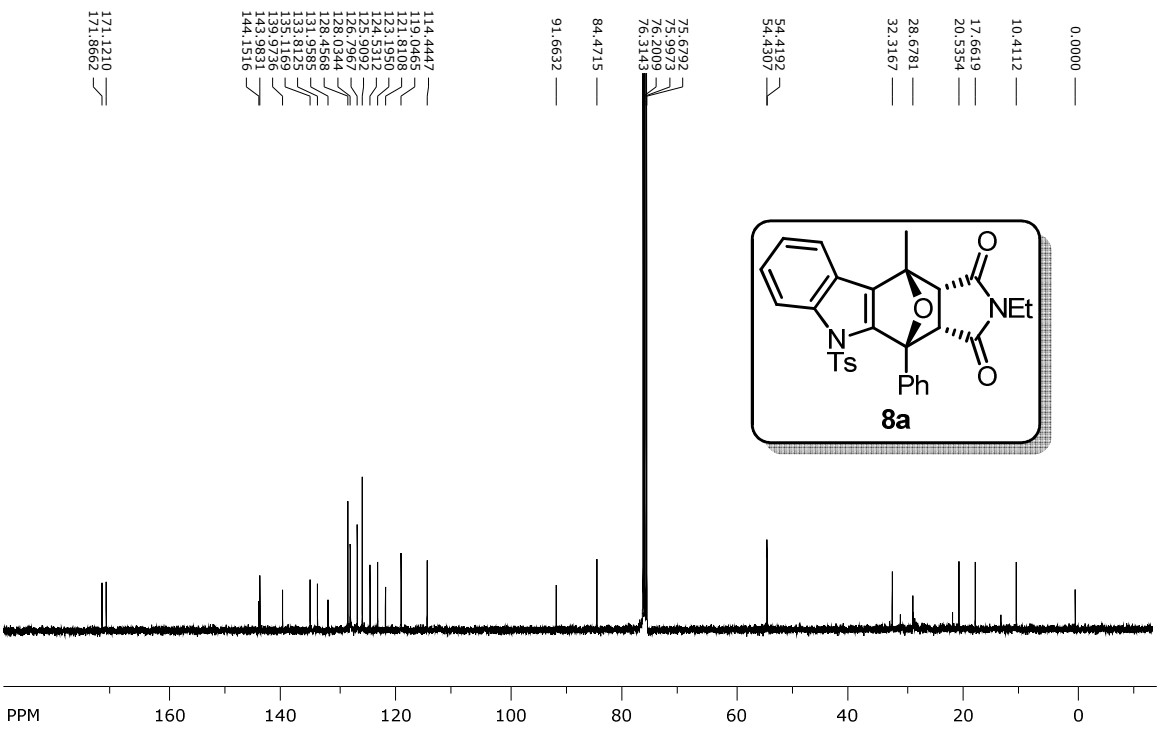
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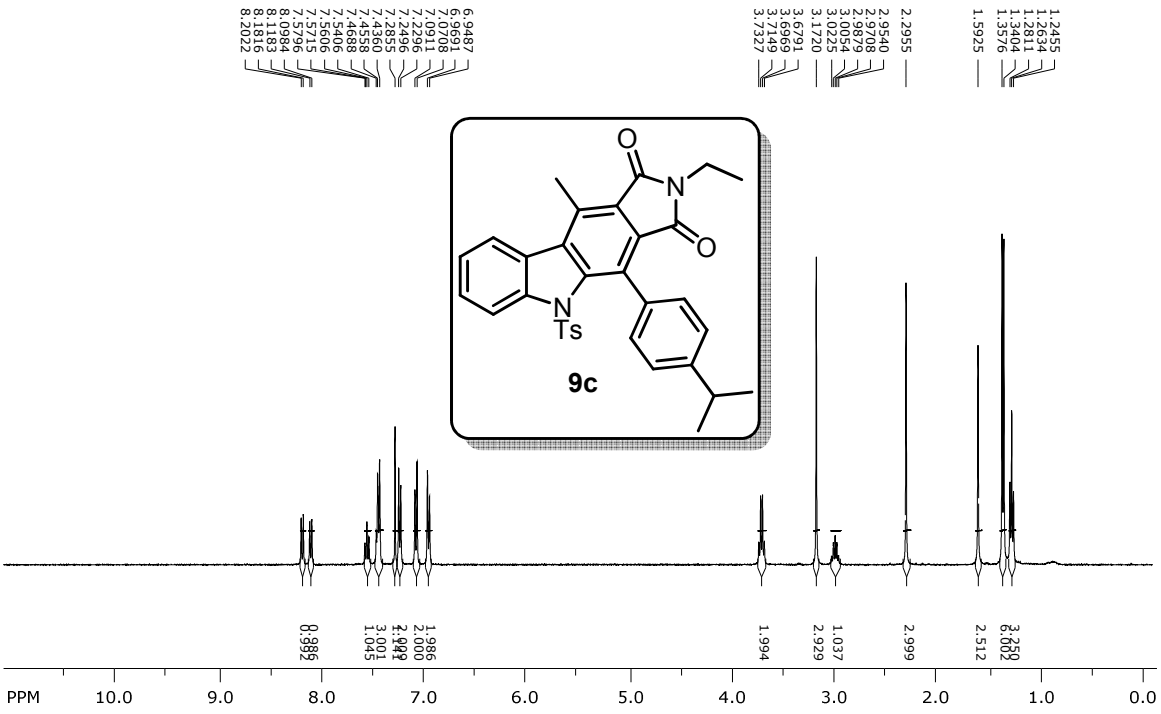
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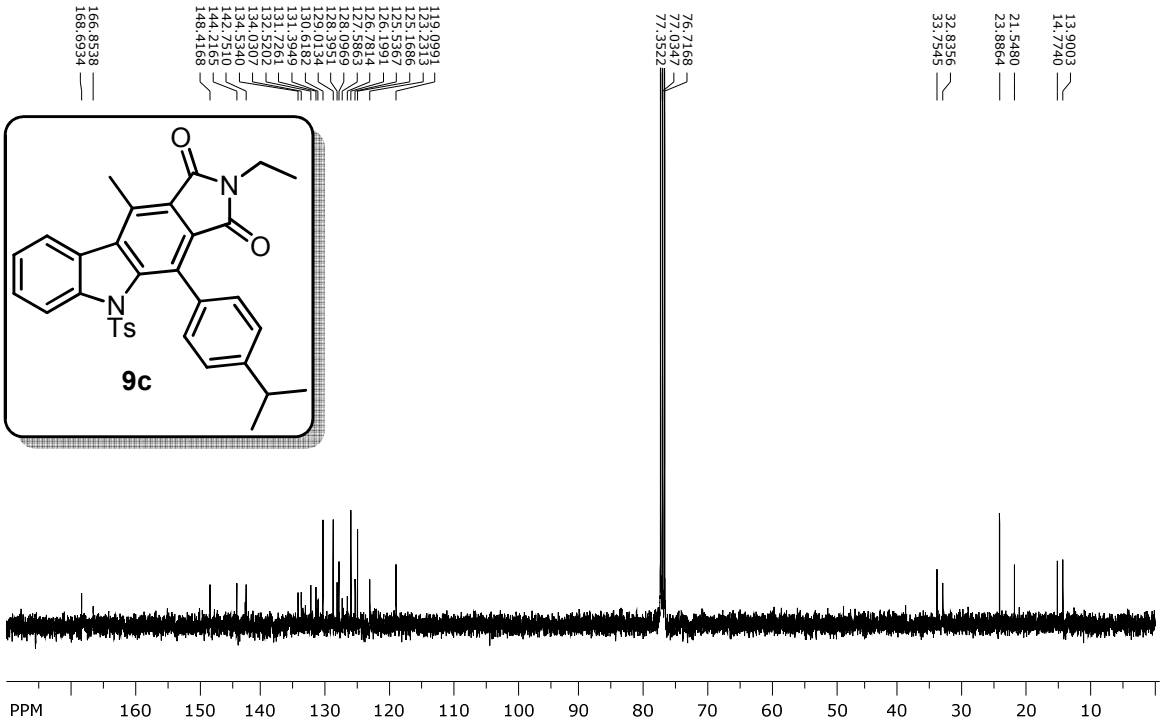
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