Supporting Information

Nazarov Cyclization of 1,4-Pentadien-3-ols: Preparation of Cyclopenta[*b*]indoles and Spiro[indene-1,4´-quinoline]s

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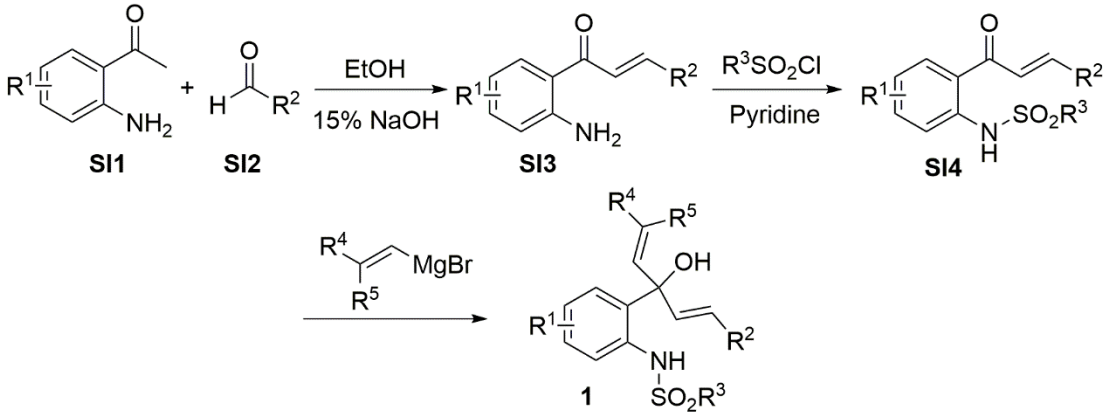
General Information

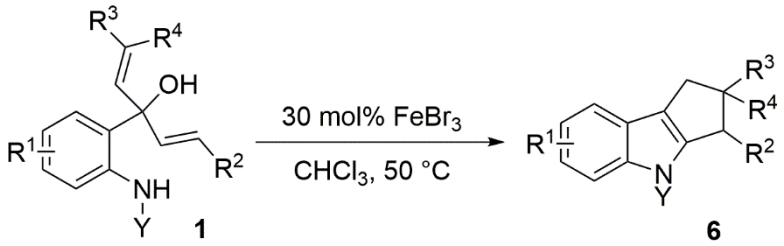
All reactions were performed under a N_2 atmosphere in oven-dried glassware with magnetic stirring. Unless otherwise stated, all reagents were purchased from commercial suppliers and used without further purification. Toluene, dichloromethane (CH_2Cl_2), and chloroform ($CHCl_3$) were freshly distilled from CaH_2. Tetrahydrofuran (THF) was distilled from sodium benzophenone ketyl prior to use. Organic solutions were concentrated under reduced pressure on a rotary evaporator or an oil pump. Reactions were monitored through thin layer chromatography (TLC) on silica gel–precoated glass plates. Chromatograms were visualized by fluorescence quenching under UV light at 254 nm. Flash column chromatography was performed using Qingdao Haiyang flash silica gel (200–300 mesh). Infrared spectra were recorded using a Thermo Nicolet 6700 instrument. ^1H and ^{13}C NMR spectra were recorded in $CDCl_3$ using a Bruker Avance 300, 400, or 500 MHz NMR spectrometer (referenced internally to Me_4Si). Chemical shifts (δ, ppm) are reported relative to tetramethylsilane (TMS) with the resonance of the nondeuterated solvent or TMS as the internal standard. ^1H NMR data are reported as follows: chemical shift, multiplicity (s = singlet; d = doublet; q = quartet; m = multiplet; br = broad), coupling constant (Hz), and integral. Data for ^{13}C NMR spectra are reported in terms of chemical shift. Accurate mass measurements were performed using a Varian instrument with the ESI-MS technique. Melting points were determined using a X-4 digital micro melting point apparatus. X-ray crystallographic data were collected using a Bruker Smart Apex CCD apparatus.

Preparation of 3-(2-Anilinyl)-1,4-pentadien-3-ols 1



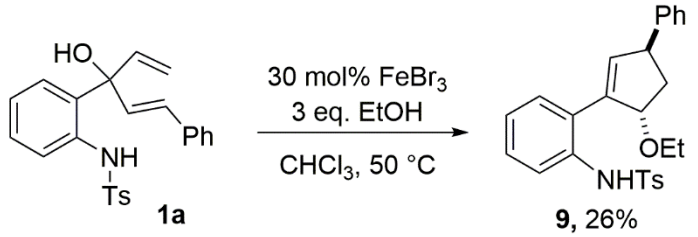
The appropriate aldehyde (1.2 equiv) was added to a 0.75 M solution of the corresponding *o*-aminoacetophenone (1.0 equiv) in EtOH at 0 °C. 15% Aqueous NaOH was added over a period of 15 min and then the mixture was stirred at room temperature until the reaction was complete (TLC). The reaction was quenched with 1.0 M HCl and the aqueous phase extracted with EtOAc. The combined organic phases were washed with brine, dried (anhydrous Na_2SO_4), and concentrated under reduced pressure. The resulting solid was recrystallized (EtOH) to afford compound **SI3** for the next step. An appropriate sulfonylchloride (1.2 equiv) and pyridine (8.0 equiv) were added to a 0.5 M solution of **SI3** in CH_2Cl_2 at 0 °C. The mixture was stirred at room temperature until the reaction was complete (TLC). The reaction was quenched with water and the aqueous phase extracted with EtOAc. The combined organic phases were washed with brine, dried (anhydrous Na_2SO_4), and concentrated under reduced pressure. The resulting solid was recrystallized (EtOH) to afford compound **SI4** for the next step. A 1.0 M solution of the appropriate vinyl magnesium bromide in THF (1.5 equiv) was added to a 1.0 M solution of **SI4** in THF at room temperature over a period of 5 min. The mixture was stirred under reflux until the reaction was complete (TLC). The reaction was quenched with saturated NH_4Cl and the aqueous phase extracted with EtOAc. The combined organic phases were washed with brine, dried (anhydrous Na_2SO_4), and concentrated under reduced pressure. Flash column chromatography on silica gel (petroleum ether/EtOAc) afforded the corresponding 3-(2-anilinyl)-1,4-pentadien-3-ols **1**.

General Procedure for Intramolecular Interrupted Nazarov Cyclization



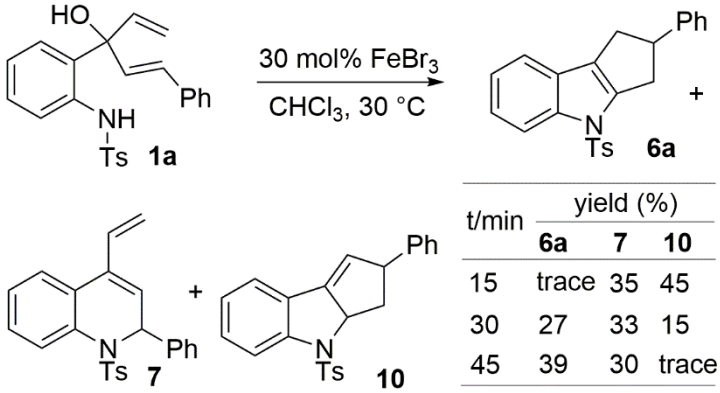
$FeBr_3$ (0.06 mmol) was added to a solution of a protected 3-(2-anilinyl)-1,4-pentadien-3-ol (0.2 mmol) in $CHCl_3$ (2 mL). The mixture was stirred at 50 °C for 0.5 h and monitored using TLC. Flash column chromatography on silica gel (petroleum ether/EtOAc) gave the desired pure product (**6a**–**w**). From the reactions of the polysubstituted 1,4-pentadien-3-ols **1w**–**y**, the spiro[indene-1,4′-quinoline] compounds **8w**–**y** were isolated.

Procedure for Trapping of the Cyclopentyl Allylic Carbocation (Compound 9)



$FeBr_3$ (0.15 mmol) and EtOH (1.5 mmol) were added to a solution of (*E*)-3-(2-tosylaminophenyl)-1-phenylpenta-1,4-dien-3-ol (0.5 mmol) in $CHCl_3$ (5 mL). The mixture was stirred at 50 °C for 0.5 h and monitored using TLC. Flash column chromatography on silica gel (petroleum ether/EtOAc) gave compound **9** in 26% yield.

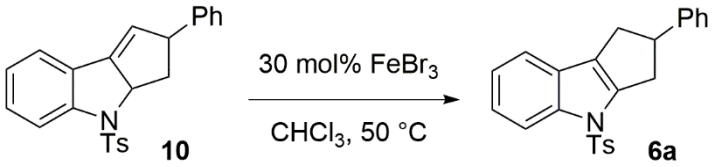
Procedure for Identification of the Key Reaction Intermediate (Compound 10)



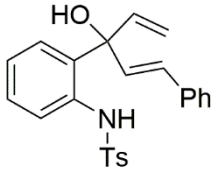
t/min	yield (%)		
	6a	**7**	**10**
15	trace	35	45
30	27	33	15
45	39	30	trace

$FeBr_3$ (0.15 mmol) was added to a solution of (*E*)-3-(2-tosylaminophenyl)-1-phenylpenta-1,4-dien-3-ol (0.5 mmol) in $CHCl_3$ (5 mL). The mixture was stirred at 30 °C for 15, 30, or 45 min (three batches). Flash column chromatography on silica gel (petroleum ether/EtOAc) gave the compounds **6a**, **7**, and **10**.

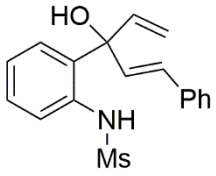
Procedure for Transformation of Compound 10 to Compound 6a



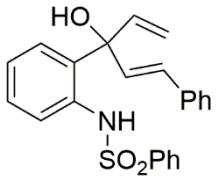
$FeBr_3$ (0.06 mmol) was added to a solution of compound **10** (0.2 mmol) in $CHCl_3$ (2 mL). The mixture was stirred at 50 °C for 15 min and monitored using TLC. Flash column chromatography on silica gel (petroleum ether/EtOAc) gave compound **6a** in 90% yield.



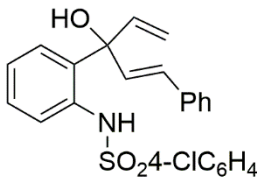
(*E*)-*N*-(2-(3-Hydroxy-1-phenylpenta-1,4-dien-3-yl)phenyl)-4-methylbenzenesulfonamide (1a). Three steps, 50% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.27 (br, 1H), 7.64–7.61 (m, 3H), 7.34–7.16 (m, 7H), 6.98–6.93 (m, 3H), 6.49 (d, J = 16.2 Hz, 1H), 6.32 (d, J = 16.2 Hz, 1H), 6.11 (dd, J = 17.4, 10.5 Hz, 1H), 5.25 (d, J = 17.4 Hz, 1H), 5.24 (d, J = 10.0 Hz, 1H), 3.08 (br, 1H), 2.24 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.5, 79.6, 115.9, 119.4, 123.1, 126.9, 127.5, 128.1, 128.3, 128.7, 128.9, 129.4, 130.5, 130.6, 131.9, 136.1, 136.74, 136.75, 140.7, 143.4; HRMS (ESI): $[M + H]^+$ calcd for $C_{24}H_{24}NO_3S^+$: m/z 406.1471, found: 406.1469.



(*E*)-*N*-(2-(3-Hydroxy-1-phenylpenta-1,4-dien-3-yl)phenyl)methanesulfonamide (1b). Three steps, 48% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.87 (br, 1H), 7.59 (d, *J* = 7.5 Hz, 1H), 7.32–7.16 (m, 7H), 6.99 (t, *J* = 7.0 Hz, 1H), 6.55 (d, *J* = 16.9 Hz, 1H), 6.38 (d, *J* = 16.0 Hz, 1H), 6.16 (dd, *J* = 17.4, 10.5 Hz, 1H), 5.35–5.30 (m, 2H), 3.26 (br, 1H), 2.70 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 39.4, 79.5, 115.9, 120.1, 123.9, 126.8, 128.3, 128.4, 128.8, 129.3, 130.7, 131.5, 132.0, 135.8, 136.8, 140.8; HRMS (ESI): $[M + H]^+$ calcd for $C_{18}H_{20}NO_3S^+$: *m*/*z* 330.1158, found: 330.1160.

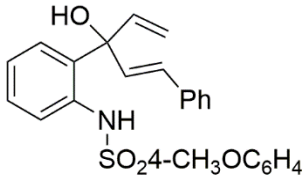


(*E*)-*N*-(2-(3-Hydroxy-1-phenylpenta-1,4-dien-3-yl)phenyl)benzenesulfonamide (1c). Three steps, 45% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.23 (br, 1H), 7.79 (d, *J* = 8.4 Hz, 2H), 7.67 (d, *J* = 8.1 Hz, 1H), 7.41–7.19 (m, 10H), 7.00 (t, *J* = 7.5 Hz, 1H), 6.55 (d, *J* = 16.0 Hz, 1H), 6.36 (d, *J* = 16.0 Hz, 1H), 6.11 (dd, *J* = 17.4, 10.0 Hz, 1H), 5.27 (d, *J* = 17.4 Hz, 1H), 5.25 (d, *J* = 10.0 Hz, 1H), 2.76 (br, 1H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 79.5, 115.8, 119.4, 123.2, 126.8, 127.4, 128.2, 128.3, 128.65, 128.66, 128.7, 128.9, 130.6, 131.7, 132.7, 135.9, 136.5, 139.6, 140.5; HRMS (ESI): $[M + H]^+$ calcd for $C_{23}H_{22}NO_3S^+$: *m*/*z* 392.1315, found: 392.1315.

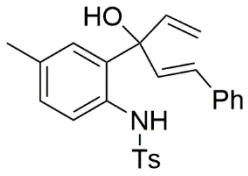


(*E*)-4-Chloro-*N*-(2-(3-hydroxy-1-phenylpenta-1,4-dien-3-yl)phenyl)benzenesulfonamide (1d). Three steps, 48% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.27 (br, 1H), 7.70–7.65 (m, 3H), 7.38–7.34 (m, 5H), 7.28–7.19 (m, 2H), 7.15–7.11 (m, 2H), 7.05–7.00 (m, 1H), 6.52 (d, *J* = 16.2 Hz, 1H), 6.32 (d, *J* = 16.2 Hz, 1H), 6.14 (dd, *J* = 17.4, 10.5 Hz, 1H), 5.32–5.26 (m, 2H), 2.80 (br, 1H);

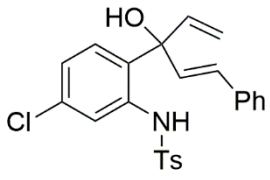
^{13}C NMR (75 MHz, $CDCl_3$): δ 79.7, 116.1, 119.5, 123.6, 126.9, 128.43, 128.48, 128.89, 128.95, 129.1, 129.2, 130.7, 130.9, 131.6, 135.9, 136.4, 138.1, 139.2, 140.7; HRMS (ESI): $[M + H]^+$ calcd for $C_{23}H_{21}ClNO_3S^+$: *m*/*z* 426.0925, found: 426.0926.



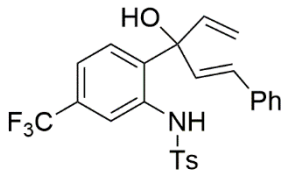
(*E*)-*N*-(2-(3-Hydroxy-1-phenylpenta-1,4-dien-3-yl)phenyl)-4-methoxybenzene-sulfonamide (1e). Three steps, 40% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.16 (br, 1H), 7.69–7.62 (m, 3H), 7.34–7.27 (m, 5H), 7.25–7.16 (m, 2H), 6.99–6.93 (m, 1H), 6.65–6.62 (m, 2H), 6.52 (d, *J* = 16.0 Hz, 1H), 6.33 (d, *J* = 16.0 Hz, 1H), 6.13 (dd, *J* = 17.4, 10.5 Hz, 1H), 5.28 (d, *J* = 17.4 Hz, 1H), 5.27 (d, *J* = 10.5 Hz, 1H), 3.71 (s, 3H), 2.84 (br, 1H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 55.6, 79.6, 113.9, 116.0, 119.4, 123.1, 126.97, 126.99, 128.3, 128.4, 128.8, 129.0, 129.8, 130.6, 131.3, 131.9, 136.1, 136.8, 140.8, 162.9; HRMS (ESI): $[M + H]^+$ calcd for $C_{24}H_{24}NO_4S^+$: *m*/*z* 422.1421, found: 422.1420.



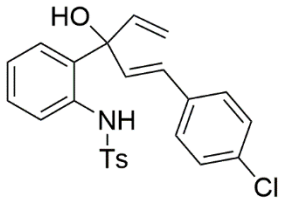
(*E*)-*N*-(2-(3-Hydroxy-1-phenylpenta-1,4-dien-3-yl)-4-methylphenyl)-4-methyl-benzenesulfonamide (1f). Three steps, 44% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.95 (br, 1H), 7.54 (d, *J* = 8.4 Hz, 2H), 7.46 (d, *J* = 8.4 Hz, 1H), 7.26–7.18 (m, 5H), 6.95–6.87 (m, 4H), 6.43 (d, *J* = 16.0 Hz, 1H), 6.24 (d, *J* = 16.0 Hz, 1H), 6.02 (dd, *J* = 17.1, 10.5 Hz, 1H), 5.19 (d, *J* = 17.1 Hz, 1H), 5.16 (d, *J* = 10.5 Hz, 1H), 2.69 (br, 1H), 2.16 (s, 3H), 2.15 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.0, 21.6, 79.6, 115.8, 119.8, 127.0, 127.6, 128.2, 128.8, 128.9, 129.4, 129.5, 130.5, 130.7, 132.0, 132.8, 134.1, 136.2, 136.9, 140.9, 143.4; HRMS (ESI): $[M + H]^+$ calcd for $C_{25}H_{26}NO_3S^+$: *m*/*z* 420.1628, found: 420.1629.



(*E*)-*N*-(5-Chloro-2-(3-hydroxy-1-phenylpenta-1,4-dien-3-yl)phenyl)-4-methylbenzenesulfonamide (1g). Three steps, 52% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.26 (br, 1H), 7.59–7.53 (m, 3H), 7.25–7.22 (m, 5H), 7.01 (d, J = 8.4 Hz, 1H), 6.91 (d, J = 8.1 Hz, 2H), 6.84 (dd, J = 8.4, 2.1 Hz, 1H), 6.38 (d, J = 16.2 Hz, 1H), 6.20 (d, J = 16.2, Hz, 1H), 6.01 (dd, J = 17.1, 10.8 Hz, 1H), 5.18 (d, J = 10.0 Hz, 1H), 5.17 (d, J = 17.4 Hz, 1H), 3.08 (br, 1H), 2.18 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.6, 79.5, 116.5, 119.1, 123.0, 127.0, 127.5, 128.4, 128.8, 129.0, 129.5, 129.6, 131.0, 131.3, 134.7, 135.9, 136.2, 137.9, 140.3, 143.9; HRMS (ESI): $[M + H]^+$ calcd for $C_{24}H_{23}ClNO_3S^+$: m/z 440.1082, found: 440.1080.

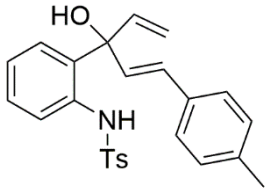


(*E*)-*N*-(2-(3-Hydroxy-1-phenylpenta-1,4-dien-3-yl)-5-(trifluoromethyl)phenyl)-4-methylbenzenesulfonamide (1h). Three steps, 43% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.91 (s, 1H), 7.61 (d, J = 8.1 Hz, 2H), 7.33–7.25 (m, 6H), 7.18 (dd, J = 8.4, 1.2 Hz, 1H), 6.96 (d, J = 8.1 Hz, 2H), 6.50 (d, J = 15.9 Hz, 1H), 6.29 (d, J = 15.9 Hz, 1H), 6.10 (dd, J = 17.1, 10.8 Hz, 1H), 5.30 (d, J = 10.0 Hz, 1H), 5.28 (d, J = 17.7 Hz, 1H), 2.24 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.7, 79.7, 115.7 (q, J = 4.5 Hz), 116.9, 119.4 (q, J = 3.5 Hz), 123.7 (q, J = 270.4 Hz), 126.8, 127.2, 127.5, 127.8, 128.7 (q, J = 27.8 Hz), 129.5, 129.7, 131.3, 134.1, 135.8, 135.9, 137.4, 140.0, 140.2, 144.1; HRMS (ESI): $[M + H]^+$ calcd for $C_{25}H_{23}F_3NO_3S^+$: m/z 474.1345, found: 474.1344.

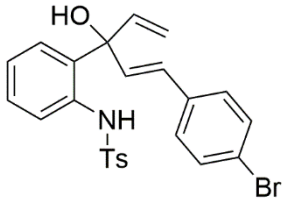


(*E*)-*N*-(2-(1-(4-Chlorophenyl)-3-hydroxypenta-1,4-dien-3-yl)phenyl)-4-methylbenzenesulfonamide (1i). Three steps, 49% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.52–7.50 (m, 3H), 7.17–7.05 (m, 6H), 6.89–6.84 (m, 3H), 6.33 (d, J = 16.2 Hz, 1H), 6.20 (d, J = 16.2 Hz, 1H), 6.00 (dd, J = 17.4, 10.5 Hz, 1H), 5.16–5.11 (m, 2H), 2.15 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 20.4, 78.5, 115.0, 118.2, 122.1,

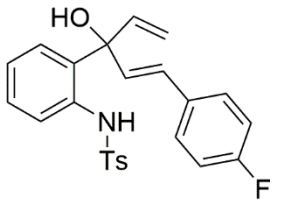
126.3, 127.0, 127.2, 127.6, 127.8, 128.1, 128.3, 129.5, 131.5, 132.5, 133.6, 135.5, 135.6, 139.5, 142.5; HRMS (ESI): $[M + H]^+$ calcd for $C_{24}H_{23}ClNO_3S^+$: *m*/*z* 440.1082, found: 440.1083.



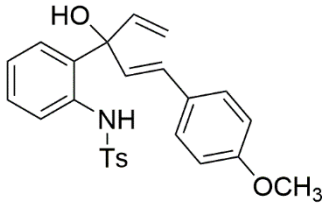
(*E*)-*N*-(2-(3-Hydroxy-1-(*p*-tolyl)penta-1,4-dien-3-yl)phenyl)-4-methylbenzene-sulfonamide (1j). Three steps, 41% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.66–7.62 (m, 3H), 7.25–7.12 (m, 6H), 7.03–6.95 (m, 3H), 6.47 (d, *J* = 16.2 Hz, 1H), 6.28 (d, *J* = 16.2 Hz, 1H), 6.09 (dd, *J* = 17.4, 10.5 Hz, 1H), 5.25 (d, *J* = 17.7 Hz, 1H), 5.24 (d, *J* = 10.2 Hz, 1H), 2.35 (s, 3H), 2.27 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 21.2, 21.5, 79.6, 115.7, 119.4, 123.0, 126.7, 127.45, 127.46, 128.3, 128.8, 129.34, 129.35, 130.6, 130.7, 133.2, 136.7, 136.8, 138.1, 140.6, 143.3; HRMS (ESI): $[M + H]^+$ calcd for $C_{25}H_{26}NO_3S^+$: *m*/*z* 420.1628, found: 420.1630.



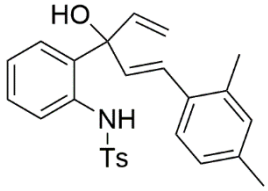
(*E*)-*N*-(2-(1-(4-Bromophenyl)-3-hydroxypenta-1,4-dien-3-yl)phenyl)-4-methyl-benzenesulfonamide (1k). Three steps, 40% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.57–7.54 (m, 3H), 7.36 (d, *J* = 8.4 Hz, 2H), 7.17–7.07 (m, 4H), 6.96–6.90 (m, 3H), 6.37 (d, *J* = 16.2 Hz, 1H), 6.24 (d, *J* = 16.2 Hz, 1H), 6.04 (dd, *J* = 17.4, 10.2 Hz, 1H), 5.20 (d, *J* = 10.2 Hz, 1H), 5.19 (d, *J* = 17.4 Hz, 1H), 2.21 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 21.5, 79.5, 116.0, 119.5, 121.9, 123.1, 127.3, 128.2, 128.3, 129.0, 129.3, 129.4, 130.4, 131.7, 132.5, 135.0, 136.7, 136.8, 140.4, 143.5; HRMS (ESI): $[M + H]^+$ calcd for $C_{24}H_{23}BrNO_3S^+$: *m*/*z* 484.0577, found: 484.0577.



(*E*)-*N*-(2-(1-(4-Fluorophenyl)-3-hydroxypenta-1,4-dien-3-yl)phenyl)-4-methyl-benzenesulfonamide (1l). Three steps, 39% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.66–7.60 (m, 3H), 7.33–7.28 (m, 2H), 7.24–7.15 (m, 2H), 7.04–6.94 (m, 5H), 6.47 (d, J = 16.2 Hz, 1H), 6.25 (d, J = 16.2 Hz, 1H), 6.11 (dd, J = 17.4, 10.5 Hz, 1H), 5.30–5.24 (m, 2H), 2.28 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 21.5, 79.5, 115.7 (d, J = 21.3 Hz), 115.9, 119.4, 123.1, 127.4, 128.2, 128.4 (d, J = 7.9 Hz), 128.9, 129.3, 129.4, 130.4, 131.5, 132.2 (d, J = 3.6 Hz), 136.7, 136.8, 140.6, 143.4, 162.6 (d, J = 246.2 Hz); HRMS (ESI): $[M + H]^+$ calcd for $C_{24}H_{23}FNO_3S^+$: m/z 424.1377, found: 424.1377.

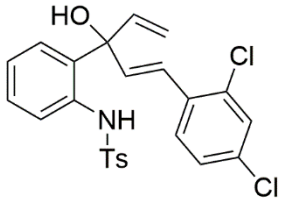


(*E*)-*N*-(2-(3-Hydroxy-1-(4-methoxyphenyl)penta-1,4-dien-3-yl)phenyl)-4-methyl-benzenesulfonamide (1m). Three steps, 44% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.66–7.61 (m, 3H), 7.27 (d, J = 8.4 Hz, 2H), 7.23–7.16 (m, 2H), 7.03 (d, J = 8.1 Hz, 2H), 6.98–6.92 (m, 1H), 6.88–6.84 (m, 2H), 6.45 (d, J = 15.9 Hz, 1H), 6.20 (d, J = 15.9 Hz, 1H), 6.09 (dd, J = 17.1, 10.5 Hz, 1H), 5.28–5.22 (m, 2H), 3.82 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 21.5, 55.4, 79.6, 114.0, 115.6, 119.4, 123.0, 127.5, 128.1, 128.3, 128.7, 128.8, 129.3, 129.6, 130.2, 130.7, 136.7, 136.8, 140.7, 143.4, 159.6; HRMS (ESI): $[M + H]^+$ calcd for $C_{25}H_{26}NO_4S^+$: m/z 436.1577, found: 436.1576.

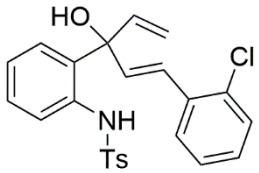


(*E*)-*N*-(2-(1-(2,4-Dimethylphenyl)-3-hydroxypenta-1,4-dien-3-yl)phenyl)-4-methylbenzenesulfonamide (1n). Three steps, 46% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.10 (br, 1H), 7.66–7.62 (m, 3H), 7.29 (d, J = 8.1 Hz, 1H), 7.24–7.17 (m, 2H), 7.03–6.93 (m, 5H), 6.70 (d, J = 15.9 Hz, 1H), 6.18 (d, J = 15.9 Hz, 1H), 6.11 (dd, J = 17.4, 10.5 Hz, 1H), 5.30–5.23 (m, 2H), 2.57 (br, 1H), 2.32 (s, 3H), 2.27 (s, 3H), 2.23 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 19.8, 21.2, 21.6, 79.8, 115.8, 119.5,

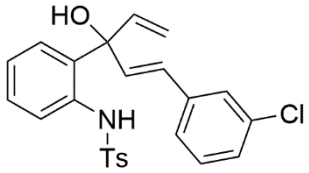
123.1, 125.7, 127.0, 127.5, 128.4, 128.5, 129.0, 129.4, 130.8, 131.3, 132.1, 132.3, 136.0, 136.8, 136.9, 138.0, 140.8, 143.5; HRMS (ESI): $[M + H]^+$ calcd for $C_{26}H_{28}NO_3S^+$: *m*/*z* 434.1784, found: 434.1782.



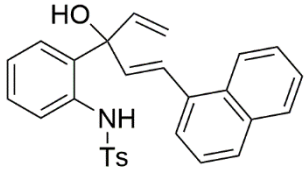
(*E*)-*N*-(2-(1-(2,4-Dichlorophenyl)-3-hydroxypenta-1,4-dien-3-yl)phenyl)-4-methylbenzenesulfonamide (1o). Three steps, 43% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.00 (br, 1H), 7.60–7.57 (m, 3H), 7.32–7.29 (m, 2H), 7.17–7.08 (m, 3H), 6.99–6.89 (m, 3H), 6.74 (d, *J* = 15.9 Hz, 1H), 6.24 (d, *J* = 15.9 Hz, 1H), 6.06 (dd, *J* = 17.1, 10.5 Hz, 1H), 5.24–5.17 (m, 2H), 2.70 (br, 1H), 2.21 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.6, 79.7, 116.4, 119.9, 123.4, 125.8, 127.38, 127.39, 128.0, 128.3, 129.2, 129.5, 129.7, 130.4, 133.0, 134.1, 134.2, 135.3, 136.8, 137.1, 140.4, 143.6; HRMS (ESI): $[M + H]^+$ calcd for $C_{24}H_{22}Cl_2NO_3S^+$: *m*/*z* 474.0692, found: 474.0690.



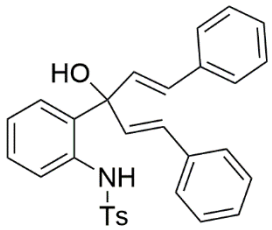
(*E*)-*N*-(2-(1-(2-Chlorophenyl)-3-hydroxypenta-1,4-dien-3-yl)phenyl)-4-methyl-benzenesulfonamide (1p). Three steps, 41% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.10 (br, 1H), 7.61–7.56 (m, 3H), 7.40–7.35 (m, 1H), 7.30–7.26 (m, 1H), 7.15–7.07 (m, 4H), 6.96–6.88 (m, 3H), 6.80 (d, *J* = 16.2 Hz, 1H), 6.25 (d, *J* = 16.2 Hz, 1H), 6.05 (dd, *J* = 17.4, 10.5 Hz, 1H), 5.22–5.16 (m, 2H), 2.80 (br, 1H), 2.17 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 21.5, 79.7, 116.1, 119.7, 123.2, 126.8, 126.9, 127.1, 127.3, 128.3, 129.0, 129.1, 129.3, 129.8, 130.4, 133.6, 134.3, 134.7, 136.7, 136.9, 140.4, 143.4; HRMS (ESI): $[M + H]^+$ calcd for $C_{24}H_{23}ClNO_3S^+$: *m*/*z* 440.1082, found: 440.1085.



(*E*)-*N*-(2-(1-(3-Chlorophenyl)-3-hydroxypenta-1,4-dien-3-yl)phenyl)-4-methyl-benzenesulfonamide (1q). Three steps, 47% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.05 (br, 1H), 7.60–7.53 (m, 3H), 7.20–7.07 (m, 6H), 6.95–6.91 (m, 3H), 6.37 (d, J = 16.2 Hz, 1H), 6.24 (d, J = 16.2 Hz, 1H), 6.07 (dd, J = 17.7, 10.2 Hz, 1H), 5.21 (d, J = 10.2 Hz, 1H), 5.20 (d, J = 17.7 Hz, 1H), 2.77 (br, 1H), 2.20 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 21.5, 79.4, 116.2, 119.5, 123.2, 125.2, 126.6, 127.4, 128.0, 128.2, 129.0, 129.1, 129.4, 129.9, 130.2, 133.1, 134.6, 136.6, 136.7, 137.9, 140.5, 143.5; HRMS (ESI): $[M + H]^+$ calcd for $C_{24}H_{23}ClNO_3S^+$: m/z 440.1082, found: 440.1083.

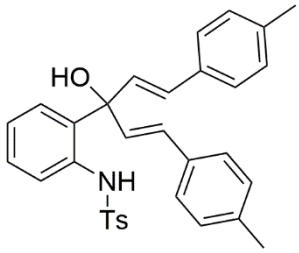


(*E*)-*N*-(2-(3-Hydroxy-1-(naphth-1-yl)penta-1,4-dien-3-yl)phenyl)-4-methyl-benzenesulfonamide (1r). Three steps, 41% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.22 (br, 1H), 7.98–7.95 (m, 1H), 7.87–7.80 (m, 2H), 7.68–7.62 (m, 3H), 7.56–7.41 (m, 4H), 7.29–7.21 (m, 3H), 7.02–6.97 (m, 1H), 6.92 (d, J = 8.1 Hz, 2H), 6.38 (d, J = 15.9 Hz, 1H), 6.19 (dd, J = 16.2, 10.2 Hz, 1H), 5.36–5.29 (m, 2H), 2.86 (br, 1H), 2.15 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.5, 79.9, 116.2, 119.7, 123.3, 123.8, 124.1, 125.6, 126.1, 126.5, 127.5, 128.1, 128.4, 128.6, 128.7, 129.1, 129.4, 130.7, 131.3, 133.7, 133.8, 134.9, 136.8, 136.9, 140.8, 143.6; HRMS (ESI): $[M + H]^+$ calcd for $C_{28}H_{26}NO_3S^+$: m/z 456.1628, found: 456.1629.

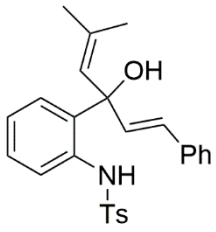


***N*-(2-((1*E*,4*E*)-3-Hydroxy-1,5-diphenylpenta-1,4-dien-3-yl)phenyl)-4-methyl-benzenesulfonamide (1s).** Three steps, 38% yield; semisolid; ^{1}H NMR (300 MHz,

$CDCl_3$): δ 7.71–7.67 (m, 1H), 7.58 (d, J = 8.1 Hz, 2H), 7.38–7.28 (m, 10H), 7.24–7.20 (m, 2H), 6.99–6.94 (m, 1H), 6.80 (d, J = 8.1 Hz, 2H), 6.57 (d, J = 16.2 Hz, 2H), 6.43 (d, J = 16.2 Hz, 2H), 2.16 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.6, 79.7, 119.3, 123.1, 127.0, 127.5, 128.3, 128.5, 128.81, 128.82, 129.1, 129.4, 130.8, 132.2, 136.1, 136.5, 136.8, 143.4; HRMS (ESI): $[M + H]^+$ calcd for $C_{30}H_{28}NO_3S^+$: m/z 482.1784, found: 482.1785.

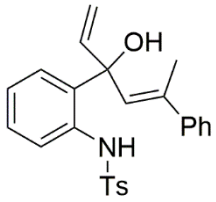


***N*-(2-((1*E*,4*E*)-3-Hydroxy-1,5-di-*p*-tolylpenta-1,4-dien-3-yl)phenyl)-4-methylbenzenesulfonamide (1t).** Three steps, 36% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.18 (br, 1H), 7.63–7.60 (m, 1H), 7.51 (d, J = 8.4 Hz, 2H), 7.20–7.13 (m, 6H), 7.08–7.06 (m, 4H), 6.91–6.86 (m, 1H), 6.75 (d, J = 7.8 Hz, 2H), 6.45 (d, J = 16.2 Hz, 2H), 6.29 (d, J = 16.2 Hz, 2H), 3.41 (br, 1H), 2.29 (s, 6H), 2.11 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 21.2, 21.4, 79.7, 119.3, 122.9, 126.8, 127.4, 127.6, 128.4, 128.9, 129.1, 129.3, 129.4, 130.5, 130.9, 131.2, 133.2, 138.1, 143.1; HRMS (ESI): $[M + H]^+$ calcd for $C_{32}H_{32}NO_3S^+$: m/z 510.2097, found: 510.2098.

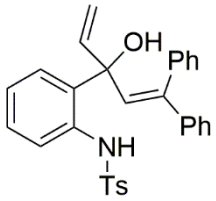


(*E*)-*N*-(2-(3-Hydroxy-5-methyl-1-phenylhexa-1,4-dien-3-yl)phenyl)-4-methylbenzenesulfonamide (1v). Three steps, 30% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.17 (br, 1H), 7.67–7.62 (m, 3H), 7.32–7.26 (m, 4H), 7.22–7.15 (m, 3H), 6.98–6.91 (m, 3H), 6.48 (d, J = 15.9 Hz, 1H), 6.28 (d, J = 15.9 Hz, 1H), 5.63–5.62 (m, 1H), 2.56 (br, 1H), 2.23 (s, 3H), 1.79 (d, J = 1.5 Hz, 3H), 1.49 (d, J = 1.5 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 19.9, 21.6, 27.1, 78.8, 119.4, 123.2, 126.9, 127.6, 127.9, 128.0, 128.5, 128.6, 128.7, 129.0, 129.5, 132.3, 134.2, 136.4, 136.6, 136.9, 139.9, 143.5; HRMS (ESI): $[M + H]^+$ calcd for $C_{26}H_{28}NO_3S^+$: m/z 434.1784, found:

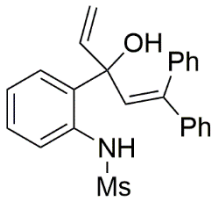
434.1786.



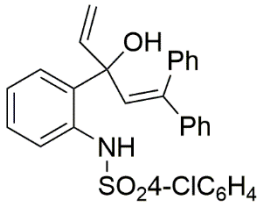
(*E*)-*N*-(2-(4-Hydroxy-2-methyl-6-phenylhepta-2,5-dien-4-yl)phenyl)-4-methyl-benzenesulfonamide (1w). Three steps, 32% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.06 (br, 1H), 7.68 (d, J = 8.4 Hz, 2H), 7.62 (dd, J = 8.4, 1.2 Hz, 1H), 7.40–7.30 (m, 5H), 7.24–7.16 (m, 2H), 7.06 (d, J = 8.4 Hz, 2H), 6.94 (td, J = 7.5, 1.2 Hz, 1H), 6.07 (dd, J = 17.1, 10.5 Hz, 1H), 6.01–6.00 (m, 1H), 5.24 (d, J = 17.4 Hz, 1H), 5.14 (d, J = 10.5 Hz, 1H), 2.54 (br, 1H), 2.31 (s, 3H), 1.86 (d, J = 1.2 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 17.8, 21.5, 78.8, 113.4, 119.5, 123.2, 126.0, 127.5, 127.7, 128.1, 128.4, 128.7, 129.4, 130.8, 131.8, 136.5, 136.8, 141.6, 142.0, 143.2, 143.4; HRMS (ESI): $[M + H]^+$ calcd for $C_{25}H_{26}NO_3S^+$: m/z 420.1628, found: 420.1629.



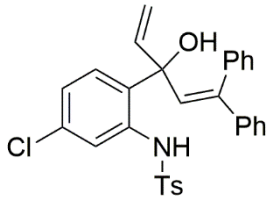
***N*-(2-(3-Hydroxy-1,1-diphenylpenta-1,4-dien-3-yl)phenyl)-4-methylbenzene-sulfonamide (1x).** Three steps, 35% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.87 (br, 1H), 7.68 (d, J = 8.4 Hz, 2H), 7.54–7.51 (m, 1H), 7.34–7.26 (m, 6H), 7.19–7.13 (m, 6H), 7.05 (d, J = 8.1 Hz, 2H), 6.90 (t, J = 8.4 Hz, 1H), 6.22 (s, 1H), 6.10 (dd, J = 17.1, 10.5 Hz, 1H), 5.29 (d, J = 17.1 Hz, 1H), 5.21 (d, J = 10.5 Hz, 1H), 2.34 (br, 1H), 2.31 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.5, 79.6, 114.9, 119.0, 122.9, 127.3, 127.4, 127.9, 128.1, 128.30, 128.31, 128.8, 128.9, 129.41, 129.42, 131.0, 132.4, 136.4, 137.1, 138.7, 141.7, 141.9, 142.5, 143.4; HRMS (ESI): $[M + H]^+$ calcd for $C_{30}H_{28}NO_3S^+$: m/z 482.1784, found: 482.1786.



***N*-(2-(3-Hydroxy-1,1-diphenylpenta-1,4-dien-3-yl)phenyl)methanesulfonamide (1y).** Three steps, 36% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.46 (br, 1H), 7.59 (dd, J = 8.1, 1.2 Hz, 1H), 7.30–7.25 (m, 4H), 7.22–7.19 (m, 4H), 7.14–7.11 (m, 4H), 6.99 (td, J = 7.8, 1.2 Hz, 1H), 6.27 (s, 1H), 6.15 (dd, J = 17.1, 10.5 Hz, 1H), 5.34 (d, J = 17.1 Hz, 1H), 5.27 (d, J = 10.5 Hz, 1H), 2.81 (s, 3H), 2.43 (br, 1H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 38.6, 78.6, 113.8, 118.8, 122.6, 126.2, 127.0, 127.1, 127.31, 127.35, 128.0, 128.2, 128.4, 129.8, 132.0, 135.5, 137.6, 140.7, 141.1, 141.6; HRMS (ESI): $[M + H]^+$ calcd for $C_{24}H_{24}NO_3S^+$: m/z 406.1471, found: 406.1470.

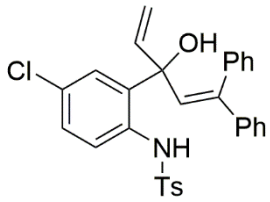


4-Chloro-*N*-(2-(3-hydroxy-1,1-diphenylpenta-1,4-dien-3-yl)phenyl)benzene-sulfonamide (1z). Three steps, 32% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.83 (br, 1H), 7.63 (d, J = 8.7 Hz, 2H), 7.50 (dd, J = 8.1, 1.2 Hz, 1H), 7.29–7.26 (m, 3H), 7.24–7.21 (m, 3H), 7.15–7.06 (m, 8H), 6.88 (td, J = 7.8, 1.2 Hz, 1H), 6.12 (s, 1H), 6.01 (dd, J = 17.4, 10.5 Hz, 1H), 5.21 (d, J = 17.4 Hz, 1H), 5.14 (d, J = 10.5 Hz, 1H), 2.34 (br, 1H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 78.6, 114.0, 118.2, 122.4, 126.2, 127.0, 127.2, 127.3, 127.7, 127.8, 127.9, 128.0, 128.3, 129.7, 129.9, 131.7, 134.9, 137.4, 137.6, 138.0, 140.6, 140.7, 141.5; HRMS (ESI): $[M + H]^+$ calcd for $C_{29}H_{25}ClNO_3S^+$: m/z 502.1238, found: 502.1239.

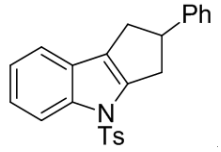


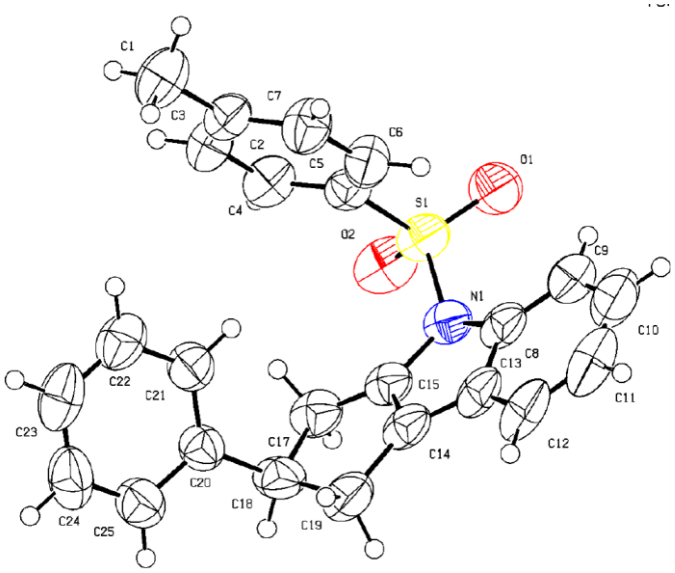
***N*-(5-Chloro-2-(3-hydroxy-1,1-diphenylpenta-1,4-dien-3-yl)phenyl)-4-methyl-benzenesulfonamide (1aa).** Three steps, 36% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.92 (br, 1H), 7.68 (d, J = 8.4 Hz, 2H), 7.56 (d, J = 2.1 Hz, 1H), 7.33–7.27 (m, 6H), 7.18–7.14 (m, 2H), 7.09–7.02 (m, 5H), 6.82 (dd, J = 8.4, 2.1 Hz, 1H), 6.19 (s, 1H), 6.06 (dd, J = 17.1, 10.2 Hz, 1H), 5.29 (d, J = 17.1 Hz, 1H), 5.22 (d, J = 10.2 Hz, 1H), 2.47 (br, 1H), 2.33 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.6, 79.3, 115.3, 118.7, 122.7, 127.3, 127.5, 128.0, 128.2, 128.3, 128.9, 129.0, 129.3, 129.6, 130.4,

130.6, 134.5, 136.6, 137.5, 138.5, 141.3, 141.7, 142.9, 143.8; HRMS (ESI): $[M + H]^+$ calcd for $C_{30}H_{27}ClNO_3S^+$: *m*/*z* 516.1395, found: 516.1395.



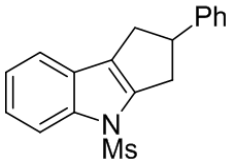
***N*-(4-Chloro-2-(3-hydroxy-1,1-diphenylpenta-1,4-dien-3-yl)phenyl)-4-methyl-benzenesulfonamide (1aa).** Three steps, 35% yield; semisolid; ^{1}H NMR (300 MHz, $CDCl_3$): δ 10.0 (br, 1H), 7.46 (d, J = 8.4 Hz, 2H), 7.25–7.03 (m, 11H), 6.86–6.81 (m, 4H), 6.52 (s, 1H), 6.07 (dd, J = 17.4, 10.5 Hz, 1H), 4.78–4.73 (m, 2H), 2.91 (br, 1H), 2.23 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 20.4, 78.9, 113.0, 119.2, 125.6, 126.1, 126.3, 126.6, 126.8, 127.0, 127.1, 127.2, 127.8, 128.4, 129.2, 131.3, 132.4, 135.6, 137.1, 137.4, 140.1, 140.8, 141.8, 142.4; HRMS (ESI): $[M + H]^+$ calcd for $C_{30}H_{27}ClNO_3S^+$: *m*/*z* 516.1395, found: 516.1396.



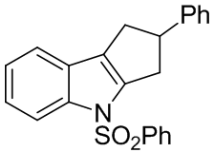


2-Phenyl-4-tosyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6a). 75% yield; white solid; m.p.: 138–140 ℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.07 (d, J = 8.0 Hz, 1H), 7.70 (d, J = 8.0 Hz, 2H), 7.34–7.28 (m, 3H), 7.24–7.18 (m, 7H), 4.12–4.06 (m, 1H), 3.67–3.64 (m, 1H), 3.25–3.21 (m, 2H), 2.84–2.81 (m, 1H), 2.34 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 21.6, 33.2, 37.0, 47.7, 114.5, 119.1, 123.4, 123.5, 125.4, 126.4, 126.6, 126.7, 127.1, 128.6, 129.9, 135.7, 140.2, 141.9, 144.7, 146.1; IR (neat): 3030, 2923, 2854, 1458, 1090, 581 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for

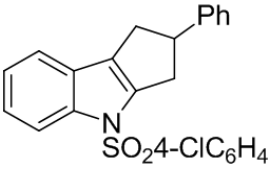
$C_{24}H_{22}NO_2S^+$: *m*/*z* 388.1366, found: 388.1361.



4-(Methylsulfonyl)-2-phenyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6b). 60% yield; white solid; m.p.: 111–113 ℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.94–7.92 (m, 1H), 7.45–7.44 (m, 1H), 7.34–7.28 (m, 6H), 7.25–7.22 (m, 1H), 4.16–4.11 (m, 1H), 3.57 (ddd, *J* = 17.0, 9.0, 1.5 Hz, 1H), 3.30 (ddd, *J* = 15.0, 8.5, 1.5 Hz, 1H), 3.16 (ddt, *J* = 16.5, 6.5, 2.5 Hz, 1H), 3.05 (s, 3H), 2.91 (ddt, *J* = 15.0, 6.5, 2.5 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 33.2, 36.6, 40.6, 47.8, 114.0, 119.4, 123.71, 123.72, 125.0, 126.5, 126.8, 127.1, 128.7, 140.1, 141.9, 145.8; IR (neat): 3054, 2928, 2852, 1604, 1120, 565 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{18}H_{18}NO_2S^+$: *m*/*z* 312.1053, found: 312.1058.

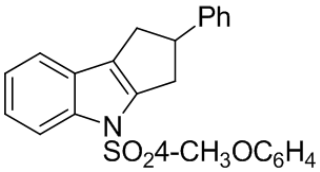


2-Phenyl-4-(phenylsulfonyl)-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6c). 62% yield; white solid; m.p.: 105–106 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.00 (d, *J* = 7.5 Hz, 1H), 7.78–7.74 (m, 2H), 7.49–7.44 (m, 1H), 7.37–7.32 (m, 2H), 7.29–7.12 (m, 8H), 4.08–3.98 (m, 1H), 3.64–3.56 (m, 1H), 3.21–3.13 (m, 2H), 2.80–2.72 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 33.2, 37.1, 47.7, 114.5, 119.2, 123.5, 123.6, 125.7, 126.5, 126.6, 126.8, 127.2, 128.7, 129.3, 133.7, 138.7, 140.3, 141.8, 146.1; IR (neat): 3056, 2924, 2857, 1605, 1119, 574 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{23}H_{20}NO_2S^+$: *m*/*z* 374.1209, found: 374.1211.

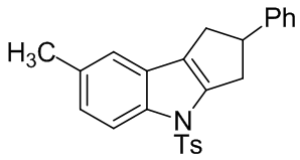


4-((4-Chlorophenyl)sulfonyl)-2-phenyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6d). 70% yield; white solid; m.p.: 122–124 ℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.04 (d, *J* = 7.5 Hz, 1H), 7.73 (d, *J* = 9.0 Hz, 2H), 7.38–7.34 (m, 3H), 7.32–7.22 (m, 7H),

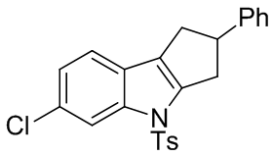
4.11–4.08 (m, 1H), 3.66 (ddd, *J* = 17.0, 5.4, 2.0 Hz, 1H), 3.26–3.17 (m, 2H), 2.87–2.82 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 33.1, 37.2, 47.6, 114.5, 119.3, 123.7, 123.8, 126.3, 126.6, 126.7, 127.3, 128.0, 128.7, 129.6, 137.0, 140.2, 140.3, 141.6, 146.0; IR (neat): 3051, 2934, 2858, 1582, 1117, 572 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{23}H_{19}ClNO_2S^+$: *m*/*z* 408.0820, found: 408.0822.



4-((4-Methoxyphenyl)sulfonyl)-2-phenyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6e). 59% yield; white solid; m.p.: 116–118 ℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.07 (d, *J* = 7.5 Hz, 1H), 7.75 (d, *J* = 9.0 Hz, 2H), 7.33 (d, *J* = 7.0 Hz, 1H), 7.30–7.19 (m, 7H), 6.84 (d, *J* = 8.5 Hz, 2H), 4.11–4.05 (m, 1H), 3.77 (s, 3H), 3.68–3.63 (m, 1H), 3.25–3.20 (m, 2H), 2.84–2.79 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 33.2, 37.1, 47.6, 55.6, 114.4, 114.5, 119.1, 123.4, 123.5, 125.4, 126.4, 126.8, 127.1, 128.6, 128.8, 130.2, 140.2, 141.9, 146.2, 163.6; IR (neat): 3057, 2931, 2857, 1593, 1116, 583 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{24}H_{22}NO_3S^+$: *m*/*z* 404.1315, found: 404.1317.

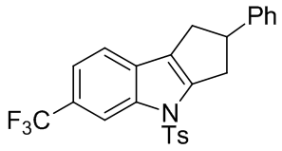


7-Methyl-2-phenyl-4-tosyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6f). 75% yield; white solid; m.p.: 154–155 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.86 (d, *J* = 8.4 Hz, 1H), 7.61 (d, *J* = 8.4 Hz, 2H), 7.24–6.96 (m, 9H), 4.05–3.95 (m, 1H), 3.61–3.52 (m, 1H), 3.17–3.09 (m, 2H), 2.75–2.68 (m, 1H), 2.32 (s, 3H), 2.27 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 20.3, 20.5, 32.2, 36.0, 46.6, 113.2, 118.2, 123.7, 124.3, 125.4, 125.5, 125.7, 126.3, 127.6, 128.8, 132.0, 134.7, 137.4, 140.9, 143.6, 145.2; IR (neat): 3053, 2923, 2854, 1560, 1090, 582 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{25}H_{24}NO_2S^+$: *m*/*z* 402.1522, found: 402.1517.

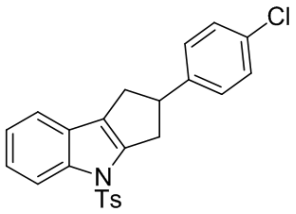


6-Chloro-2-phenyl-4-tosyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6g). 81% yield;

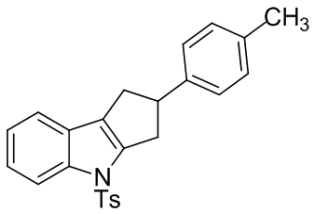
white solid; m.p.: 157–159 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.09 (d, J = 1.5 Hz, 1H), 7.71 (d, J = 8.4 Hz, 2H), 7.33–7.17 (m, 9H), 4.13–4.04 (m, 1H), 3.68–3.59 (m, 1H), 3.25–3.17 (m, 2H), 2.84–2.77 (m, 1H), 2.37 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.8, 33.3, 37.2, 47.9, 114.8, 119.9, 124.1, 125.1, 125.7, 126.7, 126.8, 126.9, 128.8, 129.5, 130.2, 135.6, 140.6, 142.7, 145.2, 146.0; IR (neat): 3026, 2933, 2857, 1598, 1115, 582 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{24}H_{21}ClNO_2S^+$: *m*/*z* 422.0976, found: 422.0980.



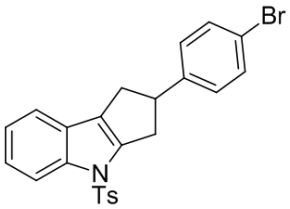
2-Phenyl-4-tosyl-6-(trifluoromethyl)-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6h). 59% yield; white solid; m.p.: 142–144 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.27 (s, 1H), 7.64 (d, J = 8.4 Hz, 2H), 7.41–7.33 (m, 2H), 7.25–7.14 (m, 7H), 4.09–3.99 (m, 1H), 3.66–3.56 (m, 1H), 3.22–3.14 (m, 2H), 2.81–2.74 (m, 1H), 2.29 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 21.6, 33.0, 37.0, 47.8, 111.8 (q, J = 4.1 Hz), 119.4, 120.3 (q, J = 3.8 Hz), 124.7 (q, J = 270.4 Hz), 125.0, 125.5 (q, J = 32.0 Hz), 126.63, 126.68, 126.7, 128.7, 129.4, 130.1, 135.4, 139.3, 144.9, 145.3, 145.6; IR (neat): 3055, 2936, 2855, 1595, 1117, 586 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{25}H_{21}F_3NO_2S^+$: *m*/*z* 456.1240, found: 456.1244.



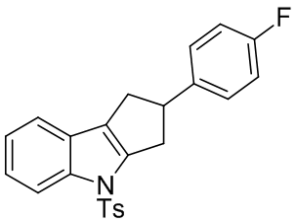
2-(4-Chlorophenyl)-4-tosyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6i). 74% yield; white solid; m.p.: 128–129 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.99 (d, J = 7.5 Hz, 1H), 7.62 (d, J = 8.4 Hz, 2H), 7.28–7.25 (m, 1H), 7.20–7.06 (m, 8H), 4.03–3.93 (m, 1H), 3.63–3.54 (m, 1H), 3.20–3.06 (m, 2H), 2.74–2.66 (m, 1H), 2.28 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 21.6, 33.2, 37.1, 47.0, 114.6, 119.1, 123.5, 123.6, 125.3, 126.6, 127.0, 128.1, 128.7, 129.9, 132.1, 135.7, 140.3, 141.6, 144.7, 144.8; IR (neat): 3060, 2911, 2851, 1597, 1116, 584 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{24}H_{21}ClNO_2S^+$: *m*/*z* 422.0976, found: 422.0979.



2-(4-Tolyl)-4-tosyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6j). 64% yield; white solid; m.p.: 126–128 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.99 (d, J = 7.2 Hz, 1H), 7.63 (d, J = 8.1 Hz, 2H), 7.27–7.24 (m, 1H), 7.20–7.11 (m, 4H), 7.08–7.02 (m, 4H), 4.04–3.94 (m, 1H), 3.62–3.52 (m, 1H), 3.18–3.10 (m, 2H), 2.76–2.68 (m, 1H), 2.27 (s, 3H), 2.26 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.1, 21.6, 33.3, 37.1, 47.4, 114.5, 119.1, 123.4, 123.5, 125.5, 126.6, 126.7, 127.2, 129.3, 129.9, 135.8, 136.0, 140.2, 142.0, 143.1, 144.7; IR (neat): 3052, 2912, 2851, 1595, 1115, 581 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{25}H_{24}NO_2S^+$: m/z 402.1522, found: 402.1524.

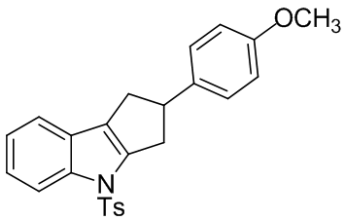


2-(4-Bromophenyl)-4-tosyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6k). 72% yield; white solid; m.p.: 131–132 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.99 (d, J = 7.2 Hz, 1H), 7.62 (d, J = 8.4 Hz, 2H), 7.35–7.30 (m, 2H), 7.28–7.11 (m, 5H), 7.04–7.01 (m, 2H), 4.02–3.92 (m, 1H), 3.63–3.54 (m, 1H), 3.20–3.06 (m, 2H), 2.74–2.65 (m, 1H), 2.28 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.6, 33.2, 37.0, 47.0, 114.6, 119.1, 120.1, 123.5, 123.6, 125.3, 126.6, 127.0, 128.5, 129.9, 131.7, 135.7, 140.3, 141.6, 144.8, 145.2; IR (neat): 3058, 2917, 2854, 1632, 1118, 585 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{24}H_{21}BrNO_2S^+$: m/z 466.0471, found: 466.0470.

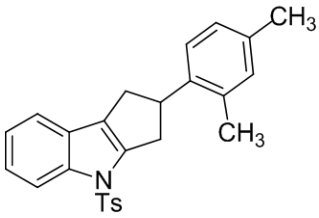


2-(4-Fluorophenyl)-4-tosyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6l). 77% yield; white solid; m.p.: 110–111 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.99 (d, J = 7.2 Hz,

1H), 7.63 (d, *J* = 8.4 Hz, 2H), 7.28–7.25 (m, 1H), 7.20–7.08 (m, 6H), 6.93–6.85 (m, 2H), 4.04–3.95 (m, 1H), 3.63–3.53 (m, 1H), 3.20–3.06 (m, 2H), 2.75–2.66 (m, 1H), 2.28 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 21.6, 33.4, 37.2, 46.9, 114.5, 115.3 (d, *J* = 21.2 Hz), 119.1, 123.5, 123.6, 125.3, 126.6, 127.0, 128.2 (d, *J* = 8.8 Hz), 129.9, 135.8, 140.3, 141.7, 141.9 (d, *J* = 3.4 Hz), 144.8, 161.5 (d, *J* = 242.2 Hz); IR (neat): 3067, 2934, 2851, 1599, 1116, 582 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{24}H_{21}FNO_2S^+$: *m*/*z* 406.1272, found: 406.1270.

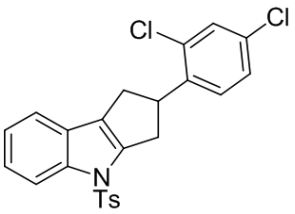


2-(4-Methoxyphenyl)-4-tosyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6m). 61% yield; white solid; m.p.: 118–119 ℃; ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.06 (d, *J* = 8.0 Hz, 1H), 7.70 (d, *J* = 8.4 Hz, 2H), 7.33 (d, *J* = 7.2 Hz, 1H), 7.27–7.15 (m, 6H), 6.83 (d, *J* = 8.8 Hz, 2H), 4.08–4.01 (m, 1H), 3.80 (s, 3H), 3.66–3.60 (m, 1H), 3.23–3.16 (m, 2H), 2.81–2.75 (m, 1H), 2.34 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 21.6, 33.4, 37.2, 47.0, 55.3, 114.0, 114.5, 119.1, 123.4, 123.5, 125.4, 126.6, 127.2, 127.7, 129.9, 135.8, 138.2, 140.2, 141.9, 144.7, 158.1; IR (neat): 3060, 2942, 2865, 1607, 1117, 581 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{25}H_{24}NO_3S^+$: *m*/*z* 418.1471, found: 418.1471.

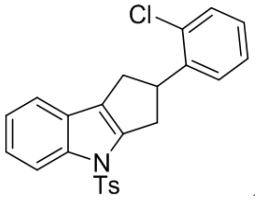


2-(2,4-Dimethylphenyl)-4-tosyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6n). 60% yield; white solid; m.p.: 188–190 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.98 (d, *J* = 7.2 Hz, 1H), 7.61 (d, *J* = 8.4 Hz, 2H), 7.26–7.08 (m, 5H), 6.93–6.91 (m, 2H), 6.81 (d, *J* = 7.8 Hz, 1H), 4.21–4.16 (m, 1H), 3.57–3.48 (m, 1H), 3.15–3.05 (m, 2H), 2.71–2.65 (m, 1H), 2.27 (s, 3H), 2.26 (s, 3H), 2.21 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 18.7, 19.8, 20.5, 31.6, 35.4, 41.9, 113.5, 118.1, 122.38, 122.39, 124.5, 124.7, 125.6, 126.0, 126.1, 128.8, 130.2, 134.0, 134.6, 134.7, 139.3, 140.2, 140.9, 143.6; IR (neat): 3034,

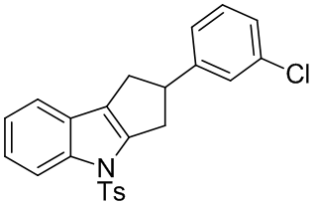
2922, 2862, 1598, 1117, 580 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{26}H_{26}NO_2S^+$: *m*/*z* 416.1679, found: 416.1681.



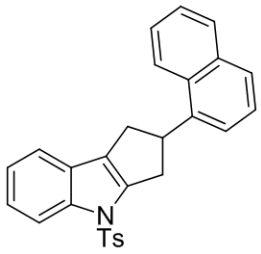
2-(2,4-Dichlorophenyl)-4-tosyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6o). 85% yield; white solid; m.p.: 141–143 ℃; ^1H NMR (300 MHz, $CDCl_3$): δ 8.07 (d, J = 7.2 Hz, 1H), 7.68 (d, J = 8.4 Hz, 2H), 7.41 (t, J = 1.0 Hz, 1H), 7.35–7.17 (m, 5H), 7.10–7.09 (m, 2H), 4.53–4.44 (m, 1H), 3.69–3.60 (m, 1H), 3.28–3.15 (m, 2H), 2.80–2.72 (m, 1H), 2.35 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.7, 32.1, 35.9, 43.5, 114.7, 119.3, 123.7, 123.8, 125.2, 126.7, 127.0, 127.5, 128.6, 129.5, 130.0, 132.7, 134.2, 135.8, 140.5, 141.5, 142.0, 145.0; IR (neat): 3053, 2934, 2866, 1595, 1117, 580 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{24}H_{20}Cl_2NO_2S^+$: *m*/*z* 456.0586, found: 456.0588.



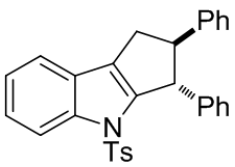
2-(2-Chlorophenyl)-4-tosyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6p). 79% yield; white solid; m.p.: 151–153 ℃; ^1H NMR (500 MHz, $CDCl_3$): δ 8.06 (d, J = 8.0 Hz, 1H), 7.69 (d, J = 7.5 Hz, 2H), 7.40–7.38 (m, 1H), 7.33 (d, J = 7.5 Hz, 1H), 7.28–7.12 (m, 7H), 4.57–4.51 (m, 1H), 3.68–3.62 (m, 1H), 3.28–3.23 (m, 2H), 2.84–2.79 (m, 1H), 2.34 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 21.6, 32.0, 35.8, 43.9, 114.5, 119.1, 123.5, 123.6, 125.3, 126.6, 127.0, 127.1, 127.6, 129.7, 129.8, 129.9, 133.4, 135.7, 140.3, 141.7, 143.1, 144.7; IR (neat): 3059, 2924, 2862, 1597, 1117, 579 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{24}H_{21}ClNO_2S^+$: *m*/*z* 422.0976, found: 422.0980.



2-(3-Chlorophenyl)-4-tosyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6q). 66% yield; white solid; m.p.: 118–119 ℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.07 (d, J = 8.5 Hz, 1H), 7.70 (d, J = 8.0 Hz, 2H), 7.33 (d, J = 7.5 Hz, 1H), 7.29–7.19 (m, 7H), 7.12–7.10 (m, 1H), 4.07–4.02 (m, 1H), 3.69–3.64 (m, 1H), 3.26–3.18 (m, 2H), 2.82–2.77 (m, 1H), 2.35 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 21.6, 33.1, 37.0, 47.2, 114.6, 119.1, 123.5, 123.6, 125.0, 125.3, 126.5, 126.6, 126.8, 127.0, 129.9, 130.0, 134.4, 135.6, 140.3, 141.5, 144.8, 148.4; IR (neat): 3054, 2931, 2857, 1596, 1115, 576 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{24}H_{21}ClNO_2S^+$: m/z 422.0976, found: 422.0977.

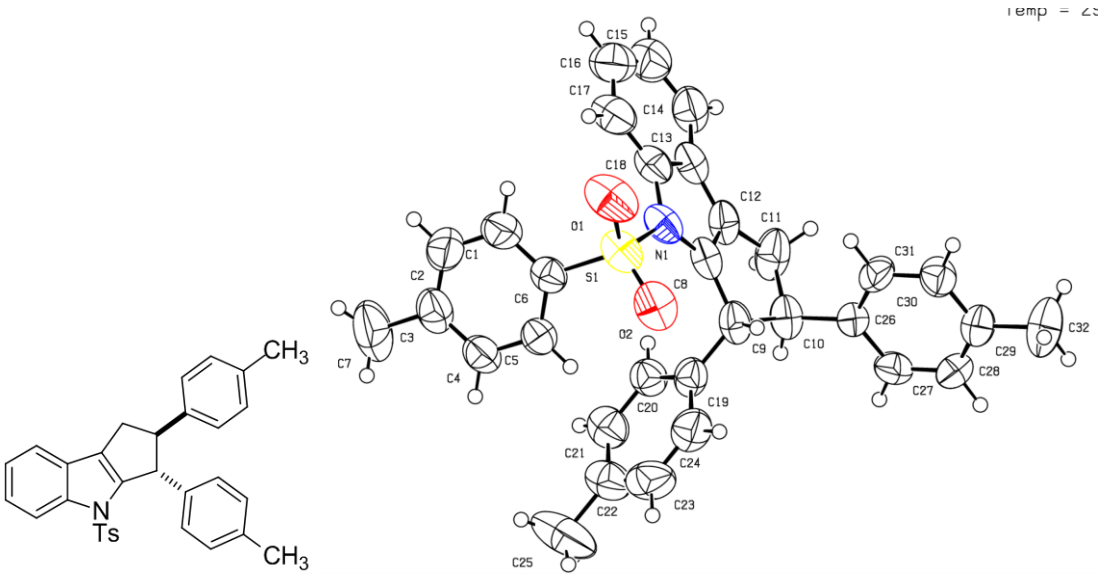


2-(Naphth-1-yl)-4-tosyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6r). 63% yield; white solid; m.p.: 179–180 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.10 (d, J = 7.8 Hz, 1H), 7.96 (d, J = 8.4 Hz, 1H), 7.89 (d, J = 7.8 Hz, 1H), 7.77–7.72 (m, 1H), 7.69 (d, J = 8.1 Hz, 2H), 7.51–7.22 (m, 7H), 7.17 (d, J = 8.1 Hz, 2H), 4.83–4.74 (m, 1H), 3.80–3.71 (m, 1H), 3.49–3.30 (m, 2H), 3.07–3.00 (m, 1H), 2.35 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.7, 32.7, 36.5, 44.6, 114.7, 119.3, 123.6, 123.7, 124.1, 125.61, 125.66, 125.7, 126.1, 126.77, 126.78, 127.3, 127.4, 129.3, 130.0, 131.3, 134.4, 135.8, 140.5, 141.4, 142.1, 144.8; IR (neat): 3052, 2940, 2866, 1599, 1119, 577 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{28}H_{24}NO_2S^+$: m/z 438.1522, found: 438.1522.

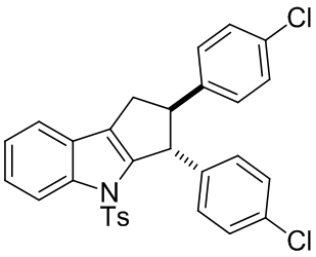


***trans*-2,3-Diphenyl-4-tosyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6s).** 79% yield;

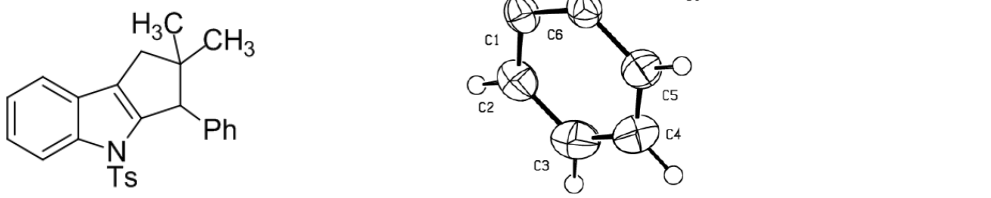
white solid; m.p.: 186–187 ℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.05 (d, J = 8.0 Hz, 1H), 7.47 (d, J = 7.5 Hz, 1H), 7.34–7.26 (m, 8H), 7.20 (d, J = 9.0 Hz, 2H), 7.13–7.08 (m, 4H), 6.97 (d, J = 8.0 Hz, 2H), 4.64 (s, 1H), 3.81 (d, J = 8.5 Hz, 1H), 3.45 (ddd, J = 16.0, 8.5, 2.5 Hz, 1H), 2.87 (dd, J = 16.0, 2.5 Hz, 1H), 2.29 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 21.5, 31.8, 56.6, 58.8, 114.8, 119.6, 123.5, 124.0, 126.3, 126.6, 126.66, 126.69, 126.9, 127.3, 127.4, 128.7, 128.8, 129.5, 135.4, 140.8, 144.0, 144.2, 144.3, 147.1; IR (neat): 3059, 2925, 2870, 1597, 1109, 585 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{30}H_{26}NO_2S^+$: m/z 464.1679, found: 464.1673.

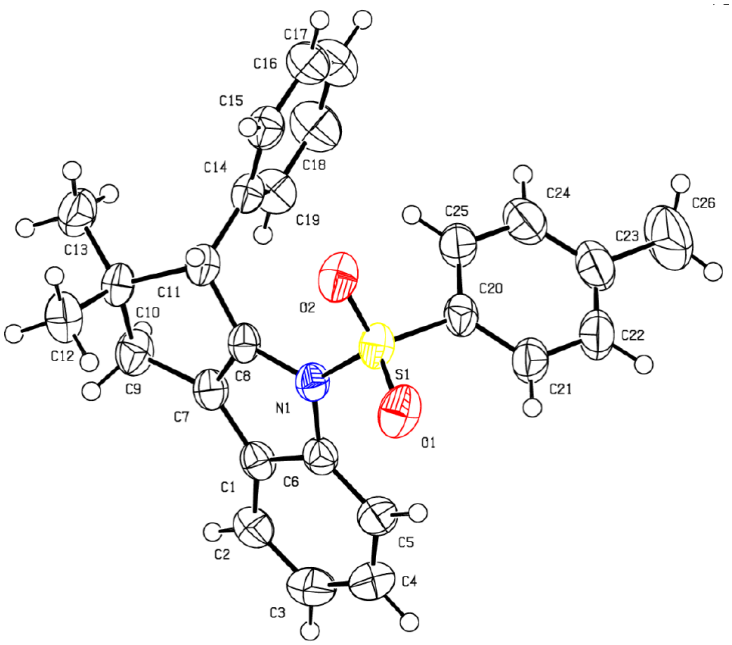


***trans*-2,3-Di-4-tolyl-4-tosyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6t).** 72% yield; white solid; m.p.: 157–158 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.06 (dd, J = 7.2, 1.2 Hz, 1H), 7.47–7.44 (m, 1H), 7.34–7.29 (m, 2H), 7.22 (d, J = 8.4 Hz, 2H), 7.07–6.94 (m, 10H), 4.58 (s, 1H), 3.75 (d, J = 8.4 Hz, 1H), 3.42 (ddd, J = 15.6, 8.4, 2.0 Hz, 1H), 2.82 (dd, J = 15.6, 2.0 Hz, 1H), 2.35 (s, 3H), 2.34 (s, 3H), 2.30 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.1, 21.2, 21.6, 31.9, 56.2, 58.6, 114.8, 119.6, 123.4, 123.9, 126.2, 126.7, 126.8, 127.2, 127.3, 129.34, 129.36, 129.38, 135.5, 136.1, 136.2, 140.8, 141.1, 144.2, 144.3, 144.4; IR (neat): 3019, 2962, 2857, 1598, 1114, 590 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{32}H_{30}NO_2S^+$: m/z 492.1992, found: 492.1994.



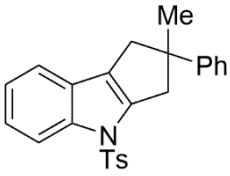
***trans*-2,3-Di-4-chlorophenyl-4-tosyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6u).** 68% yield; white solid; m.p.: 155–156 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.03 (d, J = 7.5 Hz, 1H), 7.42–7.39 (m, 1H), 7.32–7.26 (m, 2H), 7.16–7.08 (m, 6H), 6.98–6.92 (m, 4H), 6.87 (d, J = 8.4 Hz, 2H), 4.46 (s, 1H), 3.64 (dt, J = 8.1, 2.1 Hz, 1H), 3.34 (ddd, J = 15.9, 8.4, 1.8 Hz, 1H), 2.75 (dd, J = 15.9, 2.4 Hz, 1H), 2.27 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 20.5, 30.8, 54.9, 57.2, 113.9, 118.7, 122.6, 123.4, 125.2, 125.5, 126.2, 126.7, 127.6, 127.8, 127.9, 128.5, 131.4, 131.6, 134.4, 139.9, 141.0, 142.2, 143.6, 144.0; IR (neat): 3053, 2961, 2858, 1598, 1171, 587 cm^{-1}; HRMS (ESI): [M + H]$^{+}$ calculated for $C_{30}H_{24}Cl_2NO_2S^{+}$: m/z 532.0899, found: 532.0899.



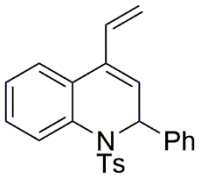


2,2-Dimethyl-3-phenyl-4-tosyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6v). 62% yield; white solid; m.p.: 139–141 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.00 (dd, J = 6.9, 2.1 Hz, 1H), 7.43–7.40 (m, 1H), 7.28–7.16 (m, 8H), 6.96–6.93 (m, 3H), 4.20 (d, J = 1.2 Hz, 1H), 2.71 (dd, J = 15.0, 1.2 Hz, 1H), 2.50 (d, J = 15.0 Hz, 1H), 2.25 (s, 3H), 1.35 (s, 3H), 0.80 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.6, 26.3, 32.4, 38.4, 49.6, 58.6, 114.6, 119.5, 123.3, 123.6, 125.4, 126.6, 126.9, 127.0, 127.3, 128.4, 129.5, 135.6, 139.8, 141.0, 144.3, 145.3; IR (neat): 3055, 2957, 2861, 1596, 1120, 587 cm^{-1};

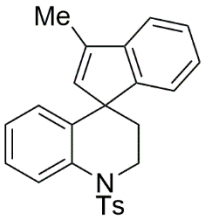
HRMS (ESI): $[M + H]^+$ calculated for $C_{26}H_{26}NO_2S^+$: *m*/*z* 416.1679, found: 416.1682.



2-Methyl-2-phenyl-4-tosyl-1,2,3,4-tetrahydrocyclopenta[*b*]indole (6w). 34% yield; white solid; m.p.: 129–130 ℃; ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.07 (d, J = 6.0 Hz, 1H), 7.70 (d, J = 6.0 Hz, 2H), 7.36–7.35 (m, 5H), 7.26–7.23 (m, 3H), 7.19 (d, J = 6.0 Hz, 2H), 3.57 (d, J = 16.8 Hz, 1H), 3.42 (d, J = 16.8 Hz, 1H), 3.18 (d, J = 14.8 Hz, 1H), 2.93 (d, J = 14.8 Hz, 1H), 2.34 (s, 3H), 1.56 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.6, 31.7, 40.0, 43.8, 51.8, 114.6, 119.1, 123.4, 123.5, 124,7, 125.6, 126.0, 126.6, 127.6, 128.5, 129.9, 135.6, 140.0, 141.3, 144.8, 150.3; IR (neat): 3054, 2952, 2860, 1596, 1118, 586 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{25}H_{24}NO_2S^+$: *m*/*z* 402.1522, found: 402.1524.

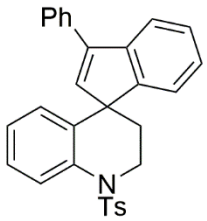


2-Phenyl-1-tosyl-4-vinyl-1,2-dihydroquinoline (7). 30% yield; white solid; m.p.: 141–143 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.65–7.62 (m, 1H), 7.32–7.18 (m, 10H), 7.07 (d, J = 8.1 Hz, 2H), 6.26 (dd, J = 17.4, 10.8 Hz, 1H), 6.00 (d, J = 6.6 Hz, 1H), 5.87 (d, J = 6.6 Hz, 1H), 5.19 (dd, J = 17.4, 1.5 Hz, 1H), 5.11 (d, J = 10.8, 1.5 Hz, 1H), 2.32 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.6, 56.7, 117.3, 123.0, 124.2, 126.7, 127.4, 127.7, 128.0, 128.4, 128.5, 128.8, 129.2, 129.3, 133.1, 133.3, 135.1, 135.8, 138.2, 143.5; IR (neat): 3065, 2968, 2921, 1345, 1160 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{24}H_{22}NO_2S^+$: *m*/*z* 388.1366, found: 388.1369.

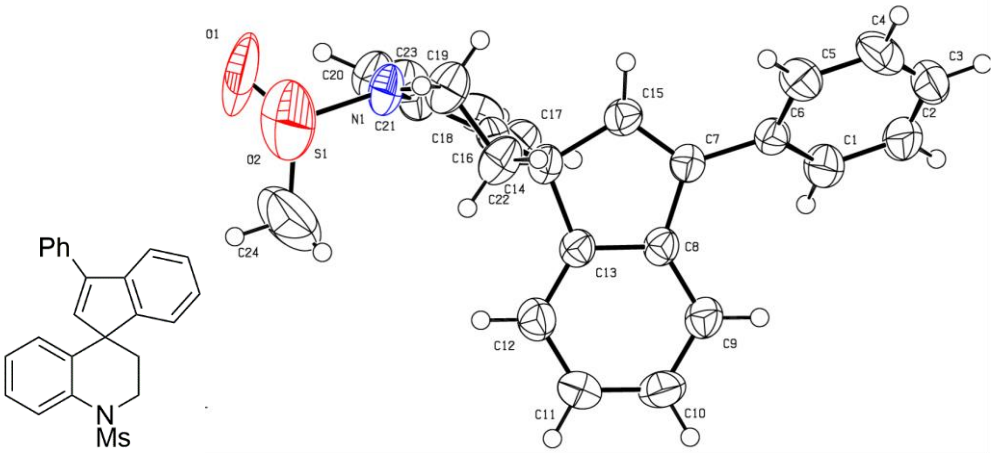


3-Methyl-1′-tosyl-2′,3′-dihydro-1′*H*-spiro[indene-1,4′-quinoline] (8w). 24% yield;

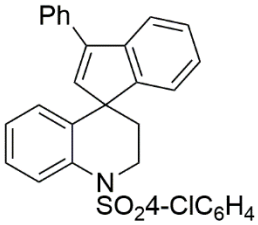
white solid; m.p.: 113–114 ℃; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.95 (d, J = 8.4 Hz, 1H), 7.57 (d, J = 8.0 Hz, 2H), 7.30–7.23 (m, 4H), 7.17 (t, J = 6.8 Hz, 1H), 7.01 (t, J = 6.8 Hz, 1H), 6.86 (t, J = 6.8 Hz, 1H), 6.33 (d, J = 7.6 Hz, 2H), 5.84 (s, 1H), 4.38–4.34 (m, 1H), 3.82 (t, J = 12.8 Hz, 1H), 2.46 (s, 3H), 2.06 (s, 3H), 1.84 (t, J = 13.2 Hz, 1H), 1.54–1.51 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 12.7, 21.5, 29.8, 45.8, 53.4, 119.4, 122.2, 125.1, 125.3, 125.8, 127.0, 127.1, 127.5, 128.0, 129.7, 130.6, 136.91, 136.92, 137.2, 140.1, 143.8, 144.8, 153.5; IR (neat): 3034, 2913, 1604, 1172, 758 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{25}H_{24}NO_2S^+$: m/z 402.1522, found: 402.1517.



3-Phenyl-1′-tosyl-2′,3′-dihydro-1′*H*-spiro[indene-1,4′-quinoline] (8x). 66% yield; white solid; m.p.: 114–116 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.98 (dd, J = 8.4, 0.9 Hz, 1H), 7.58 (d, J = 8.4 Hz, 2H), 7.52–7.49 (m, 3H), 7.45–7.34 (m, 3H), 7.29–7.26 (m, 3H), 7.24–7.16 (m, 1H), 7.07 (td, J = 7.5, 0.9 Hz, 1H), 6.89 (td, J = 7.8, 0.9 Hz, 1H), 6.46–6.41 (m, 2H), 6.11 (s, 1H), 4.38 (ddd, J = 14.1, 5.4, 3.6 Hz, 1H), 3.87 (ddd, J = 14.1, 10.8, 3.0 Hz, 1H), 2.42 (s, 3H), 1.96 (ddd, J = 14.1, 10.8, 3.6 Hz, 1H), 1.67 (ddd, J = 14.1, 5.7, 3.0 Hz, 1H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.6, 30.0, 45.8, 53.6, 121.0, 123.9, 125.3, 125.4, 126.2, 127.2, 127.3, 127.5, 127.6, 128.0, 128.1, 128.6, 129.8, 130.2, 134.9, 136.8, 137.0, 141.3, 142.1, 142.5, 144.0, 154.0; IR (neat): 3060, 2925, 1598, 1164, 760 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{30}H_{26}NO_2S^+$: m/z 464.1679, found: 464.1678.

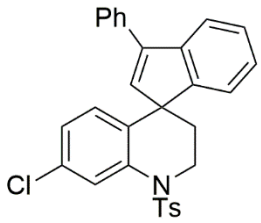


1′-(Methylsulfonyl)-3-phenyl-2′,3′-dihydro-1′*H*-spiro[indene-1,4′-quinoline] (8y). 59% yield; white solid; m.p.: 103–105 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.79 (d, J = 8.4 Hz, 1H), 7.63–7.57 (m, 3H), 7.48–7.31 (m, 4H), 7.24–7.14 (m, 3H), 6.87 (t, J = 7.5 Hz, 1H), 6.60–6.58 (m, 2H), 4.33 (ddd, J = 13.5, 6.3, 3.3 Hz, 1H), 3.94 (ddd, J = 13.2, 9.9, 3.0 Hz, 1H), 3.10 (s, 3H), 2.35 (ddd, J = 13.5, 6.3, 3.3 Hz, 1H), 2.12 (ddd, J = 13.2, 9.9, 3.0 Hz, 1H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 31.8, 39.5, 45.1, 54.0, 121.3, 122.3, 123.3, 124.8, 126.6., 127.5, 127.8, 128.26, 128.27, 128.7, 128.88, 128.89, 135.0, 137.3, 141.5, 142.7, 142.8, 154.1; IR (neat): 3056, 2928, 1606, 1180, 745 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{24}H_{22}NO_2S^+$: m/z 388.1366, found: 388.1368.

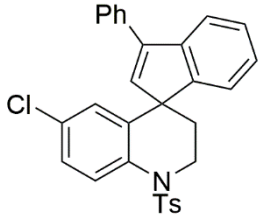


1′-((4-Chlorophenyl)sulfonyl)-3-phenyl-2′,3′-dihydro-1′*H*-spiro[indene-1,4′-quinoline] (8z). 70% yield; white solid; m.p.: 105–107 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.88 (d, J = 8.4 Hz, 1H), 7.55 (d, J = 8.7 Hz, 2H), 7.42–7.09 (m, 10H), 7.04 (t, J = 7.2 Hz, 1H), 6.82 (t, J = 7.5 Hz, 1H), 6.36 (d, J = 7.8 Hz, 2H), 6.06 (s, 1H), 4.31 (ddd, J = 13.8, 5.1, 3.6 Hz, 1H), 3.80 (ddd, J = 13.8, 10.8, 2.7 Hz, 1H), 1.90 (ddd, J = 13.8, 10.8, 2.7 Hz, 1H), 1.62 (ddd, J = 13.8, 10.8, 2.7 Hz, 1H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 29.2, 44.8, 52.4, 120.1, 121.8, 124.1, 124.7, 125.3, 126.2, 126.4, 126.5, 127.1, 127.3, 127.7, 127.8, 128.4, 129.3, 133.7, 135.6, 137.2, 138.6, 139.9, 141.3, 141.4, 152.7; IR (neat): 3070, 2928, 1460, 1182, 753 cm^{-1}; HRMS (ESI): [M +

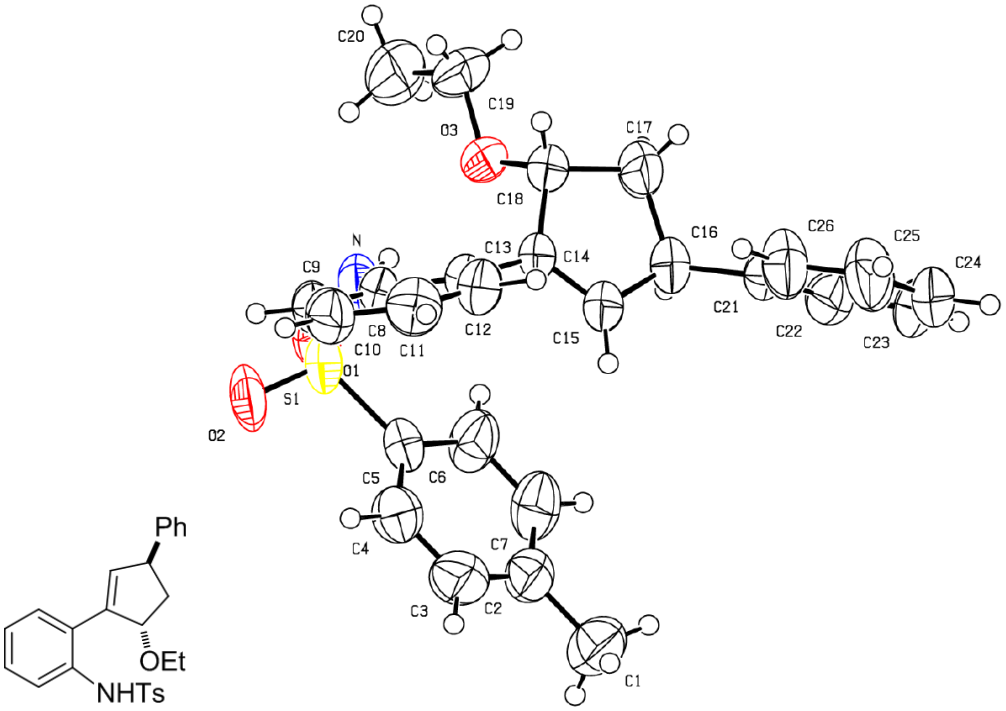
H]$^+$ calculated for $C_{29}H_{23}ClNO_2S^+$: *m*/*z* 484.1133, found: 484.1135.



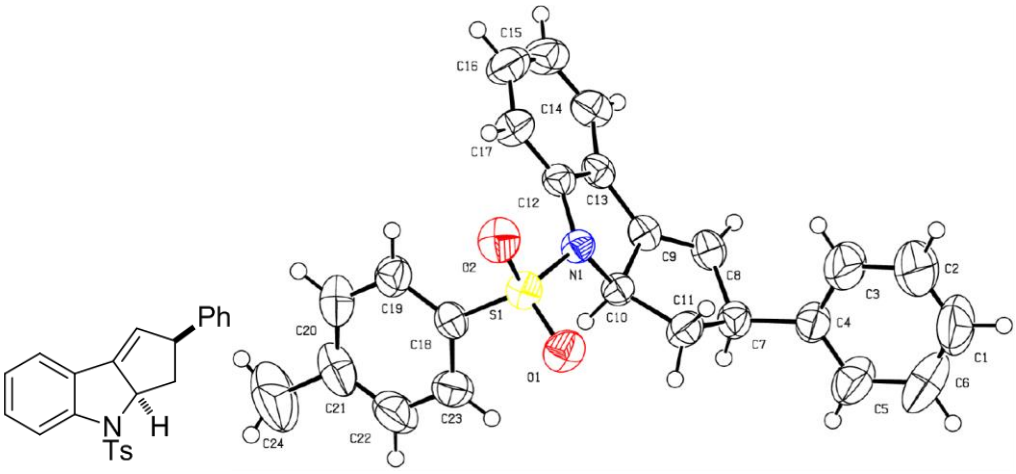
7 ′-Chloro-3-phenyl-1 ′-tosyl-2 ′,3 ′-dihydro-1 ′*H*-spiro[indene-1,4 ′-quinoline] (8aa). 60% yield; white solid; m.p.: 134–135 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.04 (d, *J* = 2.1 Hz, 1H), 7.63 (d, *J* = 8.4 Hz, 2H), 7.54–7.27 (m, 9H), 7.09 (t, *J* = 7.5 Hz, 1H), 6.86 (dd, *J* = 8.4, 2.4 Hz, 1H), 6.46 (d, *J* = 7.2 Hz, 1H), 6.35 (d, *J* = 8.4 Hz, 1H), 6.08 (s, 1H), 4.37 (ddd, *J* = 14.1, 5.4, 3.6 Hz, 1H), 3.84 (ddd, *J* = 14.1, 10.8, 3.0 Hz, 1H), 2.44 (s, 3H), 1.93 (ddd, *J* = 14.1, 10.8, 3.0 Hz, 1H), 1.67 (ddd, *J* = 14.1, 5.4, 3.6 Hz, 1H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.6, 29.9, 45.6, 53.2, 121.2, 122.9, 124.8, 125.6, 126.3, 127.4, 127.5, 127.6, 128.2, 128.6, 128.7, 129.2, 130.0, 132.6, 134.7, 136.4, 138.1, 140.7, 142.4, 142.5, 144.3, 153.4; IR (neat): 3067, 2932, 1620, 1134, 780 cm^{-1}; HRMS (ESI): [M + H]$^+$ calculated for $C_{30}H_{25}ClNO_2S^+$: *m*/*z* 498.1289, found: 498.1291.



6 ′-Chloro-3-phenyl-1 ′-tosyl-2 ′,3 ′-dihydro-1 ′*H*-spiro[indene-1,4 ′-quinoline] (8ab). 68% yield; white solid; m.p.: 138–139 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.93 (dd, *J* = 8.1, 1.2 Hz, 1H), 7.47–7.28 (m, 8H), 7.24–7.10 (m, 4H), 7.00–6.95 (m, 2H), 6.30 (d, *J* = 7.5 Hz, 1H), 6.04 (s, 1H), 4.20 (ddd, *J* = 14.1, 6.6, 3.0 Hz, 1H), 3.78 (ddd, *J* = 14.1, 9.6, 2.7 Hz, 1H), 2.37 (s, 3H), 1.66 (ddd, *J* = 14.1, 9.6, 2.7 Hz, 1H), 1.53 (ddd, *J* = 14.1, 6.6, 3.0 Hz, 1H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 20.5, 32.8, 44.6, 52.8, 120.4, 120.5, 123.6, 124.8, 125.8, 126.45, 126.46, 126.6, 126.9, 127.3, 127.5, 127.6, 128.9, 133.9, 134.3, 135.8, 137.6, 138.7, 141.6, 142.8, 143.2, 151.8; IR (neat): 3062, 2935, 1618, 1131, 776 cm^{-1}; HRMS (ESI): [M + H]$^+$ calculated for $C_{30}H_{25}ClNO_2S^+$: *m*/*z* 498.1289, found: 498.1286.



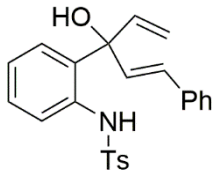
***N*-(2-(*trans*-5-Ethoxy-3-phenylcyclopent-1-en-1-yl)phenyl)-4-methylbenzene-sulfonamide (9).** 26% yield; white solid; m.p.: 97–99 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.71 (s, 1H), 7.64 (d, J = 8.1 Hz, 1H), 7.54 (d, J = 8.4 Hz, 2H), 7.34–7.23 (m, 4H), 7.16–7.02 (m, 6H), 5.16 (d, J = 1.5 Hz, 1H), 4.58 (d, J = 6.0 Hz, 1H), 3.93 (t, J = 7.2 Hz, 1H), 3.72–3.67 (m, 1H), 3.55–3.49 (m, 1H), 2.51 (ddd, J = 13.8, 7.2, 1.5 Hz, 1H), 2.29 (s, 3H), 1.96 (dt, J = 13.8, 6.8 Hz, 1H), 1.38 (t, J = 6.9 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 15.4, 21.6, 40.9, 49.4, 65.8, 87.6, 124.0, 125.1, 126.8, 127.1, 127.4, 128.8, 128.9, 129.2, 130.6, 131.2, 135.5, 137.4, 140.7, 142.4, 143.2, 144.2; IR (neat): 3130, 2927, 2875, 1598, 1161, 564 cm^{-1}; HRMS (ESI): $[M + Na]^+$ calculated for $C_{26}H_{27}NNaO_3S^+$: m/z 456.1604, found: 456.1607.



2-Phenyl-4-tosyl-2,3,3a,4-tetrahydrocyclopenta[*b*]indole (10). 45% yield; white

solid; m.p.: 139–141 ℃; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.80–7.78 (m, 3H), 7.35–7.20 (m, 9H), 7.04 (td, J = 7.5, 0.9 Hz, 1H), 5.92 (dd, J = 3.0, 1.8 Hz, 1H), 4.69–4.61 (m, 1H), 4.19–4.12 (m, 1H), 3.11 (dt, J = 12.3, 5.4 Hz, 1H), 2.38 (s, 3H), 2.20 (dt, J = 11.7, 10.2 Hz, 1H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.6, 47.1, 54.3, 72.7, 115.3, 122.5, 123.8, 124.7, 124.8, 126.8, 127.5, 127.8, 128.6, 129.7, 129.8, 133.4, 143.6, 143.7, 144.4, 147.6; IR (neat): 3059, 3027, 2862, 1599, 1168, 581 cm^{-1}; HRMS (ESI): $[M + H]^+$ calculated for $C_{24}H_{22}NO_2S^+$: m/z 388.1366, found: 388.1373.

^{1}H and ^{13}C NMR Spectra of All Products



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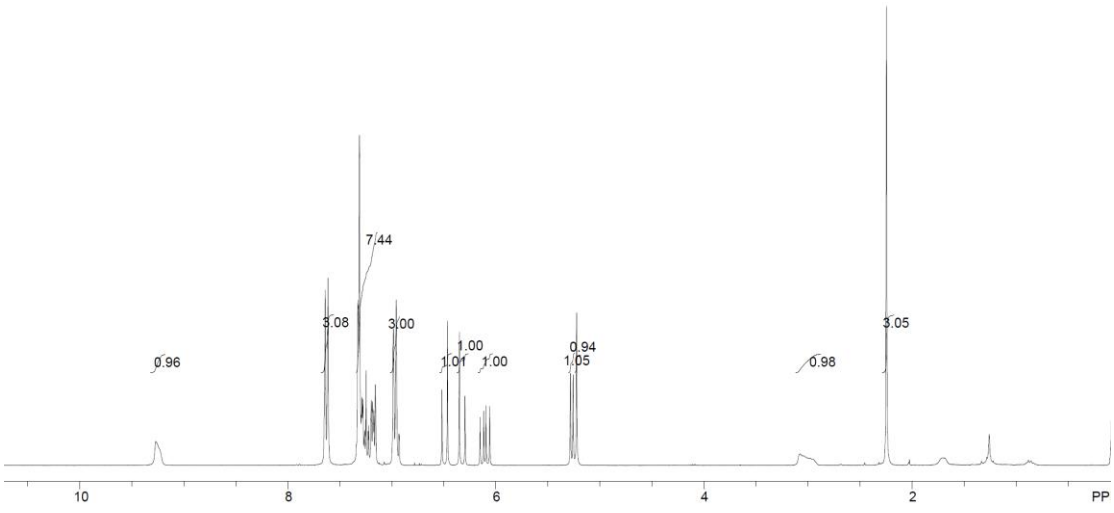
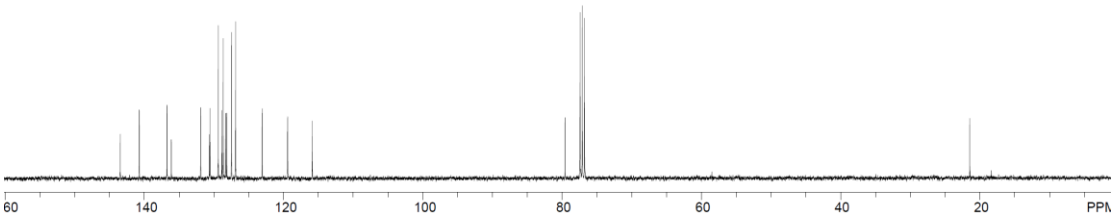
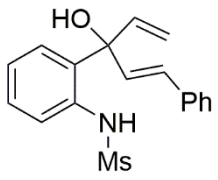
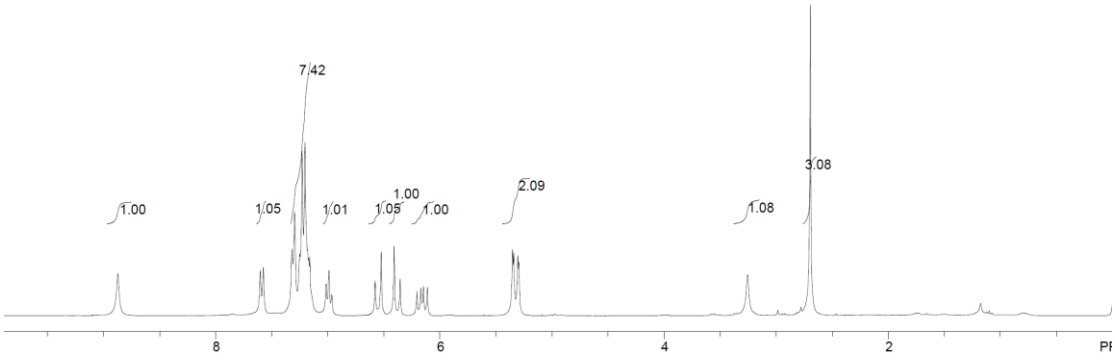





HO
Ph
NH
Ms

1b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1.08
3.08
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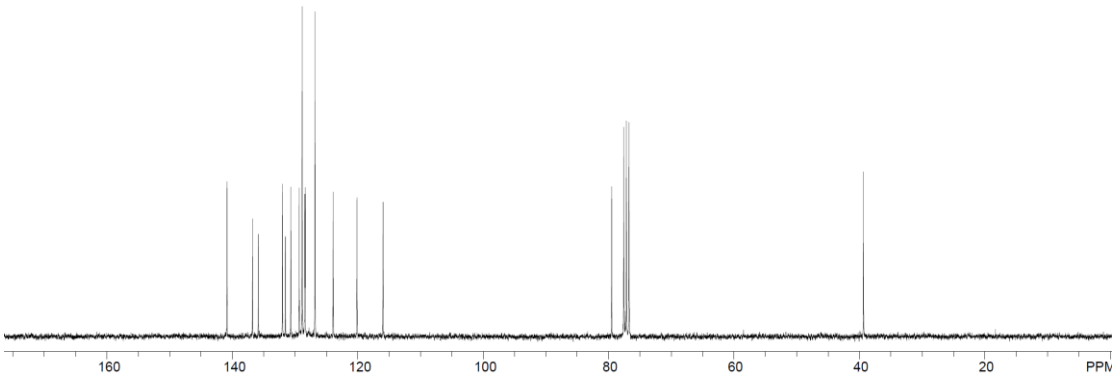
6
4
2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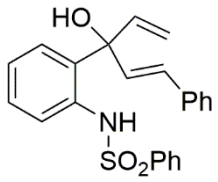
140
120
100
80
60
40
20
PPM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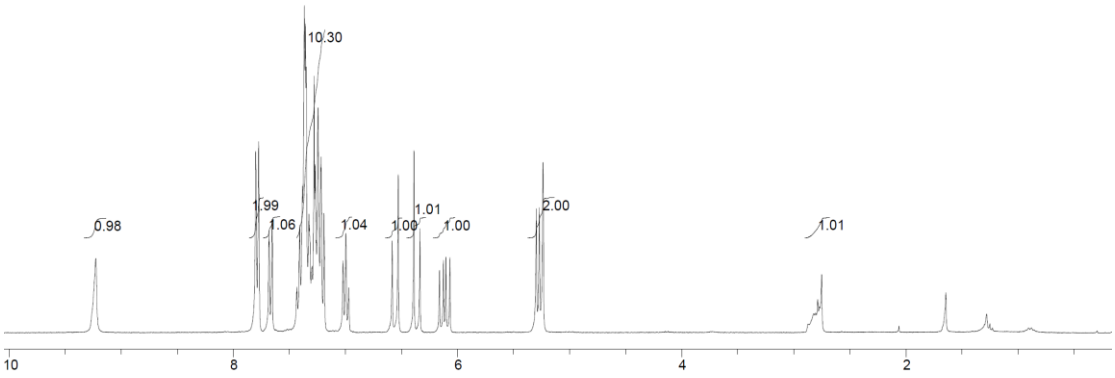
Ph
NH
SO2Ph

1c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1.01
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8
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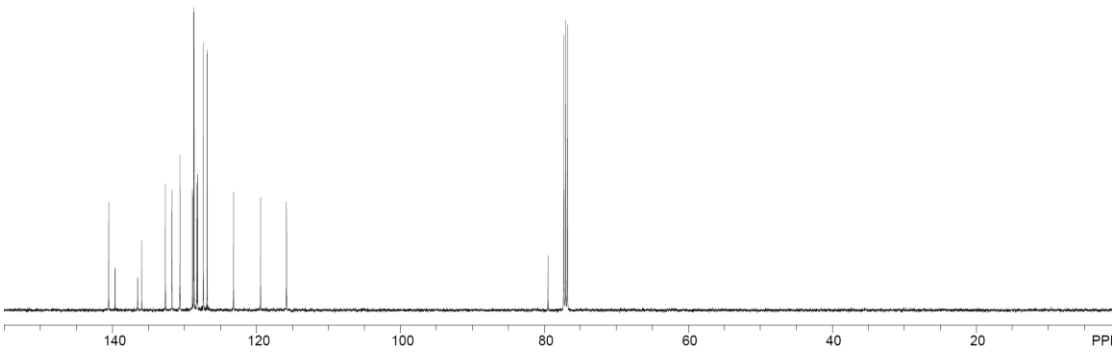
4
2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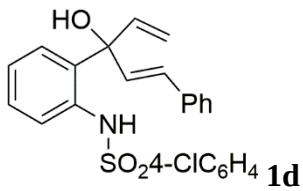
120
100
80
60
40
20
PPI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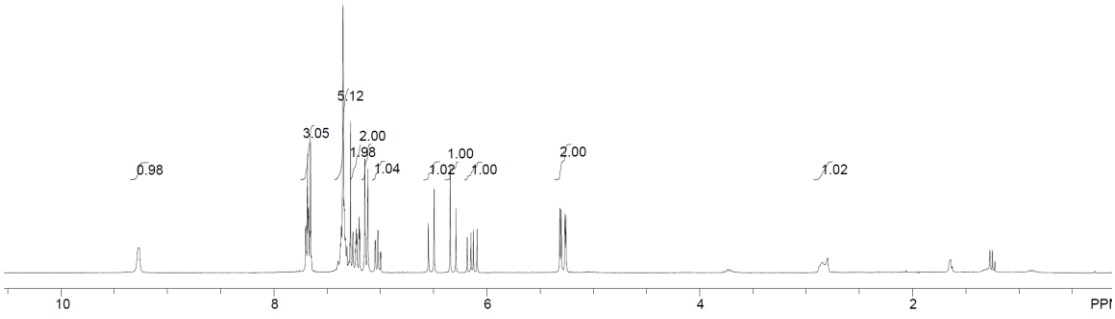
Ph
NH
SO2
4-ClC6H4

1d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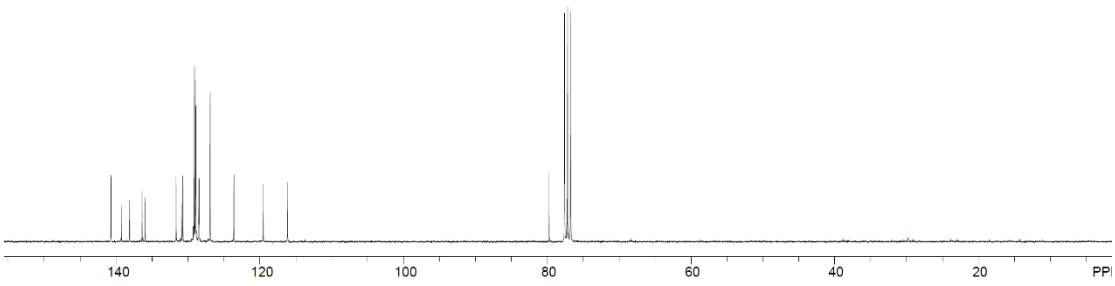
PPI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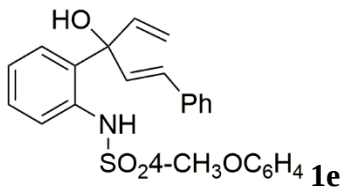
100
80
60
40
20
PPI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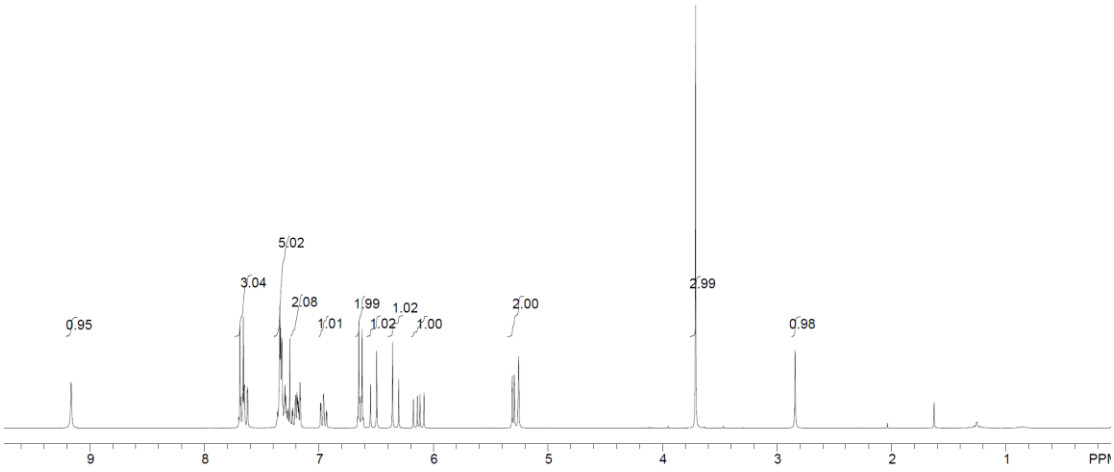
Ph
NH
SO2 4-CH3OC6H4

1e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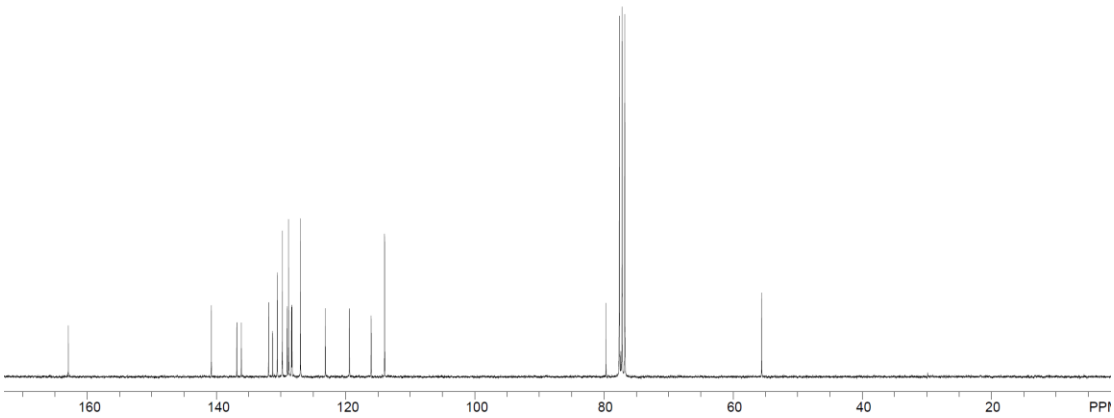
1
PPM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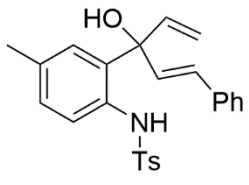
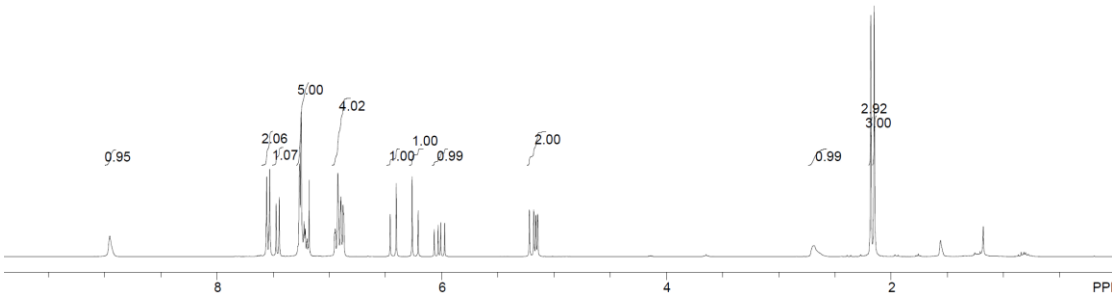
20
PPM


HO
Ph
NH
Ts

1f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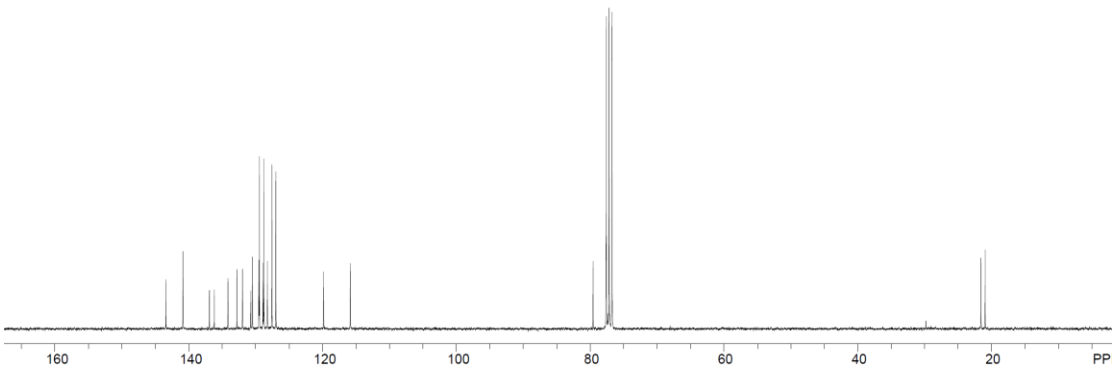
2
PPI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80
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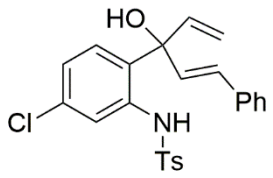
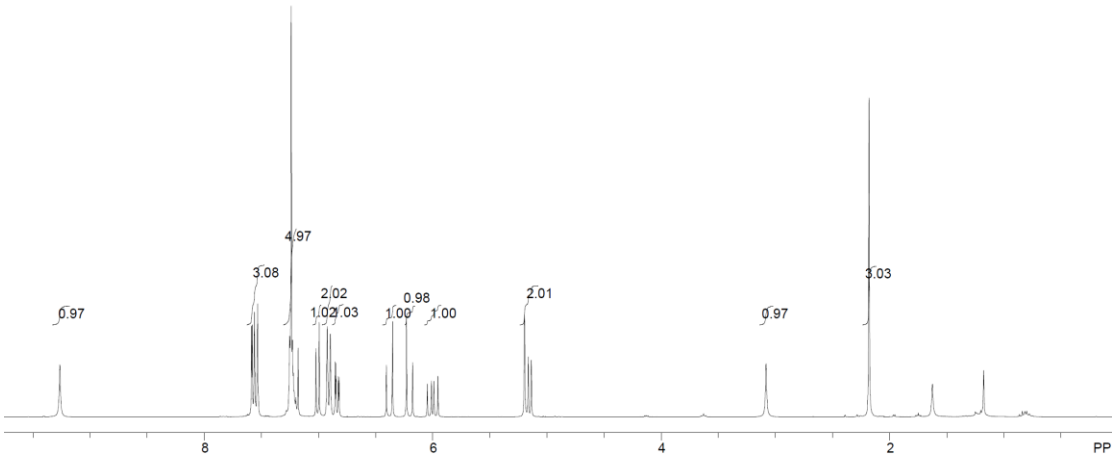
40
20
PP


HO
Ph
Cl
NH
Ts

1g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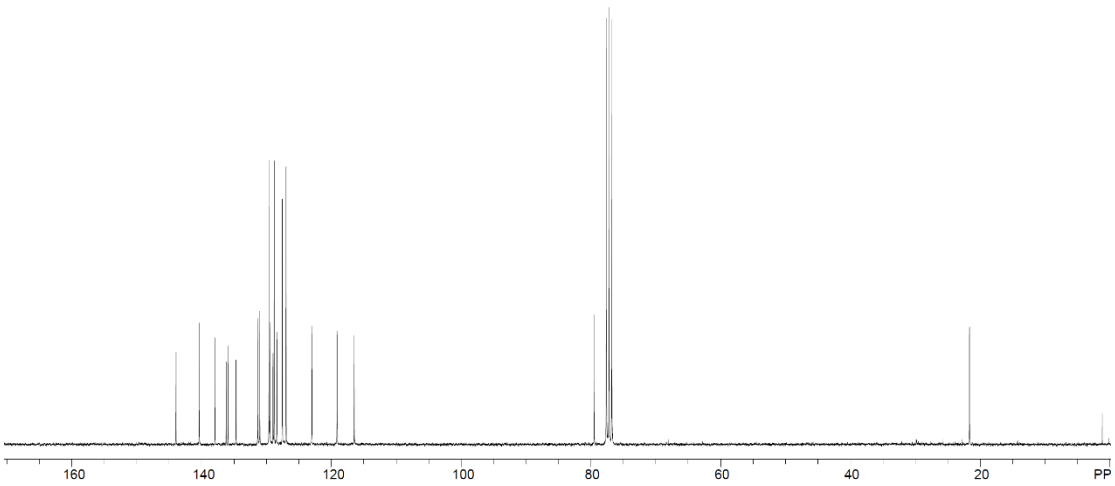
6
4
2
PP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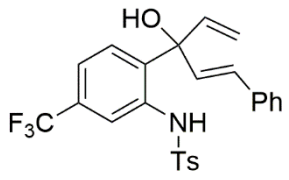
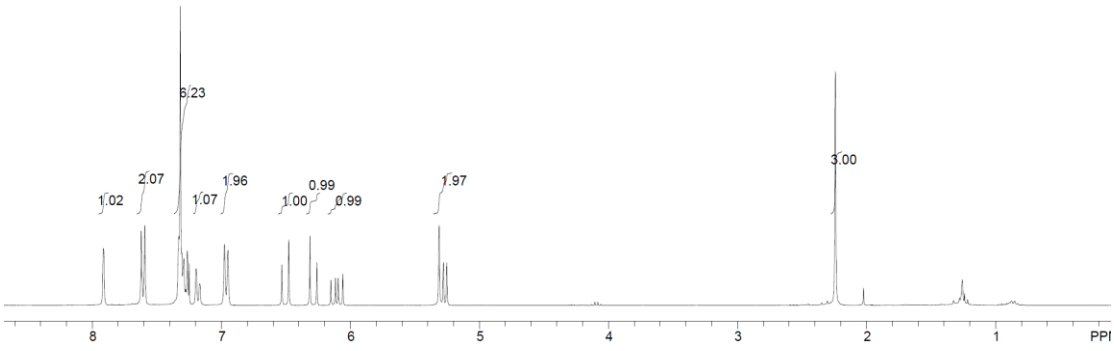
140
120
100
80
60
40
20
PP


HO
Ph
F3C
NH
Ts

1h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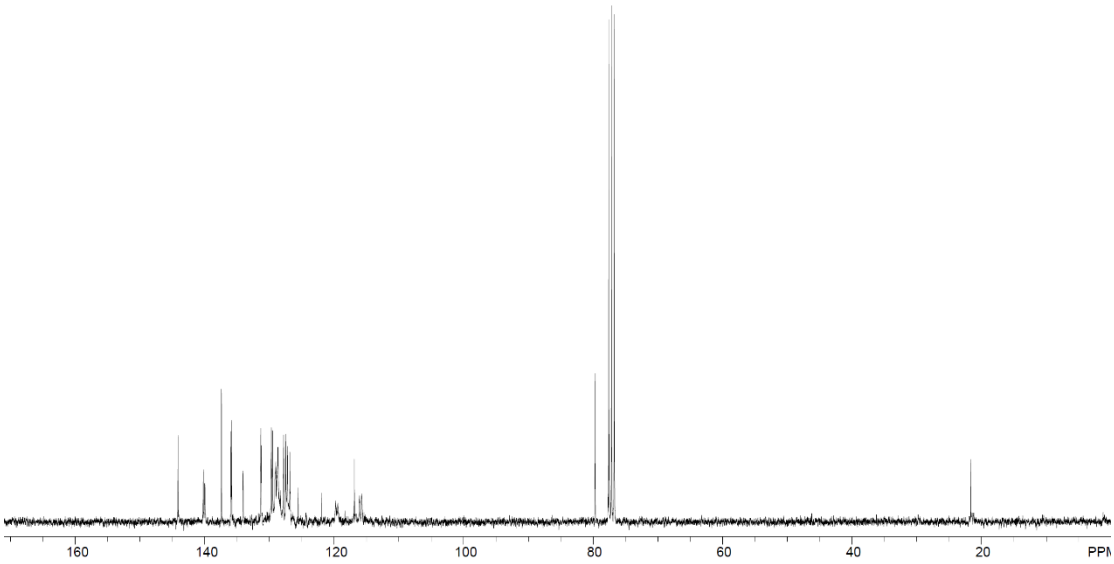
1.07
1.00
0.99
8
7
6
5
4
3
2
1
PPI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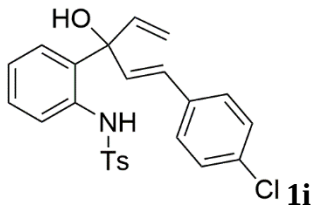
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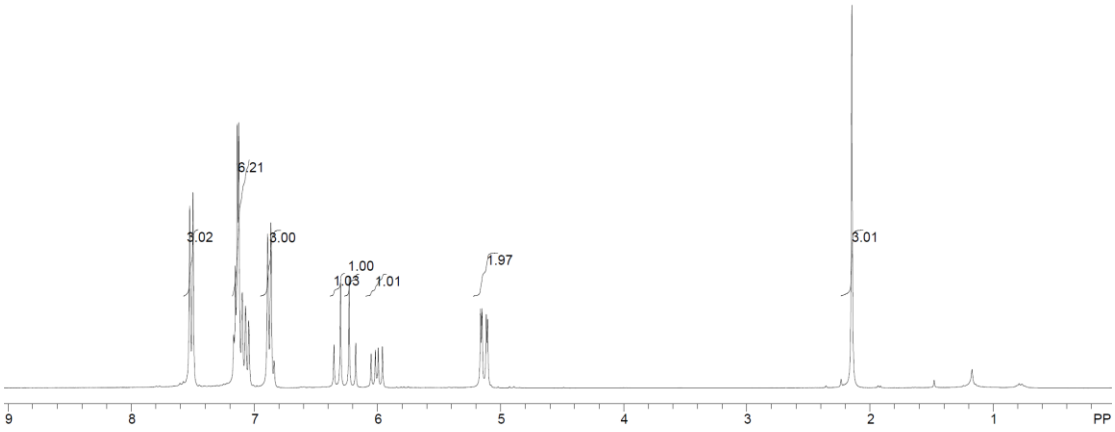
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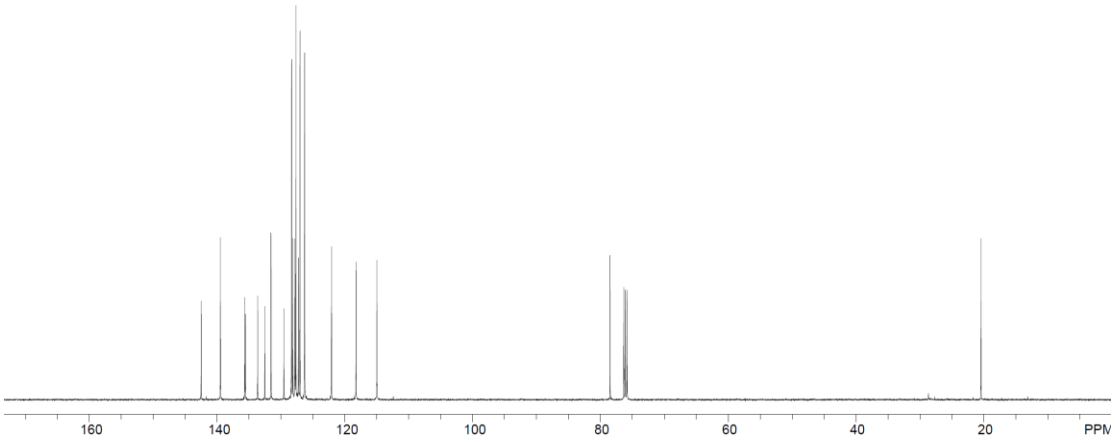
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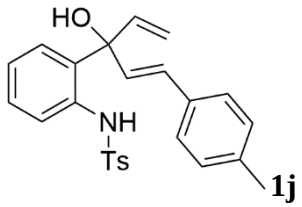
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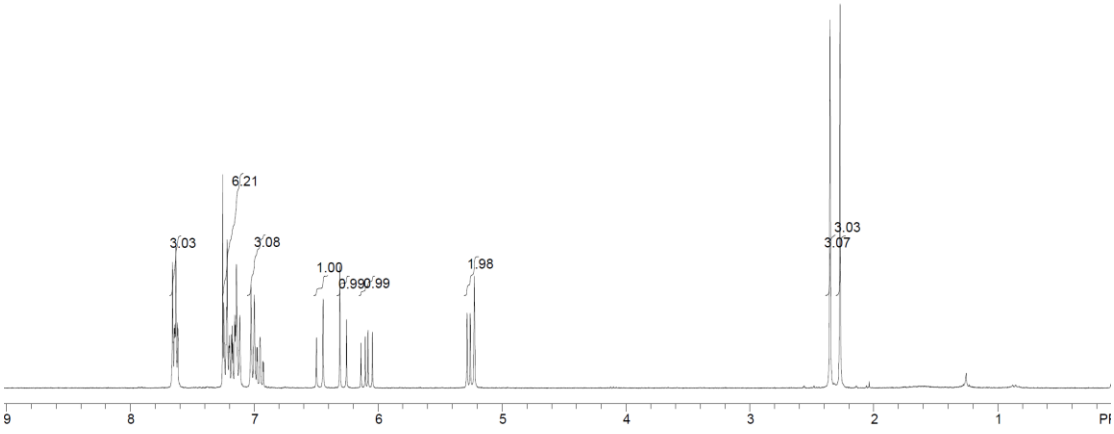
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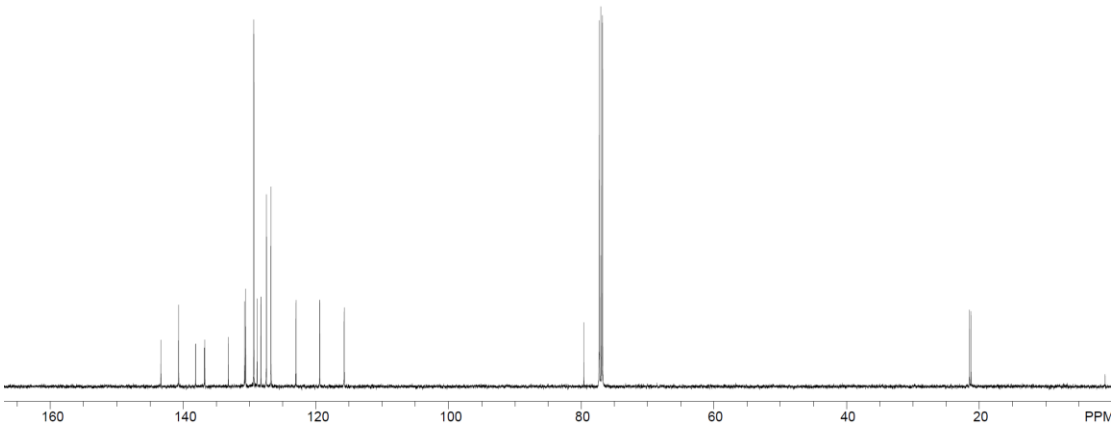
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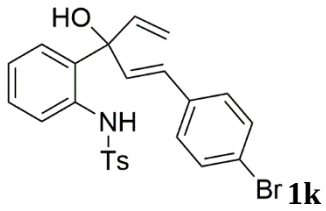
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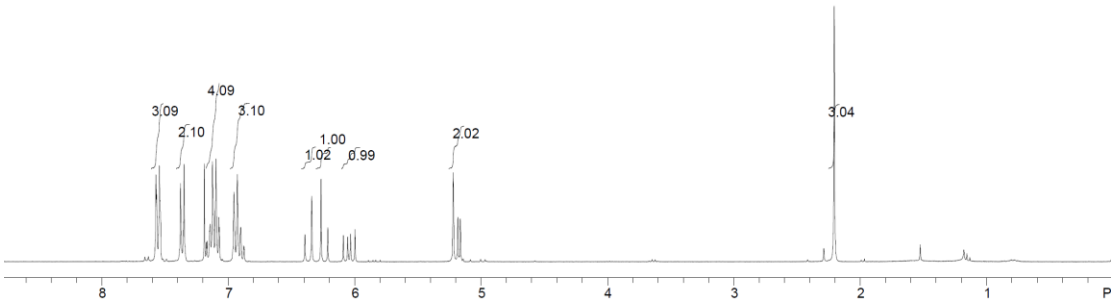
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7
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1
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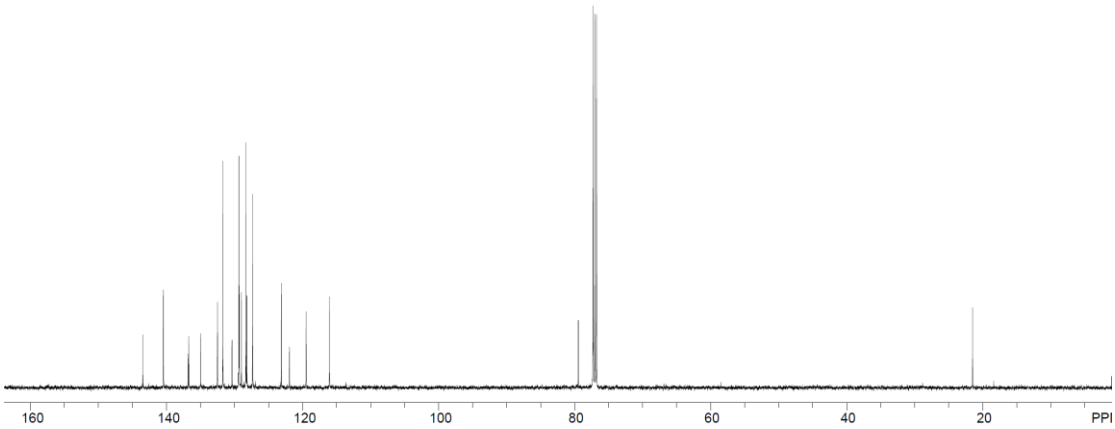
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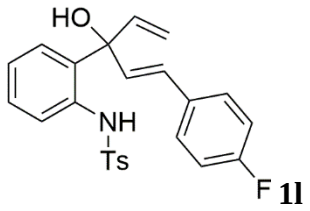
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F

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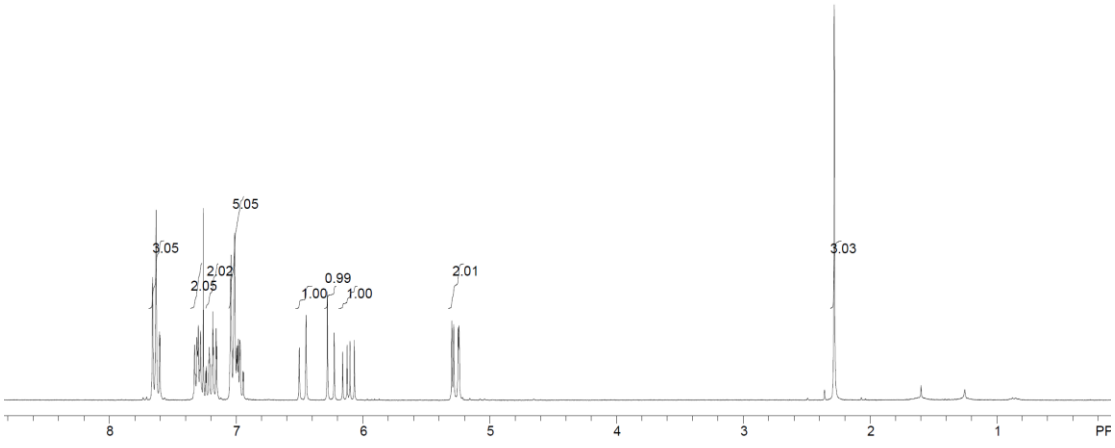
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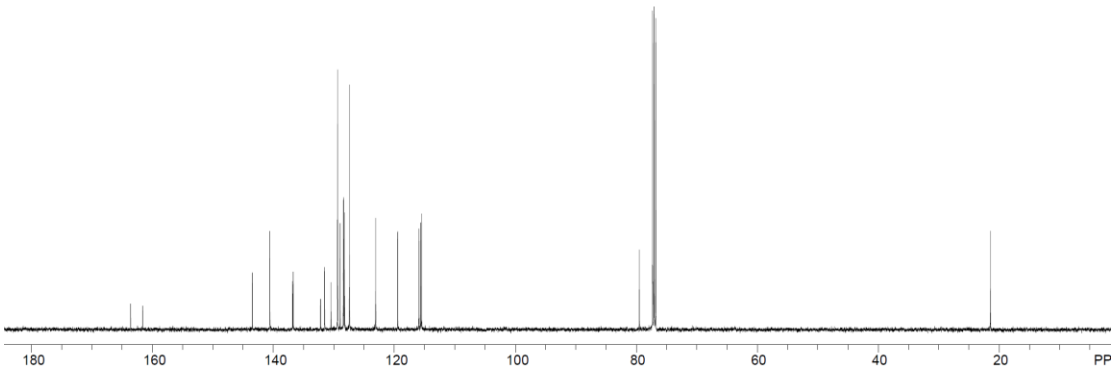
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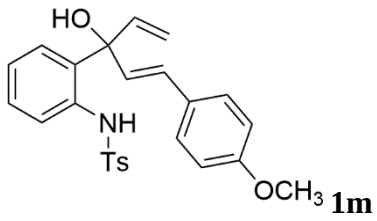
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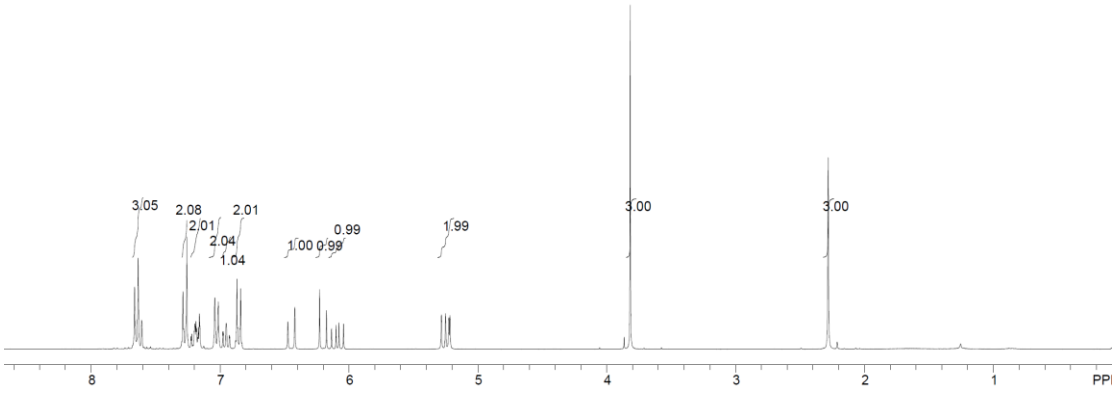
Ts
OCH3

1m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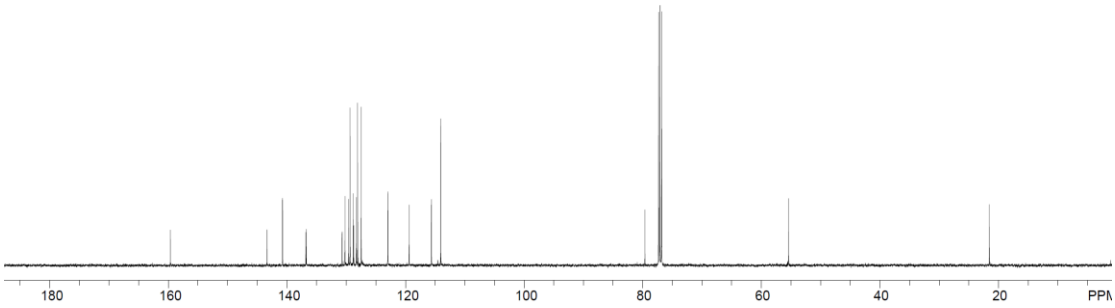
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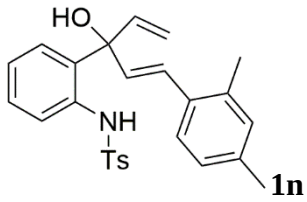
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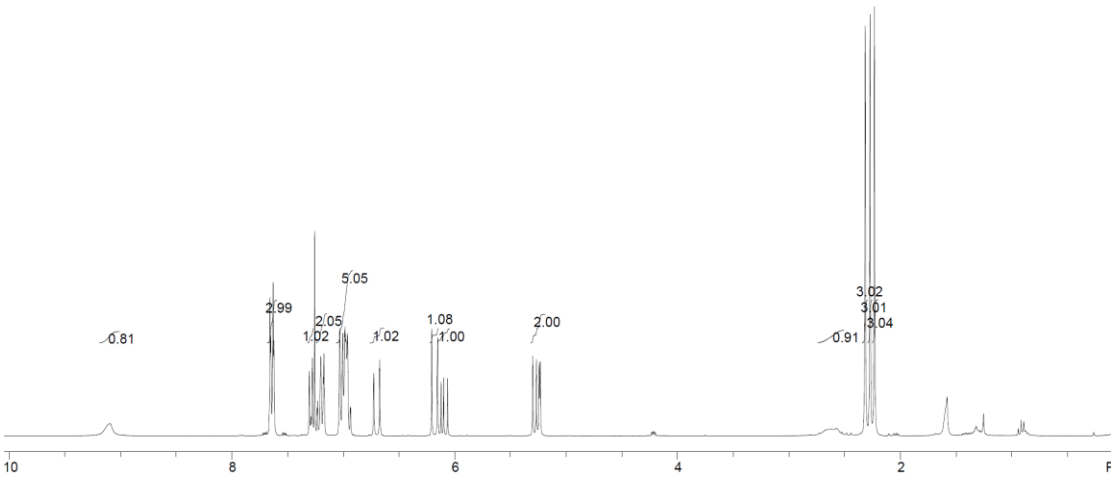
NH
Ts

1n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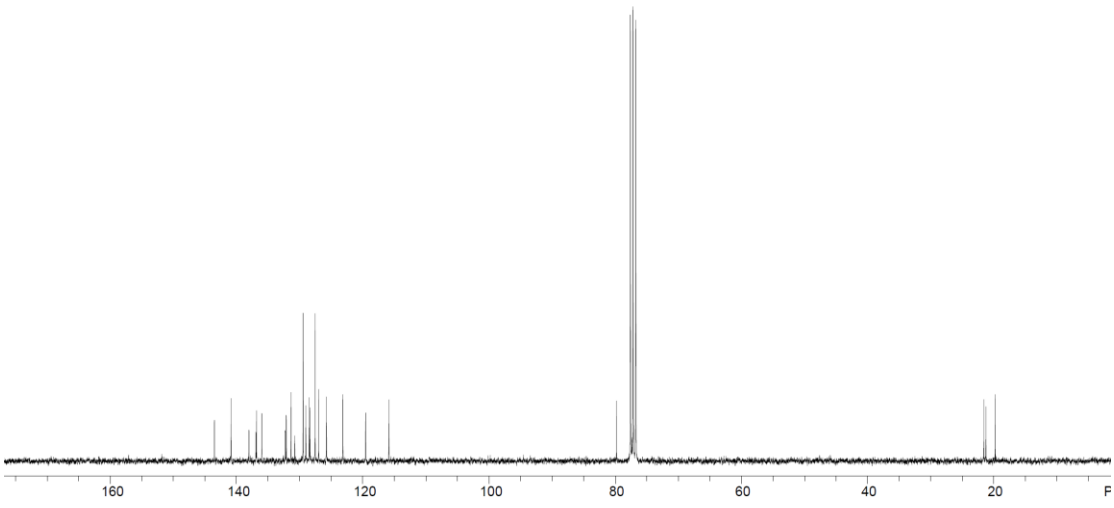
4
2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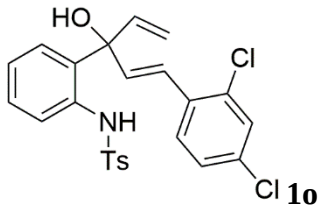
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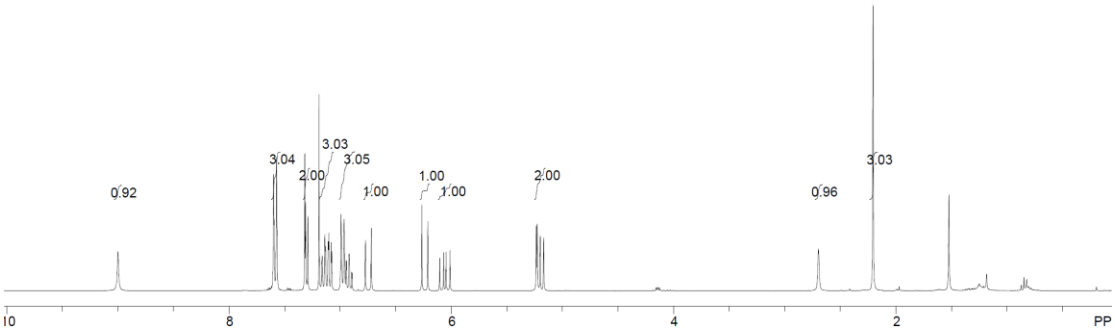
Cl
NH
Ts
Cl

1o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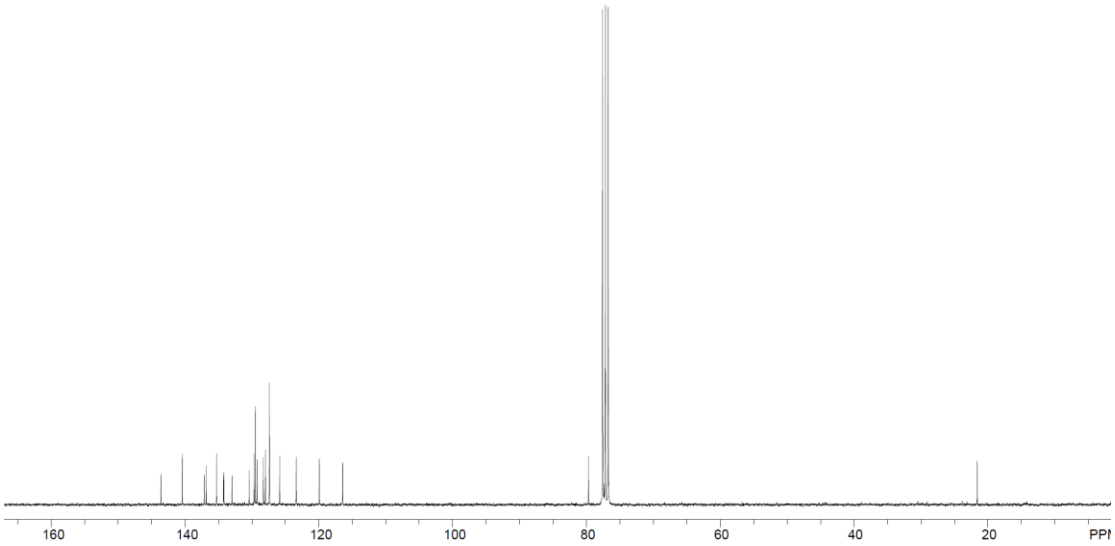
2
PP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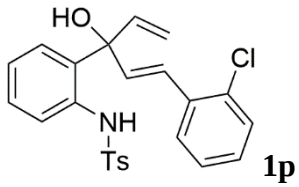
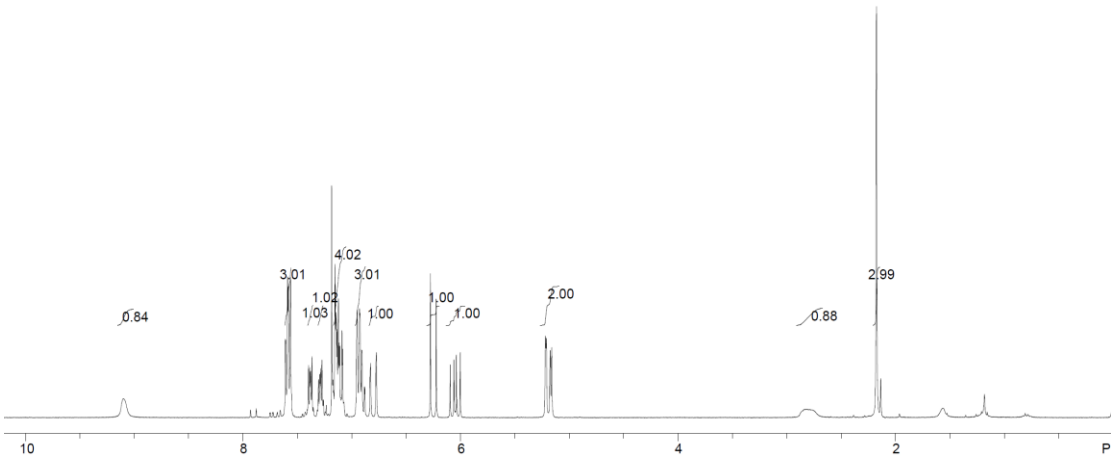

HO
Cl
NH
Ts

1p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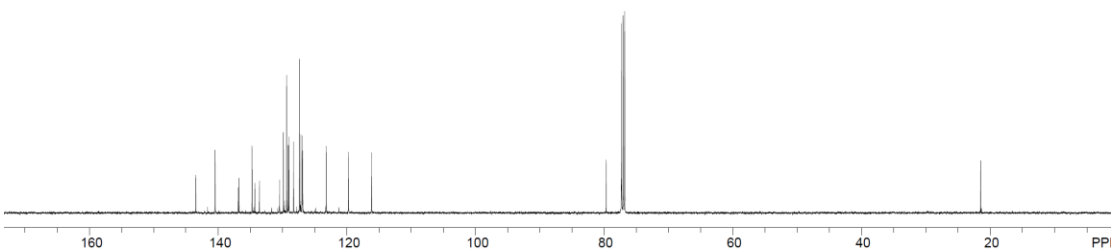
2
P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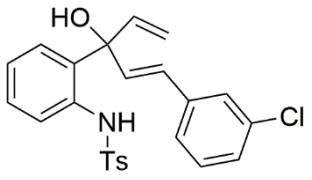
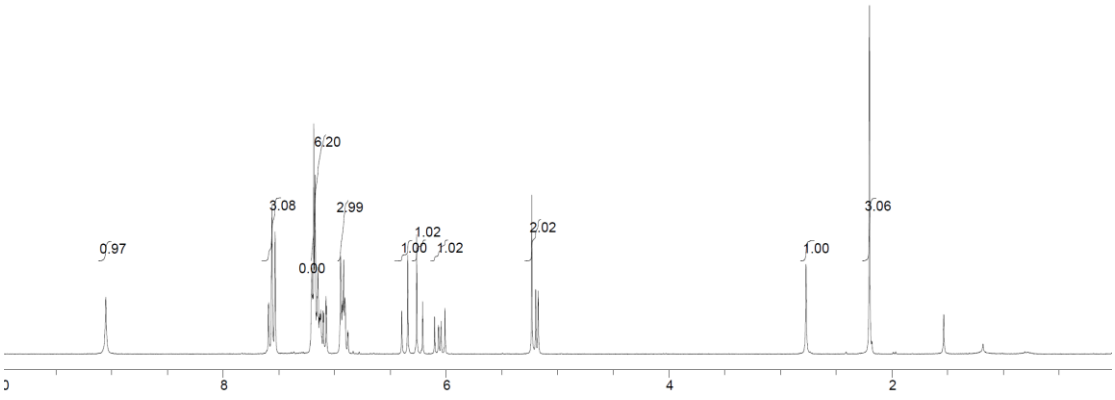

HO
NH
Ts
Cl

1q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1.02
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1.00
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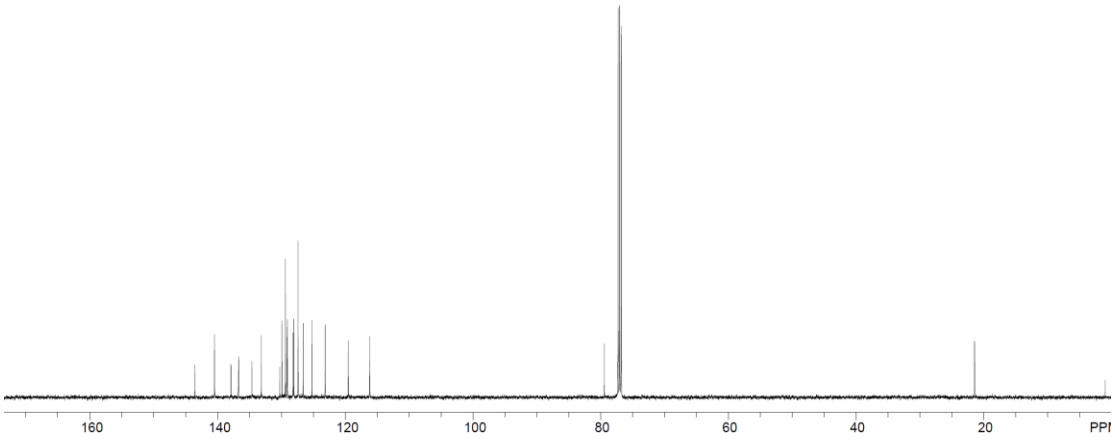
8
6
4
2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60
40
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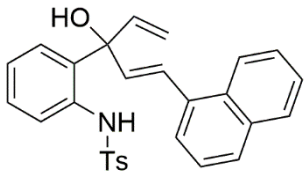
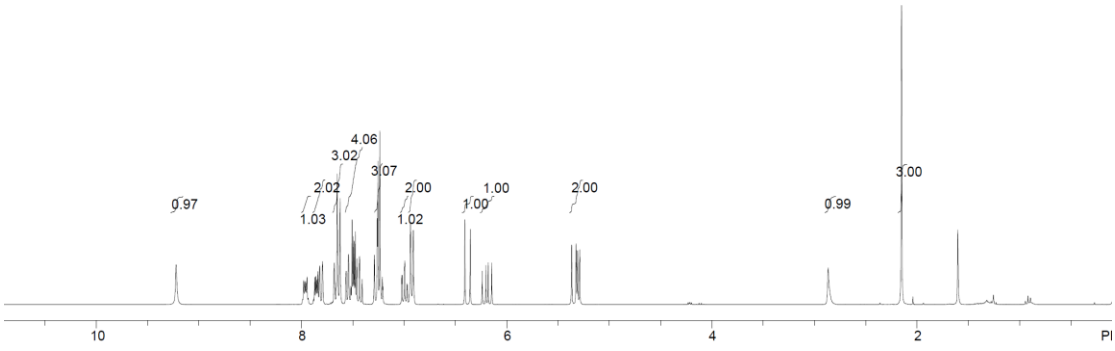

HO
NH
Ts

1r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3.02
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1.02
1.00
1.00
2.00
0.99
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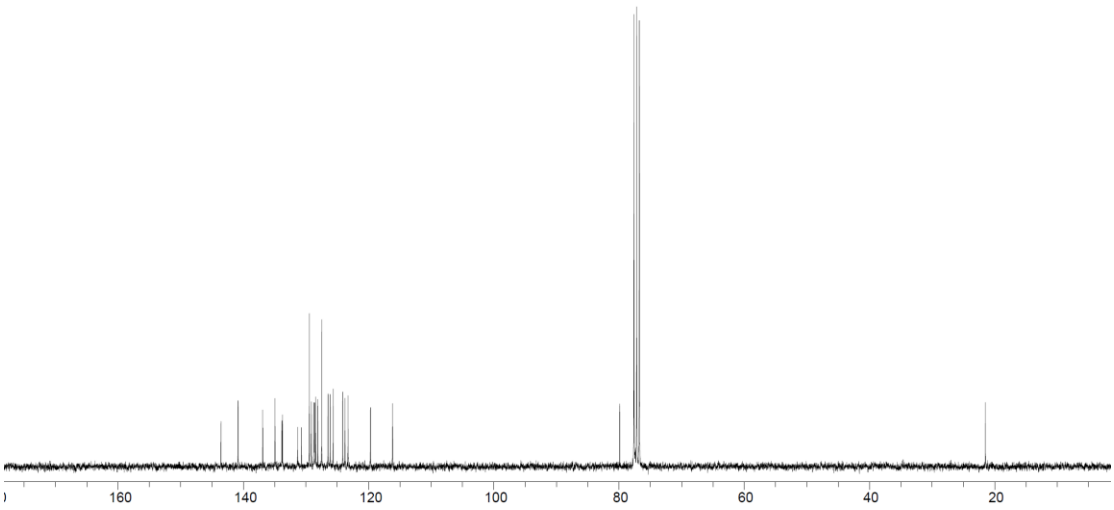
10
8
6
4
2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40
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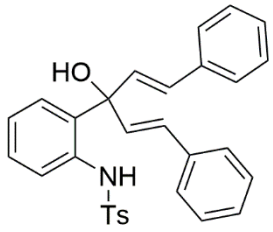
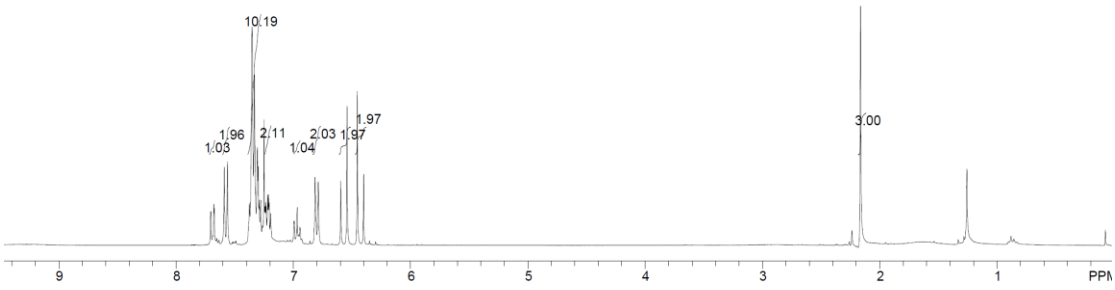

HO
NH
Ts

1s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3.00
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1
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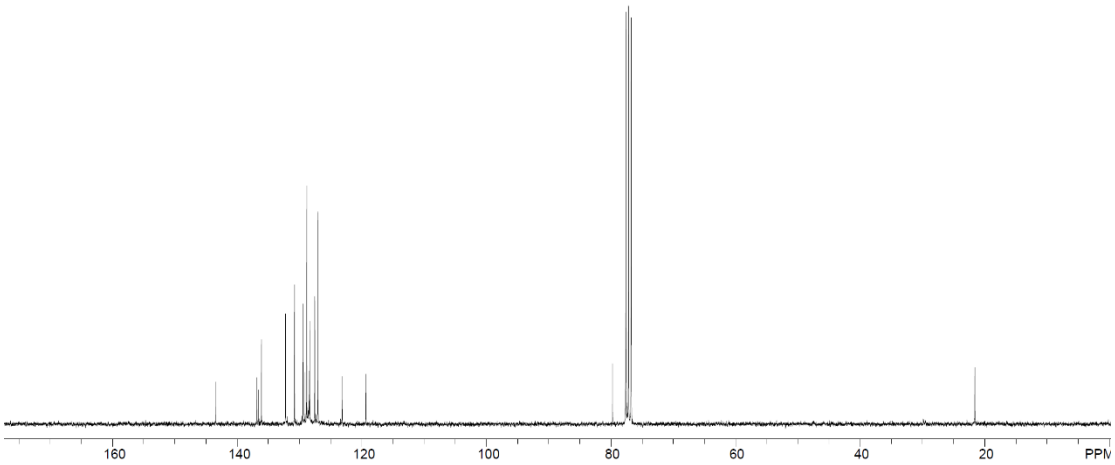
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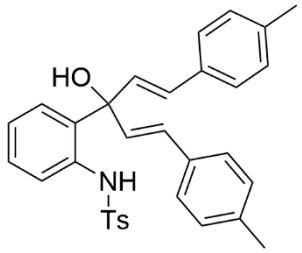
PPM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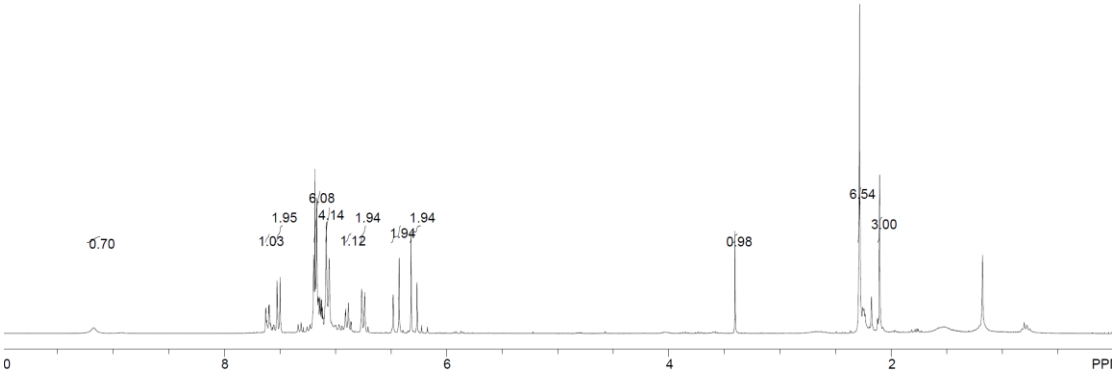
NH
Ts

1t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1.12
1.94
1.94
0.98
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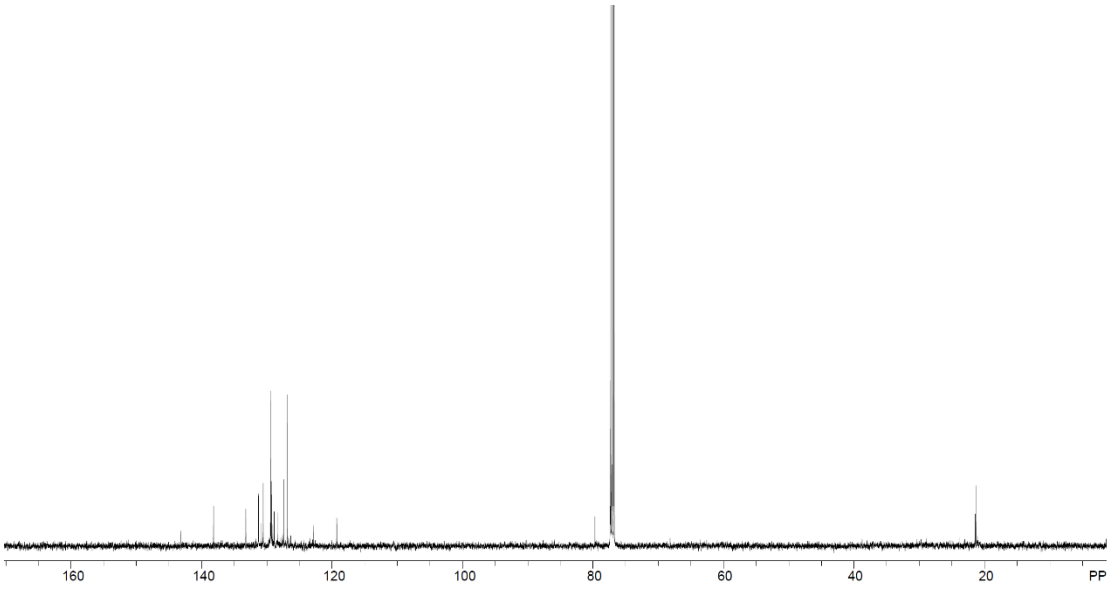
8
6
4
2
PPI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60
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20
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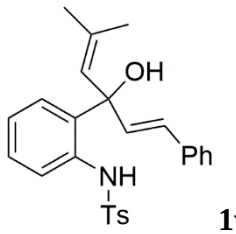
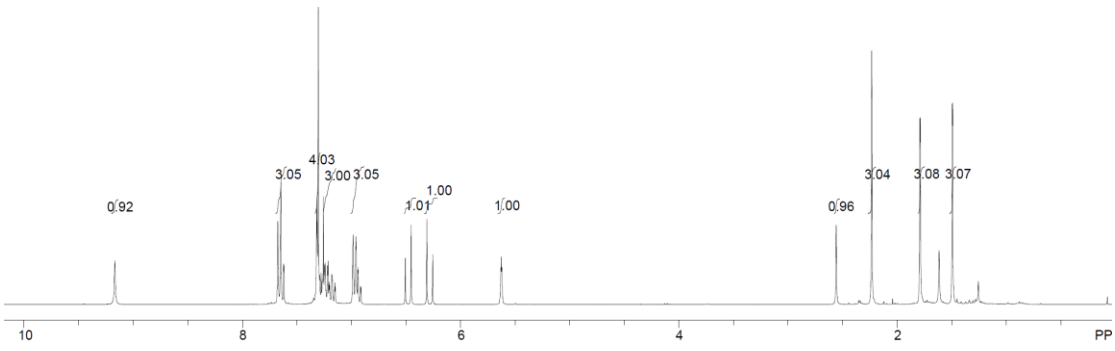

OH
Ph
NH
Ts

1v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3.05
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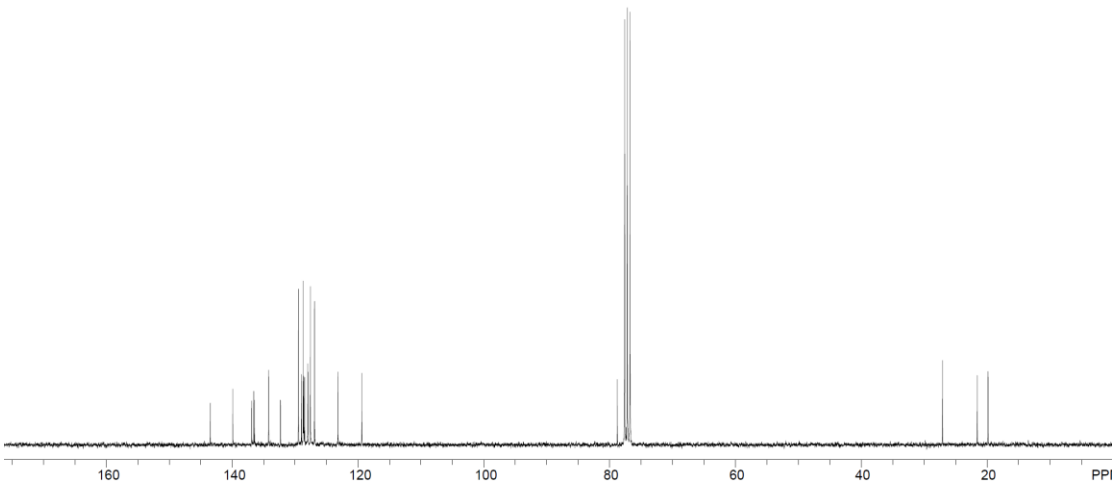
1.00
1.00
0.96
3.04
3.08
3.07
10
8
6
4
2
PP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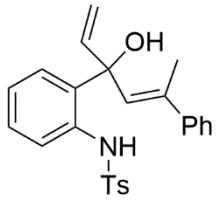
PPI



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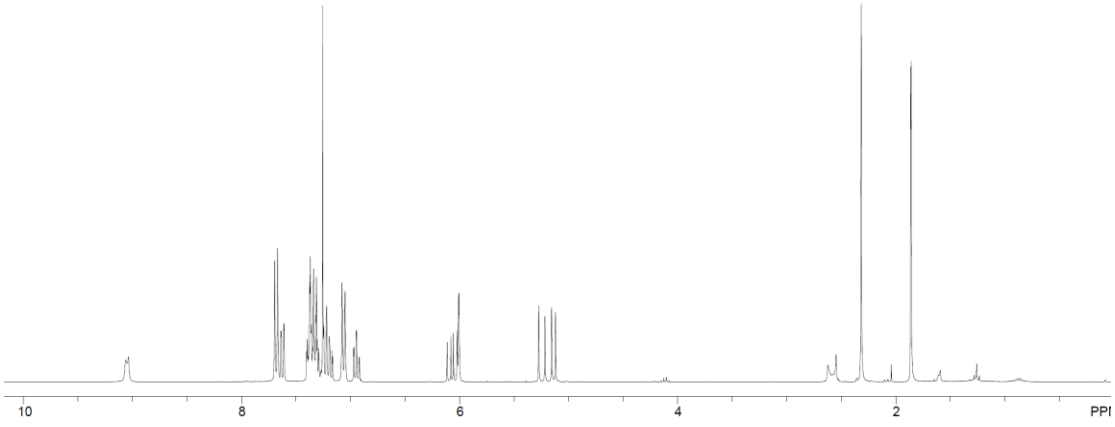

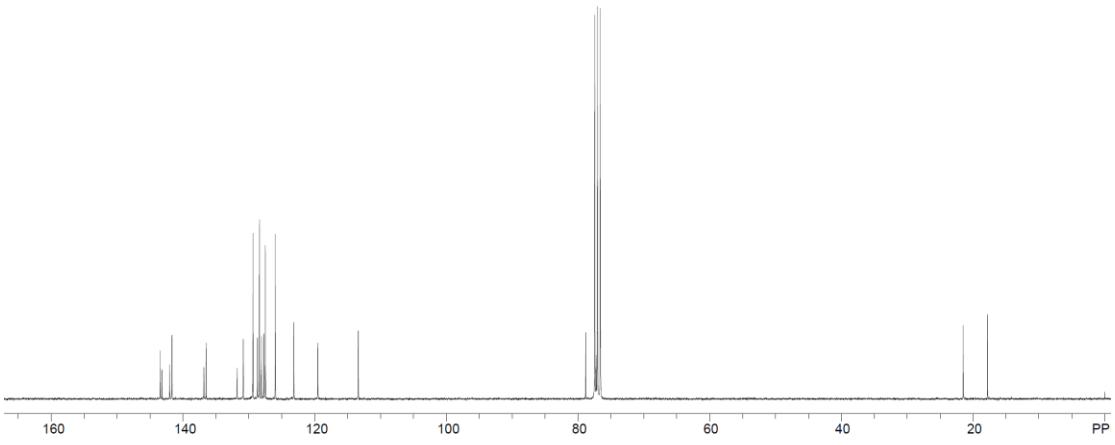

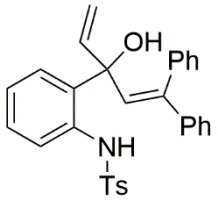
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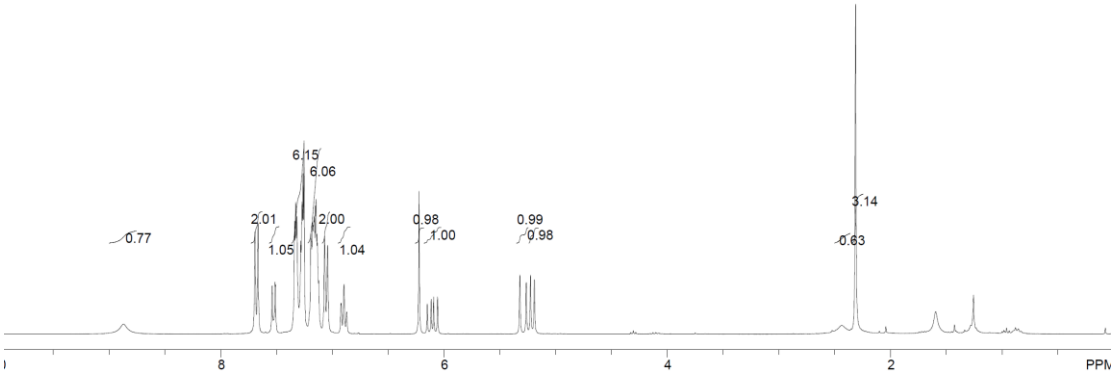
Ph
Ph
NH
Ts

1x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1.05
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1.00
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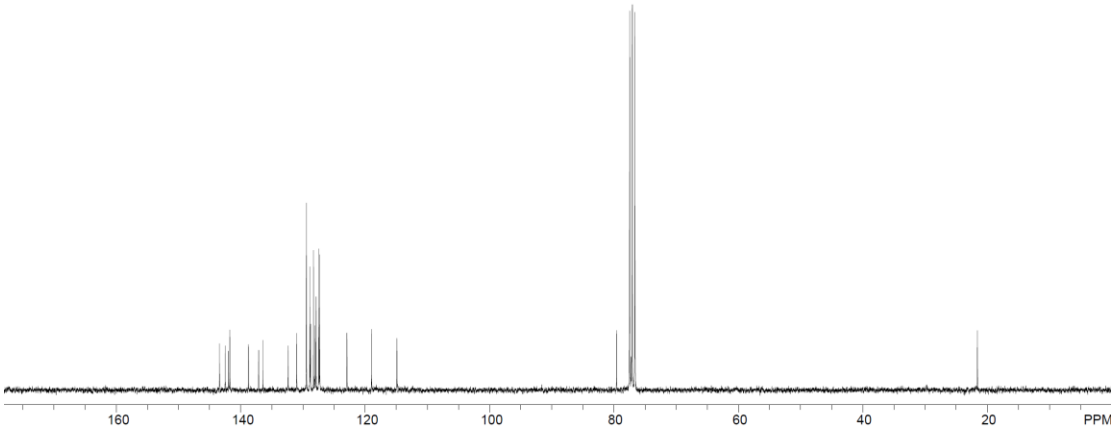
0.63
8
6
4
2
PPM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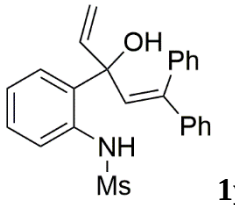
80
60
40
20
PPM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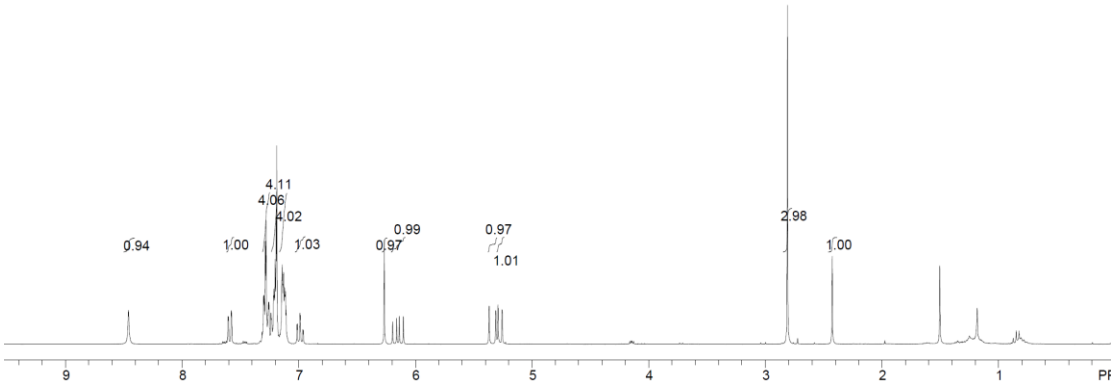
Ph
Ph
NH
Ms

1y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0.99
0.97
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2.98
1.00
9
8
7
6
5
4
3
2
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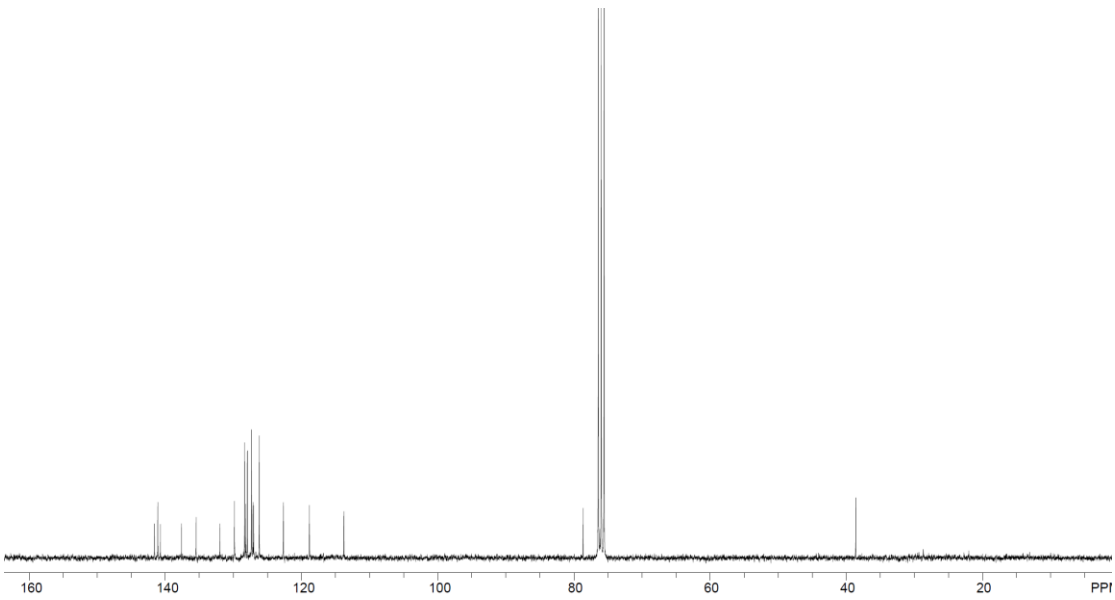
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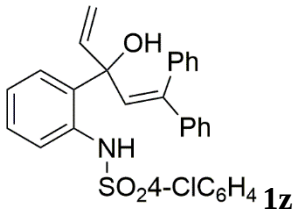
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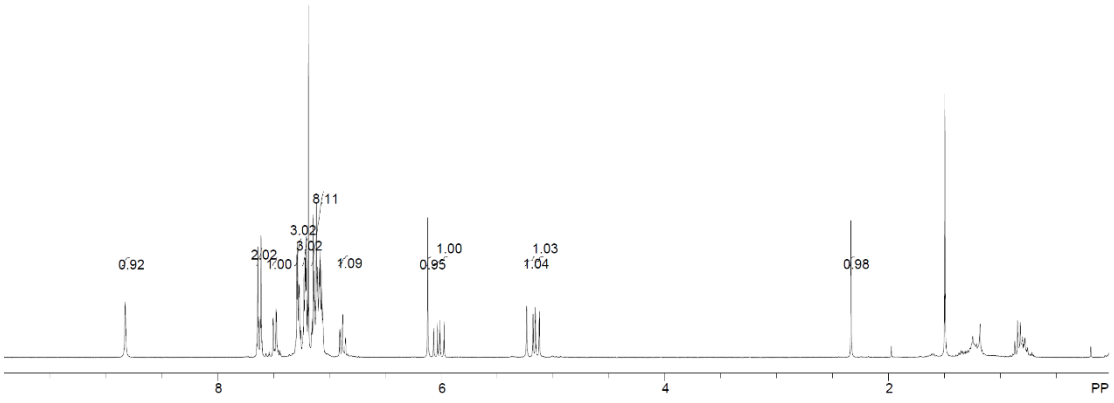
Ph
NH
SO2 4-ClC6H4

1z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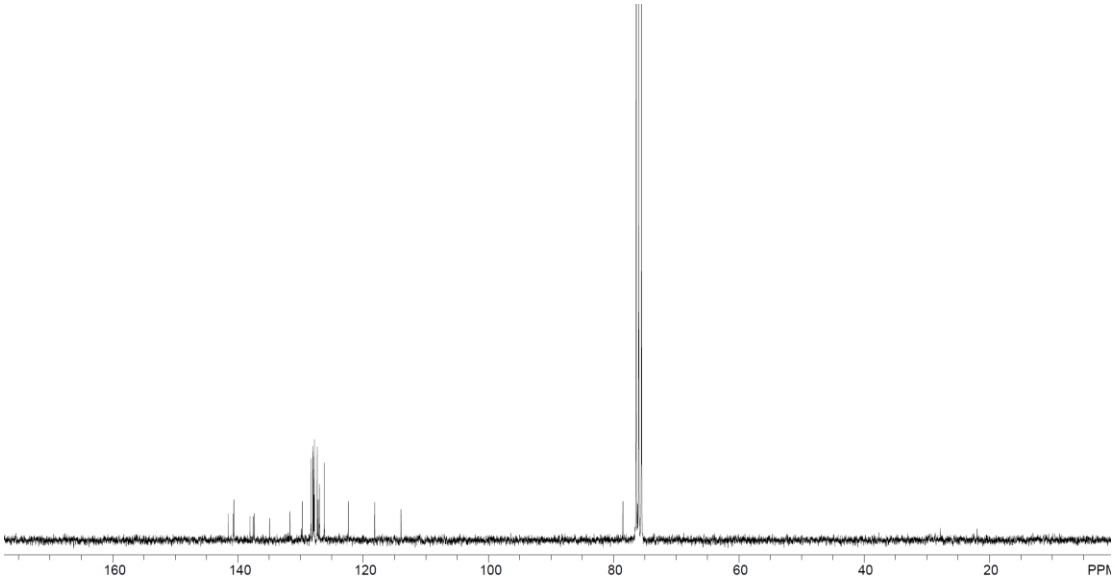
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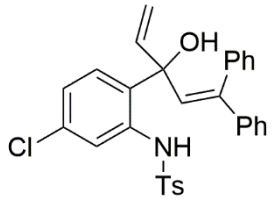
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Ph
Cl
NH
Ts

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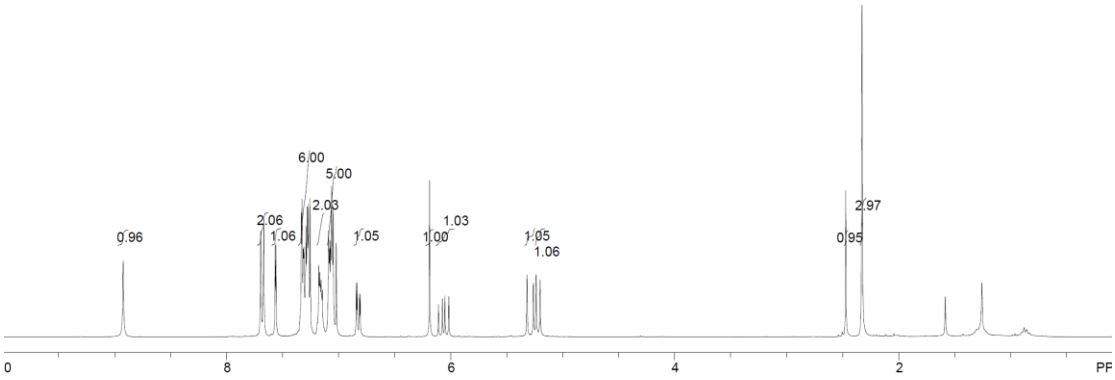
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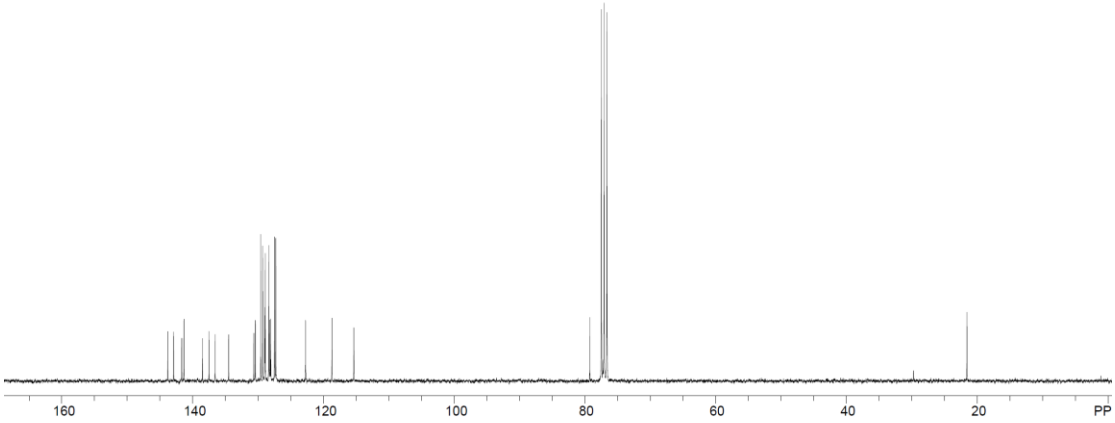
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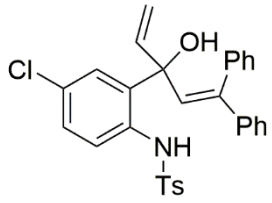
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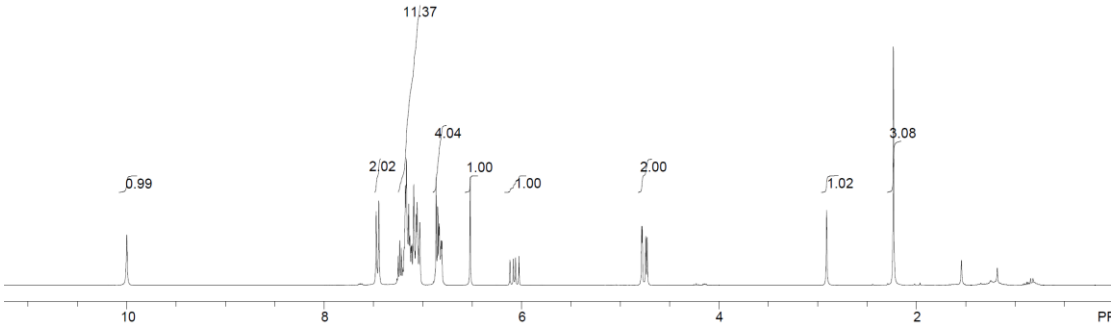
Ts

1ab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1.00
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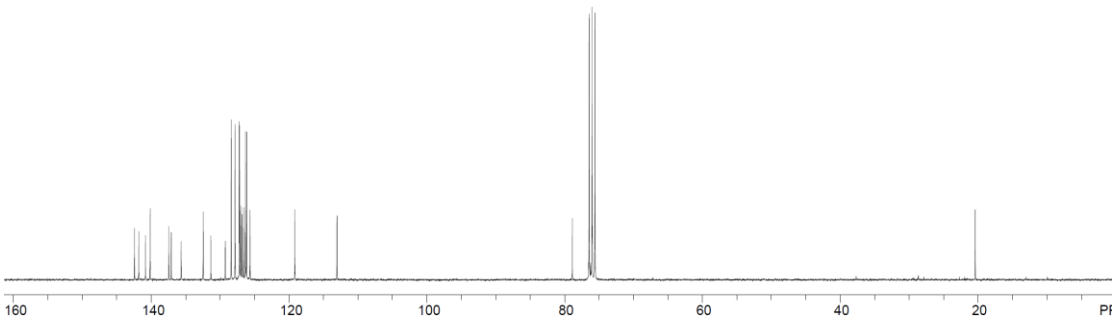
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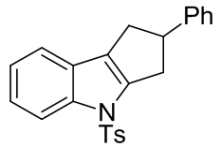
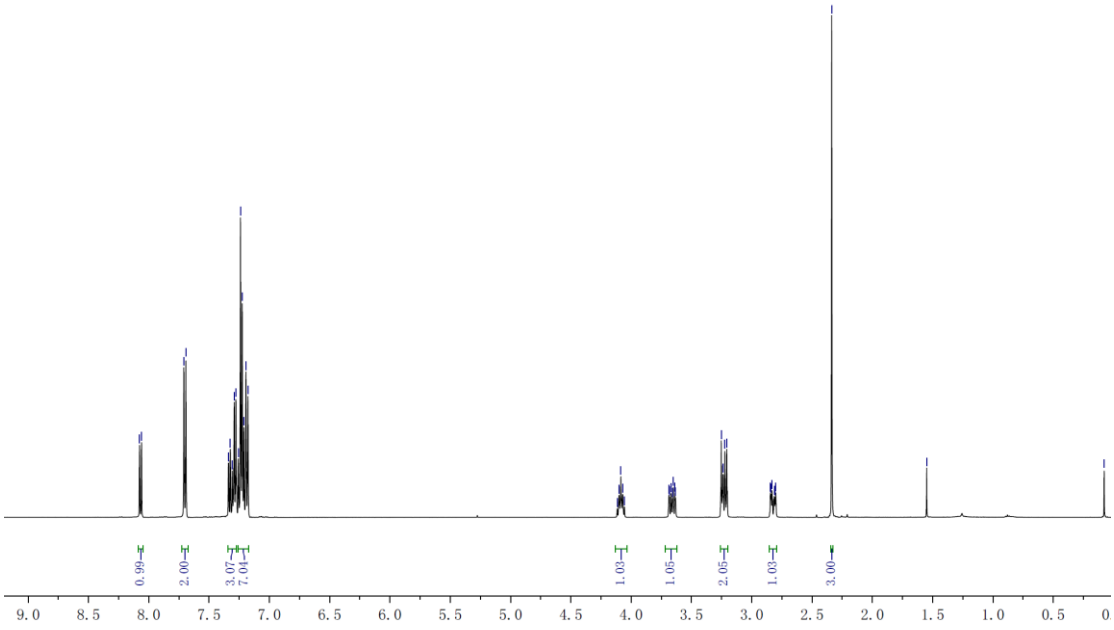

Ph
N
Ts

6a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8.0
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6.5
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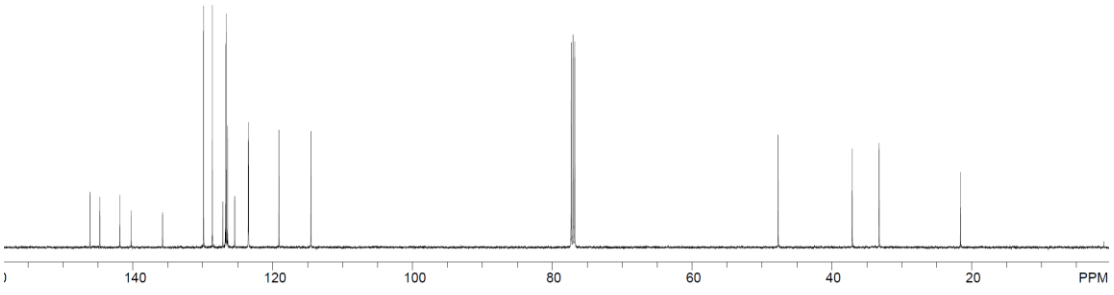
1.0
0.5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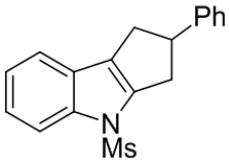
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N
Ms

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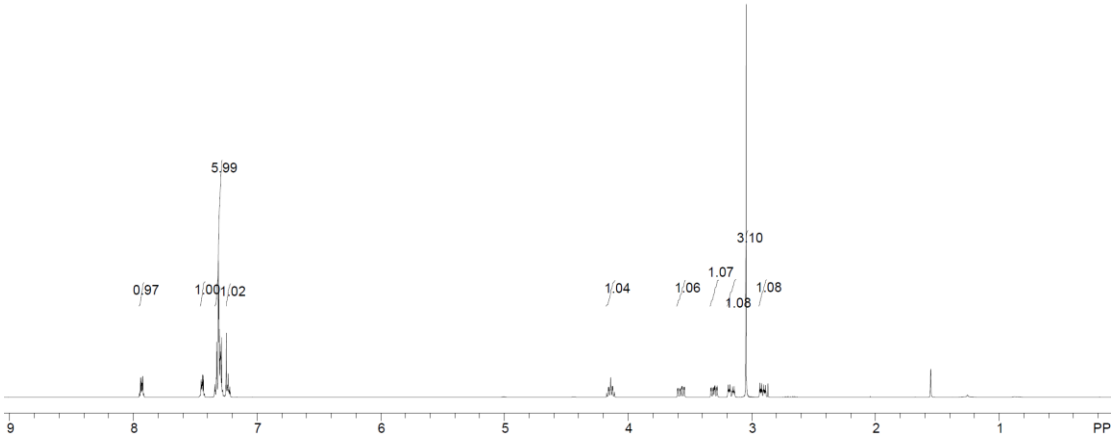
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3
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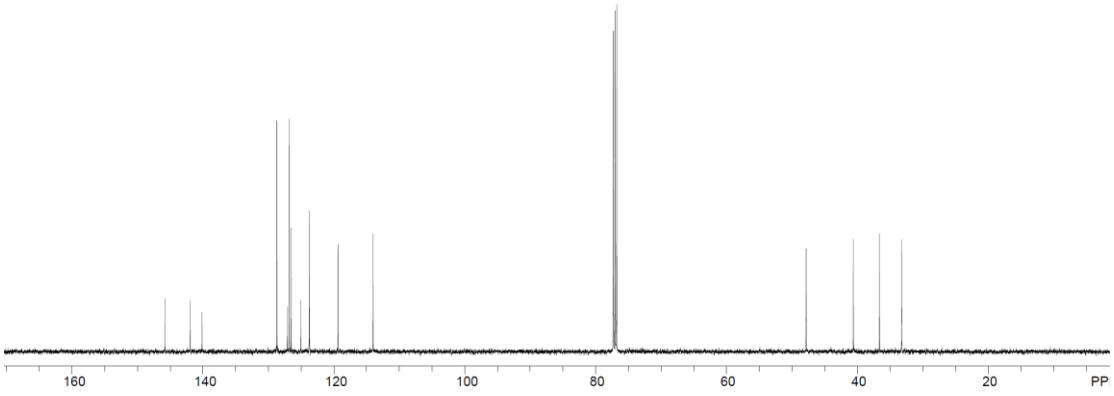
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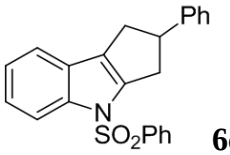
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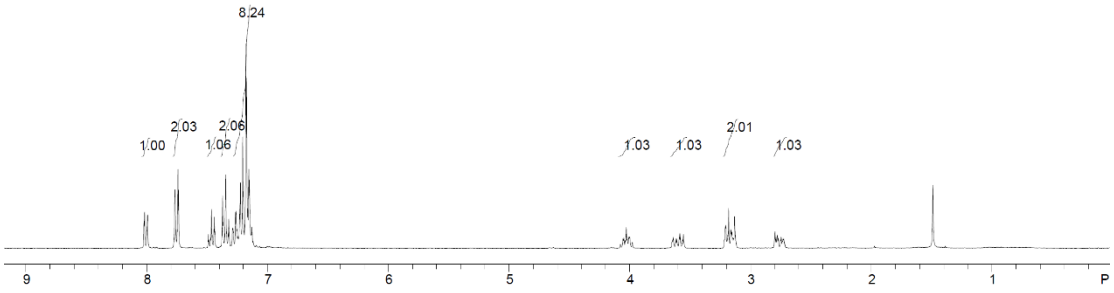
N
SO2Ph

6c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3
2
1
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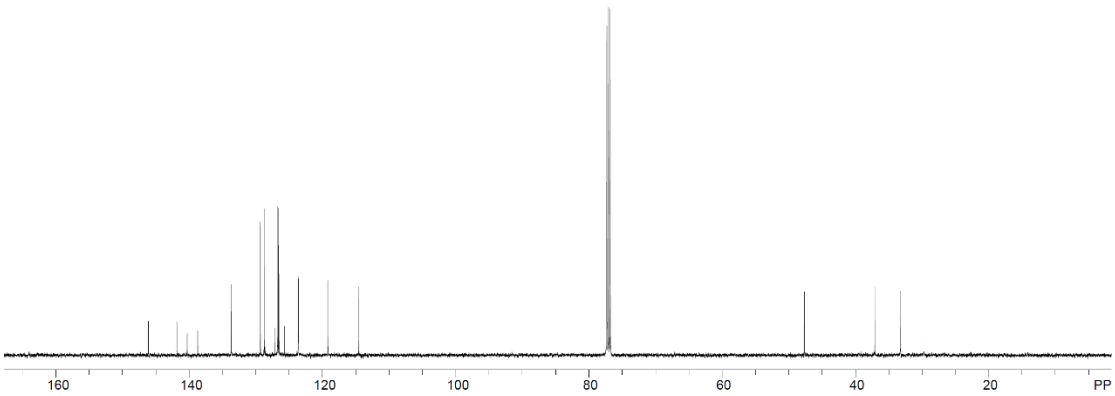
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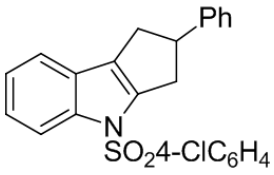
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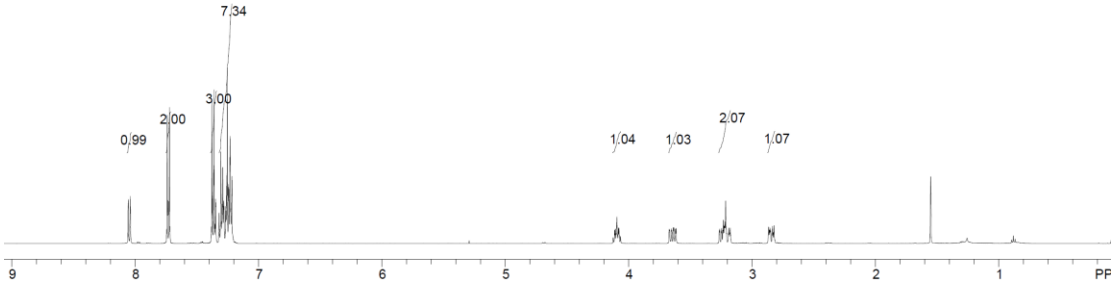
N
SO2 4-ClC6H4

6d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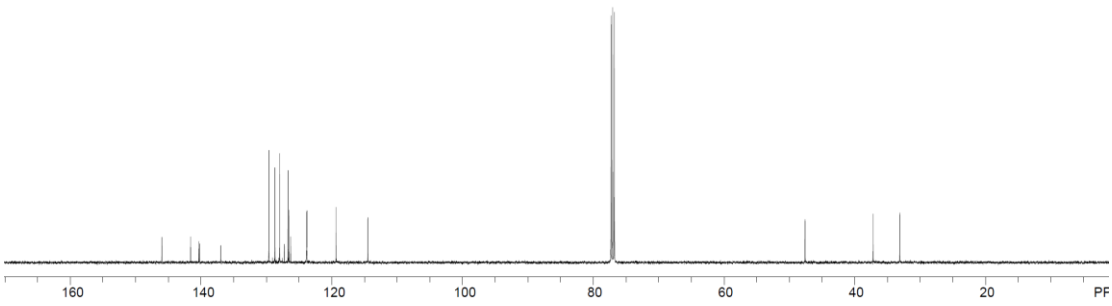
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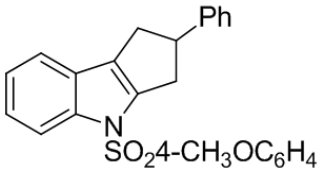
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N
SO2 4-CH3OC6H4

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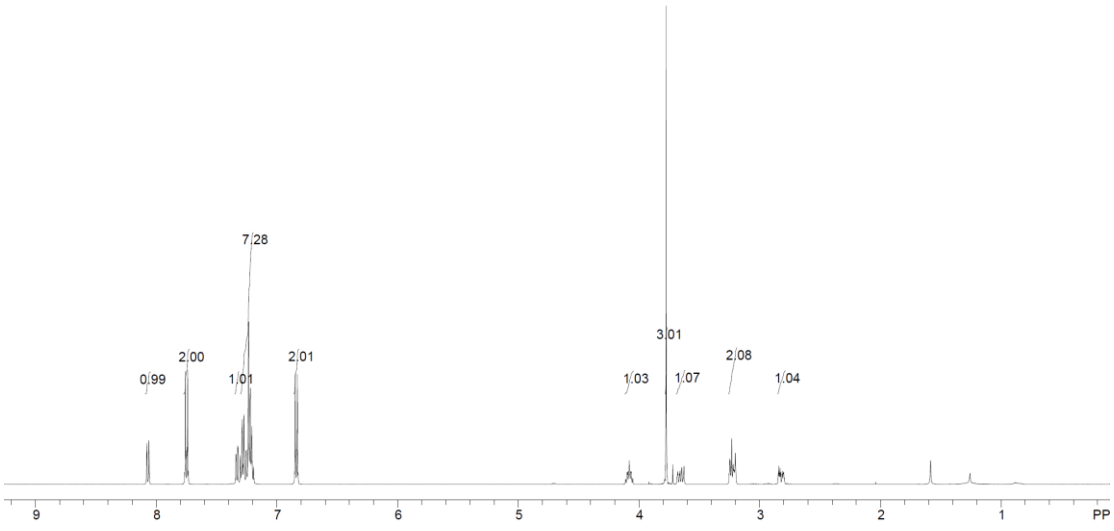
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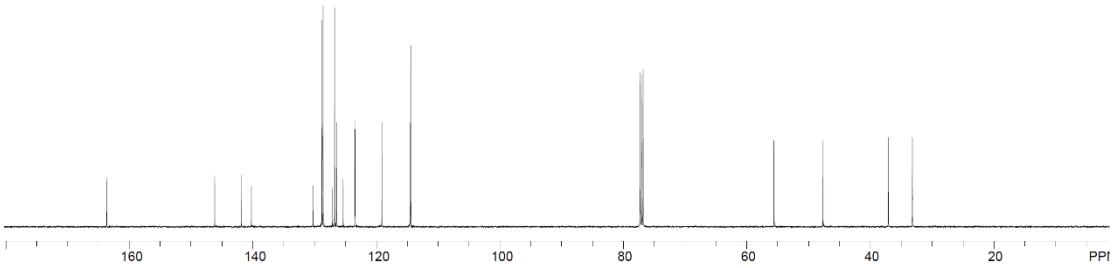
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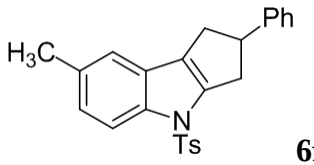
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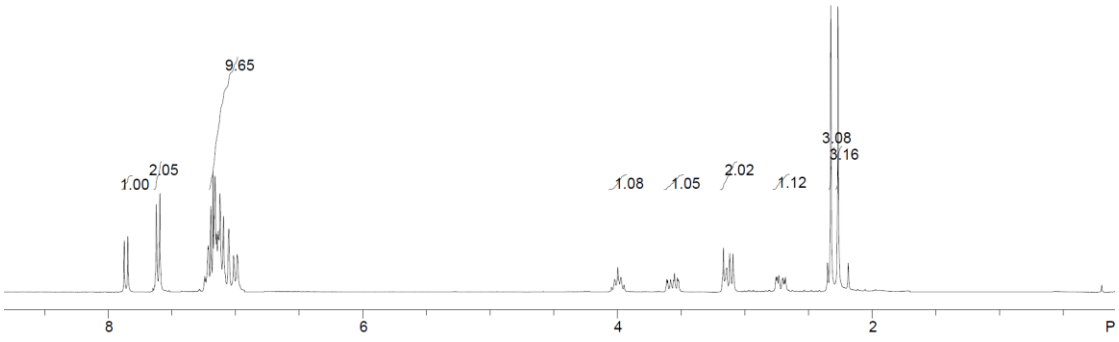
H3C
N
Ts

6f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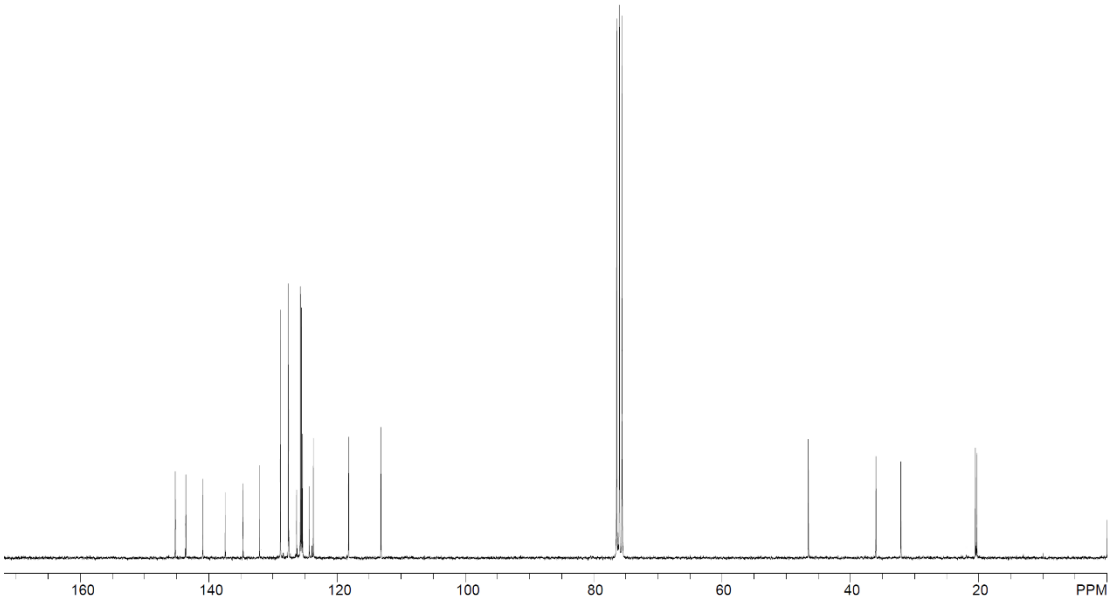
6
4
2
P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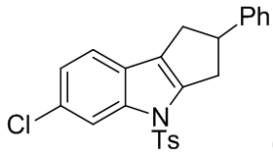
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Cl
N
Ts

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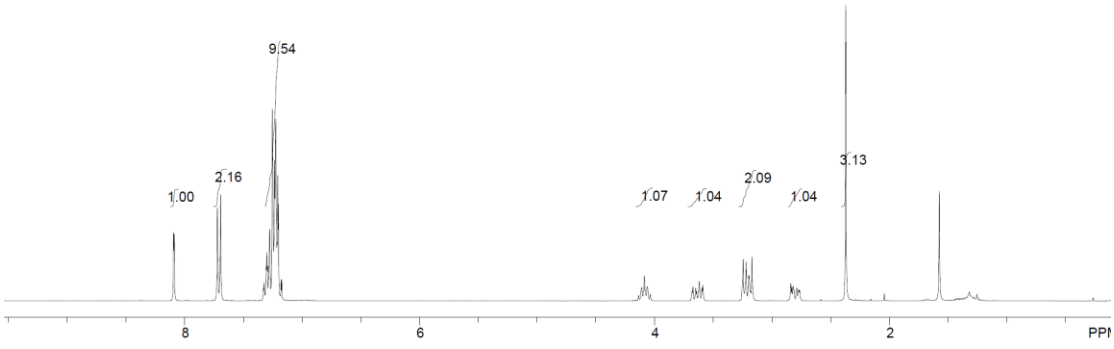
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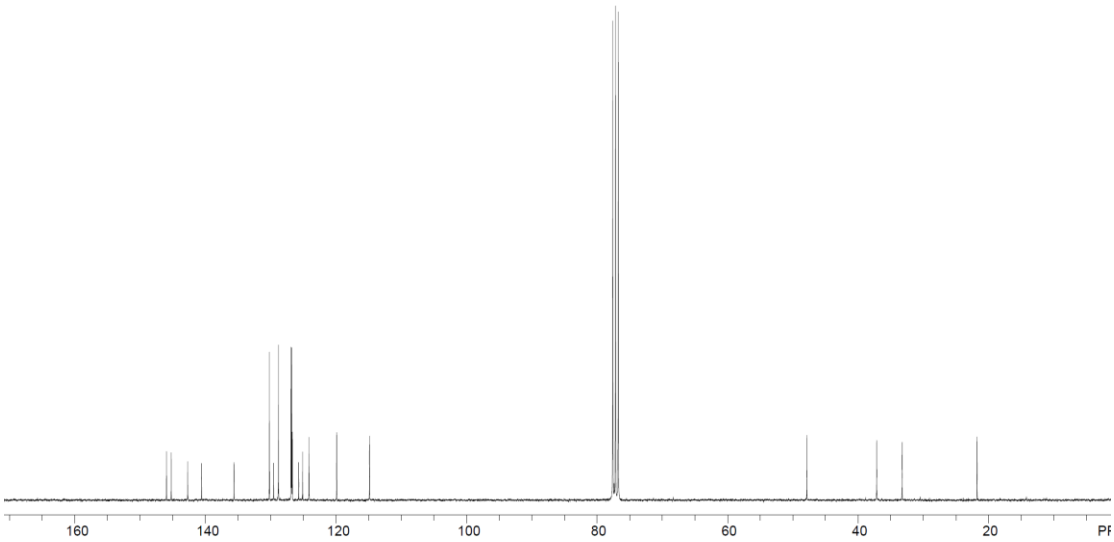
PPM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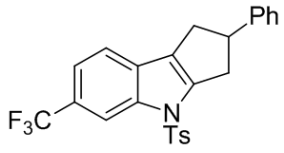
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F3C
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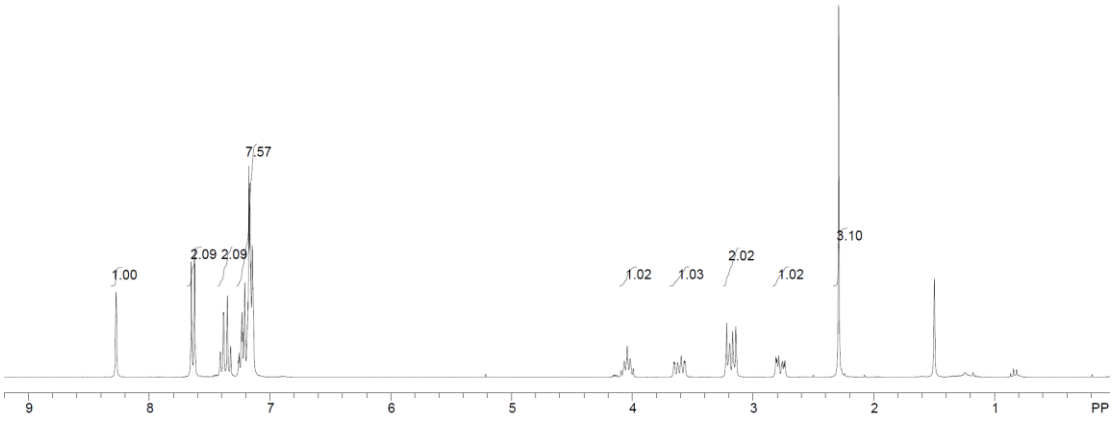
Ts

6h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1.02
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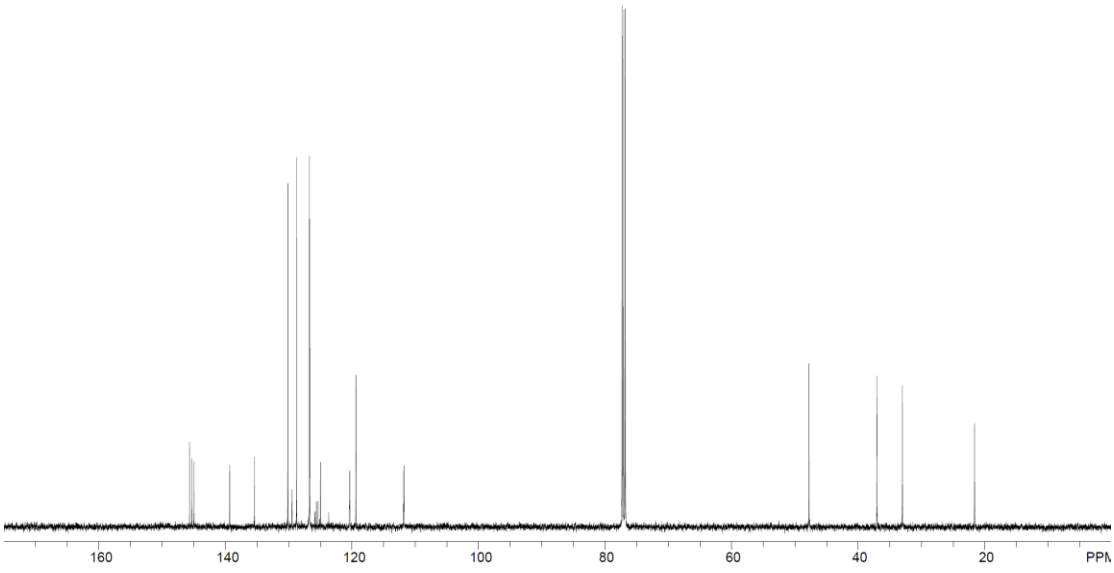
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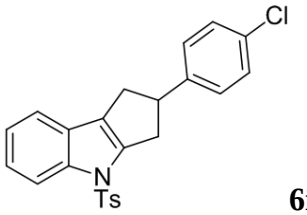
Cl
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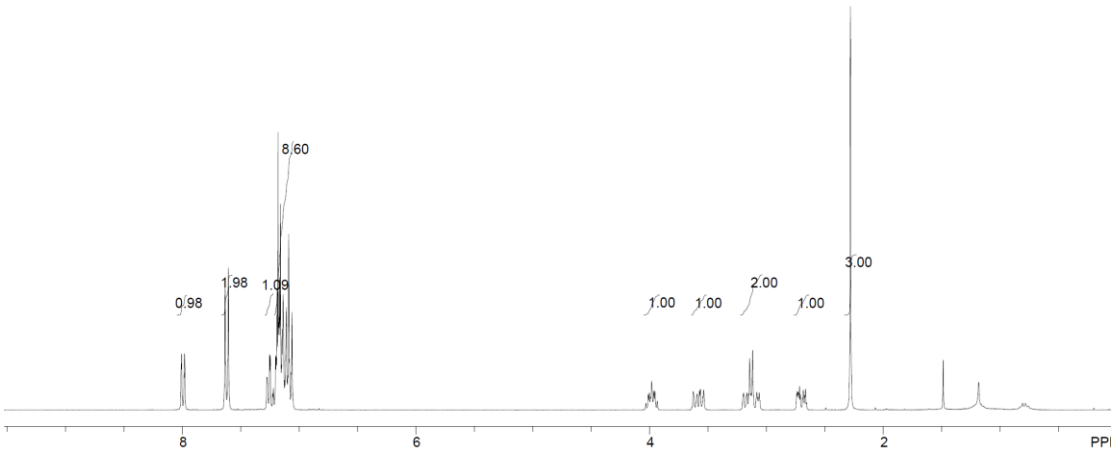
Ts

6i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1.00
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6
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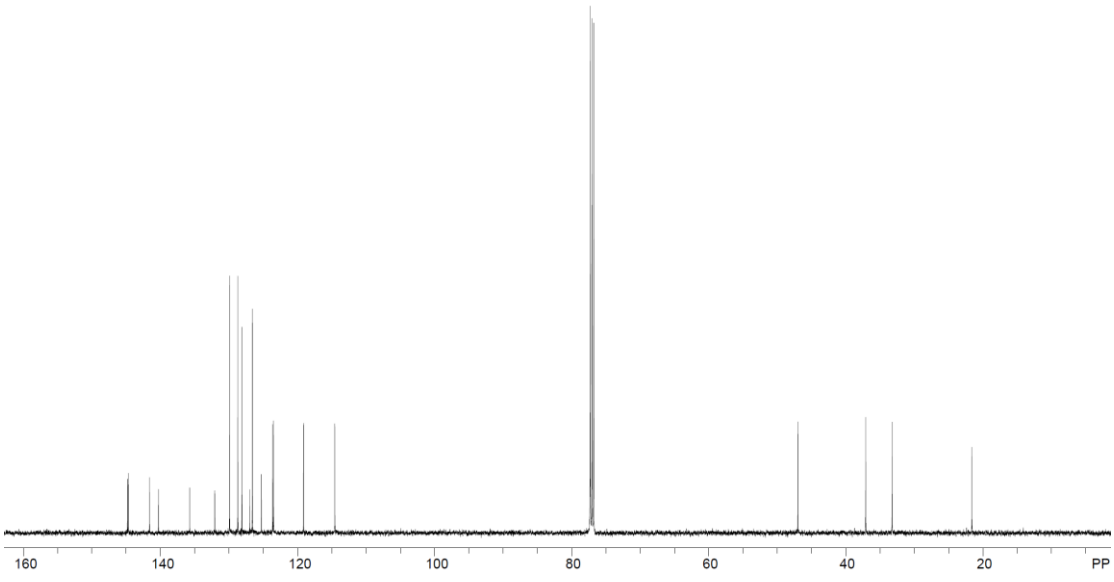
2
PPI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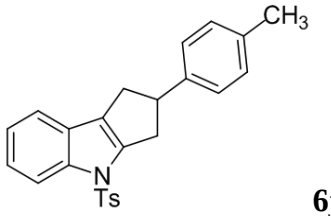
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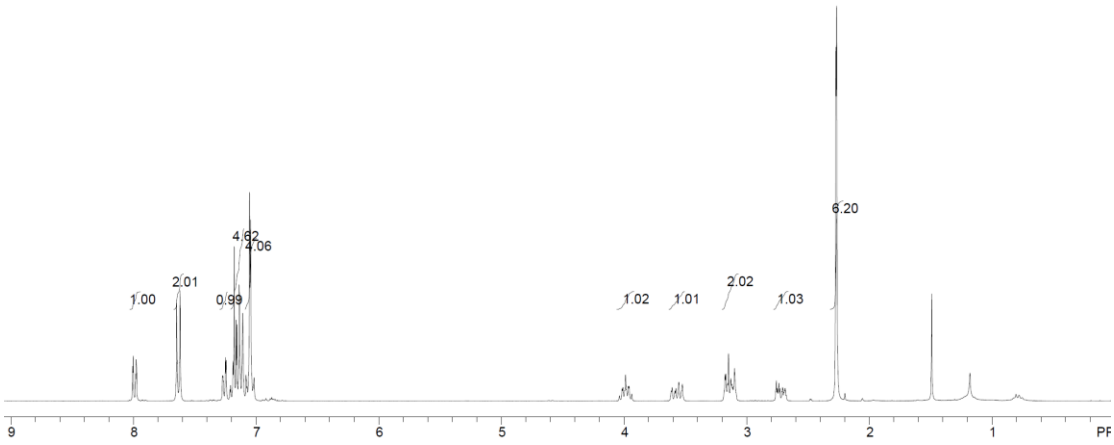
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1.03
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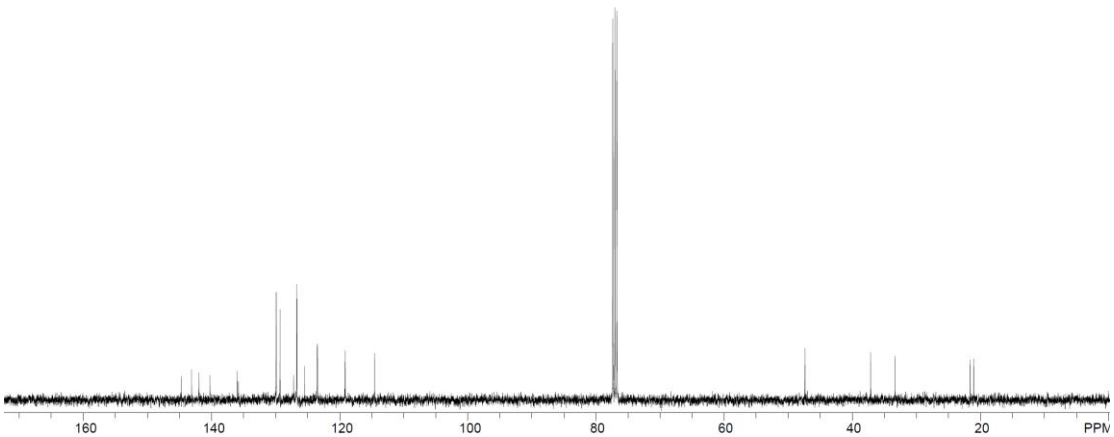
PF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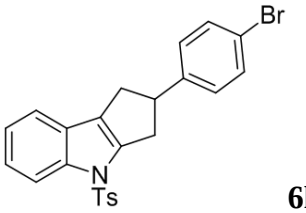
Br
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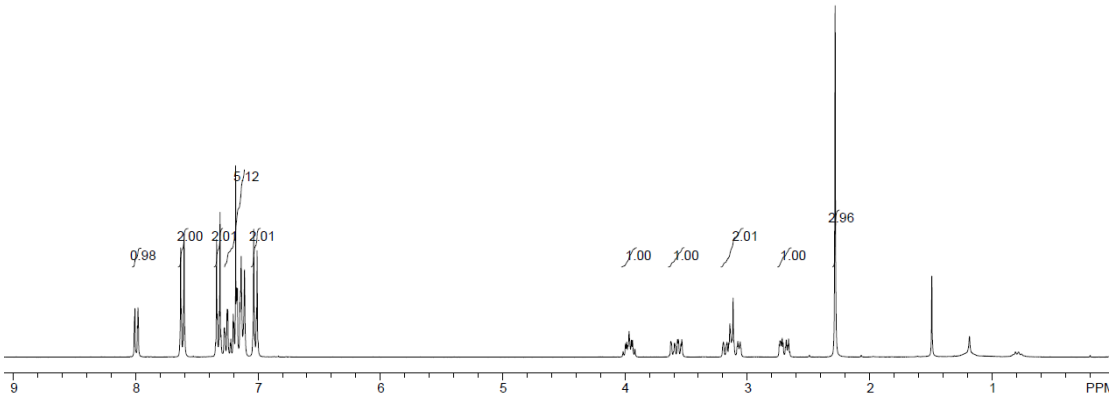
Ts

6k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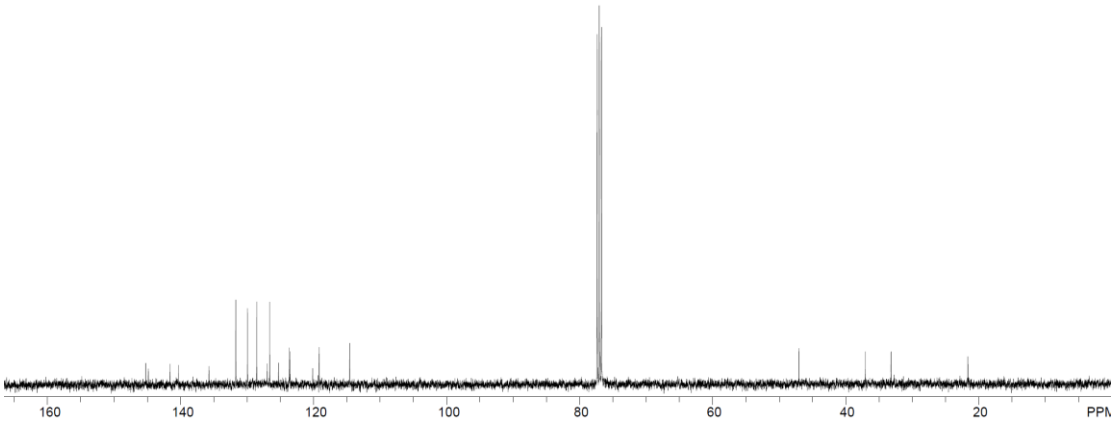
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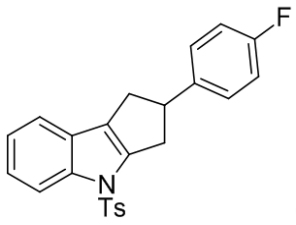
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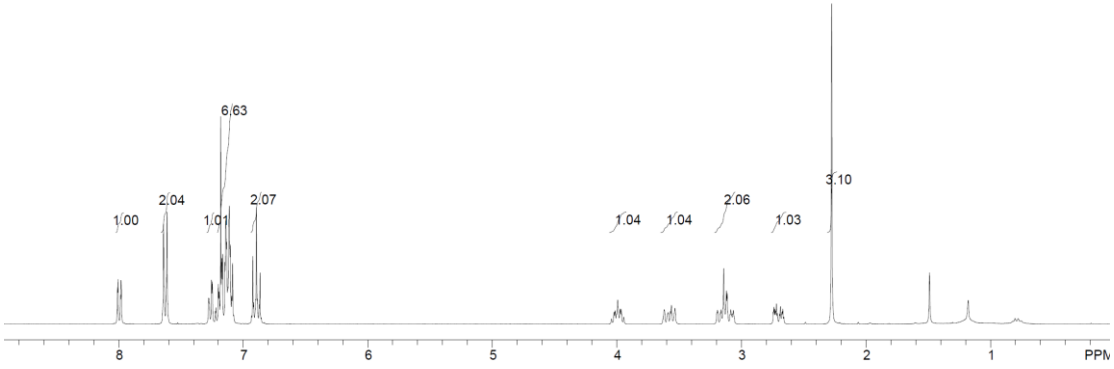
N
Ts

6l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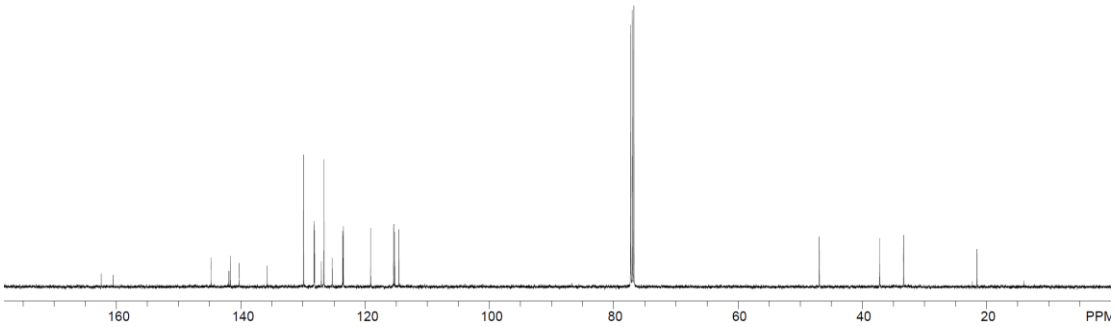
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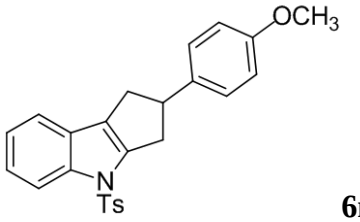
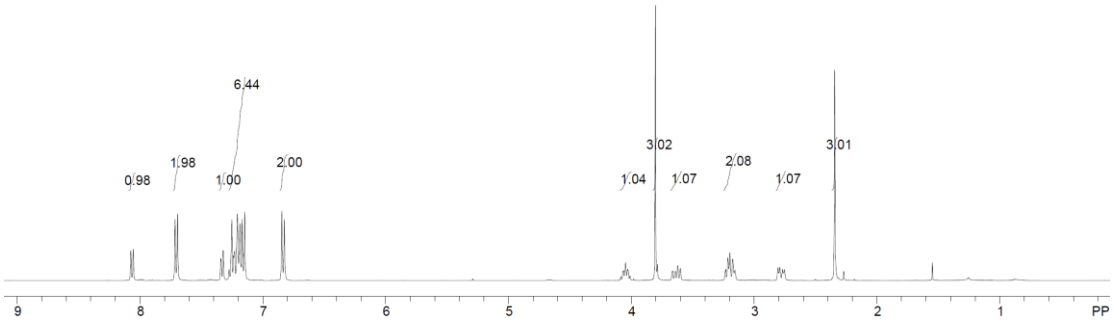

OCH3
N
Ts

6m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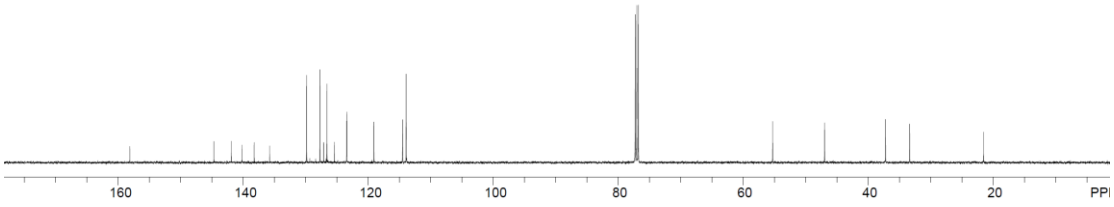
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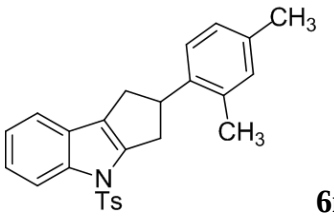
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CH3
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Ts

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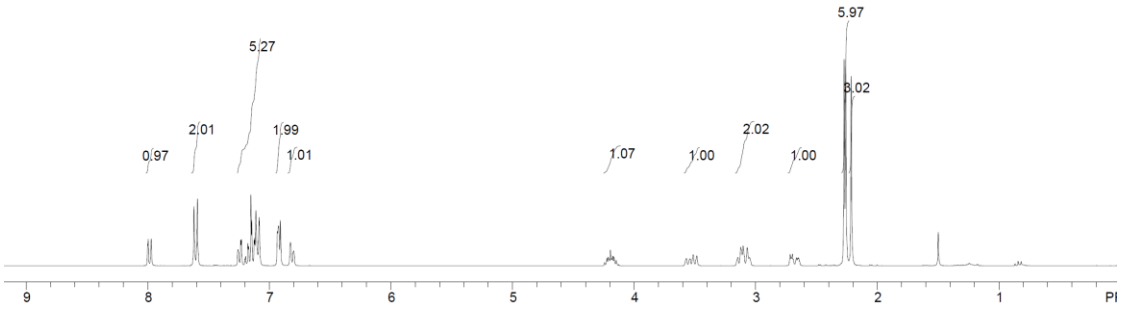
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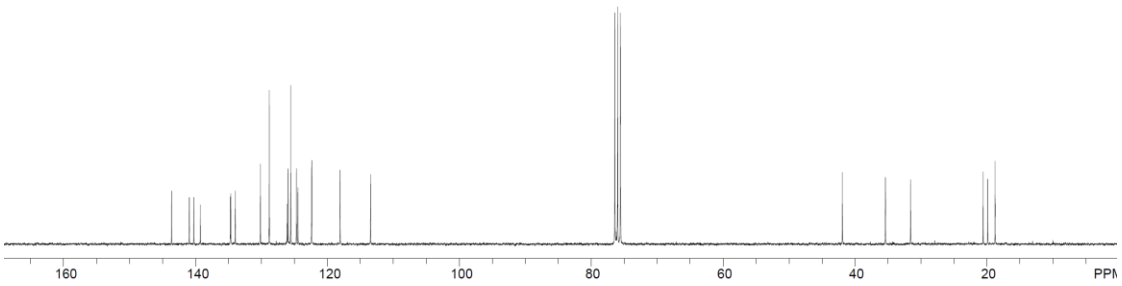
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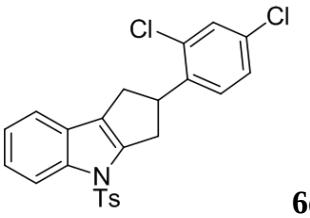
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Cl
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Ts

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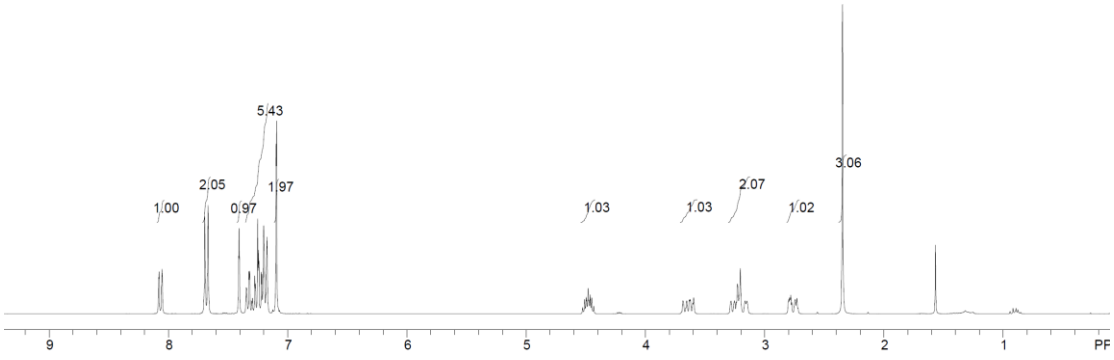
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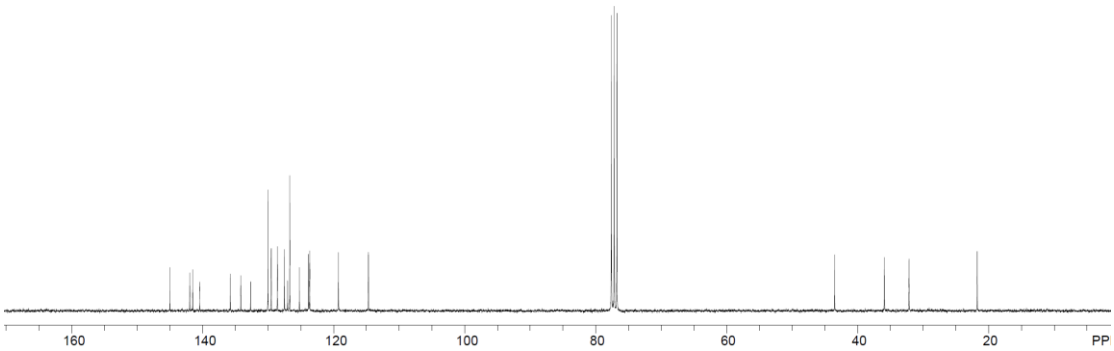
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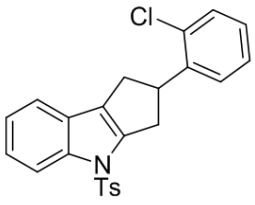
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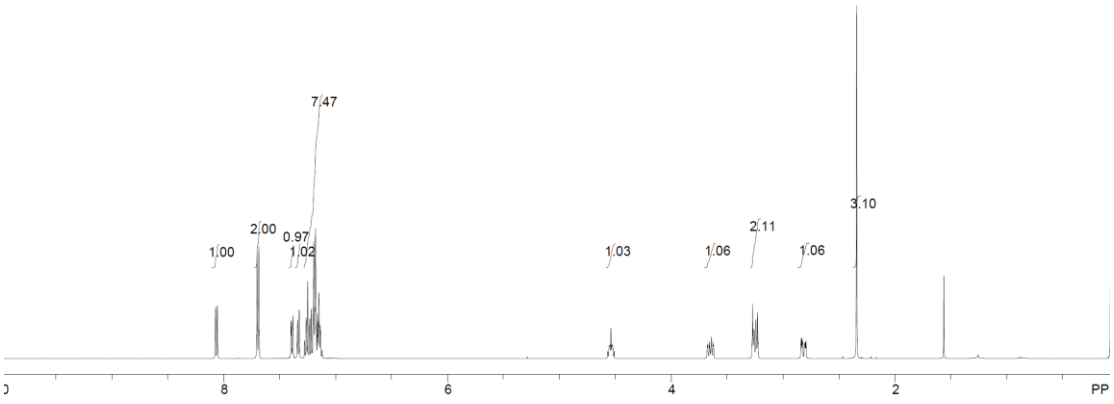
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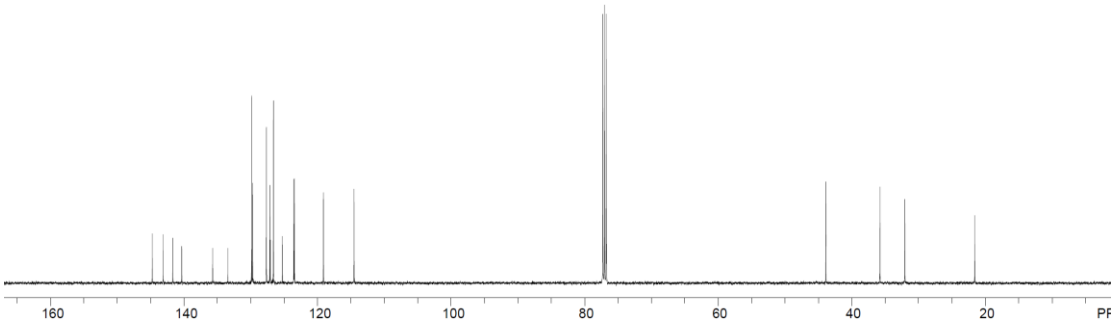
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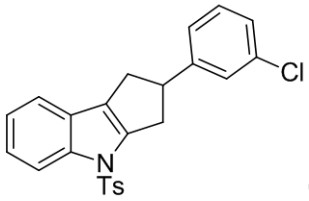
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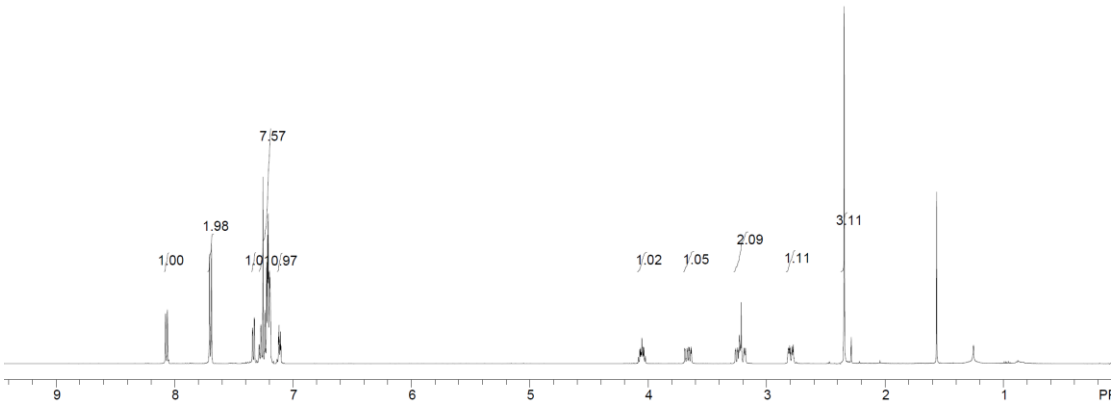
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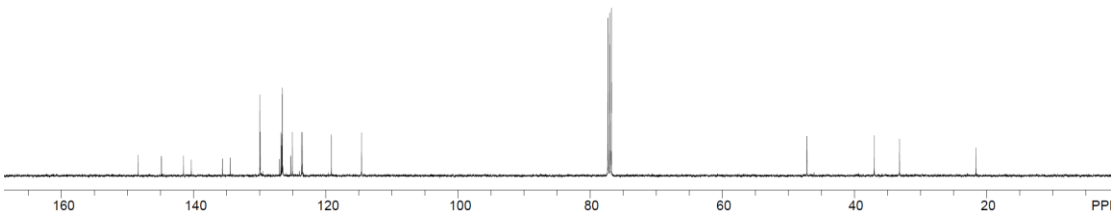
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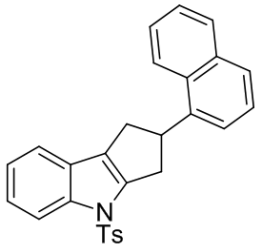
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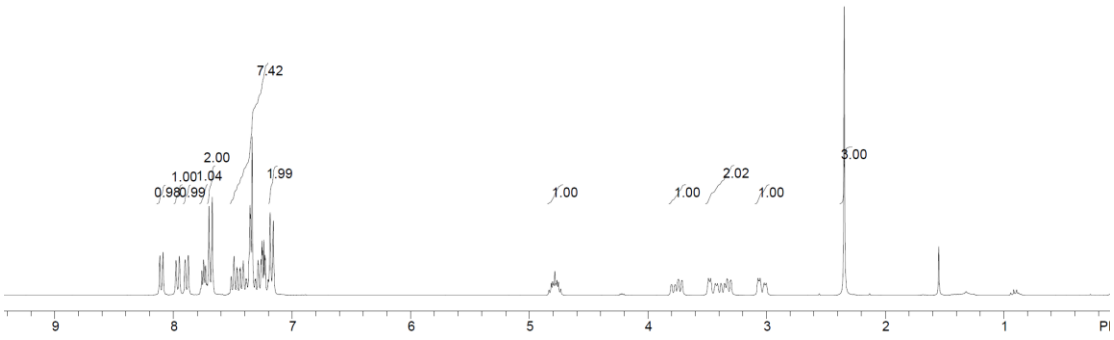
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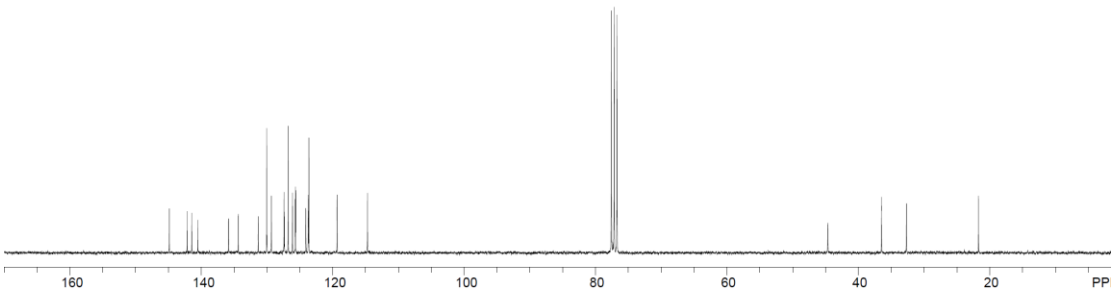
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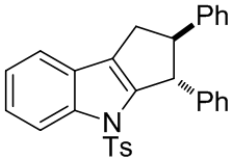
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Ph
N
Ts

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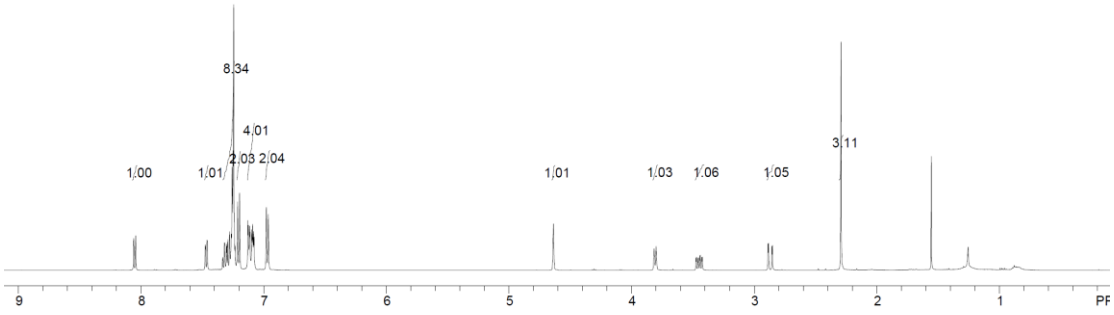
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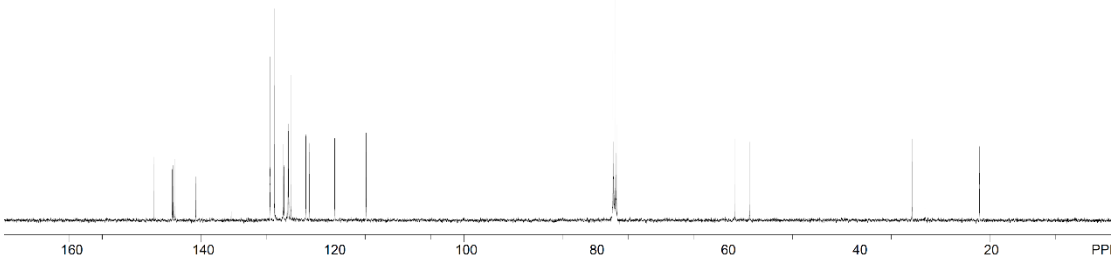
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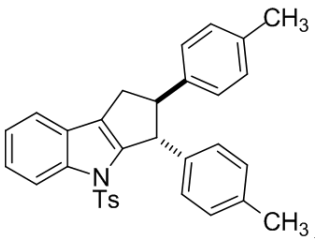
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CH3

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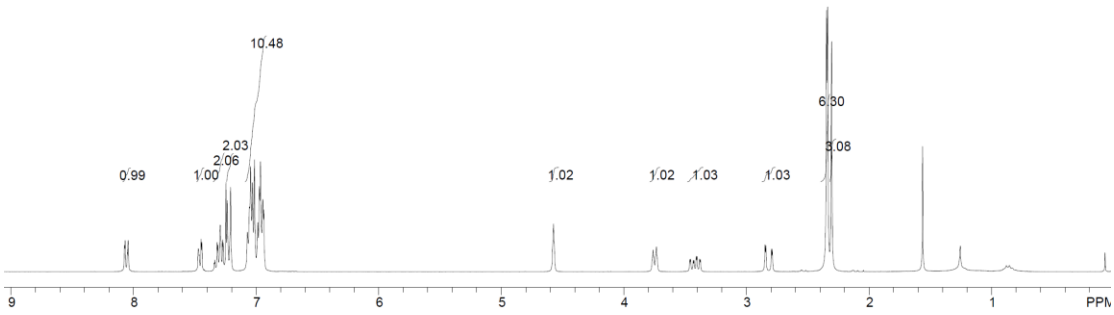
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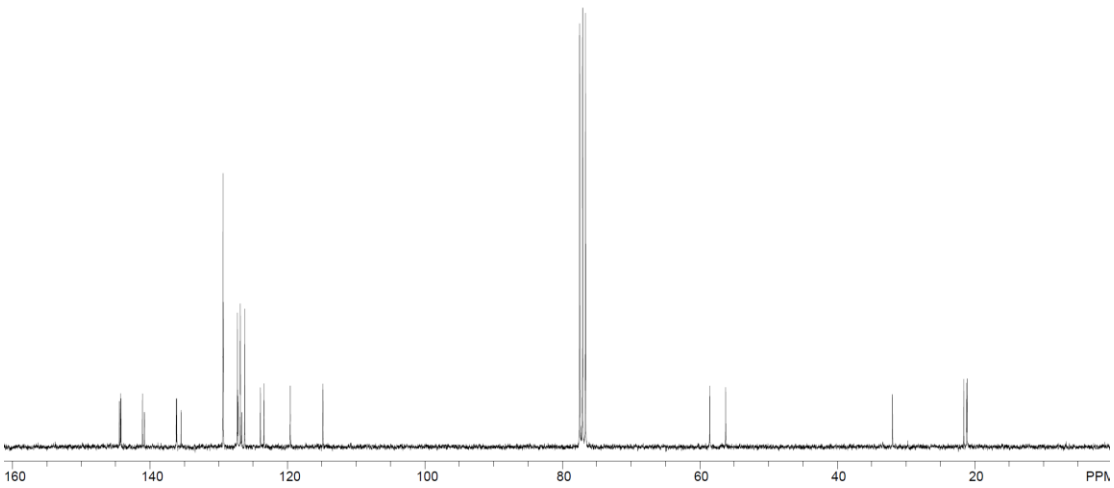
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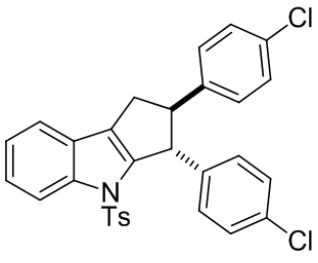
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Ts
Cl

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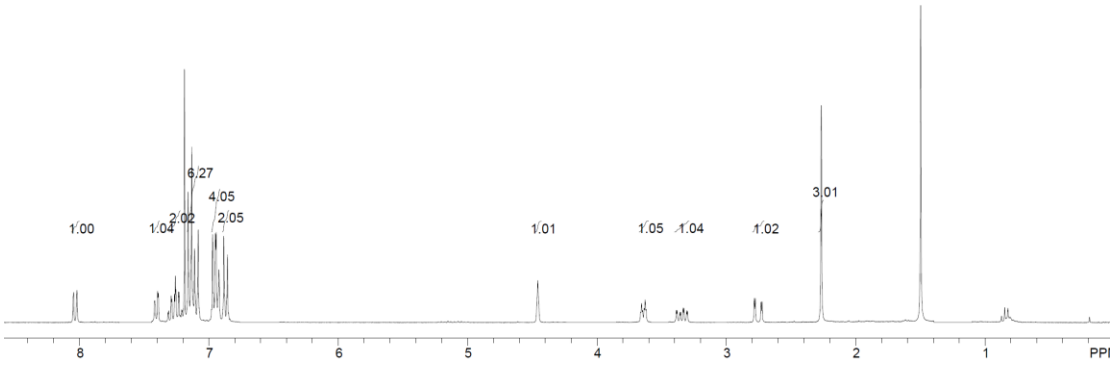
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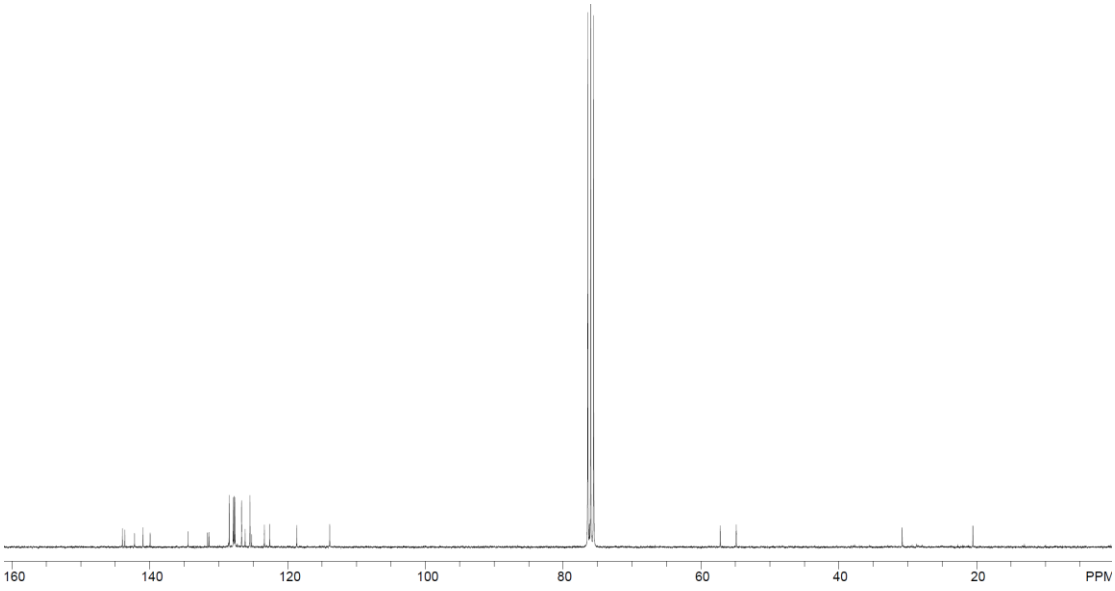
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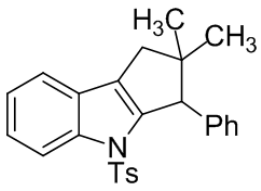
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CH3
Ph
N
Ts

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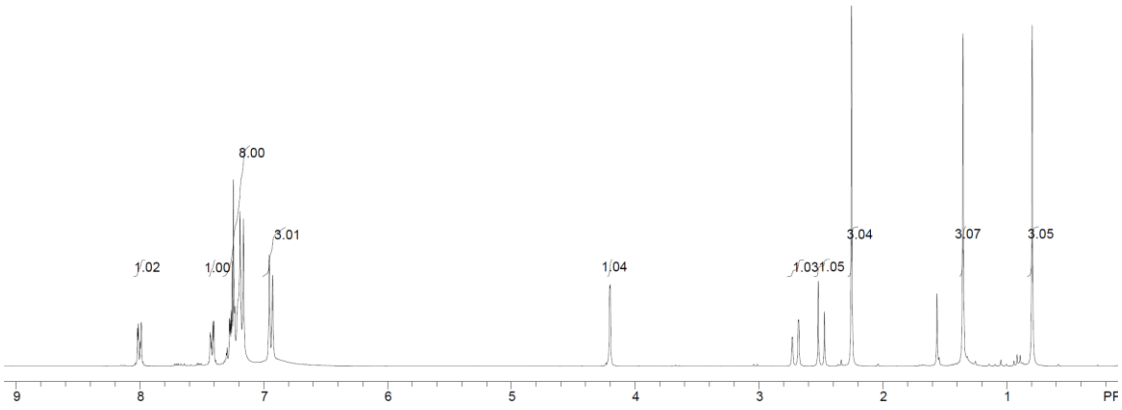
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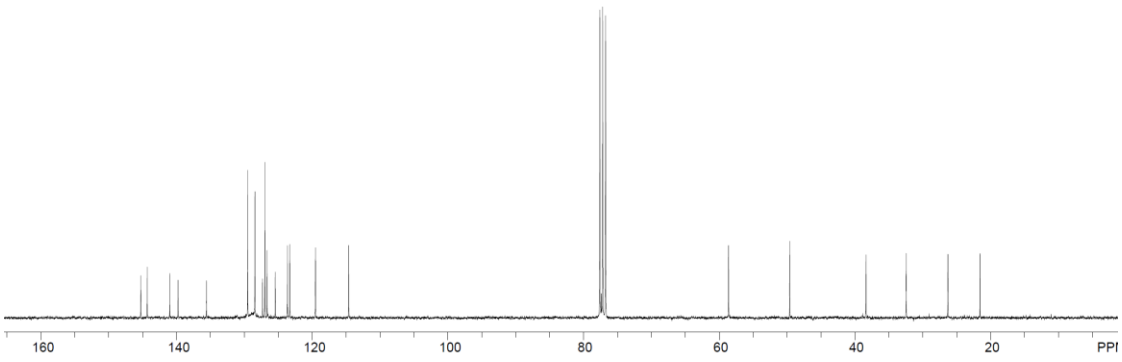
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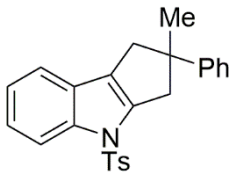
Me
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Ts

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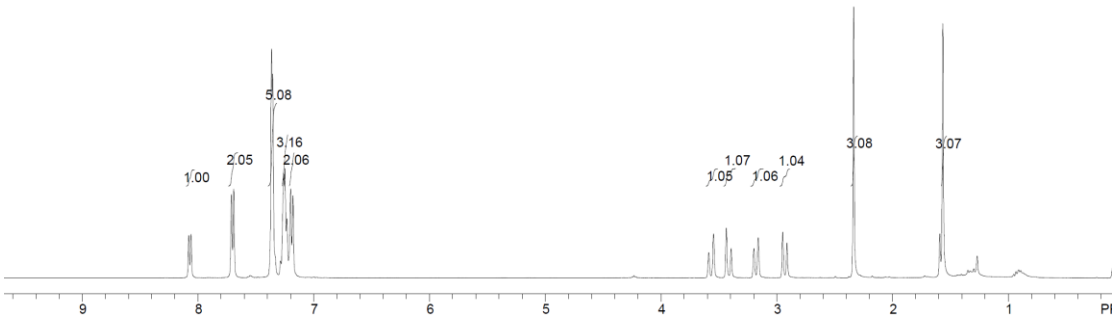
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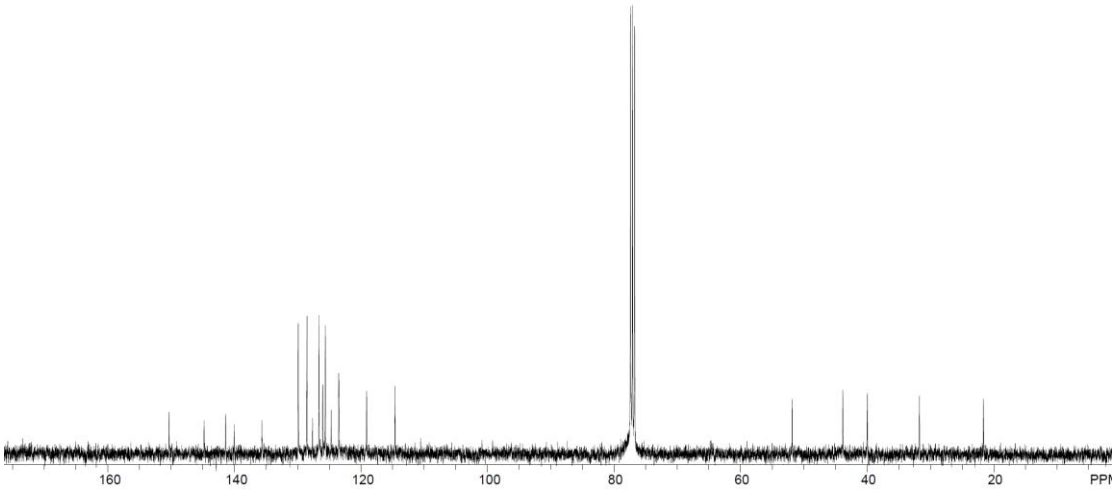
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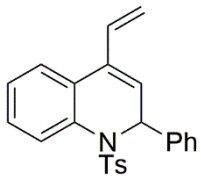
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Ph

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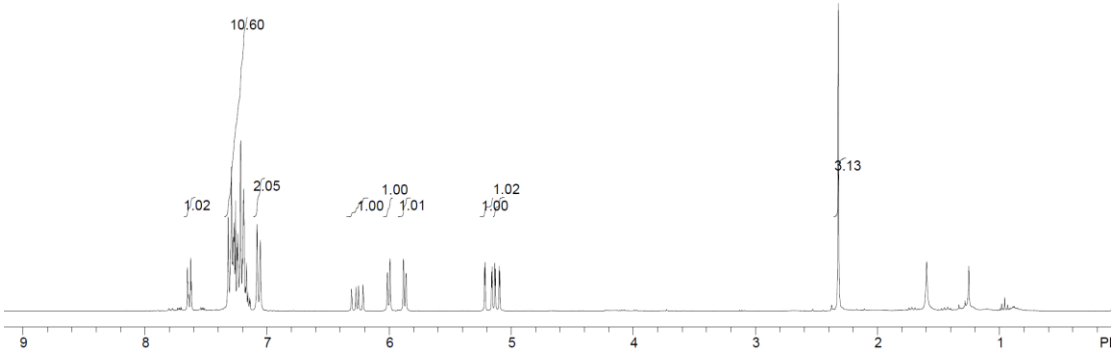
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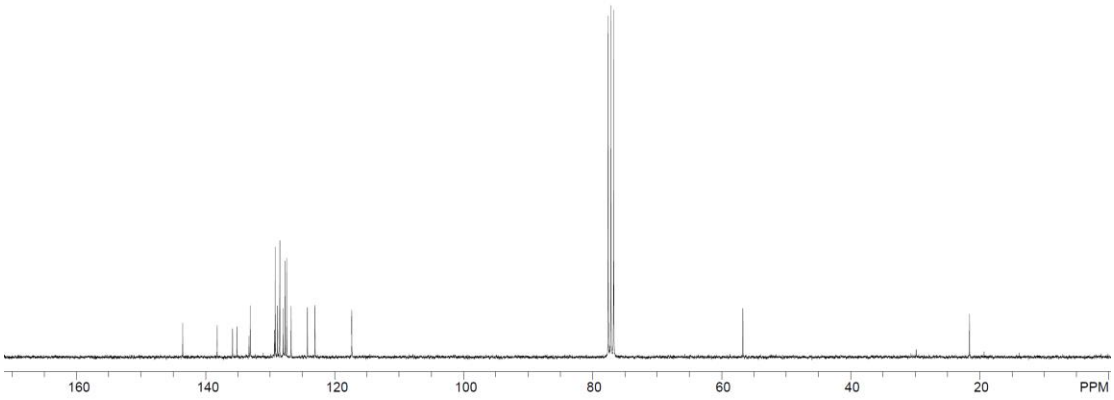
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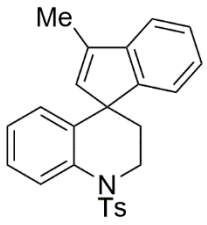
Me
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Ts

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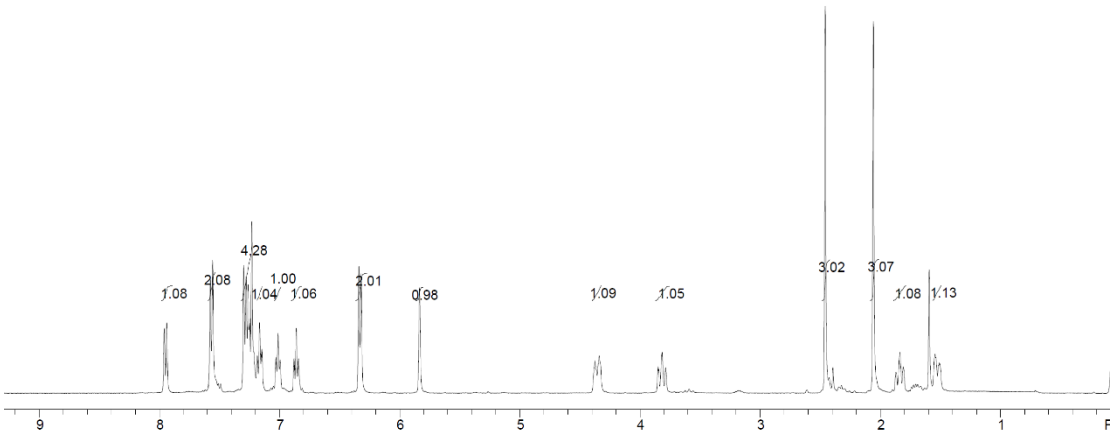
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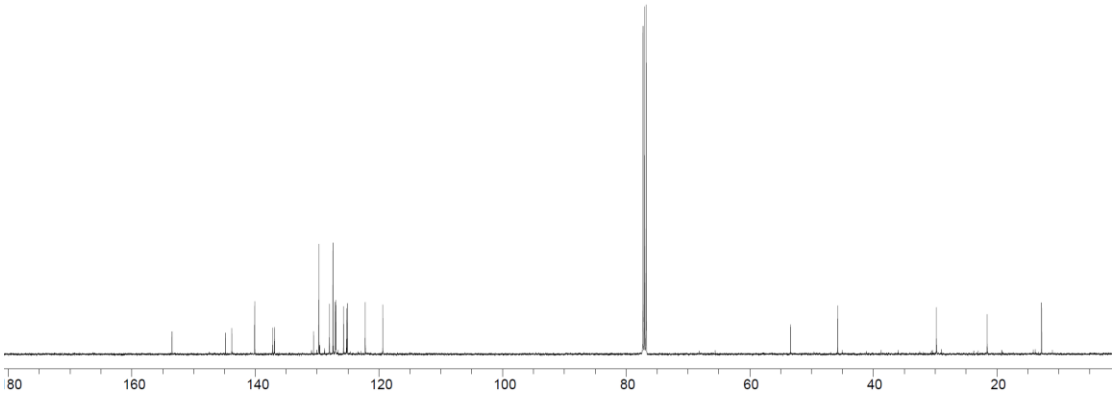
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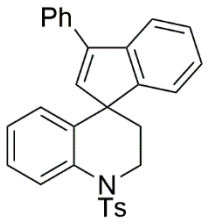
Ph
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Ts

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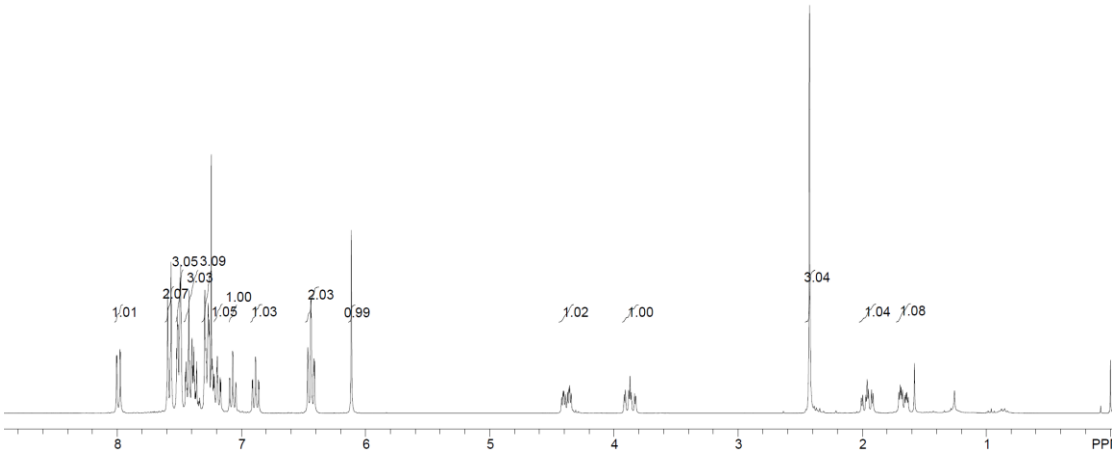
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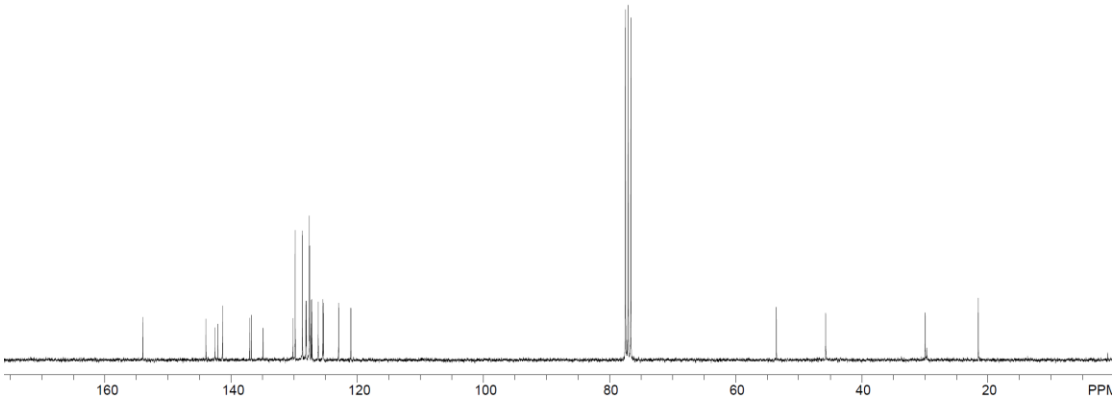
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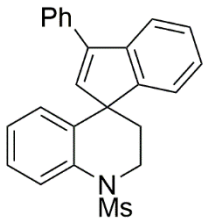
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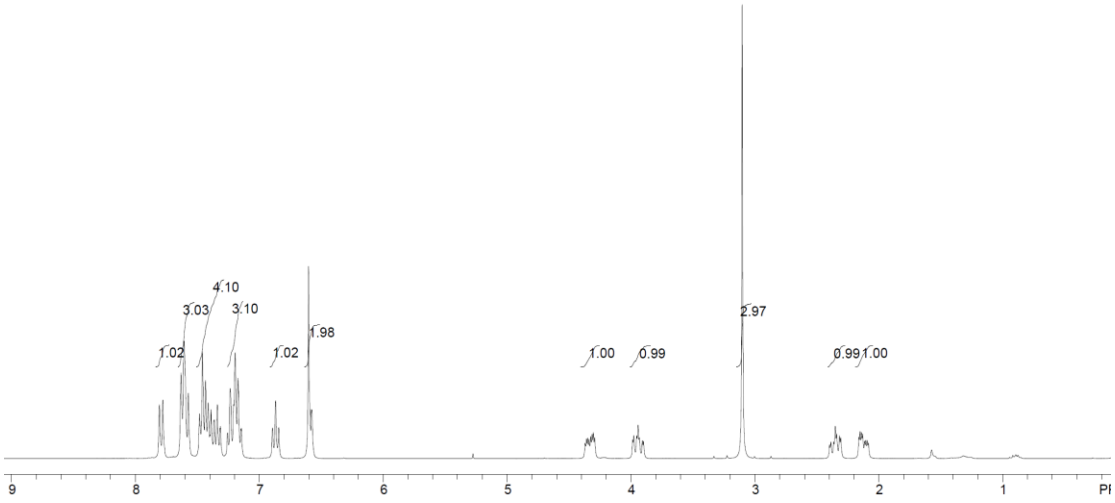
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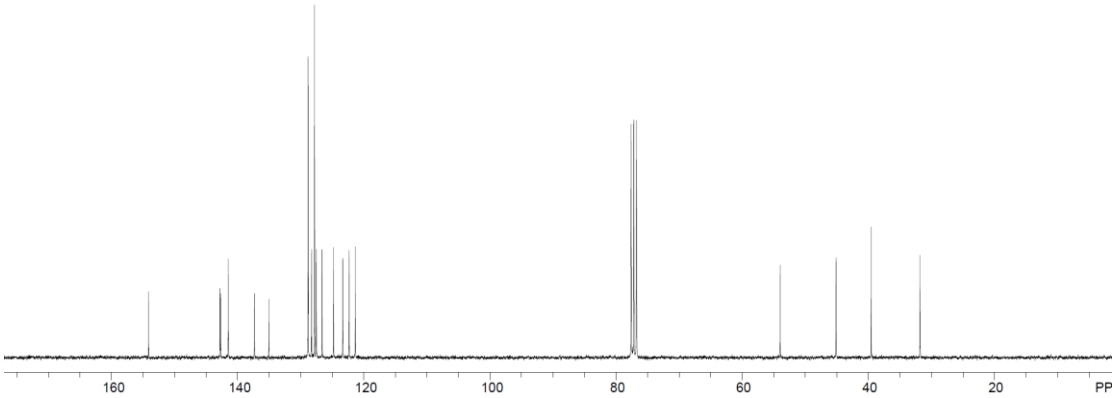
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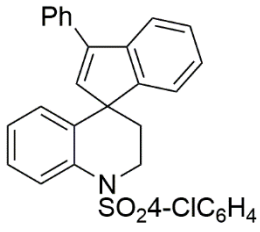
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SO2 4-ClC6H4

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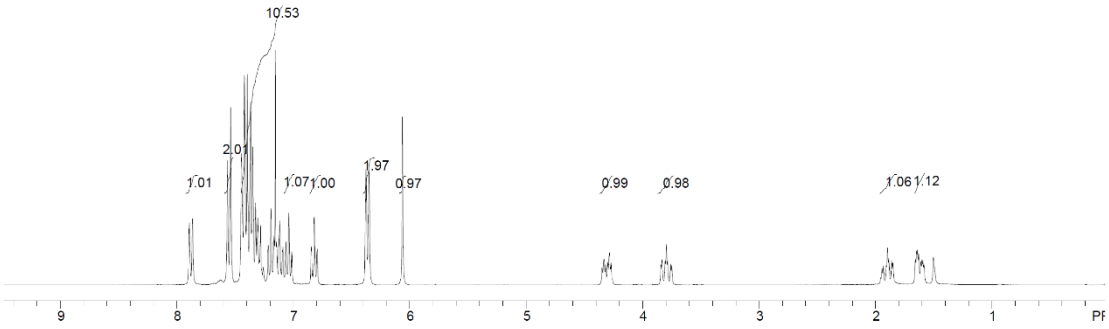
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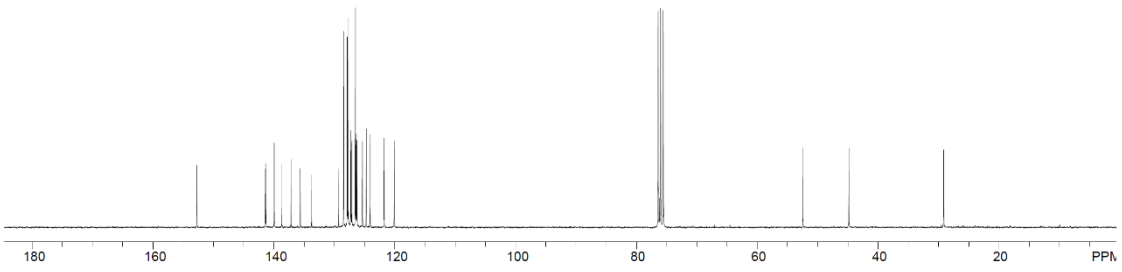
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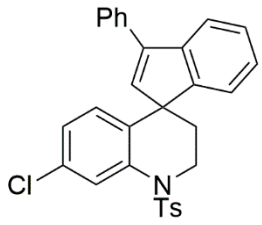
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Cl
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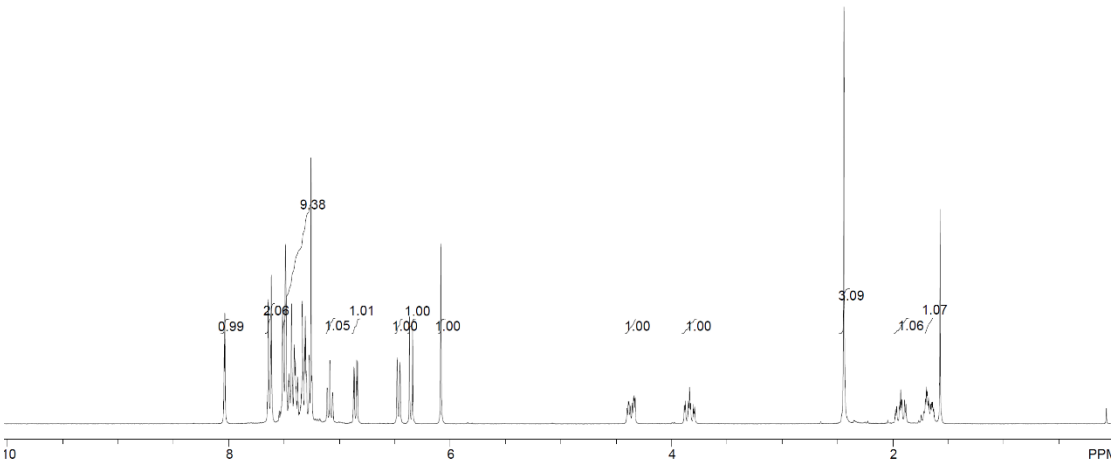
Ts

8aa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2
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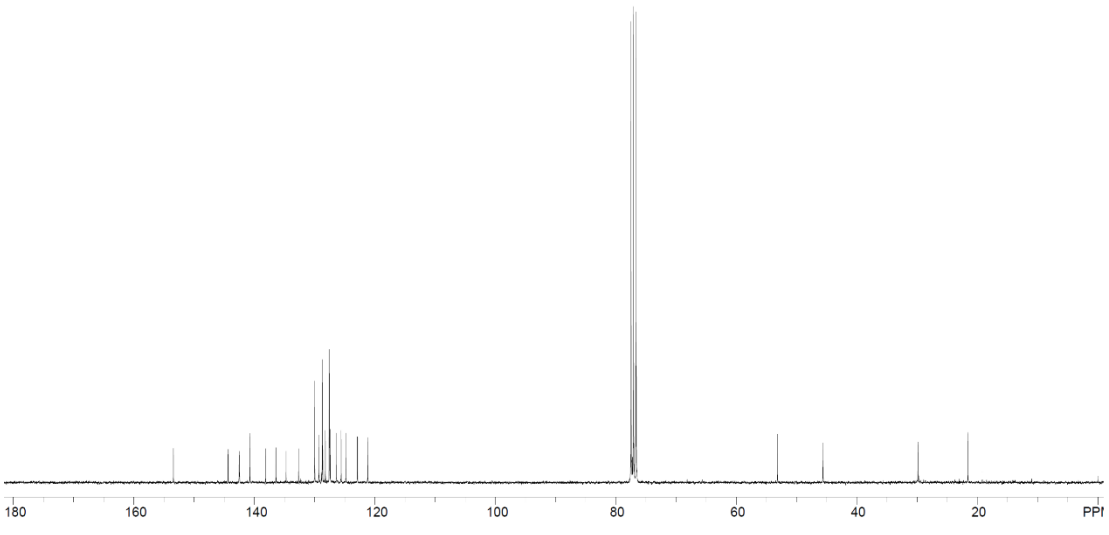
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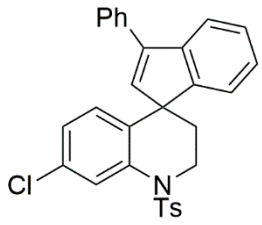
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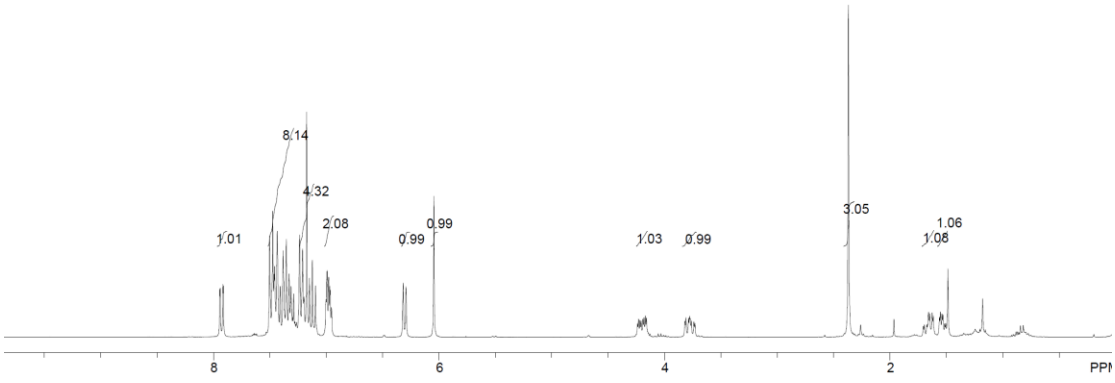
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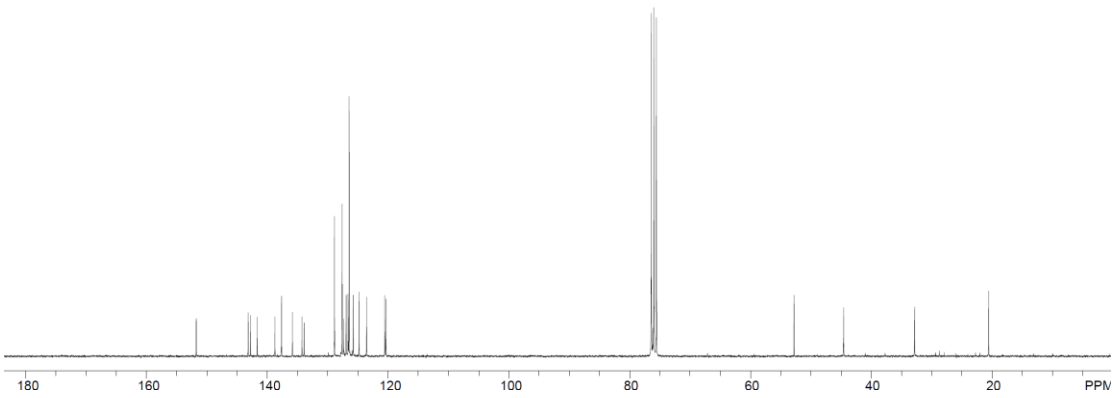
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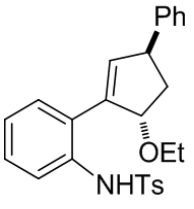
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OEt
NHTs

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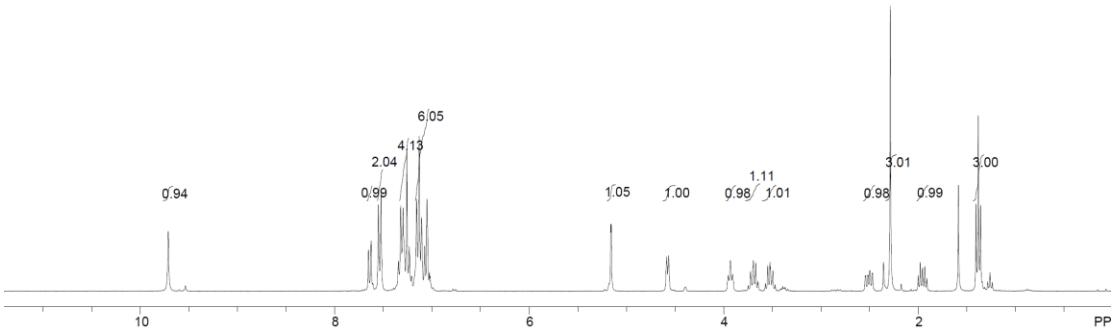
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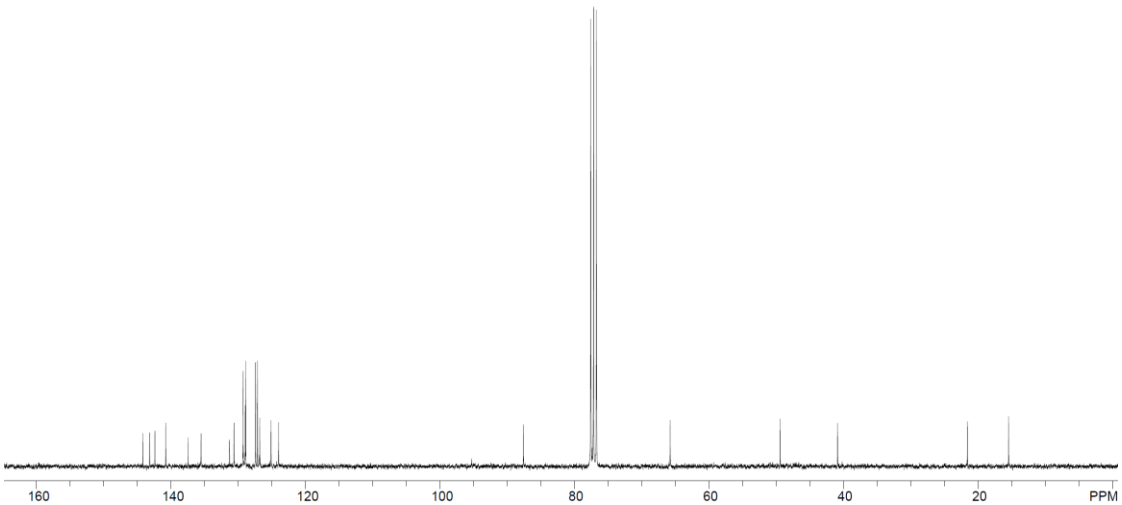
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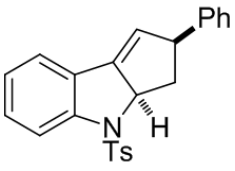
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Ts

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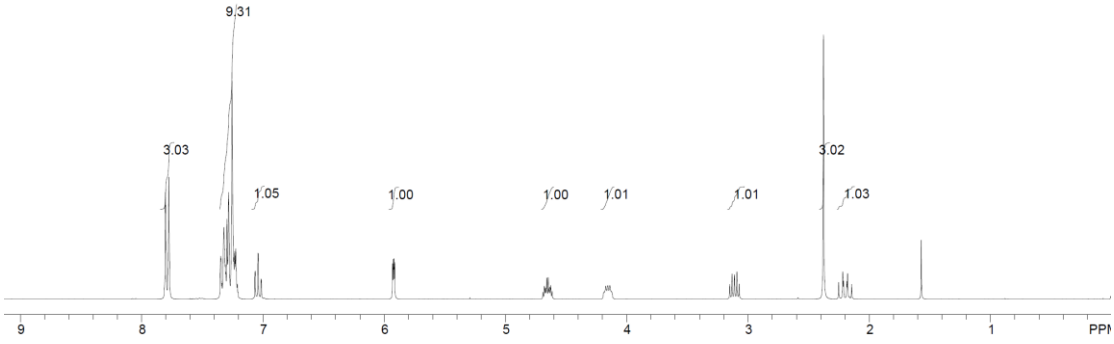
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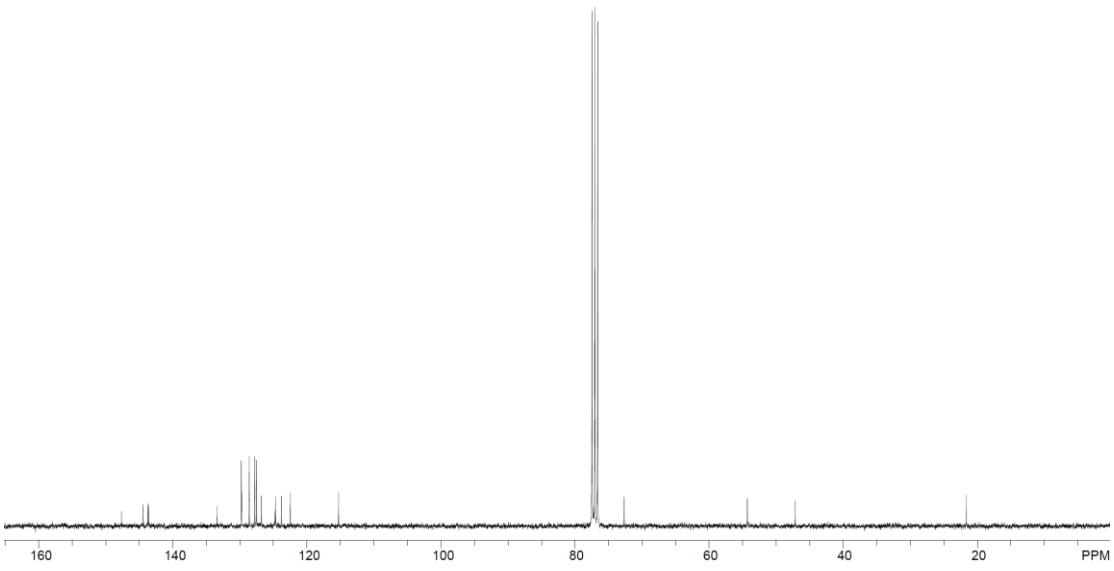
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