Supporting Information for

Rh-Catalyzed Transannulation of N-Tosyl-1,2,3-Triazoles with Terminal Alkynes

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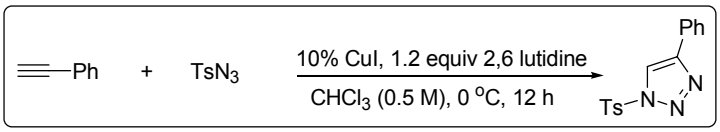
Contents:

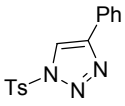
General Information

NMR spectra were recorded on Bruker Avance DRX-500 (500 MHz) or DPX-400 (400 MHz) instruments. LRMS and HRMS analyses were performed on Micromass 70 VSE mass spectrometer. GC/MS analysis was performed on a Hewlett Packard Model 6890 GC interfaced to a Hewlett Packard Model 5973 mass selective detector (15 m x 0.25 mm capillary column, HP-5MS). Column chromatography was carried out employing Silicycle silica gel (Kieselgel 60, 63-200 μm). Pre-coated silica gel plates F-254 were used for thin-layer analytical chromatography. Anhydrous solvents were purchased from Aldrich and stored over calcium hydride. *n*-Hexane was dried twice over Na and stored for a week. Reactions were performed in oven-dried glassware under inert atmosphere unless otherwise stated. Alkynes and Rh-catalysts were commercially available and purchased from Sigma Aldrich and used immediately as received.

Preparation of 1,2,3-triazoles:

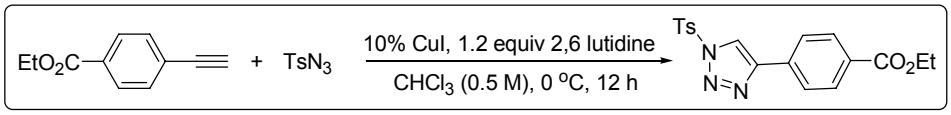
Preparation of 4-phenyl-1-(*p*-tolylsulfonodithioyl)-1*H*-1,2,3-triazole:

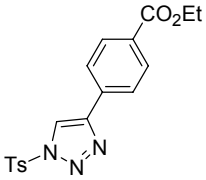




Compound 1a: This compound was prepared according to the previously reported copper-catalyzed azide-alkyne cycloaddition (CuAAC) procedure.[1]

Preparation of ethyl 4-(1-tosyl-1*H*-1,2,3-triazol-4-yl)benzoate:

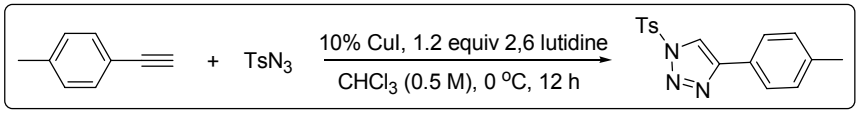


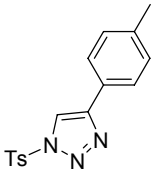


Compound 1b: To a stirred mixture of alkyne (2.2 g, 12.0 mmol), *p*-toluenesulfonyl azide (1.9 g, 10.0 mmol), and CuI (190 mg, 10 mol %) in 50 mL chloroform, 2,6-lutidine (1.4 mL, 12.0 mmol) was added at 0 ºC under inert atmosphere. Reaction mixture was stirred for 12 h at −5-0 ºC until judged complete by TLC analysis, and quenched with saturated aq. NH_4Cl

solution (40 mL). The aqueous layer was extracted with CH_2Cl_2 (3 × 50 mL) and the combined organic fractions were sequentially washed with water and brine, and dried (Na_2SO_4). After removal of solvents *in vacuo,* the residue was purified by flash chromatography (ethyl acetate: hexane = 1:9) to afford the corresponding 1,2,3-triazole **1b** 2.2 g (60%) as a white solid.

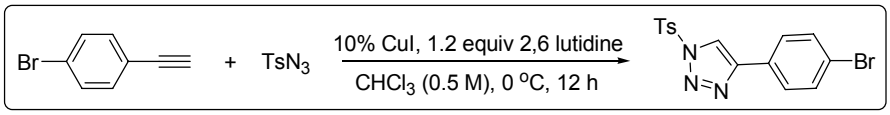
Preparation of 4-*p*-tolyl-1-tosyl-1*H*-1,2,3-triazole:

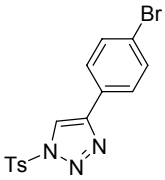




Compound 1c: This compound was prepared according to the previously reported copper-catalyzed azide-alkyne cycloaddition (CuAAC) procedure.[1]

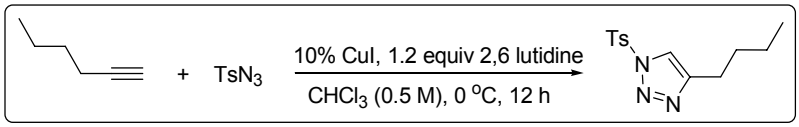
Preparation of 4-(4-bromophenyl)-1-tosyl-1*H*-1,2,3-triazole:

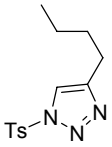




Compound 1d: This compound was prepared according to the previously reported copper-catalyzed azide-alkyne cycloaddition (CuAAC) procedure.[1]

Preparation of 4-butyl-1-tosyl-1*H*-1,2,3-triazole:

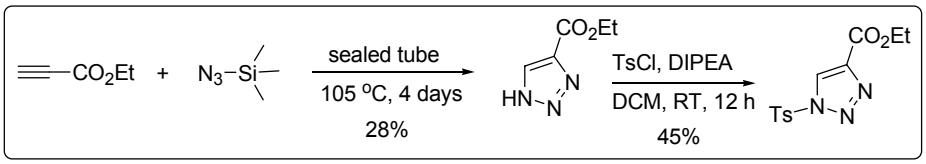


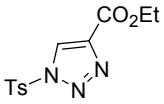


Compound 1e: To a stirred mixture of alkyne (985.7 mg, 12.0 mmol), *p*-toluenesulfonyl azide (1.9 g, 10.0 mmol), and CuI (190 mg, 10 mol %) in 50 mL chloroform, 2,6-lutidine (1.4 mL, 12.0 mmol) was added at 0 ºC under inert atmosphere. Reaction mixture was stirred for 12 hours at −5-0 ºC until judged complete by TLC analysis, and quenched with saturated aq. NH_4Cl solution (40 mL). The aqueous layer was extracted with CH_2Cl_2 (3 × 50 mL) and the combined organic fractions were

sequentially washed with water and brine, and dried (Na_2SO_4). After removal of solvents *in vacuo,* the residue was purified by flash chromatography (ethyl acetate: hexane = 1:9) to afford the corresponding 1,2,3-triazole **1e** 1.74 g (62%) as a pale yellow oil; (^{1}H NMR (500 MHz, $CDCl_3$): δ 7.94 (d, *J*=8.44 Hz, 2 H), 7.62 (s, 1 H), 7.33 (d, *J*=8.07 Hz, 2 H), 2.61 - 2.77 (m, 2 H), 2.42 (s, 3 H), 1.48 - 1.71 (m, 2 H), 1.15 - 1.44 (m, 2 H), 0.89 (t, *J*=7.34 Hz, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 153.4, 146.3, 137.9, 133.2, 130.1, 128.6, 30.6, 25.3, 22.2, 21.8, 13.6.

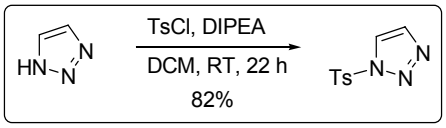
Preparation of ethyl 1-tosyl-1*H*-1,2,3-triazole-4-carboxylate:

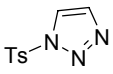




Compound 1f: A mixture of ethylpropiolate (2.5 g, 25.50 mmol) trimethylsilyl azide (7.3 g, 63.75 mmol) was heated in a sealed tube at 105 ^{o}C for four days. The reaction mixture was cooled and ethanol was added dropwise with stirring on ice bath. The solid formed was allowed to stand for 30 min and ether was added. The solid was filtered off, washed with ether and hexane to give the pure NH-triazole in 28% yield. The product was pure enough for further reaction. To *p*-toluenesulfonyl chloride (1.0 g, 5.31 mmol) dissolved in dichloromethane (50 mL), DIPEA (2.2 g, 17.25 mmol) was added at room temperature, and the reaction solution was stirred for a few minutes. After the addition of the 4-ethylcarboxylate-1*H*-1,2,3-triazole (500 mg, 3.54 mmol), stirring at room temperature was continued for 12 h before the solvent was removed *in vacuo*. Flash chromatography (ethyl acetate: hexane = 1:9) provided 450 mg of **1f** (45%) as white solid.

Preparation of 1-tosyl-1*H*-1,2,3-triazole:





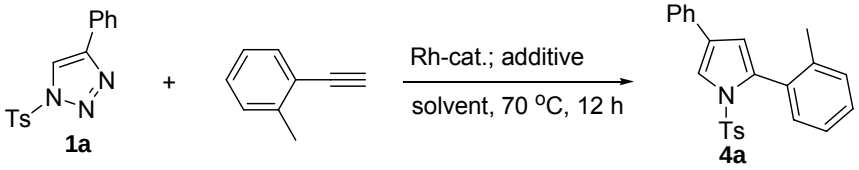
Compound 1g: This compound was prepared according to the earlier published procedure.[2]

Preparation of alkynes:

Alkynes such as 1-ethynyl-2,4,6-trimethylbenzene,[3] 1-ethynyl-2,3-dimethylbenzene,[4] 1-ethynyl-3,4-dimethylbenzene,[4] 1-ethynyl-2-isopropylbenzene[4] were prepared according to the published procedures.

Transannulation Reaction:

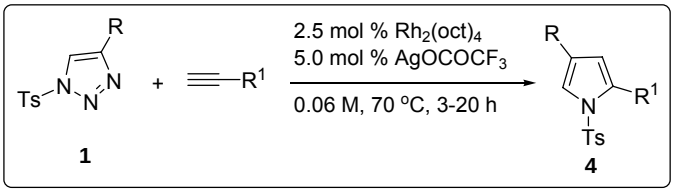
Optimization of the transannulation reaction[a]



#	catalyst (2.5%)	Lewis acid (5.0%)	solvent (0.06M)	yield (%)[b]
1	$Rh_2(OAc)_4$	$AgOCOCF_3$	toluene	NR
2	$Rh_2(pfb)_4$	$AgOCOCF_3$	toluene	NR
3	$Rh_2(dosp)_4$	$Al(OTf)_3$	toluene	63
4	$Rh_2(oct)_4$	$AgOCOCF_3$	toluene	53
5	$Rh_2(oct)_4$	$AgOCOCF_3$	hexane	67
6	$Rh_2(oct)_4$	-	hexane	NR[c]
7	$Rh_2(oct)_4$	AgOTf	hexane	NR
8	$Rh_2(oct)_4$	CsF	hexane	NR
9	$Rh_2(oct)_4$	$Zn(OTf)_2$	hexane	NR
10	$Rh_2(oct)_4$	$Y(OTf)_2$	hexane	NR
11	$Rh_2(oct)_4$	$AgOCOCF_3$	DCM	NR
12	$Rh_2(oct)_4$	$AgOCOCF_3$	DCE	NR
13	$Rh_2(oct)_4$	$AgOCOCF_3$	THF	NR
14	$Rh_2(oct)_4$	CF_3SO_3H	hexane	Dce.[d]
15	$Rh_2(oct)_4$	CF_3CO_2H	hexane	Dce.

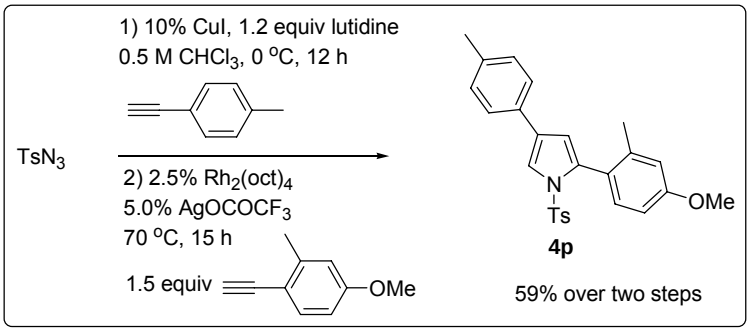
[a]All reactions were performed at 70 °C with 0.2 mmol of triazoles using 1.5 equiv of alkynes; [b]Isolated yield; [c]NR = No Reaction; [d]Dce. = Decomposition.

General Procedure for the Transannulation:



In a glovebox, 5 mL Weaton microreactor was charged with triazole **1** (0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by alkyne (1.5 equiv). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^{o}C. The reaction mixture was stirred for 3-20 h (as judged by TLC analysis). After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel gave products **4**.

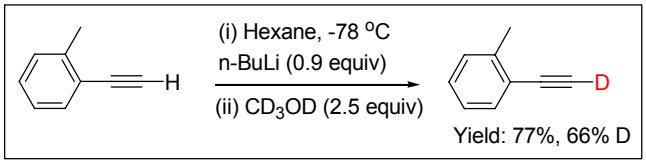
Semi-one-pot method for the Transannulation Reaction



In a glovebox, 5 mL standard Weaton microreactor was charged with CuI (3.8 mg, 10 mol %), tosyl azide (40 mg, 0.2 mmol), *p*-tollylacetylene (24.4 mg, 0.21 mmol) and 2,6-lutidine (25.72 mg, 0.24 mmol). The vial capped and dry chloroform (0.4 mL, 0.5 M) was added outside the glovebox. The reaction mixture was stirred for 12 h at 0 ^{o}C. After completion, the reaction mixture was passed through a short pad of silica and dried under reduced pressure to give the crude triazole. To this crude mixture, rhodium(II) octanoate dimer (3.9 mg 2.5 mol %), $AgOCOCF_3$ (2.2 mg, 5.0 mol %) and 1-ethynyl-2-methyl-4-methoxybenzene (43.8 mg, 0.3 mmol) and dry hexane (3 mL, 0.06 M) were added. The resulting mixture was placed into pre-heated aluminum block at 70 °C for 15 h. After completion, hexane was removed under reduced pressure and chromatographic separation

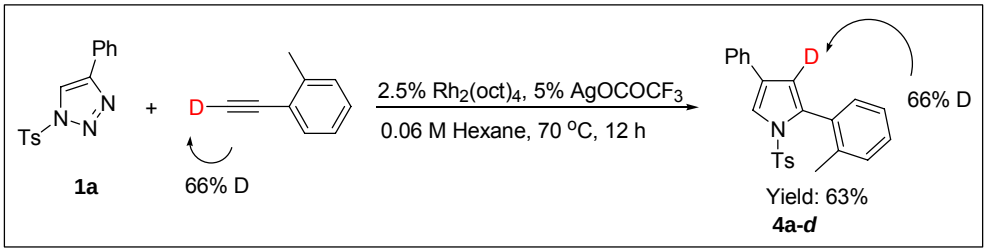
with silica gel (ethyl acetate: hexane = 2:98) gave product 50.9 mg of **4p** (59%) over two steps.

Preparation of deuteriated *o*-tollyl acetylene



To a 50 mL flame-dried two-necked flask equipped with a stir bar, rubber septum, and T-shaped stopcock with argon filled balloon were added anhydrous hexane (30 mL) and *o*-tollylacetylene (0.58 g, 5 mmol). The solution was cooled to -78 ºC in a dry ice/acetone bath while stirring and 0.42 mL of *n*-BuLi solution (0.90 equiv, 2.5 M in hexane) was added slowly dropwise. After 10 minutes, 0.51 mL of methanol-*d4* (2.5 equiv, 99.5% D) were added and the reaction was stirred for 20 minutes at -78 ºC. After warming to room temperature, the solvent was removed under reduced pressure and the residue filtered through a short silica gel column (hexane:ether = 9:1 as eluent) affording 0.45 g of deuteriated *o*-tollyl acetylene (77% yield, 66% D) as a yellow oil. ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.50 (d, *J*=7.70 Hz, 1 H), 7.21 - 7.32 (m, 2 H), 7.18 (d, *J*=7.70 Hz, 1 H), 2.49 (s, 3 H).

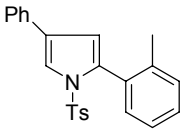
D-Labeling Experiment



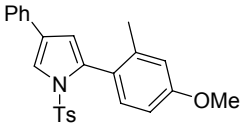
In a glovebox, 5 mL Weaton microreactor was charged with triazole **1a** (~ 60 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by deuteriated *o*-tollyl acetylene (35.1 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 °C. The reaction mixture was stirred for 12 h (as judged by TLC analysis). After completion, hexane was removed

under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 2:98) gave product 49 mg of **4a-*d*** (63%) with 66% D. ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.78 (s, 1 H), 7.56 (d, *J*=7.34 Hz, 2 H), 7.39 (t, *J*=7.70 Hz, 2 H), 7.24 - 7.35 (m, 4 H), 7.06 - 7.22 (m, 4 H), 6.91 - 7.01 (m, 1 H), 2.39 (s, 3 H), 1.98 (s, 3 H).

Compound Characterization data:

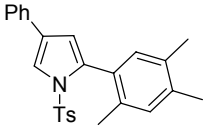


Compound 4a: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1a** (~ 60 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by *o*-tollyl acetylene (34.8 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^{o}C. The reaction mixture was stirred for 6 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 2:98) gave product 51.9 mg of **4a** (67%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.77 (d, *J*=2.02 Hz, 1 H), 7.56 (dd, *J*=8.25, 1.10 Hz, 2 H), 7.39 (t, *J*=7.79 Hz, 2 H), 7.24 - 7.35 (m, 4 H), 7.08 - 7.21 (m, 4 H), 6.96 (dd, *J*=7.70, 1.28 Hz, 1 H), 6.43 (d, *J*=2.02 Hz, 1 H), 2.39 (s, 3 H), 1.98 (s, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 144.8, 139.7, 135.6, 134.7, 133.5, 132.0, 130.7, 129.4, 129.4, 129.0, 128.8, 127.5, 126.9, 125.4, 124.5, 118.2, 113.7, 109.6, 21.6, 20.1. HRMS (EI) calcd. for $C_{24}H_{21}O_2NS$: 387.1293. Found: 387.1300.

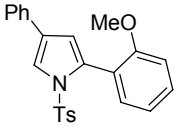


Compound 4b: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1a** (~ 60 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 1-ethynyl-4-methoxy-2-methylbenzene (43.9 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^{o}C. The reaction mixture was stirred for 3 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 2:98)

gave product 80.9 mg of **4b** (97%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.75 (d, *J*=2.02 Hz, 1 H), 7.50 - 7.57 (m, 2 H), 7.38 (t, *J*=7.70 Hz, 2 H), 7.27 - 7.34 (m, 2 H), 7.22 - 7.26 (m, 1 H), 7.15 (d, *J*=8.44 Hz, 2 H), 6.87 (d, *J*=8.44 Hz, 1 H), 6.72 (d, *J*=2.57 Hz, 1 H), 6.66 (dd, *J*=8.34, 2.66 Hz, 1 H), 6.39 (d, *J*=1.83 Hz, 1 H), 3.86 (s, 3 H), 2.39 (s, 3 H), 1.92 (s, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 160.0, 144.7, 141.2, 135.7, 134.5, 133.5, 133.2, 129.4, 128.8, 127.5, 126.9, 126.8, 125.4, 123.0, 118.1, 114.7, 113.9, 109.9, 55.2, 21.6, 20.3. HRMS (EI) calcd. for $C_{25}H_{23}O_3NS$: 417.1398. Found: 417.1390.

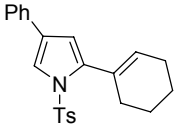


Compound 4c: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1a** (~ 60 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 1-ethynyl-2,4,5-trimethylbenzene (43.3 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^{o}C. The reaction mixture was stirred for 6 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 2:98) gave product 65.6 mg of **4c** (79%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.75 (d, *J*=2.02 Hz, 1 H), 7.54 (d, *J*=7.89 Hz, 2 H), 7.38 (t, *J*=7.79 Hz, 2 H), 7.32 (d, *J*=8.25 Hz, 2 H), 7.23 - 7.27 (m, 1 H), 7.15 (d, *J*=8.44 Hz, 2 H), 6.98 (s, 1 H), 6.55 (s, 1 H), 6.38 (d, *J*=2.02 Hz, 1 H), 2.40 (s, 3 H), 2.29 (s, 3 H), 2.13 (s, 3 H), 1.96 (s, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 144.4, 137.1, 136.5, 135.8, 135.6, 134.8, 133.4, 132.8, 132.0, 130.6, 129.1, 128.6, 127.8, 127.4, 126.6, 125.2, 117.8, 113.3, 21.3, 19.3, 19.2, 18.7. HRMS (EI) calcd. for $C_{26}H_{25}O_2NS$: 415.1606. Found: 415.1596.

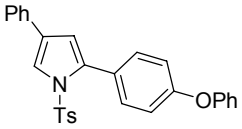


Compound 4d: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1a** (~ 60 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 1-ethynyl-2-methoxybenzene (39.6 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^{o}C. The reaction mixture was stirred for 5 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 2:98) gave product 41.1 mg of **4d** (51%); ^{1}H NMR

(500 MHz, $CDCl_3$): δ 7.73 (t, *J*=2.48 Hz, 1 H), 7.51 - 7.57 (m, 2 H), 7.30 - 7.42 (m, 5 H), 7.20 - 7.26 (m, 1 H), 7.14 (d, *J*=8.44 Hz, 2 H), 6.99 - 7.04 (m, 1 H), 6.88 - 6.94 (m, 1 H), 6.86 (dd, *J*=8.34, 1.93 Hz, 1 H), 6.48 (t, *J*=2.48 Hz, 1 H), 3.63 (s, 3 H), 2.37 (s, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 158.4, 144.1, 135.7, 133.3, 132.6, 132.1, 130.2, 129.1, 128.4, 127.1, 127.0, 126.5, 125.2, 120.2, 119.2, 118.4, 113.8, 110.1, 54.9, 21.3. HRMS (EI) calcd. for $C_{24}H_{21}O_3NS$: 403.1242. Found: 403.1256.

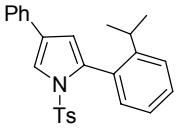


Compound 4e: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1a** (~ 60 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 1-ethynylcyclohex-1-ene (31.8 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^oC. The reaction mixture was stirred for 5 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 2:98) gave product 39.2 mg of **4e** (52%); ^1H NMR (400 MHz, $CDCl_3$): δ 7.63 (d, *J*=8.18 Hz, 2 H), 7.57 (d, *J*=1.90 Hz, 1 H), 7.49 (d, *J*=8.04 Hz, 2 H), 7.35 (t, *J*=7.67 Hz, 2 H), 7.19 - 7.30 (m, 3 H), 6.29 (d, *J*=1.75 Hz, 1 H), 5.46 (br. s., 1 H), 2.39 (s, 3 H), 2.21 (d, *J*=1.90 Hz, 2 H), 2.09 (dd, *J*=5.63, 2.70 Hz, 2 H), 1.60 - 1.79 (m, 4 H); ^{13}C NMR (101 MHz, $CDCl_3$): δ 144.3, 139.1, 135.6, 133.1, 130.8, 129.7, 129.1, 128.4, 127.1, 126.8, 126.5, 125.0, 118.2, 111.6, 30.3, 25.3, 22.4, 21.3, 21.3. HRMS (EI) calcd. for $C_{23}H_{23}O_2NS$: 377.1449. Found: 377.1440.

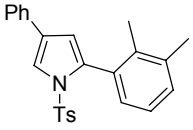


Compound 4f: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1a** (~ 60 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 1-ethynyl-4-phenoxybenzene (58.3 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^oC. The reaction mixture was stirred for 5 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 3:98) gave product 48.4 mg of **4f** (52%); ^1H NMR (500 MHz, $CDCl_3$): δ 7.73 (d, *J*=2.02 Hz, 1 H), 7.54 (dd,

J=8.34, 1.19 Hz, 2 H), 7.34 - 7.42 (m, 4 H), 7.30 - 7.33 (m, 2 H), 7.26 - 7.29 (m, 1 H), 7.21 - 7.26 (m, 2 H), 7.16 (t, *J*=7.34 Hz, 1 H), 7.13 (d, *J*=8.07 Hz, 2 H), 7.06 - 7.11 (m, 2 H), 6.95 - 6.97 (m, 1 H), 6.93 - 6.95 (m, 1 H), 6.48 (d, *J*=2.02 Hz, 1 H), 2.36 (s, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 157.7, 156.7, 144.8, 136.2, 135.5, 133.3, 132.3, 129.8, 129.4, 128.8, 127.4, 127.2, 127.1, 125.9, 125.4, 123.6, 119.4, 119.2, 117.4, 114.2, 21.6. HRMS (EI) calcd. for $C_{29}H_{23}O_3NS$: 465.1398. Found: 465.1401.

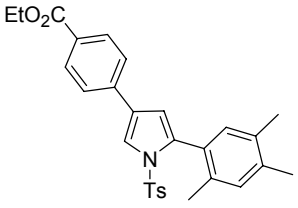


Compound 4g: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1a** (~ 60 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 1-ethynyl-2-isopropylbenzene (43.3 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^{o}C. The reaction mixture was stirred for 12 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 2:98) gave product 44.8 mg of **4g** (54%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.78 (d, *J*=2.02 Hz, 1 H), 7.51 - 7.60 (m, 2 H), 7.32 - 7.43 (m, 6 H), 7.24 - 7.31 (m, 1 H), 7.17 (d, *J*=8.07 Hz, 2 H), 6.99 - 7.07 (m, 1 H), 6.73 (dd, *J*=7.61, 1.19 Hz, 1 H), 6.46 (d, *J*=2.02 Hz, 1 H), 2.79 - 2.93 (m, 1 H), 2.39 (s, 3 H), 1.19 (d, *J*=6.79 Hz, 3 H), 1.06 (d, *J*=6.79 Hz, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 150.6, 145.0, 136.2, 134.6, 133.8, 132.1, 129.8, 129.7, 129.6, 129.1, 127.8, 127.2, 127.0, 125.7, 125.2, 124.5, 118.3, 114.3, 30.8, 26.0, 22.1, 21.8. HRMS (EI) calcd. for $C_{26}H_{25}O_2NS$: 415.1606. Found: 415.1608.

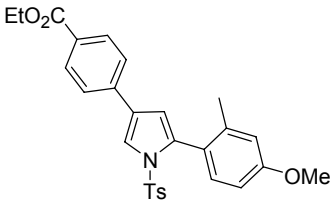


Compound 4h: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1a** (~ 60 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 1-ethynyl-2,3-dimethylbenzene (39.1 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^{o}C. The reaction mixture was stirred for 12 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 2:98) gave product 53.0 mg of **4h** (66%); ^{1}H NMR

(500 MHz, $CDCl_3$): δ 7.77 (d, *J*=2.02 Hz, 1 H), 7.53 - 7.59 (m, 2 H), 7.35 - 7.43 (m, 2 H), 7.24 - 7.32 (m, 3 H), 7.21 (d, *J*=7.52 Hz, 1 H), 7.14 (d, *J*=7.89 Hz, 2 H), 7.03 (t, *J*=7.61 Hz, 1 H), 6.82 (d, *J*=7.34 Hz, 1 H), 6.42 (d, *J*=2.02 Hz, 1 H), 2.39 (s, 3 H), 2.27 (s, 3 H), 1.82 (s, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 144.5, 138.2, 136.1, 135.4, 135.0, 133.3, 130.5, 130.2, 129.6, 129.1, 128.5, 127.4, 126.6, 126.4, 125.1, 123.9, 117.6, 113.2, 21.3, 20.1, 16.7. HRMS (EI) calcd. for $C_{25}H_{23}O_2NS$: 401.1449. Found: 401.1456.

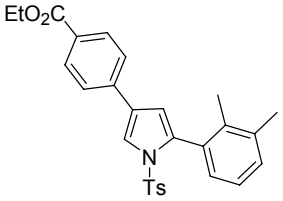


Compound 4i: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1b** (~ 74.3 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 1-ethynyl-2,4,5-trimethylbenzene (43.3 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^oC. The reaction mixture was stirred for 12 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 4:96) gave product 72.1 mg of **4i** (74%); ^1H NMR (500 MHz, $CDCl_3$): δ 8.05 (d, *J*=8.07 Hz, 2 H), 7.84 (s, 1 H), 7.60 (d, *J*=8.07 Hz, 2 H), 7.31 (d, *J*=8.25 Hz, 2 H), 7.16 (d, *J*=8.07 Hz, 2 H), 6.98 (s, 1 H), 6.53 (s, 1 H), 6.41 (s, 1 H), 4.39 (q, *J*=7.03 Hz, 2 H), 2.40 (s, 3 H), 2.29 (s, 3 H), 2.13 (s, 3 H), 1.95 (s, 3 H), 1.41 (t, *J*=7.15 Hz, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 166.6, 145.2, 138.3, 137.7, 137.1, 135.8, 135.5, 133.3, 132.6, 131.1, 130.4, 129.6, 128.9, 128.0, 125.9, 125.3, 119.2, 113.4, 61.1, 21.8, 19.8, 19.7, 19.2, 14.6. HRMS (EI) calcd. for $C_{29}H_{29}O_4NS$: 487.1817. Found: 487.1808.

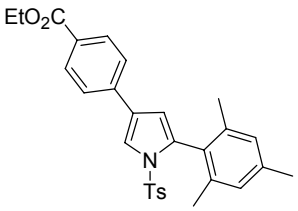


Compound 4j: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1b** (~ 74.3 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06M) was added under inert atmosphere, followed by 1-ethynyl-4-methoxy-2-methylbenzene (43.9 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^oC. The reaction mixture was stirred for 4 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica

gel (ethyl acetate: hexane = 4:96) gave product 92.0 mg of **4j** (94%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.05 (d, *J*=8.80 Hz, 2 H), 7.85 (d, *J*=1.83 Hz, 1 H), 7.53 - 7.64 (m, 2 H), 7.32 (d, *J*=8.44 Hz, 2 H), 7.16 (d, *J*=8.44 Hz, 2 H), 6.86 (d, *J*=8.07 Hz, 1 H), 6.60 - 6.75 (m, 2 H), 6.42 (d, *J*=2.20 Hz, 1 H), 4.39 (q, *J*=7.09 Hz, 2 H), 3.85 (s, 3 H), 2.39 (s, 3 H), 1.90 (s, 3 H), 1.41 (t, *J*=7.15 Hz, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 166.1, 159.8, 144.7, 140.9, 137.8, 135.2, 134.6, 133.0, 129.8, 129.2, 128.4, 127.3, 125.4, 124.8, 122.4, 118.8, 114.5, 113.3, 109.8, 60.6, 54.9, 21.3, 20.1, 14.1. HRMS (EI) calcd. for $C_{28}H_{27}O_5NS$: 489.1609. Found: 489.1620.

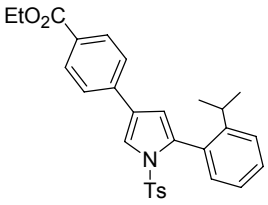


Compound 4k: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1b** (~ 74.3 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 1-ethynyl-2,3-dimethylbenzene (39.1 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^{o}C. The reaction mixture was stirred for 9 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 4:96) gave product 54.9 mg of **4k** (58%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.05 (d, *J*=8.44 Hz, 2 H), 7.85 (d, *J*=2.20 Hz, 1 H), 7.60 (d, *J*=8.44 Hz, 2 H), 7.26 - 7.30 (m, 2 H), 7.21 (d, *J*=7.70 Hz, 1 H), 7.14 (d, *J*=8.07 Hz, 2 H), 7.02 (t, *J*=7.70 Hz, 1 H), 6.81 (d, *J*=7.34 Hz, 1 H), 6.44 (d, *J*=2.20 Hz, 1 H), 4.39 (q, *J*=7.21 Hz, 2 H), 2.40 (s, 3 H), 2.25 (s, 3 H), 1.79 (s, 3 H), 1.41 (t, *J*=7.15 Hz, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 166.2, 144.6, 138.2, 137.8, 135.3, 135.1, 130.4, 130.2, 129.8, 129.6, 129.1, 128.4, 127.5, 125.3, 124.8, 124.0, 118.5, 112.9, 60.6, 21.3, 20.1, 16.7, 14.1. HRMS (EI) calcd. for $C_{28}H_{27}O_4NS$: 473.1660. Found: 473.1671.

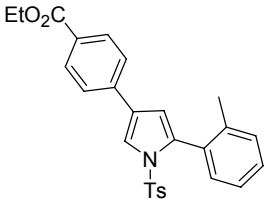


Compound 4l: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1b** (~ 74.3 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 2-ethynyl-1,3,5-trimethylbenzene (43.3 mg, 0.3 mmol). The microreactor

was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^{o}C. The reaction mixture was stirred for 9 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 4:96) gave product 70.2 mg of **4l** (72%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.06 (d, *J*=8.44 Hz, 2 H), 7.91 (d, *J*=1.83 Hz, 1 H), 7.58 - 7.65 (m, 2 H), 7.34 (d, *J*=8.44 Hz, 2 H), 7.17 (d, *J*=8.07 Hz, 2 H), 6.84 (s, 2 H), 6.39 (d, *J*=2.20 Hz, 1 H), 4.39 (q, *J*=6.97 Hz, 2 H), 2.41 (s, 3 H), 2.35 (s, 3 H), 1.71 (s, 6 H), 1.42 (t, *J*=7.15 Hz, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 166.2, 144.8, 139.6, 138.5, 137.9, 134.8, 133.4, 129.8, 129.2, 128.3, 127.9, 127.3, 126.9, 125.2, 124.8, 118.5, 112.5, 60.6, 21.3, 20.9, 19.9, 14.1. HRMS (EI) calcd. for $C_{29}H_{29}O_4NS$: 487.1817. Found: 487.1826.

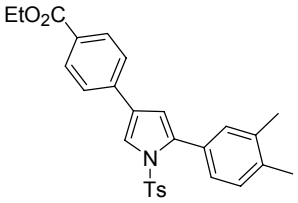


Compound 4m: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1b** (~ 74.3 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 1-ethynyl-2-isopropylbenzene (43.3 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^{o}C. The reaction mixture was stirred for 8 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 4:96) gave product 44.8 mg of **4m** (46%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.06 (d, *J*=8.44 Hz, 2 H), 7.86 (s, 1 H), 7.61 (d, *J*=8.44 Hz, 2 H), 7.30 - 7.43 (m, 4 H), 7.17 (d, *J*=8.07 Hz, 2 H), 7.02 (t, *J*=7.34 Hz, 1 H), 6.70 (d, *J*=7.70 Hz, 1 H), 6.48 (s, 1 H), 4.39 (q, *J*=7.34 Hz, 2 H), 2.77 - 2.88 (m, 1 H), 2.39 (s, 3 H), 1.41 (t, *J*=6.97 Hz, 3 H), 1.17 (d, *J*=6.60 Hz, 3 H), 1.05 (d, *J*=6.97 Hz, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 166.1, 144.7, 137.7, 135.4, 134.4, 131.5, 129.9, 129.3, 129.0, 128.5, 127.4, 125.4, 124.8, 124.7, 124.0, 121.9, 118.8, 113.5, 60.6, 30.4, 25.6, 21.6, 21.3, 14.1. HRMS (EI) calcd. for $C_{29}H_{29}O_4NS$: 487.1817. Found: 487.1829.

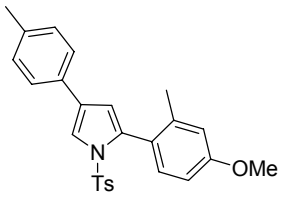


Compound 4n: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1b** (~ 74.3 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %).

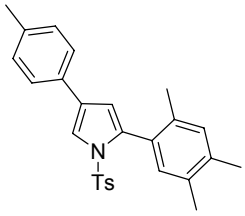
Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by *o*-tollyl acetylene (34.8 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^{o}C. The reaction mixture was stirred for 8 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 4:96) gave product 59.7 mg of **4n** (65%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.01 - 8.10 (m, 2 H), 7.85 (d, *J*=1.83 Hz, 1 H), 7.60 (d, *J*=8.44 Hz, 2 H), 7.27 - 7.36 (m, 3 H), 7.06 - 7.21 (m, 4 H), 6.94 (dd, *J*=7.70, 1.47 Hz, 1 H), 6.46 (d, *J*=1.83 Hz, 1 H), 4.39 (q, *J*=6.97 Hz, 2 H), 2.39 (s, 3 H), 1.95 (s, 3 H), 1.41 (t, *J*=7.15 Hz, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 166.6, 145.2, 139.9, 138.2, 135.6, 135.2, 132.3, 130.7, 130.4, 129.7, 129.6, 129.3, 128.9, 127.8, 126.3, 126.0, 125.3, 124.8, 119.3, 113.6, 61.1, 21.8, 20.2, 14.6. HRMS (EI) calcd. for $C_{27}H_{25}O_4NS$: 459.1504. Found: 459.1515.



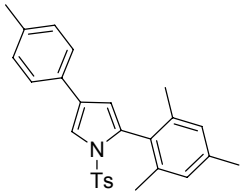
Compound 4o: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1b** (~ 74.3 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 4-ethynyl-1,2-dimethylbenzene (39.1 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^{o}C. The reaction mixture was stirred for 9 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 4:96) gave product 56.8 mg of **4o** (60%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.05 (d, *J*=8.44 Hz, 2 H), 7.85 (d, *J*=2.20 Hz, 1 H), 7.60 (d, *J*=8.44 Hz, 2 H), 7.28 (d, *J*=8.44 Hz, 2 H), 7.21 (d, *J*=7.70 Hz, 1 H), 7.14 (d, *J*=8.07 Hz, 2 H), 7.02 (t, *J*=7.70 Hz, 1 H), 6.81 (d, *J*=7.34 Hz, 1 H), 6.44 (d, *J*=2.20 Hz, 1 H), 4.39 (q, *J*=7.21 Hz, 2 H), 2.40 (s, 3 H), 2.25 (s, 3 H), 1.79 (s, 3 H), 1.41 (t, *J*=7.15 Hz, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 166.6, 145.1, 138.2, 137.5, 135.8, 133.2, 132.2, 130.3, 129.6, 129.0, 128.6, 127.6, 126.4, 125.3, 121.6, 120.2, 113.7, 111.8, 109.1, 61.1, 21.8, 19.8, 19.8, 14.6. HRMS (EI) calcd. for $C_{28}H_{27}O_4NS$: 473.1660. Found: 473.1653.



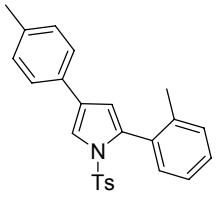
Compound 4p: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1c** (~ 62.7 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 1-ethynyl-4-methoxy-2-methylbenzene (43.9 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^oC. The reaction mixture was stirred for 12 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 2:98) gave product 69.8 mg of **4p** (81%); ^1H NMR (500 MHz, $CDCl_3$): δ 7.72 (d, *J*=1.83 Hz, 1 H), 7.44 (d, *J*=8.07 Hz, 2 H), 7.32 (d, *J*=8.44 Hz, 2 H), 7.20-7.16 (m, 4 H), 6.87 (d, *J*=8.44 Hz, 1 H), 6.73 (d, *J*=2.57 Hz, 1 H), 6.66 (dd, *J*=8.44, 2.57 Hz, 1 H), 6.37 (d, *J*=2.20 Hz, 1 H), 3.86 (s, 3 H), 2.39 (s, 3 H), 2.37 (s, 3 H), 1.93 (s, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 160.2, 144.9, 141.5, 136.9, 136.0, 134.7, 133.5, 130.9, 129.7, 129.6, 127.7, 127.1, 125.5, 123.4, 118.0, 114.9, 114.2, 110.2, 55.4, 21.8, 21.4, 20.6. HRMS (EI) calcd. for $C_{26}H_{25}O_3NS$: 431.1555. Found: 431.1563.



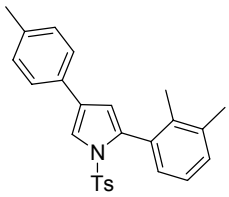
Compound 4q: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1c** (~ 62.7 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 1-ethynyl-2,4,5-trimethylbenzene (43.3 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^oC. The reaction mixture was stirred for 12 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 2:98) gave product 66.1 mg of **4q** (77%); ^1H NMR (500 MHz, $CDCl_3$): δ 7.71 (d, *J*=2.20 Hz, 1 H), 7.44 (d, *J*=8.07 Hz, 2 H), 7.32 (d, *J*=8.44 Hz, 2 H), 7.19 (d, *J*=7.70 Hz, 2 H), 7.15 (d, *J*=8.07 Hz, 2 H), 6.98 (s, 1 H), 6.56 (s, 1 H), 6.36 (d, *J*=1.83 Hz, 1 H), 2.40 (s, 3 H), 2.37 (s, 3 H), 2.29 (s, 3 H), 2.14 (s, 3 H), 1.97 (s, 3 H); ^{13}C NMR (126 MHz, C): δ 144.6, 137.3, 136.8, 136.6, 135.8, 134.9, 133.1, 132.3, 130.8, 130.7, 129.5, 129.3, 128.1, 127.6, 126.9, 125.3, 117.7, 113.5, 21.6, 21.1, 19.5, 19.4, 18.9. HRMS (EI) calcd. for $C_{27}H_{27}O_2NS$: 429.1762. Found: 429.1771.



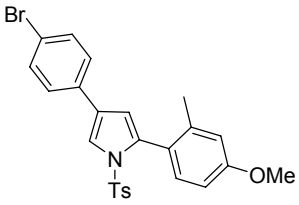
Compound 4r: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1c** (~ 62.7 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 2-ethynyl-1,3,5-trimethylbenzene (43.3 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^{o}C. The reaction mixture was stirred for 7 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 2:98) gave product 74.7 mg of **4r** (87%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.79 (d, *J*=2.20 Hz, 1 H), 7.47 (d, *J*=8.07 Hz, 2 H), 7.35 (d, *J*=8.07 Hz, 2 H), 7.21-7.18 (m, 4 H), 6.84 (s, 2 H), 6.35 (d, *J*=1.83 Hz, 1 H), 2.41 (s, 3 H), 2.38 (s, 3 H), 2.35 (s, 3 H), 1.73 (s, 6 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 144.5, 139.5, 138.3, 136.2, 135.2, 132.8, 130.5, 129.2, 129.1, 127.7, 127.3, 127.3, 126.2, 125.0, 117.1, 112.8, 21.3, 21.0, 20.9, 20.0. HRMS (EI) calcd. for $C_{27}H_{27}O_2NS$: 429.1762. Found: 429.1751.



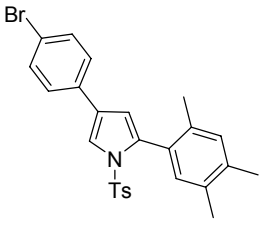
Compound 4s: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1c** (~ 62.7 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by *o*-tollyl acetylene (34.8 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^{o}C. The reaction mixture was stirred for 7 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 2:98) gave product 43.3 mg of **4s** (54%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.72 (d, *J*=1.83 Hz, 1 H), 7.44 (d, *J*=8.44 Hz, 2 H), 7.30 (d, *J*=8.44 Hz, 2 H), 7.16 - 7.22 (m, 4 H), 7.08 - 7.16 (m, 3 H), 6.93 - 6.99 (m, 1 H), 6.40 (d, *J*=1.83 Hz, 1 H), 2.39 (s, 3 H), 2.37 (s, 3 H), 1.97 (s, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 144.7, 142.4, 139.6, 136.7, 134.6, 133.9, 132.0, 130.6, 129.4, 129.4, 128.9, 127.4, 126.9, 125.3, 124.5, 117.8, 115.6, 113.8, 21.5, 21.1, 20.1. HRMS (EI) calcd. for $C_{25}H_{23}O_2NS$: 401.1449. Found: 401.1457.



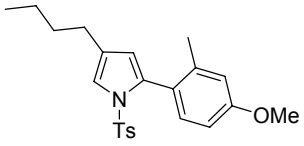
Compound 4t: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1c** (~ 62.7 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 1-ethynyl-2,3-dimethylbenzene (39.1 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^{o}C. The reaction mixture was stirred for 10 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 2:98) gave product 58.1 mg of **4t** (70%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.73 (d, *J*=1.83 Hz, 1 H), 7.45 (d, *J*=8.07 Hz, 2 H), 7.29 (d, *J*=8.44 Hz, 2 H), 7.17 - 7.22 (m, 3 H), 7.13 (d, *J*=7.70 Hz, 2 H), 7.03 (t, *J*=7.70 Hz, 1 H), 6.82 (d, *J*=7.34 Hz, 1 H), 6.40 (d, *J*=2.20 Hz, 1 H), 2.39 (s, 3 H), 2.37 (s, 3 H), 2.27 (s, 3 H), 1.82 (s, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 144.8, 138.6, 136.8, 136.5, 135.4, 131.1, 130.9, 130.6, 130.1, 129.7, 129.5, 127.8, 127.0, 125.5, 124.4, 117.7, 113.8, 21.8, 21.3, 20.6, 17.2. HRMS (EI) calcd. for $C_{26}H_{25}O_2NS$: 415.1606. Found: 415.1621.



Compound 4u: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1d** (~ 75.6 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 1-ethynyl-4-methoxy-2-methylbenzene (43.9 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^{o}C. The reaction mixture was stirred for 10 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 3:97) gave product 98.0 mg of **4u** (99%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.75 (d, *J*=2.20 Hz, 1 H), 7.46 - 7.52 (m, 2 H), 7.38 - 7.43 (m, 2 H), 7.31 (d, *J*=8.44 Hz, 2 H), 7.16 (d, *J*=8.07 Hz, 2 H), 6.86 (d, *J*=8.44 Hz, 1 H), 6.72 (d, *J*=2.93 Hz, 1 H), 6.66 (dd, *J*=8.44, 2.57 Hz, 1 H), 6.34 (d, *J*=1.83 Hz, 1 H), 3.86 (s, 3 H), 2.39 (s, 3 H), 1.91 (s, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 160.3, 145.1, 141.4, 135.7, 134.9, 133.5, 132.8, 132.1, 129.7, 127.8, 127.2, 125.8, 123.0, 120.7, 118.4, 114.9, 113.7, 110.2, 55.4, 21.8, 20.5. HRMS (EI) calcd. for $C_{25}H_{22}O_3NBrS$: 495.0503. Found: 495.0488.

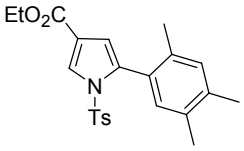


Compound 4v: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1d** (~ 75.6 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 1-ethynyl-2,4,5-trimethylbenzene (43.3 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^{o}C. The reaction mixture was stirred for 12 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 3:97) gave product 84.8 mg of **4v** (86%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.74 (d, *J*=1.83 Hz, 1 H), 7.45 - 7.53 (m, 2 H), 7.40 (d, *J*=8.25 Hz, 2 H), 7.31 (d, *J*=8.25 Hz, 2 H), 7.16 (d, *J*=8.25 Hz, 2 H), 6.98 (s, 1 H), 6.54 (s, 1 H), 6.33 (d, *J*=1.83 Hz, 1 H), 2.40 (s, 3 H), 2.29 (s, 3 H), 2.13 (s, 3 H), 1.95 (s, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 145.1, 137.7, 137.0, 135.8, 135.4, 133.3, 132.8, 132.6, 132.1, 131.1, 129.6, 128.0, 127.9, 127.2, 125.9, 120.7, 118.3, 113.3, 21.8, 19.8, 19.7, 19.2. HRMS (EI) calcd. for $C_{26}H_{24}O_2NBrS$: 493.0722. Found: 493.0711.

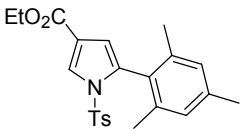


Compound 4w: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1e** (~ 55.9 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 1-ethynyl-4-methoxy-2-methylbenzene (43.9 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^{o}C. The reaction mixture was stirred for 12 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 2:98) gave product 35.0 mg of **4w** (44%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.23 - 7.31 (m, 2 H), 7.10 - 7.19 (m, 3 H), 6.82 (d, *J*=8.25 Hz, 1 H), 6.69 (d, *J*=2.57 Hz, 1 H), 6.63 (dd, *J*=8.25, 2.75 Hz, 1 H), 5.91 (d, *J*=1.83 Hz, 1 H), 3.83 (s, 3 H), 2.42 (t, *J*=7.34 Hz, 2 H), 2.38 (s, 3 H), 1.89 (s, 3 H), 1.55 (t, *J*=7.70 Hz, 2 H), 1.29 - 1.41 (m, 2 H), 0.93 (t, *J*=7.43 Hz, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 159.5, 144.0, 140.7, 133.4, 132.8, 128.9, 128.4, 127.2,

127.0, 121.4, 118.9, 116.6, 114.4, 109.6, 54.9, 31.8, 26.2, 22.0, 21.3, 20.1, 13.6. HRMS (EI) calcd. for $C_{23}H_{27}O_3NS$: 397.1699. Found: 397.1711.

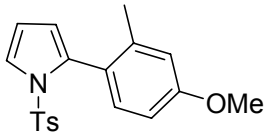


Compound 4x: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1f** (~ 59.0 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 1-ethynyl-2,4,5-trimethylbenzene (43.3 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^oC. The reaction mixture was stirred for 15 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 5:95) gave product 46.9 mg of **4x** (57%); ^1H NMR (500 MHz, $CDCl_3$): δ 8.09 (d, *J*=1.83 Hz, 1 H), 7.22 - 7.29 (m, 2 H), 7.15 (d, *J*=7.89 Hz, 2 H), 6.94 (s, 1 H), 6.45 (s, 1 H), 6.42 (d, *J*=2.02 Hz, 1 H), 4.31 (q, *J*=7.15 Hz, 2 H), 2.41 (s, 3 H), 2.27 (s, 3 H), 2.09 (s, 3 H), 1.85 (s, 3 H), 1.36 (t, *J*=7.15 Hz, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 164.0, 145.5, 137.9, 137.1, 135.2, 134.5, 133.4, 132.6, 131.0, 129.8, 128.3, 127.3, 126.8, 118.5, 114.5, 60.6, 21.8, 19.8, 19.5, 19.2, 14.6. HRMS (EI) calcd. for $C_{23}H_{25}O_4NS$: 411.1513. Found: 411.1504.



Compound 4y: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1f** (~ 59.0 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 2-ethynyl-1,3,5-trimethylbenzene (43.3 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^oC. The reaction mixture was stirred for 15 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 5:95) gave product 37.8 mg of **4y** (46%); ^1H NMR (500 MHz, $CDCl_3$): δ 8.14 (d, *J*=1.83 Hz, 1 H), 7.24 - 7.32 (m, 2 H), 7.16 (d, *J*=8.07 Hz, 2 H), 6.80 (s, 2 H), 6.40 (d, *J*=1.83 Hz, 1 H), 4.32 (q, *J*=7.15 Hz, 2 H), 2.41 (s, 3 H), 2.33 (s, 3 H), 1.63 (s, 6 H), 1.37 (t, *J*=7.15 Hz, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): δ 163.6, 145.2, 139.7, 138.7, 134.1, 132.7, 129.2, 128.2, 127.3,

126.3, 126.3, 117.9, 113.9, 60.1, 21.4, 20.9, 19.8, 14.1. HRMS (EI) calcd. for $C_{23}H_{25}O_4NS$: 411.1487. Found: 411.1504.



Compound 4z: In a glovebox, 5 mL Weaton microreactor was charged with triazole **1g** (~ 44.6 mg, 0.20 mmol), $Rh_2(oct)_4$ (3.9 mg, 2.5 mol %) and silver trifluoroacetate (2.2 mg, 5.0 mol %). Dry hexane (3 mL, 0.06 M) was added under inert atmosphere, followed by 1-ethynyl-4-methoxy-2-methylbenzene (43.9 mg, 0.3 mmol). The microreactor was capped with Teflon pressure cap and placed into pre-heated aluminum block at 70 ^oC. The reaction mixture was stirred for 20 h. After completion, hexane was removed under reduced pressure and chromatographic separation with silica gel (ethyl acetate: hexane = 1:99) gave product 36.8 mg of **4z** (54%); ^1H NMR (500 MHz, $CDCl_3$): δ 7.45 (dd, *J*=3.30, 1.83 Hz, 1 H), 7.25 - 7.30 (m, 2 H), 7.15 (d, *J*=8.07 Hz, 2 H), 6.82 (d, *J*=8.44 Hz, 1 H), 6.70 (d, *J*=2.57 Hz, 1 H), 6.63 (dd, *J*=8.44, 2.93 Hz, 1 H), 6.31 (t, *J*=3.30 Hz, 1 H), 6.05 (dd, *J*=3.30, 1.83 Hz, 1 H), 3.84 (s, 3 H), 2.38 (s, 3 H), 1.85 (s, 3 H); ^{13}C NMR (126 MHz, $CDCl_3$): 159.8, 144.5, 135.8, 133.5, 133.3, 129.3, 127.4, 123.2, 122.5, 115.3, 114.6, 111.2, 110.5, 109.8, 55.1, 21.5, 20.2. HRMS (EI) calcd. for $C_{19}H_{19}O_3NS$: 341.1074. Found: 341.1085.

References:

[1] Yoo, E. J; Ahlquist, M.; Kim, S. H.; Bae, I.; Fokin, V.V.; Sharpless, K. B.; Chang, S. *Angew. Chem. Int. Ed.* **2007**, *46*, 1730.

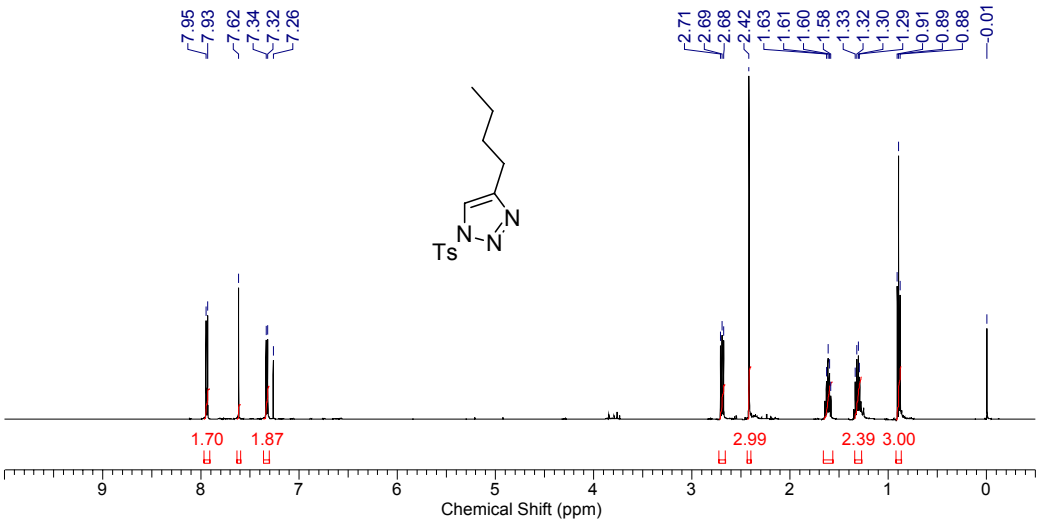
[2] Keith, J. M. *J. Org. Chem.* **2010**, *75*, 2722.

[3] Ishihara, K.; Nakano, K.; Ishibashi, H.; Yamamoto, H. *Chirality* **2003**, *15*, 135.

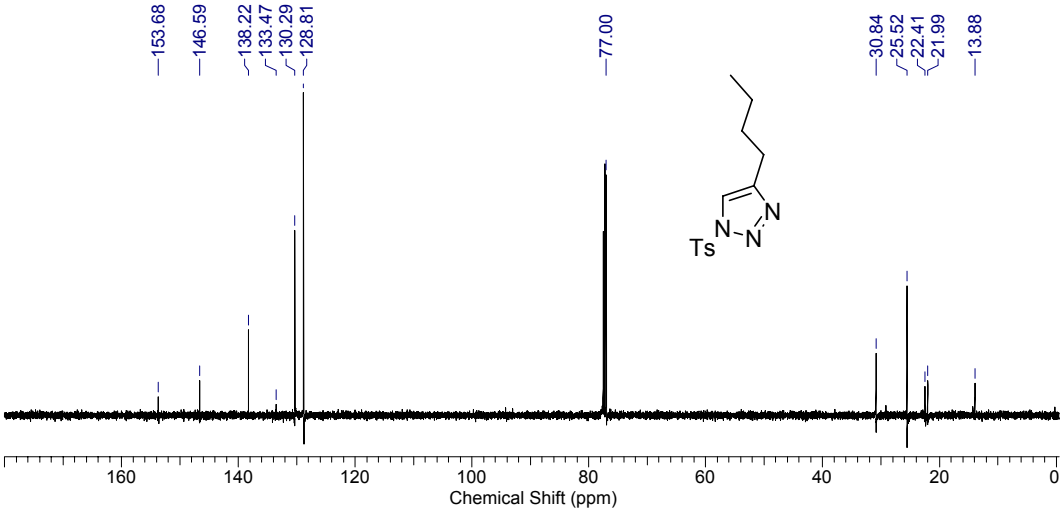
[4] Nepveu, F.; Kim, S.; Boyer, J.; Chatriant, O.; Ibrahim, H.; Reybier, K.; Monje, M.-C.; Chevalley, S.; Perio, P.; Lajoie, B. H.; Bouajila, J.; Deharo, E.; Sauvain, M.; Tahar, R.; Basco, L.; Pantaleo, A.; Turini, F.; Arese, P.; Valentin, A.; Thompson, E.; Vivas, L.; Petit, S.; Nallet, J.-P. *J. Med. Chem.* **2010**, *53*, 699.

Copies of NMR spectra:

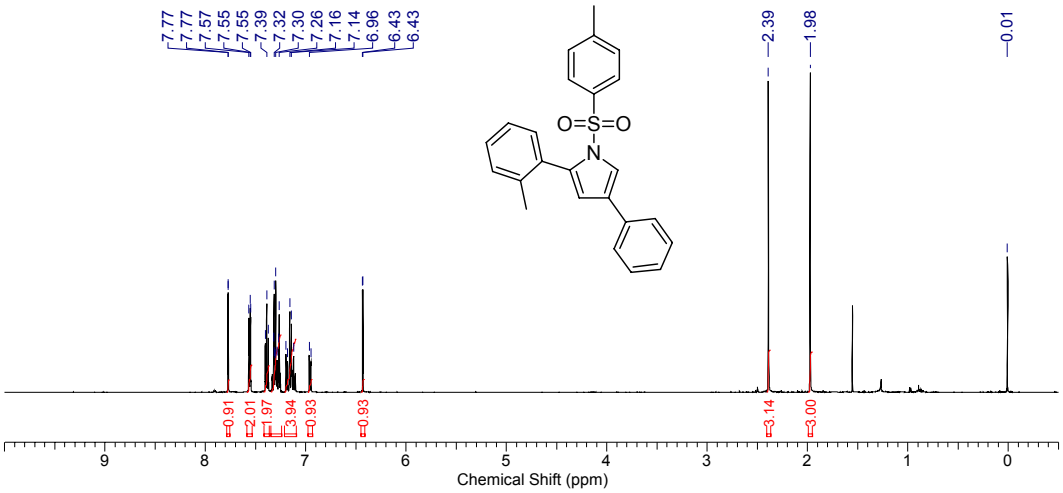
1H Spectrum of 1e (500 MHz, CDCl3)



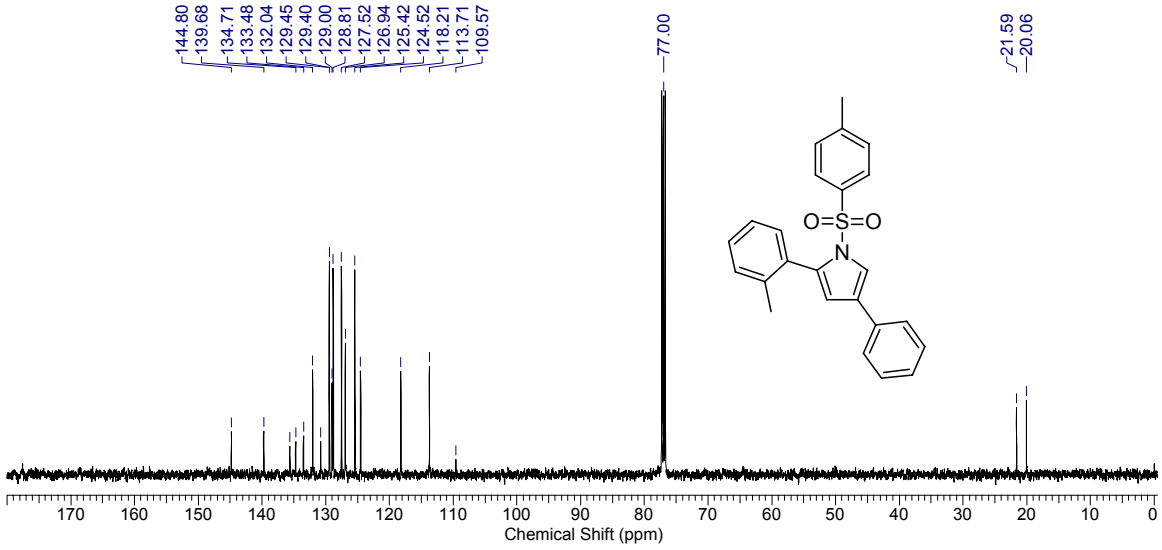
13C Spectrum of 1e (126 MHz, CDCl3)



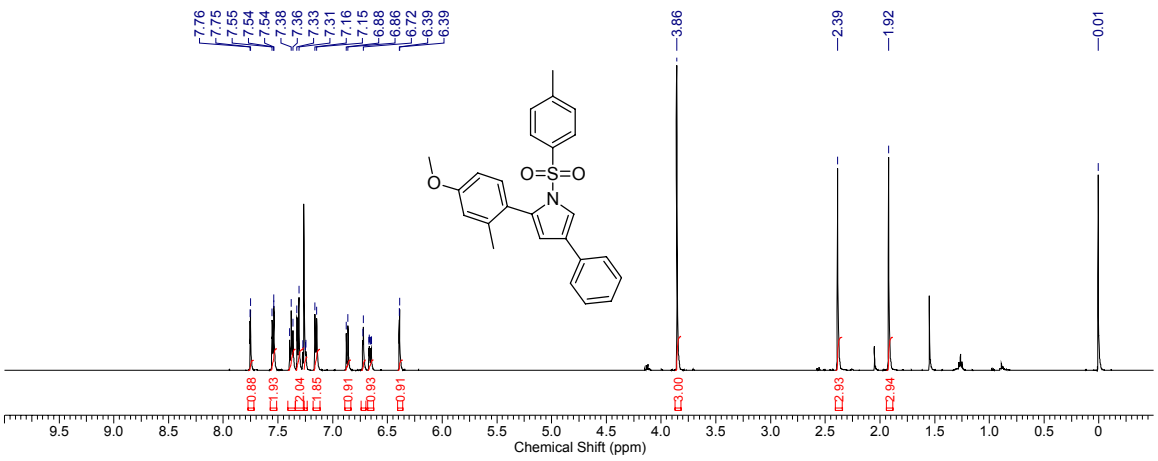
1H Spectrum of 4a (500 MHz, CDCl3)



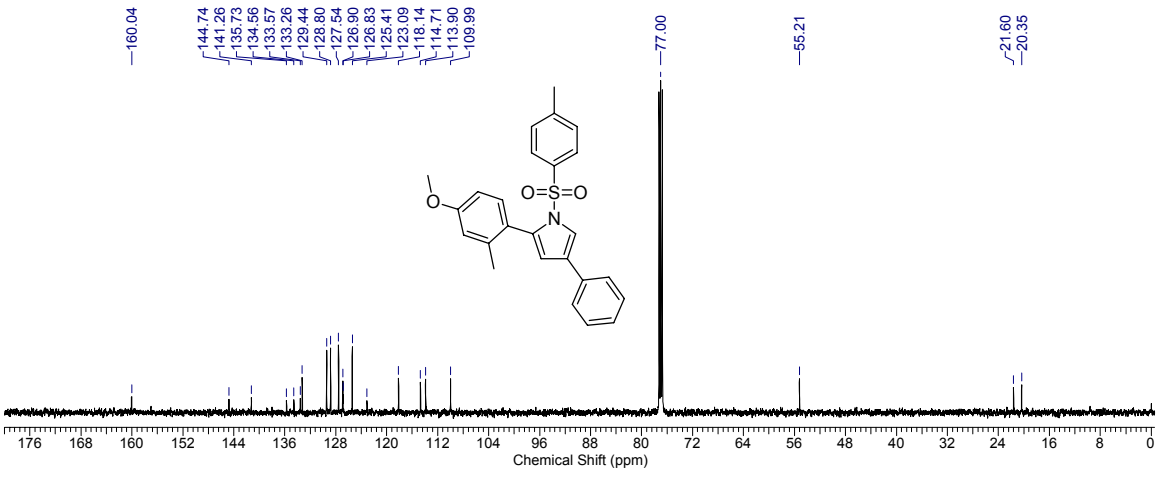
13C Spectrum of 4a (126 MHz, CDCl3)



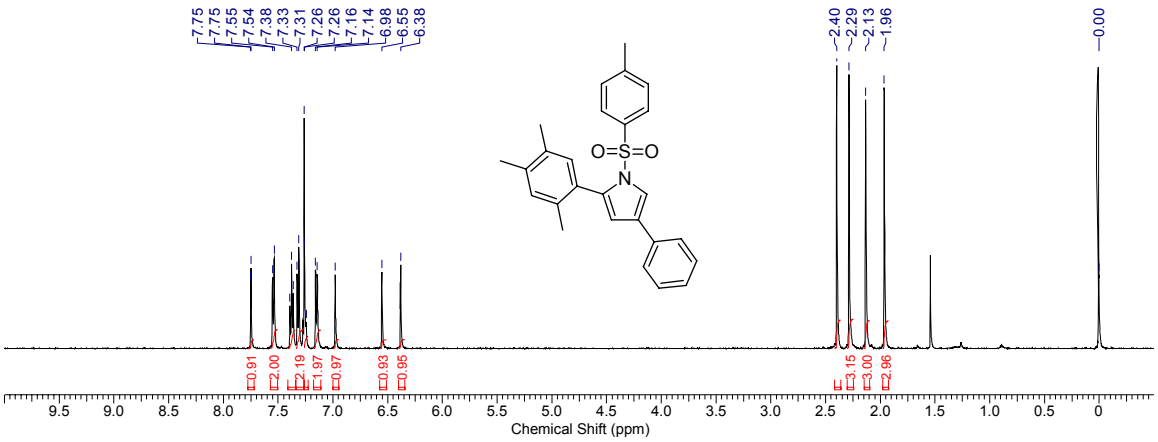
1H Spectrum of 4b (500 MHz, CDCl3)



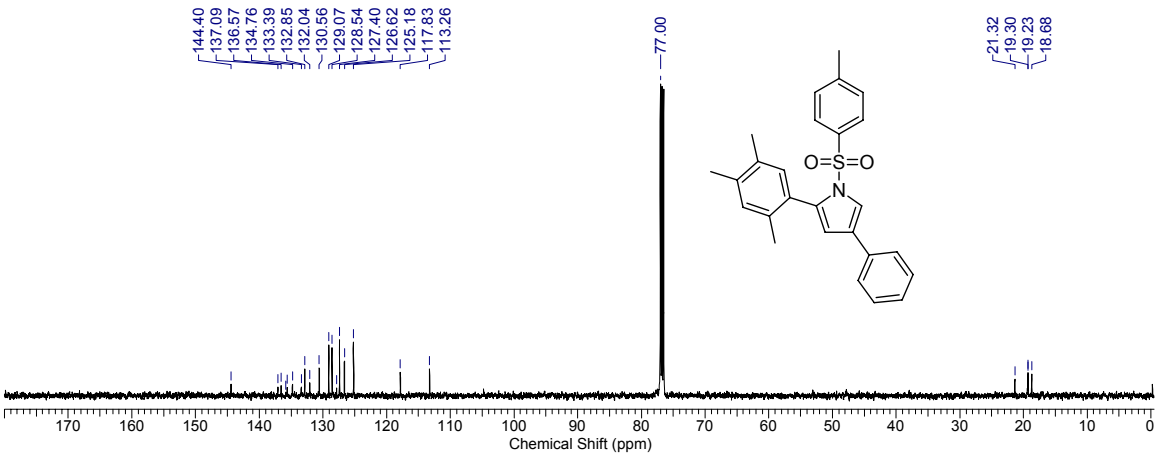
13C Spectrum of 4b (126 MHz, CDCl3)



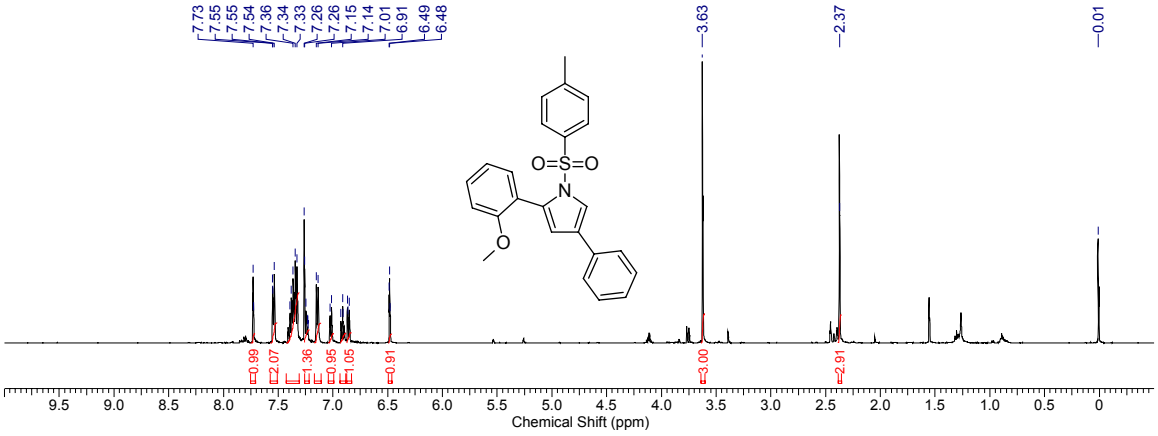
1H Spectrum of 4c (500 MHz, CDCl3)



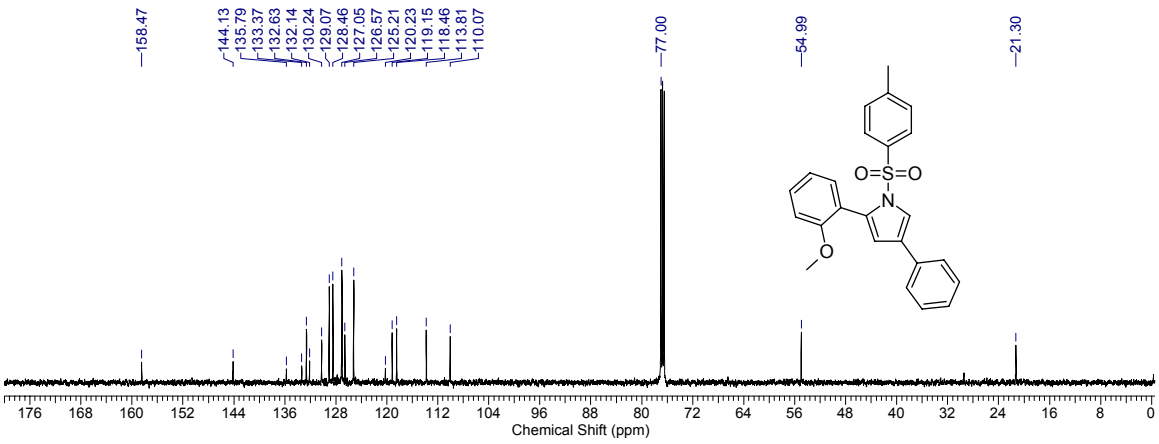
13C Spectrum of 4c (126 MHz, CDCl3)



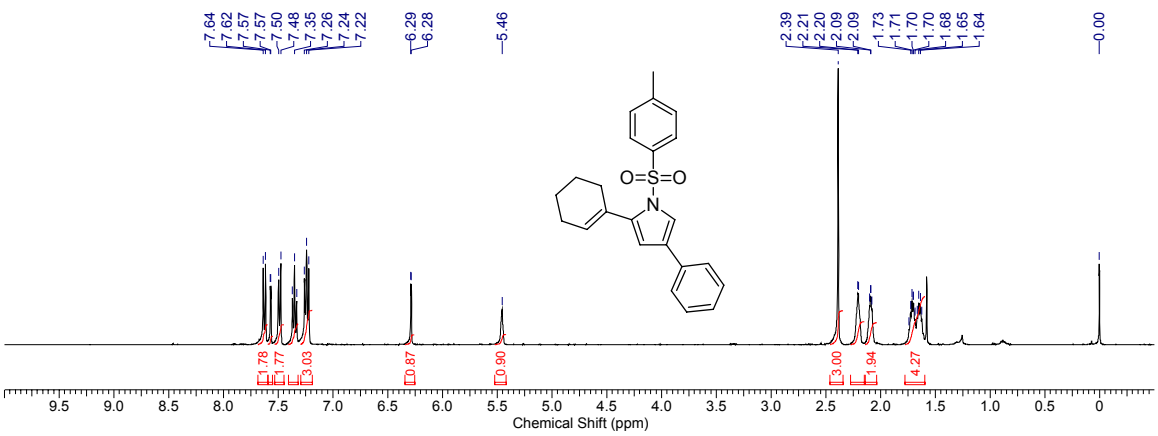
1H Spectrum of 4d (500 MHz, CDCl3)



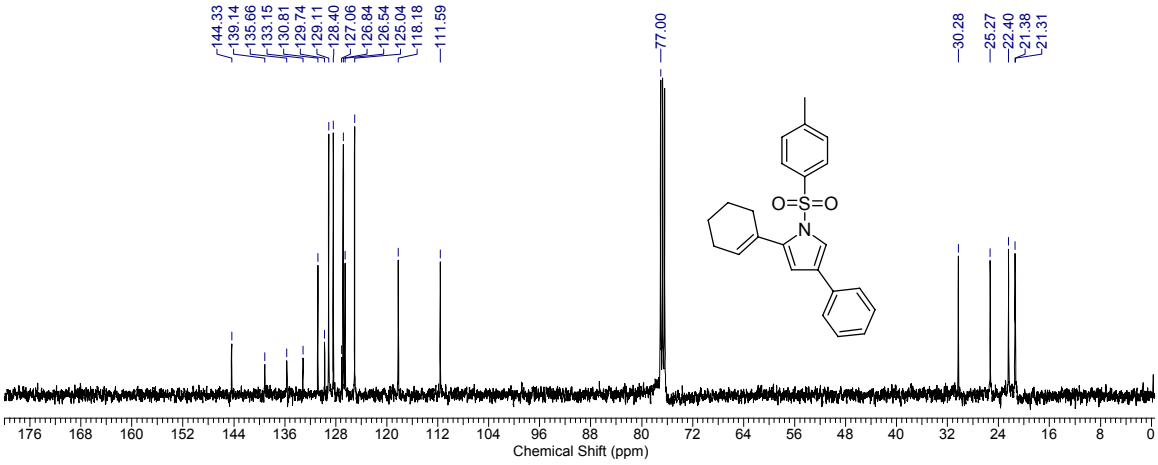
13C Spectrum of 4d (126 MHz, CDCl3)



1H Spectrum of 4e (400 MHz, CDCl3)



13C Spectrum of 4e (101 MHz, CDCl3)



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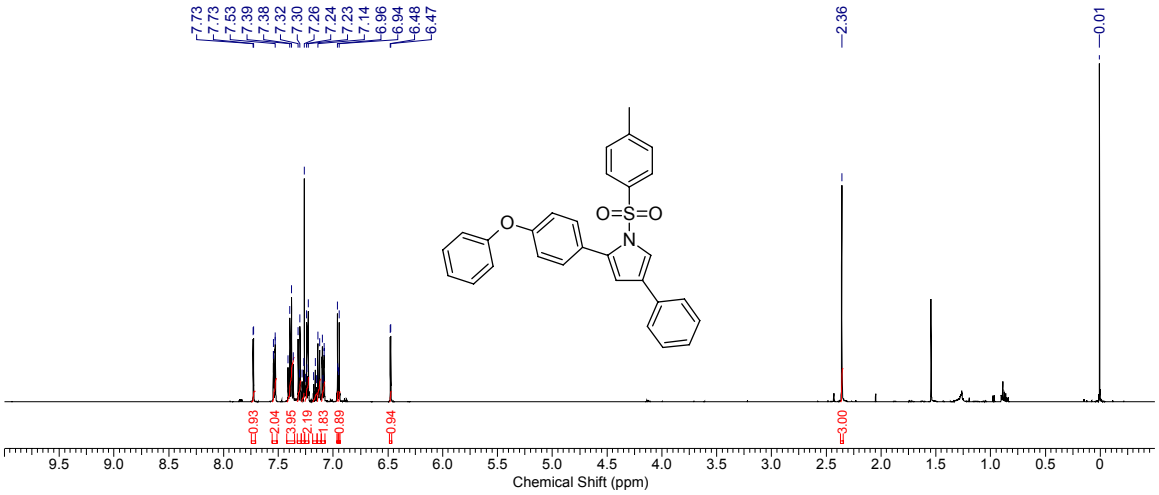
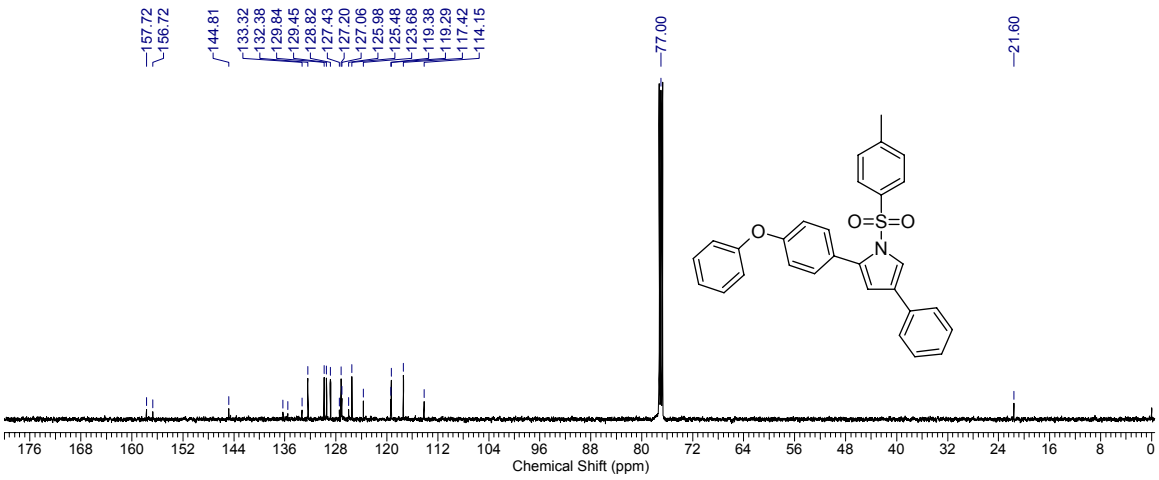
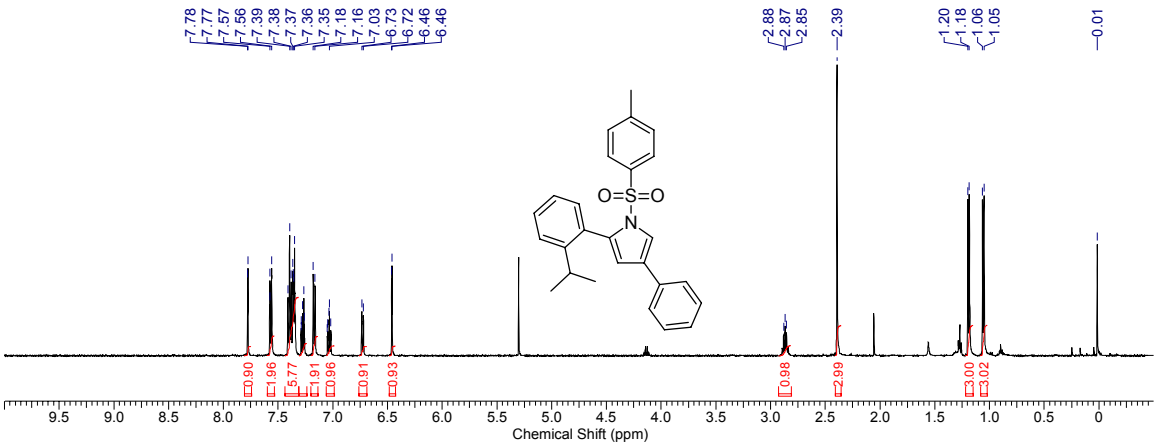


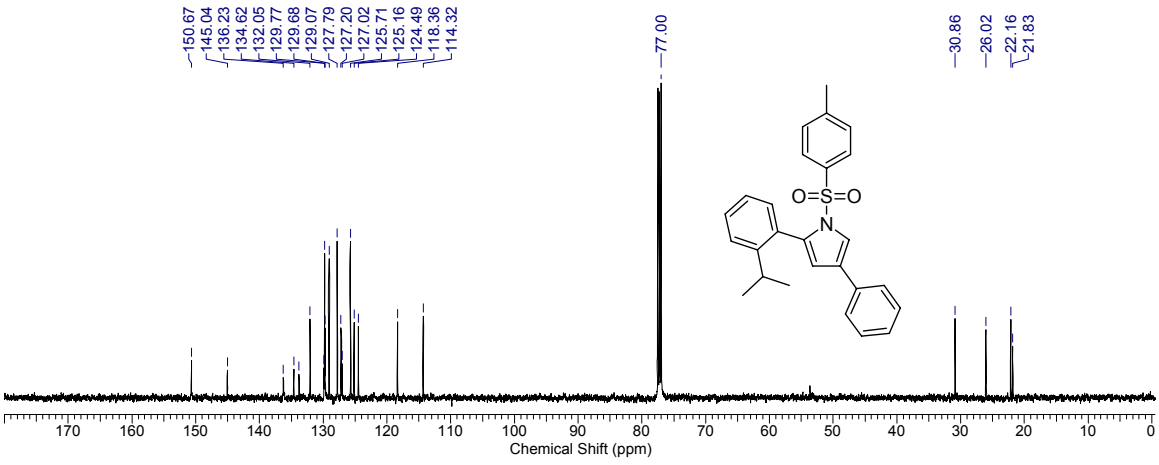
13C Spectrum of 4f (126 MHz, CDCl3)



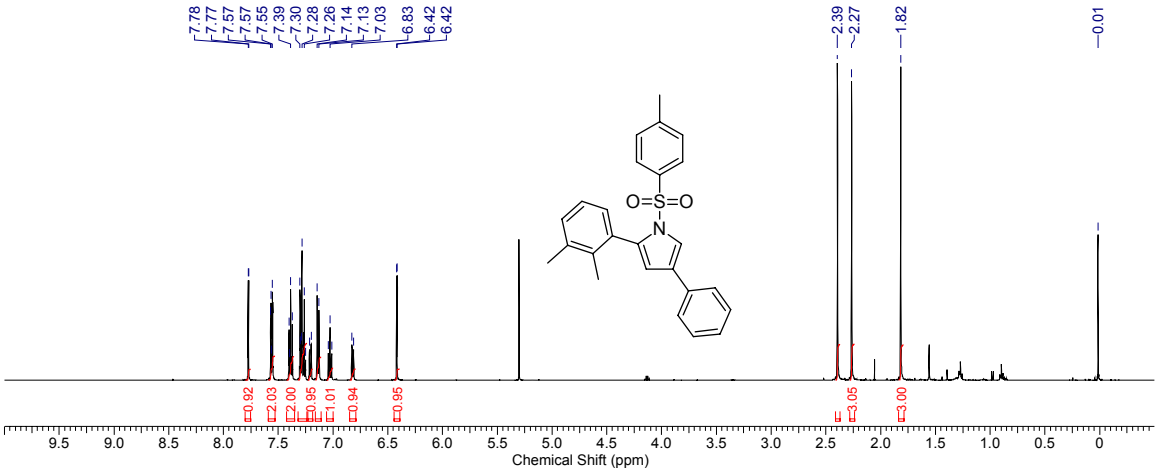
1H Spectrum of 4g (500 MHz, CDCl3)



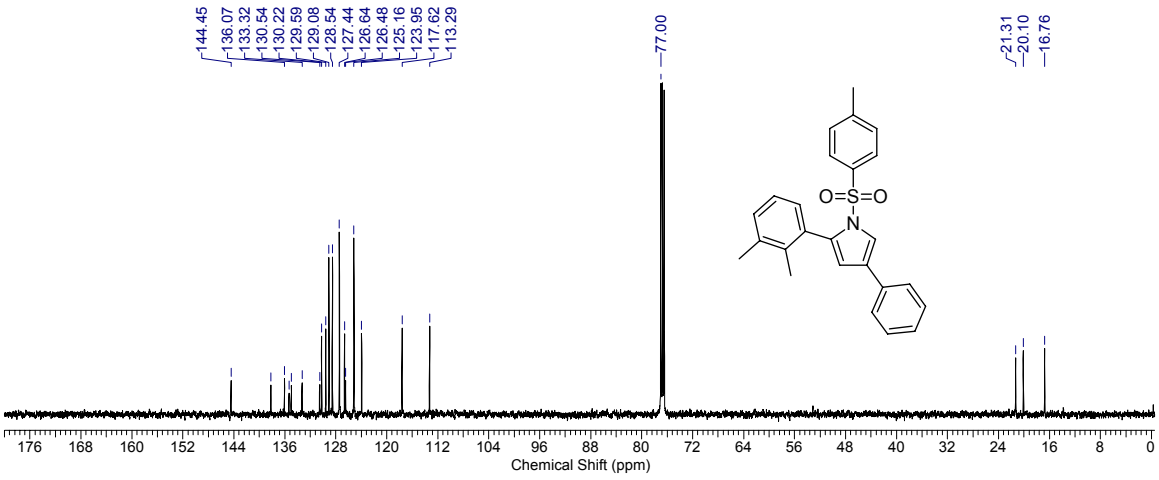
13C Spectrum of 4g (126 MHz, CDCl3)



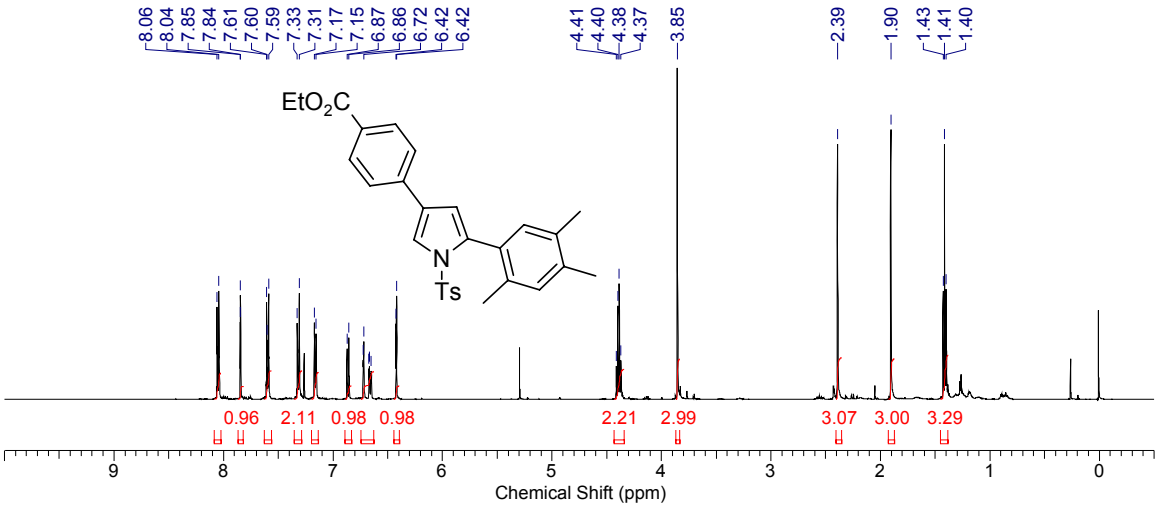
1H Spectrum of 4h (500 MHz, CDCl3)



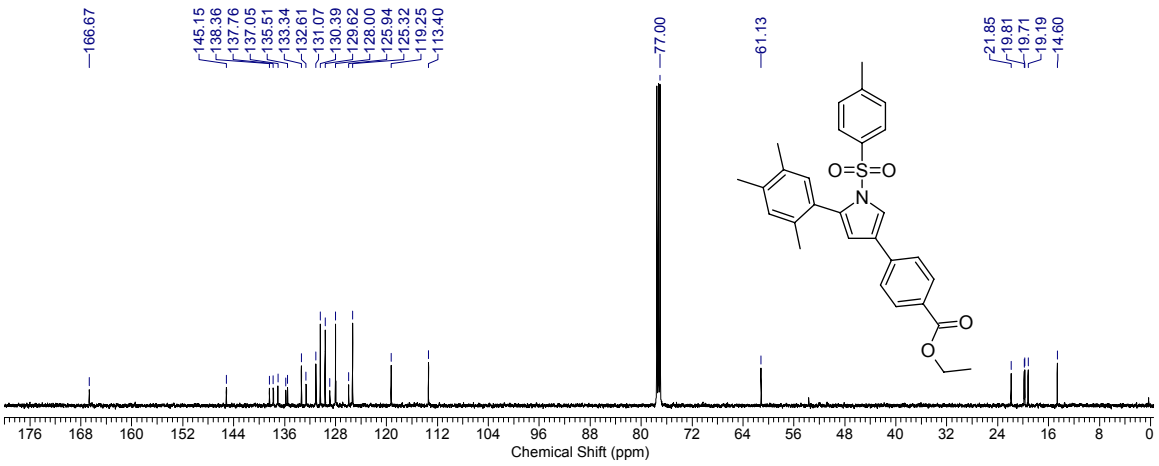
13C Spectrum of 4h (126 MHz, CDCl3)



1H Spectrum of 4i (500 MHz, CDCl3)



13C Spectrum of 4i (126 MHz, CDCl3)



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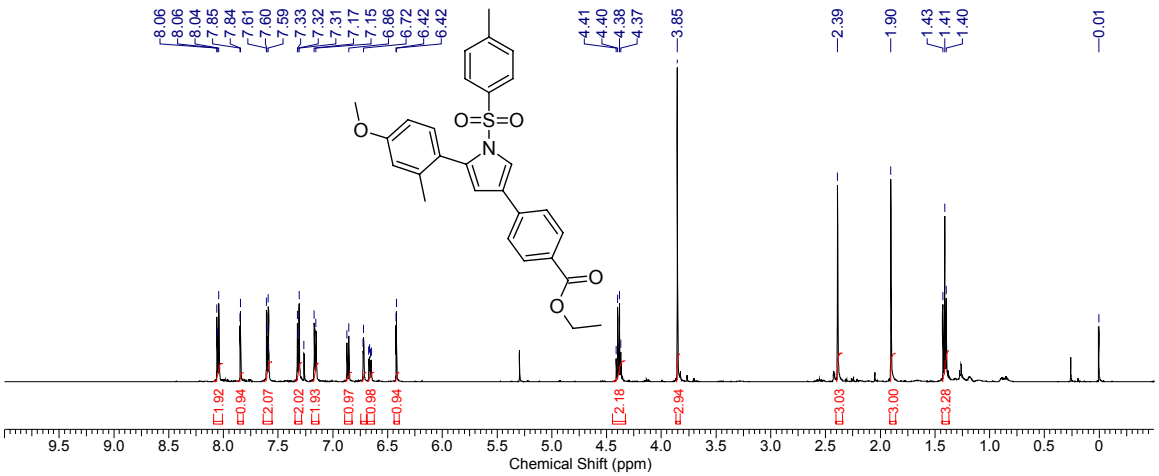

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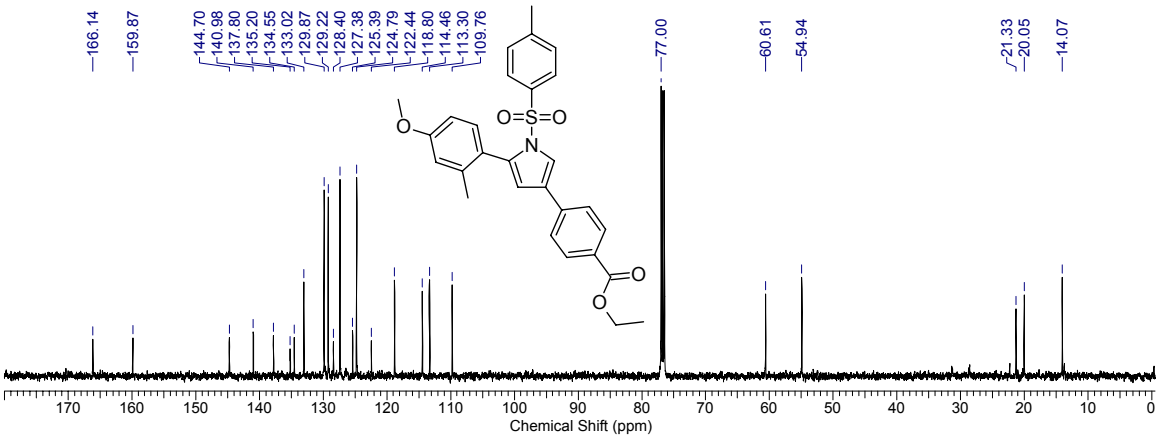
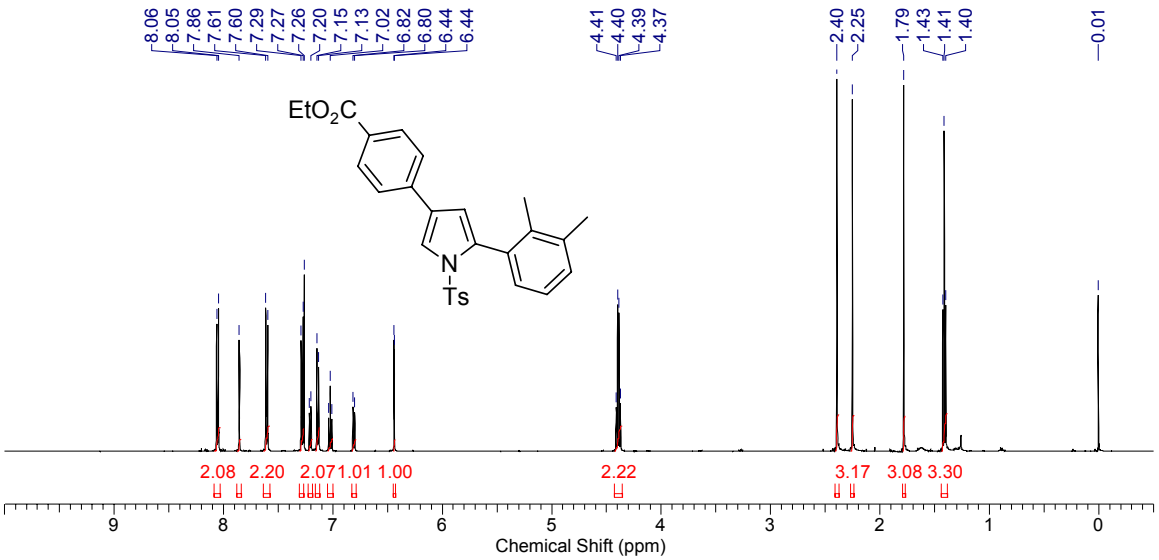
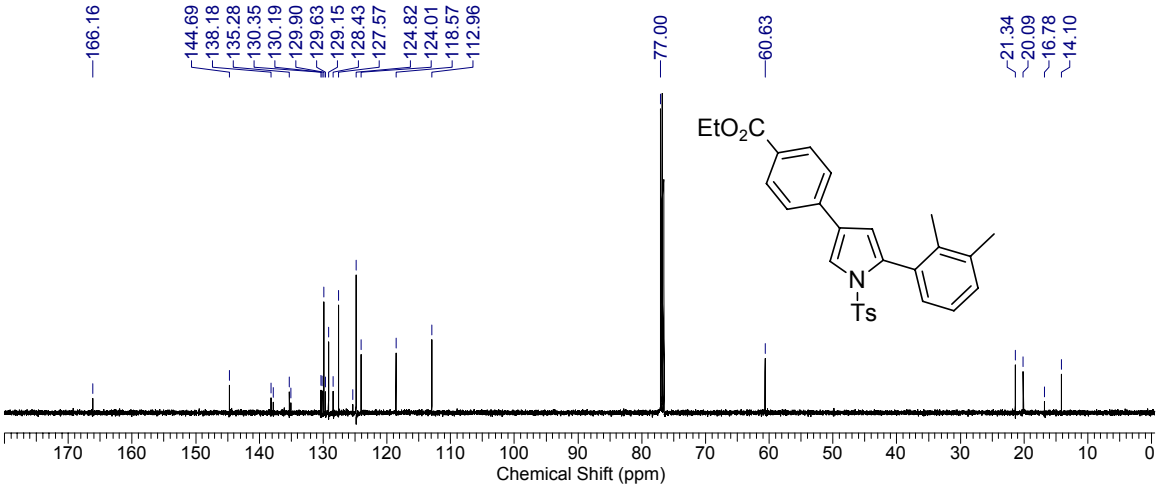


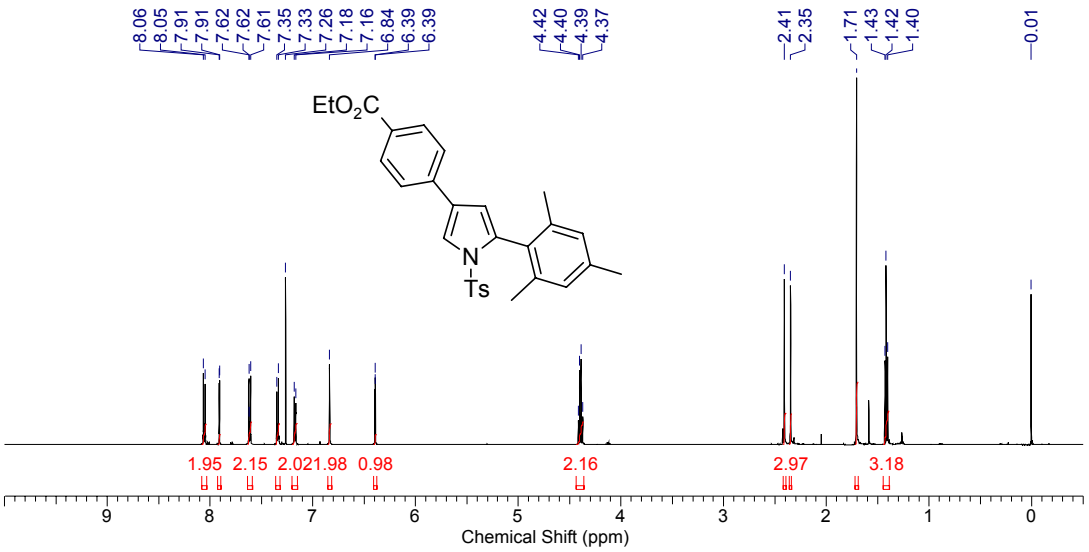
1H Spectrum of 4k (500 MHz, CDCl3)



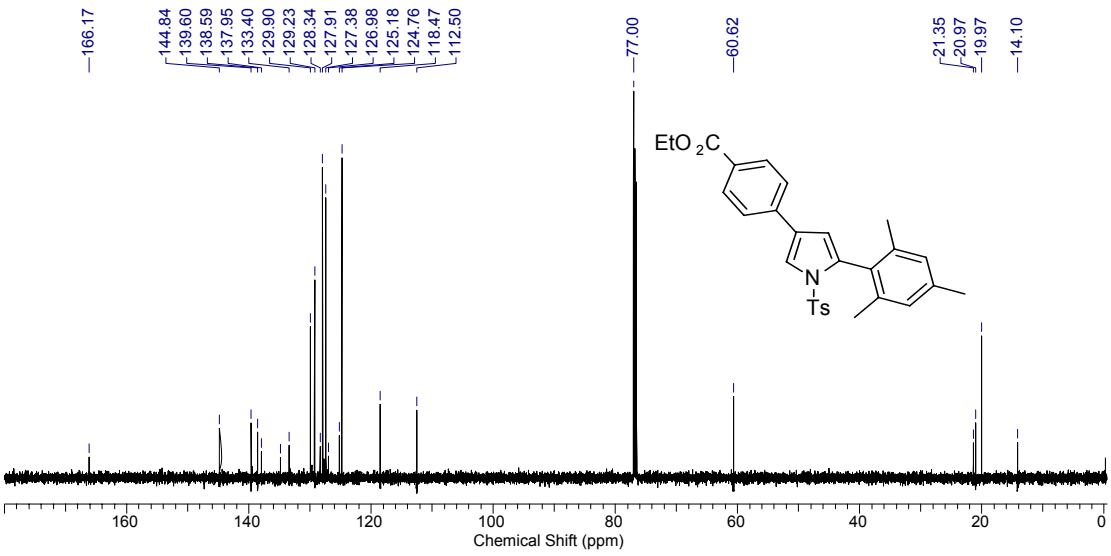
13C Spectrum of 4k (126 MHz, CDCl3)



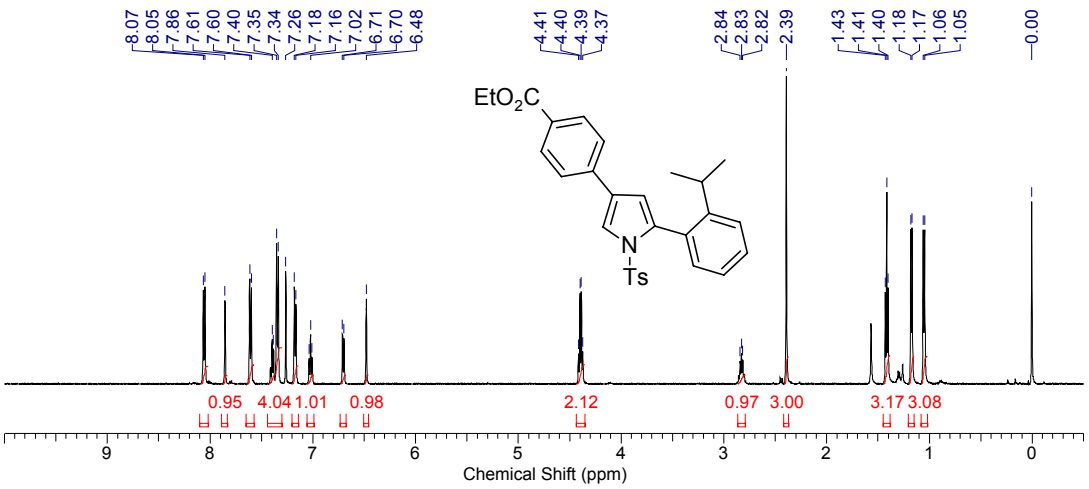
1H Spectrum of 4l (500 MHz, CDCl3)



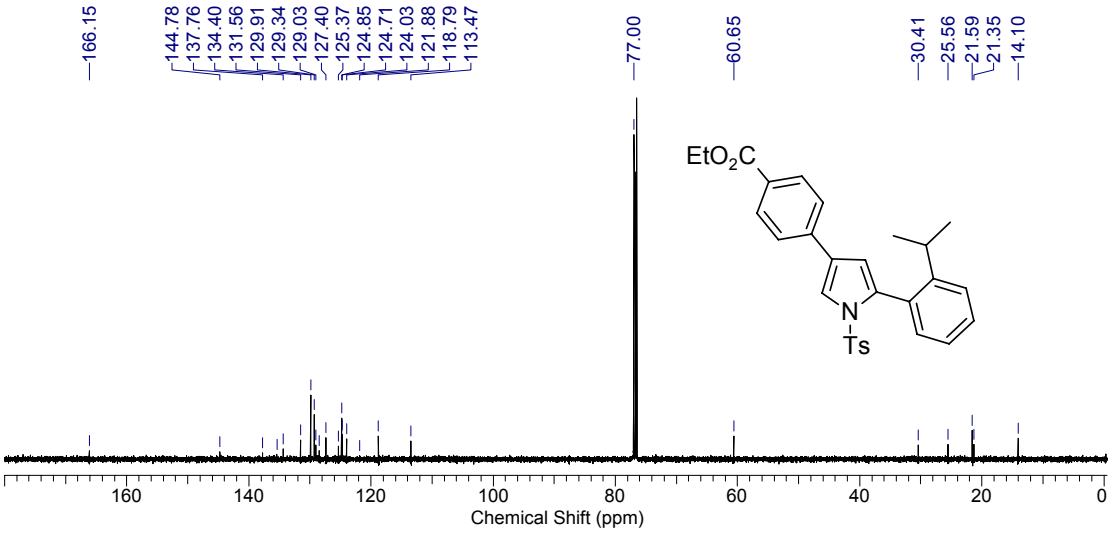
13C Spectrum of 4l (126 MHz, CDCl3)



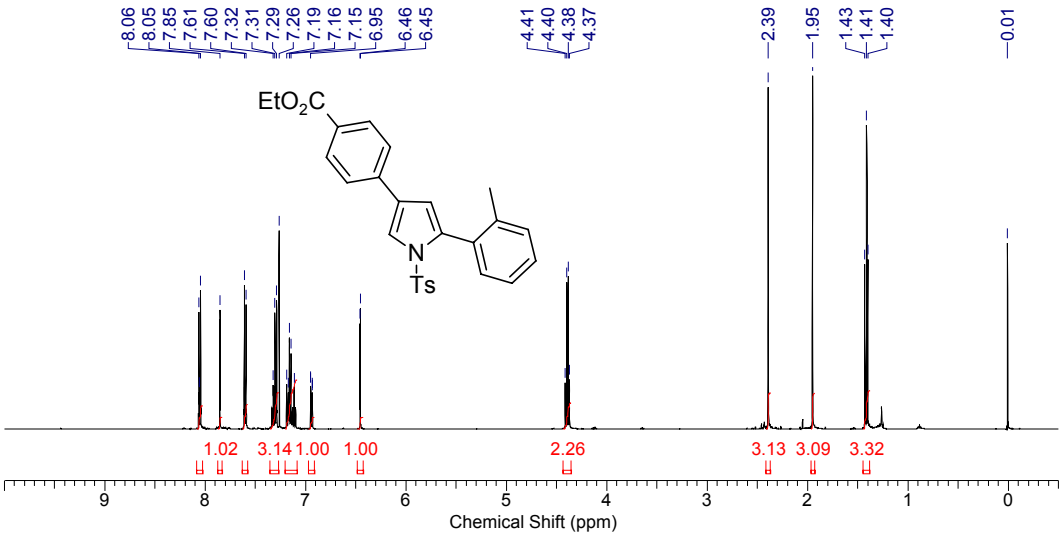
1H Spectrum of 4m (500 MHz, CDCl3)



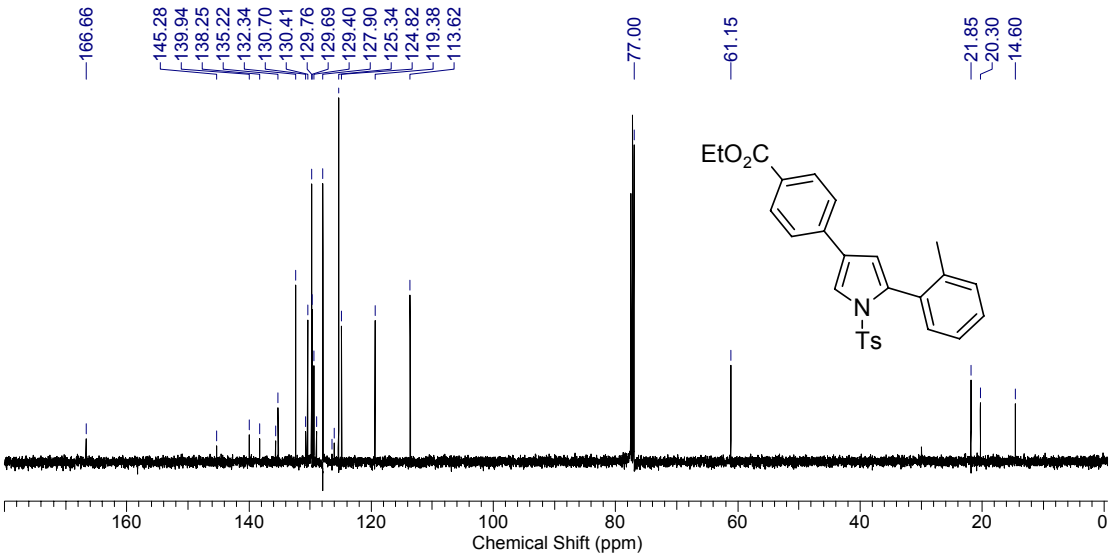
13C Spectrum of 4m (126 MHz, CDCl3)



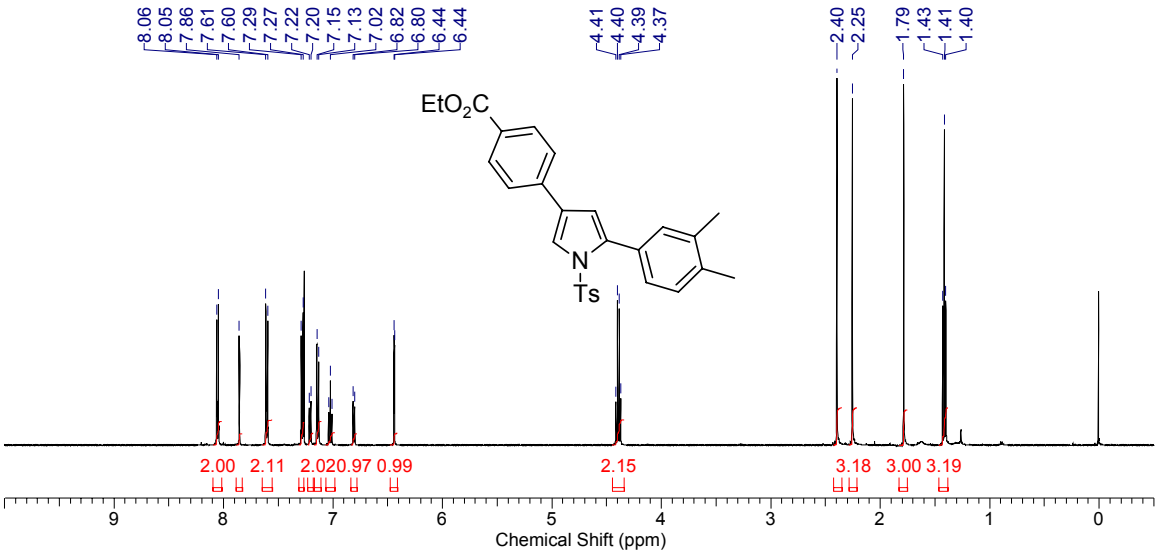
1H Spectrum of 4n (500 MHz, CDCl3)



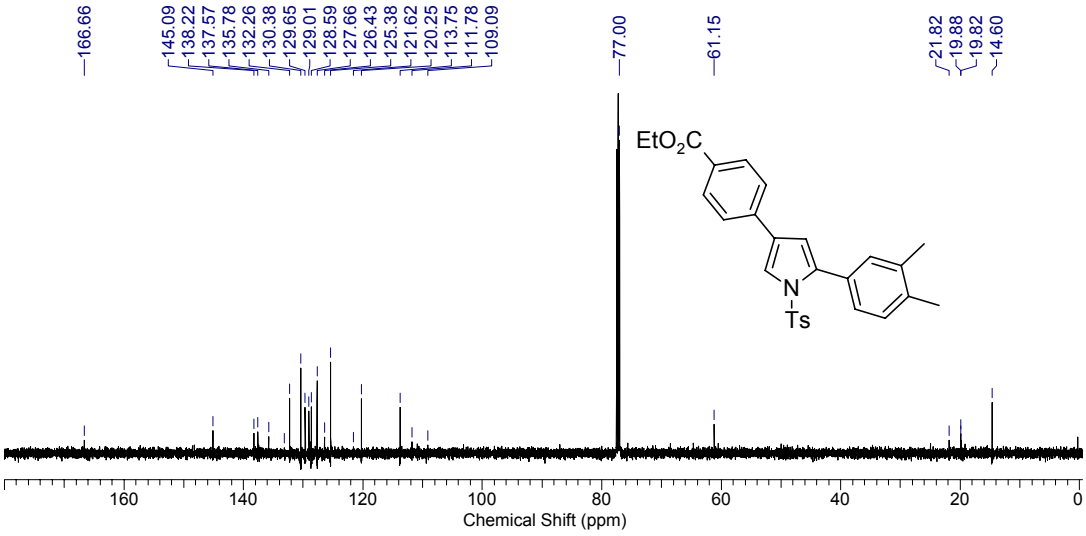
13C Spectrum of 4n (126 MHz, CDCl3)



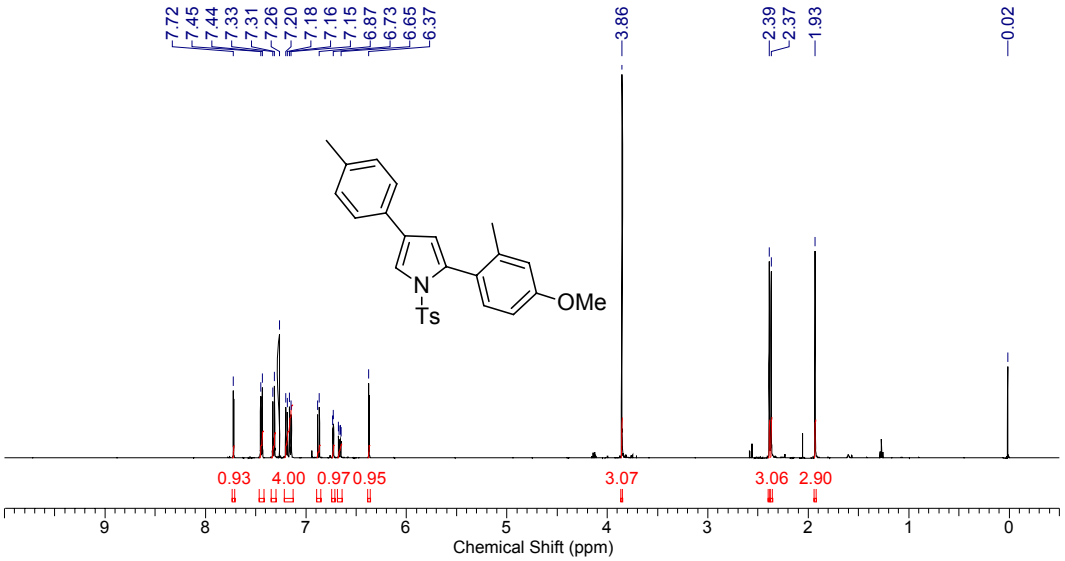
1H Spectrum of 4o (500 MHz, CDCl3)



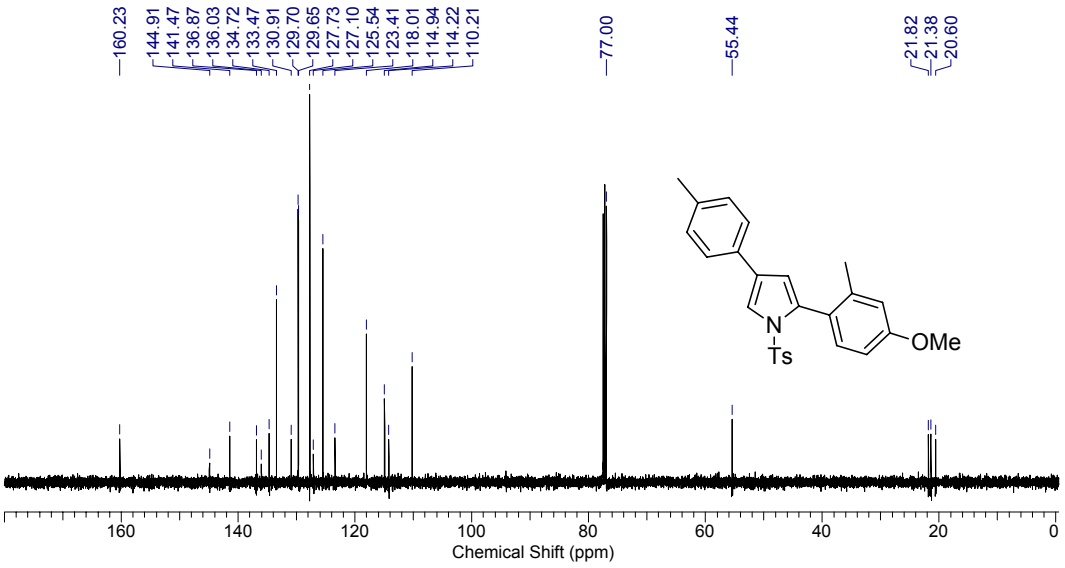
13C Spectrum of 4o (126 MHz, CDCl3)



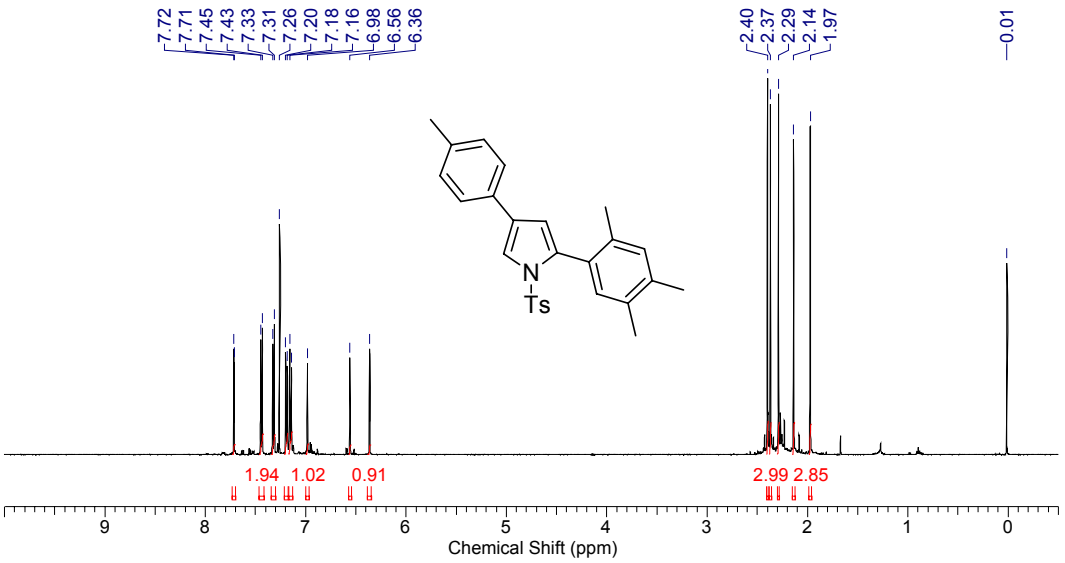
1H Spectrum of 4p (500 MHz, CDCl3)



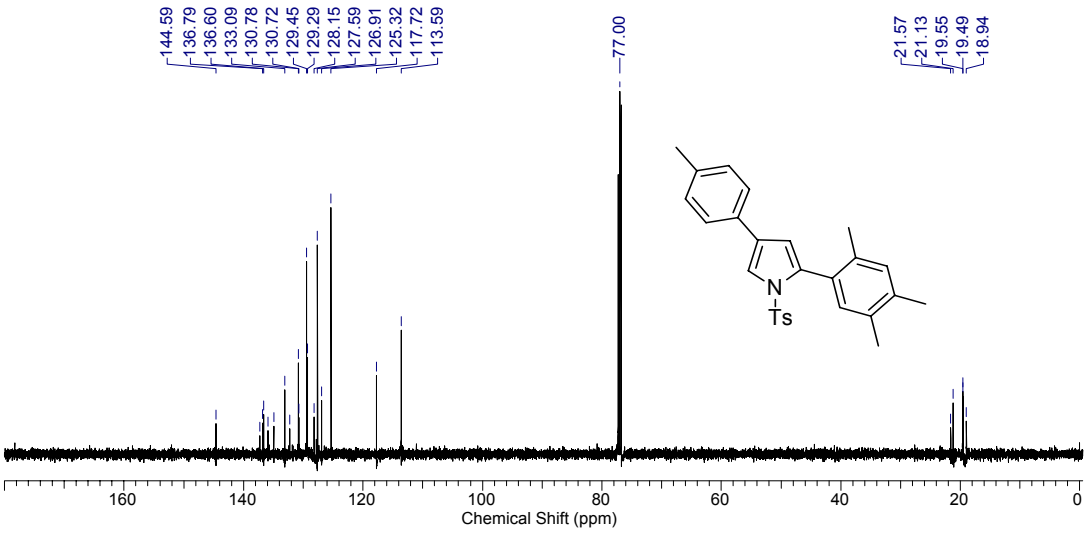
13C Spectrum of 4p (126 MHz, CDCl3)



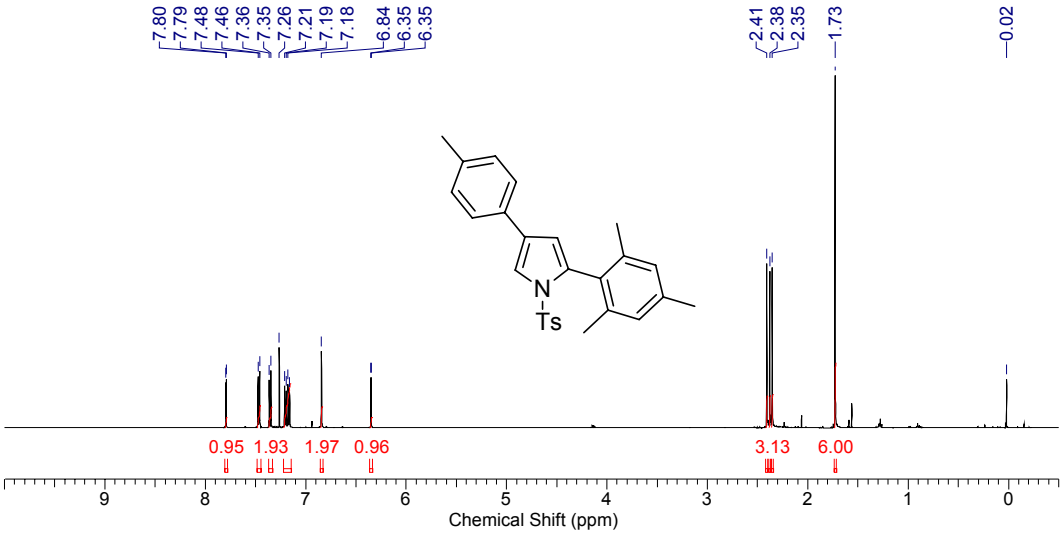
1H Spectrum of 4q (500 MHz, CDCl3)



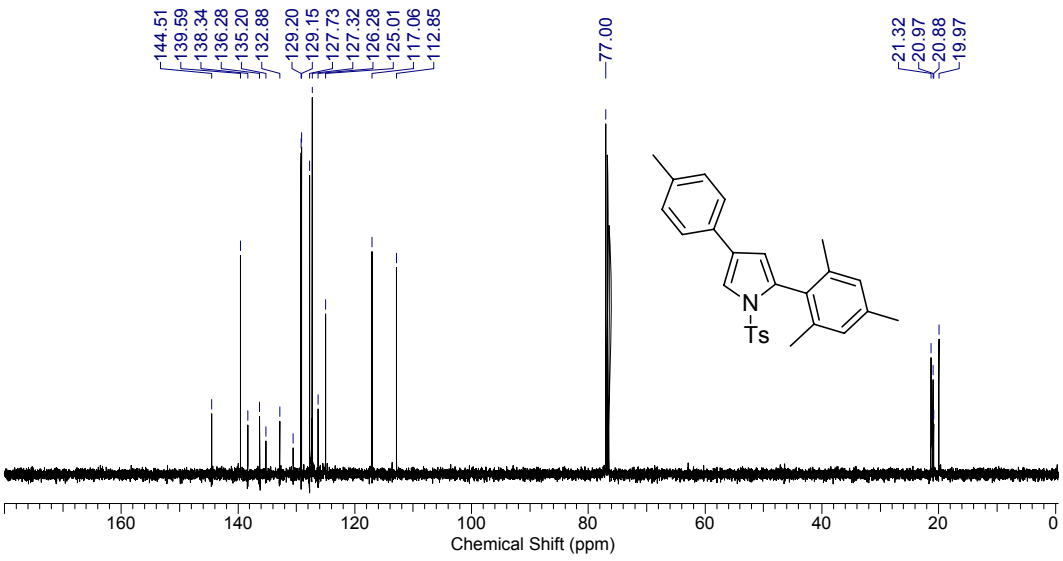
13C Spectrum of 4q (126 MHz, CDCl3)



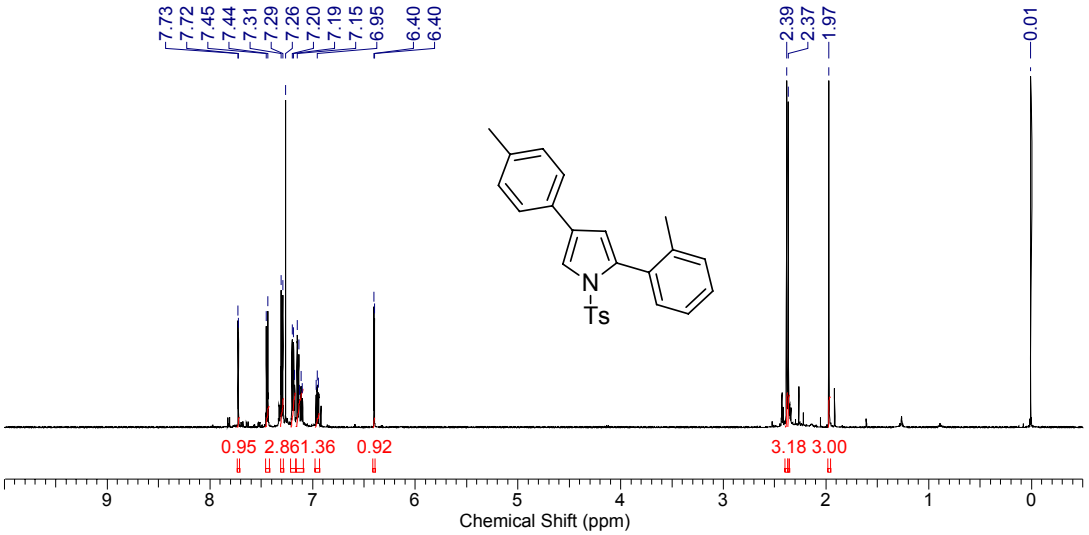
1H Spectrum of 4r (500 MHz, CDCl3)



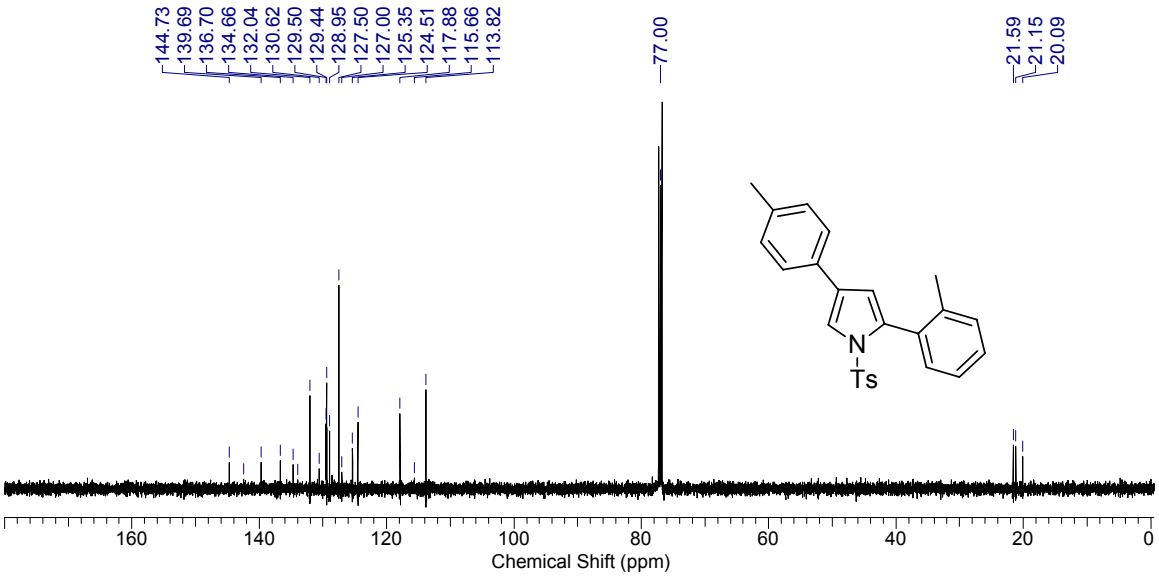
13C Spectrum of 4r (126 MHz, CDCl3)



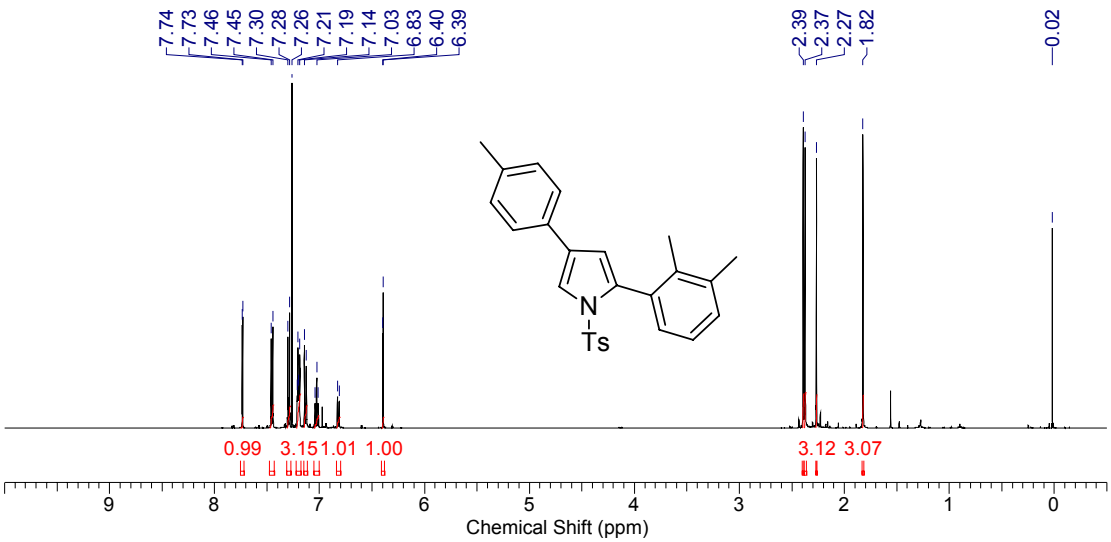
1H Spectrum of 4s (500 MHz, CDCl3)



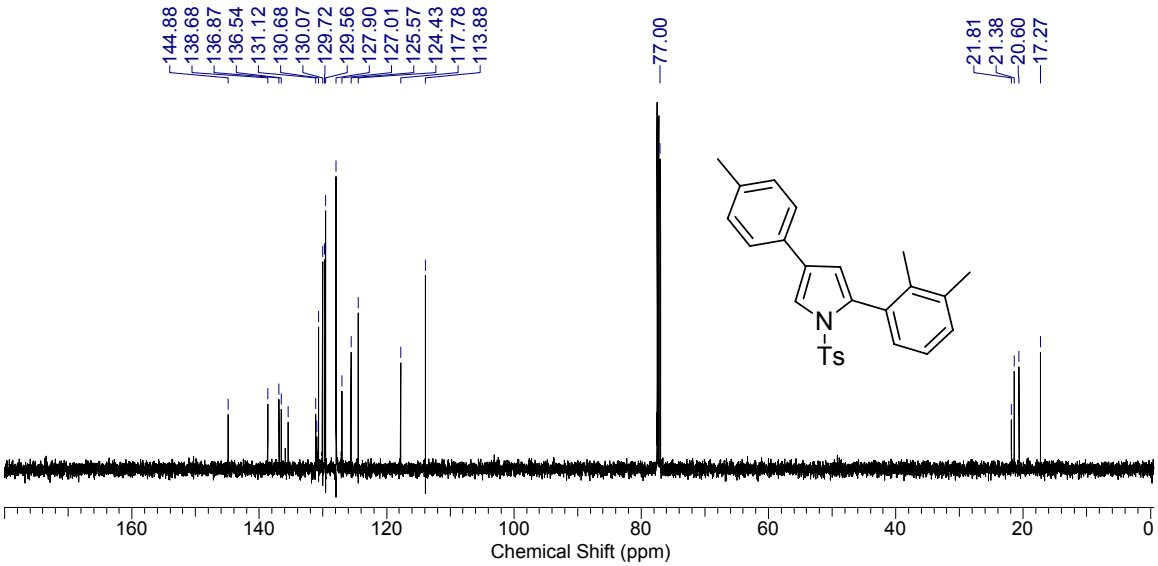
13C Spectrum of 4s (126 MHz, CDCl3)



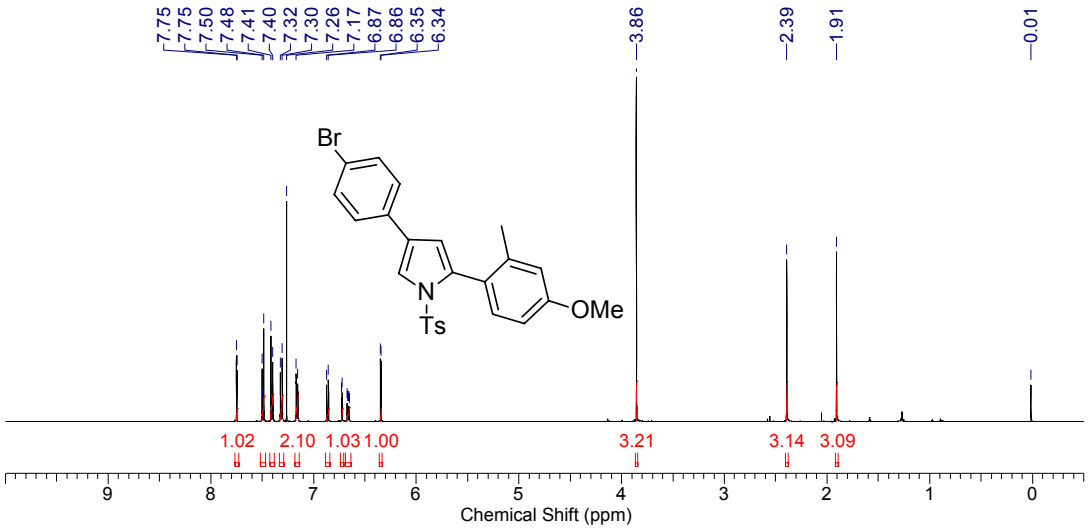
1H Spectrum of 4t (500 MHz, CDCl3)



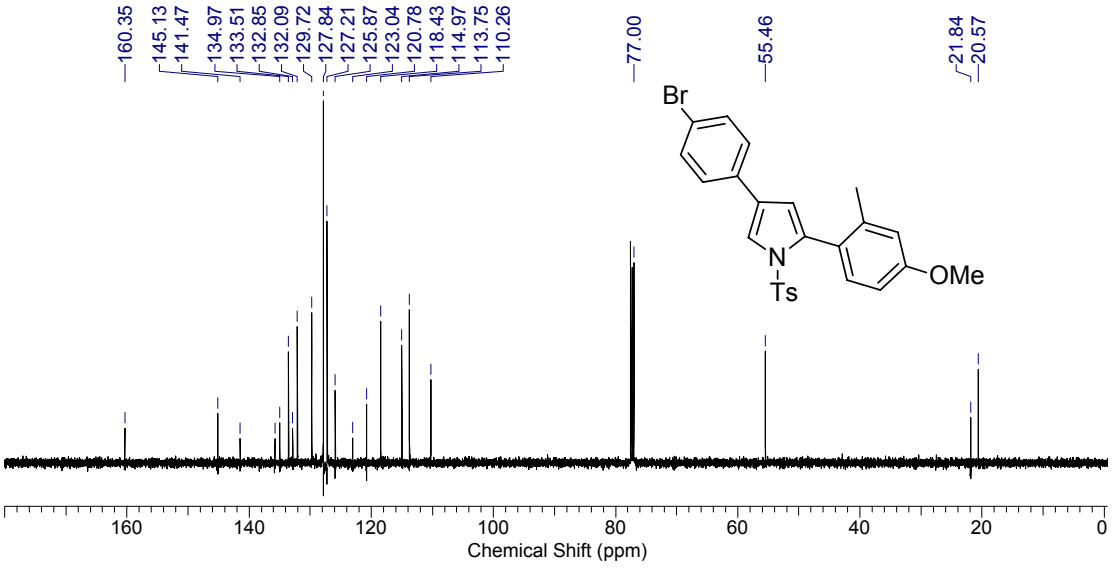
13C Spectrum of 4t (126 MHz, CDCl3)



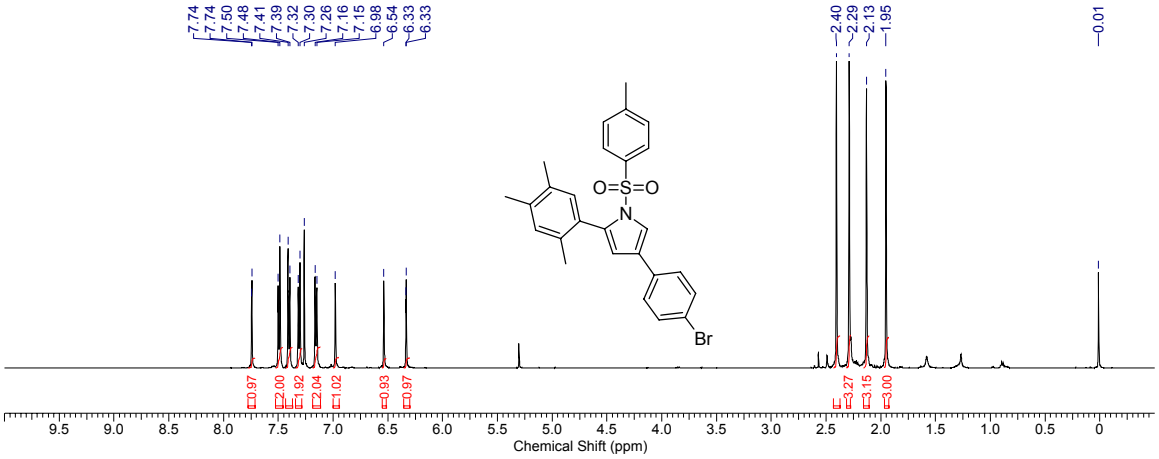
1H Spectrum of 4u (500 MHz, CDCl3)



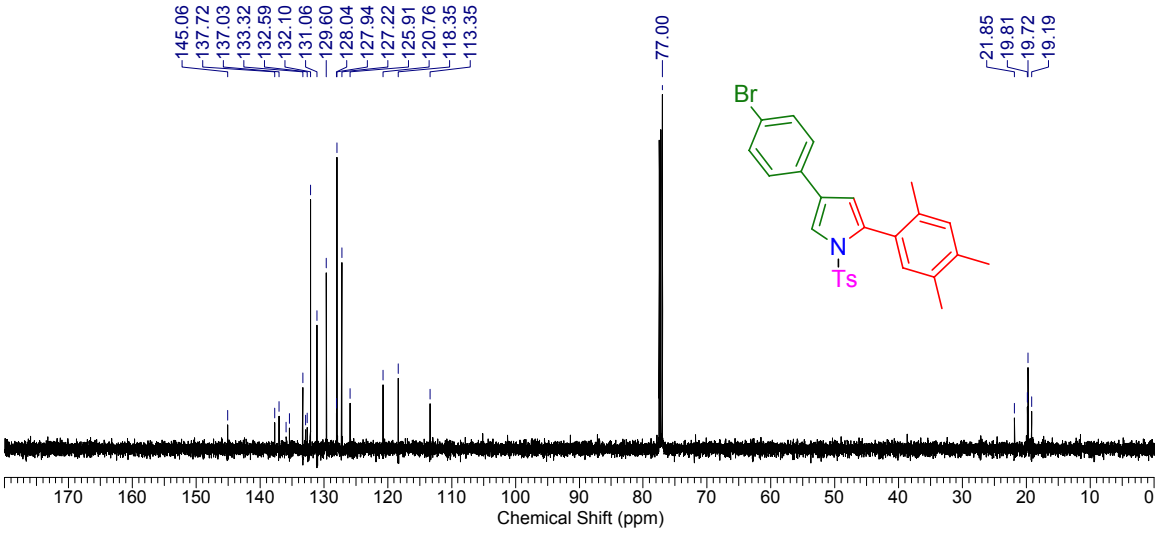
13C Spectrum of 4u (126 MHz, CDCl3)



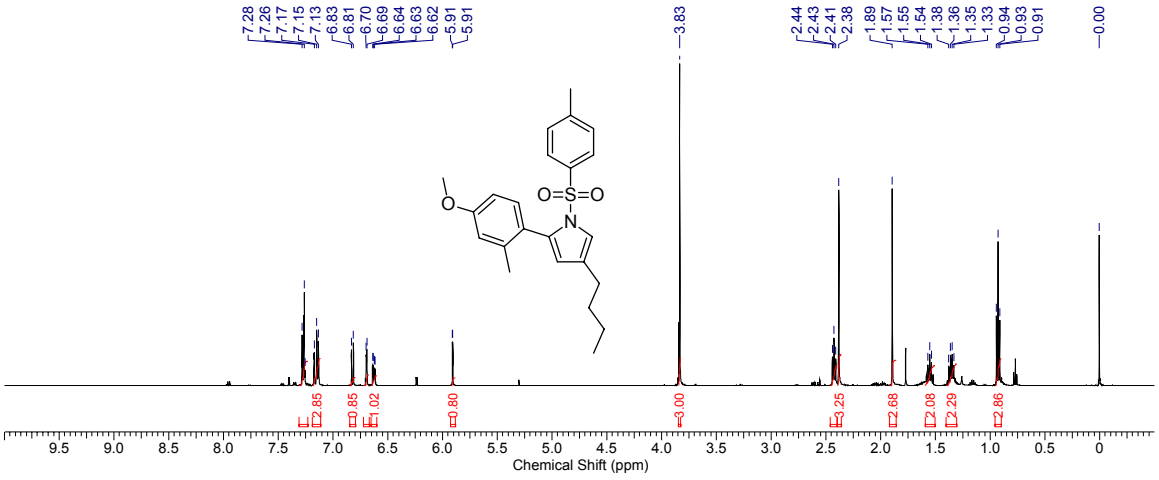
1H Spectrum of 4v (500 MHz, CDCl3)



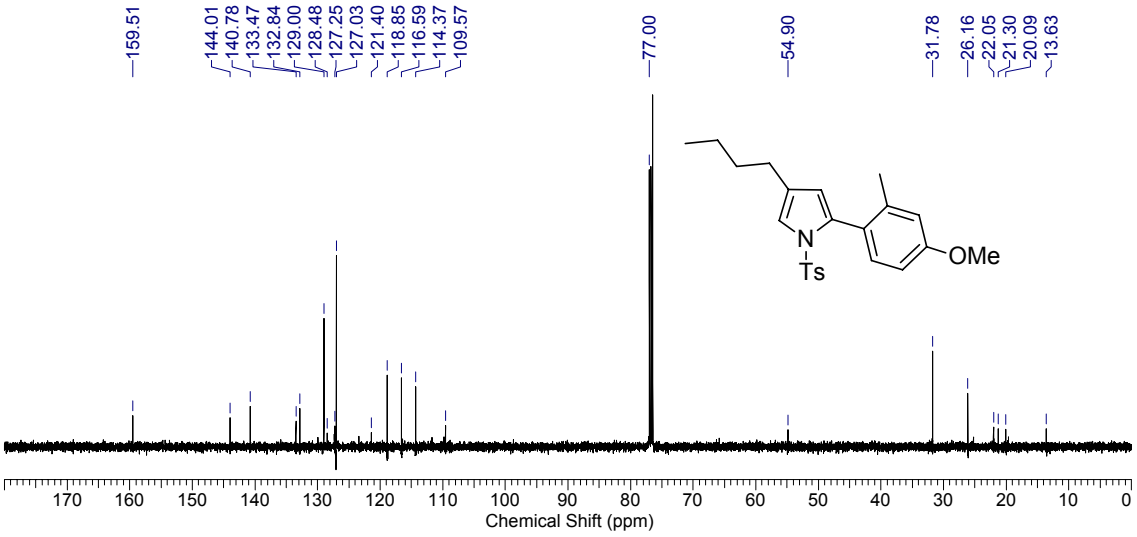
13C Spectrum of 4v (126 MHz, CDCl3)



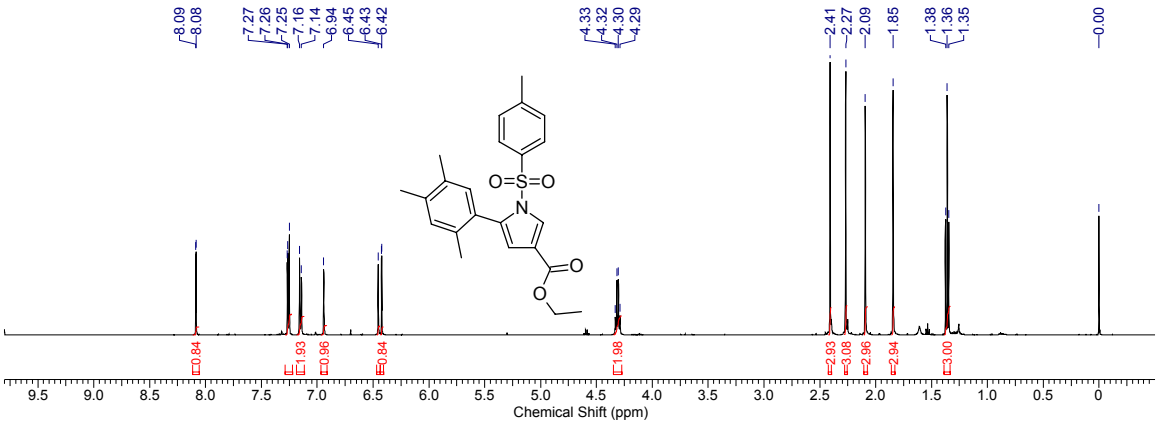
1H Spectrum of 4w (500 MHz, CDCl3)



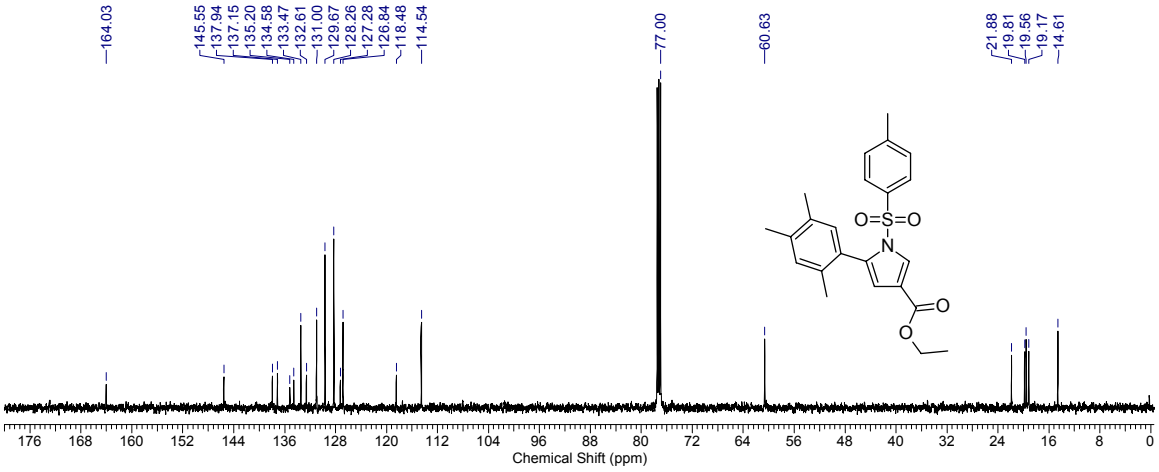
13C Spectrum of 4w (126 MHz, CDCl3)



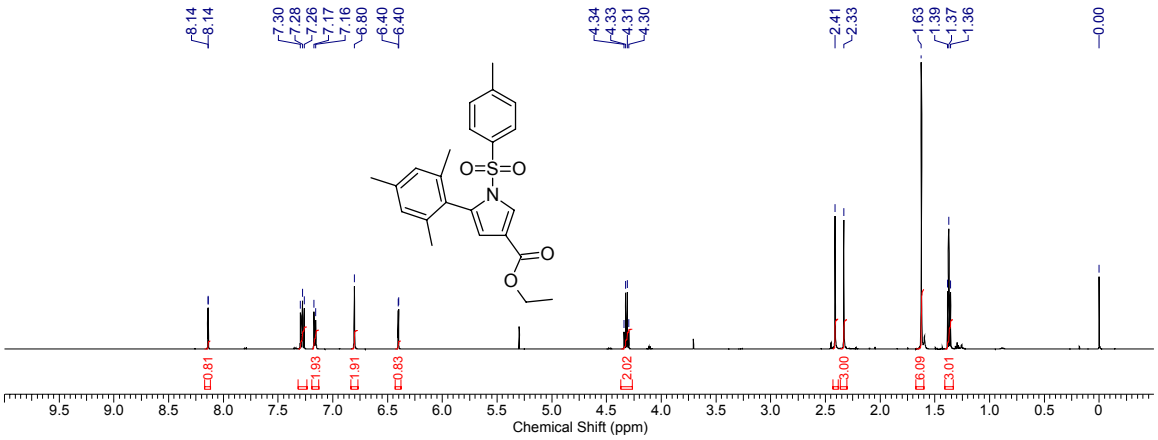
1H Spectrum of 4x (500 MHz, CDCl3)



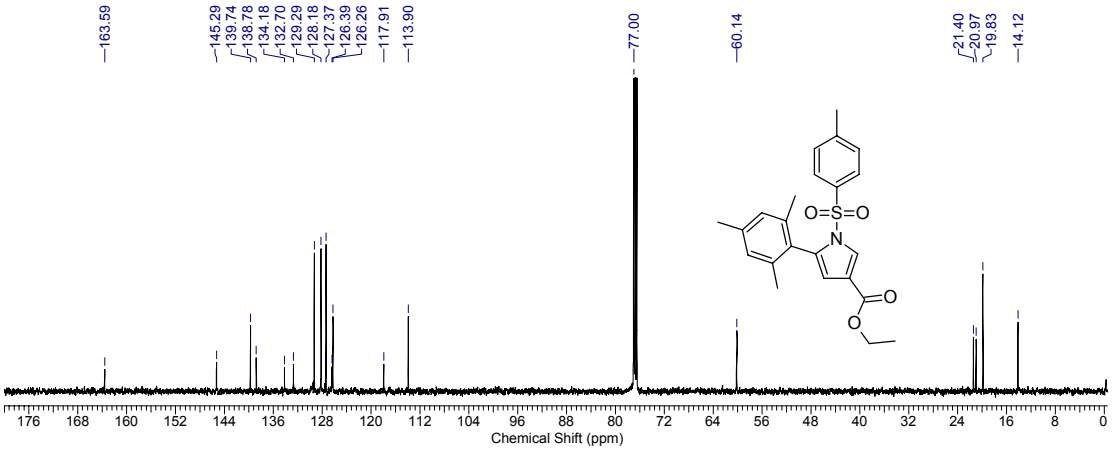
13C Spectrum of 4x (126 MHz, CDCl3)



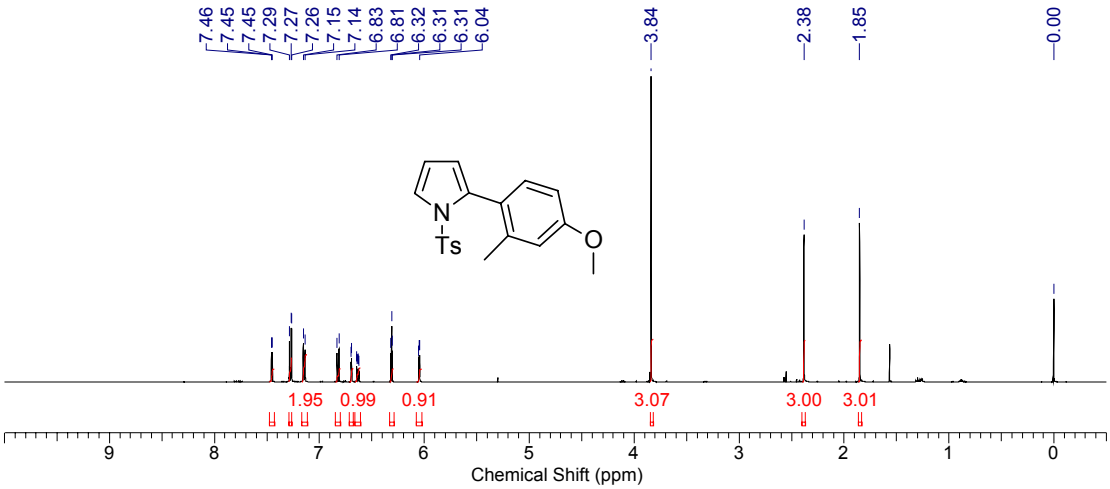
1H Spectrum of 4y (500 MHz, CDCl3)



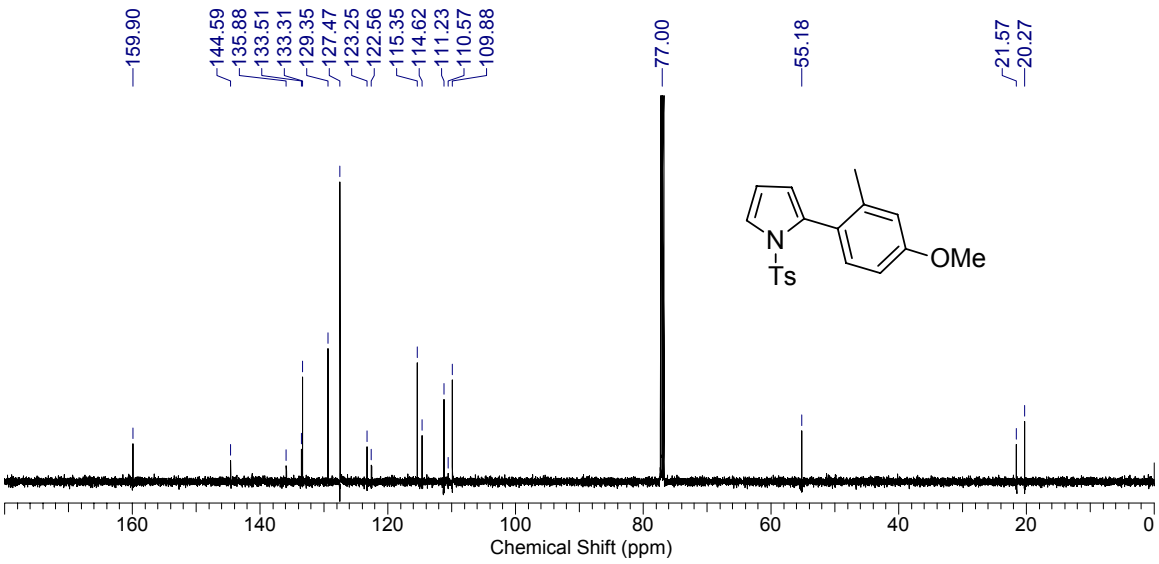
13C Spectrum of 4y (126 MHz, CDCl3)



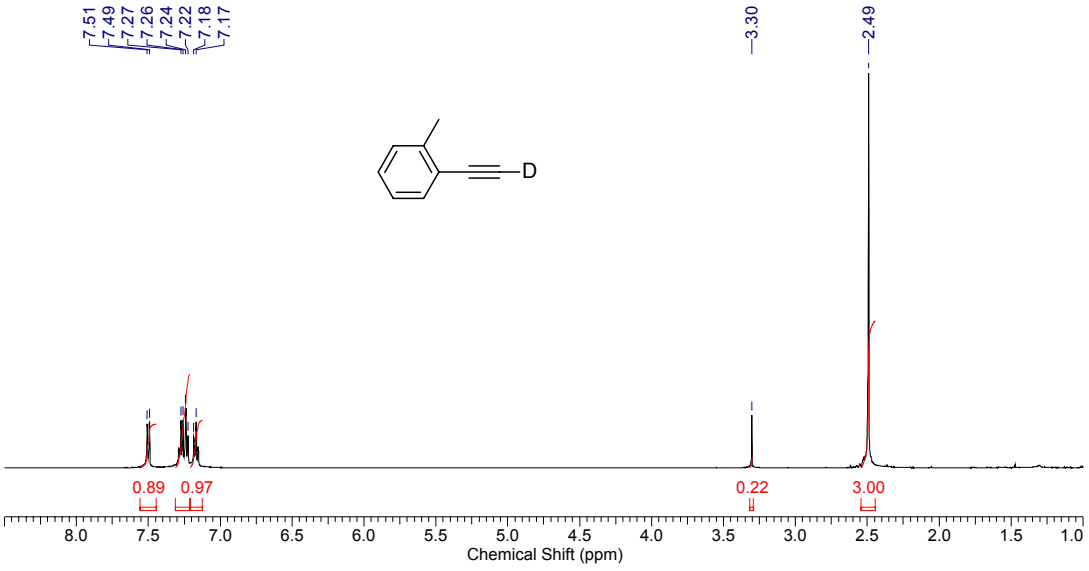
1H Spectrum of 4z (500 MHz, CDCl3)



13C Spectrum of 4z (126 MHz, CDCl3)



(500 MHz, CDCl3)



1H Spectrum of 4*a_d* (500 MHz, CDCl3)