Electronic Supplementary Information for:

Pd-catalyzed cascade reactions between *o*-iodo-*N*-alkenylanilines and tosylhydrazones. Novel approaches to the synthesis of polysubstituted indoles and 1,4-dihydroquinolines.

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CONTENTS

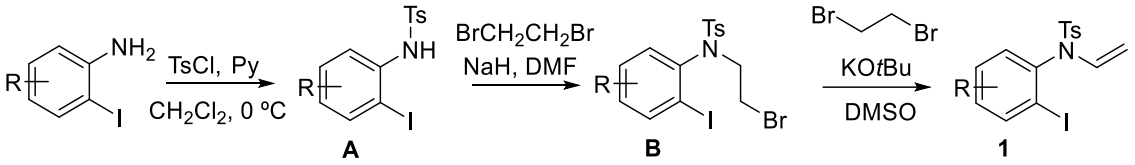
1.- Experimental procedures

1.1- General considerations:

Reactions performed by conventional heating were carried out in a RR98030 12 place Carousel Reaction Station™ from Radleys Discovery Technologies, equipped with gas tight threaded caps with a valve, cooling reflux head system, and digital temperature controller. Lithium *tert*-butoxide was purchased from Acros Chemical Co., stored in a flask purged with nitrogen and weighted in the air. Dioxane, acetonitrile, tetrahydrofurane, dimethylformamide and $CHCl_3$ were dried using the procedures described in D. Perrin Purification of Laboratory Chemicals, Pergamon Press Ltd. 1980, 2nd Ed. 2-Iodoaniline, 4-Chloro-2-iodoaniline, 4-Trifluoromethyl-2-iodoaniline and 4-Fluoro-2-iodoaniline are commercially available from Aldrich Chemical Co. *N*-Tosylhydrazones were prepared from the corresponding carbonyl compounds and through previously described methodologies.[1] NMR spectra were recorded in $CDCl_3$ at 300 MHz, 400 MHz and 600 MHz for ^1H, 75 MHz, 100 MHz and 150 MHz for ^{13}C and 282 MHz for ^{19}F, with tetramethylsilane as internal standard for ^1H and the residual solvent signals as standard for ^{13}C. The data is being reported as s = singlet, bs = broad singlet, d = doublet, dd = double doublet, t = triplet, dt = double triplet, q = quatriplet and m = multiplet or unresolved, chemical shifts in ppm and coupling constant(s) in Hz. HRMS were measured in EI mode, and the mass analyser of the HRMS was TOF. Melting points are uncorrected and were measured in a Gallenkamp apparatus.

2.- General procedure for the synthesis of the starting materials

2.1- General procedure and characterization data for enamides 1



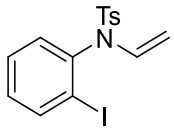
A Schlenk was charged under nitrogen atmosphere with the corresponding 2-iodoaniline (4.6 mmol) and CH_2Cl_2 (15 mL). The solution was stirred at 0 ºC, then *p*-toluenesulfonyl chloride (5.0 mmol) and pyridine (137 mmol) were added. The reaction mixture was stirred at room temperature and monitored by TLC. When the starting material was consumed *N*,*N*-dimethylendiamine (0.91 mmol) was added and the reaction mixture was allowed stir during 2 hours. The resulting mixture was extracted with 1M HCl aqueous solution and CH_2Cl_2. After removal of the solvent, *N*-tosylamide **A** was obtained as a white solid which was used in the next step without further purification.

A 1 M solution of NaH in DMF (6.4 mL) under nitrogen was stirred at 0 ºC. A 0.5 M solution of **A** in DMF (6.4 mL) was poured slowly onto the first solution. The reaction was stirred at room temperature during 1 hour and then 1,2-dibromoethane (4.81 mmol) was added. The reaction mixture was maintained at 80 ºC during 1.5 hours. The resulting mixture was quenched with a saturated aqueous solution of NH_4Cl, extracted with AcOEt. The combined organic layers were washed with brine, dried over sodium sulfate and concentrated. The residue of the reaction was directly used in the next step of the synthesis without further purification.

To a solution of the residue from the previous step (3.0 mmol) in DMSO (15 mL) was added KO*t*Bu (4.0 mmol). The resulting mixture was stirred at room temperature overnight. The reaction mixture was quenched with water, and extracted with AcOEt. The organic layers were washed with water, dried over anhydrous sodium sulfate, and concentrated under reduced pressure. The residue was purified by flash chromatography on silica gel using a mixture of hexane / ethyl acetate as eluent to give **1** as a solid. The solid was recrystallized using a mixture methanol / dichloromethane 98:2 giving a crystalline material.

***N*-(2-Iodophenyl)-4-methyl-*N*-vinylbenzenesulfonamide (1a)**

The title compound **1a** was prepared as yellow crystals in 45 % isolated yield (888 mg) from 2-iodoaniline, according to the procedure for **1**. R_f 0.22 (10:1 hexane : AcOEt). m.p = 92.4 – 94.0 ˚C. Spectroscopic data were consistent with those reported in the literature.[2]

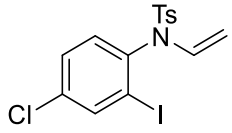


1a

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.97 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.66 (d, *J* = 8.3 Hz, 2H), 7.32 (d, *J* = 9.0 Hz, 3H), 7.23 – 7.01 (m, 2H), 6.78 (dd, *J* = 7.9, 1.7 Hz, 1H), 4.33 (dd, *J* = 8.8, 1.3 Hz, 1H), 3.68 (dd, *J* = 15.5, 1.2 Hz, 1H), 2.46 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 144.3 (C), 140.9 (CH), 138.5 (C), 136.3 (C), 133.1 (CH), 130.6 (CH), 130.6 (CH), 129.8 (CH), 129.2 (CH), 127.7 (CH), 102.03 (C), 94.78 (CH_2), 21.69 (CH_3). EI HRMS: calcd. For $[C_{15}H_{14}INO_2S+H]^+$: 399.9853, found: 399.9849

***N*-(4-Chloro-2-iodophenyl)-4-methyl-*N*-vinylbenzenesulfonamide (1b)**

The title compound **1b** was prepared as yellow crystals in 37 % isolated yield (695 mg) from 4-chloro-2-iodoaniline, according to the general procedure for **1**. R_f 0.24 (10:1 hexane : AcOEt). m.p = 167.7 – 169.3 ˚C

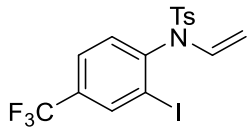


1b

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.97 (d, *J* = 2.4 Hz, 1H), 7.65 (d, *J* = 8.4 Hz, 2H), 7.38 – 7.25 (m, 3H), 7.13 (dd, *J* = 15.4, 8.8 Hz, 1H), 6.71 (d, *J* = 8.4 Hz, 1H), 4.35 (dd, *J* = 8.8, 1.4 Hz, 1H), 3.70 (dd, *J* = 15.5, 1.4 Hz, 1H), 2.47 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 144.4 (C), 140.3 (CH), 137.3 (C), 136.0 (C), 135.6 (C), 132.9 (CH), 131.1 (CH), 129.8 (CH), 129.4 (CH), 127.7 (CH), 102.3 (C), 94.8 (CH_2), 21.6 (CH_3). EI HRMS: calcd. For $[C_{15}H_{13}ClINO_2S+H]^+$: 433.9474, found: 433.9473

***N*-(2-Iodo-4-(trifluoromethyl)phenyl)-4-methyl-*N*-vinylbenzenesulfonamide (1c)**

The title compound **1c** was prepared as yellow crystals in 40 % isolated yield (701 mg) from 4-trifluoromethyl-2-iodoaniline, according to the general procedure for **1**. R_f 0.15 (15:1 hexane : AcOEt). m.p = 112.7 – 113.9 ˚C

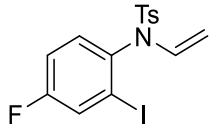


1c

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.23 (d, *J* = 1.9 Hz, 1H), 7.67 (d, *J* = 8.4 Hz, 2H), 7.59 (dd, *J* = 8.2, 2.0 Hz, 1H), 7.36 (d, *J* = 8.0 Hz, 2H), 7.14 (dd, *J* = 15.5, 8.8 Hz, 1H), 6.92 (d, *J* = 8.2 Hz, 1H), 4.38 (dd, *J* = 8.8, 1.5 Hz, 1H), 3.67 (dd, *J* = 15.4, 1.5 Hz, 1H), 2.48 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 144.6 (C), 137.9 (q, C-CF_3, J = 34.5 Hz), 135.9 (C), 132.7 (CH), 130.9 (CH), 129.9 (CH), 127.7 (C), 127.7 (CH), 126.2 (CH), 126.1 (CH), 116.5 (C), 102.1 (C), 95.2 (CH_2), 21.6 (CH_3). ^{19}F NMR (282 MHz, $CDCl_3$) δ -62.82. EI HRMS: calcd. For $[C_{16}H_{13}F_3INO_2S+H]^+$: 467.9738, found: 467.9754

***N*-(4-Fluoro-2-iodophenyl)-4-methyl-*N*-vinylbenzenesulfonamide (1d)**

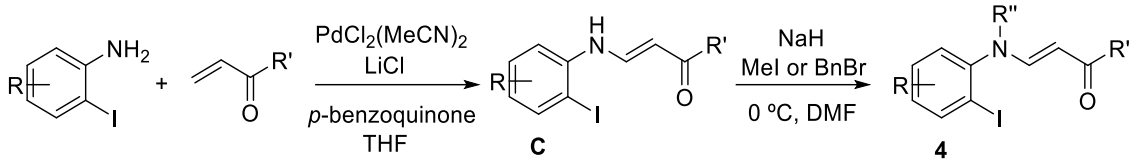
The title compound **1d** was prepared as yellow crystals in 40 % isolated yield (701 mg) from 4-fluoro-2-iodoaniline, according to the procedure for **1**. R_f 0.21 (10:1 hexane : AcOEt). m.p = 161.6 – 162.3 ˚C



1d

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.69 (dd, *J* = 7.8, 2.9 Hz, 1H), 7.65 (d, *J* = 8.3 Hz, 2H), 7.34 (d, *J* = 8.0 Hz, 2H), 7.15 (dd, *J* = 15.4, 8.8 Hz, 1H), 7.04 (ddd, *J* = 8.8, 7.6, 2.9 Hz, 1H), 6.75 (dd, *J* = 8.8, 5.4 Hz, 1H), 4.35 (dd, *J* = 8.8, 1.3 Hz, 1H), 3.69 (dd, *J* = 15.4, 1.3 Hz, 1H), 2.47 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 161.7 (C-F, d, ^{2}J = 254.9 Hz), 144.4 (C), 136.0 (C), 134.7 (C, d, $^{5}J_{C\text{-}F}$= 3.6 Hz) 133.1 (CH), 131.3 (CH, d, $^{4}J_{C\text{-}F}$= 8.8 Hz), 129.8 (CH), 127.8 (CH, d, $^{3}J_{C\text{-}F}$= 24.4 Hz), 127.72 (CH), 116.3 (CH, d, $^{3}J_{C\text{-}F}$= 22.3 Hz), 102.16 (C, d, $^{4}J_{C\text{-}F}$= 8.8 Hz), 94.7 (CH_2), 21.6 (CH_3). EI HRMS: calcd. For $[C_{15}H_{13}FINO_2S+H]^+$: 417.9770, found: 417.9768

2.2- General procedure and characterization data of starting enaminones 4



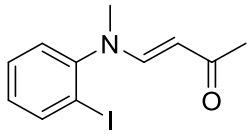
Methyl vinyl ketone and ethyl vinyl ketone are commercially available from Aldrich Chemical Co. Phenyl vinyl ketone was synthesized following the process described in the literature.[3]

Intermediate iodoenaminones **C** was prepared according to the method previously described in the literature.[4]

To a solution of **C** (2.32 mmol) in anhydrous DMF (12 mL) under nitrogen was added NaH (5.82 mmol) slowly at 0 ºC. The mixture was stirring at room temperature for 2 hours before methyl iodide, benzyl bromide or 4-methoxybenzyl bromide (5.82 mmol) was added dropwise to the mixture. The reaction progress was monitored using TLC. After the consumption of starting material, the reaction mixture was extracted with ethyl acetate and water. The organic layers were combined and dried with Na_2SO_4. After filtration, the solvent was removed under reduced pressure. The residue was purified by flash chromatography on silica gel using a mixture of hexane / ethyl acetate as eluent to give **4**.

(*E*)-4-((2-Iodophenyl)(methyl)amino)but-3-en-2-one (4a)

The title compound **4a** was prepared as yellow oil in 41 % isolated yield (286 mg) from 2-iodoaniline and methyl vinyl ketone, according to the procedure for **4**. R_f 0.31 (1:2 hexane : AcOEt).

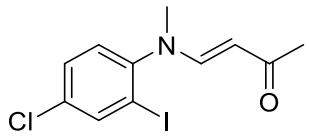


4a

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.91 (d, *J* = 8.1 Hz, 1H), 7.50 (d, *J* = 13.0 Hz, 1H), 7.40 (t, *J* = 7.5 Hz, 1H), 7.20 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.05 (t, *J* = 7.7 Hz, 1H), 5.36 (bs, 1H), 3.19 (s, 3H), 2.14 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 196.1 (C), 151.1 (CH), 149.5 (C, broad signal due to the presence of rotamers), 140.3 (CH), 129.7 (CH), 129.3 (CH), 127.9 (CH), 100.6 (CH), 96.3 (C), 38.6 (CH_3, broad signal due to the presence of rotamers), 27.8 (CH_3). EI HRMS: calcd. For $[C_{11}H_{12}INO+H]^+$: 302.0031, found: 302.0036

(*E*)-4-((4-Chloro-2-iodophenyl)(methyl)amino)but-3-en-2-one (4b)

According to the procedure **4**, for the corresponding intermediate iodoenaminone **C** (0.58 mmol) was obtained 59 mg of **4b** (30 % isolated yield) as a colorless oil. R_f 0.35 (1:2 hexane : AcOEt).

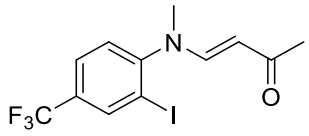


4b

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.89 (s, 1H), 7.45 (d, *J* = 12.6 Hz, 1H), 7.38 (d, *J* = 8.7 Hz, 1H), 7.13 (d, *J* = 8.4 Hz, 1H), 5.33 (bs, 1H), 3.17 (s, 3H), 2.14 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 196.0 (C), 150.6 (CH), 147.0 (C, broad signal due to the presence of rotamers), 139.6 (CH), 134.0 (C), 129.9 (CH), 128.4 (CH), 101.0 (CH), 96.7 (C), 38.7 (CH_3, broad signal due to the presence of rotamers), 28.0 (CH_3). EI HRMS: calcd. For $[C_{11}H_{11}ClINO+H]^+$: 335.9637, found: 335.9646

(*E*)-4-((2-Iodo-4-(trifluoromethyl)phenyl)(methyl)amino)but-3-en-2-one (4c)

According to the procedure **4**, for the corresponding intermediate iodoenaminone **C** (0.25 mmol) was obtained 19 mg of **4c** (20 % isolated yield) as a yellow oil. R_f 0.35 (1:2 hexane : AcOEt).

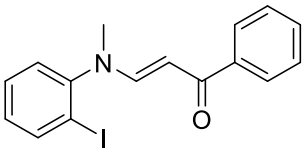


4c

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.18 (s, 1H), 7.69 (d, *J* = 8.6 Hz, 1H), 7.51 (d, *J* = 13.1 Hz, 1H), 7.32 (d, *J* = 8.3 Hz, 1H), 5.30 (bs, 1H), 3.24 (s, 3H), 2.18 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 196.2 (C), 152.0 (C, broad signal due to the presence of rotamers), 150.1 (CH), 137.5 (CH), 128.0 (CH), 126.8 (CH), 108.6 (C), 101.7 (CH), 95.9 (C), 39.0 (CH_3), 28.0 (CH_3). EI HRMS: calcd. For $[C_{12}H_{11}F_3INO+H]^+$: 369.9910, found: 369.9910

(*E*)-3-((2-Iodophenyl)(methyl)amino)-1-phenylprop-2-en-1-one (4d)

According to the procedure **4**, for the corresponding intermediate iodoenaminone **C** (1.12 mmol) was obtained 204 mg of **4d** (50 % isolated yield) as a yellow oil. R_f 0.33 (2:1 hexane : AcOEt).

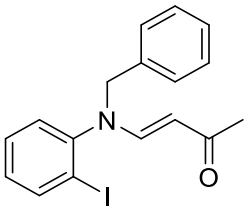


4d

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.90 (bs, 4H), 7.43 (bs, 4H), 7.24 (d, *J* = 7.7 Hz, 1H), 7.06 (bs, 1H), 6.08 (bs, 1H), 3.29 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 189.4 (C), 152.7 (CH), 149.4 (C broad signal due to the presence of rotamers), 140.3 (C), 140.0 (CH), 131.2 (CH), 129.7 (CH), 129.5 (CH), 128.2 (CH), 128.0 (CH), 127.7 (CH), 96.2 (C), 95.7 (CH), 39.0 (CH_3). EI HRMS: calcd. For $[C_{16}H_{14}INO+H]^+$: 364.0189, found: 364.0192

(*E*)-4-(Benzyl(2-iodophenyl)amino)but-3-en-2-one (4e)

According to the procedure **4**, for the corresponding intermediate iodoenaminone **C** (0.275 mmol) was obtained 49 mg of **4e** (48 % isolated yield) as a brown oil. R_f 0.14 (2:1 hexane : AcOEt).

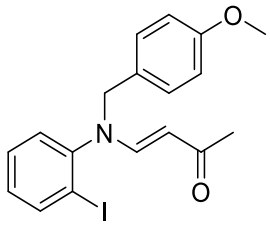


4e

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.94 (dd, *J* = 8.0, 1.2 Hz, 1H), 7.70 (bs, 1H), 7.36 – 7.28 (m, 4H), 7.27 – 7.21 (m, 2H), 7.03 (td, *J* = 7.8, 1.5 Hz, 1H), 6.92 (bs, 1H), 4.70 (bs, 3H), 2.09 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 196.2 (C), 150.8 (CH), 140.5 (CH), 140.0 (C, broad signal due to the presence of rotamers), 135.5 (C), 129.6 (CH), 129.4 (CH), 128.7 (CH), 128.3 (CH), 128.1 (CH), 100.9 (CH), 97.4 (C), 60.0 (CH_2, broad signal due to the presence of rotamers), 28.1 (CH_3). EI HRMS: calcd. For $[C_{17}H_{16}INO+H]^+$: 378.0351, found: 378.0349

(*E*)-4-((2-Iodophenyl)(4-methoxybenzyl)amino)but-3-en-2-one (4f)

According to the procedure **4**, for the corresponding intermediate iodoenaminone **C** (0.805 mmol) was obtained 147 mg of **4f** (45 % isolated yield) as a yellow oil. R_f 0.09 (2:1 hexane : AcOEt).

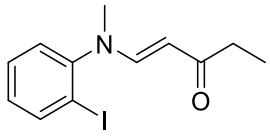


4f

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.06 – 7.86 (m, 2H), 7.67 (bs, 1H), 7.32 – 7.21 (m, 1H), 7.13 (d, *J* = 8.6 Hz, 2H), 7.01 (td, *J* = 7.5, 1.5 Hz, 1H), 6.83 (d, *J* = 8.6 Hz, 3H), 4.62 (bs, 2H), 3.78 (s, 3H), 2.90 (d, *J* = 21.0 Hz, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 196.1 (C), 162.5 (CH), 159.3 (C), 150.7 (CH), 140.4 (CH), 129.8 (CH), 129.6 (CH), 129.4 (CH), 127.4 (C), 114.0 (CH), 110.3 (CH, broad signal due to the presence of rotamers), 100.7 (C), 97.5 (C), 60.3 (CH_2, broad signal due to the presence of rotamers), 55.2 (CH_3), 36.4 (CH_3). EI HRMS: calcd. For $[C_{18}H_{18}INO_2+H]^+$: 408.0451, found: 408.0455

(*E*)-1-((2-Iodophenyl)(methyl)amino)pent-1-en-3-one (4g)

According to the procedure **4**, for the corresponding intermediate iodoenaminone **C** (1.32 mmol) was obtained 121 mg of **4g** (29 % isolated yield) as a yellow oil. R_f 0.12 (2:1 hexane : AcOEt).



4g

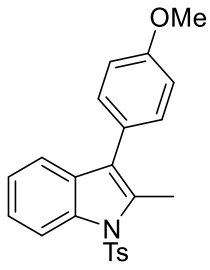
^{1}H NMR (300 MHz, $CDCl_3$) δ 7.86 (d, *J* = 7.9 Hz, 1H), 7.52 (d, *J* = 13.2 Hz, 1H), 7.37 (t, *J* = 7.7 Hz, 1H), 7.17 (d, *J* = 7.7 Hz, 1H), 7.01 (t, *J* = 7.6 Hz, 1H), 5.31 (bs, 1H), 3.15 (bs, 3H), 2.39 (bs, 2H), 1.08 (bs, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 199.3 (C), 150.3 (CH), 147.4 (C, broad signal due to the presence of rotamers), 140.2 (CH), 129.7 (CH), 129.2 (CH), 127.9 (CH), 99.2 (CH), 96.4 (C), 38.6 (CH_3, broad signal due to the presence of rotamers), 34.2 (CH_2), 9.4 (CH_3). EI HRMS: calcd. For $[C_{12}H_{14}INO+H]^+$: 316.0185, found: 316.0192

3.- General procedure and characterization data for índoles 3

A carousel reaction tube was charged under nitrogen atmosphere with the corresponding iodoenamine **(1)** (0.05 mmol), allylpalladium(II) chloride dimer (3 mol %), triphenylphosphine (PPh_3) (12 mol %), lithium tert-butoxide (6 equiv), and acetonitrile (1 mL). The *N*-tosylhydrazone (2 equiv) is diluted in 2 mL of acetonitrile and then added via syringe pump over a period of 2 h. The reaction mixture was stirred at 110 °C during the slow addiction. After cooling to room temperature, the reaction crude was dissolved in DCM and filtered through celite. The solvents were evaporated under reduced pressure. The reaction crude was diluted in 3 mL of THF and then 0.5 mL of 1 M HCl (aqueous solution) were added. The reaction mixture was extracted with ethyl acetate and water. The solvent was removed under reduced pressure and the residue was purified by flash chromatography on silica gel using a mixture of hexane / ethyl acetate as eluent.

3-(4-Methoxyphenyl)-2-methyl-1-tosyl-1*H*-indole (3a)

Following the general method, from iodoenamine **(1a)** (0.05 mmol) and *p*-anisaldehyde tosylhydrazone (30.4 mg, 0.1 mmol) were obtained 10.4 mg of **3a** (53 % isolated yield) as a yelow oil. Rf 0.12 (20:1 hexane : AcOEt). Spectroscopic data were consistent with those reported in the literature.[5]

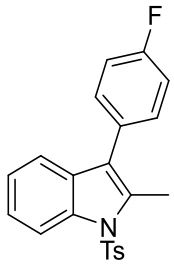


3a

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.27 (dd, *J* = 8.3, 1.0 Hz, 1H), 7.73 (d, *J* = 8.5 Hz, 2H), 7.41 (d, *J* = 7.7 Hz, 1H), 7.36 – 7.29 (m, 2H), 7.27 – 7.19 (m, 4H), 7.01 (d, *J* = 8.7 Hz, 2H), 3.88 (s, 3H), 2.59 (s, 3H), 2.38 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 158.8 (C), 144.6 (C), 136.4 (C), 136.2 (C), 132.8 (C), 131.1 (CH), 130.2 (C), 129.8 (CH), 126.4 (CH), 125.2 (C), 124.1 (CH), 123.4 (CH), 122.2 (C), 119.1 (CH), 114.5 (CH), 114.0 (CH), 55.3 (CH_3), 21.5 (CH_3), 13.5 (CH_3). EI HRMS: calcd. For $[C_{23}H_{21}NO_3S+H]^+$: 392.1314, found: 392.1314

3-(4-Fluorophenyl)-2-methyl-1-tosyl-1*H*-indole (3b)

Following the general method, from iodoenamine **(1a)** (0.05 mmol) and 4-fluorobenzaldehyde tosylhydrazone (29.2 mg, 0.1 mmol) were obtained 11 mg of **3b** (58 % isolated yield) as a colorless oil. Rf 0.15 (20:1 hexane : AcOEt).



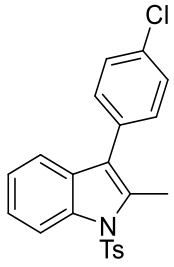
3b

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.28 (d, *J* = 8.2 Hz, 1H), 7.74 (d, *J* = 8.3 Hz, 2H), 7.41 – 7.30 (m, 4H), 7.26 (d, *J* = 7.9 Hz, 3H), 7.17 (t, *J* = 8.6 Hz, 2H), 2.59 (s, 3H), 2.39 (s, 3H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 162.1 (C-F, d, ^{2}J = 246.7 Hz), 144.8 (C), 136.3 (C), 136.1 (C), 133.1 (C), 131.6 (CH, d, $^{4}J_{C\text{-}F}$= 8.1 Hz), 129.9 (CH), 129.8 (C), 128.9 (C, d, $^{5}J_{C\text{-}F}$= 3.2 Hz), 126.4 (CH), 124.3 (CH), 123.5 (CH), 121.5 (C), 118.9 (CH), 115.5 (CH, d, $^{3}J_{C\text{-}F}$= 21.3 Hz), 114.5 (CH), 21.5 (CH_3), 13.4 (CH_3). EI HRMS: calcd. For $[C_{22}H_{18}FNO_2S+H]^{+}$: 380.1116, found: 380.1115

3-(4-Chlorophenyl)-2-methyl-1-tosyl-1*H*-indole (3c)

Following the general method, from iodoenamine **(1a)** (0.05 mmol) and 4-chlorobenzaldehyde tosylhydrazone (30.8 mg, 0.1 mmol) were obtained 16 mg of **3c** (84 % isolated yield) as a colorless oil. Rf 0.15 (20:1 hexane : AcOEt).



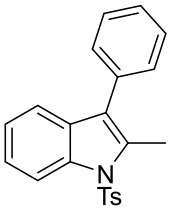
3c

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.28 (d, *J* = 8.3 Hz, 1H), 7.74 (d, *J* = 8.3 Hz, 2H), 7.45 (d, *J* = 8.3 Hz, 2H), 7.37 (t, *J* = 7.0 Hz, 2H), 7.30 (d, *J* = 8.6 Hz, 2H), 7.26 (d, *J* = 8.4 Hz, 3H), 2.59 (s, 3H), 2.39 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 144.8 (C), 136.3 (C), 136.2 (C), 133.2 (C), 131.5 (C), 131.3 (CH), 129.9 (CH), 129.5 (C), 128.8 (CH), 126.4 (CH), 124.9 (C), 124.4 (CH), 123.6 (CH), 121.3 (C), 118.9

(CH), 114.5 (CH), 21.6 (CH_3), 13.4 (CH_3). EI HRMS: calcd. For $[C_{22}H_{18}ClNO_2S+H]^+$: 396.0818, found: 396.0819

2-Methyl-3-phenyl-1-tosyl-1*H*-indole (3d)

Following the general method, from iodoenamine **(1a)** (0.05 mmol) and benzaldehyde tosylhydrazone (27.4 mg, 0.1 mmol) were obtained 13 mg of **3d** (72 % isolated yield) as a yellow oil. Rf 0.16 (20:1 hexane : AcOEt). Spectroscopic data were consistent with those reported in the literature.[6]

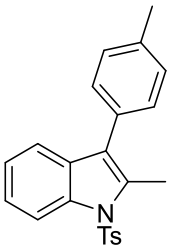


3d

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.29 (d, *J* = 8.5 Hz, 1H), 7.74 (d, *J* = 8.3 Hz, 2H), 7.49 – 7.41 (m, 3H), 7.41 – 7.35 (m, 3H), 7.32 (dd, *J* = 8.3, 1.4 Hz, 1H), 7.25 (d, *J* = 8.3 Hz, 2H), 2.62 (s, 3H), 2.38 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 144.9 (C), 136.5 (C), 136.4 (C), 133.3 (C), 133.2 (C), 130.2 (CH), 130.1 (C), 130.0 (CH), 128.7 (CH), 127.4 (CH), 126.6 (CH), 124.4 (CH), 123.6 (CH), 122.7 (C), 119.3 (CH), 114.7 (CH), 21.7 (CH_3), 13.7 (CH_3). EI HRMS: calcd. For $[C_{22}H_{19}NO_2S+H]^+$: 362.1211, found: 362.1209

2-Methyl-3-(*p*-tolyl)-1-tosyl-1*H*-indole (3e)

Following the general method, from iodoenamine **(1a)** (0.05 mmol) and *p*-tolualdehyde tosylhydrazone (28.8 mg, 0.1 mmol) were obtained 15 mg of **3e** (80 % isolated yield) as a yellow oil. Rf 0.16 (20:1 hexane : AcOEt).



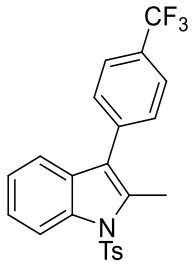
3e

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.27 (d, *J* = 8.6 Hz, 1H), 7.74 (d, *J* = 8.3 Hz, 2H), 7.42 (d, *J* = 8.4 Hz, 1H), 7.36 – 7.29 (m, 2H), 7.29 – 7.22 (m, 6H), 2.61 (s, 3H), 2.43 (s, 3H), 2.38 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 144.6 (C), 137.0 (C), 136.4 (C), 136.2 (C), 132.9 (C), 130.1 (C), 130.0 (C), 129.8 (2xCH), 129.27 (CH), 126.4

(CH), 124.1 (CH), 123.4 (CH), 122.4 (C), 119.2 (CH), 114.5 (CH), 21.5 (CH_3), 21.2 (CH_3), 13.5 (CH_3). EI HRMS: calcd. For $[C_{23}H_{21}NO_2S+H]^+$: 376.1365, found: 376.1365

2-Methyl-1-tosyl-3-(4-(trifluoromethyl)phenyl)-1*H*-indole (3f)

Following the general method, from iodoenamine **(1a)** (0.05 mmol) and 4-(trifluoromethyl)benzaldehyde tosylhydrazone (34.2 mg, 0.1 mmol) were obtained 13 mg of **3f** (62 % isolated yield) as a yellow oil. Rf 0.23 (25:1 hexane : AcOEt).

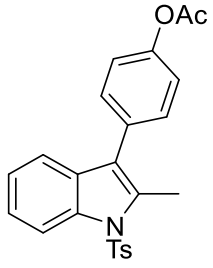


3f

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.30 (d, *J* = 8.2 Hz, 1H), 7.75 (t, *J* = 8.4 Hz, 4H), 7.50 (d, *J* = 8.0 Hz, 2H), 7.44 – 7.30 (m, 2H), 7.27 (d, *J* = 7.0 Hz, 3H), 2.62 (s, 3H), 2.39 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 145.0 (C), 137.1 (C), 137.1 (C), 136.3 (C), 136.3 (C), 133.7 (C), 130.4 (CH), 130.0 (CH), 129.3 (C), 126.5 (CH), 125.6 (q, CH-CF_3, *J* = 3.7 Hz), 124.6 (CH), 123.8 (CH), 121.2 (C), 118.9 (CH), 114.6 (CH), 21.6 (CH_3), 13.5 (CH_3). EI HRMS: calcd. For $[C_{23}H_{18}F_3NO_2S+H]^+$: 430.1084, found: 430.1083

4-(2-Methyl-1-tosyl-1*H*-indol-3-yl)phenyl acetate (3g)

Following the general method, from iodoenamine **(1a)** (0.05 mmol) and 4-(trifluoromethyl)benzaldehyde tosylhydrazone (33.2 mg, 0.1 mmol) were obtained 11 mg of **3g** (55 % isolated yield) as a brown oil. Rf 0.22 (5:1 hexane : AcOEt).

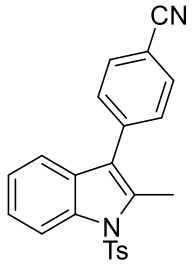


3g

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.37 (d, *J* = 8.3 Hz, 1H), 7.83 (d, *J* = 7.9 Hz, 2H), 7.56 – 7.38 (m, 4H), 7.38 – 7.31 (m, 3H), 7.29 (d, *J* = 8.3 Hz, 2H), 2.70 (s, 3H), 2.48 (s, 3H), 2.45 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 169.4 (C), 149.8 (C), 144.8 (C), 136.3 (C), 136.2 (C), 133.3 (C), 131.0 (CH), 130.7 (C), 129.9 (CH), 129.8(C), 126.4 (CH), 124.3 (CH), 123.5 (CH), 121.7 (CH), 121.6 (C), 119.0(CH), 114.5 (CH), 21.5 (CH_3), 21.2 (CH_3), 13.5 (CH_3). EI HRMS: calcd. For $[C_{24}H_{21}NO_4S+H]^+$: 420.1263, found: 420.1264

4-(2-Methyl-1-tosyl-1*H*-indol-3-yl)benzonitrile (3h)

Following the general method, from iodoenamine **(1a)** (0.05 mmol) and 4-formylbenzonitrile tosylhydrazone (29.9 mg, 0.1 mmol) were obtained 9 mg of **3h** (47 % isolated yield) as a yelow oil. Rf 0.10 (10:1 hexane : AcOEt).

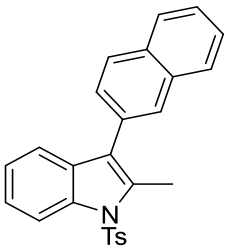


3h

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.33 – 8.26 (m, 1H), 7.79 – 7.73 (m, 4H), 7.53 – 7.46 (m, 2H), 7.41 – 7.33 (m, 2H), 7.31 – 7.28 (m, 1H), 7.27 – 7.24 (m, 2H), 2.61 (s, 3H), 2.39 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 145.6 (C), 138.8 (C), 136.7 (C), 136.7 (C), 134.4 (C), 132.9 (CH), 131.2 (CH), 130.5 (CH), 129.3 (C), 127.0 (CH), 125.2 (CH), 124.3 (CH), 121.2 (C), 119.3 (C), 119.1 (CH), 115.1 (CH), 111.5 (C), 22.1 (CH_3), 14.0 (CH_3). EI HRMS: calcd. For $[C_{23}H_{18}N_2O_2S+H]^+$: 387.1164, found: 387.1168

2-Methyl-3-(naphthalen-2-yl)-1-tosyl-1*H*-indole (3i)

Following the general method, from iodoenamine **(1a)** (0.05 mmol) and 2-naphthaldehyde tosylhydrazone (32.4 mg, 0.1 mmol) were obtained 11 mg of **3i** (55 % isolated yield) as a colourless oil. Rf 0.19 (20:1 hexane : AcOEt).

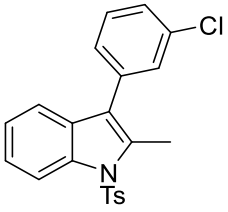


3i

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.31 (d, *J* = 8.4 Hz, 1H), 7.97 – 7.82 (m, 4H), 7.78 (d, *J* = 8.4 Hz, 2H), 7.57 – 7.44 (m, 4H), 7.36 (t, *J* = 7.8 Hz, 1H), 7.30 – 7.22 (m, 3H), 2.67 (s, 3H), 2.40 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 144.7 (C), 136.4 (C), 136.3 (C), 133.4 (C), 133.4 (C), 132.5 (C), 130.6 (C), 130.0 (C), 129.9 (CH), 128.9 (CH), 128.1 (CH), 128.0 (CH), 127.8 (CH), 127.7 (CH), 126.4 (CH), 126.3 (CH), 126.1 (CH), 124.3 (CH), 123.5 (CH), 122.4 (C), 119.2 (CH), 114.5(CH), 21.6 (CH3), 13.6 (CH3). EI HRMS: calcd. For $[C_{26}H_{21}NO_2S+H]^+$: 412.1354, found: 412.1365

3-(3-Chlorophenyl)-2-methyl-1-tosyl-1*H*-indole (3j)

Following the general method, from iodoenamine **(1a)** (0.05 mmol) and 3-chlorobenzaldehyde tosylhydrazone (30.9 mg, 0.1 mmol) were obtained 13 mg of **3j** (66 % isolated yield) as a colourless oil. Rf 0.18 (20:1 hexane : AcOEt).

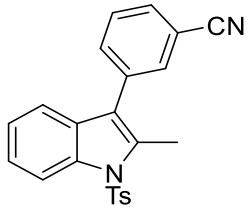


3j

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.29 (d, *J* = 8.3 Hz, 1H), 7.75 (d, *J* = 8.4 Hz, 2H), 7.46 – 7.31 (m, 5H), 7.30 – 7.22 (m, 4H), 2.61 (s, 3H), 2.39 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 144.9 (C), 136.2 (C), 136.2 (C), 135.0 (C), 134.4 (C), 133.5 (C), 130.0 (CH), 129.9 (CH), 129.8 (CH), 129.4 (C), 128.2 (CH), 127.4 (CH), 126.4 (CH), 124.4 (CH), 123.6 (CH), 121.2 (C), 118.9 (CH), 114.5 (CH), 21.6 (CH_3), 13.5 (CH_3). EI HRMS: calcd. For $[C_{22}H_{18}ClNO_2S+H]^+$: 396.0819, found: 396.0819

3-(2-Methyl-1-tosyl-1*H*-indol-3-yl)benzonitrile (3k)

Following the general method, from iodoenamine **(1a)** (0.05 mmol) and 3-formylbenzonitrile tosylhydrazone (29.9 mg, 0.1 mmol) were obtained 10 mg of **3k** (53 % isolated yield) as a colourless oil. Rf 0.16 (10:1 hexane : AcOEt).

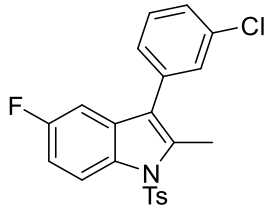


3k

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.39 (d, *J* = 8.2 Hz, 1H), 7.84 (d, *J* = 8.3 Hz, 2H), 7.80 – 7.62 (m, 4H), 7.52 – 7.40 (m, 2H), 7.40 – 7.31 (m, 3H), 2.68 (s, 3H), 2.48 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 145.0 (C), 136.1 (C), 136.1 (C), 134.7 (C), 134.4 (CH), 133.8 (C), 133.5 (CH), 130.8 (CH), 130.0 (CH), 129.5 (CH), 129.0(C), 126.4 (CH), 124.7 (CH), 123.8 (CH), 120.2 (C), 118.6 (C), 118.5 (CH), 114.6 (CH), 112.9 (C), 21.6 (CH_3), 13.4 (CH_3). EI HRMS: calcd. For $[C_{23}H_{18}N_2O_2S+H]^+$: 387.1159, found: 387.1161

3-(3-Chlorophenyl)-5-fluoro-2-methyl-1-tosyl-1*H*-indole (3l)

Following the general method, from iodoenamine **(1d)** (0.05 mmol) and 3-chlorobenzaldehyde tosylhydrazone (30.8 mg, 0.1 mmol) were obtained 12 mg of **3l** (60 % isolated yield) as a colourless oil. Rf 0.23 (20:1 hexane : AcOEt).

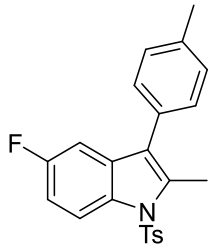


3l

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.23 (ddd, *J* = 8.5, 4.6, 1.2 Hz, 1H), 7.72 (d, *J* = 8.4 Hz, 2H), 7.45 – 7.37 (m, 2H), 7.32 (td, *J* = 1.8, 0.7 Hz, 1H), 7.29 – 7.28 (m, 1H), 7.27 – 7.26 (m, 1H), 7.25 – 7.20 (dt, J = 6.9, 1.8 Hz, 1H), 7.04 (d, *J* = 8.8 Hz, 2H), 2.59 (s, 3H), 2.40 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 159.98 (C-F, d, ^{2}J = 240.6 Hz), 145.1 (C), 136.0 (C), 135.2 (C), 134.5 (C), 134.5 (C), 132.4 (C, d, $^{5}J_{C\text{-}F}$= 1.1 Hz), 130.6 (C, d, $^{4}J_{C\text{-}F}$= 9.4 Hz), 130.0 (CH), 129.9 (CH), 129.8 (CH), 128.0 (CH), 127.7 (CH), 126.4 (CH), 121.1 (C, d, $^{5}J_{C\text{-}F}$= 3.8 Hz), 115.68 (CH, d, $^{4}J_{C\text{-}F}$= 8.8 Hz), 112.17 (CH, d, $^{3}J_{C\text{-}F}$= 24.8 Hz), 104.64 (CH, d, $^{3}J_{C\text{-}F}$= 24.7 Hz), 21.6 (CH_3), 13.6 (CH_3). ^{19}F NMR (282 MHz, $CDCl_3$) δ -119.35. EI HRMS: calcd. For $[C_{22}H_{17}ClFNO_2S+H]^+$: 414.0711, found: 414.0713

5-Fluoro-2-methyl-3-(*p*-tolyl)-1-tosyl-1*H*-indole (3m)

Following the general method, from iodoenamine **(1d)** (0.05 mmol) and *p*-tolualdehyde tosylhydrazone (28.8 mg, 0.1 mmol) were obtained 11 mg of **3m** (58 % isolated yield) as a colourless oil. Rf 0.20 (20:1 hexane : AcOEt).

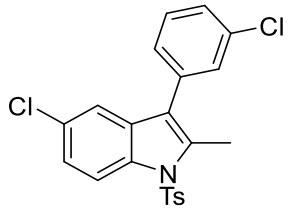


3m

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.21 (dd, *J* = 8.9, 4.5 Hz, 1H), 7.71 (d, *J* = 8.3 Hz, 2H), 7.31 – 7.20 (m, 6H), 7.06 (dq, *J* = 8.5, 2.6 Hz, 2H), 2.59 (s, 3H), 2.43 (s, 3H), 2.39 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 159.93 (C-F, d, ^{2}J = 240.1 Hz), 144.9 (C), 137.3 (C), 136.1 (C), 134.7 (C), 132.4 (C), 131.28 (C, d, $^{4}J_{C\text{-}F}$= 9.5 Hz), 129.9 (CH), 129.7 (CH), 129.5 (C), 129.4 (CH), 126.3 (CH), 122.4 (C, d, $^{5}J_{C\text{-}F}$= 4.0 Hz), 115.5 (CH, d, $^{4}J_{C\text{-}F}$= 9.0 Hz), 111.8 (CH, d, $^{3}J_{C\text{-}F}$= 25.0 Hz), 104.9 (CH, d, $^{3}J_{C\text{-}F}$= 24.8 Hz), 21.6 (CH_3), 21.2 (CH_3), 13.6 (CH_3). ^{19}F NMR (282 MHz, $CDCl_3$) δ -119.84. EI HRMS: calcd. For $[C_{23}H_{20}FNO_2S+H]^+$: 394.1272, found: 394.1271

5-Chloro-3-(3-chlorophenyl)-2-methyl-1-tosyl-1*H*-indole (3n)

Following the general method, from iodoenamine **(1b)** (0.05 mmol) and 3-chlorobenzaldehyde tosylhydrazone (30.8 mg, 0.1 mmol) were obtained 13 mg of **3n** (62 % isolated yield) as a colourless oil. Rf 0.24 (20:1 hexane : AcOEt).

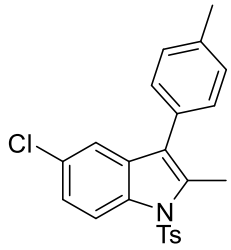


3n

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.21 (d, *J* = 8.9 Hz, 1H), 7.72 (d, *J* = 8.3 Hz, 2H), 7.45 – 7.38 (m, 2H), 7.34 (d, *J* = 2.1 Hz, 1H), 7.32 – 7.28 (m, 3H), 7.28 – 7.26 (m, 1H), 7.22 (dt, *J* = 6.9, 1.8 Hz, 1H), 2.58 (s, 3H), 2.40 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 145.2 (C), 135.9 (C), 134.9 (C), 134.5 (C), 134.5 (C), 134.3 (C), 130.7 (C), 130.0 (CH), 130.0 (CH), 129.8 (CH), 129.5 (C), 128.1 (CH), 127.8 (CH), 126.4 (CH), 124.5 (CH), 120.6 (C), 118.5 (CH), 115.6 (CH), 21.6 (CH_3), 13.5 (CH_3). EI HRMS: calcd. For $[C_{22}H_{17}Cl_2NO_2S]^+$: 429.0351, found: 429.0351

5-Chloro-2-methyl-3-(*p*-tolyl)-1-tosyl-1*H*-indole (3o)

Following the general method, from iodoenamine **(1b)** (0.05 mmol) and *p*-tolualdehyde tosylhydrazone (28.8 mg, 0.1 mmol) were obtained 10 mg of **3o** (50 % isolated yield) as a colourless oil. Rf 0.17 (20:1 hexane : AcOEt).

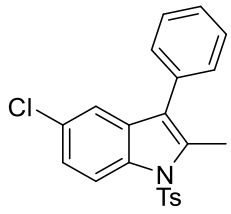


3o

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.19 (d, *J* = 8.8 Hz, 1H), 7.71 (d, *J* = 8.4 Hz, 2H), 7.37 (d, *J* = 2.2 Hz, 1H), 7.31 – 7.29 (m, 1H), 7.28 – 7.26 (m, 2H), 7.26 – 7.20 (m, 4H), 2.58 (s, 3H), 2.43 (s, 3H), 2.39 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 145.0 (C), 137.3 (C), 136.1 (C), 134.5 (C), 134.4 (C), 131.4 (C), 130.0 (CH), 129.7 (CH), 129.4 (CH), 129.3 (C), 129.3 (C), 126.4 (CH), 124.2 (CH), 121.9 (C), 118.8 (CH), 115.5 (CH), 21.6 (CH_3), 21.2 (CH_3), 13.5 (CH_3). EI HRMS: calcd. For $[C_{23}H_{20}ClNO_2S+H]^+$: 410.0969, found: 410.0976

5-Chloro-2-methyl-3-phenyl-1-tosyl-1*H*-indole (3p)

Following the general method, from iodoenamine **(1b)** (0.05 mmol) and benzaldehyde tosylhydrazone (27.4 mg, 0.1 mmol) were obtained 10 mg of **3p** (52 % isolated yield) as a colourless oil. Rf 0.18 (20:1 hexane : AcOEt).

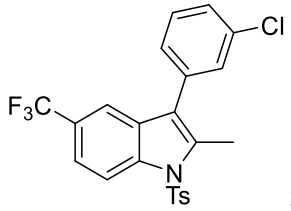


3p

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.21 (d, *J* = 8.8 Hz, 1H), 7.72 (d, *J* = 8.4 Hz, 2H), 7.53 – 7.41 (m, 3H), 7.41 – 7.30 (m, 5H), 7.28 – 7.24 (m, 1H), 2.60 (s, 3H), 2.40 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 145.0 (C), 136.0 (C), 135.1 (C), 134.6 (C), 132.4 (C), 131.2 (C), 130.0 (CH), 129.9 (CH), 129.4 (C), 128.7 (CH), 127.6 (CH), 126.4 (CH), 124.3 (CH), 121.9 (C), 118.8 (CH), 115.5 (CH), 21.6 (CH_3), 13.5 (CH_3). EI HRMS: calcd. For $[C_{22}H_{18}ClNO_2S+H]^+$: 396.0816, found: 396.0819

3-(3-Chlorophenyl)-2-methyl-1-tosyl-5-(trifluoromethyl)-1*H*-indole (3q)

Following the general method, from iodoenamine **(1c)** (0.05 mmol) and 3-chlorobenzaldehyde tosylhydrazone (30.8 mg, 0.1 mmol) were obtained 11 mg of **3p** (50 % isolated yield) as a colourless oil. Rf 0.21 (20:1 hexane : AcOEt).



3q

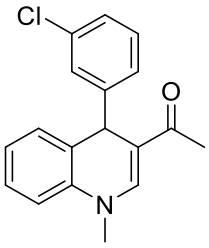
^{1}H NMR (300 MHz, $CDCl_3$) δ 8.39 (d, *J* = 8.8 Hz, 1H), 7.75 (d, *J* = 8.4 Hz, 2H), 7.65 – 7.55 (m, 2H), 7.46 – 7.38 (m, 2H), 7.36 – 7.28 (m, 3H), 7.24 (dt, *J* = 6.9, 1.8 Hz, 1H), 2.61 (s, 3H), 2.41 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 145.4 (C), 137.6 (C), 135.9 (C), 135.4 (C), 134.6 (C), 134.1 (C), 130.1 (CH), 130.1 (CH), 129.9 (CH), 129.2 (C), 128.2 (CH), 127.9 (CH), 126.5(CH), 126.2 (C), 121.1 (q, CH-CF_3, *J* = 3.7 Hz), 121.0 (C), 116.3 (q, CH-CF_3, *J* = 4.1 Hz), 114.7 (CH), 21.6 (CH_3), 13.4 (CH_3). EI HRMS: calcd. For $[C_{23}H_{17}ClF_3NO_2S+H]^+$: 464.0689, found: 464.0693

4.- General procedure and characterization data for 1,4-dihydroquinolines 6

A carousel reaction tube was charged under nitrogen atmosphere with the corresponding iodoenaminone **(4)**, tetrakis(triphenylphosphine)palladium(0) (6 mol %), lithium tert-butoxide (6 equiv), and acetonitrile (1 mL). The *N*-tosylhydrazone (2 equiv) is diluted in 2 mL of acetonitrile and then added via syringe pump over a period of 2 h. The reaction mixture was stirred at 110 °C during the slow addiction. After cooling to room temperature, the reaction crude was dissolved in DCM and filtered through celite. The solvents were evaporated under reduced pressure and the residue was purified by flash chromatography on silica gel using hexane or a mixture of hexane / ethyl acetate as eluent.

1-(4-(3-Chlorophenyl)-1-methyl-1,4-dihydroquinolin-3-yl)ethan-1-one (6a)

Following the general method, from iodoenaminone **(4a)** (0.076 mmol) and 3-chlorobenzaldehyde tosylhydrazone (47.1 mg, 0.152 mmol) were obtained 17 mg of **6a** (77 % isolated yield) as a yelow oil. Rf 0.15 (2:1 hexane : AcOEt).

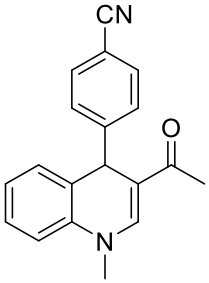


6a

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.41 (s, 1H), 7.24 (ddd, *J* = 8.6, 7.3, 1.5 Hz, 1H), 7.18 – 7.12 (m, 4H), 7.09 (dt, *J* = 7.3, 1.9 Hz, 1H), 7.04 (td, *J* = 7.5, 1.2 Hz, 1H), 6.98 (d, *J* = 7.3 Hz, 1H), 5.33 (s, 1H), 3.47 (s, 3H), 2.24 (s, 3H). ^{13}C NMR (151 MHz, $CDCl_3$) δ 193.5 (C), 149.5 (C), 143.7 (CH), 137.4 (C), 134.1 (C), 130.4 (CH), 129.5 (CH), 127.5 (CH), 127.4 (CH), 126.4 (C), 126.3 (CH), 125.7 (CH), 124.1 (CH), 113.4 (C), 112.9 (CH), 41.2 (CH), 39.5 (CH_3), 24.6 (CH_3). EI HRMS: calcd. For $[C_{18}H_{16}ClNO+H]^+$: 298.0982, found: 298.0993

4-(3-Acetyl-1-methyl-1,4-dihydroquinolin-4-yl)benzonitrile (6b)

Following the general method, from iodoenaminone **(4a)** (0.049 mmol) and 4-formylbenzonitrile tosylhydrazone (29.8 mg, 0.098 mmol) were obtained 12 mg of **6b** (86 % isolated yield) as a yelow oil. Rf 0.20 (1:1 hexane : AcOEt).

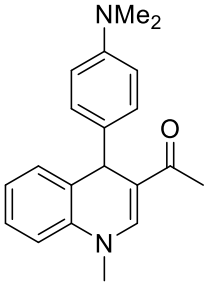


6b

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.50 (d, *J* = 8.3 Hz, 2H), 7.40 (s, 1H), 7.33 (d, *J* = 8.3 Hz, 2H), 7.26 (ddd, *J* = 8.6, 7.4, 1.6 Hz, 1H), 7.12 (dd, *J* = 7.6, 1.5 Hz, 1H), 7.05 (td, *J* = 7.4, 1.1 Hz, 1H), 7.00 (d, *J* = 8.1 Hz, 1H), 5.41 (s, 1H), 3.49 (s, 3H), 2.23 (s, 3H). ^{13}C NMR (151 MHz, $CDCl_3$) δ 193.4 (C), 152.6 (C), 143.9 (CH), 137.5 (C), 132.2 (CH), 130.5 (CH), 128.3 (CH), 127.8 (CH), 125.7 (C), 124.3 (CH), 119.1 (C), 113.1 (C), 113.0 (CH), 109.7 (C), 41.6 (CH), 39.5 (CH_3), 24.4 (CH_3). To confirm the structure of the expected product 2D NMR experiments were performed. EI HRMS: calcd. For $[C_{19}H_{16}N_2O+H]^+$: 289.1334, found: 289.1335

1-(4-(4-(Dimethylamino)phenyl)-1-methyl-1,4-dihydroquinolin-3-yl)ethan-1-one (6c)

Following the general method, from iodoenaminone **(4a)** (0.056 mmol) and 4-(dimethylamino)benzaldehyde tosylhydrazone (35.5 mg, 0.112 mmol) were obtained 11 mg of **6c** (65 % isolated yield) as a red oil. Rf 0.14 (1:1 hexane : AcOEt).



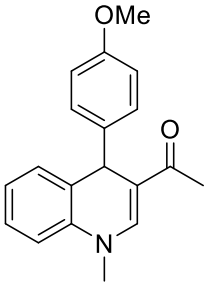
6c

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.38 (s, 1H), 7.19 (td, *J* = 7.2, 1.7 Hz, 2H), 7.07 (d, *J* = 8.7 Hz, 2H), 7.01 (td, *J* = 7.5, 1.1 Hz, 1H), 6.94 (d, *J* = 8.5 Hz, 1H), 6.60 (d, *J* = 8.7 Hz, 2H), 5.24 (s, 1H), 3.43 (s, 3H), 2.87 (s, 6H), 2.21 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 194.1 (C), 149.0 (C), 143.0 (CH), 137.6 (C), 136.3 (C), 130.4 (CH), 127.9 (CH), 127.9 (C), 126.8 (CH), 123.9 (CH), 114.3 (C), 112.6 (CH), 112.4

(CH), 40.6 (CH_3), 40.3 (CH), 39.3 (CH_3), 24.9 (CH_3). EI HRMS: calcd. For $[C_{20}H_{22}N_2O+H]^+$: 307.1806, found: 307.1804

1-(4-(4-Methoxyphenyl)-1-methyl-1,4-dihydroquinolin-3-yl)ethan-1-one (6d)

Following the general method, from iodoenaminone **(4a)** (0.083 mmol) and *p*-anisaldehyde tosylhydrazone (50.5 mg, 0.166 mmol) were obtained 12 mg of **6d** (50 % isolated yield) as a yellow oil. Rf 0.10 (2:1 hexane : AcOEt).

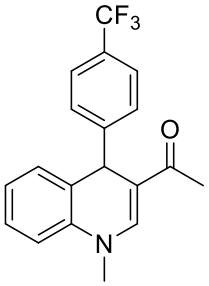


6d

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.38 (s, 1H), 7.25 – 7.15 (m, 2H), 7.13 (d, *J* = 8.7 Hz, 2H), 7.02 (td, *J* = 7.4, 1.2 Hz, 1H), 6.95 (d, *J* = 8.6 Hz, 1H), 6.75 (d, *J* = 8.7 Hz, 2H), 5.29 (s, 1H), 3.73 (s, 3H), 3.45 (s, 3H), 2.22 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 193.9 (C), 157.8 (C), 143.2 (CH), 140.2 (C), 137.5 (C), 130.4 (CH), 128.3 (CH), 127.5 (C), 127.0 (CH), 124.0 (CH), 114.2 (C), 113.6 (CH), 112.6 (CH), 55.1 (CH_3), 40.5 (CH), 39.4 (CH_3), 24.7 (CH_3). EI HRMS: calcd. For $[C_{19}H_{19}NO_2+H]^+$: 294.1487, found: 294.1488

1-(1-Methyl-4-(4-(trifluoromethyl)phenyl)-1,4-dihydroquinolin-3-yl)ethan-1-one (6e)

Following the general method, from iodoenaminone **(4a)** (0.046 mmol) and 4-(trifluoromethyl)benzaldehyde tosylhydrazone (31.8 mg, 0.092 mmol) were obtained 9 mg of **6e** (60 % isolated yield) as a yellow oil. Rf 0.34 (1:1 hexane : AcOEt).

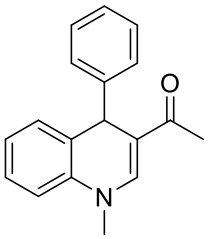


6e

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.46 (d, *J* = 8.2 Hz, 2H), 7.40 (s, 1H), 7.33 (d, *J* = 8.2 Hz, 2H), 7.28 – 7.21 (m, 1H), 7.15 (dd, *J* = 7.5, 1.6 Hz, 1H), 7.05 (dd, *J* = 7.4, 1.1 Hz, 1H), 6.99 (d, *J* = 8.0 Hz, 1H), 5.41 (s, 1H), 3.48 (s, 3H), 2.23 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 193.5 (C), 151.3 (C), 143.7 (CH), 137.5 (C), 130.4 (CH), 128.4 (C), 127.7 (CH), 127.5 (CH), 126.2 (C), 125.3 (q, CH-CF_3, *J* = 3.7 Hz), 124.2 (CH), 113.5 (C), 112.9 (CH), 41.3 (CH), 39.5 (CH_3), 24.5 (CH_3). ^{19}F NMR (282 MHz, $CDCl_3$) δ -62.35. EI HRMS: calcd. For $[C_{19}H_{16}F_3NO+H]^+$: 332.1253, found: 332.1256

1-(1-Methyl-4-phenyl-1,4-dihydroquinolin-3-yl)ethan-1-one (6f)

Following the general method, from iodoenaminone **(4a)** (0.069 mmol) and benzaldehyde tosylhydrazone (37.8 mg, 0.069 mmol) were obtained 11 mg of **6f** (61 % isolated yield) as a yellow oil. Rf 0.35 (1:1 hexane : AcOEt).

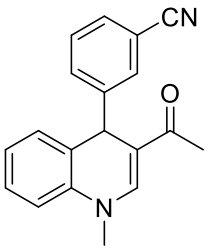


6f

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.40 (s, 1H), 7.24 – 7.17 (m, 6H), 7.14 – 7.07 (m, 1H), 7.02 (td, *J* = 7.6, 1.1 Hz, 1H), 6.96 (d, *J* = 8.7 Hz, 1H), 5.34 (s, 1H), 3.45 (s, 3H), 2.22 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 193.8 (C), 147.6 (C), 143.4 (CH), 137.6 (C), 130.4 (CH), 128.3 (CH), 127.3 (CH), 127.2 (C), 127.1 (CH), 126.0 (CH), 124.0 (CH), 114.0 (C), 112.6 (CH), 41.4 (CH), 39.4 (CH_3), 24.7 (CH_3). EI HRMS: calcd. For $[C_{18}H_{17}NO+H]^+$: 264.1384, found: 264.1382

3-(3-Acetyl-1-methyl-1,4-dihydroquinolin-4-yl)benzonitrile (6g)

Following the general method, from iodoenaminone **(4a)** (0.043 mmol) and 3-formylbenzonitrile tosylhydrazone (25.8 mg, 0.086 mmol) were obtained 8 mg of **6g** (66 % isolated yield) as a yellow oil. Rf 0.20 (1:1 hexane : AcOEt).

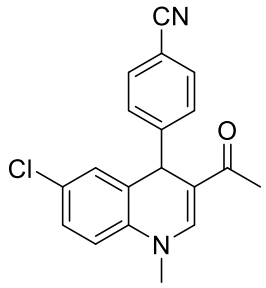


6g

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.58 (dt, *J* = 7.6, 1.6 Hz, 1H), 7.42 – 7.38 (m, 3H), 7.33 (d, *J* = 7.8 Hz, 1H), 7.25 (d, *J* = 8.1 Hz, 1H), 7.12 (dd, *J* = 7.5, 1.6 Hz, 1H), 7.06 (dd, *J* = 7.4, 1.2 Hz, 1H), 7.01 (d, *J* = 8.4 Hz, 1H), 5.38 (s, 1H), 3.49 (s, 3H), 2.24 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 193.4 (C), 148.8 (C), 143.9 (CH), 137.4 (C), 132.1 (CH), 131.3 (CH), 130.4 (CH), 129.7 (CH), 128.9 (CH), 127.7 (CH), 125.8 (C), 124.3 (CH), 119.2 (C), 113.2 (C), 113.0 (CH), 112.2 (C), 41.0 (CH), 39.6 (CH_3), 24.4 (CH_3). EI HRMS: calcd. For $[C_{19}H_{16}N_2O+H]^+$: 289.1336, found: 289.1335

4-(3-Acetyl-6-chloro-1-methyl-1,4-dihydroquinolin-4-yl)benzonitrile (6h)

Following the general method, from iodoenaminone **(4b)** (0.074 mmol) and 4-formylbenzonitrile tosylhydrazone (44.7 mg, 0.148 mmol) were obtained 16 mg of **6h** (70 % isolated yield) as a yellow oil. Rf 0.12 (1:1 hexane : AcOEt).

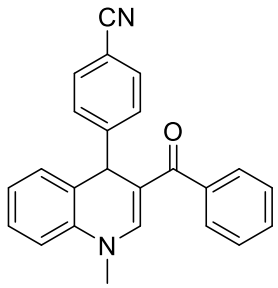


6h

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.51 (d, *J* = 8.4 Hz, 2H), 7.37 (s, 1H), 7.31 – 7.27 (m, 2H), 7.20 (dd, *J* = 8.6, 2.4 Hz, 1H), 7.07 (d, *J* = 2.4 Hz, 1H), 6.91 (d, *J* = 8.7 Hz, 1H), 5.33 (s, 1H), 3.46 (s, 3H), 2.22 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 193.3 (C), 151.9 (C), 143.5 (CH), 136.2 (C), 132.3 (CH), 130.2 (CH), 129.2 (C), 128.3 (CH), 127.7 (CH), 127.4 (C), 118.9 (C), 114.3 (CH), 113.1 (C), 110.1 (C), 41.5 (CH), 39.6 (CH_3), 24.5 (CH_3). EI HRMS: calcd. For $[C_{19}H_{15}ClN_2O+H]^+$: 323.0943, found: 323.0945

4-(3-Benzoyl-1-methyl-1,4-dihydroquinolin-4-yl)benzonitrile (6i)

Following the general method, from iodoenaminone **(4d)** (0.063 mmol) and 4-formylbenzonitrile tosylhydrazone (37.9 mg, 0.126 mmol) were obtained 15 mg of **6i** (68 % isolated yield) as a yellow oil. Rf 0.16 (3:1 hexane : AcOEt).

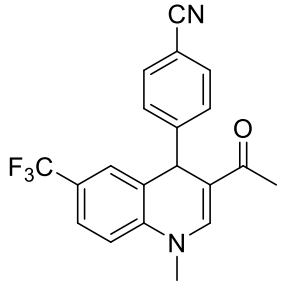


6i

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.54 (d, *J* = 8.3 Hz, 2H), 7.50 – 7.45 (m, 3H), 7.44 – 7.38 (m, 4H), 7.29 – 7.24 (m, 1H), 7.19 – 7.14 (m, 2H), 7.08 (td, *J* = 7.4, 1.2 Hz, 1H), 7.01 (d, *J* = 8.2 Hz, 1H), 5.60 (s, 1H), 3.39 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 193.2 (C), 152.5 (C), 147.4 (CH), 139.7 (C), 137.3 (C), 132.3 (CH), 130.6 (CH), 130.3 (CH), 128.3 (CH), 128.2 (CH), 128.2 (CH), 127.9 (CH), 125.7 (C), 124.6 (CH), 119.1 (C), 113.1 (CH), 112.3 (C), 109.8 (C), 41.9 (CH), 39.6 (CH_3). EI HRMS: calcd. For $[C_{24}H_{18}N_2O+H]^+$: 351.1497, found: 351.1491

4-(3-Acetyl-1-methyl-6-(trifluoromethyl)-1,4-dihydroquinolin-4-yl)benzonitrile (6j)

Following the general method, from iodoenaminone **(4c)** (0.048 mmol) and 4-formylbenzonitrile tosylhydrazone (29.2 mg, 0.096 mmol) were obtained 9 mg of **6j** (68 % isolated yield) as a yellow oil. Rf 0.10 (1:1 hexane : AcOEt).

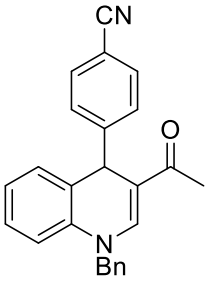


6j

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.56 – 7.47 (m, 3H), 7.38 (s, 1H), 7.35 (bs, 1H), 7.31 (d, *J* = 8.3 Hz, 2H), 7.06 (d, *J* = 8.5 Hz, 1H), 5.41 (s, 1H), 3.51 (s, 3H), 2.25 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 193.4 (C), 151.5 (C), 143.3 (CH), 140.3 (C), 132.4 (CH), 128.2 (CH), 127.44 (q, CH-CF_3, *J* = 3.6 Hz), 126.0 (C), 125.0 (q, CH-CF_3, *J* = 3.6 Hz), 124.9 (C), 118.8 (C), 114.1 (C), 113.0 (CH), 110.3 (C), 41.4 (CH), 39.6 (CH_3), 24.6 (CH_3). ^{19}F NMR (282 MHz, $CDCl_3$) δ -62.00. EI HRMS: calcd. For $[C_{20}H_{15}F_3N_2O+H]^+$: 357.1206, found: 357.1209

4-(3-Acetyl-1-benzyl-1,4-dihydroquinolin-4-yl)benzonitrile (6k)

Following the general method, from iodoenaminone **(4e)** (0.063 mmol) and 4-formylbenzonitrile tosylhydrazone (37.9 mg, 0.126 mmol) were obtained 22 mg of **6k** (96 % isolated yield) as a yellow oil. Rf 0.11 (2:1 hexane : AcOEt).

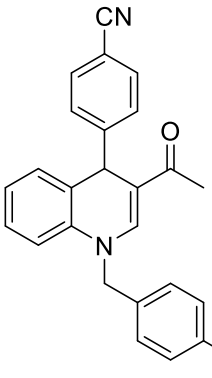


6k

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.54 – 7.47 (m, 3H), 7.44 – 7.37 (m, 3H), 7.36 – 7.27 (m, 4H), 7.16 – 7.08 (m, 2H), 6.99 (t, *J* = 6.8 Hz, 1H), 6.92 (d, *J* = 7.9 Hz, 1H), 5.46 (s, 1H), 5.08 (d, *J* = 16.6 Hz, 1H), 4.96 (d, *J* = 16.7 Hz, 1H), 2.23 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 193.7 (C), 152.4 (C), 143.6 (CH), 136.7 (C), 135.7 (C), 132.2 (CH), 130.6 (CH), 129.1 (CH), 128.4 (CH), 128.1 (CH), 127.7 (CH), 126.3 (CH), 125.8 (C), 124.4 (CH), 119.1 (C), 114.1 (CH), 113.6 (C), 109.8 (C), 55.3 (CH_2), 41.5 (CH), 24.5 (CH_3). EI HRMS: calcd. For $[C_{25}H_{20}N_2O+H]^+$: 365.1641, found: 365.1648

4-(3-Acetyl-1-(4-methoxybenzyl)-1,4-dihydroquinolin-4-yl)benzonitrile (6l)

Following the general method, from iodoenaminone **(4f)** (0.051 mmol) and 4-formylbenzonitrile tosylhydrazone (30.8 mg, 0.102 mmol) were obtained 12 mg of **6l** (60 % isolated yield) as a yellow oil. Rf 0.10 (2:1 hexane : AcOEt).



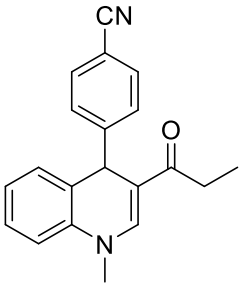
6l

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.53 – 7.47 (m, 3H), 7.32 (d, *J* = 8.2 Hz, 2H), 7.22 (d, *J* = 8.3 Hz, 2H), 7.17 – 7.09 (m, 2H), 7.01 (d, *J* = 7.3 Hz, 1H), 6.97 – 6.90 (m, 3H), 5.45 (s, 1H), 5.02 (d, *J* = 16.2 Hz, 1H), 4.88 (d, *J* = 16.4 Hz, 1H), 3.84 (s, 3H), 2.22 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 193.6 (C), 159.4 (C), 152.4 (C),

143.4 (CH), 136.7 (C), 132.2 (CH), 130.6 (CH), 128.4 (CH), 127.7 (CH), 127.7 (CH), 127.5 (C), 125.9 (C), 124.3 (CH), 119.1 (C), 114.5 (CH), 114.1 (CH), 113.5 (C), 109.8 (C), 55.3 (CH_3), 54.9 (CH_2), 41.5 (CH), 24.5 (CH_3). EI HRMS: calcd. For $[C_{26}H_{22}N_2O_2+H]^+$: 395.1758, found: 395.1754

4-(1-Methyl-3-propionyl-1,4-dihydroquinolin-4-yl)benzonitrile (6m)

Following the general method, from iodoenaminone **(4g)** (0.082 mmol) and 4-formylbenzonitrile tosylhydrazone (49.4 mg, 0.164 mmol) were obtained 15 mg of **6m** (62 % isolated yield) as a yellow oil. Rf 0.17 (2:1 hexane : AcOEt).

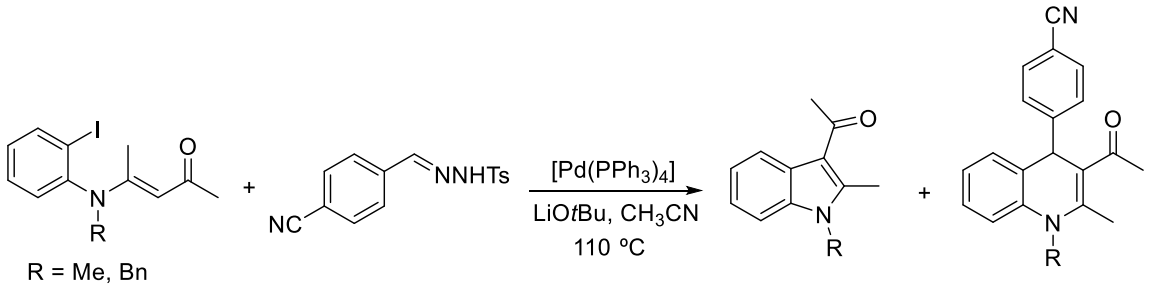


6m

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.50 (d, *J* = 8.3 Hz, 2H), 7.43 (s, 1H), 7.33 (d, *J* = 8.3 Hz, 2H), 7.27 – 7.21 (m, 1H), 7.11 (dd, *J* = 7.8, 1.7 Hz, 1H), 7.04 (dd, *J* = 7.4, 1.2 Hz, 1H), 6.99 (dd, *J* = 8.2, 1.1 Hz, 1H), 5.39 (s, 1H), 3.47 (s, 3H), 2.69 – 2.45 (m, 2H), 1.09 (t, *J* = 7.4 Hz, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 196.6 (C), 152.7 (C), 142.9 (CH), 137.5 (C), 132.2 (CH), 130.4 (CH), 128.2 (CH), 127.7 (CH), 125.7 (C), 124.2 (CH), 119.1 (C), 112.9 (CH), 112.3 (C), 109.7 (C), 41.7 (CH), 39.5 (CH_3), 29.3 (CH_2), 9.2 (CH_3). EI HRMS: calcd. For $[C_{20}H_{18}N_2O+H]^+$: 303.1483, found: 303.1478

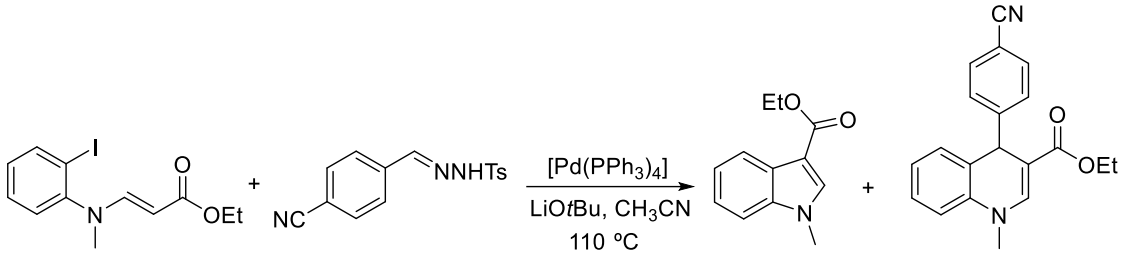
5.- Attempts of cascade reactions with other *o*-iodoalkenylanilines

The synthesis of 1,2,3,4-tetrasubstituted dihydroquinolines was attempted with the model enaminone **7**. Although the dihydroquinoline **11** was indeed formed, the indole **12**, derived from the 5-*endo*-trig cyclization was the major product under all the reaction conditions tested.

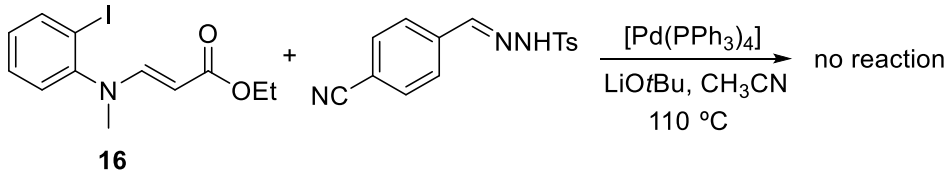


R	12		11
Me	61	:	39
Bn	80	:	20

The cascade reaction employing enaminoester **13**, also provided a mixture of dihydroquinoline **14** and indole **15**, being the indole **15** again the major product under the conditions tested.

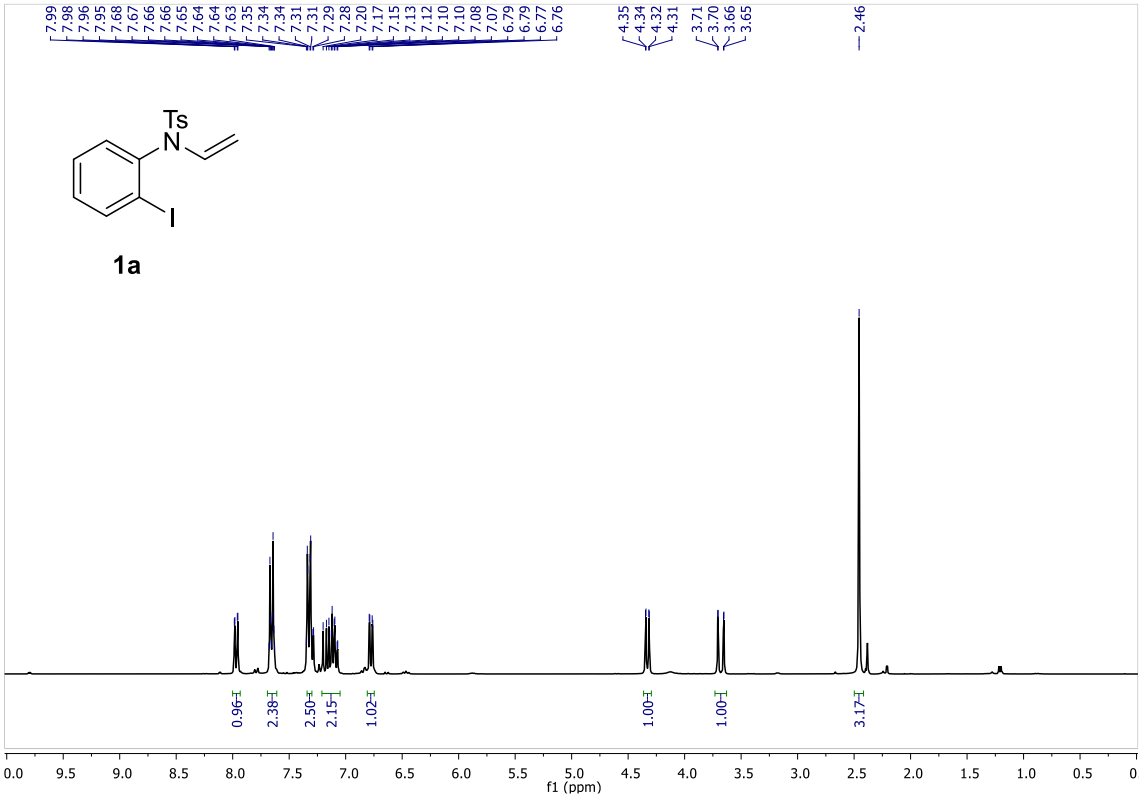


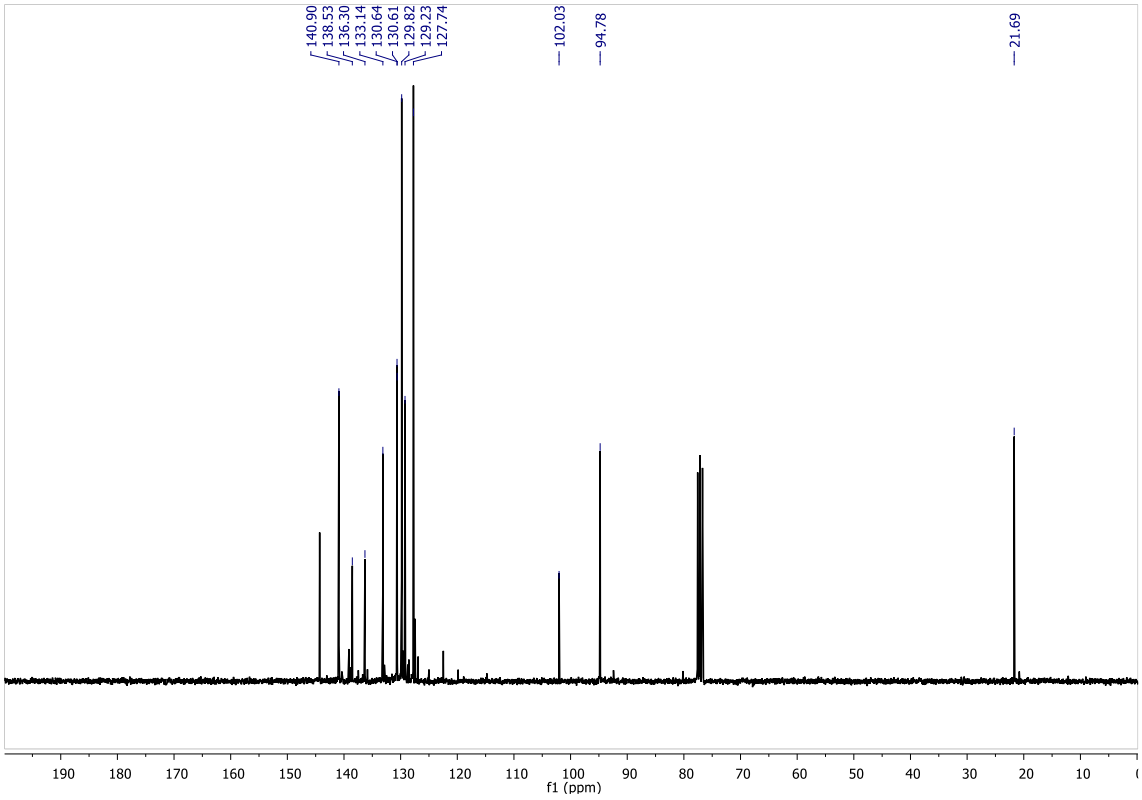
The reaction with the unprotected enaminone **16** did not proceed under the standard reaction conditions and the starting iodoaniline was recovered.



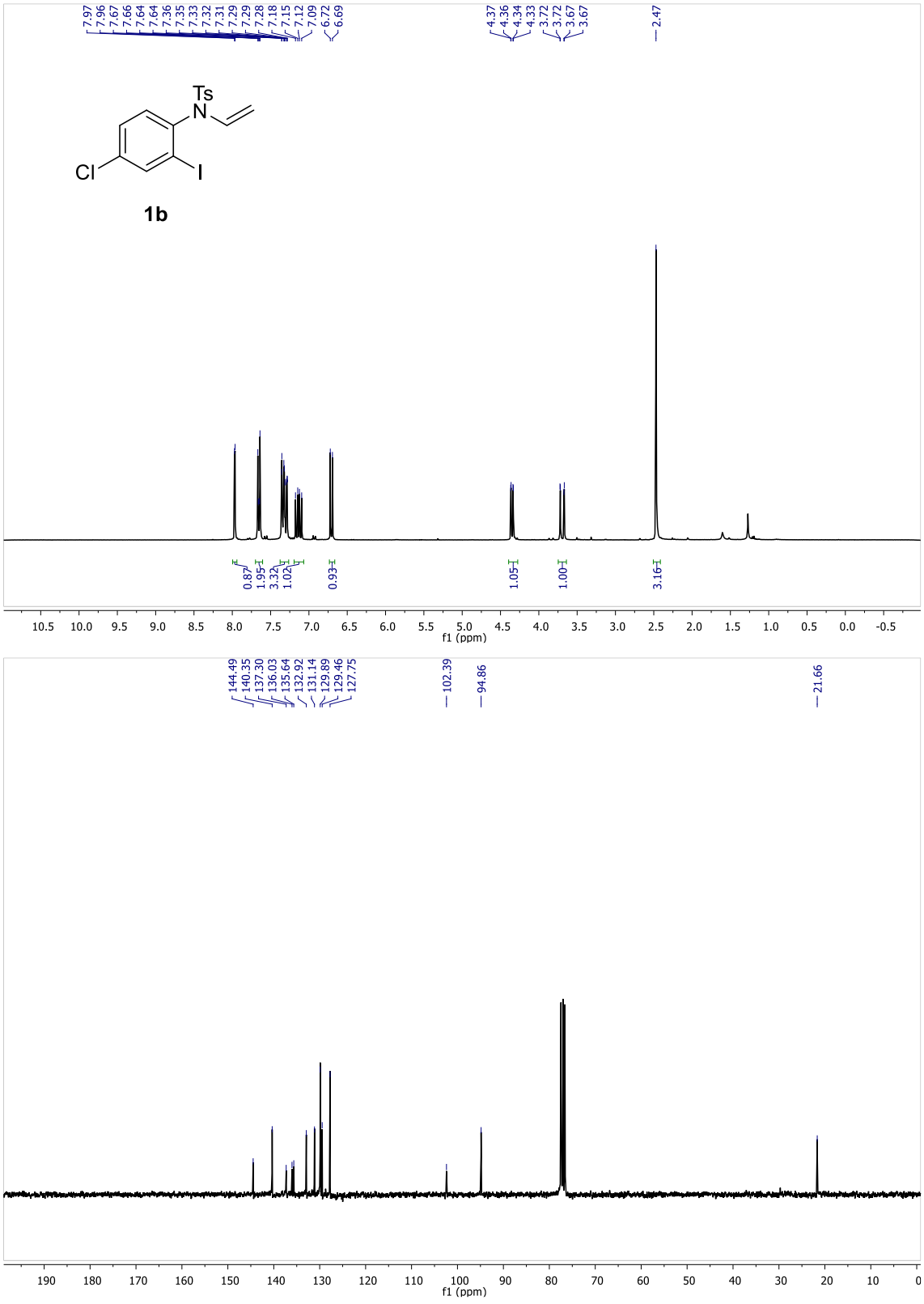
6.- Copies of the 1H and 13C NMR spectra

N-(2-Iodophenyl)-4-methyl-*N*-vinylbenzenesulfonamide (1a)

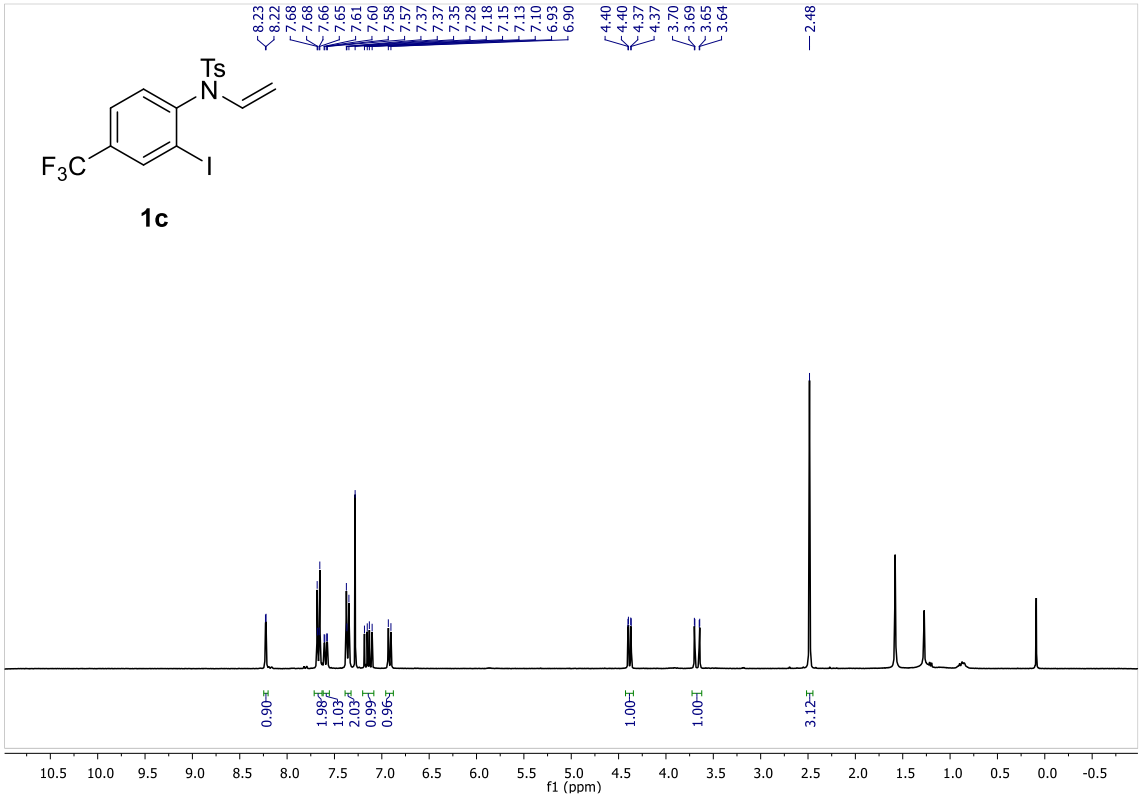


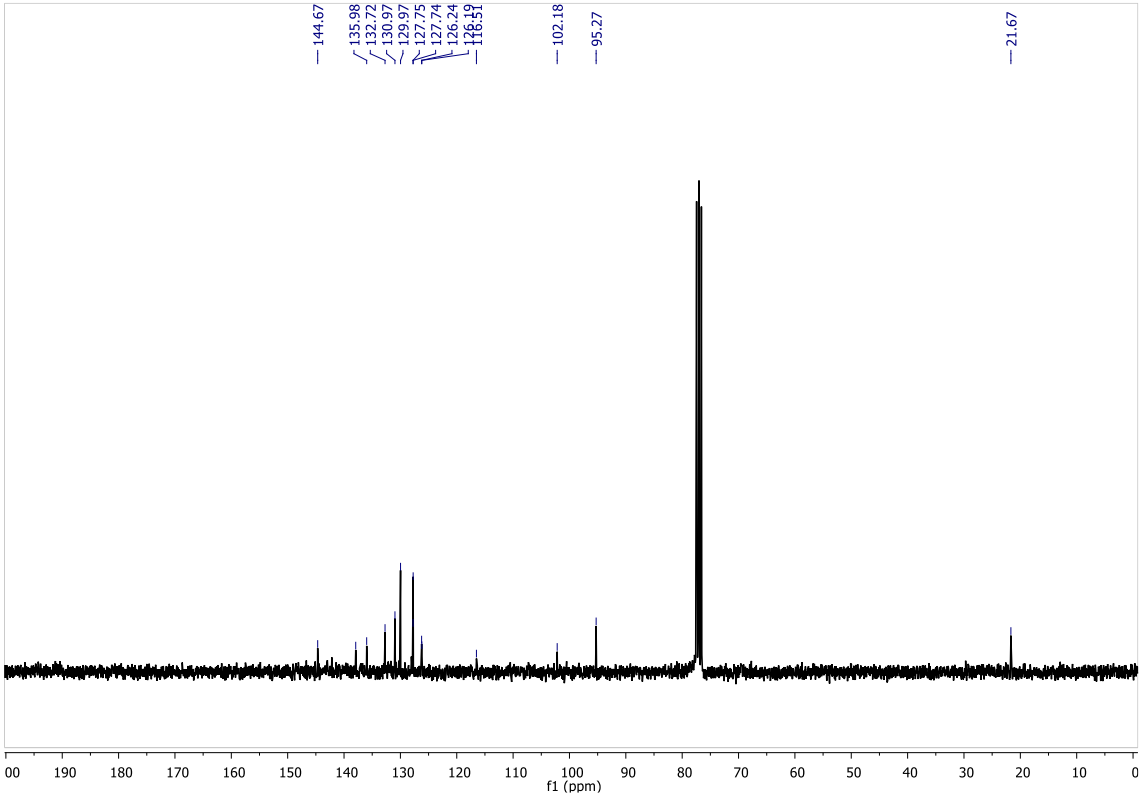


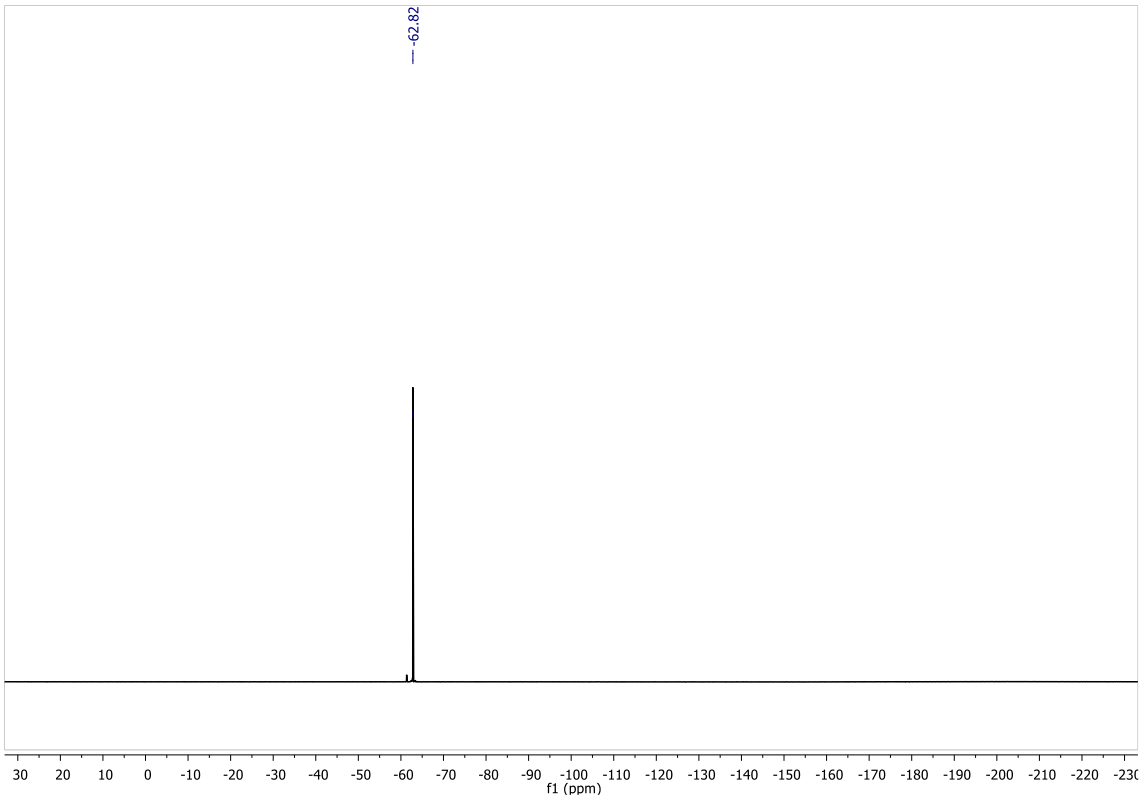
N-(4-Chloro-2-iodophenyl)-4-methyl-*N*-vinylbenzenesulfonamide (1b)



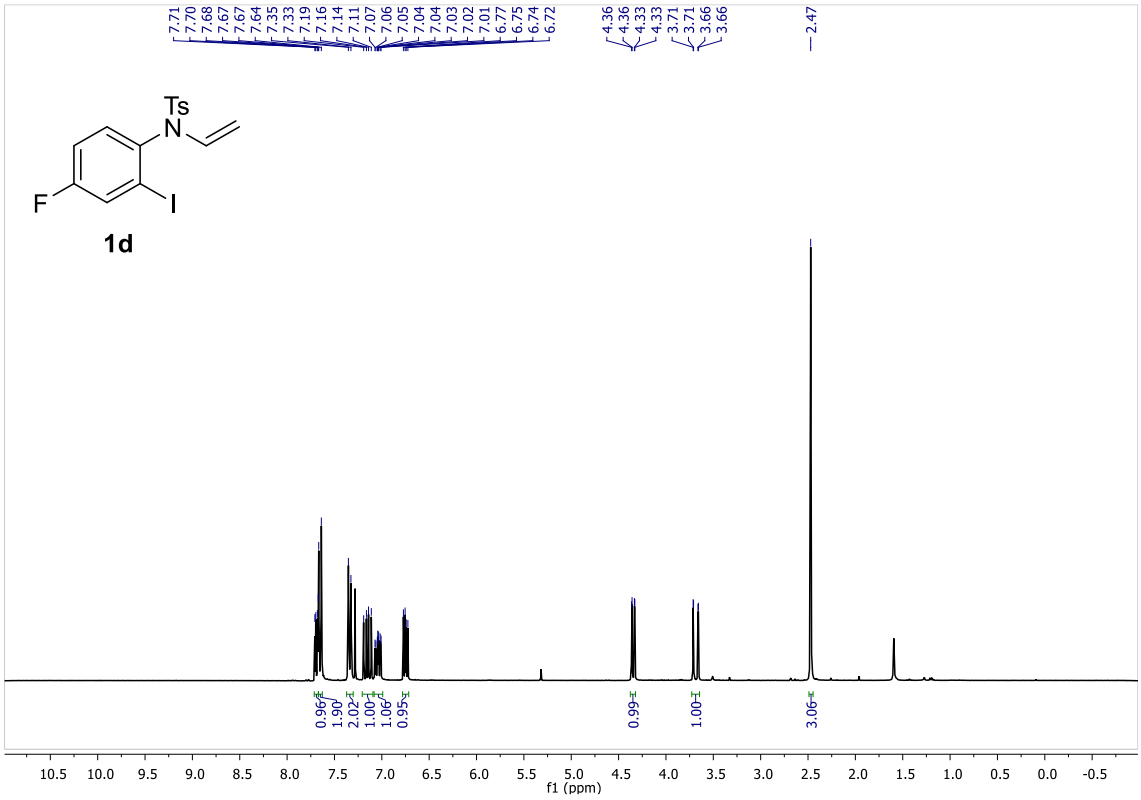
_N_-(2-Iodo-4-(trifluoromethyl)phenyl)-4-methyl-_N_-vinylbenzenesulfonamide (1c)

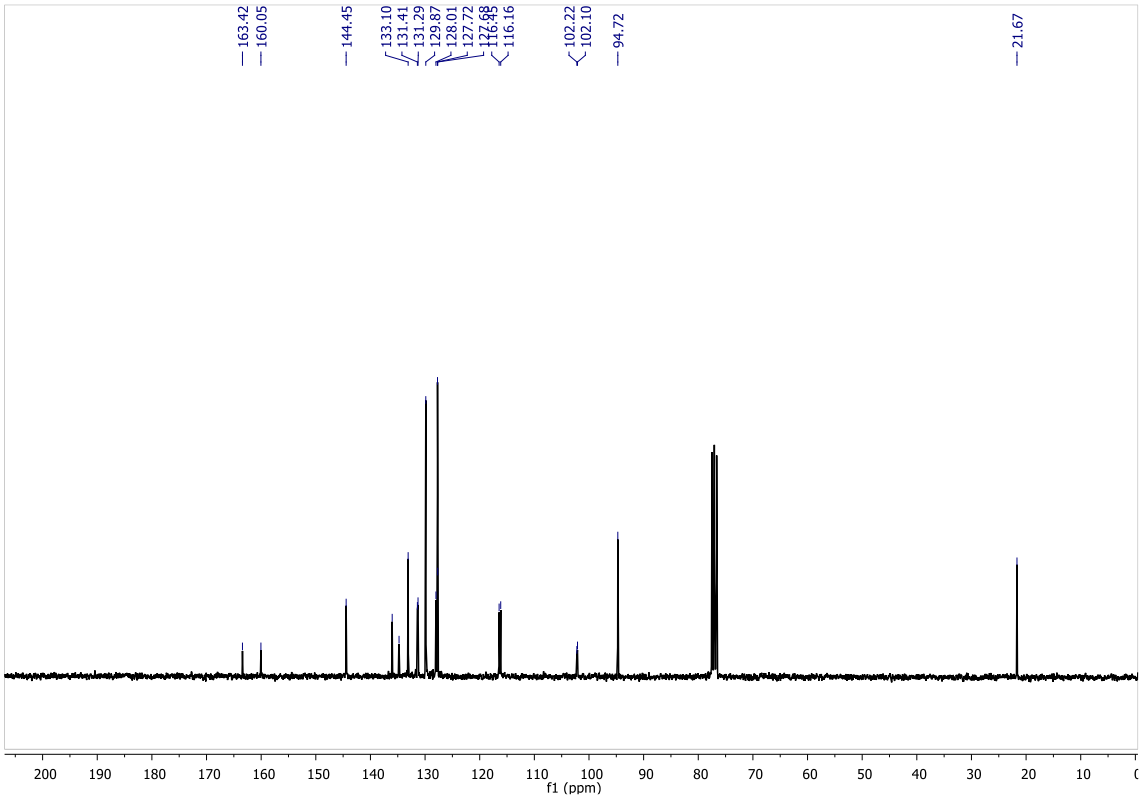




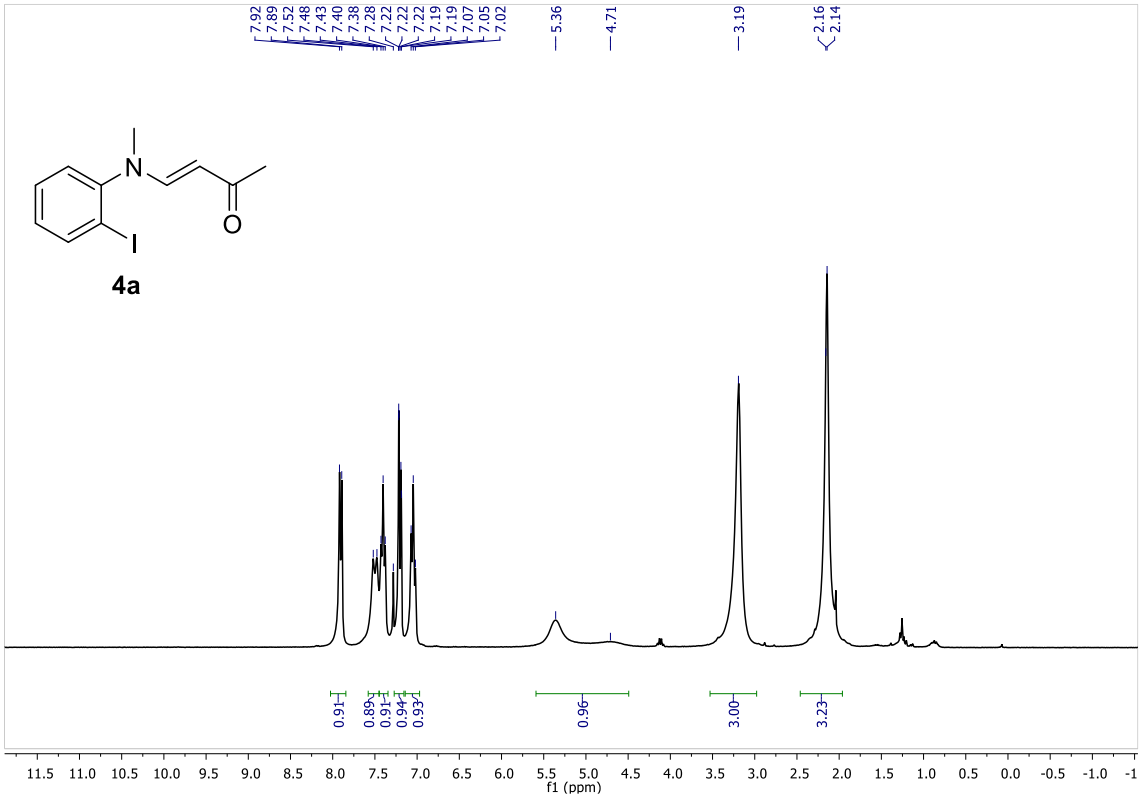

-62.82
30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220 -230
f1 (ppm)

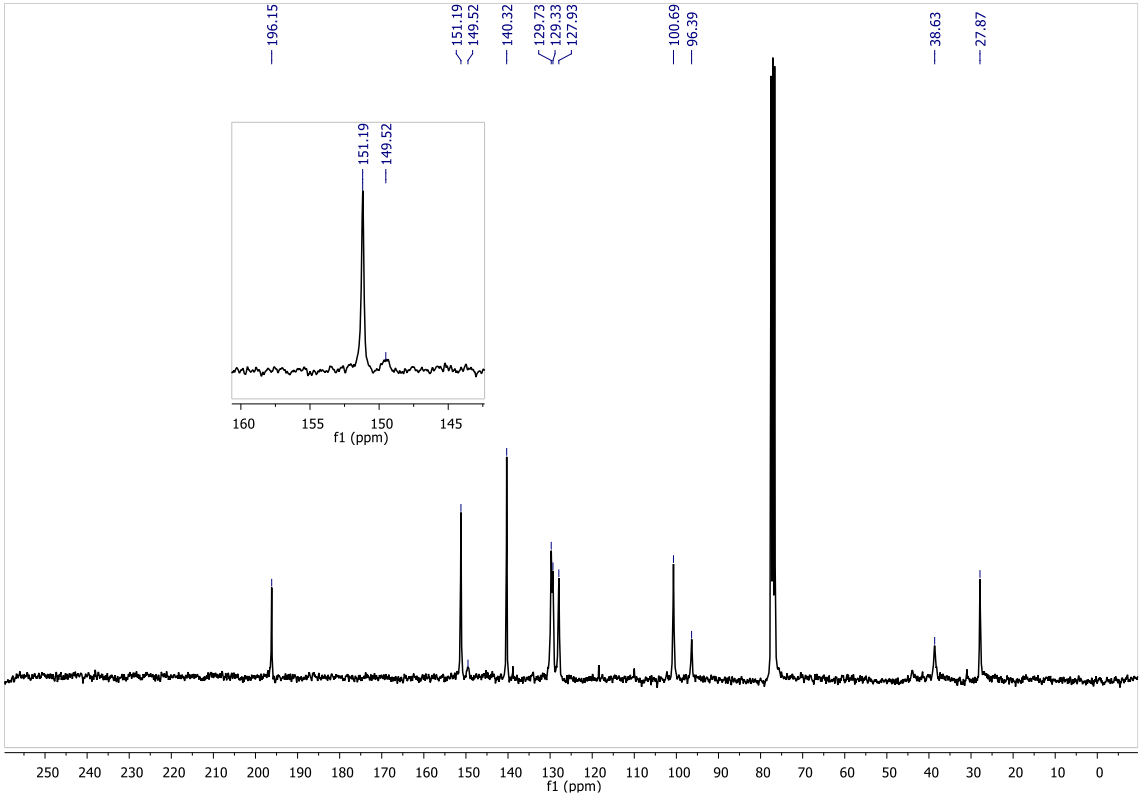
N-(4-Fluoro-2-iodophenyl)-4-methyl-*N*-vinylbenzenesulfonamide (1d)



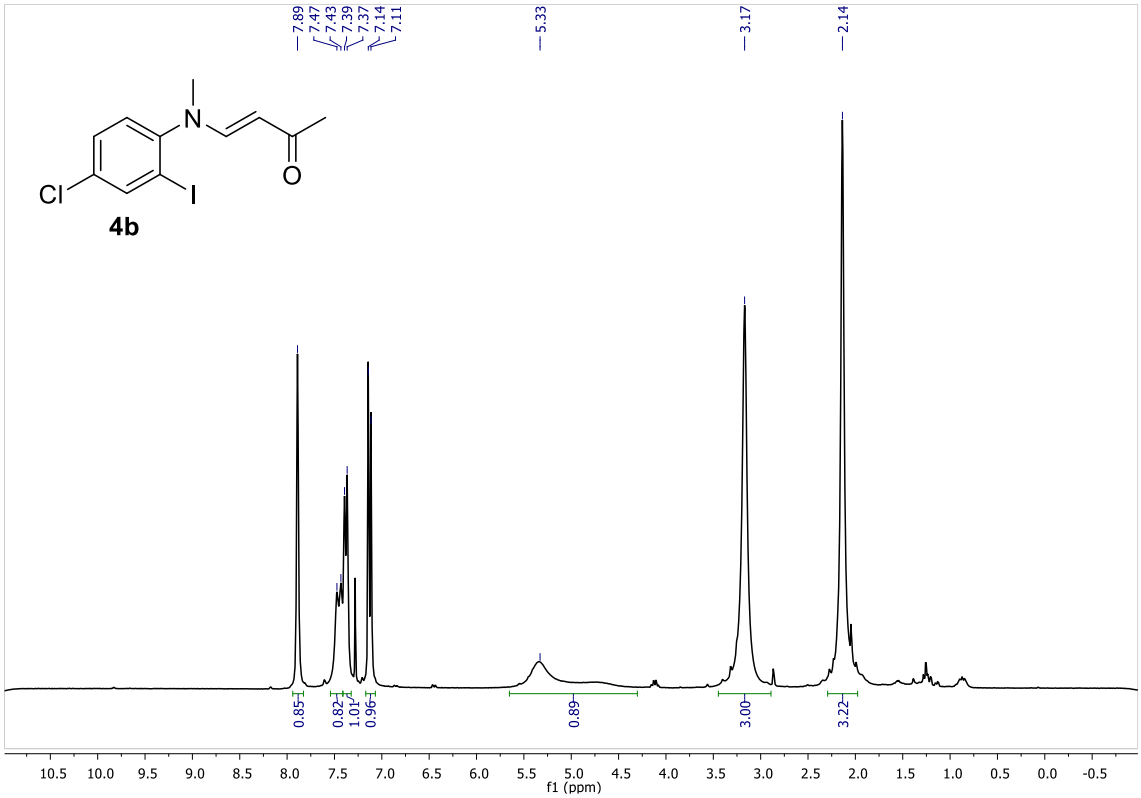


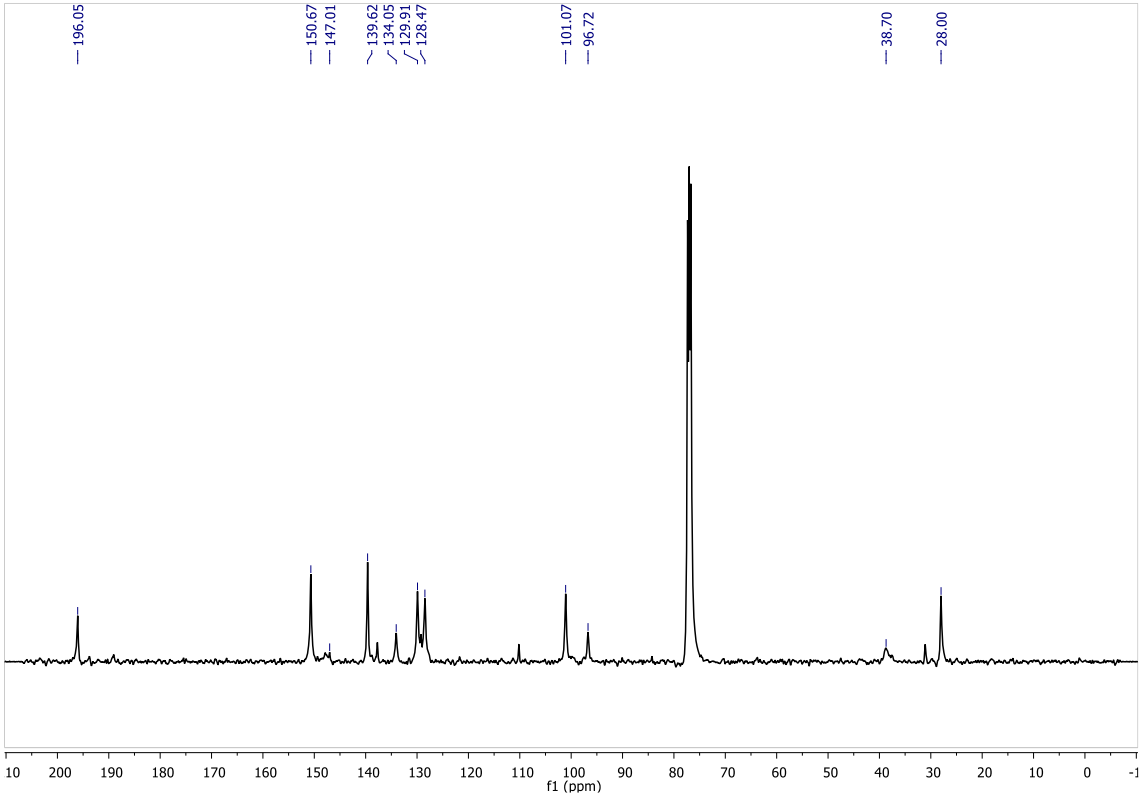
(*E*)-4-((2-Iodophenyl)(methyl)amino)but-3-en-2-one (4a)



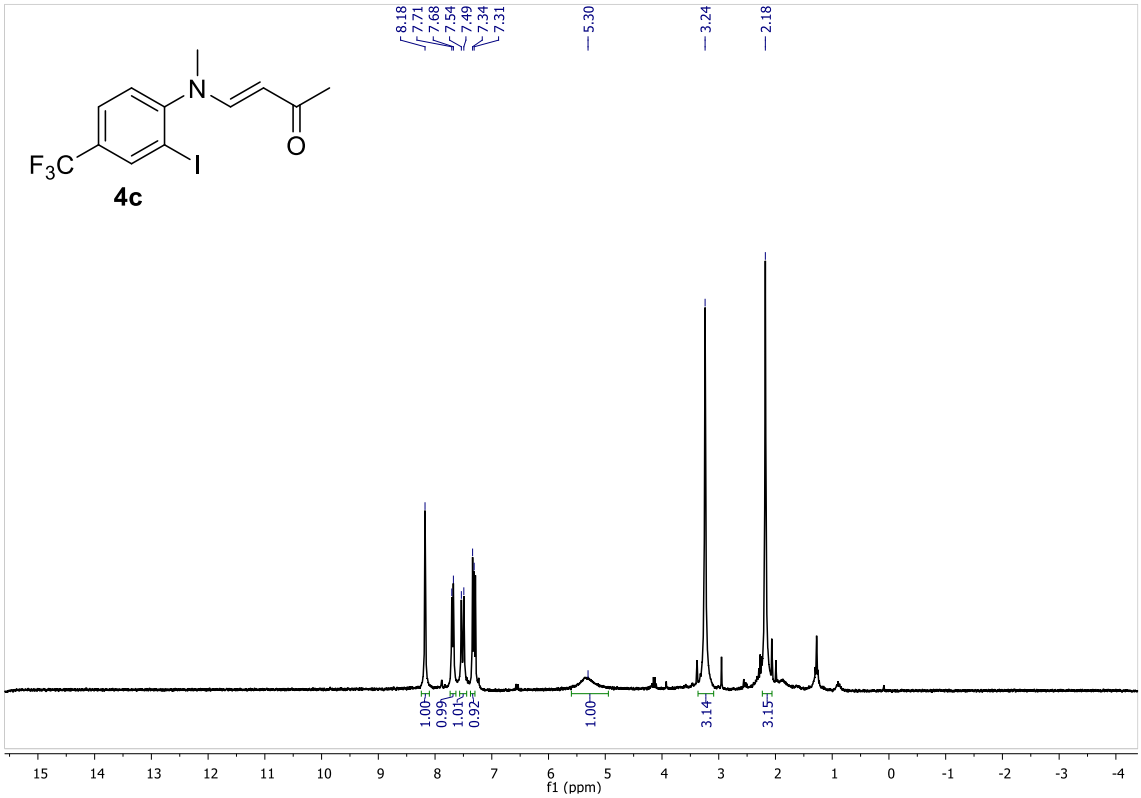


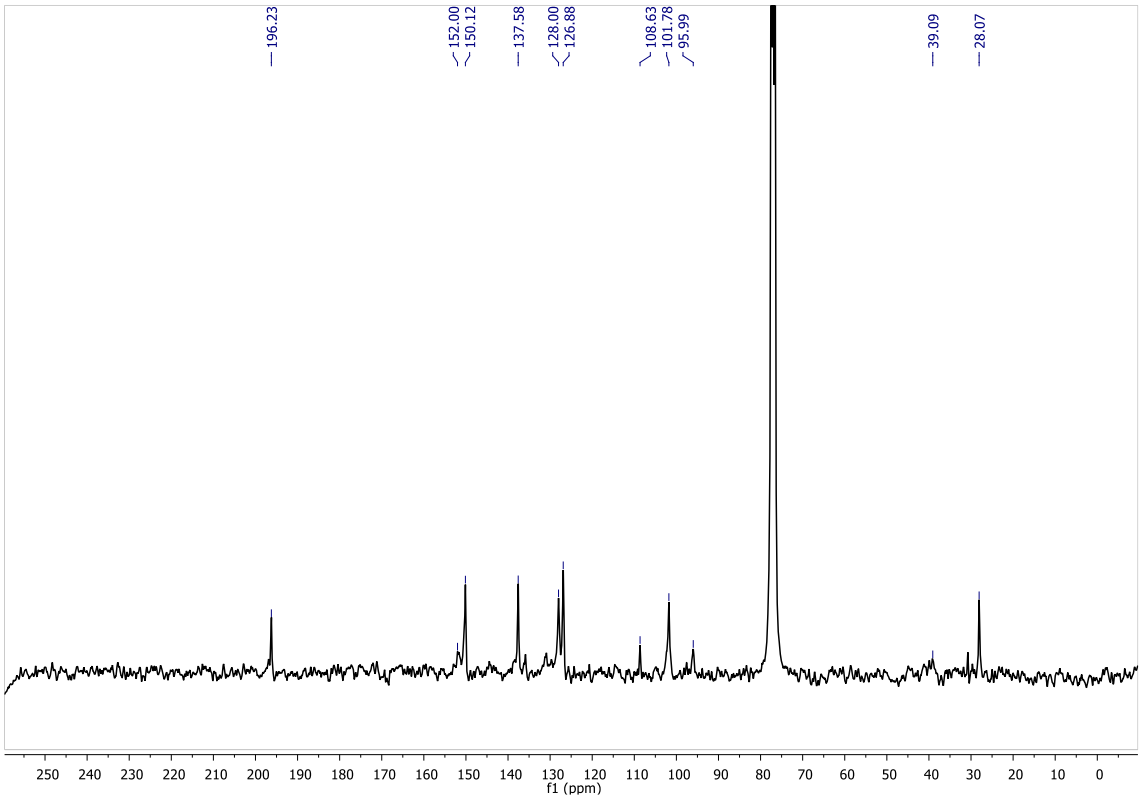
(*E*)-4-((4-Chloro-2-iodophenyl)(methyl)amino)but-3-en-2-one (4b)



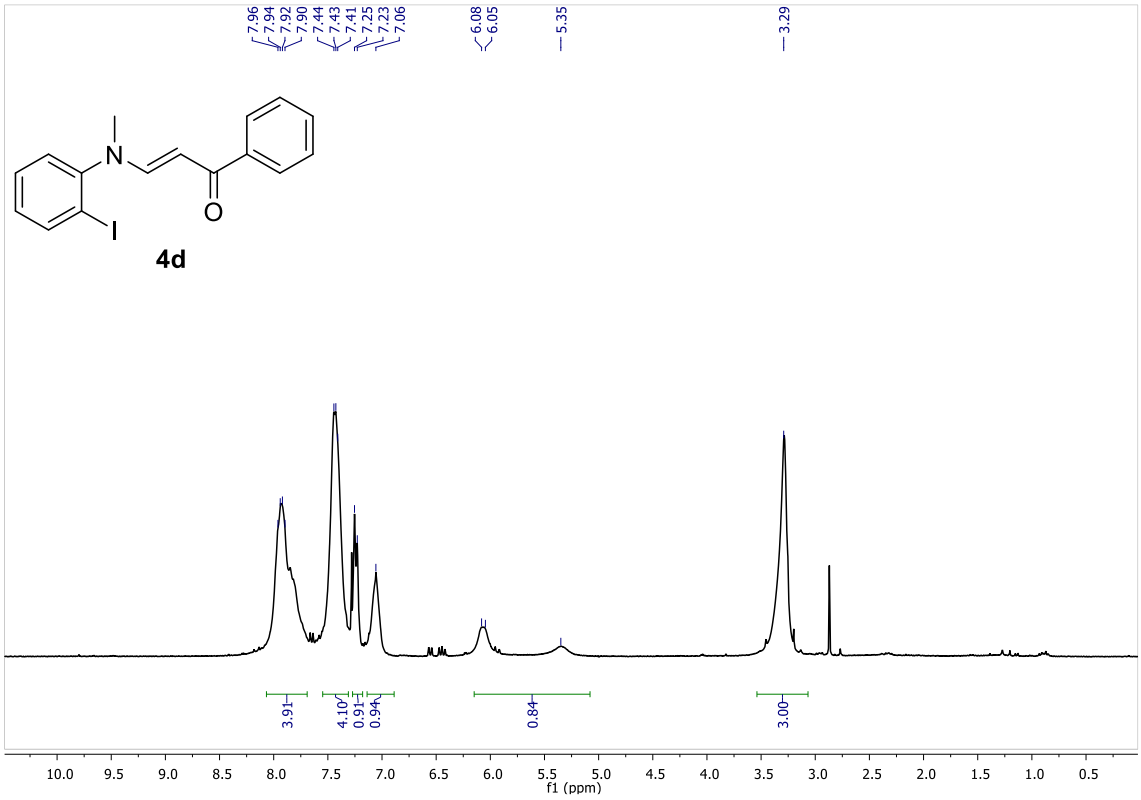


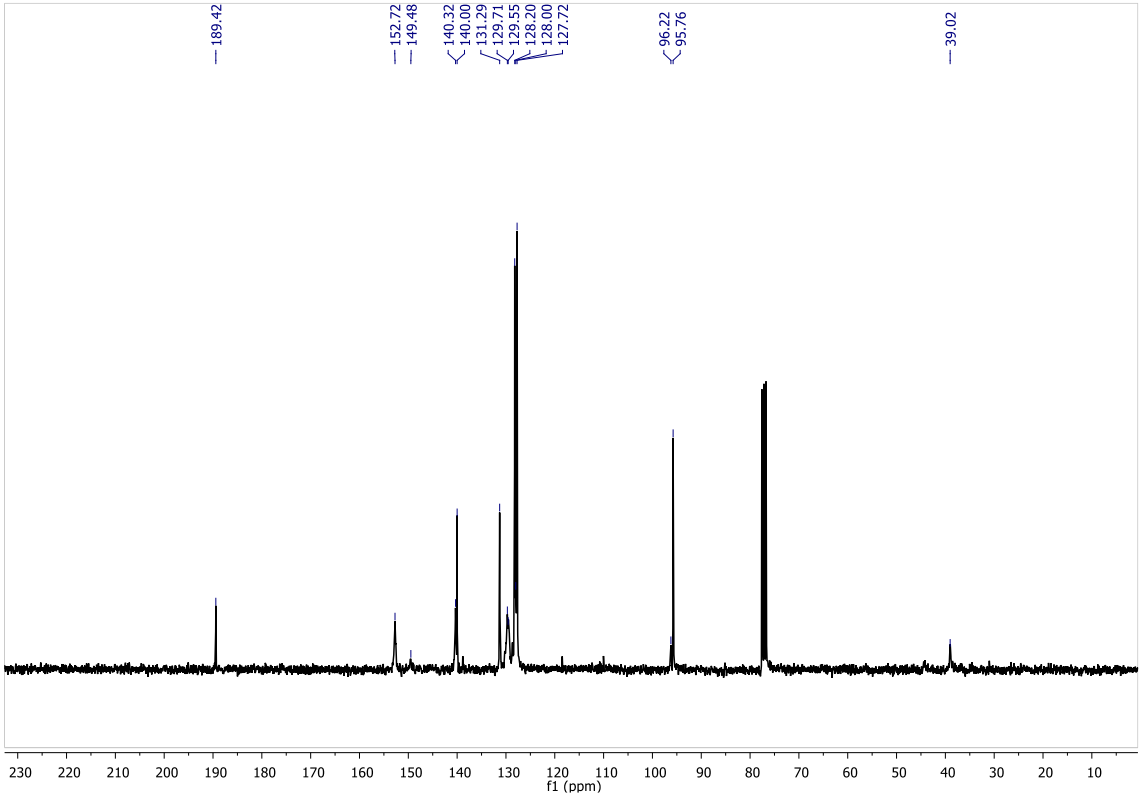
(*E*)-4-((2-Iodo-4-(trifluoromethyl)phenyl)(methyl)amino)but-3-en-2-one (4c)



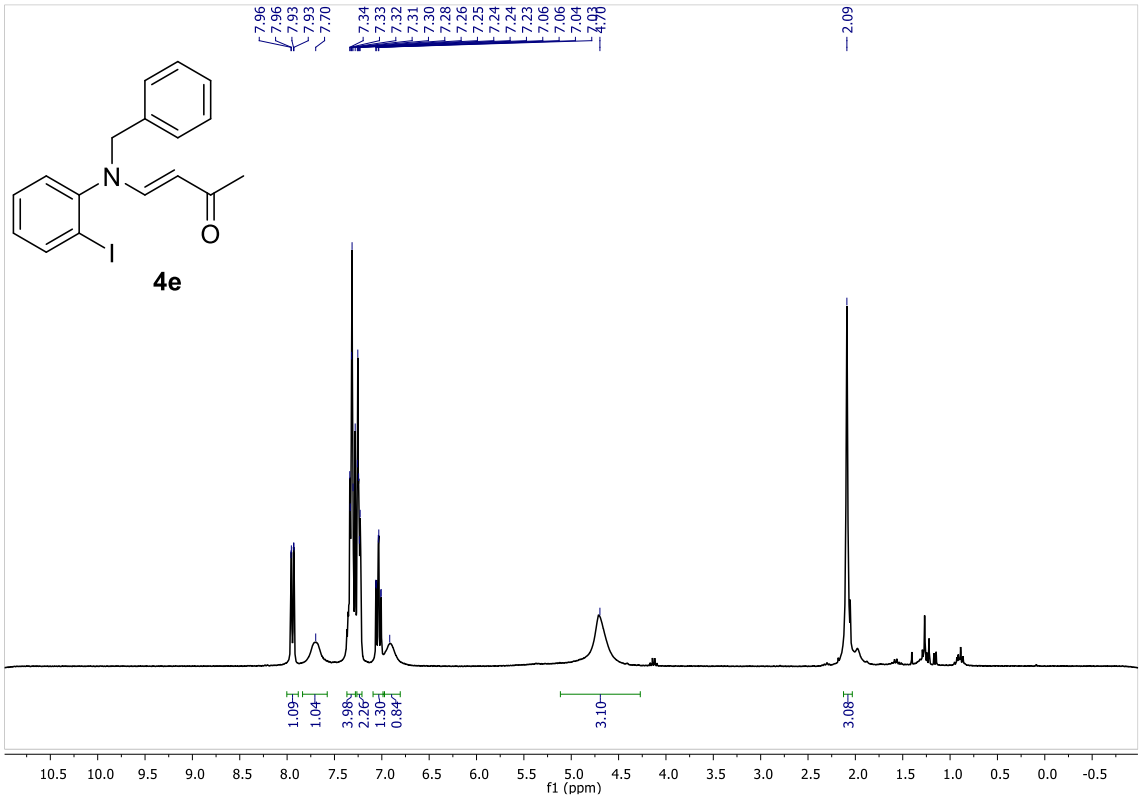


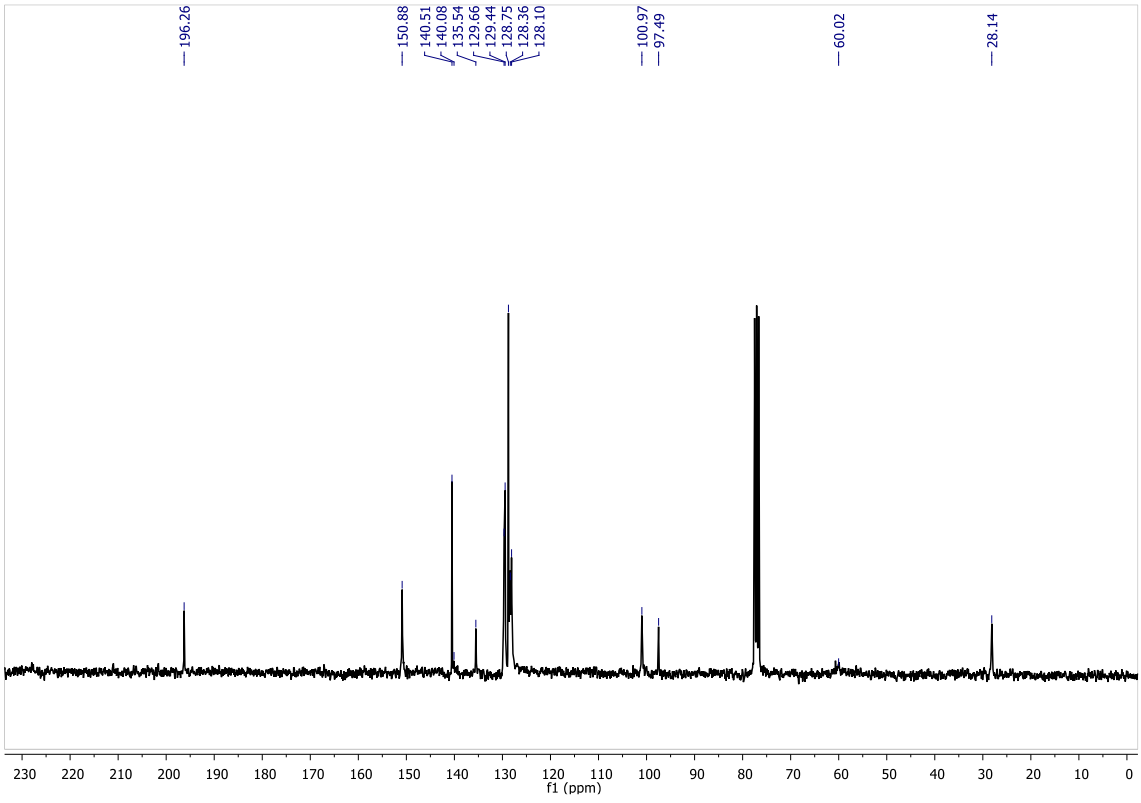
(*E*)-3-((2-Iodophenyl)(methyl)amino)-1-phenylprop-2-en-1-one (4d)



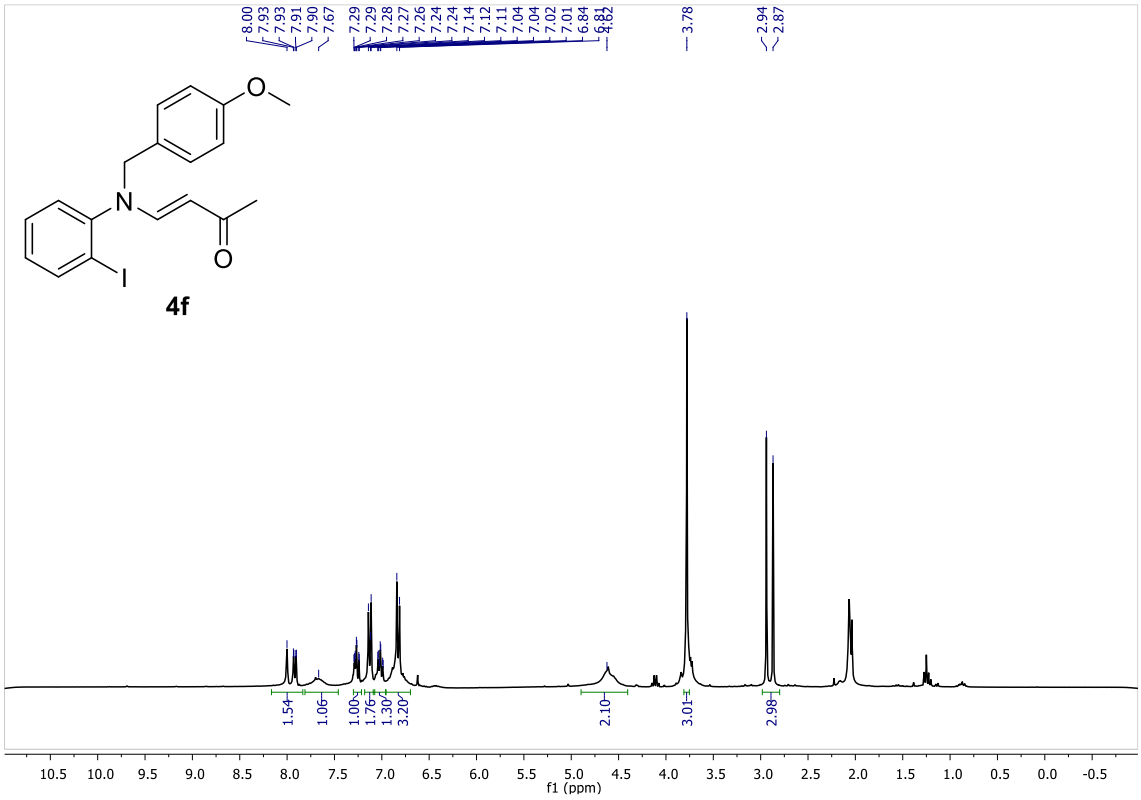


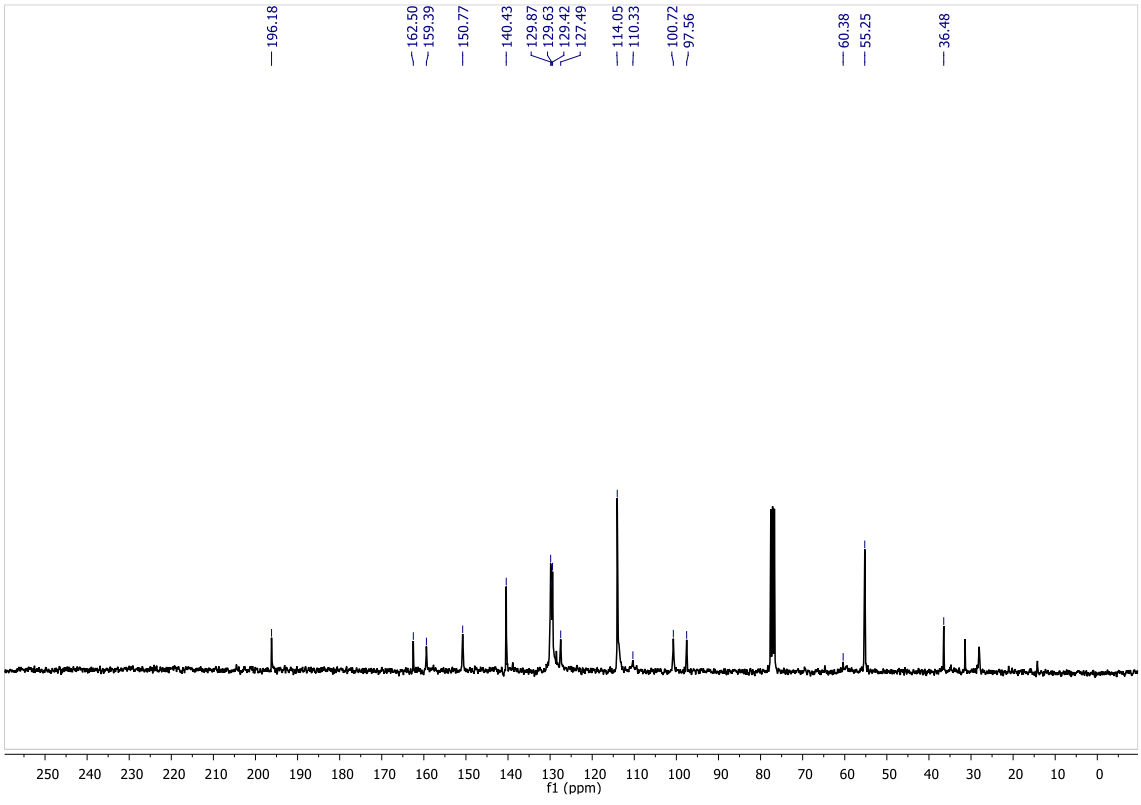
(*E*)-4-(Benzyl(2-iodophenyl)amino)but-3-en-2-one (4e)



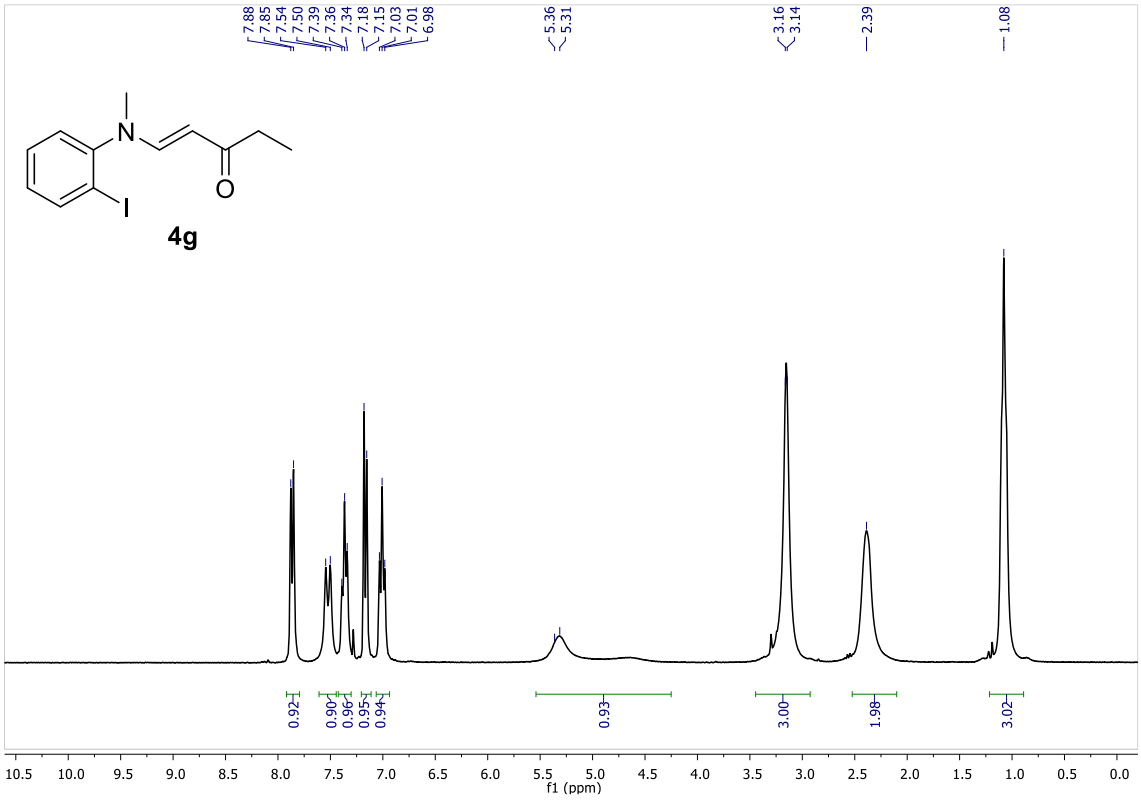


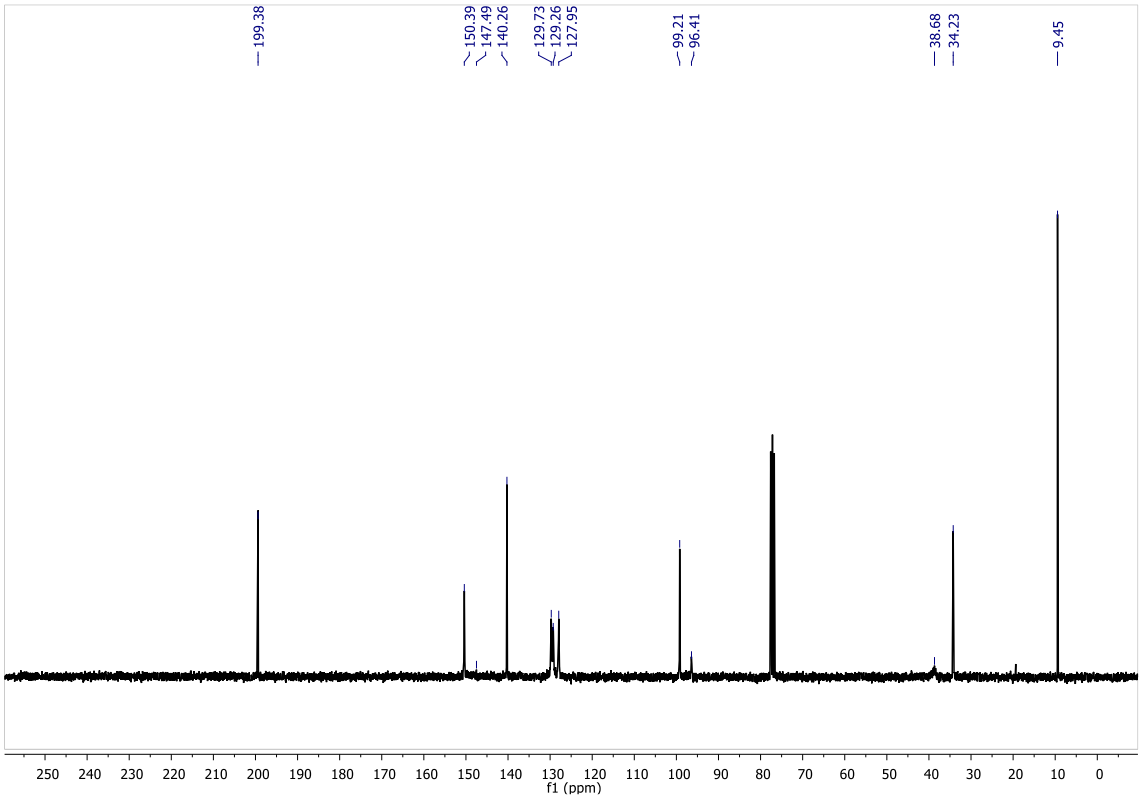
(*E*)-4-((2-Iodophenyl)(4-methoxybenzyl)amino)but-3-en-2-one (4f)



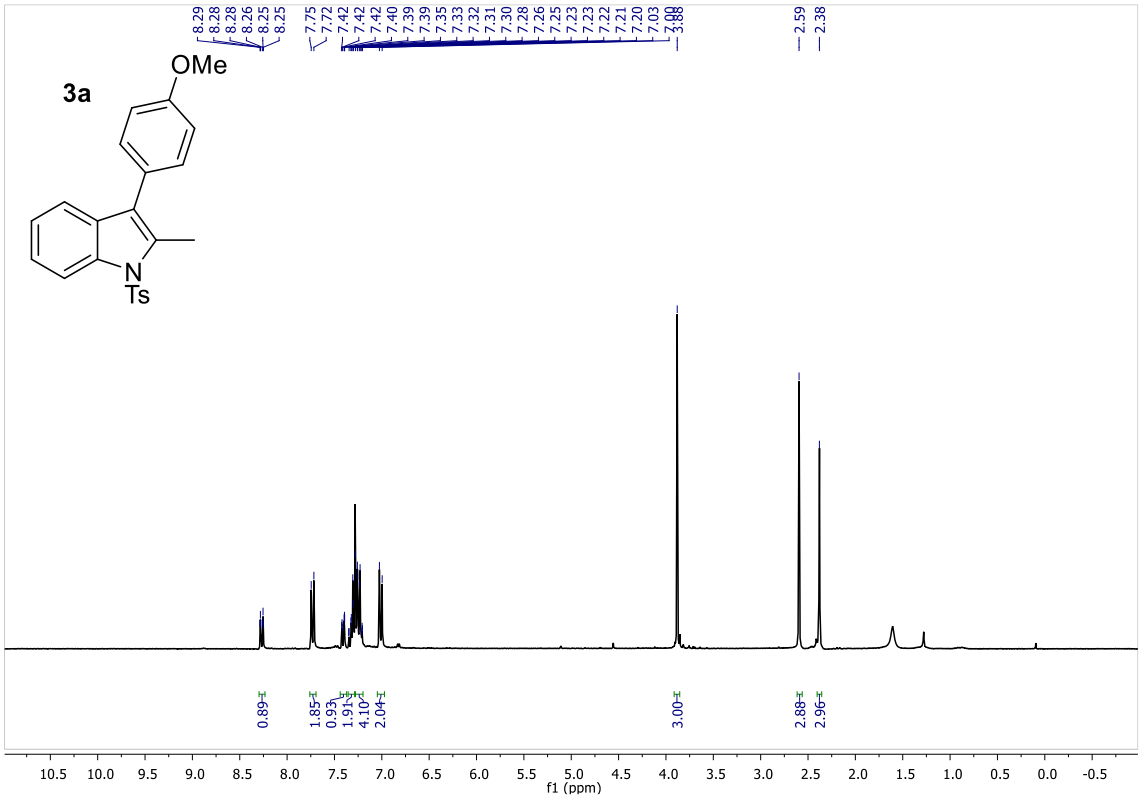


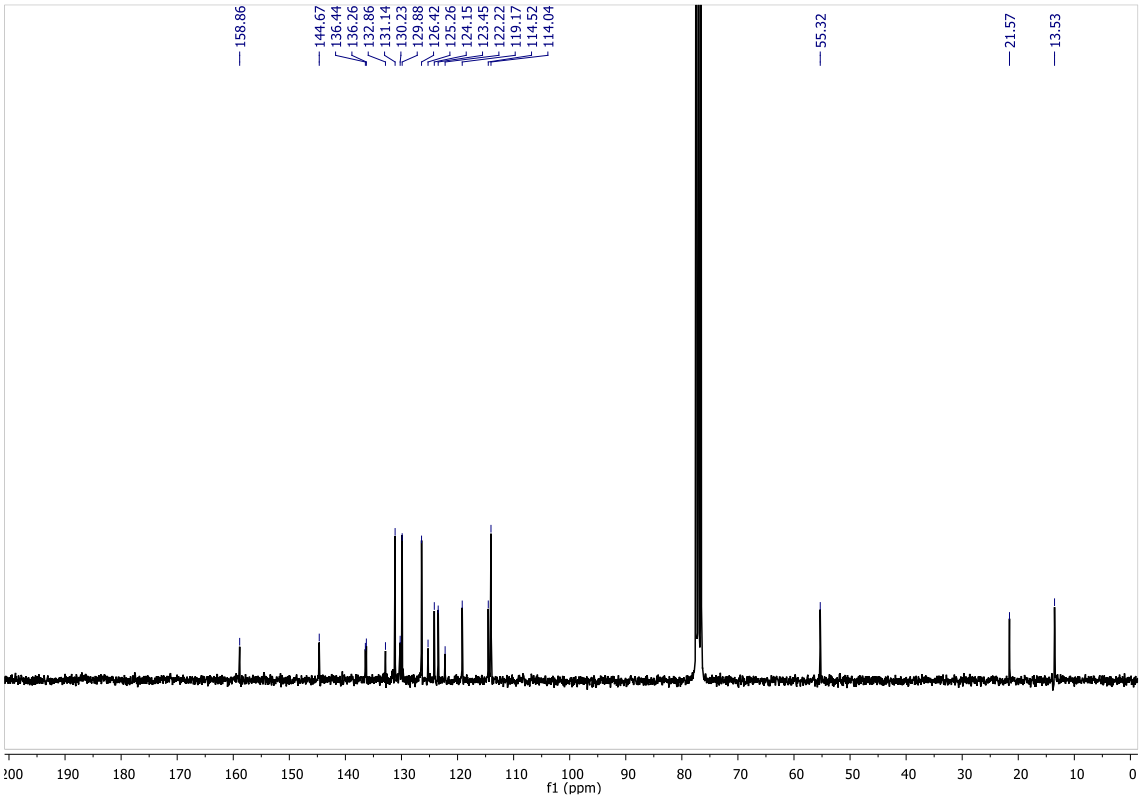
(*E*)-1-((2-Iodophenyl)(methyl)amino)pent-1-en-3-one (4g)



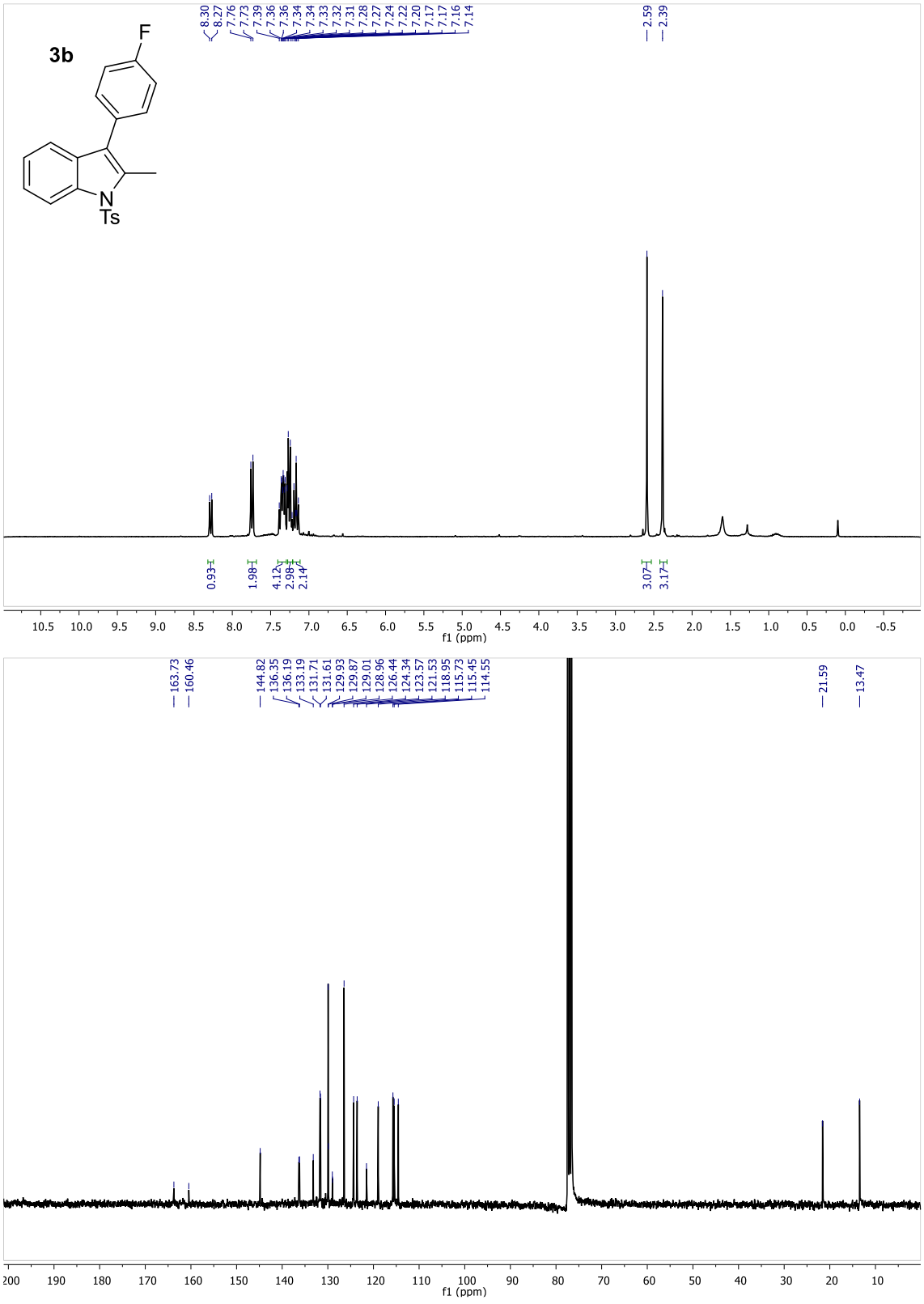


3-(4-Methoxyphenyl)-2-methyl-1-tosyl-1*H*-indole (3a)

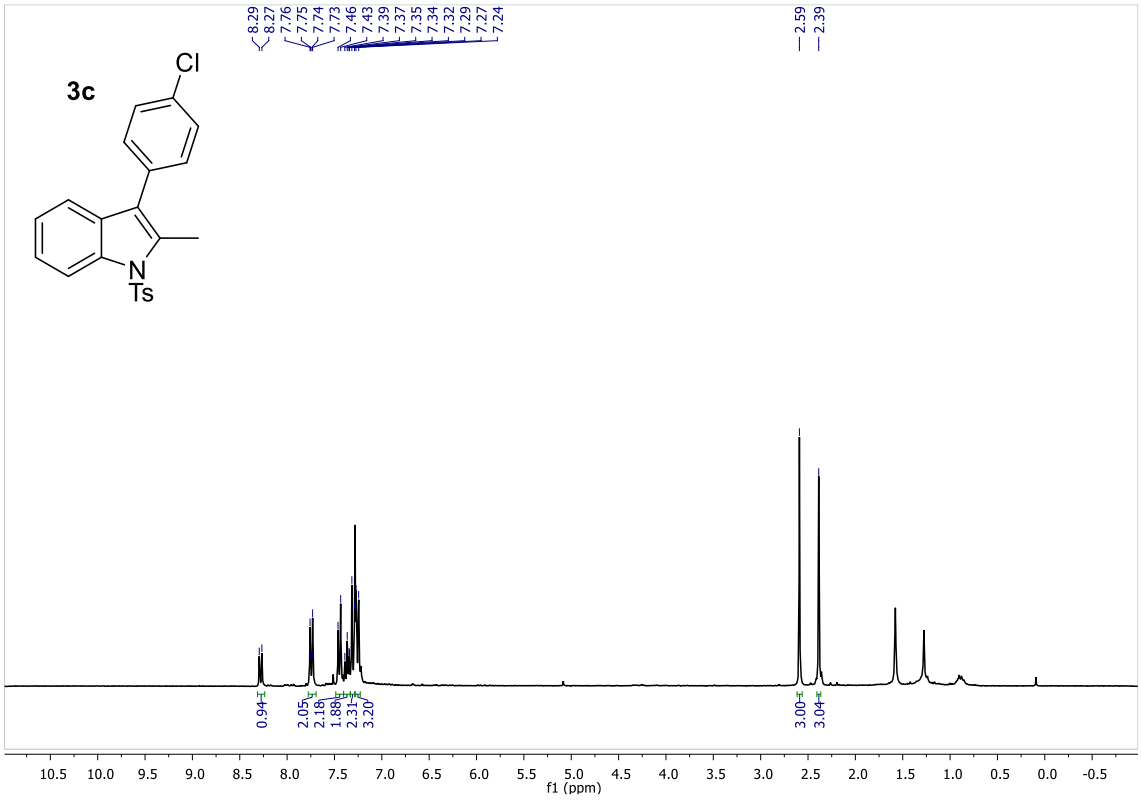


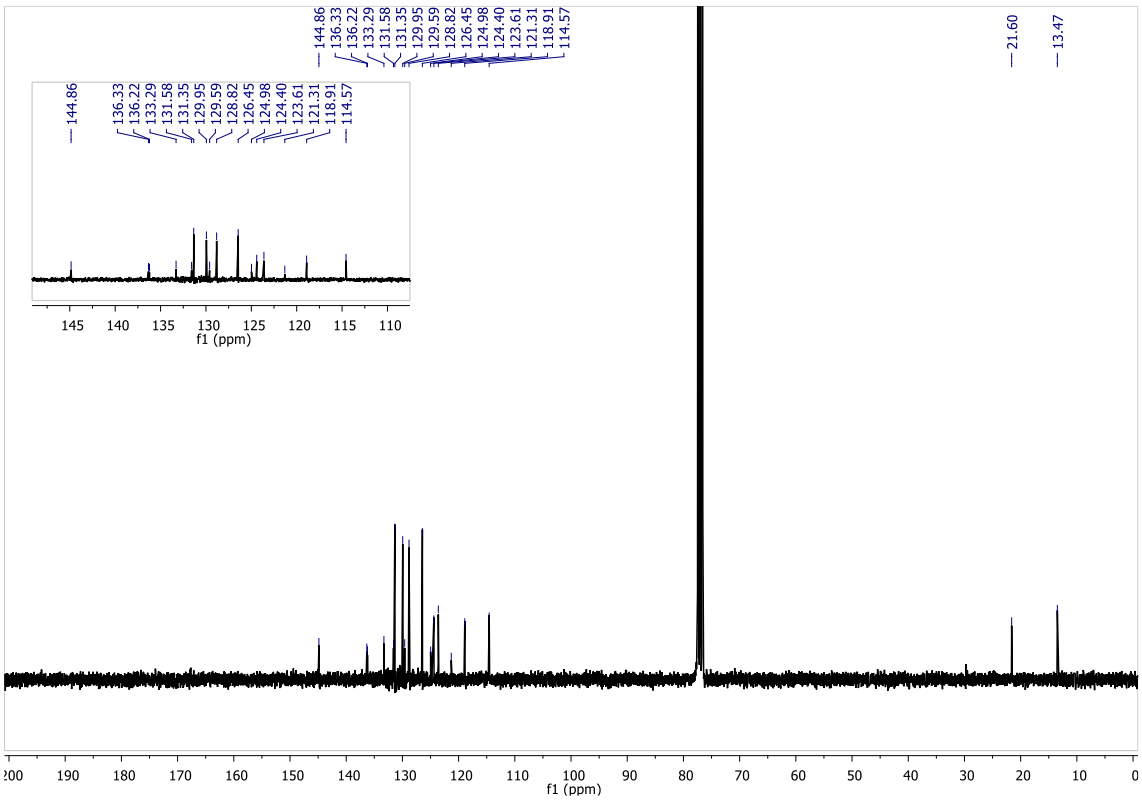


3-(4-Fluorophenyl)-2-methyl-1-tosyl-1*H*-indole (3b)

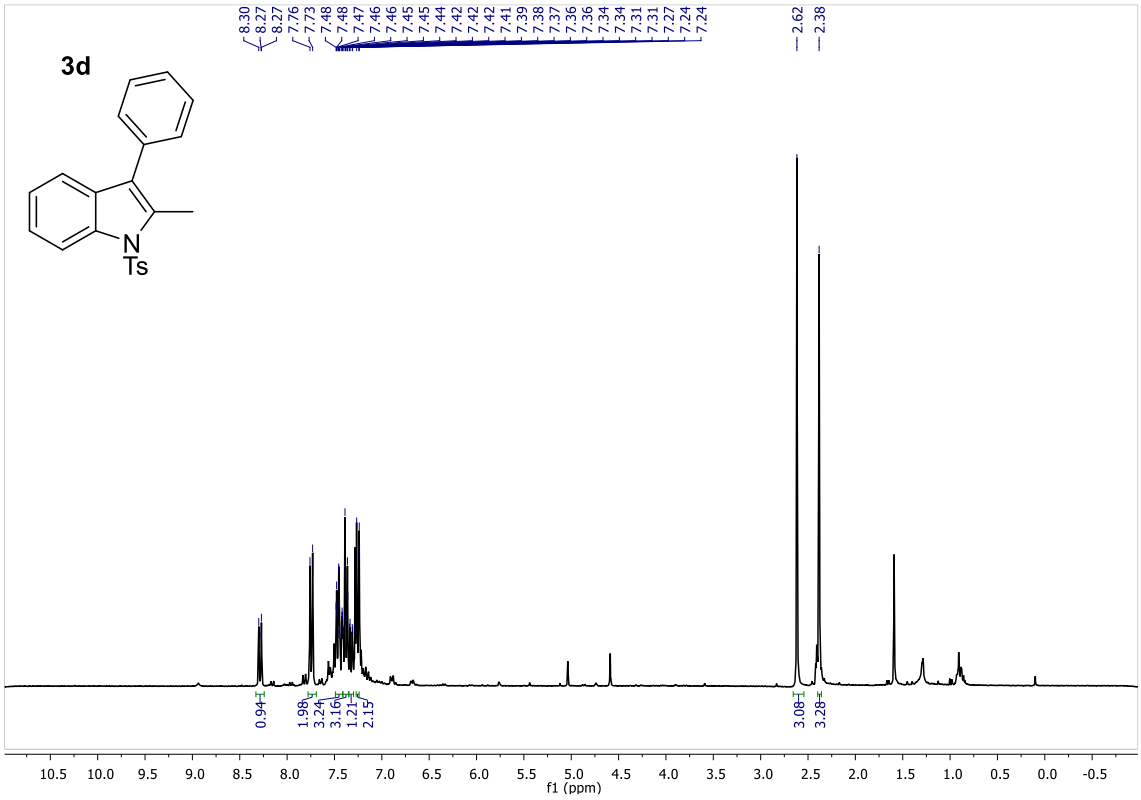


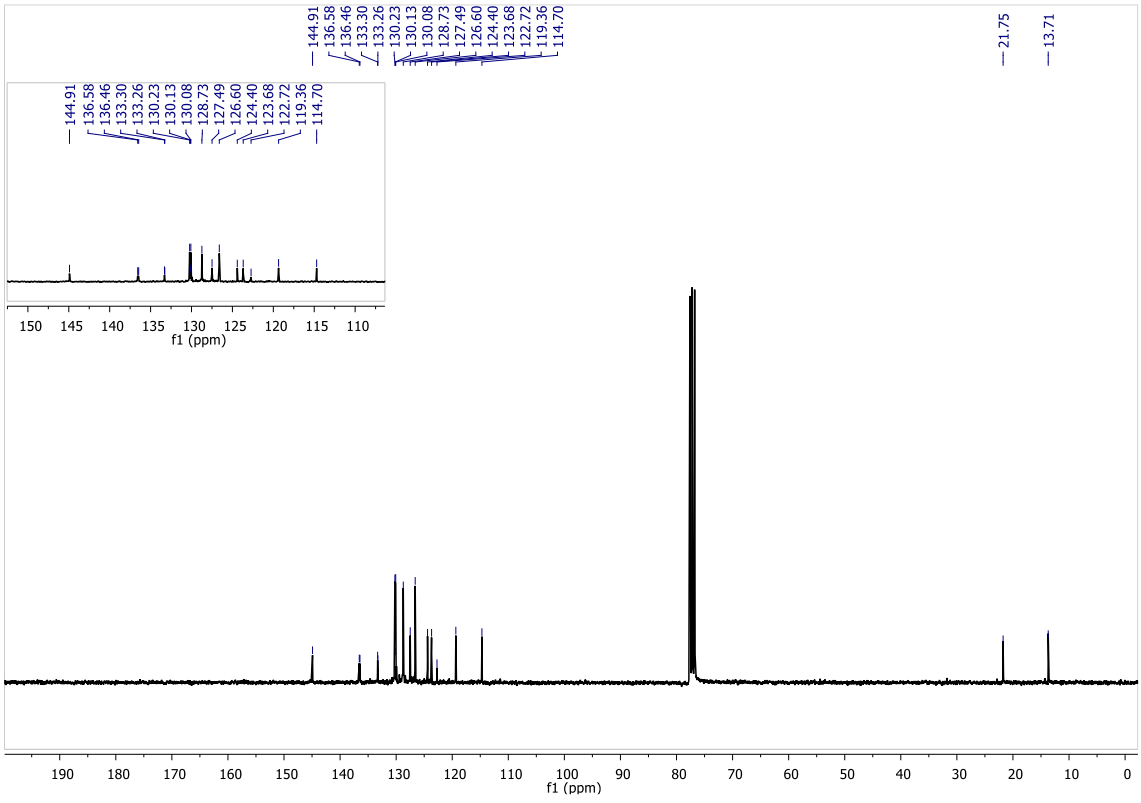
3-(4-Chlorophenyl)-2-methyl-1-tosyl-1*H*-indole (3c)



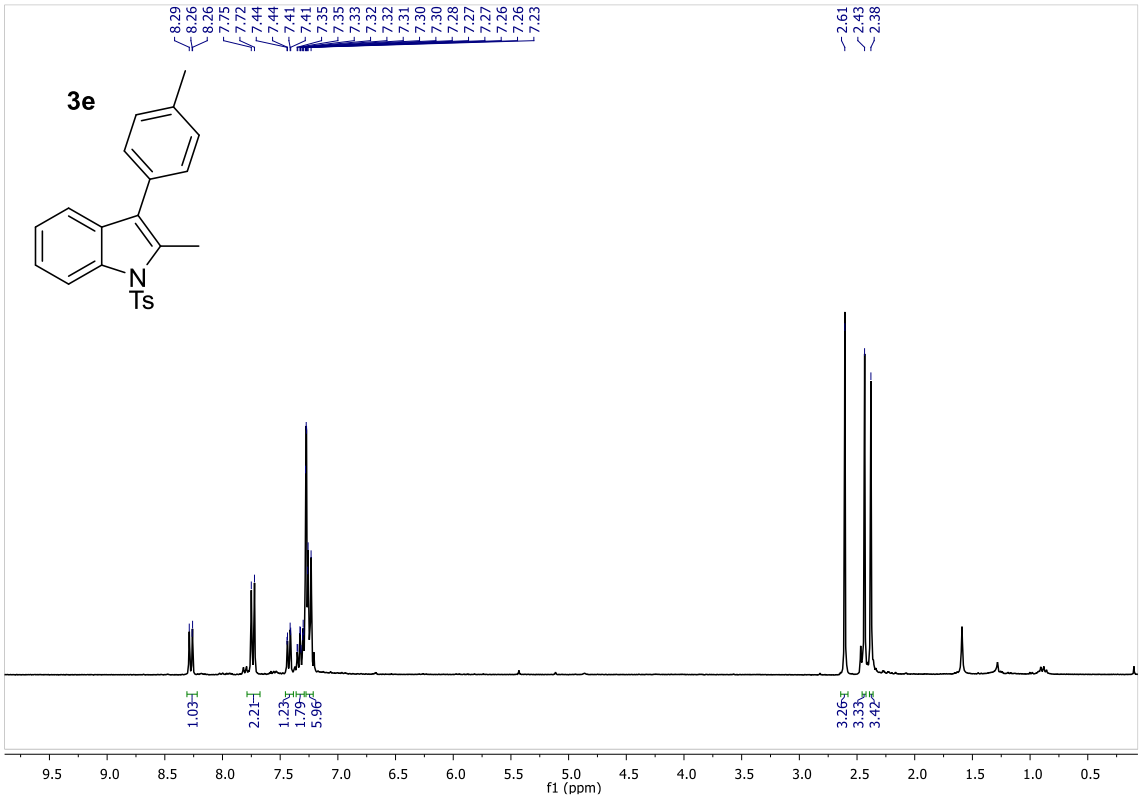


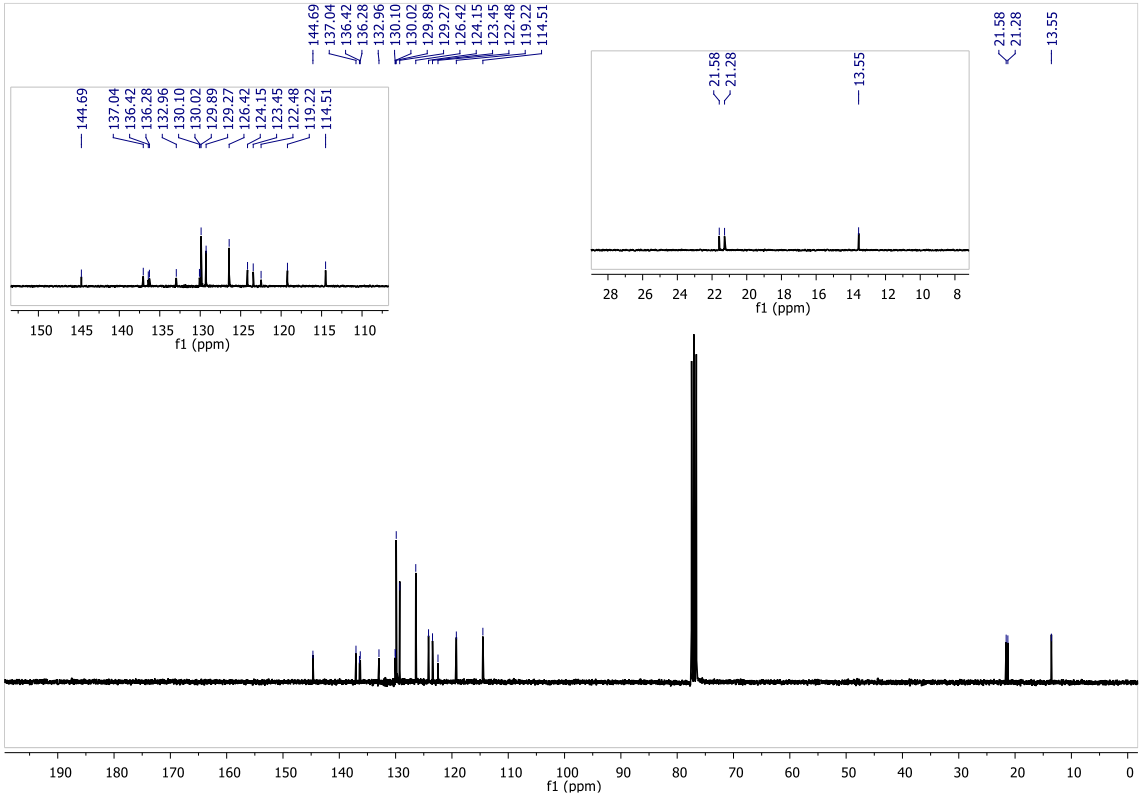
2-Methyl-3-phenyl-1-tosyl-1*H*-indole (3d)



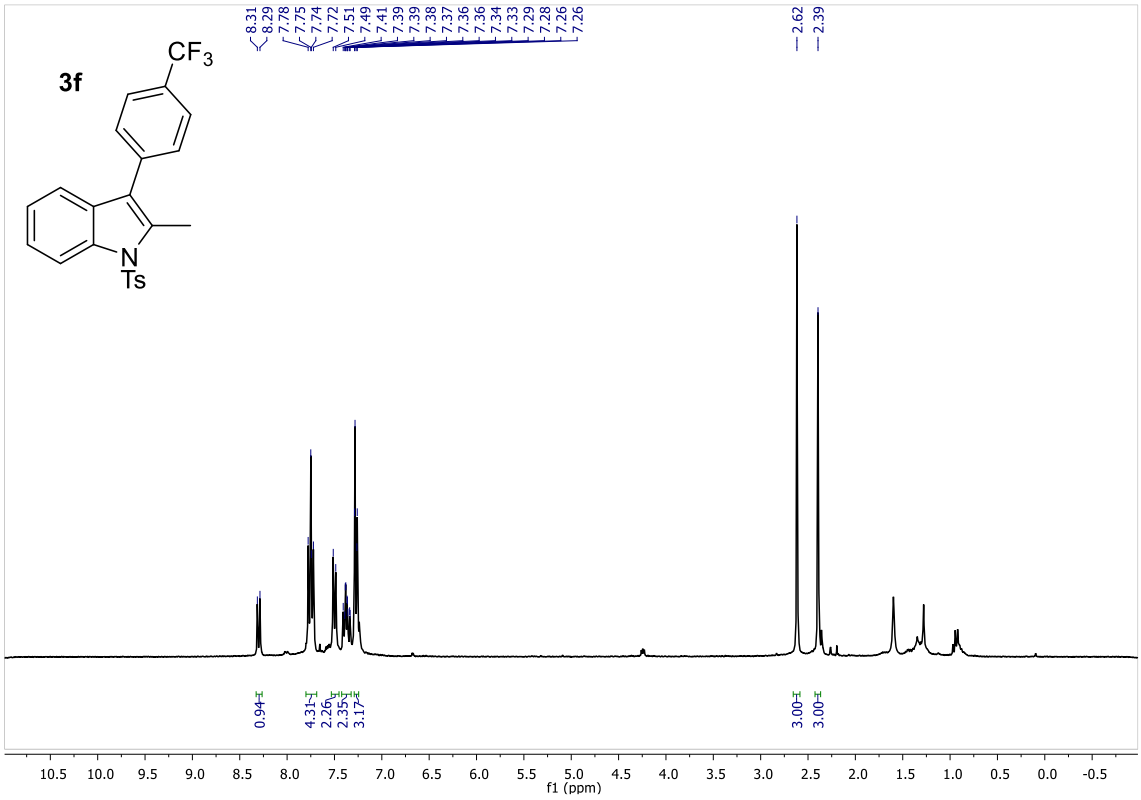


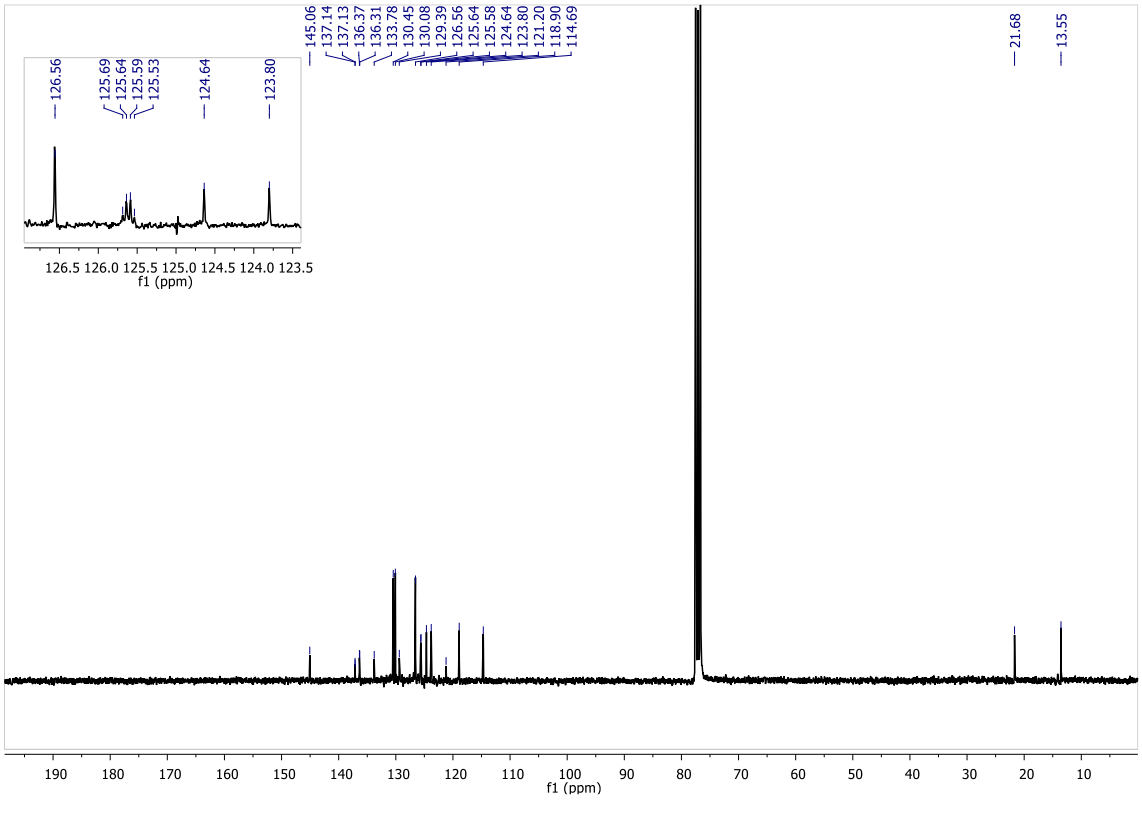
2-Methyl-3-(*p*-tolyl)-1-tosyl-1*H*-indole (3e)



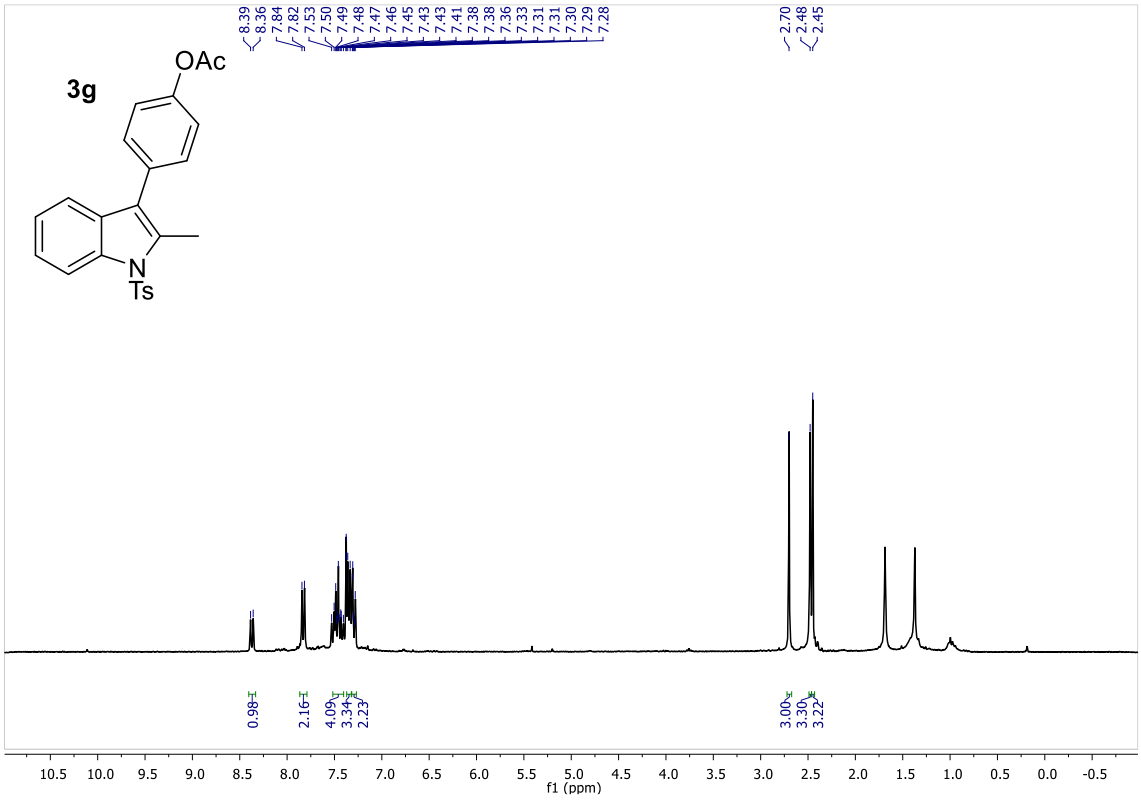


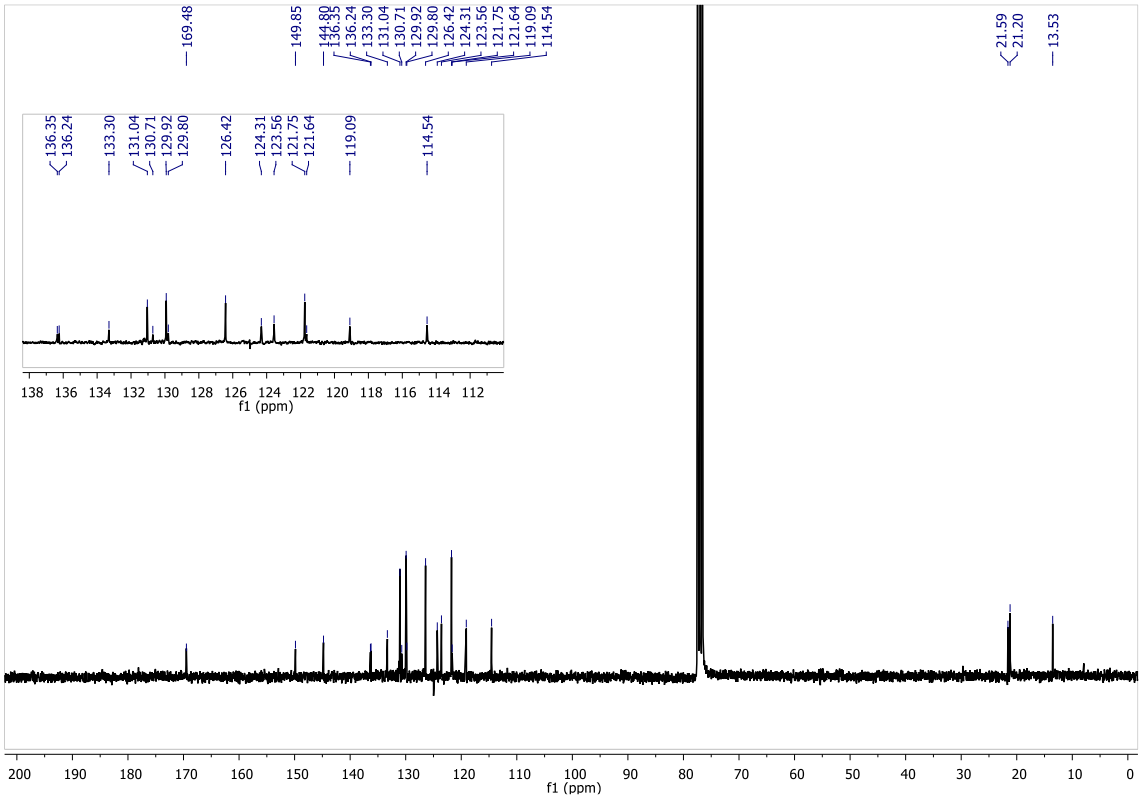
2-Methyl-1-tosyl-3-(4-(trifluoromethyl)phenyl)-1*H*-indole (3f)



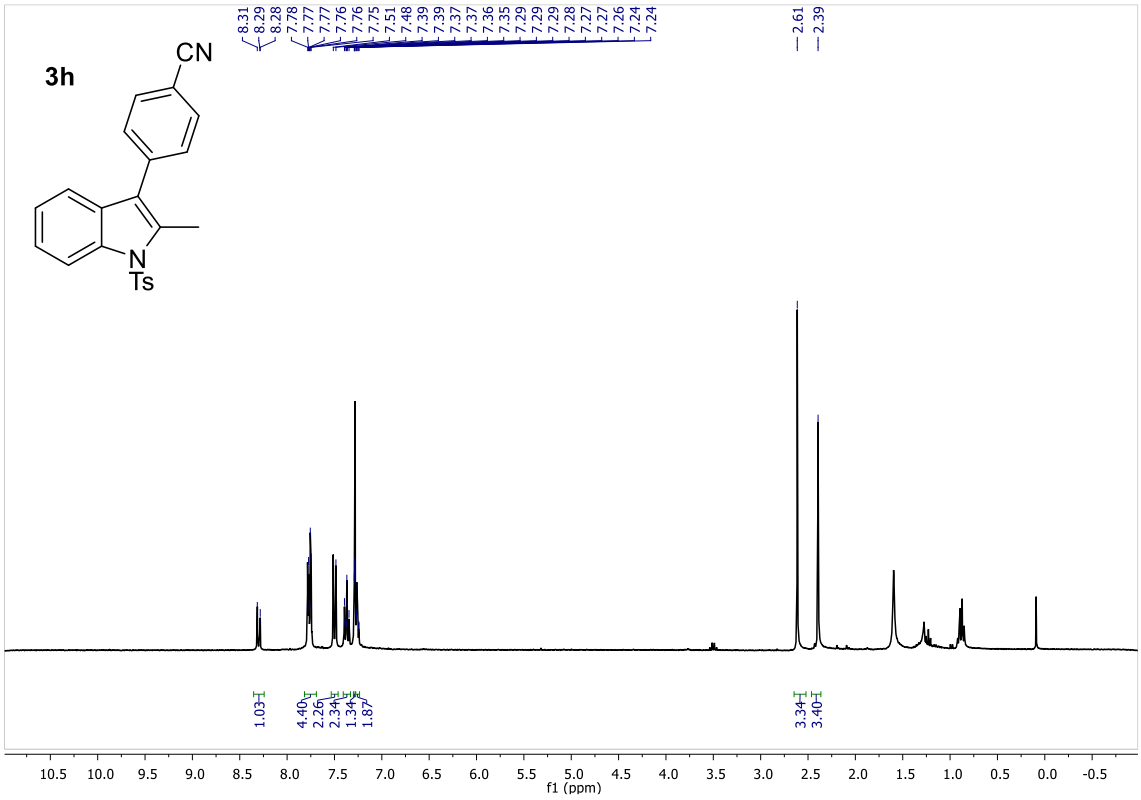


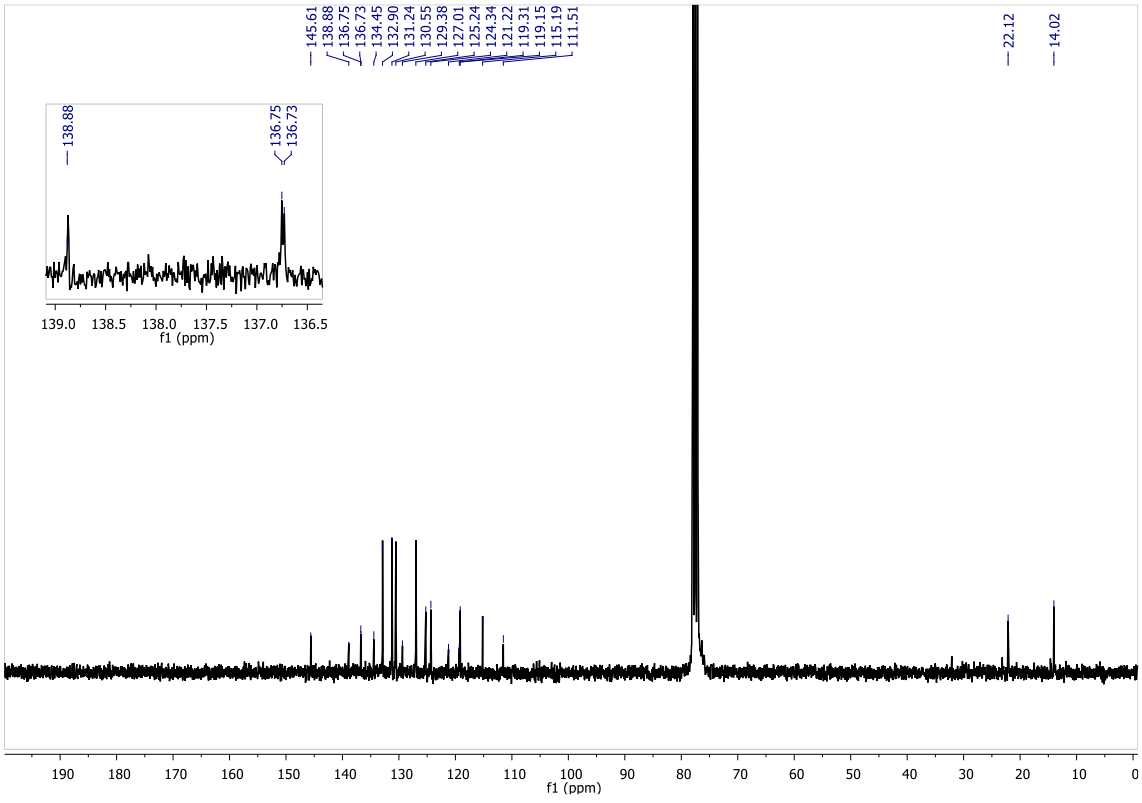
4-(2-Methyl-1-tosyl-1*H*-indol-3-yl)phenyl acetate (3g)



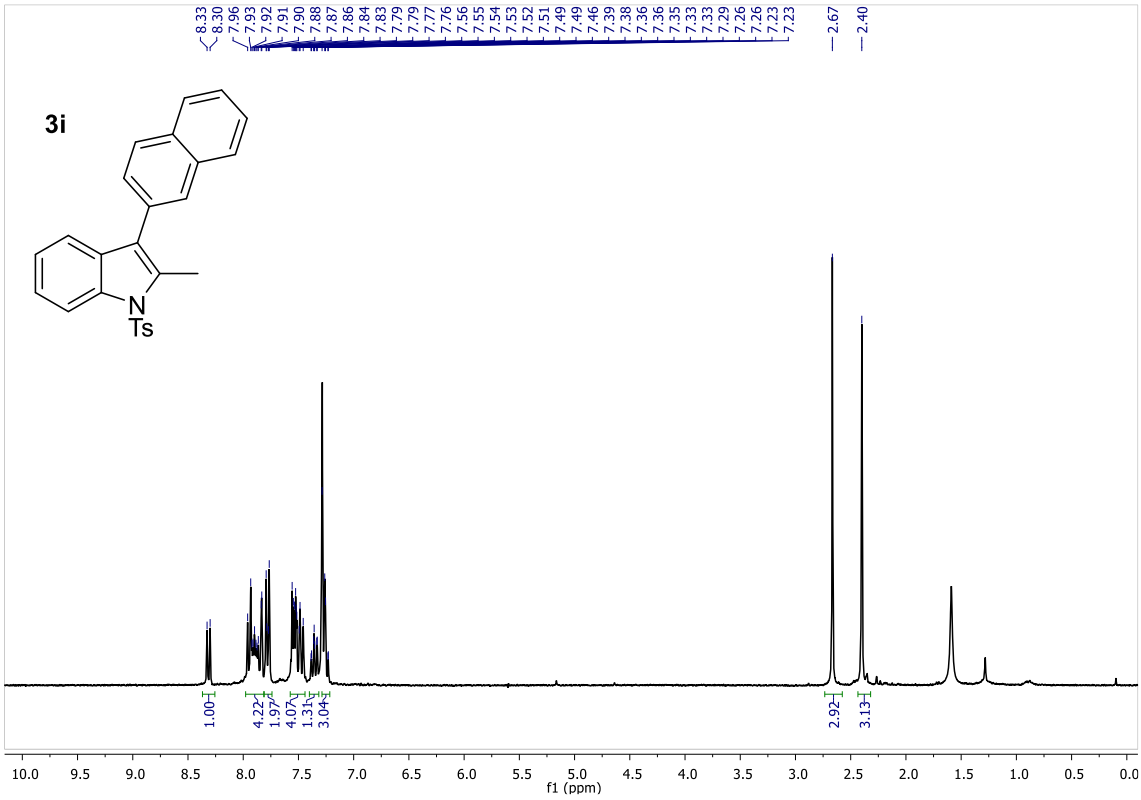


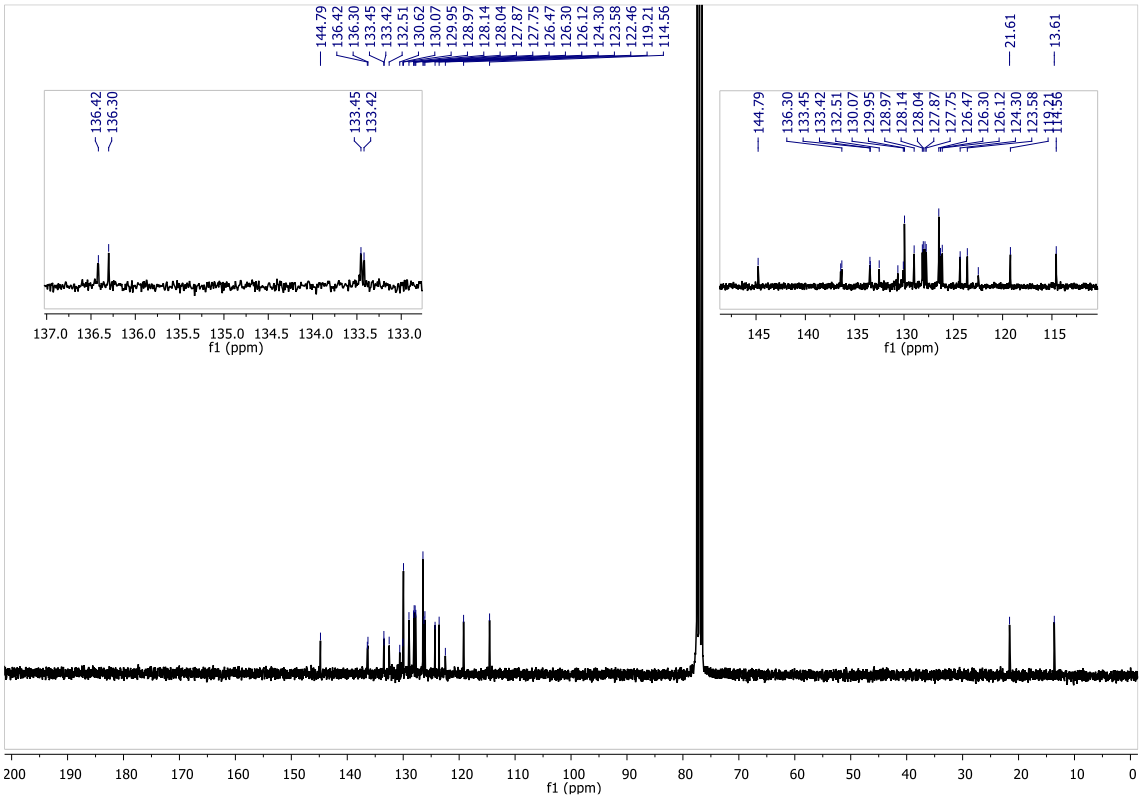
4-(2-Methyl-1-tosyl-1*H*-indol-3-yl)benzonitrile (3h)



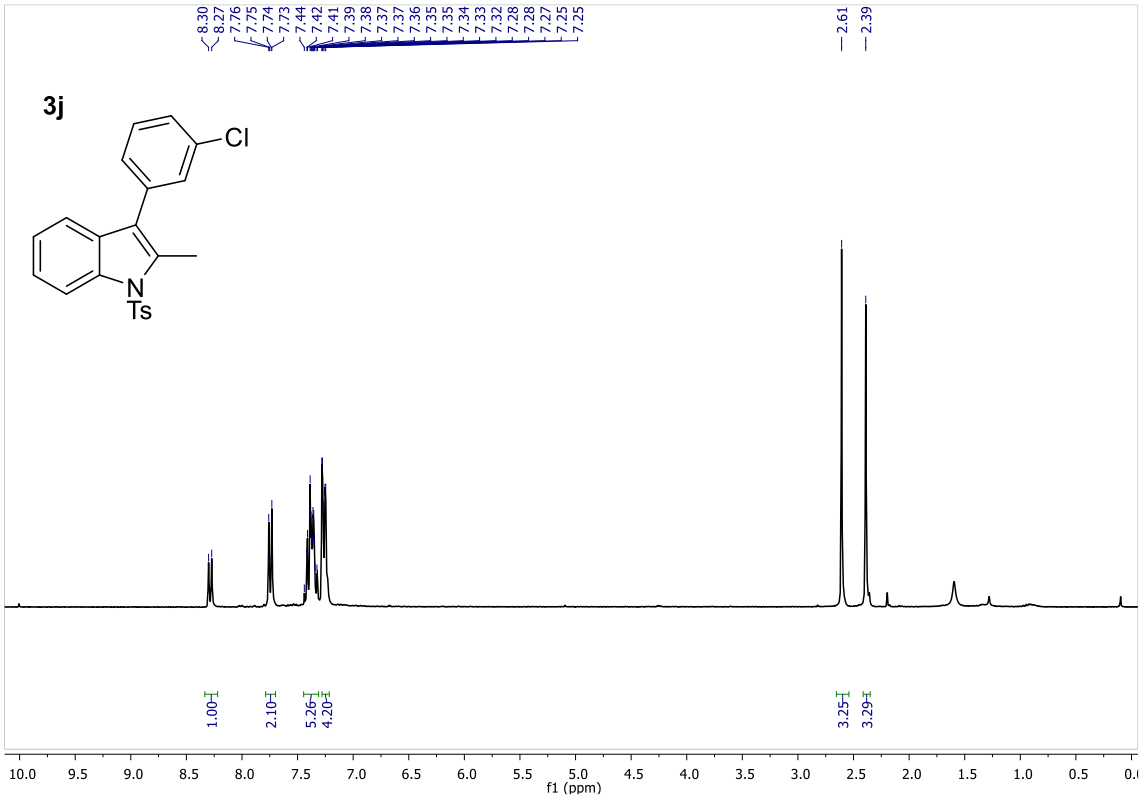


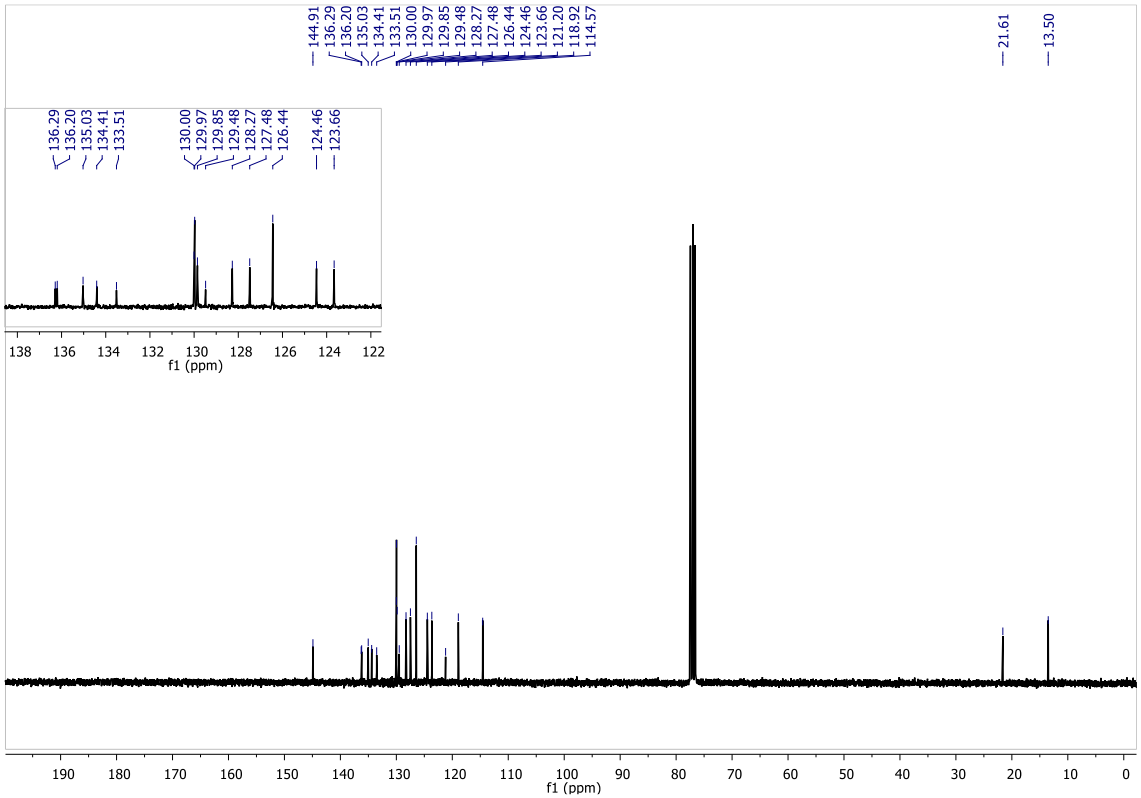
2-Methyl-3-(naphthalen-2-yl)-1-tosyl-1*H*-indole (3i)



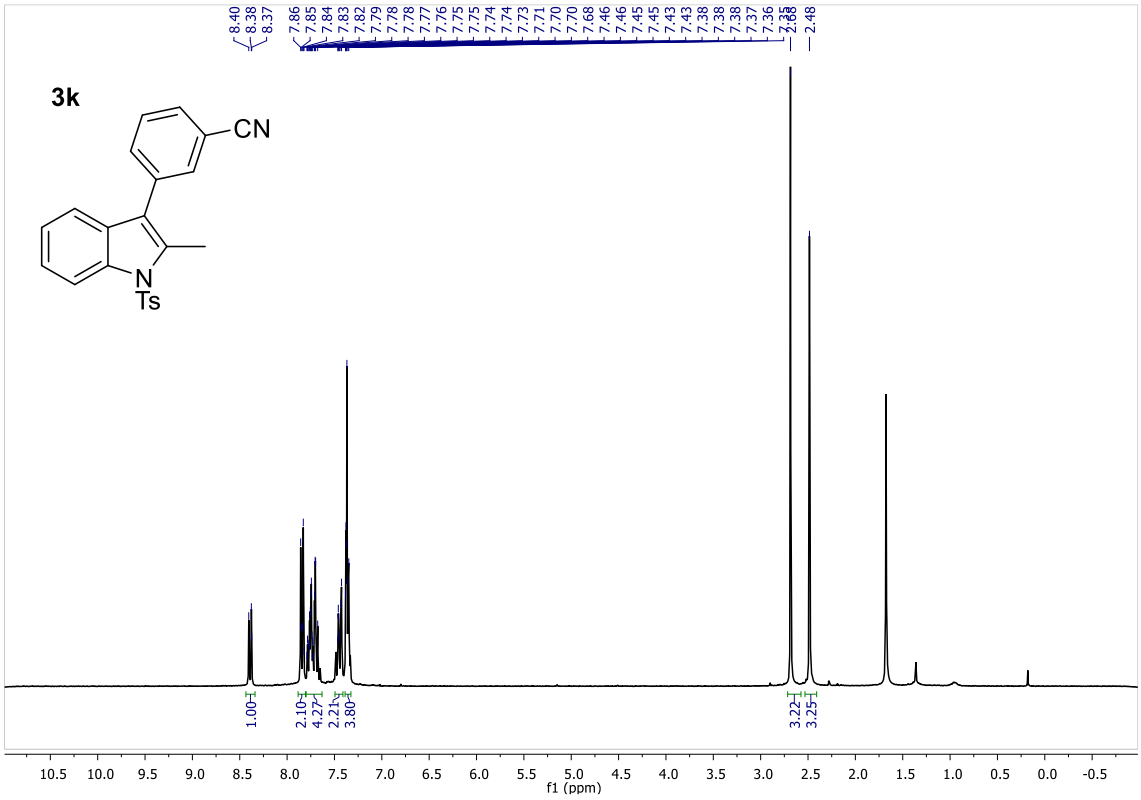


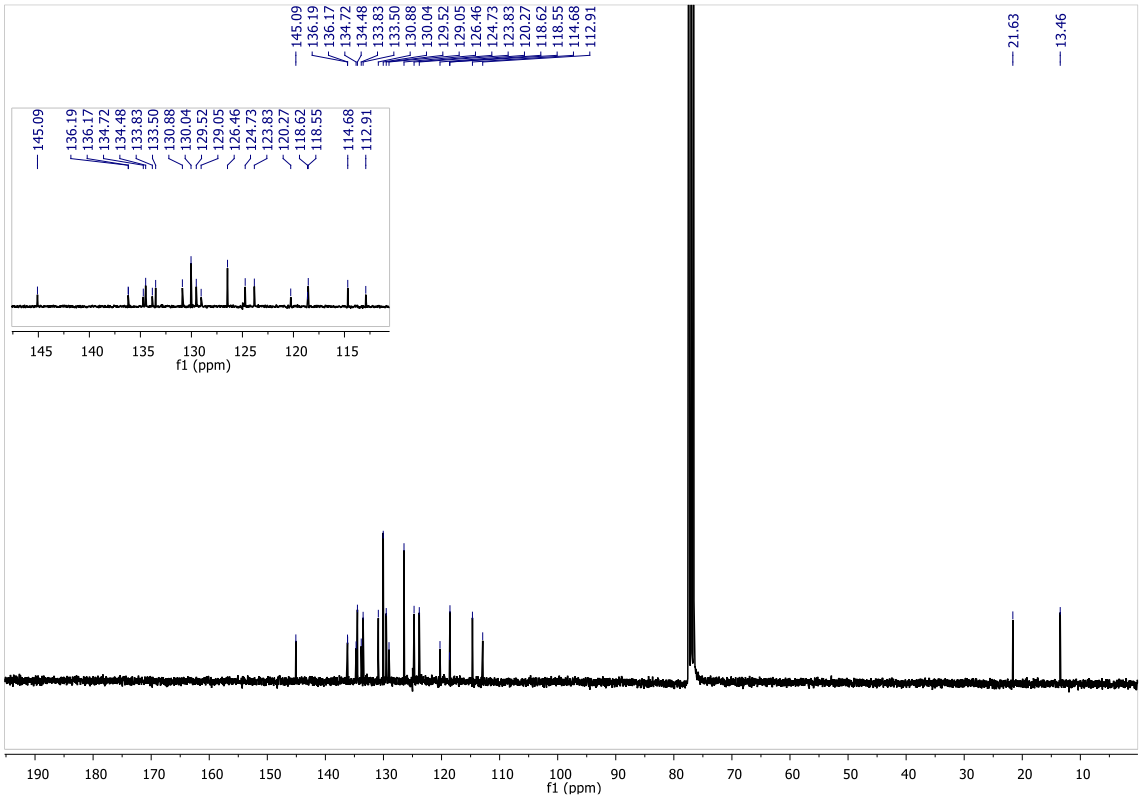
3-(3-Chlorophenyl)-2-methyl-1-tosyl-1*H*-indole (3j)



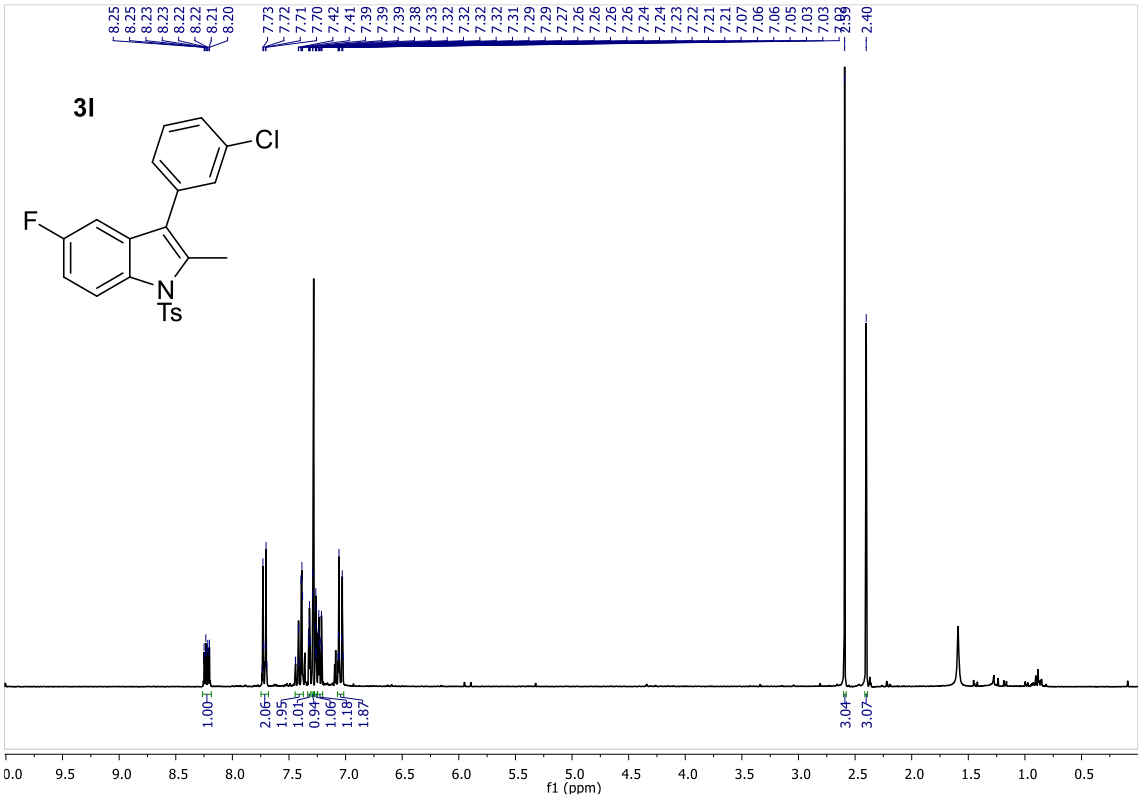


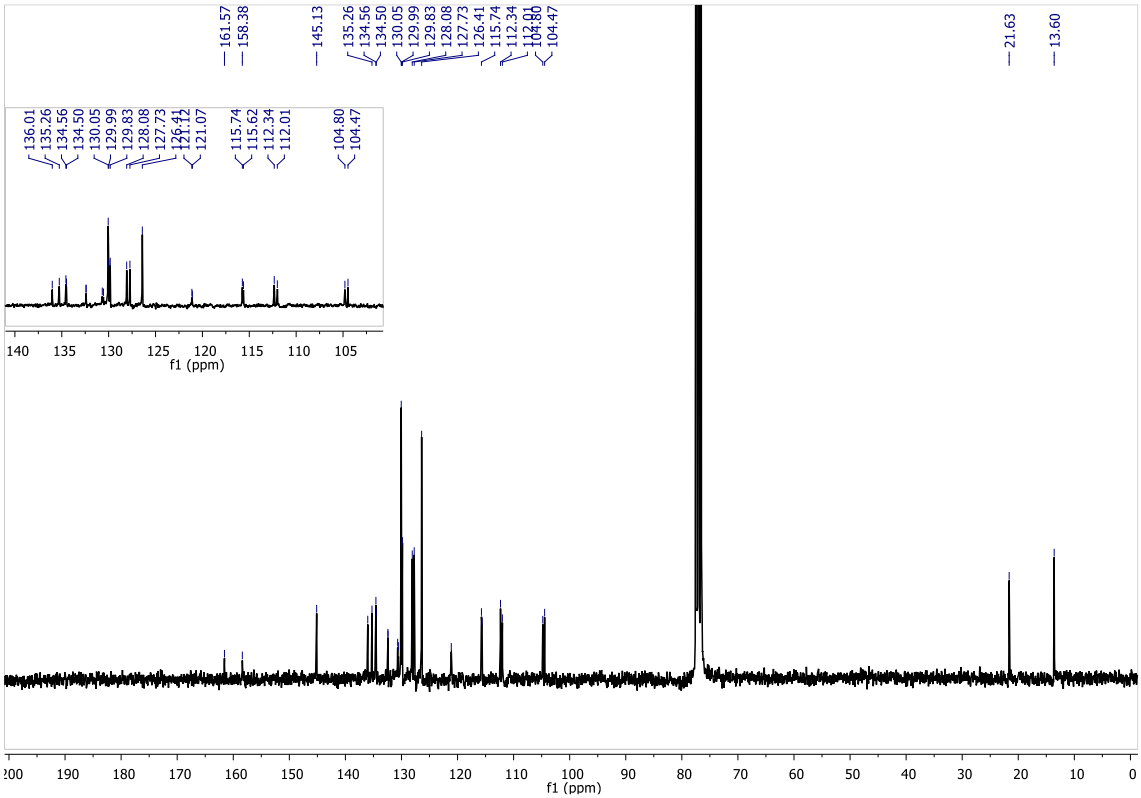
3-(2-Methyl-1-tosyl-1*H*-indol-3-yl)benzonitrile (3k)

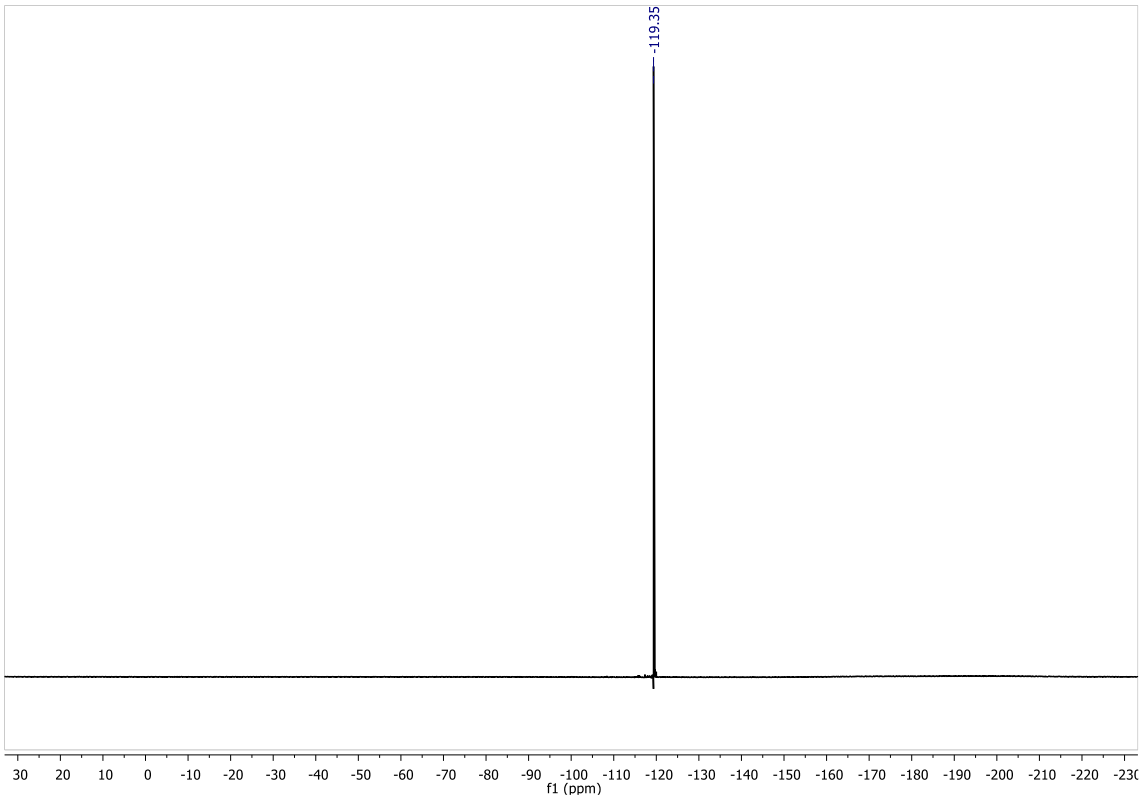




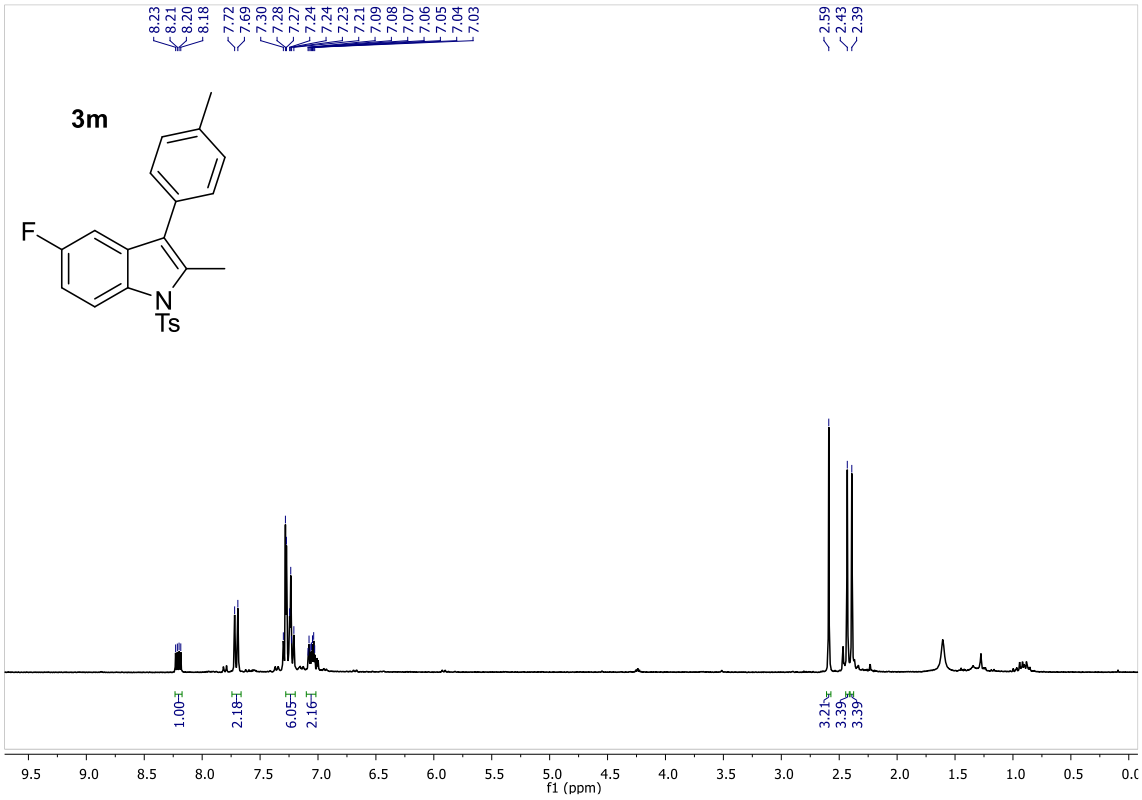
3-(3-Chlorophenyl)-5-fluoro-2-methyl-1-tosyl-1*H*-indole (3l)

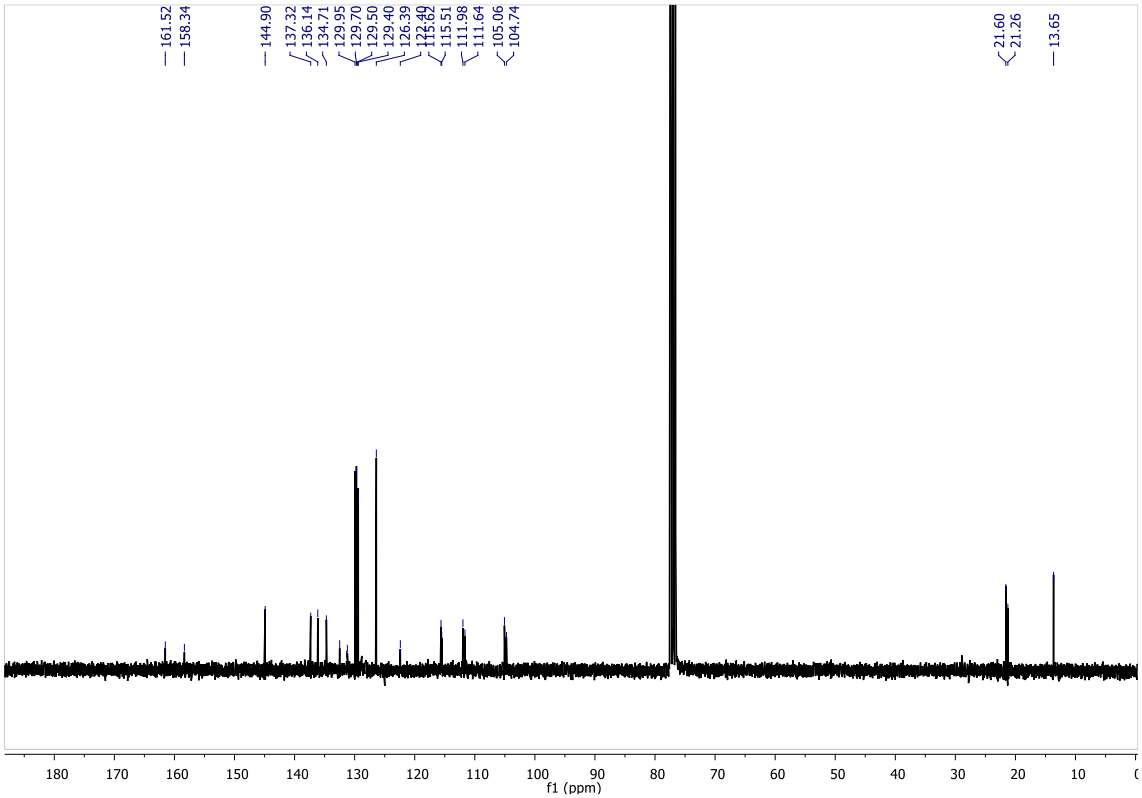


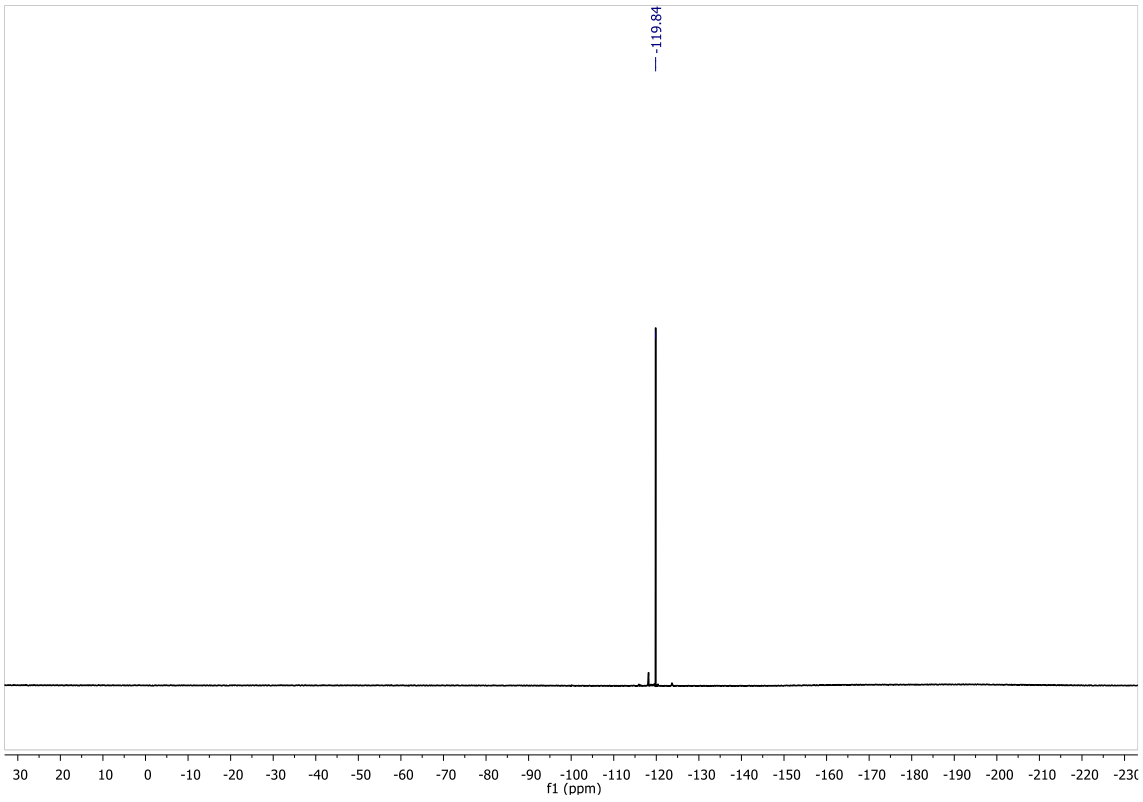



-119.35
30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220 -230
f1 (ppm)

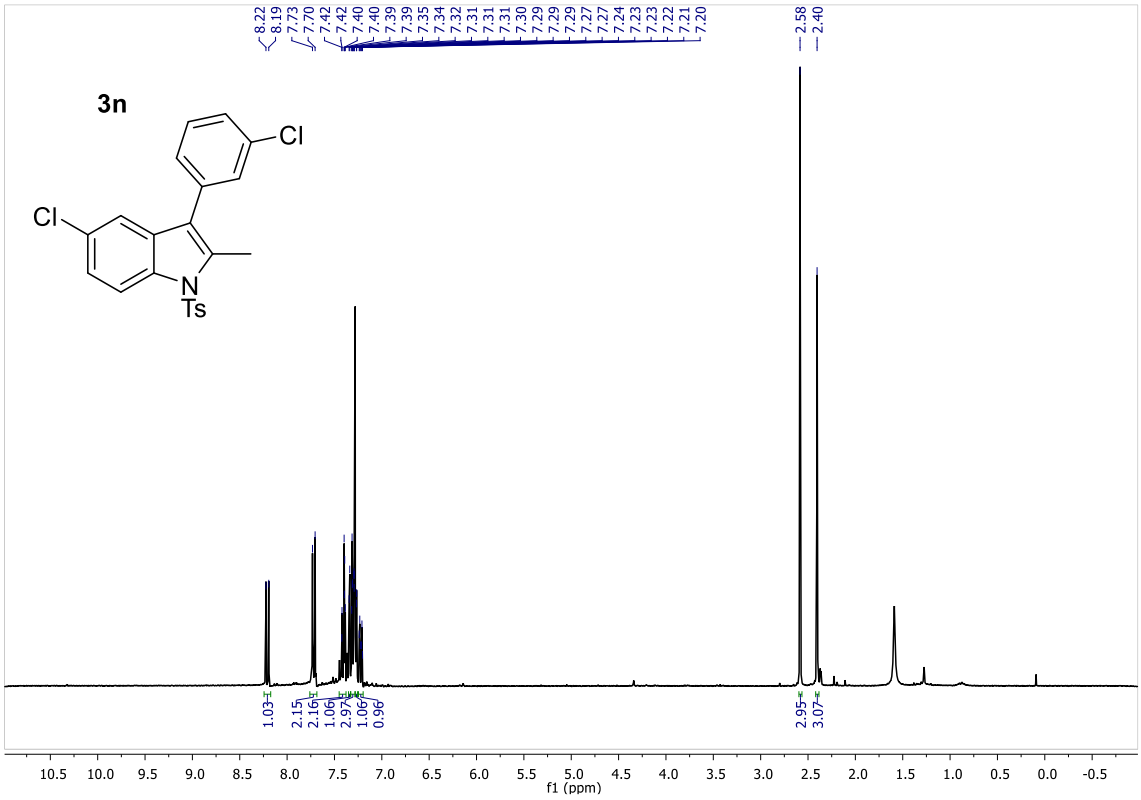
5-Fluoro-2-methyl-3-(*p*-tolyl)-1-tosyl-1*H*-indole (3m)

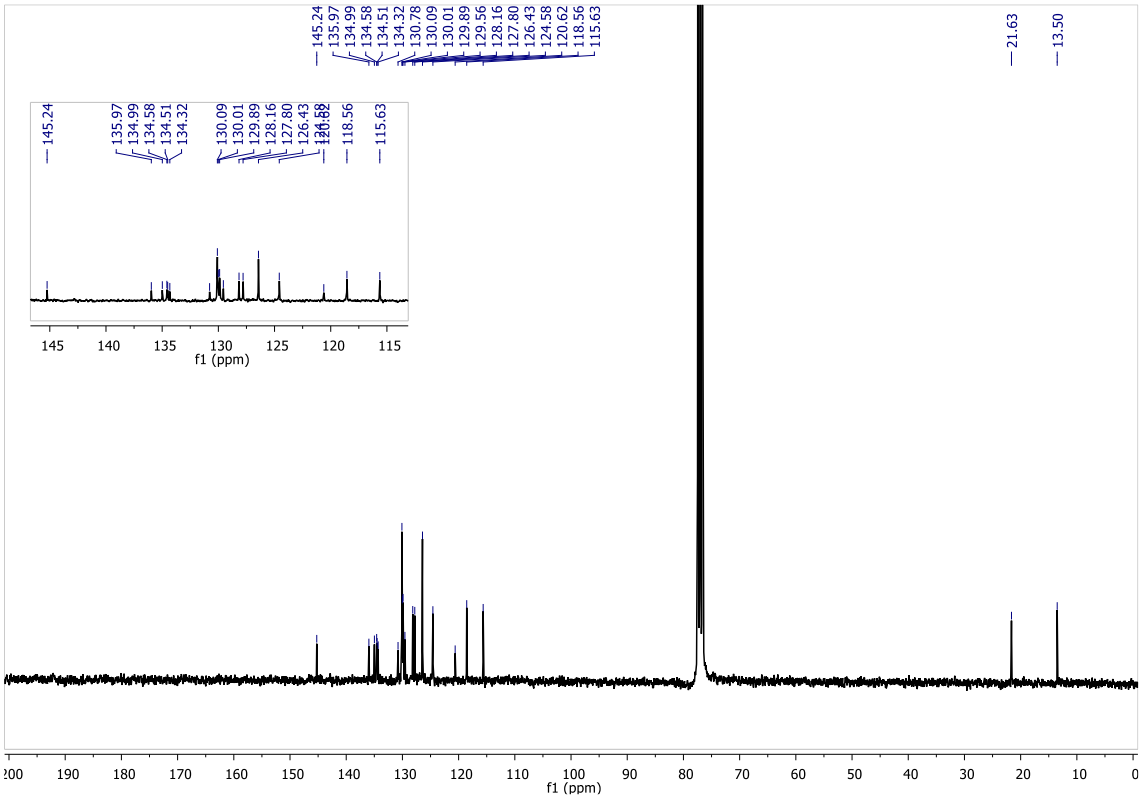




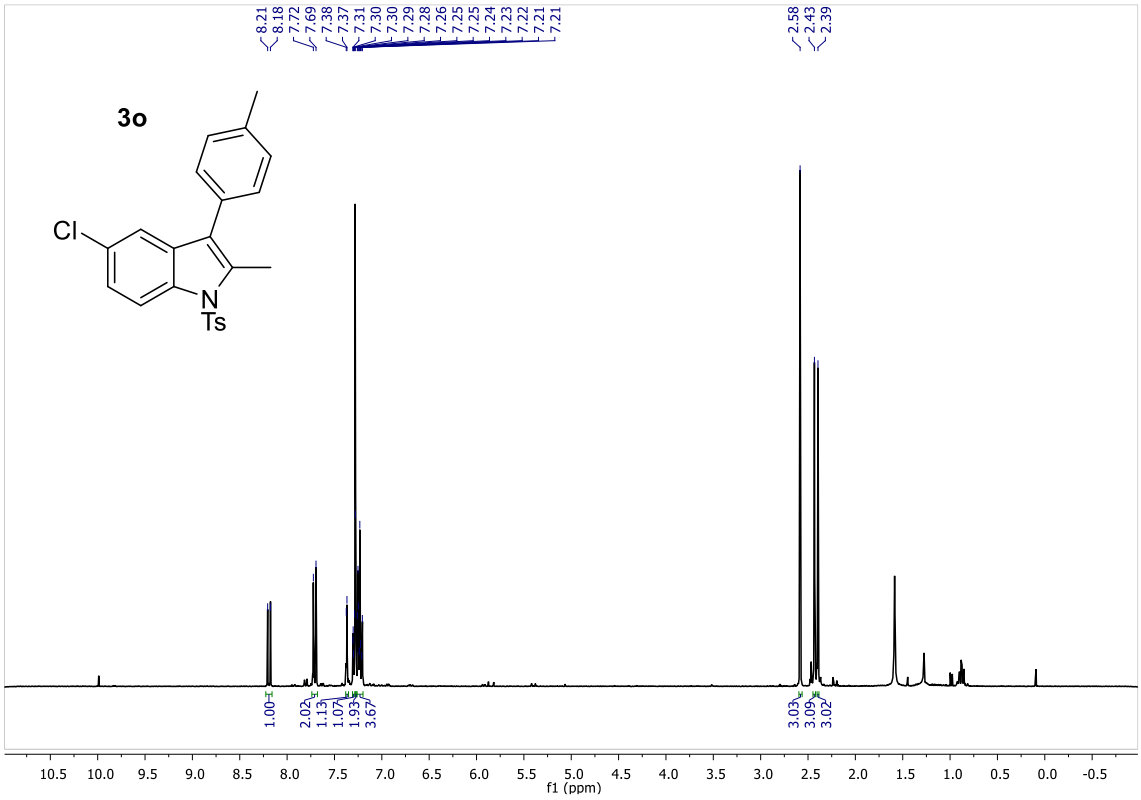

-119.84
30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220 -230
f1 (ppm)

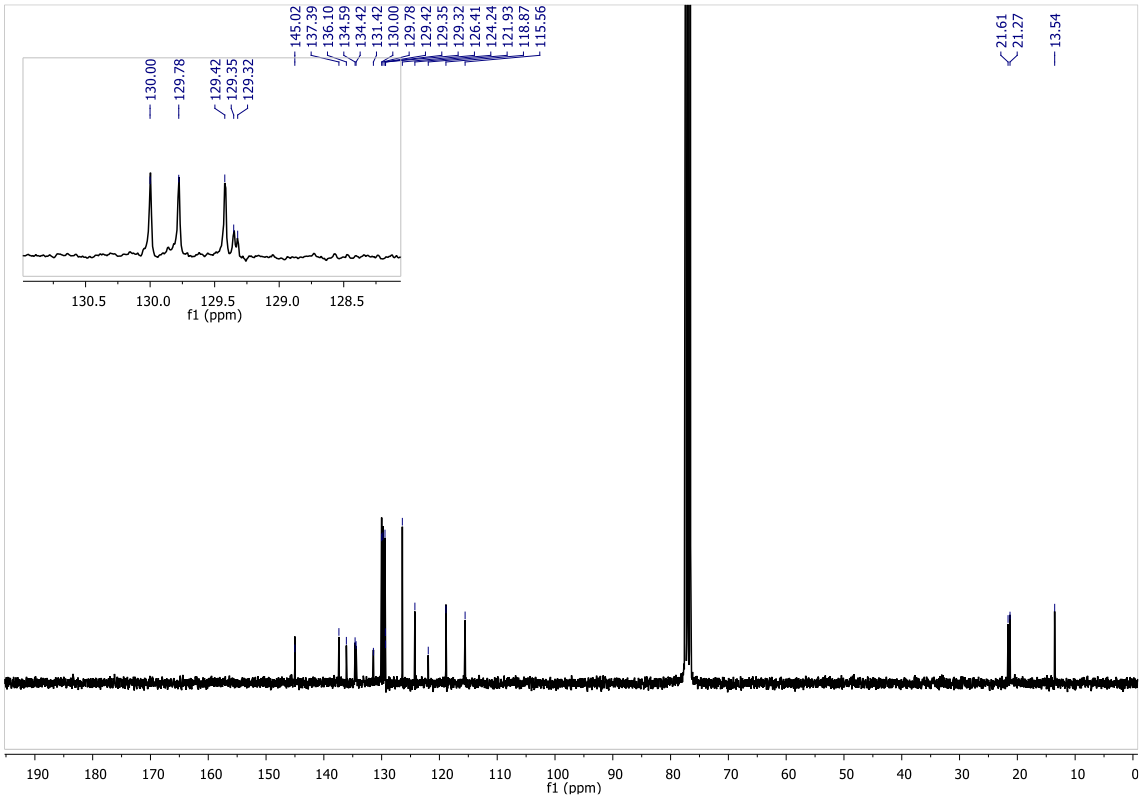
5-Chloro-3-(3-chlorophenyl)-2-methyl-1-tosyl-1*H*-indole (3n)



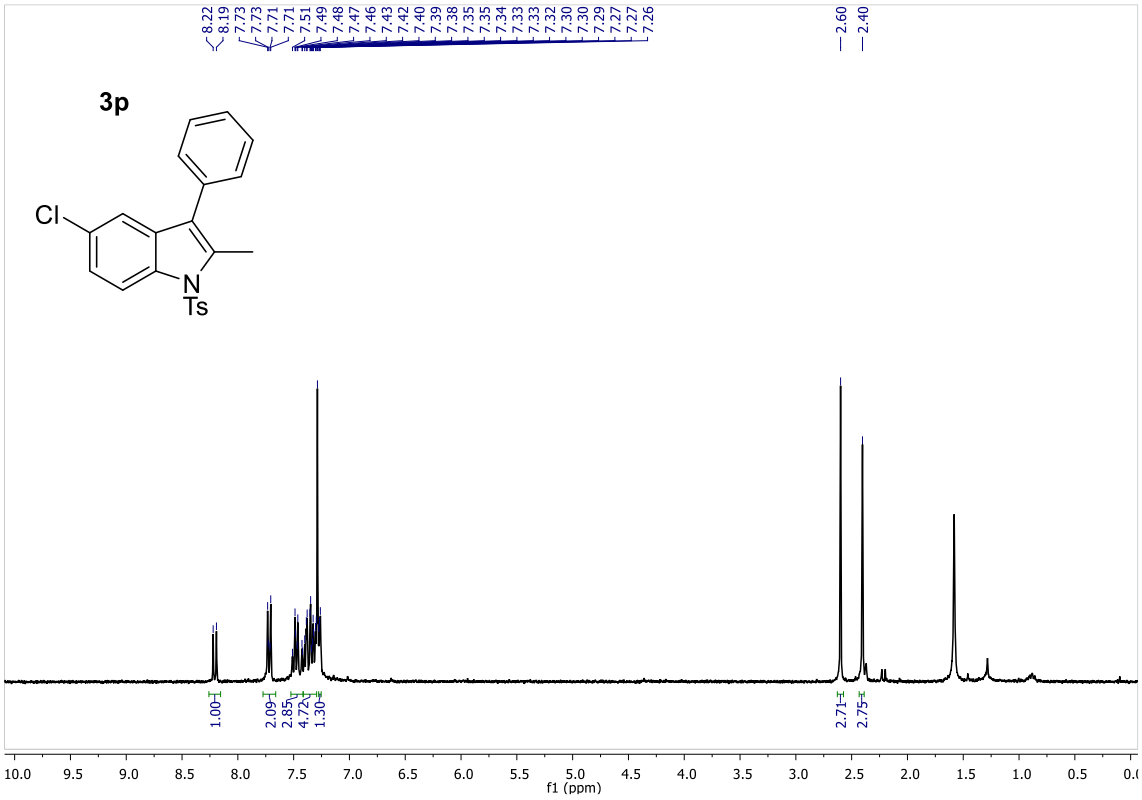


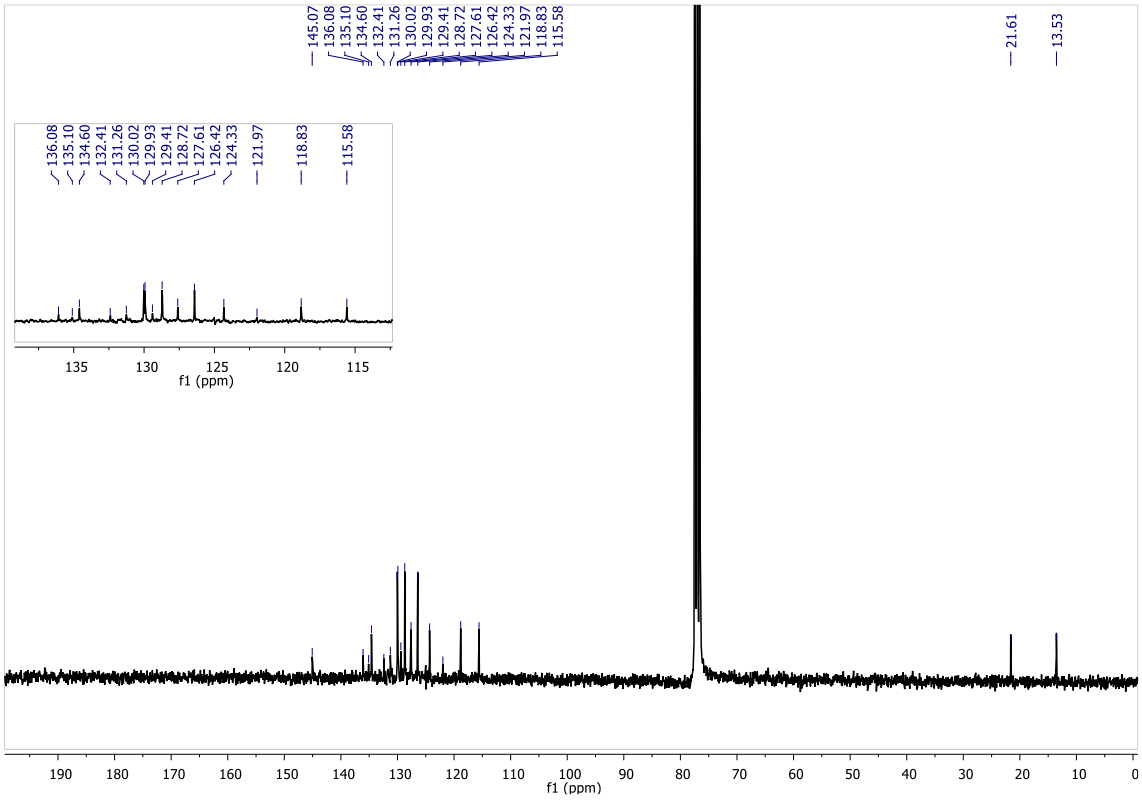
5-Chloro-2-methyl-3-(*p*-tolyl)-1-tosyl-1*H*-indole (3o)



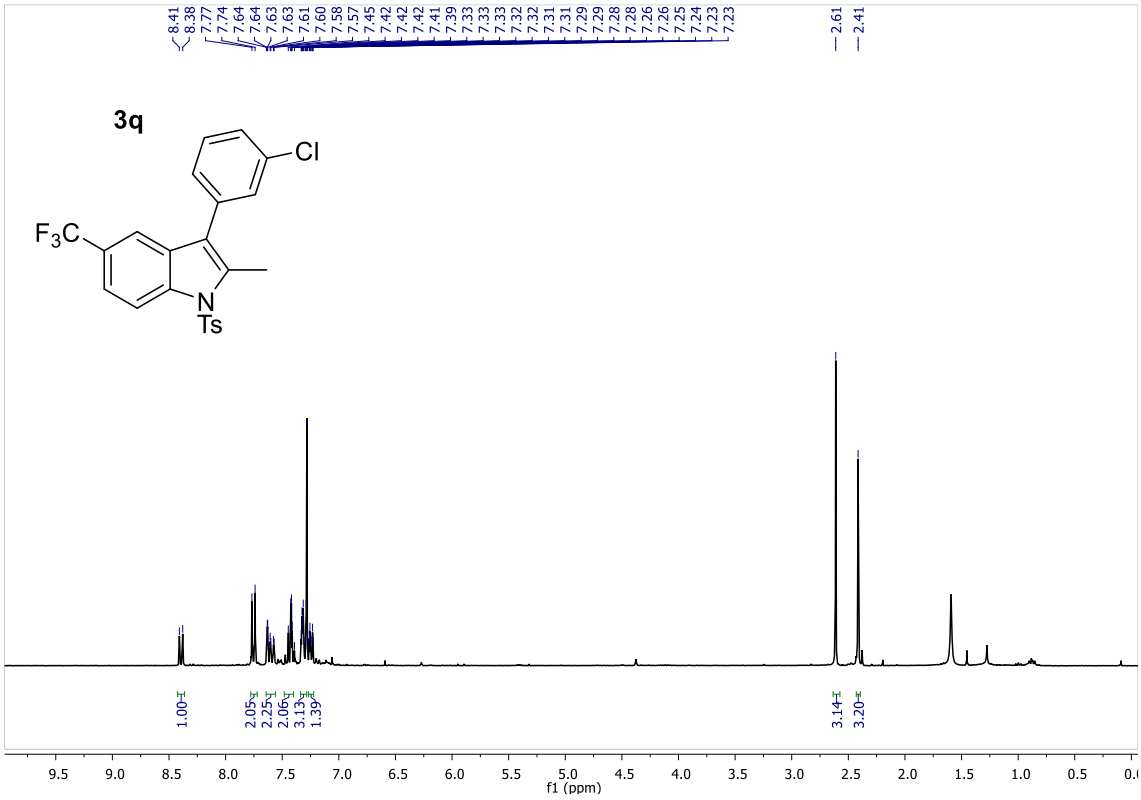


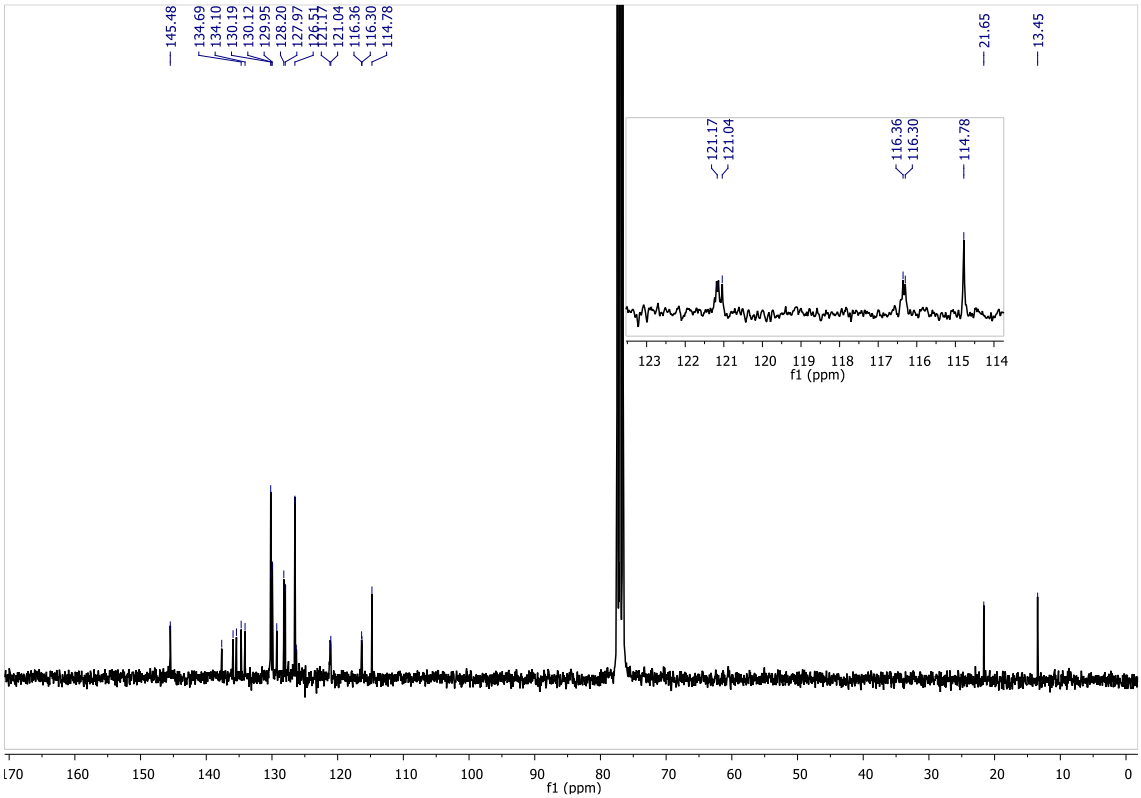
5-Chloro-2-methyl-3-phenyl-1-tosyl-1*H*-indole (3p)



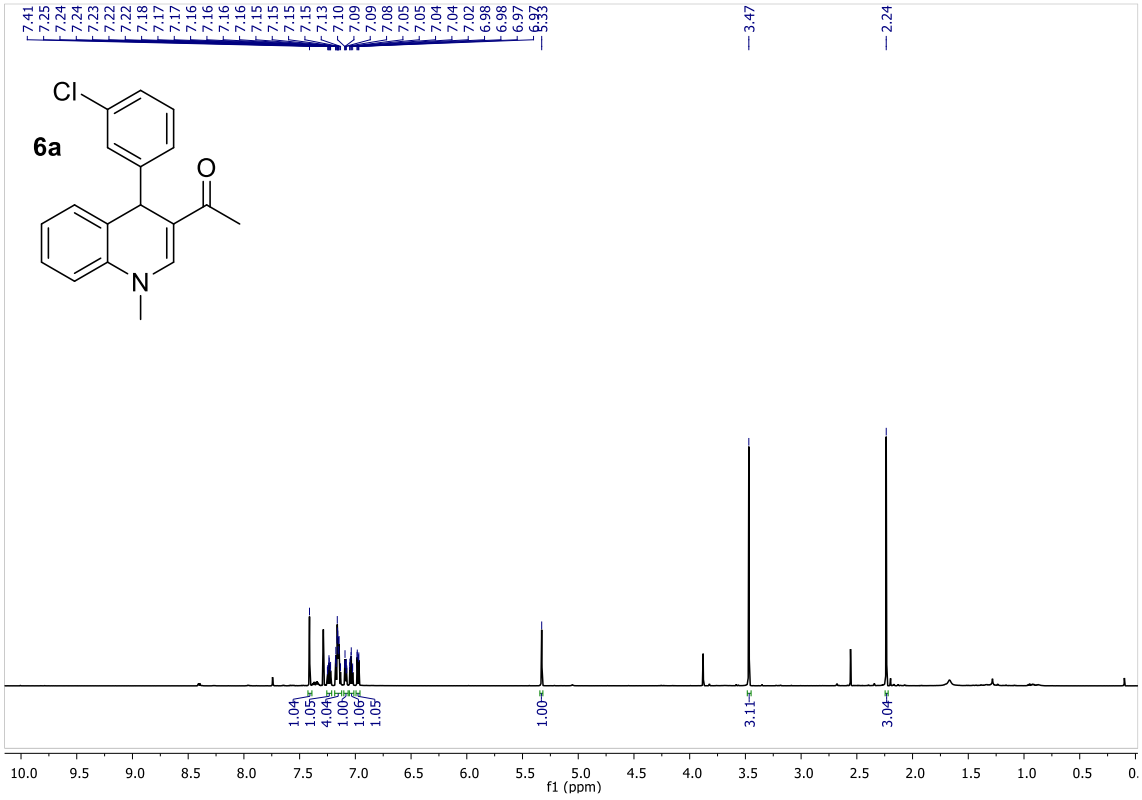


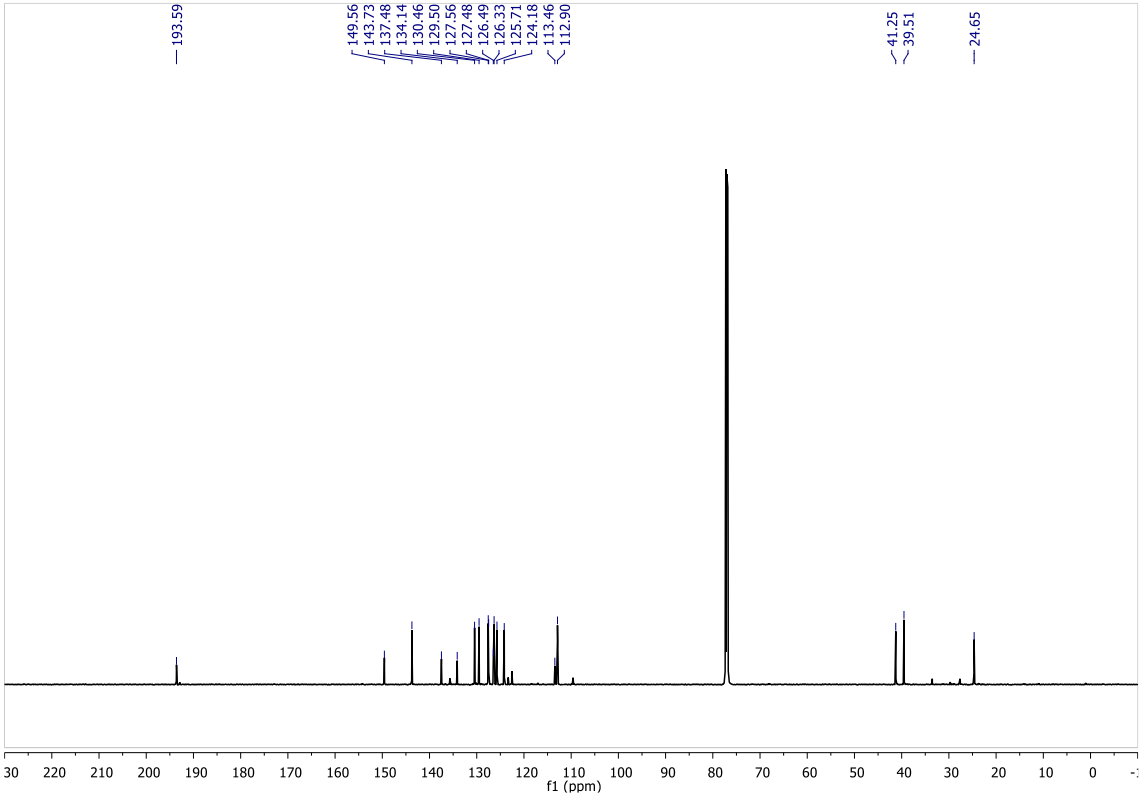
3-(3-Chlorophenyl)-2-methyl-1-tosyl-5-(trifluoromethyl)-1*H*-indole (3q)



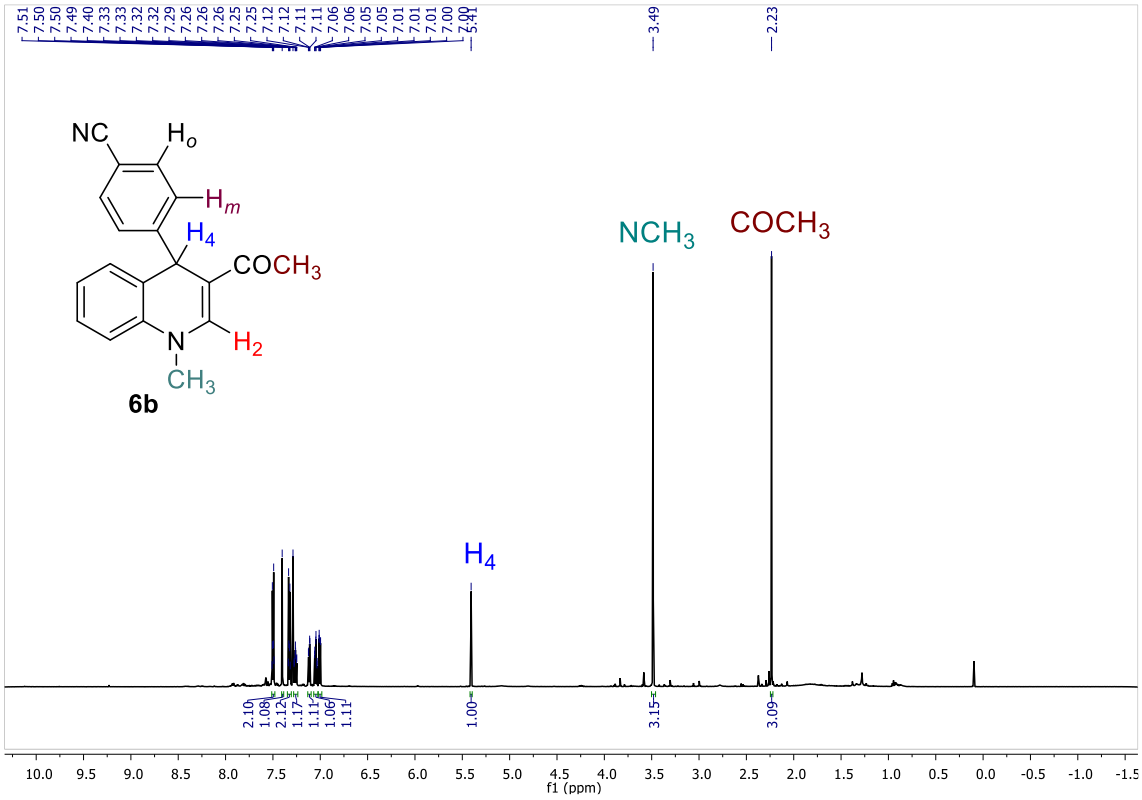


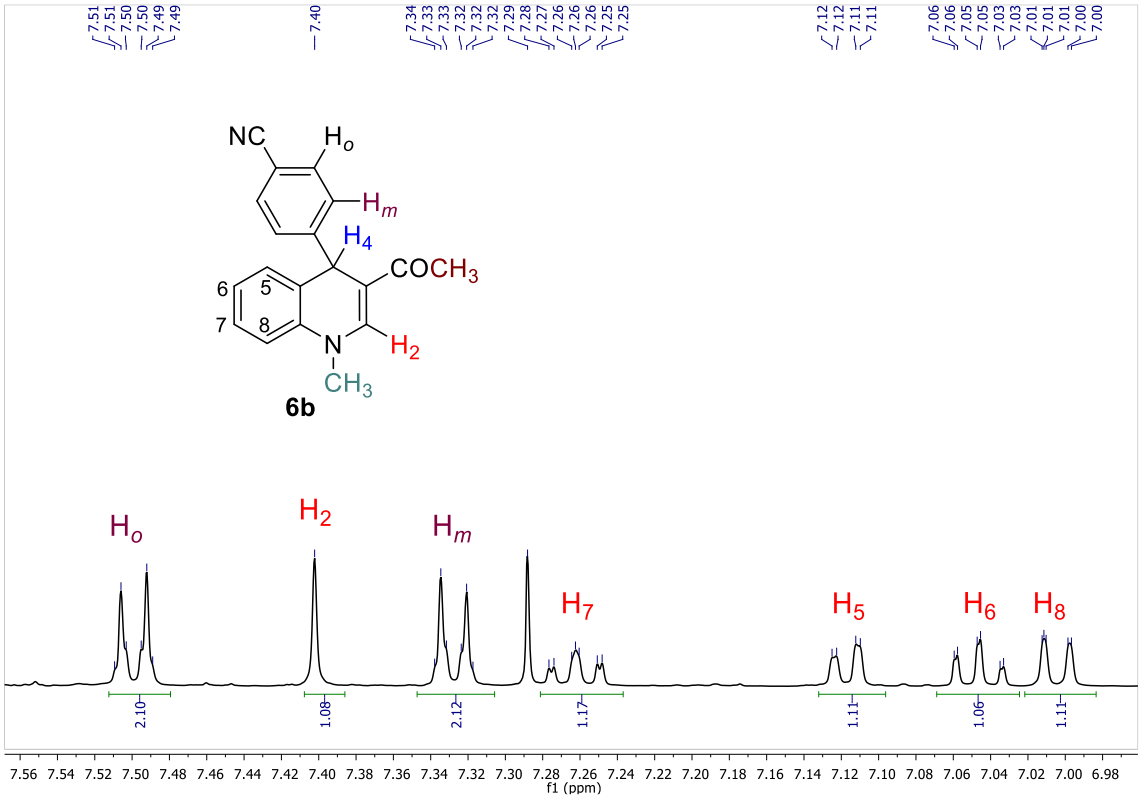
1-(4-(3-Chlorophenyl)-1-methyl-1,4-dihydroquinolin-3-yl)ethan-1-one (6a)

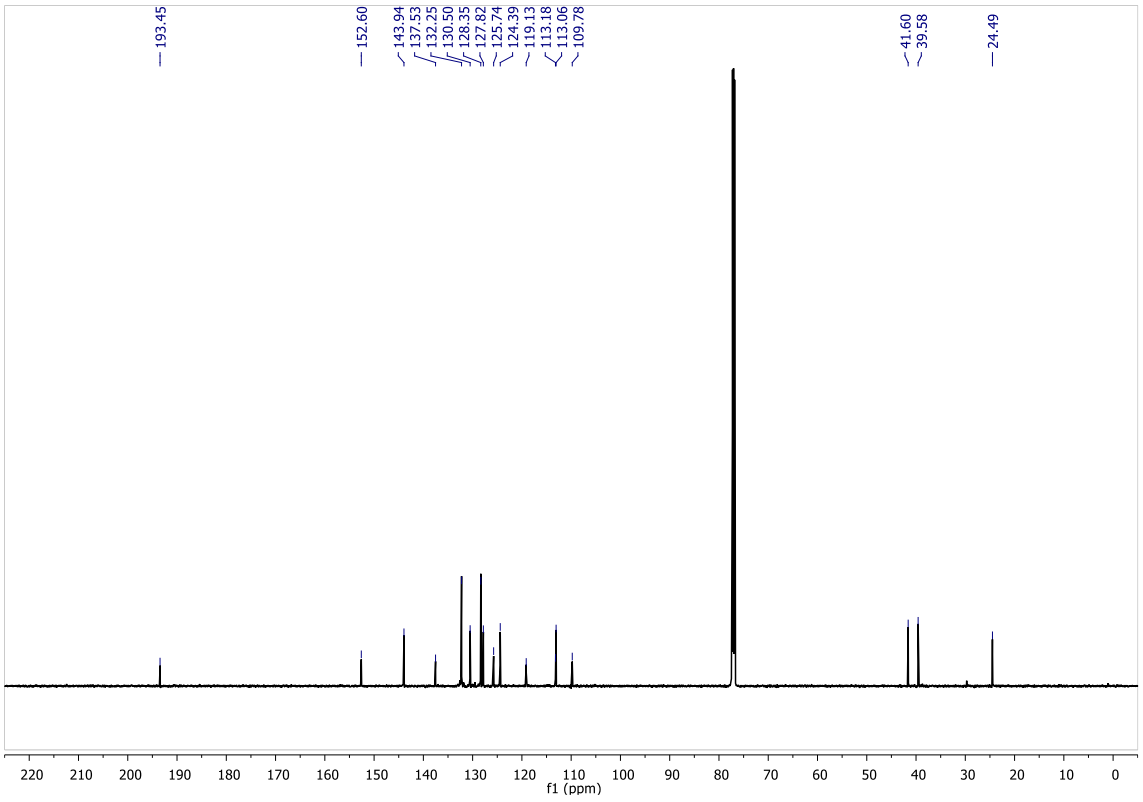




4-(3-Acetyl-1-methyl-1,4-dihydroquinolin-4-yl)benzonitrile 6b



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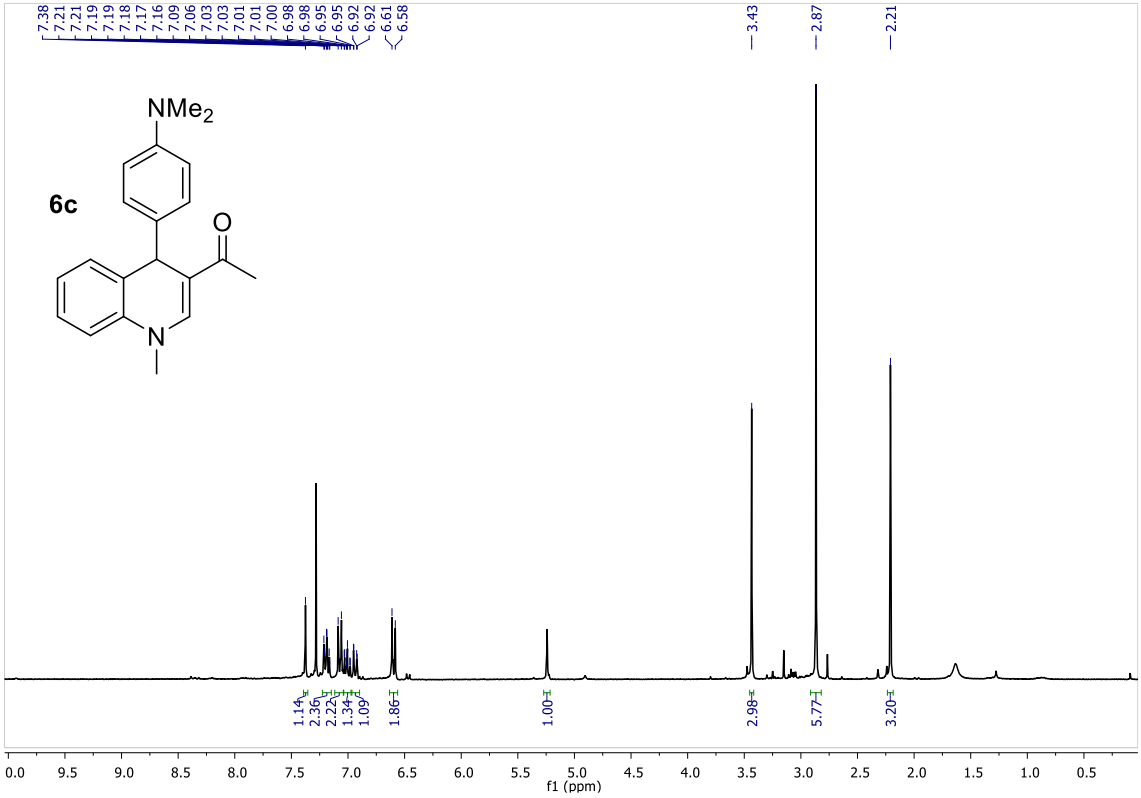
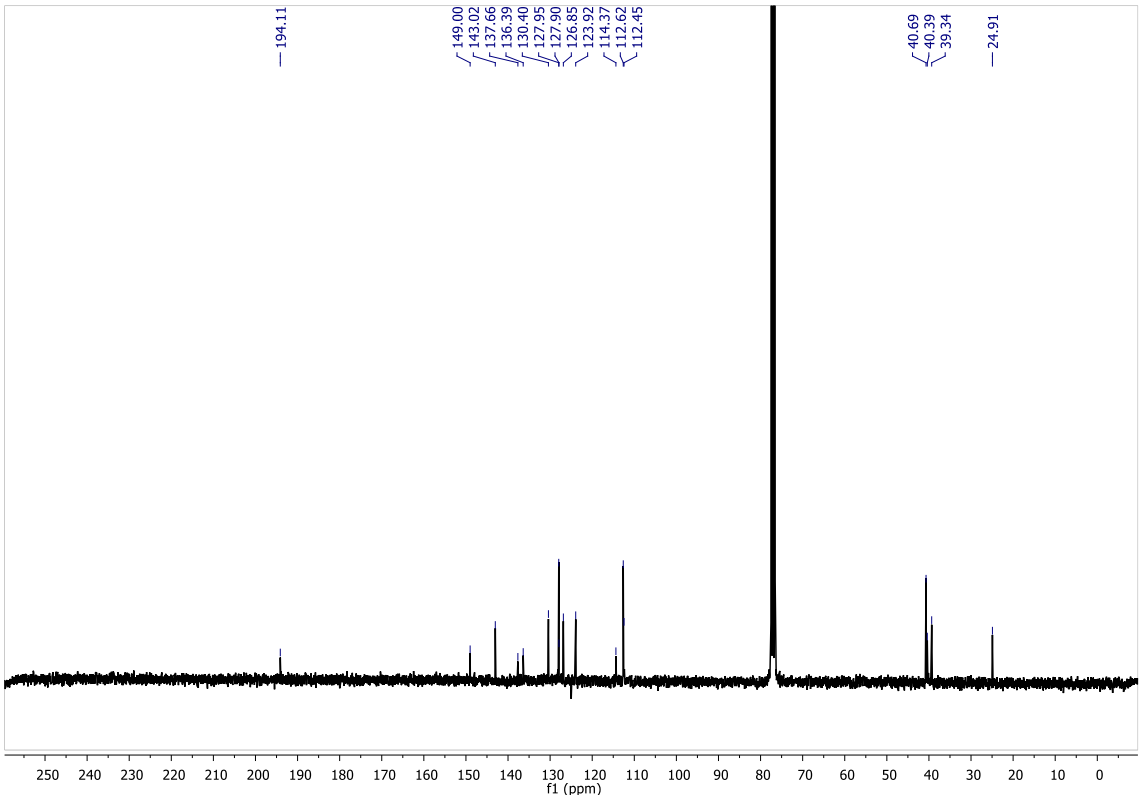
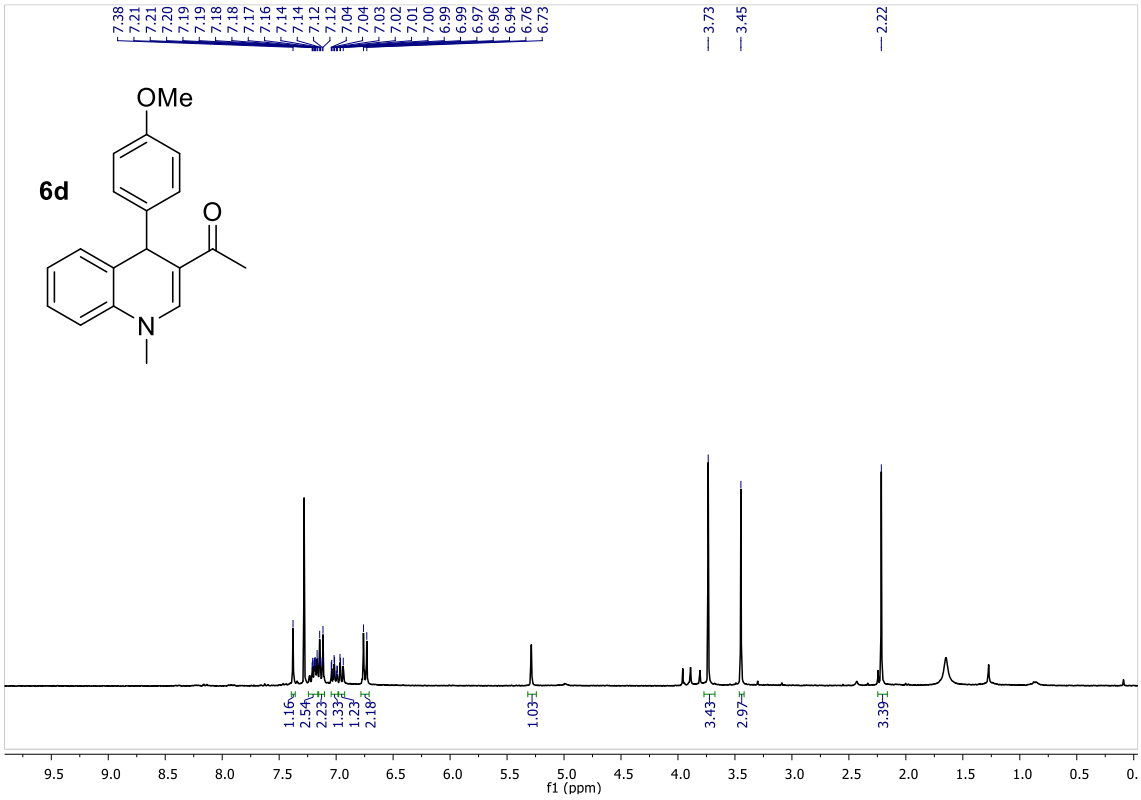
152.60
143.94
137.53
132.25
130.50
128.35
127.82
125.74
124.39
119.13
113.18
113.06
109.78
41.60
39.58
24.49
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

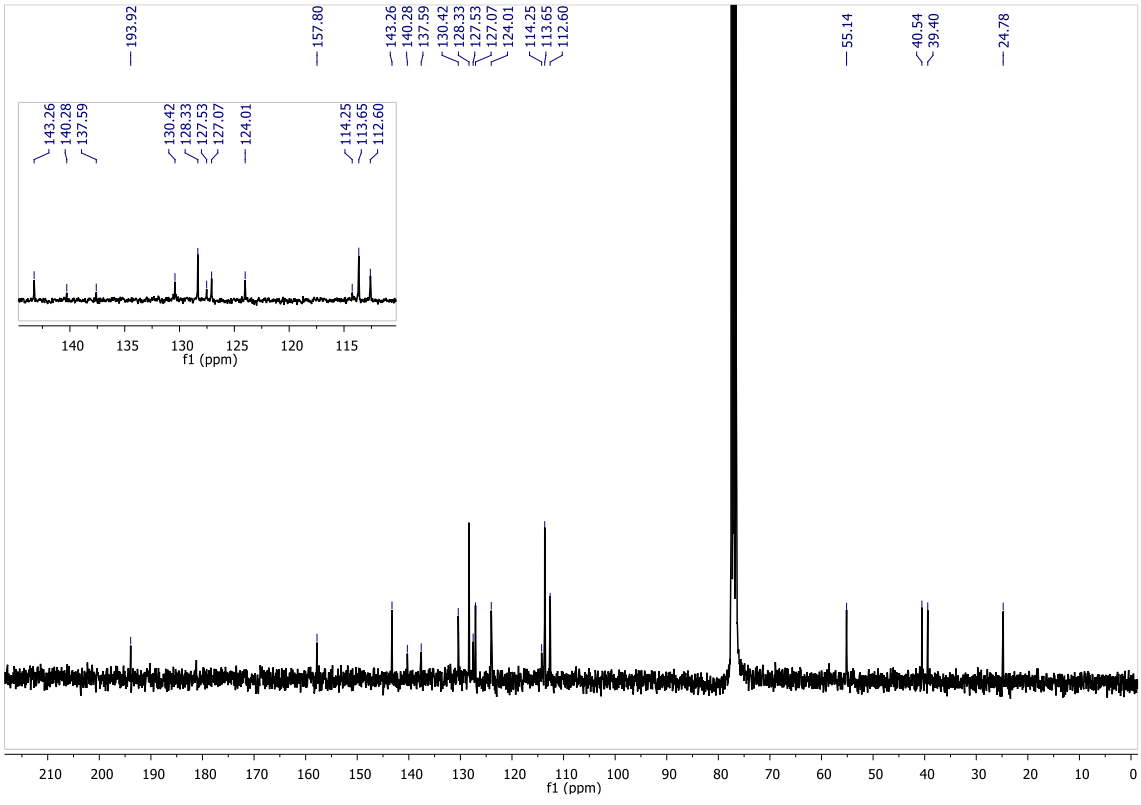
1-(4-(4-(Dimethylamino)phenyl)-1-methyl-1,4-dihydroquinolin-3-yl)ethan-1-one (6c)



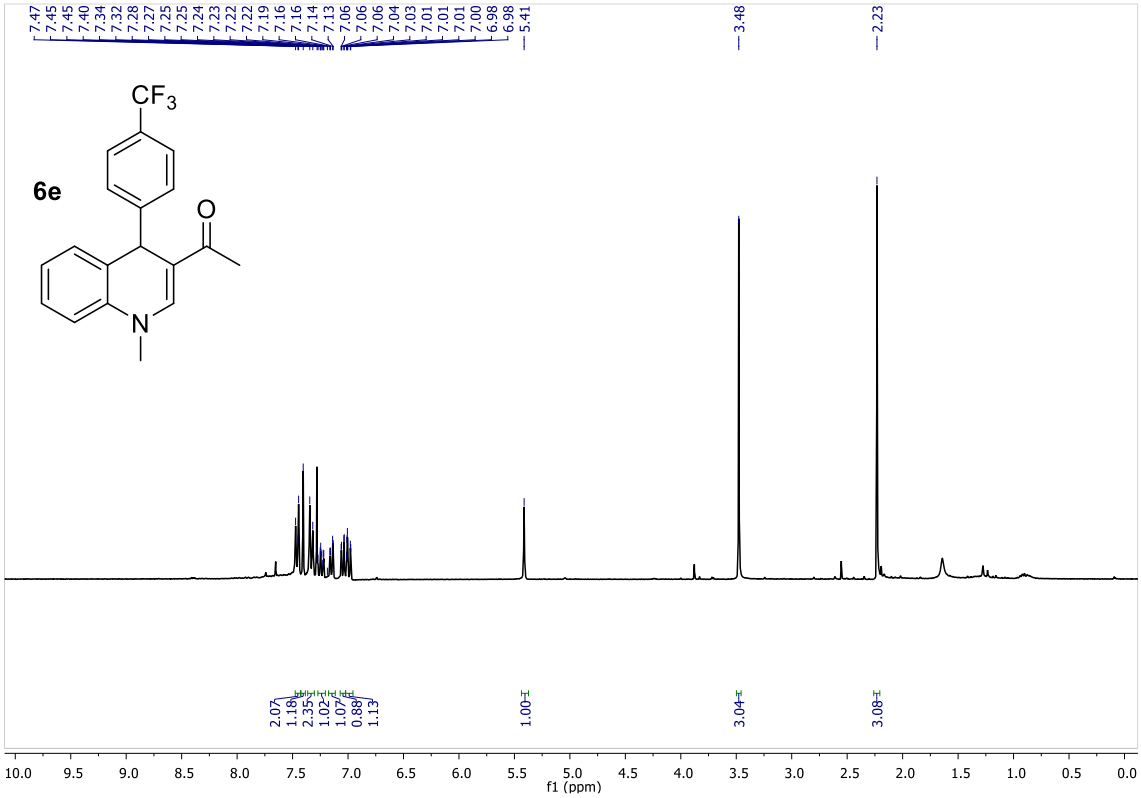


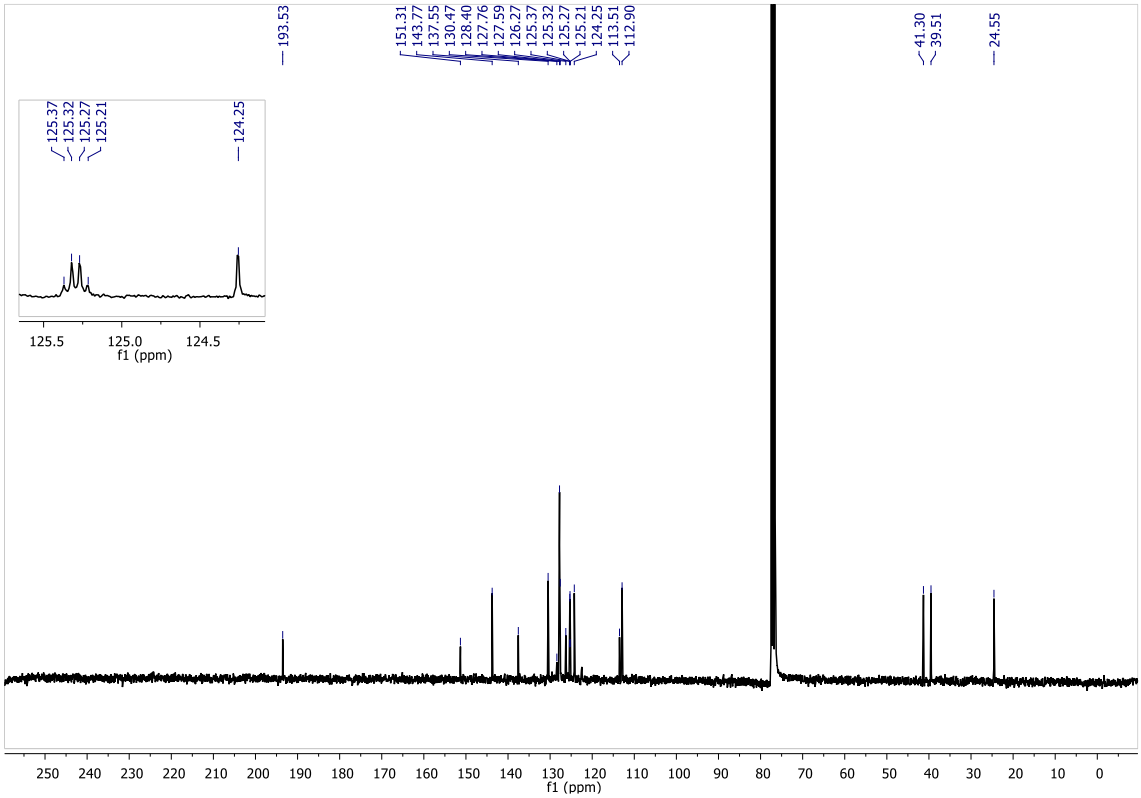
1-(4-(4-Methoxyphenyl)-1-methyl-1,4-dihydroquinolin-3-yl)ethan-1-one (6d)

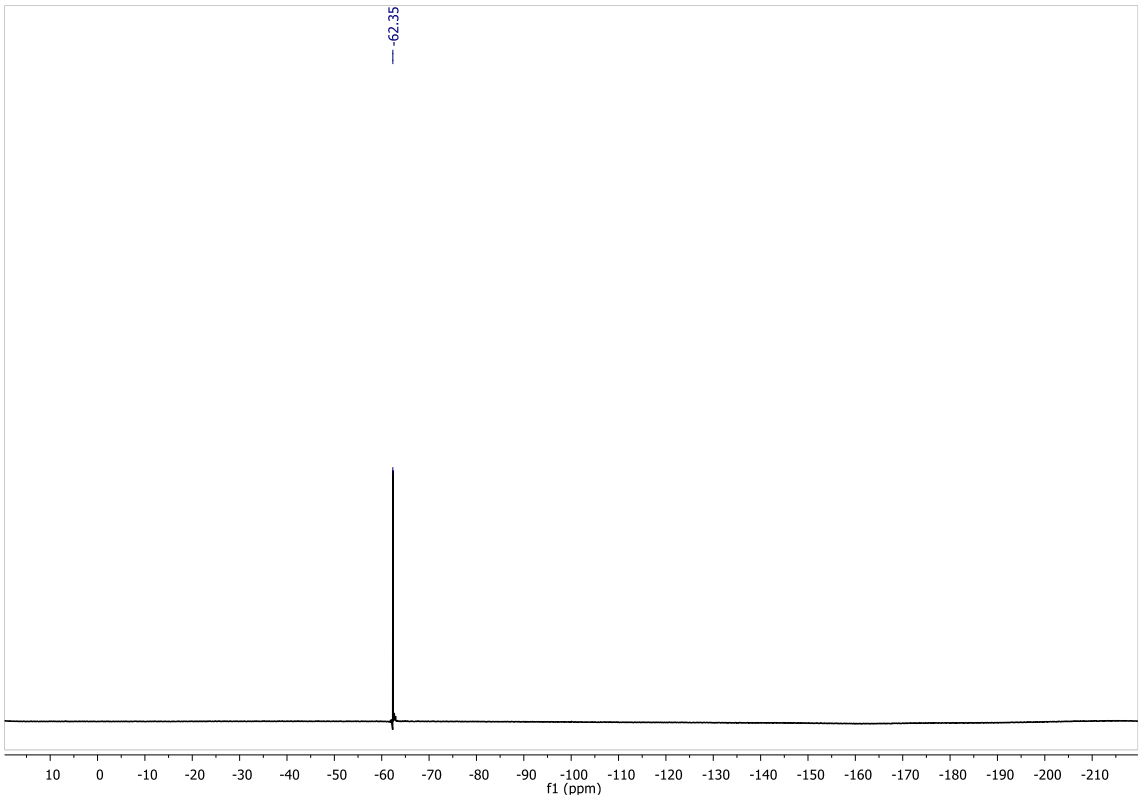




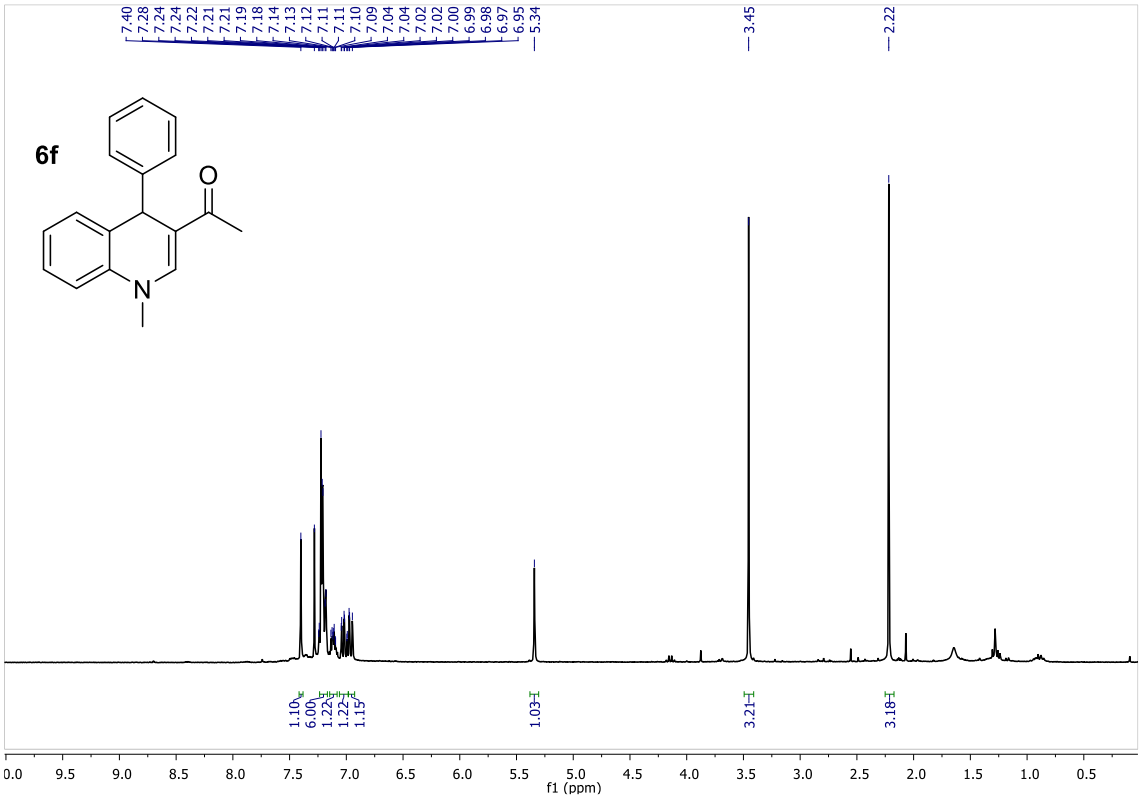
1-(1-Methyl-4-(4-(trifluoromethyl)phenyl)-1,4-dihydroquinolin-3-yl)ethan-1-one (6e)

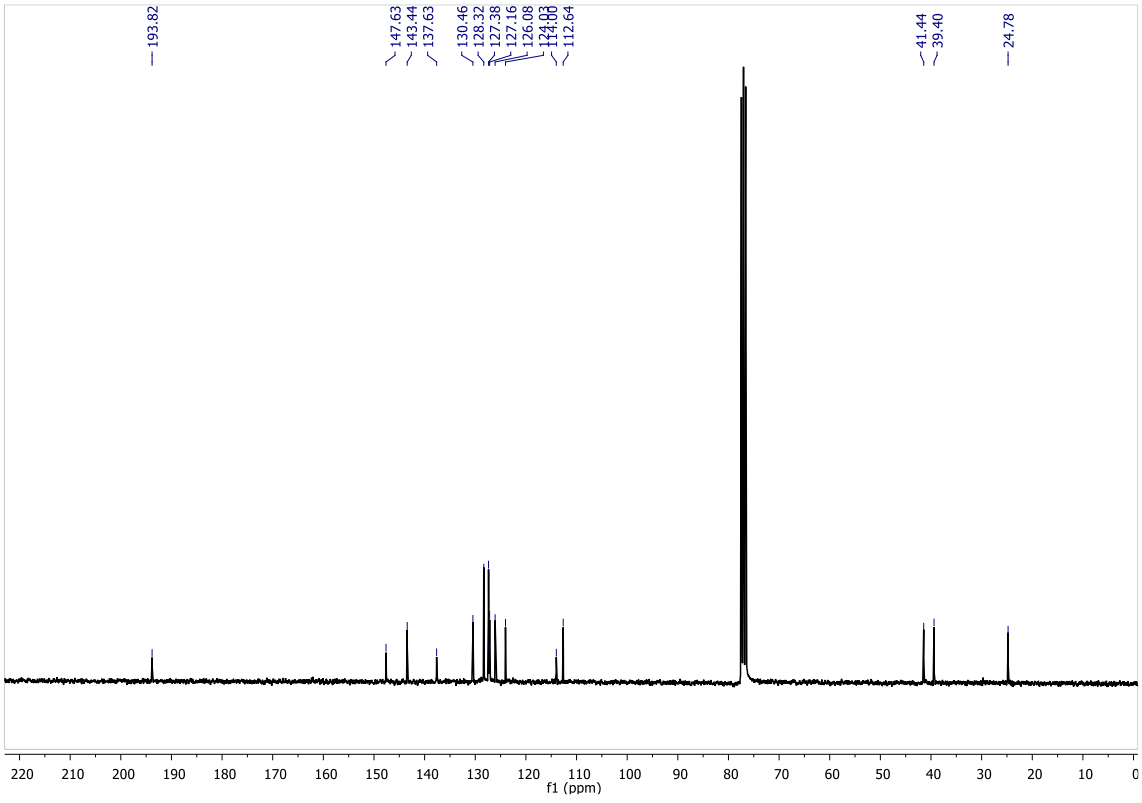




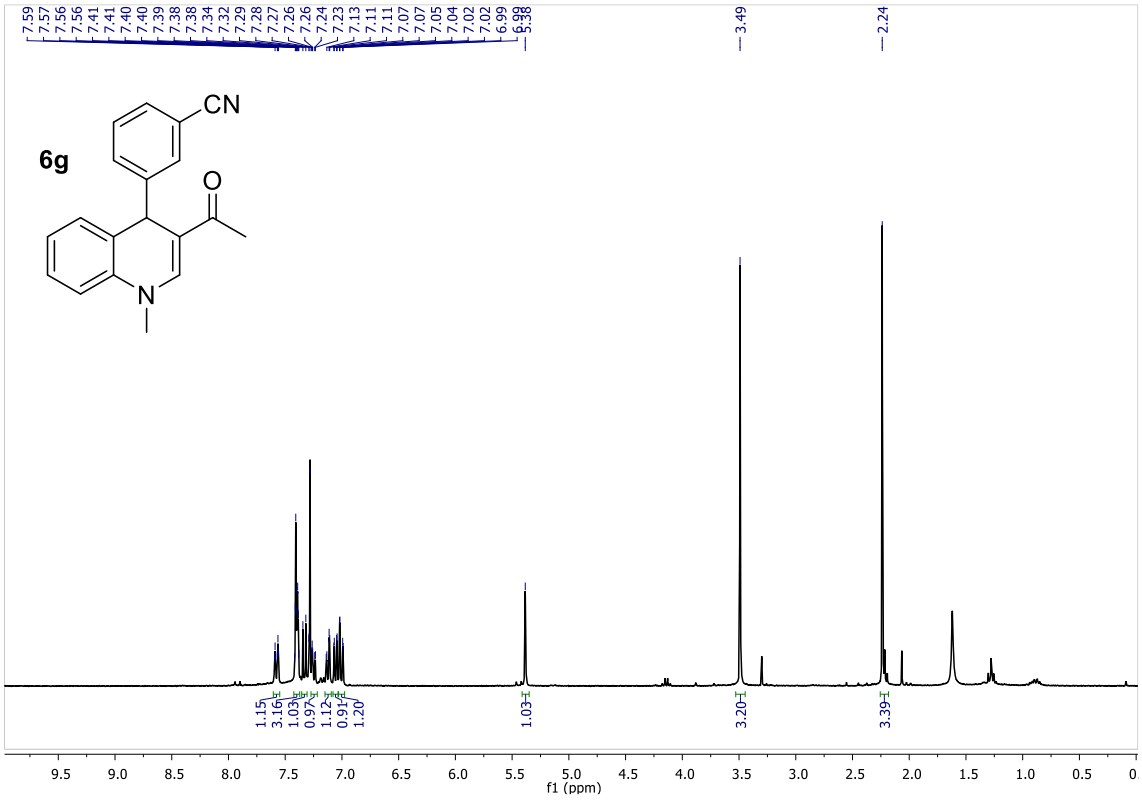

-62.35
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

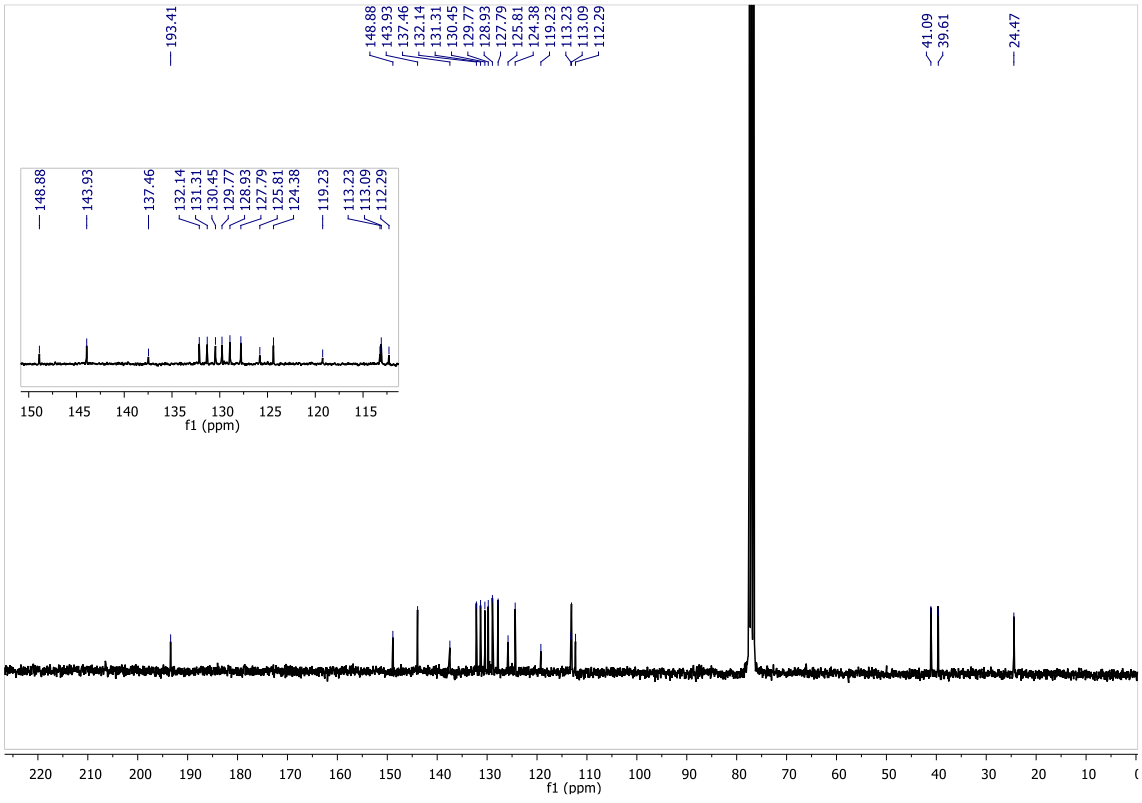
1-(1-Methyl-4-phenyl-1,4-dihydroquinolin-3-yl)ethan-1-one (6f)



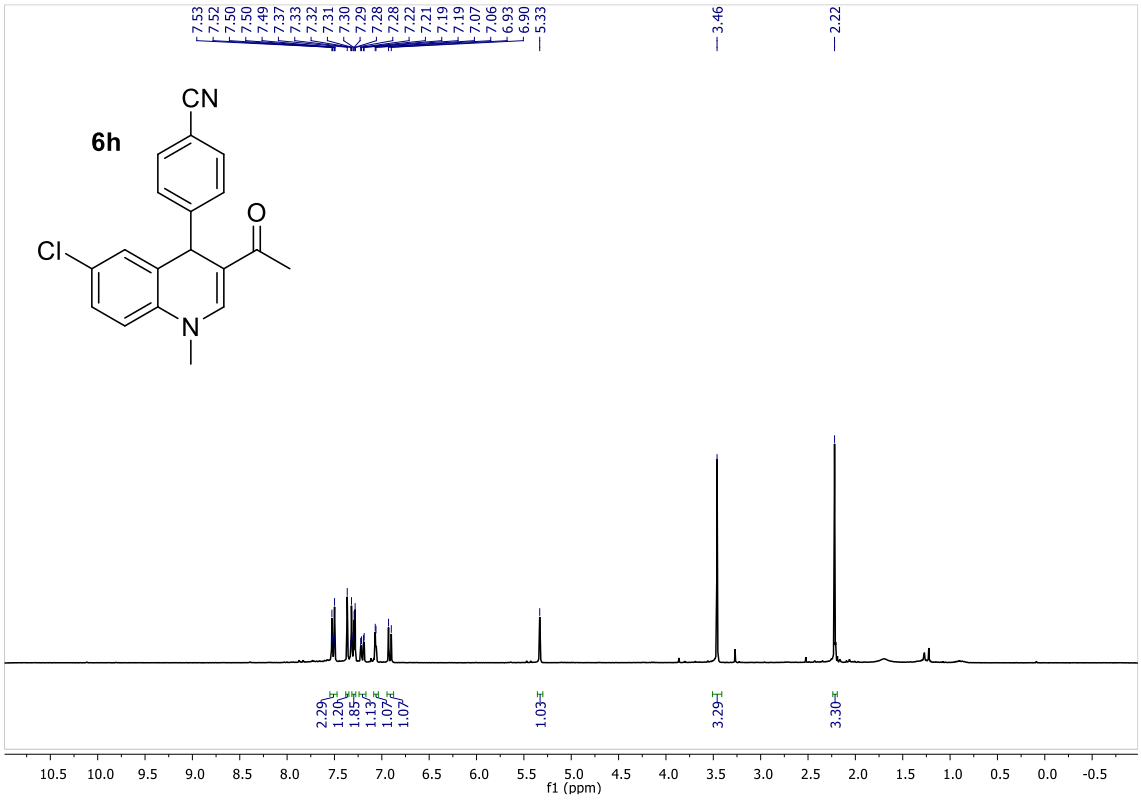


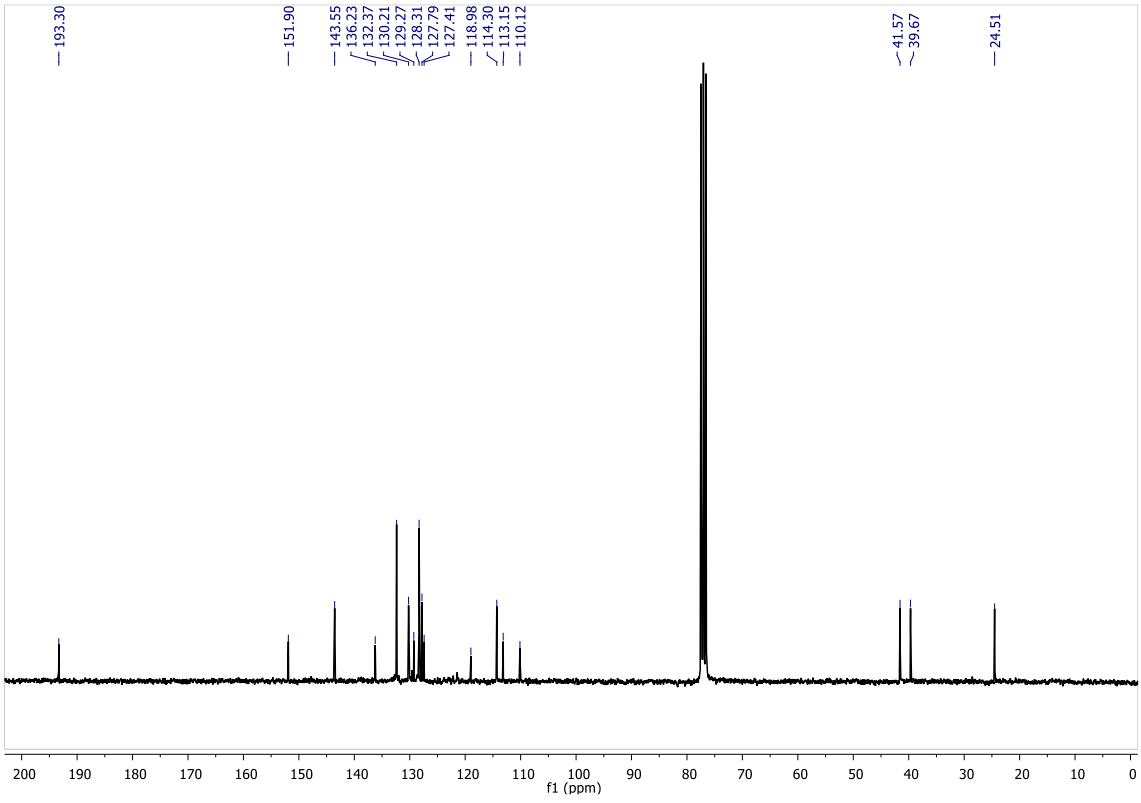
3-(3-Acetyl-1-methyl-1,4-dihydroquinolin-4-yl)benzonitrile (6g)



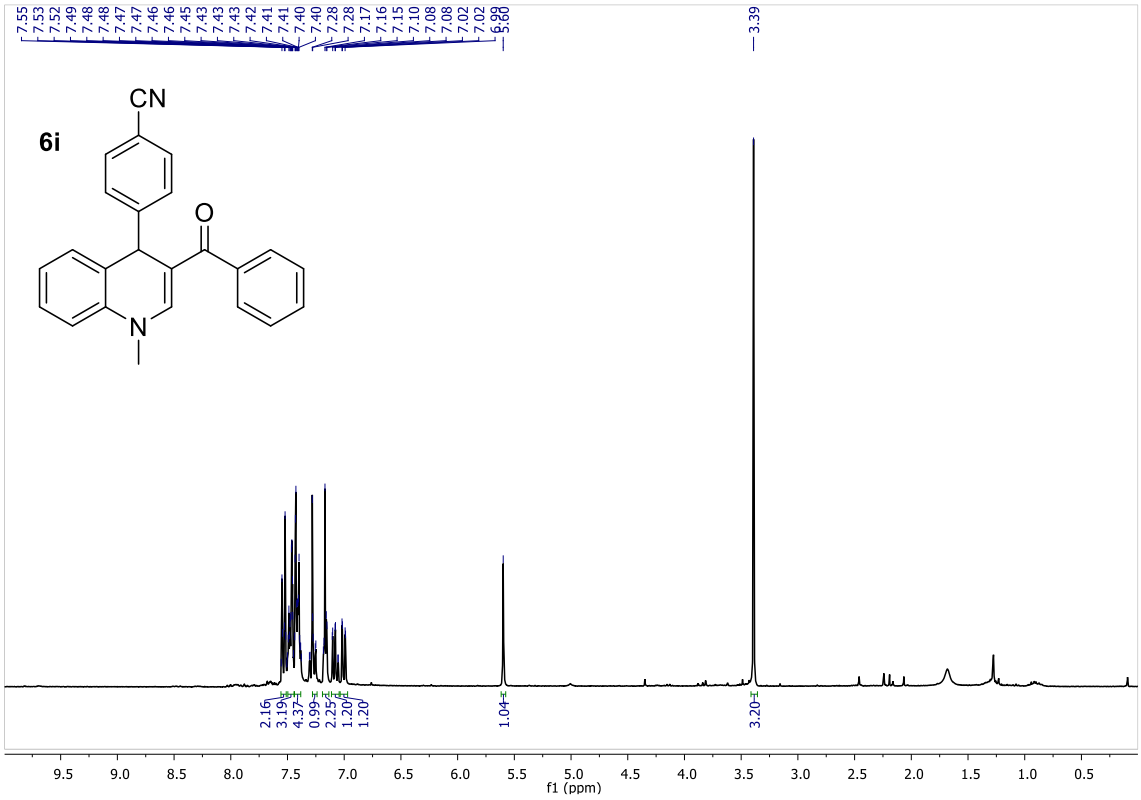


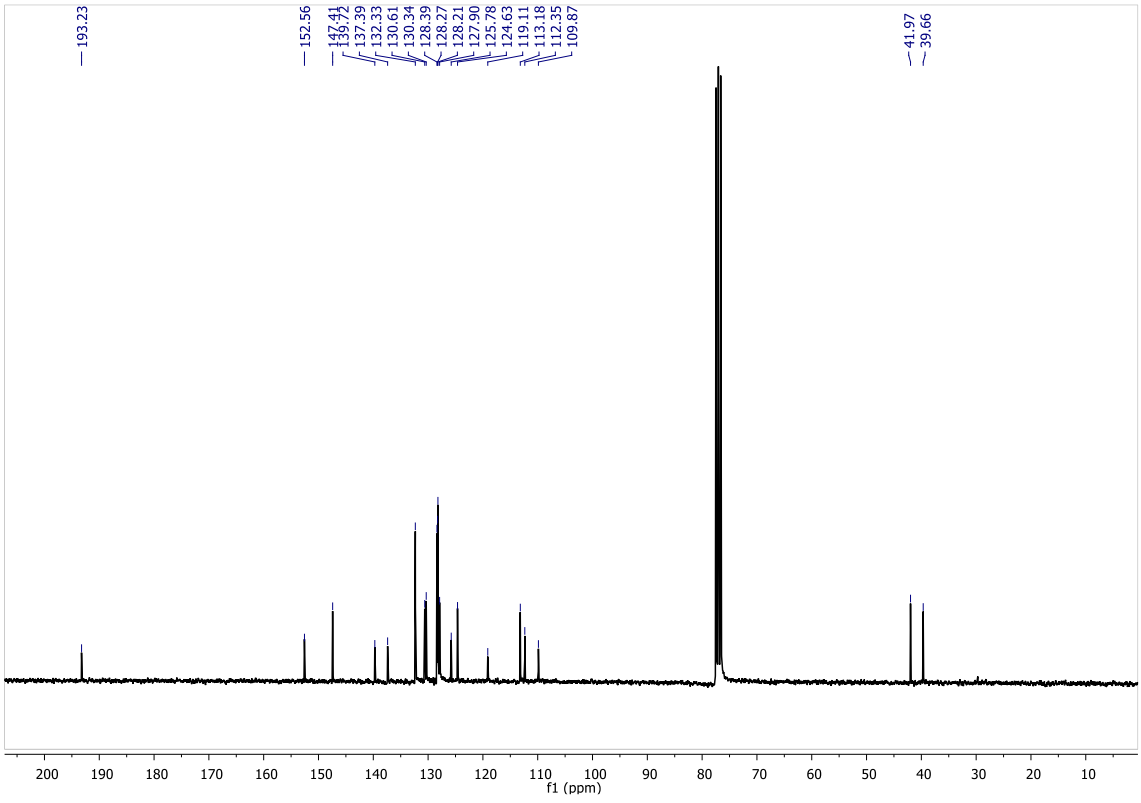
4-(3-Acetyl-6-chloro-1-methyl-1,4-dihydroquinolin-4-yl)benzonitrile (6h)



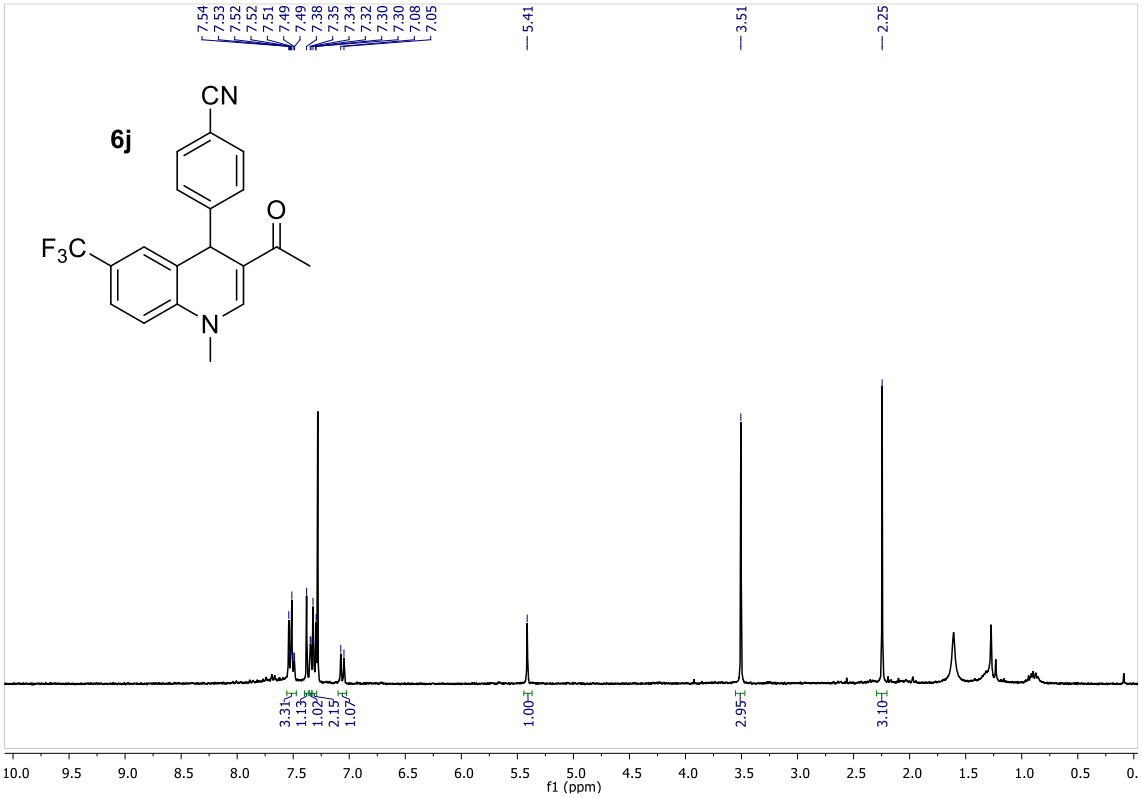


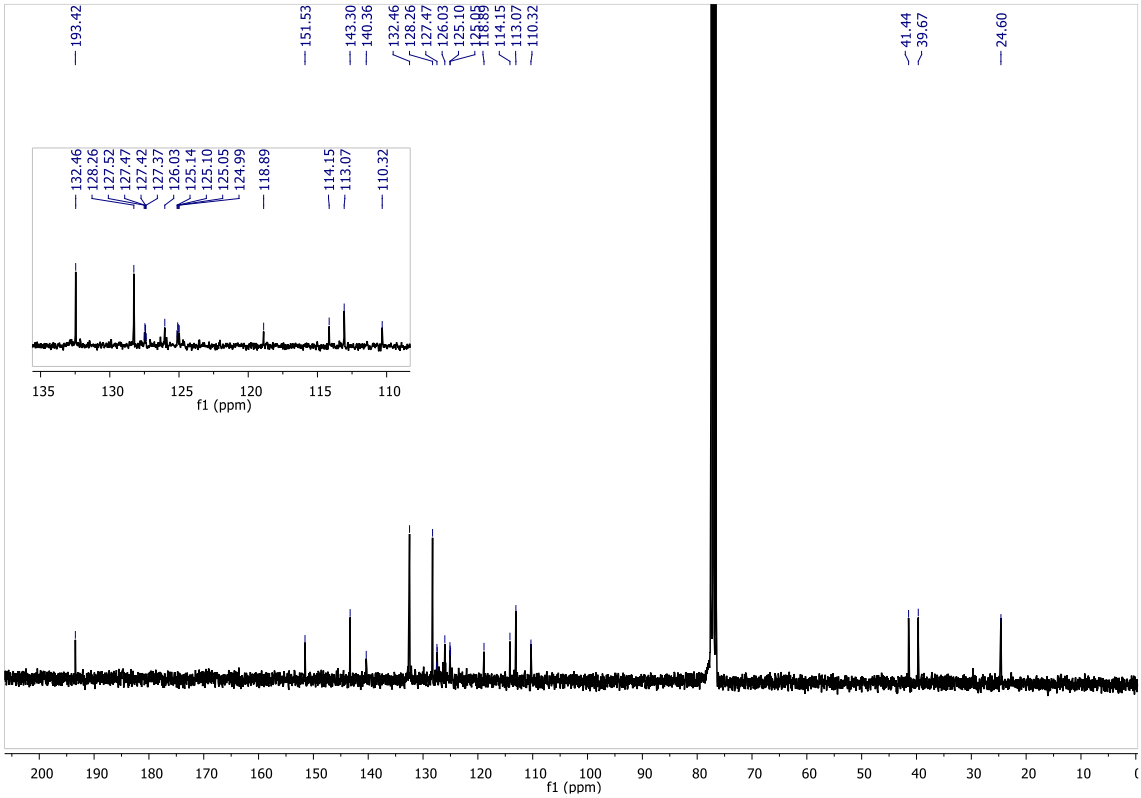
4-(3-Benzoyl-1-methyl-1,4-dihydroquinolin-4-yl)benzonitrile (6i)

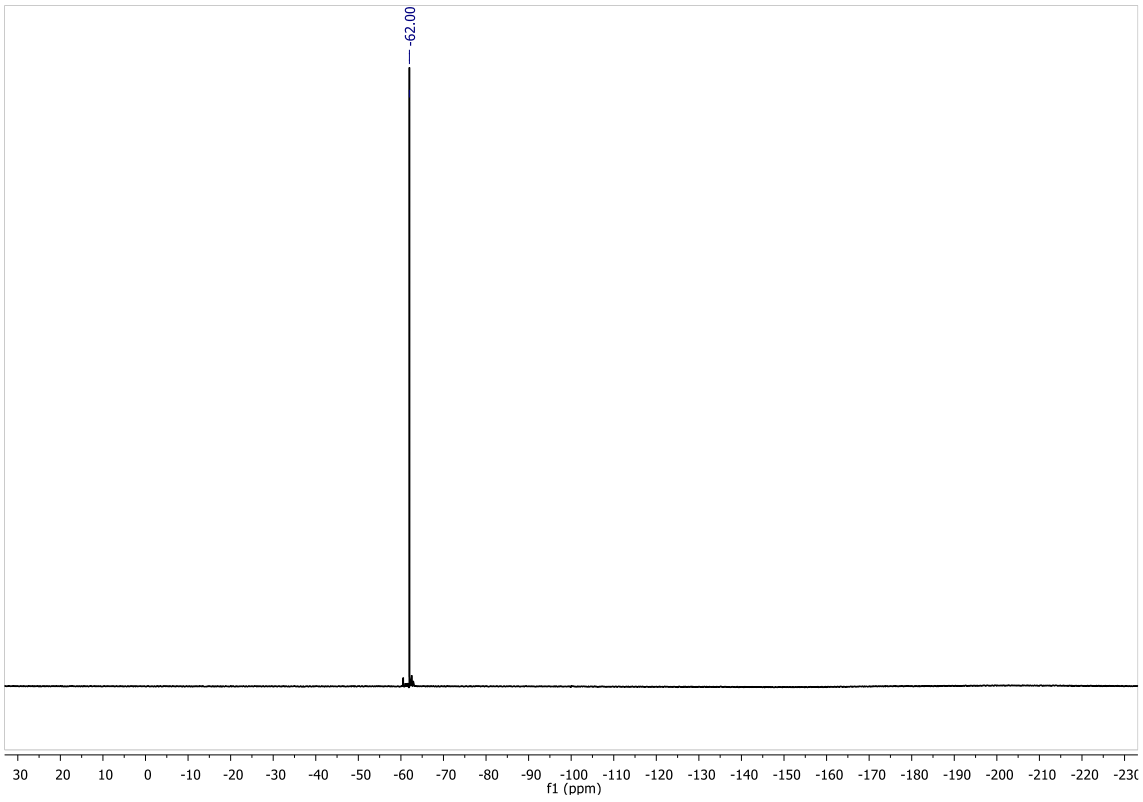




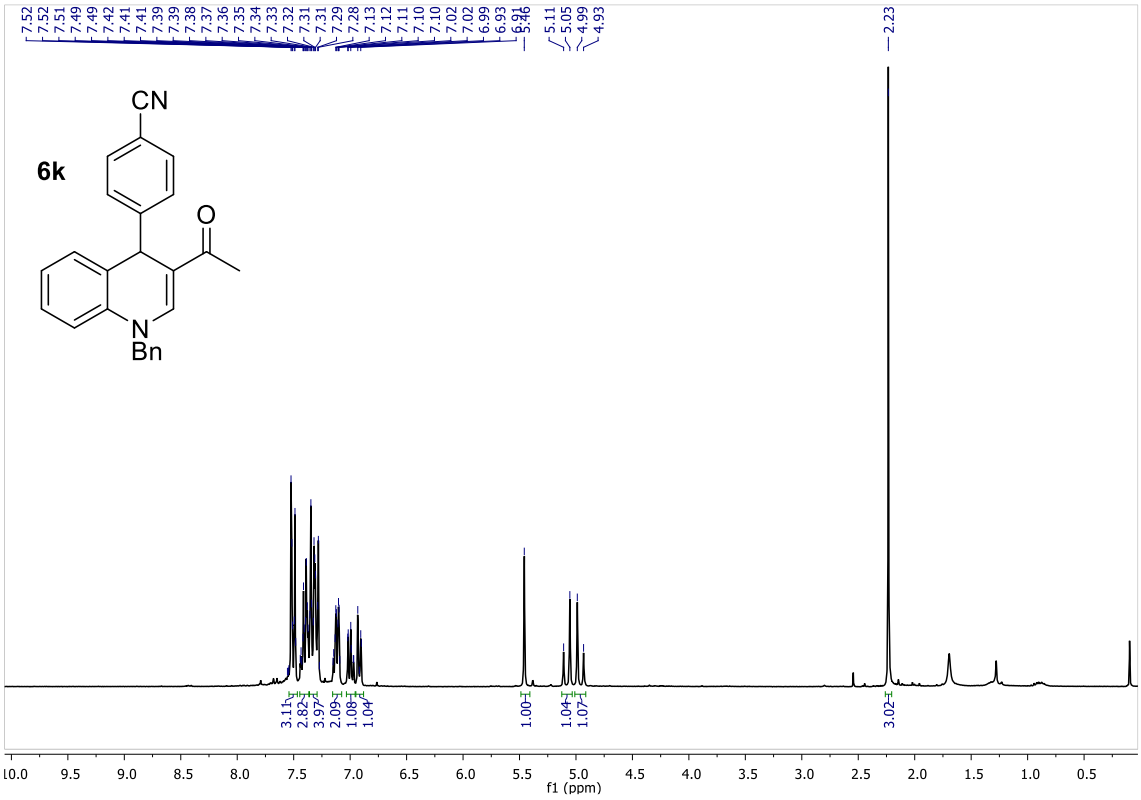
4-(3-Acetyl-1-methyl-6-(trifluoromethyl)-1,4-dihydroquinolin-4-yl)benzonitrile (6j)

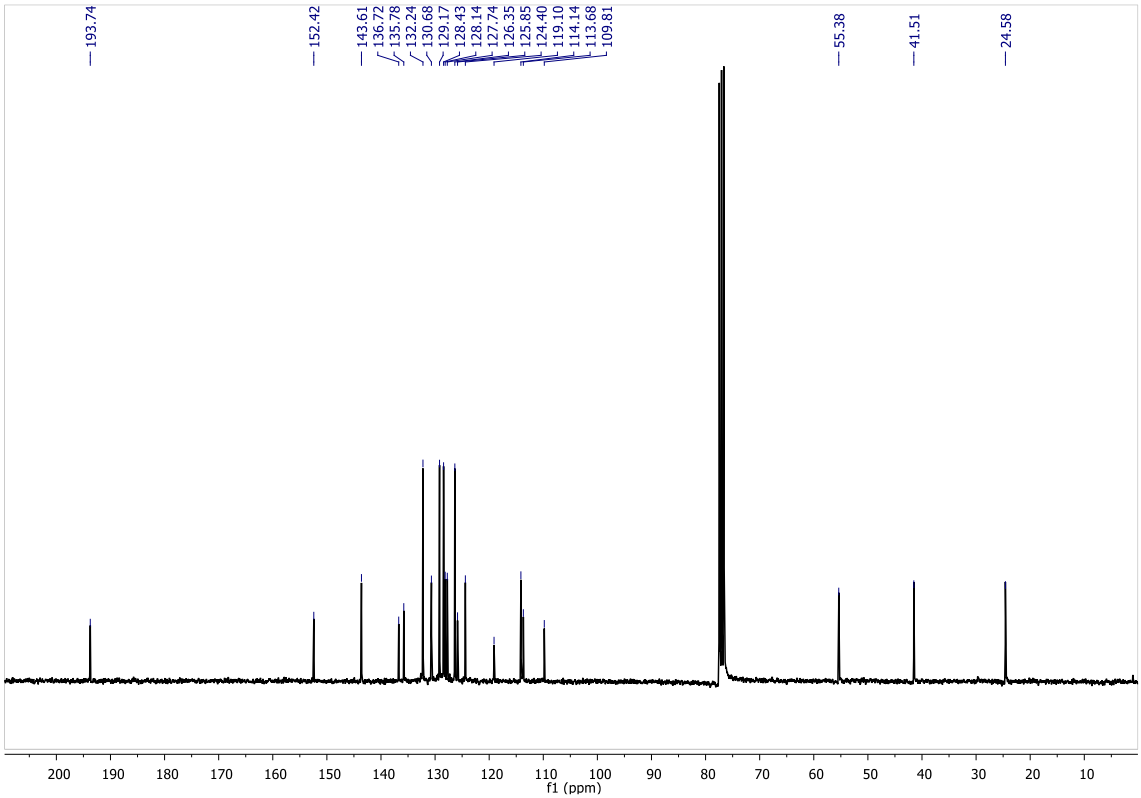




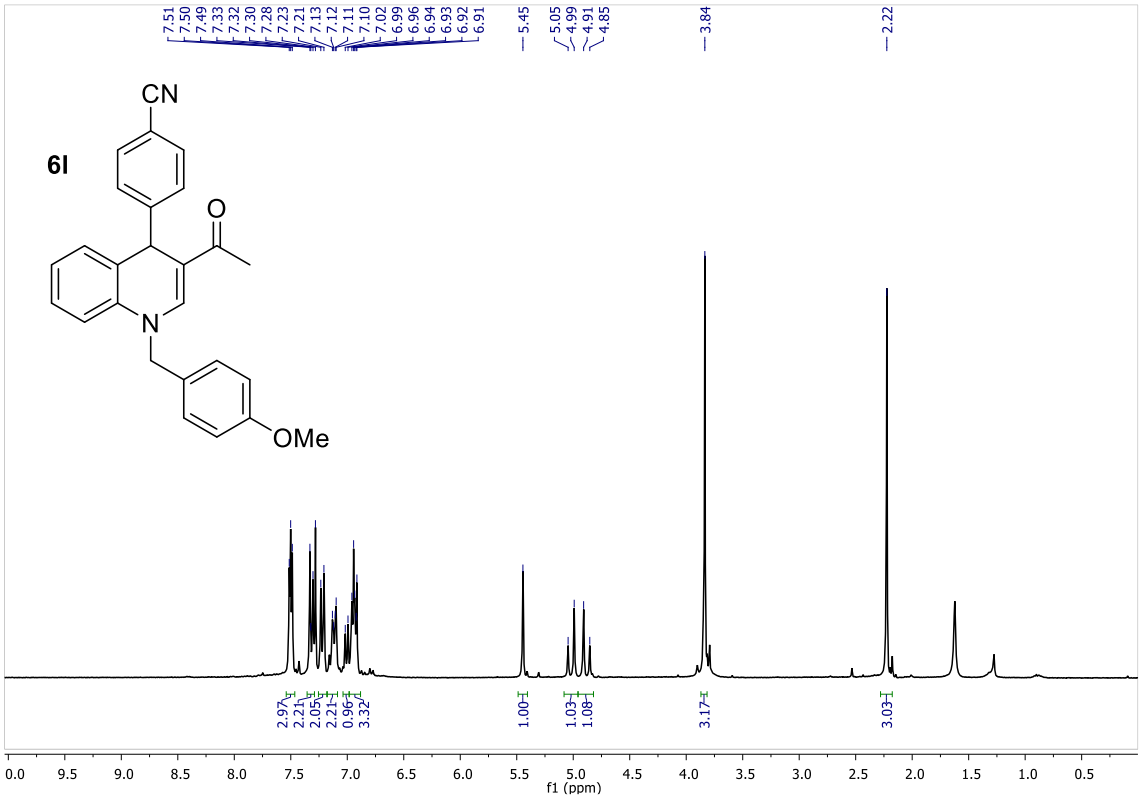

-62.00
30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220 -230
f1 (ppm)

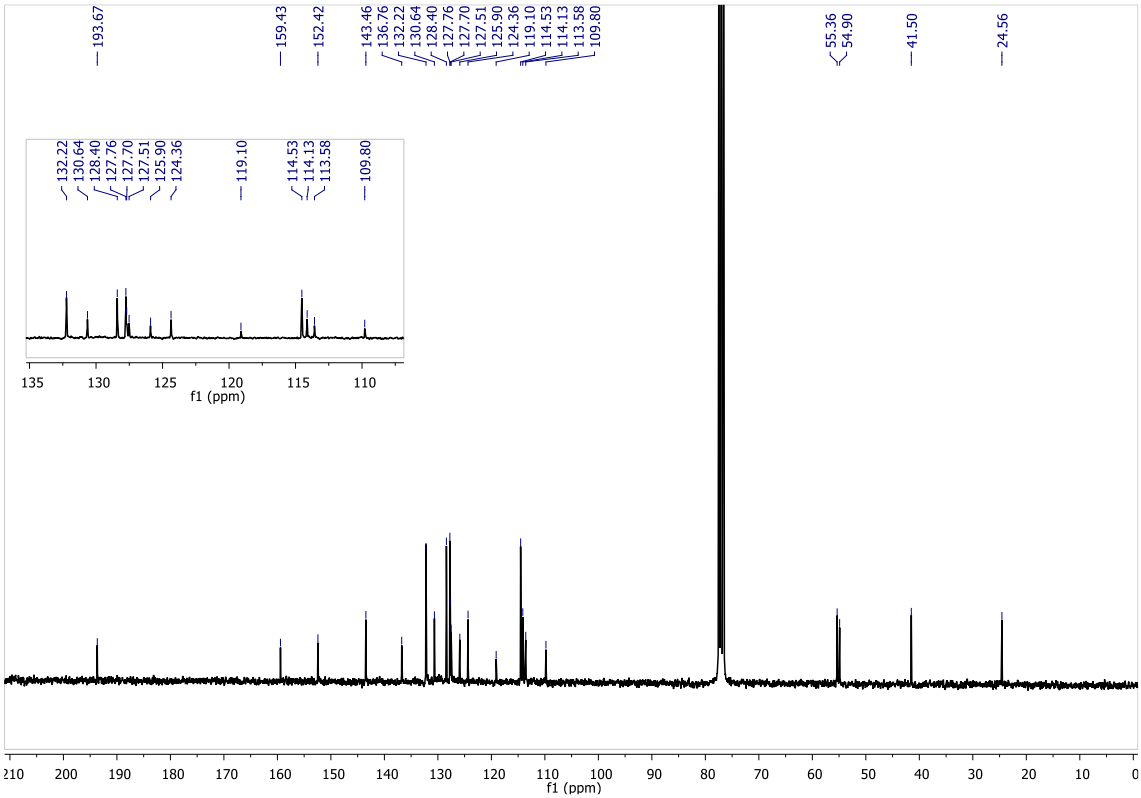
4-(3-Acetyl-1-benzyl-1,4-dihydroquinolin-4-yl)benzonitrile (6k)



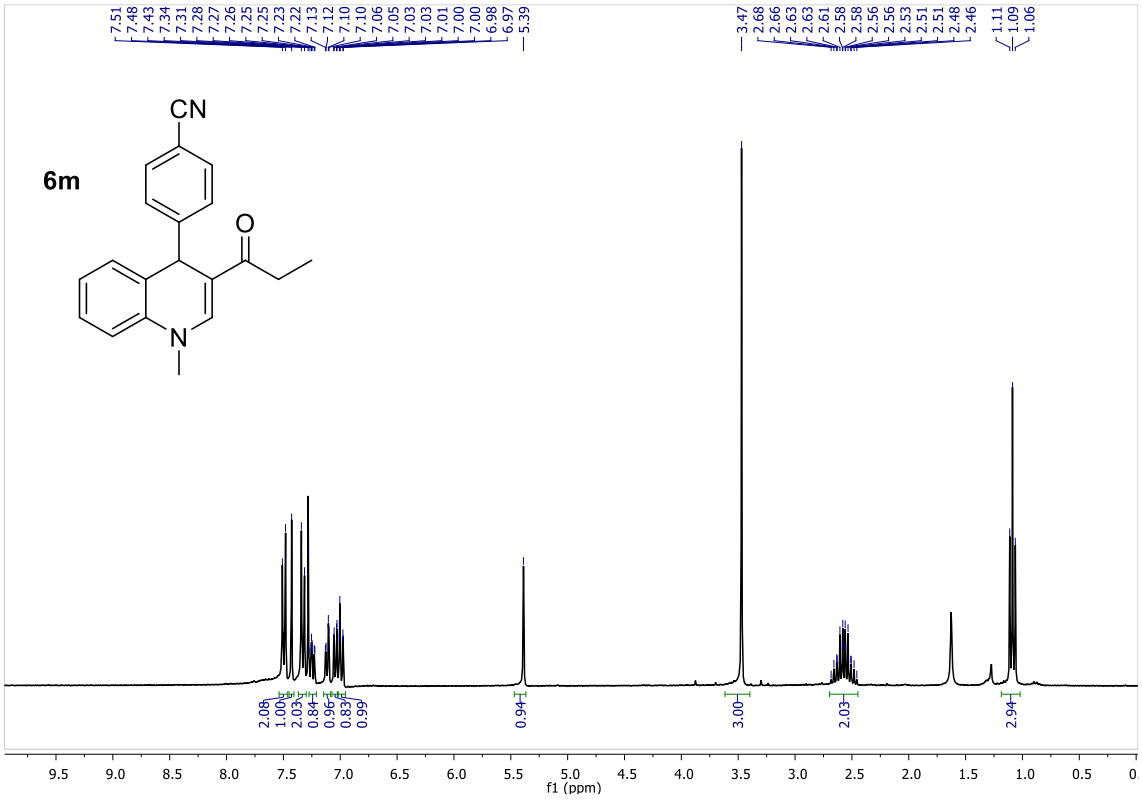


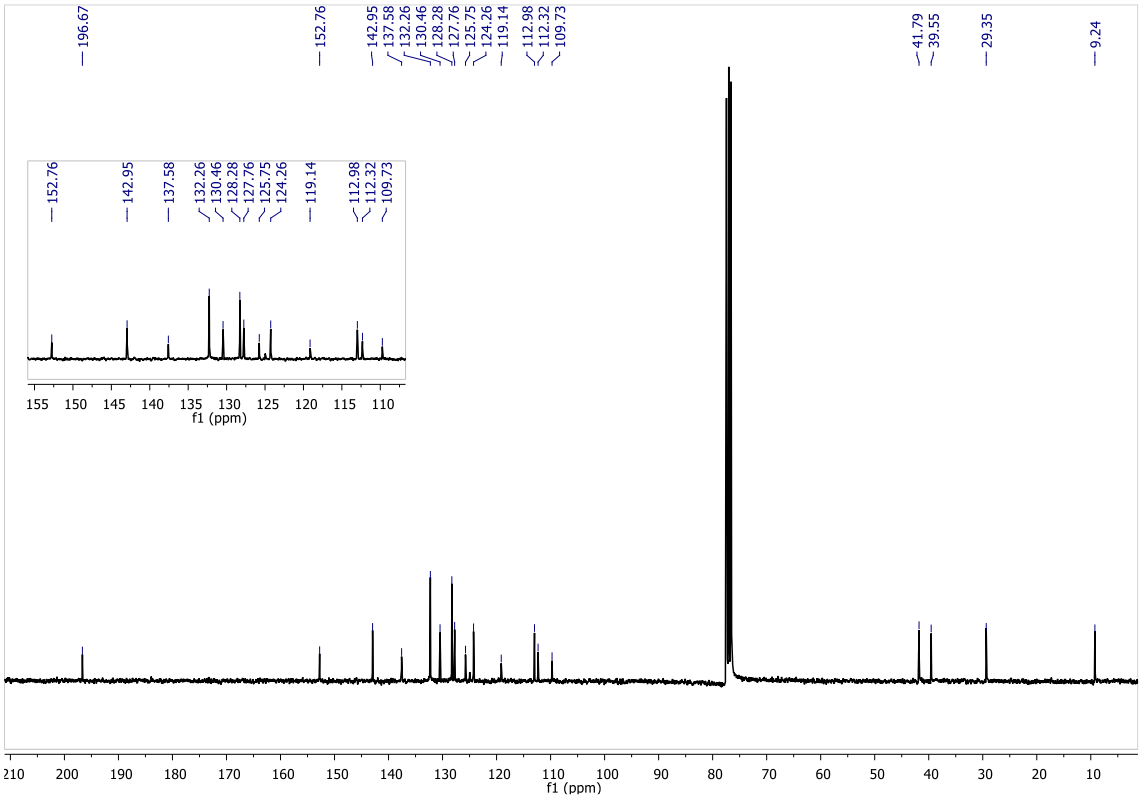
4-(3-Acetyl-1-(4-methoxybenzyl)-1,4-dihydroquinolin-4-yl)benzonitrile (6l)





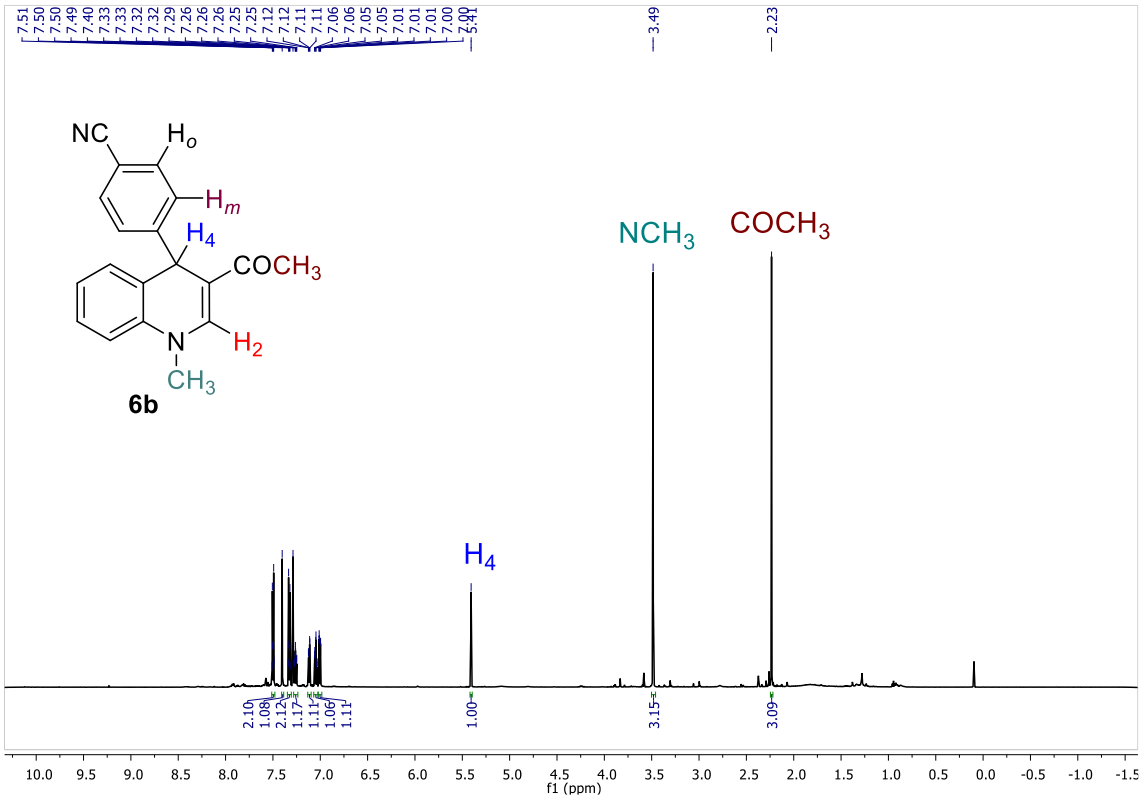
4-(1-Methyl-3-propionyl-1,4-dihydroquinolin-4-yl)benzonitrile (6m)

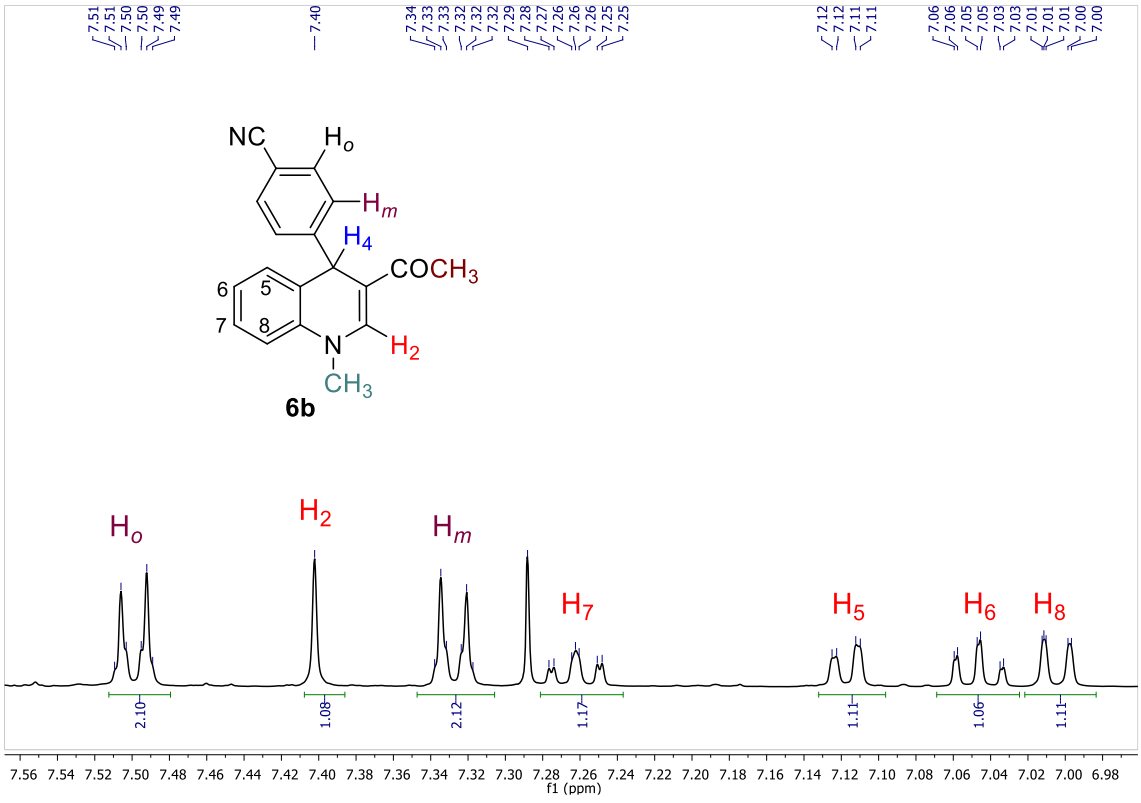


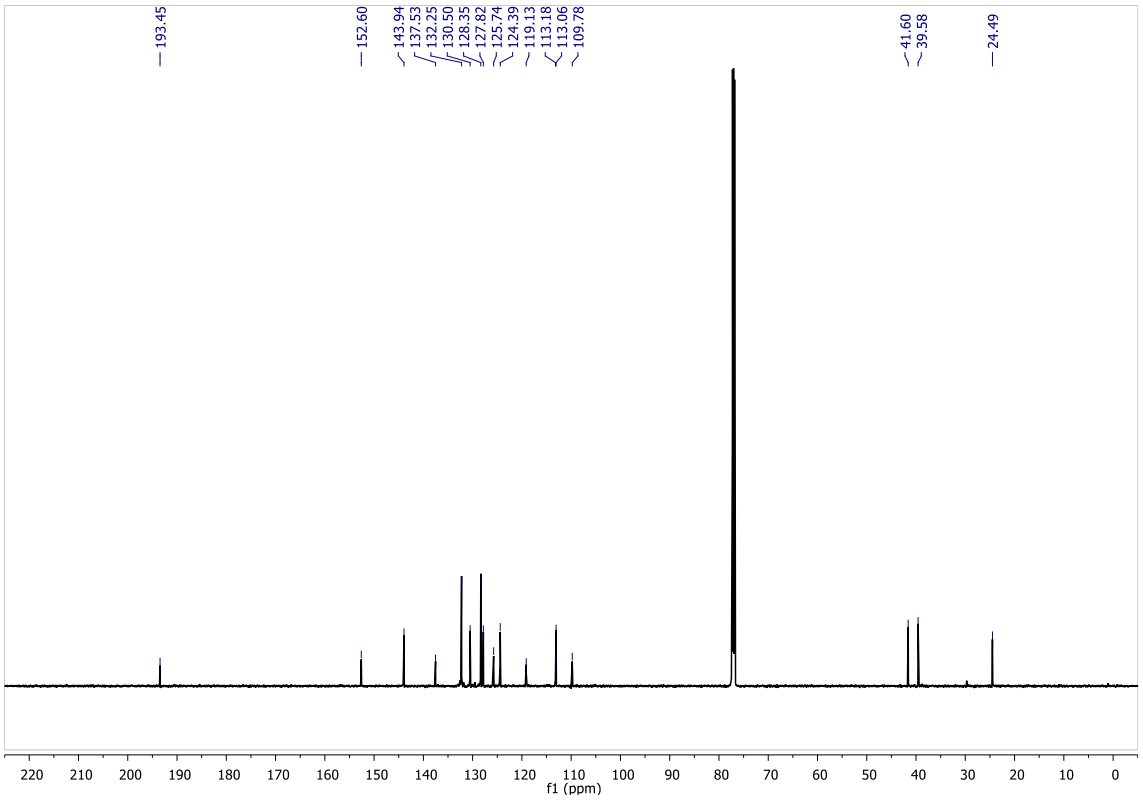


2D-NMR experiments on 6b to confirm the structure of the 1,4-dihydroisoquinolines

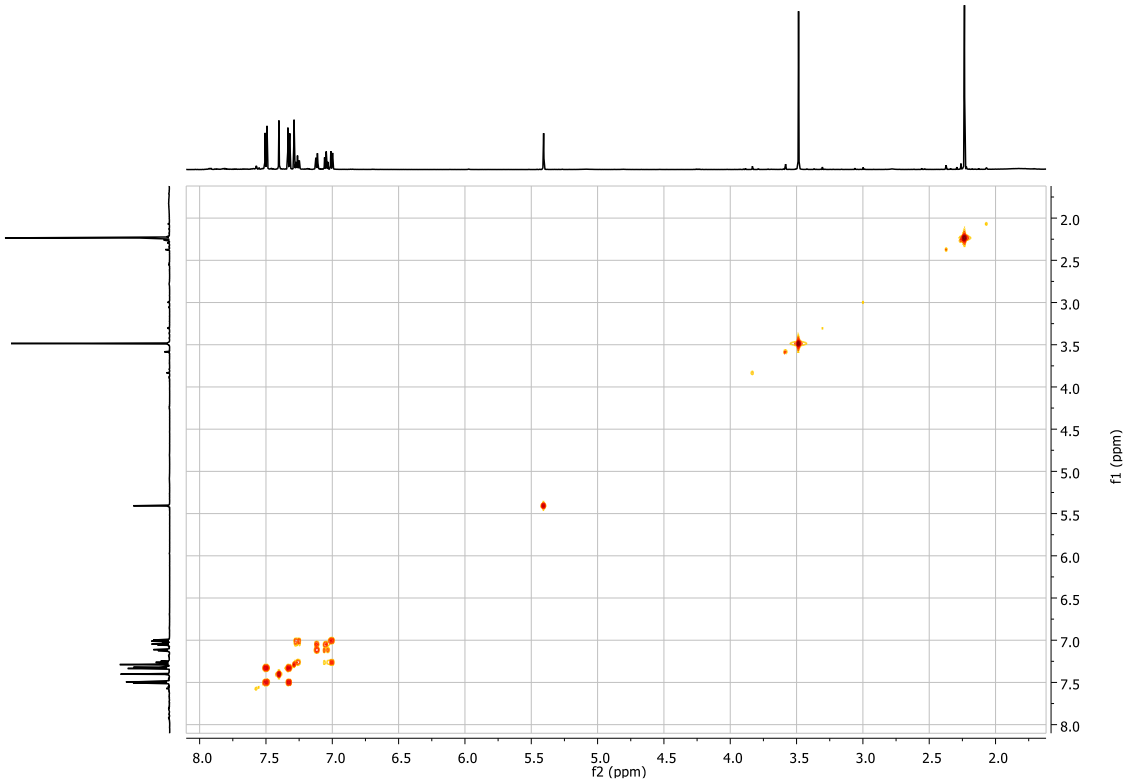
4-(3-Acetyl-1-methyl-1,4-dihydroquinolin-4-yl)benzonitrile 6b

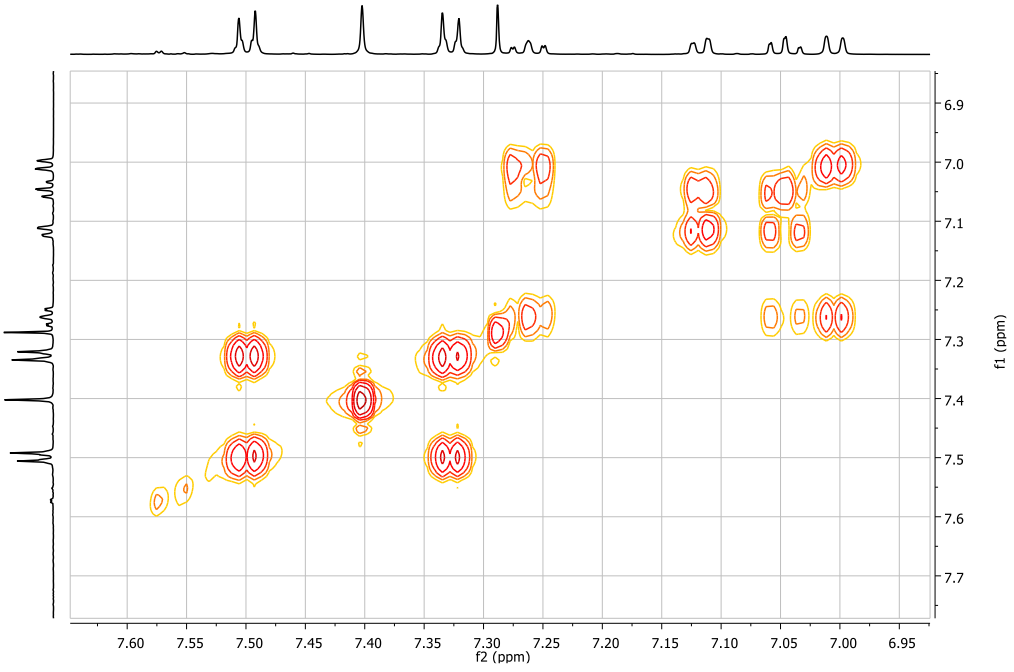




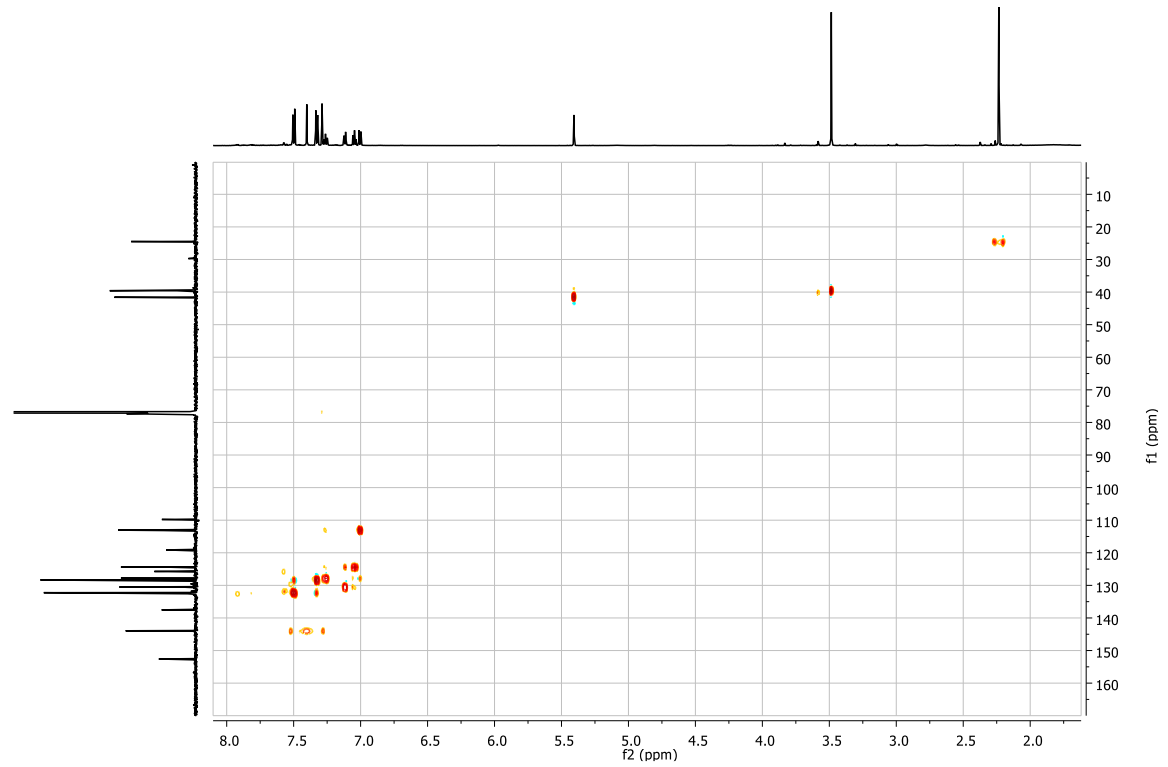

193.45
152.60
143.94
137.53
132.25
130.50
128.35
127.82
125.74
124.39
119.13
113.18
113.06
109.78
41.60
39.58
24.49
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

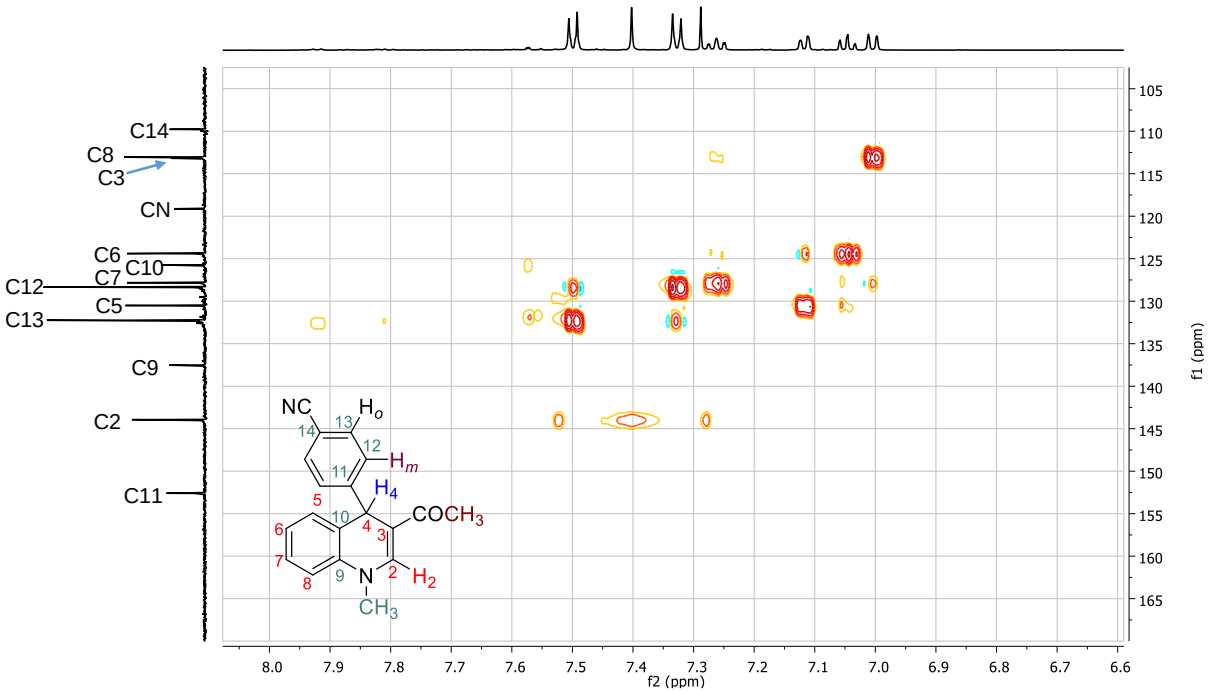
COSY



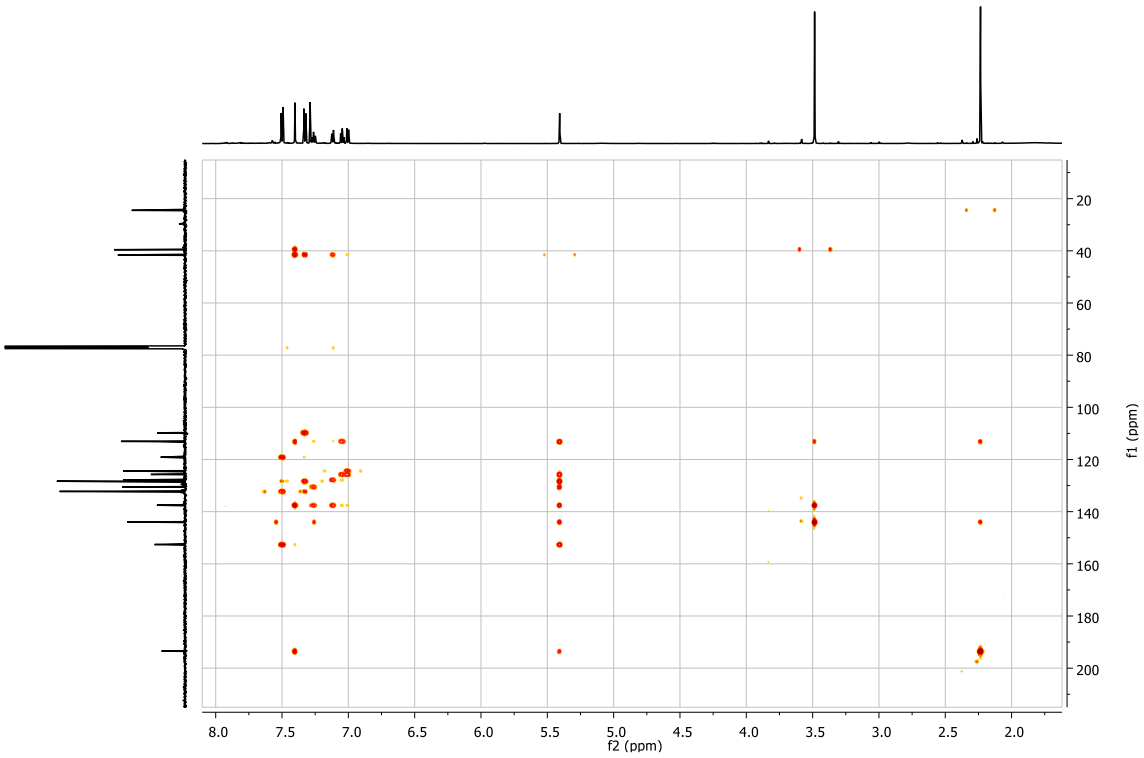


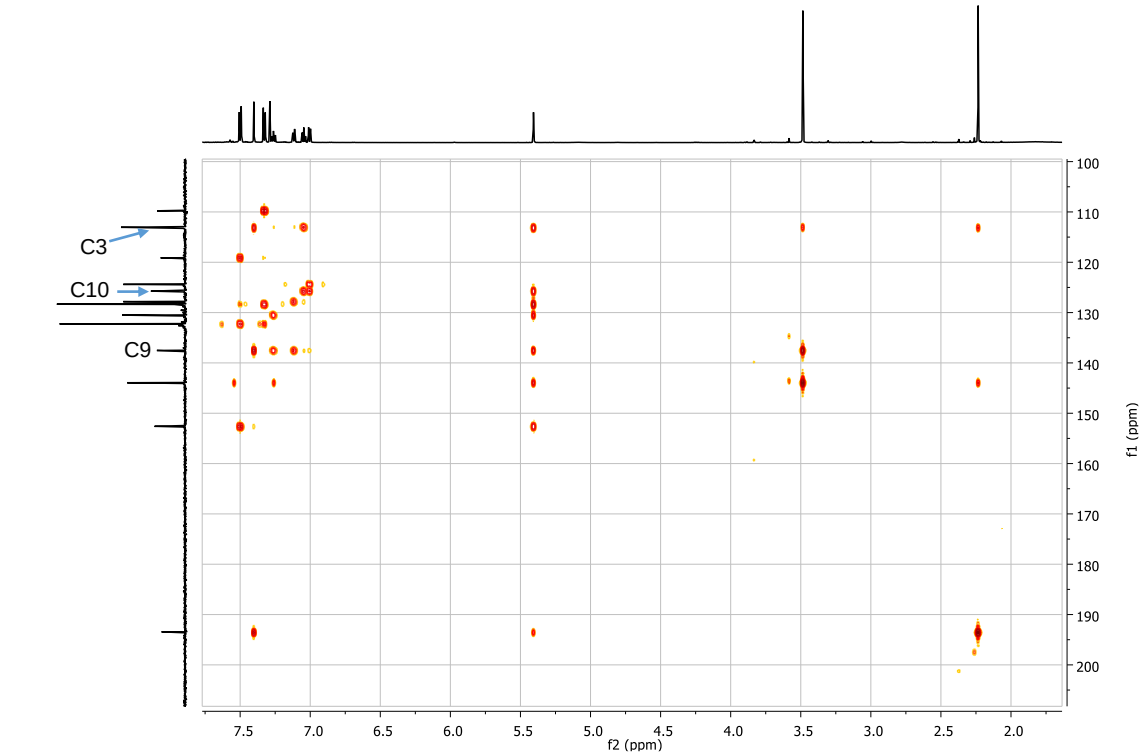
HSQC


f2 (ppm)
f1 (ppm)

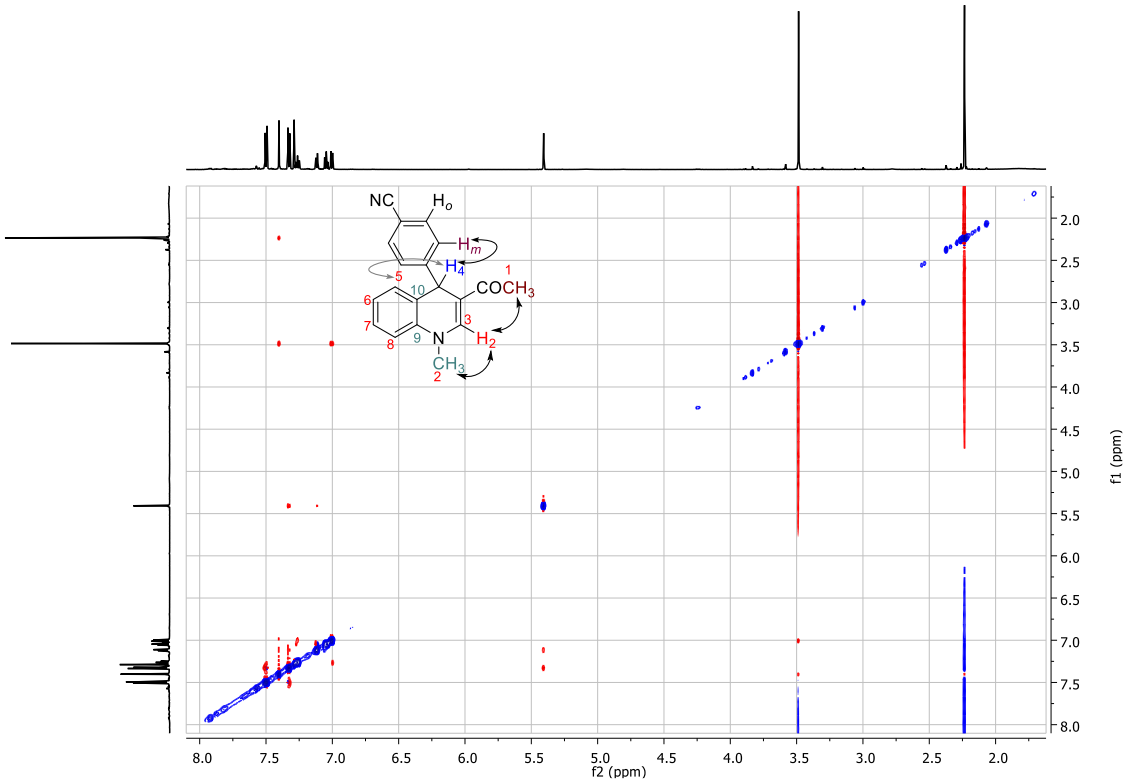

C14
C8
C3
CN
C6
C10
C7
C12
C5
C13
C9
C2
C11
NC
H$_o$
H$_m$
H$_4$
COCH$_3$
H$_2$
CH$_3$
N
f2 (ppm)
f1 (ppm)

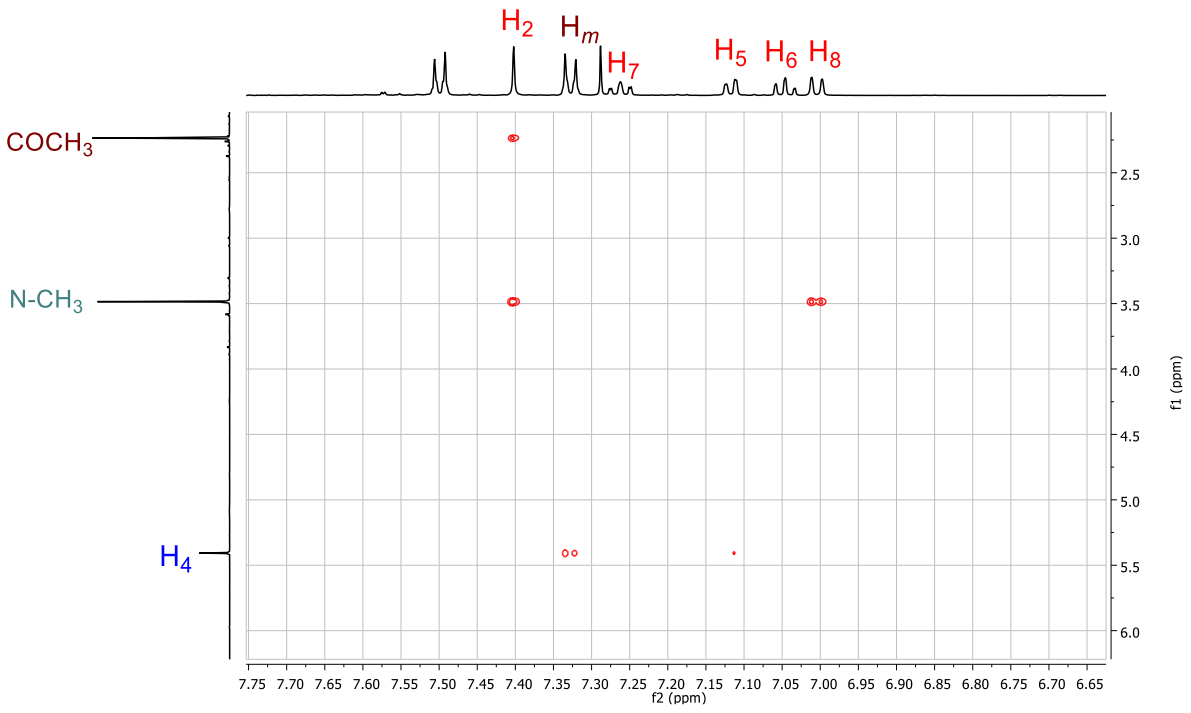
HMBC





NOESY


NC
H_o
H_m
H_4
$COCH_3$
H_2
CH_3
f2 (ppm)
f1 (ppm)

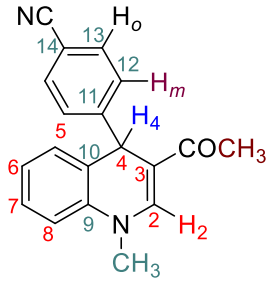

H_2
H_m
H_7
H_5
H_6
H_8
$COCH_3$
N-CH_3
H_4
f2 (ppm)
f1 (ppm)

The structure proposed is supported by the 2D NMR experiments presented above.

Some characteristic signals to establish the connectivity:

HMBC:

Cross-peaks between H4 (5.41 ppm) and C3 (113.18 ppm), C10 (125.7 ppm), C9 (134.7 ppm), C2 (143.9 ppm) and the carbonyl carbon (109.3 ppm).



NOESY:

Cross-peaks between H4 (5.41 ppm) and H$_m$ (7.33 ppm) and H$_5$ (7.11 ppm) respectively.

Cross-peaks between H$_2$ (7.40 ppm) and N-C***H***$_3$ (3.49 ppm) and COC***H***$_3$ (2.23 ppm) respectively.

References:

[1] V. K. Aggarwal, E. Alonso, I. Bae, G. Hynd, K. M. Lydon, M. J. Palmer, M. Patel, M. Porcelloni, J. Richardson, R. A. Stenson, J. R. Studley, J.-L. Vasse and C. L. Winn, *J. Am. Chem. Soc.*, 2003, **125**, 10926.

[2] L. Hui, W. Jianpeng, Q. Zongjun, F. Yang, J. Xuefeng, *Chem. Eur. J.*, 2014, **20**, 8308.

[3] Soda Chanthamath, Suguru Takaki, Kazutaka Shibatomi, and Seiji Iwasa, *Angew. Chem. Int. Ed.*, 2013, **52**, 5818.

[4] T. Sakamoto, T. Nagano, Y. Kondo and H. Yamanaka, *Synthesis*, 1990, 215-218.

[5] Z.Can, M. Shengming, *Org. Lett.*, 2013, **15**, 2782.

[6] Y. So Won, K. Tae Yun, J. Min Jung, J. Su San, *Adv. Synth. Catal*., 2015, **357**, 227.