

Electronic Supplementary Information

**Cascade double isocyanide insertion and C-N coupling of
2-iodo-2'-isocyano-1,1'-biphenyls**

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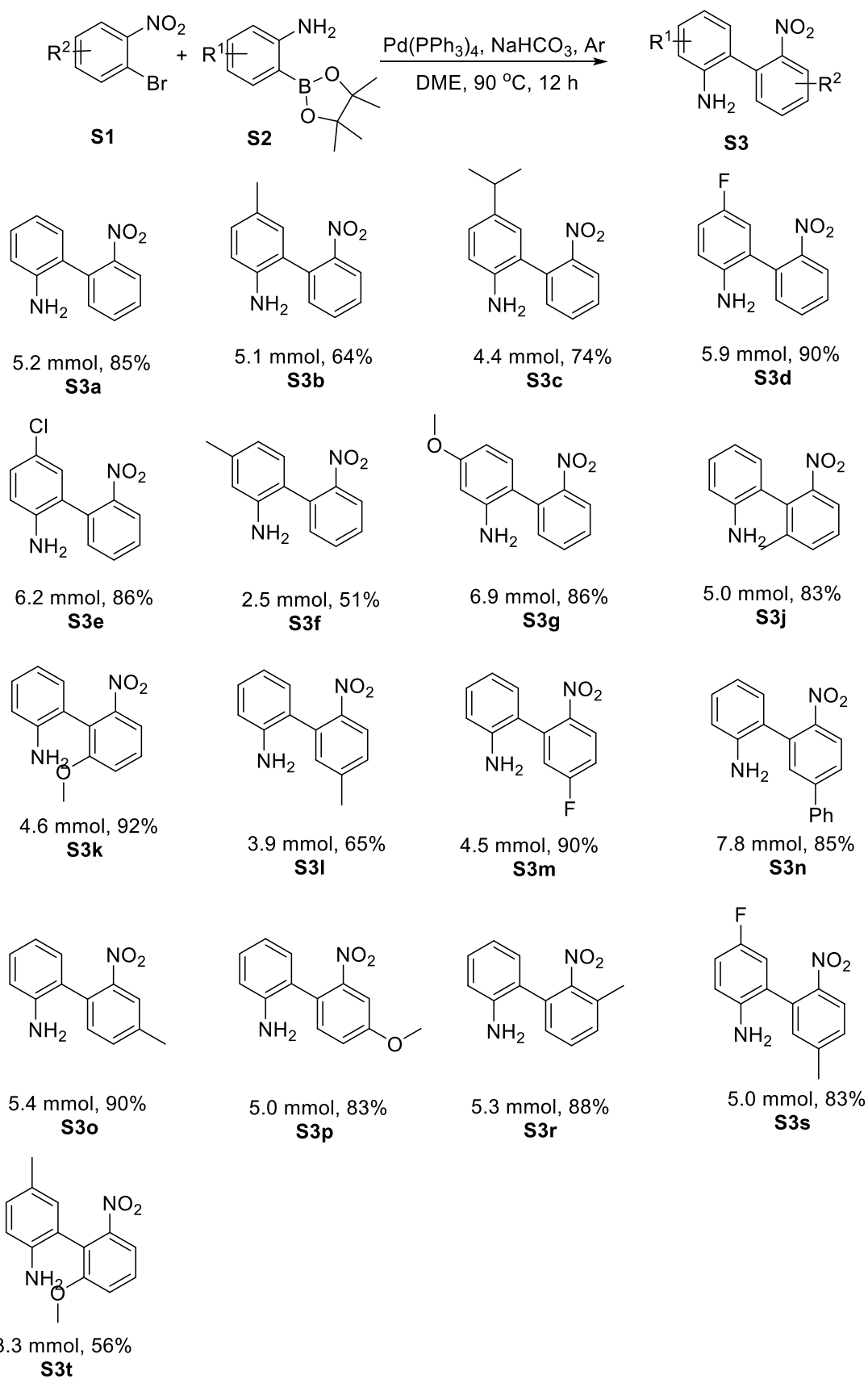
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1. General Information

All the solvents and reagents were purchased from commercial suppliers. ^1H NMR and ^{13}C NMR spectra were recorded on a 400 MHz or/and 500 MHz Bruker FT-NMR spectrometers. All chemical shifts were given as δ value (ppm) with reference to tetramethylsilane (TMS) as an internal standard. The peak patterns are indicated as follows: s, singlet; d, doublet; t, triplet; m, multiplet; q, quartet. The coupling constants, J , are reported in Hertz (Hz). High Resolution Mass (MS) analysis was obtained using on a LC/MSD TOF spectrometer system with Electrospray Ionization (ESI). Melting points were measured on a Mel-Temp apparatus and are uncorrected. IR was recorded on a Bruker Tensor 27 FT-IR spectrometer. Reactions were monitored by thin-layer chromatography (TLC) carried out on commercial silica gel plates (GF254) under UV light. Flash chromatography was performed on silica gel 60 (200–300 mesh).

2. Synthesis and Characterization of the Starting Materials

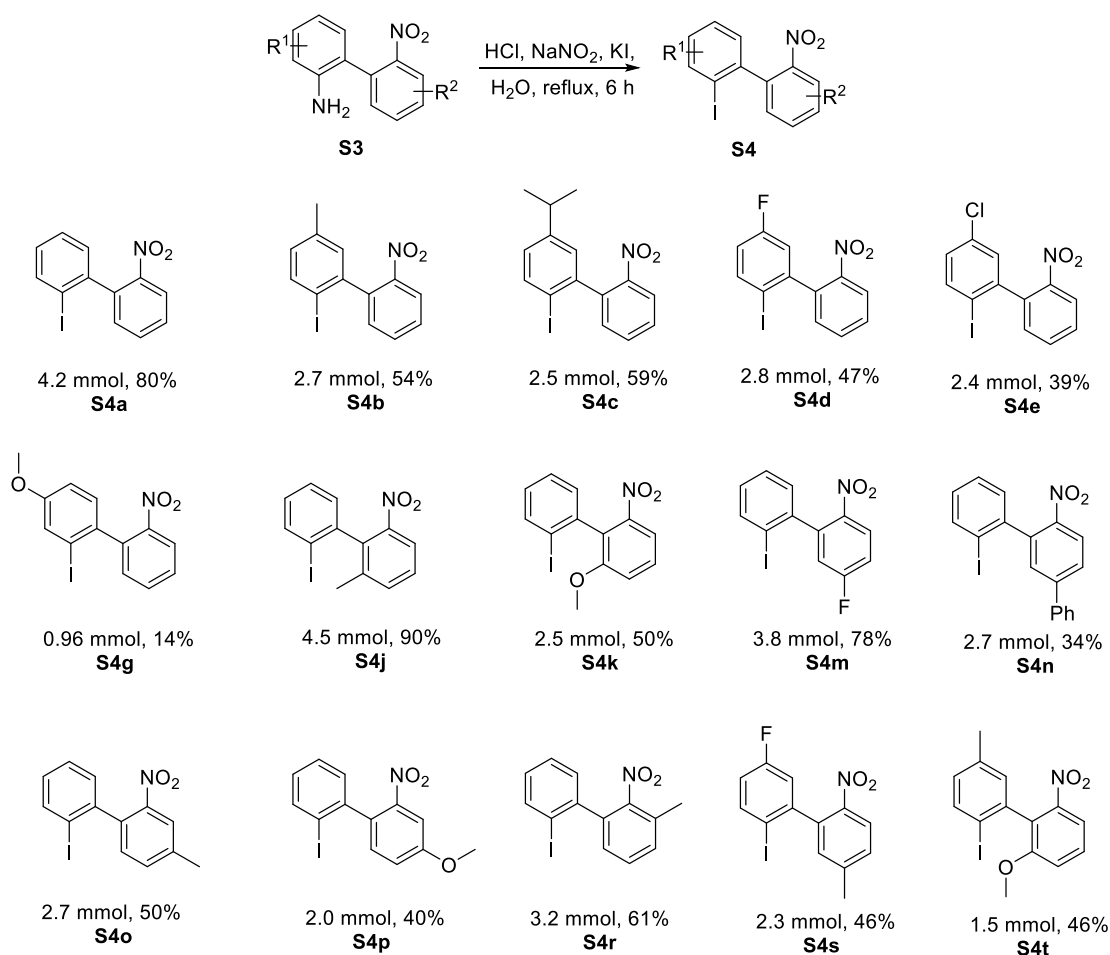
2.1 Preparation of 2'-nitro-[1,1'-biphenyl]-2-amines



The above 2'-nitro-[1,1'-biphenyl]-2-amines were prepared by following a reported procedure.¹ In a 250 mL Schlenk flask, 1-bromo-2-nitrobenzene (1.0 equiv,

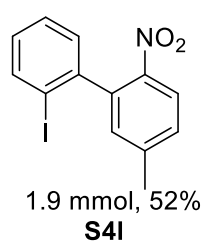
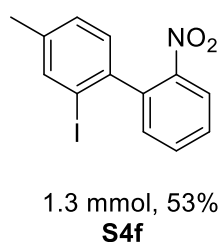
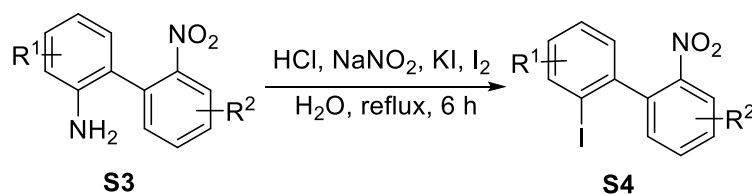
2.0-6.0 mmol) and 2-aminophenylboronic acid pinacol esters (1.2 equiv) were charged under the protection of argon. Then, dimethoxyethane (80 mL) and NaHCO₃ aqueous solution (5.0 equiv, 1.0 mol/L) were added to the above flask and was degassed for 30 minutes. Pd(PPh₃)₄ (5 mol %) was added, then the mixture was heated to 90 °C and stirred for 12 hours (monitored by TLC). After completion of the reaction, it was cooled to room temperature. The reaction mixture was extracted with ethyl acetate (50 mL×3) and the combined organic phase was dried over Na₂SO₄ and concentrated under reduced pressure. The residue was purified by flash chromatography (ethyl acetate/petroleum ether = 1/30 to 1/10) to afford the desired 2'-nitro-[1,1'-biphenyl]-2-amines.

2.2 Iodination of 2'-nitro-[1,1'-biphenyl]-2-amines



The above 2'-nitro-[1,1'-biphenyl]-2-amines were prepared by following a reported procedure.² A mixture of 2'-nitro-[1,1'-biphenyl]-2-amines (1.0 equiv, 1.0-5.0 mmol), water (72 mL), and conc. hydrochloric acid (12 mL) was warmed at 60-70 °C

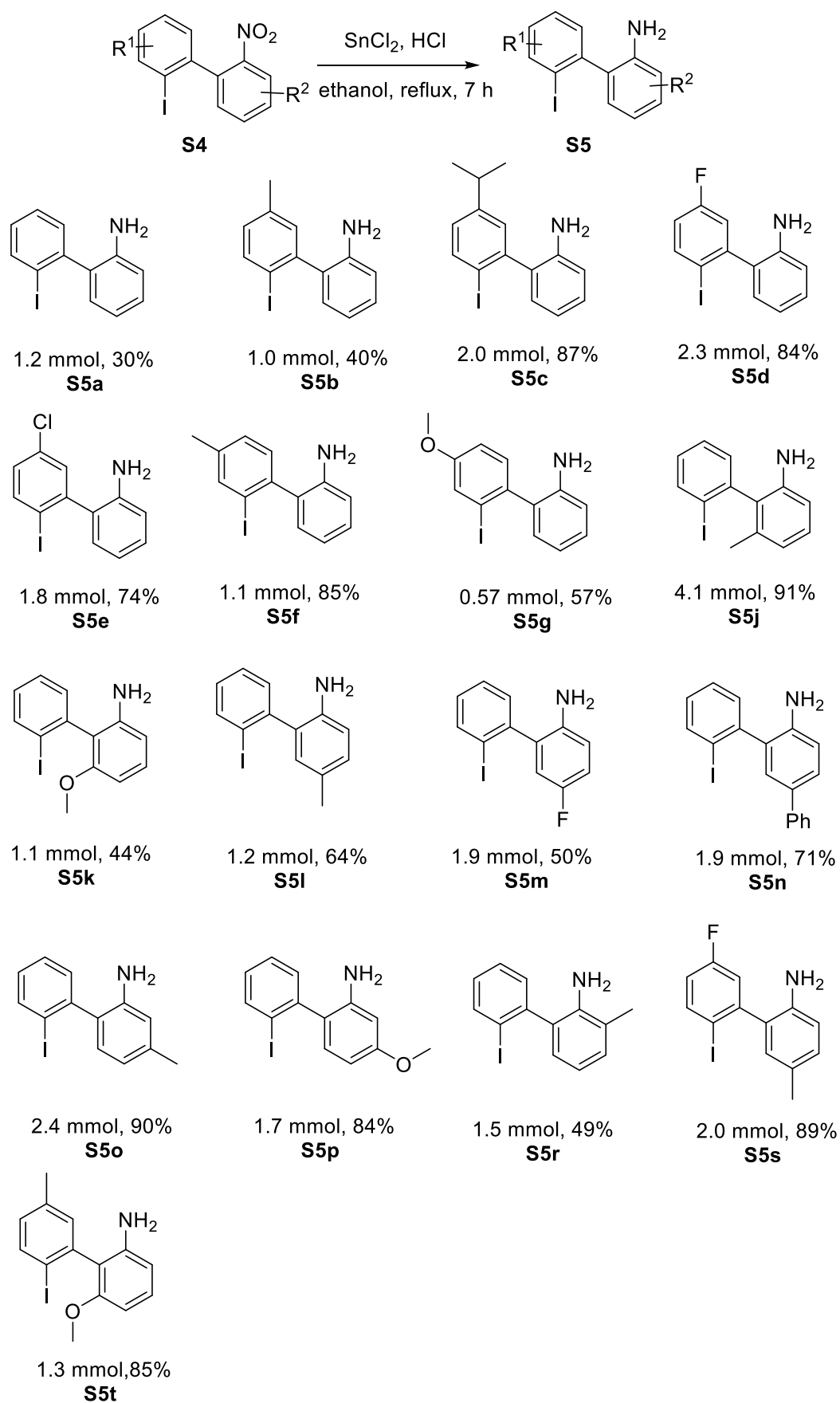
until a clear solution was obtained. Then the mixture was diazotized at 5 °C with sodium nitrite (1.6 equiv) in water (12 mL). After stirring for 30 minutes, a solution of potassium iodine (3.0 equiv) in the minimum amount of water was rapidly added and the mixture was cautiously warmed up to its boiling point and refluxed for 6 hours. After completion of the reaction (monitored by TLC), it was cooled to room temperature. The mixture was quenched by adding saturated aqueous sodium thiosulfate solution and pH was regulated with saturated sodium hydroxide aqueous solution to 8-10. After extraction with ethyl acetate (30 mL×3) and the combined organic phase was dried over Na₂SO₄ and concentrated under reduced pressure. The residue was purified by flash chromatography (ethyl acetate/petroleum ether = 1/30) to afford the desired product.



The above 2'-nitro-[1,1'-biphenyl]-2-amines were prepared by following a reported procedure.³ A mixture of 2'-nitro-[1,1'-biphenyl]-2-amines (1.0 equiv, 1.0-5.0 mol), water (30 mL), and conc. hydrochloric acid (5 mL) was warmed at 60-70 °C until a clear solution was obtained. Then the mixture was diazotized at 5 °C with sodium nitrite (1.2 equiv) in water (5 mL). After stirring for 30 minutes, the resulting solution was poured into a solution of potassium iodine (2.0 equiv) and iodine (0.3 equiv) and the mixture was cautiously warmed up to its boiling point. After completion of the reaction (monitored by TLC), it was cooled to room temperature. The mixture was quenched by adding saturated aqueous sodium thiosulfate solution and pH was regulated with saturated sodium hydroxide aqueous solution to 8-10. The solution was extracted with ethyl acetate (10 mL×3) and the combined organic phase was dried over Na₂SO₄ and concentrated under reduced pressure. The residue was

purified by flash chromatography (ethyl acetate/petroleum ether = 1/30) to afford the desired product.

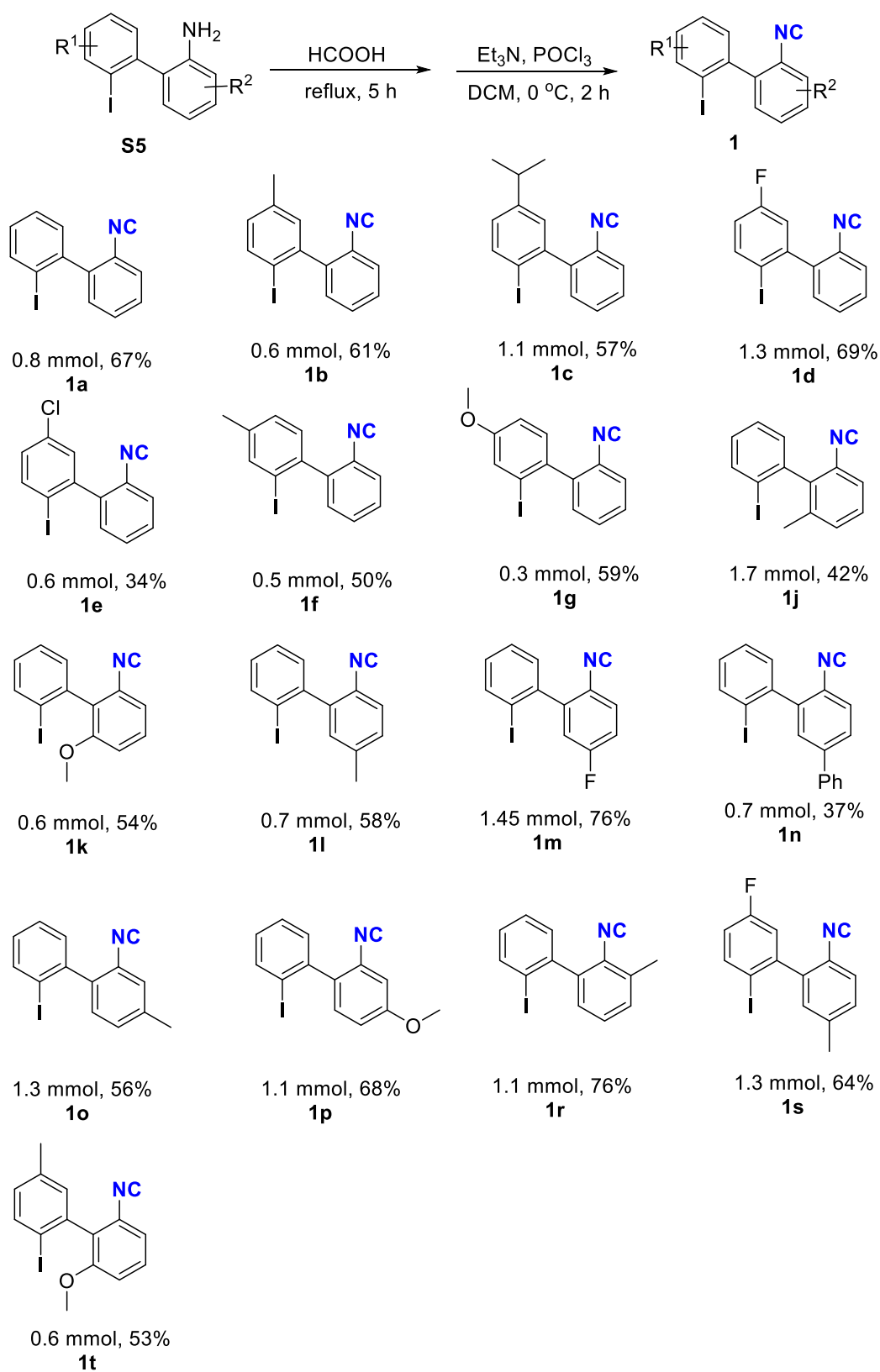
2.3 Preparation of 2'-iodo-[1,1'-biphenyl]-2-amines



The above 2'-nitro-[1,1'-biphenyl]-2-amines were prepared by following a

reported procedure.⁴ A mixture of 2-iodo-2'-nitro-1,1'-biphenyl (1.0 equiv, 1.0-4.0 mmol), anhydrous tin (II) chloride (4.0 equiv), and concentrated hydrochloric acid (4.0 equiv) in absolute ethanol (15 mL) were refluxed for 7 hours. After completion of the reaction (monitored by TLC), it was cooled to room temperature and pH was regulated with saturated sodium hydroxide aqueous solution to 8-10. The mixture was filtered through diatomaceous earth. The filtrate was extracted with ethyl acetate (30 mL×3) and the combined organic phase was dried over Na₂SO₄ and concentrated under reduced pressure. The residue was purified by flash chromatography (ethyl acetate/petroleum ether = 1/10) to afford the desired product.

2.4 Preparation of substituted 2-iodo-2'-isocyano-1,1'-biphenyl



The above substituted 2-iodo-2'-isocyano-1,1'-biphenyl were prepared by following a reported procedure with minor changes.⁵ A mixture of

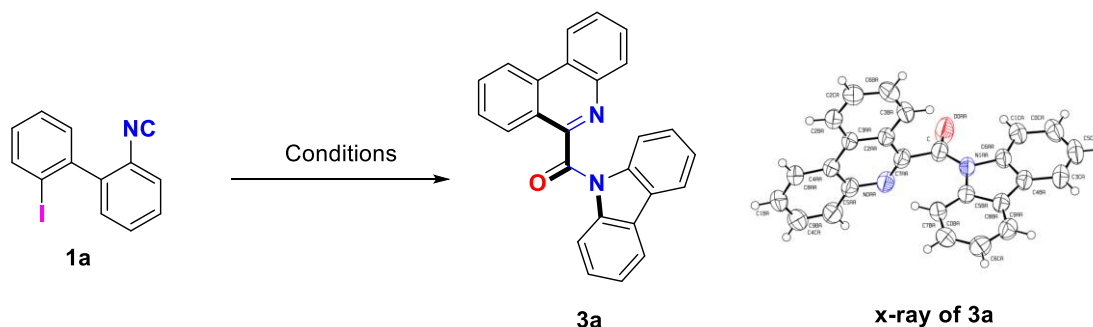
2'-iodo-[1,1'-biphenyl]-2-amine (1.0 equiv, 0.3-2.0 mmol) and formic acid (15 mL) was refluxed for 5 hours. After completion of the reaction (monitored by TLC), the mixture was concentrated under reduced pressure to afford crude product as a yellow oil for next step without further purification.

The crude product was dissolved in dichloromethane (20 mL) and NEt₃ (3.0 equiv) and cooled to 0 °C by ice bath. To the above mixture was added phosphory chloride (1.1 equiv) dropwise. After stirring for an hour, the reaction temperature was warmed to room temperature and the mixture was stirred for another hour. When the reaction was completed, the resulting mixture was cooled to 0 °C and aqueous saturated solution of sodium carbonate (10 mL) was added dropwise to quench the reaction. After vigorous stirring for an hour, the mixture was extracted with ethyl acetate (10 mL×3) and the combined organic phase was dried over Na₂SO₄ and concentrated under reduced pressure. The residue was purified by flash chromatography (ethyl acetate/petroleum ether = 1/50) to afford the desired product.

3. Optimization of Reaction Condition and General Procedures

3.1 Optimization of Reaction Condition for the Synthesis of 3a

Table S1. Optimization of the Reaction Conditions ^a



Entry	[Pd]	[Cu]	Base	Solvent	Yield (%) ^b
1 ^c	Pd(OAc) ₂	CuI	K ₂ CO ₃	DMSO	48
2	Pd(OAc) ₂	CuI	K ₂ CO ₃	DMSO	67
3	Pd(acac) ₂	CuI	K ₂ CO ₃	DMSO	56
4	Pd(CF ₃ COO) ₂	CuI	K ₂ CO ₃	DMSO	65

5	PdCl ₂ (CH ₃ CN) ₂	CuI	K ₂ CO ₃	DMSO	44
6	Pd(OAc) ₂	CuCl	K ₂ CO ₃	DMSO	50
7	Pd(OAc) ₂	CuBr	K ₂ CO ₃	DMSO	62
8	Pd(OAc) ₂	Cu(acac) ₂	K ₂ CO ₃	DMSO	62
9	Pd(OAc) ₂	Cu ₂ O	K ₂ CO ₃	DMSO	52
10 ^d	Pd(OAc) ₂	CuI	K ₂ CO ₃	DMSO	46
11 ^e	Pd(OAc) ₂	CuI	K ₂ CO ₃	DMSO	18
12 ^f	Pd(OAc) ₂	CuI	K ₂ CO ₃	DMSO	60
13 ^g	Pd(OAc) ₂	CuI	K ₂ CO ₃	DMSO	45
14	Pd(OAc) ₂	CuI	K ₂ CO ₃	acetone	19
15	Pd(OAc) ₂	CuI	K ₂ CO ₃	DCM	4
16	Pd(OAc) ₂	CuI	K ₂ CO ₃	EtOH	11
17	Pd(OAc) ₂	CuI	Na ₂ CO ₃	DMSO	48
18	Pd(OAc) ₂	CuI	CS ₂ CO ₃	DMSO	48
19	Pd(OAc) ₂	CuI	DBU	DMSO	56
20	Pd(OAc) ₂	CuI	DIPEA	DMSO	5
21 ^h	Pd(OAc) ₂	CuI	K ₂ CO ₃	DMSO	59
22 ⁱ	Pd(OAc) ₂	CuI	K ₂ CO ₃	DMSO	65
23 ^j	Pd(OAc) ₂	CuI	K ₂ CO ₃	DMSO	80
24 ^k	Pd(OAc) ₂	CuI	K ₂ CO ₃	DMSO	70
25 ^{l, o}	Pd(OAc) ₂	CuI	K ₂ CO ₃	DMSO	72
26 ^{m, o}	Pd(OAc) ₂	CuI	K ₂ CO ₃	DMSO	90
27 ^{n, o}	Pd(OAc) ₂	CuI	K ₂ CO ₃	DMSO	84

^a Reaction conditions: an aqueous solution of base (0.12 mmol) in water (0.15 mL) was added to a mixture of **1a** (0.1 mmol), [Pd] (10 mol%), [Cu] (20 mol%) in solvent (1.5 mL) via syringe bump within 15 minutes and stirred for 30 minutes, at 23 °C, in Ar. ^b The yields were determined by ¹H NMR using CH₂Br₂ as internal standard. ^c PPh₃ (0.01 mmol) was used. ^d At 40 °C. ^e At 60 °C. ^f 0.5 equiv base was used. ^g 2.0 equiv base was used. ^h Pd(OAc)₂ (5 mol%), CuI (20 mol%) were used. ⁱ Pd(OAc)₂ (2 mol%), CuI (20 mol%) were used. ^j Pd(OAc)₂ (10 mol%), CuI (15 mol%) were used. ^k Pd(OAc)₂ (10 mol%), CuI (10 mol%) were used. ^l Pd(OAc)₂ (10 mol%), CuI (20 mol%) were used. ^m Pd(OAc)₂ (2 mol%), CuI (20 mol%) were used. ⁿ Pd(OAc)₂ (2 mol%), CuI (15 mol%) were used. ^o CuI was added to the mixture after addition of

aqueous solution of K_2CO_3 when the substrate was consumed completely.

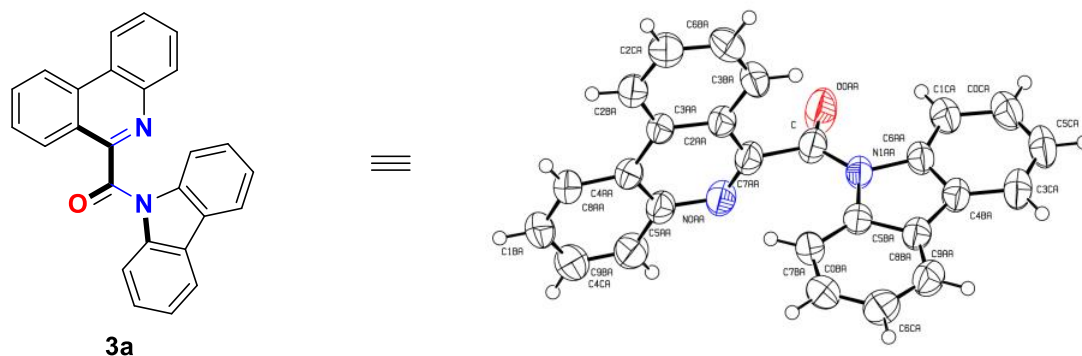
3.2 Procedures for the Synthesis of **2a**

To a solution of **1a** (1.0 equiv, 0.1 mmol) in anhydrous DMSO (1.5 mL) was added $\text{Pd}(\text{OAc})_2$ (2 mol%). The tube was then evacuated and backfilled with argon for 3 times and stirred at 23 °C for 15 minutes. Then an aqueous solution of K_2CO_3 (1.2 equiv) in H_2O (0.15 mL) was added to the mixture via syringe bump with a duration time of 15 minutes and stirred for 30 minutes. After completion of the reaction (monitored by TLC), the mixture was washed with saturated aqueous NH_4Cl solution. The solution was extracted with ethyl acetate (10 mL×3) and the combined organic phase was dried over Na_2SO_4 and concentrated under reduced pressure. The residue was purified by flash chromatography (ethyl acetate/petroleum ether = 1/50-1/30) to afford the desired product **2a**.

3.3 General Procedures for the Synthesis of **3**

To a 10 mL oven-dried Schlenk tube was added **1** (1.0 equiv, 0.1 mmol), $\text{Pd}(\text{OAc})_2$ (2 mol%) and anhydrous DMSO (1.5 mL). The tube was then evacuated and backfilled with argon for 3 times and stirred at 23 °C. Then an aqueous solution of K_2CO_3 (1.2 equiv) in H_2O (0.15 mL) was added to the mixture via syringe bump with a duration time of 15 minutes and stirred for 30 minutes to 4 hours. After complete consumption of **1** (monitored by TLC), CuI (20 mol%) was added to the mixture and stirred for 30 minutes. The mixture was washed with saturated aqueous NH_4Cl solution. The solution was extracted with ethyl acetate (10 mL×3) and the combined organic phase was dried over Na_2SO_4 and concentrated under reduced pressure. The residue was purified by flash chromatography (ethyl acetate/petroleum ether = 1/50-1/30) to afford the desired product **3**.

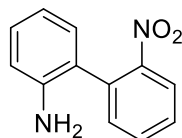
4. X-ray Crystallography of 3a



Crystallographic data for compound **3a** (CCDC-1582339) has been deposited with the Cambridge Crystallographic Data Centre. Copies of the data can be obtained, free of charge, on application to CCDC (Email:deposit@ccdc.cam.ac.uk).

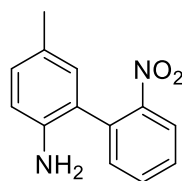
Bond precision: C-C = 0.0033 Å		Wavelength=1.54184
Cell:	a=8.9209(3)	b=9.1610(3) c=12.7949(4)
	alpha=101.938(2)	beta=106.434(3) gamma=107.197(3)
Temperature:	293 K	
	Calculated	Reported
Volume	908.67(6)	908.67(4)
Space group	P -1	P -1
Hall group	-P 1	-P 1
Moiety formula	C26 H16 N2 O	C26 H16 N2 O
Sum formula	C26 H16 N2 O	C26 H16 N2 O
Mr	372.41	372.41
Dx, g cm ⁻³	1.361	1.361
Z	2	2
Mu (mm ⁻¹)	0.660	0.660
F000	388.0	388.0
F000'	389.10	
h, k, lmax	10, 10, 15	10, 10, 15
Nref	3225	3191
Tmin, Tmax	0.789, 0.876	0.678, 1.000
Tmin'	0.719	
Correction method= # Reported T Limits: Tmin=0.678 Tmax=1.000		
AbsCorr = MULTI-SCAN		
Data completeness=	0.989	Theta(max)= 66.780
R(reflections)=	0.0457(2767)	wR2(reflections)= 0.1563(3191)
S =	1.214	Npar= 262

5. Characterization Data



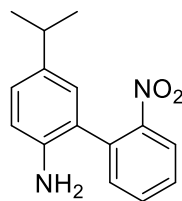
2'-Nitro-[1,1'-biphenyl]-2-amine (S3a)

Yellow oil (1112.8 mg, 85% yield). ^1H NMR (500 MHz, CDCl_3): δ 7.96 (d, J = 13.5 Hz, 1H), 7.67-7.64 (m, 1H), 7.54-7.50 (m, 1H), 7.46 (d, J = 8.0 Hz, 1H), 7.21-7.18 (m, 1H), 6.99 (d, J = 7.5 Hz, 1H), 6.84-6.80 (m, 1H), 6.77 (d, J = 12.0 Hz, 1H), 3.16 (br, 1H); ^{13}C NMR (125 MHz, CDCl_3): 150.16, 144.02, 134.06, 133.20, 133.10, 129.83, 129.58, 128.98, 124.66, 123.70, 119.2, 116.20; HRMS (ESI) calcd for $\text{C}_{12}\text{H}_{11}\text{N}_2\text{O}_2^+$ $[\text{M}+\text{H}]^+$ 215.0815, found 215.0819.



5-Methyl-2'-nitro-[1,1'-biphenyl]-2-amine (S3b)

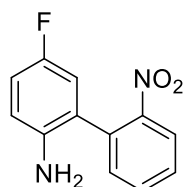
Yellow solid (1162.8 mg, 64% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.94 (dd, J = 0.8 Hz, J = 8.0 Hz, 1H), 7.66-7.62 (m, 1H), 7.53-7.49 (m, 1H), 7.44 (dd, J = 0.8 Hz, J = 8.4 Hz, 1H), 7.01 (dd, J = 1.6 Hz, J = 8.0 Hz, 1H), 6.80 (d, J = 1.2 Hz, 1H), 6.69 (d, J = 8.0 Hz, 1H), 2.98 (br, 2H), 2.25 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 149.76, 141.15, 133.89, 132.78, 132.76, 130.06, 129.57, 128.48, 128.11, 124.22, 123.52, 116.05, 20.34; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{13}\text{N}_2\text{O}_2^+$ $[\text{M}+\text{H}]^+$ 229.0972, found 229.0962.



5-Isopropyl-2'-nitro-[1,1'-biphenyl]-2-amine (S3c)

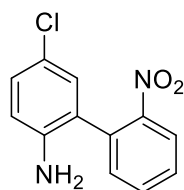
Yellow oil (1126.4 mg, 74% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.95-7.93 (m, 1H),

7.66-7.62 (m, 1H), 7.52-7.47 (m, 2H), 7.07 (dd, $J = 1.6$ Hz, $J = 8.4$ Hz, 1H), 6.85 (d, $J = 1.6$ Hz, 1H), 6.72 (d, $J = 8.4$ Hz, 1H), 3.20 (br, 2H), 2.87-2.77 (m, 1H), 1.21 (d, $J = 6.8$ Hz, 6H); ^{13}C NMR (125 MHz, CDCl_3): 149.96, 141.50, 139.47, 134.15, 132.84, 132.76, 128.52, 127.45, 127.21, 124.27, 123.36, 116.08, 33.18, 24.17; HRMS (ESI) calcd for $\text{C}_{15}\text{H}_{17}\text{N}_2\text{O}_2^+$ $[\text{M}+\text{H}]^+$ 257.1285, found 257.1282.



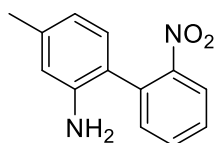
5-Fluoro-2'-nitro-[1,1'-biphenyl]-2-amine (S3d)

Yellow solid (1368.8 mg, 90% yield). ^1H NMR (500 MHz, CDCl_3): δ 8.00 (d, $J = 8.0$ Hz, 1H), 7.70-7.67 (m, 1H), 7.57-7.54 (m, 1H), 7.44 (d, $J = 7.5$ Hz, 1H), 6.94-6.90 (m, 1H), 6.75 (dd, $J = 2.5$ Hz, $J = 8.0$ Hz, 1H), 6.75 (dd, $J = 5.0$ Hz, $J = 9.0$ Hz, 1H), 3.33 (br, 2H); ^{13}C NMR (125 MHz, CDCl_3): 156.31 (d, $J = 236.3$ Hz), 149.55, 139.94, 133.25, 132.77, 132.66, 129.20, 124.65, 124.60, 116.98 (d, $J = 7.6$ Hz), 116.18 (d, $J = 22.1$ Hz), 115.95 (d, $J = 23.3$ Hz); ^{19}F NMR (470 MHz, CDCl_3): -126.33 (s, 1F); HRMS (ESI) calcd for $\text{C}_{12}\text{H}_{10}\text{FN}_2\text{O}_2^+$ $[\text{M}+\text{H}]^+$ 233.0721, found 233.0712.



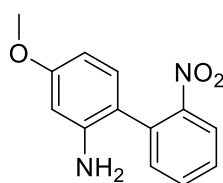
5-chloro-2'-nitro-[1,1'-biphenyl]-2-amine (S3e)

Yellow oil (1513.9 mg, 86% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.96 (d, $J = 2.4$ Hz, 1H), 7.63 (dd, $J = 2.0$ Hz, $J = 8.0$ Hz, 1H), 7.42 (d, $J = 8.4$ Hz, 1H), 7.23-7.19 (m, 1H), 6.96 (dd, $J = 1.6$ Hz, $J = 7.6$ Hz, 1H), 6.84-6.80 (m, 1H), 6.76 (d, $J = 7.2$ Hz, 1H), 3.28 (br, 2H); ^{13}C NMR (125 MHz, CDCl_3): 150.30, 143.96, 134.71, 134.26, 133.37, 132.47, 130.14, 129.51, 124.87, 122.49, 119.32, 116.33; HRMS (ESI) calcd for $\text{C}_{12}\text{H}_{10}\text{ClN}_2\text{O}_2^+$ $[\text{M}+\text{H}]^+$ 249.0425, found 249.0431.



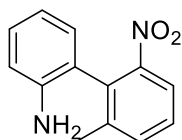
4-Methyl-2'-nitro-[1,1'-biphenyl]-2-amine (S3f)

Yellow oil (570.0 mg, 51% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.93 (dd, $J = 0.8$ Hz, $J = 8.0$ Hz, 1H), 7.65-7.61 (m, 1H), 7.52-7.48 (m, 1H), 7.48-7.44 (m, 1H), 6.88 (d, $J = 7.6$ Hz, 1H), 6.64 (d, $J = 8.0$ Hz, 1H), 6.60 (s, 1H), 3.27 (br, 1H); ^{13}C NMR (125 MHz, CDCl_3): 150.32, 143.82, 139.84, 134.08, 133.22, 133.07, 129.47, 128.77, 124.58, 120.92, 120.18, 116.90, 21.62; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{13}\text{N}_2\text{O}_2^+$ $[\text{M}+\text{H}]^+$ 229.0972, found 229.0965.



4-Methoxy-2'-nitro-[1,1'-biphenyl]-2-amine (S3g)

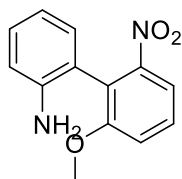
Yellow oil (1683.6 mg, 86% yield). ^1H NMR (500 MHz, CDCl_3): δ 7.90 (d, $J = 7.5$ Hz, 1H), 7.64-7.61 (m, 1H), 7.51-7.47 (m, 1H), 7.45 (dd, $J = 0.5$ Hz, $J = 7.5$ Hz, 1H), 6.90 (d, $J = 8.5$ Hz, 1H), 7.39 (dd, $J = 2.5$ Hz, $J = 8.5$ Hz, 1H), 6.32 (d, $J = 2.0$ Hz, 1H), 3.79 (s, 3H), 3.55 (s, 2H); ^{13}C NMR (125 MHz, CDCl_3): 160.93, 150.24, 145.01, 133.49, 133.18, 132.74, 130.33, 128.46, 124.30, 116.18, 104.69, 101.49, 55.24; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{13}\text{N}_2\text{O}_3^+$ $[\text{M}+\text{H}]^+$ 245.0921, found 245.0914.



2'-Methyl-6'-nitro-[1,1'-biphenyl]-2-amine (S3j)

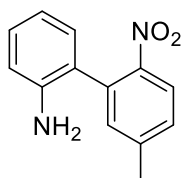
Yellow oil (1140.0 mg, 83% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.69 (d, $J = 8.0$ Hz, 1H), 7.52 (d, $J = 7.6$ Hz, 1H), 7.42-7.38 (m, 1H), 7.22-7.18 (m, 1H), 6.86-6.84 (m, 1H), 6.81-6.77 (m, 2H), 3.25 (br, 2H), 2.16 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 151.40, 144.38, 141.08, 134.25, 132.57, 129.74, 129.08, 128.63, 122.06, 121.50, 119.15, 115.98, 20.23; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{13}\text{N}_2\text{O}_2^+$ $[\text{M}+\text{H}]^+$ 229.0972, found

229.0962.



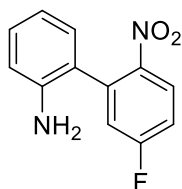
2'-Methoxy-6'-nitro-[1,1'-biphenyl]-2-amine (S3k)

Yellow solid (1122.4 mg, 92% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.50-7.44 (m, 2H), 7.21-7.18 (m, 2H), 6.92 (d, $J = 7.2$ Hz, 1H), 6.81-6.78 (m, 2H), 3.81 (s, 3H), 3.20 (br, 2H); ^{13}C NMR (125 MHz, CDCl_3): 158.15, 151.61, 144.60, 129.64, 129.45, 122.19, 118.82, 118.67, 115.78, 115.65, 114.77, 56.64; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{13}\text{N}_2\text{O}_3^+$ $[\text{M}+\text{H}]^+$ 245.0921, found 245.0921.



5'-Methyl-2'-nitro-[1,1'-biphenyl]-2-amine (S3l)

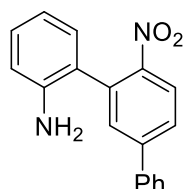
Yellow oil (809.2 mg, 65% yield). ^1H NMR (500 MHz, CDCl_3): δ 7.89 (d, $J = 8.5$ Hz, 1H), 7.29 (d, $J = 8.5$ Hz, 1H), 7.23 (s, 3H), 7.19-7.16 (m, 1H), 6.96 (dd, $J = 1.5$ Hz, $J = 7.5$ Hz, 1H), 6.81-6.79 (m, 1H), 6.75 (d, $J = 8.0$ Hz, 1H), 3.50 (br, 2H), 2.45 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 147.40, 144.21, 143.72, 133.88, 133.30, 129.33, 129.22, 129.16, 124.60, 123.93, 118.81, 115.81, 21.40; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{13}\text{N}_2\text{O}_2^+$ $[\text{M}+\text{H}]^+$ 229.0972, found 229.0973.



5'-Fluoro-2'-nitro-[1,1'-biphenyl]-2-amine (S3m)

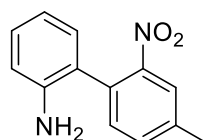
Yellow oil (1044.0 mg, 90% yield). ^1H NMR (400 MHz, CDCl_3): δ 8.05-8.02 (m, 1H), 7.23-7.15 (m, 3H), 6.98 (dd, $J = 1.2$ Hz, $J = 7.6$ Hz, 1H), 6.85-6.81 (m, 1H), 6.77 (d, J

= 8.0 Hz, 1H), 3.36 (br, 2H); ^{13}C NMR (125 MHz, CDCl_3): 164.34 (d, $J = 256.3$ Hz), 145.78, 143.40, 137.05 (d, $J = 8.8$ Hz), 129.85, 128.91, 127.15 (d, $J = 10.0$ Hz), 122.52, 119.63 (d, $J = 23.8$ Hz), 118.97, 116.03, 115.60 (d, $J = 22.9$ Hz); ^{19}F NMR (470 MHz, CDCl_3): -103.95 (s, 1F); HRMS (ESI) calcd for $\text{C}_{12}\text{H}_{10}\text{FN}_2\text{O}_2^+$ $[\text{M}+\text{H}]^+$ 233.0721, found 233.0717.



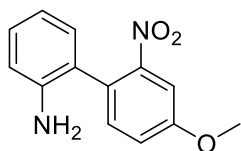
6'-Nitro-[1,1':3',1''-terphenyl]-2-amine (S3n)

Yellow oil (2262.0 mg, 85% yield). ^1H NMR (500 MHz, CDCl_3): δ 8.08 (d, $J = 8.5$ Hz, 1H), 7.73 (dd, $J = 1.5$ Hz, $J = 8.5$ Hz, 1H), 7.68 (d, $J = 1.5$ Hz, 1H), 7.64 (d, $J = 7.5$ Hz, 2H), 7.50-7.47 (m, 2H), 7.45-7.42 (m, 1H), 7.24-7.21 (m, 1H), 7.06-7.05 (m, 1H), 6.87-6.84 (m, 1H), 6.80 (d, $J = 8.0$ Hz, 1H), 3.54 (br, 2H); ^{13}C NMR (125 MHz, CDCl_3): 148.42, 146.12, 143.77, 138.55, 134.51, 131.38, 129.58, 129.30, 129.22, 128.93, 127.42, 127.04, 125.22, 123.72, 118.95, 115.94; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{15}\text{N}_2\text{O}_2^+$ $[\text{M}+\text{H}]^+$ 291.1128, found 291.1124.



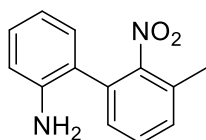
4'-Methyl-2'-nitro-[1,1'-biphenyl]-2-amine (S3o)

Yellow oil (1231.2 mg, 90% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.77 (d, $J = 0.4$ Hz, 1H), 7.46 (dd, $J = 0.8$ Hz, $J = 7.6$ Hz, 1H), 7.33 (d, $J = 7.6$ Hz, 1H), 7.21-7.16 (m, 1H), 6.98-6.96 (m, 1H), 6.82-6.78 (m, 1H), 6.76 (d, $J = 8.0$ Hz, 1H), 3.35 (br, 2H), 2.48 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 149.90, 144.13, 139.54, 134.00, 132.82, 131.02, 129.67, 129.63, 124.97, 123.73, 119.12, 116.08, 21.28; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{13}\text{N}_2\text{O}_2^+$ $[\text{M}+\text{H}]^+$ 229.0972, found 229.0966.



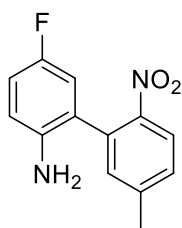
5'-Methoxy-2'-nitro-[1,1'-biphenyl]-2-amine (S3p)

Yellow oil (1220.0 mg, 83% yield). ^1H NMR (500 MHz, CDCl_3): δ 7.48 (s, 1H), 7.35 (d, $J = 8.5$ Hz, 1H), 7.20-7.17 (m, 2H), 6.97 (d, $J = 7.5$ Hz, 1H), 6.81-6.78 (m, 1H), 6.76 (d, $J = 8.0$ Hz, 1H), 3.91 (s, 3H), 3.54 (br, 2H); ^{13}C NMR (125 MHz, CDCl_3): 159.52, 150.30, 144.11, 133.64, 129.64, 129.33, 125.72, 123.34, 119.45, 118.86, 115.79, 109.31, 56.01; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{13}\text{N}_2\text{O}_3^+$ $[\text{M}+\text{H}]^+$ 245.0921, found 245.0918.



3'-Methyl-2'-nitro-[1,1'-biphenyl]-2-amine (S3r)

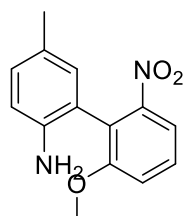
Yellow oil (1208.4 mg, 88% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.46-7.42 (m, 1H), 7.32 (dd, $J = 0.4$ Hz, $J = 7.6$ Hz, 1H), 7.28 (d, $J = 7.6$ Hz, 1H), 7.20-7.15 (m, 1H), 6.99 (dd, $J = 1.2$ Hz, $J = 7.6$ Hz, 1H), 6.79-6.74 (m, 2H), 3.44 (br, 2H), 2.39 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 152.12, 144.42, 131.96, 131.03, 130.59, 130.43, 130.12, 129.63, 122.11, 118.88, 116.2017.83; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{13}\text{N}_2\text{O}_2^+$ $[\text{M}+\text{H}]^+$ 229.0972, found 229.0969.



5-Fluoro-5'-methyl-2'-nitro-[1,1'-biphenyl]-2-amine (S3s)

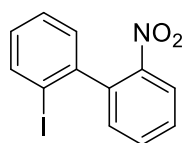
Yellow oil (1230.0 mg, 83% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.94 (d, $J = 8.4$ Hz, 1H), 7.33 (d, $J = 8.4$ Hz, 1H), 7.21 (s, 1H), 6.93-6.88 (m, 1H), 6.75-6.68 (m, 2H), 3.44 (br, 2H), 2.47 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 156.31 (d, $J = 236.3$ Hz), 147.14, 144.60, 139.92, 133.02 (d, $J = 30.0$ Hz), 129.69, 125.19 (d, $J = 7.6$ Hz),

124.81, 116.83 (d, $J = 8.8$ Hz), 115.91 (d, $J = 7.9$ Hz), 115.73 (d, $J = 9.0$ Hz), 21.45;
 ^{19}F NMR (470 MHz, CDCl_3): -126.43 (s, 1F); HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{12}\text{FN}_2\text{O}_2^+$
[$\text{M}+\text{H}$] $^+$ 247.0877, found 247.0867.



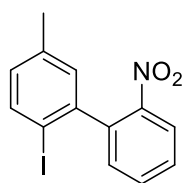
2'-Methoxy-5-methyl-6'-nitro-[1,1'-biphenyl]-2-amine (S3t)

Yellow oil (851.0 mg, 56% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.48-7.42 (m, 2H), 7.18 (dd, $J = 1.6$ Hz, $J = 7.6$ Hz, 1H), 7.01-6.99 (m, 1H), 6.72-6.69 (m, 2H), 3.82 (s, 3H), 3.43 (br, 2H), 2.23 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 158.24, 151.76, 124.28, 130.25, 130.01, 129.42, 128.00, 122.54, 119.08, 116.10, 115.72, 114.78, 56.76, 24.94, 20.49; HRMS (ESI) calcd for $\text{C}_{14}\text{H}_{15}\text{N}_2\text{O}_3^+$ [$\text{M}+\text{H}$] $^+$ 259.1077, found 259.1072.



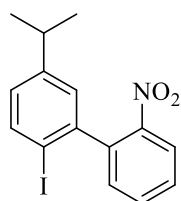
2-Iodo-2'-nitro-1,1'-biphenyl (S4a)

Yellow solid (1352.0 mg, 80% yield). ^1H NMR (500 MHz, CDCl_3): δ 8.11 (d, $J = 8.0$ Hz, 1H), 7.93 (d, $J = 8.0$ Hz, 1H), 7.70-7.67 (m, 1H), 7.60-7.57 (m, 1H), 7.43-7.39 (m, 1H), 7.29 (d, $J = 8.0$ Hz, 1H), 7.22 (d, $J = 9.0$ Hz, 1H), 7.10-7.07 (m, 1H); ^{13}C NMR (125 MHz, CDCl_3): 148.46, 143.70, 139.45, 139.30, 133.29, 133.76, 129.76, 139.39, 129.19, 128.46, 124.78, 98.41; HRMS (ESI) calcd for $\text{C}_{12}\text{H}_9\text{INO}_2^+$ [$\text{M}+\text{H}$] $^+$ 325.9672, found 325.9673.



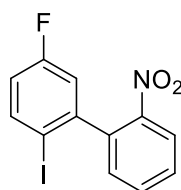
2-Iodo-5-methyl-2'-nitro-1,1'-biphenyl (S4b)

Yellow solid (915.3 mg, 54% yield). ^1H NMR (400 MHz, CDCl_3): δ 8.09 (d, $J = 8.4$ Hz, 1H), 7.77 (d, $J = 4.0$ Hz, 1H), 7.69-7.65 (m, 1H), 7.58-7.54 (m, 1H), 7.31-7.29 (m, 1H), 7.03 (d, $J = 1.2$ Hz, 1H), 6.92-6.90 (m, 1H), 2.32 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 148.13, 143.08, 139.15, 138.66, 138.18, 132.86, 132.44, 130.45, 129.65, 128.90, 124.37, 93.94, 20.92; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{11}\text{INO}_2^+$ $[\text{M}+\text{H}]^+$ 339.9829, found 339.9828.



2-Iodo-5-isopropyl-2'-nitro-1,1'-biphenyl (S4c)

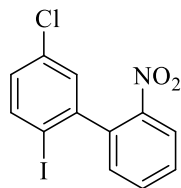
Yellow oil (917.5 mg, 59% yield). ^1H NMR (500 MHz, CDCl_3): δ 8.08 (d, $J = 8.0$ Hz, 1H), 7.81 (d, $J = 8.5$ Hz, 1H), 7.68-7.66 (m, 1H), 7.58-7.55 (m, 1H), 7.32 (d, $J = 7.5$ Hz, 1H), 7.07 (s, 1H), 6.97 (d, $J = 8.0$ Hz, 1H), 2.92-2.84 (m, 1H), 1.25-1.23 (m, 6H); ^{13}C NMR (125 MHz, CDCl_3): 149.49, 148.52, 143.35, 139.58, 139.06, 133.14, 132.84, 129.22, 128.11, 127.58, 124.65, 94.60, 33.98, 24.07, 24.06; HRMS (ESI) calcd for $\text{C}_{15}\text{H}_{15}\text{INO}_2^+$ $[\text{M}+\text{H}]^+$ 368.0142, found 368.0163.



5-Fluoro-2-iodo-2'-nitro-1,1'-biphenyl (S4d)

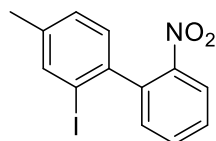
Yellow solid (960.4 mg, 47% yield). ^1H NMR (400 MHz, CDCl_3): δ 8.14 (d, $J = 8.4$ Hz, 1H), 7.84 (dd, $J = 5.6$ Hz, $J = 8.8$ Hz, 1H), 7.73-7.69 (m, 1H), 7.63-7.59 (m, 1H), 7.28 (d, $J = 7.8$ Hz, 1H), 6.98 (dd, $J = 2.8$ Hz, $J = 8.8$ Hz, 1H), 6.89-6.84 (m, 1H); ^{13}C NMR (125 MHz, CDCl_3): 162.73 (d, $J = 247.5$ Hz), 147.76, 145.26 (d, $J = 7.5$ Hz), 140.15 (d, $J = 7.5$ Hz), 138.10 (d, $J = 1.3$ Hz), 133.25, 132.08, 129.48, 124.64, 116.77 (d, $J = 51.5$ Hz), 116.60 (d, $J = 53.1$ Hz), 91.14 (d, $J = 3.8$ Hz); ^{19}F NMR (470 MHz, CDCl_3): -113.87 (s, 1F); HRMS (ESI) calcd for $\text{C}_{12}\text{H}_8\text{FINO}_2^+$ $[\text{M}+\text{H}]^+$ 343.9578,

found 343.9592.



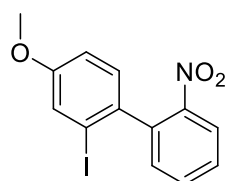
5-chloro-2-iodo-2'-nitro-1,1'-biphenyl (S4e)

Yellow solid (853.9 mg, 39% yield). ^1H NMR (400 MHz, CDCl_3): δ 8.09 (d, J = 2.4 Hz, 1H), 7.90 (dd, J = 0.8 Hz, J = 8.0 Hz, 1H), 7.64 (dd, J = 2.0 Hz, J = 8.0 Hz, 1H), 7.42-7.38 (m, 1H), 7.25 (d, J = 8.0 Hz, 1H), 7.17 (dd, J = 1.6 Hz, J = 7.6 Hz, 1H), 7.11-7.07 (m, 1H); ^{13}C NMR (125 MHz, CDCl_3): 148.68, 142.55, 139.39, 137.81, 135.24, 133.87, 133.45, 130.09, 129.17, 128.59, 122.02, 98.31; HRMS (ESI) calcd for $\text{C}_{12}\text{H}_8\text{ClINO}_2^+$ $[\text{M}+\text{H}]^+$ 359.9283, found 359.9279.



2-Iodo-4-methyl-2'-nitro-1,1'-biphenyl (S4f)

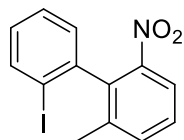
Yellow solid (440.7 mg, 53% yield). ^1H NMR (400 MHz, CDCl_3): δ 8.08-8.06 (m, 1H), 7.76 (s, 1H), 7.66-7.64 (m, 1H), 7.58-7.56 (m, 1H), 7.31-7.29 (m, 1H), 7.22-7.20 (m, 1H), 7.09 (d, J = 7.6 Hz, 1H), 2.36 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 148.67, 140.62, 139.95, 139.76, 139.31, 133.15, 132.95, 129.30, 129.22, 128.83, 124.68, 98.25; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{11}\text{INO}_2^+$ $[\text{M}+\text{H}]^+$ 339.9829, found 339.9859.



2-Iodo-4-methoxy-2'-nitro-1,1'-biphenyl (S4g)

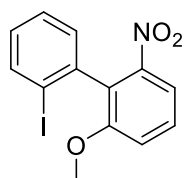
Yellow oil (340.8 mg, 14% yield). ^1H NMR (500 MHz, CDCl_3): δ 8.06 (d, J = 0.5 Hz, 1H), 7.67-7.64 (m, 1H), 7.57-7.53 (m, 1H), 7.45 (d, J = 2.5 Hz, 1H), 7.31 (dd, J = 1.0

Hz, $J = 8.0$ Hz, 1H), 7.11 (d, $J = 8.5$ Hz, 1H), 6.95 (dd, $J = 2.5$ Hz, $J = 8.0$ Hz, 1H), 3.83 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 159.49, 148.72, 138.77, 135.47, 132.99, 132.77, 129.31, 128.94, 124.40, 124.32, 114.32, 98.22, 55.64; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{11}\text{INO}_3^+$ $[\text{M}+\text{H}]^+$ 355.9778, found 355.9775.



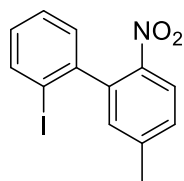
2'-Iodo-2-methyl-6-nitro-1,1'-biphenyl (S4j)

Pale yellow solid (1525.5 mg, 90% yield). ^1H NMR (500 MHz, CDCl_3): δ 7.94 (d, $J = 8.0$ Hz, 1H), 7.87 (d, $J = 8.0$ Hz, 1H), 7.55 (d, $J = 7.5$ Hz, 1H), 7.47-7.44 (m, 1H), 7.43-7.40 (m, 1H), 7.13 (d, $J = 7.5$ Hz, 1H), 7.10-7.07 (m, 1H), 2.06 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 149.25, 142.23, 139.63, 139.43, 138.10, 134.95, 129.67, 129.19, 128.90, 128.74, 122.09, 99.35, 20.68; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{11}\text{INO}_2^+$ $[\text{M}+\text{H}]^+$ 339.9829, found 339.9871.



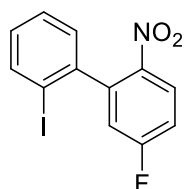
2'-Iodo-2-methoxy-6-nitro-1,1'-biphenyl (S4k)

Pale yellow solid (887.5 mg, 50% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.93-7.91 (m, 1H), 7.61-7.59 (m, 1H), 7.54-7.50 (m, 1H), 7.41-7.37 (m, 1H), 7.21 (d, $J = 8.0$ Hz, 1H), 7.14-7.12 (m, 1H), 7.09-7.05 (m, 1H), 3.81 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 157.69, 149.56, 139.11, 138.78, 129.65, 129.48, 129.31, 128.03, 127.88, 115.85, 115.38, 99.77, 56.60; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{11}\text{INO}_3^+$ $[\text{M}+\text{H}]^+$ 355.9778, found 355.9767.



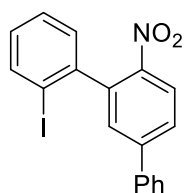
2'-Iodo-5-methyl-2-nitro-1,1'-biphenyl (S4l)

Yellow solid (644.1 mg, 52% yield). ^1H NMR (400 MHz, CDCl_3): δ 8.04 (d, $J = 8.4$ Hz, 1H), 7.90 (dd, $J = 0.8$ Hz, $J = 8.0$ Hz, 1H), 7.42-7.38 (m, 1H), 7.36 (dd, $J = 1.6$ Hz, $J = 8.4$ Hz, 1H), 7.21-7.19 (m, 1H), 7.10-7.05 (m, 2H), 2.47 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 145.82, 144.38, 143.86, 139.27, 138.90, 132.91, 129.64, 129.30, 128.82, 128.14, 124.71, 98.15, 21.50; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{11}\text{INO}_2^+$ $[\text{M}+\text{H}]^+$ 339.9829, found 339.9821.



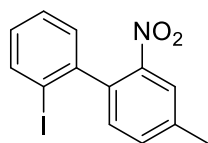
5-Fluoro-2'-iodo-2-nitro-1,1'-biphenyl (S4m)

Pale yellow oil (1303.4 mg, 78% yield). ^1H NMR (400 MHz, CDCl_3): δ 8.19 (dd, $J = 5.2$ Hz, $J = 9.2$ Hz, 1H), 7.92 (d, $J = 8.0$ Hz, 1H), 7.44-7.40 (m, 1H), 7.28-7.23 (m, 1H), 7.20 (dd, $J = 1.2$ Hz, $J = 7.6$ Hz, 1H), 7.13-7.09 (m, 1H), 7.01 (dd, $J = 2.4$ Hz, $J = 8.4$ Hz, 1H); ^{13}C NMR (125 MHz, CDCl_3): 164.34 (d, $J = 256.3$ Hz), 144.20, 142.43, 142.13 (d, $J = 10.0$ Hz), 139.03, 129.75, 128.53, 128.23, 127.38 (d, $J = 10.0$ Hz), 119.43 (d, $J = 22.5$ Hz), 116.05 (d, $J = 22.5$ Hz), 97.38; ^{19}F NMR (470 MHz, CDCl_3): -103.39 (s, 1F); HRMS (ESI) calcd for $\text{C}_{12}\text{H}_8\text{FINO}_2^+$ $[\text{M}+\text{H}]^+$ 343.9578, found 343.9546.



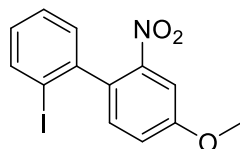
2-Iodo-6'-nitro-1,1':3',1''-terphenyl (S4n)

Yellow oil (1082.7 mg, 34% yield). ^1H NMR (400 MHz, CDCl_3): δ 8.20 (d, $J = 8.4$ Hz, 1H), 7.95-7.93 (m, 1H), 7.77 (dd, $J = 2.0$ Hz, $J = 8.4$ Hz, 1H), 7.65-7.64 (m, 2H), 7.51-7.40 (m, 5H), 7.26 (dd, $J = 2.0$ Hz, $J = 7.6$ Hz, 1H), 7.12-7.08 (m, 1H); ^{13}C NMR (125 MHz, CDCl_3): 146.69, 146.00, 143.56, 139.70, 138.97, 138.41, 130.99, 129.41, 129.13, 128.93, 128.81, 128.14, 127.37, 127.30, 125.20, 98.12; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{13}\text{INO}_2^+$ $[\text{M}+\text{H}]^+$ 401.9985, found 401.9995.



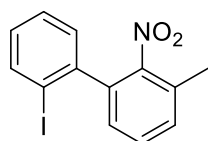
2'-Iodo-4-methyl-2-nitro-1,1'-biphenyl (S4o)

Yellow oil (915.3 mg, 50% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.92-7.90 (m, 2H), 7.49 (dd, $J = 0.8$ Hz, $J = 8.0$ Hz, 1H), 7.41-7.37 (m, 1H), 7.21-7.17 (m, 2H), 7.09-7.05 (m, 1H), 2.51 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 148.17, 143.73, 139.98, 139.20, 136.65, 134.07, 132.46, 129.61, 129.30, 128.43, 125.08, 98.80, 21.40; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{11}\text{INO}_2^+$ $[\text{M}+\text{H}]^+$ 339.9829, found 339.9837.



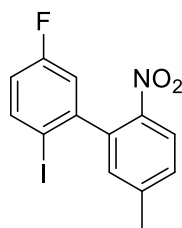
2'-Iodo-5-methoxy-2-nitro-1,1'-biphenyl (S4p)

Pale yellow oil (710.0 mg, 40% yield). ^1H NMR (500 MHz, CDCl_3): δ 7.91 (d, $J = 7.5$ Hz, 1H), 7.61 (s, 1H), 7.40-7.37 (m, 1H), 7.20 (s, 3H), 7.08-7.05 (m, 1H), 3.94 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 159.76, 148.67, 143.36, 138.96, 133.26, 131.63, 129.32, 129.28, 128.19, 119.52, 109.17, 99.15, 56.03; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{11}\text{INO}_3^+$ $[\text{M}+\text{H}]^+$ 355.9778, found 355.9756.



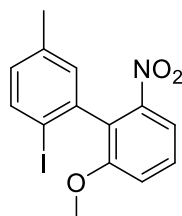
2'-Iodo-3-methyl-2-nitro-1,1'-biphenyl (S4r)

Yellow oil (1084.8 mg, 61% yield). ^1H NMR (500 MHz, CDCl_3): δ 7.91 (d, J = 8.0 Hz, 1H), 7.45-7.42 (m, 1H), 7.36-7.34 (m, 2H), 7.25-7.23 (m, 1H), 7.15 (d, J = 7.5 Hz, 1H), 7.08-7.05 (m, 1H), 2.40 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 150.53, 141.50, 139.33, 136.67, 131.17, 130.01, 129.99, 129.83, 129.61, 129.28, 128.01, 98.97, 17.78; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{11}\text{INO}_2^+$ $[\text{M}+\text{H}]^+$ 339.9829, found 339.9834.



5-Fluoro-2-iodo-5'-methyl-2'-nitro-1,1'-biphenyl (S4s)

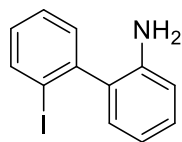
Yellow oil (821.1 mg, 46% yield). ^1H NMR (500 MHz, CDCl_3): δ 8.07 (d, J = 8.5 Hz, 1H), 7.83 (dd, J = 5.5 Hz, J = 9.0 Hz, 1H), 7.38 (dd, J = 1.0 Hz, J = 8.5 Hz, 1H), 7.06 (d, J = 1.0 Hz, 1H), 6.98-6.95 (m, 1H), 6.86-6.83 (m, 1H), 2.48 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 162.74 (d, J = 247.5 Hz), 145.70 (d, J = 8.0 Hz), 145.44, 144.68, 140.04 (d, J = 7.8 Hz), 138.20, 132.51, 129.97, 124.82, 116.68 (d, J = 21.5 Hz), 116.39 (d, J = 22.8 Hz), 91.16 (d, J = 3.8 Hz), 21.42; ^{19}F NMR (470 MHz, CDCl_3): -114.05 (s, 1F); HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{10}\text{FINO}_2^+$ $[\text{M}+\text{H}]^+$ 357.9735, found 357.9745.



2-Iodo-2'-methoxy-5-methyl-6'-nitro-1,1'-biphenyl (S4t)

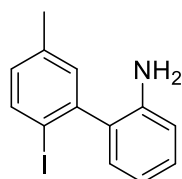
Yellow solid (553.5 mg, 46% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.77 (d, J = 8.0 Hz, 1H), 7.58 (dd, J = 0.8 Hz, J = 8.4 Hz, 1H), 7.53-7.49 (m, 1H), 7.21-7.19 (m, 1H), 6.94 (d, J = 1.6 Hz, 1H), 6.89 (dd, J = 1.6 Hz, J = 8.4 Hz, 1H), 3.81 (s, 3H), 2.30 (s,

3H); ^{13}C NMR (125 MHz, CDCl_3): 157.78, 149.71, 138.86, 138.56, 138.13, 130.51, 130.27, 129.62, 127.96, 115.87, 115.40, 95.82, 56.70, 21.05; HRMS (ESI) calcd for $\text{C}_{14}\text{H}_{13}\text{INO}_3^+$ $[\text{M}+\text{H}]^+$ 369.9935, found 369.9945.



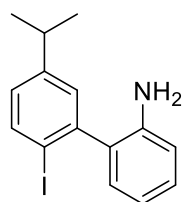
2'-Iodo-[1,1'-biphenyl]-2-amine (S5a)

Colorless oil (354.0 mg, 30% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.99-7.97 (m, 1H), 7.45-7.41 (m, 1H), 7.33-7.31 (m, 1H), 7.25-7.20 (m, 1H), 7.09-7.05 (m, 1H), 6.99-6.97 (m, 1H), 6.86-6.84 (m, 1H), 6.78 (d, $J = 8.4$ Hz, 1H), 3.19 (br, 1H); ^{13}C NMR (125 MHz, CDCl_3): 144.50, 143.57, 139.84, 131.00, 130.74, 130.43, 129.55, 129.49, 129.00, 118.61, 115.87, 100.96; HRMS (ESI) calcd for $\text{C}_{12}\text{H}_{11}\text{IN}^+$ $[\text{M}+\text{H}]^+$ 295.9931, found 295.9926.



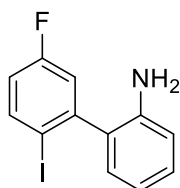
2'-Iodo-5'-methyl-[1,1'-biphenyl]-2-amine (S5b)

Yellow oil (309.0 mg, 40% yield). ^1H NMR (500 MHz, CDCl_3): δ 7.84 (d, $J = 10.0$ Hz, 1H), 7.24-7.20 (m, 1H), 7.15 (d, $J = 1.0$ Hz, 1H), 6.98-6.97 (m, 1H), 6.90 (dd, $J = 1.2$ Hz, $J = 8.0$ Hz, 1H), 6.85-6.82 (m, 1H), 6.78 (d, $J = 8.0$ Hz, 1H), 3.52 (br, 2H), 2.34 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 143.99, 143.32, 139.27, 138.80, 131.58, 130.54, 130.31, 130.12, 129.11, 118.32, 115.56, 96.40, 20.96; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{13}\text{IN}^+$ $[\text{M}+\text{H}]^+$ 310.0087, found 310.0076.



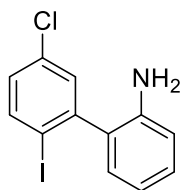
2'-Iodo-5'-isopropyl-[1,1'-biphenyl]-2-amine (S5c)

Colorless oil (674.0 mg, 87% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.88 (d, $J = 8.0$ Hz, 1H), 7.26-7.20 (m, 2H), 7.01-6.94 (m, 2H), 6.86-6.82 (m, 1H), 6.79 (dd, $J = 0.4$ Hz, $J = 8.0$ Hz, 1H), 3.27 (br, 2H), 2.95-2.85 (m, 1H), 1.26 (d, $J = 7.2$ Hz, 6H); ^{13}C NMR (125 MHz, CDCl_3): 150.09, 144.27, 143.61, 139.61, 130.92, 130.49, 129.37, 129.30, 127.95, 118.54, 115.82, 97.00, 34.02, 24.17, 24.10; HRMS (ESI) calcd for $\text{C}_{15}\text{H}_{17}\text{IN}^+$ $[\text{M}+\text{H}]^+$ 338.0400, found 338.0401.



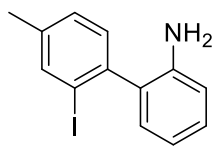
5'-Fluoro-2'-iodo-[1,1'-biphenyl]-2-amine (S5d)

Colorless oil (719.9 mg, 84% yield). ^1H NMR (500 MHz, CDCl_3): δ 7.91-7.88 (m, 1H), 7.23-7.19 (m, 1H), 7.06 (dd, $J = 3.0$ Hz, $J = 9.0$ Hz, 1H), 6.94 (dd, $J = 1.5$ Hz, $J = 7.5$ Hz, 1H), 6.84-6.80 (m, 2H), 6.76 (d, $J = 8.0$ Hz, 1H), 3.33 (br, 2H); ^{13}C NMR (125 MHz, CDCl_3): 163.22 (d, $J = 247.5$ Hz), 146.23 (d, $J = 8.8$ Hz), 143.08, 140.75 (d, $J = 8.8$ Hz), 129.74 (d, $J = 41.6$ Hz), 129.36, 118.40, 118.05 (d, $J = 21.4$ Hz), 116.78 (d, $J = 21.5$ Hz), 115.74, 93.59 (d, $J = 1.3$ Hz); ^{19}F NMR (470 MHz, CDCl_3): -113.49 (s, 1F); HRMS (ESI) calcd for $\text{C}_{12}\text{H}_{10}\text{FIN}^+$ $[\text{M}+\text{H}]^+$ 313.9836, found 313.9829.



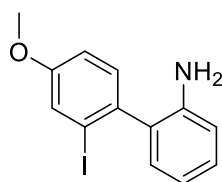
5'-chloro-2'-iodo-[1,1'-biphenyl]-2-amine (S5e)

Colorless oil (590.0 mg, 74% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.98 (d, $J = 0.8$ Hz, 1H), 7.45-7.41 (m, 1H), 7.28-7.26 (m, 1H), 7.09-7.05 (m, 1H), 6.89 (d, $J = 8.0$ Hz, 1H), 6.80-6.76 (m, 2H), 3.12 (br, 2H); ^{13}C NMR (125 MHz, CDCl_3): 144.83, 143.37, 139.98, 134.92, 131.54, 131.03, 129.87, 129.12, 128.93, 118.58, 115.50, 100.81; HRMS (ESI) calcd for $\text{C}_{12}\text{H}_{10}\text{ClIN}^+$ $[\text{M}+\text{H}]^+$ 329.9541, found 329.9547.



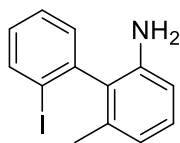
2'-Iodo-4'-methyl-[1,1'-biphenyl]-2-amine (S5f)

Colorless oil (339.9 mg, 85% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.82 (s, 1H), 7.26-7.17 (m, 3H), 6.97-6.95 (m, 1H), 6.84-6.80 (m, 1H), 6.77 (d, J = 8.0 Hz, 1H), 3.17 (br, 2H), 2.36 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 143.52, 141.21, 140.00, 139.39, 130.40, 130.33, 129.61, 129.11, 118.33, 115.55, 100.55, 20.62; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{13}\text{IN}^+$ $[\text{M}+\text{H}]^+$ 310.0087, found 310.0080.



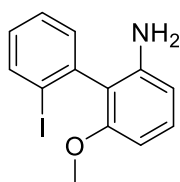
2'-Iodo-4'-methoxy-[1,1'-biphenyl]-2-amine (S5g)

Pale yellow solid (182.3 mg, 57% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.5 (d, J = 2.4 Hz, 1H), 7.22-7.18 (m, 2H), 6.99-6.95 (m, 2H), 6.83-6.80 (m, 1H), 6.77 (d, J = 8.0 Hz, 1H), 3.83 (s, 3H), 3.41 (br, 2H); ^{13}C NMR (125 MHz, CDCl_3): 159.31, 143.80, 136.43, 130.89, 130.70, 130.10, 129.10, 124.61, 118.28, 115.48, 114.91, 100.70, 55.66; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{13}\text{INO}^+$ $[\text{M}+\text{H}]^+$ 326.0036, found 326.0036.



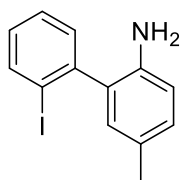
2'-Iodo-6-methyl-[1,1'-biphenyl]-2-amine (S5j)

Colorless oil (1266.9 mg, 91% yield). ^1H NMR (500 MHz, CDCl_3): δ 8.00 (d, J = 8.0 Hz, 1H), 7.46-7.43 (m, 1H), 7.23 (d, J = 7.5 Hz, 1H), 7.12-7.09 (m, 1H), 7.07-7.04 (m, 1H), 6.70 (d, J = 7.5 Hz, 1H), 6.63 (d, J = 8.0 Hz, 1H), 3.22 (br, 2H), 1.92 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 143.75, 143.68, 140.02, 136.97, 130.94, 130.65, 129.47, 128.99, 120.24, 113.30, 101.69, 20.51; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{13}\text{IN}^+$ $[\text{M}+\text{H}]^+$ 310.0087, found 310.0076.



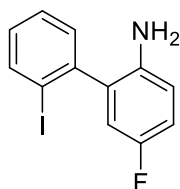
2'-Iodo-6-methoxy-[1,1'-biphenyl]-2-amine (S5k)

Colorless oil (357.5 mg, 44% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.98 (d, J = 8.0 Hz, 1H), 7.46-7.42 (m, 1H), 7.28-7.26 (m, 1H), 7.20-7.16 (m, 1H), 7.07-7.03 (m, 1H), 6.43 (dd, J = 8.0 Hz, J = 13.2 Hz, 2H), 3.71 (s, 3H), 2.58 (br, 2H); ^{13}C NMR (125 MHz, CDCl_3): 157.46, 144.67, 140.83, 139.50, 131.25, 129.49, 129.07, 128.75, 119.38, 108.51, 102.17, 101.12, 55.76; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{13}\text{INO}^+$ $[\text{M}+\text{H}]^+$ 326.0036, found 326.0030.



2'-Iodo-5-methyl-[1,1'-biphenyl]-2-amine (S5l)

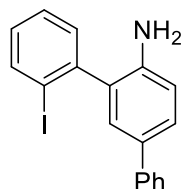
Colorless oil (370.8 mg, 64% yield). ^1H NMR (500 MHz, CDCl_3): δ 7.97 (d, J = 8.0 Hz, 1H), 7.43-7.40 (m, 1H), 7.30 (dd, J = 1.0 Hz, J = 7.5 Hz, 1H), 7.07-7.02 (m, 2H), 6.80 (s, 1H), 6.70 (d, J = 8.0 Hz, 1H), 3.00 (br, 2H), 2.29 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 144.38, 140.69, 139.40, 130.66, 130.53, 130.45, 129.67, 129.07, 128.59, 127.48, 115.70, 100.53, 20.42; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{13}\text{IN}^+$ $[\text{M}+\text{H}]^+$ 310.0087, found 310.0089.



5-Fluoro-2'-iodo-[1,1'-biphenyl]-2-amine (S5m)

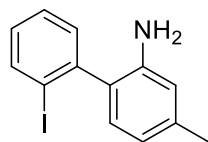
Colorless oil (594.7 mg, 50% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.97 (d, J = 8.0 Hz, 1H), 7.45-7.41 (m, 1H), 7.30-7.27 (m, 1H), 7.10-7.06 (m, 1H), 6.96-6.91 (m, 1H),

6.74-6.69 (m, 2H), 2.71 (br, 2H); ^{13}C NMR (125 MHz, CDCl_3): 155.90 (d, $J = 235.0$ Hz), 143.16, 139.55 (d, $J = 20.0$ Hz), 131.19 (d, $J = 7.5$ Hz), 130.51, 129.57, 128.77, 116.59 (d, $J = 7.5$ Hz), 116.46 (d, $J = 7.5$ Hz), 115.72 (d, $J = 22.1$ Hz), 99.92; ^{19}F NMR (470 MHz, CDCl_3): -126.82 (s, 1F); HRMS (ESI) calcd for $\text{C}_{12}\text{H}_{10}\text{FIN}^+$ $[\text{M}+\text{H}]^+$ 313.9836, found 313.9829.



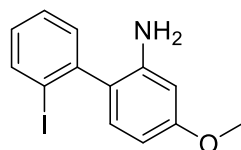
2'-Iodo-[1,1':3,1'-terphenyl]-4'-amine (S5n)

Yellow oil (704.9 mg, 71% yield). ^1H NMR (500 MHz, CDCl_3): δ 8.01 (dd, $J = 1.0$ Hz, $J = 8.0$ Hz, 1H), 7.60-7.58 (m, 2H), 7.51-7.49 (m, 1H), 7.47-7.44 (m, 1H), 7.41-7.37 (m, 3H), 7.28-7.26 (m, 2H), 7.10-7.07 (m, 1H), 6.86 (d, $J = 8.5$ Hz, 1H), 3.35 (br, 2H); ^{13}C NMR (125 MHz, CDCl_3): 144.12, 142.81, 140.95, 139.71, 131.32, 130.81, 130.64, 129.41, 128.96, 128.78, 128.74, 127.79, 126.46, 126.40, 115.98, 100.70; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{15}\text{IN}^+$ $[\text{M}+\text{H}]^+$ 372.0244, found 372.0239.



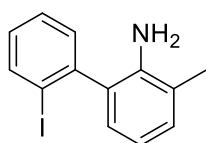
2'-Iodo-4-methyl-[1,1'-biphenyl]-2-amine (S5o)

Colorless oil (741.6 mg, 90% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.97 (dd, $J = 0.8$ Hz, $J = 8.0$ Hz, 1H), 7.44-7.39 (m, 1H), 7.31-7.29 (m, 1H), 7.07-7.03 (m, 1H), 6.87 (d, $J = 7.6$ Hz, 1H), 6.67 (d, $J = 7.6$ Hz, 1H), 6.62 (s, 1H), 3.11 (br, 2H), 2.33 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 144.53, 143.30, 139.78, 139.44, 131.19, 130.29, 129.44, 128.97, 128.19, 119.61, 116.57, 101.32, 21.57; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{13}\text{IN}^+$ $[\text{M}+\text{H}]^+$ 310.0087, found 310.0077.



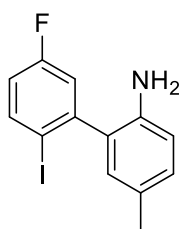
2'-Iodo-5-methoxy-[1,1'-biphenyl]-2-amine (S5p)

Green solid (552.5 mg, 84% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.97 (dd, $J = 1.2$ Hz, $J = 8.0$ Hz, 1H), 7.43-7.39 (m, 1H), 7.31 (dd, $J = 2.0$ Hz, $J = 7.6$ Hz, 1H), 7.07-7.02 (m, 1H), 6.89 (d, $J = 8.4$ Hz, 1H), 6.41 (dd, $J = 2.4$ Hz, $J = 8.4$ Hz, 1H), 6.33 (d, $J = 2.4$ Hz, 1H), 3.82 (s, 3H), 3.42 (br, 2H); ^{13}C NMR (125 MHz, CDCl_3): 160.61, 144.52, 144.06, 139.54, 131.18, 131.09, 129.15, 128.68, 123.81, 104.00, 101.70, 100.95, 55.20; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{13}\text{INO}^+$ $[\text{M}+\text{H}]^+$ 326.0036, found 326.0040.



2'-Iodo-3-methyl-[1,1'-biphenyl]-2-amine (S5r)

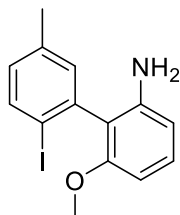
Colorless oil (463.5 mg, 49% yield). ^1H NMR (500 MHz, CDCl_3): δ 7.99 (d, $J = 3.0$ Hz, 1H), 7.44-7.41 (m, 1H), 7.32 (dd, $J = 1.5$ Hz, $J = 7.5$ Hz, 1H), 7.13 (d, $J = 7.5$ Hz, 1H), 7.08-7.05 (m, 1H), 6.86 (d, $J = 7.5$ Hz, 1H), 6.79-6.76 (m, 1H), 3.43 (br, 2H), 2.23 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 144.61, 141.54, 139.63, 130.81, 130.27, 130.25, 129.23, 128.75, 127.96, 122.59, 117.88, 100.88, 17.85; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{13}\text{IN}^+$ $[\text{M}+\text{H}]^+$ 310.0087, found 310.0083.



5'-Fluoro-2'-iodo-5-methyl-[1,1'-biphenyl]-2-amine (S5s)

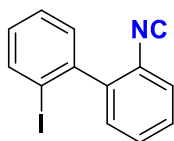
Colorless oil (654.0 mg, 89% yield). ^1H NMR (500 MHz, CDCl_3): δ 7.90 (dd, $J = 5.5$ Hz, $J = 9.0$ Hz, 1H), 7.07-7.03 (m, 2H), 6.85-6.81 (m, 1H), 6.78 (d, $J = 1.0$ Hz, 1H), 6.70 (d, $J = 8.0$ Hz, 1H), 3.25 (br, 2H), 2.29 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 163.25 (d, $J = 247.5$ Hz), 146.52 (d, $J = 7.5$ Hz), 140.69 (d, $J = 8.8$ Hz), 140.60, 130.22 (d, $J = 12.5$ Hz), 129.58, 127.74, 118.10 (d, $J = 21.3$ Hz), 116.70 (d, $J = 21.5$ Hz), 115.98, 93.53, 20.48; ^{19}F NMR (470 MHz, CDCl_3): -113.77 (s, 1F); HRMS (ESI)

calcd for $C_{13}H_{12}FIN^+$ $[M+H]^+$ 327.9993, found 327.9986.



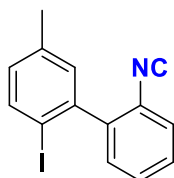
2'-Iodo-6-methoxy-5'-2-methyl-[1,1'-biphenyl]-2-amine (S5t)

Pale yellow solid (440.7 mg, 85% yield). 1H NMR (500 MHz, $CDCl_3$): δ 7.85 (d, J = 8.0 Hz, 1H), 7.19-7.15 (m, 1H), 7.10 (d, J = 2.0 Hz, 1H), 6.88 (dd, J = 2.0 Hz, J = 8.0 Hz, 1H), 6.42 (dd, J = 8.0 Hz, J = 13.0 Hz, 2H), 3.73 (s, 3H), 3.14 (br, 2H), 2.34 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): 157.50, 144.77, 140.58, 139.25, 138.80, 132.05, 130.23, 129.43, 119.44, 108.56, 101.19, 98.00, 55.85, 21.03; HRMS (ESI) calcd for $C_{14}H_{15}INO^+$ $[M+H]^+$ 340.0193, found 340.0203.



2-Iodo-2'-isocyano-1,1'-biphenyl (1a)

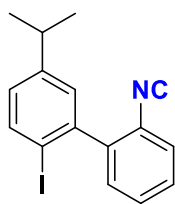
Green solid (244.0 mg, 67% yield). 1H NMR (400 MHz, $CDCl_3$): δ 7.98 (d, J = 8.0 Hz, 1H), 7.49-7.43 (m, 4H), 7.31-7.27 (m, 2H), 7.15-7.10 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$): 167.27, 142.57, 141.94, 139.71, 131.11, 130.34, 130.23, 129.46, 129.29, 128.61, 127.30, 125.95, 98.95; HRMS (ESI) calcd for $C_{13}H_9IN^+$ $[M+H]^+$ 305.9774, found 305.9776.



2-Iodo-2'-isocyano-5-methyl-1,1'-biphenyl (1b)

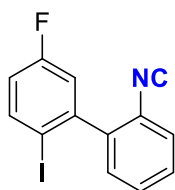
Green solid (191.4 mg, 61% yield). 1H NMR (400 MHz, $CDCl_3$): δ 7.83 (d, J = 8.4 Hz, 1H), 7.49-7.41 (m, 3H), 7.29-7.27 (m, 1H), 7.09 (d, J = 1.6 Hz, 1H), 6.95 (dd, J = 1.6 Hz, J = 8.0 Hz, 1H), 2.35 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): 166.78, 142.00,

141.67, 139.06, 138.31, 131.00, 130.75, 130.72, 129.06, 128.80, 126.90, 94.42, 20.89;
HRMS (ESI) calcd for $C_{14}H_{11}IN^+$ $[M+H]^+$ 319.9931, found 319.9925.



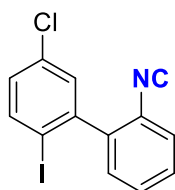
2-Iodo-2'-isopropyl-1,1'-biphenyl (1c)

Green oil (381.7 mg, 57% yield). 1H NMR (500 MHz, $CDCl_3$): δ 7.87 (d, J = 8.0 Hz, 1H), 7.49-7.42(m, 3H), 7.32 (d, J = 7.5 Hz, 1H), 7.14 (s, 1H), 7.00 (d, J = 8.0 Hz, 1H), 2.96-2.87 (m, 1H), 1.27 (d, J = 1.0 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$): 167.18, 149.65, 142.26, 142.14, 139.54, 131.28, 129.36, 129.13, 128.73, 128.67, 127.31, 125.98, 95.06, 34.07, 24.16, 24.05; HRMS (ESI) calcd for $C_{16}H_{15}IN^+$ $[M+H]^+$ 348.0244, found 348.0244.



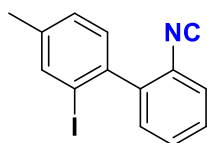
5-Fluoro-2-iodo-2'-isocyano-1,1'-biphenyl (1d)

Green solid (419.9 mg, 69% yield). 1H NMR (400 MHz, $CDCl_3$): δ 7.92 (dd, J = 5.6 Hz, J = 8.8 Hz, 1H), 7.49-7.48 (m, 3H), 7.29-7.26 (m, 1H), 7.04 (dd, J = 3.2 Hz, J = 8.8 Hz, 1H), 6.93-6.88 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$): 167.46, 162.74 (d, J = 247.5 Hz), 161.75, 143.98 (d, J = 7.5 Hz), 140.64 (d, J = 8.0 Hz), 140.52, 130.44, 129.33 (d, J = 11.3 Hz), 127.04, 117.60 (d, J = 15.0 Hz), 117.41 (d, J = 16.3 Hz), 91.70 (d, J = 3.8 Hz); ^{19}F NMR (470 MHz, $CDCl_3$): -113.61 (s, 1F); HRMS (ESI) calcd for $C_{13}H_8FIN^+$ $[M+H]^+$ 323.9680, found 323.9670.



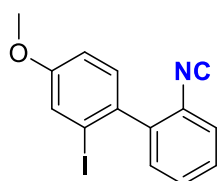
5-chloro-2-iodo-2'-isocyano-1,1'-biphenyl (1e)

Green solid (202.8 mg, 34% yield). ^1H NMR (500 MHz, CDCl_3): 7.98 (dd, $J = 1.0$ Hz, $J = 8.0$ Hz, 1H), 7.49-7.43(m, 3H), 7.26-7.23 (m, 2H), 7.15-7.12 (m, 1H); ^{13}C NMR (125 MHz, CDCl_3): 168.94, 141.47, 140.40, 139.82, 134.89, 132.23, 130.65, 130.20, 129.93, 128.73, 127.32, 98.81; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_8\text{ClIN}^+$ $[\text{M}+\text{H}]^+$ 339.9384, found 339.9379.



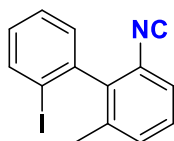
2-Iodo-2'-isocyano-4-methyl-1,1'-biphenyl (1f)

Green oil (159.5 mg, 50% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.81 (s, 1H), 7.47-7.39 (m, 3H), 7.28 (d, $J = 8.4$ Hz, 1H), 7.24 (d, $J = 8.0$ Hz, 1H), 7.14 (d, $J = 8.0$ Hz, 1H), 2.37 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 166.91, 141.65, 140.27, 139.91, 139.36, 131.07, 129.58, 129.19, 129.12, 128.85, 126.97, 125.85, 98.52, 20.72; HRMS (ESI) calcd for $\text{C}_{14}\text{H}_{11}\text{IN}^+$ $[\text{M}+\text{H}]^+$ 319.9931, found 319.9924.



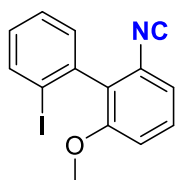
2-Iodo-2'-isocyano-4-methoxy-1,1'-biphenyl (1g)

White solid (100.5 mg, 59% yield). ^1H NMR (500 MHz, CDCl_3): δ 7.50 (s, 1H), 7.47-7.40 (m, 3H), 7.29 (d, $J = 9.0$ Hz, 1H), 7.17 (d, $J = 7.5$ Hz, 1H), 6.99 (d, $J = 8.5$ Hz, 1H), 3.84 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 166.82, 159.83, 141.40, 134.58, 131.37, 130.26, 129.08, 128.81, 126.96, 124.59, 114.47, 98.73, 55.65; HRMS (ESI) calcd for $\text{C}_{14}\text{H}_{11}\text{INO}^+$ $[\text{M}+\text{H}]^+$ 335.9880, found 335.9882.



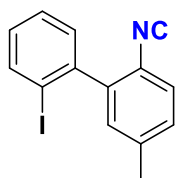
2'-Iodo-2-isocyano-6-methyl-1,1'-biphenyl (1j)

Green solid (638.0 mg, 42% yield). ^1H NMR (500 MHz, CDCl_3): δ 7.99 (d, J = 8.0 Hz, 1H), 7.49-7.46 (m, 1H), 7.34-7.32 (m, 3H), 7.19 (d, J = 7.5 Hz, 1H), 7.15-7.11 (m, 1H), 2.06 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 166.47, 142.16, 141.57, 139.75, 138.45, 131.21, 130.18, 129.80, 129.05, 128.96, 126.31, 124.62, 99.30, 20.61; HRMS (ESI) calcd for $\text{C}_{14}\text{H}_{11}\text{IN}^+$ $[\text{M}+\text{H}]^+$ 319.9931, found 319.9941.



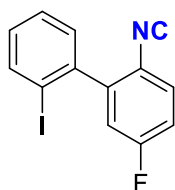
2'-Iodo-2-isocyano-6-methoxy-1,1'-biphenyl (1k)

White solid (201.0 mg, 54% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.97 (d, J = 8.0 Hz, 1H), 7.48-7.44 (m, 1H), 7.42-7.38 (m, 1H), 7.22 (d, J = 6.8 Hz, 1H), 7.14-7.09 (m, 2H), 7.02 (d, J = 8.8 Hz, 1H), 3.79 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 166.52, 157.32, 139.13, 139.11, 130.97, 130.32, 129.75, 128.30, 126.67, 118.92, 112.13, 99.77, 56.18; HRMS (ESI) calcd for $\text{C}_{14}\text{H}_{11}\text{INO}^+$ $[\text{M}+\text{H}]^+$ 335.9880, found 335.9887.



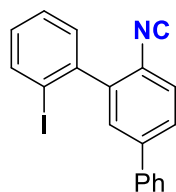
2'-Iodo-2-isocyano-5-methyl-1,1'-biphenyl (1l)

Green solid (223.3 mg, 58% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.97 (dd, J = 0.8 Hz, J = 8.0 Hz, 1H), 7.46-7.42 (m, 1H), 7.36 (d, J = 8.0 Hz, 1H), 7.27-7.22 (m, 2H), 7.13-7.09 (m, 2H), 2.42 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 166.23, 142.47, 141.42, 139.60, 139.38, 131.29, 129.95, 129.61, 128.29, 126.80, 123.18, 98.73, 21.42; HRMS (ESI) calcd for $\text{C}_{14}\text{H}_{11}\text{IN}^+$ $[\text{M}+\text{H}]^+$ 319.9931, found 319.9932.



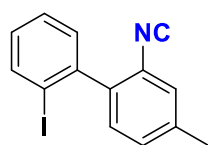
5-Fluoro-2'-iodo-2-isocyano-1,1'-biphenyl (1m)

Green oil (468.4 mg, 76% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.99 (d, J = 8.0 Hz, 1H), 7.50-7.45 (m, 2H), 7.28-7.26 (m, 1H), 7.17-7.13 (m, 2H), 7.02 (dd, J = 1.6 Hz, J = 8.4 Hz, 1H); ^{13}C NMR (125 MHz, CDCl_3): 167.15, 161.72 (d, J = 251.3 Hz), 143.74 (d, J = 8.8 Hz), 141.11, 139.46, 130.35, 129.65, 128.82 (d, J = 9.3 Hz), 128.35, 121.93, 117.97 (d, J = 23.5 Hz), 116.13 (d, J = 23.0 Hz), 97.97; ^{19}F NMR (470 MHz, CDCl_3): -108.67 (s, 1F); HRMS (ESI) calcd for $\text{C}_{13}\text{H}_8\text{FIN}^+$ $[\text{M}+\text{H}]^+$ 323.9680, found 323.9672.



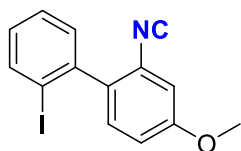
2-Iodo-6'-isocyano-1,1':3',1''-terphenyl (1n)

Green solid (266.7 mg, 37% yield). ^1H NMR (500 MHz, CDCl_3): δ 8.03 (d, J = 8.0 Hz, 1H), 7.68-7.63 (m, 3H), 7.56 (s, 2H), 7.50-7.47 (m, 3H), 7.43-7.40 (m, 1H), 7.37 (d, J = 7.5 Hz, 1H), 7.17-7.14 (m, 1H); ^{13}C NMR (125 MHz, CDCl_3): 167.53, 142.15, 142.04, 141.84, 139.45, 139.08, 130.09, 129.99, 129.47, 129.06, 128.35, 128.33, 127.42, 127.39, 127.18, 124.44, 98.73; HRMS (ESI) calcd for $\text{C}_{19}\text{H}_{13}\text{IN}^+$ $[\text{M}+\text{H}]^+$ 382.0087, found 382.0082.



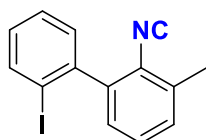
2'-Iodo-2-isocyano-4-methyl-1,1'-biphenyl (1o)

Dark green oil (414.7 mg, 56% yield). ^1H NMR (500 MHz, CDCl_3): δ 7.97 (d, J = 1.0 Hz, 1H), 7.45-7.42 (m, 1H), 7.30-7.25 (m, 3H), 7.18 (d, J = 7.5 Hz, 1H), 7.12-7.09 (m, 1H), 2.43 (s, 1H); ^{13}C NMR (125 MHz, CDCl_3): 166.65, 142.55, 139.63, 139.08, 130.82, 130.38, 130.29, 130.17, 128.55, 127.65, 125.63, 99.32, 21.32; HRMS (ESI) calcd for $\text{C}_{14}\text{H}_{11}\text{IN}^+$ $[\text{M}+\text{H}]^+$ 319.9931, found 319.9932.



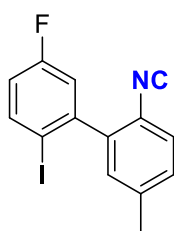
2'-Iodo-2-isocyano-5-methoxy-1,1'-biphenyl (1p)

Green solid (368.5 mg, 68% yield). ^1H NMR (400 MHz, CDCl_3): δ 7.96 (dd, $J = 0.8$ Hz, $J = 8.0$ Hz, 1H), 7.44-7.40 (m, 1H), 7.28-7.25 (m, 1H), 7.19 (d, $J = 8.4$ Hz, 1H), 7.12-7.08 (m, 1H), 7.02-6.98 (m, 2H), 3.87 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 167.03, 159.97, 142.39, 139.66, 134.52, 131.98, 130.63, 130.15, 128.57, 126.54, 115.85, 112.27, 99.92, 56.05; HRMS (ESI) calcd for $\text{C}_{14}\text{H}_{11}\text{INO}^+ [\text{M}+\text{H}]^+$ 335.9880, found 335.9882.



2'-Iodo-2-isocyano-3-methyl-1,1'-biphenyl (1r)

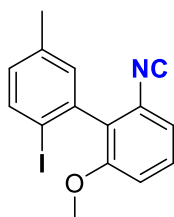
Colorless oil (350.9 mg, 76% yield). ^1H NMR (500 MHz, CDCl_3): δ 7.97 (d, $J = 8.0$ Hz, 1H), 7.45-7.42 (m, 1H), 7.37-7.32 (m, 2H), 7.26 (d, $J = 8.0$ Hz, 1H), 7.12-7.09 (m, 2H), 2.50 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 168.92, 142.83, 141.75, 139.39, 135.42, 130.06, 129.91, 128.65, 128.29, 128.12, 98.77, 19.16; HRMS (ESI) calcd for $\text{C}_{14}\text{H}_{11}\text{IN}^+ [\text{M}+\text{H}]^+$ 319.9931, found 319.9931.



5-Fluoro-2-iodo-2'-isocyano-5'-methyl-1,1'-biphenyl (1s)

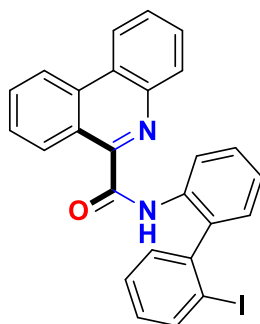
Green oil (438.0 mg, 64% yield). ^1H NMR (500 MHz, CDCl_3): δ 7.90 (dd, $J = 5.5$ Hz, $J = 9.0$ Hz, 1H), 7.36 (d, $J = 8.0$ Hz, 1H), 7.26-7.24 (m, 1H), 7.07 (s, 1H), 7.01 (dd, $J = 3.0$ Hz, $J = 9.0$ Hz, 1H), 6.90-6.86 (m, 1H), 2.42 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 166.70, 162.81 (d, $J = 248.8$ Hz), 144.26 (d, $J = 8.8$ Hz), 140.65 (d, $J = 7.9$ Hz), 140.37, 139.86, 130.96, 130.04, 126.90, 117.50 (d, $J = 21.3$ Hz), 91.85 (d, $J = 3.8$ Hz), 21.41; ^{19}F NMR (470 MHz, CDCl_3): -113.91 (s, 1F); HRMS (ESI) calcd for

$C_{14}H_{10}FIN^+ [M+H]^+ 337.9836$, found 337.9839.



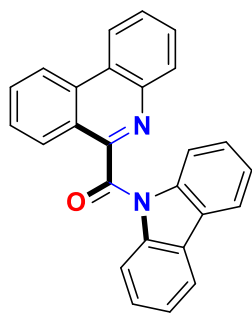
2-Iodo-2'-isocyano-6'-methoxy-5-methyl-1,1'-biphenyl (1t)

Green solid (209.4 mg, 53% yield). 1H NMR (400 MHz, $CDCl_3$): δ 7.82 (d, $J = 8.0$ Hz, 1H), 7.41-7.37 (m, 1H), 7.10 (d, $J = 8.0$ Hz, 1H), 7.05-7.01 (m, 2H), 6.94 (dd, $J = 0.8$ Hz, $J = 8.0$ Hz, 1H), 3.79 (s, 3H), 2.35 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): 166.44, 157.44, 138.89, 138.39, 131.17, 130.95, 129.71, 126.77, 119.01, 112.20, 95.68, 56.31, 21.06; HRMS (ESI) calcd for $C_{15}H_{13}INO^+ [M+H]^+ 350.0036$, found 350.0031.



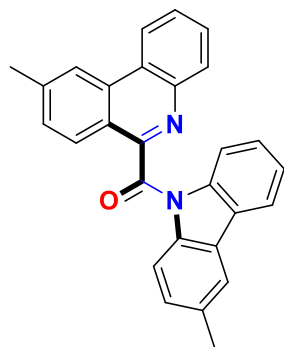
N-(2'-iodo-[1,1'-biphenyl]-2-yl)phenanthridine-6-carboxamide (2a)

White solid (16.3 mg, 65% yield). Mp 219-221 °C. 1H NMR (500 MHz, $CDCl_3$): δ 10.45 (s, 1H), 9.85 (d, $J = 10.0$ Hz, 1H), 8.75 (d, $J = 8.0$ Hz, 1H), 8.61 (d, $J = 8.0$ Hz, 1H), 8.54-8.53 (m, 1H), 8.14 (d, $J = 7.5$ Hz, 1H), 7.87-7.84 (m, 1H), 7.77-7.74 (m, 1H), 7.70-7.69 (m, 2H), 7.62-7.56 (m, 3H), 7.46 (d, $J = 7.0$ Hz, 1H), 7.29-7.26 (m, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): 163.20, 147.79, 143.33, 141.39, 139.73, 135.54, 134.93, 134.00, 131.19, 131.04, 130.43, 129.79, 129.76, 129.31, 129.09, 128.88, 128.84, 128.72, 128.15, 125.73, 124.60, 123.86, 122.10, 121.89, 120.12, 100.92; IR (cm^{-1}) 3284, 3114, 1682, 1628, 1579, 1456, 1251, 869, 804, 785, 772, 490; HRMS (ESI) calcd for $C_{26}H_{18}IN_2O^+ [M+H]^+ 501.0458$, found 501.0437.



(9H-carbazol-9-yl)(phenanthridin-6-yl)methanone (3a)

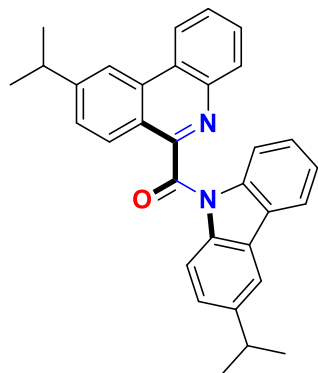
White solid (16.7 mg, 90% yield). Mp 202-205 °C. ^1H NMR (500 MHz, $\text{DMSO}-d_6$): δ 9.09 (d, J = 8.5 Hz, 1H), 9.01 (d, J = 8.0 Hz, 1H), 8.24 (d, J = 7.5 Hz, 2H), 8.16 (d, J = 8.0 Hz, 1H), 8.11-8.08 (m, 2H), 7.94-7.87 (m, 2H), 7.83-7.80 (m, 1H), 7.42-7.36 (m, 3H), 7.30 (br, 3H); ^{13}C NMR (125 MHz, $\text{DMSO}-d_6$): 167.00, 155.26, 143.28, 138.60, 134.00, 133.39, 130.86, 130.72, 129.95, 129.88, 128.47, 127.19, 126.99, 125.42, 125.10, 124.25, 124.15, 123.21, 121.45, 116.29; IR (cm^{-1}) 3379, 2059, 1675, 1610, 1581, 1489, 1443, 876, 848, 762, 736; HRMS (ESI) calcd for $\text{C}_{26}\text{H}_{17}\text{N}_2\text{O}^+$ $[\text{M}+\text{H}]^+$ 373.1335, found 373.1338.



(3-Methyl-9H-carbazol-9-yl)(9-methylphenanthridin-6-yl)methanone (3b)

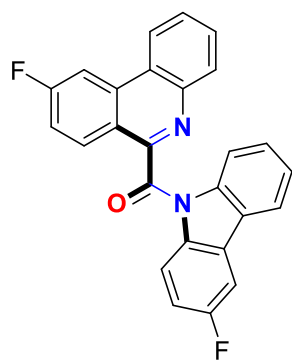
White solid (19.0 mg, 95% yield). Mp 285-290 °C. ^1H NMR (400 MHz, $\text{DMSO}-d_6$): δ 8.97 (d, J = 7.6 Hz, 1H), 8.89 (s, 1H), 8.18 (d, J = 7.6 Hz, 1H), 8.07 (d, J = 8.0 Hz, 1H), 8.02 (s, 1H), 7.98 (d, J = 8.0 Hz, 1H), 7.89-7.85 (m, 2H), 7.71-7.62 (m, 3H), 7.38 (br, 1H), 7.27 (br, 1H), 7.09 (br, 1H); ^{13}C NMR (125 MHz, CDCl_3): 166.66, 154.98, 143.39, 142.43, 138.79, 136.63, 133.88, 133.77, 130.80, 130.06, 129.19, 128.38, 128.23, 127.14, 126.99, 126.89, 126.61, 124.46, 124.12, 122.26, 122.15, 121.40, 119.88, 119.64, 22.47, 21.23; IR (cm^{-1}) 3440, 2956, 2851, 1671, 1583, 1486,

1464, 1447, 1379, 878, 824, 760; HRMS (ESI) calcd for $C_{28}H_{21}N_2O^+$ $[M+H]^+$ 401.1648, found 401.1644.



(3-Isopropyl-9H-carbazol-9-yl)(9-isopropylphenanthridin-6-yl)methanone (3c)

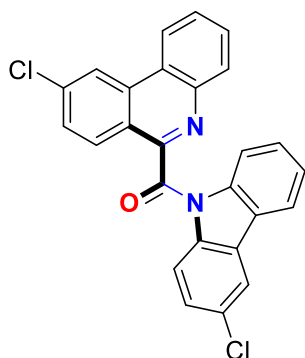
Pale yellow solid (17.3 mg, 76% yield). Mp 175-179 °C. 1H NMR (400 MHz, DMSO- d_6): δ 9.05 (d, J = 7.2 Hz, 1H), 8.89 (s, 1H), 8.23 (d, J = 8.0 Hz, 1H), 8.08-8.05 (m, 2H), 8.01 (d, J = 8.4 Hz, 1H), 7.91-7.82 (m, 2H), 7.71-7.68 (m, 1H), 7.41-7.37 (m, 2H), 7.29 (br, 1H), 7.10 (br, 2H), 3.28-3.20 (m, 1H), 2.99-2.93 (m, 1H), 1.36 (d, J = 6.8 Hz, 6H), 1.21 (d, J = 6.8 Hz, 6H); ^{13}C NMR (125 MHz, DMSO- d_6): 165.92, 154.20, 153.29, 144.92, 142.45, 137.92, 135.85, 133.23, 129.80, 129.52, 128.58, 127.91, 127.31, 126.24, 126.18, 126.11, 125.94, 124.34, 124.12, 123.23, 120.76, 120.34, 120.12, 117.78, 115.46, 114.95, 34.12, 33.16, 23.87, 23.42; IR (cm^{-1}) 3362, 2958, 2865, 1634, 1582, 1512, 1460, 1448, 1357, 885, 851, 692; HRMS (ESI) calcd for $C_{32}H_{29}N_2O^+$ $[M+H]^+$ 457.2274, found 457.2260.



(3-Fluoro-9H-carbazol-9-yl)(9-fluorophenanthridin-6-yl)methanone (3d)

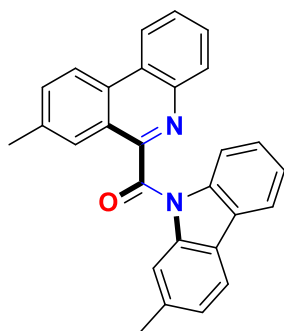
Pale yellow solid (18.8 mg, 92% yield). Mp 181-185 °C. 1H NMR (400 MHz,

DMSO-*d*₆): δ 9.01-8.99 (m, 1H), 8.95 (dd, J = 2.4 Hz, J = 10.8 Hz, 1H), 8.32 (dd, J = 4.8 Hz, J = 9.2 Hz, 1H), 8.26 (d, J = 6.8 Hz, 1H), 8.16 (dd, J = 2.4 Hz, J = 8.4 Hz, 1H), 8.11-8.08 (m, 1H), 7.93-7.90 (m, 2H), 7.73-7.68 (m, 1H), 7.42-7.38 (m, 2H), 7.28-7.23 (m, 3H); ¹³C NMR (125 MHz, DMSO-*d*₆): 165.68, 164.20 (d, J = 352.0 Hz), 159.42 (d, J = 239.1 Hz), 153.49, 142.53, 138.43, 135.96 (d, J = 10.1 Hz), 134.26, 130.56, 130.11 (d, J = 7.3 Hz), 130.01, 129.14, 128.23, 127.80 (d, J = 9.9 Hz), 125.56 (d, J = 3.4 Hz), 124.54, 124.03 (d, J = 4.3 Hz), 123.90, 121.17, 119.60, 118.22 (d, J = 24.3 Hz), 117.17, 115.34, 114.87 (d, J = 24.6 Hz), 108.93 (d, J = 22.9 Hz), 106.95 (d, J = 24.4 Hz); ¹⁹F NMR (470 MHz, CDCl₃): -103.64 (s, 1F), -117.74 (s, 1F); IR (cm⁻¹) 3392, 2956, 2920, 1674, 1597, 1583, 1459, 1447, 1392, 894, 836, 744, 698; HRMS (ESI) calcd for C₂₆H₁₅F₂N₂O⁺ [M+H]⁺ 409.1147, found 409.1144.



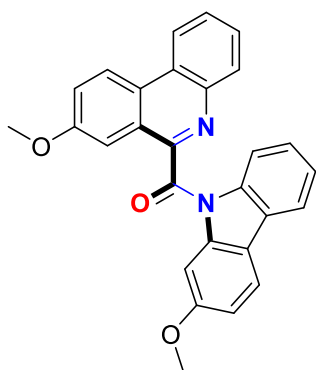
(3-chloro-9H-carbazol-9-yl)(9-chlorophenanthridin-6-yl)methanone (3e)

Pale yellow solid (15.0 mg, 68% yield). Mp 223-227 °C. ¹H NMR (400 MHz, CDCl₃): δ 8.75 (s, 1H), 8.65-8.63 (m, 1H), 8.17-8.15 (m, 1H), 8.09 (d, J = 8.8 Hz, 1H), 7.96-7.94 (m, 2H), 7.86-7.84 (m, 2H), 7.63 (d, J = 9.2 Hz, 1H), 7.36-7.21 (m, 5H); ¹³C NMR (125 MHz, CDCl₃): 116.11, 153.86, 143.36, 138.62, 136.90, 134.93, 130.95, 130.22, 129.15, 129.12, 128.33, 128.01, 127.36, 125.78, 124.53, 123.58, 122.49, 122.42, 121.42, 120.15, 119.78, 117.61, 116.13, 138.82, 130.10, 129.94; IR (cm⁻¹) 3065, 2921, 2851, 1674, 1442, 1323, 881, 849, 788, 764, 746, 706; HRMS (ESI) calcd for C₂₆H₁₅Cl₂N₂O⁺ [M+H]⁺ 441.0556, found 441.0551.



(2-Methyl-9H-carbazol-9-yl)(8-methylphenanthridin-6-yl)methanone (3f)

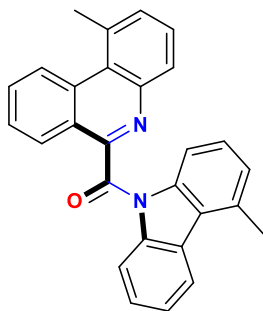
White solid (18.8 mg, 94% yield). Mp 181-183 °C. ^1H NMR (400 MHz, $\text{DMSO}-d_6$): δ 9.00-8.95 (m, 2H), 8.16 (d, J = 7.6 Hz, 1H), 8.11 (d, J = 8.0 Hz, 1H), 8.08-8.06 (m, 1H), 7.98-7.84 (m, 4H), 7.55 (br, 1H), 7.35-7.31 (m, 1H), 7.29 (d, J = 8.0 Hz, 1H), 7.14 (s, 1H), 6.81 (br, 1H), 3.35 (s, 3H), 2.28 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 167.01, 154.80, 142.96, 139.29, 138.65, 138.48, 137.74, 133.71, 131.66, 130.84, 128.94, 128.50, 127.16, 126.65, 126.15, 125.63, 124.77, 124.58, 124.06, 123.53, 122.51, 122.18, 119.61, 119.40, 117.42, 115.94, 22.22, 21.70; IR (cm^{-1}) 3424, 3057, 2955, 1679, 1602, 1568, 1499, 1459, 877, 826, 742, 703; HRMS (ESI) calcd for $\text{C}_{28}\text{H}_{21}\text{N}_2\text{O}^+ [\text{M}+\text{H}]^+$ 401.1648, found 401.1652.



(2-Methoxy-9H-carbazol-9-yl)(8-methoxyphenanthridin-6-yl)methanone (3g)

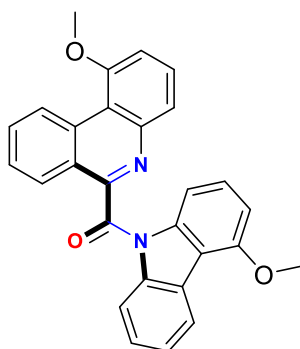
White solid (20.5 mg, 95% yield). Mp 170-173 °C. ^1H NMR (400 MHz, $\text{DMSO}-d_6$): δ 9.03 (d, J = 9.6 Hz, 1H), 8.92 (d, J = 8.4 Hz, 1H), 8.12 (d, J = 8.8 Hz, 2H), 8.04 (d, J = 8.0 Hz, 1H), 7.80-7.86 (m, 1H), 7.82-7.78 (m, 1H), 7.75 (dd, J = 9.2 Hz, J = 2.4 Hz, 1H), 7.53 (d, J = 2.4 Hz, 1H), 7.37-7.34 (m, 2H), 7.19 (br, 2H), 7.04 (d, J = 8.8 Hz, 1H), 3.84 (s, 3H), 3.48 (s, 3H); ^{13}C NMR (125 MHz, $\text{DMSO}-d_6$): 166.26, 159.20, 159.08, 153.21, 141.56, 139.14, 137.87, 129.90, 129.17, 128.80, 127.56, 126.20,

126.14, 125.31, 124.43, 124.39, 123.82, 123.01, 122.72, 121.22, 119.70, 119.44, 115.34, 111.87, 106.13, 100.89, 55.68, 55.08; IR (cm⁻¹) 3393, 3058, 2921, 1646, 1602, 1500, 1463, 1145, 883, 834, 757, 743, 702; HRMS (ESI) calcd for C₂₈H₂₁N₂O₃⁺ [M+H]⁺ 433.1574, found 433.1554.



(4-Methyl-9H-carbazol-9-yl)(1-methylphenanthridin-6-yl)methanone (3j)

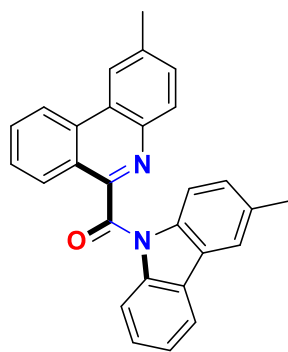
Pale yellow solid (14.2 mg, 71% yield). Mp 210-215 °C. ¹H NMR (400 MHz, DMSO-*d*₆): δ 9.18 (d, *J* = 8.4 Hz, 1H), 8.26 (d, *J* = 8.0 Hz, 1H), 8.22 (d, *J* = 8.0 Hz, 1H), 8.15-8.11 (m, 1H), 8.01-7.99 (m, 1H), 7.89-7.85 (m, 1H), 7.82-7.77 (m, 2H), 7.49-7.35 (m, 3H), 7.23 (br, 3H), 3.25 (s, 3H), 2.86 (s, 3H); ¹³C NMR (125 MHz, DMSO-*d*₆): 167.27, 155.34, 144.88, 138.82, 138.68, 136.78, 134.91, 134.12, 133.92, 132.76, 129.85, 129.79, 129.12, 128.19, 128.03, 127.82, 127.53, 127.36, 127.16, 125.46, 125.07, 124.53, 124.16, 123.72, 116.11, 113.76, 27.09, 21.41; IR (cm⁻¹) 3363, 2957, 2850, 2921, 2850, 1666, 1598, 1583, 1497, 1450, 1347, 781, 740, 670; HRMS (ESI) calcd for C₂₈H₂₁N₂O⁺ [M+H]⁺ 401.1648, found 401.1659.



(4-Methoxy-9H-carbazol-9-yl)(1-methoxyphenanthridin-6-yl)methanone (3k)

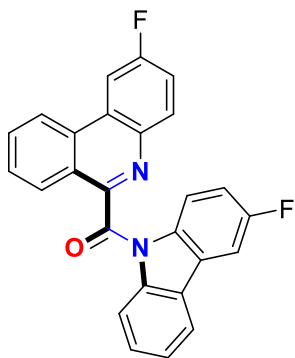
Yellow solid (15.3 mg, 71% yield). Mp 214-222 °C. ¹H NMR (500 MHz, DMSO-*d*₆):

δ 9.74 (d, J = 8.5 Hz, 1H), 8.31 (d, J = 8.0 Hz, 1H), 8.15 (d, J = 8.0 Hz, 1H), 8.11-8.08 (m, 1H), 7.88-7.85 (m, 1H), 7.83-7.80 (m, 1H), 7.77-7.69 (m, 2H), 7.57 (d, J = 8.0 Hz, 1H), 7.45-7.42 (m, 1H), 7.32-7.26 (m, 3H), 7.04 (d, J = 8.0 Hz, 1H), 4.26 (s, 3H), 4.08 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 167.05, 158.23, 155.84, 155.64, 145.31, 139.71, 137.81, 133.55, 131.55, 128.77, 128.37, 127.90, 127.53, 126.32, 126.23, 126.17, 124.23, 123.60, 123.52, 123.15, 115.86, 115.69, 115.38, 109.46, 108.88, 105.51, 56.01, 55.58; IR (cm^{-1}) 3365, 2957, 2921, 2850, 1600, 1573, 1487, 1450, 1137, 783, 742, 725; HRMS (ESI) calcd for $\text{C}_{28}\text{H}_{21}\text{N}_2\text{O}_3^+$ $[\text{M}+\text{H}]^+$ 433.1547, found 433.1557.



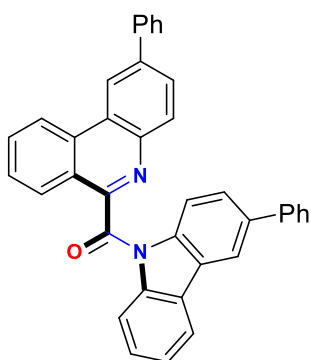
(3-Methyl-9H-carbazol-9-yl)(2-methylphenanthridin-6-yl)methanone (3l)

White solid (19.6 mg, 98% yield). Mp 214-218 °C. ^1H NMR (500 MHz, $\text{DMSO}-d_6$): δ 9.05 (d, J = 8.5 Hz, 1H), 8.81 (s, 1H), 8.19 (d, J = 7.5 Hz, 1H), 8.10-8.03 (m, 3H), 7.99 (d, J = 8.0 Hz, 1H), 7.80-7.77 (m, 1H), 7.71 (d, J = 8.0 Hz, 1H), 7.40-7.10 (m, 5H), 2.68 (s, 3H), 2.41 (s, 3H); ^{13}C NMR (125 MHz, $\text{DMSO}-d_6$): 166.10, 155.52, 140.78, 139.15, 137.98, 135.89, 133.95, 132.82, 132.27, 131.49, 129.76, 129.66, 128.87, 128.57, 127.47, 126.28, 126.16, 124.52, 124.11, 123.34, 122.71, 122.45, 120.51, 120.47, 115.47, 115.18, 21.58, 20.78; IR (cm^{-1}) 3367, 2919, 2851, 1671, 1634, 1585, 1486, 1446, 875, 846, 755, 699; HRMS (ESI) calcd for $\text{C}_{28}\text{H}_{21}\text{N}_2\text{O}^+$ $[\text{M}+\text{H}]^+$ 401.1648, found 401.1643.



(3-Fluoro-9H-carbazol-9-yl)(2-fluorophenanthridin-6-yl)methanone (3m)

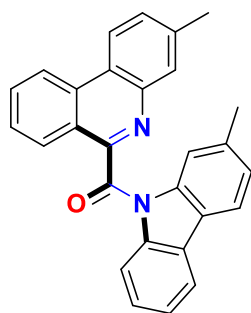
Pale yellow solid (14.3 mg, 70% yield). Mp 199-204 °C. ^1H NMR (400 MHz, DMSO- d_6): δ 9.09 (d, J = 8.4 Hz, 1H), 8.87 (dd, J = 2.4 Hz, J = 6.4 Hz, 1H), 8.26 (d, J = 8.0 Hz, 1H), 8.20-8.14 (m, 3H), 8.13-8.09 (m, 1H), 7.88-7.84 (m, 1H), 7.79-7.74 (m, 1H), 7.42-7.38 (m, 2H), 7.28-7.23 (m, 3H); ^{13}C NMR (125 MHz, CDCl_3): 166.23, 162.43 (d, J = 248.4 Hz), 160.03 (d, J = 241.4 Hz), 153.91 (d, J = 3.0 Hz), 139.91, 139.12, 134.82, 133.14 (d, J = 9.3 Hz), 133.09 (d, J = 4.3 Hz), 131.89, 129.04, 128.28 (d, J = 9.4 Hz), 127.84, 126.82, 126.23, 126.18 (d, J = 4.8 Hz), 124.26, 123.23, 122.79, 120.14, 118.56 (d, J = 24.3 Hz), 117.74, 116.07, 114.63 (d, J = 24.4 Hz), 107.44 (d, J = 23.4 Hz), 106.04 (d, J = 24.1 Hz); ^{19}F NMR (470 MHz, CDCl_3): -109.62 (s, 1F), -117.83 (s, 1F); IR (cm^{-1}) 3360, 3050, 2921, 2851, 1666, 1631, 1598, 1581, 1485, 1447, 895, 833, 764, 707; HRMS (ESI) calcd for $\text{C}_{26}\text{H}_{15}\text{F}_2\text{N}_2\text{O}^+$ $[\text{M}+\text{H}]^+$ 409.1147, found 409.1163.



(3-Phenyl-9H-carbazol-9-yl)(2-phenylphenanthridin-6-yl)methanone (3n)

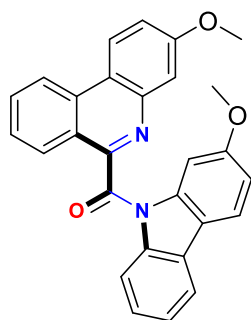
White solid (23.8 mg, 91% yield). Mp > 350 °C. ^1H NMR (400 MHz, DMSO- d_6): δ 9.33 (d, J = 8.4 Hz, 1H), 9.27 (s, 1H), 8.60 (d, J = 1.2 Hz, 1H), 8.38 (d, J = 7.6 Hz,

1H), 8.20-8.19 (m, 3H), 8.14-8.10 (m, 1H), 8.04 (d, $J = 7.2$ Hz, 2H), 7.87-7.83 (m, 1H), 7.77 (d, $J = 7.6$ Hz, 2H), 7.62-7.58 (m, 3H), 7.51-7.45 (m, 5H), 7.39-7.35 (m, 3H); ^{13}C NMR (125 MHz, DMSO- d_6): 166.10, 154.26, 141.85, 140.76, 139.56, 139.35, 138.24, 137.13, 136.70, 133.28, 132.50, 130.66, 129.19, 129.14, 128.93, 128.71, 128.22, 127.85, 127.60, 127.46, 126.94, 126.85, 126.37, 126.28, 124.72, 124.67, 123.90, 122.63, 120.95, 118.58, 115.81, 115.60; IR (cm^{-1}) 3439, 2957, 2920, 2851, 1674, 1629, 1468, 1450, 987, 933, 531, 526; HRMS (ESI) calcd for $\text{C}_{38}\text{H}_{25}\text{N}_2\text{O}^+ [\text{M}+\text{H}]^+$ 525.1961, found 525.1992.



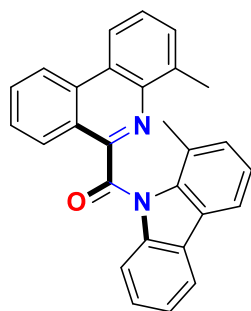
(2-Methyl-9H-carbazol-9-yl)(3-methylphenanthridin-6-yl)methanone (3o)

White solid (18.0 mg, 90% yield). Mp 220-225 °C. ^1H NMR (400 MHz, DMSO- d_6): δ 9.03 (d, $J = 8.4$ Hz, 1H), 8.89 (d, $J = 8.4$ Hz, 1H), 8.16-8.04 (m, 4H), 7.91 (s, 1H), 7.79-7.42 (m, 2H), 7.56 (br, 1H), 7.34-7.28 (m, 2H), 7.12 (br, 1H), 6.79 (br, 1H), 2.56 (s, 3H), 2.28 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3): 166.21, 154.42, 142.59, 139.85, 138.33, 137.52, 137.38, 133.15, 132.44, 130.76, 129.36, 128.55, 126.92, 126.24, 126.19, 125.79, 124.34, 123.80, 123.16, 123.06, 122.06, 121.90, 120.33, 120.19, 116.28, 114.93, 21.77, 21.02; IR (cm^{-1}) 3361, 3032, 2920, 2851, 1678, 1600, 1581, 1499, 1458, 889, 844, 746, 696; HRMS (ESI) calcd for $\text{C}_{28}\text{H}_{21}\text{N}_2\text{O}^+ [\text{M}+\text{H}]^+$ 401.1648, found 401.1696.



(3-Methoxy-9H-carbazol-9-yl)(2-methoxyphenanthridin-6-yl)methanone (3p)

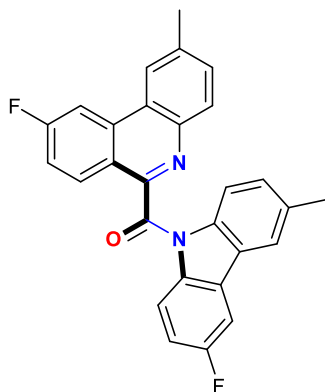
White solid (21.2 mg, 98% yield). Mp 200-205 °C. ^1H NMR (500 MHz, $\text{DMSO-}d_6$): δ 8.97 (d, J = 8.5 Hz, 1H), δ 8.89 (d, J = 9.0 Hz, 1H), 8.12-8.08 (m, 3H), 8.05-8.02 (m, 1H), 7.74-7.71 (m, 1H), 7.60 (s, 1H), 7.53 (d, J = 9.0 Hz, 1H), 7.36-7.02 (m, 4H), 3.92 (s, 3H), 3.48 (s, 3H); ^{13}C NMR (125 MHz, $\text{DMSO-}d_6$): 166.23, 160.47, 159.13, 154.79, 144.32, 138.98, 137.73, 133.36, 132.56, 127.91, 126.27, 126.25, 126.15, 124.57, 124.53, 122.84, 121.37, 121.30, 119.80, 119.77, 119.49, 118.18, 115.32, 111.93, 110.08, 100.88, 55.67, 55.09; IR (cm^{-1}) 3388, 3365, 2920, 1667, 1616, 1583, 1459, 1439, 1121, 886, 853, 765, 699; HRMS (ESI) calcd for $\text{C}_{28}\text{H}_{21}\text{N}_2\text{O}_3^+$ $[\text{M}+\text{H}]^+$ 433.1547, found 433.1549.



(1-Methyl-9H-carbazol-9-yl)(4-methylphenanthridin-6-yl)methanone (3r)

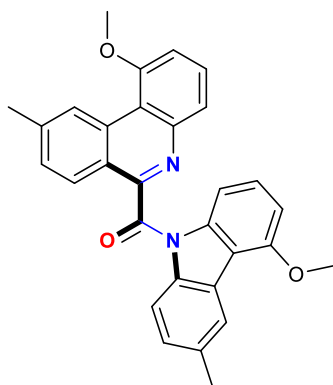
Pale yellow solid (17.6 mg, 88% yield). Mp 183-186 °C. ^1H NMR (500 MHz, $\text{DMSO-}d_6$): δ 9.01 (d, J = 8.5 Hz, 1H), 8.74 (d, J = 8.0 Hz, 2H), 8.23 (d, J = 7.5 Hz, 1H), 8.11-8.06 (m, 2H), 7.95-7.91 (m, 1H), 7.74-7.71 (m, 1H), 7.64 (d, J = 8.0 Hz, 1H), 7.59 (d, J = 7.0 Hz, 1H), 7.42-7.31 (m, 3H), 7.08 (d, J = 7.5 Hz, 1H), 2.01 (s, 3H), 1.72 (s, 3H); ^{13}C NMR (125 MHz, $\text{DMSO-}d_6$): 167.39, 149.98, 140.17, 140.00, 139.54, 138.18, 133.71, 131.81, 130.01, 129.48, 129.41, 128.82, 127.32, 126.83,

126.50, 126.11, 125.34, 124.58, 123.94, 123.33, 122.92, 120.78, 120.48, 117.95, 114.11, 20.34, 16.72; IR (cm⁻¹) 3365, 2957, 2920, 2851, 1678, 1595, 1543, 1493, 1468, 1446, 1374, 788, 766; HRMS (ESI) calcd for C₂₈H₂₁N₂O⁺ [M+H]⁺ 401.1648, found 401.1649.



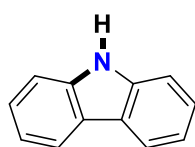
(9-Fluoro-2-methylphenanthridin-6-yl)(3-fluoro-6-methyl-9H-carbazol-9-yl)methanone (3s)

White solid (18.1 mg, 83% yield). Mp 234-236 °C. ¹H NMR (500 MHz, DMSO-*d*₆): δ 8.86 (d, *J* = 10.5 Hz, 1H), 8.79 (s, 1H), 8.23 (s, 3H), 8.05-7.96 (m, 4H), 7.72-7.65 (m, 3H), 7.18-7.05 (m, 3H), 2.64 (s, 3H), 2.36 (s, 3H); ¹³C NMR (125 MHz, DMSO-*d*₆): 165.59, 164.01 (d, *J* = 250.0 Hz), 159.37 (d, *J* = 238.8 Hz), 152.55, 140.83, 139.23, 136.55, 135.56 (d, *J* = 9.9 Hz), 134.46, 133.88, 132.12, 129.86 (d, *J* = 9.9 Hz), 129.72, 129.14, 127.77 (d, *J* = 9.9 Hz), 125.67 (d, *J* = 3.3 Hz), 123.84 (d, *J* = 3.8 Hz), 123.26, 120.95, 119.67, 118.02 (d, *J* = 24.4 Hz), 117.15, 115.01, 114.65 (d, *J* = 24.5 Hz), 108.76 (d, *J* = 22.8 Hz), 106.75 (d, *J* = 24.4 Hz), 21.48, 20.70; ¹⁹F NMR (470 MHz, CDCl₃): -104.25 (s, 1F), -117.95 (s, 1F); IR (cm⁻¹) 3429, 2951, 2919, 2852, 1679, 1620, 1585, 1457, 1274, 859, 831, 815; HRMS (ESI) calcd for C₂₈H₁₉F₂N₂O⁺ [M+H]⁺ 437.1460, found 437.1461.



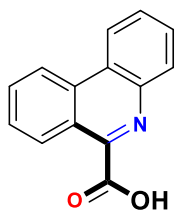
(3-Methoxy-5-methyl-9H-carbazol-9-yl)(1-methoxy-9-methylphenanthridin-6-yl) methanone (3t)

Yellow solid (21.2 mg, 92% yield). Mp 238-241 °C. ^1H NMR (400 MHz, $\text{DMSO-}d_6$): δ 9.49 (s, 1H), 8.07 (s, 1H), 7.96 (d, $J = 8.0$ Hz, 1H), 7.81-7.77 (m, 1H), 7.70-7.68 (m, 1H), 7.60 (dd, $J = 1.2$ Hz, $J = 8.4$ Hz, 1H), 7.49 (d, $J = 7.6$ Hz, 2H), 7.19-6.97 (m, 4H), 4.21 (s, 3H), 4.03 (s, 3H), 2.64 (s, 3H), 2.40 (s, 3H); ^{13}C NMR (125 MHz, $\text{DMSO-}d_6$): 166.24, 158.01, 155.38, 154.96, 144.65, 142.55, 139.03, 135.12, 133.81, 132.95, 129.66, 129.47, 128.44, 127.66, 127.51, 125.80, 125.46, 122.93, 122.48, 120.80, 114.72, 114.57, 114.18, 110.27, 107.85, 106.31, 56.28, 55.84, 22.39, 20.88; IR (cm^{-1}) 3392, 3185, 2920, 2850, 1635, 1585, 1506, 1452, 1034, 880, 812, 782, 770, 751; HRMS (ESI) calcd for $\text{C}_{30}\text{H}_{25}\text{N}_2\text{O}_3^+$ $[\text{M}+\text{H}]^+$ 461.1860, found 461.1864.



9H-carbazole (4)

Yellow solid (15.0 mg, 90% yield). ^1H NMR (400 MHz, $\text{DMSO-}d_6$): δ 11.22 (s, 1H), 8.10 (d, $J = 10.0$ Hz, 2H), 7.47 (d, $J = 10.5$ Hz, 2H), 7.39-7.35 (m, 2H), 7.17-7.13 (m, 2H); ^{13}C NMR (125 MHz, $\text{DMSO-}d_6$): 139.68, 125.45, 122.35, 120.08, 118.43, 110.88; HRMS (ESI) calcd for $\text{C}_{12}\text{H}_{10}\text{N}^+$ $[\text{M}+\text{H}]^+$ 168.0808, found 168.0807.



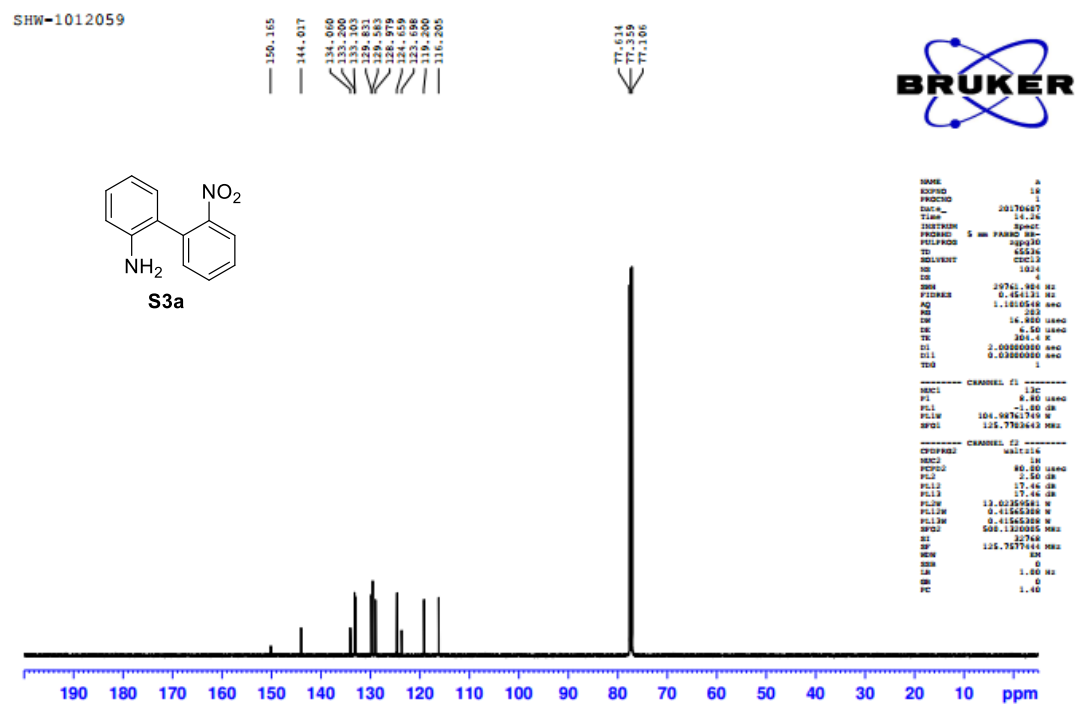
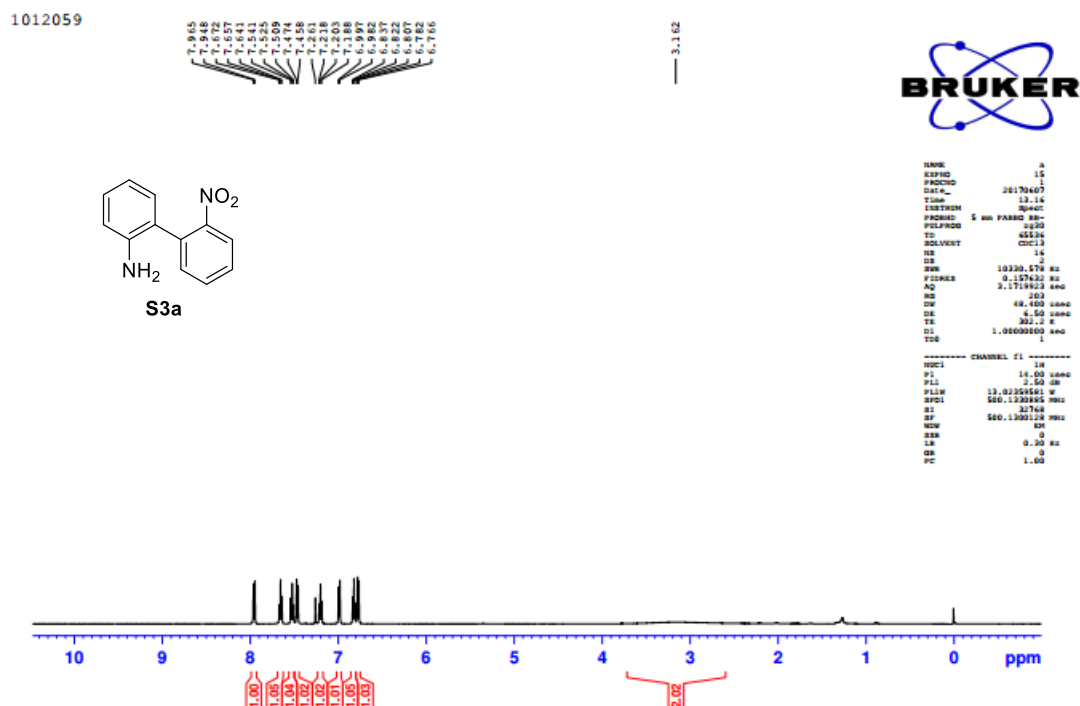
Phenanthridine-6-carboxylic acid (5)

Yellow solid (20.5 mg, 92% yield). ^1H NMR (500 MHz, CDCl_3): δ 9.74 (d, $J = 5.0$ Hz, 1H), 8.69 (d, $J = 5.0$ Hz, 1H), 8.64 (s, 1H), 8.21 (s, 1H), 7.97-7.94 (m, 1H), 7.84-7.82 (m, 3H), 6.73 (br, 1H); ^{13}C NMR (125 MHz, $\text{DMSO}-d_6$): 163.99, 144.46, 140.50, 134.36, 132.05, 130.17, 129.96, 129.60, 129.01, 128.92, 126.69, 124.13, 122.46, 122.12; HRMS (ESI) calcd for $\text{C}_{14}\text{H}_{10}\text{NO}_2^+$ $[\text{M}+\text{H}]^+$ 224.0706, found 224.0708.

6. References

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4. M. Gionaola, R. Leardini, D. Nanni, P. Pareschi, G. Zanardi, *Tetrahedron* **1995**, *51*, 2039.
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7. Copies of ^1H and ^{13}C NMR Spectra

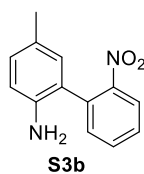


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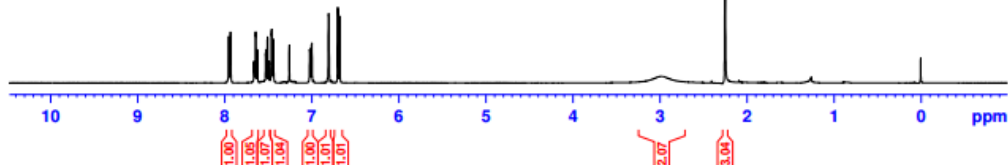
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2.253



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TE 300.2 K
D1 1.00000000 sec
TD0 1

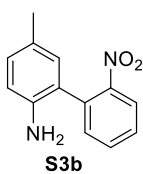
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SSB 0
LB 0.30 Hz
GB 0
PC 1.00



SHW-1012103

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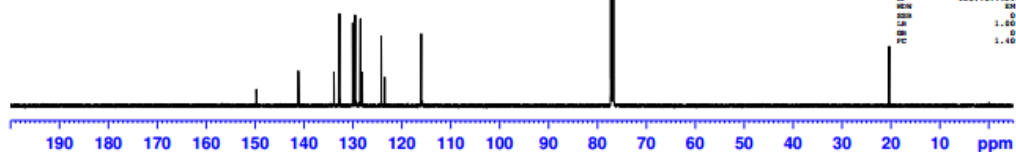
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DS 4
SWH 20785.194 Hz
FIDRES 0.466111 Hz
AQ 1.1010548 sec
RG 256
DM 16.800 umm
DE 4.50 umm
TE 300.2 K
D1 2.00000000 sec
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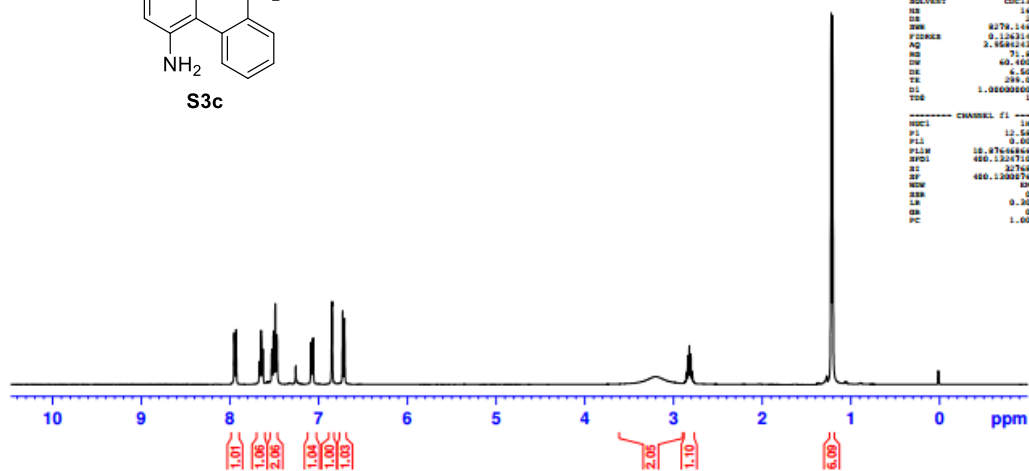
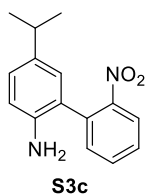
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PL12 17.44 dB
PL13 17.44 dB
PL14 17.44 dB
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PL16 0.41565308 Hz
PL17 0.41565308 Hz
SFO2 500.1320000 MHz
SI 32768
SF 100.7762643 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



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2.770

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1.206



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D1	1.0000000 sec
TDR	1

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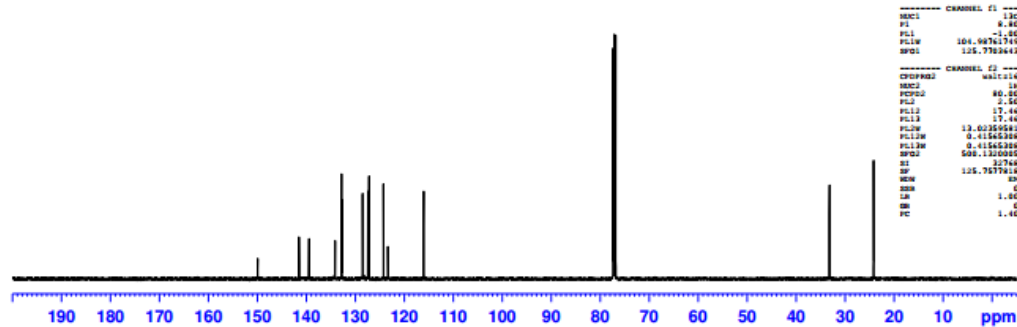
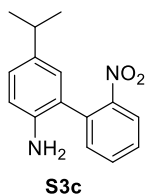
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— 33.160

— 24.167

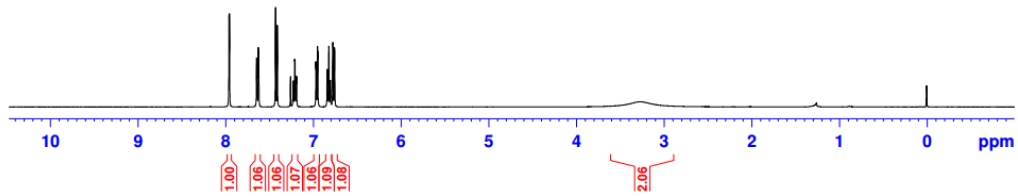
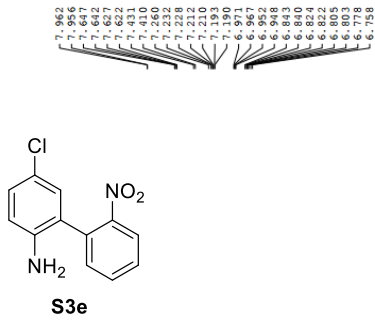


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SOLVENT	CDCl3
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D11	0.03000000 sec
DELTA	

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FL1        -1.80 dB
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WOL        105.3780243 W
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PL20	509.1300000	NRZ	
SI	32768		
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WDM	EM		
WDR			
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1012052

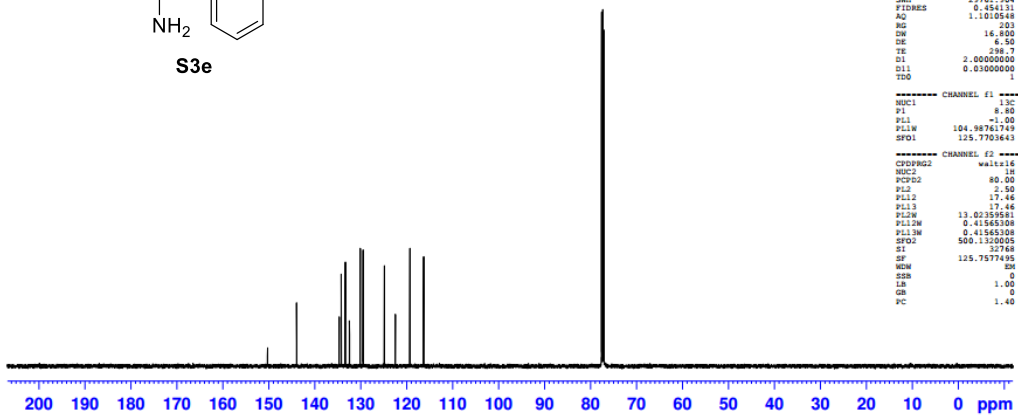
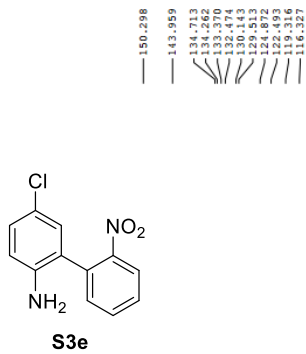


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1012052



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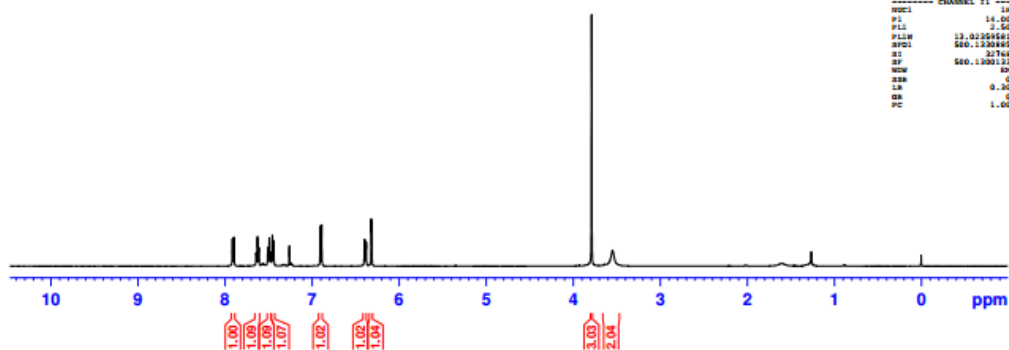
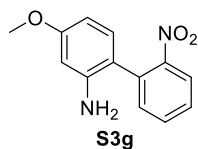
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RG            203
WE           16.800 usec
DE            6.50 usec
TE            298.2 K
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D11           0.03000000 sec
TD0           1
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PL12W         0.41545308 W
PL13W         0.41545308 W
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SF            125.7577495 MHz
WDW           EM
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1990	25.1
1995	27.8
2000	30.6
2005	33.4
2010	36.2
2015	39.0
2020	41.8

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VOLTAGE      2.177822 e+00
SW          48.400
NS          4.00 e+00
DE          2.00 e-04
DI          1.000000000 e+00
TD0          1
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=====
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P12         13.02000000 Hz
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SHW-1012195

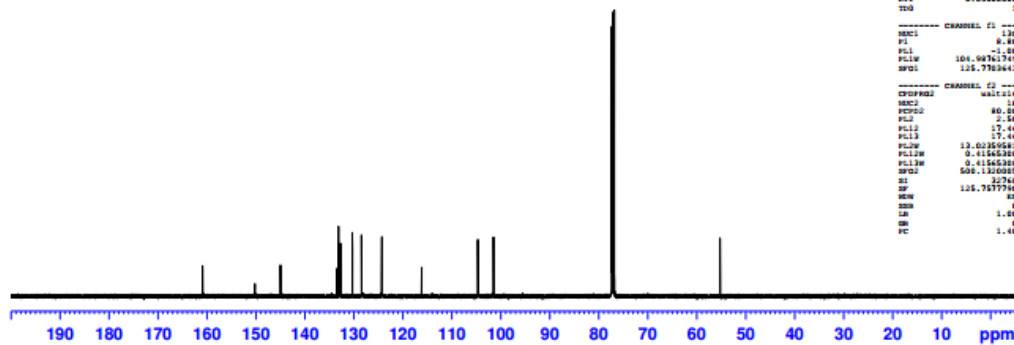
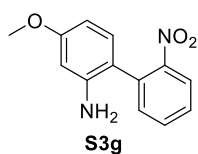
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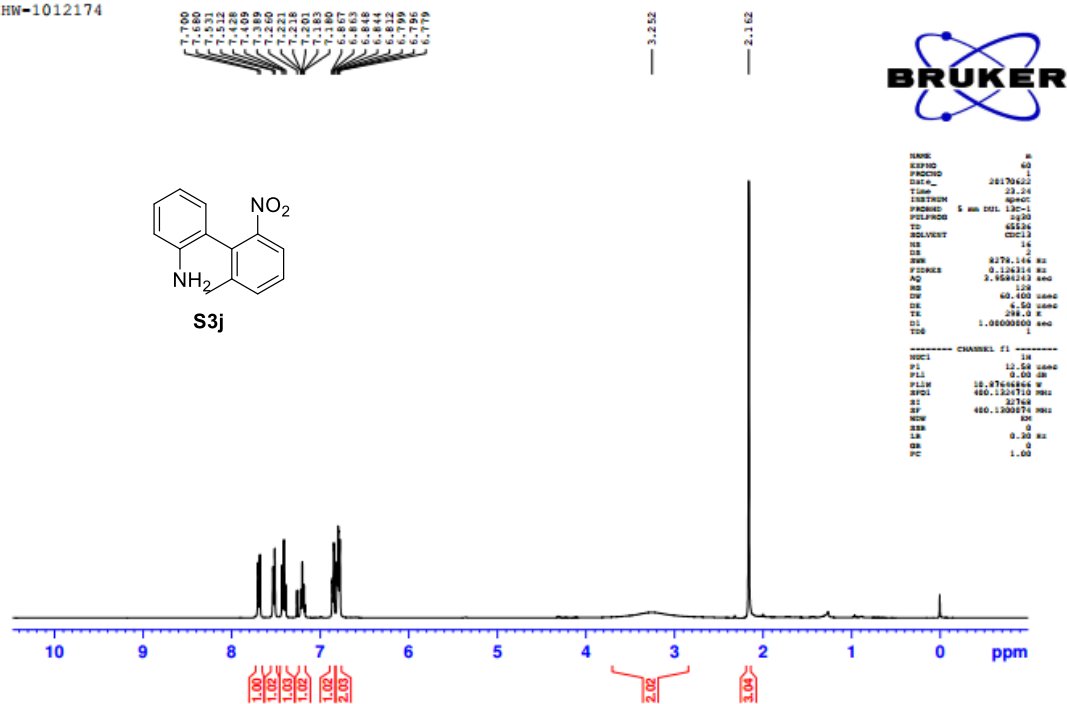
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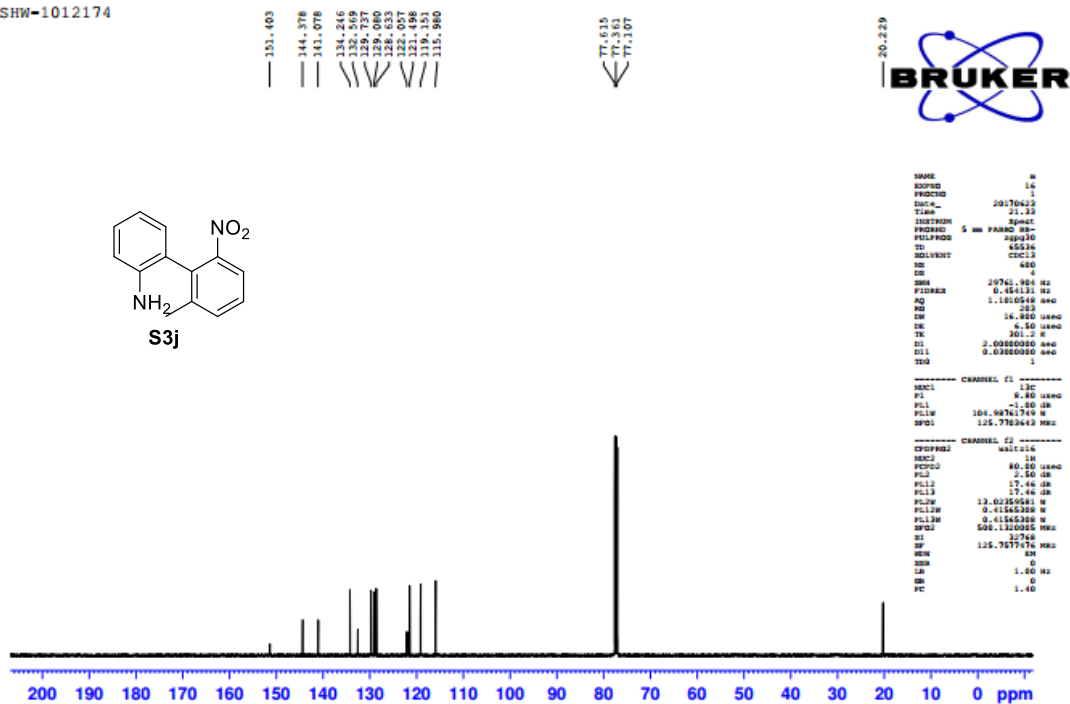


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WDW	16.000000 Hz
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GB	0.000000 Hz
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TG0	0.00000000 Hz
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PCPD1	80.000000 Hz
PLW1	100.62679470 Hz
PLW2	100.62679470 Hz
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PCPD1	80.000000 Hz
PLW1	17.440000 Hz
PLW2	17.440000 Hz
PLW3	32.000000 Hz
PLW4	0.000000 Hz
PLW5	0.000000 Hz
PLW6	0.000000 Hz
PLW7	0.000000 Hz
PLW8	0.000000 Hz
PLW9	0.000000 Hz
PLW10	0.000000 Hz
PLW11	0.000000 Hz
PLW12	0.000000 Hz
PLW13	0.000000 Hz
PLW14	0.000000 Hz
PLW15	0.000000 Hz
PLW16	0.000000 Hz
PLW17	0.000000 Hz
PLW18	0.000000 Hz
PLW19	0.000000 Hz
PLW20	0.000000 Hz
PLW21	0.000000 Hz
PLW22	0.000000 Hz
PLW23	0.000000 Hz
PLW24	0.000000 Hz
PLW25	0.000000 Hz
PLW26	0.000000 Hz
PLW27	0.000000 Hz
PLW28	0.000000 Hz
PLW29	0.000000 Hz
PLW30	0.000000 Hz
PLW31	0.000000 Hz
PLW32	0.000000 Hz
PLW33	0.000000 Hz
PLW34	0.000000 Hz
PLW35	0.000000 Hz
PLW36	0.000000 Hz
PLW37	0.000000 Hz
PLW38	0.000000 Hz
PLW39	0.000000 Hz
PLW40	0.000000 Hz
PLW41	0.000000 Hz
PLW42	0.000000 Hz
PLW43	0.000000 Hz
PLW44	0.000000 Hz
PLW45	0.000000 Hz
PLW46	0.000000 Hz
PLW47	0.000000 Hz
PLW48	0.000000 Hz
PLW49	0.000000 Hz
PLW50	0.000000 Hz
PLW51	0.000000 Hz
PLW52	0.000000 Hz
PLW53	0.000000 Hz
PLW54	0.000000 Hz
PLW55	0.000000 Hz
PLW56	0.000000 Hz
PLW57	0.000000 Hz
PLW58	0.000000 Hz
PLW59	0.000000 Hz
PLW60	0.000000 Hz
PLW61	0.000000 Hz
PLW62	0.000000 Hz
PLW63	0.000000 Hz
PLW64	0.000000 Hz
PLW65	0.000000 Hz
PLW66	0.000000 Hz
PLW67	0.000000 Hz
PLW68	0.000000 Hz
PLW69	0.000000 Hz
PLW70	0.000000 Hz
PLW71	0.000000 Hz
PLW72	0.000000 Hz
PLW73	0.000000 Hz
PLW74	0.000000 Hz
PLW75	0.000000 Hz
PLW76	0.000000 Hz
PLW77	0.000000 Hz
PLW78	0.000000 Hz
PLW79	0.000000 Hz
PLW80	0.000000 Hz
PLW81	0.000000 Hz
PLW82	0.000000 Hz
PLW83	0.000000 Hz
PLW84	0.000000 Hz
PLW85	0.000000 Hz
PLW86	0.000000 Hz
PLW87	0.000000 Hz
PLW88	0.000000 Hz
PLW89	0.000000 Hz
PLW90	0.000000 Hz
PLW91	0.000000 Hz
PLW92	0.000000 Hz
PLW93	0.000000 Hz
PLW94	0.000000 Hz
PLW95	0.000000 Hz
PLW96	0.000000 Hz
PLW97	0.000000 Hz
PLW98	0.000000 Hz
PLW99	0.000000 Hz
PLW100	0.000000 Hz
PLW101	0.000000 Hz
PLW102	0.000000 Hz
PLW103	0.000000 Hz
PLW104	0.000000 Hz
PLW105	0.000000 Hz
PLW106	0.000000 Hz
PLW107	0.000000 Hz
PLW108	0.000000 Hz
PLW109	0.000000 Hz
PLW110	0.000000 Hz
PLW111	0.000000 Hz
PLW112	0.000000 Hz
PLW113	0.000000 Hz
PLW114	0.000000 Hz
PLW115	0.000000 Hz
PLW116	0.000000 Hz
PLW117	0.000000 Hz
PLW118	0.000000 Hz
PLW119	0.000000 Hz
PLW120	0.000000 Hz
PLW121	0.000000 Hz
PLW122	0.000000 Hz</

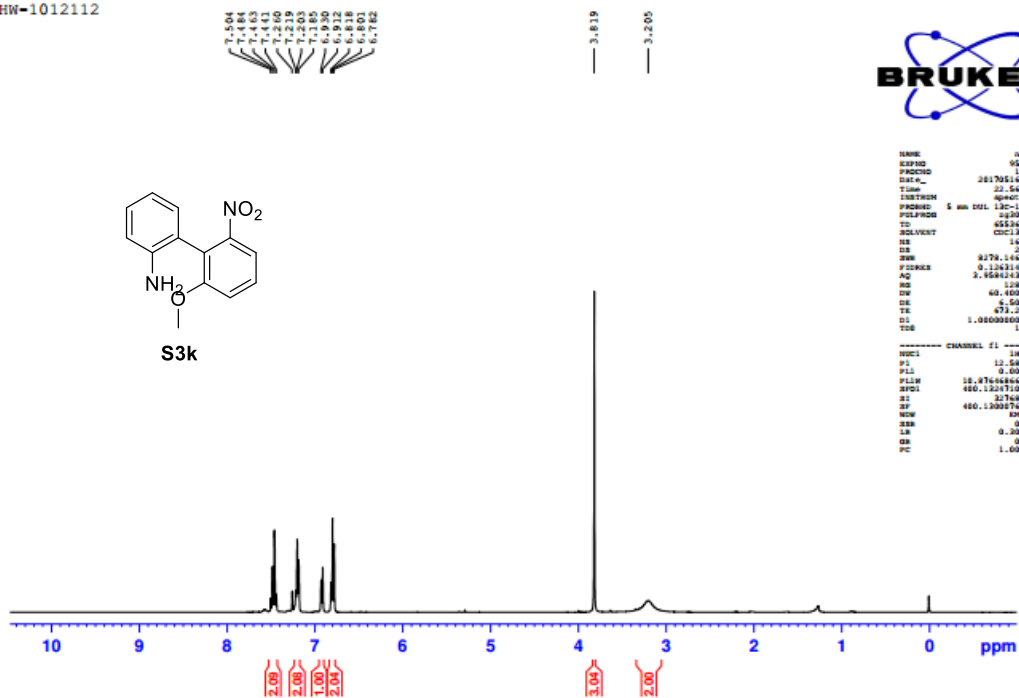
SHW-1012174



SHW-1012174



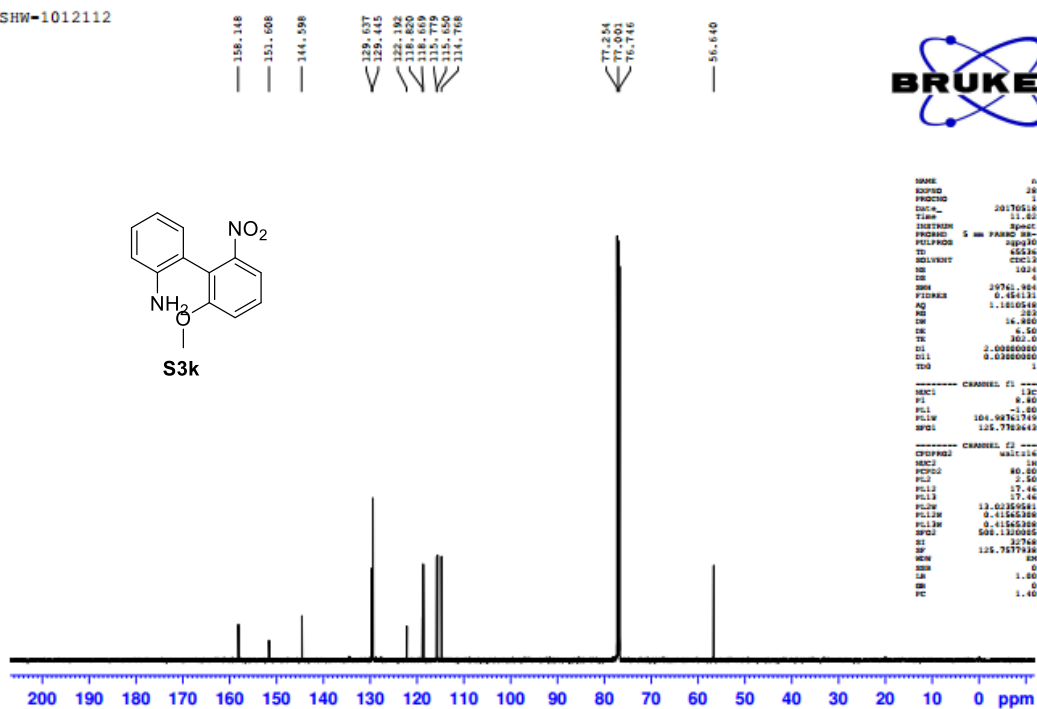
SHW-1012112



NAME: a
EXPNO: 1
PROCNO: 1
DATE_: 20170514
TIME: 22.54
INSTRUM: spect
PROBHD: 5 mm DUL 13C-1
PULPROG: zgpg30
TD: 65536
SOLVENT: CDCl3
NS: 14
DS: 2
SWH: 8274.144 Hz
FIDRES: 0.124314 Hz
AQ: 2.1681113 sec
RG: 128
CW: 68.400 kHz
DE: 4.50 kHz
TE: 300.2 K
D1: 1.00000000 sec
TD0: 1

----- CHANNEL f1 -----
NUC1: 1H
P1: 12.00 sec
PL1: 0.00 dB
PL12: 18.4746866 dB
SFO1: 400.1461710 MHz
SI: 32768
SF: 400.1460976 MHz
WDW: EM
SSB: 0
LB: 0.30 Hz
GB: 0
PC: 1.00

SHW-1012112

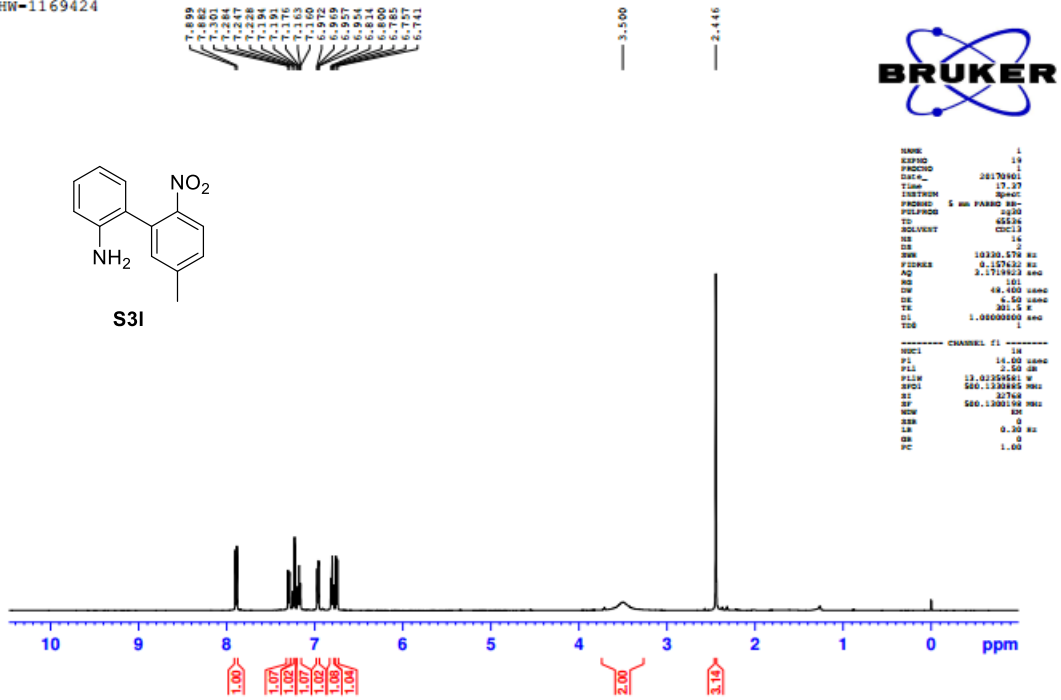
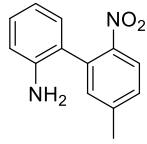


NAME: a
EXPNO: 28
PROCNO: 1
DATE_: 20170518
TIME: 11.42
INSTRUM: spect
PROBHD: 5 mm PABBO 13C-1
PULPROG: zgpg30
TD: 65536
SOLVENT: CDCl3
NS: 1024
DS: 4
SWH: 29741.904 Hz
FIDRES: 0.1651113 Hz
AQ: 1.1810548 sec
RG: 253
CW: 14.900 kHz
DE: 4.50 kHz
TE: 300.2 K
D1: 2.00000000 sec
D11: 0.03000000 sec
TD0: 1

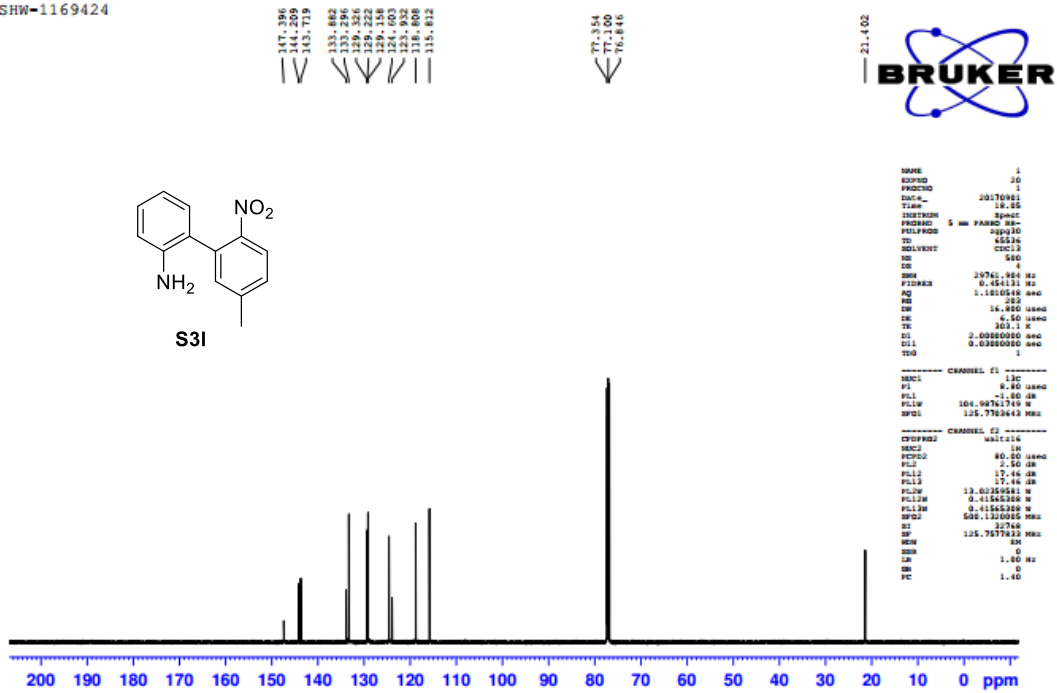
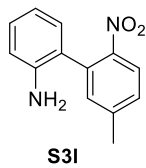
----- CHANNEL f1 -----
NUC1: 13C
P1: 8.00 sec
PL1: 0.00 dB
PL12: 104.9874749 dB
SFO1: 125.7703643 MHz

----- CHANNEL f2 -----
EXPNO2: 841116
PROCNO2: 18
FIDRES2: 80.00 kHz
PL2: 2.50 dB
PL12: 17.44 dB
PL13: 17.44 dB
PL14: 17.44 dB
PL15: 12.0330561 dB
PL12W: 0.1156308 dB
PL13W: 0.1156308 dB
SFO2: 500.1360005 MHz
SI: 32768
SF: 125.7677438 MHz
WDW: EM
SSB: 0
LB: 1.00 Hz
GB: 0
PC: 1.40

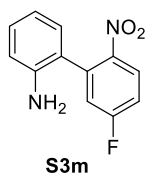
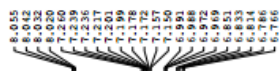
SHW-1169424



SHW-1169424

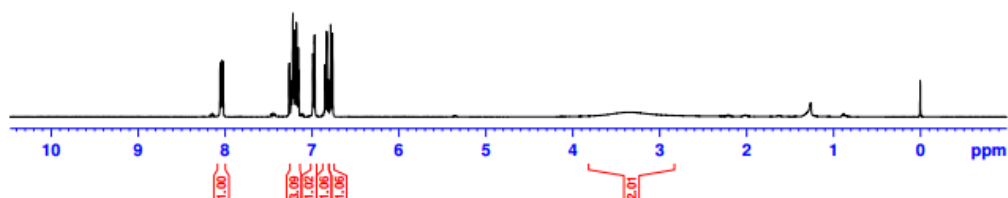


SHW-1012113

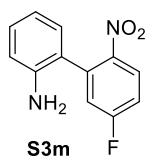
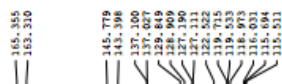


NAME
EXPNO 3
PROCNO 25
DATE_ 20170510
TIME 14.19
INSTRUM spect
PROBHD 5 mm QNP 13C-1
PULPROG zgpg30
TD 48224
SOLVENT CDCl3
NS 14
DS 4
SWH 2076.146 Hz
FIDRES 0.124310 Hz
AQ 9.9581243 sec
RG 181
DW 60.400 sec
DE 6.50 sec
TE 300.2 K
D1 1.00000000 sec
TD0 1

===== CHANNEL f1 =====
NUC1 13C
P1 12.50 sec
PL1 0.100 dB
PL1W 10.8764884 W
SFO1 400.1261710 MHz
Z1 31704
SF 400.1260790 MHz
WDW EM
SSB 0
LA 0 Hz
GB 0
PC 1.00



SHW-1012113

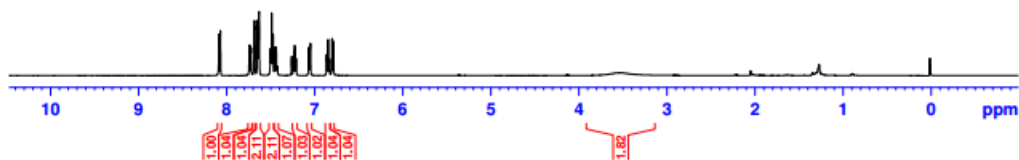


NAME
EXPNO 3
PROCNO 1
DATE_ 20170511
TIME 4.17
INSTRUM spect
PROBHD 5 mm PABO BB-
PULPROG zgpg30
TD 48224
SOLVENT CDCl3
NS 1024
DS 4
SWH 20761.064 Hz
FIDRES 0.464131 Hz
AQ 1.1010568 sec
RG 203
DW 14.400 sec
DE 6.50 sec
TE 300.2 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

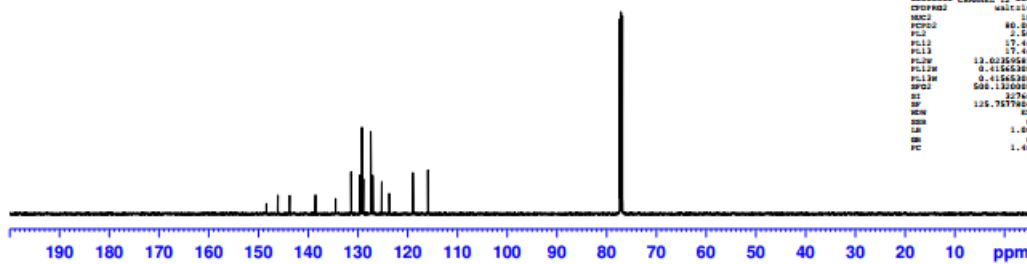
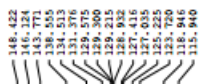
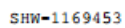
===== CHANNEL f1 =====
NUC1 13C
P1 8.40 sec
PL1 -1.00 dB
PL1W 104.9276710 W
SFO1 125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2 waltz16
NUC2 1H
PCPD2 40.00 sec
PL2 2.50 dB
PL12 17.46 dB
PL13 17.46 dB
PL1W 13.0230581 W
PL1W 0.41545208 W
PL1W 0.41545208 W
SFO2 500.1360505 MHz
SI 32768
SF 125.7677900 MHz
WDW EM
SSB 0
LA 0 Hz
GB 0
PC 1.00





```
NAME                                1
KEPNO                               1
PROBNO                               1
DATE=                               20170405
TIME                                20.06
USER                                9904C
PROBNO= $ MM PARNO= 880
POLYNO                               220
X= 432.26
SOLVENT= CHCl3
DS = 1.4
MM                               10320.176 KZ
FURKE= 0.17848 KZ
AQ= 2.171923 aeo
MS = 1.28
DE                               48.000 aeo
DE                               4.50 aeo
T= 201.5 K
D1 = 1.000000000 aeo
TDS = 1
===== CHANNEL F1 =====
P1 = 14.00 aeo
P2 = 2.50 KZ
WLEN = 13.022588888 KZ
NPOL = 550.1235895 NMZ
SF = 500.1200123 NMZ
MWK = NMZ
XN = 0
DS = 0.0 KZ
DS = 0.0 KZ
PC = 1.00
```



NAME	1
EXPNO	35
PROCNO	1
DATE_	20170905
TIME	20.34
INSTRUM	spect
PROBHD	5 mm PABBO HR-
PULPROG	zgpg30
TD	65536
SOLVENT	CDCl3
NS	500
DS	4
SWH	29761.924 Hz
FIDRES	0.454131 Hz
AQ	1.1010549 sec
RG	203
WE	16.880 used
DE	6.50 used
TE	302.2 K
D1	2.00000000 sec
D11	0.03000000 sec
TD0	1

```
----- CHANNEL f1 -----
MNC1          13c
PI            8.00 used
PLI           -1.00 dB
PLIW          104.98761749 W
SFOI          125.7782643 MHz
```

```

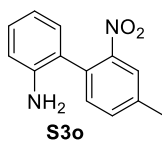
===== CRANDEL f2 =====
CVPFRQ2      wt1216
MJC2         1M
PCPFRQ2      80.00 used
PL2          2.50 dB
PL12         17.46 dB
PL13         17.46 dB
PL14         12.62356512 W
PL15         0.41565368 W
PL16         0.41565368 W
PL17         508.1300055 MHz
SI           32768
SEW          125.7577804 MHz
SM           SM
LN           0
LN           1.00 Hz
GM           0
PC           1.40

```

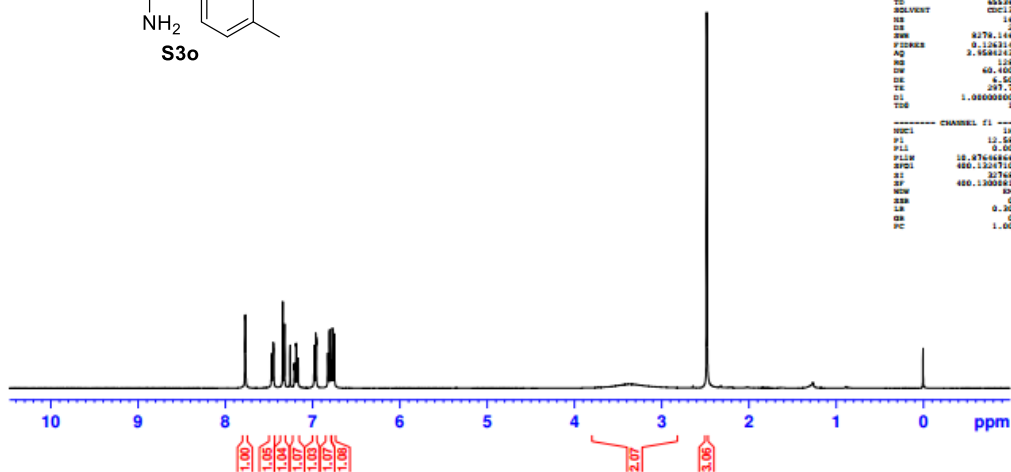
7-770
7-769
7-471
7-469
7-452
7-450
7-343
7-324
7-260
7-210
7-206
7-190
7-187
7-171
7-168
6-983
6-979
6-964
6-961
6-828
6-826
6-809
6-807
6-791
6-788
6-774
6-754

3.359

2.484



S3o



```
NAME h
KEPNO 5
PRGNO 1
DATE_ 20170412
TIME 0.40
INSTRUM spect
PROBHD $ mm DGL 13C-1
PULPROG zgpg
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8078.146 Hz
FIDRES 0.126314 Hz
AQ 2.9568243 sec
RG 128
DW 60.4000000 sec
DE 4.5000000 sec
TE 293.7 K
D1 0.00000000
D11 1.00000000
```

```

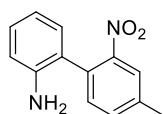
----- CHANNEL F1 -----
WDC1              1M
P1                 12.50  used
P11                0.00  dB
PLW                10.8766686  W
FWD1               400.1224710  MHz
Z1                 22768
ZF                 400.1300881  MHz
WOW                100
XSR                0
LA                 0.20  Hz
GR                 0
PC                 1.00

```

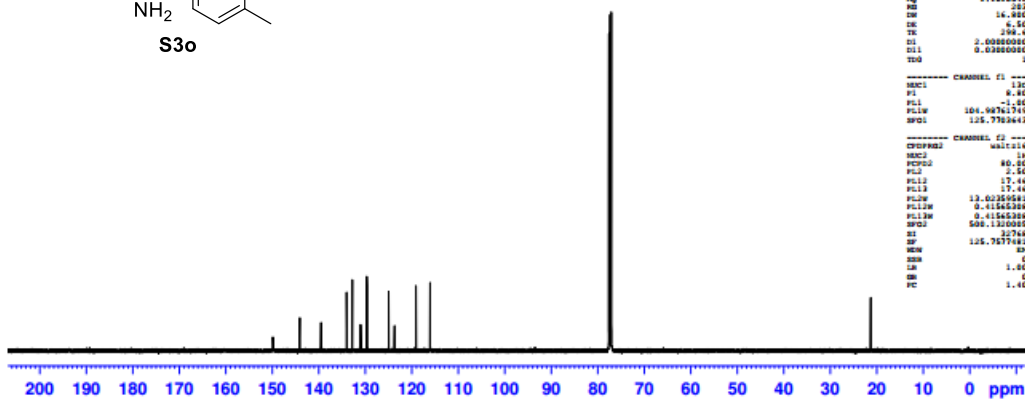
—	149.897
—	144.134
—	139.538
—	134.004
—	132.818
—	131.018
—	129.669
—	129.635
—	124.969
—	123.731
—	119.118
—	116.076

77.614
77.359
77.106

— 21.277



S3o



NAME	h
EXPNO	16
PROCNO	1
DATE_	20170412
TIME	12.35
INSTRUM	Spec
PROBHD	5 mm PABBO BB-
PULPROG	zgpg30
TD	65536
SOLVENT	CDC12
DS	500
DE	4
SWH	29762.984 Hz
FIDRES	0.454131 Hz
AQ	1.1010549 sec
RG	209
CH	16.800 mmHG
DE	6.50 mmHG
SI	394.6 Hz
DI1	2.00000000 sec
DI1	0.03000000 sec
TD0	1

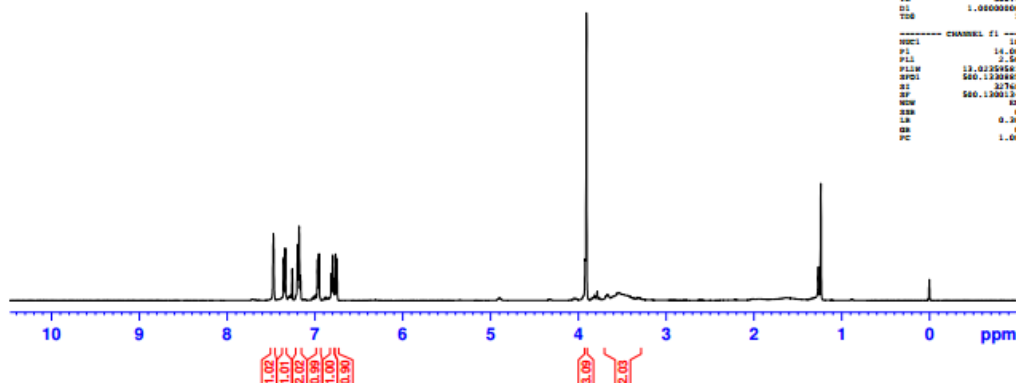
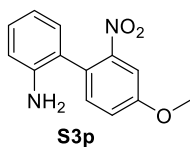
```
----- CHANNEL F1 -----
MAGI          13c
PI             8.80 used
PLI           -1.00 dB
PLIW          104.98761749 W
SPQI          125.7702642 MHz
```

	CHARGE2	
CVFFRQ2	wait416	
MMJ2	1M	
PCPD2	80.00 ussec	
PL2	2.50 dB	
PL12	17.46 dB	
PL13	17.44 dB	
PLW	12.0360581 M	
PL1W	0.41565308 M	
PL1W	0.41565308 M	
SPD2	500.1320005 MHz	
SI	32768	
SP	125.7577681 MHz	
WCH	KHz	
XDR		
LA	1.00 Hz	
LO	0	
PC	1.40	

SHW-1169486

7.475
7.356
7.339
7.259
7.258
7.182
7.166
6.970
6.954
6.884
6.799
6.784
6.767
6.751

3.910
3.541



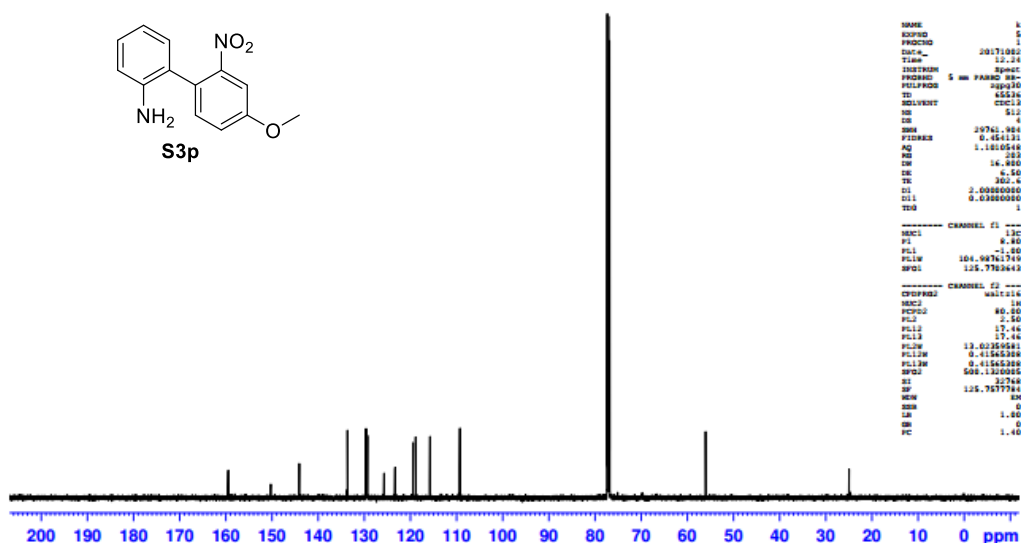
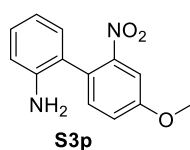
```
NAME      k
EXPNO     4
PROCNO    1
DATA_     20171005
TIME      11.48
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         16
DS         4
SWH        10330.576 Hz
FIDRES     0.157432 Hz
AQ         2.1719833 sec
RG         344
WDW         48.400 sec
DE         4.50 sec
TE         302.2 K
D1         1.00000000 sec
TDS        1

===== CHANNEL f1 =====
NUC1       1H
P1         14.00 sec
PL1        2.50 dB
PL1W       13.02359581 W
SFO1       500.132005 MHz
SI         32768
SF         500.1320134 MHz
WDW         EM
SSB         0.30 Hz
LA         0
GB         1.00
```

SHW-1169486

159.522
150.296
144.105
133.640
128.638
128.329
125.719
125.718
119.449
118.856
115.787
109.314

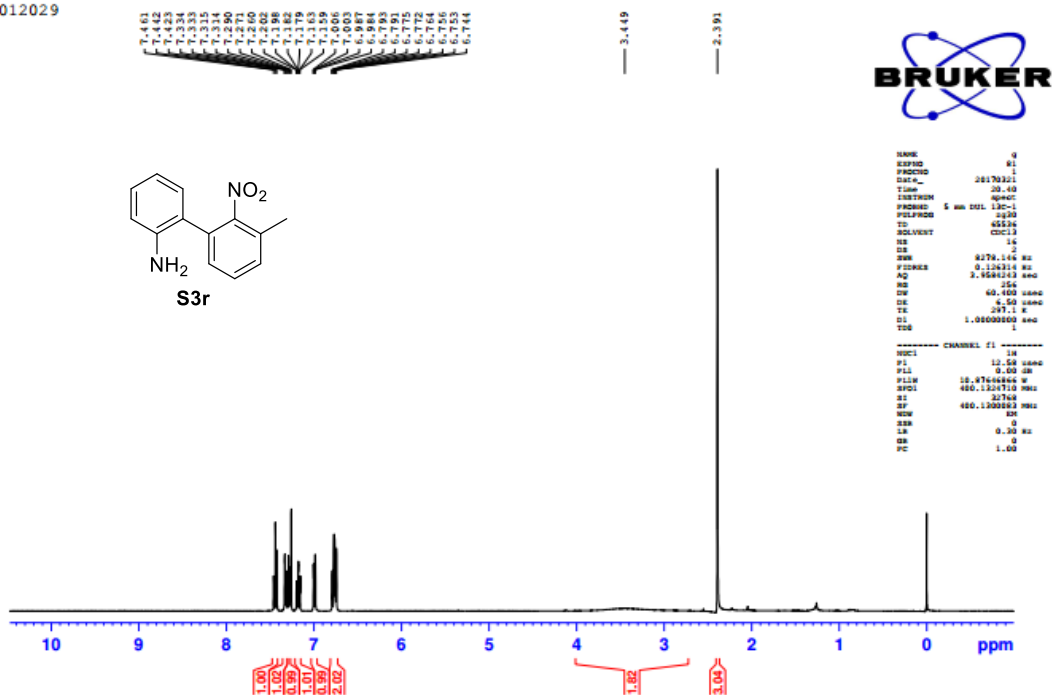
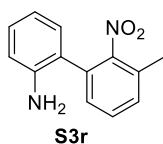
77.355
77.101
76.847
56.015



```
NAME      k
EXPNO     4
PROCNO    1
DATA_     20171005
TIME      12.24
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         16
DS         4
SWH        20761.984 Hz
FIDRES     0.464121 Hz
AQ         1.1810508 sec
RG         303
WDW         16.400 sec
DE         4.50 sec
TE         302.2 K
D1         2.00000000 sec
D11        0.03000000 sec
TDS        1

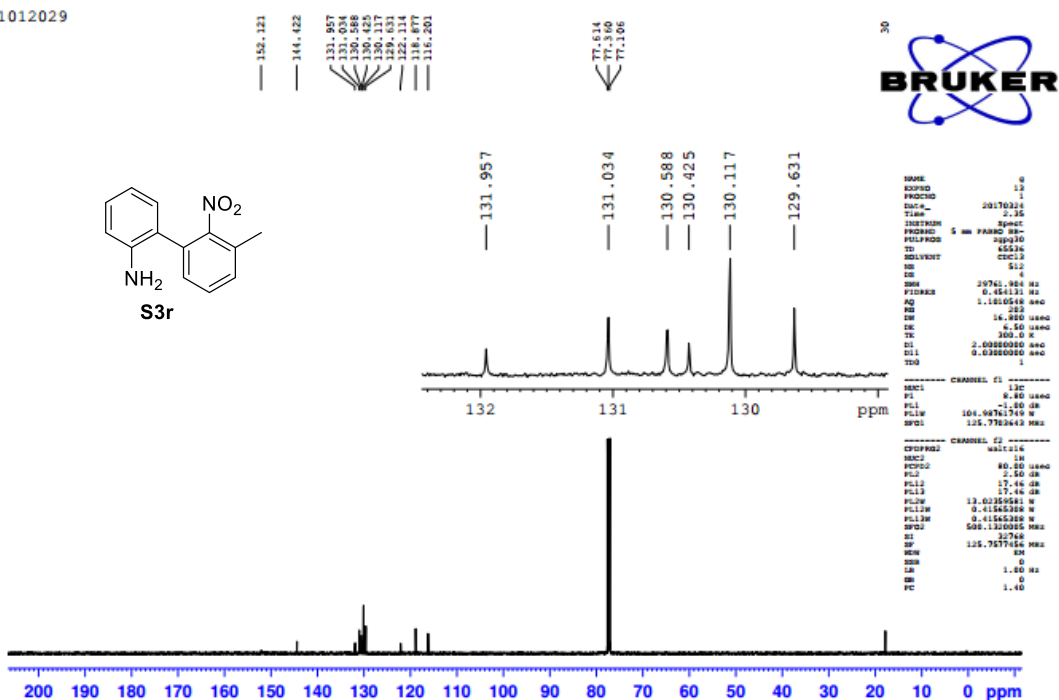
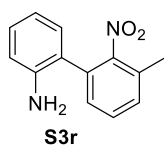
===== CHANNEL f1 =====
NUC1       13C
P1         8.00 sec
PL1        1.00 dB
PL1W       104.98761719 W
SFO1       125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2   waltz16
NUC2       1H
PCPD2     80.00 sec
PL2        2.50 dB
PL2W       17.14 dB
PL3        17.14 dB
PL3W       13.02359581 W
PL1W       0.41565308 W
PL1W       0.41565308 W
SFO2       500.132005 MHz
SI         32768
SF         125.7677784 MHz
WDW         EM
SSB         0
LA         1.00 Hz
GB         0
PC         1.00
```



```
NAME
KEYNO          0
FREQHZ        20170321
TIME          20.40
INSTRUM       160MHz
FREQHD        $ mm DPL 130-1
PULPROG       sgprp
TO SOLVENT    C5D12O
NR            16
DS            2
AQ            2.9789146 Hz
F2 - F1       0.1863 Hz
ZQ            3.6544243 MHz
RW            254
WD            600.000 MHz
DE            5.00 MHz
TE            300.2 K
D1            1.000000000 MHz
TD0           1
----- CHANNEL f1 -----
NUC1
P1            12.50 MHz
P11           0.000 Hz
P12           18.676777 MHz
SFO1          400.1260410 MHz
SFR           27.768
SR            400.1260410 MHz
NDCW          16
LA            0.30 Hz
OR            0
GC            1.000
```

1012029

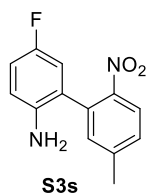


NAME _____
 EXPNO 1
 PROCNO 1
 DATE_ 20170321
 TIME_ 7.35
 F2 -
 FREQ0 500 MHz FAIMS-MS
 PULPROG zgpg30
 SFO 500.135061 MHz
 SOLVENT CDCl3
 NS 612
 DS 4
 SWH 26762.960 Hz
 FIDRES 0.456113 Hz
 1.1653000 Hz
 F2 -
 MD 203
 DE 15.00 uS
 TE 300.2 K
 DQ 0.56 uS
 SFO 500.135061 MHz
 D1 1.0000000 sec
 T2 0.0000000 sec
 T20 _____

===== CHANNEL f2 =====
 NUC1 13C
 P1 130.00 uS
 PL1 -1.00 dB
 FWH 104.9676745 MHz
 SFO1 125.7603442 MHz

===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 P2PD2 80.00 uS
 PL2 -1.00 dB
 PL12 17.46 dB
 PL13 17.46 dB
 PLW 1.00235561 uS
 F2 - 0.4133333 MHz
 PL12H 0.1616358 MHz
 F2 - 500.135061 MHz
 SFO2 500.135061 MHz
 H1 27.764
 SFO 125.7577618 MHz
 NUC1 1H
 NUC2 13C
 SWH 1.80 MHz
 LA 1.80 MHz
 F2 -
 PG 0.00 uS

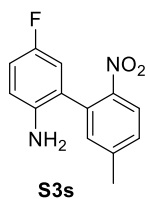
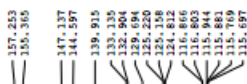
SHW-1169440



NAME
EXPNO
PROCNO
DATE_

NAME
EXPNO
PROCNO
DATE_

SHW-1169440

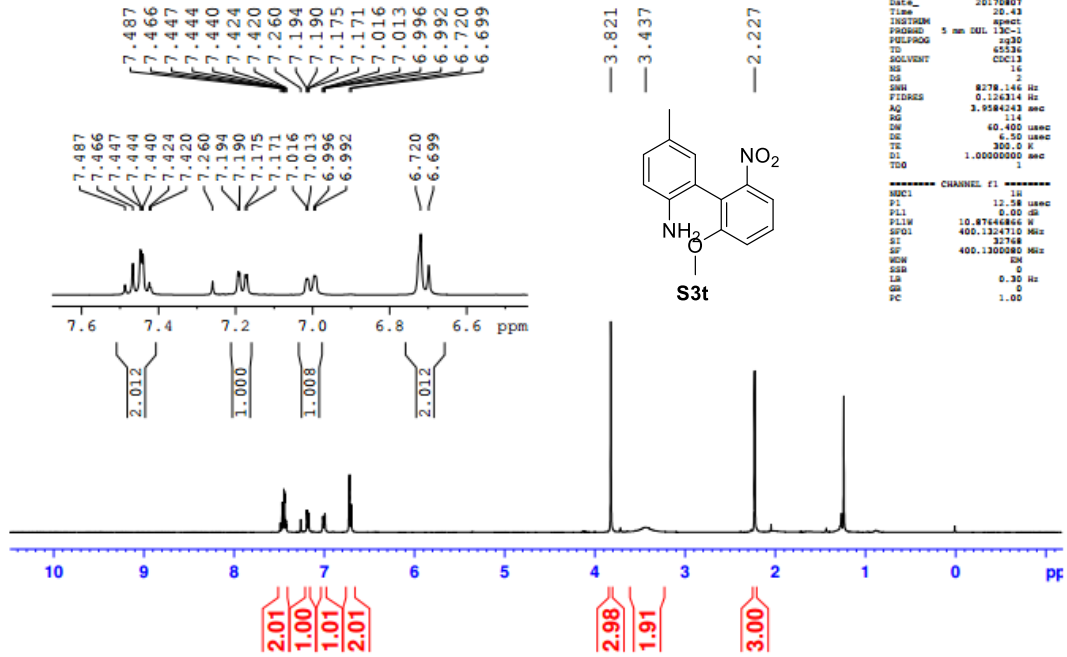


NAME
EXPNO
PROCNO
DATE_

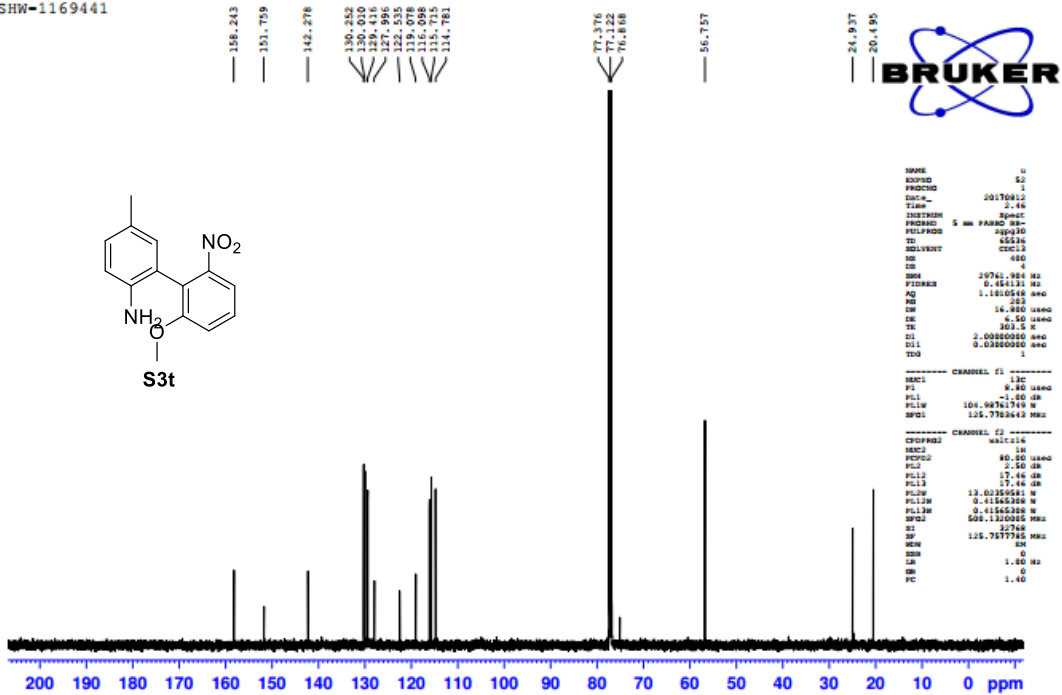
NAME
EXPNO
PROCNO
DATE_

NAME
EXPNO
PROCNO
DATE_

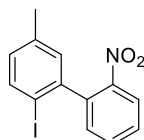
SHW-1169441



SHW-1169441



SHW-1012104



S4b

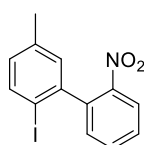
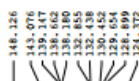


```

NAME      d
EXPNO     2
PROCNO    1
DATE_     20170510
TIME      16.13
INSTRUM    spect
PROBHD     5 mm DOL 13C-1
PULPROG    zgpg30
TD         65536
SOLVENT    CDCl3
NS         16
DS         4
SWH         8179.146 Hz
FIDRES     0.126310 Hz
AQ         2.9581243 sec
RG         322.5
DW         60.400 usec
DE         8.50 usec
TE         298.2 K
D1         1.00000000 sec
TDS        1

===== CHANNEL f1 =====
NUC1       13C
P1         12.50 usec
PL1        0.00 dB
PL12       10.8764866 dB
SFO1       400.1264710 MHz
SI         32768
SF         400.1300379 MHz
WDW         0
SSB         0
GB         0.20 Hz
PC         1.00
  
```

SHW-1012104



S4b



```

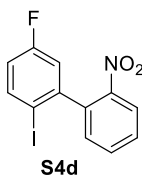
NAME      d
EXPNO     1
PROCNO    1
DATE_     20170512
TIME      9.19
INSTRUM    spect
PROBHD     5 mm PABBO MM-
PULPROG    zgpg30
TD         65536
SOLVENT    CDCl3
NS         1024
DS         4
SWH         25761.044 Hz
FIDRES     0.464131 Hz
AQ         1.1810548 sec
RG         322
DW         16.400 usec
DE         8.50 usec
TE         302.4 K
D1         2.00000000 sec
D11        0.03000000 sec
TDS        1

===== CHANNEL f1 =====
NUC1       13C
P1         8.50 usec
PL1        -1.00 dB
PL12       104.88761749 dB
SFO1       125.7702643 MHz

===== CHANNEL f2 =====
CPDPRG2    waltz16
NUC2       1H
PCPD2      80.50 usec
PL2        2.50 dB
PL12       17.46 dB
PL13       17.46 dB
PL2W       13.82285941 W
PL12W      0.41565388 W
PL13W      0.41565388 W
SFO2       500.1310000 MHz
SI         32768
SF         125.757784 MHz
WDW         0
SSB         0
GB         0
PC         1.40
  
```

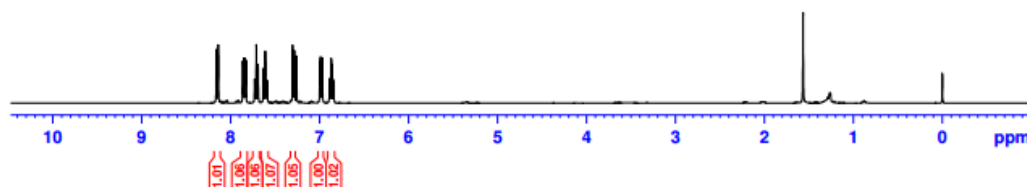
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

shw-1169412

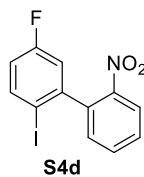


```

NAME      1a
EXPNO     1
PROCNO    1
Date_     20170713
Time      14.33
INSTRUM    spect
PROBHD     5 mm BBO 13C-1
PULPROG    zgpg30
TD         65536
SOLVENT    CDCl3
DS         14
GB         2
SFR        2079.144 Hz
F2SFR      0.126214 Hz
AQ         2.9581243 sec
RG         204.1
DW         60.400 usec
DE         6.50 usec
TE         298.2 K
D1         1.00000000 sec
TDO        1
----- CHANNEL f1 -----
NUC1       13C
P1         12.50 usec
PL1        0.00 dB
PL1W       18.8764685 W
SFO1       400.132110 MHz
B1         127.50
SF         400.1320094 MHz
WDW        0
SSB        0
GB         0.00 Hz
DB         0
PC         1.00
  
```

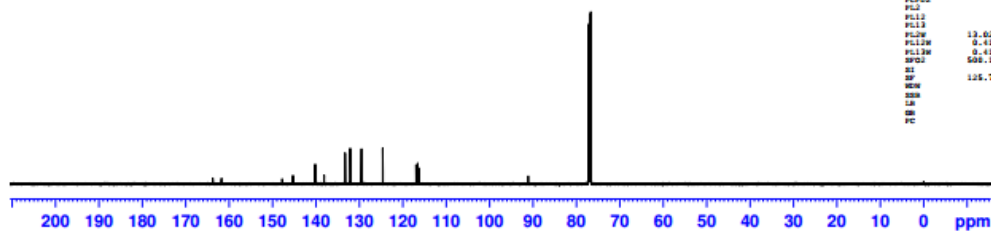


SHW-1169412

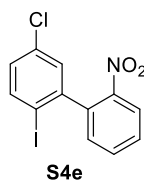


```

NAME      1a
EXPNO     24
PROCNO    1
Date_     20170901
Time      10.12
INSTRUM    spect
PROBHD     5 mm PABBO 13C-1
PULPROG    zgpg30
TD         65536
SOLVENT    CDCl3
DS         6
GB         2
SFR        2079.144 Hz
F2SFR      0.126214 Hz
AQ         1.1810548 sec
RG         204.1
DW         16.800 usec
DE         6.50 usec
TE         303.2 K
D1         2.00000000 sec
D11        0.03000000 sec
TDO        1
----- CHANNEL f1 -----
NUC1       13C
P1         8.80 usec
PL1        -1.00 dB
PL1W       104.98761749 W
SFO1       125.7633443 MHz
----- CHANNEL f2 -----
CYCPRG2    waltz16
NUC2       13C
P2         80.00 usec
PL2        2.00 dB
PL2W       17.44 dB
PL3        17.44 dB
PL3W       17.44 dB
PL4W       13.0235581 W
PL1W       0.41543288 W
PL3W       0.41543288 W
SFO2       500.1320095 MHz
B2         312.74
SF         125.7637799 MHz
WDW        0
SSB        0
GB         1.00 Hz
DB         0
PC         1.00
  
```



1012064



```

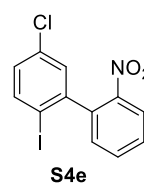
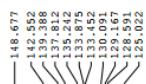
NAME          g
EXPNO         1
PROCNO        1
Date_         20170414
Time          18.49
INSTRUM       spect
PROBHD        5 mm DUL 13C-1
PULPROG       zgpg30
TD            65536
SOLVENT       CDCl3
NS            16
DS            2
SWH           8278.146 Hz
FIDRES       0.124314 Hz
AQ           3.9584243 sec
RG           256
DW           60.400 usec
DE           6.50 usec
TE           299.1 K
D1           1.00000000 sec
TD0          1
  
```

----- CHANNEL f1 -----

```

NUC1          13C
P1            12.58 usec
PL1           0.00 dB
PL1W         10.87646866 W
SFO1         400.132710 MHz
SI            32768
SF           400.1300156 MHz
WDW           EM
GB            0
LB            0.30 Hz
GB            0
PC            1.00
  
```

1012064



```

NAME          g
EXPNO         1
PROCNO        1
Date_         20170414
Time          4.32
INSTRUM       spect
PROBHD        5 mm PABBO 13C-1
PULPROG       zgpg30
TD            65536
SOLVENT       CDCl3
NS            4
DS            4
SWH           29761.504 Hz
FIDRES       0.454131 Hz
AQ           1.1010548 sec
RG           203
DW           16.50 usec
DE           6.50 usec
TE           299.1 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0          1
  
```

----- CHANNEL f1 -----

```

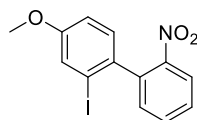
NUC1          13C
P1            8.50 usec
PL1           -1.00 dB
PL1W         104.98761749 W
SFO1         125.7703643 MHz
  
```

----- CHANNEL f2 -----

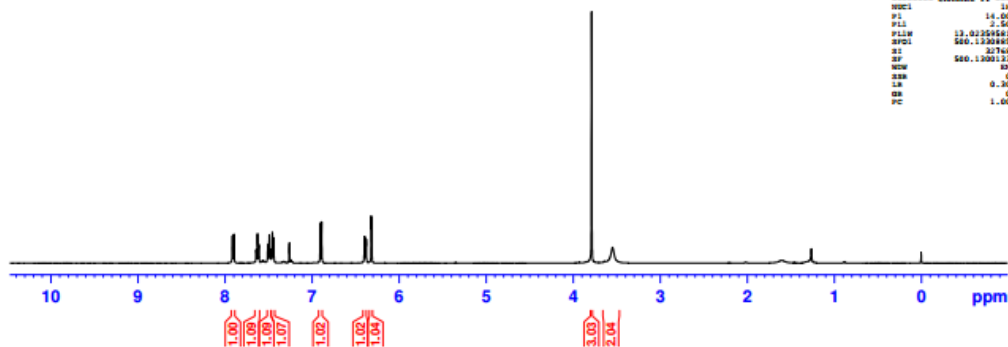
```

CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12         17.46 dB
PL13         17.46 dB
PL1W         13.02359581 W
PL12W        0.41565308 W
PL13W        0.41565308 W
SFO2         500.1310005 MHz
SI            32768
SF           125.7577468 MHz
WDW           EM
GB            0
LB            1.60 Hz
GB            0
PC            1.40
  
```


SHW-1012195



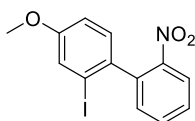
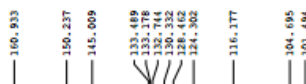
S4g



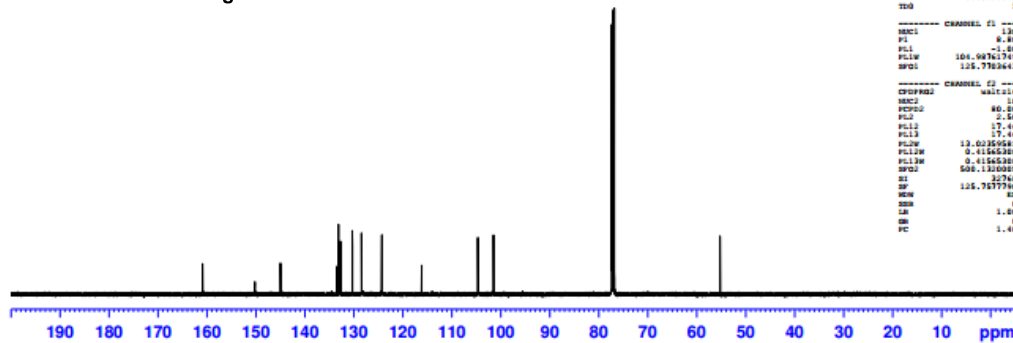
NAME 0
EXPNO 17
PROCNO 1
F2 20170401
Time 17.03
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 10320.574 Hz
FIDRES 0.107623 Hz
AQ 2.1719623 s
RG 128
CW 48.400 uHz
DE 6.50 uHz
TE 301.2 K
SI 1.00000000 s
TSD 1

----- CHANNEL f1 -----
NUC1 1H
P1 14.00 uHz
PL1 2.50 dB
PL12 13.0235658 W
SFO1 500.1360985 MHz
SI 20760
SF 500.1360985 MHz
WDW EM
SSB 0
GB 0.20 Hz
PC 1.00

SHW-1012195



S4g



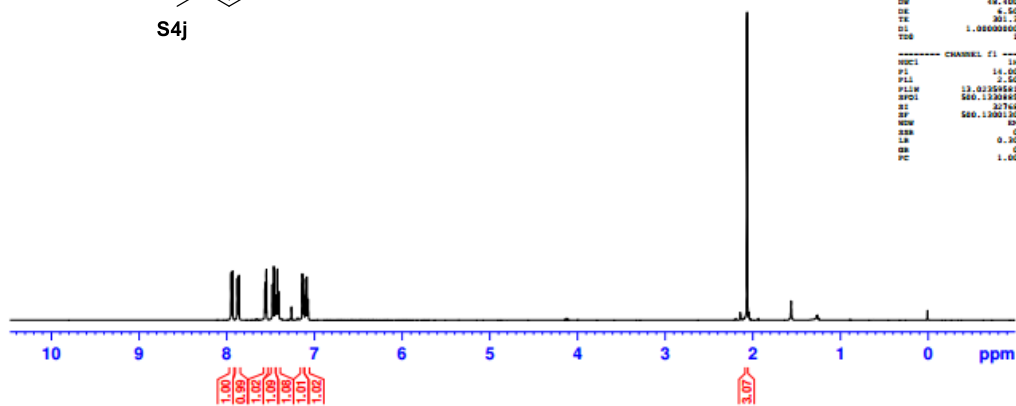
NAME 0
EXPNO 18
PROCNO 1
F2 20170401
Time 17.31
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 20761.964 Hz
FIDRES 0.454131 Hz
AQ 1.1016548 s
RG 256
CW 16.400 uHz
DE 6.50 uHz
TE 303.0 K
SI 2.00000000 s
TSD 1

----- CHANNEL f1 -----
NUC1 13C
P1 8.00 uHz
PL1 -1.00 dB
PL12 104.9876174 W
SFO1 125.7603642 MHz

----- CHANNEL f2 -----
NUC2 1H
P2 80.00 uHz
PL2 2.50 dB
PL12 17.44 uHz
PL13 17.44 uHz
PL14 0.41565308 W
PL15 0.41565308 W
SFO2 500.1360985 MHz
SI 20760
SF 125.7677790 MHz
WDW EM
SSB 0
GB 1.00 Hz
PC 1.40

1012176

7.948
7.932
7.877
7.861
7.562
7.547
7.477
7.461
7.446
7.437
7.422
7.407
7.389
7.374
7.359
7.344
7.324
7.304
7.089
7.074



NAME: h
EXPNO: 5
PROCNO: 1
DATE_: 20170412
TIME: 13.03
INSTRUM: spect
PROBHD: 5 mm PABBO BB-
PULPROG: zgpg30
TD: 65536
SOLVENT: CDCl3
NS: 14
DS: 2
SWH: 10330.570 Hz
FIDRES: 0.107430 Hz
AQ: 3.1719863 sec
RG: 101
DB: 48.400 dB
DE: 4.50 dB
TE: 301.2 K
D1: 1.00000000 sec
TDS: 1

----- CHANNEL f1 -----
NUC1: 1H
P1: 10.00 dB
PL1: 2.50 dB
PL12: 13.02355641 dB
NUC2: 500.1300445 MHz
SI: 32768
SF: 500.1300150 MHz
WDW: EM
SSB: 0
LB: 0.30 Hz
GB: 0
PC: 1.00

SHW-1012176

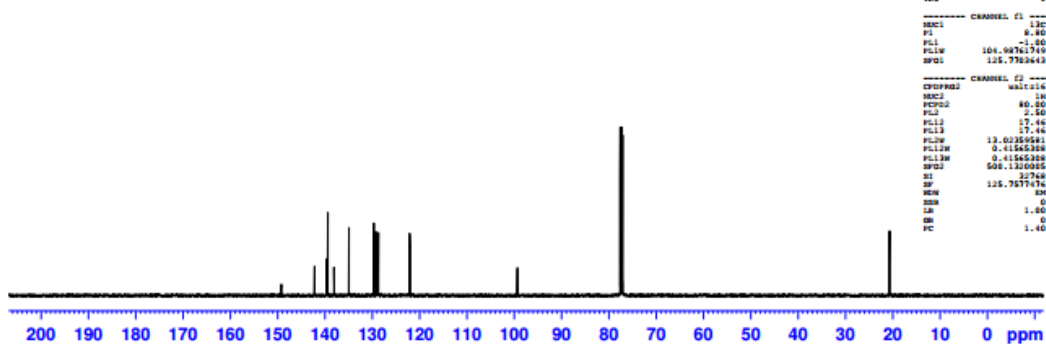
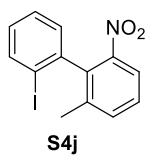
149.253
142.227
139.633
138.095
134.947
129.675
128.185
128.189
128.737
122.088

99.348

77.615

77.361

77.107



NAME: h
EXPNO: 4
PROCNO: 1
DATE_: 20170412
TIME: 13.36
INSTRUM: spect
PROBHD: 5 mm PABBO BB-
PULPROG: zgpg30
TD: 65536
SOLVENT: CDCl3
NS: 540
DS: 4
SWH: 24761.984 Hz
FIDRES: 0.454131 Hz
AQ: 1.1810548 sec
RG: 203
DB: 14.00 dB
DE: 6.50 dB
TE: 303.2 K
D1: 2.00000000 sec
D11: 0.03000000 sec
TDS: 1

----- CHANNEL f1 -----
NUC1: 13C
P1: 0.00 dB
PL1: -1.00 dB
PL12: 104.90761710 dB
NUC2: 125.7603643 MHz

----- CHANNEL f2 -----
CPDPRG2: waltz16
NUC3: 1H
PCPD2: 80.00 dB
PL3: 2.50 dB
PL12: 17.44 dB
PL13: 17.44 dB
PL12W: 13.02355641 dB
NUC4: 0.11545388 MHz
PL14W: 0.41545388 MHz
SF2: 500.1300150 MHz
SI: 32768
SF: 125.7677474 MHz
WDW: EM
SSB: 0
LB: 1.00 Hz
GB: 0
PC: 1.40

SHW-1168428

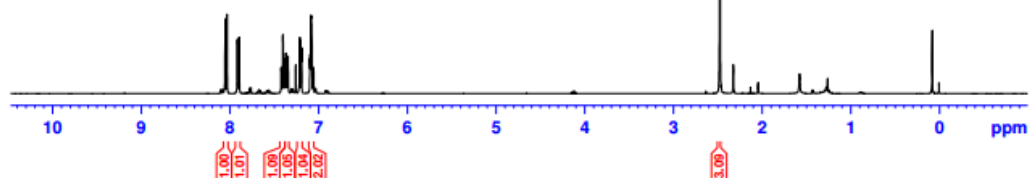


S4I

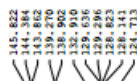


NAME 1
EXPNO 20
PROCNO 1
DATE_ 20170721
TIME 16.17
INSTRUM 5 mm BBO 125-1
PROBHD 5 mm BBO 125-1
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8178.164 Hz
FIDRES 0.126314 Hz
AQ 2.9584243 sec
RG 328
DW 60.400 sec
DE 6.50 sec
TE 298.2 K
D1 1.00000000 sec
TDS 1

----- CHANNEL f1 -----
NUC1 1H
P1 12.50 sec
PL1 0.00 dB
PL1W 10.8764864 W
SFO1 400.126110 MHz
SI 32768
SF 400.126110 MHz
WDW 0
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



SHW-1169428



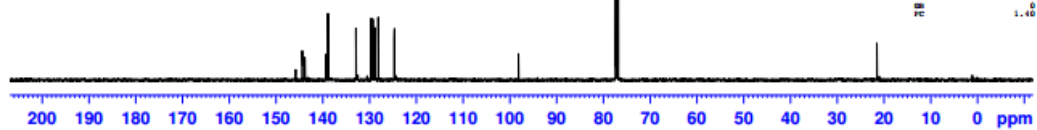
S4I



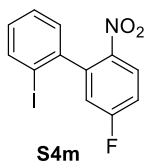
NAME 1
EXPNO 20
PROCNO 1
DATE_ 20170801
TIME 22.22
INSTRUM 5 mm F400 N2
PROBHD 5 mm F400 N2
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 20761.904 Hz
FIDRES 0.454121 Hz
AQ 1.1810516 sec
RG 328
DW 14.400 sec
DE 6.50 sec
TE 303.1 K
D1 2.00000000 sec
D11 0.03000000 sec
TDS 1

----- CHANNEL f1 -----
NUC1 13C
P1 8.00 sec
PL1 -1.00 dB
PL1W 104.9871710 W
SFO1 125.7703443 MHz

----- CHANNEL f2 -----
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00 sec
PL2 2.50 dB
PL2W 17.44 dB
PL3 17.44 dB
PL3W 13.02359581 W
PL4W 0.41565398 W
PL5W 0.41565398 W
SFO2 500.1360505 MHz
SI 32768
SF 125.7677944 MHz
WDW 0
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

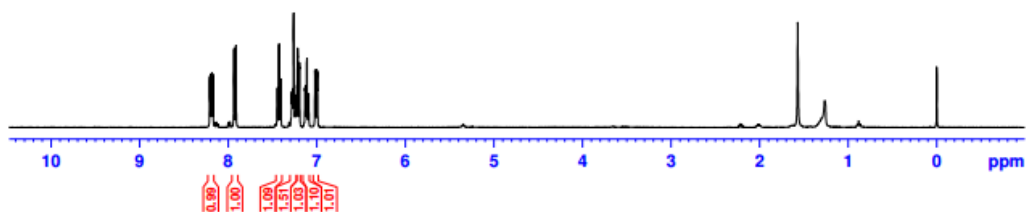


SHW-1012115

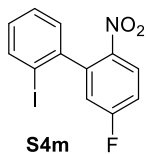


NAME	3
EXPNO	54
PROCNO	1
DATE_	20170523
TIME	22.28
INSTRUM	gpcrct
PROBHD	5 mm DCL 13C-1
PULPROG	zgpg30
TD	65536
SOLVENT	CDCl3
NS	14
DS	2
SWH	8279.144 Hz
FIDRES	0.124314 Hz
AQ	3.5684213 sec
RG	322.5
DW	60.400 sec
DE	6.50 sec
TE	300.2 K
D1	1.00000000 sec
TD0	1

CHANNEL F1	
NUC1	13C
P1	12.50 sec
PL1	0.00 dB
PL1W	10.87646864 W
SFO1	400.1261751 MHz
Z1	32768
WDW	400.1300000 MHz
SSB	0
LB	0.30 Hz
GB	0
PC	1.00



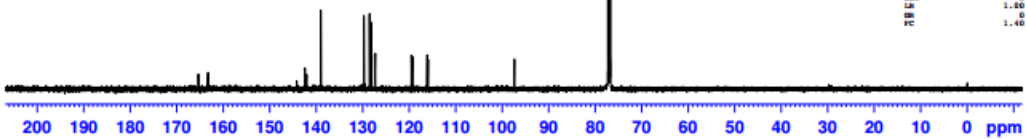
SHW-1012115



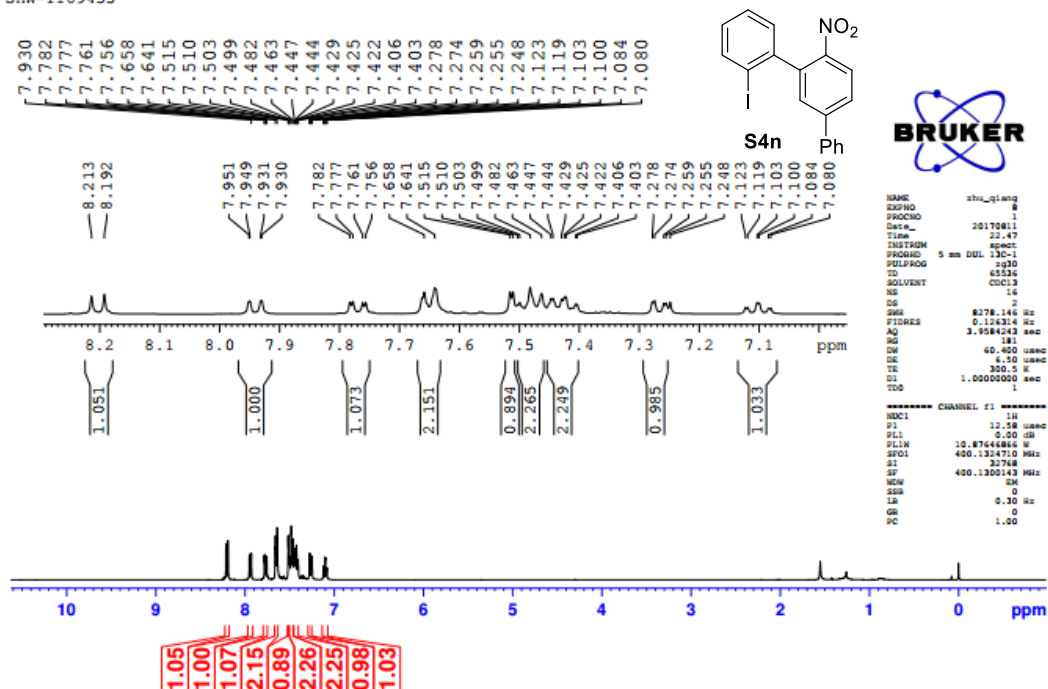
NAME	3
EXPNO	24
PROCNO	1
DATE_	20170525
TIME	0.52
INSTRUM	gpcrct
PROBHD	5 mm PABBO
PULPROG	zgpg30
TD	65536
SOLVENT	CDCl3
NS	1024
DS	4
SWH	20761.904 Hz
FIDRES	0.464131 Hz
AQ	1.1010548 sec
RG	0.0
DW	14.800 sec
DE	6.50 sec
TE	300.2 K
D1	2.00000000 sec
D11	0.03000000 sec
TD0	1

CHANNEL F1	
NUC1	13C
P1	8.00 sec
PL1	-1.00 dB
PL1W	104.98761749 W
SFO1	125.7703443 MHz

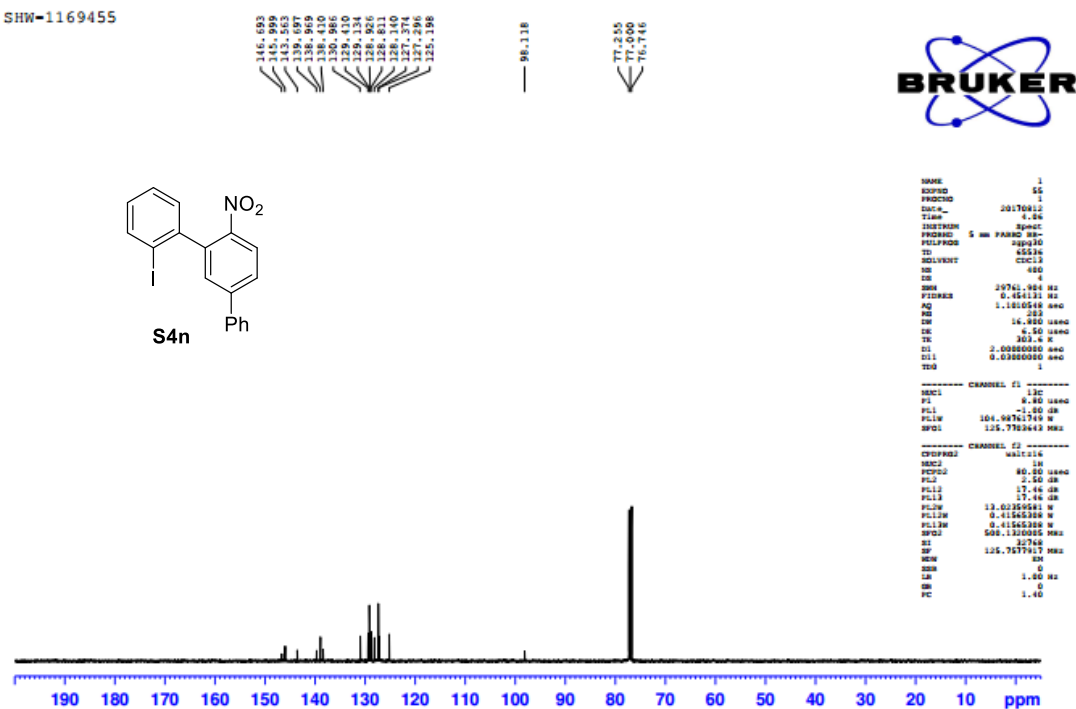
CHANNEL F2	
NUC2	1H
P2	80.00 sec
PL2	2.50 dB
PL2W	17.44 dB
PL3	17.44 dB
PL3W	12.02105081 W
PL1W	0.41846308 W
PL1W	0.41846308 W
SFO2	500.1320005 MHz
Z2	32768
WDW	125.7577941 MHz
SSB	0
LB	1.00 Hz
GB	0
PC	1.40



SHW-1169455



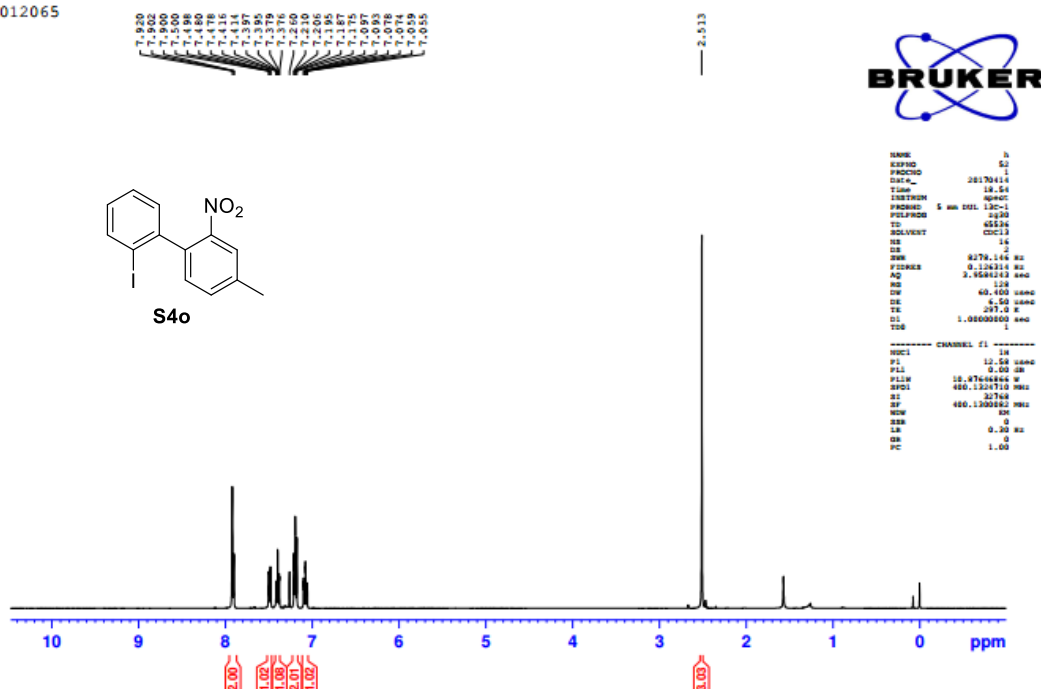
SHW-1169455



Year	Population (millions)
1980	7,920
1985	7,902
1990	7,900
1995	7,900
2000	7,900
2005	7,900
2010	7,900
2015	7,900
2020	8,055



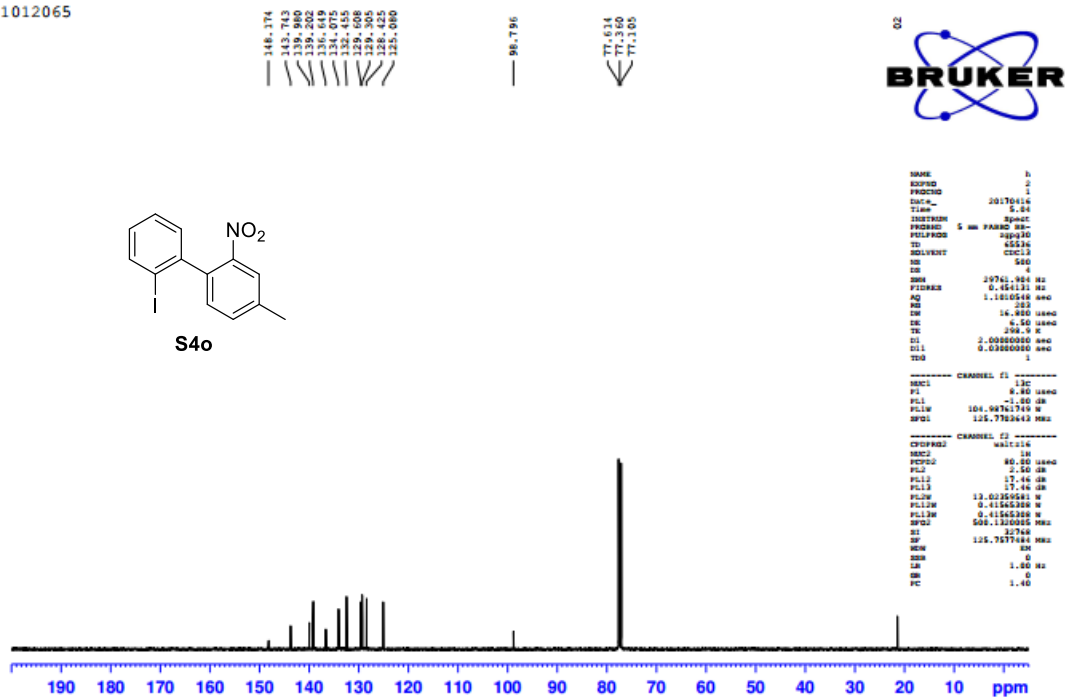
S4o



1012065

— 148, 174
— 143, 743
— 139, 980
— 139, 202
— 136, 649
— 134, 075
— 132, 455
— 129, 608
— 129, 305
— 128, 425
— 125, 080

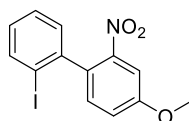
S4o



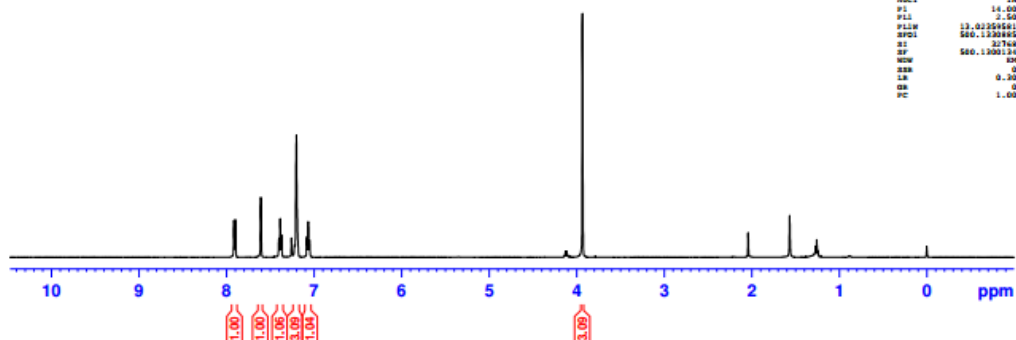
SHW-1169487

7.917
7.902
7.887
7.484
7.389
7.374
7.359
7.284
7.084
7.069
7.054

3.936



S4p



```

NAME      k
EXPNO    2
PROCNO    1
DATE_     20171002
TIME      11.38
INSTRUM    spect
PROBHD    5 mm PABBO BB-
PULPROG    zgpg30
TD         65536
SOLVENT    CDCl3
NS         16
DS         2
SWH         10300.578 Hz
FIDRES     0.157430 Hz
AQ         2.1719823 sec
RG         320
DW         48.400 usec
DE         8.50 usec
TE         300.2 K
TEC         0.6
D1         1.00000000 sec
TD0        1
----- CHANNEL f1 -----
NUC1       1H
P1         14.00 usec
PL1        2.50 dB
PL12       13.0235450 Hz
SFO1       500.1300000 MHz
SI         32768
SF         500.1300134 MHz
WDW         EM
SSB         0
LB         0.30 Hz
GB         0
PC         1.00

```

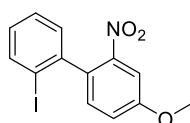
SHW-1169487

159.758
148.668
143.361
138.957
133.258
131.626
129.322
128.193

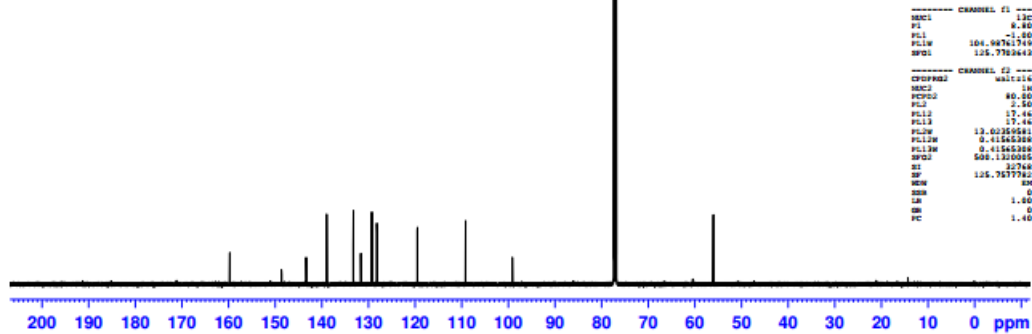
119.517
109.173
99.153

77.354
77.100
76.846

55.029



S4p



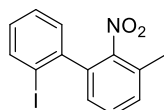
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NAME      k
EXPNO    4
PROCNO    1
DATE_     20171002
TIME      11.57
INSTRUM    spect
PROBHD    5 mm PABBO BB-
PULPROG    zgpg30
TD         65536
SOLVENT    CDCl3
NS         16
DS         2
SWH         20761.884 Hz
FIDRES     0.154131 Hz
AQ         1.1010549 sec
RG         320
DW         16.900 usec
DE         8.50 usec
TE         300.2 K
TEC         0.6
D1         2.00000000 sec
D11        0.03000000 sec
TD0        1
----- CHANNEL f1 -----
NUC1       13C
P1         8.80 usec
PL1        -1.00 dB
PL12       104.98761749 Hz
SFO1       125.7603642 MHz
----- CHANNEL f2 -----
CYCPRG2    waltz16
NUC2       1H
PCYC2      80.00 usec
PL2        2.50 dB
PL12       17.44 dB
PL13       17.44 dB
PL14       17.44 dB
PL15       17.44 dB
PL16       17.44 dB
PL17       17.44 dB
PL18       17.44 dB
PL19       17.44 dB
PL20       17.44 dB
PL21       17.44 dB
PL22       17.44 dB
PL23       17.44 dB
PL24       17.44 dB
PL25       17.44 dB
PL26       17.44 dB
PL27       17.44 dB
PL28       17.44 dB
PL29       17.44 dB
PL30       17.44 dB
PL31       17.44 dB
PL32       17.44 dB
PL33       17.44 dB
PL34       17.44 dB
PL35       17.44 dB
PL36       17.44 dB
PL37       17.44 dB
PL38       17.44 dB
PL39       17.44 dB
PL40       17.44 dB
PL41       17.44 dB
PL42       17.44 dB
PL43       17.44 dB
PL44       17.44 dB
PL45       17.44 dB
PL46       17.44 dB
PL47       17.44 dB
PL48       17.44 dB
PL49       17.44 dB
PL50       17.44 dB
PL51       17.44 dB
PL52       17.44 dB
PL53       17.44 dB
PL54       17.44 dB
PL55       17.44 dB
PL56       17.44 dB
PL57       17.44 dB
PL58       17.44 dB
PL59       17.44 dB
PL60       17.44 dB
PL61       17.44 dB
PL62       17.44 dB
PL63       17.44 dB
PL64       17.44 dB
PL65       17.44 dB
PL66       17.44 dB
PL67       17.44 dB
PL68       17.44 dB
PL69       17.44 dB
PL70       17.44 dB
PL71       17.44 dB
PL72       17.44 dB
PL73       17.44 dB
PL74       17.44 dB
PL75       17.44 dB
PL76       17.44 dB
PL77       17.44 dB
PL78       17.44 dB
PL79       17.44 dB
PL80       17.44 dB
PL81       17.44 dB
PL82       17.44 dB
PL83       17.44 dB
PL84       17.44 dB
PL85       17.44 dB
PL86       17.44 dB
PL87       17.44 dB
PL88       17.44 dB
PL89       17.44 dB
PL90       17.44 dB
PL91       17.44 dB
PL92       17.44 dB
PL93       17.44 dB
PL94       17.44 dB
PL95       17.44 dB
PL96       17.44 dB
PL97       17.44 dB
PL98       17.44 dB
PL99       17.44 dB
PL100      17.44 dB

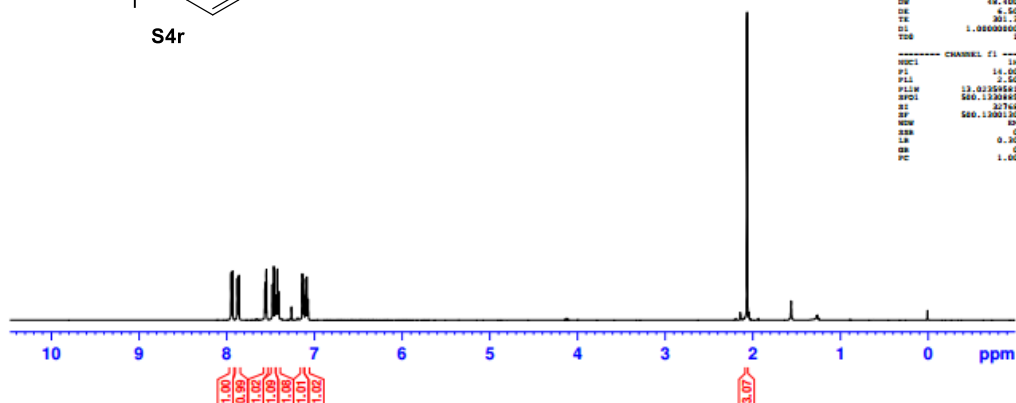
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1012176

7.948
7.932
7.877
7.861
7.562
7.547
7.477
7.461
7.446
7.432
7.422
7.407
7.389
7.375
7.360
7.345
7.324
7.304
7.089
7.074



S4r



NAME S
EXPNO 4
PROCNO 1
DATE_ 20170412
TIME 13.03
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 14
DS 2
SWH 10330.570 Hz
FIDRES 0.107430 Hz
AQ 3.1719803 sec
RG 101
OR 48.400 umax
DE 4.50 umax
TE 301.2 K
D1 1.00000000 sec
TD0 1

----- CHANNEL f1 -----
NUC1 1H
P1 10.00 umax
PL1 2.50 dB
PL12 13.02355641 dB
SFO1 500.1300450 MHz
SI 32768
SF 500.1300150 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

SHW-1012176

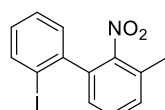
149.253
142.227
139.633
138.095
134.947
129.675
128.899
128.737
122.088

99.348

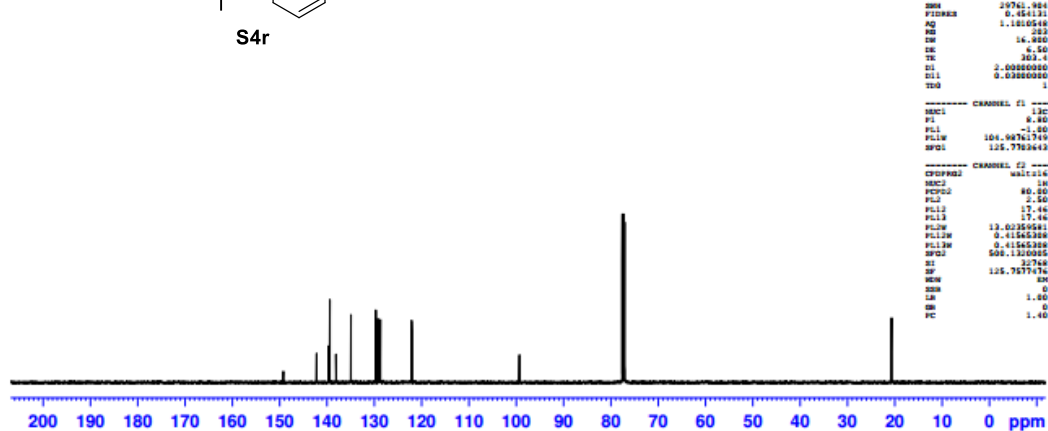
77.615

77.361

77.107



S4r

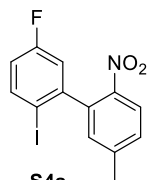


NAME S
EXPNO 4
PROCNO 1
DATE_ 20170412
TIME 13.36
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 14
DS 2
SWH 24761.984 Hz
FIDRES 0.454131 Hz
AQ 1.1810548 sec
RG 203
OR 14.50 umax
DE 6.50 umax
TE 303.2 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

----- CHANNEL f1 -----
NUC1 13C
P1 6.00 umax
PL1 -1.00 dB
PL12 104.96761710 dB
SFO1 125.7603643 MHz

----- CHANNEL f2 -----
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00 umax
PL2 2.50 dB
PL12 17.44 dB
PL13 17.44 dB
PL14 17.44 dB
PL12W 13.02355641 dB
PL12W 0.41545388 W
PL13W 0.41545388 W
SFO2 500.1300150 MHz
SI 32768
SF 125.7677474 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

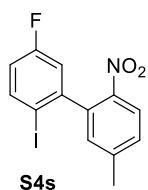
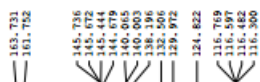
SHW-1169443



NAME 0
EXPNO 18
PROCNO 1
DATE_ 20170807
TIME 12.27
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 10320.574 Hz
FIDRES 0.157623 Hz
AQ 3.1719923 sec
RG 263
CW 48.400 usec
DE 4.50 usec
TE 303.2 K
D1 1.0000000 sec
TD0 1

----- CHANNEL f1 -----
NUC1 13C
P1 16.00 usec
PL1 2.00 dB
PL1W 13.02256561 W
SFO1 500.1300485 MHz
SI 32768
SF 500.1300123 MHz
WDW EM
SSB 0
LA 0.30 Hz
GB 0
PC 1.00

SHW-1169443



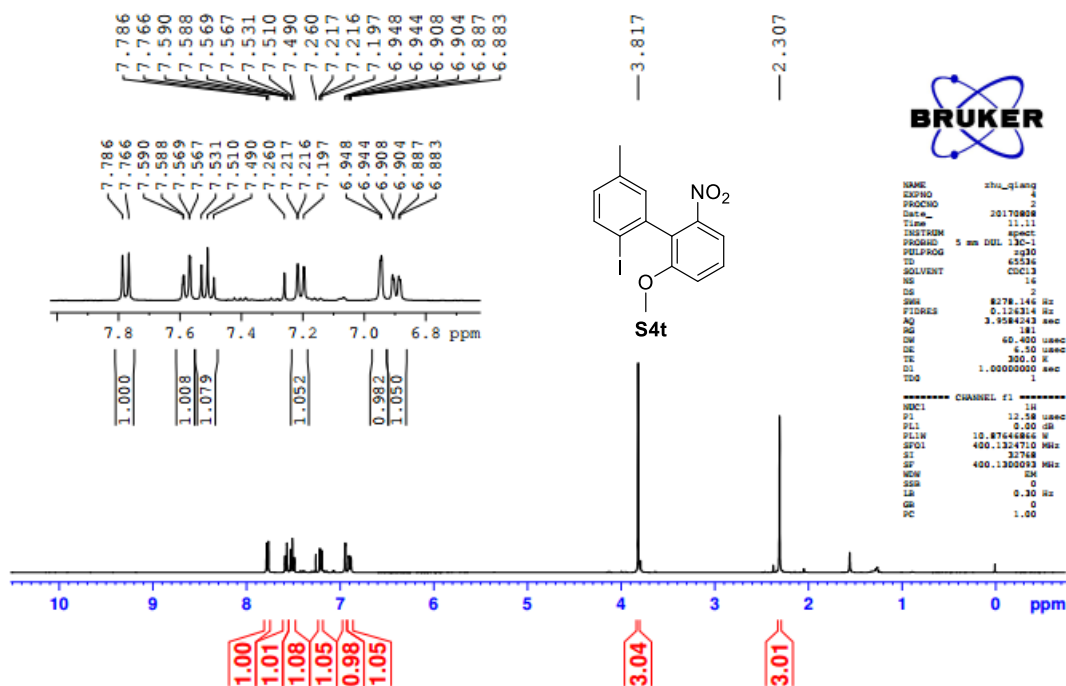
NAME 0
EXPNO 54
PROCNO 1
DATE_ 20170812
TIME 14.34
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 20762.501 Hz
FIDRES 0.454133 Hz
AQ 1.1010548 sec
RG 263
CW 16.300 usec
DE 4.50 usec
TE 303.2 K
D1 2.0000000 sec
D11 0.0300000 sec
TD0 1

----- CHANNEL f1 -----
NUC1 13C
P1 8.00 usec
PL1 0.00 dB
PL1W 104.90761743 W
SFO1 125.7703643 MHz

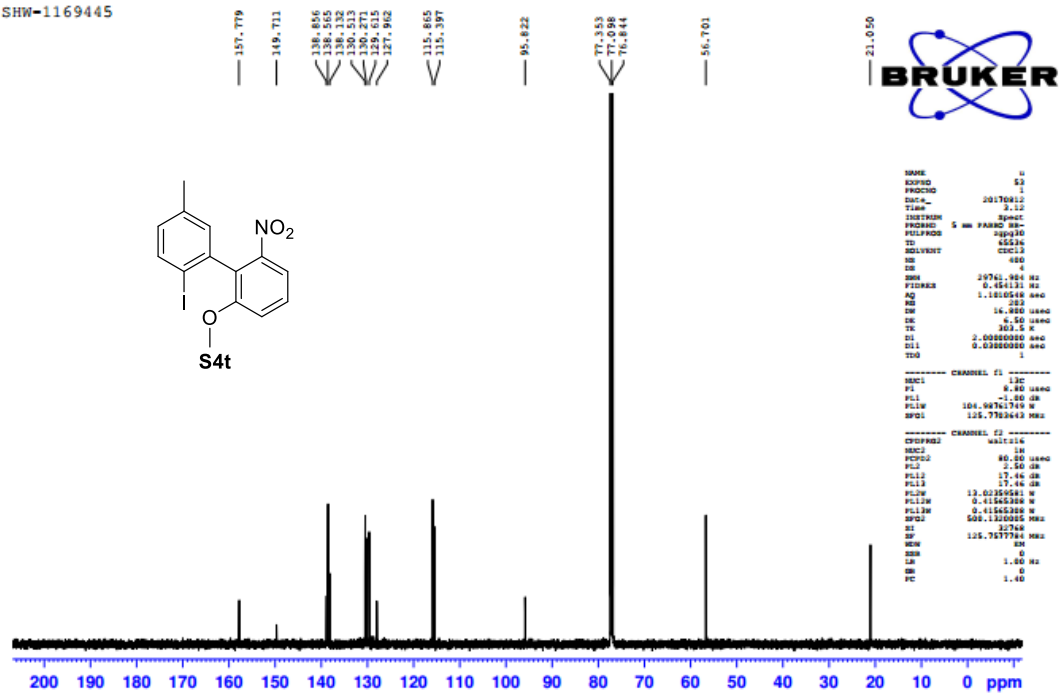
----- CHANNEL f2 -----
CPDPRG2 hllc114
NUC2 1H
P2C2 80.00 usec
PL2 2.00 dB
PL1 17.44 dB
PL1W 17.44 dB
PL1W 13.02256561 W
PL1W 0.41545388 W
PL1W 0.41545388 W
SFO2 500.1300485 MHz
SI 32768
SF 125.7677940 MHz
WDW EM
SSB 0
LA 1.00 Hz
GB 0
PC 1.40



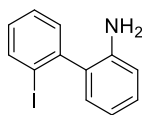
SHW-1169445-2



SHW-1169445



SHW-1012162-2

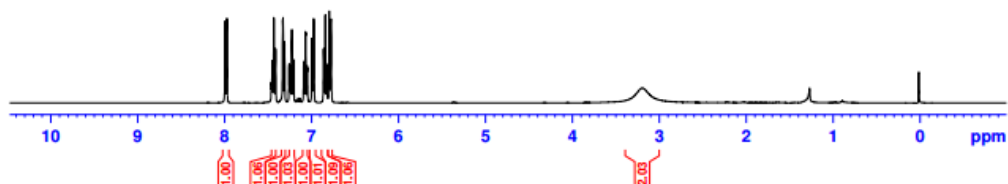


S5a

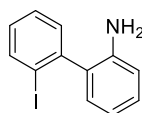


NAME S5a
EXPNO 5
PROCNO 1
DATE_ 20170423
TIME 22.19
INSTRUM spect
PROBHD 5 mm QNP 13C-1
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 16
DS 4
SWH 8279.144 Hz
FIDRES 0.132319 Hz
AQ 2.9581243 sec
RG 320
DW 60.400 usec
DE 6.50 usec
TE 298.2 K
D1 1.0000000 sec
D2

----- CHANNEL f1 -----
NUC1 13C
P1 12.50 usec
PL1 0.00 dB
PL12 16.974564 W
SFO1 400.126110 MHz
SI 32768
SF 400.126110 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



SHW-1012162-2



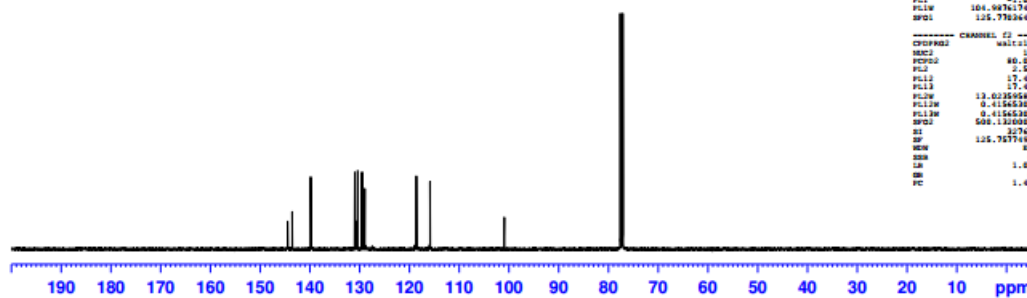
S5a



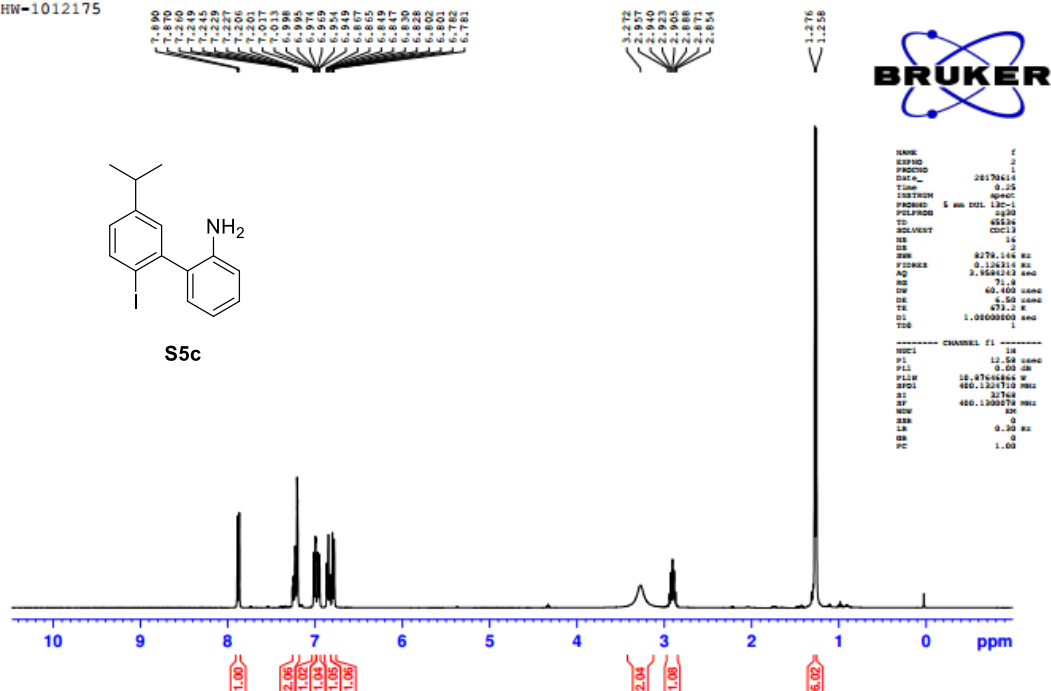
NAME S5a
EXPNO 161
PROCNO 1
DATE_ 20170423
TIME 20.54
INSTRUM spect
PROBHD 5 mm QNP 13C-1
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 4
DS 4
SWH 20762.904 Hz
FIDRES 0.054131 Hz
AQ 1.1810518 sec
RG 320
DW 16.900 usec
DE 6.50 usec
TE 298.2 K
D1 2.0000000 sec
D2 0.4300000 sec
D3 1

----- CHANNEL f1 -----
NUC1 13C
P1 8.80 usec
PL1 1.00 dB
PL12 104.96761719 W
SFO1 125.762643 MHz

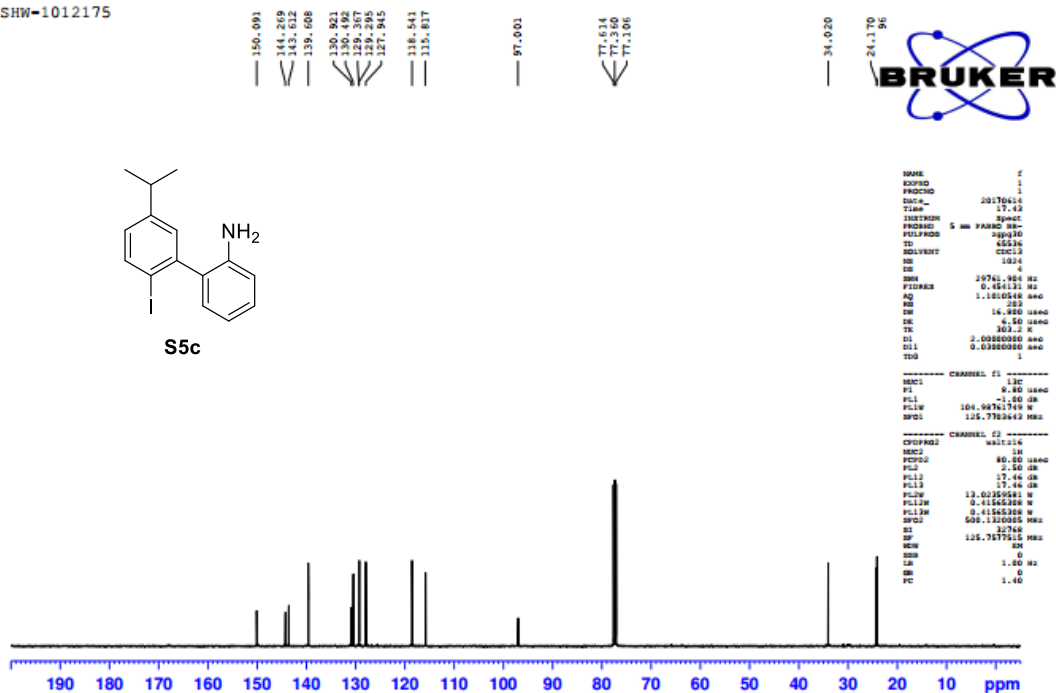
----- CHANNEL f2 -----
CPDPRG2 WALTZ16
NUC2 1H
PCPD2 80.00 usec
PL2 2.50 dB
PL12 17.14 dB
PL13 17.14 dB
PL14 17.14 dB
PL15 12.6235601 W
PL16 0.41545308 W
PL17 0.41545308 W
SFO2 500.1360508 MHz
SI 32768
SF 125.762643 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.00



SHW-1012175



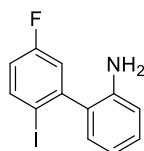
SHW-1012175



SHW-1169414



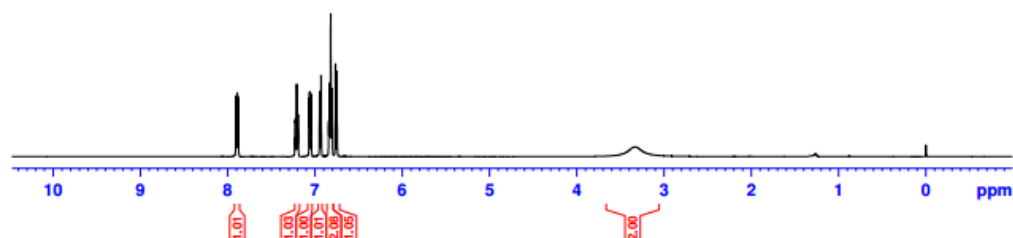
3.329



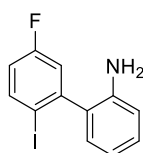
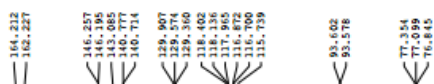
S5d

NAME 1a
EXPNO 17
PROCNO 1
DATE_ 20170604
TIME 9.13
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
DS 16
SWH 10330.578 Hz
FIDRES 0.157432 Hz
AQ 3.1715913 sec
RG 96.5
GB 49.400 sec
DE 6.50 sec
TE 301.2 K
D1 1.00000000 sec
TD0 1

----- CHANNEL f1 -----
NUC1 1H
P1 16.00 sec
PL1 2.50 dB
PL1W 13.01259591 W
SFO1 500.1300000 MHz
SI 32768
SF 500.1300133 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



SHW-1169414

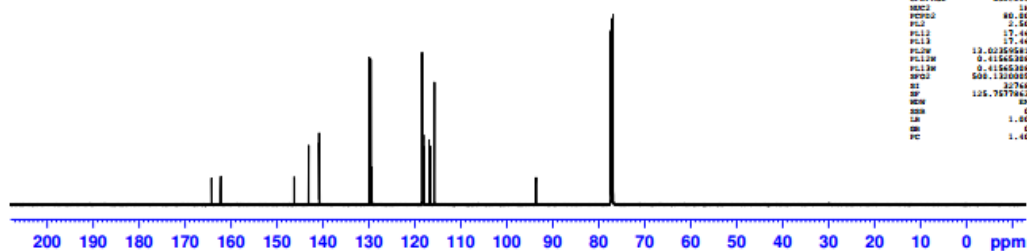


S5d

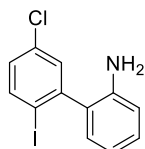
NAME 1a
EXPNO 18
PROCNO 1
DATE_ 20170604
TIME 9.41
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
DS 16
SWH 20761.964 Hz
FIDRES 0.164131 Hz
AQ 1.1810548 sec
RG 96.5
GB 49.400 sec
DE 6.50 sec
TE 301.2 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

----- CHANNEL f1 -----
NUC1 13C
P1 8.80 sec
PL1 1.80 dB
PL1W 104.98761749 W
SFO1 125.7703643 MHz

----- CHANNEL f2 -----
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00 sec
PL2 2.50 dB
PL2W 17.46 dB
PL3 17.46 dB
PL3W 13.01259591 W
PL1W 0.41845388 W
PL1W 0.41845388 W
SFO2 500.1300000 MHz
SI 32768
SF 125.7717362 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.00



1012066

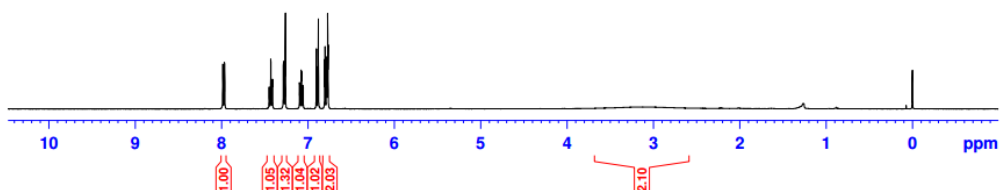


S5e

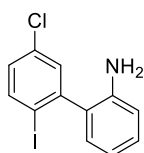


NAME 9
EXPNO 53
PROCNO 1
Date_ 20170414
Time 15.59
INSTRUM spect
PROBHD 5 mm DUL 13C-1
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8276.146 Hz
FIDRES 0.126314 Hz
AQ 3.9584241 sec
RG 356
DW 60.400 usec
DE 6.50 usec
TE 297.0 K
D1 1.00000000 sec
TDO 1

----- CHANNEL f1 -----
NUC1 13
P1 12.58 usec
PL1 8.00 dB
PL1W 10.8764886 W
SFO1 400.1324719 MHz
SI 32768
SF 400.1300083 MHz
WDW RM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



1012066



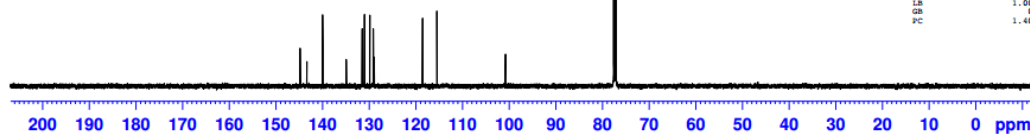
S5e



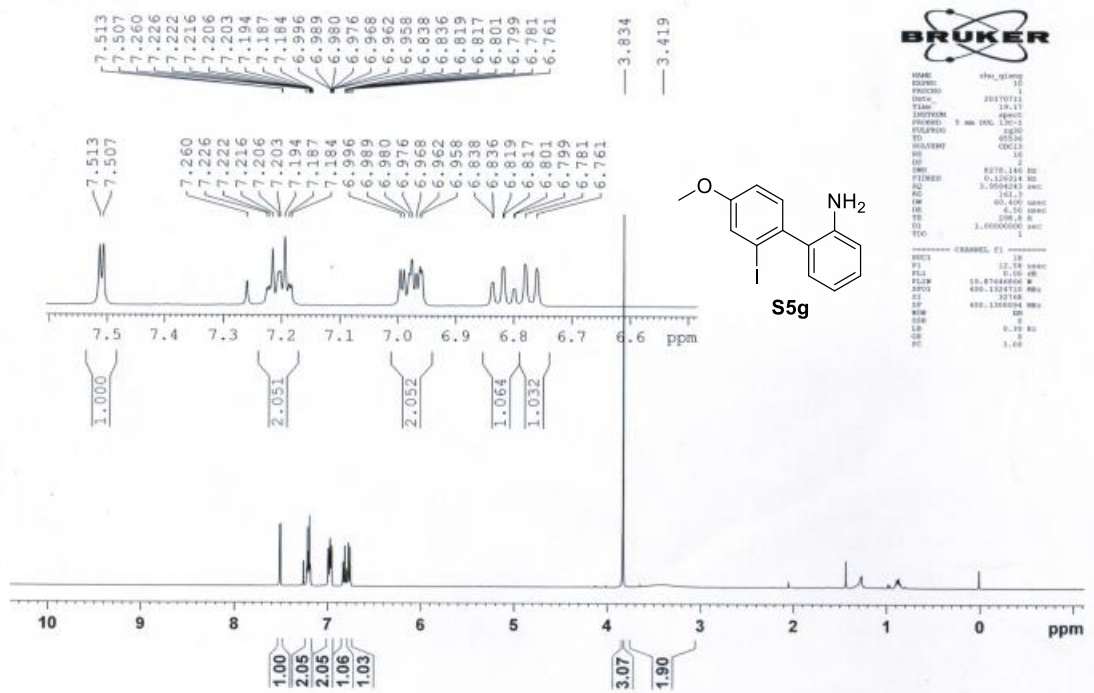
NAME 9
EXPNO 3
PROCNO 1
Date_ 20170416
Time 5.35
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 500
DS 4
SWH 29761.904 Hz
FIDRES 0.45411 Hz
AQ 1.1010548 sec
RG 203
DW 16.400 usec
DE 6.50 usec
TE 298.2 K
D1 2.00000000 sec
D11 0.03000000 sec
TDO 1

----- CHANNEL f1 -----
NUC1 13C
P1 8.80 usec
PL1 -1.00 dB
PL1W 104.9876149 W
SFO1 125.7703643 MHz

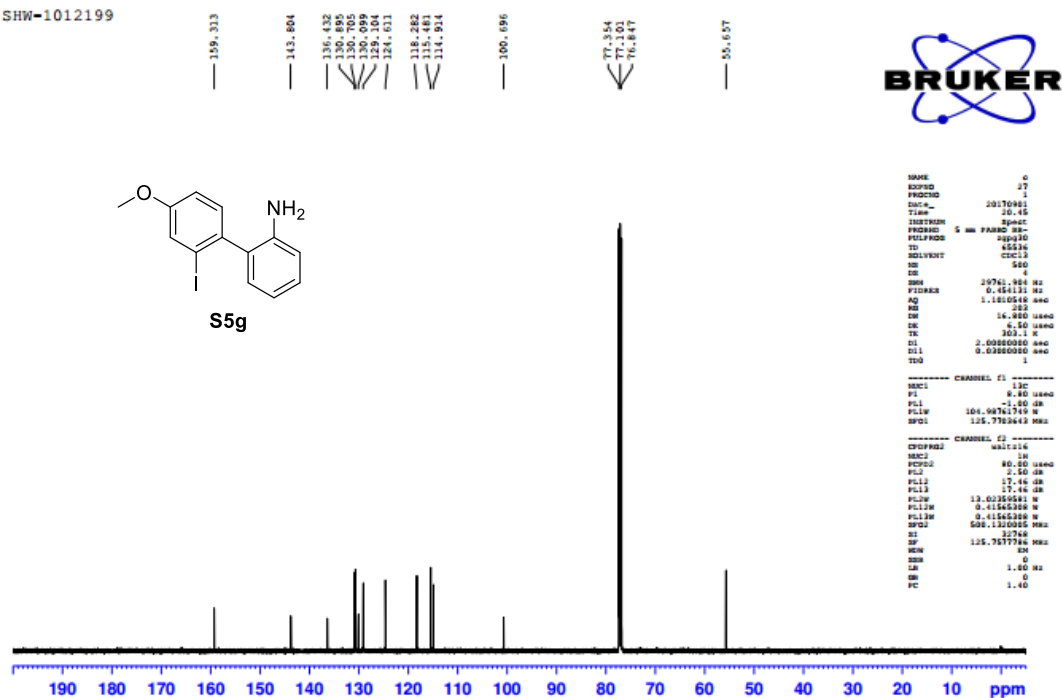
----- CHANNEL f2 -----
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL2 2.50 dB
PL12 17.46 dB
PL13 17.46 dB
PL1W 13.02359581 W
PL12W 0.41565308 W
PL13W 0.41565308 W
SFO2 500.132005 MHz
SI 32768
SF 125.7577466 MHz
WDW RM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



shw-1012199



SHW-1012199

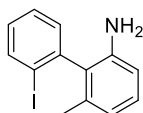


SHW-1012177

8.000
7.984
7.435
7.434
7.239
7.234
7.227
7.111
7.096
6.977
6.962
6.946
6.712
6.697
6.680
6.524

3.221

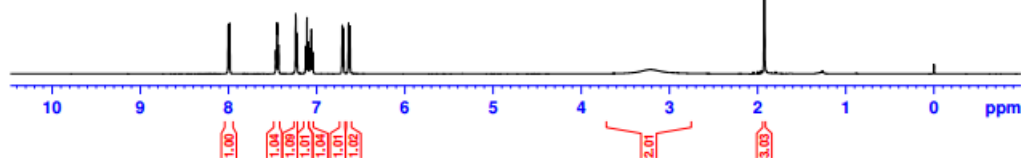
1.924



S5j

NAME 4
EXPNO 42
PROCNO 1
DATE_ 20170415
TIME 10.27
INSTRUM spect
PROBHD 5 mm PABBO 80-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
DS 16
OS 2
SWH 10120.570 KHz
FIDRES 0.157430 Hz
AQ 2.1719023 sec
RG 383
DW 48.10000000 sec
DE 6.50000000 sec
TE 301.2 K
D1 1.00000000 sec
TD0

----- CHANNEL f1 -----
NUC1 1H
P1 14.00000000 sec
PL1 2.50 dB
PC1 13.02000000 W
SFO1 500.13200000 MHz
SI 32768
SF 500.13200000 MHz
WDW EM
SSB 0
LB 0.20000000 Hz
GB 0
PC 1.00

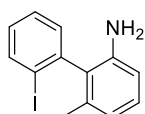


SHW-1012177

143.755
143.684
140.025
136.974
135.940
130.450
129.468
128.991
120.245
113.303
101.693

77.614
77.360
77.106

20.513

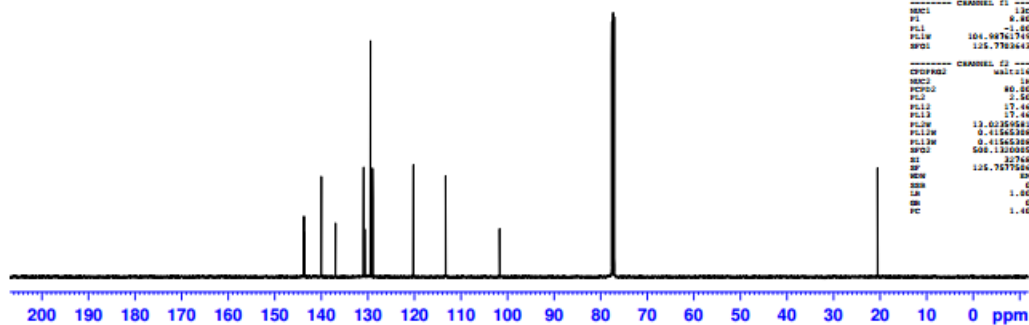


S5j

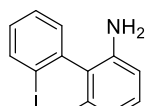
NAME 4
EXPNO 4
PROCNO 1
DATE_ 20170417
TIME 1.54
INSTRUM spect
PROBHD 5 mm PABBO 80-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
DS 16
OS 2
SWH 20761.984 KHz
FIDRES 0.454131 Hz
AQ 1.1810548 sec
RG 383
DW 16.90000000 sec
DE 6.50000000 sec
TE 301.2 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

----- CHANNEL f1 -----
NUC1 13C
P1 9.80000000 sec
PL1 1.00 dB
PC1W 104.98761749 W
SFO1 125.7702643 MHz

----- CHANNEL f2 -----
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00000000 sec
PL2 2.50 dB
PL12 17.44 dB
PL13 17.44 dB
PC1W 13.02000000 W
PC12W 0.41545388 W
PC13W 0.41545388 W
SFO2 500.13200000 MHz
SI 32768
SF 125.76757504 MHz
WDW EM
SSB 0
LB 1.00000000 Hz
GB 0
PC 1.40



SHW-1012116



S5k



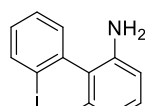
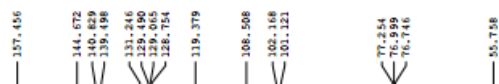
NAME
EXPNO
PROCNO
DATE_
TIME
INSTRUM
PROBHD
PULPROG
TD
SOLVENT
NS
DS
SWH
F2DRG
AQ
RG
CW
DE
TE
D1
TD0

CHANNEL F1
NUC1
P1
PL1
PL1W
SFO1
SF
NUC2
SFO2
SF2
PC

NAME
EXPNO
PROCNO
DATE_
TIME
INSTRUM
PROBHD
PULPROG
TD
SOLVENT
NS
DS
SWH
F2DRG
AQ
RG
CW
DE
TE
D1
TD0

CHANNEL F1
NUC1
P1
PL1
PL1W
SFO1
SF
NUC2
SFO2
SF2
PC

SHW-1012116



S5k



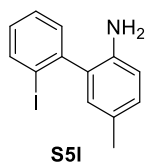
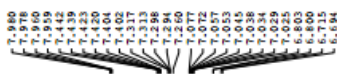
NAME
EXPNO
PROCNO
DATE_
TIME
INSTRUM
PROBHD
PULPROG
TD
SOLVENT
NS
DS
SWH
F2DRG
AQ
RG
CW
DE
TE
D1
TD0

CHANNEL F1
NUC1
P1
PL1
PL1W
SFO1
SF

CHANNEL F2
NAME
EXPNO
PROCNO
DATE_
TIME
INSTRUM
PROBHD
PULPROG
TD
SOLVENT
NS
DS
SWH
F2DRG
AQ
RG
CW
DE
TE
D1
TD0

CHANNEL F2
NAME
EXPNO
PROCNO
DATE_
TIME
INSTRUM
PROBHD
PULPROG
TD
SOLVENT
NS
DS
SWH
F2DRG
AQ
RG
CW
DE
TE
D1
TD0

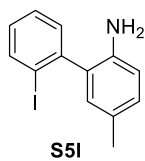
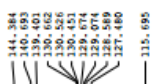
SHW-1169430



NAME 1
EXPNO 24
PROCNO 1
DATA_ 20171103
TIME 11.34
INSTRUM spect
PROBHD 5 mm BBO 13C-1
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8079.144 Hz
FIDRES 0.126214 Hz
AQ 2.9581213 sec
RG 128
WB 60.400 kHz
DE 6.50 uV
TE 297.2 K
D1 1.00000000 sec
TD0 1

----- CHANNEL f1 -----
NUC1 13C
P1 12.50 uV
PL1 0.00 dB
PL1W 10.8769888 W
SFO1 400.126110 MHz
SI 27468
SF 400.1260000 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

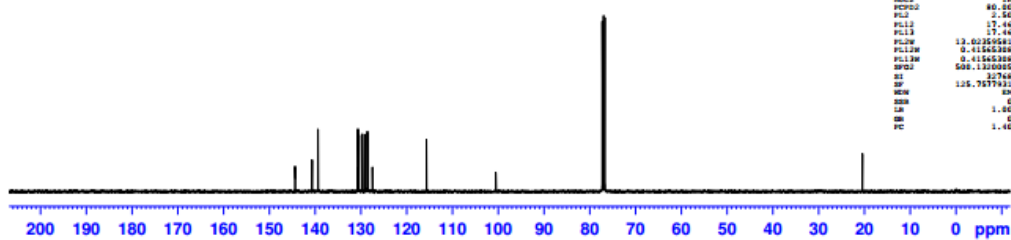
SHW-1169430



NAME 1
EXPNO 24
PROCNO 1
DATA_ 20170904
TIME 21.17
INSTRUM spect
PROBHD 5 mm F400 13C-1
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 16
DS 4
SWH 29761.988 Hz
FIDRES 0.454131 Hz
AQ 1.1810548 sec
RG 223
WB 16.400 kHz
DE 6.50 uV
TE 303.2 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

----- CHANNEL f1 -----
NUC1 13C
P1 6.50 uV
PL1 -1.80 dB
PL1W 104.9876174 W
SFO1 125.7613643 MHz

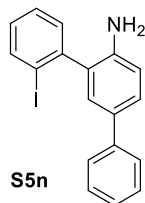
----- CHANNEL f2 -----
NUC2 1H
P2 80.00 uV
PL2 2.50 dB
PL2W 17.44 W
PL3 17.44 W
PL3W 12.02355581 W
PL4W 0.11563388 W
PL5W 0.11563388 W
SFO2 500.1320000 MHz
SI 27468
SF 125.7613643 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



SHW-1169457

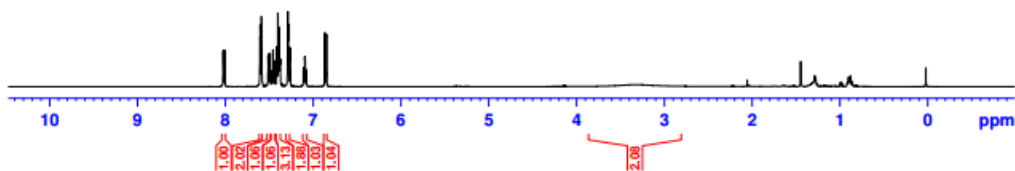


3.346
3.316



NAME	1
EXPNO	25
PROCNO	1
DATE_	20170814
TIME	15.56
INSTRUM	spac
PROBHD	5 mm PABBO BBO
PULPROG	zgpg30
TD	65536
SOLVENT	CDCl3
NS	16
DS	2
SWH	10330.574 Hz
FREQH	0.157621 MHz
AQ	3.1719923 sec
RG	128
DW	68.400 usec
DE	6.50 usec
TE	300.2 K
D1	1.00000000 sec
TD0	1

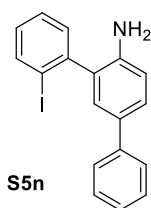
CHANNEL f1	---
NUC1	1H
P1	14.00 usec
PL1	2.00 dB
PL12	13.02305681 W
RFQ1	500.130085 MHz
ST	2076
SP	500.1300123 MHz
SW	4
SR	0
LA	0.30 Hz
GB	0
PC	1.00



SHW-1169457



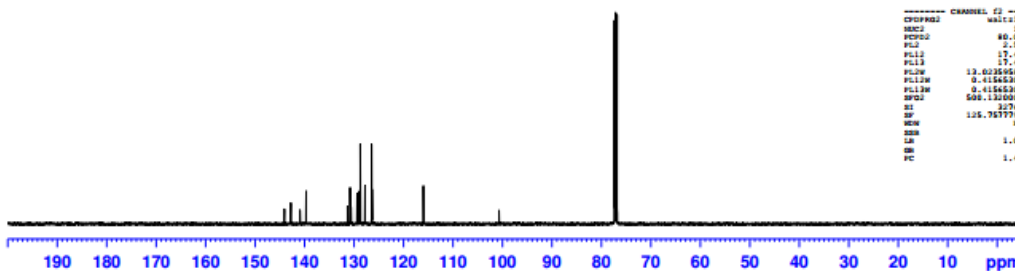
77.254
77.040
76.840



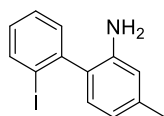
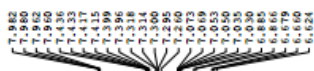
NAME	1
EXPNO	29
PROCNO	1
DATE_	20170901
TIME	11.50
INSTRUM	spac
PROBHD	5 mm PABBO BBO
PULPROG	zgpg30
TD	65536
SOLVENT	CDCl3
NS	500
DS	4
SWH	20761.386 Hz
FREQH	0.157621 MHz
AQ	1.1010549 sec
RG	256
DW	14.500 usec
DE	6.50 usec
TE	303.1 K
D1	2.00000000 sec
D11	0.03000000 sec
TD0	1

CHANNEL f1	---
NUC1	13C
P1	8.00 usec
PL1	-1.00 dB
PL12	104.98761749 W
RFQ1	125.7703413 MHz

CHANNEL f2	---
EXPNO2	multis16
NUC2	1H
P2P22	80.00 usec
PL2	2.50 dB
PL13	17.44 dB
PL12	17.44 dB
PL12W	13.02305681 W
PL12W	0.41565388 W
PL12W	0.41565388 W
RFQ2	500.130085 MHz
ST	12740
SP	125.7677757 MHz
SW	4
SR	0
LA	1.40 Hz
GB	0
PC	1.40



1012067



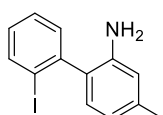
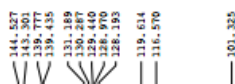
S5o



NAME h
EXPNO 4
PROCNO 1
DATE_ 20170414
TIME 19.04
INSTRUM spect
PROBHD 5 mm DUL 13C-1
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
DS 4
SWH 29761.464 Hz
FIDRES 0.126114 Hz
AQ 0.454131 Hz
RG 203
WDW EM
SSB 0
LB 1.80 Hz
GB 0
PC 1.40

----- CHANNEL f1 -----
NUC1 13C
P1 12.00 uS
PL1 0.00 dB
PL1W 10.0761040 W
SFO1 400.126110 MHz
Z1 277.64
ZF 400.126110 MHz
WDW EM
SSB 0
LB 0 Hz
GB 0
PC 1.00

1012067



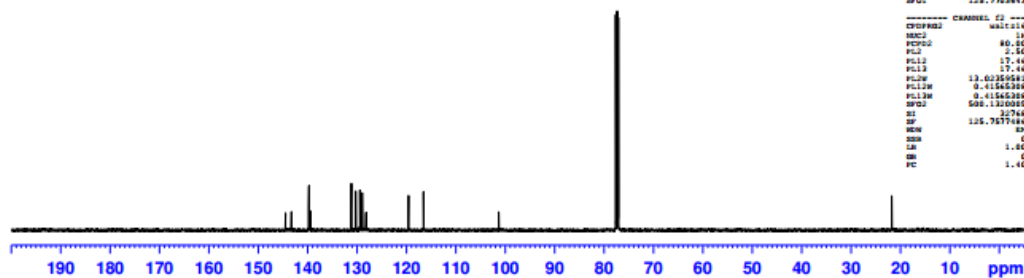
S5o



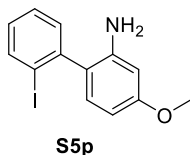
NAME h
EXPNO 4
PROCNO 1
DATE_ 20170414
TIME 8.25
INSTRUM spect
PROBHD 5 mm FRABO 1H-1
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
DS 4
SWH 29761.464 Hz
FIDRES 0.454131 Hz
AQ 0.454131 Hz
RG 203
WDW EM
SSB 0
LB 1.80 Hz
GB 0
PC 1.40

----- CHANNEL f1 -----
NUC1 13C
P1 12.00 uS
PL1 0.00 dB
PL1W 10.0761040 W
SFO1 400.126110 MHz

----- CHANNEL f2 -----
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00 uS
PL2 2.00 dB
PL12 17.46 dB
PL13 17.46 dB
PL1W 13.02359581 W
PL1W 0.41565288 W
PL1W 0.41565288 W
SFO2 500.136050 MHz
Z1 277.64
ZF 500.136050 MHz
WDW EM
SSB 0
LB 1.80 Hz
GB 0
PC 1.40



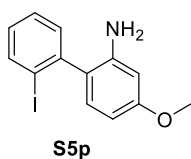
SHW-1169488



NAME k
EXPNO 2
PROCNO 1
DATE_ 20171011
TIME 14.34
INSTRUM spect
PROBHD 5 mm BBO 13C-1
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8278.146 Hz
FIDRES 0.126312 Hz
AQ 3.9581243 sec
RG 96.5
DW 60.400 sec
DE 6.50 sec
TE 298.2 K
D1 1.00000000 sec
TD0 1

----- CHANNEL f1 -----
NUC1 13C
P1 12.00 sec
PL1 0.00 dB
PL1W 10.8764248 W
SFO1 100.626110 MHz
SI 32768
SF 100.626110 MHz
WDW 0
SSB 0
GB 0
PC 1.00

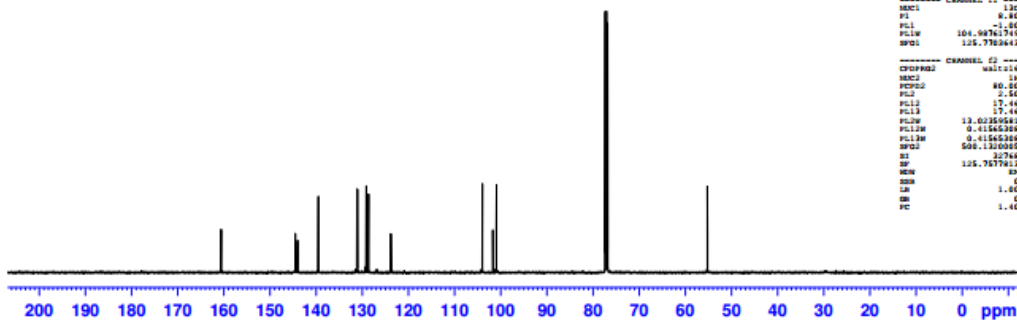
SHW-1169488



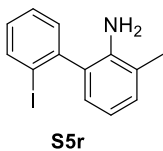
NAME k
EXPNO 20
PROCNO 1
DATE_ 20171012
TIME 17.00
INSTRUM spect
PROBHD 5 mm BBO HD-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 2048
DS 4
SWH 20762.904 Hz
FIDRES 0.454133 Hz
AQ 1.1810548 sec
RG 252
DW 16.800 sec
DE 6.50 sec
TE 303.2 K
D1 2.00000000 sec
D11 0.23000000 sec
TD0 1

----- CHANNEL f1 -----
NUC1 13C
P1 8.00 sec
PL1 -1.50 dB
PL1W 104.98761719 W
SFO1 125.7678113 MHz

----- CHANNEL f2 -----
NUC2 1H
PCPD2 80.00 sec
PL2 2.50 dB
PL2W 17.14 dB
PL3 17.14 dB
PL3W 12.0230601 W
PL1W 0.01565308 W
PL1W 0.01565308 W
SFO2 500.1360516 MHz
SI 32768
SF 125.7678113 MHz
WDW 0
SSB 0
GB 0
PC 1.40

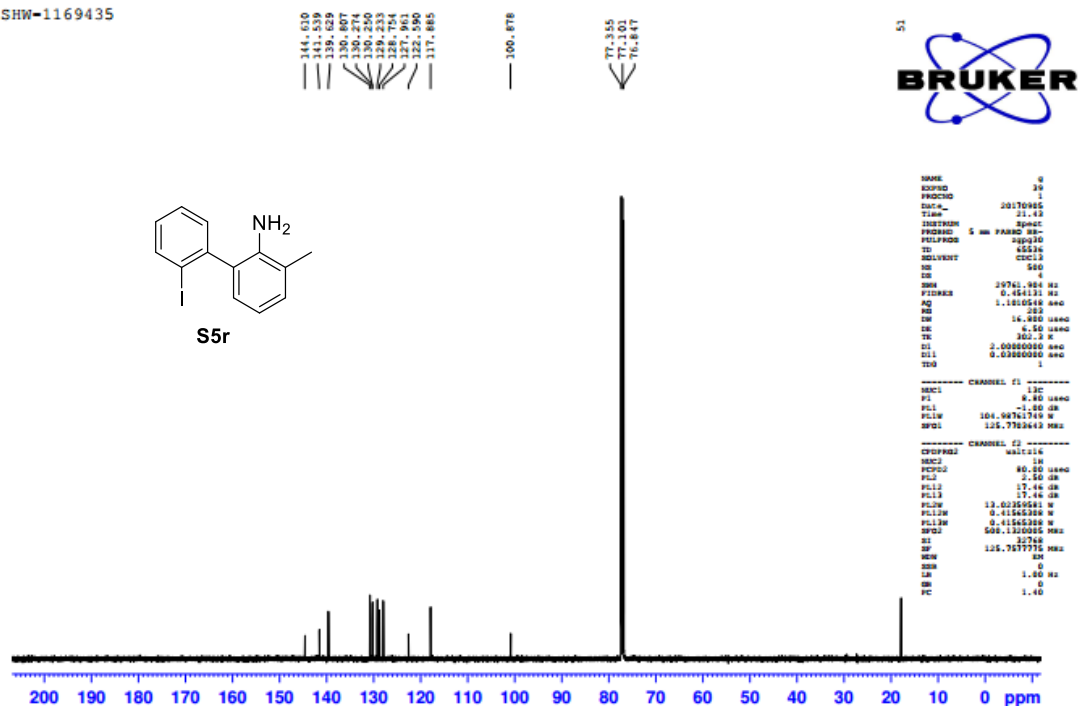


SHW-1169435



NAME	Q
EXPNO	20
F4CDIC	
TIME	20170405
TIME	21.14
INSTRUM	HRCT
PROBHD	5 mm PABBO BB-
PULPROG	zgpg30
TD	65536
SOLVENT	CDCl3
NS	14
DS	2
SWH	10320.576 Kz
F2	0.17420 Kz
QW	2.1719822 sec
NUC1	13
NUC2	13
DE	400.140 MHz
NUC1	13C 4.50 usec
NUC2	13C 4.50 usec
TD0	1,000,000.00 sec
TD1	1
===== CHANNEL f1 =====	
NUC1	13
P1	14.00 usec
P12	2.50 sec
NUC2	13
SPFO	500.130045 MHz
NUC1	13
NUC2	500.130045 MHz
DE	400.140 MHz
LA	0.30 Kz
LB	1.00

SHW-1169435



```
NAME
EXPNO 39
PROCNO 1
DATE_ 20170905
TIME 18.00
INSTRUM sm
F2 -5 mm F4000
TELEPRD 200000
FL1 45536
CORRECT 0
SUB 500
SOL 1
SOLN 1974.100 Hz
F2 0.1610000 Hz
AQ 1.1010500 Hz
IN 16.80000 Hz
PD 16.80000 Hz
F1 16.80000 Hz
TUN 3602.4 Hz
SFO 0.2000000 Hz
C11 1.0000000 Hz
TDC 1
----- CHANNEL 13C -----
NUC1 13C
F1 80.5000000 Hz
FL1 105.7974700 Hz
----- CHANNEL 2C -----
CPDPRG2 waltz16
PCPD2 80.5000000 Hz
FL2 17.64000 Hz
FL3 13.0235500 Hz
FL4 13.0235500 Hz
FL5 0.1564588 Hz
FL1W 0.1564588 Hz
SF2 125.7377070 Hz
SF3 125.7377070 Hz
NUC2 13C
SOLN 1
SOL 1.000 Hz
F2 0 Hz
TDC 1.400
```

SHW-1169444



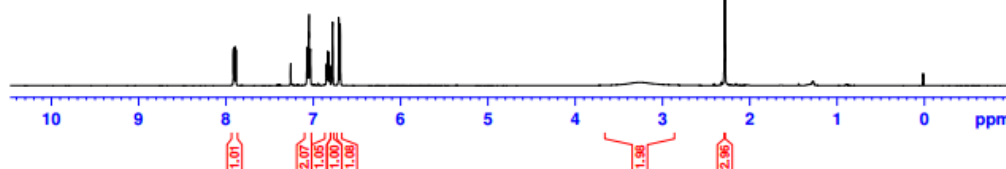
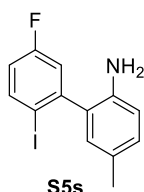
3.252

2.286



NAME 0
EXPNO 28
PROCNO 1
DATE_ 20170409
TIME 17.09
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
DS 16
SS 2
SWH 10330.579 Hz
FIDRES 0.157432 Hz
AQ 2.1719023 sec
RG 514
DW 68.400 usec
DE 4.50 usec
TE 303.2 K
D1 1.0000000 sec
TD0 1

----- CHANNEL f1 -----
NUC1 1H
P1 14.00 usec
PL1 2.50 dB
PL1W 13.02354561 W
SFO1 500.1300895 MHz
SI 327
SF 500.1300133 MHz
WDW EM
SSB 0
GB 0.0 Hz
PC 1.00



SHW-1169444



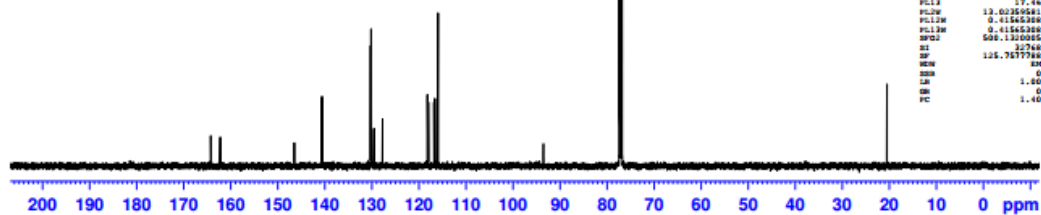
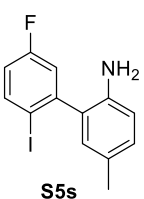
20.483



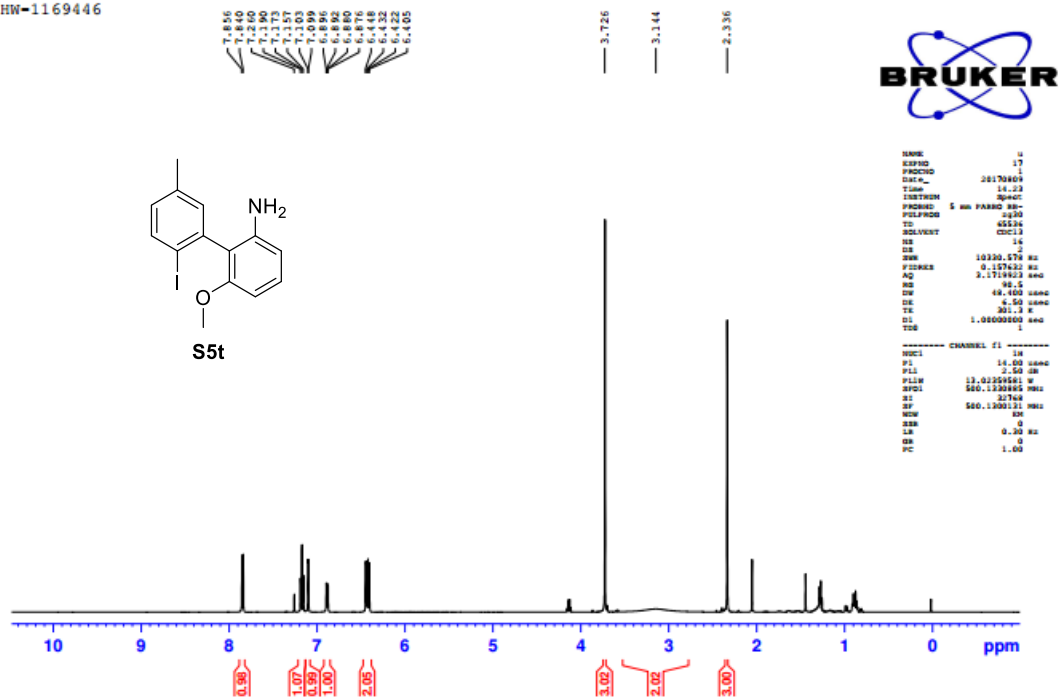
NAME 0
EXPNO 57
PROCNO 1
DATE_ 20170412
TIME 5.07
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
DS 16
SS 2
SWH 20761.904 Hz
FIDRES 0.454131 Hz
AQ 1.1010549 sec
RG 512
DW 16.900 usec
DE 6.50 usec
TE 303.2 K
D1 2.0000000 sec
D11 0.0300000 sec
TD0 1

----- CHANNEL f1 -----
NUC1 13C
P1 9.00 usec
PL1 0.00 dB
PL1W 104.987617419 W
SFO1 125.7703643 MHz

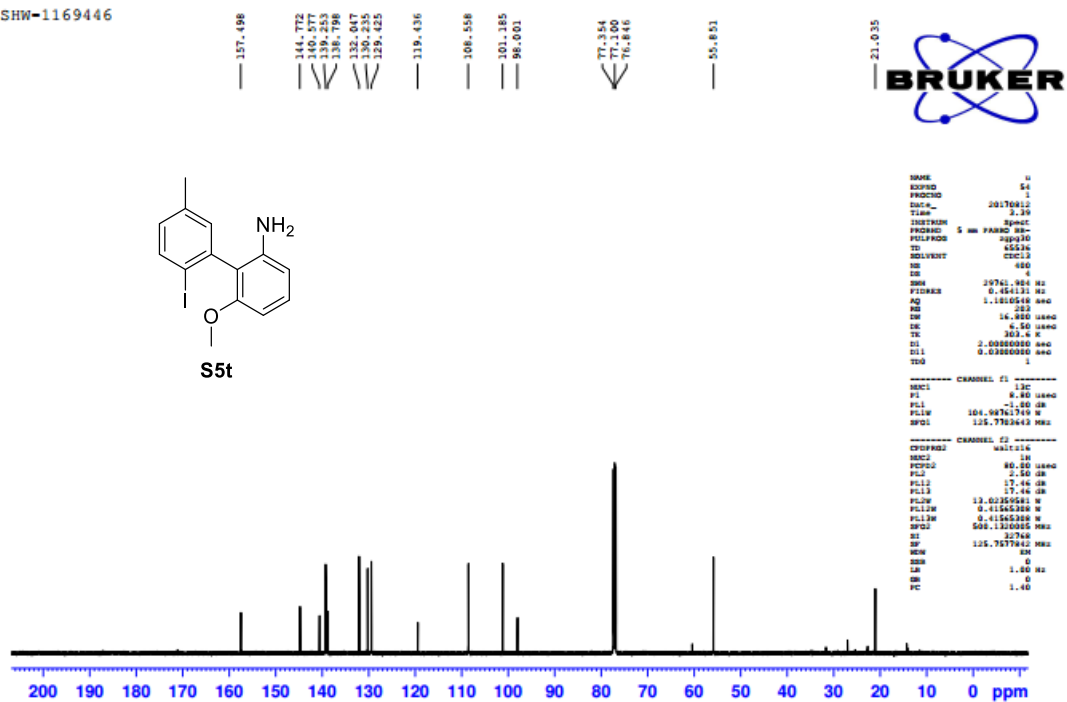
----- CHANNEL f2 -----
CYCPRG2 hmlc116
NUC2 1H
PCYC2 80.00 usec
PL2 2.50 dB
PL2W 17.44 dB
PL1W 13.02354561 W
PL12W 0.41545368 W
SFO2 500.1300895 MHz
SI 327
SF 125.7677748 MHz
WDW EM
SSB 0
GB 1.00 Hz
PC 1.40



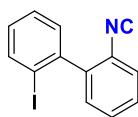
SHW-1169446



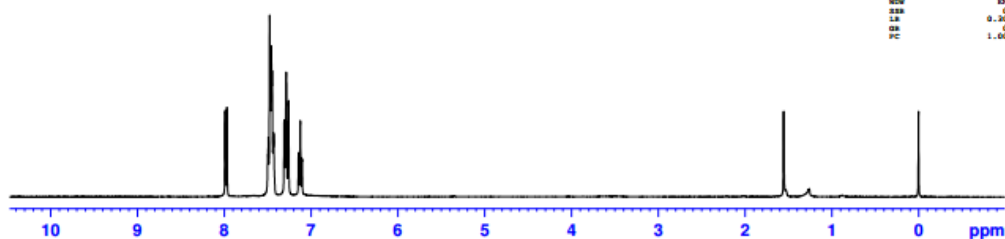
SHW-1169446



SHW-MODEL-NC



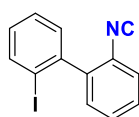
1a



NAME: 1a
EXPNO: 1
PROCNO: 1
DATE_: 20170612
TIME: 20.12
INSTRUM: spect
PROBHD: 5 mm BBO 13C-1
PULPROG: zgpg30
TD: 65536
SOLVENT: CDCl3
NS: 16
DS: 4
SWH: 8079.144 Hz
FIDRES: 0.124311 Hz
AQ: 2.1654143 sec
RG: 322.5
DE: 40.100 umax
TE: 300.2 K
DE: 4.50 umax
D1: 1.0000000 sec
TDS: 1

----- CHANNEL f1 -----
NUC1: 13C
P1: 12.50 umax
PL1: 0.00 dB
PL12: 18.9764848 W
NUC2: 1H
PC1: 480.1303580 MHz
SI: 32768
SF: 480.1303580 MHz
WDW: RM
SSB: 0
LB: 0.30 Hz
GB: 0
PC: 1.00

SHW-MODEL-NC



1a

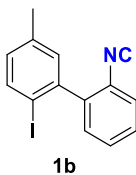


NAME: 1a
EXPNO: 1
PROCNO: 1
DATE_: 20170612
TIME: 20.14
INSTRUM: spect
PROBHD: 5 mm PABBO 13C-
PULPROG: zgpg30
TD: 65536
SOLVENT: CDCl3
NS: 16
DS: 4
SWH: 20741.961 Hz
FIDRES: 0.456131 Hz
AQ: 1.1810548 sec
RG: 283
DE: 16.400 umax
TE: 300.2 K
DE: 4.50 umax
D1: 2.0000000 sec
D11: 0.0300000 sec
TDS: 1

----- CHANNEL f1 -----
NUC1: 13C
P1: 8.50 umax
PL1: -1.50 dB
PL12: 104.9474749 W
NUC2: 1H
PC1: 125.7702643 MHz

----- CHANNEL f2 -----
EXPRES: waltz16
NUC2: 1H
PCPD2: 80.50 umax
PL2: 2.50 dB
PL12: 17.14 dB
PL13: 17.14 dB
PL12W: 13.0235681 W
PL13W: 0.41565288 W
PL13W: 0.41565288 W
SF2: 400.1460050 MHz
SI: 32768
SF: 125.7677410 MHz
WDW: RM
SSB: 0
LB: 1.00 Hz
GB: 0
PC: 1.40

SHW-1012120



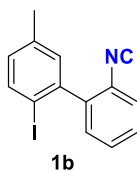
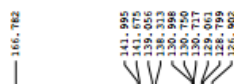
NAME	d
KEPNO	111
PFNOHD	1
DATE	20170511
TIME	0.06
INSTRUM	aspect
PROBHD	5 mm EML 130-1
SOLPROB	ag30
TD	65526
SOLVENT	CDCl3
NS	16
DS	2
SWH	8278.146 Hz
F2FREQS	0.126314 Hz
AQ	3.9588263 sec
NS	262
DS	60.00000000
DE	6.50
TE	298.7
D1	1.000000000 sec
T00	1

```

----- CHANNEL F1 -----
HDC1              1M
P1                12.50 usec
PL1              0.00 dB
PLIN             10.97606866 W
XPOL             450.1224710 MHz
SI               32768
SF              450.1300882 MHz
NDW              800
XSR              0
LR              0.20 Hz
GR              0
PC              1.00

```

SHW-1012120

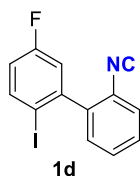
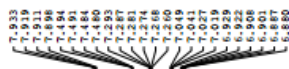


```
NAME          d
COORD         1111
PROCR         1
DATE_         20170512
TIME          1.37
INSTRUM       Spect
PROGRAM       $ MM PARMO MM-
PULPROG       zgpg30
TD             65536
SOLVENT       CDCl3
DS            1479
DE            4
ZM            20761.924 H2
PDEPR         0.454121 H2
AQ            1.1810549 sec
NU            202
DE            16.9200 used
DE            6.50 used
TK            302.8 K
D1            2.00000000 sec
D11           0.03000000 sec
```

```
----- CHANNEL f1 -----
MUC1                13c
F1                   8.80 used
PL1                  -1.80 dB
PL1W                 104.98761749 W
SFO1                 125.7782642 MHz
```

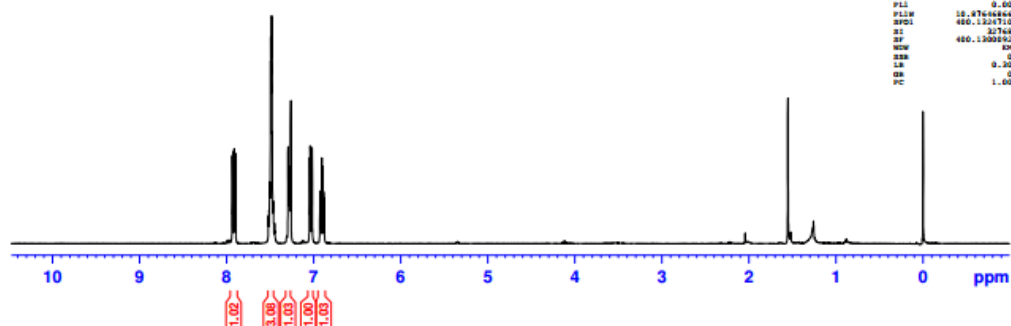
CHANNEL F2	
CFOPR2	WAT14
MCD3	1M
PLD2	80.00 usad
PL2	2.50 GR
PL12	17.46 GR
PL13	17.46 GR
PL2W	13.0235981 W
PL2W	0.4156388 W
PL3W	0.4156388 W
SFD2	508.1320055 MHz
SI	32768
SP	125.7637882 MHz
WEN	EM
WEN	0
WEN	1.00 Hz
WEN	0
WEN	1.40

SHW-1169466

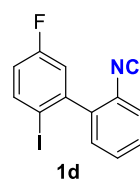
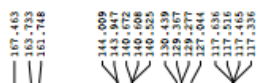


NAME 1a
EXPNO 1
PROCNO 1
DATE_ 20170917
TIME 17.19
INSTRUM spect
PROBHD 5 mm BBO 125-1
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 2
DS 4
SWH 8179.144 Hz
FIDRES 0.126318 Hz
AQ 2.9581213 sec
RG 363
GB 0
DE 60.000 umol
TE 299.2 K
D1 1.00000000 sec
TDS 1

----- CHANNEL f1 -----
NUC1 13C
P1 12.00 umol
PL1 0.00 dB
PL12 18.8764848 dB
SFO1 400.132610 MHz
SI 32768
SF 400.132610 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

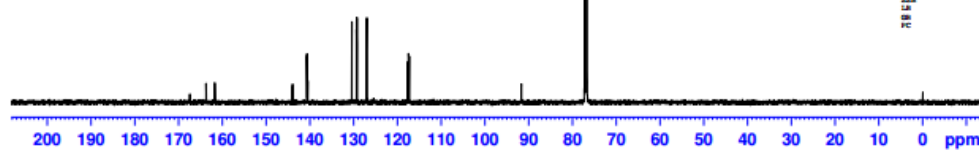


SHW-1169466



NAME 1a
EXPNO 1
PROCNO 1
DATE_ 20170917
TIME 22.27
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 2048
DS 4
SWH 20761.964 Hz
FIDRES 0.461131 Hz
AQ 1.1810518 sec
RG 283
GB 0
DE 16.000 umol
TE 299.2 K
D1 2.00000000 sec
D11 0.03000000 sec
TDS 1

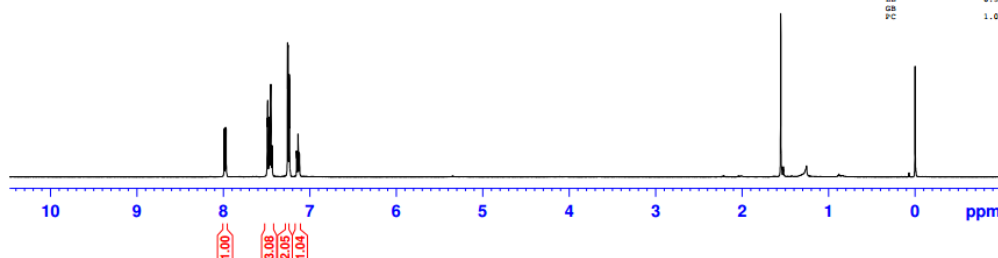
----- CHANNEL f1 -----
NUC1 13C
P1 8.00 umol
PL1 -1.00 dB
PL12 104.9476749 dB
SFO1 125.7702643 MHz
----- CHANNEL f2 -----
CPDPRG2 waltz16
NUC2 1H
P2 80.00 umol
PL2 2.50 dB
PL12 17.16 dB
PL13 17.16 dB
PL12 13.02305681 dB
PL13 0.11645208 dB
PL13 0.11645208 dB
SFO2 400.132610 MHz
SI 32768
SF 125.7702643 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



7.989
7.987
7.973
7.971
7.994
7.990
7.973
7.969
7.956
7.952
7.939
7.937
7.920
7.924
7.921
7.938
7.954
7.951
7.939
7.936
7.923
7.920



1e



```
NAME
EXPNO      15
PROCNO      1
Date_       20170418
Time        10.32
INSTRUM     spect
PROBHD      5 mm PABBO
PULPROG      zg30
TD          65536
SOLVENT     CDCl3
DS          16
NS          2
SWH          10310.578 Hz
FIDRES      0.17633 Hz
AQ           3.171976 sec
RG           203
WDW          EM
SSB          0
GB           48.400 usec
PC           6.50 usec
DE           297.4 Hz
D1           1.0000000 sec
TDO          1
----- CHANNEL f1 -----
NUC1         P1
P1           14.00 usec
P2           1.00 usec
P3           2.50 dB
NUC2         13.0213033 MHz
SF01         500.1330885 MHz
SF           1      32768
SF           2      500.1300137 MHz
PCMDW        0.00 usec
ZSR          0
GB           0.30 Hz
GB           0
PC           1.00 usec
```

1012070

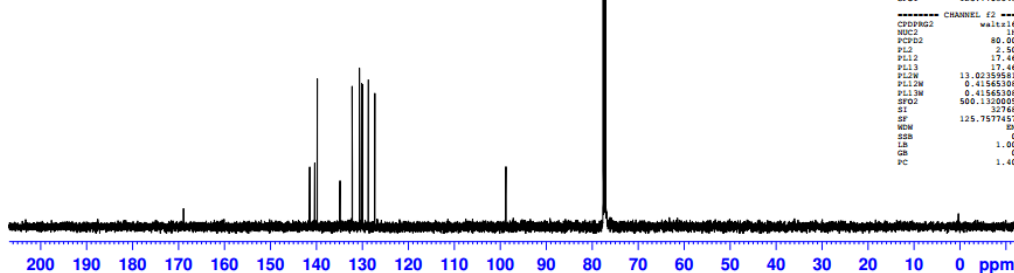
—168.939

141.470
140.400
139.823
134.887
132.232
130.649
130.203
129.934
128.735
127.940

— 98.807

77.614
77.360
77.106

1e



NAME	g
EXPNO	25
PROCNO	1
Date_	20170418
Time	17.56
INSTRUM	Spect
PROBHD	5 mm PABBO BB-
PULPROG	zgpg30
TD	65536
SOLVENT	CDCl3
NS	1024
DS	4
SWH	29761.904 Hz
F2RES	0.454131 Hz
RG	1.1010548 sec
RG	203
DW	16.800 usec
DE	6.50 usec
TE	299.7 K
D1	2.000000000 sec
D11	0.030000000 sec
TD0	1

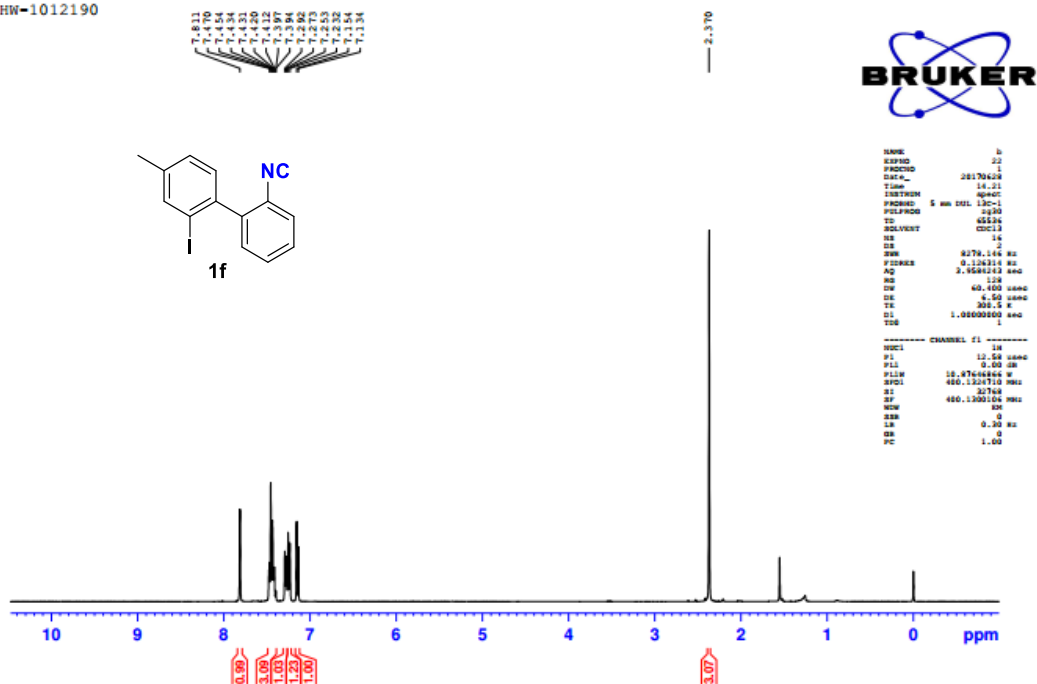
```

----- CHANNEL f1 -----
NUC1      1.3C
P1         8.80 usec
PL1        -1.00 dB
PL1W       104.98761749 W
SF01       125.7703643 MHz

----- CHANNEL f2 -----
CDDPRG2    waitx16
NUC2        1H
PCD2        80.00 usec
PL2         2.50 dB
PL12        17.46 dB
PL13        17.46 dB
PL12W       13.02359581 W
PL13W       0.41565308 W
SF02        500.1320005 MHz
SI          32768
SF1         125.7577745 MHz
WDW         EM
SSB         0
LB          1.00 Hz
GB          0
EC          1.40

```

SHW-1012190



```

NAME                                b
EXPNO                               22
PROCNO                               1
DATE_                                20170626
TIME                                16.21
INSTRUM                             agc4ct
PROBHD 5 mm DUL 13C-1             agc4ct
PULPROG                             zgpg30
TD                                   65536
TE                                   300.2 K
SOLVENT                             CDCl3
NS                                   14
DS                                   2
SWH                                   8278.144 Hz
FIDRES                               0.126314 Hz
AQ                                   2.95681242 sec
RG                                   128
SD                                   60.400 lines
DE                                   6.50 lines
TE                                   300.2 K
D1                                   1.00000000 sec
TD0

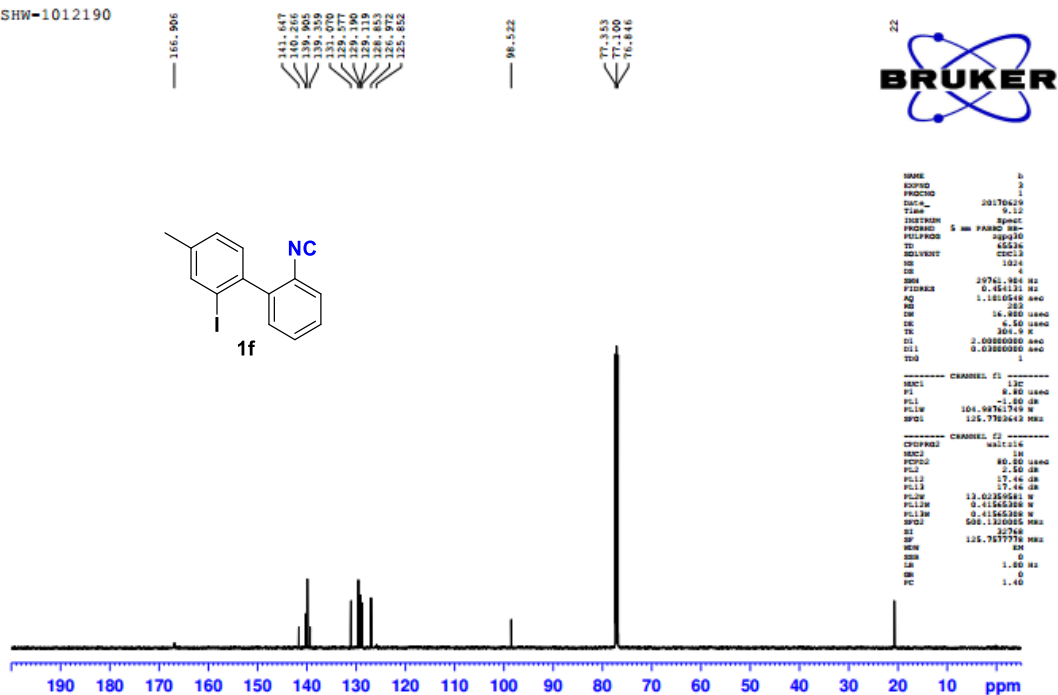
```

```

----- CHANNEL F1 -----
MDEL      1M
P1         12.5W  uuee
P11        0.00  dB
P1LM       10.8766866  W
SF01       480.1224710  MHz
SI         22768
SF         480.1200106  MHz
NDW        8M
SSB        0
LB         0.20  Hz
GB         0
PC         1.00

```

SHW-1012190

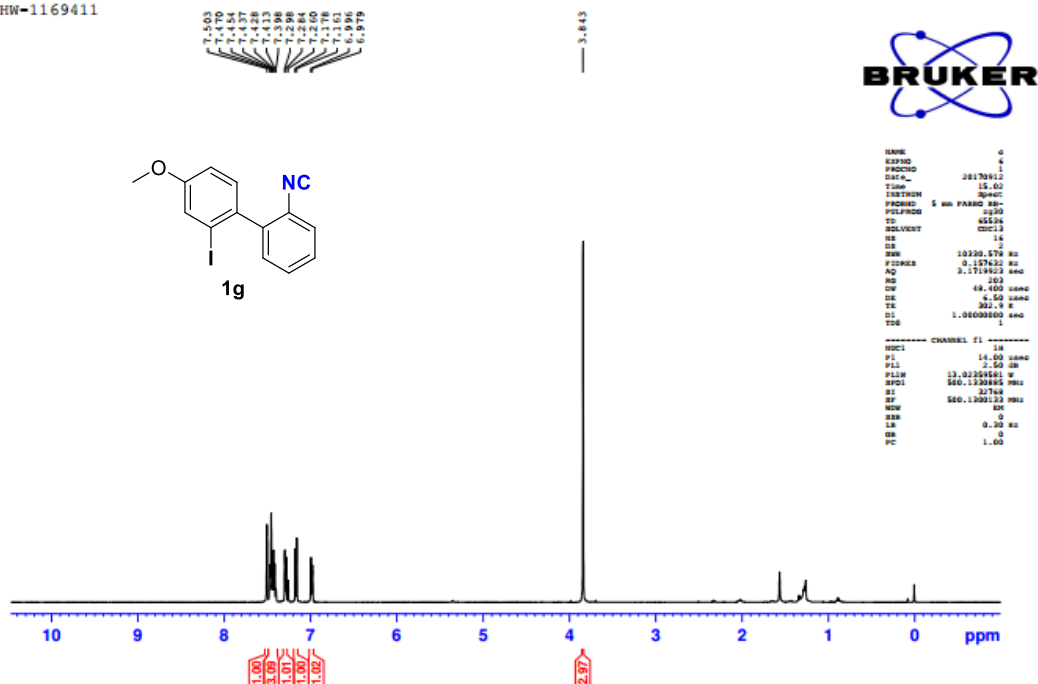


NAME	b
EXPNO	2
PROCNO	1
DATE_	20170429
TIME	9.12
INSTRUM	SPECT
PROBHD	5 mm PABBO BB-
PULPROG	zgpg30
TD	65536
SOLVENT	CDCl3
DE	1024
IN	
NUM	29761.908 Hz
FIDRES	0.454131 sec
AQ	1.1810549 sec
RG	282
DM	16.880 used
DE	6.50 used
TE	301.9 K
D1	2.00000000 sec
D2	0.02000000 sec
PROB	

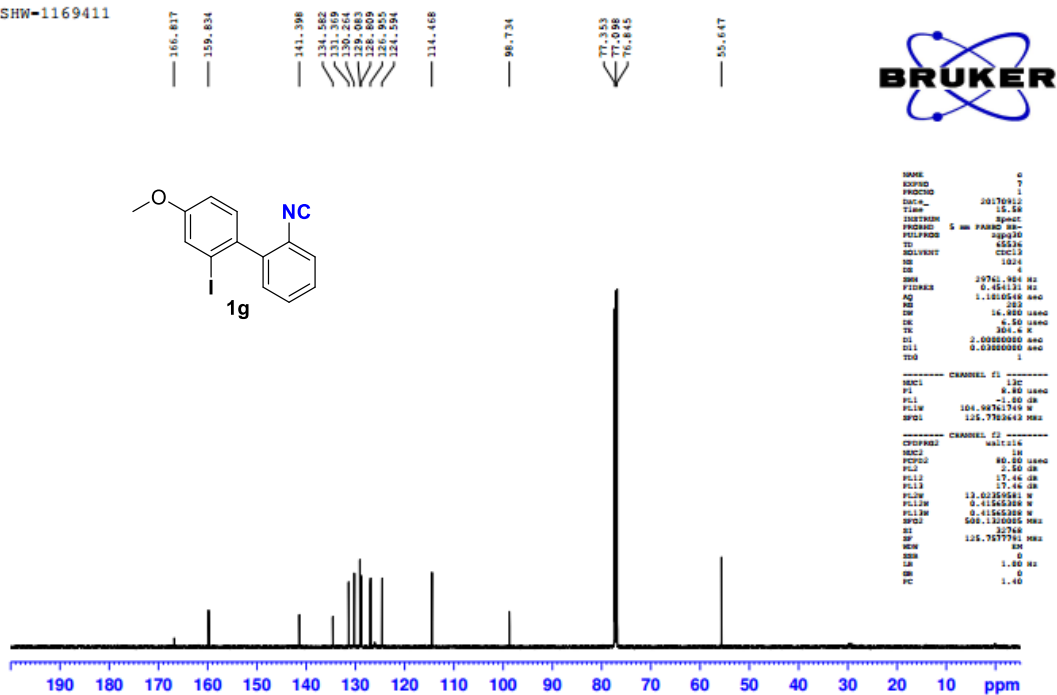
```
----- CHANNEL F1 -----
MACI          13C
F1             8.80 used
PLI            -1.80 dB
PLIW          104.98761749 W
SPWL          125.7703642 Mhz
```

CPYPRG2	CHANNEL ID	UNIT16
MCJ2	1H	
PCPD2	80.00 0000	
PL2	2.50 0H	
PL12	17.46 0H	
PL13	17.46 0H	
PL2W	12.02350581 W	
PL2W	0.41565308 W	
PL2W	0.41565308 W	
MR2	508.13300015 MR2	
RI	32768	
SP	125.7677778 MR2	
WCM	EM	
ZSM	0	
LN	1.60 H2	
HT	1.40	

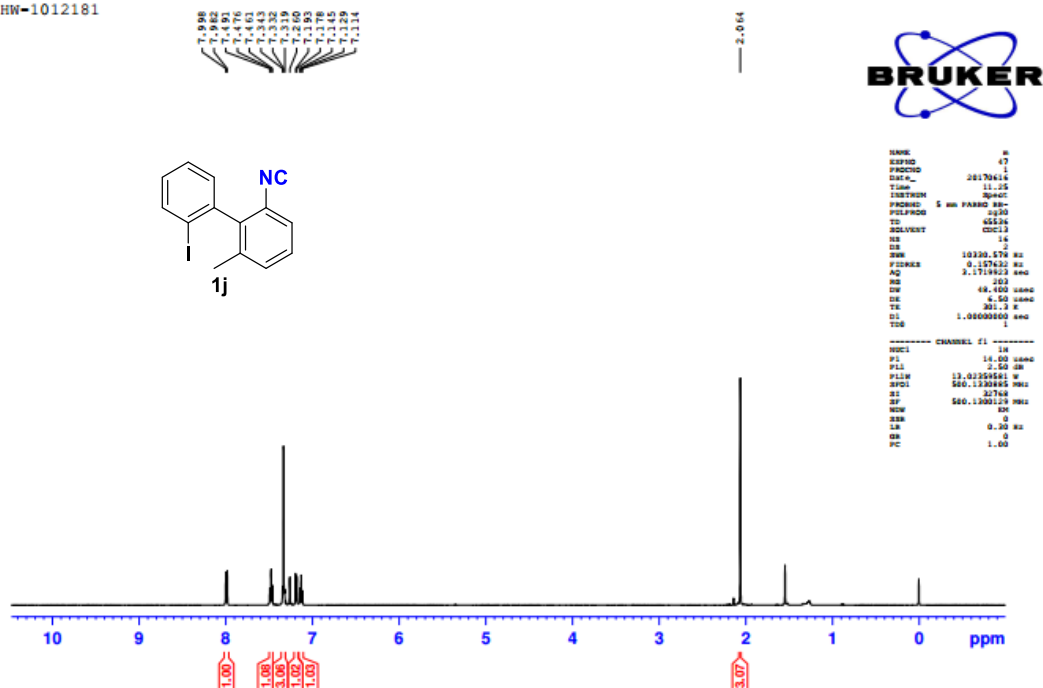
SHW-1169411



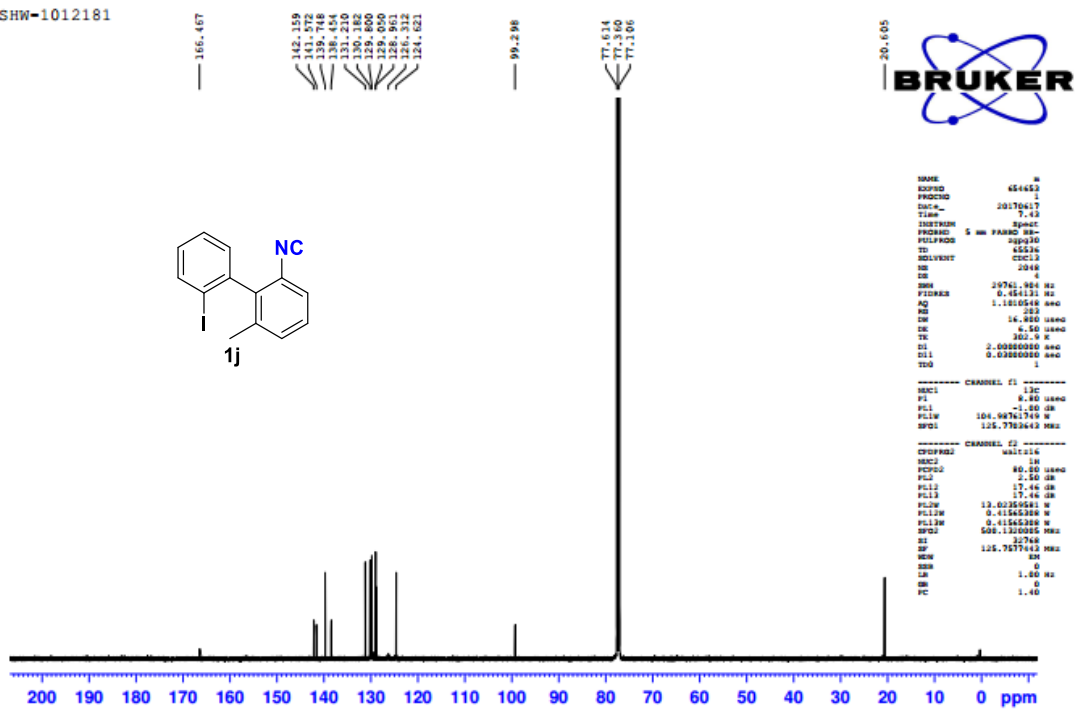
SHW-1169411



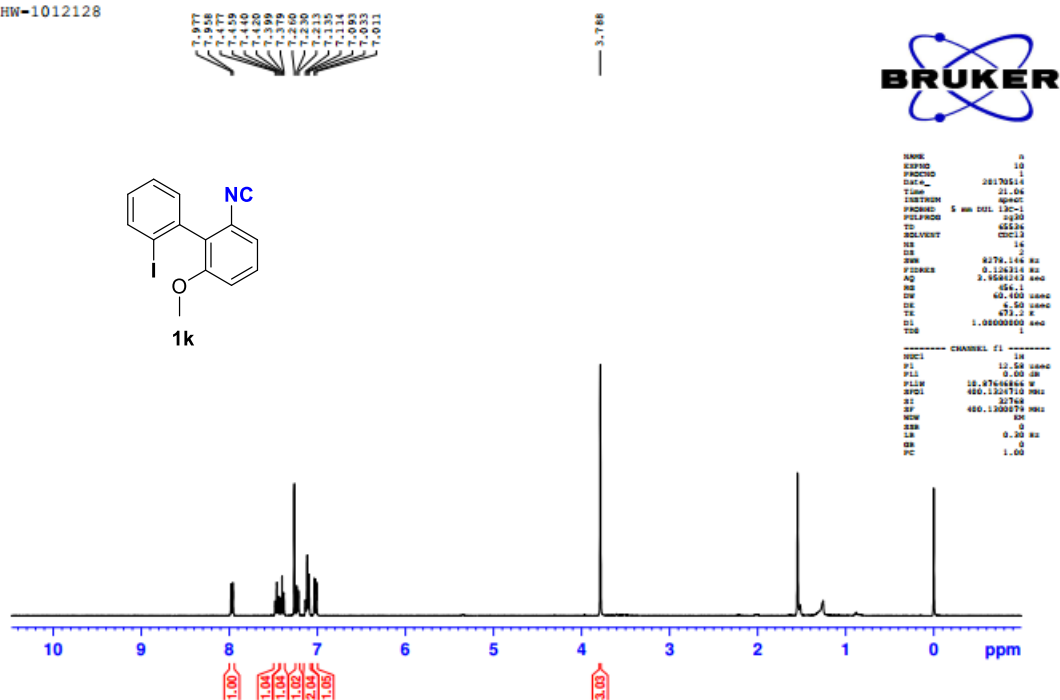
SHW-1012181



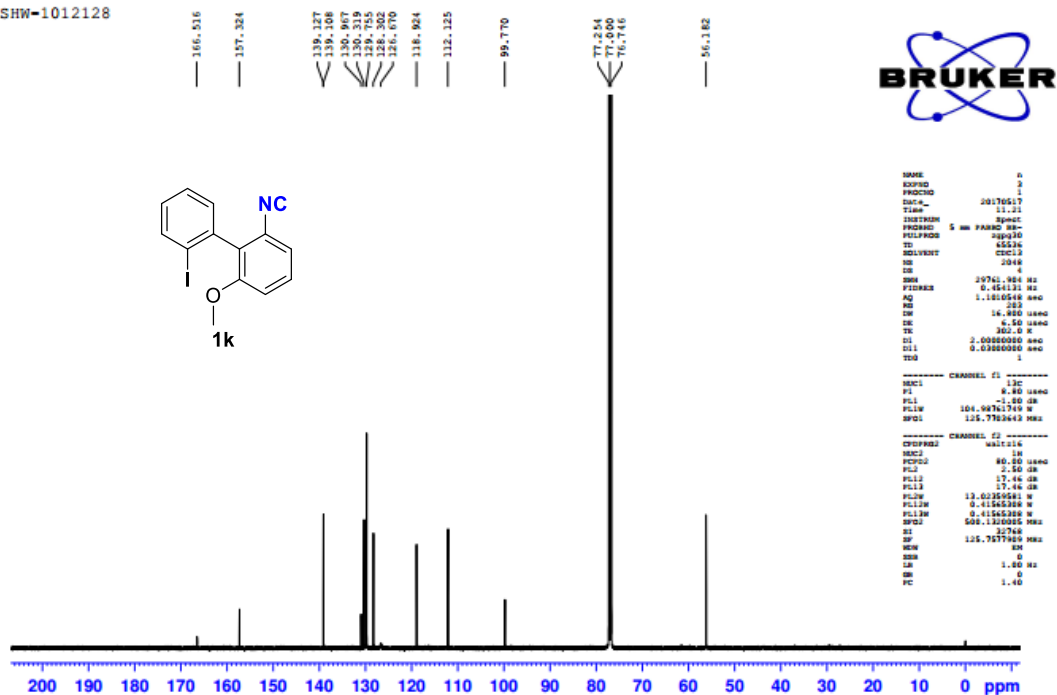
SHW-1012181



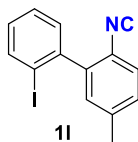
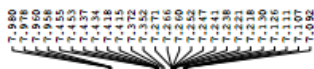
SHW-1012128



SHW-1012128



SHW-1169468

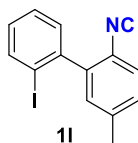


```

NAME      1
EXPNO     1
PROCNO    1
DATE_     20170919
TIME      18.29
INSTRUM    spect
PROBHD     5 mm DUL 13C-1
PULPROG    zgpg30
TD         65536
SOLVENT    CDCl3
NS         16
DS         4
SWH         8178.146 Hz
FIDRES     0.126214 Hz
AQ         2.9581213 sec
RG         321
DW         60.400 usec
DE         4.50 usec
TE         298.2 K
D1         1.0000000 sec
TSD        1

===== CHANNEL f1 =====
NUC1       13C
P1         12.50 usec
PL1        0.00 dB
PL12       10.8704646 W
SFO1       400.126110 MHz
SI         32768
WDW         400.1200001 MHz
SSB         0
LB          0.30 Hz
GB          0
PC          1.00
  
```

SHW-1169468



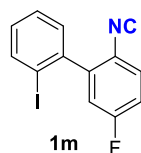
```

NAME      1
EXPNO     1
PROCNO    1
DATE_     20170919
TIME      9.39
INSTRUM    spect
PROBHD     5 mm PABBO 80-
PULPROG    zgpg30
TD         65536
SOLVENT    CDCl3
NS         16
DS         4
SWH         20761.0 Hz
FIDRES     0.456131 Hz
AQ         1.1010540 sec
RG         321
DW         18.800 usec
DE         4.50 usec
TE         300.2 K
D1         2.0000000 sec
D11        0.6300000 sec
TSD        1

===== CHANNEL f1 =====
NUC1       13C
P1         8.80 usec
PL1        -1.80 dB
PL12       104.9076174 W
SFO1       125.7705410 MHz

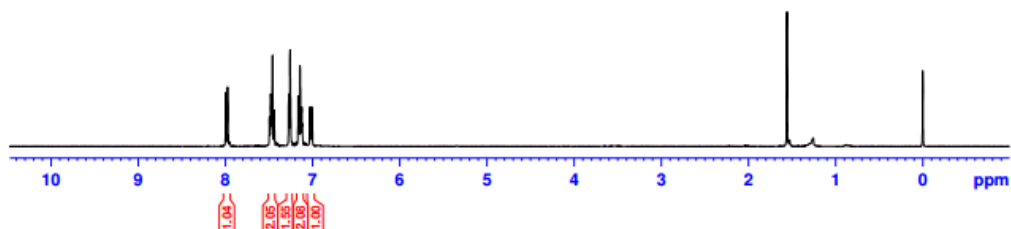
===== CHANNEL f2 =====
CPDPRG2    waltz16
NUC2       1H
PCPD2      80.00 usec
P12        2.50 dB
PL12       17.44 dB
PL12       17.44 dB
PL12W      13.6235054 W
PL12W      0.4184520 W
PL12W      0.4184520 W
SFO2       500.1320000 MHz
SI         32768
WDW         125.7577702 MHz
SSB         0
LB          1.80 Hz
GB          0
PC          1.40
  
```

SHW-1012127

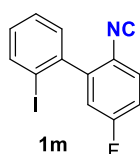
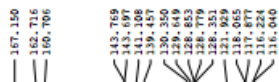


NAME 3
EXPNO 8
PROCNO 1
Date_ 20170514
Time 20.54
INSTRUM agnuc
PROBHD 5 mm BBO-1
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 14
DS 2
SWH 8178.144 Hz
FIDRES 0.126314 Hz
AQ 2.9581213 sec
RG 362
DW 60.400 nsec
DE 4.50 nsec
TE 473.2 K
D1 1.00000000 sec
TD0 1

----- CHANNEL f1 -----
NUC1 1H
P1 12.50 nsec
PL1 0.50 dB
PL1W 10.47648644 W
SFO1 400.1326110 MHz
H1 32768
SF 400.1326110 MHz
WDW EM
SSB 0
LA 0.30 Hz
GB 0
PC 1.00



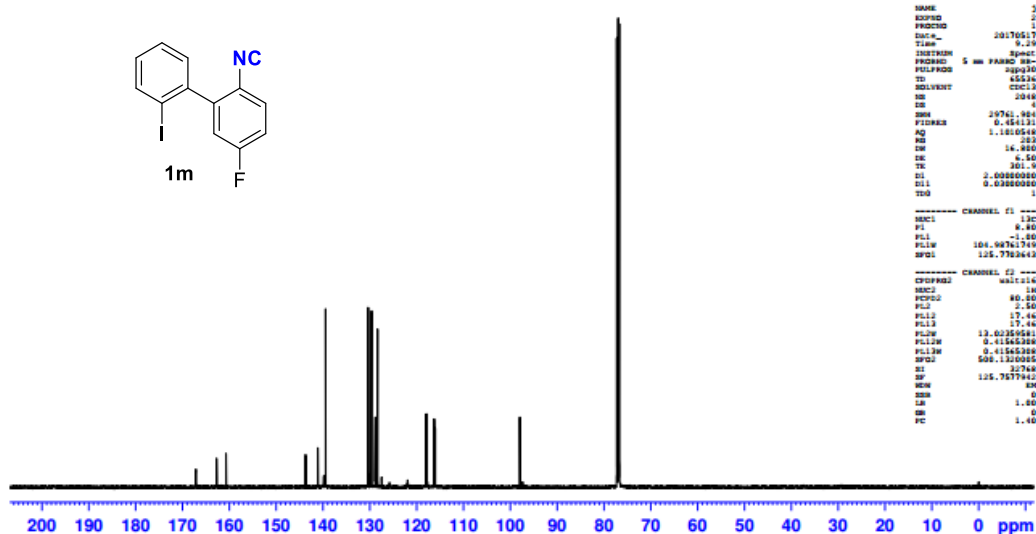
SHW-1012127



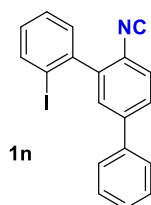
NAME 3
EXPNO 8
PROCNO 1
Date_ 20170517
Time 9.29
INSTRUM agnuc
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 14
DS 4
SWH 24761.964 Hz
FIDRES 0.464131 Hz
AQ 1.1810548 sec
RG 232
DW 60.400 nsec
DE 4.50 nsec
TE 401.5 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

----- CHANNEL f1 -----
NUC1 13C
P1 4.50 nsec
PL1 -1.00 dB
PL1W 104.96767919 W
SFO1 125.77026412 MHz

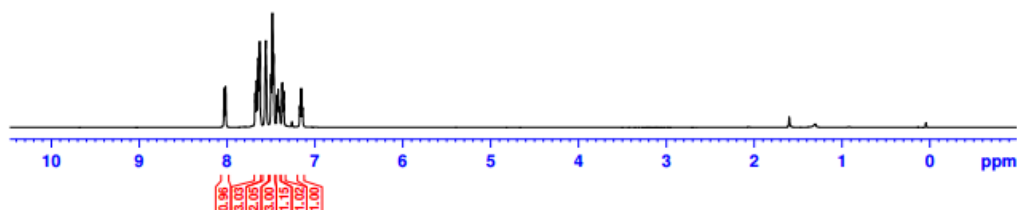
----- CHANNEL f2 -----
CPDPRG2 waltz16
NUC2 1H
PCPD2 40.50 nsec
PL2 2.50 dB
PL12 17.44 dB
PL13 17.44 dB
PL2W 13.82359581 W
PL12W 0.11565308 W
PL13W 0.11565308 W
SFO2 500.1326110 MHz
H2 32768
SF 125.7577942 MHz
WDW EM
SSB 0
LA 1.50 Hz
GB 0
PC 1.40



SHW-1169475



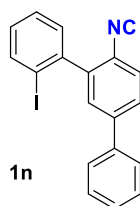
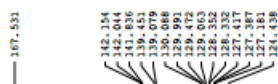
1n



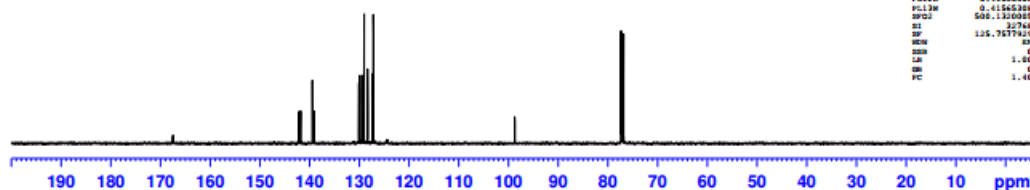
NAME 1
EXPNO 12
PROCNO 12
DATE_ 20170924
TIME 14.12
INSTRUM spect
PROBHD 5 mm PABBO 80-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 14
DS 4
SWH 10300.579 Hz
FIDRES 0.137332 Hz
AQ 3.1719613 sec
RG 71.4
DW 19.400 usec
DE 6.50 usec
TE 300.2 K
D1 1.0000000 sec
TD0 1

----- CHANNEL f1 -----
NUC1 1H
P1 14.00 usec
PL1 0.00 dB
PL12 13.02305641 W
SFO1 500.1320065 MHz
SI 32768
SF 500.1320065 MHz
WDW EM
SSB 0
LB 0.00 Hz
GB 0
PC 1.00

SHW-1169475



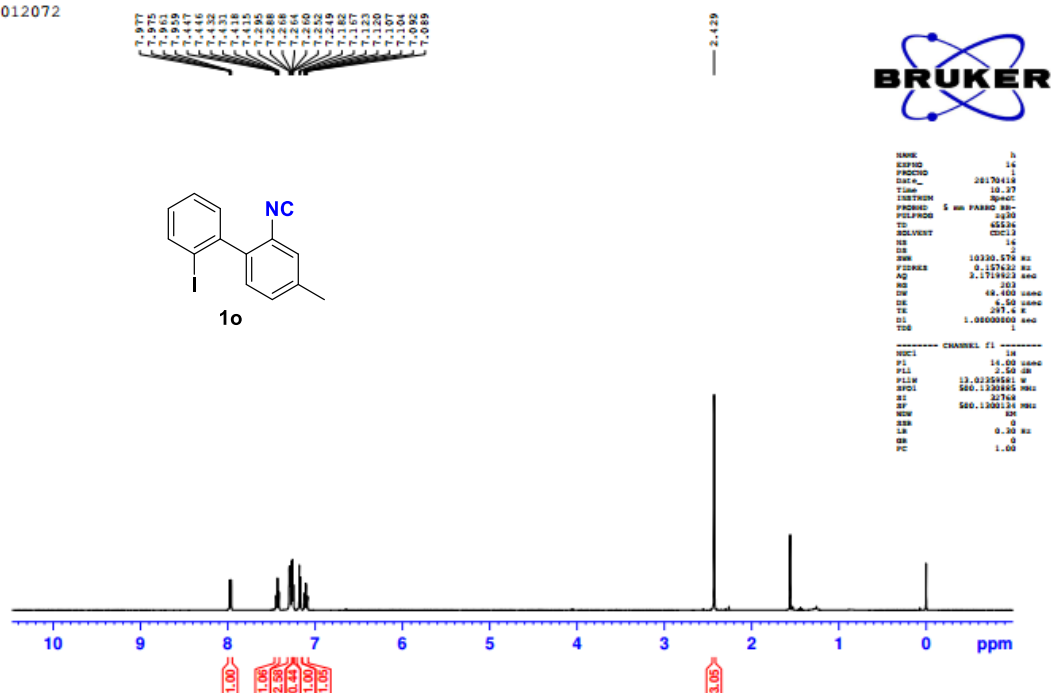
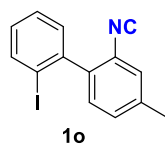
1n



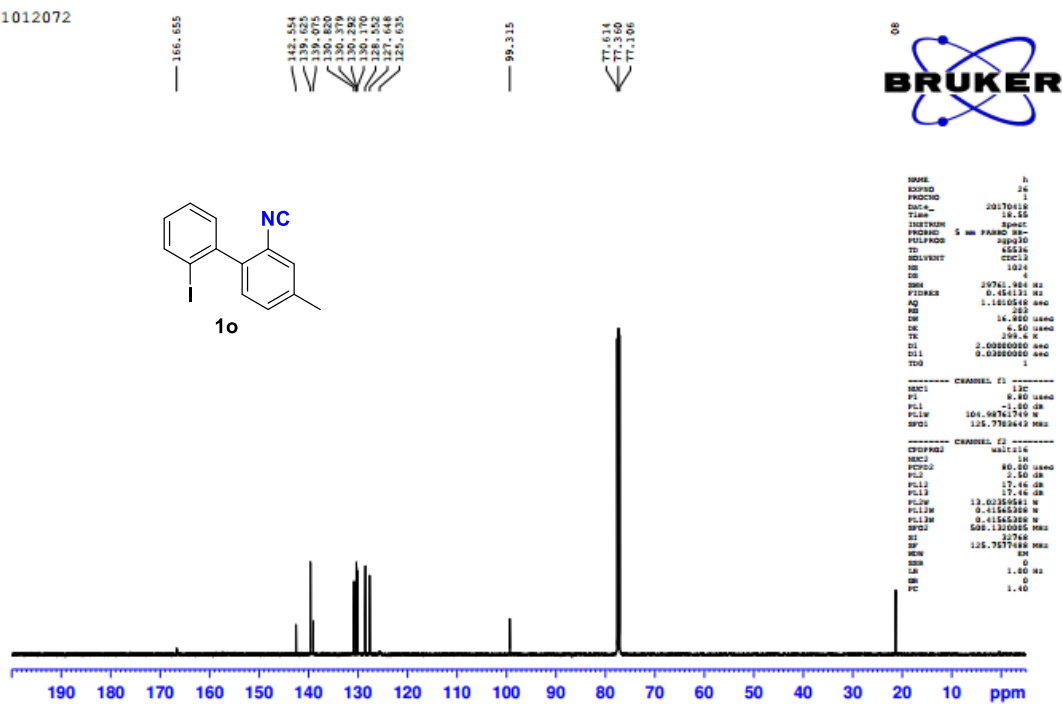
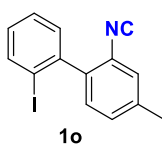
NAME 1
EXPNO 14
PROCNO 14
DATE_ 20170924
TIME 14.37
INSTRUM spect
PROBHD 5 mm PABBO 80-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 6
DS 4
SWH 20761.854 Hz
FIDRES 0.164131 Hz
AQ 1.1810548 sec
RG 223
DW 16.800 usec
DE 6.50 usec
TE 300.2 K
D1 2.0000000 sec
D11 0.0300000 sec
TD0 1

----- CHANNEL f1 -----
NUC1 13C
P1 8.80 usec
PL1 0.00 dB
PL12 104.98761749 W
SFO1 125.7703643 MHz

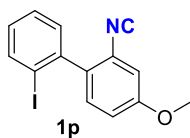
----- CHANNEL f2 -----
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL2 0.00 dB
PL12 17.44 dB
PL13 17.44 dB
PL12W 13.02305641 W
PL13W 0.41563328 W
PL13W 0.41563328 W
SFO2 500.1320065 MHz
SI 32768
SF 125.7677029 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



1012072



SHW-1169490

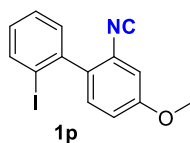
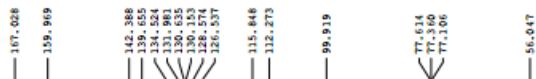


```

NAME      k
EXPNO     24
PROCNO    1
DATE_     20171011
TIME      14.05
INSTRUM    5 mm DUL 125-1
PROBHD    zg30
PULPROG    zgpg30
TD         65536
SOLVENT    CDCl3
NS         14
DS         2
SWH        8278.164 Hz
FIDRES     0.120314 Hz
AQ         2.9581243 sec
RG         364
DW         60.400 usec
DE         6.50 usec
TE         299.2 K
D1         1.0000000 sec
TD0        1
----- CHANNEL f1 -----
NUC1       1H
P1         12.50 usec
PL1        0.00 dB
PL12       10.8764848 W
SFO1       400.1324710 MHz
SI         32768
SF         400.1324710 MHz
WDW        EM
SSB         0
LB         0.30 Hz
GB         0
PC         1.00

```

SHW-1169490



```

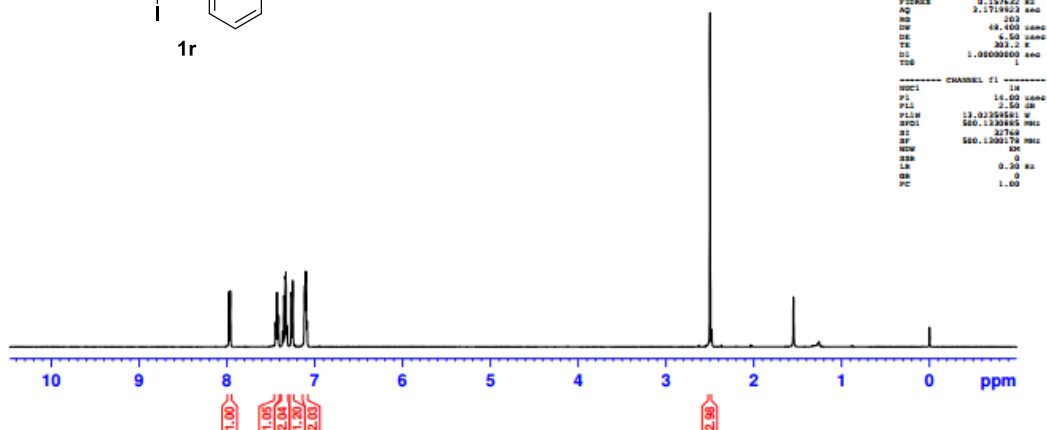
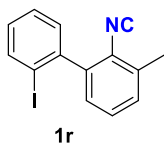
NAME      k
EXPNO     7
PROCNO    1
DATE_     20171011
TIME      22.29
INSTRUM    5 mm PABBO 80-
PROBHD    zgpg30
PULPROG    zgpg30
TD         65536
SOLVENT    CDCl3
NS         2048
DS         4
SWH        20761.924 Hz
FIDRES     0.454131 Hz
AQ         1.1810548 sec
RG         382
DW         16.900 usec
DE         6.50 usec
TE         302.5 K
D1         2.0000000 sec
D11        0.0300000 sec
TD0        1
----- CHANNEL f1 -----
NUC1       13C
P1         9.80 usec
PL1        -1.00 dB
PL12       104.98761749 W
SFO1       125.7702642 MHz
----- CHANNEL f2 -----
CPDPRG2    waltz16
NUC2       1H
P2         80.00 usec
PL2        2.50 dB
PL13       17.44 dB
PL14       17.44 dB
PL15       17.44 dB
PL16       12.02305661 W
PL17       0.41545388 W
PL18       0.41545388 W
PL19       500.1320005 MHz
SFO2       400.1320005 MHz
SI         32768
SF         125.7702642 MHz
WDW        EM
SSB         0
LB         1.00 Hz
GB         0
PC         1.40

```

SHW-1169463



2.499



NAME 0
EXPNO 2
PROCNO 1
DATE_ 20170912
TIME 14.22
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
DS 16
SS 2
FIDRES 0.127926 Hz
AQ 3.1719023 sec
RG 363
DW 49.400 usec
DE 6.50 usec
TE 303.2 K
D1 1.0000000 sec
TDO 1

----- CHANNEL f1 -----
NUC1 1H
P1 14.00 usec
PL1 2.50 dB
PL12 13.0235081 W
SFO1 500.1320845 MHz
SI 32768
SF 500.1320179 MHz
WDW EM
SSB 0
LB 0.00 Hz
GB 0
PC 1.00

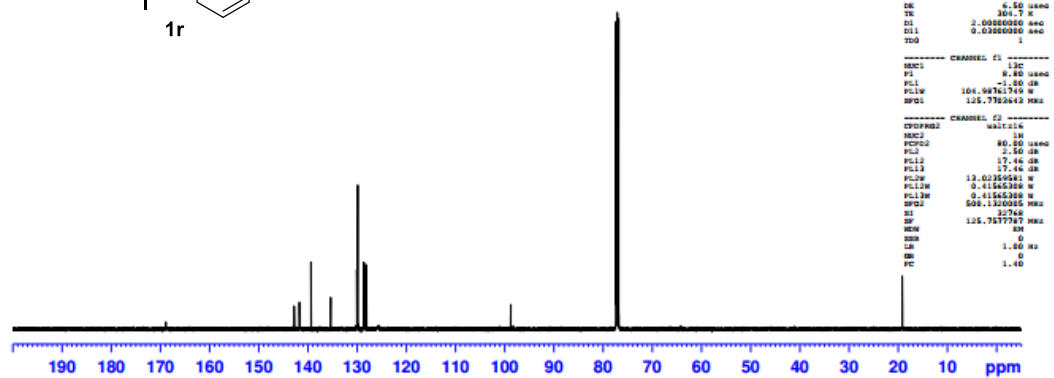
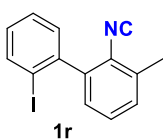
SHW-1169463

168.917

142.826
141.768
138.821
136.060
128.909
128.522
128.193
128.119

96.772

77.354
77.100
76.847

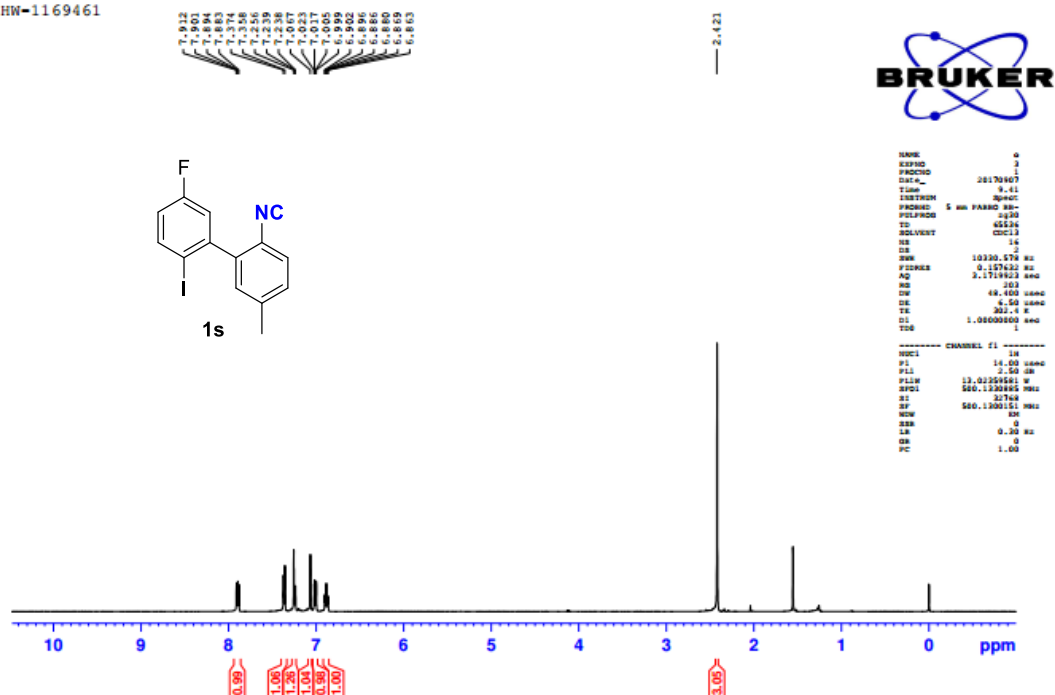


NAME 0
EXPNO 4
PROCNO 1
DATE_ 20170912
TIME 14.50
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
DS 560
SS 4
FIDRES 29761.924 Hz
AQ 0.454131 Hz
RG 1.1610516 sec
DE 14.200 usec
DW 6.50 usec
TE 303.2 K
D1 2.0000000 sec
D11 0.0300000 sec
TDO 1

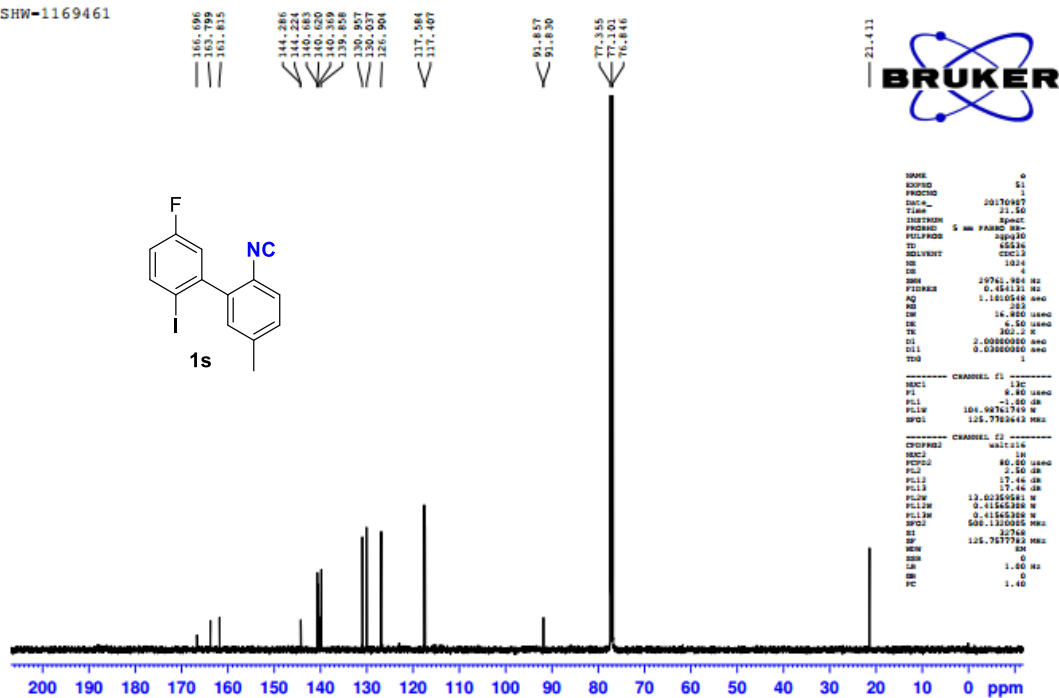
----- CHANNEL f1 -----
NUC1 13C
P1 8.00 usec
PL1 -1.00 dB
PL12 104.9876119 W
SFO1 125.7703443 MHz

----- CHANNEL f2 -----
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL2 2.50 dB
PL12 17.46 dB
PL13 17.46 dB
PL14 17.46 dB
PL15 13.0235081 W
PL12W 0.11565388 W
PL13W 0.11565388 W
SFO2 500.1320845 MHz
SI 32768
SF 125.7577787 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

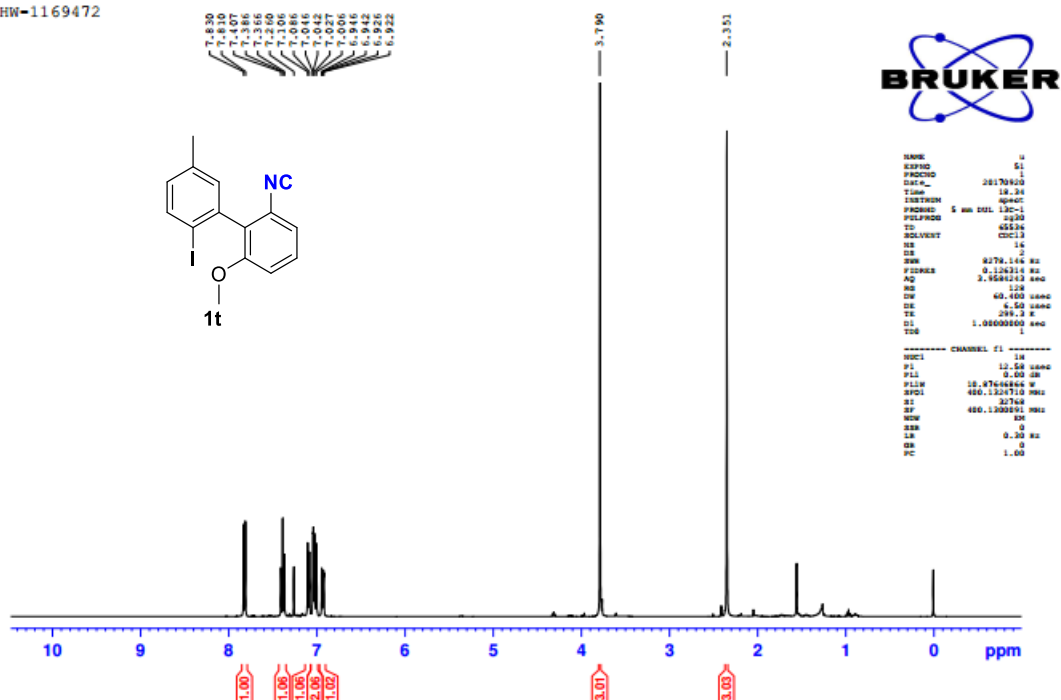
SHW-1169461



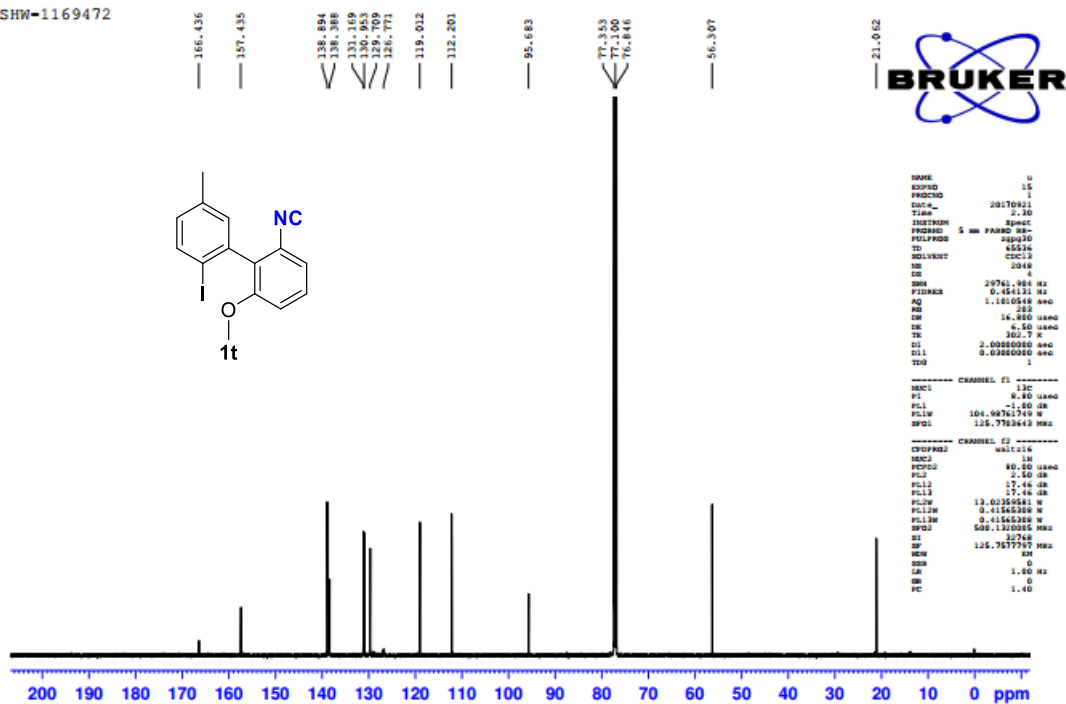
SHW-1169461

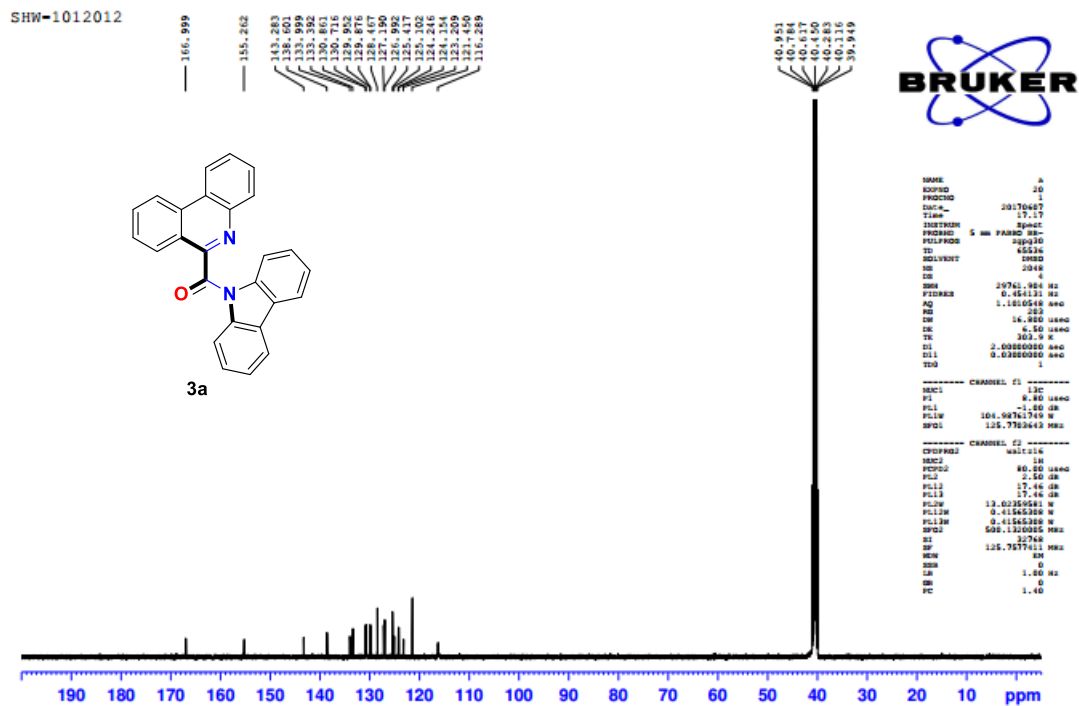
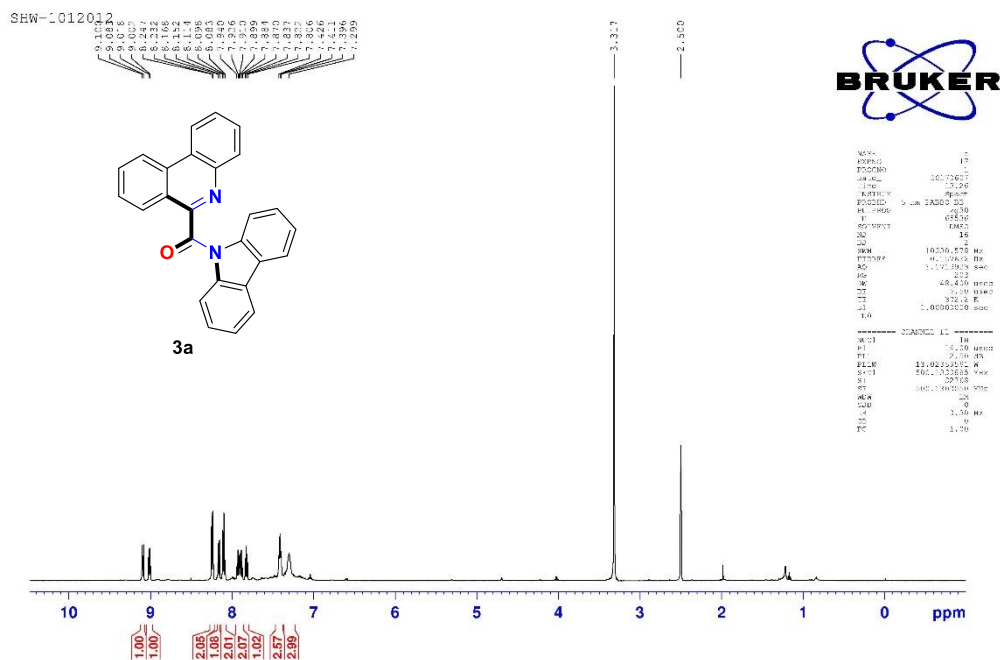


SHW-1169472

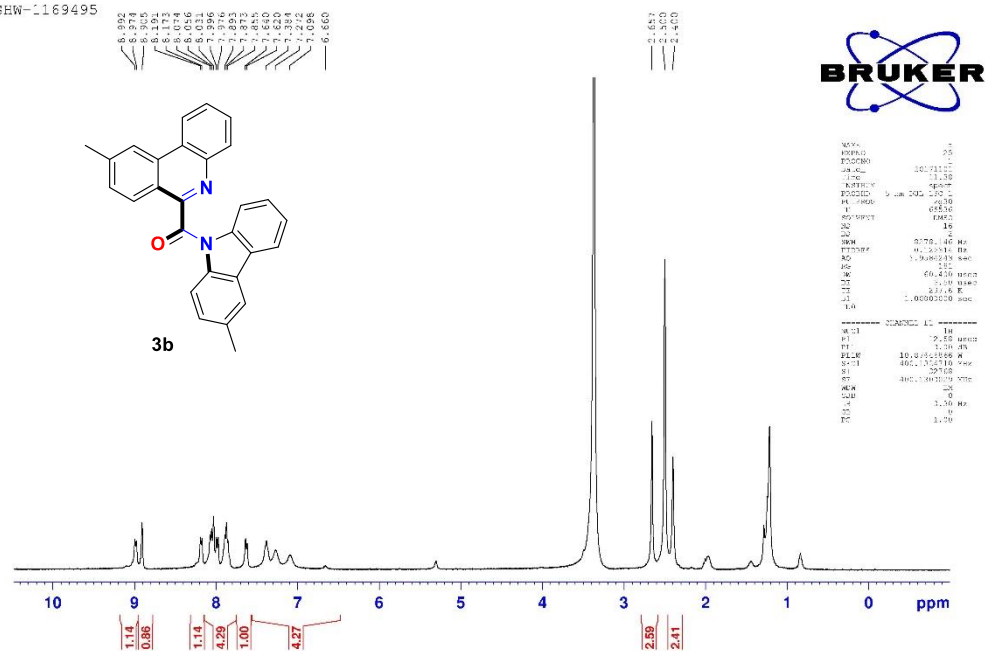


SHW-1169472

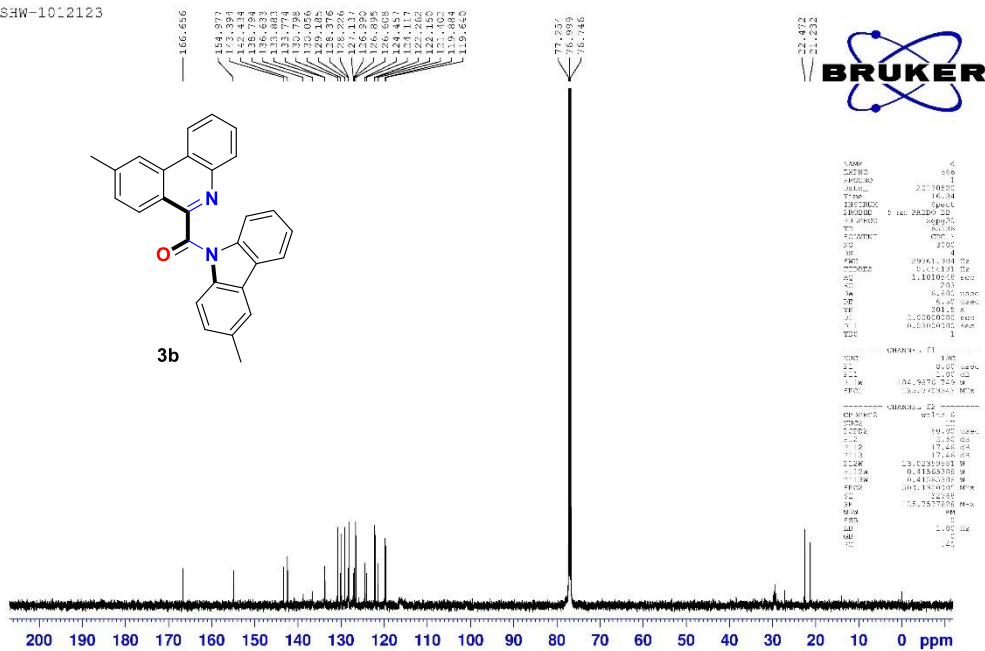


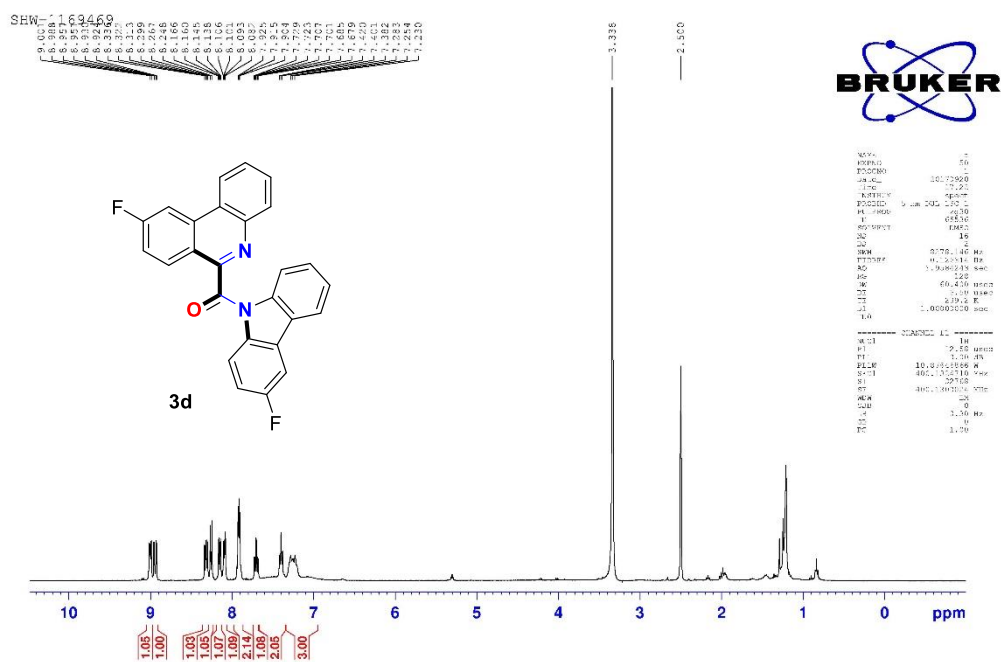


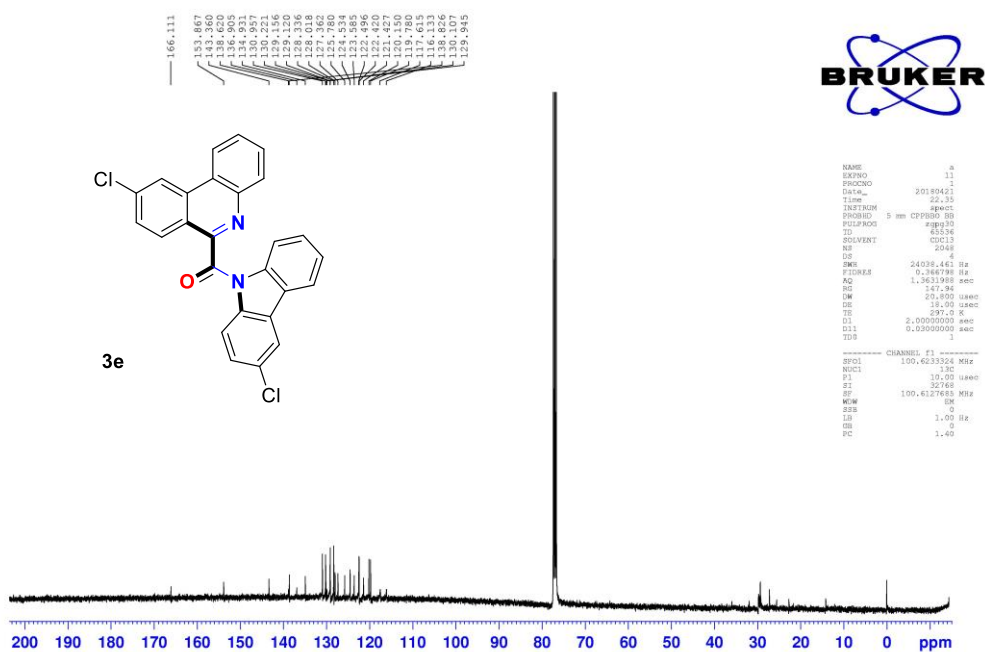
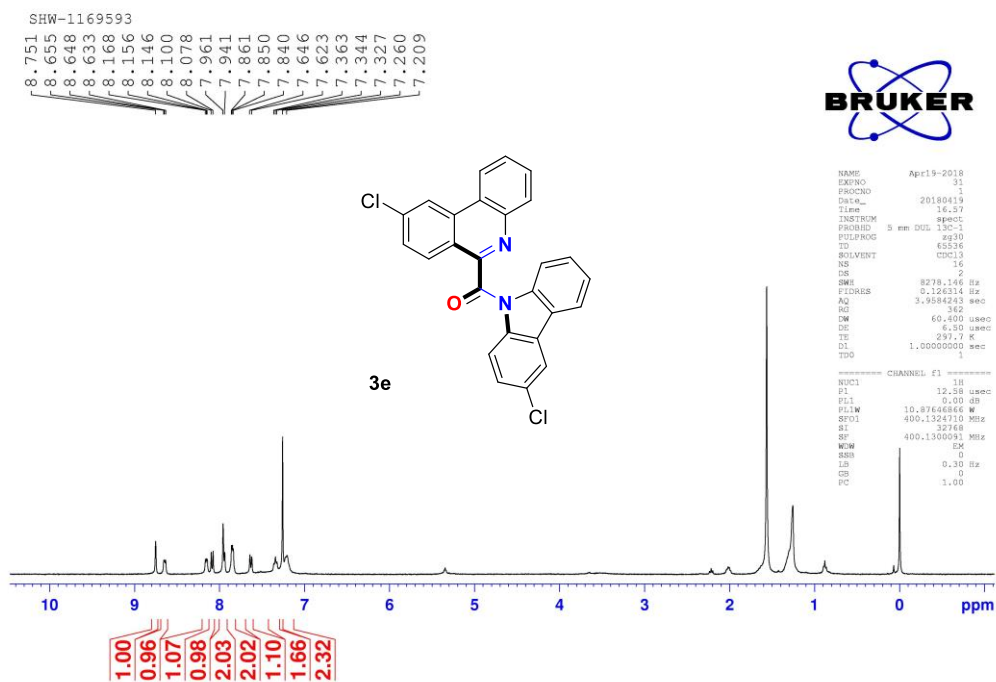
SHW-1169495

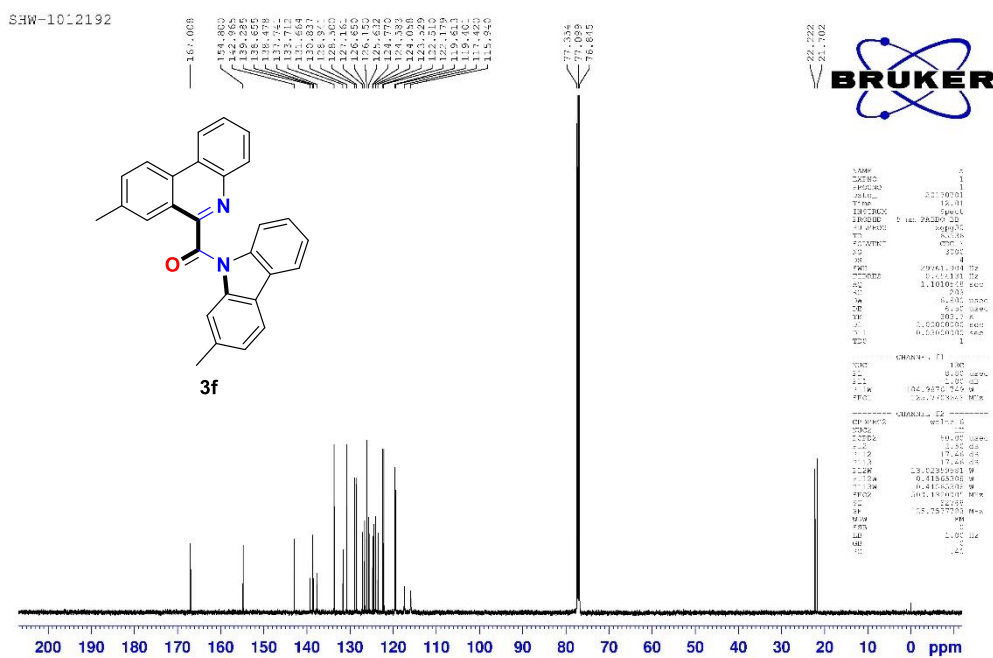
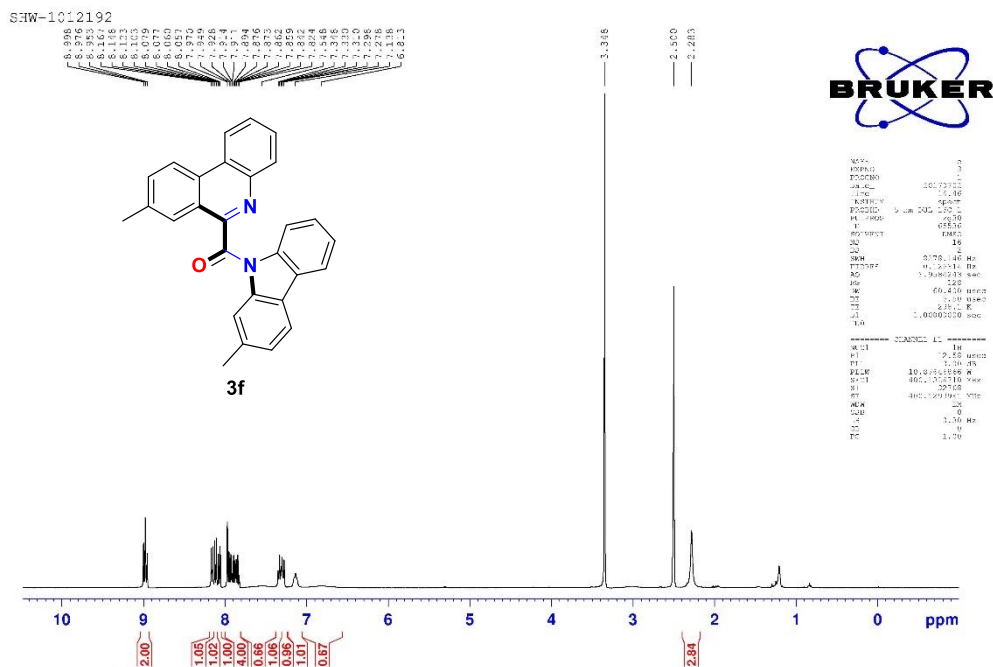


SHW-102123

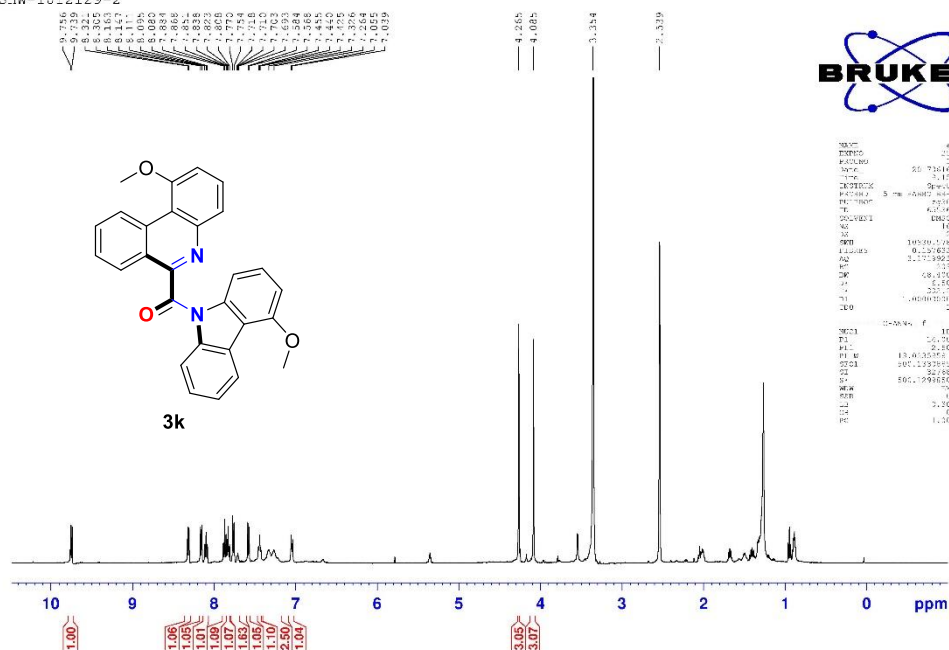








SEW-1012129-2

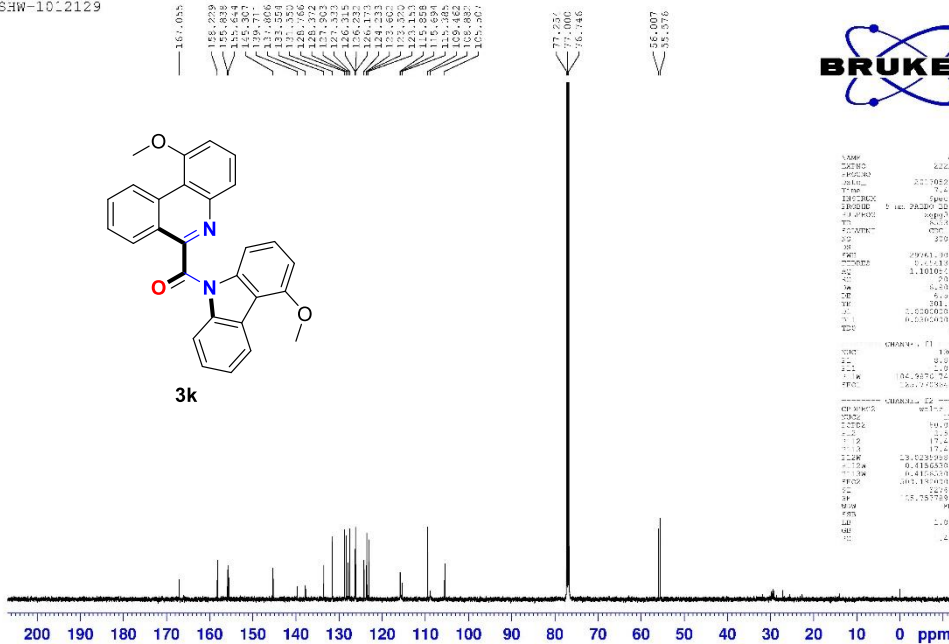


```

NAME          3k
EXPNO         2
PROCNO        1
F2 - F1       20.71616
TIME          7.15
DATE_        09-03-11
PROCNO       1
F2 - F1       20.71616
INSTRUM      spect
P1           6.00
TE           300.2
SOLVENT      CDCl3
NS           16
DS           4
SWH           10030.178 Hz
FIDRES       0.120675 Hz
AQ           3.1571862 sec
RG           655
AQ           3.1571862 sec
PC           1.00
SFO           500.1370 MHz
NUC1          13C
NUC2          13C
NUC3          13C
NUC4          13C
NUC5          13C
NUC6          13C
NUC7          13C
NUC8          13C
NUC9          13C
NUC10         13C
NUC11         13C
NUC12         13C
NUC13         13C
NUC14         13C
NUC15         13C
NUC16         13C

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SEW-1012129

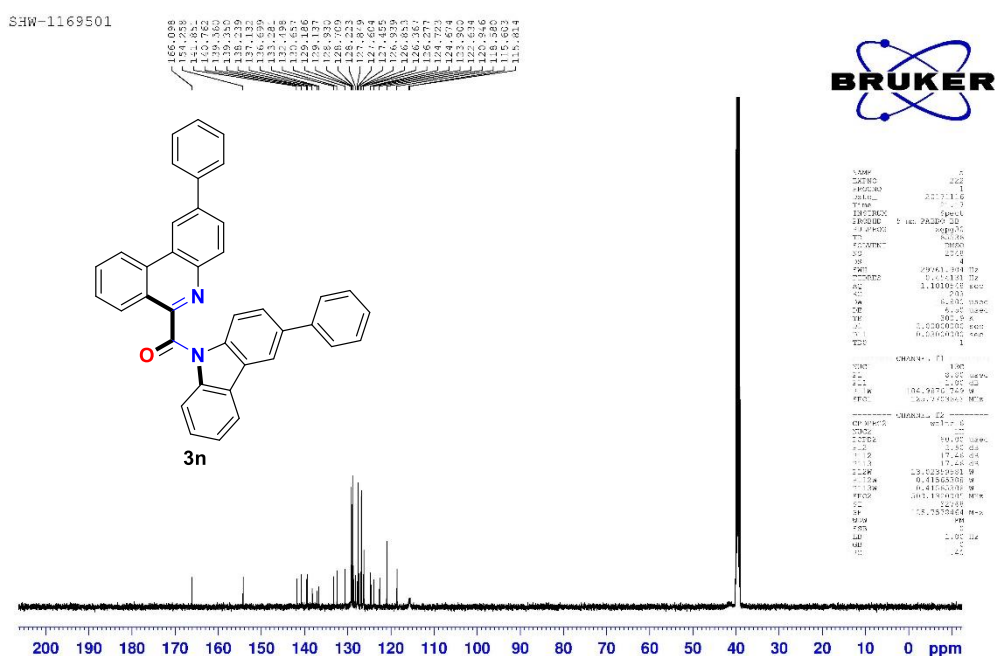
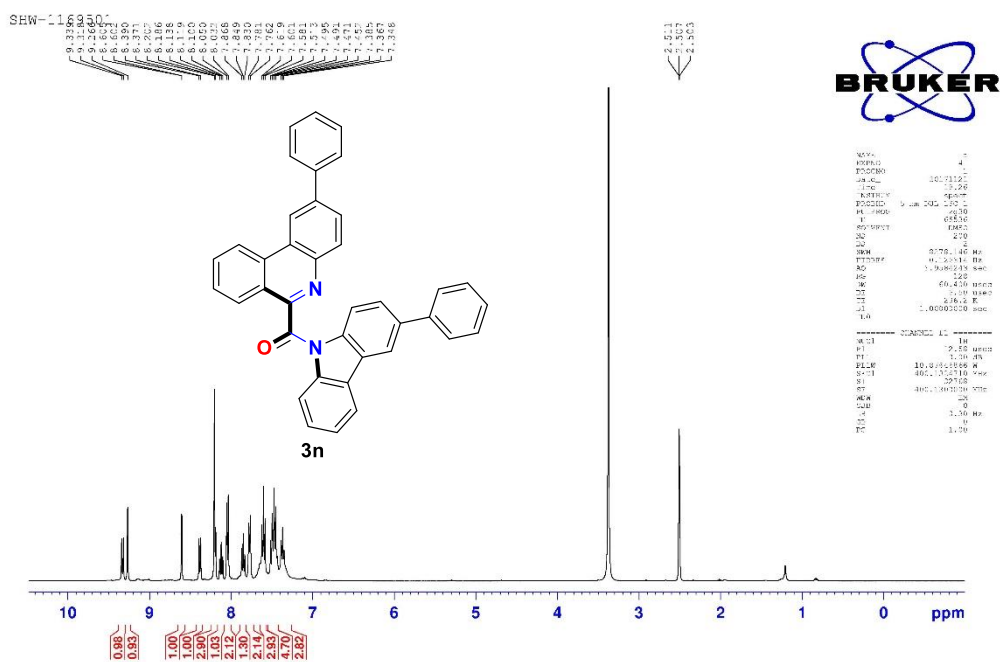


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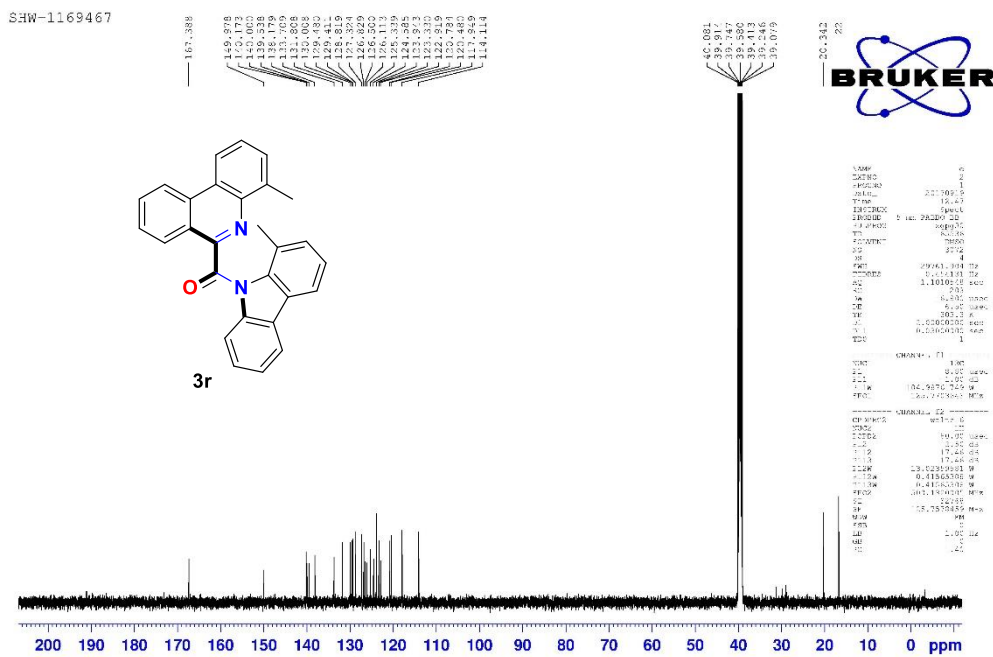
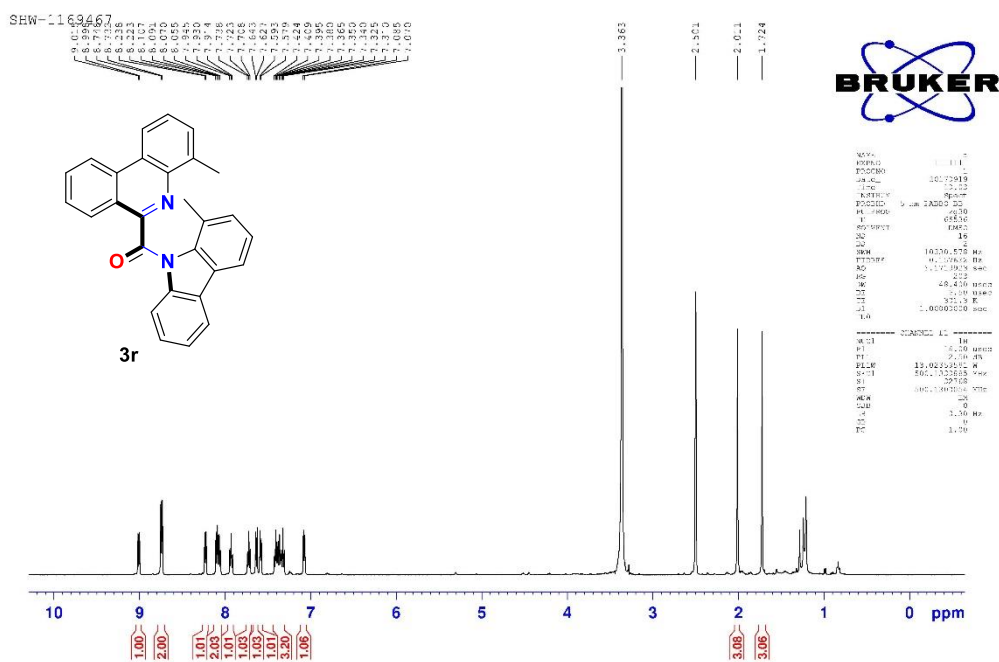
NAME          3k
EXPNO         2
PROCNO        1
F2 - F1       20.71616
TIME          7.15
DATE_        09-03-11
PROCNO       1
F2 - F1       20.71616
INSTRUM      spect
P1           6.00
TE           300.2
SOLVENT      CDCl3
NS           16
DS           4
SWH           10030.178 Hz
FIDRES       0.120675 Hz
AQ           3.1571862 sec
RG           655
AQ           3.1571862 sec
PC           1.00
SFO           500.1370 MHz
NUC1          13C
NUC2          13C
NUC3          13C
NUC4          13C
NUC5          13C
NUC6          13C
NUC7          13C
NUC8          13C
NUC9          13C
NUC10         13C
NUC11         13C
NUC12         13C
NUC13         13C
NUC14         13C
NUC15         13C
NUC16         13C

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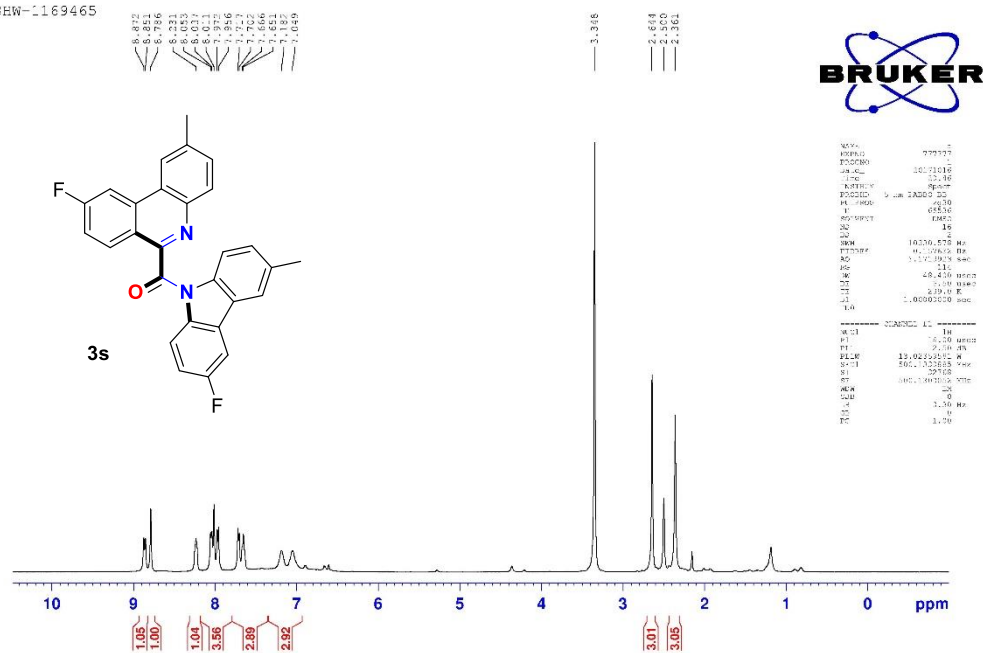




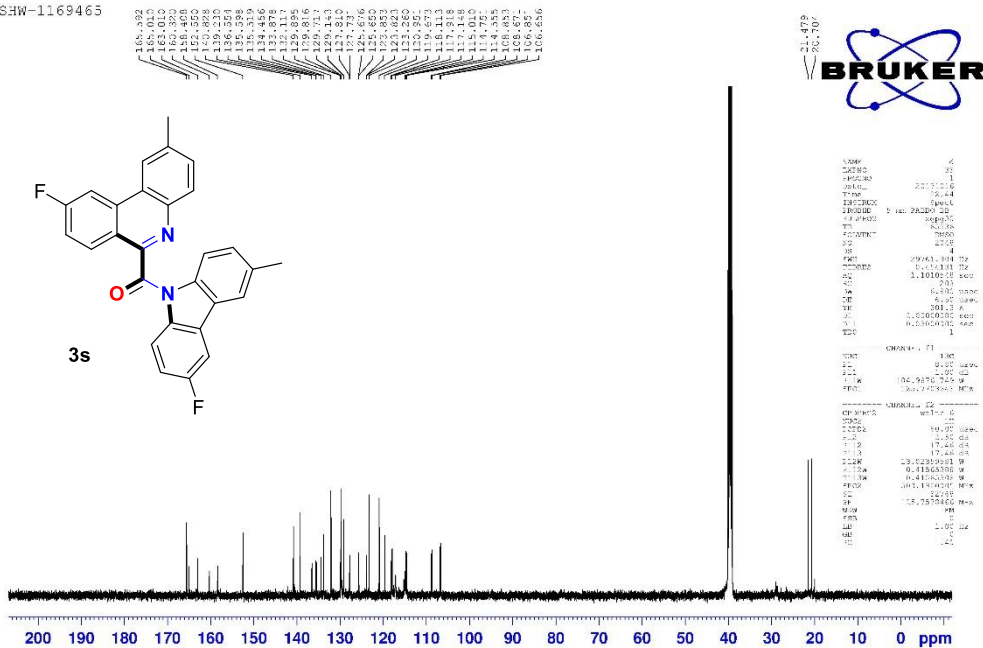




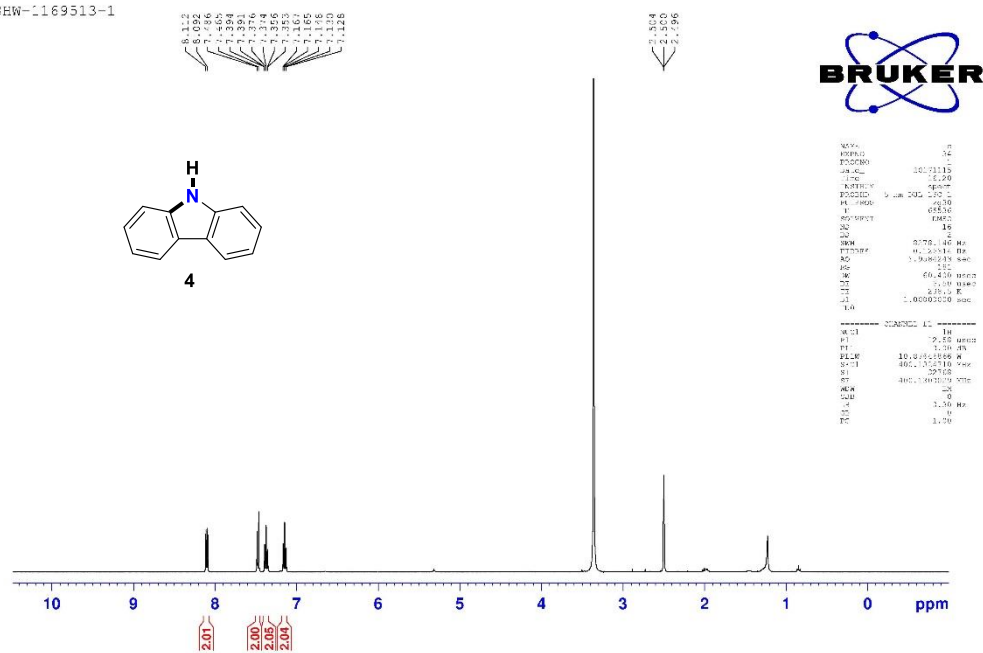
SHW-1169465



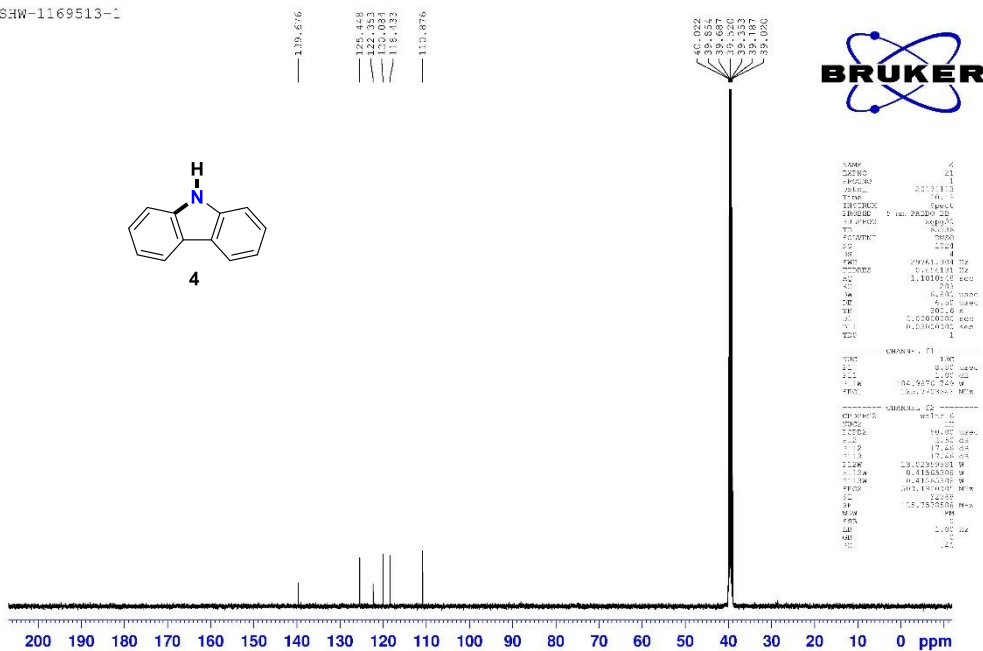
SHW-1169465



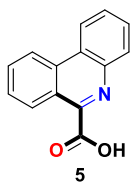
SHW-1169513-1



SHW-1169513-1



SHW-1169513-2

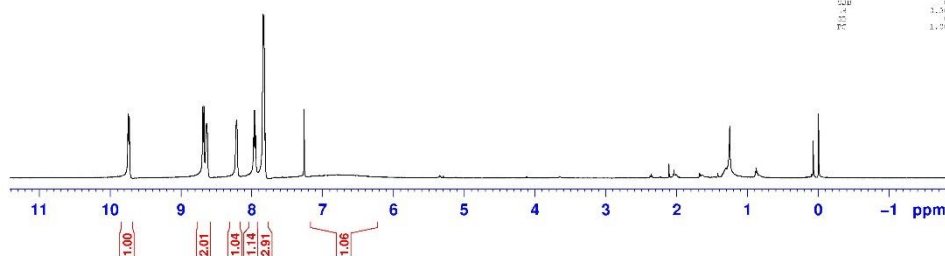


NAME 2
EXPNO 17
PROCNO 1
F2 - 20171102
INSTRUM spect
PROBHD 5 mm PABBO 2D
PULPROG zgpg30
TD 65536
SOLVENT CHCl3
NS 4
DS 4
SWH 10030.670 Hz
FIDRES 0.120620 Hz
AQ 1.1010548 sec
RG 323
SQ 16.900 usec
DE 6.50 usec
TE 300.2 K
D1 0.03000000 sec
D11 0.03000000 sec
TD0 1

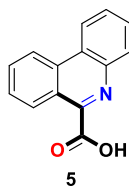
----- CHANNEL f1 -----
NUC1 1H
P1 12.00 usec
PL1 0.00 dB
PL1P 13.0229200 W
SFO1 500.1360000 MHz
NUC2 13C
P2 1.00 usec
PL2 0.00 dB
PL2P 100.6261200 W
SFO2 125.7603442 MHz

----- CHANNEL f2 -----
NAME 2
EXPNO 17
PROCNO 1
F2 - 20171102
INSTRUM spect
PROBHD 5 mm PABBO 2D
PULPROG zgpg30
TD 65536
SOLVENT CHCl3
NS 4
DS 4
SWH 20761.924 Hz
FIDRES 0.454131 Hz
AQ 1.1010548 sec
RG 323
SQ 16.900 usec
DE 6.50 usec
TE 300.2 K
D1 0.03000000 sec
D11 0.03000000 sec
TD0 1

----- CHANNEL f1 -----
NAME 2
EXPNO 17
PROCNO 1
F2 - 20171102
INSTRUM spect
PROBHD 5 mm PABBO 2D
PULPROG zgpg30
TD 65536
SOLVENT CHCl3
NS 4
DS 4
SWH 20761.924 Hz
FIDRES 0.454131 Hz
AQ 1.1010548 sec
RG 323
SQ 16.900 usec
DE 6.50 usec
TE 300.2 K
D1 0.03000000 sec
D11 0.03000000 sec
TD0 1



SHW-1169513-2



NAME 2
EXPNO 17
PROCNO 1
F2 - 20171102
INSTRUM spect
PROBHD 5 mm PABBO 2D
PULPROG zgpg30
TD 65536
SOLVENT CHCl3
NS 4
DS 4
SWH 20761.924 Hz
FIDRES 0.454131 Hz
AQ 1.1010548 sec
RG 323
SQ 16.900 usec
DE 6.50 usec
TE 300.2 K
D1 0.03000000 sec
D11 0.03000000 sec
TD0 1

----- CHANNEL f1 -----
NAME 2
EXPNO 17
PROCNO 1
F2 - 20171102
INSTRUM spect
PROBHD 5 mm PABBO 2D
PULPROG zgpg30
TD 65536
SOLVENT CHCl3
NS 4
DS 4
SWH 20761.924 Hz
FIDRES 0.454131 Hz
AQ 1.1010548 sec
RG 323
SQ 16.900 usec
DE 6.50 usec
TE 300.2 K
D1 0.03000000 sec
D11 0.03000000 sec
TD0 1

----- CHANNEL f2 -----
NAME 2
EXPNO 17
PROCNO 1
F2 - 20171102
INSTRUM spect
PROBHD 5 mm PABBO 2D
PULPROG zgpg30
TD 65536
SOLVENT CHCl3
NS 4
DS 4
SWH 20761.924 Hz
FIDRES 0.454131 Hz
AQ 1.1010548 sec
RG 323
SQ 16.900 usec
DE 6.50 usec
TE 300.2 K
D1 0.03000000 sec
D11 0.03000000 sec
TD0 1

