

A Difluorocarbene-triggered Annulation/Ring Expansion Cascade via Sequential Single-atom-insertions: Direct Assembly of 2- Fluoroquinazolinones from Azo Compounds

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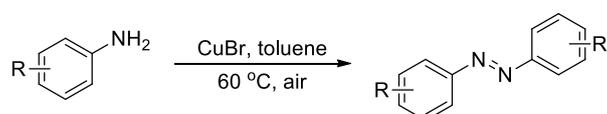
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1. General Information.

All chemicals were obtained from commercial sources and were used as received unless otherwise noted. All the reactions were carried out under air. The NMR spectra of samples were acquired on a Bruker Avance 400, 600 MHz, or Qone AS600 MHz spectrometer using TMS as an internal standard in CDCl₃ as solvent. The ¹H NMR spectra were recorded on a 400 MHz or 600 MHz NMR spectrometer. The ¹³C NMR spectra were recorded at 100 MHz or 150 MHz. The ¹⁹F NMR spectra were recorded at 376 MHz or 565 MHz. Chemical shifts were expressed in parts per million (δ) downfield from the internal standard TMS, and were reported as s (singlet), d (doublet), t (triplet), dd (doublet of doublet), m (multiplet), brs (broad singlet), etc. The residual solvent signals were used as references and the chemical shifts were converted to the TMS scale. HRMS spectra were obtained on an Agilent Q-TOF 6540 spectrometer or LC-HRMS (Orbitrap Explorix MX). Column chromatography was performed on silica gel (300-400 mesh).

2. General Procedures for the Preparation of Substrates

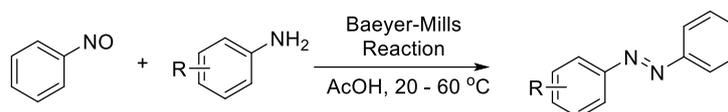
(1) Synthesis of symmetrical aryl azobenzene 1a-1r



Symmetrical azobenzenes were synthesized according to the literature reported.¹⁹ Aniline (5.0 mmol), CuBr (0.3 mmol, 43.2 mg) and toluene (20 mL, without drying) were added to a 50 mL flask. Then,

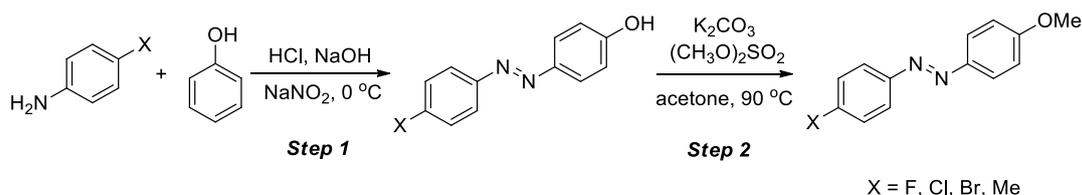
pyridine (0.9 mmol, 73 μ L) were added and the mixture were stirred at 60 $^{\circ}$ C for 20 hours, exposing to air in a fume cupboard. When the reaction completed, 2 gram silica gel were added to the mixture and the mixture were evaporated to give black powder. The products were obtained by eluting the powder over silica gel column (petroleum ether/ethyl acetate = 100:1, v/v).

(2) Synthesis of unsymmetric aryl azobenzene 1s, 1t, 1u and 1ab



Unsymmetric aryl azobenzene **1s**, **1t**, **1u** and **1ab** were synthesized according to the literature reported.²⁰ Dissolve nitrobenzene in 6 mL glacial acetic acid and 1.5 mL ethanol, then add aniline (2.79 mmol, 1.0 equiv) to the mixed solution, stir the reaction mixture at 20-60 $^{\circ}$ C for 12 hours, and then wash the reaction substance with ice water, and finally filter the product and dry the resulting solid substance. A yellowish-brown solid product is obtained.

(3) Synthesis of unsymmetric aryl azobenzene 1v-1z

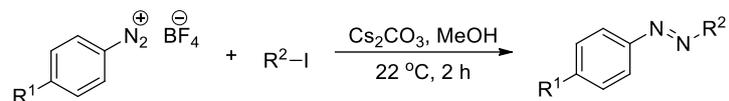


Unsymmetric aryl azobenzene **1v-1z** were synthesized according to the literature reported.²¹

Step 1: 10 mmol of aniline was added to an aqueous solution (20 mL) containing 5 mL of 37 % HCl (aq) to prepare an Aniline solution, which was added dropwisely into another aqueous solution (5 mL) containing 12.8 mmol NaNO_2 under ice water bath (0 $^{\circ}$ C) with strong stirring for about 6 minutes. After mixing, the resulting solution was stirred for 40 minutes at 0 $^{\circ}$ C to form a diazo salt solution. Then a separated aqueous phenol solution (20 mL) containing 10 mmol of phenol and 4 g of NaOH was prepared, and the diazo salt solution was added to the phenol solution slowly under ice water bath. The color of the solution would become dark during this process. After stirring at 0 $^{\circ}$ C for 1 hour, the resulting solution was acidified by adding 20 % HCl (aq) solution. Afterwards, the resulting solution was filtered by suction filtration to collect the dark solid which was washed by water, dissolved in acetone and reprecipitated by adding water slowly. Filtered the solution by suction filtration, and the brown powders were obtained as product with about 90 % yield.

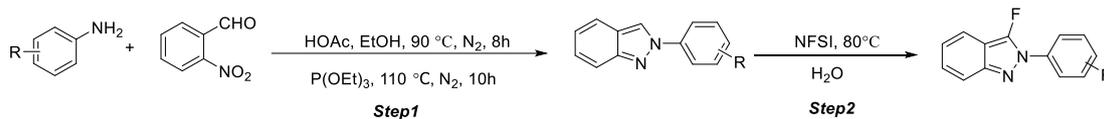
Step 2: 1 mmol of the above product was dissolved in 15 mL of acetone, then 1.6 mmol of potassium carbonate was added and stirred for some time (at least one minute), then dimethyl sulphate was added dropwise and refluxed with stirring for 12 hours, the reaction was cooled and the reaction solution was transferred to a beaker containing 50 mL of water and filtered by adsorptive precipitation to give a yellowish brown solid.

(4) Synthesis of alkyl azobenzene 1ad-1ak



Alkyl azobenzene were synthesized according to the literature reported.²² A 25 mL glass vial fitted with a stirring bar was charged with arenediazonium tetrafluoroborate (1.5 mmol, 3.0 equiv) and Cs₂CO₃ (244 mg, 0.75 mmol, 1.5 equiv). The mixture was evacuated and backfilled with nitrogen three times. Then the alkyl iodide (0.5 mmol, 1.0 equiv) and MeOH (5 mL) were added under nitrogen. The mixture was allowed to stir at 22 °C for 2 hours. After the completion of reaction, the reaction mixture was poured into H₂O (50 mL) and extracted with EtOAc (20 mL × 3). The combined organic layers were washed with H₂O (20 mL), dried over Na₂SO₄ and filtered. The solvent was removed by rotary evaporation and the residue was purified by flash silica gel chromatography. (Caution: The alkyl-aryl azo-compounds are not stable at DCM, CDCl₃ and needed to be handled with care).

(5) Synthesis of benzimidazole derivatives.4a, 4e

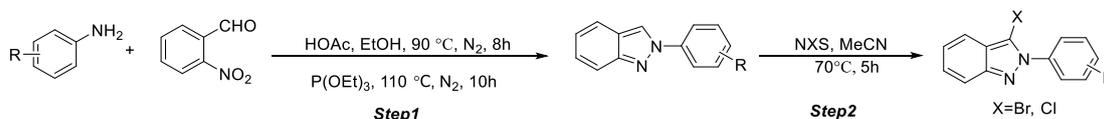


Benzopyrazole compounds were synthesized according to literature reports.²³⁻²⁴

Step 1: Under N₂ conditions, 1.0 grams (10.7 millimoles) of aniline is refluxed with 1.6 grams (10.7 millimoles) of 2-nitrobenzaldehyde and 771.0 milligrams (12.84 millimoles) of acetic acid in 20 milliliters of ethanol for 8 hours. After removal of most of the solvent, the yellow solid was collected by filtration to afforded compound 1b, which was used in the next step without further purification. Under N₂ conditions, compound 1b (1.2 g, 5.3 mmol) was dissolved in P(OEt)₃ (15 mL) and heated at 110 °C for 10 h. The solvent was removed, and the resulting residue was purified by column chromatography on silica gel and eluted with EtOAc/hexanes [1:50 (v/v)] to give compound as a yellow solid.

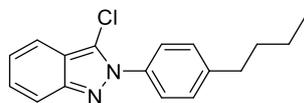
Step 2: A 100 mL round-bottom flask containing a stir bar was charged with the above-mentioned product (0.2mmol, 38.8mg) and phenylsulfonyl fluoride (NFSI) (1.5 equivalents, 3.0 mmol, 94.6g). Then, water (2.0 mL) was added. The resulting mixture was stirred for 30 minutes in a preheated metal bath at 80°C under ambient air. After the reaction was complete (as monitored by thin-layer chromatography, TLC), it was cooled to room temperature and extracted with ethyl acetate. The combined organic layers were dried with anhydrous sodium sulfate and then concentrated under reduced pressure. The residue was purified by silica gel chromatography using a petroleum ether: ethyl acetate eluent to yield product 4a

(6) Synthesis of indazole derivatives.4b, 4c, 4ba-4bq, 4by, 4cc



Step 1: Refer to Step 1 in the synthesis steps of reference 4a.²⁵⁻²⁷

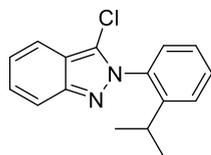
Step 2: Place 1 mole of the above product into a 50 mL dry round-bottom flask containing a magnetic stir bar, dissolve in acetonitrile (10 mL), and add NXS (1 mol). React at 70°C for 5 hours. After removing the solvent, purify the resulting residue by silica gel column chromatography, eluting with ethyl acetate/alkane [1:20 (v/v)].



4be

2-(4-butylphenyl)-3-chloro-2H-indazole

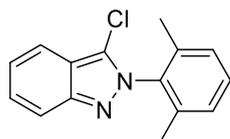
Eluent: PE/EA = 5:1, yellow oil (10.7 mol, 758.5 mg, 25%), ¹H NMR (400 MHz, Chloroform-*d*) δ 7.72 (d, *J* = 8.8 Hz, 1H), 7.63 (dt, *J* = 8.4, 1.2 Hz, 1H), 7.61 – 7.57 (m, 2H), 7.41 – 7.31 (m, 3H), 7.16 (ddd, *J* = 8.6, 6.6, 0.8 Hz, 1H), 2.73 (t, *J* = 4 Hz 2H), 1.73 – 1.61 (m, 2H), 1.40 (h, *J* = 7.3 Hz, 2H), 0.96 (t, *J* = 7.3 Hz, 2H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 148.56, 144.36, 136.29, 129.18, 127.54, 125.59, 122.76, 119.95, 119.55, 119.08, 118.29, 35.45, 33.56, 22.41, 14.06. HRMS (ESI): *m/z* calcd. for C₁₇H₁₇ClN₂Na⁺, [M+Na]⁺ : 307.0973; found: 307.0968.



4bo

3-chloro-2-(2-isopropylphenyl)-2H-indazole

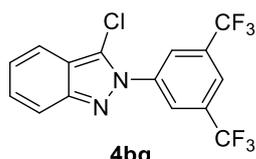
Eluent: PE/EA = 5:1, yellow oil (10.7 mol, 224.4 mg, 8%), ¹H NMR (400 MHz, Chloroform-*d*) δ 7.75 (d, *J* = 8.8 Hz, 1H), 7.66 (d, *J* = 8.5 Hz, 1H), 7.59 – 7.49 (m, 2H), 7.40 – 7.33 (m, 2H), 7.29 (dd, *J* = 7.8, 1.4 Hz, 1H), 7.19 (dd, *J* = 8.5, 6.6 Hz, 1H), 2.53 (hept, *J* = 6.9 Hz, 1H), 1.18 (s, 3H), 1.17 (s, 3H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 146.45, 130.72, 127.92, 127.33, 126.74, 126.41, 122.70, 119.03, 118.49, 28.12. HRMS (ESI): *m/z* calcd. for C₁₆H₁₅ClN₂Na⁺, [M+Na]⁺ : 293.0816; found: 293.0815.



4bp

3-chloro-2-(2,6-dimethylphenyl)-2H-indazole

Eluent: PE/EA = 20:1, brownish-yellow oil (10.7 mol, 340.7 mg, 11%), ¹H NMR (400 MHz, Chloroform-*d*) δ 7.76 (dd, *J* = 8.9, 1.0 Hz, 1H), 7.67 (dd, *J* = 8.5, 1.1 Hz, 1H), 7.43 – 7.32 (m, 2H), 7.27 – 7.13 (m, 3H), 1.98 (s, 6H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 148.93, 136.75, 136.20, 130.04, 128.25, 127.19, 122.57, 120.78, 119.04, 118.59, 118.54, 17.26. HRMS (ESI): *m/z* calcd. for C₁₅H₁₄ClN₂⁺, [M+H]⁺ : 257.0841; found: 257.0832.

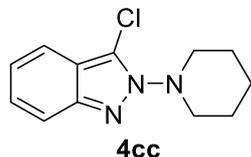


4bq

2-(3,5-bis(trifluoromethyl)phenyl)-3-chloro-2H-indazole

Eluent: PE/EA = 20:1, yellow solid (10.7 mol, 223.2 mg, 6%, m.p. 51.0 – 51.3 °C), ¹H NMR (400 MHz,

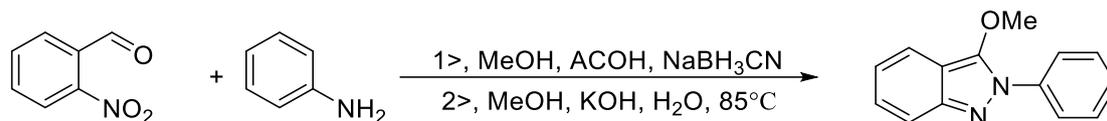
Chloroform-*d* δ 8.30 (s, 2H), 8.01 (s, 1H), 7.72 (d, $J = 8.9$ Hz, 1H), 7.63 (d, $J = 8.6$ Hz, 1H), 7.42 – 7.38 (m, 1H), 7.21 (dd, $J = 8.6, 6.5$ Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 149.41, 139.90, 132.92 (q, $J = 34.3$ Hz), 128.79, 123.91, 120.59, 122.48 (q, $J = 3.8$ Hz), 125.68 (q, $J = 3.74$ Hz), δ 122.68 (q, $J = 273.912$ Hz), 119.18, 118.43. ^{19}F NMR (376 MHz, CDCl_3) δ -62.9. HRMS (ESI): m/z calcd. for $\text{C}_{15}\text{H}_8\text{ClF}_6\text{N}_2^+$, $[\text{M}+\text{Na}]^+$: 365.0275; found: 365.0276.



3-chloro-2-(piperidin-1-yl)-2H-indazole

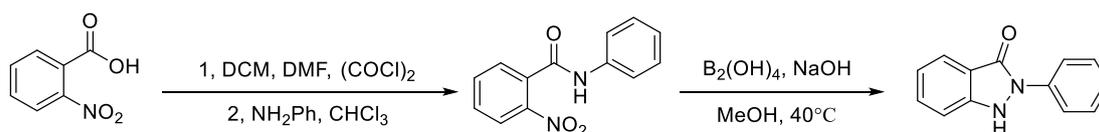
^1H NMR (400 MHz, Chloroform-*d*) δ 7.63 (d, $J = 8.8$ Hz, 1H), 7.56 (d, $J = 8.4$ Hz, 1H), 7.33 – 7.29 (m, 1H), 7.10 (dd, $J = 8.4, 6.6$ Hz, 1H), 3.56 – 2.90 (m, 4H), 1.86 (p, $J = 5.7$ Hz, 4H), 1.60 (q, $J = 6.0$ Hz, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 145.53, 126.98, 122.19, 119.08, 117.89, 117.50, 117.24, 56.23, 26.00, 23.45. HRMS (ESI): m/z calcd. for $\text{C}_{12}\text{H}_{15}\text{ClN}_3^+$, $[\text{M}+\text{H}]^+$: 236.0950; found: 236.0951.

(7) Synthesis of indazole derivatives.4d



Benzopyrazole compounds were synthesized according to literature reports.²⁸ Dissolve 2-nitrobenzaldehyde (5.22 mmol) and the required amine (6.26 mmol) in 13 mL of MeOH in a 250 mL round-bottom flask. Add ice-cold acetic acid (26.1 mmol) and sodium cyanoborohydride (6.26 mmol), and stir the solution at room temperature for 2.5 hours. Then add additional alcohol solvent (37 mL) and KOH (78.3 mmol) aqueous solution (6 mL), connect a water-cooled reflux condenser, and heat the solution to reflux for 2 hours. After that, cool the reaction mixture to room temperature, add water (20 mL), and remove the alcohol solvent by rotary evaporation. Neutralize the aqueous mixture with 1 N HCl and extract with ethyl acetate (3 \times 30 mL). Wash the combined organic extracts with 1 N HCl (40 mL), saturated sodium bicarbonate (40 mL), water (40 mL), and brine (40 mL), dry with anhydrous sodium sulfate, and concentrate and purify by flash chromatography to obtain product 4d.

(8) Synthesis of indazole derivatives.4e



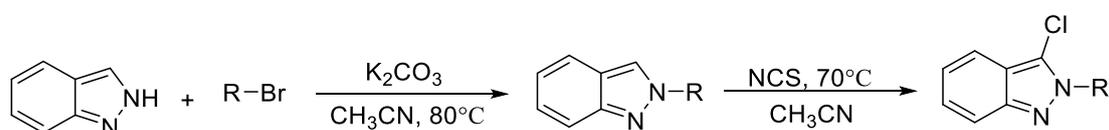
Benzopyrazole compounds were synthesized according to literature reports.²⁹⁻³⁰

Step 1: Add 2-nitrobenzoic acid (5.0g, 29.9mmol) to a dry 250ml round-bottom flask and dissolve it in ultra-dry DCM (140ml). Add a catalytic amount of DMF, and then add $(\text{COCl})_2$ (3.7ml, 41.9mmol) dropwise to the solution. Allow the reaction to proceed at room temperature for 20 minutes, then

concentrate the solvent. Transfer the concentrated product to a 100ml two-neck flask, add NH₂Ar (10g, 107.3mmol) and CHCl₃ (20ml), and reflux under nitrogen at 80°C for 3 hours. After the reaction is complete, wait for the reaction to cool to room temperature, add water to quench, extract with EA, dry with anhydrous sodium sulfate, then concentrate over a silica gel column to obtain the target product.

Step 2: Add the above-mentioned compound (242.0 mg, 1.0 mmol, 1.0 equivalent) to methanol (12.5 mL), then add B₂(OH)₄ (448.8 mg, 5.0 mmol, 5.0 equivalents). Cool the mixture to 0 degrees Celsius, then slowly add NaOH solution (0.80 M in methanol, 12.5 mL, 10 equivalents). After stirring at 0 degrees Celsius for 10 minutes, heat the mixture to 40 degrees Celsius (metal bath) and react overnight at 40 degrees Celsius. Mix the reaction mixture with silica gel (3.0 g) and concentrate it under reduced pressure. Purify the crude product by silica gel chromatography (PE/EtOAc = 2:1) to obtain the desired product.

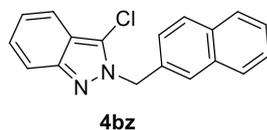
(9) Synthesis of indazole derivatives.4bz, 4ca



Benzopyrazole compounds were synthesized according to literature reports.^{6, 27}

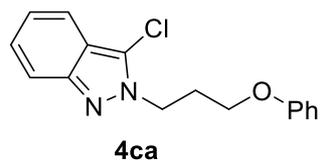
Step 1: CH₃CN (25 mL) was added to the mixture of bromo compounds (6 mmol), K₂CO₃ (1.4 g, 10 mmol) and 2H-indazole (0.59 g, 5 mmol) in a 100 mL sealed tube. Then the reaction mixture was heated at 80 oC for 16 h. Upon completion of the reaction, the solvents were removed via rotary evaporator and the residue was purified by flash column chromatograph (silica gel, petroleum ether:EtOAc = 5:1, v/v) to give the desired 2H-indazoles.

Step 2: Refer to Step 2 in Program (6)



3-chloro-2-(naphthalen-2-ylmethyl)-2H-indazole

Eluent: PE/EA = 2:1, White solid (5 mol, 522.1mg, 36%, m.p. 96.8 – 97.2 °C), ¹H NMR (400 MHz, Chloroform-*d*) δ 7.80 (dd, *J* = 9.1, 3.8 Hz, 3H), 7.73 (s, 1H), 7.69 (dd, *J* = 8.8, 0.9 Hz, 1H), 7.57 (dt, *J* = 8.5, 1.1 Hz, 1H), 7.51 – 7.42 (m, 2H), 7.42 (dd, *J* = 8.5, 1.8 Hz, 1H), 7.35 – 7.29 (m, 1H), 7.15 – 7.11 (m, 1H), 5.81 (s, 2H). ¹³C NMR (101 MHz, CDCl₃) δ 148.26, 133.38, 133.15, 132.78, 128.88, 128.12, 127.83, 127.10, 126.93, 126.54, 126.46, 125.34, 122.49, 119.56, 119.32, 118.87, 118.21, 54.58. HRMS (ESI): *m/z* calcd. for C₁₈H₁₄ClN₂⁺, [M+H]⁺ : 293.0841; found: 293.0843



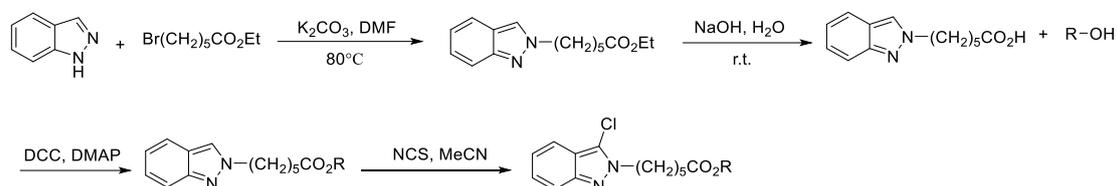
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3-chloro-2-(3-phenoxypropyl)-2H-indazole

¹H NMR (400 MHz, Chloroform-*d*) δ 7.64 (dt, *J* = 8.9, 0.9 Hz, 1H), 7.55 (dt, *J* = 8.6, 1.1 Hz, 1H), 7.35 – 7.24 (m, 3H), 7.11 (ddd, *J* = 8.5, 6.6, 0.8 Hz, 1H), 6.95 (tt, *J* = 7.2, 1.1 Hz, 1H), 6.91 – 6.83 (m, 2H), 4.68 (t, *J* = 6.9 Hz, 2H), 3.99 (t, *J* = 5.8 Hz, 2H), 2.49 (p, *J* = 6.6 Hz, 2H). ¹³C NMR (101 MHz,

Chloroform-*d*) δ 158.71, 148.14, 129.59, 127.02, 122.31, 121.05, 119.61, 118.85, 117.91, 114.63, 64.33, 47.32, 29.83. HRMS (ESI): m/z calcd. for $C_{16}H_{16}ClN_2O^+$, $[M+H]^+$: 287.0945; found: 287.0948.

(10) Synthesis of indazole derivatives.4cb,4cd



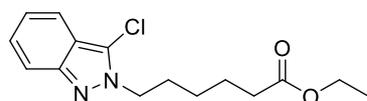
Benzopyrazole compounds were synthesized according to literature reports.^{6,31}

Step 1: Indazole 1 (200 mg, 1.69 mmol) reacted in DMF (2 mL), K_2CO_3 (2.34 g, 16.93 mmol), and $Br(CH_2)_5CO_2Et$ (0.6 mL, 3.39 mmol) for 5 h. to obtain the desired compound.

Step 2: The above compounds (1.05 mg, 4.04 mmol) were reacted in NaOH in water (10 M, 3 mL) for 2 h. The result is a compound, which is a white crystal.

Step 3: To a round-bottom flask, DCM (10 mL) was added to a mixture of 2-(2H-indazol-2-yl)ethan-1-ol (2 mmol), carboxylic acid (2.4 mmol), DCC (536 mg, 2.6 mmol) and DMAP (49 mg, 0.4 mmol). Then, the reaction mixture was stirred at room temperature for 12h. Upon completion of the reaction, the solvents were removed via rotary evaporator and the residue was purified by flash column chromatograph to give the desired functionalized 2H-indazoles.

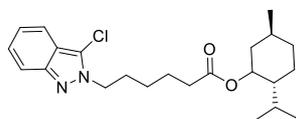
Step 4: Refer to Step 2 in Program (6)



4cb

ethyl 6-(3-chloro-2H-indazol-2-yl) hexanoate

1H NMR (400 MHz, Chloroform-*d*) δ 7.63 (d, J = 8.8 Hz, 1H), 7.54 (d, J = 8.5 Hz, 1H), 7.37 – 7.22 (m, 1H), 7.14 – 7.03 (m, 1H), 4.44 (t, J = 7.2 Hz, 2H), 4.10 (q, J = 7.2 Hz, 2H), 2.29 (t, J = 7.5 Hz, 2H), 2.00 (p, J = 7.4 Hz, 2H), 1.72 – 1.64 (m, 2H), 1.45 – 1.33 (m, 2H), 1.22 (t, J = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 34.16, 29.77, 26.16, 24.56, 14.34. HRMS (ESI): m/z calcd. for $C_{15}H_{20}ClN_2O_2^+$, $[M+H]^+$: 295.1208; found: 295.1210



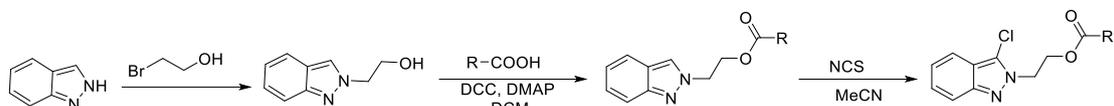
4cd

(2R,5S)-2-isopropyl-5-methylcyclohexyl 6-(3-chloro-2H-indazol-2-yl) hexanoate

Eluent: PE/EA = 5:1, brown oil (1.69 mol, 530.9 mg, 78%), 1H NMR (400 MHz, Chloroform-*d*) δ 7.63 (d, J = 8.8 Hz, 1H), 7.53 (d, J = 8.9 Hz, 1H), 7.28 (dd, J = 8.7, 6.4 Hz, 1H), 7.13 – 7.06 (m, 1H), 4.65 (td, J = 10.9, 4.4 Hz, 1H), 4.43 (t, J = 7.3 Hz, 2H), 2.27 (t, J = 7.4 Hz, 2H), 2.00 (p, J = 7.5 Hz, 3H), 1.82 (td, J = 6.9, 2.6 Hz, 1H), 1.66 (dt, J = 14.5, 5.3 Hz, 4H), 1.53 – 1.31 (m, 4H), 0.87 (dd, J = 6.8, 3.1 Hz, 9H), 0.73 (d, J = 7.0 Hz, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 173.10, 126.88, 122.24, 118.97, 118.75, 117.91, 74.19, 50.35, 47.11, 41.05, 34.54, 34.37, 31.49, 29.79, 26.41, 26.20, 24.71,

23.54, 22.14, 20.87, 16.42. HRMS (ESI): m/z calcd. for $C_{23}H_{34}ClN_2O_2^+$, $[M+H]^+$: 405.2304; found: 405.2312.

(11) Synthesis of indazole derivatives.4bx, 4ce,4cf

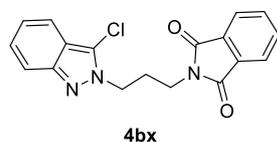


Benzopyrazole compounds were synthesized according to literature reports.^{6, 27}

Step 1: To a 100 mL sealed tube, 25 mmol of 2-bromoethanol was added to 2H-indazole (1.18 g, 10 mmol). Then, the reaction mixture was stirred at 145 °C for 3h. Upon completion of the reaction, ethyl acetate (20 mL) was added to the mixture, and then washed with saturated brine with thrice. The combined water layers were extracted with ethyl acetate twice. The combined organic layers were dried over anhydrous Na_2SO_4 . The solvents were removed via rotary evaporator and the residue was purified by flash column chromatograph (silica gel, petroleum ether:EtOAc = 1:3, v/v) to give the desired 2-(2H-indazol-2-yl)ethan-1-ol as yellow solid.

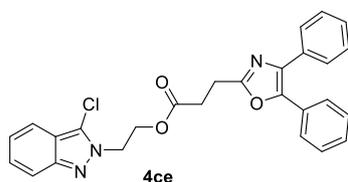
Step 2: To a round-bottom flask, DCM (10 mL) was added to a mixture of 2-(2H-indazol-2-yl)ethan-1-ol (2 mmol), carboxylic acid (2.4 mmol), DCC (536 mg, 2.6 mmol) and DMAP (49 mg, 0.4 mmol). Then, the reaction mixture was stirred at room temperature for 12h. Upon completion of the reaction, the solvents were removed via rotary evaporator and the residue was purified by flash column chromatograph to give the desired functionalized 2H-indazoles.

Step 3: Refer to Step 2 in Program (6)



2-(3-(3-chloro-2H-indazol-2-yl)propyl) isoindoline-1,3-dione

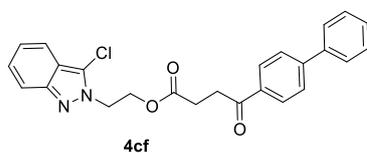
Eluent: PE/EA = 5:1, pale yellow solid (10 mol, 549.1mg, 12%, m.p. 85.7 – 86.8 °C), 1H NMR (400 MHz, Chloroform- d) δ 7.83 – 7.79 (m, 2H), 7.72 – 7.67 (m, 2H), 7.57 – 7.45 (m, 2H), 7.26 – 7.21 (m, 1H), 7.10 – 7.02 (m, 1H), 4.52 (t, J = 8.0 Hz, 2H), 3.84 (t, J = 6.8 Hz, 2H), 2.42 (p, J = 7.0 Hz, 2H). ^{13}C NMR (101 MHz, Chloroform- d) δ 168.30, 148.01, 134.14, 132.10, 126.98, 123.41, 122.33, 119.24, 119.03, 118.73, 117.88, 48.39, 35.67, 28.75. HRMS (ESI): m/z calcd. for $C_{18}H_{14}ClN_3O_2Na^+$, $[M+Na]^+$: 362.0667; found: 362.0657.



2-(3-chloro-2H-indazol-2-yl) ethyl 3-(4,5-diphenyloxazol-2-yl) propanoate

Eluent: PE/EA = 5:1, pale yellow solid (10 mol, 549.1mg, 12%, m.p. 85.7 – 86.8 °C), 1H NMR (400 MHz, Chloroform- d) δ 7.66 – 7.59 (m, 3H), 7.55 (td, J = 6.2, 3.3 Hz, 3H), 7.33 (dddd, J = 16.3, 9.0, 6.5, 4.1 Hz, 7H), 7.11 (dd, J = 8.5, 6.6 Hz, 1H), 4.78 – 4.69 (m, 2H), 4.69 – 4.62 (m, 2H), 3.14 (t, J = 7.6 Hz, 2H), 2.89 (d, J = 15.1 Hz, 2H). ^{13}C NMR (101 MHz, Chloroform- d) δ 171.73, 161.58, 148.39,

145.57, 132.52, 129.04, 128.76, 128.67, 128.59, 128.18, 128.01, 127.29, 126.58, 122.53, 120.06, 118.96, 118.89, 117.96, 62.84, 49.04, 30.99, 23.42. HRMS (ESI): m/z calcd. for $C_{25}H_{22}ClN_2O_3^+$, $[M+H]^+$: 433.1314; found: 433.1301.



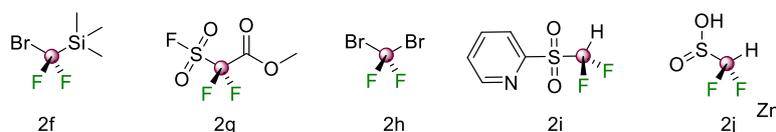
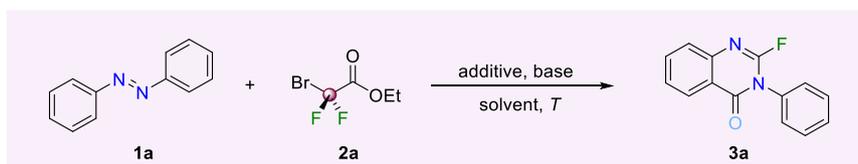
2-(3-chloro-2H-indazol-2-yl) ethyl 4-([1,1'-biphenyl]-4-yl)-4-oxobutanoate

Eluent: PE/EA = 2:1, White solid (5 mol, 631.3mg, 29%, m.p. 68.8 – 69.2 °C), 1H NMR (400 MHz, Chloroform-*d*) δ 7.99 (d, J = 8.3 Hz, 2H), 7.70 – 7.58 (m, 5H), 7.55 (d, J = 8.5 Hz, 1H), 7.48 (t, J = 7.5 Hz, 2H), 7.46 – 7.36 (m, 1H), 7.34 – 7.28 (m, 1H), 7.11 (dd, J = 8.5, 6.6 Hz, 1H), 4.72 (t, J = 5.1 Hz, 2H), 4.64 (t, J = 5.1 Hz, 2H), 3.28 (t, J = 6.7 Hz, 2H), 2.76 (t, J = 6.7 Hz, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.47, 172.58, 148.36, 146.03, 139.95, 135.21, 129.08, 128.71, 128.38, 127.38, 127.36, 127.23, 122.48, 120.09, 118.98, 118.89, 117.98, 62.64, 49.09, 33.37, 28.25. HRMS (ESI): m/z calcd. for $C_{25}H_{22}ClN_2O_3^+$, $[M+H]^+$: 433.1314; found: 433.1301.

3. Experimental Section

(1) Optimization of the conditions.

Table S1. Verifications of the conditions ^[a]

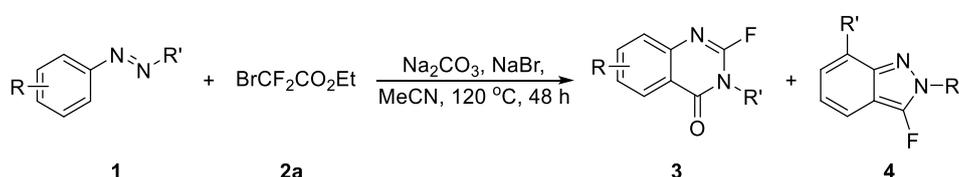


Entry	2	Solvent	Additive	Yield (%)
1	2a	Toluene	NaBr	n.d.
2	2a	DMSO	NaBr	n.d.
3	2a	HFIP	NaBr	n.d.
4	2a	EA	NaBr	n.d.
5	2a	DMF	NaBr	n.d.
6	2a	n-Hexane	NaBr	n.d.
7	2a	MeOH	NaBr	n.d.
8	2a	PhCF ₃	NaBr	51
9	2f	MeCN	NaBr	n.d.
10	2g	MeCN	NaBr	n.d.
11	2h	MeCN	NaBr	n.d.

12	2i	MeCN	NaBr	n.d.
13	2j	MeCN	NaBr	n.d.
14	2a	MeCN	KBr	48
15	2a	MeCN	TBAB	11
16	2a	MeCN	NaSO ₄	n.d.
17	2a	MeCN	AlCl ₃	n.d.
18	2a	MeCN	CaCl ₂	n.d.
19	2a	MeCN	PPh ₃	53
20	2a	MeCN	NaI	n.d.

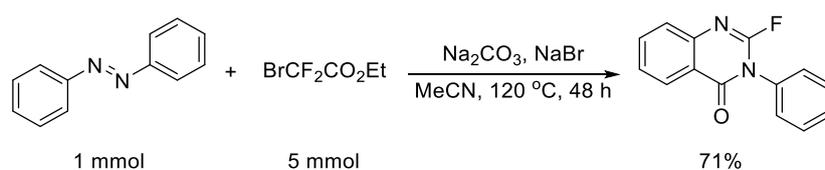
[a] Reaction Conditions: **1a** (0.2 mmol, 1.0 equiv), **2** (1 mmol, 5.0 equiv), Na₂CO₃ (2.0 equiv), and Additive (0.1 mmol, 0.5 equiv) in Solvent (4.0 mL) at 120 °C under air atmosphere for 48 h; NMR yields using CH₂Br₂ as an internal standard; n.d. = not detected.

(2) General procedures for the synthesis of products **3a-3ak**, **4j'**, **4k'**.



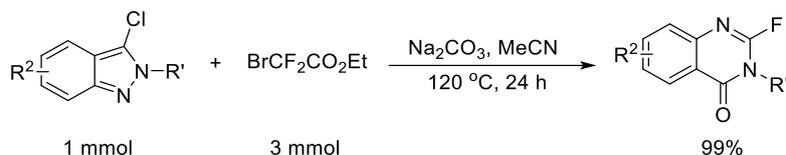
Azobenzene (0.2 mmol, 1.0 equiv), sodium bromide (0.1 mmol, 0.5 equiv), and sodium carbonate (0.4 mmol, 2.0 equiv) were added to 10 or 25 mL of Shrek reaction tubes, followed by 4 mL of ultradry MeCN and BrCF₂CO₂Et (202.2 mg, 1.0 mmol, 5.0 equiv) to the reaction tubes. Then the sealed tube was stirred at 120 °C under air for 48 hours. Upon completion of the reaction, the solvent was evaporated under reduced pressure and the residue was purified by flash column chromatograph (silica gel, petroleum ether/ethyl acetate = 20:1 – 5:1, v/v) to give the desired product **3a-3ak**, **4j'**, **4k'**.

(3) Scale-up synthesis of **3a**



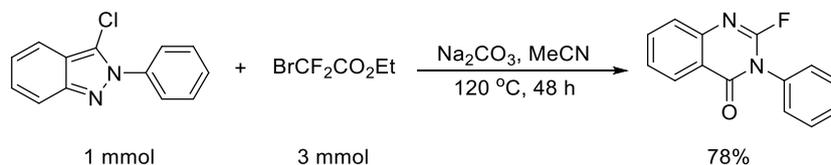
In an air atmosphere, azobenzene **1a** (182.0 mg, 1.0 mmol), sodium bromide (60.0 mg, 0.5 mmol), and sodium carbonate (212.0 mg, 2.0 mmol) were added to 100 mL Shrek reaction tubes, then 20 mL of MeCN and BrCF₂CO₂Et (1.0 g, 5.0 mmol) were added to the tubes. The reaction mixture was stirred at 120 °C for 48 hours. After the reaction, the solvent was removed under reduced pressure and the residue was purified using PE: EA = 10:1 by silica column chromatography to give product **3a** (170.4 mg, 71% yield).

(4) General procedures for the synthesis of products **3a**, **3ba**-**3cf**.



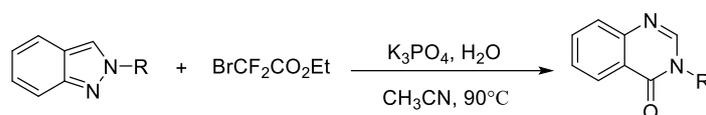
3-chloroindazole (0.1 mmol, 1.0 equiv), and sodium carbonate (0.2 mmol, 2.0 equiv) were added to 10 or 25 mL of Shrek reaction tubes, followed by 2 mL of ultradry MeCN and BrCF₂CO₂Et (60.9 mg, 0.3 mmol, 3.0 equiv) to the reaction tubes. Then the sealed tube was stirred at 120 °C under air for 24 hours. Upon completion of the reaction, the solvent was evaporated under reduced pressure and the residue was purified by flash column chromatograph (silica gel, petroleum ether/ethyl acetate = 20:1 – 5:1, v/v) to give the desired product **3a**, **3ba**-**3cf**

(5) Scale-up synthesis of **3a**



In an air atmosphere, azobenzene **4b** (228.0 mg, 1.0 mmol), and sodium carbonate (212.0 mg, 2.0 mmol) were added to 100 mL Shrek reaction tubes, then 20 mL of MeCN and BrCF₂CO₂Et (608.9 mg, 3.0 mmol) were added to the tubes. The reaction mixture was stirred at 120 °C for 48 hours. After the reaction, the solvent was removed under reduced pressure and the residue was purified using PE: EA = 10:1 by silica column chromatography to give product **3a** (186.1 mg, 78% yield).

(6) Synthesis of products **3bw'**, **3by'**, **3cc'**-**3ce'**



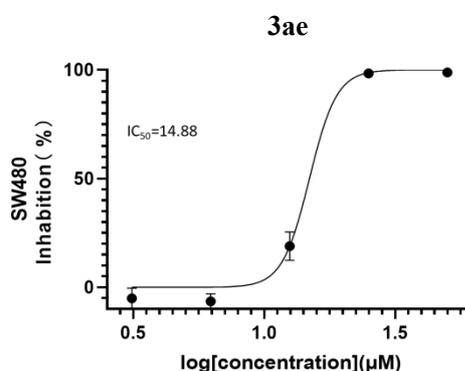
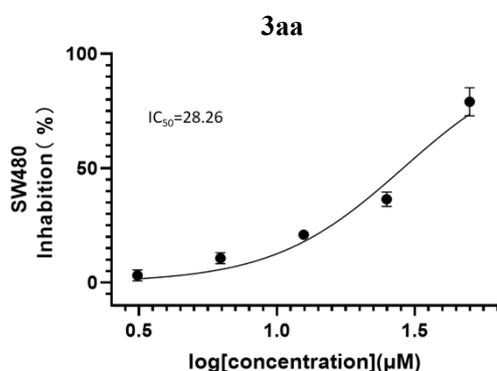
CH₃CN (2 mL) was added to a mixture of 2*H*-indazoles (0.3 mmol), K₃PO₄ (191 mg, 0.9 mmol), H₂O (17 mg, 0.9 mmol), BrCF₂COOEt (183 mg, 0.9 mmol). Then the sealed tube was stirred at 90 °C for 16 h. Upon completion of the reaction, the solvent was evaporated under reduced pressure and the residue was purified by flash column chromatograph (silica gel, petroleum ether:EtOAc = 3:1, v/v) to give the desired quinazolin-4(3*H*)-ones.⁶

(7) Activity Test

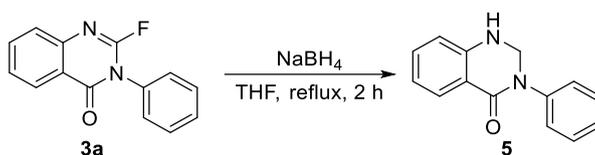
Inhibition rate of the compound on cells

Compound	X	Inhibition rate (%)				
		1	2	3	4	5
SW480	X = F	22.49%	46.35% (IC ₅₀ = 28.67±2.48) ^b	59.7% (IC ₅₀ = 14.88±0.91) ^b	13.82%	23.85%
	X = H	7.40%	29.37%	8.55%	1.14%	11.40%
H1299	X = F	12.95%	30.99%	28.98%	9.92%	10.41%
	X = H	1.54%	33.38%	2.67%	14.31%	5.35%
5637	X = F	2.66%	6.35%	5.96%	0.84%	10.05%
	X = H	2.97%	3.53%	38.91%	20.82%	3.05%

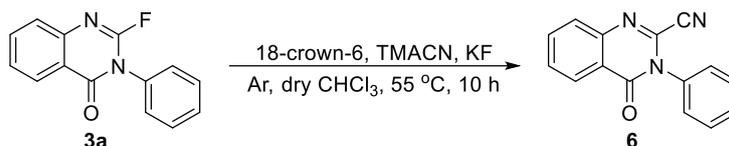
[a] CCK-8 assay; Inhibition rate of the compound at 25 μ M in cells; [b] IC₅₀ value of the product on cells (mean \pm SD)



(8) Synthetic transformation of the products

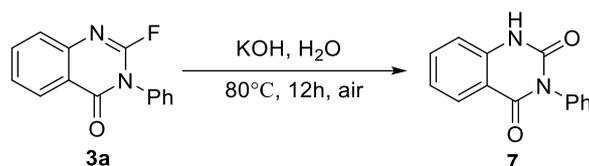


3a (0.36 mmol, 86.4 mg), NaBH₄ (0.36 mmol, 13.6 mg) were placed in a 25 mL Schlenk tube in air, followed by the addition of anhydrous THF (3.6 mL), 2 hours of reflux. The completion of the reaction was monitored by TLC, cooled to room temperature, added water to destroy NaBH₄, the reaction produced bubbles and a white solid appeared, and filtered to obtain a white solid **5** (43.5 mg, 54%, m.p. 157 – 158 °C). ¹H NMR (400 MHz, CDCl₃) δ 8.04 (dd, *J* = 7.8, 1.5 Hz, 1H), 7.45 – 7.32 (m, 5H), 7.30 – 7.23 (m, 1H), 6.99 – 6.91 (m, 1H), 6.77 (d, *J* = 8.1 Hz, 1H), 5.00 (s, 2H), 4.48 (br, 1H). ¹³C NMR (100 MHz, CDCl₃) δ 163.4, 147.6, 141.1, 133.7, 129.6, 129.2, 126.6, 125.2, 120.4, 118.5, 115.5, 62.3. HRMS (ESI): *m/z* calcd. for C₁₄H₁₂N₂NaO⁺, [M+H]⁺ : 247.0842; found: 247.0842.

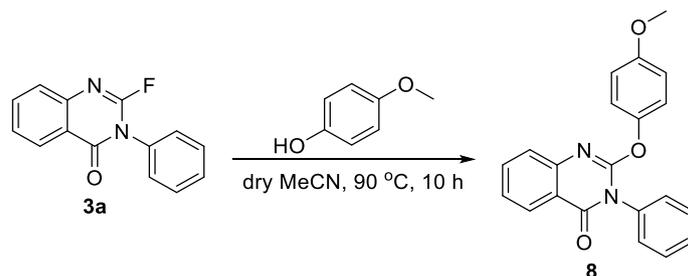


3a (0.10 mmol, 24.0 mg), 18-crown-6 (0.3 mmol, 79.3 mg), and TMSCN (0.3 mmol, 29.8 mg) were combined in a dry 25 mL Schlenk tube under argon, followed by KF (0.3 mmol, 17.4 mg) and anhydrous

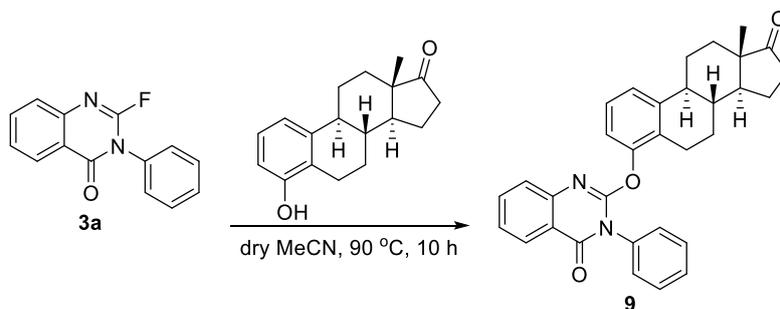
CHCl₃ (3.0 mL). The mixture was stirred at 55 °C for 10 hours. After completion of the reaction, it was neutralized with 3 mL of NaOH (1 N). The aqueous layer was separated and the organic phase was extracted with ether and then washed with brine. Finally, the organic phase was washed with brine again. The solvent was removed by rotary evaporation and the residue was purified by flash silica gel chromatography (PE/EA = 10:1) to give **6** (15.6 mg, 63%) as a yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 8.38 – 8.34 (m, 1H), 7.94 – 7.84 (m, 2H), 7.73 – 7.64 (m, 1H), 7.66 – 7.57 (m, 3H), 7.44 – 7.39 (m, 2H). ¹³C NMR (100 MHz, CDCl₃) δ 160.2, 146.6, 135.5, 135.4, 131.6, 130.9, 130.4, 130.3, 128.9, 128.4, 127.6, 123.1, 111.2. HRMS (ESI): m/z calcd. for C₁₅H₁₀N₃O⁺, [M+H]⁺ : 248.0818; found: 248.0815.



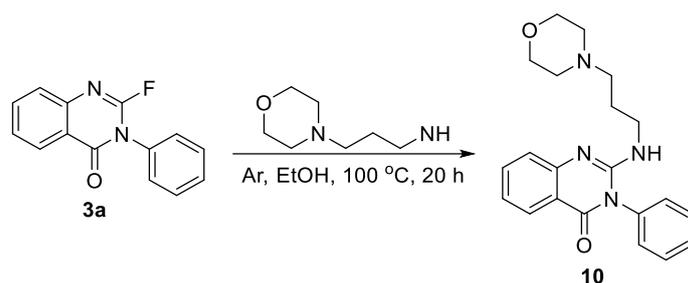
3a (0.1 mmol, 24.0 mg), KOH (0.15 mmol, 8.4 mg) were placed in a 25 mL Schlenk tube in air, then anhydrous H₂O (1.0 mL) was added for 12 hours at 80°C. Cooled to room temperature, EA extracted the organic term, spin evaporation to remove the solvent, and residue purified by flash silica gel chromatography (PE/EA = 5:1) to yield **7** (20.3 mg, 85%, m.p. 96.0 - 97.0 °C) as a white solid. ¹H NMR (400 MHz, Chloroform-*d*) δ 9.75 (s, 1H), 8.15 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.55 (tt, *J* = 6.7, 1.1 Hz, 3H), 7.52 – 7.46 (m, 1H), 7.34 – 7.29 (m, 2H), 7.23 (ddd, *J* = 8.1, 7.3, 1.0 Hz, 1H), 6.92 (d, *J* = 8.1 Hz, 1H).



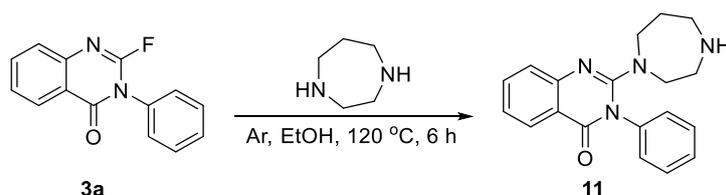
3a (0.1 mmol, 24.0 mg), *p*-Methoxyphenol (0.1 mmol, 12.4 mg), and K₂CO₃ (0.15 mmol, 20.7 mg) were placed in a 10 mL Schlenk tube in air, followed by the addition of anhydrous MeCN (2.0 mL), and stirred for 10 hours at 90 °C. The solvent was removed by rotary evaporation and the residue was purified by flash silica gel chromatography (PE/EA = 10:1) to give **8** (24.1 mg, 70%, m.p. 134 – 135 °C) as a white solid. ¹H NMR (400 MHz, CDCl₃) δ 8.24 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.70 – 7.61 (m, 1H), 7.55 (t, *J* = 7.5 Hz, 2H), 7.51 – 7.42 (m, 2H), 7.42 – 7.32 (m, 3H), 7.12 – 7.04 (m, 2H), 6.94 – 6.85 (m, 2H), 3.82 (s, 3H). ¹³C NMR (100 MHz, CDCl₃) δ 163.1, 157.4, 152.2, 147.0, 145.4, 135.4, 134.8, 129.6, 129.1, 128.3, 127.6, 126.4, 125.3, 122.5, 119.6, 114.5, 55.7. HRMS (ESI): m/z calcd. for C₂₁H₁₆N₂NaO₃⁺, [M+Na]⁺ : 367.1053; found: 367.1051.



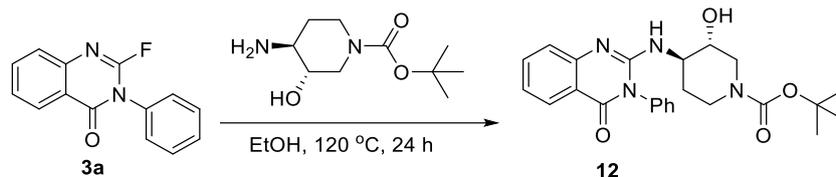
3a (0.1 mmol, 24.0 mg), estrone (0.1 mmol, 27.4 mg), and K_2CO_3 (0.15 mmol, 20.7 mg) were placed in a 10-mL Schlenk tube in air, followed by the addition of anhydrous MeCN (2 mL), and stirred for 10 hours at 90 °C. The solvent was removed by rotary evaporation and the residue was purified by flash silica gel chromatography (PE/EA = 5:1) to give **9** (32.8 mg, 67%, m.p. 86 – 87 °C) as a white solid. 1H NMR (400 MHz, $CDCl_3$) δ 8.25 (dd, $J = 7.8, 1.5$ Hz, 1H), 7.70 – 7.61 (m, 1H), 7.58 – 7.51 (m, 2H), 7.50 – 7.44 (m, 2H), 7.41 – 7.34 (m, 3H), 7.30 (d, $J = 8.6$ Hz, 1H), 6.97 (dd, $J = 8.6, 2.6$ Hz, 1H), 6.88 (d, $J = 2.6$ Hz, 1H), 2.94 – 2.86 (m, 2H), 2.55 – 2.47 (m, 1H), 2.46 – 2.38 (m, 1H), 2.36 – 2.25 (m, 1H), 2.21 – 1.93 (m, 3H), 1.71 – 1.38 (m, 7H), 0.92 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.0, 151.9, 149.8, 147.0, 138.2, 137.4, 135.3, 134.8, 129.5, 129.0, 128.3, 127.6, 126.5, 126.4, 125.3, 121.3, 119.7, 118.7, 50.5, 48.0, 44.3, 38.1, 36.0, 31.7, 29.5, 26.4, 25.9, 21.7, 14.0. HRMS (ESI): m/z calcd. for $C_{32}H_{31}N_2O_3^+$, $[M+H]^+$: 491.2329; found: 491.2328.



3a (0.2 mmol, 48.0 mg), *N*-[3-aminopropyl (3-aminopropyl)]morpholine (0.2 mmol, 28.8 mg), and EtOH (1 mL, without drying) were added to a 10 mL Schlenk in air. Then, Et_3N (0.3 mmol, 30.4 mg) were added and the mixture were stirred at 100 °C for 20 hours. When the reaction completed, The solvent was removed by rotary evaporation and the residue was purified by flash silica gel chromatography (DCM/MeOH = 20:1) to give **10** (62.6 mg, 86%, m.p. 130 – 131 °C) as a white solid. 1H NMR (400 MHz, $CDCl_3$) δ 8.08 (dd, $J = 7.9, 1.6$ Hz, 1H), 7.61 – 7.45 (m, 4H), 7.38 (dd, $J = 8.3, 1.0$ Hz, 1H), 7.31 – 7.26 (m, 2H), 7.16 – 7.09 (m, 1H), 4.60 (t, $J = 5.4$ Hz, 1H), 3.53 – 3.46 (m, 6H), 2.31 – 2.23 (m, 6H), 1.74 – 1.63 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.7, 149.5, 135.0, 134.5, 130.5, 129.8, 128.9, 127.2, 124.8, 122.4, 117.5, 66.5, 56.6, 53.7, 40.6, 25.1. HRMS (ESI): m/z calcd. for $C_{21}H_{25}N_4O_2^+$, $[M+H]^+$: 365.1972; found: 365.1970.



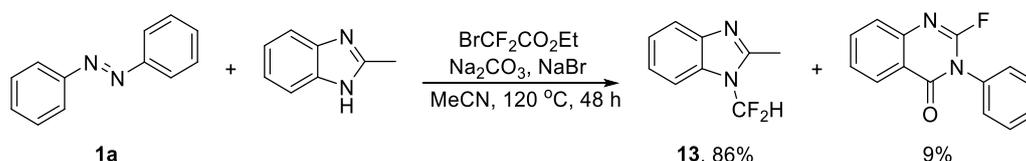
3a (0.2 mmol, 48.0 mg), Homopiperazine (0.22 mmol, 22.0 mg), and EtOH (1 mL) were added to a 10 mL Schlenk tube under argon, the mixture was stirred at 120 °C for 6 hours. When the reaction completed, The solvent was removed by rotary evaporation and the residue was purified by flash silica gel chromatography (PE/EA = 1:1) to give **11** (38.5 mg, 60%) as a white oil. 1H NMR (400 MHz, $CDCl_3$) δ 8.17 (dd, $J = 8.0, 1.5$ Hz, 1H), 7.72 – 7.63 (m, 1H), 7.57 – 7.46 (m, 3H), 7.46 – 7.35 (m, 3H), 7.31 – 7.24 (m, 1H), 3.41 (t, $J = 5.4$ Hz, 2H), 3.34 (t, $J = 6.1$ Hz, 2H), 2.82 – 2.68 (m, 5H), 1.49 – 1.38 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.8, 154.7, 148.3, 138.3, 134.8, 129.2, 129.1, 128.3, 127.5, 125.7, 124.1, 118.7, 54.2, 51.2, 48.9, 47.7, 29.7. HRMS (ESI) m/z : calcd. for $C_{19}H_{20}N_4O^+$ $[M+H]^+$: 321.1710; found: 321.1713.



3a (0.1 mmol, 24.0 mg) and 1-Piperidinecarboxylic acid, 4-amino-3-hydroxy-, 1,1-dimethylethyl ester, (3R,4R) (0.1 mmol, 21.6 mg) were placed in a 10 mL Schlenk tube in air, followed by the addition of anhydrous ethanol (1.0 mL) and stir at 120°C for 24 hours. The solvent was removed by rotary evaporation and the residue was purified by flash silica gel chromatography (PE/EA = 1:1) to give **12** (35 mg, 80%, m.p. 95.8 – 98.7 °C) as a white solid. ¹H NMR (400 MHz, Chloroform-*d*) δ 8.11 (dd, *J* = 7.9, 1.6 Hz, 1H), 7.72 – 7.52 (m, 4H), 7.40 (d, *J* = 8.2 Hz, 1H), 7.35 (dd, *J* = 7.5, 2.5 Hz, 1H), 7.29 – 7.27 (m, 1H), δ 7.22 (t, *J* = 7.5 Hz, 1H), 6.54 (s, 1H) 4.31 – 4.28 (m, 1H), 4.08 (d, *J* = 5.5 Hz, 2H), 3.93 – 3.85 (m, 1H), 3.41 - 3.35 (m, 1H), 2.86 – 2.48 (m, 2H), 1.87 – 1.67 (m, 1H), 1.42 (s, 9H), 1.31 – 1.17 (m, 1H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 162.10, 151.22, 147.72, 135.13, 134.25, 130.95, 130.84, 130.41, 129.12, 128.51, 127.49, 124.37, 123.64, 117.75, 80.17, 56.88, 28.46. [M+H]⁺ : 437.2184; found:437.2191.

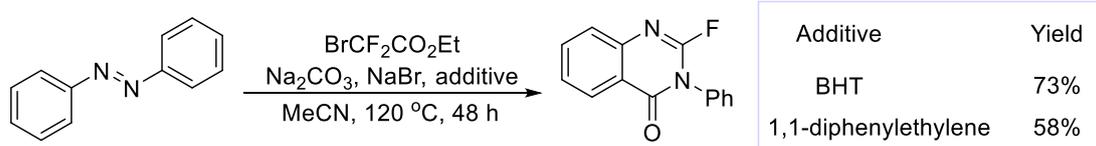
4. Mechanistic Studies

(1) Carbene capture experiment



In an air atmosphere, azobenzene **1a** (36.4 mg, 0.2 mmol), sodium bromide (10.2 mg, 0.1 mmol), 2-methylbenzimidazole (26.5 mg, 0.2 mmol) and sodium carbonate (42.4 mg, 0.4 mmol) were added to 10 or 25 mL Shrek tubes, followed by 4 mL MeCN and BrCF₂CO₂Et (202.2 mg, 1.0 mmol), and then stirred at 120 °C for 48 hours. After the completion of the reaction, after using the thin layer chromatography (TLC) to observe the reaction, it is found that the large surplus of raw material azobenzene, 2-methyl benzimidazole is basically consumed, and the product **3a** only trace, and a new point appeared. The solvent was subsequently removed under reduced pressure, and the residue was purified using PE: EA = 3:1, separating the new product and confirmed as product **13** (31.3 mg, 86% yield). Product **13** is known substance⁵.

(2) Radical verification experiments



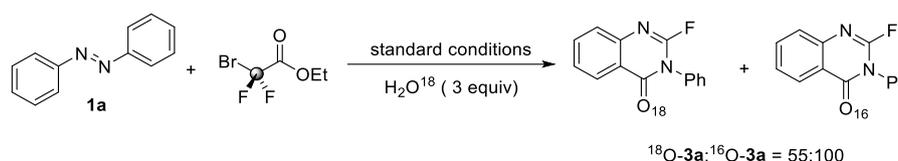
(1) BHT as the free radical trap agent

Under an air atmosphere, azobenzene **1a** (36.4 mg, 0.2 mmol), sodium bromide (10.2 mg, 0.1 mmol), BHT (132.2 mg, 0.6 mmol), and sodium carbonate (42.4 mg, 0.4 mmol) were added to 10 or 25 mL Shrek tubes, and then 4 mL MeCN and BrCF₂CO₂Et (202.2 mg, 1.0 mmol) were added to the reaction tube. It was then stirred at 120 °C for 48 hours. After the reaction, the solvent was removed under reduced pressure and the residue was purified using PE: EA = 10:1 by silica column chromatography to obtain product **3a** (35.0 mg, 73% yield).

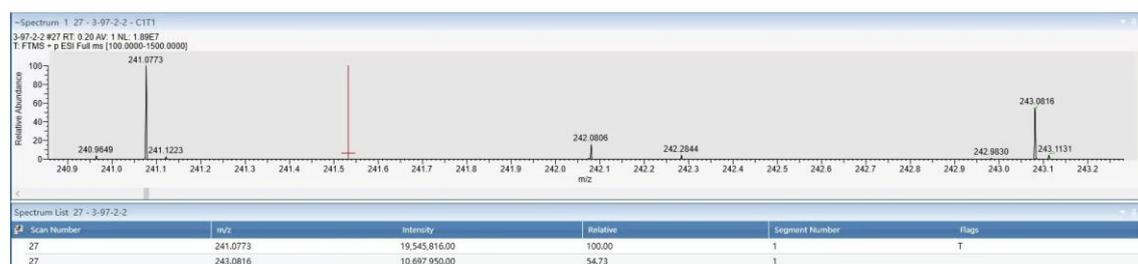
(2) 1,1-stilbene as the free radical trap agent

Under an air atmosphere, azobenzene **1a** (36.4 mg, 0.2 mmol), sodium bromide (10.2 mg, 0.1 mmol), 1,1-stilbene (108.2 mg, 0.6 mmol) and sodium carbonate (42.4 mg, 0.4 mmol) were added to 10 or 25 mL Shrek tubes, and then 4 mL MeCN and BrCF₂CO₂Et (202.2 mg, 1.0 mmol) were added to the reaction tube. It was then stirred at 120 °C for 48 hours. After the completion of the reaction, the solvent was removed under reduced pressure and the residue was purified using PE: EA = 10:1 by silica column chromatography to obtain product **3a** (27.8 mg, 58% yield).

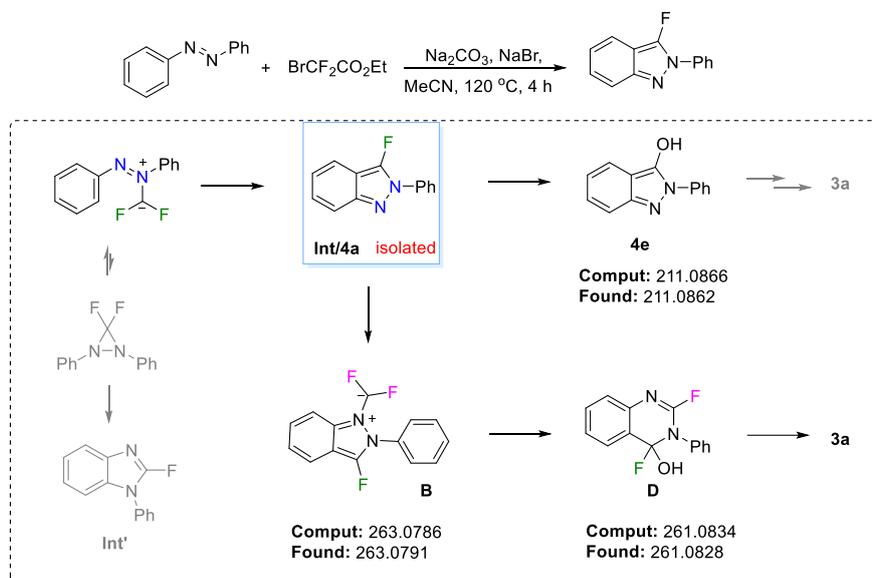
(3) ¹⁸O-labeling experiment



Azobenzene (0.2 mmol, 1.0 equiv), sodium bromide (0.1 mmol, 0.5 equiv), and sodium carbonate (0.4 mmol, 2.0 equiv) were added to 10 or 25 mL of Shrek reaction tubes, followed by 4 mL of ultradry MeCN, H₂O¹⁸ (3.0 equiv) and BrCF₂CO₂Et (202.2 mg, 1.0 mmol, 5.0 equiv) to the reaction tubes. Then the sealed tube was stirred at 120 °C under air for 48 hours. Upon completion of the reaction, the reaction liquid was filtered through the organic phase filter head, and the molecular weight of the product ¹⁸O-**3a** and ¹⁶O-**3a** was found by HRMS, at the same time, the ratio of product ¹⁸O-**3a** to product ¹⁶O-**3a** was also determined by HRMS.



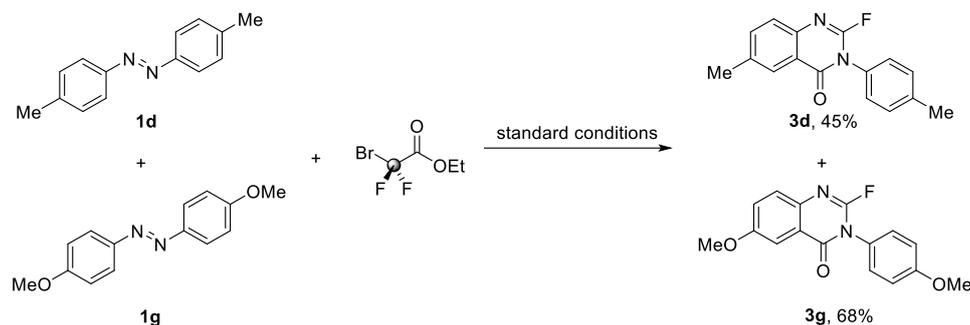
(4) Intermediates verification experiments



Azobenzene (0.2 mmol, 1.0 equiv), sodium bromide (0.1 mmol, 0.5 equiv), and sodium carbonate (0.4 mmol, 2.0 equiv) were added to 10 or 25 mL of Shrek reaction tubes, followed by 4 mL of MeCN and $\text{BrCF}_2\text{CO}_2\text{Et}$ (202.2 mg, 1.0 mmol, 5.0 equiv) to the reaction tubes. Then the sealed tube was stirred at $120\text{ }^\circ\text{C}$ under air for 4 hours. Upon completion of the reaction, the reaction liquid was filtered through the organic phase filter head, and the molecular weight of the intermediates **4e** (hydrolyzed), **Int**, **B** and **D** was found by HRMS. Then the reaction liquid was removed by rotary evaporation and the residue was purified by flash silica gel chromatography (PE/EA = 20:1) to give **Int** (1.7 mg, 8%) as a yellow oil. Eluent: PE/EA = 10:1, yellow oil (1.7 mg, 8%). ^1H NMR (400 MHz, CDCl_3) δ 7.87 – 7.79 (m, 2H), 7.62 – 7.53 (m, 4H), 7.47 – 7.42 (m, 1H), 7.33 – 7.27 (m, 1H), 7.06 (dd, J = 8.6, 6.5 Hz, 1H). ^{13}C NMR (100 MHz, CDCl_3) δ 147.4, 147.4, 145.6 (d, J = 288.3 Hz), 137.4 (d, J = 3.0 Hz), 129.6, 128.6, 127.9 (d, J = 2.0 Hz), 123.1 (d, J = 3.8 Hz), 122.1 (d, J = 2.9 Hz), 118.3 – 117.7 (m), 104.9 (d, J = 13.8 Hz). ^{19}F NMR (376 MHz, CDCl_3) δ -133.2. HRMS (ESI): m/z calcd. for $\text{C}_{13}\text{H}_{10}\text{FN}_2^+$, $[\text{M}+\text{H}]^+$: 213.0823; found: 213.0822.



(5) Competition experiment



Substrate **1d** (0.1 mmol, 21.0 mg) and **1g** (0.1 mmol, 24.2 mg), sodium bromide (0.1 mmol, 0.5 equiv), and sodium carbonate (0.4 mmol, 2.0 equiv) were added to 10 or 25 mL of Shrek reaction tubes, followed by 4 mL of MeCN and BrCF₂CO₂Et (202.2 mg, 1.0 mmol, 5.0 equiv) to the reaction tubes. Then the sealed tube was stirred at 120 °C under air for 48 hours. When the reaction completed, the solvent was removed by rotary evaporation and the residue was purified by flash silica gel chromatography (PE/EA = 10:1) to give **3d** (12.1 mg, 45%) and **3g** (20.4 mg, 68%), and no cross products were obtained.

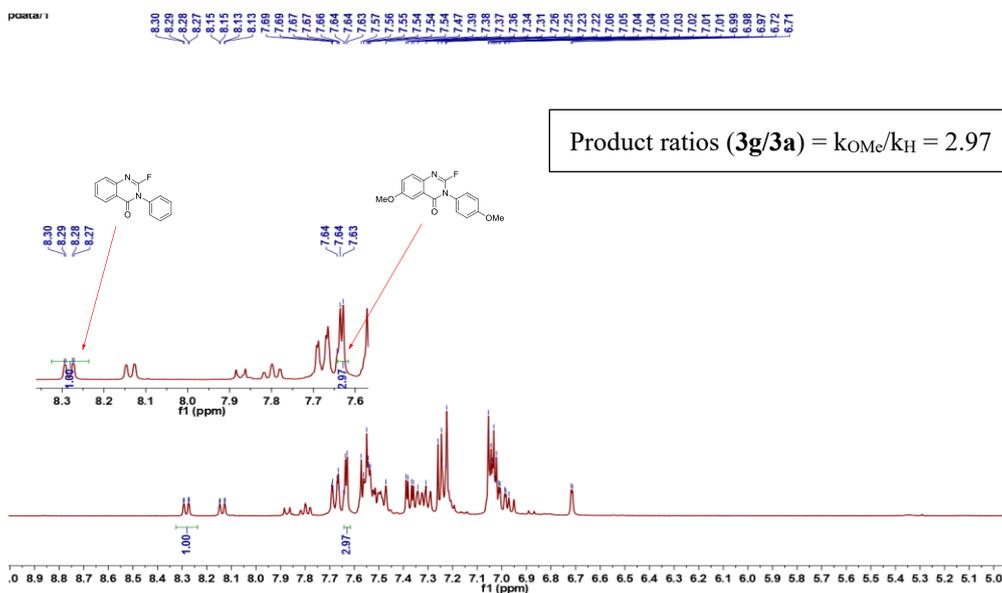
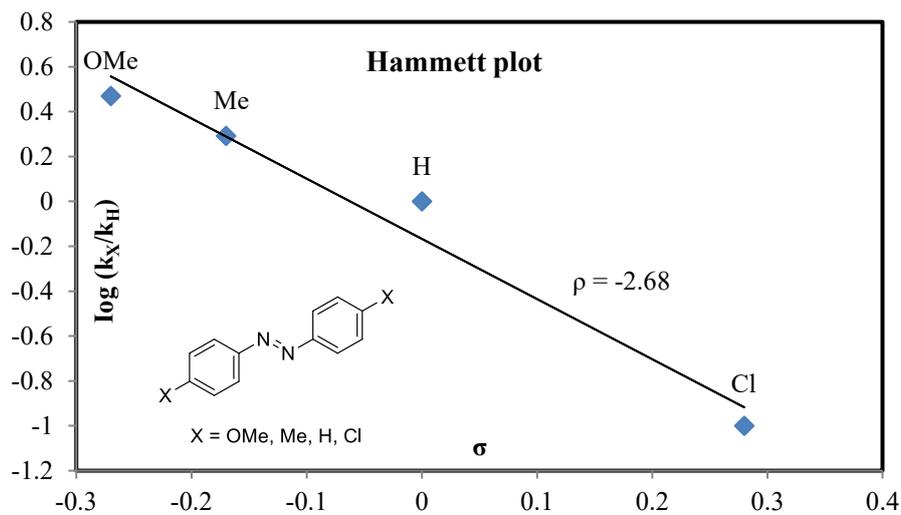
(6) Hammett analysis

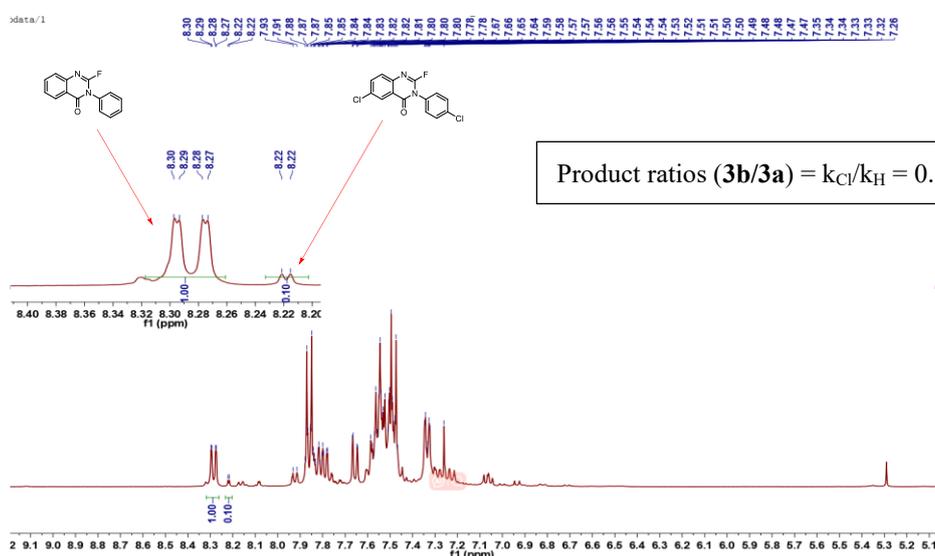
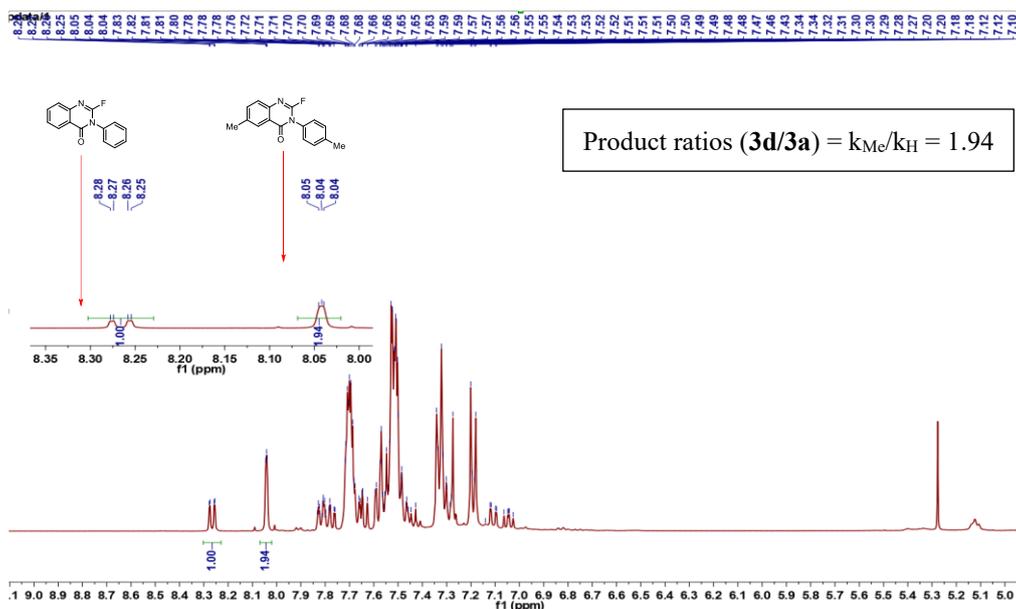
Experimental procedure for studies of the intermolecular competition reactions of BrCF₂CO₂Et with para-substituted azobenzenes.

Azobenzene (0.2 mmol, 1.0 equiv), para-substituted azobenzenes (0.2 mmol, 1.0 equiv), sodium bromide (0.1 mmol, 0.5 equiv), and sodium carbonate (0.4 mmol, 2.0 equiv) were added to 10 or 25 mL of Shrek reaction tubes, followed by 4 mL MeCN and BrCF₂CO₂Et (202.2 mg, 1.0 mmol, 5.0 equiv) to the reaction tubes. Then the sealed tube was stirred at 120 °C under air for 48 hours. the solvent was evaporated under reduced pressure and the residue was then purified by flash chromatography on silica gel to remove azobenzene and para-substituted azobenzene, the mixed product of **3a** and **3x** was obtained, and the yield ratio of **3a** and **3x** was determined by ¹H NMR yield.

Table S2. Intermolecular competition reactions of BrCF₂COOEt with para-substituted azobenzenes.

Entry	X	Product ratios (3x/3a)	Log (K _x /K _H)	σ
1	OMe	2.97	0.47276	-0.268
2	Me	1.94	0.28780	-0.270
3	Cl	0.10	-1	0.280

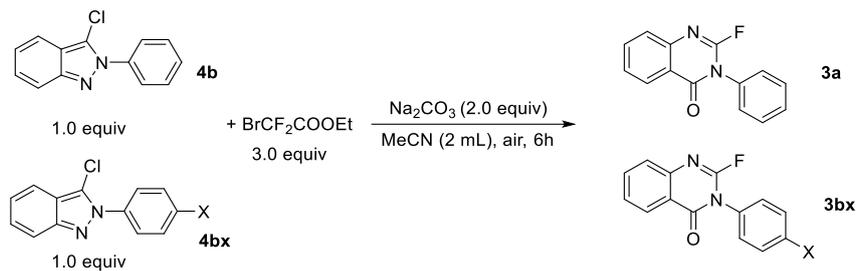




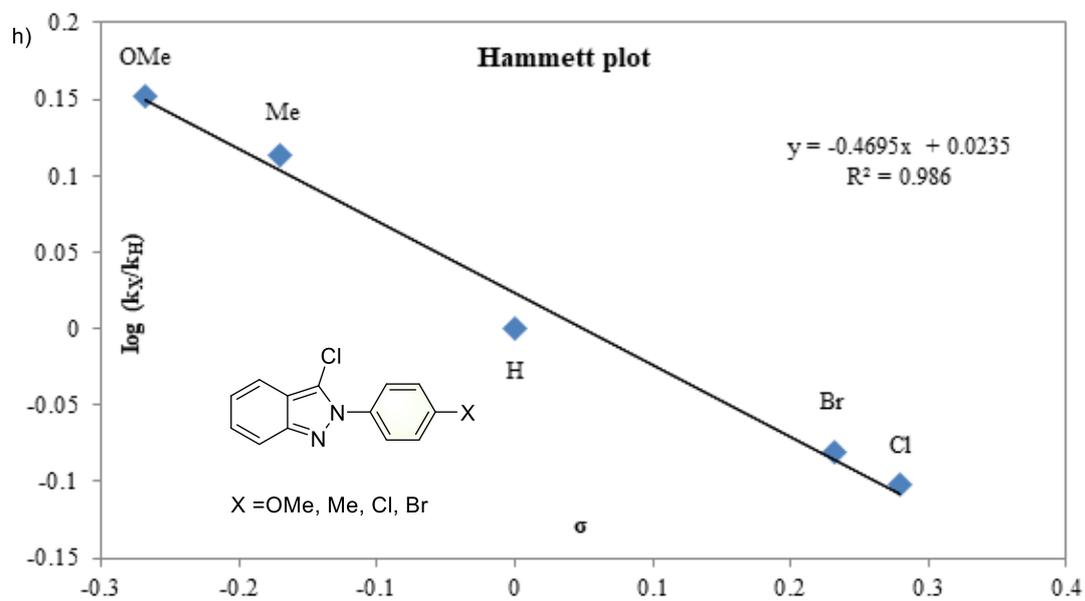
Experimental procedure for studies of the intermolecular competition reactions of $\text{BrCF}_2\text{CO}_2\text{Et}$ with *para*-substituted phenyl chlorobenzopyrazoles.

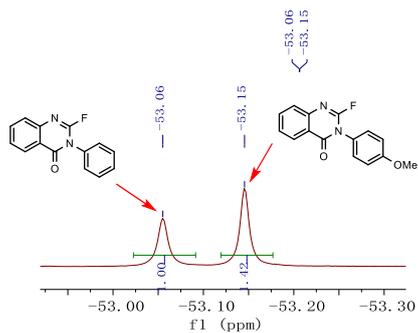
Chlorobenzopyrazoles (0.1 mmol, 1.0 equiv), *para*-substituted phenyl chlorobenzopyrazoles (0.1 mmol, 1.0 equiv), and sodium carbonate (0.2 mmol, 2.0 equiv) were added to 10 or 25 mL of Shrek reaction tubes, followed by 2 mL MeCN and $\text{BrCF}_2\text{CO}_2\text{Et}$ (60.9 mg, 0.3 mmol, 3.0 equiv) to the reaction tubes. Then the sealed tube was stirred at 120 °C under air for 24 hours. the solvent was evaporated under reduced pressure and the residue was then purified by flash chromatography on silica gel to remove chlorobenzopyrazoles and *para*-substituted phenyl chlorobenzopyrazoles, the mixed product of **3a** and **3bx** was obtained, and the yield ratio of **3a** and **3bx** was determined by ^{19}F NMR yield.

Table S3. Intermolecular competition reactions of BrCF₂COOEt with *para*-substituted phenyl chlorobenzopyrazoles

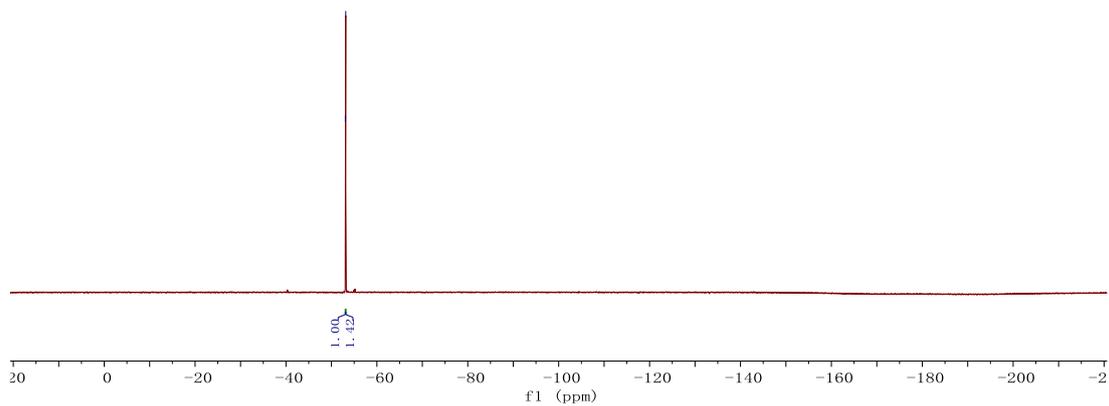


Entry	X	Product ratios (3bx/3a)	Log (K _X /K _H)	σ
1	OMe	1.42	0.15229	-0.268
2	Me	1.30	0.11394	-0.170
3	Br	0.83	-0.10237	0.232
4	Cl	0.79	-0.08092	0.28

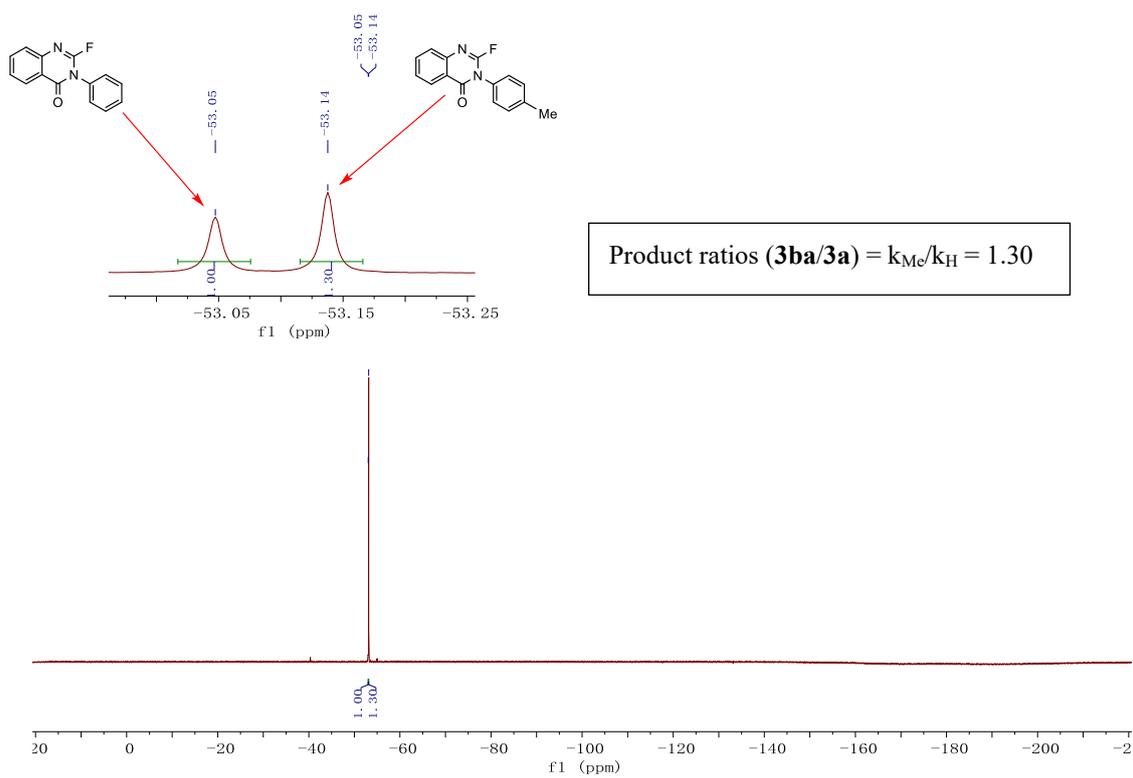


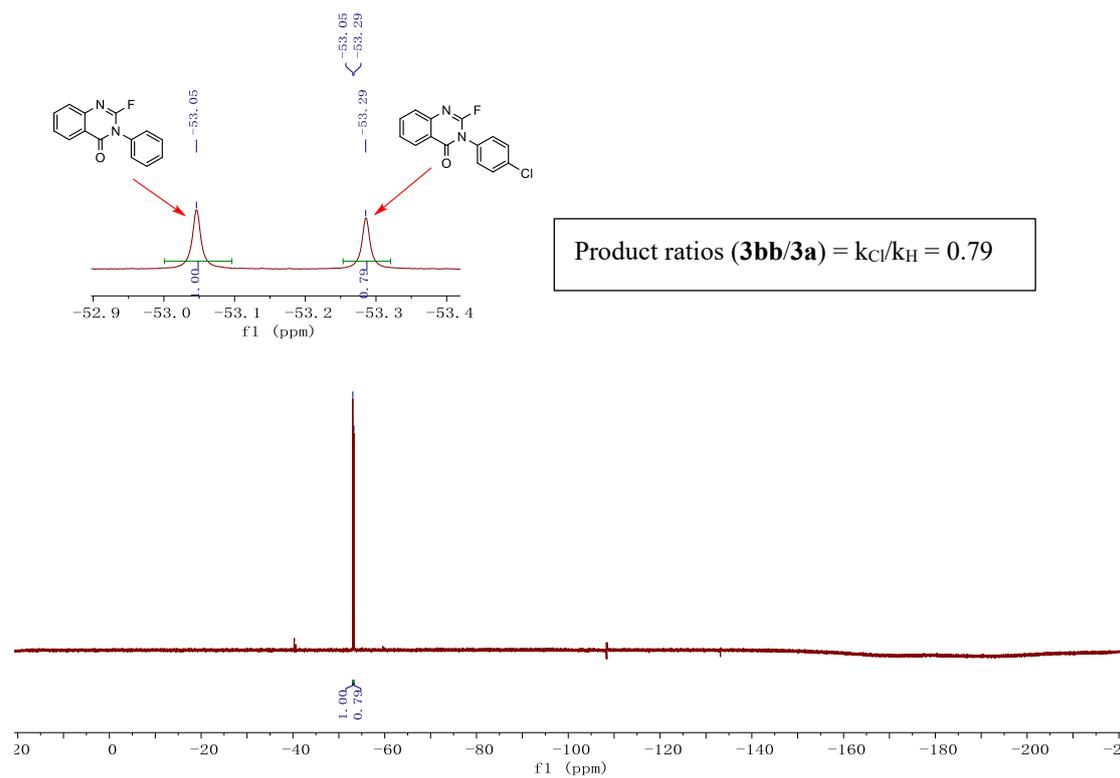
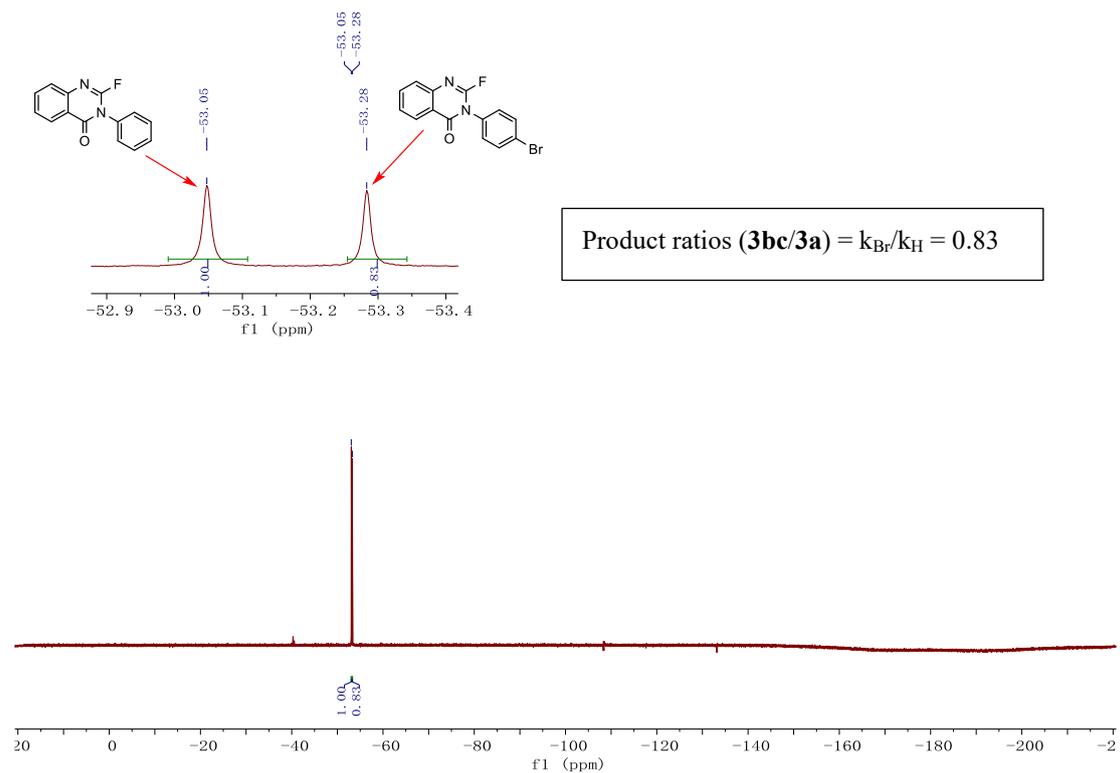


Product ratios (**3bh/3a**) = $k_{\text{OMe}}/k_{\text{H}} = 1.42$



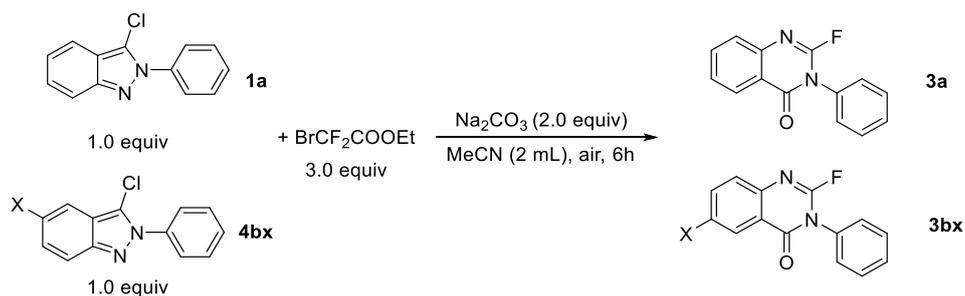
Product ratios (**3ba/3a**) = $k_{\text{Me}}/k_{\text{H}} = 1.30$



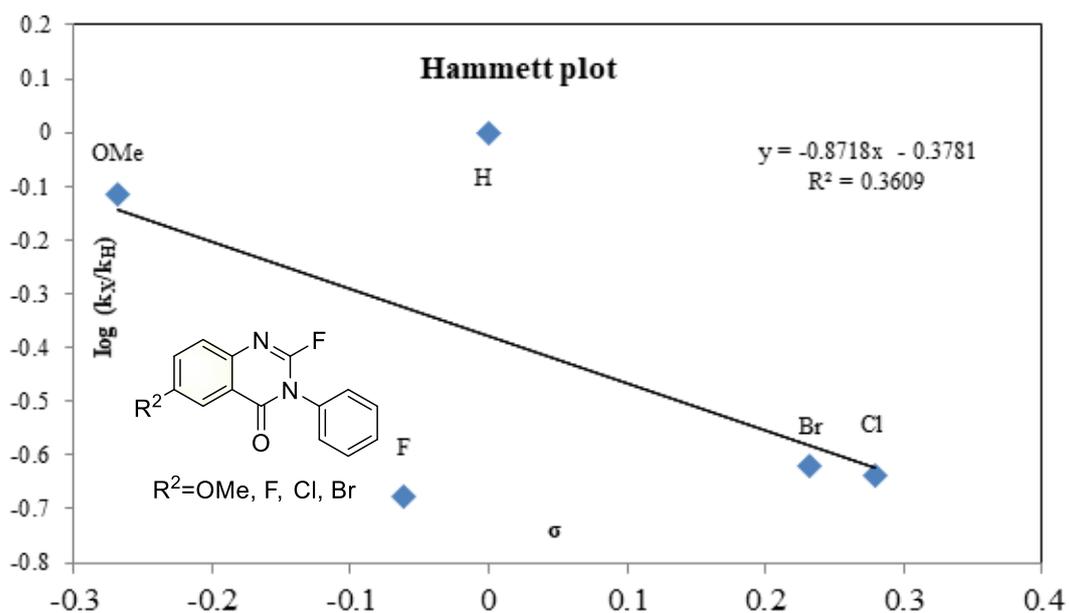


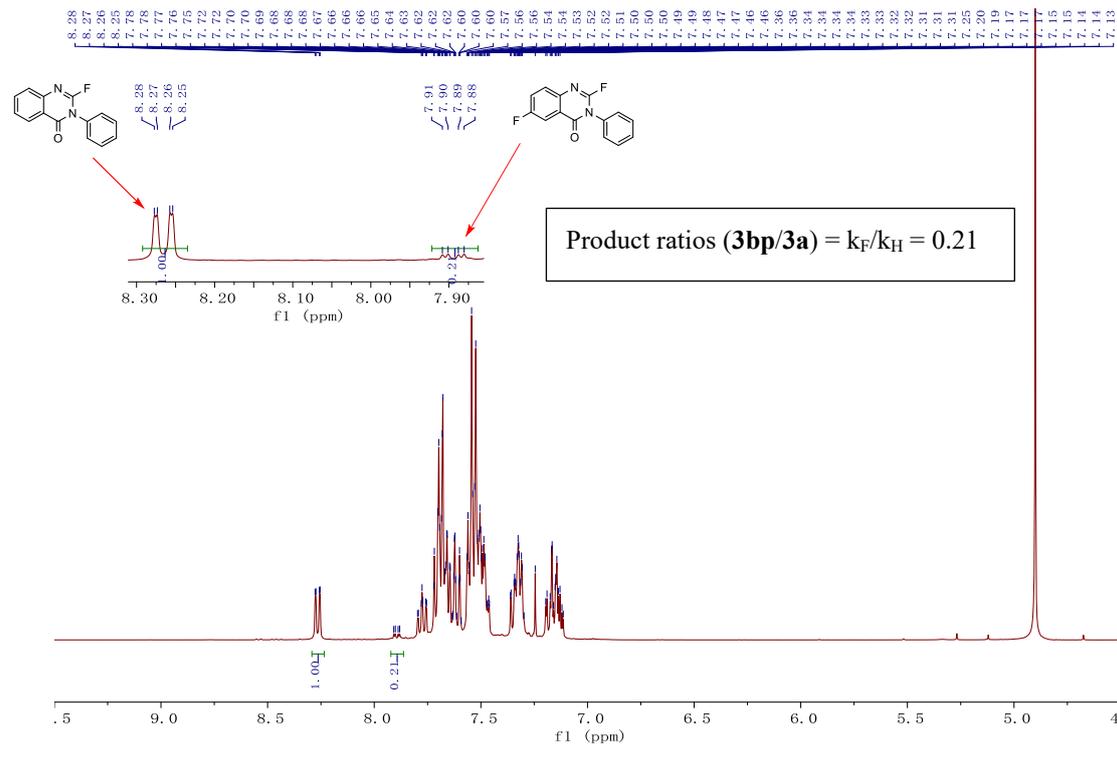
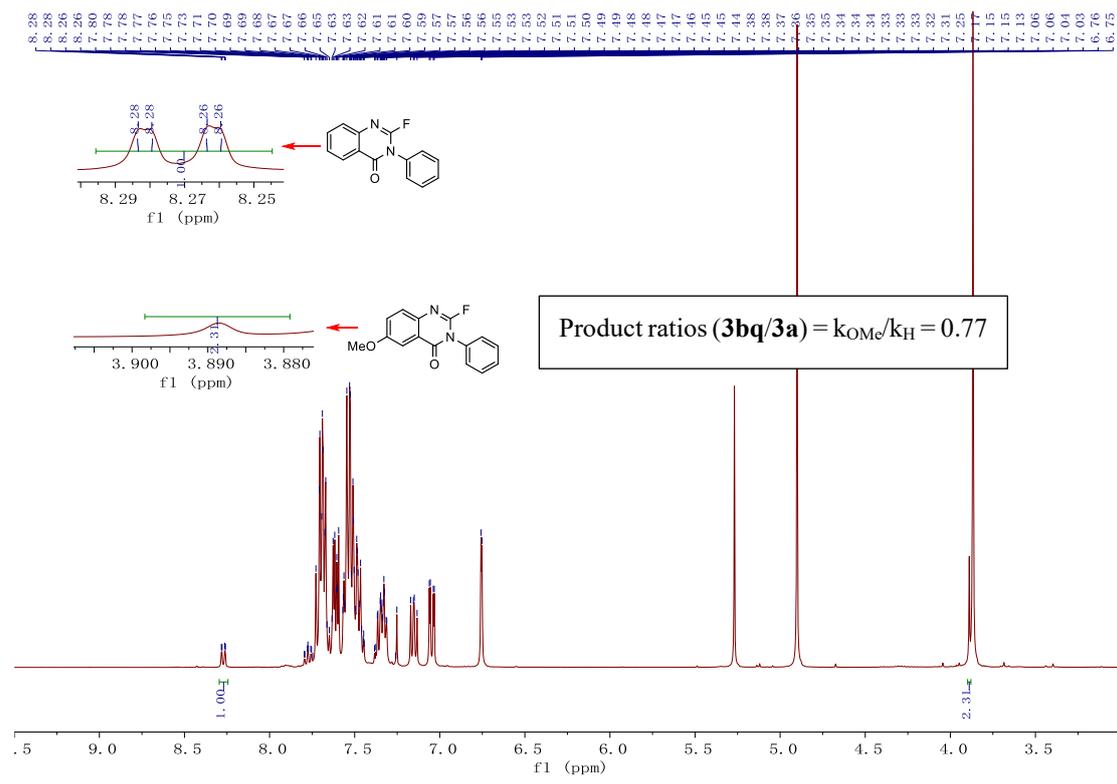
The methodology is the same as that used in Table S2.

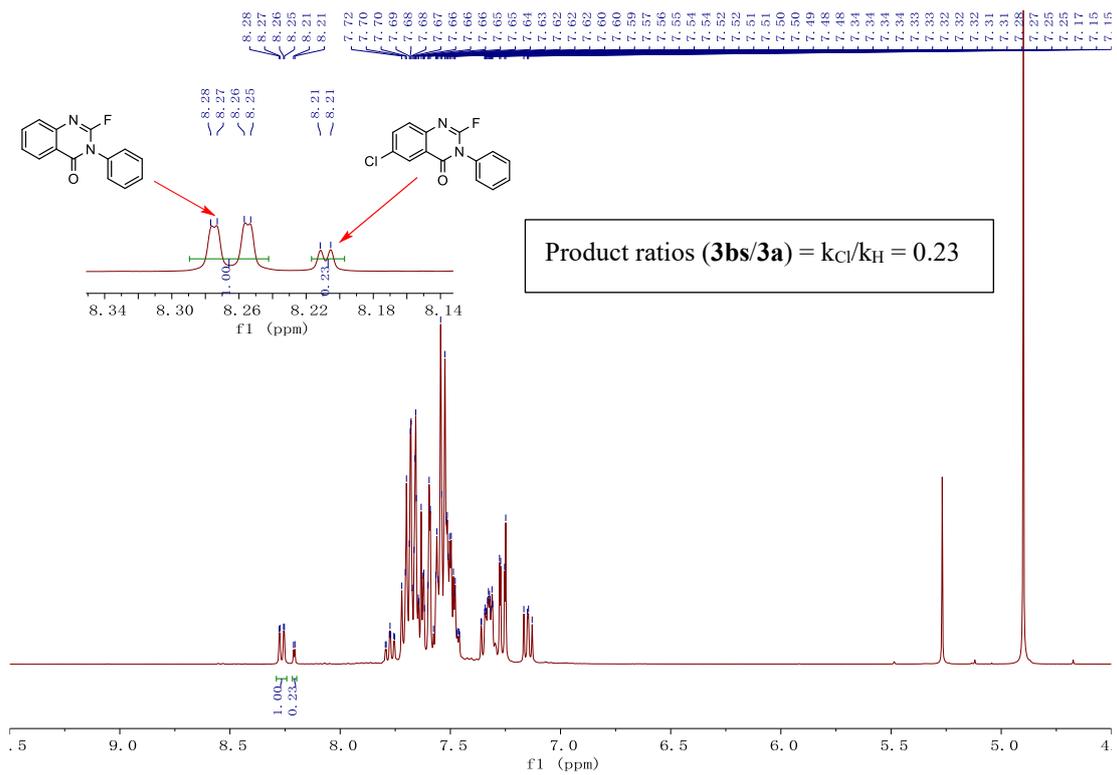
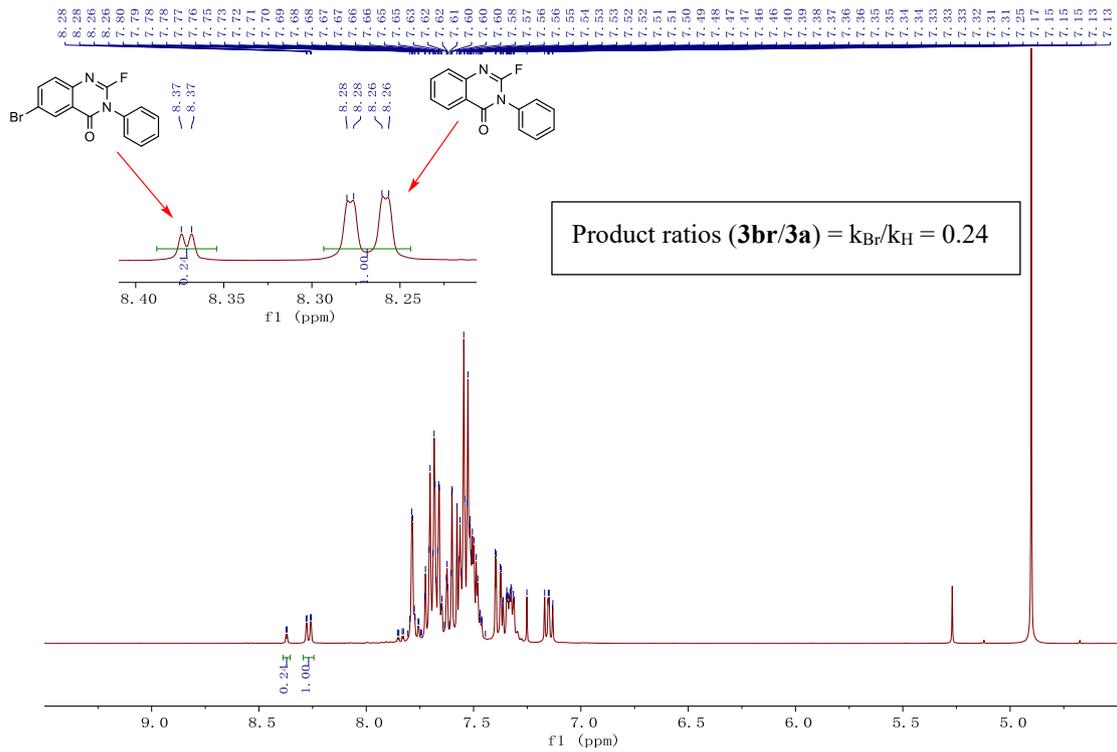
Table S4. Intermolecular competition reactions of BrCF₂COOEt with Position 5 substituted phenylchlorobenzopyrazole



Entry	X	Product ratios (3bx/3a)	Log (K _X /K _H)	σ
1	OMe	0.77	-0.11351	-0.268
2	F	0.21	-0.67778	-0.062
3	Br	0.24	-0.61979	0.232
4	Cl	0.23	-0.63827	0.28







5. X-Ray Crystal Structures

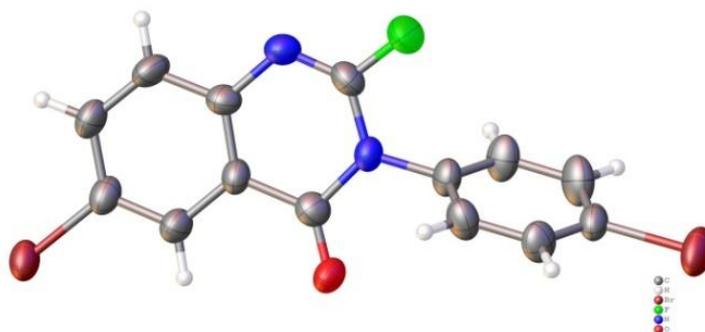
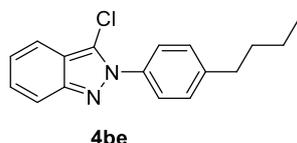


Table s5 Crystal data and structure refinement for compound-3c.

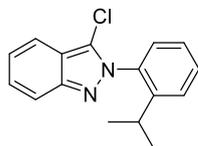
Identification code	Compound-3c
Empirical formula	C ₁₄ H ₇ Br ₂ FN ₂ O
Formula weight	1592.14
Temperature/K	293(2)
Crystal system	triclinic
Space group	P-1
a/Å	11.3057(3)
b/Å	15.3237(5)
c/Å	16.8638(5)
α/°	90.985(3)
β/°	109.561(3)
γ/°	100.644(3)
Volume/Å ³	2695.71(15)
Z	2
ρ _{calc} /cm ³	1.961
μ/mm ⁻¹	7.719
F(000)	1536.0
Crystal size/mm ³	0.3 × 0.15 × 0.1
Radiation	Cu Kα (λ = 1.54184)
2θ range for data collection/°	7.764 to 142.81
Index ranges	-9 ≤ h ≤ 13, -18 ≤ k ≤ 18, -20 ≤ l ≤ 20
Reflections collected	20750
Independent reflections	10255 [R _{int} = 0.0343, R _{sigma} = 0.0390]
Data/restraints/parameters	10255/0/721
Goodness-of-fit on F ²	1.027
Final R indexes [I ≥ 2σ (I)]	R ₁ = 0.0486, wR ₂ = 0.1535
Final R indexes [all data]	R ₁ = 0.0799, wR ₂ = 0.1869
Largest diff. peak/hole / e Å ⁻³	0.96/-0.95

6. Characterization Data



2-(4-butylphenyl)-3-chloro-2H-indazole

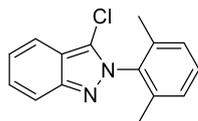
Eluent: PE/EA = 5:1, yellow oil (10.7 mol, 758.5 mg, 25%), ¹H NMR (400 MHz, Chloroform-*d*) δ 7.72 (d, *J* = 8.8 Hz, 1H), 7.63 (dt, *J* = 8.4, 1.2 Hz, 1H), 7.61 – 7.57 (m, 2H), 7.41 – 7.31 (m, 3H), 7.16 (ddd, *J* = 8.6, 6.6, 0.8 Hz, 1H), 2.73 (t, *J* = 4 Hz 2H), 1.73 – 1.61 (m, 2H), 1.40 (h, *J* = 7.3 Hz, 2H), 0.96 (t, *J* = 7.3 Hz, 2H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 148.56, 144.36, 136.29, 129.18, 127.54, 125.59, 122.76, 119.95, 119.55, 119.08, 118.29, 35.45, 33.56, 22.41, 14.06. HRMS (ESI): *m/z* calcd. for C₁₇H₁₇ClN₂Na⁺, [M+Na]⁺ 307.0973; found: 307.0968.



4bl

3-chloro-2-(2-isopropylphenyl)-2H-indazole

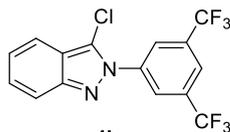
Eluent: PE/EA = 5:1, yellow oil (10.7 mol, 224.4 mg, 8%), ¹H NMR (400 MHz, Chloroform-*d*) δ 7.75 (d, *J* = 8.8 Hz, 1H), 7.66 (d, *J* = 8.5 Hz, 1H), 7.59 – 7.49 (m, 2H), 7.40 – 7.33 (m, 2H), 7.29 (dd, *J* = 7.8, 1.4 Hz, 1H), 7.19 (dd, *J* = 8.5, 6.6 Hz, 1H), 2.53 (hept, *J* = 6.9 Hz, 1H), 1.18 (s, 3H), 1.17 (s, 3H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 146.45, 130.72, 127.92, 127.33, 126.74, 126.41, 122.70, 119.03, 118.49, 28.12. HRMS (ESI): *m/z* calcd. for C₁₆H₁₅ClN₂Na⁺, [M+Na]⁺ : 293.0816; found: 293.0815.



4bt

3-chloro-2-(2,6-dimethylphenyl)-2H-indazole

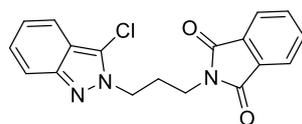
Eluent: PE/EA = 20:1, brownish-yellow oil (10.7 mol, 340.7 mg, 11%), ¹H NMR (400 MHz, Chloroform-*d*) δ 7.76 (dd, *J* = 8.9, 1.0 Hz, 1H), 7.67 (dd, *J* = 8.5, 1.1 Hz, 1H), 7.43 – 7.32 (m, 2H), 7.27 – 7.13 (m, 3H), 1.98 (s, 6H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 148.93, 136.75, 136.20, 130.04, 128.25, 127.19, 122.57, 120.78, 119.04, 118.59, 118.54, 17.26. HRMS (ESI): *m/z* calcd. for C₁₅H₁₄ClN₂⁺, [M+H]⁺ : 257.0841; found: 257.0832.



4bu

2-(3,5-bis(trifluoromethyl)phenyl)-3-chloro-2H-indazole

Eluent: PE/EA = 20:1, yellow solid (10.7 mol, 223.2 mg, 6%, m.p. 51.0 – 51.3 °C), ¹H NMR (400 MHz, Chloroform-*d*) δ 8.30 (s, 2H), 8.01 (s, 1H), 7.72 (d, *J* = 8.9 Hz, 1H), 7.63 (d, *J* = 8.6 Hz, 1H), 7.42 – 7.38 (m, 1H), 7.21 (dd, *J* = 8.6, 6.5 Hz, 1H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 149.41, 139.90, 132.92 (q, *J* = 34.3 Hz), 128.79, 123.91, 120.59, 122.48 (q, *J* = 3.8 Hz), 125.68 (q, *J* = 3.74 Hz), δ 122.68 (q, *J* = 273.912 Hz), 119.18, 118.43. ¹⁹F NMR (376 MHz, CDCl₃) δ -62.9. HRMS (ESI): *m/z* calcd. for C₁₅H₈ClF₆N₂⁺, [M+Na]⁺ : 365.0275; found: 365.0276.

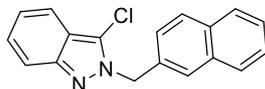


4bx

2-(3-(3-chloro-2H-indazol-2-yl)propyl)isoindoline-1,3-dione

Eluent: PE/EA = 5:1, pale yellow solid (10 mol, 549.1mg, 12%, m.p. 85.7 – 86.8 °C), ¹H NMR (400

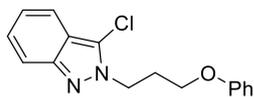
MHz, Chloroform-*d*) δ 7.83 – 7.79 (m, 2H), 7.72 – 7.67 (m, 2H), 7.57 – 7.45 (m, 2H), 7.26 – 7.21 (m, 1H), 7.10 – 7.02 (m, 1H), 4.52 (t, $J = 8.0$ Hz, 2H), 3.84 (t, $J = 6.8$ Hz, 2H), 2.42 (p, $J = 7.0$ Hz, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 168.30, 148.01, 134.14, 132.10, 126.98, 123.41, 122.33, 119.24, 119.03, 118.73, 117.88, 48.39, 35.67, 28.75. HRMS (ESI): m/z calcd. for $\text{C}_{18}\text{H}_{14}\text{ClN}_3\text{O}_2\text{Na}^+$, $[\text{M}+\text{Na}]^+$: 362.0667; found: 362.0657.



4by

3-chloro-2-(naphthalen-2-ylmethyl)-2H-indazole

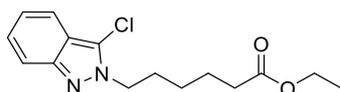
Eluent: PE/EA = 2:1, White solid (5 mol, 522.1mg, 36%, m.p. 96.8 – 97.2 °C), ^1H NMR (400 MHz, Chloroform-*d*) δ 7.80 (dd, $J = 9.1, 3.8$ Hz, 3H), 7.73 (s, 1H), 7.69 (dd, $J = 8.8, 0.9$ Hz, 1H), 7.57 (dt, $J = 8.5, 1.1$ Hz, 1H), 7.51 – 7.42 (m, 2H), 7.42 (dd, $J = 8.5, 1.8$ Hz, 1H), 7.35 – 7.29 (m, 1H), 7.15 – 7.11 (m, 1H), 5.81 (s, 2H). ^{13}C NMR (101 MHz, CDCl_3) δ 148.26, 133.38, 133.15, 132.78, 128.88, 128.12, 127.83, 127.10, 126.93, 126.54, 126.46, 125.34, 122.49, 119.56, 119.32, 118.87, 118.21, 54.58. HRMS (ESI): m/z calcd. for $\text{C}_{18}\text{H}_{14}\text{ClN}_2^+$, $[\text{M}+\text{H}]^+$: 293.0841; found: 293.0843.



4bz

3-chloro-2-(3-phenoxypropyl)-2H-indazole

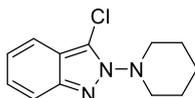
^1H NMR (400 MHz, Chloroform-*d*) δ 7.64 (dt, $J = 8.9, 0.9$ Hz, 1H), 7.55 (dt, $J = 8.6, 1.1$ Hz, 1H), 7.35 – 7.24 (m, 3H), 7.11 (ddd, $J = 8.5, 6.6, 0.8$ Hz, 1H), 6.95 (tt, $J = 7.2, 1.1$ Hz, 1H), 6.91 – 6.83 (m, 2H), 4.68 (t, $J = 6.9$ Hz, 2H), 3.99 (t, $J = 5.8$ Hz, 2H), 2.49 (p, $J = 6.6$ Hz, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 158.71, 148.14, 129.59, 127.02, 122.31, 121.05, 119.61, 118.85, 117.91, 114.63, 64.33, 47.32, 29.83. HRMS (ESI): m/z calcd. for $\text{C}_{16}\text{H}_{16}\text{ClN}_2\text{O}^+$, $[\text{M}+\text{H}]^+$: 287.0945; found: 287.0948.



4ca

ethyl 6-(3-chloro-2H-indazol-2-yl) hexanoate

^1H NMR (400 MHz, Chloroform-*d*) δ 7.63 (d, $J = 8.8$ Hz, 1H), 7.54 (d, $J = 8.5$ Hz, 1H), 7.37 – 7.22 (m, 1H), 7.14 – 7.03 (m, 1H), 4.44 (t, $J = 7.2$ Hz, 2H), 4.10 (q, $J = 7.2$ Hz, 2H), 2.29 (t, $J = 7.5$ Hz, 2H), 2.00 (p, $J = 7.4$ Hz, 2H), 1.72 – 1.64 (m, 2H), 1.45 – 1.33 (m, 2H), 1.22 (t, $J = 7.1$ Hz, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 34.16, 29.77, 26.16, 24.56, 14.34. HRMS (ESI): m/z calcd. for $\text{C}_{15}\text{H}_{20}\text{ClN}_2\text{O}_2^+$, $[\text{M}+\text{H}]^+$: 295.1208; found: 295.1210.

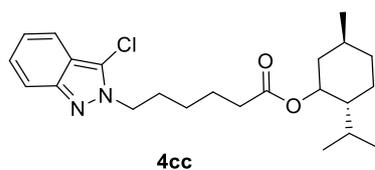


4cb

3-chloro-2-(piperidin-1-yl)-2H-indazole

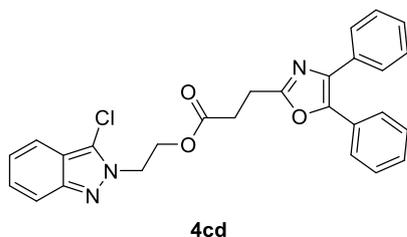
^1H NMR (400 MHz, Chloroform-*d*) δ 7.63 (d, $J = 8.8$ Hz, 1H), 7.56 (d, $J = 8.4$ Hz, 1H), 7.33 – 7.29 (m, 1H), 7.10 (dd, $J = 8.4, 6.6$ Hz, 1H), 3.56 – 2.90 (m, 4H), 1.86 (p, $J = 5.7$ Hz, 4H), 1.60 (q, $J = 6.0$ Hz, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 145.53, 126.98, 122.19, 119.08, 117.89, 117.50, 117.24,

56.23, 26.00, 23.45. HRMS (ESI): m/z calcd. for $C_{12}H_{15}ClN_3^+$, $[M+H]^+$: 236.0950; found: 236.0951



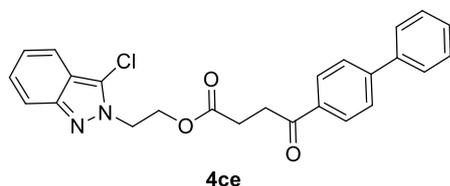
(2R,5S)-2-isopropyl-5-methylcyclohexyl 6-(3-chloro-2H-indazol-2-yl)hexanoate

Eluent: PE/EA = 5:1, brown oil (1.69 mol, 530.9 mg, 78%), 1H NMR (400 MHz, Chloroform-*d*) δ 7.63 (d, J = 8.8 Hz, 1H), 7.53 (d, J = 8.9 Hz, 1H), 7.28 (dd, J = 8.7, 6.4 Hz, 1H), 7.13 – 7.06 (m, 1H), 4.65 (td, J = 10.9, 4.4 Hz, 1H), 4.43 (t, J = 7.3 Hz, 2H), 2.27 (t, J = 7.4 Hz, 2H), 2.00 (p, J = 7.5 Hz, 3H), 1.82 (td, J = 6.9, 2.6 Hz, 1H), 1.66 (dt, J = 14.5, 5.3 Hz, 4H), 1.53 – 1.31 (m, 4H), 0.87 (dd, J = 6.8, 3.1 Hz, 9H), 0.73 (d, J = 7.0 Hz, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 173.10, 126.88, 122.24, 118.97, 118.75, 117.91, 74.19, 50.35, 47.11, 41.05, 34.54, 34.37, 31.49, 29.79, 26.41, 26.20, 24.71, 23.54, 22.14, 20.87, 16.42. HRMS (ESI): m/z calcd. for $C_{23}H_{34}ClN_2O_2^+$, $[M+H]^+$: 405.2304; found: 405.2312.



2-(3-chloro-2H-indazol-2-yl) ethyl 3-(4,5-diphenyloxazol-2-yl)propanoate

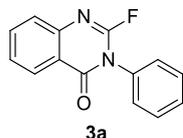
Eluent: PE/EA = 5:1, pale yellow solid (10 mol, 549.1mg, 12%, m.p. 85.7 – 86.8 °C), 1H NMR (400 MHz, Chloroform-*d*) δ 7.66 – 7.59 (m, 3H), 7.55 (td, J = 6.2, 3.3 Hz, 3H), 7.33 (dddd, J = 16.3, 9.0, 6.5, 4.1 Hz, 7H), 7.11 (dd, J = 8.5, 6.6 Hz, 1H), 4.78 – 4.69 (m, 2H), 4.69 – 4.62 (m, 2H), 3.14 (t, J = 7.6 Hz, 2H), 2.89 (d, J = 15.1 Hz, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 171.73, 161.58, 148.39, 145.57, 132.52, 129.04, 128.76, 128.67, 128.59, 128.18, 128.01, 127.29, 126.58, 122.53, 120.06, 118.96, 118.89, 117.96, 62.84, 49.04, 30.99, 23.42. HRMS (ESI): m/z calcd. for $C_{25}H_{22}ClN_2O_3^+$, $[M+H]^+$: 433.1314; found: 433.1301.



2-(3-chloro-2H-indazol-2-yl) ethyl 4-([1,1'-biphenyl]-4-yl)-4-oxobutanoate

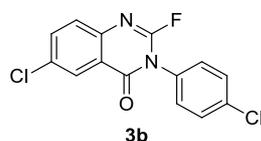
Eluent: PE/EA = 2:1, White solid (5 mol, 631.3mg, 29%, m.p. 68.8 – 69.2 °C), 1H NMR (400 MHz, Chloroform-*d*) δ 7.99 (d, J = 8.3 Hz, 2H), 7.70 – 7.58 (m, 5H), 7.55 (d, J = 8.5 Hz, 1H), 7.48 (t, J = 7.5 Hz, 2H), 7.46 – 7.36 (m, 1H), 7.34 – 7.28 (m, 1H), 7.11 (dd, J = 8.5, 6.6 Hz, 1H), 4.72 (t, J = 5.1 Hz, 2H), 4.64 (t, J = 5.1 Hz, 2H), 3.28 (t, J = 6.7 Hz, 2H), 2.76 (t, J = 6.7 Hz, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.47, 172.58, 148.36, 146.03, 139.95, 135.21, 129.08, 128.71, 128.38, 127.38,

127.36, 127.23, 122.48, 120.09, 118.98, 118.89, 117.98, 62.64, 49.09, 33.37, 28.25. HRMS (ESI): m/z calcd. for $C_{25}H_{22}ClN_2O_3^+$, $[M+H]^+$: 433.1314; found: 433.1301.



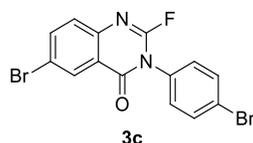
2-fluoro-3-phenylquinazolin-4(3H)-one

Eluent: PE/EA = 10:1, yellowish solid (34.6 mg, 72%, m.p. 158 – 159 °C). 1H NMR (400 MHz, $CDCl_3$) δ 8.29 (dd, $J = 8.0, 1.5$ Hz, 1H), 7.85 – 7.76 (m, 1H), 7.66 (dd, $J = 8.2, 1.1$ Hz, 1H), 7.60 – 7.48 (m, 4H), 7.36 – 7.32 (m, 2H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 162.4, 148.5 (d, $J = 233.5$ Hz), 145.4 (d, $J = 18.8$ Hz), 135.6, 133.0, 129.9, 129.9, 128.1, 128.0, 127.1, 126.9, 120.3 (d, $J = 3.4$ Hz). ^{19}F NMR (376 MHz, $CDCl_3$) δ -53.1. HRMS (ESI): m/z calcd. for $C_{14}H_{10}FN_2O^+$, $[M+H]^+$: 241.0772; found: 241.0773.



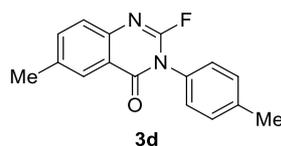
6-chloro-3-(4-chlorophenyl)-2-fluoroquinazolin-4(3H)-one

Eluent: PE/EA = 40:1, yellowish solid (20.9 mg, 34%, m.p. 218 – 219 °C). 1H NMR (400 MHz, $CDCl_3$) δ 8.22 (d, $J = 2.4$ Hz, 1H), 7.74 (dd, $J = 8.6, 2.5$ Hz, 1H), 7.59 (d, $J = 8.7$ Hz, 1H), 7.56 – 7.52 (m, 2H), 7.30 – 7.25 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.2, 148.2 (d, $J = 234.5$ Hz), 143.8 (d, $J = 19.0$ Hz), 136.3, 136.1, 133.2 (d, $J = 2.1$ Hz), 131.0, 130.2, 129.3, 128.5 (d, $J = 2.1$ Hz), 127.4, 121.3 (d, $J = 4.2$ Hz). ^{19}F NMR (376 MHz, $CDCl_3$) δ -53.0. HRMS (ESI): m/z calcd. for $C_{14}H_8Cl_2FN_2O^+$, $[M+H]^+$: 308.9992; found: 308.9993.



6-bromo-3-(4-bromophenyl)-2-fluoroquinazolin-4(3H)-one

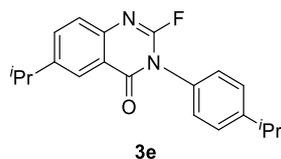
Eluent: PE/EA = 40:1, yellowish solid (31.6 mg, 40%, m.p. 214 – 215 °C). 1H NMR (400 MHz, $CDCl_3$) δ 8.36 (d, $J = 2.3$ Hz, 1H), 7.87 (dd, $J = 8.6, 2.3$ Hz, 1H), 7.71 – 7.67 (m, 2H), 7.51 (d, $J = 8.6$ Hz, 1H), 7.23 – 7.17 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.0, 148.2 (d, $J = 234.3$ Hz), 144.2 (d, $J = 19.5$ Hz), 138.9, 133.2, 131.6, 130.5, 129.5, 128.7 (d, $J = 2.1$ Hz), 124.4, 121.6 (d, $J = 3.7$ Hz), 120.7 (d, $J = 2.2$ Hz). ^{19}F NMR (376 MHz, $CDCl_3$) δ -52.6. HRMS (ESI): m/z calcd. for $C_{14}H_7Br_2FN_2NaO^+$, $[M+Na]^+$: 418.8801; found: 418.8801.



2-fluoro-6-methyl-3-(p-tolyl)quinazolin-4(3H)-one

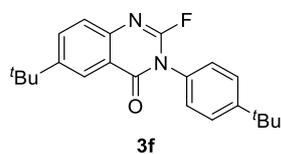
Eluent: PE/EA = 20:1, light yellow solid (30.0 mg, 56%, m.p. 120 – 121 °C). 1H NMR (600 MHz, $CDCl_3$) δ 8.05 (s, 1H), 7.59 (dd, $J = 8.2, 2.1$ Hz, 1H), 7.53 (d, $J = 8.4$ Hz, 1H), 7.34 (d, $J = 8.1$ Hz, 2H), 7.22 – 7.18 (m, 2H), 2.48 (s, 3H), 2.44 (s, 3H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 162.5, 148.2 (d, $J = 231.9$ Hz), 143.2 (d, $J = 18.7$ Hz), 139.9, 137.1 (d, $J = 1.6$ Hz), 136.9, 130.4, 127.6, 127.4, 126.6 (d, $J = 1.6$ Hz),

120.0 (d, $J = 3.4$ Hz), 21.4, 21.3. ^{19}F NMR (376 MHz, CDCl_3) δ -54.4. HRMS (ESI): m/z calcd. for $\text{C}_{16}\text{H}_{14}\text{FN}_2\text{O}^+$, $[\text{M}+\text{H}]^+$: 269.1085; found: 269.1083.



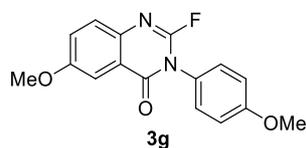
2-fluoro-6-isopropyl-3-(4-isopropylphenyl)quinazolin-4(3H)-one

Eluent: PE/EA = 10:1, yellow oil (55.7 mg, 86%). ^1H NMR (400 MHz, CDCl_3) δ 8.11 (d, $J = 2.1$ Hz, 1H), 7.68 (dd, $J = 8.4, 2.2$ Hz, 1H), 7.58 (d, $J = 8.4$ Hz, 1H), 7.42 – 7.38 (m, 2H), 7.25 – 7.18 (m, 2H), 3.13 – 2.94 (m, 2H), 1.32 (d, $J = 3.3$ Hz, 6H), 1.30 (d, $J = 3.3$ Hz, 6H). ^{13}C NMR (100 MHz, CDCl_3) δ 162.7 (d, $J = 1.9$ Hz), 150.6, 148.4 (d, $J = 232.3$ Hz), 148.1 (d, $J = 1.5$ Hz), 143.5 (d, $J = 18.9$ Hz), 134.5, 130.6, 127.9, 127.7, 126.8 (d, $J = 2.3$ Hz), 125.0, 120.1 (d, $J = 3.6$ Hz), 34.1, 24.0, 24.0. ^{19}F NMR (376 MHz, CDCl_3) δ -54.2. HRMS (ESI): m/z calcd. for $\text{C}_{20}\text{H}_{22}\text{FN}_2\text{O}^+$, $[\text{M}+\text{H}]^+$: 325.1711; found: 325.1704.



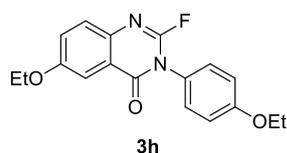
6-(tert-butyl)-3-(4-(tert-butyl)phenyl)-2-fluoroquinazolin-4(3H)-one

Eluent: PE/EA = 20:1, light yellow solid (43.6 mg, 62%, m.p. 154 – 155 °C). ^1H NMR (400 MHz, CDCl_3) δ 8.26 (d, $J = 2.3$ Hz, 1H), 7.86 (dd, $J = 8.6, 2.4$ Hz, 1H), 7.59 (d, $J = 8.6$ Hz, 1H), 7.57 – 7.53 (m, 2H), 7.26 – 7.20 (m, 2H), 1.40 (s, 9H), 1.38 (s, 9H). ^{13}C NMR (100 MHz, CDCl_3) δ 162.7 (d, $J = 2.0$ Hz), 152.8, 150.4 (d, $J = 2.0$ Hz), 148.4 (d, $J = 232.5$ Hz), 143.2 (d, $J = 18.4$ Hz), 133.4, 130.4, 127.3, 126.7, 126.5 (d, $J = 2.1$ Hz), 123.8, 119.7 (d, $J = 3.7$ Hz), 35.1, 35.0, 31.4, 31.4. ^{19}F NMR (376 MHz, CDCl_3) δ -54.1. HRMS (ESI): m/z calcd. for $\text{C}_{22}\text{H}_{26}\text{FN}_2\text{O}^+$, $[\text{M}+\text{H}]^+$: 353.2024; found: 353.2024.



2-fluoro-6-methoxy-3-(4-methoxyphenyl)quinazolin-4(3H)-one

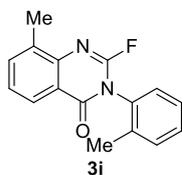
Eluent: PE/EA = 20:1, light yellow solid (54.0 mg, 90%, m.p. 126 – 127 °C). ^1H NMR (400 MHz, CDCl_3) δ 7.62 (d, $J = 3.0$ Hz, 1H), 7.55 (d, $J = 8.9$ Hz, 1H), 7.36 (dd, $J = 8.9, 2.9$ Hz, 1H), 7.23 (d, $J = 8.9$ Hz, 2H), 7.04 (d, $J = 8.9$ Hz, 2H), 3.90 (s, 3H), 3.87 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 162.3 (d, $J = 2.1$ Hz), 160.3, 158.3 (d, $J = 1.6$ Hz), 147.4 (d, $J = 230.8$ Hz), 139.3 (d, $J = 18.8$ Hz), 128.9, 128.0 (d, $J = 1.5$ Hz), 125.5, 125.2, 120.8 (d, $J = 4.1$ Hz), 114.9, 107.6, 55.8, 55.6. ^{19}F NMR (376 MHz, CDCl_3) δ -56.2. HRMS (ESI): m/z calcd. for $\text{C}_{16}\text{H}_{13}\text{FN}_2\text{NaO}_3^+$, $[\text{M}+\text{H}]^+$: 323.0802; found: 323.0816.



6-ethoxy-3-(4-ethoxyphenyl)-2-fluoroquinazolin-4(3H)-one

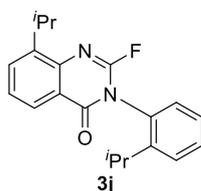
Eluent: PE/EA = 20:1, light yellow solid (56.4 mg, 86%, m.p. 145 – 146 °C). ^1H NMR (600 MHz, CDCl_3) δ 7.60 (d, $J = 2.9$ Hz, 1H), 7.54 (d, $J = 8.8$ Hz, 1H), 7.36 (dd, $J = 8.9, 2.9$ Hz, 1H), 7.23 – 7.18 (m, 2H), 7.05 – 6.98 (m, 2H), 4.16 – 4.05 (m, 4H), 1.48 – 1.42 (m, 6H). ^{13}C NMR (100 MHz, CDCl_3) δ 162.4 (d, $J = 2.1$ Hz), 159.7, 157.7 (d, $J = 1.9$ Hz), 147.4 (d, $J = 230.5$ Hz), 139.2 (d, $J = 18.8$ Hz), 128.9, 128.0

(d, $J = 2.0$ Hz), 125.5, 125.3, 120.9 (d, $J = 4.0$ Hz), 115.4, 108.3, 64.2, 63.9, 14.8, 14.7. ^{19}F NMR (376 MHz, CDCl_3) δ -56.3. HRMS (ESI): m/z calcd. for $\text{C}_{18}\text{H}_{17}\text{FN}_2\text{NaO}_3^+$, $[\text{M}+\text{Na}]^+$: 351.1115; found: 351.1115.



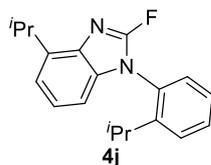
2-fluoro-8-methyl-3-(o-tolyl)quinazolin-4(3H)-one

Eluent: PE/EA = 20:1, light yellow solid (43.9 mg, 82%, m.p. 147 – 148 °C). ^1H NMR (400 MHz, CDCl_3) δ 8.14 (d, $J = 7.9$ Hz, 1H), 7.65 (d, $J = 7.3$ Hz, 1H), 7.46 – 7.34 (m, 4H), 7.22 (d, $J = 7.7$ Hz, 1H), 2.60 (s, 3H), 2.18 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 162.4 (d, $J = 1.4$ Hz), 147.7 (d, $J = 231.1$ Hz), 144.3 (d, $J = 17.5$ Hz), 136.2, 135.8, 135.5 (d, $J = 2.2$ Hz), 132.5, 131.5, 130.1, 128.2, 127.4, 126.5 (d, $J = 1.2$ Hz), 125.7, 120.3 (d, $J = 3.7$ Hz), 17.5, 17.3. ^{19}F NMR (376 MHz, CDCl_3) δ -54.0. HRMS (ESI): m/z calcd. for $\text{C}_{16}\text{H}_{13}\text{FN}_2\text{NaO}^+$, $[\text{M}+\text{Na}]^+$: 291.0904; found: 291.0904.



2-fluoro-8-isopropyl-3-(2-isopropylphenyl)quinazolin-4(3H)-one

Eluent: PE/EA = 10:1, white solid (20.7 mg, 32%, m.p. 113 – 114 °C). ^1H NMR (400 MHz, CDCl_3) δ 8.16 (dd, $J = 7.9, 1.5$ Hz, 1H), 7.74 (d, $J = 7.4$ Hz, 1H), 7.52 (d, $J = 4.3$ Hz, 2H), 7.48 (t, $J = 7.7$ Hz, 1H), 7.41 – 7.31 (m, 1H), 7.18 (d, $J = 7.8$ Hz, 1H), 3.98 – 3.86 (m, 1H), 2.78 – 2.66 (m, 1H), 1.35 (dd, $J = 8.5, 6.9$ Hz, 6H), 1.22 (d, $J = 6.8$ Hz, 6H). ^{13}C NMR (100 MHz, CDCl_3) δ 162.9 (d, $J = 1.9$ Hz), 147.9 (d, $J = 229.4$ Hz), 146.3, 145.7 (d, $J = 2.7$ Hz), 143.0 (d, $J = 17.6$ Hz), 131.9, 130.9, 130.5, 128.1, 127.2 (d, $J = 4.1$ Hz), 126.8, 125.6, 120.3 (d, $J = 4.2$ Hz), 28.7, 27.3, 23.7, 23.7, 23.6, 23.3. ^{19}F NMR (376 MHz, CDCl_3) δ -53.0. HRMS (ESI): m/z calcd. for $\text{C}_{20}\text{H}_{21}\text{FN}_2\text{NaO}^+$, $[\text{M}+\text{Na}]^+$: 347.1530; found: 347.1530.



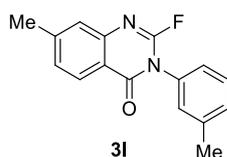
2-fluoro-4-isopropyl-1-(2-isopropylphenyl)-1H-benzo[d]imidazole

Eluent: PE/EA = 10:1, yellow oil (27.2 mg, 46%). ^1H NMR (400 MHz, CDCl_3) δ 7.52 (dd, $J = 5.5, 2.0$ Hz, 2H), 7.45 (d, $J = 8.4$ Hz, 1H), 7.40 – 7.32 (m, 2H), 7.15 (d, $J = 6.8$ Hz, 1H), 7.07 (dd, $J = 8.4, 6.8$ Hz, 1H), 3.70 – 3.58 (m, 1H), 2.74 – 2.63 (m, 1H), 1.42 (d, $J = 6.9$ Hz, 6H), 1.21 (d, $J = 6.9$ Hz, 6H). ^{13}C NMR (100 MHz, CDCl_3) δ 148.1, 146.4 (d, $J = 4.3$ Hz), 145.9 (d, $J = 120.7$ Hz), 138.5, 134.5 (d, $J = 2.1$ Hz), 130.6, 127.8, 126.9, 126.6, 122.2 (d, $J = 2.3$ Hz), 121.8 (d, $J = 1.7$ Hz), 115.3 (d, $J = 5.0$ Hz), 103.5 (d, $J = 13.1$ Hz), 28.5, 28.3, 23.8, 22.7. ^{19}F NMR (376 MHz, CDCl_3) δ -134.4. HRMS (ESI): m/z calcd. for $\text{C}_{19}\text{H}_{22}\text{FN}_2^+$, $[\text{M}+\text{H}]^+$: 297.1762; found: 297.1760.



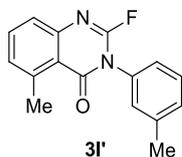
2-fluoro-4-methoxy-1-(2-methoxyphenyl)-1H-benzo[d]imidazole

Eluent: PE/EA = 10:1, yellow oil (22.8 mg, 42%). ¹H NMR (400 MHz, CDCl₃) δ 7.55 (dd, *J* = 7.8, 1.7 Hz, 1H), 7.49 – 7.40 (m, 1H), 7.14 (d, *J* = 8.5 Hz, 1H), 7.10 – 7.01 (m, 2H), 6.95 (dd, *J* = 8.5, 7.3 Hz, 1H), 6.53 (d, *J* = 7.2 Hz, 1H), 3.98 (s, 3H), 3.78 (s, 3H). ¹³C NMR (100 MHz, CDCl₃) δ 154.1, 149.8 (d, *J* = 2.8 Hz), 147.0 (d, *J* = 285.1 Hz), 141.5 (d, *J* = 8.7 Hz), 131.2, 128.7, 125.6 (d, *J* = 2.7 Hz), 122.1 (d, *J* = 2.7 Hz), 120.7, 111.9, 109.8 (d, *J* = 4.5 Hz), 105.2 (d, *J* = 14.4 Hz), 103.4 (d, *J* = 2.1 Hz), 56.0, 55.4. ¹⁹F NMR (376 MHz, CDCl₃) δ -131.4. HRMS (ESI): *m/z* calcd. for C₁₅H₁₄FN₂O₂⁺, [M+H]⁺: 273.1034; found: 273.1035.



2-fluoro-7-methyl-3-(m-tolyl)quinazolin-4(3H)-one

Eluent: PE/EA = 20:1, light yellow solid (20.4 mg, 38%, m.p. 112 – 113 °C). ¹H NMR (400 MHz, CDCl₃) δ 8.16 (d, *J* = 8.1 Hz, 1H), 7.46 – 7.40 (m, 2H), 7.34 – 7.29 (m, 2H), 7.12 (d, *J* = 8.6 Hz, 2H), 2.52 (s, 3H), 2.43 (s, 3H). ¹³C NMR (100 MHz, CDCl₃) δ 162.4, 148.7 (d, *J* = 232.6 Hz), 146.9, 145.5 (d, *J* = 18.9 Hz), 140.0, 133.0, 130.7, 129.6, 128.5, 127.8, 126.7 (d, *J* = 1.7 Hz), 124.9, 117.9 (d, *J* = 3.7 Hz), 22.1, 21.4. ¹⁹F NMR (376 MHz, CDCl₃) δ -53.2. HRMS (ESI): *m/z* calcd. for C₁₆H₁₃FN₂NaO⁺, [M+Na]⁺: 291.0904; found: 291.0906.



2-fluoro-5-methyl-3-(m-tolyl)quinazolin-4(3H)-one

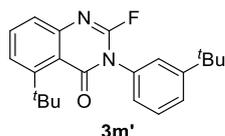
Eluent: PE/EA = 20:1, light yellow solid (21.4 mg, 40%, m.p. 118 – 119 °C). ¹H NMR (400 MHz, CDCl₃) δ 7.61 (t, *J* = 7.8 Hz, 1H), 7.50 – 7.40 (m, 2H), 7.35 – 7.29 (m, 1H), 7.28 – 7.23 (m, 1H), 7.12 (d, *J* = 8.0 Hz, 2H), 2.82 (s, 3H), 2.43 (s, 3H). ¹³C NMR (100 MHz, CDCl₃) δ 163.0, 148.4 (d, *J* = 233.2 Hz), 147.0 (d, *J* = 18.9 Hz), 142.6, 140.1, 134.5, 133.1, 130.6, 129.8 (d, *J* = 1.4 Hz), 129.7, 128.6, 125.0, 120.6, 118.7 (d, *J* = 4.2 Hz), 22.9, 21.5. ¹⁹F NMR (376 MHz, CDCl₃) δ -53.9. HRMS (ESI): *m/z* calcd. for C₁₆H₁₃FN₂NaO⁺, [M+Na]⁺: 291.0904; found: 291.0903.



7-(tert-butyl)-3-(3-(tert-butyl)phenyl)-2-fluoroquinazolin-4(3H)-one

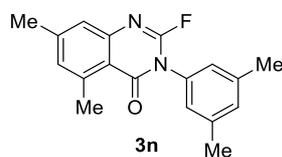
Eluent: PE/EA = 40:1, light yellow solid (26.8 mg, 38%, m.p. 154 – 155 °C). ¹H NMR (400 MHz, CDCl₃) δ 8.20 (d, *J* = 8.4 Hz, 1H), 7.64 (d, *J* = 1.8 Hz, 1H), 7.58 – 7.52 (m, 2H), 7.47 (t, *J* = 7.8 Hz, 1H), 7.29 (t, *J* = 2.0 Hz, 1H), 7.15 – 7.11 (m, 1H), 1.40 (s, 9H), 1.35 (s, 9H). ¹³C NMR (100 MHz, CDCl₃) δ 162.3, 159.9, 153.2, 148.8 (d, *J* = 233.1 Hz), 145.4 (d, *J* = 18.8 Hz), 132.8, 129.3, 127.6, 126.9, 124.9, 124.9,

123.2 (d, $J = 2.1$ Hz), 117.7 (d, $J = 3.6$ Hz), 35.6, 35.0, 31.3, 31.1. ^{19}F NMR (376 MHz, CDCl_3) δ -53.3. HRMS (ESI): m/z calcd. for $\text{C}_{22}\text{H}_{25}\text{FN}_2\text{NaO}^+$, $[\text{M}+\text{H}]^+$: 375.1843; found: 375.1840.



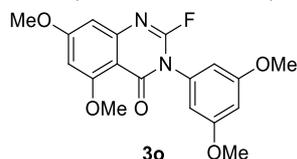
5-(*tert*-butyl)-3-(3-(*tert*-butyl)phenyl)-2-fluoroquinazolin-4(3*H*)-one

Eluent: PE/EA = 40:1, light yellow solid (33.1 mg, 47%, m.p. 166 – 167 °C). ^1H NMR (400 MHz, $(\text{CD}_3)_2\text{CO}$) δ 7.76 – 7.58 (m, 4H), 7.55 – 7.45 (m, 2H), 7.39 – 7.34 (m, 1H), 1.53 (s, 9H), 1.37 (s, 9H). ^{13}C NMR (100 MHz, $(\text{CD}_3)_2\text{CO}$) δ 162.6 (d, $J = 2.6$ Hz), 154.2, 153.6, 149.3 (d, $J = 229.5$ Hz), 149.9 (d, $J = 20.0$ Hz), 135.1, 134.9, 129.9, 127.0 (d, $J = 3.8$ Hz), 126.4, 126.2, 120.4 (d, $J = 5.0$ Hz), 37.8, 35.5, 31.6, 31.6. ^{19}F NMR (376 MHz, $(\text{CD}_3)_2\text{CO}$) δ -57.4. HRMS (ESI): m/z calcd. for $\text{C}_{22}\text{H}_{26}\text{FN}_2\text{O}^+$, $[\text{M}+\text{H}]^+$: 353.2024; found: 353.2025.



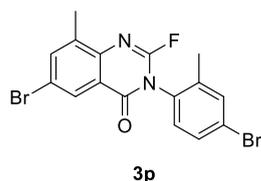
3-(3,5-dimethylphenyl)-2-fluoro-5,7-dimethylquinazolin-4(3*H*)-one

Eluent: PE/EA = 20:1, light yellow solid (54.5 mg, 92%, m.p. 179 – 180 °C). ^1H NMR (600 MHz, CDCl_3) δ 7.26 (s, 1H), 7.13 (s, 1H), 7.07 (s, 1H), 6.92 (s, 2H), 2.78 (s, 3H), 2.44 (s, 3H), 2.38 (s, 6H). ^{13}C NMR (150 MHz, CDCl_3) δ 162.9 (d, $J = 1.6$ Hz), 148.5 (d, $J = 232.9$ Hz), 147.1 (d, $J = 19.2$ Hz), 145.5, 142.1, 139.7, 133.0, 131.5, 131.2, 125.6, 124.9, 116.2 (d, $J = 3.5$ Hz), 22.7, 21.7, 21.3. ^{19}F NMR (565 MHz, CDCl_3) δ -54.1. HRMS (ESI): m/z calcd. for $\text{C}_{18}\text{H}_{18}\text{FN}_2\text{O}^+$, $[\text{M}+\text{H}]^+$: 297.1398; found: 297.1398.



3-(3,5-dimethoxyphenyl)-2-fluoro-5,7-dimethoxyquinazolin-4(3*H*)-one

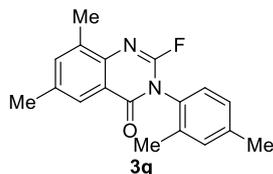
Eluent: PE/EA = 2:1, light yellow solid (53.3 mg, 74%, m.p. 177 – 178 °C). ^1H NMR (400 MHz, CDCl_3) δ 6.62 (d, $J = 2.3$ Hz, 1H), 6.56 (t, $J = 2.3$ Hz, 1H), 6.43 (d, $J = 2.3$ Hz, 3H), 3.92 (s, 3H), 3.91 (s, 3H), 3.78 (s, 6H). ^{13}C NMR (100 MHz, CDCl_3) δ 165.8, 162.2, 161.4, 159.7 (d, $J = 2.7$ Hz), 149.9 (d, $J = 20.2$ Hz), 149.3 (d, $J = 234.4$ Hz), 134.5, 106.5, 104.1 (d, $J = 4.7$ Hz), 102.1, 100.9, 98.0 (d, $J = 1.0$ Hz), 56.4, 55.9, 55.7. ^{19}F NMR (376 MHz, CDCl_3) δ -53.4. HRMS (ESI): m/z calcd. for $\text{C}_{18}\text{H}_{18}\text{FN}_2\text{O}_5^+$, $[\text{M}+\text{H}]^+$: 361.1194; found: 361.1193.



6-bromo-3-(4-bromo-2-methylphenyl)-2-fluoro-8-methylquinazolin-4(3*H*)-one

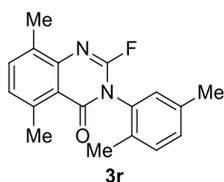
Eluent: PE/EA = 5:1, light yellow solid (27.1 mg, 32%, m.p. 170 – 171 °C). ^1H NMR (400 MHz, CDCl_3) δ 8.24 (d, $J = 2.3$ Hz, 1H), 7.79 – 7.76 (m, 1H), 7.57 (d, $J = 2.2$ Hz, 1H), 7.55 – 7.47 (m, 1H), 7.08 (d, $J = 8.4$ Hz, 1H), 2.56 (s, 3H), 2.15 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 161.0, 147.4 (d, $J = 232.5$ Hz), 143.2 (d, $J = 18.2$ Hz), 139.2, 138.1 (d, $J = 2.3$ Hz), 138.0, 134.6, 131.2, 130.8, 129.6,

128.1, 124.4, 121.5 (d, $J = 4.0$ Hz), 120.3, 17.5 (d, $J = 2.0$ Hz), 17.2 (d, $J = 3.7$ Hz). ^{19}F NMR (376 MHz, CDCl_3) δ -53.6. HRMS (ESI): m/z calcd. for $\text{C}_{14}\text{H}_5\text{ON}_2\text{ClF}^+$, $[\text{M}+\text{H}]^+$: 281.0851; found: 281.0856.



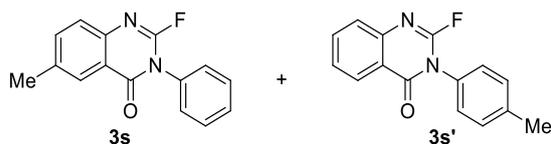
3-(2,4-dimethylphenyl)-2-fluoro-6,8-dimethylquinazolin-4(3H)-one

Eluent: PE/EA = 10:1, light yellow solid (49.7 mg, 84%, m.p. 184 – 185 °C). ^1H NMR (400 MHz, CDCl_3) δ 7.93 (s, 1H), 7.48 (s, 1H), 7.21 (s, 1H), 7.17 (dd, $J = 8.0, 1.9$ Hz, 1H), 7.09 (d, $J = 8.0$ Hz, 1H), 2.56 (s, 3H), 2.45 (s, 3H), 2.40 (s, 3H), 2.13 (s, 3H). ^{13}C NMR (150 MHz, CDCl_3) δ 162.5, 147.4 (d, $J = 230.0$ Hz), 142.1 (d, $J = 17.6$ Hz), 140.1, 137.5, 136.4, 135.4, 135.1 (d, $J = 1.9$ Hz), 132.2, 129.9, 128.1, 127.8, 125.2, 120.0 (d, $J = 4.0$ Hz), 21.3, 21.3, 17.5, 17.2. ^{19}F NMR (376 MHz, CDCl_3) δ -55.3. HRMS (ESI): m/z calcd. for $\text{C}_{18}\text{H}_{17}\text{FN}_2\text{NaO}^+$, $[\text{M}+\text{Na}]^+$: 319.1217; found: 319.1215.



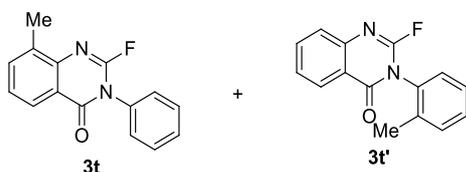
3-(2,5-dimethylphenyl)-2-fluoro-5,8-dimethylquinazolin-4(3H)-one

Eluent: PE/EA = 10:1, light yellow solid (47.4 mg, 80%, m.p. 118 – 119 °C). ^1H NMR (600 MHz, CDCl_3) δ 7.50 (d, $J = 7.5$ Hz, 1H), 7.28 (d, $J = 7.8$ Hz, 1H), 7.23 (d, $J = 8.0$ Hz, 1H), 7.16 (d, $J = 7.6$ Hz, 1H), 7.03 (s, 1H), 2.80 (s, 3H), 2.54 (s, 3H), 2.39 (s, 3H), 2.14 (s, 3H). ^{13}C NMR (150 MHz, CDCl_3) δ 162.9, 147.5 (d, $J = 230.4$ Hz), 145.6 (d, $J = 18.4$ Hz), 139.9, 137.4, 135.2, 133.0 (d, $J = 1.8$ Hz), 132.5, 132.3, 131.2, 130.8, 129.2, 128.6, 118.7 (d, $J = 4.4$ Hz), 22.8, 21.0, 17.6, 17.1. ^{19}F NMR (565 MHz, CDCl_3) δ -54.9. HRMS (ESI): m/z calcd. for $\text{C}_{18}\text{H}_{17}\text{FN}_2\text{NaO}^+$, $[\text{M}+\text{Na}]^+$: 319.1217; found: 319.1215.



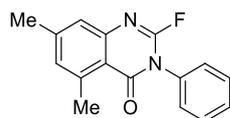
2-fluoro-6-methyl-3-phenylquinazolin-4(3H)-one and 2-fluoro-3-(p-tolyl)quinazolin-4(3H)-one

Eluent: PE/EA = 10:1, light yellow solid (41.7 mg, 82%). ^1H NMR (400 MHz, CDCl_3) δ 8.24 (dd, $J = 8.0, 1.5$ Hz, 1H), 8.05 – 8.01 (m, 2H), 7.80 – 7.71 (m, 1H), 7.64 – 7.43 (m, 12H), 7.38 – 7.29 (m, 5H), 7.22 – 7.19 (m, 2H), 2.47 (s, 5H), 2.43 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 162.4, 162.3 (d, $J = 2.1$ Hz), 148.6 (d, $J = 232.9$ Hz), 148.0 (d, $J = 232.5$ Hz), 145.3 (d, $J = 19.0$ Hz), 143.2, 143.0, 139.9, 137.1 (d, $J = 1.9$ Hz), 136.8, 135.4, 133.1, 130.4, 130.2, 129.7, 127.9, 127.9, 127.5, 127.3, 126.8 (d, $J = 1.9$ Hz), 126.7 (d, $J = 2.2$ Hz), 126.5 (d, $J = 2.1$ Hz), 120.2 (d, $J = 3.7$ Hz), 119.9 (d, $J = 3.7$ Hz), 21.3, 21.2. ^{19}F NMR (376 MHz, CDCl_3) δ -53.2, -54.3. HRMS (ESI): m/z calcd. for $\text{C}_{15}\text{H}_{11}\text{FN}_2\text{NaO}^+$, $[\text{M}+\text{Na}]^+$: 277.0748; found: 277.0746.

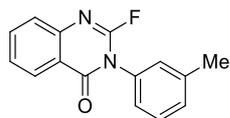


2-fluoro-8-methyl-3-phenylquinazolin-4(3H)-one and 2-fluoro-3-(o-tolyl)quinazolin-4(3H)-one

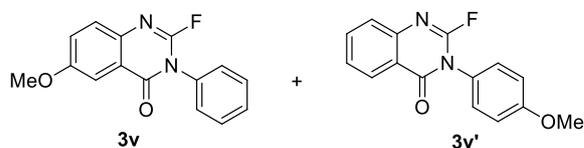
Eluent: PE/EA = 10:1, light yellow solid (42.7 mg, 84%). ¹H NMR (400 MHz, CDCl₃) δ 8.29 (dd, *J* = 8.0, 1.5 Hz, 1H), 8.12 (dd, *J* = 8.0, 1.5 Hz, 2H), 7.86 – 7.76 (m, 1H), 7.71 – 7.62 (m, 3H), 7.61 – 7.48 (m, 7H), 7.45 – 7.31 (m, 9H), 7.23 (dd, *J* = 7.7, 1.2 Hz, 1H), 2.58 (s, 5H), 2.18 (s, 3H). ¹³C NMR (100 MHz, CDCl₃) δ 162.8, 162.0, 149.7 (d, *J* = 233.0 Hz), 148.6 (d, *J* = 231.5 Hz), 145.6 (d, *J* = 19.2 Hz), 144.0 (d, *J* = 18.0 Hz), 136.2, 135.8, 135.6, 135.5 (d, *J* = 2.7 Hz), 133.1, 132.2, 131.5, 130.3, 129.8, 128.1, 128.0, 128.0, 127.5, 127.0 (d, *J* = 2.0 Hz), 126.9 (d, *J* = 2.3 Hz), 126.6 (d, *J* = 1.5 Hz), 125.7, 120.3 (d, *J* = 3.8 Hz), 17.6, 17.4. ¹⁹F NMR (565 MHz, CDCl₃) δ -52.7, -54.4. HRMS (ESI): *m/z* calcd. for C₁₅H₁₁FN₂NaO⁺, [M+Na]⁺ : 277.0748; found: 277.0746.

**3u****2-fluoro-5,7-dimethyl-3-phenylquinazolin-4(3H)-one**

Eluent: PE/EA = 10:1, light yellow solid (22.5 mg, 42%, m.p. 128 – 129 °C). ¹H NMR (400 MHz, CDCl₃) δ 7.57 – 7.46 (m, 3H), 7.35 – 7.28 (m, 2H), 7.26 (s, 1H), 7.07 (s, 1H), 2.77 (s, 3H), 2.44 (s, 3H). ¹³C NMR (100 MHz, CDCl₃) δ 162.7 (d, *J* = 2.2 Hz), 148.3 (d, *J* = 233.1 Hz), 147.0 (d, *J* = 18.8 Hz), 145.6, 142.2, 133.2, 131.3 (d, *J* = 1.9 Hz), 129.8, 129.7, 129.5, 128.8, 128.1, 125.0 (d, *J* = 2.0 Hz), 116.2 (d, *J* = 4.3 Hz), 22.7, 21.8. ¹⁹F NMR (376 MHz, CDCl₃) δ -54.0. HRMS (ESI): *m/z* calcd. for C₁₆H₁₄FN₂O⁺, [M+H]⁺ : 269.1085; found: 269.1087.

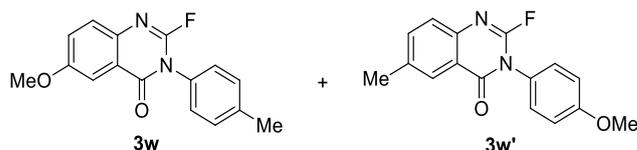
**3u'****3-(3,5-dimethylphenyl)-2-fluoroquinazolin-4(3H)-one**

Eluent: PE/EA = 10:1, light yellow solid (20.4 mg, 38%, m.p. 86 – 87 °C). ¹H NMR (400 MHz, (CD₃)₂CO) δ 8.17 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.90 – 7.80 (m, 1H), 7.60 (d, *J* = 8.1 Hz, 1H), 7.57 – 7.51 (m, 1H), 7.18 (d, *J* = 8.6 Hz, 3H), 2.38 (s, 6H). ¹³C NMR (100 MHz, (CD₃)₂CO) δ 162.7, 149.7 (d, *J* = 228.9 Hz), 146.5 (d, *J* = 20.2 Hz), 140.0, 136.0, 134.5, 131.7, 128.2, 127.4 (d, *J* = 2.1 Hz), 127.3 (d, *J* = 2.1 Hz), 126.6, 121.5 (d, *J* = 3.7 Hz), 21.1. ¹⁹F NMR (376 MHz, (CD₃)₂CO) δ -55.1. HRMS (ESI): *m/z* calcd. for C₁₆H₁₄FN₂O⁺, [M+H]⁺ : 269.1085; found: 269.1086.

**2-fluoro-6-methoxy-3-phenylquinazolin-4(3H)-one and 2-fluoro-3-(4-methoxyphenyl)quinazolin-4(3H)-one**

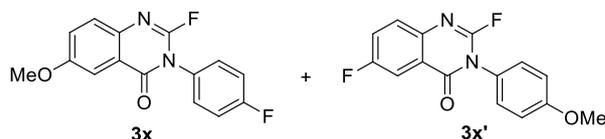
Eluent: PE/EA = 3:1, light yellow solid (43.2 mg, 80%). ¹H NMR (600 MHz, CDCl₃) δ 8.26 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.81 – 7.75 (m, 1H), 7.63 – 7.61 (m, 4H), 7.57 – 7.50 (m, 15H), 7.48 (m, 1H), 7.37 (dd, *J* = 8.9, 3.0 Hz, 4H), 7.34 – 7.31 (m, 7H), 7.27 – 7.22 (m, 3H), 7.07 – 7.01 (m, 2H), 3.90 (s, 10H), 3.86 (s, 3H). ¹³C NMR (100 MHz, CDCl₃) δ 162.7, 162.2, 160.5, 158.6, 148.8 (d, *J* = 233.1 Hz), δ 147.2 (d, *J* = 231.9 Hz), 145.5, 145.3, 139.5 (d, *J* = 18.2 Hz), 135.5, 133.1, 129.8 (d, *J* = 2.2 Hz), 129.0, 128.3 (d, *J* = 2.0 Hz), 128.0, 128.0, 126.9, 126.8 (d, *J* = 2.1 Hz), 125.5, 125.3, 121.0, 120.3, 115.0, 107.8, 56.0, 55.7.

^{19}F NMR (376 MHz, CDCl_3) δ -53.2, -56.1. HRMS (ESI): m/z calcd. for $\text{C}_{15}\text{H}_{11}\text{FN}_2\text{NaO}_2^+$, $[\text{M}+\text{Na}]^+$: 293.0697; found: 293.0697.



2-fluoro-6-methoxy-3-(p-tolyl)quinazolin-4(3H)-one and 2-fluoro-3-(4-methoxyphenyl)-6-methylquinazolin-4(3H)-one

Eluent: PE/EA = 10:1, light yellow solid (50.6 mg, 89%). ^1H NMR (600 MHz, CDCl_3) δ 8.04 (s, 1H), 7.62 (d, J = 2.9 Hz, 2H), 7.59 (dd, J = 8.3, 2.1 Hz, 1H), 7.53 (dd, J = 18.1, 8.6 Hz, 3H), 7.37 (d, J = 3.0 Hz, 1H), 7.36 – 7.33 (m, 4H), 7.25 – 7.19 (m, 5H), 7.06 – 7.02 (m, 2H), 3.90 (s, 5H), 3.86 (s, 3H), 2.48 (s, 3H), 2.44 (s, 5H). ^{13}C NMR (150 MHz, CDCl_3) δ 162.6, 162.3, 160.4, 158.5, 148.4 (d, J = 231.5 Hz), 147.4 (d, J = 231.5 Hz), 143.2 (d, J = 18.7 Hz), 140.0, 139.5 (d, J = 18.7 Hz), 137.1, 136.9, 130.5, 130.4, 129.0, 128.2, 127.6, 127.5, 126.6, 125.5, 125.4, 121.0 (d, J = 3.4 Hz), 120.0 (d, J = 4.1 Hz), 115.0, 107.8, 56.0, 55.7, 21.4, 21.3. ^{19}F NMR (565 MHz, CDCl_3) δ -54.4, -56.2. HRMS (ESI): m/z calcd. for $\text{C}_{16}\text{H}_{13}\text{FN}_2\text{NaO}_2^+$, $[\text{M}+\text{Na}]^+$: 307.0853; found: 307.0850.



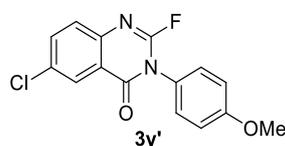
2-fluoro-3-(4-fluorophenyl)-6-methoxyquinazolin-4(3H)-one and 2,6-difluoro-3-(4-methoxyphenyl)quinazolin-4(3H)-one

Eluent: PE/EA = 20:1, light yellow solid (51.9 mg, 90%). ^1H NMR (400 MHz, CDCl_3) δ 7.83 (dd, J = 8.2, 3.0 Hz, 1H), 7.63 – 7.44 (m, 9H), 7.38 – 7.28 (m, 11H), 7.25 – 7.19 (m, 9H), 7.06 – 7.00 (m, 2H), 3.88 (s, 11H), 3.85 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 164.3, 162.1, 161.8, 160.5, 158.5 (d, J = 1.8 Hz), 146.9 (d, J = 231.4 Hz), 141.8 (d, J = 2.2 Hz), 141.6 (d, J = 1.6 Hz), 139.3, 139.1, 129.9, 129.8, 128.9, 128.2 (d, J = 1.5 Hz), 125.4, 125.1, 123.9, 120.8 (d, J = 4.0 Hz), 117.0, 116.7, 115.1, 113.1, 112.9, 107.7. ^{19}F NMR (376 MHz, CDCl_3) δ -54.2, -56.3, -110.9, -112.8. HRMS (ESI): m/z calcd. for $\text{C}_{15}\text{H}_{10}\text{F}_2\text{N}_2\text{NaO}_2^+$, $[\text{M}+\text{Na}]^+$: 311.0603; found: 311.0603.



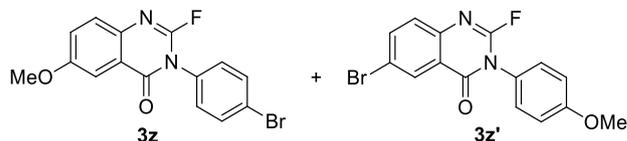
3-(4-chlorophenyl)-2-fluoro-6-methoxyquinazolin-4(3H)-one

Eluent: PE/EA = 10:1, light yellow solid (37.1 mg, 61%, m.p. 165 – 166 °C). ^1H NMR (400 MHz, CDCl_3) δ 7.59 (d, J = 3.0 Hz, 1H), 7.56 – 7.49 (m, 3H), 7.37 (dd, J = 8.9, 3.0 Hz, 1H), 7.27 (dd, J = 8.7, 2.1 Hz, 2H), 3.89 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 162.0 (d, J = 2.2 Hz), 158.7, 146.7 (d, J = 231.8 Hz), 139.3 (d, J = 18.3 Hz), 135.9, 131.5, 130.1, 129.4, 128.3 (d, J = 2.1 Hz), 125.6, 120.8 (d, J = 3.7 Hz), 107.8, 56.0. ^{19}F NMR (376 MHz, CDCl_3) δ -56.4. HRMS (ESI): m/z calcd. for $\text{C}_{15}\text{H}_{10}\text{ClFN}_2\text{NaO}_2^+$, $[\text{M}+\text{Na}]^+$: 327.0307; found: 327.0305.



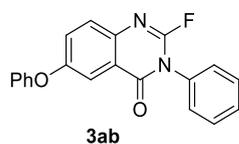
6-chloro-2-fluoro-3-(4-methoxyphenyl)quinazolin-4(3H)-one

Eluent: PE/EA = 10:1, light yellow solid (11.6 mg, 19%, m.p. 170 – 171 °C). ¹H NMR (400 MHz, CDCl₃) δ 8.23 (d, *J* = 2.5 Hz, 1H), 7.72 (dd, *J* = 8.7, 2.5 Hz, 1H), 7.59 (d, *J* = 8.7 Hz, 1H), 7.27 – 7.20 (m, 2H), 7.08 – 7.01 (m, 2H), 3.87 (s, 3H). ¹³C NMR (100 MHz, CDCl₃) δ 161.7, 160.6, 149.0 (d, *J* = 233.9 Hz), 143.9 (d, *J* = 19.6 Hz), 135.9, 132.9, 128.9, 128.4 (d, *J* = 2.2 Hz), 127.4, 125.0, 121.5 (d, *J* = 4.0 Hz), 115.2, 55.7. ¹⁹F NMR (376 MHz, CDCl₃) δ -52.8. HRMS (ESI): *m/z* calcd. for C₁₅H₁₁ClFN₂O₂⁺, [M+H]⁺: 305.0488; found: 305.0481.



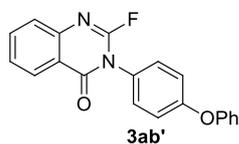
3-(4-bromophenyl)-2-fluoro-6-methoxyquinazolin-4(3H)-one and 6-bromo-2-fluoro-3-(4-methoxyphenyl)quinazolin-4(3H)-one

Eluent: PE/EA = 20:1, light yellow solid (45.8 mg, 44%). ¹H NMR (400 MHz, CDCl₃) δ 8.37 (d, *J* = 2.3 Hz, 1H), 7.85 (dd, *J* = 8.7, 2.3 Hz, 1H), 7.71 – 7.66 (m, 3H), 7.61 (d, *J* = 2.9 Hz, 1H), 7.56 (dd, *J* = 8.8, 1.0 Hz, 1H), 7.50 (d, *J* = 8.6 Hz, 1H), 7.38 (dd, *J* = 8.9, 3.0 Hz, 1H), 7.25 – 7.18 (m, 5H), 7.07 – 7.02 (m, 2H), 3.90 (s, 4H), 3.87 (s, 3H). ¹³C NMR (100 MHz, CDCl₃) δ 162.0 (d, *J* = 2.0 Hz), 161.5, 160.6, 158.7, 149.1 (d, *J* = 233.7 Hz), 146.7 (d, *J* = 232.2 Hz), 144.3 (d, *J* = 19.5 Hz), 139.3 (d, *J* = 18.7 Hz), 138.6, 133.1, 132.1, 130.5, 129.7, 128.9, 128.6 (d, *J* = 2.1 Hz), 128.3 (d, *J* = 2.1 Hz), 125.6, 125.0, 124.0, 121.8 (d, *J* = 4.1 Hz), 120.8 (d, *J* = 3.7 Hz), 120.4 (d, *J* = 2.1 Hz), 115.2, 107.8, 56.0, 55.7. ¹⁹F NMR (376 MHz, CDCl₃) δ -52.5, -56.4. HRMS (ESI): *m/z* calcd. for C₁₅H₁₀BrFN₂NaO₂⁺, [M+H]⁺: 370.9802; found: 370.9803.



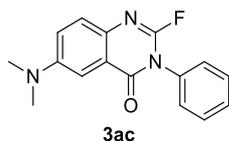
2-fluoro-6-phenoxy-3-phenylquinazolin-4(3H)-one

Eluent: PE/EA = 10:1, white solid (30.5 mg, 46%, m.p. 58 – 59 °C). ¹H NMR (600 MHz, CDCl₃) δ 7.78 (d, *J* = 2.9 Hz, 1H), 7.63 (d, *J* = 8.8 Hz, 1H), 7.58 – 7.47 (m, 4H), 7.38 (t, *J* = 8.0 Hz, 2H), 7.32 (d, *J* = 1.8 Hz, 2H), 7.17 (t, *J* = 7.4 Hz, 1H), 7.06 (d, *J* = 7.9 Hz, 2H). ¹³C NMR (150 MHz, CDCl₃) δ 161.8, 156.4 (d, *J* = 17.9 Hz), 147.7 (d, *J* = 233.0 Hz), 140.8 (d, *J* = 18.7 Hz), 132.9, 130.2, 129.8, 129.8, 128.6, 127.9, 127.1, 124.4, 121.3 (d, *J* = 4.2 Hz), 119.5, 115.1. ¹⁹F NMR (376 MHz, CDCl₃) δ -55.0. HRMS (ESI): *m/z* calcd. for C₂₀H₁₄FN₂O₂⁺, [M+H]⁺: 333.1034; found: 333.1035.



2-fluoro-3-(4-phenoxyphenyl)quinazolin-4(3H)-one

Eluent: PE/EA = 10:1, white solid (15.3 mg, 23%, m.p. 62 – 63 °C). ¹H NMR (400 MHz, CDCl₃) δ 8.29 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.84 – 7.77 (m, 1H), 7.65 (dd, *J* = 8.2, 1.1 Hz, 1H), 7.51 (m, 1H), 7.41 (dd, *J* = 8.6, 7.4 Hz, 2H), 7.29 – 7.25 (m, 2H), 7.19 (t, *J* = 7.4 Hz, 1H), 7.15 – 7.10 (m, 4H). ¹³C NMR (150 MHz, CDCl₃) δ 161.8, 156.5, 156.3, 147.7 (d, *J* = 233.0 Hz), 140.8 (d, *J* = 18.7 Hz), 133.0, 130.2, 129.8, 129.8, 128.6, 127.9, 127.1, 124.4, 121.3 (d, *J* = 4.2 Hz), 119.5, 115.1. ¹⁹F NMR (376 MHz, CDCl₃) δ -53.1. HRMS (ESI): *m/z* calcd. for C₂₀H₁₄FN₂O₂⁺, [M+H]⁺: 333.1034; found: 333.1038.



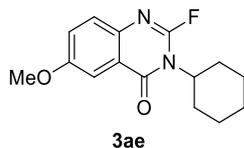
6-(dimethylamino)-2-fluoro-3-phenylquinazolin-4(3H)-one

Eluent: PE/EA = 10:1, white solid (24.3 mg, 43%, m.p. 145 – 146 °C). ¹H NMR (400 MHz, CDCl₃) δ 7.52 – 7.38 (m, 4H), 7.40 (d, *J* = 3.1 Hz, 1H), 7.35 – 7.30 (m, 2H), 7.27 – 7.21 (m, 1H), 3.06 (s, 6H). ¹³C NMR (100 MHz, CDCl₃) δ 162.6 (d, *J* = 1.8 Hz), 149.4, 146.1 (d, *J* = 230.2 Hz), 135.5 (d, *J* = 18.1 Hz), 133.5, 129.7, 129.6, 128.1, 127.5 (d, *J* = 2.0 Hz), 121.2, 120.9 (d, *J* = 3.7 Hz), 107.6, 40.7. ¹⁹F NMR (376 MHz, CDCl₃) δ -58.3. HRMS (ESI): *m/z* calcd. for C₁₆H₁₅FN₃O⁺, [M+H]⁺: 284.1194; found: 284.1193.



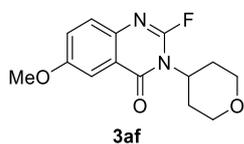
3-cyclohexyl-2-fluoroquinazolin-4(3H)-one

Eluent: PE/EA = 20:1, yellow oil (31.2 mg, 63%). ¹H NMR (400 MHz, (CD₃)₂CO) δ 8.19 – 8.10 (m, 1H), 7.79 (m, 1H), 7.49 (t, *J* = 7.3 Hz, 2H), 5.03 – 4.91 (m, 1H), 2.14 – 2.05 (m, 2H), 1.97 – 1.87 (m, 4H), 1.78 – 1.68 (m, 1H), 1.54 – 1.40 (m, 2H), 1.33 – 1.24 (m, 1H). ¹³C NMR (100 MHz, (CD₃)₂CO) δ 162.9, 151.2 (d, *J* = 232.5 Hz), 146.3 (d, *J* = 21.2 Hz), 135.7, 128.3, 127.2 (d, *J* = 2.0 Hz), 127.0 (d, *J* = 2.0 Hz), 121.2 (d, *J* = 3.8 Hz), 55.4, 30.9 (d, *J* = 4.4 Hz), 27.0, 26.0. ¹⁹F NMR (376 MHz, (CD₃)₂CO) δ -56.4. HRMS (ESI): *m/z* calcd. for C₁₄H₁₆FN₂O⁺, [M+H]⁺: 247.1241; found: 247.1242.



3-cyclohexyl-2-fluoro-6-methoxyquinazolin-4(3H)-one

Eluent: PE/EA = 20:1, white solid (32.1 mg, 58%, m.p. 125 – 126 °C). ¹H NMR (400 MHz, (CD₃)₂CO) δ 7.53 (d, *J* = 2.9 Hz, 1H), 7.43 (d, *J* = 8.8 Hz, 1H), 7.37 (dd, *J* = 8.9, 2.9 Hz, 1H), 4.98 (t, *J* = 12.6 Hz, 1H), 3.91 (s, 3H), 2.16 – 2.08 (m, 1H), 1.96 – 1.86 (m, 5H), 1.78 – 1.68 (m, 1H), 1.55 – 1.39 (m, 2H), 1.35 – 1.22 (m, 1H). ¹³C NMR (100 MHz, (CD₃)₂SO) δ 161.5, 157.6, 148.6 (d, *J* = 231.0 Hz), 138.8 (d, *J* = 20.9 Hz), 127.6, 124.4, 120.6 (d, *J* = 3.8 Hz), 107.5, 55.7, 54.2, 29.8 (d, *J* = 4.2 Hz), 25.8, 24.8. ¹⁹F NMR (376 MHz, (CD₃)₂CO) δ -59.4. HRMS (ESI): *m/z* calcd. for C₁₅H₁₈FN₂O₂⁺, [M+H]⁺: 277.1347; found: 277.1348.



2-fluoro-6-methoxy-3-(tetrahydro-2H-pyran-4-yl)quinazolin-4(3H)-one

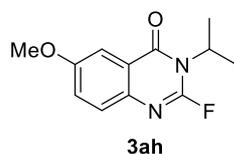
Eluent: PE/EA = 5:1, white solid (44.5 mg, 80%, m.p. 170 – 171 °C). ¹H NMR (400 MHz, CDCl₃) δ 7.60 (d, *J* = 2.9 Hz, 1H), 7.48 (d, *J* = 8.9 Hz, 1H), 7.33 (dd, *J* = 8.9, 3.0 Hz, 1H), 5.36 – 5.27 (m, 1H), 4.13 (dd, *J* = 11.7, 4.5 Hz, 2H), 3.91 (s, 3H), 3.56 (t, *J* = 12.0 Hz, 2H), 2.50 – 2.37 (m, 2H), 1.83 – 1.72 (m, 2H). ¹³C NMR (100 MHz, CDCl₃) δ 162.4, 158.5, 148.7 (d, *J* = 234.1 Hz), 139.3 (d, *J* = 20.1 Hz), 128.0, 125.4, 120.7 (d, *J* = 3.8 Hz), 107.7, 67.9, 56.0, 51.6 (d, *J* = 2.1 Hz), 30.6 (d, *J* = 4.5 Hz). ¹⁹F NMR (376

MHz, CDCl₃) δ -57.6. HRMS (ESI): m/z calcd. for C₁₄H₁₇FN₂NaO⁺, [M+Na]⁺ : 279.1138; found: 279.1139.

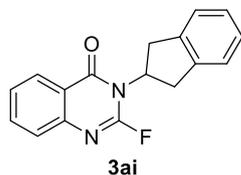


tert-butyl 4-(2-fluoro-6-methoxy-4-oxoquinazolin-3(4H)-yl)piperidine-1-carboxylate

Eluent: PE/EA = 5:1, white solid (51.3 mg, 68%, m.p. 165 – 166 °C). ¹H NMR (400 MHz, CDCl₃) δ 7.49 (d, J = 2.9 Hz, 1H), 7.39 (d, J = 8.9 Hz, 1H), 7.25 (dd, J = 8.9, 3.0 Hz, 1H), 5.20 – 5.07 (m, 1H), 4.24 (s, 2H), 3.83 (s, 3H), 2.78 (d, J = 14.6 Hz, 2H), 2.24 – 2.12 (m, 2H), 1.80 – 1.70 (m, 2H), 1.42 (s, 9H). ¹³C NMR (100 MHz, CDCl₃) δ 162.2, 158.3, 154.6, 148.5 (d, J = 233.9 Hz), 139.2 (d, J = 19.7 Hz), 127.8, 125.2, 120.6 (d, J = 3.8 Hz), 107.5, 80.03, 55.89, 52.65, 29.55, 28.46. ¹⁹F NMR (376 MHz, CDCl₃) δ -57.8. HRMS (ESI): m/z calcd. for C₁₄H₁₇FN₂NaO⁺, [M+Na]⁺ : 400.1643; found: 400.1639.

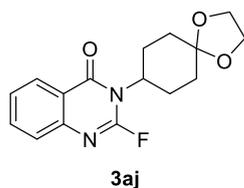


Eluent: PE/EA = 20:1, white solid (25.7 mg, 54%, m.p. 85.2 – 85.4 °C). ¹H NMR (600 MHz, Chloroform-*d*) δ 7.60 (d, J = 2.9 Hz, 1H), 7.47 (d, J = 8.9 Hz, 1H), 7.32 (dd, J = 8.9, 2.9 Hz, 1H), 5.44 (p, J = 7.1 Hz, 1H), 3.90 (s, 3H), 1.53 (dd, J = 6.9, 2.0 Hz, 6H). ¹³C NMR (151 MHz, Chloroform-*d*) δ 162.4, 158.3, 149.3 (d, J = 234.0 Hz), 139.5 (d, J = 20.0 Hz), 127.8, 125.2, 120.9 (d, J = 3.5 Hz), 107.5, 56.0, 46.7, 20.7, 20.7. ¹⁹F NMR (564 MHz, Chloroform-*d*) δ -58.4. HRMS (ESI): m/z calcd. for C₁₂H₁₄FN₂O₂⁺, [M+H]⁺ : 237.1034; found: 237.1019.



3-(2,3-dihydro-1H-inden-2-yl)-2-fluoroquinazolin-4(3H)-one

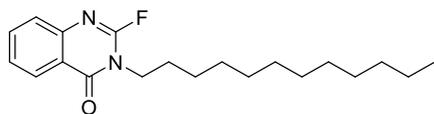
Eluent: PE/EA = 5:1, yellow oil (19.2 mg, 34%). ¹H NMR (600 MHz, Chloroform-*d*) δ 8.26 (dd, J = 8.0, 1.5 Hz, 1H), 7.76 (ddd, J = 8.5, 7.3, 1.5 Hz, 1H), 7.58 (dd, J = 7.9, 0.9 Hz, 1H), 7.48 (ddd, J = 8.1, 7.2, 1.2 Hz, 1H), 7.24 (m, 4H), 6.08 – 5.98 (m, 1H), 3.45 (m, 4H). ¹³C NMR (151 MHz, Chloroform-*d*) δ 162.7, 150.0 (d, J = 235.5 Hz), 145.2 (d, J = 20.2 Hz), 140.1, 135.3, 128.0, 127.2, 126.9, 126.6, 124.7, 120.1 (d, J = 3.6 Hz), 37.4 (d, J = 4.0 Hz), 52.1. ¹⁹F NMR (564 MHz, Chloroform-*d*) δ -53.0. HRMS (ESI): m/z calcd. for C₁₇H₁₄FN₂O⁺, [M+H]⁺ : 281.1085; found: 281.1083.



2-fluoro-3-(1,4-dioxaspiro[4.5]decan-8-yl)quinazolin-4(3H)-one

Eluent: PE/EA = 5:1, white solid (35.5 mg, 58%%, m.p. 114.1 – 115.5 °C). ¹H NMR (600 MHz, Chloroform-*d*) δ 8.23 (dd, J = 8.0, 1.5 Hz, 1H), 7.72 (ddd, J = 8.5, 7.2, 1.6 Hz, 1H), 7.55 (d, J = 8.1 Hz, 1H), 7.44 (ddd, J = 8.1, 7.1, 1.1 Hz, 1H), 5.20 – 5.08 (m, 1H), 3.98 (tt, J = 8.7, 4.3 Hz, 4H), 2.46 – 2.35

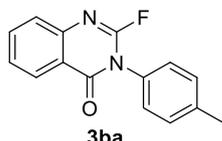
(m, 2H), 1.91 – 1.74 (m, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 162.6, 150.2 (d, $J = 236.7$ Hz), 145.3 (d, $J = 20.4$ Hz), 135.2, 128.0, 126.6 (d, $J = 38.8$ Hz), 120.0 (d, $J = 3.7$ Hz), 64.7 (d, $J = 5.1$ Hz), 27.4 (d, $J = 5.4$ Hz). 107.5, 53.0, 34.5. ^{19}F NMR (564 MHz, Chloroform-*d*) δ -54.2. HRMS (ESI): m/z calcd. for $\text{C}_{16}\text{H}_{18}\text{FN}_2\text{O}_3^+$, $[\text{M}+\text{H}]^+$: 305.1296; found: 305.1297.



3ak

3-dodecyl-2-fluoroquinazolin-4(3H)-one

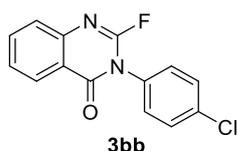
Eluent: PE/EA = 20:1, white solid (56.9 mg, 43%%, m.p. 51.4 – 51.8 °C). ^1H NMR (600 MHz, Chloroform-*d*) δ 8.24 (dd, $J = 8.1, 1.5$ Hz, 1H), 7.76 – 7.72 (m, 1H), 7.58 (d, $J = 8.2$ Hz, 1H), 7.46 (t, $J = 7.6$ Hz, 1H), 4.09 (td, $J = 7.5, 1.6$ Hz, 2H), 1.29 – 1.23 (m, 20H), 0.88 (d, $J = 7.0$ Hz, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 162.39, δ 149.94 (d, $J = 233.2$ Hz), 145.47 (d, $J = 20.1$ Hz), 135.15, 127.69, 126.66, 120.07 (d, $J = 3.7$ Hz), 42.71 (d, $J = 2.1$ Hz), 32.05, 29.84, 29.81, 29.74, 29.67, 29.58, 29.47, 29.30, 28.81, 26.82, 22.82. ^{19}F NMR (564 MHz, Chloroform-*d*) δ -59.27. HRMS (ESI): m/z calcd. for $\text{C}_{20}\text{H}_{30}\text{FN}_2\text{O}^+$, $[\text{M}+\text{H}]^+$: 333.2337; found: 333.2335.



3ba

2-fluoro-3-(*p*-tolyl)quinazolin-4(3H)-one

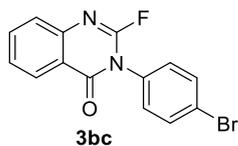
Eluent: PE/EA = 20:1, White solid (26.9 mg, 99%, m.p. 148.8-149.1 °C). ^1H NMR (400 MHz, Chloroform-*d*) δ 8.28 (dd, $J = 8.0, 1.5$ Hz, 1H), 7.79 (ddd, $J = 8.5, 7.2, 1.6$ Hz, 1H), 7.64 (dd, $J = 8.2, 1.1$ Hz, 1H), 7.49 (ddd, $J = 8.2, 7.2, 1.2$ Hz, 1H), 7.35 (d, $J = 8.1$ Hz, 2H), 7.21 (d, $J = 8.3$ Hz, 2H), δ 2.45 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.5, 162.5, δ 148.7 (d, $J = 233.0$ Hz), 145.4 (d, $J = 19.1$ Hz), 140.1, 135.5, 130.5, 130.3, 128.0, 127.6, δ 127.0 (d, $J = 1.8$ Hz), 126.8 (d, $J = 2.1$ Hz), 120.3 (d, $J = 3.9$ Hz), 21.4. ^{19}F NMR (376 MHz, CDCl_3) δ -53.2. HRMS (ESI): m/z calcd. for $\text{C}_{15}\text{H}_{12}\text{FN}_2\text{O}^+$, $[\text{M}+\text{H}]^+$: 255.0929; found: 255.0929.



3bb

3-(4-chlorophenyl)-2-fluoroquinazolin-4(3H)-one

Eluent: PE/EA = 20:1, White solid (19.5mg, 71%, m.p. 124.6-125.5 °C). ^1H NMR (400 MHz, Chloroform-*d*) δ 8.27 (dd, $J = 8.1, 1.5$ Hz, 1H), 7.81 (ddd, $J = 8.5, 7.2, 1.6$ Hz, 1H), 7.65 (dd, $J = 8.1, 1.0$ Hz, 1H), 7.57 – 7.46 (m, 3H), 7.33 – 7.22 (m, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.2 (d, $J = 1.8$ Hz), δ 148.1 (d, $J = 233.5$ Hz), 145.3 (d, $J = 18.9$ Hz), 136.1, 135.8, 131.4, 130.1, 129.4, 128.1, δ 127.2 (d, $J = 1.8$ Hz), 127.0 (d, $J = 2.2$ Hz), 120.2 (d, $J = 3.9$ Hz). ^{19}F NMR (376 MHz, CDCl_3) δ -53.3. $[\text{M}+\text{H}]^+$: 275.0382; found: 275.0385.



3bc

3-(4-bromophenyl)-2-fluoroquinazolin-4(3H)-one

Eluent: PE/EA = 20:1, White solid (27.1 mg, 85%, m.p. 131.7-132.9 °C). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.25 (dd, *J* = 7.9, 1.6 Hz, 1H), 7.80 (ddd, *J* = 8.6, 7.2, 1.6 Hz, 1H), 7.73 – 7.66 (m, 2H), 7.64 (d, *J* = 8.1 Hz, 1H), 7.55 – 7.47 (m, 1H), 7.24 – 7.18 (m, 2H). ¹³C NMR (101 MHz, CDCl₃) δ 162.1 (d, *J* = 1.7 Hz), 148.0 (d, *J* = 233.5 Hz), 145.2 (d, *J* = 19.0 Hz), δ 135.8, 133.1, 131.9, 129.7, 128.1, 127.2 (d, *J* = 1.8 Hz), 127.0 (d, *J* = 2.0 Hz), 124.1, 120.1 (d, *J* = 3.9 Hz). ¹⁹F NMR (376 MHz, CDCl₃) δ -53.3. [M+H]⁺ : 318.9877; found:318.9876



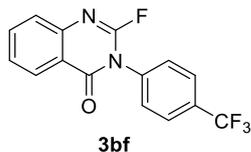
2-fluoro-3-(4-fluorophenyl)quinazolin-4(3H)-one

Eluent: PE/EA = 20:1, White solid (11.7mg, 45%, m.p. 166.0-166.3 °C). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.25 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.81 – 7.77 (m, 1H), 7.63 (d, *J* = 8.1 Hz, 1H), 7.49 (t, *J* = 7.3 Hz, 1H), 7.38 – 7.29 (m, 2H), 7.29 – 7.19 (m, 2H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 163.1 (d, *J* = 250.2 Hz), 162.3 (d, *J* = 1.4 Hz), 148.2 (d, *J* = 233.3 Hz), 145.2 (d, *J* = 19.0 Hz), 128.7 (d, *J* = 3.4 Hz), 135.7, 129.9, 129.8, 128.0, 127.1 (d, *J* = 1.8 Hz), 126.9 (d, *J* = 2.1 Hz), 120.1 (d, *J* = 3.8 Hz), 116.8. ¹⁹F NMR (376 MHz, Chloroform-*d*) δ -53.2, -110.8 (ddd, *J* = 12.6, 8.3, 4.8 Hz). [M+H]⁺ : 259.0678; found:259.0674.



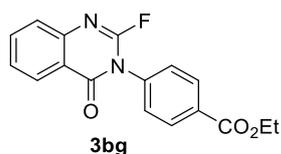
3-(4-butylphenyl)-2-fluoroquinazolin-4(3H)-one

Eluent: PE/EA = 10:1, White solid (30.3mg, 99%, m.p. 98.6 – 99.1 °C). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.27 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.79 (ddd, *J* = 8.6, 7.2, 1.6 Hz, 1H), 7.64 (dd, *J* = 8.2, 1.1 Hz, 1H), 7.49 (ddd, *J* = 8.2, 7.2, 1.2 Hz, 1H), 7.35 (d, *J* = 8.3 Hz, 2H), 7.23 – 7.21 (m, 2H), 2.698 (t, *J* = 8.0 Hz 2H), 1.73 – 1.60 (m, 2H), 1.40 (h, *J* = 7.4 Hz, 2H), 0.96 (t, *J* = 7.3 Hz, 3H). ¹³C NMR (101 MHz, CDCl₃) δ 162.5 (d, *J* = 1.8 Hz), 148.7 (d, *J* = 233.0 Hz), 145.4 (d, *J* = 19.1 Hz), δ 144.9, 135.5, 130.4, 129.8, 128.0, 127.5, 126.9 (d, *J* = 1.8 Hz), 126.8 (d, *J* = 2.1 Hz), 120.3 (d, *J* = 3.7 Hz), 35.5, 33.5, 22.5, 14.1. ¹⁹F NMR (376 MHz, CDCl₃) δ -53.1. [M+H]⁺ : 297.1398; found:297.1394.



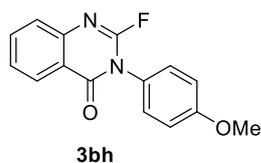
2-fluoro-3-(4-(trifluoromethyl)phenyl)quinazolin-4(3H)-one

Eluent: PE/EA = 20:1, White solid (20.4 mg, 66%, m.p. 105.7 - 106.0°C). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.29 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.83 (m, 3H), 7.67 (d, *J* = 8.1 Hz, 1H), 7.53 (t, *J* = 7.6 Hz, 1H), 7.50 (d, *J* = 8.3 Hz, 2H). ¹³C NMR (101 MHz, CDCl₃) δ 162.1 (d, *J* = 1.7 Hz), 147.7 (d, *J* = 234.0 Hz), 145.2 (d, *J* = 18.9 Hz), 136.1 (d, *J* = 1.2 Hz), δ 136.0, δ 132.2 (q, *J* = 33.1 Hz), 131.1, 129.0, 128.8, 128.1, 127.4 (d, *J* = 1.9 Hz), 127.1 (d, *J* = 1.9 Hz), 127.0 (q, *J* = 3.8 Hz), 123.7 (q, *J* = 272.7 Hz), 120.1 (d, *J* = 3.8 Hz). ¹⁹F NMR (376 MHz, CDCl₃) δ -53.3, -62.8. [M+H]⁺ : 309.0645; found:309.0653.



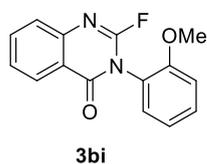
ethyl 4-(2-fluoro-4-oxoquinazolin-3(4H)-yl)benzoate

Eluent: PE/EA = 20:1, White oil (23.4 mg, 75%). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.28 (dd, *J* = 8.0, 1.5 Hz, 1H), 8.26 – 8.21 (m, 2H), 7.82 (ddd, *J* = 8.5, 7.3, 1.6 Hz, 1H), 7.66 (dd, *J* = 8.3, 1.1 Hz, 1H), 7.52 (ddd, *J* = 8.2, 7.2, 1.2 Hz, 1H), 7.43 (d, *J* = 8.4 Hz, 2H), 4.43 (q, *J* = 7.1 Hz, 2H), 1.42 (t, *J* = 7.1 Hz, 3H). ¹³C NMR (101 MHz, CDCl₃) δ 165.6, δ 147.9 (d, *J* = 233.9 Hz), 145.3 (d, *J* = 18.9 Hz), 162.1, 136.7, 135.8, 132.0, 131.1, 128.2, 128.1, 127.3 (d, *J* = 1.8 Hz), 127.0 (d, *J* = 2.0 Hz), 120.2 (d, *J* = 3.7 Hz), 61.6, 14.5. ¹⁹F NMR (376 MHz, CDCl₃) δ -53.3. [M+H]⁺ : 313.0983; found:313.0990.



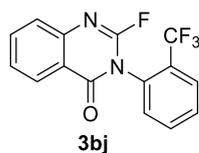
2-fluoro-3-(4-methoxyphenyl)quinazolin-4(3H)-one

Eluent: PE/EA = 10:1, White solid (23.9 mg, 88%, m.p. 178.0-179.0 °C). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.27 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.79 (ddd, *J* = 8.5, 7.2, 1.6 Hz, 1H), 7.64 (dd, *J* = 8.1, 1.1 Hz, 1H), 7.49 (ddd, *J* = 8.1, 7.3, 1.1 Hz, 1H), 7.25 – 7.21 (m, 2H), 7.05 (d, *J* = 8.9 Hz, 2H), 3.87 (s, 3H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 162.6 (d, *J* = 1.9 Hz), δ 160.5, 148.8 (d, *J* = 232.5 Hz), 145.4 (d, *J* = 19.0 Hz), 135.5, 129.5 (d, *J* = 22.7 Hz), 129.0, 128.0, 126.9 (d, *J* = 1.8 Hz), 126.8 (d, *J* = 2.1 Hz), 125.3, 120.3 (d, *J* = 3.7 Hz), 115.1, 55.7. ¹⁹F NMR (376 MHz, CDCl₃) δ -53.2. [M+Na]⁺ : 293.0697; found:293.0703.



2-fluoro-3-(2-methoxyphenyl)quinazolin-4(3H)-one

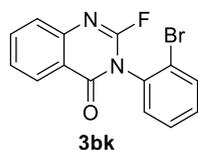
Eluent: PE/EA = 10:1, yellow oil (24.1 mg, 89%). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.28 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.79 (ddd, *J* = 8.5, 7.2, 1.6 Hz, 1H), 7.65 (d, *J* = 8.1 Hz, 1H), 7.54 – 7.44 (m, 2H), 7.30 (dd, *J* = 7.8, 1.7 Hz, 1H), 7.15 – 7.03 (m, 2H), 3.81 (s, 3H). ¹³C NMR (101 MHz, CDCl₃) δ 162.1 (d, *J* = 1.3 Hz), 148.9 (d, *J* = 233.0 Hz), 145.6 (d, *J* = 19.0 Hz), δ 154.6, 135.3, 131.4, 129.3, 128.0, 126.7 (d, *J* = 2.1 Hz), 126.6 (d, *J* = 1.7 Hz), 121.5, 121.0, 120.3 (d, *J* = 3.7 Hz), 112.1, 55.9. ¹⁹F NMR (376 MHz, CDCl₃) δ -55.5. [M+H]⁺ : 271.0878; found:271.0882.



2-fluoro-3-(2-(trifluoromethyl)phenyl)quinazolin-4(3H)-one

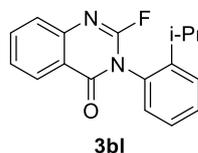
Eluent: PE/EA = 10:1, yellow oil (20.8mg, 68%). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.27 (dd, *J* = 7.9, 1.6 Hz, 1H), 7.89 (d, *J* = 7.6 Hz, 1H), 7.85 – 7.75 (m, 2H), 7.68 (dd, *J* = 13.6, 7.8 Hz, 2H), 7.55 – 7.49 (m, 1H), 7.43 (d, *J* = 7.8 Hz, 1H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 162.2 (d, *J* = 1.6 Hz),

147.9 (d, $J = 234.0$ Hz), 145.5 (d, $J = 18.7$ Hz), δ 135.9, 133.7, 130.8 (d, $J = 8.3$ Hz), 128.5 (q, $J = 31.4$ Hz), 128.1, 127.9 (q, $J = 4.8$ Hz), 127.2 (d, $J = 1.8$ Hz), 127.1 (d, $J = 2.1$ Hz), 122.9 (d, $J = 273.4$ Hz), 119.9 (d, $J = 3.9$ Hz). ^{19}F NMR (376 MHz, Chloroform-*d*) δ -52.8 (q, $J = 4.5$ Hz), -61.7 (d, $J = 4.5$ Hz). $[\text{M}+\text{H}]^+$: 309.0646; found:309.0643.



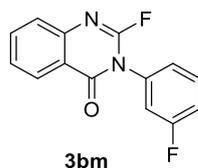
3-(2-bromophenyl)-2-fluoroquinazolin-4(3H)-one

Eluent: PE/EA = 20:1, yellow oil (19.9mg, 63%). ^1H NMR (400 MHz, Chloroform-*d*) δ 8.29 (dd, $J = 8.0, 1.5$ Hz, 1H), 7.86 – 7.75 (m, 2H), 7.67 (d, $J = 8.0$ Hz, 1H), 7.57 – 7.44 (m, 2H), 7.43 – 7.36 (m, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 161.6 (d, $J = 1.8$ Hz), 147.8 (d, $J = 233.8$ Hz), 145.4 (d, $J = 18.9$ Hz), δ 135.7, 133.9, 132.7, 131.6, 130.1, 128.9, 128.1, 127.1 (d, $J = 1.8$ Hz), 127.0 (d, $J = 2.1$ Hz), 122.7 120.1. ^{19}F NMR (376 MHz, CDCl_3) δ -54.32. $[\text{M}+\text{Na}]^+$: 340.9697; found: 340.9694.



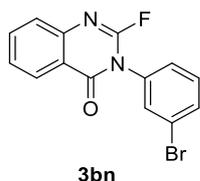
2-fluoro-3-(2-isopropylphenyl)quinazolin-4(3H)-one

Eluent: PE/EA = 20:1, Pale yellow solid (25.4 mg, 90%, m.p. 159.7 - 159.9 °C). ^1H NMR (400 MHz, Chloroform-*d*) δ 8.30 (dd, $J = 7.9, 1.5$ Hz, 1H), 7.82 (td, $J = 7.7, 7.3, 1.6$ Hz, 1H), 7.67 (d, $J = 8.1$ Hz, 1H), 7.58 – 7.47 (m, 3H), 7.36 (m, 1H), 7.17 (d, $J = 7.8$ Hz, 1H), 2.69 (hept, $J = 6.8$ Hz, 1H), 1.21 (d, $J = 2.4$ Hz, 3H), 1.20 (d, $J = 2.4$ Hz, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.4 (d, $J = 1.6$ Hz), 148.9 (d, $J = 232.4$ Hz), 146.2, 145.7 (d, $J = 18.9$ Hz), 135.6, 130.7, 130.7, 128.13 127.26 (d, $J = 2.9$ Hz), 126.97 (d, $J = 1.8$ Hz), 126.90 (d, $J = 2.2$ Hz), 120.25 (d, $J = 3.9$ Hz), 28.74, 23.66, 23.64. ^{19}F NMR (376 MHz, CDCl_3) δ -53.01. $[\text{M}+\text{H}]^+$: 283.1242; found:283.1245.



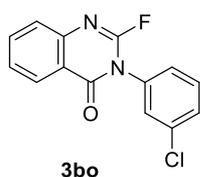
2-fluoro-3-(3-fluorophenyl)quinazolin-4(3H)-one

Eluent: PE/EA = 20:1, yellow solid (22.6 mg, 88%, m.p. 160.0-161.2 °C). ^1H NMR (400 MHz, Chloroform-*d*) δ 8.25 (d, $J = 7.9$ Hz, 1H), 7.79 (t, $J = 7.4$ Hz, 1H), 7.63 (d, $J = 8.1$ Hz, 1H), 7.55 - 7.48 (m, 2H), 7.24 (td, $J = 8.4, 2.5$ Hz, 1H), 7.14 (d, $J = 8.0$ Hz, 1H), 7.10 (dt, $J = 8.7, 2.4$ Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 163.0 (d, $J = 249.3$ Hz), 162.1 (d, $J = 1.4$ Hz), 147.9 (d, $J = 233.8$ Hz), 145.2 (d, $J = 18.9$ Hz), 134.1(d, $J = 9.9$ Hz), 131.0 (d, $J = 8.8$ Hz), 135.8, 128.0, 127.2 (d, $J = 1.6$ Hz), 127.0 (d, $J = 2.1$ Hz), 124.0 (d, $J = 3.4$ Hz), 120.1 (d, $J = 3.7$ Hz), 117.2 (d, $J = 21.0$ Hz), 115.9 (d, $J = 24.0$ Hz). ^{19}F NMR (376 MHz, Chloroform-*d*) δ -53.4, -110.3 (d, $J = 6.2$ Hz). $[\text{M}+\text{H}]^+$: 259.0678; found:259.0669.



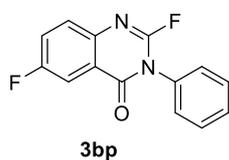
3-(3-bromophenyl)-2-fluoroquinazolin-4(3H)-one

Eluent: PE/EA = 20:1, yellow oil (23.0 mg, 72%). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.27 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.81 (ddd, *J* = 8.6, 7.2, 1.6 Hz, 1H), 7.71 – 7.62 (m, 2H), 7.56 – 7.49 (m, 2H), 7.44 (t, *J* = 8.0 Hz, 1H), 7.33 – 7.28 (m, 1H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 162.1 (d, *J* = 1.8 Hz), 147.9 (d, *J* = 233.9 Hz), 145.2 (d, *J* = 18.8 Hz), δ 135.8, 134.0, 133.2, 131.3, 131.0, 128.1, 127.3 (d, *J* = 1.8 Hz), 127.0 (d, *J* = 2.1 Hz), 126.9, 123.1, 120.1 (d, *J* = 3.9 Hz). ¹⁹F NMR (376 MHz, CDCl₃) δ -53.2. [M+H]⁺ : 320.9857; found:320.9865.



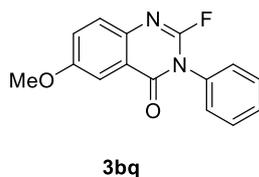
3-(3-chlorophenyl)-2-fluoroquinazolin-4(3H)-one

Eluent: PE/EA = 10:1, White oil (20 mg, 73%). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.27 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.81 (ddd, *J* = 8.5, 7.3, 1.6 Hz, 1H), 7.65 (d, *J* = 8.1 Hz, 1H), 7.56 – 7.46 (m, 3H), 7.37 (d, *J* = 2.1 Hz, 1H), 7.29 – 7.17 (m, 1H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 162.1 (d, *J* = 1.8 Hz), 147.9 (d, *J* = 233.9 Hz), 145.2 (d, *J* = 18.9 Hz), 135.8, 135.4, 133.9, 130.8, 130.3, 128.5, 128.1, 127.2 (d, *J* = 1.8 Hz), 127.0 (d, *J* = 2.1 Hz), 126.4, 120.1 (d, *J* = 3.9 Hz). ¹⁹F NMR (376 MHz, CDCl₃) δ -53.3. [M+H]⁺ : 275.0388; found:275.0390.



2,6-difluoro-3-phenylquinazolin-4(3H)-one

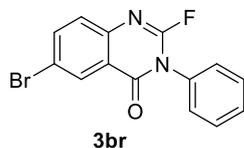
Eluent: PE/EA = 20:1, White solid (12mg, 46%, m.p. 147.3 – 150.0°C). ¹H NMR (400 MHz, Chloroform-*d*) δ 7.90 (dd, *J* = 8.2, 3.0 Hz, 1H), 7.65 (dd, *J* = 8.9, 4.7 Hz, 1H), 7.60 – 7.48 (m, 4H), 7.32 (dd, *J* = 7.8, 1.9 Hz, 2H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 161.62 (dd, *J* = 3.2, 1.4 Hz), 160.98 (dd, *J* = 248.6, 2.0 Hz), 148.13 (dd, *J* = 233.0, 2.1 Hz), 141.81 (dd, *J* = 19.2, 2.0 Hz), 132.74, 130.01, 129.89, 129.14 (d, *J* = 2.0 Hz), 129.06 (d, *J* = 2.1 Hz), 127.87, 121.62 (dd, *J* = 8.7, 4.0 Hz), 123.97 (d, *J* = 24.1 Hz), 113.10 (d, *J* = 24.0 Hz). ¹⁹F NMR (376 MHz, Chloroform-*d*) δ -54.17 (d, *J* = 4.2 Hz), -112.64. [M+H]⁺ : 259.0678; found:259.0680.



2-fluoro-6-methoxy-3-phenylquinazolin-4(3H)-one

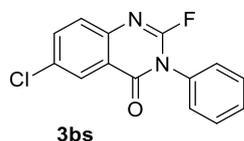
Eluent: PE/EA = 20: 1, White solid (23mg, 85%, m.p. 174.8-175.4 °C). ¹H NMR (400 MHz, Chloroform-*d*) δ 7.63 (d, *J* = 3.0 Hz, 1H), 7.55 (tdd, *J* = 9.0, 4.9, 1.5 Hz, 4H), 7.38 (dd, *J* = 8.9, 3.0 Hz,

1H), 7.36 – 7.30 (m, 2H), 3.91 (s, 3H). ¹³C NMR (101 MHz, CDCl₃) δ 162.2 (d, *J* = 1.8 Hz), 158.6 (d, *J* = 1.8 Hz), 147.2 (d, *J* = 231.9 Hz), 139.5 (d, *J* = 18.6 Hz), δ 133.2, 129.8, 129.8, 128.3 (d, *J* = 1.9 Hz), 128.0, 125.4, 121.0 (d, *J* = 4.0 Hz), 107.8, 56.0. ¹⁹F NMR (376 MHz, CDCl₃) δ -56.1. [M+H]⁺ : 271.0878; found:271.0876.



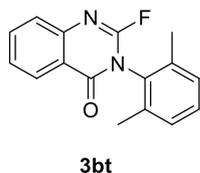
6-bromo-2-fluoro-3-phenylquinazolin-4(3H)-one

Eluent: PE/Acetone = 20:1, White solid (9.5 mg, 30%, m.p. 170.1 – 172.1 °C). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.39 (d, *J* = 2.3 Hz, 1H), 7.87 (dd, *J* = 8.6, 2.4 Hz, 1H), 7.76 – 7.45 (m, 4H), 7.32 (dd, *J* = 7.8, 1.9 Hz, 2H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 161.21 (d, *J* = 1.3 Hz), 148.74 (d, *J* = 234.3 Hz), 144.31 (d, *J* = 19.3 Hz), 138.72, 132.64, 130.48, 130.08, 129.93, 128.63 (d, *J* = 2.0 Hz), 127.85 121.79 (d, *J* = 3.9 Hz), 120.51 (d, *J* = 2.1 Hz). ¹⁹F NMR (376 MHz, CDCl₃) δ -52.4. [M+H]⁺ : 320.9857; found:320.9851.



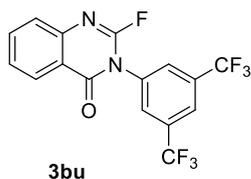
6-chloro-2-fluoro-3-phenylquinazolin-4(3H)-one

Eluent: PE/EA = 20:1, White solid (13.0 mg, 40%, m.p. 172.5 – 173.5 °C). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.24 (d, *J* = 2.5 Hz, 1H), 7.74 (dd, *J* = 8.7, 2.5 Hz, 1H), 7.65 – 7.51 (m, 4H), 7.32 (dd, *J* = 7.7, 1.9 Hz, 2H). ¹³C NMR (101 MHz, CDCl₃) δ 161.4 (d, *J* = 1.6 Hz), 148.7 (d, *J* = 234.3 Hz), 143.9 (d, *J* = 19.4 Hz), δ 136.0, 133.0 (d, *J* = 2.2 Hz), 132.7, 130.1, 129.9, 128.5 (d, *J* = 2.1 Hz), 127.9, 127.4, 121.5 (d, *J* = 3.8 Hz). ¹⁹F NMR (376 MHz, CDCl₃) δ -52.7. [M+H]⁺ : 275.0381; found:275.0391



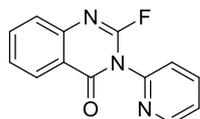
3-(2,6-dimethylphenyl)-2-fluoroquinazolin-4(3H)-one

Eluent: PE/EA = 20:1, yellow oil (26.0 mg, 97%). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.32 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.82 (ddd, *J* = 8.6, 7.2, 1.6 Hz, 1H), 7.68 (d, *J* = 8.1 Hz, 1H), 7.52 (ddd, *J* = 8.2, 7.2, 1.1 Hz, 1H), 7.32 (dd, *J* = 8.3, 6.8 Hz, 1H), 7.24 (t, *J* = 8.8 Hz, 2H), 2.14 (s, 6H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 161.5, 161.5, δ 148.7 (d, *J* = 232.6 Hz), 145.9 (d, *J* = 18.9 Hz), 135.6 (d, *J* = 4.9 Hz), 131.6, 130.0, 129.0, 128.2, 120.3, 127.0 (d, *J* = 2.0 Hz), 126.9 (d, *J* = 2.0 Hz), 120.3 (d, *J* = 3.9 Hz), 120.2, 17.8. ¹⁹F NMR (376 MHz, CDCl₃) δ -56.4. HRMS (ESI): *m/z* calcd. for C₁₆H₁₄FN₂O⁺, [M+H]⁺ : 269.1085; found:269.1088.



3-(3,5-bis(trifluoromethyl)phenyl)-2-fluoroquinazolin-4(3H)-one

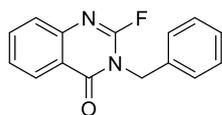
Eluent: PE/EA = 20:1, White solid (10.6mg, 28%, m.p. 116.8-117.1 °C). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.27 (dd, *J* = 8.0, 1.6 Hz, 1H), 8.05 (s, 1H), 7.89 – 7.78 (m, 3H), 7.67 (d, *J* = 8.0 Hz, 1H), 7.58 – 7.48 (m, 1H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 161.9 (d, *J* = 1.9 Hz), 147.0 (d, *J* = 234.5 Hz), 145.0 (d, *J* = 18.8 Hz), δ 136.3, 134.4, δ 133.5 (q, *J* = 34.5 Hz), 128.9 (q, *J* = 3.43 Hz), 128.1, 127.7 (d, *J* = 1.8 Hz), 127.2 (d, *J* = 2.0 Hz), 124.0 (q, *J* = 3.63 Hz), 124.0 (q, *J* = 3.63 Hz), 122.7 (q, *J* = 274.1 Hz), 119.8 (d, *J* = 3.9 Hz). ¹⁹F NMR (376 MHz, CDCl₃) δ -53.5, -62.9. [M+H]⁺ : 377.0520; found:377.0527.



3bv

2-fluoro-3-(pyridin-2-yl)quinazolin-4(3H)-one

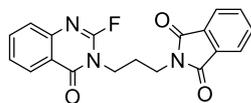
Eluent: PE/EA = 20:1, yellow oil (6.2 mg, 26%). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.69 (dd, *J* = 5.0, 1.9 Hz, 1H), 8.27 (dd, *J* = 8.1, 1.5 Hz, 1H), 7.96 (td, *J* = 7.7, 1.9 Hz, 1H), 7.86 – 7.72 (m, 1H), 7.65 (d, *J* = 8.1 Hz, 1H), 7.57 – 7.47 (m, 2H), 7.45 (d, *J* = 7.9 Hz, 1H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 162.25 (d, *J* = 1.3 Hz), 150.28, 147.99 (d, *J* = 235.2 Hz), 146.92 (d, *J* = 1.8 Hz), 139.00, 135.74, 127.96, 127.11 (d, *J* = 1.8 Hz), 127.01 (d, *J* = 2.1 Hz), 125.09, 123.57, 120.31 (d, *J* = 3.9 Hz). [M+H]⁺ : 242.0725; found:242.0724.



3bw

3-benzyl-2-fluoroquinazolin-4(3H)-one

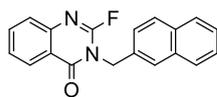
Eluent: PE/EA = 10:1, yellow oil (18.9 mg, 74%). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.27 (dd, *J* = 8.1, 1.5 Hz, 1H), 7.74 (td, *J* = 7.7, 7.1, 1.5 Hz, 1H), 7.58 (d, *J* = 8.2 Hz, 1H), 7.48 (d, *J* = 7.5 Hz, 1H), 7.46 – 7.42 (m, 2H), 7.39 – 7.29 (m, 3H), 5.28 (d, *J* = 1.6 Hz, 2H). ¹³C NMR (101 MHz, CDCl₃) δ 162.4, δ 149.6 (d, *J* = 234.0 Hz), 145.3 (d, *J* = 19.9 Hz), 135.4, 135.3, 129.0, 128.6 (d, *J* = 0.9 Hz), 128.5, 127.9, 126.8 (d, *J* = 1.8 Hz), 126.8 (d, *J* = 2.0 Hz), 120.1 (d, *J* = 3.7 Hz), 45.7 (d, *J* = 2.1 Hz). ¹⁹F NMR (376 MHz, CDCl₃) δ -57.1. [M+H]⁺ : 255.0929; found:255.0927.



3bx

2-(3-(2-fluoro-4-oxoquinazolin-3(4H)-yl)propyl)isoindoline-1,3-dione

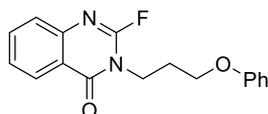
Eluent: PE/EA = 5:1, White solid (23mg, 66%, m.p. 111.4-112.9 °C). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.19 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.84 (dd, *J* = 5.4, 3.1 Hz, 2H), 7.73 (m, 3H), 7.56 (d, *J* = 8.1 Hz, 1H), 7.44 (t, *J* = 7.6 Hz, 1H), 4.53 – 4.06 (m, 2H), 3.82 (t, *J* = 7.0 Hz, 2H), 2.16 (p, *J* = 7.1 Hz, 2H). ¹³C NMR (101 MHz, CDCl₃) δ 168.3, 162.2, δ 149.4 (d, *J* = 233.3 Hz), 145.3 (d, *J* = 20.0 Hz), 135.3, 134.2, 132.1, 127.7, 126.8 (d, *J* = 1.7 Hz), 126.7 (d, *J* = 1.9 Hz), 123.5, 119.9 (d, *J* = 3.9 Hz), 40.4 (d, *J* = 2.4 Hz), 35.6, 28.0. ¹⁹F NMR (376 MHz, CDCl₃) δ -59.5. [M+H]⁺ : 352.1092; found:352.1096.



3by

2-fluoro-3-(naphthalen-2-ylmethyl)quinazolin-4(3H)-one

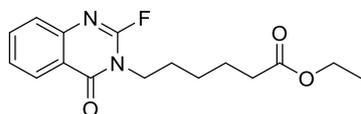
Eluent: PE/EA = 5:1, White solid (12.8mg, 42%, m.p. 148.8-149.1 °C). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.30 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.88 (s, 1H), 7.84 – 7.79 (m, 3H), 7.75 (ddd, *J* = 8.6, 7.2, 1.6 Hz, 1H), 7.58 (d, *J* = 8.1 Hz, 1H), 7.54 (d, *J* = 8.6 Hz, 1H), 7.51 – 7.45 (m, 3H), 5.45 (d, *J* = 1.6 Hz, 2H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 162.5, δ 149.6 (d, *J* = 234.0 Hz), 145.4 (d, *J* = 19.8 Hz), 135.4, 133.3 (d, *J* = 17.8 Hz), 132.6, 128.9, 128.1, 127.9, 127.8, 126.9 (d, *J* = 1.8 Hz), 126.8 (d, *J* = 1.9 Hz), 126.6 (d, *J* = 3.3 Hz), 126.1 (d, *J* = 1.0 Hz), 120.1 (d, *J* = 3.8 Hz), 45.9 (d, *J* = 2.1 Hz). ¹⁹F NMR (376 MHz, CDCl₃) δ -57.0. [M+H]⁺ :327.0905; found:327.0909.



3bz

2-fluoro-3-(3-phenoxypropyl)quinazolin-4(3H)-one

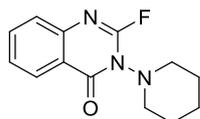
Eluent: PE/EA = 20:1, White oil (24.6 mg, 83%). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.22 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.75 (ddd, *J* = 8.5, 7.2, 1.6 Hz, 1H), 7.59 (dd, *J* = 8.2, 1.1 Hz, 1H), 7.46 (ddd, *J* = 8.2, 7.2, 1.2 Hz, 1H), 7.31 – 7.15 (m, 2H), 7.00 – 6.89 (m, 1H), 6.86 – 6.74 (m, 2H), 4.34 (td, *J* = 7.0, 1.6 Hz, 2H), 4.08 (t, *J* = 5.8 Hz, 2H), 2.26 (p, *J* = 6.3 Hz, 2H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 162.4, 158.5, 149.6 (d, *J* = 233.2 Hz), 145.3 (d, *J* = 20.1 Hz), 135.1, 129.5, 127.5, 126.6 (d, *J* = 1.6 Hz), 126.6 (d, *J* = 1.9 Hz), 121.0, 119.9 (d, *J* = 3.8 Hz), 114.4, 65.3, 40.3 (d, *J* = 2.5 Hz). 28.3. ¹⁹F NMR (376 MHz, CDCl₃) δ -59.2. [M+H]⁺ : 321.1010; found:321.1013.



3ca

ethyl 6-(2-fluoro-4-oxoquinazolin-3(4H)-yl)hexanoate

Eluent: PE/EA = 20:1, yellow oil (20.1 mg, 65%). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.23 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.73 (ddd, *J* = 8.5, 7.2, 1.6 Hz, 1H), 7.57 (d, *J* = 8.2 Hz, 1H), 7.51 – 7.39 (m, 1H), 4.11 (q, *J* = 7.3 Hz, 4H), 2.30 (t, *J* = 7.4 Hz, 2H), 1.77 (p, *J* = 7.7 Hz, 2H), 1.69 (p, *J* = 7.4 Hz, 2H), 1.43 (m, 2H), 1.23 (t, *J* = 7.0 Hz, 3H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 173.50, 162.3, 149.8 (d, *J* = 233.2 Hz), 145.4 (d, *J* = 20.0 Hz), 135.2, 127.7, 126.7 (d, *J* = 1.7 Hz), 126.7 (d, *J* = 1.9 Hz), 120.0 (d, *J* = 3.7 Hz), 60.4, 42.4 (d, *J* = 2.2 Hz), 34.2, 28.5, 26.3, 24.6, 14.3. ¹⁹F NMR (376 MHz, CDCl₃) δ -59.3. [M+H]⁺ : 309.1609; found:309.1605.

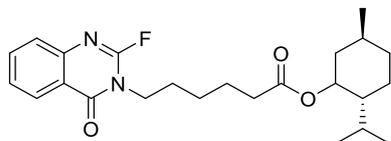


3cb

2-fluoro-3-(piperidin-1-yl)quinazolin-4(3H)-one

Eluent: PE/EA = 20:1, White solid (15.1 mg, 61%, m.p. 88.2 – 89.1 °C). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.18 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.71 (ddd, *J* = 8.5, 7.1, 1.6 Hz, 1H), 7.53 (d, *J* = 8.1 Hz, 1H), 7.46 – 7.37 (m, 1H), 3.80 (td, *J* = 10.3, 3.7 Hz, 2H), 3.03 (dt, *J* = 10.0, 3.9 Hz, 2H), 1.83 – 1.62

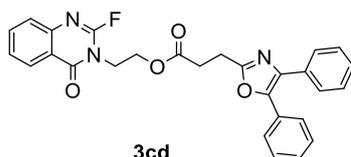
(m, 5H), 1.57 – 1.29 (m, 1H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 162.6 (d, *J* = 2.2 Hz), 150.1 (d, *J* = 234.1 Hz), 144.7 (d, *J* = 18.8 Hz), 135.1, 127.3, 126.6 (d, *J* = 2.1 Hz), 126.5 (d, *J* = 1.8 Hz), 121.8 (d, *J* = 3.1 Hz), 52.6, 26.5, 23.2. ¹⁹F NMR (376 MHz, CDCl₃) δ -62.3. [M+H]⁺ : 248.1194; found:248.1191.



3cc

(2S,5R)-2-isopropyl-5-methylcyclohexyl 6-(2-fluoro-4-oxoquinazolin-3(4H)-yl)hexanoate

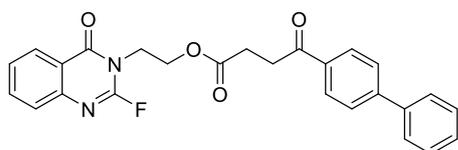
Eluent: PE/EA = 20: 1, yellow oil (18.5mg, 45%). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.24 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.75 (ddd, *J* = 8.5, 7.2, 1.6 Hz, 1H), 7.58 (d, *J* = 8.0 Hz, 1H), 7.52 – 7.42 (m, 1H), 4.67 (td, *J* = 10.9, 4.4 Hz, 1H), 4.10 (td, *J* = 7.5, 1.7 Hz, 2H), 2.30 (t, *J* = 7.5 Hz, 2H), 2.06 – 1.92 (m, 1H), 1.89 – 1.75 (m, 3H), 1.73 – 1.61 (m, 5H), 1.50 – 1.29 (m, 5H), 0.90 (d, *J* = 1.7 Hz, 4H), 0.88 (d, *J* = 2.3 Hz, 3H), 0.75 (d, *J* = 6.9 Hz, 3H). ¹³C NMR (101 MHz, CDCl₃) δ 173.1, 162.3, δ 149.8 (d, *J* = 233.4 Hz), 145.4 (d, *J* = 20.0 Hz), 135.2, 127.7, 126.7 (d, *J* = 1.8 Hz), 126.7 (d, *J* = 1.8 Hz), 120.0 (d, *J* = 3.8 Hz), 74.2, 47.1, δ 42.4 (d, *J* = 2.2 Hz), 41.0, 34.5, 34.4, 31.5, 28.5, 26.4, 26.3, 24.7, 23.6, 22.1, 20.9, 16.4. ¹⁹F NMR (376 MHz, CDCl₃) δ -59.4. [M+H]⁺ : 417.2548; found:417.2538.



3cd

2-(2-fluoro-4-oxoquinazolin-3(4H)-yl)ethyl 3-(4,5-diphenyloxazol-2-yl)propanoate

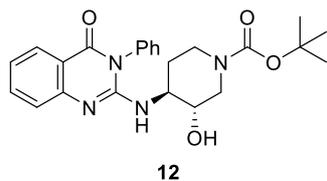
Eluent: DCM/EA = 8:1, yellow oil (23.8mg, 49%). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.24 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.75 (ddd, *J* = 8.5, 7.2, 1.6 Hz, 1H), 7.64 – 7.52 (m, 5H), 7.47 (t, *J* = 7.6 Hz, 1H), 7.34 (m, 6H), 4.46-4.49 (m, 2H), 4.44 – 4.38 (m, 2H), 3.16 (t, *J* = 7.6 Hz, 2H), 3.04 – 2.79 (m, 2H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 171.8, 162.3, 161.5, δ 149.3 (d, *J* = 233.3 Hz), 145.3 (d, *J* = 19.9 Hz), 145.6, 135.4, 135.2, 132.5, 129.0, 128.7, 128.6, 128.6, 128.2, 128.0, 127.7, 126.9 (d, *J* = 1.7 Hz), 126.8 (d, *J* = 1.9 Hz), 126.6, 119.8 (d, *J* = 3.7 Hz) 61.7, 41.5, 31.0, 23.4. ¹⁹F NMR (376 MHz, CDCl₃) δ -59.0. [M+H]⁺ :484.1668; found:484.1665



3ce

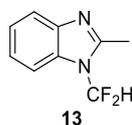
2-(2-fluoro-4-oxoquinazolin-3(4H)-yl)ethyl 4-([1,1'-biphenyl]-4-yl)-4-oxobutanoate

Eluent: DCM/EA = 8:1, yellow solid (30.7mg, 69%, m.p. 111.4-112.9 °C). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.23 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.99 (d, *J* = 8.4 Hz, 2H), 7.74 (m, 1H), 7.69 – 7.59 (m, 4H), 7.57 (d, *J* = 8.1 Hz, 1H), 7.44-7.49 (m, 3H), 7.43 – 7.38 (m, 1H), 4.46 (m, 2H), 4.42 – 4.37 (m, 2H), 3.31 (t, *J* = 6.7 Hz, 2H), 2.77 (t, *J* = 6.6 Hz, 2H). ¹³C NMR (101 MHz, CDCl₃) δ 197.4, 172.7, 162.3, 146.0, δ 149.4 (d, *J* = 233.4 Hz), 145.4 (d, *J* = 20.0 Hz), 139.9, 135.4, 135.2, 129.1, 128.7, 128.4, 127.7, 127.4 (d, *J* = 3.5 Hz) 126.9 (d, *J* = 1.6 Hz), 126.8 (d, *J* = 1.9 Hz), 119.8 (d, *J* = 3.7 Hz), 61.5, 41.6, 33.4, 28.2. ¹⁹F NMR (376 MHz, CDCl₃) δ -58.9. [M+H]⁺ : 467.1378; found:467.1389.



tert-butyl (3S,4S)-3-hydroxy-4-((4-oxo-3-phenyl-3,4-dihydroquinazolin-2-yl)amino)piperidine-1-carboxylate

Eluent: PE/EA = 1:1, White solid (35 mg, 80%, m.p. 95.8 – 98.7 °C). ¹H NMR (400 MHz, Chloroform-*d*) δ 8.11 (dd, *J* = 7.9, 1.6 Hz, 1H), 7.72 – 7.52 (m, 4H), 7.40 (d, *J* = 8.2 Hz, 1H), 7.35 (dd, *J* = 7.5, 2.5 Hz, 1H), 7.29 – 7.27 (m, 1H), δ 7.22 (t, *J* = 7.5 Hz, 1H), 6.54 (s, 1H) 4.31 – 4.28 (m, 1H), 4.08 (d, *J* = 5.5 Hz, 2H), 3.93 – 3.85 (m, 1H), 3.41 - 3.35 (m, 1H), 2.86 – 2.48 (m, 2H), 1.87 – 1.67 (m, 1H), 1.42 (s, 9H), 1.31 – 1.17 (m, 1H). ¹³C NMR (101 MHz, Chloroform-*d*) δ 162.10, 151.22, 147.72, 135.13, 134.25, 130.95, 130.84, 130.41, 129.12, 128.51, 127.49, 124.37, 123.64, 117.75, 80.17, 56.88, 28.46. [M+H]⁺ : 437.2184; found:437.2191.



1-(difluoromethyl)-2-methyl-1H-benzo[d]imidazole

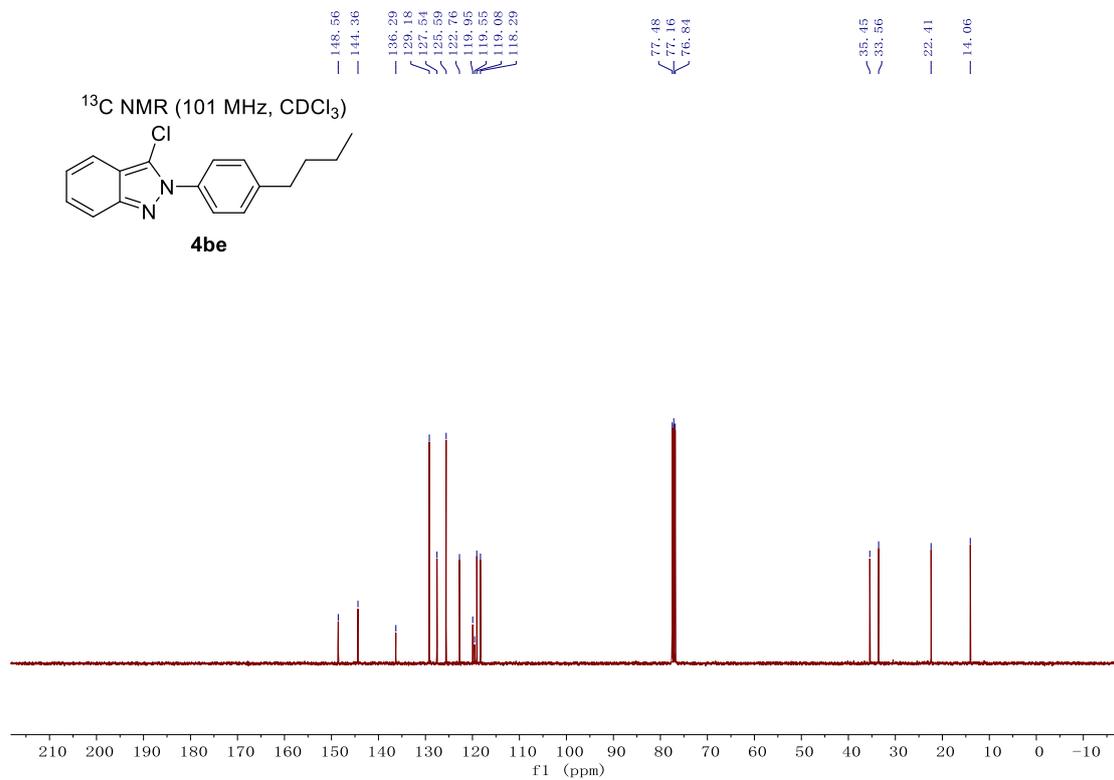
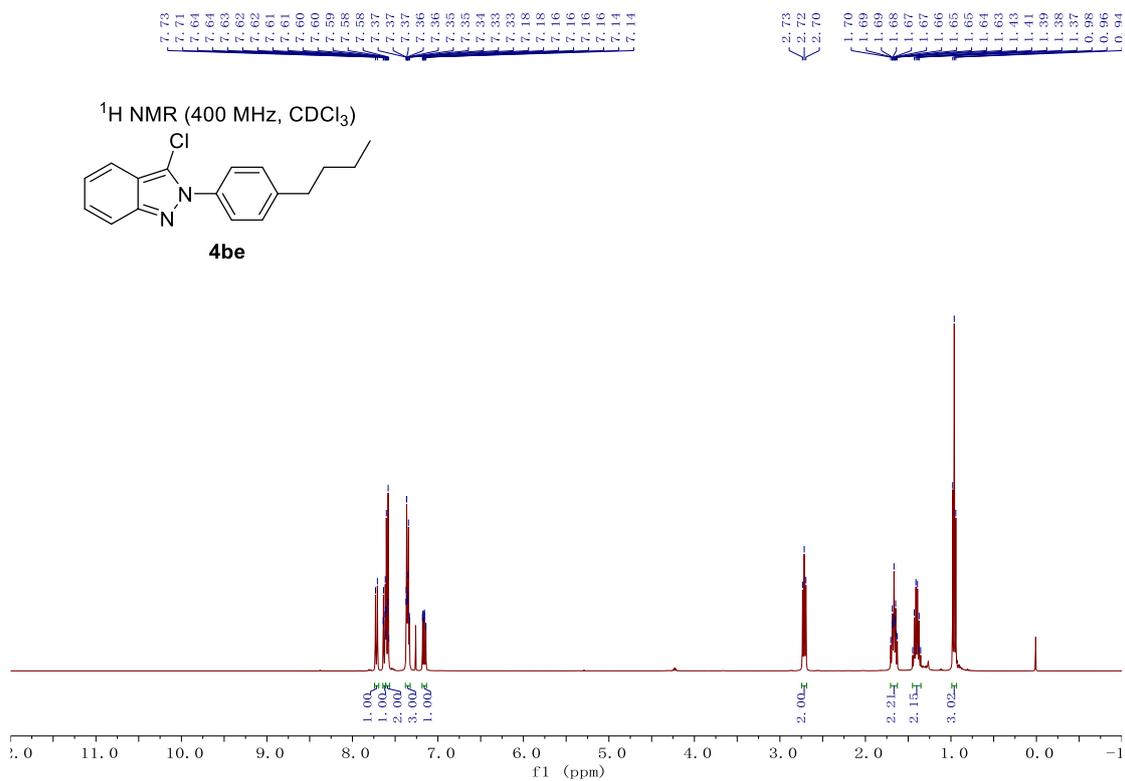
Eluent: PE/EA = 2:1, white solid (20.9 mg, 86%, m.p. 61 – 62 °C). ¹H NMR (400 MHz, CDCl₃) δ 7.72 – 7.67 (m, 1H), 7.54 – 7.48 (m, 1H), 7.43 – 7.11 (m, 3H), 2.67 (s, 3H). ¹³C NMR (100 MHz, CDCl₃) δ 149.5, 142.6, 132.1, 123.9, 123.7, 119.7, 110.6, 108.9 (t, *J* = 247.8 Hz), 14.6. ¹⁹F NMR (376 MHz, CDCl₃) δ -94.54 (d, *J* = 59.5 Hz). HRMS (ESI): *m/z* calcd. for C₉H₉FN₂⁺, [M+H]⁺ : 183.0728; found: 183.0729.

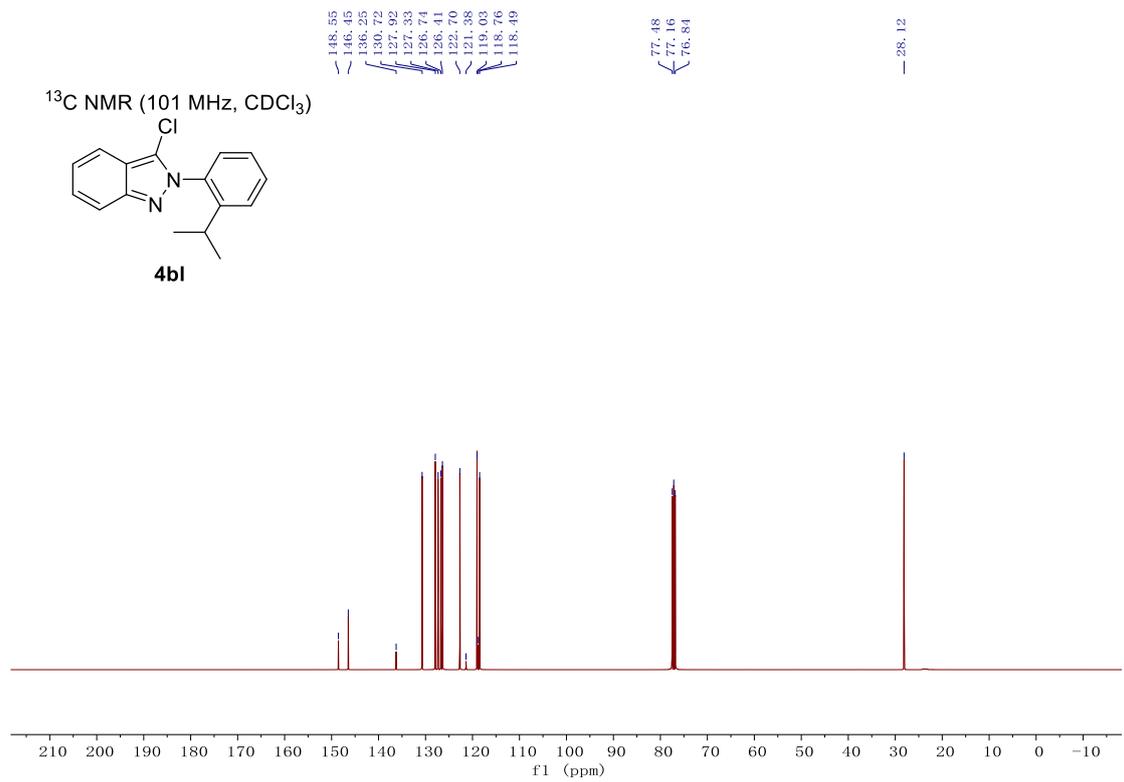
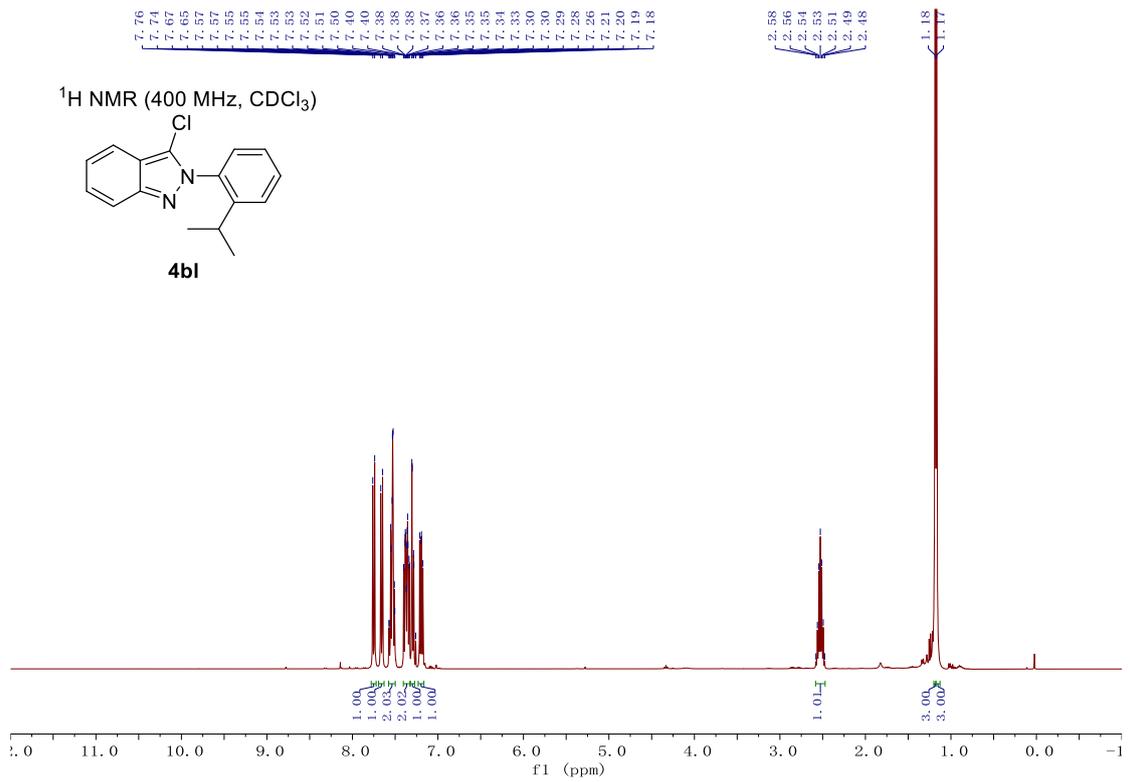
7. References

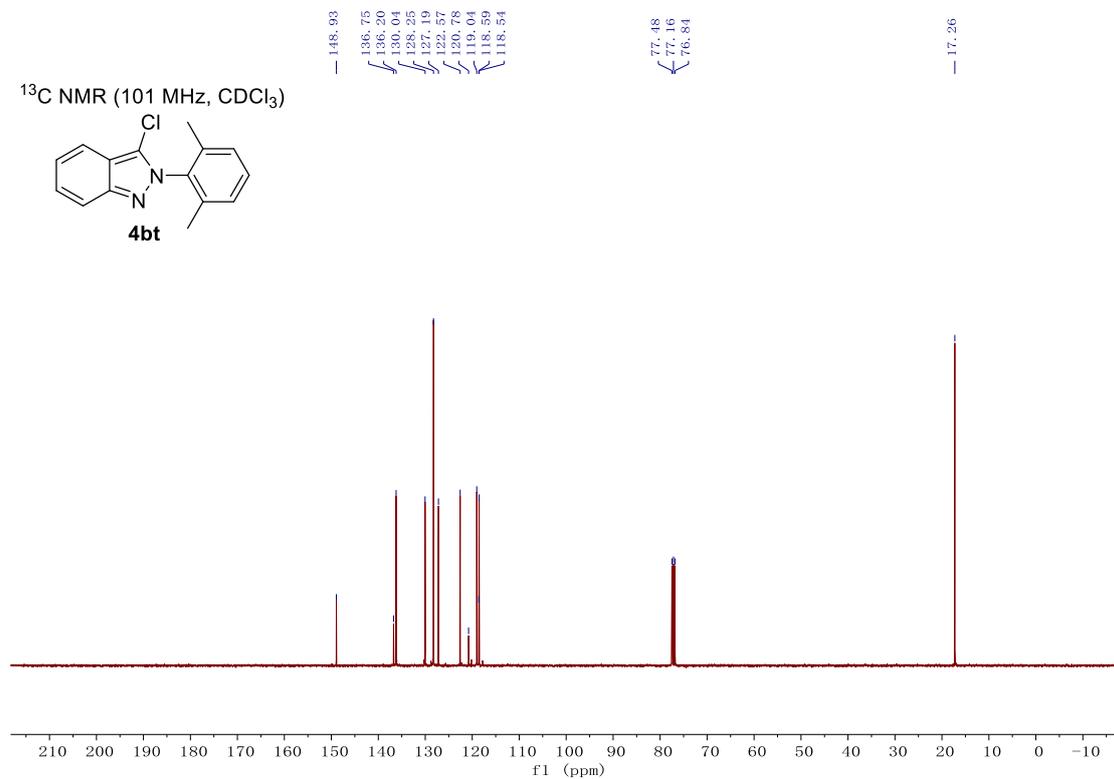
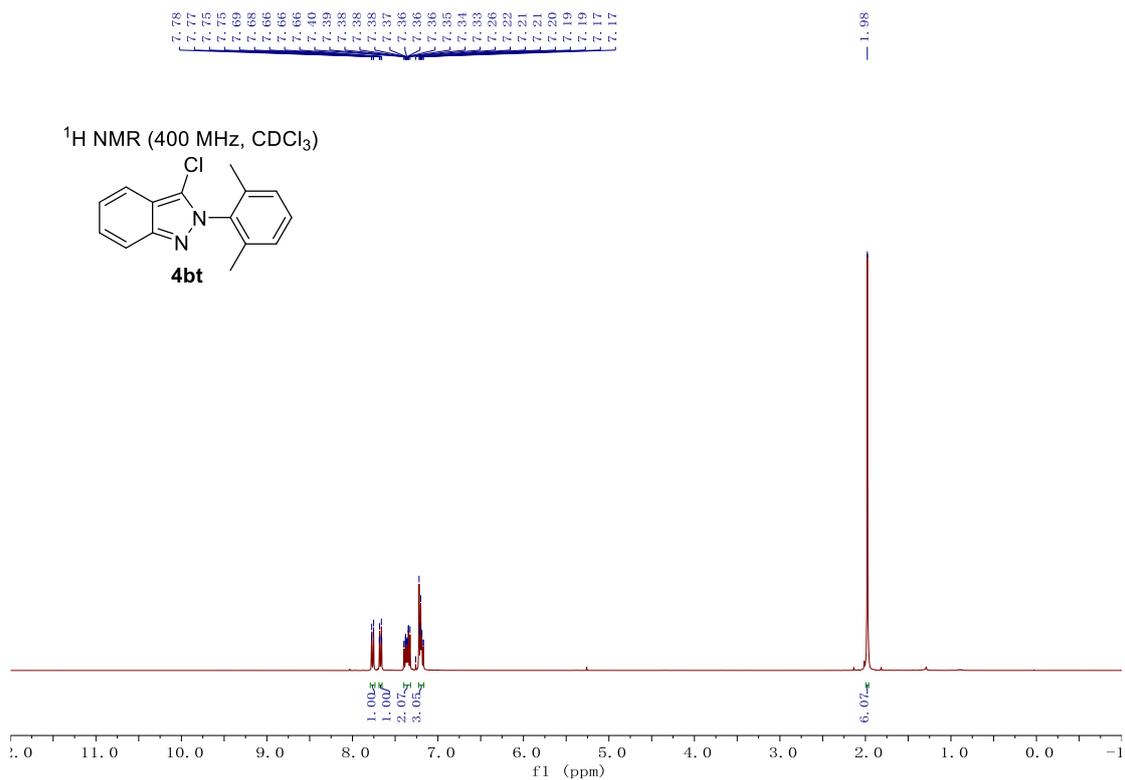
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8. NMR spectrum

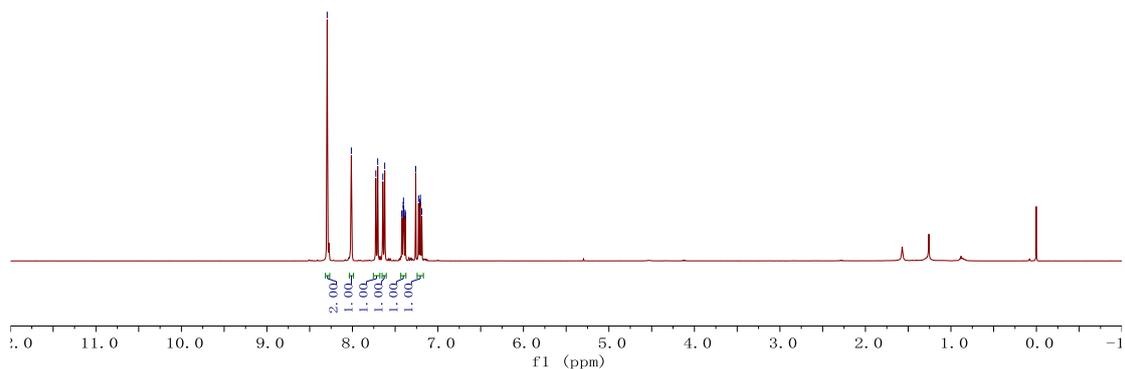
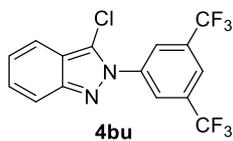






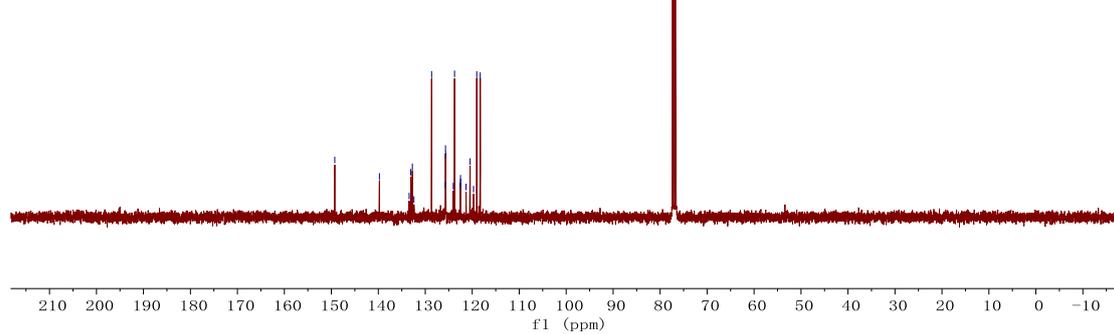
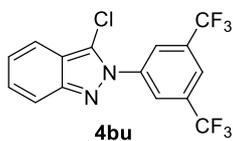
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7.21
7.19

¹H NMR (400 MHz, CDCl₃)

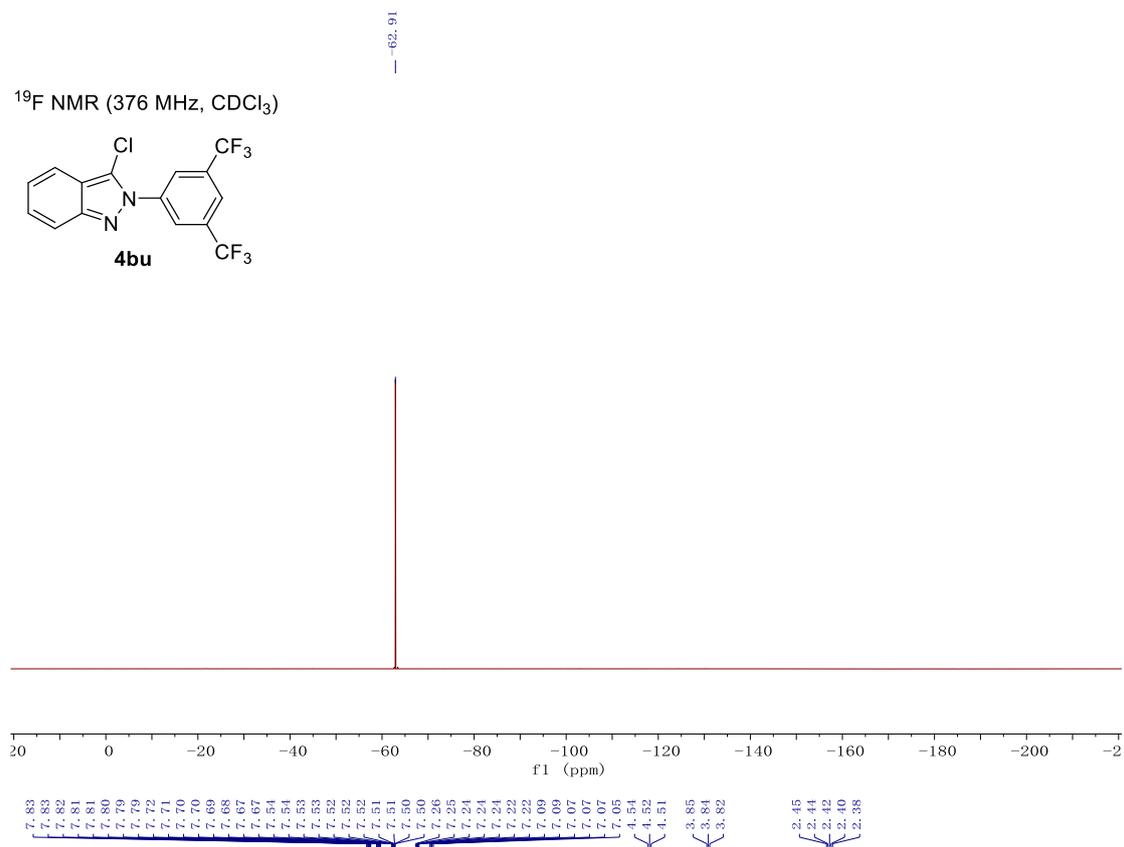
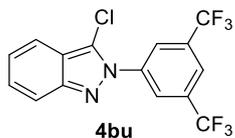


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77.34

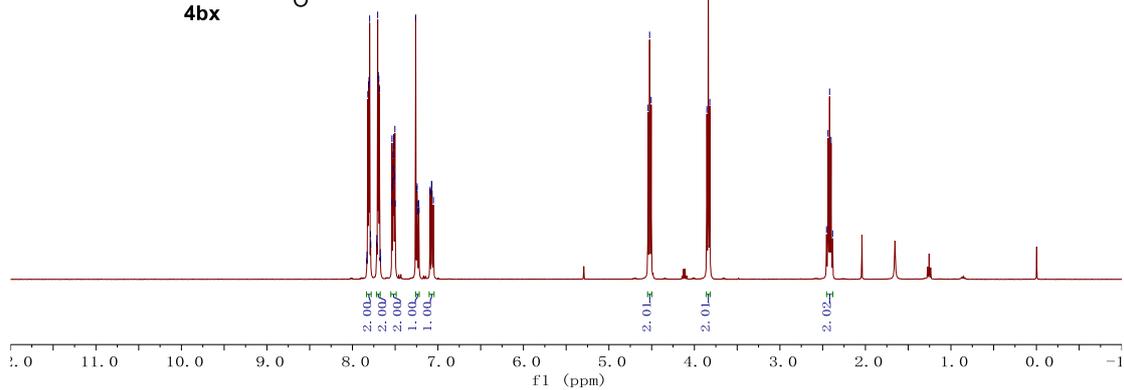
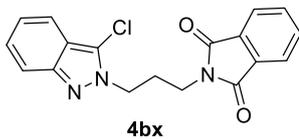
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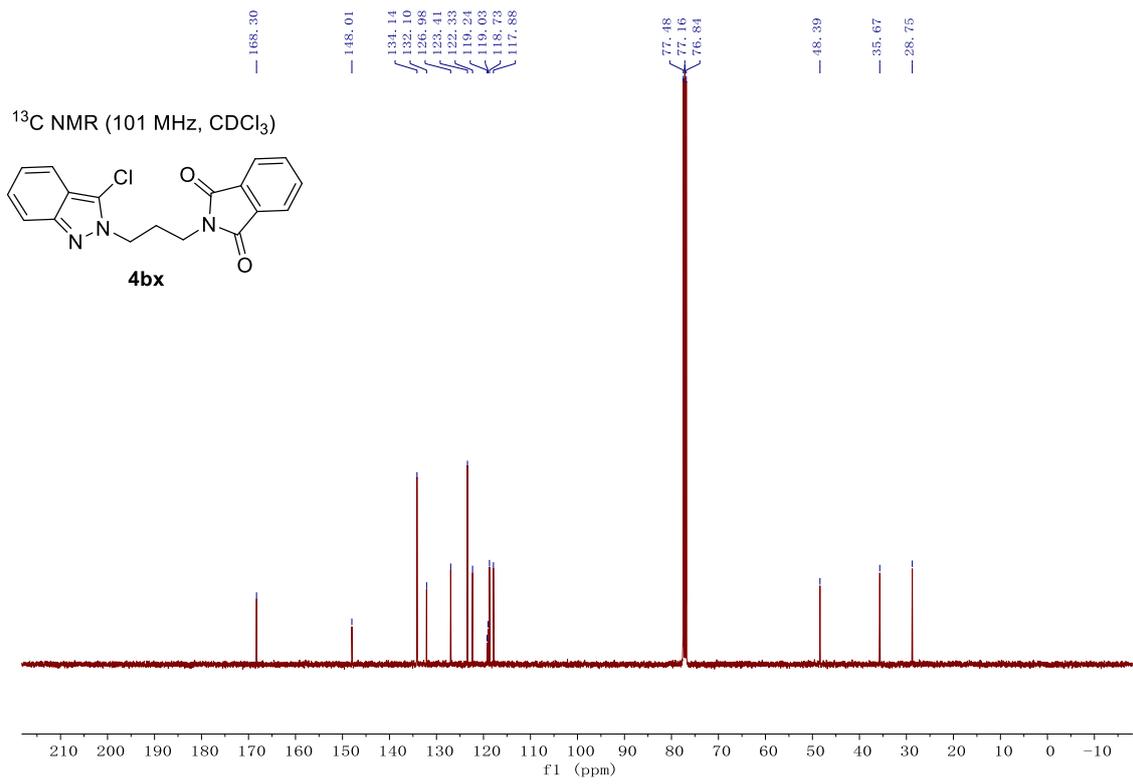


¹⁹F NMR (376 MHz, CDCl₃)

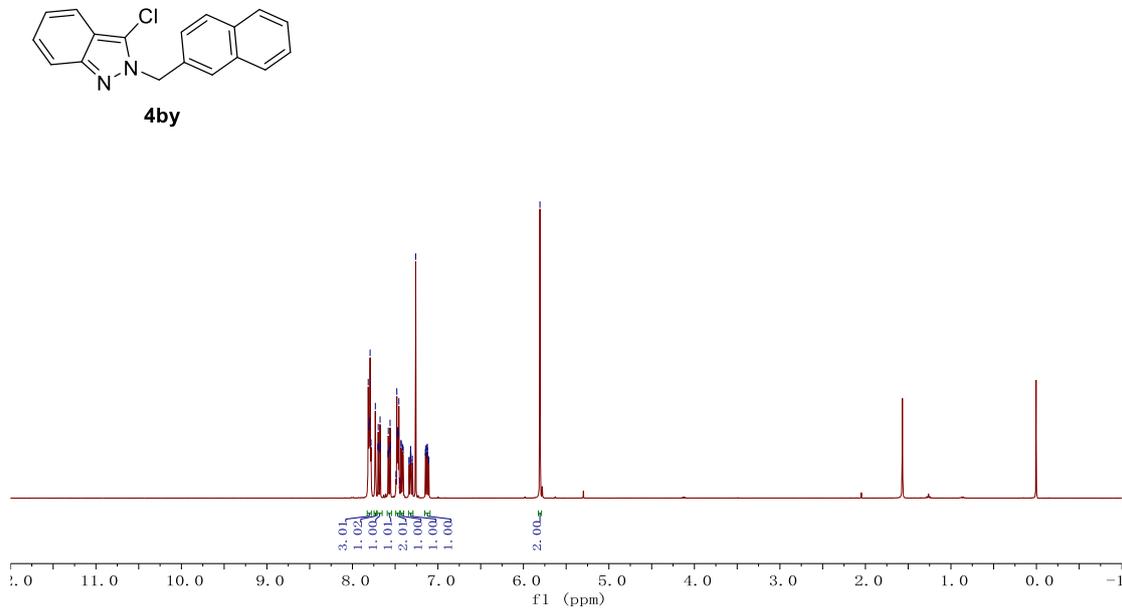


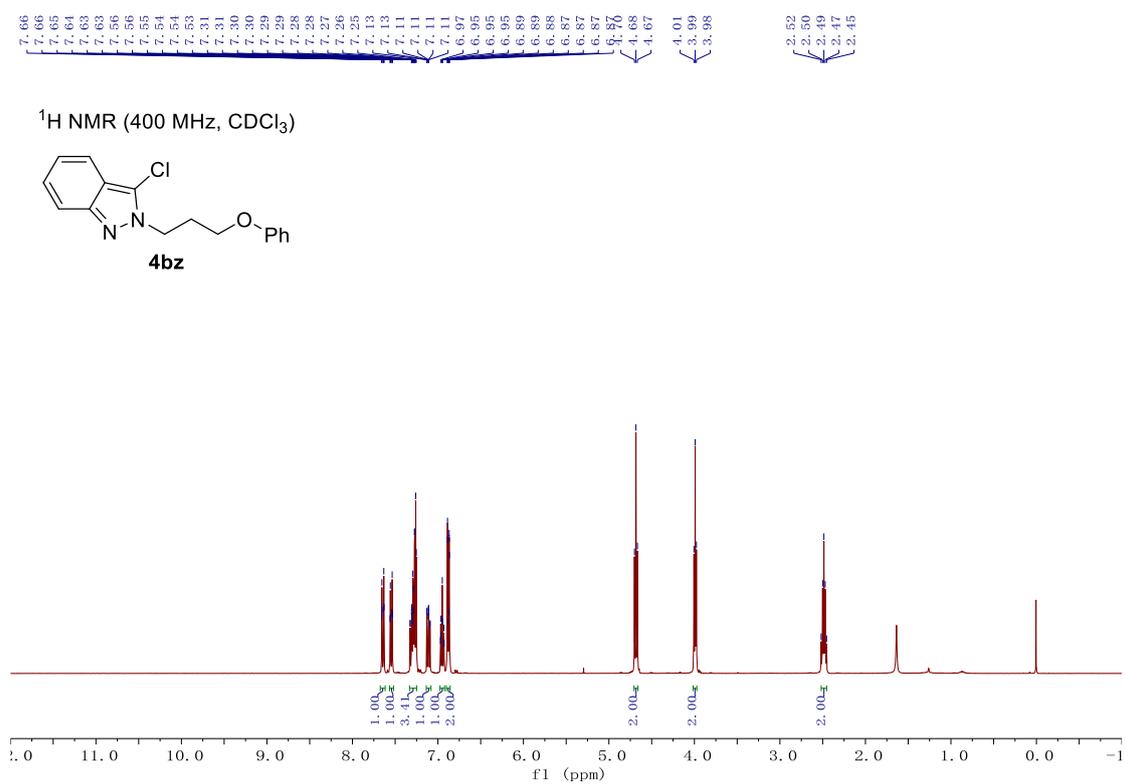
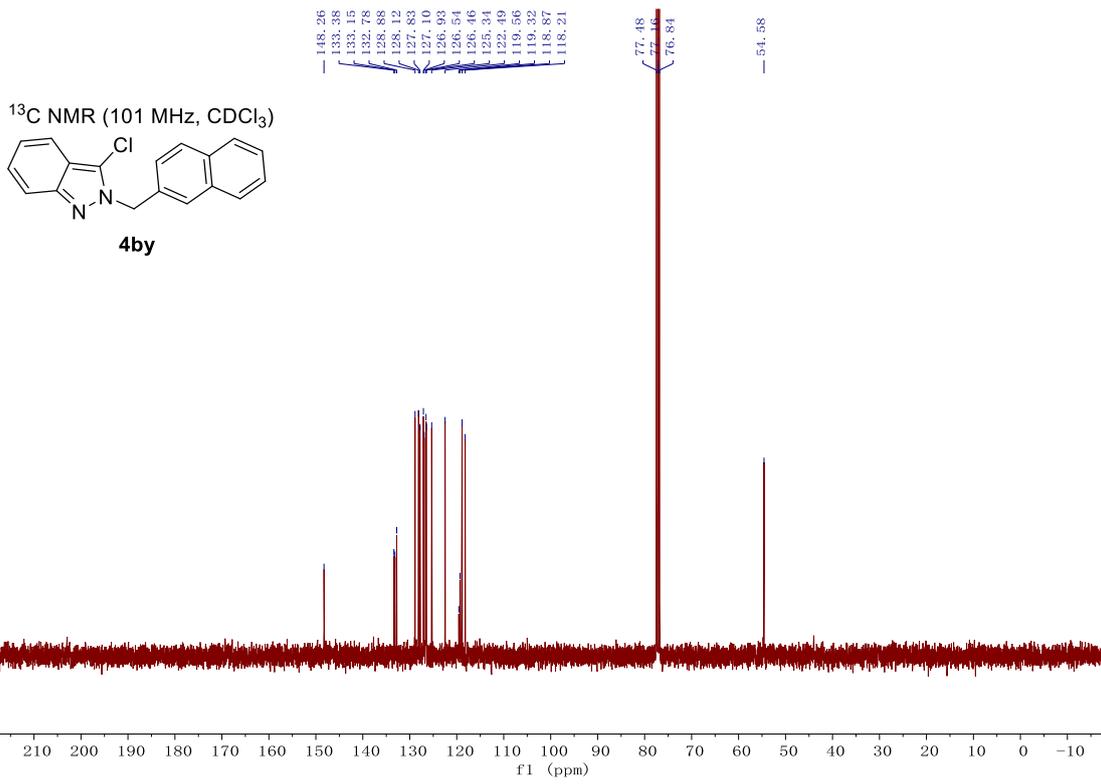
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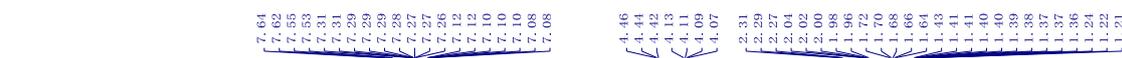
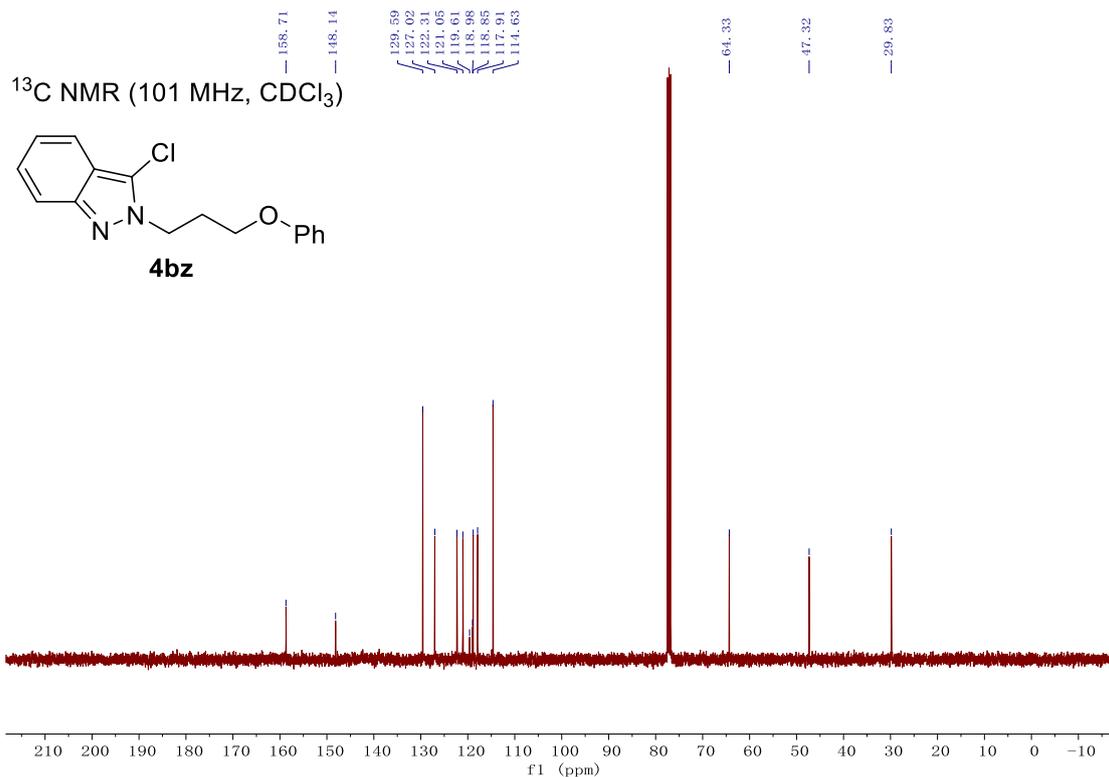




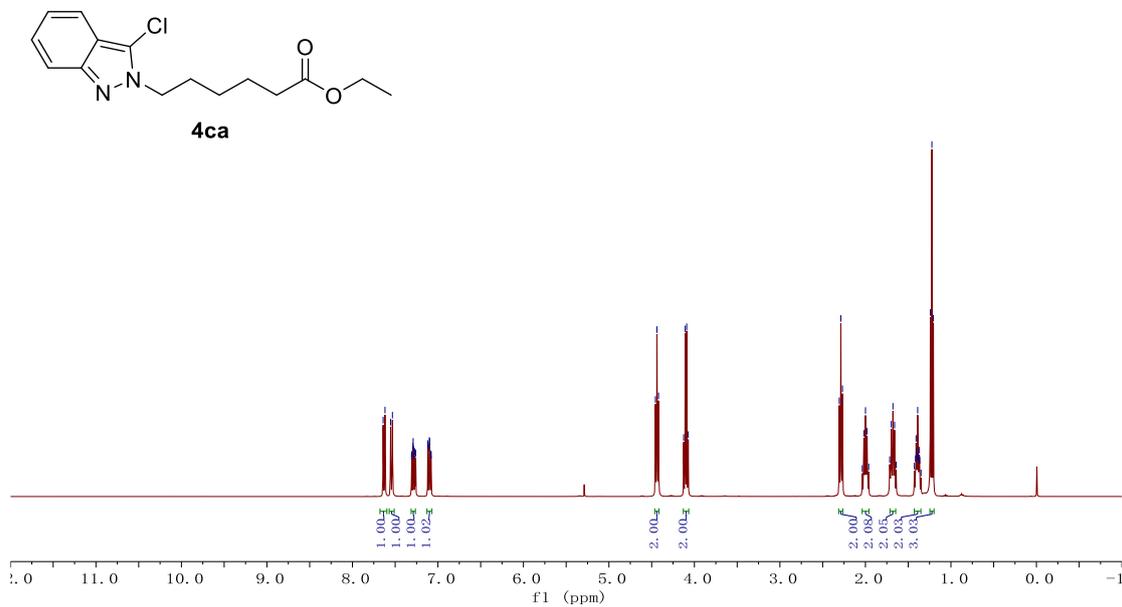
¹H NMR (400 MHz, CDCl₃)

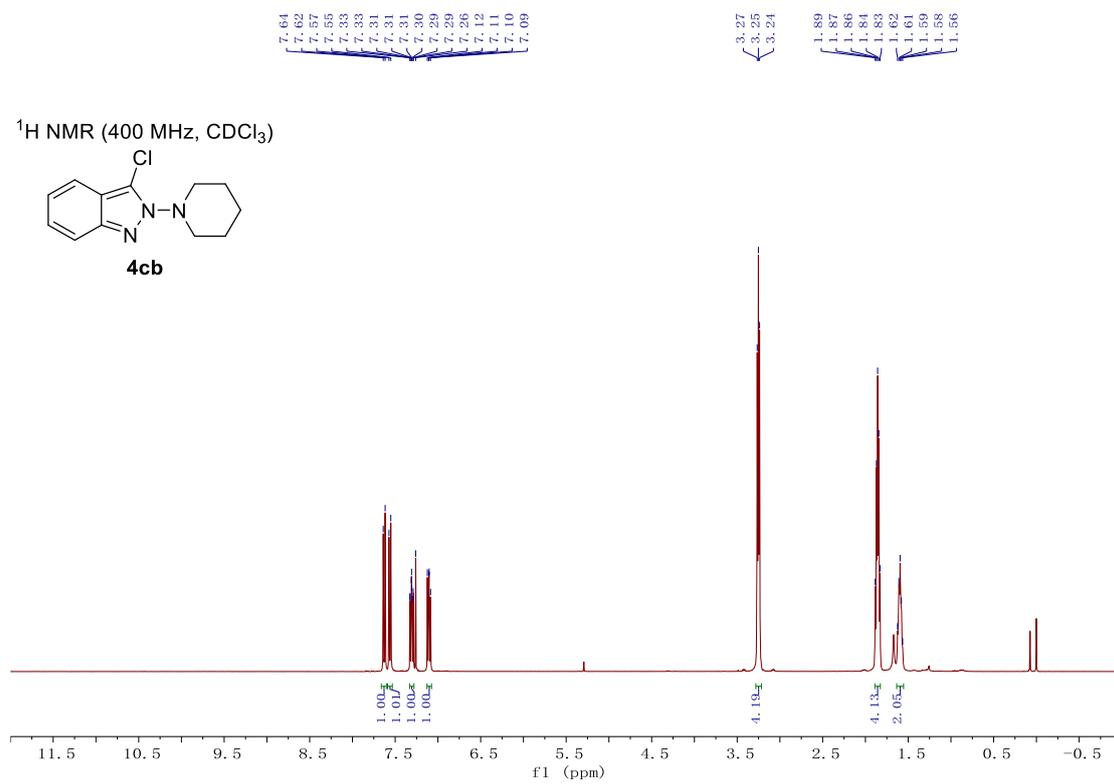
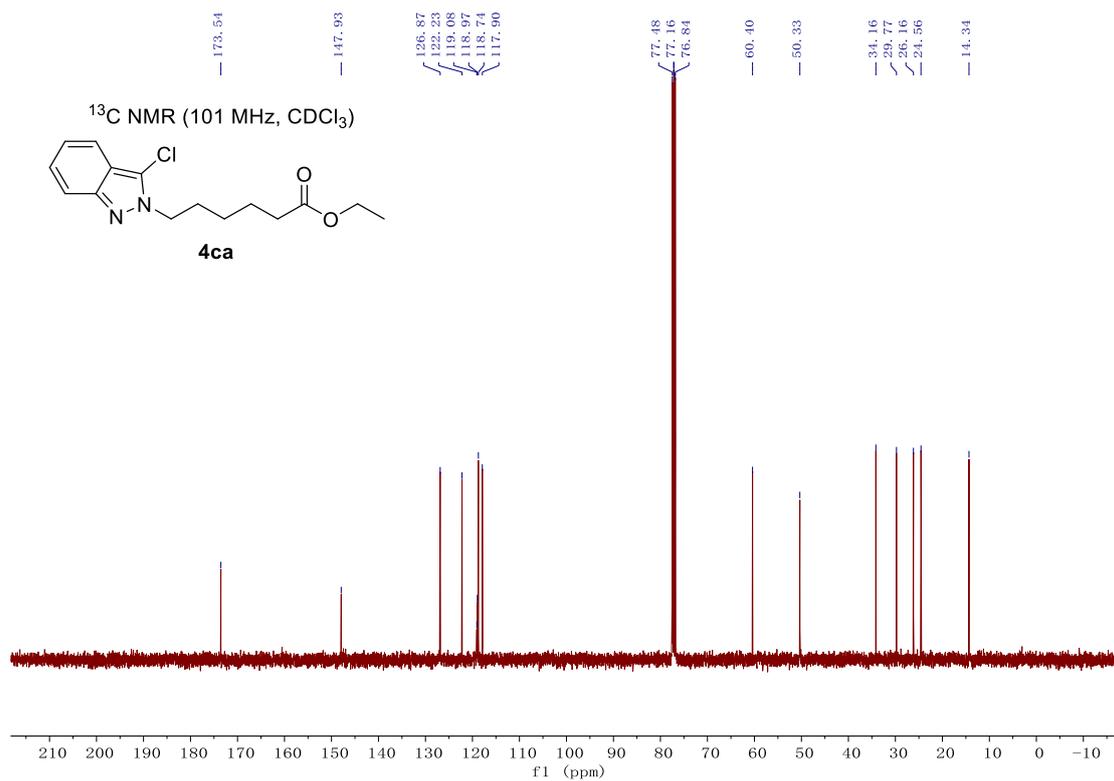




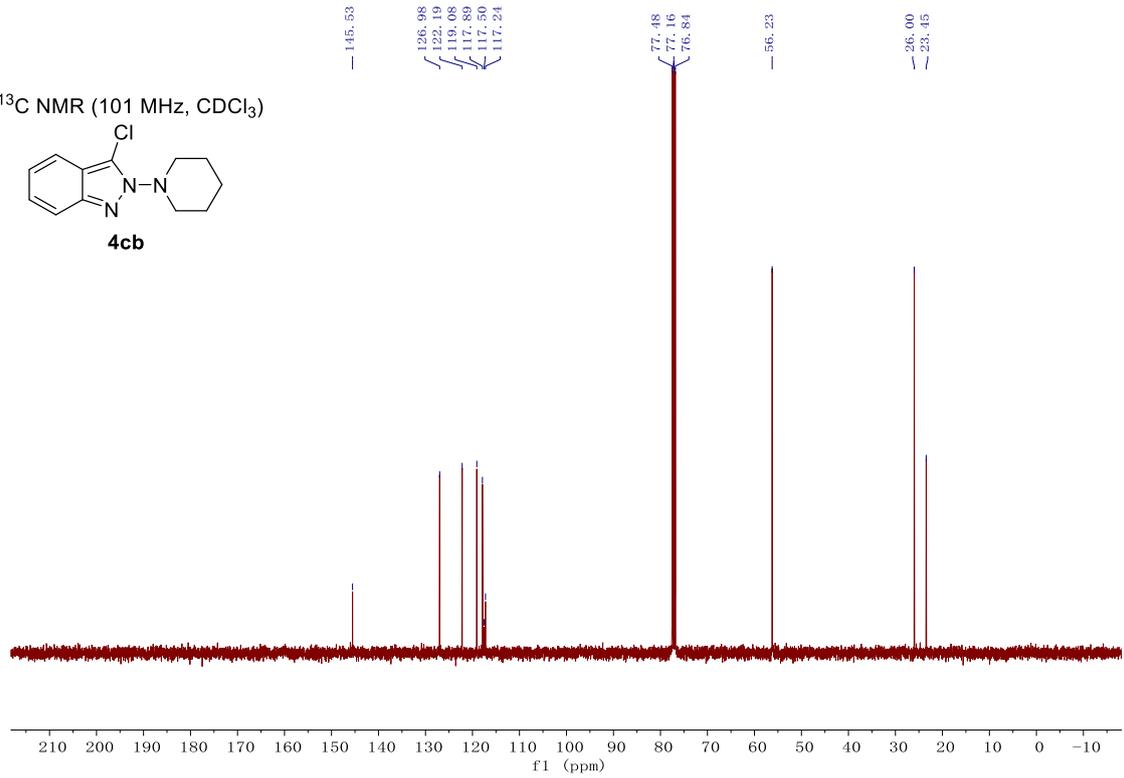
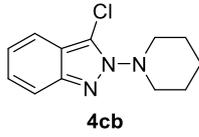


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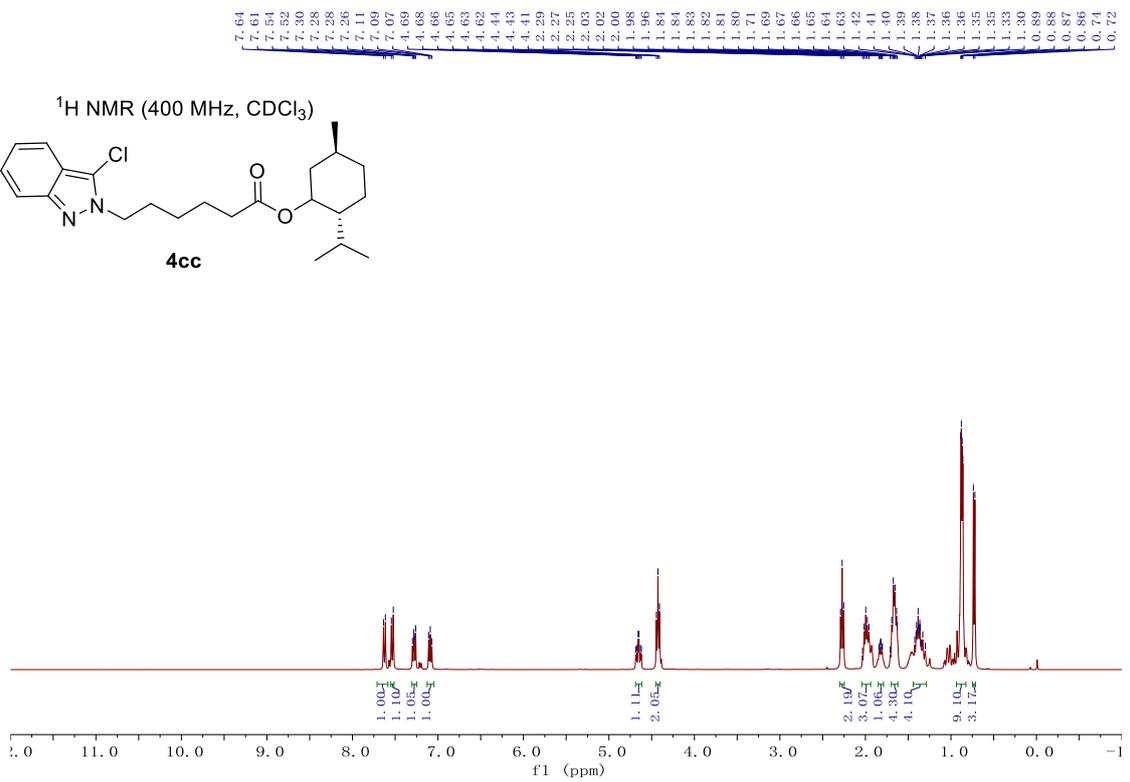
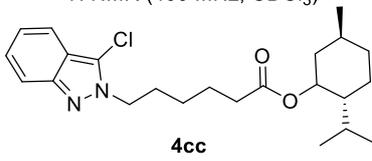


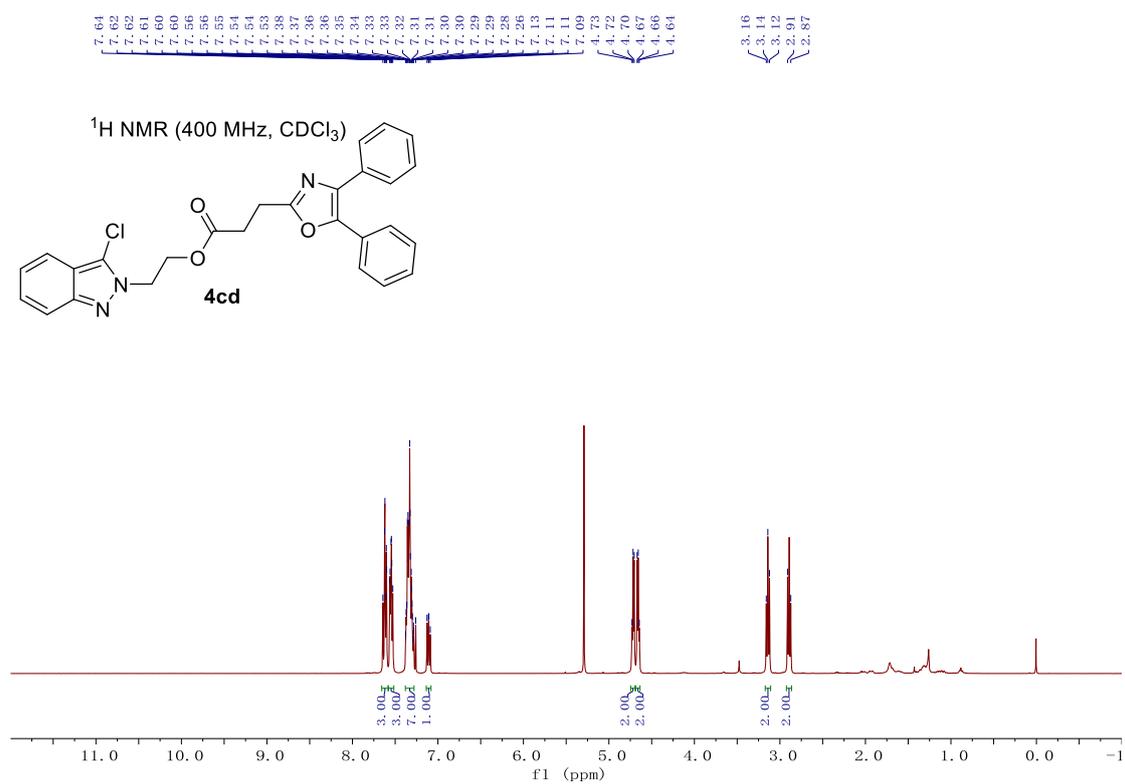
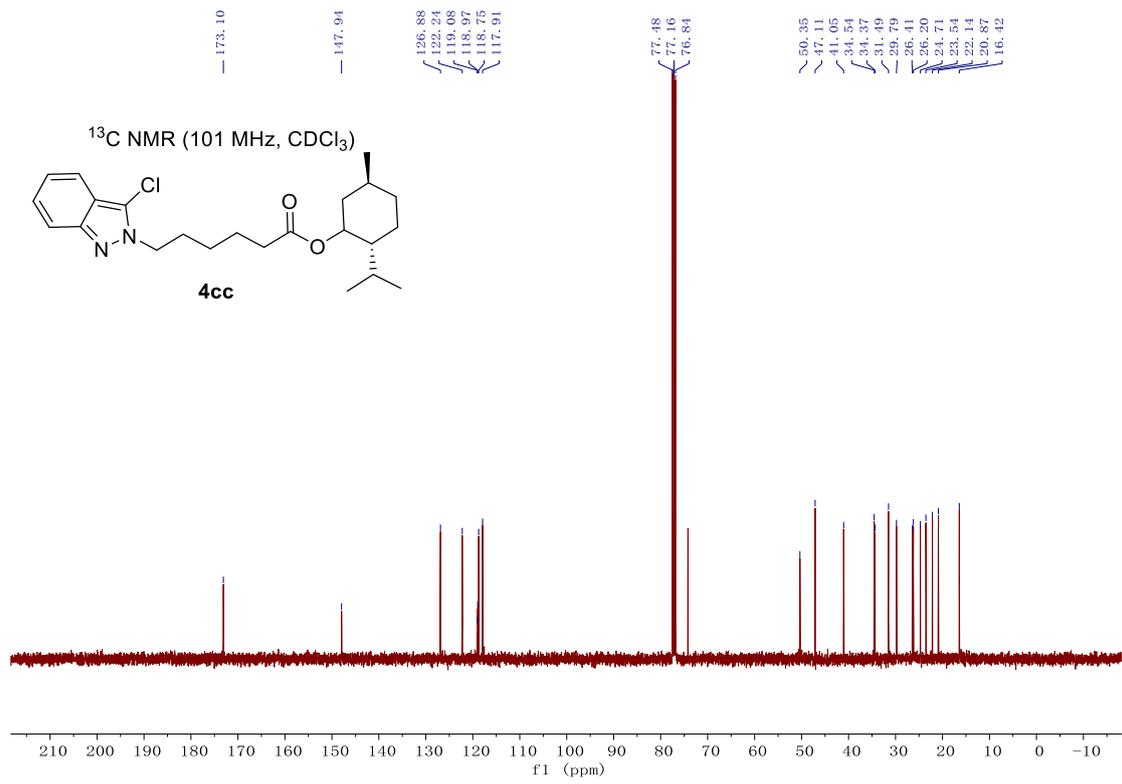


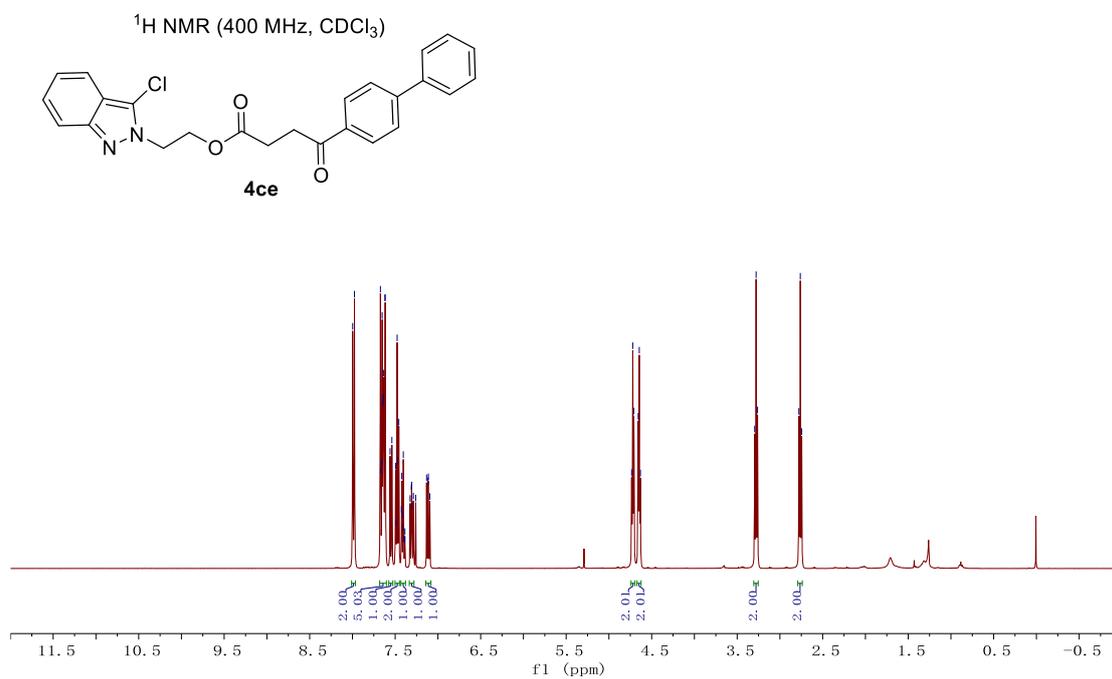
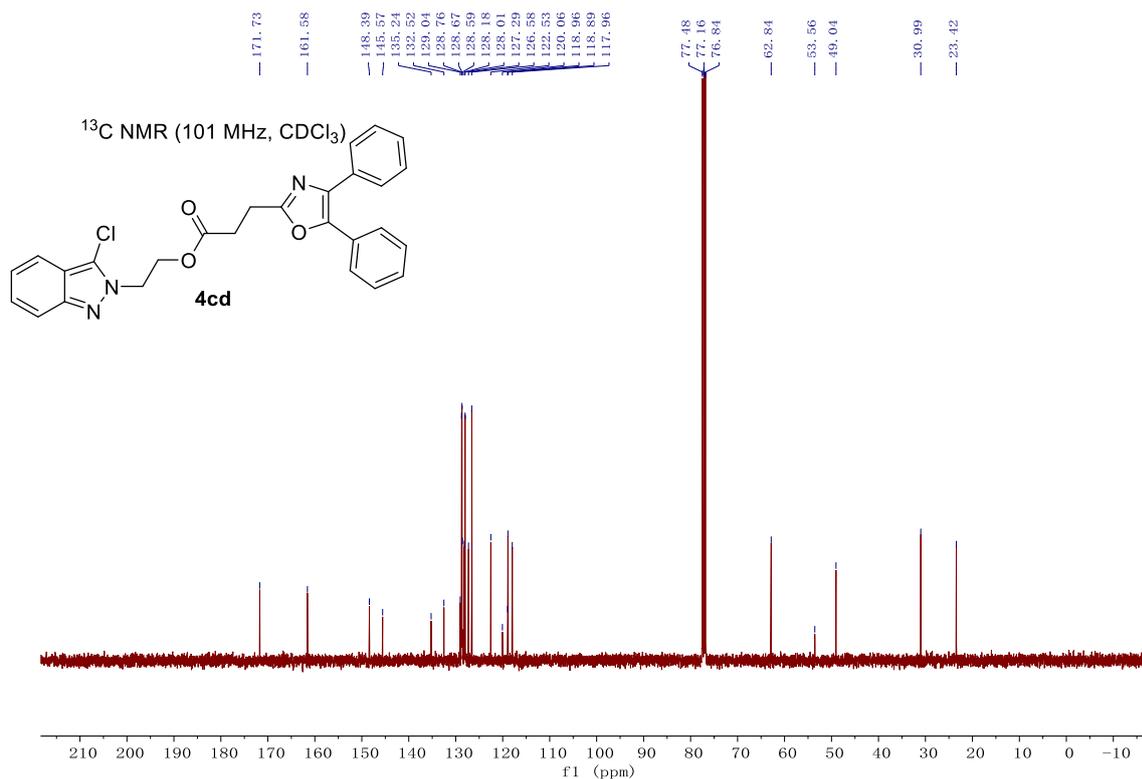
¹³C NMR (101 MHz, CDCl₃)



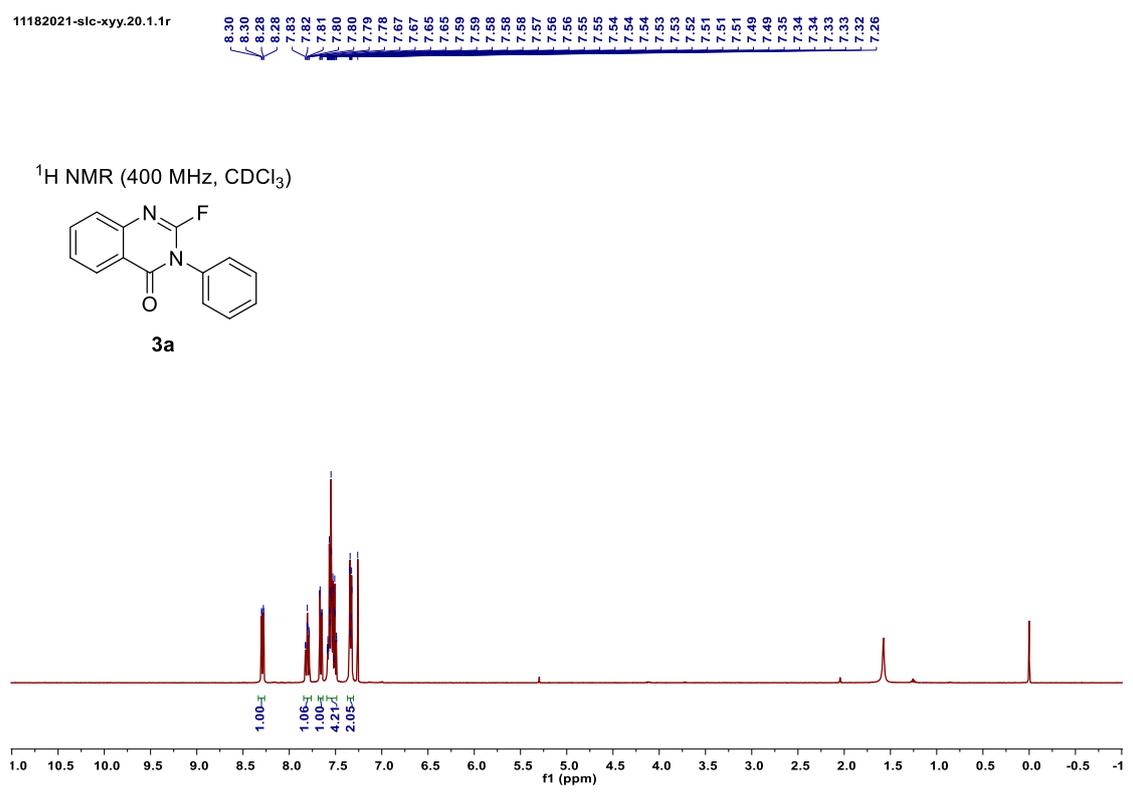
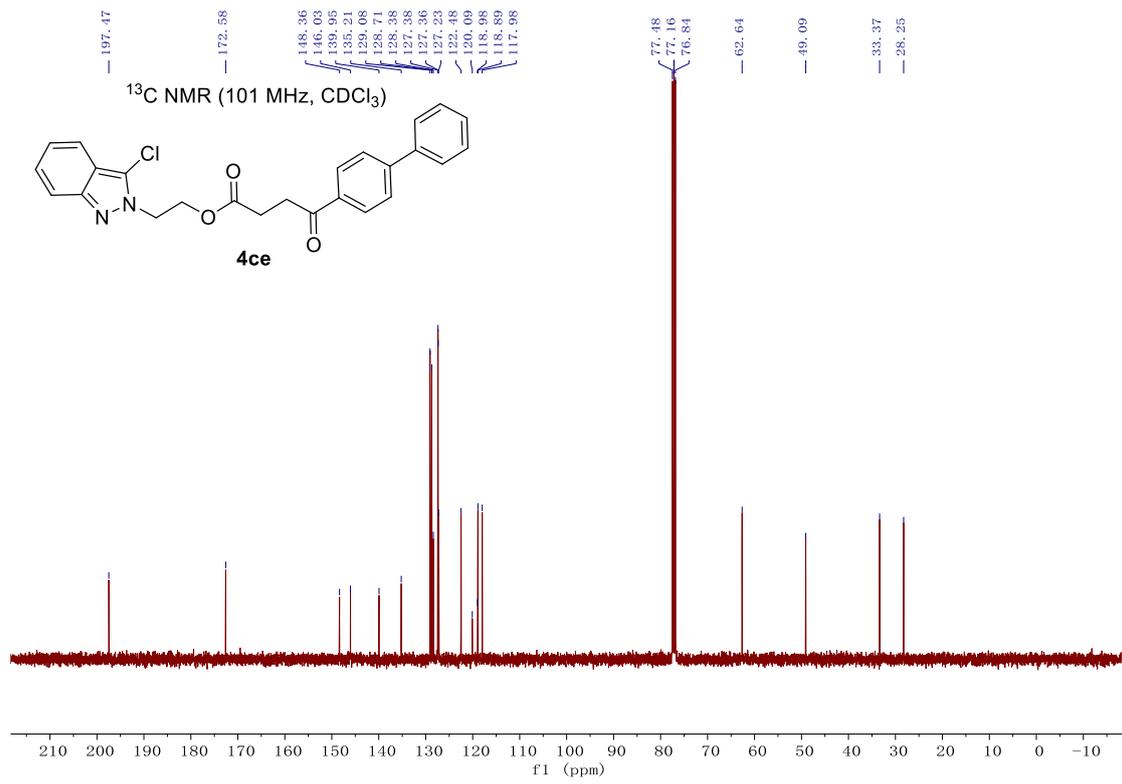
¹H NMR (400 MHz, CDCl₃)





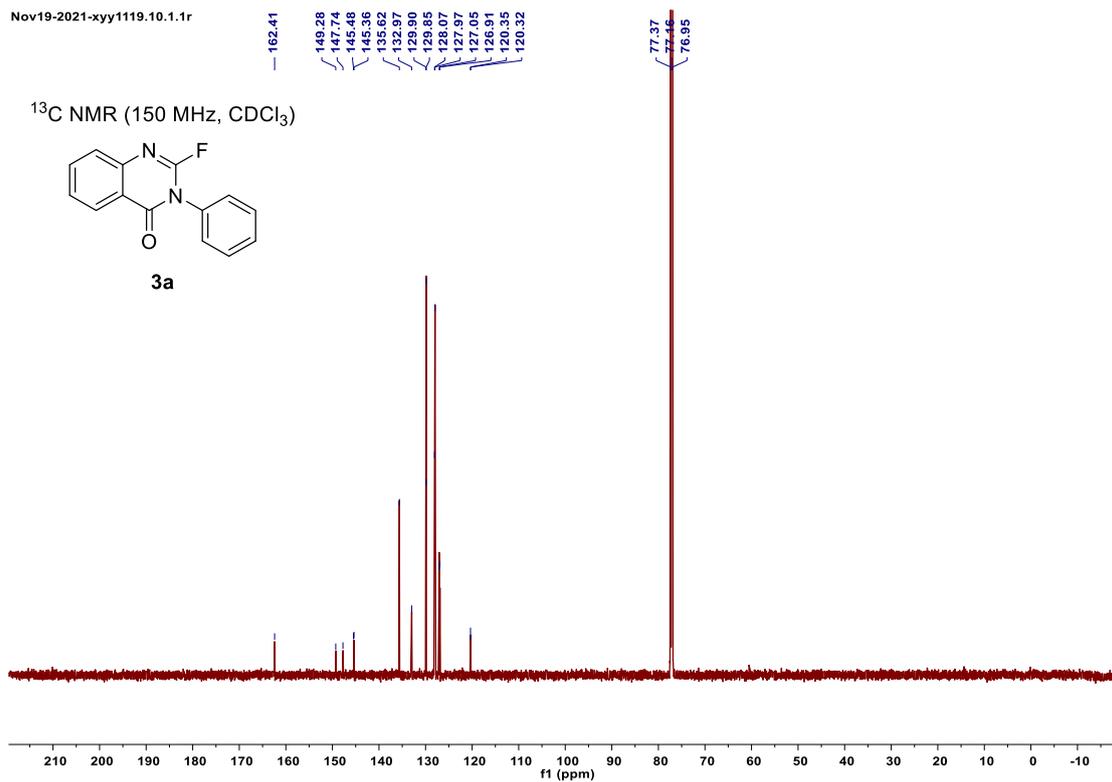
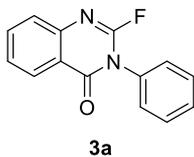


¹H NMR (400 MHz, Chloroform-*d*) δ 7.99 (d, J = 8.3 Hz, 2H), 7.70 – 7.58 (m, 5H), 7.55 (d, J = 8.5 Hz, 1H), 7.48 (t, J = 7.5 Hz, 2H), 7.46 – 7.36 (m, 1H), 7.34 – 7.28 (m, 1H), 7.11 (dd, J = 8.5, 6.6 Hz, 1H), 4.72 (t, J = 5.1 Hz, 2H), 4.64 (t, J = 5.1 Hz, 2H), 3.28 (t, J = 6.7 Hz, 2H), 2.76 (t, J = 6.7 Hz, 2H).



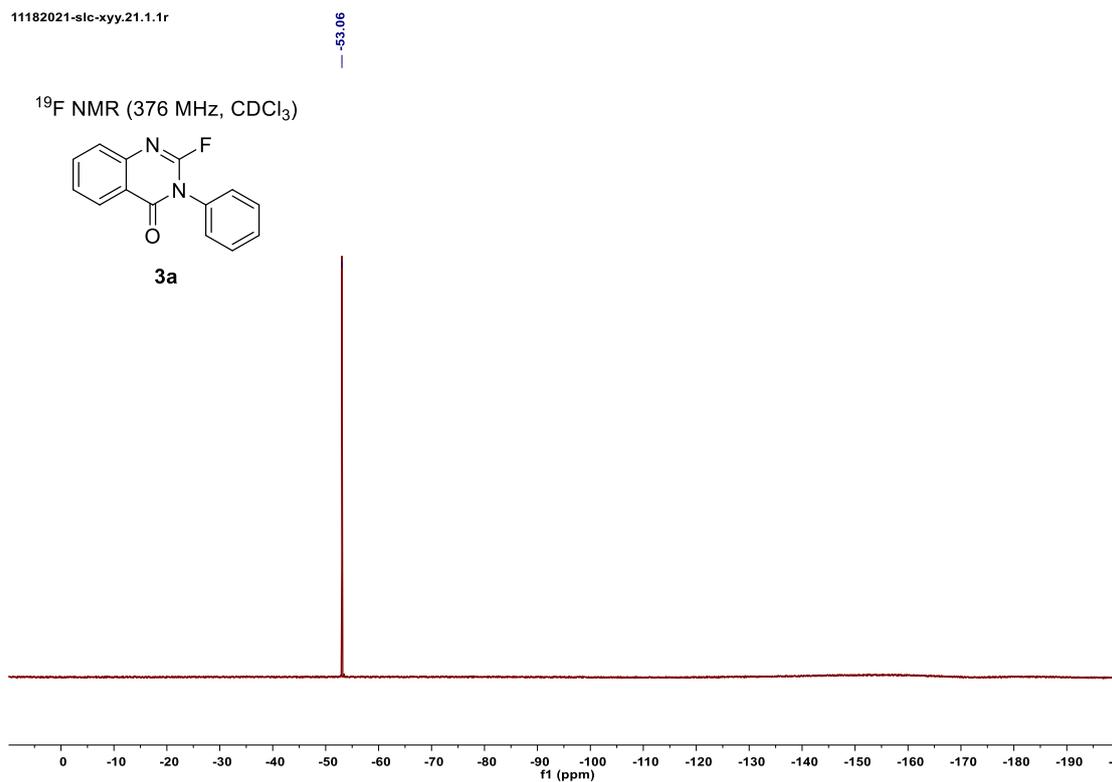
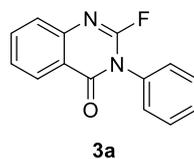
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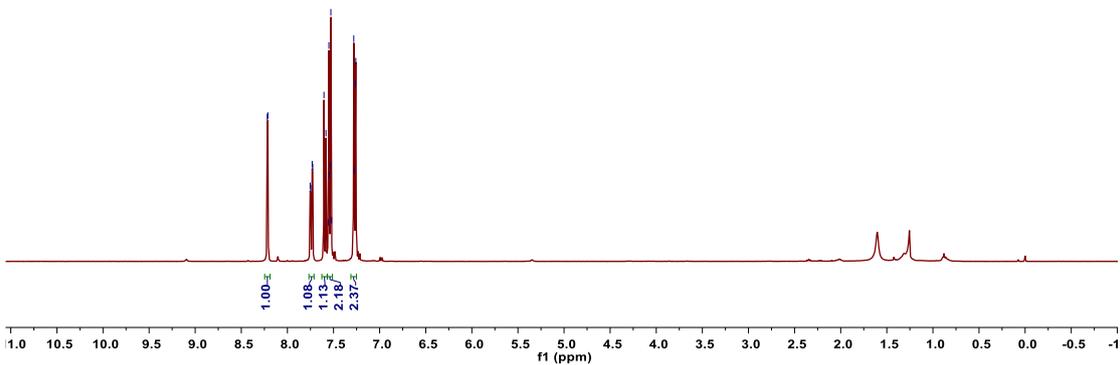
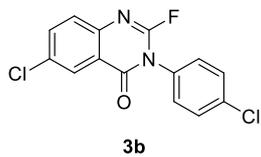
¹⁹F NMR (376 MHz, CDCl₃)



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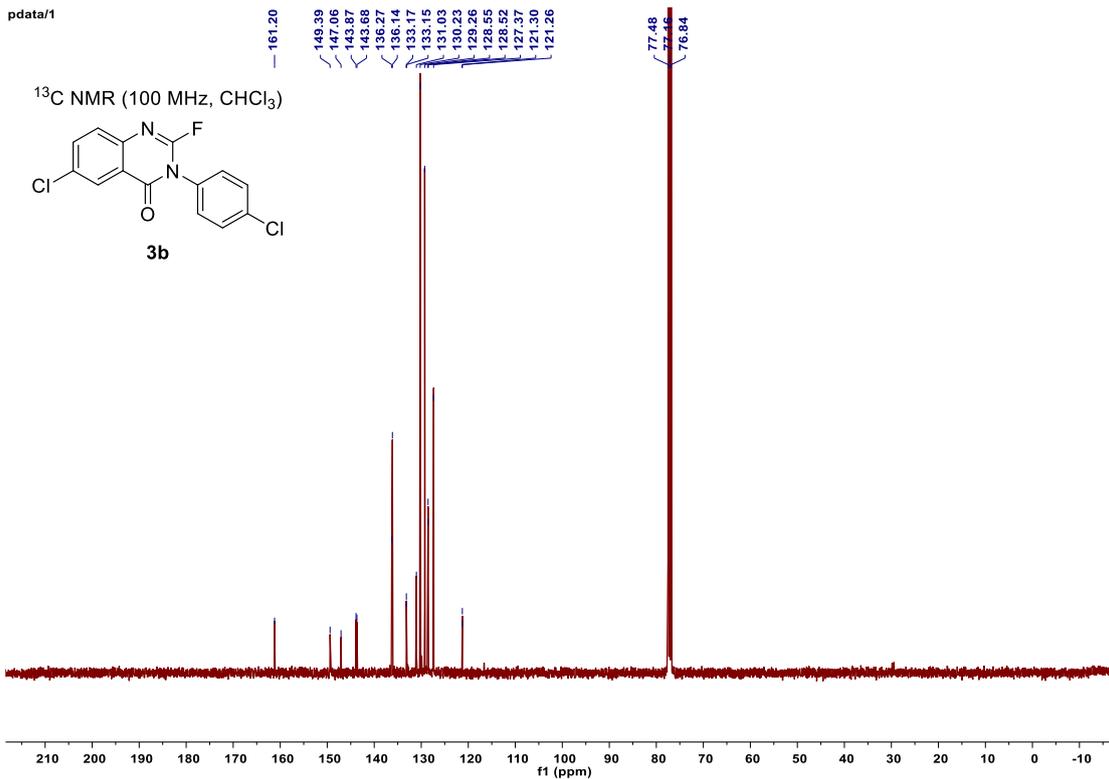
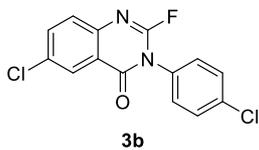
¹H NMR (400 MHz, CDCl₃)



pdata/1

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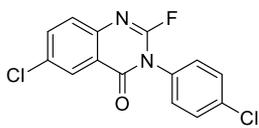
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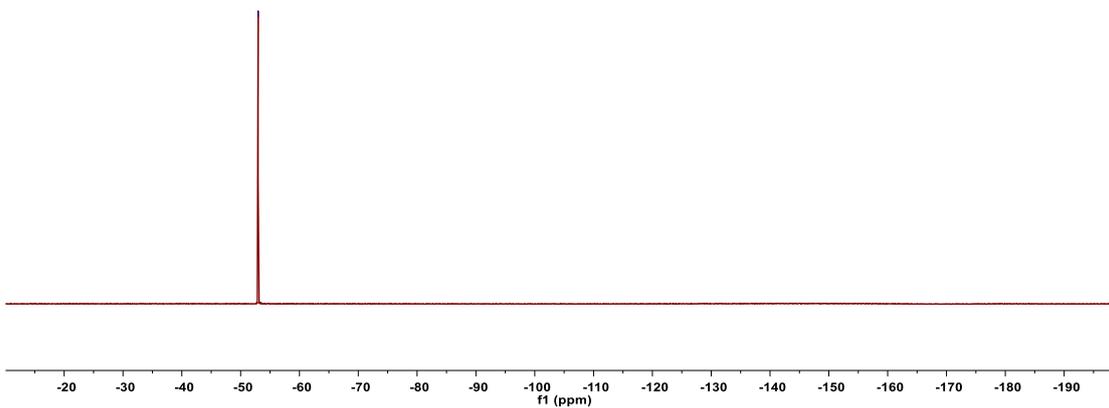
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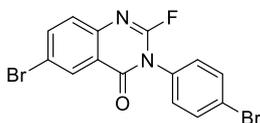
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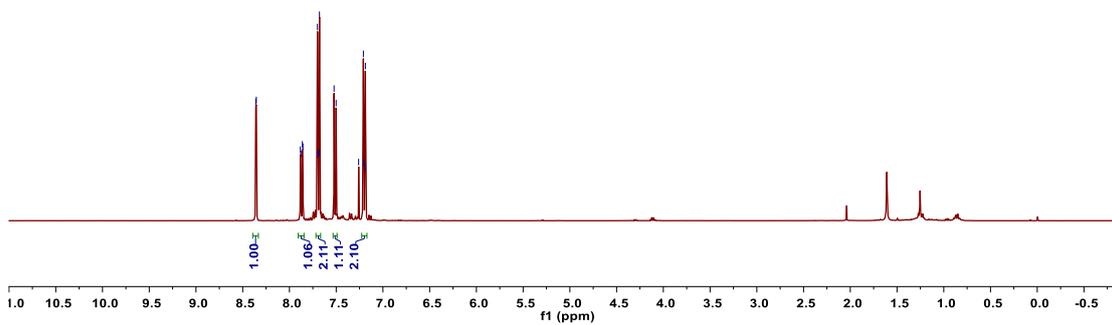
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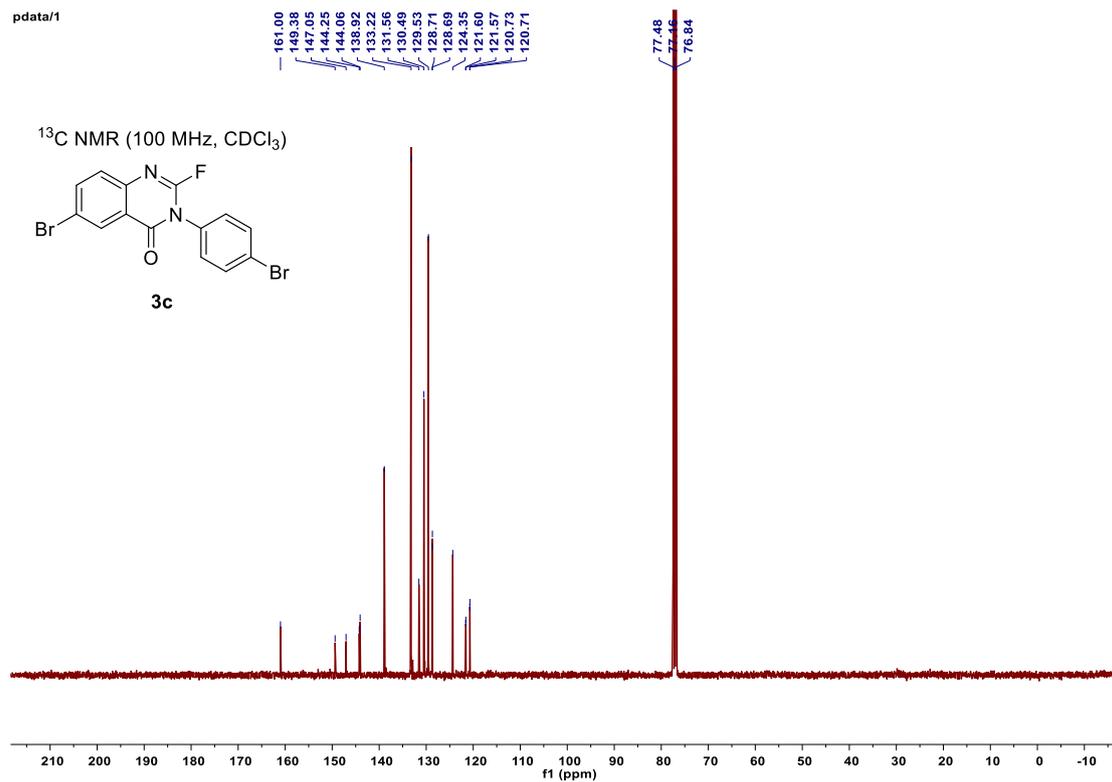
^1H NMR (400 MHz, CDCl_3)



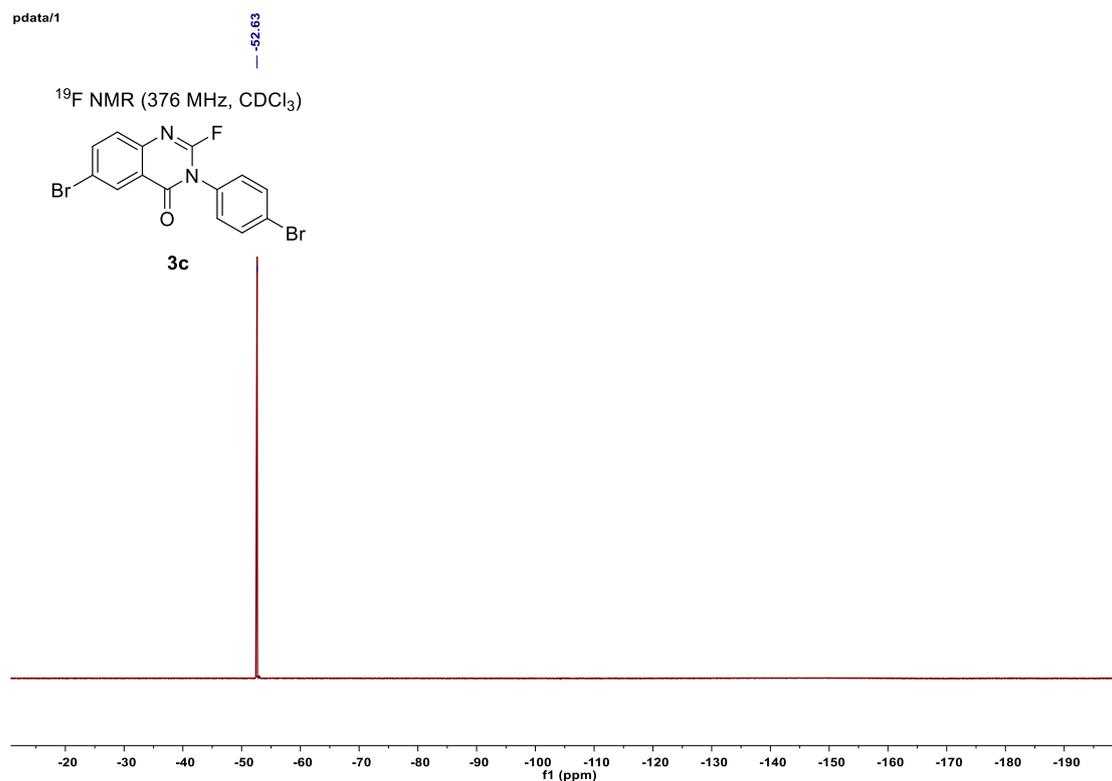
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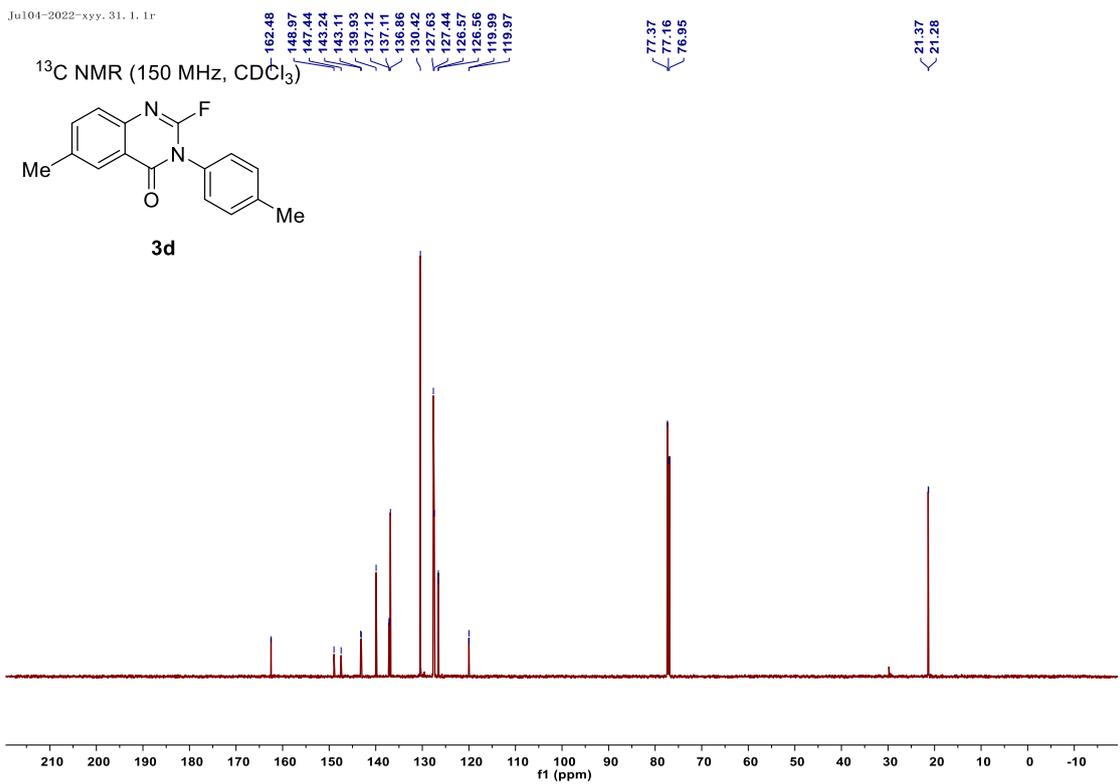
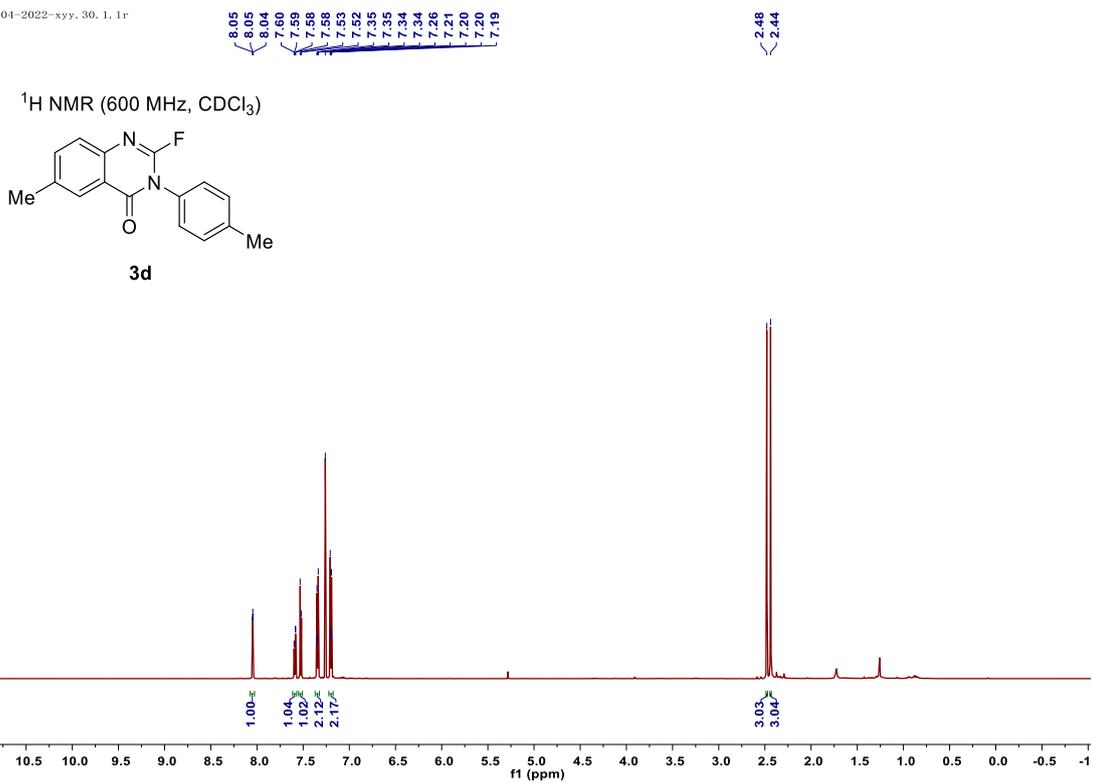


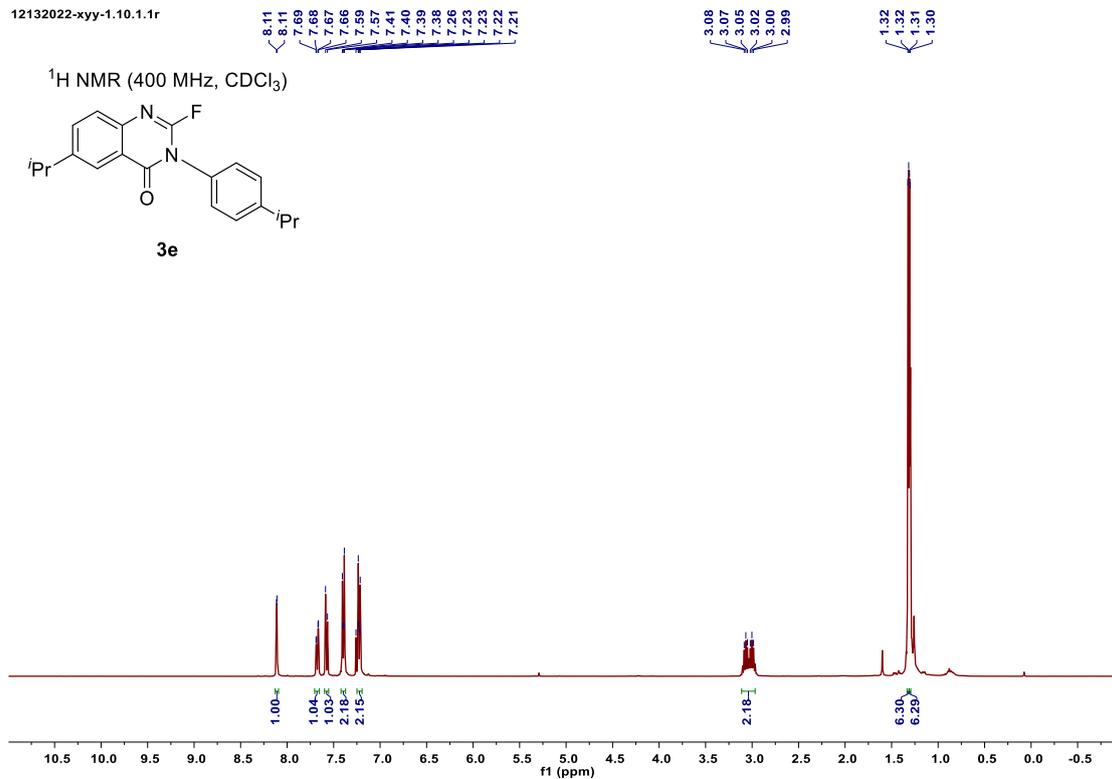
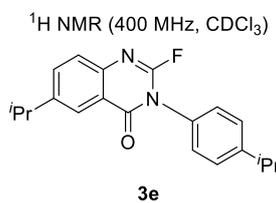
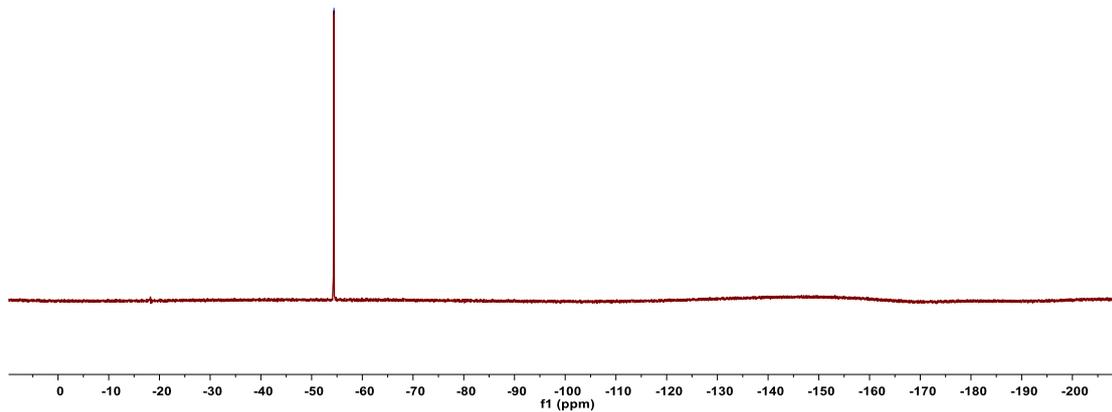
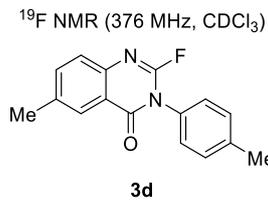
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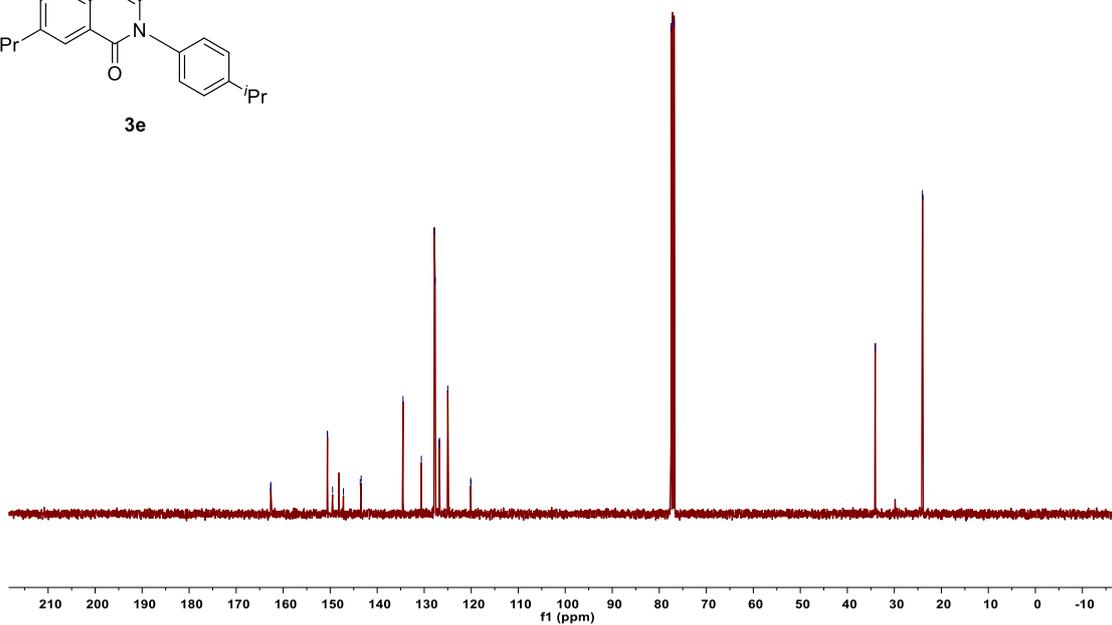
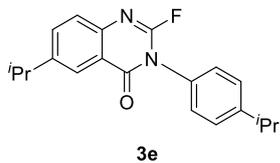
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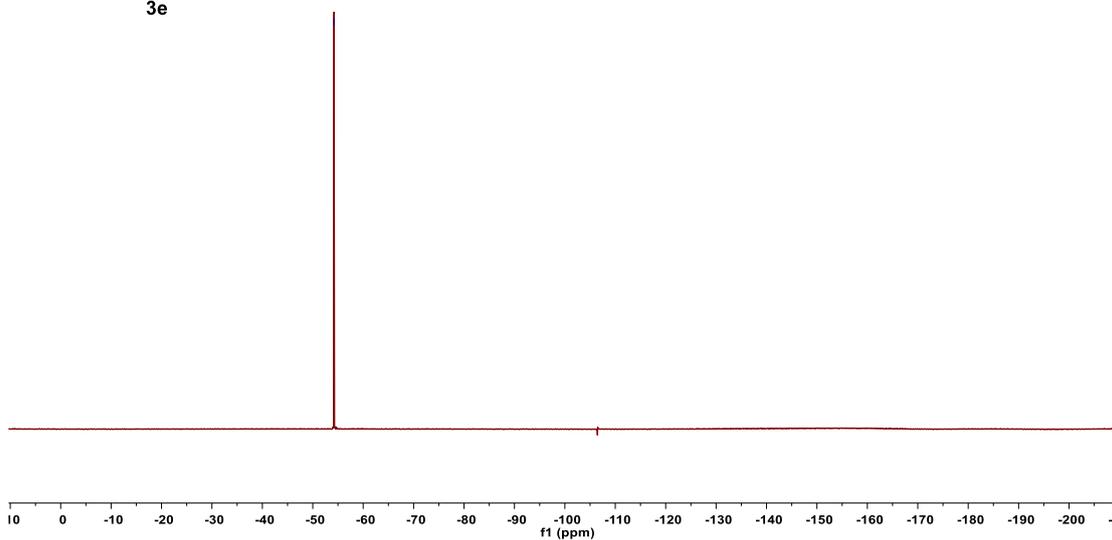
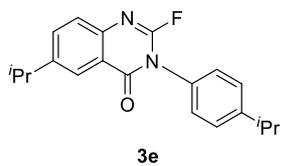
^{13}C NMR (100 MHz, CDCl_3)



12132022-xyy-1.11.1.1r

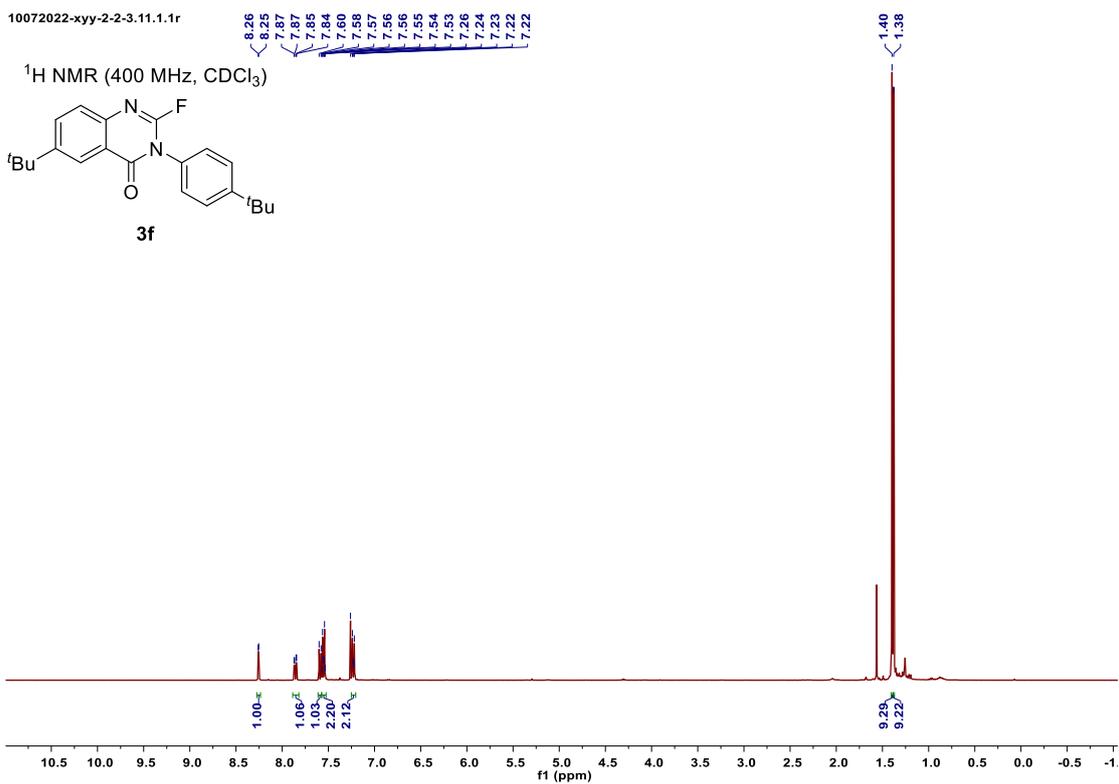
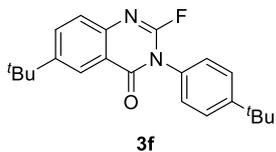
-54.22

^{19}F NMR (376 MHz, CDCl_3)



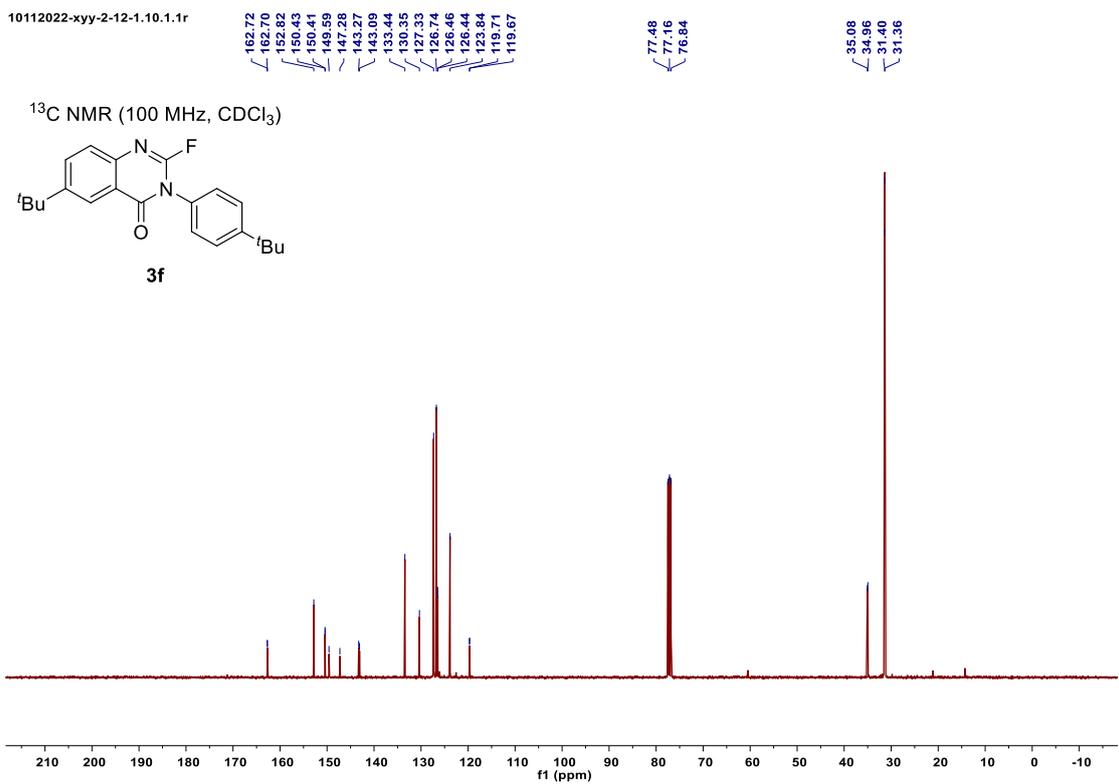
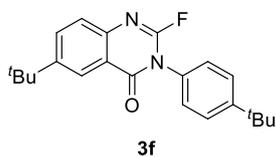
10072022-xyy-2-2-3.11.1.1r

¹H NMR (400 MHz, CDCl₃)



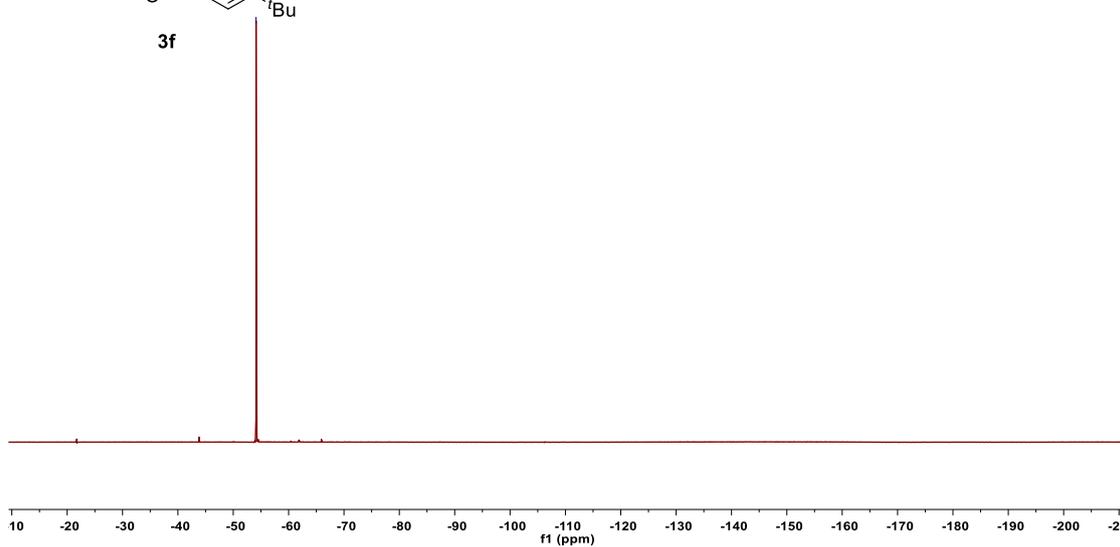
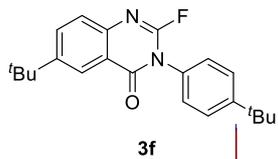
10112022-xyy-2-12-1.10.1.1r

¹³C NMR (100 MHz, CDCl₃)



-54.12

¹⁹F NMR (376 MHz, CDCl₃)

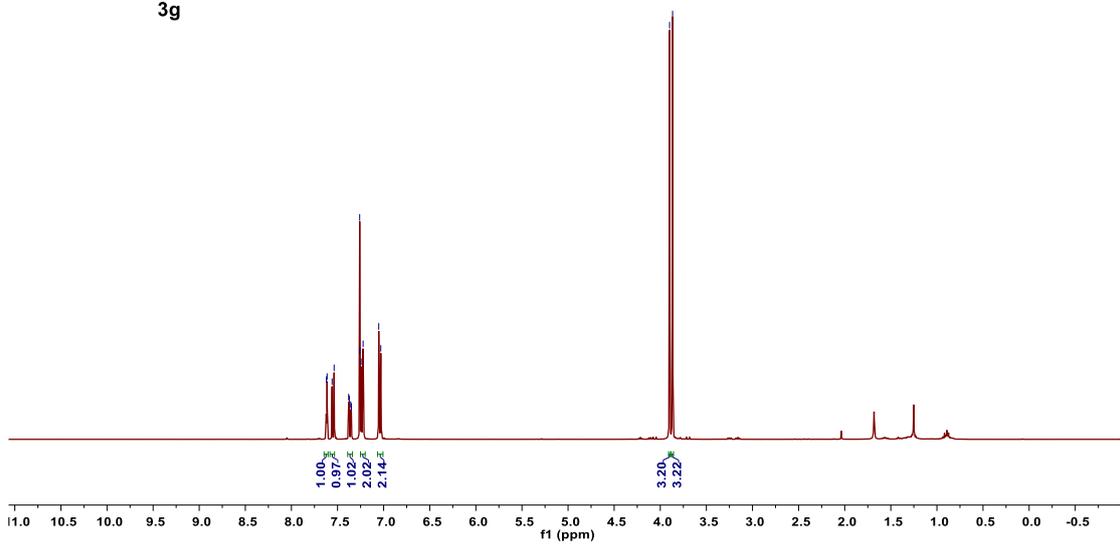
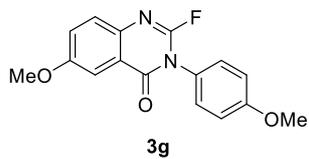


07022022-xyy.40.1.1r

7.62
7.61
7.56
7.54
7.38
7.37
7.36
7.35
7.26
7.24
7.22
7.05
7.03

3.90
3.87

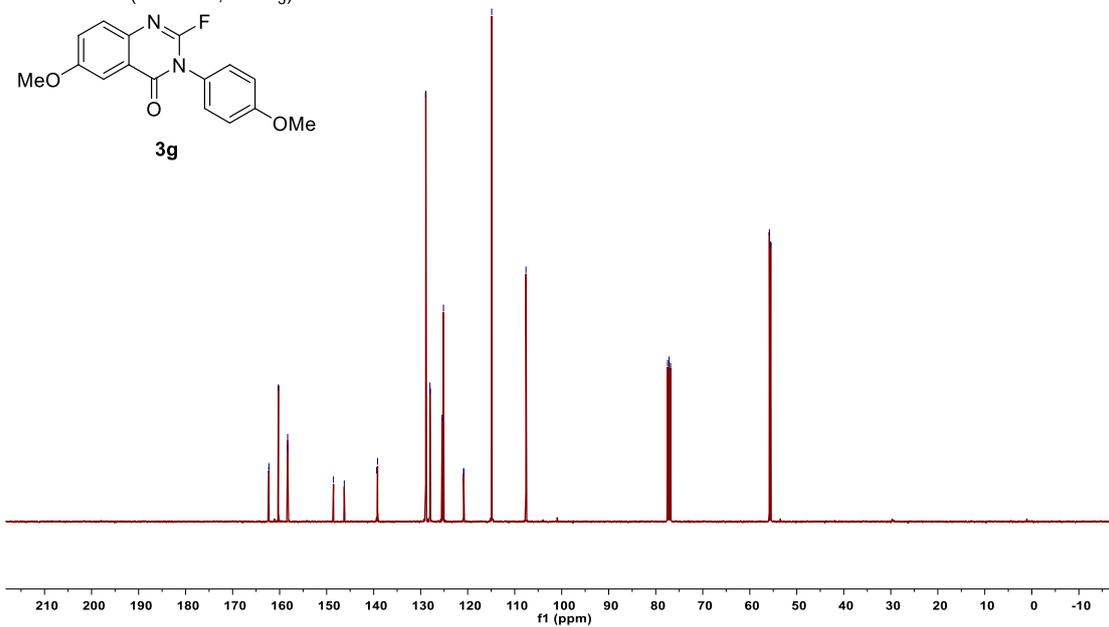
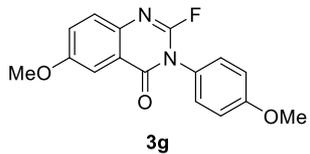
¹H NMR (400 MHz, CDCl₃)



pdata/1

162.30
162.28
160.27
158.30
156.28
148.55
146.25
139.35
139.17
128.91
128.02
128.00
125.45
125.16
120.86
120.82
114.89
107.60
77.48
77.16
76.84
55.82
55.55

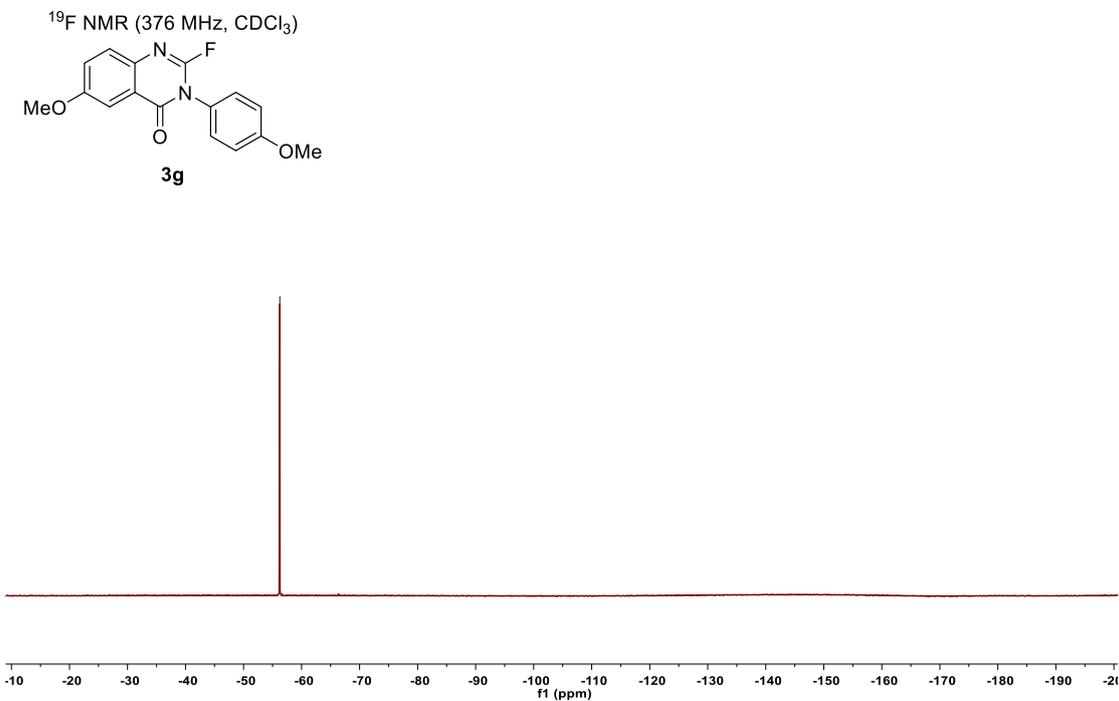
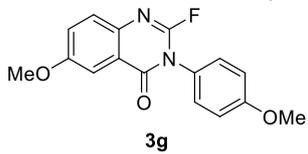
¹³C NMR (100 MHz, CDCl₃)



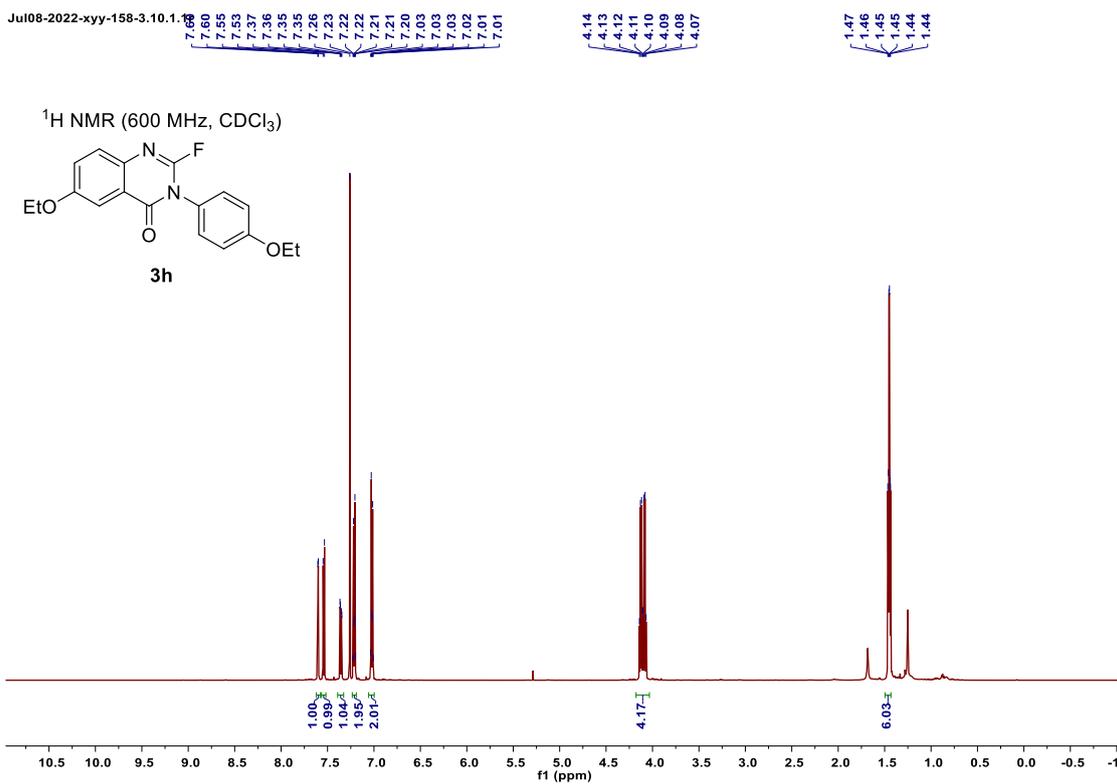
Jun30-2022-xyy.41.1.1r

-56.25

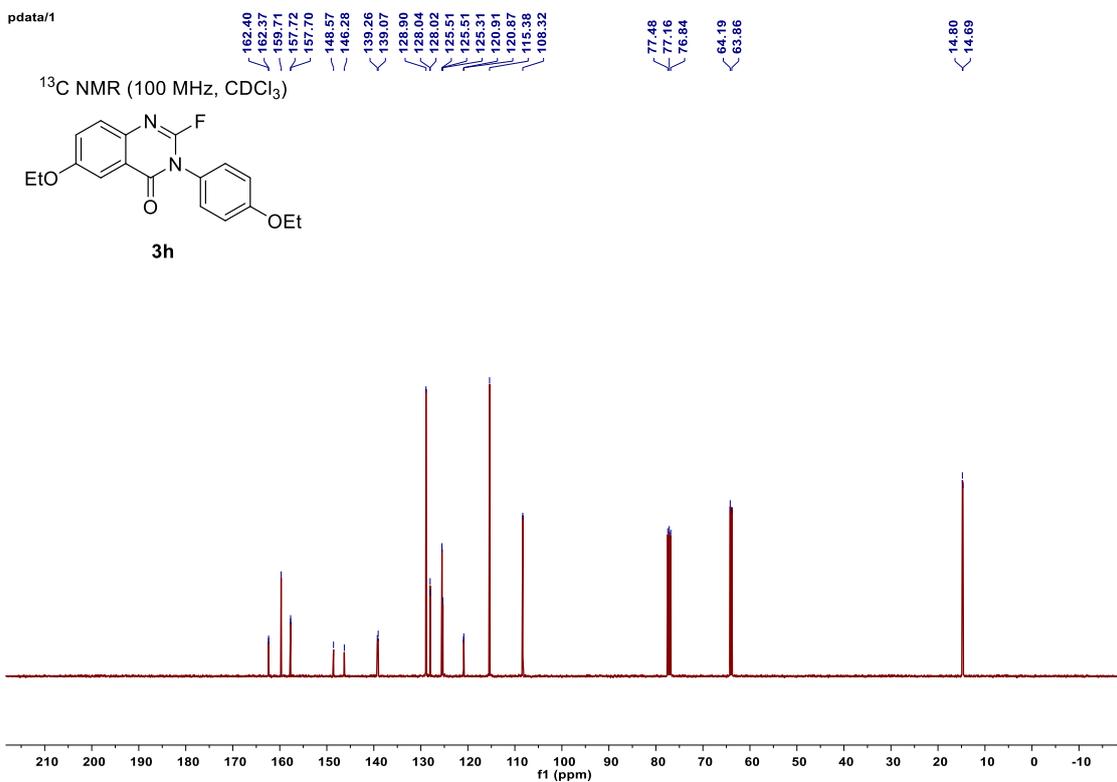
¹⁹F NMR (376 MHz, CDCl₃)



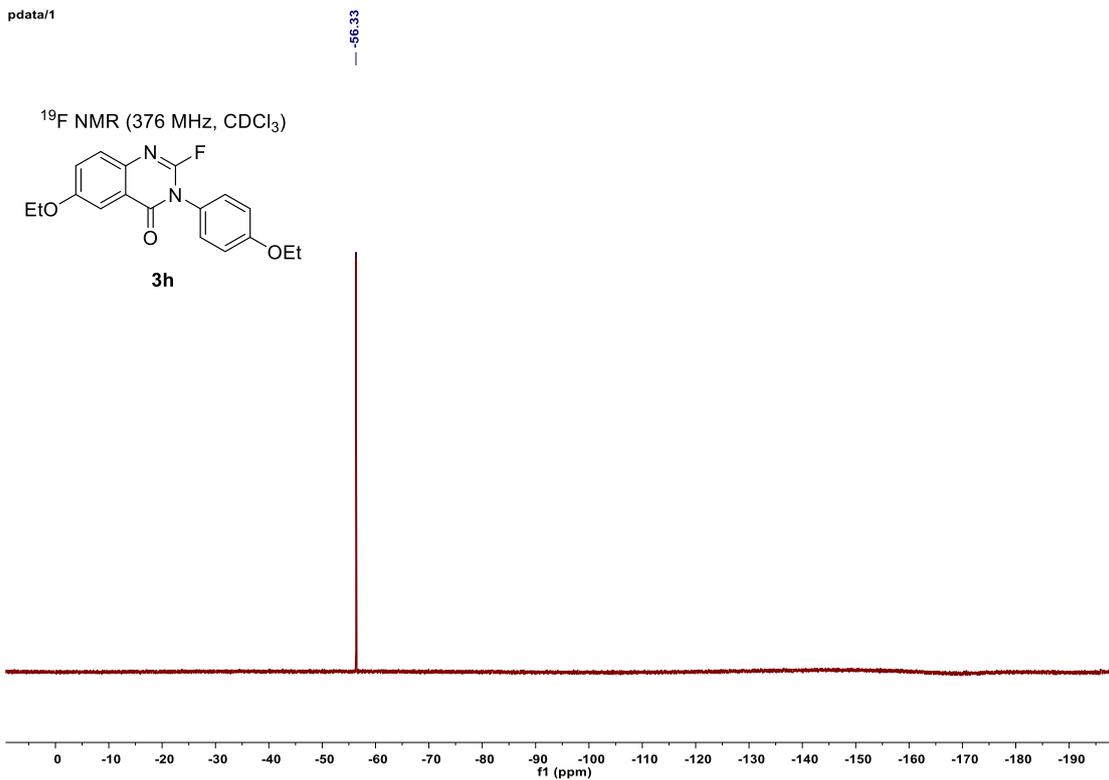
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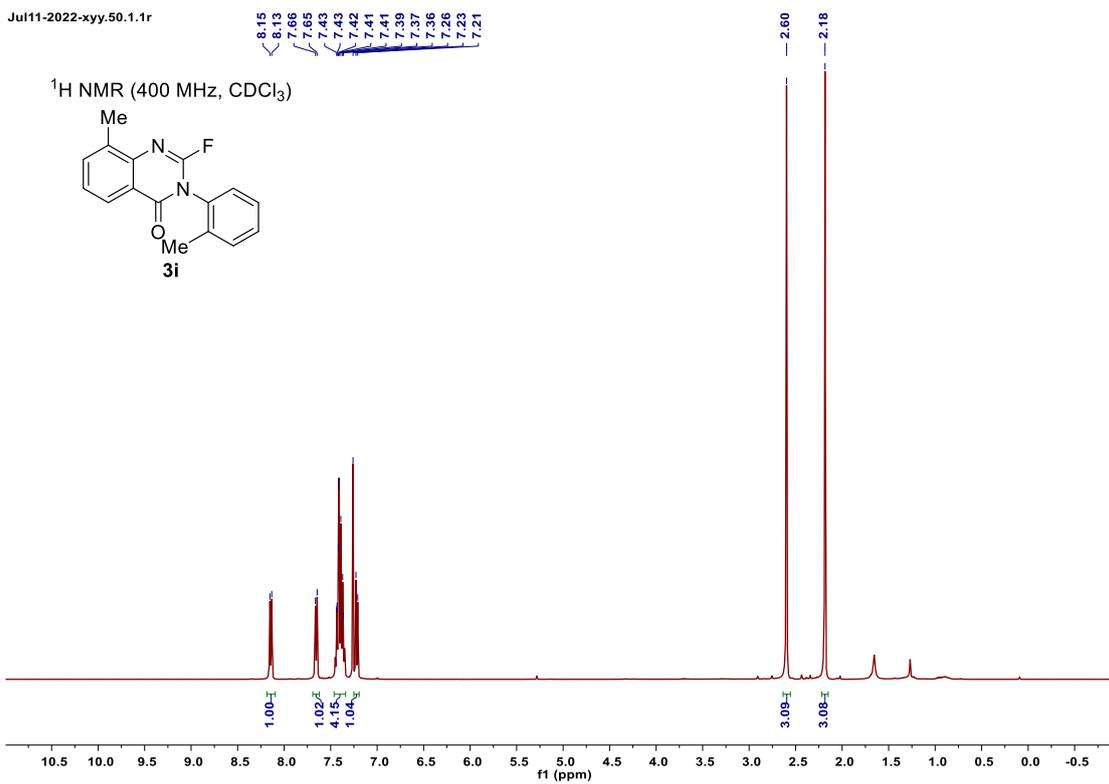
pdata/1



pdata/1



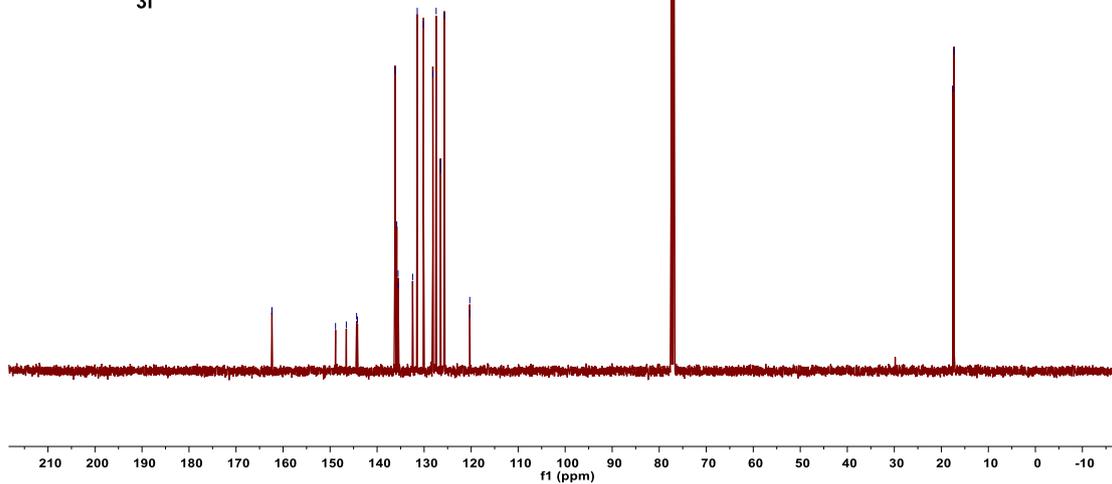
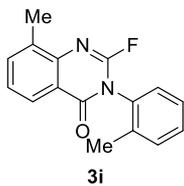
Jul11-2022-xyy.50.1.1r



Jul11-2022-xyy.52.1.1r

162.38
162.36
148.84
146.54
144.36
144.19
136.20
135.82
135.54
135.51
132.45
131.46
130.12
128.15
127.43
126.50
126.49
125.70
120.29
120.26
77.48
77.16
76.84

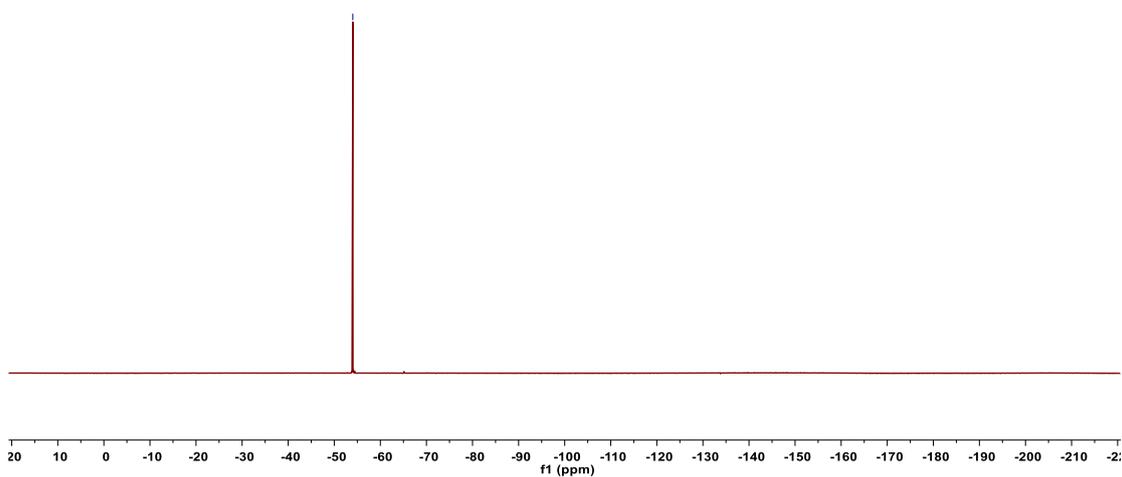
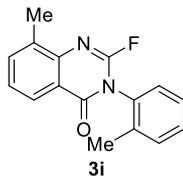
^{13}C NMR (100 MHz, CDCl_3)



Jul11-2022-xyy.51.1.1r

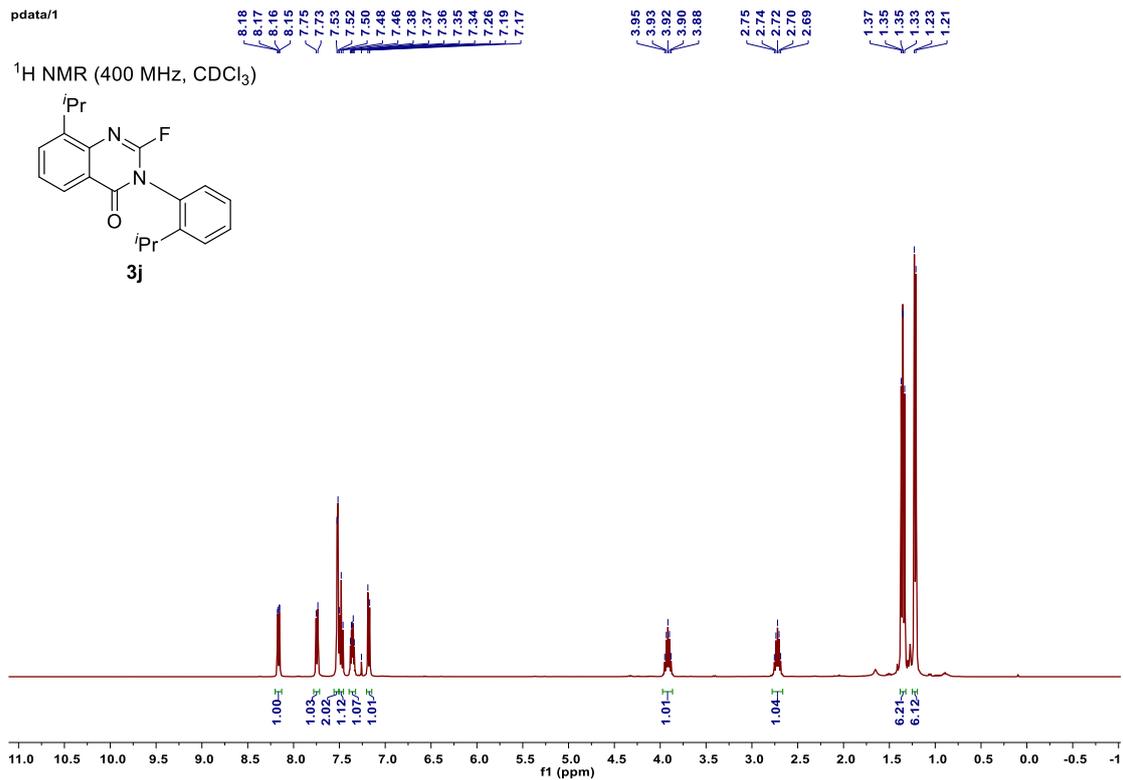
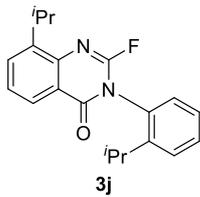
-54.02

^{19}F NMR (376 MHz, CDCl_3)



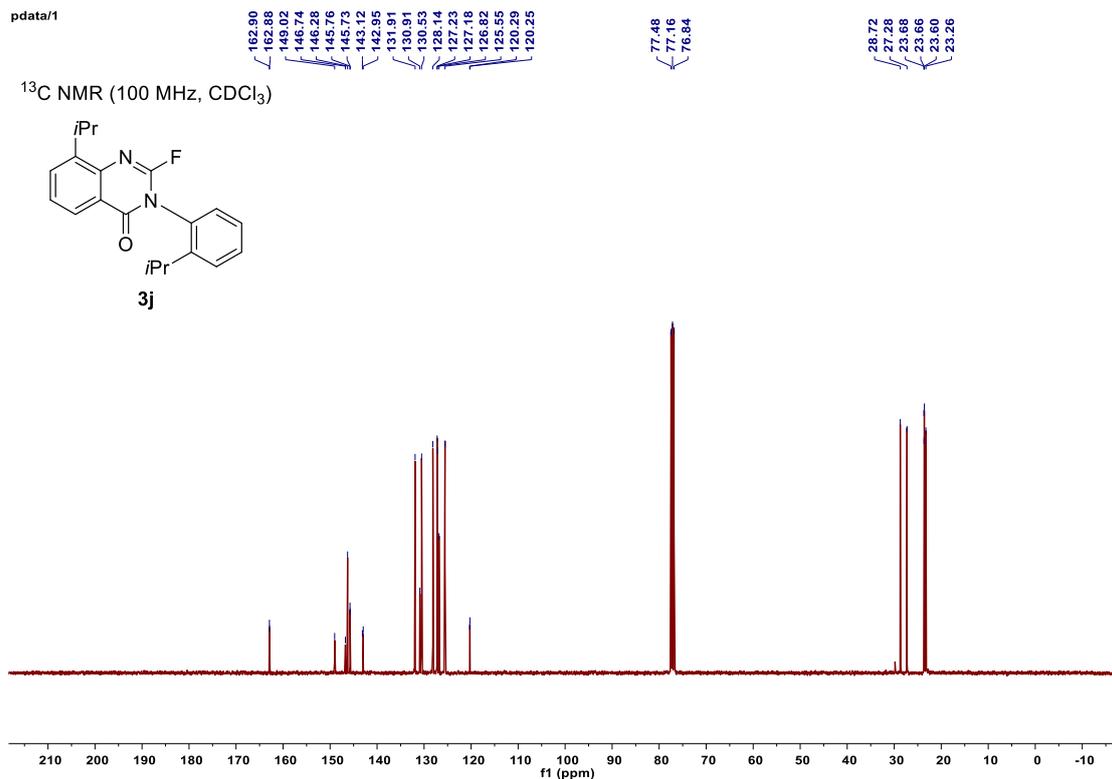
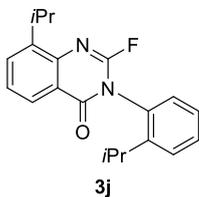
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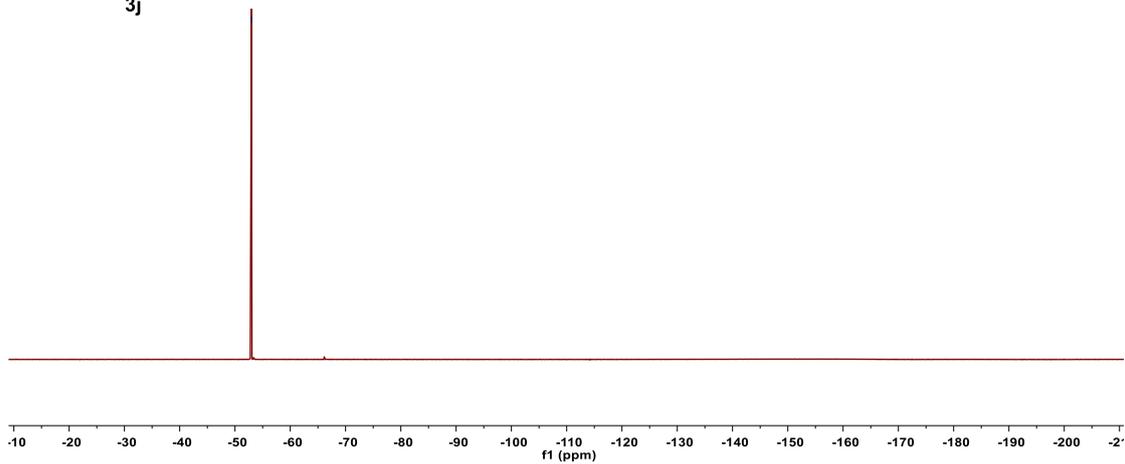
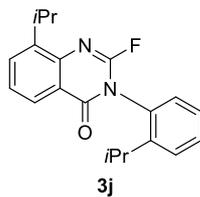
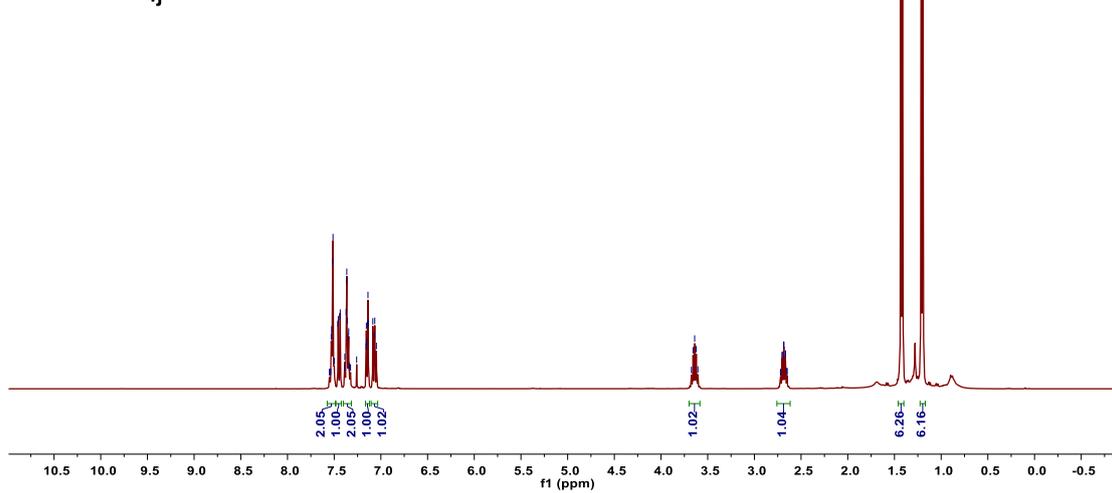
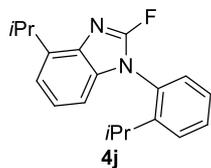
¹H NMR (400 MHz, CDCl₃)



pdata/1

¹³C NMR (100 MHz, CDCl₃)

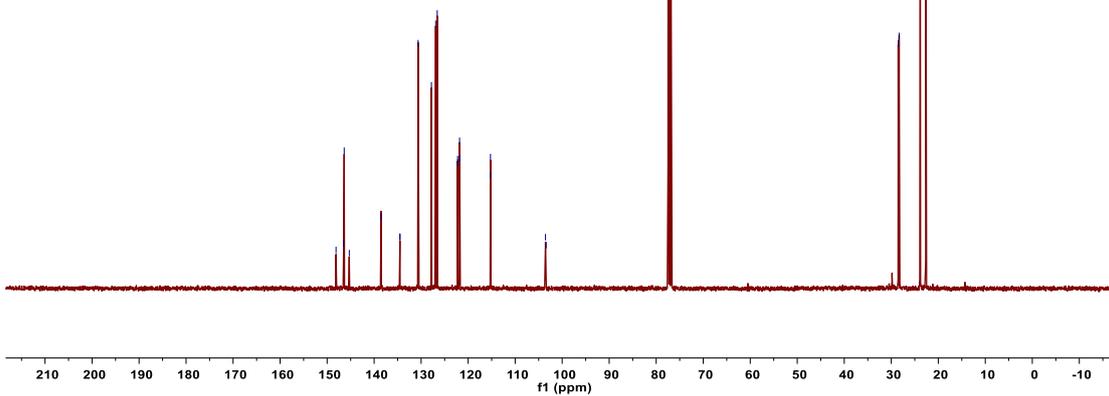
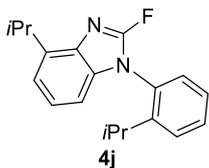


^{19}F NMR (376 MHz, CDCl_3) ^1H NMR (400 MHz, CDCl_3)

pdata/1

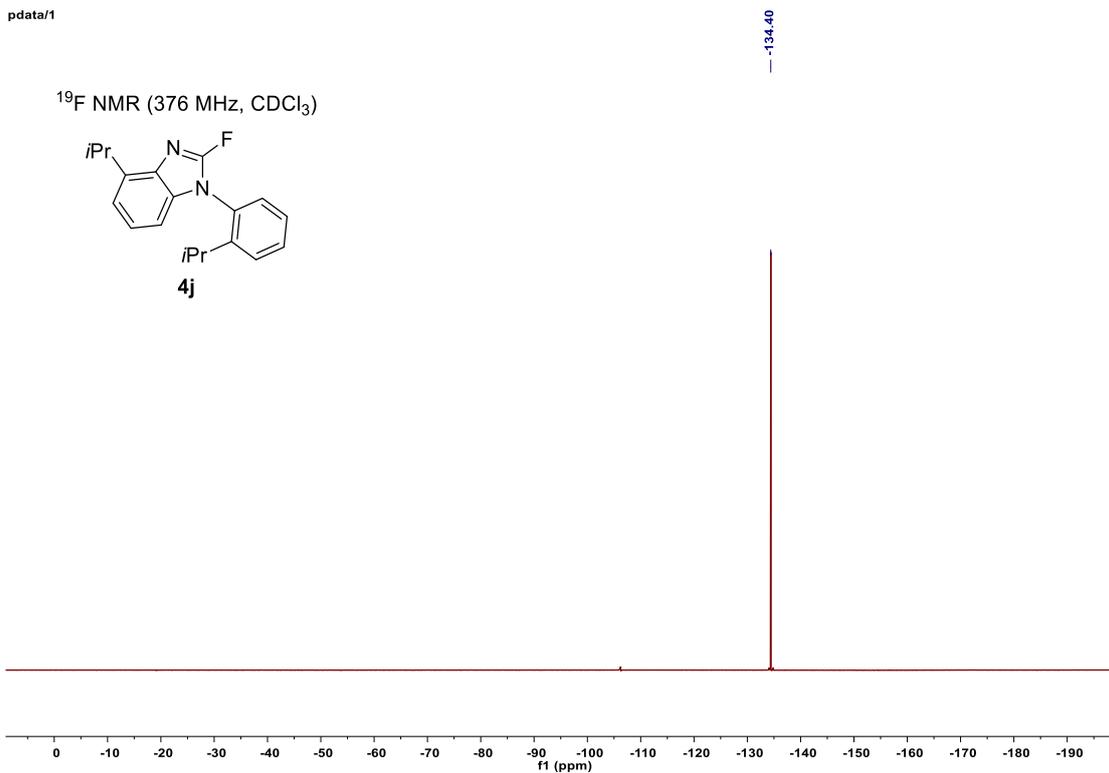
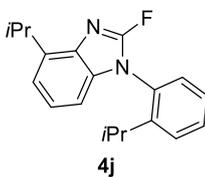
148.11
146.49
146.37
145.29
138.54
134.52
134.50
130.64
127.81
126.91
122.25
122.22
121.83
121.81
115.20
103.55
103.42
77.48
77.16
76.84
26.52
26.32
23.84
22.65

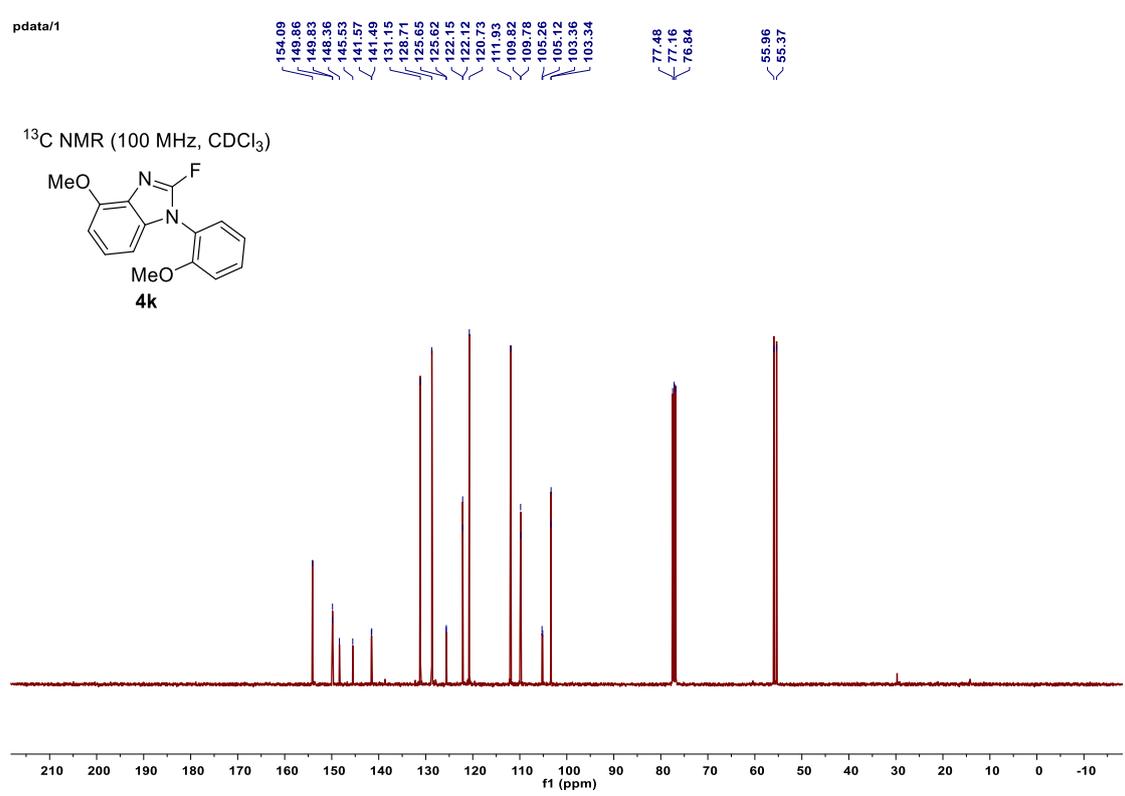
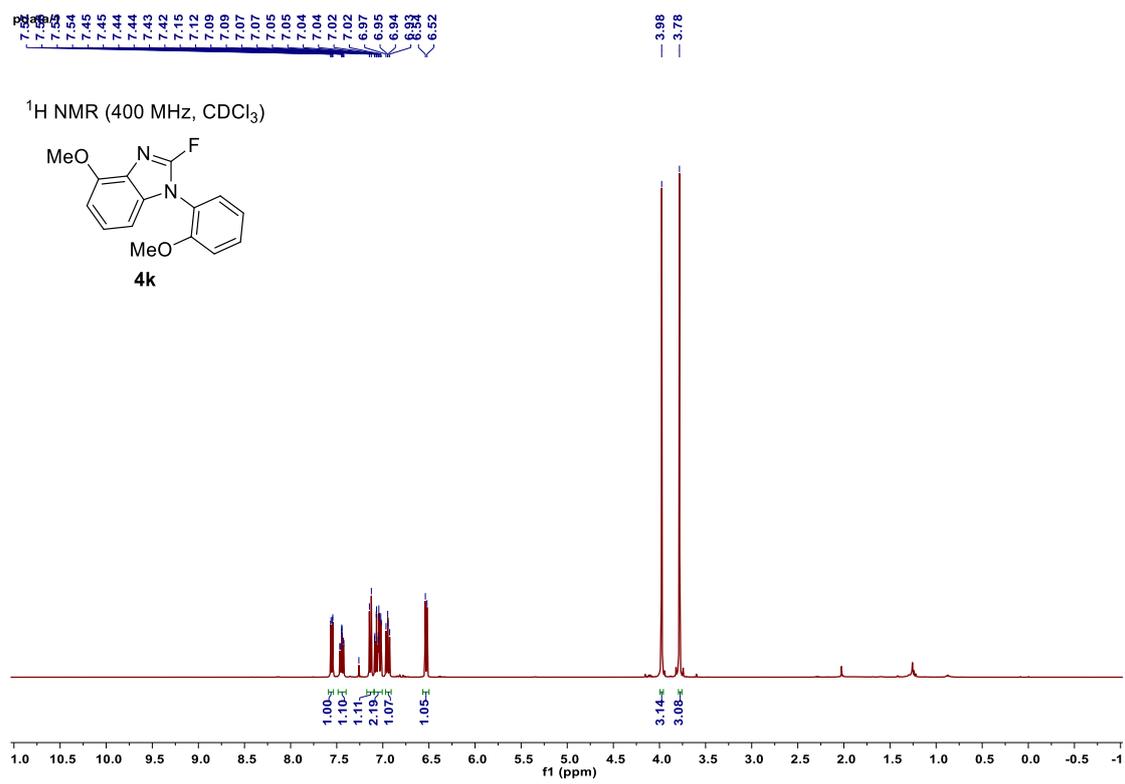
^{13}C NMR (100 MHz, CDCl_3)



pdata/1

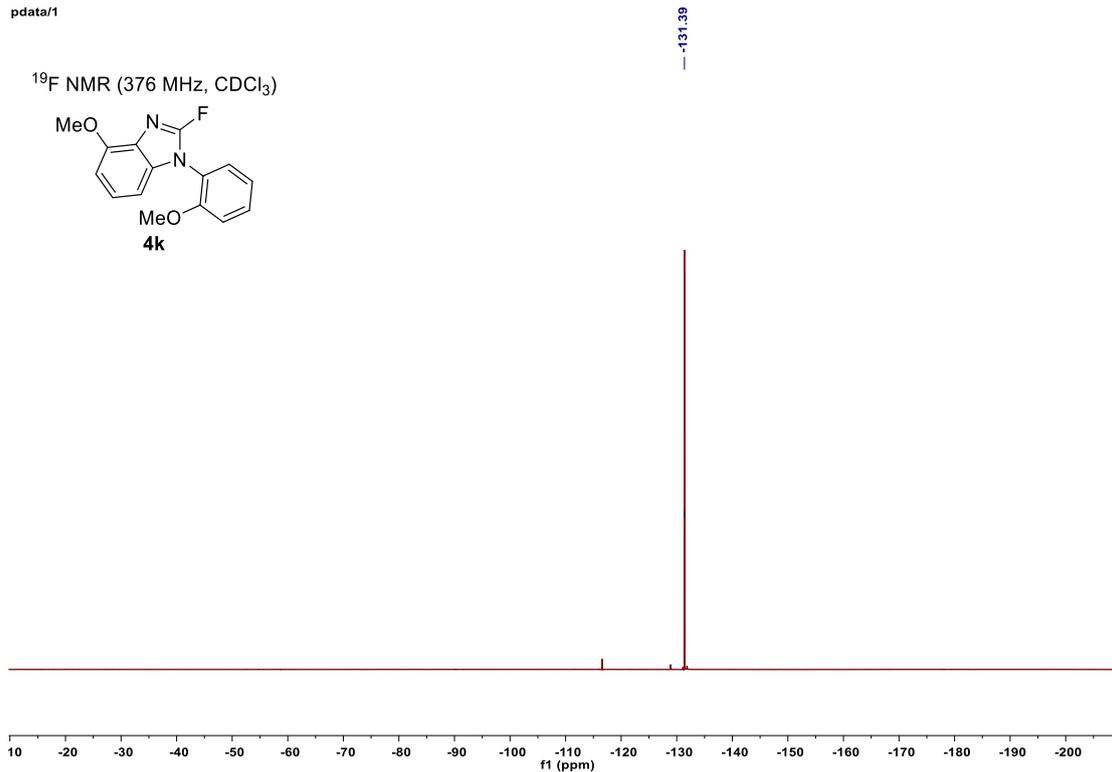
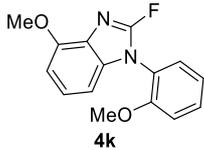
^{19}F NMR (376 MHz, CDCl_3)





pdata/1

^{19}F NMR (376 MHz, CDCl_3)

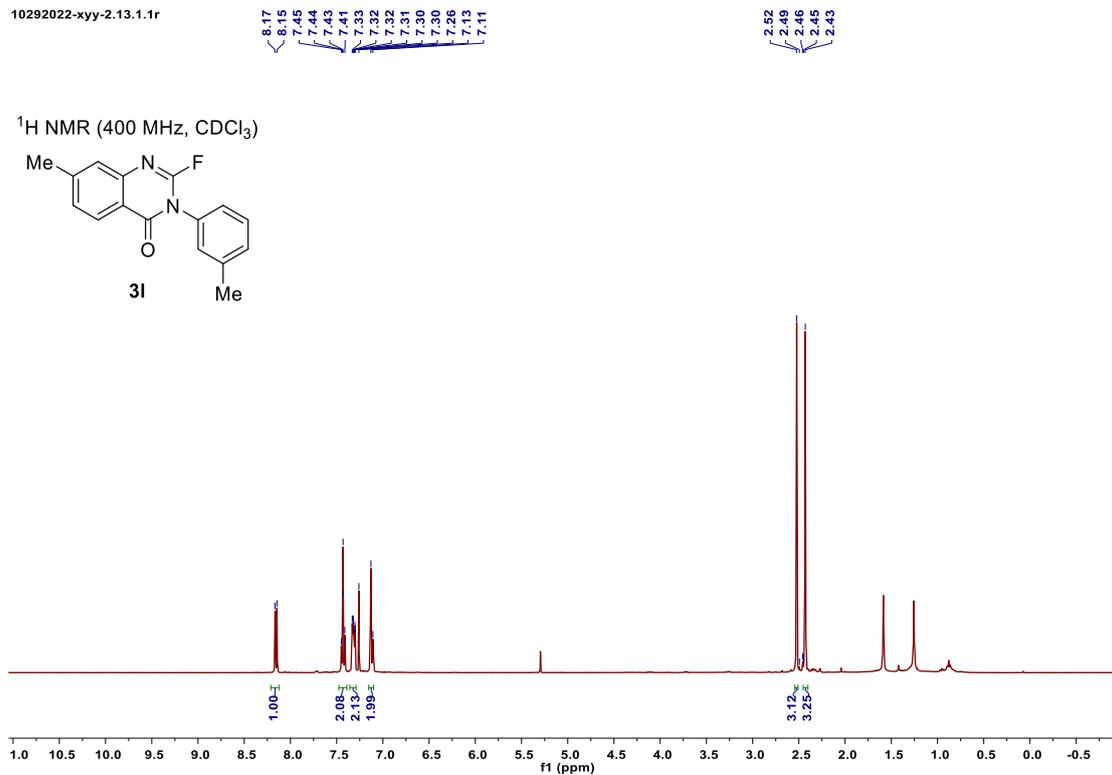
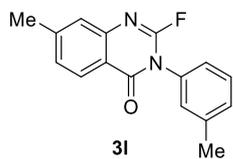


10292022-xyy-2.13.1.1r

8.17
7.45
7.44
7.43
7.41
7.33
7.32
7.31
7.30
7.30
7.26
7.13
7.11

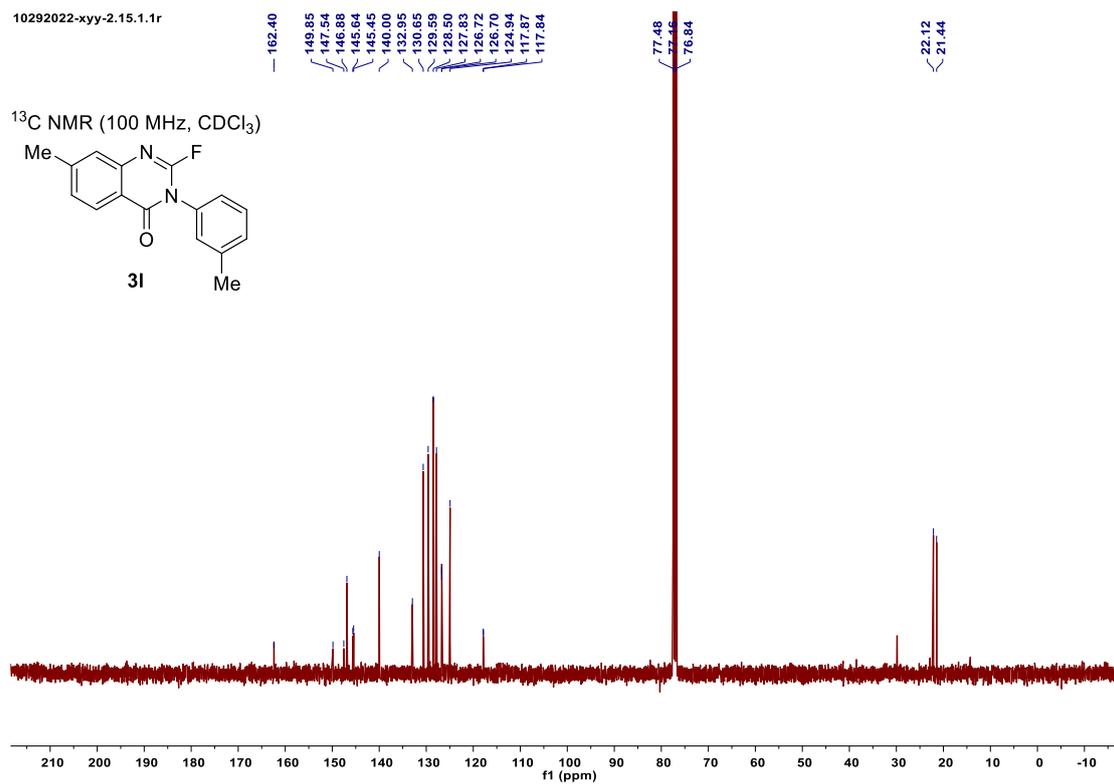
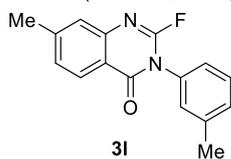
2.52
2.49
2.46
2.45
2.43

^1H NMR (400 MHz, CDCl_3)



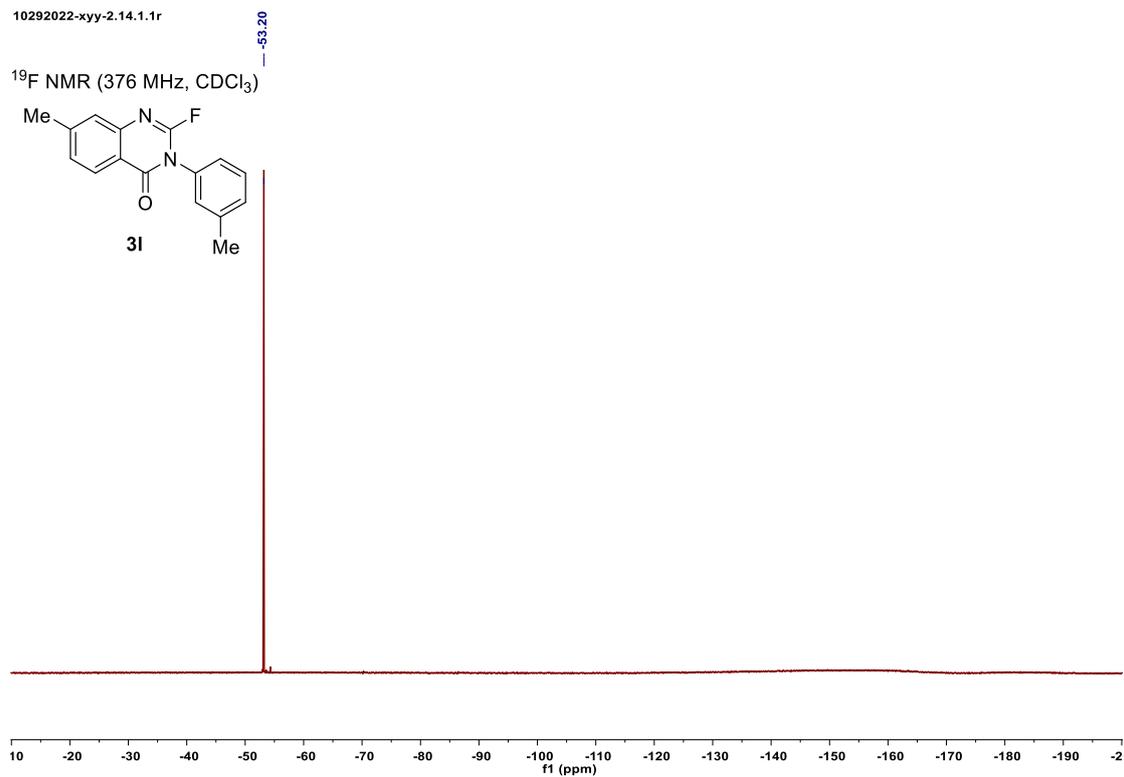
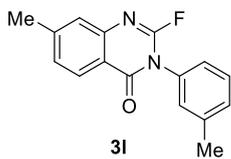
10292022-xyy-2.15.1.1r

¹³C NMR (100 MHz, CDCl₃)



10292022-xyy-2.14.1.1r

¹⁹F NMR (376 MHz, CDCl₃)

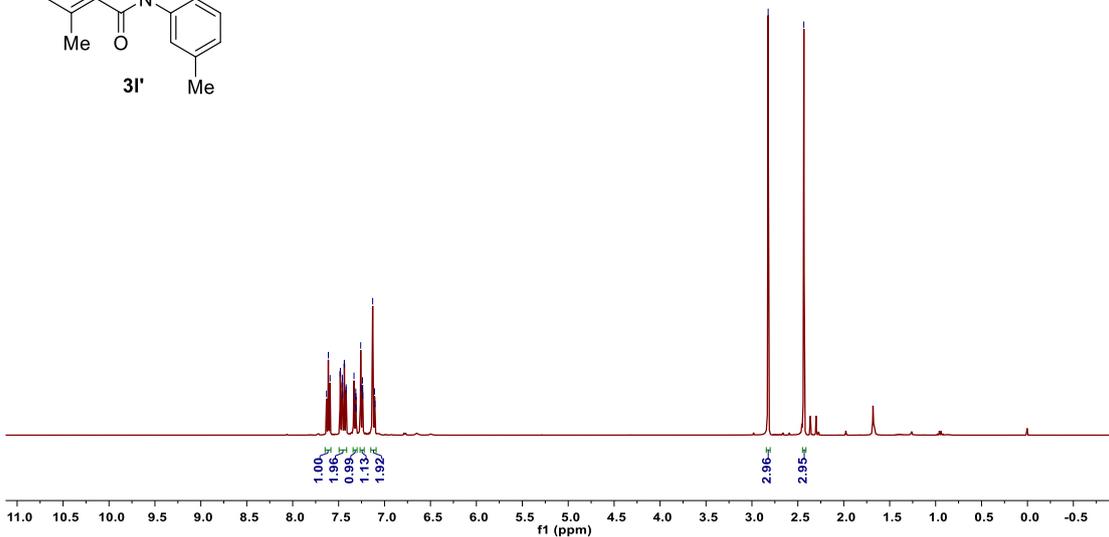
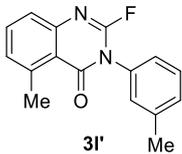


pdata/1

7.63
7.61
7.39
7.48
7.46
7.46
7.46
7.46
7.44
7.44
7.42
7.42
7.33
7.32
7.32
7.31
7.31
7.26
7.26
7.24
7.24
7.24
7.13
7.11
7.10

2.82
2.43

^1H NMR (400 MHz, CDCl_3)



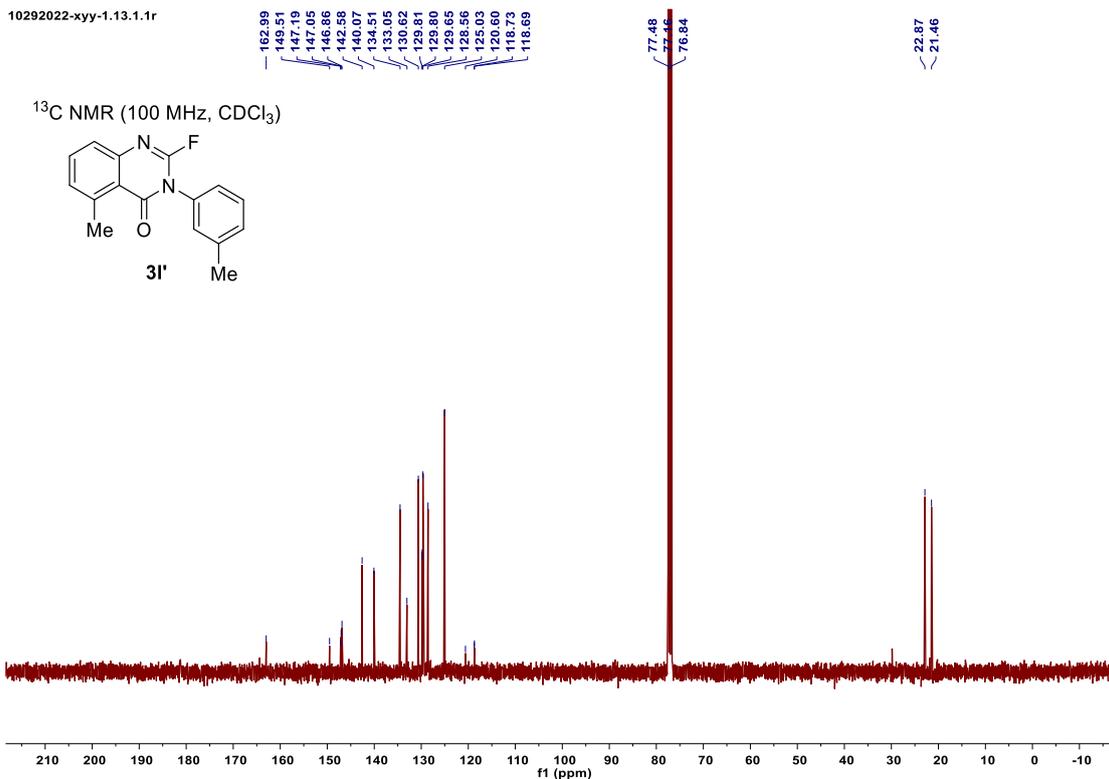
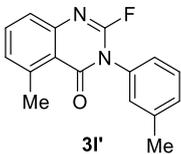
10292022-xyy-1.13.1.1r

162.99
148.51
147.19
147.05
146.86
142.58
140.07
134.51
133.05
129.82
129.80
129.65
129.56
125.03
120.60
118.73
118.69

77.48
77.45
76.84

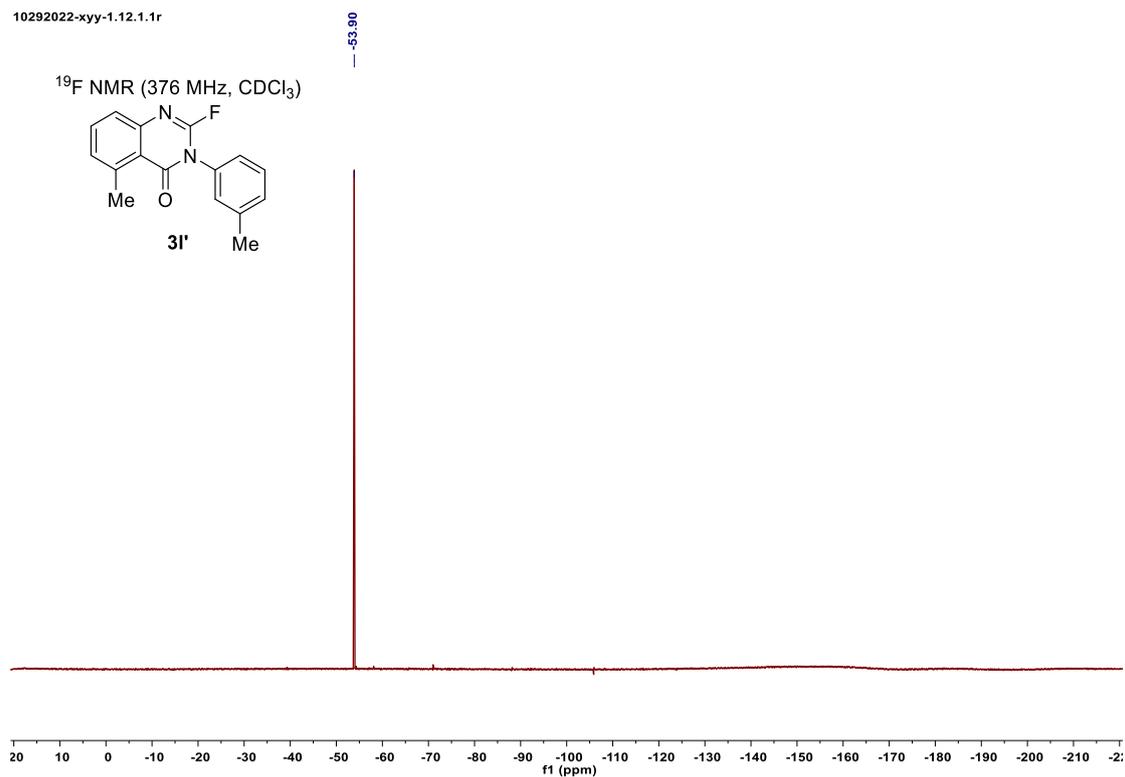
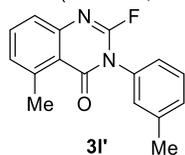
22.87
21.46

^{13}C NMR (100 MHz, CDCl_3)



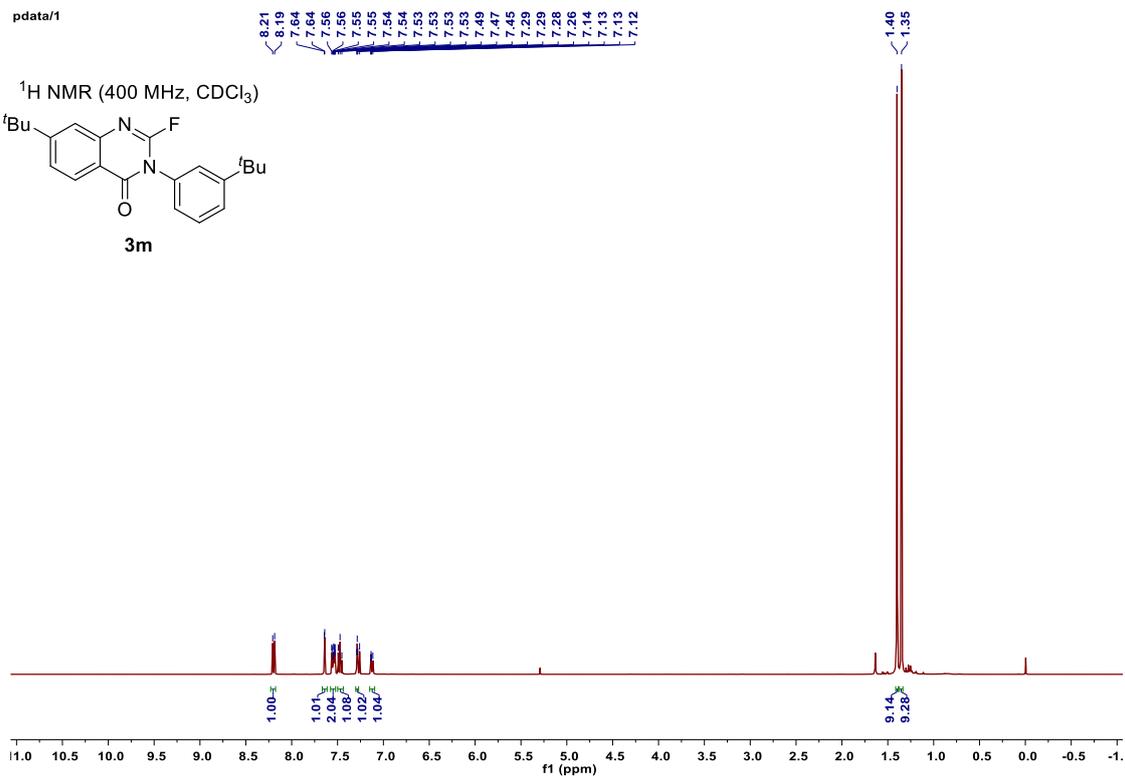
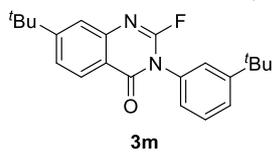
10292022-xyy-1.12.1.1r

¹⁹F NMR (376 MHz, CDCl₃)



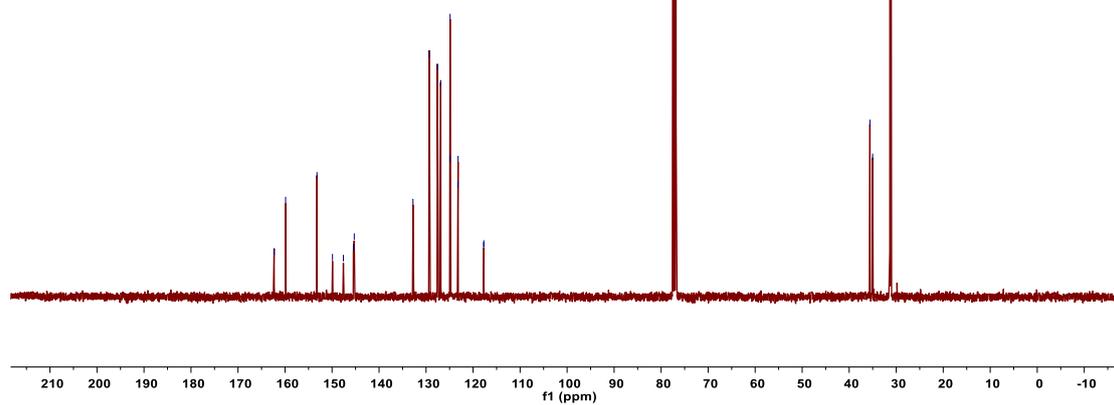
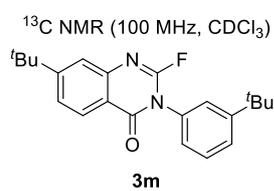
pdata/1

¹H NMR (400 MHz, CDCl₃)



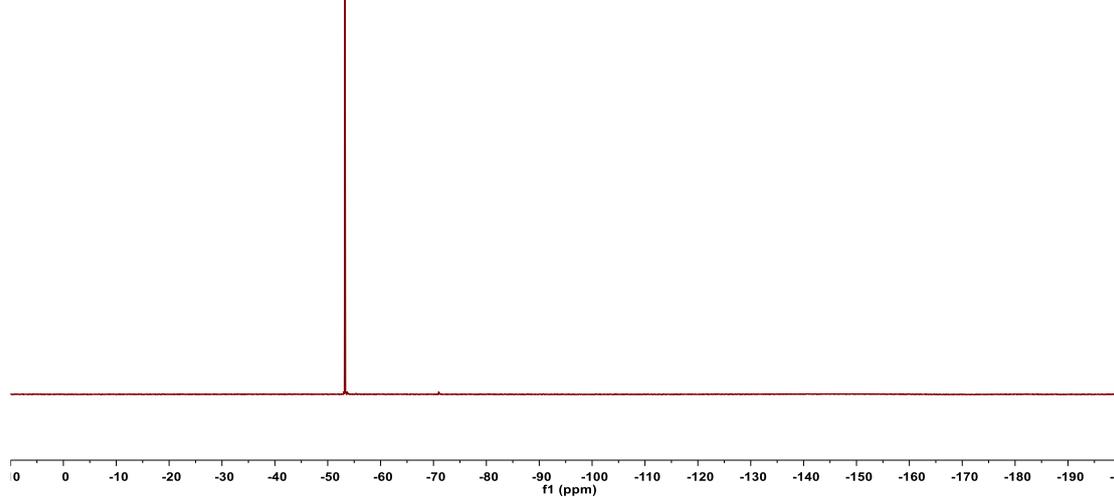
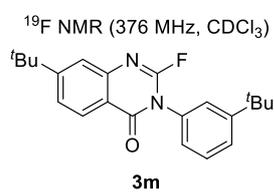
pdata/1

162.32
159.88
153.21
149.90
147.59
145.46
145.28
132.78
129.34
127.60
126.89
124.94
124.89
123.21
123.19
117.75
117.72



pdata/1

-53.28

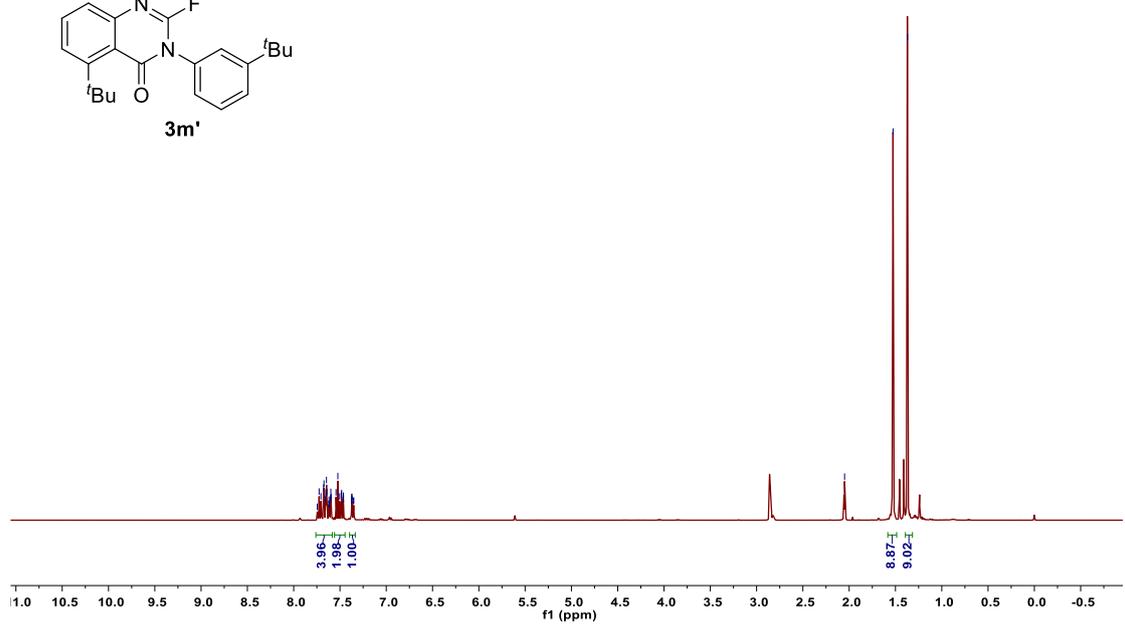
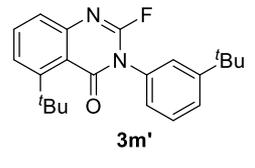


pdata/1

7.74
7.73
7.71
7.68
7.67
7.66
7.65
7.64
7.62
7.61
7.60
7.59
7.54
7.52
7.50
7.49
7.48
7.47
7.46
7.38
7.37
7.35

2.05
1.53
1.37

¹H NMR (400 MHz, (CD₃)₂CO)

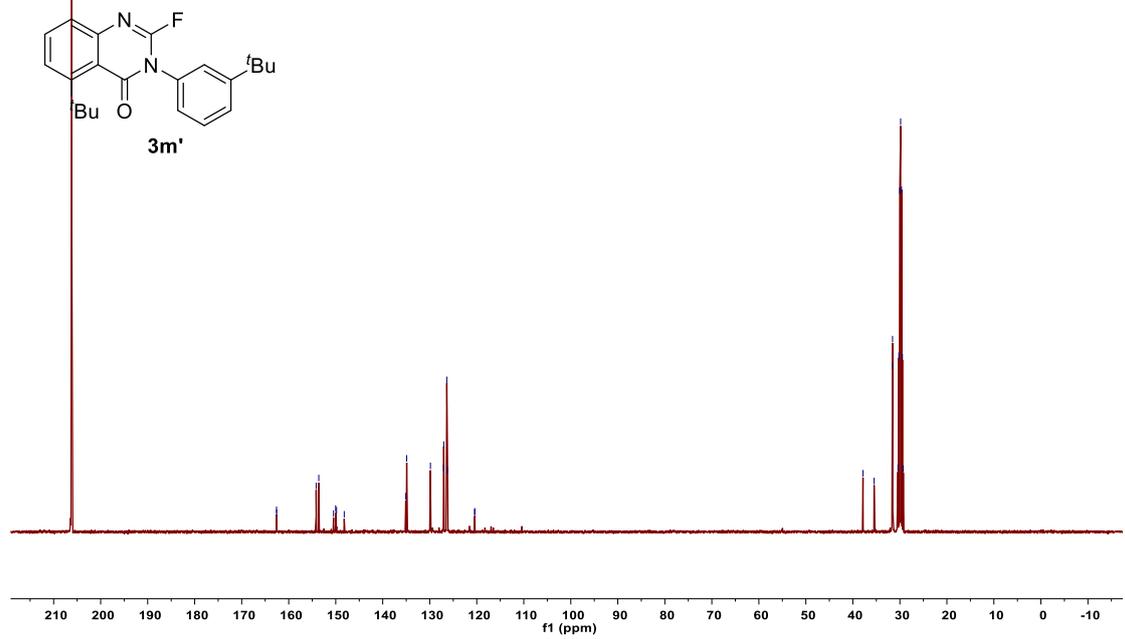
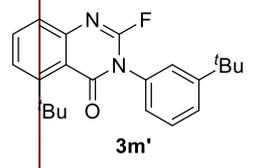


pdata/1

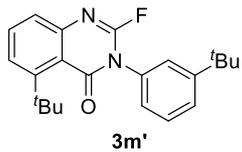
162.60
162.57
154.16
153.60
150.47
150.02
149.82
148.19
135.10
134.90
125.86
121.06
121.06
126.37
126.18
120.46
120.41

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30.03
29.84
29.65
29.46
29.26

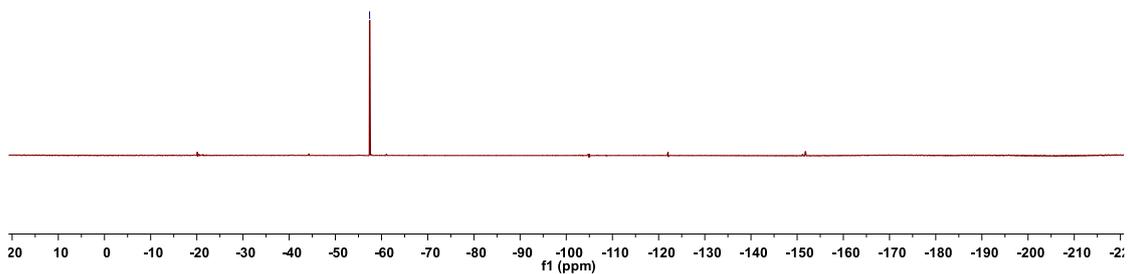
¹³C NMR (100 MHz, (CD₃)₂CO)



^{19}F NMR (376 MHz, $(\text{CD}_3)_2\text{CO}$)

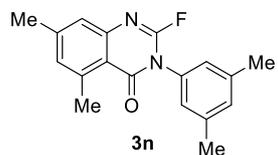


-57.41



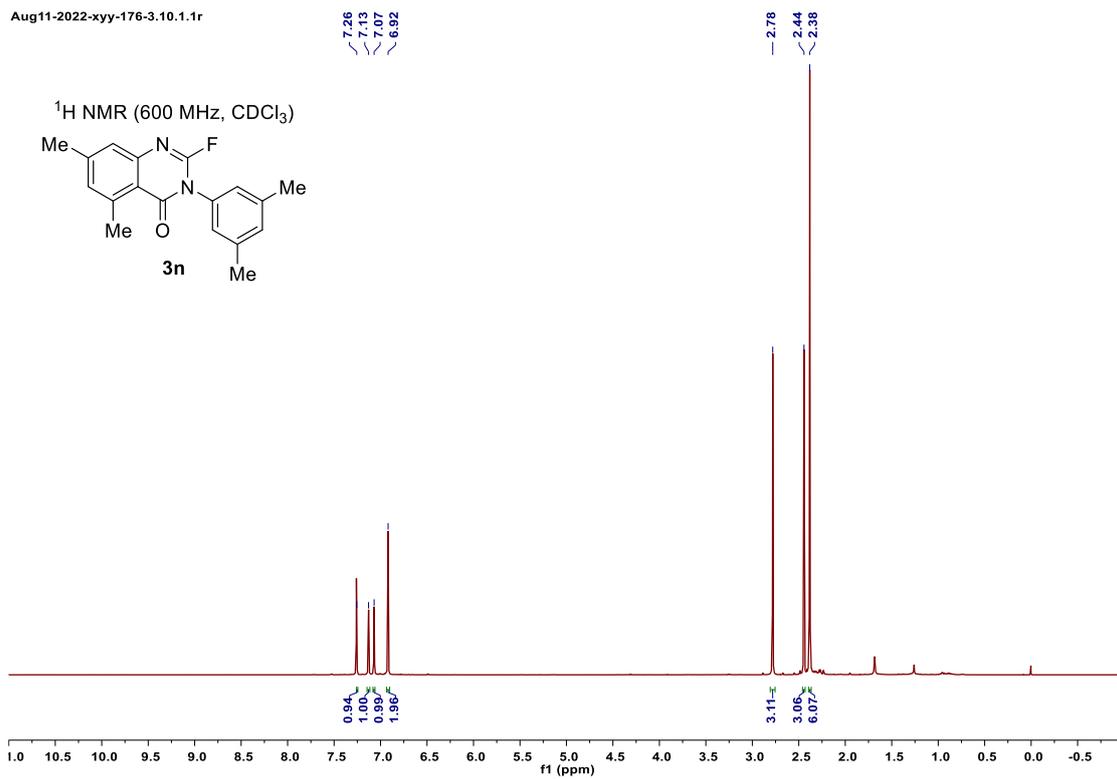
Aug11-2022-xyy-176-3.10.1.1r

^1H NMR (600 MHz, CDCl_3)



7.26
7.13
7.07
6.92

2.78
2.44
2.38



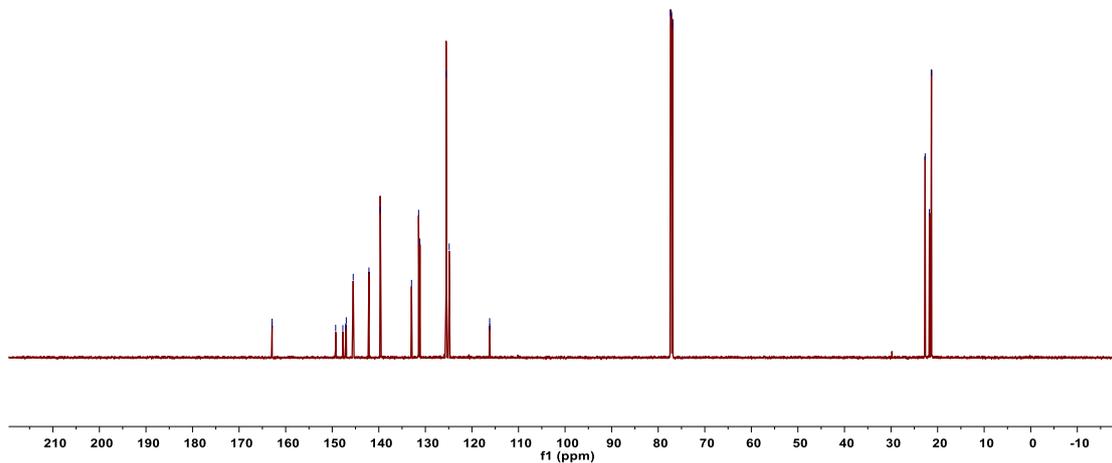
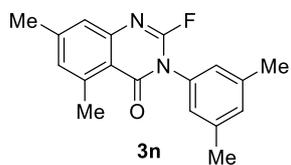
Aug11-2022-xyy-176-3.11.1.1r

162.93
162.92
147.77
147.72
147.11
146.99
145.50
142.12
139.69
132.98
131.45
131.18
125.55
124.89
116.20
116.17

77.37
77.16
76.95

22.67
21.76
21.33

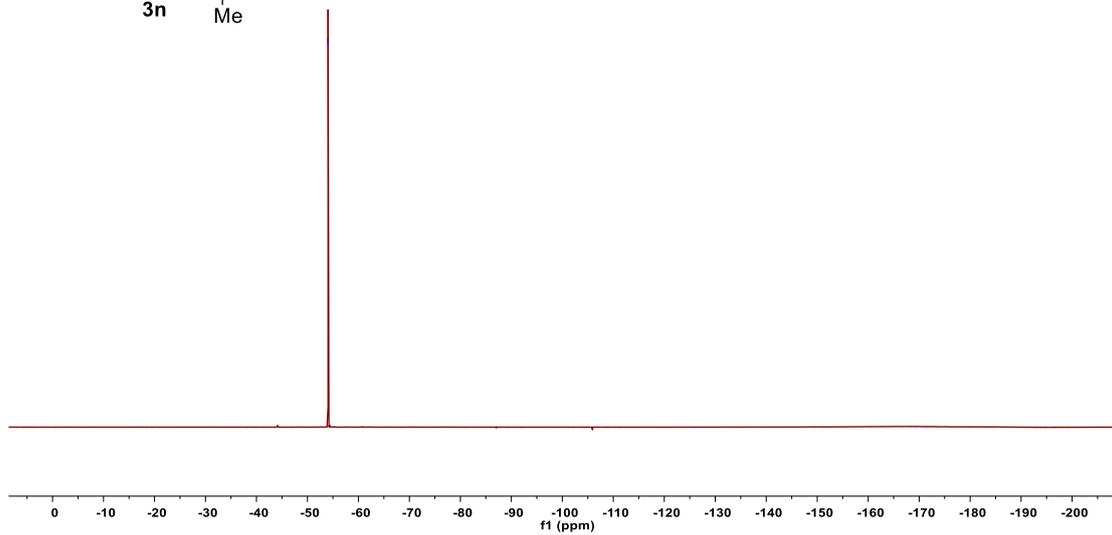
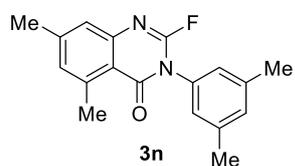
¹³C NMR (150 MHz, CDCl₃)



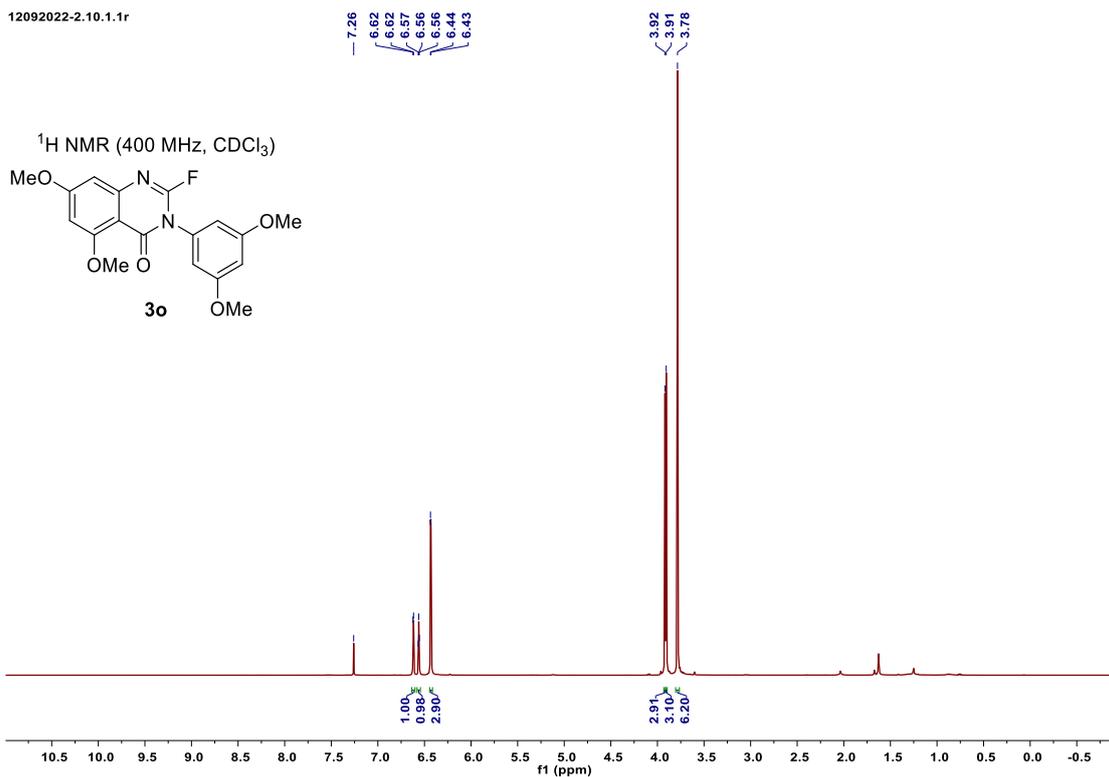
Aug11-2022-xyy-176-3.12.1.1r

-54.05

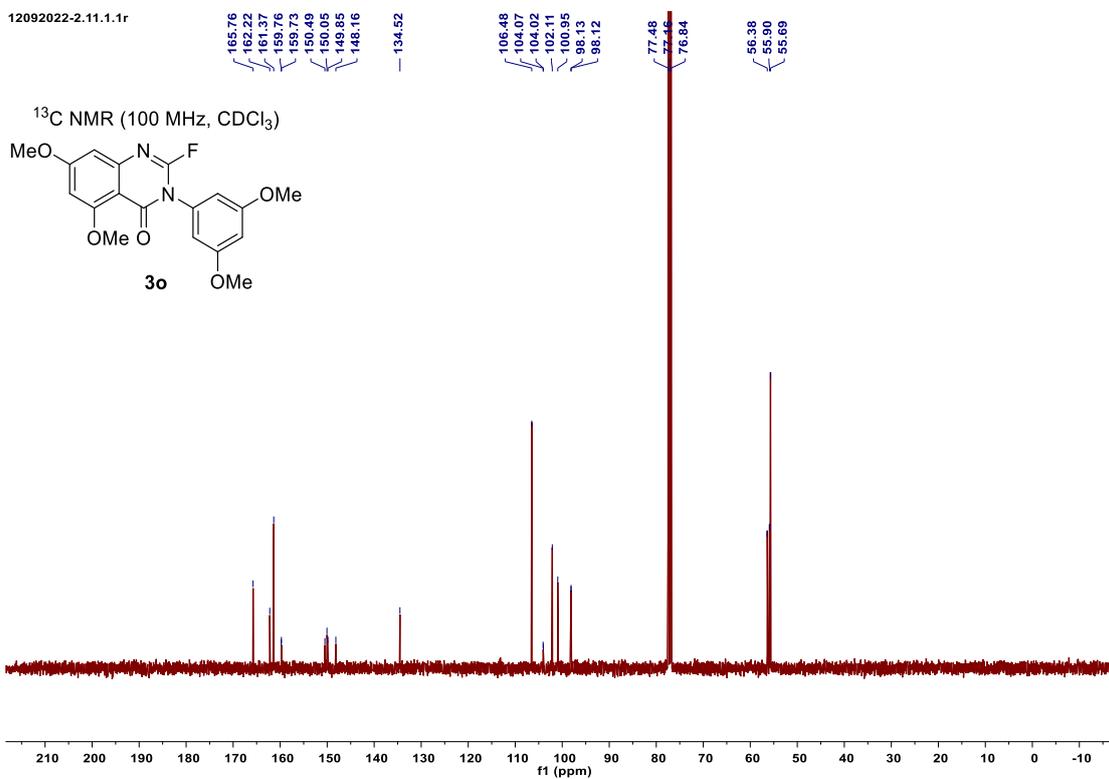
¹⁹F NMR (376 MHz, CDCl₃)



12092022-2.10.1.1r



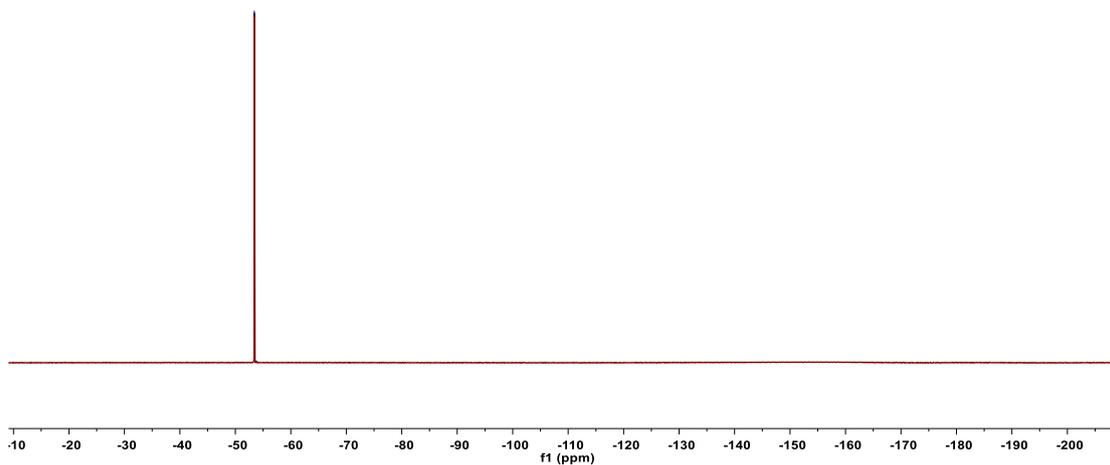
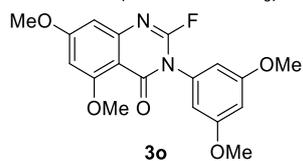
12092022-2.11.1.1r



12082022-xyy-2-65.11.1.1r

53.42

^{19}F NMR (376 MHz, CDCl_3)



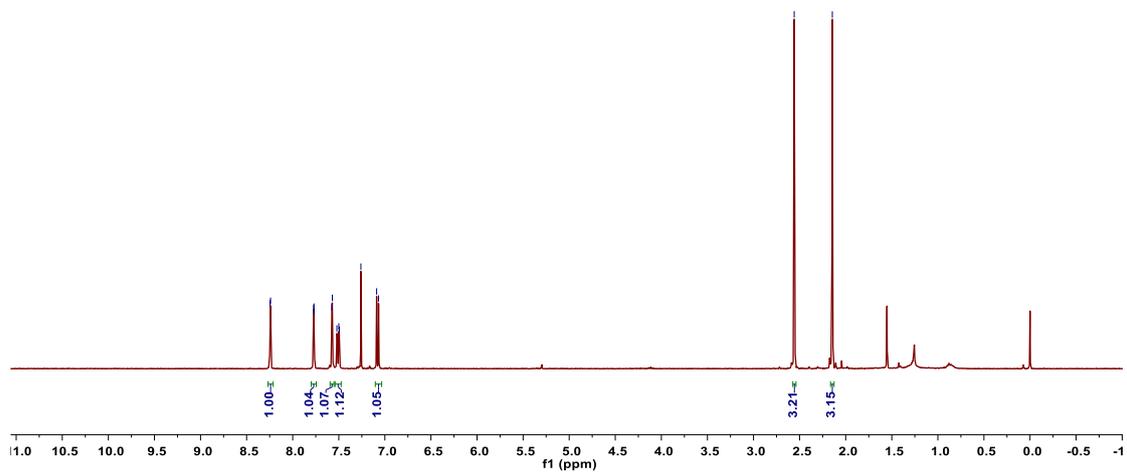
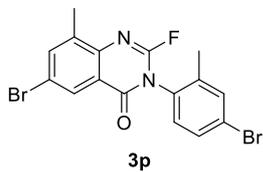
01202024-xyy-wjy.10.1.1r

8.25
8.24
7.77
7.77
7.58
7.57
7.52
7.50
7.49
7.26
7.09
7.07

2.56

2.15

^1H NMR (400 MHz, CDCl_3)

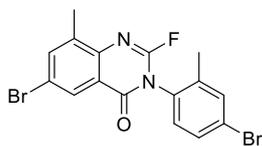


01202024-xyy-wjy.11.1.1r

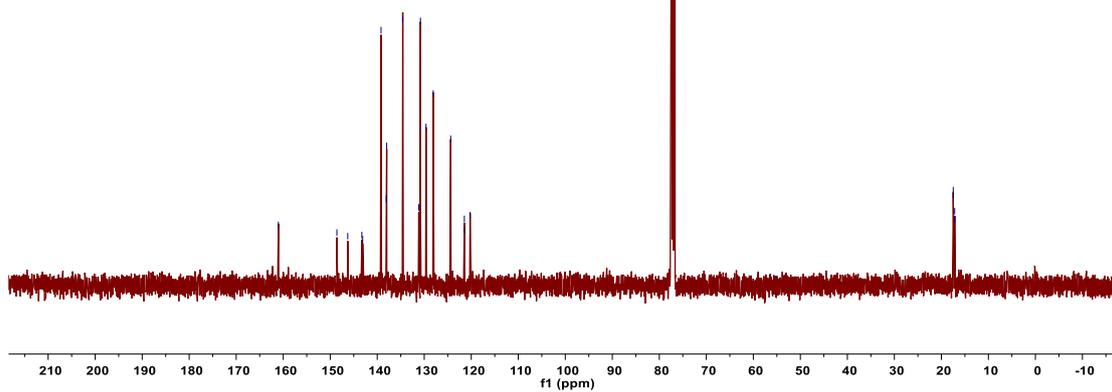
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148.59
146.28
143.28
143.10
139.19
138.06
138.04
137.99
134.58
131.16
130.81
129.63
128.09
124.37
121.51
121.47
120.25

77.48
77.46
76.84
17.48
17.46
17.17
17.13

^{13}C NMR (100 MHz, CDCl_3)



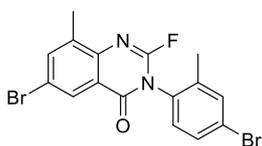
3p



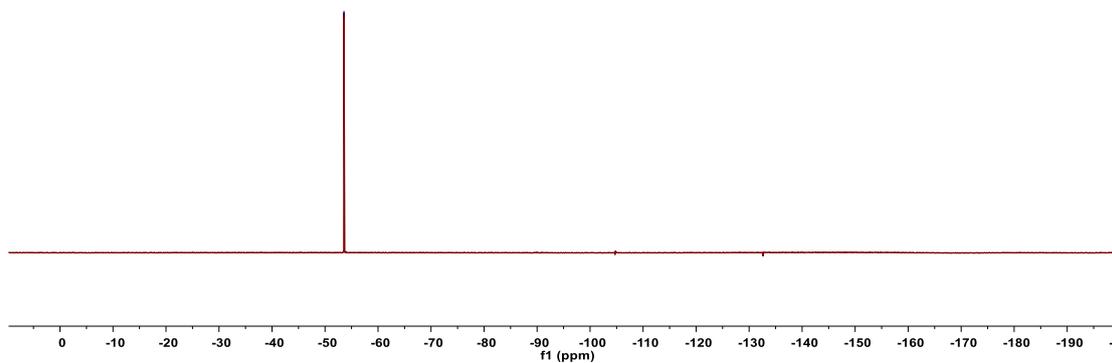
pdata/1

-53.57

^{19}F NMR (376 MHz, CDCl_3)



3p

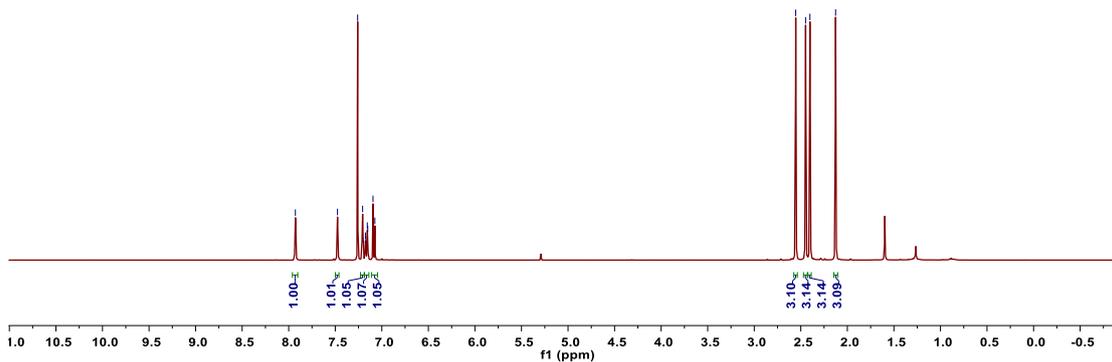
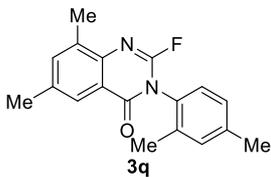


Jun30-2022-xyy.30.1.1r

7.93
7.48
7.26
7.21
7.18
7.17
7.16
7.15
7.09
7.07

2.55
2.45
2.40
2.13

¹H NMR (400 MHz, CDCl₃)

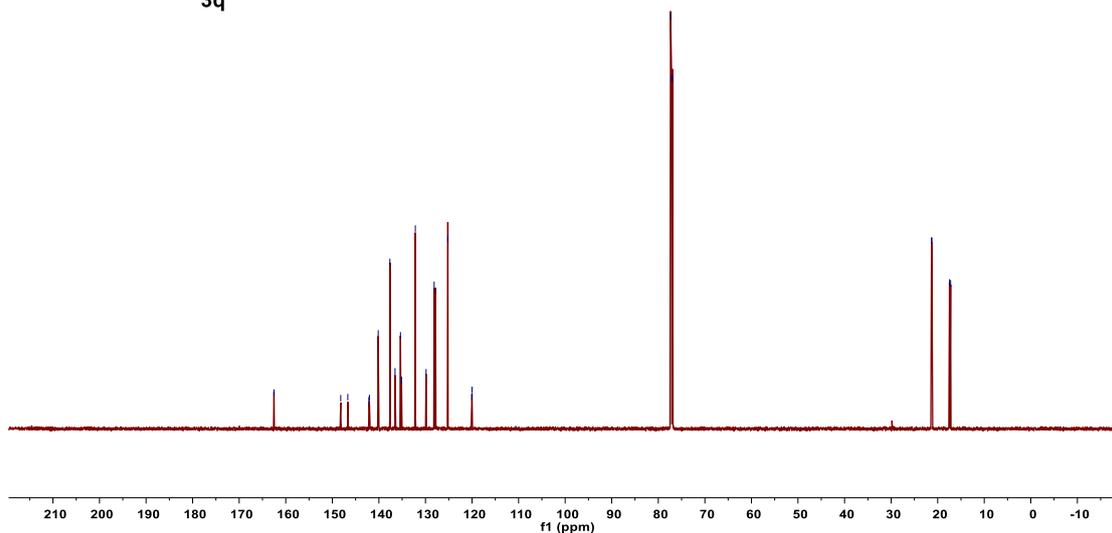
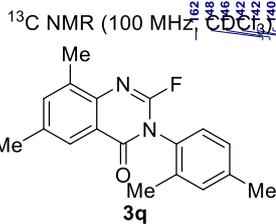


Jul01-2022-xyy.10.1.1r

162.52
148.20
146.68
142.16
142.04
140.14
137.64
136.53
135.37
135.13
135.12
132.17
129.87
128.13
127.83
125.19
120.03
120.01

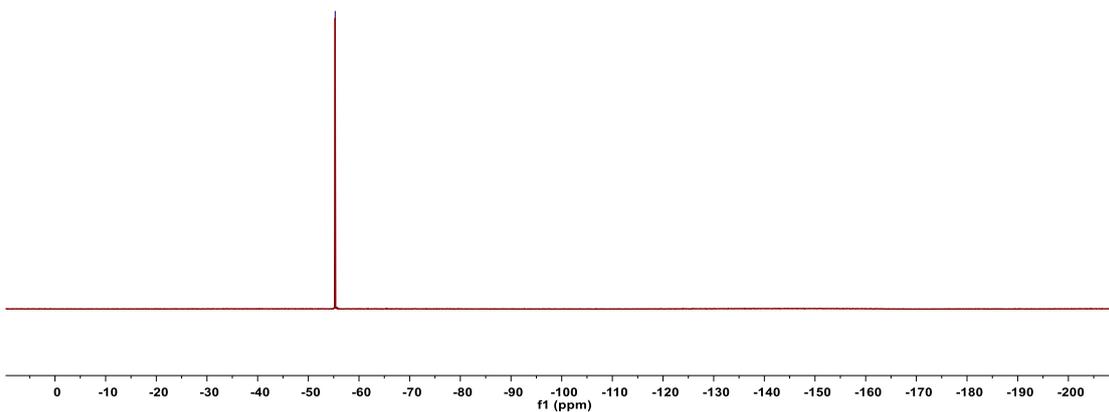
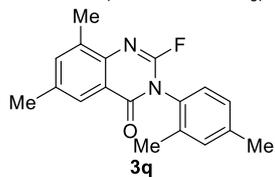
77.37
77.16
76.85

21.33
21.25
17.46
17.23



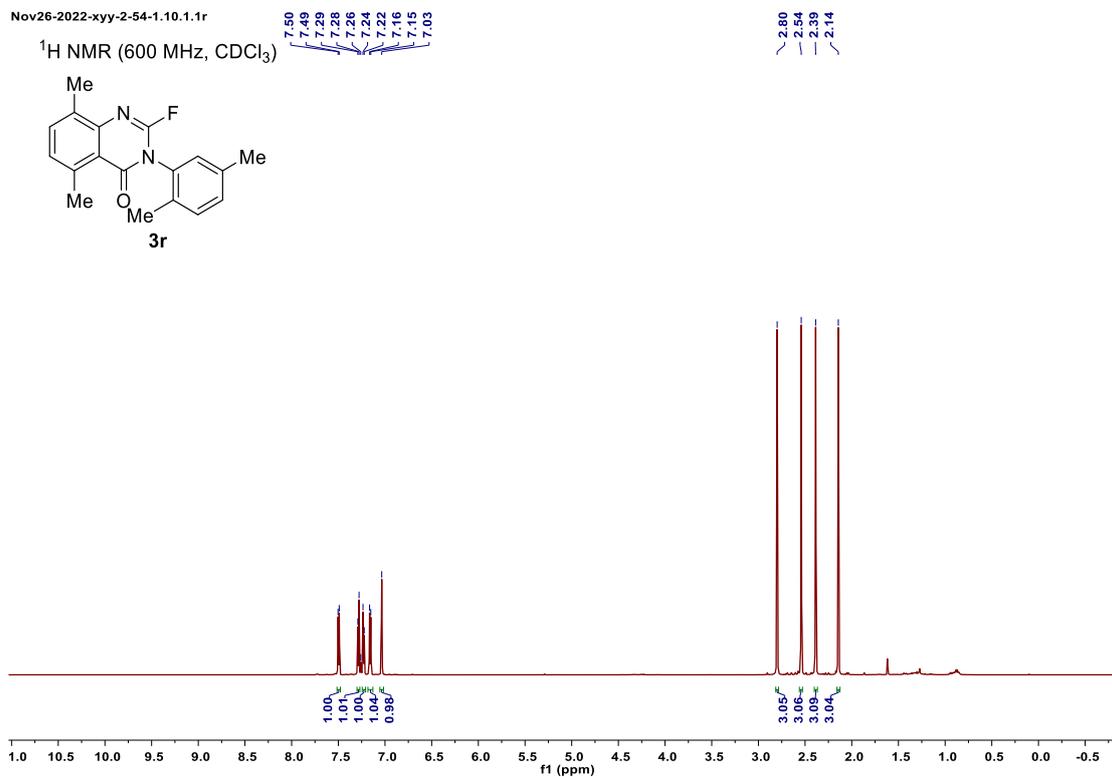
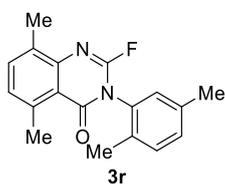
Jun30-2022-xyy.31.1.1r

¹⁹F NMR (376 MHz, CDCl₃)



Nov26-2022-xyy-2-54-1.10.1.1r

¹H NMR (600 MHz, CDCl₃)



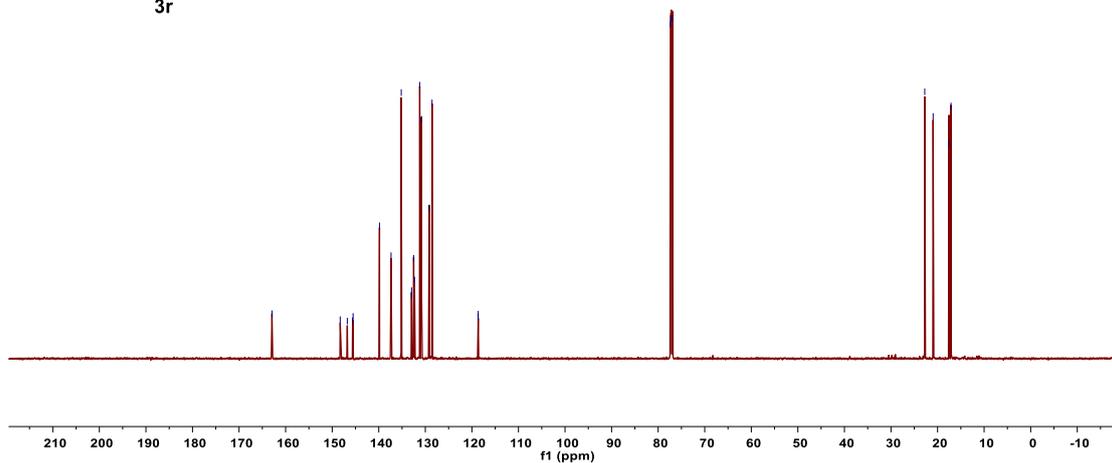
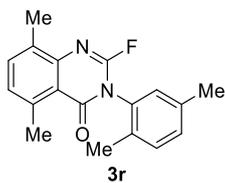
Nov26-2022-xyy-2-54-1.21.1.1r

162.93
148.28
146.76
145.63
145.51
139.85
137.36
135.17
132.96
132.95
132.51
132.31
131.21
130.82
128.57
128.55
118.65
118.64

77.37
77.16
76.95

22.75
20.95
17.54
17.11

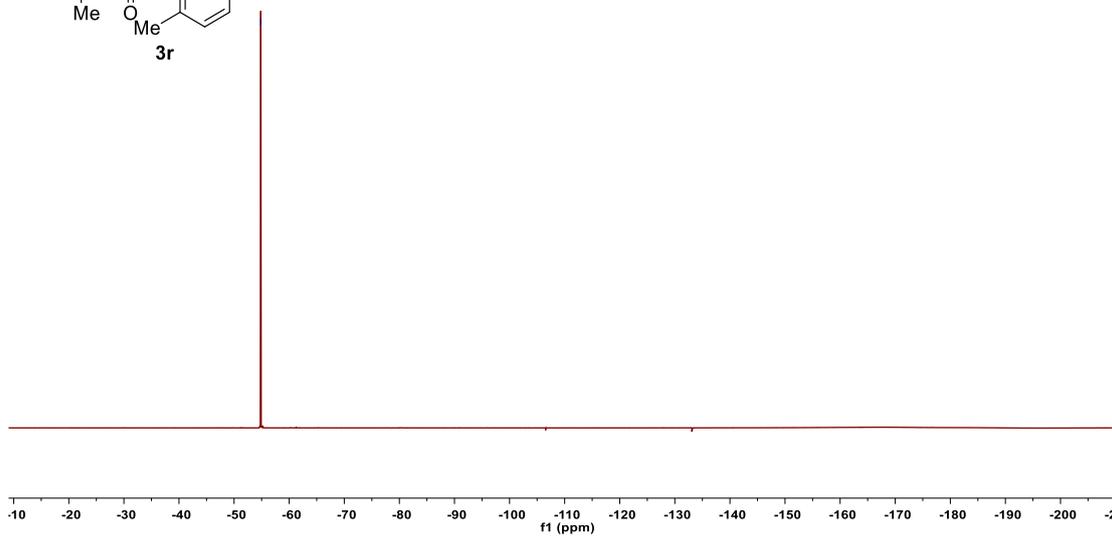
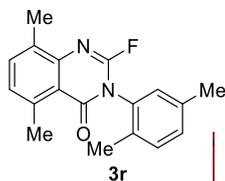
^{13}C NMR (150 MHz, CDCl_3)



Nov26-2022-xyy-2-54-1.11.1.1r

-54.85

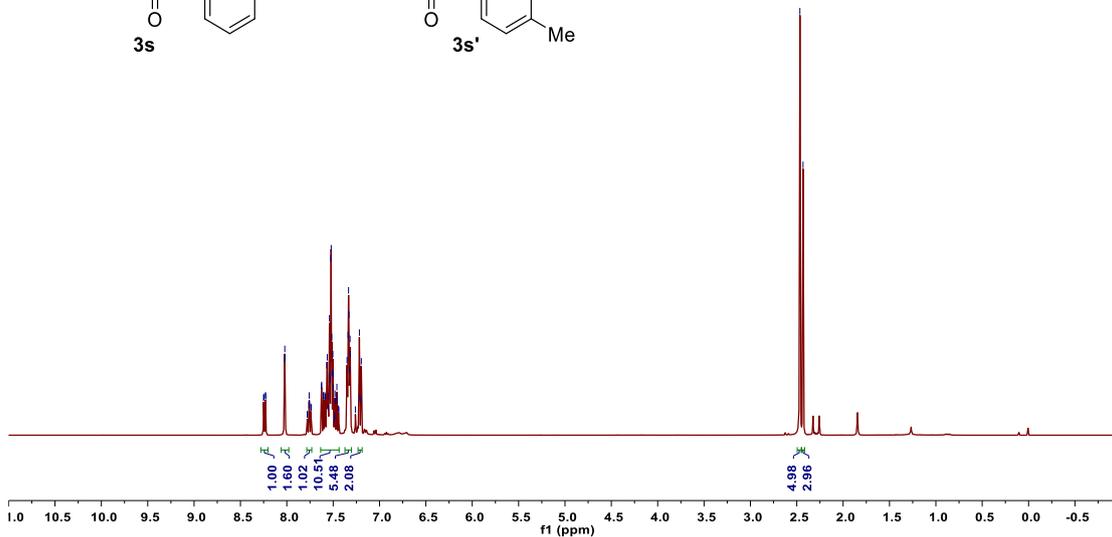
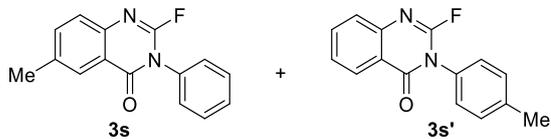
^{19}F NMR (565 MHz, CDCl_3)



pdata/1

8.25
8.25
8.23
8.23
8.02
8.02
8.02
8.02
7.78
7.78
7.76
7.76
7.74
7.74
7.63
7.62
7.61
7.61
7.59
7.59
7.57
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7.48
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7.33
7.32
7.32
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7.20
2.47
2.43

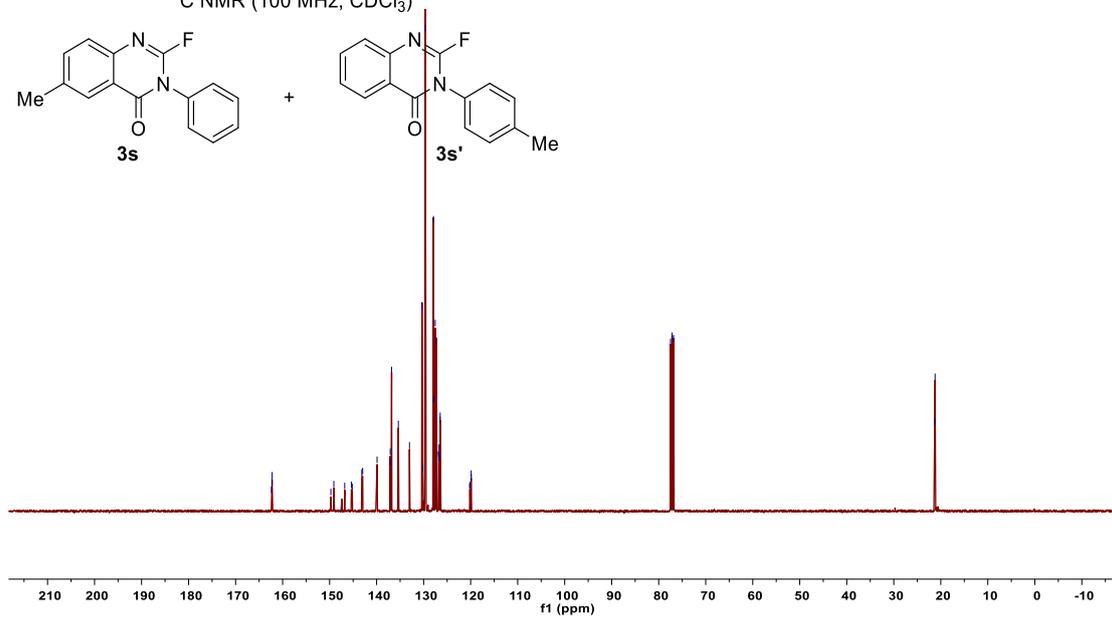
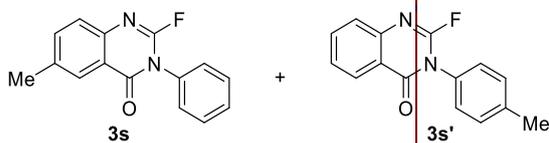
¹H NMR (400 MHz, CDCl₃)



pdata/1

162.36
162.24
162.24
149.73
149.10
146.79
145.37
145.18
143.16
142.97
139.91
137.10
137.06
136.81
135.88
135.82
130.26
130.20
129.68
129.68
127.91
127.87
127.54
127.33
127.33
126.82
126.80
126.71
126.69
126.50
126.48
120.21
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119.80
77.48
77.16
76.84
21.30
21.21

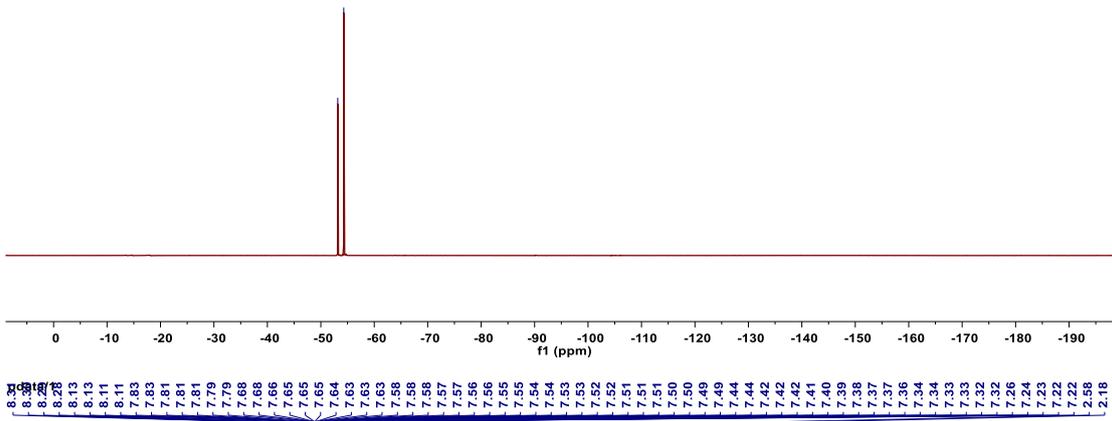
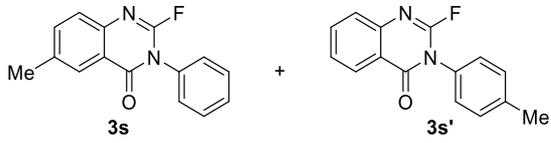
¹³C NMR (100 MHz, CDCl₃)



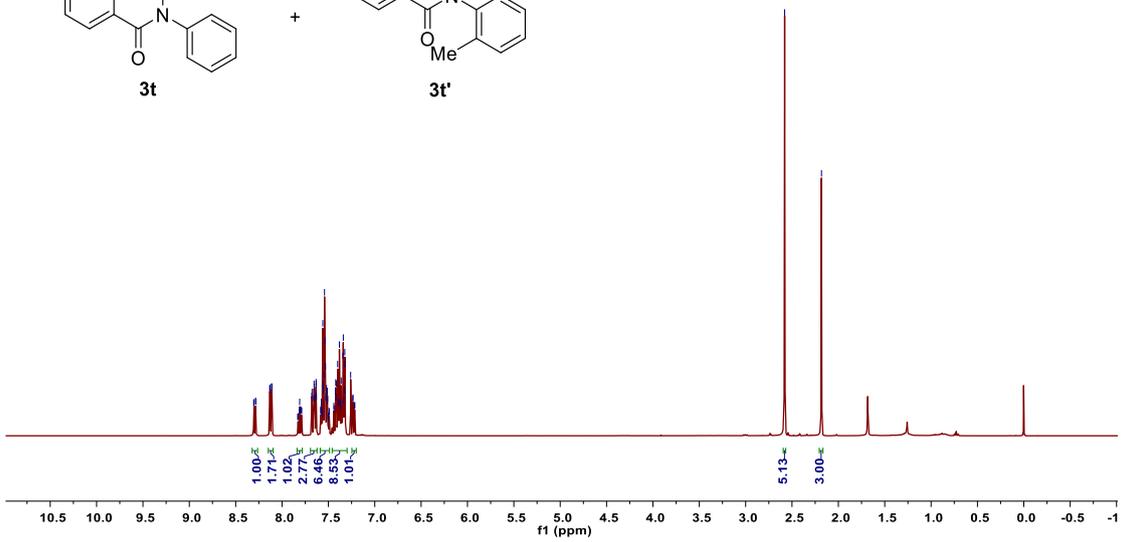
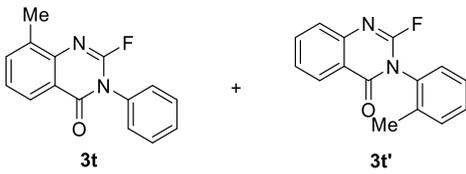
pdata/1

53.16
54.29

^{19}F NMR (376 MHz, CDCl_3)



^1H NMR (400 MHz, CDCl_3)

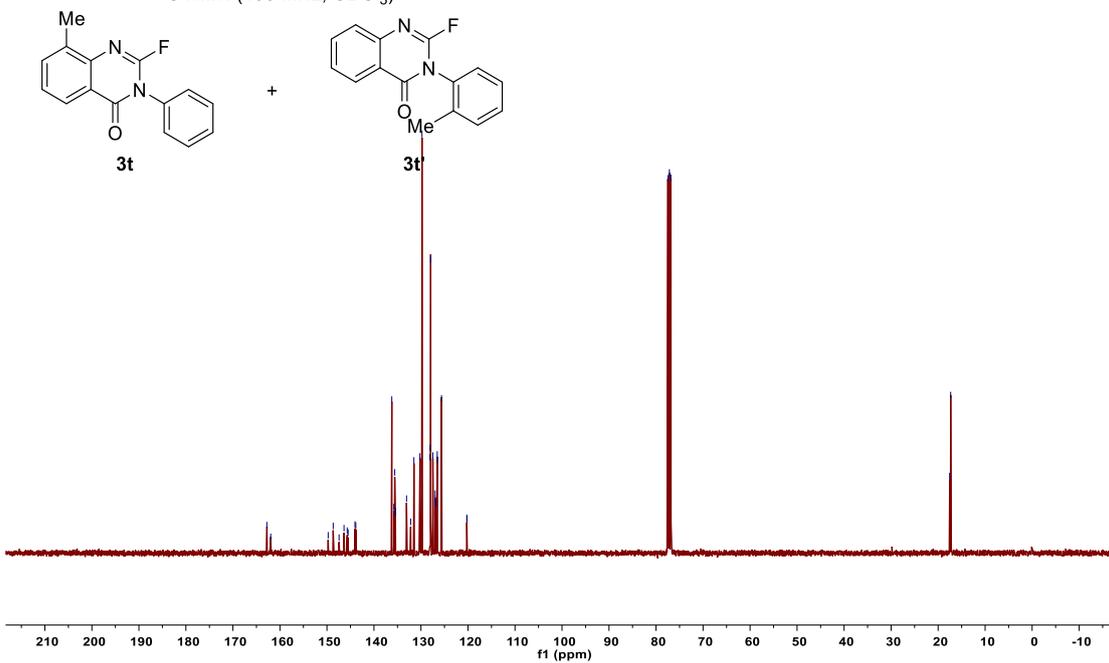


pdata/1

162.78
161.96
149.74
148.67
147.42
146.37
145.69
145.50
144.04
143.86
136.21
135.76
135.59
135.45
135.43
133.07
132.19
131.50
130.22
129.79
128.10
128.05
127.93
127.48
126.89
126.86
126.88
126.86
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126.54
126.53
125.63
120.25
120.22
77.48
77.16
76.84

17.54
17.33

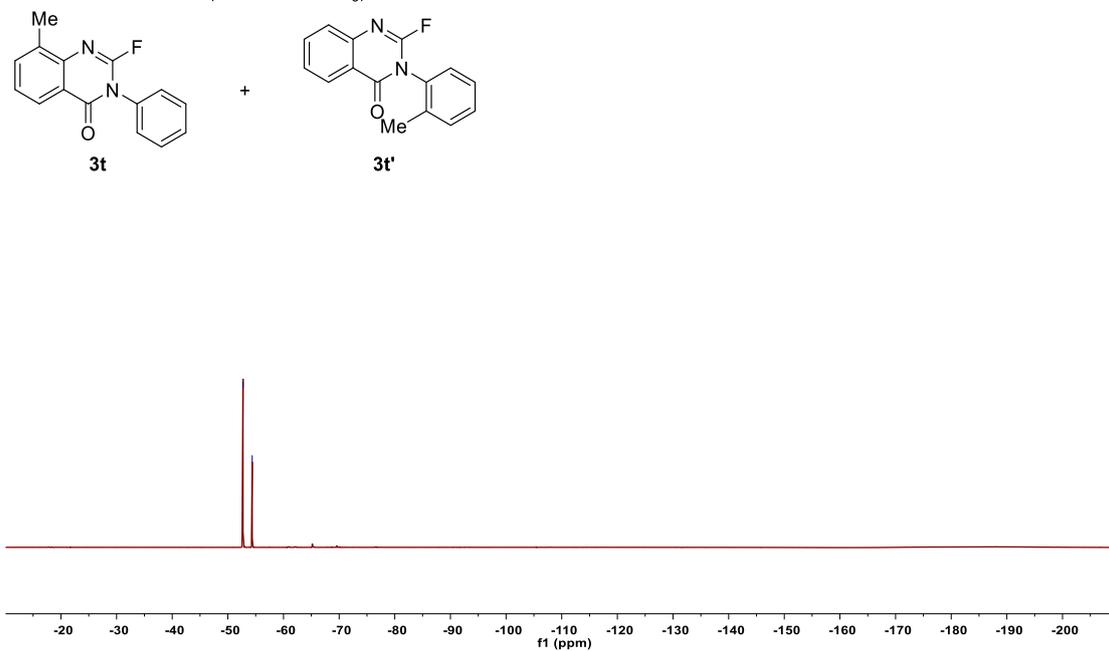
¹³C NMR (100 MHz, CDCl₃)

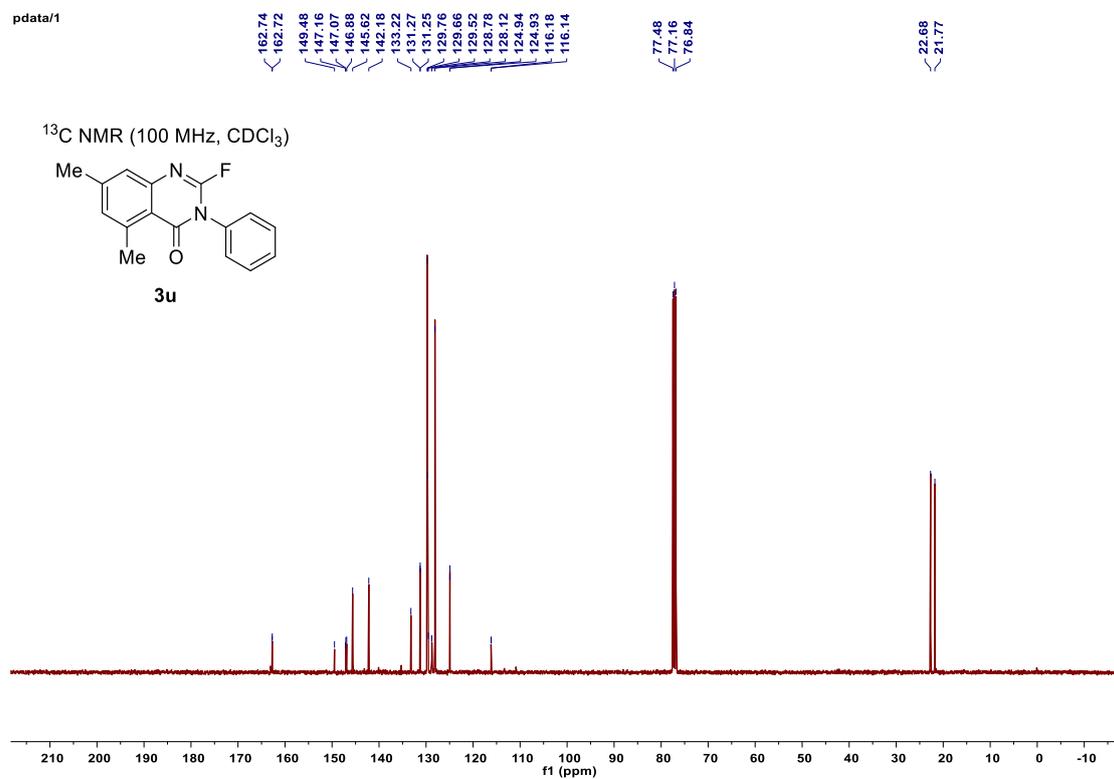
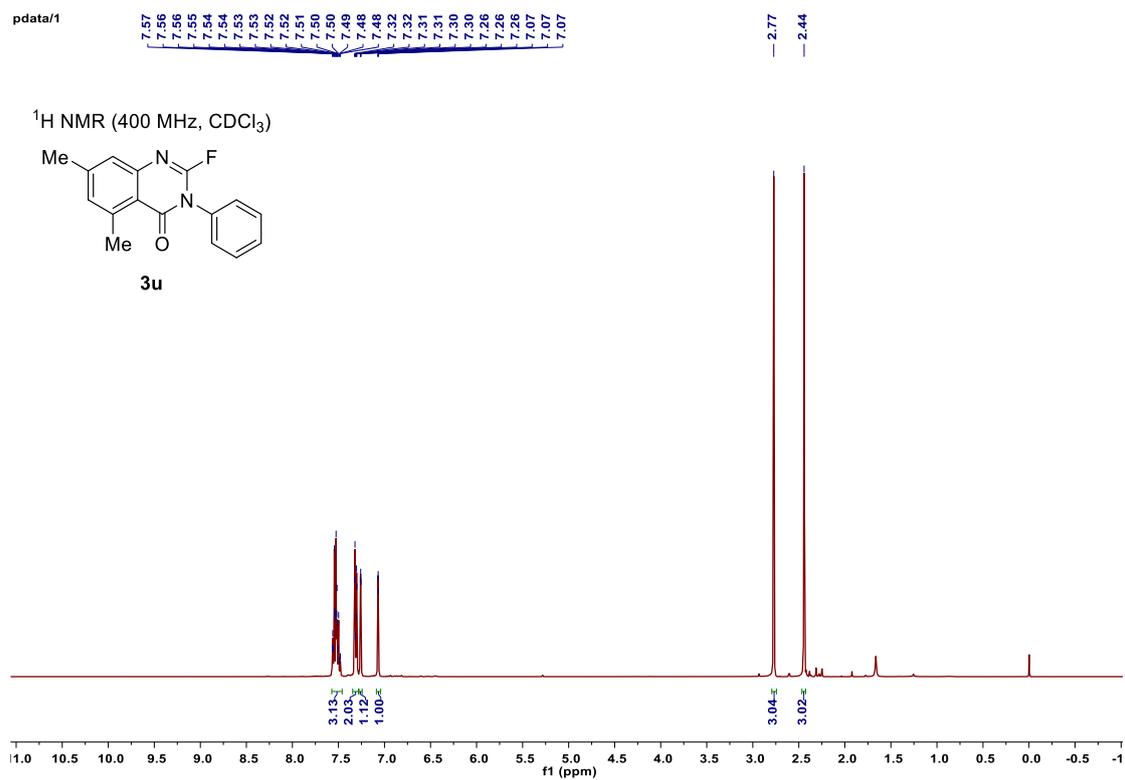


Aug11-2022-xyy-176-1.12.1.1r

-52.72
-54.38

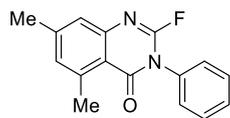
¹⁹F NMR (565 MHz, CDCl₃)



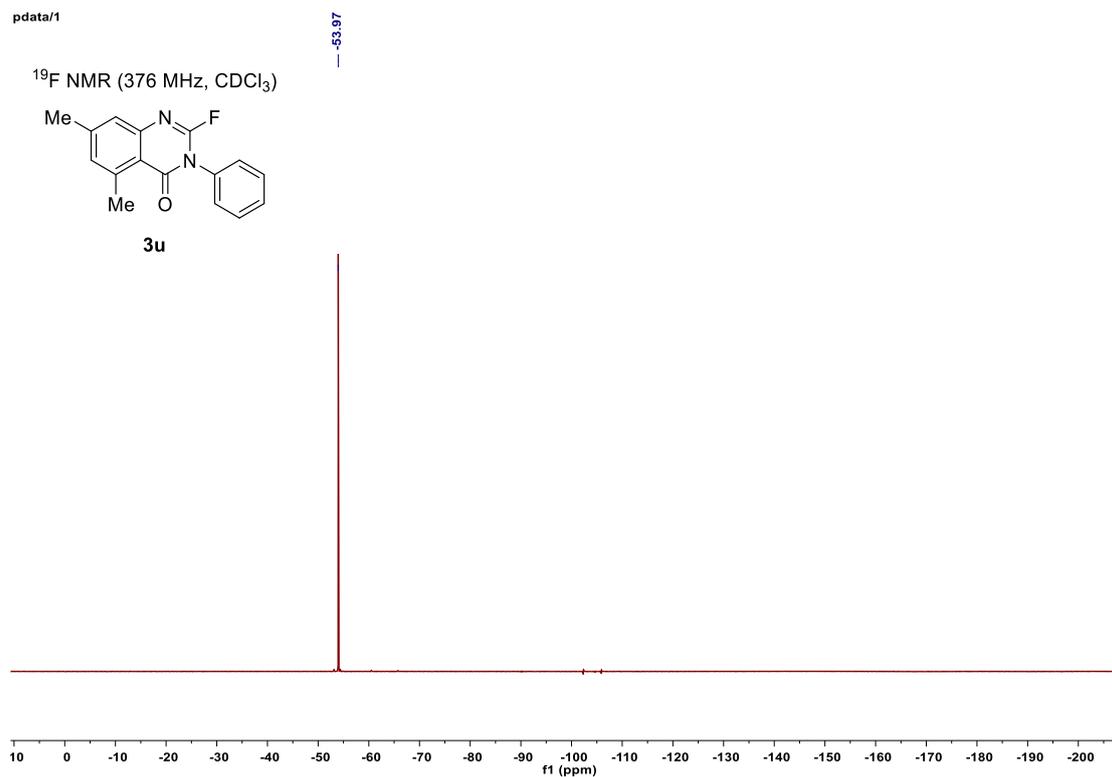


pdata/1

^{19}F NMR (376 MHz, CDCl_3)

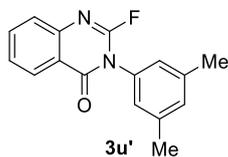


3u

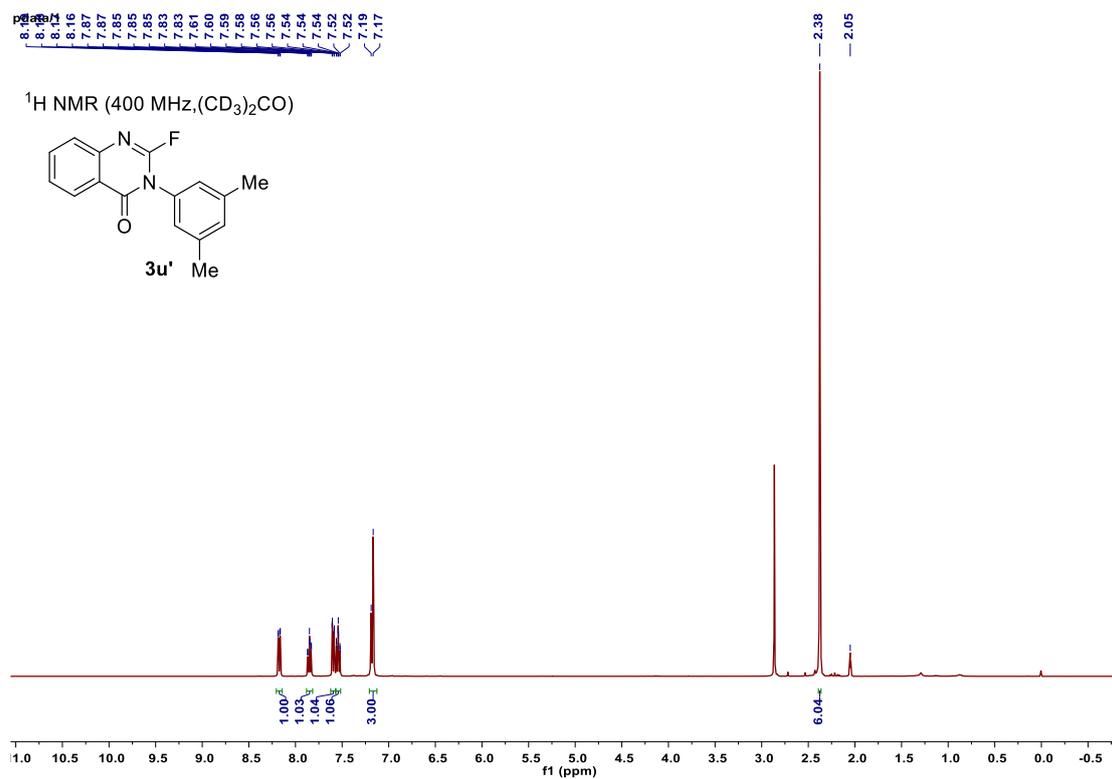


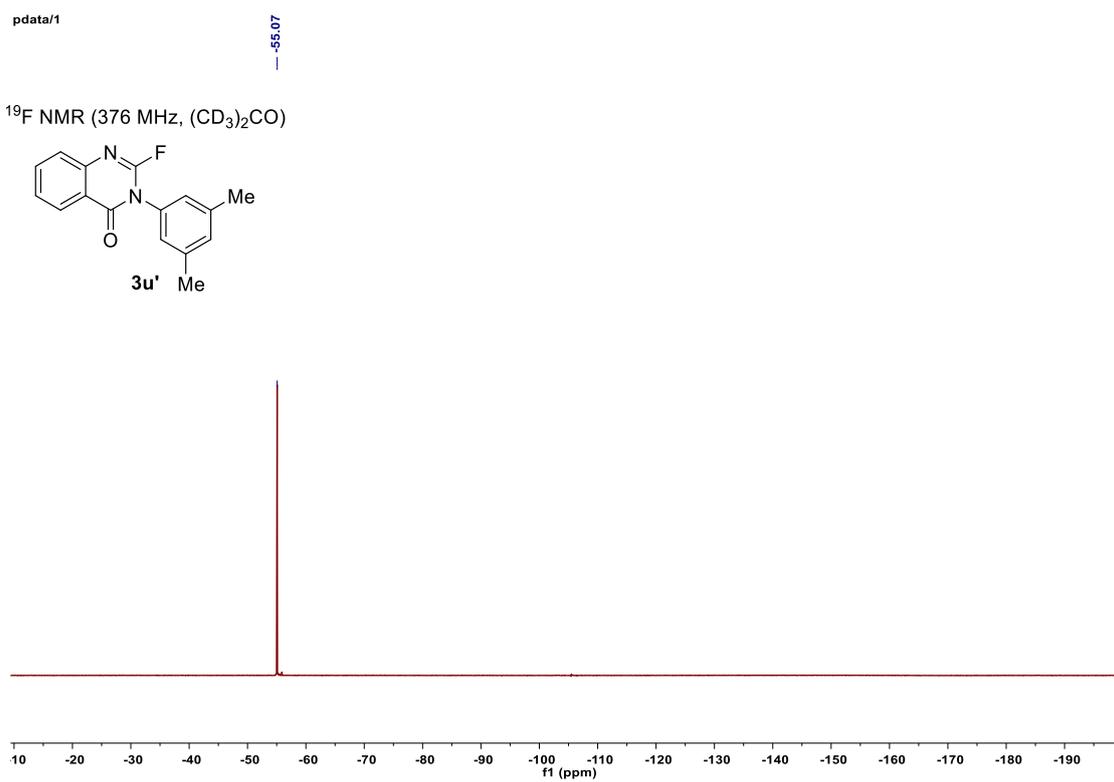
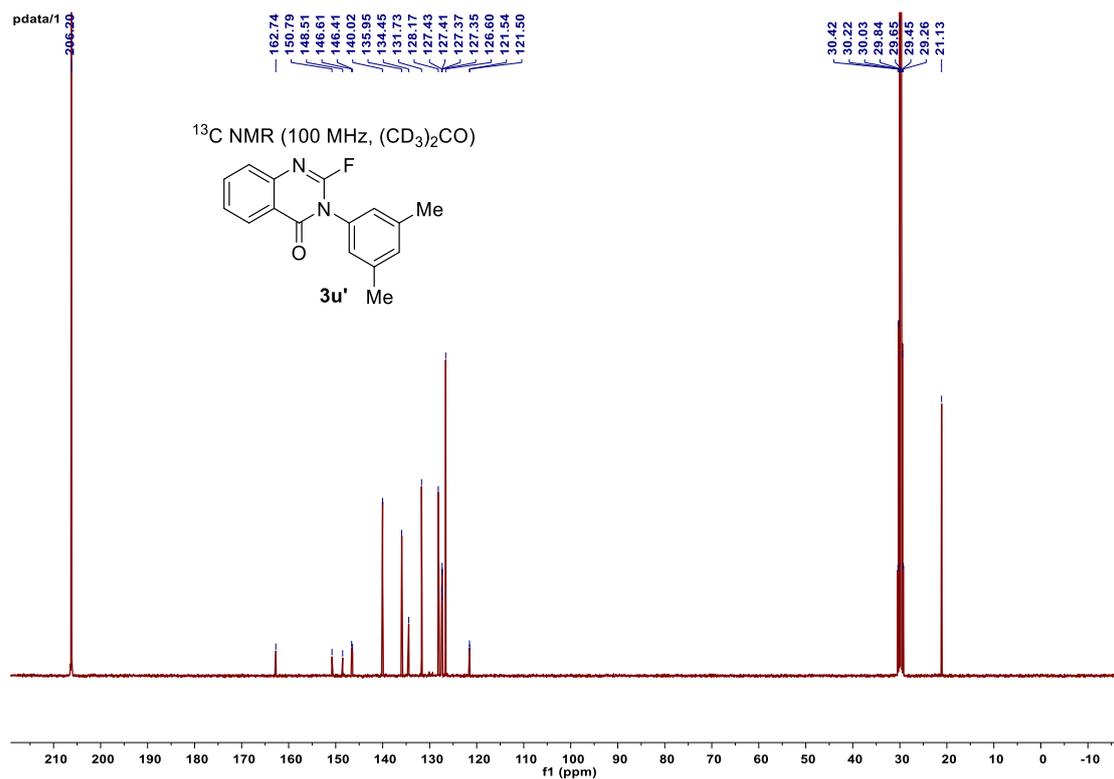
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8.02
8.00
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7.94
7.92
7.90
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7.86
7.84
7.82
7.80
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7.52
7.50
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7.40
7.38
7.36
7.34
7.32
7.30
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7.24
7.22
7.20
7.18
7.16

^1H NMR (400 MHz, $(\text{CD}_3)_2\text{CO}$)



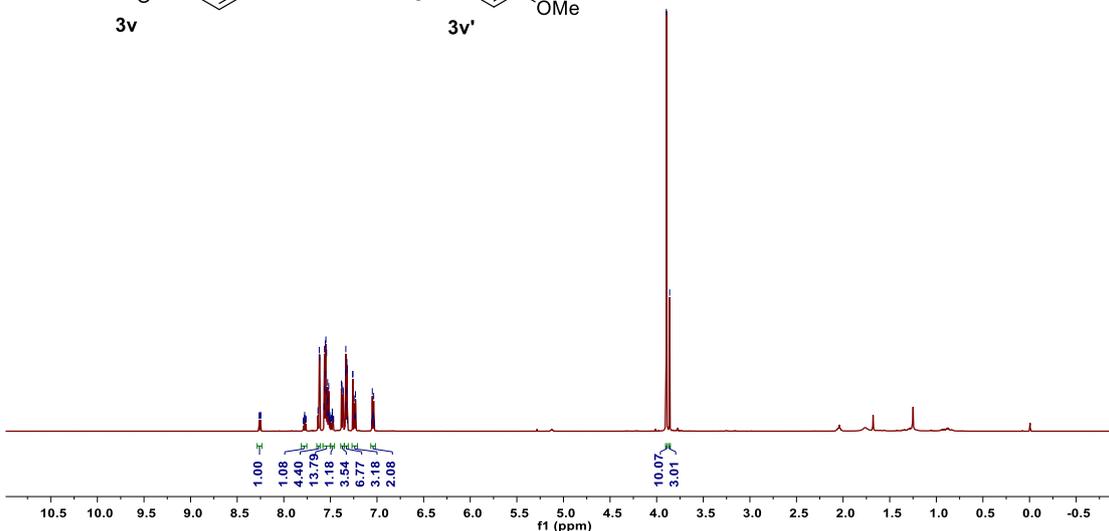
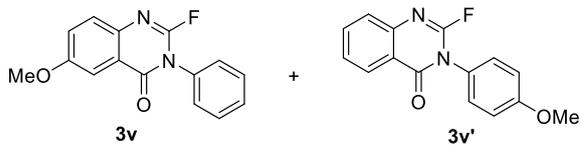
3u'





8.26
8.26
8.25
8.25
7.78
7.78
7.77
7.76
7.63
7.62
7.61
7.57
7.57
7.56
7.55
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7.05
7.05
7.04
7.04
3.90
3.90

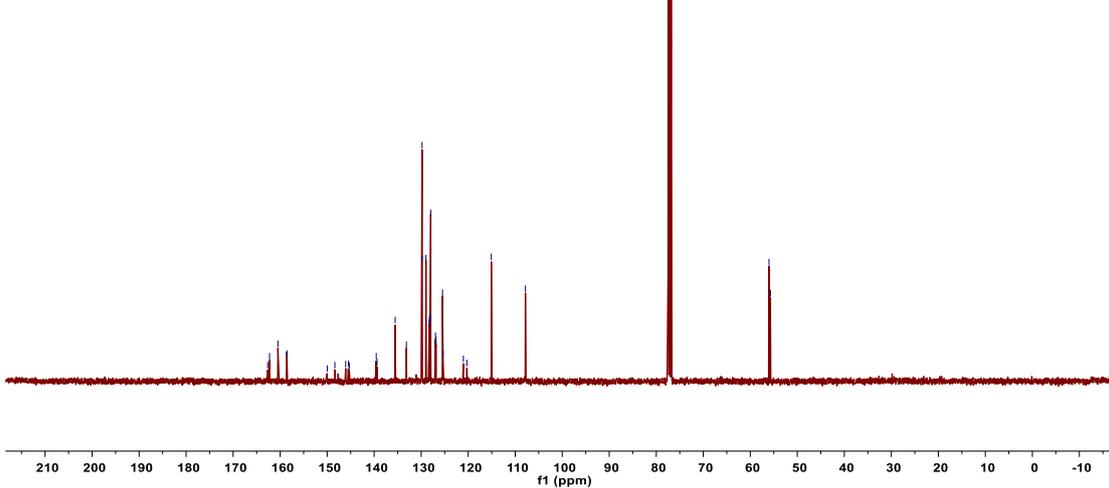
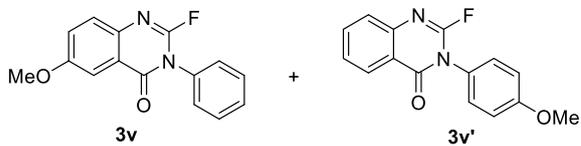
¹H NMR (600 MHz, CDCl₃)



pdata/1

162.65
162.26
160.47
158.57
149.99
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146.06
145.48
145.29
139.56
139.38
135.53
133.15
129.83
129.81
128.99
128.77
128.56
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126.85
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125.46
125.35
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120.29
115.08
107.83

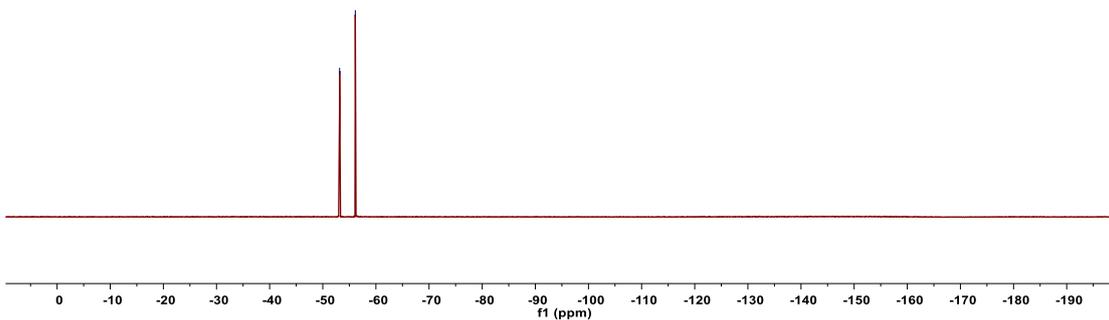
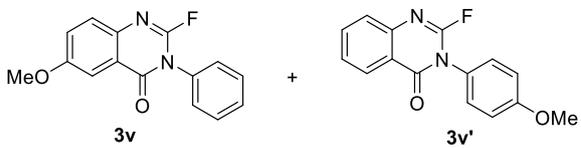
¹³C NMR (100 MHz, CDCl₃)



pdata/1

-53.16
-56.12

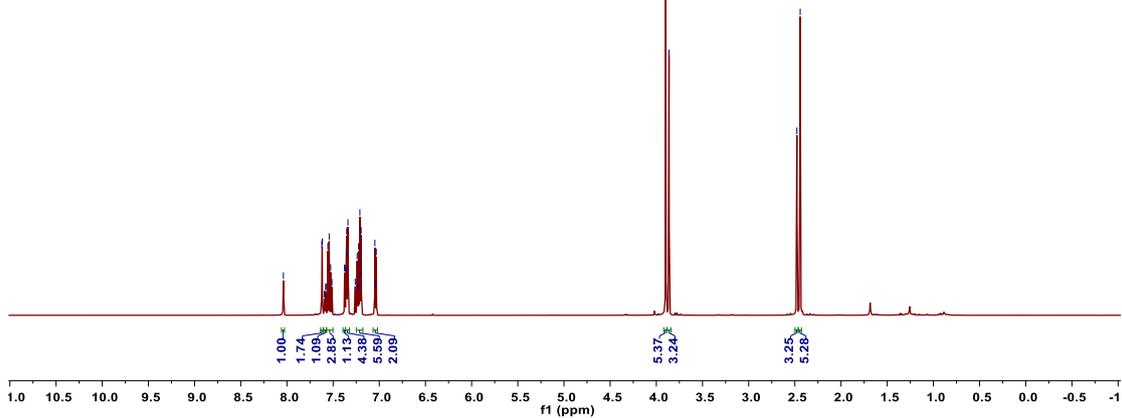
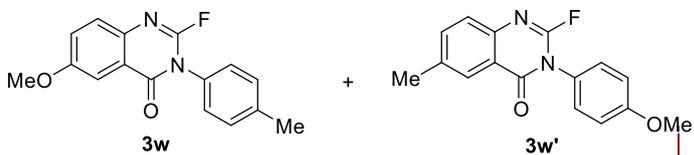
¹⁹F NMR (376 MHz, CDCl₃)



Feb09-2023-xyy-2-84.10.1.1r

8.04
7.62
7.62
7.59
7.59
7.58
7.58
7.56
7.53
7.51
7.38
7.37
7.36
7.36
7.35
7.34
7.26
7.24
7.24
7.23
7.22
7.21
7.21
7.20
7.20
7.05
7.04
7.03
3.90
3.86
2.48
2.44

¹H NMR (600 MHz, CDCl₃)



Feb09-2023-xyy-2-84.11.1.1r

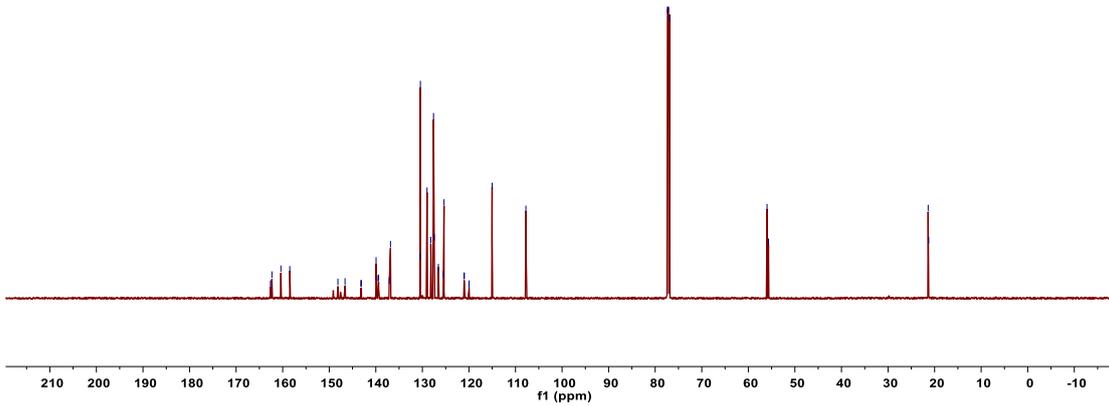
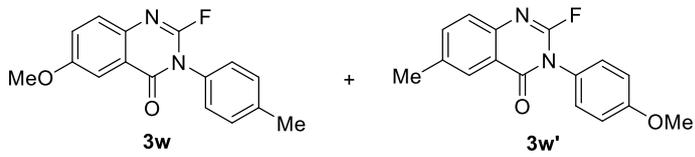
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143.22
143.09
139.94
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139.39
137.11
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130.43
128.00
127.66
127.66
127.45
126.56
125.49
125.35
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77.16
76.95

55.97
55.67

21.39
21.29

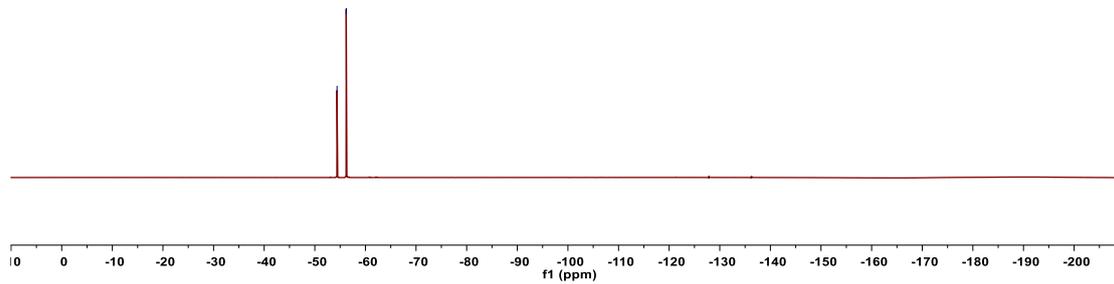
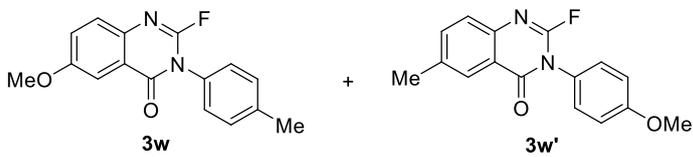
¹³C NMR (150 MHz, CDCl₃)

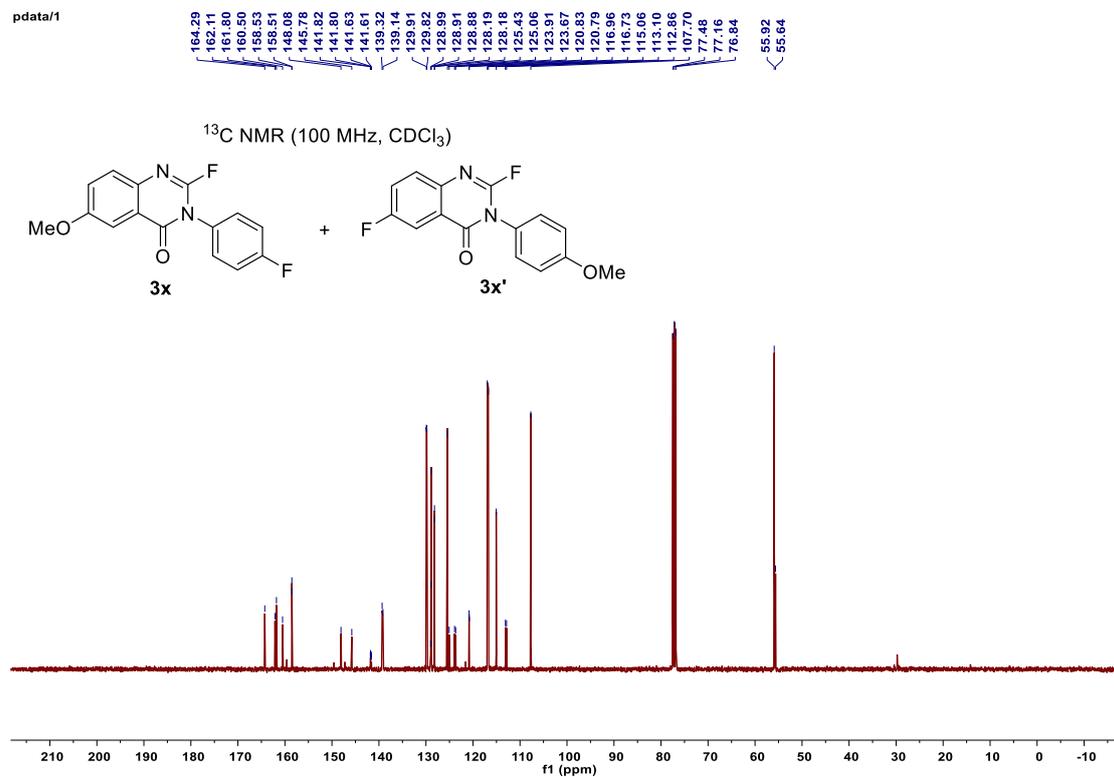
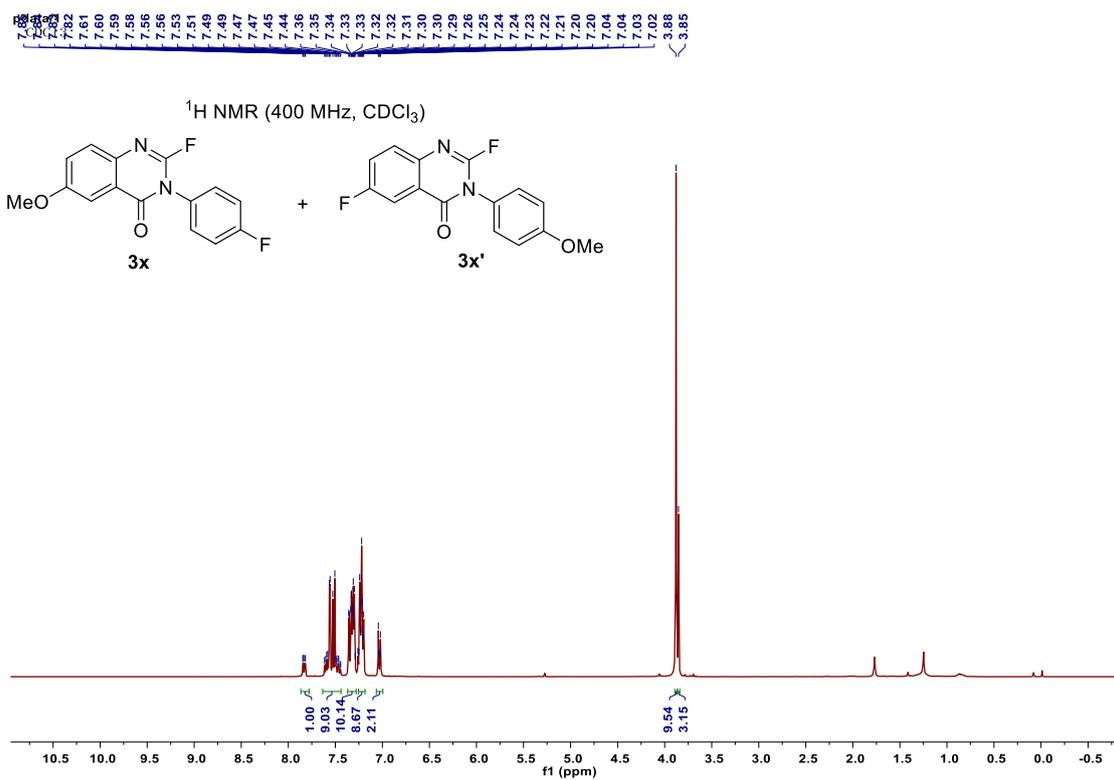


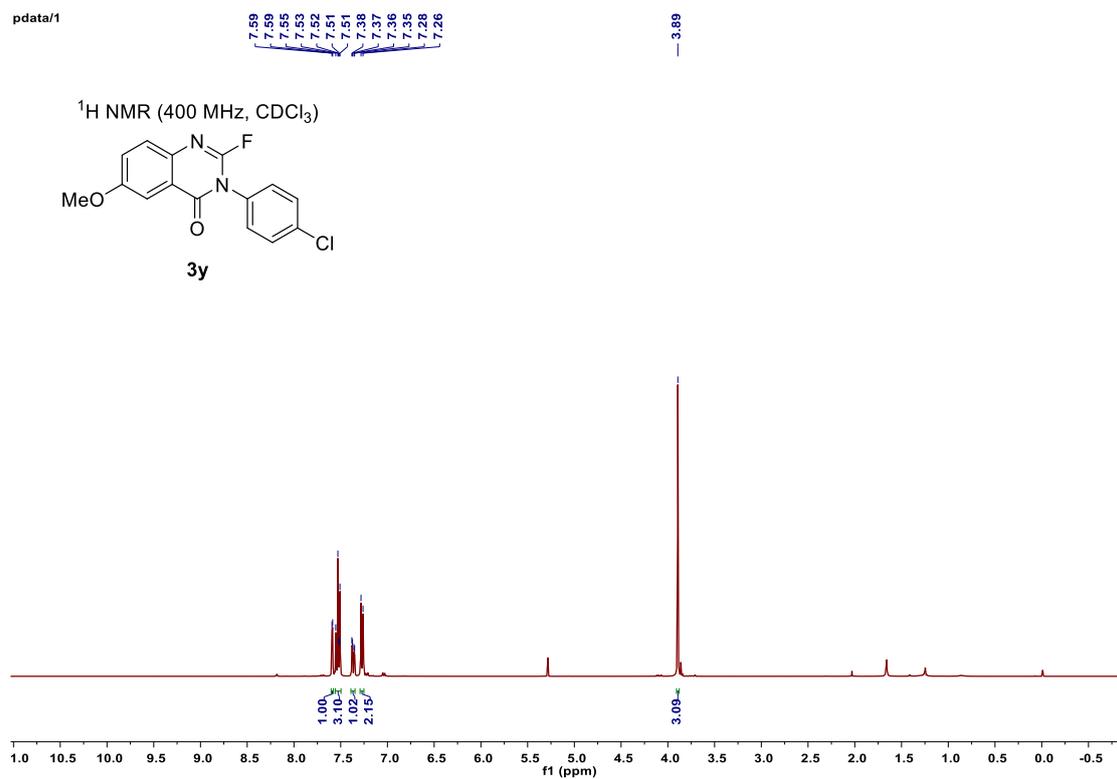
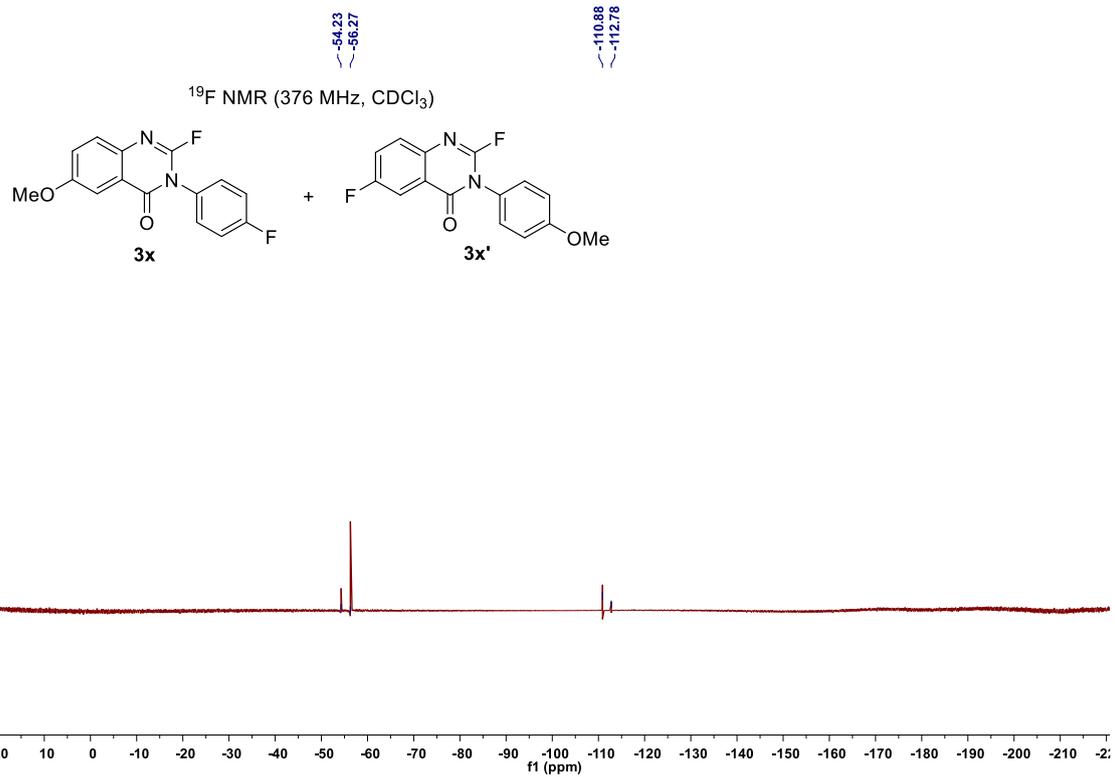
Feb09-2023-xyy-2-84.11.1.1r

-54.39
-56.21

¹⁹F NMR (565 MHz, CDCl₃)





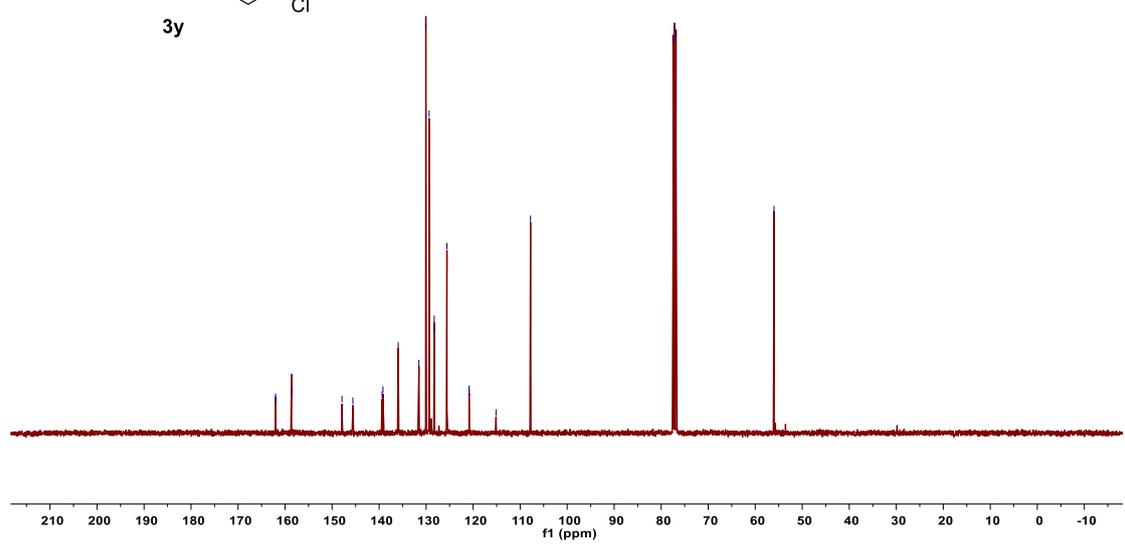
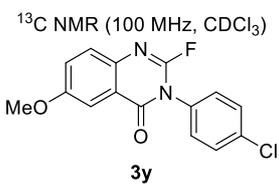


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138.96
135.93
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107.79

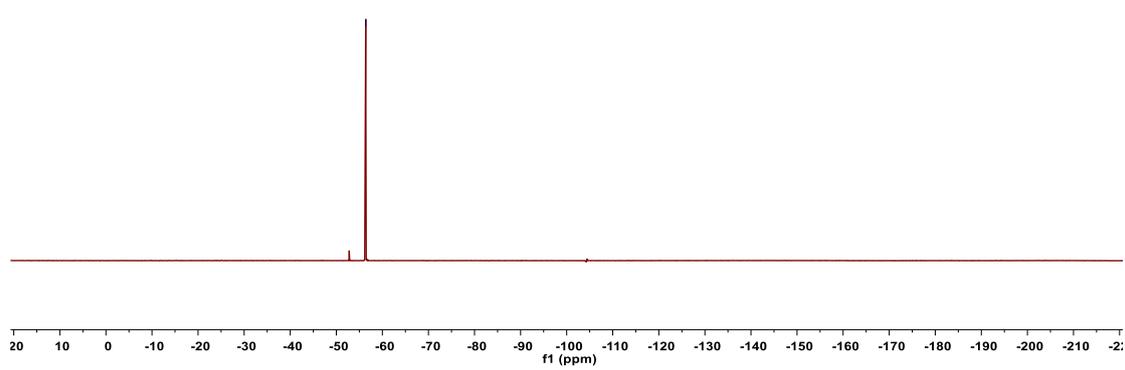
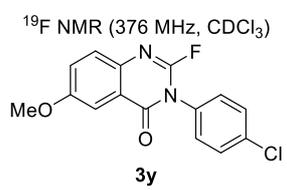
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76.84

56.01



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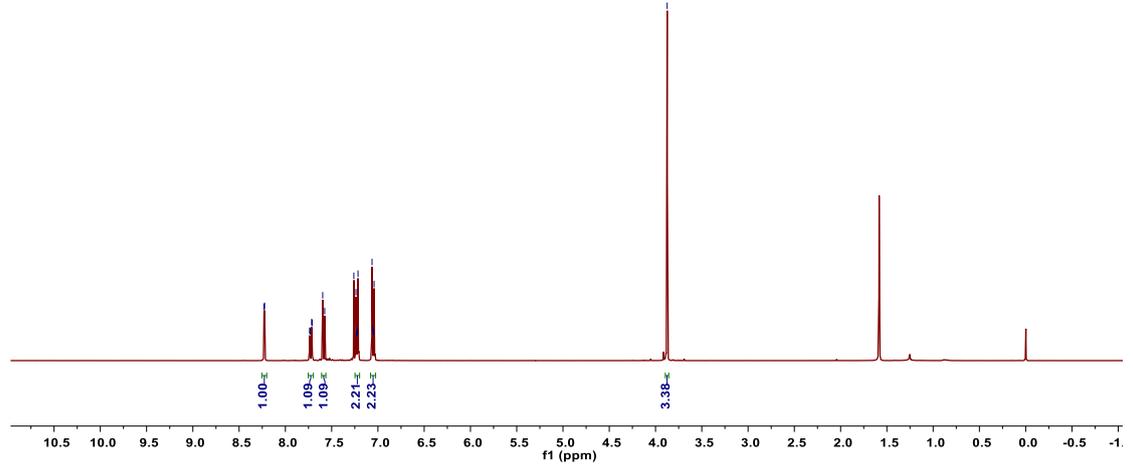
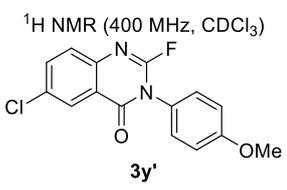
-56.38



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7.05
7.04

3.87

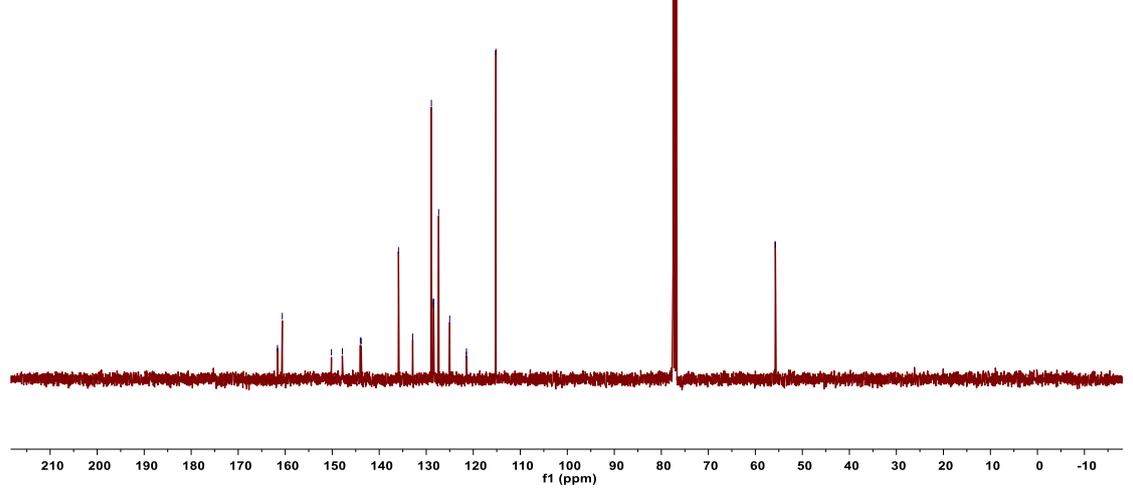
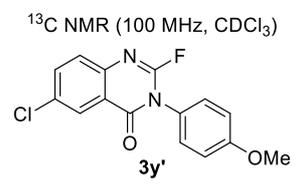


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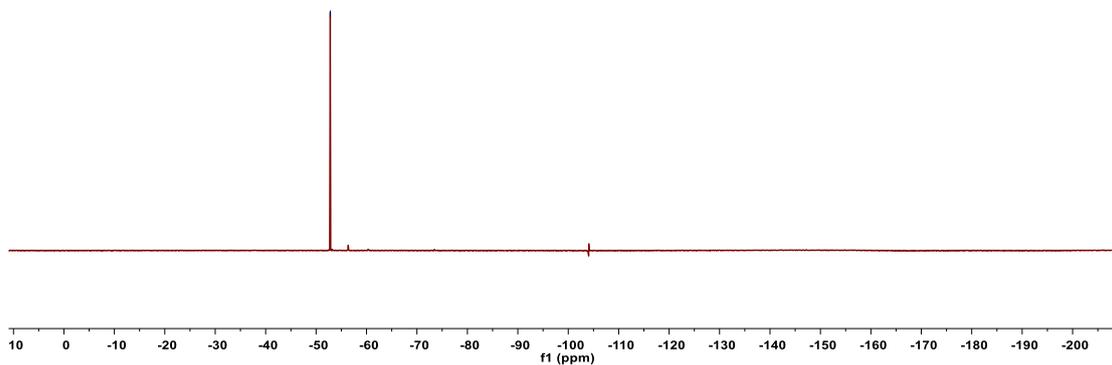
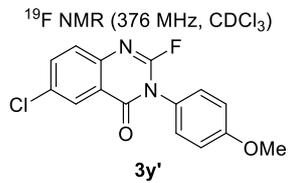
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125.02
121.48
121.44
115.18

77.48
77.46
76.84

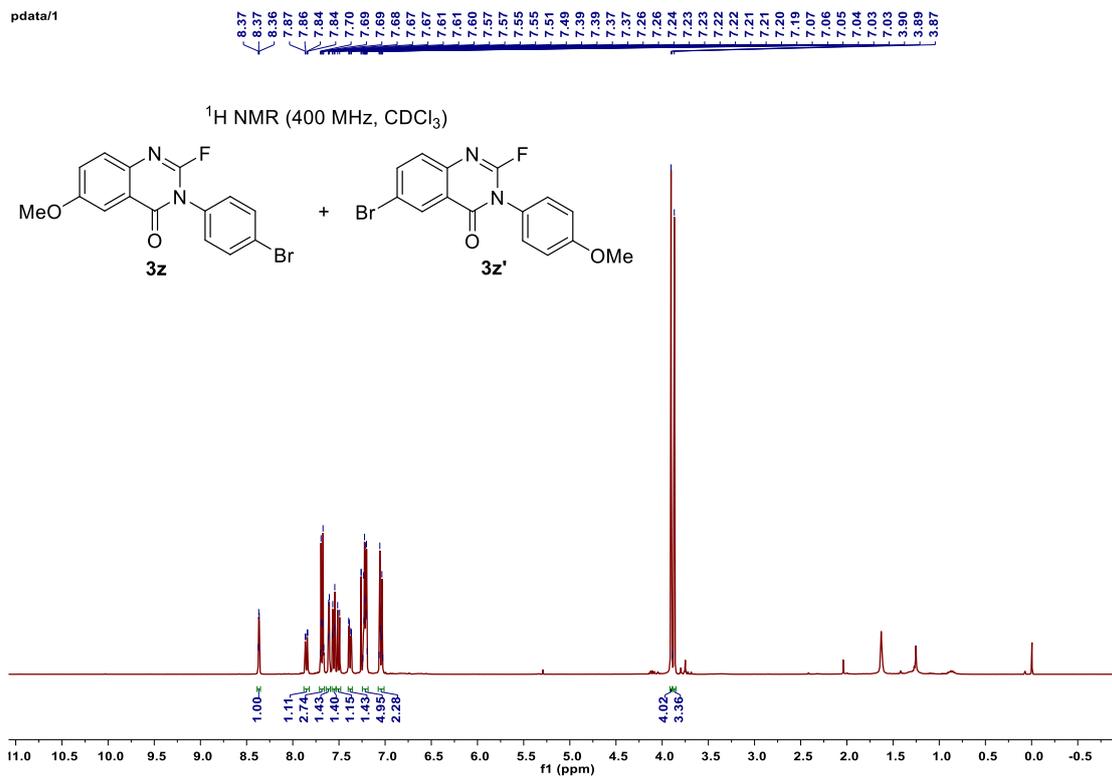
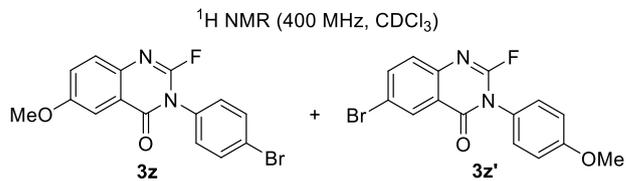
55.74

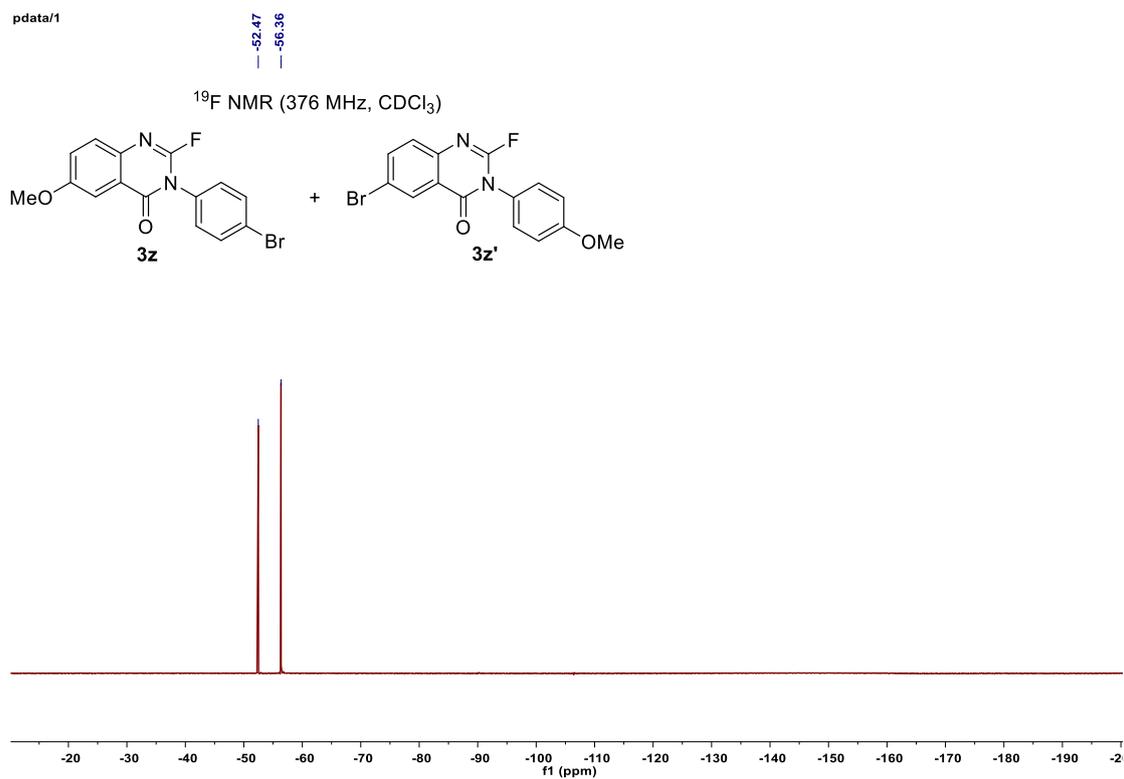
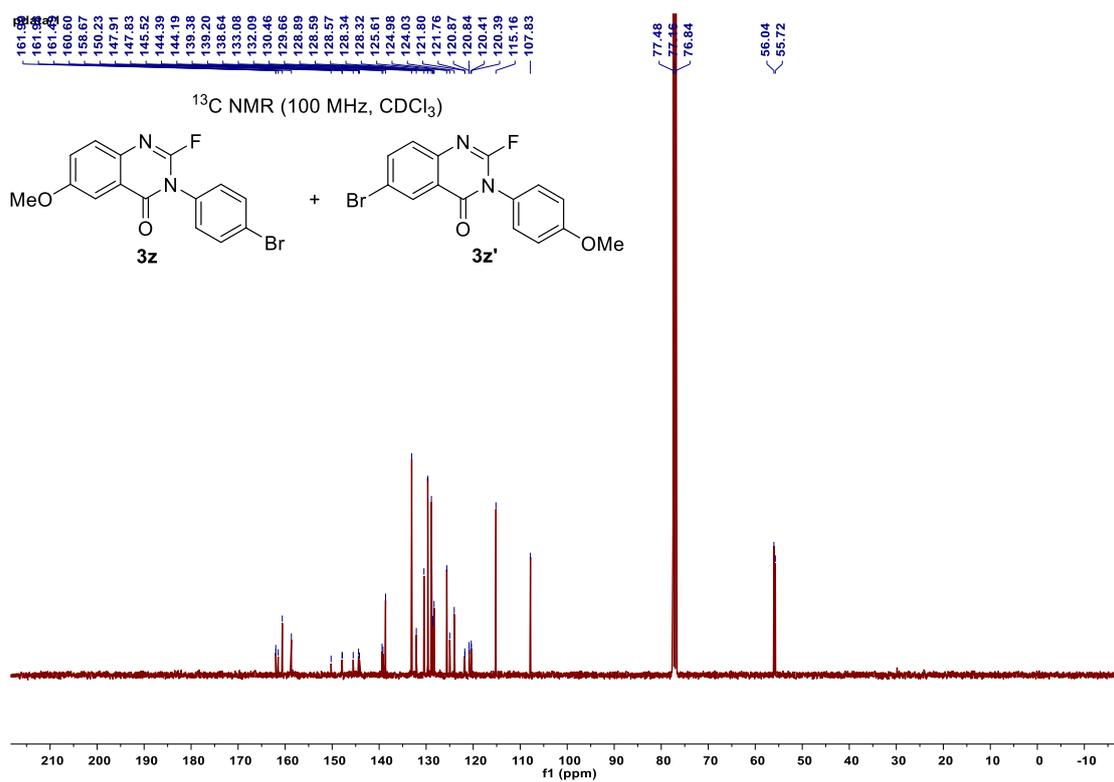


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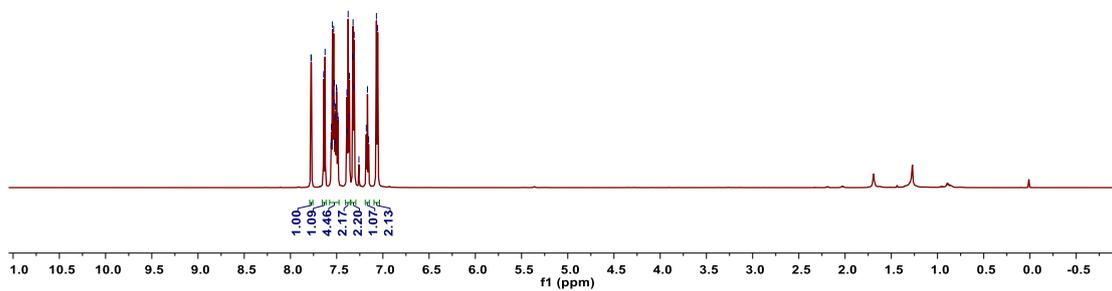
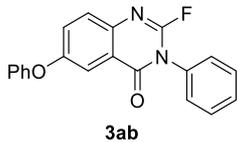
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May02-2023-xyy-2-171-5-1.11.1.1r
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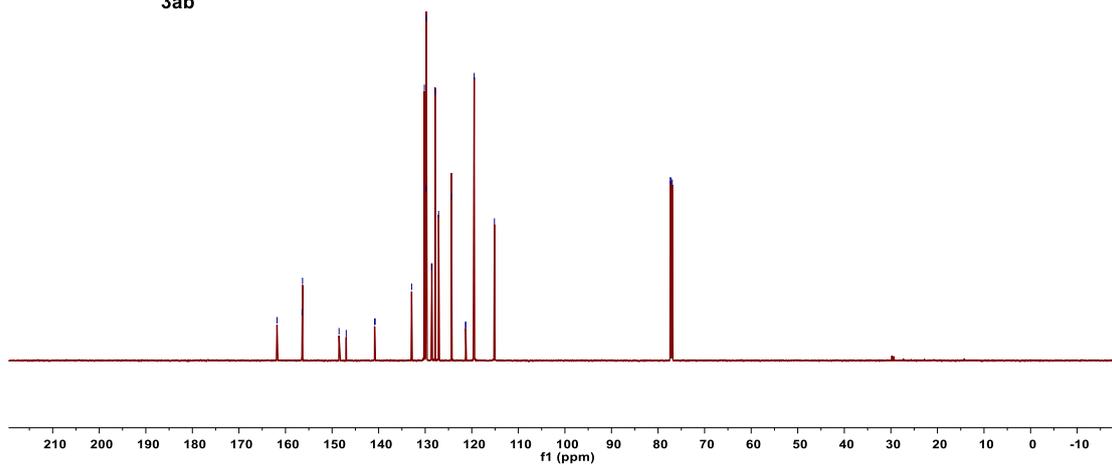
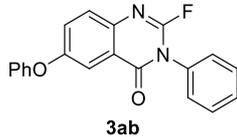
¹H NMR (600 MHz, CDCl₃)



May02-2023-xyy-2-171-5-1.11.1.1r

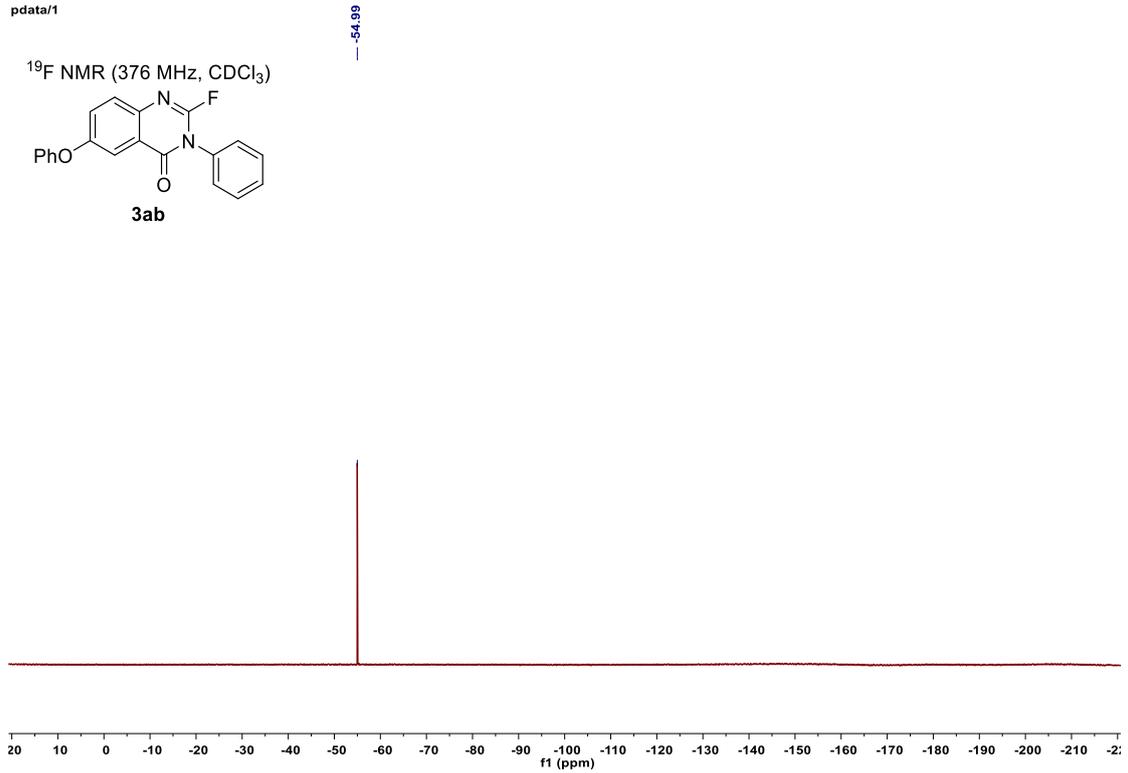
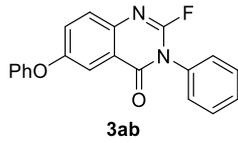
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¹³C NMR (150 MHz, CDCl₃)



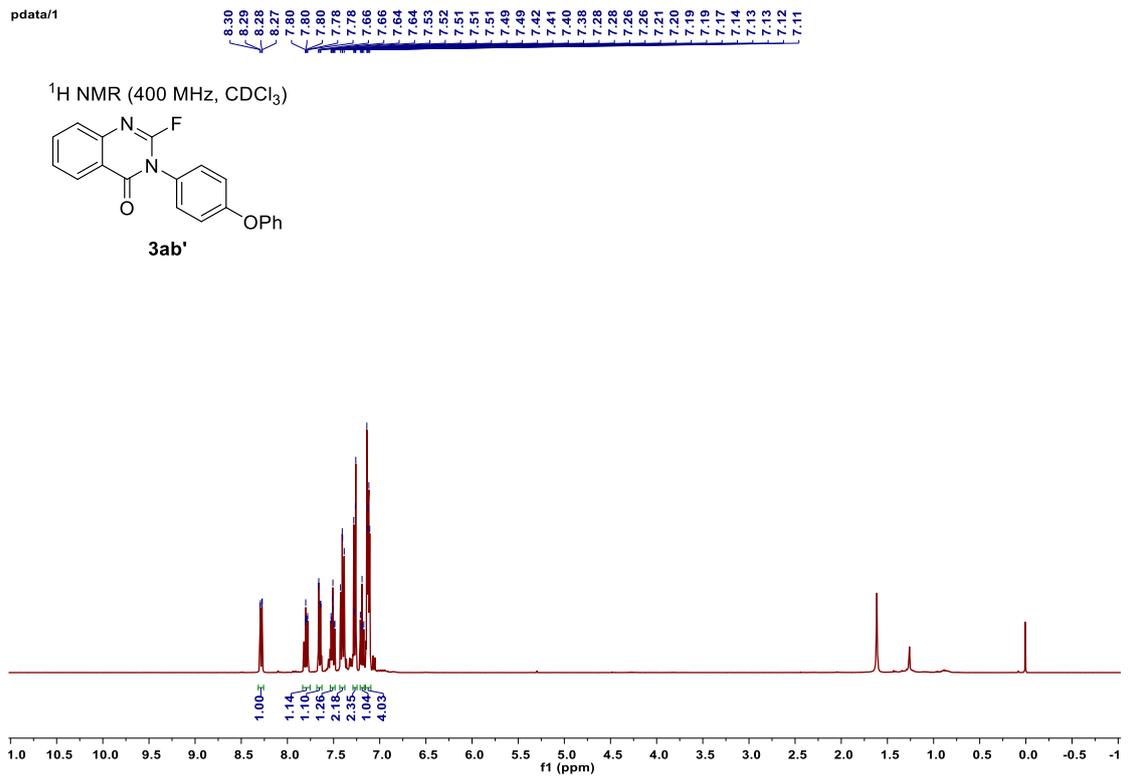
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^{19}F NMR (376 MHz, CDCl_3)



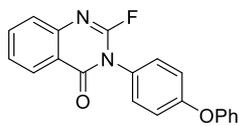
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^1H NMR (400 MHz, CDCl_3)

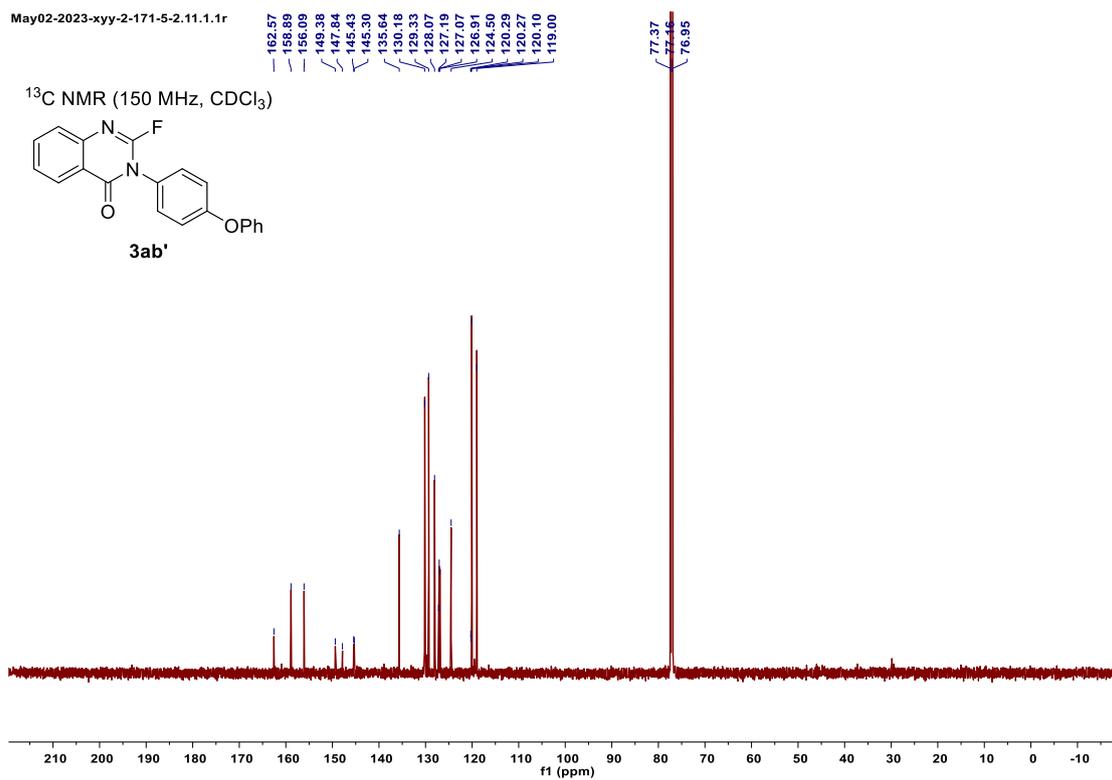


May02-2023-xyy-2-171-5-2.11.1.1r

^{13}C NMR (150 MHz, CDCl_3)

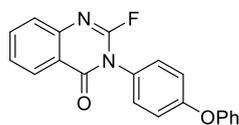


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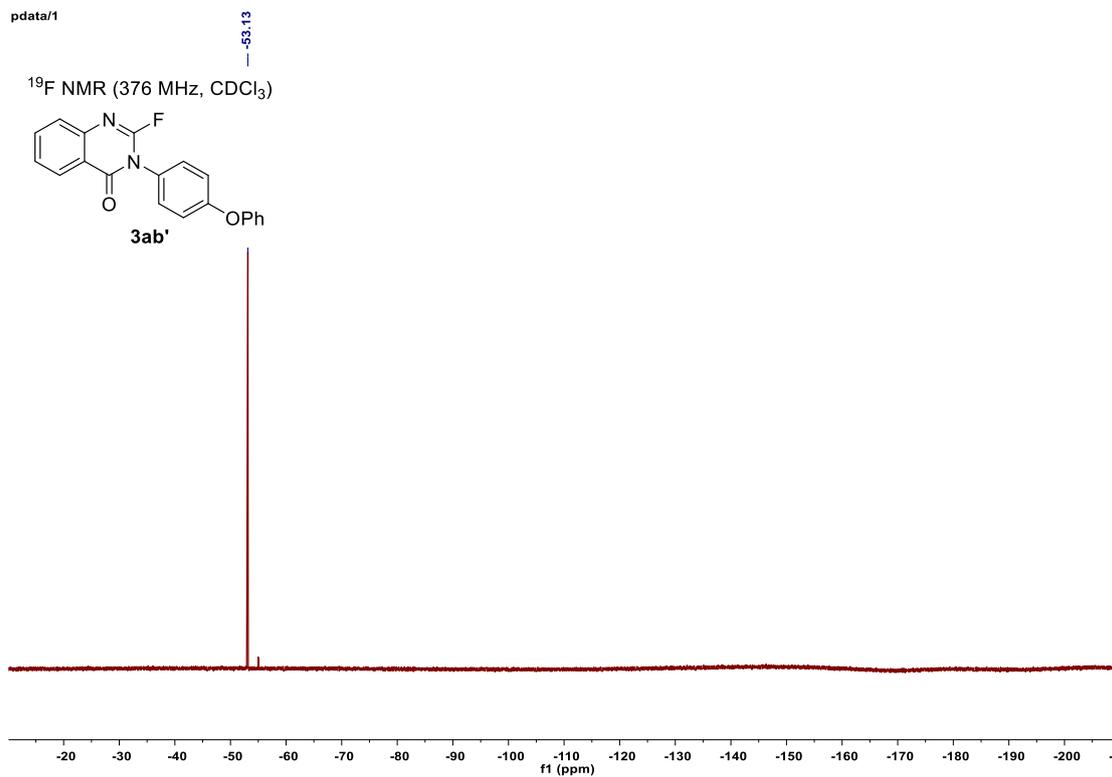


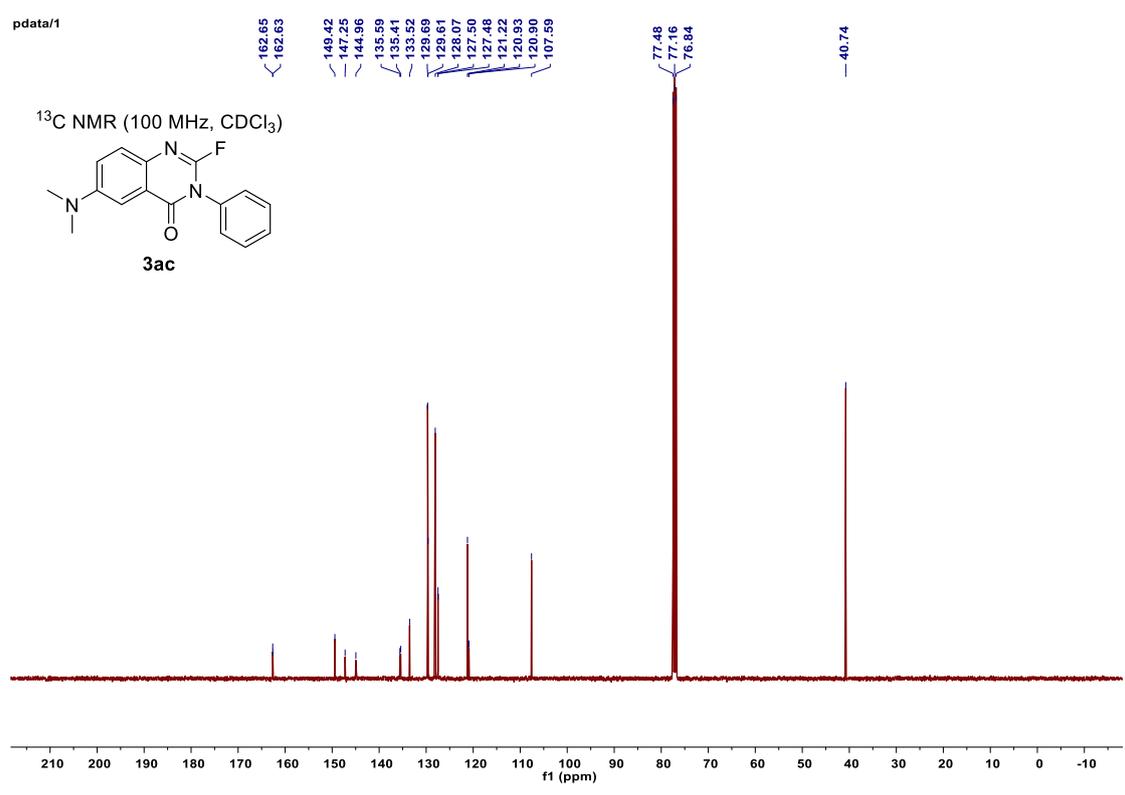
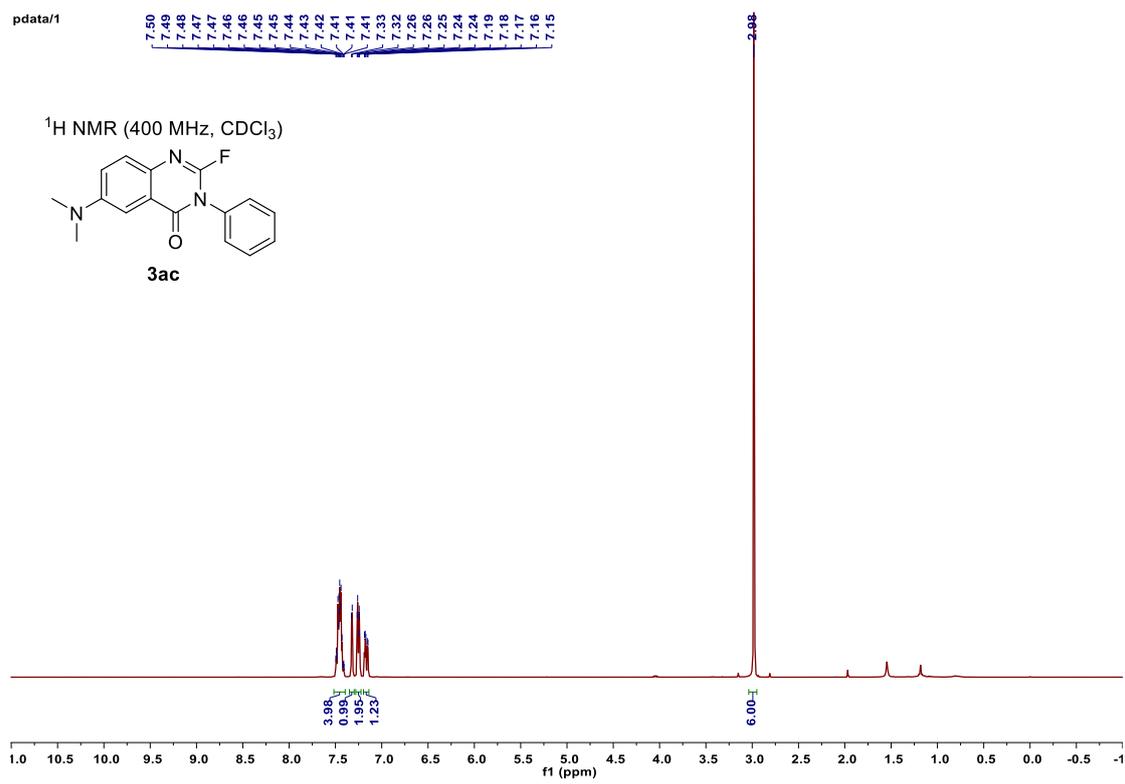
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^{19}F NMR (376 MHz, CDCl_3)

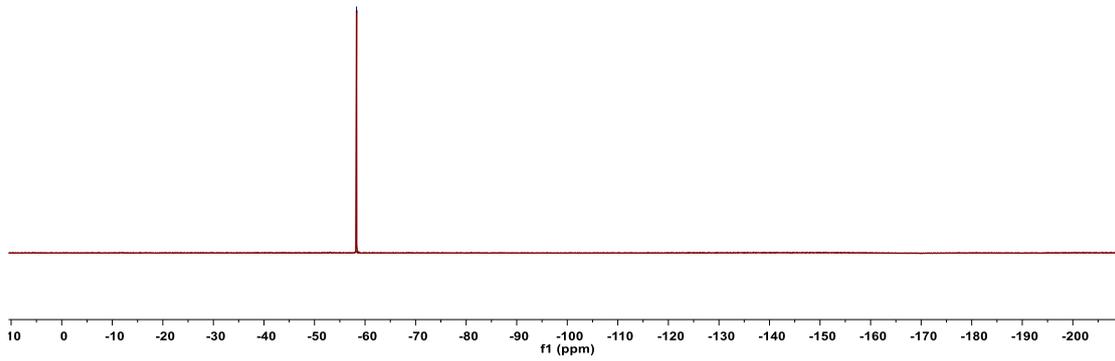
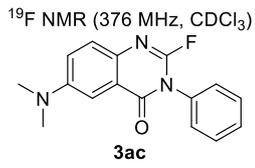


3ab'



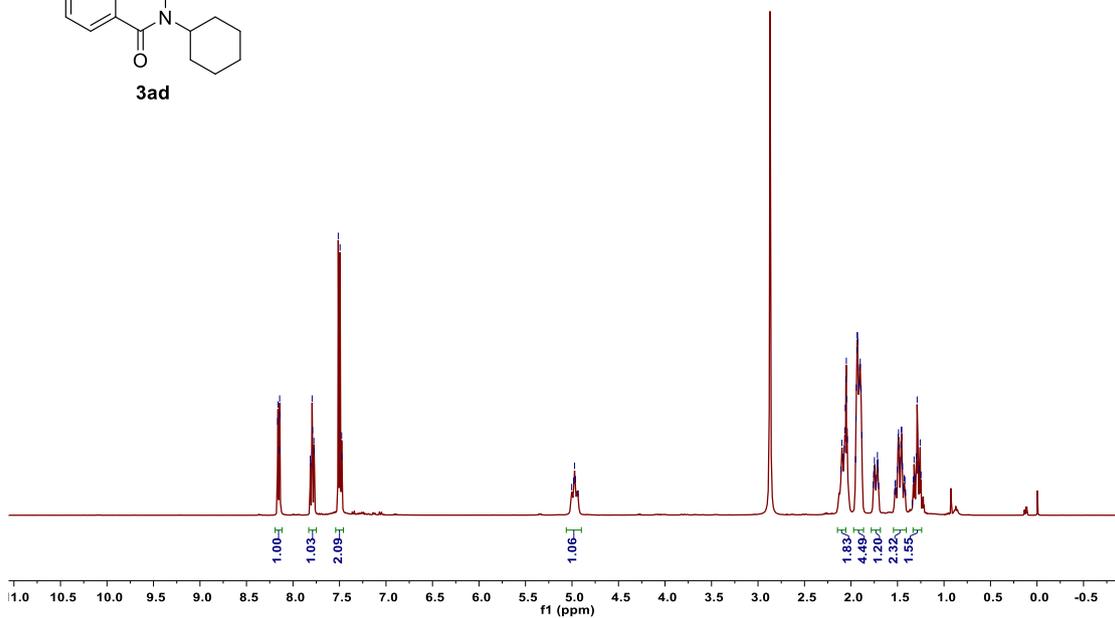
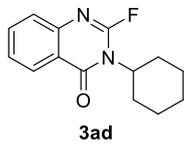


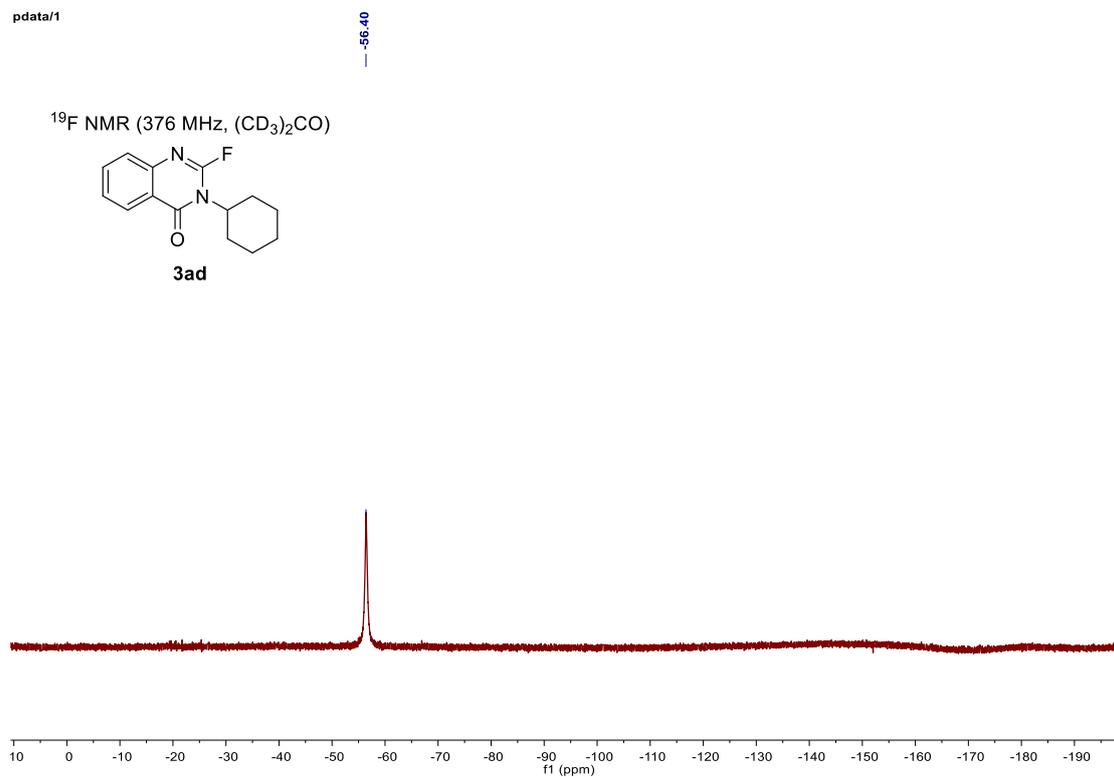
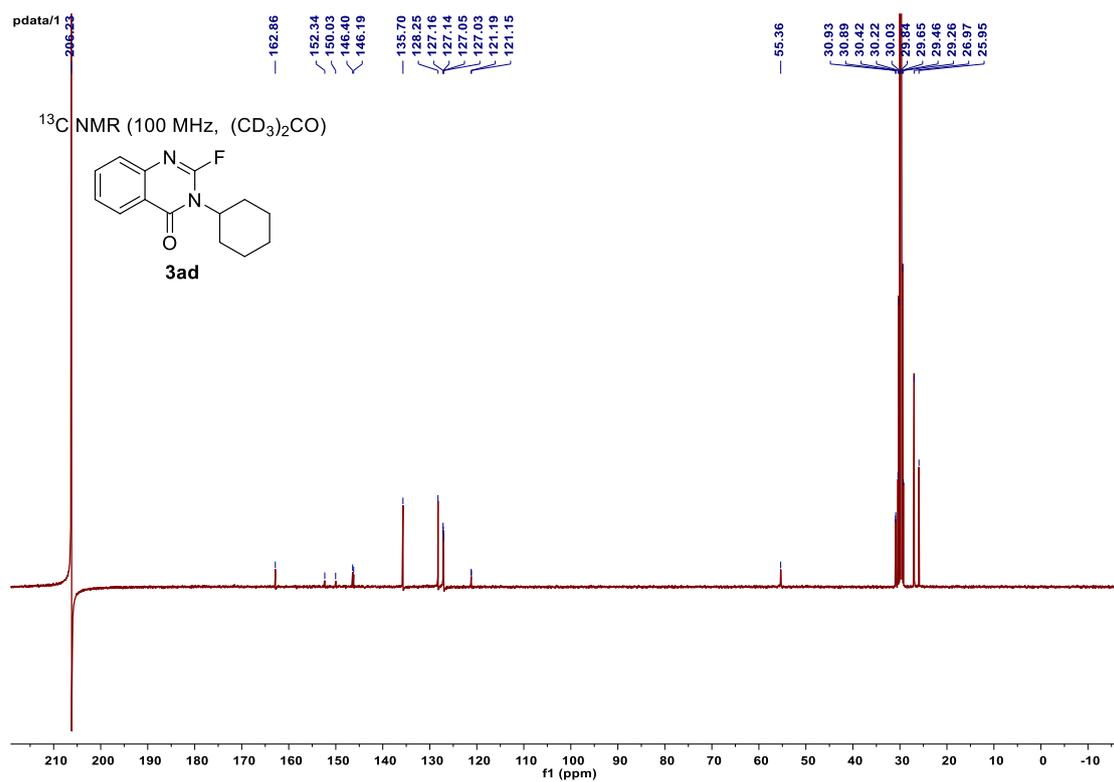
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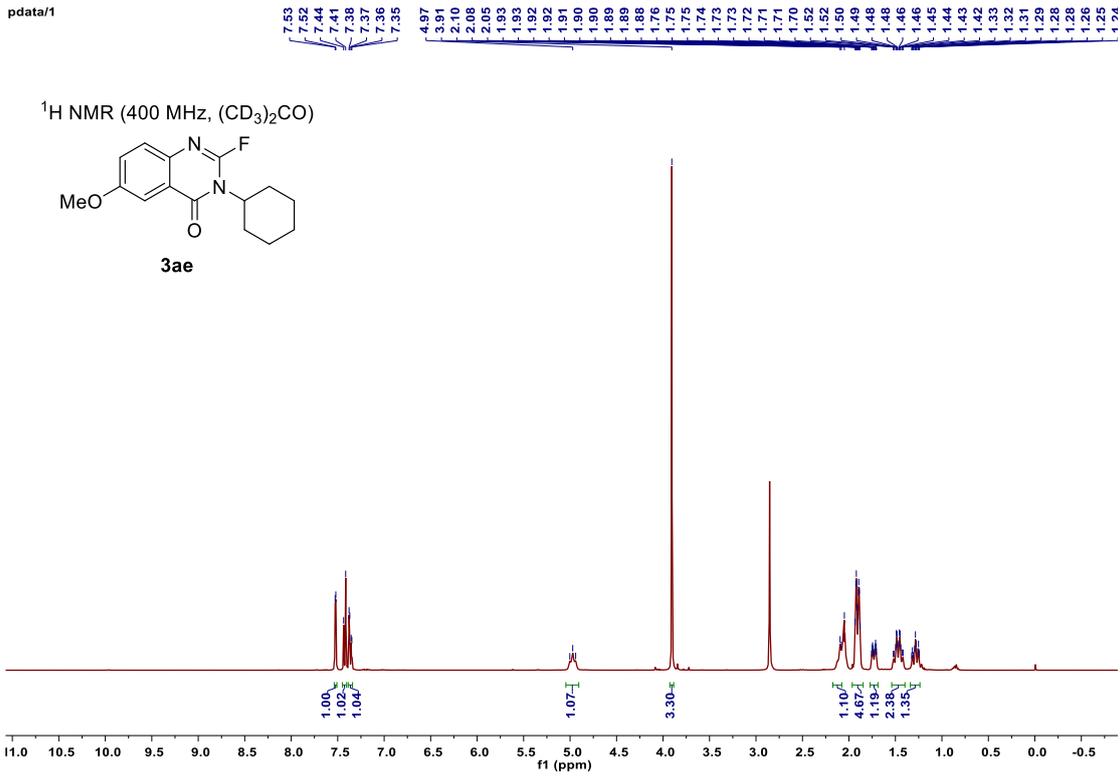
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1.47
1.46
1.46
1.45
1.45
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1.26

¹H NMR (400 MHz, (CD₃)₂CO)

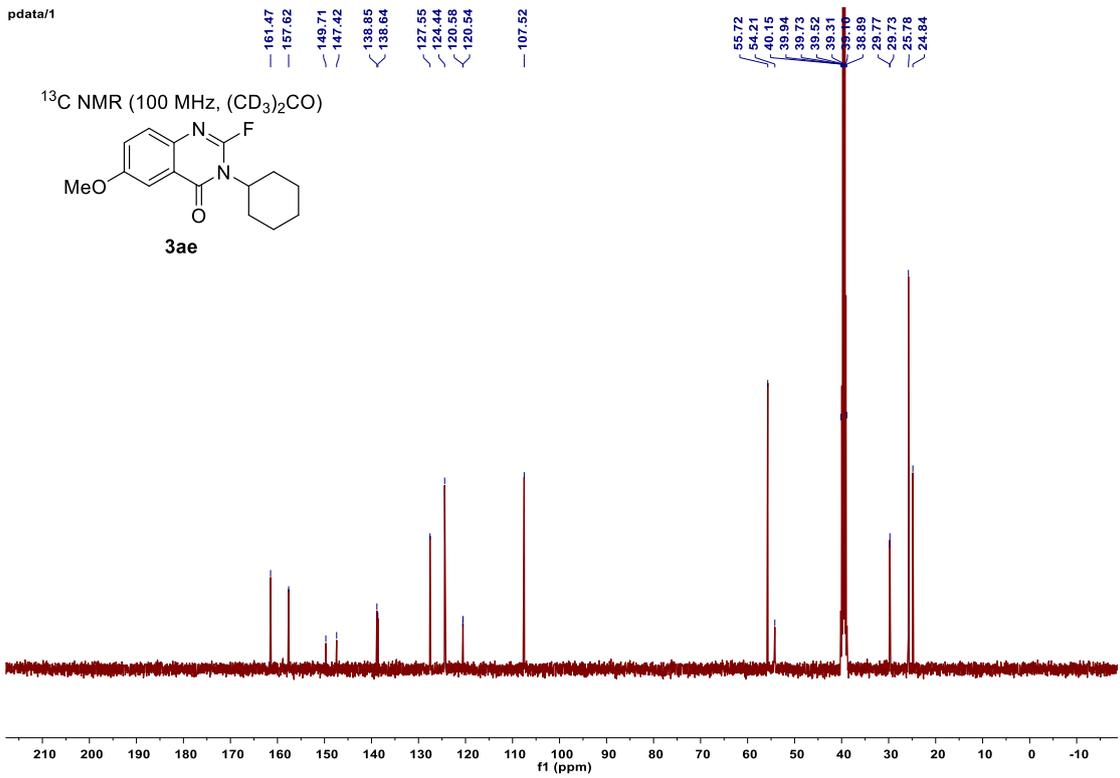




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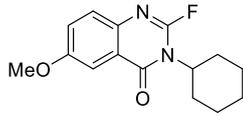
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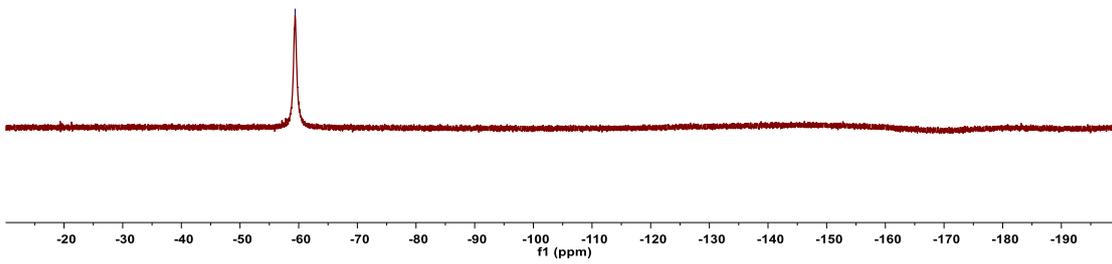
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-99.39

^{19}F NMR (376 MHz, $(\text{CD}_3)_2\text{CO}$)



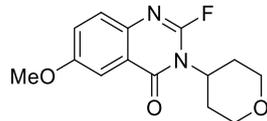
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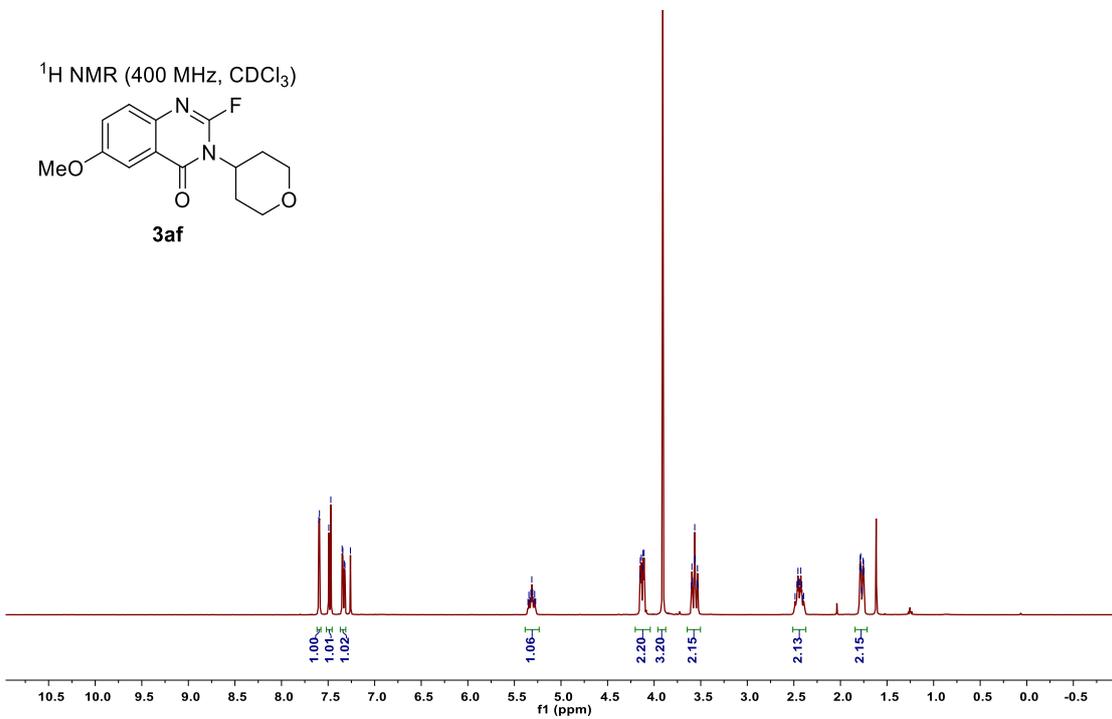
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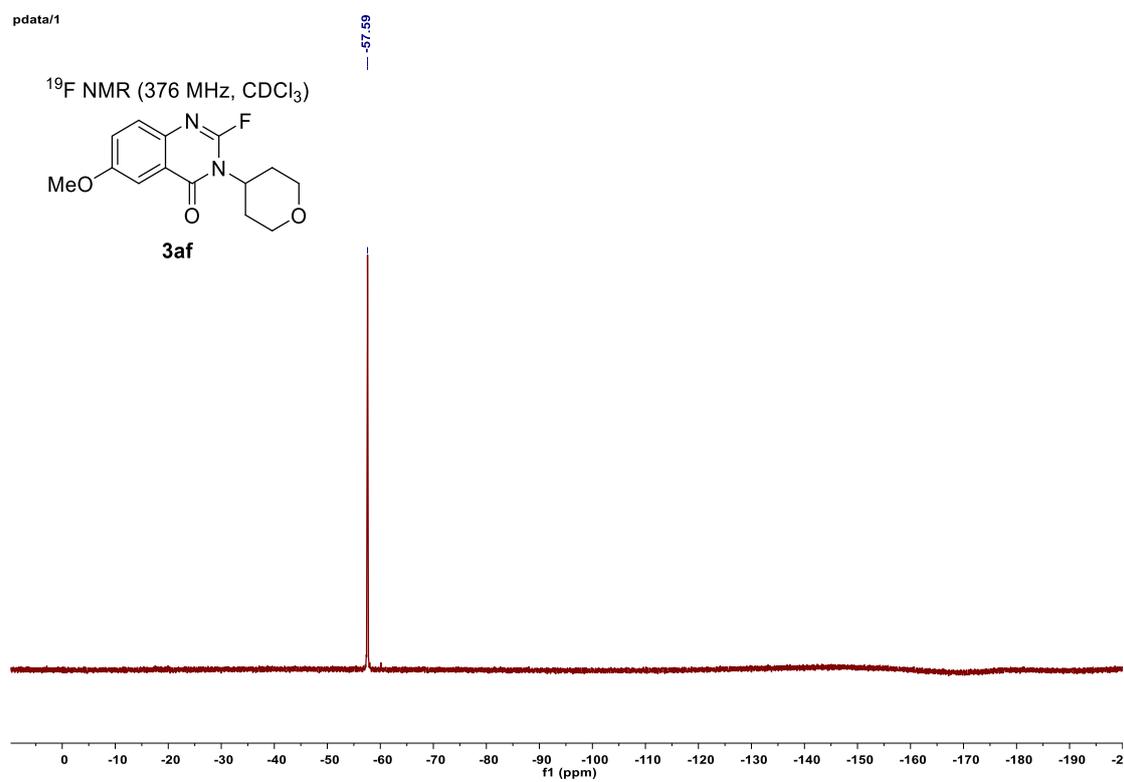
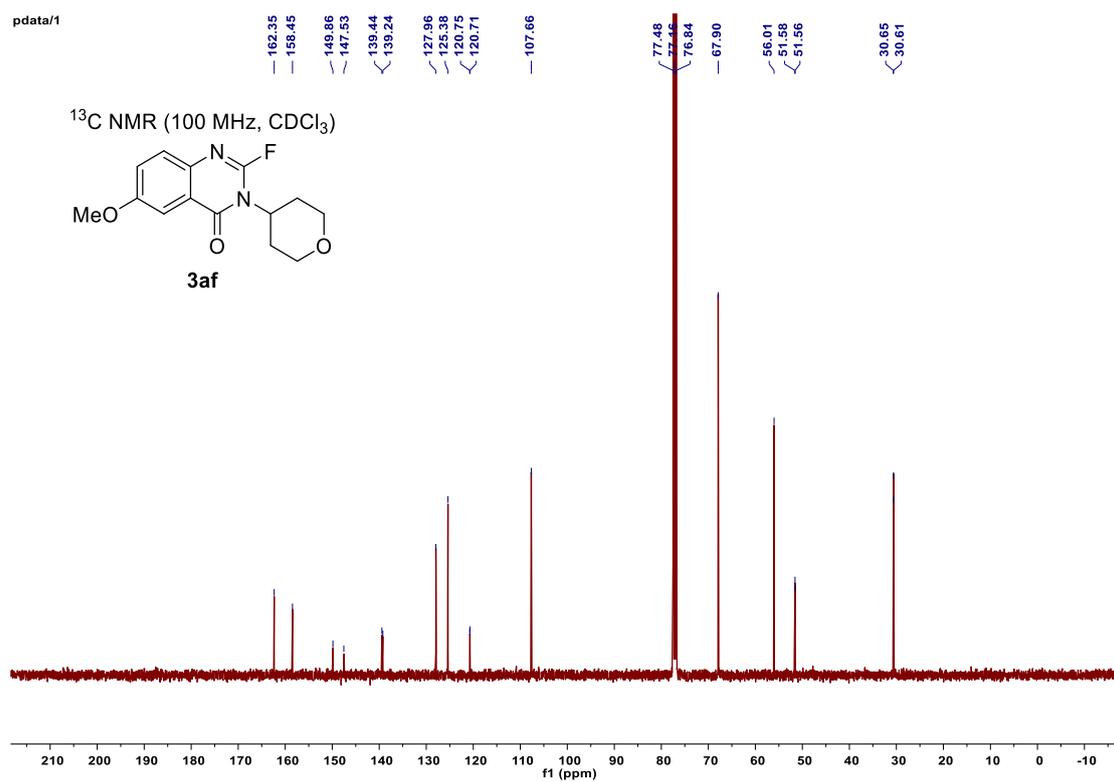
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^1H NMR (400 MHz, CDCl_3)

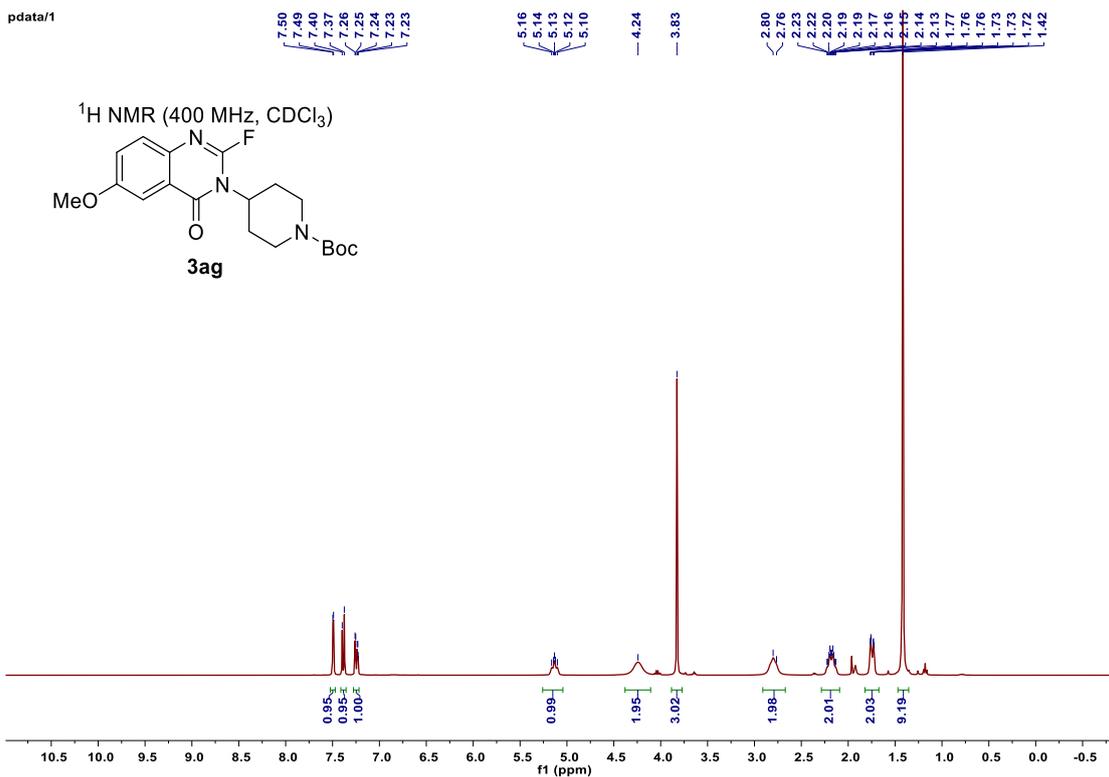
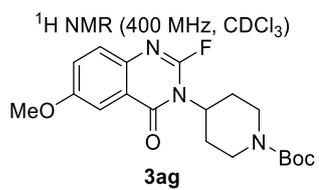


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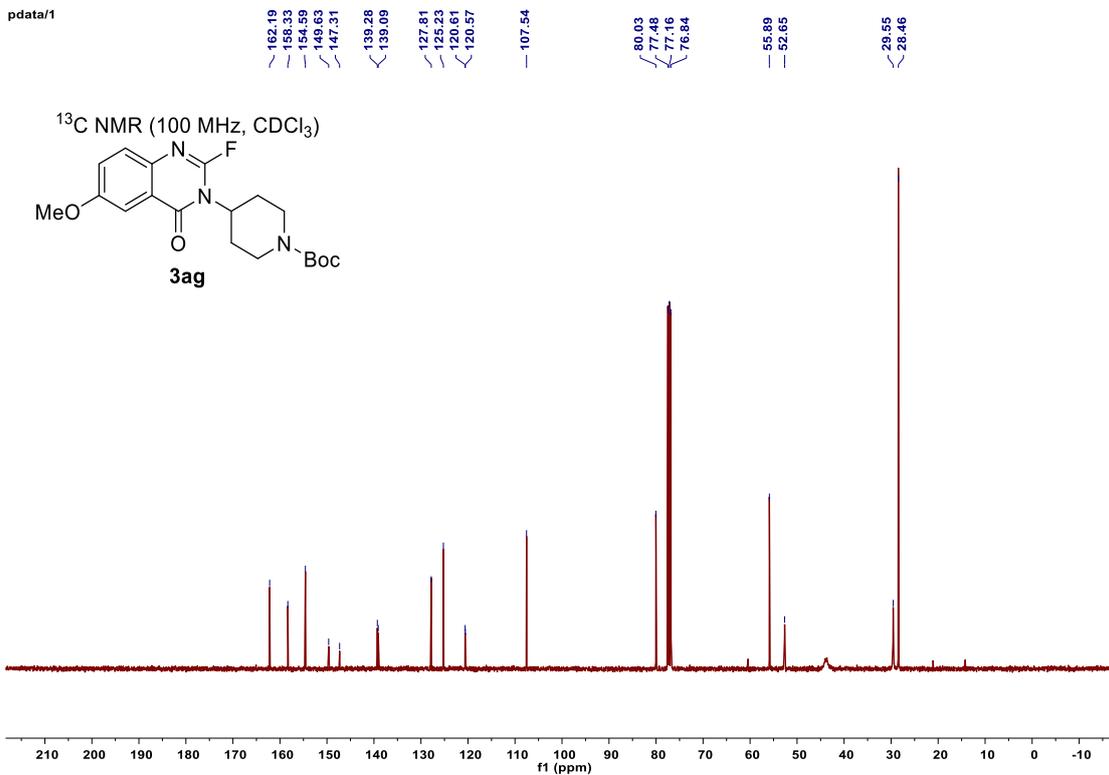
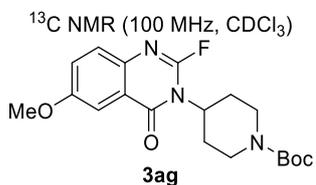




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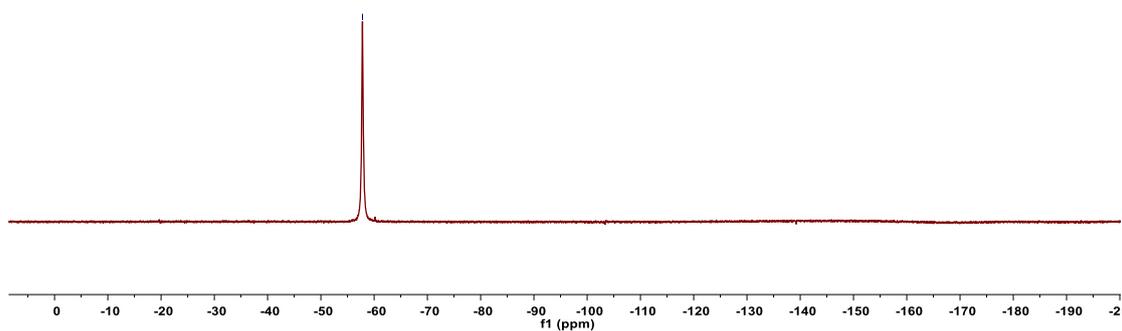
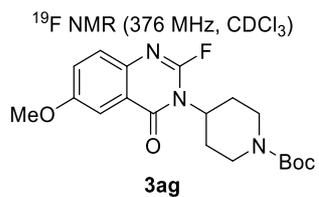
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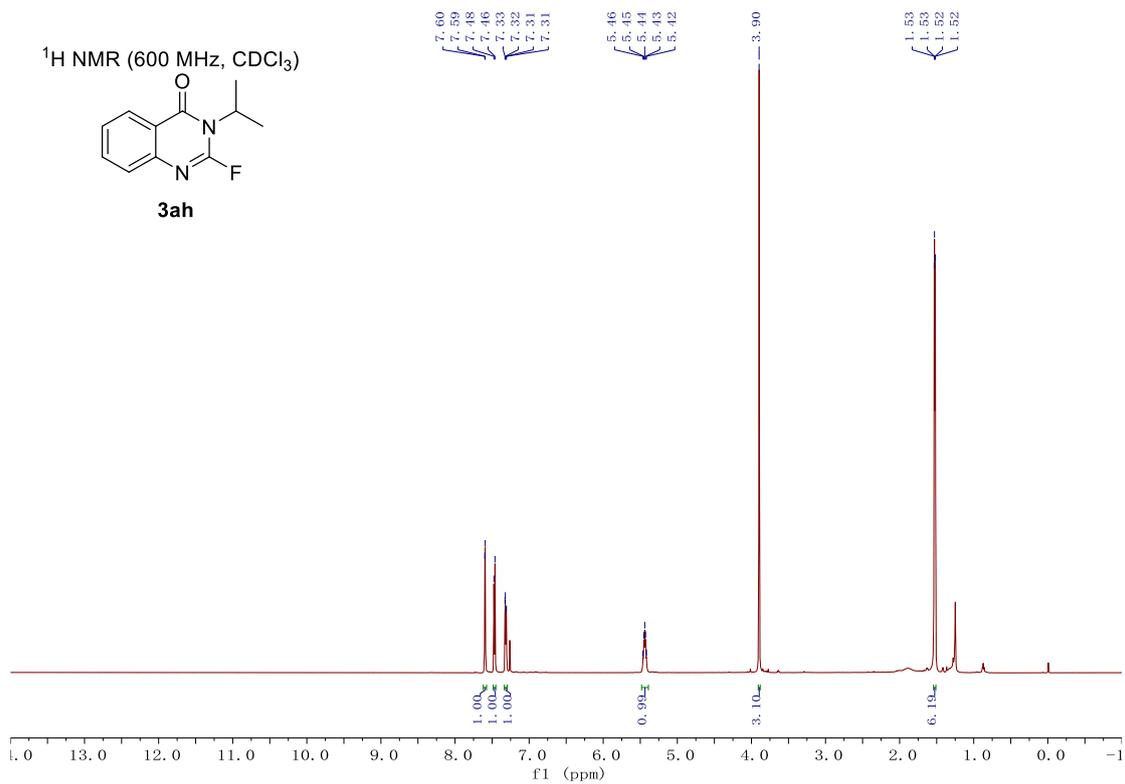
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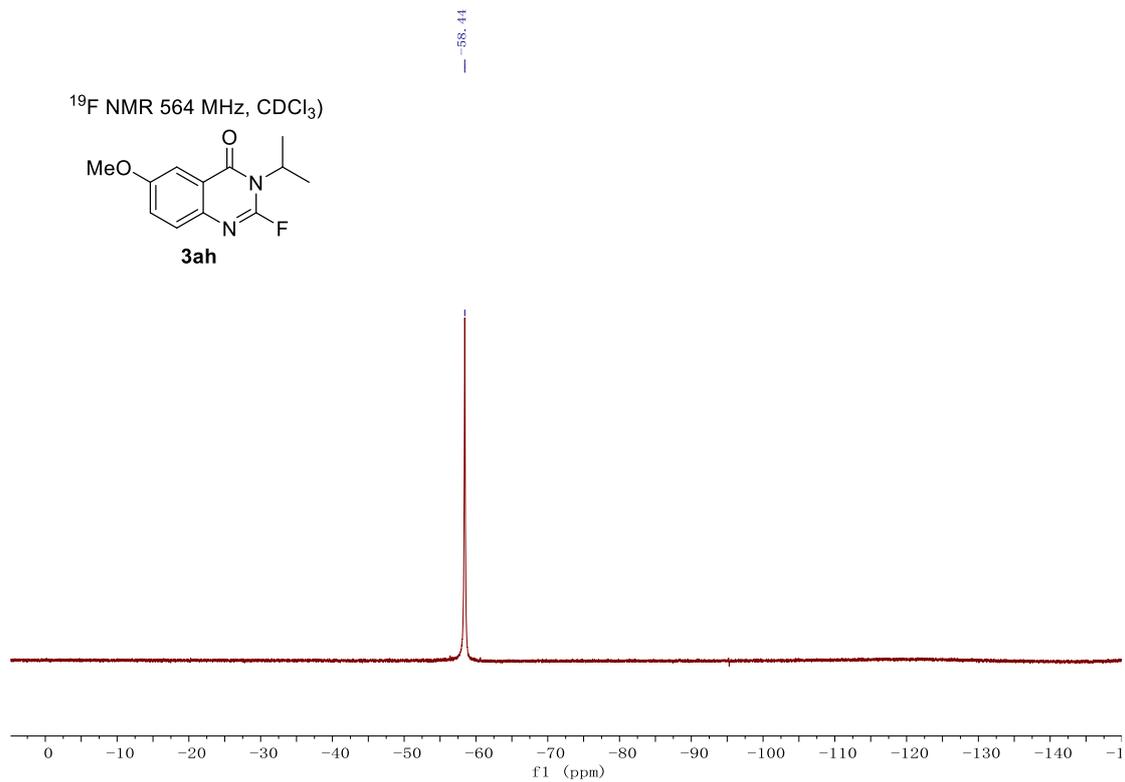
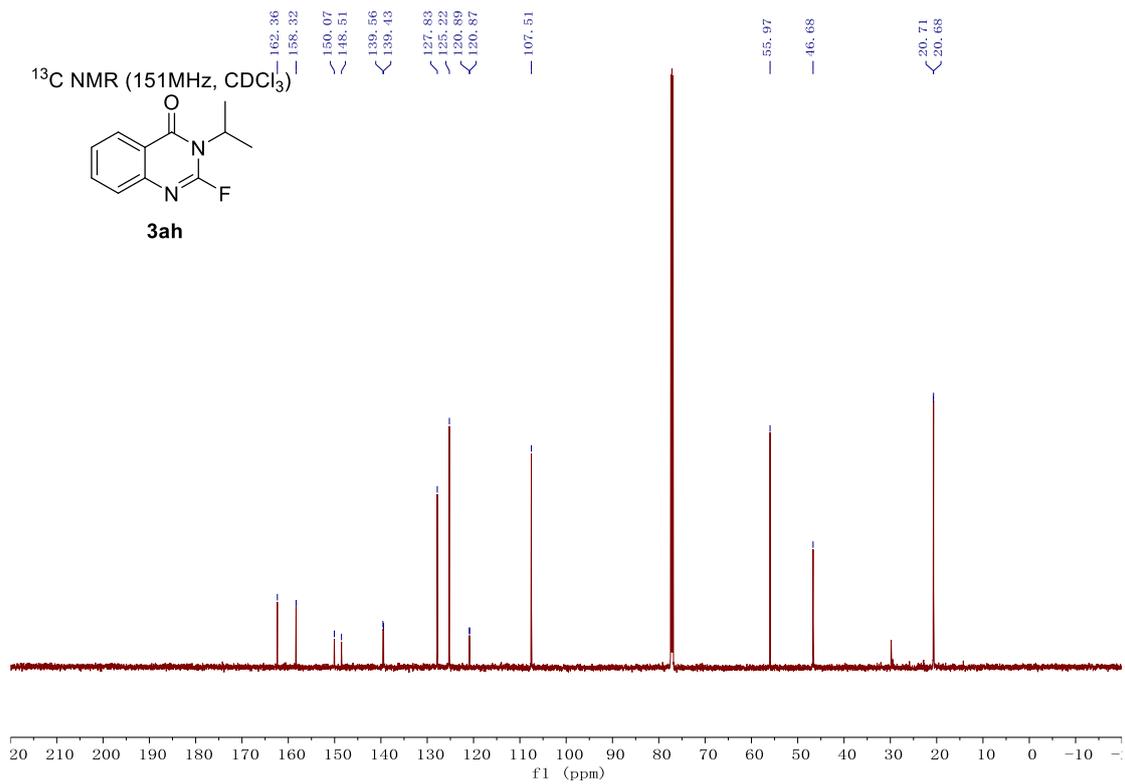
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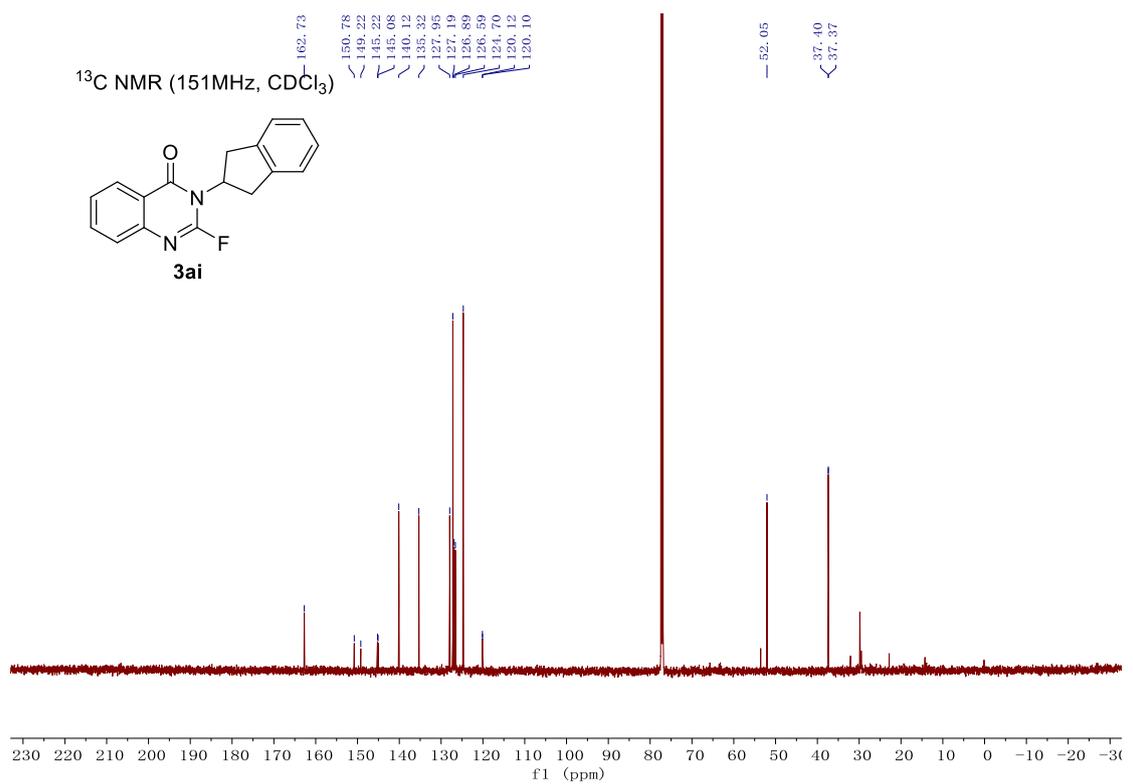
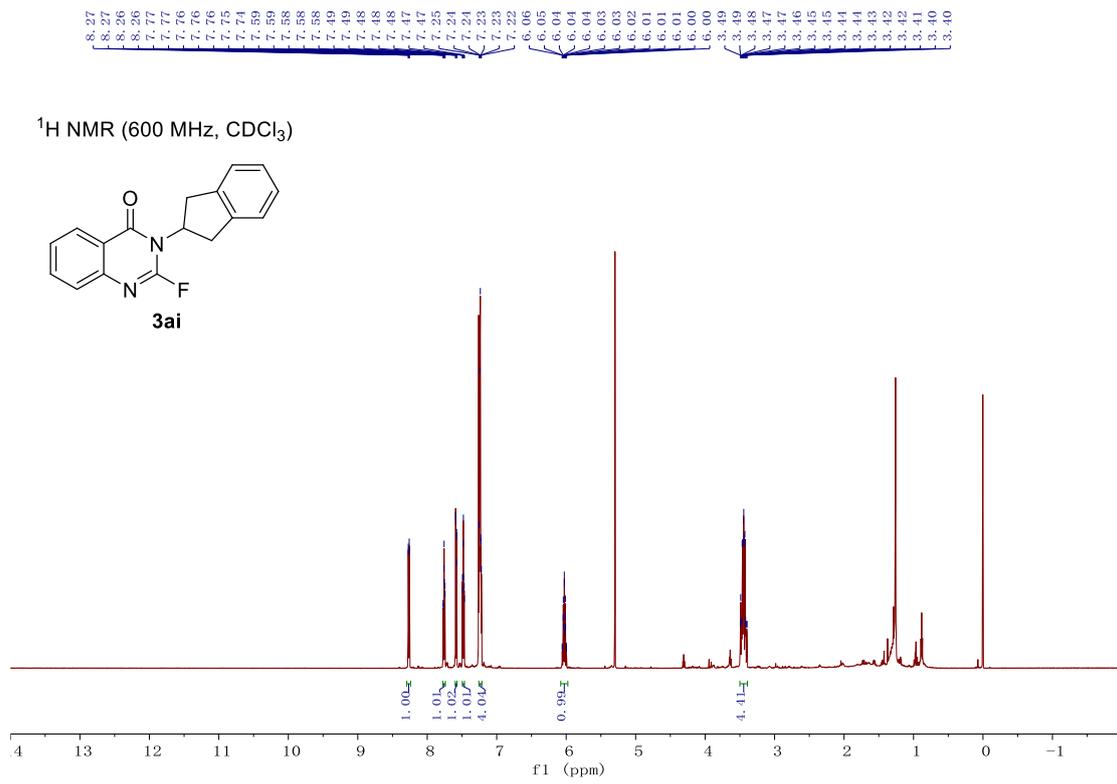
^{19}F NMR (376 MHz, CDCl_3)



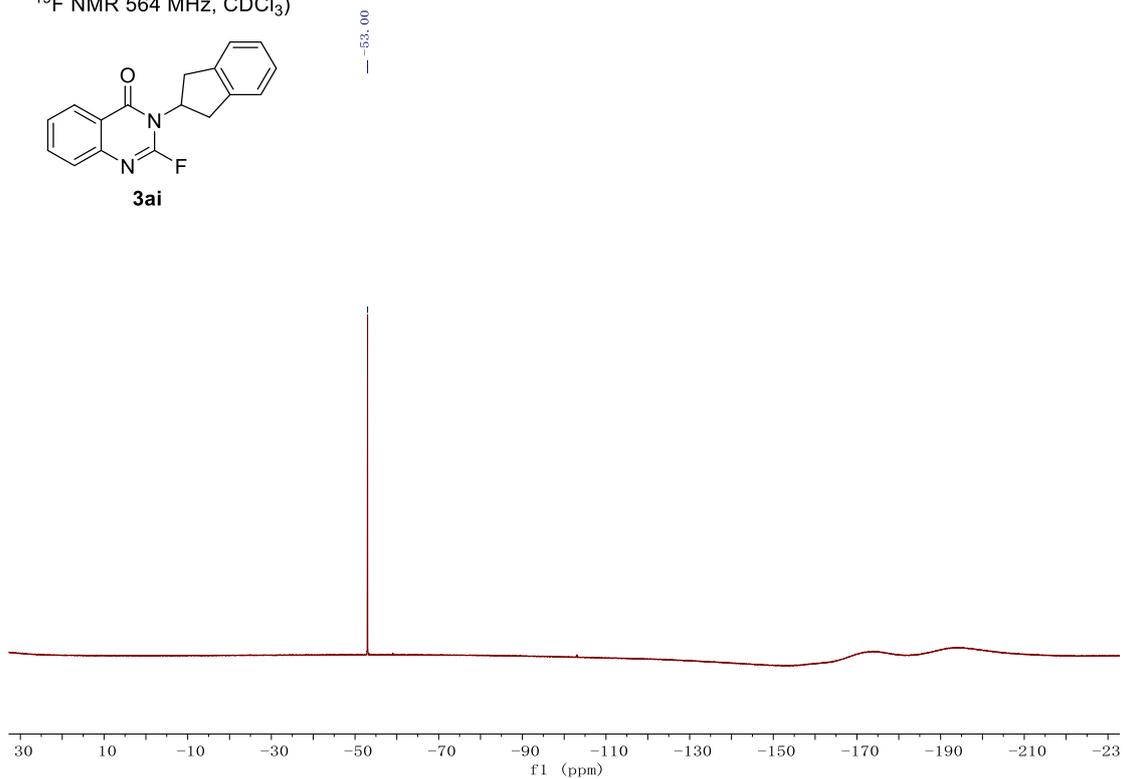
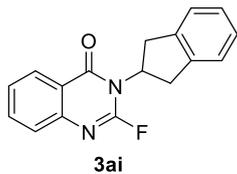
^1H NMR (600 MHz, CDCl_3)





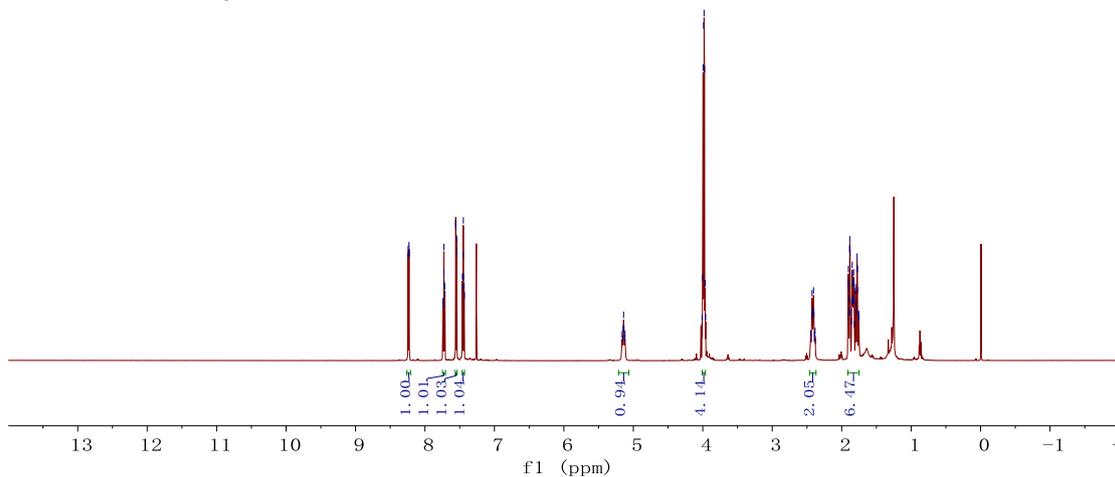
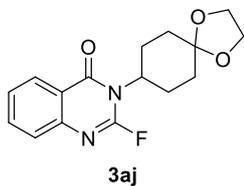


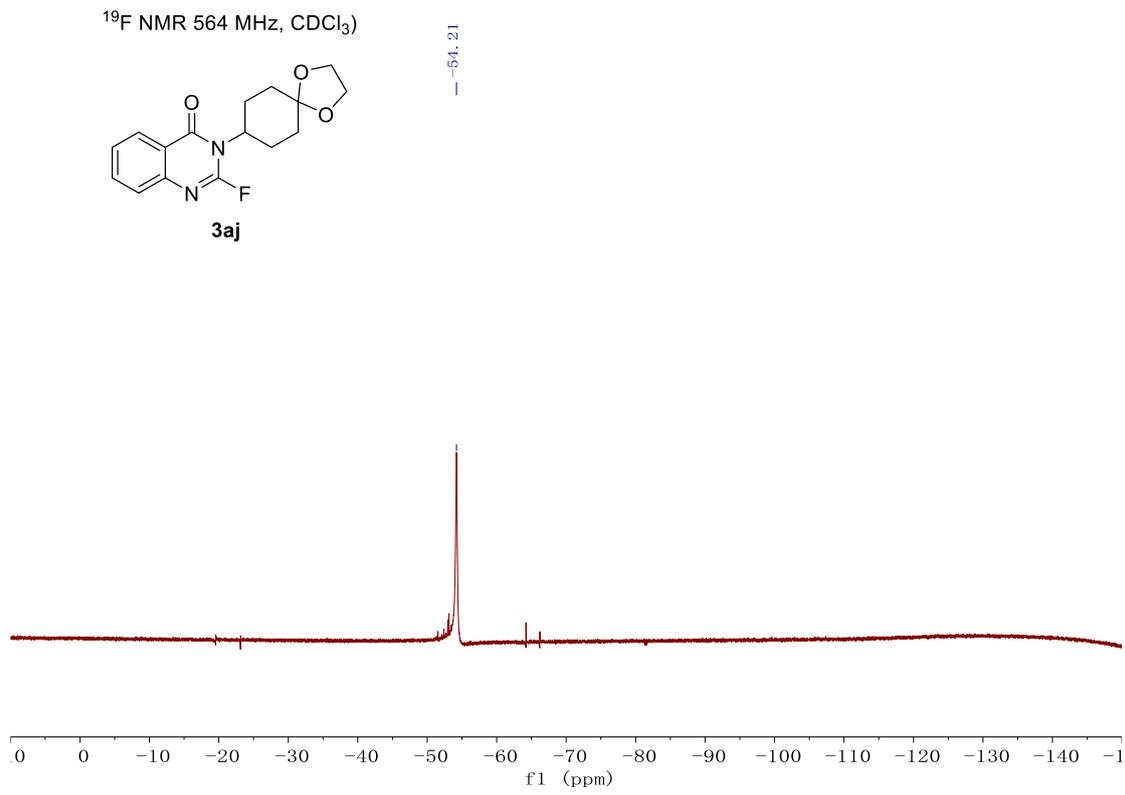
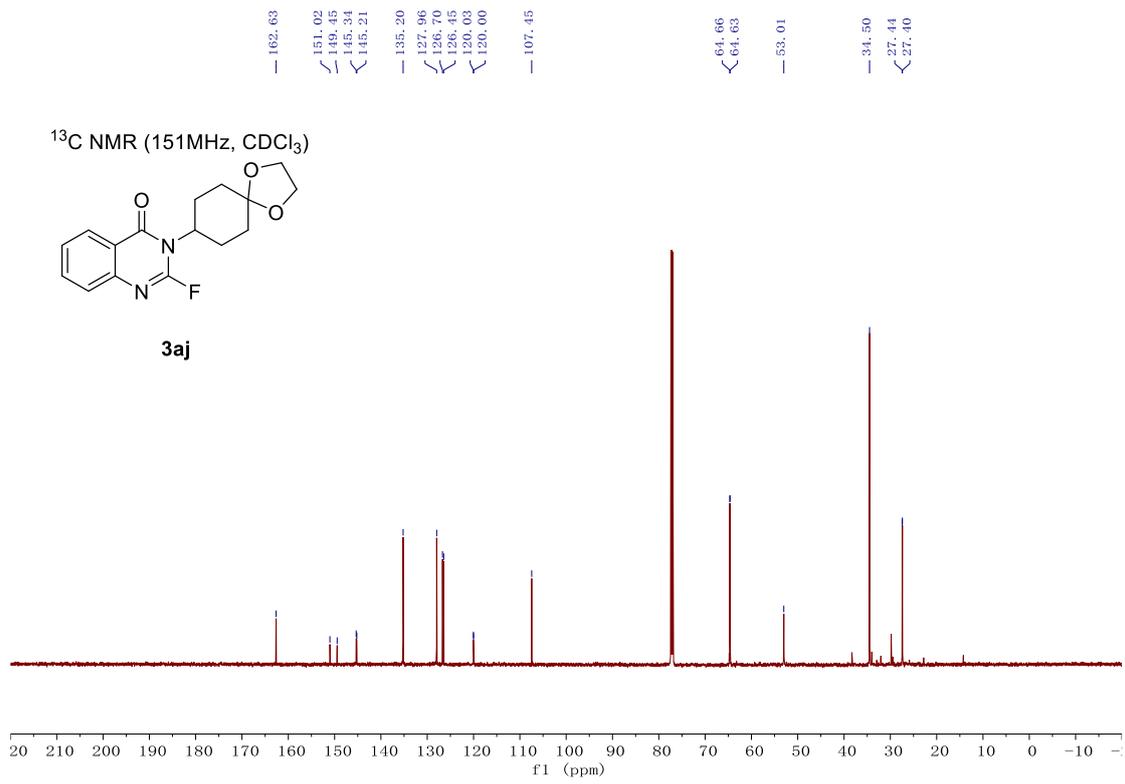
¹⁹F NMR 564 MHz, CDCl₃)

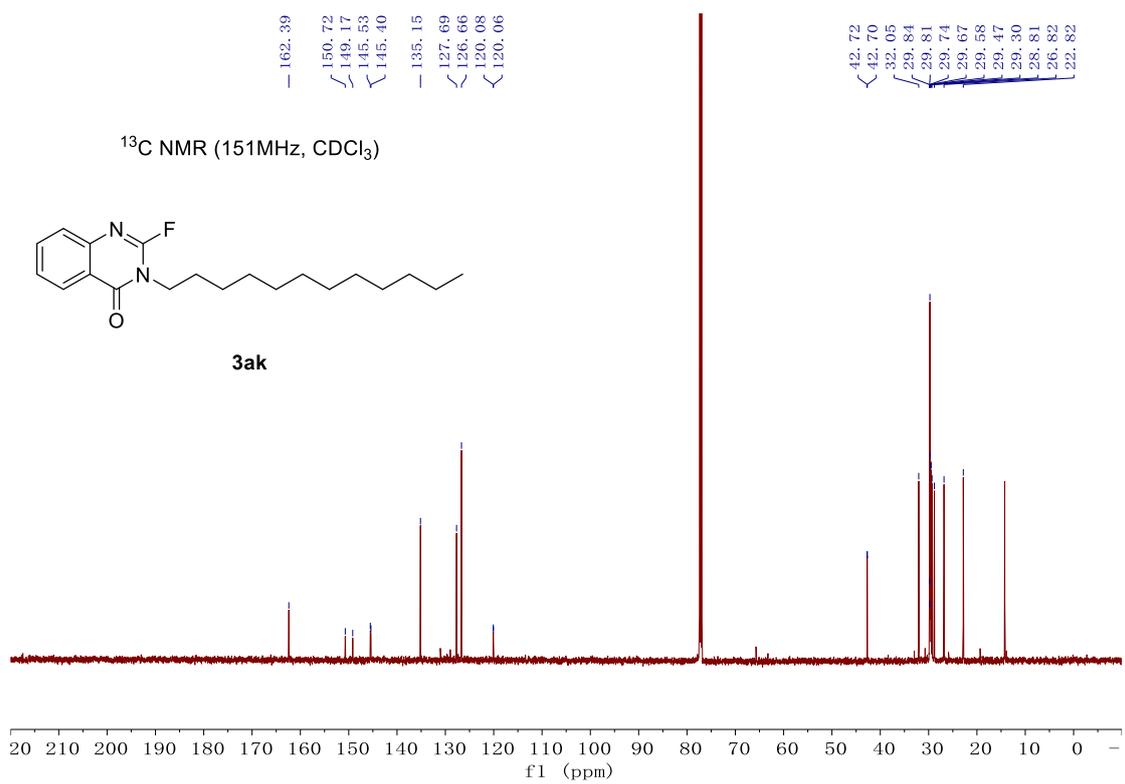
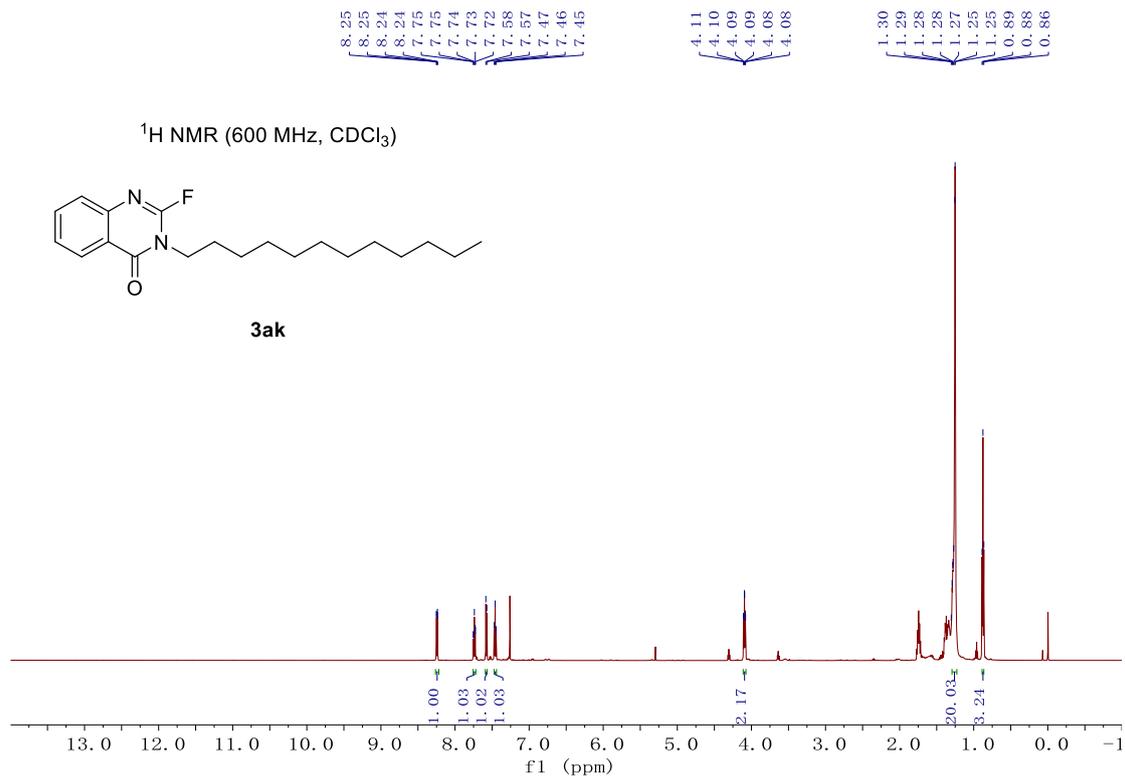


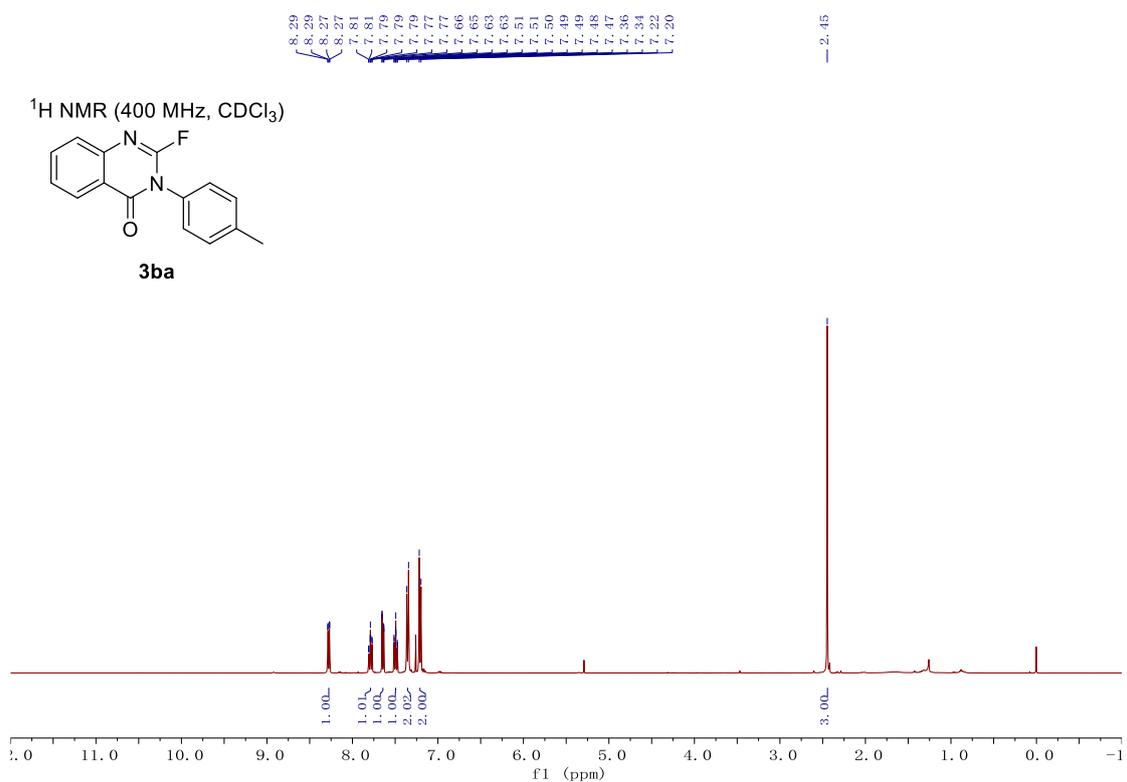
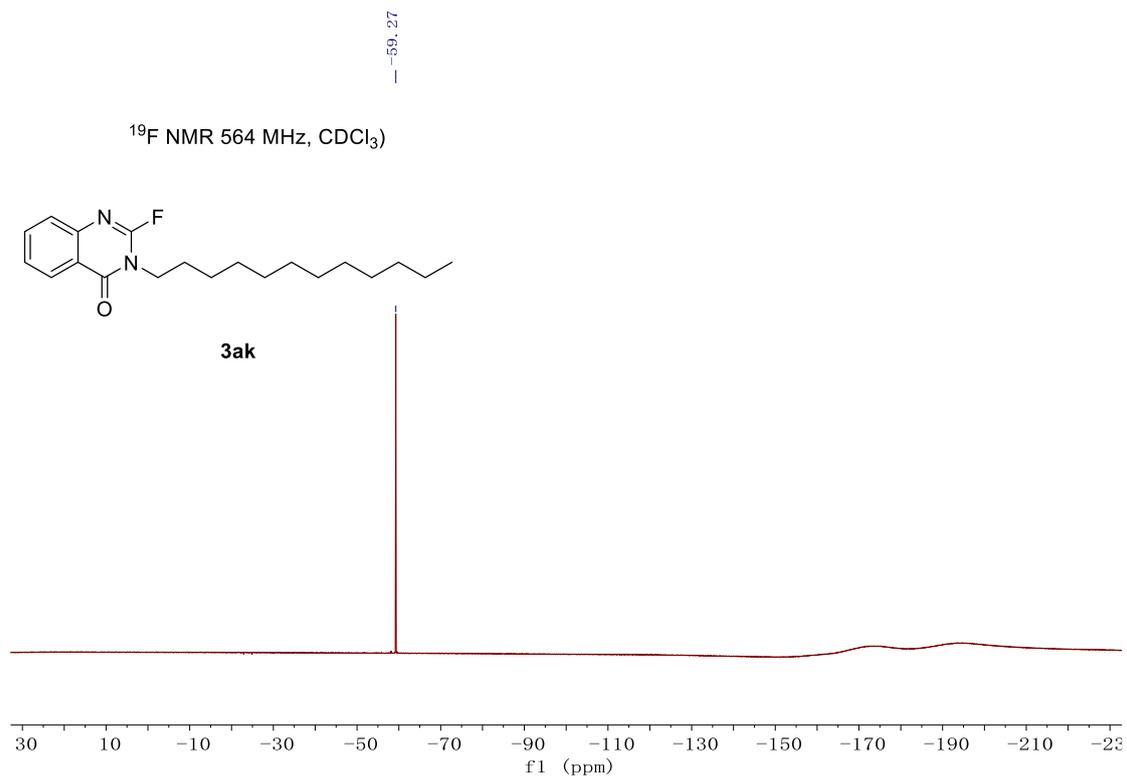
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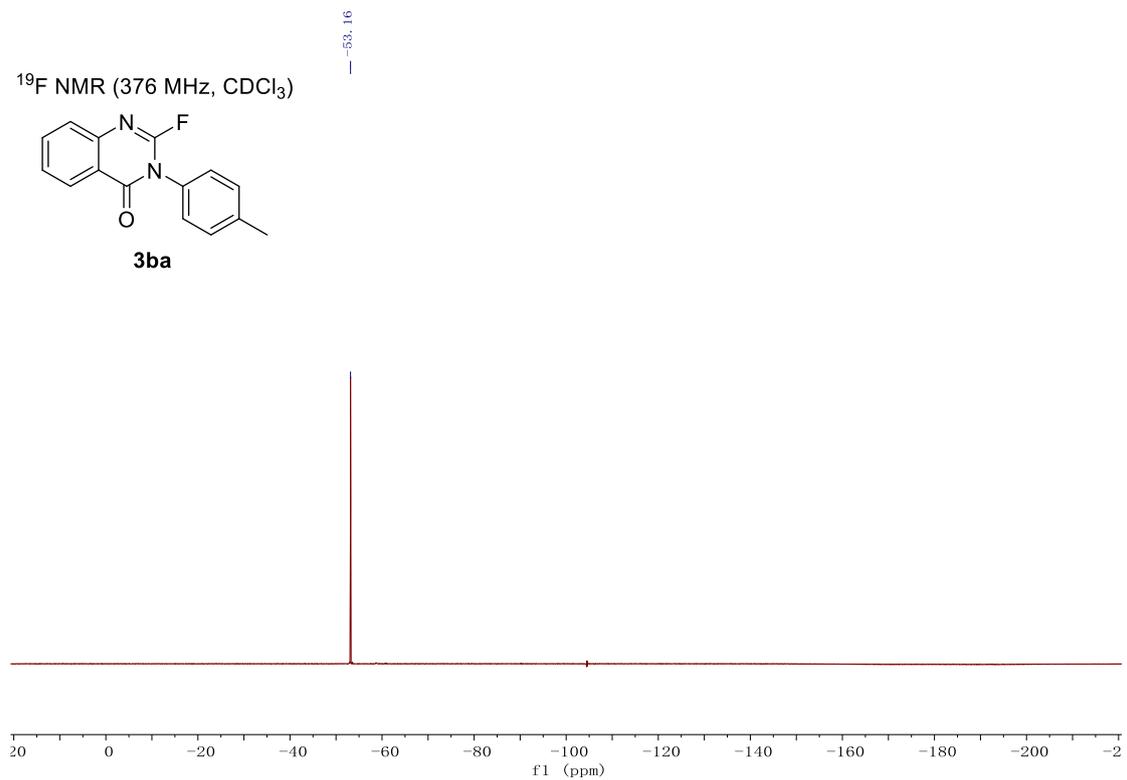
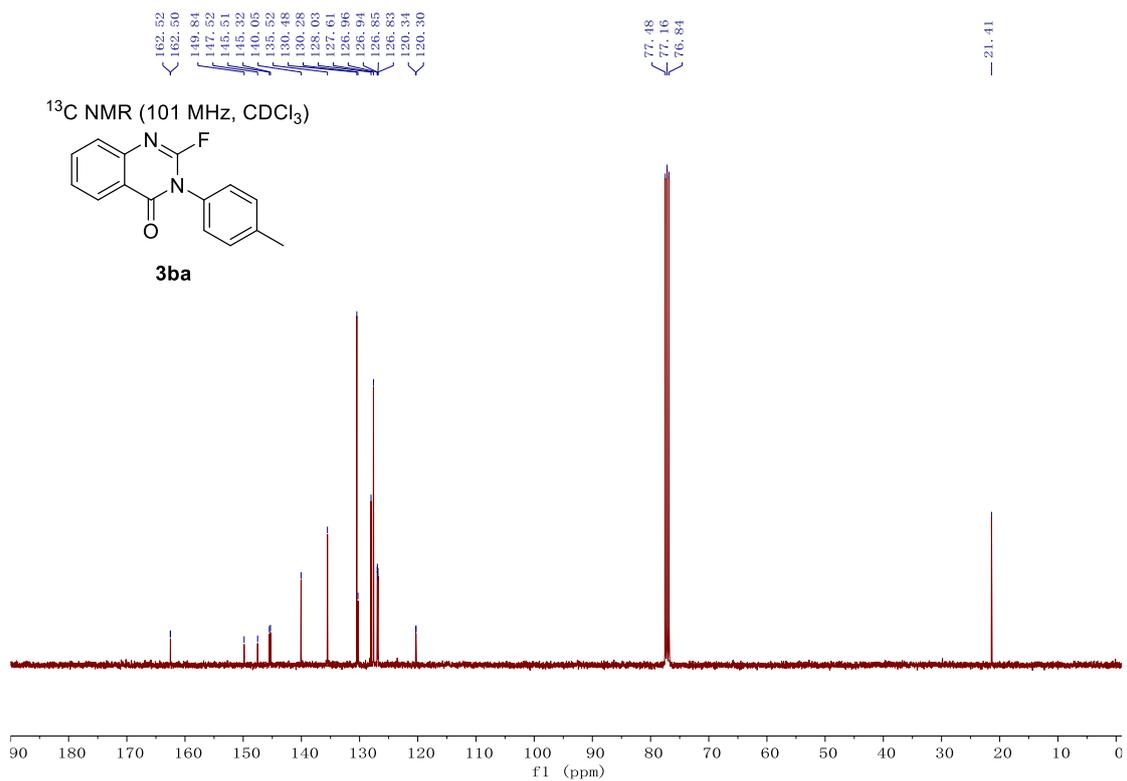
¹H NMR (600 MHz, CDCl₃)

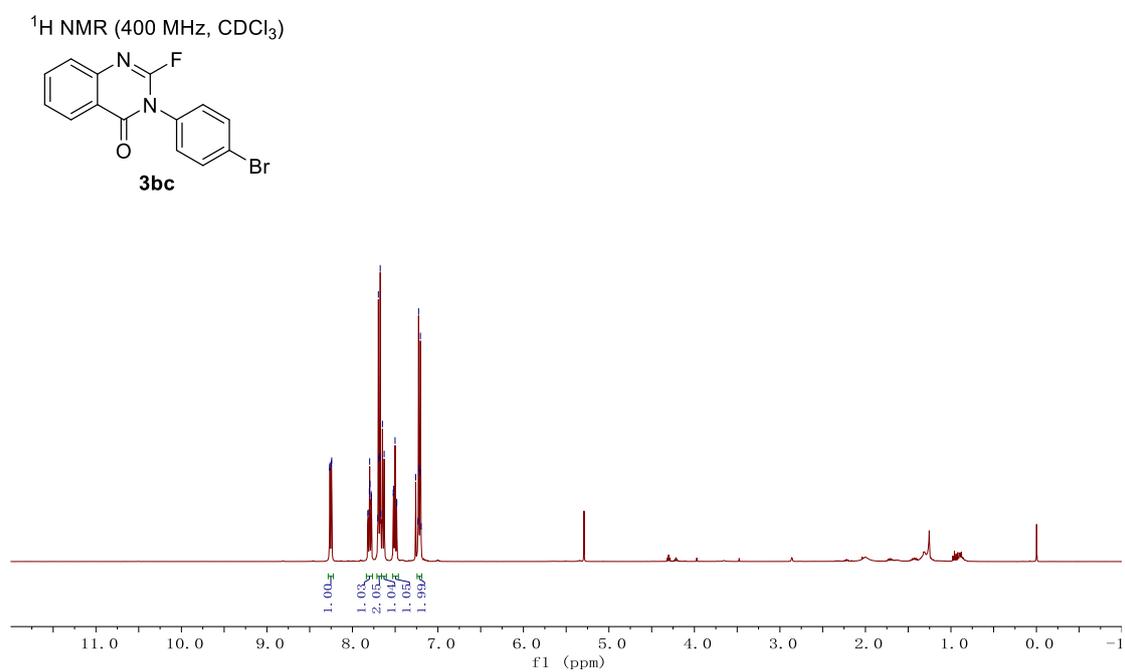
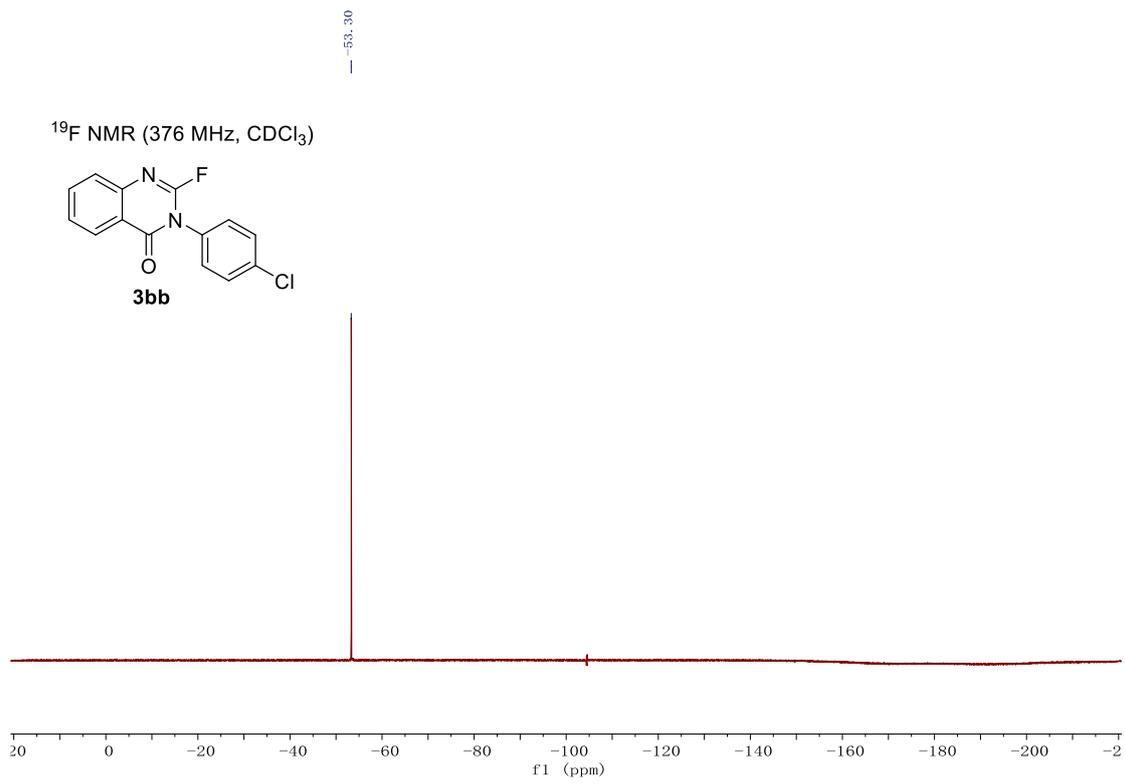


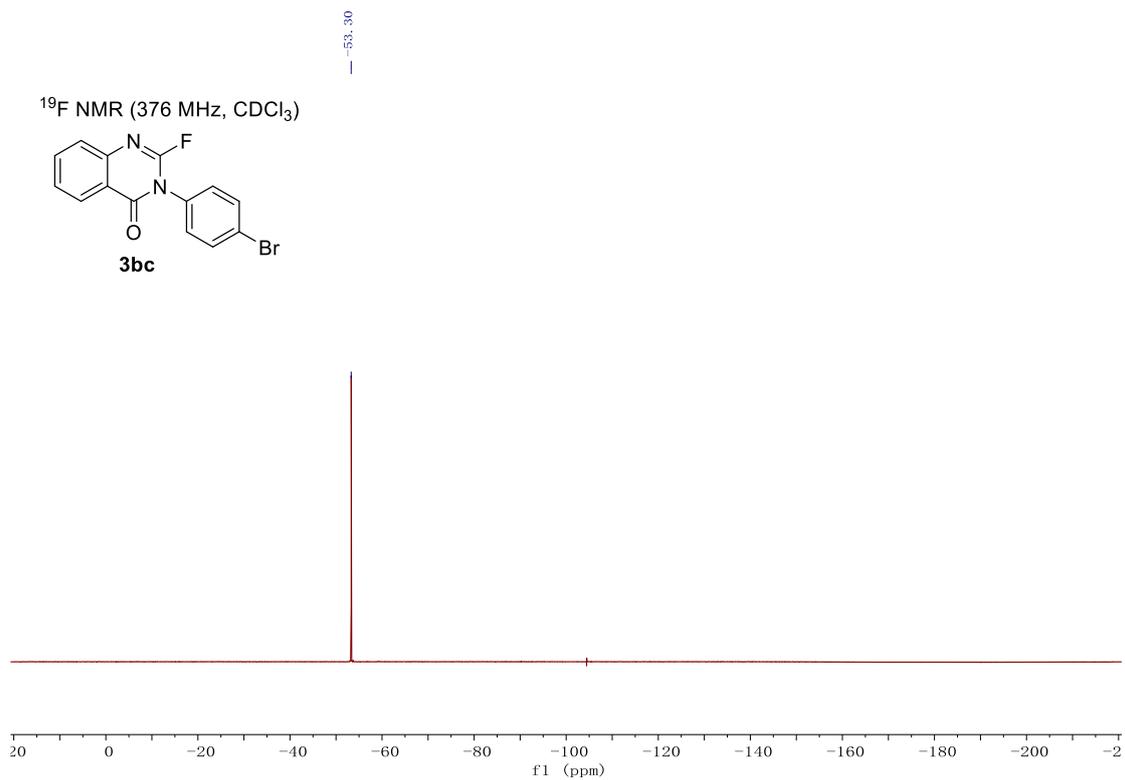
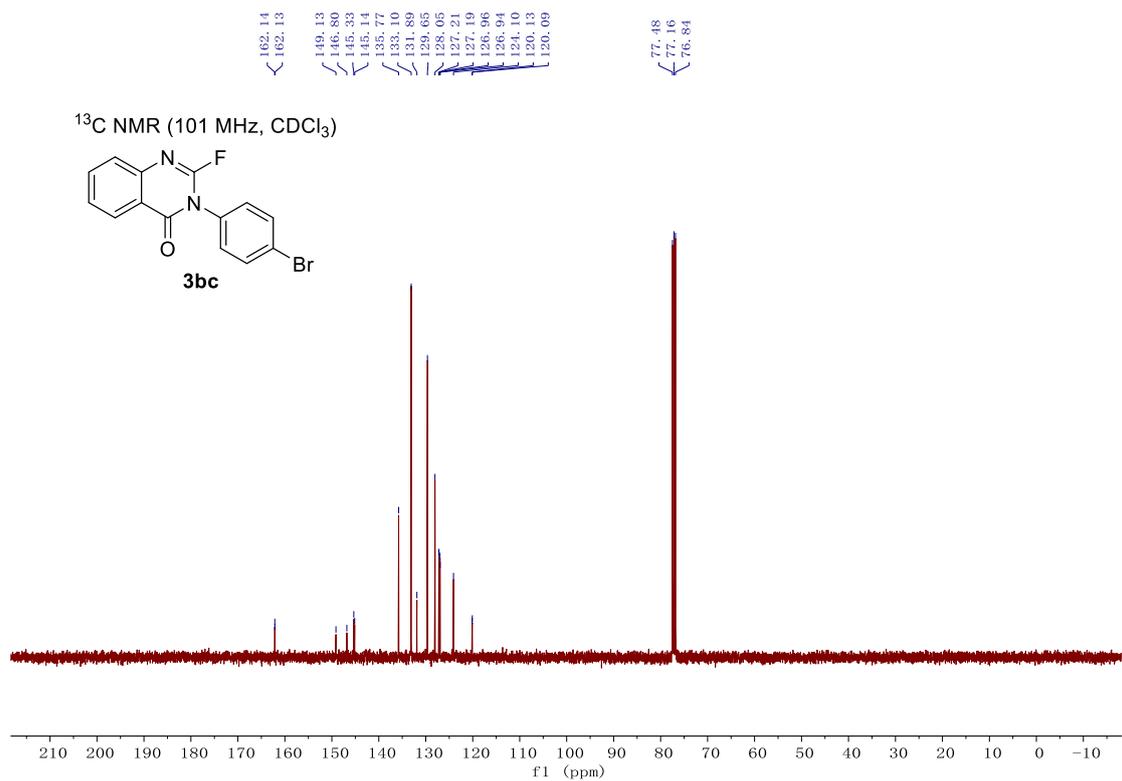




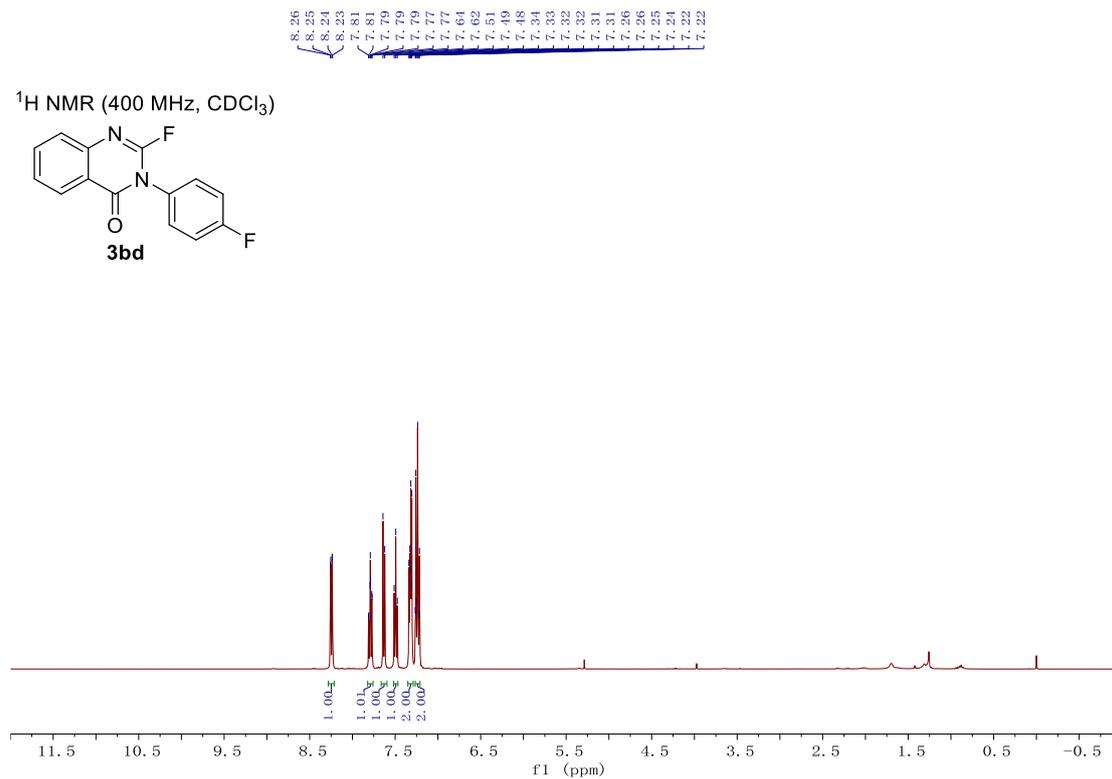
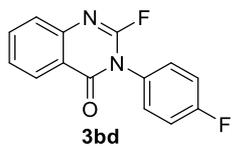




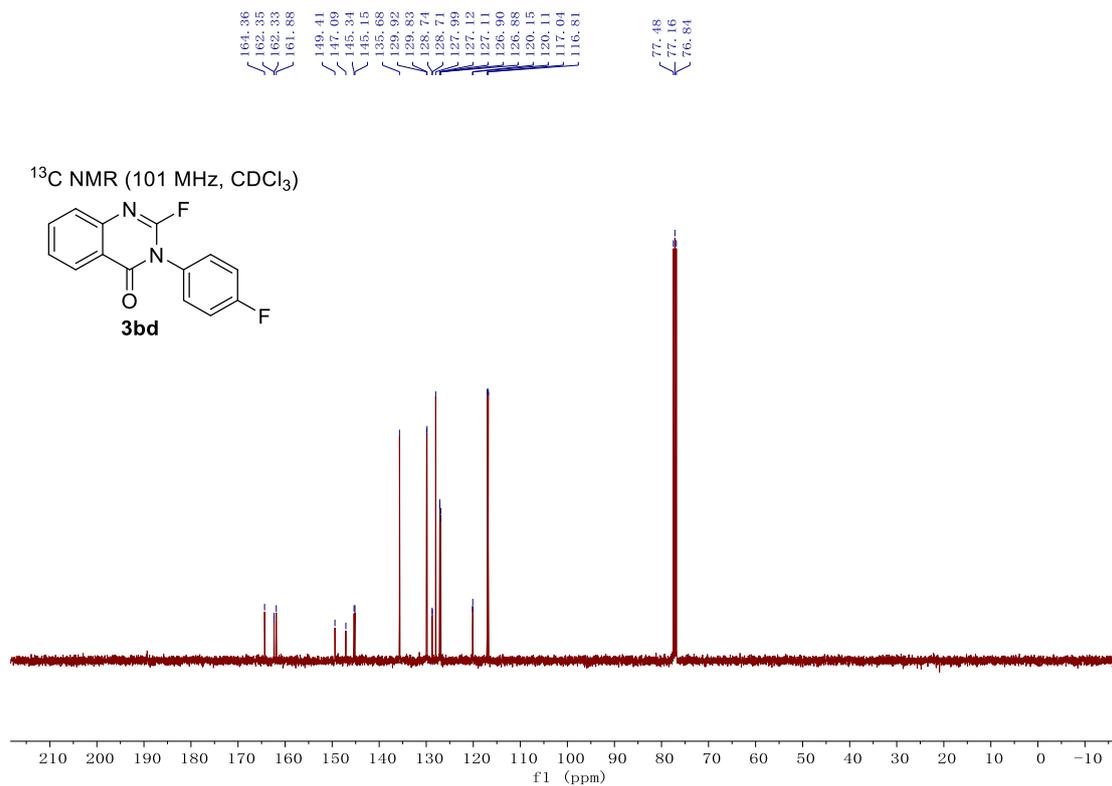


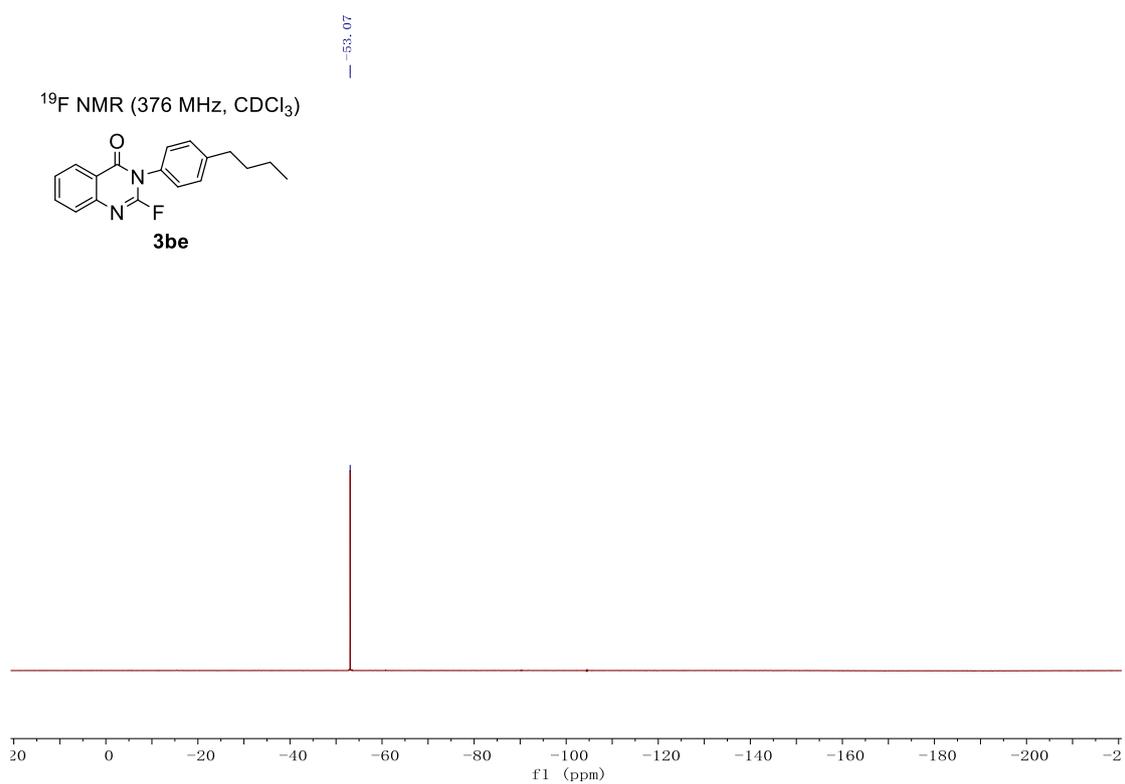
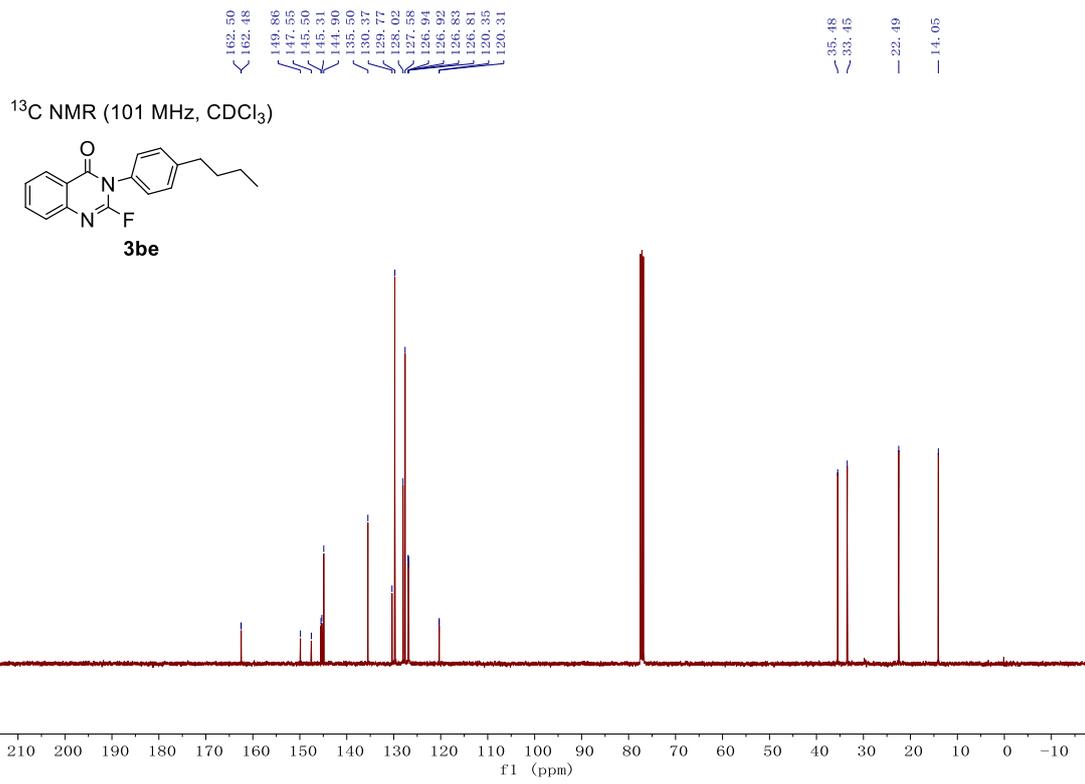


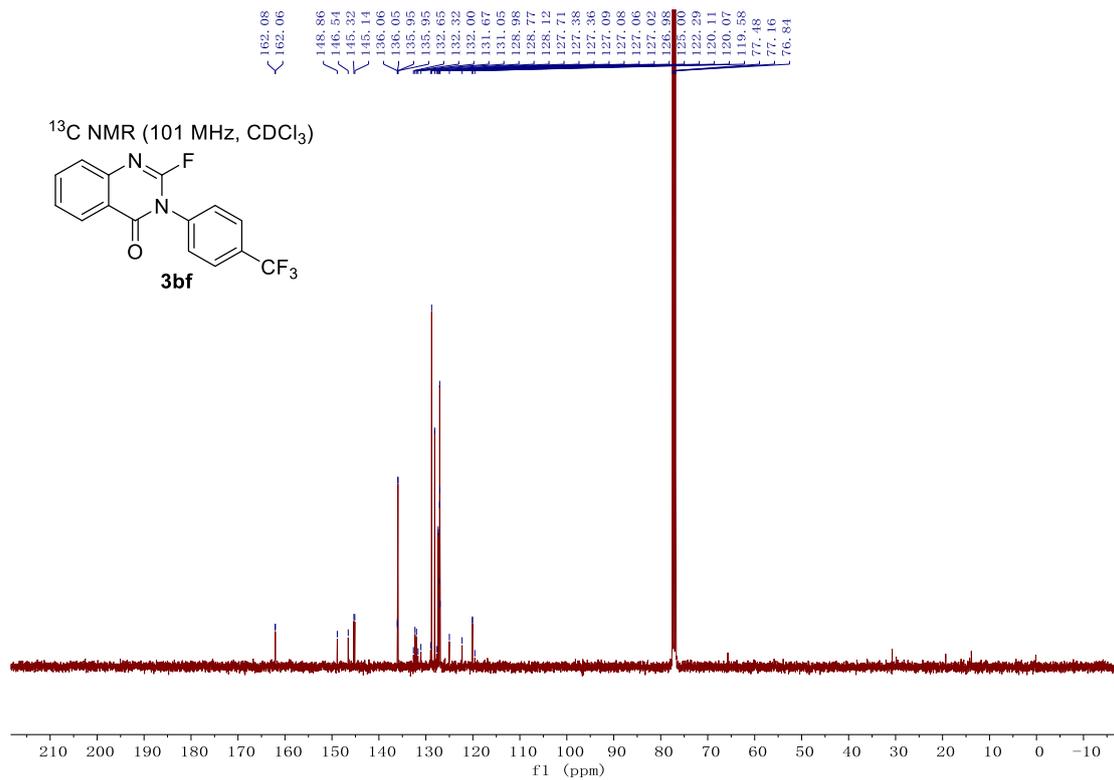
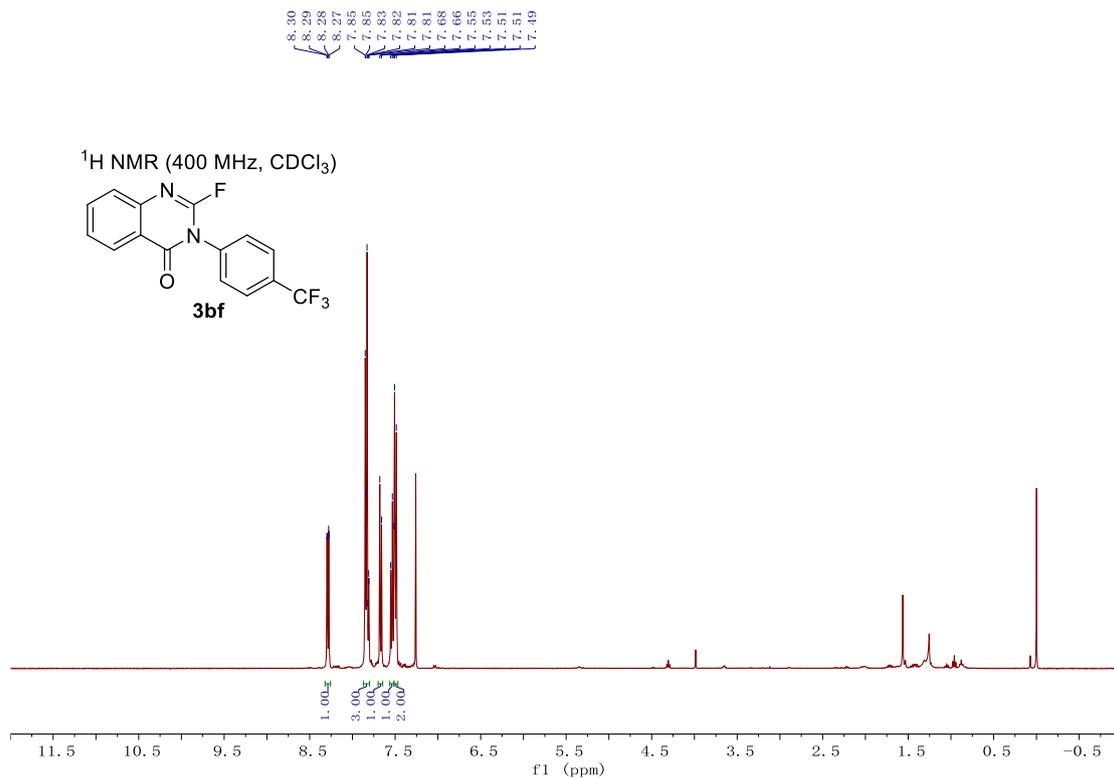
¹H NMR (400 MHz, CDCl₃)

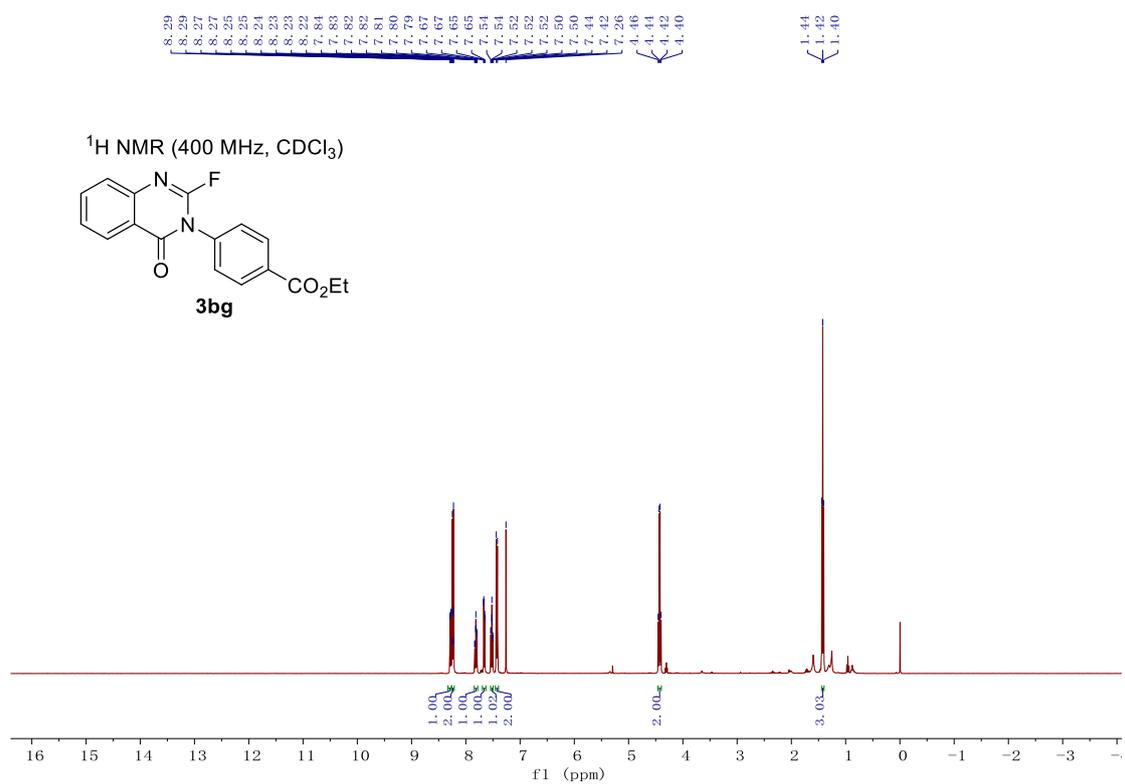
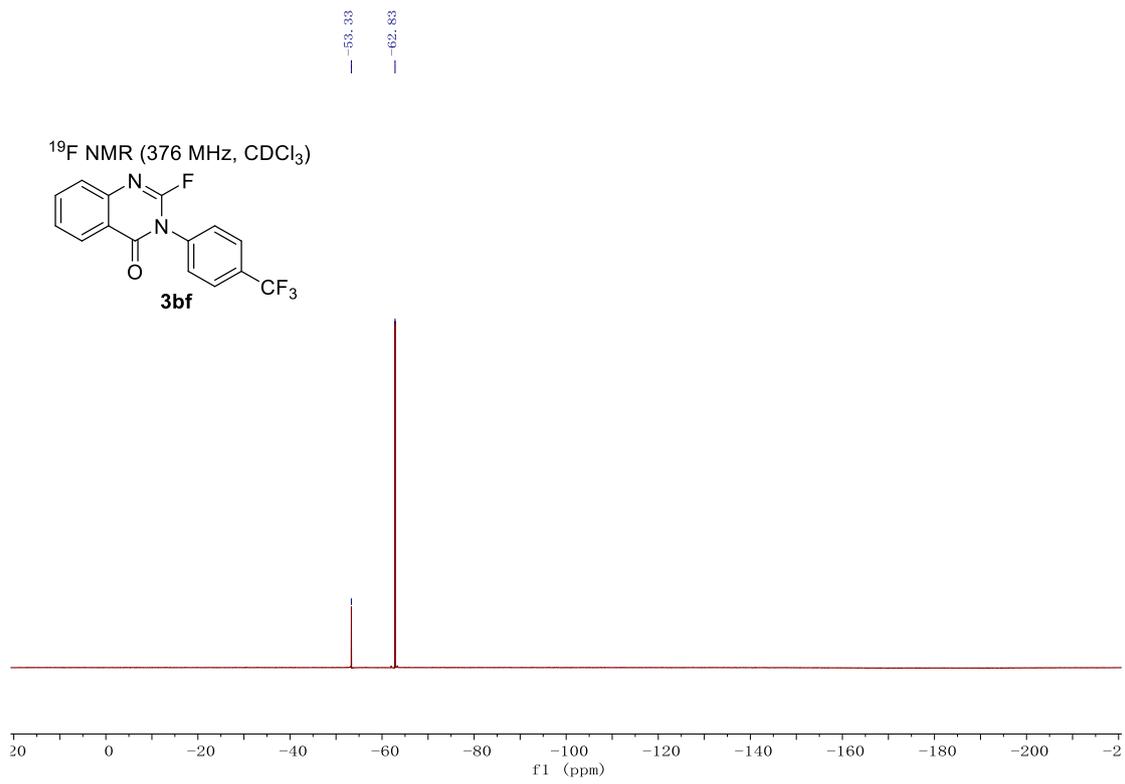


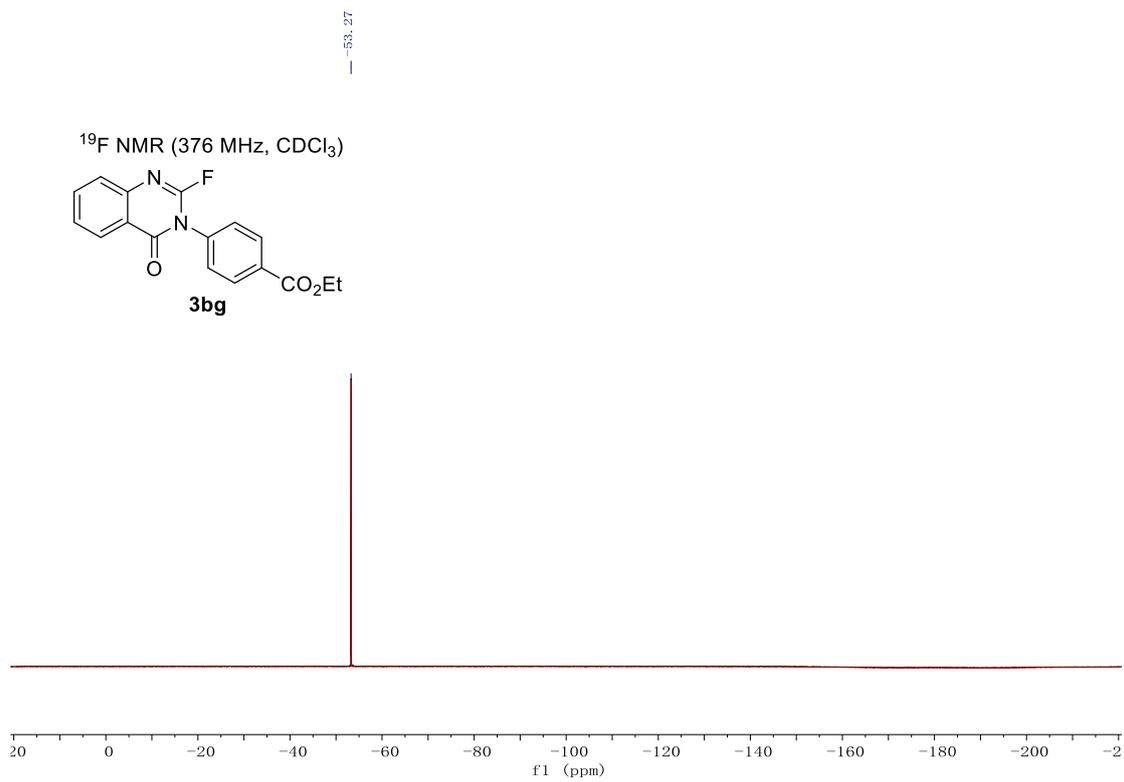
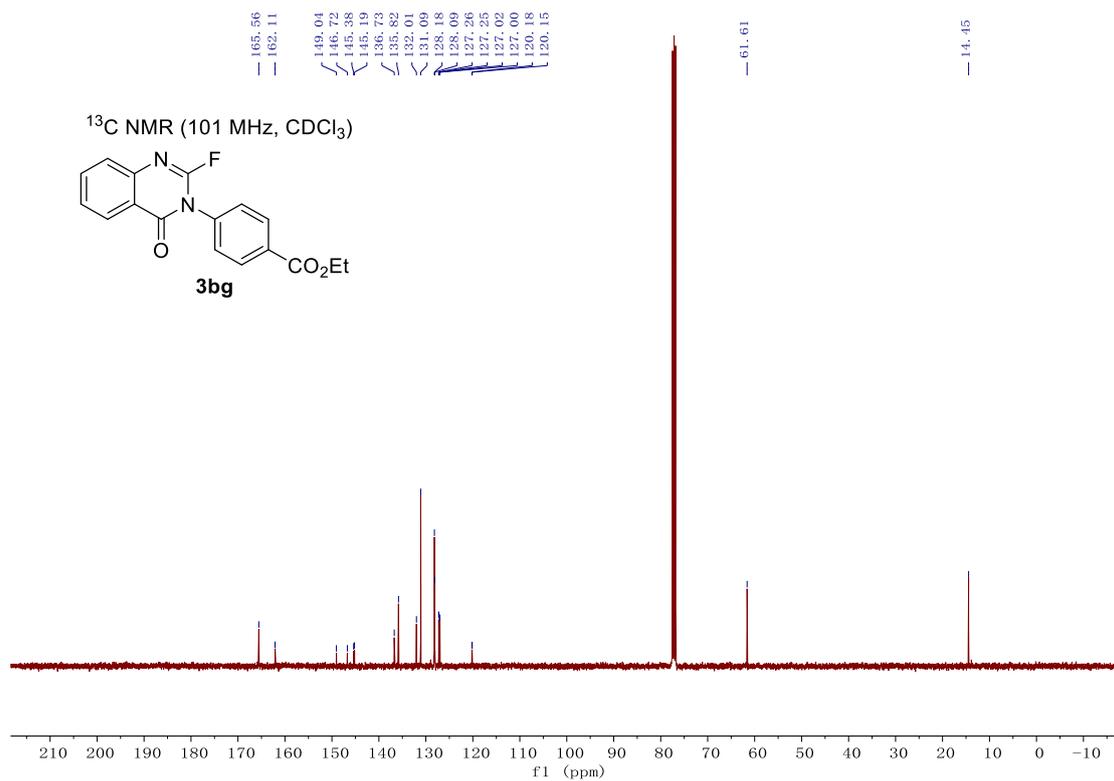
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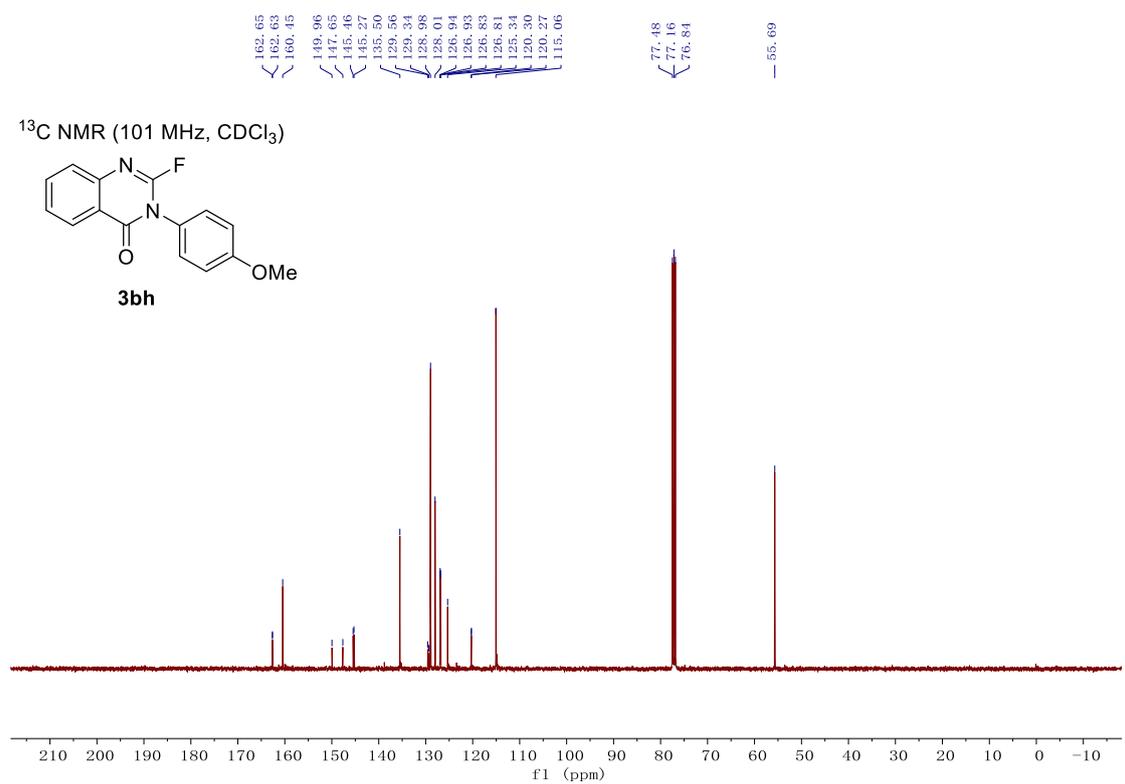
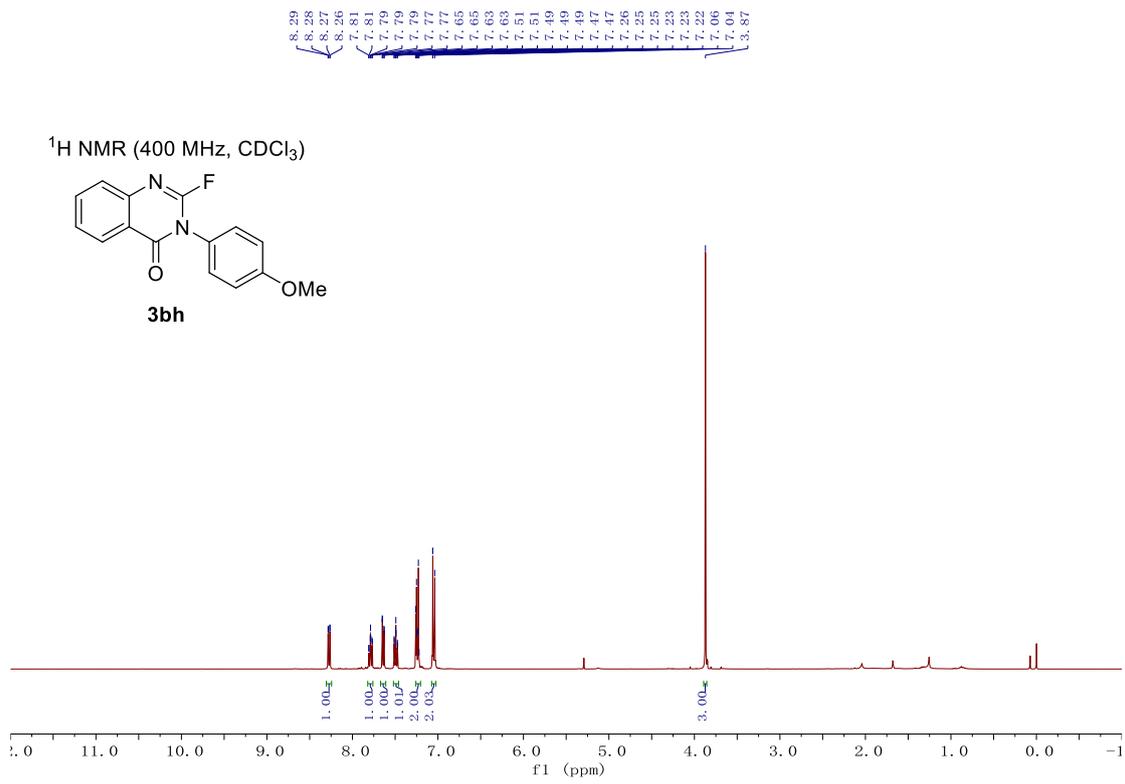




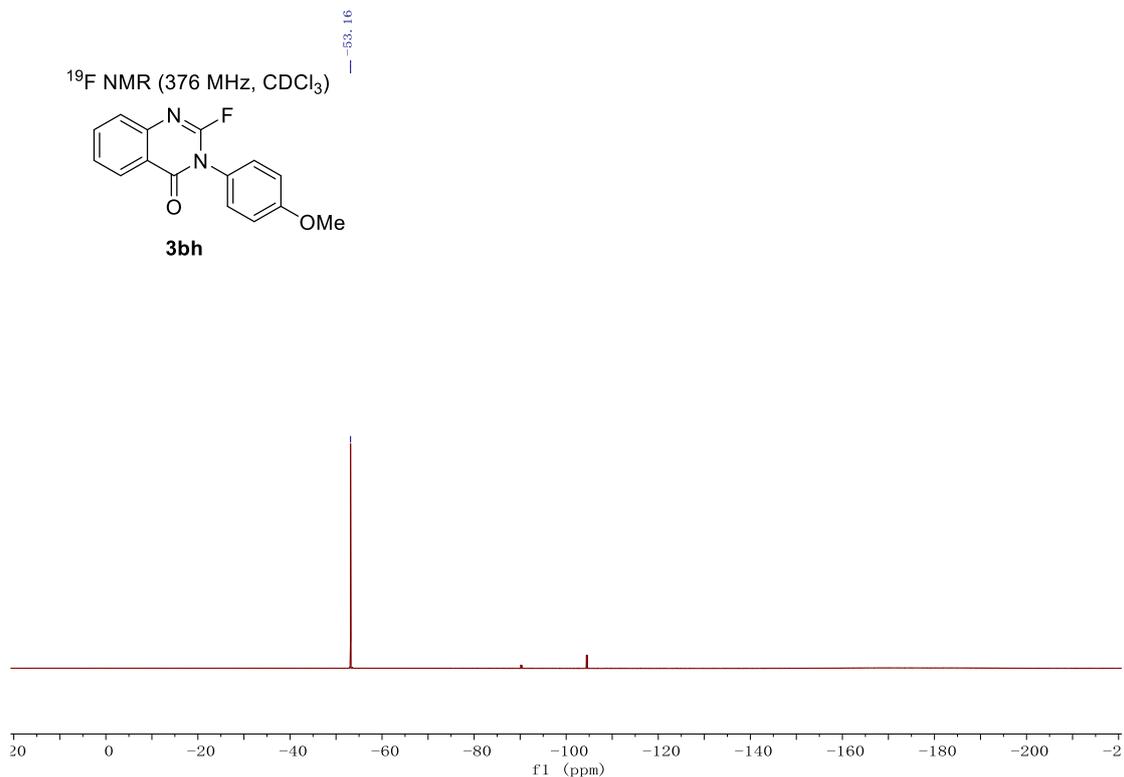
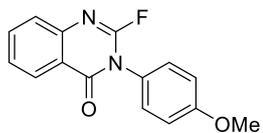






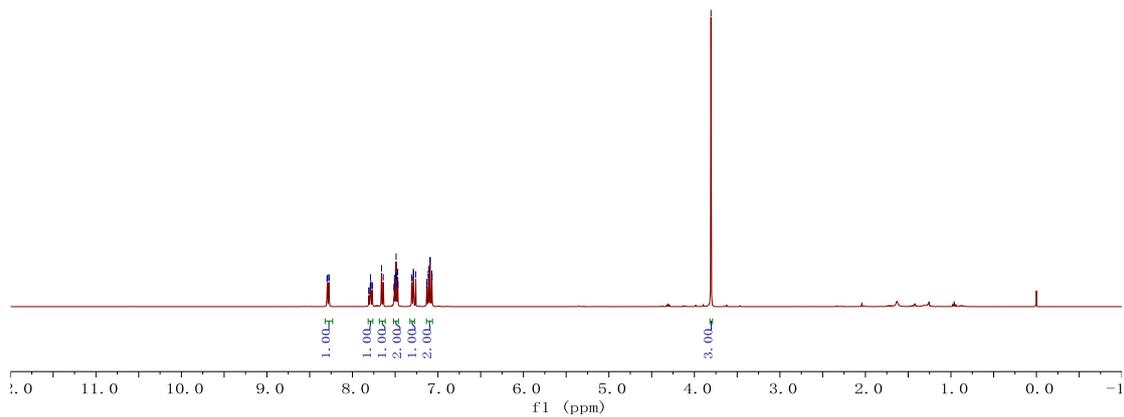
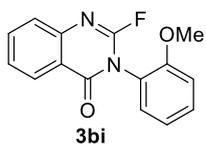


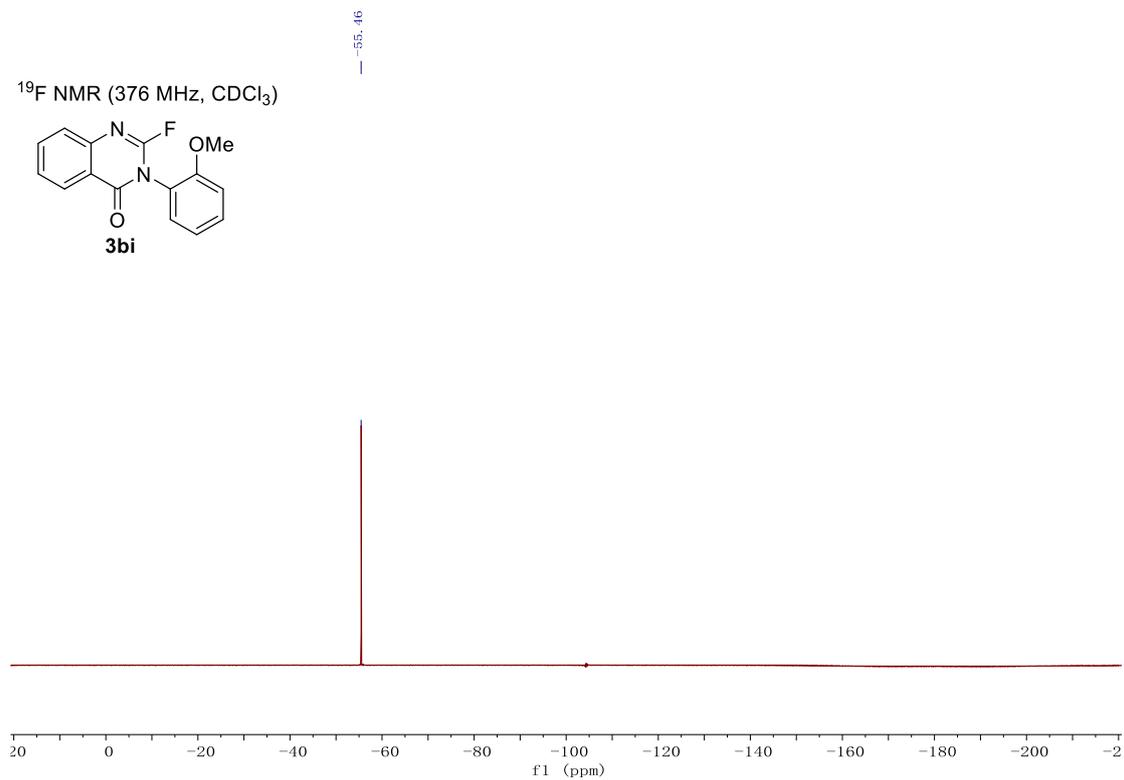
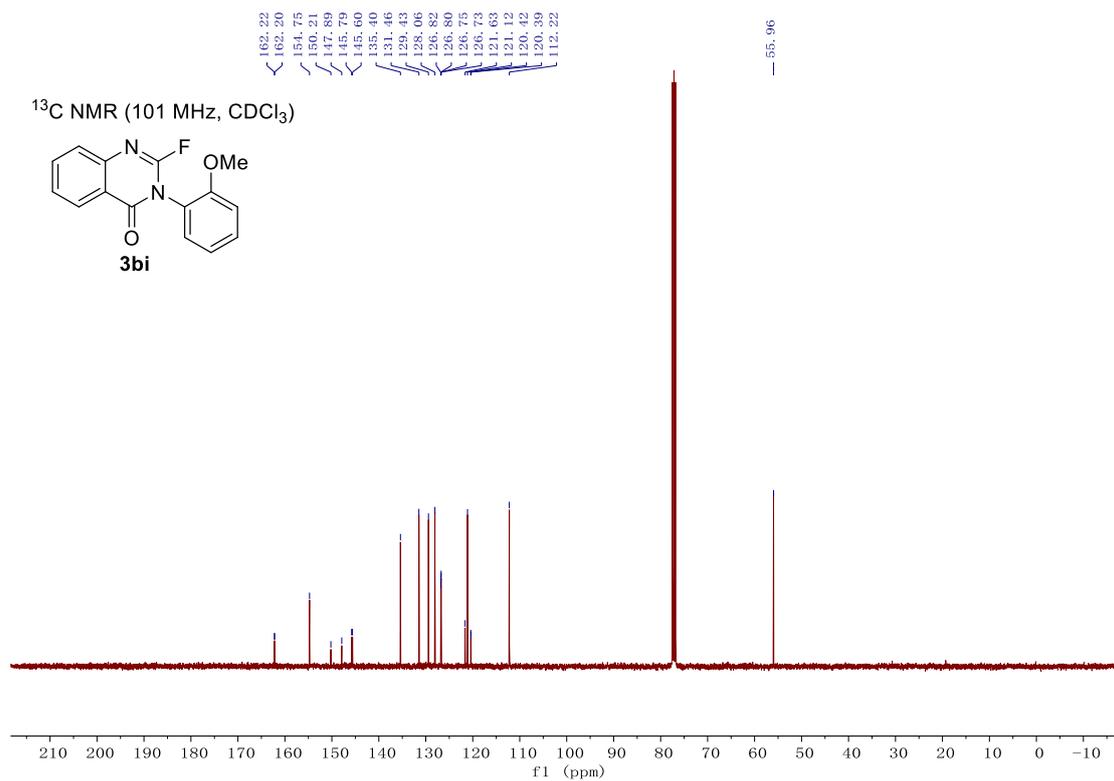
¹⁹F NMR (376 MHz, CDCl₃)



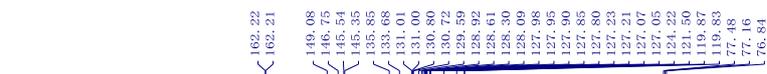
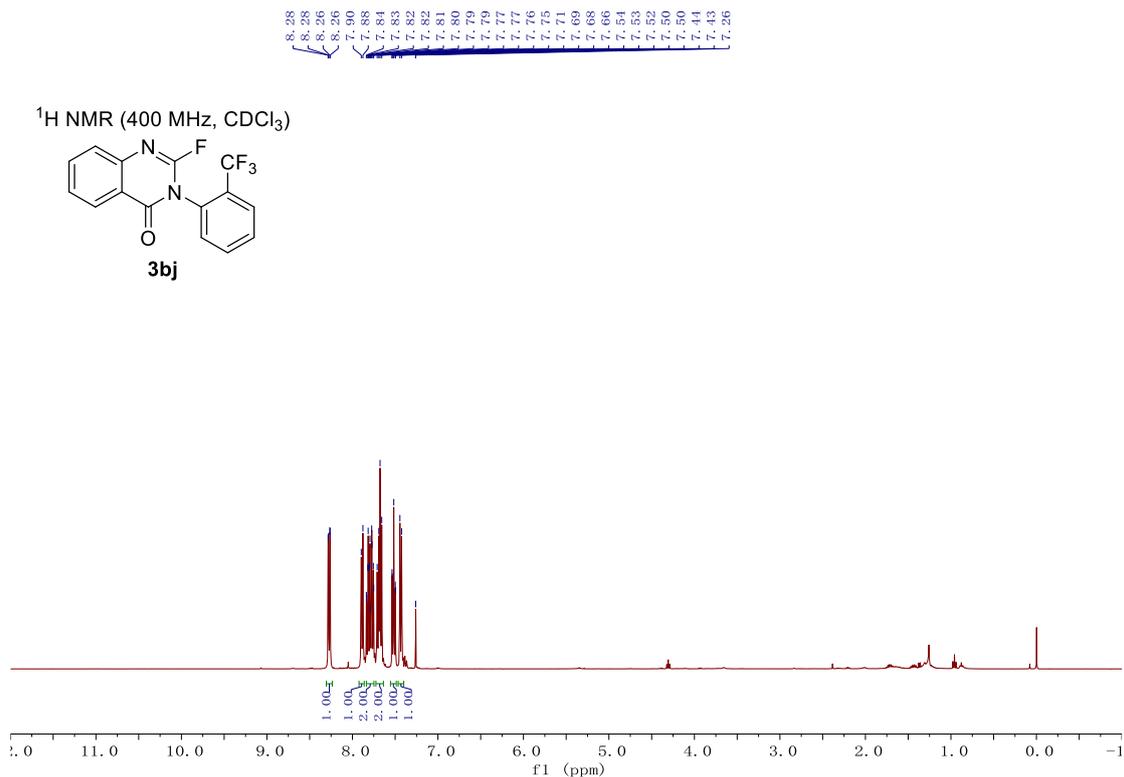
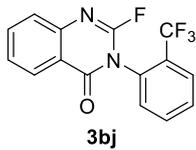
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¹H NMR (400 MHz, CDCl₃)

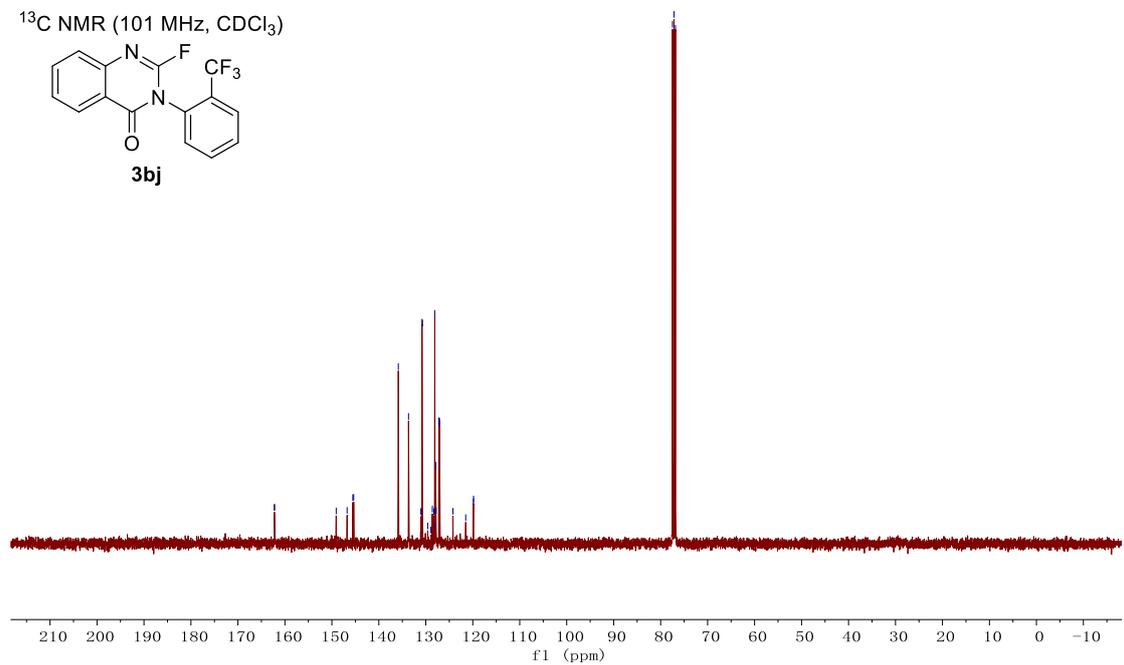
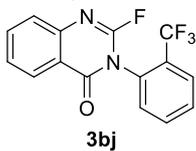


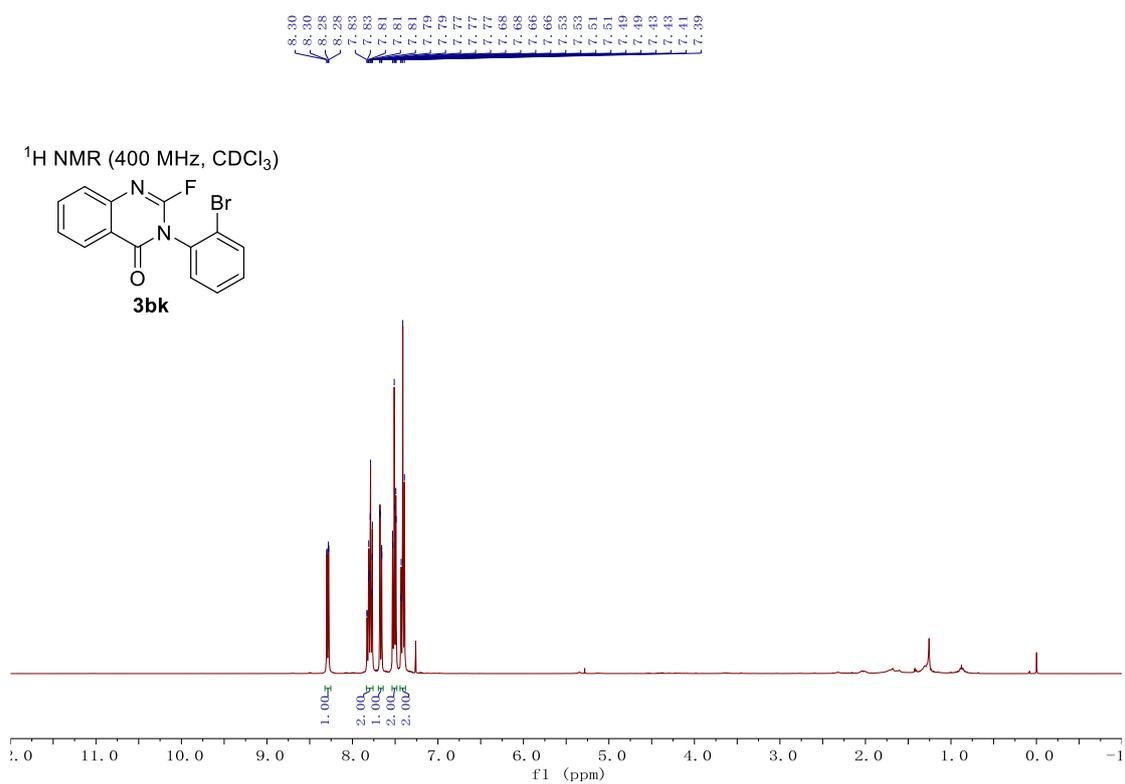
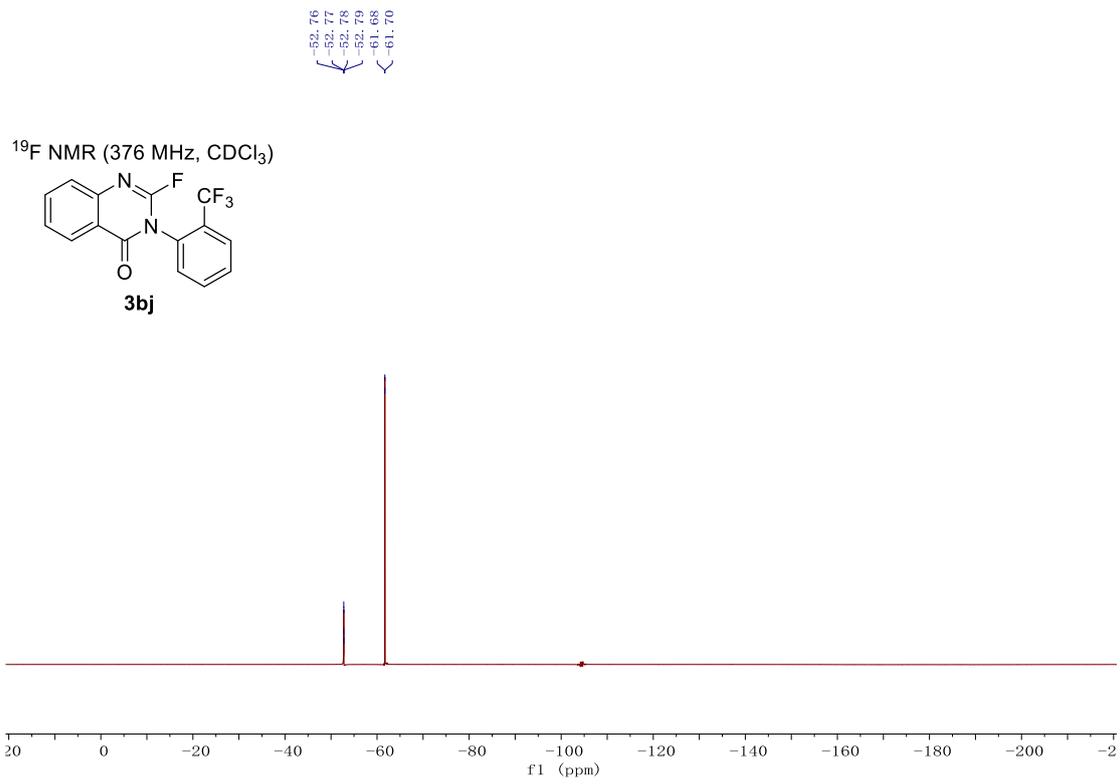


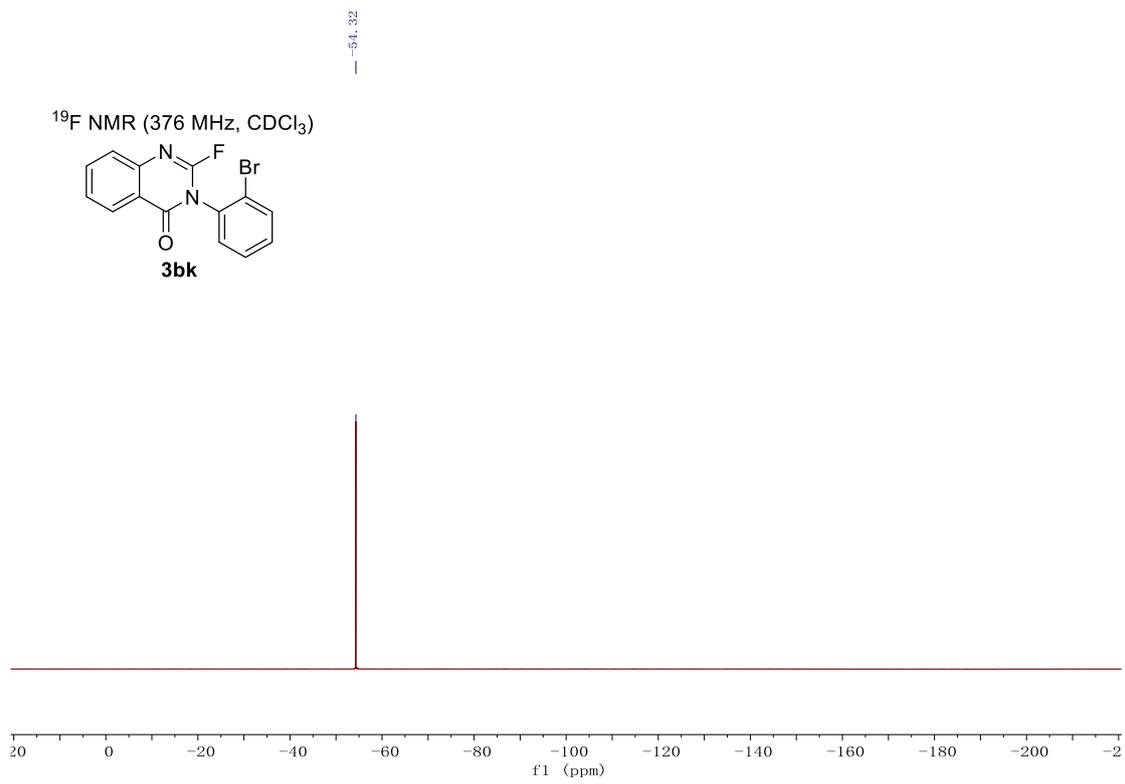
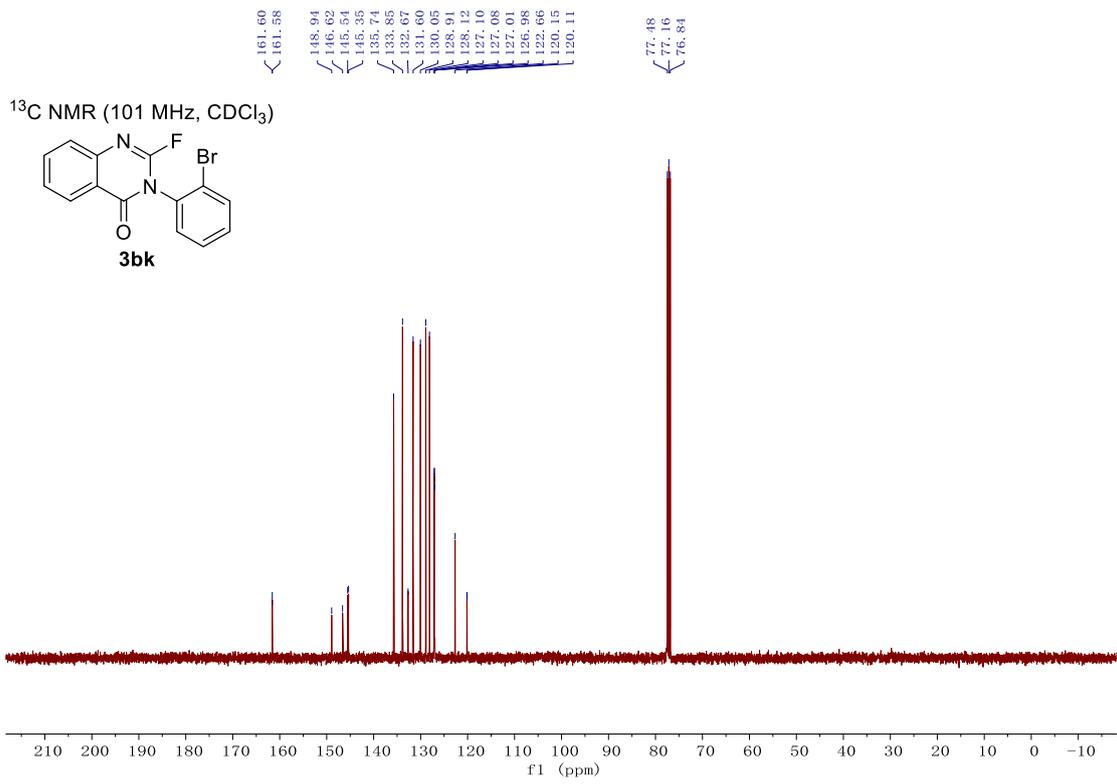
¹H NMR (400 MHz, CDCl₃)



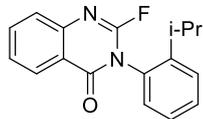
¹³C NMR (101 MHz, CDCl₃)



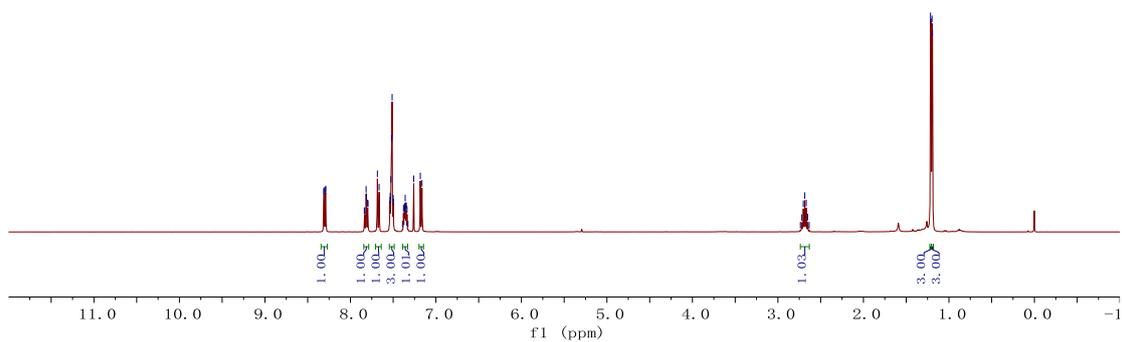




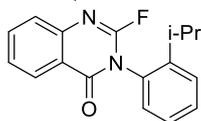
¹H NMR (400 MHz, CDCl₃)



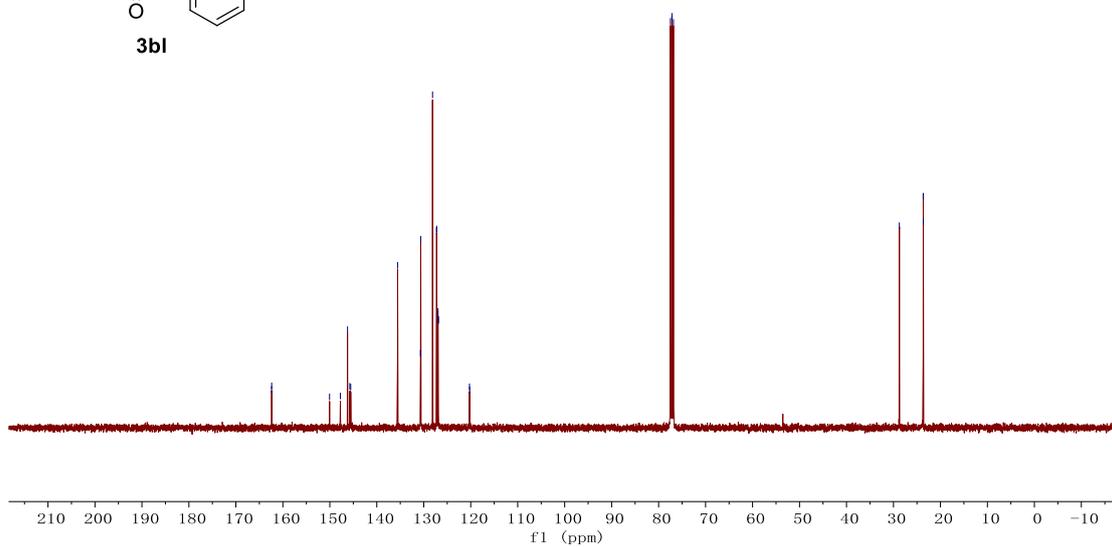
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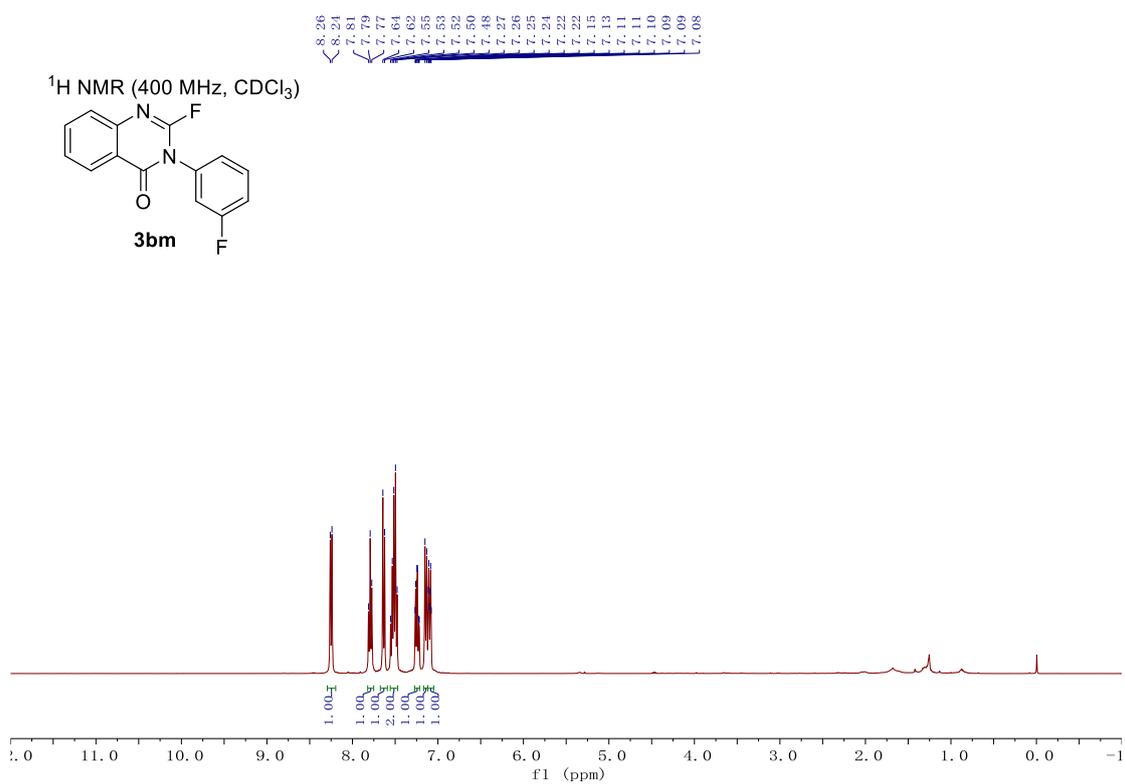
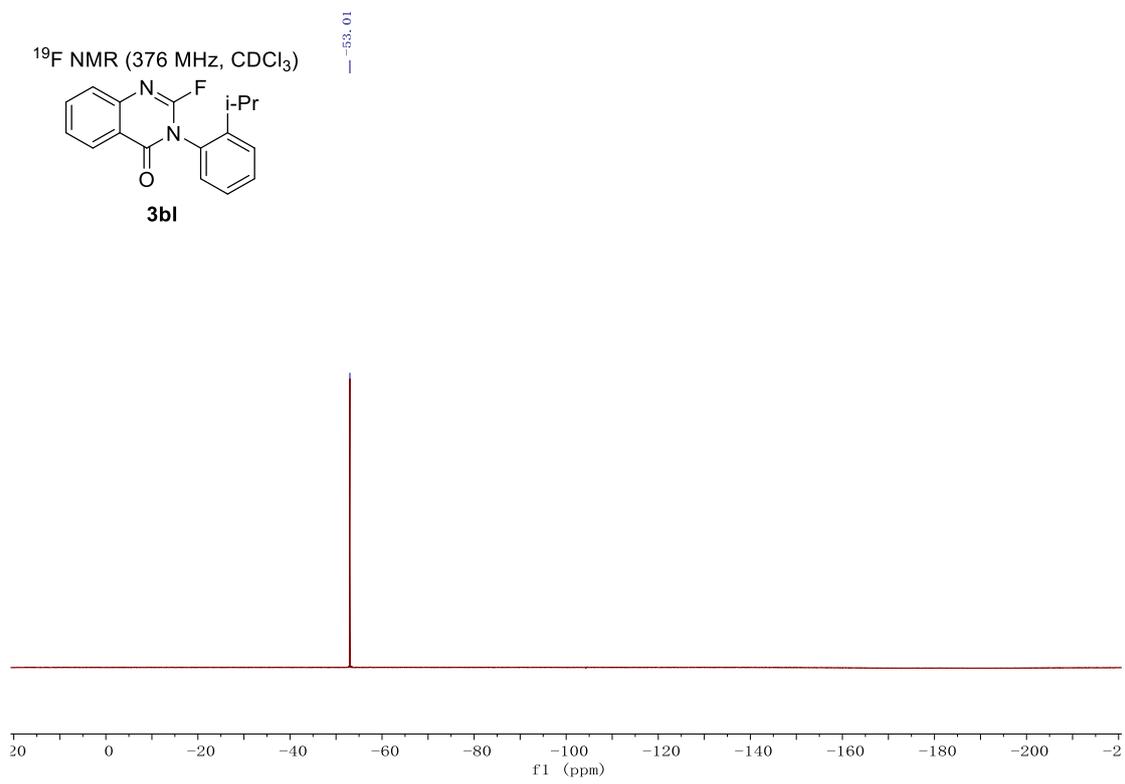


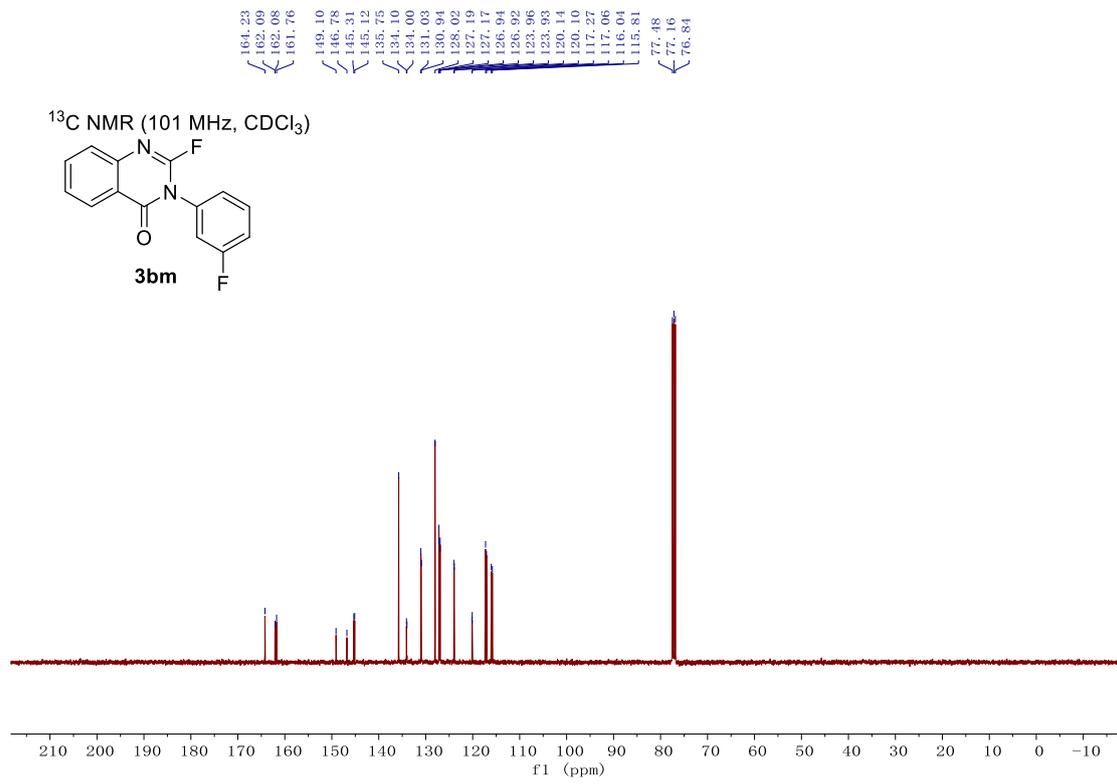
¹³C NMR (101 MHz, CDCl₃)



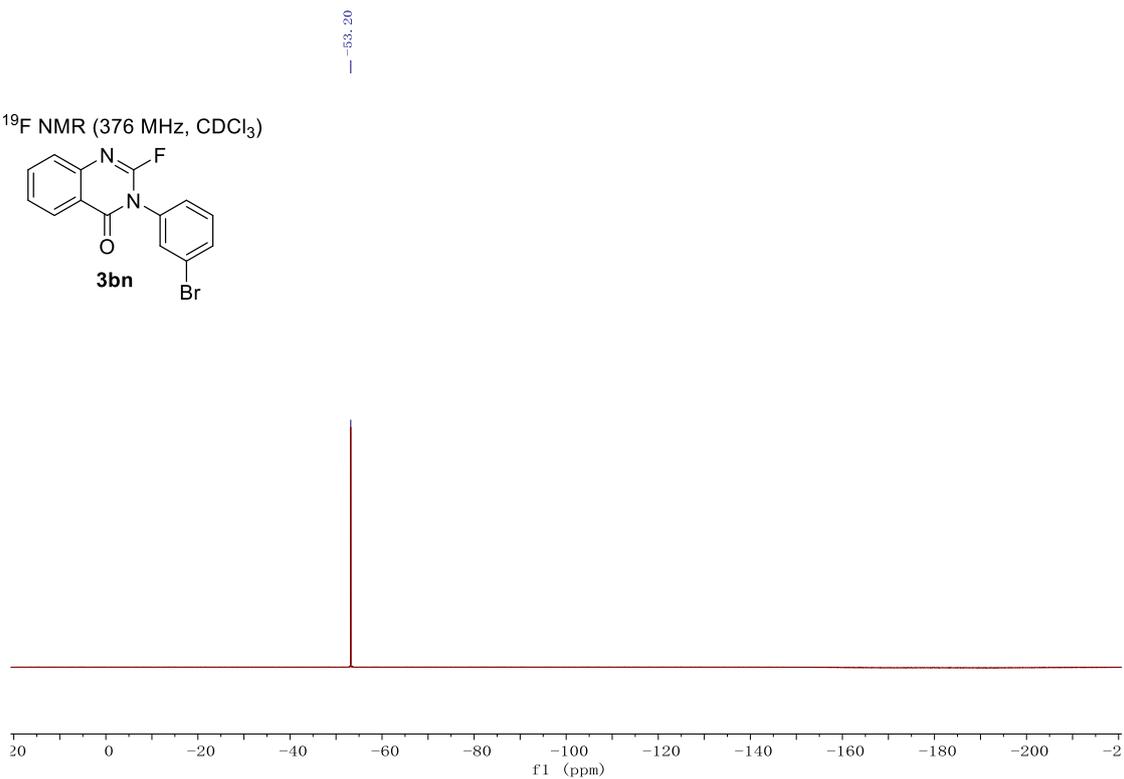
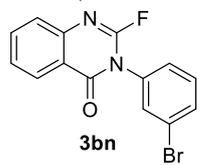
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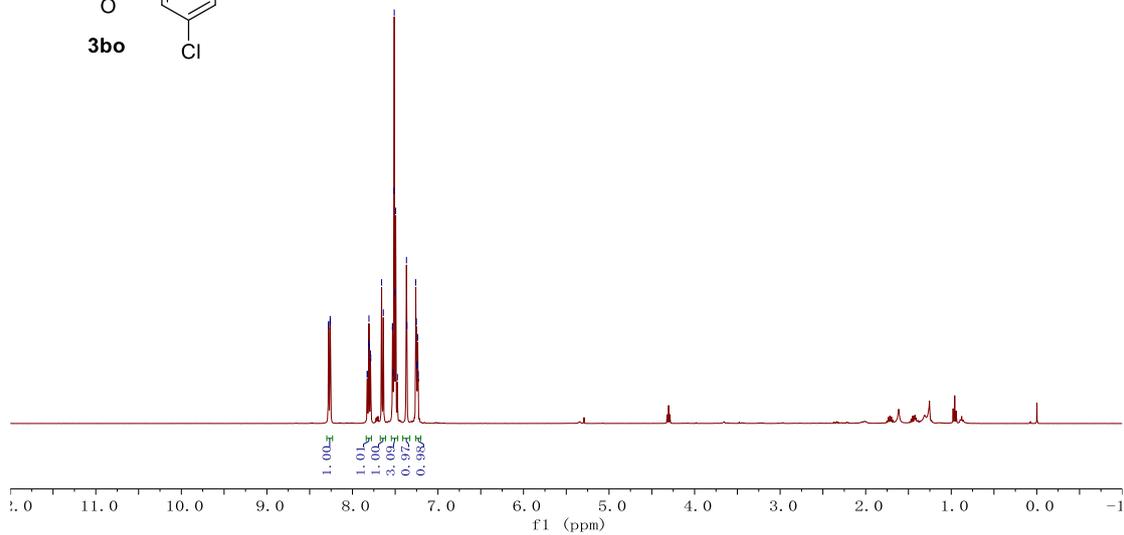
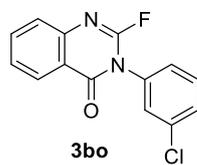


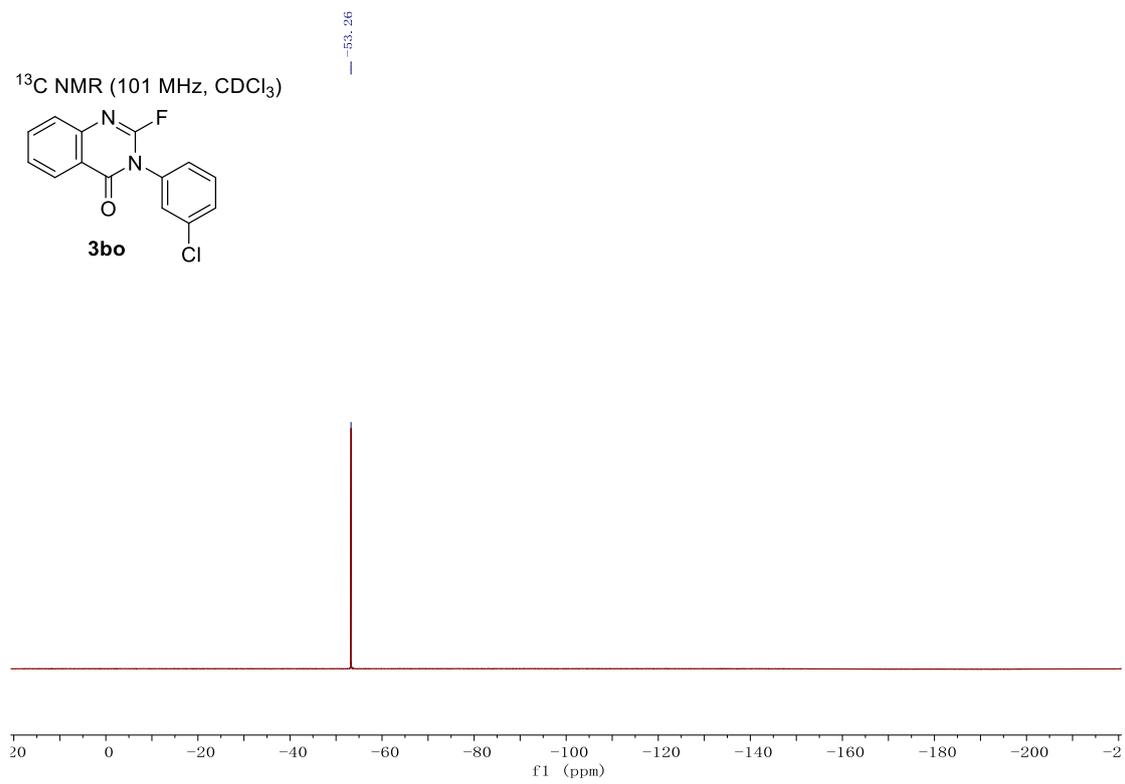
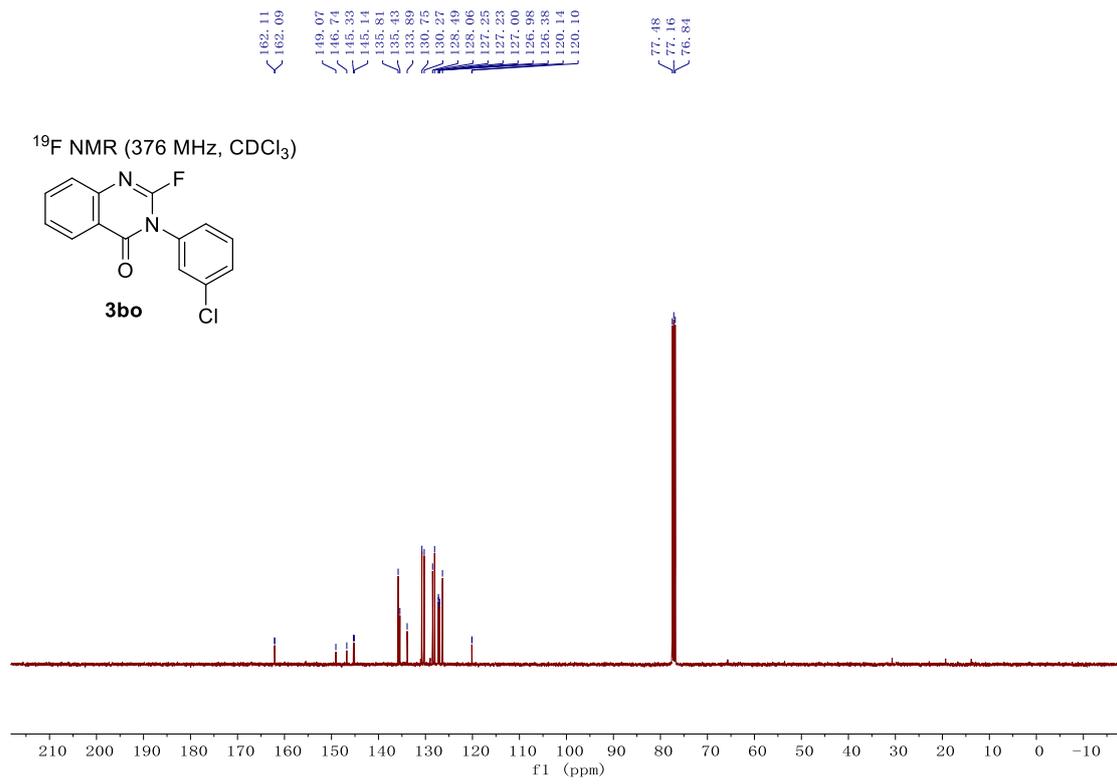
¹⁹F NMR (376 MHz, CDCl₃)

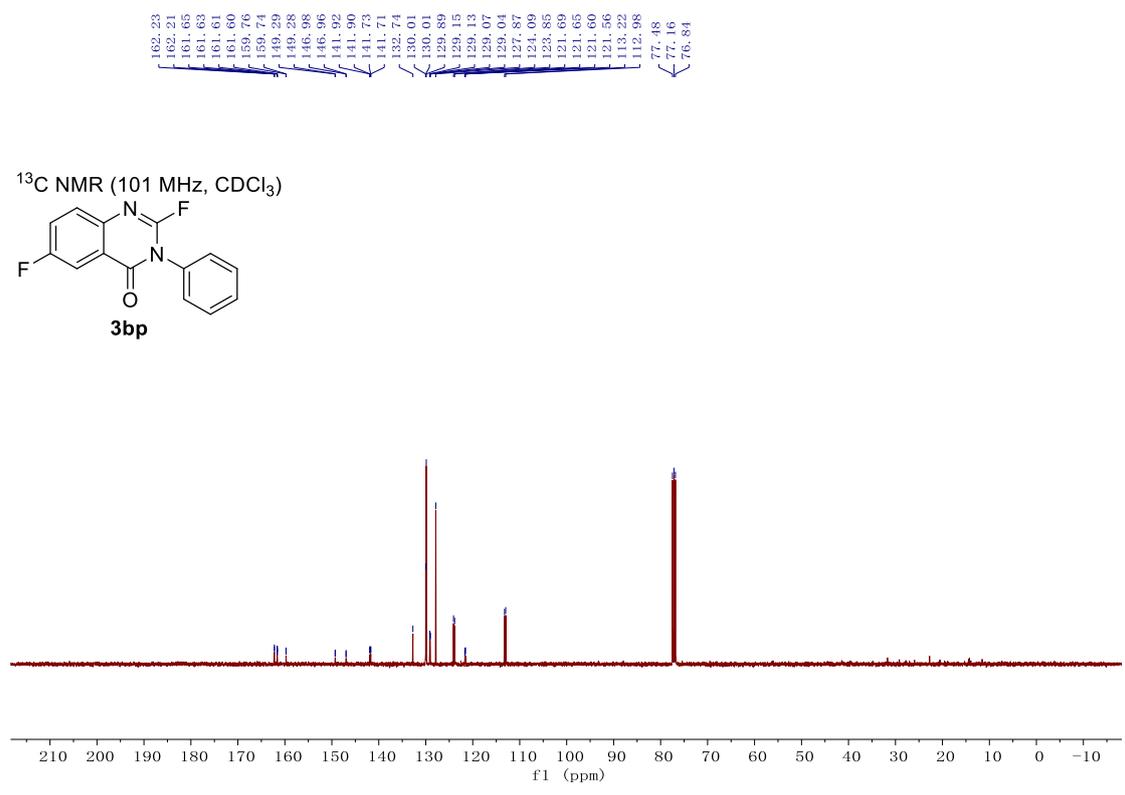
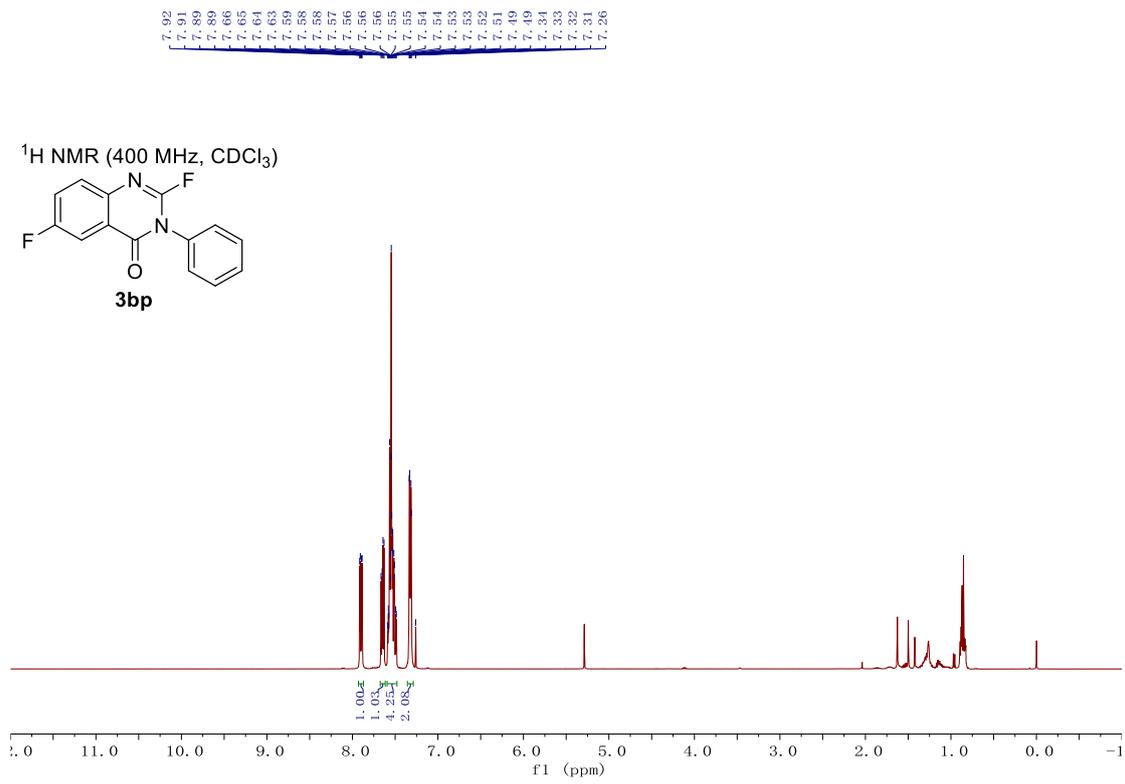


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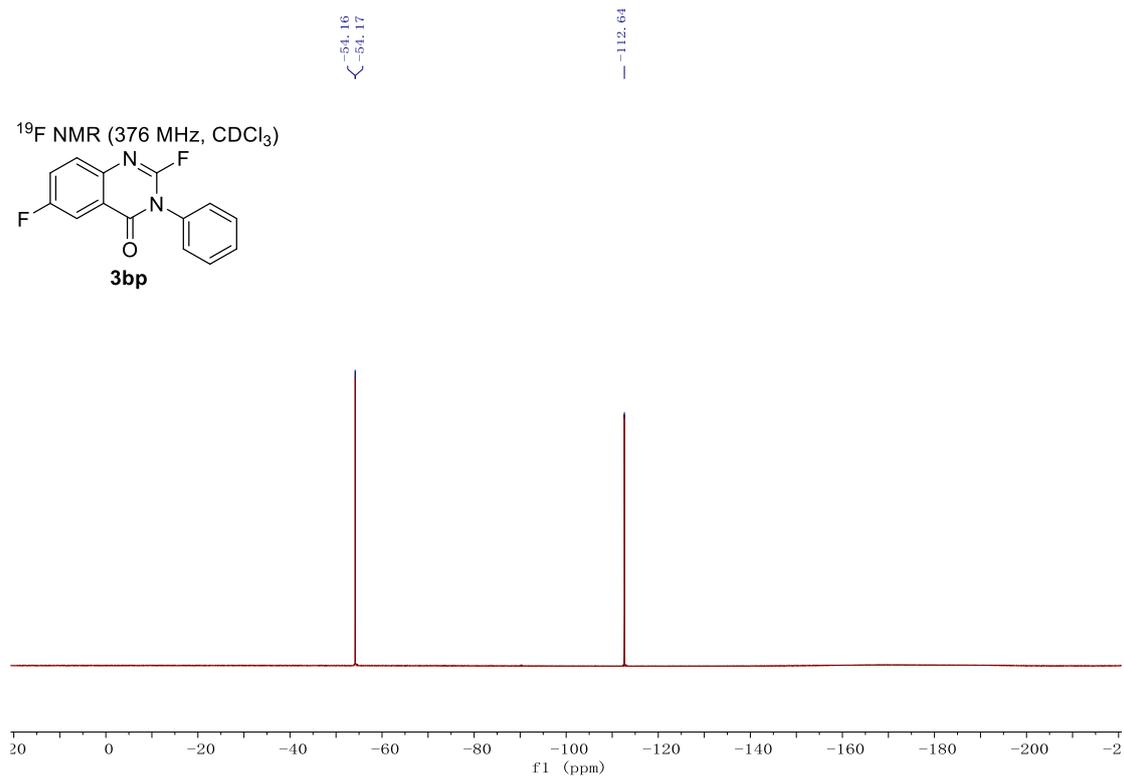
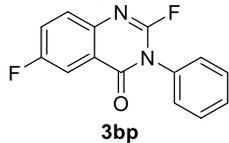
¹H NMR (400 MHz, CDCl₃)



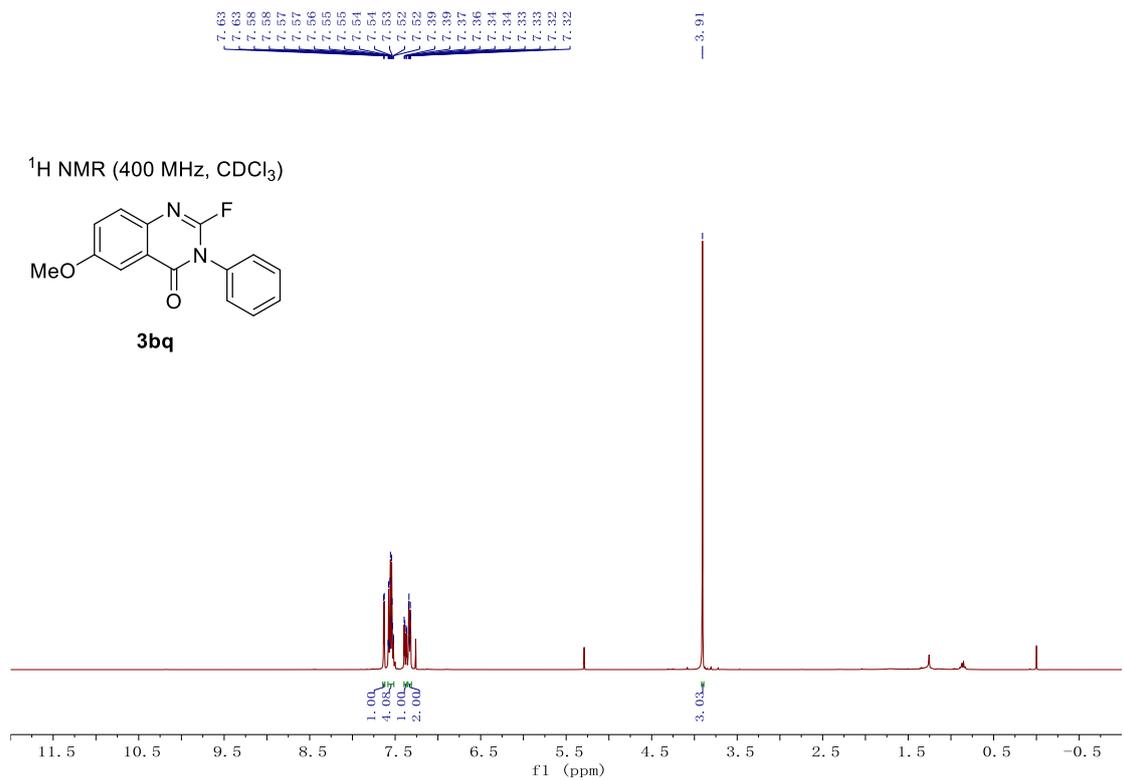
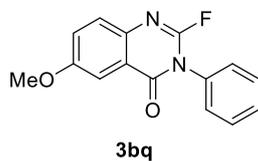


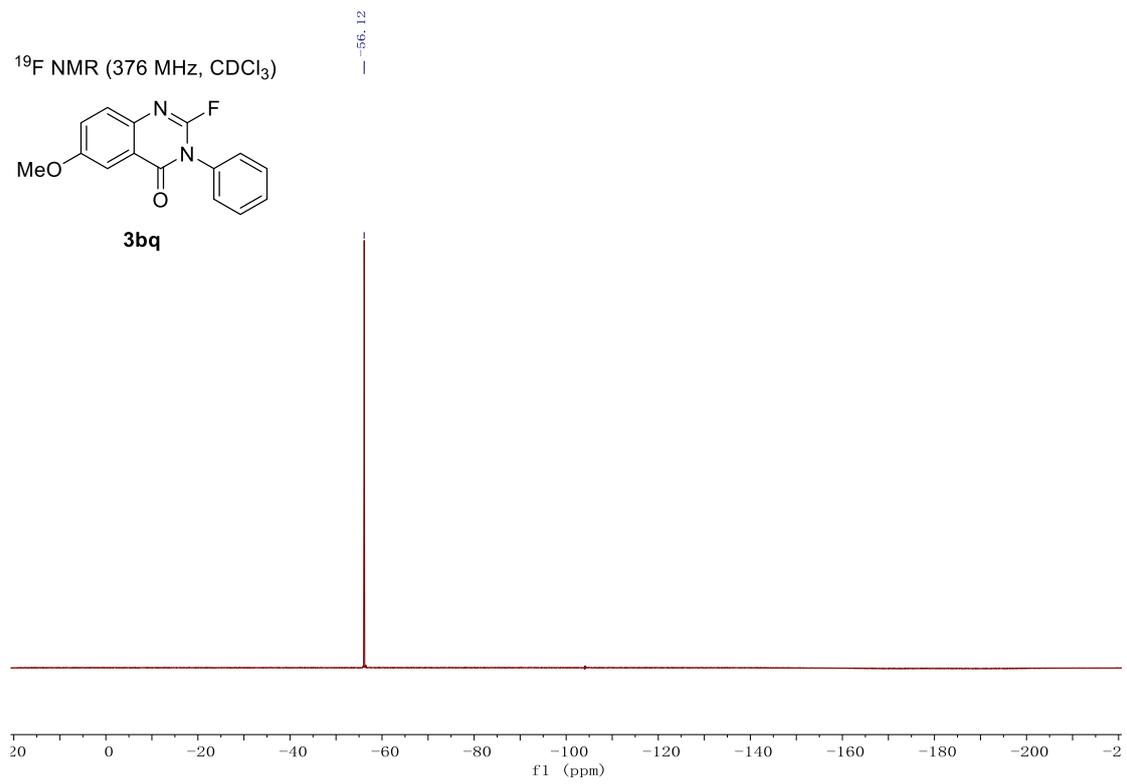
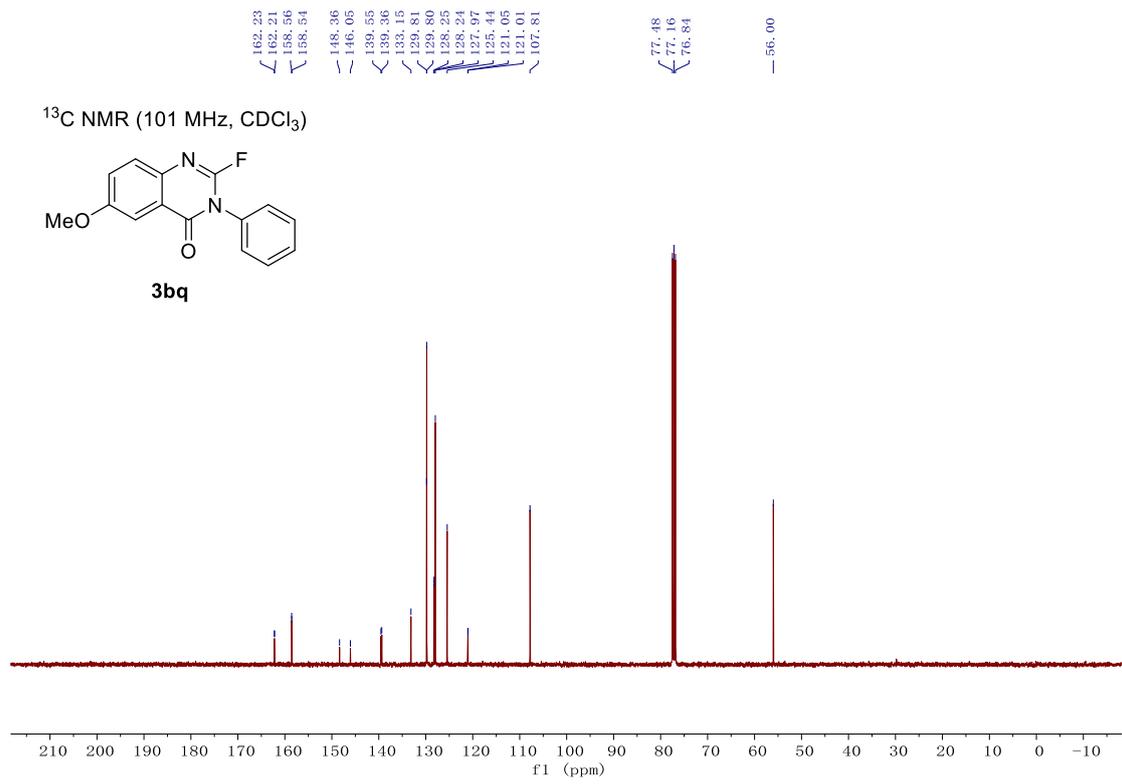


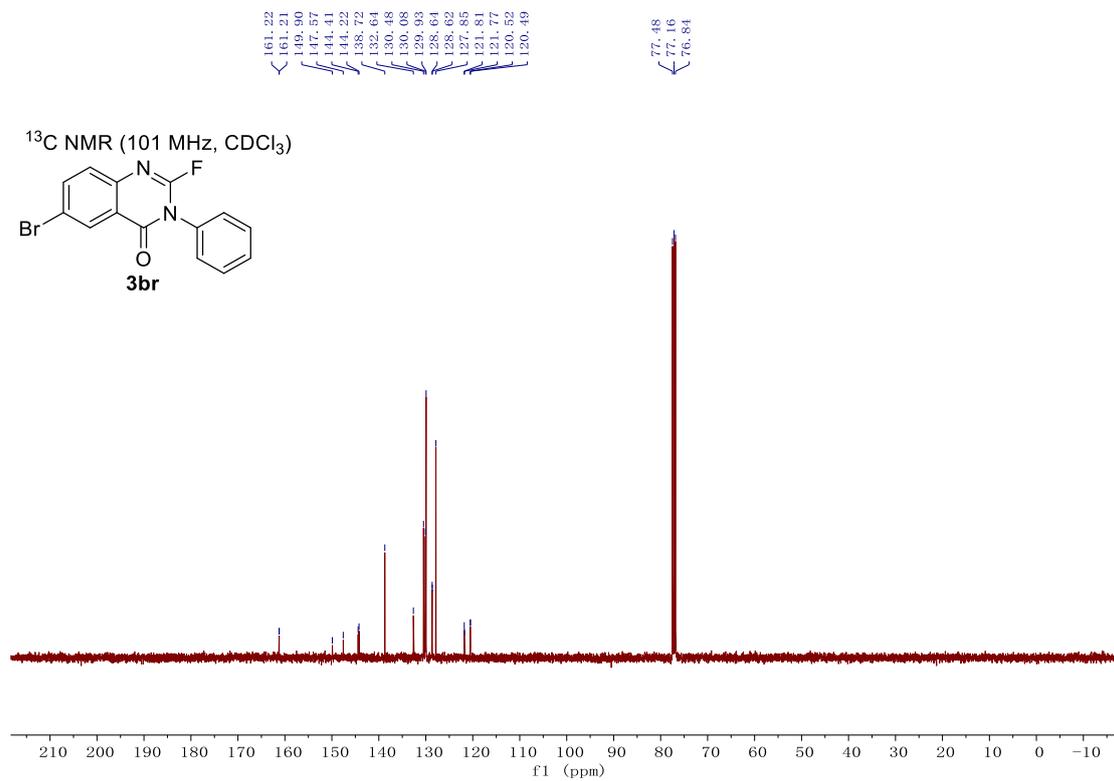
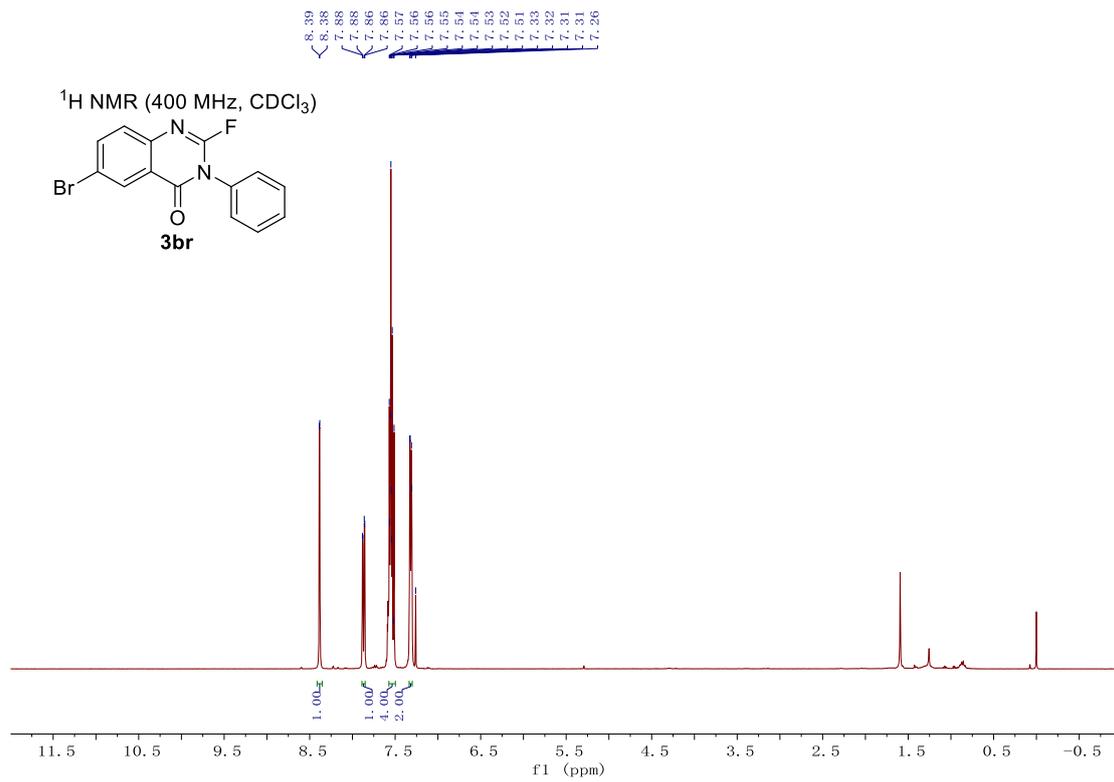
¹⁹F NMR (376 MHz, CDCl₃)

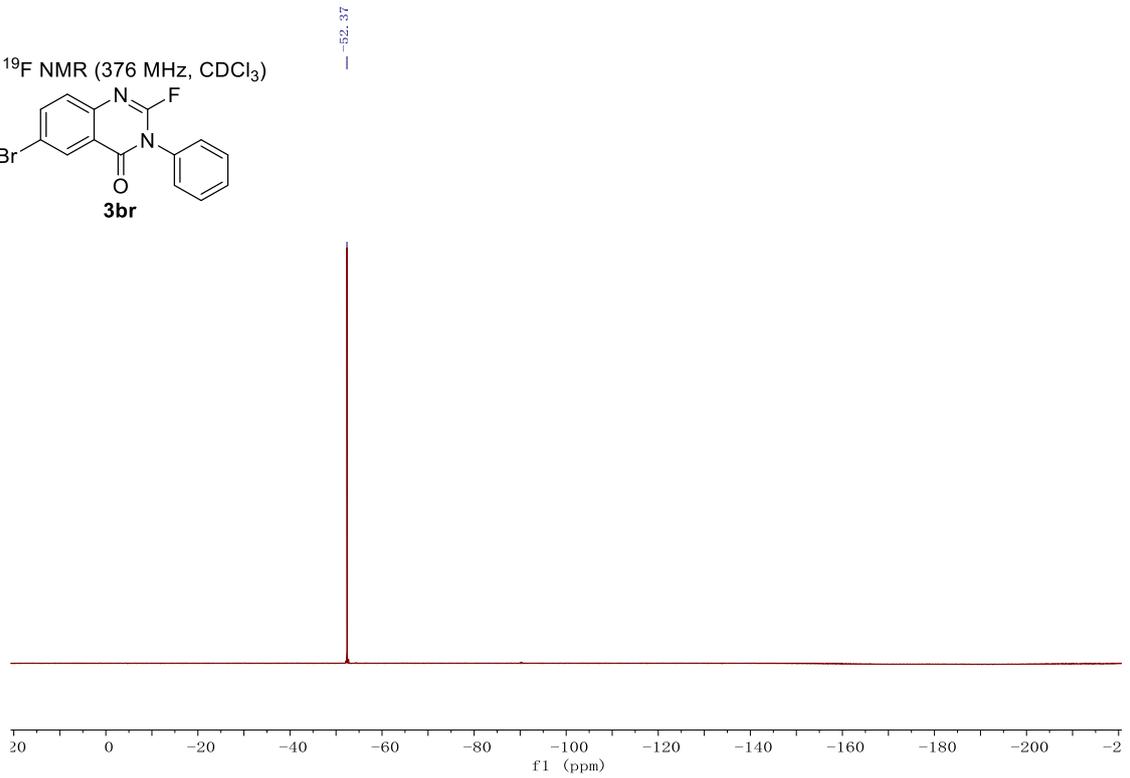
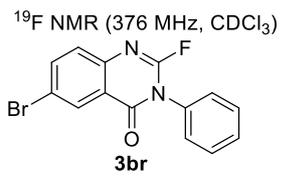


¹H NMR (400 MHz, CDCl₃)



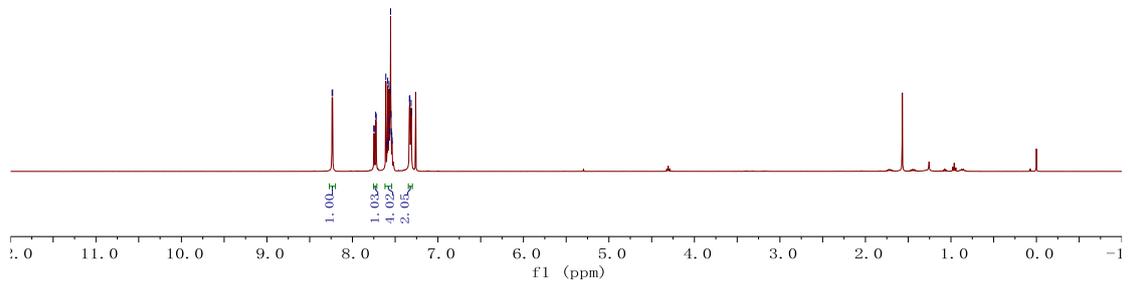
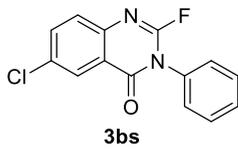


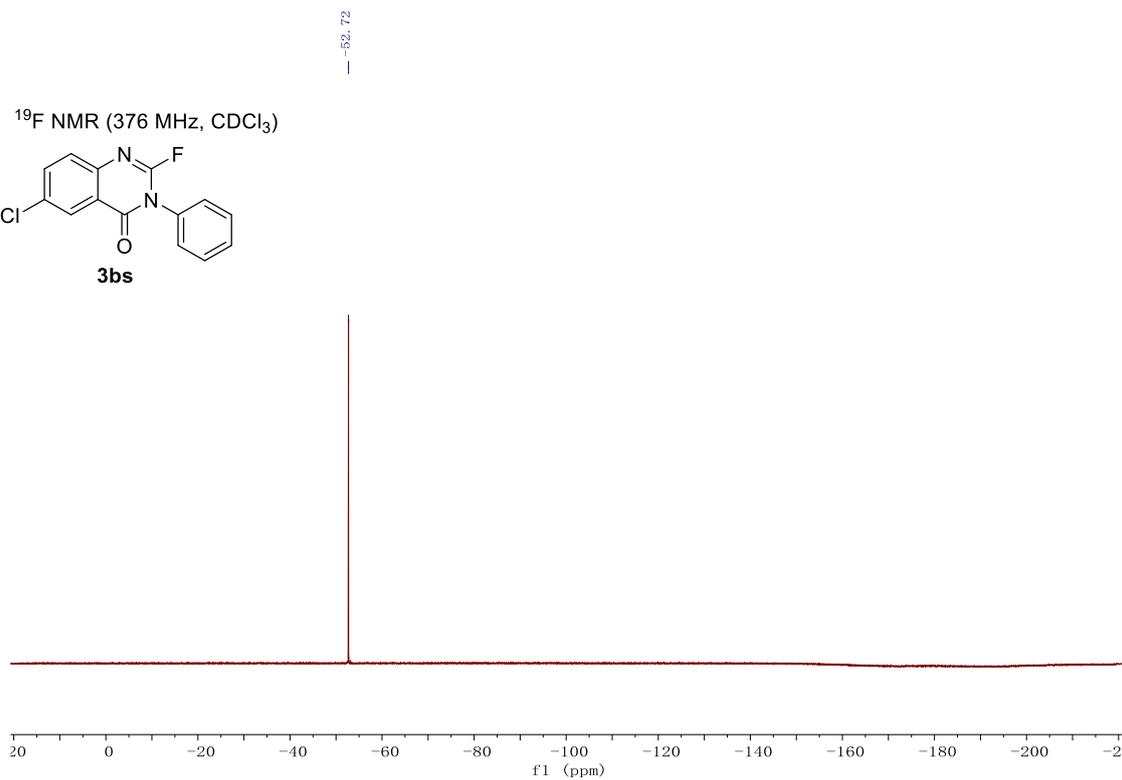
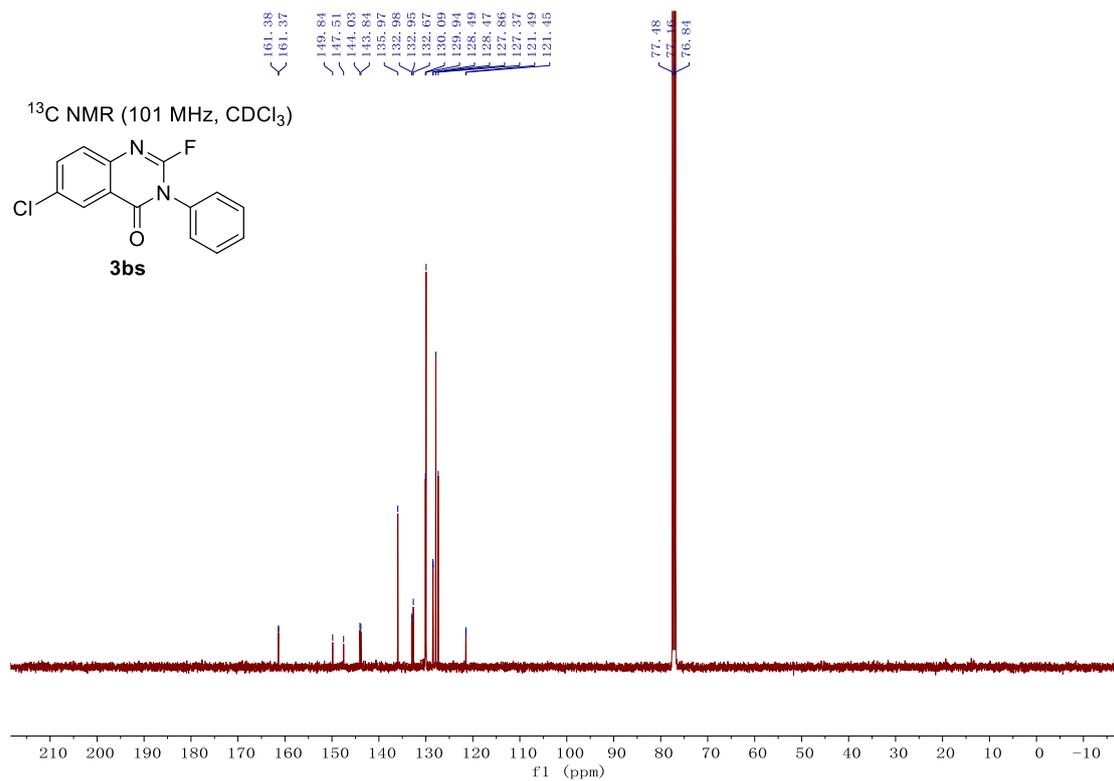


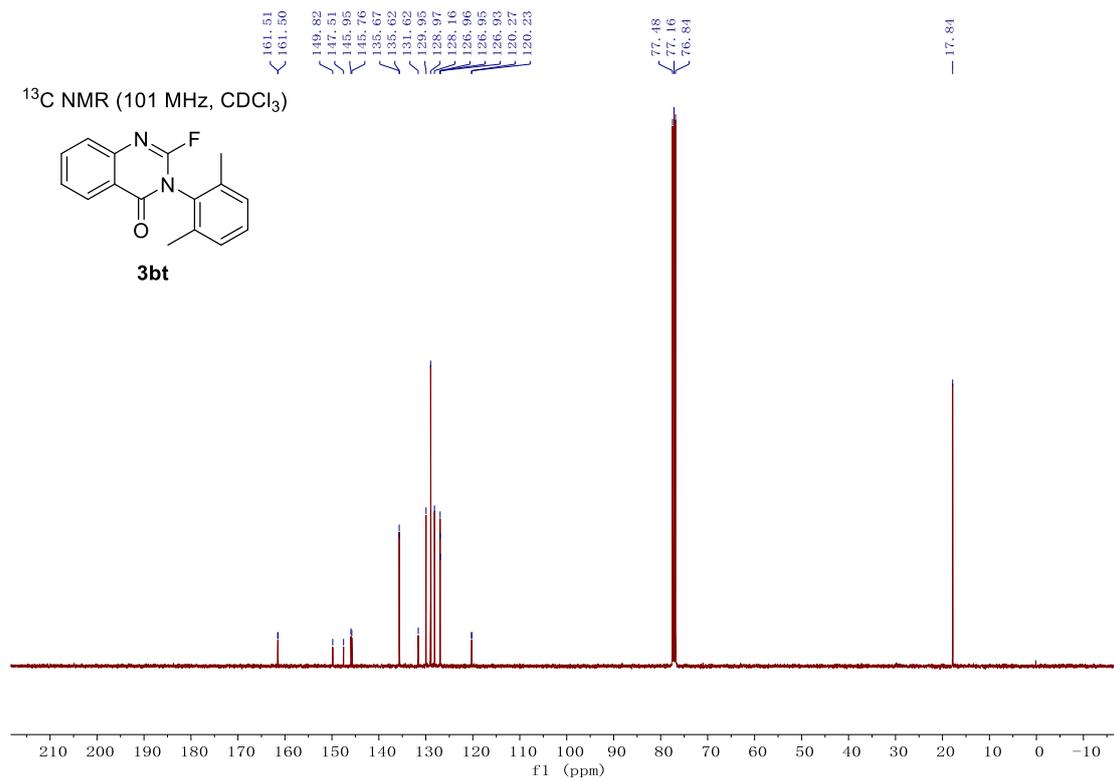
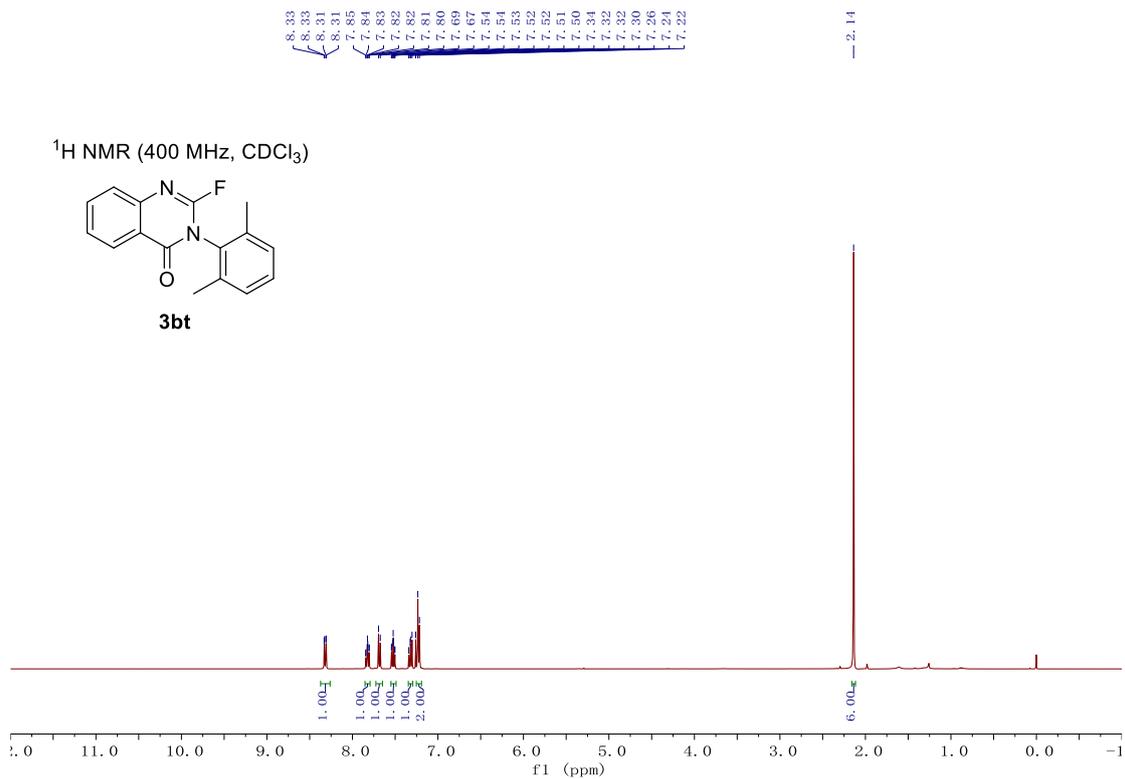


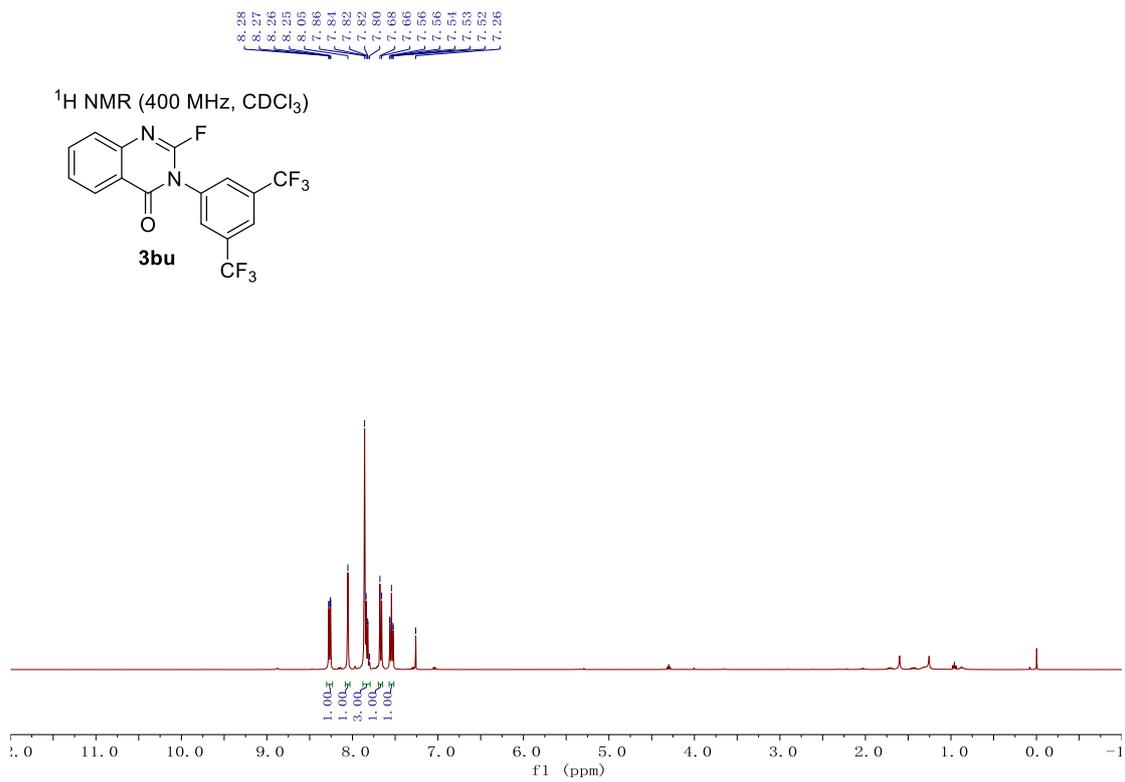
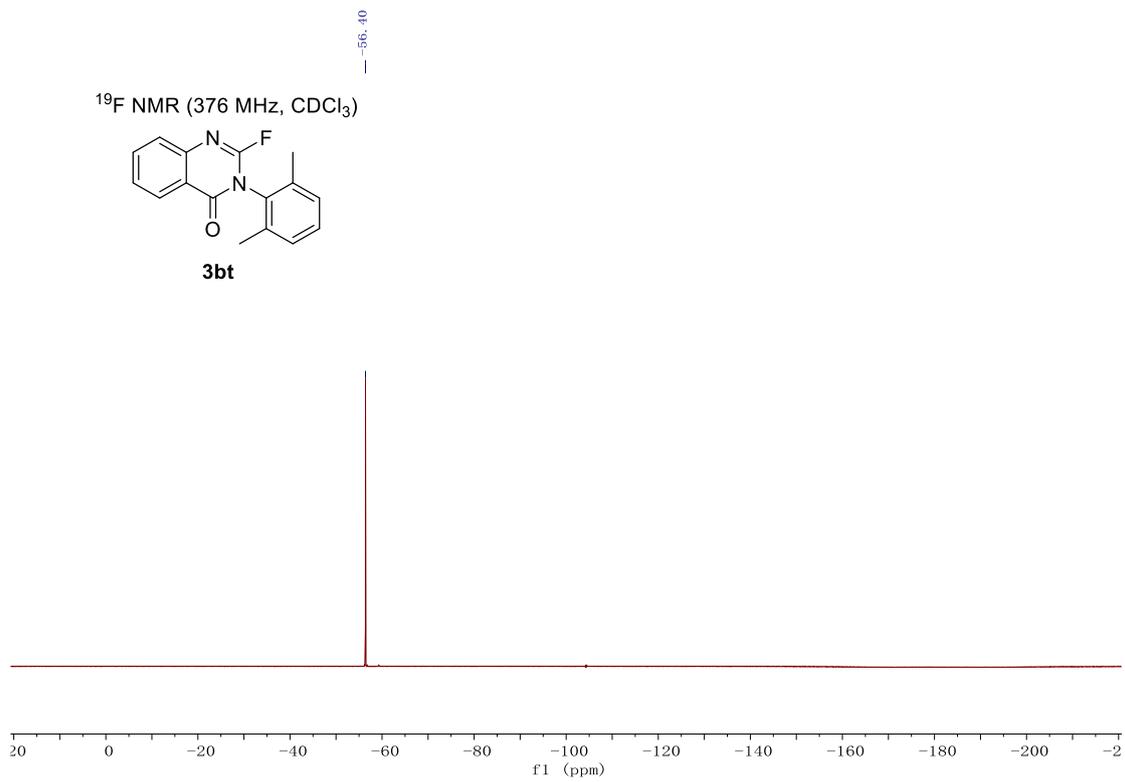
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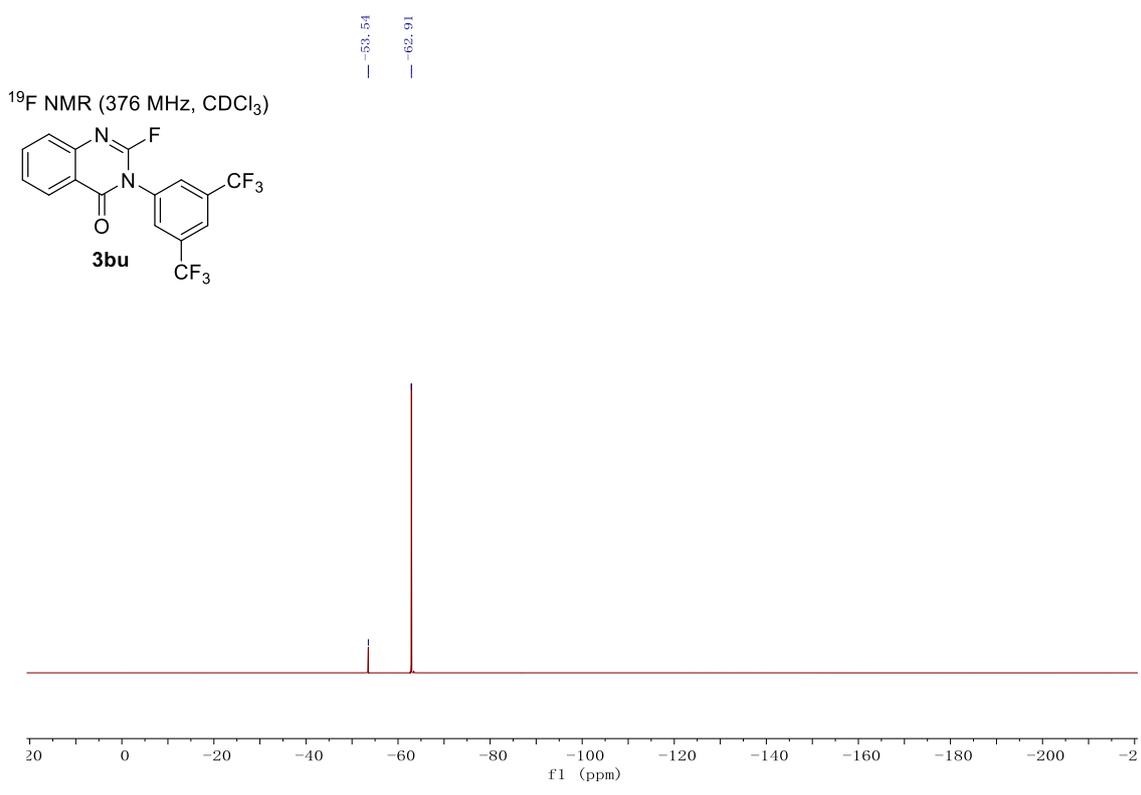
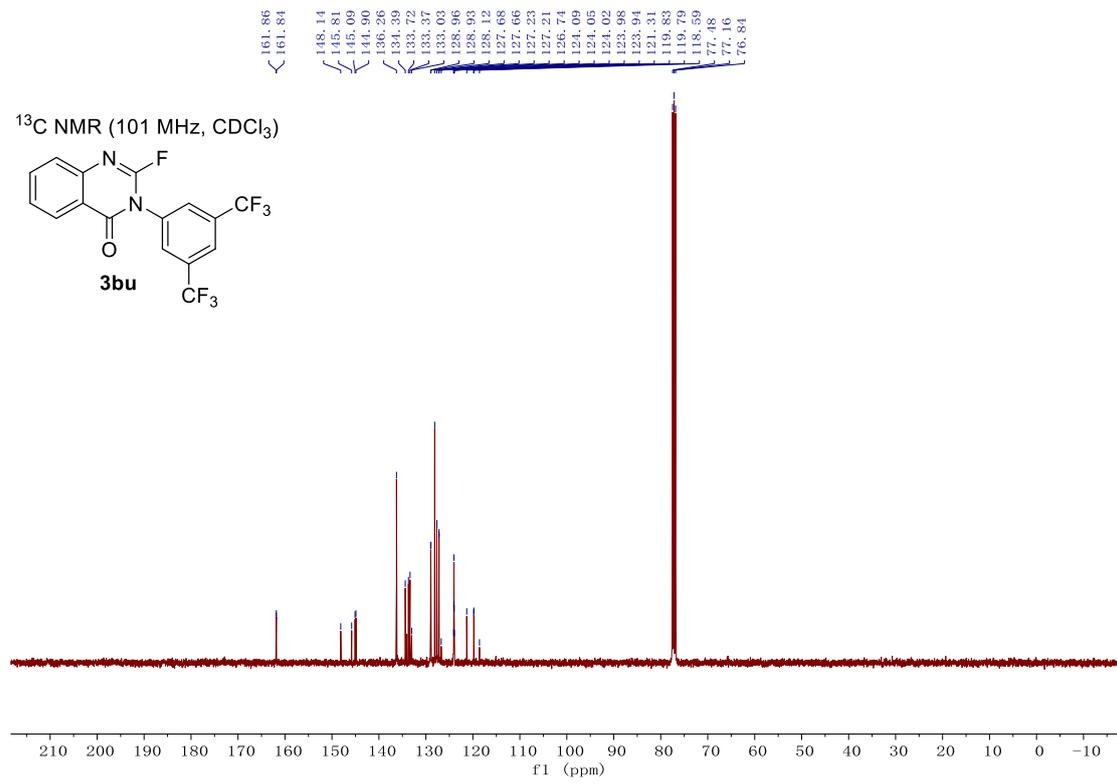
¹H NMR (400 MHz, CDCl₃)



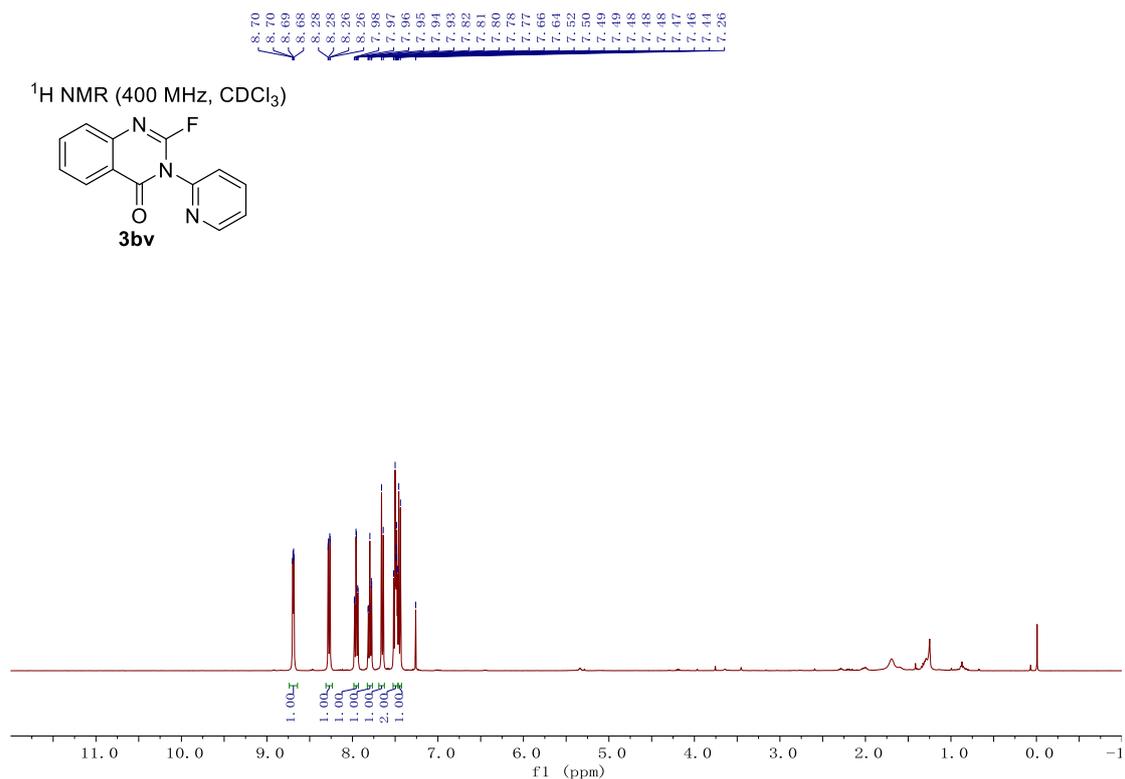
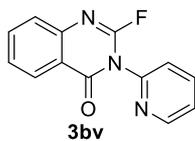




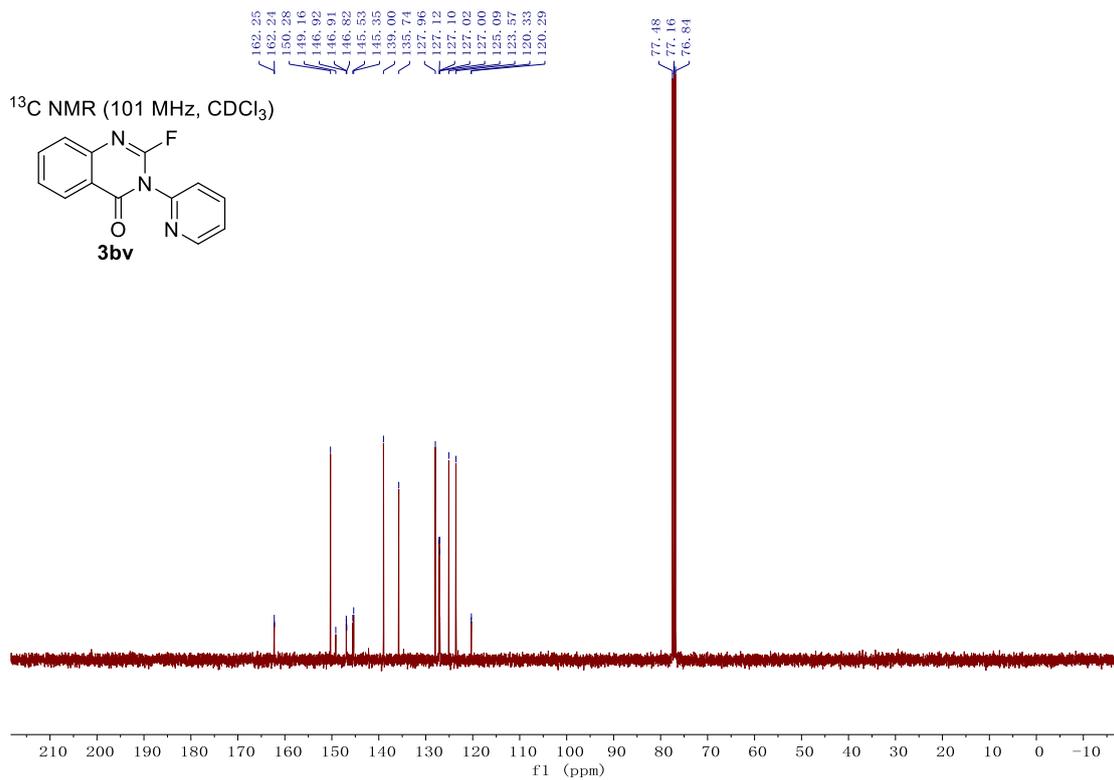
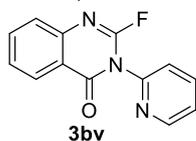




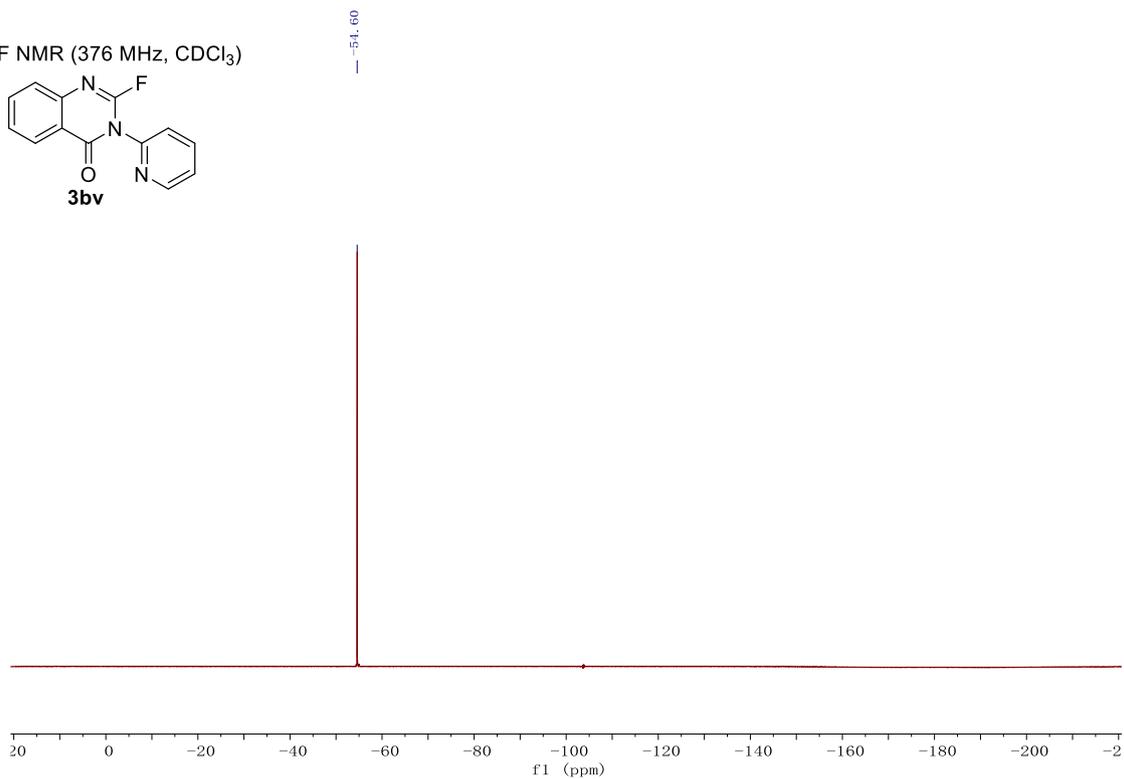
¹H NMR (400 MHz, CDCl₃)



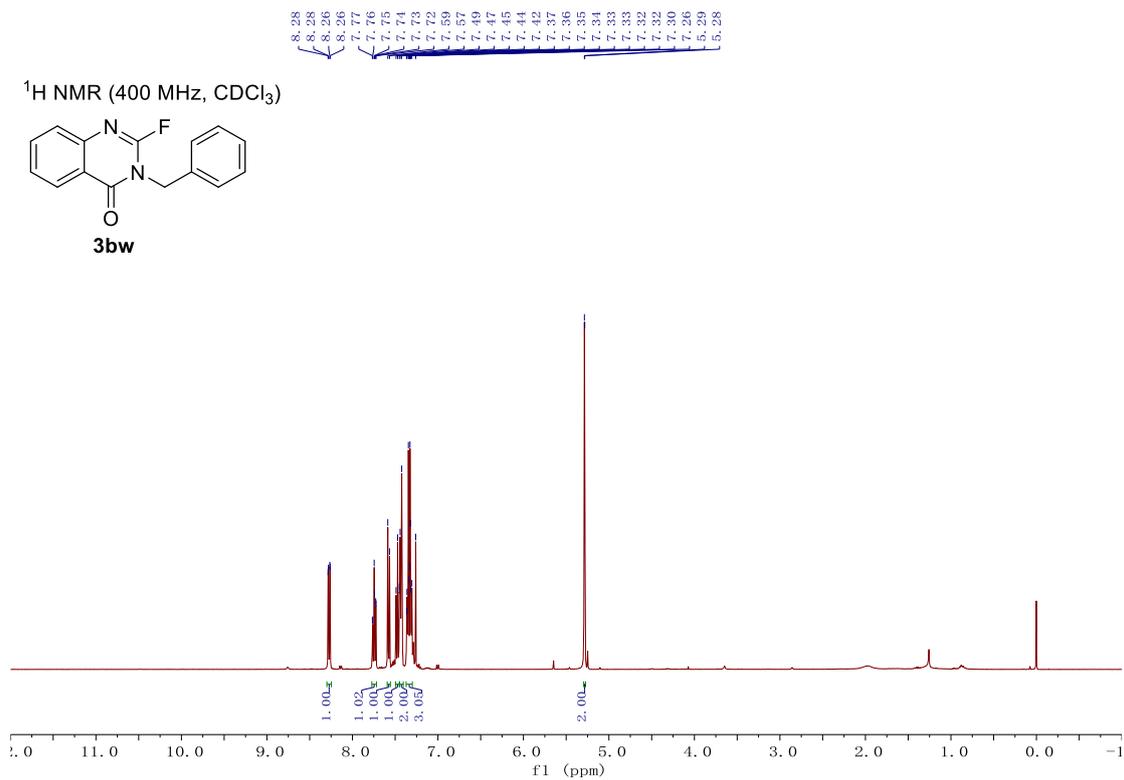
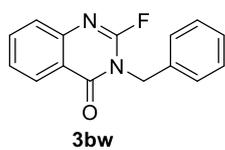
¹³C NMR (101 MHz, CDCl₃)

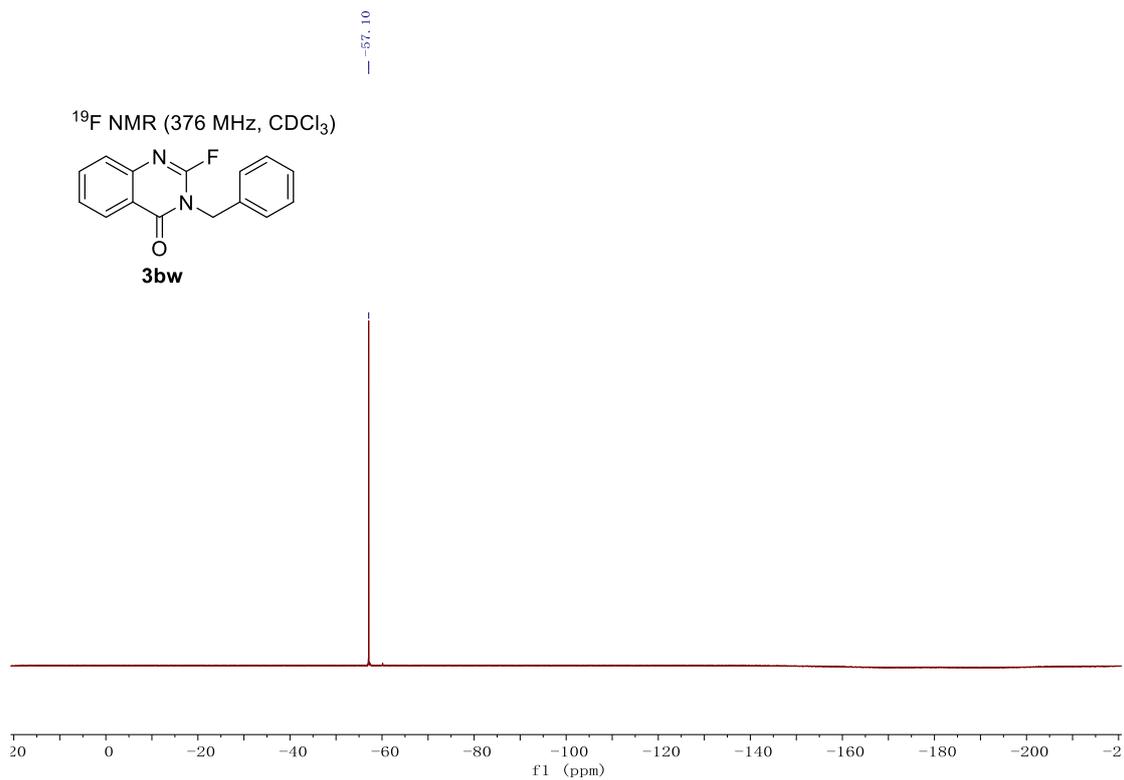
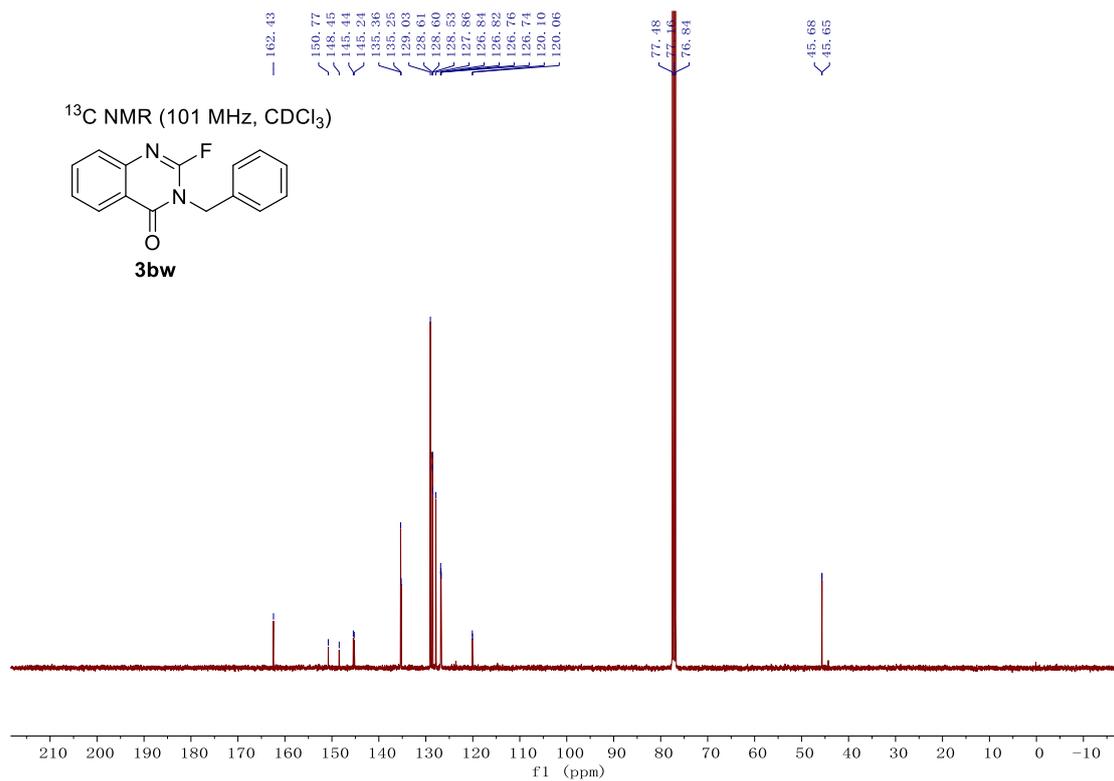


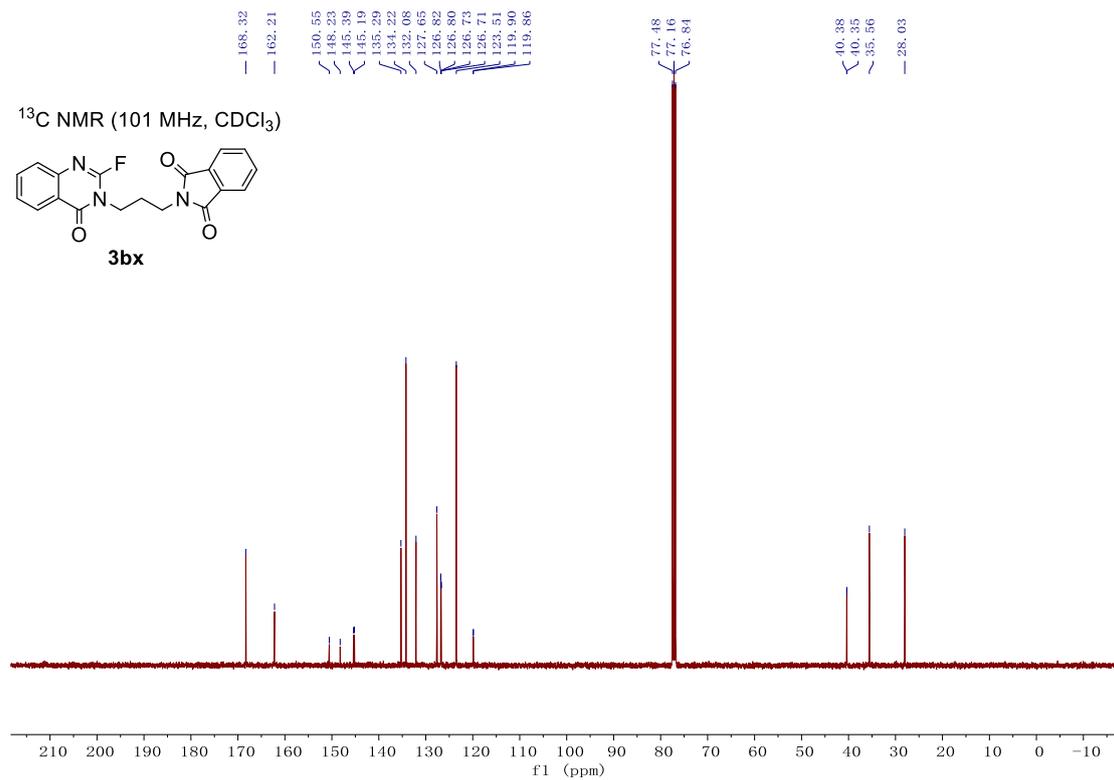
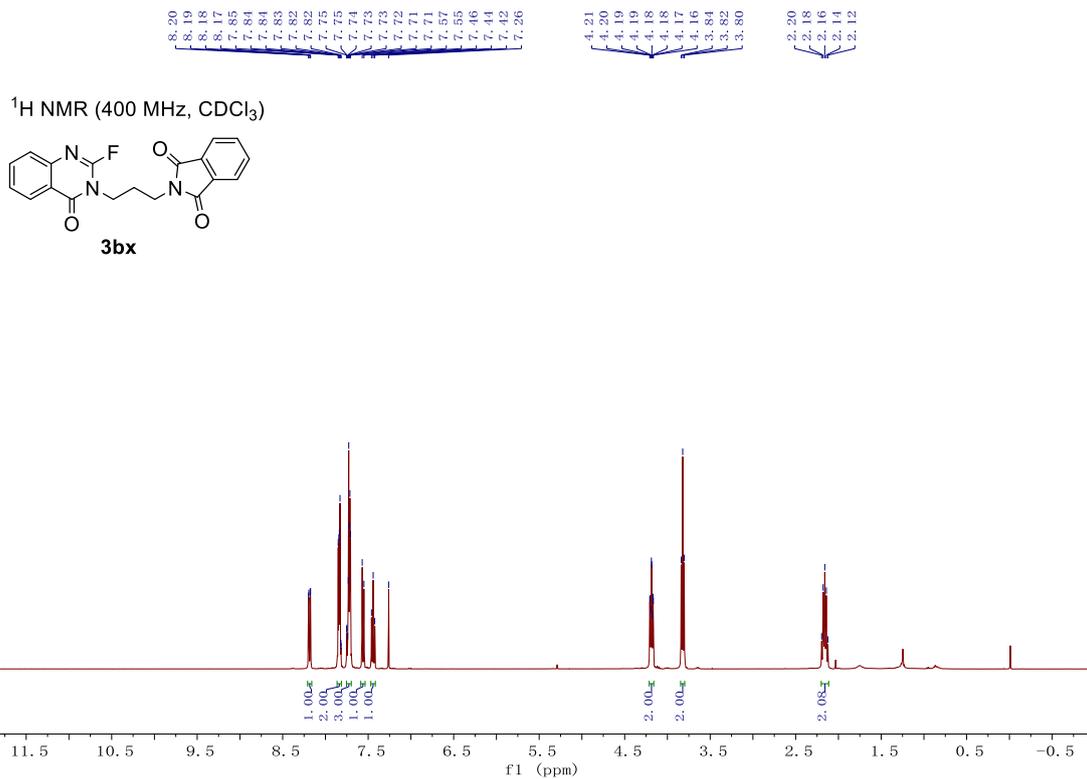
^{19}F NMR (376 MHz, CDCl_3)



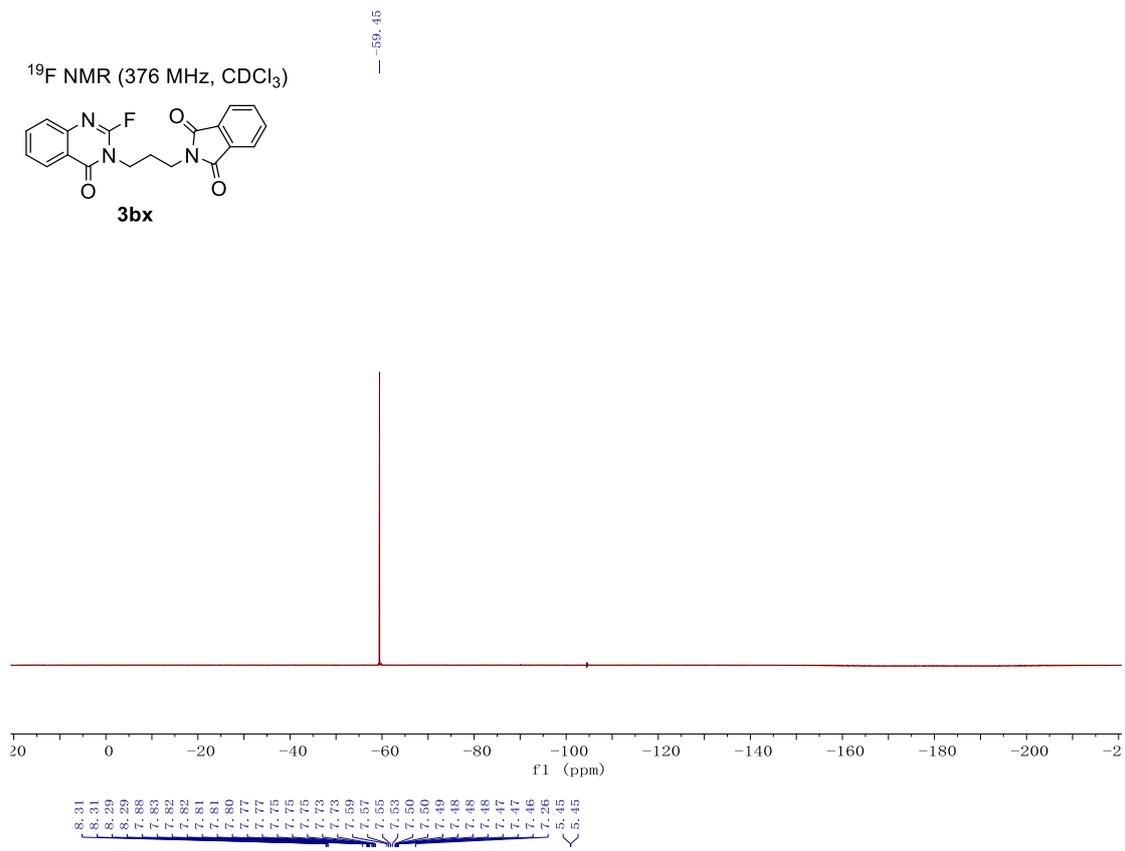
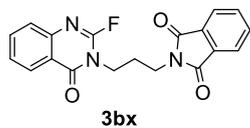
^1H NMR (400 MHz, CDCl_3)



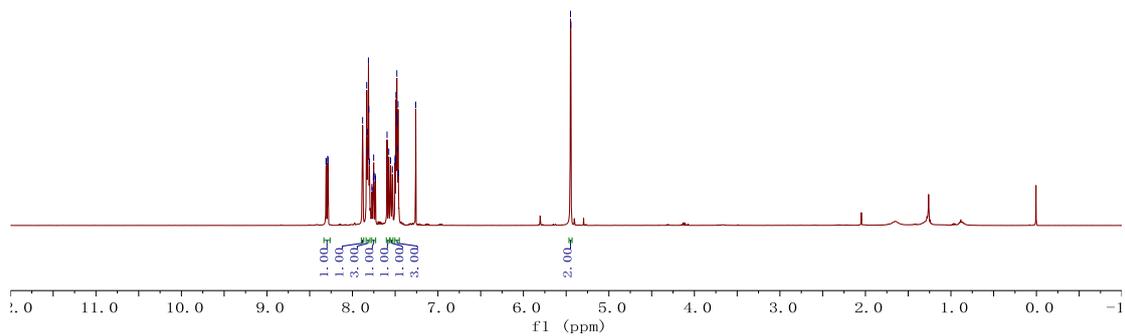
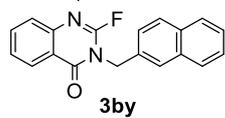


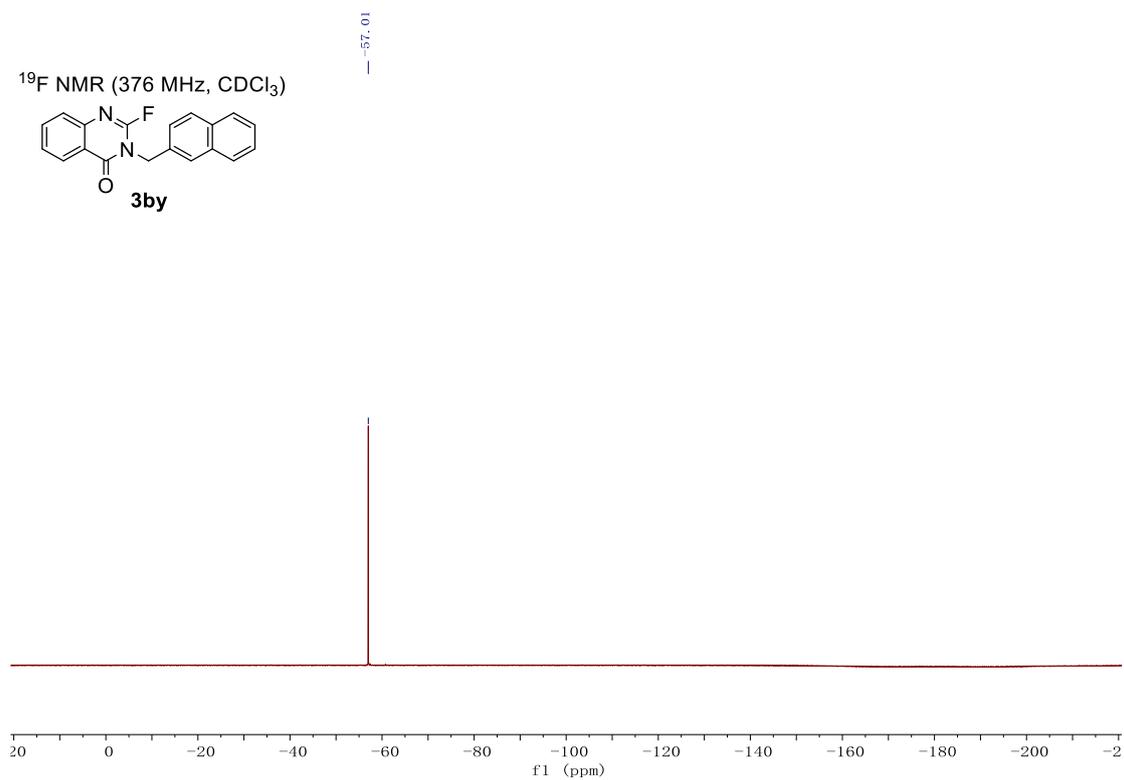
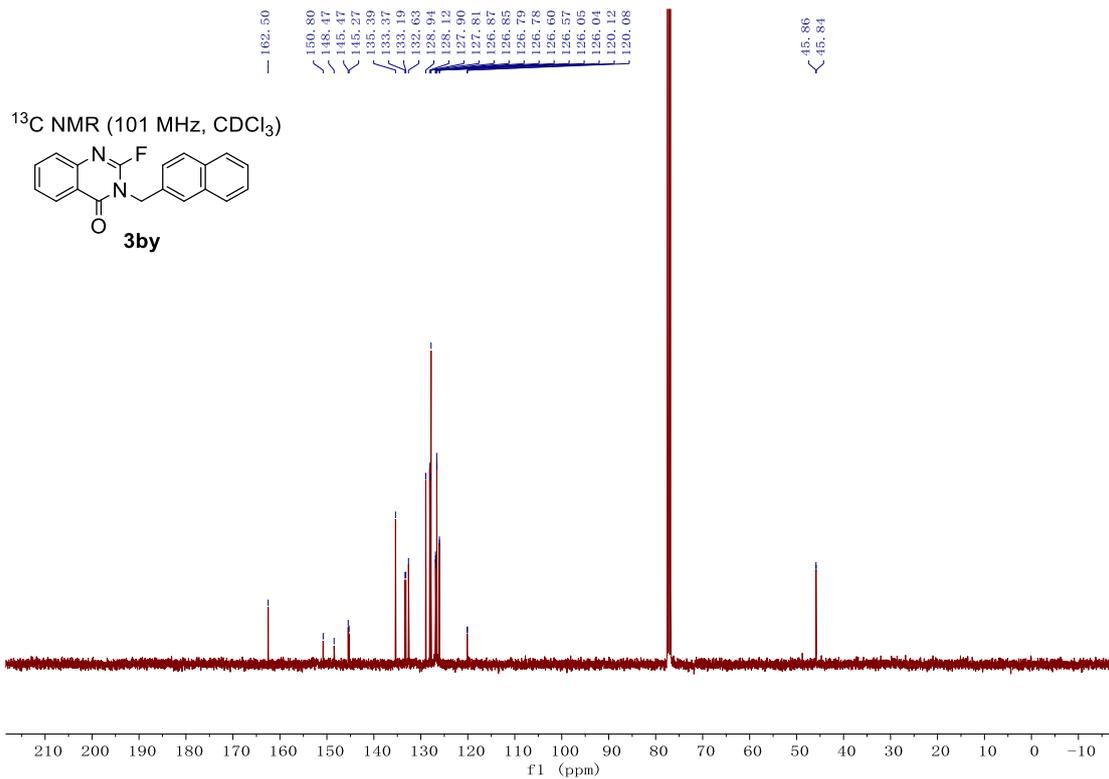


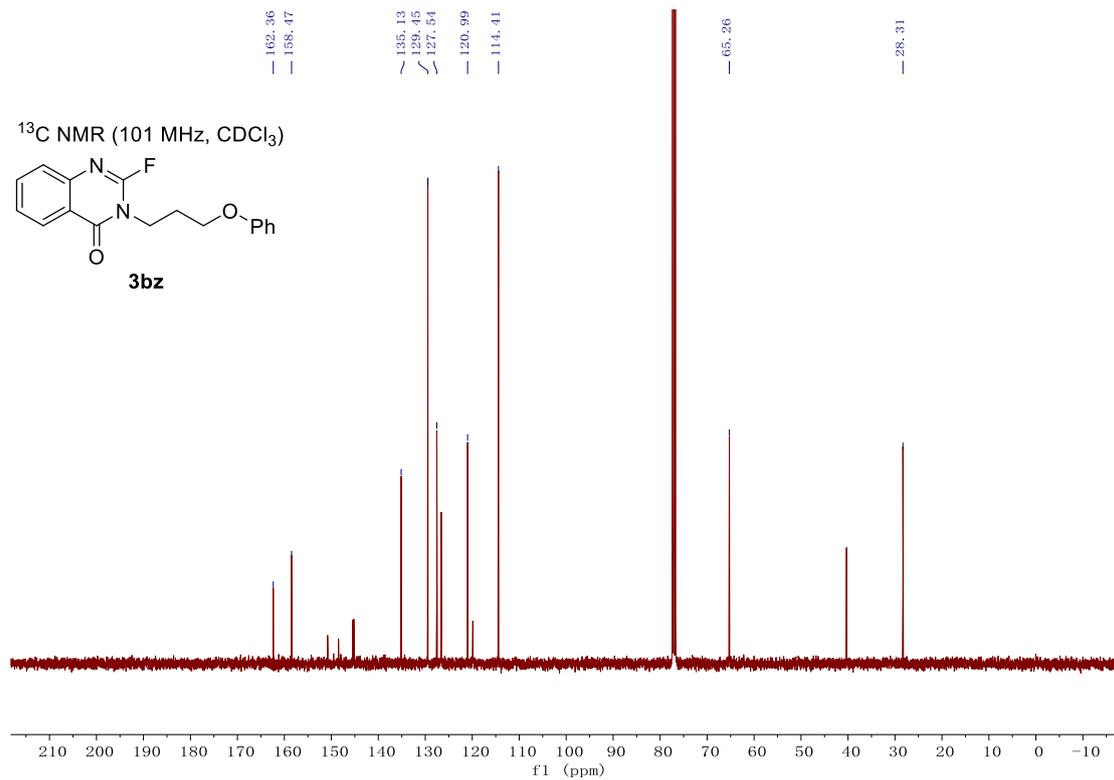
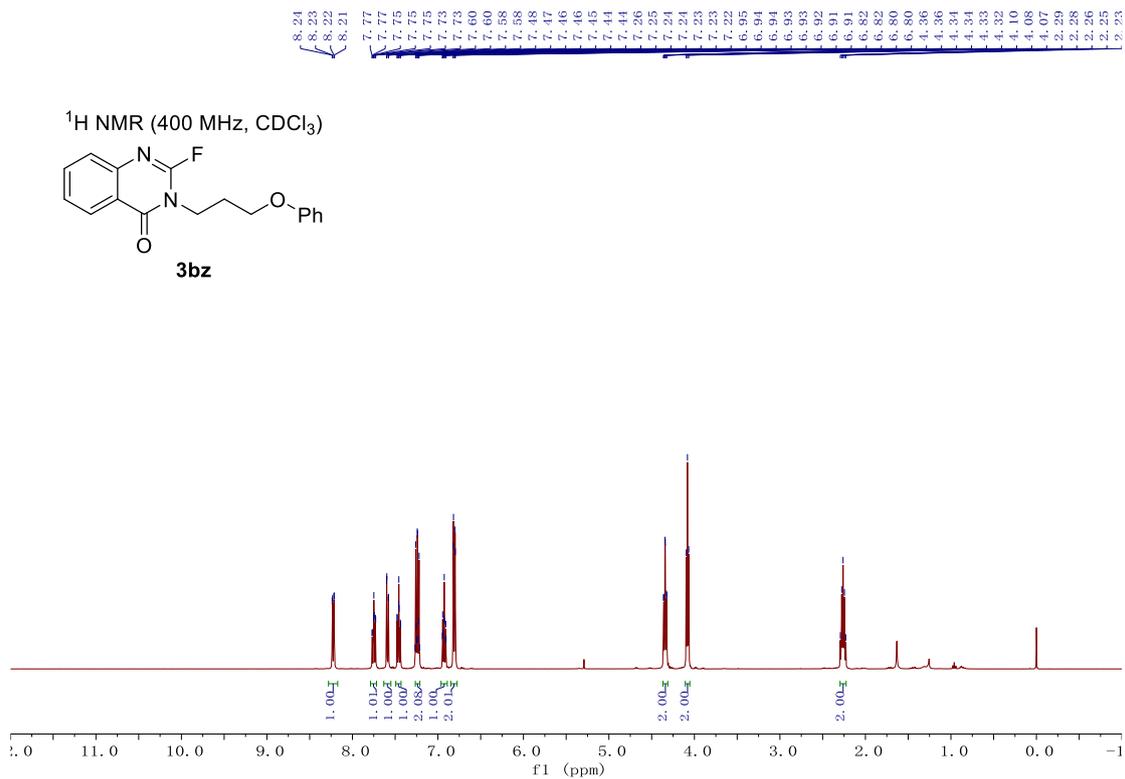
^{19}F NMR (376 MHz, CDCl_3)



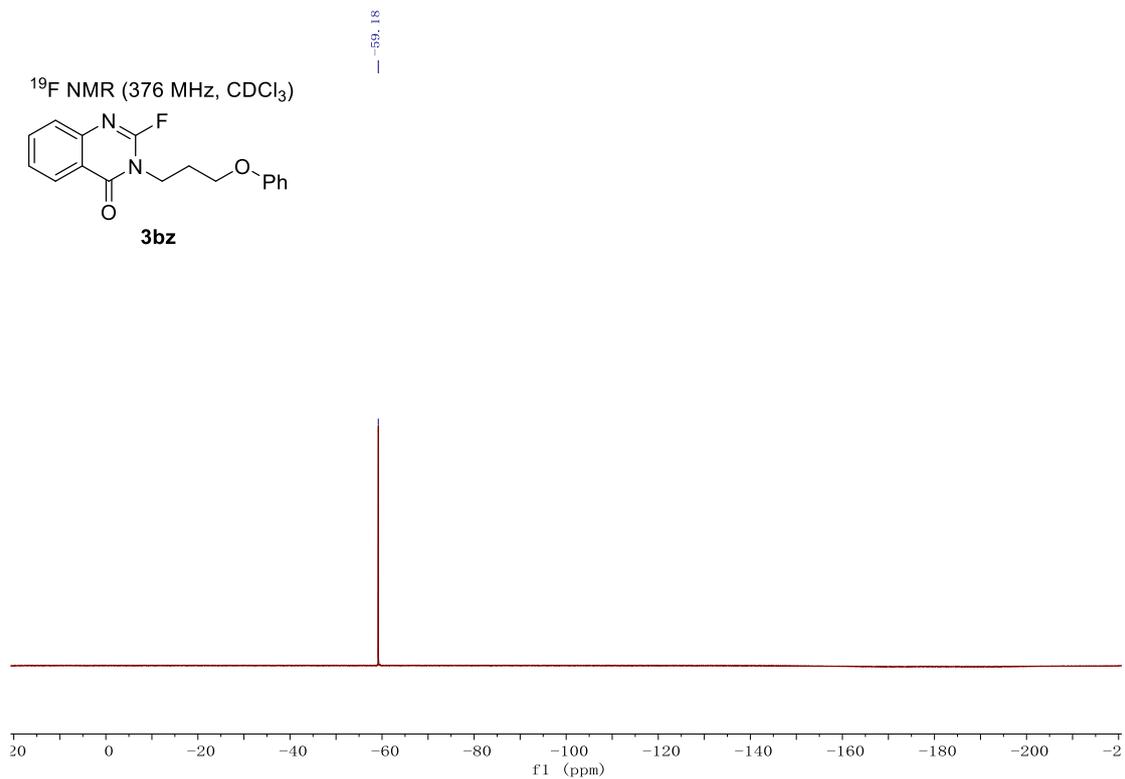
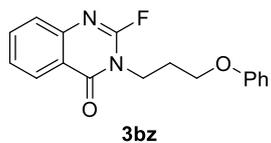
^1H NMR (400 MHz, CDCl_3)



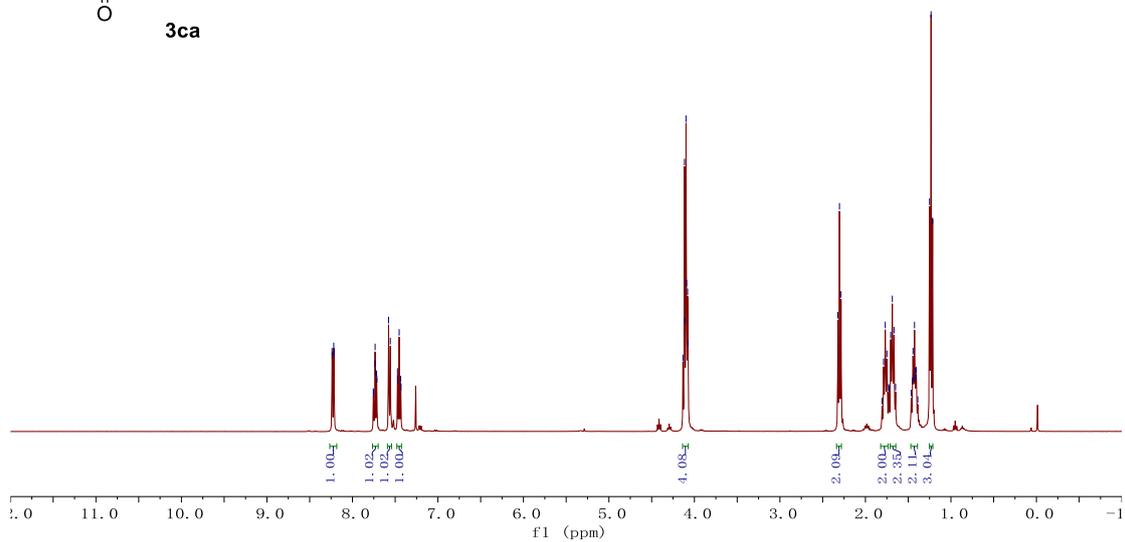
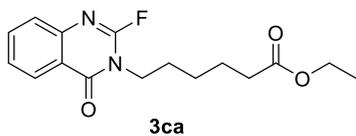


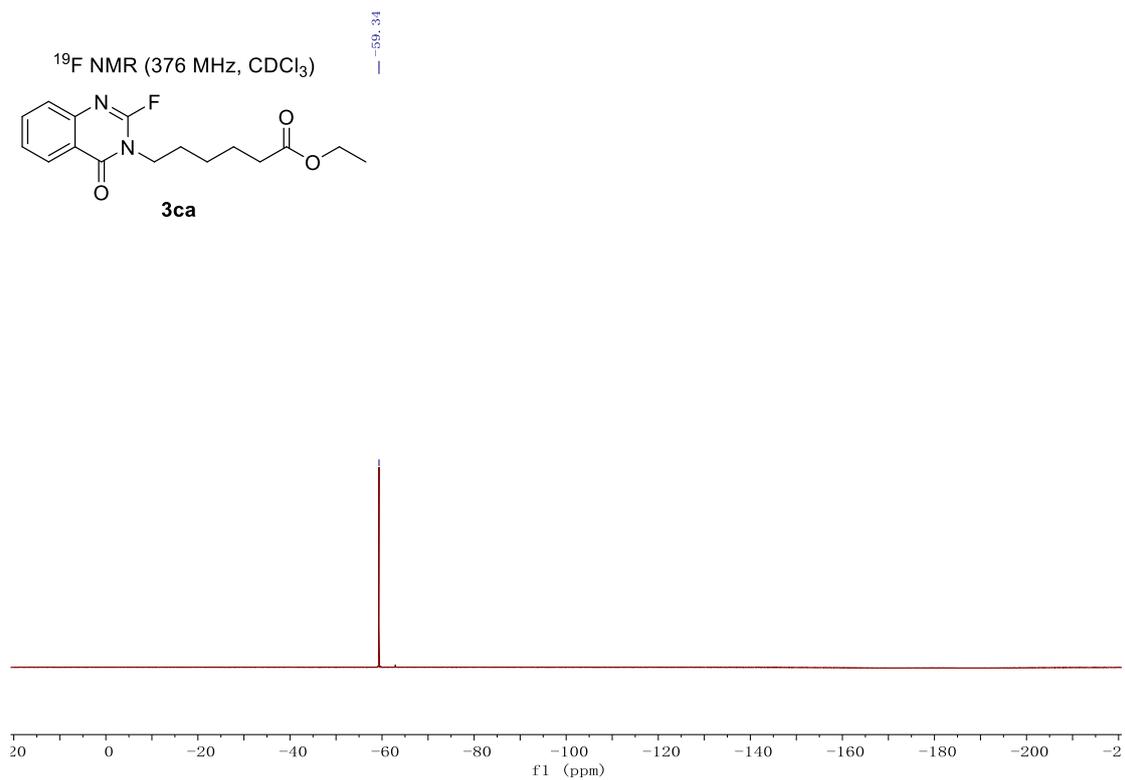
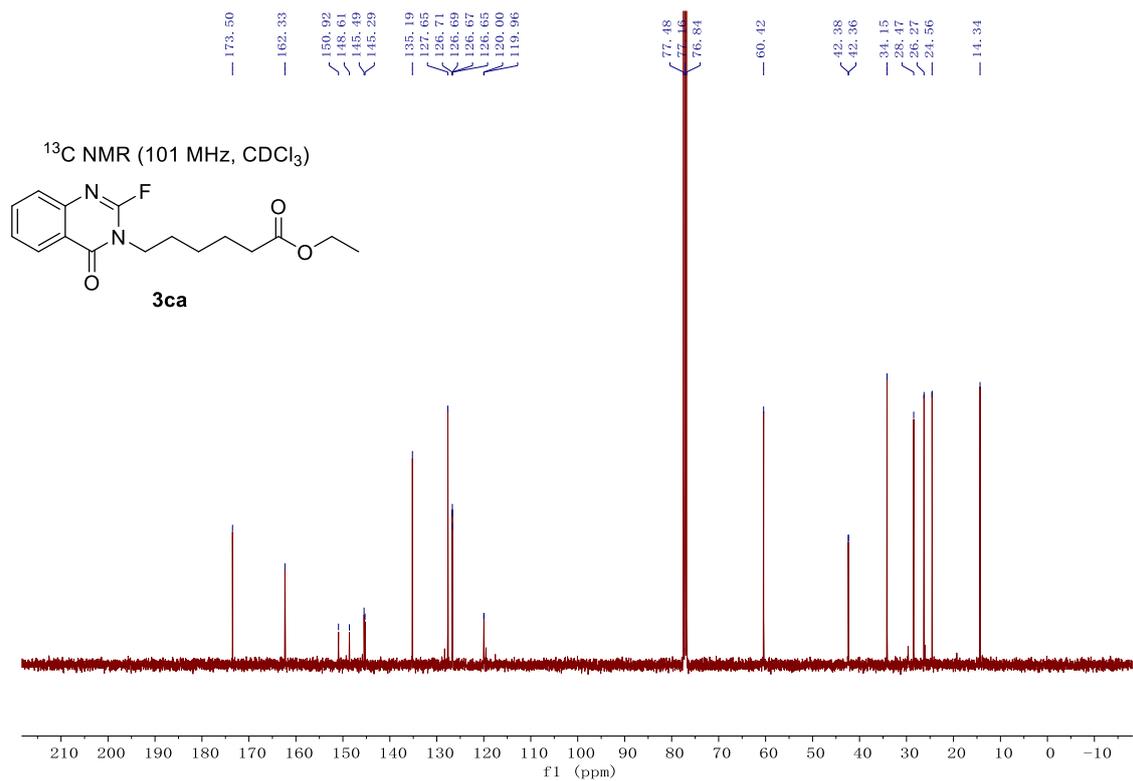


^{19}F NMR (376 MHz, CDCl_3)

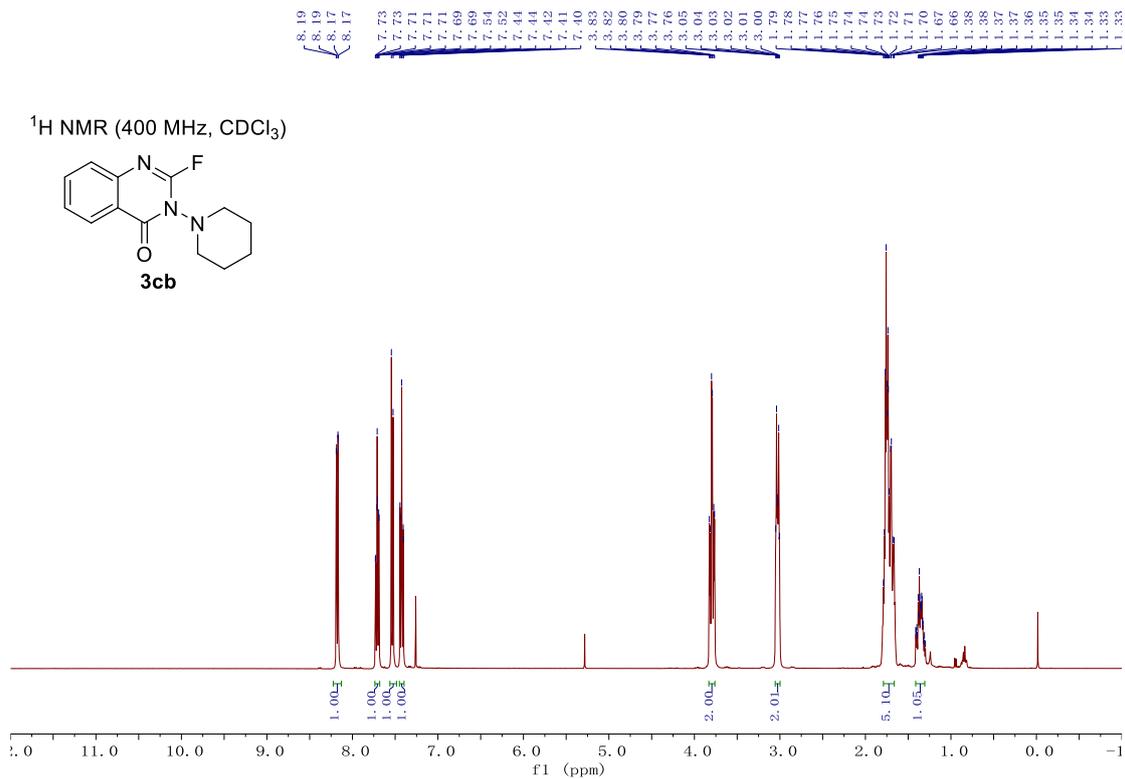
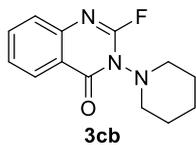


^1H NMR (400 MHz, CDCl_3)

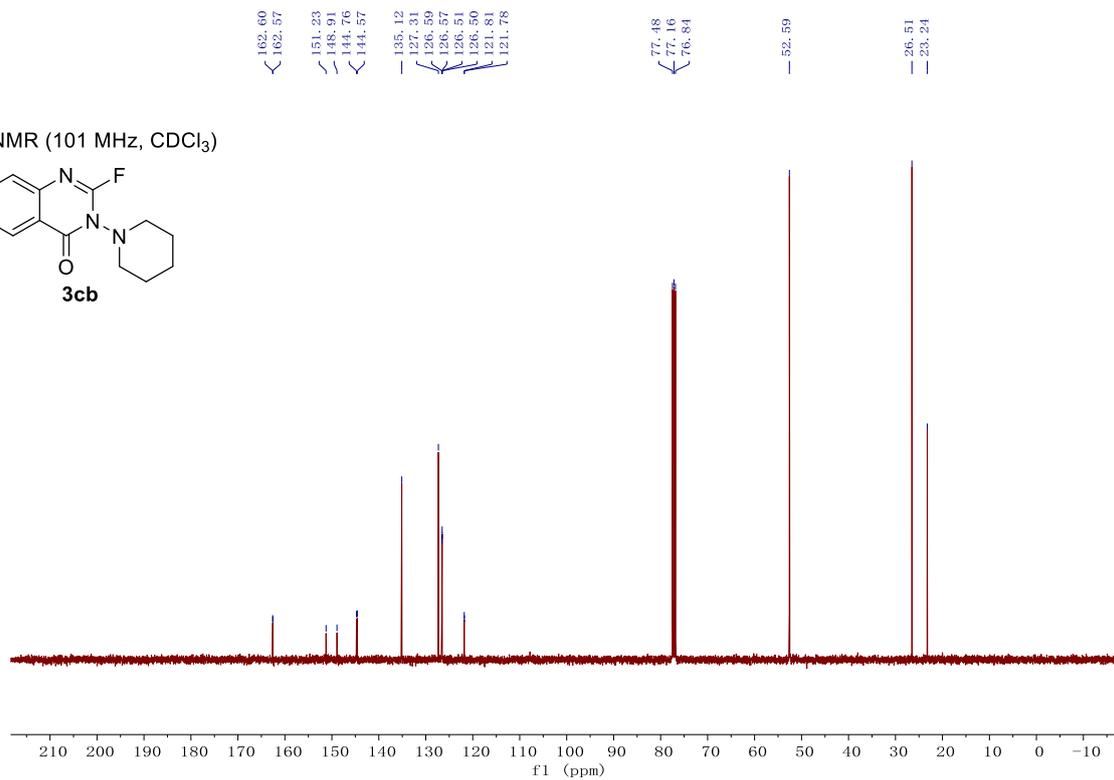
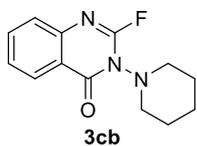




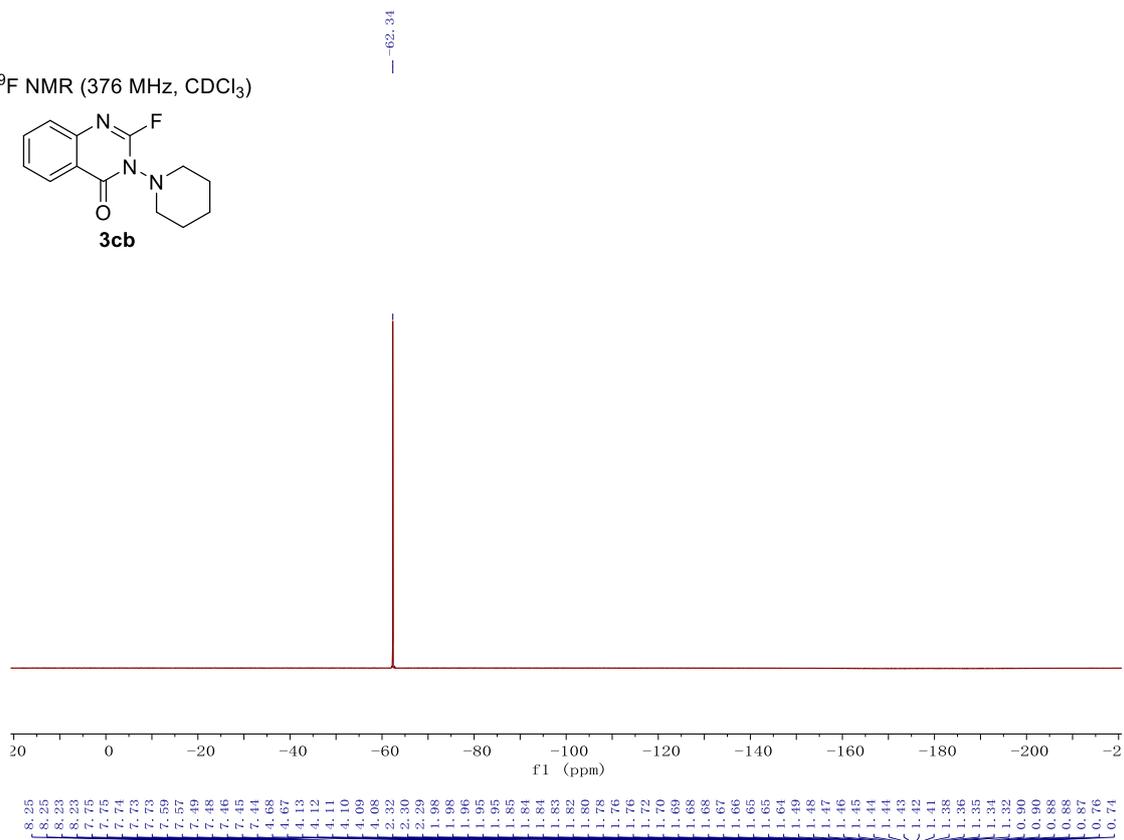
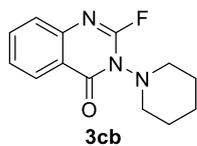
¹H NMR (400 MHz, CDCl₃)



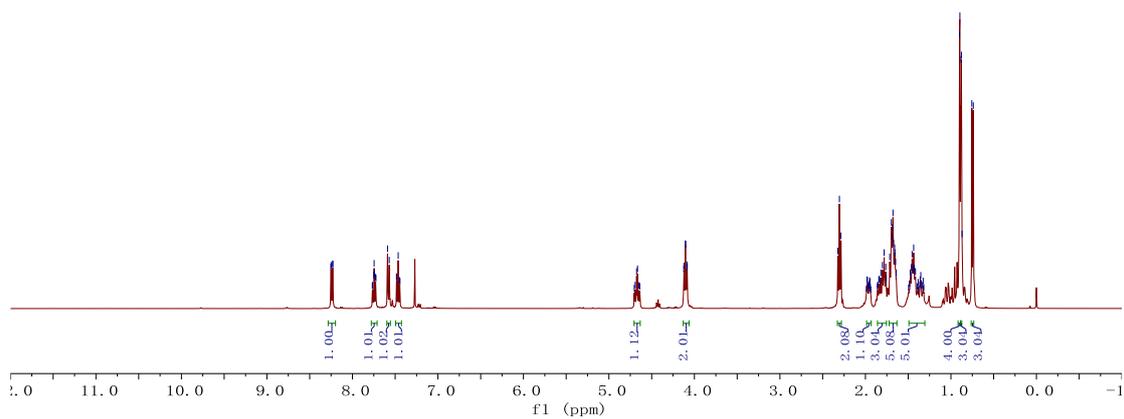
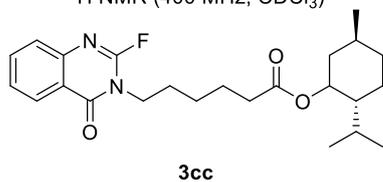
¹³C NMR (101 MHz, CDCl₃)

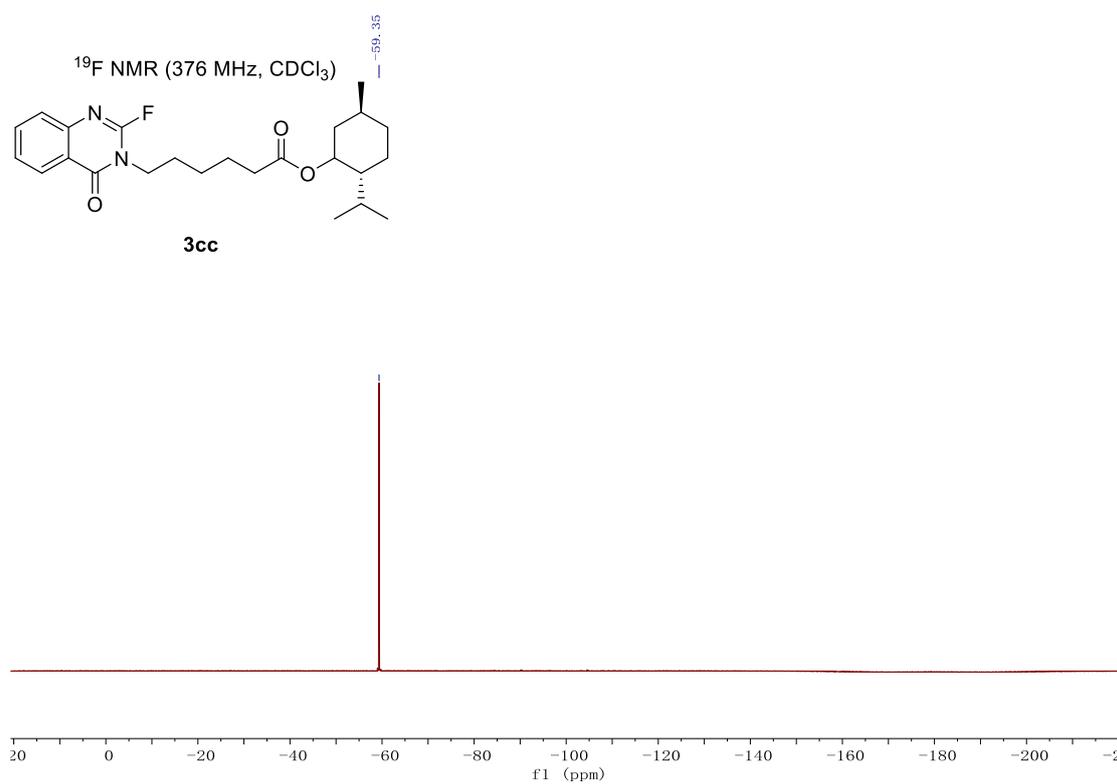
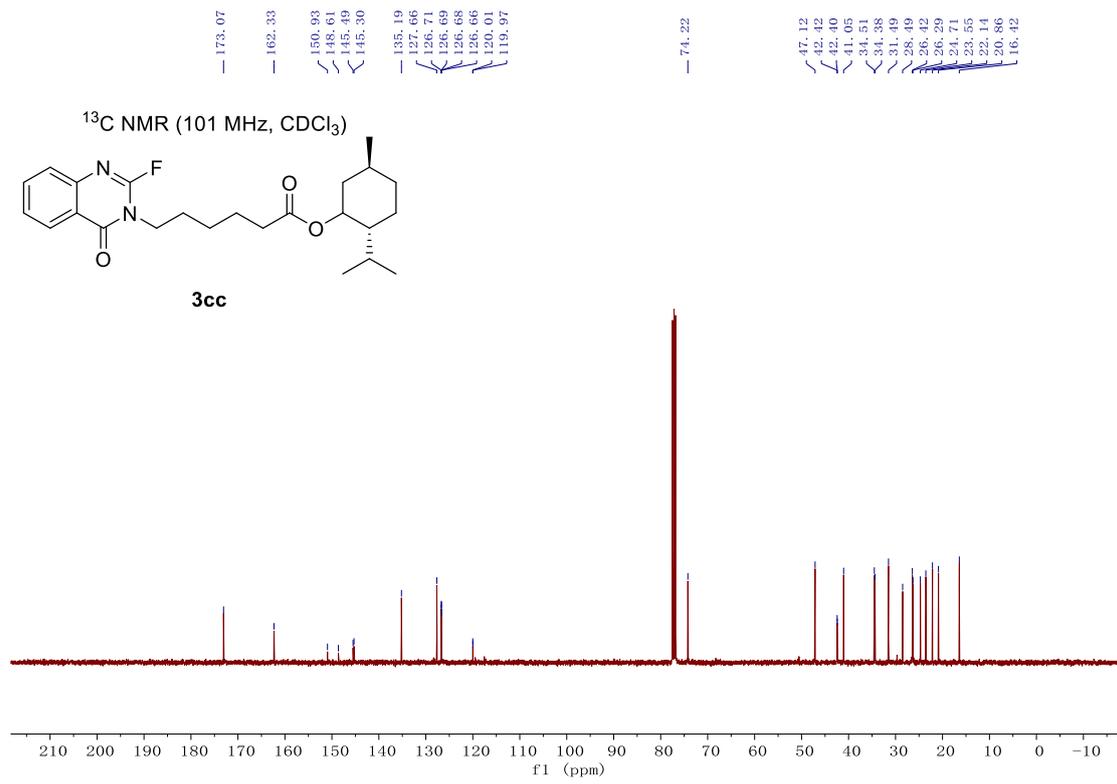


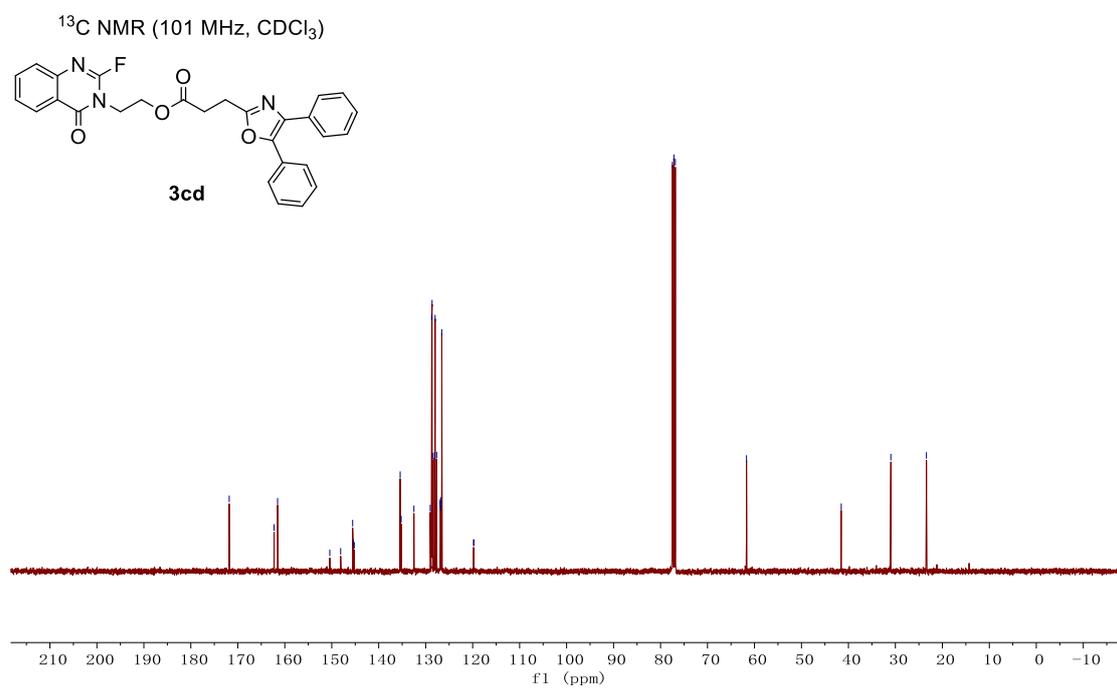
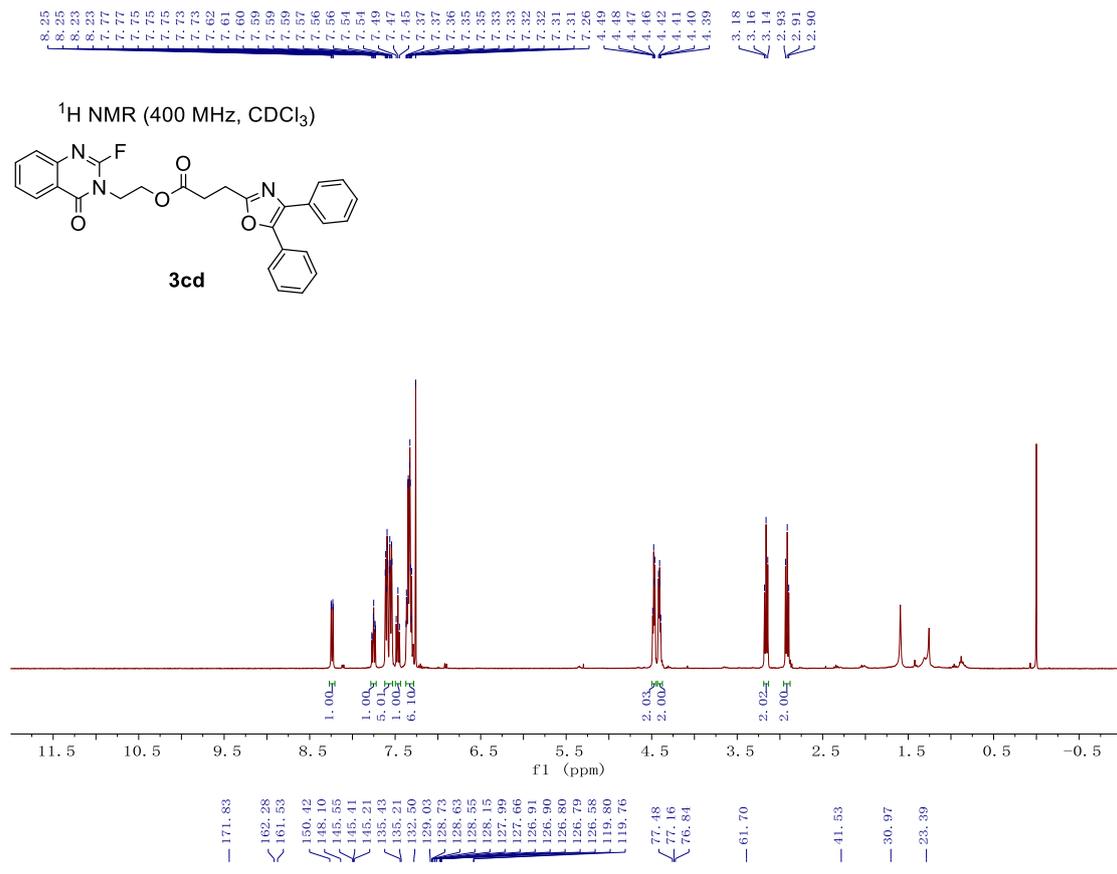
¹⁹F NMR (376 MHz, CDCl₃)

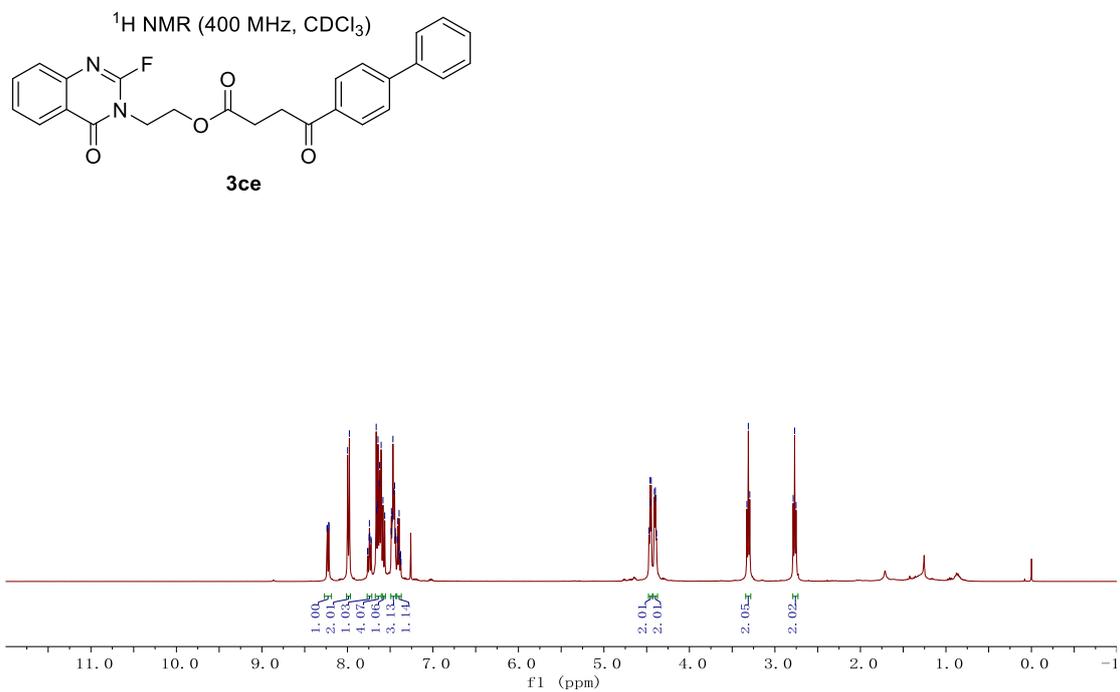
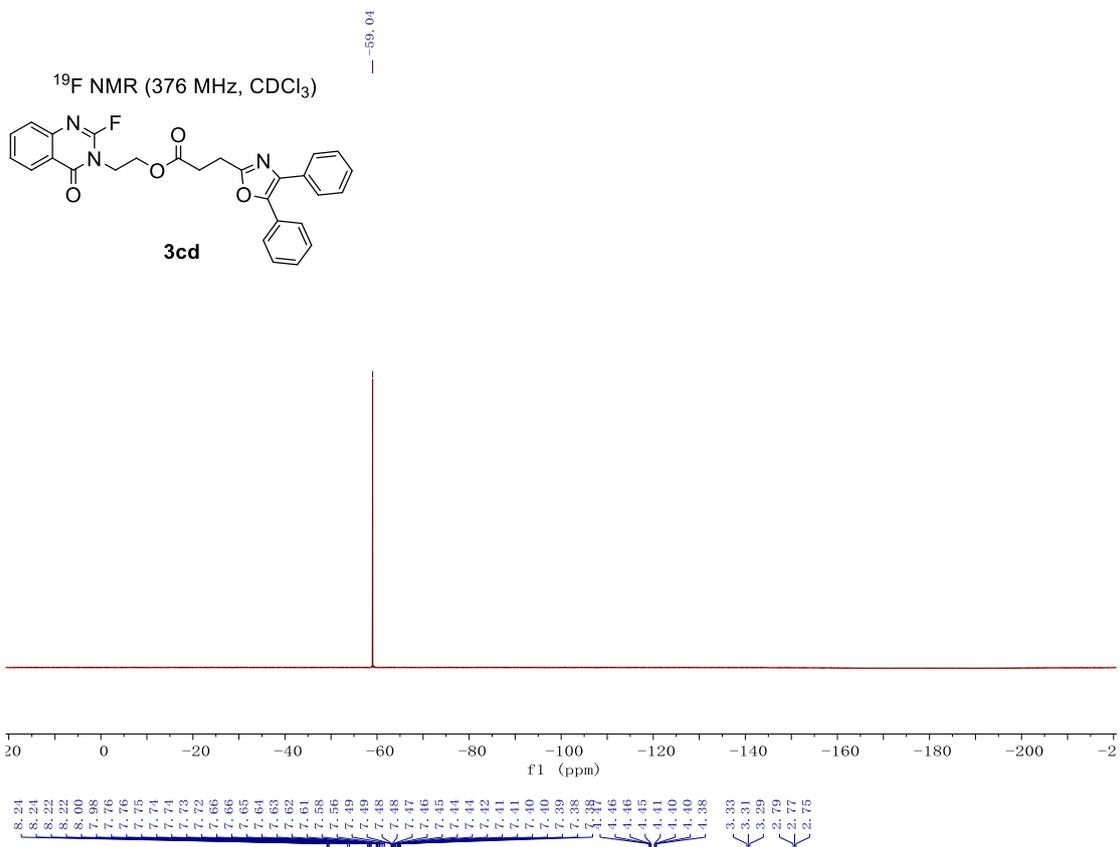


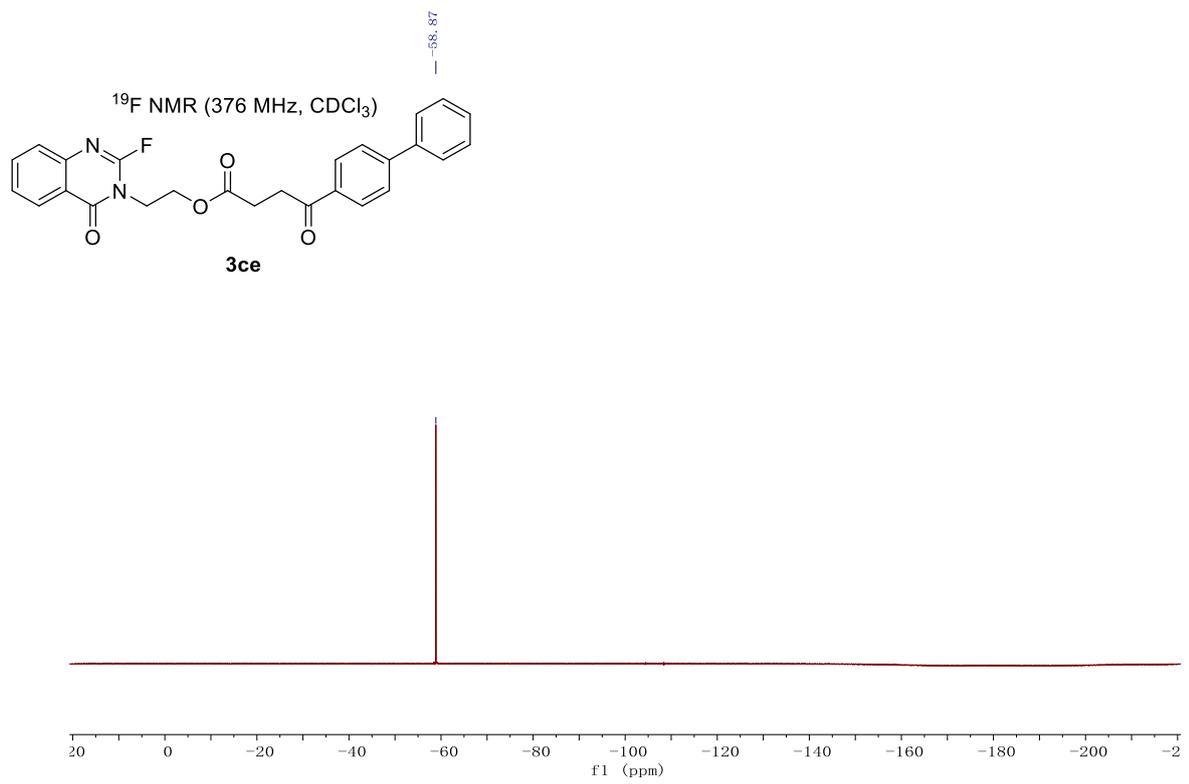
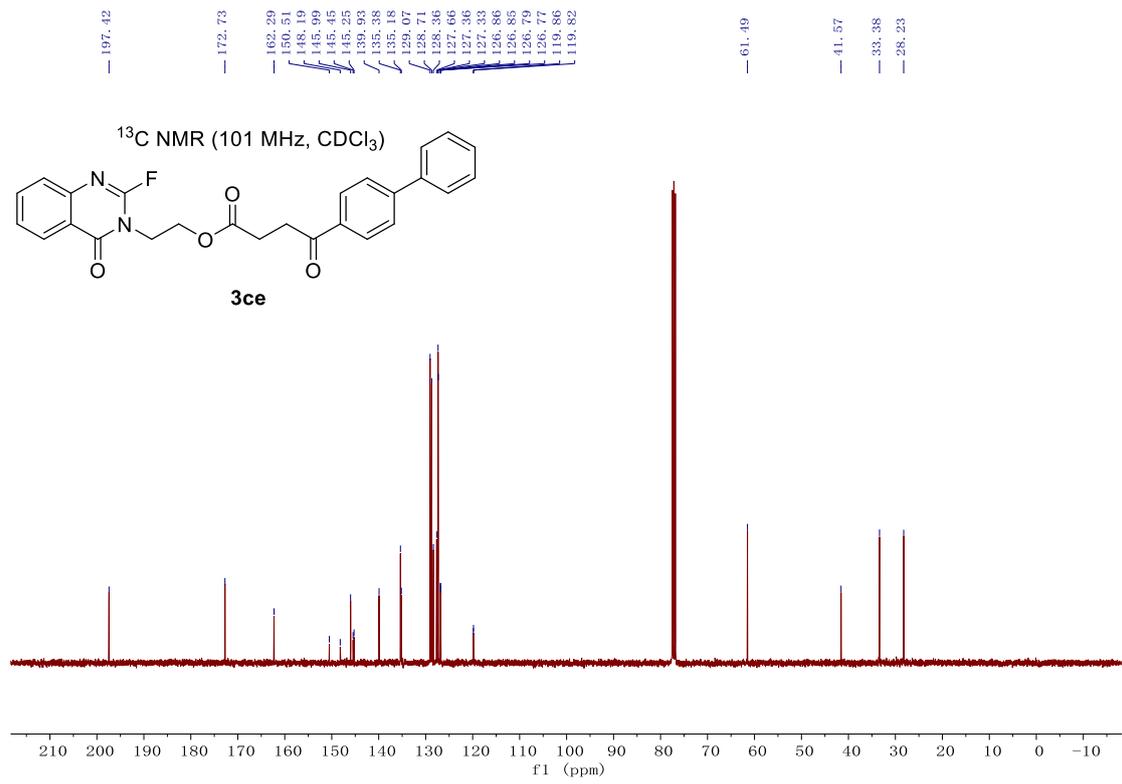
¹H NMR (400 MHz, CDCl₃)

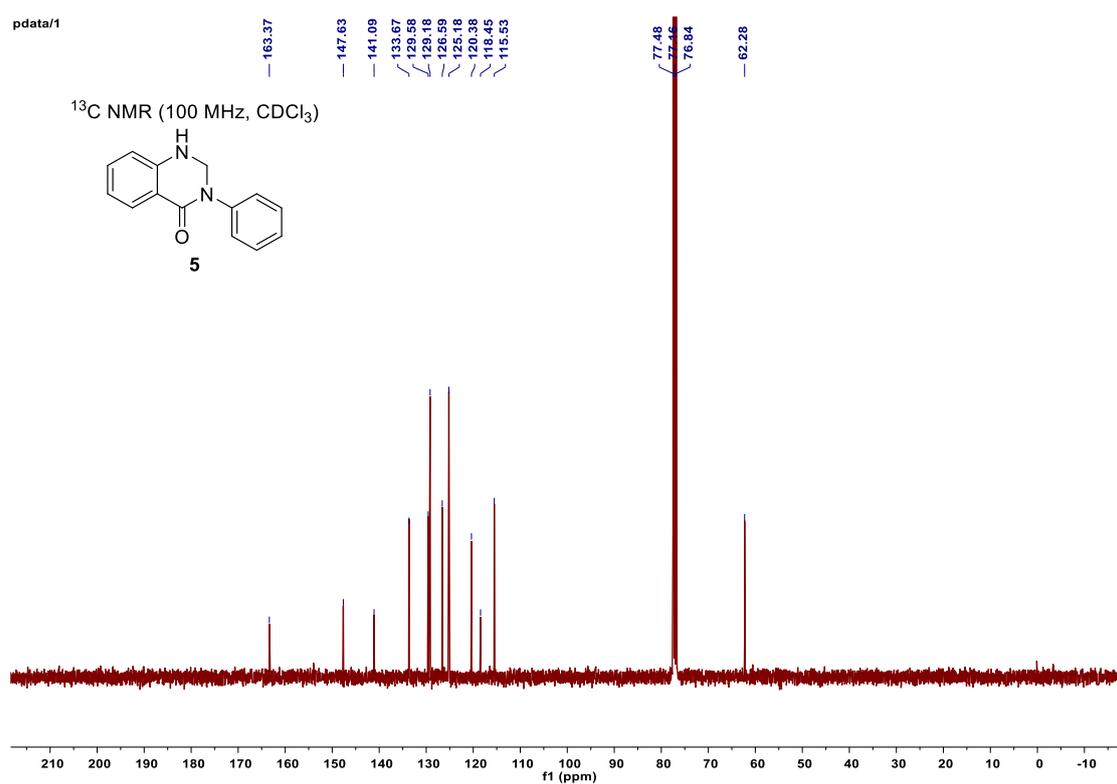
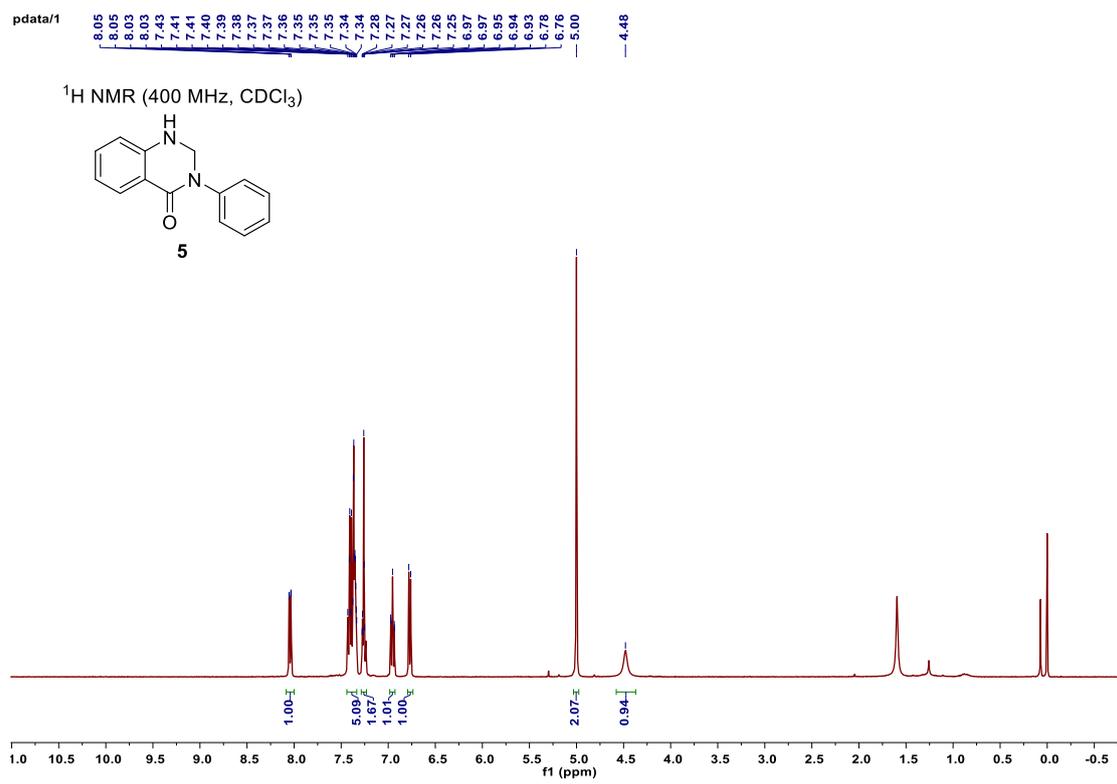








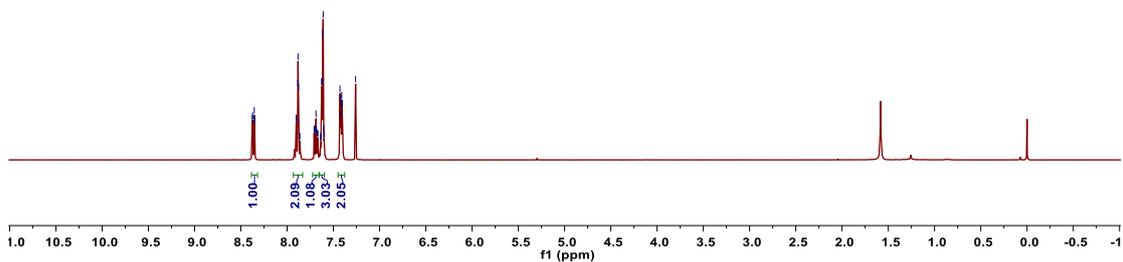
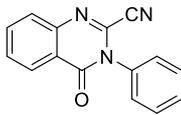




pdata/1

8.38
8.37
8.36
8.35
8.35
7.90
7.88
7.88
7.86
7.96
7.71
7.71
7.69
7.68
7.68
7.67
7.67
7.64
7.63
7.62
7.62
7.61
7.60
7.60
7.43
7.42
7.42
7.41
7.41
7.40
7.26

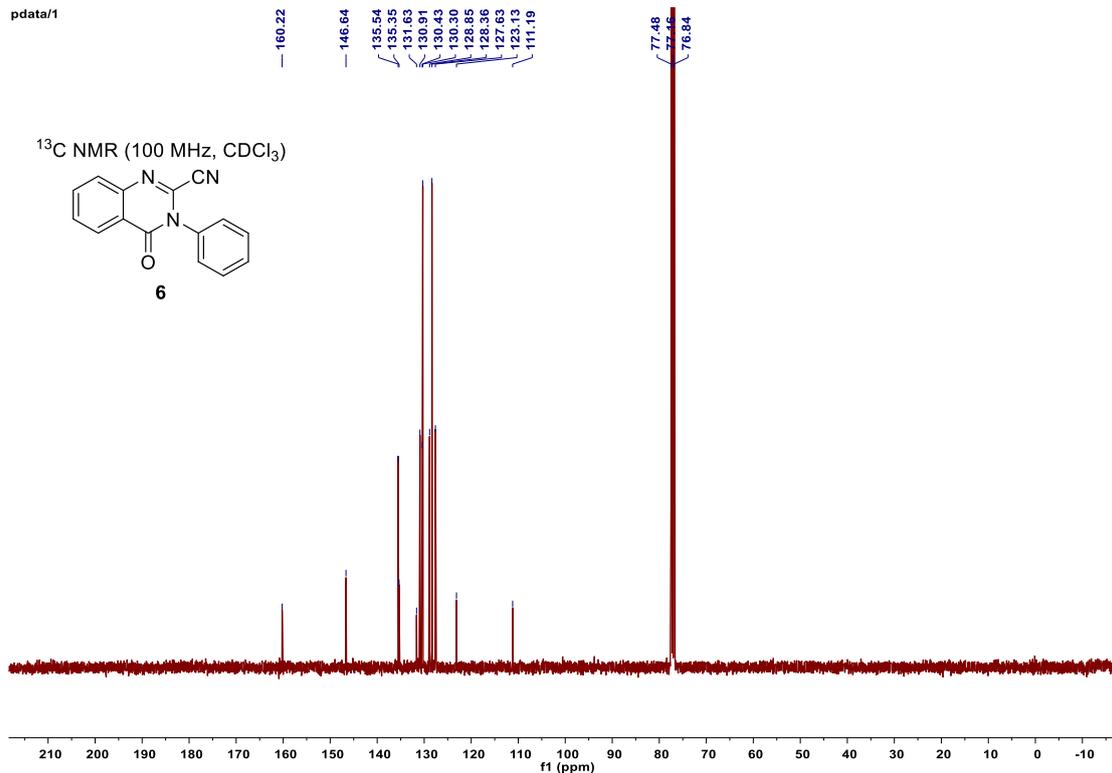
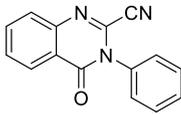
¹H NMR (400 MHz, CDCl₃)

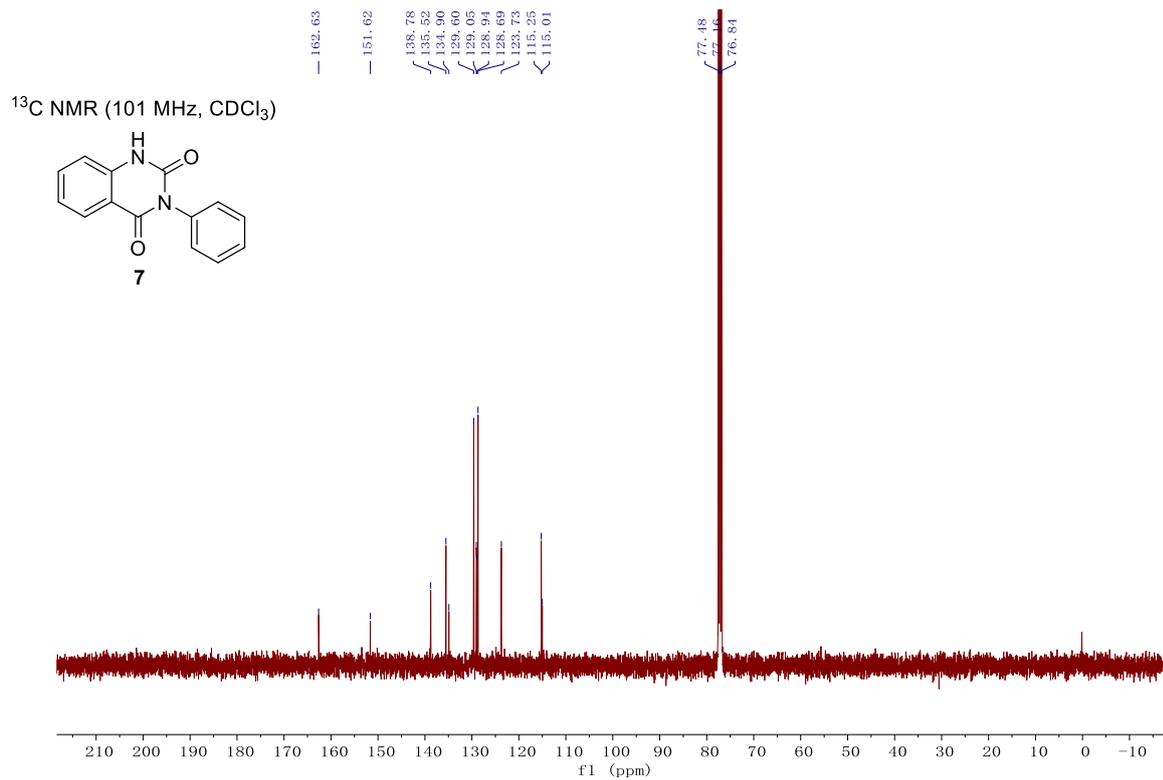
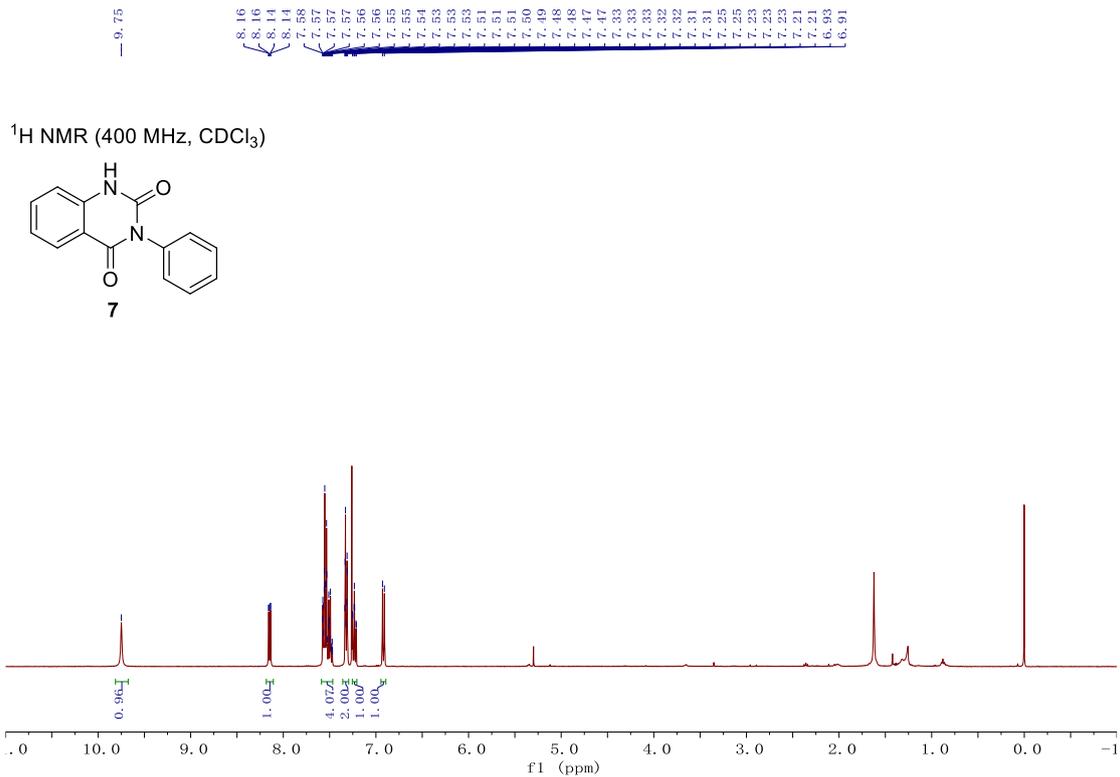


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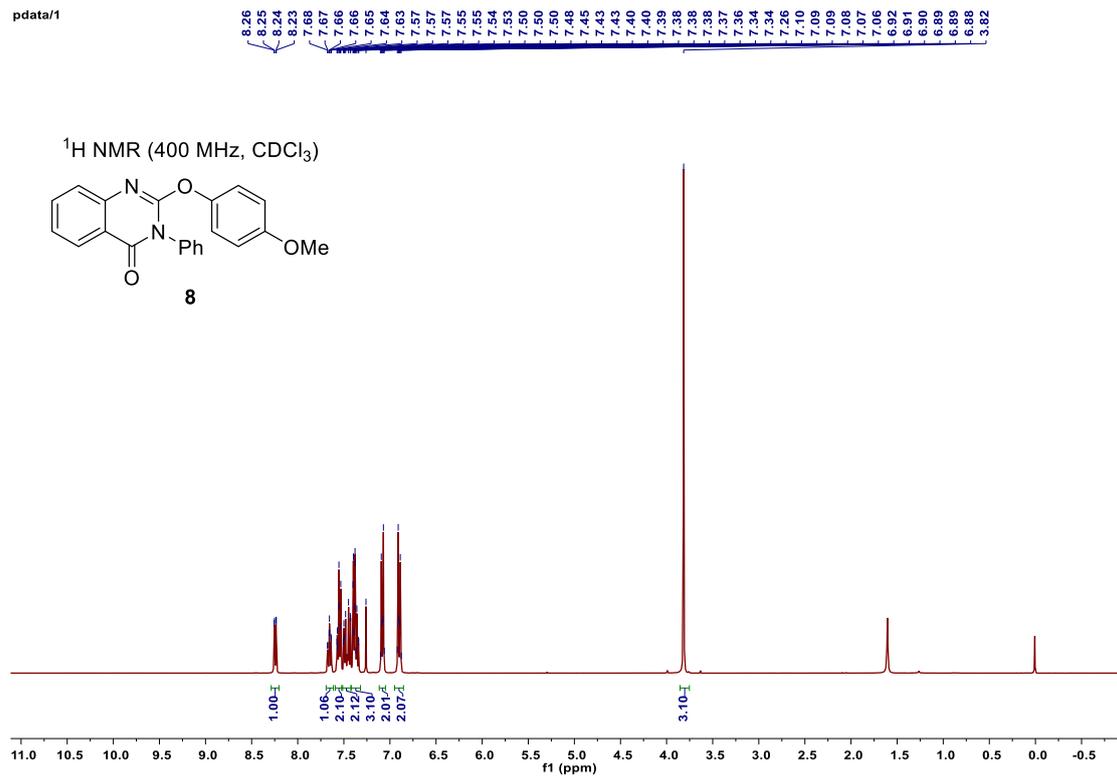
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146.64
135.54
131.63
130.91
130.43
128.80
128.36
127.63
123.13
111.19
77.48
77.46
76.84

¹³C NMR (100 MHz, CDCl₃)

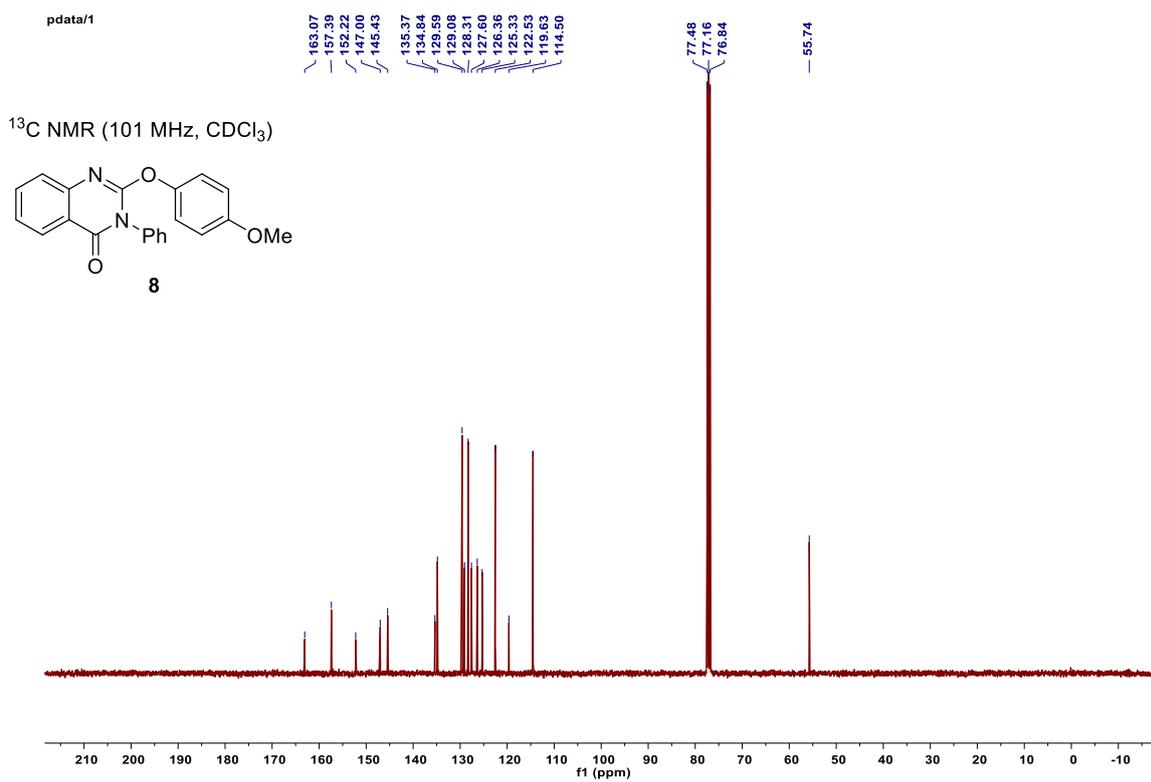




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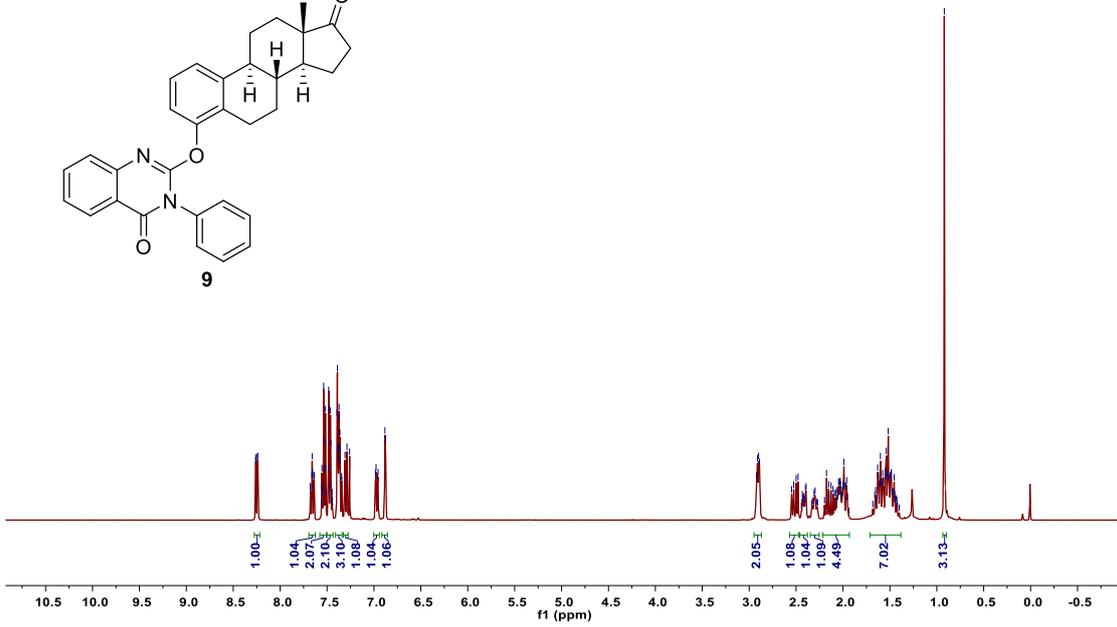
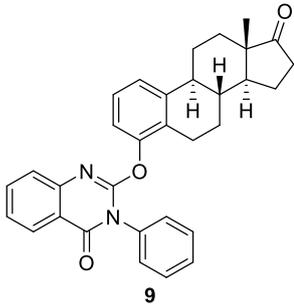


pdata/1



8.24
8.23
8.23
8.24
7.66
7.65
7.64
7.55
7.54
7.53
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7.49
7.48
7.46
7.46
7.39
7.39
7.38
7.38
7.37
7.37
7.37
7.36
7.36
7.35
7.34
7.31
7.29
7.26
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6.88
6.88
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2.91
2.90
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2.04
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2.03
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1.96
1.63
1.62
1.61
1.60
1.59
1.58
1.57
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0.92

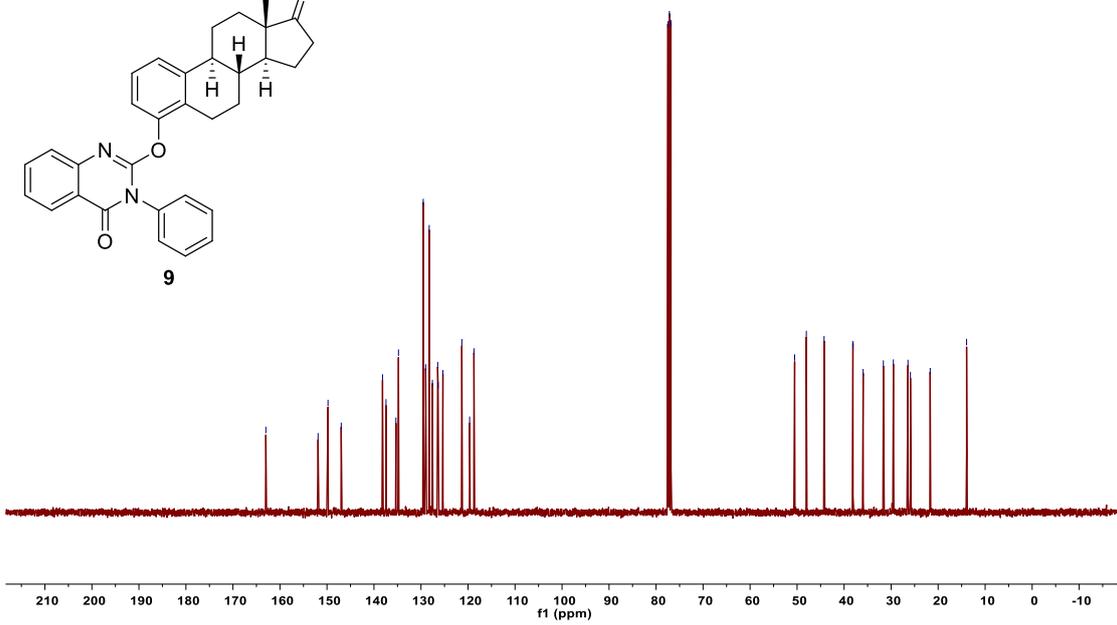
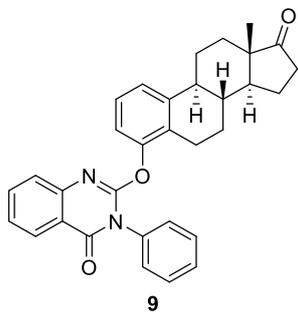
¹H NMR (400 MHz, CDCl₃)

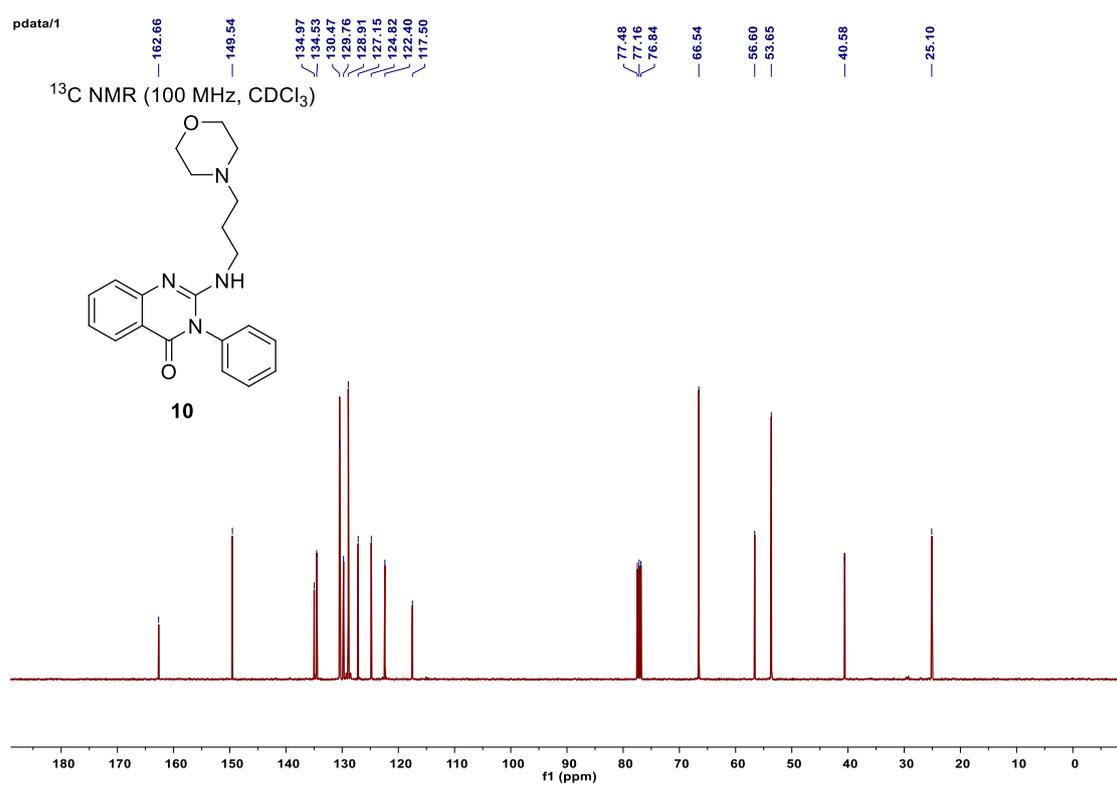
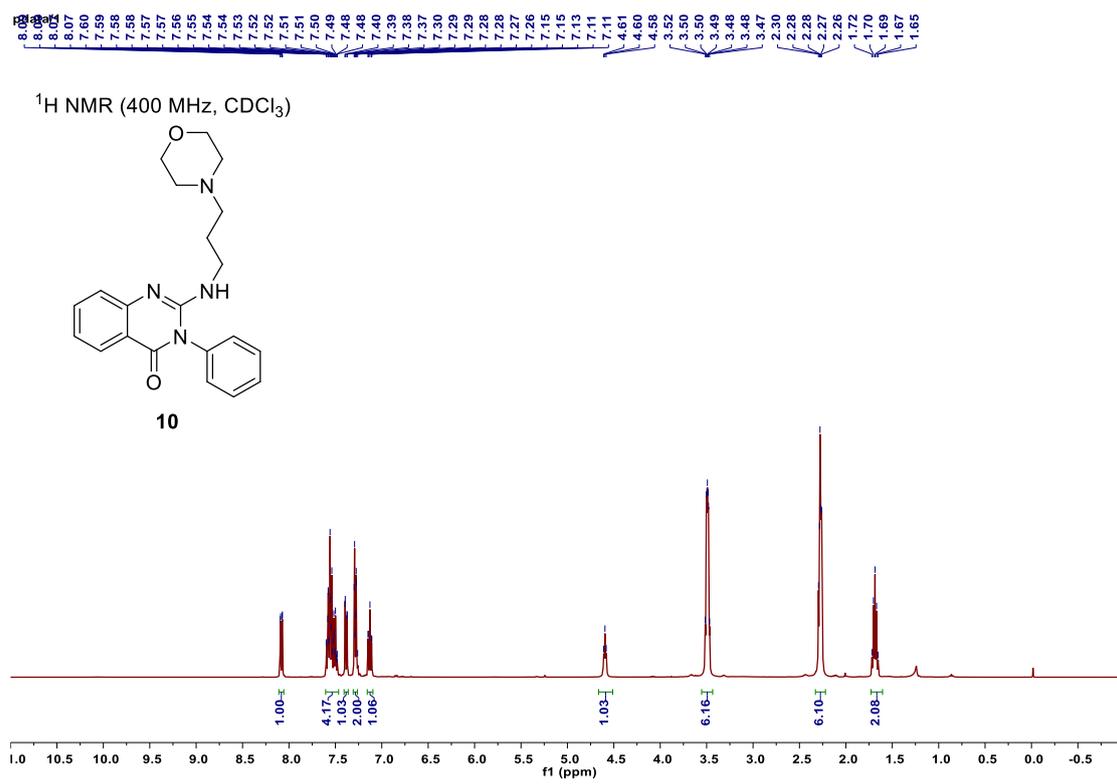


pdata/1

163.00
151.90
149.78
146.97
138.18
137.44
135.33
134.79
129.52
129.00
128.68
128.45
126.45
126.35
125.34
121.31
119.65
118.73
77.48
77.16
76.84
50.52
48.03
44.25
38.12
35.95
31.65
28.52
26.42
25.89
21.69
13.95

¹³C NMR (100 MHz, CDCl₃)

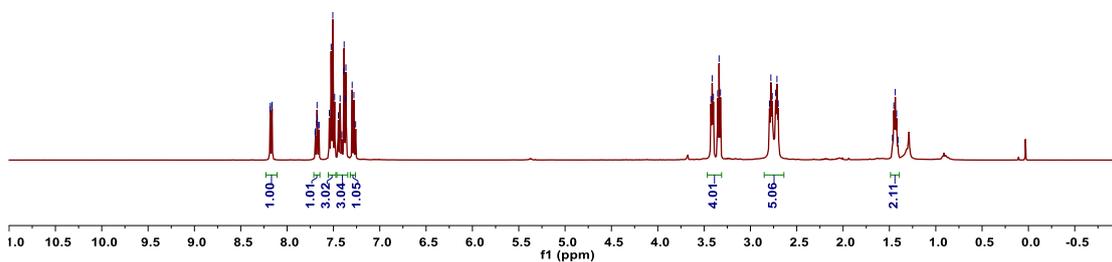
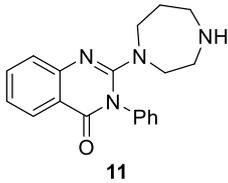




pdata/1

8.18
8.17
8.16
7.70
7.69
7.68
7.67
7.66
7.66
7.54
7.53
7.51
7.49
7.48
7.43
7.41
7.39
7.38
7.37
7.37
7.30
7.28
7.26
3.43
3.41
3.40
3.35
3.34
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1.42
1.41

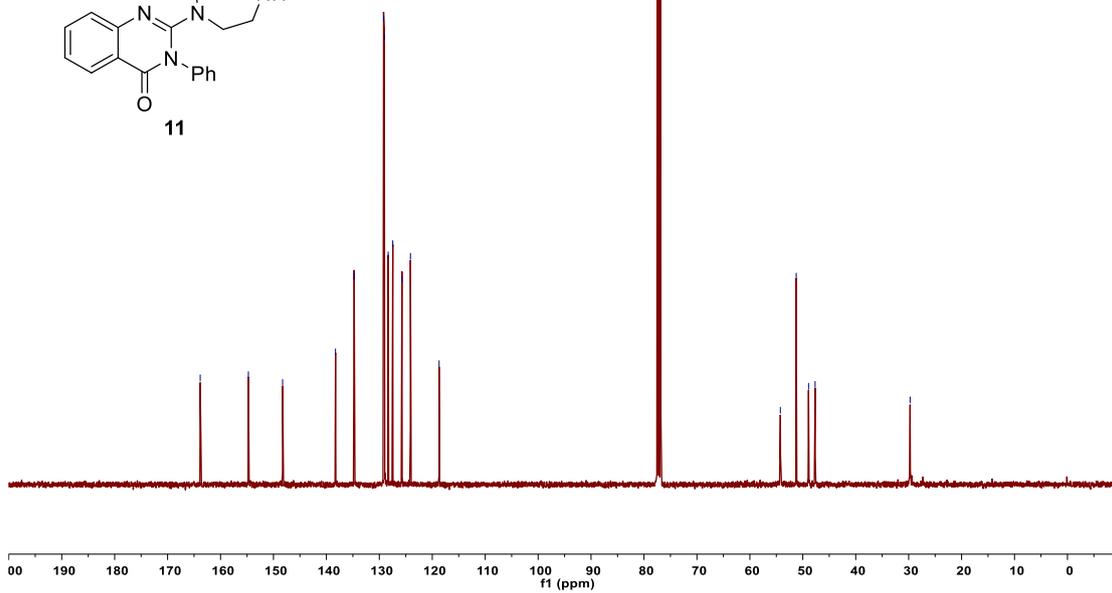
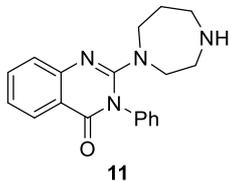
¹H NMR (400 MHz, CDCl₃)

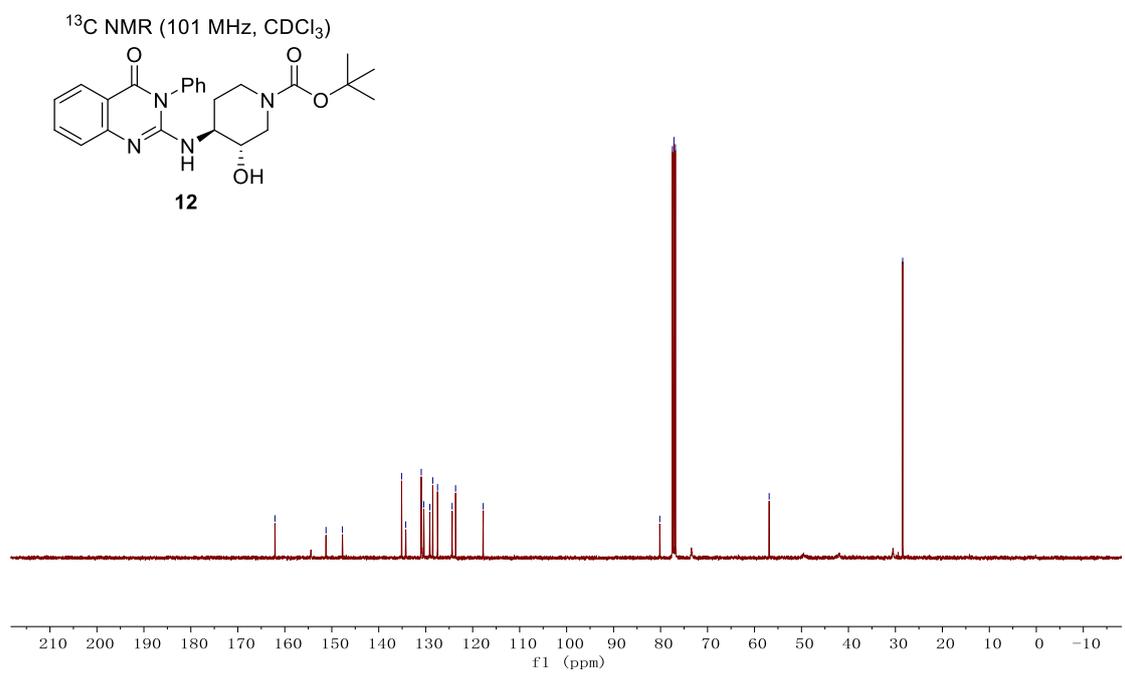
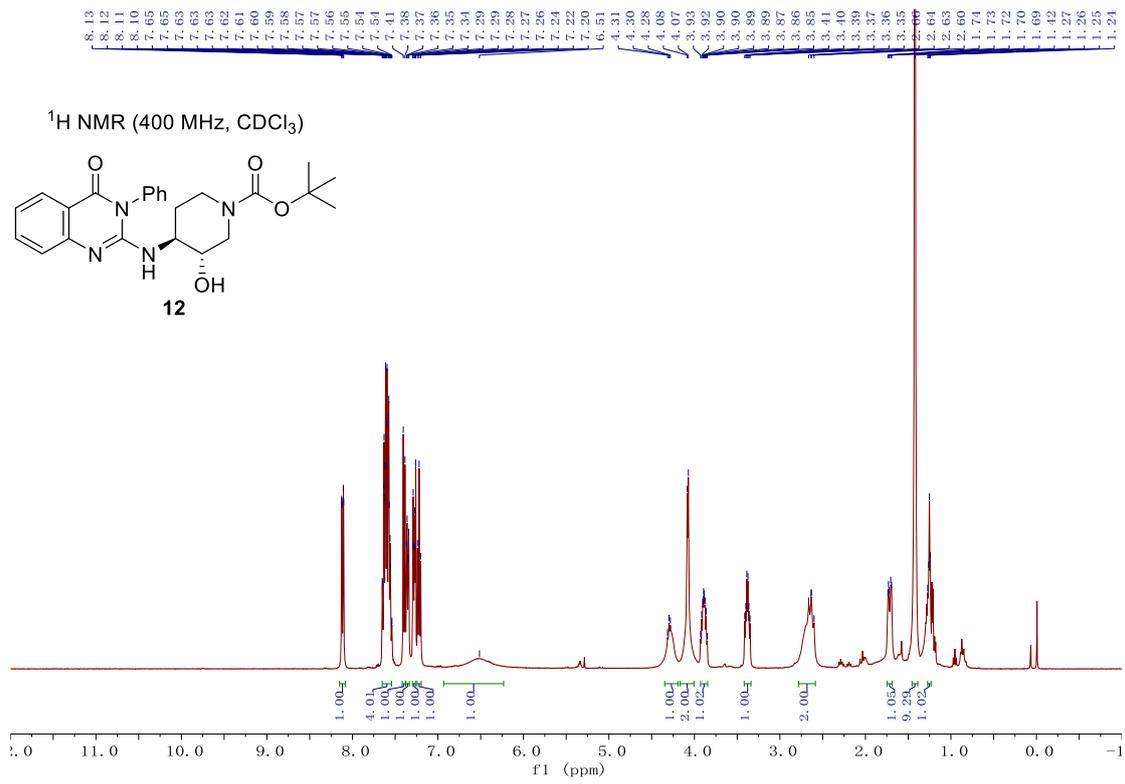


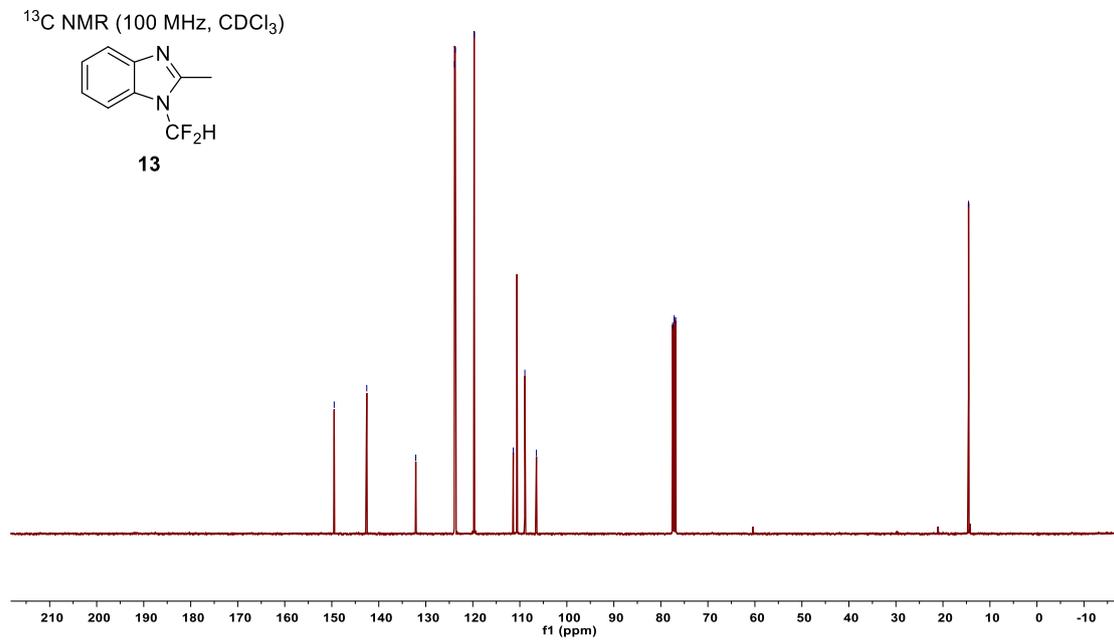
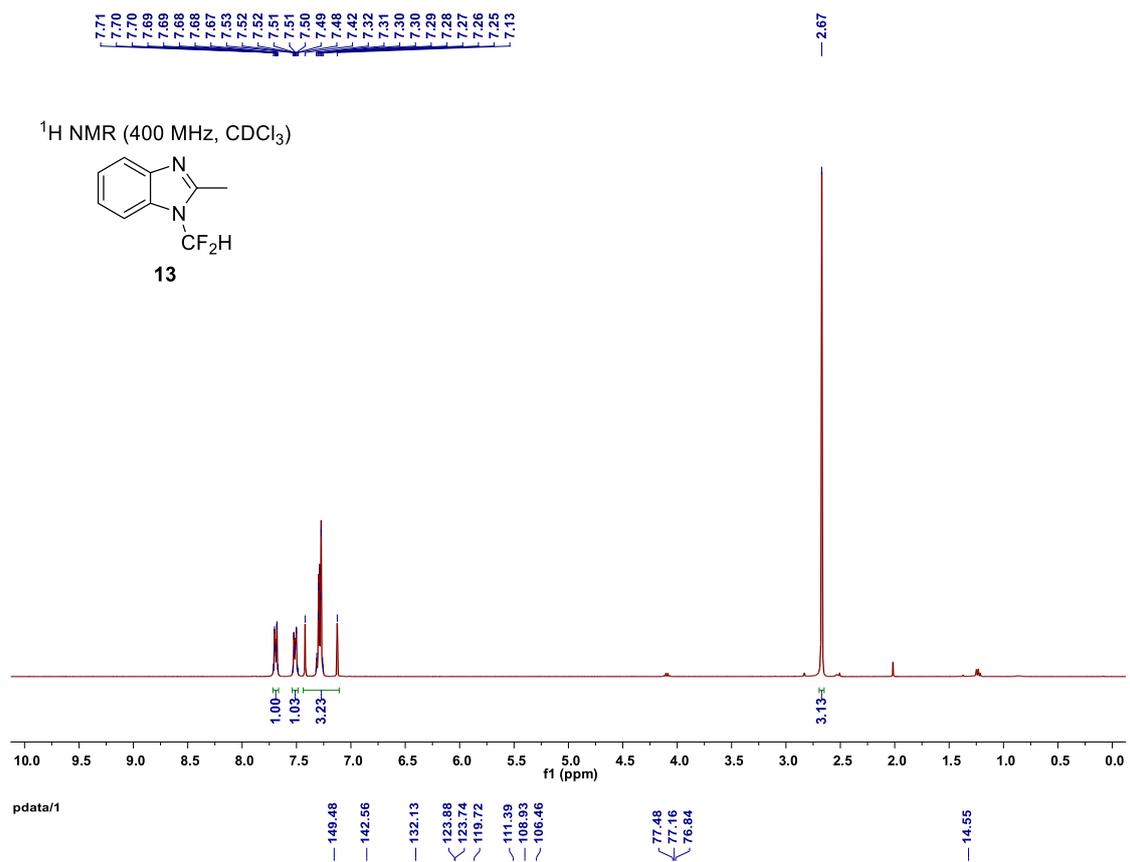
pdata/1

163.84
154.74
148.27
138.28
134.76
129.20
129.06
128.33
127.46
125.74
124.12
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76.84
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54.24
48.91
47.67
29.73

¹³C NMR (100 MHz, CDCl₃)

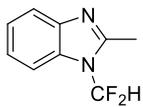






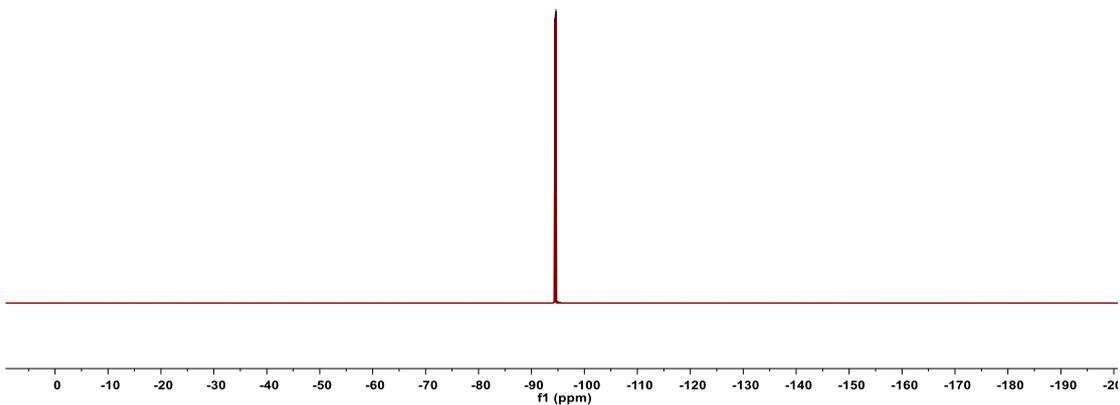
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¹⁹F NMR (376 MHz, CDCl₃)



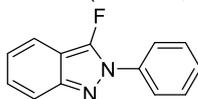
13

94.45
94.62

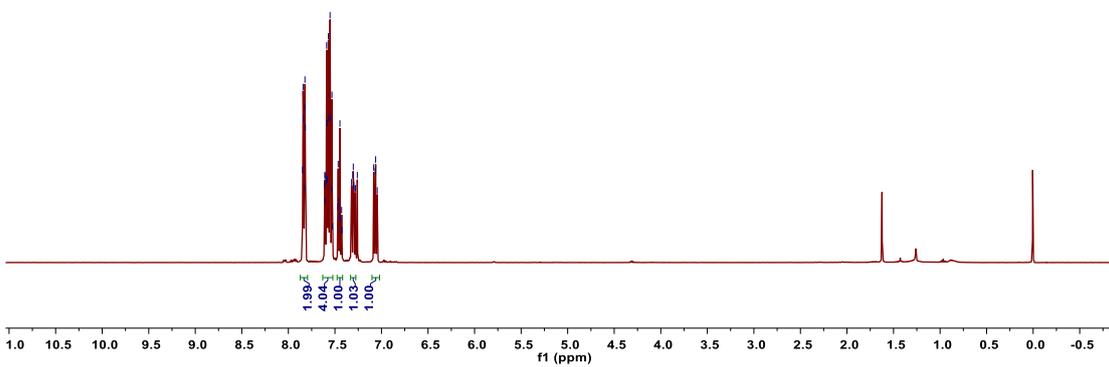


7.89
7.88
7.84
7.83
7.82
7.82
7.81
7.81
7.61
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7.58
7.57
7.57
7.55
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7.42
7.42
7.32
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7.06
7.05

¹H NMR (400 MHz, CDCl₃)

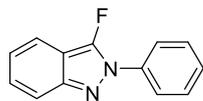


Int/4a

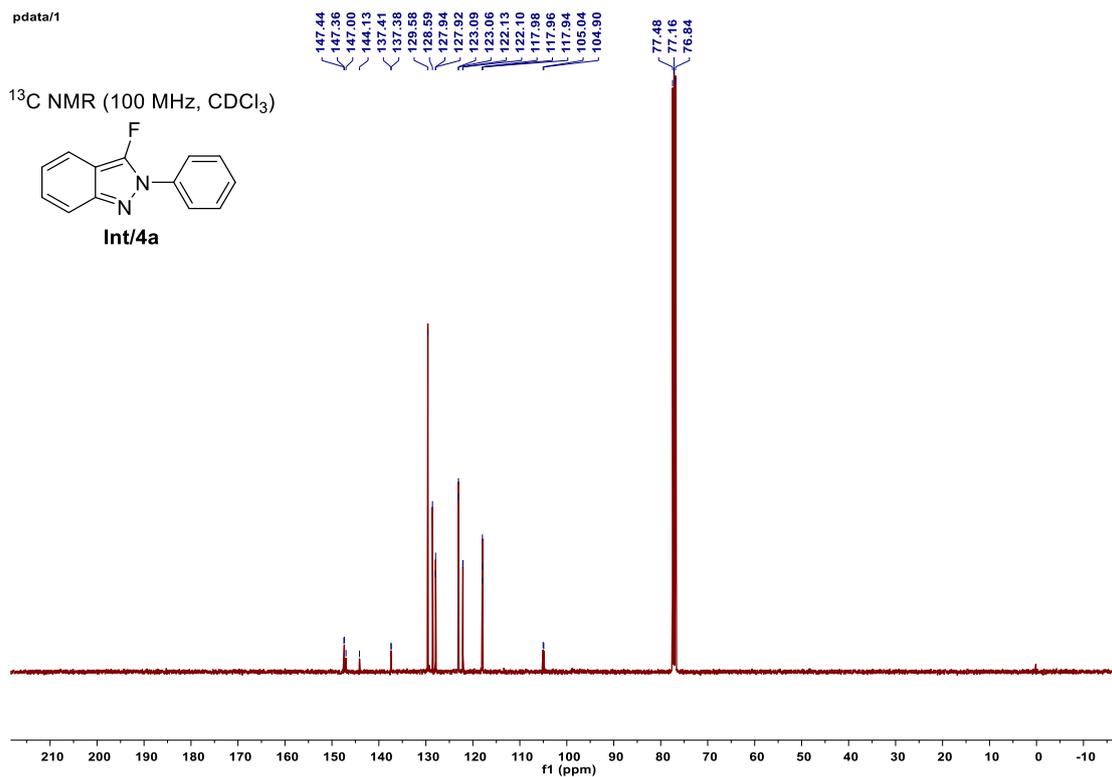


pdata/1

¹³C NMR (100 MHz, CDCl₃)

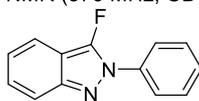


Int/4a



pdata/1

¹⁹F NMR (376 MHz, CDCl₃)



Int/4a

