Electronic Supplementary Material (ESI) for Organic Chemistry Frontiers.

Supporting Information

Palladium-Catalyzed Reductive Desulfonative Aminocarbonylation of Benzylsulfonyl Chlorides with Nitroarenes to Arylacetamides

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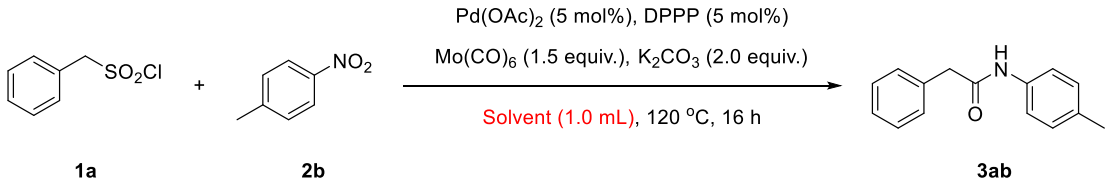
1. General Information

Unless otherwise noted, all reactions were carried out under N_2 atmosphere. All reagents were from commercial sources and used as received without further purification. All solvents were dry. Column chromatography was performed on silica gel (200-300 mesh size) using petroleum ether and ethyl acetate as eluent. NMR spectra were recorded on a Bruker Avance operating at for ^{1}H NMR at 400 MHz, ^{13}C NMR at 101 MHz and ^{19}F NMR at 377 MHz and spectral data were reported in ppm relative to tetramethylsilane (TMS) as internal standard and $CDCl_3$ (^{1}H NMR δ 7.26, ^{13}C NMR δ 77.16), DMSO-d_6 (^{1}H NMR δ 2.50, ^{13}C NMR δ 39.52) as solvent. All coupling constants (*J*) are reported in Hz. The following abbreviations were used to describe peak splitting patterns when appropriate: s = singlet, d = doublet, dd = double doublet, ddd = double doublet of doublets, t = triplet, dt = double triplet, q = quatriplet, m = multiplet, br = broad. Gas chromatography (GC) analyses were performed on a Shimadzu GC-2014C chromatograph equipped with a FID detector. Mass spectra (MS) were measured on spectrometer by direct inlet at 70 eV. Mass spectroscopy data of the products were collected on an HRMS-TOF instrument or Waters TOFMS GCT Premier using EI or ESI ionization. Melting points were measured with WRR digital point apparatus and not corrected.

2. Optimization of Reaction Conditions

Table S1. Screening of Solvents[a]

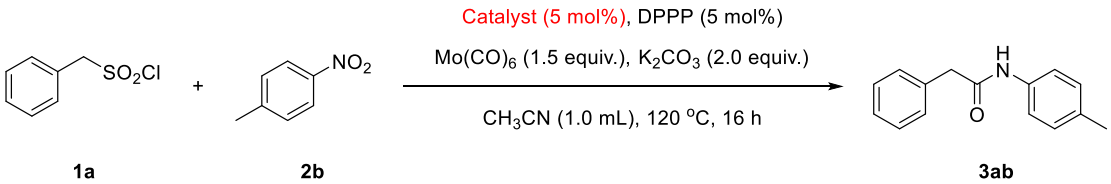


1a **2b** **3ab**

Entry	Solvent	Yield(%)
1	CH_3CN	43
2	1,4-Dioxane	16
3	THF	31
4	DMF	Trace
5	DMSO	N.D.
6	Toluene	8

[a]Reaction conditions: **1a** (0.2 mmol), **2b** (0.3 mmol), $Pd(OAc)_2$ (5 mol%), DPPP (5 mol%), $Mo(CO)_6$ (1.5 equiv.), K_2CO_3 (2.0 equiv.), Solvent (1.0 mL), 120 °C, 16 h. GC yield, with dodecane as the internal standard.

Table S2. Screening of Catalysts[a]

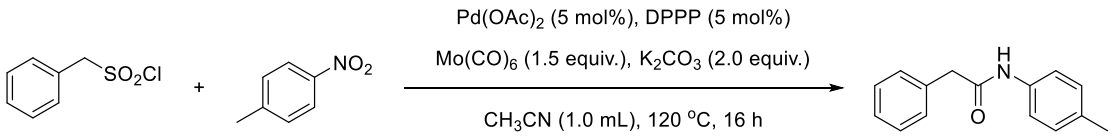


1a **2b** **3ab**

Entry	Catalyst	Yield(%)
1	$Pd(OAc)_2$	43
2	$Pd(PPh_3)_4$	40
3	$Pd_2(dba)_3$	36
4	$Pd(acac)_2$	27
5	$PdCl_2$	23
6	$Pd(TFA)_2$	19

[a]Reaction conditions: **1a** (0.2 mmol), **2b** (0.3 mmol), Catalyst (5 mol%), DPPP (5 mol%), $Mo(CO)_6$ (1.5 equiv.), K_2CO_3 (2.0 equiv.), CH_3CN (1.0 mL), 120 °C, 16 h. GC yield, with dodecane as the internal standard.

Table S3. Screening of the Amount of **1a** and **2b**[a]

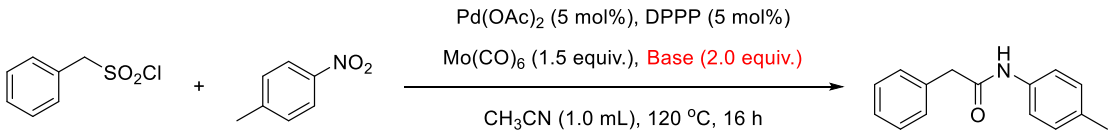


1a **2b** **3ab**

Entry	Condition	Yield(%)
1	1a : 2b = 0.2 : 0.2	38
2	1a : 2b = 0.3 : 0.2	47
3	1a : 2b = 0.4 : 0.2	56
4	1a : 2b = 0.5 : 0.2	52
5	1a : 2b = 0.6 : 0.2	34

[a]Reaction conditions: **1a** (x mmol), **2b** (0.2 mmol), $Pd(OAc)_2$ (5 mol%), DPPP (5 mol%), $Mo(CO)_6$ (1.5 equiv.), K_2CO_3 (2.0 equiv.), CH_3CN (1.0 mL), 120 °C, 16 h. GC yield, with dodecane as the internal standard.

Table S4. Screening of Bases[a]

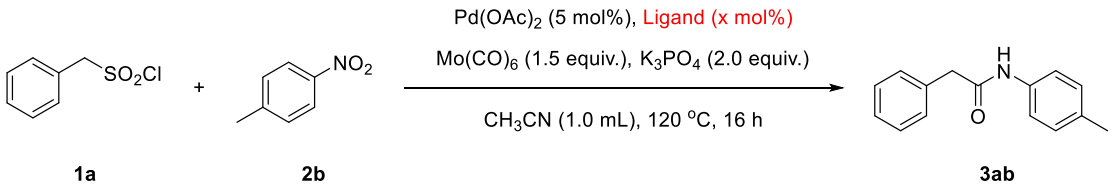


1a **2b** **3ab**

Entry	Base	Yield(%)
1	Cs_2CO_3	42
2	K_3PO_4	74
3	$KHCO_3$	55
4	*t*-BuOK	26
5	Na_2CO_3	57
6	Na_3PO_4	51
7	Et_3N	24
8	DIPEA	35
9	DBU	13

[a]Reaction conditions: **1a** (0.4 mmol), **2b** (0.2 mmol), $Pd(OAc)_2$ (5 mol%), DPPP (5 mol%), $Mo(CO)_6$ (1.5 equiv.), Base (2.0 equiv.), CH_3CN (1.0 mL), 120 °C, 16 h. GC yield, with dodecane as the internal standard.

Table S5. Screening of Ligands[a]

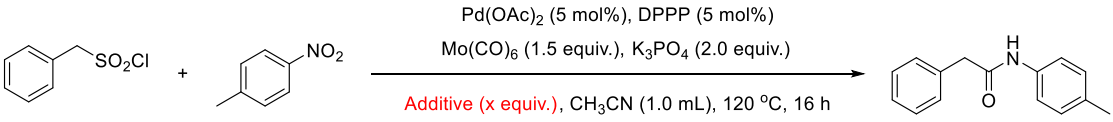


1a **2b** **3ab**

Entry	Ligand	Yield(%)
1	DPPF	57
2	PPh_3	59
3	Xantphos	56
4	BINAP	63
5	DPPB	72
6	DPEphos	62

[a]Reaction conditions: **1a** (0.4 mmol), **2b** (0.2 mmol), $Pd(OAc)_2$ (5 mol%), mono-dentate ligand (10 mol%), bidentate ligand (5 mol%), $Mo(CO)_6$ (1.5 equiv.), K_3PO_4 (2.0 equiv.), CH_3CN (1.0 mL), 120 °C, 16 h. GC yield, with dodecane as the internal standard.

Table S6. Screening of the Additives[a]



1a **2b** **3ab**

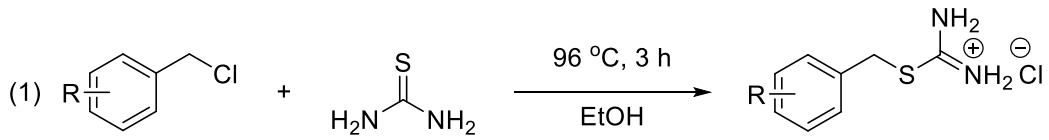
Entry	Additives	Yield(%)
1	$PhSiH_3$	66
2	Zn	63
3[b]	H_2O	56

[a]Reaction conditions: **1a** (0.4 mmol), **2b** (0.2 mmol), $Pd(OAc)_2$ (5 mol%), DPPP (5 mol%), $Mo(CO)_6$ (1.5 equiv.), K_3PO_4 (2.0 equiv.), CH_3CN (1.0 mL), Additive (1.0 equiv.), 120 °C, 16 h. [b]0.5 equiv. H_2O. GC yield, with dodecane as the internal standard.

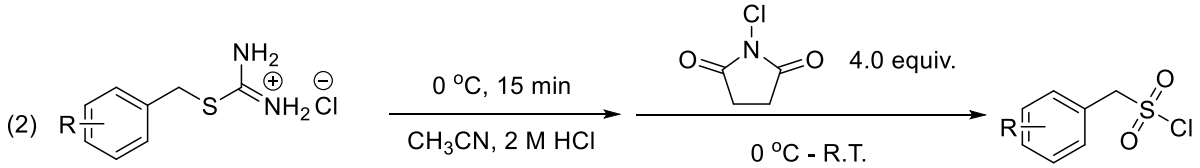
3. Experimental Section

3.1 General Procedure for the Synthesis of Benzylsulfonyl Chlorides

Benzylsulfonyl Chlorides were prepared according to literature.[1]



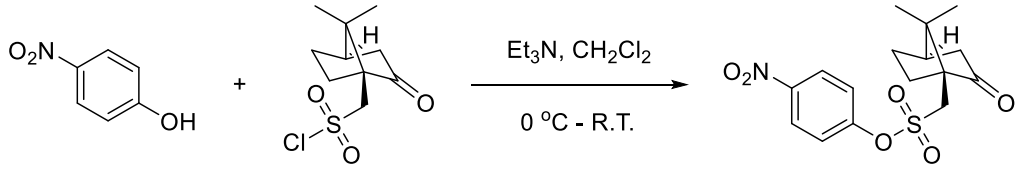
Step 1: An oven dried clean round-bottom flask was charged with magnetic stir-bar, the corresponding benzyl chloride (10 mmol) and thiourea (10 mmol, 762 mg). 10 mL of absolute ethanol was added and refluxed at 96 °C (oil bath). After 3 h the reaction was taken out and solvent was evaporated under reduced pressure to obtained white solid thiouric salt.



Step 2: The obtained solid salt was suspended in 14 mL of CH_3CN and 3 mL 2 M HCl was added to it. The mixture was stirred at 0 °C (ice bath) for 15 min. N-chlorosuccinimide (NCS) (40 mmol, 5.342 g) was added in portion to the suspension in order to obtain a clear solution (Pay attention to the temperature of the reaction, if the temperature is higher than 25 °C (oil bath), put it into an ice bath to cool). The solution was stirred for another 30 min at room temperature. The solution was evaporated under reduced pressure to remove the CH_3CN. The remaining aqueous portion was extracted with ethyl acetate (20 mL × 3). The organic portion was dried over anhydrous Na_2SO_4 and the crude mixture was evaporated and purified by column chromatography using silica gel and petroleum ether/ethyl acetate as the eluent.

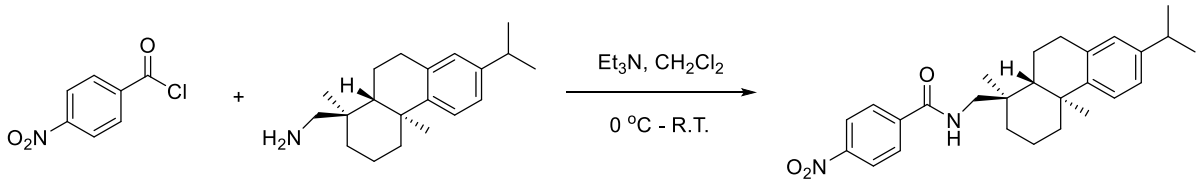
3.2 General Procedure for the Synthesis of Compounds 4 and 6

Compounds **4** and **6** were prepared according to literature.[2]



D-10-Camphorsulfonyl chloride **4**, 67%

An oven dried clean round-bottom flask was charged with magnetic stir-bar, 4-nitrophenol (10 mmol, 1.391 g), D-10-Camphorsulfonyl chloride (10 mmol, 2.507 g). Dichloromethane (40 mL) and triethylamine (12 mmol, 1.215 g) was added slowly and stirred at 0 °C (ice bath), then stir the reaction mixture at room temperature until completed (monitored by TLC). The reaction mixture was then diluted with water (40 mL) and extracted with dichloromethane (20 mL × 3). The combined organic phases were dried over anhydrous Na_2SO_4. The crude mixture was evaporated and purified by column chromatography using silica gel and petroleum ether/ethyl acetate (10/1 to 5/1, volume ratio) as the eluent, afforded **4** as a white solid (2.35 g, 67% yield).

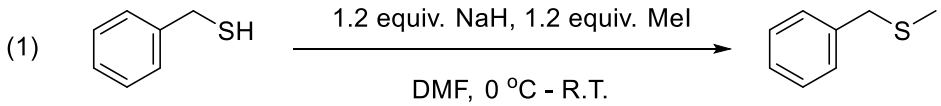


Dehydroabietylamine **6**, 63%

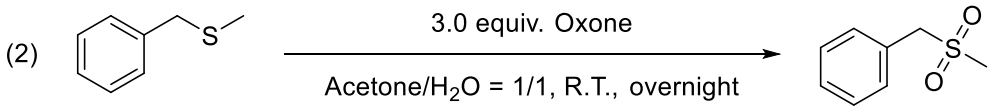
An oven dried clean round-bottom flask was charged with magnetic stir-bar, dehydroabietylamine (10 mmol, 2.854 g), 4-nitrobenzoyl chloride (12 mmol, 2.226 g). Dichloromethane (40 mL) and triethylamine (12 mmol, 1.215 g) was added slowly and stirred at 0 °C (ice bath), then stir the reaction mixture at room temperature until completed (monitored by TLC). The reaction mixture was then diluted with water (40 mL) and extracted with dichloromethane (20 mL × 3). The combined organic phases were dried over anhydrous Na_2SO_4. The crude mixture was evaporated and purified by column chromatography using silica gel and petroleum ether/ethyl acetate (5/1 to 2/1, volume ratio) as the eluent, afforded **6** as a white solid (2.75 g, 63% yield).

3.3 General Procedure for the Synthesis of Benzylmethylsulfone

Benzylmethylsulfone was prepared according to literature.[3,4]

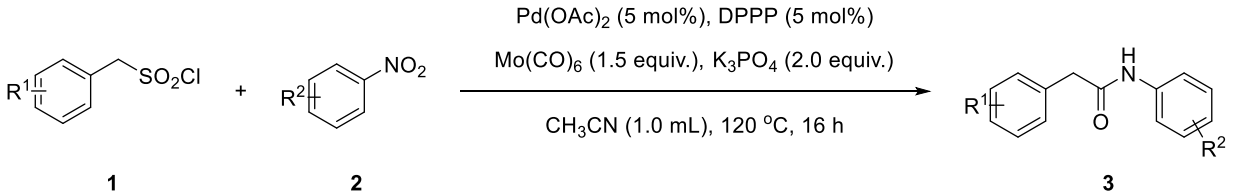


Step 1: An oven dried round-bottom flask was charged with phenylmethanethiol (10 mmol, 1.242 g) in DMF (20 mL) and stirred at 0 °C (ice bath) for 30 min. NaH (12 mmol, 480 mg, 60% dispersion in mineral oil) was added and the mixture was stirred at 0 °C for 30 min. MeI (12 mmol, 1.703 g) was added at 0 °C, warmed to room temperature then stir the reaction mixture at room temperature until completed (monitored by TLC). The reaction mixture was diluted with water (40 mL) and extracted with ethyl acetate (20 mL × 3). The combined organic layer was washed with brine and dried over anhydrous Na_2SO_4. The crude product was purified by column chromatography using silica gel and petroleum ether/ethyl acetate (100/1 to 30/1, volume ratio) as the eluent, afforded benzyl(methyl)sulfane as light yellow liquid (980 mg, 71% yield).



Step 2: An oven dried clean round-bottom flask was charged with magnetic stir-bar, benzyl(methyl)sulfane (5 mmol, 690 mg) and Oxone (15 mmol, 5.195 g). 20 mL of acetone and water mixture (acetone/water = 1/1, volume ratio) was added and then stir the reaction mixture at room temperature until completed (monitored by TLC). The reaction mixture was diluted with water (40 mL) and extracted with dichloromethane (20 mL × 3). The combined organic layer was washed with brine and dried over anhydrous Na_2SO_4. The crude product was purified by column chromatography using silica gel and petroleum ether/ethyl acetate (10/1 to 5/1, volume ratio) as the eluent, afforded benzylmethylsulfone as a white solid (625 mg, 74% yield).

3.4 General Procedure for Palladium-Catalyzed Benzylsulfonyl Chlorides with Nitroarenes



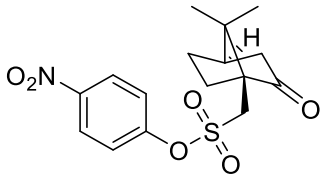
1 **2** **3**

Under nitrogen atmosphere, **1** (0.4 mmol), **2** (0.2 mmol), $Pd(OAc)_2$ (5 mol %, 2.2 mg), DPPP (5 mol %, 4.1 mg), K_3PO_4 (2 equiv., 84.9 mg) and $Mo(CO)_6$ (1.5 equiv., 79.2 mg) were added to an oven dried 15 mL *In-Ex* tube. Then CH_3CN (1 mL) were added to the reaction. The tube was sealed and the mixture was stirred at 120 °C (oil bath) for 16 h. After the reaction was completed, the reaction mixture was filtered and concentrated under vacuum. The crude product was purified by column chromatography using silica gel and petroleum ether/ethyl acetate as the eluent, afford the corresponding product **3, 5** and **7**.

1 mmol scale: Under nitrogen atmosphere, **1a** (2 mmol), **2a** (1 mmol), $Pd(OAc)_2$ (5 mol %), DPPP (5 mol %), K_3PO_4 (2 equiv.) and $Mo(CO)_6$ (1.5 equiv.) were added to an oven dried 15 mL *In-Ex* tube. Then CH_3CN (5 mL) were added to the reaction. The tube was sealed and the mixture was stirred at 120 °C (oil bath) for 16 h. After the reaction was completed, the reaction mixture was filtered and concentrated under vacuum. The crude product was purified by column chromatography using silica gel and petroleum ether/ethyl acetate as the eluent (10/1 to 5/1), afford the corresponding product **3aa** in 70% yield (147.7 mg).

4. Characterization Data

4.1 Characterization Data of Compounds 4, 5, 6, 7



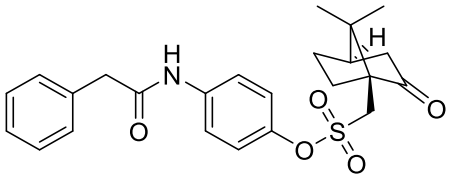
4-nitrophenyl((1*S*,4*R*)-7,7-dimethyl-2-oxobicyclo[2.2.1]heptan-1-yl)methanesulfonate (4)

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (2.35 g, 67% yield).[2]

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.31 (d, J = 9.1 Hz, 2H), 7.49 (d, J = 9.1 Hz, 2H), 3.86 (d, J = 15.0 Hz, 1H), 3.26 (d, J = 15.0 Hz, 1H), 2.55 – 2.40 (m, 2H), 2.18 (t, J = 4.5 Hz, 1H), 2.10 (tdd, J = 12.2, 7.9, 4.3 Hz, 1H), 2.00 (d, J = 18.6 Hz, 1H), 1.76 (ddd, J = 13.9, 9.4, 4.7 Hz, 1H), 1.49 (ddd, J = 13.0, 9.4, 3.9 Hz, 1H), 1.15 (s, 3H), 0.92 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 214.0, 153.6, 146.3, 125.8, 122.9, 58.3, 48.8, 48.2, 42.9, 42.6, 27.0, 25.3, 20.0, 19.8.

M.p. 119.3 - 120.6 °C



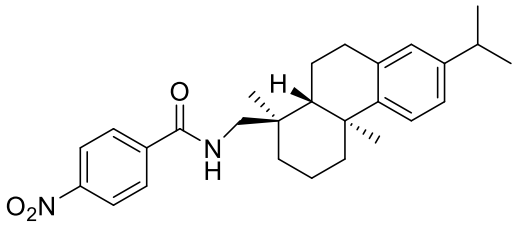
4-(2-phenylacetamido)phenyl((1*S*,4*R*)-7,7-dimethyl-2-oxobicyclo[2.2.1]heptan-1-yl)methanesulfonate (5)

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 5/1 to 2/1, volume ratio) to afford the title compound as a colorless oil (61.7 mg, 70% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.46 (d, J = 7.8 Hz, 2H), 7.40 (dd, J = 10.7, 4.0 Hz, 2H), 7.33 (t, J = 7.5 Hz, 3H), 7.26 (brs, 1H), 7.21 (d, J = 8.7 Hz, 2H), 3.76 (dd, J = 15.2, 1.1 Hz, 1H), 3.73 (s, 2H), 3.15 (dd, J = 15.0, 0.9 Hz, 1H), 2.55 – 2.49 (m, 1H), 2.40 (d, J = 18.6 Hz, 1H), 2.13 (t, J = 4.2 Hz, 1H), 2.11 – 2.03 (m, 1H), 1.96 (d, J = 18.5 Hz, 1H), 1.70 (ddd, J = 13.8, 9.5, 4.3 Hz, 1H), 1.48 – 1.42 (m, 1H), 1.14 (s, 3H), 0.89 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 214.2, 169.3, 145.4, 136.8, 134.3, 129.6, 129.4, 127.9, 122.8, 121.1, 58.2, 48.1, 47.5, 44.9, 43.0, 42.6, 27.0, 25.2, 20.1, 19.8.

HRMS (ESI) m/z: $[M+H]^+$ Calcd. for $C_{24}H_{27}NO_5S$ 442.1683; Found 442.1685.



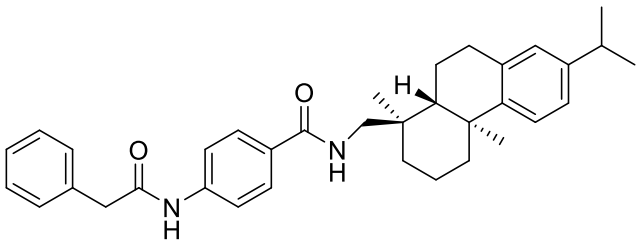
***N*-(((1*R*,4a*S*,10a*R*)-7-isopropyl-1,4a-dimethyl-1,2,3,4,4a,9,10,10a-octahydrophenanthren-1-yl)methyl)-4-nitrobenzamide (6)**

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 5/1 to 2/1, volume ratio) to afford the title compound as a white solid (2.75 g, 63% yield).[2]

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.20 (dd, J = 8.6, 2.1 Hz, 2H), 7.90 (dd, J = 8.6, 2.0 Hz, 2H), 7.19 (d, J = 8.1 Hz, 1H), 7.02 (d, J = 8.1 Hz, 1H), 6.91 (s, 1H), 6.61 (s, 1H), 3.49 (dd, J = 12.8, 5.7 Hz, 1H), 3.33 (dd, J = 12.8, 5.4 Hz, 1H), 2.96 (dd, J = 17.1, 6.1 Hz, 1H), 2.88 – 2.81 (m, 2H), 2.33 (d, J = 12.5 Hz, 1H), 1.99 (dd, J = 17.7, 5.2 Hz, 1H), 1.82 (dd, J = 26.0, 12.9 Hz, 2H), 1.70 (d, J = 11.7 Hz, 1H), 1.52 (t, J = 14.1 Hz, 2H), 1.40 (t, J = 12.8 Hz, 2H), 1.25 (d, J = 2.7 Hz, 6H), 1.23 (d, J = 2.2 Hz, 3H), 1.04 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 165. 9, 149.4, 146.9, 145.7, 140.5, 134.6, 128.2, 127.0, 124.2, 124.0, 123.7, 50.7, 45.8, 38.3, 37.9, 37.6, 36.4, 33.4, 30.4, 25.4, 24.0, 19.2, 18.8, 18.6.

M.p. 100.1 - 101.7 °C



***N*-(((1*R*,4a*S*,10a*R*)-7-isopropyl-1,4a-dimethyl-1,2,3,4,4a,9,10,10a-octahydrophenanthren-1-yl)methyl)-4-(2-phenylacetamido)benzamide (7)**

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 5/1 to 1/1, volume ratio) to afford the title compound as a white solid (65.2 mg, 62% yield).

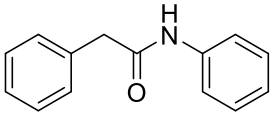
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 (d, J = 8.7 Hz, 2H), 7.48 (t, J = 7.5 Hz, 3H), 7.41 – 7.37 (m, 2H), 7.34 – 7.31 (m, 3H), 7.16 (d, J = 8.2 Hz, 1H), 6.99 (dd, J = 8.2, 1.6 Hz, 1H), 6.87 (d, J = 1.2 Hz, 1H), 6.11 (t, J = 6.3 Hz, 1H), 3.74 (s, 2H), 3.41 – 3.30 (m, 2H), 2.91 (dd, J = 17.1, 6.0 Hz, 1H), 2.85 – 2.76 (m, 2H), 2.29 (d, J = 12.7 Hz, 1H), 1.95 (dd, J = 13.1, 7.2 Hz, 1H), 1.84 – 1.73 (m, 2H), 1.71 – 1.68 (m, 1H), 1.52 – 1.46 (m, 2H), 1.35 (dd, J = 13.8, 3.8 Hz, 2H), 1.22 (d, J = 1.4 Hz, 6H), 1.20 (s, 3H), 0.99 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.4, 167.1, 147.1, 145.8, 140.7, 134.8, 134.2, 130.5, 129.6, 129.4, 127.92, 127.89, 127.1, 124.3, 124.0, 119.4, 50.5, 46.0, 44.9, 38.5, 37.8, 37.7, 36.6, 33.5, 30.6, 25.6, 24.1, 19.2, 18.9, 18.8.

M.p. 145.3 - 147.2 °C

HRMS (ESI) m/z: $[M+H]^+$ Calcd. for $C_{35}H_{42}N_2O_2$ 523.3319; Found 523.3320.

4.2 Characterization Data of the Corresponding Products



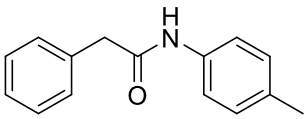
***N*,2-diphenylacetamide (3aa)**

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (30.2 mg, 72% yield).[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.37 (m, 4H), 7.33 – 7.32 (m, 3H), 7.29 – 7.25 (m, 2H), 7.21 (brs, 1H), 7.07 (t, J = 7.4 Hz, 1H), 3.72 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.3, 137.7, 134.6, 129.6, 129.4, 129.1, 127.8, 124.6, 120.0, 45.0.

M.p. 114.8 - 116.1 °C



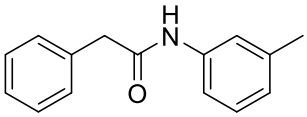
2-phenyl-*N*-(*p*-tolyl)acetamide (3ab)

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (33.4 mg, 74% yield).[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56 (brs, 1H), 7.35 – 7.27 (m, 7H), 7.04 (d, J = 8.2 Hz, 2H), 3.64 (s, 2H), 2.26 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.5, 135.3, 134.8, 134.1, 129.5, 129.4, 129.1, 127.5, 120.2, 44.6, 20.9.

M.p. 132.3 - 133.7 °C



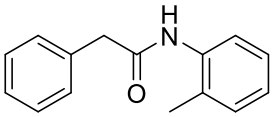
2-phenyl-*N*-(*m*-tolyl)acetamide (3ac)

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (32.8 mg, 73% yield).[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.45 (brs, 1H), 7.40 – 7.37 (m, 2H), 7.33 – 7.29 (m, 4H), 7.23 (d, J = 8.2 Hz, 1H), 7.16 (t, J = 7.8 Hz, 1H), 6.90 (d, J = 7.4 Hz, 1H), 3.70 (s, 2H), 2.29 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.4, 138.9, 137.7, 134.7, 129.6, 129.2, 128.8, 127.6, 125.3, 120.7, 117.1, 44.8, 21.5.

M.p. 89.6 - 91.4 °C



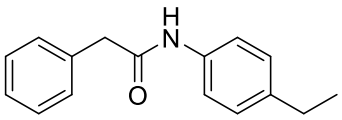
2-phenyl-*N*-(*o*-tolyl)acetamide (3ad)

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (31.2 mg, 69% yield).[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.89 (d, J = 8.1 Hz, 1H), 7.45 – 7.41 (m, 2H), 7.38 – 7.34 (m, 3H), 7.18 (t, J = 7.6 Hz, 1H), 7.09 (d, J = 7.2 Hz, 1H), 7.02 (t, J = 7.4 Hz, 1H), 6.92 (brs, 1H), 3.79 (s, 2H), 1.90 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.1, 135.7, 134.9, 130.5, 129.8, 129.5, 128.3, 128.0, 126.9, 125.1, 122.3, 45.1, 17.2.

M.p. 153.4 - 156.2 °C



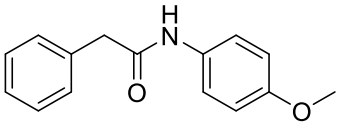
***N*-(4-ethylphenyl)-2-phenylacetamide (3ae)**

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (35.2 mg, 74% yield).[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 – 7.38 (m, 2H), 7.34 – 7.30 (m, 5H), 7.10 (d, J = 8.4 Hz, 3H), 3.73 (s, 2H), 2.59 (q, J = 7.6 Hz, 2H), 1.19 (t, J = 7.6 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.1, 140.7, 135.3, 134.7, 129.7, 129.3, 128.4, 127.8, 120.1, 44.9, 28.4, 15.8.

M.p. 110.9 - 112.4 °C



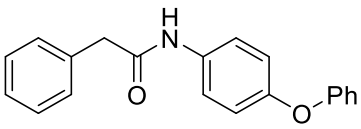
***N*-(4-methoxyphenyl)-2-phenylacetamide (3af)**

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 5/1 to 2/1, volume ratio) to afford the title compound as a white solid (37.7 mg, 78% yield).[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.38 (m, 2H), 7.34 – 7.32 (m, 4H), 7.30 – 7.29 (m, 1H), 7.02 (brs, 1H), 6.81 (d, J = 9.0 Hz, 2H), 3.76 (s, 3H), 3.72 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.1, 156.7, 134.7, 130.8, 129.7, 129.4, 127.8, 121.9, 114.2, 55.6, 44.8.

M.p. 124.6 - 125.4 °C



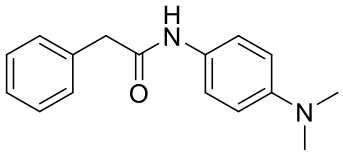
***N*-(4-phenoxyphenyl)-2-phenylacetamide (3ag)**

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (48.0 mg, 79% yield).[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.39 (m, 3H), 7.37 – 7.34 (m, 3H), 7.33 – 7.29 (m, 3H), 7.17 (brs, 1H), 7.07 (t, J = 7.4 Hz, 1H), 6.96 – 6.93 (m, 4H), 3.74 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.2, 157.6, 153.7, 134.5, 133.2, 129.8, 129.7, 129.4, 127.8, 123.2, 121.8, 119.7, 118.5, 44.8.

M.p. 139.5 - 140.6 °C



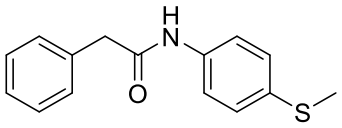
***N*-(4-(dimethylamino)phenyl)-2-phenylacetamide (3ah)**

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 5/1 to 2/1, volume ratio) to afford the title compound as a white solid (31.8 mg, 63% yield).[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 – 7.36 (m, 2H), 7.34 – 7.30 (m, 3H), 7.24 (d, J = 9.0 Hz, 2H), 7.02 (brs, 1H), 6.65 (d, J = 9.0 Hz, 2H), 3.70 (s, 2H), 2.89 (s, 6H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.0, 148.3, 134.9, 129.7, 129.3, 127.6, 127.5, 122.0, 113.1, 44.7, 41.0.

M.p. 40.6 - 41.7 °C



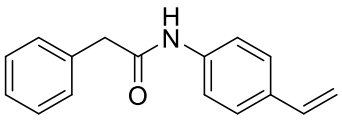
***N*-(4-(methylthio)phenyl)-2-phenylacetamide (3ai)**

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (38.9 mg, 76% yield).[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 – 7.38 (m, 2H), 7.36 – 7.31 (m, 5H), 7.18 (d, J = 8.7 Hz, 3H), 3.72 (s, 2H), 2.44 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.2, 135.3, 134.5, 133.9, 129.6, 129.4, 128.0, 127.8, 120.6, 44.9, 16.8.

M.p. 117.8 - 119.3 °C



2-phenyl-*N*-(4-vinylphenyl)acetamide (3aj)

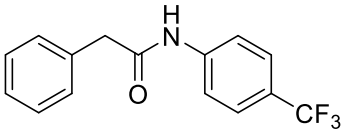
Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (29.4 mg, 62% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.43 – 7.31 (m, 9H), 7.08 (brs, 1H), 6.64 (dd, J = 17.6, 10.9 Hz, 1H), 5.66 (d, J = 17.6 Hz, 1H), 5.18 (d, J = 11.0 Hz, 1H), 3.74 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.1, 137.3, 136.2, 134.5, 134.0, 129.7, 129.4, 127.9, 126.9, 119.9, 113.2, 45.0.

M.p. 98.4 - 100.2 °C

HRMS (ESI) m/z: $[M+H]^+$ Calcd. for $C_{16}H_{15}NO$ 238.1226; Found 238.1229.



2-phenyl-*N*-(4-(trifluoromethyl)phenyl)acetamide (3ak)

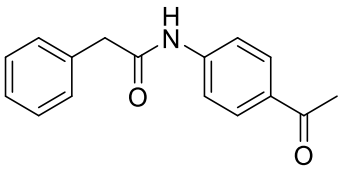
Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (39.6 mg, 71% yield).[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56 – 7.51 (m, 4H), 7.43 – 7.40 (m, 2H), 7.38 – 7.32 (m, 3H), 7.29 (brs, 1H), 3.76 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.5, 140.7, 134.1, 129.6, 129.5, 128.1, 126.34 (C-F, q, $^2J_{C\text{-}F}$ = 32.7 Hz), 126.33 (C-F, q, $^3J_{C\text{-}F}$ = 3.6 Hz), 124.1 (C-F, q, $^1J_{C\text{-}F}$ = 271.6 Hz), 119.5, 45.0.

^{19}F NMR (377 MHz, $CDCl_3$) δ -62.1.

M.p. 161.2 - 162.5 °C



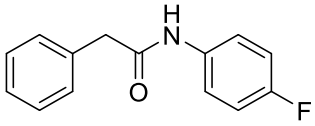
***N*-(4-acetylphenyl)-2-phenylacetamide (3al)**

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 5/1 to 2/1, volume ratio) to afford the title compound as a white solid (29.5 mg, 58% yield).[6]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.89 (d, J = 8.7 Hz, 2H), 7.53 (d, J = 8.7 Hz, 2H), 7.44 – 7.40 (m, 2H), 7.38 – 7.33 (m, 3H), 7.31 (brs, 1H), 3.77 (s, 2H), 2.56 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 197.0, 169.4, 142.0, 134.0, 133.2, 129.8, 129.7, 129.5, 128.1, 119.0, 45.1, 26.6.

M.p. 121.3 - 123.1 °C



***N*-(4-fluorophenyl)-2-phenylacetamide (3am)**

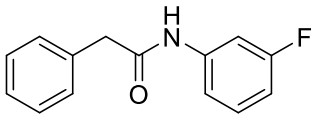
Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (33.2 mg, 73% yield).[7]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.38 (m, 3H), 7.37 – 7.32 (m, 4H), 7.14 (brs, 1H), 6.96 (t, J = 8.7 Hz, 2H), 3.73 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.2, 159.6 (C-F, d, $^1J_{C\text{-}F}$ = 243.7 Hz), 134.4, 133.7 (C-F, d, $^4J_{C\text{-}F}$ = 2.5 Hz), 129.7, 129.4, 127.9, 121.9 (C-F, d, $^3J_{C\text{-}F}$ = 7.9 Hz), 115.7 (C-F, d, $^2J_{C\text{-}F}$ = 22.5 Hz), 44.8.

^{19}F NMR (377 MHz, $CDCl_3$) δ -117.7.

M.p. 125.6 - 127.8 °C



***N*-(3-fluorophenyl)-2-phenylacetamide (3an)**

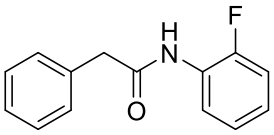
Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (33.0 mg, 72% yield).[8]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.43 – 7.39 (m, 3H), 7.37 – 7.32 (m, 3H), 7.24 – 7.18 (m, 1H), 7.15 (brs, 1H), 7.01 (dd, J = 8.1, 1.2 Hz, 1H), 6.78 (td, J = 8.3, 2.0 Hz, 1H), 3.74 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.2, 163.1 (C-F, d, $^1J_{C\text{-}F}$ = 244.9 Hz), 139.2 (C-F, d, $^3J_{C\text{-}F}$ = 10.7 Hz), 134.2, 130.1 (C-F, d, $^3J_{C\text{-}F}$ = 9.3 Hz), 129.7, 129.5, 128.0, 115.0 (C-F, d, $^4J_{C\text{-}F}$ = 2.6 Hz), 111.3 (C-F, d, $^2J_{C\text{-}F}$ = 21.4 Hz), 107.4 (C-F, d, $^2J_{C\text{-}F}$ = 26.4 Hz), 45.0.

^{19}F NMR (377 MHz, $CDCl_3$) δ -111.4.

M.p. 105.6 - 107.1 °C



***N*-(2-fluorophenyl)-2-phenylacetamide (3ao)**

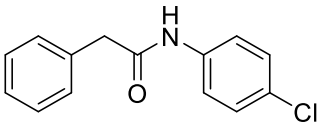
Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (24.3 mg, 53% yield).[9]

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.29 (t, J = 8.0 Hz, 1H), 7.43 – 7.34 (m, 6H), 7.12 – 7.08 (m, 1H), 7.03 – 7.00 (m, 2H), 3.78 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.2, 152.5 (C-F, d, $^1J_{C\text{-}F}$ = 243.2 Hz), 134.2, 129.6, 129.4, 127.9, 126.3 (C-F, d, $^3J_{C\text{-}F}$ = 10.0 Hz), 124.7 (C-F, d, $^4J_{C\text{-}F}$ = 3.7 Hz), 124.6 (C-F, d, $^3J_{C\text{-}F}$ = 8.1 Hz), 121.8, 114.8 (C-F, d, $^2J_{C\text{-}F}$ = 19.2 Hz), 45.0.

^{19}F NMR (377 MHz, $CDCl_3$) δ -131.6.

M.p. 97.6 - 98.4 °C



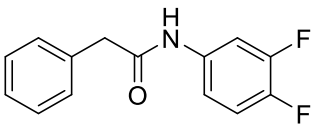
***N*-(4-chlorophenyl)-2-phenylacetamide (3ap)**

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (39.9 mg, 81% yield).[7]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.38 (m, 3H), 7.35 – 7.31 (m, 4H), 7.24 – 7.22 (m, 2H), 7.17 (brs, 1H), 3.73 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.2, 136.3, 134.3, 129.64, 129.56, 129.4, 129.1, 127.9, 121.2, 44.9.

M.p. 165.6 - 167.4 °C



***N*-(3,4-difluorophenyl)-2-phenylacetamide (3aq)**

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (34.4 mg, 70% yield).

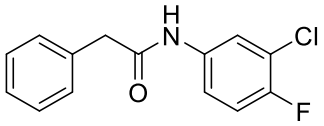
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.54 (ddd, J = 12.1, 7.2, 2.6 Hz, 1H), 7.43 – 7.39 (m, 2H), 7.37 – 7.31 (m, 3H), 7.12 (brs, 1H), 7.04 (dd, J = 18.5, 8.8 Hz, 1H), 6.96 – 6.92 (m, 1H), 3.73 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.2, 150.2 (C-F, dd, $^{1,2}J_{C\text{-}F}$ = 247.3, 13.2 Hz), 147.2 (C-F, dd, $^{1,2}J_{C\text{-}F}$ = 245.6, 12.7 Hz), 134.2 (C-F, dd, $^{3,4}J_{C\text{-}F}$ = 5.9, 3.1 Hz), 134.1, 129.6, 129.5, 128.0, 117.2 (C-F, d, $^{2}J_{C\text{-}F}$ = 18.2 Hz), 115.5 (C-F, dd, $^{3,4}J_{C\text{-}F}$ = 5.7, 3.7 Hz), 109.8 (C-F, d, $^{2}J_{C\text{-}F}$ = 21.8 Hz), 44.8.

^{19}F NMR (377 MHz, $CDCl_3$) δ -135.6, -142.4.

M.p. 93.9 - 94.7 °C

HRMS (ESI) m/z: $[M+H]^+$ Calcd. for $C_{14}H_{11}F_2NO$ 248.0881; Found 248.0892.



***N*-(3-chloro-4-fluorophenyl)-2-phenylacetamide (3ar)**

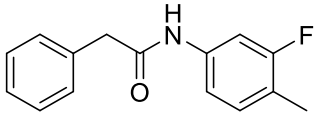
Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (35.8 mg, 68% yield).[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 (dd, J = 6.5, 2.6 Hz, 1H), 7.43 – 7.39 (m, 2H), 7.37 – 7.31 (m, 3H), 7.26 – 7.20 (m, 1H), 7.15 (brs, 1H), 7.03 (t, J = 8.8 Hz, 1H), 3.73 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.3, 155.0 (C-F, d, $^{1}J_{C\text{-}F}$ = 246.5 Hz), 134.3 (C-F, d, $^{4}J_{C\text{-}F}$ = 3.1 Hz), 134.1, 129.6, 129.5, 128.0, 122.3, 121.2 (C-F, d, $^{2}J_{C\text{-}F}$ = 18.5 Hz), 119.7 (C-F, d, $^{3}J_{C\text{-}F}$ = 6.8 Hz), 116.7 (C-F, d, $^{2}J_{C\text{-}F}$ = 22.1 Hz), 44.8.

^{19}F NMR (377 MHz, $CDCl_3$) δ -120.3.

M.p. 105.7 - 106.9 °C



***N*-(3-fluoro-4-methylphenyl)-2-phenylacetamide (3as)**

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (35.5 mg, 73% yield).

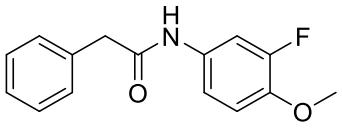
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.38 (m, 2H), 7.36 – 7.31 (m, 4H), 7.13 (brs, 1H), 7.04 (t, J = 8.3 Hz, 1H), 6.92 (dd, J = 8.2, 2.0 Hz, 1H), 3.72 (s, 2H), 2.20 (d, J = 1.5 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.2, 161.2 (C-F, d, $^1J_{C\text{-}F}$ = 244.0 Hz), 136.8 (C-F, d, $^3J_{C\text{-}F}$ = 10.8 Hz), 134.4, 131.4 (C-F, d, $^3J_{C\text{-}F}$ = 6.3 Hz), 129.7, 129.4, 127.9, 120.8 (C-F, d, $^2J_{C\text{-}F}$ = 17.6 Hz), 115.0 (C-F, d, $^4J_{C\text{-}F}$ = 3.1 Hz), 107.3 (C-F, d, $^2J_{C\text{-}F}$ = 27.2 Hz), 44.9, 14.2 (C-F, d, $J_{C\text{-}F}$ = 3.1 Hz).

^{19}F NMR (377 MHz, $CDCl_3$) δ -115.4.

M.p. 116.9 - 118.6 °C

HRMS (ESI) m/z: $[M+H]^+$ Calcd. for $C_{15}H_{14}FNO$ 244.1132; Found 244.1145.



***N*-(3-fluoro-4-methoxyphenyl)-2-phenylacetamide (3at)**

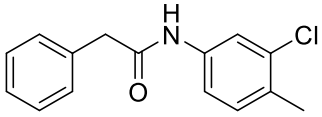
Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 5/1 to 2/1, volume ratio) to afford the title compound as a white solid (36.3 mg, 70% yield).[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.38 (m, 2H), 7.36 – 7.32 (m, 4H), 7.03 (brs, 1H), 7.02 (d, J = 9.0 Hz, 1H), 6.84 (t, J = 9.0 Hz, 1H), 3.84 (s, 3H), 3.72 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.2, 152.2 (C-F, d, $^1J_{C\text{-}F}$ = 245.5 Hz), 144.7 (C-F, d, $^3J_{C\text{-}F}$ = 10.8 Hz), 134.4, 131.2 (C-F, d, $^3J_{C\text{-}F}$ = 9.0 Hz), 129.7, 129.4, 127.9, 115.8 (C-F, d, $^4J_{C\text{-}F}$ = 3.4 Hz), 113.8 (C-F, d, $^4J_{C\text{-}F}$ = 1.5 Hz), 109.4 (C-F, d, $^2J_{C\text{-}F}$ = 22.6 Hz), 56.7, 44.8.

^{19}F NMR (377 MHz, $CDCl_3$) δ -133.1.

M.p. 125.2 - 126.8 °C



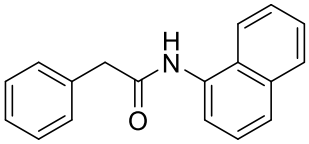
***N*-(3-chloro-4-methylphenyl)-2-phenylacetamide (3au)**

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (38.9 mg, 75% yield).[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.48 (d, J = 2.0 Hz, 1H), 7.42 – 7.38 (m, 2H), 7.36 – 7.31 (m, 3H), 7.19 (dd, J = 8.3, 2.1 Hz, 1H), 7.14 (brs, 1H), 7.10 (d, J = 8.3 Hz, 1H), 3.72 (s, 2H), 2.30 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.2, 136.5, 134.5, 134.4, 132.2, 131.0, 129.6, 129.4, 127.9, 120.6, 118.3, 44.9, 19.6.

M.p. 123.7 - 124.9 °C



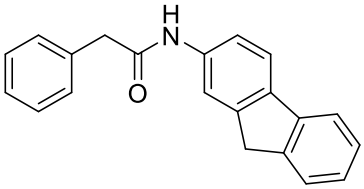
***N*-(naphthalen-1-yl)-2-phenylacetamide (3av)**

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (21.9 mg, 42% yield).[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 (d, J = 7.5 Hz, 1H), 7.82 (d, J = 8.0 Hz, 1H), 7.66 (d, J = 8.2 Hz, 1H), 7.49 – 7.38 (m, 9H), 7.29 (d, J = 8.3 Hz, 1H), 3.90 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 134.8, 134.2, 132.1, 129.9, 129.7, 128.9, 128.1, 126.9, 126.4, 126.0, 125.88, 125.85, 120.4, 120.1, 45.1.

M.p. 150.8 - 152.1 °C



***N*-(9*H*-fluoren-2-yl)-2-phenylacetamide (3aw)**

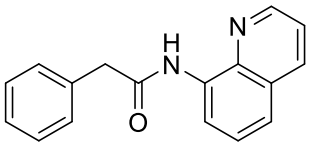
Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a light yellow solid (43.1 mg, 72% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 (s, 1H), 7.70 (d, J = 7.5 Hz, 1H), 7.66 (d, J = 8.2 Hz, 1H), 7.51 (d, J = 7.4 Hz, 1H), 7.44 – 7.40 (m, 2H), 7.37 – 7.31 (m, 4H), 7.28 – 7.24 (m, 2H), 7.16 (brs, 1H), 3.85 (s, 2H), 3.78 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.1, 144.4, 143.3, 141.4, 138.4, 136.6, 134.6, 129.7, 129.4, 127.9, 126.9, 126.5, 125.1, 120.2, 119.7, 118.7, 117.0, 45.1, 37.1.

M.p. 190.0 - 191.2 °C

HRMS (ESI) m/z: $[M+H]^+$ Calcd. for $C_{21}H_{17}NO$ 300.1383; Found 300.1389.

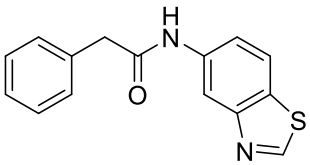


2-phenyl-*N*-(quinolin-8-yl)acetamide (3ax)

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a colorless oil (28.8 mg, 55% yield).[10]

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.91 (brs, 1H), 8.76 (dd, J = 7.2, 1.7 Hz, 1H), 8.70 (dd, J = 4.2, 1.6 Hz, 1H), 8.12 (dd, J = 8.3, 1.6 Hz, 1H), 7.53 – 7.47 (m, 2H), 7.46 – 7.39 (m, 5H), 7.34 (dt, J = 9.5, 4.2 Hz, 1H), 3.90 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 148.3, 138.6, 136.4, 134.8, 134.5, 129.7, 129.1, 128.0, 127.5, 121.72, 121.67, 116.5, 45.5.



***N*-(benzo[*d*]thiazol-5-yl)-2-phenylacetamide (3ay)**

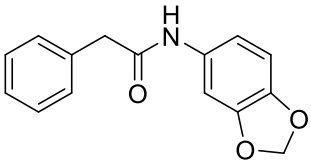
Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 5/1 to 1/1, volume ratio) to afford the title compound as a light yellow solid (31.1 mg, 58% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.98 (s, 1H), 8.19 (d, J = 1.8 Hz, 1H), 7.84 (d, J = 8.7 Hz, 1H), 7.57 (dd, J = 8.7, 1.8 Hz, 1H), 7.44 – 7.41 (m, 2H), 7.38 – 7.34 (m, 3H), 7.32 (brs, 1H), 3.80 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.4, 155.3, 153.9, 136.5, 134.4, 129.7, 129.6, 129.5, 128.0, 122.1, 119.0, 114.5, 45.0.

M.p. 97.6 - 99.3 °C

HRMS (ESI) m/z: $[M+H]^+$ Calcd. for $C_{15}H_{12}N_2OS$ 269.0743; Found 269.0751.



***N*-(benzo[*d*][1,3]dioxol-5-yl)-2-phenylacetamide (3az)**

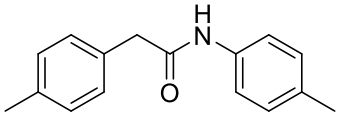
Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 5/1 to 2/1, volume ratio) to afford the title compound as a white solid (39.8 mg, 78% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.38 (m, 2H), 7.35 – 7.30 (m, 3H), 7.15 (d, J = 1.9 Hz, 1H), 7.02 (brs, 1H), 6.70 – 6.63 (m, 2H), 5.92 (s, 2H), 3.71 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.2, 147.9, 144.6, 134.6, 131.9, 129.7, 129.4, 127.8, 113.3, 108.1, 103.0, 101.4, 44.8.

M.p. 144.6 - 146.2 °C

HRMS (ESI) m/z: $[M+H]^+$ Calcd. for $C_{15}H_{13}NO_3$ 256.0968; Found 256.0977.



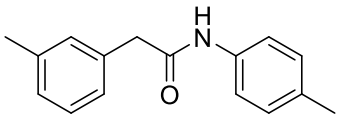
***N*,2-di-*p*-tolylacetamide (3bb)**

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (37.3 mg, 78% yield).[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.28 (d, J = 8.4 Hz, 2H), 7.23 – 7.19 (m, 4H), 7.07 (d, J = 8.3 Hz, 2H), 7.03 (brs, 1H), 3.69 (s, 2H), 2.37 (s, 3H), 2.29 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.3, 137.5, 135.2, 134.2, 131.5, 130.1, 129.6, 129.5, 120.0, 44.6, 21.3, 21.0.

M.p. 151.8 - 153.5 °C



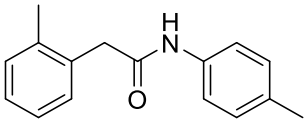
2-(*m*-tolyl)-*N*-(*p*-tolyl)acetamide (3cb)

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (35.8 mg, 75% yield).[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.28 (t, J = 7.9 Hz, 3H), 7.15 – 7.12 (m, 3H), 7.08 (d, J = 8.2 Hz, 3H), 3.69 (s, 2H), 2.37 (s, 3H), 2.29 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.2, 139.1, 135.2, 134.6, 134.2, 130.4, 129.5, 129.2, 128.5, 126.7, 120.0, 44.9, 21.5, 21.0.

M.p. 104.1 - 105.9 °C



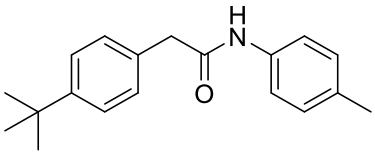
2-(*o*-tolyl)-*N*-(*p*-tolyl)acetamide (3db)

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (31.9 mg, 67% yield).[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.27 – 7.24 (m, 6H), 7.07 (d, J = 8.3 Hz, 2H), 6.93 (brs, 1H), 3.73 (s, 2H), 2.33 (s, 3H), 2.28 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 168.9, 137.6, 135.1, 134.3, 133.2, 131.1, 130.7, 129.5, 128.3, 127.0, 120.1, 43.0, 21.0, 19.7.

M.p. 146.7 - 148.3 °C



2-(4-(*tert*-butyl)phenyl)-*N*-(*p*-tolyl)acetamide (3eb)

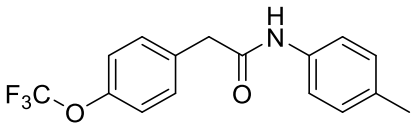
Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (36.7mg, 65% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 (d, J = 8.2 Hz, 2H), 7.31 – 7.25 (m, 4H), 7.11 (brs, 1H), 7.08 (d, J = 8.3 Hz, 2H), 3.69 (s, 2H), 2.29 (s, 3H), 1.34 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.4, 150.7, 135.2, 134.2, 131.6, 129.5, 129.4, 126.3, 120.1, 44.4, 34.7, 31.5, 21.0.

M.p. 112.8 - 113.9 °C

HRMS (ESI) m/z: $[M+H]^+$ Calcd. for $C_{19}H_{23}NO$ 282.1852; Found 282.1865.



***N*-(*p*-tolyl)-2-(4-(trifluoromethoxy)phenyl)acetamide (3fb)**

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (46.5 mg, 75% yield).

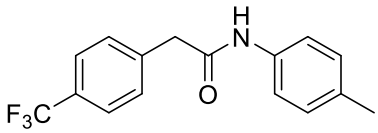
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37 (d, J = 8.6 Hz, 2H), 7.32 (d, J = 8.4 Hz, 2H), 7.23 (d, J = 8.1 Hz, 2H), 7.09 (d, J = 8.2 Hz, 3H), 3.71 (s, 2H), 2.30 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 168.4, 148.8, 135.0, 134.5, 133.4, 131.0, 129.6, 121.7, 120.6 (C-F, q, $^1J_{C\text{-}F}$ = 257.4 Hz), 120.1, 44.0, 21.0.

^{19}F NMR (377 MHz, $CDCl_3$) δ -57.8.

M.p. 150.7 - 152.1 °C

HRMS (ESI) m/z: $[M+H]^+$ Calcd. for $C_{16}H_{14}F_3NO_2$ 310.1049; Found 310.1062.



***N*-(*p*-tolyl)-2-(4-(trifluoromethyl)phenyl)acetamide (3gb)**

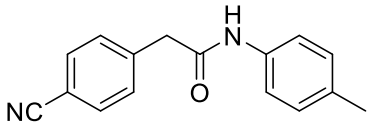
Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (45.1 mg, 77% yield).[5]

^{1}H NMR (400 MHz, DMSO-d_6) δ 10.15 (s, 1H), 7.69 (d, J = 8.1 Hz, 2H), 7.55 (d, J = 8.0 Hz, 2H), 7.47 (d, J = 8.4 Hz, 2H), 7.09 (d, J = 8.3 Hz, 2H), 3.75 (s, 2H), 2.23 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 168.1, 140.9, 136.6, 132.3, 130.0, 129.1, 127.3 (C-F, q, $^2J_{C\text{-}F}$ = 31.7 Hz), 125.1 (C-F, q, $^3J_{C\text{-}F}$ = 3.7 Hz), 124.4 (C-F, q, $^1J_{C\text{-}F}$ = 271.9 Hz), 119.2, 42.9, 20.4.

^{19}F NMR (377 MHz, DMSO-d_6) δ -60.8.

M.p. 185.1 - 186.7 °C



2-(4-cyanophenyl)-*N*-(*p*-tolyl)acetamide (3hb)

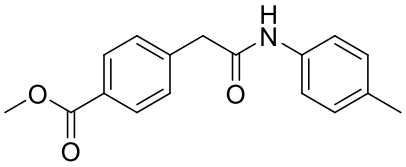
Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 5/1 to 2/1, volume ratio) to afford the title compound as a white solid (41.6 mg, 83% yield).

^{1}H NMR (400 MHz, DMSO-d_6) δ 10.14 (s, 1H), 7.79 (d, J = 8.2 Hz, 2H), 7.52 (d, J = 8.2 Hz, 2H), 7.46 (d, J = 8.4 Hz, 2H), 7.09 (d, J = 8.3 Hz, 2H), 3.74 (s, 2H), 2.23 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 167.8, 141.9, 136.5, 132.3, 132.2, 130.3, 129.1, 119.2, 118.9, 109.4, 43.1, 20.4.

M.p. 205.2 - 207.1 °C

HRMS (ESI) m/z: $[M+H]^+$ Calcd. for $C_{16}H_{14}N_2O$ 251.1179; Found 251.1192.



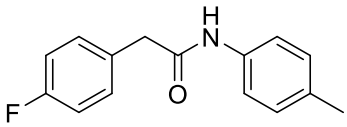
methyl 4-(2-oxo-2-(*p*-tolylamino)ethyl)benzoate (3ib)

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 5/1 to 2/1, volume ratio) to afford the title compound as a white solid (45.2 mg, 80% yield).[11]

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.04 (d, J = 8.2 Hz, 2H), 7.41 (d, J = 8.2 Hz, 2H), 7.30 (d, J = 8.4 Hz, 2H), 7.17 (brs, 1H), 7.08 (d, J = 8.3 Hz, 2H), 3.92 (s, 3H), 3.75 (s, 2H), 2.29 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 168.1, 166.9, 139.8, 135.0, 134.5, 130.4, 129.62, 129.60, 129.5, 120.1, 52.3, 44.7, 21.0.

M.p. 159.3 - 160.8 °C



2-(4-fluorophenyl)-*N*-(*p*-tolyl)acetamide (3jb)

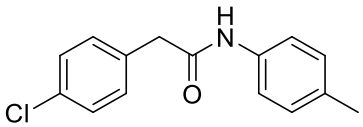
Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (32.2 mg, 66% yield).[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30 (dd, J = 8.5, 3.1 Hz, 4H), 7.09 (d, J = 8.5 Hz, 4H), 7.06 (brs, 1H), 3.69 (s, 2H), 2.29 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 168.8, 162.4 (C-F, d, $^1J_{C\text{-}F}$ = 246.5 Hz), 135.1, 134.4, 131.2 (C-F, d, $^3J_{C\text{-}F}$ = 8.0 Hz), 130.4 (C-F, d, $^4J_{C\text{-}F}$ = 3.2 Hz), 129.6, 120.1, 116.2 (C-F, d, $^2J_{C\text{-}F}$ = 21.4 Hz), 44.0, 21.0.

^{19}F NMR (377 MHz, $CDCl_3$) δ -114.7.

M.p. 146.6 - 148.3 °C



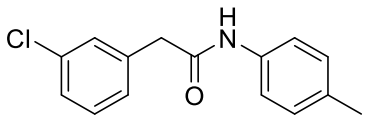
2-(4-chlorophenyl)-*N*-(*p*-tolyl)acetamide (3kb)

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (31.7 mg, 61% yield).[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36 (d, J = 8.3 Hz, 2H), 7.31 – 7.26 (m, 4H), 7.09 (d, J = 8.2 Hz, 2H), 7.03 (brs, 1H), 3.68 (s, 2H), 2.29 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 168.5, 135.0, 134.5, 133.7, 133.1, 131.0, 129.6, 129.4, 120.1, 44.1, 21.0.

M.p. 185.8 - 187.1 °C



2-(3-chlorophenyl)-*N*-(*p*-tolyl)acetamide (3lb)

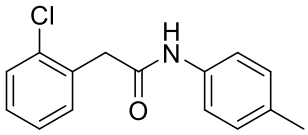
Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (44.0 mg, 85% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.32 – 7.29 (m, 5H), 7.26 – 7.20 (m, 2H), 7.08 (d, J = 8.0 Hz, 2H), 3.65 (s, 2H), 2.29 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 168.4, 136.6, 135.0, 134.9, 134.5, 130.4, 129.7, 129.6, 127.9, 127.7, 120.2, 44.3, 21.0.

M.p. 110.9 - 113.4 °C

HRMS (ESI) m/z: $[M+H]^+$ Calcd. for $C_{15}H_{14}ClNO$ 260.0837; Found 260.0849.



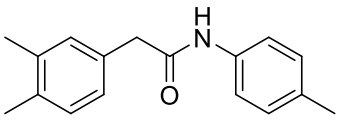
2-(2-chlorophenyl)-*N*-(*p*-tolyl)acetamide (3mb)

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (37.9 mg, 73% yield).[12]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.45 – 7.40 (m, 2H), 7.32 (d, J = 8.4 Hz, 2H), 7.29 – 7.27 (m, 2H), 7.21 (brs, 1H), 7.09 (d, J = 8.2 Hz, 2H), 3.83 (s, 2H), 2.29 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 167.8, 135.2, 134.5, 134.3, 132.9, 131.9, 130.0, 129. 6, 129.3, 127.6, 120.2, 42.6, 21.0.

M.p. 160.8 - 162.2 °C



2-(3,4-dimethylphenyl)-*N*-(*p*-tolyl)acetamide (3nb)

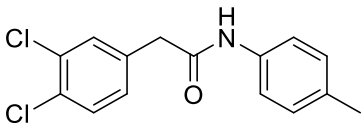
Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (33.9 mg, 67% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.29 (d, J = 8.1 Hz, 2H), 7.15 (d, J = 7.7 Hz, 1H), 7.08 – 7.04 (m, 5H), 3.66 (s, 2H), 2.29 (s, 3H), 2.27 (s, 6H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.5, 137.7, 136.2, 135.2, 134.1, 131.9, 131.0, 130.6, 129.5, 127.0, 120.0, 44.6, 21.0, 19.9, 19.6.

M.p. 121.2 - 122.8 °C

HRMS (ESI) m/z: $[M+H]^+$ Calcd. for $C_{17}H_{19}NO$ 254.1539; Found 254.1552.



2-(3,4-dichlorophenyl)-*N*-(*p*-tolyl)acetamide (3ob)

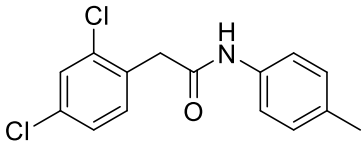
Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (48.2 mg, 82% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44 – 7.42 (m, 2H), 7.32 (d, J = 8.4 Hz, 2H), 7.19 – 7.16 (m, 2H), 7.10 (d, J = 8.2 Hz, 2H), 3.64 (s, 2H), 2.30 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 167.9, 134.9, 134.7, 134.6, 133.1, 131.9, 131.5, 131.0, 129.7, 128.9, 120.2, 43.6, 21.0.

M.p. 148.2 - 150.4 °C

HRMS (ESI) m/z: $[M+H]^+$ Calcd. for $C_{15}H_{13}Cl_2NO$ 294.0447; Found 294.0457.



2-(2,4-dichlorophenyl)-*N*-(*p*-tolyl)acetamide (3pb)

Purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 10/1 to 5/1, volume ratio) to afford the title compound as a white solid (41.1 mg, 70% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44 (d, J = 2.0 Hz, 1H), 7.35 – 7.31 (m, 3H), 7.27 – 7.24 (m, 2H), 7.09 (d, J = 8.2 Hz, 2H), 3.77 (s, 2H), 2.29 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 167.3, 135.1, 135.0, 134.5, 134.3, 132.6, 131.5, 129.7, 129.6, 127.9, 120.3, 41.8, 21.0.

M.p. 159.5 - 161.3 ^{o}C

HRMS (ESI) m/z: $[M+H]^+$ Calcd. for $C_{15}H_{13}Cl_2NO$ 294.0447; Found 294.0453.

5. References

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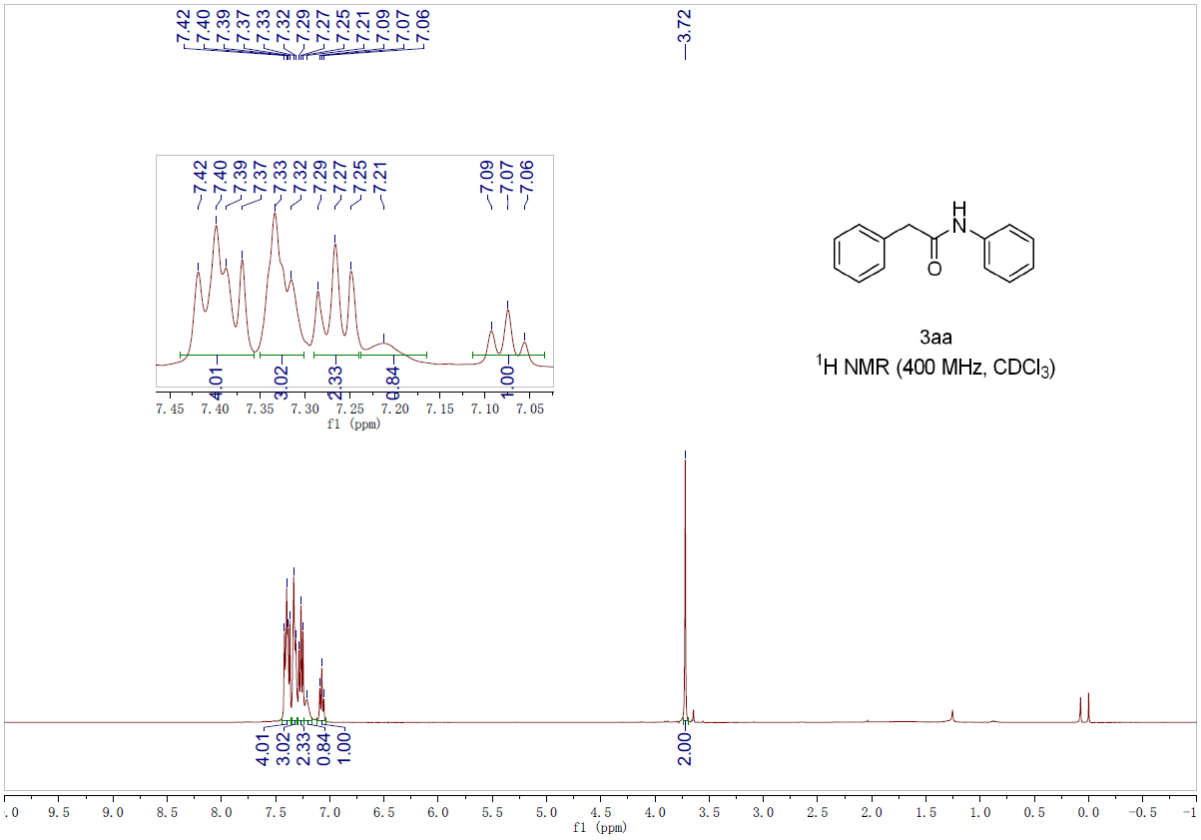
6. Copies of NMR Spectra



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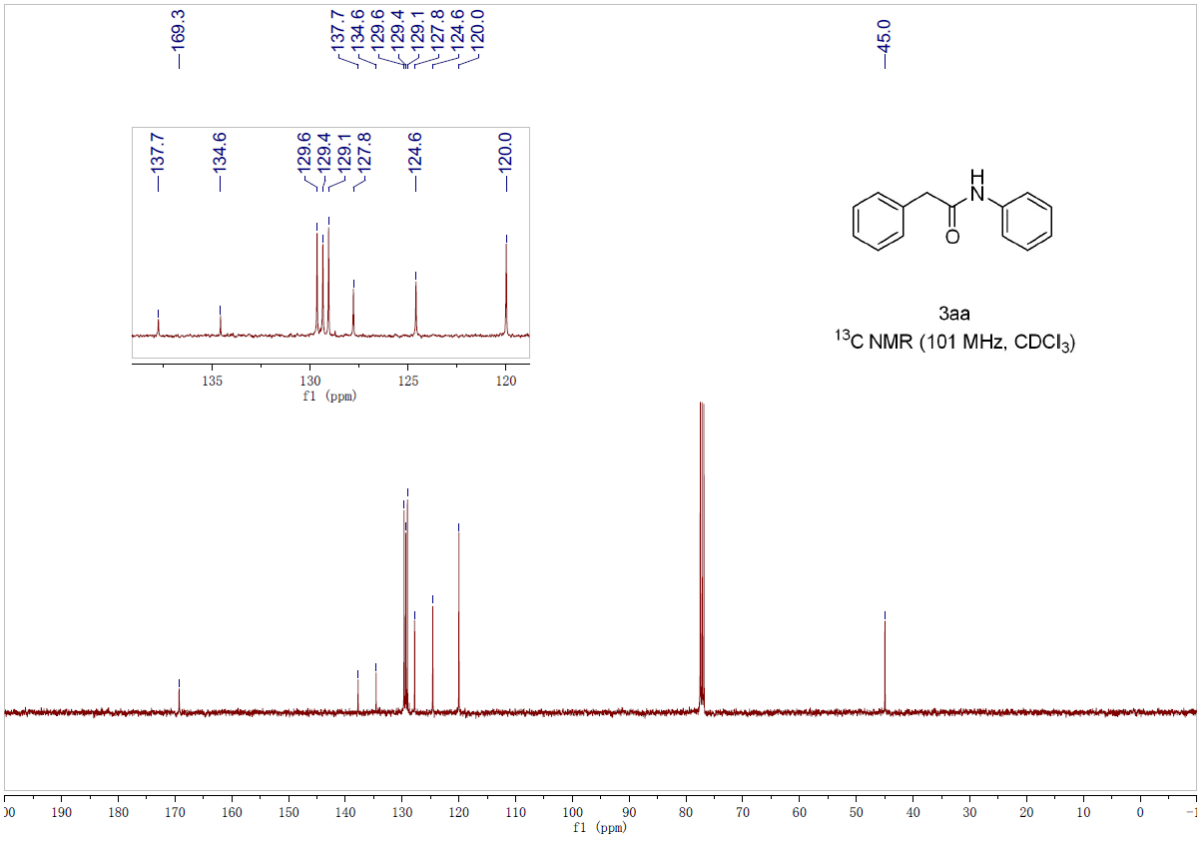

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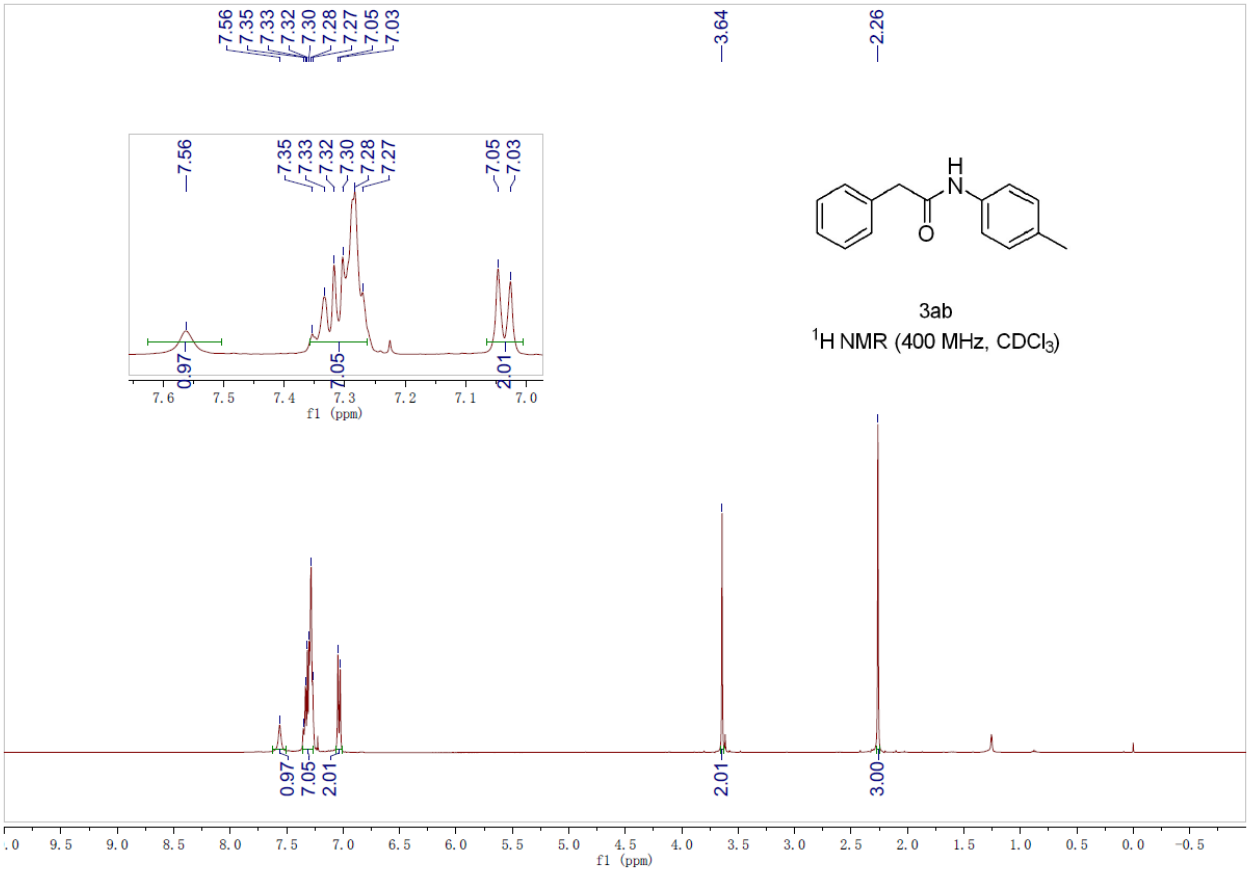

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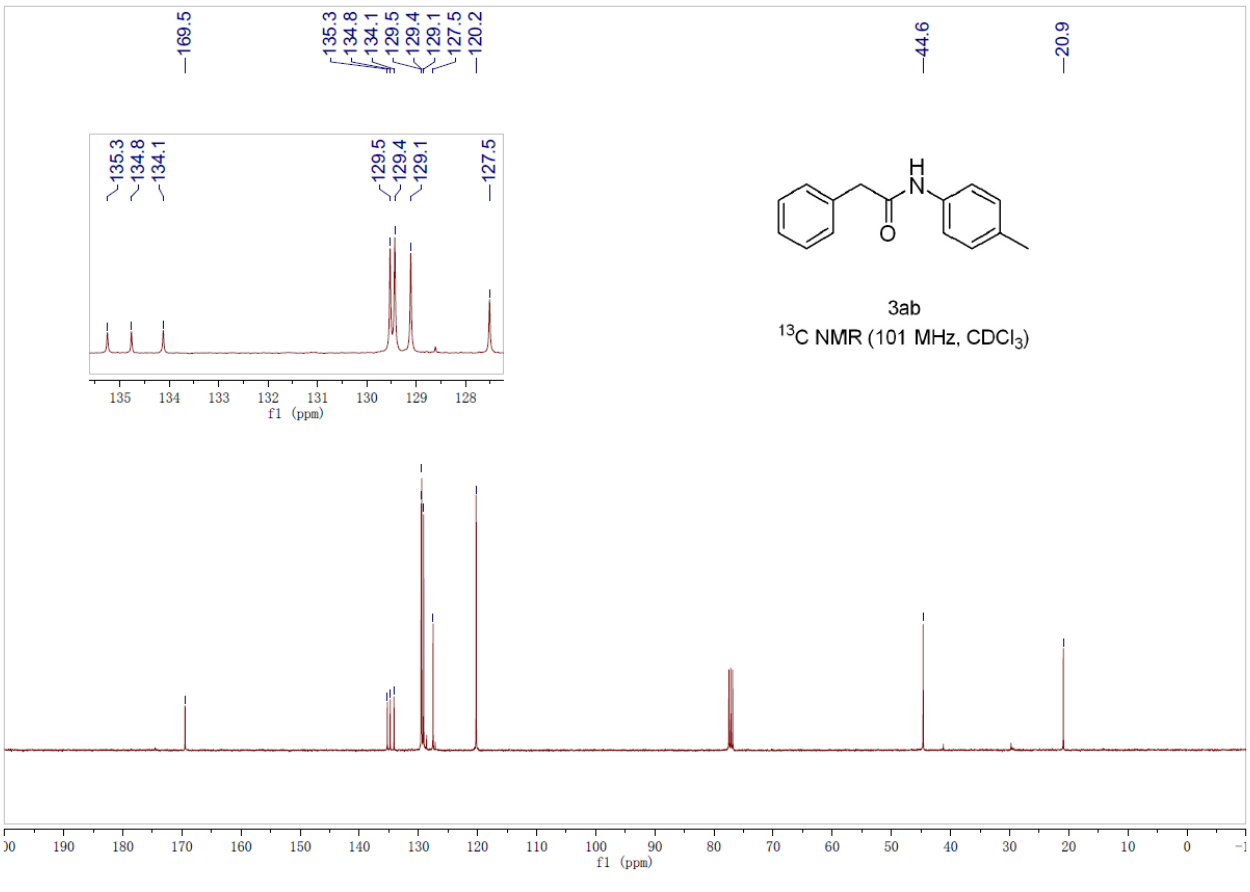

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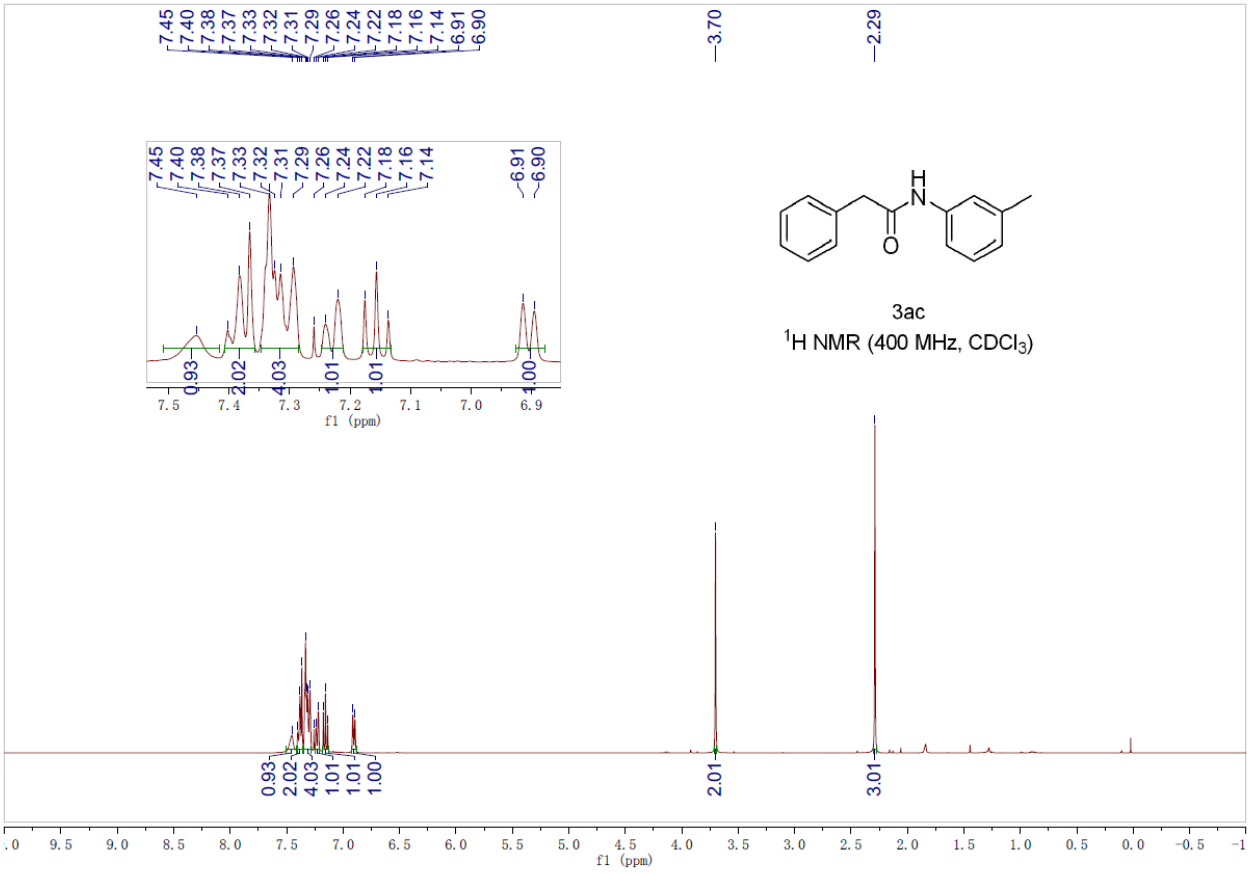

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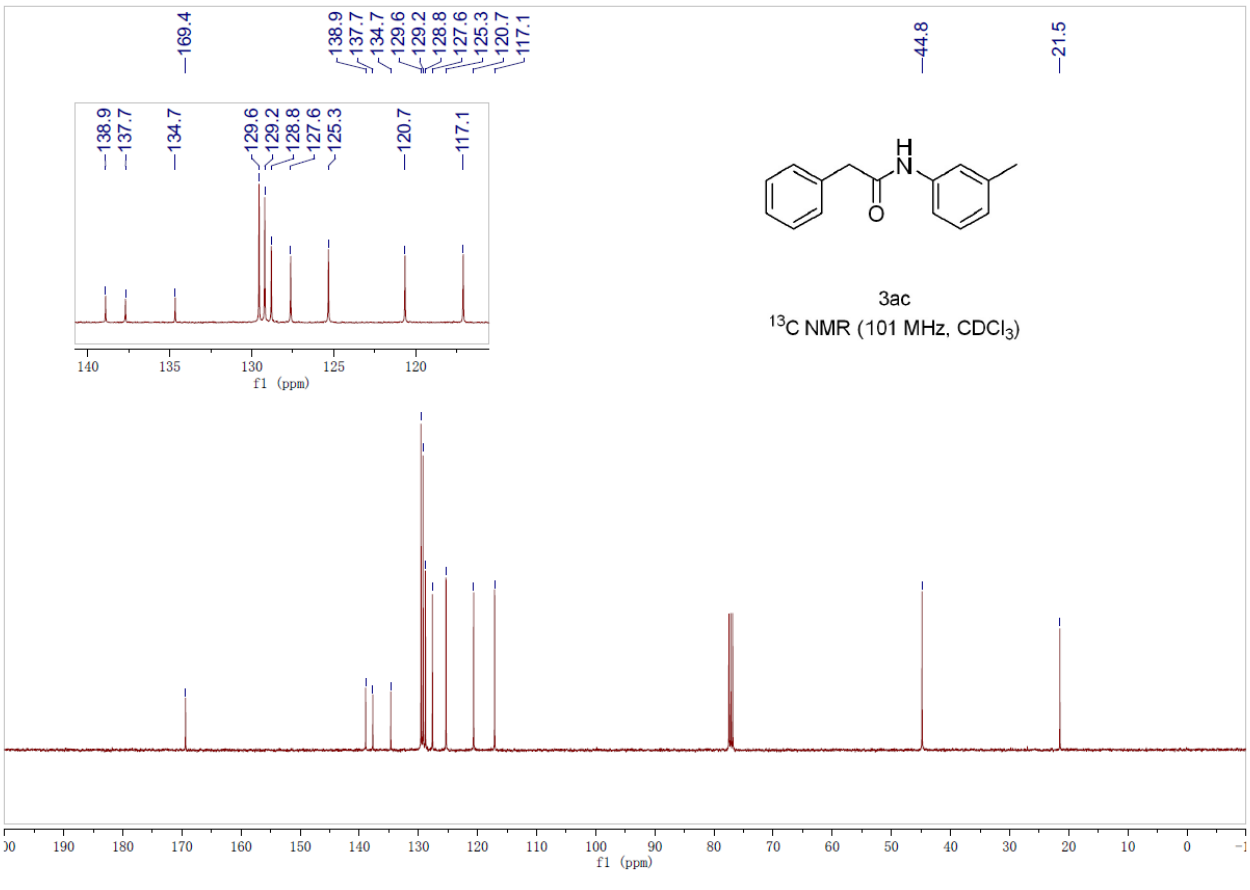

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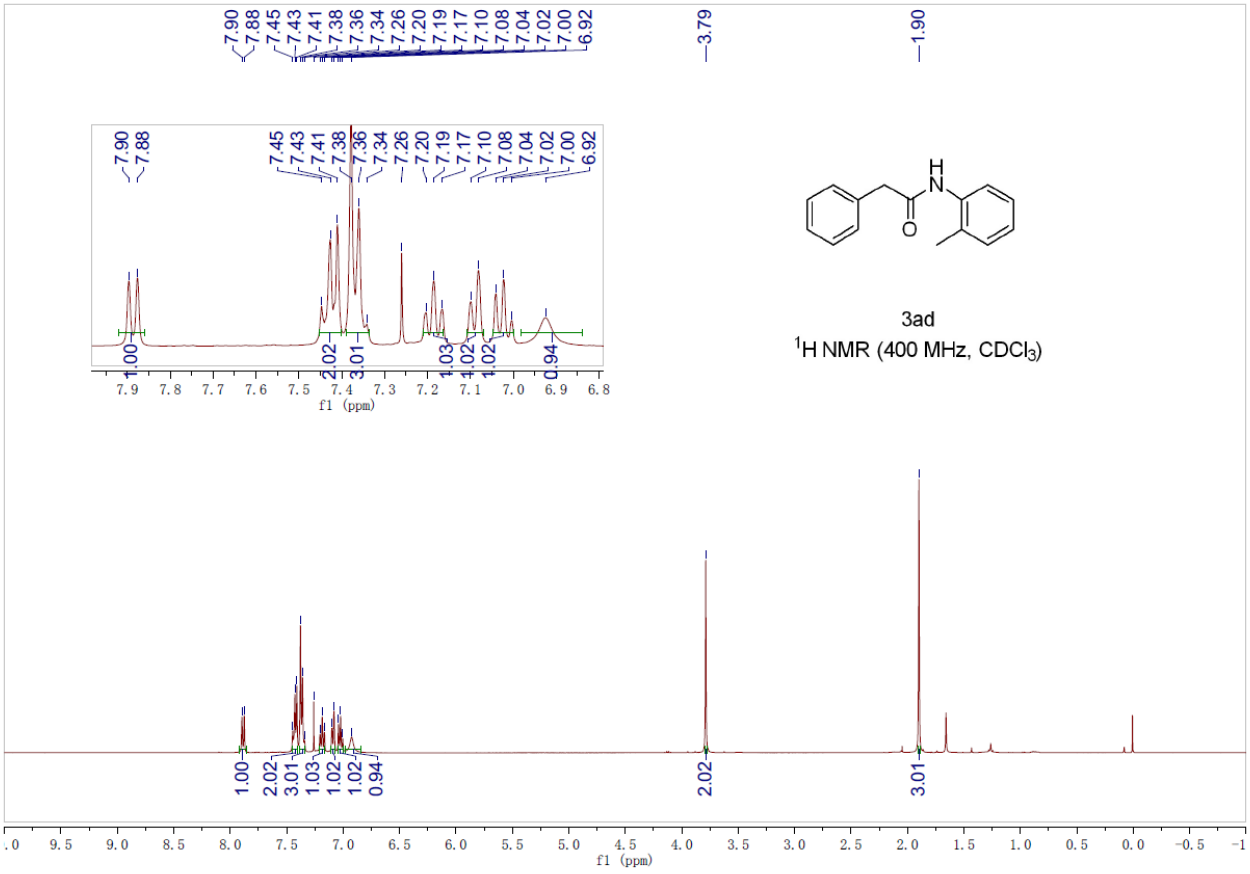

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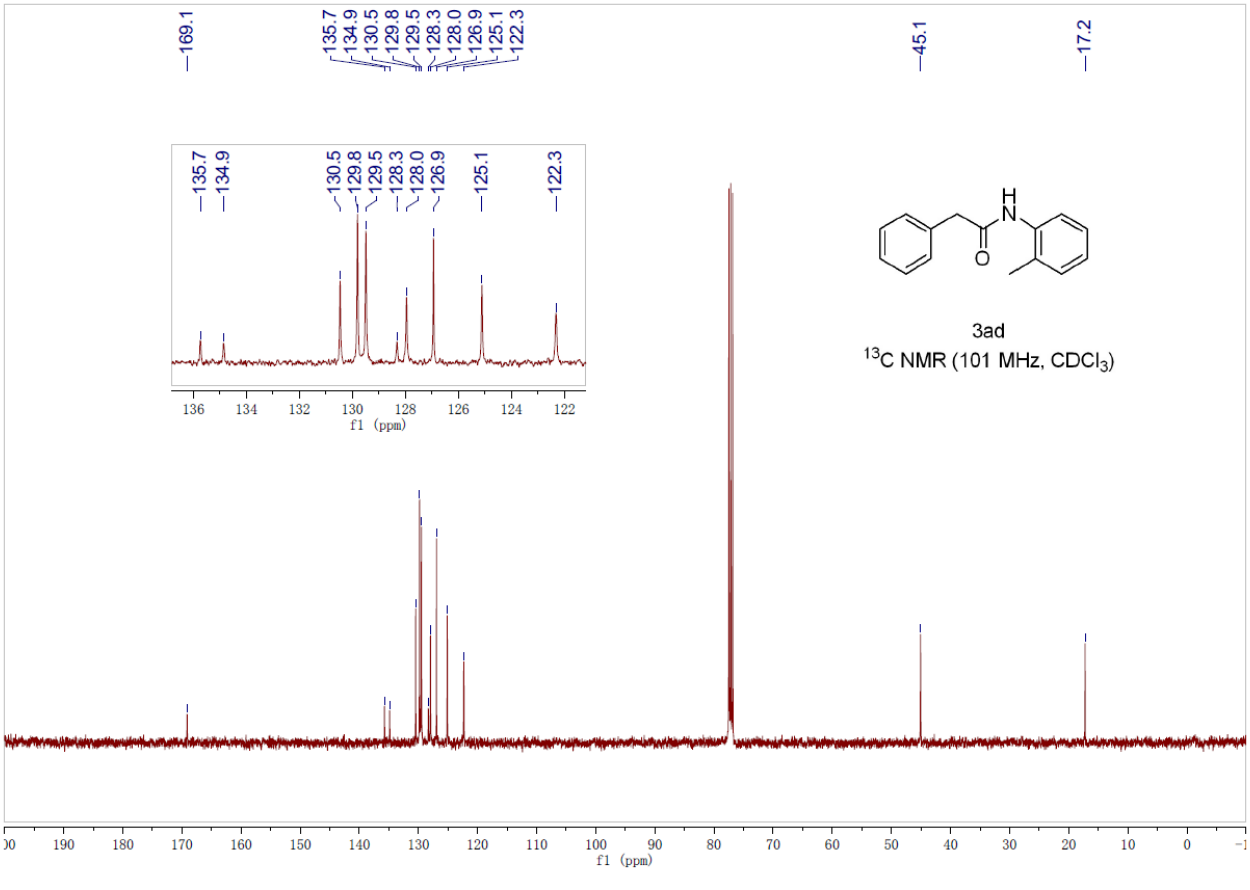

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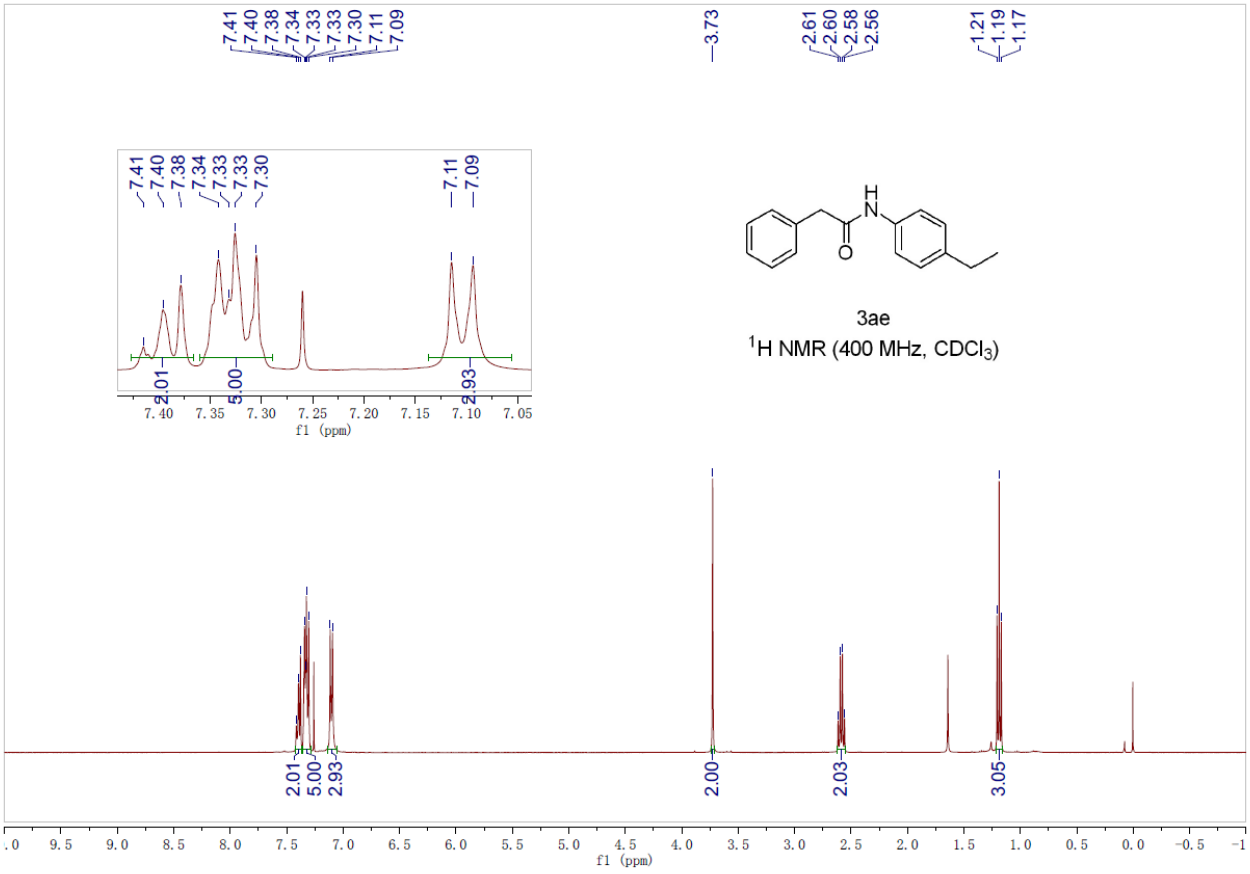

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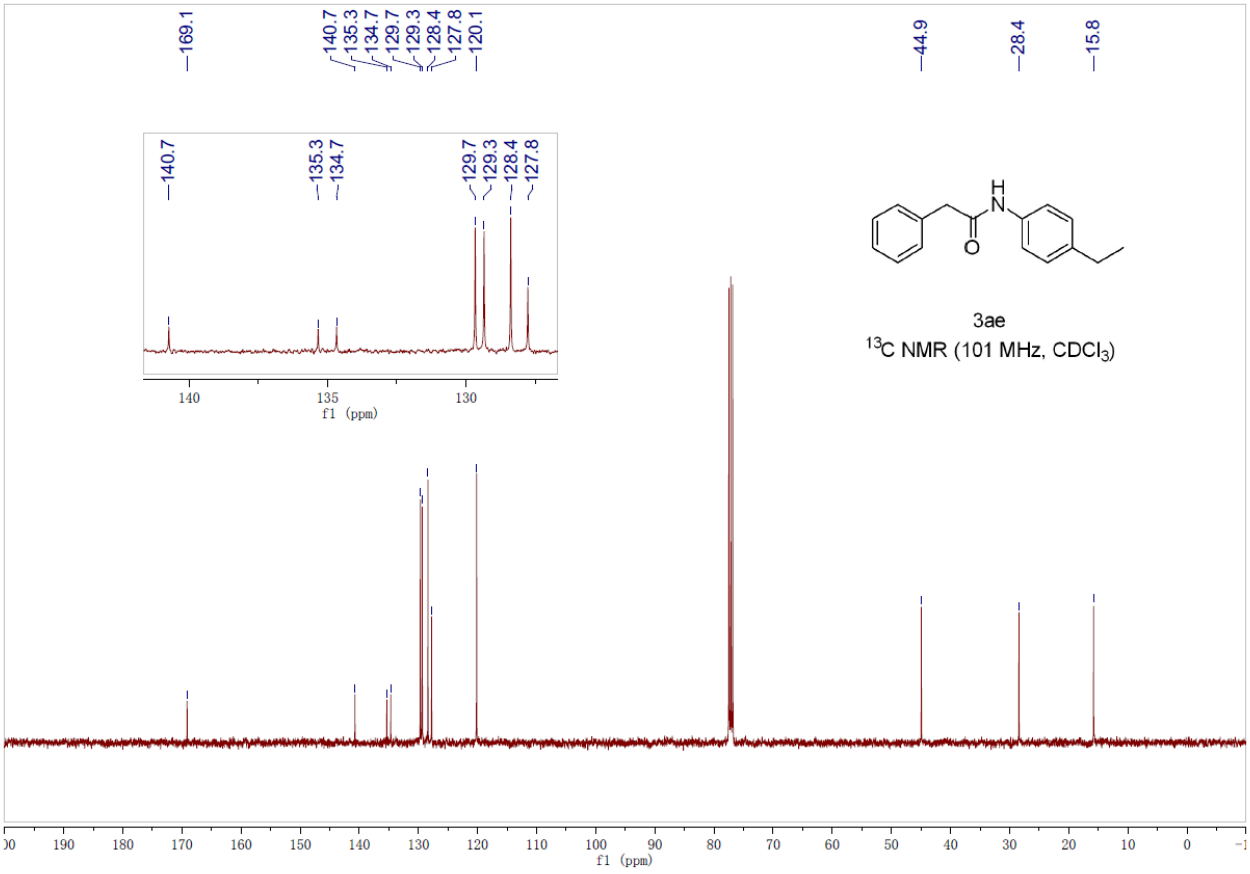

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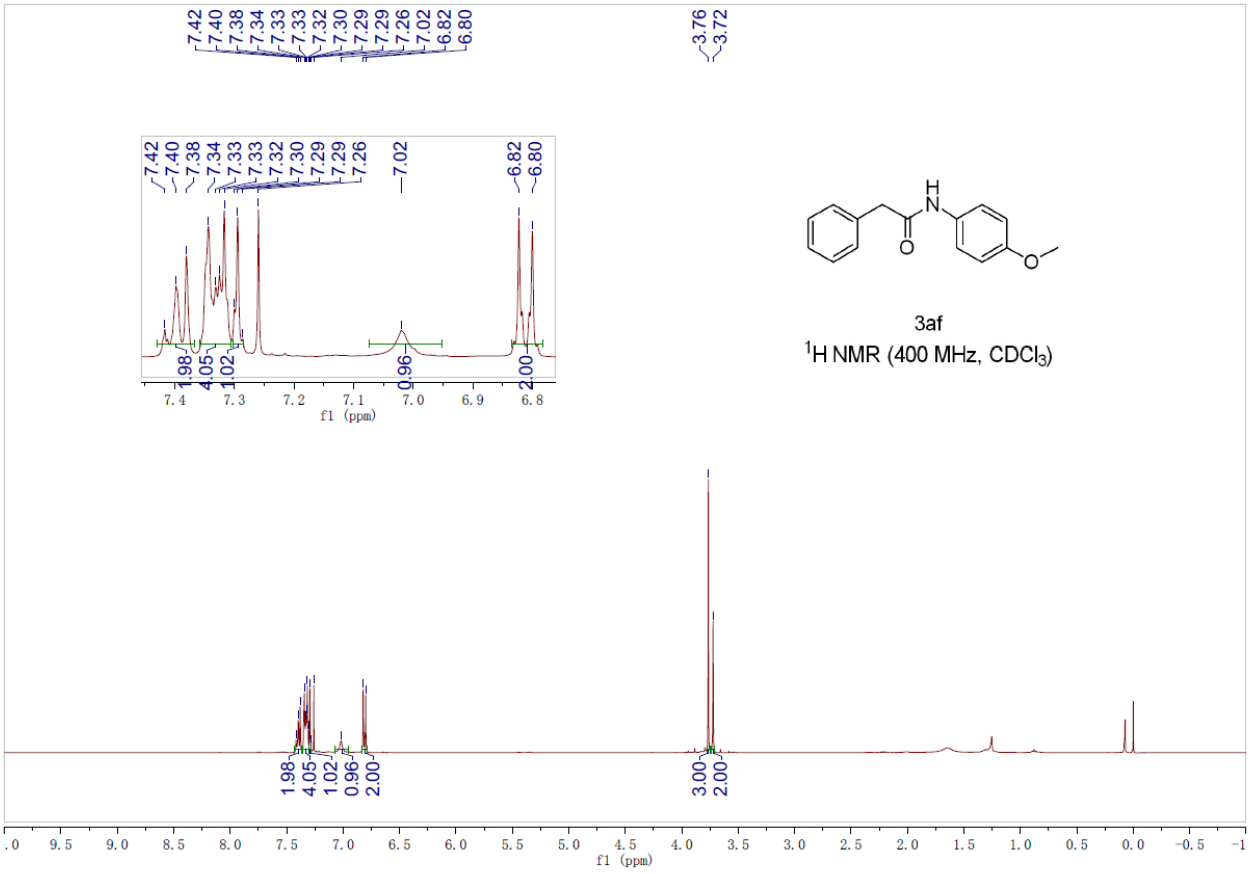

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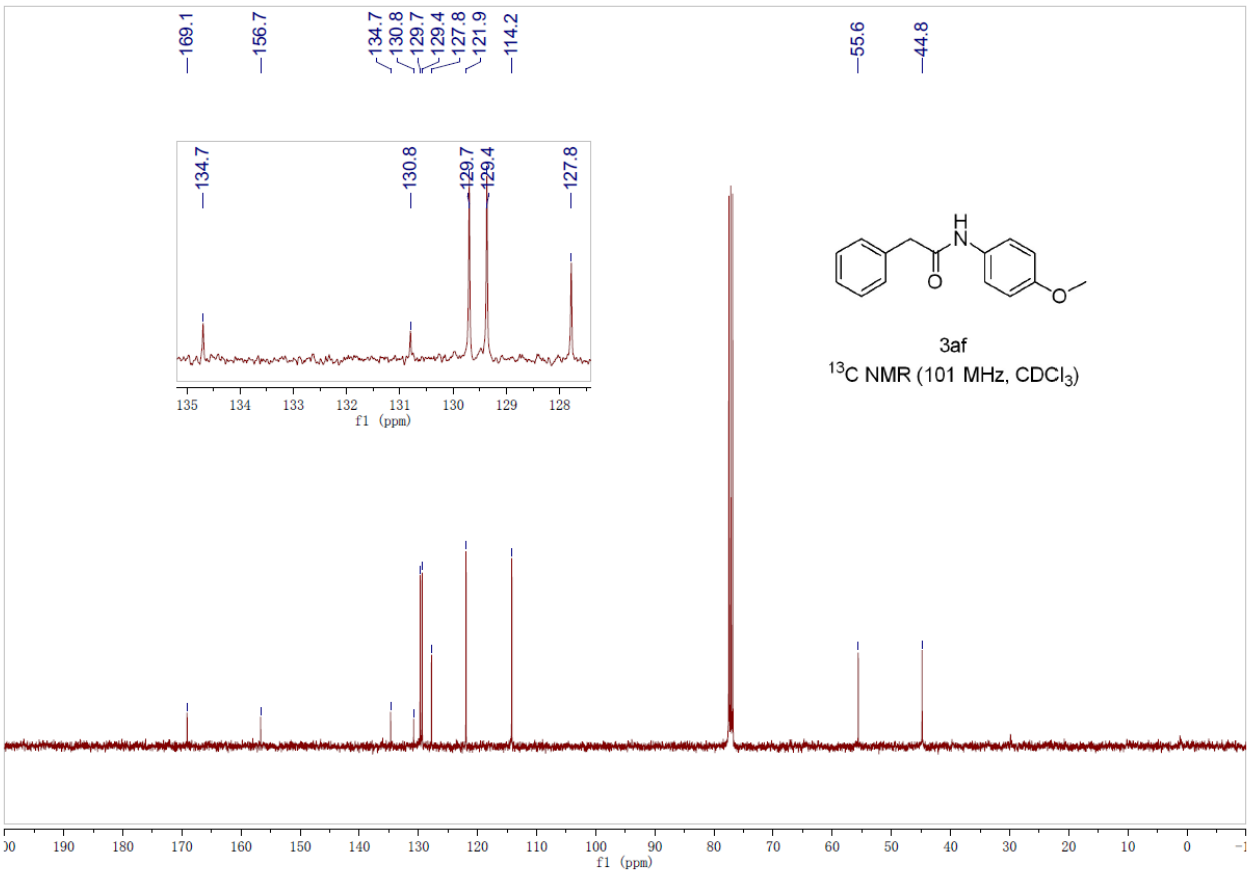

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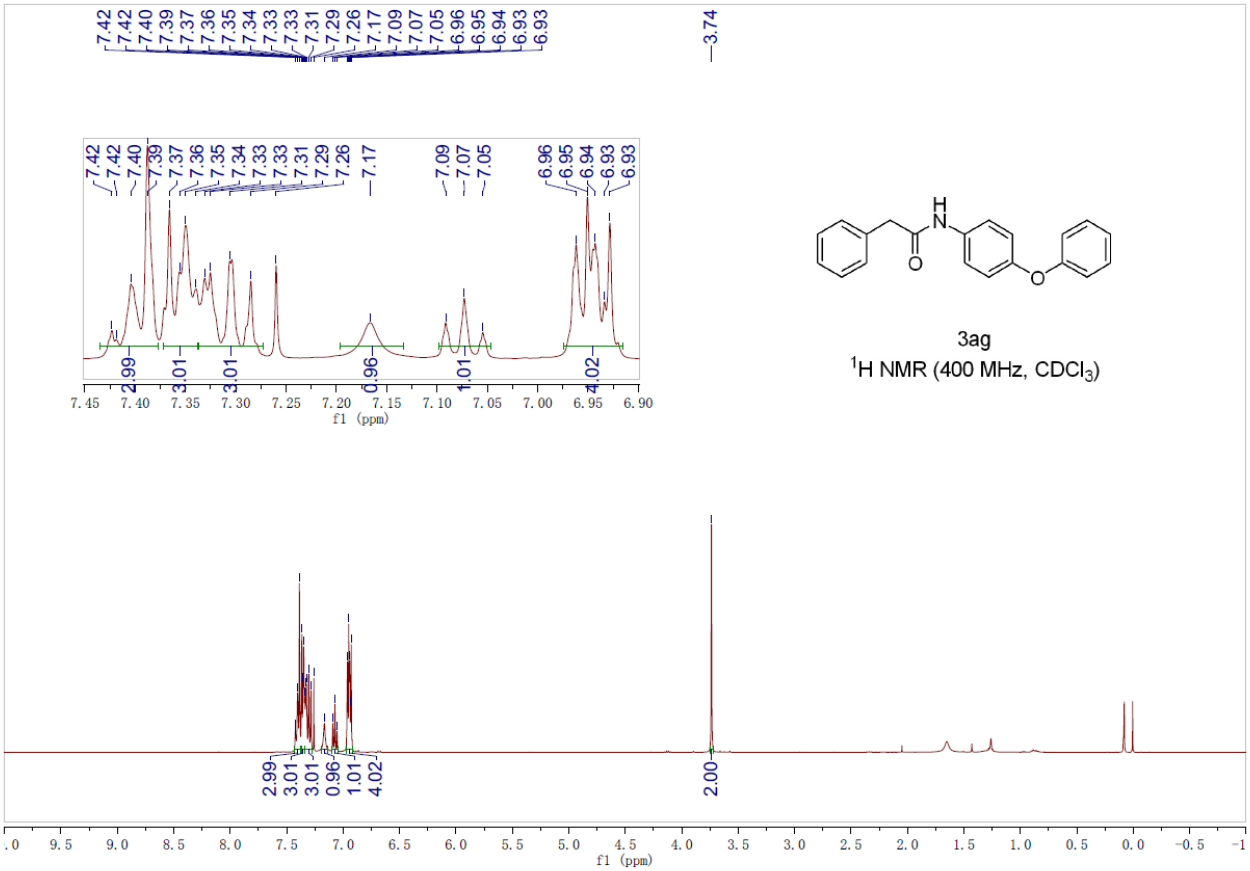

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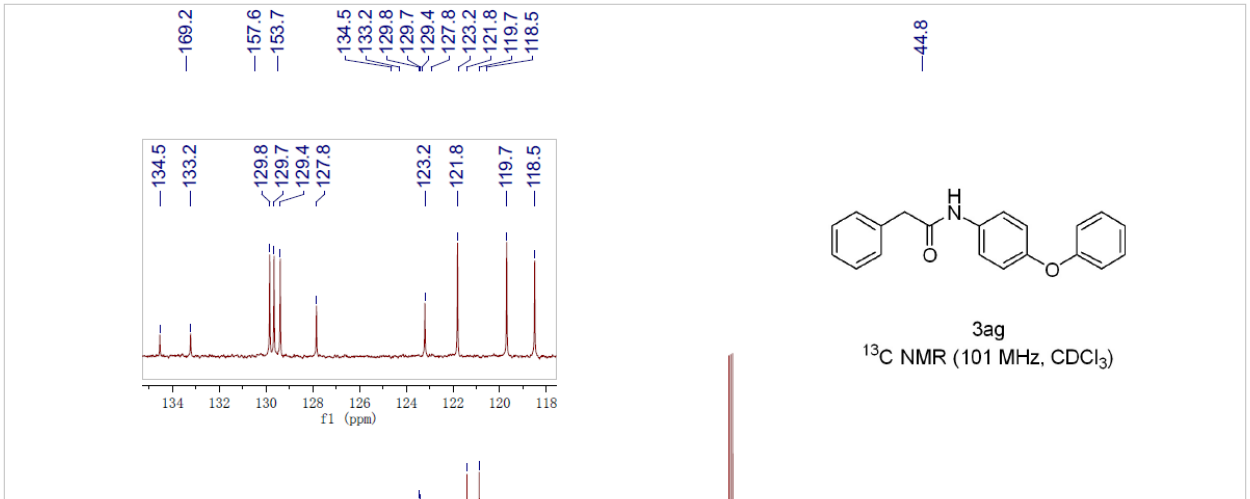

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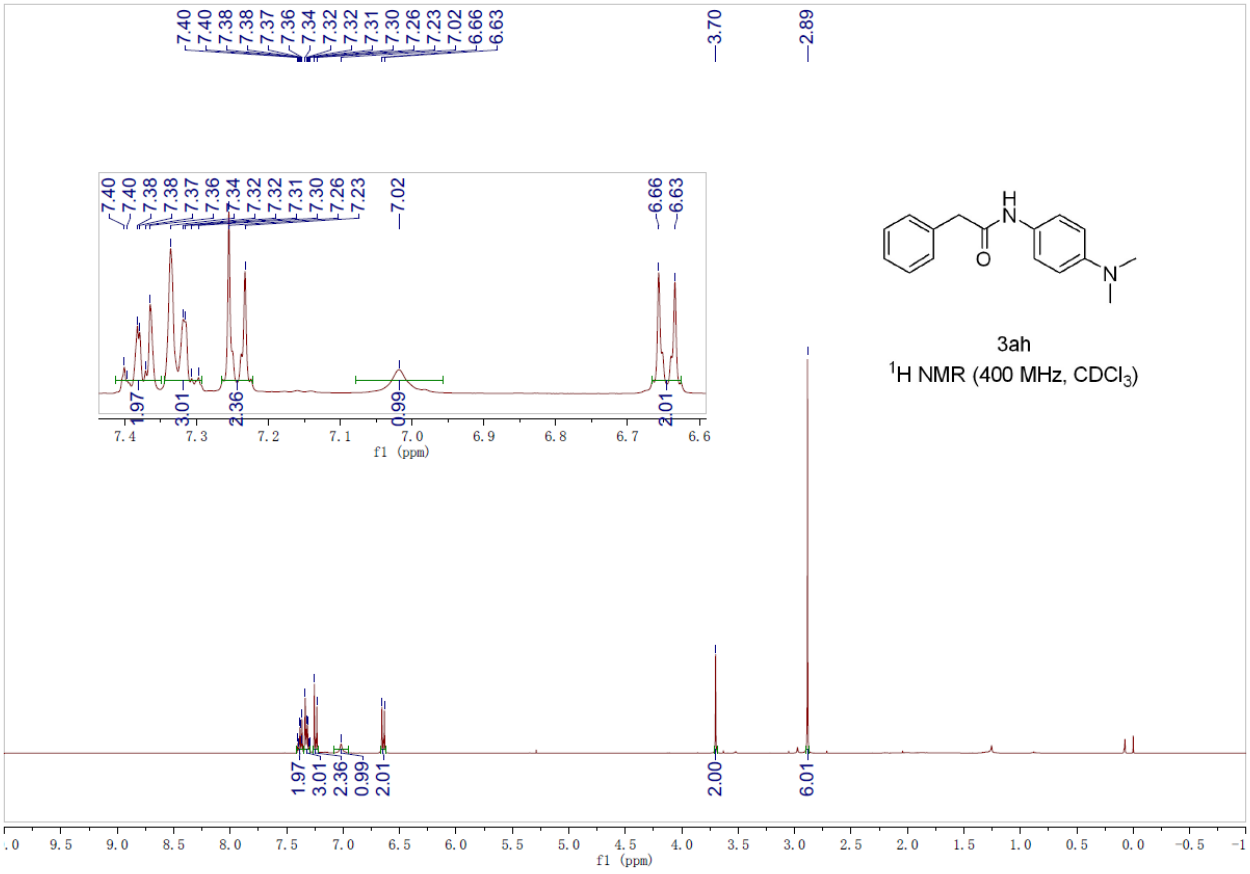

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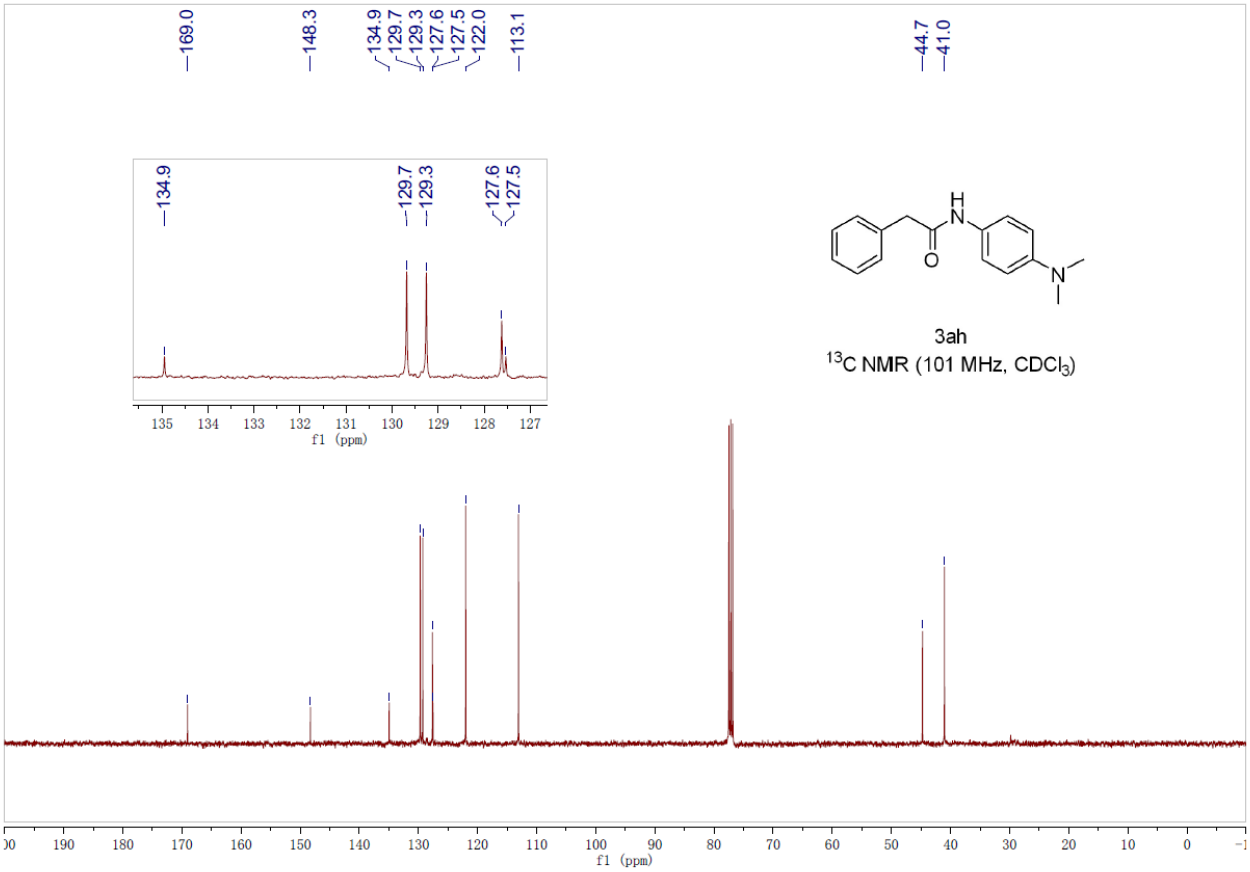

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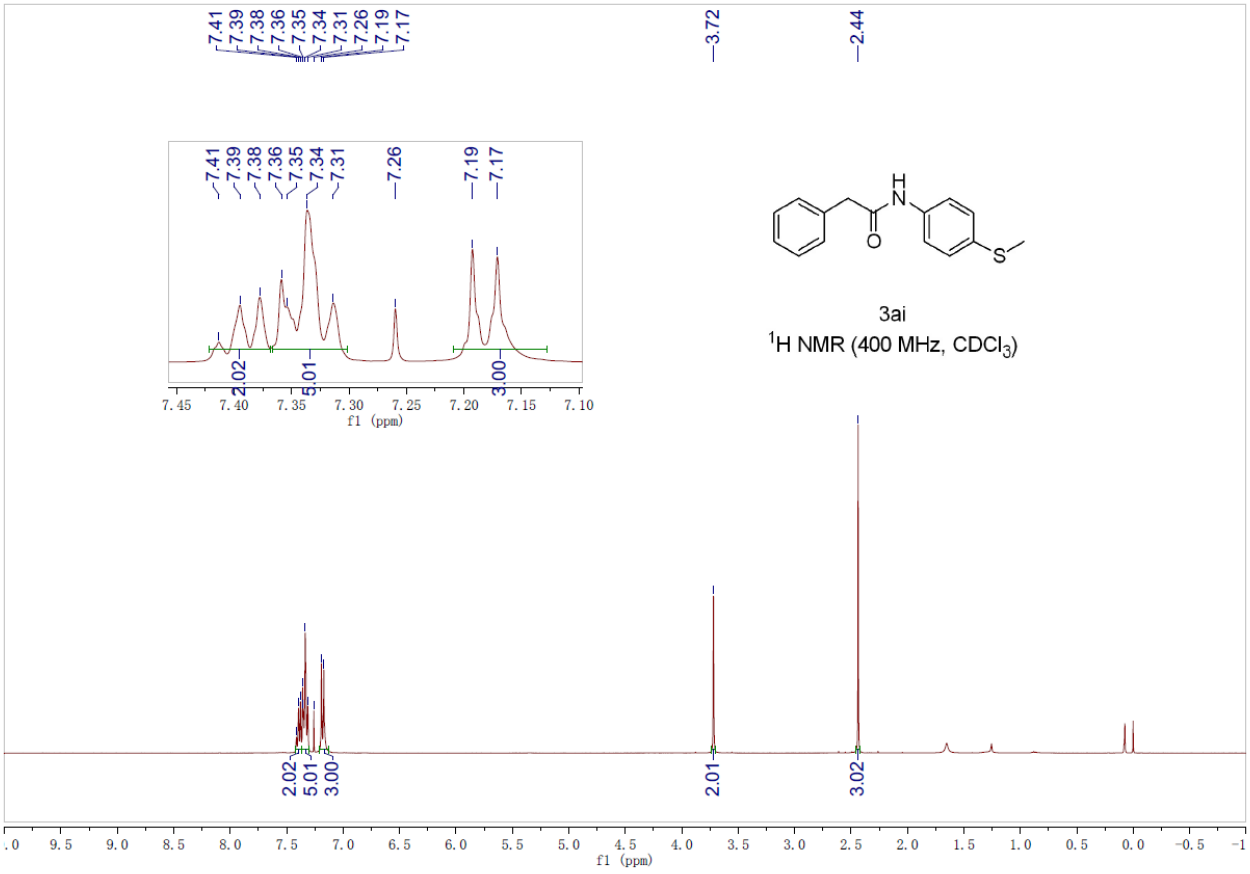

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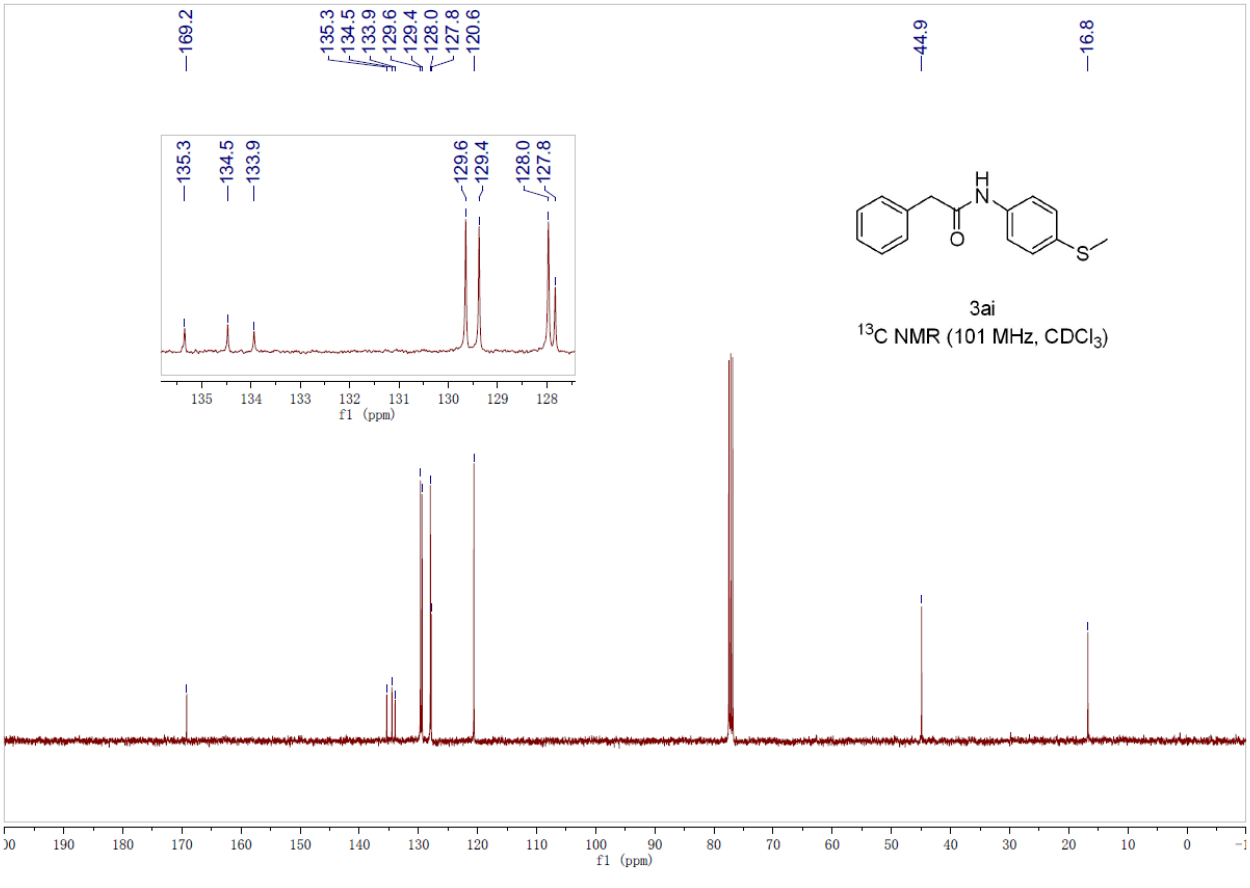

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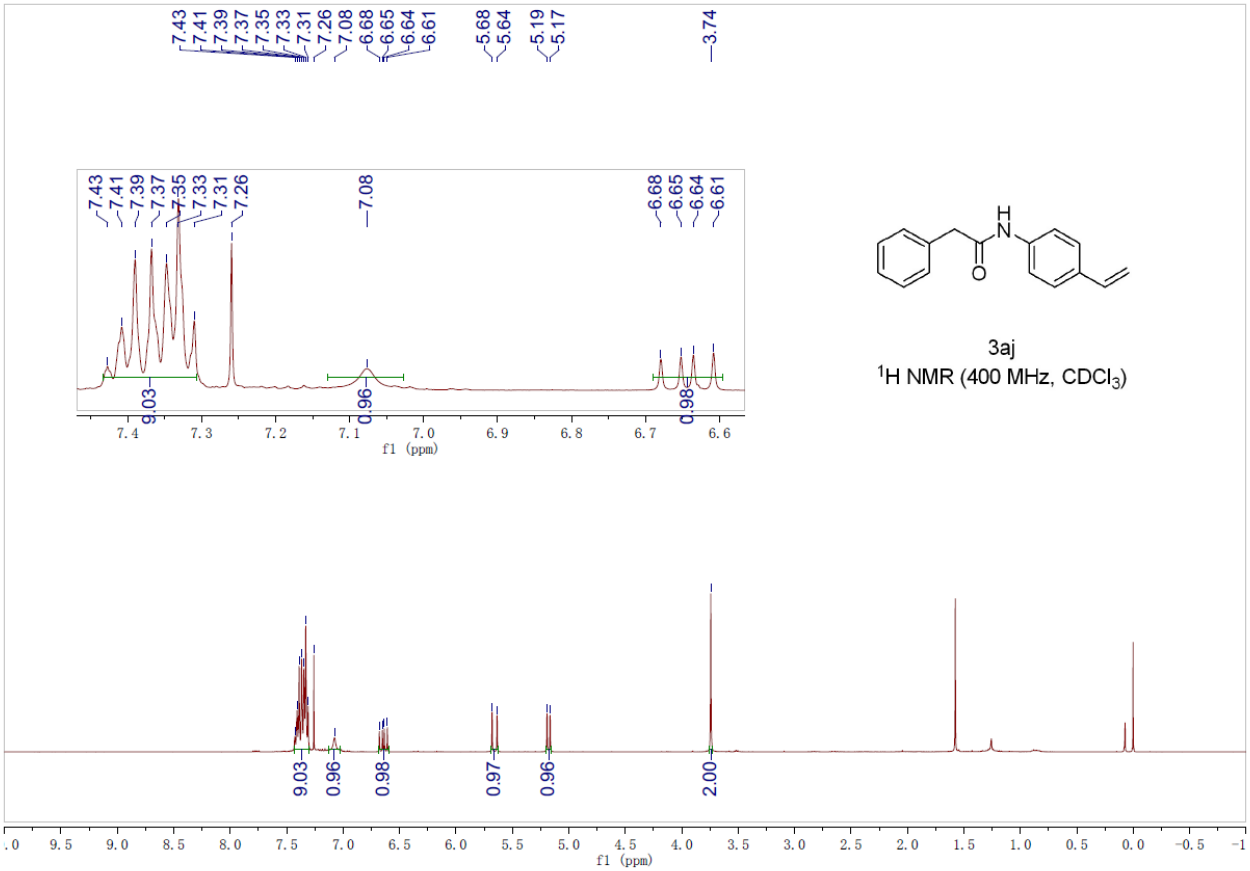

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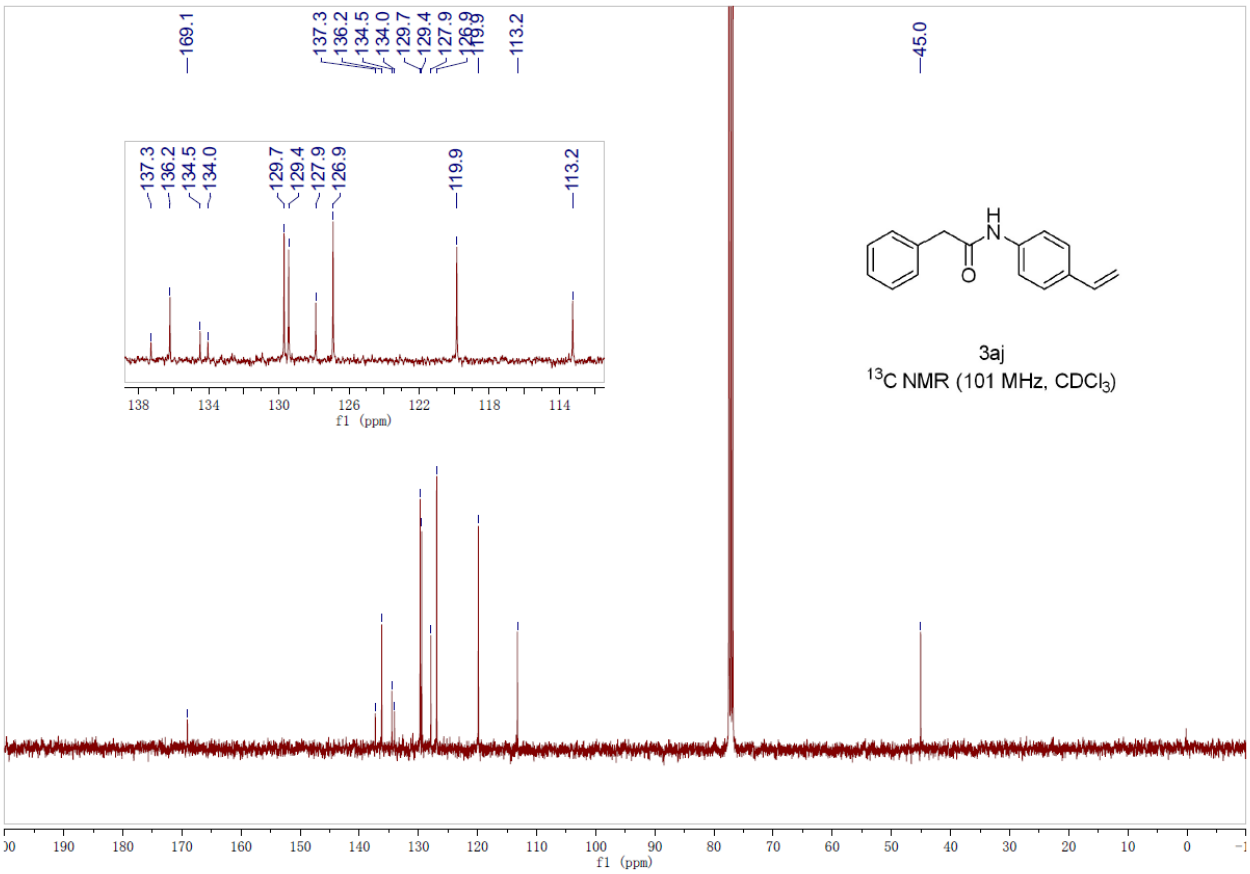

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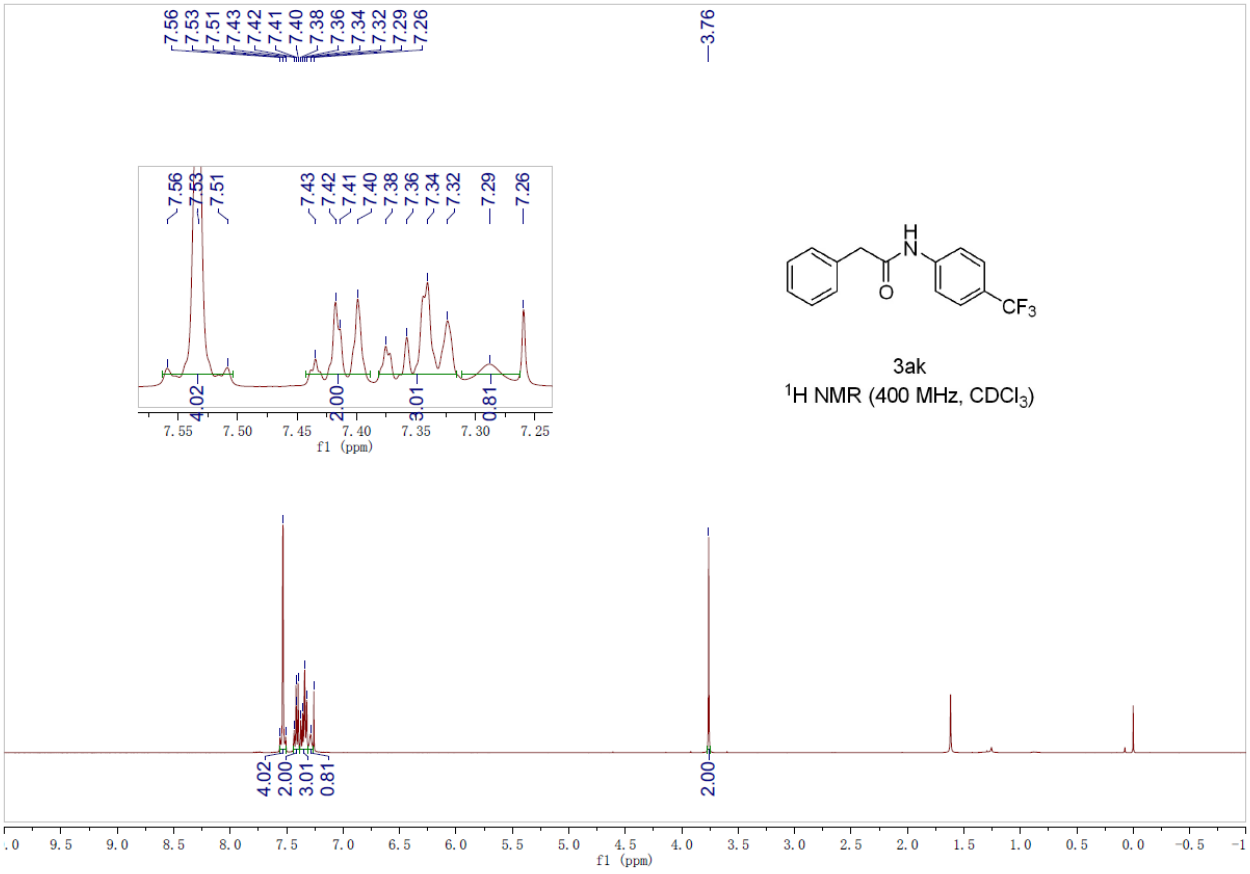
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7.34
7.32
7.29
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3.76
4.02
2.00
3.01
0.81
f1 (ppm)
3ak
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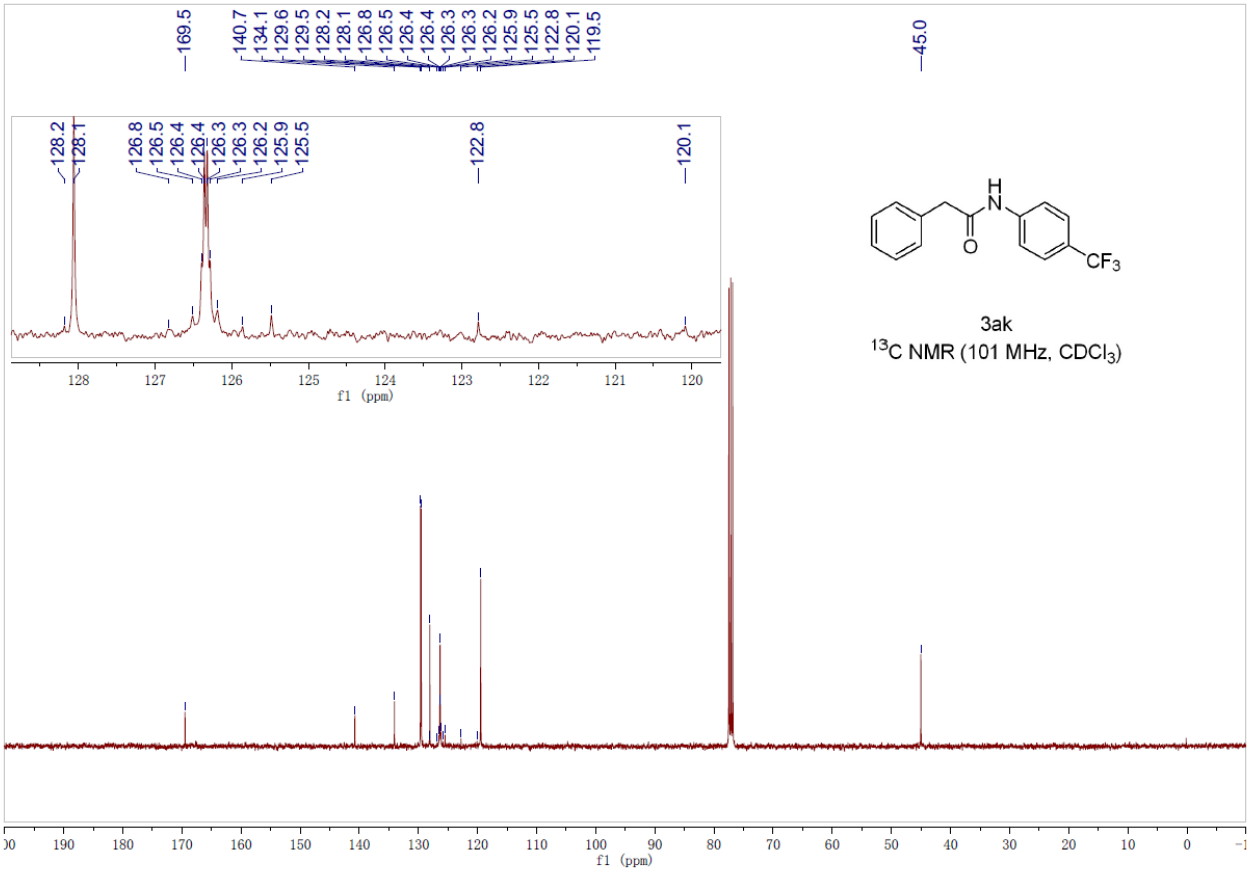
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f1 (ppm)
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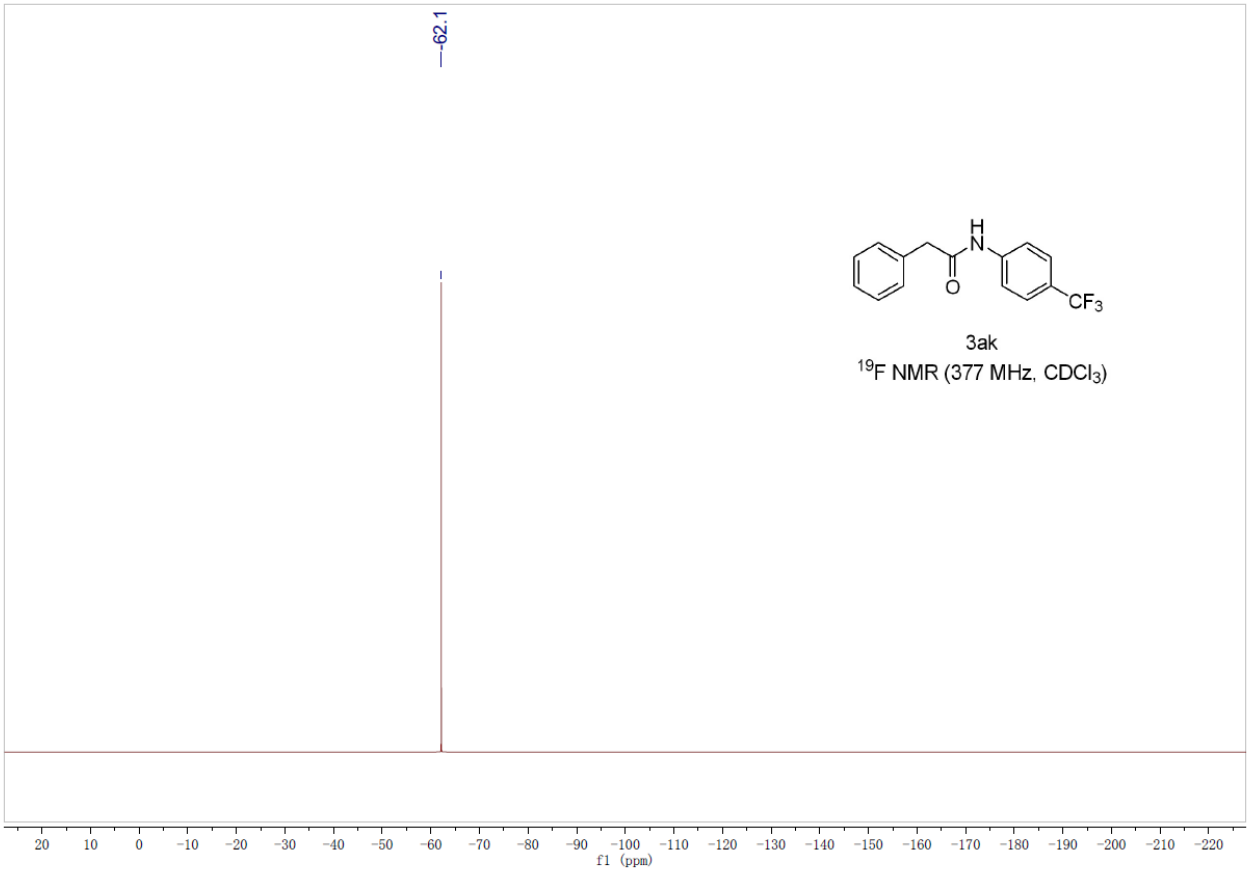

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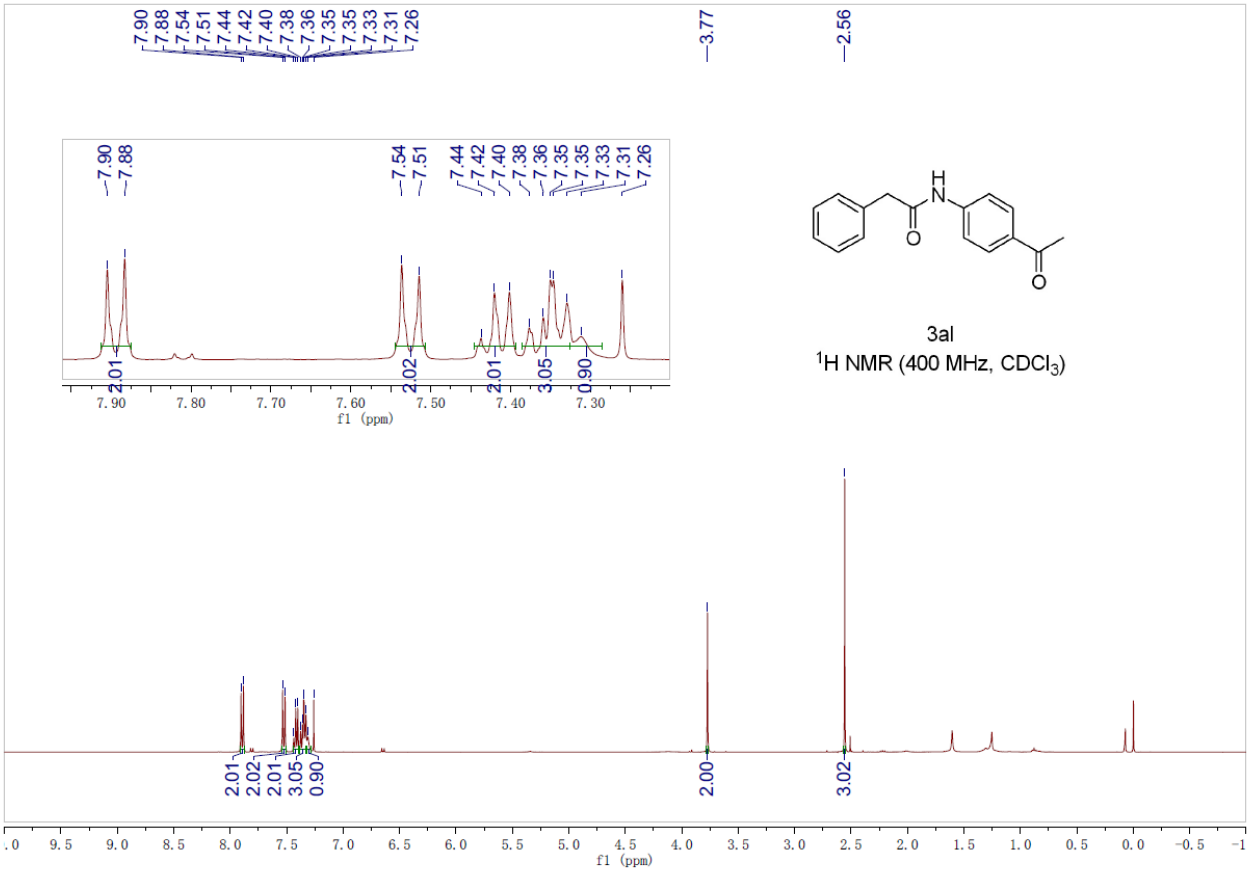
^{19}F NMR (377 MHz, $CDCl_3$)



3al

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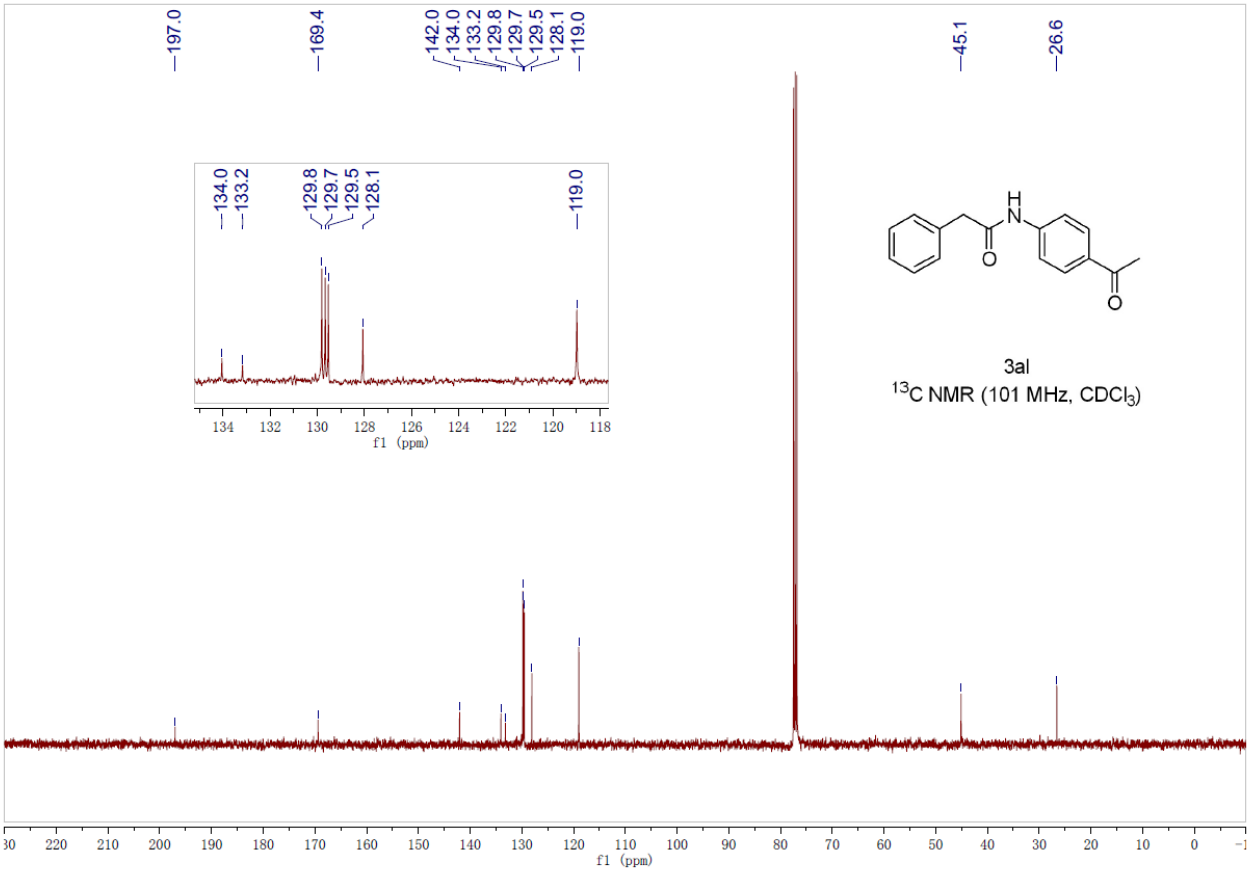

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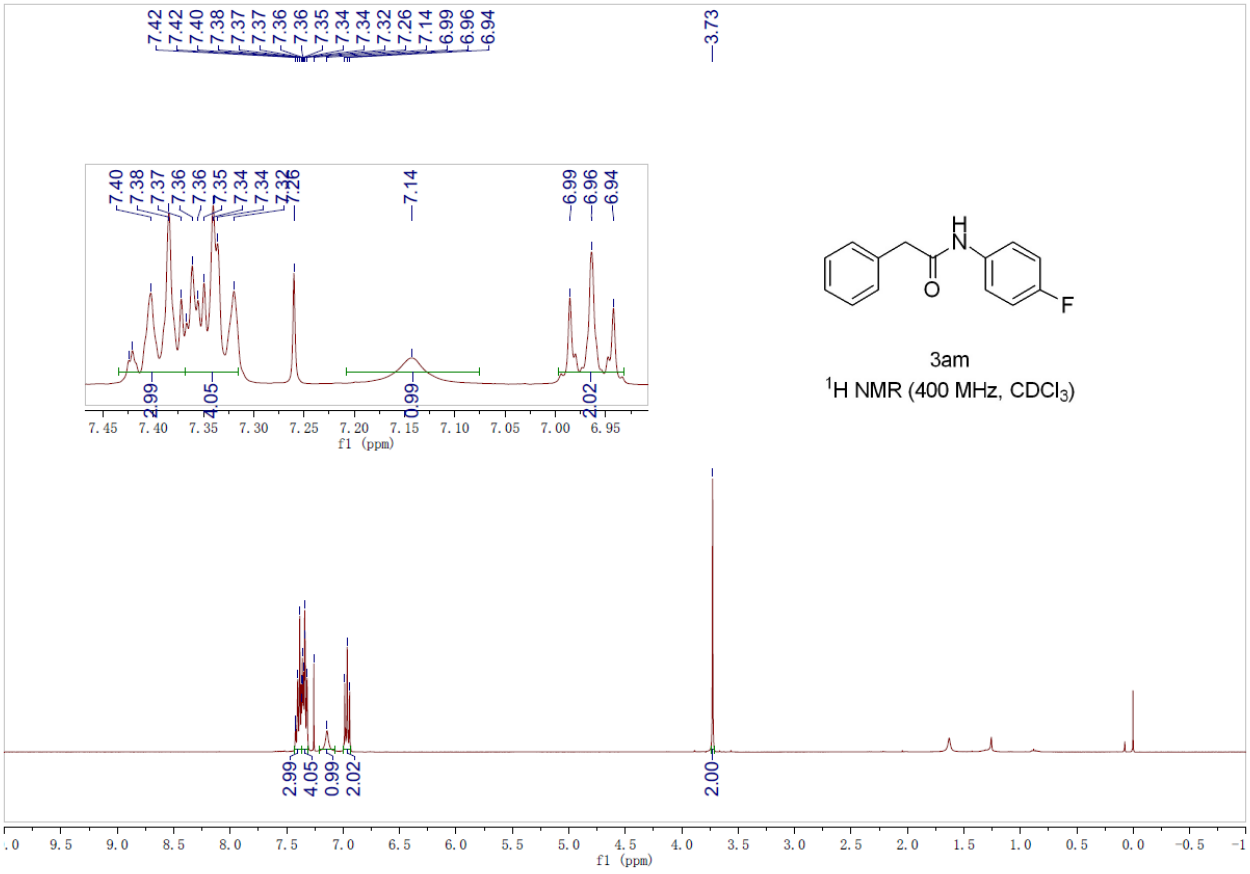
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7.14
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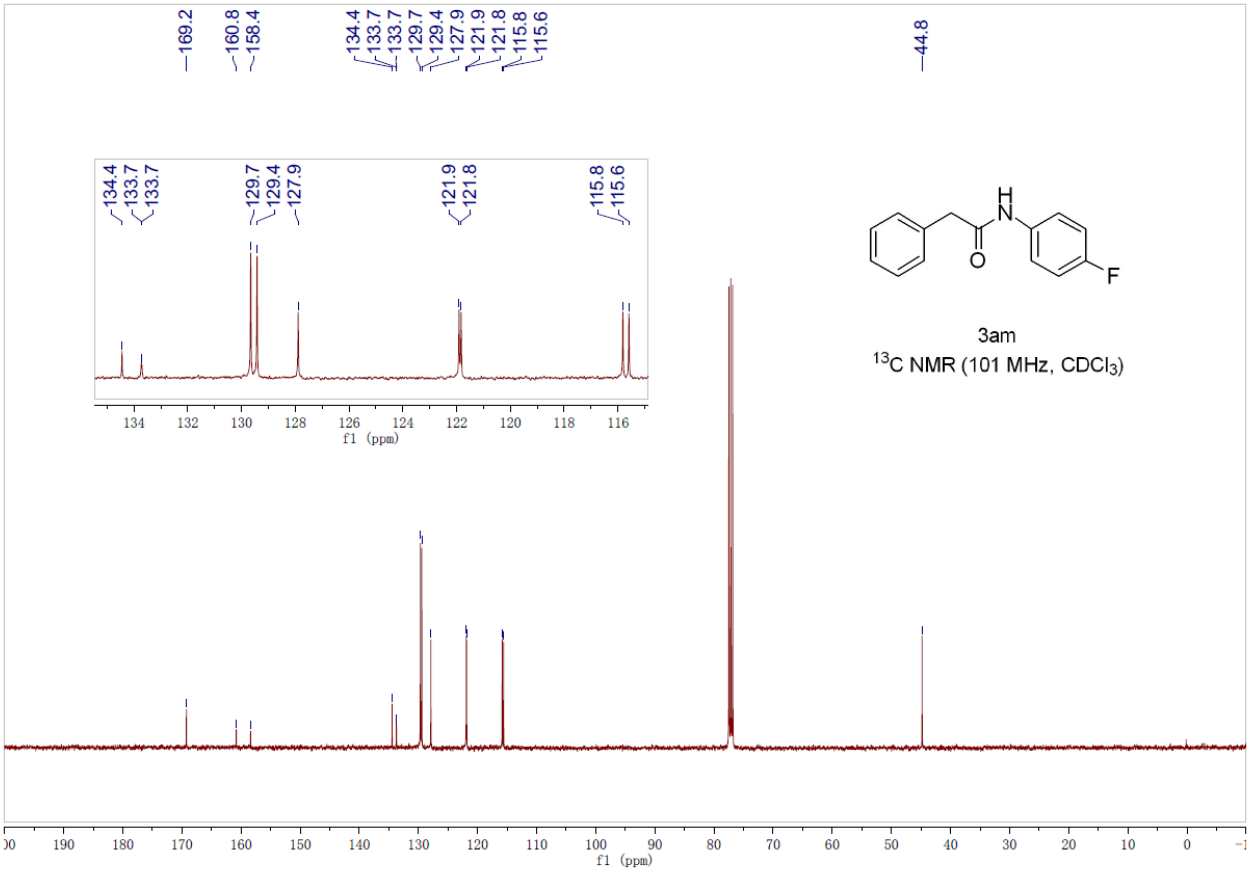
6.96
6.94
3.73
7.40
7.38
7.37
7.36
7.36
7.35
7.34
7.34
7.32
7.26
7.14
6.99
6.96
6.94
2.99
4.05
0.99
2.02
7.45 7.40 7.35 7.30 7.25 7.20 7.15 7.10 7.05 7.00 6.95
f1 (ppm)
2.99
4.05
0.99
2.02
2.00
f1 (ppm)
3am
1H NMR (400 MHz, CDCl3)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129.4
127.9
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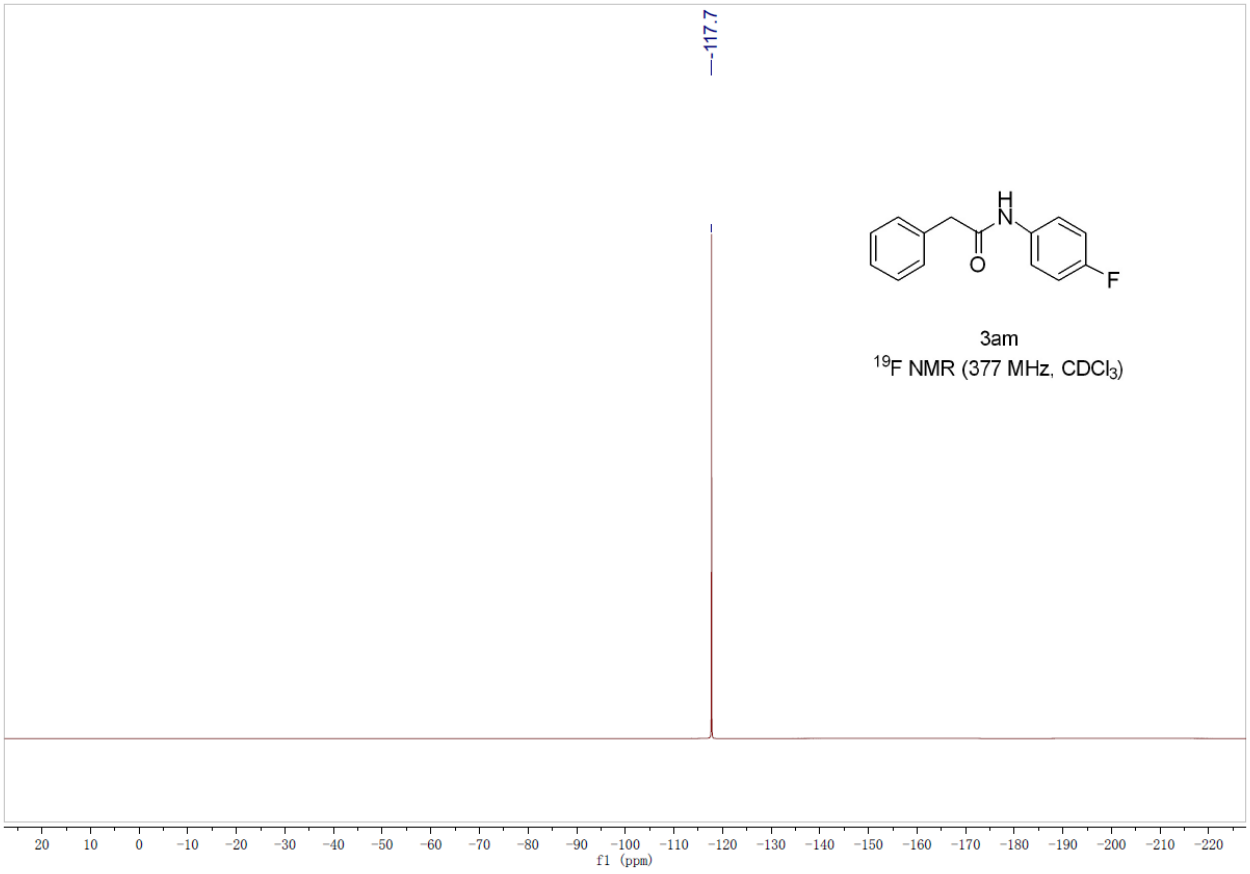
f1 (ppm)
f1 (ppm)
3am
13C NMR (101 MHz, CDCl3)



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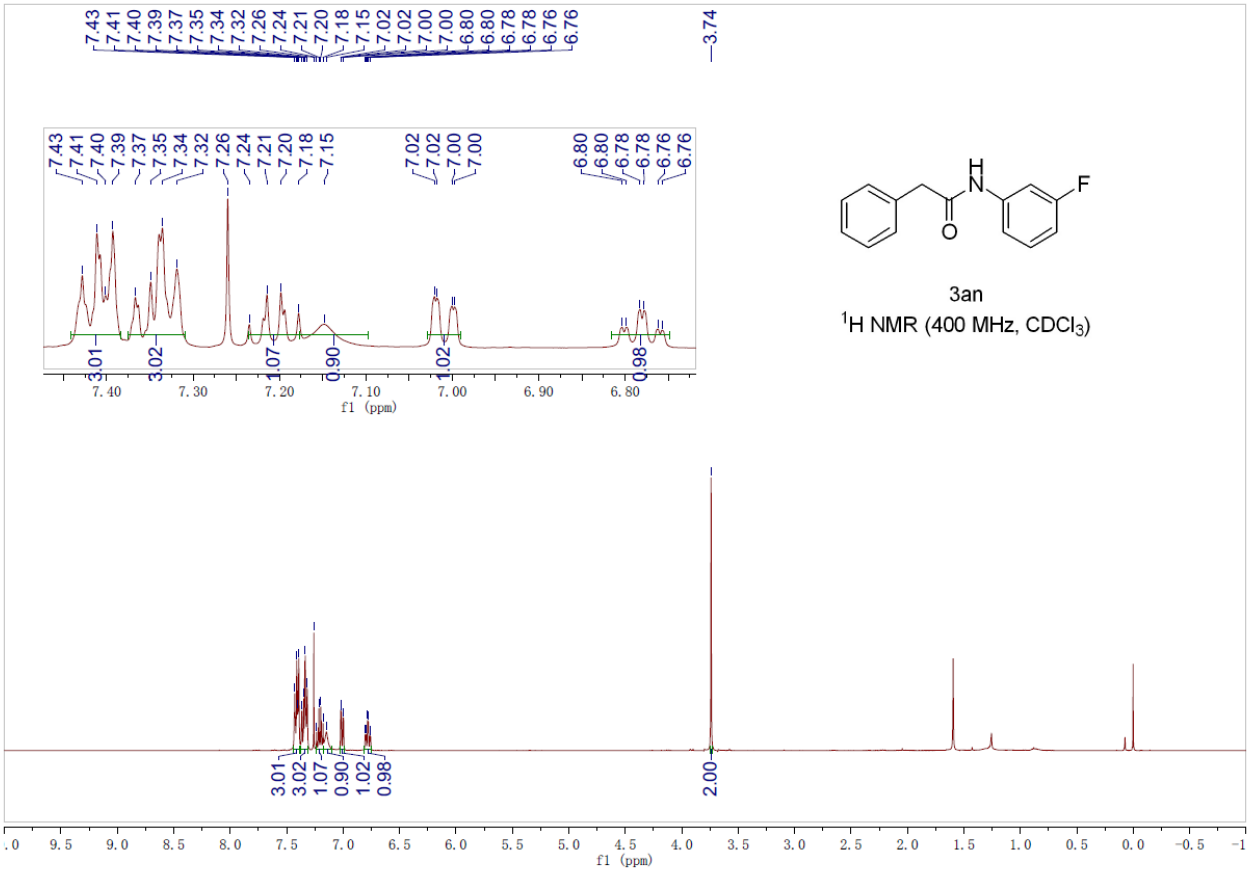

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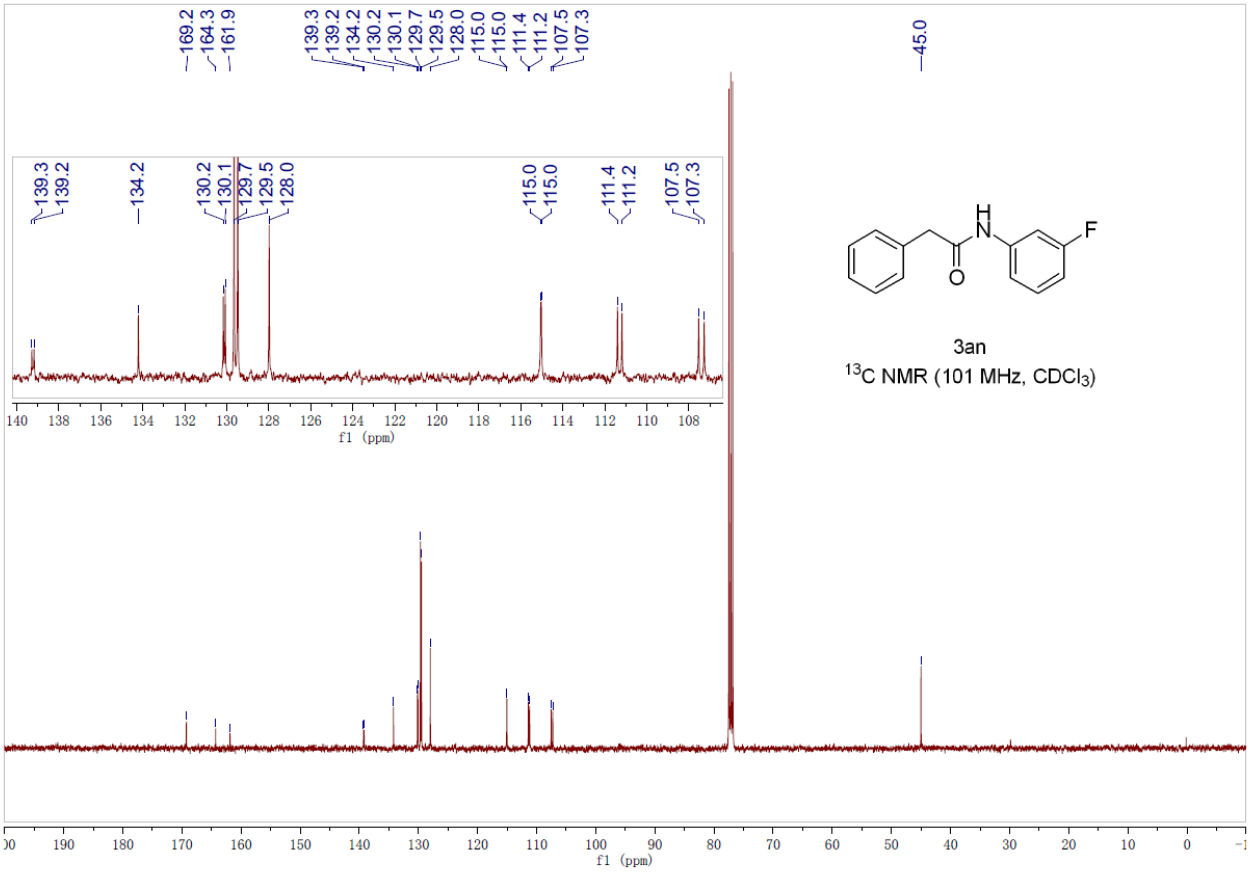
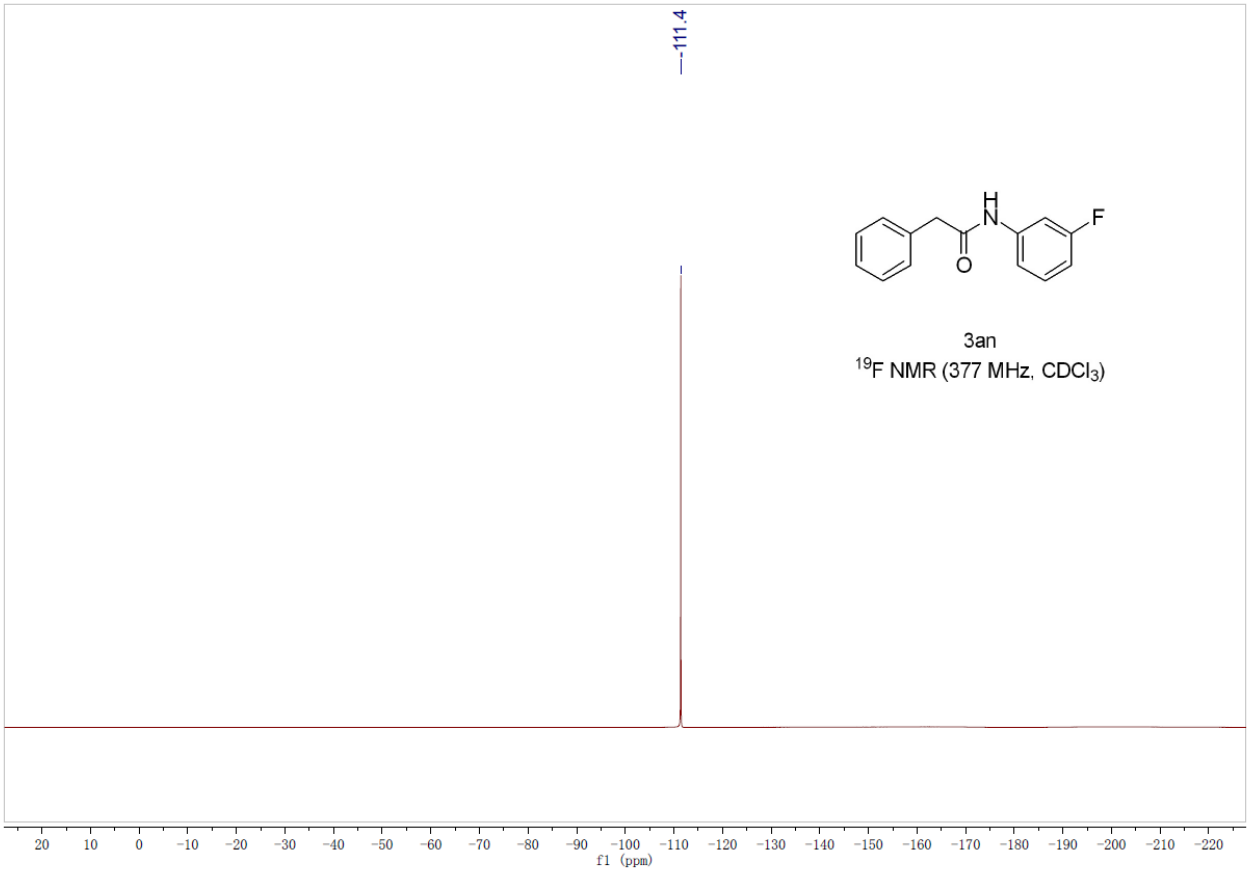
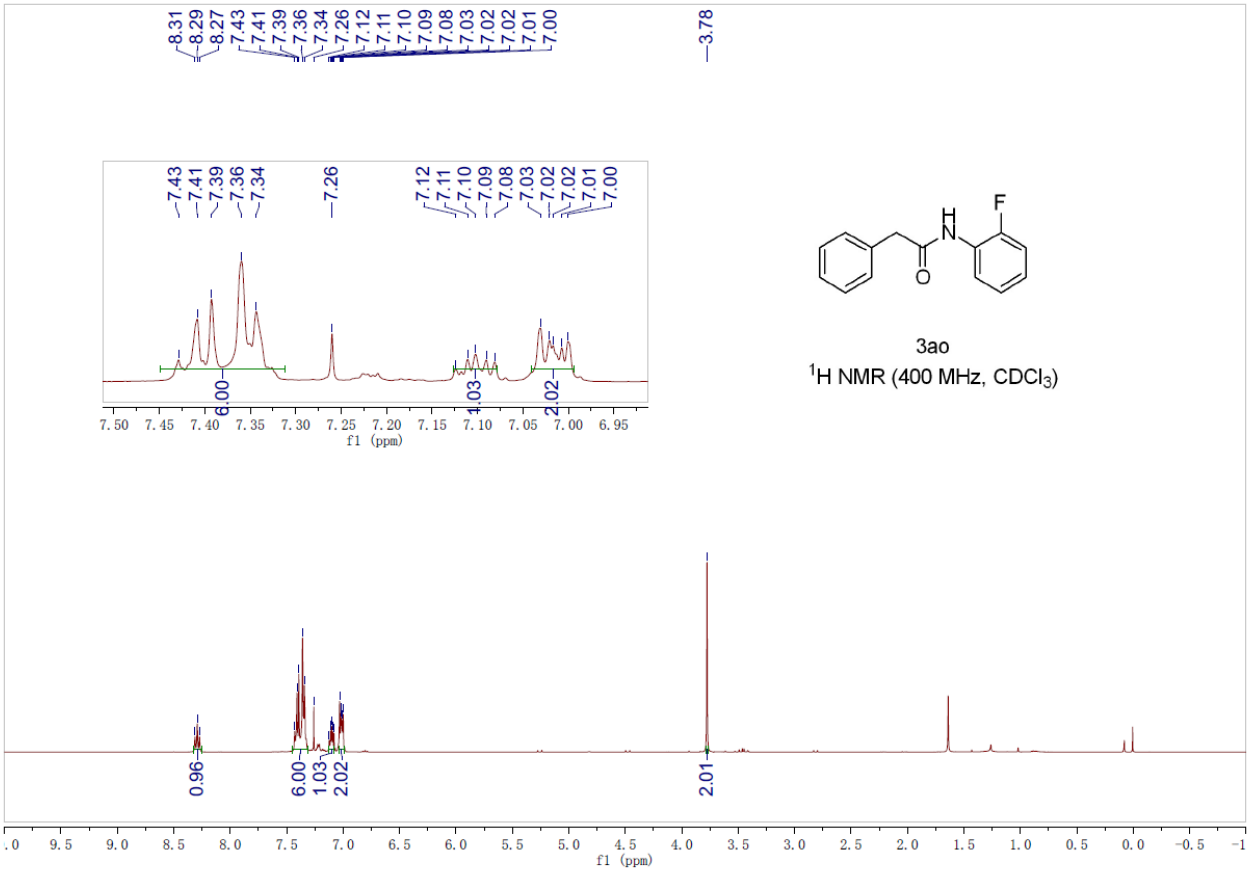


3an

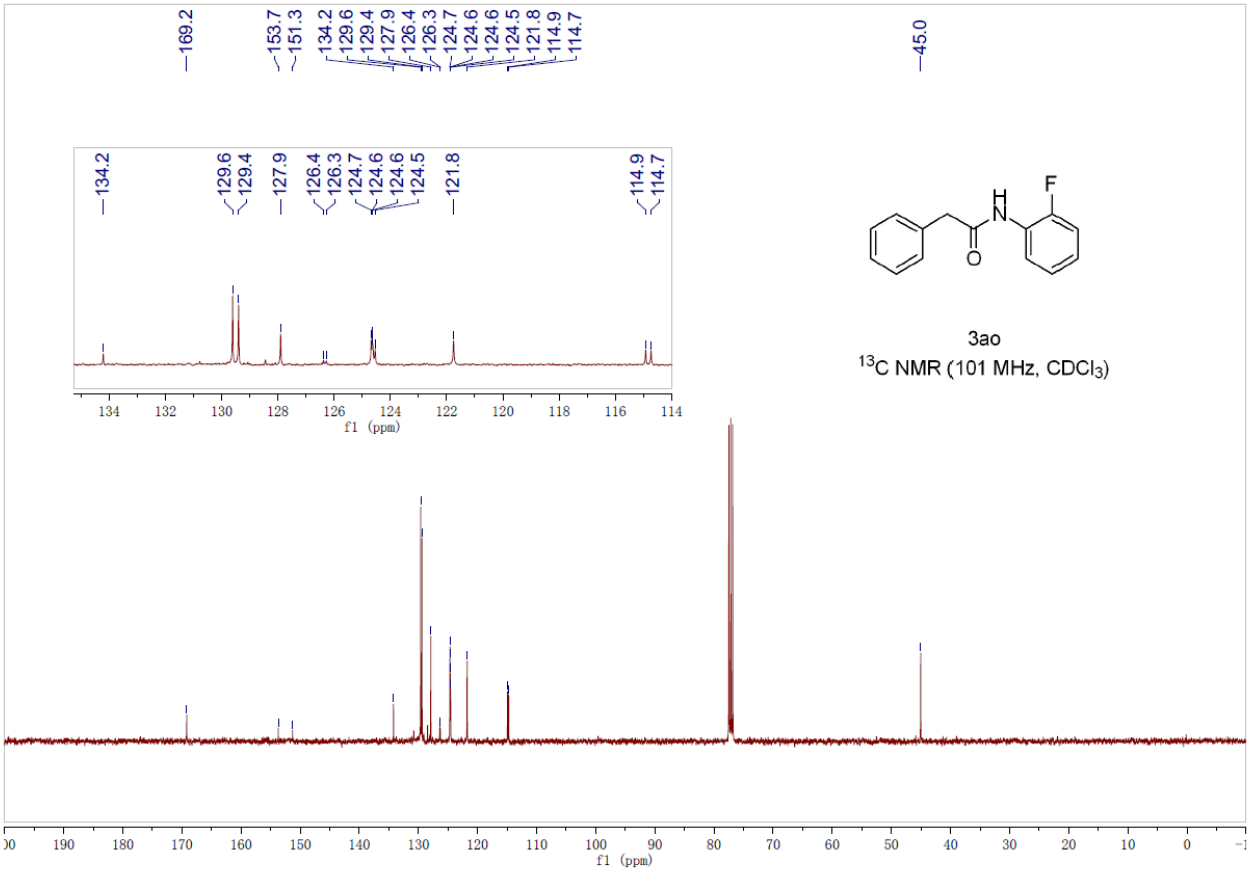
^{13}C NMR (101 MHz, $CDCl_3$)


-111.4
H
N
O
F
3an
19F NMR (377 MHz, CDCl3)
20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220
f1 (ppm)



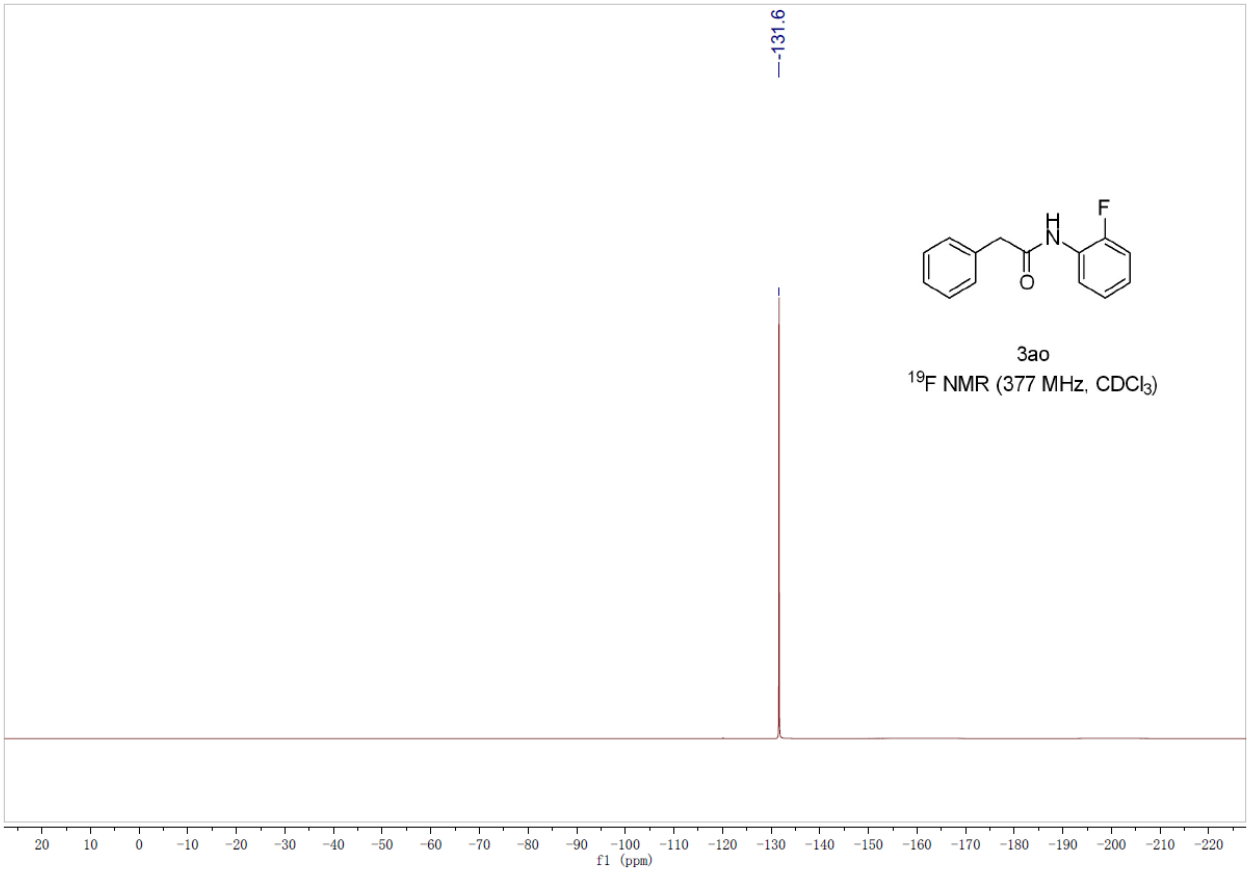
3ao

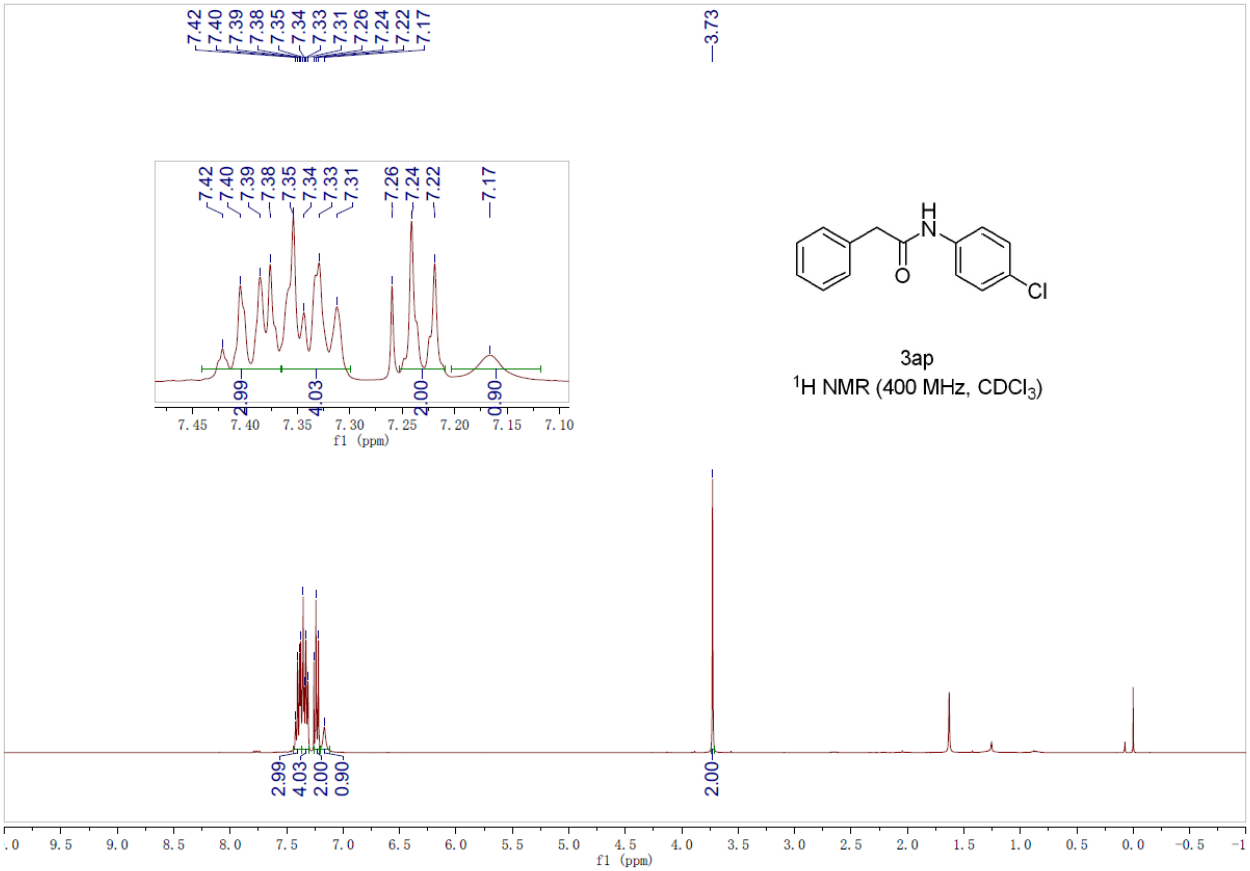
^{1}H NMR (400 MHz, $CDCl_3$)

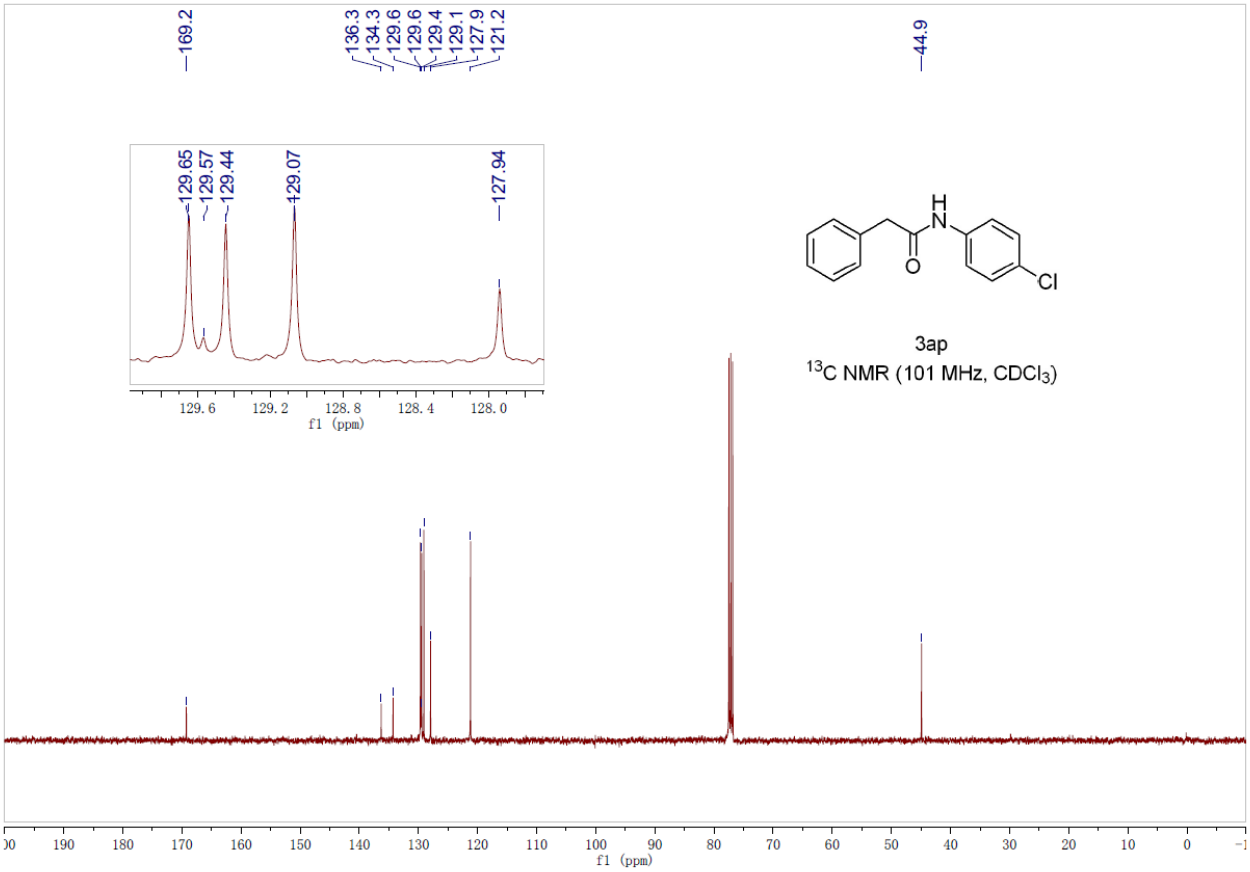


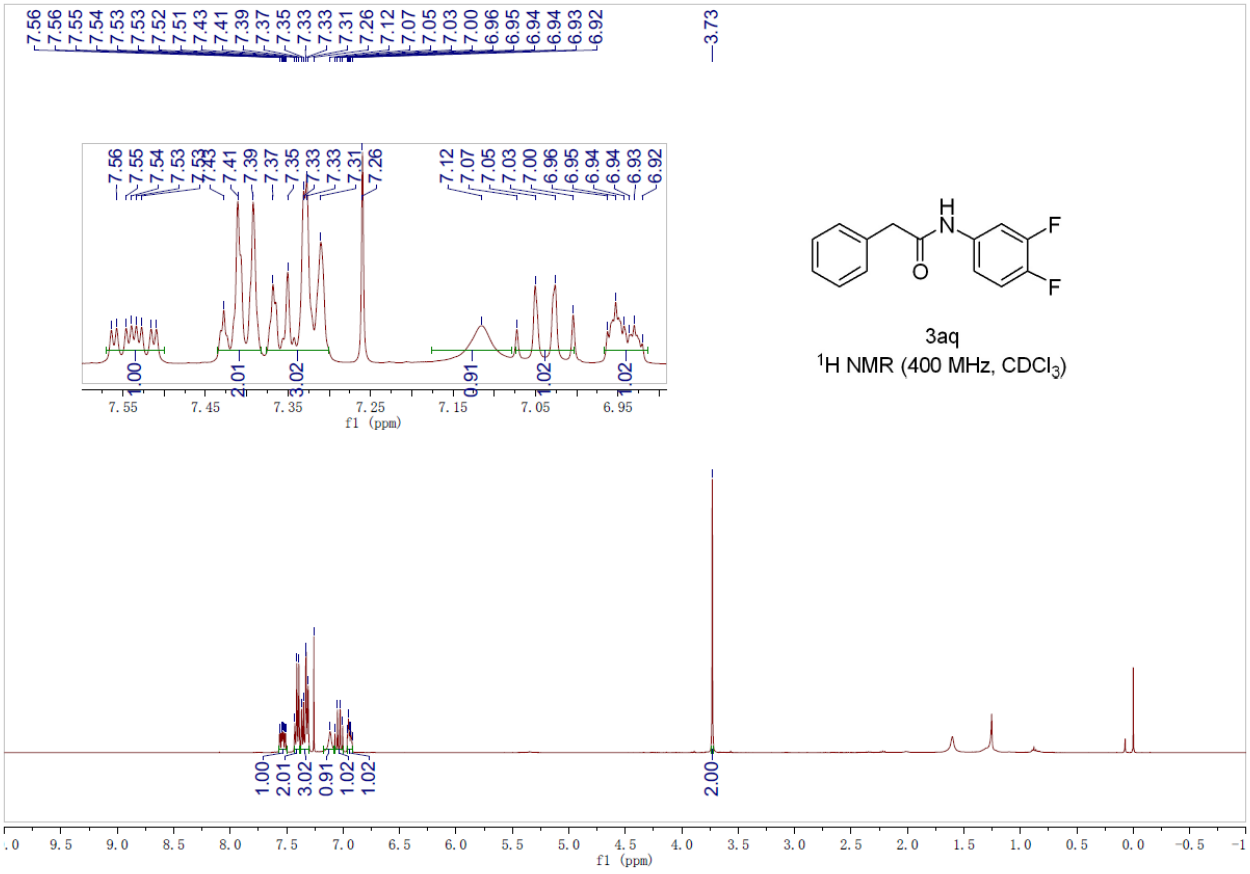
3ao

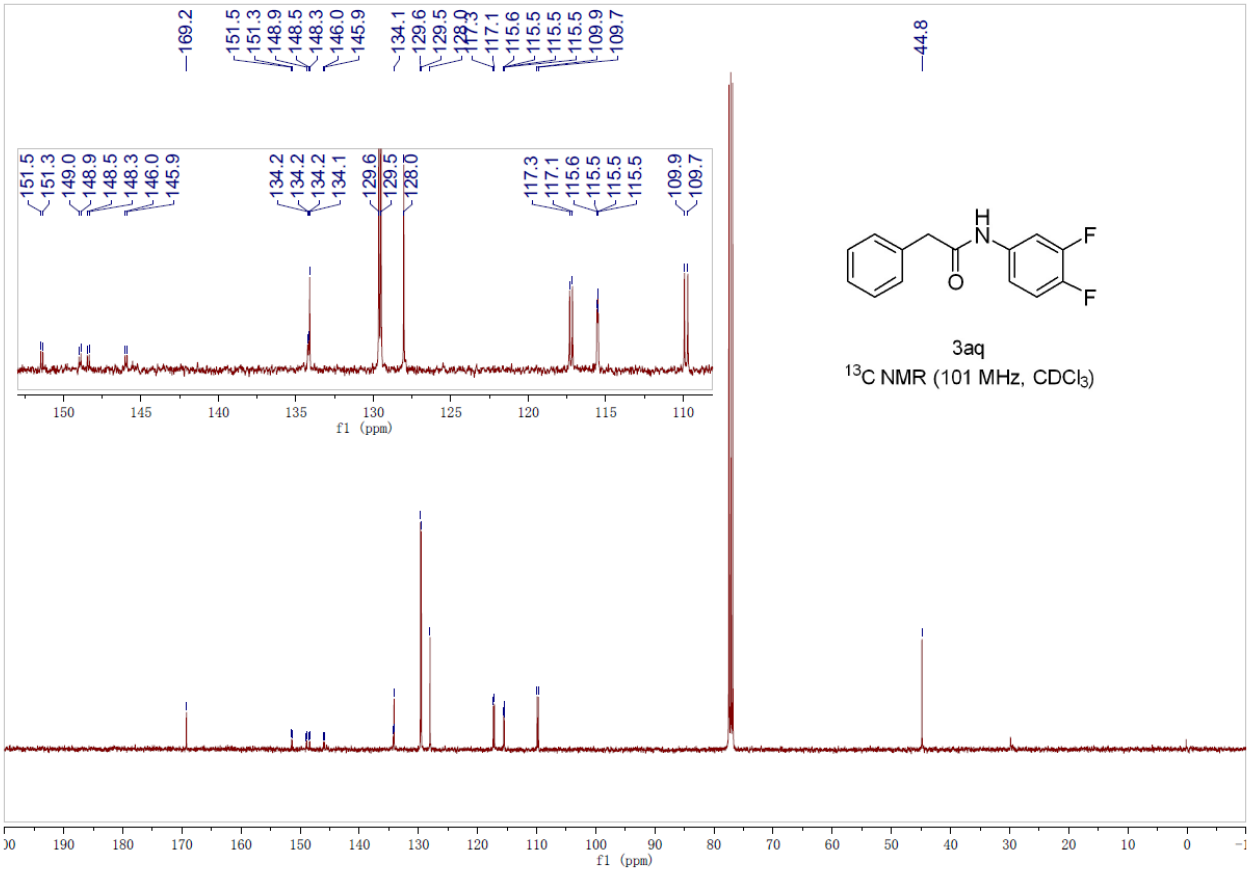
^{13}C NMR (101 MHz, $CDCl_3$)

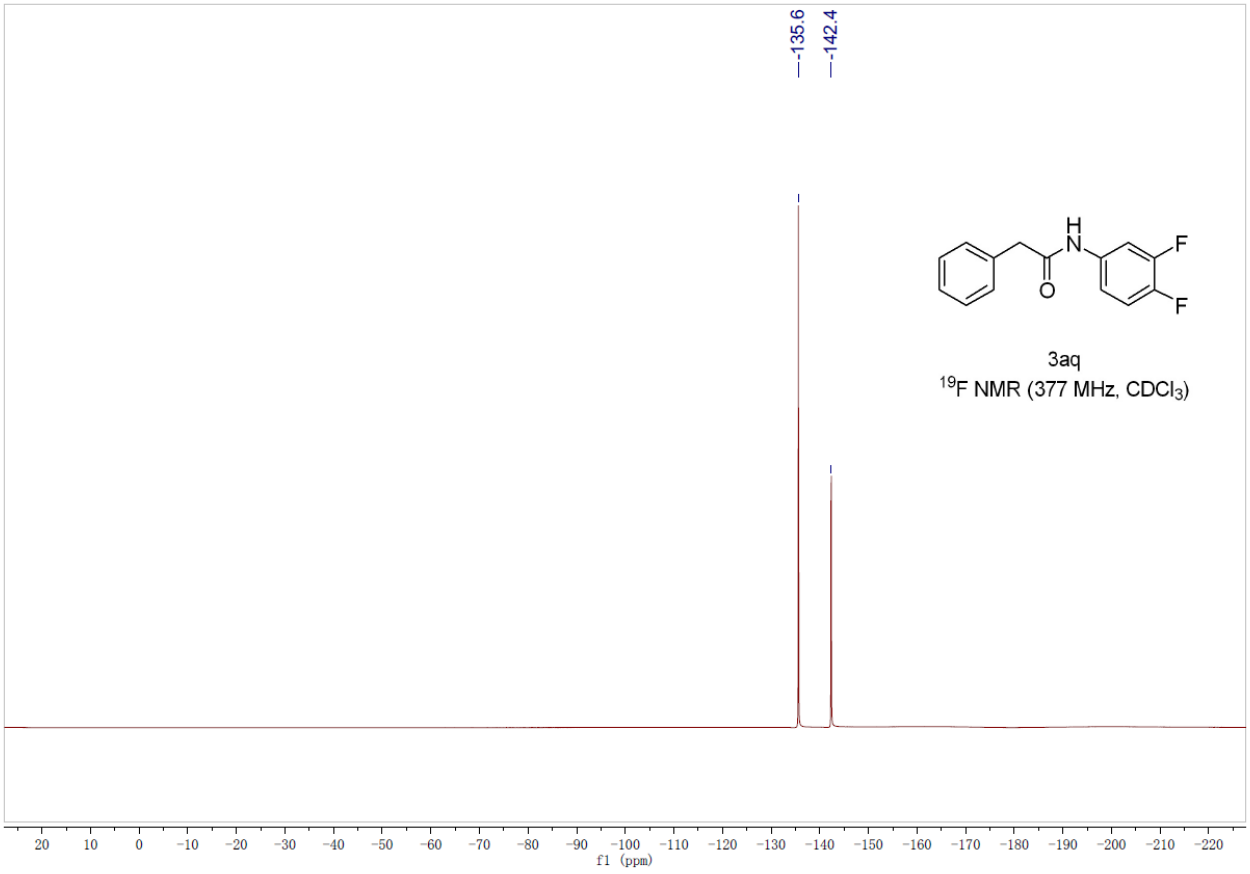

-131.6
H
N
F
O
3ao
19F NMR (377 MHz, CDCl3)
20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220
f1 (ppm)

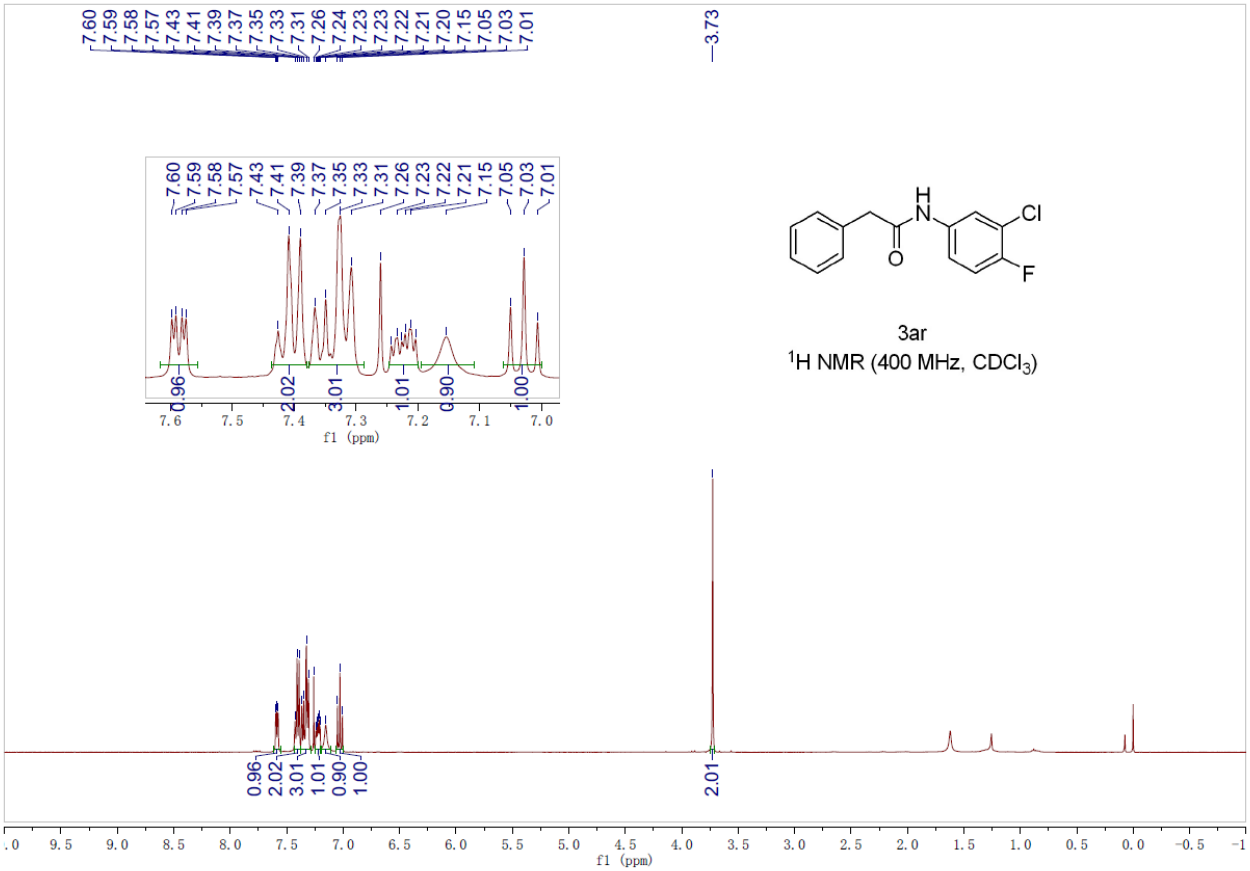

7.42
7.40
7.39
7.38
7.35
7.34
7.33
7.31
7.26
7.24
7.22
7.17
3.73
2.99
4.03
2.00
0.90
f1 (ppm)
H
N
O
Cl
3ap
1H NMR (400 MHz, CDCl3)


169.2
136.3
134.3
129.6
129.6
129.4
129.1
127.9
121.2
44.9
129.65
129.57
129.44
129.07
127.94
f1 (ppm)
H
N
O
Cl
3ap
13C NMR (101 MHz, CDCl3)


3aq
^{1}H NMR (400 MHz, CDCl$_3$)


3aq
^{13}C NMR (101 MHz, CDCl$_3$)


-135.6
-142.4
H
N
O
F
F
3aq
19F NMR (377 MHz, CDCl3)
20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220
f1 (ppm)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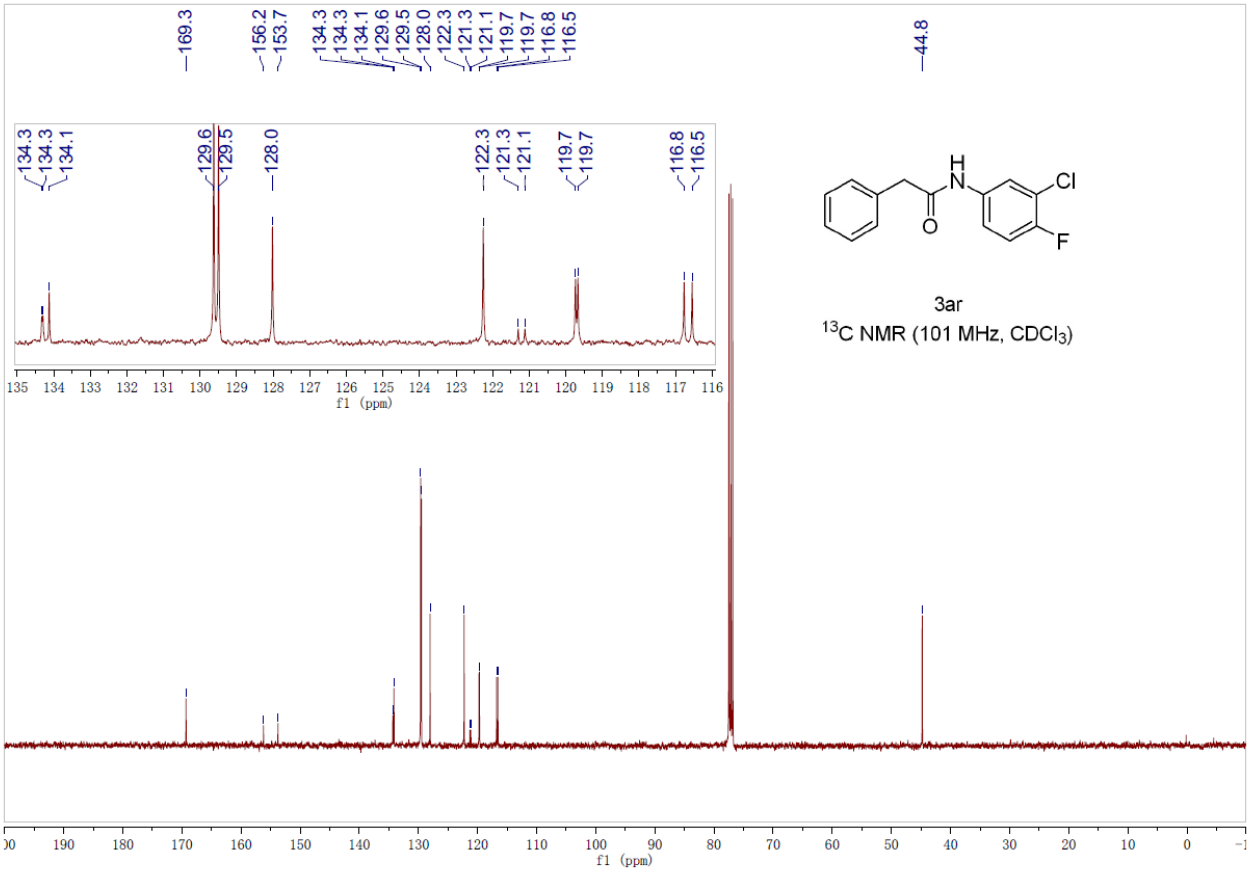
7.59
7.58
7.57
7.43
7.41
7.39
7.37
7.35
7.33
7.31
7.26
7.24
7.23
7.23
7.22
7.21
7.20
7.15
7.05
7.03
7.01
3.73
0.96
2.02
3.01
1.01
0.90
1.00
2.01
f1 (ppm)
Cl
F
3ar
^{1}H NMR (400 MHz, $CDCl_3$)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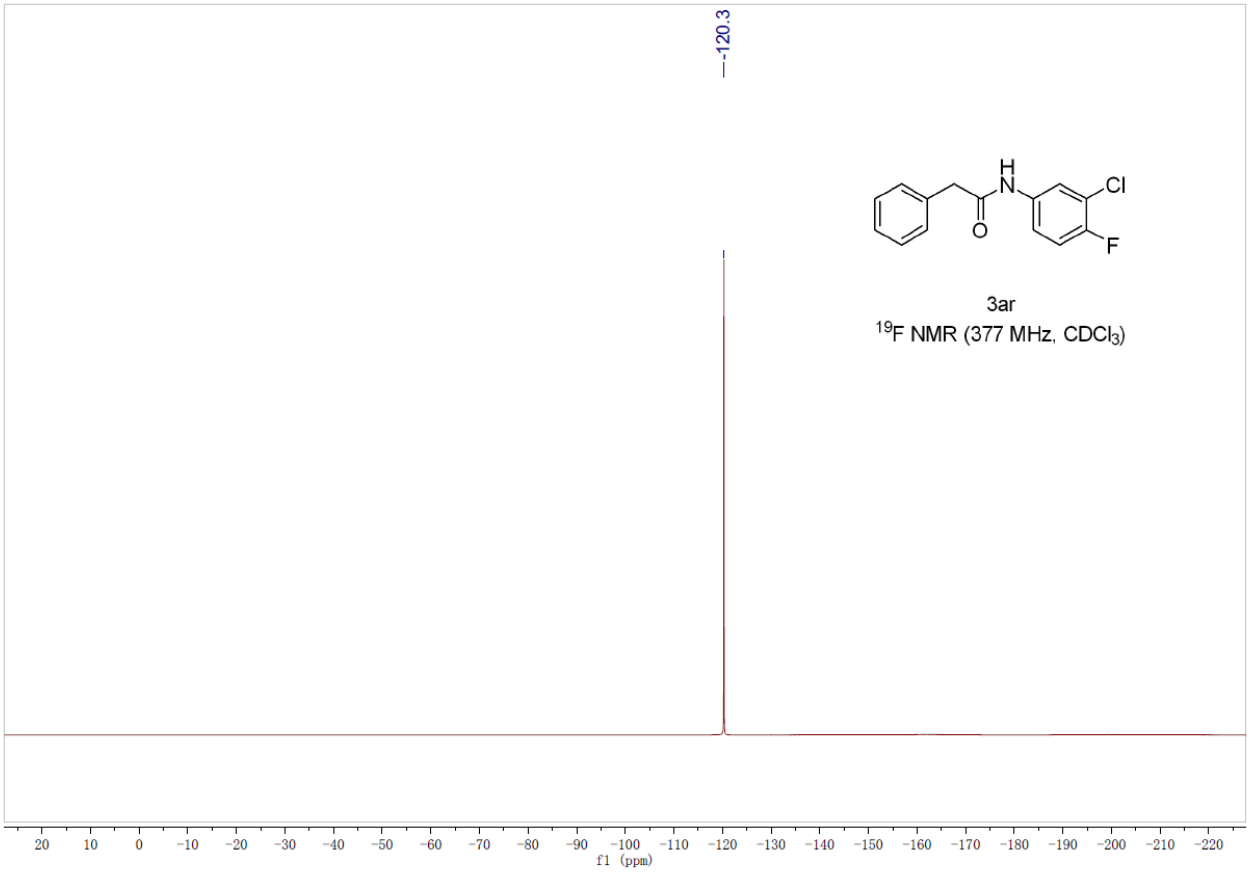
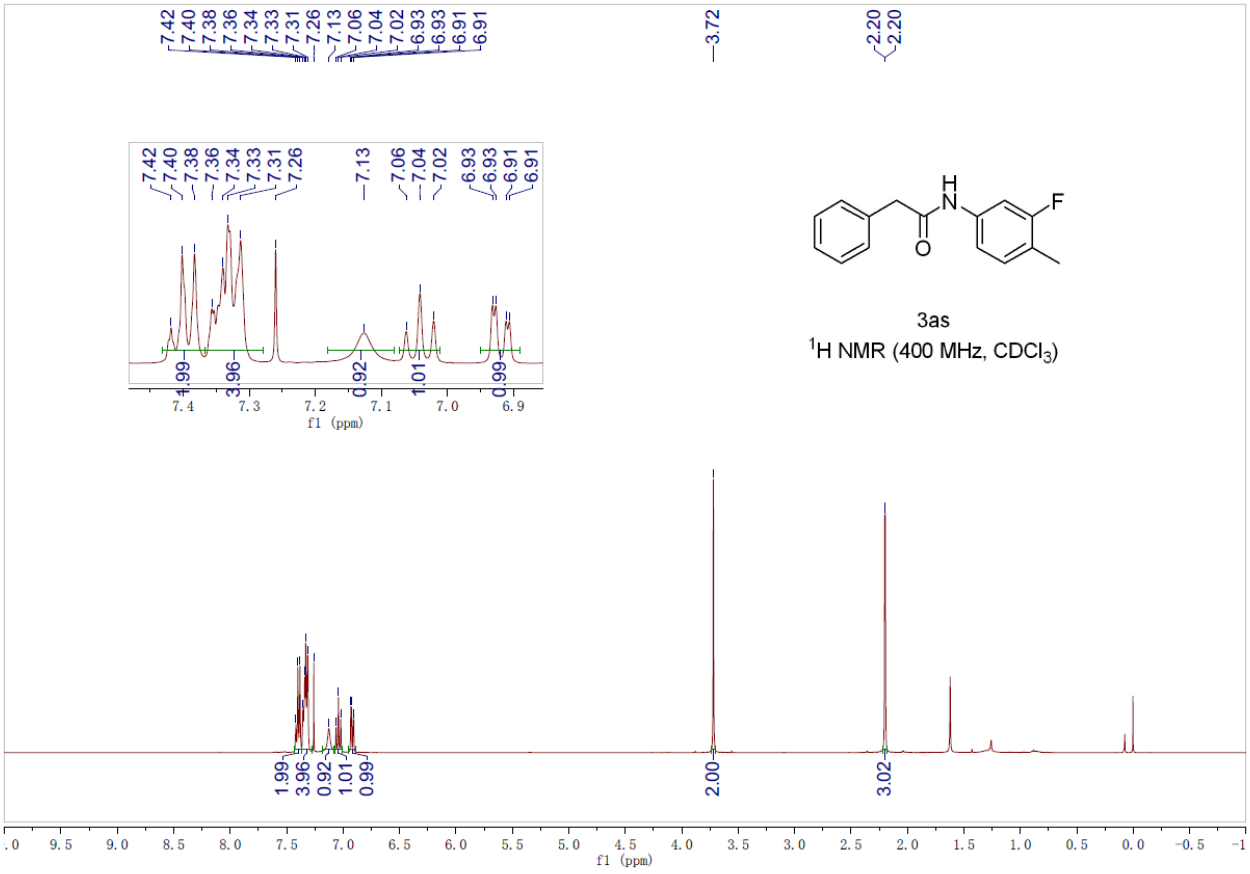
156.2
153.7
134.3
134.3
134.1
129.6
129.5
128.0
122.3
121.3
121.1
119.7
119.7
116.8
116.5
44.8
f1 (ppm)
Cl
F
3ar
^{13}C NMR (101 MHz, $CDCl_3$)


-120.3
H
N
O
Cl
F
3ar
19F NMR (377 MHz, CDCl3)
20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220
f1 (ppm)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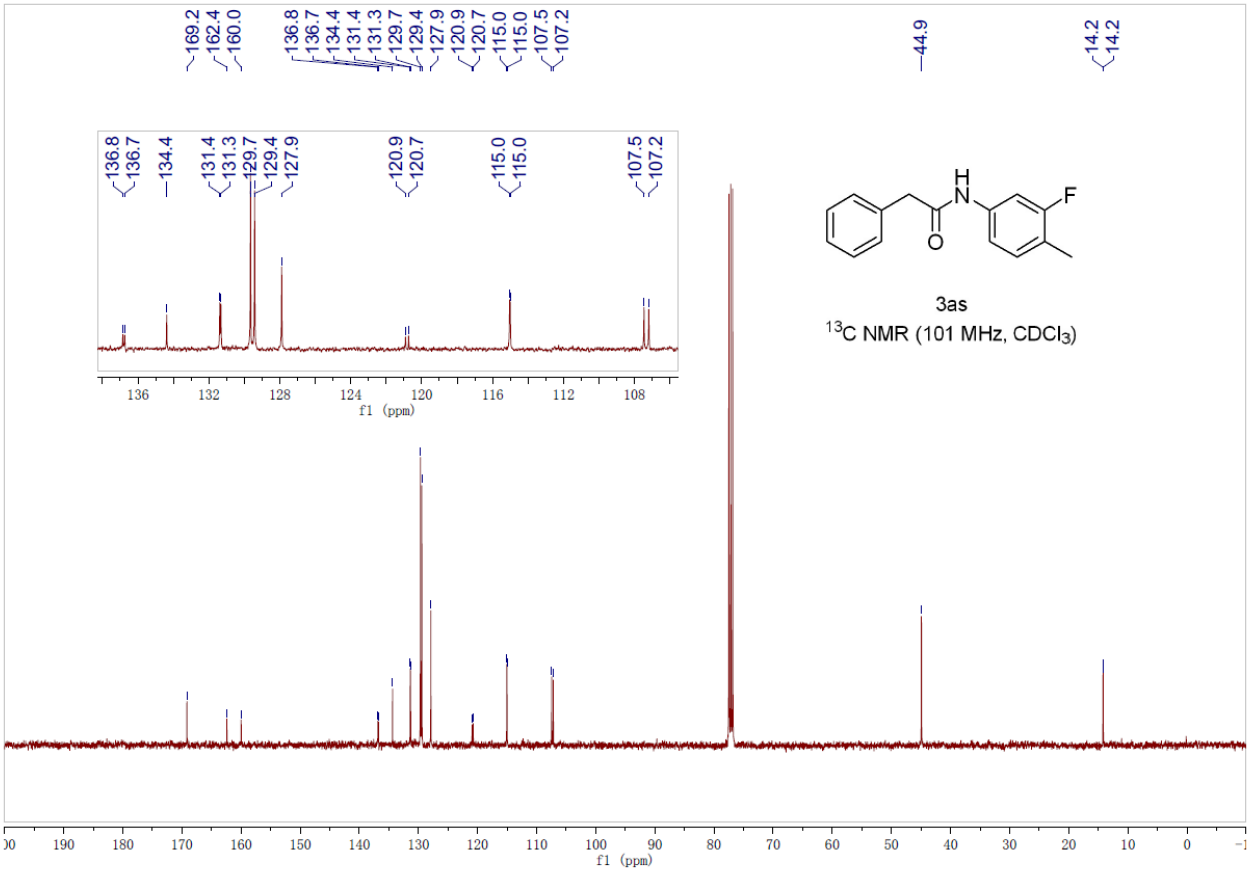
7.40
7.38
7.36
7.34
7.33
7.31
7.26
7.13
7.06
7.04
7.02
6.93
6.93
6.91
6.91
3.72
2.20
2.20
1.99
3.96
0.92
1.01
0.99
2.00
3.02
f1 (ppm)
H
N
O
F
3as
^{1}H NMR (400 MHz, CDCl$_3$)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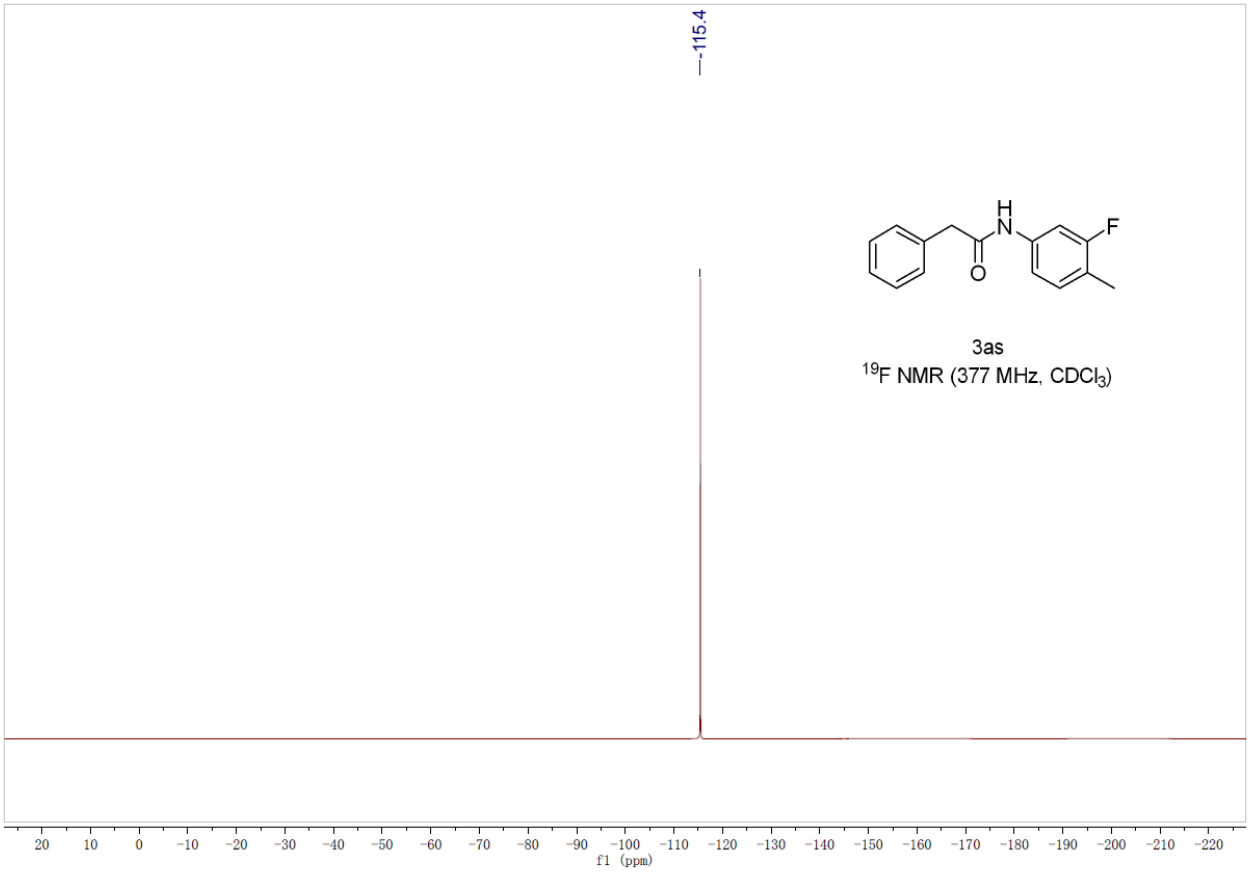
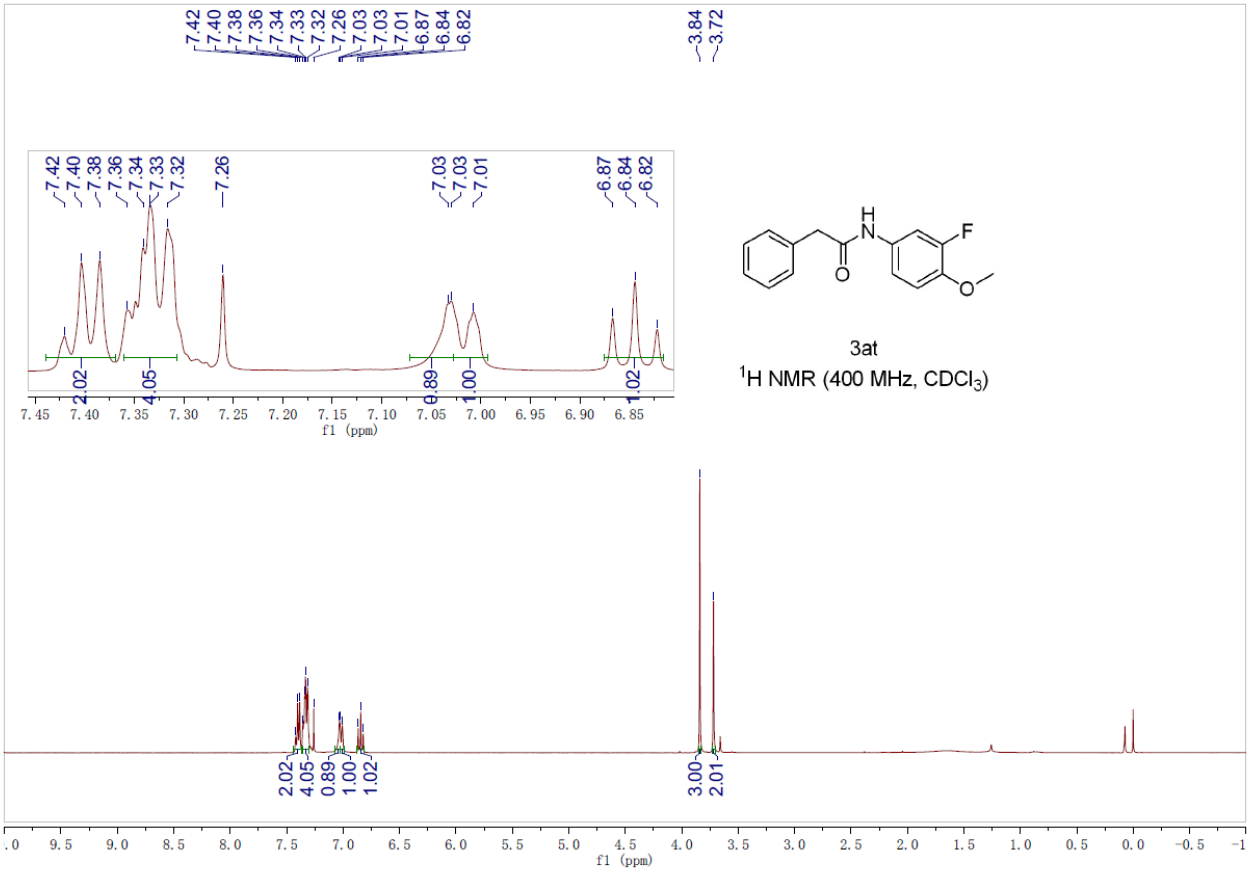
162.4
160.0
136.8
136.7
134.4
131.4
131.3
129.7
129.4
127.9
120.9
120.7
115.0
115.0
107.5
107.2
44.9
14.2
14.2
f1 (ppm)
H
N
O
F
3as
^{13}C NMR (101 MHz, CDCl$_3$)



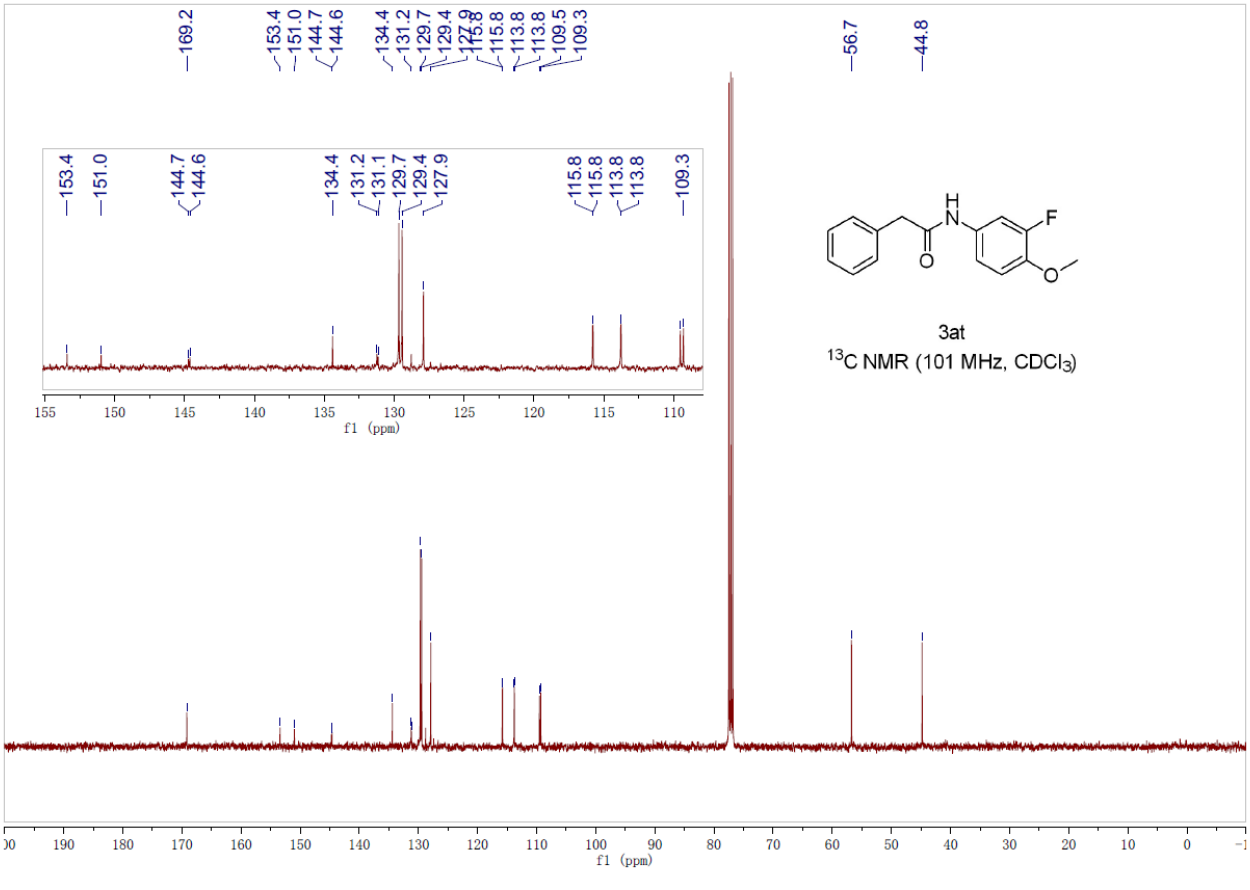
3as

^{19}F NMR (377 MHz, $CDCl_3$)



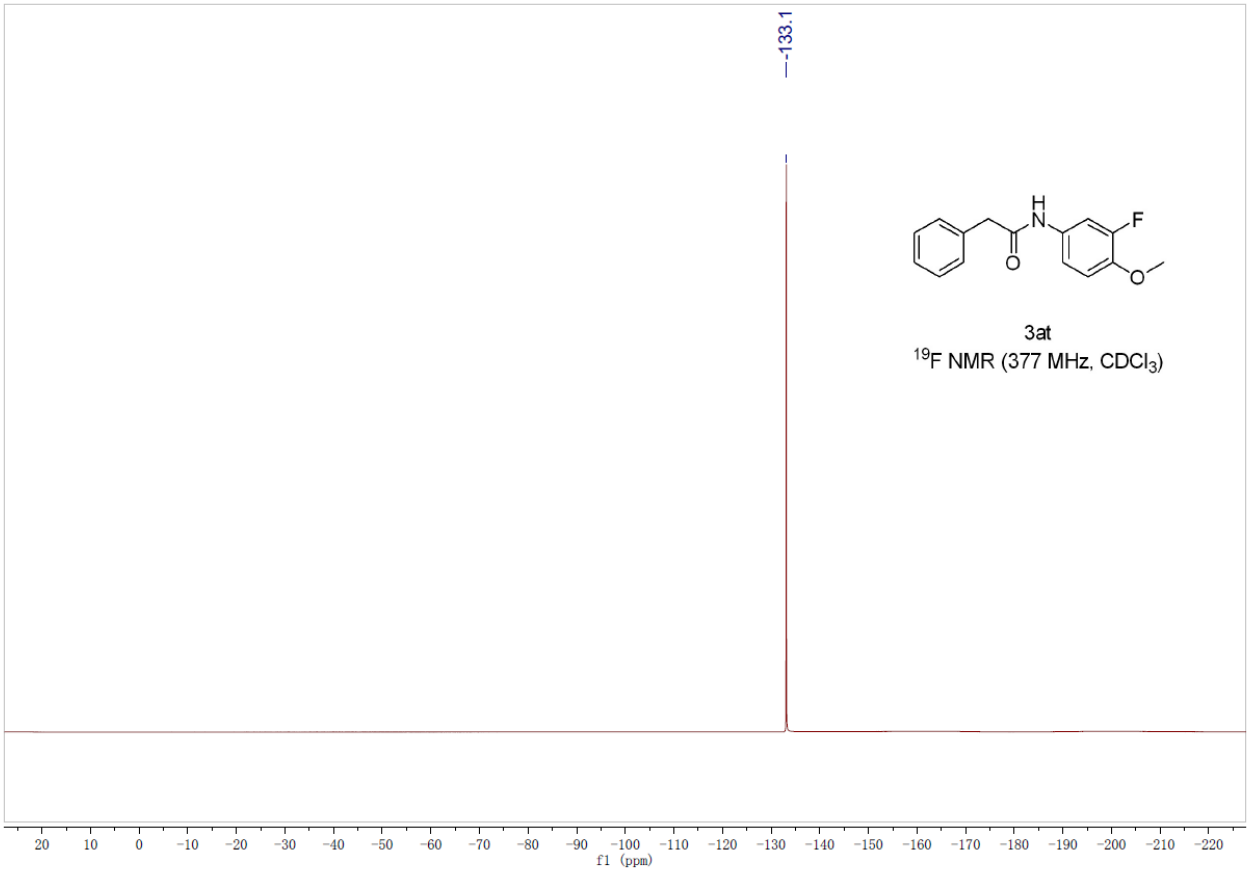
3at

^{1}H NMR (400 MHz, $CDCl_3$)



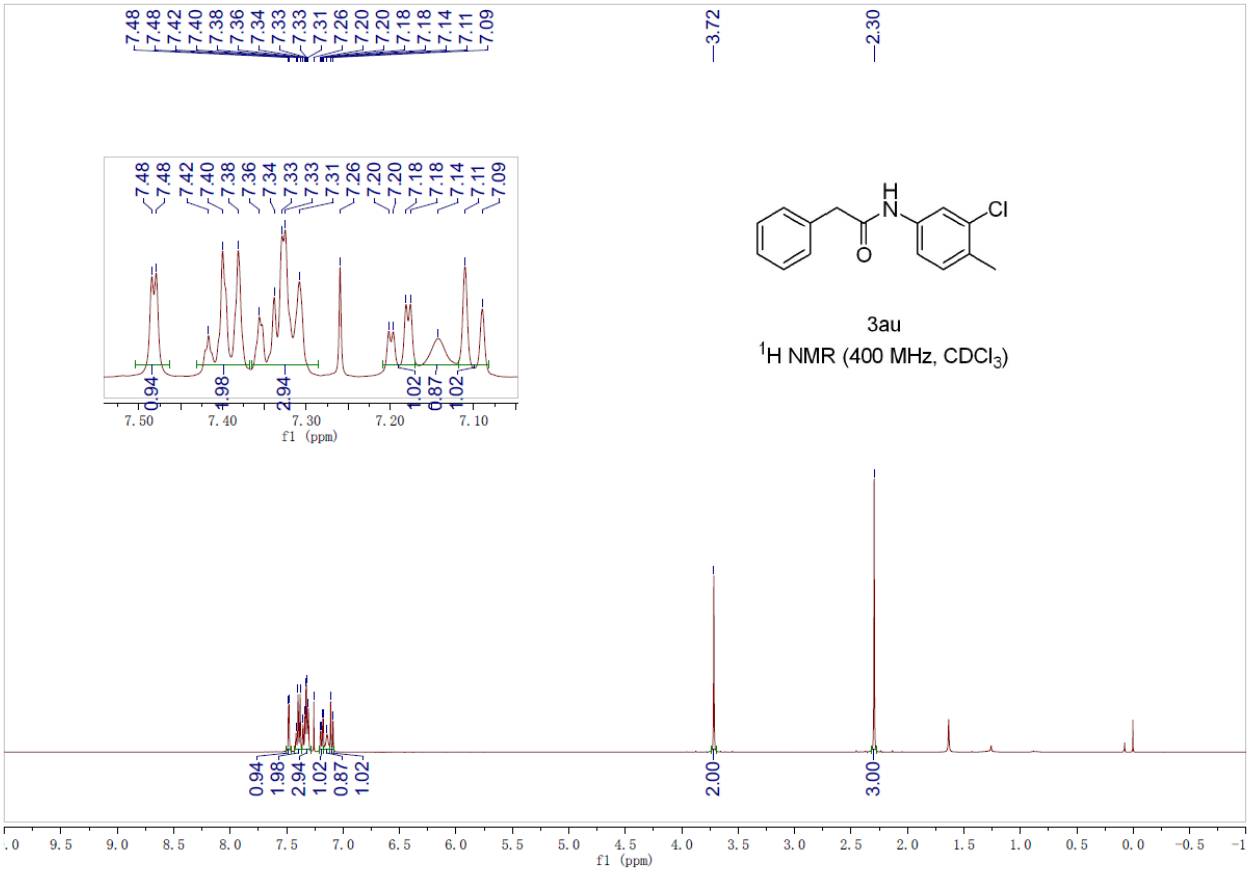
3at

^{13}C NMR (101 MHz, $CDCl_3$)



3at

^{19}F NMR (377 MHz, $CDCl_3$)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7.48
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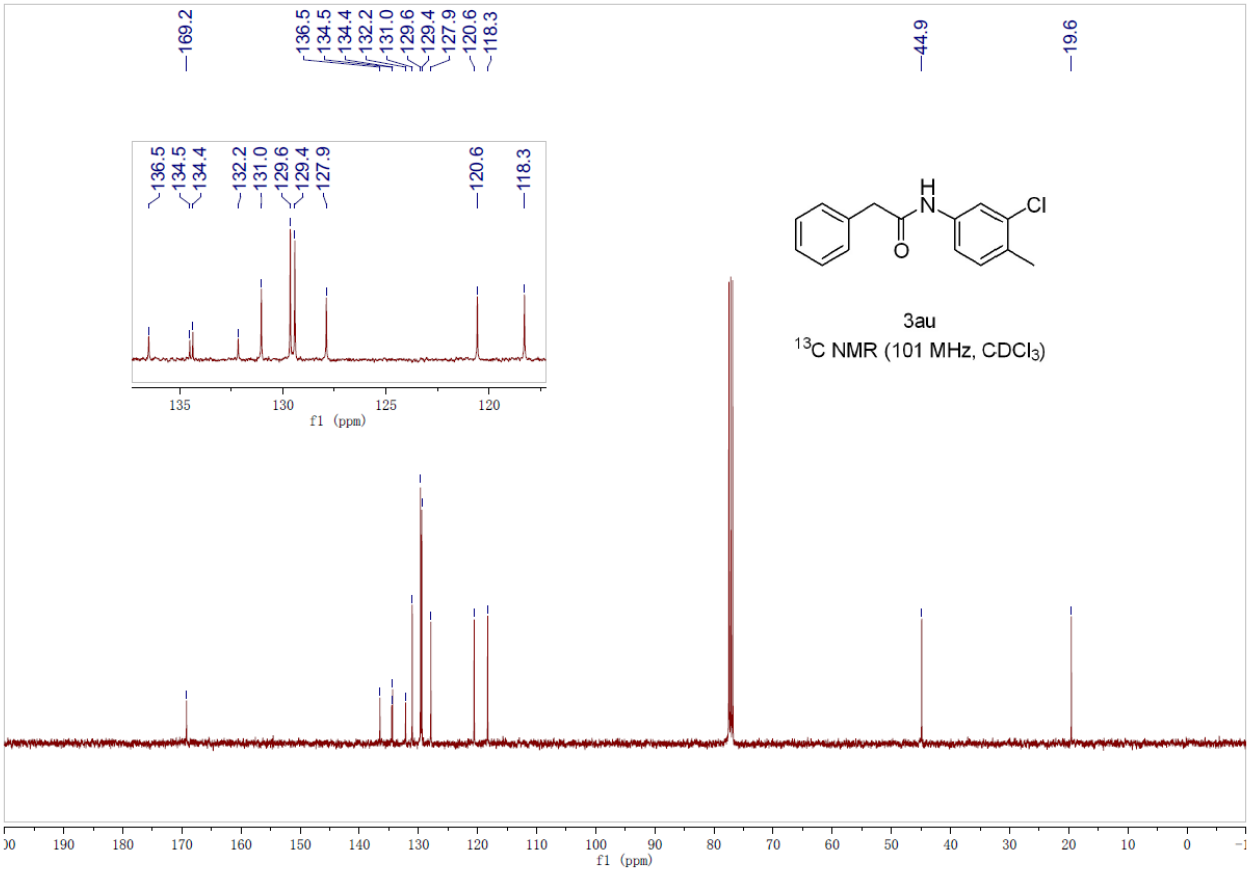
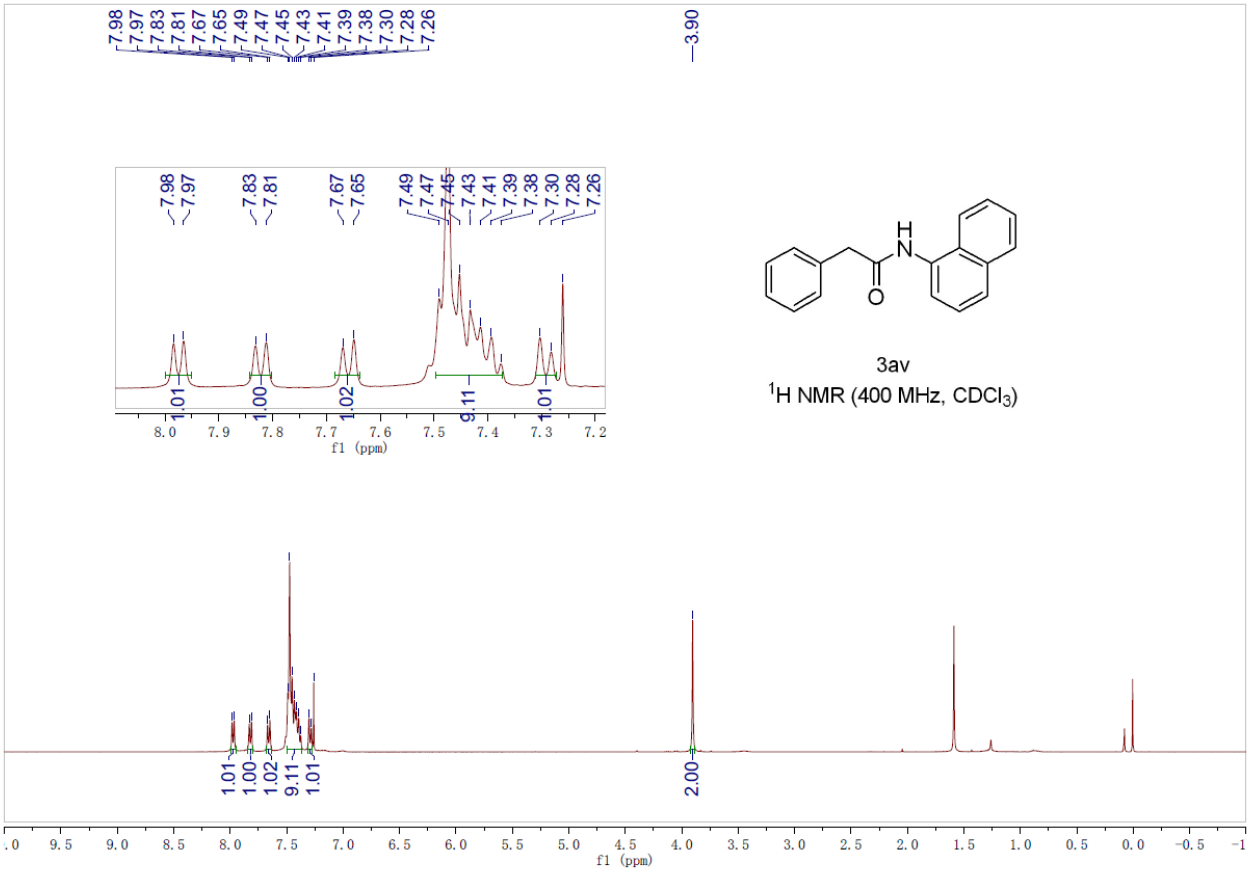
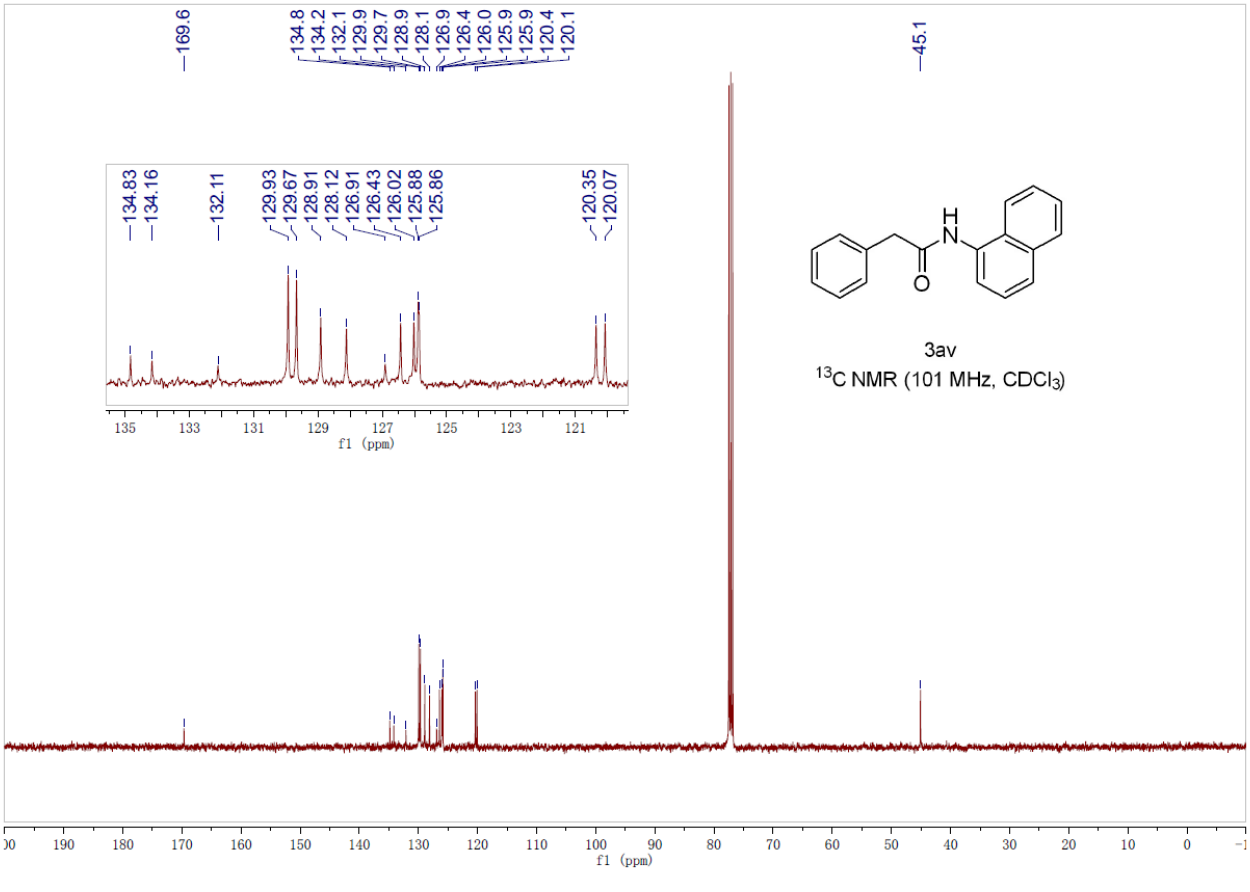
7.38
7.36
7.34
7.33
7.33
7.31
7.26
7.20
7.20
7.18
7.18
7.14
7.11
7.09
3.72
2.30
0.94
1.98
2.94
1.02
0.87
1.02
2.00
3.00
f1 (ppm)
3au
1H NMR (400 MHz, CDCl3)


169.2
136.5
134.5
134.4
132.2
131.0
129.6
129.4
127.9
120.6
118.3
44.9
19.6
f1 (ppm)
3au
13C NMR (101 MHz, CDCl3)



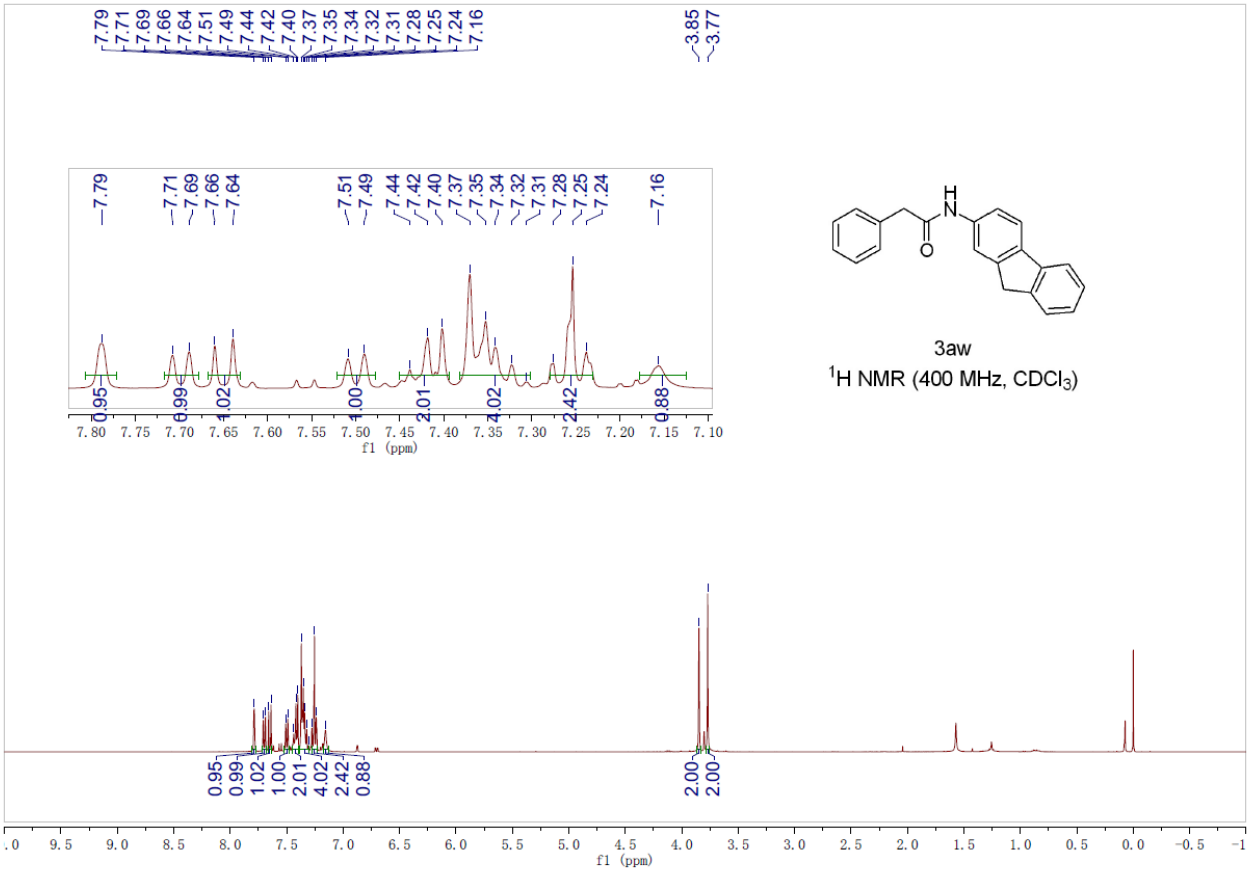
3av

^{1}H NMR (400 MHz, $CDCl_3$)



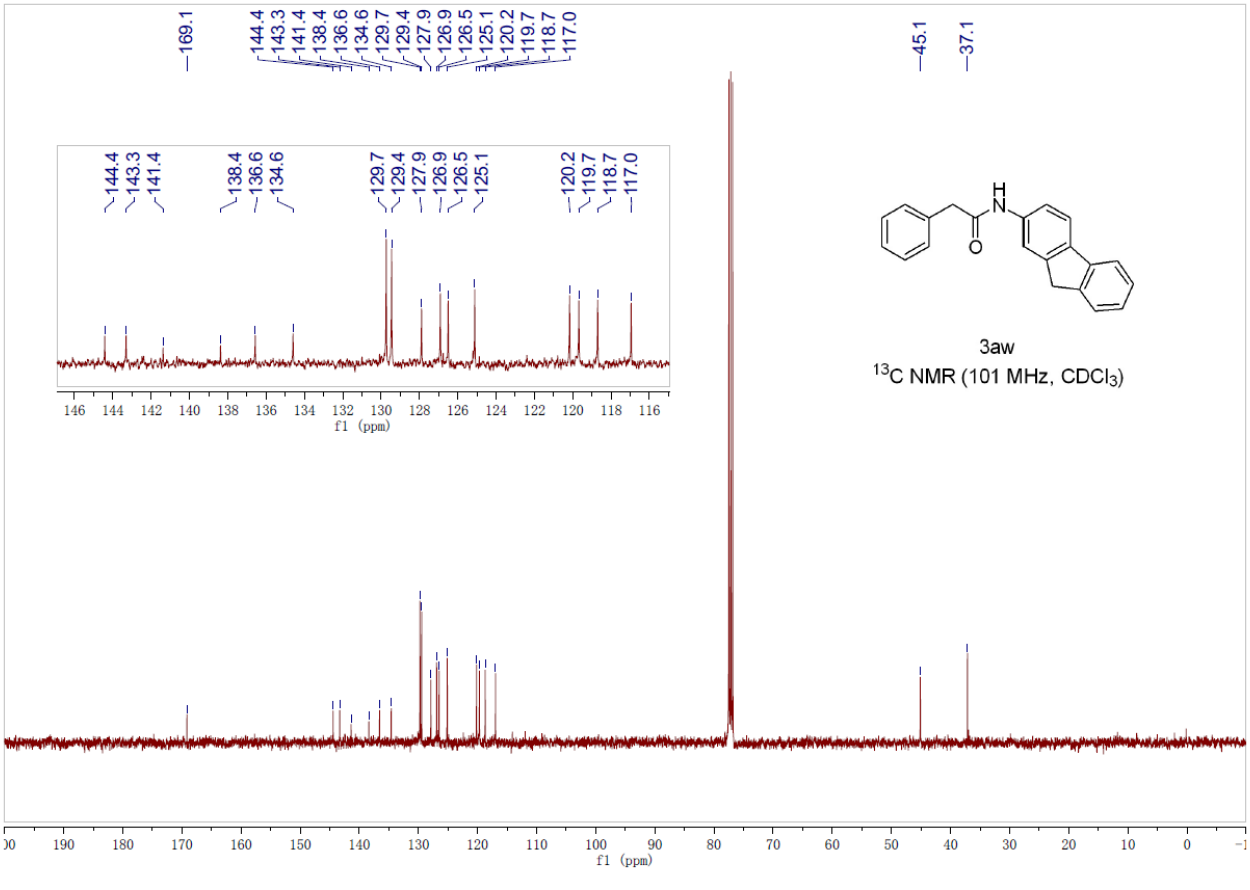
3av

^{13}C NMR (101 MHz, $CDCl_3$)



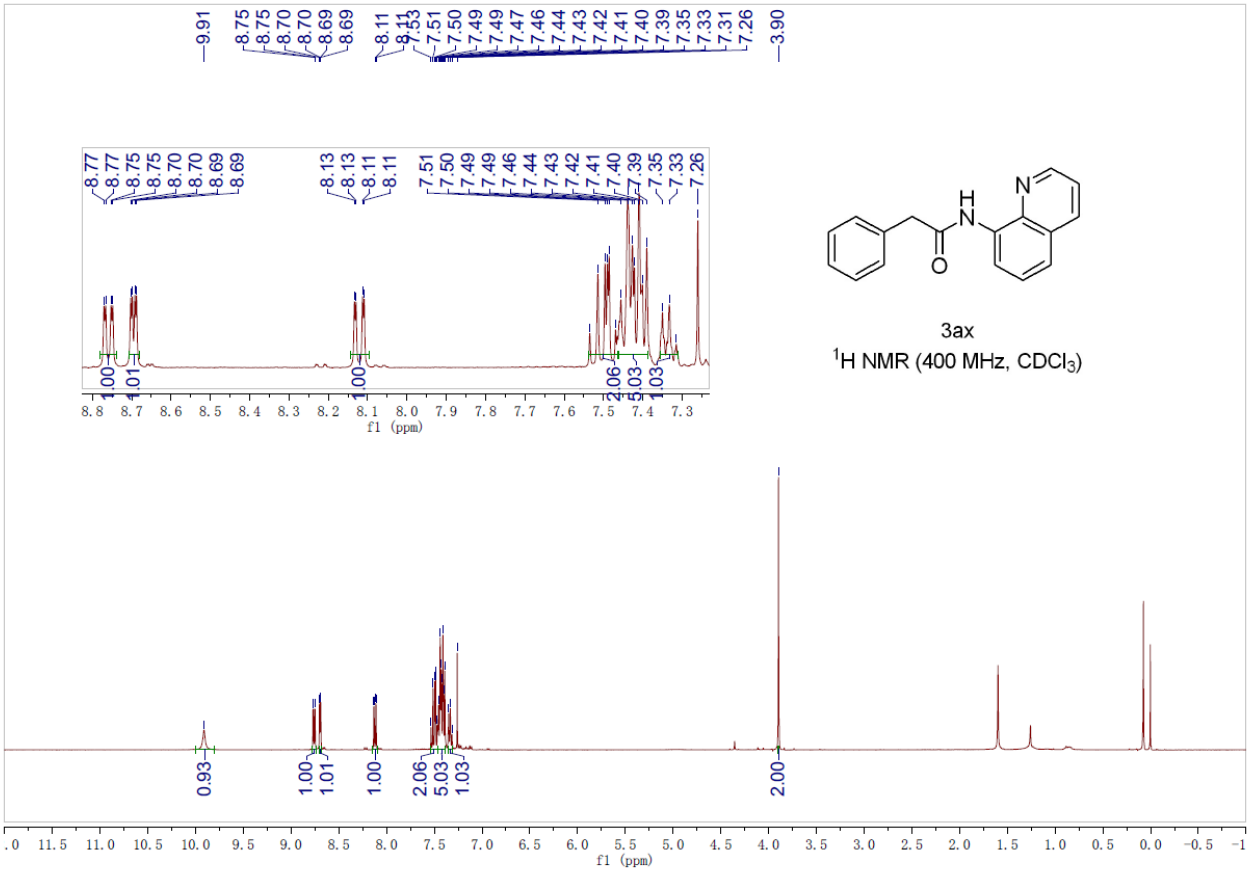
3aw

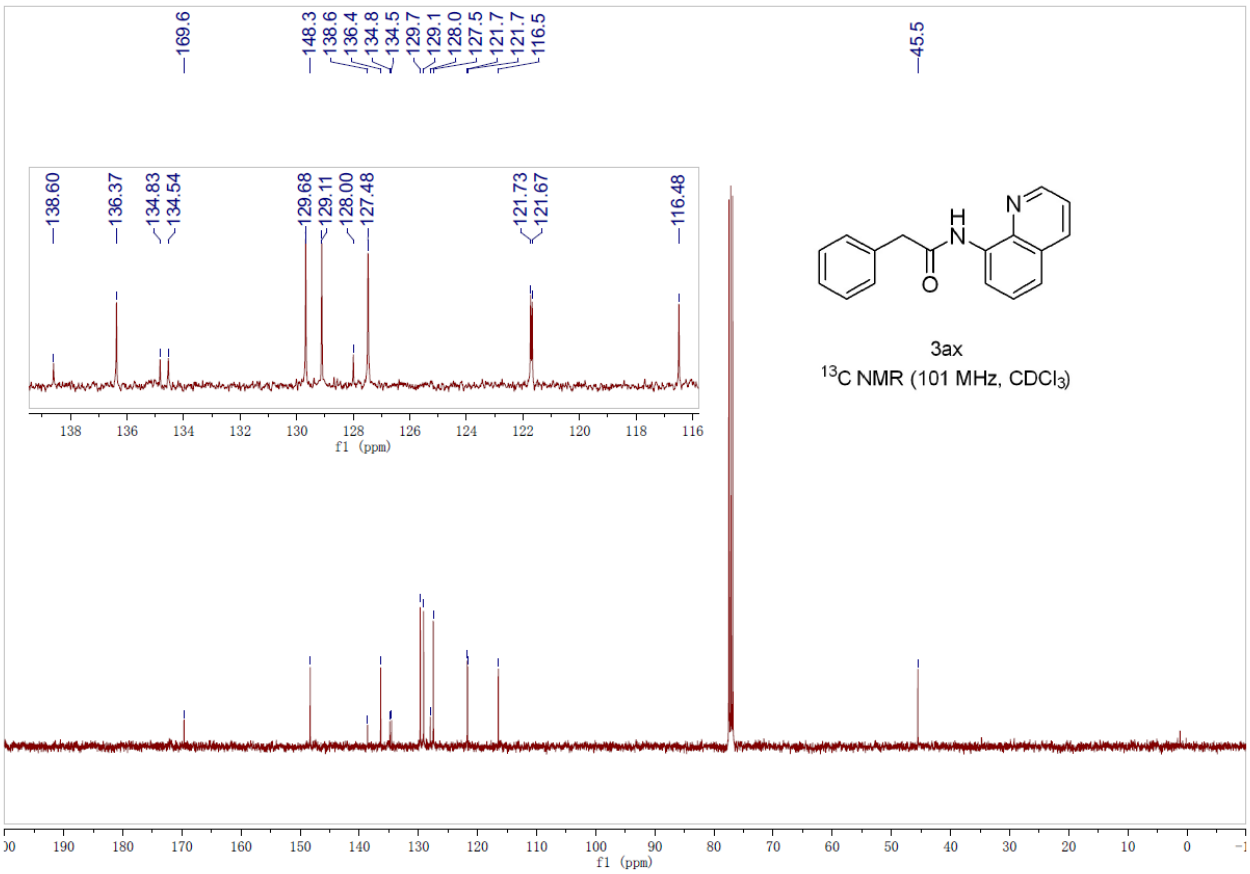
^{1}H NMR (400 MHz, $CDCl_3$)

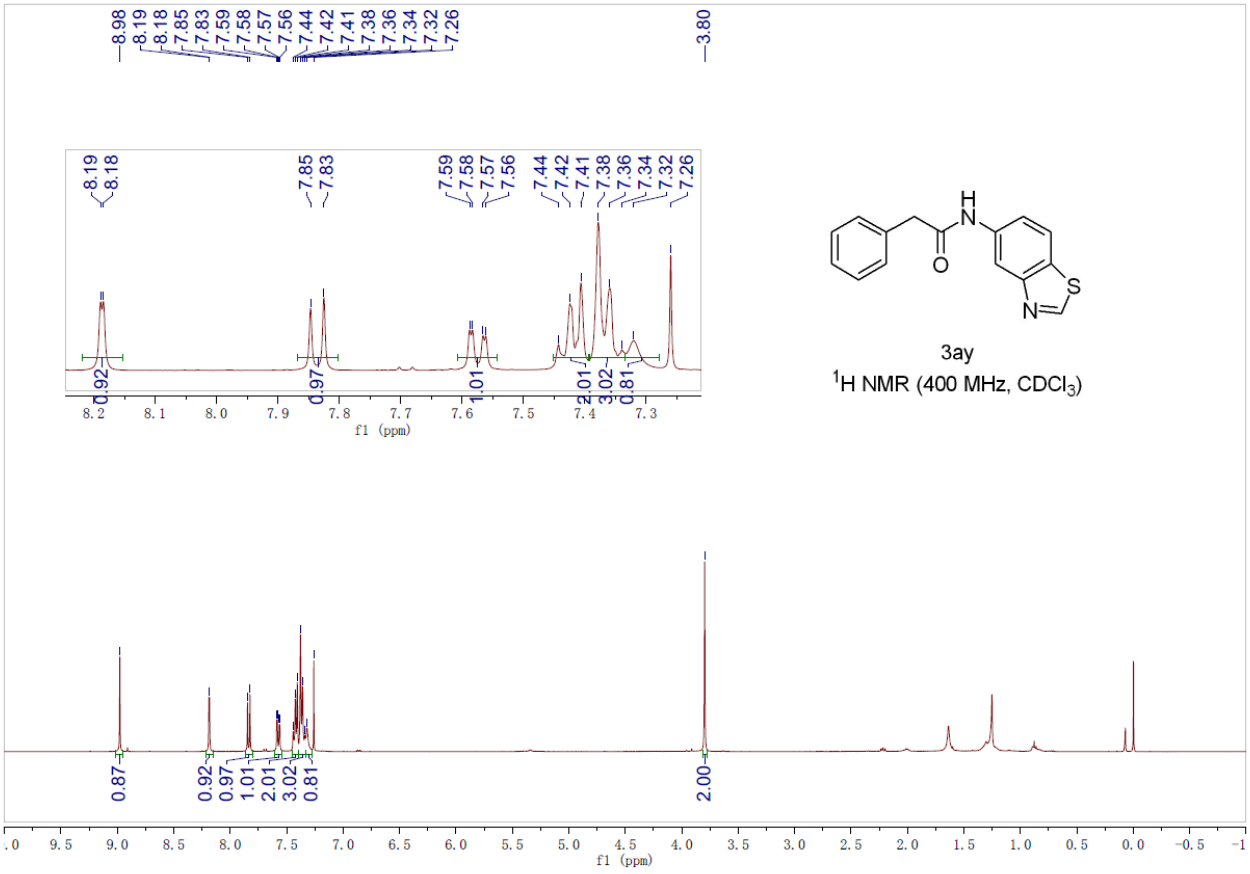


3aw

^{13}C NMR (101 MHz, $CDCl_3$)

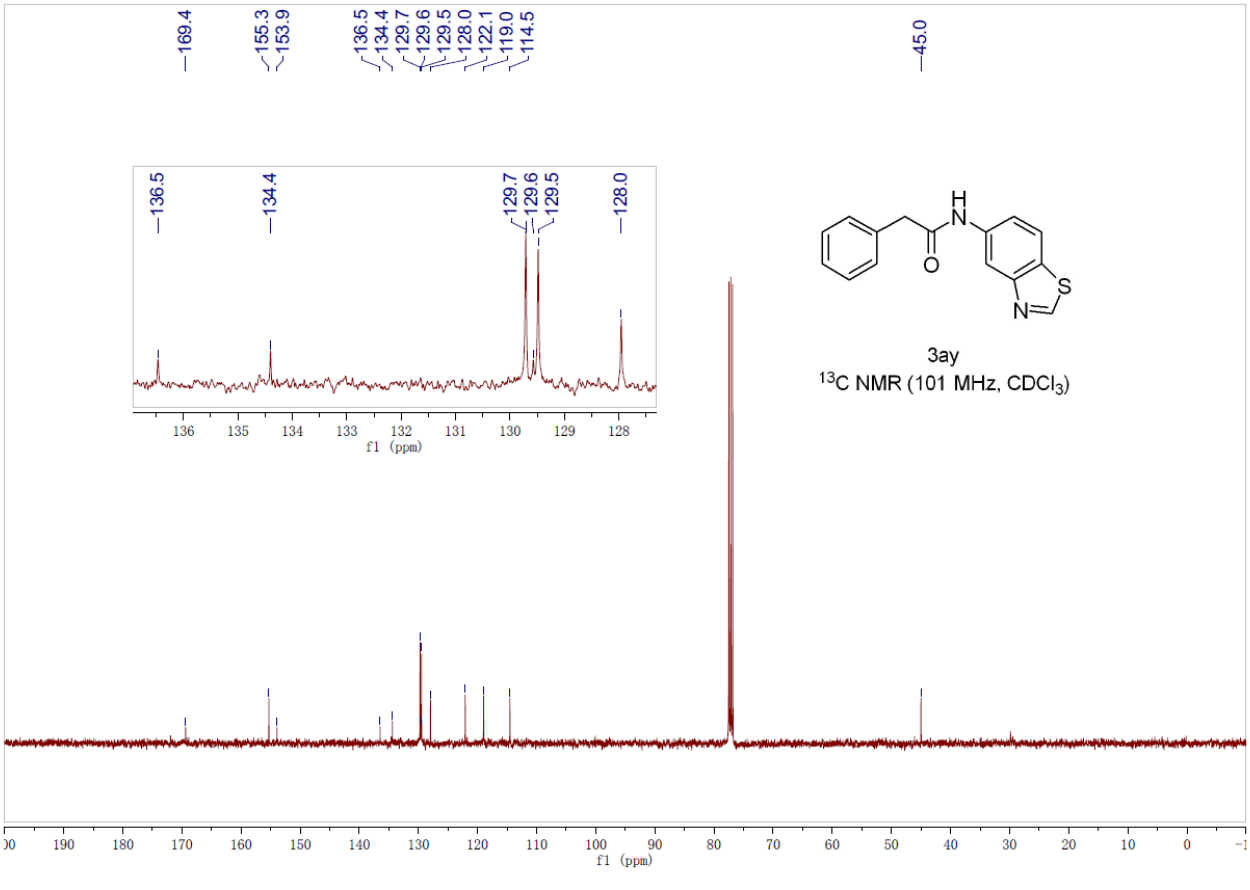

3ax
1H NMR (400 MHz, CDCl3)
f1 (ppm)


3ax
13C NMR (101 MHz, CDCl3)
f1 (ppm)



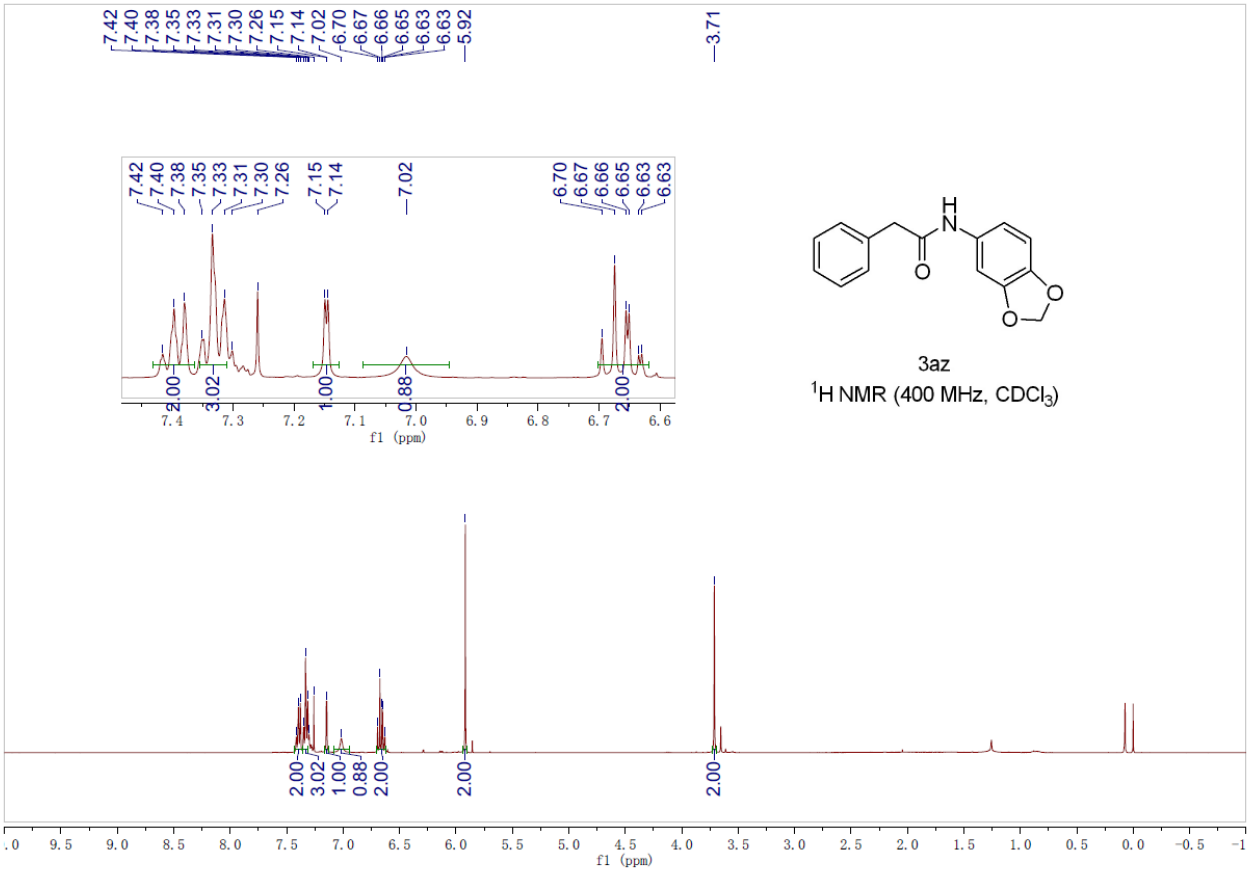
3ay

^{1}H NMR (400 MHz, $CDCl_3$)



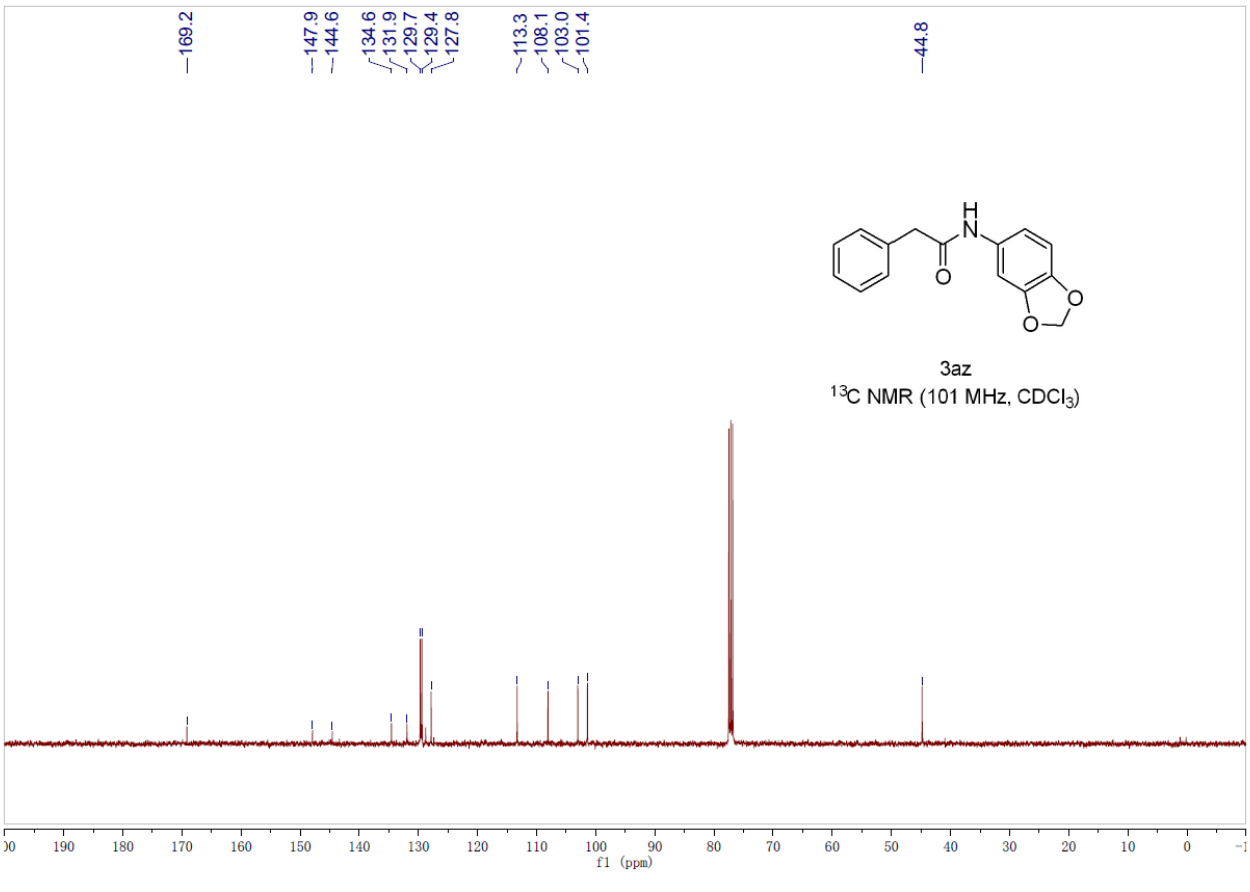
3ay

^{13}C NMR (101 MHz, $CDCl_3$)



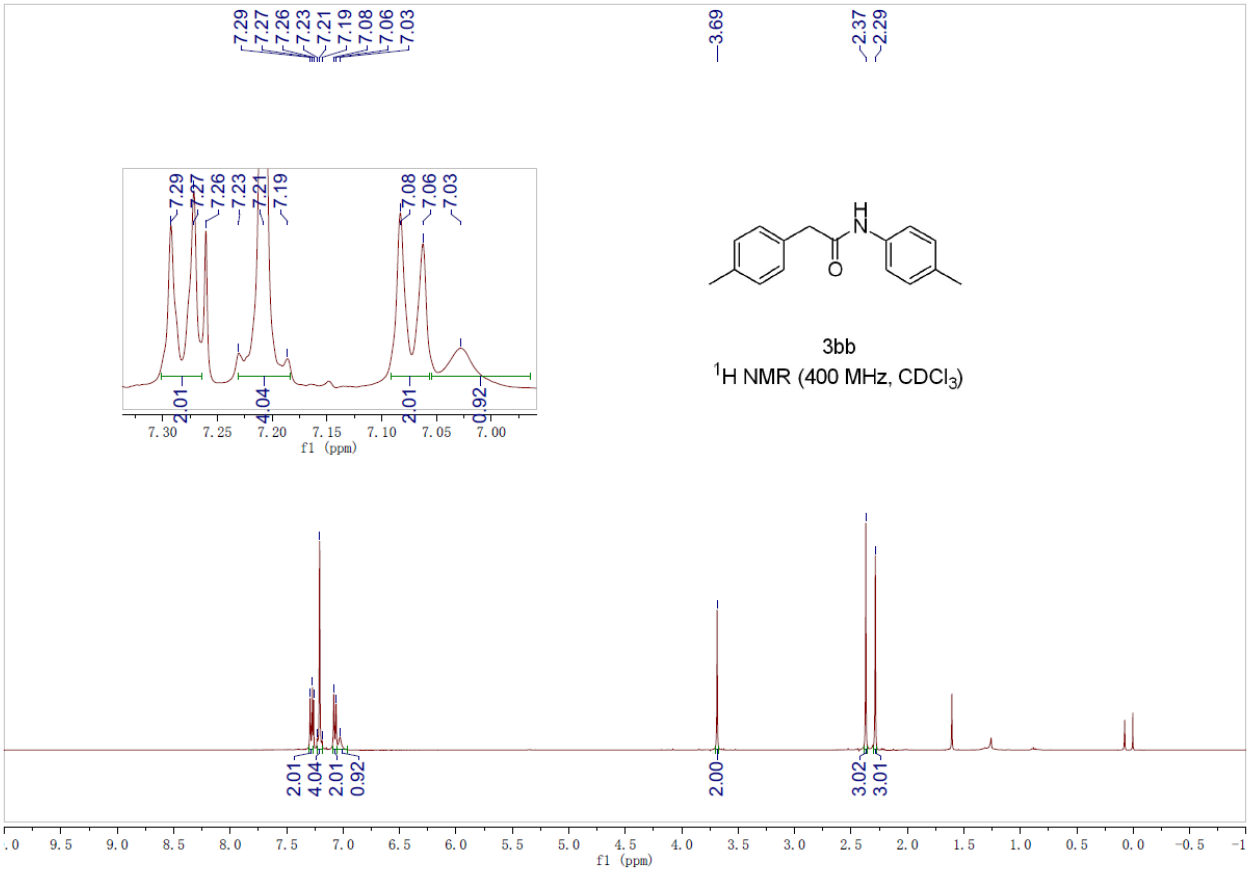
3az

^{1}H NMR (400 MHz, $CDCl_3$)



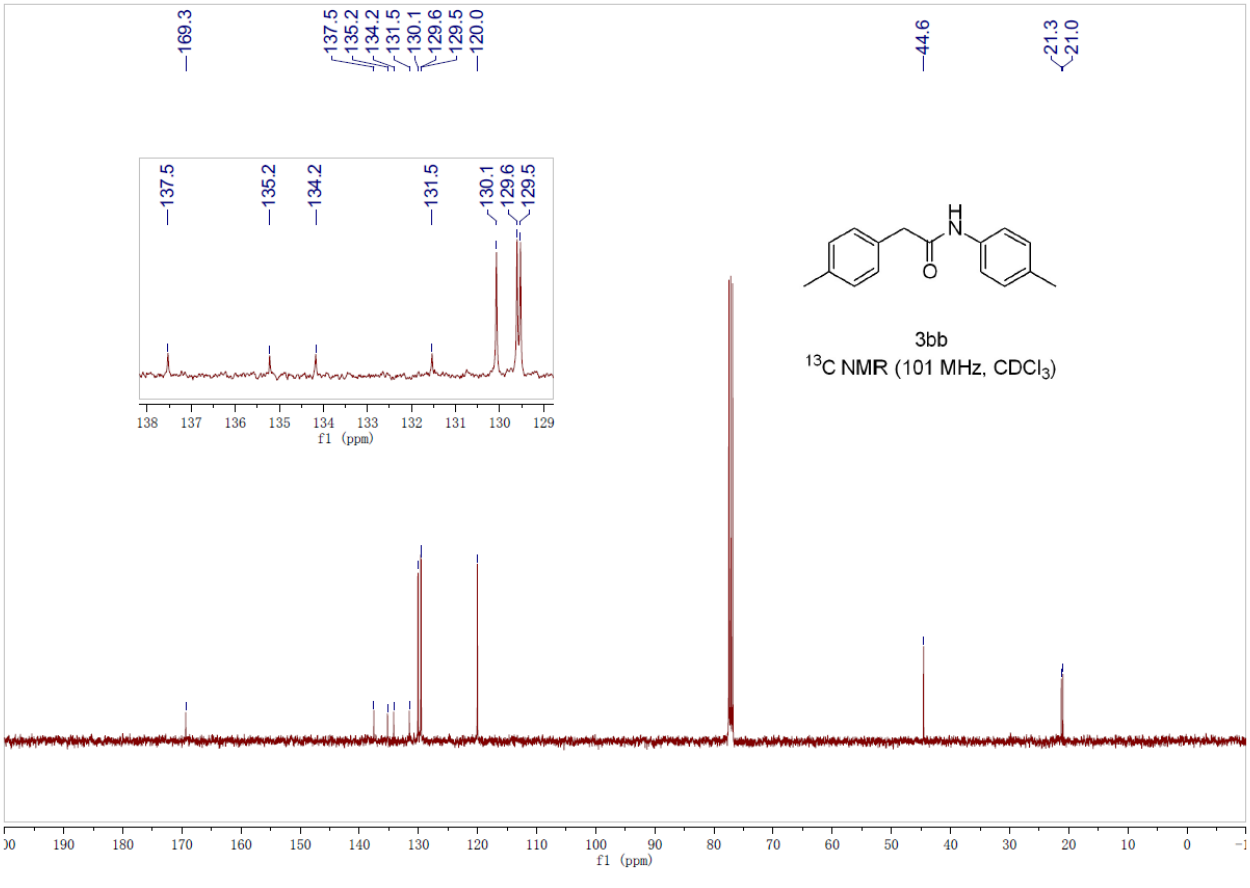
3az

^{13}C NMR (101 MHz, $CDCl_3$)



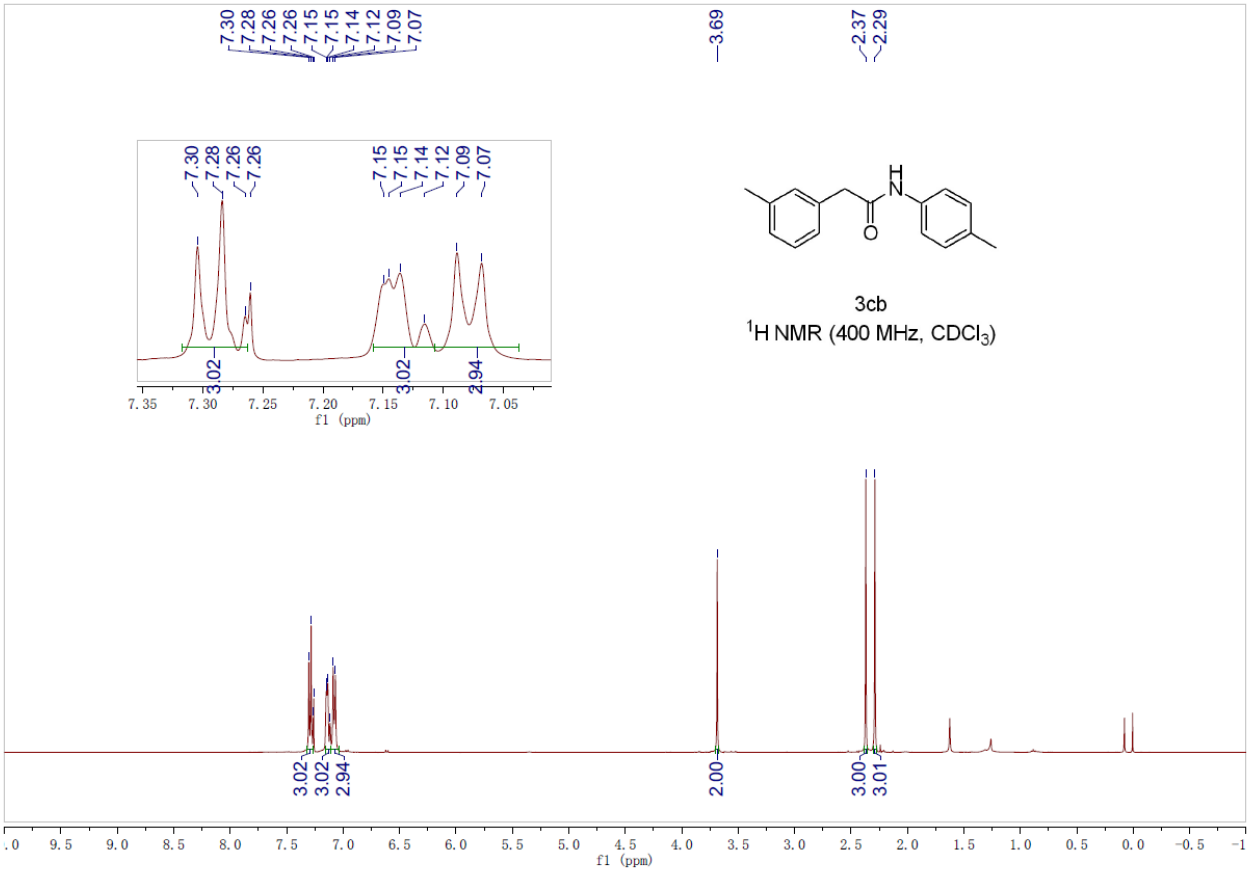
3bb

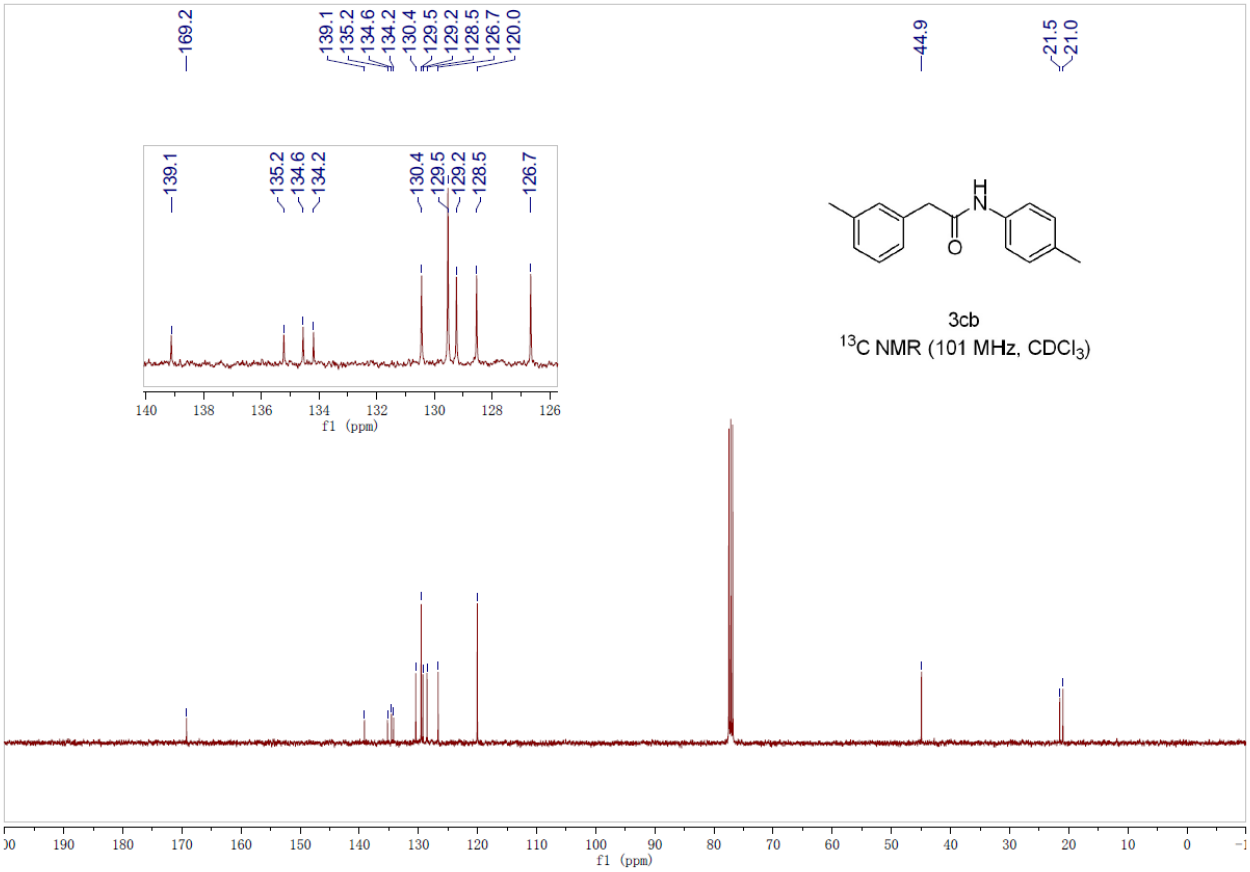
^{1}H NMR (400 MHz, $CDCl_3$)



3bb

^{13}C NMR (101 MHz, $CDCl_3$)


7.30
7.28
7.26
7.26
7.15
7.15
7.14
7.12
7.09
7.07
3.69
2.37
2.29
3cb
1H NMR (400 MHz, CDCl3)
f1 (ppm)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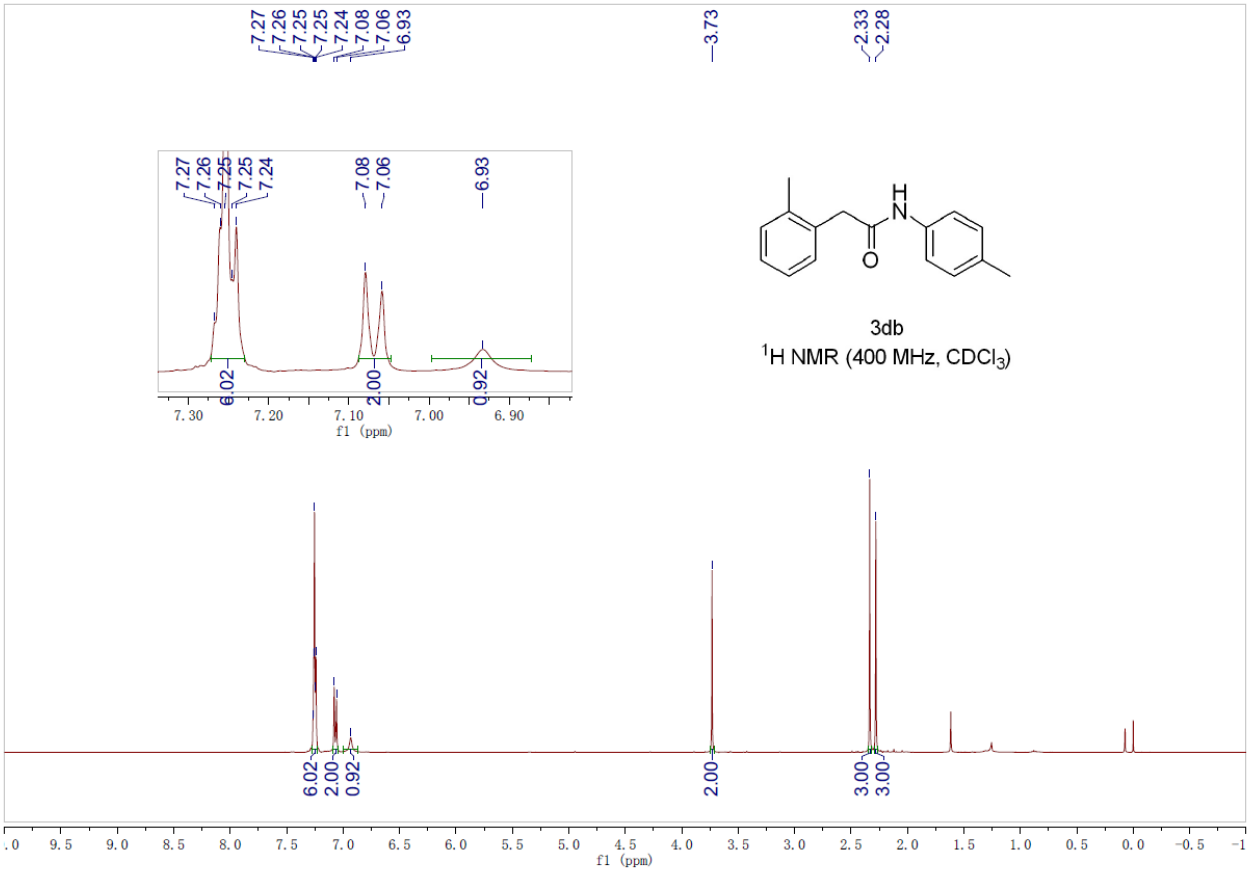
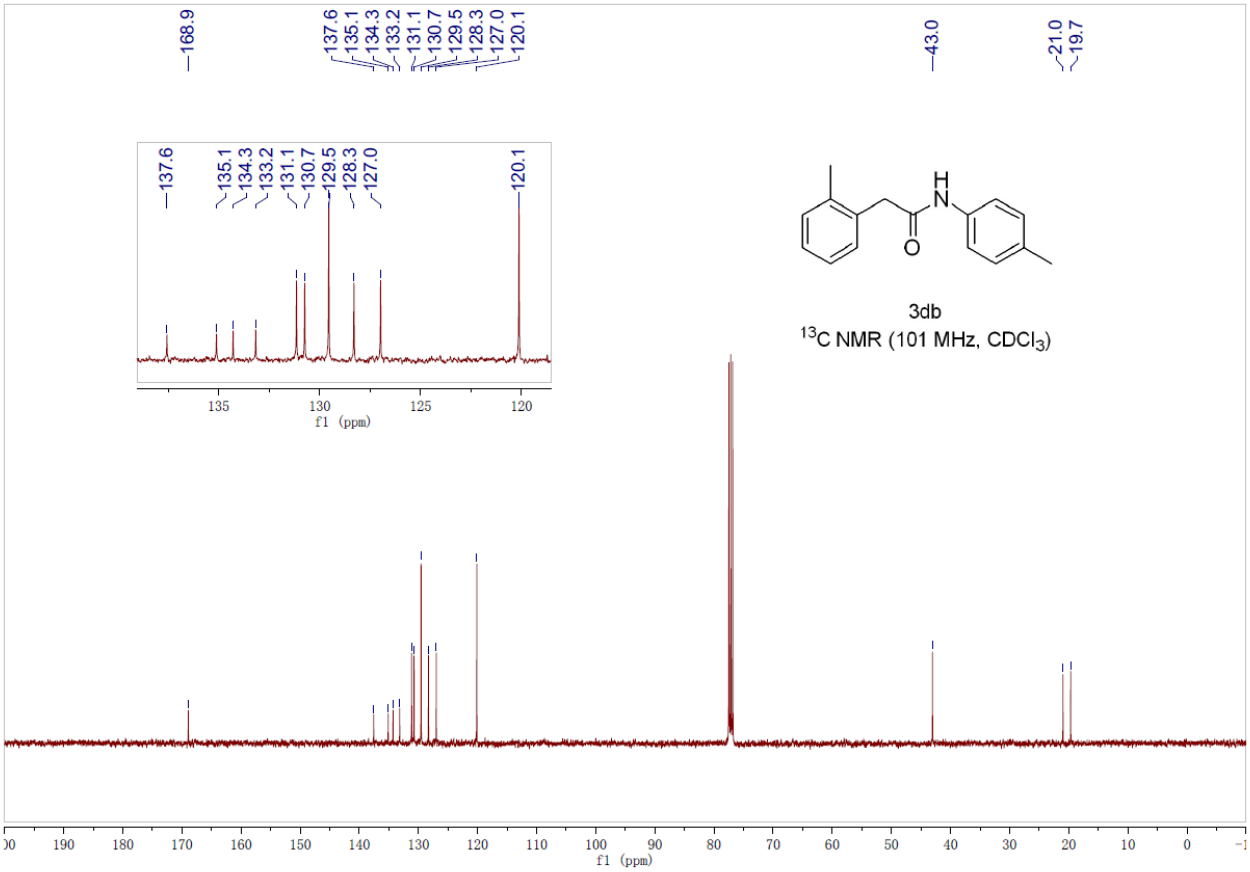
139.1
135.2
134.6
134.2
130.4
129.5
129.2
128.5
126.7
120.0
44.9
21.5
21.0
3cb
13C NMR (101 MHz, CDCl3)
f1 (ppm)


7.27
7.26
7.25
7.25
7.24
7.08
7.06
6.93
3.73
2.33
2.28
6.02
2.00
0.92
3db
1H NMR (400 MHz, CDCl3)
f1 (ppm)


168.9
137.6
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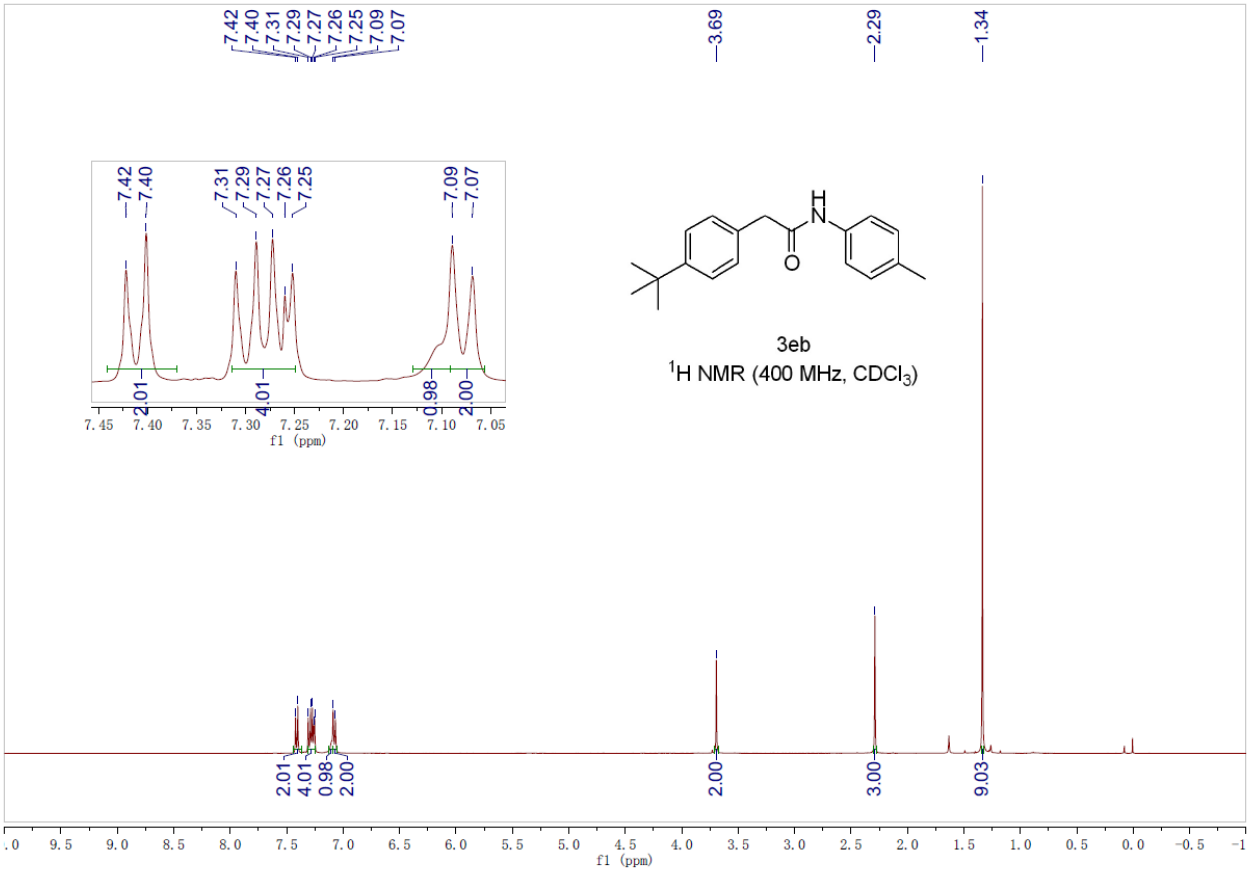
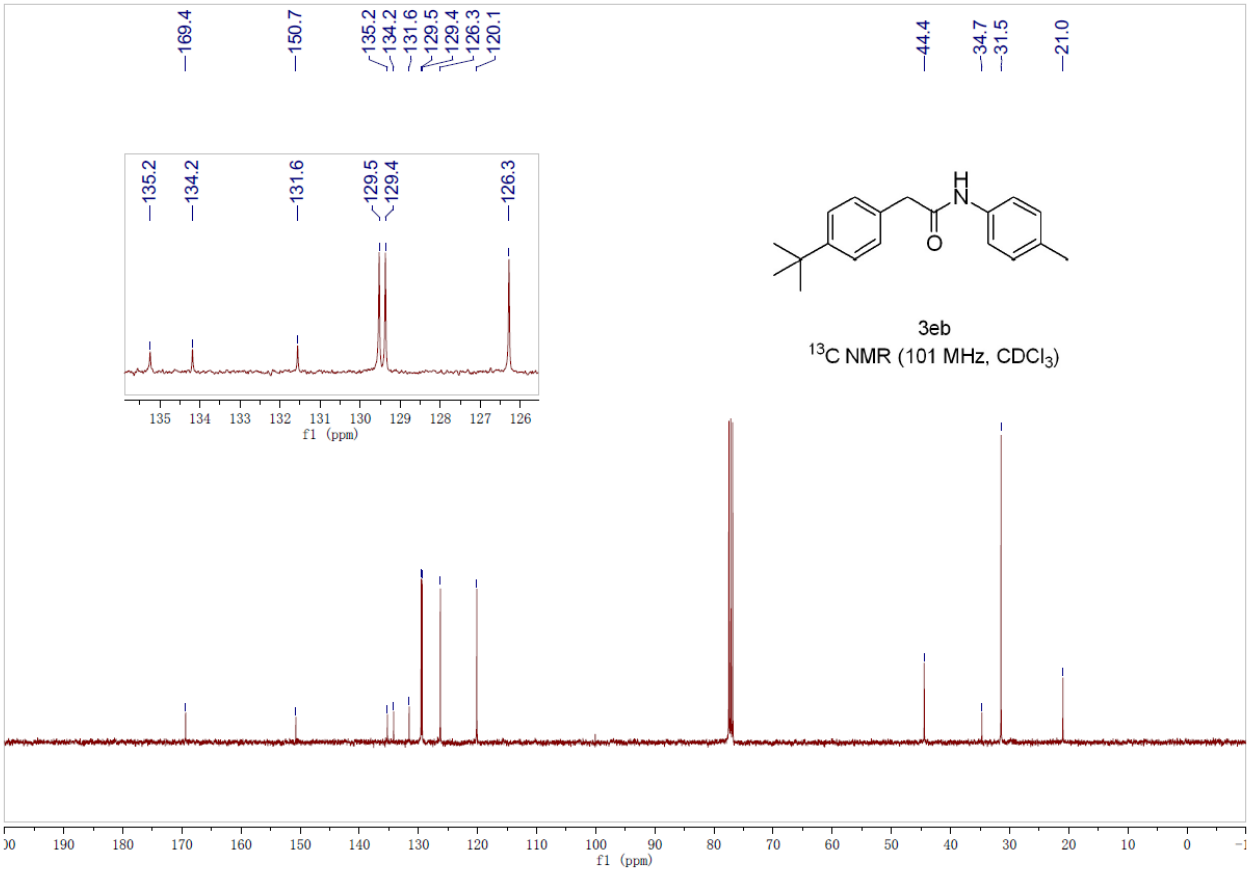
134.3
133.2
131.1
130.7
129.5
128.3
127.0
120.1
43.0
21.0
19.7
3db
13C NMR (101 MHz, CDCl3)
f1 (ppm)



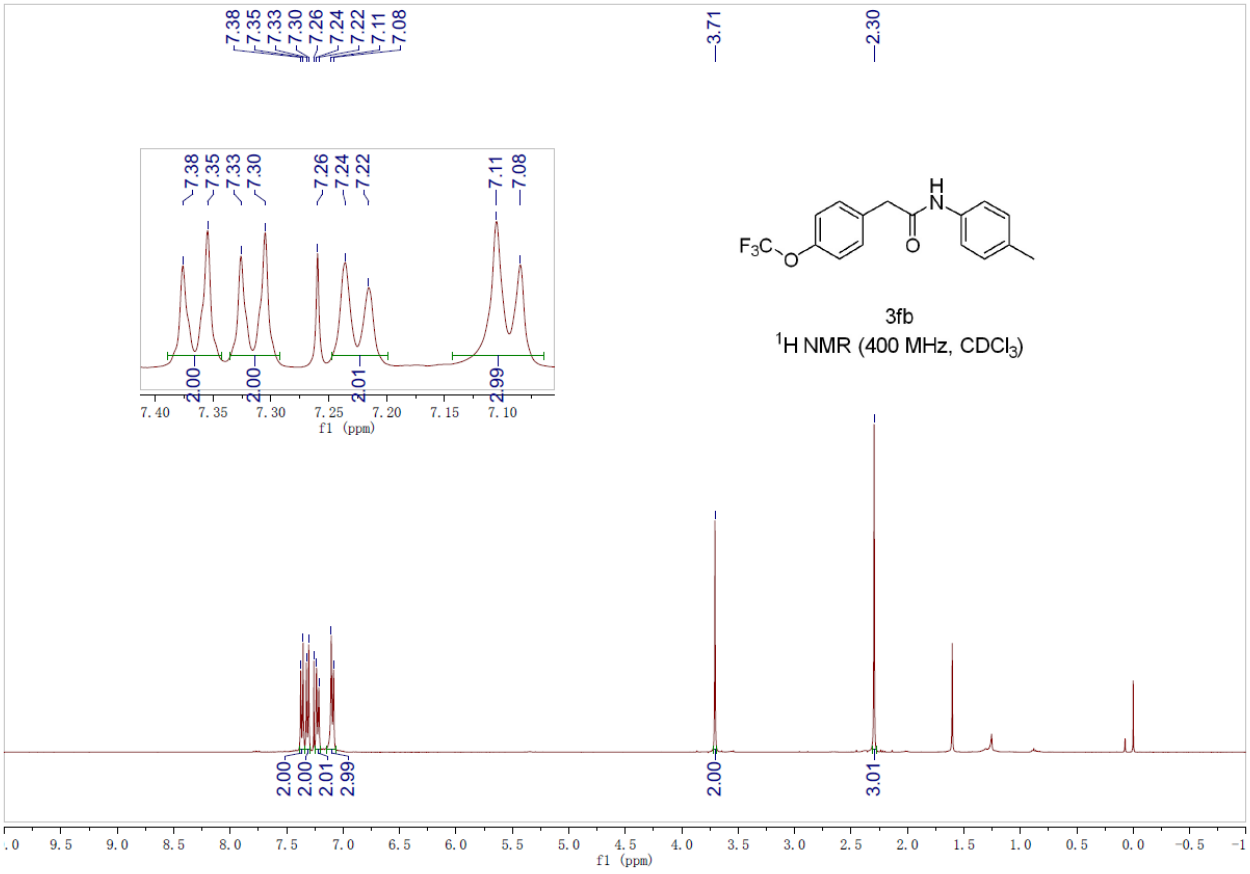
3eb

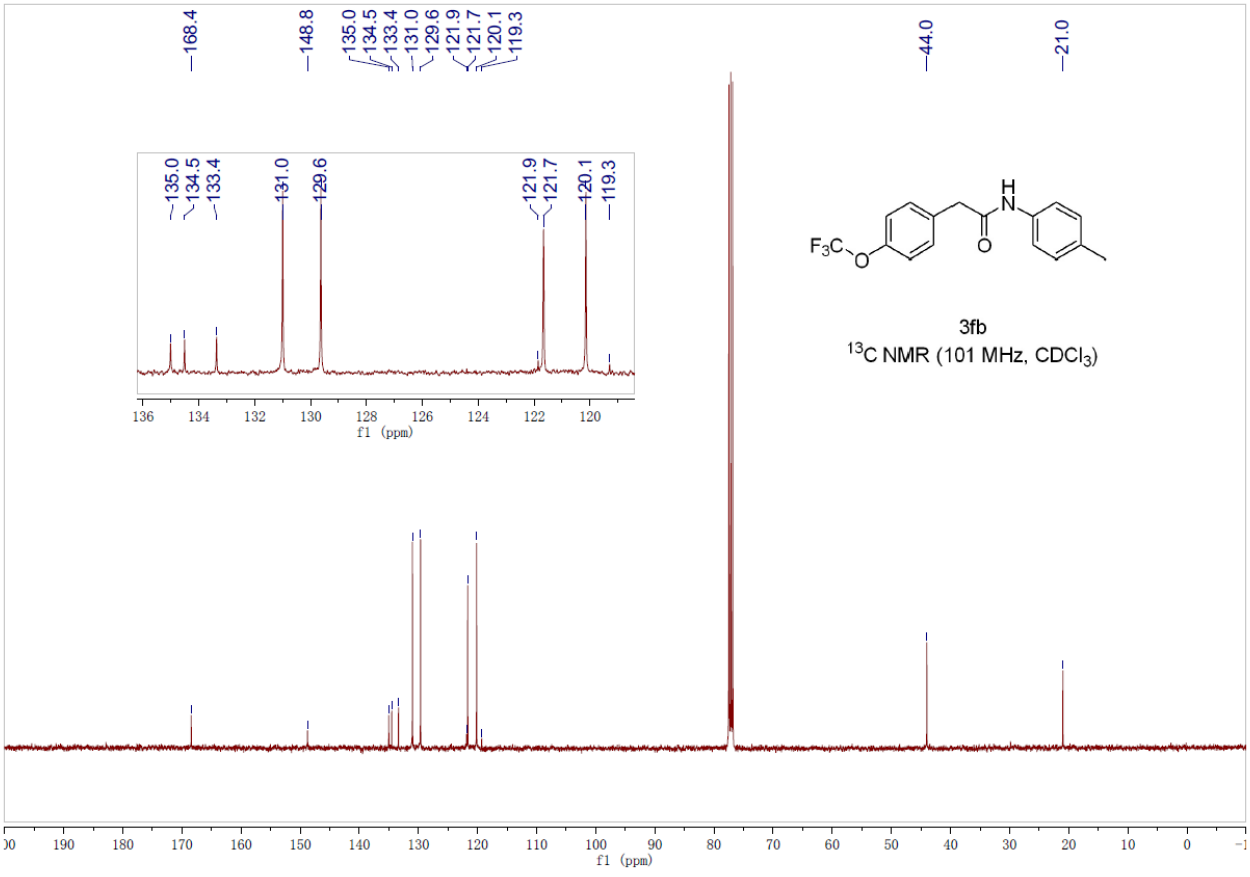
^{1}H NMR (400 MHz, $CDCl_3$)

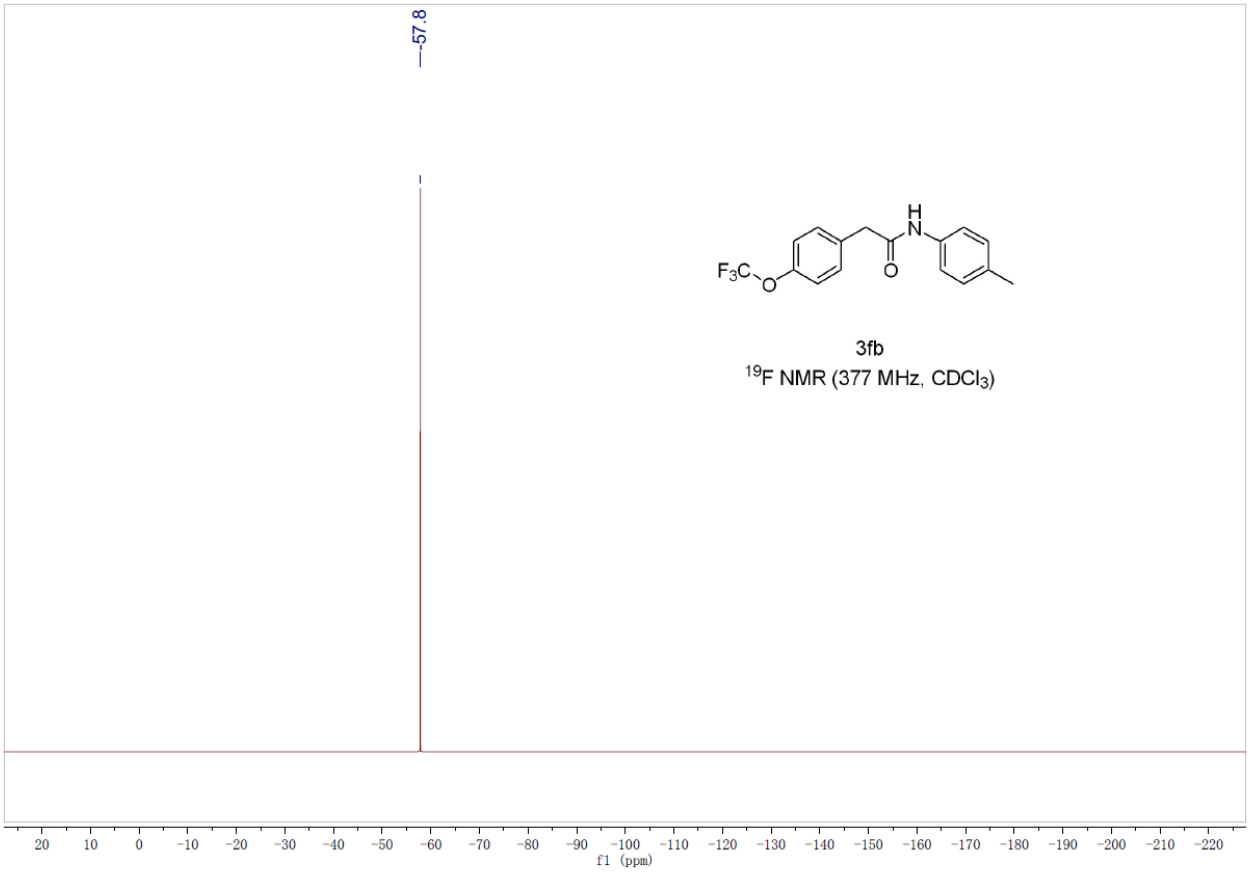


3eb

^{13}C NMR (101 MHz, $CDCl_3$)

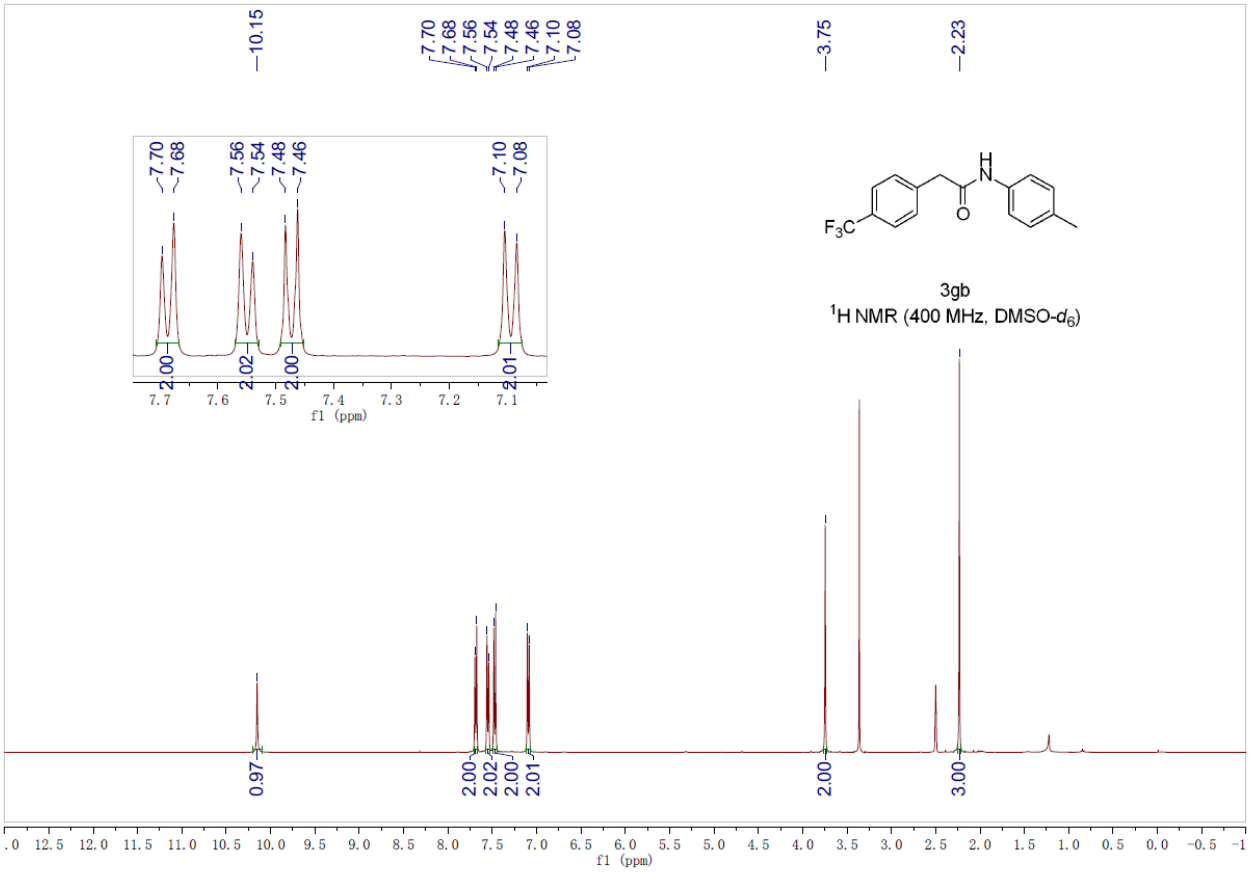

7.38
7.35
7.33
7.30
7.26
7.24
7.22
7.11
7.08
3.71
2.30
2.00
2.00
2.01
2.99
f1 (ppm)
F3C
O
H
N
O
3fb
1H NMR (400 MHz, CDCl3)
2.00
2.00
2.01
2.99
2.00
3.01
f1 (ppm)

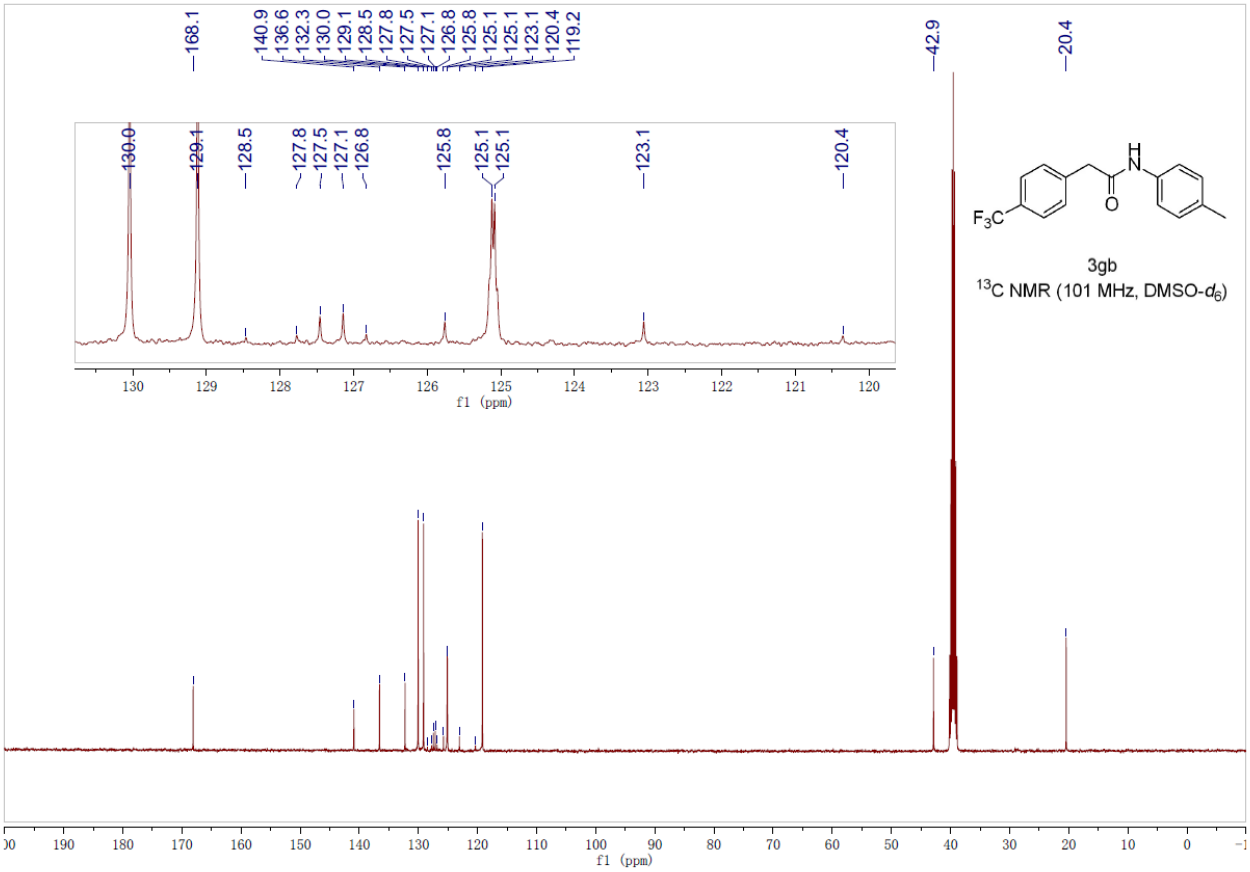

168.4
148.8
135.0
134.5
133.4
131.0
129.6
121.9
121.7
120.1
119.3
44.0
21.0
f1 (ppm)
F3C
O
H
N
O
3fb
13C NMR (101 MHz, CDCl3)
f1 (ppm)

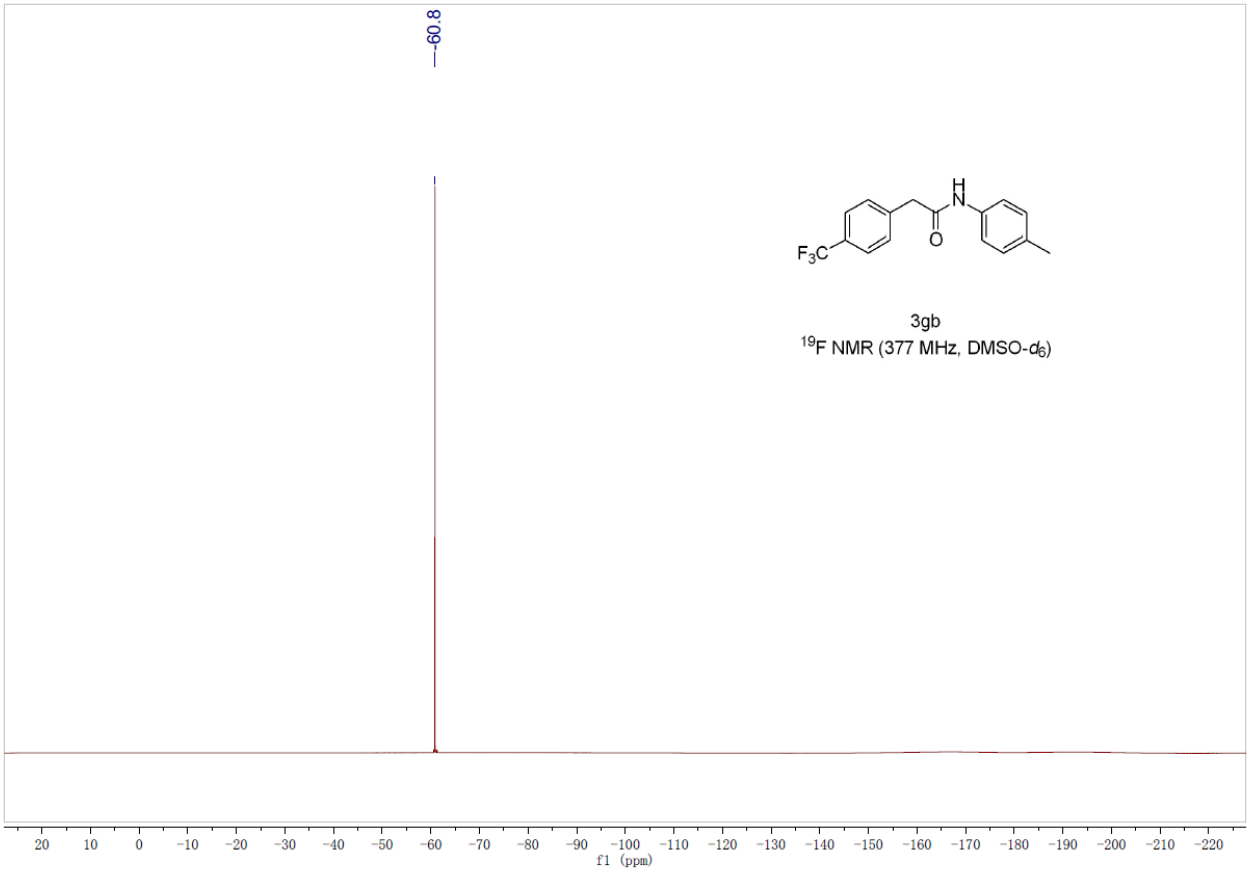


3fb

^{19}F NMR (377 MHz, $CDCl_3$)

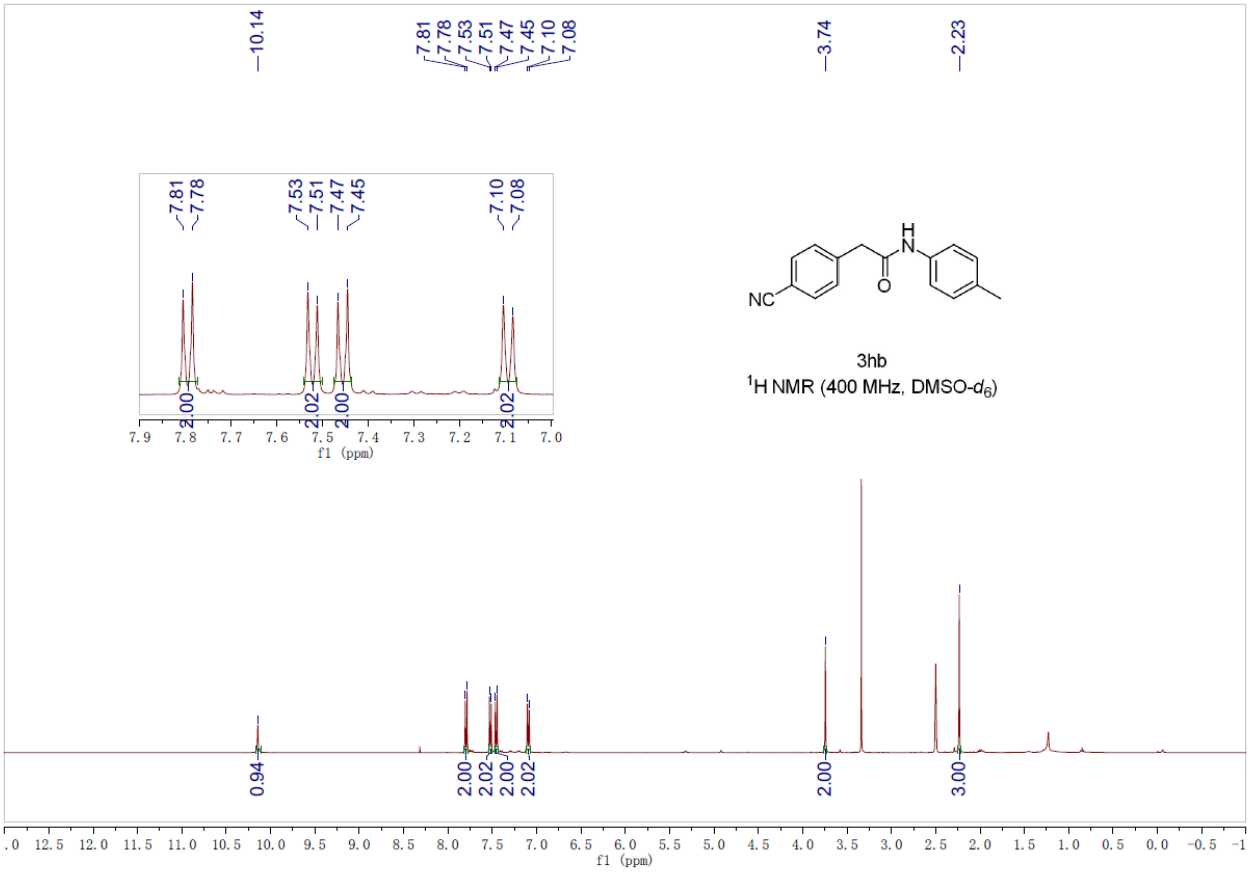

10.15
7.70
7.68
7.56
7.54
7.48
7.46
7.10
7.08
3.75
2.23
F3C
H
N
O
3gb
1H NMR (400 MHz, DMSO-d6)
f1 (ppm)

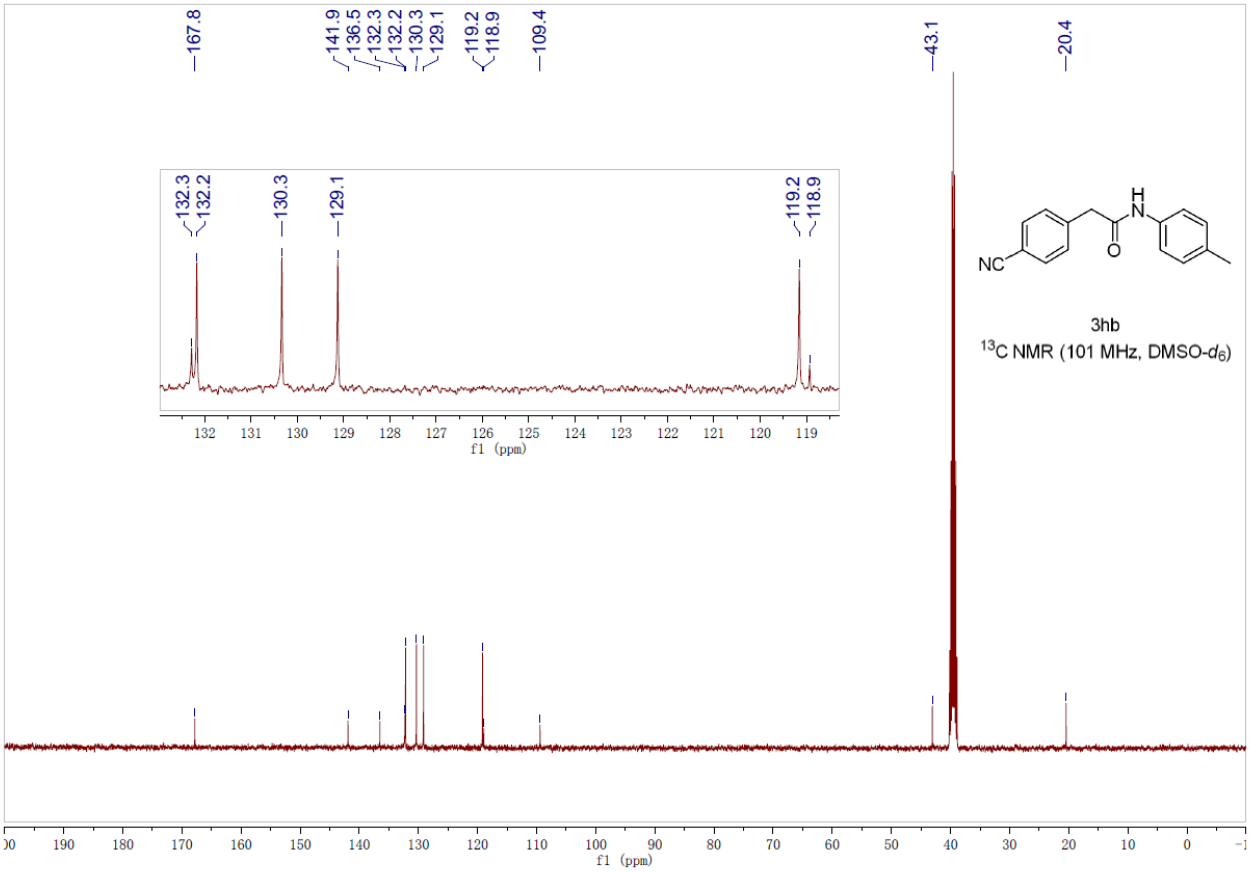

168.1
140.9
136.6
132.3
130.0
129.1
128.5
127.8
127.5
127.1
126.8
125.8
125.1
125.1
123.1
120.4
119.2
42.9
20.4
F3C
H
N
O
3gb
13C NMR (101 MHz, DMSO-d6)
f1 (ppm)

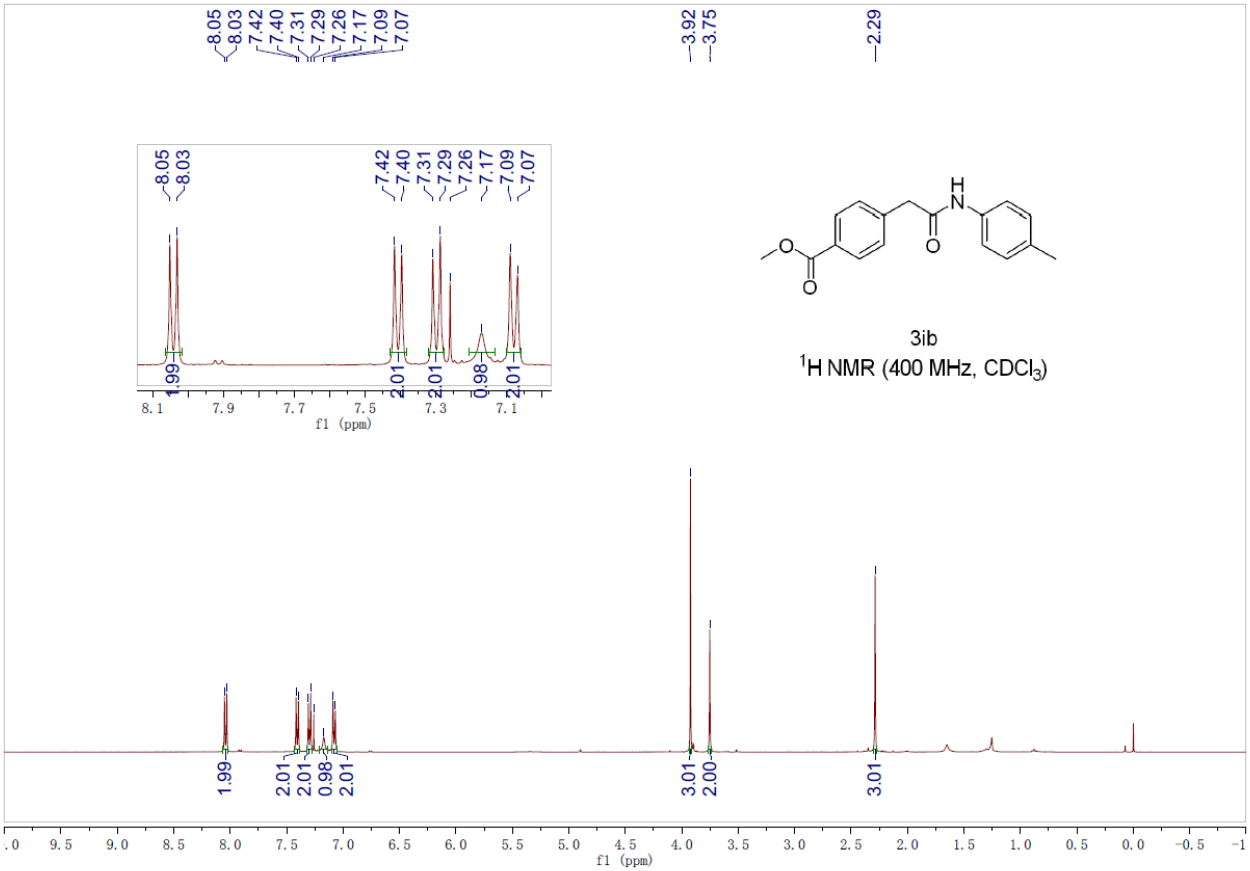


3gb

^{19}F NMR (377 MHz, DMSO-d_6)

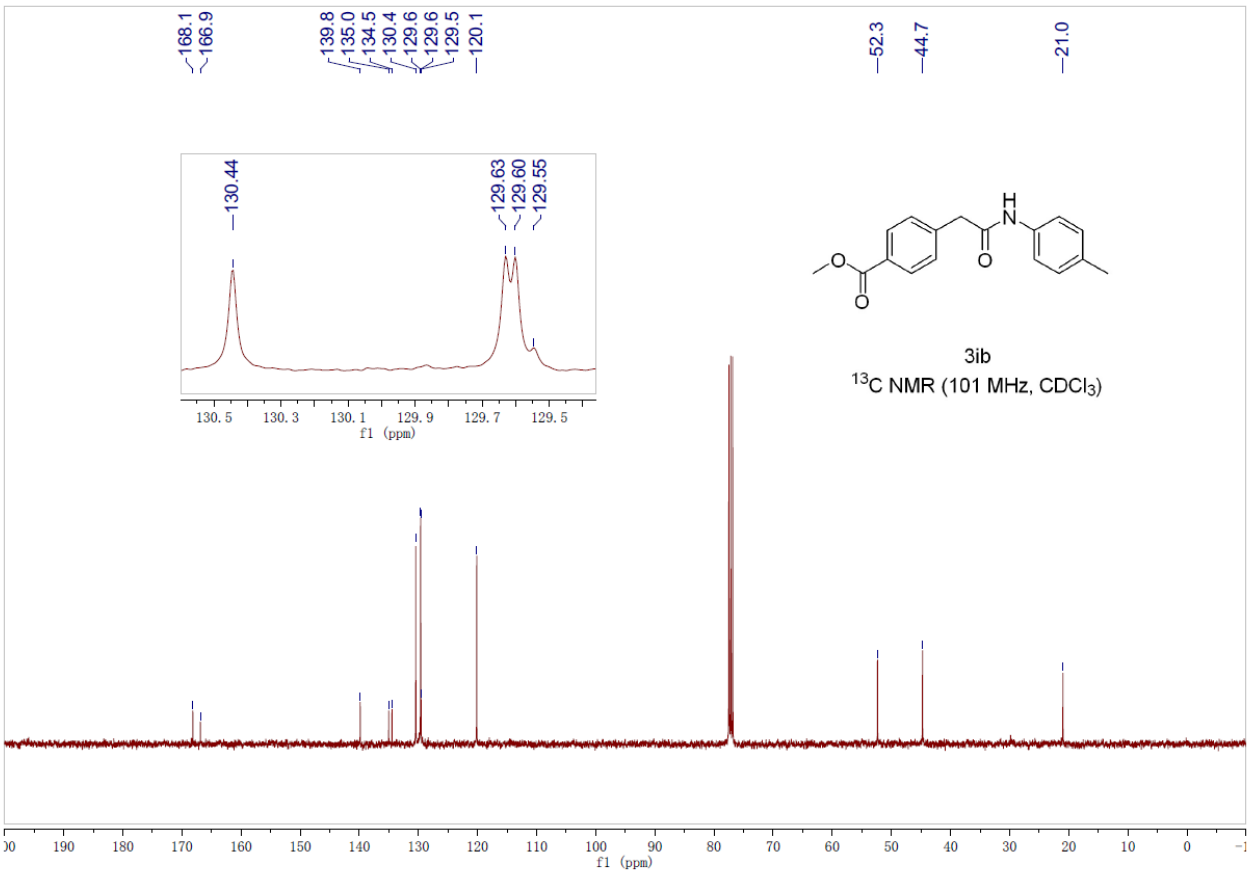

10.14
7.81
7.78
7.53
7.51
7.47
7.45
7.10
7.08
3.74
2.23
NC
H
N
O
3hb
^{1}H NMR (400 MHz, DMSO-d_6)
f1 (ppm)


167.8
141.9
136.5
132.3
132.2
130.3
129.1
119.2
118.9
109.4
43.1
20.4
NC
H
N
O
3hb
^{13}C NMR (101 MHz, DMSO-d_6)
f1 (ppm)



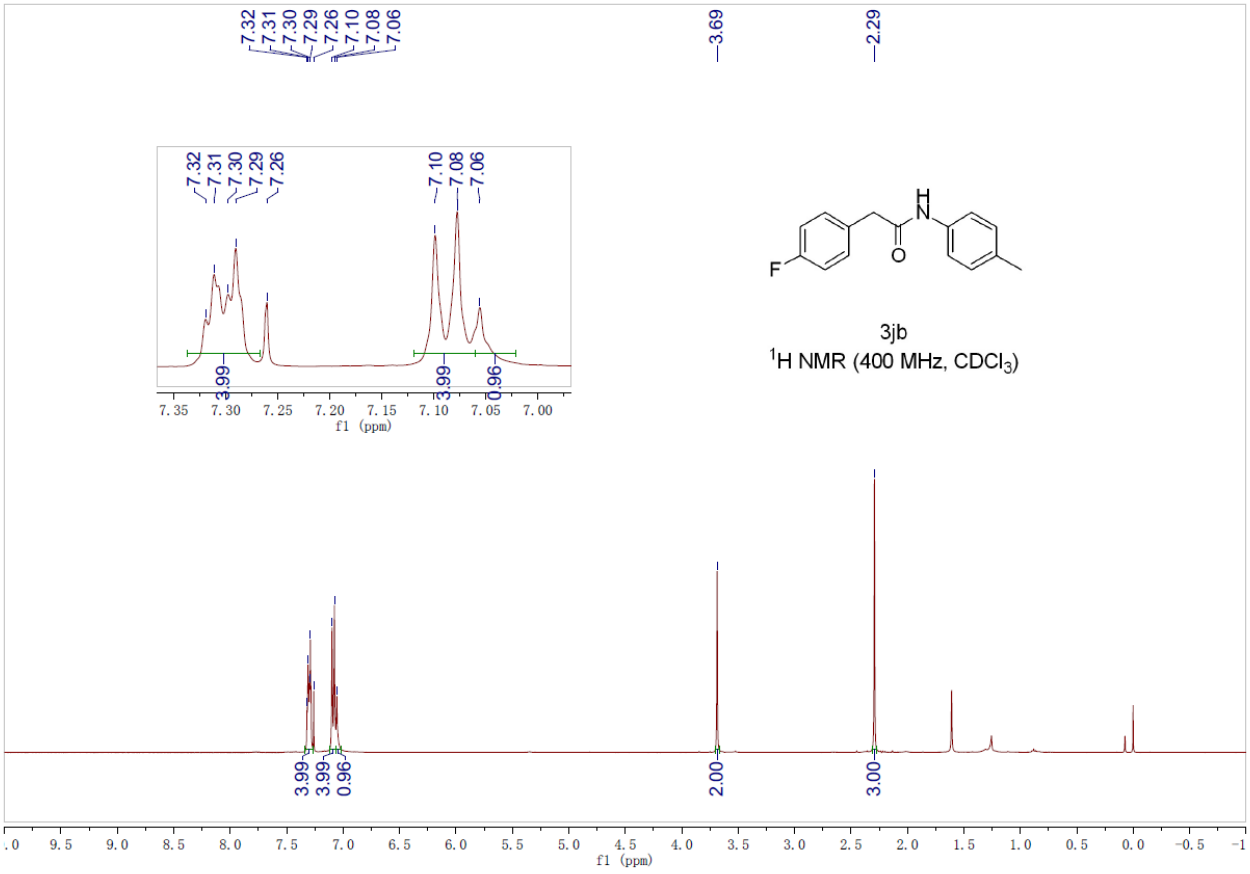
3ib

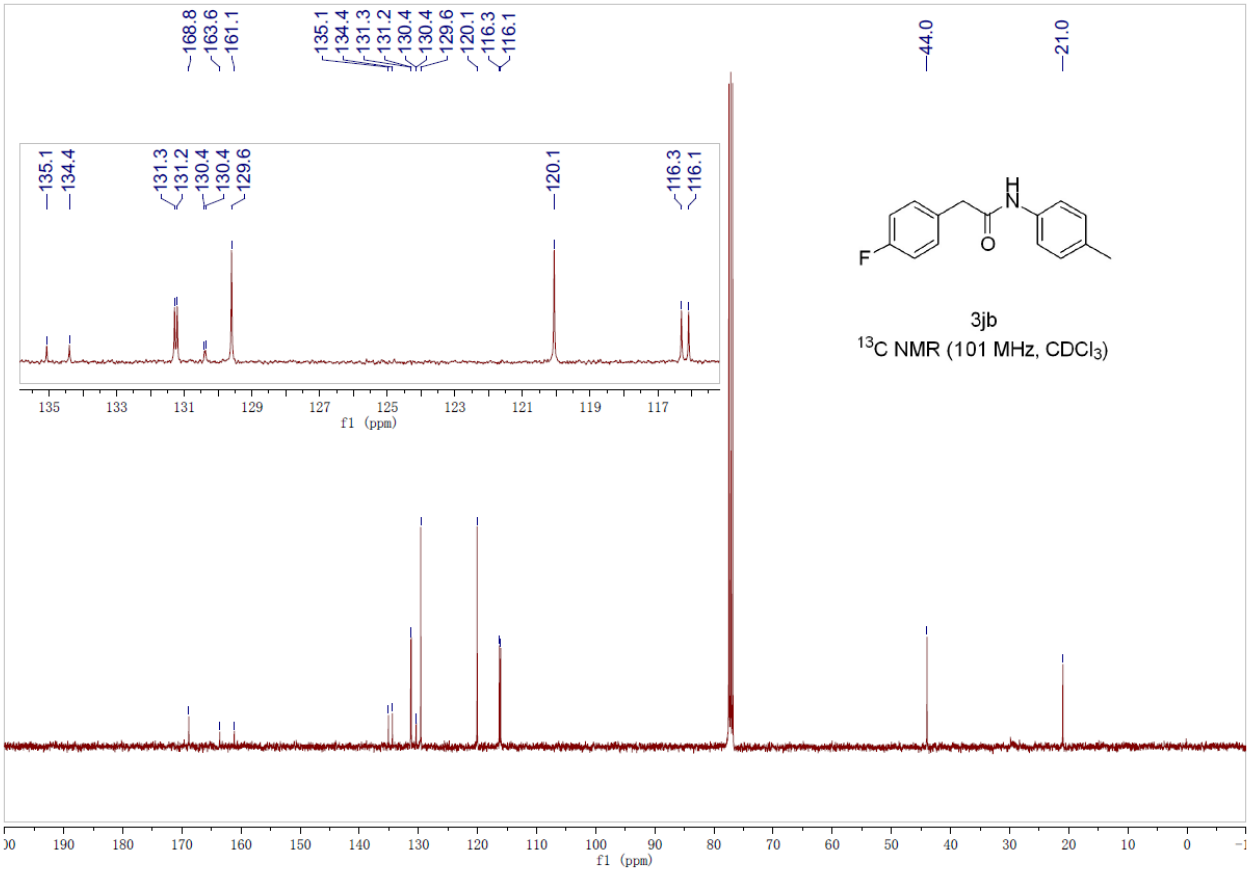
^{1}H NMR (400 MHz, $CDCl_3$)

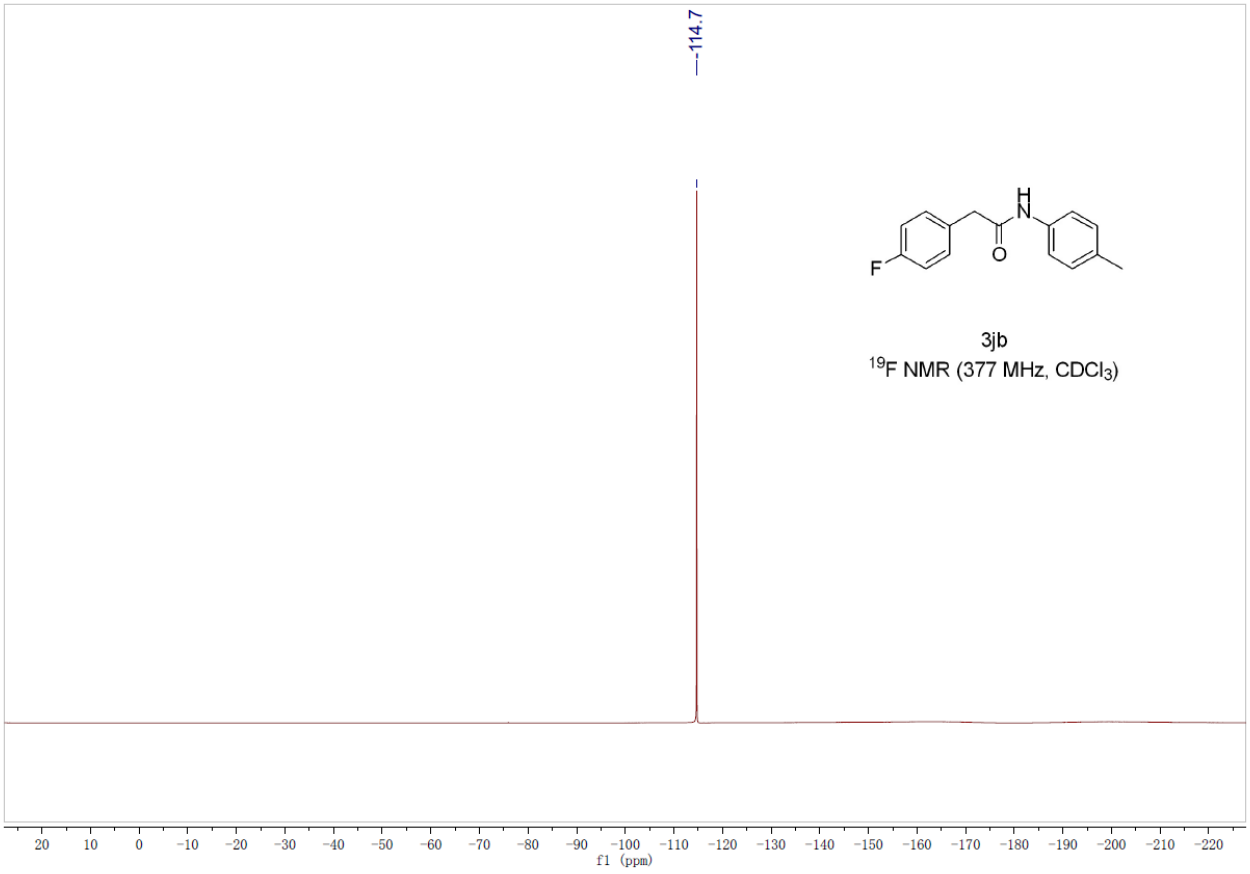


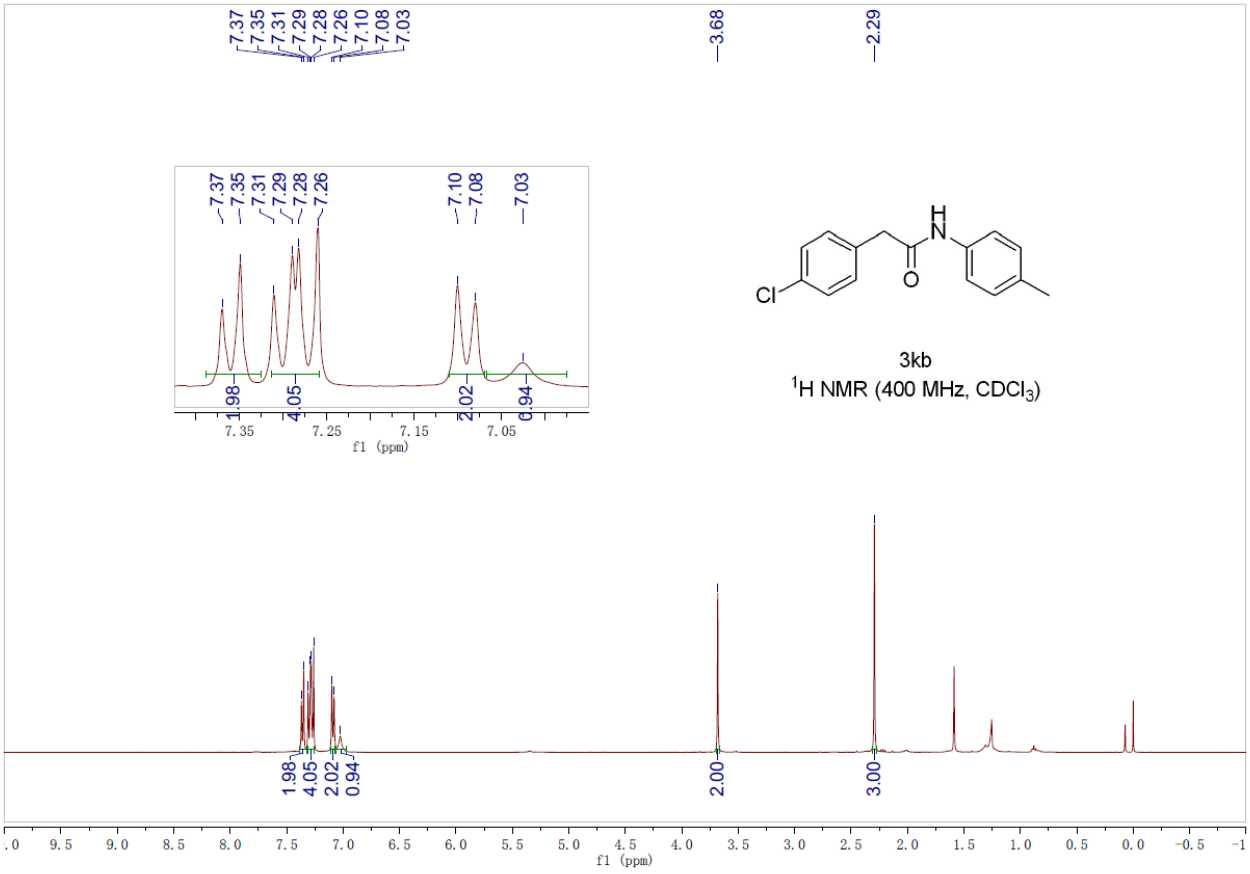
3ib

^{13}C NMR (101 MHz, $CDCl_3$)


7.32
7.31
7.30
7.29
7.26
7.10
7.08
7.06
3.69
2.29
3.99
3.99
0.96
2.00
3.00
F
H
N
O
3jb
1H NMR (400 MHz, CDCl3)
f1 (ppm)

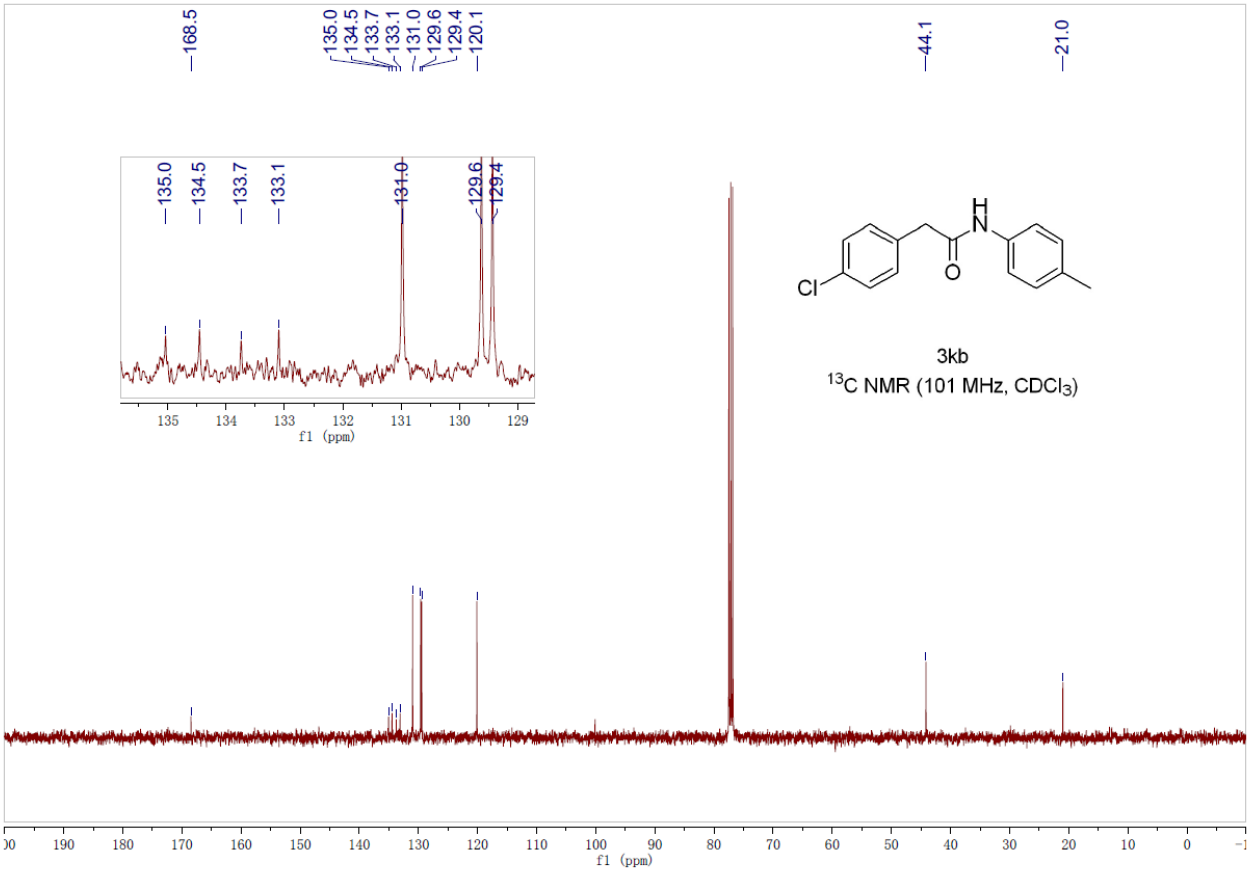

168.8
163.6
161.1
135.1
134.4
131.3
131.2
130.4
130.4
129.6
120.1
116.3
116.1
44.0
21.0
F
H
N
O
3jb
13C NMR (101 MHz, CDCl3)
f1 (ppm)


-114.7
F
H
N
O
3jb
19F NMR (377 MHz, CDCl3)
20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220
f1 (ppm)



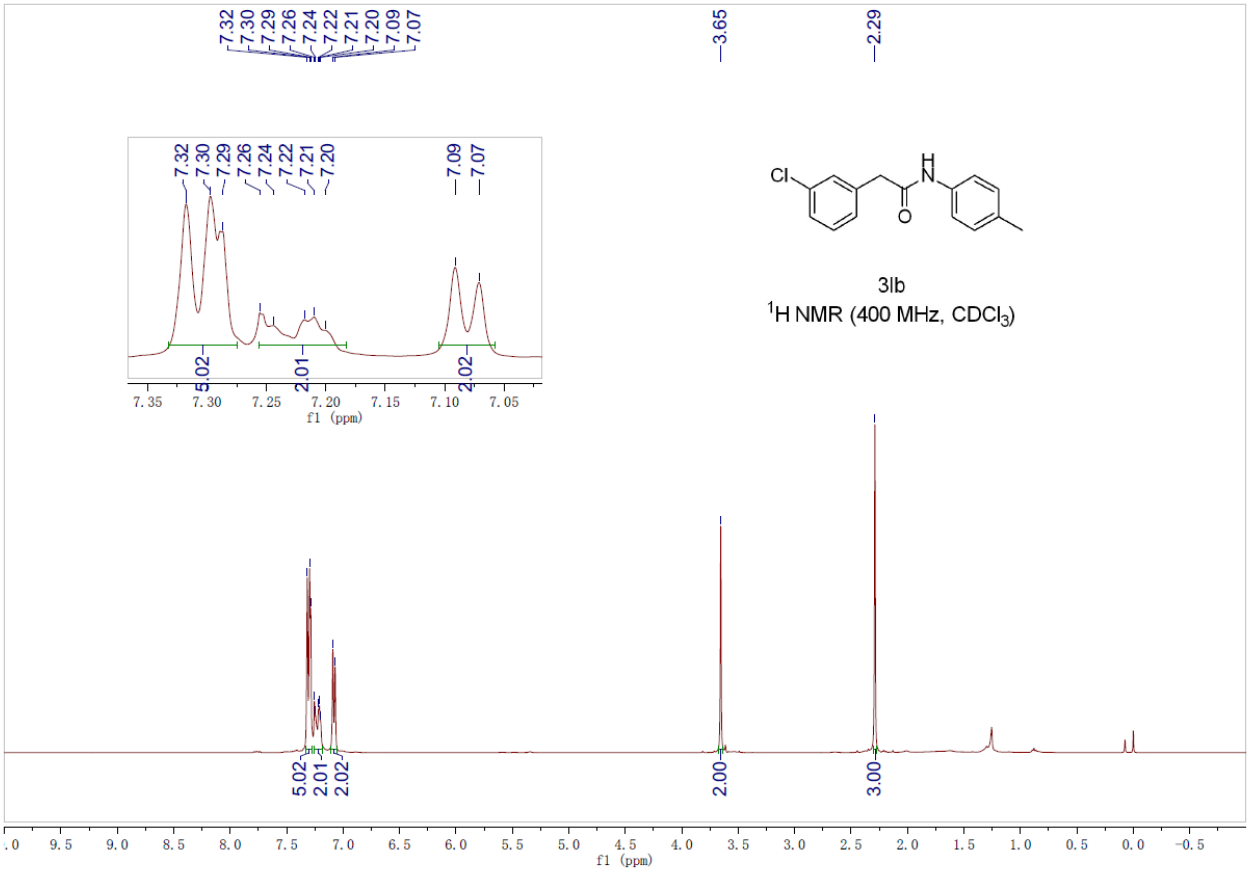
3kb

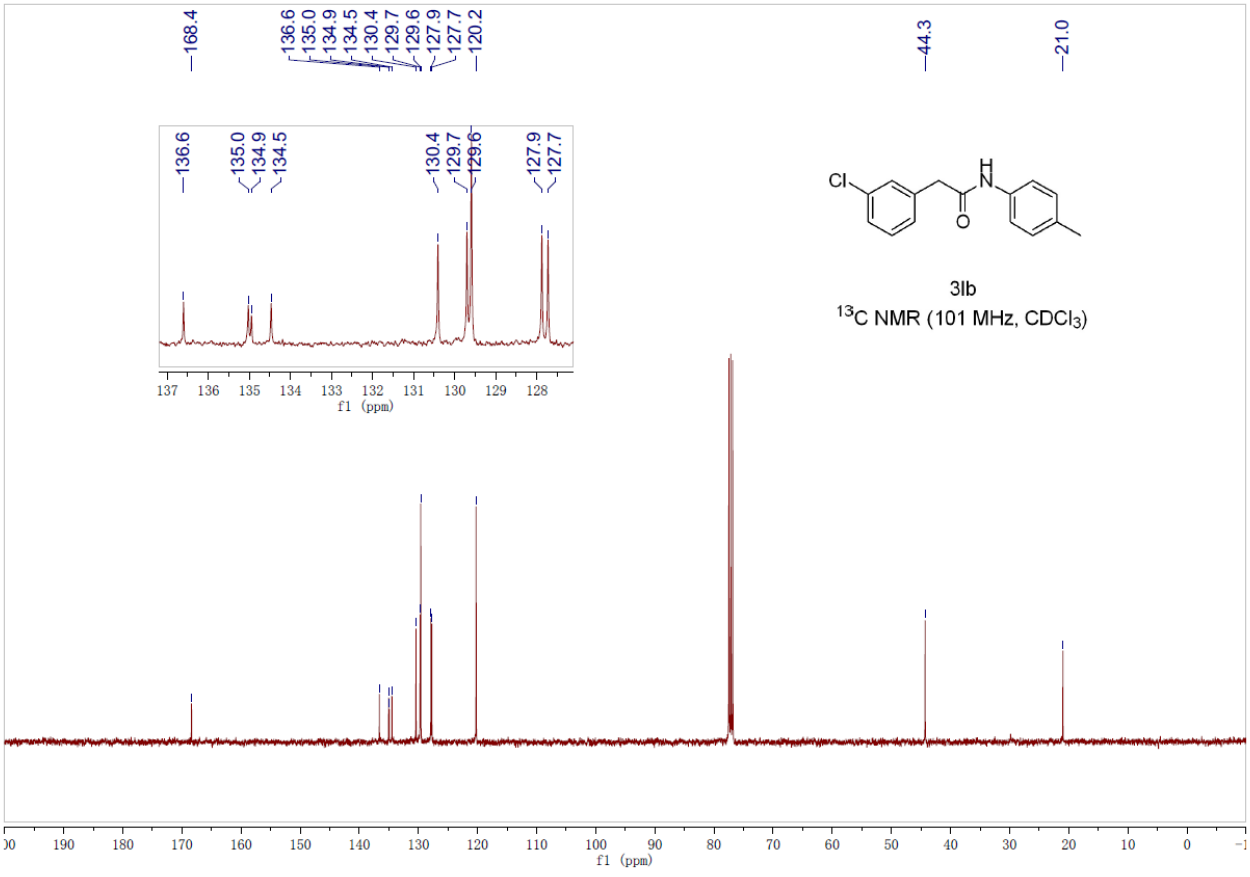
^{1}H NMR (400 MHz, $CDCl_3$)

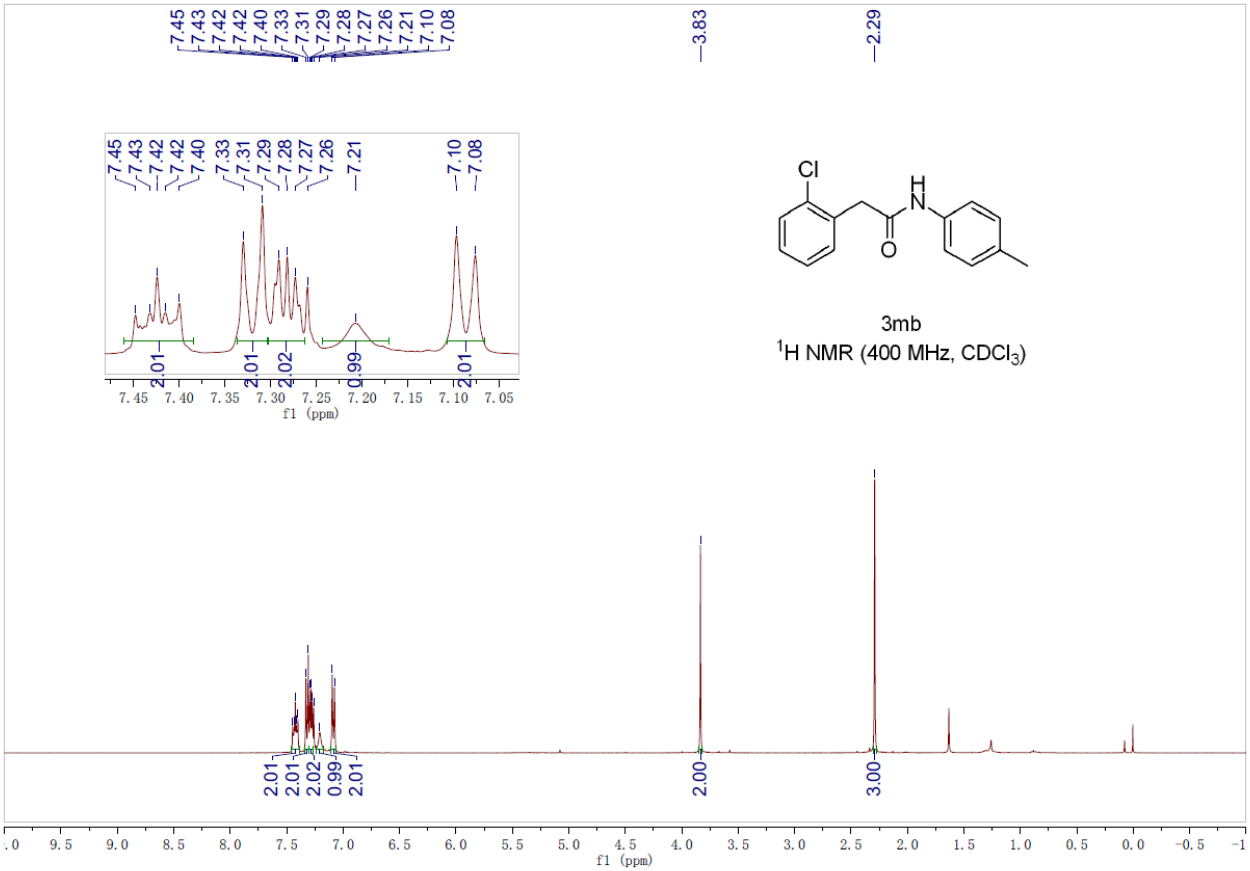


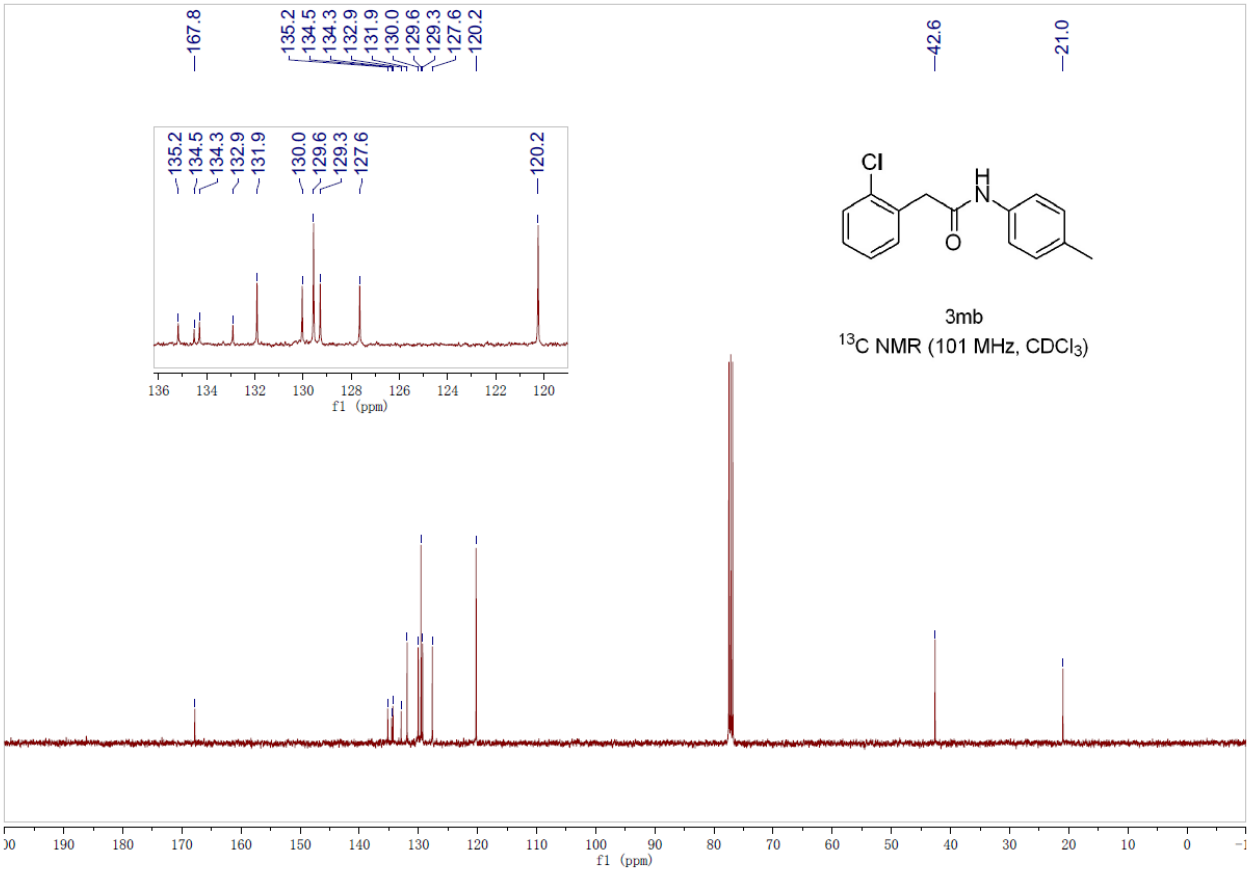
3kb

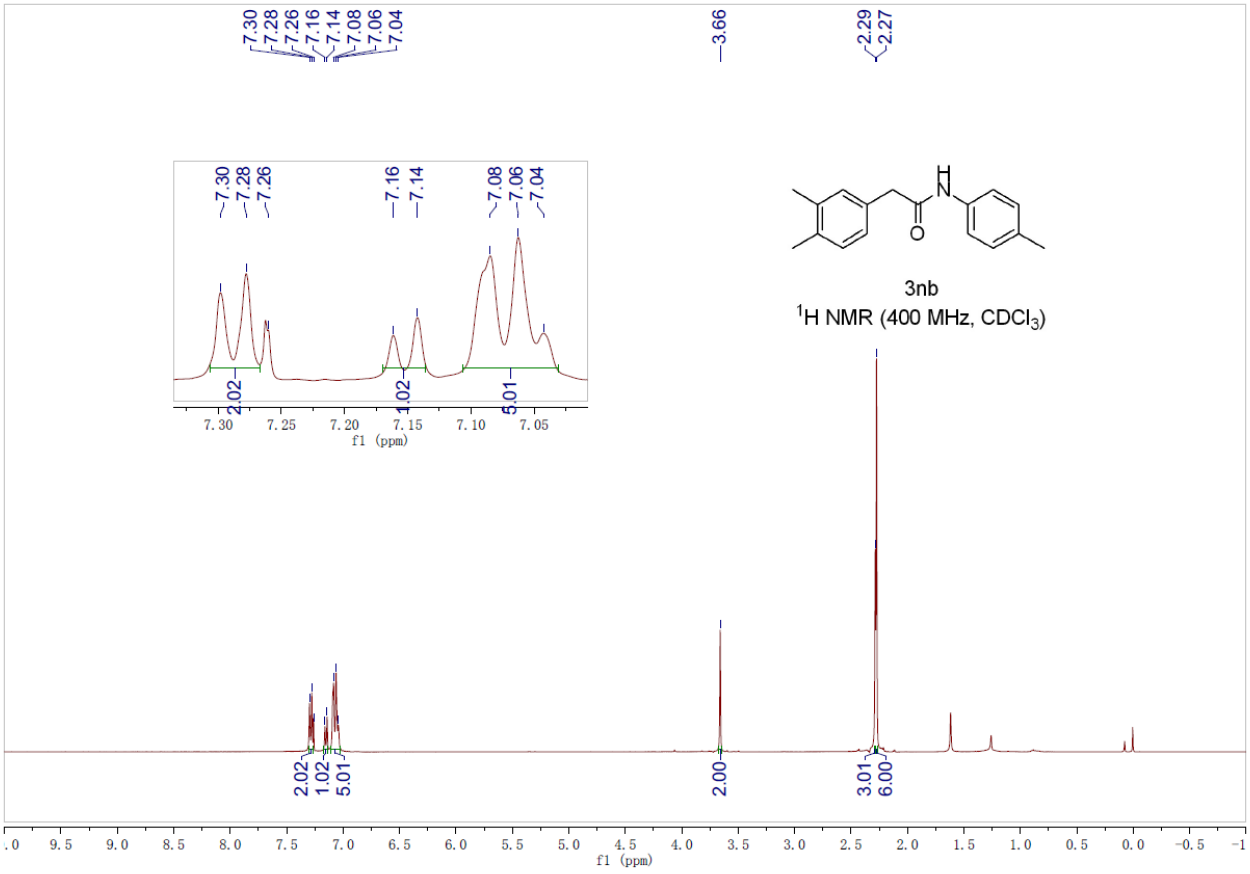
^{13}C NMR (101 MHz, $CDCl_3$)


7.32
7.30
7.29
7.26
7.24
7.22
7.21
7.20
7.09
7.07
3.65
2.29
Cl
H
N
O
3lb
^{1}H NMR (400 MHz, $CDCl_3$)
5.02
2.01
2.02
2.00
3.00
f1 (ppm)


168.4
136.6
135.0
134.9
134.5
130.4
129.7
129.6
127.9
127.7
120.2
44.3
21.0
Cl
H
N
O
3lb
^{13}C NMR (101 MHz, $CDCl_3$)
f1 (ppm)

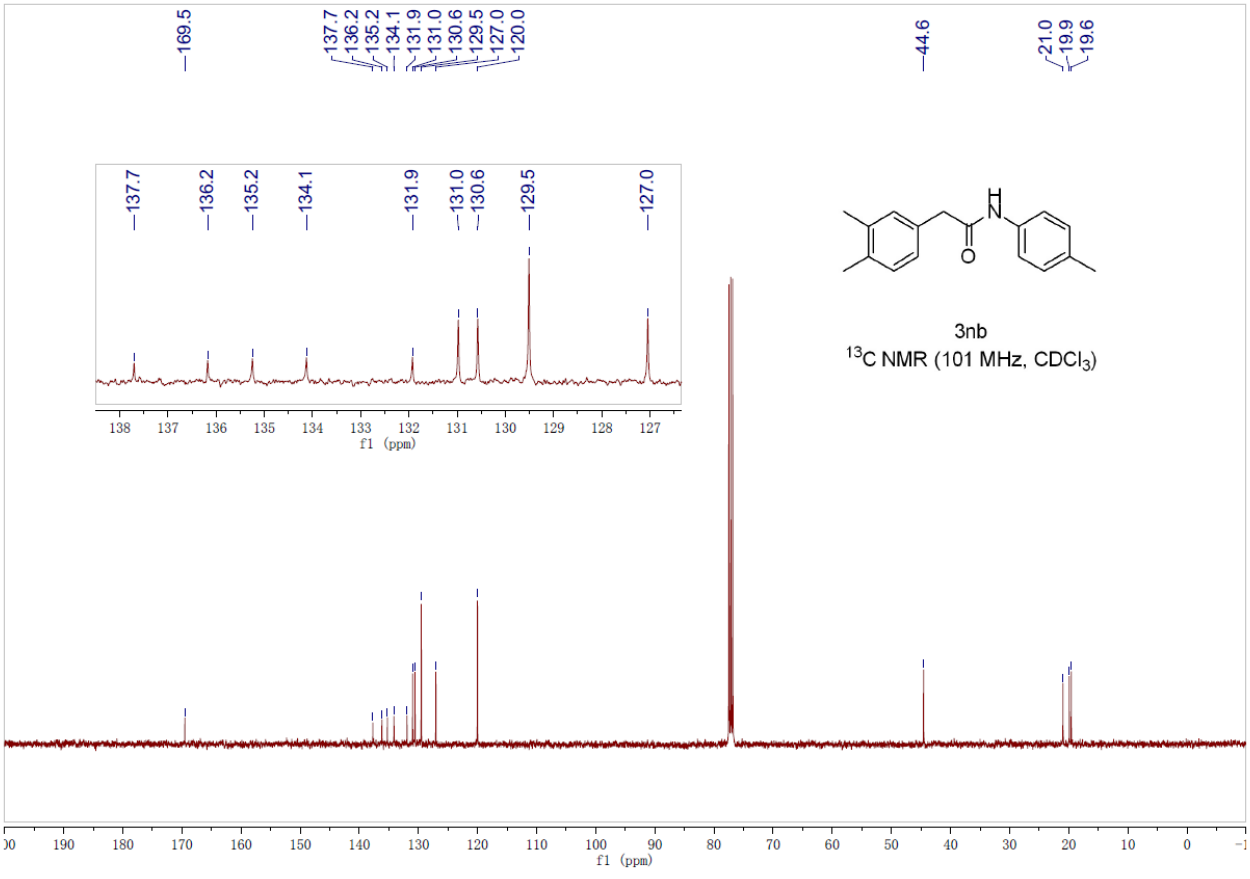

7.45
7.43
7.42
7.42
7.40
7.33
7.31
7.29
7.28
7.27
7.26
7.21
7.10
7.08
3.83
2.29
Cl
H
N
O
3mb
1H NMR (400 MHz, CDCl3)
2.01
2.01
2.02
0.99
2.01
2.00
3.00
f1 (ppm)


167.8
135.2
134.5
134.3
132.9
131.9
130.0
129.6
129.3
127.6
120.2
42.6
21.0
Cl
H
N
O
3mb
13C NMR (101 MHz, CDCl3)
f1 (ppm)



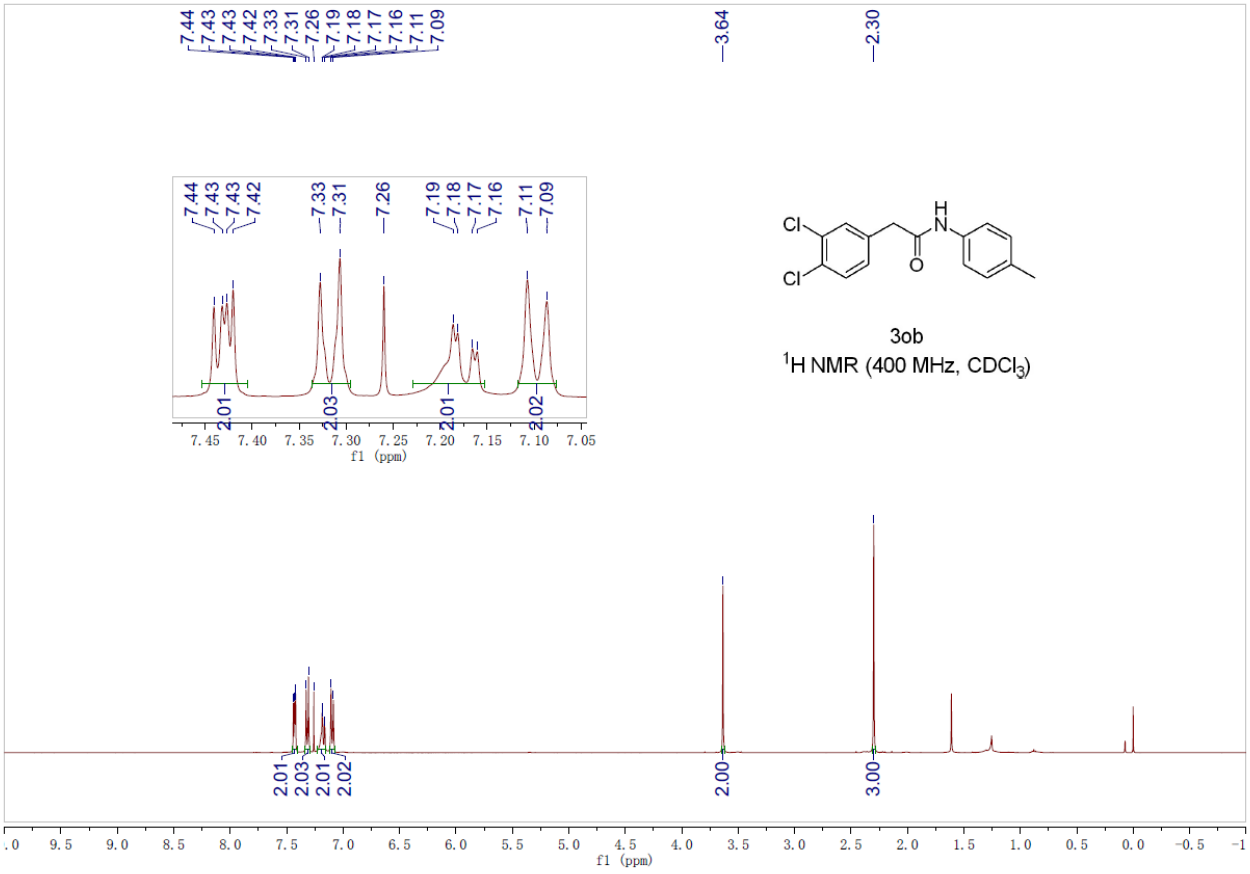
3nb

^{1}H NMR (400 MHz, $CDCl_3$)



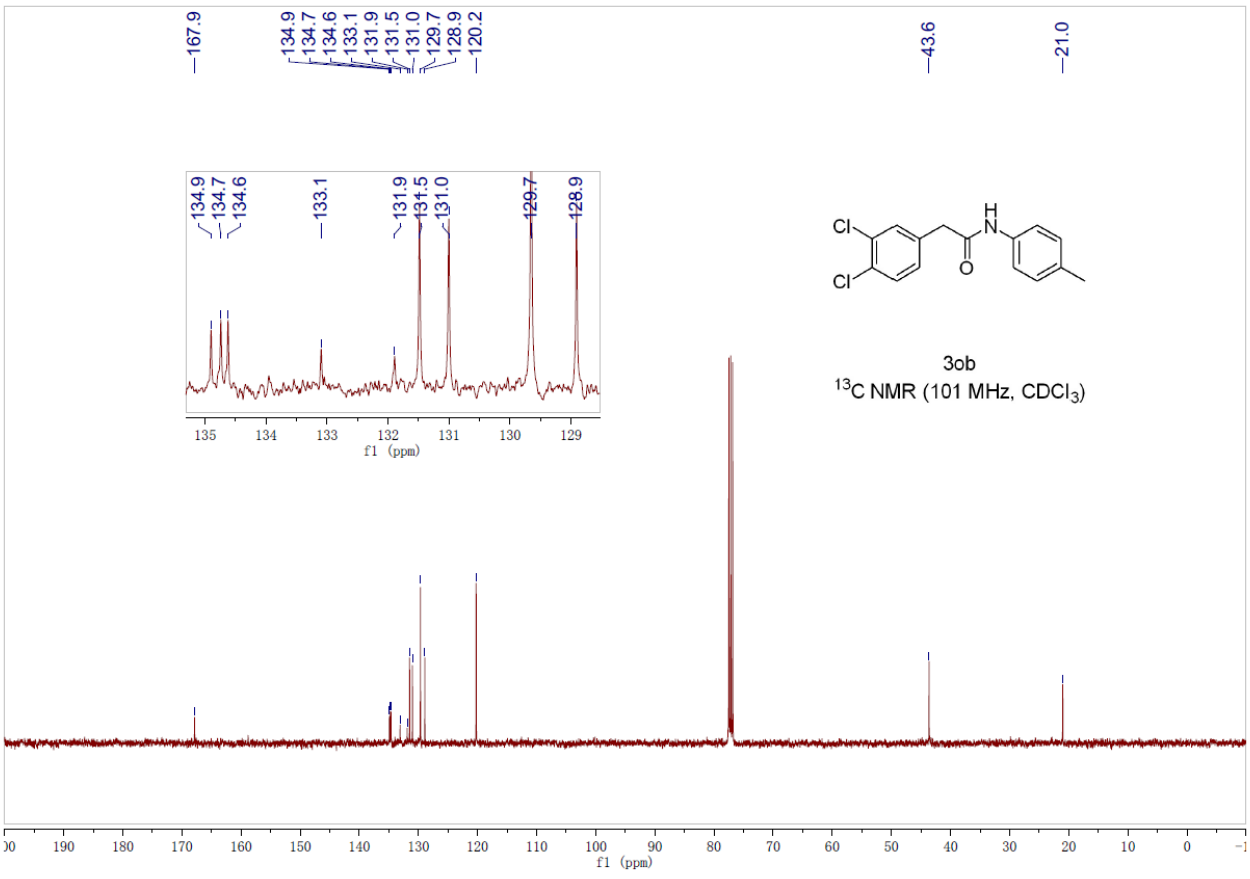
3nb

^{13}C NMR (101 MHz, $CDCl_3$)



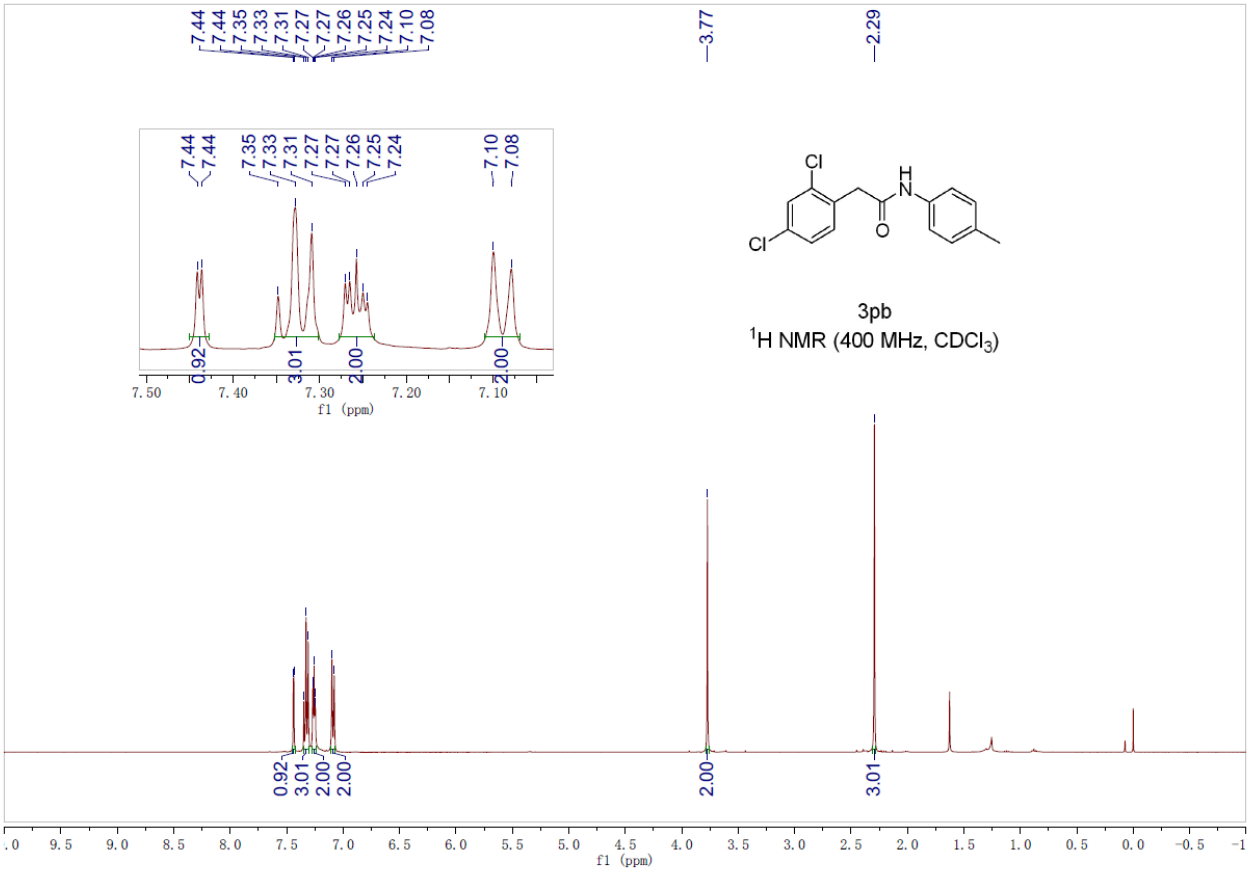
3ob

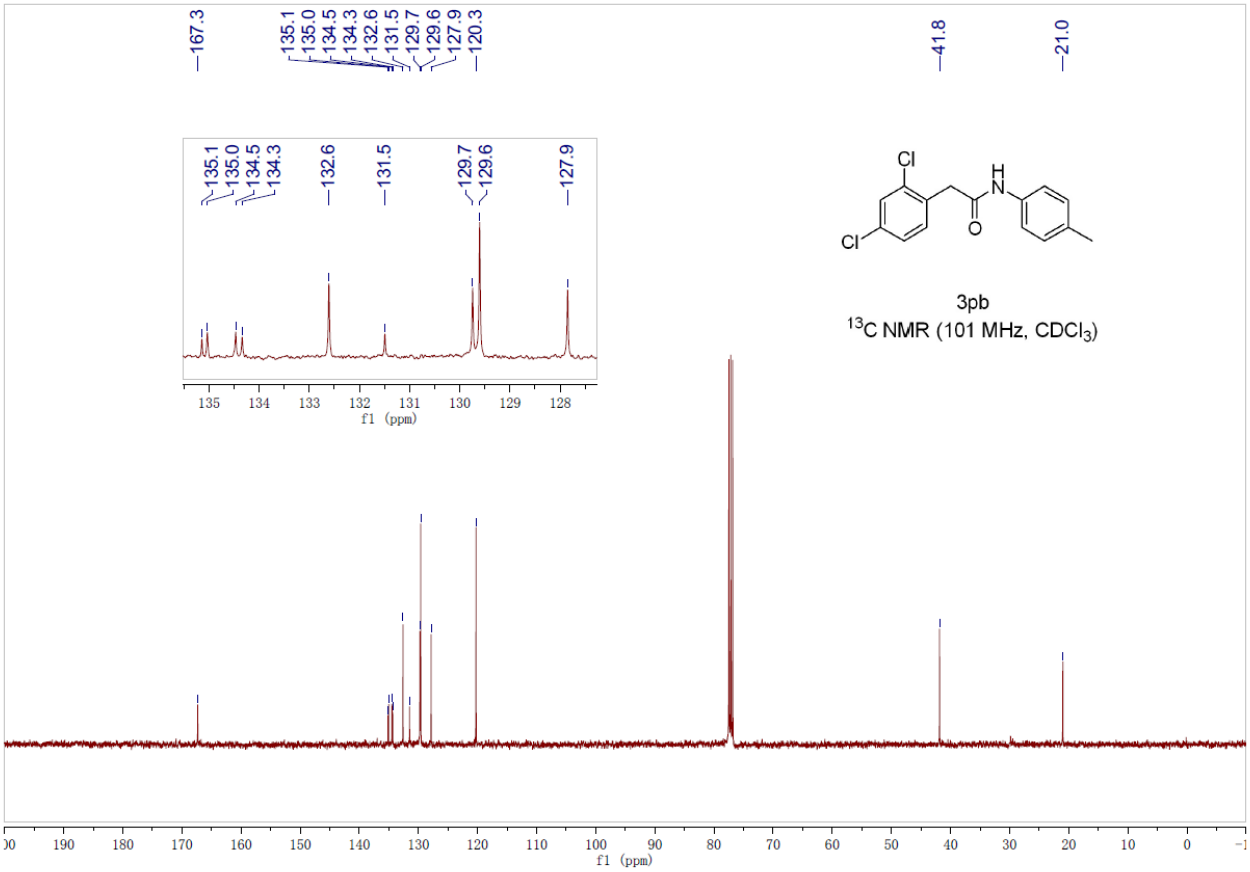
^{1}H NMR (400 MHz, $CDCl_3$)

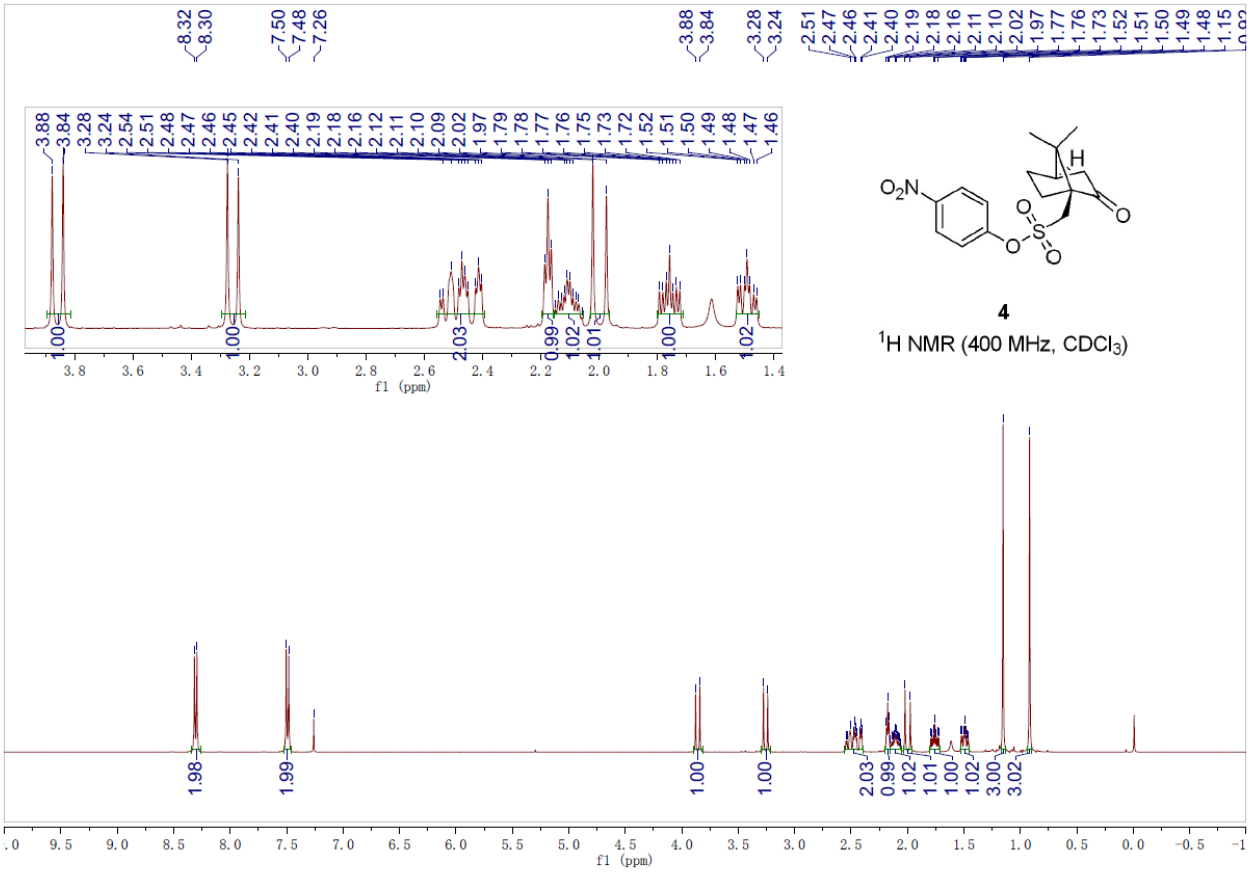


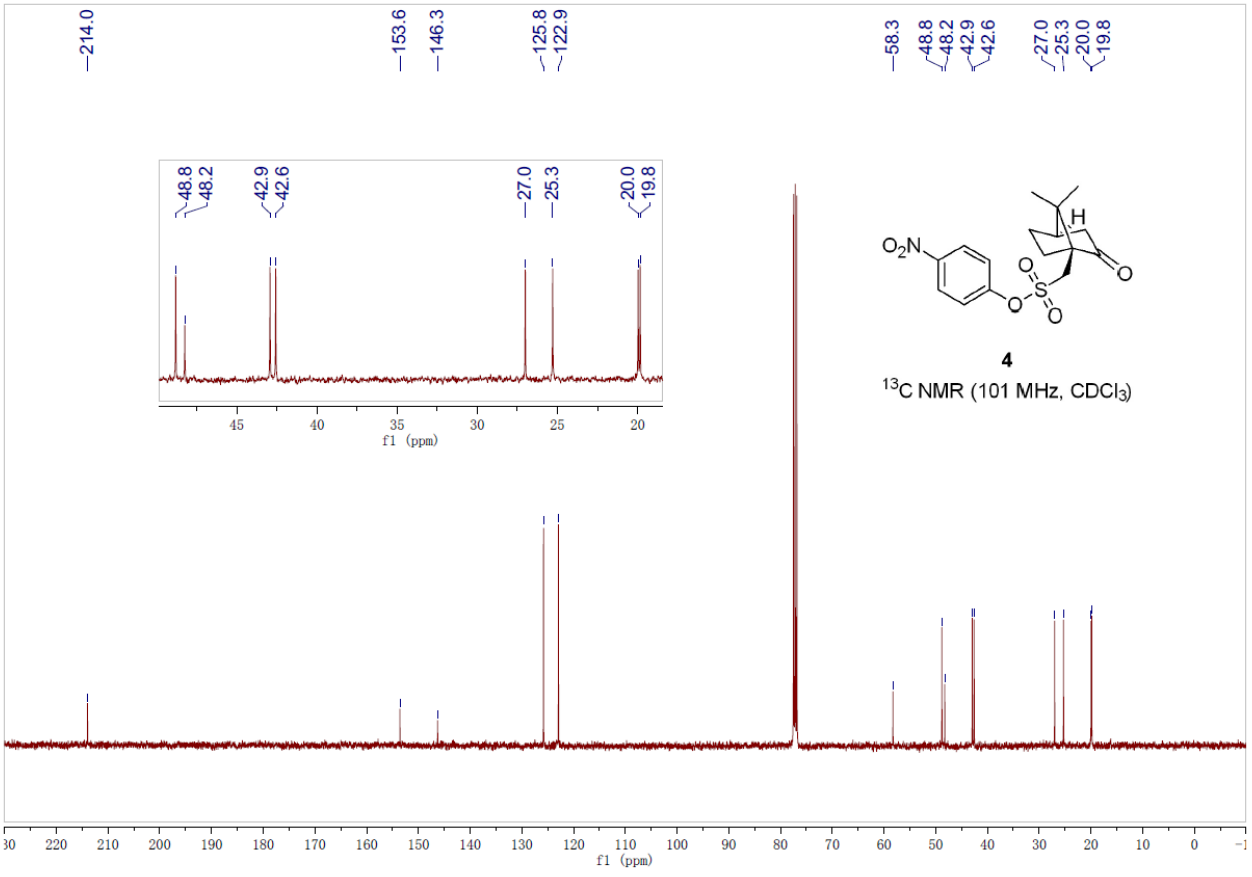
3ob

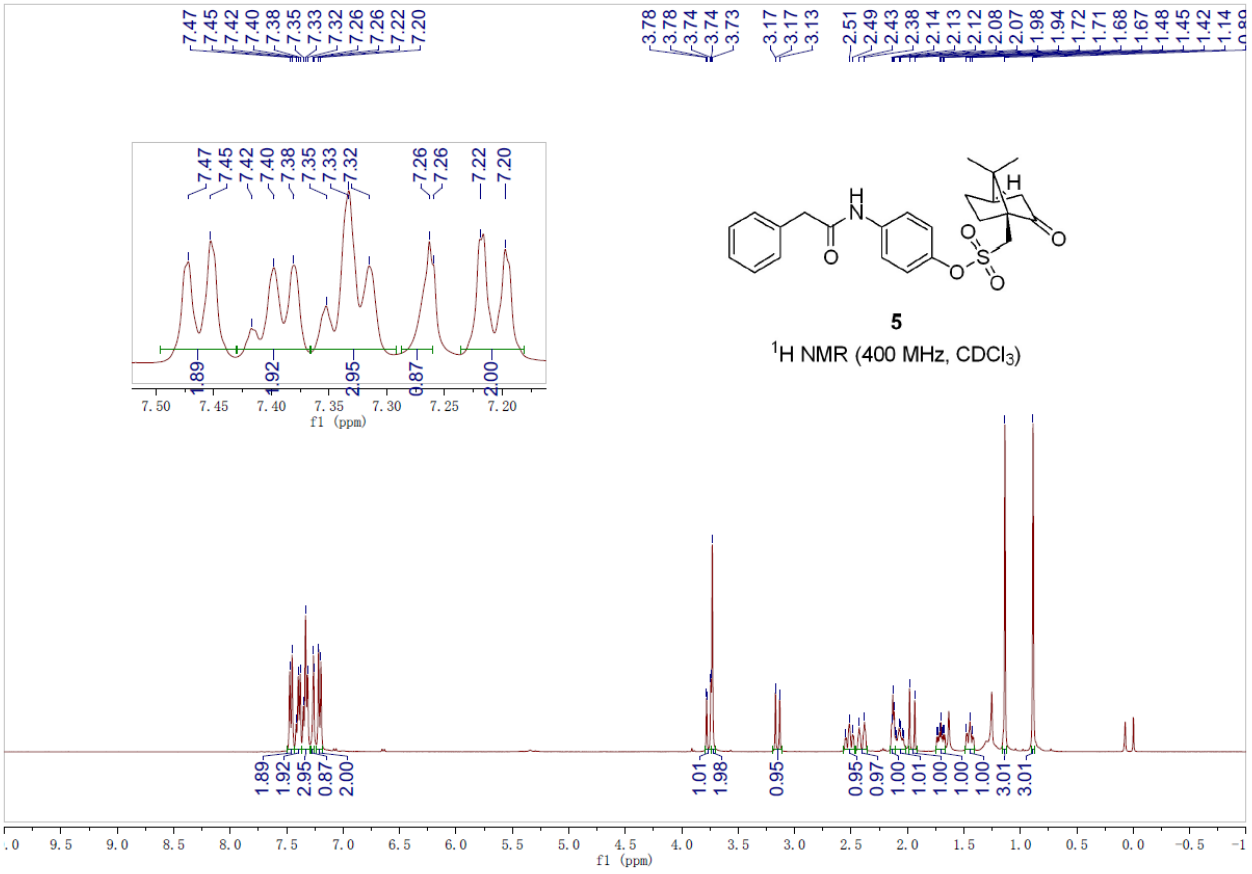
^{13}C NMR (101 MHz, $CDCl_3$)

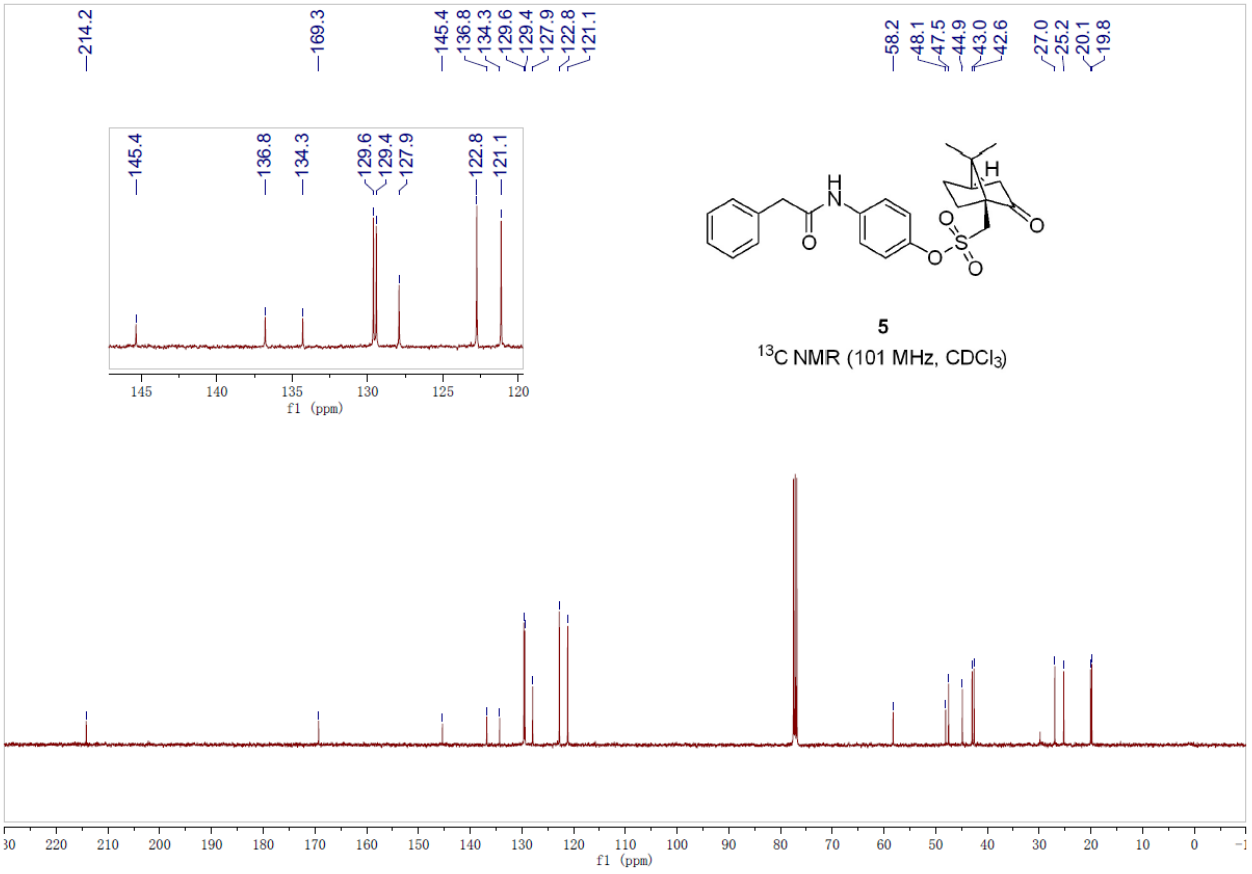

7.44
7.44
7.35
7.33
7.31
7.27
7.27
7.26
7.25
7.24
7.10
7.08
3.77
2.29
0.92
3.01
2.00
2.00
f1 (ppm)
Cl
Cl
H
N
O
3pb
1H NMR (400 MHz, CDCl3)

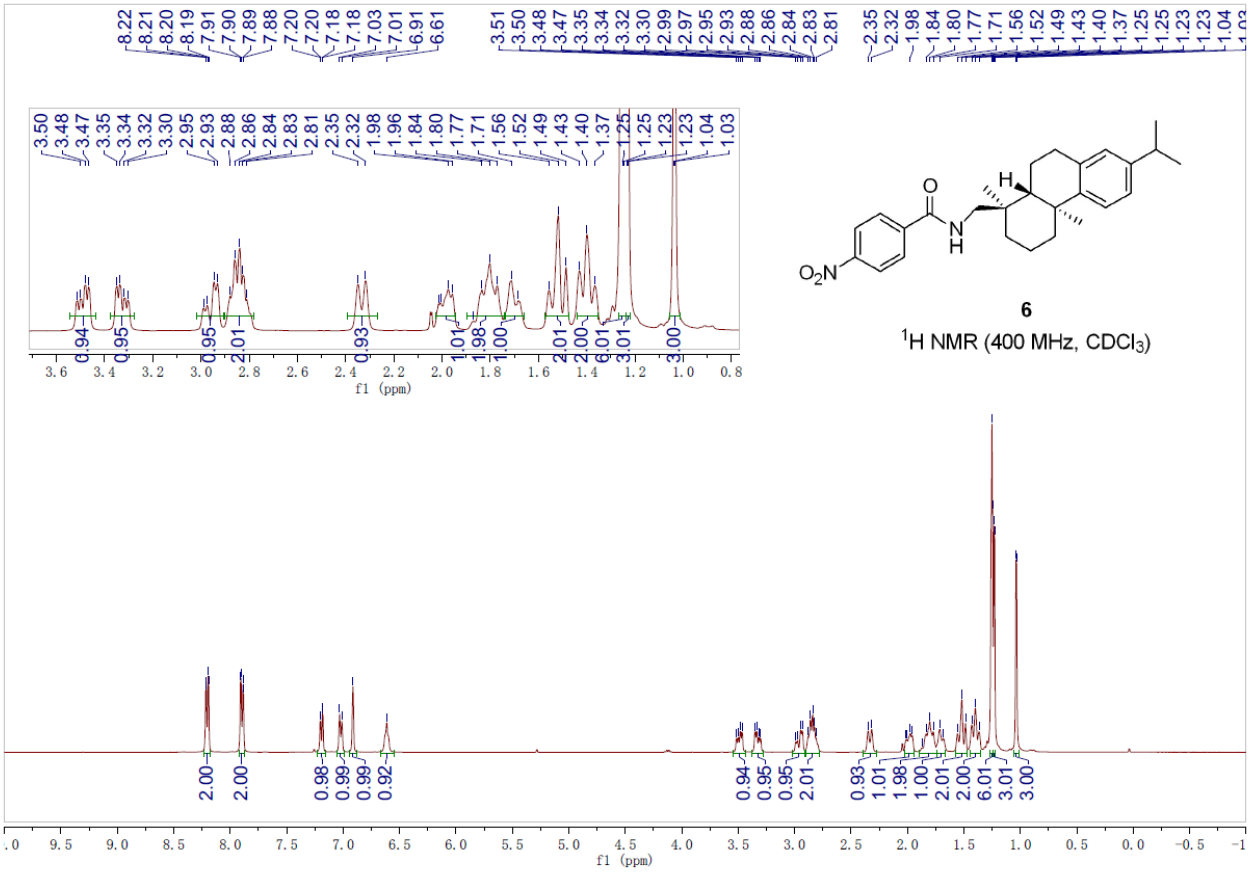

167.3
135.1
135.0
134.5
134.3
132.6
131.5
129.7
129.6
127.9
120.3
41.8
21.0
f1 (ppm)
Cl
Cl
H
N
O
3pb
13C NMR (101 MHz, CDCl3)

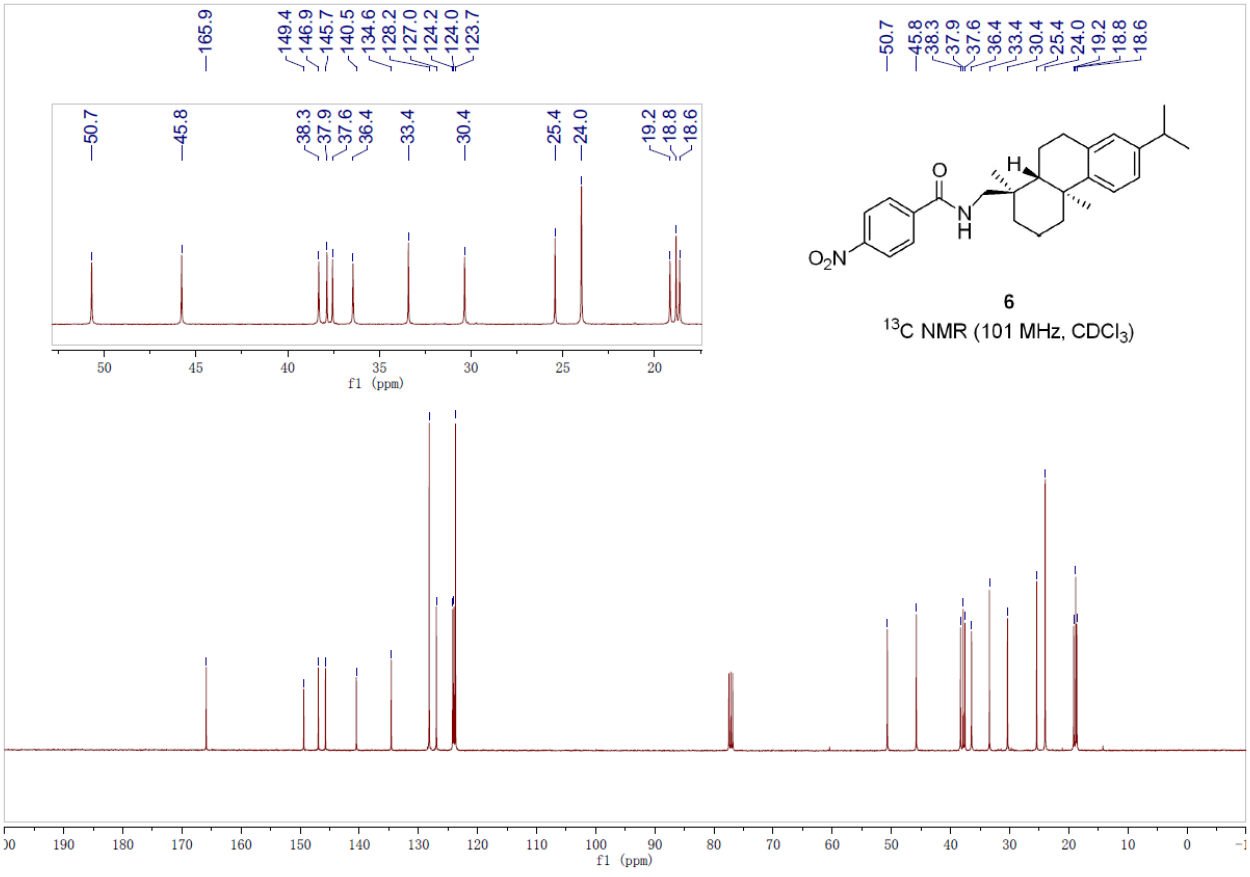

4
^{1}H NMR (400 MHz, CDCl$_3$)
f1 (ppm)

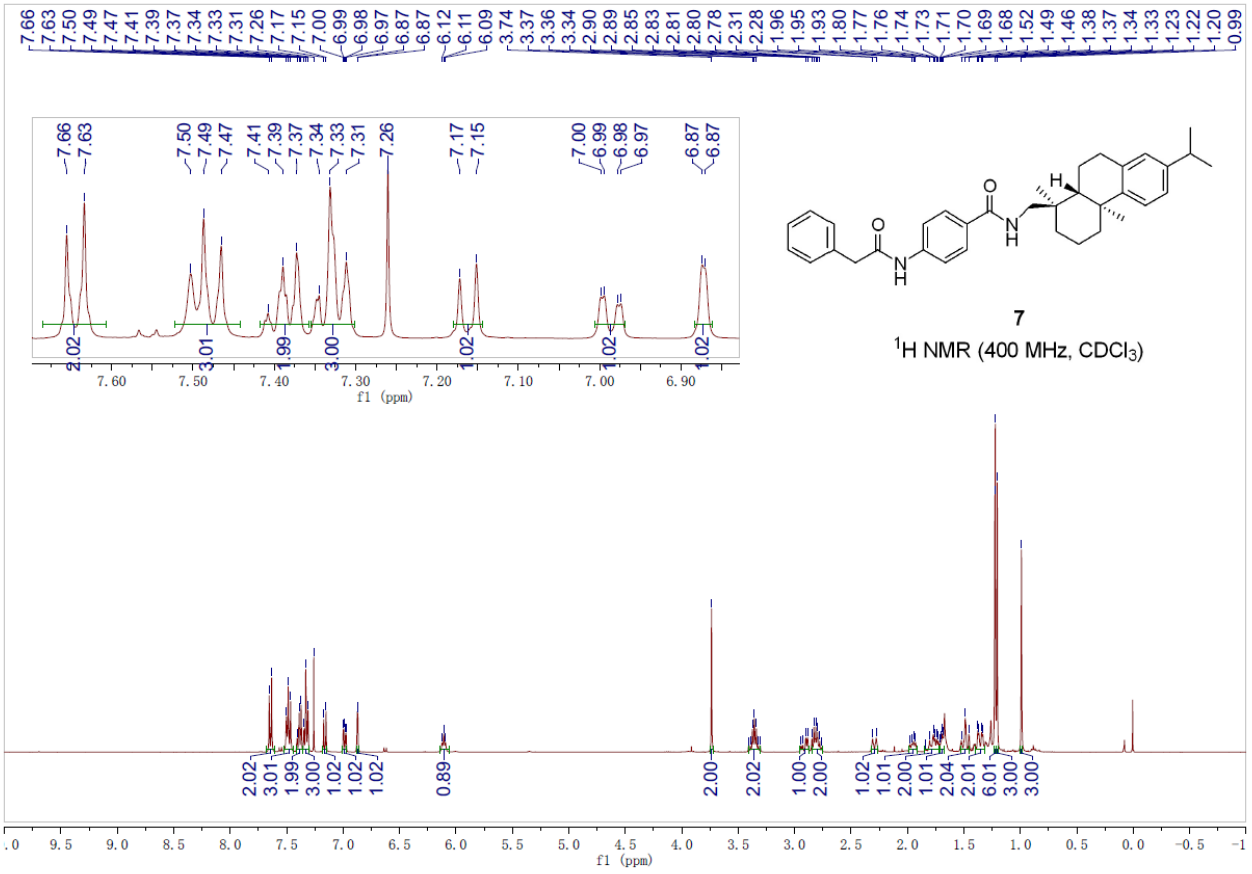

4
^{13}C NMR (101 MHz, CDCl$_3$)
f1 (ppm)

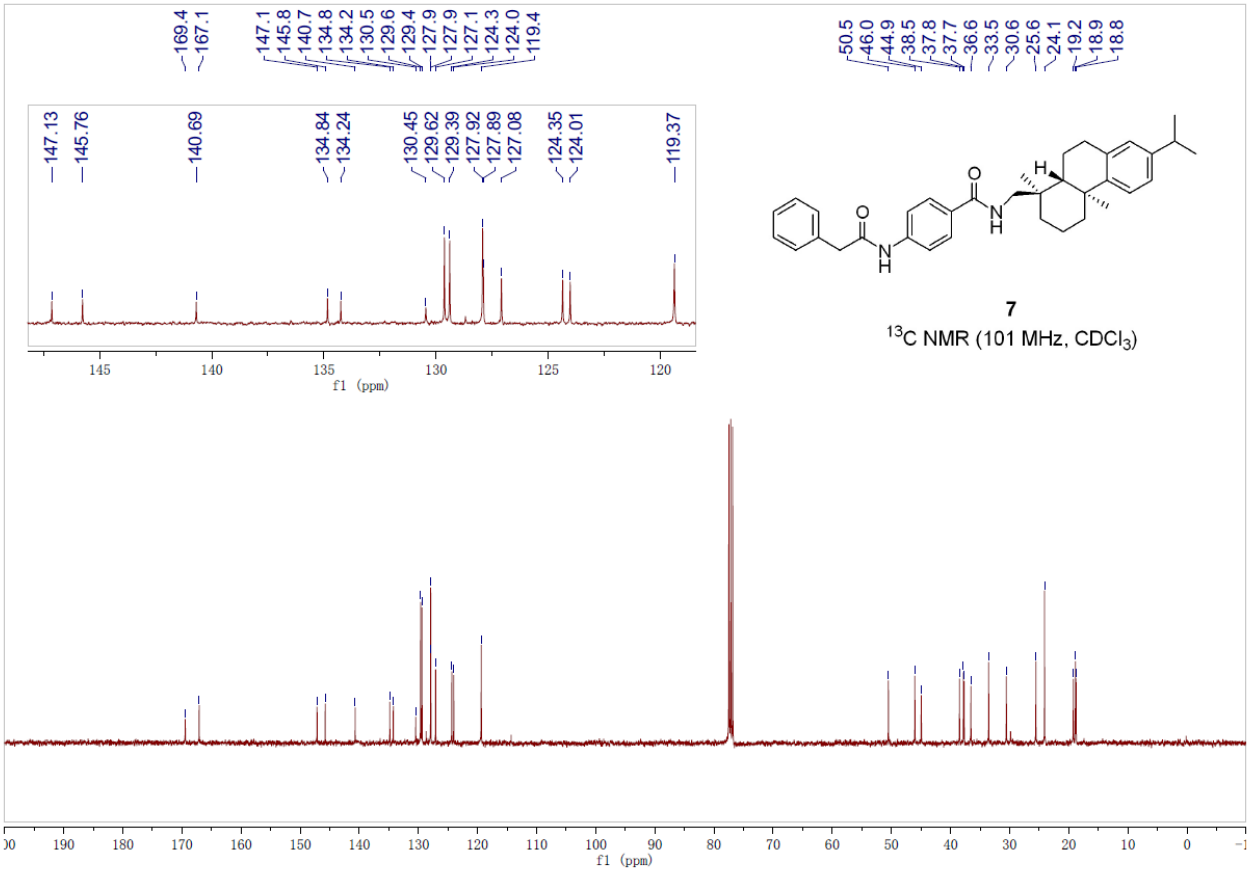

7.47 7.45 7.42 7.40 7.38 7.35 7.33 7.32 7.26 7.26 7.22 7.20
3.78 3.78 3.74 3.74 3.73 3.17 3.17 3.13 2.51 2.49 2.43 2.38 2.14 2.13 2.12 2.08 2.07 1.98 1.94 1.72 1.71 1.68 1.67 1.48 1.45 1.42 1.14
1.89 1.92 2.95 0.87 2.00
1.01 1.98 0.95 0.95 0.97 1.00 1.01 1.00 1.00 3.01 3.01
f1 (ppm)
5
^{1}H NMR (400 MHz, CDCl$_3$)


214.2 169.3 145.4 136.8 134.3 129.6 129.4 127.9 122.8 121.1 58.2 48.1 47.5 44.9 43.0 42.6 27.0 25.2 20.1 19.8
f1 (ppm)
5
^{13}C NMR (101 MHz, CDCl$_3$)


6
^{1}H NMR (400 MHz, $CDCl_3$)
f1 (ppm)


6
^{13}C NMR (101 MHz, $CDCl_3$)
f1 (ppm)


7
1H NMR (400 MHz, CDCl3)
f1 (ppm)


7
13C NMR (101 MHz, CDCl3)
f1 (ppm)