

**An electrochemical multicomponent [2+2+1] cascade
cyclization of enaminones with primary amines: access to 1,2-
disubstituted 4-acylimidazoles**

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Supporting Information

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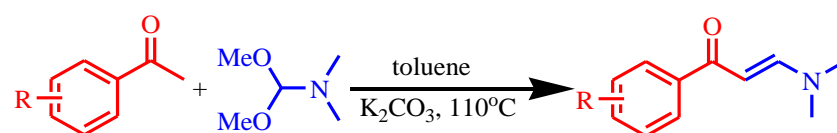
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(A) Materials and equipment

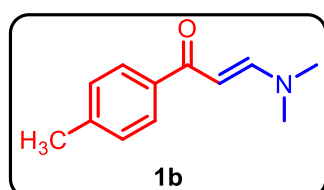
All solvents and reagents were obtained from commercial sources and were purified following the standard procedure prior to use. All glassware was oven-dried at 110 °C for hours and cooled down under a vacuum. Unless otherwise noted, materials were obtained from commercial suppliers and used without further purification. The instrument for electrolysis was a dual display potentiostat (DJS-292B) (made in China). The anode was platinum plate (10 mm × 10 mm × 0.2 mm), and the cathode was nickel plate (10 mm × 10 mm × 0.2 mm). Thin layer chromatography (TLC) employed glass 0.25 mm silica gel plates. Flash chromatography columns were packed with 200- 300 mesh silica gel in petroleum (bp. 60-90°C). ¹H, ¹³C and ¹⁹F NMR data for all compounds were recorded with Bruker Advance III (400 MHz) spectrometers with tetramethylsilane as an internal standard. All chemical shifts (δ) are reported in ppm and coupling constants (J) in Hz. All chemical shifts are reported relative to tetramethylsilane and D-solvent peaks (77.00 ppm, chloroform; 39.50 ppm, Dimethyl Sulfoxide), respectively. Highresolution mass spectral analysis (HRMS) data were measured on a Waters Acquity UPLC I-Class plus Xevo G2-XS (Q-TOF) mass spectrum by means of the ESI technique. **Crystallographic data** were obtained from a Bruker D8 Ovest diffractometer.

(B) Typical experimental procedure

1. General procedure for the synthesis of enaminones **1**:



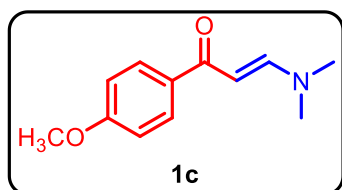
To a stirred solution of ketone (5.0 mmol, 1.0 equiv) in 5.0 mL of toluene, 1, 1-dimethoxy-N, N-dimethylmethanamine (7.0 mmol, 1.4 equiv) and K₂CO₃ (5.0 mmol, 1.0 equiv) was added and stirred at 110 °C. After completion of the reaction (monitored by TLC), The resulting brown mixture was concentrated under a vacuum, the crude product was purified by flash column chromatography using petroleum ether/EtOAc (1:1) to give the enaminones **1**.^[1]



(E)-3-(dimethylamino)-1-(p-tolyl)prop-2-en-1-one (1b)

According to the general procedure, **1b** was obtained using 1-(p-tolyl)ethan-1-one (670.9 mg, 668.2 μ L, 5 mmol) and 1,1-dimethoxy-N,N-dimethylmethanamine (834.12 mg, 929.9 μ L, 7 mmol) in 75% yield (708.8 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 1:1).

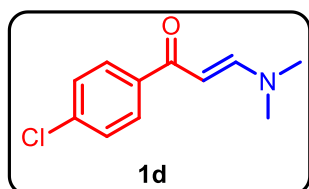
¹H NMR (400 MHz, CDCl₃) δ 7.815 - 7.778 (m, 3H), 7.208 (d, J = 7.6 Hz, 2H), 5.712 (d, J = 12.4 Hz, 1H), 3.117 (s, 3H), 2.937 (s, 3H), 2.384 (s, 3H).



(E)-3-(dimethylamino)-1-(4-methoxyphenyl)prop-2-en-1-one (1c)

According to the general procedure, **1c** was obtained using 1-(4-methoxyphenyl)ethan-1-one (751.0 mg, 694.1 μ L, 5 mmol) and 1,1-dimethoxy-N,N-dimethylmethanamine (834.12 mg, 929.9 μ L, 7 mmol) in 82% yield (840.5 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 1:1).

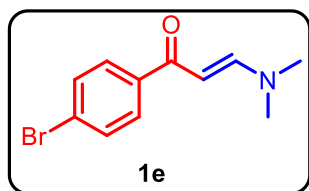
¹H NMR (400 MHz, CDCl₃) δ 7.896 - 7.854 (m, 2H), 7.750 (d, J = 12.4 Hz, 1H), 6.899 - 6.862 (m, 2H), 5.678 (d, J = 12.4 Hz, 1H), 3.811 (s, 3H), 3.053 (s, 3H), 2.913 (s, 3H).



(E)-1-(4-chlorophenyl)-3-(dimethylamino)prop-2-en-1-one (1d)

According to the general procedure, **1d** was obtained using 1-(4-chlorophenyl)ethan-1-one (773.0 mg, 664.6 μ L, 5 mmol) and 1,1-dimethoxy-N,N-dimethylmethanamine (834.12 mg, 929.9 μ L, 7 mmol) in 83% yield (867.4 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 1:1).

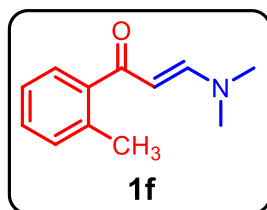
¹H NMR (400 MHz, CDCl₃) δ 7.840 - 7.777 (m, 3H), 7.374 - 7.347 (m, 2H), 5.647 (d, J = 12.0 Hz, 1H), 3.139 (s, 3H), 2.913 (s, 3H).



(E)-1-(4-bromophenyl)-3-(dimethylamino)prop-2-en-1-one (1e)

According to the general procedure, **1e** was obtained using 1-(4-bromophenyl)ethan-1-one (995.2 mg, 604.27 μL , 5 mmol) and 1,1-dimethoxy-N,N-dimethylmethanamine (834.12 mg, 929.9 μL , 7 mmol) in 86% yield (1092.2 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 1:1).

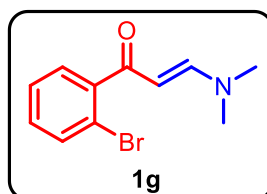
$^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.808 - 7.736 (m, 3H), 7.537 - 7.503 (m, 2H), 5.640 (d, $J = 12.4$ Hz, 1H), 3.138 (s, 3H), 2.910 (s, 3H).



(E)-3-(dimethylamino)-1-(o-tolyl)prop-2-en-1-one (1f)

According to the general procedure, **1f** was obtained using 1-(o-tolyl)ethan-1-one (670.9 mg, 668.2 μL , 5 mmol) and 1,1-dimethoxy-N,N-dimethylmethanamine (834.12 mg, 929.9 μL , 7 mmol) in 83% yield (784.4 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 1:1).

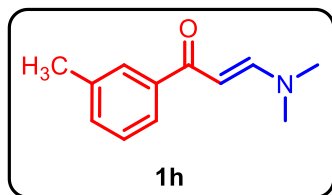
$^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.361 - 7.182 (m, 5H), 5.362 (d, $J = 12.8$ Hz, 1H), 3.036 (s, 3H), 2.867 (s, 3H), 2.423 (s, 3H).



(E)-1-(2-bromophenyl)-3-(dimethylamino)prop-2-en-1-one (1g)

According to the general procedure, **1g** was obtained using 1-(2-bromophenyl)ethan-1-one (995.2 mg, 604.27 μL , 5 mmol) and 1,1-dimethoxy-N,N-dimethylmethanamine (834.12 mg, 929.9 μL , 7 mmol) in 74% yield (939.8 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 1:1).

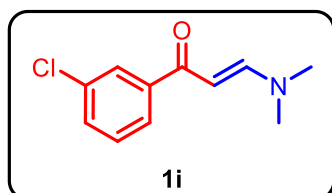
¹H NMR (400 MHz, CDCl₃) δ 7.827 - 7.802 (m, 1H), 7.364 - 7.318 (m, 4H), 5.640 (d, *J* = 12.4 Hz, 1H), 2.871 (s, 3H), 2.801 (s, 3H).



(*E*)-3-(dimethylamino)-1-(*m*-tolyl)prop-2-en-1-one (1h)

According to the general procedure, **1h** was obtained using 1-(*m*-tolyl)ethan-1-one (670.9 mg, 668.2 μL, 5 mmol) and 1,1-dimethoxy-*N,N*-dimethylmethanamine (834.12 mg, 929.9 μL, 7 mmol) in 82% yield (774.9 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 1:1).

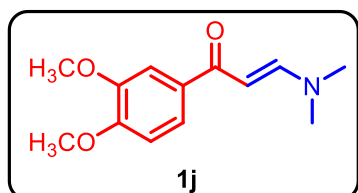
¹H NMR (400 MHz, CDCl₃) δ 7.664 - 7.557 (m, 3H), 7.176 - 7.107 (m, 2H), 5.600 - 5.551 (m, 1H), 2.920 (s, 3H), 2.725 (s, 3H), 2.275 - 2.255 (s, 3H).



(*E*)-1-(3-chlorophenyl)-3-(dimethylamino)prop-2-en-1-one (1i)

According to the general procedure, **1i** was obtained using 1-(3-chlorophenyl)ethan-1-one (773.0 mg, 664.6 μL, 5 mmol) and 1,1-dimethoxy-*N,N*-dimethylmethanamine (834.12 mg, 929.9 μL, 7 mmol) in 78% yield (815.1 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 1:1).

¹H NMR (400 MHz, CDCl₃) δ 7.813 - 7.695 (m, 3H), 7.375 - 7.343 (m, 1H), 7.309-7.266 (m, 1H), 5.596 (d, *J* = 12.4 Hz, 1H), 3.108 (s, 3H), 2.883 (s, 3H).

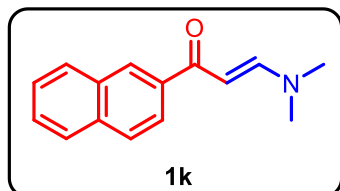


(*E*)-1-(3,4-dimethoxyphenyl)-3-(dimethylamino)prop-2-en-1-one (1j)

According to the general procedure, **1j** was obtained using 1-(3,4-dimethoxyphenyl)ethan-1-one (901.0 mg, 799.3 μL, 5 mmol) and 1,1-dimethoxy-*N,N*-dimethylmethanamine (834.12 mg, 929.9 μL, 7 mmol) in 53% yield (622.8 mg) as a yellow solid (silica gel flash chromatography: petroleum

ether/EtOAc = 1:1).

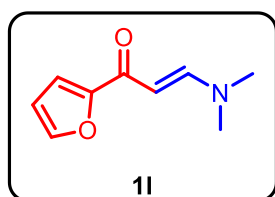
$^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.750 (d, $J = 12.4$ Hz, 1H), 7.526 (d, $J = 2.0$ Hz, 1H), 7.471 (dd, $J = 8.4, 2.0$ Hz, 1H), 6.828 (d, $J = 8.4$ Hz, 1H), 5.682 (d, $J = 12.4$ Hz, 1H), 3.898 (d, $J = 10.8$ Hz, 6H), 3.053 (s, 3H), 2.918 (s, 3H).



(E)-3-(dimethylamino)-1-(naphthalen-2-yl)prop-2-en-1-one (1k)

According to the general procedure, **1k** was obtained using 1-(naphthalen-2-yl)ethan-1-one (850.0 mg, 5 mmol) and 1,1-dimethoxy-N,N-dimethylmethanamine (834.12 mg, 929.9 μL , 7 mmol) in 77% yield (866.5 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 1:1).

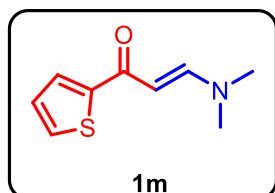
$^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.390 (s, 1H), 8.008 (dd, $J = 8.4, 1.6$ Hz, 1H), 7.932 - 7.898 (m, 1H), 7.856 - 7.809 (m, 3H), 7.526 - 7.454 (m, 2H), 5.840 (d, $J = 12.4$ Hz, 1H), 3.078 (s, 3H), 2.899 (s, 3H).



(E)-3-(dimethylamino)-1-(furan-2-yl)prop-2-en-1-one (1l)

According to the general procedure, **1l** was obtained using 1-(furan-2-yl)ethan-1-one (550.2 mg, 5 mmol) and 1,1-dimethoxy-N,N-dimethylmethanamine (834.12 mg, 929.9 μL , 7 mmol) in 81% yield (668.3 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 1:1).

$^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.676 - 7.599 (m, 1H), 7.374 - 7.341 (m, 1H), 6.945 - 6.898 (m, 1H), 6.358 - 6.308 (m, 1H), 5.563 - 5.489 (m, 1H), 2.944 (s, 3H), 2.731 (s, 3H).

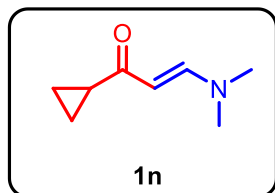


(E)-3-(dimethylamino)-1-(thiophen-2-yl)prop-2-en-1-one (1m)

According to the general procedure, **1m** was obtained using 1-(thiophen-2-yl)ethan-1-one (630.0

mg, 5 mmol) and 1,1-dimethoxy-N,N-dimethylmethanamine (834.12 mg, 929.9 μL , 7 mmol) in 79% yield (715.0 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 1:1).

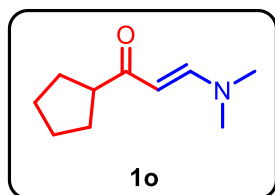
$^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.758 - 7.704 (m, 1H), 7.601 - 7.575 (m, 1H), 7.443 - 7.414 (m, 1H), 7.057 - 7.019 (m, 1H), 5.609 - 5.563 (m, 1H), 3.069 (s, 3H), 2.871 (s, 3H).



(E)-1-cyclopropyl-3-(dimethylamino)prop-2-en-1-one (1n)

According to the general procedure, **1n** was obtained using 1-cyclopropylethan-1-one (420.3 mg, 5 mmol) and 1,1-dimethoxy-N,N-dimethylmethanamine (834.12 mg, 929.9 μL , 7 mmol) in 58% yield (403.4 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 1:1).

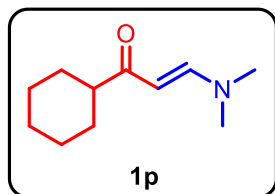
$^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.500 - 7.457 (m, 1H), 5.142 - 5.101 (m, 1H), 3.041 - 2.763 (m, 6H), 1.761 - 1.691 (m, 1H), 0.925 - 0.878 (m, 2H), 0.687 - 0.632 (m, 2H).



(E)-1-cyclopentyl-3-(dimethylamino)prop-2-en-1-one (1o)

According to the general procedure, **1o** was obtained using 1-cyclopentylethan-1-one (560.4 mg, 5 mmol) and 1,1-dimethoxy-N,N-dimethylmethanamine (834.12 mg, 929.9 μL , 7 mmol) in 69% yield (576.2 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 1:1).

$^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.460 (d, $J = 12.8$ Hz, 1H), 4.978 (d, $J = 12.4$ Hz, 1H), 2.935 - 2.708 (m, 6H), 2.228 - 2.118 (s, 1H), 1.727 - 1.451 (m, 8H).



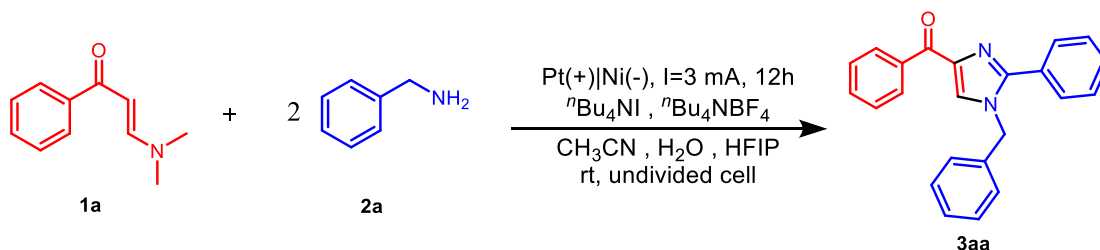
(E)-1-cyclohexyl-3-(dimethylamino)prop-2-en-1-one (1p)

According to the general procedure, **1p** was obtained using 1-cyclohexylethan-1-one (630.5 mg, 5 mmol) and 1,1-dimethoxy-N,N-dimethylmethanamine (834.12 mg, 929.9 μL , 7 mmol) in 14% yield

(127.0 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 1:1).

$^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.405 - 7.305 (m, 1H), 4.903 - 4.756 (m, 1H), 2.872 - 2.640 (m, 6H), 2.138 - 1.965 (m, 1H), 1.642 - 1.410 (m, 5H), 1.281 - 0.975 (m, 5H).

2. General procedure for the synthesis of products **3**.



A 10-mL oven-dried undivided three-necked bottle was equipped with Pt plate anode (10 mm \times 10 mm \times 0.2 mm), Ni plate cathode (10 mm \times 10 mm \times 0.2 mm), constant current = 3 mA, **1a** (0.2 mmol), **2a** (0.4 mmol), $^n\text{Bu}_4\text{NI}$ (0.6 mmol), $^n\text{Bu}_4\text{NBF}_4$ (0.2 mmol), H_2O (0.5 mL), HFIP (0.5 mL), CH_3CN (8 mL), room temperature, undivided cell. Then stirred for 12 h. The resulting brown mixture was concentrated under a vacuum, the crude product was purified by flash column chromatography using petroleum ether/EtOAc (6:1) to give the title compounds **3aa**.

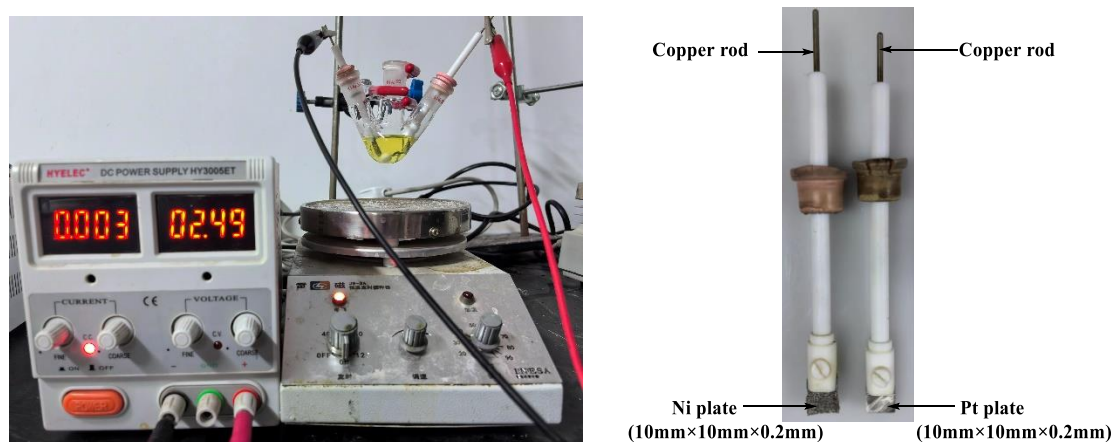


Figure S1 Electrolysis setup



Figure S2 Gram-scale amplification Electrolysis setup

(C) Cyclic voltammetry experiments

Cyclic voltammetry was performed in a three-electrode cell connected to a schlenk line under nitrogen at room temperature. The working electrode was a steady glassy carbon disk electrode, the counter electrode a platinum wire. The reference was an Ag/AgCl electrode submerged in saturated aqueous KCl solution. 8 mL of CH₃CN were poured into the electrochemical cell in all experiments. The scan rate is 0.1 V/s, ranging from -0.2 V to 3.5 V.

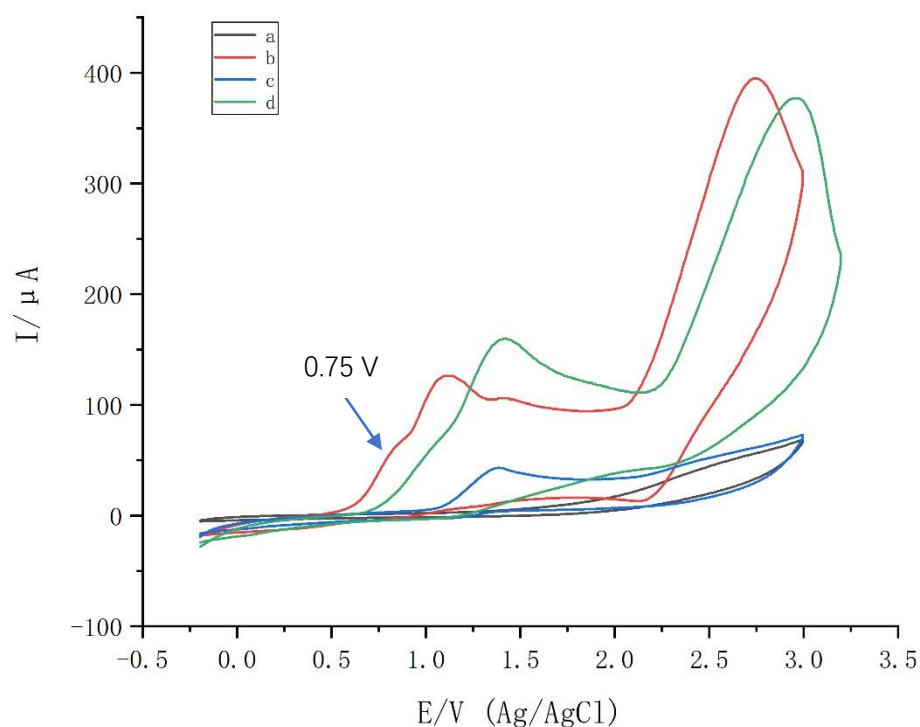
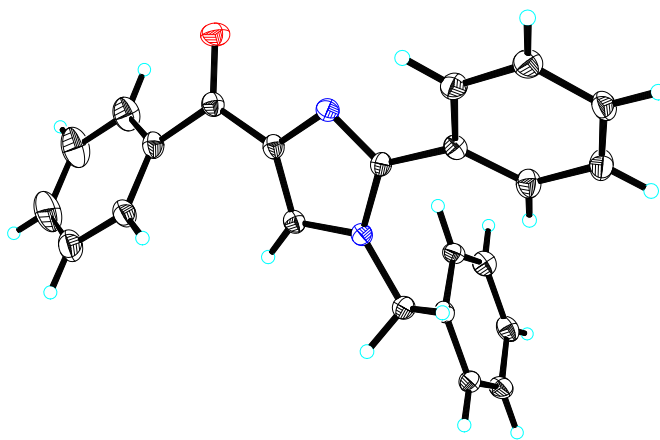


Figure S3 Cyclic voltammograms of in 8 mL of CH₃CN solution containing different compounds: (a) CH₃CN (8 mL), tetrabutylammonium tetrafluoroborate (0.02 mmol), benzylamine (0.04 mmol); (b) CH₃CN (8 mL), tetrabutylammonium tetrafluoroborate (0.02 mmol), tetrabutylammonium iodide (0.06 mmol); (c) CH₃CN (8 mL), tetrabutylammonium tetrafluoroborate (0.02 mmol), 3-(Dimethylamino)-1-phenyl-2-propen-1-one (0.02 mmol); (d) CH₃CN (8 mL), tetrabutylammonium tetrafluoroborate (0.02 mmol), tetrabutylammonium iodide (0.06 mmol), 3-(Dimethylamino)-1-phenyl-2-propen-1-one (0.02 mmol).

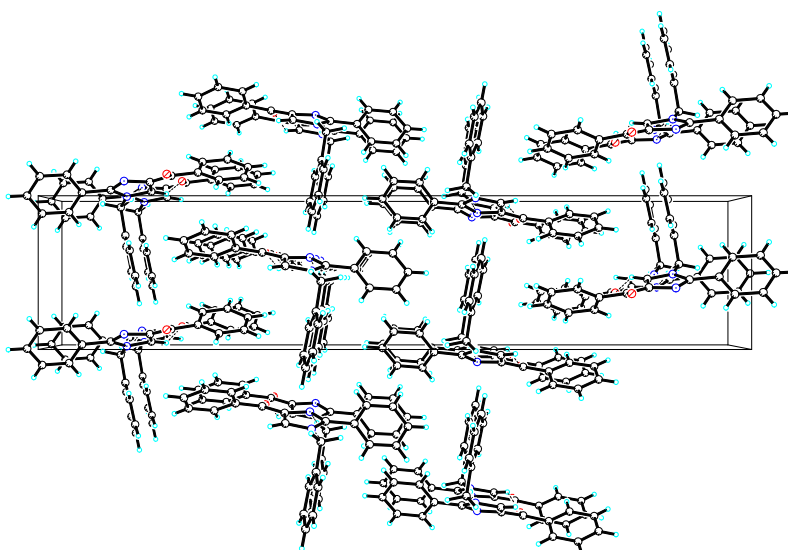
(D) X-Ray crystallographic studies

Crystal data for md_zxj4: $C_{23}H_{18}N_2O$, $M = 338.39$, $a = 6.2987(4)$ Å, $b = 7.8754(5)$ Å, $c = 36.641(2)$ Å, $\alpha = 90^\circ$, $\beta = 90^\circ$, $\gamma = 90^\circ$, $V = 1817.6(2)$ Å³, $T = 150.(2)$ K, space group $P212121$, $Z = 4$, $\mu(\text{Cu K}\alpha) = 0.601$ mm⁻¹, 24679 reflections measured, 3343 independent reflections ($R_{int} = 0.1563$). The final R_I values were 0.0706 ($I > 2\sigma(I)$). The final $wR(F^2)$ values were 0.2053 ($I > 2\sigma(I)$). The final R_I values were 0.0800 (all data). The final $wR(F^2)$ values were 0.2108 (all data). The goodness of fit on F^2 was 1.096. Flack parameter = 0.1(3).



View of a molecule of md_zxj4.

Displacement ellipsoids are drawn at the 30% probability level.



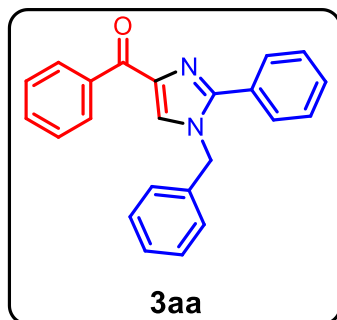
View of the pack drawing of md_zxj4.

Hydrogen-bonds are shown as dashed lines.

Table 1. Crystal data and structure refinement for md_zxj4_0m.

Identification code	global	
Empirical formula	C23 H18 N2 O	
Formula weight	338.39	
Temperature	150(2) K	
Wavelength	1.54178 Å	
Crystal system	Orthorhombic	
Space group	P2 ₁ 2 ₁ 2 ₁	
Unit cell dimensions	a = 6.2987(4) Å	α = 90 °
	b = 7.8754(5) Å	β = 90 °
	c = 36.641(2) Å	γ = 90 °
Volume	1817.6(2) Å ³	
Z	4	
Density (calculated)	1.237 Mg/m ³	
Absorption coefficient	0.601 mm ⁻¹	
F(000)	712	
Crystal size	0.460 x 0.030 x 0.030 mm ³	
Theta range for data collection	2.41 to 68.52 °	
Index ranges	-6<=h<=7, -9<=k<=9, -44<=l<=44	
Reflections collected	24679	
Independent reflections	3343 [R(int) = 0.1563]	
Completeness to theta = 68.52 °	99.7 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.98 and 0.80	
Refinement method	Full-matrix least-squares on F ²	
Data / restraints / parameters	3343 / 0 / 236	
Goodness-of-fit on F ²	1.096	
Final R indices [I>2σ(I)]	R1 = 0.0706, wR2 = 0.2053	
R indices (all data)	R1 = 0.0800, wR2 = 0.2108	
Absolute structure parameter	0.1(3)	
Extinction coefficient	0.0026(9)	
Largest diff. peak and hole	0.458 and -0.272 e.Å ⁻³	

(E) Analytical data for products



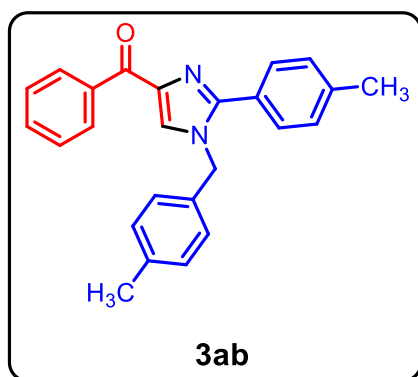
(1-benzyl-2-phenyl-1*H*-imidazol-4-yl)(phenyl)methanone (**3aa**)

According to the general procedure, **3aa** was obtained using (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (35.0 mg, 0.2 mmol) and phenylmethanamine **2a** (42.8 mg, 43.6 μ L, 0.4 mmol) in 84% yield (56.8 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, DMSO-*d*₆) δ 8.256 - 8.228 (m, 3H), 7.641 - 7.600 (m, 3H), 7.533 (t, *J* = 8.0 Hz, 2H), 7.484 - 7.460 (m, 3H), 7.336 - 7.266 (m, 3H), 7.058 (d, *J* = 6.8 Hz, 2H), 5.442 (s, 2H);

¹³C NMR (100 MHz, DMSO-*d*₆) δ 186.47, 147.82, 139.75, 137.79, 136.73, 132.29, 130.49, 129.86, 129.73, 129.40, 128.84, 128.74, 128.70, 128.24, 127.82, 126.82, 50.25.

HRMS (ESI) *m/z* calcd. for C₂₃H₁₉N₂O (M+H)⁺: 339.1492, found 339.1487.



(1-(4-methylbenzyl)-2-(*p*-tolyl)-1*H*-imidazol-4-yl)(phenyl)methanone (**3ab**)

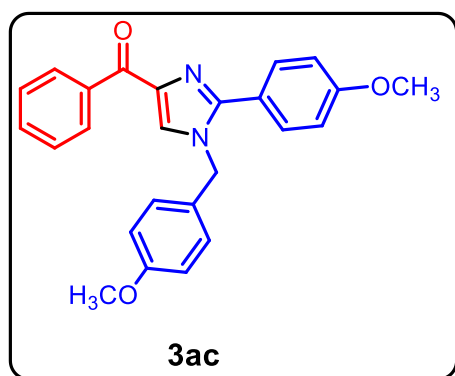
According to the general procedure, **3ab** was obtained using (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (35.0 mg, 0.2 mmol) and *p*-tolylmethanamine **2b** (48.4 mg, 50.9 μ L, 0.4 mmol) in 61% yield (44.7 mg) as yellow oily liquid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 8.216 - 8.192 (m, 2H), 7.622 (s, 1H), 7.482 - 7.434 (m, 3H), 7.402 -

7.362 (m, 2H), 7.176 (d, $J = 7.6$ Hz, 2H), 7.088 (d, $J = 7.6$ Hz, 2H), 6.933 (d, $J = 8.0$ Hz, 2H), 5.122 (s, 2H), 2.326 (s, 3H), 2.271 (s, 3H);

^{13}C NMR (100 MHz, CDCl_3) δ 187.93, 149.22, 140.93, 139.74, 138.34, 138.21, 132.89, 132.26, 130.34, 129.94, 129.48, 129.23, 128.62, 128.23, 127.08, 126.89, 50.90, 21.50, 21.22.

HRMS (ESI) m/z calcd. for $\text{C}_{25}\text{H}_{23}\text{N}_2\text{O}$ ($\text{M}+\text{H}$) $^+$: 367.1805, found 367.1799.



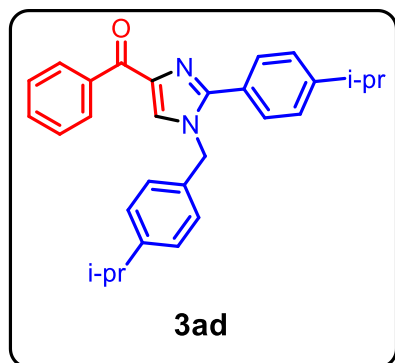
(1-(4-methoxybenzyl)-2-(4-methoxyphenyl)-1H-imidazol-4-yl)(phenyl)methanone (3ac)

According to the general procedure, **3ac** was obtained using (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (35.0 mg, 0.2 mmol) and (4-methoxyphenyl)methanamine **2c** (54.8 mg, 52.2 μL , 0.4 mmol) in 62% yield (49.4 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

^1H NMR (400 MHz, CDCl_3) δ 8.272 - 8.284 (m, 2H), 7.671 (s, 1H), 7.572 - 7.502 (m, 3H), 7.447 (t, $J = 7.6$ Hz, 2H), 7.032 (d, $J = 8.8$ Hz, 2H), 6.958 (d, $J = 8.8$ Hz, 2H), 6.864 (d, $J = 8.8$ Hz, 2H), 5.151 (s, 2H), 3.835 (s, 3H), 3.786 (s, 3H);

^{13}C NMR (100 MHz, CDCl_3) δ 187.90, 160.64, 159.66, 148.94, 140.73, 138.20, 132.23, 130.72, 130.26, 128.51, 128.47, 128.21, 127.82, 122.16, 114.61, 114.17, 55.45, 55.42, 50.61.

HRMS (ESI) m/z calcd. for $\text{C}_{25}\text{H}_{23}\text{N}_2\text{O}_3$ ($\text{M}+\text{H}$) $^+$: 399.1703, found 399.1709.



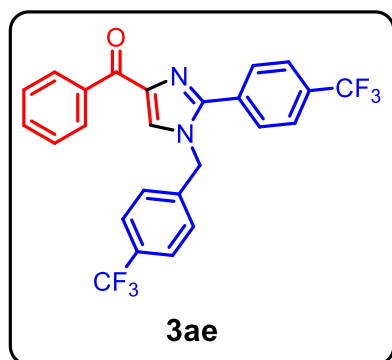
(1-(4-isopropylbenzyl)-2-(4-isopropylphenyl)-1H-imidazol-4-yl)(phenyl)methanone (3ad)

According to the general procedure, **3ad** was obtained using (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (35.0 mg, 0.2 mmol) and (4-isopropylphenyl)methanamine **2d** (59.6 mg, 0.4 mmol) in 74% yield (62.5 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 8.304 (d, *J* = 7.6 Hz, 2H), 7.717 (s, 1H), 7.575 - 7.517 (m, 3H), 7.458 (t, *J* = 7.6 Hz, 2H), 7.308 (d, *J* = 7.6 Hz, 2H), 7.219 (d, *J* = 8.0 Hz, 2H), 7.054 (d, *J* = 8.0 Hz, 2H), 5.221 (s, 2H), 2.973 - 2.890 (m, 2H), 1.281 - 1.236 (m, 12H);

¹³C NMR (100 MHz, CDCl₃) δ 187.98, 150.65, 149.35, 149.25, 141.07, 138.20, 133.29, 132.30, 130.44, 129.35, 128.62, 128.24, 127.37, 127.20, 126.94, 50.92, 34.17, 33.95, 29.84, 24.04, 23.98.

HRMS (ESI) *m/z* calcd. for C₂₉H₃₁N₂O (M+H)⁺: 423.2431, found 423.2437.



Phenyl(1-(4-(trifluoromethyl)benzyl)-2-(4-(trifluoromethyl)phenyl)-1*H*-imidazol-4-yl)methanone (3ae)

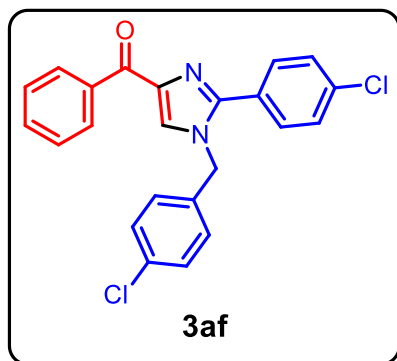
According to the general procedure, **3ae** was obtained using (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (35.0 mg, 0.2 mmol) and (4-(trifluoromethyl)phenyl)methanamine **2e** (70.0 mg, 0.4 mmol) in 72% yield (68.3 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 8.312 - 8.284 (m, 2H), 7.788 (s, 1H), 7.702 (s, 4H), 7.628 (d, *J* = 8.0 Hz, 2H), 7.569 - 7.541 (m, 1H), 7.494 - 7.454 (m, 2H), 7.207 (d, *J* = 8.0 Hz, 2H), 5.347 (s, 2H);

¹³C NMR (100 MHz, CDCl₃) δ 187.56, 147.43, 141.79, 139.45, 137.70, 132.93, 132.70, 131.42 (dd, *J* = 33.3, 33.3 Hz), 130.34, 129.48, 129.06, 128.37, 127.38 (d, *J* = 26.3 Hz), 127.08, 126.46 (q, *J* = 7.1, 4.0 Hz), 125.93 (q, *J* = 8.1, 4.0 Hz), 125.18 (d, *J* = 4.0 Hz), 122.47 (d, *J* = 4.0 Hz), 50.72;

¹⁹F NMR (376 MHz, CDCl₃) δ -62.76, -62.89.

HRMS (ESI) *m/z* calcd. for C₂₅H₁₇F₆N₂O (M+H)⁺: 475.1240, found 475.1233.



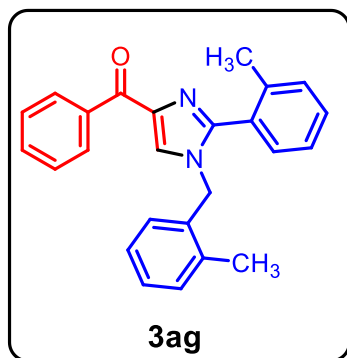
(1-(4-chlorobenzyl)-2-(4-chlorophenyl)-1*H*-imidazol-4-yl)(phenyl)methanone (3af)

According to the general procedure, **3af** was obtained using (*E*)-3-(dimethylamino)-1-phenyl prop-2-en-1-one **1a** (35.0 mg, 0.2 mmol) and (4-chlorophenyl)methanamine **2f** (56.4 mg, 0.4 mmol) in 66% yield (53.7 mg) as yellow oily liquid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 8.290 - 8.268 (m, 2H), 7.732 (s, 1H), 7.572 - 7.511 (m, 3H), 7.470 (t, *J* = 7.6 Hz, 2H), 7.416 (d, *J* = 8.4 Hz, 2H), 7.334 (d, *J* = 8.4 Hz, 2H), 7.018 (d, *J* = 8.4 Hz, 2H), 5.212 (s, 2H);

¹³C NMR (100 MHz, CDCl₃) δ 187.69, 147.83, 141.41, 137.88, 136.09, 134.68, 134.08, 132.55, 130.50, 130.34, 129.63, 129.20, 128.74, 128.34, 128.25, 128.03, 50.56.

HRMS (ESI) *m/z* calcd. for C₂₃H₁₇Cl₂N₂O (M+H)⁺: 407.0712, found 407.0706.



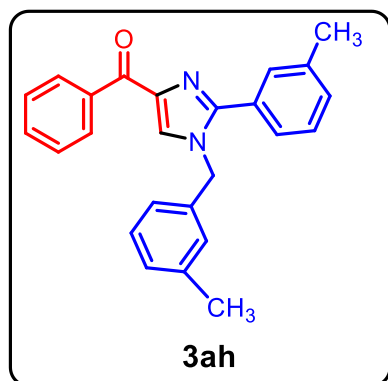
(1-(2-methylbenzyl)-2-(o-tolyl)-1*H*-imidazol-4-yl)(phenyl)methanone (3ag)

According to the general procedure, **3ag** was obtained using (*E*)-3-(dimethylamino)-1-phenyl prop-2-en-1-one **1a** (35.0 mg, 0.2 mmol) and o-tolylmethanamine **2g** (48.4 mg, 0.4 mmol) in 57% yield (41.7 mg) as yellow oily liquid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 8.214 (d, *J* = 7.6 Hz, 2H), 7.582 (s, 1H), 7.431 (t, *J* = 7.6 Hz, 1H),

7.357 (t, $J = 7.6$ Hz, 2H), 7.285 (t, $J = 7.6$ Hz, 1H), 7.224 (d, $J = 7.6$ Hz, 2H), 7.174 - 7.126 (m, 2H), 7.098 - 7.049 (m, 2H), 6.872 (d, $J = 7.6$ Hz, 1H), 4.867 (s, 2H), 2.186 (s, 3H), 1.987 (s, 3H);
 $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 188.04, 148.27, 140.93, 138.77, 138.05, 136.08, 133.40, 132.25, 130.93, 130.75, 130.43, 130.39, 130.00, 129.42, 128.77, 128.55, 128.19, 127.17, 126.73, 125.88, 48.98, 19.98, 18.98.

HRMS (ESI) m/z calcd. for $\text{C}_{25}\text{H}_{23}\text{N}_2\text{O}$ ($\text{M}+\text{H}$) $^+$: 367.1805, found 367.1801.



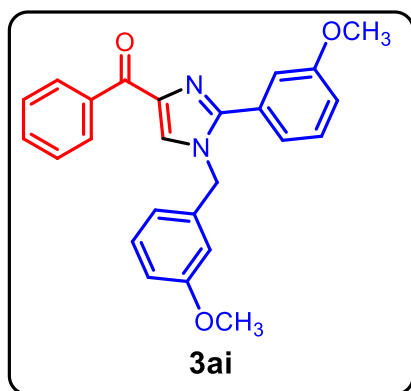
(1-(3-methylbenzyl)-2-(m-tolyl)-1H-imidazol-4-yl)(phenyl)methanone (3ah)

According to the general procedure, **3ah** was obtained using (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (35.0 mg, 0.2 mmol) and *m*-tolylmethanamine **2h** (48.4 mg, 49.6 μL , 0.4 mmol) in 64% yield (46.8 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

$^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.217 (d, $J = 7.2$ Hz, 2H), 7.643 (s, 1H), 7.452 (t, $J = 7.2$ Hz, 1H), 7.378 (t, $J = 7.2$ Hz, 3H), 7.292 (d, $J = 7.6$ Hz, 1H), 7.234 (t, $J = 7.2$ Hz, 1H), 7.186 - 7.139 (m, 2H), 7.051 (d, $J = 8.0$ Hz, 1H), 6.837 (s, 2H), 5.114 (s, 2H), 2.297 (s, 3H), 2.241 (s, 3H);

$^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 187.91, 149.25, 140.99, 139.11, 138.64, 138.17, 135.84, 132.29, 130.44, 130.37, 130.26, 129.64, 129.24, 129.15, 128.70, 128.58, 128.25, 127.83, 126.19, 124.24, 51.16, 21.49, 21.47.

HRMS (ESI) m/z calcd. for $\text{C}_{25}\text{H}_{22}\text{N}_2\text{ONa}$ ($\text{M}+\text{Na}$) $^+$: 389.1624, found 389.1616.



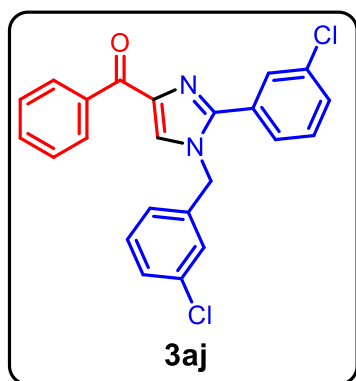
(1-(3-methoxybenzyl)-2-(3-methoxyphenyl)-1*H*-imidazol-4-yl)(phenyl)methanone (3ai)

According to the general procedure, **3ai** was obtained using (*E*)-3-(dimethylamino)-1-phenyl prop-2-en-1-one **1a** (35.0 mg, 0.2 mmol) and (3-methoxyphenyl)methanamine **2i** (54.8 mg, 51.1 μ L, 0.4 mmol) in 62% yield (49.4 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 8.269 - 8.245 (m, 2H), 7.711 (s, 1H), 7.509 (t, *J* = 7.2 Hz, 1H), 7.431 (t, *J* = 8.0 Hz, 2H), 7.311 (t, *J* = 8.0 Hz, 1H), 7.240 - 7.220 (m, 1H), 7.153 - 7.124 (m, 2H), 6.971 - 6.944 (m, 1H), 6.833 - 6.806 (m, 1H), 6.664 (d, *J* = 7.6 Hz, 1H), 6.595 (s, 1H), 5.195 (s, 2H), 3.734 (s, 3H), 3.724 (s, 3H);

¹³C NMR (100 MHz, CDCl₃) δ 187.85, 160.33, 159.85, 148.92, 141.02, 138.11, 137.46, 132.35, 130.89, 130.44, 130.34, 129.86, 128.87, 128.27, 121.50, 119.15, 115.85, 114.66, 113.67, 112.86, 55.45, 55.39, 51.06.

HRMS (ESI) *m/z* calcd. for C₂₅H₂₃N₂O₃ (M+H)⁺: 399.1703, found 399.1712.



(1-(3-chlorobenzyl)-2-(3-chlorophenyl)-1*H*-imidazol-4-yl)(phenyl)methanone (3aj)

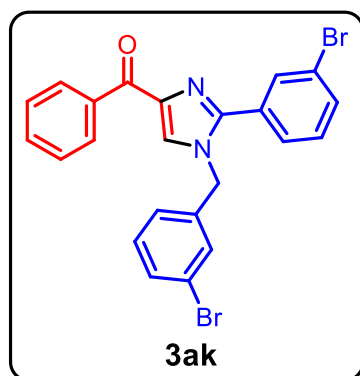
According to the general procedure, **3aj** was obtained using (*E*)-3-(dimethylamino)-1-phenyl prop-2-en-1-one **1a** (35.0 mg, 0.2 mmol) and (3-chlorophenyl)methanamine **2j** (56.4 mg, 4

8.4 μL , 0.4 mmol) in 48% yield (39.1 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

$^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.302 (d, $J = 7.6$ Hz, 2H), 7.76 (s, 1H), 7.620 (s, 1H), 7.561 (t, $J = 7.2$ Hz, 1H), 7.492 (d, $J = 7.6$ Hz, 2H), 7.463 - 7.432 (m, 2H), 7.384 (d, $J = 6.8$ Hz, 1H), 7.310 (d, $J = 6.8$ Hz, 2H), 7.097 (s, 1H), 6.972 (d, $J = 6.8$ Hz, 1H), 5.230 (s, 2H);

$^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 187.68, 147.46, 141.50, 137.81, 137.47, 135.45, 135.00, 132.60, 131.22, 130.74, 130.40, 130.17, 130.00, 129.52, 128.99, 128.78, 128.36, 127.23, 127.19, 125.11, 50.69.

HRMS (ESI) m/z calcd. for $\text{C}_{23}\text{H}_{17}\text{Cl}_2\text{N}_2\text{O}$ ($\text{M}+\text{H}$) $^+$: 407.0712, found 407.0708.



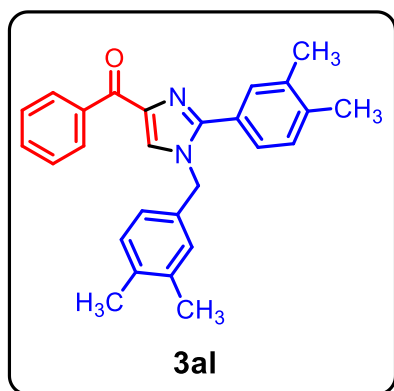
(1-(3-bromobenzyl)-2-(3-bromophenyl)-1H-imidazol-4-yl)(phenyl)methanone (3ak)

According to the general procedure, **3ak** was obtained using (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (35.0 mg, 0.2 mmol) and (3-bromophenyl)methanamine **2k** (74.0 mg, 50.0 μL , 0.4 mmol) in 62% yield (61.5 mg) as yellow oily liquid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

$^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.305 - 8.282 (m, 2H), 7.760 (s, 2H), 7.605 - 7.580 (m, 1H), 7.552 (d, $J = 6.8$ Hz, 1H), 7.500 - 7.464 (m, 4H), 7.311 (t, $J = 7.6$ Hz, 1H), 7.254 - 7.220 (m, 2H), 7.014 (d, $J = 8.8$ Hz, 1H), 5.214 (s, 2H);

$^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 187.68, 147.32, 141.51, 137.81, 137.69, 132.90, 132.59, 132.38, 131.93, 131.46, 130.99, 130.39, 130.36, 130.17, 128.79, 128.36, 127.63, 125.60, 123.50, 123.00, 50.62.

HRMS (ESI) m/z calcd. for $\text{C}_{23}\text{H}_{17}\text{Br}_2\text{N}_2\text{O}$ ($\text{M}+\text{H}$) $^+$: 494.9702, found 494.9700.



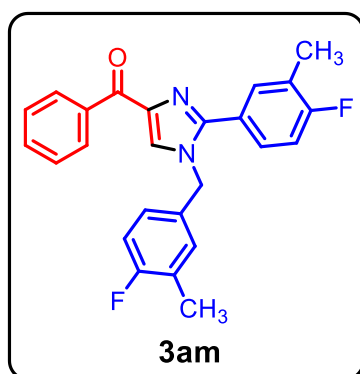
(1-(3,4-dimethylbenzyl)-2-(3,4-dimethylphenyl)-1*H*-imidazol-4-yl)(phenyl)methanone (3al)

According to the general procedure, **3al** was obtained using (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (35.0 mg, 0.2 mmol) and (3,4-dimethylphenyl)methanamine **2l** (54.0 mg, 56.9 μ L, 0.4 mmol) in 72% yield (56.7 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 8.285 (d, *J* = 7.2 Hz, 2H), 7.691 (s, 1H), 7.529 (t, *J* = 6.0 Hz, 1H), 7.456 (t, *J* = 6.8 Hz, 3H), 7.326 (d, *J* = 7.6 Hz, 1H), 7.193 (d, *J* = 8.0 Hz, 1H), 7.112 (d, *J* = 7.6 Hz, 1H), 6.872 (t, *J* = 8.4 Hz, 2H), 5.161 (s, 2H), 2.302 (d, *J* = 6.4 Hz, 6H), 2.242 (d, *J* = 8.0 Hz, 6H);

¹³C NMR (100 MHz, CDCl₃) δ 187.96, 149.35, 140.79, 138.37, 138.25, 137.58, 137.17, 136.92, 133.31, 132.20, 130.69, 130.39, 130.33, 129.86, 128.62, 128.48, 128.20, 127.25, 126.50, 124.69, 50.93, 19.87, 19.81, 19.77, 19.53.

HRMS (ESI) *m/z* calcd. for C₂₇H₂₇N₂O (M+H)⁺: 395.2118, found 395.2126.



(1-(4-fluoro-3-methylbenzyl)-2-(4-fluoro-3-methylphenyl)-1*H*-imidazol-4-yl)(phenyl)methanone (3am)

According to the general procedure, **3am** was obtained using (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (35.0 mg, 0.2 mmol) and (4-fluoro-3-methylphenyl)methanamine **2m**

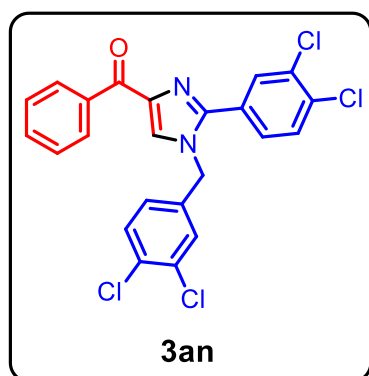
(55.6 mg, 52.5 μ L, 0.4 mmol) in 81% yield (65.1 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

$^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.273 - 8.249 (m, 2H), 7.700 (s, 1H), 7.562 - 7.518 (m, 1H), 7.484 - 7.439 (m, 3H), 7.355 - 7.316 (m, 1H), 7.056 (t, J = 9.2 Hz, 1H), 6.975 (t, J = 8.4 Hz, 1H), 6.917 - 6.853 (m, 2H), 5.142 (s, 2H), 2.292 (d, J = 2.0 Hz, 3H), 2.236 (d, J = 2.0 Hz, 3H);

$^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 187.84, 163.46, 162.48, 160.99, 160.03, 148.28, 140.96, 138.02, 132.93 (d, J = 6.1 Hz), 132.42, 131.16 (d, J = 4.0 Hz), 130.29 (t, J = 3.0 Hz), 128.52, 128.30, 128.28 (d, J = 9.1 Hz), 126.15 (d, J = 8.1 Hz), 125.95 (d, J = 12.1 Hz), 125.71, 125.47 (d, J = 4.0 Hz), 115.86 (d, J = 23.2 Hz), 115.44 (d, J = 23.2 Hz), 50.56, 14.64 (dd, J = 5.0, 4.0 Hz);

$^{19}\text{F NMR}$ (376 MHz, CDCl_3) δ -115.00, -117.36.

HRMS (ESI) m/z calcd. for $\text{C}_{25}\text{H}_{21}\text{F}_2\text{N}_2\text{O}$ ($\text{M}+\text{H}$) $^+$: 403.1616, found 403.1620.



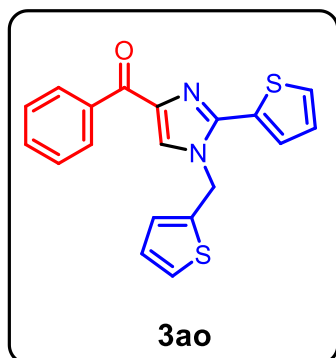
(1-(3,4-dichlorobenzyl)-2-(3,4-dichlorophenyl)-1H-imidazol-4-yl)(phenyl)methanone (3an)

According to the general procedure, **3an** was obtained using (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (35.0 mg, 0.2 mmol) and (3,4-dichlorophenyl)methanamine **2n** (70.8 mg, 53.6 μ L, 0.4 mmol) in 53% yield (50.5 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

$^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.286 (d, J = 7.6 Hz, 2H), 7.757 (s, 1H), 7.711 (s, 1H), 7.571 (t, J = 7.2 Hz, 1H), 7.528 - 7.440 (m, 4H), 7.384 - 7.359 (m, 1H), 7.195 (s, 1H), 6.929 - 6.903 (m, 1H), 5.208 (s, 2H);

$^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 187.53, 146.47, 141.74, 137.66, 135.41, 134.51, 133.90, 133.48, 133.29, 132.74, 131.54, 131.16, 130.98, 130.38, 129.26, 128.95, 128.82, 128.42, 128.05, 126.12, 50.21.

HRMS (ESI) m/z calcd. for $\text{C}_{23}\text{H}_{14}\text{Cl}_4\text{N}_2\text{ONa}$ ($\text{M}+\text{Na}$) $^+$: 496.9752, found 496.9760.



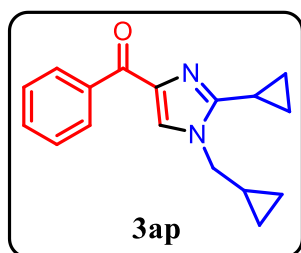
Phenyl(2-(thiophen-2-yl)-1-(thiophen-2-ylmethyl)-1*H*-imidazol-4-yl)methanone (3ao)

According to the general procedure, **3ao** was obtained using (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (35.0 mg, 0.2 mmol) and thiophen-2-ylmethanamine **2o** (45.2 mg, 41.0 μ L, 0.4 mmol) in 59% yield (41.3 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 8.296 (d, *J* = 7.2 Hz, 2H), 7.768 (s, 1H), 7.567 - 7.523 (m, 1H), 7.484 - 7.447 (m, 3H), 7.388 - 7.376 (m, 1H), 7.317 - 7.301 (m, 1H), 7.129 - 7.107 (m, 1H), 6.997 - 6.976 (m, 1H), 6.957 (s, 1H), 5.490 (s, 2H);

¹³C NMR (100 MHz, CDCl₃) δ 187.49, 142.61, 141.18, 137.87, 137.36, 132.46, 131.08, 130.41, 128.42, 128.26, 128.16, 128.06, 127.76, 127.51, 127.24, 126.73, 46.32.

HRMS (ESI) *m/z* calcd. for C₁₉H₁₅N₂OS₂(M+H)⁺: 351.0620, found 351.0624.



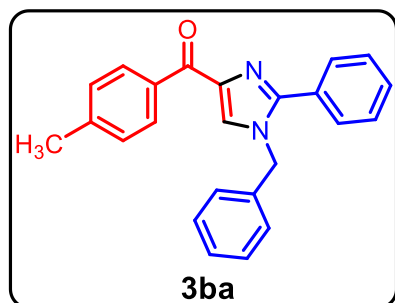
(2-cyclopropyl-1-(cyclopropylmethyl)-1*H*-imidazol-4-yl)(phenyl)methanone (3ap)

According to the general procedure, **3ap** was obtained using (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (35.0 mg, 0.2 mmol) and cyclopropylmethanamine **2p** (28.4 mg, 34.2 μ L, 0.4 mmol) in 28% yield (14.9 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 4:1).

¹H NMR (400 MHz, CDCl₃) δ 8.162 - 8.138 (m, 2H), 7.673 (s, 1H), 7.550 - 7.513 (m, 1H), 7.469 - 7.429 (m, 2H), 3.900 (d, *J* = 7.2 Hz, 2H), 1.853 - 1.787 (m, 1H), 1.257 - 1.233 (m, 1H), 1.175 - 1.136 (m, 2H), 1.025 - 0.978 (m, 2H), 0.728 - 0.680 (m, 2H), 0.414 - 0.375 (m, 2H);

$^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 187.89, 150.71, 139.20, 138.62, 132.04, 130.11, 128.19, 127.64, 50.85, 11.35, 7.42, 4.34, 1.16.

HRMS (ESI) m/z calcd. for $\text{C}_{18}\text{H}_{18}\text{N}_2\text{O}(\text{M}+\text{H})^+$: 267.1492, found 267.1493.



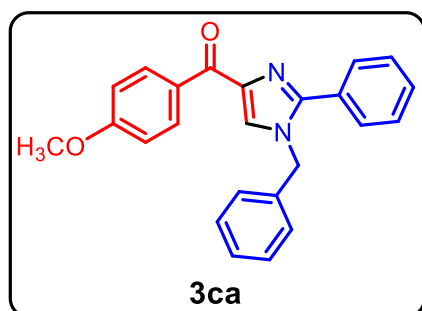
(1-benzyl-2-phenyl-1H-imidazol-4-yl)(p-tolyl)methanone (3ba)

According to the general procedure, **3ba** was obtained using (*E*)-3-(dimethylamino)-1-(p-tolyl)prop-2-en-1-one **1b** (37.8 mg, 0.2 mmol) and phenylmethanamine **2a** (42.8 mg, 43.6 μL , 0.4 mmol) in 66% yield (46.5 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

$^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.151 (d, J = 8.4 Hz, 2H), 7.649 (s, 1H), 7.552 - 7.528 (m, 2H), 7.371 - 7.354 (m, 3H), 7.302 - 7.244 (m, 3H), 7.190 (d, J = 6.8 Hz, 2H), 7.041 - 7.017 (m, 2H), 5.173 (s, 2H), 2.328 (s, 3H);

$^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 187.58, 148.93, 143.01, 141.32, 135.90, 135.48, 130.52, 129.80, 129.65, 129.32, 129.30, 128.98, 128.80, 128.52, 128.49, 127.03, 51.10, 21.78.

HRMS (ESI) m/z calcd. for $\text{C}_{24}\text{H}_{21}\text{N}_2\text{O}(\text{M}+\text{H})^+$: 353.1648, found 353.1644.



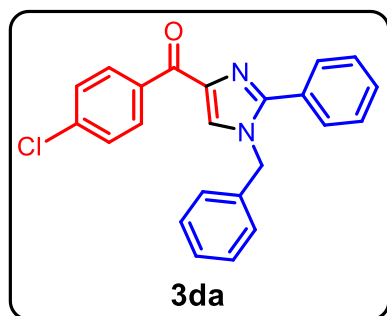
(1-benzyl-2-phenyl-1H-imidazol-4-yl)(4-methoxyphenyl)methanone (3ca)

According to the general procedure, **3ca** was obtained using (*E*)-3-(dimethylamino)-1-(4-methoxyphenyl)prop-2-en-1-one **1c** (41.0 mg, 0.2 mmol) and phenylmethanamine **2a** (42.8 mg, 43.6 μL , 0.4 mmol) in 63% yield (46.4 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 8.457 - 8.427 (m, 2H), 7.757 (s, 1H), 7.632 - 7.608 (m, 2H), 7.462 - 7.428 (m, 3H), 7.381 - 7.321 (m, 3H), 7.125 - 7.102 (m, 2H), 6.980 - 6.943 (m, 2H), 5.251 (s, 2H), 3.863 (s, 3H);

¹³C NMR (100 MHz, CDCl₃) δ 186.27, 163.14, 148.63, 141.64, 135.93, 132.90, 130.82, 129.89, 129.61, 129.30, 129.28, 128.80, 128.46, 128.26, 127.05, 113.52, 55.51, 51.08.

HRMS (ESI) *m/z* calcd. for C₂₄H₂₁N₂O₂ (M+H)⁺: 369.1598, found 369.1596.



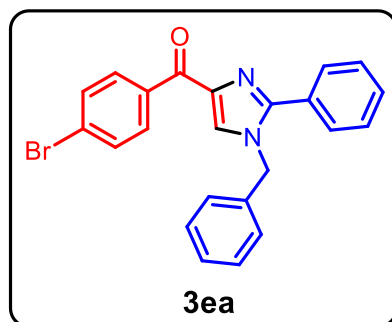
(1-benzyl-2-phenyl-1H-imidazol-4-yl)(4-chlorophenyl)methanone (3da)

According to the general procedure, **3da** was obtained using (*E*)-1-(4-chlorophenyl)-3-(dimethylamino)prop-2-en-1-one **1d** (41.8 mg, 0.2 mmol) and phenylmethanamine **2a** (42.8 mg, 43.6 μL, 0.4 mmol) in 66% yield (49.2 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 8.386 - 8.345 (m, 2H), 7.788 (s, 1H), 7.622 - 7.598 (m, 2H), 7.475 - 7.445 (m, 4H), 7.437 - 7.421 (m, 1H), 7.381 - 7.330 (m, 3H), 7.124 - 7.100 (m, 2H), 5.254 (s, 2H);

¹³C NMR (100 MHz, CDCl₃) δ 186.38, 148.93, 141.13, 138.78, 136.22, 135.72, 132.06, 129.78, 129.68, 129.34, 129.29, 128.87, 128.71, 128.58, 128.52, 127.10, 51.19.

HRMS (ESI) *m/z* calcd. for C₂₃H₁₈ClN₂O (M+H)⁺: 373.1102, found 373.1111.



(1-benzyl-2-phenyl-1H-imidazol-4-yl)(4-bromophenyl)methanone (3ea)

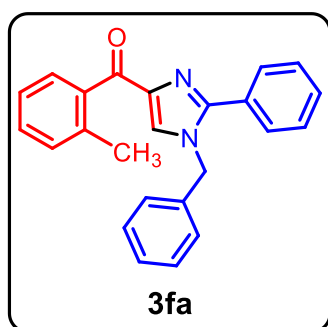
According to the general procedure, **3ea** was obtained using (*E*)-1-(4-bromophenyl)-3-(dime

thylamino)prop-2-en-1-one **1e** (50.6 mg, 0.2 mmol) and phenylmethanamine **2a** (42.8 mg, 43.6 μ L, 0.4 mmol) in 73% yield (60.9 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 8.274 (d, J = 8.4 Hz, 2H), 7.784 (s, 1H), 7.604 (d, J = 8.0 Hz, 4H), 7.463 - 7.446 (m, 3H), 7.388 - 7.313 (m, 3H), 7.112 (d, J = 8.4 Hz, 2H), 5.252 (s, 2H);

¹³C NMR (100 MHz, CDCl₃) δ 186.57, 148.97, 141.09, 136.66, 135.72, 132.19, 131.52, 129.80, 129.68, 129.35, 129.30, 128.89, 128.74, 128.60, 127.54, 127.12, 51.21.

HRMS (ESI) m/z calcd. for C₂₃H₁₇BrN₂ONa (M+Na)⁺: 439.0416, found 439.0419.



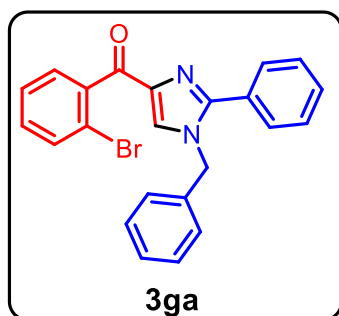
(1-benzyl-2-phenyl-1H-imidazol-4-yl)(o-tolyl)methanone (**3fa**)

According to the general procedure, **3fa** was obtained using (*E*)-3-(dimethylamino)-1-(*o*-tolyl)prop-2-en-1-one **1f** (37.8 mg, 0.2 mmol) and phenylmethanamine **2a** (42.8 mg, 43.6 μ L, 0.4 mmol) in 77% yield (54.2 mg) as yellow oily liquid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 7.675 - 7.638 (m, 3H), 7.544 (s, 1H), 7.491 - 7.464 (m, 3H), 7.391 (t, J = 7.6 Hz, 4H), 7.320 - 7.278 (m, 2H), 7.140 - 7.117 (m, 2H), 5.281 (s, 2H), 2.500 (s, 3H);

¹³C NMR (100 MHz, CDCl₃) δ 190.98, 149.85, 141.34, 138.84, 137.27, 135.80, 131.13, 130.31, 129.76, 129.44, 129.31, 129.28, 129.19, 129.04, 128.73, 128.48, 126.87, 125.13, 51.08, 20.16.

HRMS (ESI) m/z calcd. for C₂₄H₂₁N₂O (M+H)⁺: 353.1648, found 353.1653.



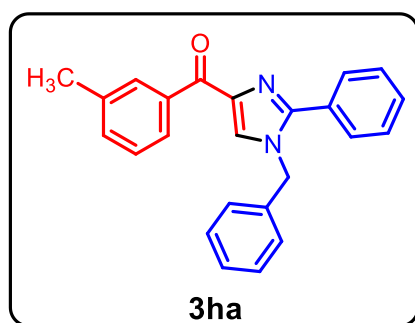
(1-benzyl-2-phenyl-1*H*-imidazol-4-yl)(2-bromophenyl)methanone (3ga)

According to the general procedure, **3ga** was obtained using (*E*)-1-(2-bromophenyl)-3-(dimethylamino)prop-2-en-1-one **1g** (50.6 mg, 0.2 mmol) and phenylmethanamine **2a** (42.8 mg, 43.6 μ L, 0.4 mmol) in 66% yield (57.5 mg) as a yellow solid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 8.303 (d, *J* = 7.2 Hz, 2H), 7.750 (s, 1H), 7.636 - 7.612 (m, 2H), 7.487 (s, 1H), 7.468 - 7.441 (m, 4H), 7.348 (t, *J* = 7.6 Hz, 3H), 7.126 - 7.103 (m, 2H), 5.265 (s, 2H);

¹³C NMR (100 MHz, CDCl₃) δ 187.89, 149.07, 141.20, 138.12, 135.87, 132.37, 130.41, 129.78, 129.72, 129.36, 129.34, 128.84, 128.73, 128.54, 128.28, 127.07, 51.17.

HRMS (ESI) *m/z* calcd. for C₂₃H₁₈BrN₂O (M+H)⁺: 417.0597, found 417.0588.



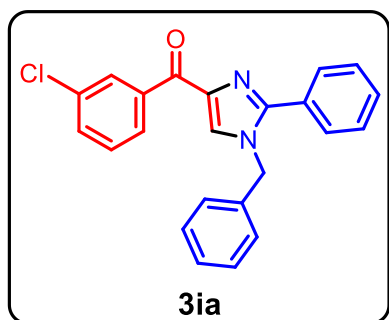
(1-benzyl-2-phenyl-1*H*-imidazol-4-yl)(m-tolyl)methanone (3ha)

According to the general procedure, **3ha** was obtained using (*E*)-3-(dimethylamino)-1-(m-tolyl)prop-2-en-1-one **1h** (37.8 mg, 0.2 mmol) and phenylmethanamine **2a** (42.8 mg, 43.6 μ L, 0.4 mmol) in 75% yield (52.8 mg) as yellow oily liquid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 8.105 - 8.078 (m, 1H), 8.016 (s, 1H), 7.708 (s, 1H), 7.634 - 7.609 (m, 2H), 7.455 - 7.437 (m, 3H), 7.364 - 7.346 (m, 5H), 7.114 - 7.100 (m, 2H), 5.261 (s, 2H), 2.416 (s, 3H);

¹³C NMR (100 MHz, CDCl₃) δ 188.22, 149.15, 141.12, 138.22, 138.03, 135.90, 133.17, 130.62, 129.76, 129.72, 129.37, 129.34, 128.83, 128.71, 128.54, 128.15, 127.65, 127.07, 51.16, 21.58.

HRMS (ESI) *m/z* calcd. for C₂₄H₂₁N₂O (M+H)⁺: 353.1648, found 353.1654.



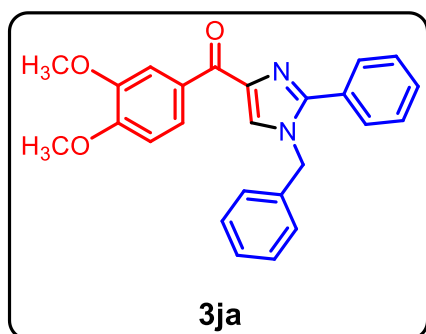
(1-benzyl-2-phenyl-1H-imidazol-4-yl)(3-chlorophenyl)methanone (3ia)

According to the general procedure, **3ia** was obtained using (*E*)-1-(3-chlorophenyl)-3-(dimethylamino)prop-2-en-1-one **1i** (41.8 mg, 0.2 mmol) and phenylmethanamine **2a** (42.8 mg, 4.36 μL, 0.4 mmol) in 69% yield (51.5 mg) as yellow oily liquid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 8.311 (s, 1H), 8.267 (d, *J* = 8.0 Hz, 1H), 7.777 (s, 1H), 7.631 - 7.607 (m, 2H), 7.526 - 7.498 (m, 1H), 7.478 - 7.452 (m, 3H), 7.427 - 7.407 (m, 1H), 7.388 - 7.354 (m, 3H), 7.127 - 7.104 (m, 2H), 5.264 (s, 2H);

¹³C NMR (100 MHz, CDCl₃) δ 186.33, 149.15, 140.85, 139.53, 135.70, 134.40, 132.35, 130.46, 129.84, 129.61, 129.39, 129.33, 128.99, 128.91, 128.73, 128.64, 127.13, 51.25.

HRMS (ESI) *m/z* calcd. for C₂₃H₁₈ClN₂O (M+H)⁺: 373.1102, found 373.1111.



(1-benzyl-2-phenyl-1H-imidazol-4-yl)(3,4-dimethoxyphenyl)methanone (3ja)

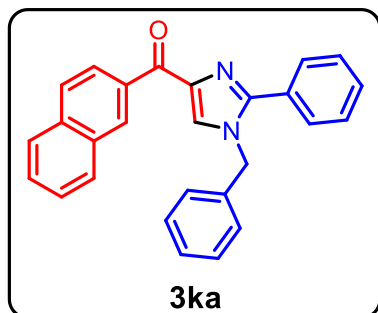
According to the general procedure, **3ja** was obtained using (*E*)-1-(3,4-dimethoxyphenyl)-3-(dimethylamino)prop-2-en-1-one **1j** (47.0 mg, 0.2 mmol) and phenylmethanamine **2a** (42.8 mg, 43.6 μL, 0.4 mmol) in 78% yield (62.1 mg) as brown oil filled liquid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 8.271 - 8.240 (m, 1H), 7.947 (s, 1H), 7.754 (s, 1H), 7.628 - 7.603 (m, 2H), 7.461 - 7.425 (m, 3H), 7.360 - 7.321 (m, 3H), 7.130 - 7.110 (m, 2H), 6.931 (d, *J* =

8.4 Hz, 1H), 5.258 (s, 2H), 3.943 (d, $J = 2.8$ Hz, 6H);

^{13}C NMR (100 MHz, CDCl_3) δ 186.08, 152.92, 148.73, 148.67, 141.56, 135.91, 130.85, 129.86, 129.64, 129.31, 129.25, 128.83, 128.51, 128.38, 127.08, 125.66, 112.80, 110.14, 56.12, 56.08, 51.12.

HRMS (ESI) m/z calcd. for $\text{C}_{25}\text{H}_{23}\text{N}_2\text{O}_3$ ($\text{M}+\text{H}$) $^+$: 399.1703, found 399.1704.



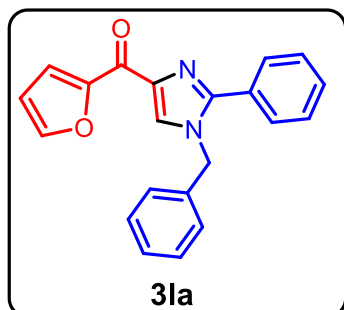
(1-benzyl-2-phenyl-1H-imidazol-4-yl)(naphthalen-2-yl)methanone (3ka)

According to the general procedure, **3ka** was obtained using (*E*)-3-(dimethylamino)-1-(naphthalen-2-yl)prop-2-en-1-one **1k** (45.0 mg, 0.2 mmol) and phenylmethanamine **2a** (42.8 mg, 43.6 μL , 0.4 mmol) in 76% yield (59.0 mg) as brown oil filled liquid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

^1H NMR (400 MHz, CDCl_3) δ 8.978 (s, 1H), 8.293 - 8.268 (m, 1H), 7.987 (d, $J = 8.0$ Hz, 1H), 7.920 - 7.861 (m, 2H), 7.794 (s, 1H), 7.665 - 7.641 (m, 2H), 7.597 - 7.501 (m, 3H), 7.472 - 7.456 (m, 2H), 7.370 - 7.331 (m, 3H), 7.152 - 7.118 (m, 2H), 5.286 (s, 2H).

^{13}C NMR (100 MHz, CDCl_3) δ 187.68, 149.13, 141.13, 135.81, 135.45, 135.36, 132.66, 132.30, 129.91, 129.82, 129.61, 129.38, 129.35, 129.21, 128.79, 128.58, 128.17, 128.05, 127.82, 127.12, 126.49, 126.10, 51.24.

HRMS (ESI) m/z calcd. for $\text{C}_{27}\text{H}_{20}\text{N}_2\text{ONa}$ ($\text{M}+\text{Na}$) $^+$: 411.1468, found 411.1467.



(1-benzyl-2-phenyl-1H-imidazol-4-yl)(furan-2-yl)methanone (3la)

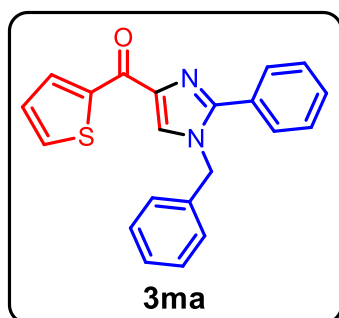
According to the general procedure, **3la** was obtained using (*E*)-3-(dimethylamino)-1-(furan-2-yl)prop-2-en-1-one **1l** (33.0 mg, 0.2 mmol) and phenylmethanamine **2a** (42.8 mg, 43.6 μL).

L, 0.4 mmol) in 73% yield (47.9 mg) as yellow oily liquid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 8.094 (d, *J* = 3.6 Hz, 1H), 7.908 (s, 1H), 7.661 - 7.657 (m, 1H), 7.626 - 7.602 (m, 2H), 7.469 - 7.432 (m, 3H), 7.378 - 7.319 (m, 3H), 7.118 - 7.094 (m, 2H), 6.575 - 6.561 (m, 1H), 5.254 (s, 2H);

¹³C NMR (100 MHz, CDCl₃) δ 174.41, 152.05, 148.95, 146.72, 140.02, 135.77, 129.75, 129.69, 129.32, 129.26, 128.85, 128.54, 128.11, 127.08, 121.70, 112.34, 51.21.

HRMS (ESI) *m/z* calcd. for C₂₁H₁₆N₂O₂Na (M+Na)⁺: 351.1104, found 351.1113.



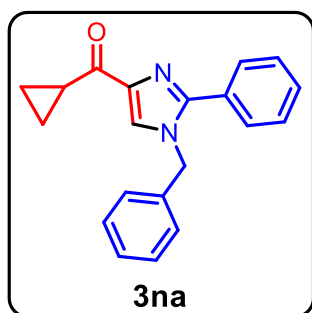
(1-benzyl-2-phenyl-1*H*-imidazol-4-yl)(thiophen-2-yl)methanone (3ma)

According to the general procedure, **3ma** was obtained using (*E*)-3-(dimethylamino)-1-(thiophen-2-yl)prop-2-en-1-one **1m** (36.2 mg, 0.2 mmol) and phenylmethanamine **2a** (42.8 mg, 43.6 μL, 0.4 mmol) in 77% yield (53.0 mg) as yellow oily liquid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 8.680 - 8.667 (m, 1H), 7.834 (s, 1H), 7.668 - 7.628 (m, 3H), 7.468 - 7.445 (m, 3H), 7.369 - 7.322 (m, 3H), 7.177 - 7.155 (m, 1H), 7.125 - 7.101 (m, 2H), 5.266 (s, 2H);

¹³C NMR (100 MHz, CDCl₃) δ 179.21, 148.59, 143.05, 140.93, 135.77, 135.62, 134.16, 129.78, 129.68, 129.30, 129.20, 128.87, 128.51, 128.03, 127.78, 127.07, 51.21.

HRMS (ESI) *m/z* calcd. for C₂₁H₁₆N₂OSK (M+K)⁺: 383.0615, found 383.0606.



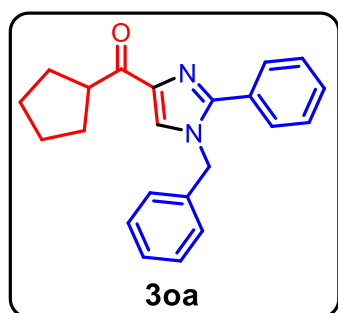
(1-benzyl-2-phenyl-1*H*-imidazol-4-yl)(cyclopropyl)methanone (3na)

According to the general procedure, **3na** was obtained using (*E*)-1-cyclopropyl-3-(dimethylamino)prop-2-en-1-one **1n** (27.8 mg, 0.2 mmol) and phenylmethanamine **2a** (42.8 mg, 43.6 μ L, 0.4 mmol) in 52% yield (31.4 mg) as brown oil filled liquid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 7.651 (s, 1H), 7.590 - 7.566 (m, 2H), 7.455 - 7.427 (m, 3H), 7.363 - 7.331 (m, 3H), 7.094 - 7.070 (m, 2H), 5.209 (s, 2H), 3.125 - 3.062 (m, 1H), 1.231 - 1.192 (m, 2H), 1.029 - 0.983 (m, 2H);

¹³C NMR (100 MHz, CDCl₃) δ 196.61, 148.90, 141.92, 135.81, 129.77, 129.34, 129.31, 128.92, 128.54, 127.13, 124.83, 51.17, 17.23, 11.80.

HRMS (ESI) m/z calcd. for C₂₀H₁₈N₂ONa (M+Na)⁺: 325.1311, found 325.1316.



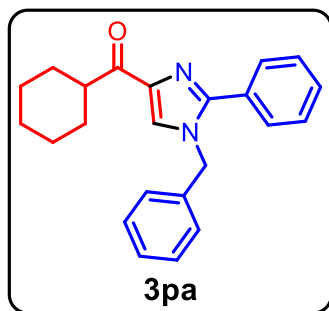
(1-benzyl-2-phenyl-1H-imidazol-4-yl)(cyclopentyl)methanone (3oa)

According to the general procedure, **3oa** was obtained using (*E*)-1-cyclopentyl-3-(dimethylamino)prop-2-en-1-one **1o** (33.4 mg, 0.2 mmol) and phenylmethanamine **2a** (42.8 mg, 43.6 μ L, 0.4 mmol) in 80% yield (52.8 mg) as yellow oily liquid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 7.637 (s, 1H), 7.569 - 7.544 (m, 2H), 7.451 - 7.415 (m, 3H), 7.366 - 7.315 (m, 3H), 7.093 - 7.070 (m, 2H), 5.186 (s, 2H), 3.944 - 3.863 (m, 1H), 1.990 - 1.927 (m, 2H), 1.904 - 1.848 (m, 2H), 1.756 - 1.714 (m, 2H), 1.659 - 1.599 (m, 2H);

¹³C NMR (100 MHz, CDCl₃) δ 199.73, 148.72, 141.54, 135.90, 129.89, 129.65, 129.34, 129.28, 128.87, 128.49, 127.11, 125.52, 51.08, 46.85, 30.09, 26.46.

HRMS (ESI) m/z calcd. for C₂₂H₂₂N₂ONa (M+Na)⁺: 353.1624, found 353.1624.



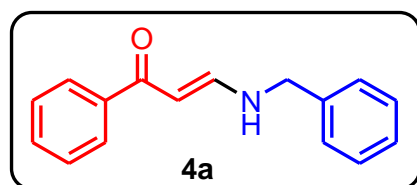
(1-benzyl-2-phenyl-1H-imidazol-4-yl)(cyclohexyl)methanone (3pa)

According to the general procedure, **3pa** was obtained using (*E*)-1-cyclohexyl-3-(dimethylamino)prop-2-en-1-one **1p** (36.2 mg, 0.2 mmol) and phenylmethanamine **2a** (42.8 mg, 0.4 mmol) in 83% yield (57.1 mg) as brown oil filled liquid (silica gel flash chromatography: petroleum ether/EtOAc = 6:1).

¹H NMR (400 MHz, CDCl₃) δ 7.637 (s, 1H), 7.570 - 7.546 (m, 2H), 7.462 - 7.416 (m, 3H), 7.364 - 7.316 (m, 3H), 7.090 - 7.066 (m, 2H), 5.185 (s, 2H), 3.522 - 3.448 (m, 1H), 1.967 - 1.929 (m, 2H), 1.821 - 1.773 (m, 2H), 1.725 - 1.674 (m, 1H), 1.537 - 1.348 (m, 5H);

¹³C NMR (100 MHz, CDCl₃) δ 200.32, 148.68, 140.88, 135.86, 129.77, 129.70, 129.37, 129.29, 128.88, 128.49, 127.10, 125.72, 51.10, 45.75, 29.07, 26.17, 25.84.

HRMS (ESI) *m/z* calcd. for C₂₃H₂₅N₂O (M+H)⁺: 345.1961, found 345.1968.



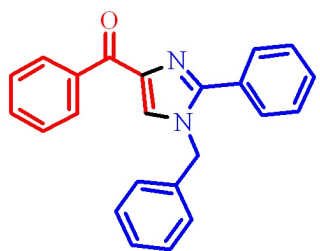
(*E*)-3-(benzylamino)-1-phenylprop-2-en-1-one (4a)²

¹H NMR (400 MHz, CDCl₃) δ 10.615 (brs, 1H), 7.897 - 7.876 (m, 2H), 7.432 - 7.407 (m, 3H), 7.364 - 7.342 (m, 2H), 7.317 - 7.285 (m, 2H), 7.042 - 6.986 (m, 1H), 5.789 - 5.766 (m, 1H), 4.469 - 4.449 (m, 2H).

[1]. Wang, F.; Sun, W.; Wang, Y.; Jiang, Y.; Loh, T.-P. J. O. I., Highly site-selective metal-free C-H acyloxylation of stable enamines. *Org. Lett.*, **2018**, *20* (4), 1256-1260.

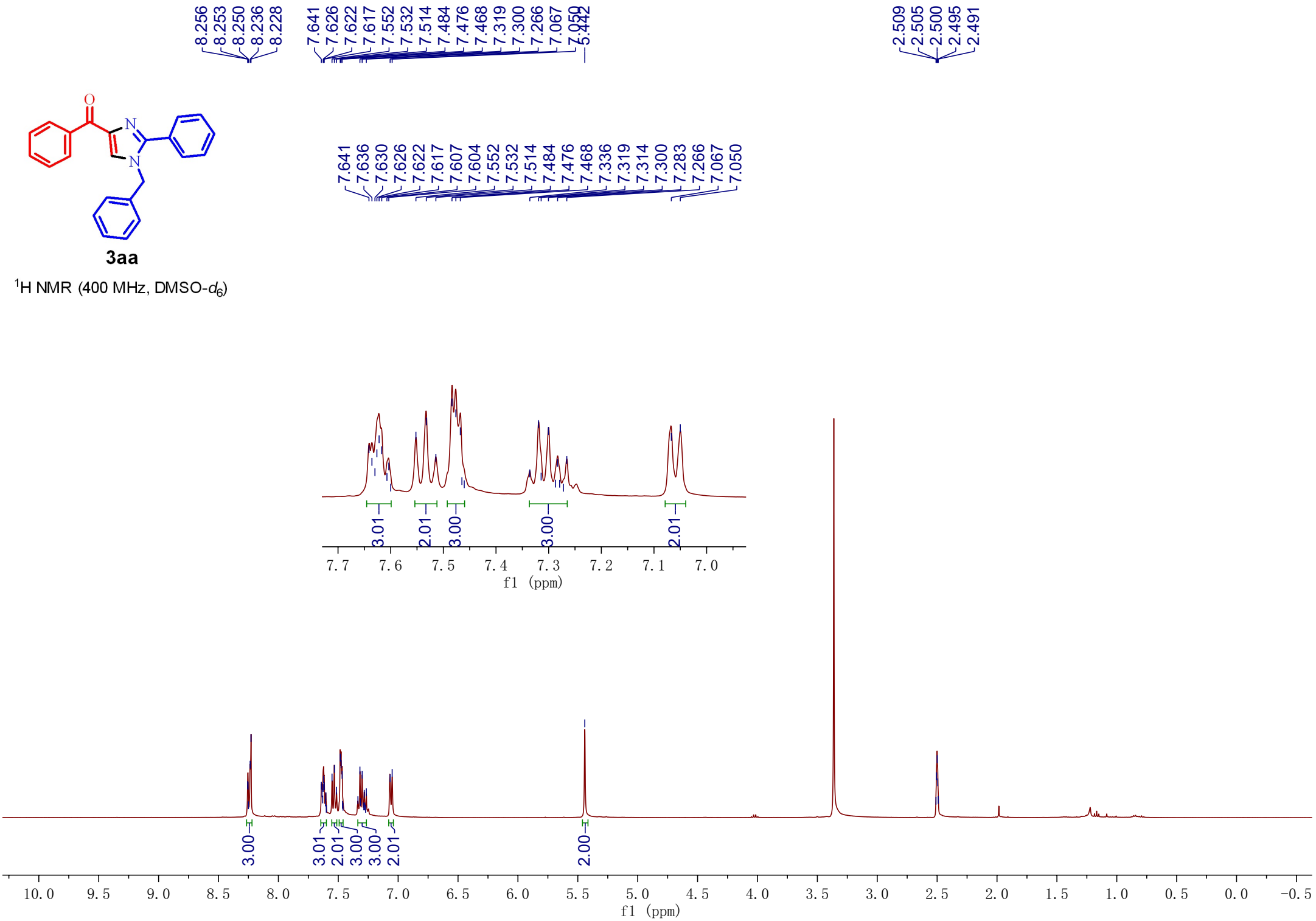
[2]. Zhou, S.; Liu, D.-Y.; Wang, S.; Tian, J.-S.; Loh, T.-P., An efficient method for the synthesis of 2-pyridones via C-H bond functionalization. *Chem. Commun.* 2020, 56(95), 15020-15023.

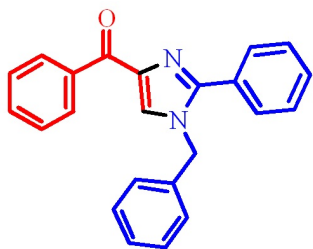
(F) Spectra



3aa

¹H NMR (400 MHz, DMSO-d₆)





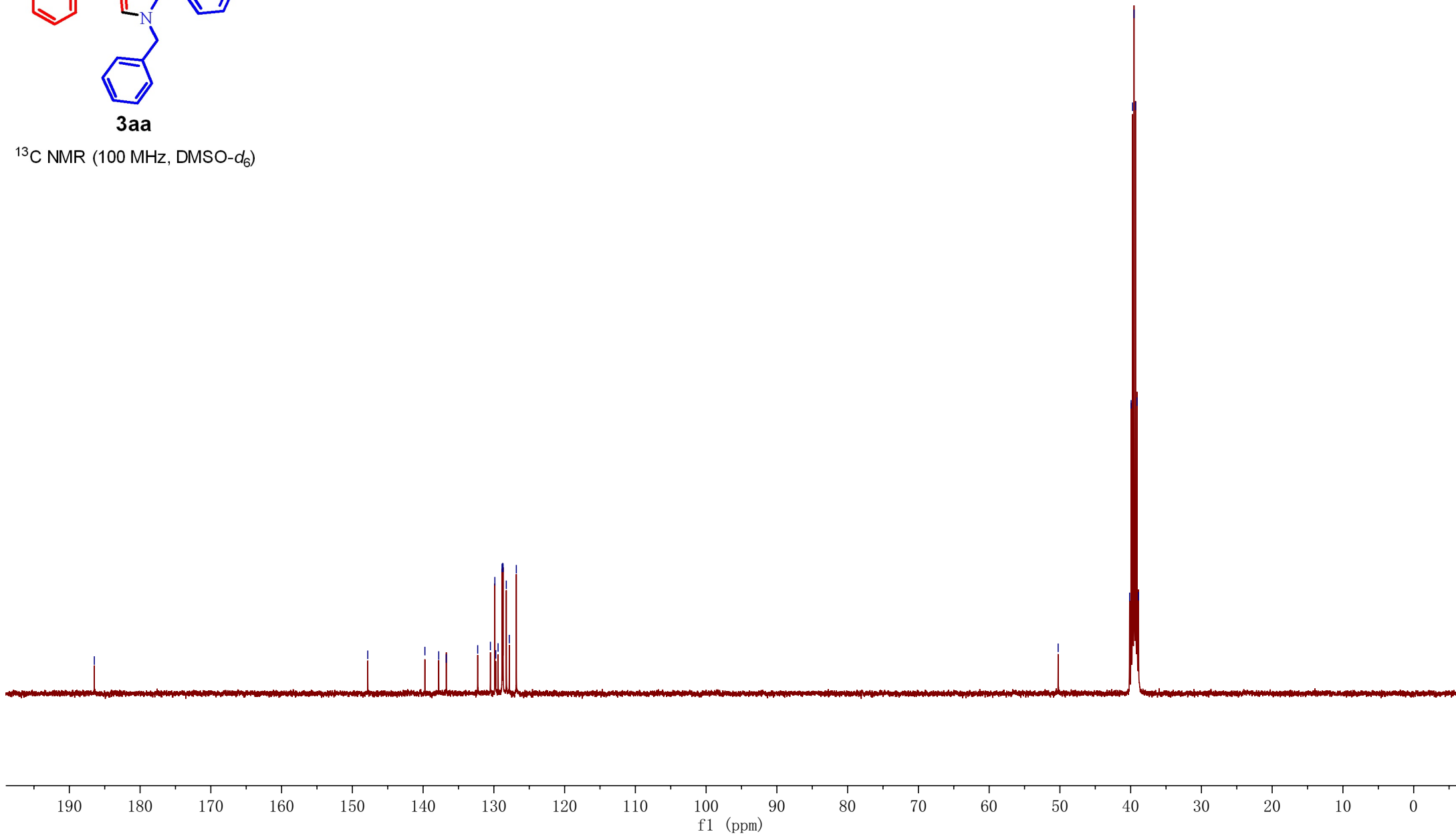
3aa

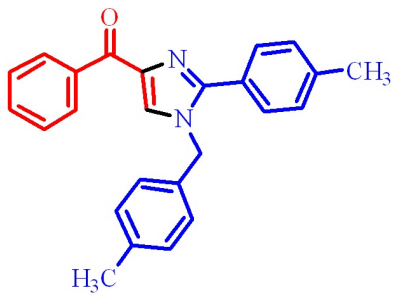
^{13}C NMR (100 MHz, DMSO- d_6)

— 186.47

— 147.82
— 139.75
— 137.79
— 136.73
— 132.29
— 130.49
— 129.86
— 129.73
— 129.40
— 128.84
— 128.74
— 128.70
— 128.24
— 127.82
— 126.82

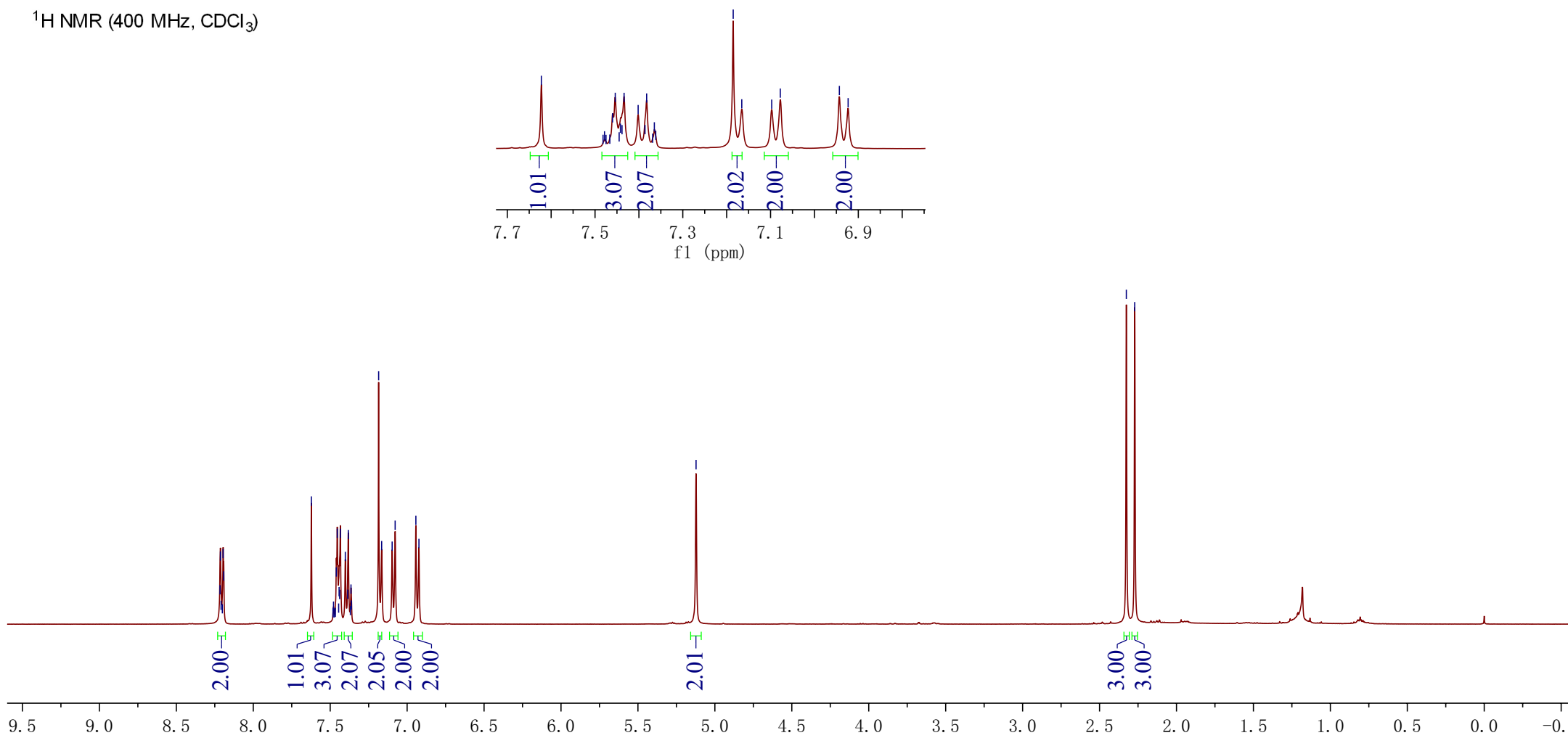
— 50.25
— 40.15
— 39.94
— 39.73
— 39.52
— 39.31
— 39.10
— 38.90

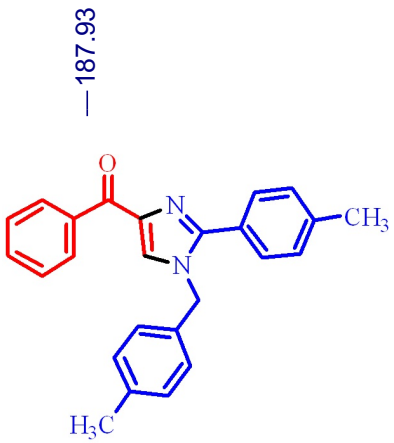




3ab

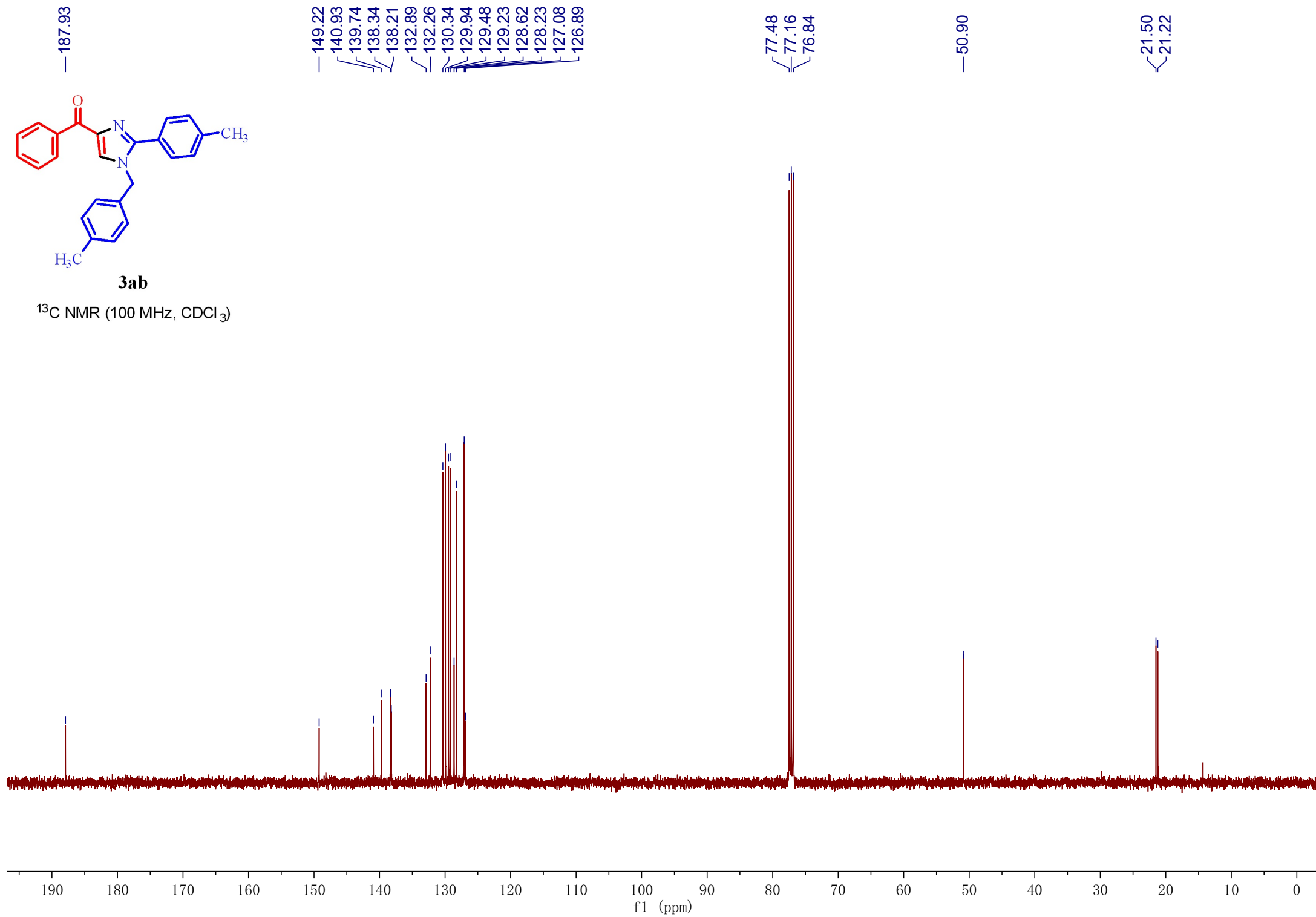
¹H NMR (400 MHz, CDCl₃)

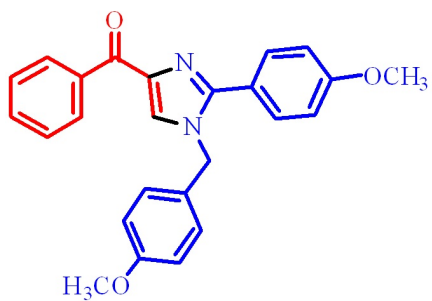




3ab

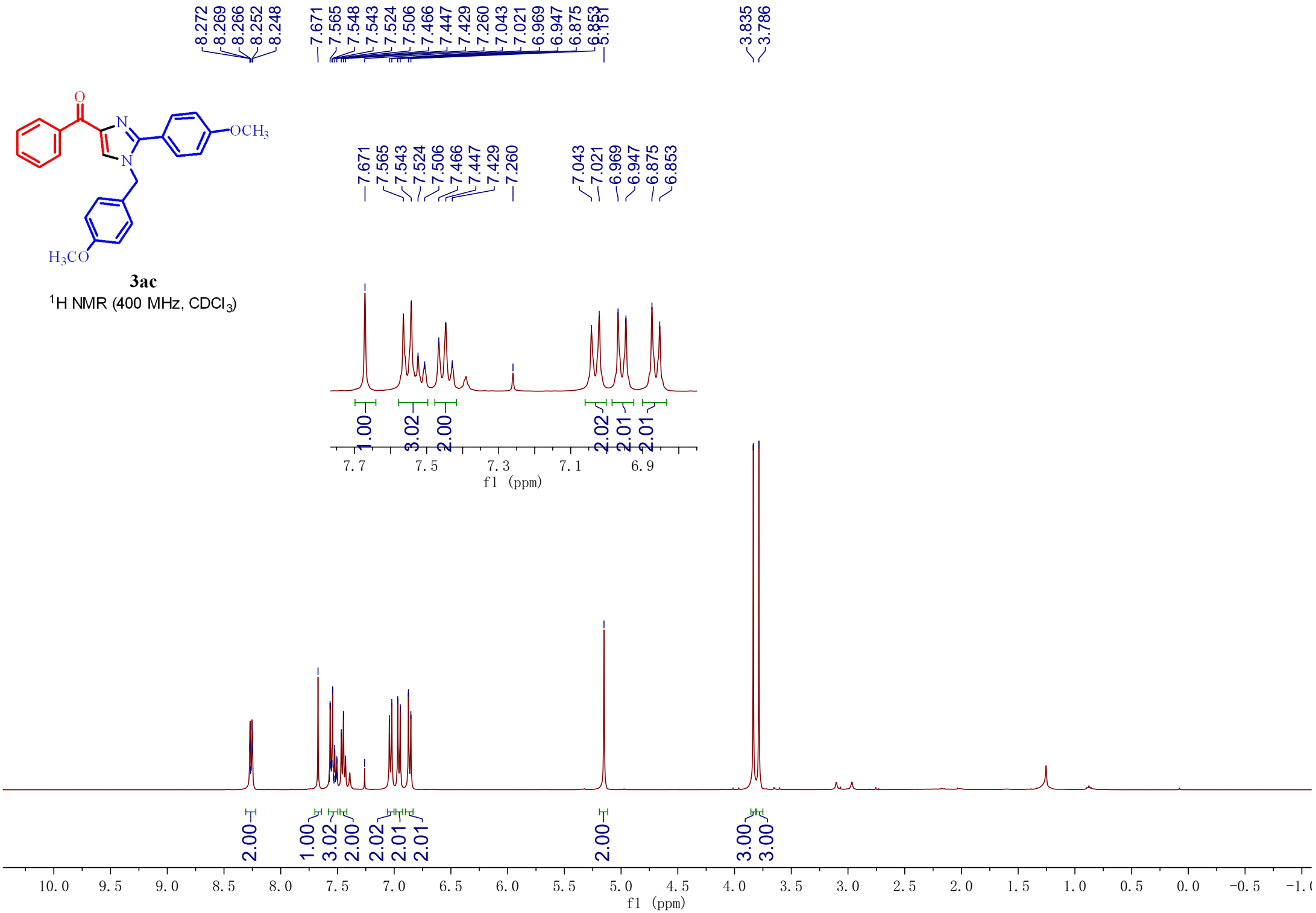
¹³C NMR (100 MHz, CDCl₃)

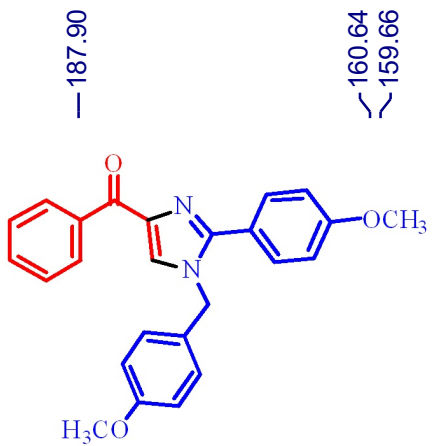




3ac

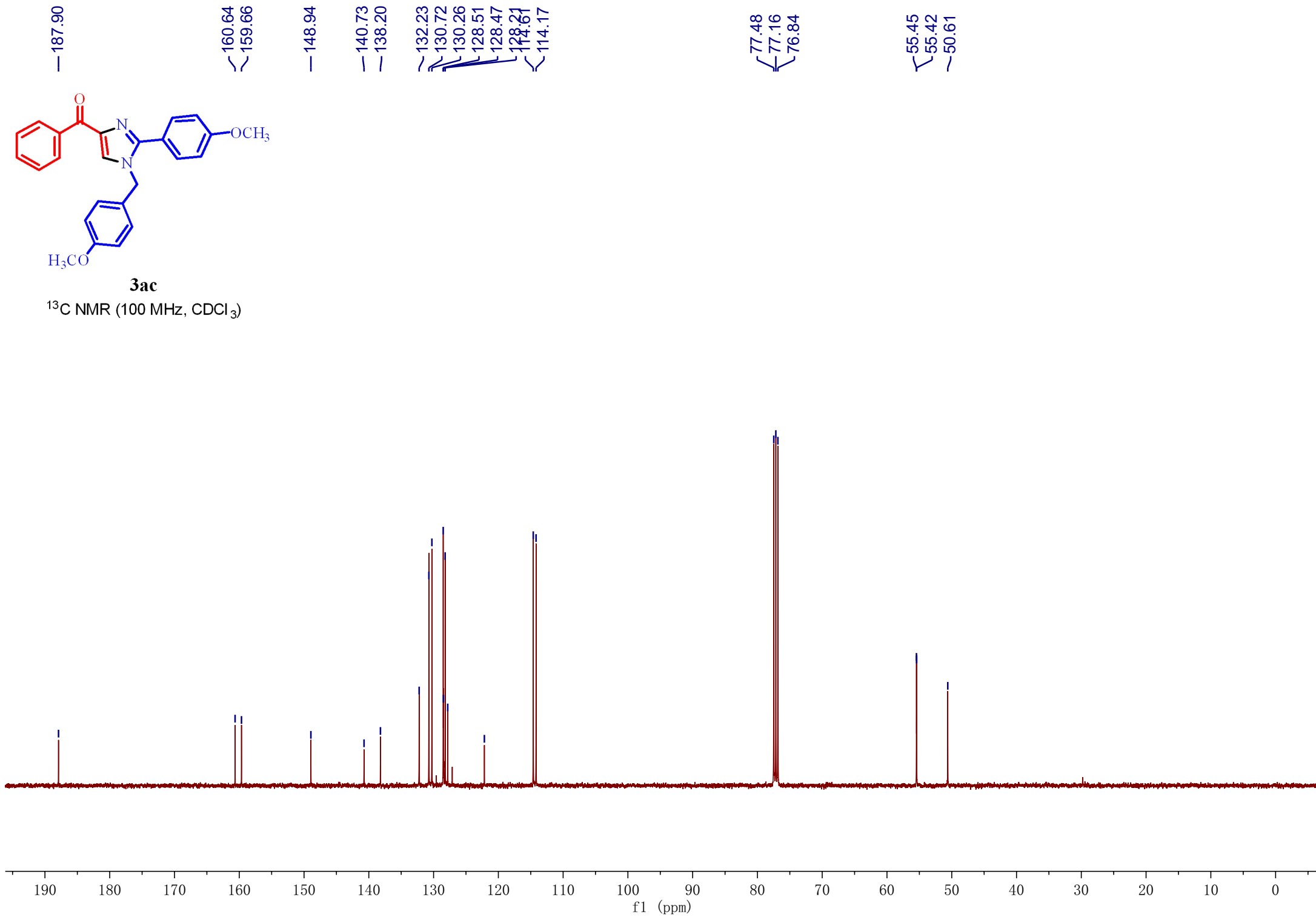
¹H NMR (400 MHz, CDCl₃)

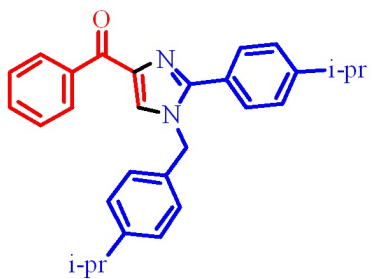




3ac

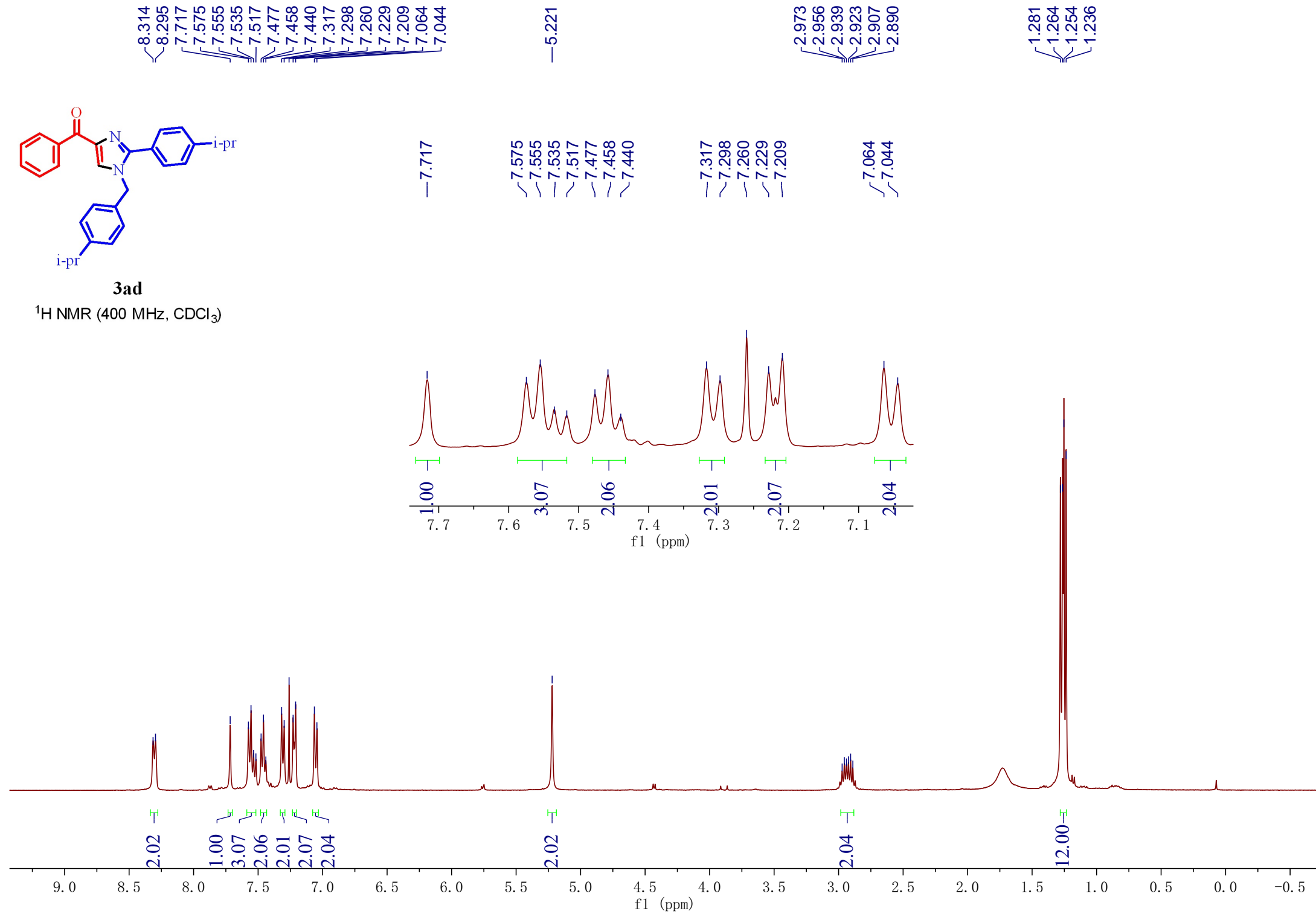
^{13}C NMR (100 MHz, CDCl_3)

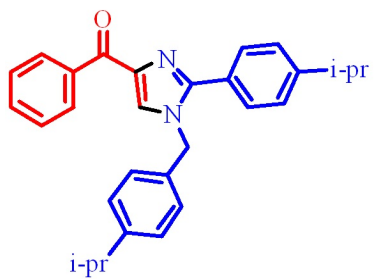




3ad

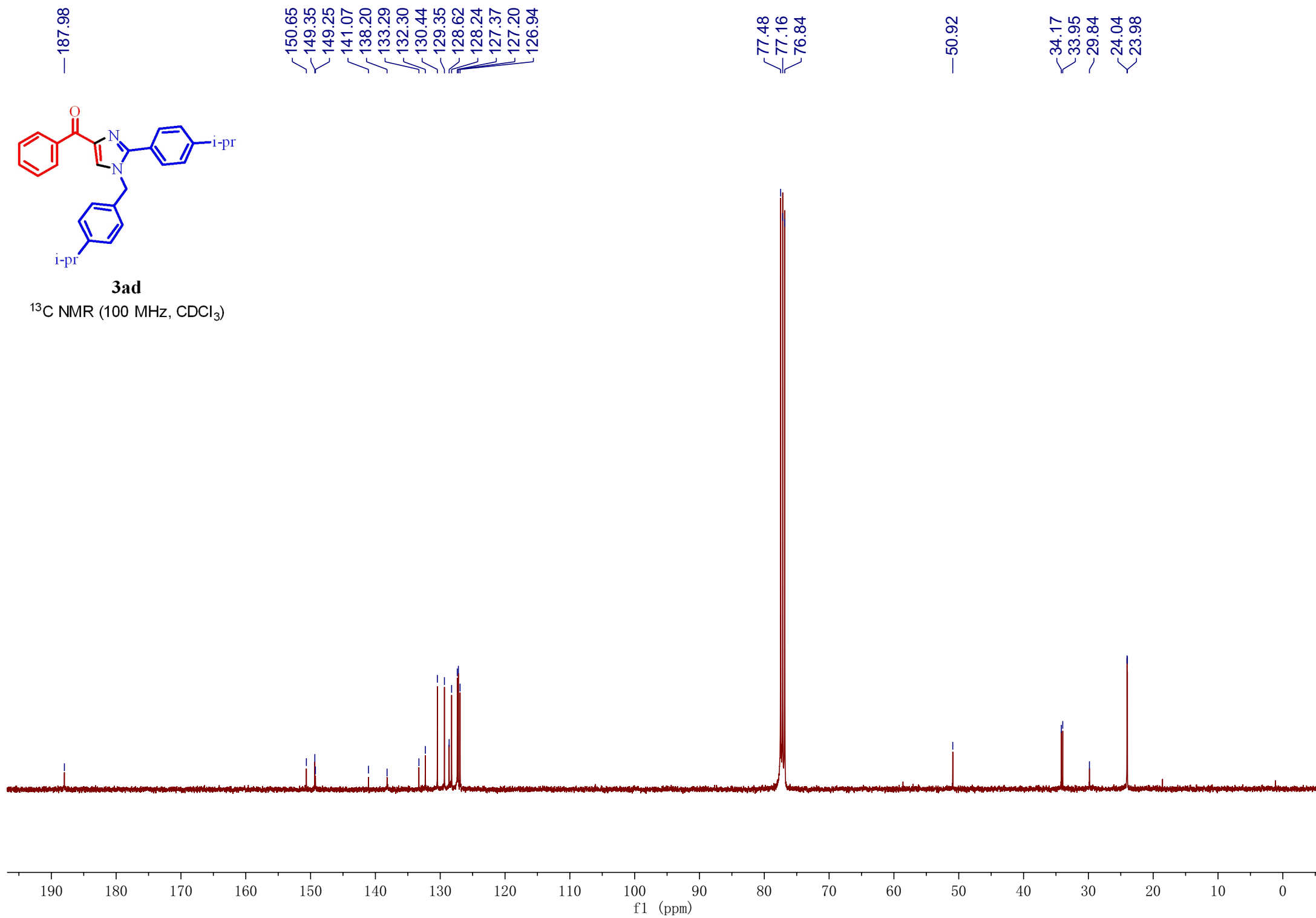
¹H NMR (400 MHz, CDCl₃)

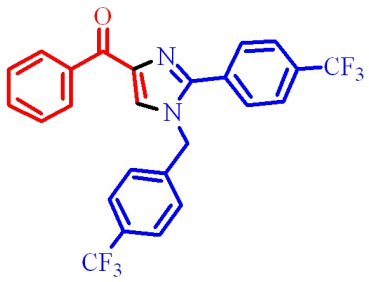




3ad

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

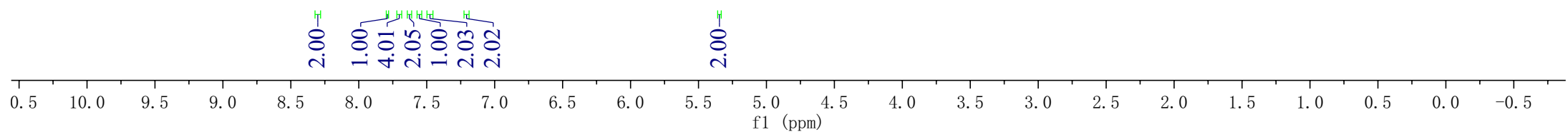
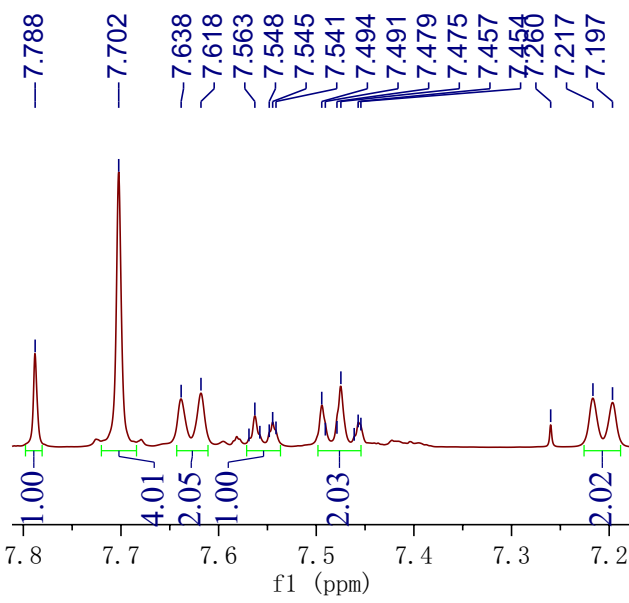


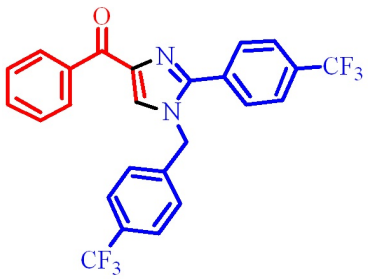


3ae

¹H NMR (400 MHz, CDCl₃)

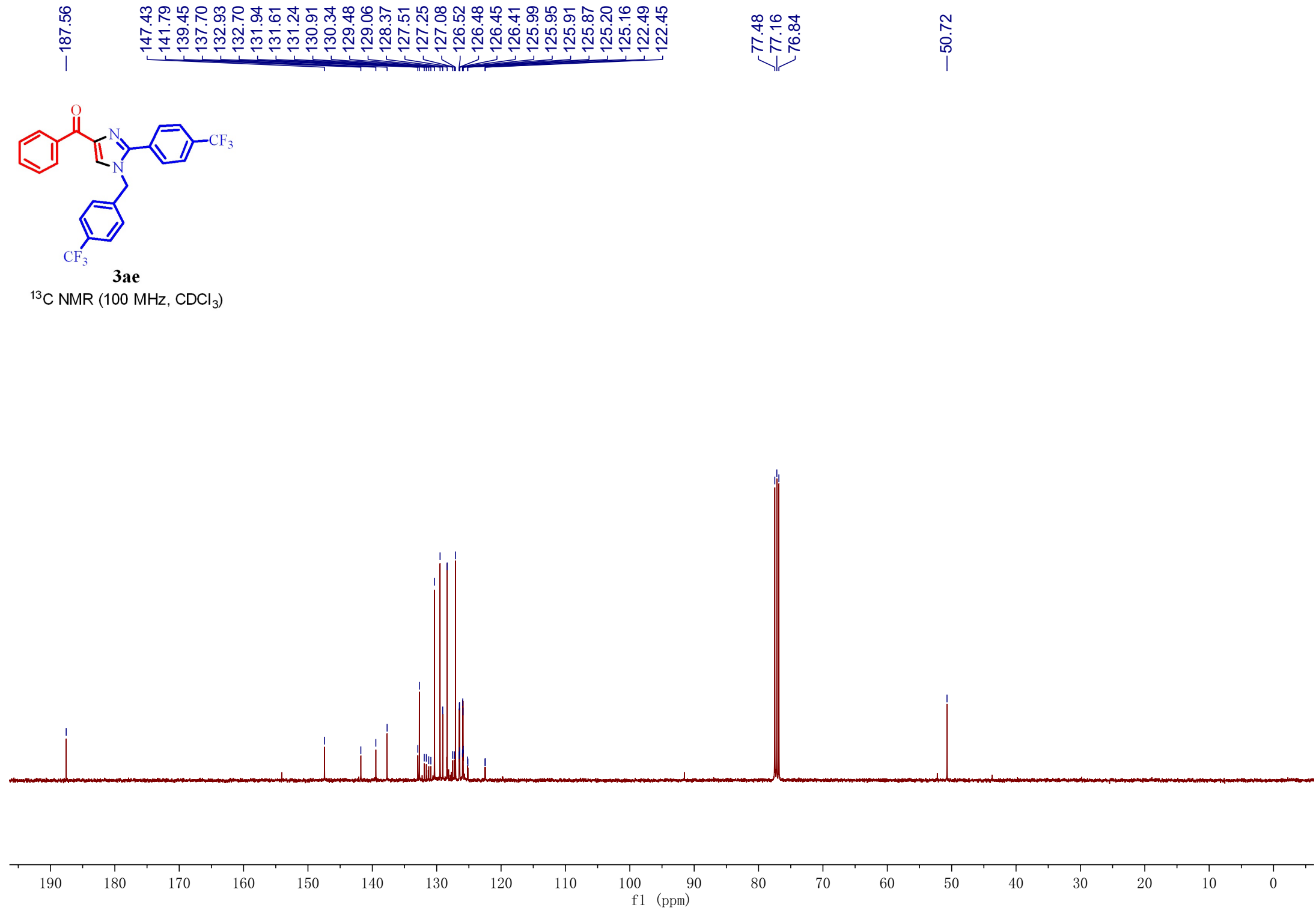
8.312
8.307
8.295
8.291
8.288
8.284
7.788
7.702
7.638
7.618
7.563
7.545
7.541
7.494
7.491
7.479
7.475
7.457
7.454
7.260
7.217
7.197

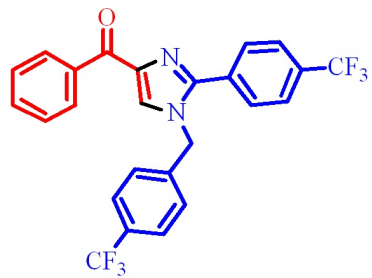




3ae

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

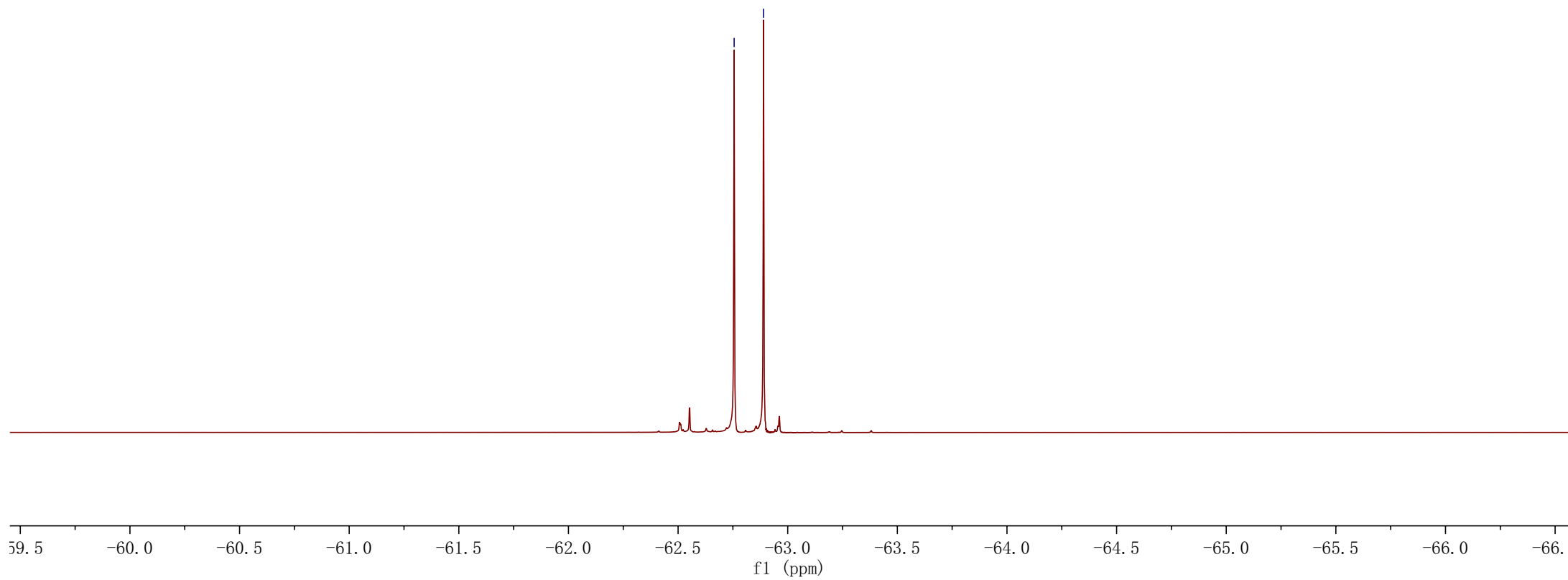


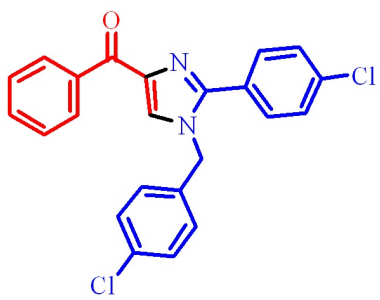


3ae

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

---62.76
---62.89





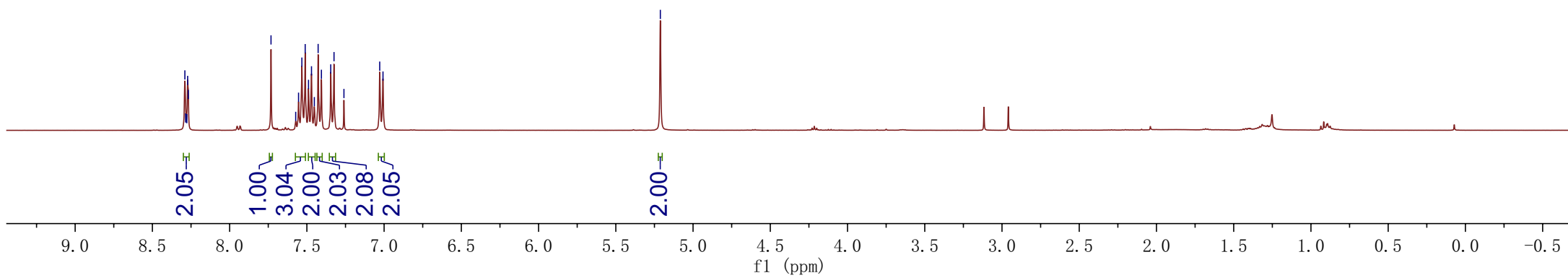
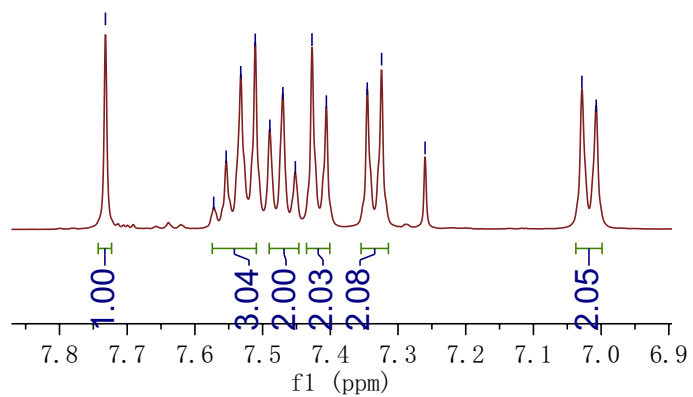
3af

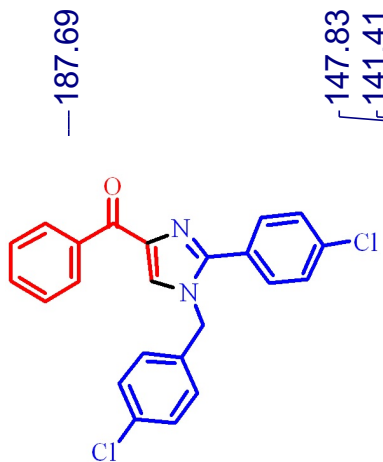
¹H NMR (400 MHz, CDCl₃)

8.290
8.285
8.277
8.272
8.268
7.732
7.572
7.554
7.532
7.511
7.489
7.470
7.452
7.427
7.406
7.345
7.324
7.260
7.028
7.007

5.212

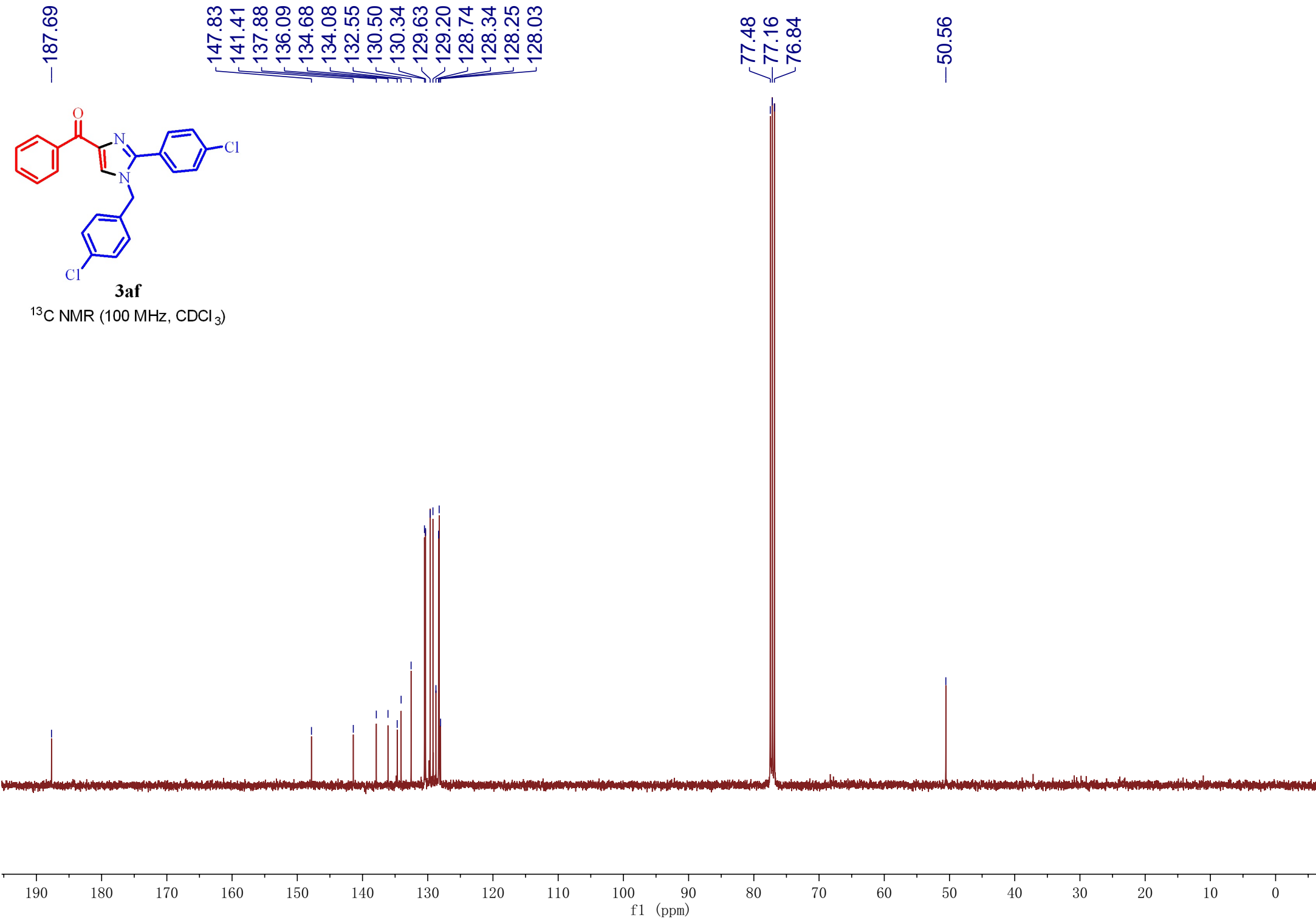
7.732
7.572
7.554
7.532
7.511
7.489
7.470
7.452
7.427
7.406
7.345
7.324
7.260
7.028
7.007

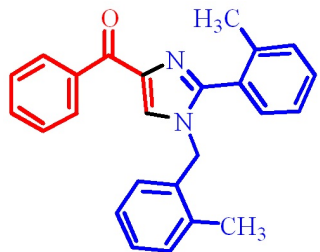




3af

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



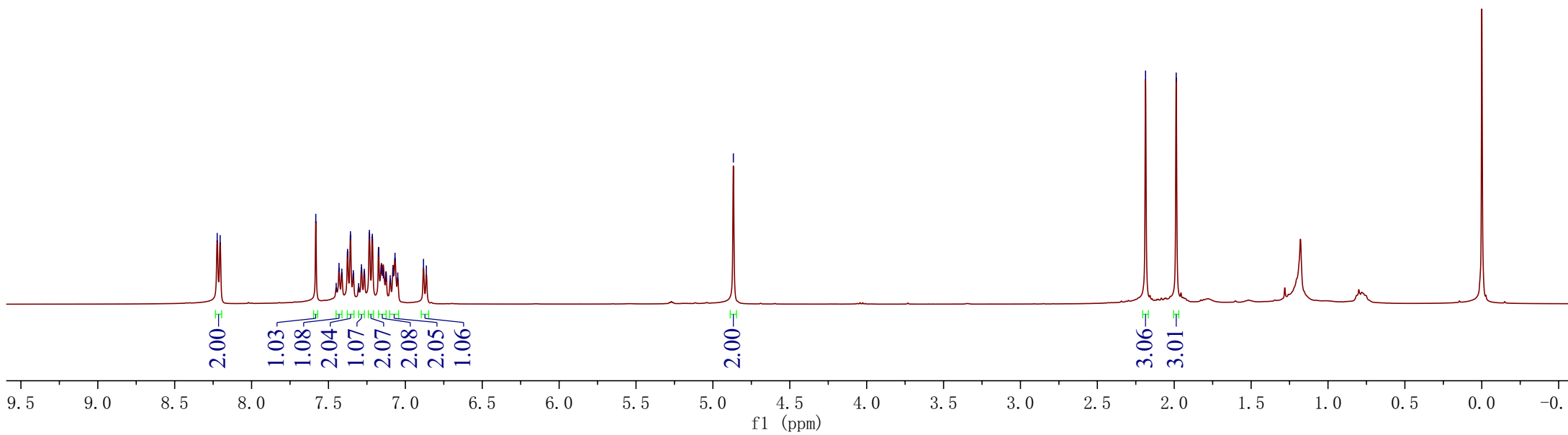
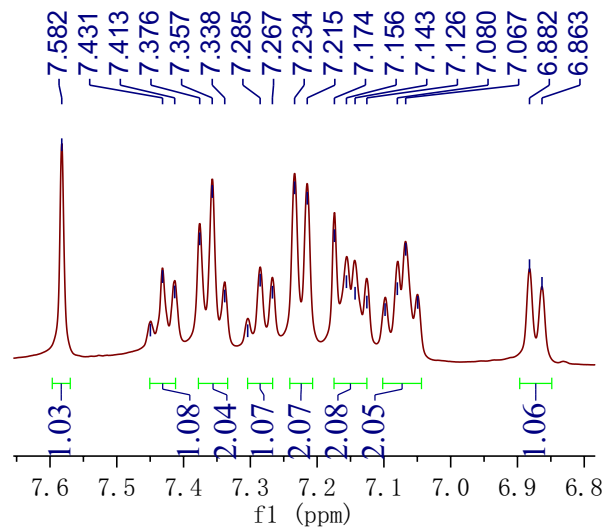


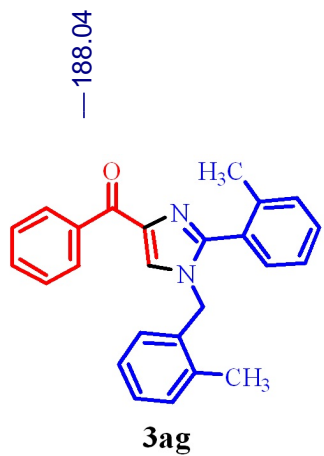
3ag

¹H NMR (400 MHz, CDCl₃)

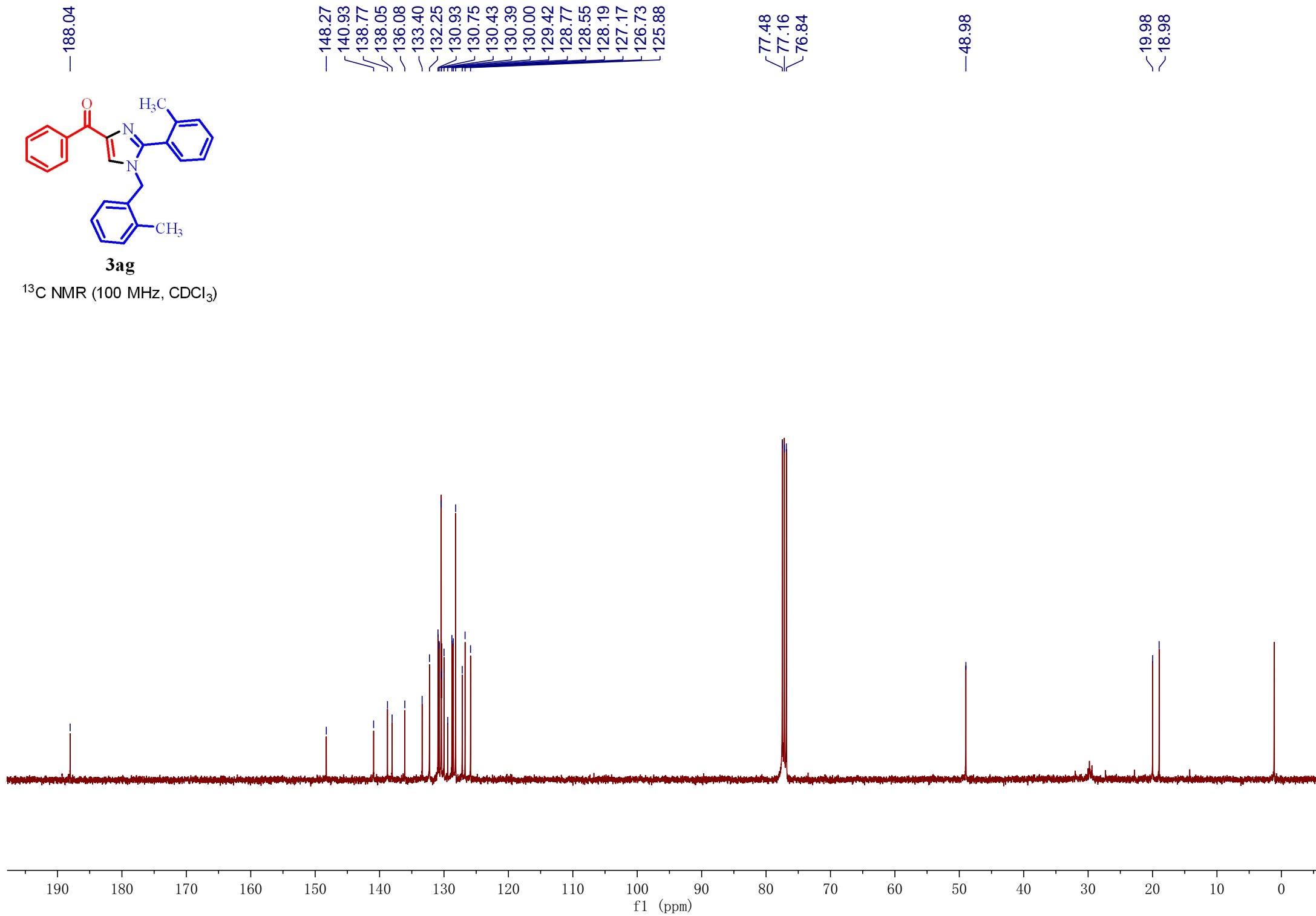
8.224
8.205
7.582
7.450
7.431
7.413
7.376
7.357
7.338
7.285
7.267
7.234
7.215
7.174
7.156
7.143
7.126
7.098
7.080
7.067
7.049
6.882
6.863

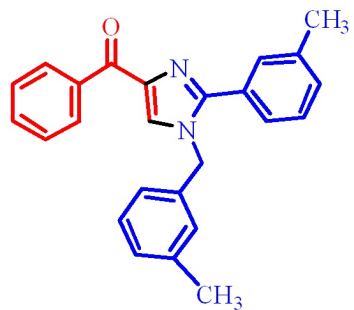
2.186
1.987





¹³C NMR (100 MHz, CDCl₃)





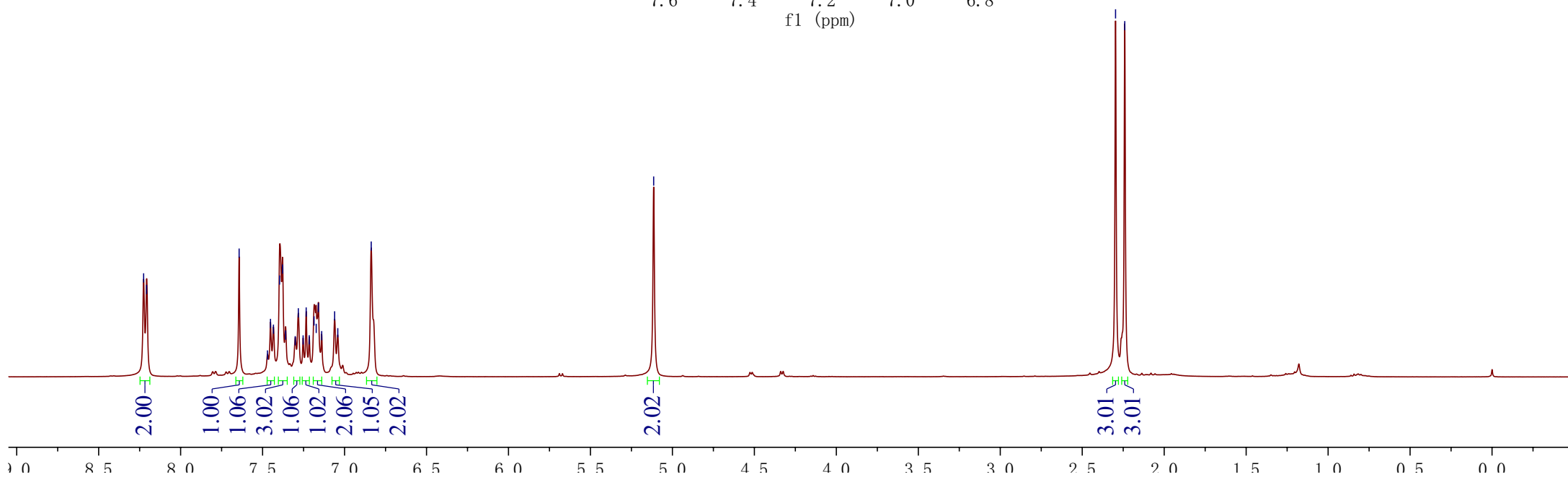
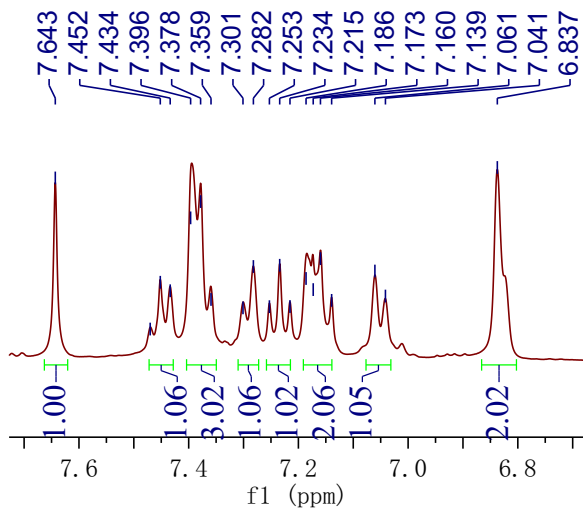
3ah

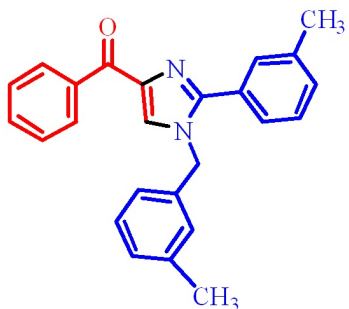
¹H NMR (400 MHz, CDCl₃)

8.226
8.208
7.643
7.470
7.452
7.434
7.396
7.378
7.359
7.301
7.282
7.253
7.234
7.215
7.186
7.173
7.160
7.139
7.061
7.041
6.837

5.114

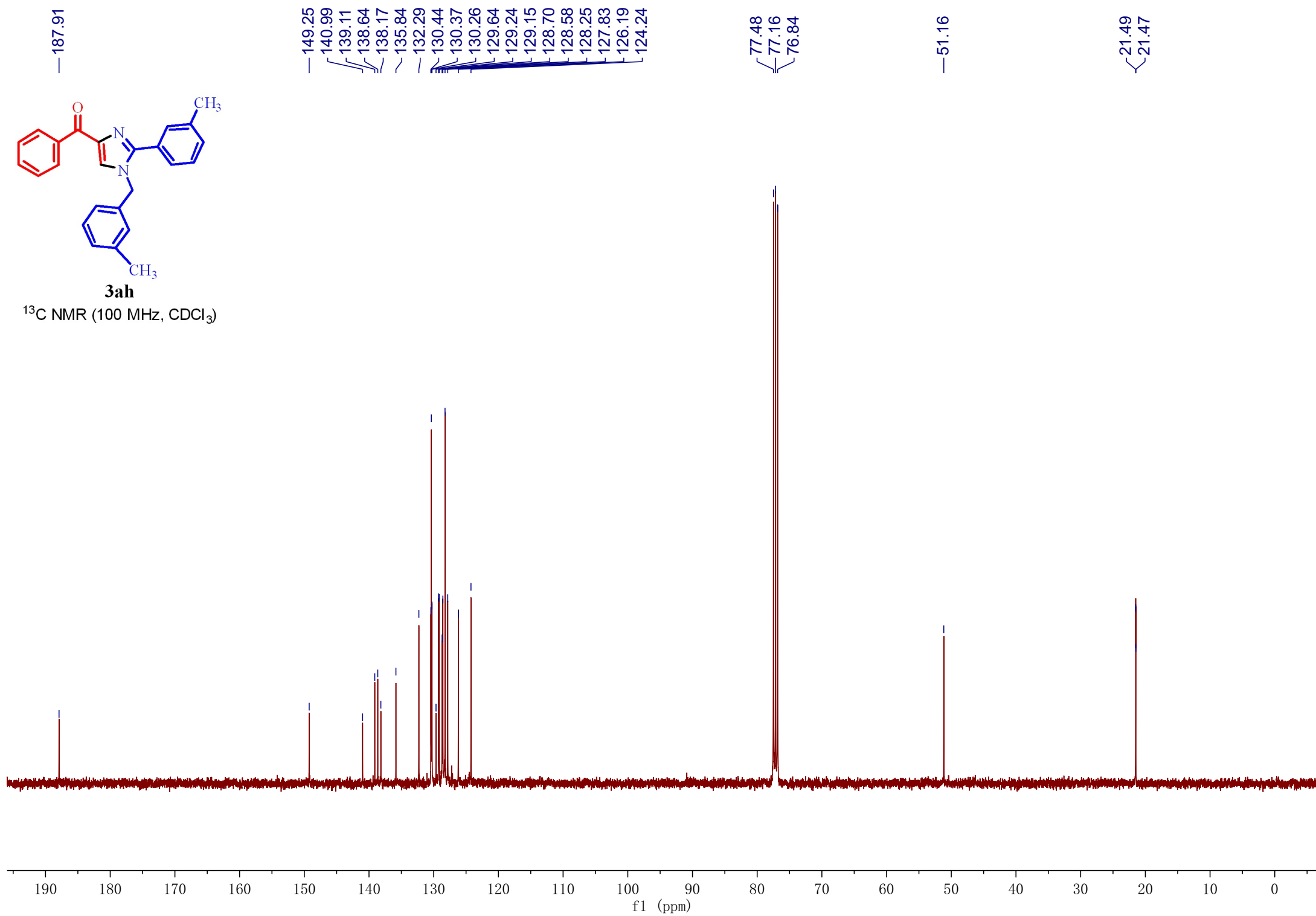
2.297
2.241

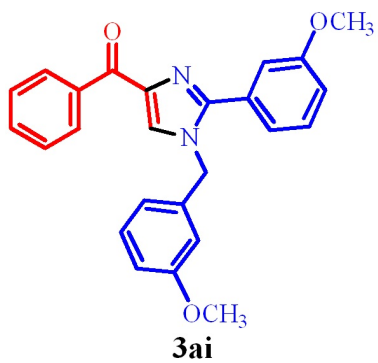




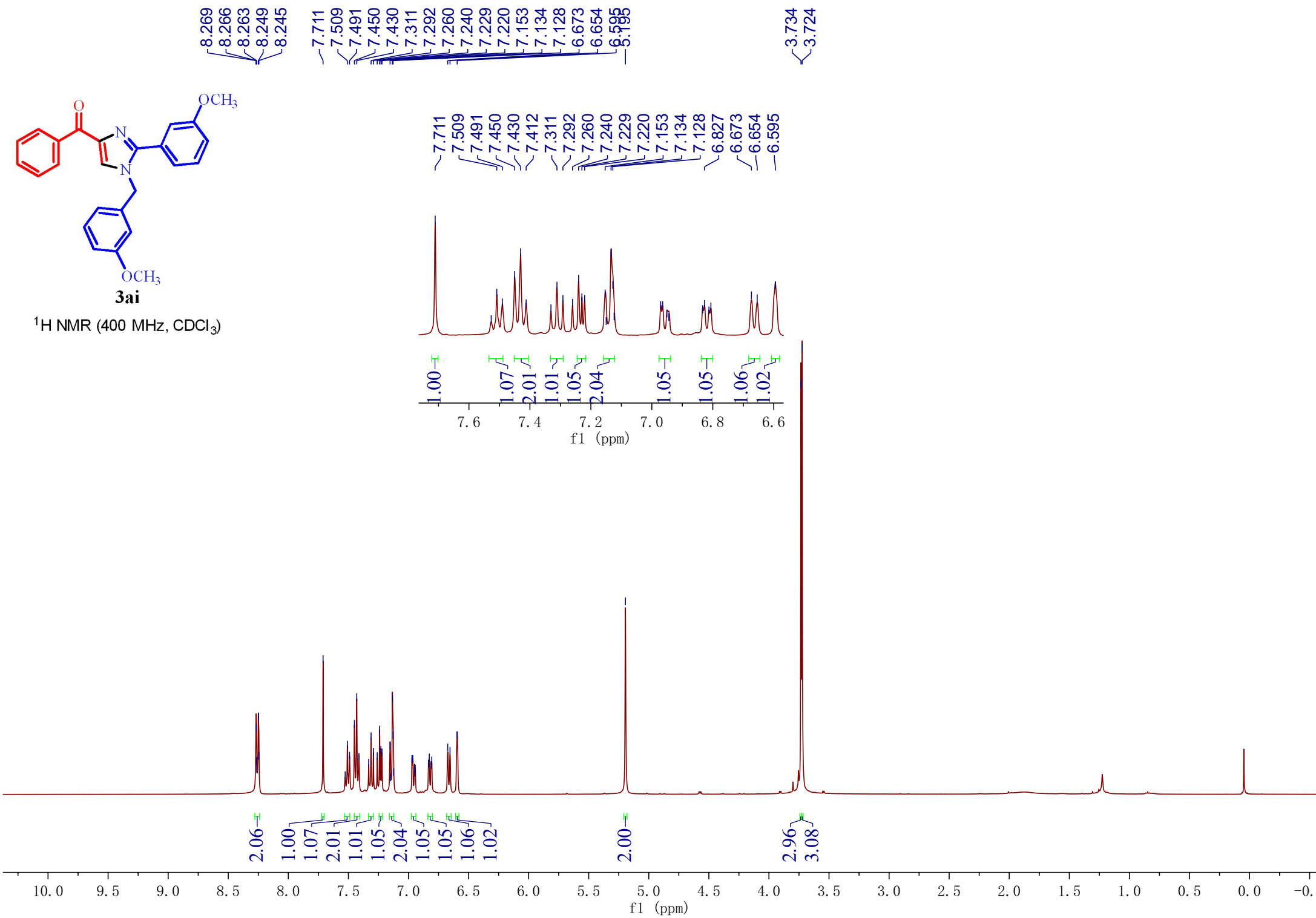
3ah

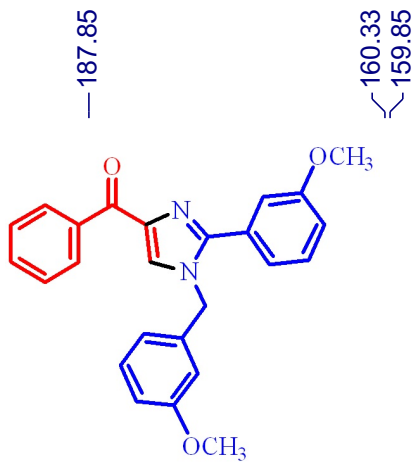
^{13}C NMR (100 MHz, CDCl_3)



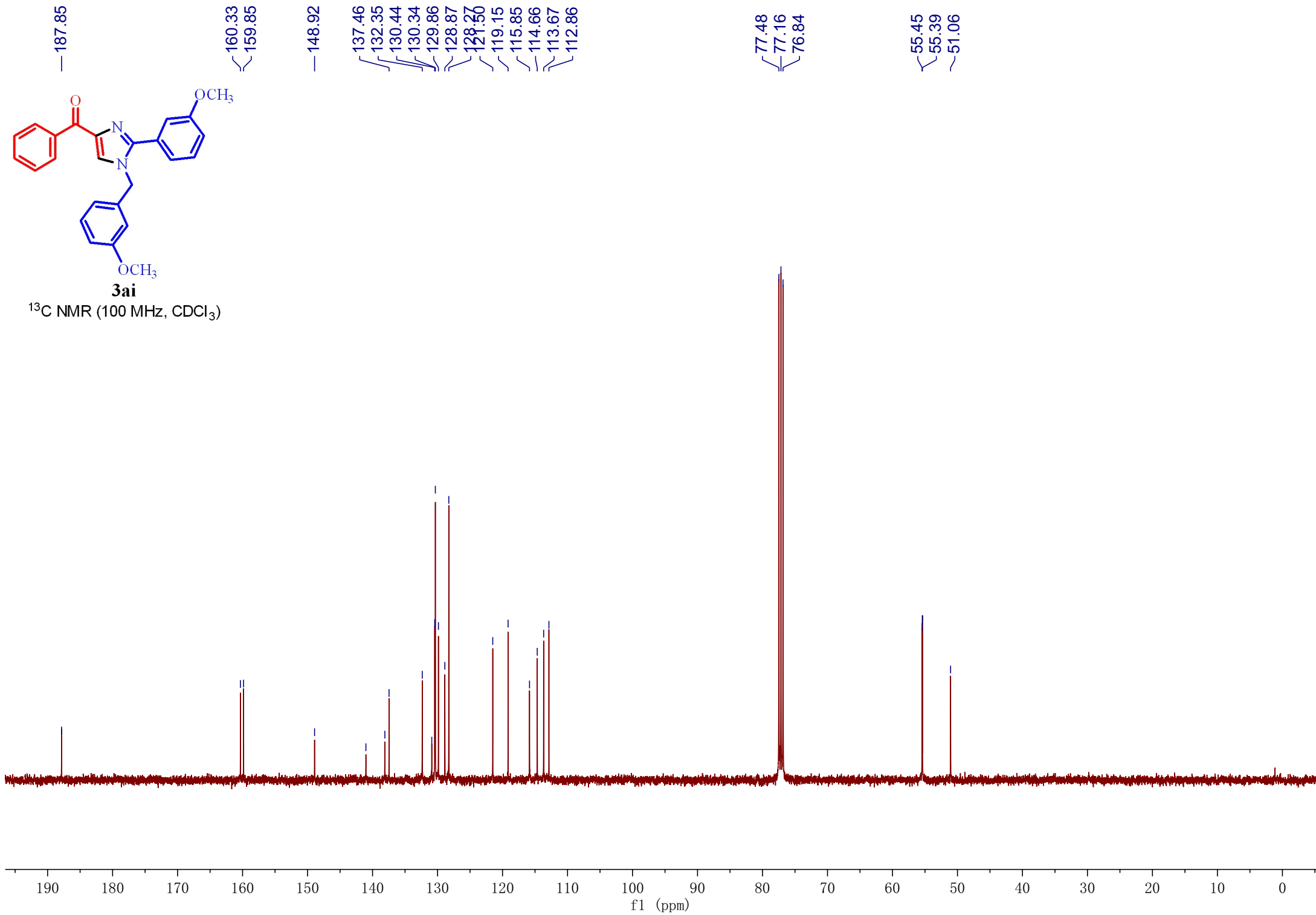


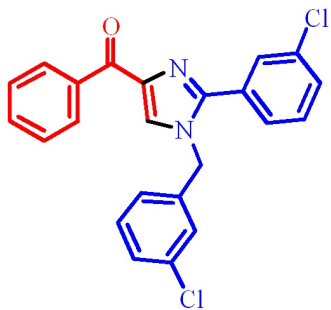
¹H NMR (400 MHz, CDCl₃)





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



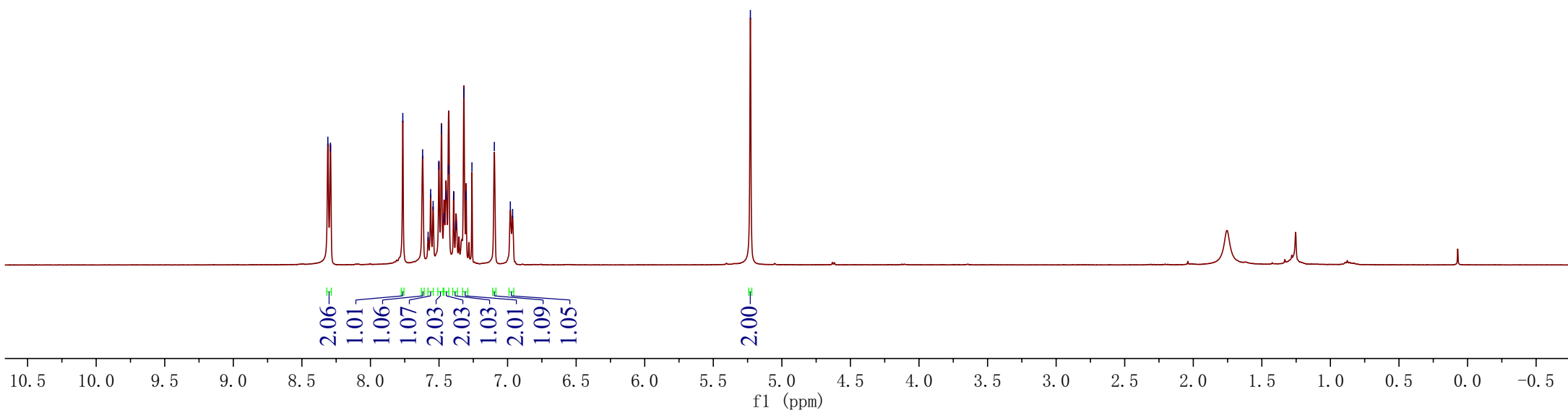
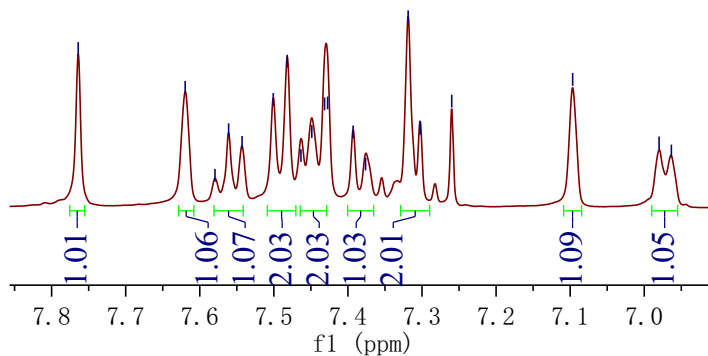


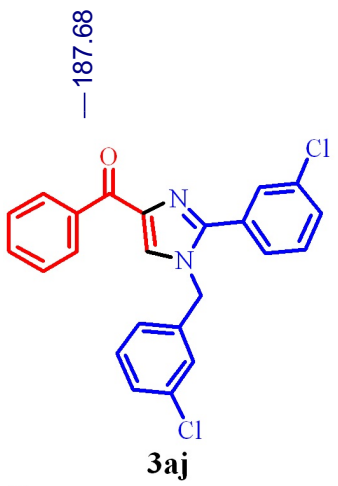
3aj

¹H NMR (400 MHz, CDCl₃)

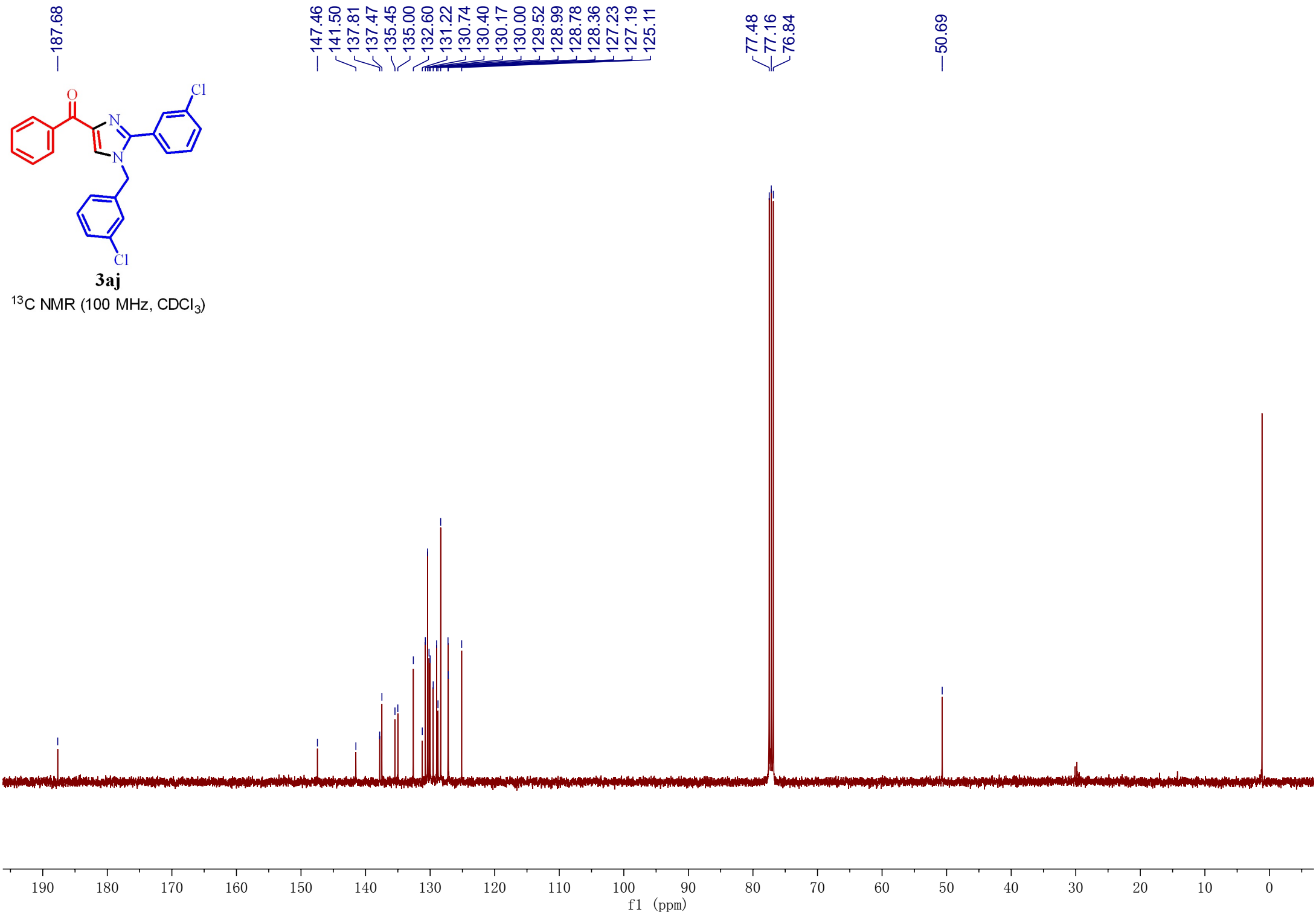
8.311
8.292
7.764
7.620
7.561
7.543
7.501
7.482
7.463
7.449
7.432
7.393
7.376
7.319
7.302
7.260
7.097
6.980
6.963

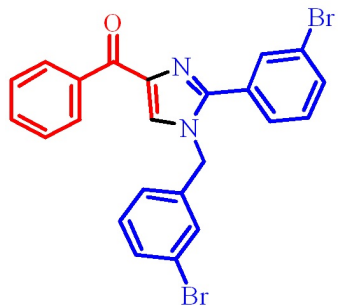
7.764
7.620
7.579
7.561
7.543
7.501
7.482
7.463
7.449
7.432
7.427
7.393
7.376
7.319
7.302
7.260
7.097
6.980
6.963





¹³C NMR (100 MHz, CDCl₃)

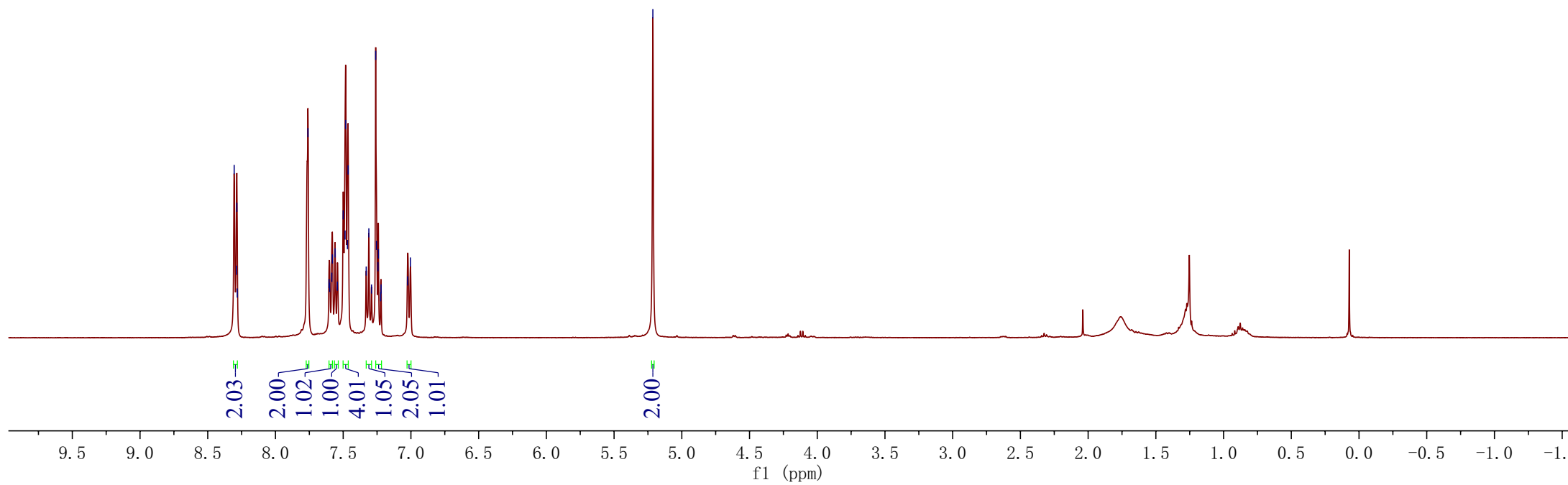
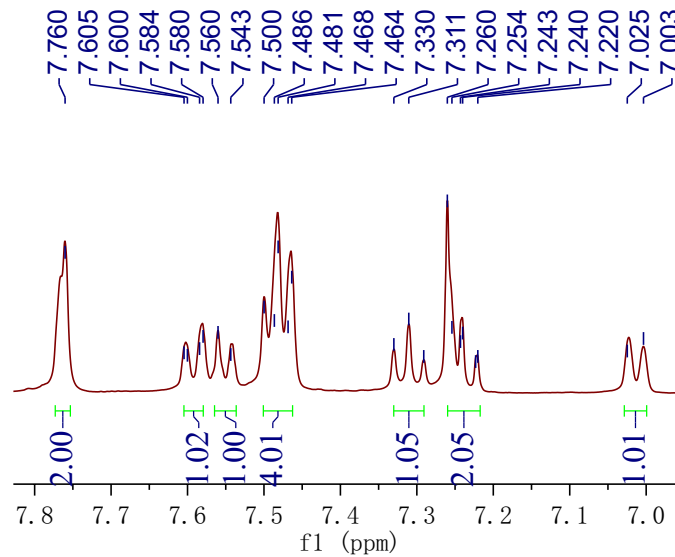


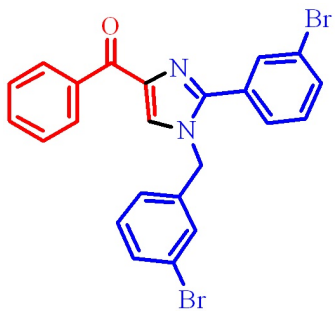


3ak

¹H NMR (400 MHz, CDCl₃)

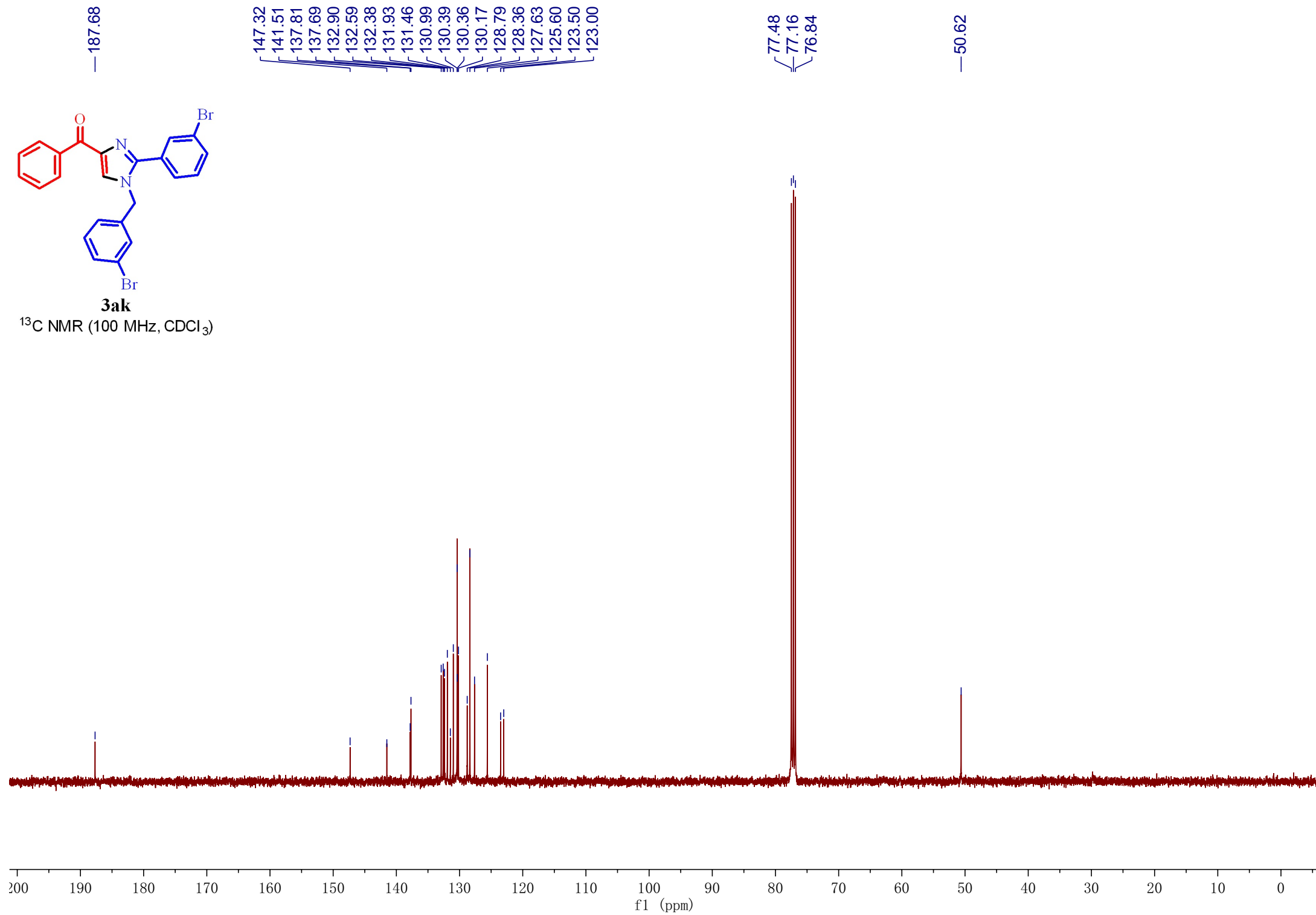
8.305
8.289
8.285
8.282
7.760
7.584
7.580
7.560
7.500
7.486
7.481
7.468
7.464
7.330
7.311
7.260
7.254
7.243
7.240
7.093
7.003

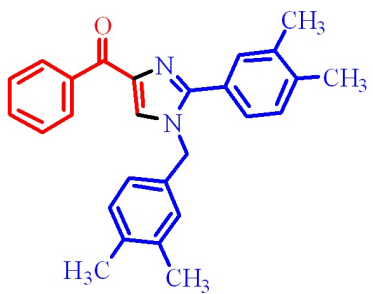




3ak

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





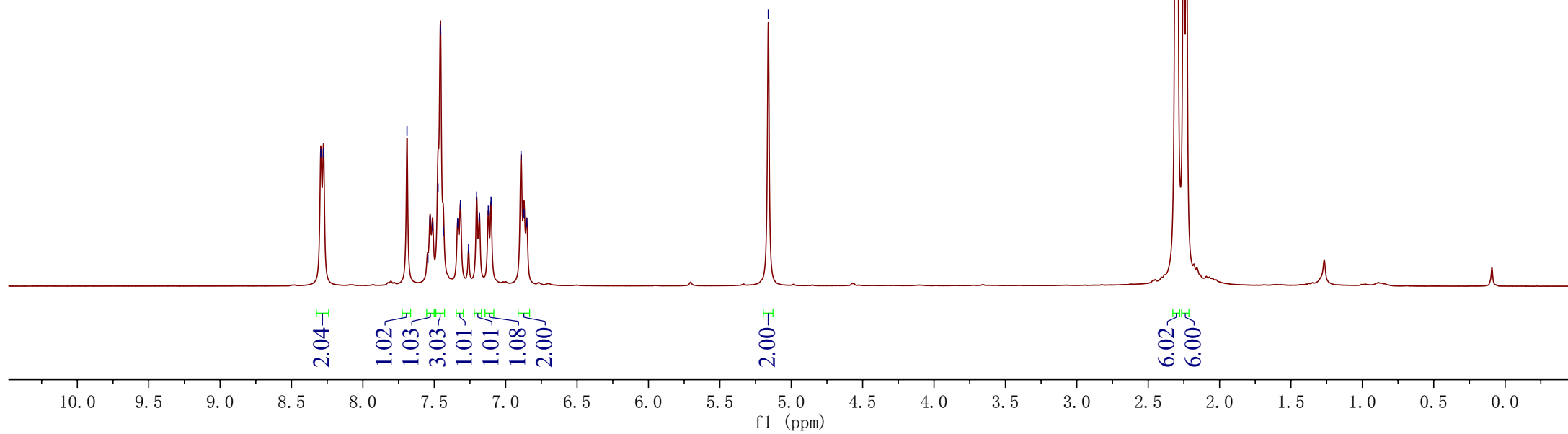
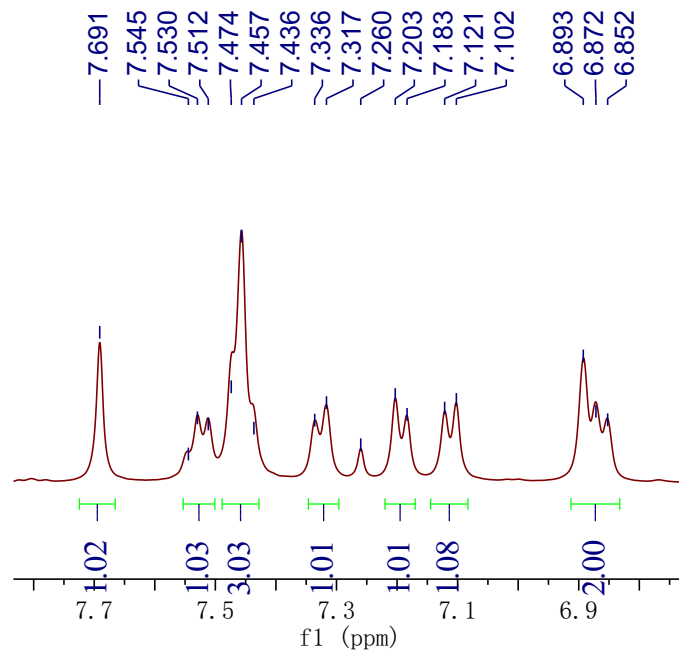
3al

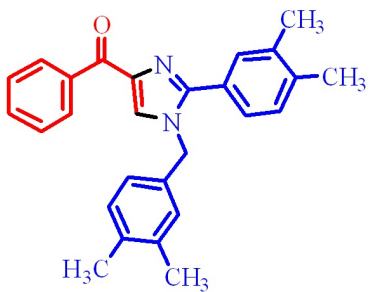
¹H NMR (400 MHz, CDCl₃)

8.294
8.276
7.691
7.545
7.530
7.512
7.474
7.457
7.436
7.336
7.317
7.260
7.203
7.183
7.121
7.102
6.893
6.872
6.852

-5.161

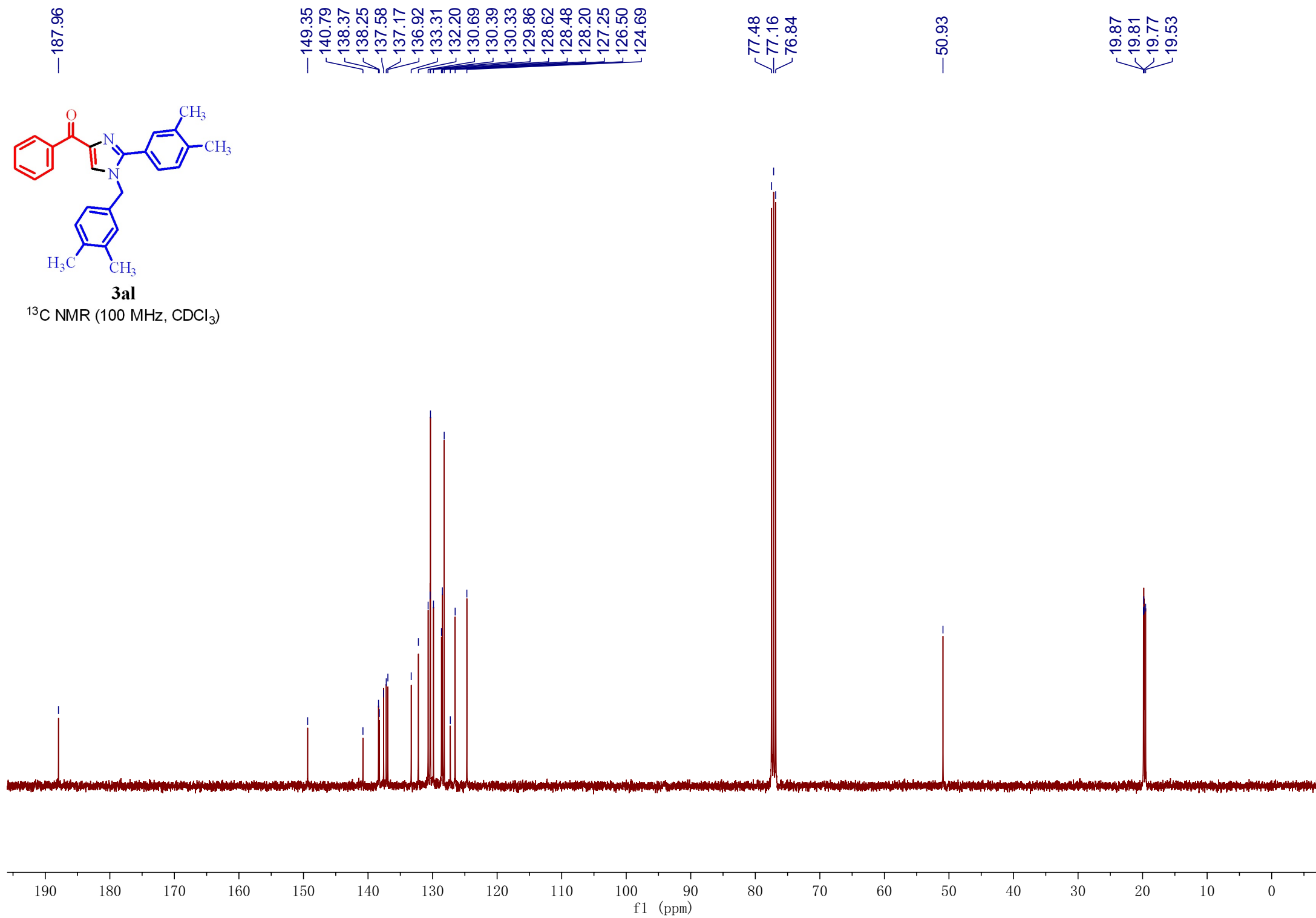
2.310
2.294
2.252
2.232

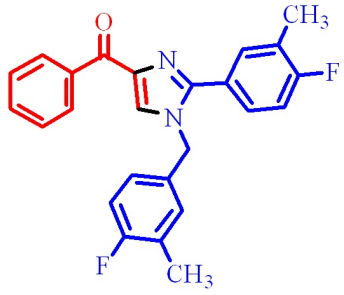




3al

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





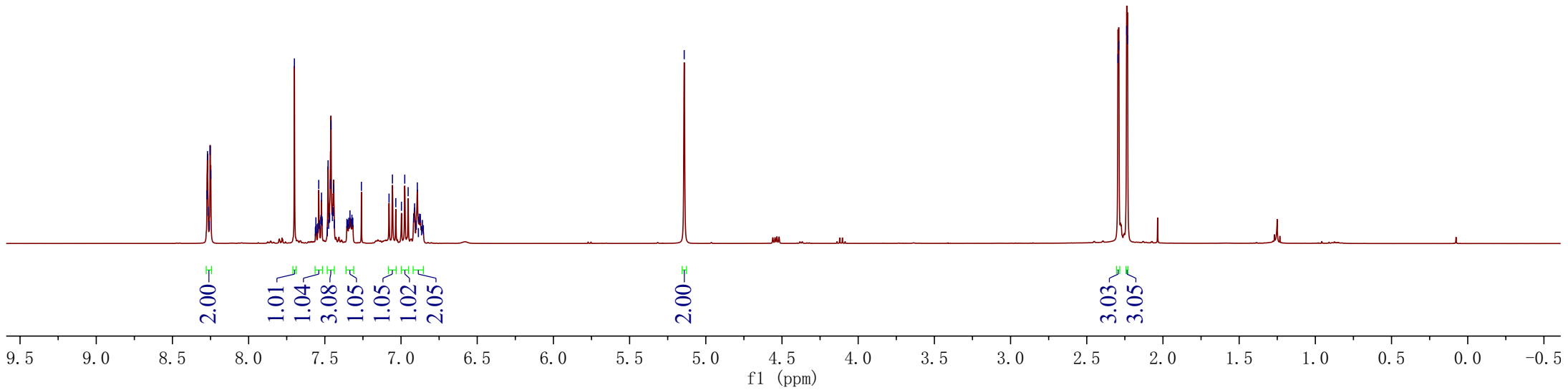
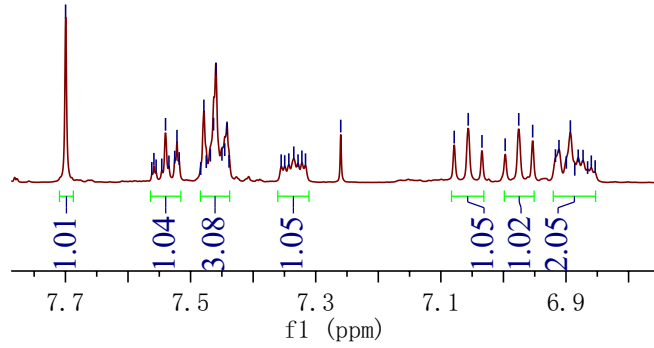
3am

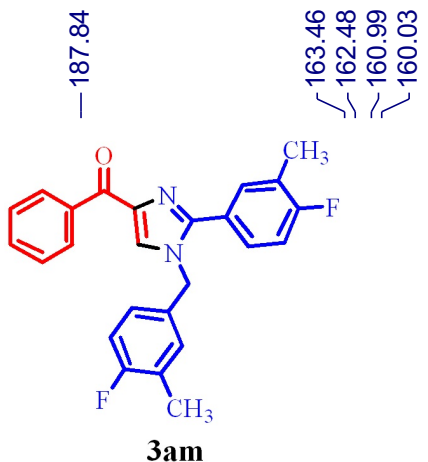
¹H NMR (400 MHz, CDCl₃)

8.273
8.270
8.266
8.258
8.253
8.249
7.700
7.540
7.522
7.479
7.463
7.460
7.450
7.445
7.442
7.335
7.260
7.079
7.056
7.034
6.997
6.976
6.953
6.911
6.893
6.893

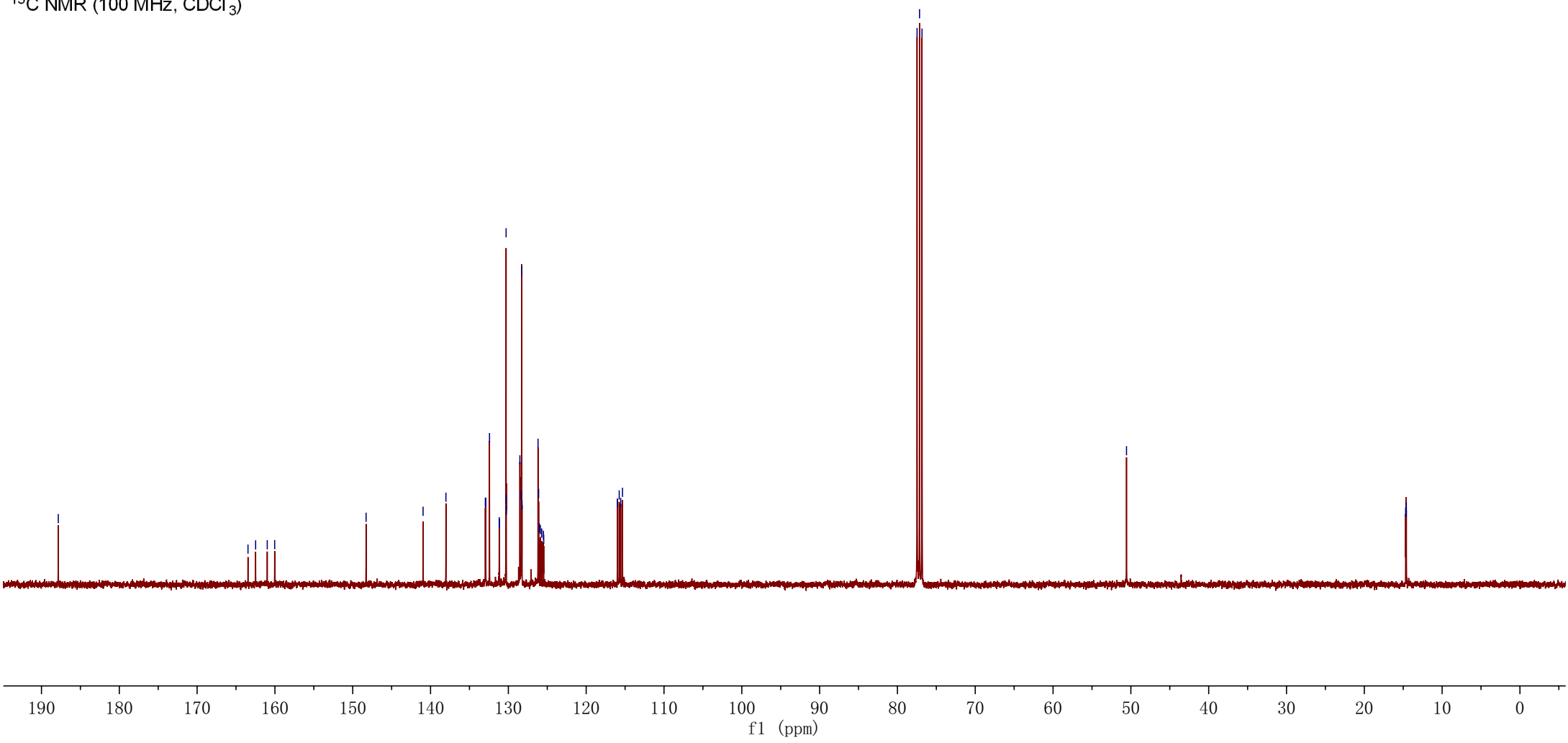
2.295
2.290
2.238
2.233

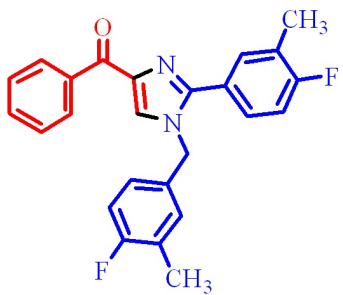
7.700
7.540
7.522
7.479
7.468
7.463
7.460
7.450
7.445
7.442
7.335
7.260
7.079
7.056
7.034
6.997
6.976
6.953
6.917
6.911
6.893





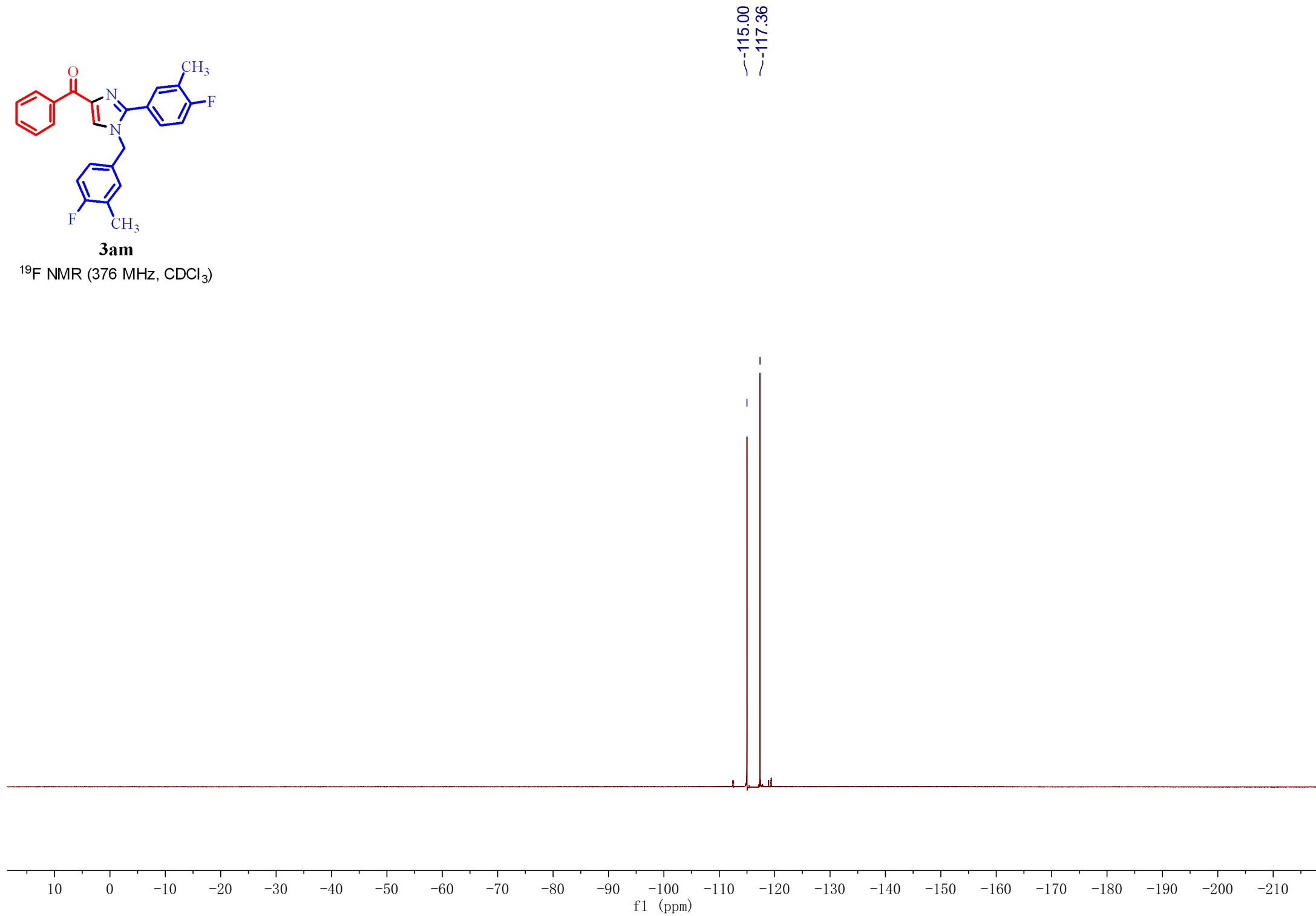
¹³C NMR (100 MHz, CDCl₃)

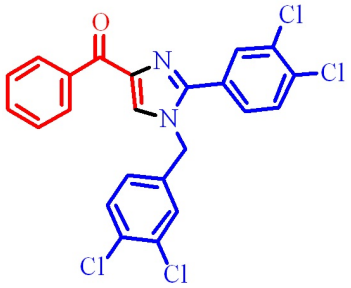




3am

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



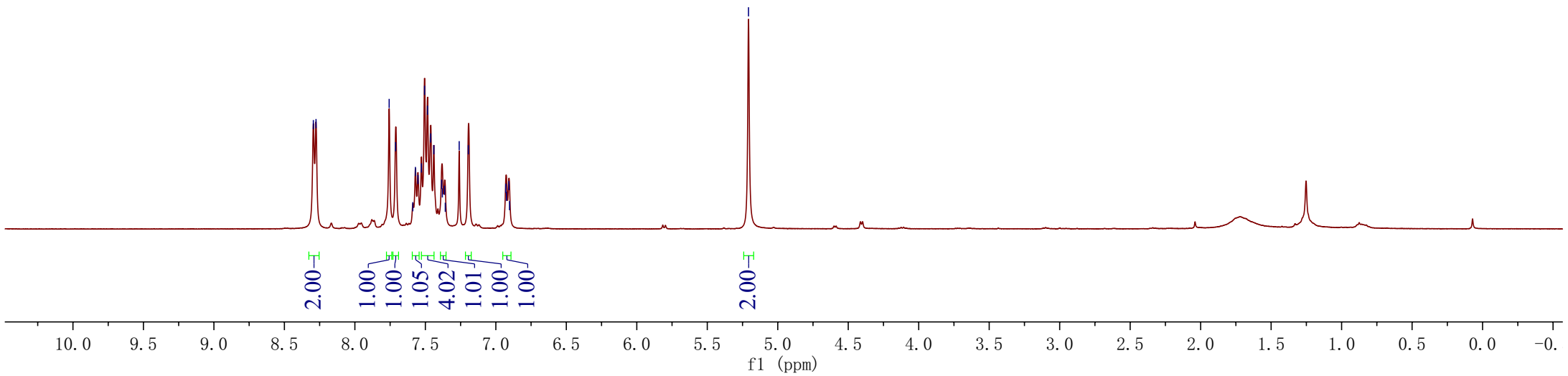
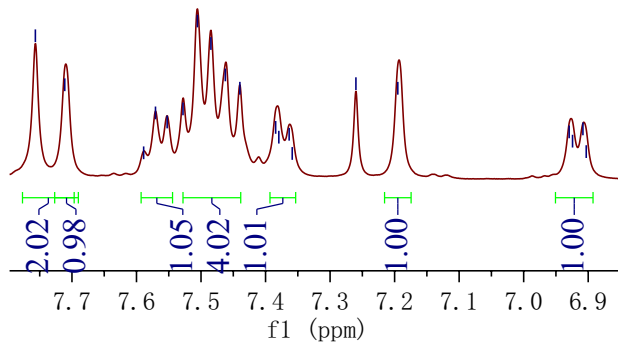


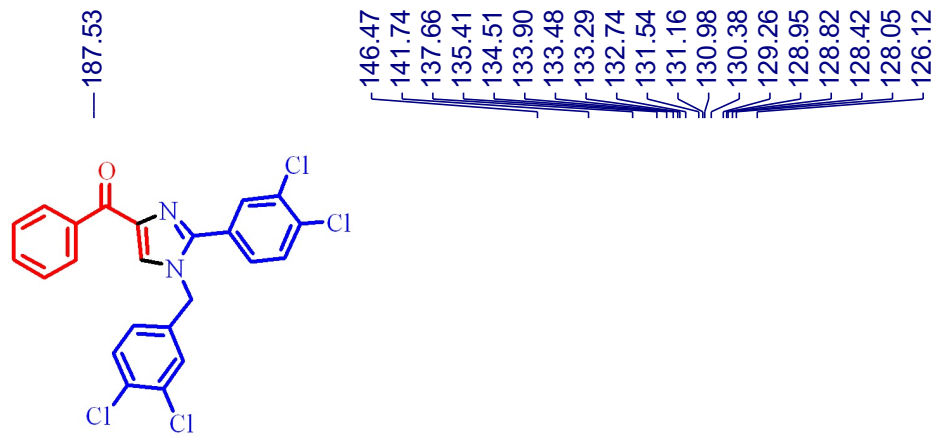
3an

^1H NMR (400 MHz, CDCl_3)

8.295
8.276
7.757
7.711
7.571
7.552
7.528
7.506
7.485
7.462
7.440
7.384
7.379
7.363
7.260
7.195
6.929
6.924
6.908
6.903

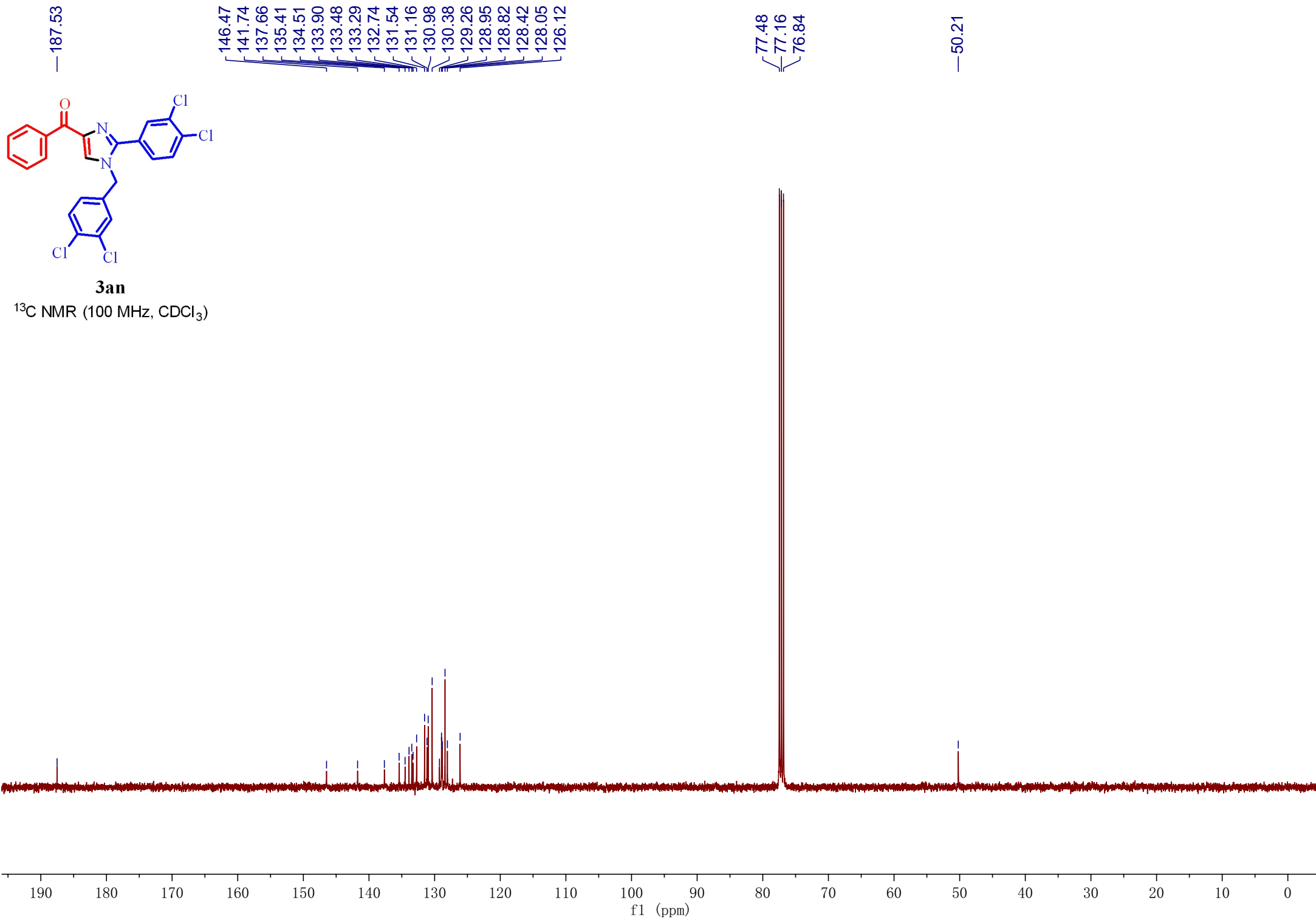
7.757
7.711
7.571
7.552
7.528
7.506
7.485
7.462
7.440
7.260
7.195
6.929
6.924
6.908
6.903

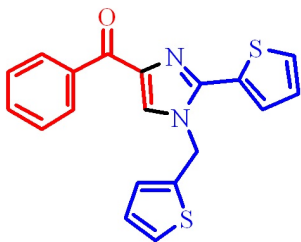




3an

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



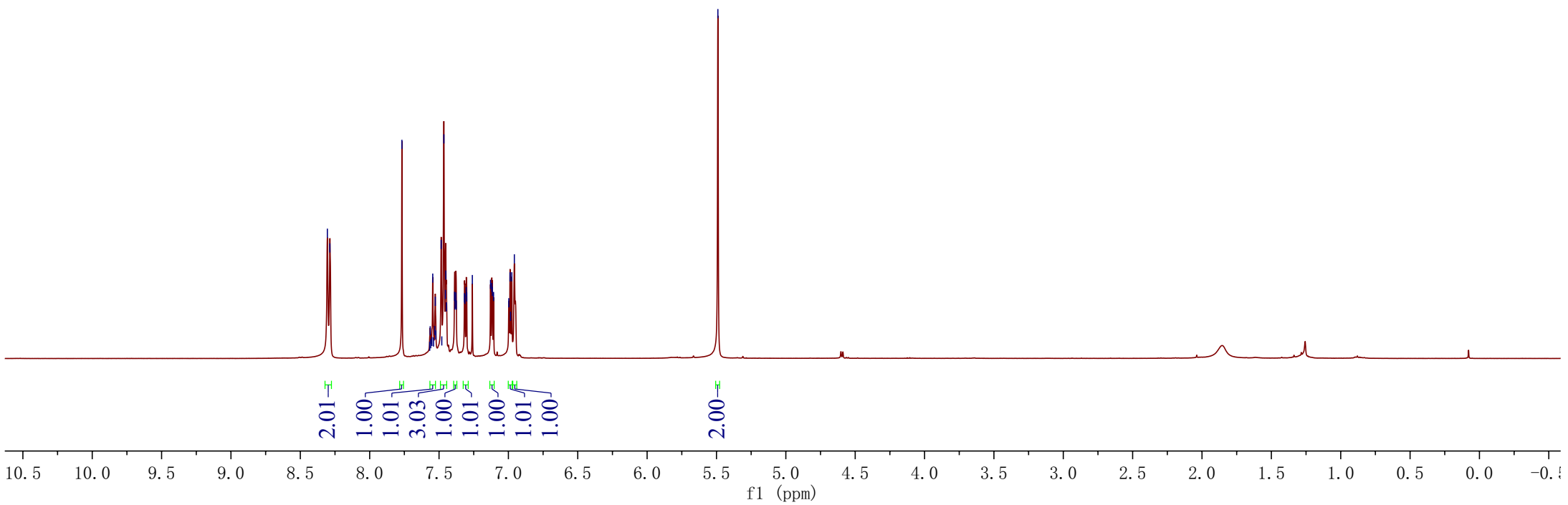
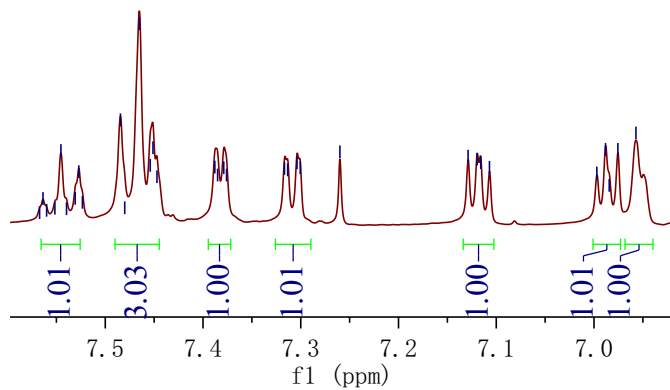


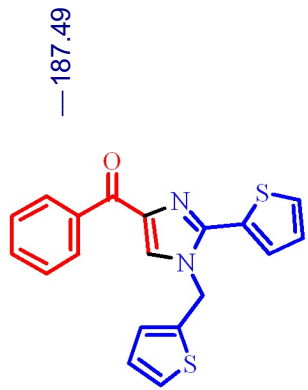
3ao

¹H NMR (400 MHz, CDCl₃)

8.305
8.287
7.768
7.545
7.484
7.465
7.454
7.451
7.388
7.304
7.260
7.129
7.120
7.116
7.107
6.988
6.976
6.957

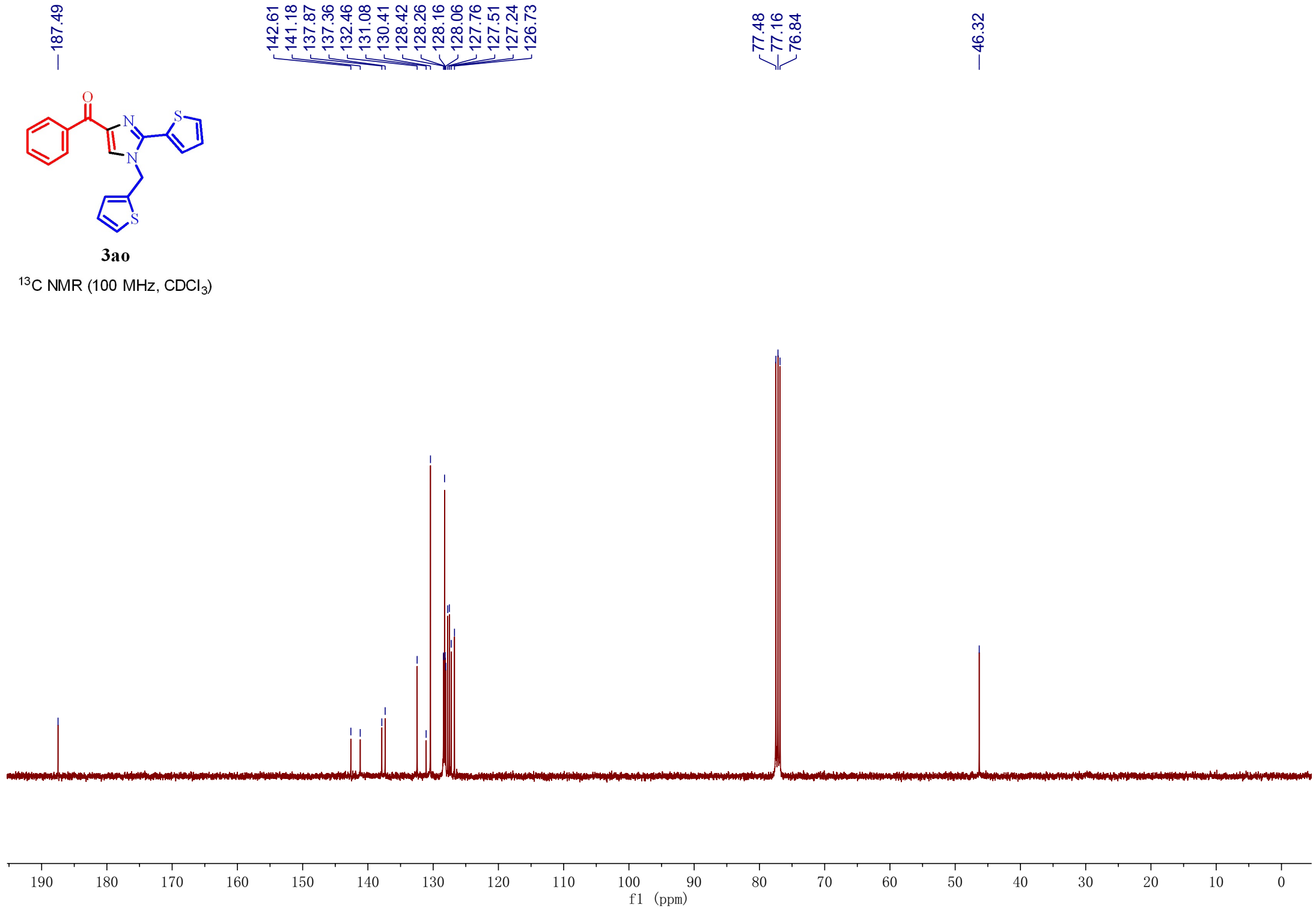
7.545
7.527
7.484
7.465
7.454
7.451
7.388
7.379
7.317
7.313
7.304
7.301
7.260
7.129
7.120
7.116
7.107
6.997
6.988
6.976
6.957

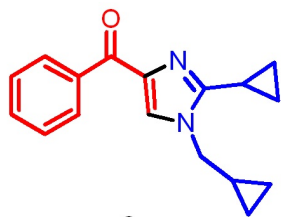




3ao

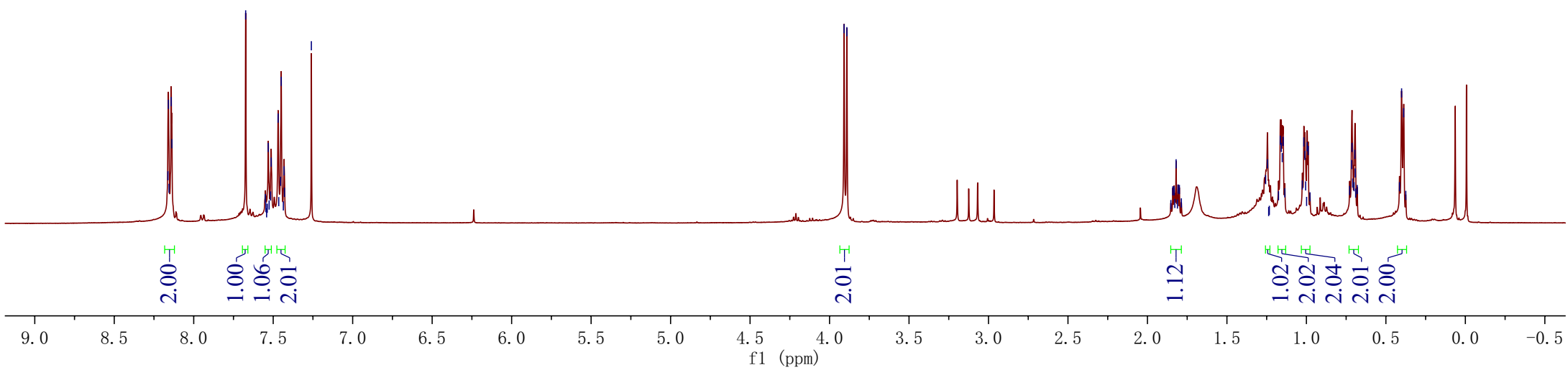
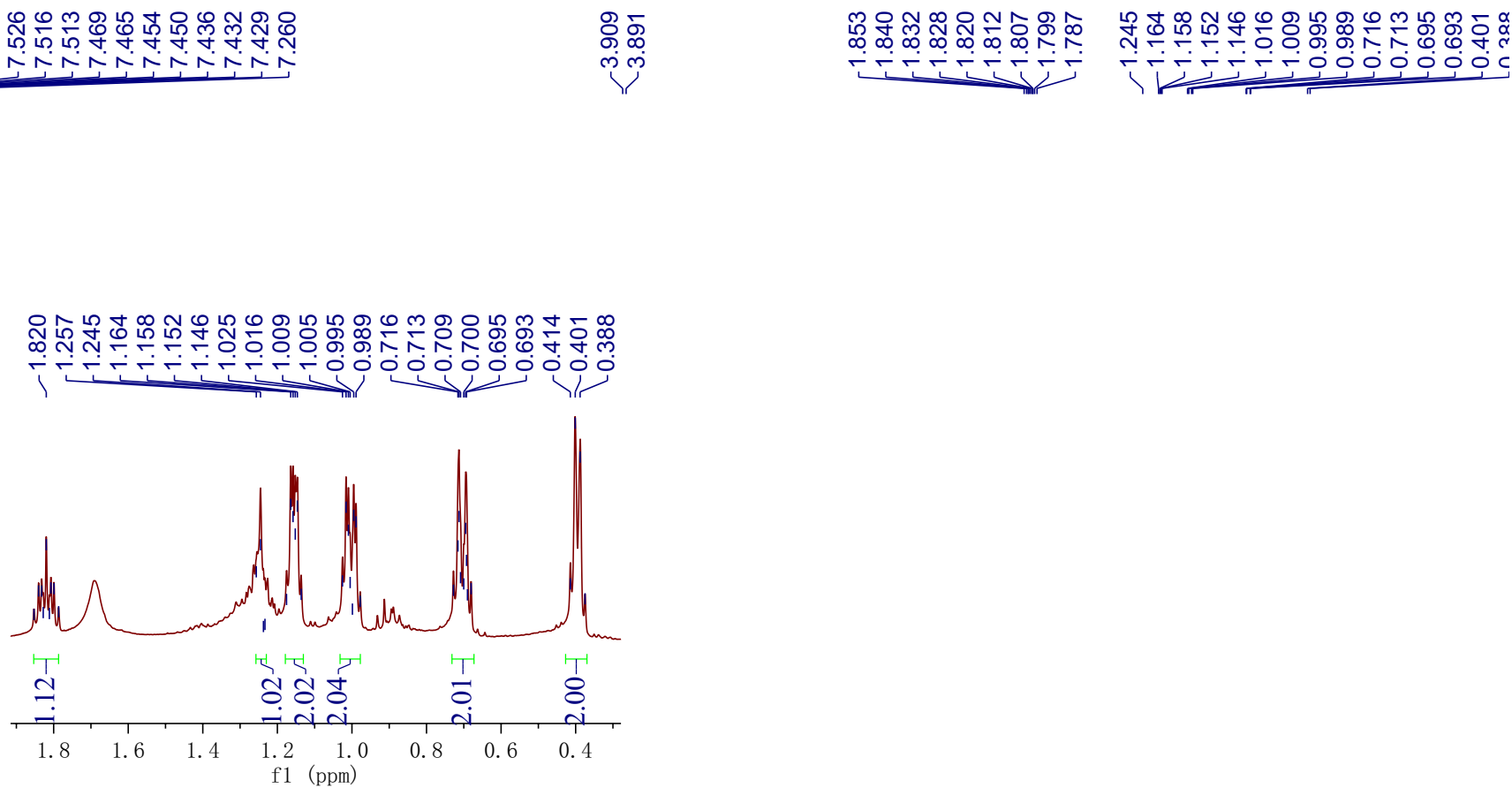
^{13}C NMR (100 MHz, CDCl_3)

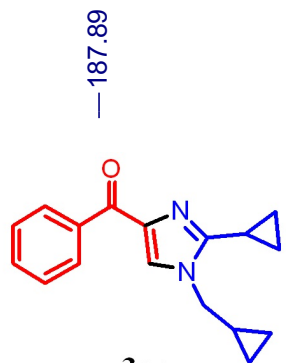




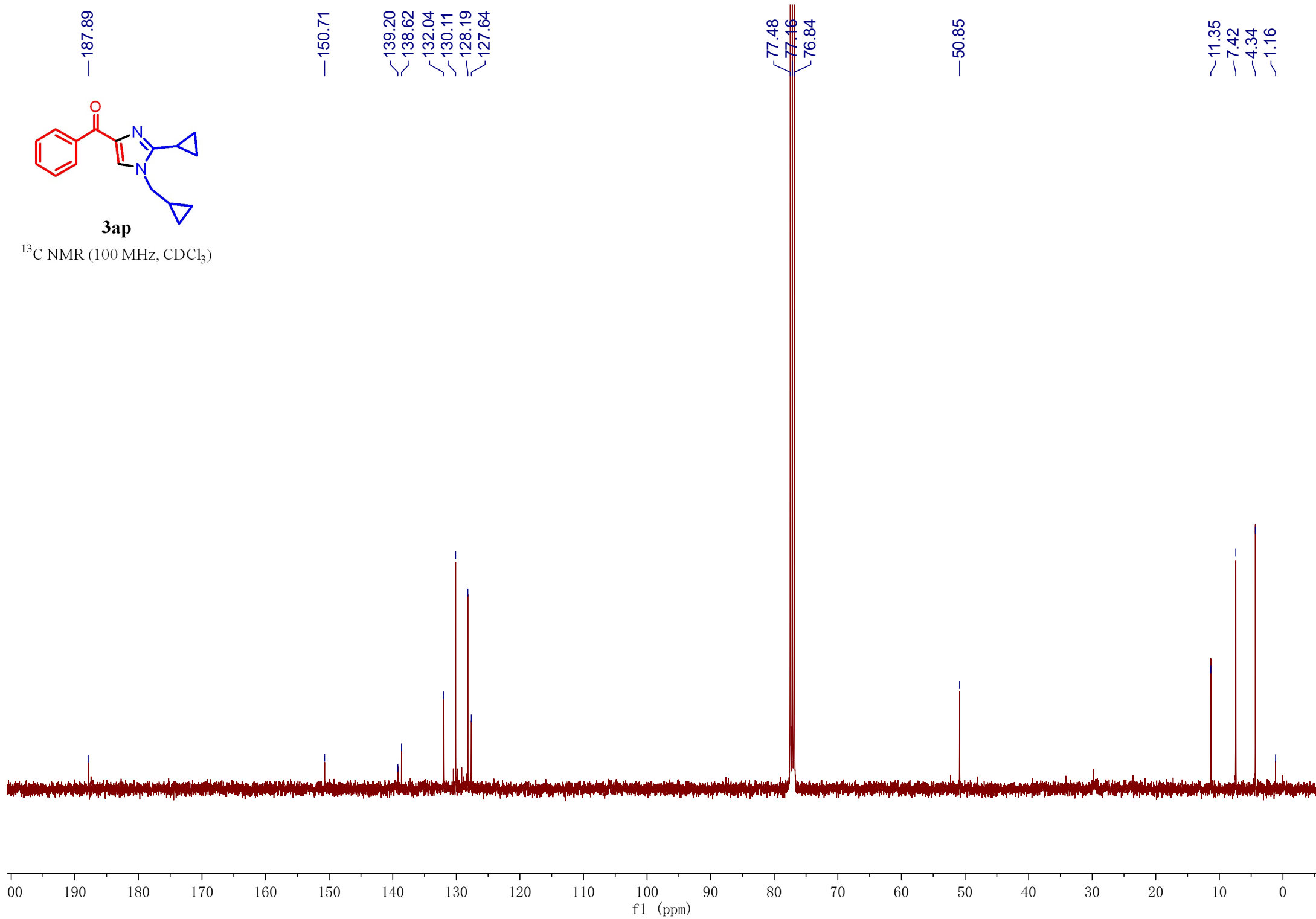
3ap

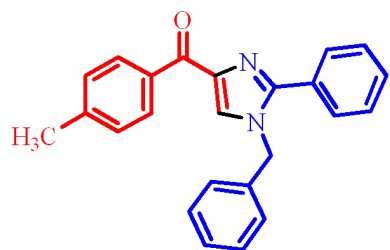
¹H NMR (400 MHz, CDCl₃)





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

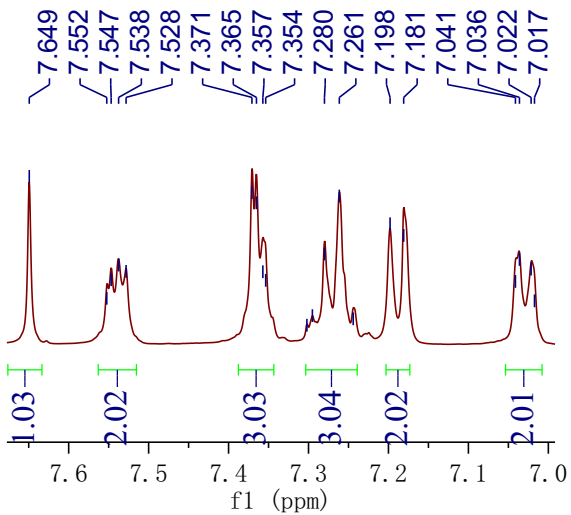




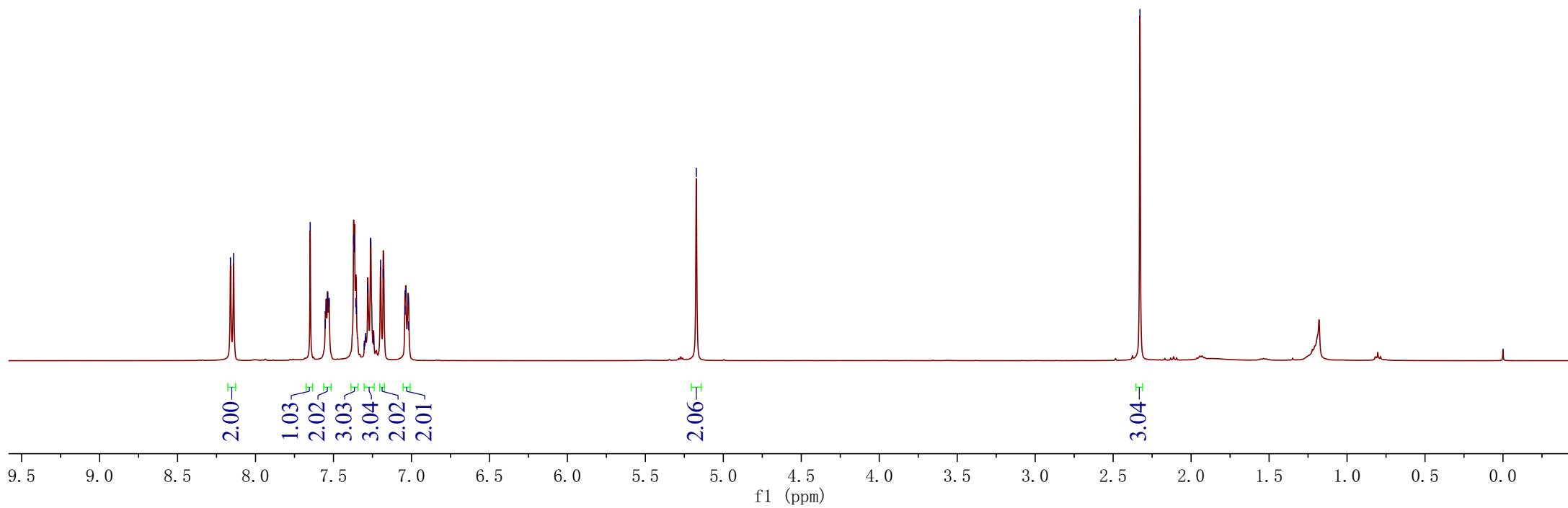
3ba

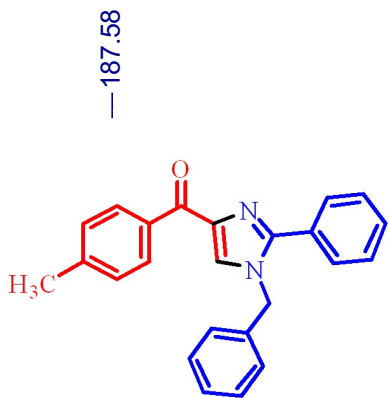
¹H NMR (400 MHz, CDCl₃)

8.161
8.140
7.649
7.552
7.547
7.538
7.528
7.371
7.365
7.357
7.354
7.295
7.280
7.261
7.244
7.198
7.181
7.041
7.036
7.022
7.017

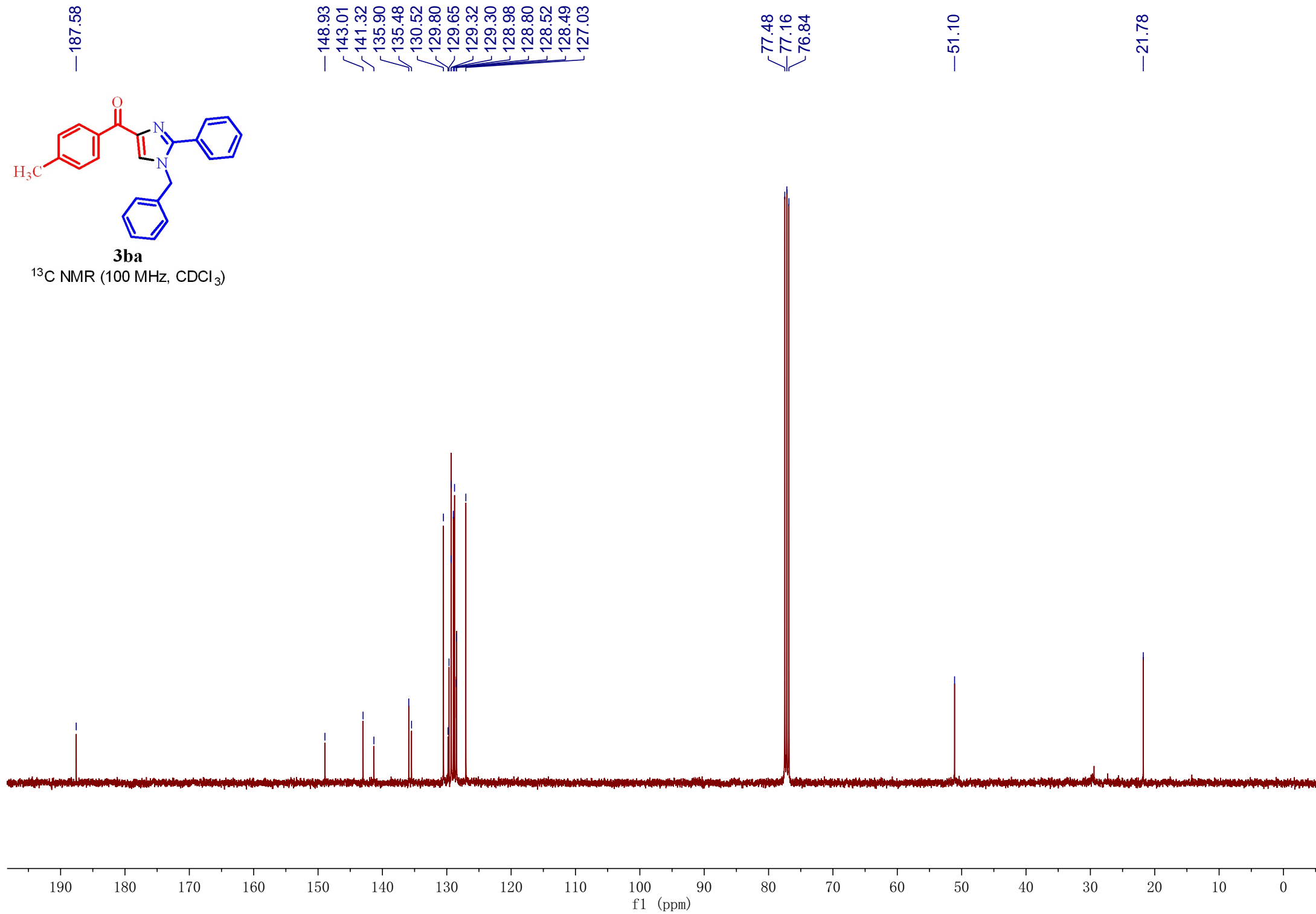


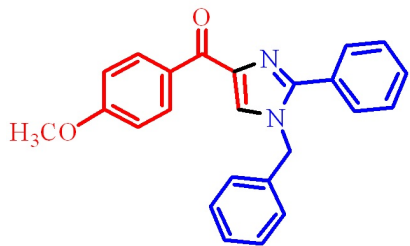
2.328





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

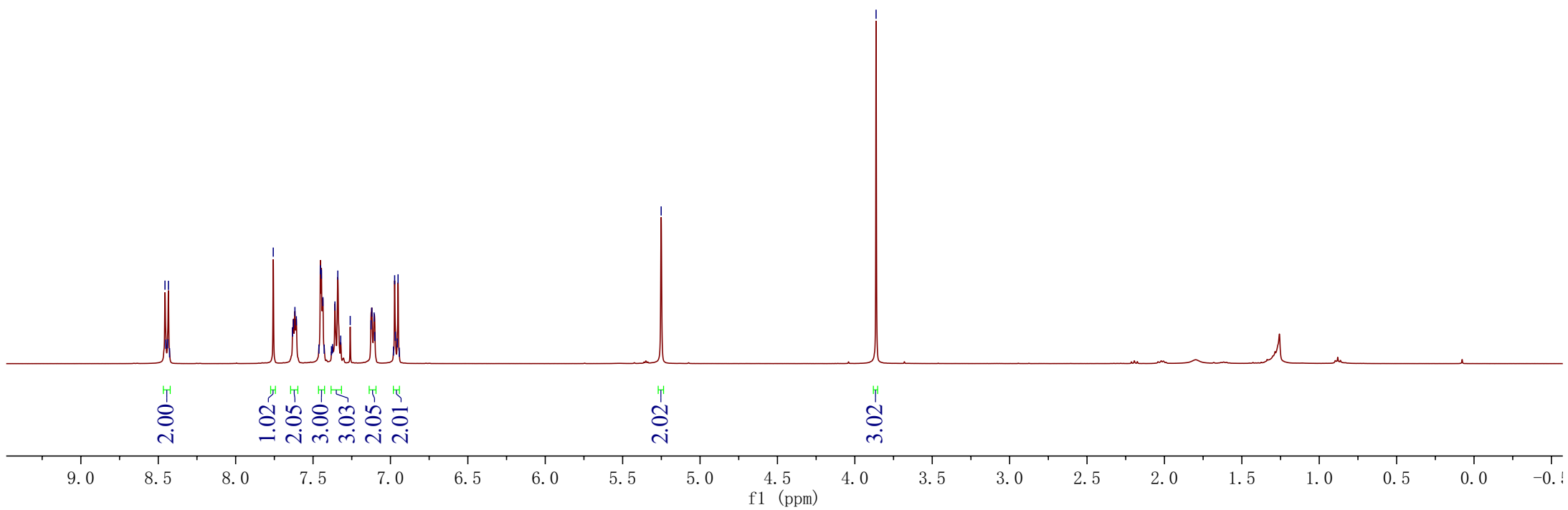
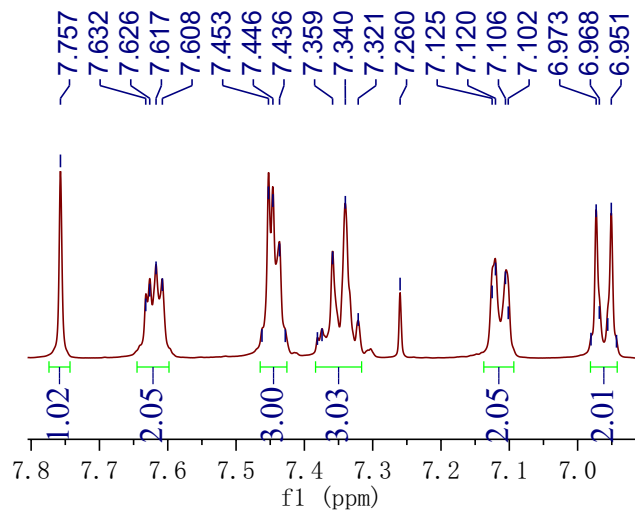


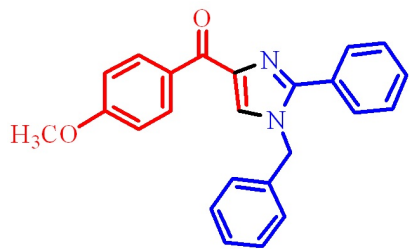


3ca

¹H NMR (400 MHz, CDCl₃)

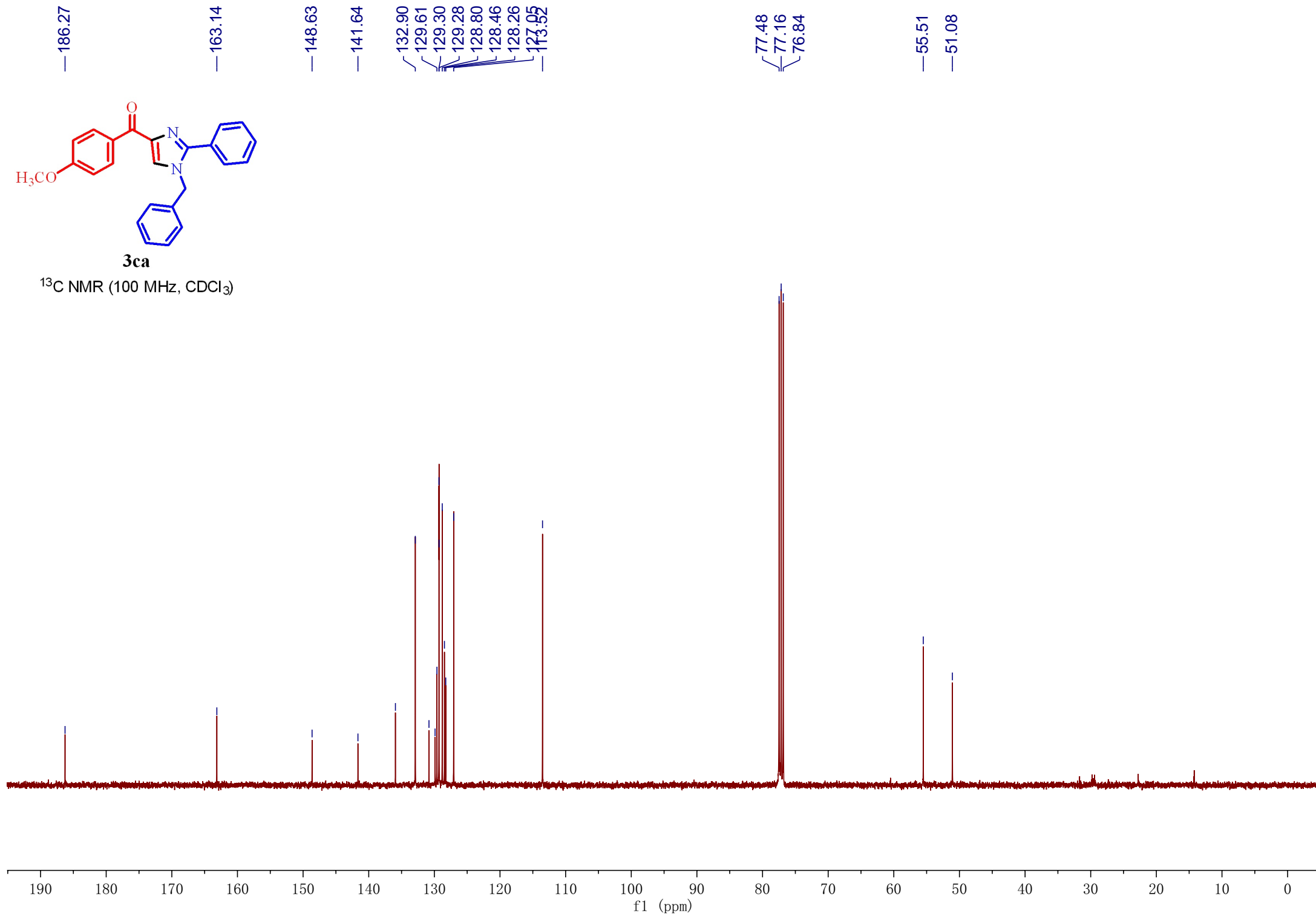
8.457
8.451
8.440
8.434
8.427
7.757
7.632
7.626
7.617
7.608
7.453
7.446
7.436
7.359
7.340
7.321
7.260
7.125
7.120
7.106
7.102
6.973
6.968
6.951
3.863





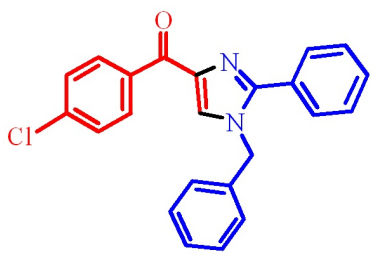
3ca

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



8.386
8.379
8.373
8.368
8.356
8.351
8.345

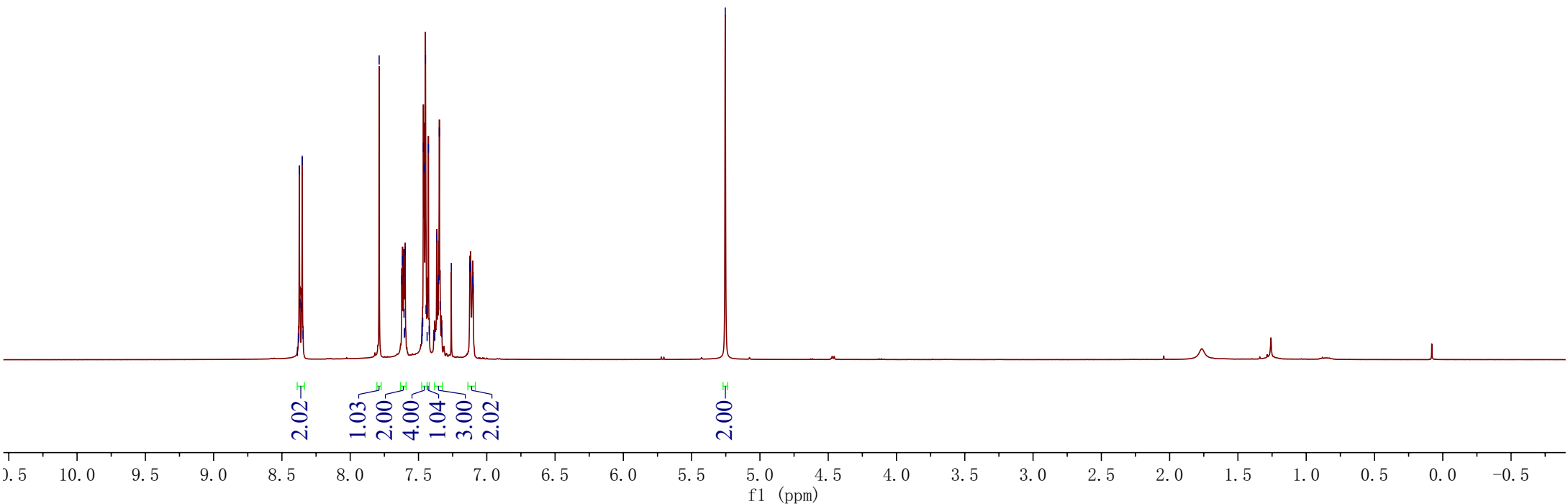
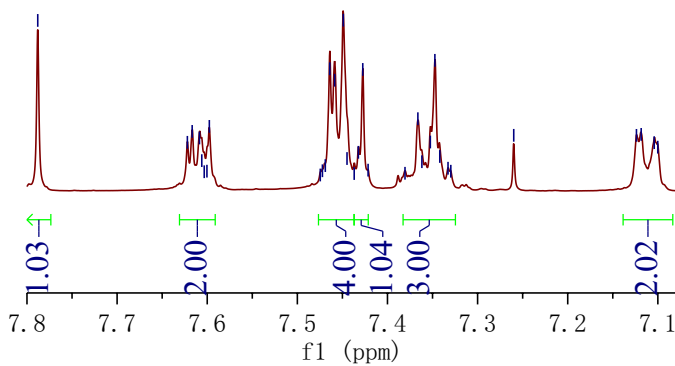
7.788
7.622
7.617
7.609
7.598
7.464
7.459
7.449
7.427
7.366
7.352
7.347
7.260
7.124
7.118
7.104
5.254

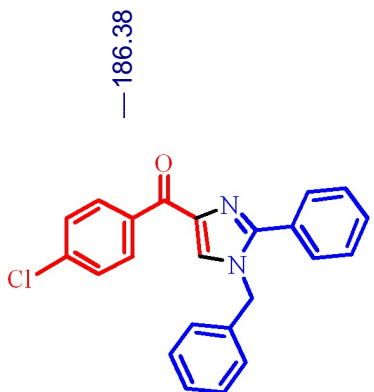


3da

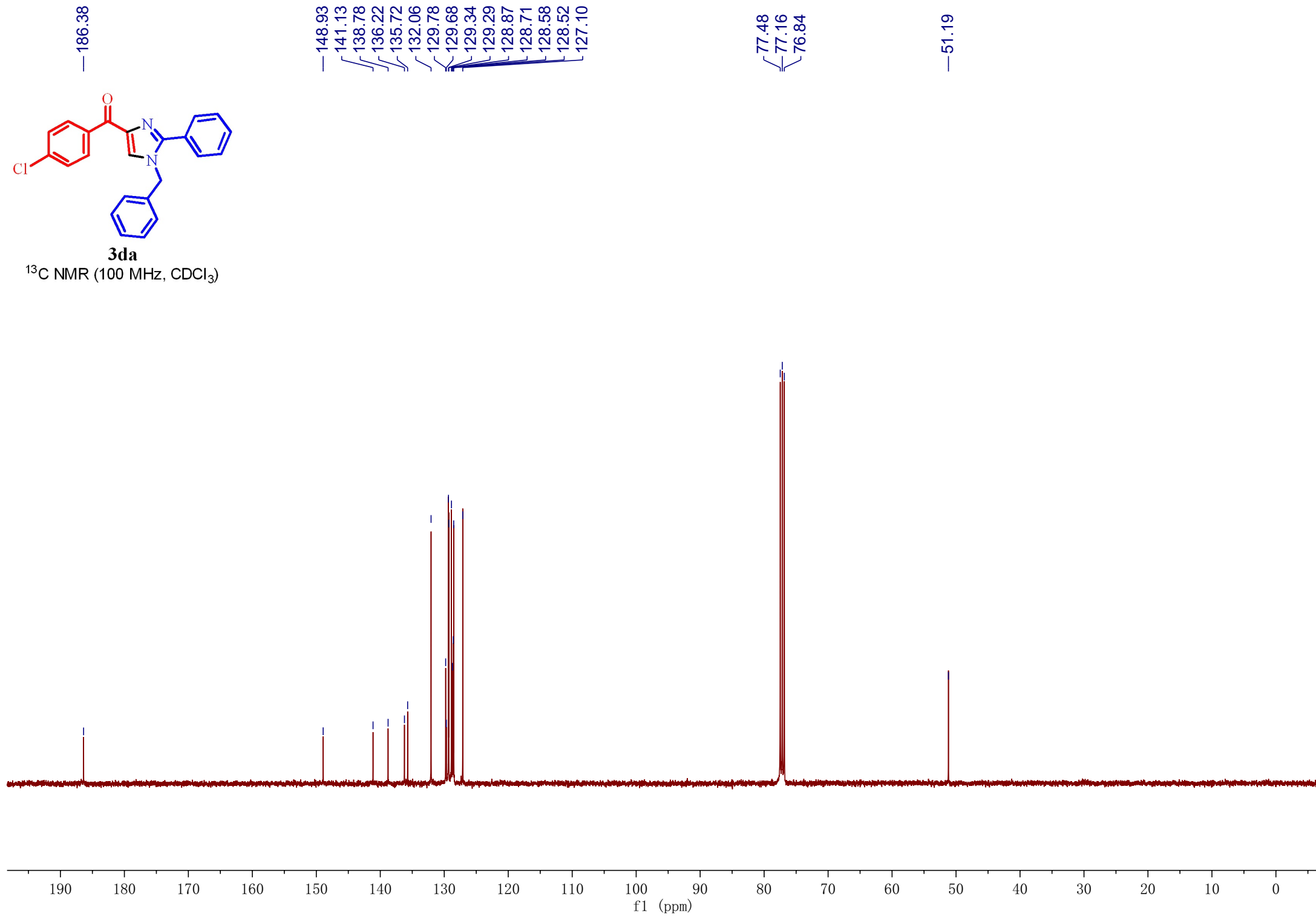
¹H NMR (400 MHz, CDCl₃)

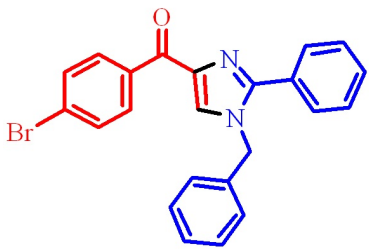
7.788
7.622
7.617
7.609
7.606
7.598
7.464
7.459
7.449
7.445
7.432
7.427
7.366
7.352
7.347
7.342
7.260
7.124
7.118
7.104
7.100





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

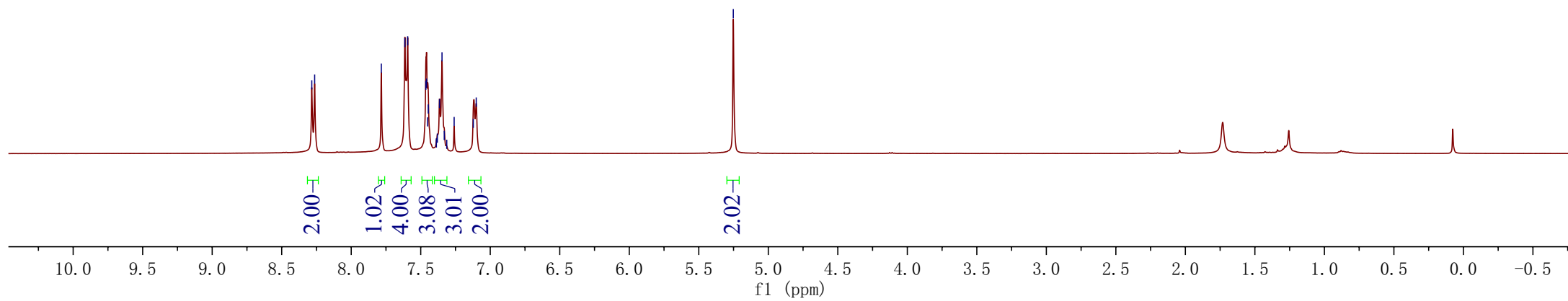
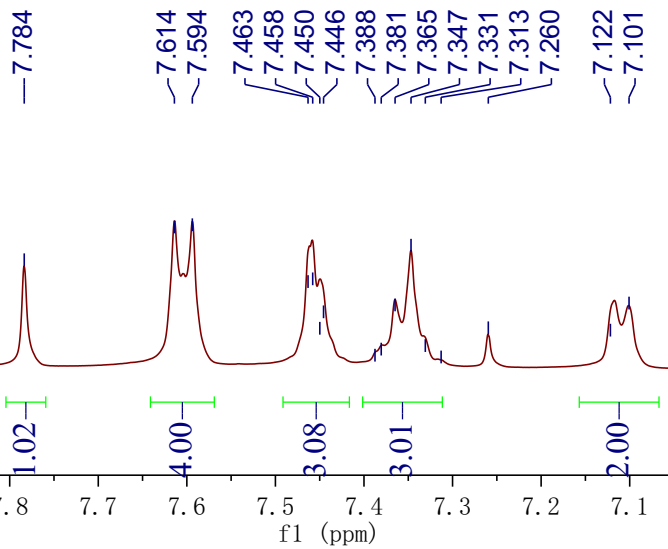


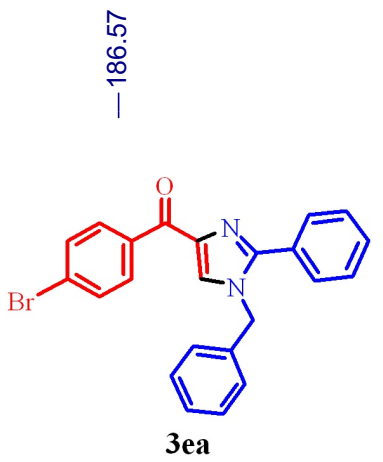


3ea

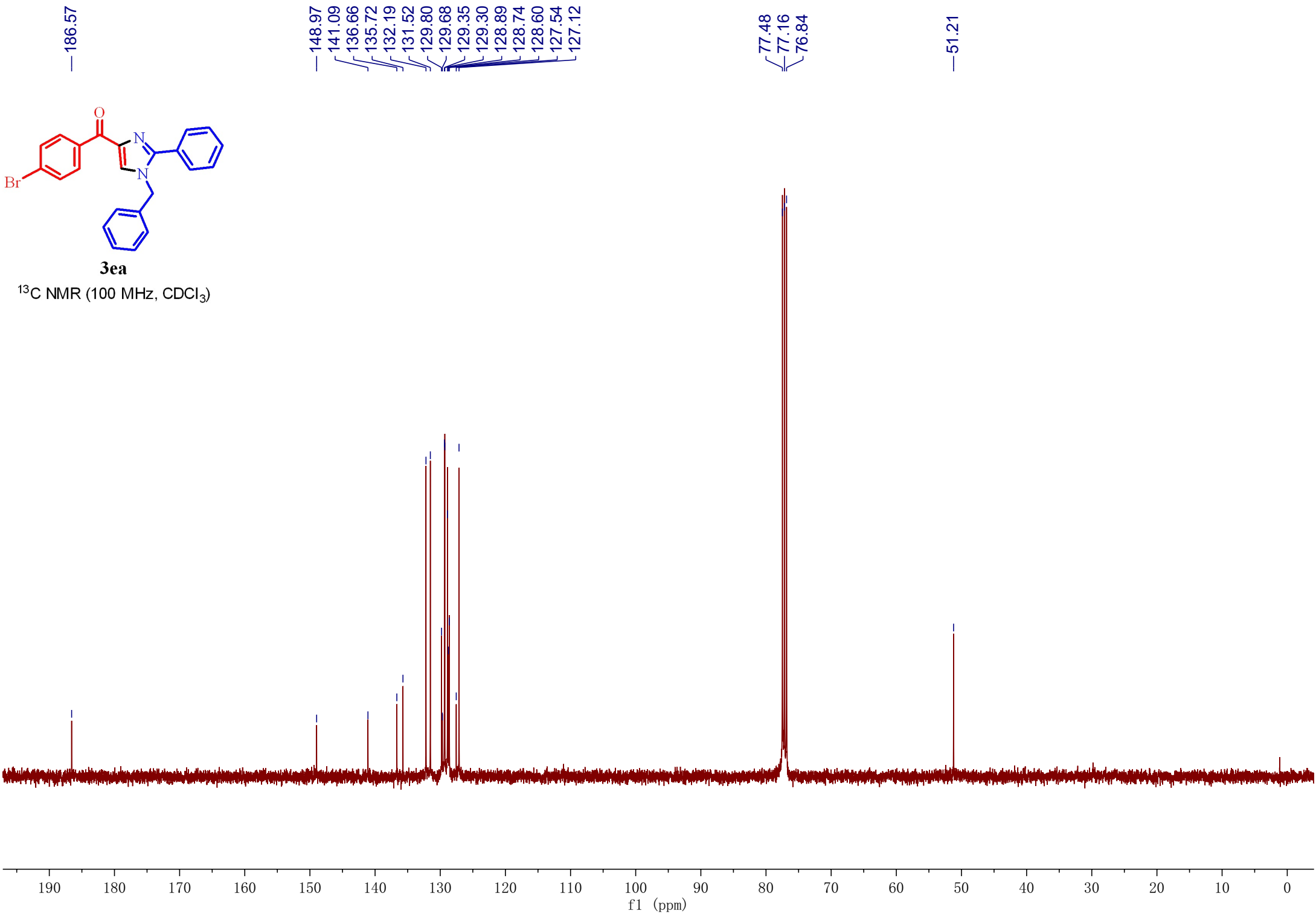
¹H NMR (400 MHz, CDCl₃)

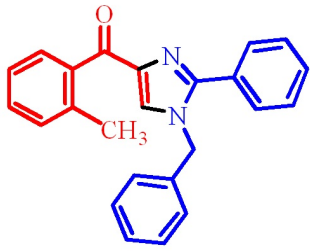
8.284
8.263
7.784
7.614
7.594
7.463
7.458
7.450
7.446
7.388
7.381
7.365
7.347
7.331
7.313
7.260
7.122
7.101
5.252





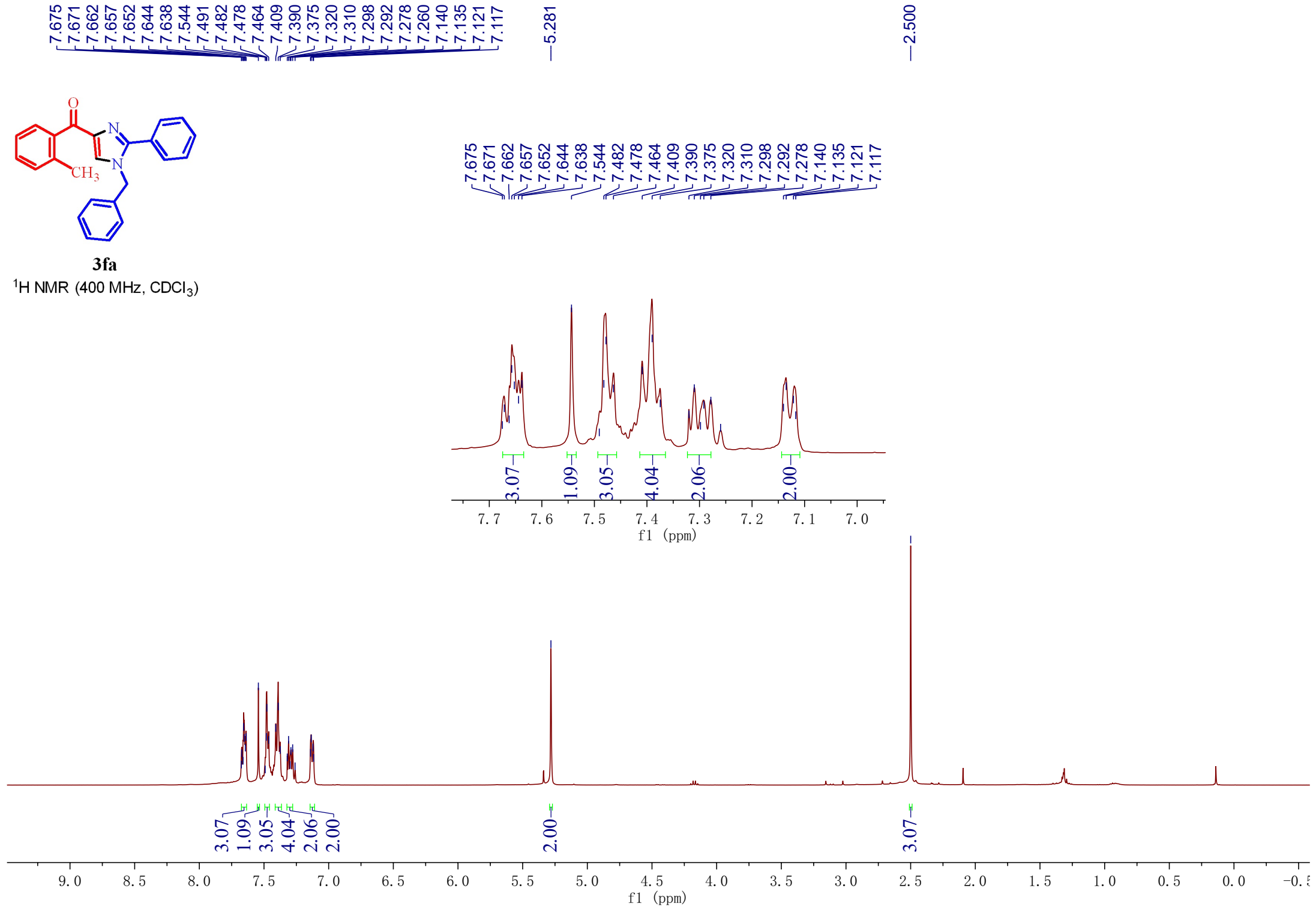
¹³C NMR (100 MHz, CDCl₃)

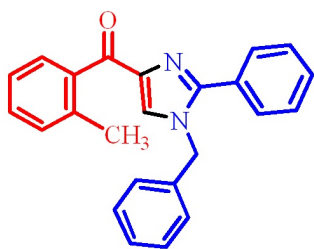




3fa

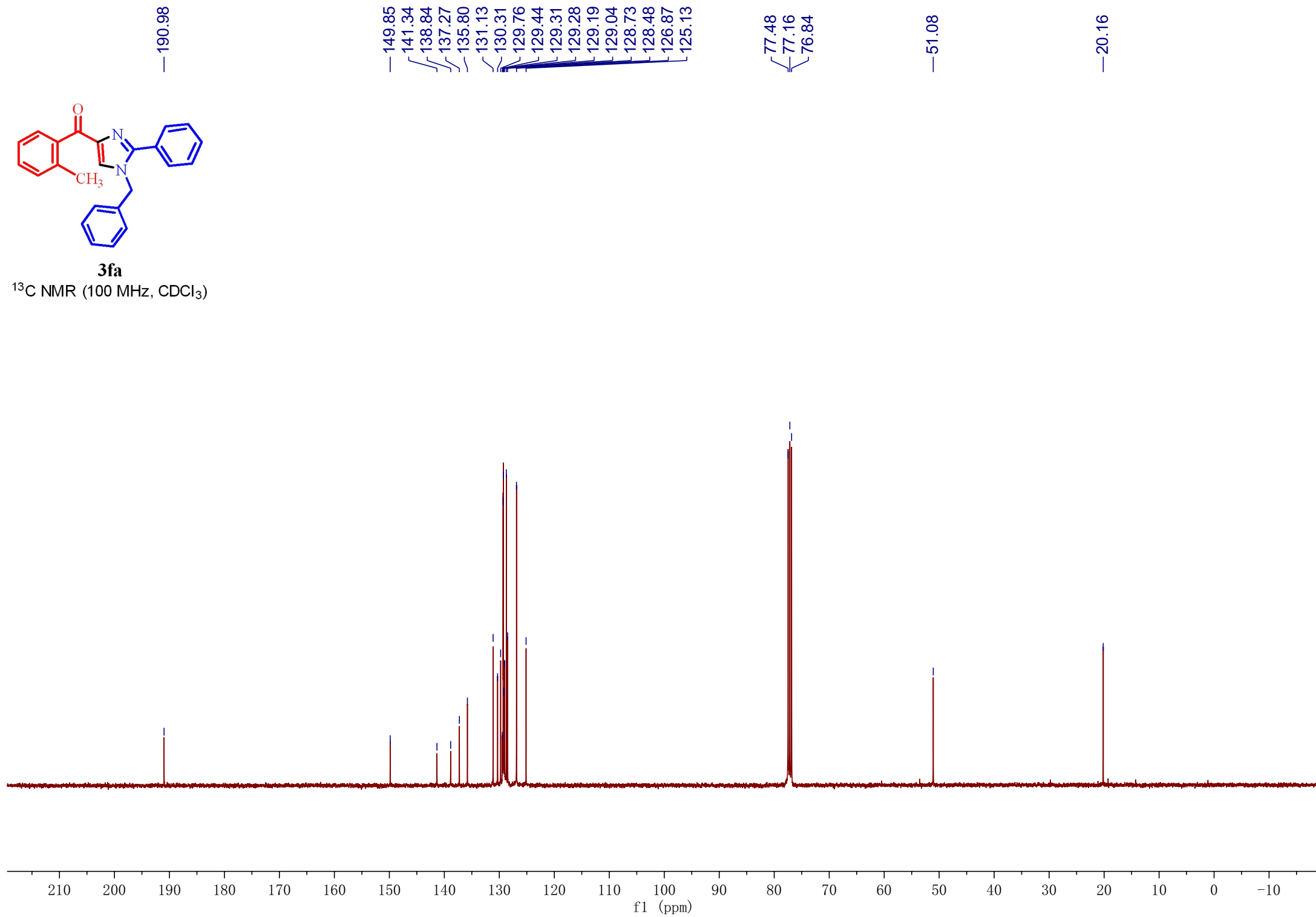
¹H NMR (400 MHz, CDCl₃)

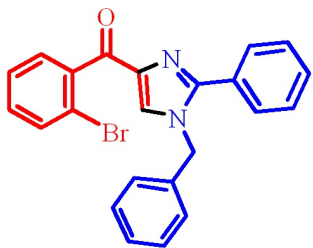




3fa

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



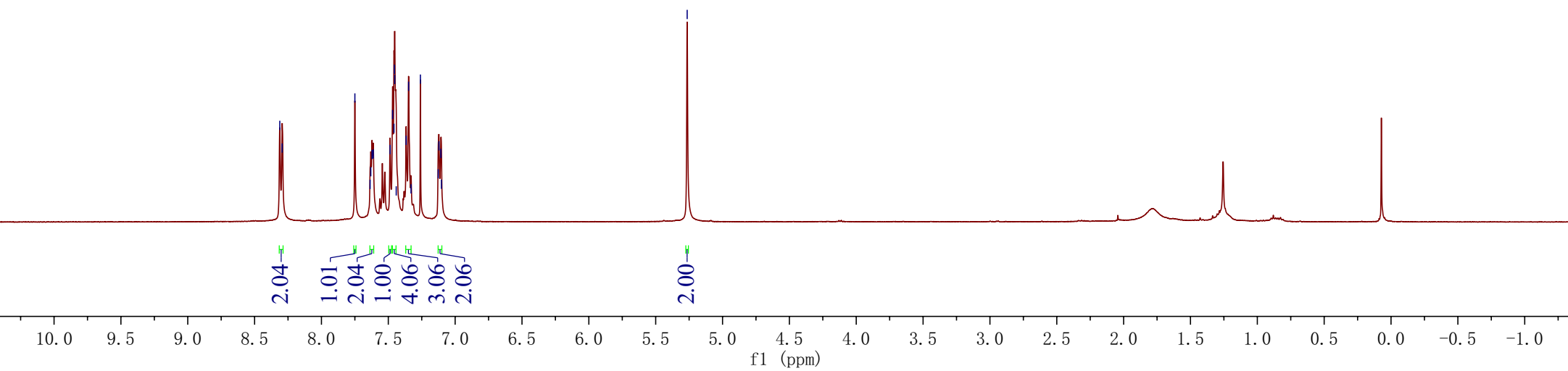
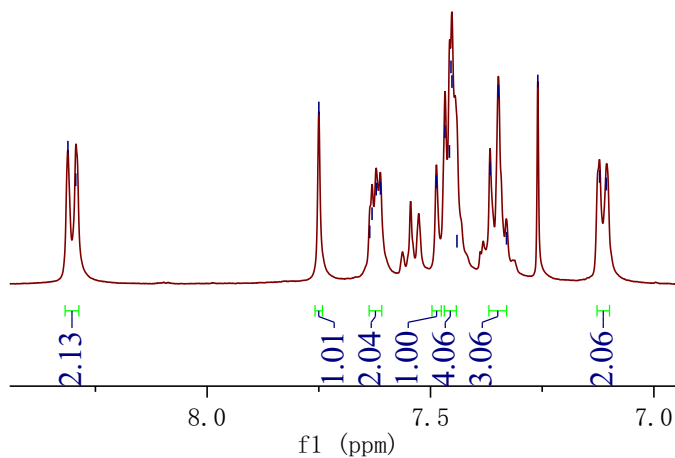


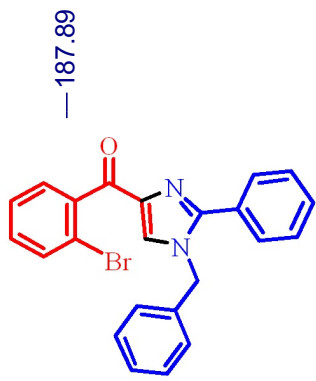
3ga

¹H NMR (400 MHz, CDCl₃)

8.312
8.294
7.750
7.631
7.622
7.612
7.487
7.468
7.458
7.454
7.452
7.367
7.348
7.260
7.126
7.121
7.107
5.265

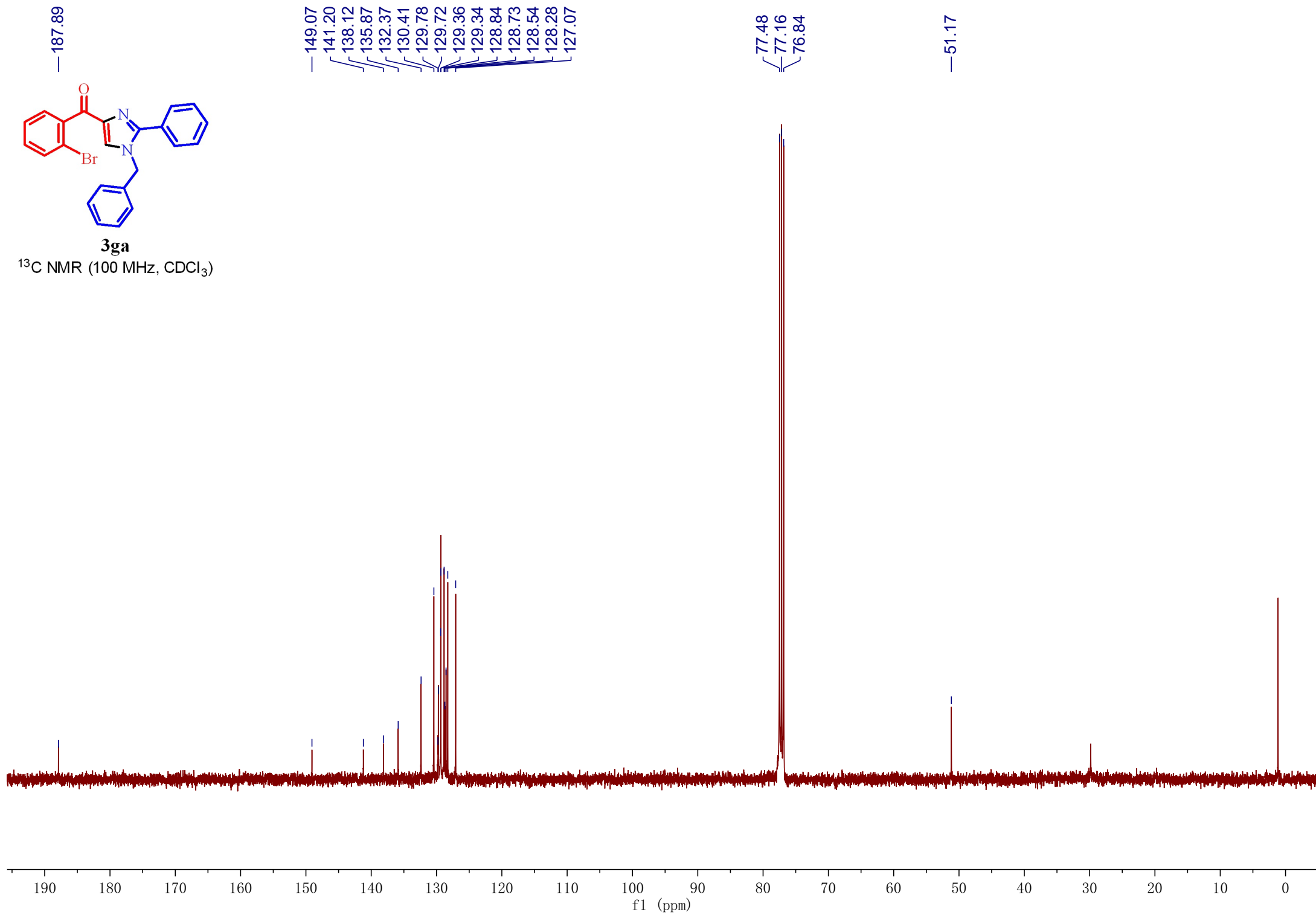
8.312
8.294
7.750
7.636
7.631
7.622
7.612
7.487
7.468
7.458
7.454
7.452
7.441
7.367
7.348
7.330
7.260
7.121
7.107

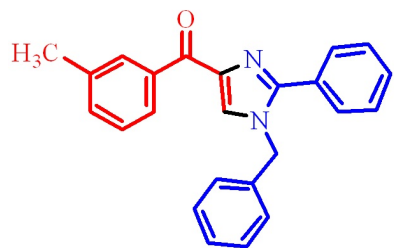




3ga

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





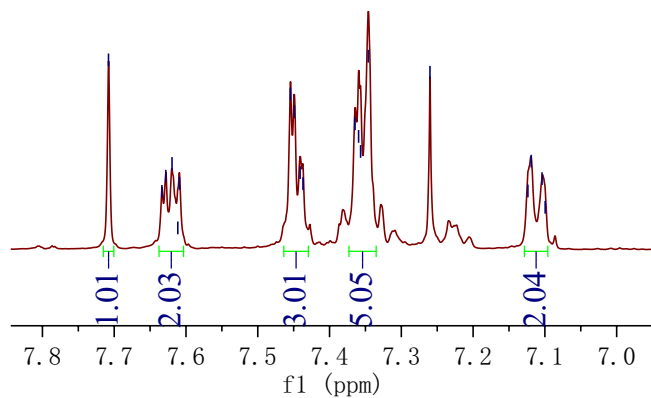
3ha

^1H NMR (400 MHz, CDCl_3)

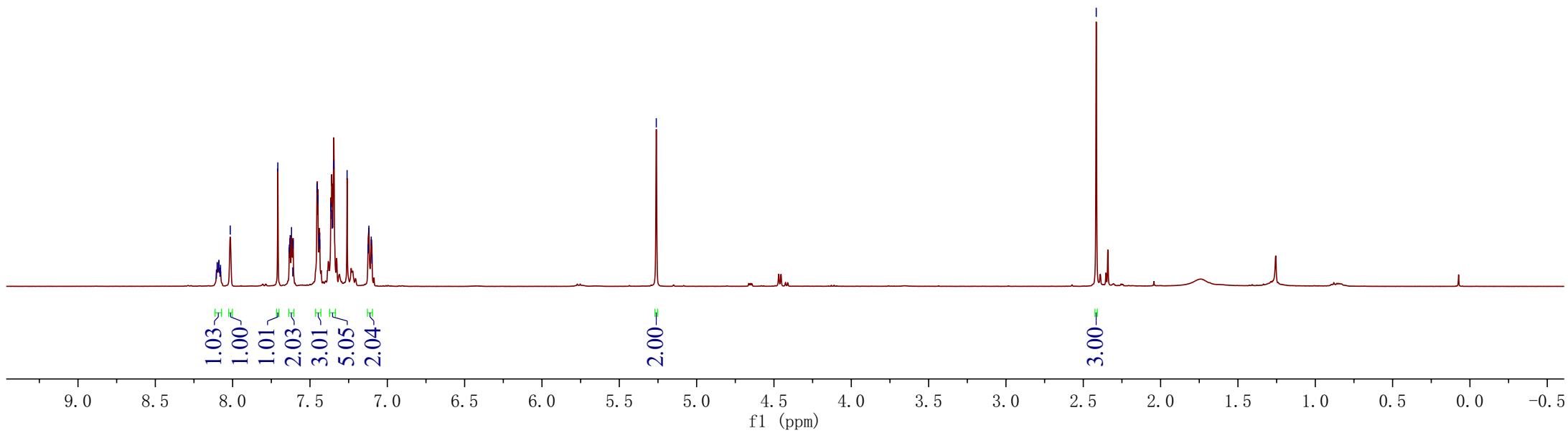
8.105
8.100
8.092
8.089
8.082
8.078
8.016

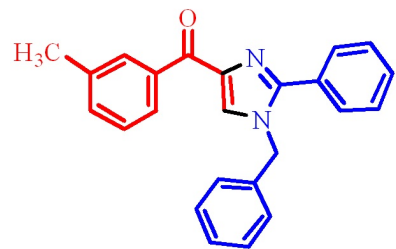
7.708
7.634
7.628
7.619
7.609
7.455
7.449
7.441
7.437
7.364
7.360
7.357
7.346
7.260
7.124
7.119
7.104
5.261

7.708
7.634
7.628
7.619
7.611
7.609
7.455
7.449
7.364
7.360
7.346
7.260
7.124
7.119
7.104
7.100



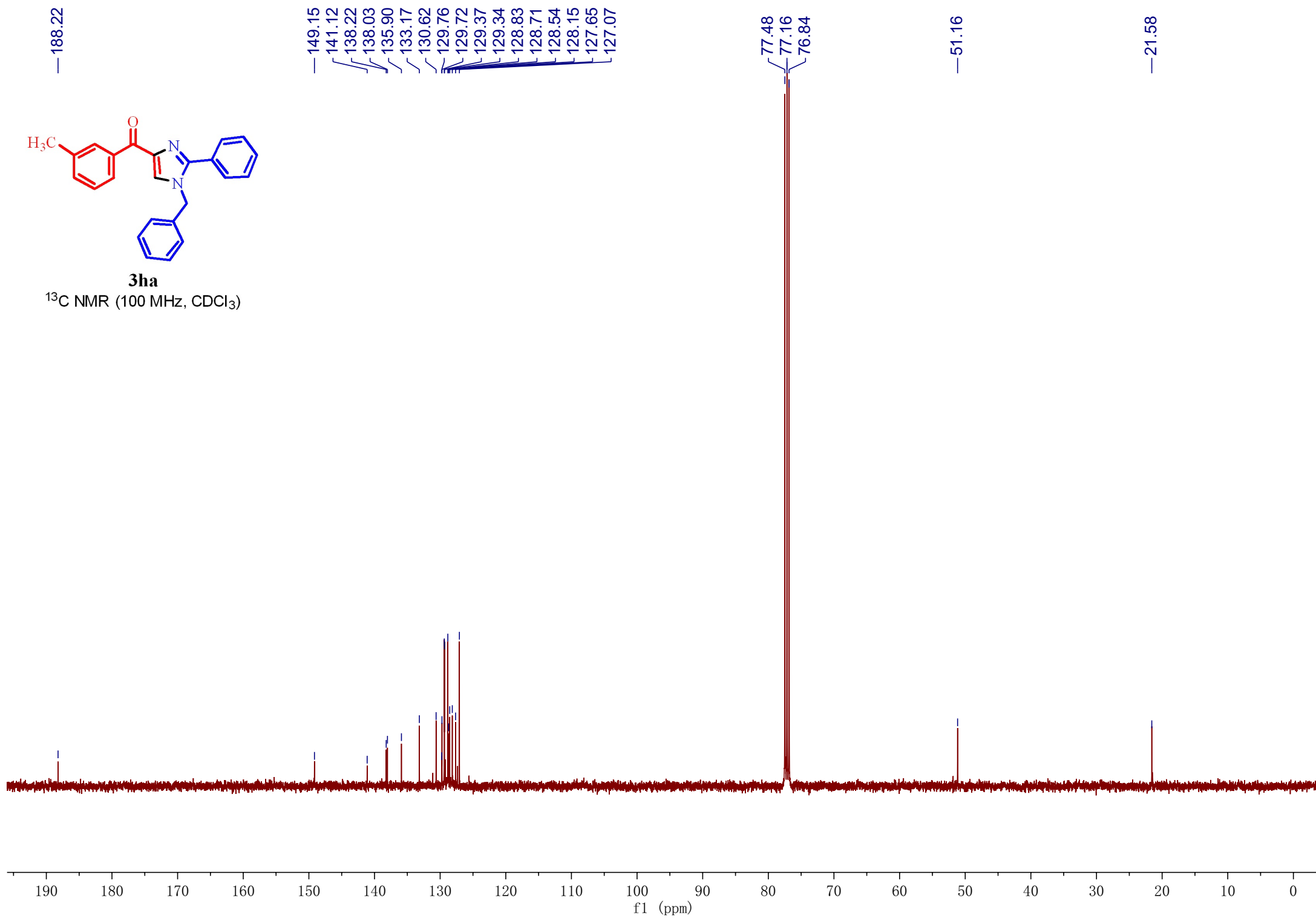
—2.416



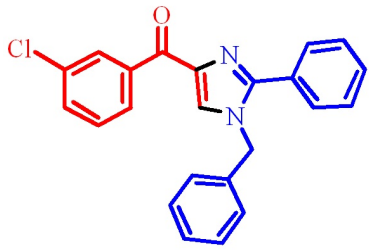


3ha

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



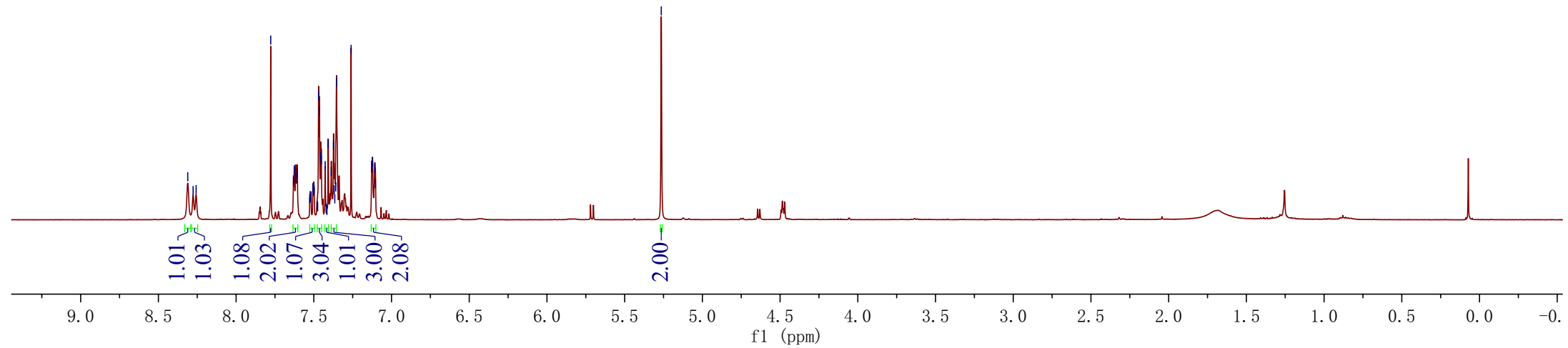
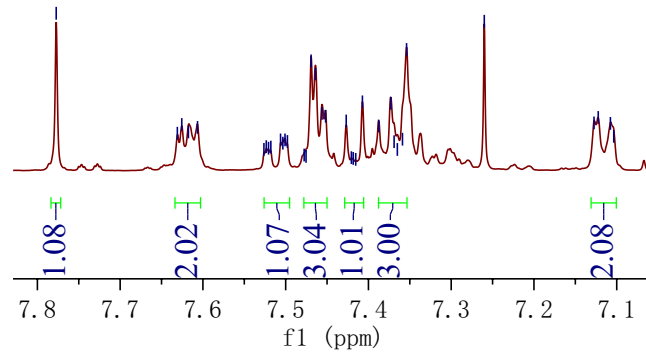
8.311
8.277
8.257
7.777
7.631
7.626
7.618
7.607
7.469
7.464
7.456
7.452
7.427
7.407
7.388
7.373
7.354
7.260
7.127
7.122
7.108
7.104
5.284

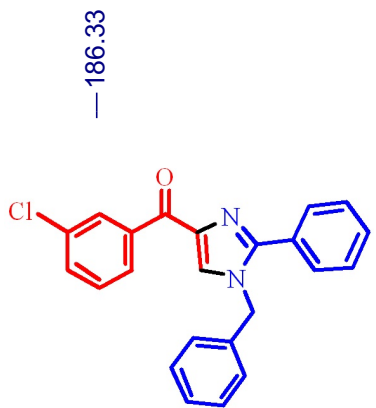


3ia

¹H NMR (400 MHz, CDCl₃)

7.777
7.631
7.626
7.618
7.607
7.469
7.464
7.456
7.452
7.427
7.407
7.388
7.373
7.359
7.354
7.260
7.127
7.122
7.108
7.104





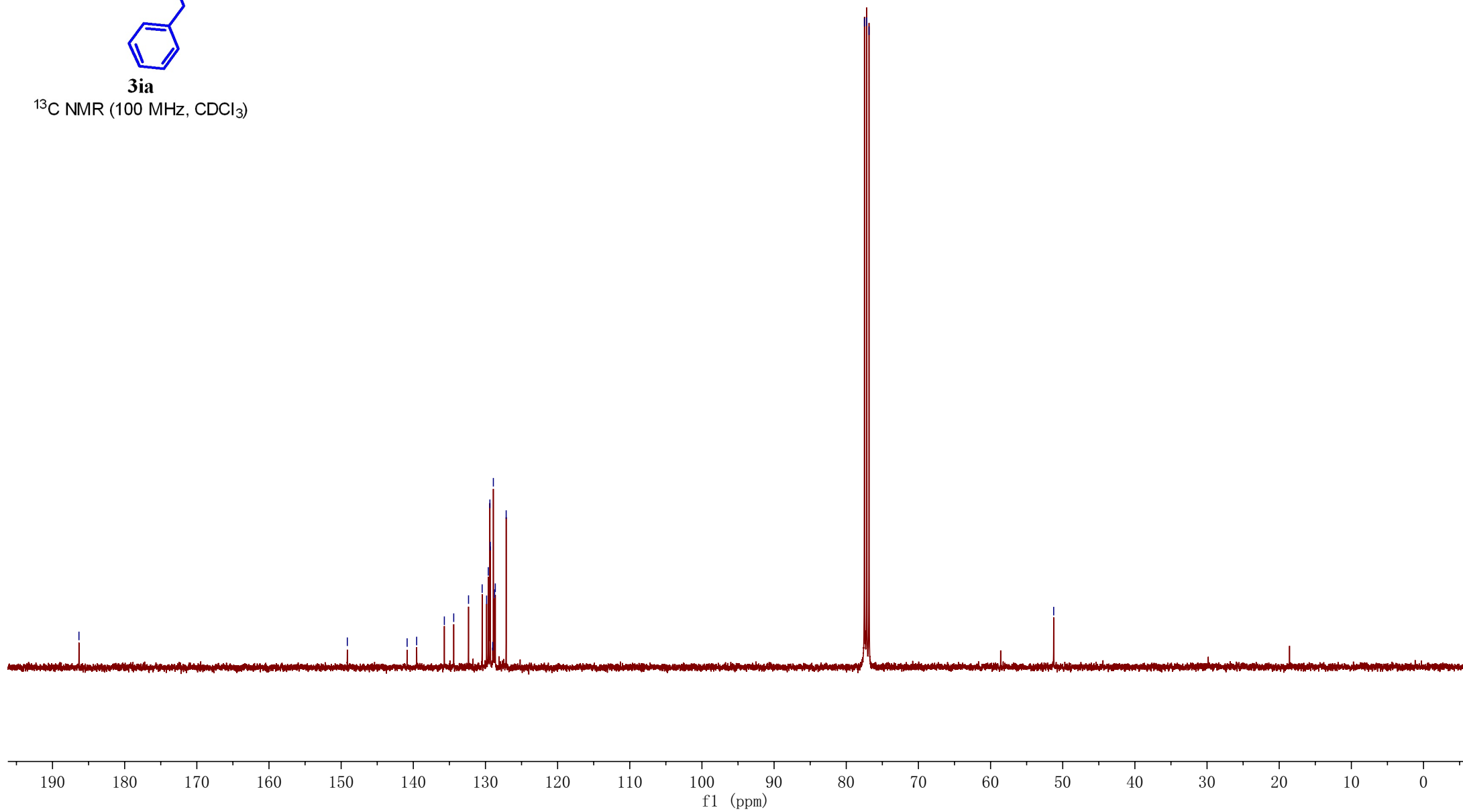
3ia

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

149.15
140.85
139.53
135.70
134.40
132.35
130.46
129.84
129.61
129.39
129.33
128.99
128.91
128.73
128.64
127.13

77.48
77.16
76.84

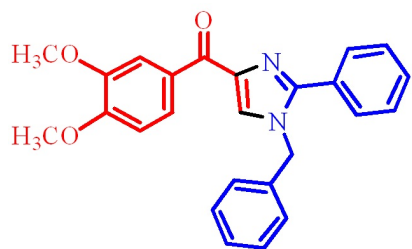
51.25



8.271
8.266
8.262
8.250
8.245
8.240

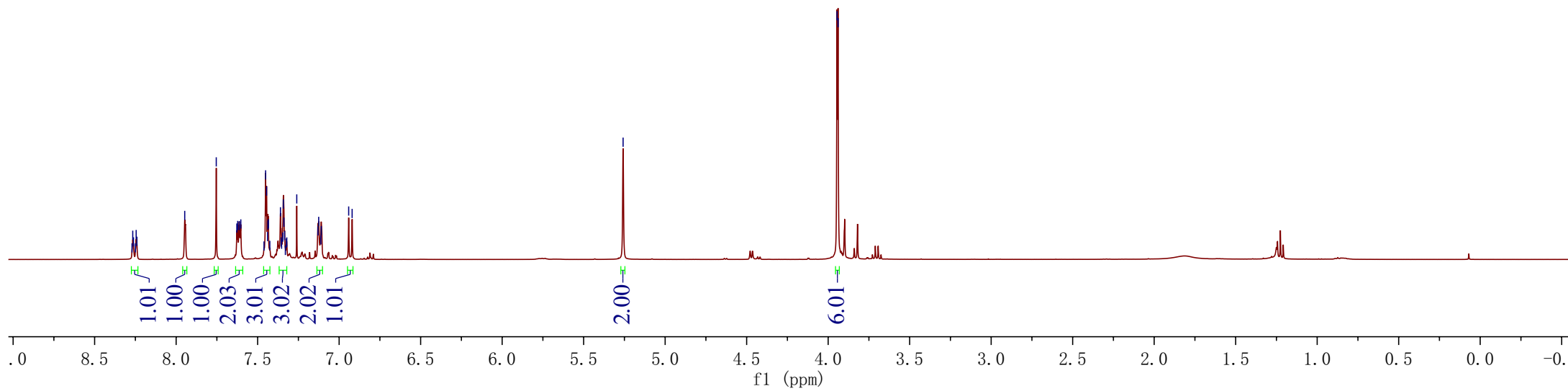
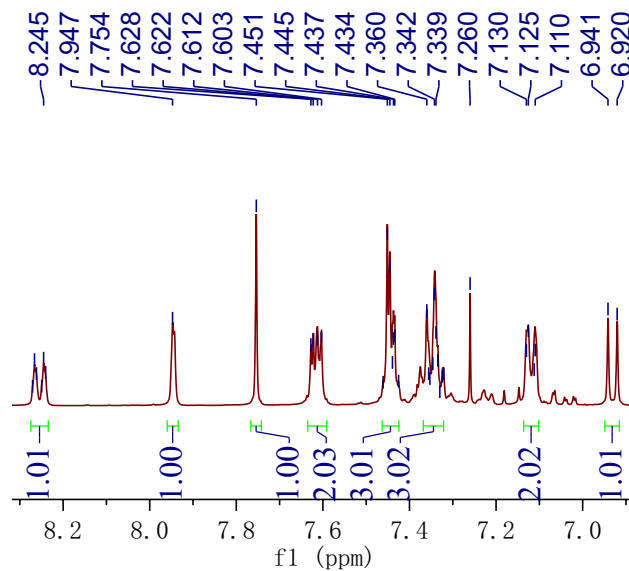
7.947
7.754
7.628
7.622
7.612
7.603
7.451
7.445
7.437
7.434
7.360
7.342
7.339
7.334
7.260
7.130
7.125
7.110
6.941
6.920

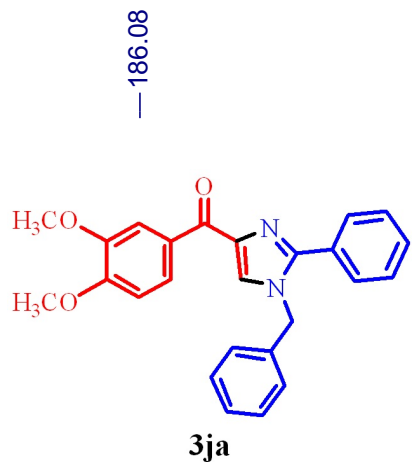
3.946
3.939



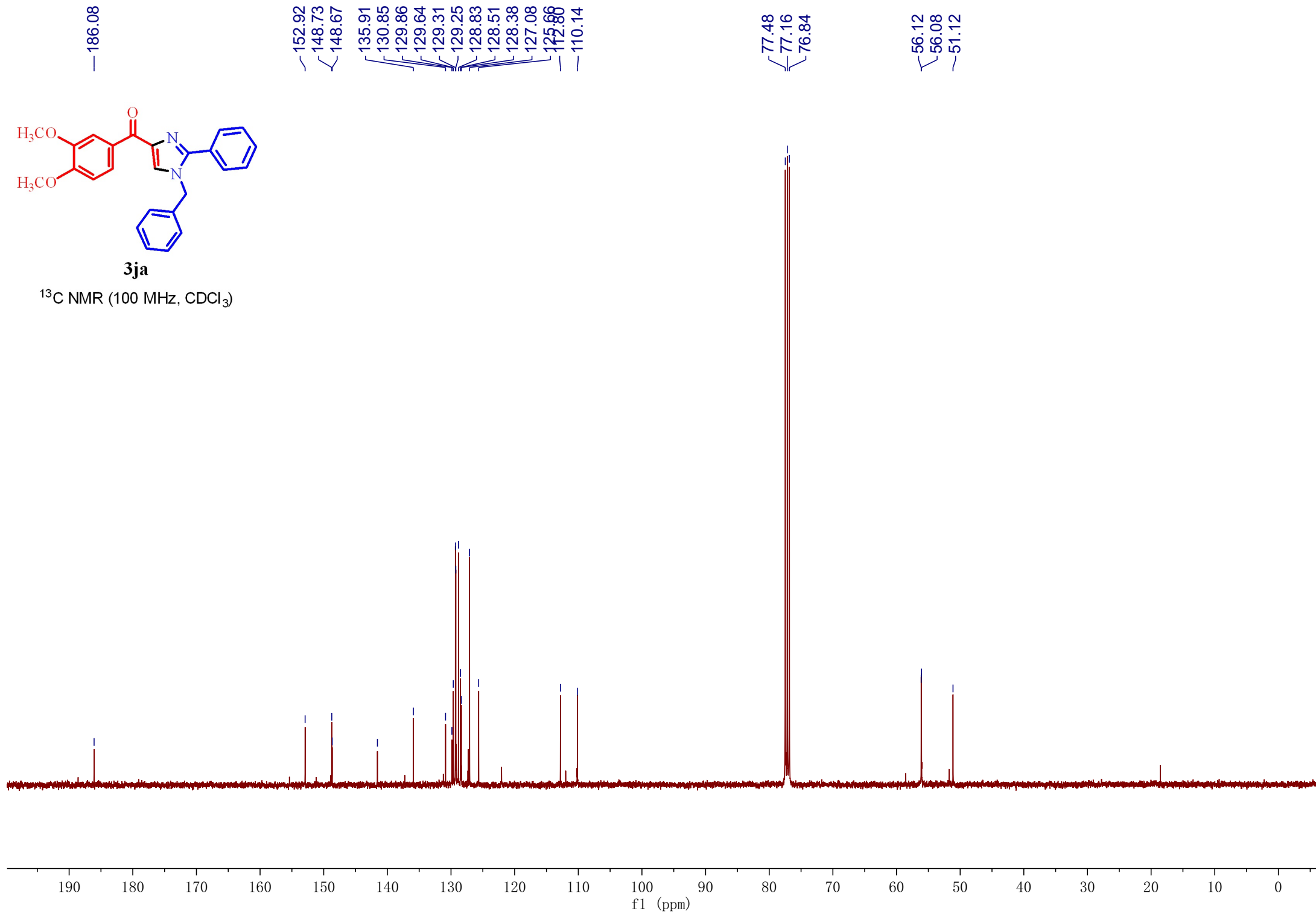
3ja

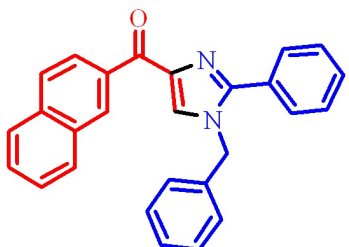
¹H NMR (400 MHz, CDCl₃)





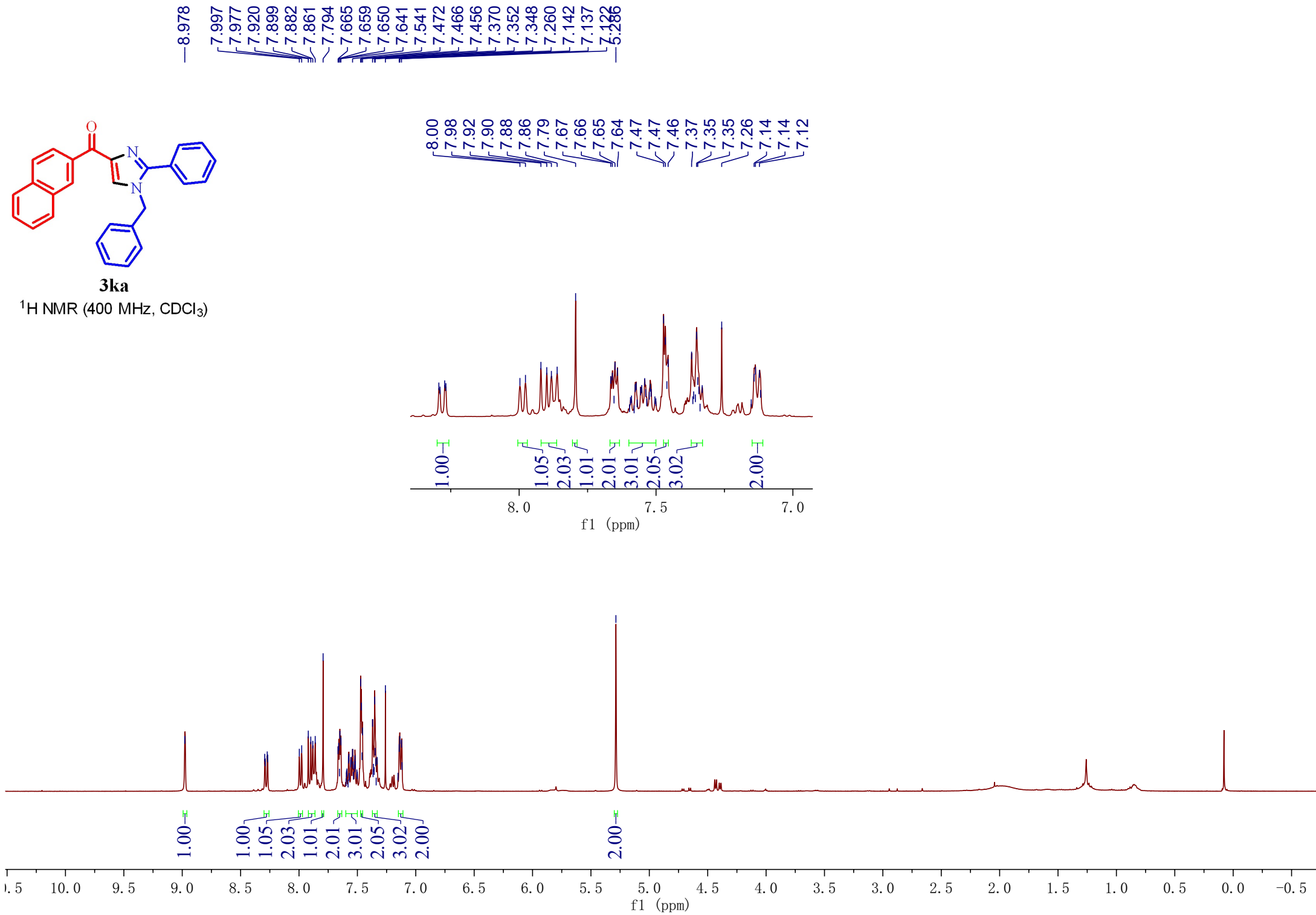
¹³C NMR (100 MHz, CDCl₃)

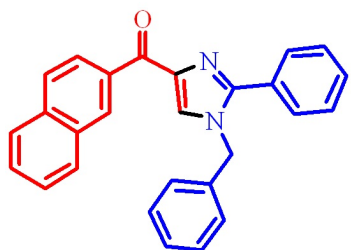




3ka

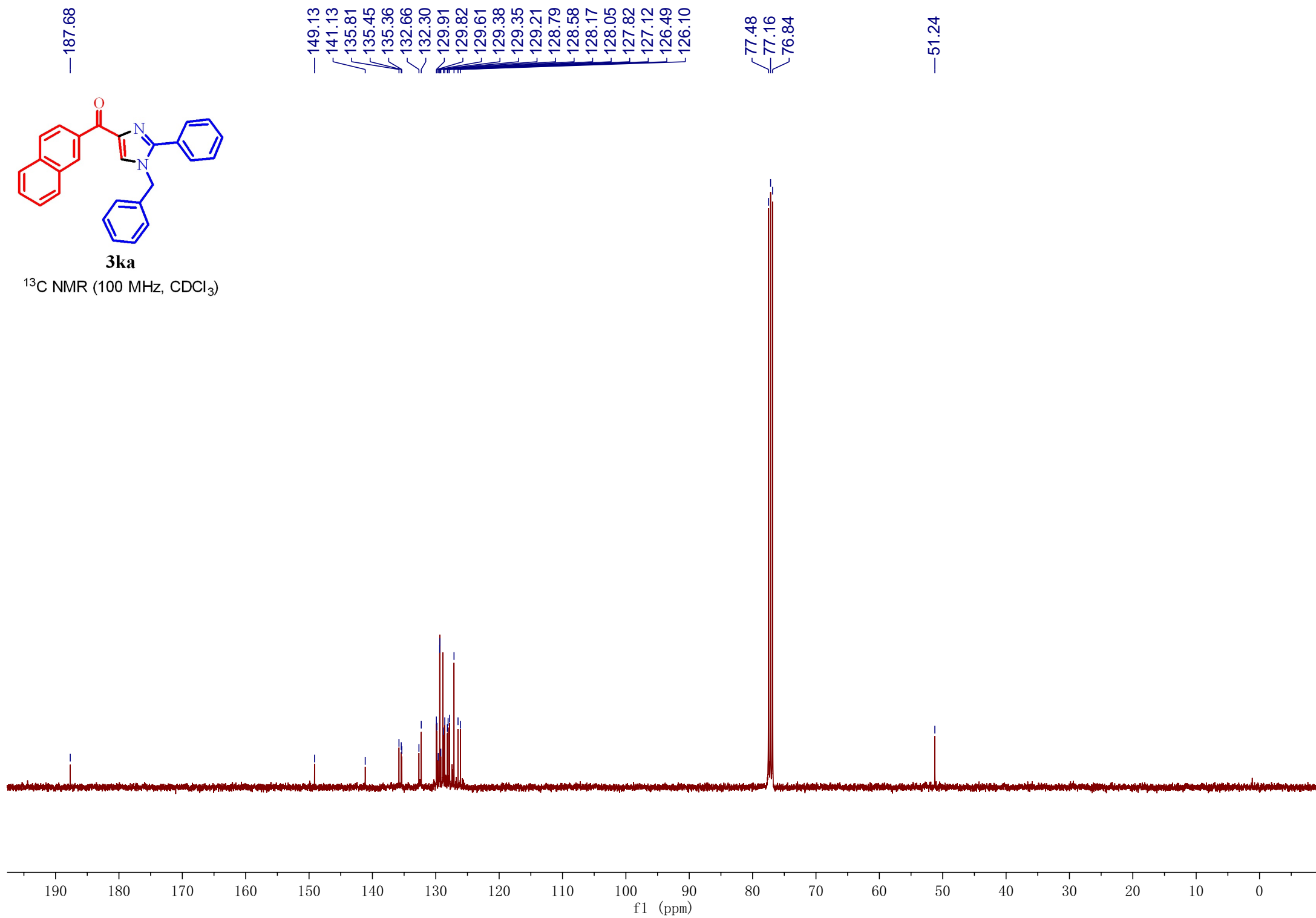
¹H NMR (400 MHz, CDCl₃)

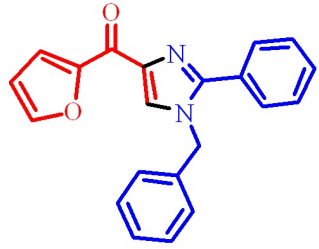




3ka

¹³C NMR (100 MHz, CDCl₃)



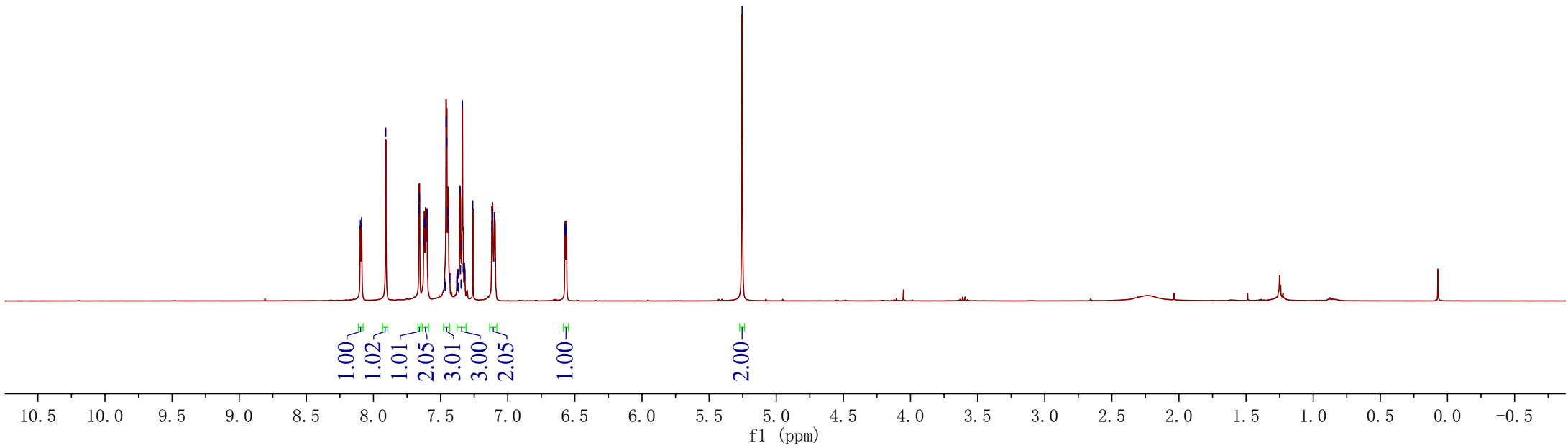
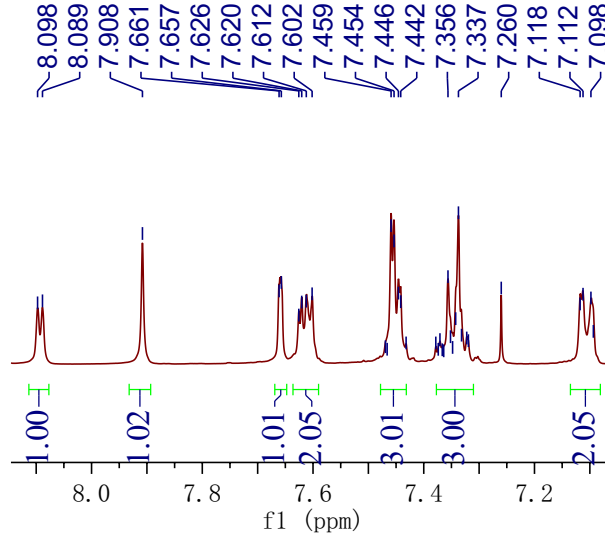


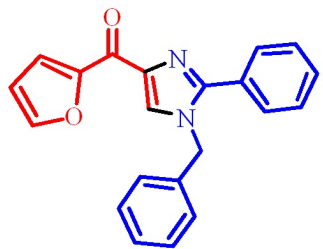
3la

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

8.098
8.089
7.908
7.661
7.657
7.626
7.620
7.612
7.602
7.459
7.454
7.446
7.442
7.356
7.337
7.260
7.118
7.112
7.098
7.094
6.571
6.566
6.561

5.254

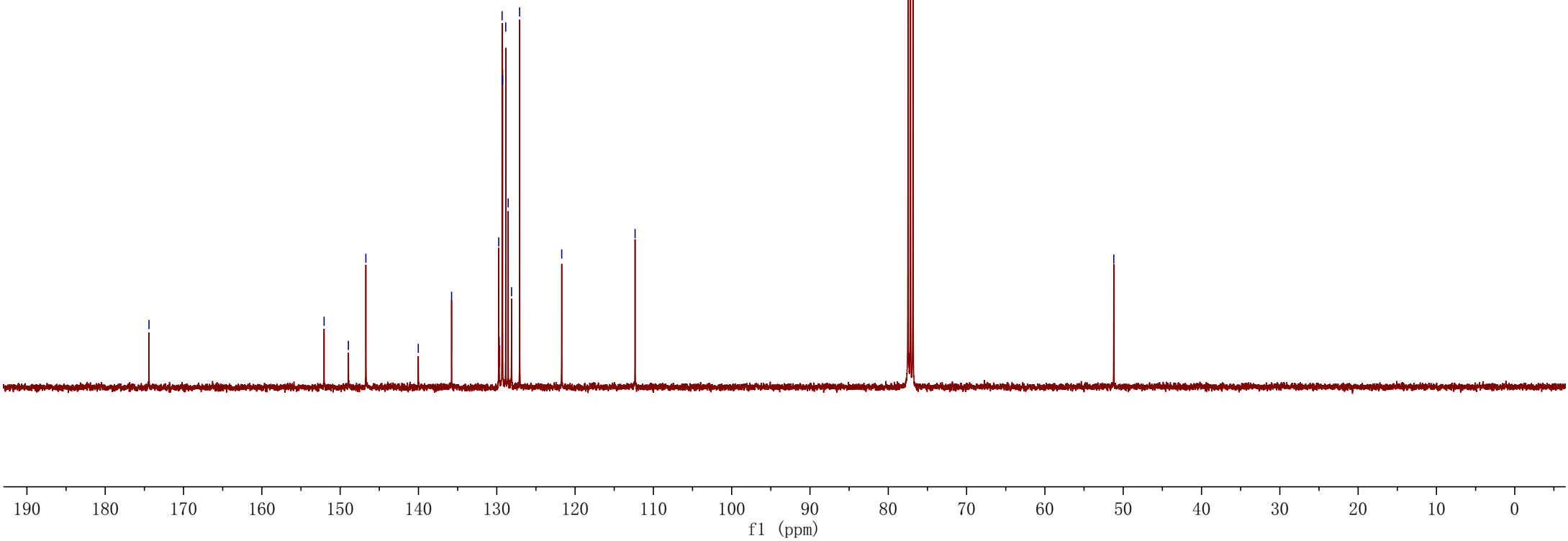


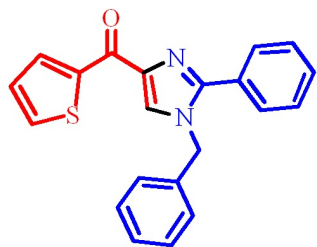


3la

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

174.41
152.05
148.95
146.72
140.02
135.77
129.75
129.32
129.26
128.85
128.54
127.08
121.39
121.34
77.48
77.16
76.84
51.21



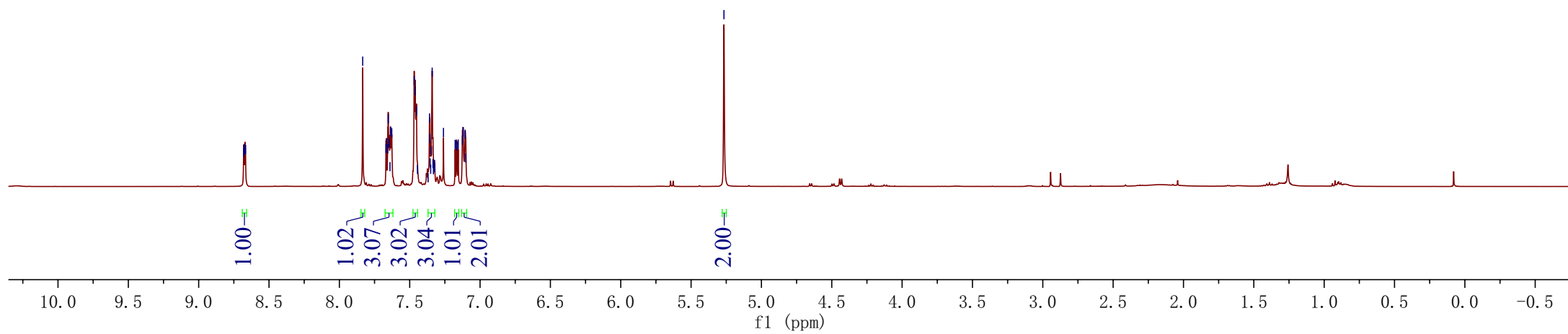
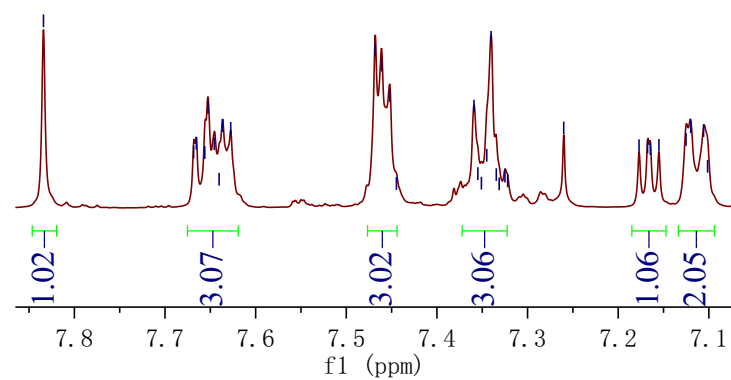


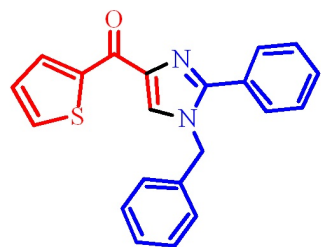
3ma

^1H NMR (400 MHz, CDCl_3)

8.680
8.677
8.670
8.667
7.834
7.665
7.653
7.646
7.636
7.628
7.468
7.461
7.452
7.359
7.356
7.340
7.260
7.177
7.168
7.155
7.125
7.120
7.106
7.101

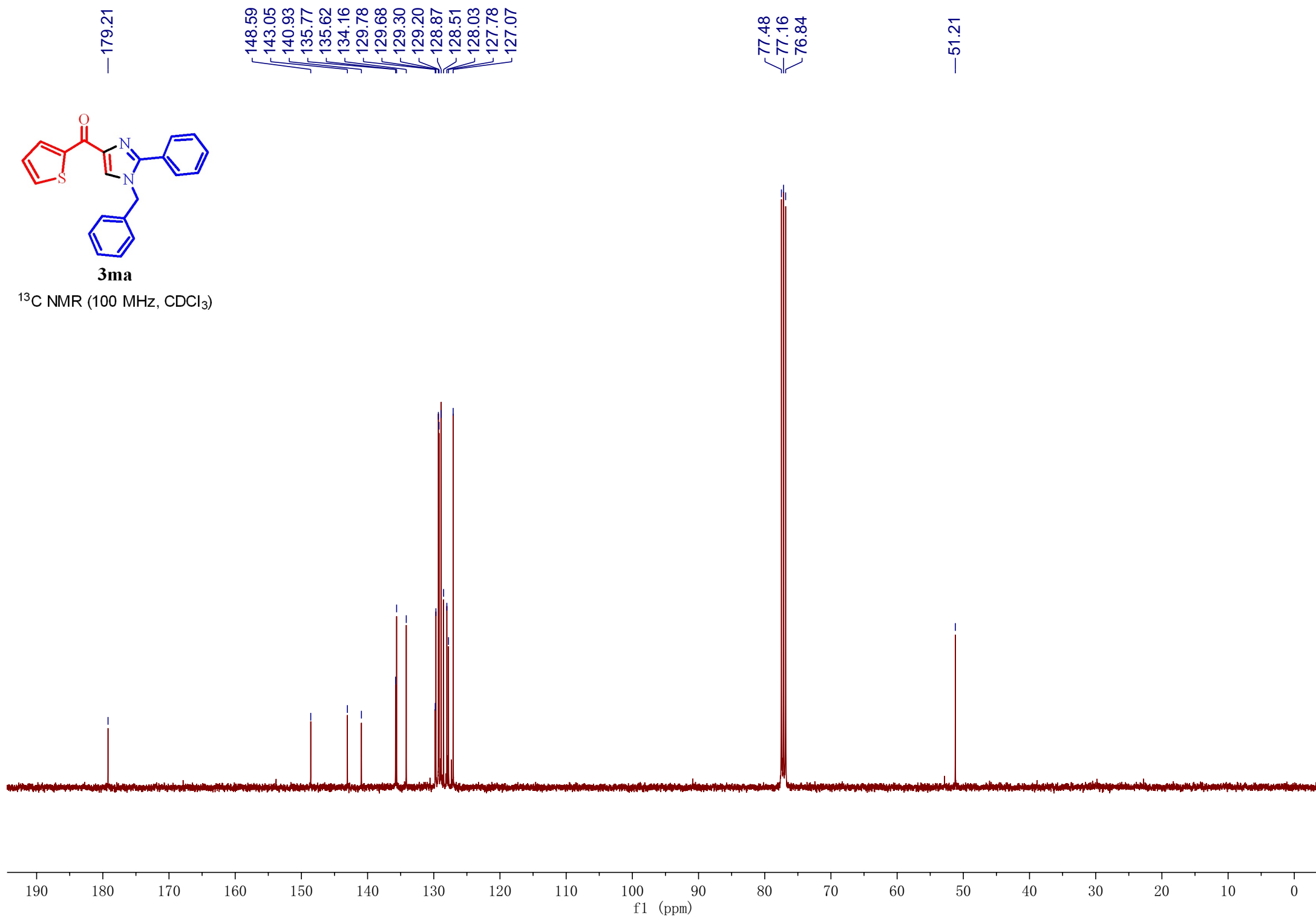
7.834
7.668
7.665
7.656
7.653
7.646
7.636
7.628
7.468
7.461
7.452
7.359
7.345
7.340
7.260
7.177
7.168
7.165
7.155
7.125
7.120
7.106
7.101

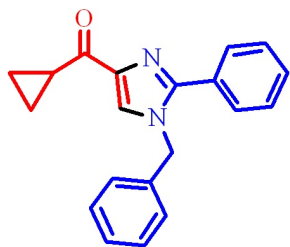




3ma

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





3na

¹H NMR (400 MHz, CDCl₃)

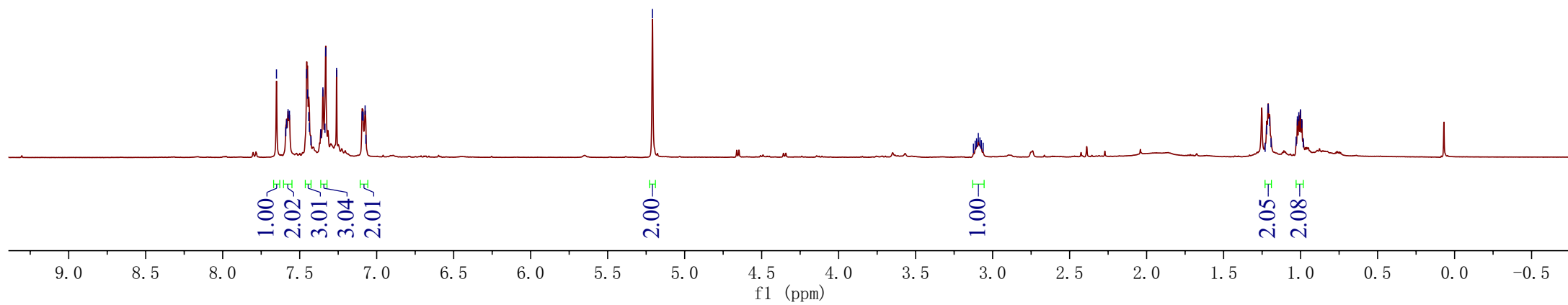
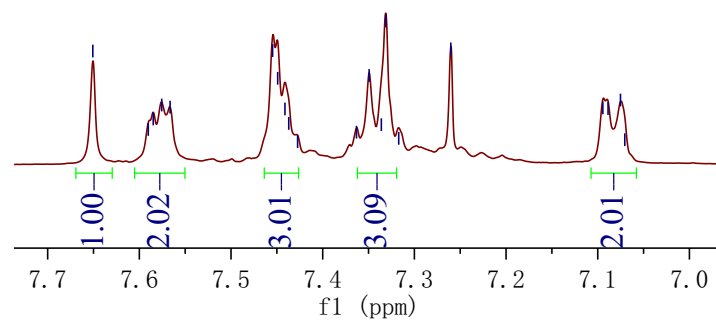
7.651
7.590
7.585
7.576
7.566
7.455
7.449
7.441
7.437
7.427
7.363
7.349
7.336
7.331
7.260
7.094
7.089
7.075
7.070

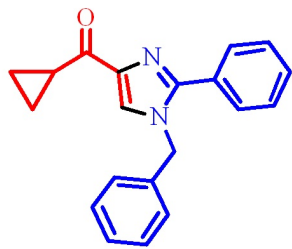
5.209

3.125
3.113
3.104
3.093
3.082
3.073
3.062

1.231
1.220
1.211
1.201
1.192
1.029
1.021
1.012
1.001
0.992
0.983

7.651
7.590
7.585
7.576
7.566
7.455
7.449
7.441
7.437
7.427
7.363
7.349
7.336
7.331
7.317
7.260
7.094
7.089
7.075
7.070





3na

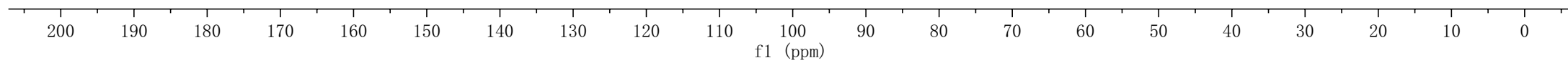
¹³C NMR (100 MHz, CDCl₃)

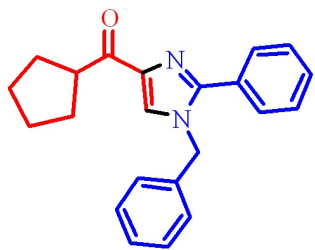
— 196.61
— 148.90
— 141.92
— 135.81
— 129.77
— 129.34
— 129.31
— 128.92
— 128.54
— 127.13
— 124.83

{ 77.48
— 77.16
— 76.84

— 51.17

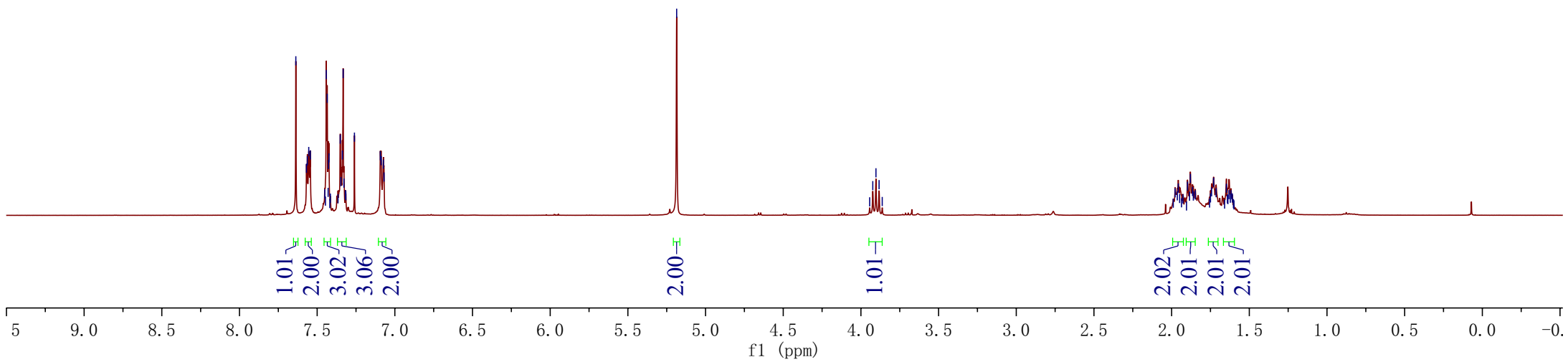
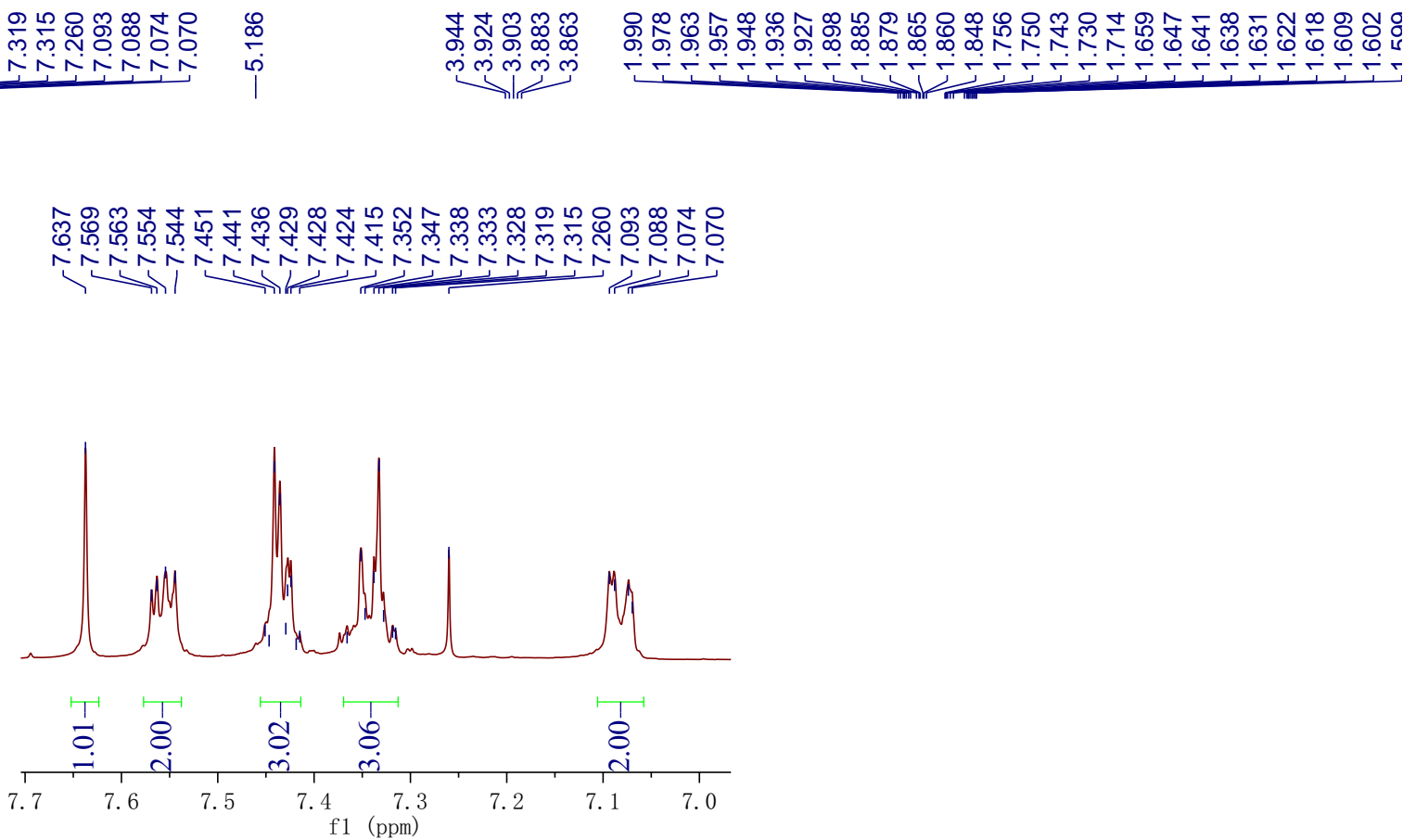
— 17.23
— 11.80

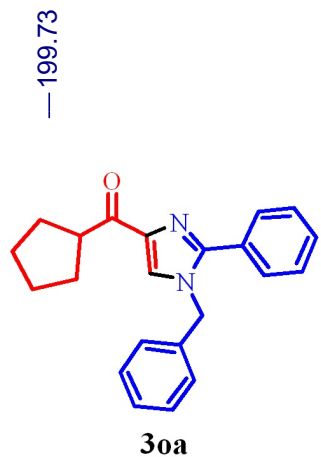




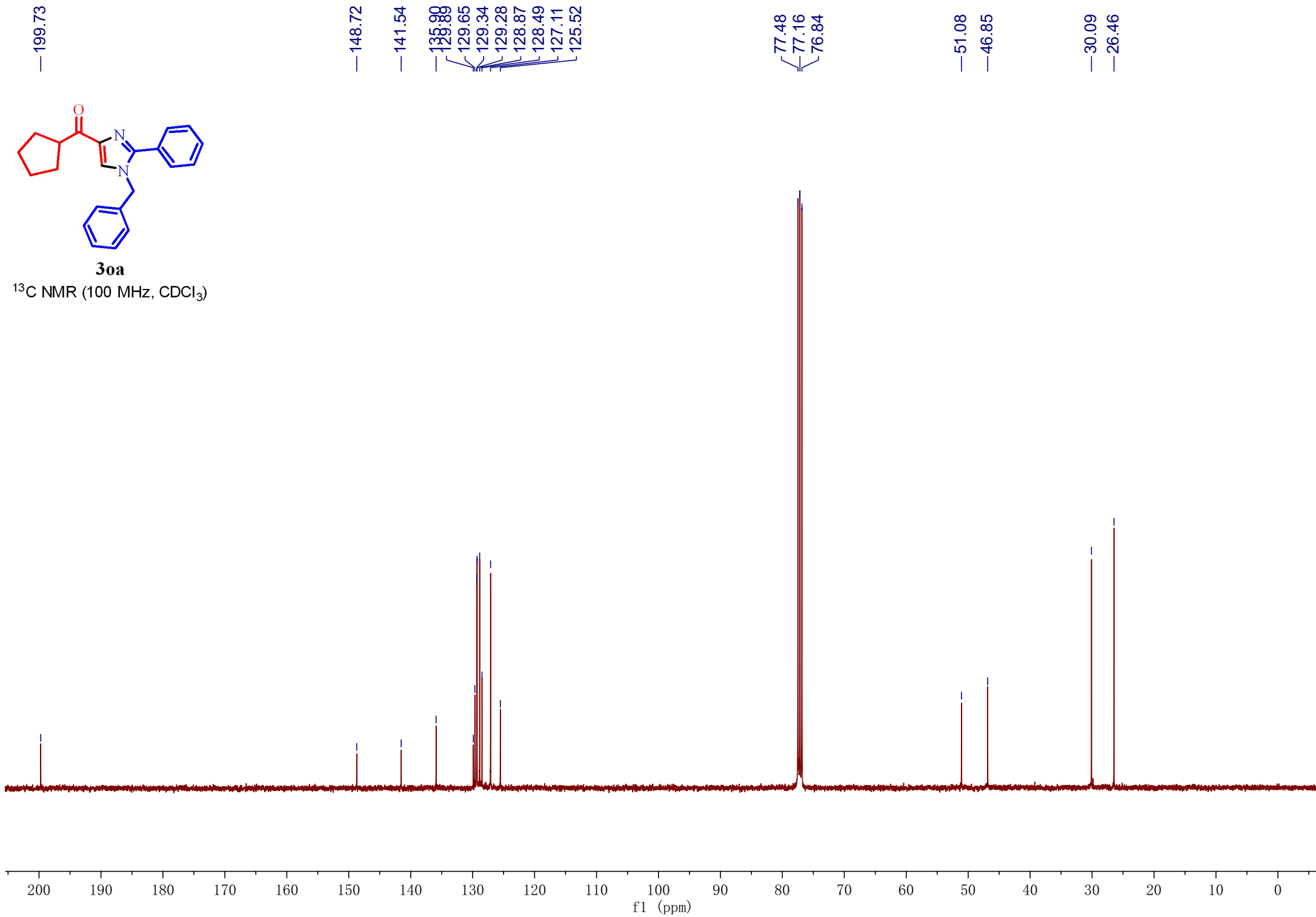
30a

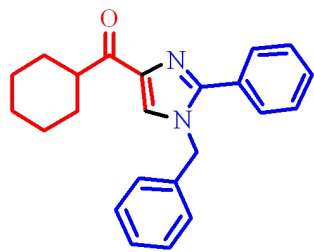
¹H NMR (400 MHz, CDCl₃)





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





3pa

¹H NMR (400 MHz, CDCl₃)

7.637
7.570
7.564
7.555
7.546
7.462
7.452
7.443
7.438
7.429
7.426
7.416
7.364
7.350
7.332
7.316
7.260
7.090
7.084
7.070
7.066

5.185

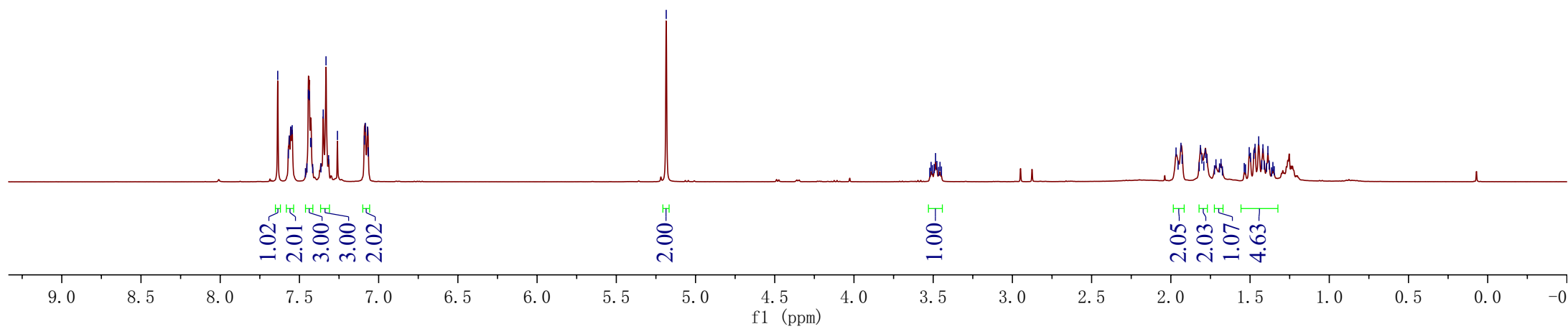
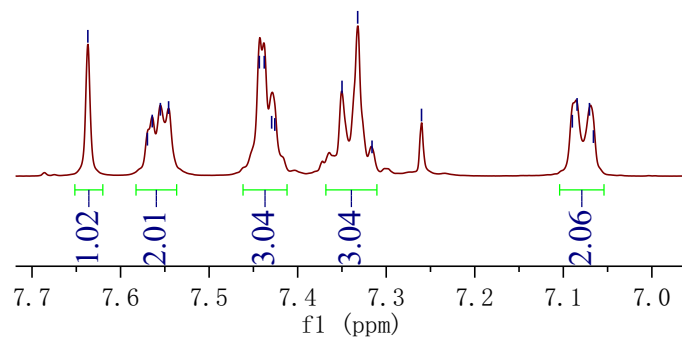
3.522
3.513
3.505
3.494
3.485
3.477
3.466
3.457
3.448

1.967
1.954
1.936
1.929
1.821
1.813
1.804
1.792
1.783
1.773
1.715
1.683
1.505
1.497
1.476
1.468
1.445
1.426
1.419
1.411
1.396
1.387
1.379
1.356

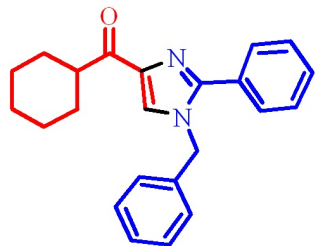
7.637
7.570
7.564
7.555
7.546

7.443
7.438
7.429
7.332
7.316
7.260

7.090
7.084
7.070
7.066



— 200.32



¹³C NMR (100 MHz, CDCl₃)

— 148.68

— 140.88

— 135.86

— 129.77

— 129.70

— 129.37

— 129.29

— 128.88

— 128.49

— 127.10

— 125.72

— 77.48

— 77.16

— 76.84

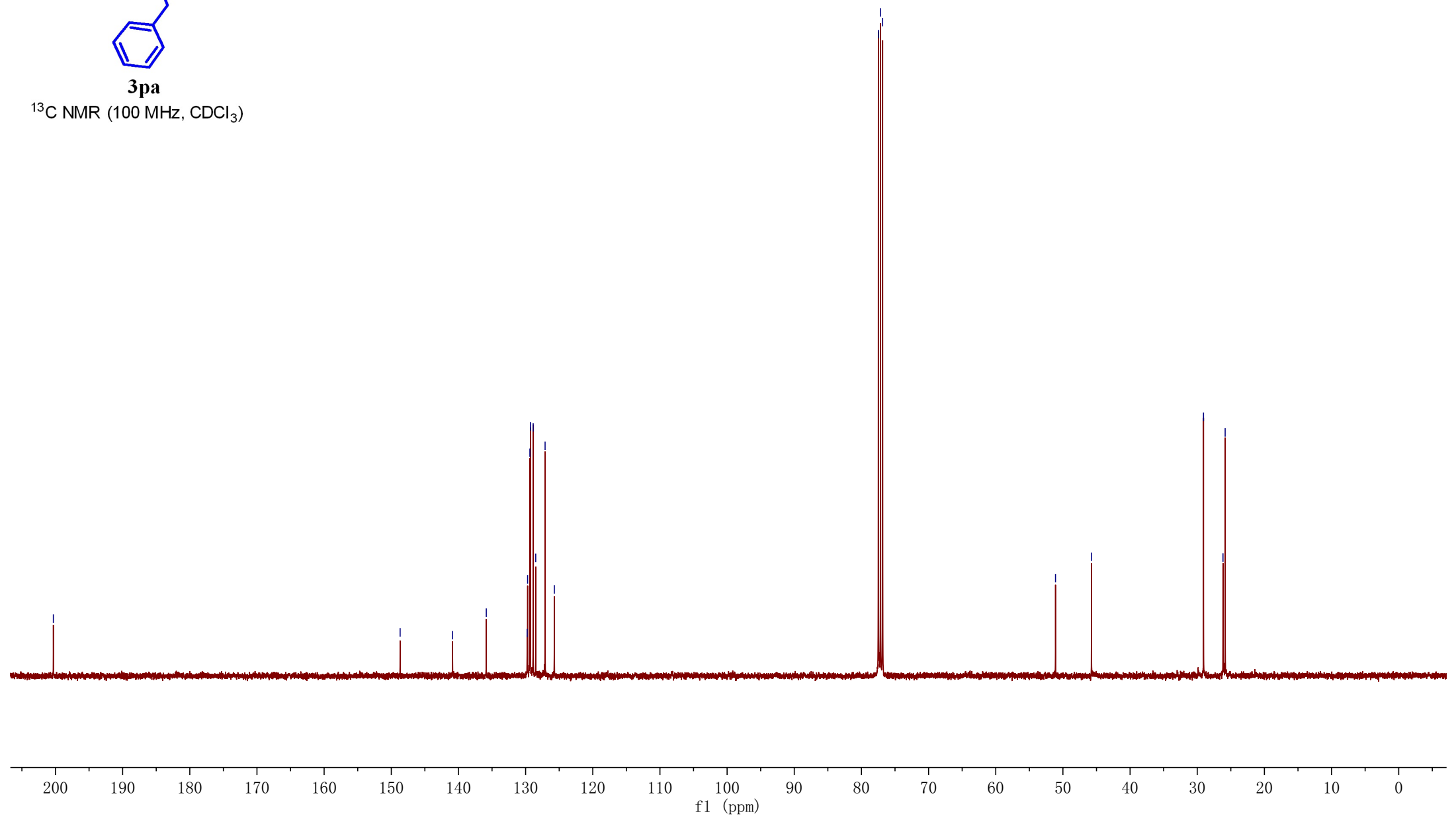
— 51.10

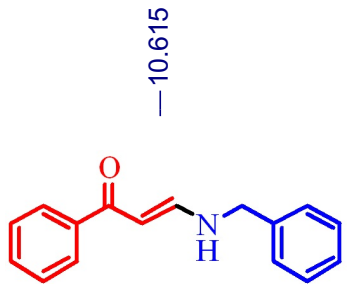
— 45.75

— 29.07

— 26.17

— 25.84





4a

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

