Supporting Information

(*E*)-2-Methoxyethene-1-sulfonyl fluoride as a precursor of acetylene for synthesis of C_1/C_2 non-functionalized pyrrolo[2,1-*a*]isoquinoline derivatives

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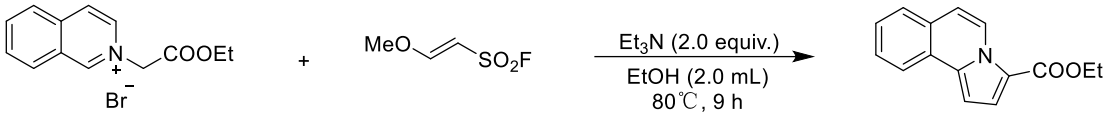
1. General Information

All reactions were carried out under an air atmosphere unless otherwise specified. Oil bath was used for the heating reactions. NMR spectra were recorded in $CDCl_3$ on a 500 MHz (for ^{1}H), 126 MHz (for ^{13}C) spectrometer. All chemical shifts are reported in ppm relative to TMS (0 ppm) as an internal standard. The following abbreviations were used to explain the multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet. The coupling constants were reported in Hertz (Hz). The HPLC experiments were carried out on a Waters e2695 instrument (column: J&K, RP-C18, 5 μm, 4.6 × 150 mm), and the HPLC yields of the products were determined by using the corresponding pure compounds as the external standards. Other reagents used in the reactions were all purchased from commercial sources and used without further purification. The product spots on the thin layer chromatography (TLC) were visualized under ultraviolet light (254 nm or 365 nm).

2. Optimization of the Reaction Conditions

Table S1 Screening the MESF equivalent[a]

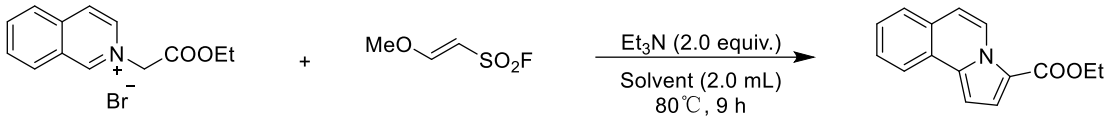


1a **2** **3a**

Entry	2 (X equiv.)	Yield (**3a**,%)[b]
1	1	22
2	2	21
3	**3**	**31**
4	4	25
5	5	22
6	6	29

[a]Reaction conditions：a mixture of 2-(2-ethoxy-2-oxoethyl)isoquinolin-2-ium bromide (**1a**, 29.6 mg, 0.1 mmol, 1.0 equiv.), (*E*)-2-methoxyethene-1-sulfonyl fluoride (**2**), Et_3N (0.2 mmol, 2.0 equiv.) dissolved in EtOH (2.0 mL) was stirred at 80 ℃ for 9 h under air atmosphere. [b]The yield was determined by HPLC using pure **3a** as the external standard ($t_{R,\mathbf{3a}}$ = 5.381 min, $\lambda_{max,\mathbf{3a}}$ = 263.0 nm, CH_3CN/H_2O = 80:20 (v/v)).

Table S2 Screening of the solvent[a]

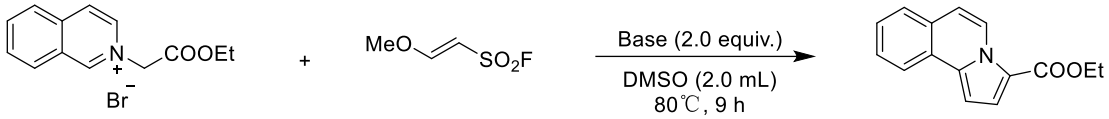


1a **2** **3a**

Entry	Solvent	Yield(**3a**,%)[b]
1	DCM	11
2	Acetone	35
3	DMF	7
4	Toluene	13
5	Ethanol	27
6	TBA	33
7	**DMSO**	**54**
8	1,4-Dioxane	23
9	THF	29

[a]Reaction conditions：a mixture of 2-(2-ethoxy-2-oxoethyl)isoquinolin-2-ium bromide (**1a**, 29.6 mg, 0.1 mmol, 1.0 equiv.), (*E*)-2-methoxyethene-1-sulfonyl fluoride (**2**, 0.3 mmol, 3.0 equiv.), Et_3N (0.2 mmol, 2.0 equiv.) dissolved in solvent (2.0 mL) was stirred at 80 ℃ for 9 h under air atmosphere. [b]The yield was determined by HPLC using pure **3a** as the external standard ($t_{R,\mathbf{3a}}$ = 5.381 min, $\lambda_{max,\mathbf{3a}}$ = 263.0 nm, CH_3CN/H_2O = 80:20 (v/v)).

Table S3 Screening of the Base[a]

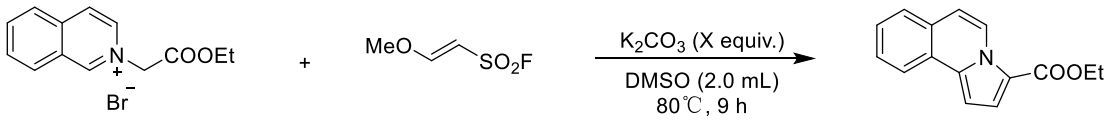


1a **2** **3a**

Entry	Base	Yield (**3a**,%)[b]
1	Et_3N	50
2	DIPEA	40
3	TMEDA	33
4	DBU	52
5	KHCO3	30
6	**K_2CO_3**	**56**
7	Na_2CO_3	33
8	$NaHCO_3$	42
9	NaOH	19
10	Cs_2CO_3	48
11	Na_3PO_4	41
12	K_3PO_4	34

[a]Reaction conditions：a mixture of 2-(2-ethoxy-2-oxoethyl)isoquinolin-2-ium bromide (**1a**, 29.6 mg, 0.1 mmol, 1.0 equiv.), (*E*)-2-methoxyethene-1-sulfonyl fluoride (**2**, 0.3 mmol, 3.0 equiv.), base (0.2 mmol, 2.0 equiv.) dissolved in DMSO (2.0 mL) was stirred at 80 °C for 9 h under air atmosphere. [b]The yield was determined by HPLC using pure **3a** as the external standard ($t_{R,\mathbf{3a}}$ = 5.381 min, $\lambda_{max,\mathbf{3a}}$ = 263.0 nm, CH_3CN/H_2O = 80:20 (v/v)).

Table S4 Screening the base equivalent[a]

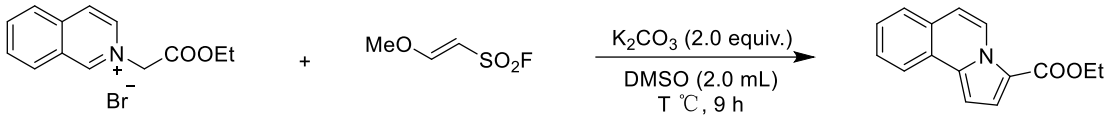


1a **2** **3a**

Entry	K_2CO_3 (X equiv.)	Yield (**3a**,%)[b]
1	1	25
2	1.5	34
3	**2**	**54**
4	2.5	47
5	3.0	43
6	4.0	40

[a]Reaction conditions：a mixture of 2-(2-ethoxy-2-oxoethyl)isoquinolin-2-ium bromide (**1a**, 29.6 mg, 0.1 mmol, 1.0 equiv.), (*E*)-2-methoxyethene-1-sulfonyl fluoride (**2**, 0.3 mmol, 3.0 equiv.), K_2CO_3 dissolved in DMSO (2.0 mL) was stirred at 80 ℃ for 9 h under air atmosphere. [b]The yield was determined by HPLC using pure **3a** as the external standard ($t_{R,\mathbf{3a}}$ = 5.381 min, $\lambda_{max,\mathbf{3a}}$ = 263.0 nm, CH_3CN/H_2O = 80:20 (v/v)).

Table S5 Screening of the reaction temperature[a]

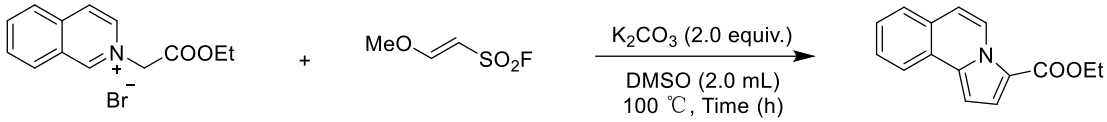


1a **2** **3a**

Entry	Temperature (℃)	Yield(**3a**,%)[b]
1	50	45
2	60	51
3	70	57
4	80	56
5	90	57
6	**100**	**65**
7	110	45
8	120	32

[a]Reaction conditions：a mixture of 2-(2-ethoxy-2-oxoethyl)isoquinolin-2-ium bromide (**1a**, 29.6 mg, 0.1 mmol, 1.0 equiv.), (*E*)-2-methoxyethene-1-sulfonyl fluoride (**2**, 0.3 mmol, 3.0 equiv.), K_2CO_3 (0.2 mmol, 2.0 equiv.) dissolved in DMSO (2.0 mL) was stirred at T ℃ for 9 h under air atmosphere. [b]The yield was determined by HPLC using pure **3a** as the external standard ($t_{R,\mathbf{3a}}$ = 5.381 min, $\lambda_{max,\mathbf{3a}}$ = 263.0 nm, CH_3CN/H_2O = 80:20 (v/v)).

Table S6 Screening the reaction time[a]

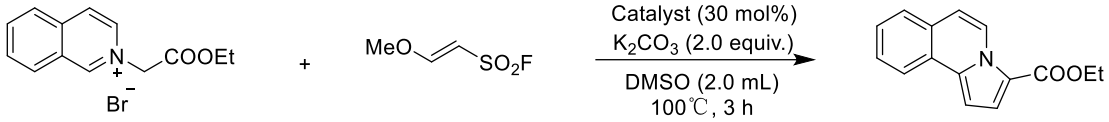


1a **2** **3a**

Entry	Time (h)	Yield(**3a**,%)[b]
1	**3**	**60**
2	6	55
3	9	59
4	12	59
5	24	51

[a]Reaction conditions：a mixture of 2-(2-ethoxy-2-oxoethyl)isoquinolin-2-ium bromide (**1a**, 29.6 mg, 0.1 mmol, 1.0 equiv.), (*E*)-2-methoxyethene-1-sulfonyl fluoride (**2**, 0.3 mmol, 3.0 equiv.), K_2CO_3 (0.2 mmol, 2.0 equiv.) dissolved in DMSO (2.0 mL) was stirred at 100 ℃ under air atmosphere. [b]The yield was determined by HPLC using pure **3a** as the external standard ($t_{R,\mathbf{3a}}$ = 5.381 min, $\lambda_{max,\mathbf{3a}}$ = 263.0 nm, CH_3CN/H_2O = 80:20 (v/v)).

Table S7 Screening of the catalytic system[a]

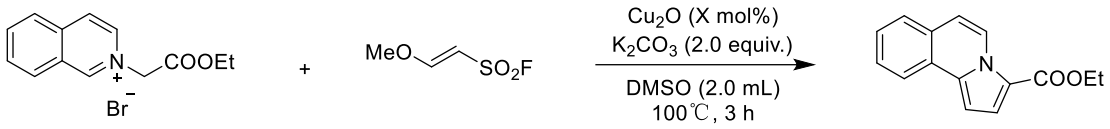


1a **2** **3a**

Entry	Catalyst (30 mol%)	Yield (**3a**,%)[b]
1	CuBr	67
2	CuCl	75
3	**Cu_2O**	**82**
4	CuI	63
5	$CuCl_2$	53
6	$CuBr_2$	56
7	CuO	63
8	$CuSO_4$	60
9	CuF_2	47
10	$Cu(acac)_2$	68
11	$Cu(OTf)_2$	64
12	$Cu(PF_6)(CH_3CN)_4$	48
13	/	57

[a]Reaction conditions：a mixture of 2-(2-ethoxy-2-oxoethyl)isoquinolin-2-ium bromide (**1a**, 29.6 mg, 0.1 mmol, 1.0 equiv.), (*E*)-2-methoxyethene-1-sulfonyl fluoride (**2**, 0.3 mmol, 3.0 equiv.), K_2CO_3 (0.2 mmol, 2.0 equiv.) dissolved in DMSO (2.0 mL) was stirred at 100 ℃ for 3 h under air atmosphere. [b]The yield was determined by HPLC using pure **3a** as the external standard ($t_{R,\mathbf{3a}}$ = 5.381 min, $\lambda_{max,\mathbf{3a}}$ = 263.0 nm, CH_3CN/H_2O = 80:20 (v/v)).

Table S8 Screening the loading amount of Cu catalyst[a]

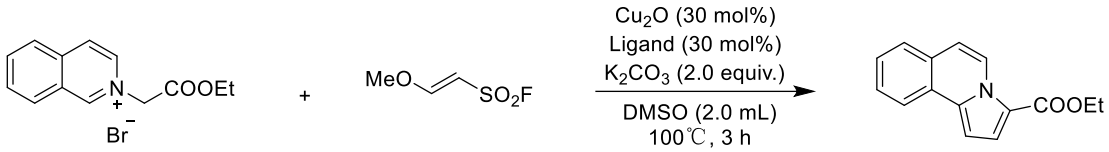


1a **2** **3a**

Entry	Cu_2O (X mol%)	Yield (**3a**,%)[b]
1	5	69
2	10	72
3	15	67
4	20	70
5	25	74
6	**30**	**84**
7	50	77

[a]Reaction conditions：a mixture of 2-(2-ethoxy-2-oxoethyl)isoquinolin-2-ium bromide (**1a**, 29.6 mg, 0.1 mmol, 1.0 equiv.), (*E*)-2-methoxyethene-1-sulfonyl fluoride (**2**, 0.3 mmol, 3.0 equiv.), K_2CO_3 (0.2 mmol, 2.0 equiv.) and Cu_2O dissolved in DMSO (2.0 mL) was stirred at 100 ℃ for 3 h under air atmosphere. [b]The yield was determined by HPLC using pure **3a** as the external standard ($t_{R,\mathbf{3a}}$ = 5.381 min, $\lambda_{max,\mathbf{3a}}$ = 263.0 nm, CH_3CN/H_2O = 80:20 (v/v)).

Table S9 Screening of the ligand[a]

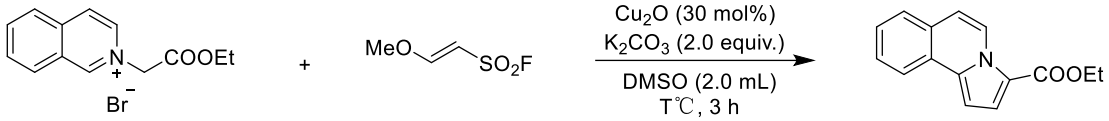


1a **2** **3a**

Entry	Ligand (30 mol%)	Yield (**3a**,%)[b]
1	/	**79**
2	DPPF	80
3	DPPB	74
4	DPPP	72
5	DPPE	73
6	Xantphos	72
7	DPE-phos	70
8	BINAP	65
9	S-phos	54
10	X-phos	28
11	Ph_3P	70

[a]Reaction conditions：a mixture of 2-(2-ethoxy-2-oxoethyl)isoquinolin-2-ium bromide (**1a**, 29.6 mg, 0.1 mmol, 1.0 equiv.), (*E*)-2-methoxyethene-1-sulfonyl fluoride (**2**, 0.3 mmol, 3.0 equiv.), K_2CO_3 (0.2 mmol, 2.0 equiv.) and Cu_2O (0.03 mmol, 30 mol%) dissolved in DMSO (2.0 mL) was stirred at 100 ℃ for 3 h under air atmosphere. [b]The yield was determined by HPLC using pure **3a** as the external standard ($t_{R,\mathbf{3a}}$ = 5.381 min, $\lambda_{max,\mathbf{3a}}$ = 263.0 nm, CH_3CN/H_2O = 80:20 (v/v)).

Table S10 Screening of the reaction temperature[a]

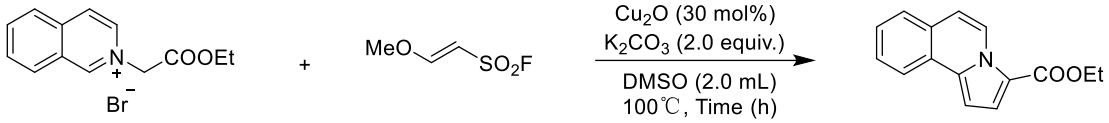


1a **2** **3a**

Entry	Temperature (℃)	Yield(**3a**,%)[b]
1	40	17
2	50	24
3	60	39
4	70	43
5	80	52
6	90	69
7	**100**	**76**
8	110	62
9	120	46
10	130	37

[a]Reaction conditions：a mixture of 2-(2-ethoxy-2-oxoethyl)isoquinolin-2-ium bromide (**1a**, 29.6 mg, 0.1 mmol, 1.0 equiv.), (*E*)-2-methoxyethene-1-sulfonyl fluoride (**2**, 0.3 mmol, 3.0 equiv.), K_2CO_3 (0.2 mmol, 2.0 equiv.) and Cu_2O (0.03 mmol, 30 mol%) dissolved in DMSO (2.0 mL) was stirred at T ℃ for 3 h under air atmosphere. [b]The yield was determined by HPLC using pure **3a** as the external standard ($t_{R,\mathbf{3a}}$ = 5.381 min, $\lambda_{max,\mathbf{3a}}$ = 263.0 nm, CH_3CN/H_2O = 80:20 (v/v)).

Table S11 Screening of the reaction time[a]



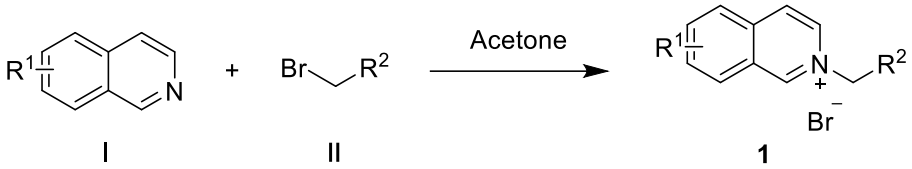
1a **2** **3a**

Entry	Time (h)	Yield(**3a**,%)[b]
1	0.5	42
2	1.0	47
3	2.0	56
4	**3.0**	**71**
5	4.0	74
6	5.0	73
7	6.0	70
8	7.0	69
9	8.0	67
10	9.0	70
11	10.0	66

[a]Reaction conditions：a mixture of 2-(2-ethoxy-2-oxoethyl)isoquinolin-2-ium bromide (**1a**, 29.6 mg, 0.1 mmol, 1.0 equiv.), (*E*)-2-methoxyethene-1-sulfonyl fluoride (**2**, 0.3 mmol, 3.0 equiv.), K_2CO_3 (0.2 mmol, 2.0 equiv.) and Cu_2O (0.03 mmol, 30 mol%) dissolved in DMSO (2.0 mL) was stirred at 100 ℃ under air atmosphere. [b]The yield was determined by HPLC using pure **3a** as the external standard ($t_{R,\mathbf{3a}}$ = 5.381 min, $\lambda_{max,\mathbf{3a}}$ = 263.0 nm, CH_3CN/H_2O = 80:20 (v/v)).

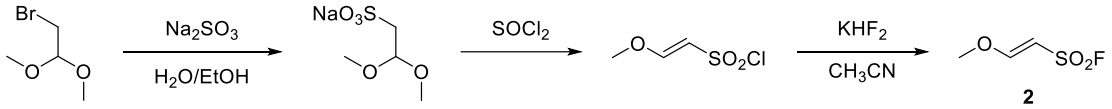
3. Experimental Procedures

3.1 General procedure for preparation of substituted isoquinoline salts (**1**)[1]



A mixture of isoquinolines (**I**, 10 mmol, 1.0 equiv.), bromines (**II**, 10 mmol, 1.0 equiv.) in acetone (10 mL) was stirred at room temperature or reflux temperature for 24 hours. The reaction mixture was cooled at room temperature, filtered under reduced pressure and the filter cake was washed with acetone (5 mL × 3) and diethyl ether (5 mL × 3). Finally, the residue was dried in vacuum to obtain the isoquinoline salts (**1**).

3.2 General procedure for preparation of (*E*)-2-Methoxyethene-1-sulfonyl Fluoride (**2**)[2]



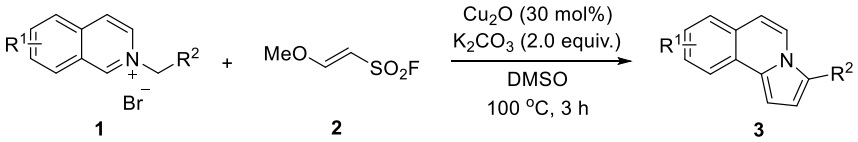
Step 1:[3] $(CH_3O)_2CHCH_2Br$ (50.7 g, 0.3 mol) was added dropwise to a solution of Na_2SO_3 (37.8 g, 0.3 mol, 1.0 equiv.) in H_2O (240 mL) with stirring at 55 °C. The mixture was then refluxed for 7 h and the solvent was evaporated in vacuo. The resulting solid residue was dissolved in a warm mixture of H_2O (64 mL) and EtOH (360 mL), and the mixture was refluxed with stirring for 30 min. After removal of some insoluble material by filtration of the hot mixture, the filtrate was cooled at -20 °C. The crystalline sodium salt was collected by filtration: 40.0 g (70% yield).

Step 2:[4] A 500 mL round-bottom flask was charged with the sulfonate (40.0 g, 0.2 mol). $SOCl_2$ (152 mL, 2.1 mol, 10.5 equiv.) was added and the mixture was heated to reflux for 6 h. The bulk of the excess $SOCl_2$ was removed by distillation, and the last traces were removed by addition of EA and rotary evaporation. The solvent was evaporated to give crude (*E*)-2-methoxyethene-1-sulfonyl chloride, which was used directly in the next step.

Step 3:[4,5] KHF_2 (156.2 g, 2.0 mol) was added to 400 mL water and a nearly saturated KHF_2 solution formed, when the solution approached room temperature after 1 h. At

this point, the resulting crude (*E*)-2-methoxyethene-1-sulfonyl chloride was dissolved in CH_3CN (120 mL) and treated with saturated aqueous KHF_2 (200 mL). The reaction mixture was stirred at room temperature overnight, and the sulfonyl fluoride was extracted with EA (3 × 250 mL), dried over anhydrous Na_2SO_4, and concentrated to dryness. Further distillation at 70 °C under reduced pressure with an oil-pump helped to remove the impurities and gave pure (*E*)-2-methoxyethene-1- sulfonyl fluoride (**2**) as a colorless liquid (11.2 g, 40% yield over two steps).

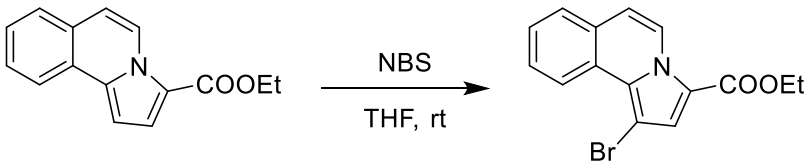
3.3 General procedure for preparation of **3a-3t**



1 **2** **3**

An oven-dried reaction tube equipped with a magnetic stirring bar was charged with isoquinolinium *N*-ylides (**1**, 1.0 mmol), Cu_2O (30 mol%, 43.0 mg), K_2CO_3 (2.0 mmol, 2.0 equiv., 276.0 mg), DMSO (5.0 mL) and 2-methoxyethene-1-sulfonyl fluoride (MESF, 3.0 mmol, 3.0 equiv., 420.0 mg). Then the mixture was stirred at 100 ℃ for 3 h. After the reaction was completed, the mixture was extracted with ethyl acetate (3 × 20 mL) and the combined organic layers were further washed with brine, and dried over anhydrous sodium sulfate. The solvent was concentrated under reduced pressure and the residue was further purified by flash silica gel chromatography using a mixture of petroleum ether, dichloromethane and ethyl acetate as eluent to afford the title products **3**.

3.4 General procedure for preparation of **4**

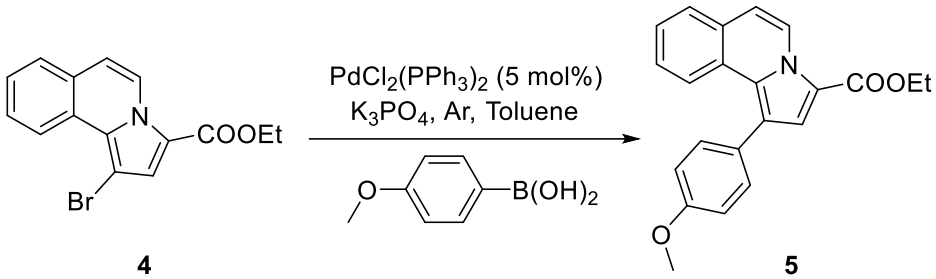


3a **4**

To a solution of **3a** (5.0 mmol, 1.20 g, 1.0 equiv.) in dry THF (5 mL), NBS (5.5 mmol, 0.98 g, 1.1 equiv) was added in portions at a temperature of 0 °C. The solution was

allowed to warm to room temperature overnight, and then the reaction was quenched by saturated sodium bicarbonate and extracted three times with EA. The combined organic layer was dried over anhydrous sodium sulfate. The solvent was removed under reduced pressure. The remaining oil was purified using silica chromatography (PE/EtOAc = 10:1) to obtain **4** as a white solid (1.46 g, 92% yield).

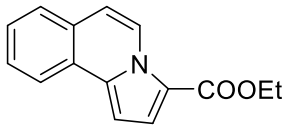
3.5 General procedure for preparation of **5**



4 **5**

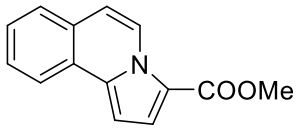
1-Bromopyrrolo[2,1-*a*]isoquinoline **4** (1.0 mmol), 4-methoxyphenylboronic acid (1.5 mmol), $PdCl_2(PPh_3)_2$ (0. 05 mmol), and K_3PO_4 (2.0 mmol) were added to a Schlenk flask. Then, toluene (3.0 mL) was added through a syringe and the mixture was stirred at 100 °C under an argon atmosphere for 12 h. After the reaction was complete, the mixture was cooled to room temperature and concentrated under reduced pressure, and the residue was subjected to flash column chromatography with petroleum ether as eluent to give the desired product **5** as a white solid (248 mg, 72% yield).

4. Characterization



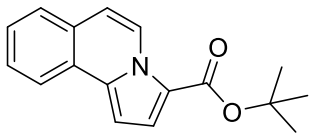
3a

Ethyl pyrrolo[2,1-a]isoquinoline-3-carboxylate (**3a**).[6] White solid, 187 mg, 78 % yield. Purified by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.23 (d, J = 7.5 Hz, 1H), 8.11 (d, J = 8.0 Hz, 1H), 7.66 (d, J = 7.5 Hz, 1H), 7.55-7.48 (m, 3H), 7.00 (d, J = 5.0 Hz, 2H), 4.40 (q, J = 7.0 Hz, 2H), 1.43 (t, J = 7.0 Hz, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 161.5, 135.4, 127.9, 127.6, 127.3, 126.9, 125.2, 125.0, 123.2, 120.6, 116.7, 112.6, 101.0, 60.0, 14.6.



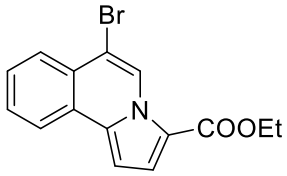
3b

Methyl pyrrolo[2,1-a]isoquinoline-3-carboxylate (**3b**).[7] White solid, 180 mg, 80 % yield. Purified by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.21 (d, J = 7.5 Hz, 1H), 8.10 (d, J = 7.5 Hz, 1H), 7.64 (d, J = 7.5 Hz, 1H), 7.53-7.48 (m, 3H), 6.98 (d, J = 3.5 Hz, 2H), 3.93 (s, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 161.9, 135.5, 127.9, 127.7, 127.4, 126.9, 125.2, 124.9, 123.2, 120.7, 116.3, 112.7, 101.1, 51.2.



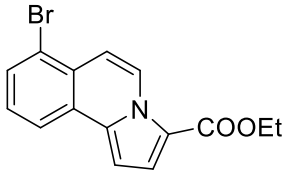
3c

Tert-butyl pyrrolo[2,1-a]isoquinoline-3-carboxylate (**3c**).[8] White solid, 200 mg, 75% yield. Purified by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.22 (d, J = 7.5 Hz, 1H), 8.11 (d, J = 8.0 Hz, 1H), 7.65 (d, J = 7.5 Hz, 1H), 7.54-7.43 (m, 3H), 6.97 (d, J = 8.0 Hz, 2H), 1.65 (s, 9H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 161.2, 135.1, 127.8, 127.6, 127.2, 126.9, 125.4, 125.1, 123.1, 120.5, 118.0, 112.4, 100.7, 80.7, 28.7.



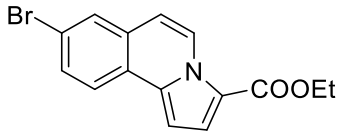
3d

Ethyl 6-bromopyrrolo[2,1-a]isoquinoline-3-carboxylate (**3d**). White solid, 181 mg, 57 % yield. M.p. 92-94 ℃. Purified by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.23 (d, J = 7.5 Hz, 1H), 7.96 (d, J = 8.5 Hz, 1H), 7.80 (d, J = 2.0 Hz, 1H), 7.61 (dd, J_1 = 2.0 Hz, J_2 = 8.5 Hz, 1H), 7.49 (d, J = 4.5 Hz, 1H), 6.97 (d, J = 4.0 Hz, 1H), 6.90 (d, J = 7.5 Hz, 1H), 4.40 (q, J = 7.5 Hz, 2H), 1.42 (t, J = 7.0 Hz, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 161.4, 134.6, 128.7, 128.1, 126.8, 126.8, 126.2, 125.2, 123.4, 120.6, 116.8, 109.1, 101.6, 60.4, 14.7. **HRMS-ESI** (m/z) calcd. for $[C_{15}H_{13}BrNO_2]^+$ ($[M+H]^+$): 318.0125, found: 318.0132.



3e

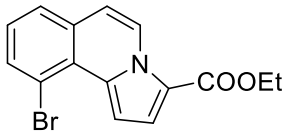
Ethyl 7-bromopyrrolo[2,1-a]isoquinoline-3-carboxylate (**3e**). White solid, 181 mg, 57 % yield. M.p. 122-124 ℃. Purified by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.25 (d, J = 8.0 Hz, 1H), 8.04 (d, J = 8.0 Hz, 1H), 7.71 (d, J = 7.5 Hz, 1H), 7.51 (d, J = 4.0 Hz, 1H), 7.37-7.33 (m, 2H), 6.99 (d, J = 4.0 Hz, 1H), 4.41 (q, J = 7.0 Hz, 2H), 1.43 (t, J = 7.0 Hz, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 161.5, 134.5, 131.2, 128.3, 127.2, 126.8, 126.3, 122.7, 122.1, 121.0, 117.1, 111.3, 101.8, 60.3, 14.7. **HRMS-ESI** (m/z) calcd. for $[C_{15}H_{13}BrNO_2]^+$ ($[M+H]^+$): 318.0125, found: 318.0128.



3f

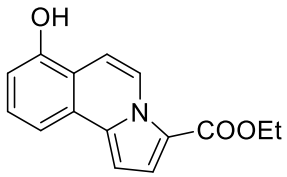
Ethyl 8-bromopyrrolo[2,1-a]isoquinoline-3-carboxylate (**3f**). White solid, 239 mg, 75% yield. M.p. 148-149 ℃. Purified by column chromatography on silica gel using petroleum ether / ethyl acetate = 40:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.23 (d, J = 7.5 Hz, 1H), 7.96 (d, J = 8.5 Hz, 1H), 7.81 (d, J = 1.0 Hz, 1H), 7.61 (dd, J_1 = 1.5 Hz, J_2 = 8.5 Hz, 1H), 7.50 (d, J = 4.0 Hz, 1H), 6.98 (d, J = 4.5 Hz, 1H), 6.90 (d, J = 7.5 Hz, 1H), 4.40(q, J = 7.0 Hz, 2H), 1.42 (t, J = 7.5 Hz, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 161.5, 134.8, 130.8, 129.4, 129.3, 126.1, 124.8, 124.0, 121.2, 120.9, 117.1, 111.5, 101.4, 60.2, 14.7. **HRMS-ESI** (m/z) calcd. for $[C_{15}H_{13}BrNO_2]^+$ ($[M+H]^+$):

318.0125, found: 318.0130.



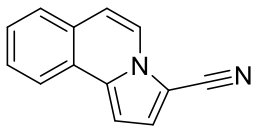
3g

Ethyl 10-bromopyrrolo[2,1-a]isoquinoline-3-carboxylate (**3g**). White solid, 216 mg, 68 % yield. M.p. 103-105 ℃. Purified by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.34 (d, J = 7.5 Hz, 1H), 8.14 (d, J = 4.0 Hz, 1H), 7.84 (d, J = 7.5 Hz, 1H), 7.61 (d, J = 7.5 Hz, 1H), 7.54 (d, J = 4.5 Hz, 1H), 7.29 (t, J = 8.0 Hz, 1H), 6.96 (d, J = 7.5 Hz, 1H), 4.42 (q, J = 7.0 Hz, 2H), 1.45 (t, J = 7.0 Hz, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 161.6, 134.0, 133.1, 131.0, 127.3, 126.7, 125.5, 124.7, 120.1, 119.1, 116.9, 112.8, 107.6, 60.3, 14.6. **HRMS-ESI** (m/z) calcd. for $[C_{15}H_{13}BrNO_2]^+$ ($[M+H]^+$): 318.0125, found: 318.0129.



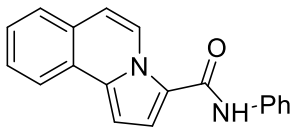
3h

Ethyl 7-hydroxypyrrolo[2,1-a]isoquinoline-3-carboxylate (**3h**). White solid, 163 mg, 64 % yield. M.p. 167-169 ℃. Purified by column chromatography on silica gel using petroleum ether / ethyl acetate = 5:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, DMSO-d_6) δ 10.34 (s, 1H), 9.08 (d, J = 7.5 Hz, 1H), 7.73 (d, J = 7.5 Hz, 1H), 7.45-7.40 (m, 3H), 7.17 (d, J = 3.5 Hz, 1H), 6.99 (d, J = 8.0 Hz, 1H), 4.32 (q, J = 7.0 Hz, 2H), 1.34 (t, J = 7.0 Hz, 3H). **^{13}C NMR** (126 MHz, DMSO-d_6) δ 161.0, 153.6, 135.3, 129.3, 126.2, 123.3, 120.8, 117.4, 116.1, 114.3, 112.2, 107.8, 102.2, 60.1, 14.9. **HRMS-ESI** (m/z) calcd. for $[C_{15}H_{14}NO_3]^+$ ($[M+H]^+$): 256.0969, found: 256.0967.



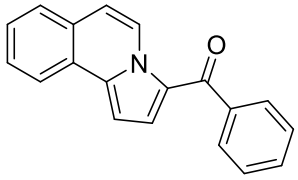
3i

Pyrrolo[2,1-a]isoquinoline-3-carbonitrile (**3i**).[6] White solid, 115 mg, 60 % yield. Purified by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.03 (d, J = 8.0 Hz, 1H), 7.97 (d, J = 7.5 Hz, 1H), 7.62 (d, J = 8.0 Hz, 1H), 7.56-7.47 (m, 2H), 7.25 (d, J = 4.0 Hz, 1H), 6.97 (d, J = 7.0 Hz, 1H), 6.90 (d, J = 4.0 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 134.3, 128.5, 127.9, 127.7, 127.4, 125.1, 123.1, 122.6, 121.9, 113.8, 113.7, 101.5, 97.8.



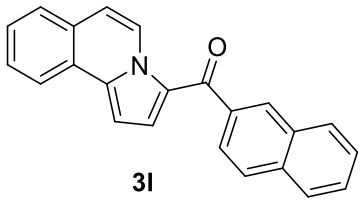
3j

N-phenylpyrrolo[2,1-a]isoquinoline-3-carboxamide (**3j**). Yellow solid, 189 mg, 66 % yield. M.p. 182-184 ℃. Purified by column chromatography on silica gel using petroleum ether / dichloromethane = 1:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.40 (d, J = 7.5 Hz, 1H), 8.13 (d, J = 7.5 Hz, 1H), 7.74 (s, 1H), 7.66 (t, J = 9.0 Hz, 3H), 7.57-7.49 (m, 2H), 7.40 (t, J = 7.5 Hz, 2H), 7.29-7.28 (m, 1H), 7.16 (t, J = 7.5 Hz, 1H), 7.03 (d, J = 4.5 Hz, 1H), 7.00 (d, J = 7.5 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 160.0, 138.2, 135.1, 129.4, 129.3, 127.9, 127.7, 127.4, 127.0, 125.4, 124.3, 123.1, 120.6, 120.3, 119.3, 116.5, 115.5, 112.8, 100.7. **HRMS-ESI** (m/z) calcd. for $[C_{19}H_{15}N_2O]^+$ ($[M+H]^+$): 287.1179, found: 287.1176.



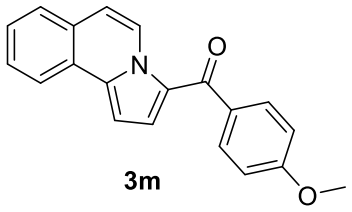
3k

Phenyl(pyrrolo[2,1-a]isoquinolin-3-yl)methanone (**3k**).[7] Yellow solid, 190 mg, 70 % yield. Purified by column chromatography on silica gel using petroleum ether / dichloromethane = 1:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.62 (d, J = 7.5 Hz, 1H), 8.18 (d, J = 7.5 Hz, 1H), 7.86 (d, J = 7.5 Hz, 2H), 7.73 (d, J = 7.0 Hz, 1H), 7.59-7.49 (m, 5H), 7.32 (d, J = 4.5 Hz, 1H), 7.12 (d, J = 7.5 Hz, 1H), 7.05 (d, J = 4.0 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 185.5, 140.7, 137.1, 131.2, 129.2, 129.0, 128.3, 128.1, 127.8, 127.0, 126.0, 125.9, 124.8, 123.7, 113.5, 102.0. Note: In the ^{13}C NMR spectrum of **3k**, theoretically, there should be seventeen peaks. Due to the compact overlaying, it is difficult to specify the overlaying peaks.



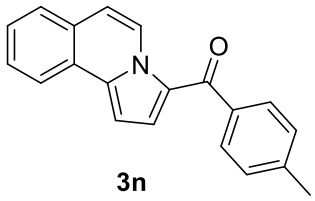
3l

Naphthalen-2-yl(pyrrolo[2,1-a]isoquinolin-3-yl)methanone (**3l**).[6] Yellow solid, 167 mg, 52 % yield. Purified by column chromatography on silica gel using petroleum ether / dichloromethane = 1:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.65 (d, J = 7.5 Hz, 1H), 8.36 (s, 1H), 8.22-8.20 (m, 1H), 7.98-7.93 (m, 4H), 7.76-7.74 (m, 1H), 7.62-7.56 (m, 4H), 7.39 (d, J = 5.0 Hz, 1H), 7.16 (d, J = 7.5 Hz, 1H), 7.09 (d, J = 4.5 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 185.5, 138.0, 137.2, 134.9, 132.6, 130.0, 129.3, 129.1, 128.2, 128.2, 128.0, 127.9, 127.8, 127.1, 126.8, 126.2, 126.0, 125.9, 125.1, 124.9, 123.8, 113.6, 102.2.



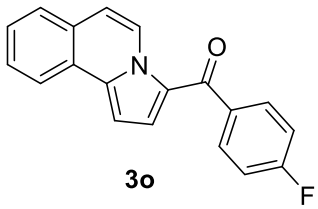
3m

(4-Methoxyphenyl)(pyrrolo[2,1-a]isoquinolin-3-yl)methanone (**3m**).[6] Yellow solid, 151 mg, 50 % yield. Purified by column chromatography on silica gel using petroleum ether / dichloromethane = 1:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.54 (d, J = 8.0 Hz, 1H), 8.17 (d, J = 7.5 Hz, 1H), 7.89-7.86 (m, 2H), 7.72-7.71 (m, 1H), 7.59-7.52 (m, 2H), 7.32 (d, J = 4.5 Hz, 1H), 7.09 (d, J = 7.5 Hz, 1H), 7.05 (d, J = 4.5 Hz, 1H), 7.02-6.99 (m, 2H), 3.90 (s, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 184.6, 162.4, 136.7, 133.2, 131.5, 129.0, 128.0, 127.8, 127.0, 126.0, 125.3, 124.9, 123.7, 113.6, 113.3, 101.8, 55.6. Note: In the ^{13}C NMR spectrum of **3m**, theoretically, there should be eighteen peaks. Due to the compact overlaying, it is difficult to specify the overlaying peaks.



3n

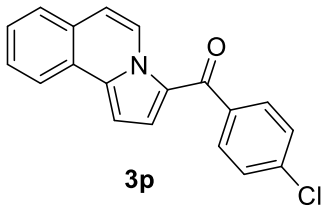
Pyrrolo[2,1-a]isoquinolin-3-yl(p-tolyl)methanone (**3n**).[6] Yellow solid, 257 mg, 90 % yield. Purified by column chromatography on silica gel using petroleum ether / dichloromethane = 1:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.59 (d, J = 7.5 Hz, 1H), 8.17 (d, J = 7.5 Hz, 1H), 7.77 (d, J = 8.0 Hz, 2H), 7.73-7.71 (m, 1H), 7.59-7.53 (m, 2H), 7.33-7.30 (m, 3H), 7.11 (d, J = 8.0 Hz, 1H), 7.05 (d, J = 4.0 Hz, 1H), 2.46 (s, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 185.5, 141.8, 138.0, 136.9, 129.4, 129.0, 129.0, 128.1, 127.8, 127.0, 126.0, 125.8, 125.0, 124.9, 123.7, 113.4, 101.9, 21.7.



3o

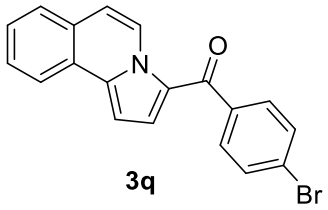
(4-Fluorophenyl)(pyrrolo[2,1-a]isoquinolin-3-yl)methanone (**3o**).[6] Yellow solid, 119 mg, 41 % yield. Purified by column chromatography on silica gel using petroleum ether / dichloromethane = 1:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.57 (d, J = 7.0 Hz, 1H), 8.19 (d, J = 7.5 Hz, 1H), 7.89-7.87 (m, 2H), 7.75-7.73 (m, 1H), 7.61-7.55 (m, 2H), 7.29 (d, J = 4.5 Hz, 1H), 7.20-7.17 (m, 2H), 7.14 (d, J = 7.5 Hz, 1H), 7.07 (d, J = 4.5 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 183.9, 164.7 (d, J = 252.0 Hz), 137.1,

136.8 (d, J = 3.7 Hz), 131.5 (d, J = 8.2 Hz), 129.0, 128.1, 127.8, 127.0, 125.8, 125.7, 124.7, 124.5, 123.7, 115.3 (d, J = 21.8 Hz), 113.5, 102.0.



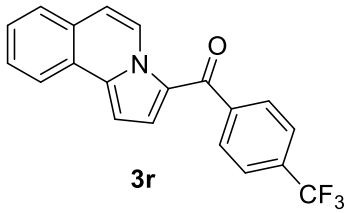
3p

(4-Chlorophenyl)(pyrrolo[2,1-a]isoquinolin-3-yl)methanone (**3p**).[6] Yellow solid, 122 mg, 40 % yield. Purified by column chromatography on silica gel using petroleum ether / dichloromethane = 1:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.58 (d, J = 7.5 Hz, 1H), 8.19 (d, J = 7.5 Hz, 1H), 7.80 (d, J = 8.5 Hz, 2H), 7.75-7.73 (m, 1H), 7.61-7.56 (m, 2H), 7.48 (d, J = 8.5 Hz, 2H), 7.28 (d, J = 4.5 Hz, 1H), 7.14 (d, J = 7.5 Hz, 1H), 7.07 (d, J = 4.5 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 184.0, 165.9, 139.1, 137.5, 137.4, 130.6, 129.1, 128.6, 128.3, 128.0, 127.1, 125.9, 124.7, 124.5, 123.8, 113.7, 102.3.



3q

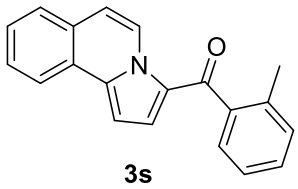
(4-Bromophenyl)(pyrrolo[2,1-a]isoquinolin-3-yl)methanone (**3q**).[9] Yellow solid, 122 mg, 48 % yield. Purified by column chromatography on silica gel using petroleum ether / dichloromethane = 1:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.58 (d, J = 7.5 Hz, 1H), 8.20-8.18 (m, 1H), 7.75-7.71 (m, 3H), 7.66-7.63 (m, 2H), 7.61-7.55 (m, 2H), 7.28 (d, J =4.5 Hz, 1H), 7.14 (d, J = 7.5 Hz, 1H), 7.06 (d, J = 4.5 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 184.1, 139.5, 137.4, 131.6, 130.8, 129.1, 128.3, 128.0, 127.1, 125.9, 125.9, 124.7, 124.5, 123.8, 113.7, 102.3. Note: In the ^{13}C NMR spectrum of **3q**, theoretically, there should be seventeen peaks. Due to the compact overlaying, it is difficult to specify the overlaying peaks.



3r

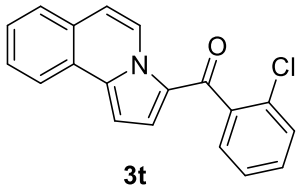
Pyrrolo[2,1-a]isoquinolin-3-yl(4-(trifluoromethyl)phenyl)methanone (**3r**). Yellow solid, 110 mg, 32 % yield. M.p. 236-238 ℃. Purified by column chromatography on silica gel using petroleum ether / dichloromethane = 1:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.64 (d, J = 7.5 Hz, 1H), 8.23-8.21 (m, 1H), 7.96 (d, J = 8.0 Hz, 2H), 7.80-7.77 (m, 3H), 7.65-7.59 (m, 2H), 7.29 (d, J = 4.0 Hz, 1H), 7.20(d, J = 7.5 Hz, 1H),

7.10 (d, J = 5.0 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 183.9, 144.0, 137.8, 132.9, 132.6, 129.4, 129.3, 128.5, 128.1, 127.2, 126.4, 125.9, 125.4 (q, J = 3.7 Hz), 125.1, 124.7, 124.4, 123.9, 122.9, 114.0, 102.6. **HRMS-ESI** (m/z) calcd. for $[C_{20}H_{13}F_3NO]^+$ ($[M+H]^+$): 340.0944, found: 340.0951.



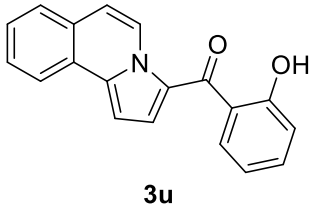
3s

Pyrrolo[2,1-a]isoquinolin-3-yl(o-tolyl)methanone (**3s**). Yellow solid, 177 mg, 62 % yield. M.p. 87-89 ℃. Purified by column chromatography on silica gel using petroleum ether / dichloromethane = 1:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.73 (d, J = 7.5 Hz, 1H), 8.18 (d, J = 8.0 Hz, 1H), 7.75 (d, J = 7.0 Hz, 1H), 7.60-7.55 (m, 2H), 7.45 (d, J = 7.5 Hz, 1H), 7.39 (t, J = 7.5 Hz, 1H), 7.31-7.27(m, 2H), 7.15 (d, J = 7.5 Hz, 1H), 7.05 (d, J = 4.5 Hz, 1H), 7.01 (d, J = 4.5 Hz, 1H), 2.43 (s, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 187.5, 140.7, 137.3, 136.2, 130.8, 129.6, 129.2, 128.3, 128.2, 127.9, 127.1, 126.5, 126.1, 125.6, 125.2, 124.8, 123.8, 113.7, 102.2, 19.8. **HRMS-ESI** (m/z) calcd. for $[C_{20}H_{16}NO]^+$ ($[M+H]^+$): 286.1227, found: 286.1234.



3t

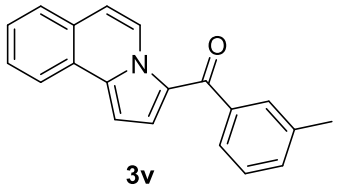
(2-Chlorophenyl)(pyrrolo[2,1-a]isoquinolin-3-yl)methanone (**3t**).[9] Yellow solid, 116 mg, 38 % yield. Purified by column chromatography on silica gel using petroleum ether / dichloromethane = 1:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.69 (d, J = 7.5 Hz, 1H), 8.18-8.16 (m, 1H), 7.75-7.74 (m, 1H), 7.60-7.56 (m, 2H), 7.50-7.48 (m, 2H), 7.43-7.40 (m, 1H), 7.38-7.35 (m, 1H), 7.17 (d, J = 7.5 Hz, 1H), 7.03-7.00 (m, 2H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 183.3, 140.0, 137.8, 131.5, 130.6, 130.1, 129.3, 129.2, 128.4, 128.0, 127.1, 126.6, 126.5, 126.0, 124.7, 124.6, 123.9, 113.9, 102.7.



3u

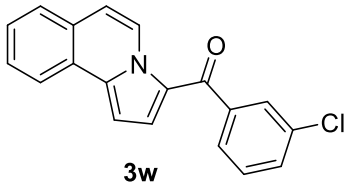
(2-Hydroxyphenyl)(pyrrolo[2,1-a]isoquinolin-3-yl)methanone (**3u**). Yellow solid, 161 mg, 56 % yield. M.p. 142-144 ℃. Purified by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 11.57 (s, 1H), 9.31 (d, J = 7.5 Hz, 1H), 8.18 (d, J = 8.0 Hz, 1H), 7.90 (d, J = 8.0 Hz, 1H), 7.73 (d, J = 7.0 Hz, 1H), 7.61-7.55 (m, 2H), 7.49-7.44 (m, 2H), 7.11-7.06 (m, 3H),

6.96 (t, J = 7.5 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 187.1, 162.0, 137.6, 134.6, 132.1, 129.1, 128.4, 128.0, 127.1, 126.1, 125.8, 124.8, 124.2, 123.8, 121.5, 118.8, 118.2, 113.6, 102.6. **HRMS-ESI** (m/z) calcd. for $[C_{19}H_{14}NO_2]^+$ ($[M+H]^+$): 288.1020, found: 288.1015.



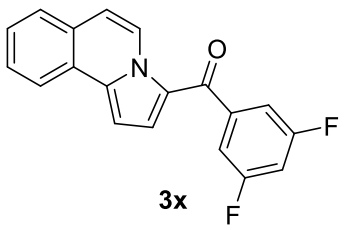
3v

Pyrrolo[2,1-a]isoquinolin-3-yl(m-tolyl)methanone (**3v**). Yellow solid, 185 mg, 65 % yield. M.p. 123-125 ℃. Purified by column chromatography on silica gel using petroleum ether / dichloromethane = 1:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.61 (d, J = 7.0 Hz, 1H), 8.19-8.18 (m, 1H), 7.74-7.72 (m, 1H), 7.66-7.63 (m, 2H), 7.60-7.54 (m, 2H), 7.40-7.37 (m, 2H), 7.32(d, J = 4.0 Hz, 1H), 7.12 (d, J = 7.5 Hz, 1H), 7.05 (d, J = 4.5 Hz, 1H), 2.46 (s, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 185.8, 140.8, 138.1, 137.0, 132.0, 129.8, 129.1, 128.1, 127.9, 127.1, 126.5, 126.0, 124.9, 124.9, 123.8, 113.5, 102.0, 21.6. Note: In the ^{13}C NMR spectrum of **3v**, theoretically, there should be twenty peaks. Due to the compact overlaying, it is difficult to specify the overlaying peaks. **HRMS-ESI** (m/z) calcd. for $[C_{20}H_{16}NO]^+$ ($[M+H]^+$): 286.1227, found: 286.1225.



3w

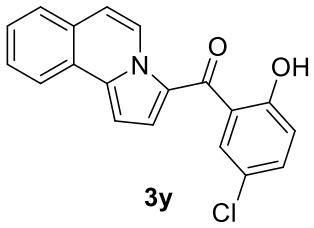
(3-Chlorophenyl)(pyrrolo[2,1-a]isoquinolin-3-yl)methanone (**3w**).[9] Yellow solid, 128 mg, 42 % yield. Purified by column chromatography on silica gel using petroleum ether / dichloromethane = 1:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.59 (d, J = 7.5 Hz, 1H), 8.21-8.19 (m, 1H), 7.82 (t, J = 2.0 Hz, 1H), 7.76-7.71 (m, 2H), 7.62-7.56 (m, 2H), 7.54-7.52 (m, 1H), 7.44 (t, J = 7.5 Hz, 1H), 7.30 (d, J = 5.0 Hz, 1H), 7.16 (d, J = 7.5 Hz, 1H), 7.07 (d, J = 4.5 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 183.7, 142.4, 137.6, 134.5, 131.2, 129.6, 129.2, 129.2, 128.4, 128.0, 127.3, 127.1, 126.2, 125.9, 124.7, 124.4, 123.9, 113.8, 102.4.



3x

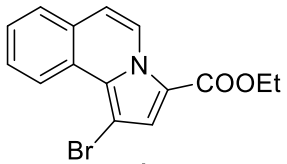
(3,5-Difluorophenyl)(pyrrolo[2,1-a]isoquinolin-3-yl)methanone (**3x**). Yellow solid, 104 mg, 34 % yield. M.p. 167-169 ℃. Purified by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz,

$CDCl_3$) δ 9.56 (d, J = 7.5 Hz, 1H), 8.19 (d, J = 7.0 Hz, 1H), 7.74 (d, J = 7.0 Hz, 1H), 7.62-7.57 (m, 2H), 7.34 (dd, J_1 = 5.5 Hz, J_2 = 23.0 Hz, 3H), 7.16 (d, J = 7.5 Hz, 1H), 7.07 (d, J = 4.5 Hz, 1H), 7.00 (t, J = 9.0 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 182.0, 162.8 (d, J = 251.1 Hz), 162.7 (d, J = 250.2 Hz), 143.7 (t, J = 8.2 Hz), 137.9, 129.3, 128.6, 128.1, 127.1, 126.1, 125.8, 124.6, 123.9, 114.0, 112.2 (dd, J_1 = 6.3 Hz, J_2 = 20.0 Hz), 106.4 (t, J = 25.6 Hz), 102.7. **HRMS-ESI** (m/z) calcd. for $[C_{19}H_{12}F_2NO]^+$ ($[M+H]^+$): 308.0882, found: 308.0891.



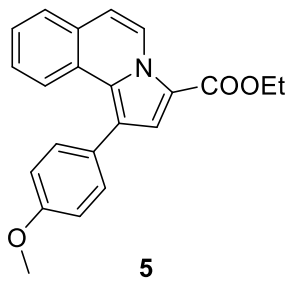
3y

(5-Chloro-2-hydroxyphenyl)(pyrrolo[2,1-a]isoquinolin-3-yl)methanone (**3y**). Yellow solid, 80 mg, 25 % yield. M.p. 194-196 ℃. Purified by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 11.41 (s, 1H), 9.31 (d, J = 7.5 Hz, 1H), 8.20 (d, J = 7.5 Hz, 1H), 7.87 (d, J = 2.5 Hz, 1H), 7.75-7.73 (m, 1H), 7.63-7.58 (m, 2H), 7.46 (d, J = 4.5 Hz, 1H), 7.41 (dd, J_1 = 2.5 Hz, J_2 = 8.5 Hz, 1H), 7.15-7.13 (m, 2H), 7.01 (d, J = 9.0 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 185.5, 160.4, 138.2, 134.2, 131.1, 129.2, 128.7, 128.2, 127.2, 126.3, 125.8, 124.7, 124.0, 123.8, 123.6, 122.3, 119.7, 114.0, 103.2. **HRMS-ESI** (m/z) calcd. for $[C_{19}H_{13}ClNO_2]^+$ ($[M+H]^+$): 322.0630, found: 322.0637.



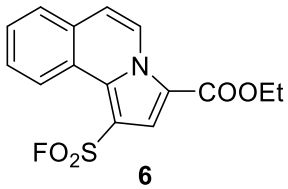
4

Ethyl 1-bromopyrrolo[2,1-a]isoquinoline-3-carboxylate (**4**).[10] White solid, 1.46 g, 92 % yield. Purified by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.26 (d, J = 7.5 Hz, 1H), 9.22 (d, J = 8.0 Hz, 1H), 7.67 (dd, J_1 = 1.0 Hz, J_2 = 8.0 Hz, 1H), 7.61-7.57 (m, 1H), 7.55-7.52 (m, 2H), 7.01 (d, J = 7.5 Hz, 1H), 4.39 (q, J = 7.0 Hz, 2H), 1.42 (t, J = 7.0 Hz, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 160.7, 129.6, 128.5, 127.7, 127.4, 126.9, 125.2, 124.4, 123.7, 123.4, 115.9, 113.5, 90.4, 60.4, 14.6.



5

Ethyl 1-(4-methoxyphenyl)pyrrolo[2,1-a]isoquinoline-3-carboxylate (**5**). White solid, 248 mg, 72 % yield. M.p. 131-133 ℃. Purified by column chromatography on silica gel using petroleum ether as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.21 (d, J = 7.5 Hz, 1H), 7.83 (d, J = 8.0 Hz, 1H), 7.54 (d, J = 8.0 Hz, 1H), 7.35-7.30 (m, 4H), 7.18-7.14 (m, 1H), 6.94-6.91 (m, 3H), 4.31 (q, J = 7.0 Hz, 2H), 3.82 (s, 3H), 1.32 (t, J = 7.0 Hz, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 161.6, 159.1, 131.2, 130.6, 129.4, 128.6, 127.1, 127.0, 125.9, 124.9, 123.7, 122.7, 119.9, 115.4, 114.2, 112.9, 60.1, 55.4, 14.6. Note: In the ^{13}C NMR spectrum of **5**, theoretically, there should be twenty peaks. Due to the compact overlaying, it is difficult to specify the overlaying peaks. **HRMS-ESI** (m/z) calcd. for $[C_{22}H_{20}NO_3]^+$ ($[M+H]^+$): 346.1438, found: 346.1433.



6

Ethyl 1-(fluorosulfonyl)pyrrolo[2,1-a]isoquinoline-3-carboxylate (**6**).[1] White solid, 25 mg, 8 % yield. Purified by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.46 (d, J = 7.5 Hz, 1H), 8.93 (d, J = 8.0 Hz, 1H), 8.08 (s, 1H), 7.82 (dd, J_1 = 1.0 Hz, J_2 = 7.5 Hz, 1H), 7.77-7.70 (m, 2H), 7.36 (d, J = 7.5 Hz, 1H), 4.44 (q, J = 7.5 Hz, 2H), 1.44 (t, J = 7.0 Hz, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 65.52 (s, 1F).

5. References

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6. Mechanistic experiments and proposal

6.1 Control Experiments

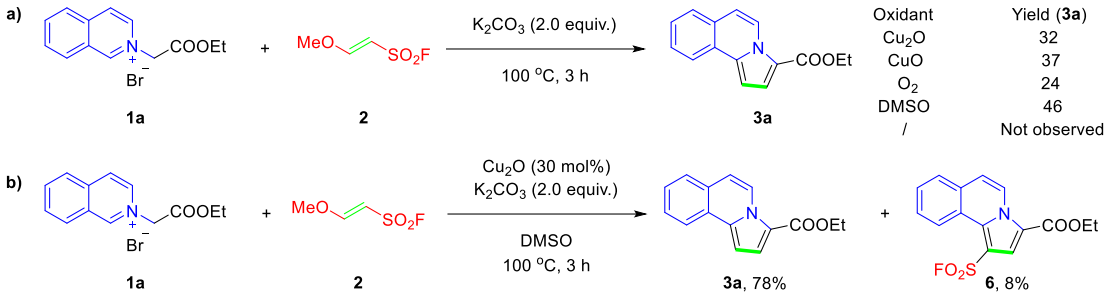


Figure S1. Experiments on mechanistic studies

No desired product **3a** was observed in the absence of oxidant (Figure S1a). This result suggested that oxidant was necessary for the cycloaddition reaction. Further control variable experiments indicated that this reaction underwent a synergistic oxidation process. We smoothly isolated by-product **6** in 8% yield, when the standard conditions was used (Figure S1b). To further gain insight into the reaction mechanism, in particular, the details on desufonylation mechanism, the reaction mixtures were detected by ^{19}F NMR analysis at different time periods (Figure S3-S9).

6.2 Proposed mechanism

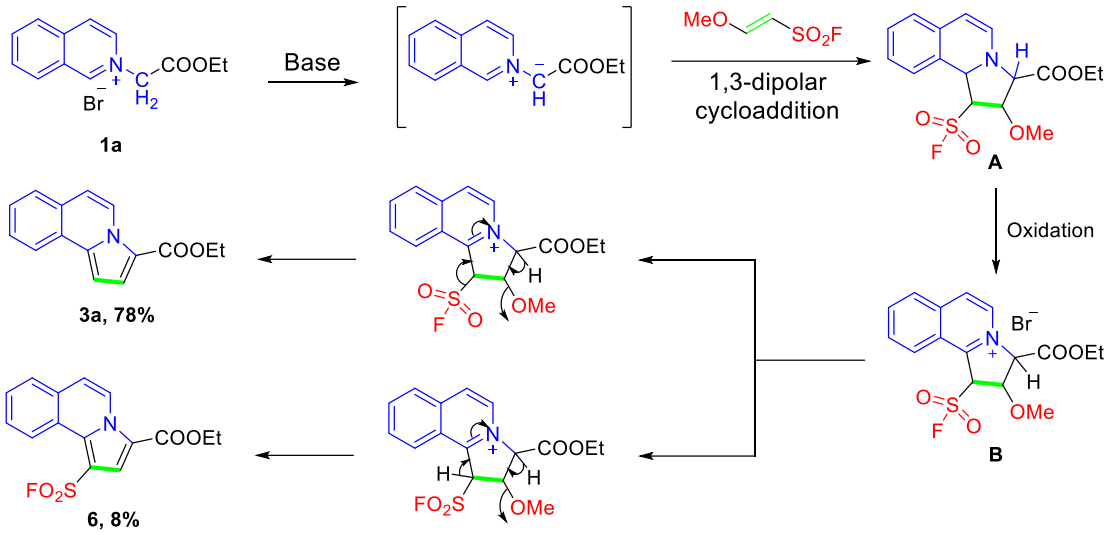


Figure S2. Proposed mechanism

A plausible mechanism of this reaction was proposed based on previous literatures and our investigation as postulated in Scheme 3 of manuscript. The 51 ppm peak and 55 ppm peak in ^{19}F NMR indicated the signals of aliphatic sulfonyl fluoride there (Figure S4-S6).The two peaks were very likely correspond to intermediate **A** and intermediate **B**. Moreover, we extrapolated that sulfonyl fluoride group was eliminated as a whole in the reaction due to the 60 ppm peaks in ^{19}F NMR.

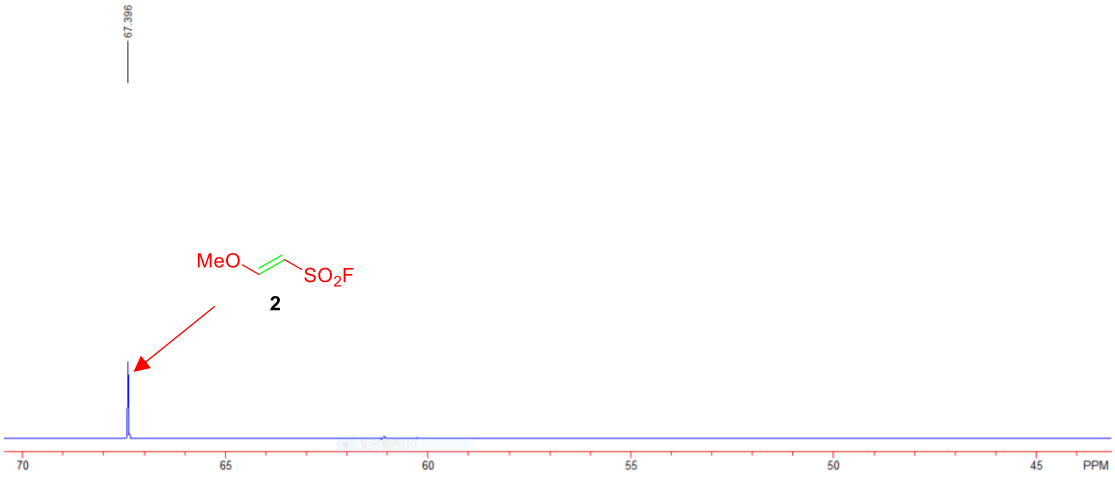


Figure S3. ^{19}F NMR of the original reaction mixtures

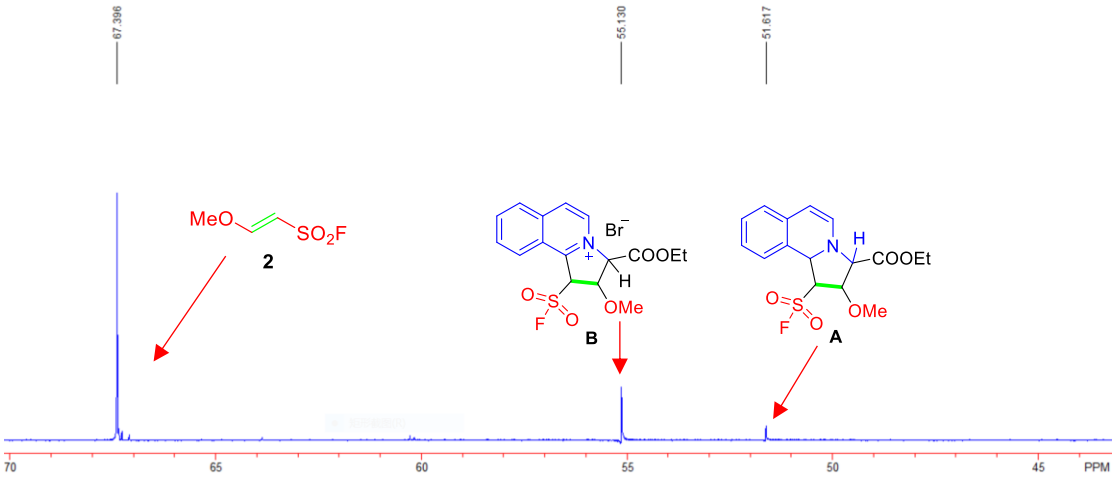


Figure S4. ^{19}F NMR of the reaction mixtures at five minutes

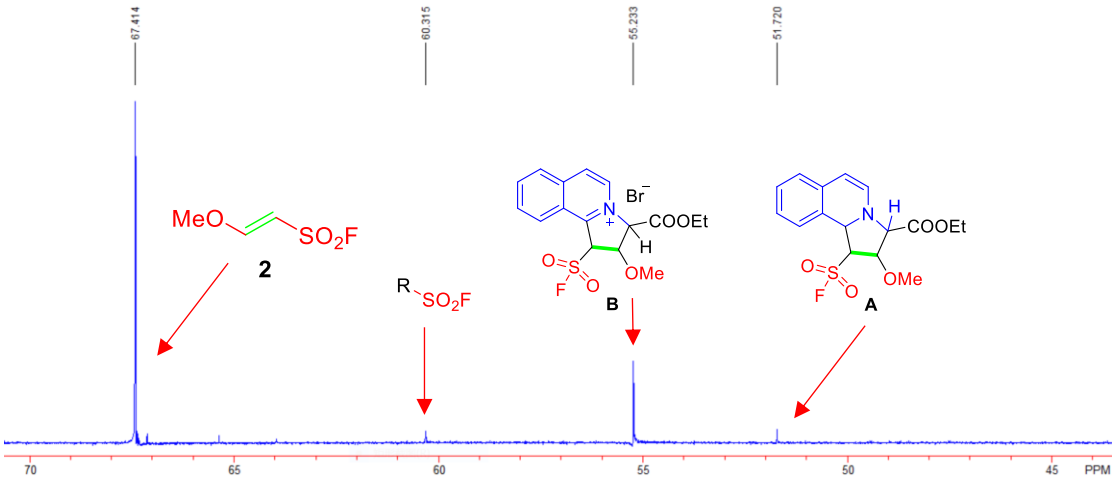


Figure S5. ^{19}F NMR of the reaction mixtures at fifteen minutes

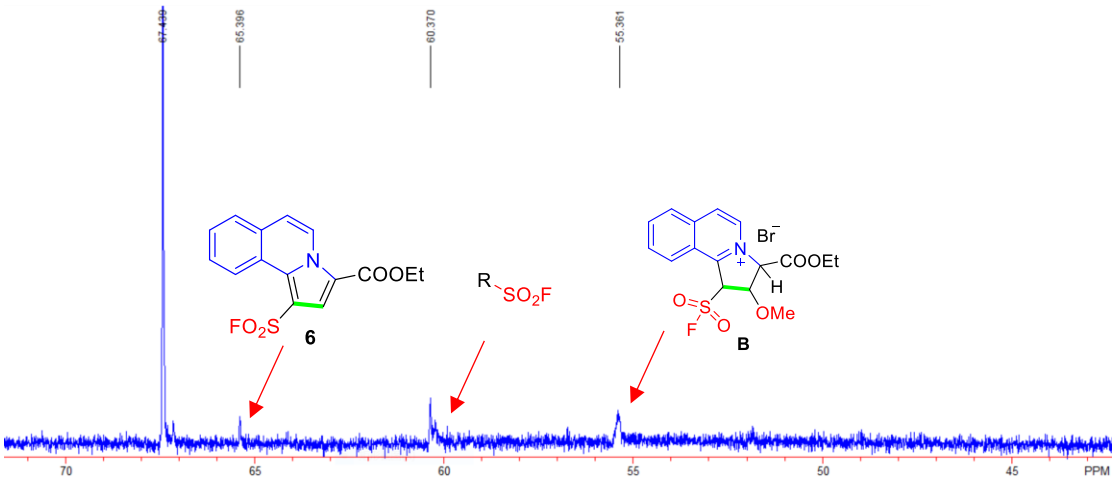


Figure S6. ^{19}F NMR of the reaction mixtures at thirty minutes

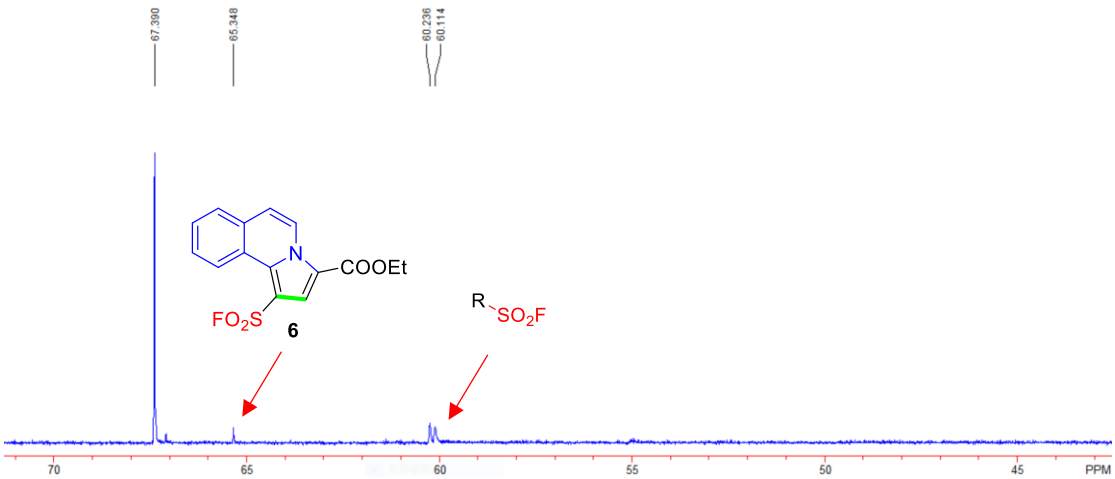


Figure S7. ^{19}F NMR of the reaction mixtures at an hour

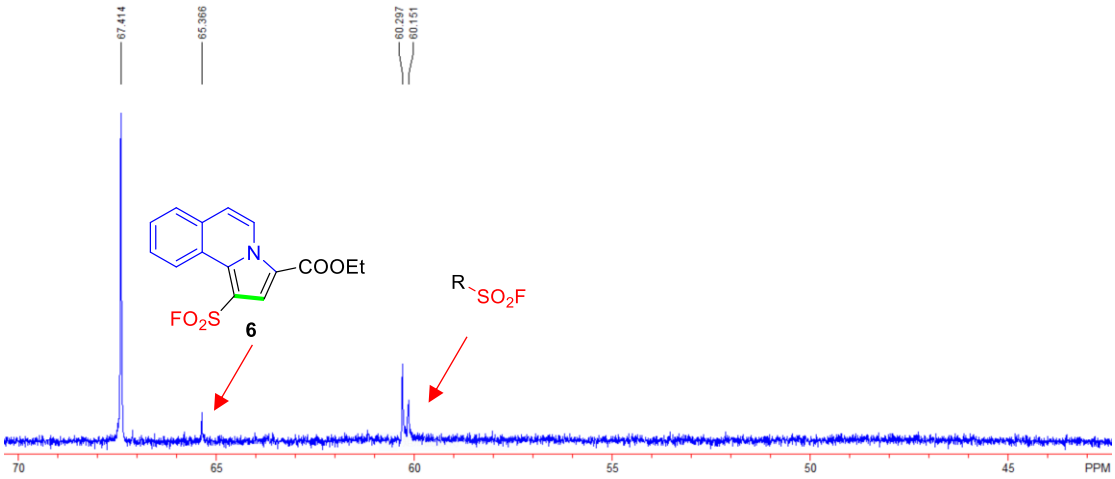


Figure S8. ^{19}F NMR of the reaction mixtures at two hours

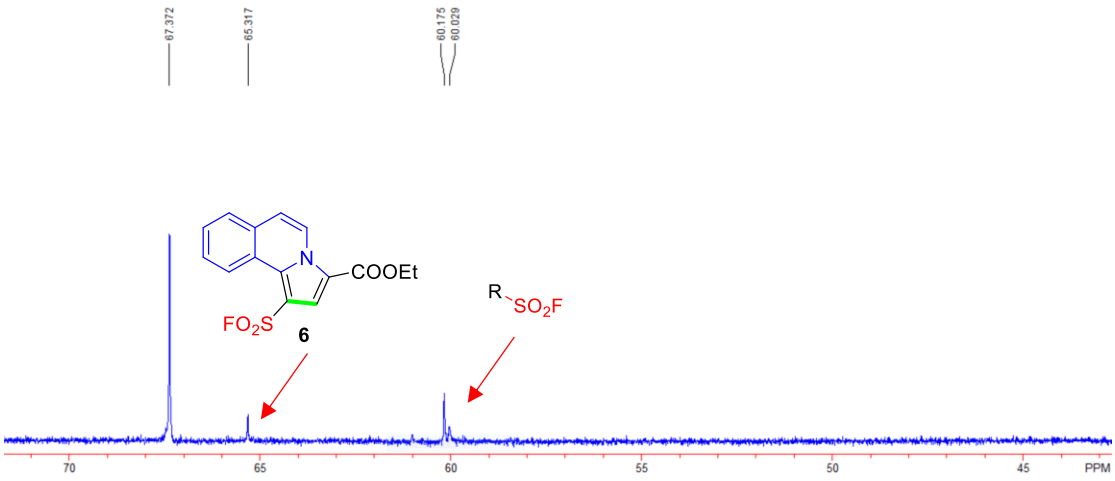
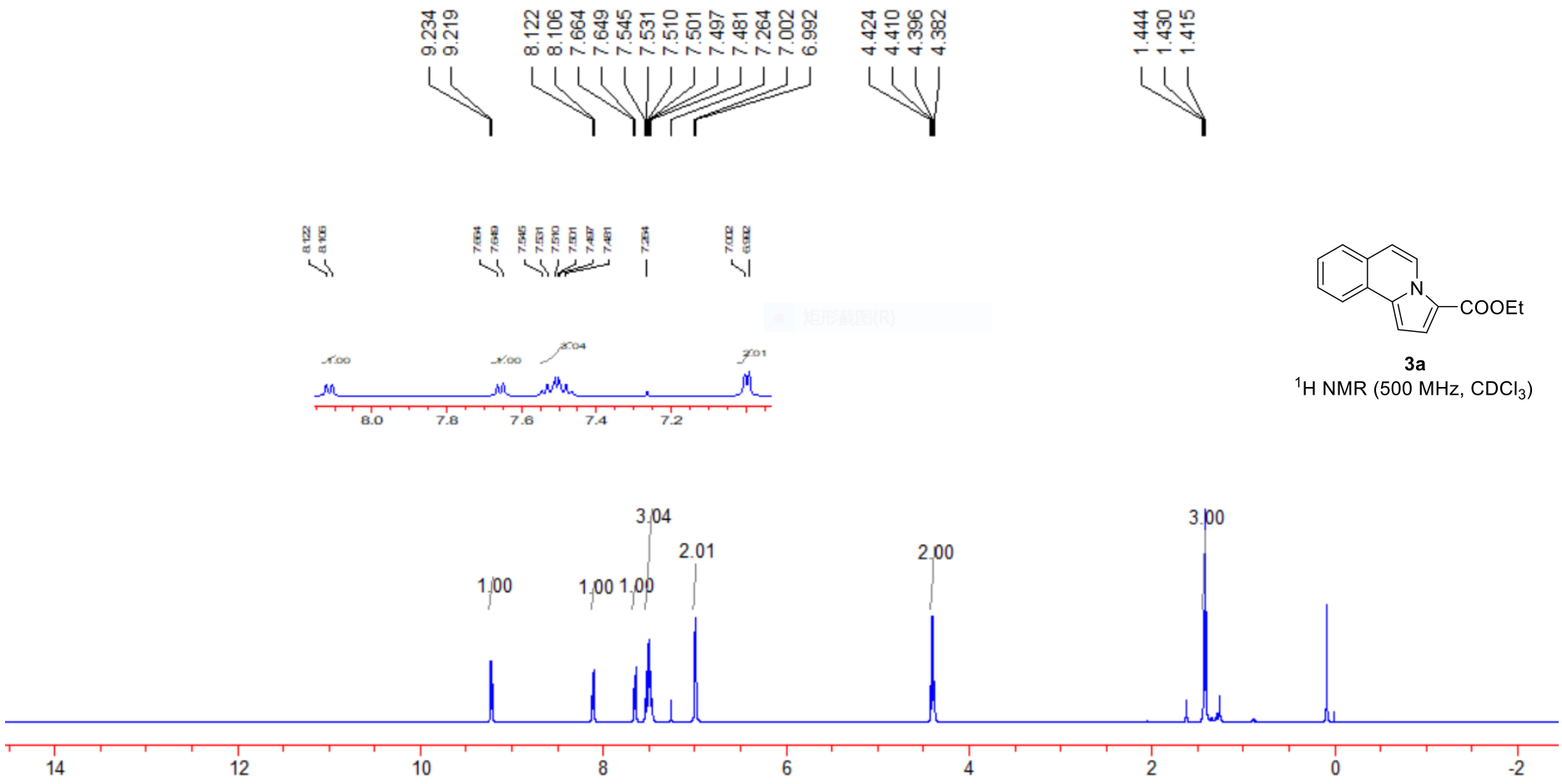
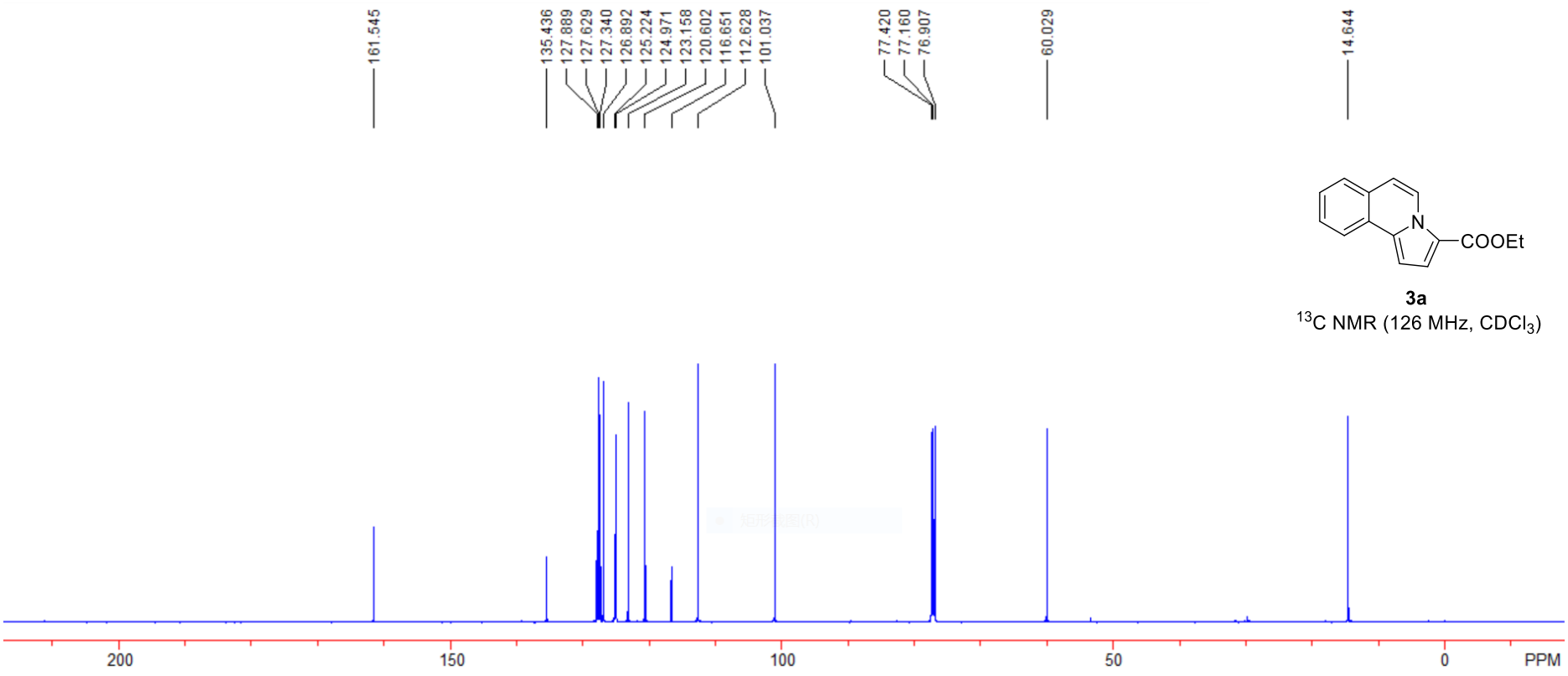


Figure S9. ^{19}F NMR of the reaction mixtures at three hours

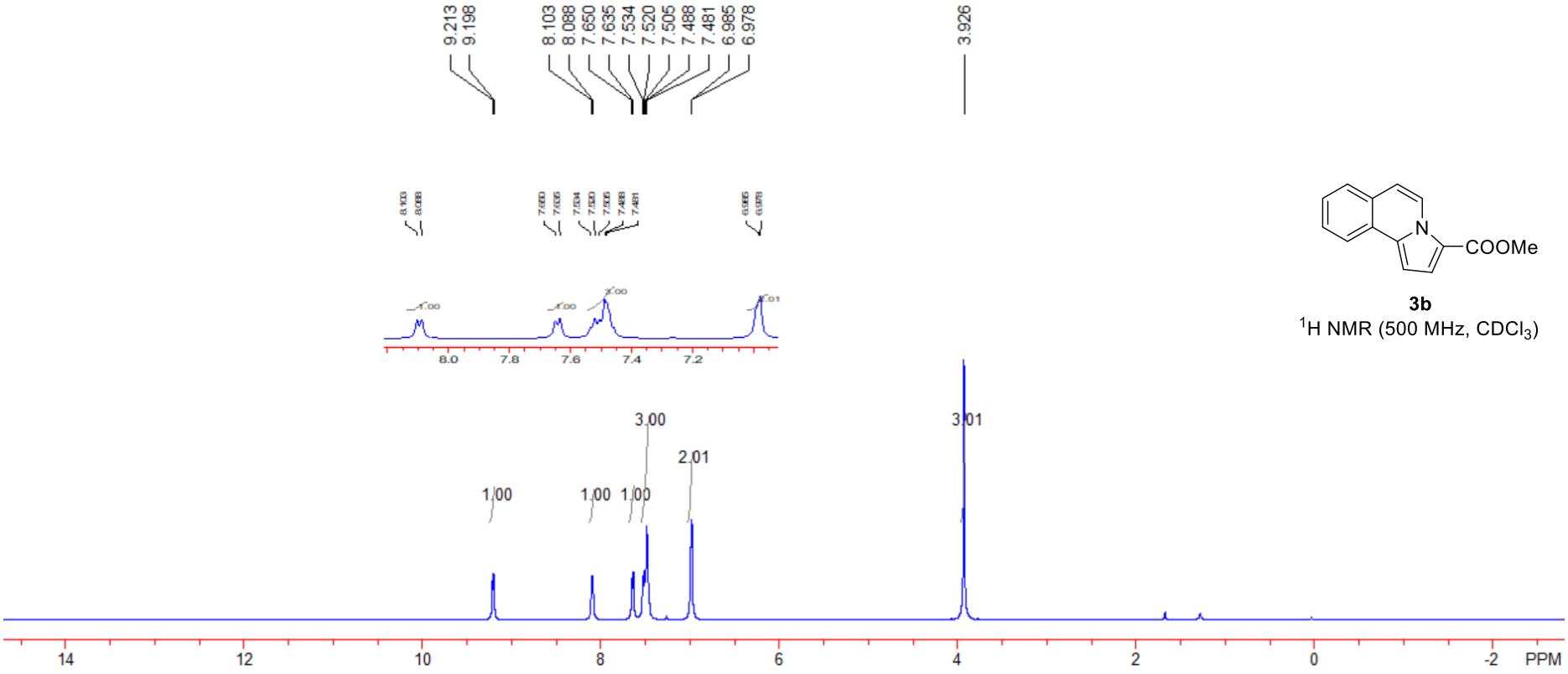
7. NMR spectra





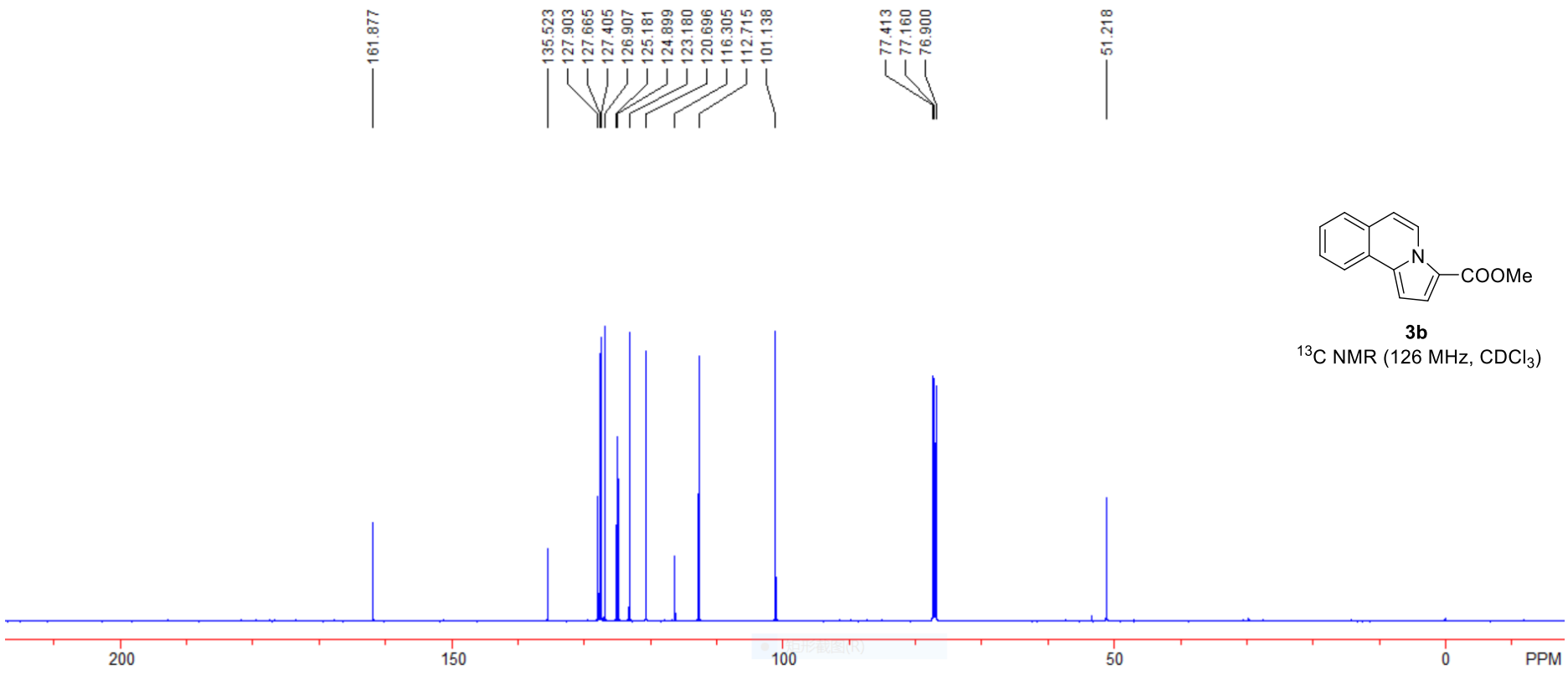
3a

^{13}C NMR (126 MHz, $CDCl_3$)



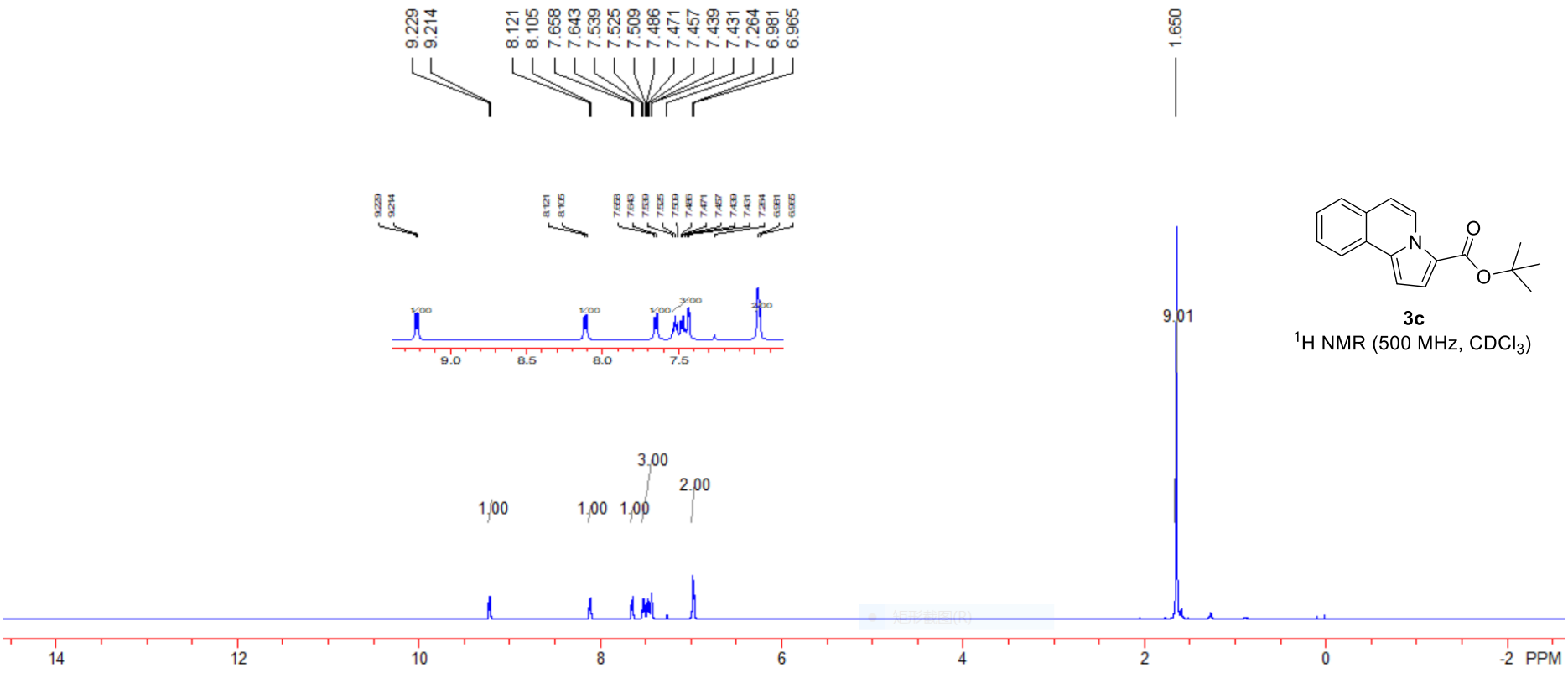
3b

^{1}H NMR (500 MHz, $CDCl_3$)



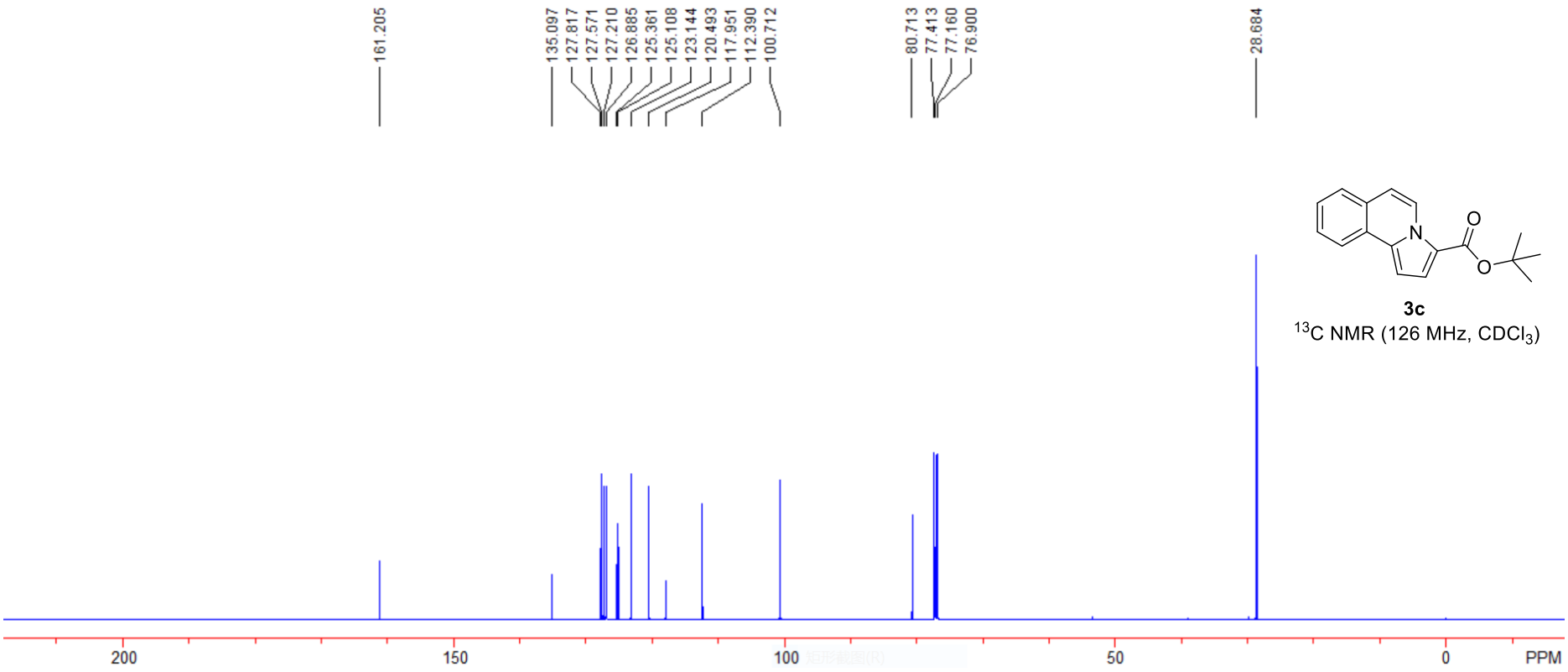
3b

^{13}C NMR (126 MHz, $CDCl_3$)



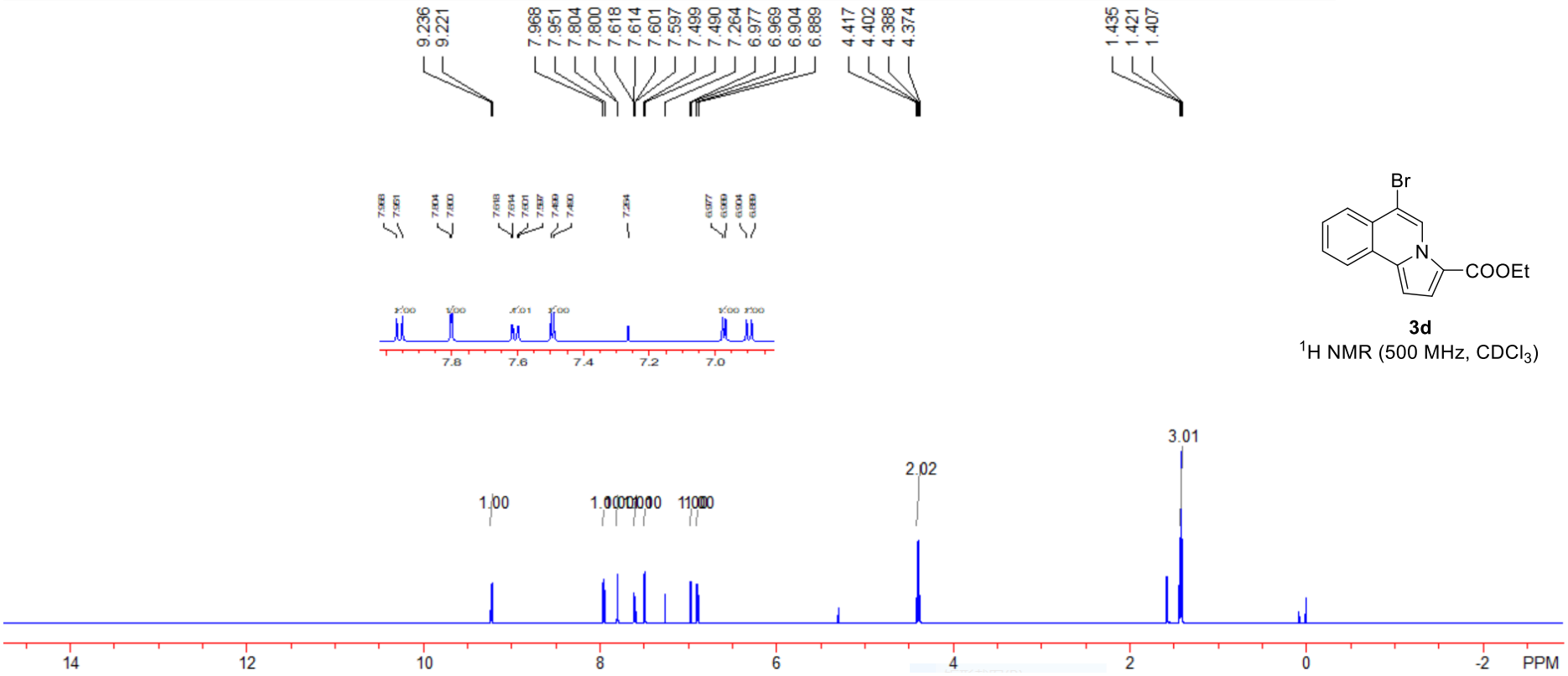
3c

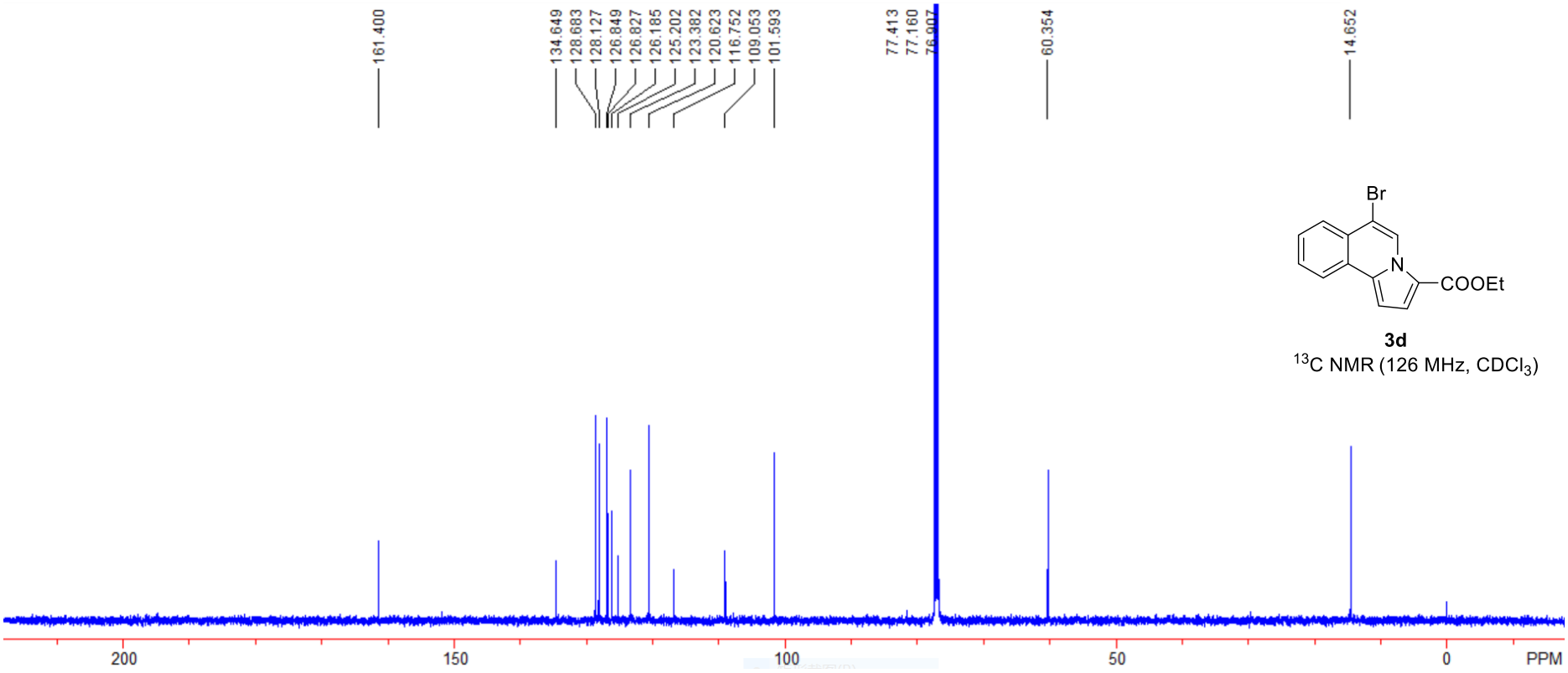
^{1}H NMR (500 MHz, $CDCl_3$)



3c

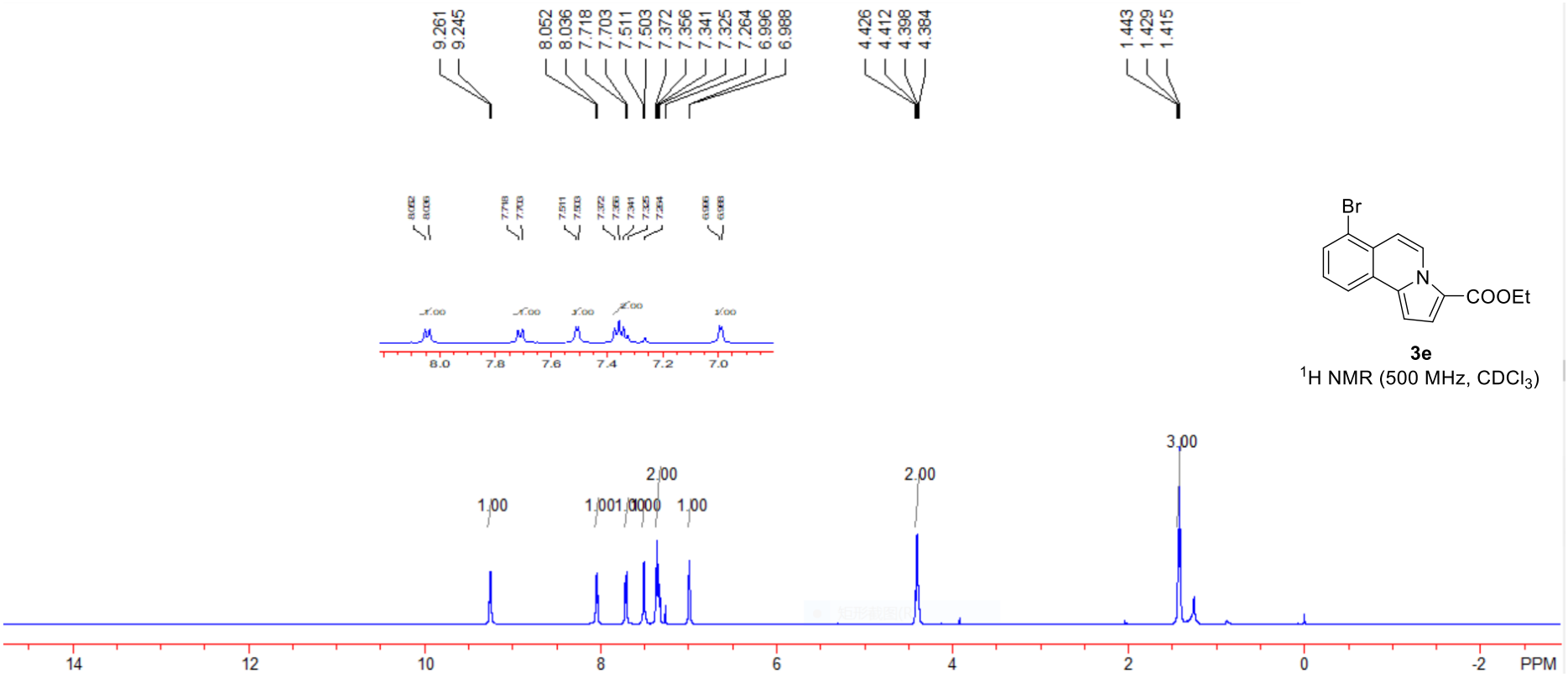
^{13}C NMR (126 MHz, $CDCl_3$)

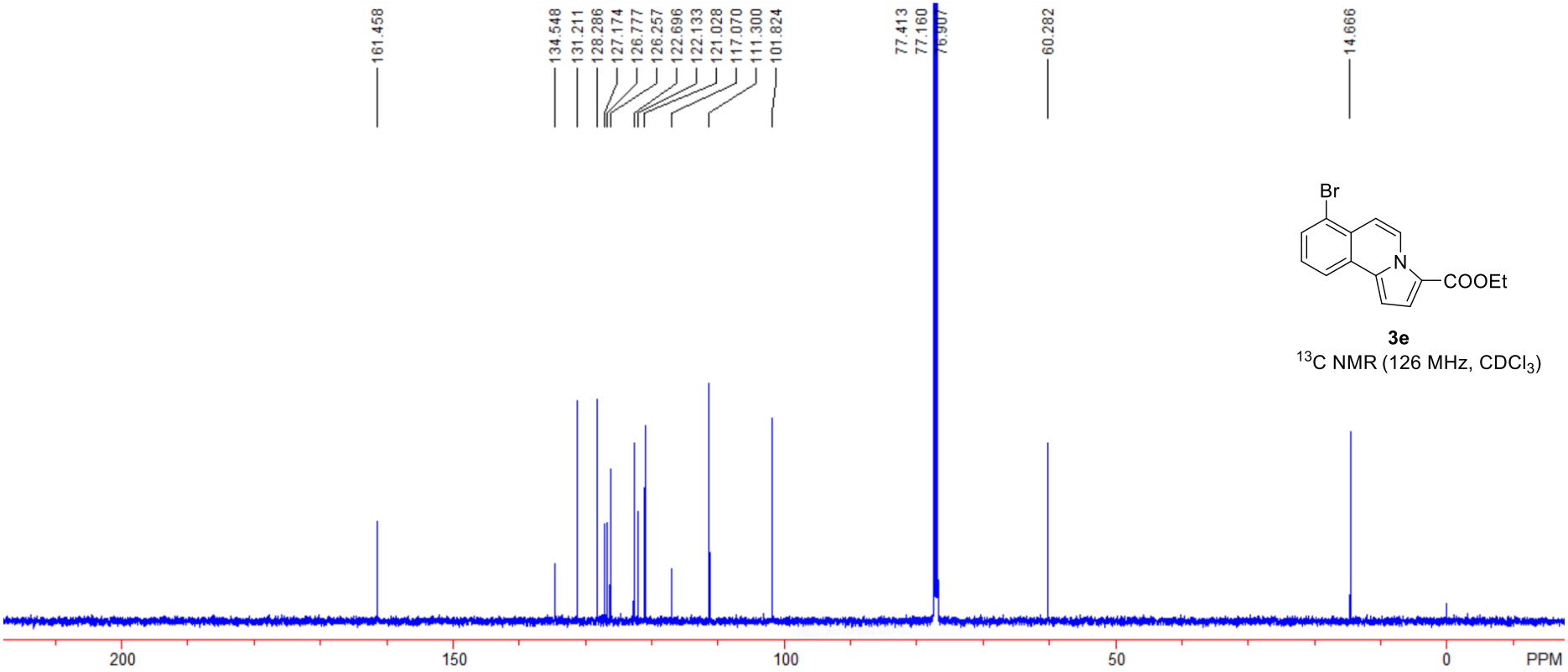

9.236
9.221
7.968
7.951
7.804
7.800
7.618
7.614
7.601
7.597
7.499
7.490
7.264
6.977
6.969
6.904
6.889
4.417
4.402
4.388
4.374
1.435
1.421
1.407
Br
N
COOEt
3d
1H NMR (500 MHz, CDCl3)
1.00
2.02
3.01
14
12
10
8
6
4
2
0
-2
PPM



3d

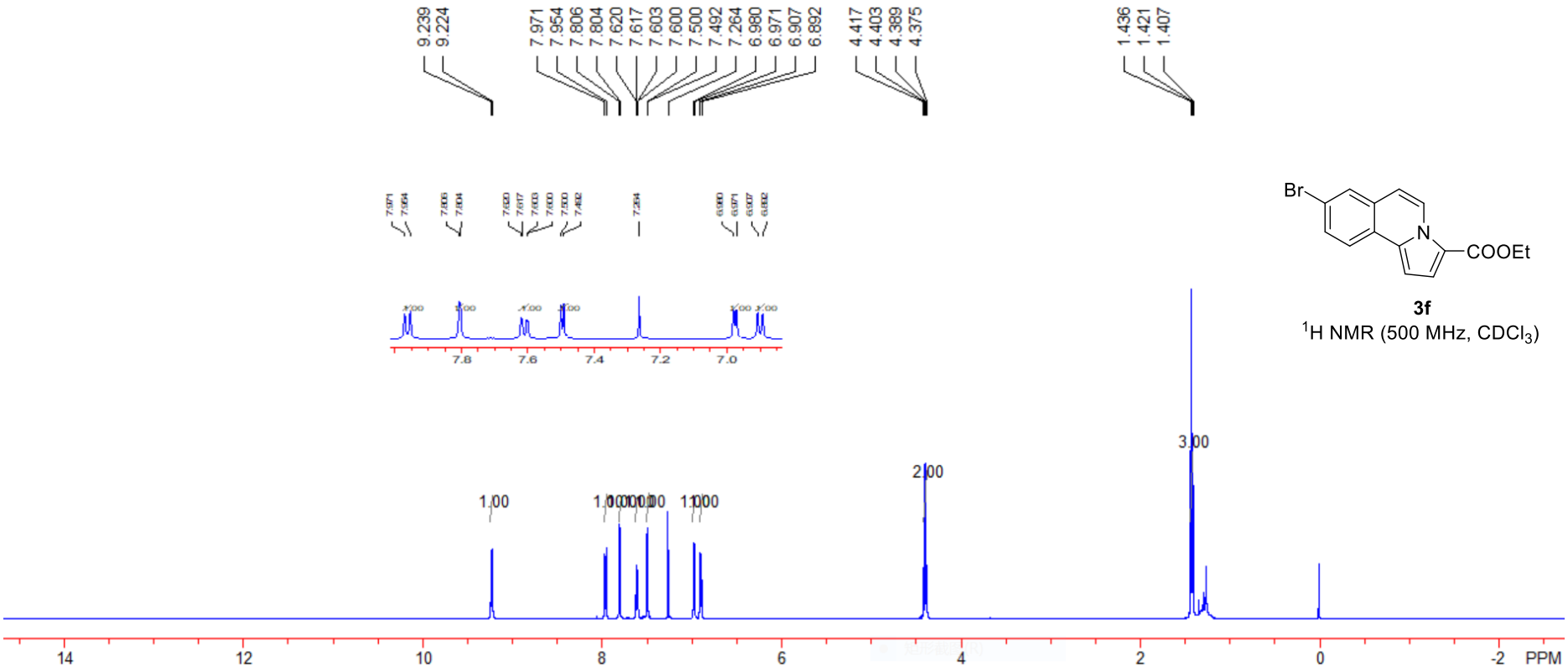
^{13}C NMR (126 MHz, $CDCl_3$)


9.261
9.245
8.052
8.036
7.718
7.703
7.511
7.503
7.372
7.356
7.341
7.325
7.264
6.996
6.988
4.426
4.412
4.398
4.384
1.443
1.429
1.415
Br
N
COOEt
3e
1H NMR (500 MHz, CDCl3)
1.00
1.00
1.00
2.00
2.00
3.00
14
12
10
8
6
4
2
0
-2
PPM



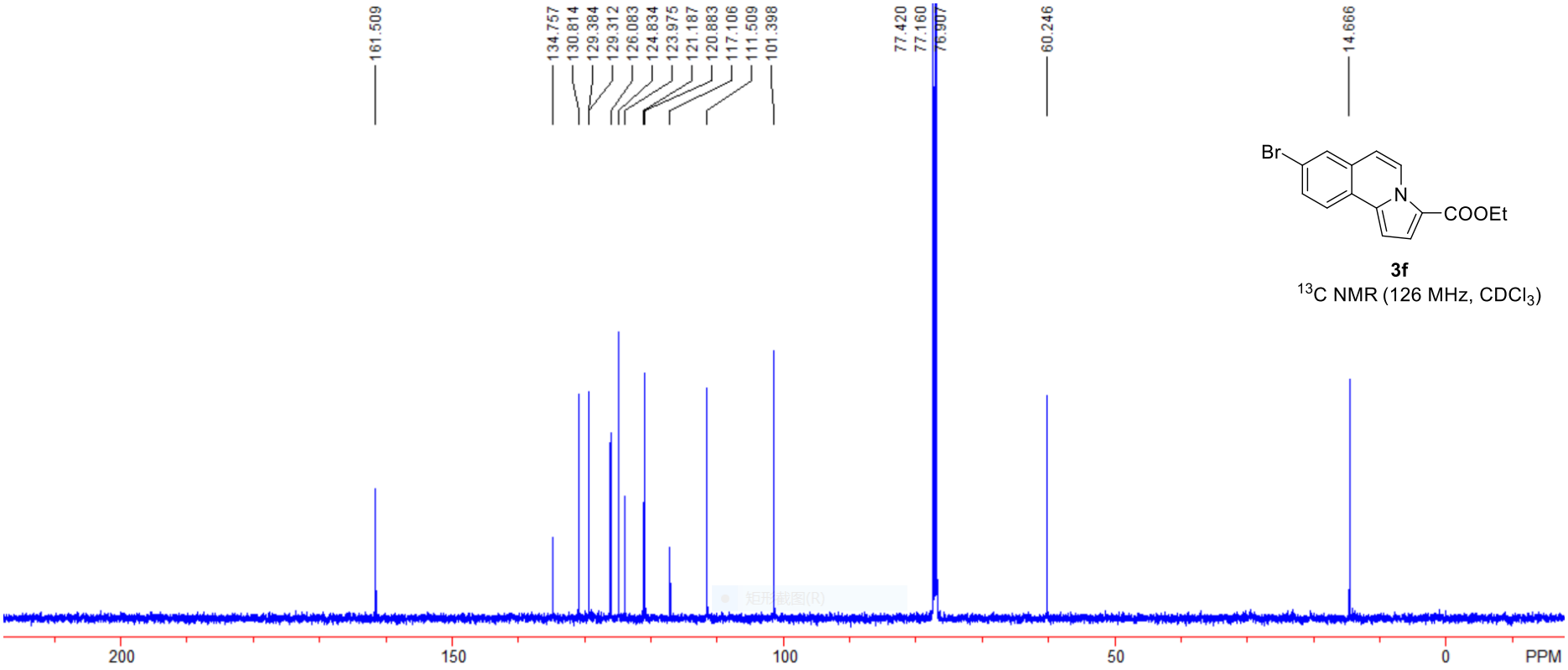
3e

^{13}C NMR (126 MHz, $CDCl_3$)



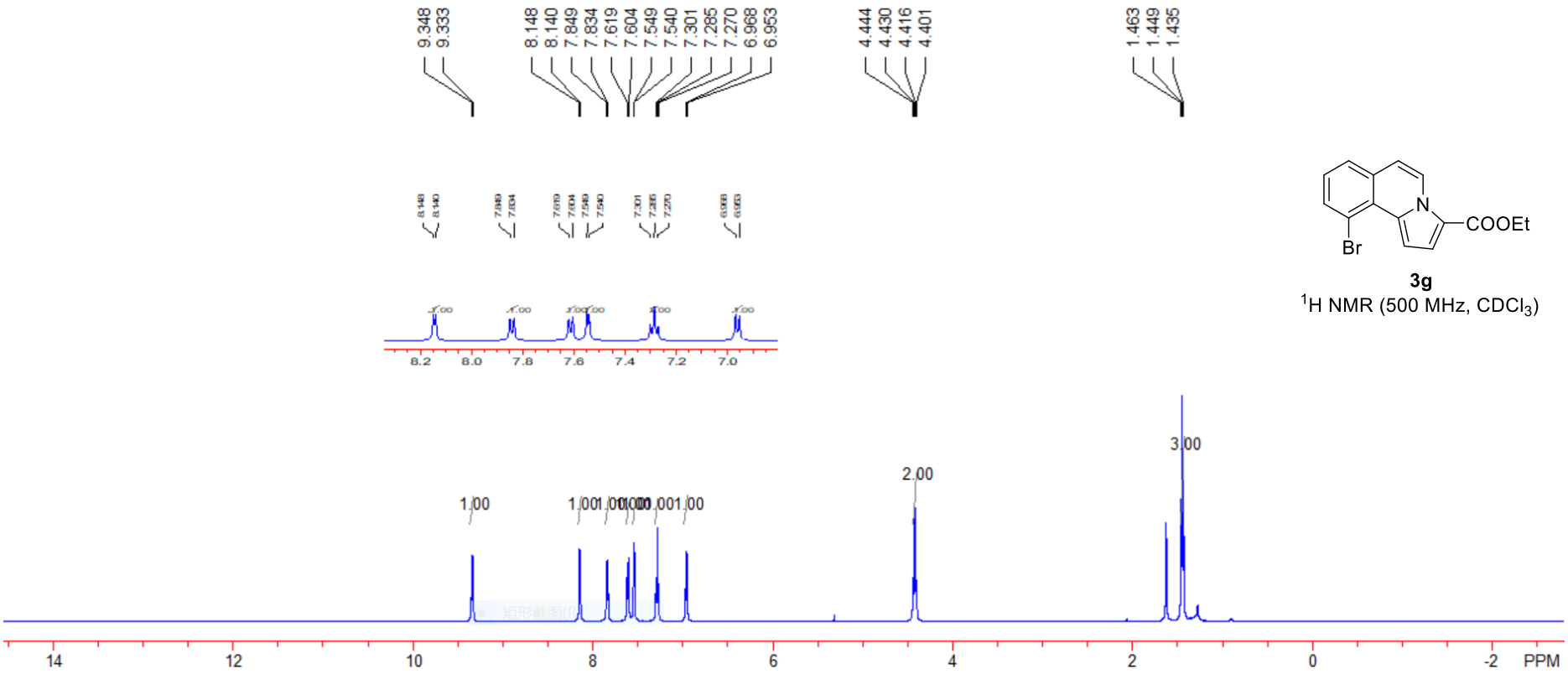
3f

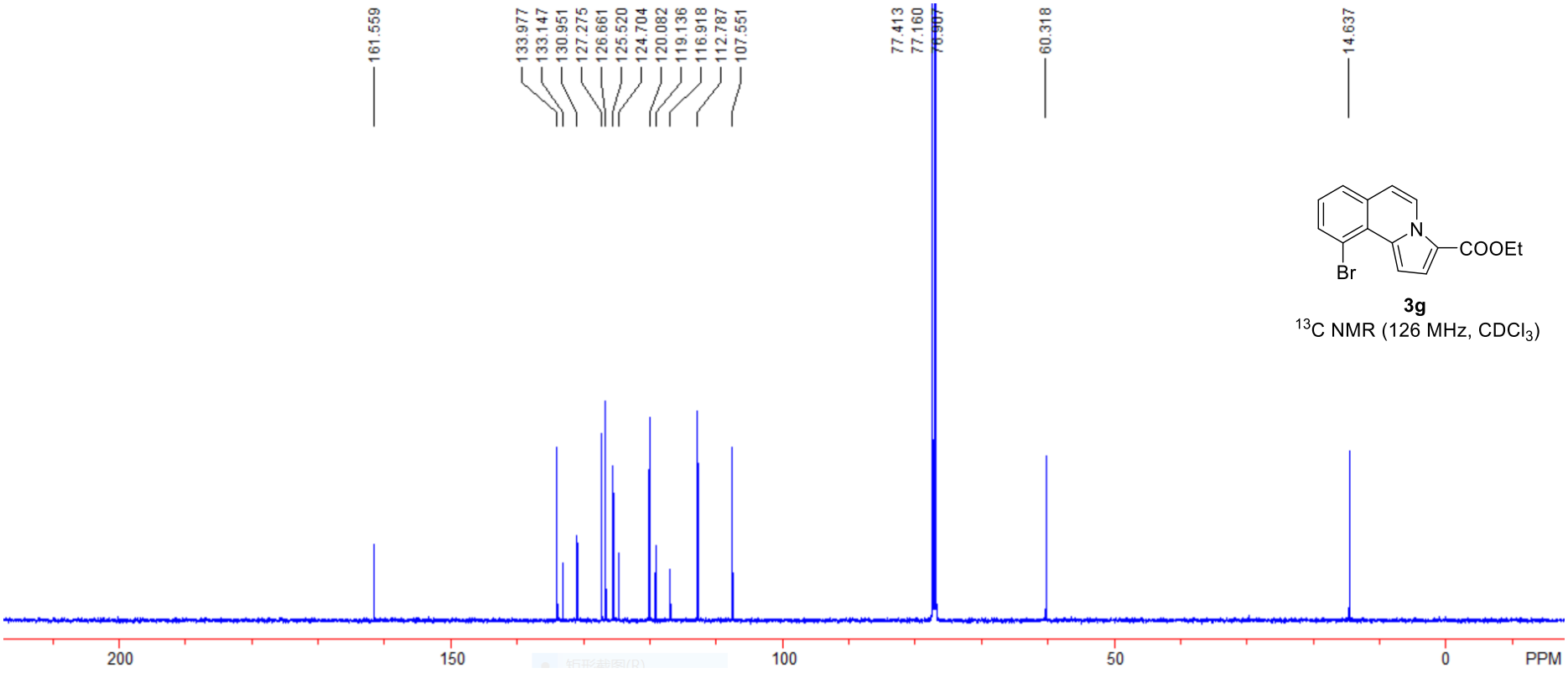
^{1}H NMR (500 MHz, $CDCl_3$)



3f

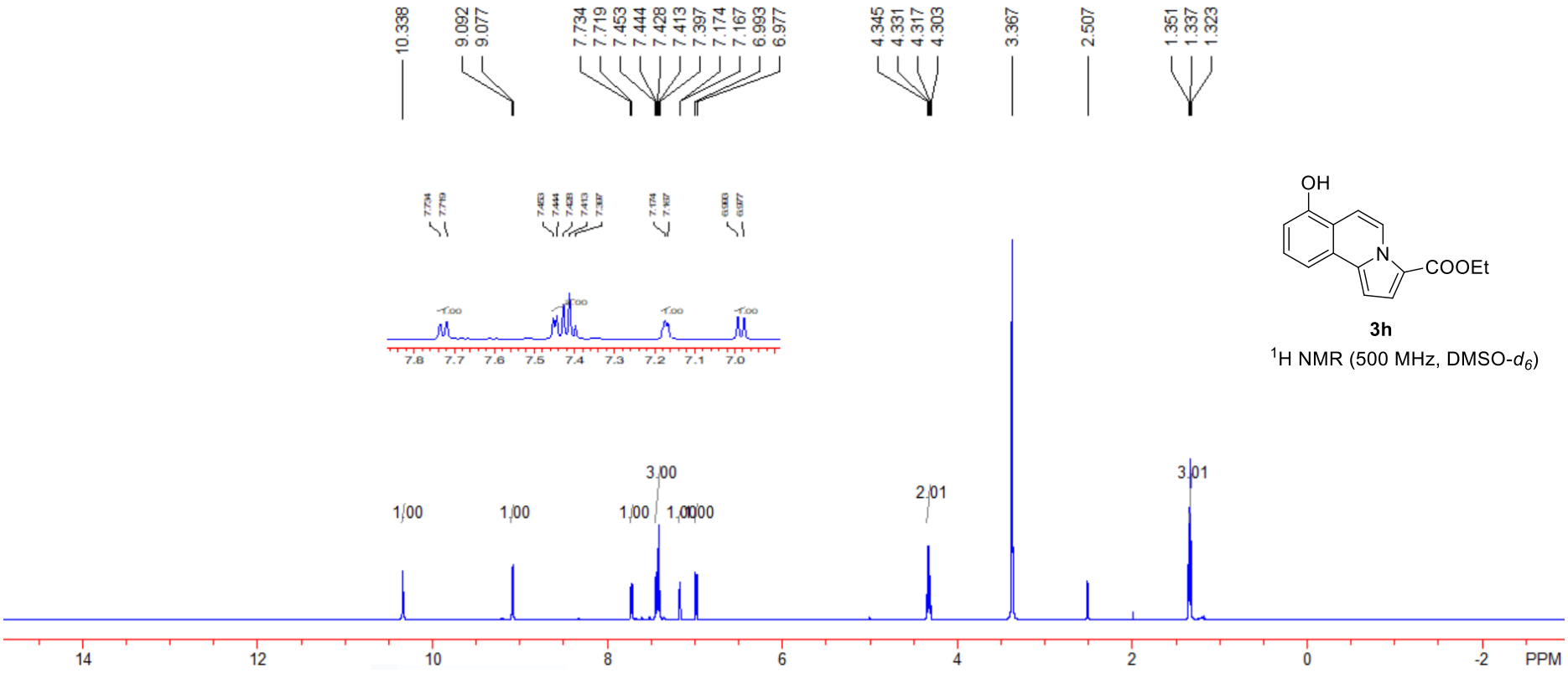
^{13}C NMR (126 MHz, $CDCl_3$)

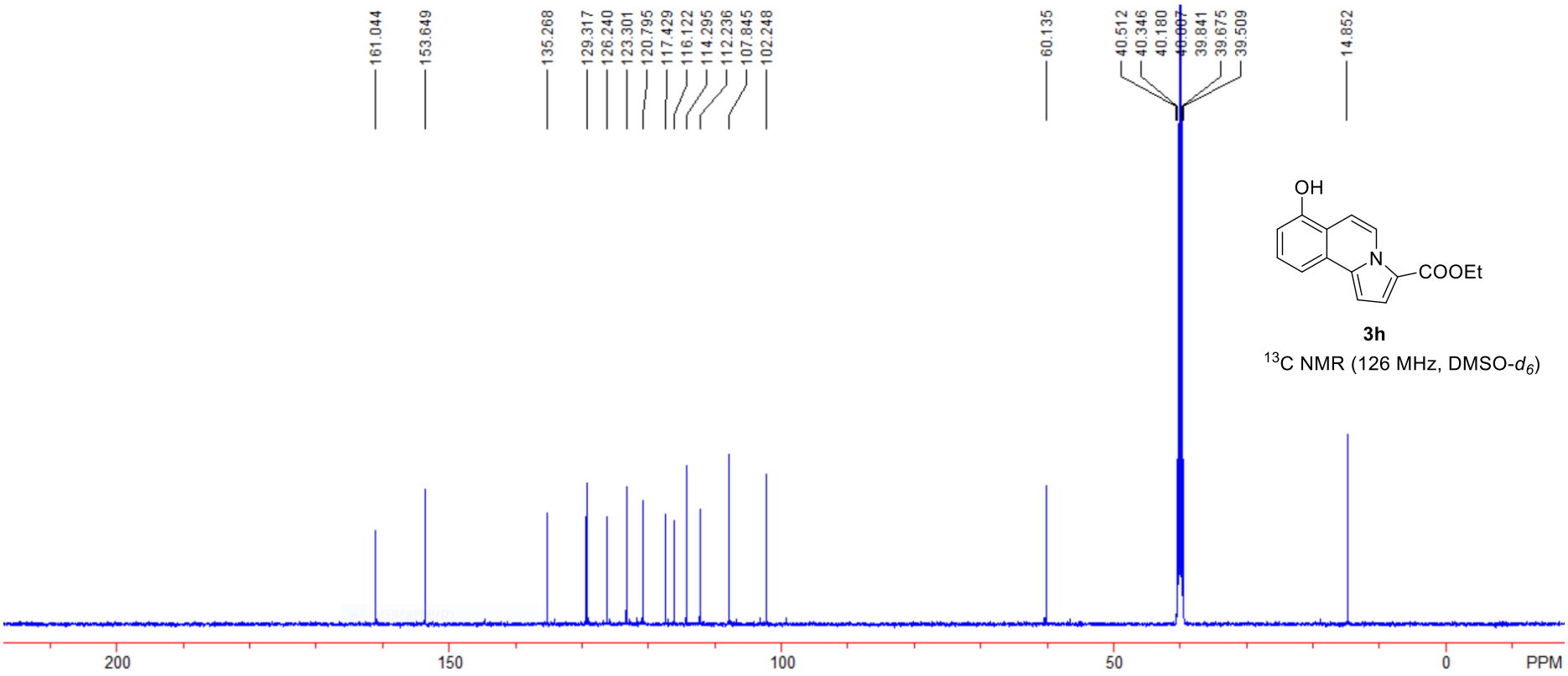

9.348
9.333
8.148
8.140
7.849
7.834
7.619
7.604
7.549
7.540
7.301
7.285
7.270
6.968
6.953
4.444
4.430
4.416
4.401
1.463
1.449
1.435
N
COOEt
Br
3g
1H NMR (500 MHz, CDCl3)
1.00
2.00
3.00
14
12
10
8
6
4
2
0
-2
PPM



3g

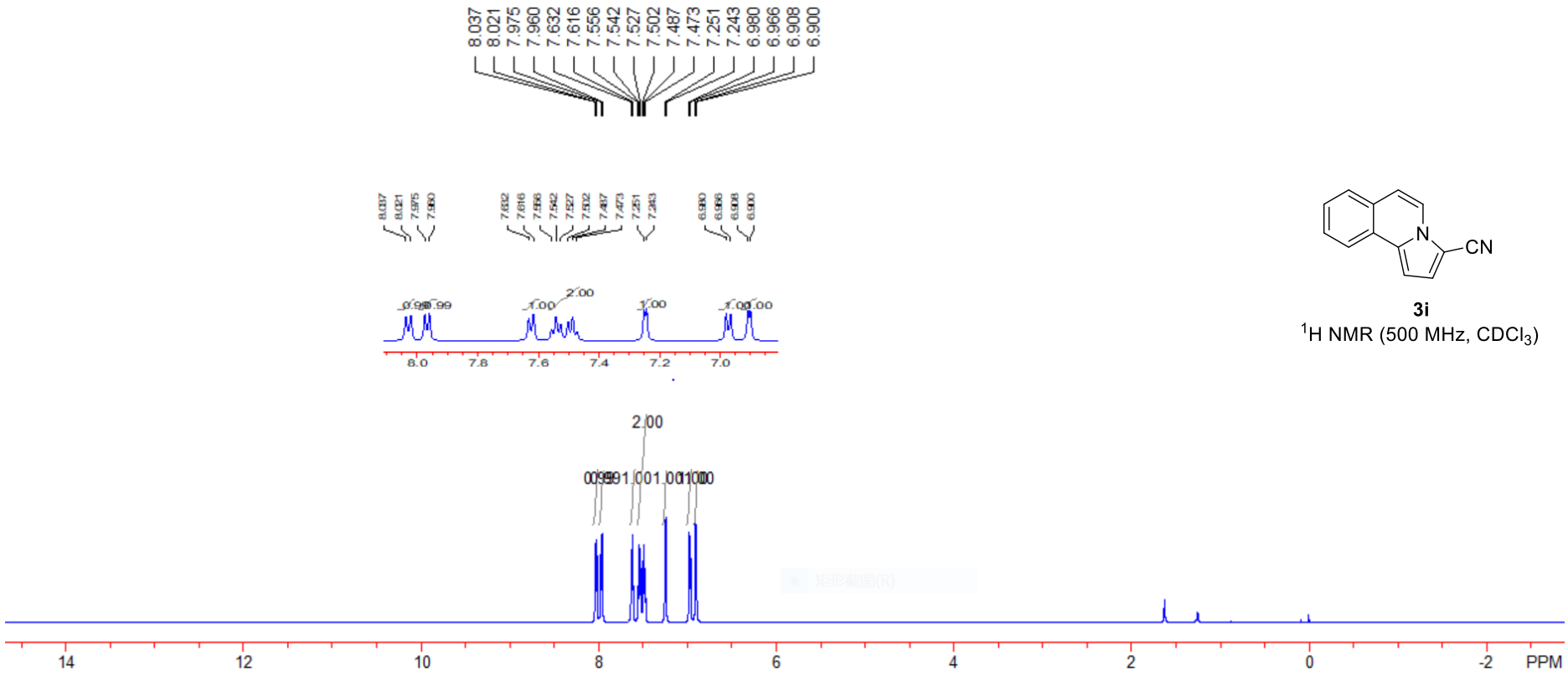
^{13}C NMR (126 MHz, $CDCl_3$)


10.338
9.092
9.077
7.734
7.719
7.453
7.444
7.428
7.413
7.397
7.174
7.167
6.993
6.977
4.345
4.331
4.317
4.303
3.367
2.507
1.351
1.337
1.323
OH
N
COOEt
3h
1H NMR (500 MHz, DMSO-d6)
1.00
1.00
1.00
3.00
1.00
2.01
3.01
14
12
10
8
6
4
2
0
-2
PPM



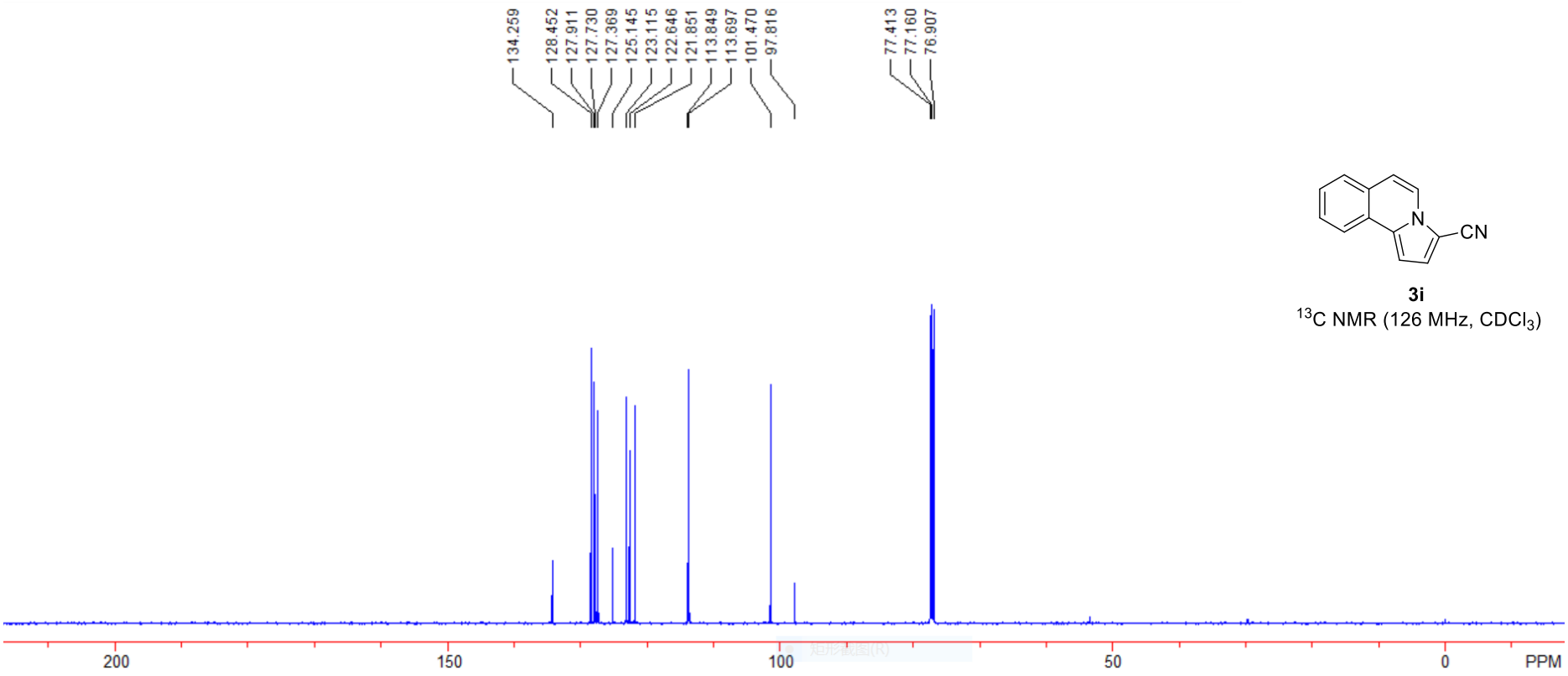
3h

^{13}C NMR (126 MHz, DMSO-d_6)



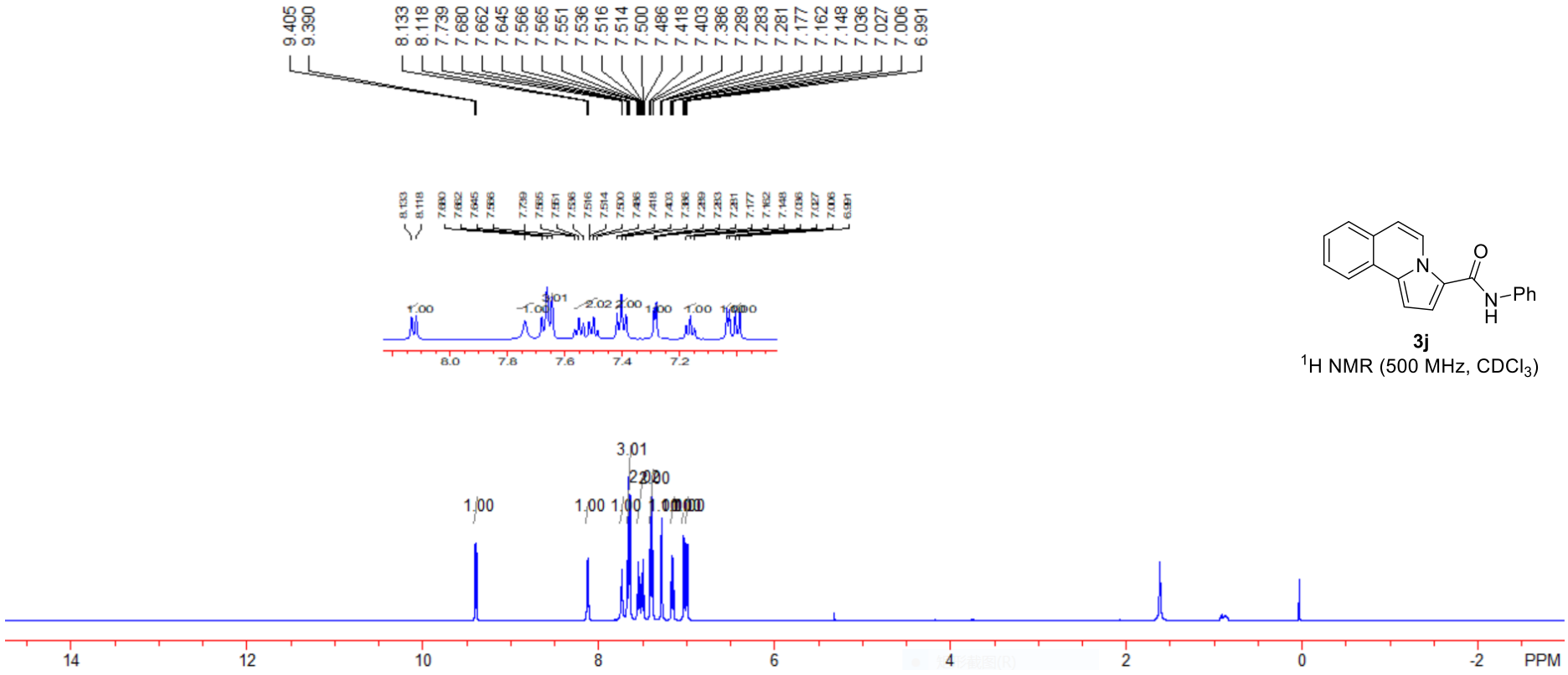
3i

^{1}H NMR (500 MHz, $CDCl_3$)



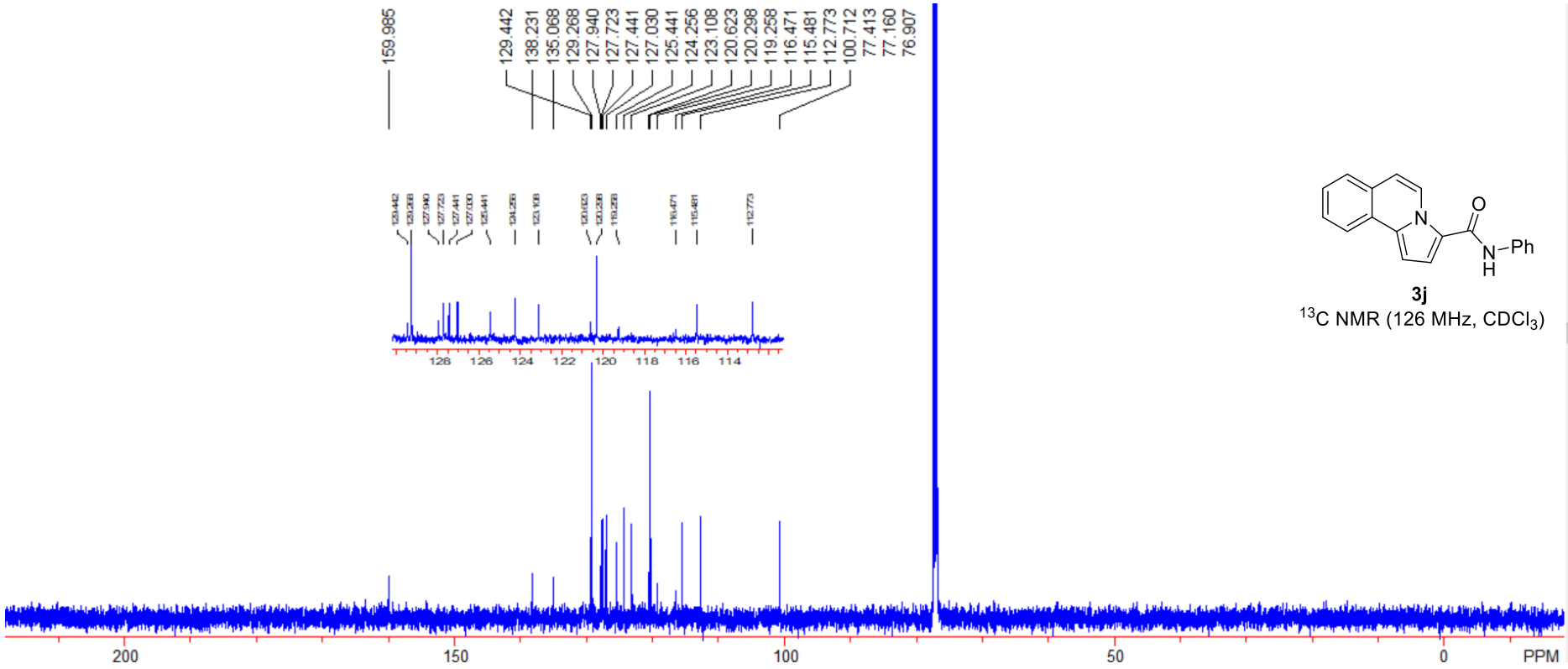
3i

^{13}C NMR (126 MHz, $CDCl_3$)



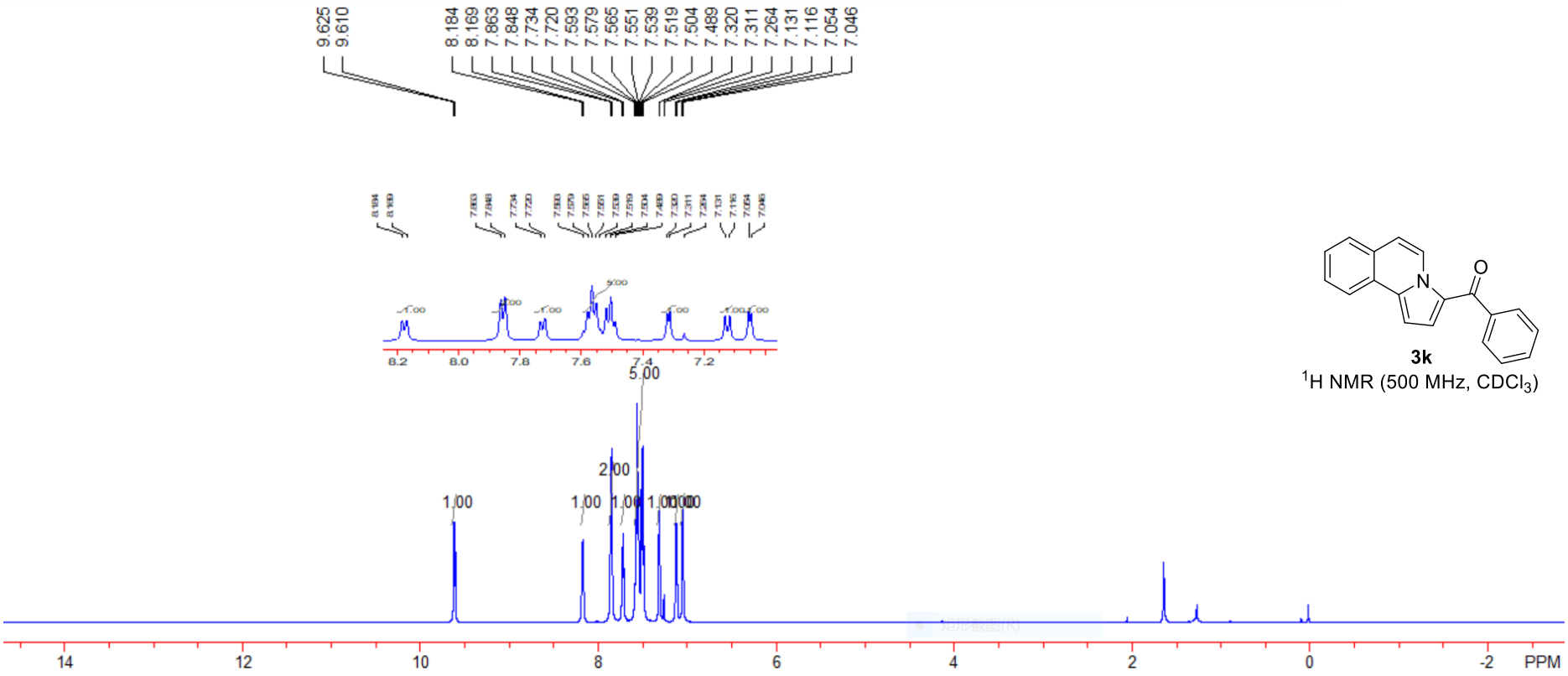
3j

^{1}H NMR (500 MHz, $CDCl_3$)



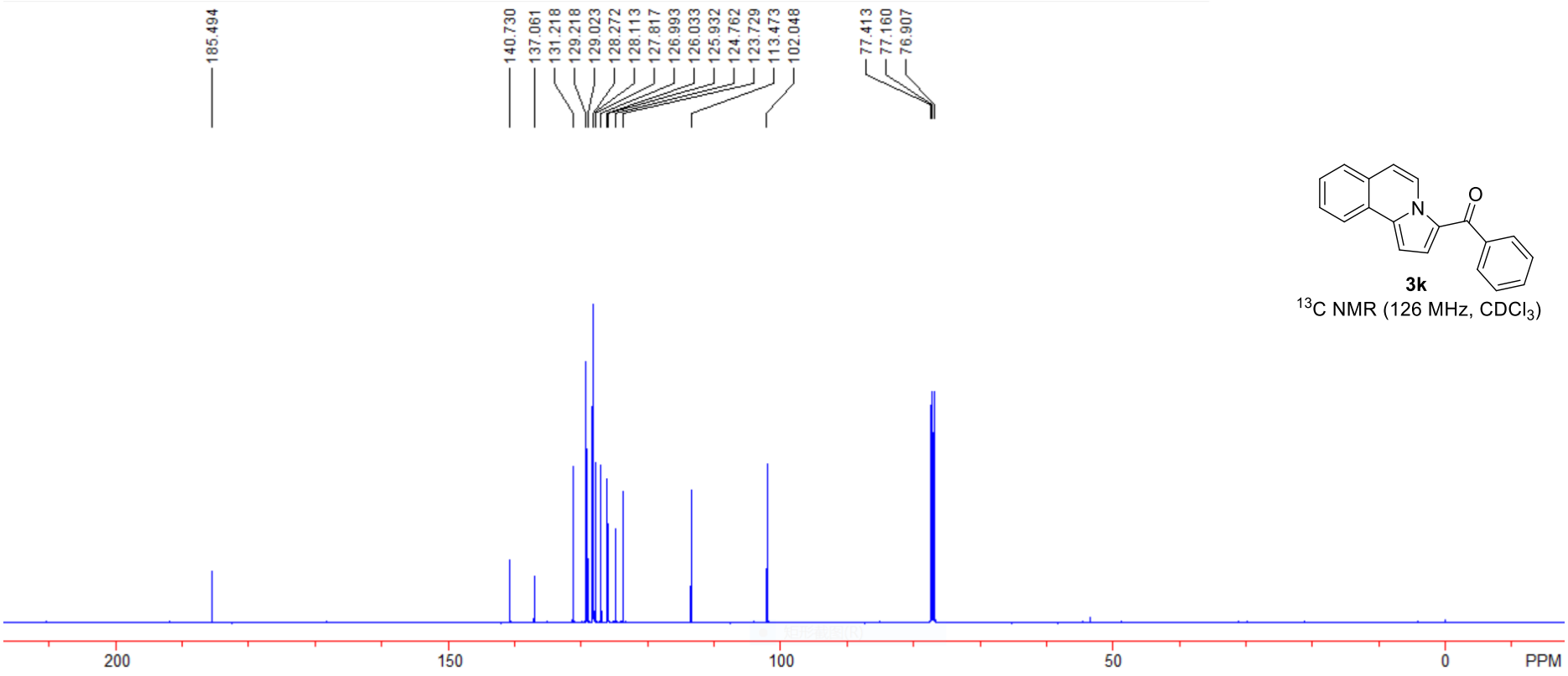
3j

^{13}C NMR (126 MHz, $CDCl_3$)



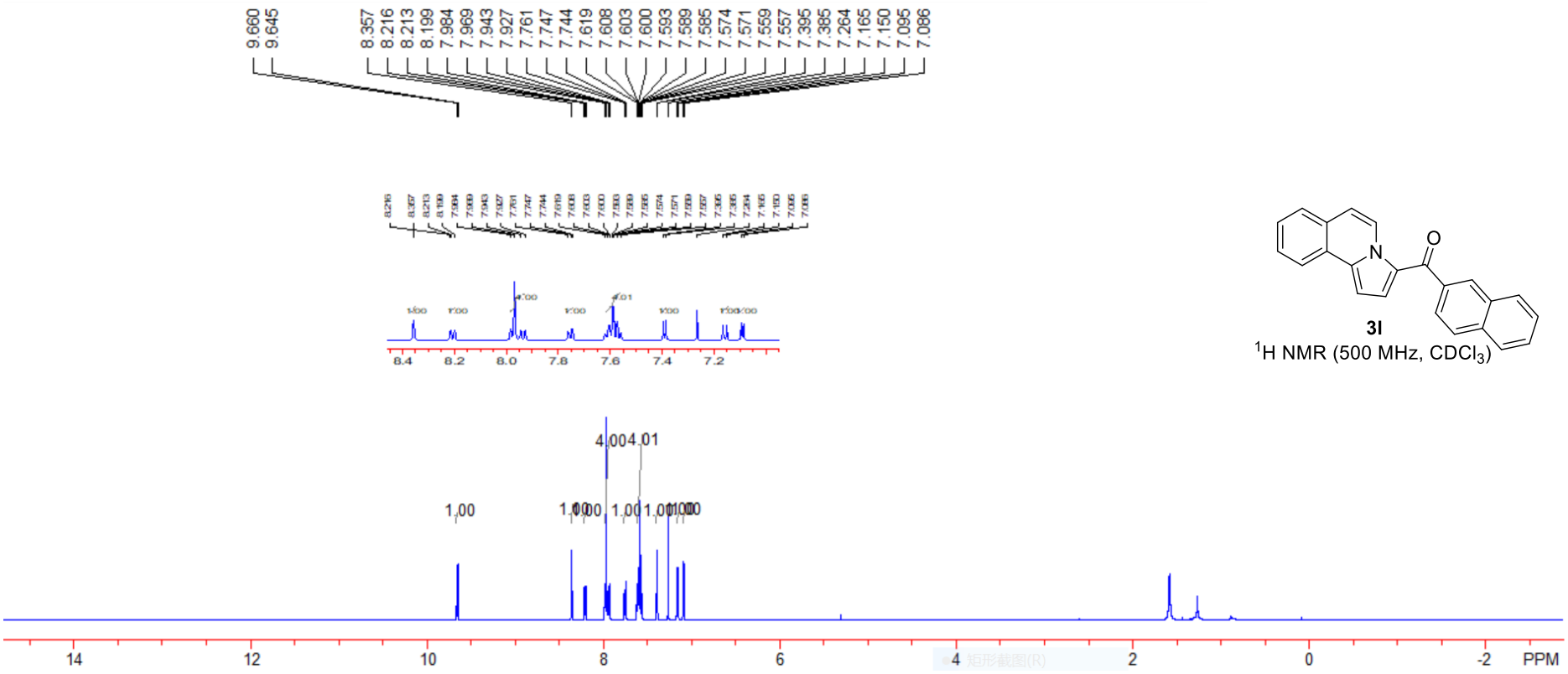
3k

^{1}H NMR (500 MHz, $CDCl_3$)



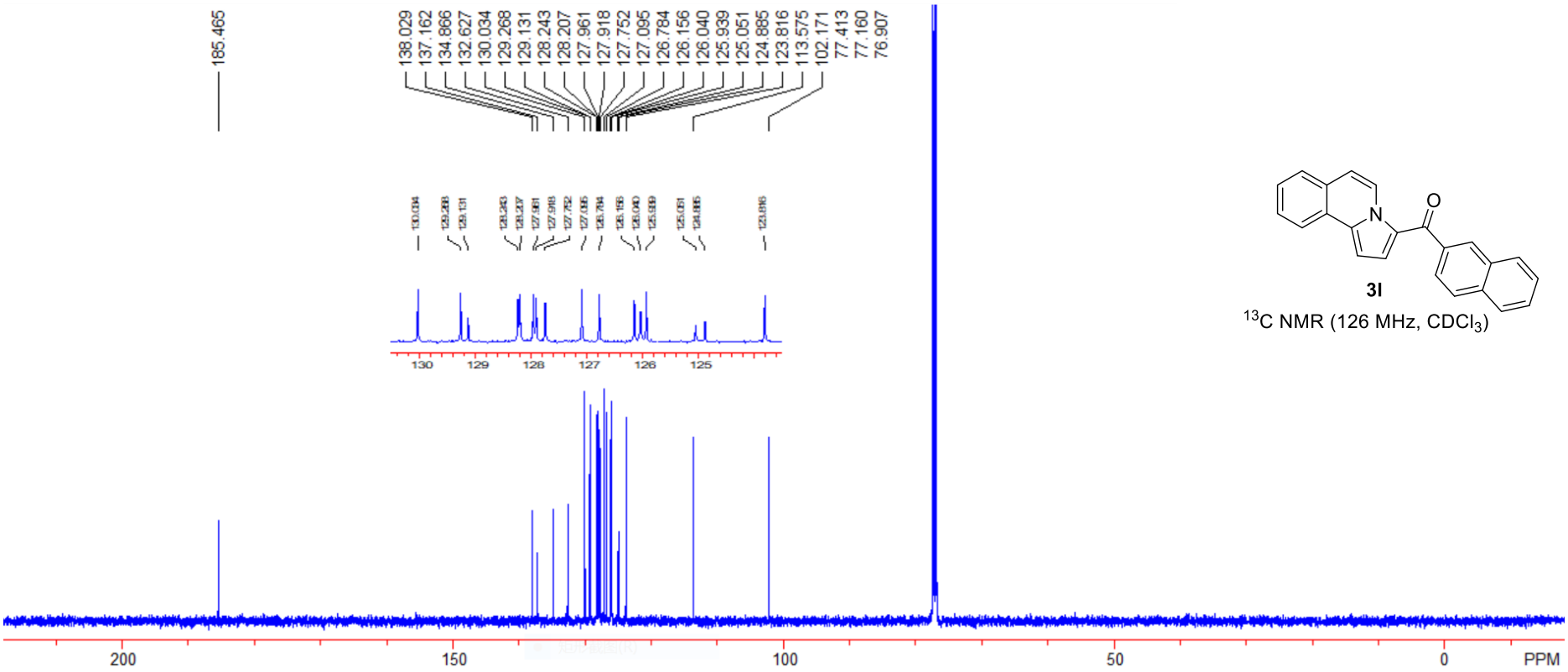
3k

^{13}C NMR (126 MHz, $CDCl_3$)



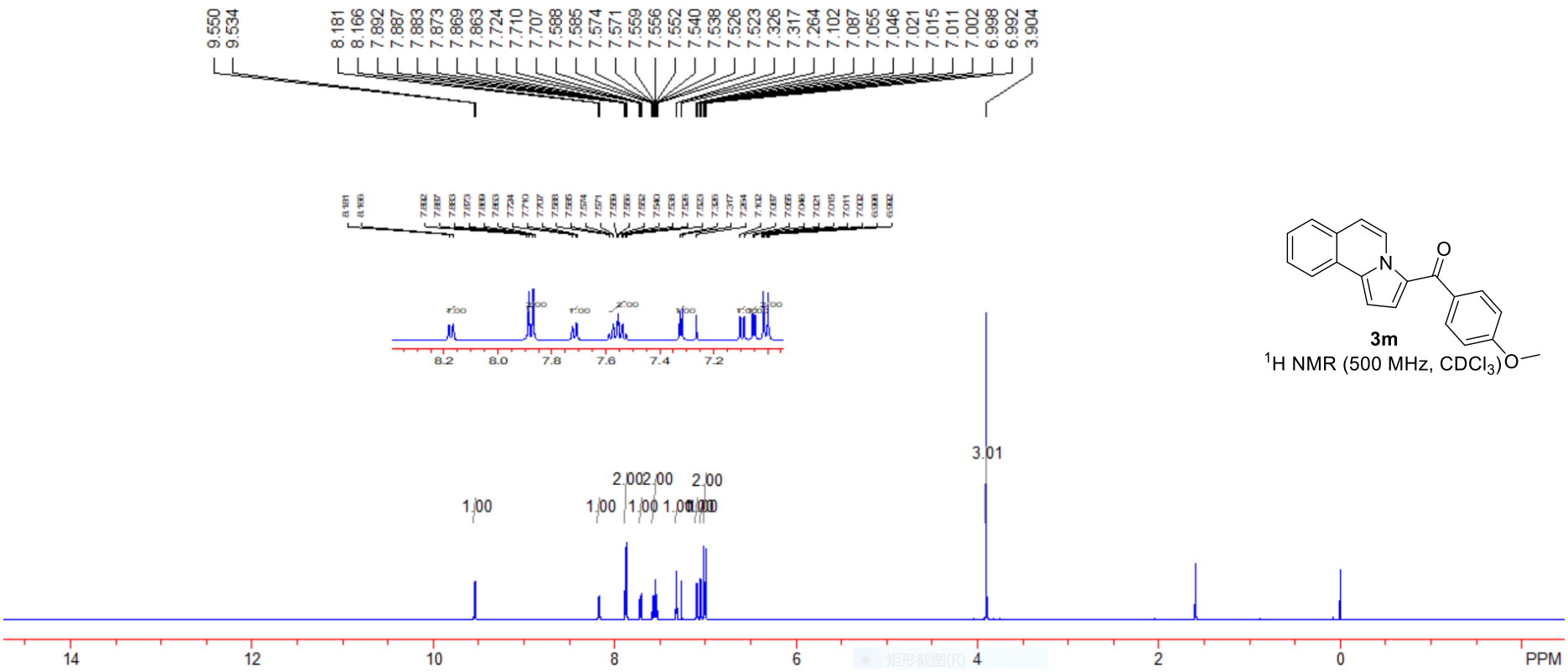
3l

^{1}H NMR (500 MHz, $CDCl_3$)



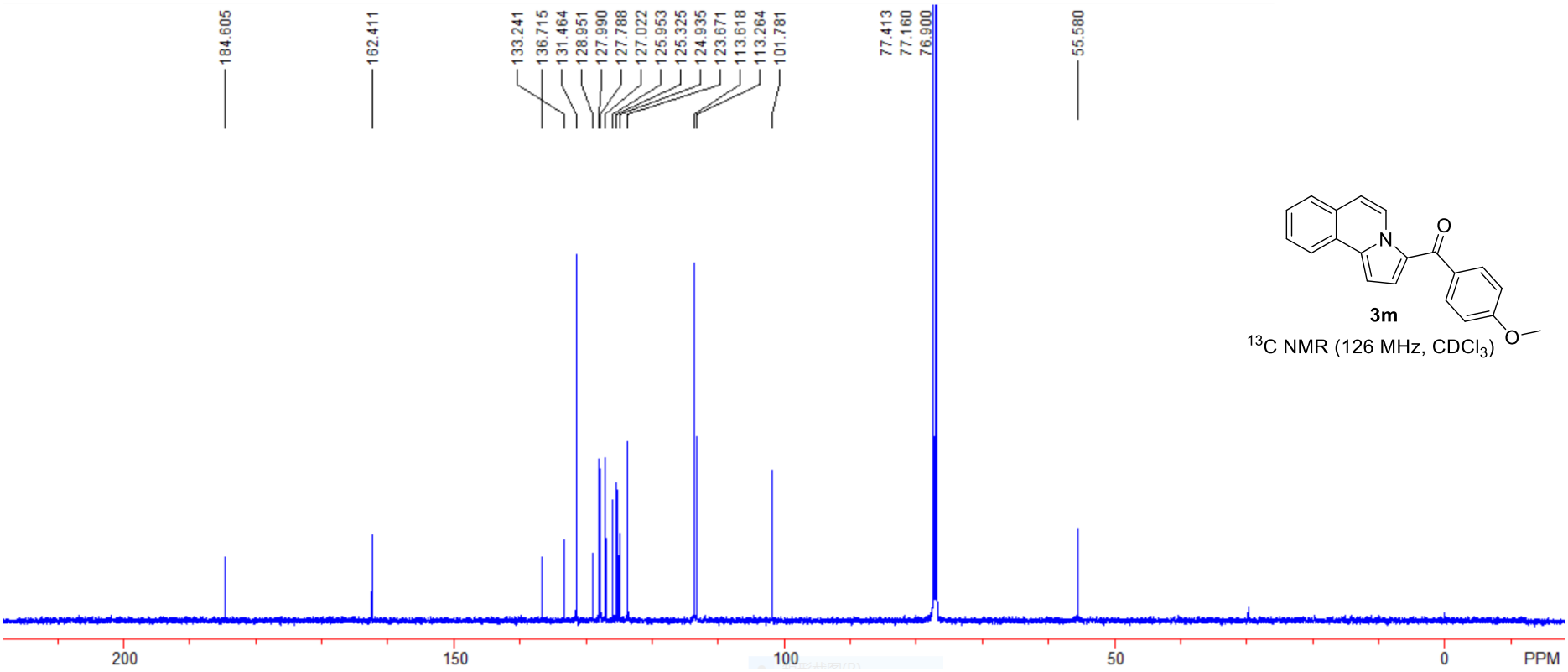
3l

^{13}C NMR (126 MHz, $CDCl_3$)



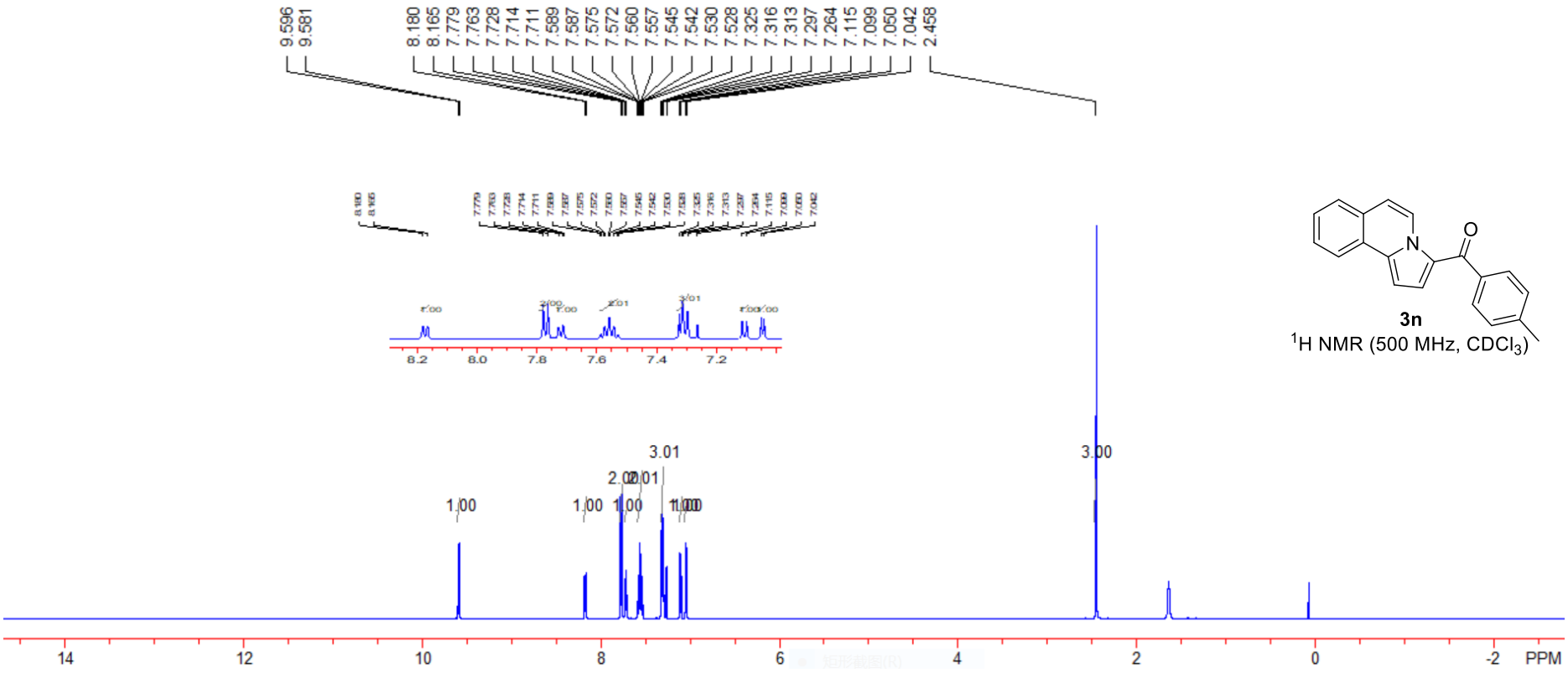
3m

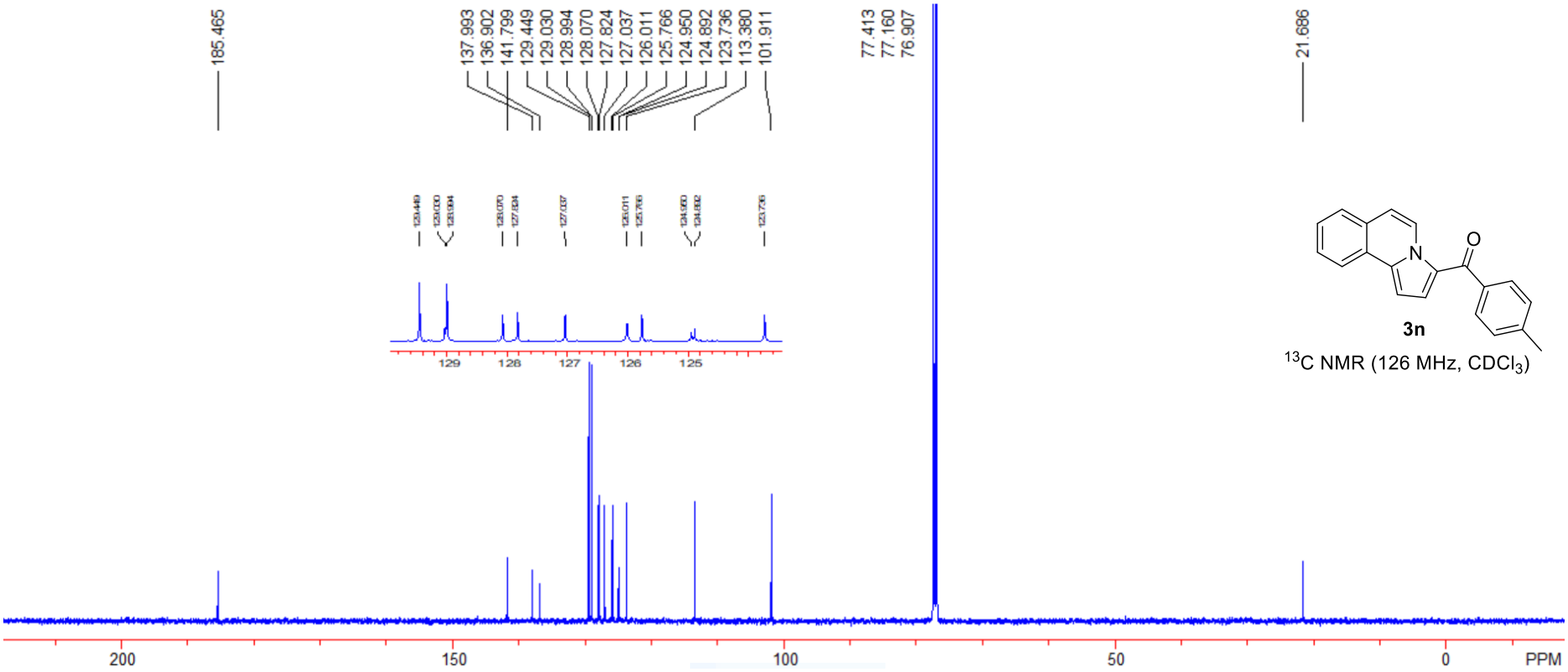
^{1}H NMR (500 MHz, $CDCl_3$)

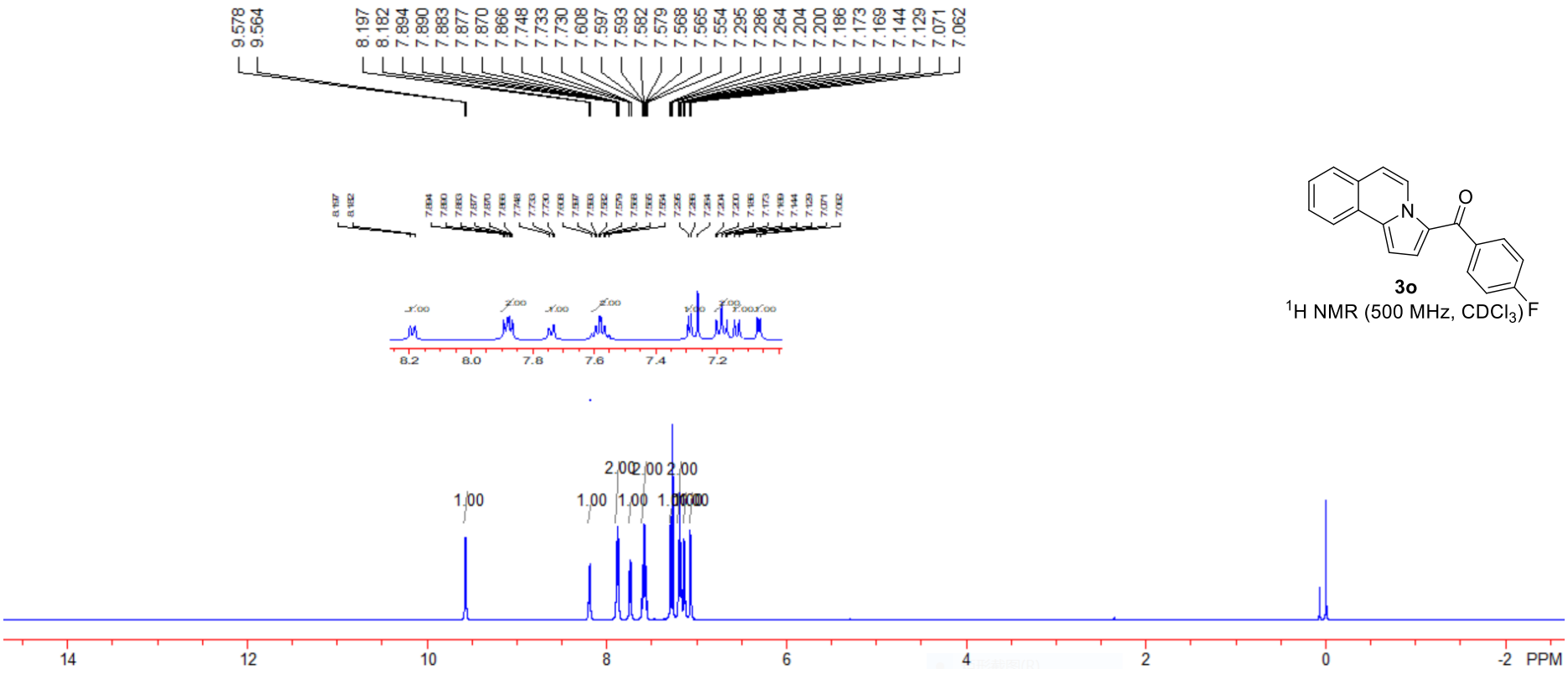


3m

^{13}C NMR (126 MHz, $CDCl_3$)

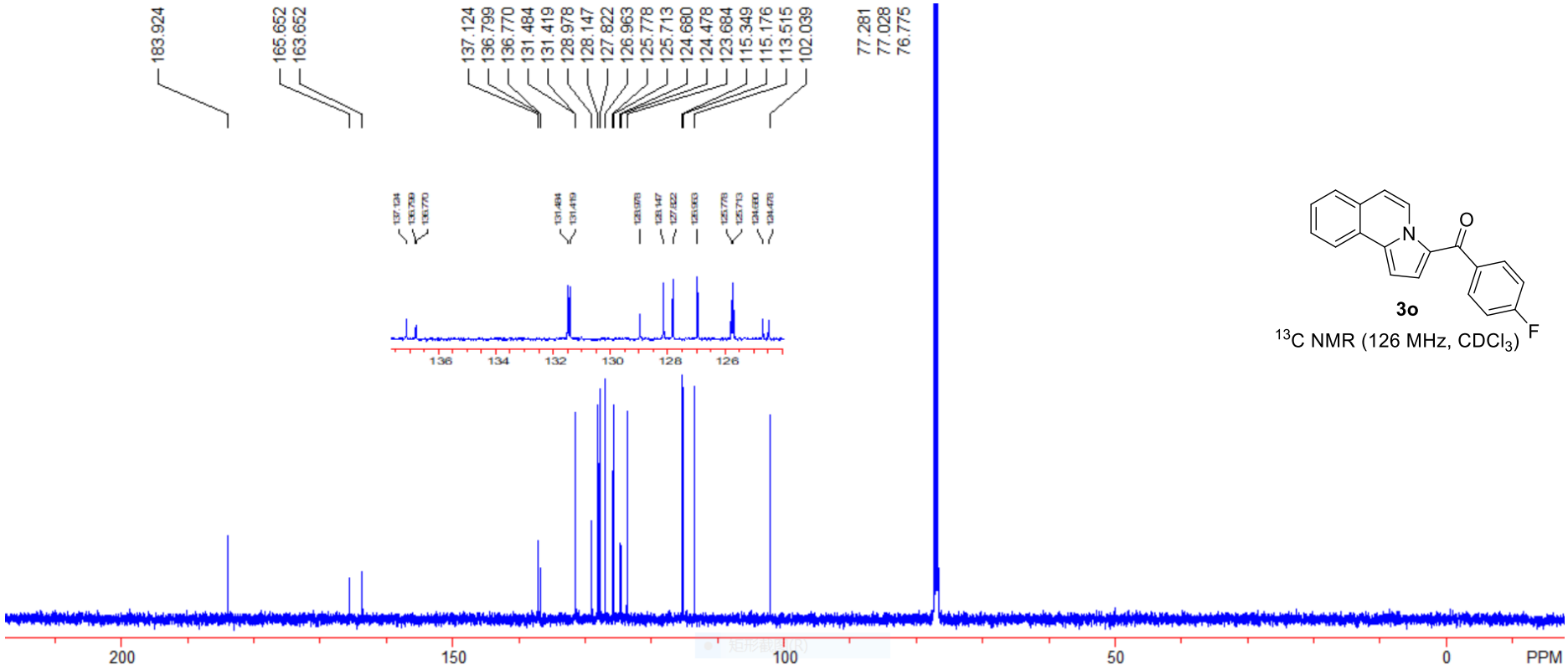

9.596
9.581
8.180
8.165
7.779
7.763
7.728
7.714
7.711
7.589
7.587
7.575
7.572
7.560
7.557
7.545
7.542
7.530
7.528
7.325
7.316
7.313
7.297
7.264
7.115
7.099
7.050
7.042
2.458
3.01
2.00
1.00
3.00
14
12
10
8
6
4
2
0
-2
PPM
N
O
3n
^{1}H NMR (500 MHz, $CDCl_3$)

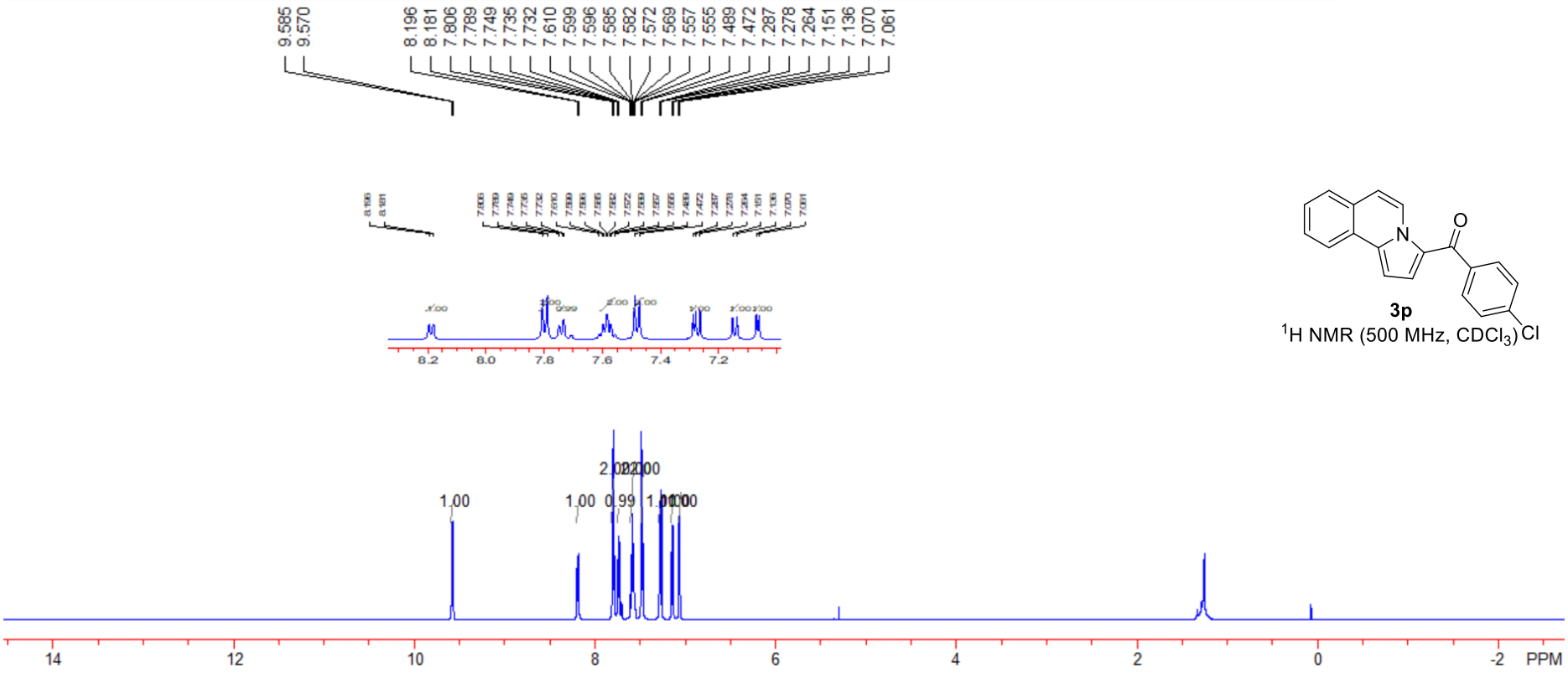

185.465
137.993
136.902
141.799
129.449
129.030
128.994
128.070
127.824
127.037
126.011
125.766
124.950
124.892
123.736
113.380
101.911
77.413
77.160
76.907
21.686
O
N
3n
^{13}C NMR (126 MHz, CDCl$_3$)
200
150
100
50
0
PPM



3o

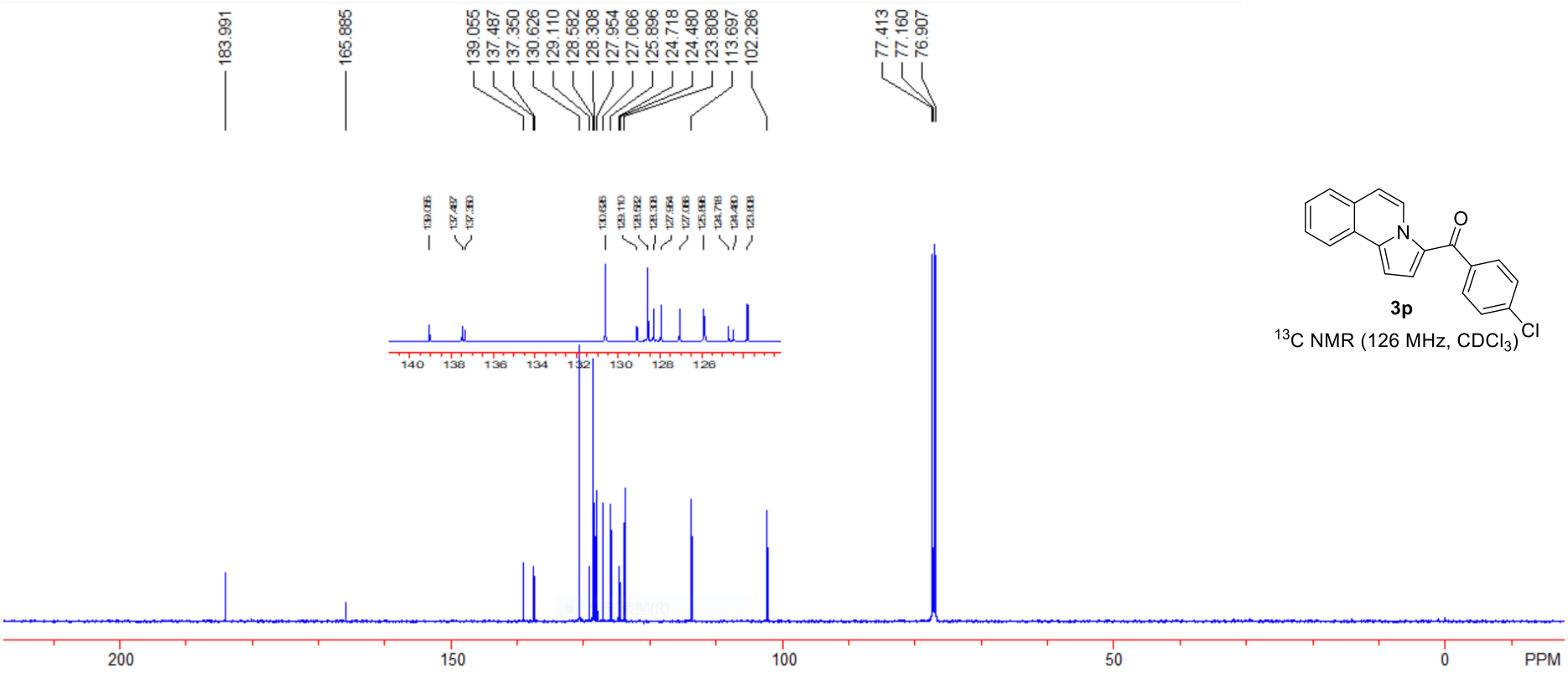
^{1}H NMR (500 MHz, $CDCl_3$)


183.924
165.652
163.652
137.124
136.799
136.770
131.484
131.419
128.978
128.147
127.822
126.963
125.778
125.713
124.680
124.478
123.684
115.349
115.176
113.515
102.039
77.281
77.028
76.775
136
134
132
130
128
126
200
150
100
50
0
PPM
O
N
F
3o
^{13}C NMR (126 MHz, $CDCl_3$)



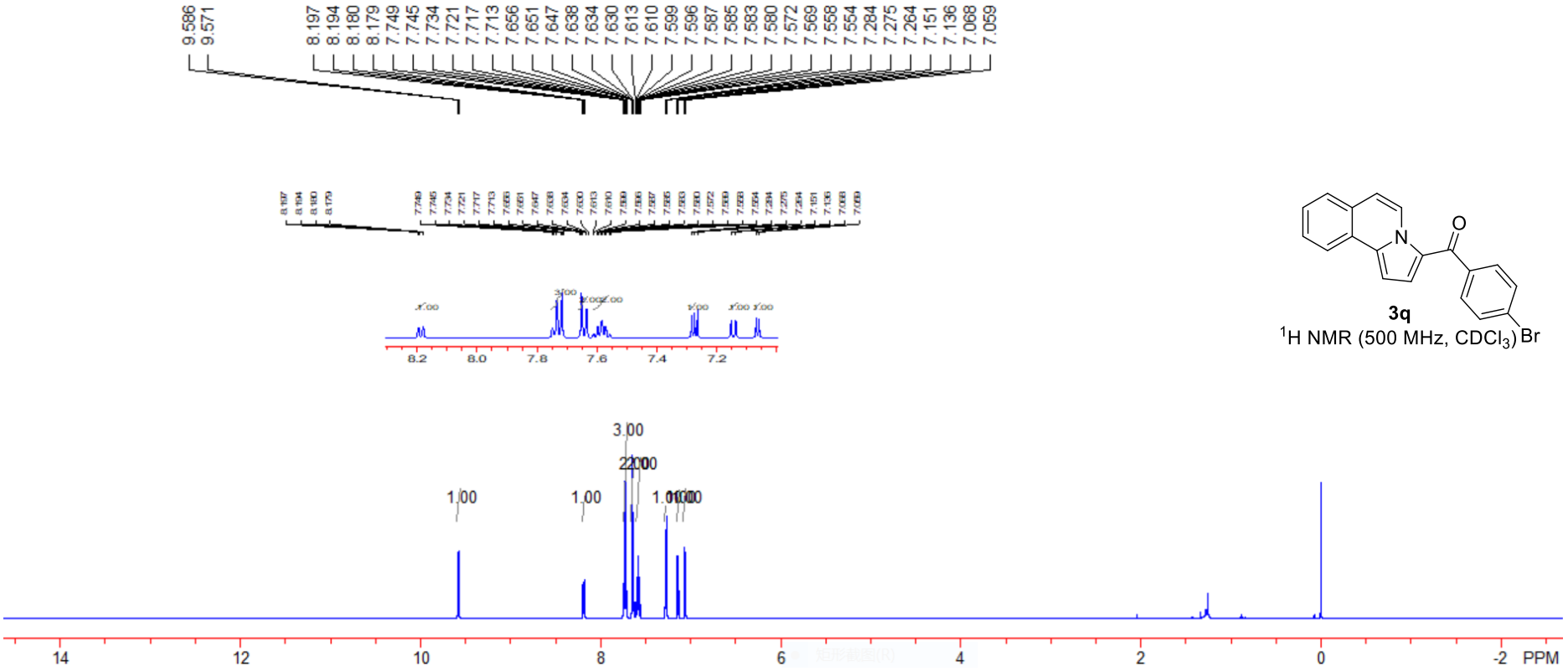
3p

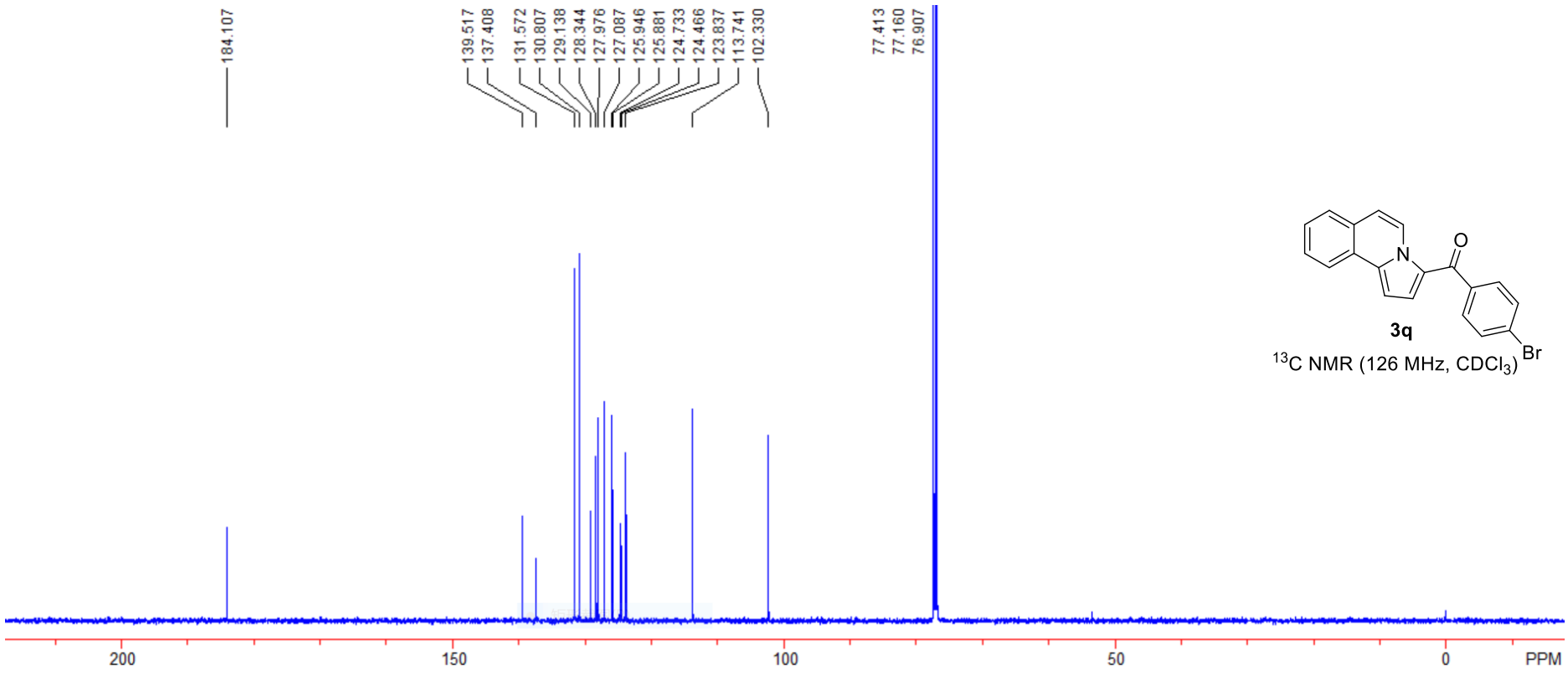
^{1}H NMR (500 MHz, $CDCl_3$)



3p

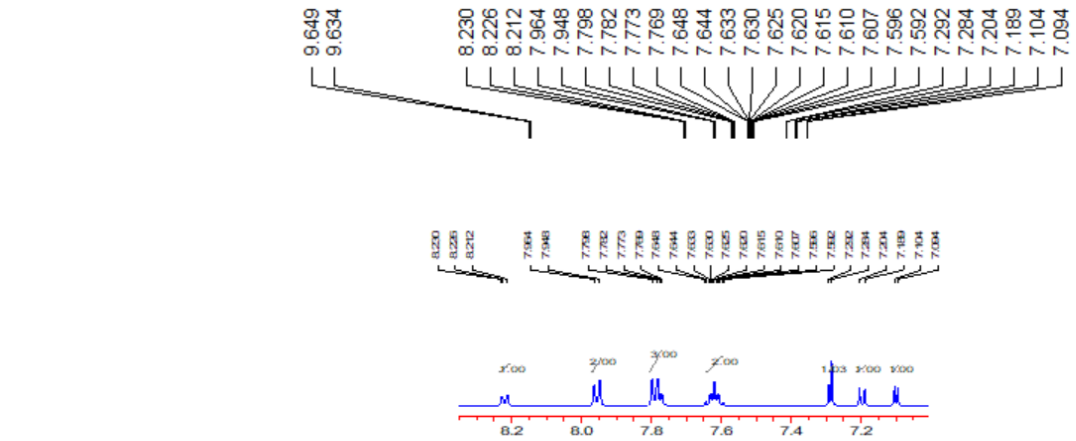
^{13}C NMR (126 MHz, $CDCl_3$)

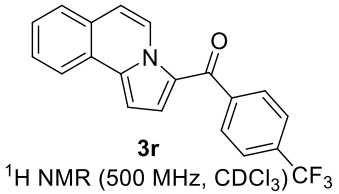

9.586
9.571
8.197
8.194
8.180
8.179
7.749
7.745
7.734
7.721
7.717
7.713
7.656
7.651
7.647
7.638
7.634
7.630
7.613
7.610
7.599
7.596
7.587
7.585
7.583
7.580
7.572
7.569
7.558
7.554
7.284
7.275
7.264
7.151
7.136
7.068
7.059
8.2
8.0
7.8
7.6
7.4
7.2
O
N
Br
3q
^{1}H NMR (500 MHz, $CDCl_3$)
3.00
2.00
1.00
1.00
14
12
10
8
6
4
2
0
-2
PPM



3q

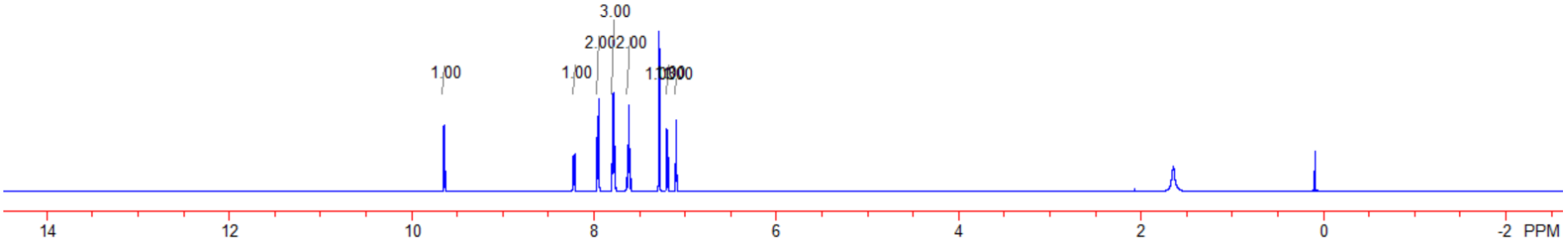
^{13}C NMR (126 MHz, $CDCl_3$)

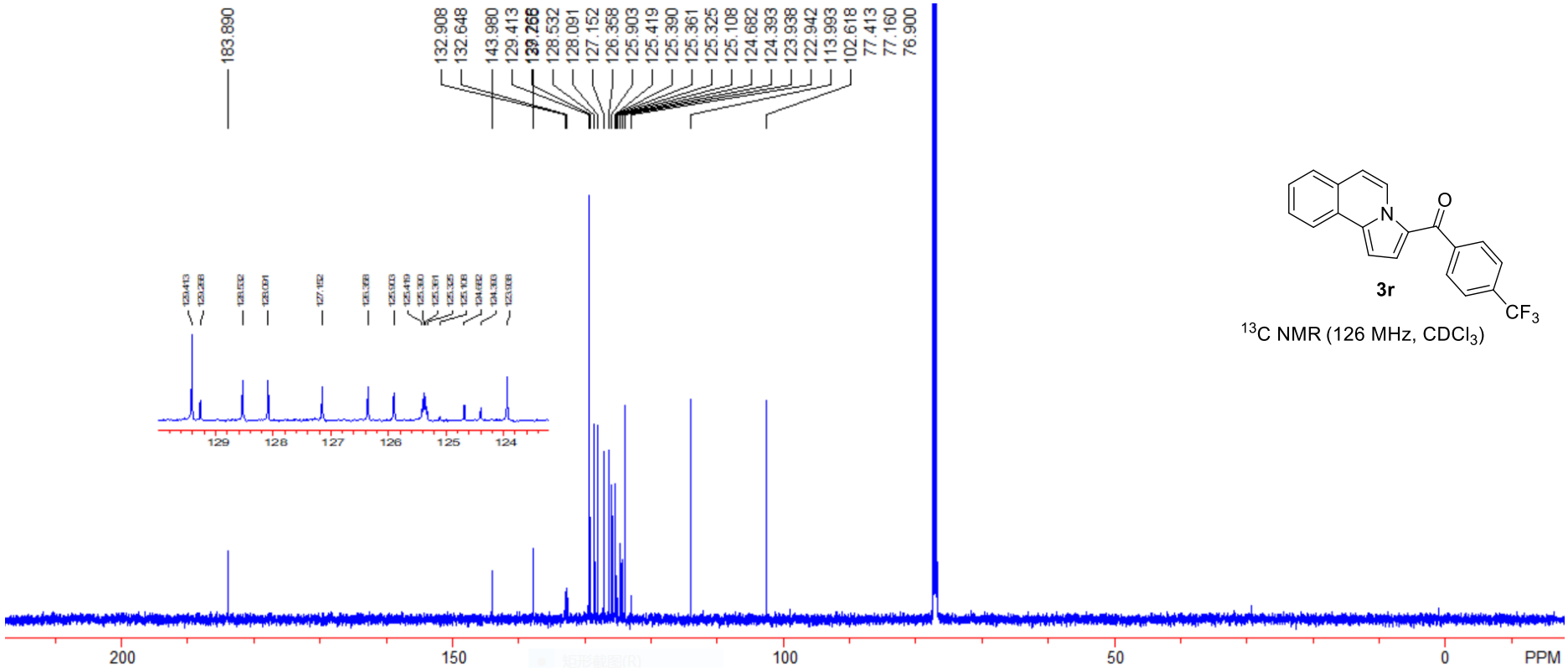




3r

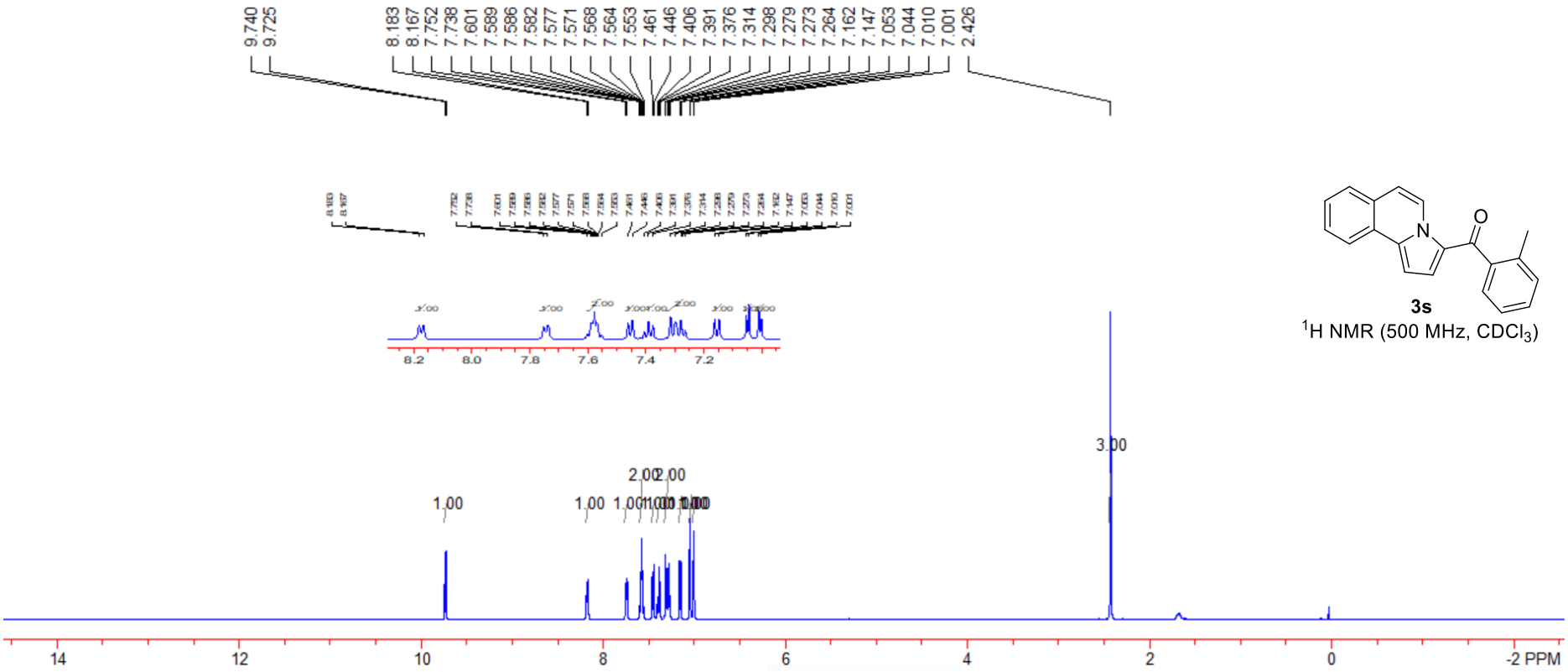
^{1}H NMR (500 MHz, $CDCl_3$) CF_3





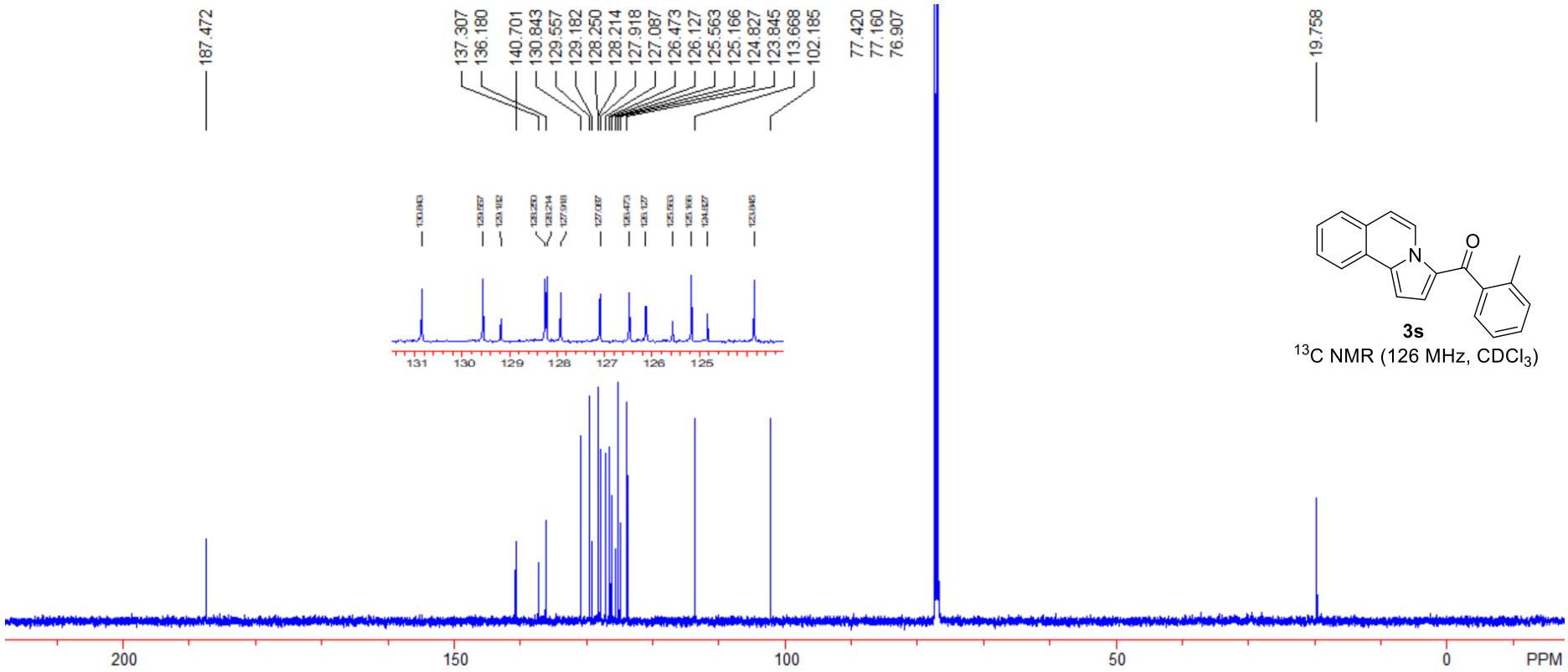
3r

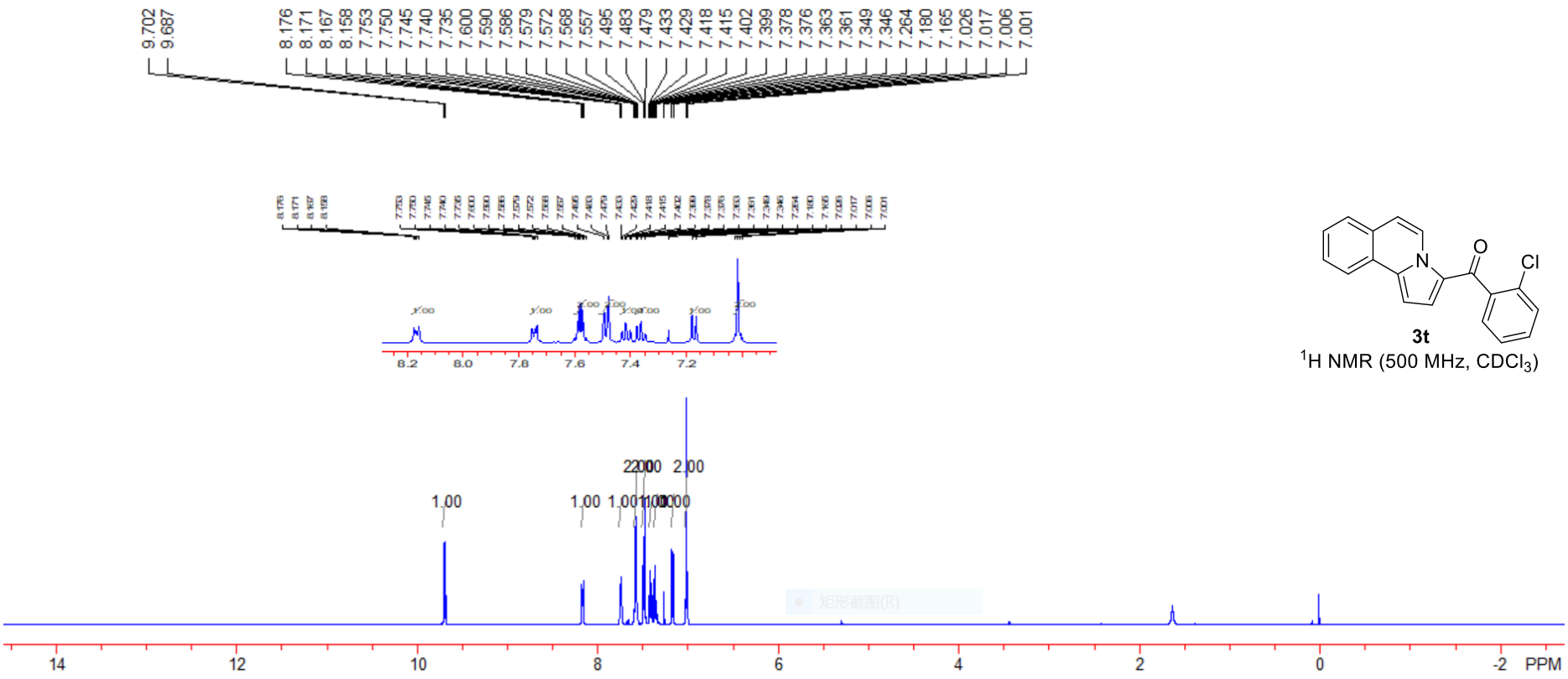
^{13}C NMR (126 MHz, $CDCl_3$)



3s

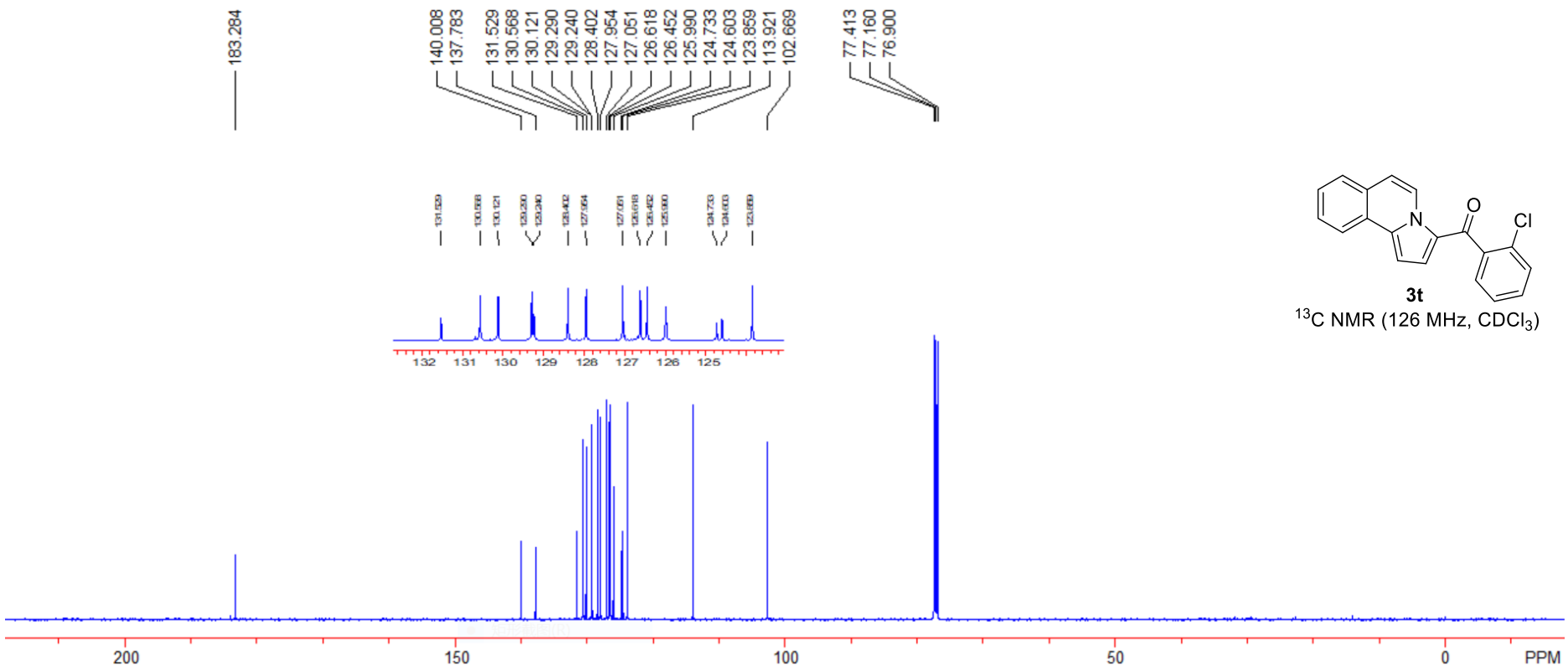
^{1}H NMR (500 MHz, $CDCl_3$)

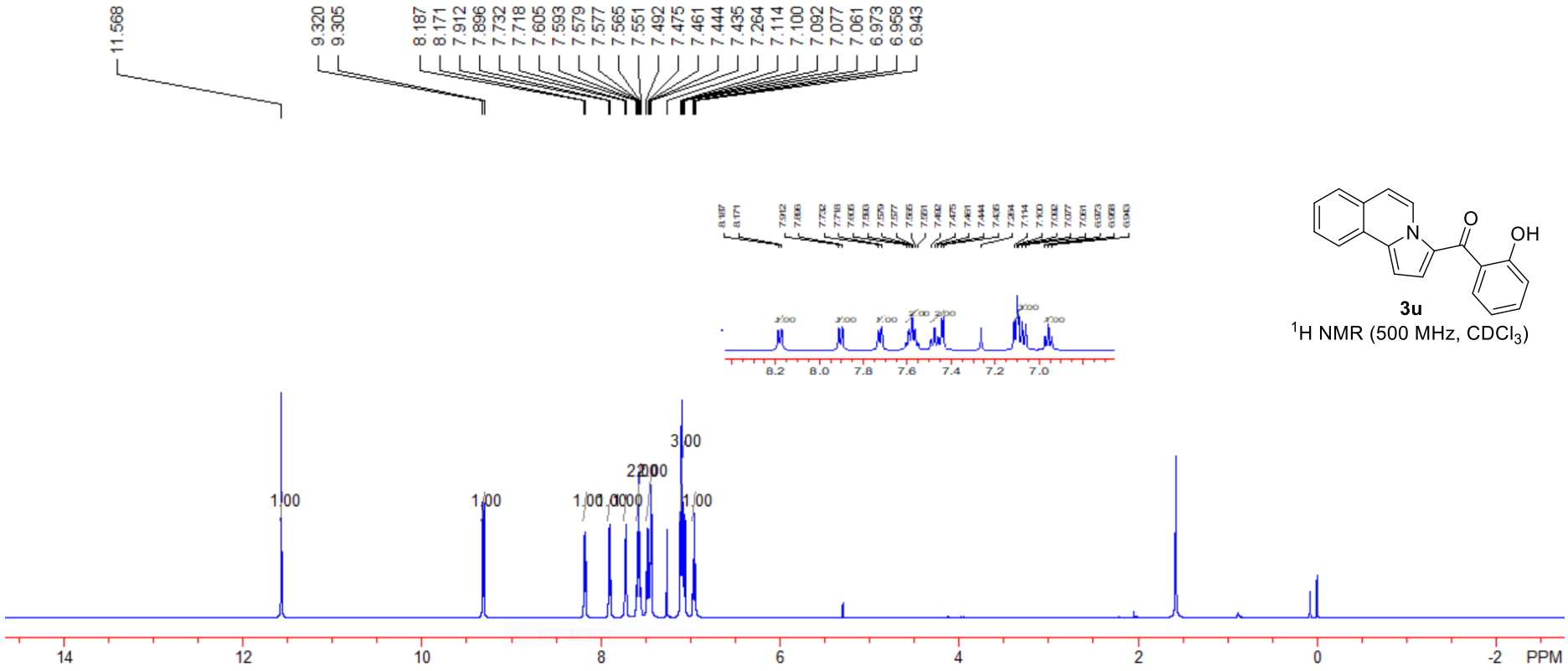

187.472
137.307
136.180
140.701
130.843
129.557
129.182
128.250
128.214
127.918
127.087
126.473
126.127
125.563
125.166
124.827
123.845
113.668
102.185
77.420
77.160
76.907
19.758
131
130
129
128
127
126
125
200
150
100
50
0
PPM
3s
^{13}C NMR (126 MHz, $CDCl_3$)

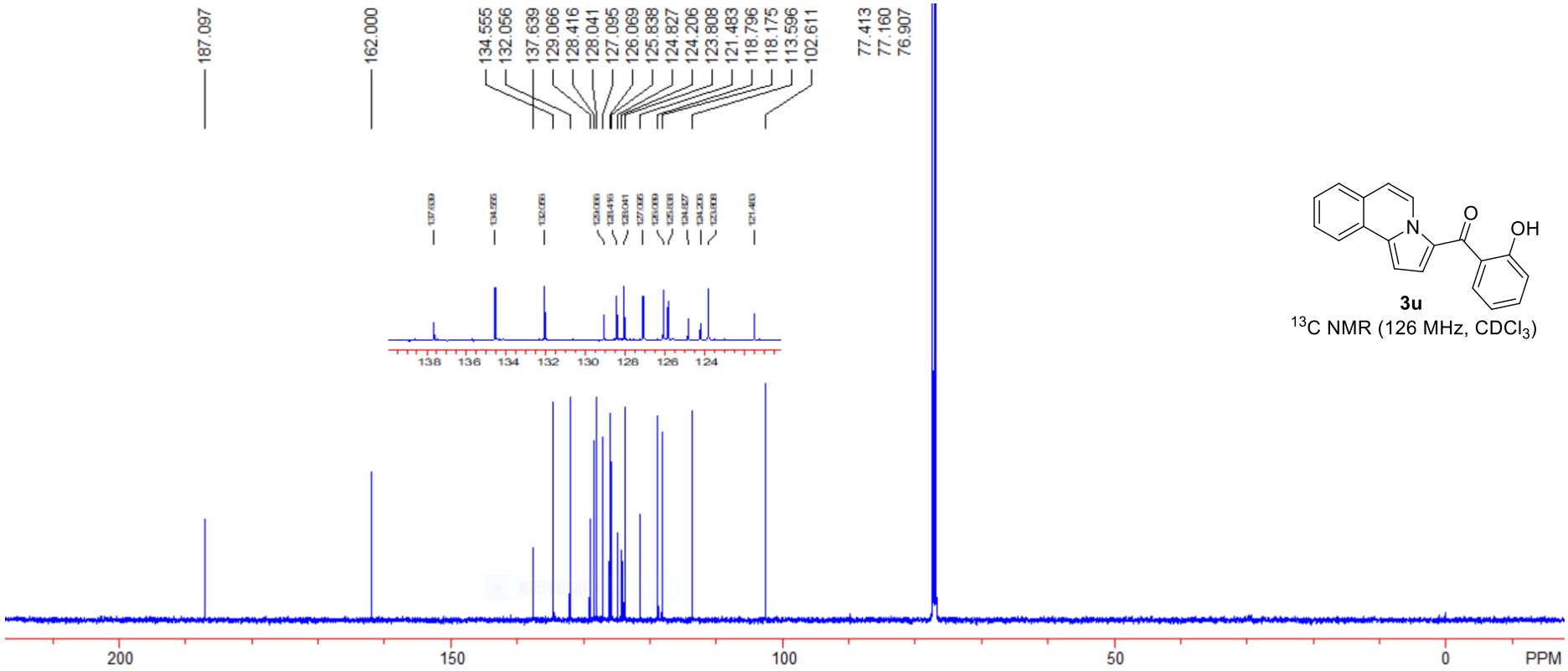


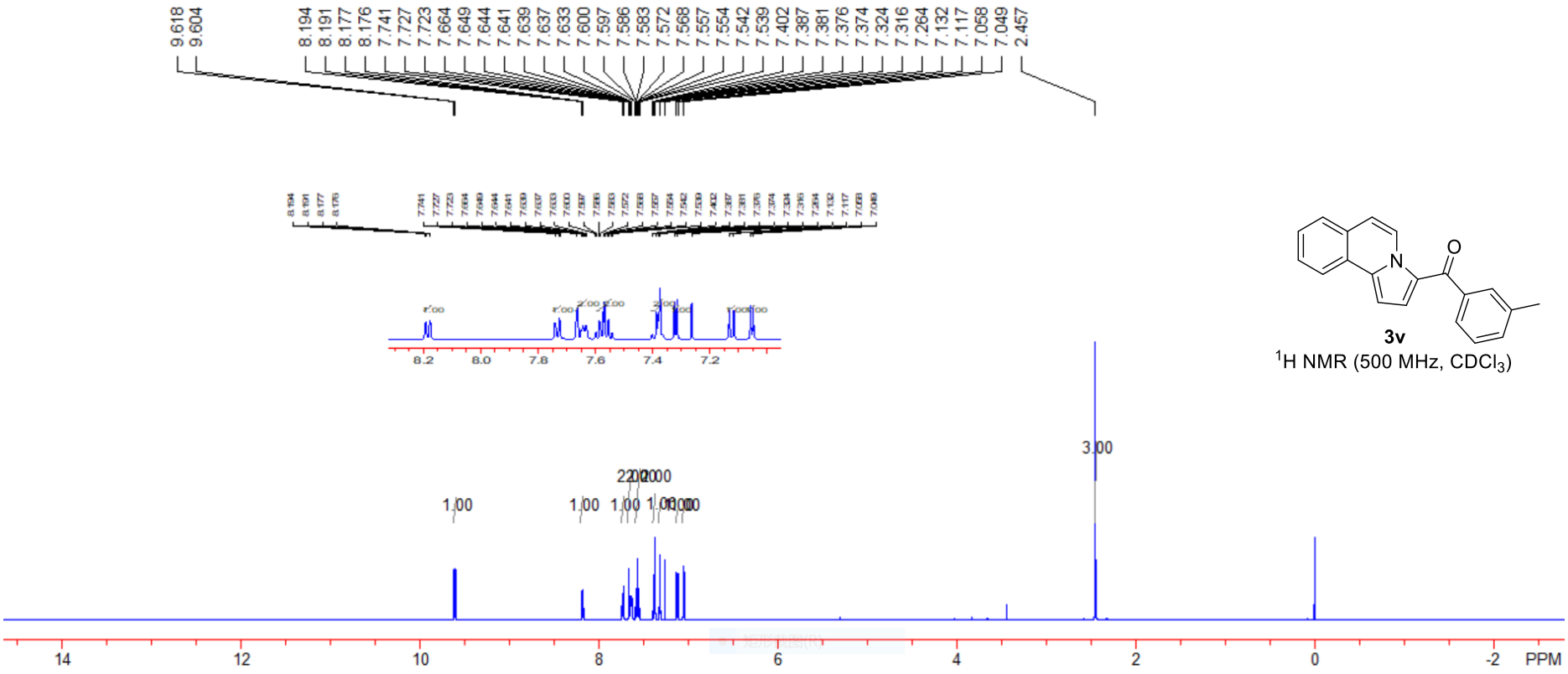
3t

^{1}H NMR (500 MHz, $CDCl_3$)


183.284
140.008
137.783
131.529
130.568
130.121
129.290
129.240
128.402
127.954
127.051
126.618
126.452
125.990
124.733
124.603
123.859
113.921
102.669
77.413
77.160
76.900
132
131
130
129
128
127
126
125
200
150
100
50
0
PPM
O
N
Cl
3t
^{13}C NMR (126 MHz, $CDCl_3$)

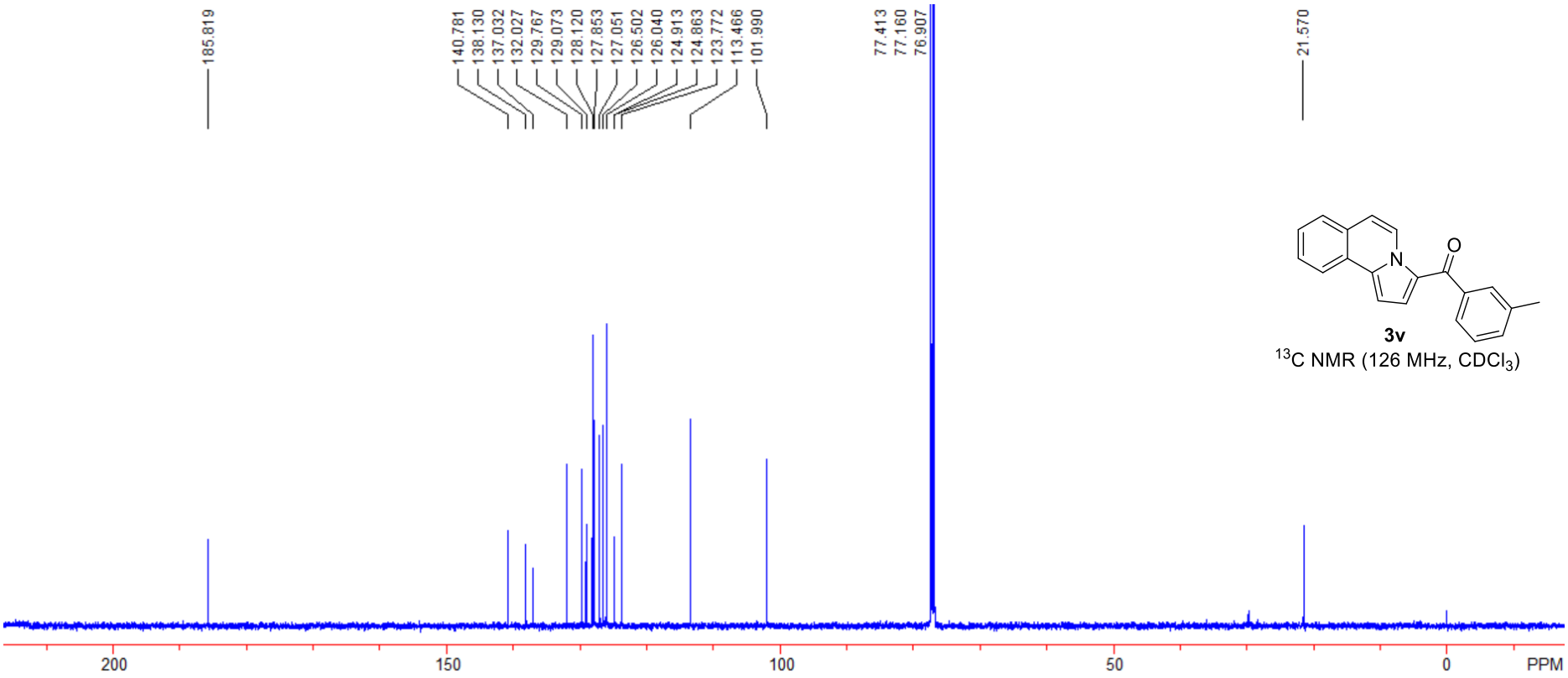

11.568
9.320
9.305
8.187
8.171
7.912
7.896
7.732
7.718
7.605
7.593
7.579
7.577
7.565
7.551
7.492
7.475
7.461
7.444
7.435
7.264
7.114
7.100
7.092
7.077
7.061
6.973
6.958
6.943
1.00
1.00
1.00
2.00
2.00
3.00
1.00
14
12
10
8
6
4
2
0
-2
PPM
O
OH
N
3u
^{1}H NMR (500 MHz, $CDCl_3$)


187.097
162.000
134.555
132.056
137.639
129.066
128.416
128.041
127.095
126.069
125.838
124.827
124.206
123.808
121.483
118.796
118.175
113.596
102.611
77.413
77.160
76.907
138
136
134
132
130
128
126
124
200
150
100
50
0
PPM
N
O
OH
3u
^{13}C NMR (126 MHz, $CDCl_3$)



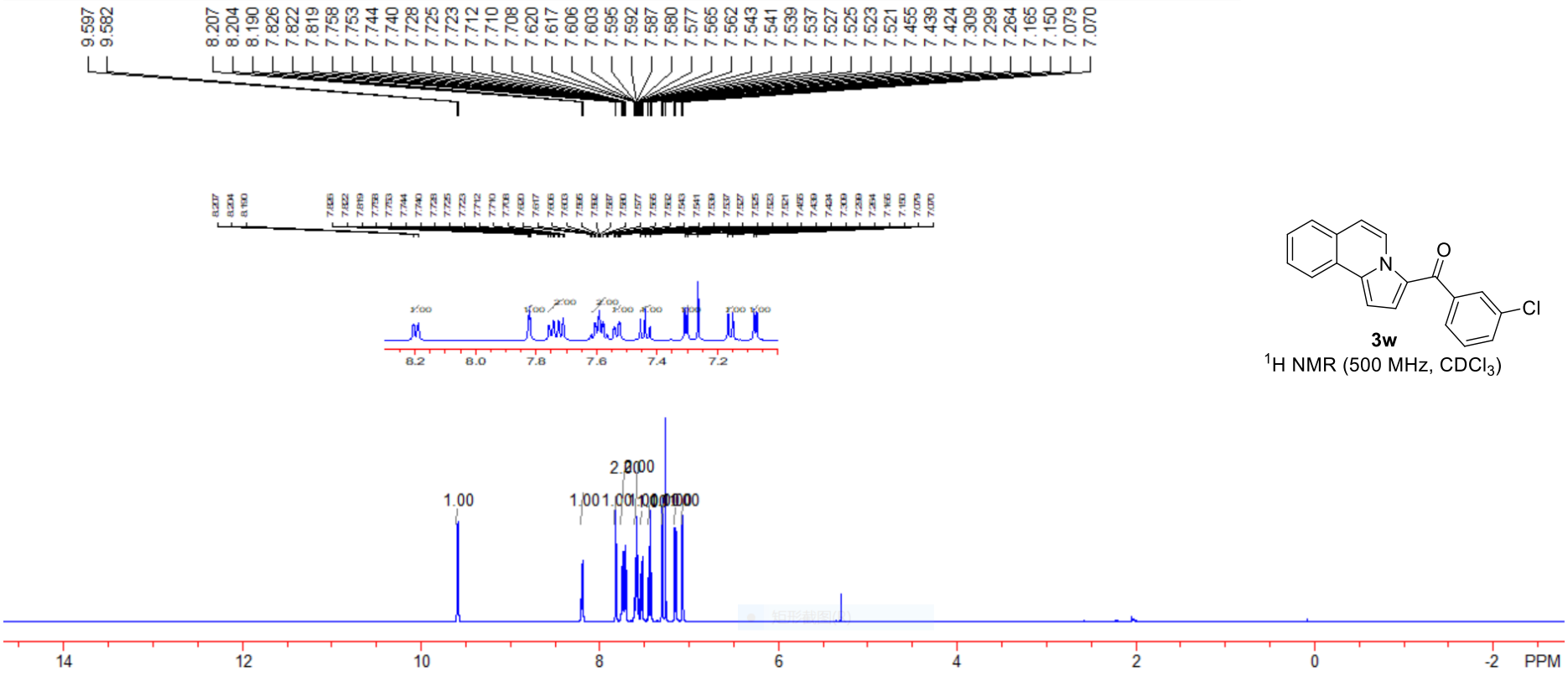
3v

^{1}H NMR (500 MHz, $CDCl_3$)



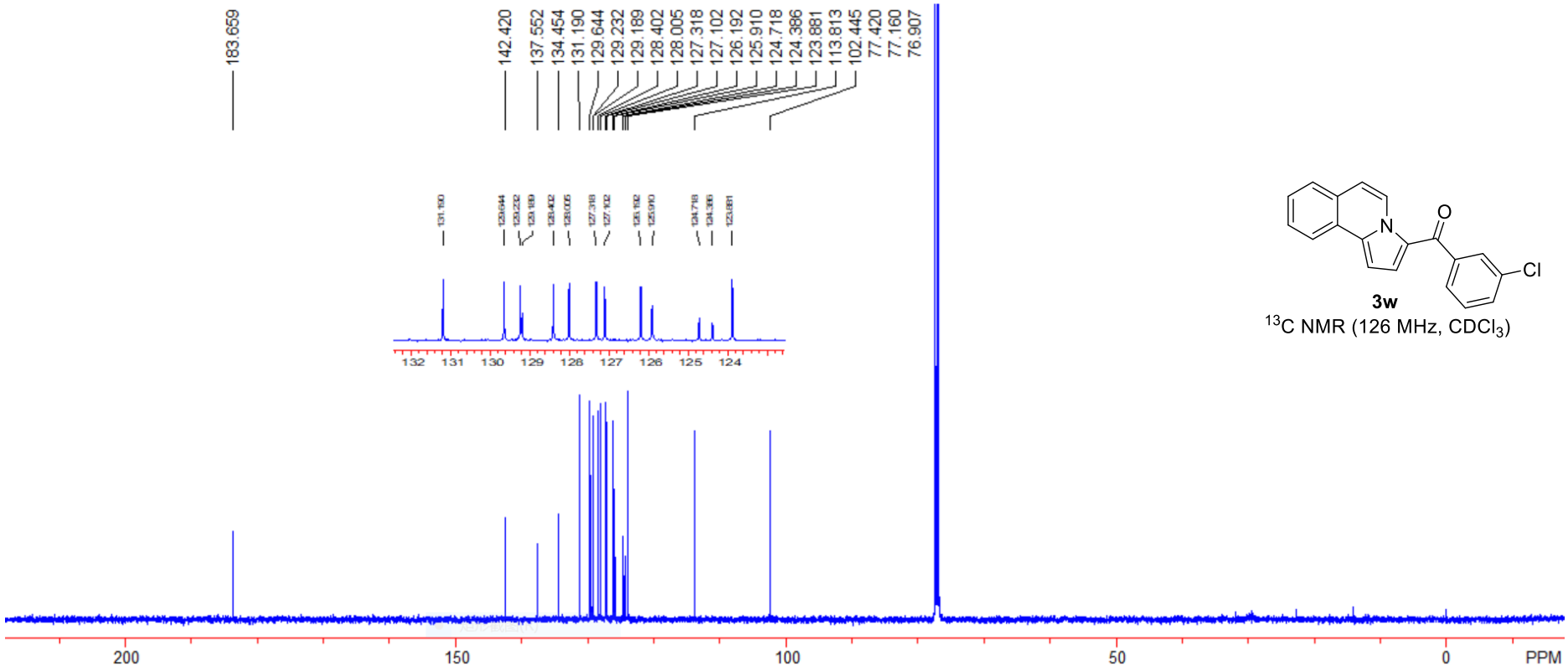
3v

^{13}C NMR (126 MHz, $CDCl_3$)



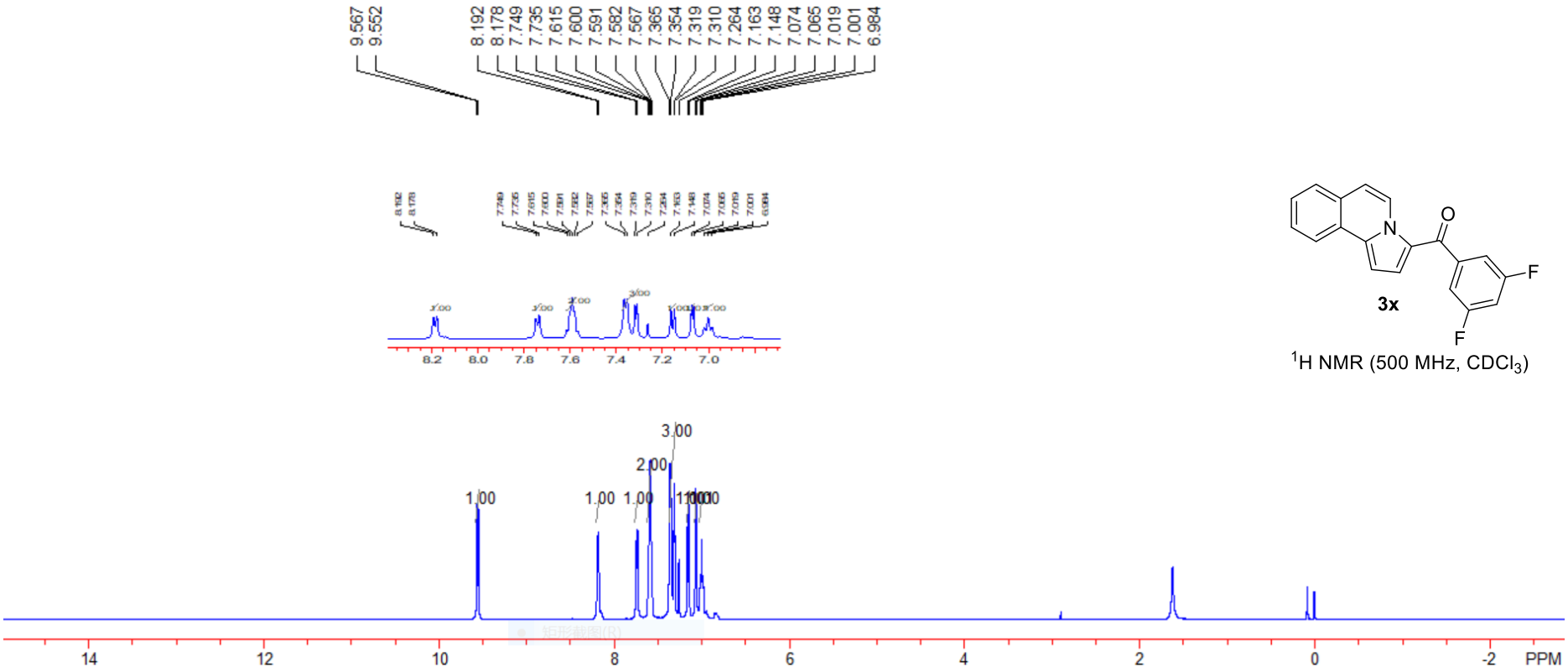
3w

^{1}H NMR (500 MHz, $CDCl_3$)



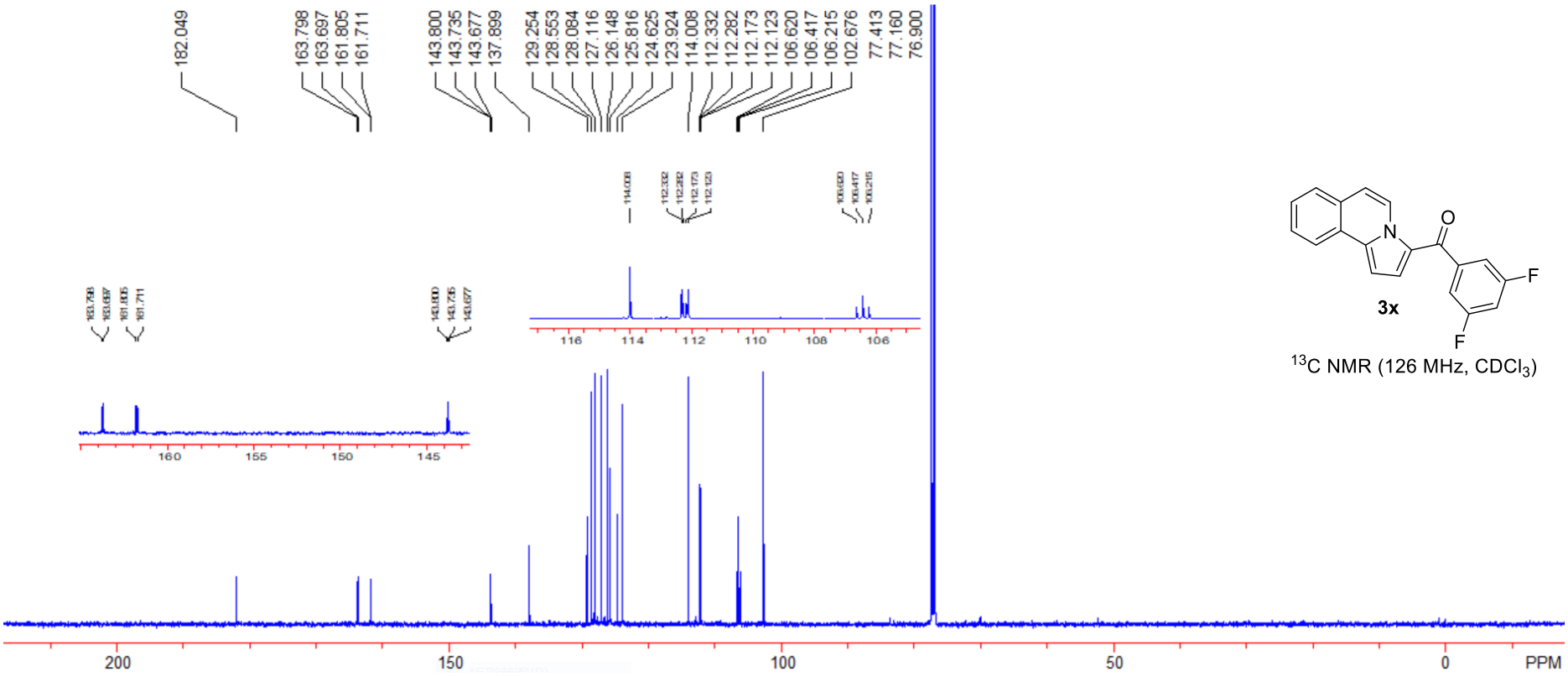
3w

^{13}C NMR (126 MHz, $CDCl_3$)

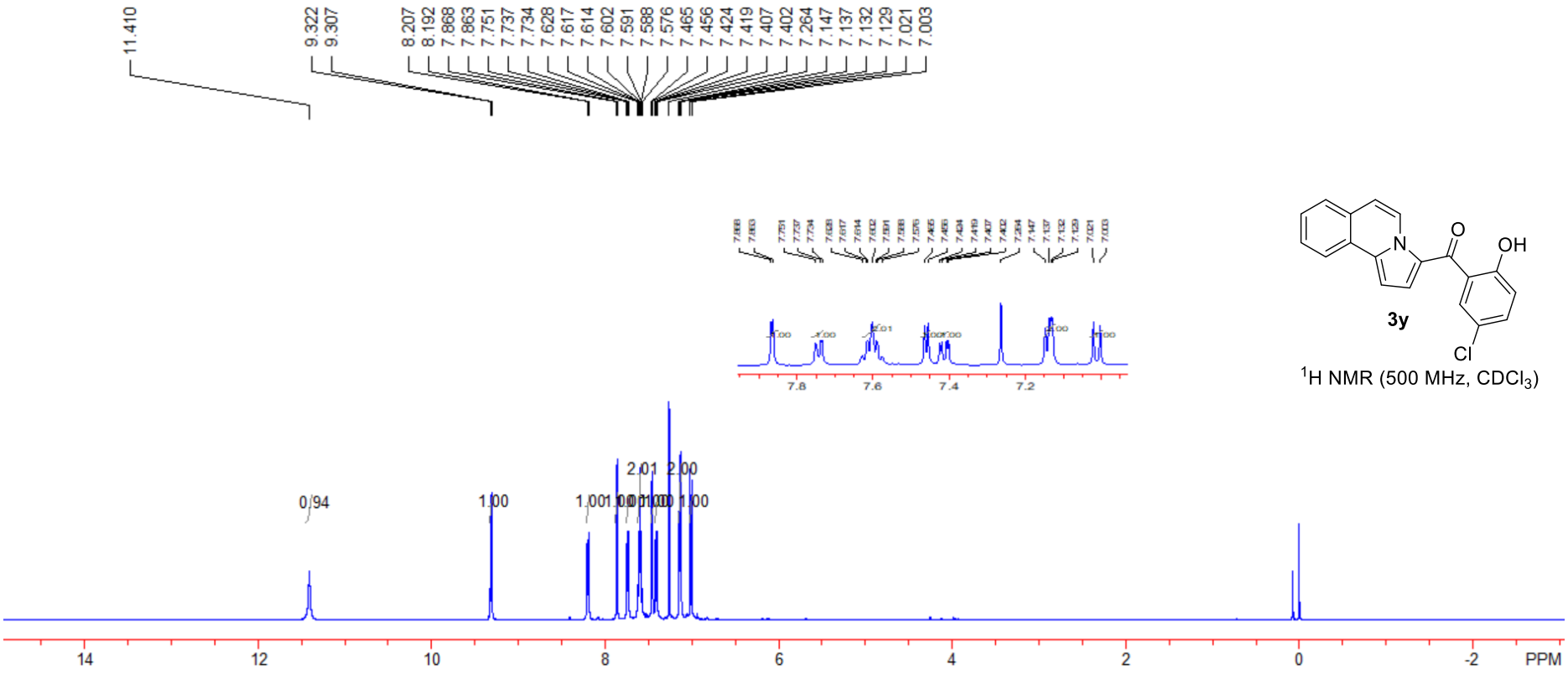


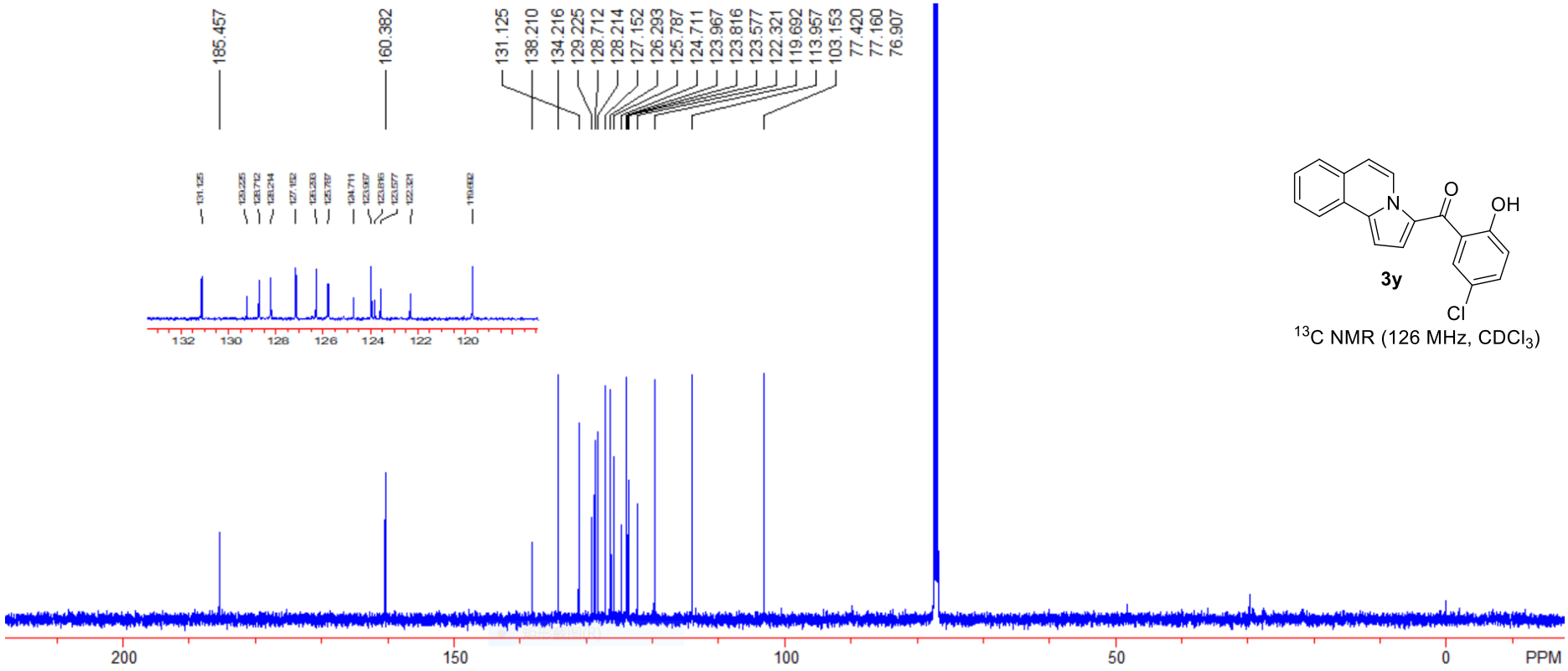
3x

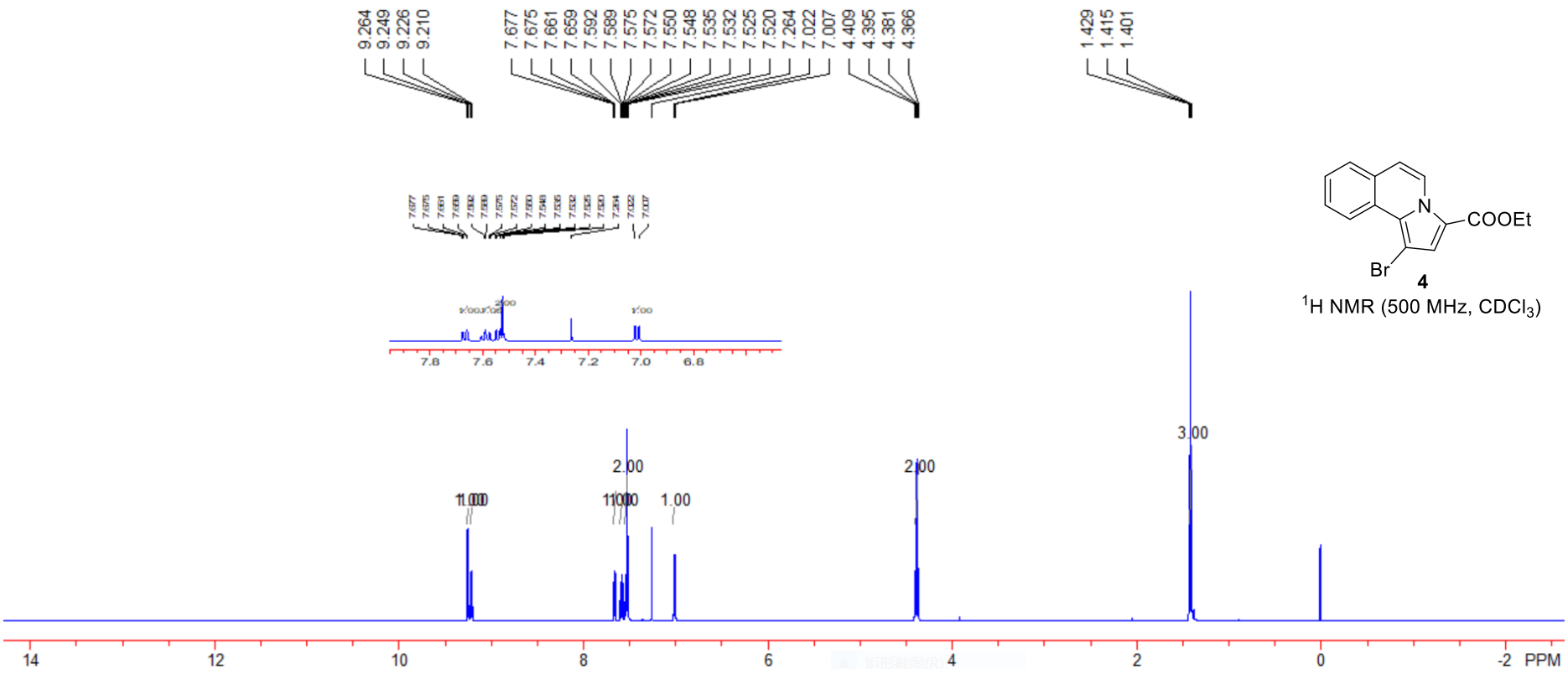
^{1}H NMR (500 MHz, $CDCl_3$)

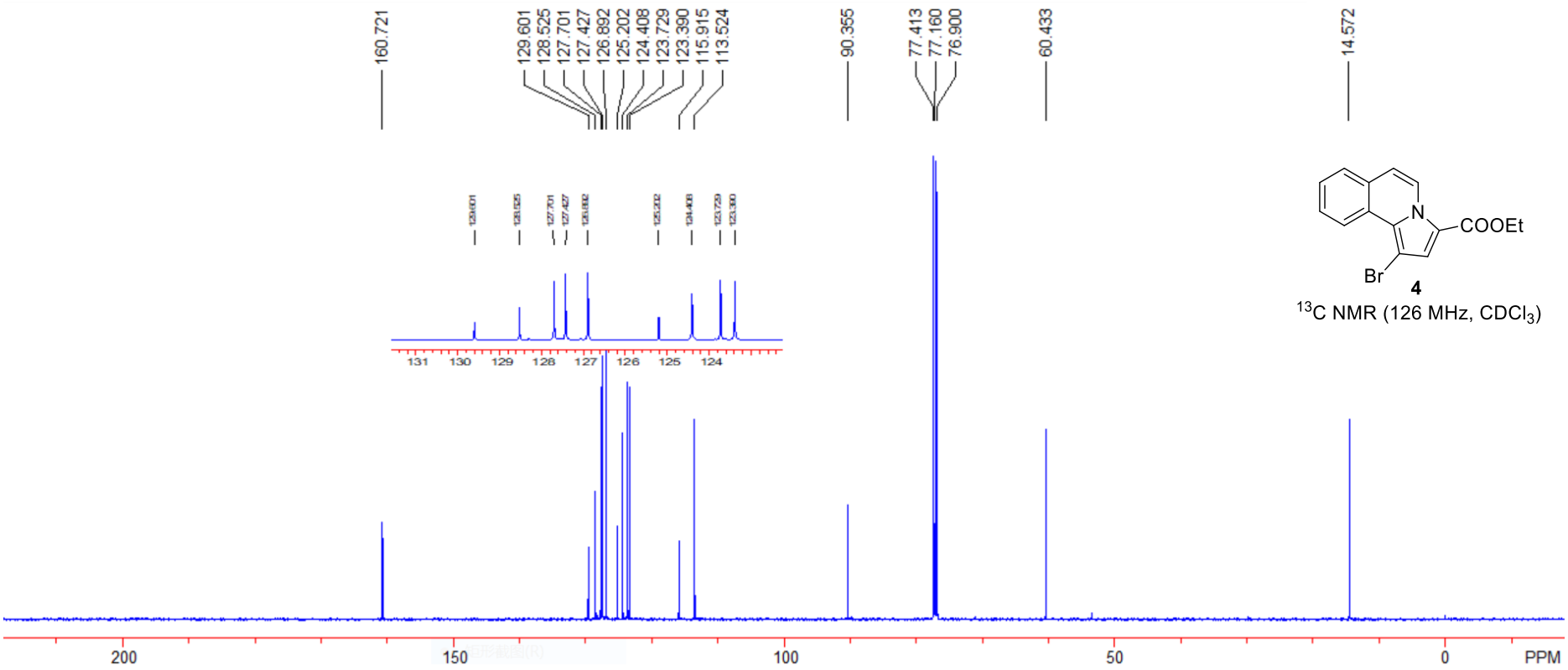


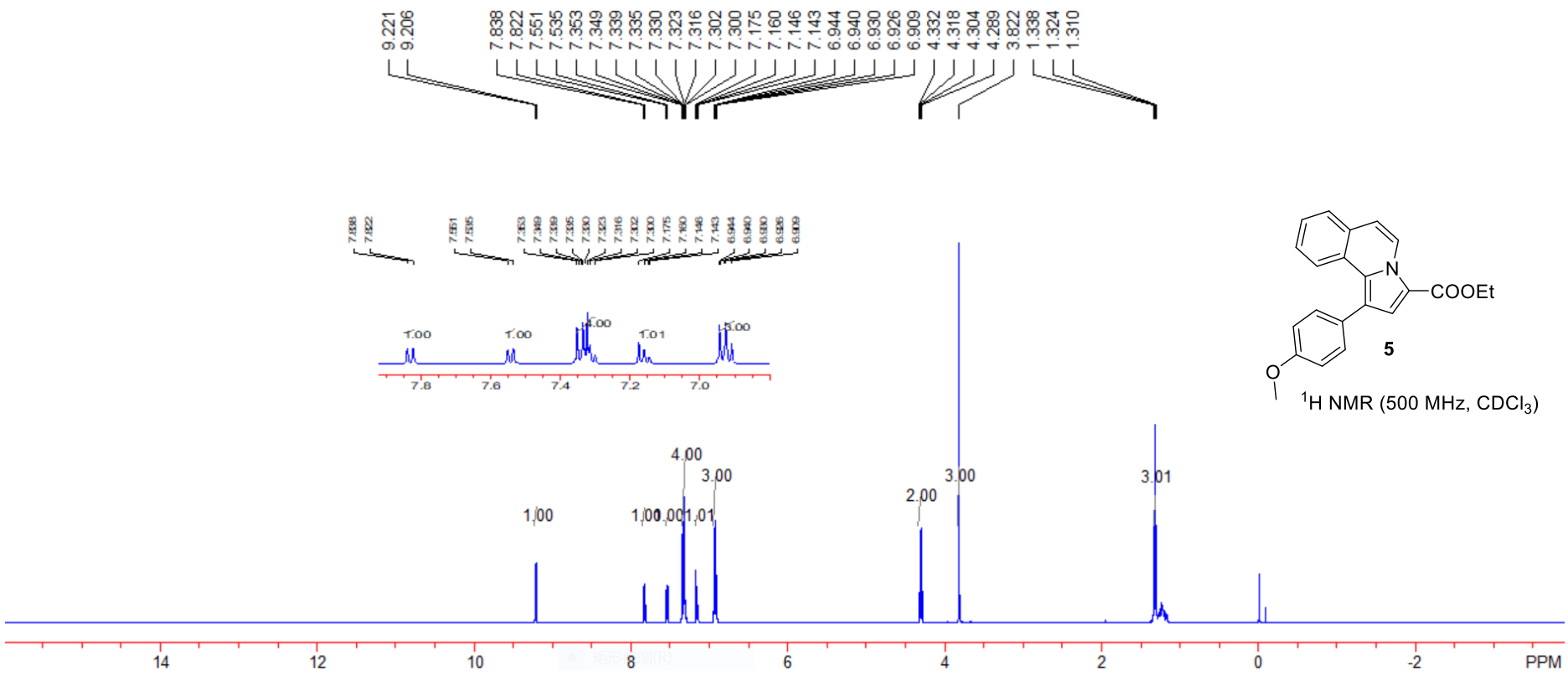
^{13}C NMR (126 MHz, $CDCl_3$)

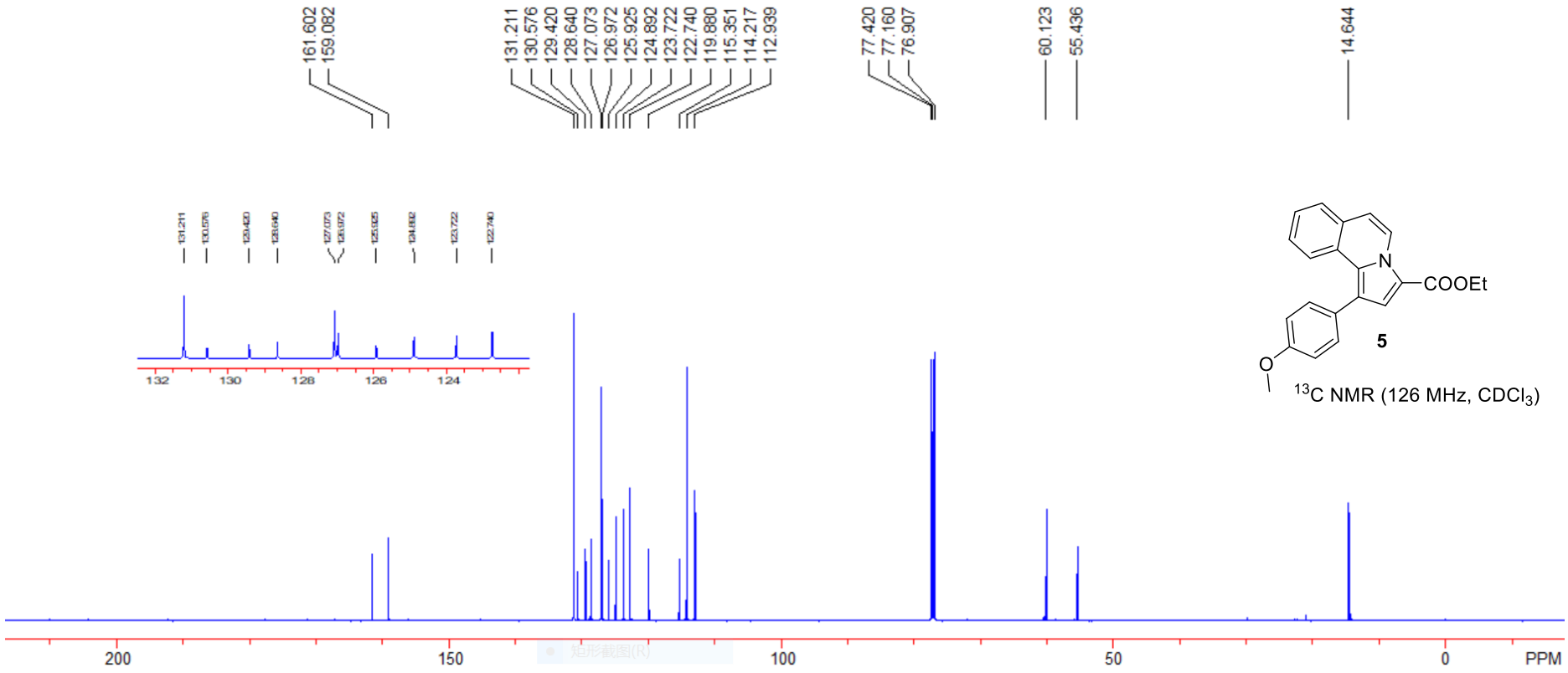

11.410
9.322
9.307
8.207
8.192
7.868
7.863
7.751
7.737
7.734
7.628
7.617
7.614
7.602
7.591
7.588
7.576
7.465
7.456
7.424
7.419
7.407
7.402
7.264
7.147
7.137
7.132
7.129
7.021
7.003
0.94
1.00
1.00
2.01
2.00
1.00
14
12
10
8
6
4
2
0
-2
PPM
7.8
7.6
7.4
7.2
O
OH
N
Cl
3y
^{1}H NMR (500 MHz, $CDCl_3$)

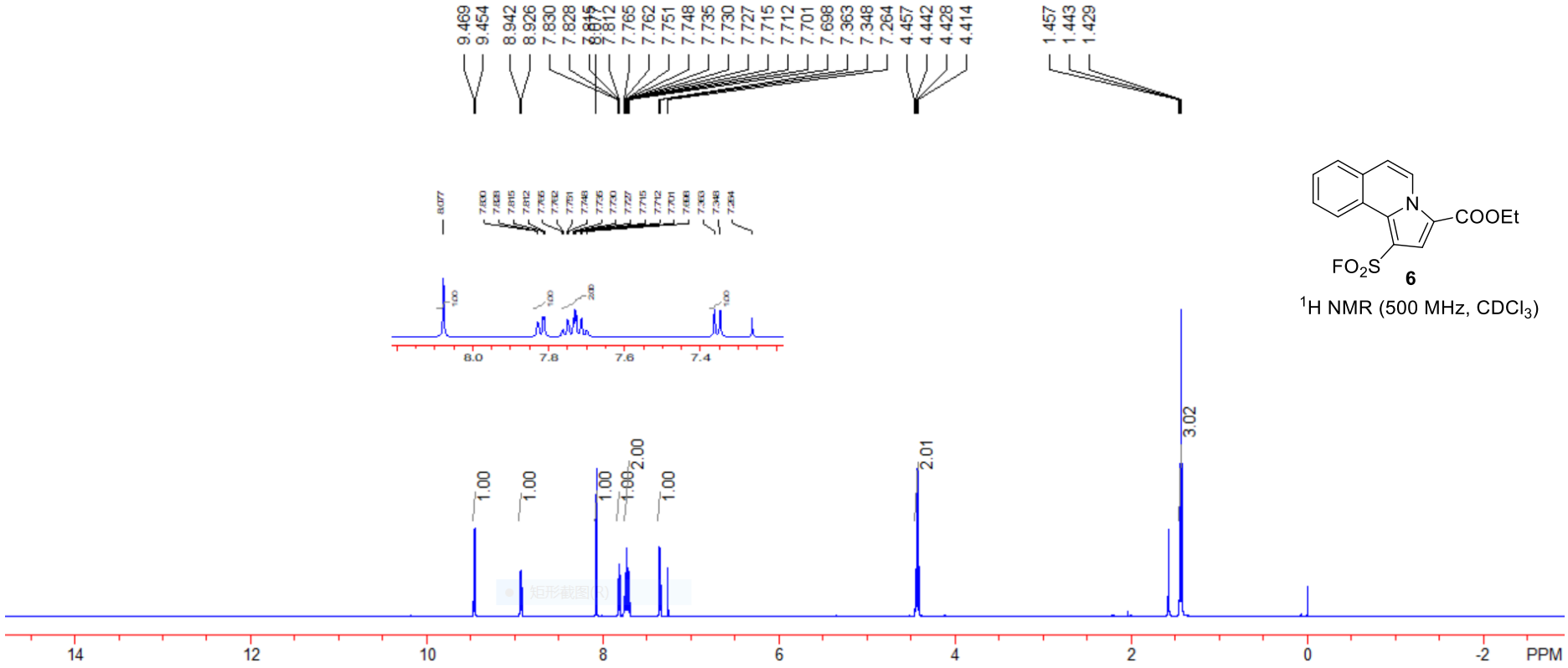

185.457
160.382
131.125
138.210
134.216
129.225
128.712
128.214
127.152
126.293
125.787
124.711
123.967
123.816
123.577
122.321
119.692
113.957
103.153
77.420
77.160
76.907
200
150
100
50
0
PPM
O
OH
N
Cl
3y
^{13}C NMR (126 MHz, $CDCl_3$)

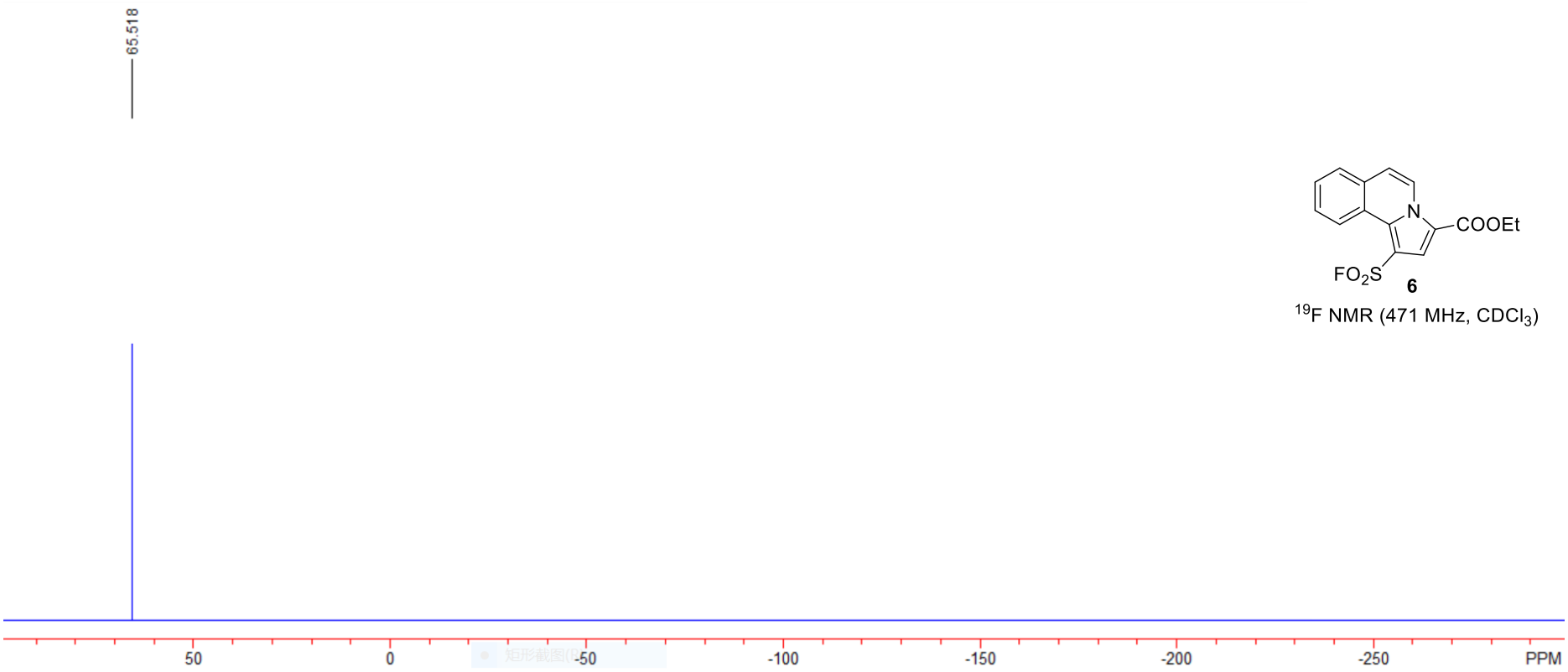

9.264
9.249
9.226
9.210
7.677
7.675
7.661
7.659
7.592
7.589
7.575
7.572
7.550
7.548
7.535
7.532
7.525
7.520
7.264
7.022
7.007
4.409
4.395
4.381
4.366
1.429
1.415
1.401
N
COOEt
Br
4
1H NMR (500 MHz, CDCl3)
3.00
2.00
2.00
1.00
14
12
10
8
6
4
2
0
-2 PPM


160.721
129.601
128.525
127.701
127.427
126.892
125.202
124.408
123.729
123.390
115.915
113.524
90.355
77.413
77.160
76.900
60.433
14.572
131
130
129
128
127
126
125
124
200
150
100
50
0
PPM
COOEt
N
Br
4
13C NMR (126 MHz, CDCl3)


9.221
9.206
7.838
7.822
7.551
7.535
7.353
7.349
7.339
7.335
7.330
7.323
7.316
7.302
7.300
7.175
7.160
7.146
7.143
6.944
6.940
6.930
6.926
6.909
4.332
4.318
4.304
4.289
3.822
1.338
1.324
1.310
1.00
1.00
4.00
1.01
5.00
7.8
7.6
7.4
7.2
7.0
N
COOEt
O
5
1H NMR (500 MHz, CDCl3)
1.00
4.00
3.00
1.00
1.00
1.01
2.00
3.00
3.01
14
12
10
8
6
4
2
0
-2
PPM


161.602
159.082
131.211
130.576
129.420
128.640
127.073
126.972
125.925
124.892
123.722
122.740
119.880
115.351
114.217
112.939
77.420
77.160
76.907
60.123
55.436
14.644
132
130
128
126
124
200
150
100
50
0
PPM
N
COOEt
O
5
^{13}C NMR (126 MHz, $CDCl_3$)


9.469
9.454
8.942
8.926
7.830
7.828
7.765
7.762
7.751
7.748
7.735
7.730
7.727
7.715
7.712
7.701
7.698
7.363
7.348
7.264
4.457
4.442
4.428
4.414
1.457
1.443
1.429
1.00
1.00
1.00
1.00
2.00
1.00
2.01
3.02
14
12
10
8
6
4
2
0
-2
PPM
N
COOEt
FO2S
6
1H NMR (500 MHz, CDCl3)



6

^{19}F NMR (471 MHz, $CDCl_3$)