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Enantioselective construction of chiral quinoline scaffold *via* a Michael addition/O-alkylation sequence

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Contents

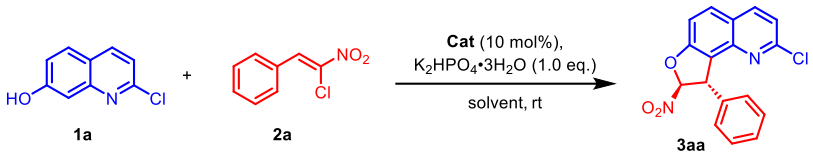
1. General information

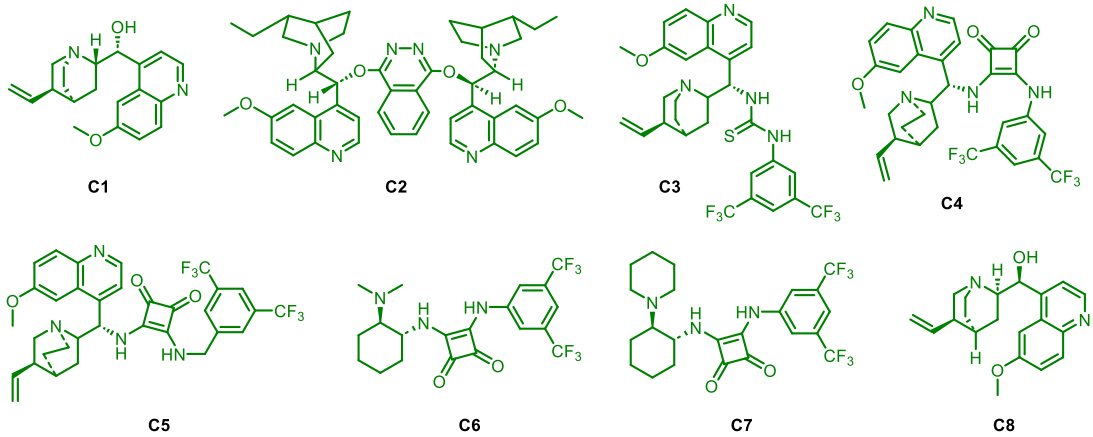
Unless otherwise noted, materials were purchased from commercial suppliers (including Shanghai Titan Scientific Co., Ltd., Bide Pharmatech Ltd., and Sinopharm Chemical Reagent Co. Ltd.) and used without further purification. Column chromatography was performed on silica gel (200~300 mesh). Diastereoisomeric ratios (dr) were determined by ^{1}H NMR (500 MHz). Enantiomeric excesses (ee) were determined by HPLC using corresponding commercial chiral columns as stated at 25 °C with UV detector at 254 nm. Optical rotations were reported as follows: $[\alpha]_D^T$ = (c g/100 mL, solvent). All ^{1}H NMR and ^{19}F NMR spectra were recorded on a Bruker AvanceII 500 MHz and Bruker Avance III 376 MHz respectively, ^{13}C NMR spectra were recorded on a Bruker Avance III 126 MHz with chemical shifts reported as ppm (in $CDCl_3$, TMS as internal standard). Data for ^{1}H NMR are recorded as follows: chemical shift (δ, ppm), multiplicity (s = singlet, d = doublet, t = triplet, m = multiplet, br = broad singlet, dd = doublet doublet, coupling constants in Hz, integration). HRMS (ESI) was obtained with a HRMS/MS instrument (LTQ Orbitrap XL TM). The absolute configuration of **3ga** was assigned by the X-ray analysis. DMEM cell culture medium, penicillin/streptomycin stock solutions, fetal bovine serum (FBS) and trypsin were all purchased from Gibco BRL (Gaithersburg, MD, USA). MCF-7 cells were all obtained from the China Center for Type Culture Collection (Wuhan, China). All of the cells were cultured in DMEM containing 10% FBS and 1% antibiotics (Penicillin/Streptomycin).

7-hydroxyquinoline series **1a-i** were prepared from 2-bromoquinolin-7-ol according to the literature.[1] **1j-n** were purchased from commercial suppliers (including Shanghai Titan Scientific Co., Ltd., Bide Pharmatech Ltd., and Sinopharm Chemical Reagent Co. Ltd.) and used without further purification. Chloronitrostyrene **2a-k** were prepared from benzodehydes and bromonitromethanes according to the literature.[2] Catalyst **C1-8** were prepared from quinine and squaramides according to the literature.[3–5] And the racemic products were synthesized using racemic squaramide **C7** as catalyst.

2. Optimization of the reaction conditions

Table S1 Catalyst screening for the product 3aa

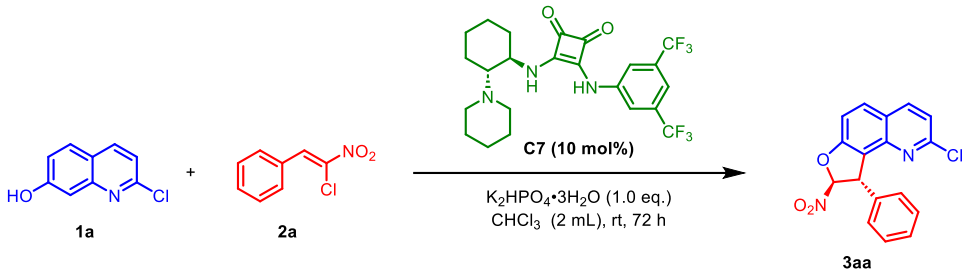




Entry [a]	**Catalyst**	Additive	Time (h)	Yield (%) [b]	ee (%) [c]
1	**C1**	$K_2HPO_4•3H_2O$	48	37	24
2	**C2**	$K_2HPO_4•3H_2O$	48	9	11
3	**C3**	$K_2HPO_4•3H_2O$	48	46	57
4	**C4**	$K_2HPO_4•3H_2O$	48	18	97
5	**C5**	$K_2HPO_4•3H_2O$	48	37	94
6	**C6**	$K_2HPO_4•3H_2O$	48	32	53
7	**C7**	$K_2HPO_4•3H_2O$	48	39	96
8 [d]	**C7**	$K_2HPO_4•3H_2O$	72	51	95
9 [e]	**C7**	$K_2HPO_4•3H_2O$ (2 eq.)	72	32	93
10	**C8**	$K_2HPO_4•3H_2O$	48	40	24

[a] Unless otherwise noted, reactions were conducted with **1a** (0.2mmol, 1.0 equiv.), **2a** (0.24mmol, 1.2 equiv.), **Cat.** (10 mmol %), and additive (0.2mmol, 1.0 equiv.) in $CHCl_3$ (2 mL, 0.1 M). The mixture was stirred for 48 h at rt. [b] Isolated yield. [c] Determined by chiral HPLC analysis. [d] Stirred for 72 h . [e] $K_2HPO_4•3H_2O$ (0.4 mmol, 2 equiv.) was used.

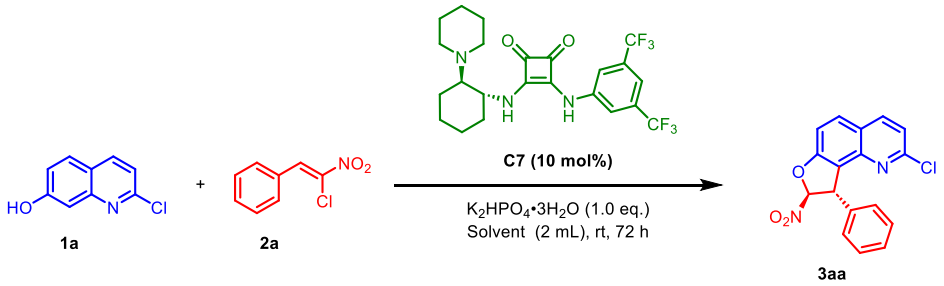
Table S2 Additive screening for the product 3aa



Entry [a]	Additive	Yield (%) [b]	ee (%) [c]
1	$K_2HPO_4•3H_2O$	51	95
2	K_2HPO_4	32	94
3	K_2CO_3	44	95
4	K_3PO_4	60	51
5	Cs_2CO_3	50	67
6	Na_2CO_3	41	94
7	$NaHCO_3$	47	95
8	DABCO	44	96
9	DBU	trace	trace
10	TEA	63	80
11	DIPEA	47	81

[a] Reactions were conducted with **1a** (0.2 mmol, 1.0 equiv.), **2a** (0.24 mmol, 1.2 equiv.), **C7** (10 mmol %), and additive (0.2 mmol, 1.0 equiv.) in $CHCl_3$ (2 mL, 0.1 M). The mixture was stirred for 72 h at rt. [b] Isolated yield. [c] Determined by chiral HPLC analysis.

Table S3 Solvent screening for the product 3aa



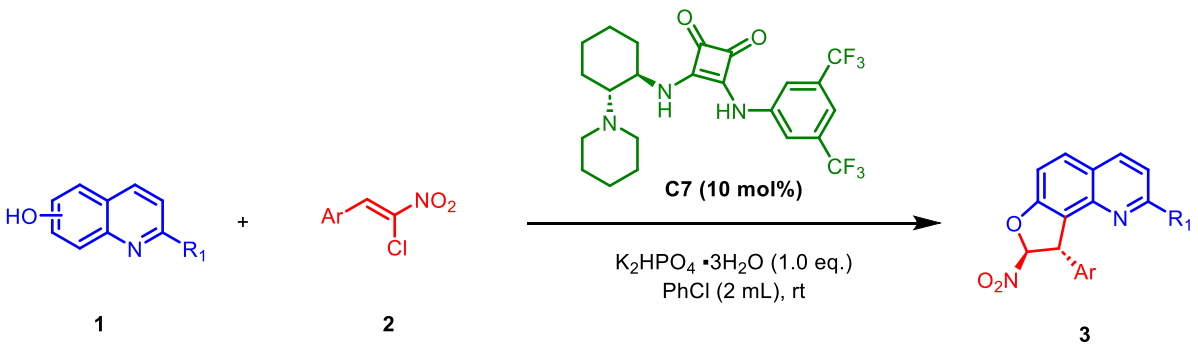
Entry [a]	Solvent	Yield (%) [b]	ee (%) [c]
1	$CHCl_3$	51	95
2	DCM	38	94
3	DCE	44	94
4	THF	41	30

5	CH_3CN	38	45
6	Ethyl Acetate	41	32
7	Acetone	47	13
8	Toluene	57	87
9	Dry toluene	56	89
10	Chlorobenzene	63	95
11	Dry chlorobenzene	52	91
12	1,3-Dichlorobenzene	59	90
13	1,2-Difluorobenzene	50	91
14	Nitrobenzene	38	95
15 [d]	Chlorobenzene	9	92
16[e]	Chlorobenzene	38	88
17 [f]	Chlorobenzene	trace	
18 [g]	Chlorobenzene	58	87

[a] The reaction was performed with 0.2 mmol of **1a**, 0.24 mmol of **2a**, 10 mmol% of **C7**, and 1 equiv. of K_2HPO_4•$3H_2O$ in 2 mL Solvent at rt for 72 h. [c] Determined by chiral HPLC analysis. [d] **C7** (5 mmol%). [e] **C7** (20 mmol%). [f] Stirred at 0 ℃. [g] Stirred at 40 ℃.

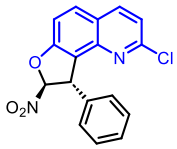
2. Experimental procedures and characterization of products 3, 5, 7 - 9

General procedure A: Synthesis of compound 3



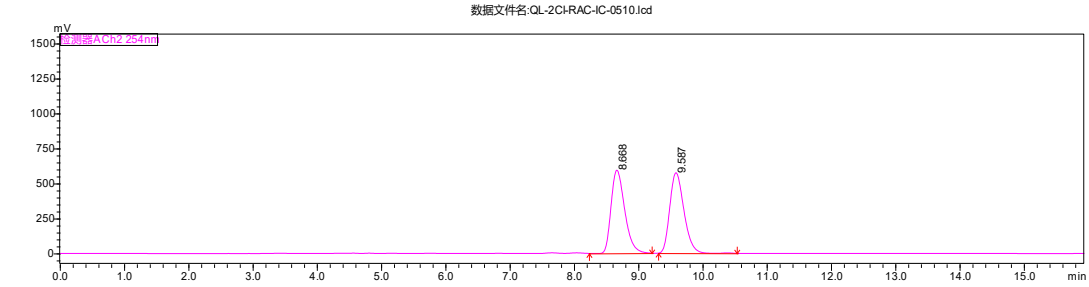
To a Schlenk tube equipped with a magnetic stir bar was charged with 2-Substituted hydroxyquinoline-one **1** (0.2 mmol), nitroolefins **2** (0.24 mmol), K_2HPO_4•$3H_2O$ (45.6 mg, 0.2 mmol), **C7** (9.8 mg, 10 mol%) and PhCl (2 mL). The reaction was detected by TLC and stirred at rt for 72 h. After **1** was consumed or the reaction was no longer proceeding, the reaction mixture was purified by column chromatography on silica gel directly to give the product **3**.

(8S,9S)-2-chloro-9-(4-fluorophenyl)-8-nitro-8,9-dihydrofuro[2,3-h]quinoline (3aa)

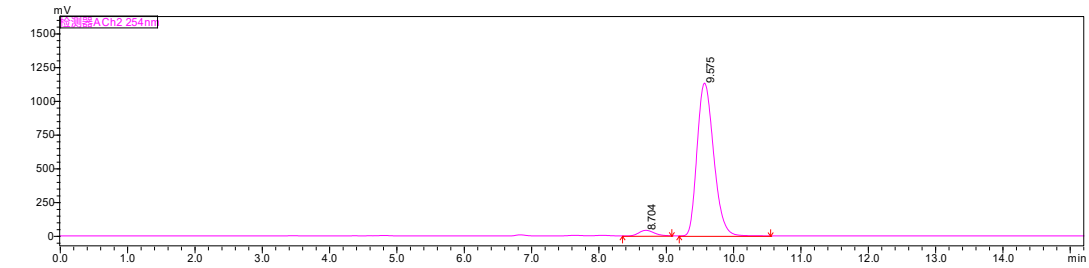


3aa

White solid; **m.p.:** 182 - 183 ºC; **Yield:** 41 mg, 63% yield; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = 6 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.05 (d, *J* = 8.6 Hz, 1H), 7.86 (d, *J* = 8.8 Hz, 1H), 7.50 (d, *J* = 8.8 Hz, 1H), 7.34 - 7.26 (m, 3H), 7.25 - 7.20 (m, 3H), 6.21 (d, *J* = 1.5 Hz, 1H), 5.52 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 159.7, 152.3, 144.5, 139.2, 137.9, 130.9, 129.1, 128.2, 127.4, 124.1, 121.2, 120.6, 112.8, 112.4, 54.4; **HRMS (ESI)** calcd for $C_{17}H_{12}ClN_2O_3^+$ $[M+H]^+$: 327.0531, found: 327.0535; **HPLC Data** 94% ee (Daicel Chiralpak IC column, hexane/isopropanol = 95/5, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 8.7 min, t_{minor} = 9.5 min).

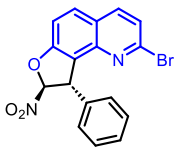


Peak	RetTime	Height	Area	Area%
1	8.668	593621	8725605	49.726
2	9.587	574281	8821858	50.274
Total		1167902	17547462	100.000



Peak	RetTime	Height	Area	Area%
1	8.704	40432	627204	3.145
2	9.575	1131451	19316783	96.855
Total		1171883	19943987	100.000

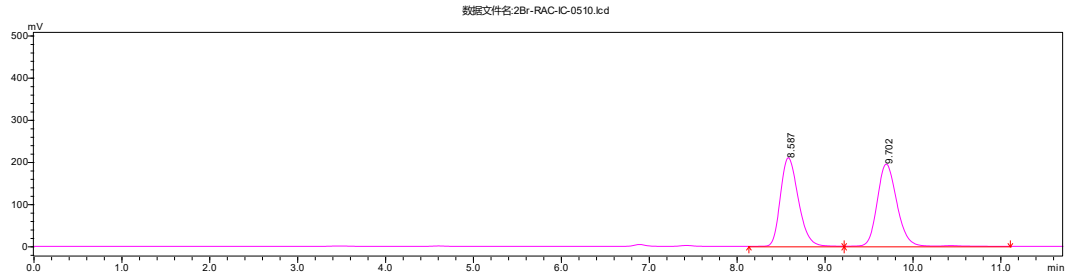
(8S,9S)-2-bromo-8-nitro-9-phenyl-8,9-dihydrofuro[2,3-h]quinoline (3ba)



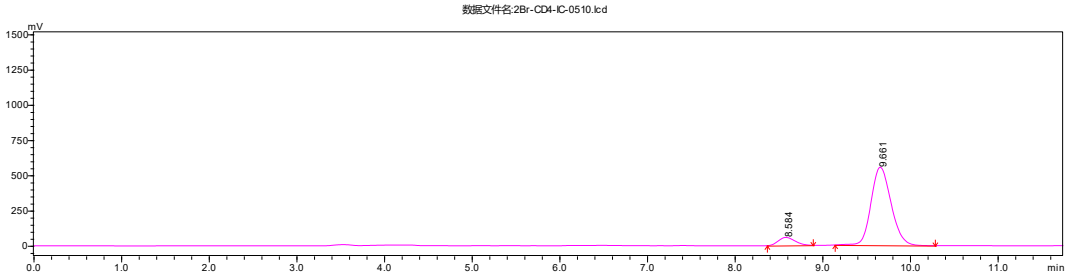
3ba

Green solid; **m.p.:** 169 - 171 ºC; **Yield:** 27 mg, 36%; ＞20:1 dr; petroleum ether/EtOAc = 2:1; $[\alpha]_D^{25}$ = 118 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 7.94 (d, *J* = 8.6 Hz, 1H), 7.85 (d, *J* = 8.8 Hz, 1H), 7.52 (d, *J* = 8.8 Hz, 1H), 7.38 (d, *J* = 8.5 Hz, 1H), 7.36 - 7.20 (m, 5H), 6.22 (d, *J* = 1.5 Hz, 1H), 5.52 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 159.5, 145.1, 143.7, 138.6, 137.9, 131.0, 129.1, 128.2, 127.4, 124.6, 124.3, 120.7, 113.0, 112.3, 54.4; **HRMS (ESI)** calcd for $C_{17}H_{11}BrClN_2O_3^+$ $[M+H]^+$: 404.9636, found: 404.9644; **HPLC Data** 85% ee (Daicel Chiralpak IC

column, hexane/isopropanol = 95/5, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 9.6 min, t_{minor} = 8.5 min).

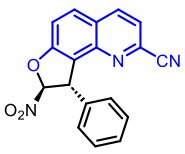


Peak	RetTime	Height	Area	Area%
1	8.587	209791	2981538	49.490
2	9.702	195107	3042941	50.510
Total		404897	6024479	100.000



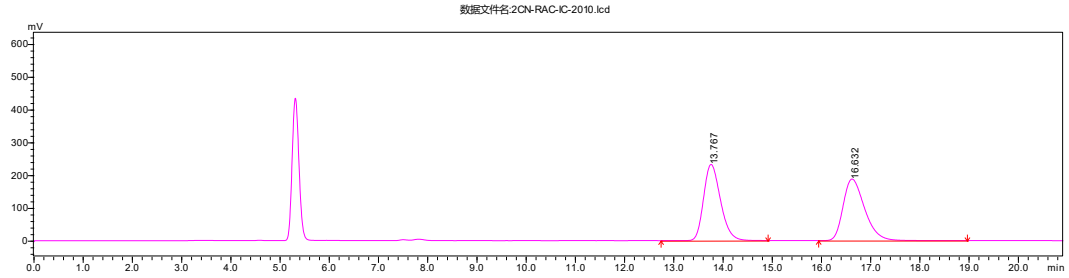
Peak	RetTime	Height	Area	Area%
1	8.584	57321	754651	7.922
2	9.661	553262	8771098	92.078
Total		610583	9525749	100.000

(8S,9S)-8-nitro-9-phenyl-8,9-dihydrofuro[2,3-h]quinoline-2-carbonitrile (3ca)

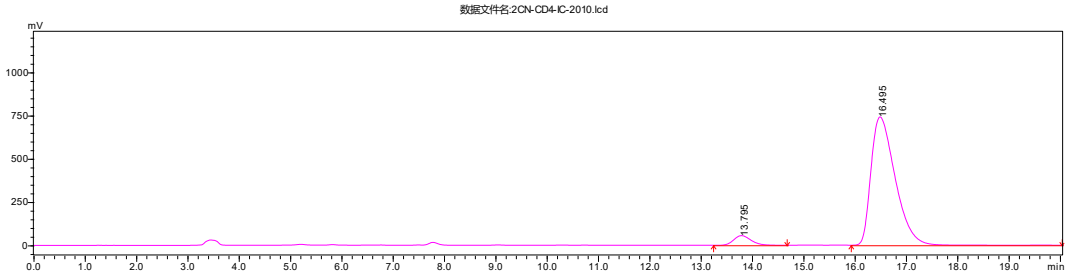


3ca

Green solid; m.p.: 174 - 176 ℃; Yield: 40 mg, 64%; ＞20:1 dr; petroleum ether/EtOAc = 2:1; $[\alpha]_D^{25}$ = 8 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.30 (d, *J* = 8.4 Hz, 1H), 7.97 (d, *J* = 8.9 Hz, 1H), 7.67 (d, *J* = 8.9 Hz, 1H), 7.57 (d, *J* = 8.4 Hz, 1H), 7.37 - 7.25 (m, 3H), 7.25 - 7.19 (m, 2H), 6.26 (d, *J* = 1.6 Hz, 1H), 5.53 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 160.0, 144.8, 138.1, 137.6, 134.7, 131.3, 129.2, 128.4, 127.3, 126.0, 122.3, 121.7, 117.2, 115.8, 112.3, 54.5; **HRMS (ESI)** calcd for $C_{18}H_{11}N_3NaO_3^+$ $[M+Na]^+$: 340.0693, found: 340.0695; **HPLC Data** 90% ee (Daicel Chiralpak IC column, hexane/isopropanol = 80/20, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 16.4 min, t_{minor} = 13.7 min).

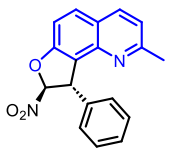


Peak	RetTime	Height	Area	Area%
1	13.767	232527	5547127	49.316
2	16.632	187878	5701037	50.684
Total		420405	11248164	100.000



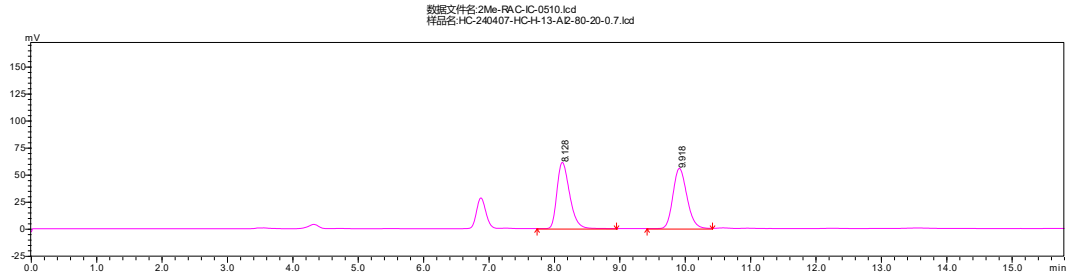
Peak	RetTime	Height	Area	Area%
1	13.795	55965	1320975	5.160
2	16.495	742012	24280243	94.840
Total		797977	25601219	100.000

(8S,9S)-2-methyl-8-nitro-9-phenyl-8,9-dihydrofuro[2,3-h]quinoline (3da)

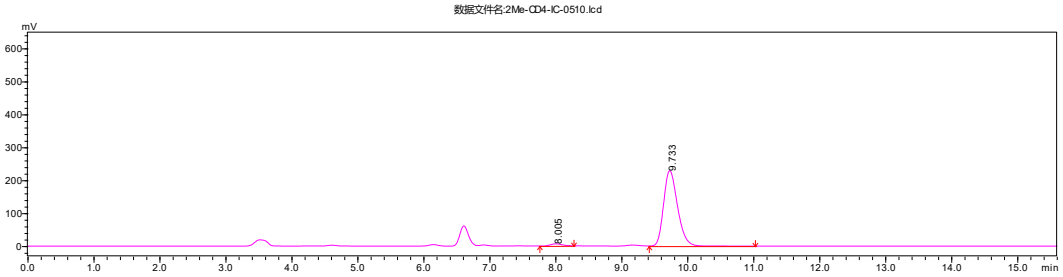


3da

Purple solid; **m.p.:** 135 - 137 °C; **Yield:** 22 mg, 36%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = 32 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.00 (d, *J* = 8.4 Hz, 1H), 7.81 (d, *J* = 8.8 Hz, 1H), 7.43 (d, *J* = 8.7 Hz, 1H), 7.34 - 7.23 (m, 5H), 7.14 (d, *J* = 8.4 Hz, 1H), 6.19 (d, *J* = 1.5 Hz, 1H), 5.55 (s, 1H), 2.56 (s, 3H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 160.6, 158.7, 144.5, 138.6, 136.4, 130.7, 128.9, 127.9, 127.5, 123.8, 120.7, 120.1, 112.6, 111.4, 54.6, 25.4; **HRMS (ESI)** calcd for $C_{18}H_{15}N_2O_3^+$ $[M+H]^+$: 307.1077, found: 307.1075; **HPLC Data** 95% ee (Daicel Chiralpak IC column, hexane/isopropanol = 95/5, λ = 254 nm, 25 °C, 1 mL/min, t_{major} = 9.7 min, t_{minor} = 8.0 min).

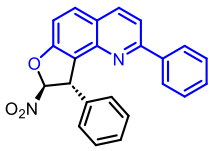


Peak	RetTime	Height	Area	Area%
1	8.128	61242	821991	49.881
2	9.918	55644	825926	50.119
Total		116885	1647917	100.000



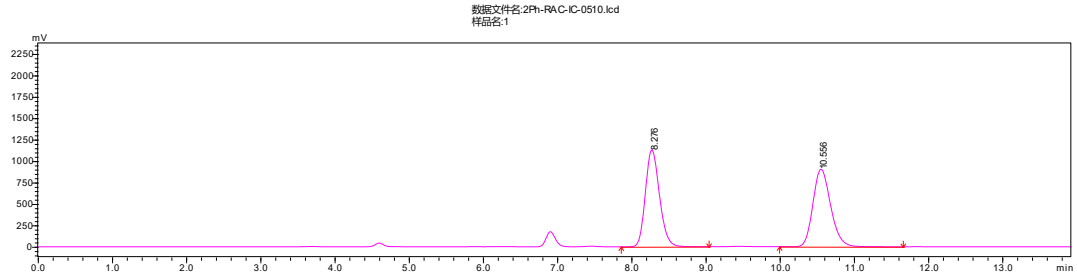
Peak	RetTime	Height	Area	Area%
1	8.005	6369	76640	2.223
2	9.733	229489	3371420	97.777
Total		235858	3448060	100.000

(8S,9S)-8-nitro-2,9-diphenyl-8,9-dihydrofuro[2,3-h]quinoline (3ea)



3ea

Purple solid; **m.p.:** 129 - 131 °C; **Yield:** 33 mg, 45%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = -63 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.18 (d, *J* = 8.6 Hz, 1H), 7.98 - 7.93 (m, 2H), 7.86 (d, *J* = 8.8 Hz, 1H), 7.76 (d, *J* = 8.6 Hz, 1H), 7.47 (d, *J* = 8.8 Hz, 1H), 7.46 - 7.40 (m, 3H), 7.34 (d, *J* = 4.4 Hz, 4H), 7.28 (q, *J* = 4.2 Hz, 1H), 6.27 (d, *J* = 1.7 Hz, 1H), 5.61 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 158.9, 157.9, 144.7, 139.0, 138.8, 137.3, 130.7, 129.7, 129.0, 128.7, 128.0, 127.6, 127.5, 124.5, 121.3, 117.3, 112.6, 112.2, 55.0; **HRMS (ESI)** calcd for $C_{23}H_{17}N_2O_3^+$ $[M+H]^+$: 369.1234, found: 369.1236; **HPLC Data** 94% ee (Daicel Chiralpak IC column, hexane/isopropanol = 95/5, λ = 254 nm, 25 °C, 1 mL/min, t_{major} = 10.5 min, t_{minor} = 8.2 min).



Peak	RetTime	Height	Area	Area%
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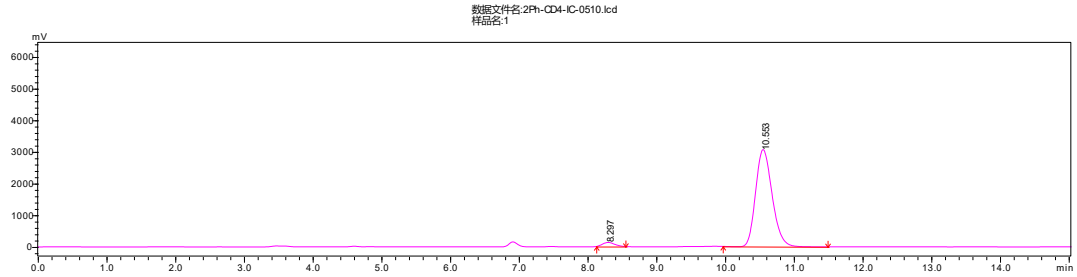
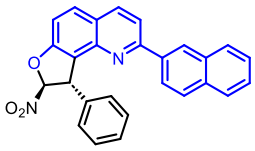
2	10.556	903370	14929209	50.030
Total		2034223	29840439	100.000



Peak	RetTime	Height	Area	Area%

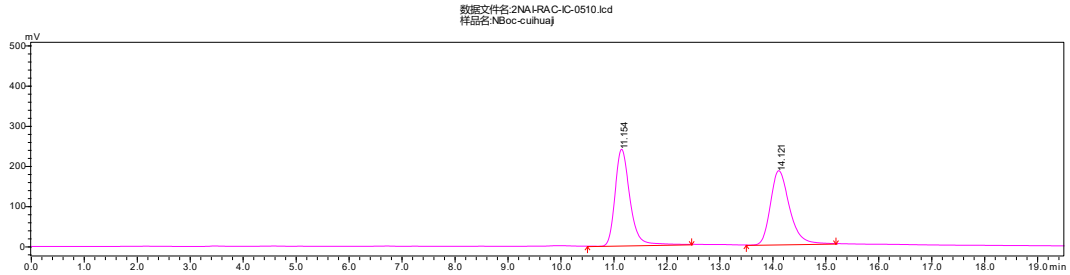
1	8.297	127290	1546733	2.946
2	10.553	3062573	50963965	97.054
Total		3189863	52510698	100.000

(8S,9S)-2-(naphthalen-2-yl)-8-nitro-9-phenyl-8,9-dihydrofuro[2,3-h]quinoline (3fa)

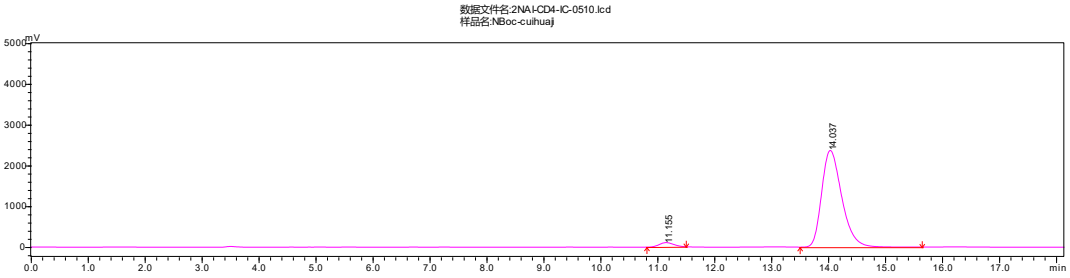


3fa

Yellow solid; **m.p.:** 156 - 158 ºC; **Yield:** 37 mg, 44%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = -140 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.37 (s, 1H), 8.16 (d, *J* = 8.6 Hz, 1H), 8.09 (dd, *J* = 8.6, 1.8 Hz, 1H), 7.89 - 7.82 (m, 5H), 7.53 - 7.44 (m, 3H), 7.40 - 7.32 (m, 4H), 7.32 - 7.26 (m, 1H), 6.30 (d, *J* = 1.8 Hz, 1H), 5.64 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 158.9, 157.7, 144.7, 138.9, 137.2, 136.3, 134.0, 133.3, 130.7, 129.0, 128.8, 128.4, 128.0, 127.69, 127.67, 127.3, 126.9, 126.4, 124.8, 124.5, 121.4, 117.5, 112.6, 112.2, 55.1; **HRMS (ESI)** calcd for $C_{27}H_{19}N_2O_3^+$ $[M+H]^+$: 419.1390, found: 419.1379; **HPLC Data** 94% ee (Daicel Chiralpak IC column, hexane/isopropanol = 95/5, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 14.0 min, t_{minor} = 11.1 min).

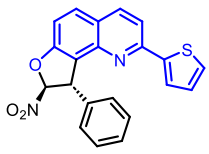


Peak	RetTime	Height	Area	Area%
1	11.154	239578	4612379	50.331
2	14.121	183662	4551751	49.669
Total		423240	9164129	100.000



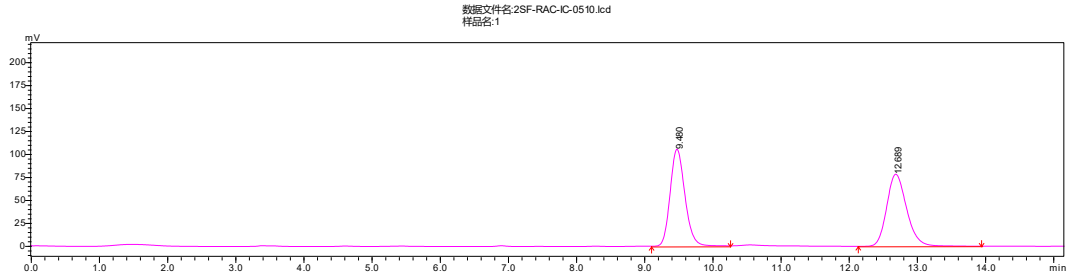
Peak	RetTime	Height	Area	Area%
1	11.155	105859	1854575	3.086
2	14.037	2371459	58235702	96.914
Total		2477319	60090277	100.000

(8S,9S)-8-nitro-9-phenyl-2-(thiophen-2-yl)-8,9-dihydrofuro[2,3-h]quinoline (3ga)

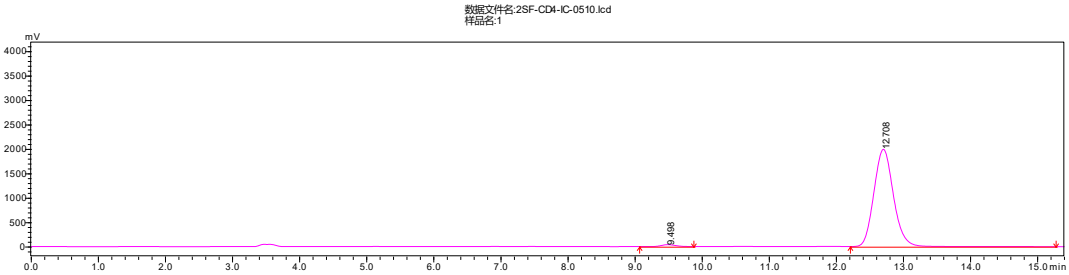


3ga

White solid; **m.p.:** 163 - 165 ºC; **Yield:** 46 mg, 61%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = -142 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 7.99 (d, *J* = 8.6 Hz, 1H), 7.73 (d, *J* = 8.8 Hz, 1H), 7.58 - 7.52 (m, 2H), 7.42 - 7.36 (m, 4H), 7.32 (dd, *J* = 8.5, 6.9 Hz, 2H), 7.27 - 7.21 (m, 1H), 7.05 (dd, *J* = 5.1, 3.7 Hz, 1H), 6.30 (d, *J* = 1.7 Hz, 1H), 5.52 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 158.7, 153.0, 145.3, 144.4, 138.8, 137.0, 130.6, 129.4, 128.9, 128.0, 127.9, 127.6, 126.1, 124.4, 121.3, 116.0, 112.5, 111.8, 54.9; **HRMS (ESI)** calcd for $C_{21}H_{15}N_2O_3S^+$ $[M+H]^+$: 375.0798, found: 375.0803; **HPLC Data** 97% ee (Daicel Chiralpak IC column, hexane/isopropanol = 95/5, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 12.7 min, t_{minor} = 9.4 min).

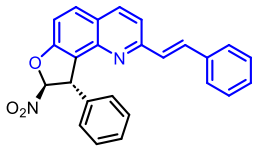


Peak	RetTime	Height	Area	Area%
1	9.480	105901	1613841	50.353
2	12.689	78481	1591190	49.647
Total		184382	3205031	100.000



Peak	RetTime	Height	Area	Area%
1	9.498	39953	617660	1.507
2	12.708	1992222	40362400	98.493
Total		2032175	40980060	100.000

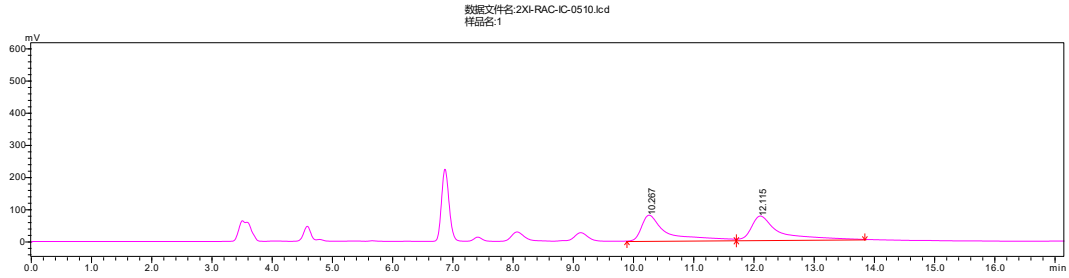
(8S,9S)-8-nitro-9-phenyl-2-((E)-styryl)-8,9-dihydrofuro[2,3-h]quinoline (3ha)



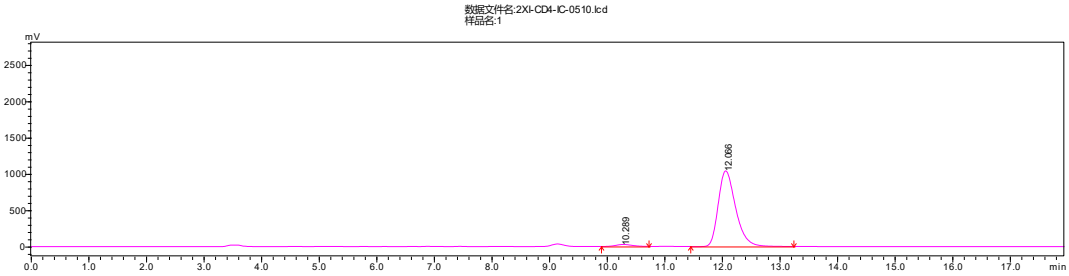
3ha

Green solid; **m.p.:** 165 - 167 ºC; **Yield:** 51 mg, 65%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = -167 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.04 (d, *J* = 8.5 Hz, 1H), 7.79 (d, *J* = 8.7 Hz, 1H), 7.58 - 7.50 (m, 3H), 7.41 (t, *J* = 8.2 Hz, 2H), 7.38 - 7.30 (m, 7H), 7.29 - 7.26 (m, 1H), 7.14 (d, *J* = 16.3 Hz, 1H), 6.24 (d, *J* = 1.7 Hz, 1H), 5.59 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 158.9, 156.7, 144.8, 138.8, 136.8, 136.4, 135.2, 130.7, 129.0, 128.8, 128.4, 128.0, 127.6, 127.4, 124.6, 120.7, 118.7, 112.6, 111.9, 54.9, 1.0; **HRMS (ESI)** calcd

for $C_{25}H_{19}N_2O_3^+$ [M+H]$^+$: 395.1390, found: 395.1387; **HPLC Data** 95% ee (Daicel Chiralpak IC column, hexane/isopropanol = 95/5, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 12.0 min, t_{minor} = 10.2 min).

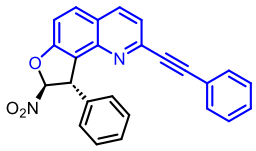


Peak	RetTime	Height	Area	Area%
1	10.267	80049	2288589	49.255
2	12.115	74929	2357831	50.745
Total		154977	4646421	100.000



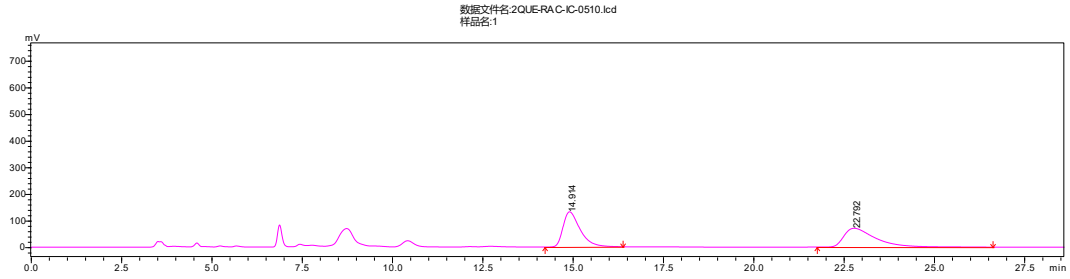
Peak	RetTime	Height	Area	Area%
1	10.289	27170	528342	2.367
2	12.066	1041675	21794663	97.633
Total		1068845	22323005	100.000

(8S,9S)-8-nitro-9-phenyl-2-(phenylethynyl)-8,9-dihydrofuro[2,3-h]quinoline (3ia)

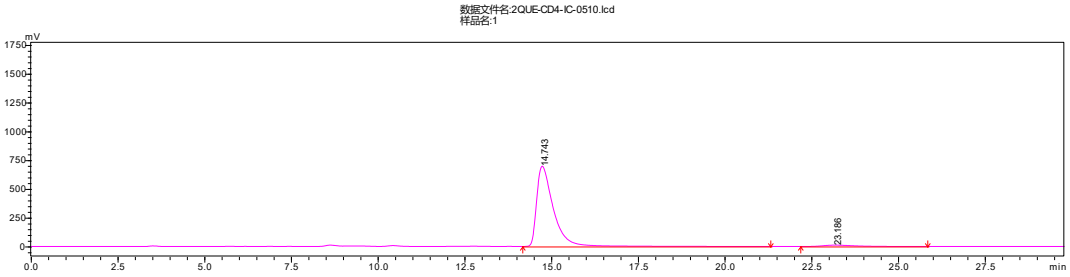


3ia

White solid; **m.p.:** 180 - 182 ºC; **Yield:** 43 mg, 55%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = -182 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.10 (d, *J* = 8.5 Hz, 1H), 7.85 (d, *J* = 8.8 Hz, 1H), 7.61 - 7.53 (m, 2H), 7.48 (dd, *J* = 17.1, 8.6 Hz, 2H), 7.38 - 7.29 (m, 5H), 7.29 - 7.23 (m, 3H), 6.18 (d, *J* = 1.4 Hz, 1H), 5.66 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 159.4, 145.0, 144.9, 138.2, 136.6, 132.2, 130.9, 129.3, 129.1, 128.4, 128.0, 127.5, 124.4, 123.5, 122.0, 120.4, 113.0, 112.5, 90.7, 89.5, 54.4; **HRMS (ESI)** calcd for $C_{25}H_{17}N_2O_3^+$ [M+H]$^+$: 393.1234, found: 393.1226; **HPLC Data** 94% ee (Daicel Chiralpak IC column, hexane/isopropanol = 95/5, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 14.7 min, t_{minor} = 23.1 min).

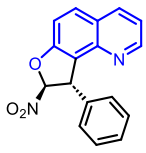


Peak	RetTime	Height	Area	Area%
1	14.914	131810	4325641	50.178
2	22.792	70655	4294966	49.822
Total		202464	8620607	100.000



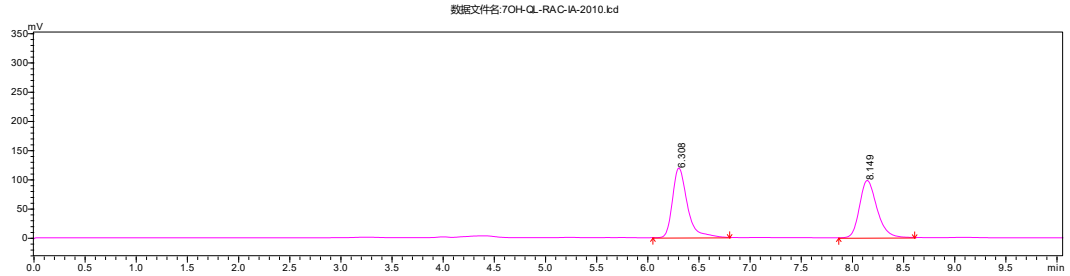
Peak	RetTime	Height	Area	Area%
1	14.743	697157	23370665	97.059
2	23.186	11368	708242	2.941
Total		708525	24078907	100.000

(8S,9S)-8-nitro-9-phenyl-8,9-dihydrofuro[2,3-h]quinoline (3ja)



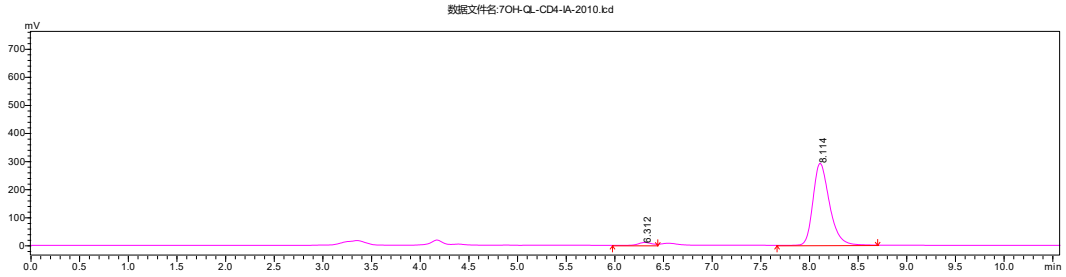
3ja

Green solid; **m.p.:** 115 - 117 °C; **Yield:** 31 mg, 54%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = 63 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.77 (dd, *J* = 4.3, 1.7 Hz, 1H), 8.16 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.90 (d, *J* = 8.8 Hz, 1H), 7.53 (d, *J* = 8.8 Hz, 1H), 7.35 - 7.23 (m, 4H), 7.23 - 7.18 (m, 2H), 6.17 (d, *J* = 1.6 Hz, 1H), 5.58 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 159.1, 151.6, 144.8, 138.1, 136.7, 131.3, 129.1, 128.1, 127.4, 125.7, 120.3, 119.9, 112.7, 112.6, 54.7; **HRMS (ESI)** calcd for $C_{17}H_{13}N_2O_3^+$ $[M+H]^+$: 293.0921, found: 293.0919; **HPLC Data** 94% ee (Daicel Chiralpak IA column, hexane/isopropanol = 80/20, λ = 254 nm, 25 °C, 1 mL/min, t_{major} = 8.1 min, t_{minor} = 6.3 min).



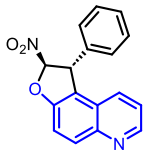
Peak	RetTime	Height	Area	Area%
1	6.308	119228	1199479	50.963

2	8.149	97879	1154147	49.037
Total		217108	2353626	100.000



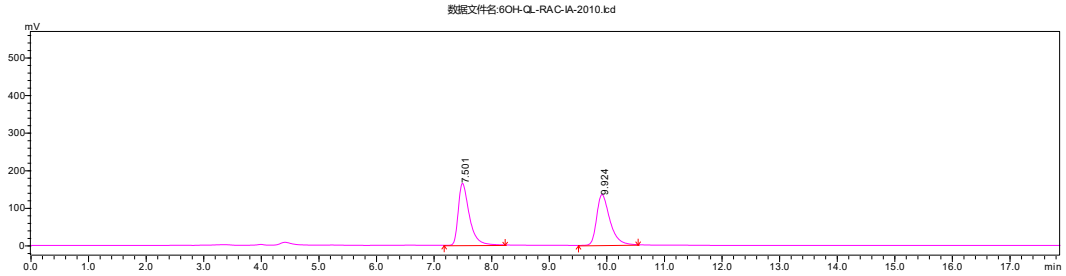
Peak	RetTime	Height	Area	Area%
1	6.312	10468	104371	2.958
2	8.114	291371	3424357	97.042
Total		301839	3528728	100.000

(1R,2R)-2-nitro-1-phenyl-1,2-dihydrofuro[3,2-f]quinoline (3ka)

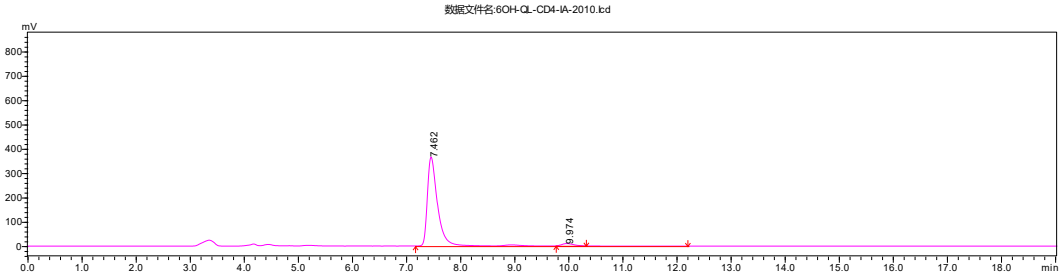


3ka

White solid; **m.p.:** 165 - 167 ºC; **Yield:** 33 mg, 57%; ＞20:1 dr; petroleum ether/EtOAc = 2:1; $[\alpha]_D^{25}$ = 116 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.81 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.19 (d, *J* = 9.1 Hz, 1H), 7.71 (ddd, *J* = 8.4, 1.8, 0.8 Hz, 1H), 7.67 (d, *J* = 9.1 Hz, 1H), 7.37 - 7.29 (m, 3H), 7.28 (dd, *J* = 8.4, 4.2 Hz, 1H), 7.21 - 7.14 (m, 2H), 6.15 (d, *J* = 1.9 Hz, 1H), 5.32 (d, *J* = 1.9 Hz, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 156.3, 148.9, 145.9, 137.5, 133.0, 131.1, 129.6, 128.7, 127.4, 124.9, 122.2, 118.4, 115.1, 112.6, 55.1; **HRMS (ESI)** calcd for $C_{17}H_{13}N_2O_3^+$ $[M+H]^+$: 293.0921, found: 293.0917; **HPLC Data** 95% ee (Daicel Chiralpak IA column, hexane/isopropanol = 80/20, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 7.4 min, t_{minor} = 9.9 min).

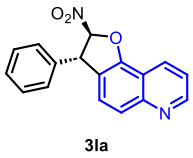


Peak	RetTime	Height	Area	Area%
1	7.501	164525	2186210	50.668
2	9.924	134520	2128556	49.332
Total		299044	4314765	100.000



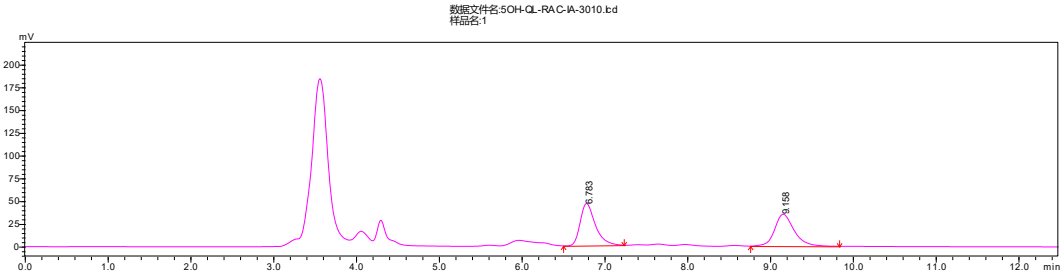
Peak	RetTime	Height	Area	Area%
1	7.462	365925	4995398	97.260
2	9.974	9556	140733	2.740
Total		375481	5136131	100.000

(2S,3S)-2-nitro-3-phenyl-2,3-dihydrofuro[2,3-f]quinoline (3la)

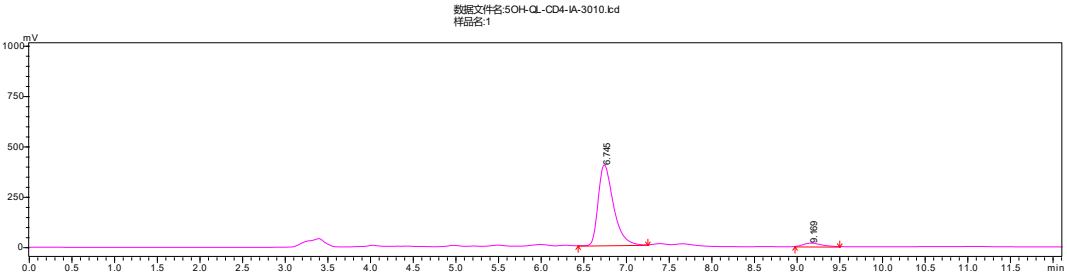


3la

White solid; **m.p.:** 159 - 161 °C; **Yield:** 20 mg, 35%; ＞20:1 dr; petroleum ether/EtOAc = 2:1; $[\alpha]_D^{25}$ = 178 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 9.00 (dd, *J* = 4.3, 1.8 Hz, 1H), 8.50 (dd, *J* = 8.4, 1.0 Hz, 1H), 7.88 (d, *J* = 8.5 Hz, 1H), 7.55 - 7.46 (m, 2H), 7.41 - 7.31 (m, 3H), 7.22 - 7.14 (m, 2H), 6.23 (d, *J* = 2.0 Hz, 1H), 5.14 (d, *J* = 2.0 Hz, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 153.2, 151.3, 149.1, 138.2, 129.9, 129.4, 128.6, 127.5, 125.4, 125.1, 121.5, 120.8, 115.8, 112.4, 56.3; **HRMS (ESI)** calcd for $C_{17}H_{13}N_2O_3^+$ $[M+H]^+$: 293.0921, found: 293.0922; **HPLC Data** 91% ee (Daicel Chiralpak IA column, hexane/isopropanol = 70/30, λ = 254 nm, 25 °C, 1 mL/min, t_{major} = 6.7 min, t_{minor} = 9.1 min).



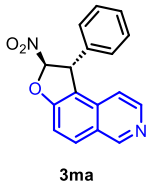
Peak	RetTime	Height	Area	Area%
1	6.783	46274	586462	50.688
2	9.158	35038	570532	49.312
Total		81312	1156994	100.000



Peak	RetTime	Height	Area	Area%
1	6.745	399324	4930673	95.357

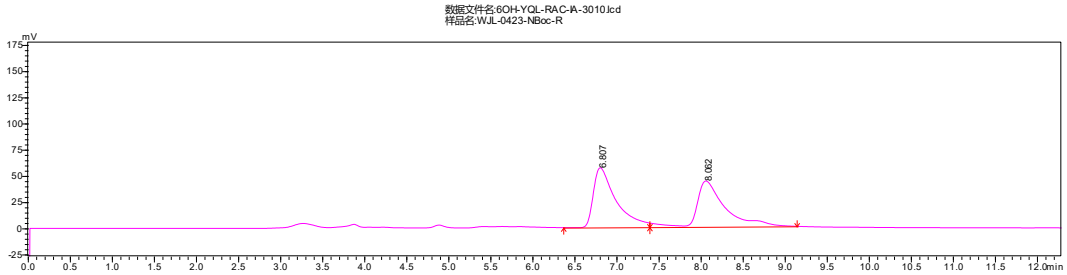
2	9.169	16933	240096	4.643
Total		416257	5170770	100.000

(1R,2R)-2-nitro-1-phenyl-1,2-dihydrofuro[3,2-f]isoquinoline (3ma)

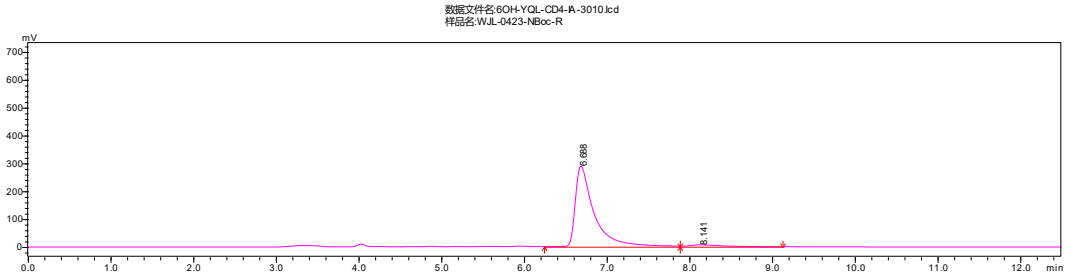


3ma

White solid; **m.p.:** 182 - 184 ºC; **Yield:** 40 mg, 69%; ＞20:1 dr; petroleum ether/EtOAc = 2:1; $[\alpha]_D^{25}$ = 93 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 9.24 (s, 1H), 8.38 (d, *J* = 5.9 Hz, 1H), 8.07 (d, *J* = 8.9 Hz, 1H), 7.56 (d, *J* = 8.9 Hz, 1H), 7.38 - 7.32 (m, 3H), 7.20 - 7.12 (m, 3H), 6.17 (d, *J* = 2.0 Hz, 1H), 5.29 (d, *J* = 2.0 Hz, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 159.4, 153.0, 144.4, 137.2, 132.6, 131.8, 129.6, 128.8, 127.4, 126.2, 117.7, 116.0, 113.4, 112.3, 54.7; **HRMS (ESI)** calcd for $C_{17}H_{13}N_2O_3^+$ $[M+H]^+$: 293.0921, found: 293.0925; **HPLC Data** 93% ee (Daicel Chiralpak IA column, hexane/isopropanol = 70/30, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 6.6 min, t_{minor} = 8.1 min).



Peak	RetTime	Height	Area	Area%
1	6.807	56891	1054227	50.762
2	8.062	43733	1022571	49.238
Total		100624	2076798	100.000

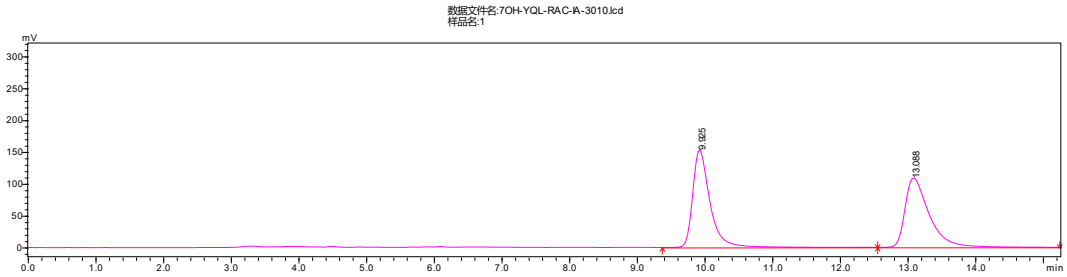


Peak	RetTime	Height	Area	Area%
1	6.688	289258	4555523	96.122
2	8.141	6879	183779	3.878
Total		296137	4739302	100.000

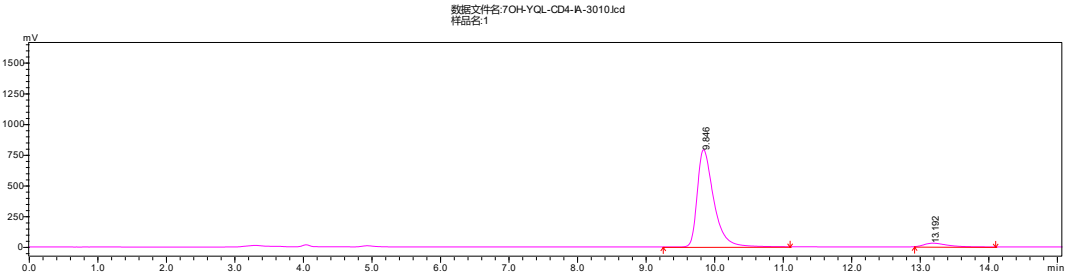
(8S,9S)-8-nitro-9-phenyl-8,9-dihydrofuro[2,3-h]isoquinoline (3na)

3na

White solid; **m.p.:** 158 - 160 ºC; **Yield:** 42 mg, 72%; ＞20:1 dr; petroleum ether/EtOAc = 2:1; $[\alpha]_D^{25}$ = 116 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.88 (s, 1H), 8.46 (d, *J* = 5.7 Hz, 1H), 7.92 (d, *J* = 8.9 Hz, 1H), 7.71 - 7.64 (m, 2H), 7.39 - 7.29 (m, 3H), 7.23 - 7.15 (m, 2H), 6.18 (d, *J* = 1.9 Hz, 1H), 5.42 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 157.0, 147.9, 142.1, 137.5, 133.3, 130.2, 129.6, 128.8, 127.4, 124.6, 121.2, 119.0, 116.6, 112.3, 54.9; **HRMS (ESI)** calcd for $C_{17}H_{13}N_2O_3^+$ $[M+H]^+$: 293.0921, found: 293.0925; **HPLC Data** 91% ee (Daicel Chiralpak IA column, hexane/isopropanol = 70/30, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 9.8 min, t_{minor} = 13.1 min).

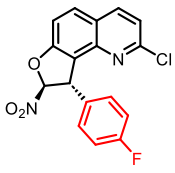


Peak	RetTime	Height	Area	Area%
1	9.925	152582	2710161	50.104
2	13.088	108886	2698947	49.896
Total		261468	5409109	100.000



Peak	RetTime	Height	Area	Area%
1	9.846	790612	13186212	95.321
2	13.192	28768	647299	4.679
Total		819380	13833511	100.000

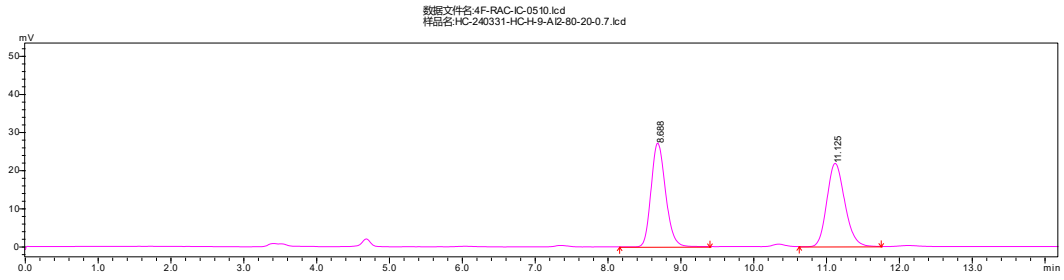
(8S,9S)-2-chloro-9-(4-fluorophenyl)-8-nitro-8,9-dihydrofuro[2,3-h]quinoline (3ab)



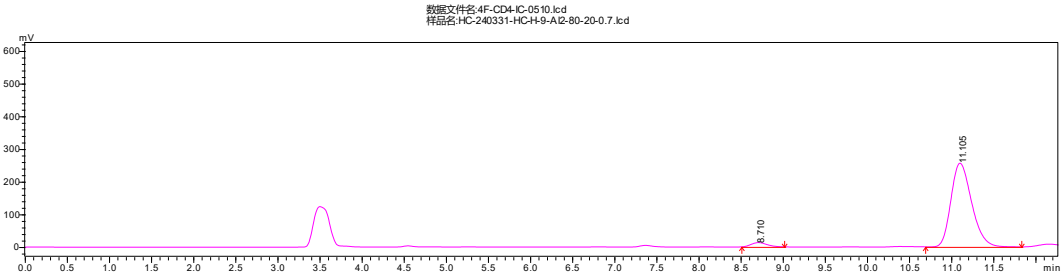
3ab

White solid; **m.p.:** 183 - 185 ºC; **Yield:** 32 mg, 47% yield; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = 57 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.08 (d, *J* = 8.6 Hz, 1H), 7.88 (d, *J* = 8.8 Hz, 1H), 7.51 (d, *J* = 8.8 Hz, 1H), 7.26 (d, *J* = 8.6 Hz, 1H), 7.24 - 7.15 (m, 2H), 7.05 - 6.97 (m, 2H), 6.17 (d, *J* = 1.5 Hz, 1H), 5.50 (s, 1H); **^{13}C NMR** (126 MHz, Chloroform-*d*) δ 162.48 (d, *J* = 247.3 Hz), 159.59, 152.41, 144.42, 139.24, 133.67 (d, *J* = 3.4 Hz), 131.10, 129.09 (d, *J* = 8.2 Hz), 124.15, 121.28, 120.34, 116.15, 115.97, 112.87, 112.17, 53.65; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -113.71; **HRMS (ESI)** calcd for $C_{17}H_9ClFN_2O_3^-$ $[M-H]^-$: 343.0291, found: 343.0295;

HPLC Data 93% ee (Daicel Chiralpak IC column, hexane/isopropanol = 95/5, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 11.1 min, t_{minor} = 8.7 min).

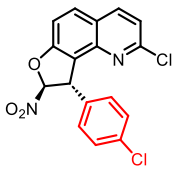


Peak	RetTime	Height	Area	Area%
1	8.688	27146	374408	50.181
2	11.125	21814	371713	49.819
Total		48961	746120	100.000



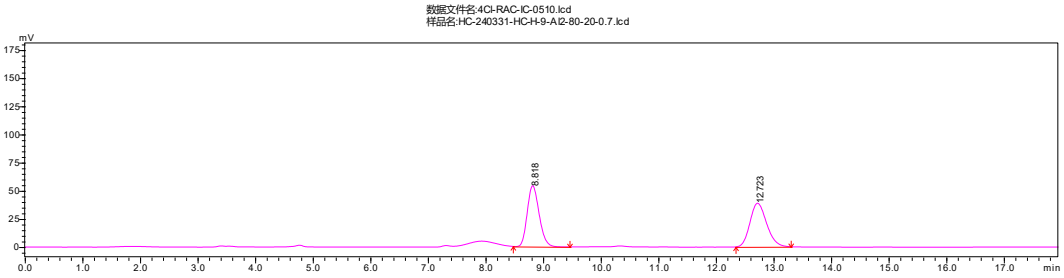
Peak	RetTime	Height	Area	Area%
1	8.710	13087	171213	3.780
2	11.105	255783	4358557	96.220
Total		268871	4529770	100.000

(8S,9S)-2-chloro-9-(4-chlorophenyl)-8-nitro-8,9-dihydrofuro[2,3-h]quinoline (3ac)

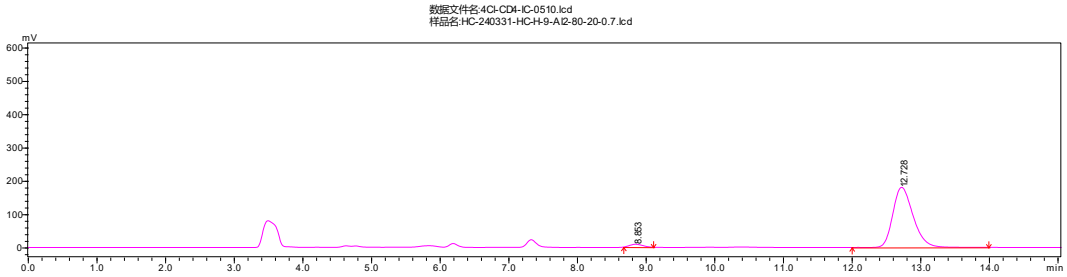


3ac

White solid; **m.p.:** 203 - 205 ℃; **Yield:** 35 mg, 49% yield; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = -62 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.08 (d, *J* = 8.6 Hz, 1H), 7.89 (d, *J* = 8.8 Hz, 1H), 7.51 (d, *J* = 8.8 Hz, 1H), 7.28 (dd, *J* = 12.7, 8.5 Hz, 3H), 7.16 (d, *J* = 8.5 Hz, 2H), 6.17 (d, *J* = 1.6 Hz, 1H), 5.49 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 159.6, 152.5, 144.4, 139.2, 136.3, 134.2, 131.2, 129.3, 128.8, 124.1, 121.3, 120.1, 112.9, 112.0, 53.7; **HRMS (ESI)** calcd for $C_{17}H_9Cl_2N_2O_3^-$ [M-H]$^-$: 358.9996, found: 358.9996; **HPLC Data** 95% ee (Daicel Chiralpak IC column, hexane/isopropanol = 95/5, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 12.7 min, t_{minor} = 8.8 min).

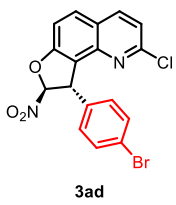


Peak	RetTime	Height	Area	Area%
1	8.818	53994	770672	49.732
2	12.723	38743	778982	50.268
Total		92737	1549654	100.000



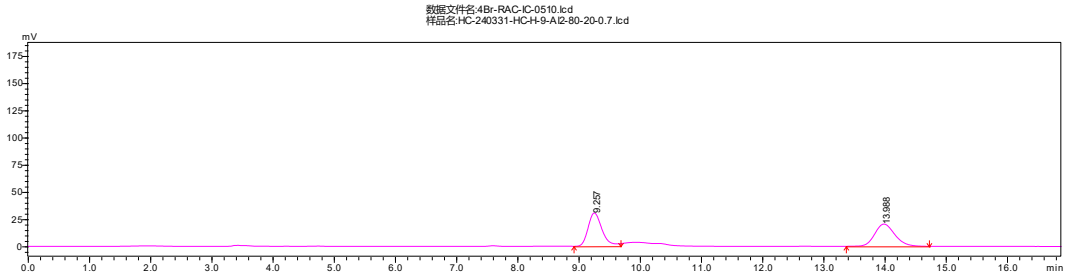
Peak	RetTime	Height	Area	Area%
1	8.853	8585	110218	2.894
2	12.728	180242	3698636	97.106
Total		188827	3808854	100.000

(8S,9S)-9-(4-bromophenyl)-2-chloro-8-nitro-8,9-dihydrofuro[2,3-h]quinoline (3ad)

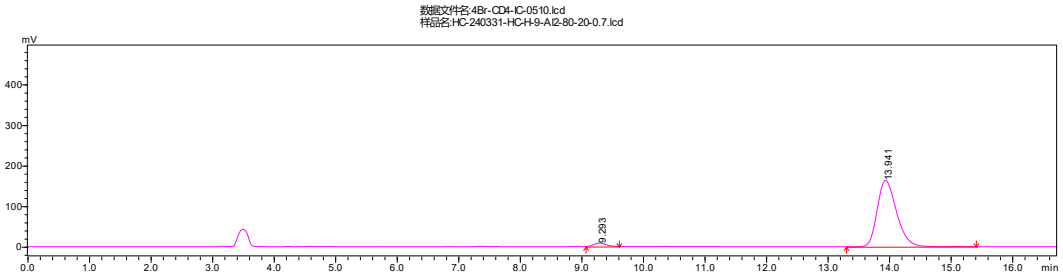


3ad

White solid; **m.p.:** 211 - 213 °C; **Yield:** 38 mg, 47%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = -54 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.08 (d, *J* = 8.6 Hz, 1H), 7.89 (d, *J* = 8.8 Hz, 1H), 7.51 (d, *J* = 8.8 Hz, 1H), 7.45 (d, *J* = 8.4 Hz, 2H), 7.27 (d, *J* = 8.6 Hz, 1H), 7.10 (d, *J* = 8.5 Hz, 2H), 6.16 (d, *J* = 1.6 Hz, 1H), 5.47 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 159.6, 152.5, 144.4, 139.7, 136.9, 132.3, 131.2, 129.1, 124.1, 122.9, 121.3, 120.0, 112.9, 111.9, 53.8; **HRMS (ESI)** calcd for $C_{17}H_9BrClN_2O_3^-$ [M-H]$^-$: 402.9491, found: 402.9478; **HPLC Data** 93% ee (Daicel Chiralpak IC column, hexane/isopropanol = 95/5, λ = 254 nm, 25 °C, 1 mL/min, t_{major} = 13.9 min, t_{minor} = 9.2 min).

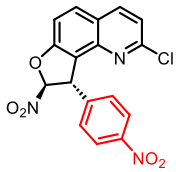


Peak	RetTime	Height	Area	Area%
1	9.257	30626	488446	50.807
2	13.988	20512	472932	49.193
Total		51139	961378	100.000



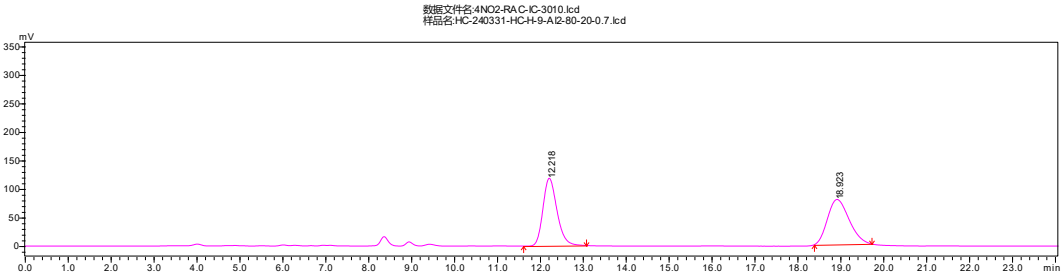
Peak	RetTime	Height	Area	Area%
1	9.293	8691	118385	3.221
2	13.941	163301	3557380	96.779
Total		171991	3675765	100.000

(8S,9S)-2-chloro-8-nitro-9-(4-nitrophenyl)-8,9-dihydrofuro[2,3-h]quinoline (3ae)

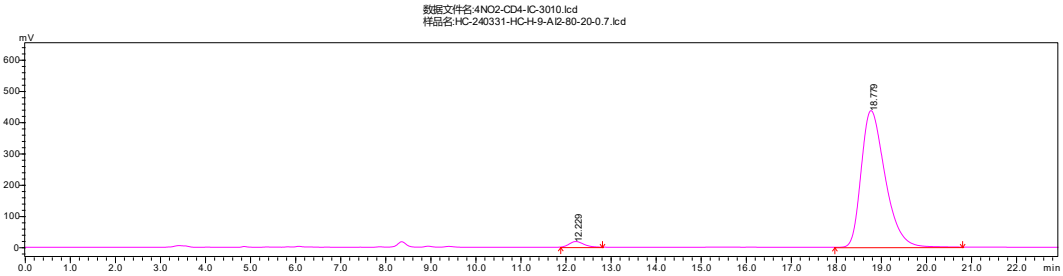


3ae

White solid; **m.p.:** 211 - 213 ºC; **Yield:** 34 mg, 46%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = -60 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.20 (d, *J* = 8.8 Hz, 2H), 8.11 (d, *J* = 8.6 Hz, 1H), 7.94 (d, *J* = 8.8 Hz, 1H), 7.55 (d, *J* = 8.9 Hz, 1H), 7.44 (d, *J* = 8.8 Hz, 2H), 7.30 (d, *J* = 8.6 Hz, 1H), 6.21 (d, *J* = 1.7 Hz, 1H), 5.61 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 159.7, 152.7, 147.8, 144.7, 144.3, 139.3, 131.6, 128.5, 124.4, 124.2, 121.6, 119.3, 112.9, 111.2, 53.9; **HRMS (ESI)** calcd for $C_{17}H_{11}ClN_3O_5^+$ $[M+H]^+$: 372.0382, found: 372.0389; **HPLC Data** 95% ee (Daicel Chiralpak IC column, hexane/isopropanol = 70/30, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 18.7 min, t_{minor} = 12.2 min).



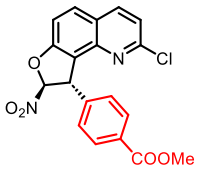
Peak	RetTime	Height	Area	Area%
1	12.218	118469	2696398	49.442
2	18.923	78825	2757260	50.558
Total		197294	5453658	100.000



Peak	RetTime	Height	Area	Area%
1	12.229	17793	389896	2.366

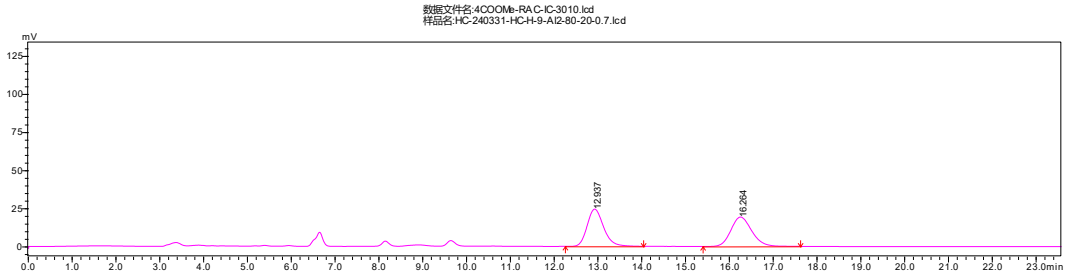
2	18.779	436840	16089608	97.634
Total		454633	16479503	100.000

methyl 4-((8S,9S)-2-chloro-8-nitro-8,9-dihydrofuro[2,3-h]quinolin-9-yl)benzoate (3af)

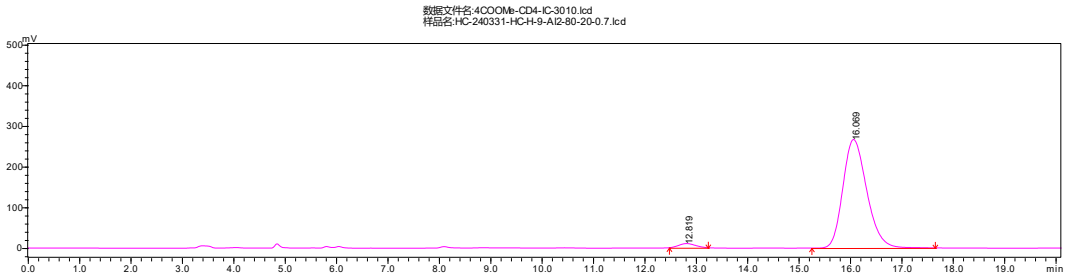


3af

White solid; **m.p.:** 211 - 213 ºC; **Yield:** 38 mg, 47%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = -54 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.08 (d, *J* = 8.6 Hz, 1H), 7.99 (d, *J* = 8.4 Hz, 2H), 7.90 (d, *J* = 8.8 Hz, 1H), 7.53 (d, *J* = 8.8 Hz, 1H), 7.31 (d, *J* = 8.3 Hz, 2H), 7.26 (d, *J* = 8.6 Hz, 1H), 6.21 (d, *J* = 1.6 Hz, 1H), 5.57 (s, 1H), 3.89 (s, 3H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 166.5, 159.7, 152.5, 144.4, 142.6, 139.2, 131.3, 130.4, 130.1, 127.5, 124.1, 121.3, 119.9, 112.9, 111.8, 54.2, 52.2; **HRMS (ESI)** calcd for $C_{19}H_{14}ClN_2O_5^+$ $[M+H]^+$: 385.0586, found: 385.0591; **HPLC Data** 93% ee (Daicel Chiralpak IC column, hexane/isopropanol = 70/30, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 16.0 min, t_{minor} = 12.8 min).

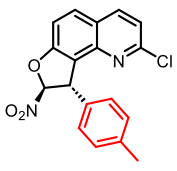


Peak	RetTime	Height	Area	Area%
1	12.937	24415	637429	50.094
2	16.264	19257	635033	49.906
Total		43671	1272462	100.000



Peak	RetTime	Height	Area	Area%
1	12.819	10084	224801	2.545
2	16.069	266609	8609065	97.455
Total		276692	8833866	100.000

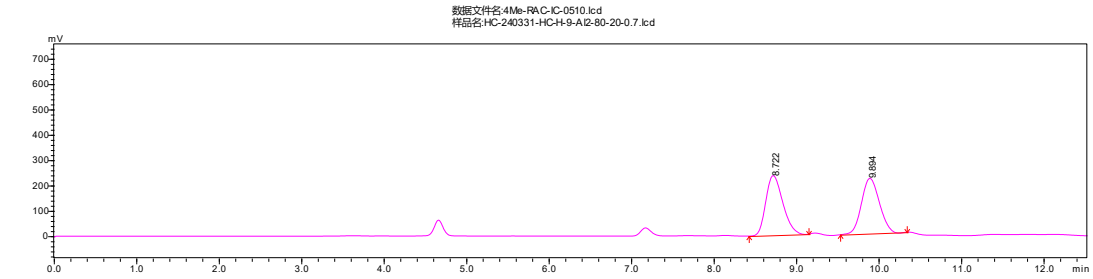
(8S,9S)-2-chloro-8-nitro-9-(p-tolyl)-8,9-dihydrofuro[2,3-h]quinoline (3ag)



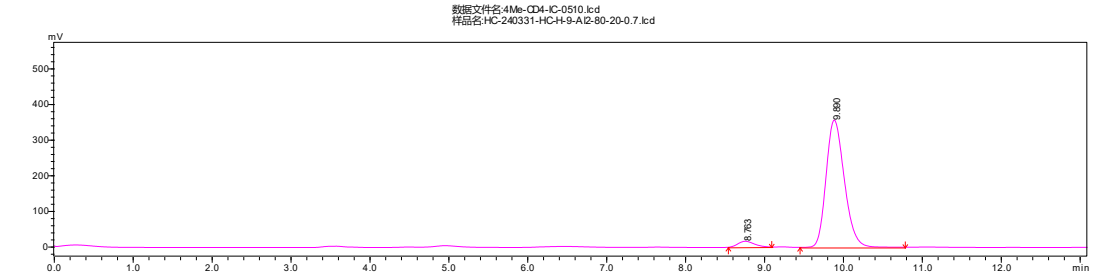
3ag

White solid; **m.p.:** 185 - 187 ºC; **Yield:** 38 mg, 56%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = -28 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.05 (d, *J* = 8.6 Hz, 1H), 7.85 (d, *J* = 8.8 Hz, 1H), 7.50 (d, *J* = 8.8 Hz, 1H), 7.23 (d, *J* = 8.6 Hz, 1H), 7.11 (s, 4H), 6.18 (d, *J* = 1.5 Hz, 1H), 5.48 (s, 1H), 2.30 (s, 3H); **^{13}C NMR** (126 MHz,

$CDCl_3$) δ 159.6, 152.3, 144.5, 139.2, 137.9, 135.0, 130.8, 129.8, 127.2, 124.1, 121.1, 120.8, 112.8, 112.5, 54.1, 21.1; **HRMS (ESI)** calcd for $C_{18}H_{12}ClN_2O_3^-$ [M-H]$^-$: 339.0542, found: 339.0556; **HPLC Data** 92% ee (Daicel Chiralpak IC column, hexane/isopropanol = 95/5, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 9.8 min, t_{minor} = 8.7 min).

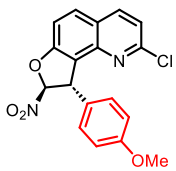


Peak	RetTime	Height	Area	Area%
1	8.722	235322	3369438	50.839
2	9.894	217660	3258279	49.161
Total		452982	6627717	100.000



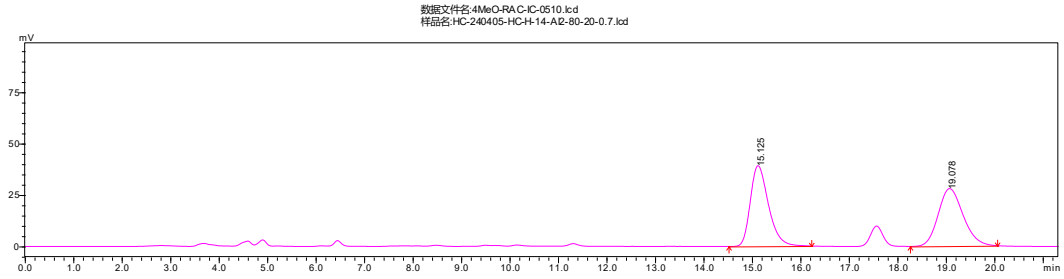
Peak	RetTime	Height	Area	Area%
1	8.763	16520	234930	3.913
2	9.890	357283	5769208	96.087
Total		373803	6004138	100.000

(8S,9S)-2-chloro-9-(4-methoxyphenyl)-8-nitro-8,9-dihydrofuro[2,3-h]quinoline (3ah)

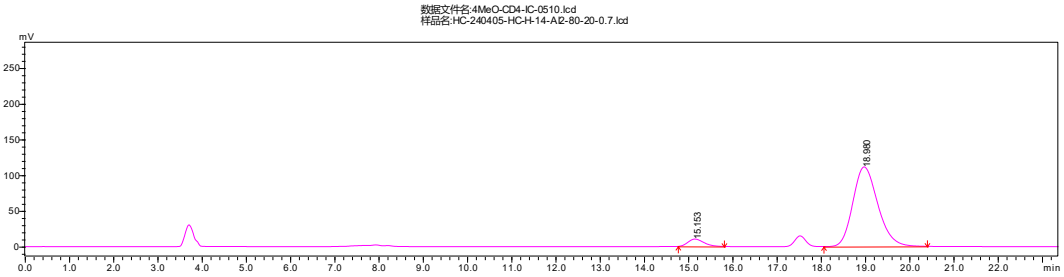


3ah

White solid; **m.p.:** 205 - 207 ℃; **Yield:** 39 mg, 55%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = -23 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.06 (d, *J* = 8.6 Hz, 1H), 7.86 (d, *J* = 8.8 Hz, 1H), 7.50 (d, *J* = 8.8 Hz, 1H), 7.24 (d, *J* = 8.6 Hz, 1H), 7.16 - 7.09 (m, 2H), 6.86 - 6.80 (m, 2H), 6.17 (d, *J* = 1.5 Hz, 1H), 5.47 (s, 1H), 3.76 (s, 3H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 159.5, 159.4, 152.3, 144.5, 139.2, 130.8, 130.0, 128.5, 124.1, 121.1, 120.8, 114.4, 112.8, 112.5, 55.3, 53.7; **HRMS (ESI)** calcd for $C_{18}H_{12}ClN_2O_4^-$ [M-H]$^-$: 355.0491, found: 355.0505; **HPLC Data** 89% ee (Daicel Chiralpak IC column, hexane/isopropanol = 95/5, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 18.9 min, t_{minor} = 15.1 min).

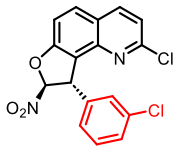


Peak	RetTime	Height	Area	Area%
1	15.125	39232	1022607	50.582
2	19.078	27968	999083	49.418
Total		67200	2021691	100.000



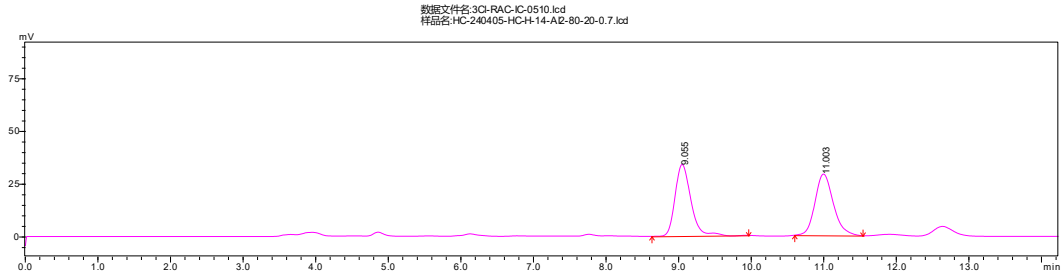
Peak	RetTime	Height	Area	Area%
1	15.153	10312	255616	5.521
2	18.980	111472	4373905	94.479
Total		121784	4629521	100.000

(8S,9S)-2-chloro-9-(3-chlorophenyl)-8-nitro-8,9-dihydrofuro[2,3-h]quinoline (3ai)



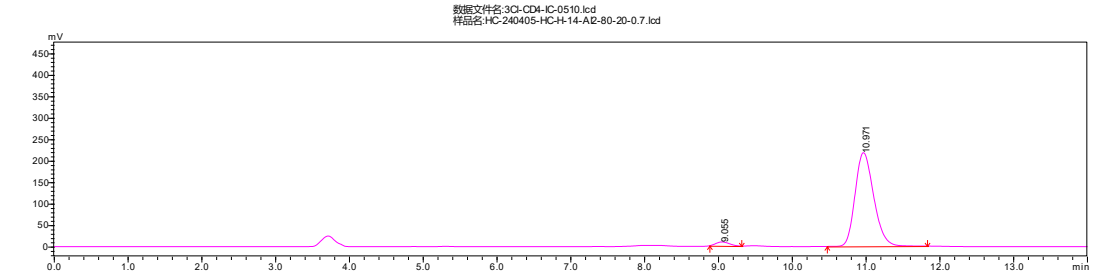
3ai

White solid; **m.p.:** 158 - 160 ºC; **Yield:** 33 mg, 46%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = -18 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.08 (d, *J* = 8.6 Hz, 1H), 7.89 (d, *J* = 8.8 Hz, 1H), 7.52 (d, *J* = 8.8 Hz, 1H), 7.32 - 7.22 (m, 3H), 7.18 - 7.12 (m, 2H), 6.17 (d, *J* = 1.6 Hz, 1H), 5.49 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 159.7, 152.5, 144.4, 139.7, 139.3, 135.0, 131.3, 130.4, 128.5, 127.4, 125.8, 124.2, 121.4, 119.8, 112.9, 111.9, 53.9; **HRMS (ESI)** calcd for $C_{17}H_9Cl_2N_2O_3^-$ [M-H]$^-$: 358.9996, found: 358.9982; **HPLC Data** 94% ee (Daicel Chiralpak IC column, hexane/isopropanol = 95/5, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 10.9 min, t_{minor} = 9.0 min).



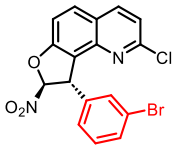
Peak	RetTime	Height	Area	Area%
1	9.055	33925	509137	49.889
2	11.003	29069	511409	50.111

Total		62994	1020546	100.000



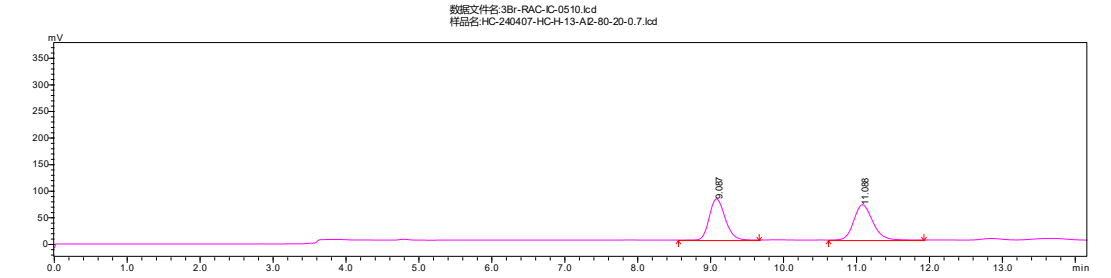
Peak	RetTime	Height	Area	Area%
1	9.055	9206	115198	2.928
2	10.971	218000	3819626	97.072
Total		227206	3934823	100.000

(8S,9S)-9-(3-bromophenyl)-2-chloro-8-nitro-8,9-dihydrofuro[2,3-h]quinoline (3aj)

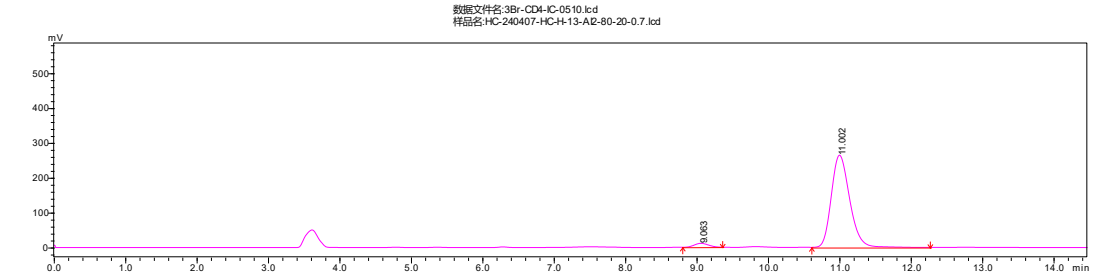


3aj

White solid; **m.p.:** 173 - 175 °C; **Yield:** 43 mg, 53%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = -27 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.08 (d, *J* = 8.6 Hz, 1H), 7.89 (d, *J* = 8.7 Hz, 1H), 7.52 (d, *J* = 8.8 Hz, 1H), 7.45 - 7.39 (m, 1H), 7.37 - 7.32 (m, 1H), 7.27 (d, *J* = 8.7 Hz, 1H), 7.24 - 7.16 (m, 2H), 6.18 (d, *J* = 1.5 Hz, 1H), 5.48 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 159.7, 152.5, 144.4, 140.0, 139.2, 131.5, 131.3, 130.7, 130.3, 126.3, 124.2, 123.2, 121.4, 119.8, 112.9, 111.8, 53.9; **HRMS (ESI)** calcd for $C_{17}H_{11}BrClN_2O_3^+$ $[M+H]^+$: 404.9636, found: 404.9628; **HPLC Data** 94% ee (Daicel Chiralpak IC column, hexane/isopropanol = 95/5, λ = 254 nm, 25 °C, 1 mL/min, t_{major} = 11.0 min, t_{minor} = 9.0 min).



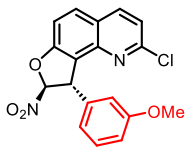
Peak	RetTime	Height	Area	Area%
1	9.087	77544	1177976	49.383
2	11.088	66570	1207389	50.617
Total		144114	2385365	100.000



Peak	RetTime	Height	Area	Area%

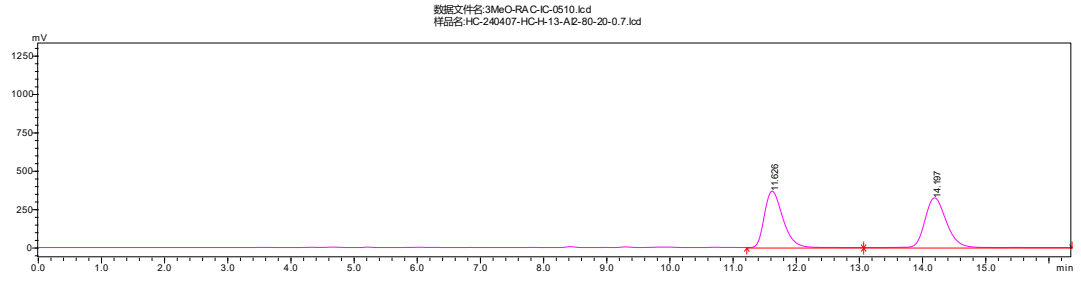
1	9.063	11088	151379	3.089
2	11.002	264884	4749783	96.911
Total		275972	4901162	100.000

(8S,9S)-9-(3-bromophenyl)-2-chloro-8-nitro-8,9-dihydrofuro[2,3-h]quinoline (3ak)

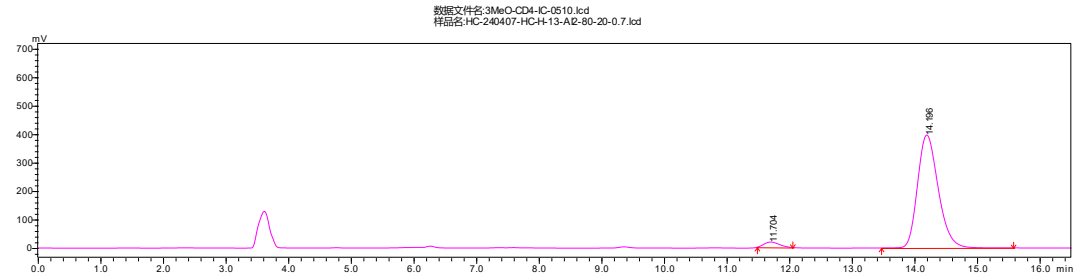


3ak

White solid; **m.p.:** 102 - 104 ºC; **Yield:** 37 mg, 52%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = -5 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.06 (d, *J* = 8.6 Hz, 1H), 7.86 (d, *J* = 8.8 Hz, 1H), 7.50 (d, *J* = 8.8 Hz, 1H), 7.27 - 7.20 (m, 2H), 6.84 - 6.77 (m, 3H), 6.22 (d, *J* = 1.5 Hz, 1H), 5.49 (s, 1H), 3.78 (s, 3H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 160.0, 159.6, 152.3, 144.5, 139.4, 139.2, 130.9, 130.1, 124.1, 121.2, 120.5, 119.3, 113.5, 112.9, 112.2, 55.3, 54.3; **HRMS (ESI)** calcd for $C_{18}H_{14}ClN_2O_4^+$ $[M+H]^+$: 357.0637, found: 357.0641; **HPLC Data** 93% ee (Daicel Chiralpak IC column, hexane/isopropanol = 95/5, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 14.1 min, t_{minor} = 11.7 min).

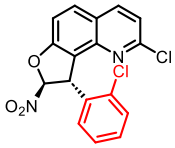


Peak	RetTime	Height	Area	Area%
1	11.626	367517	7459635	49.563
2	14.197	323941	7591167	50.437
Total		691457	15050802	100.000



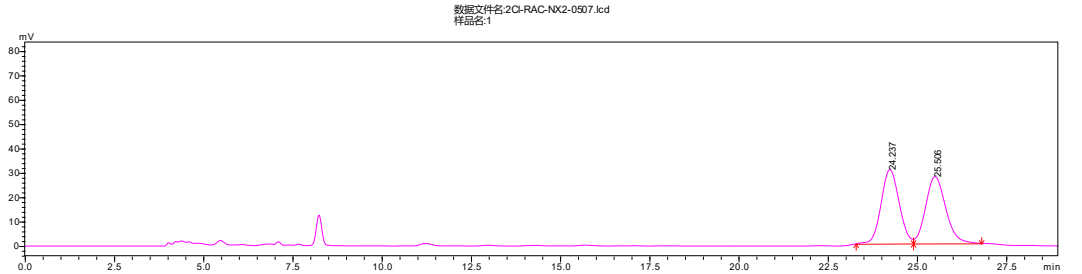
Peak	RetTime	Height	Area	Area%
1	11.704	18792	315528	3.353
2	14.196	396637	9094106	96.647
Total		415429	9409634	100.000

(8S,9R)-2-chloro-9-(2-chlorophenyl)-8-nitro-8,9-dihydrofuro[2,3-h]quinoline (3al)

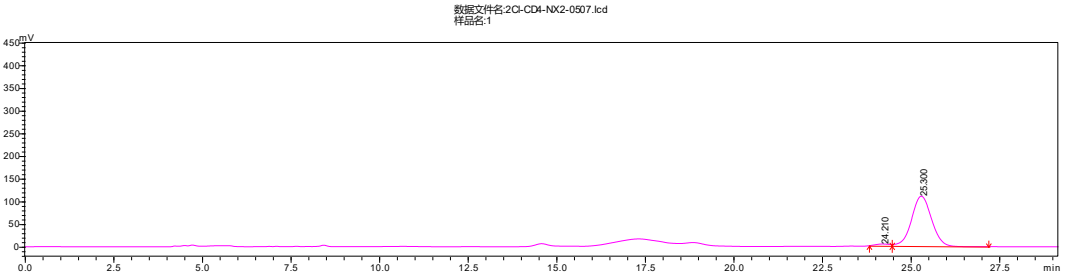


3al

Green solid; **m.p.:** 206 - 208 °C; **Yield:** 32 mg, 45%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = 70 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.10 (d, *J* = 8.6 Hz, 1H), 7.91 (d, *J* = 8.8 Hz, 1H), 7.53 - 7.47 (m, 2H), 7.30 - 7.20 (m, 2H), 7.06 (td, *J* = 7.6, 1.3 Hz, 1H), 6.55 (dd, *J* = 7.9, 1.6 Hz, 1H), 6.20 (d, *J* = 1.6 Hz, 1H), 5.96 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 160.5, 152.5, 144.6, 139.2, 134.9, 133.9, 131.2, 130.3, 129.6, 128.9, 127.2, 124.1, 121.3, 119.6, 112.8, 111.9, 51.1; **HRMS (ESI)** calcd for $C_{17}H_{10}Cl_2N_2NaO_3^+$ $[M+Na]^+$: 382.9961, found: 382.9962; **HPLC Data** 95% ee (Chiral NX(2) 5u column, hexane/isopropanol = 95/5, λ = 254 nm, 25 °C, 0.7 mL/min, t_{major} = 25.3 min, t_{minor} = 24.2 min).

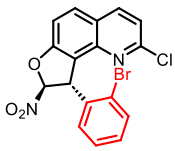


Peak	RetTime	Height	Area	Area%
1	24.237	30375	1062326	49.837
2	25.506	27405	1069275	50.163
Total		57780	2131601	100.000



Peak	RetTime	Height	Area	Area%
1	24.210	4076	112238	2.550
2	25.300	110143	4289864	97.450
Total		114219	4402102	100.000

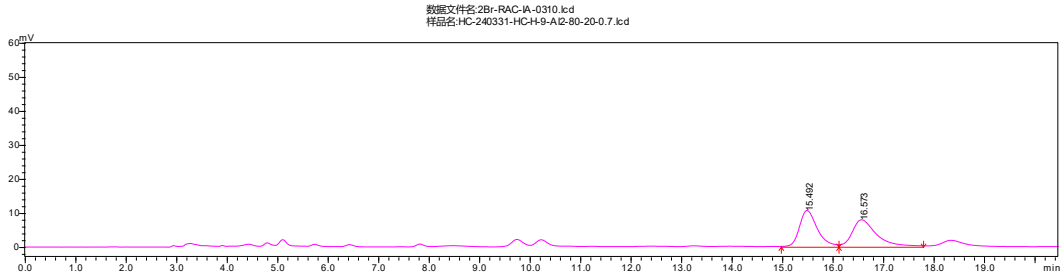
(8S,9R)-9-(2-bromophenyl)-2-chloro-8-nitro-8,9-dihydrofuro[2,3-h]quinoline (3am)



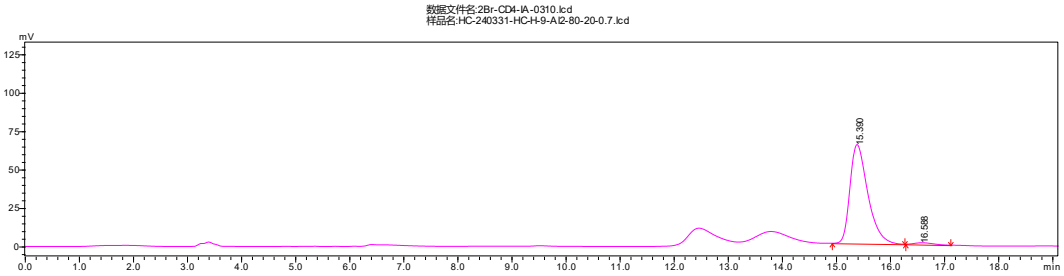
3am

White solid; **m.p.:** 199 - 201 °C; **Yield:** 22 mg, 27%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = 120 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.09 (d, *J* = 8.6 Hz, 1H), 7.91 (d, *J* = 8.8 Hz, 1H), 7.70 (dd, *J* = 7.9, 1.4 Hz, 1H), 7.50 (d, *J* = 8.8 Hz, 1H), 7.27 (d, *J* = 8.8 Hz, 1H), 7.15 (td, *J* = 7.6, 1.8 Hz, 1H), 7.10 (td, *J* = 7.5, 1.4 Hz, 1H), 6.52 (d, *J* = 7.5 Hz, 1H), 6.18 (d, *J* = 1.5 Hz, 1H), 5.99 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 160.4, 152.5, 144.5, 139.1, 136.6, 133.7, 131.2, 129.8, 128.9, 127.9, 124.2, 124.1, 121.3, 120.1, 112.8, 112.0, 53.2; **HRMS (ESI)** calcd for

$C_{17}H_9BrClN_2O_3^-$ [M-H]$^-$: 402.9491, found: 402.9485; **HPLC Data** 96% ee (Daicel Chiralpak IA column, hexane/isopropanol = 97/3, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 15.3 min, t_{minor} = 16.5 min).

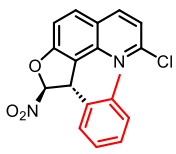


Peak	RetTime	Height	Area	Area%
1	15.492	10682	263349	49.449
2	16.573	7951	269220	50.551
Total		18633	532569	100.000



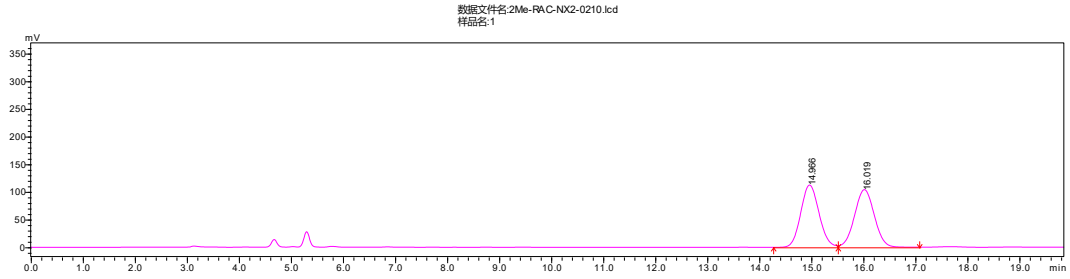
Peak	RetTime	Height	Area	Area%
1	15.390	64416	1476670	98.172
2	16.588	1187	27494	1.828
Total		65602	1504164	100.000

(8S,9S)-2-chloro-8-nitro-9-(o-tolyl)-8,9-dihydrofuro[2,3-h]quinoline (3an)

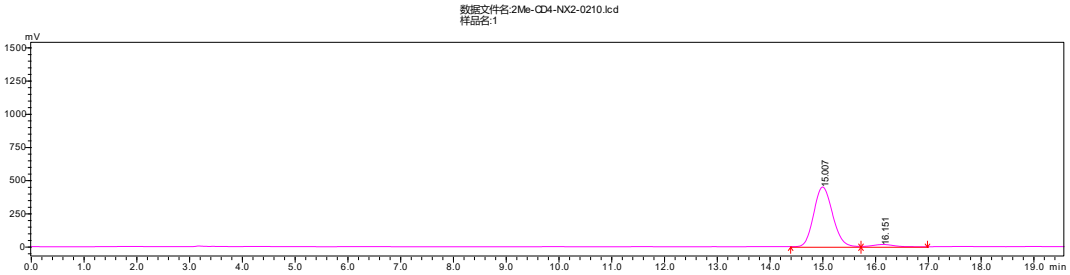


3an

Green solid; **m.p.:** 167 - 169 ℃; **Yield:** 45 mg, 67%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = 94 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.02 (d, *J* = 8.6 Hz, 1H), 7.84 (d, *J* = 8.8 Hz, 1H), 7.51 (d, *J* = 8.8 Hz, 1H), 7.28 (d, *J* = 7.6 Hz, 1H), 7.20 (d, *J* = 8.6 Hz, 1H), 7.17 - 7.14 (m, 1H), 7.02 - 6.96 (m, 1H), 6.59 (dd, *J* = 7.8, 1.4 Hz, 1H), 6.15 (d, *J* = 1.4 Hz, 1H), 5.67 (s, 1H), 2.82 (s, 3H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 159.7, 152.2, 144.3, 139.1, 136.5, 131.1, 130.7, 128.0, 126.6, 126.3, 124.1, 121.9, 121.2, 112.8, 112.4, 50.6, 20.2; **HRMS (ESI)** calcd for $C_{18}H_{13}ClN_2NaO_3^+$ [M+Na]$^+$: 363.0507, found: 363.0509; **HPLC Data** 93% ee (Chiral NX(2) 5u column, hexane/isopropanol = 98/2, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 15.0 min, t_{minor} = 16.1 min).

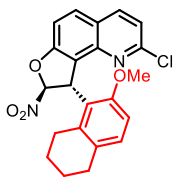


Peak	RetTime	Height	Area	Area%
1	14.966	112515	2746952	49.926
2	16.019	104120	2755090	50.074
Total		216635	5502042	100.000



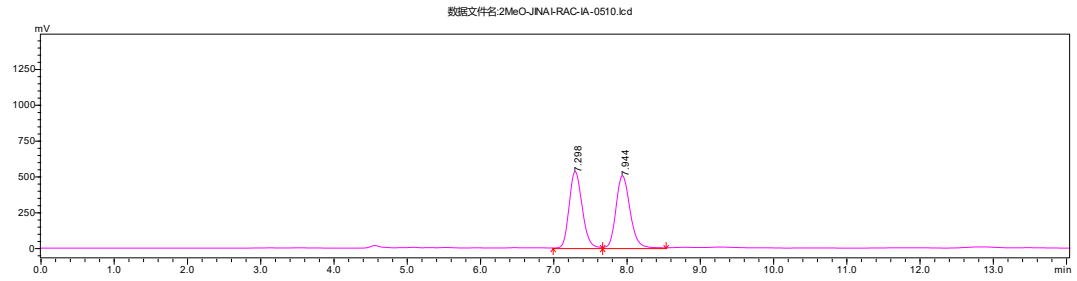
Peak	RetTime	Height	Area	Area%
1	15.007	449618	11125244	96.181
2	16.151	16597	441800	3.819
Total		466215	11567044	100.000

(8S,9S)-2-chloro-9-(2-methoxy-5,6,7,8-tetrahydronaphthalen-1-yl)-8-nitro-8,9-dihydrofuro[2,3-h]quinoline (3ao)

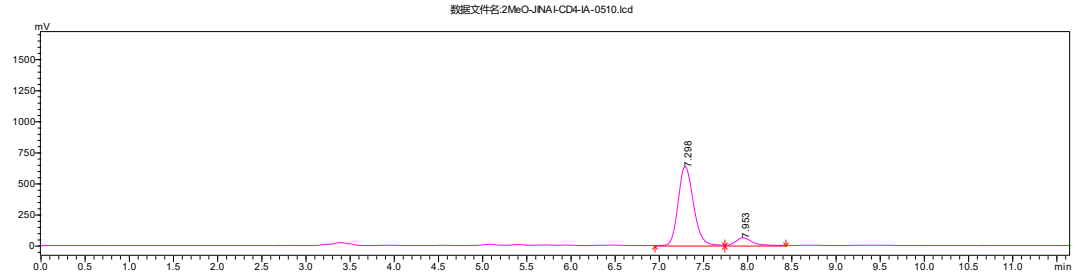


3ao

Brown solid; **m.p.:** 174 - 176 ºC; **Yield:** 37 mg, 45%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = 297 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 7.93 (d, *J* = 8.6 Hz, 1H), 7.71 (d, *J* = 8.7 Hz, 1H), 7.38 (d, *J* = 8.8 Hz, 1H), 7.09 (d, *J* = 8.6 Hz, 1H), 6.98 (d, *J* = 8.4 Hz, 1H), 6.55 (d, *J* = 8.4 Hz, 1H), 6.43 (d, *J* = 3.0 Hz, 1H), 5.65 (d, *J* = 3.0 Hz, 1H), 3.87 (dt, *J* = 16.6, 6.5 Hz, 1H), 3.45 (s, 3H), 2.97 (dt, *J* = 16.5, 6.5 Hz, 1H), 2.79 (t, *J* = 6.3 Hz, 2H), 2.08 - 2.01 (m, 1H), 2.00 - 1.93 (m, 1H),1.90 - 1.81 (m, 2H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 160.1, 155.6, 151.5, 144.3, 138.9, 137.9, 130.5, 129.9, 129.5, 124.7, 123.5, 120.6, 120.2, 112.6, 112.1, 108.9, 55.2, 48.1, 30.0, 27.3, 23.5, 22.8; **HRMS (ESI)** calcd for $C_{22}H_{20}ClN_2O_4^+$ $[M+H]^+$: 411.1106, found: 411.1105; **HPLC Data** 81% ee (Daicel Chiralpak IA column, hexane/isopropanol = 95/5, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 7.9 min, t_{minor} = 7.2 min).

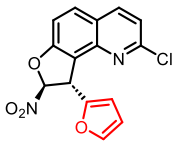


Peak	RetTime	Height	Area	Area%
1	7.298	534031	6605554	49.465
2	7.944	505412	6748345	50.535
Total		1039443	13353899	100.000



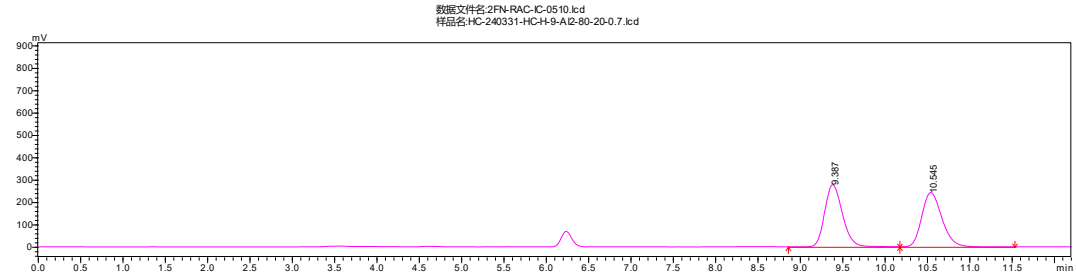
Peak	RetTime	Height	Area	Area%
1	7.298	636022	7680086	90.343
2	7.953	62425	820987	9.657
Total		698446	8501074	100.000

(8S,9R)-2-chloro-9-(furan-2-yl)-8-nitro-8,9-dihydrofuro[2,3-h]quinoline (3ap)



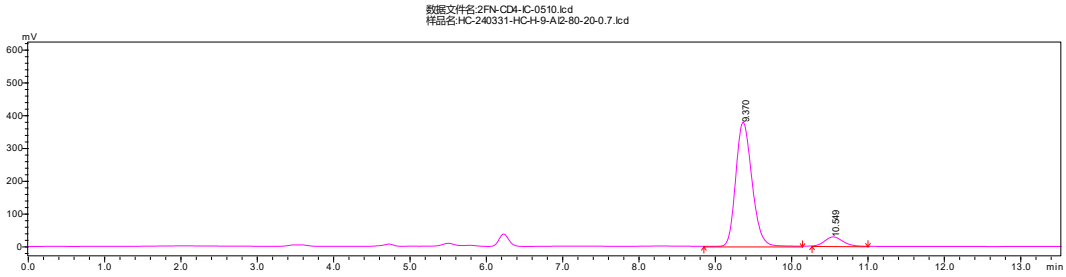
3ap

Yellow solid; **m.p.:** 178 - 180 ºC; **Yield:** 31 mg, 50%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = -34 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.09 (d, *J* = 8.6 Hz, 1H), 7.87 (d, *J* = 8.8 Hz, 1H), 7.48 (d, *J* = 8.8 Hz, 1H), 7.37 (dd, *J* = 1.8, 0.9 Hz, 1H), 7.29 (d, *J* = 8.6 Hz, 1H), 6.40 (d, *J* = 1.6 Hz, 1H), 6.31 (dd, *J* = 3.3, 1.9 Hz, 1H), 6.12 (d, *J* = 3.2 Hz, 1H), 5.63 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 159.8, 152.5, 149.3, 144.5, 142.8, 139.3, 131.2, 124.1, 121.2, 117.8, 112.9, 110.9, 109.5, 108.6, 48.1; **HRMS (ESI)** calcd for $C_{15}H_{10}ClN_2O_4^+$ $[M+H]^+$: 317.0324, found: 317.0325; **HPLC Data** 85% ee (Daicel Chiralpak IC column, hexane/isopropanol = 95/5, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 9.3 min, t_{minor} = 10.5 min).



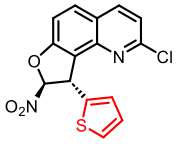
Peak	RetTime	Height	Area	Area%
1	9.387	277496	4069835	50.383

2	10.545	242892	4008030	49.617
Total		520388	8077865	100.000



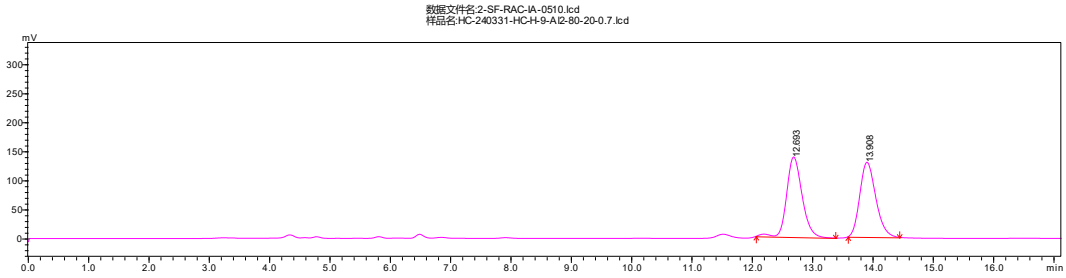
Peak	RetTime	Height	Area	Area%
1	9.370	378599	5606464	92.542
2	10.549	27906	451814	7.458
Total		406505	6058278	100.000

(8S,9S)-2-chloro-8-nitro-9-(thiophen-2-yl)-8,9-dihydrofuro[2,3-h]quinoline (3aq)

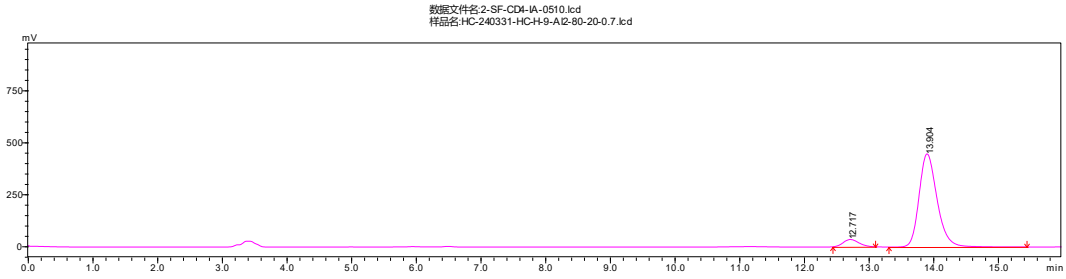


3aq

White solid; **m.p.:** 166 - 168 ºC; **Yield:** 39 mg, 59%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = -29 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.09 (d, *J* = 8.5 Hz, 1H), 7.89 (d, *J* = 8.8 Hz, 1H), 7.50 (d, *J* = 8.8 Hz, 1H), 7.28 (d, *J* = 8.6 Hz, 1H), 7.22 (dd, *J* = 4.5, 1.8 Hz, 1H), 6.98 - 6.93 (m, 2H), 6.27 (d, *J* = 1.4 Hz, 1H), 5.81 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 159.4, 152.5, 144.4, 140.4, 139.3, 131.3, 126.9, 125.9, 125.6, 124.2, 121.3, 120.1, 112.9, 112.0, 49.5; **HRMS (ESI)** calcd for $C_{15}H_8ClN_2O_3S^-$ [M-H]$^-$: 330.9950, found: 330.9964; **HPLC Data** 87% ee (Daicel Chiralpak IA column, hexane/isopropanol = 95/5, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 13.9 min, t_{minor} = 12.7 min).

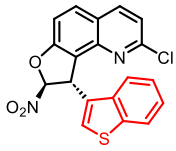


Peak	RetTime	Height	Area	Area%
1	12.693	138022	2458067	50.943
2	13.908	128754	2367060	49.057
Total		266776	4825128	100.000



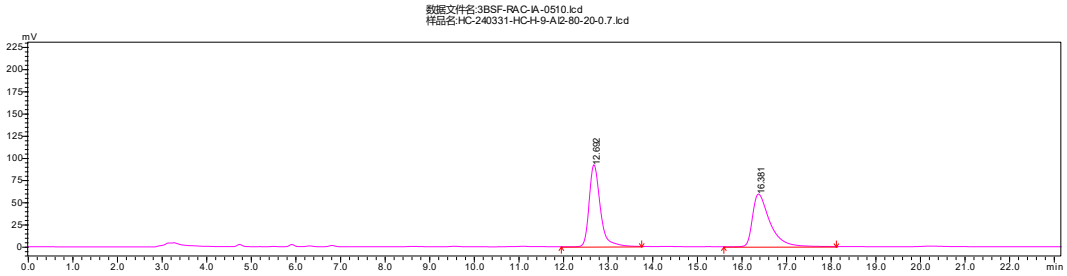
Peak	RetTime	Height	Area	Area%
1	12.717	35201	588666	6.360
2	13.904	447495	8667557	93.640
Total		482696	9256222	100.000

(8S,9R)-9-(benzo[b]thiophen-3-yl)-2-chloro-8-nitro-8,9-dihydrofuro[2,3-h]quinoline (3ar)

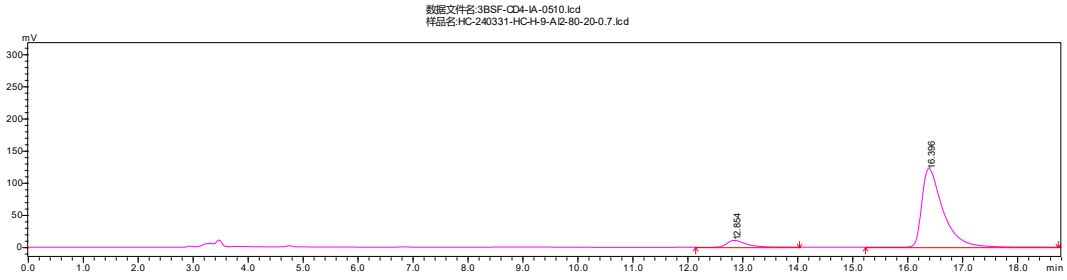


3ar

White solid; **m.p.:** 183 - 185 ºC; **Yield:** 26 mg, 34%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = -93 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.35 (d, *J* = 8.1 Hz, 1H), 8.13 (d, *J* = 8.6 Hz, 1H), 7.94 (d, *J* = 8.8 Hz, 1H), 7.89 (d, *J* = 8.1 Hz, 1H), 7.60 - 7.52 (m, 2H), 7.49 - 7.42 (m, 1H), 7.30 (d, *J* = 8.6 Hz, 1H), 6.57 (s, 1H), 6.26 (d, *J* = 1.2 Hz, 1H), 5.89 (s, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 160.0, 152.6, 144.7, 141.0, 139.3, 137.1, 131.5, 131.2, 125.3, 125.0, 124.9, 124.2, 123.2, 122.0, 121.4, 119.0, 113.0, 110.5, 48.9; **HRMS (ESI)** calcd for $C_{19}H_{10}ClN_2O_3S^-$ [M-H]$^-$: 381.0106, found: 381.0090; **HPLC Data** 85% ee (Daicel Chiralpak IA column, hexane/isopropanol = 95/5, λ = 254 nm, 25 ℃, 1 mL/min, t_{major} = 16.3 min, t_{minor} = 12.8 min).

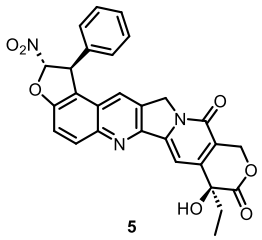


Peak	RetTime	Height	Area	Area%
1	12.692	92209	1594070	50.117
2	16.381	59257	1586620	49.883
Total		151466	3180690	100.000



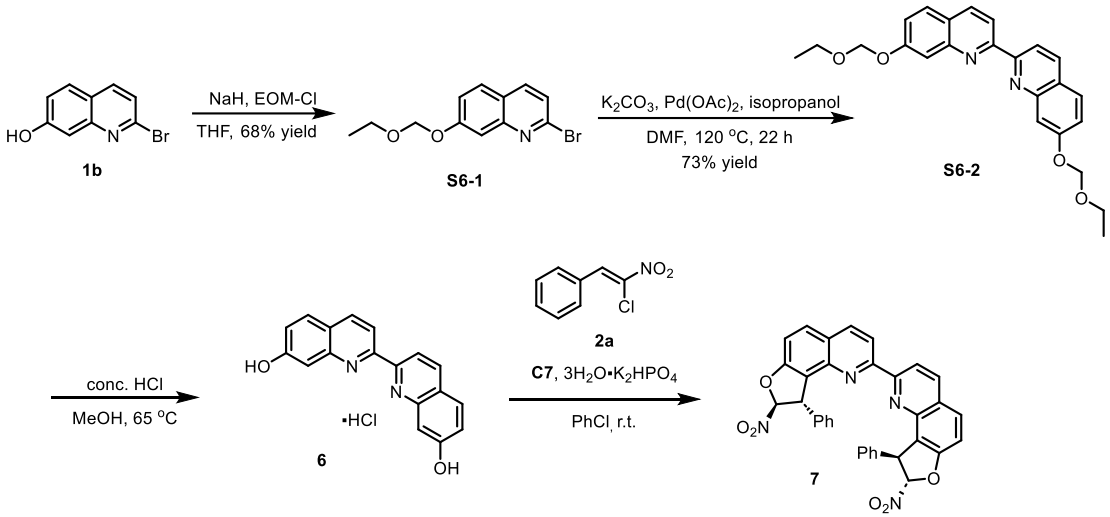
Peak	RetTime	Height	Area	Area%
1	12.854	10535	251932	7.180
2	16.396	122286	3257041	92.820
Total		132821	3508973	100.000

(1S,2S,8S)-8-ethyl-8-hydroxy-2-nitro-1-phenyl-1,8,11,14-tetrahydro-12H-furo[3,2-f]pyrano[3',4':6,7]indolizino[1,2-b]quinoline-9,12(2H)-dione (5)



White solid; **m.p.:** 204 - 206 °C; **Yield:** 37 mg, 32%; ＞20:1 dr; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = 1 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.33 (d, *J* = 9.2 Hz, 1H), 7.90 (s, 1H), 7.78 (d, *J* = 9.1 Hz, 1H), 7.65 (s, 1H), 7.44 – 7.34 (m, 3H), 7.23 – 7.18 (m, 2H), 6.19 (d, *J* = 1.8 Hz, 1H), 5.70 (d, *J* = 16.4 Hz, 1H), 5.37 (d, *J* = 1.8 Hz, 1H), 5.32 – 5.24 (m, 1H), 5.19 (dd, *J* = 19.2, 1.3 Hz, 1H), 5.12 (dd, *J* = 19.2, 1.3 Hz, 1H), 3.93 (s, 1H), 1.89 (dp, *J* = 21.4, 7.2 Hz, 2H), 1.03 (t, *J* = 7.4 Hz, 3H).; **^{13}C NMR** (126 MHz, $CDCl_3$) δ 173.8, 157.5, 157.4, 151.3, 150.1, 146.6, 146.0, 137.1, 133.5, 129.9, 129.8, 129.1, 127.4, 125.9, 124.8, 118.9, 118.7, 116.3, 112.4, 98.0, 72.8, 66.3, 55.1, 50.0, 31.6, 7.8; **HRMS (ESI)** calcd for $C_{28}H_{22}N_3O_7^+$ $[M+H]^+$: 512.1453, found: 512.1436.

Synthesis of compound 7



Step 1: To a solution of 2-bromoquinolin-7-ol (**1b**) (2.23 g, 10 mmol, 1 equiv.) in dry THF (50 mL) was added 60% NaH (480 mg, 12 mmol, 1.2 equiv.) in portions at 0 °C, the reaction mixture was allowed to stir for 1 hour. Chloromethyl ethyl ether (1.11 mL, 12 mmol, 1.2 equiv.) was added dropwise. The reaction mixture was stirred at 0 °C for 30 minutes and then kept at room temperature overnight. The progress of the reaction was monitored by TLC. After completion, the reaction was quenched with saturated aqueous ammonium chloride solution (50 mL) and extracted with ethyl acetate (3 × 100 mL). The combined organic layers were washed with brine and dried over Na_2SO_4. The crude product was purified by silica gel chromatography(eluent: petroleum ether/ethyl acetate = 5:1) to give product **S6-1** (1.9 g, 68% yield) as white solid. **m.p.:** 156 - 158 °C. **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 7.90 (d, *J* = 8.4 Hz, 1H), 7.70 (d, *J* = 8.9 Hz, 1H), 7.62 (d, *J* = 2.5 Hz, 1H), 7.38 (d, *J* = 8.5 Hz, 1H), 7.28 (dd, *J* = 8.8, 2.6 Hz, 1H), 5.35 (s, 2H), 3.76 (q, *J* = 7.1 Hz, 2H), 1.23 (t, *J* = 7.1 Hz, 3H).; **^{13}C NMR** (126 MHz, $CDCl_3$) δ 159.0, 150.1, 142.3, 137.9, 128.7, 123.6, 122.6, 120.2, 110.8, 93.2, 64.7, 15.1; **HRMS (ESI)** calcd for $C_{12}H_{13}BrNO_2^+$ $[M+H]^+$: 282.0125, found: 282.0125.

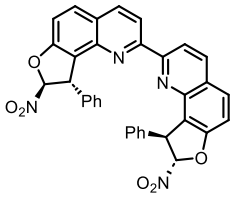
Step 2: Dissolved **S6-1** (1.9 g, 6.7 mmol), K_2CO_3 (1.0 g, 6.7 mmol) and $Pd(OAc)_2$

(150 mg, 0.67 mmol) in dry DMF (4 mL), the reaction mixture was heated to 120 ºC under argon for several minutes. The reaction mixture was added isopropanol (800 µL) and kept at same temperature for 22 hours. The progress of the reaction was monitored by TLC. After cooling, the reaction mixture was quenched with water and extracted with ethyl acetate (3 × 50 mL). The combined organic layers were washed with brine and dried over Na_2SO_4. The crude product was purified by silica gel chromatography (petroleum ether/ethyl acetate = 5:1) to give product **S6-2** (983 mg, 73% yield) as light yellow solid. **m.p.:** 132 - 134 ºC. **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.68 (d, J = 8.5 Hz, 2H), 8.23 (d, J = 8.5 Hz, 2H), 7.80 - 7.74 (m, 4H), 7.28 (dd, J = 8.8, 2.5 Hz, 2H), 5.42 (s, 4H), 3.81 (q, J = 7.1 Hz, 4H), 1.27 (t, J = 7.1 Hz, 6H).; **^{13}C NMR** (126 MHz, $CDCl_3$) δ 158.3, 156.6, 149.4, 136.3, 128.6, 124.1, 120.2, 117.7, 111.7, 93.2, 64.7, 15.2; **HRMS (ESI)** calcd for $C_{24}H_{25}N_2O_4^+$ $[M+H]^+$: 405.1809, found: 405.1801.

Step 3: This experiment was performed under air. To a solution of **S6-2** (983 mg, 2.4 mmol) in MeOH (10 mL) was added conc. HCl (294 µL, 9.6 mmol). The reaction mixture was stirred at 65 ºC for 5 hours. The precipitate was collected and dried in vacuum to afford an orange solid **6** (2.4 mmol, quant) without further purification.

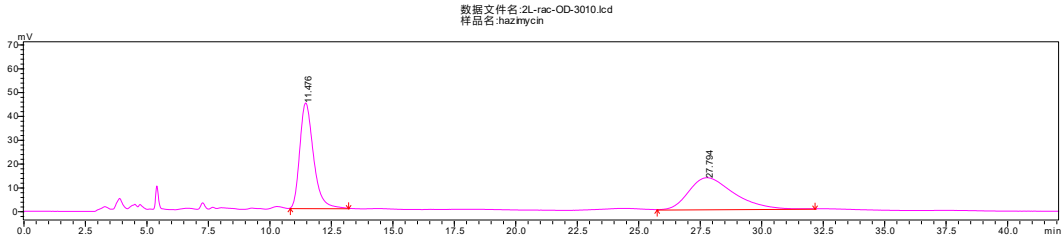
Step 4: To a Schlenk tube equipped with a magnetic stir bar was charged with **6** (2.4 mmol), nitroolefins **2a** (1.06 g, 5.76 mmol), K_2HPO_4•$3H_2O$ (5.47 g, 24 mmol), **C7** (117 mg, 0.24 mmol) and PhCl (24 mL). The solution was stirred at rt for 72 h. The reaction mixture was purified by column chromatography on silica gel directly to give the product **7**.

(8S,8'S,9S,9'S)-8,8'-dinitro-9,9'-diphenyl-8,8',9,9'-tetrahydro-2,2'-bifuro[2,3-h]quinoline (7)



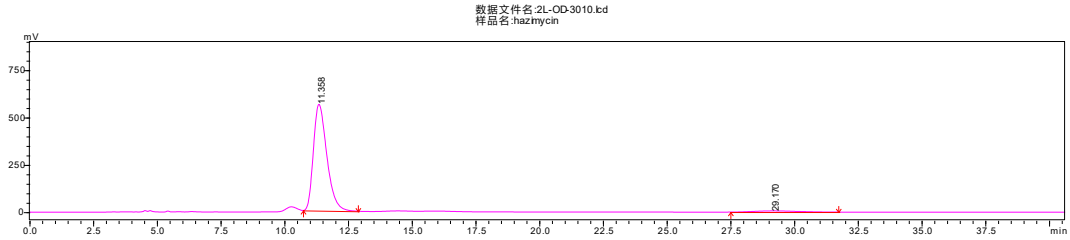
7

Light yellow solid; **m.p.:** 126 - 128 ºC; **Yield:** 37 mg, 32%; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = -136 (*c* 0.10, CH_2Cl_2); **^{1}H NMR**(500 MHz, Chloroform-*d*) δ 8.26 (dd, J = 8.6, 1.3 Hz, 2H), 8.16 (dd, J = 8.7, 1.4 Hz, 2H), 7.86 (d, J = 8.7 Hz, 2H), 7.50 (dd, J = 8.8, 1.4 Hz, 2H), 7.35 - 7.20 (m, 10H), 6.26 (t, J = 1.6 Hz, 2H), 5.60 (s, 2H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 158.8, 156.3, 144.1, 138.7, 137.1, 130.8, 129.0, 128.0, 127.5, 125.7, 121.4, 117.9, 112.9, 112.5, 55.1; **HRMS (ESI)** calcd for $C_{34}H_{23}N_4O_6^+$ $[M+H]^+$: 583.1612, found: 583.1631; **HPLC Data** 93% ee (Daicel Chiralpak OD column, hexane/isopropanol = 70/30, λ = 254 nm, 25 ºC, 1 mL/min, t_{major} = 11.3 min, t_{minor} = 29.1 min).



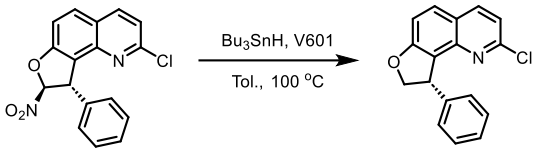
Peak	RetTime	Height	Area	Area%
1	11.476	44132	1701467	50.594
2	27.794	13266	1661521	49.406

Total		57397	3362988	100.000



Peak	RetTime	Height	Area	Area%
1	11.358	561730	20603358	96.545
2	29.170	6262	737301	3.455
Total		567992	21340659	100.000

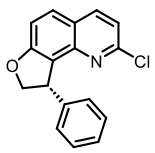
General procedure C: Synthesis of compound 8



3aa **8**

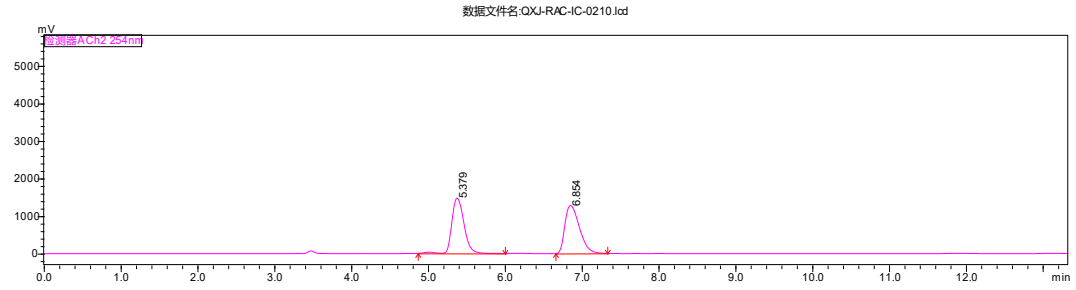
Tributyltin hydride (0.9 mmol, 3 equiv.) was added to a solution of the **3aa** (0.3 mmol, 1 equiv.) in dry deoxygenated toluene (2 mL) under argon, and after the mixture was heated to 80 °C, **V601** (0.15 mmol, 0.5 equiv.) was added and the mixture continued to be heated under 100 °C for 30 min, and reaction completion was confirmed by TLC. After cooling, the toluene was removed under reduced pressure. The crude product was purified by flash column chromatography on silica gel to give the product **8** in 28% yield.

(S)-2-chloro-9-phenyl-8,9-dihydrofuro[2,3-h]quinoline (8)

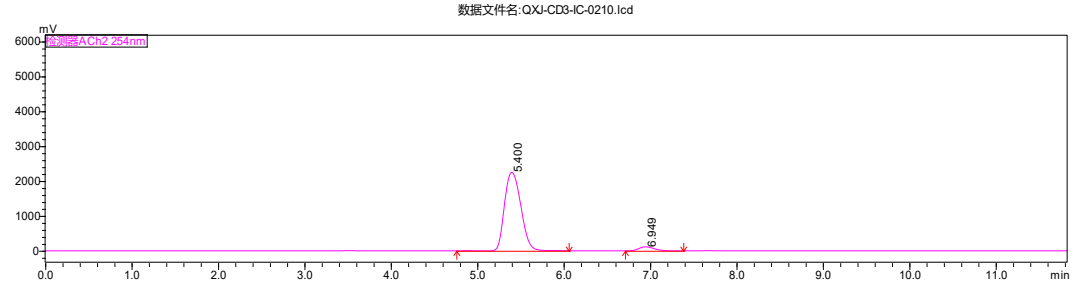


8

White solid; **m.p.:** 81 - 82 ºC; **Yield:** 24 mg, 28%; petroleum ether/EtOAc = 10:1; $[\alpha]_D^{25}$ = -174 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 7.94 (d, *J* = 8.5 Hz, 1H), 7.66 (d, *J* = 8.7 Hz, 1H), 7.30 - 7.23 (m, 5H), 7.21 - 7.15 (m, 1H), 7.10 (d, *J* = 8.5 Hz, 1H), 5.14 (dd, *J* = 9.3, 3.5 Hz, 1H), 5.05 (t, *J* = 9.1 Hz, 1H), 4.79 (dd, *J* = 8.9, 3.5 Hz, 1H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 161.7, 151.3, 145.4, 143.4, 138.9, 129.5, 128.5, 127.4, 126.7, 123.7, 122.7, 119.4, 113.1, 80.8, 46.6; **HRMS (ESI)** calcd for $C_{17}H_{13}ClNO^+$ $[M+H]^+$: 282.0680, found: 282.0684; **HPLC Data** 91% ee (Daicel Chiralpak IC column, hexane/isopropanol = 98/2, λ = 254 nm, 25 °C, 1 mL/min, t_{major} = 5.4 min, t_{minor} = 6.9 min).

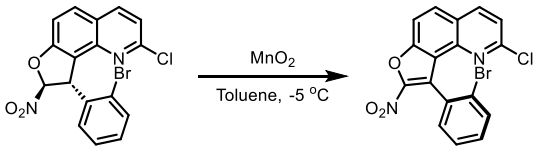


Peak	RetTime	Height	Area	Area%
1	5.379	1473238	16214104	49.033
2	6.854	1277645	16853364	50.967
Total		2750882	33067468	100.000



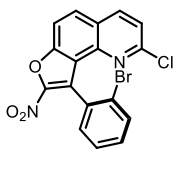
Peak	RetTime	Height	Area	Area%
1	5.400	2249683	29599466	95.353
2	6.949	115515	1442431	4.647
Total		2365198	31041898	100.000

Synthesis of compound 9



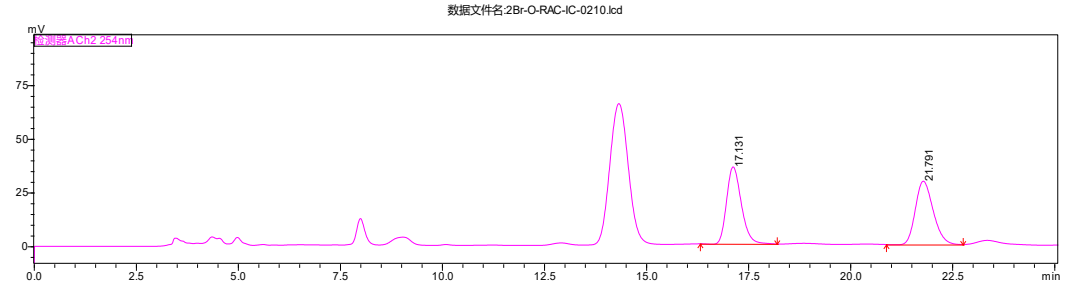
MnO_2 (20 equiv.) was added in a clear solution of **3am** in dry toluene at -5 ºC and reaction mass stirred for 16 h at same temperature. The progress of the reaction was monitored by TLC. The reaction mixture was purified by column chromatography on silica gel directly to give the product **9** in 95% yield (85% ee).

9-(2-bromophenyl)-2-chloro-8-nitrofuro[2,3-h]quinoline (9)

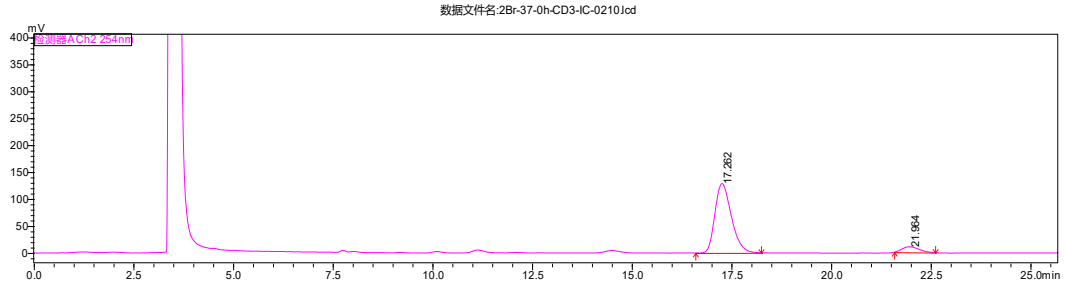


White solid; **m.p.:** 172 - 173 ºC; **Yield:** 77 mg, 95%; petroleum ether/EtOAc = 5:1; $[\alpha]_D^{25}$ = 11 (*c* 0.10, CH_2Cl_2); **^{1}H NMR** (500 MHz, Chloroform-*d*) δ 8.18 (d, *J* = 8.5 Hz, 1H), 8.01 (d, *J* = 9.0 Hz, 1H), 7.85 (d, *J* = 9.0 Hz, 1H), 7.83 - 7.67 (m, 1H), 7.49 (d, *J* = 4.5 Hz, 2H), 7.43 (dd, *J* = 8.2, 4.6 Hz, 2H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 152.3, 151.8,

144.1, 139.1, 132.4, 131.0, 130.7, 130.5, 130.4, 127.1, 124.5, 123.7, 122.8, 122.6, 122.2, 113.4; **HRMS (ESI)** calcd for $C_{17}H_8BrClN_2NaO_3^+$ $[M+Na]^+$: 424.9299, found: 424.9314; **HPLC Data** 85% ee (Daicel Chiralpak IC column, hexane/isopropanol = 98/2, λ = 254 nm, 25 °C, 1 mL/min, t_{major} = 17.2 min, t_{minor} = 21.9 min).



Peak	RetTime	Height	Area	Area%
1	17.131	35845	895081	50.178
2	21.791	29498	888744	49.822
Total		65342	1783825	100.000



Peak	RetTime	Height	Area	Area%
1	17.262	128687	3678735	92.238
2	21.964	10444	309590	7.762
Total		139131	3988324	100.000

3. X-ray crystallographic data

Single Crystal X-Ray Data of 3ga

Single crystals of $C_{21}H_{14}N_2O_3S$ **[3ga]** were obtained in a dichloromethane : hexane (1:5) solution. A suitable crystal was selected and mounted on a Bruker D8 VENTURE dual wavelength Mo/Cu diffractometer. The crystal was kept at 193.00 K during data collection. OLEX2 and SHELXTL were used for Data collection and integration.

Table S1 Crystal data and structure refinement for 3ga.

Identification code	3ga
Empirical formula	$C_{21}H_{14}N_2O_3S$
Formula weight	374.40
Temperature/K	193.00

Crystal system	monoclinic
Space group	$P2_1$
a/Å	9.8111(3)
b/Å	7.4763(2)
c/Å	12.2064(4)
α/°	90
β/°	96.8020(10)
γ/°	90
Volume/Å^3	889.05(5)
Z	2
ρ_{calc}g/cm^3	1.399
μ/mm^{-1}	1.828
F(000)	388.0
Crystal size/mm^3	0.12 × 0.1 × 0.08
Radiation	CuKα (λ = 1.54178)
2Θ range for data collection/°	7.294 to 149.204
Index ranges	$-12 \leq h \leq 12$, $-8 \leq k \leq 9$, $-14 \leq l \leq 15$
Reflections collected	15778
Independent reflections	3523 [R_{int} = 0.0399, R_{sigma} = 0.0370]
Data/restraints/parameters	3523/1/245
Goodness-of-fit on F^2	1.031
Final R indexes [I>=2σ (I)]	R_1 = 0.0278, wR_2 = 0.0734
Final R indexes [all data]	R_1 = 0.0286, wR_2 = 0.0737
Largest diff. peak/hole / e Å^{-3}	0.22/-0.20
Flack parameter	0.061(5)

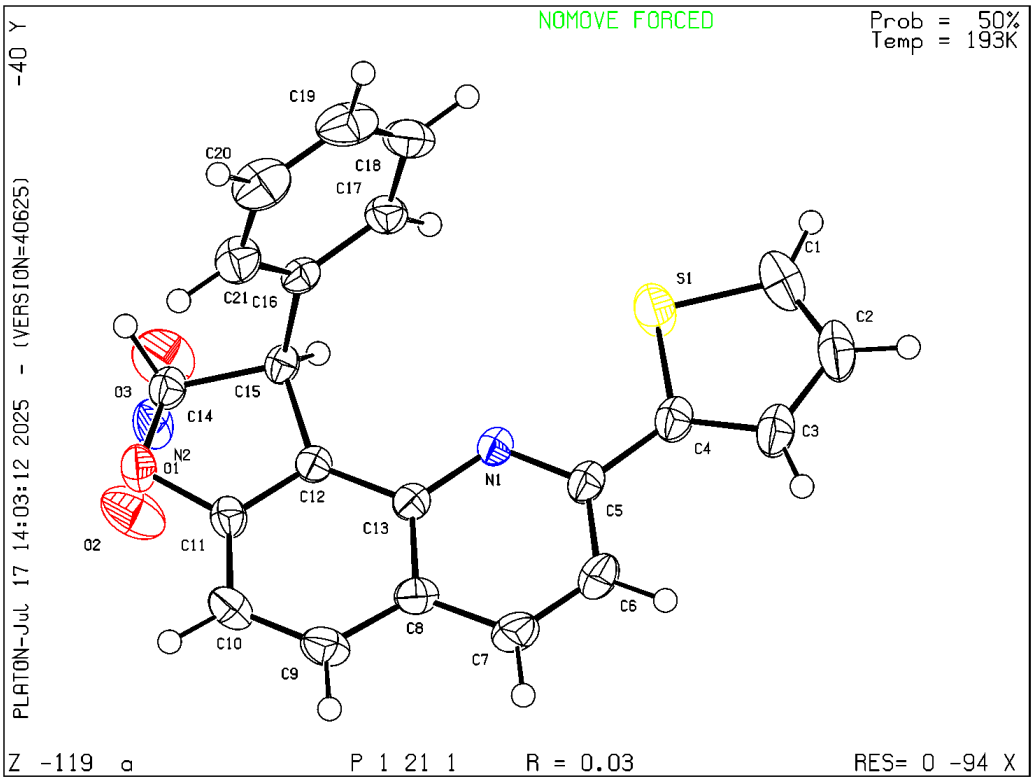


Figure S1. X-ray crystal structure of the product **3ga** (50% ellipsoid contour probability level, **CCDC:2527373**).

4. In *vitro* anti-tumor assay

In vitro cytotoxic activity of 3 on MCF-7.

MCF-7 cell (2.5×10^3 in 100 μL) were seeded in a 96-well plate in triplicate. Following a 24 h culture at 37 °C, the suspension was replaced with fresh medium containing the different doses of compounds **3** (1, 10, 25, 50, 75 and 100 μM). The drug-free medium negative control well and the solvent control well were set with the same volume of DMSO. Cell was respectively incubated at 37 °C for 48 h. After 48 hours of incubation with the compounds, the culture medium was aspirated and replaced with a fresh mixture of culture medium and CCK-8 solution (90 μL:10 μL per well). The plates were then returned to the incubator for 1 hour. Subsequently, the optical density (OD) at 450 nm was measured using a multi-mode microplate reader.

Cell inhibition rate = [A450 (negative control well) - A450 (dosing well)]/A450 (negative control well) × 100%

Anti-tumor data

Table S5 Experimental results of anti-tumor activity

Entry [a]	Compound	Inhibition rate (%)
1	**3aa**	83.85±0.46

2	**3ab**	38.88±3.65
3	**3ac**	14.40±1.34
4	**3ad**	64.45±1.68
5	**3ae**	44.92±4.80
6	**3af**	42.86±0.49
7	**3ag**	35.27±2.96
8	**3ah**	39.82±1.80
9	**3ai**	71.37±2.13
10	**3aj**	62.37±1.56
11	**3ak**	29.15±4.08
12	**3al**	37.64±0.20
13	**3am**	50.35±0.85
14	**3an**	21.95±0.57
15	**3ao**	38.47±0.17
16	**3ap**	78.48±0.04
17	**3aq**	72.58±0.51
18	**3ar**	37.80±1.13
19	**3ba**	30.60±0.43
20	**3ca**	20.29±1.68
21	**3da**	28.45±1.98
22	**3ea**	18.58±2.39
23	**3fa**	63.76±2.29
24	**3ga**	21.33±2.98
25	**3ha**	35.14±2.60
26	**3ia**	42.67±0.22
27	**3ja**	60.55±0.43
28	**3ka**	76.67±0.41
29	**3la**	85.58±0.20
30	**3ma**	69.83±0.94
31	**3na**	63.76±2.29
32 [b]	**DOX**	81.11±0.68

[a] This antitumor activity assay was carried out at a compound concentration of 100 μM. All experiments were conducted in three parallel groups. [b] Doxorubicin was used as a positive control.

Table S6 Experimental results of anti-tumor activity

Entry [a]	Compound	IC_{50} (μM)
1	**3aa**	32.94±0.20
2	**3ai**	38.92±0.20
3	**3ap**	1.52±0.06

4	**3aq**	11.23±0.17
5	**3ka**	20.45±0.24
6	**3la**	9.78±0.08
7 [b]	**DOX**	0.21±0.14

[a] This antitumor activity assay was carried out at a compound concentration of 100 μM. All experiments were conducted in three parallel groups. [b] Doxorubicin was used as a positive control.

5. Reference

(1) G. Bai, R. Liu, Y. Yang, D. Bonne, J. Rodriguez, S.-Q. Wei, H. Wang and X. Bao, Synthesis of 8-Aza- and 8,8′-Diaza-BINOL Derivatives through Cu(II)-TMEDA-Catalyzed Aerobic Oxidative Coupling, *J. Org. Chem.*, 2025, **90**, 18155–18161.

(2) J. Wu, F. Hu, G. Bai, Y. Yang, D. Bonne, J. Rodriguez, C. Yue, H. Wang and X. Bao, Basicity-Controlled [3+2] Cyclization of 3-Hydroxyquinolin-ones and β-Chlorinated Nitrostyrenes, *Eur. J. Org. Chem.*, 2023, **26**, e202300218.

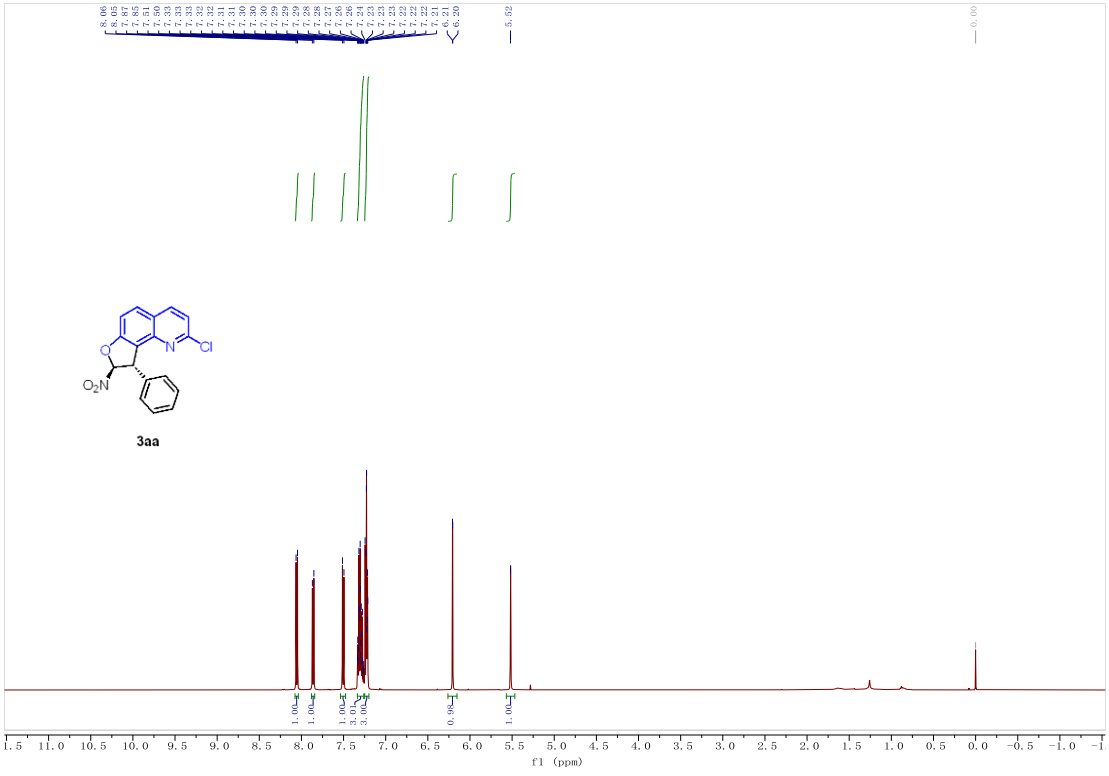
(3) J. P. Malerich, K. Hagihara and V. H. Rawal, Chiral Squaramide Derivatives are Excellent Hydrogen Bond Donor Catalysts, *J. Am. Chem. Soc.*, 2008, **130**, 14416–14417.

(4) H. Li, Y. Wang, L. Tang and L. Deng, Highly Enantioselective Conjugate Addition of Malonate and β-Ketoester to Nitroalkenes: Asymmetric C−C Bond Formation with New Bifunctional Organic Catalysts Based on Cinchona Alkaloids, *J. Am. Chem. Soc.*, 2004, **126**, 9906–9907.

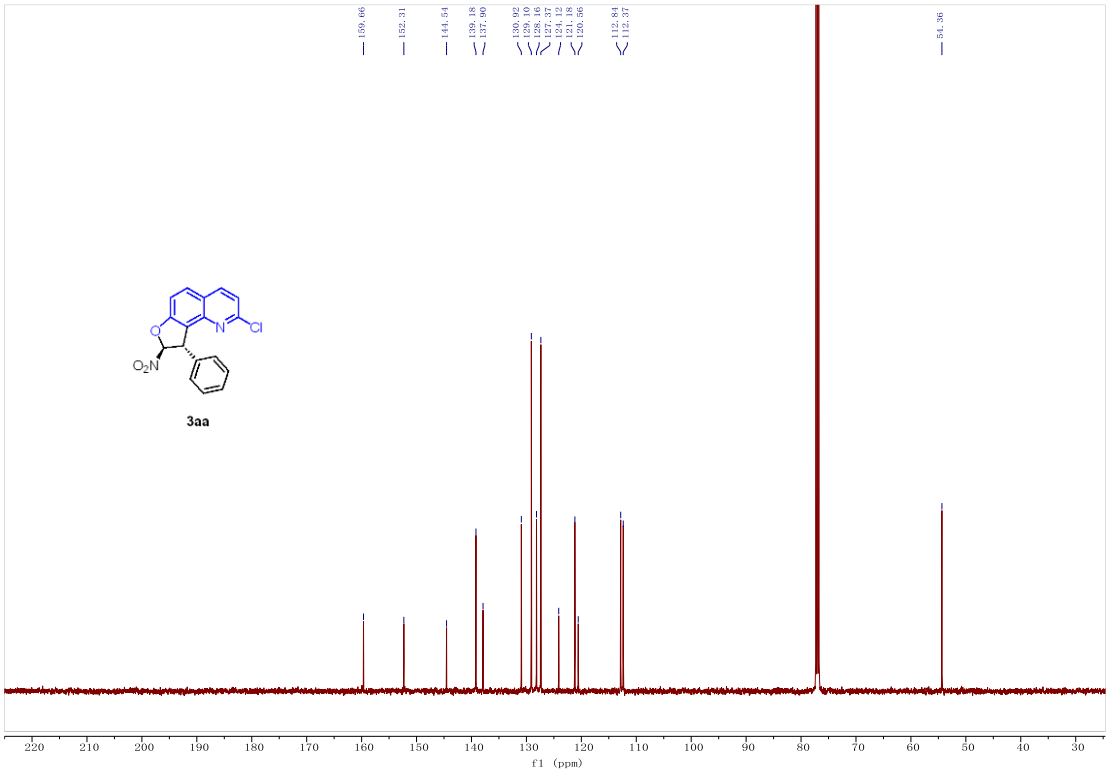
(5) Y. Zhu, J. P. Malerich and V. H. Rawal, Squaramide-Catalyzed Enantioselective Michael Addition of Diphenyl Phosphite to Nitroalkenes, *Angew. Chem. Int. Ed.*, 2010, **49**, 153–156.

6. NMR spectra for compounds

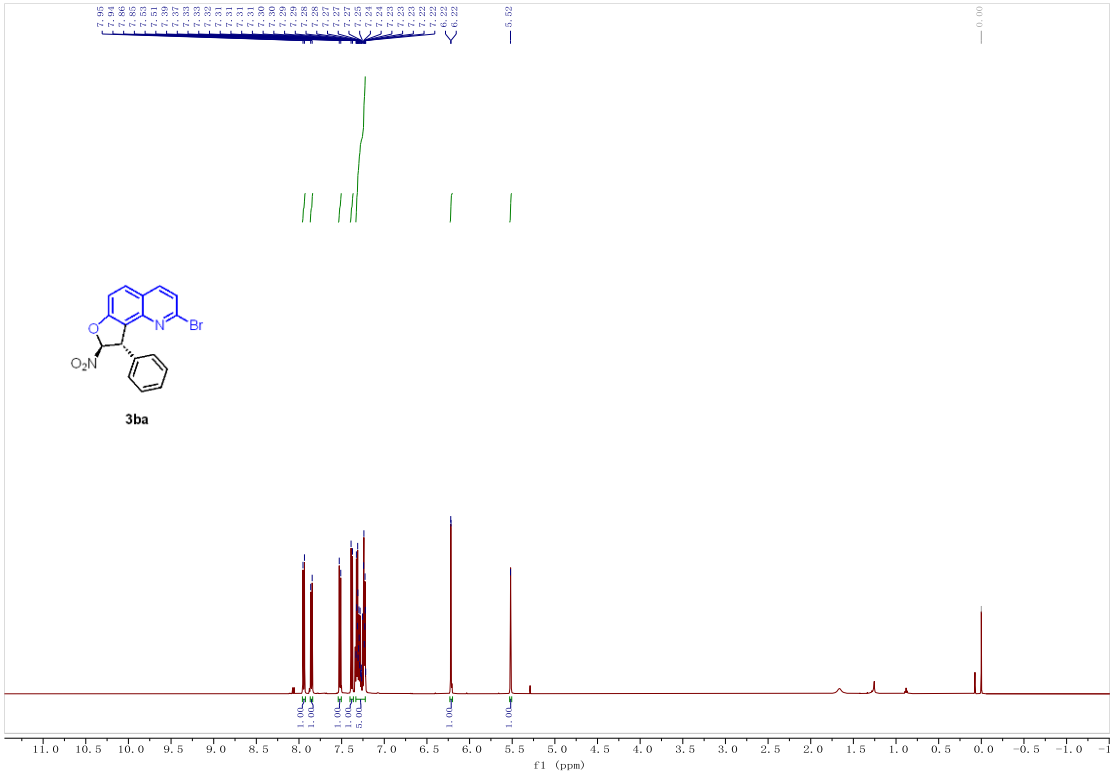
^{1}H NMR of 3aa (500 MHz, $CDCl_3$)



^{13}C NMR of 3aa (126 MHz, $CDCl_3$)



^{1}H NMR of 3ba (500 MHz, $CDCl_3$)



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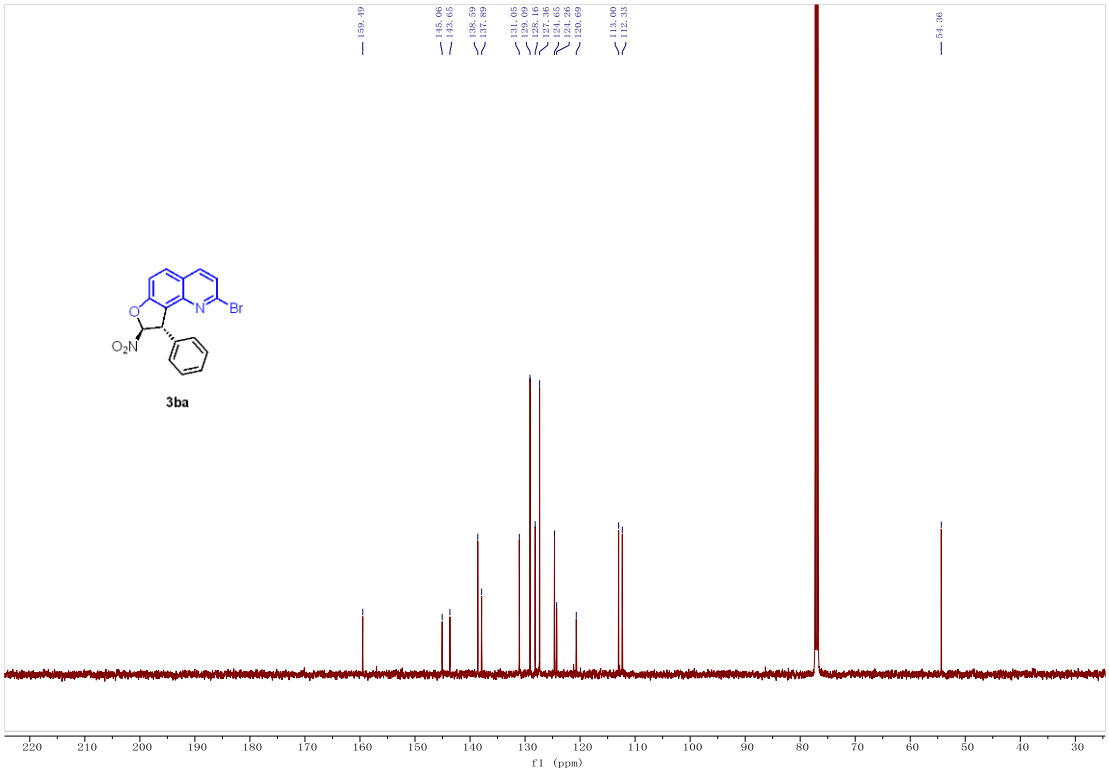

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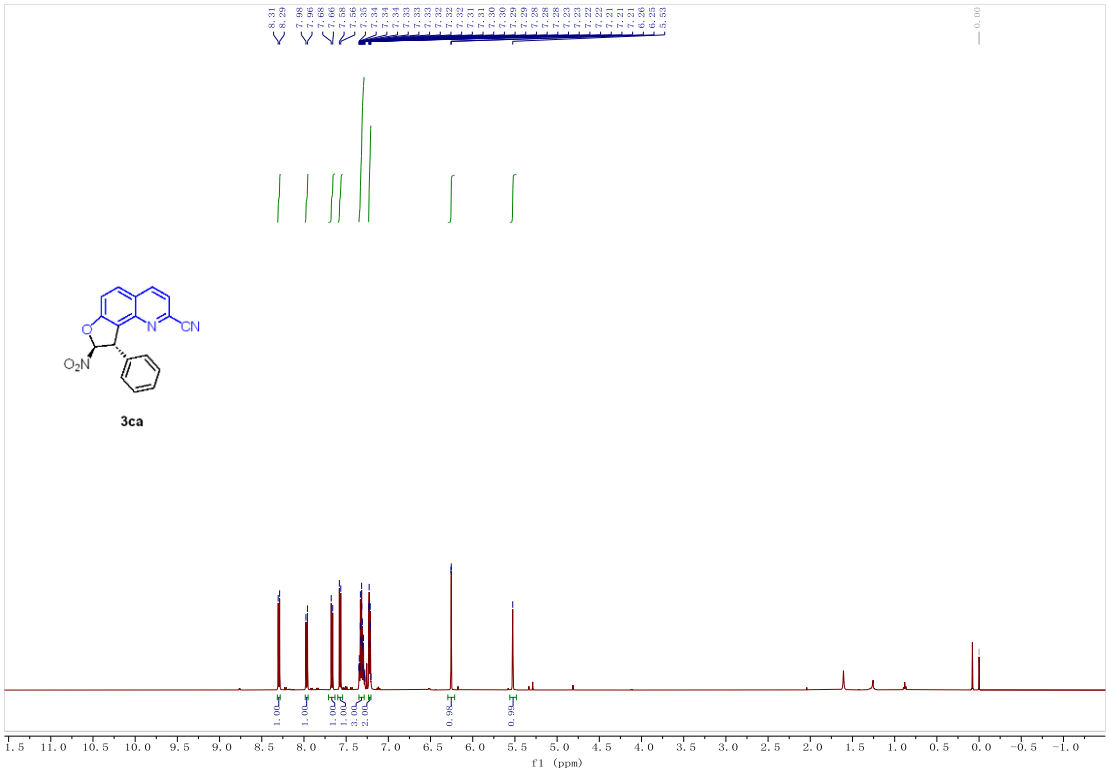

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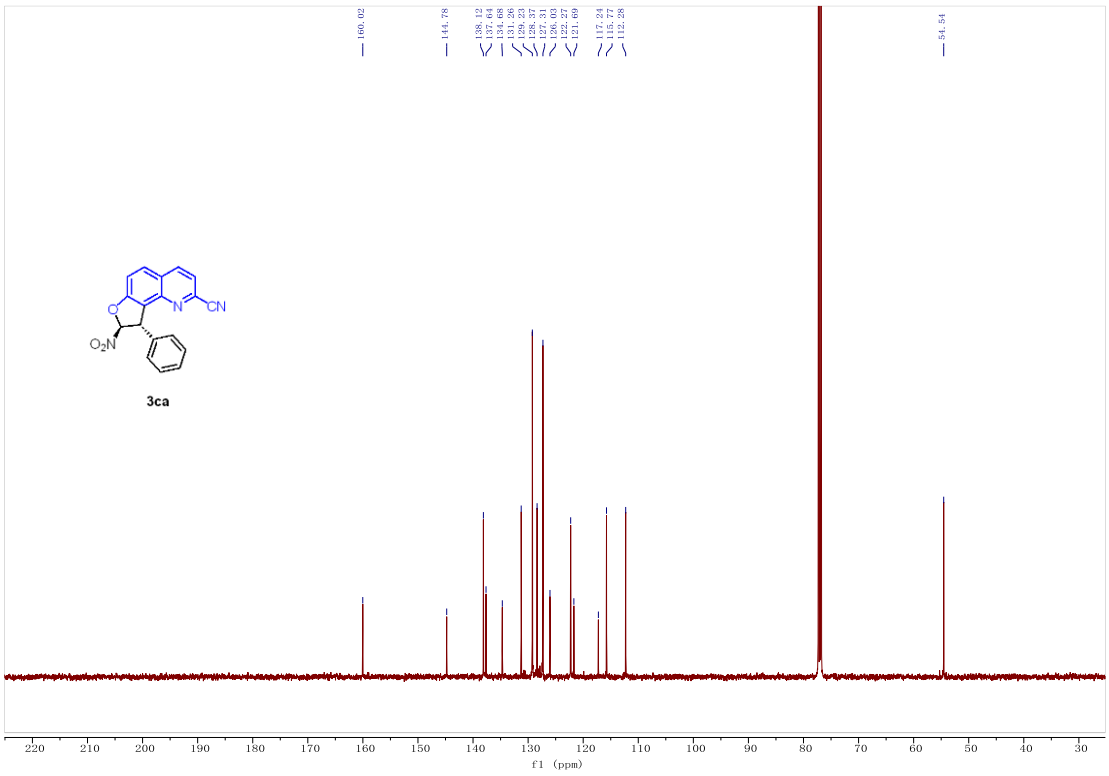

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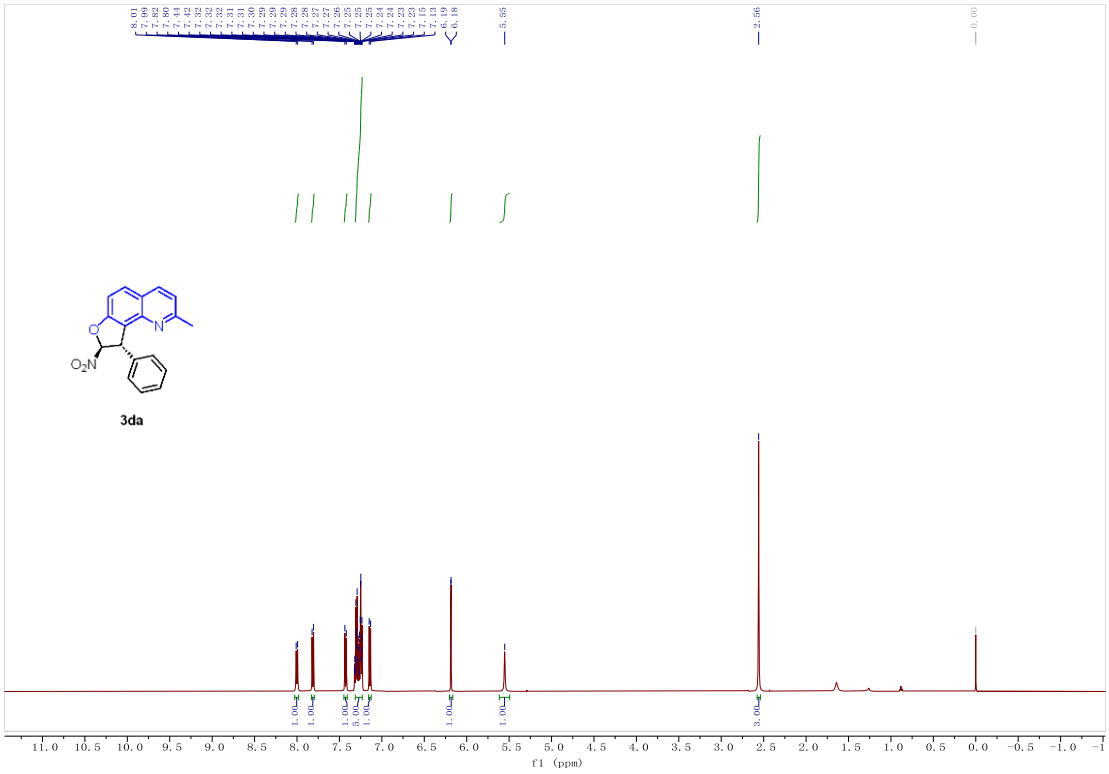

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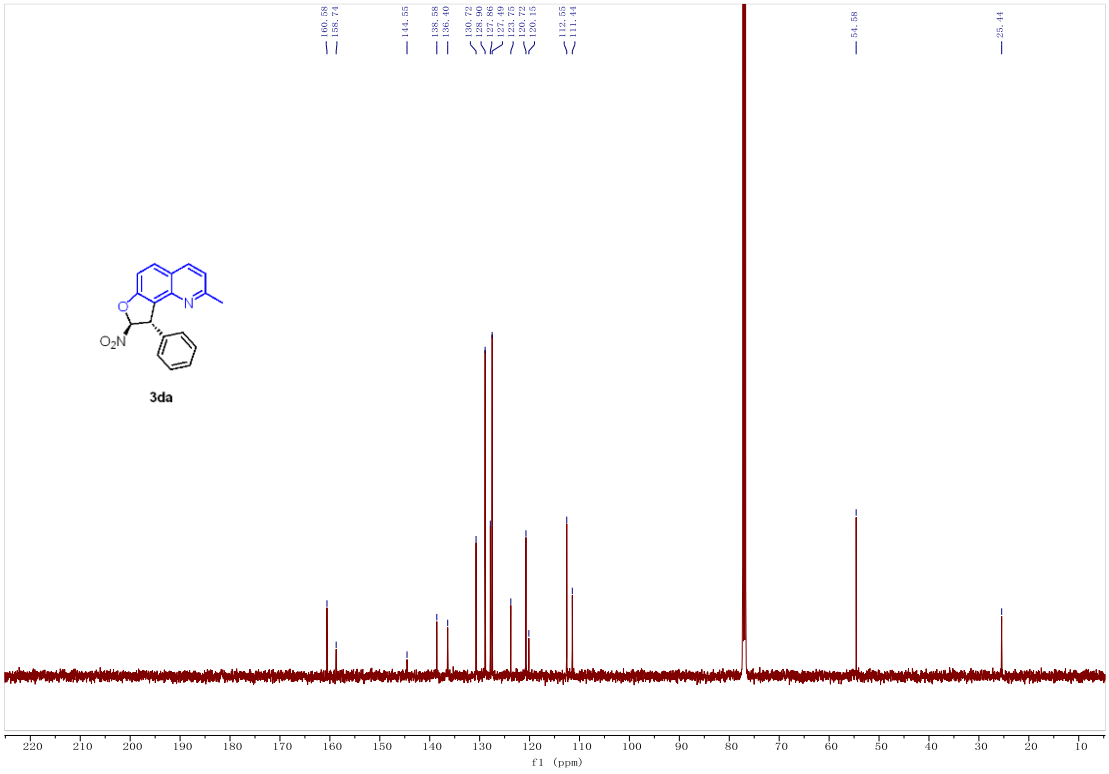
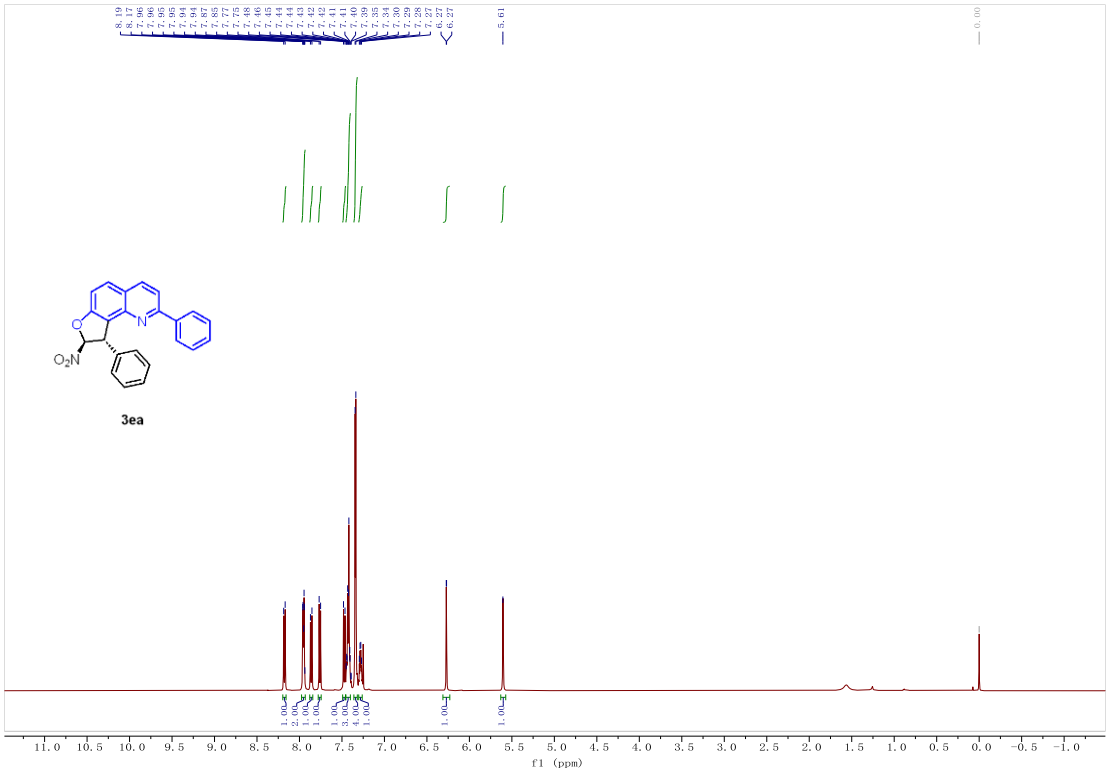


^{1}H NMR of 3ea (500 MHz, $CDCl_3$)



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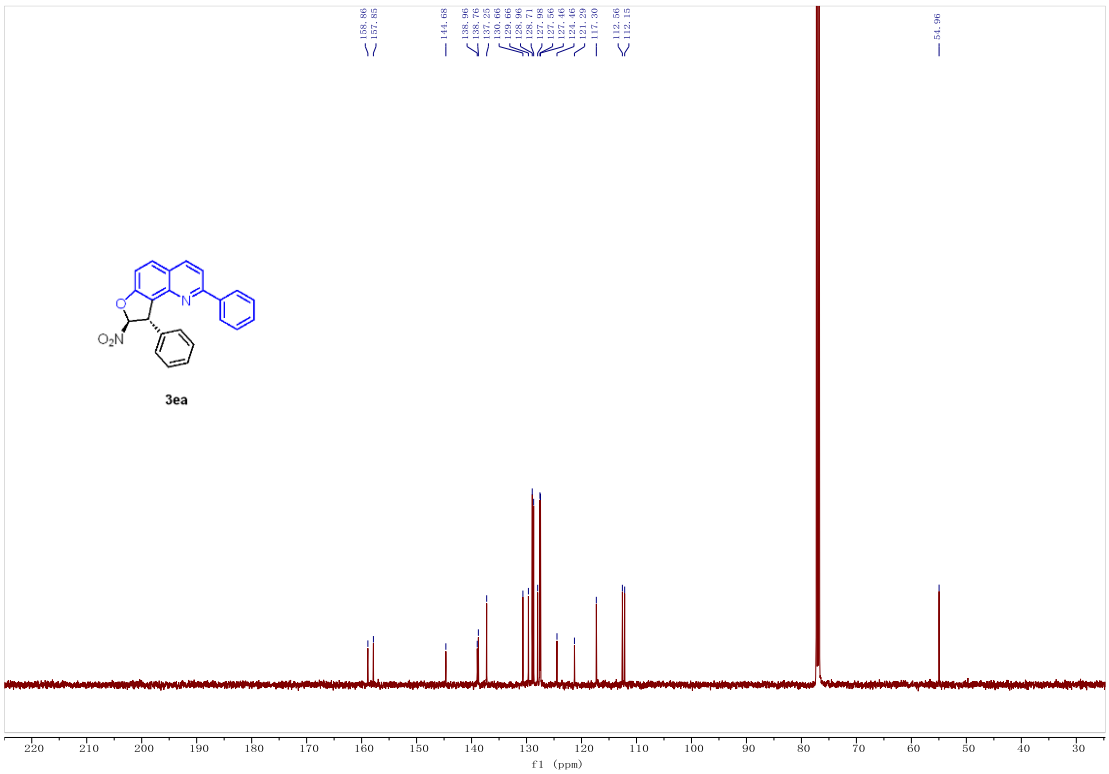
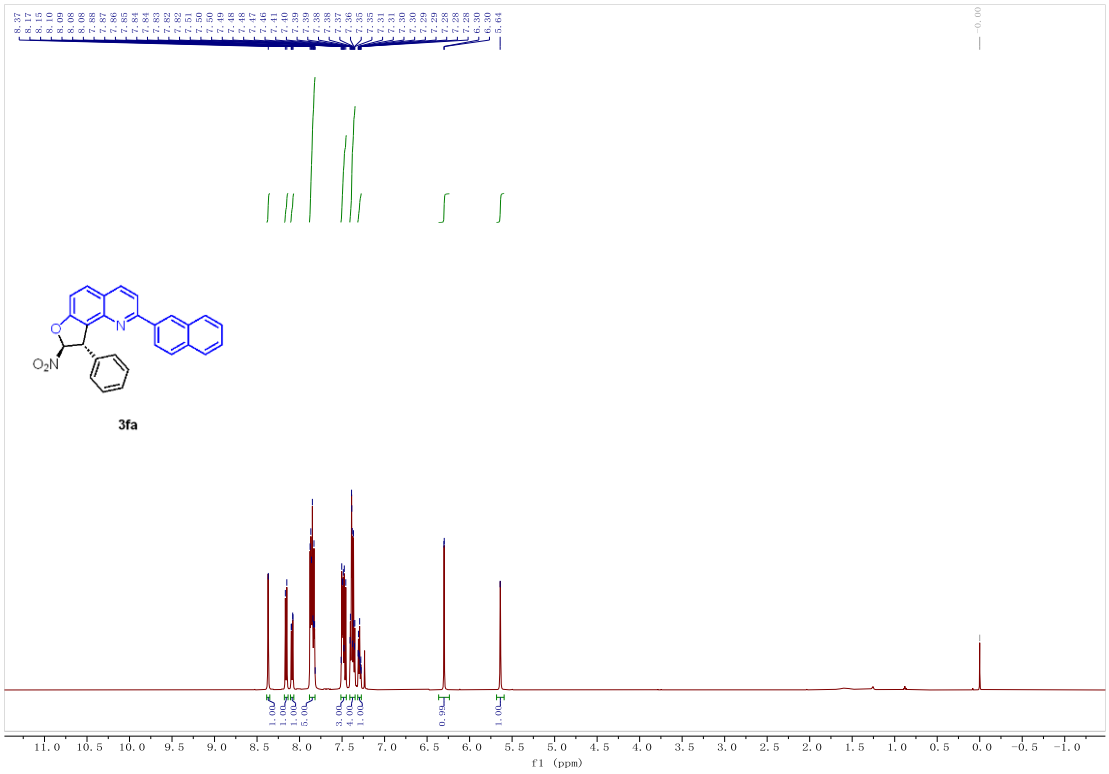
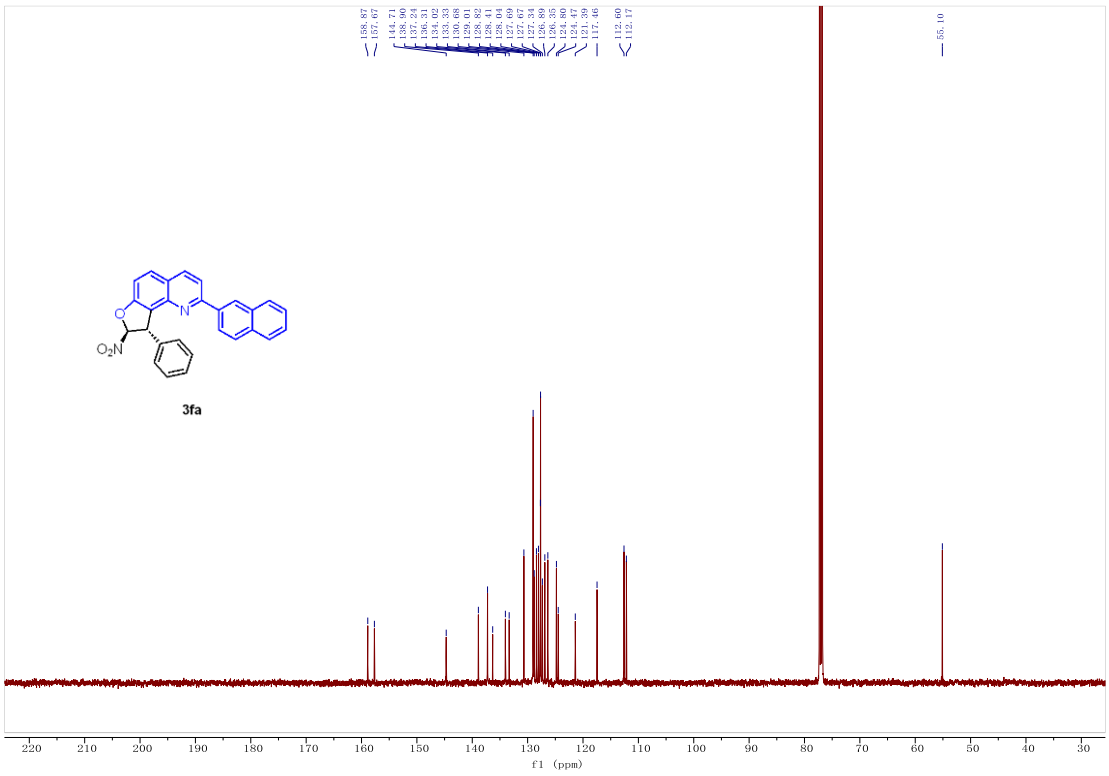


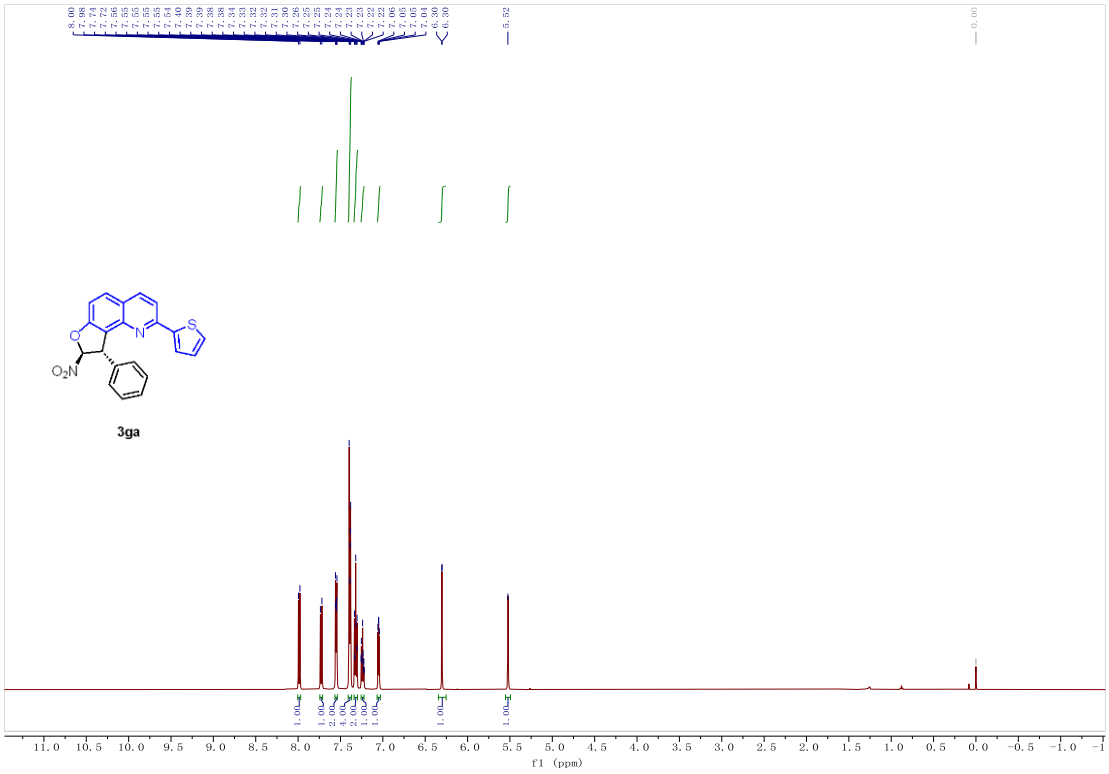
^{1}H NMR of 3fa (500 MHz, $CDCl_3$)



^{13}C NMR of 3fa (126 MHz, $CDCl_3$)



^{1}H NMR of 3ga (500 MHz, $CDCl_3$)



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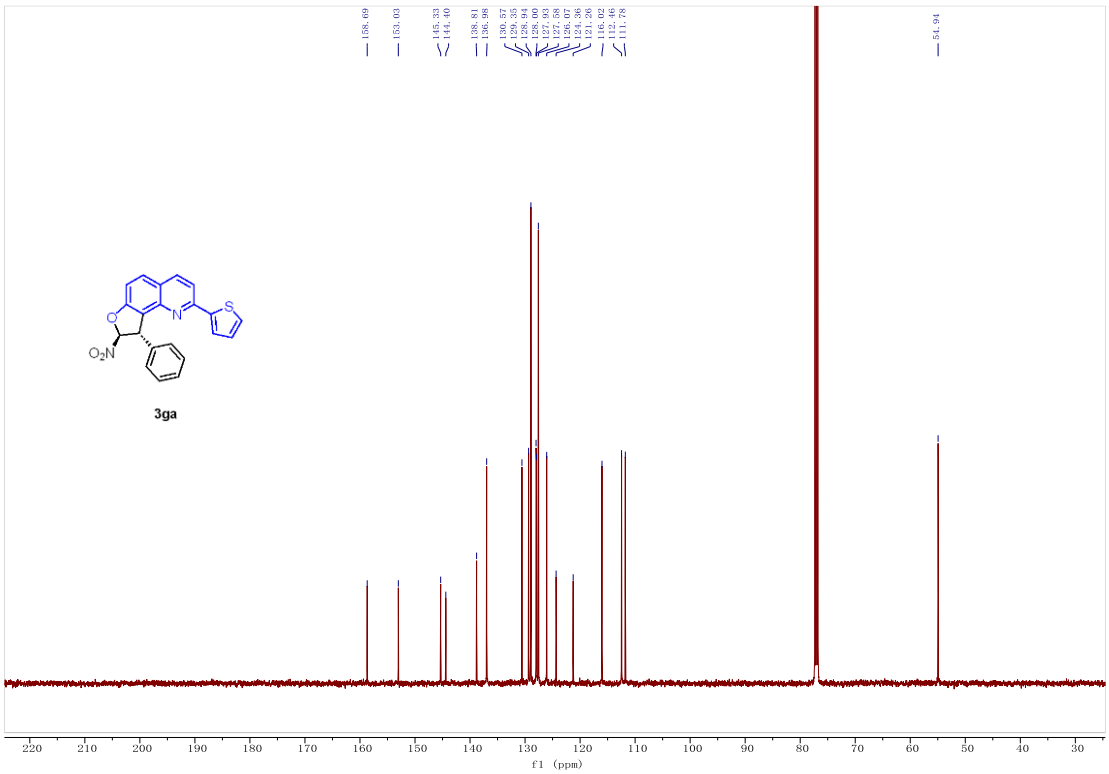

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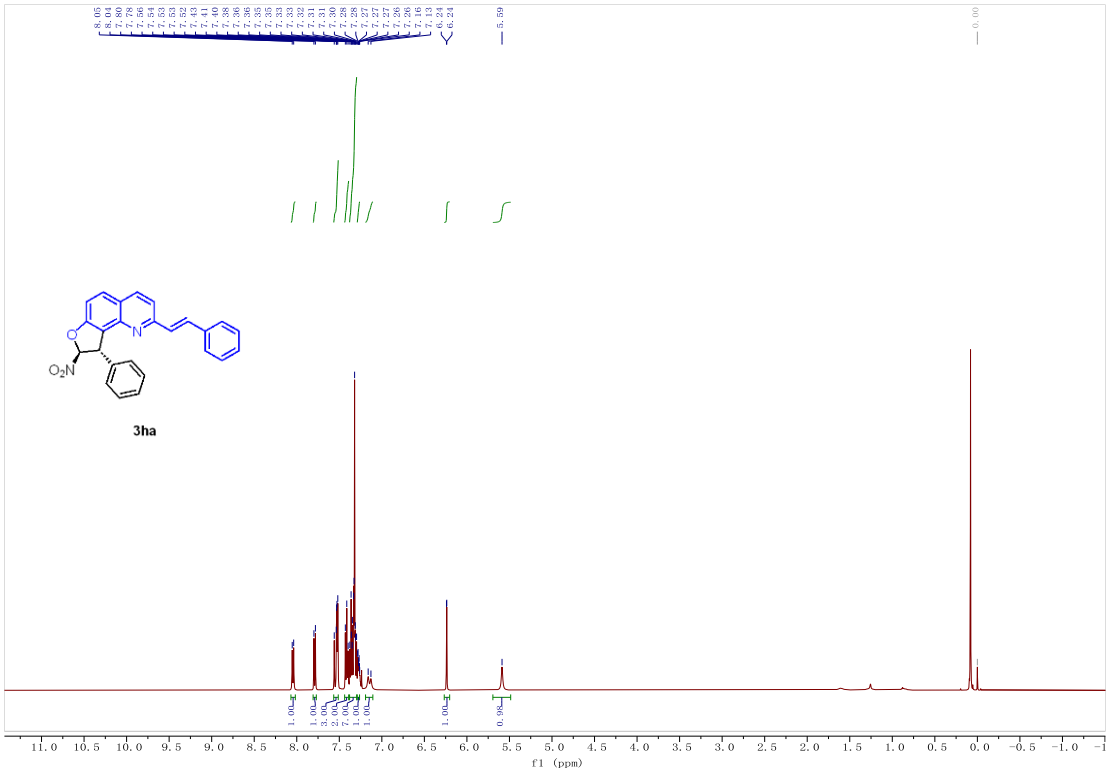
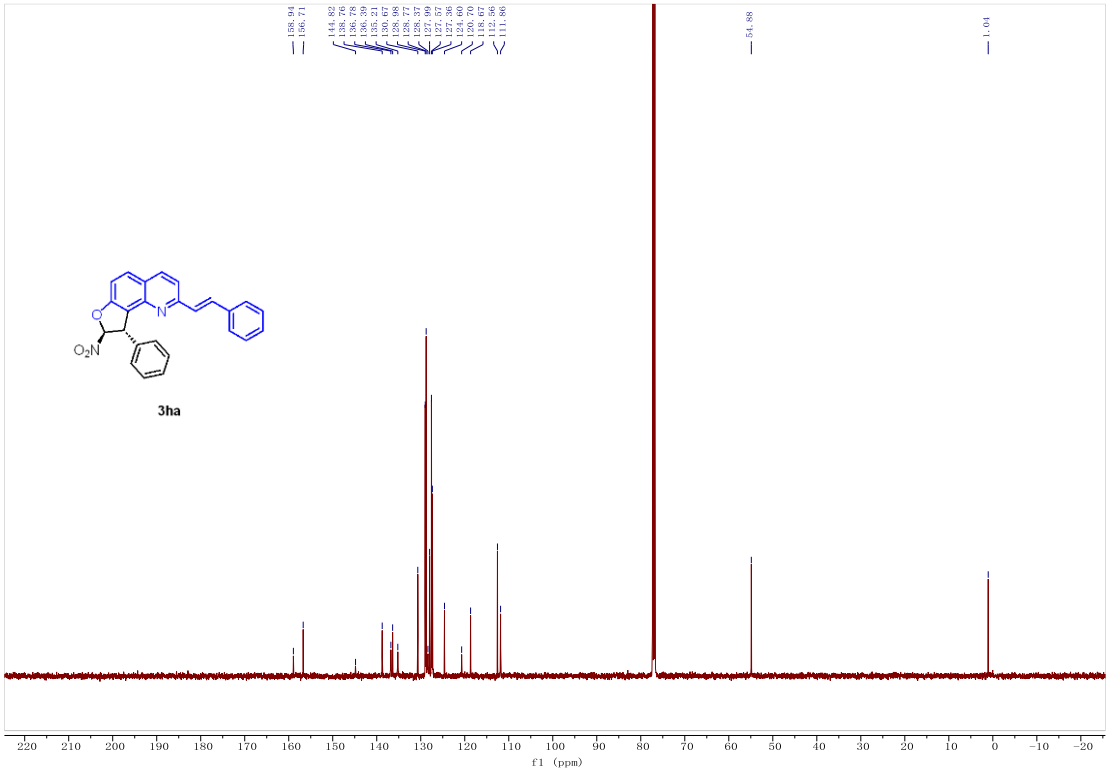
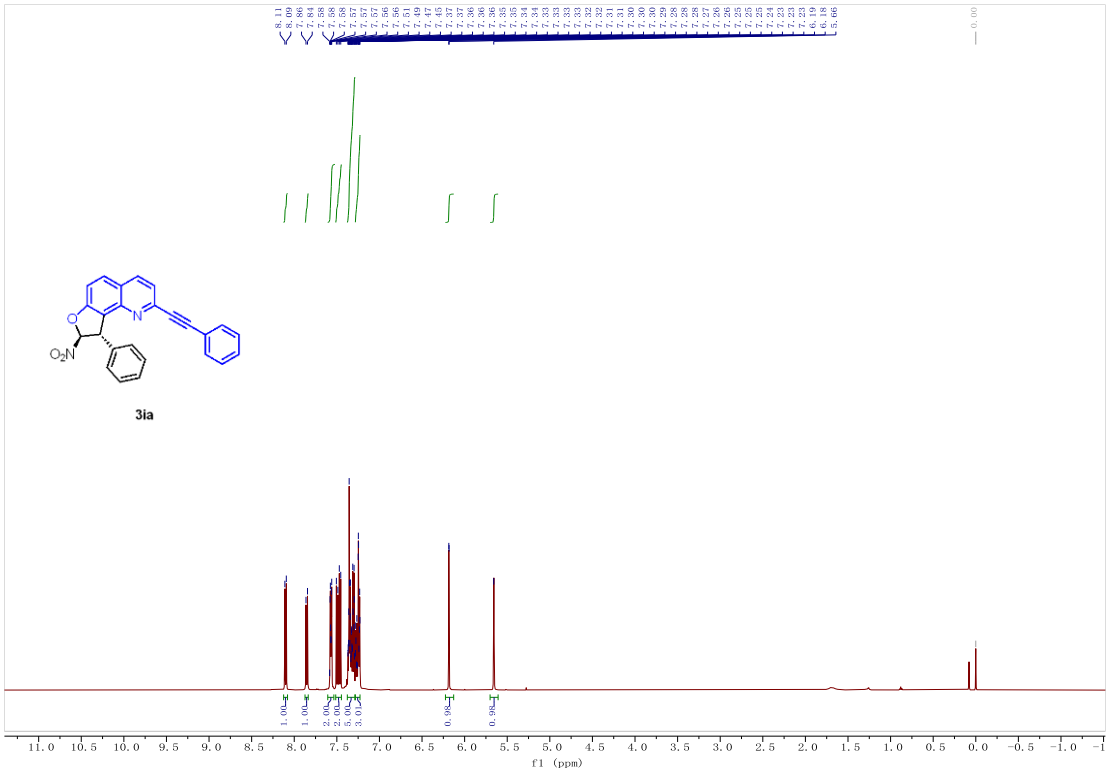


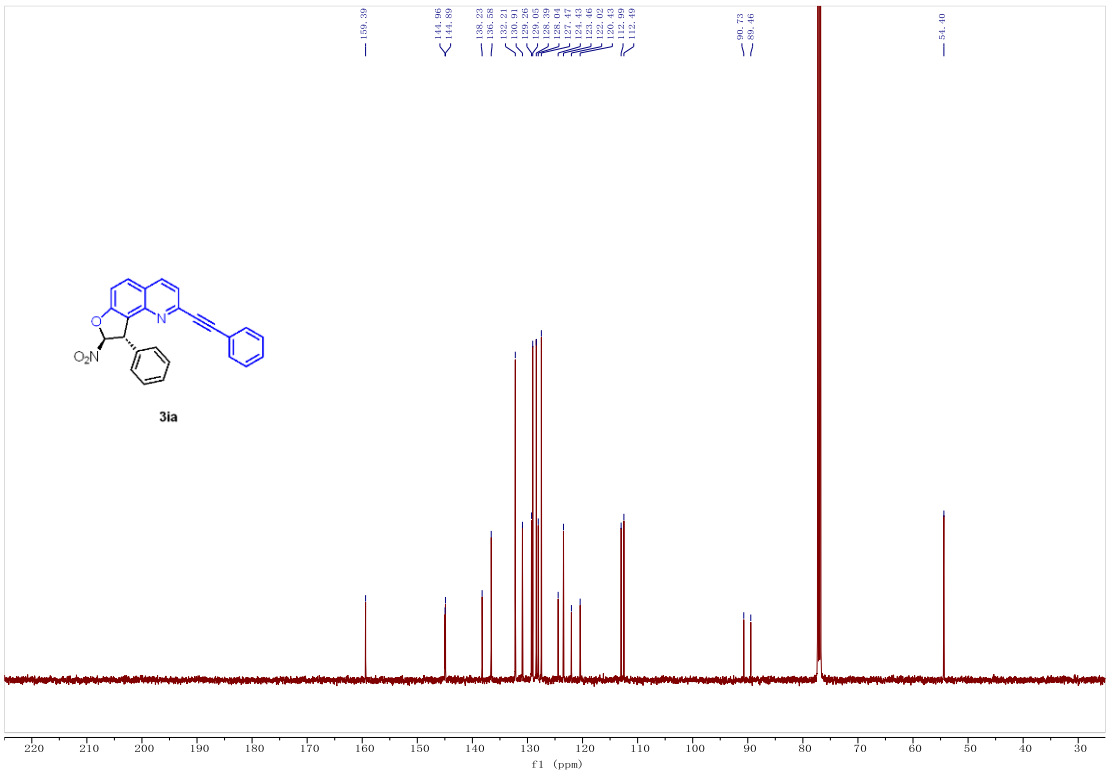
^{13}C NMR of 3ha (126 MHz, $CDCl_3$)



^{1}H NMR of 3ia (500 MHz, $CDCl_3$)



^{13}C NMR of 3ia (126 MHz, $CDCl_3$)



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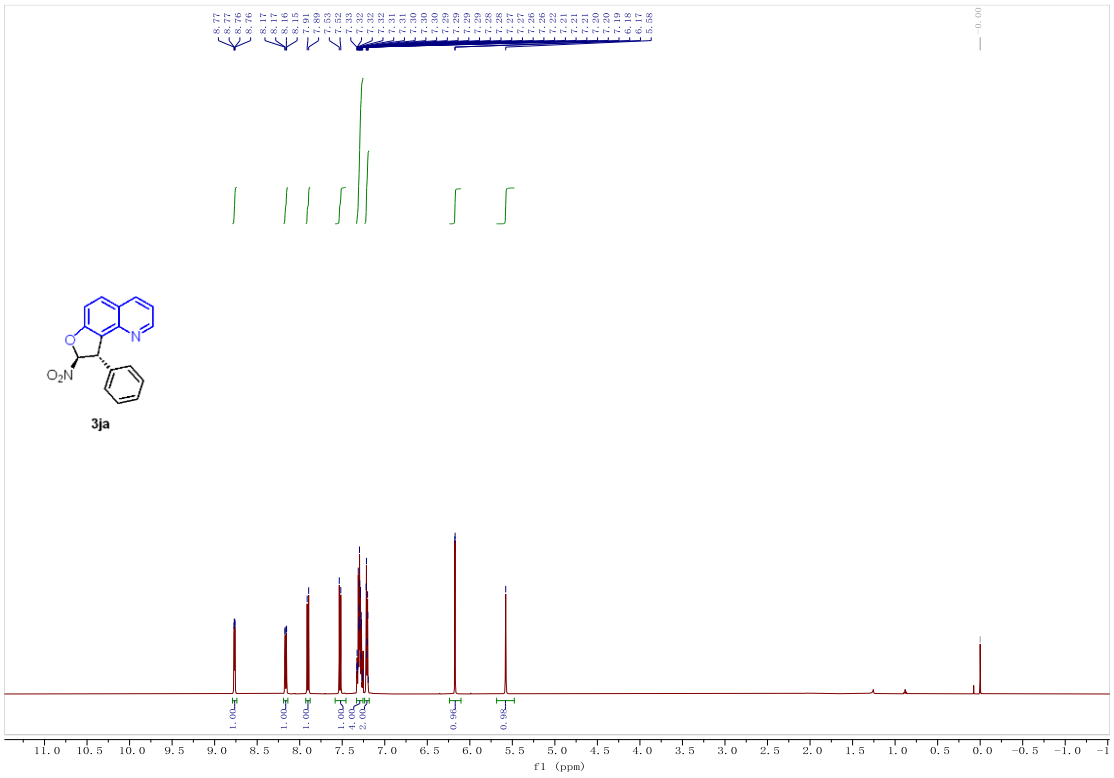

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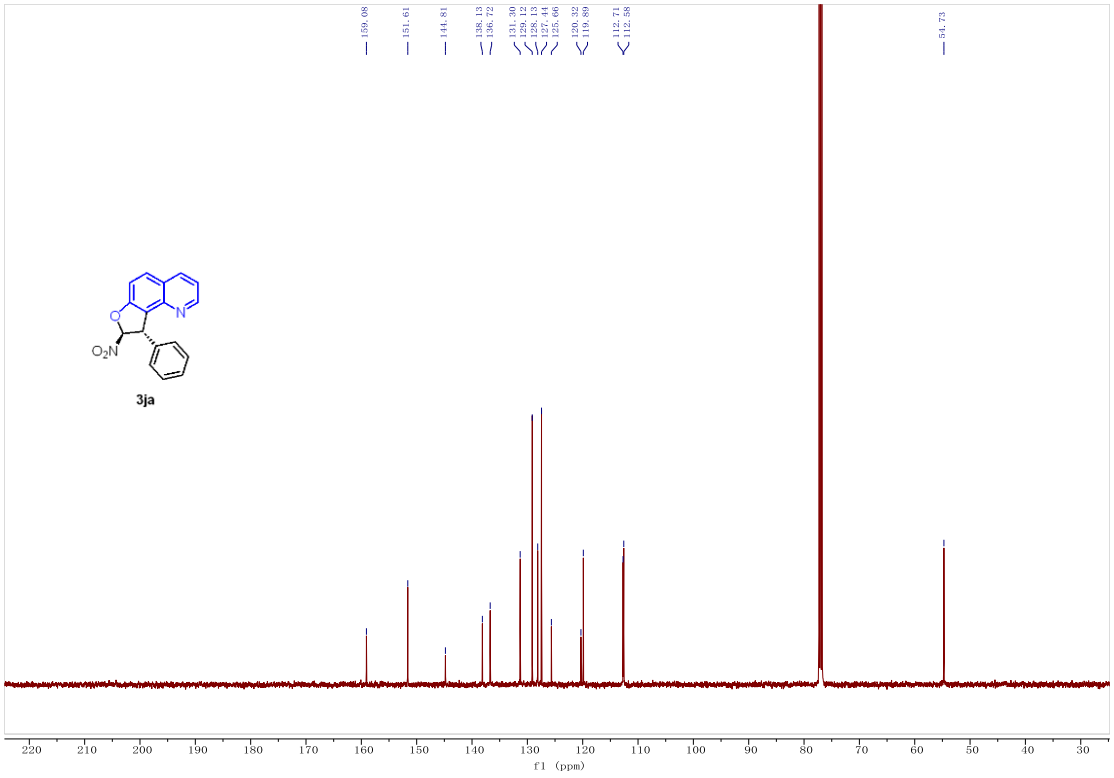

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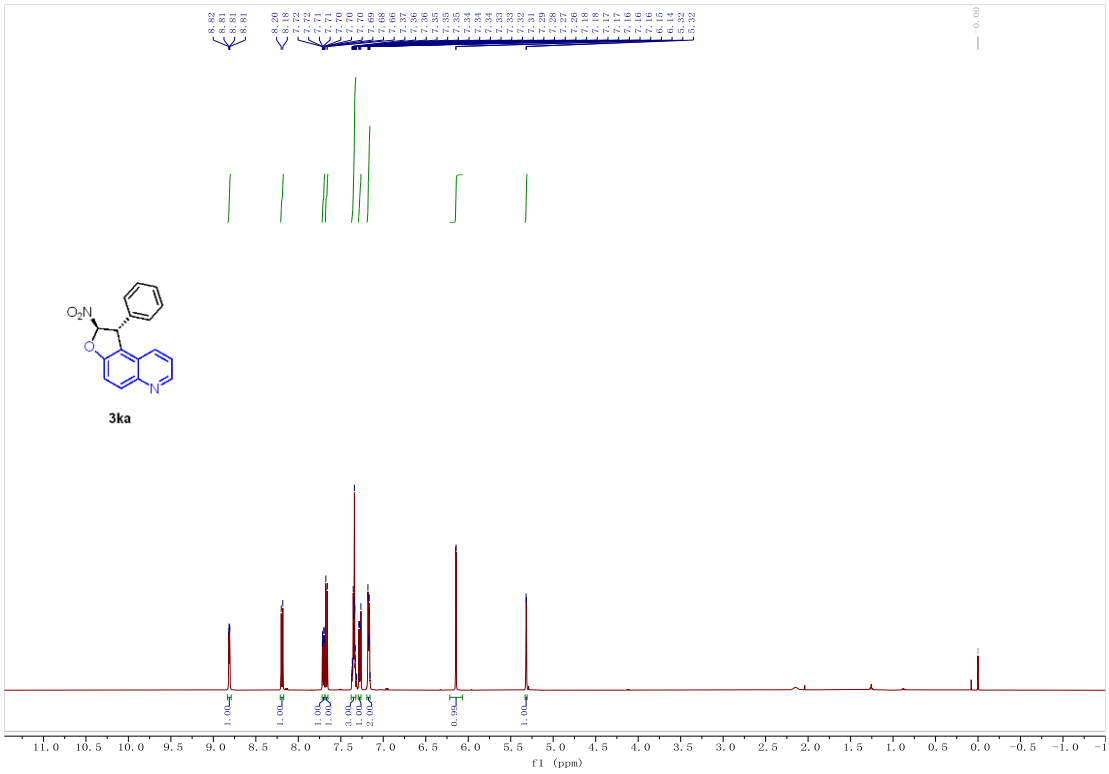

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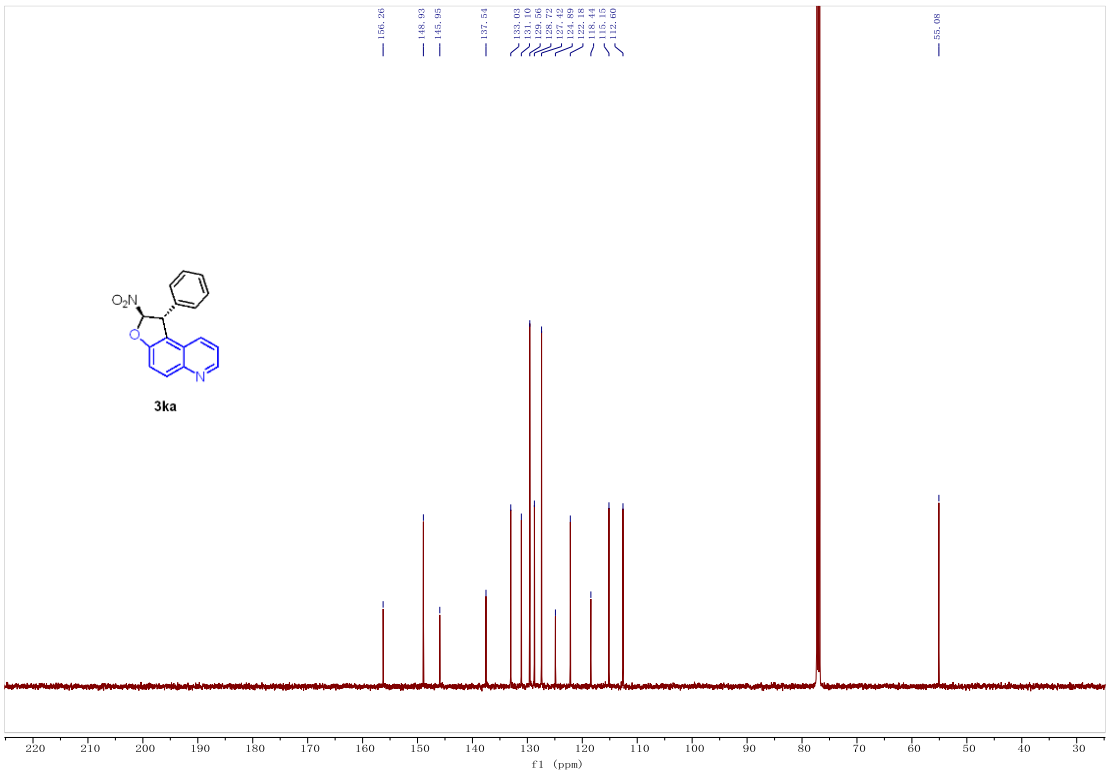

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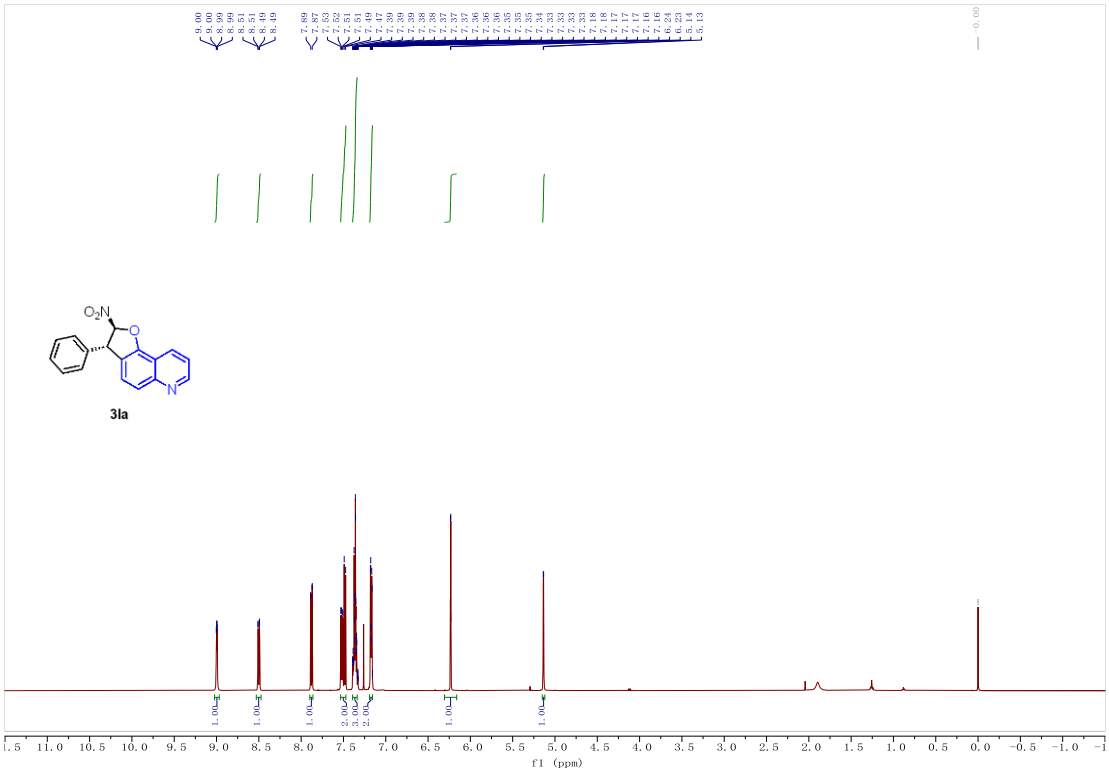

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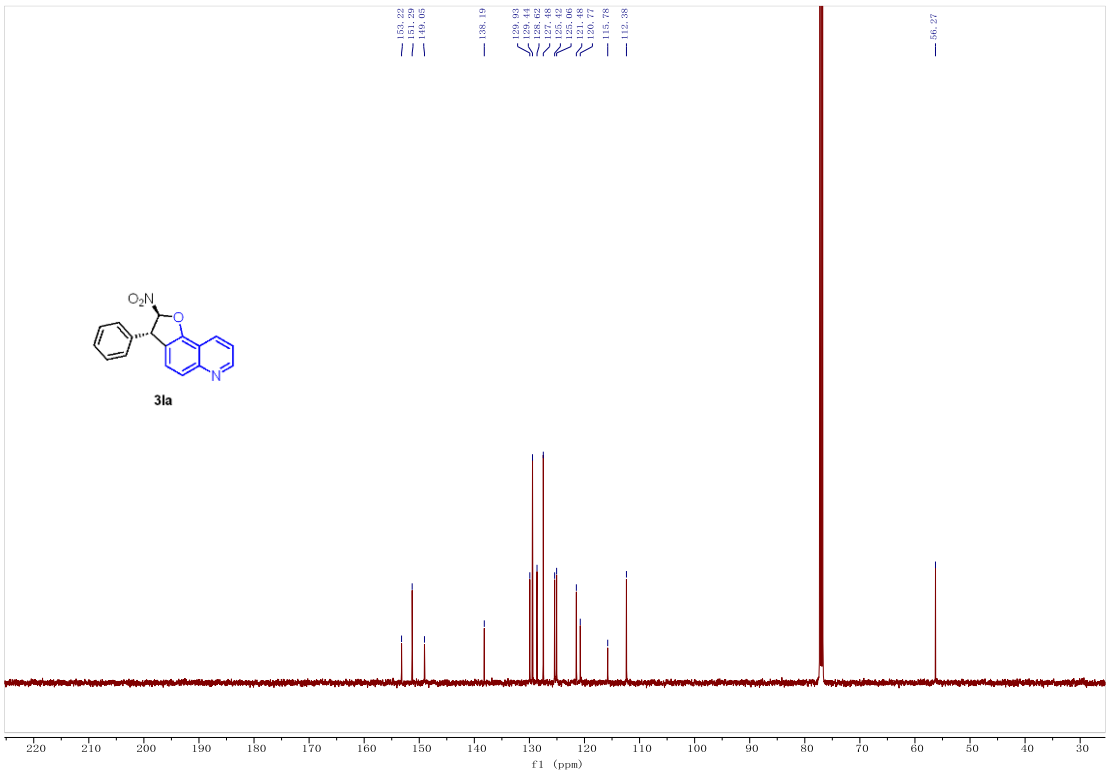
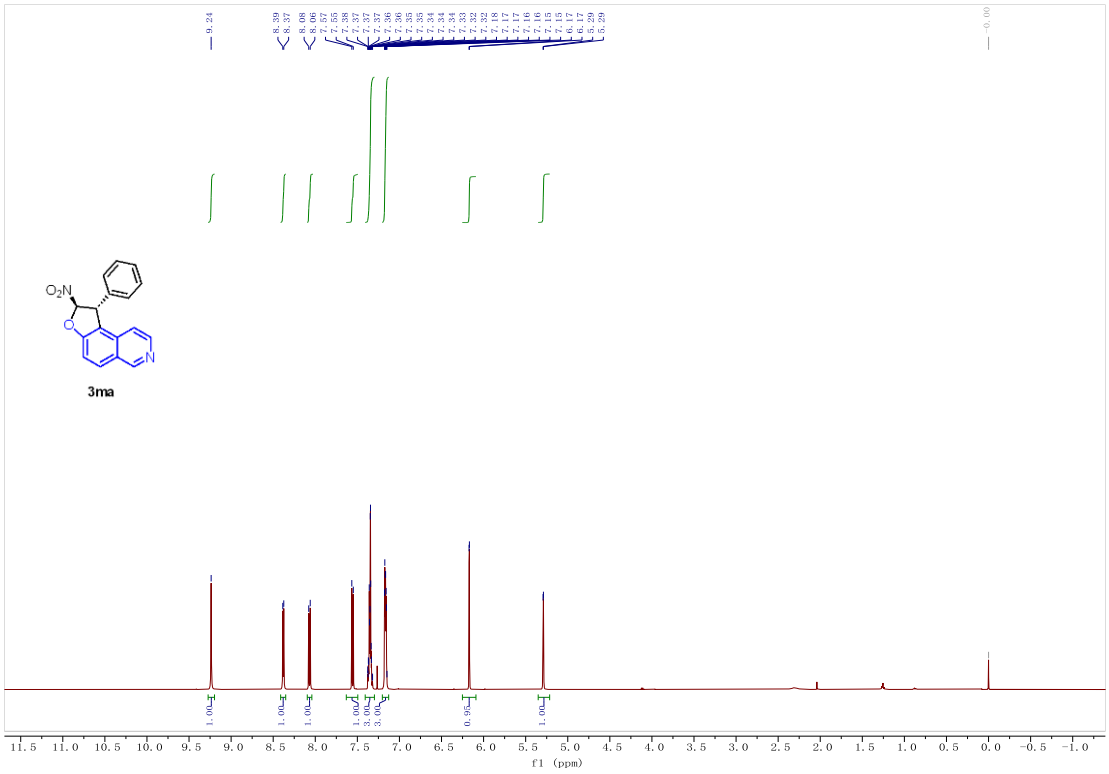
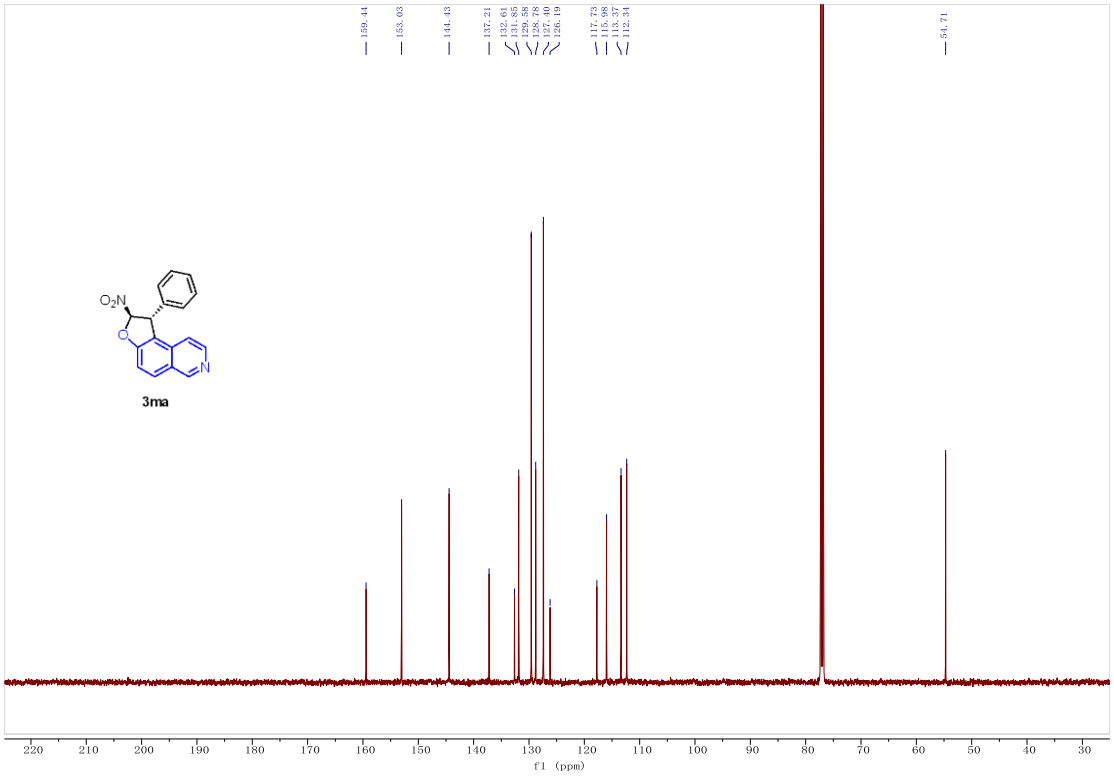


^{1}H NMR of 3ma (500 MHz, $CDCl_3$)



^{13}C NMR of 3na (126 MHz, $CDCl_3$)



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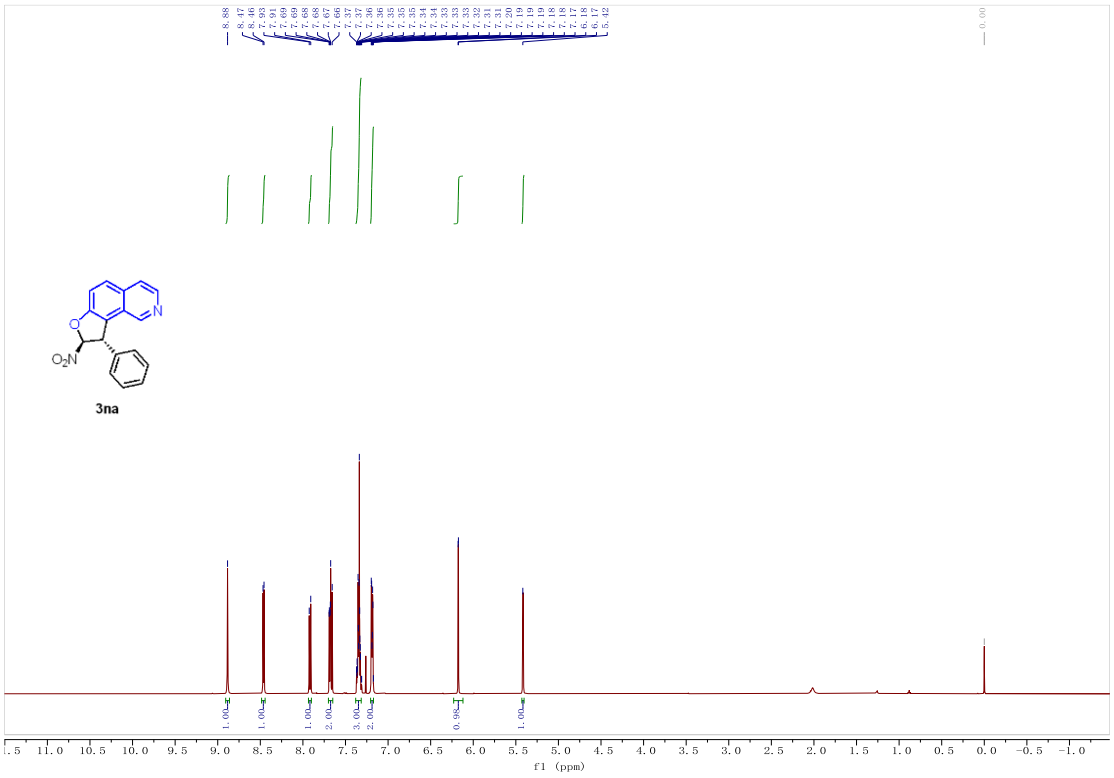

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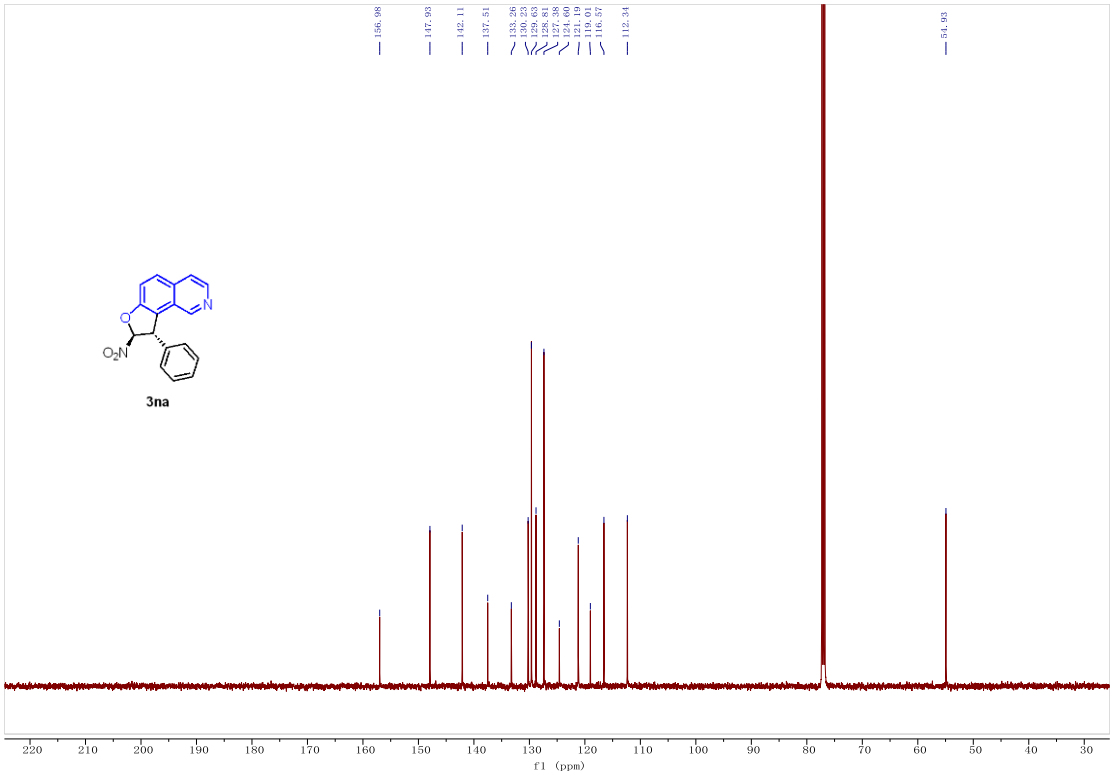
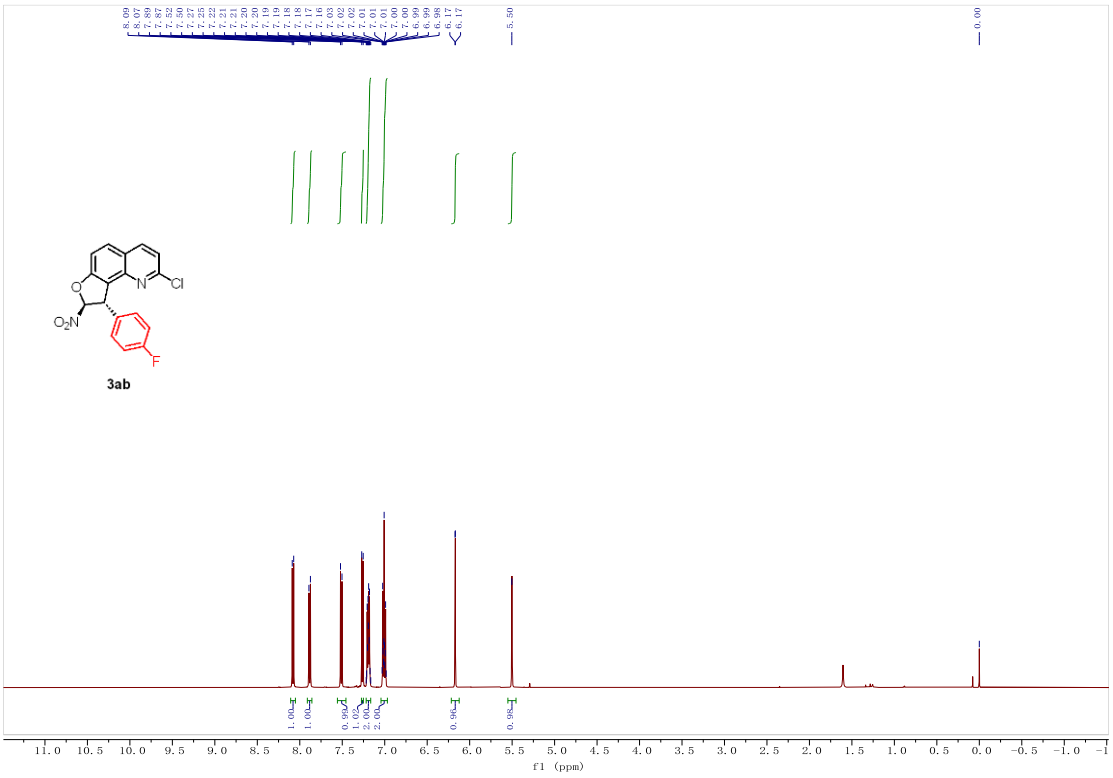
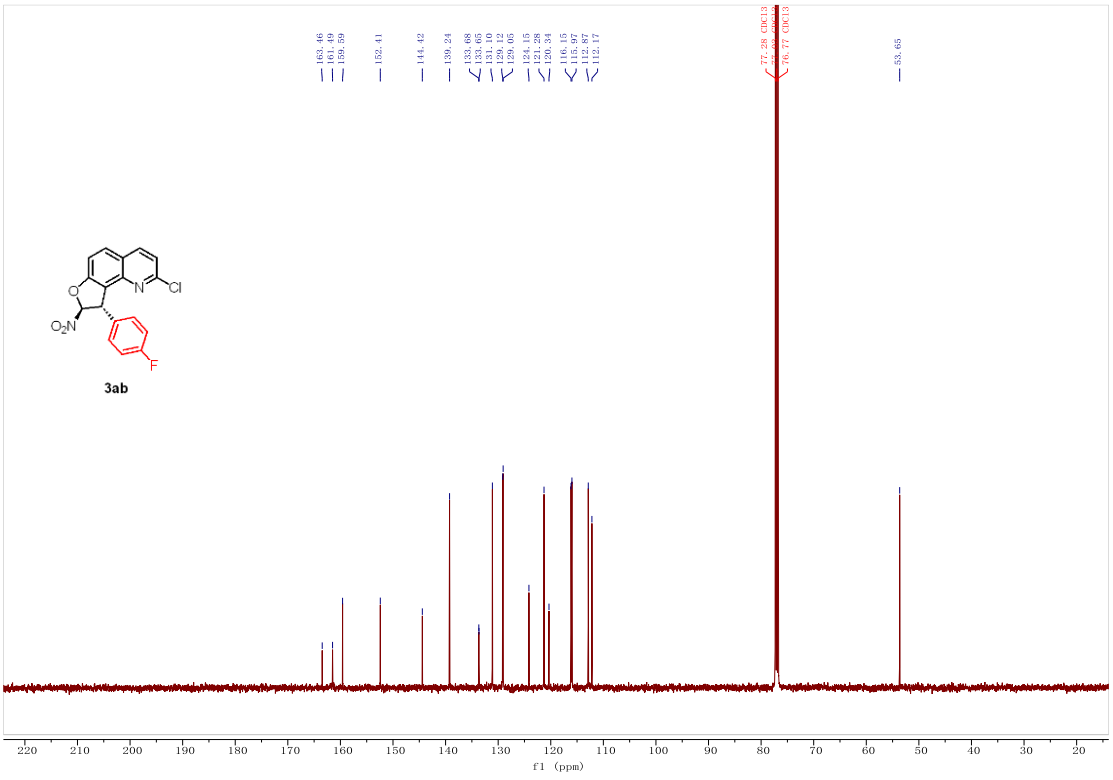


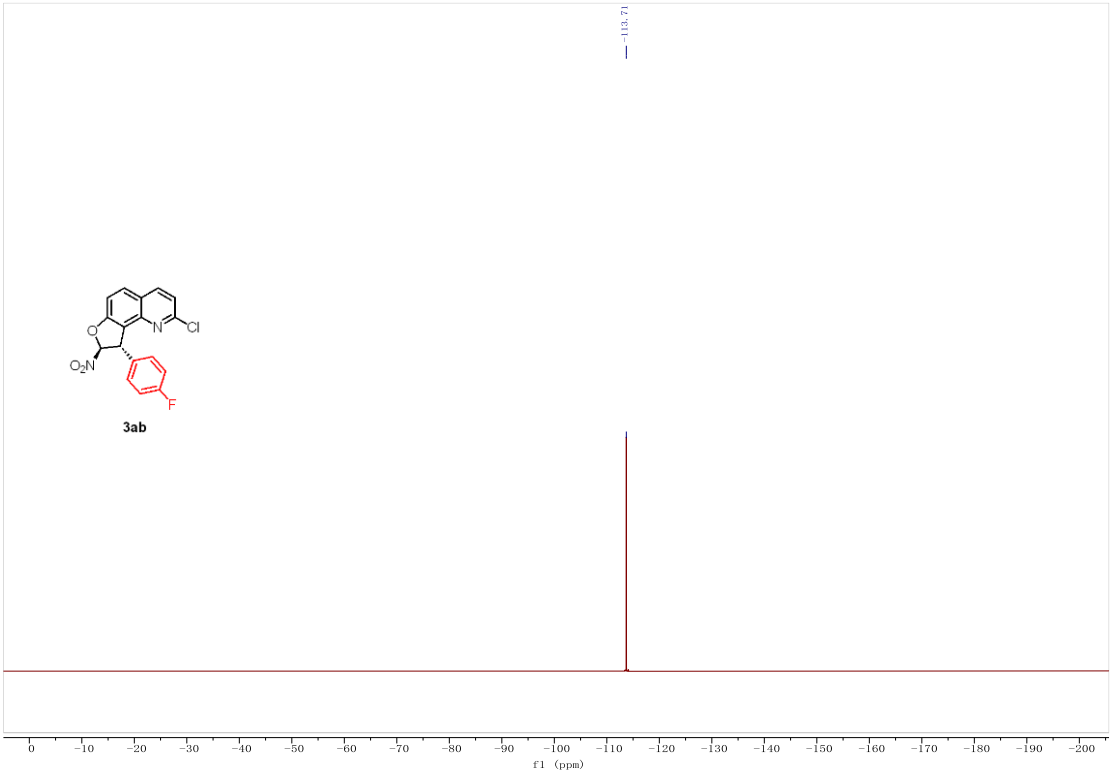
^{1}H NMR of 3ab (500 MHz, $CDCl_3$)



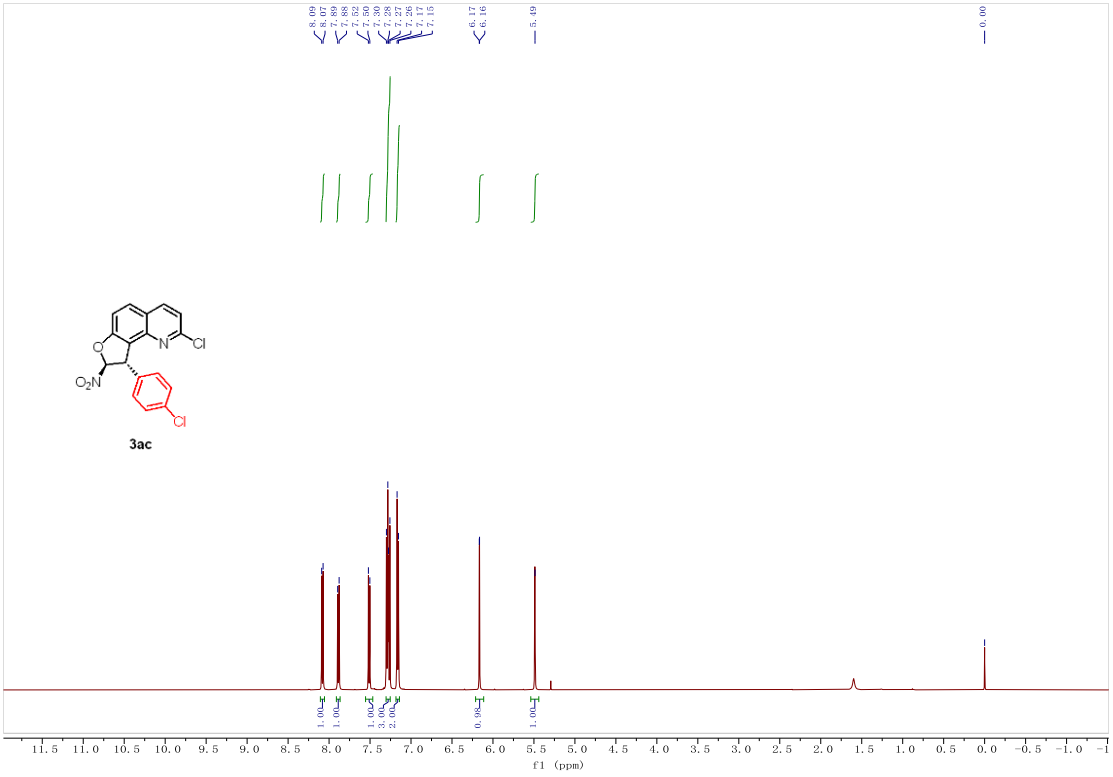
^{13}C NMR of 3ab (126 MHz, $CDCl_3$)



^{19}F NMR of 3ab (400 MHz, $CDCl_3$)



^{1}H NMR of 3ac (500 MHz, $CDCl_3$)



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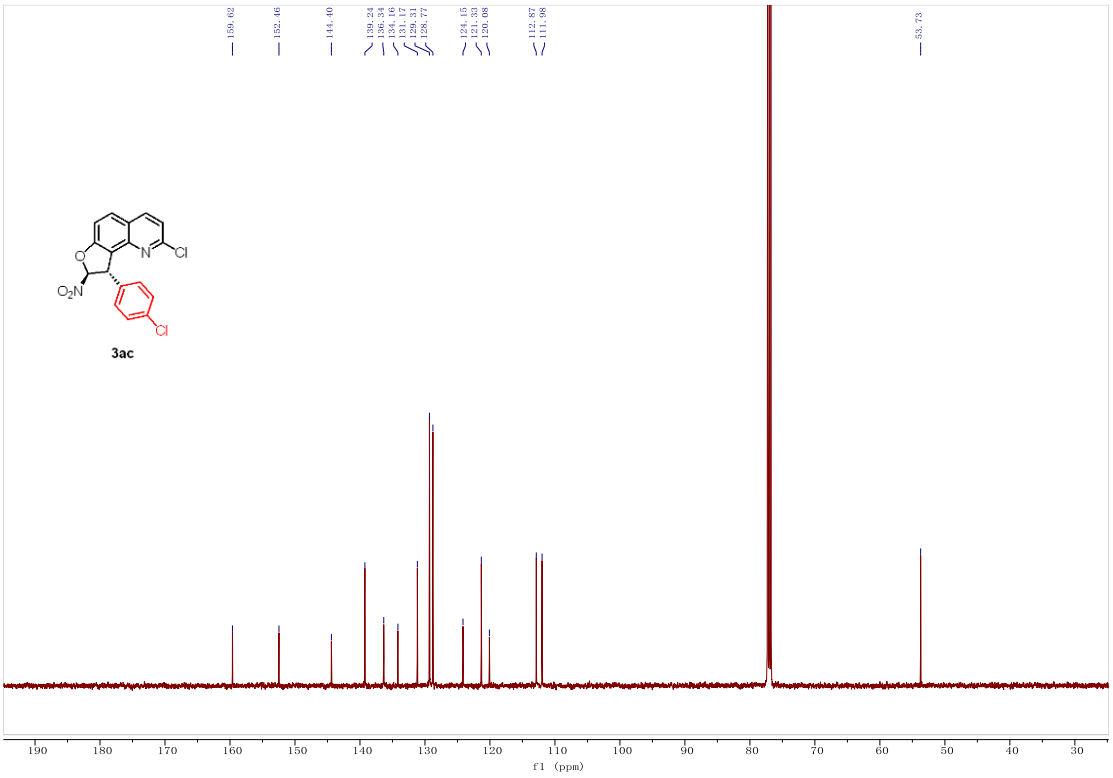

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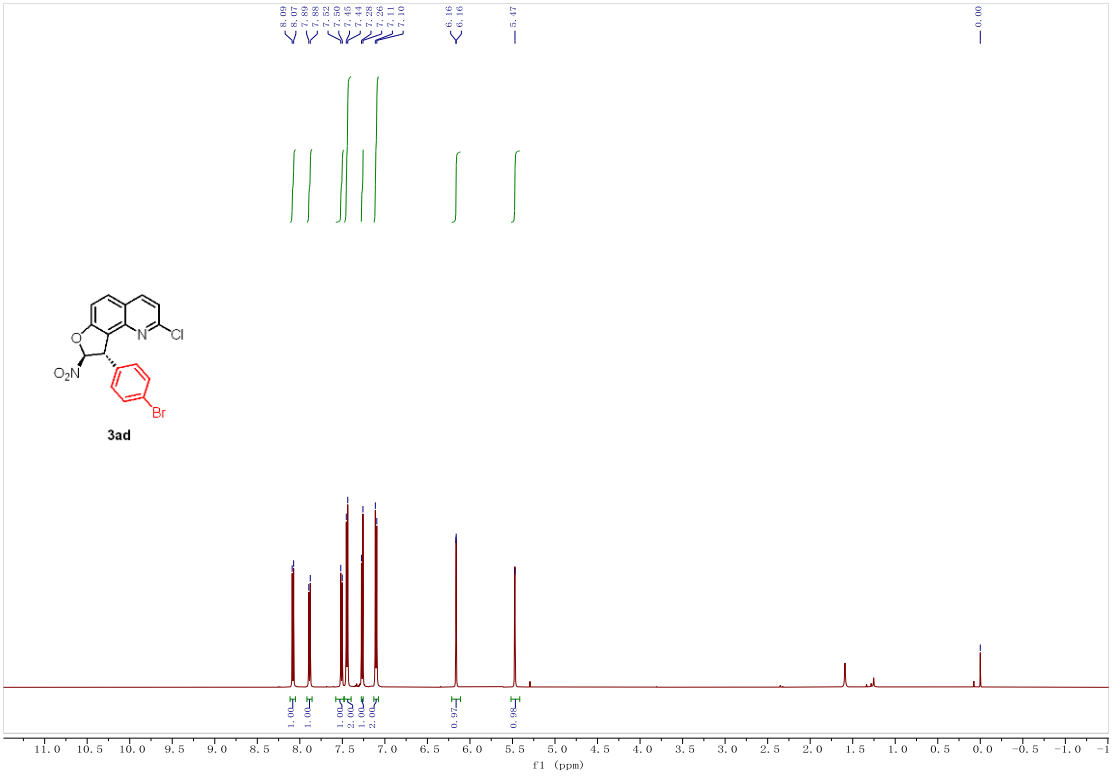

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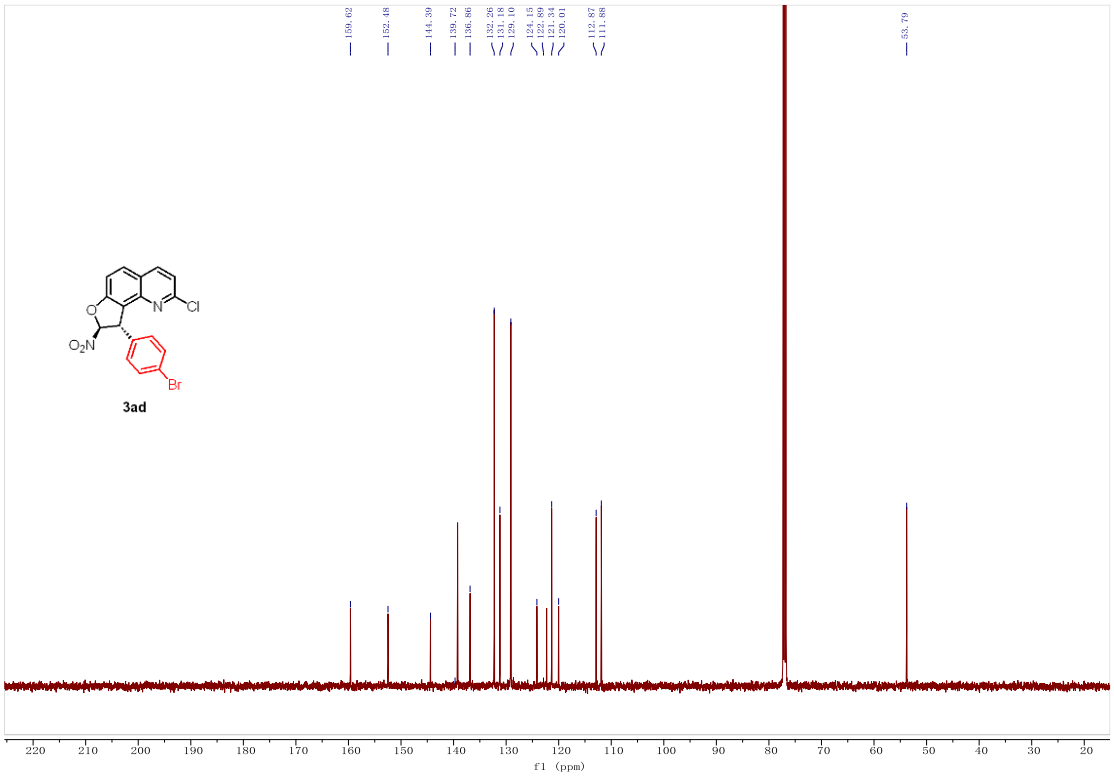

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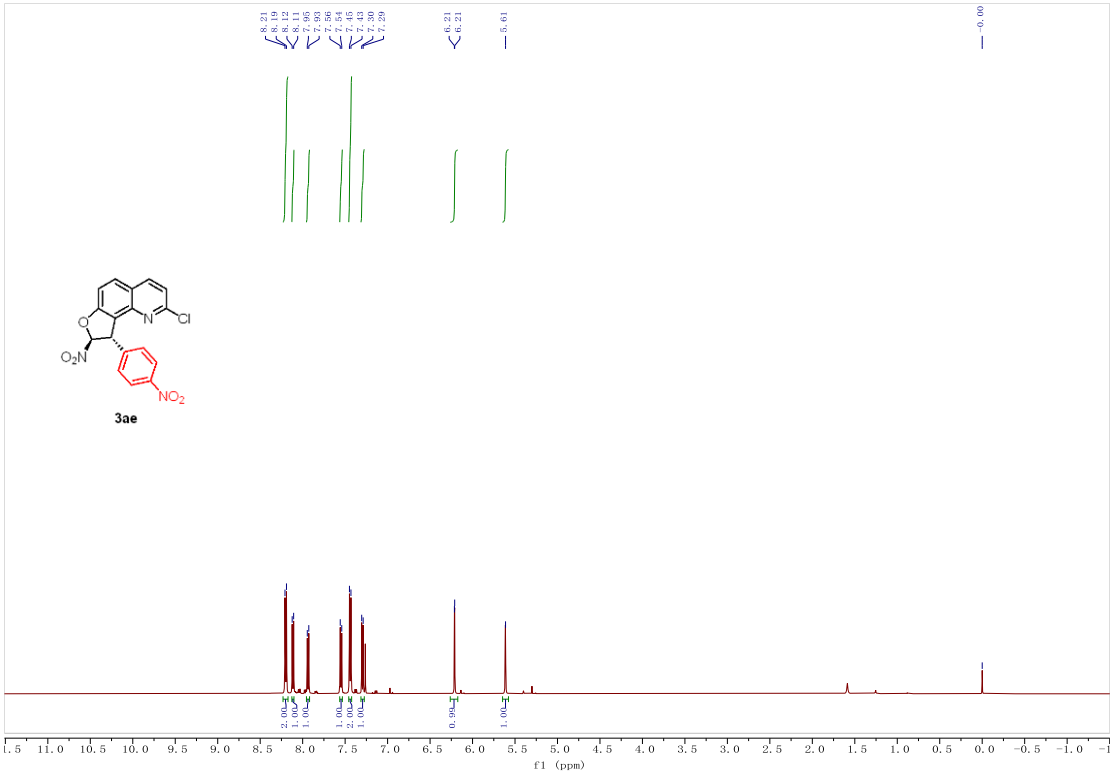

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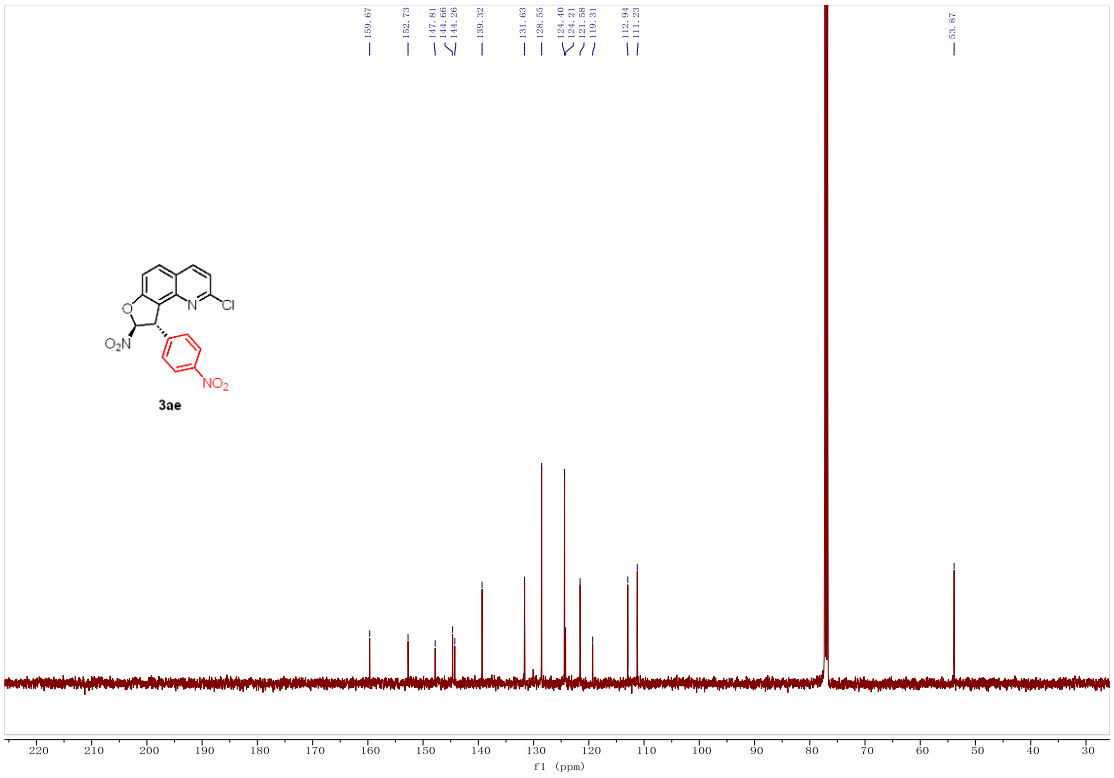

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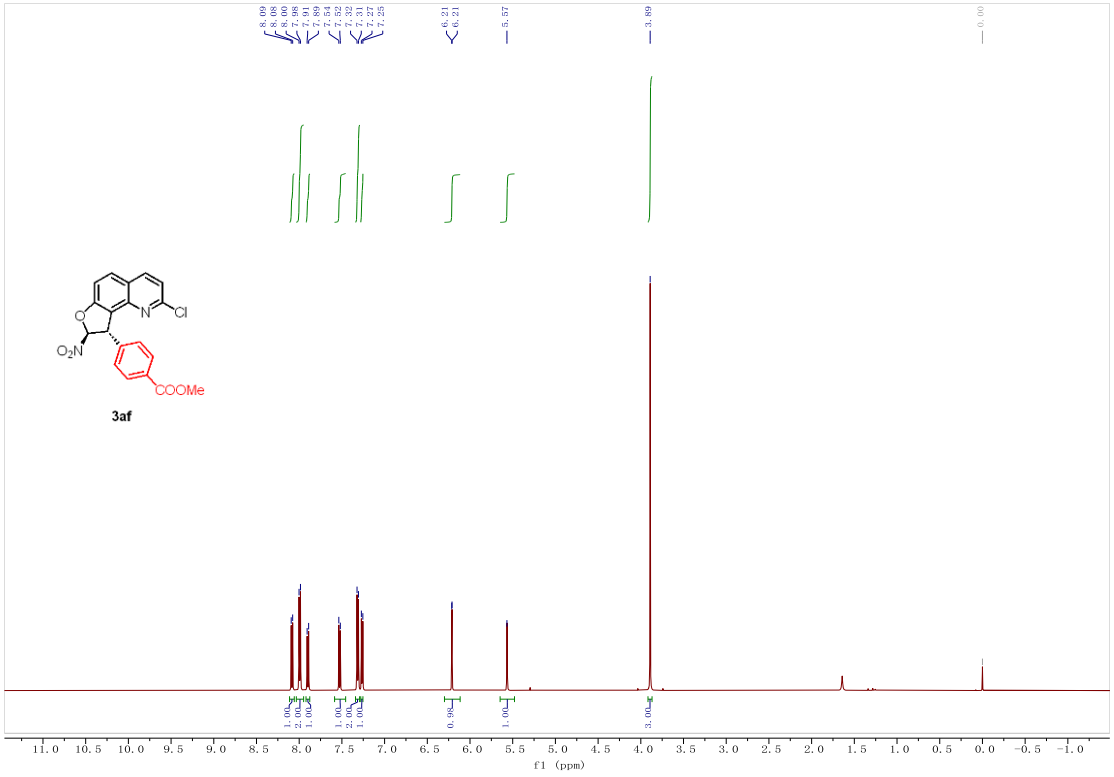

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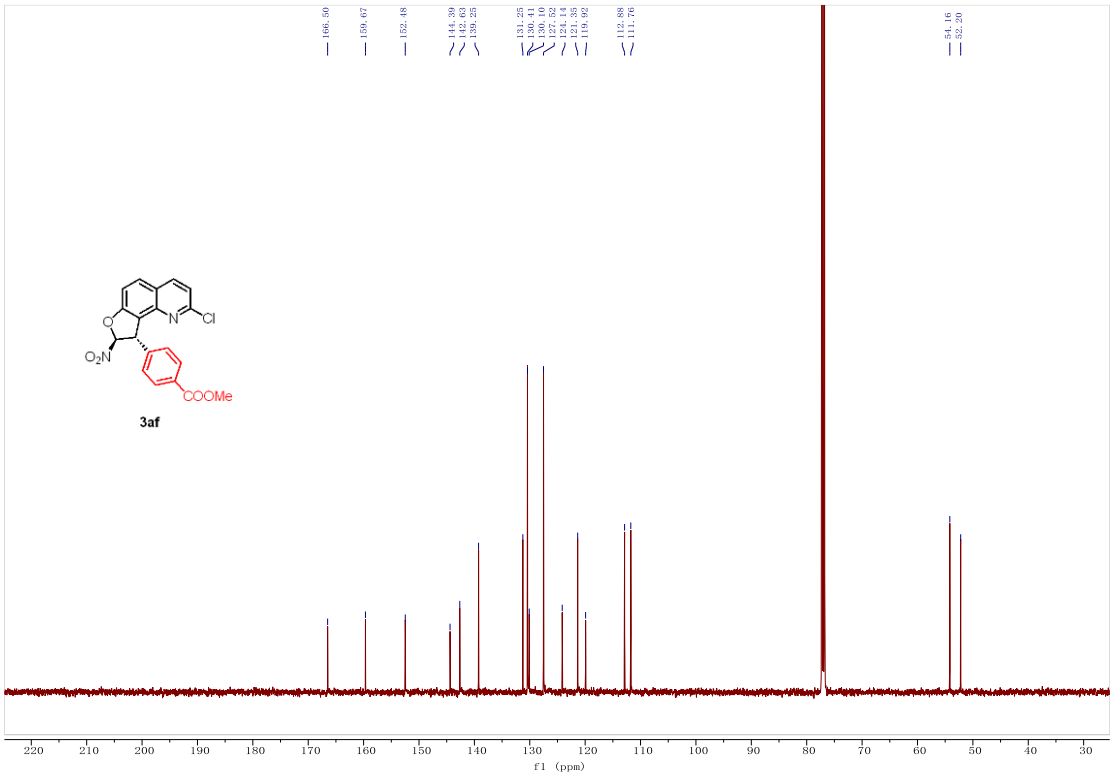

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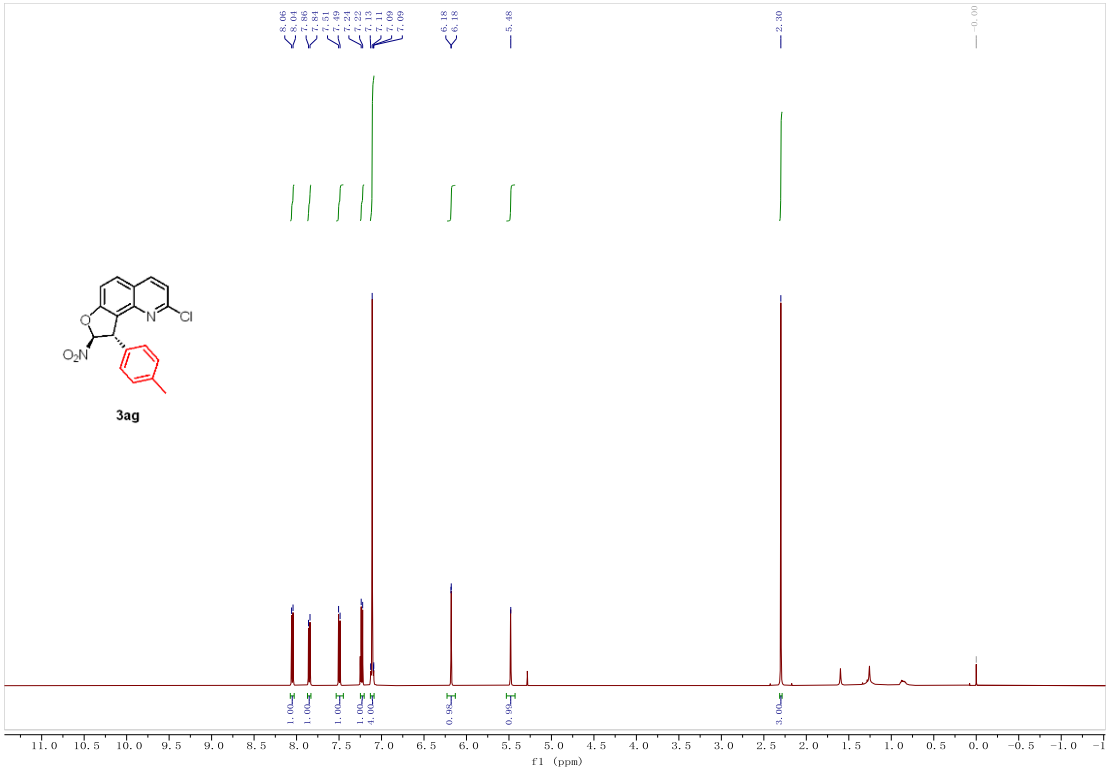

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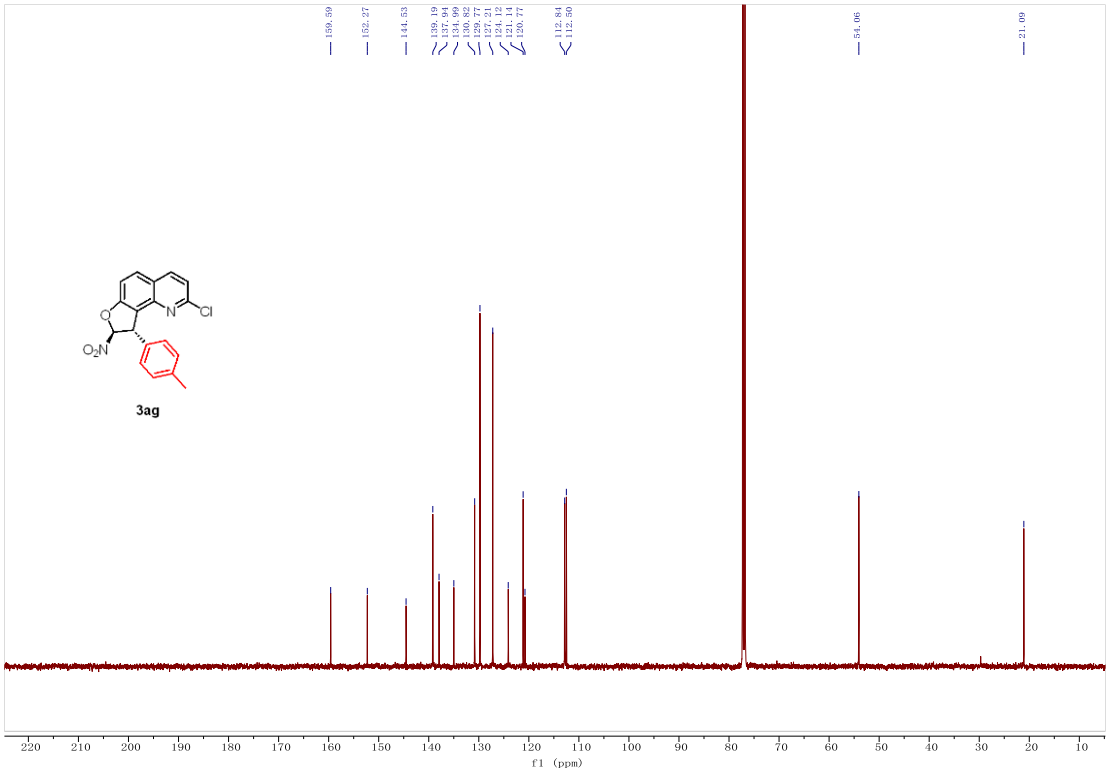

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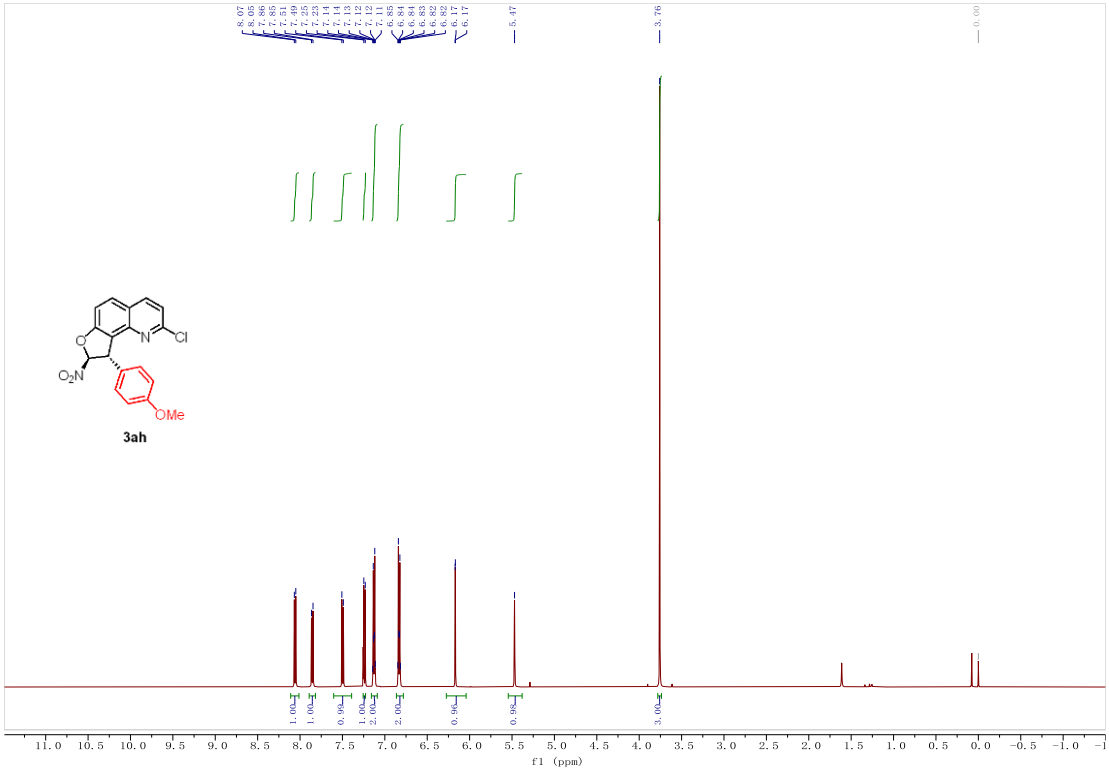

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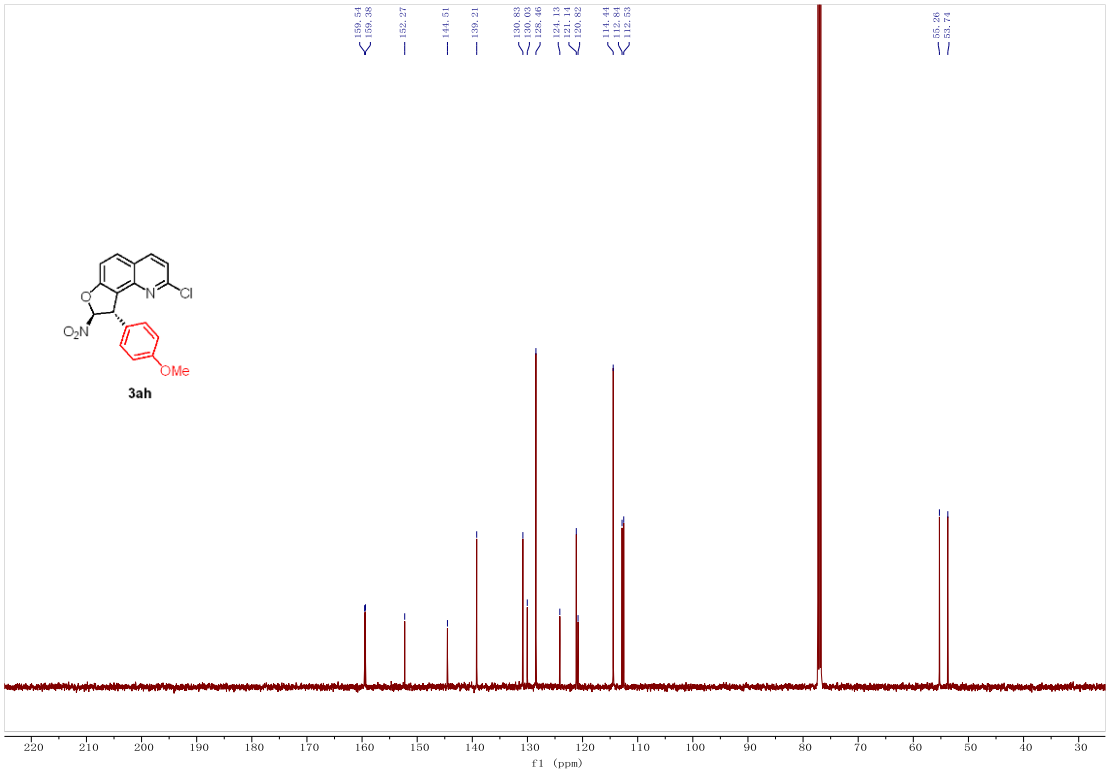

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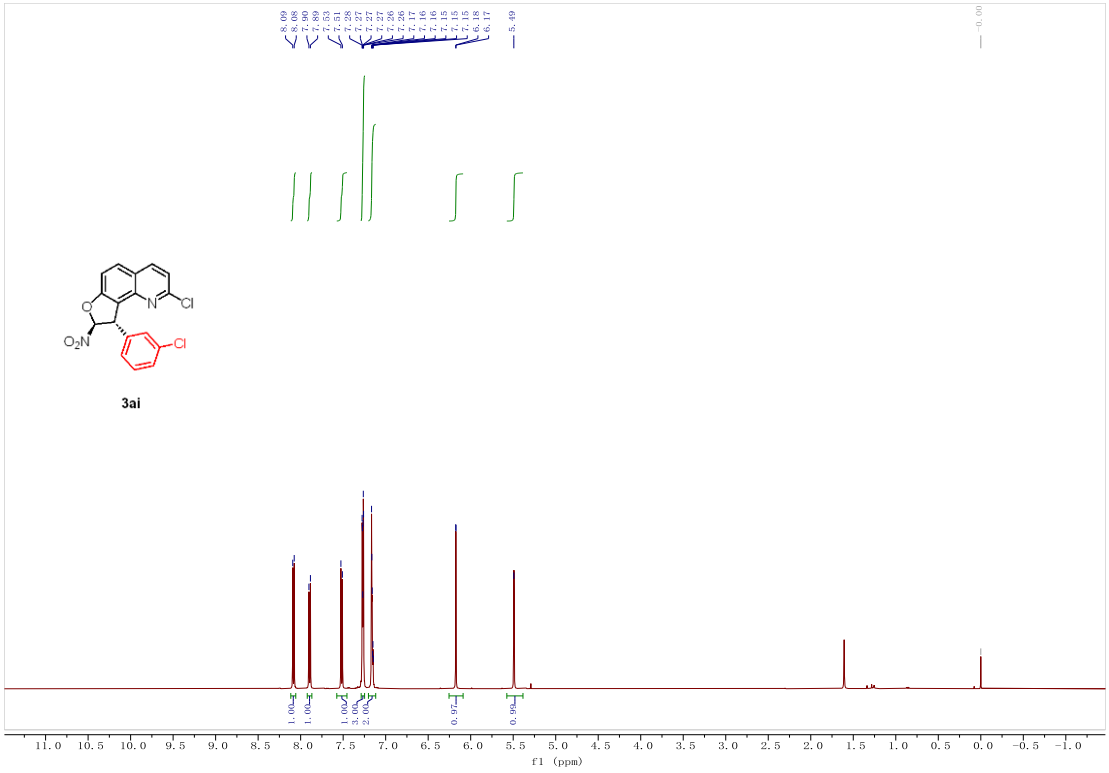

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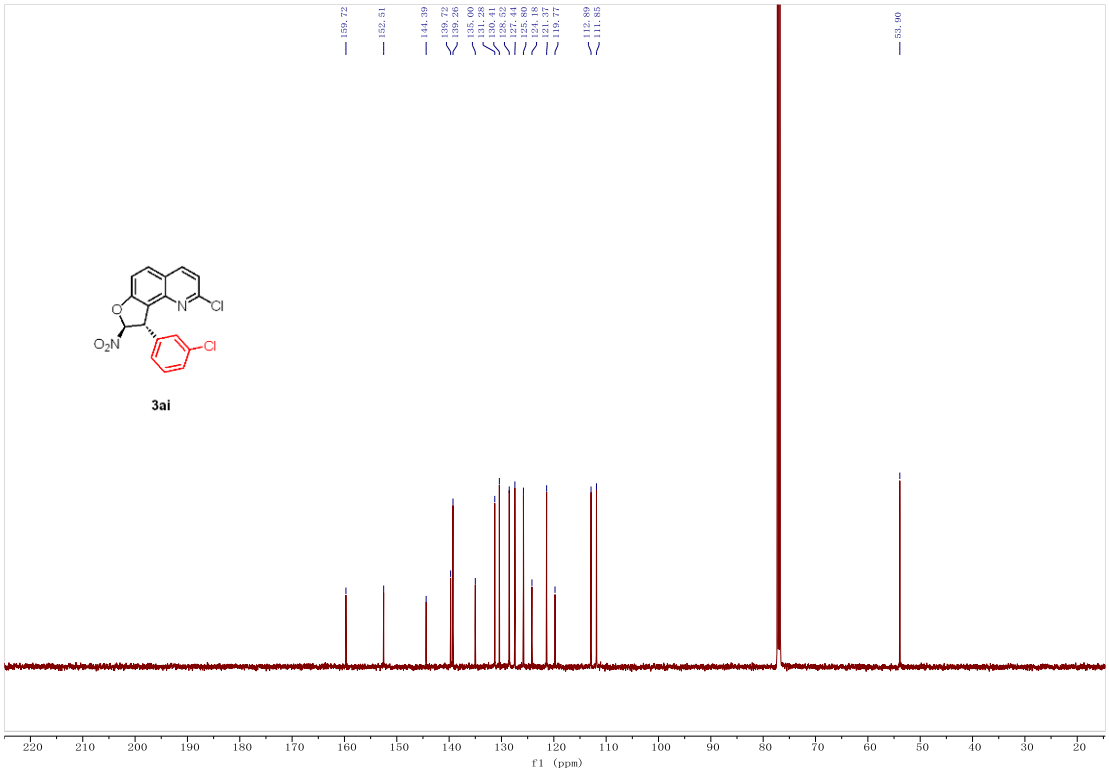

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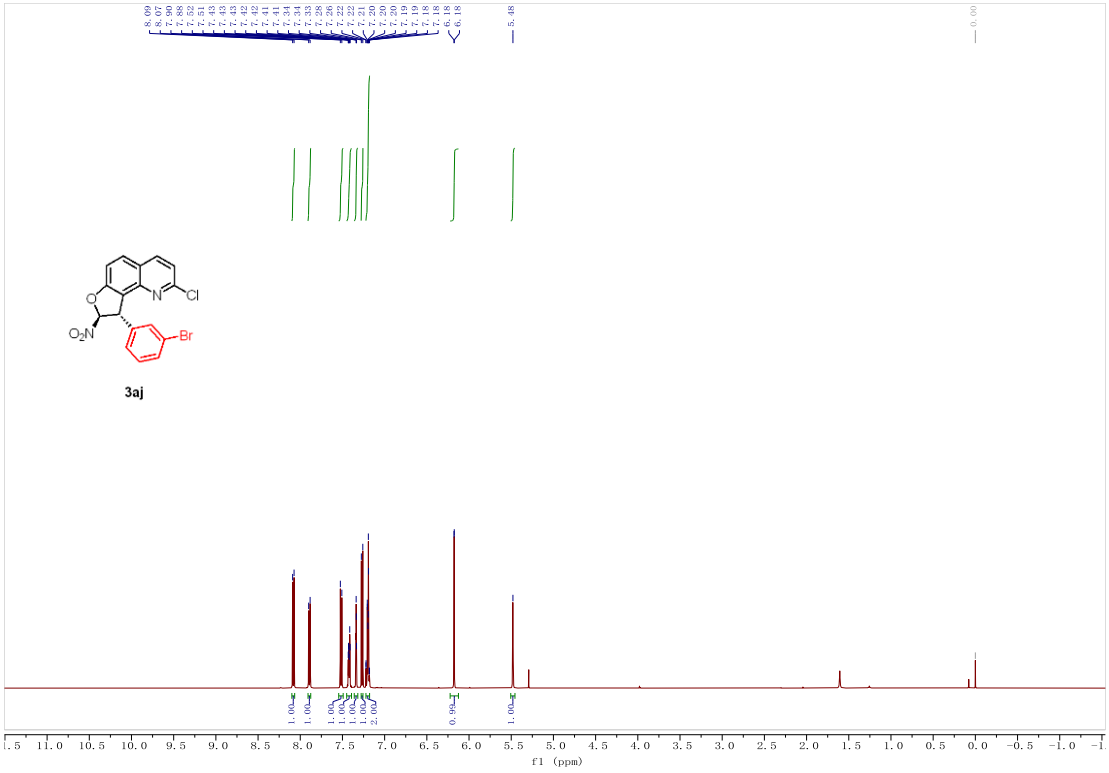
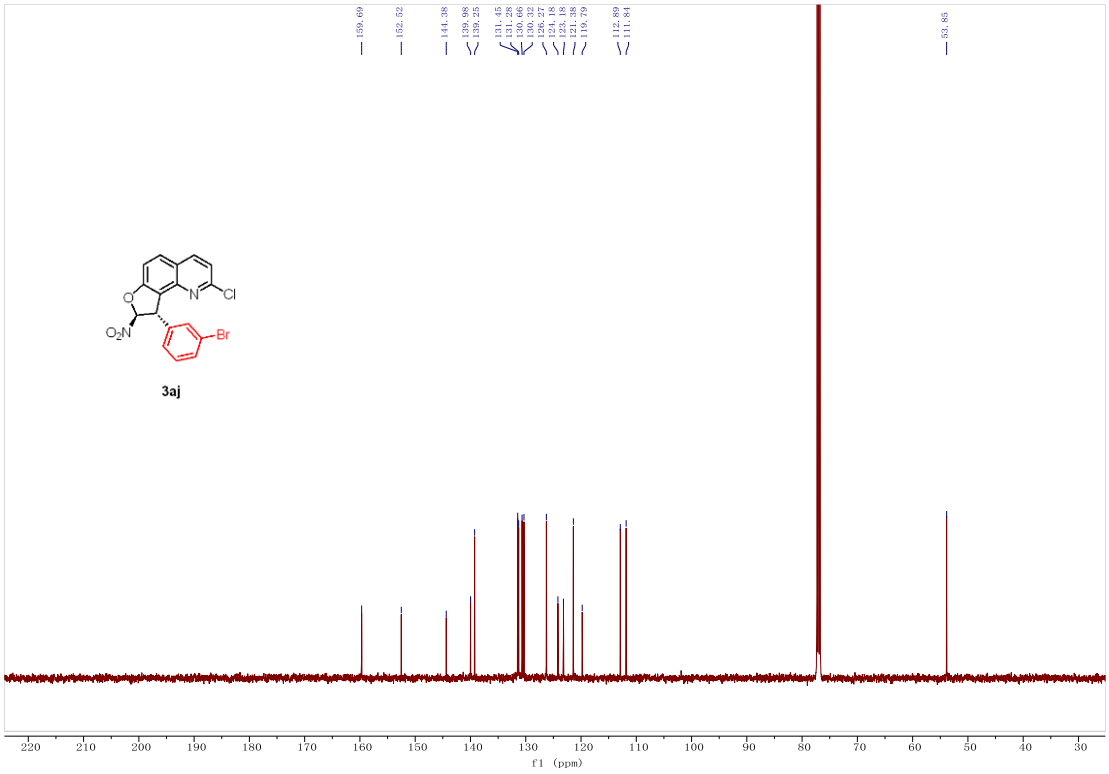
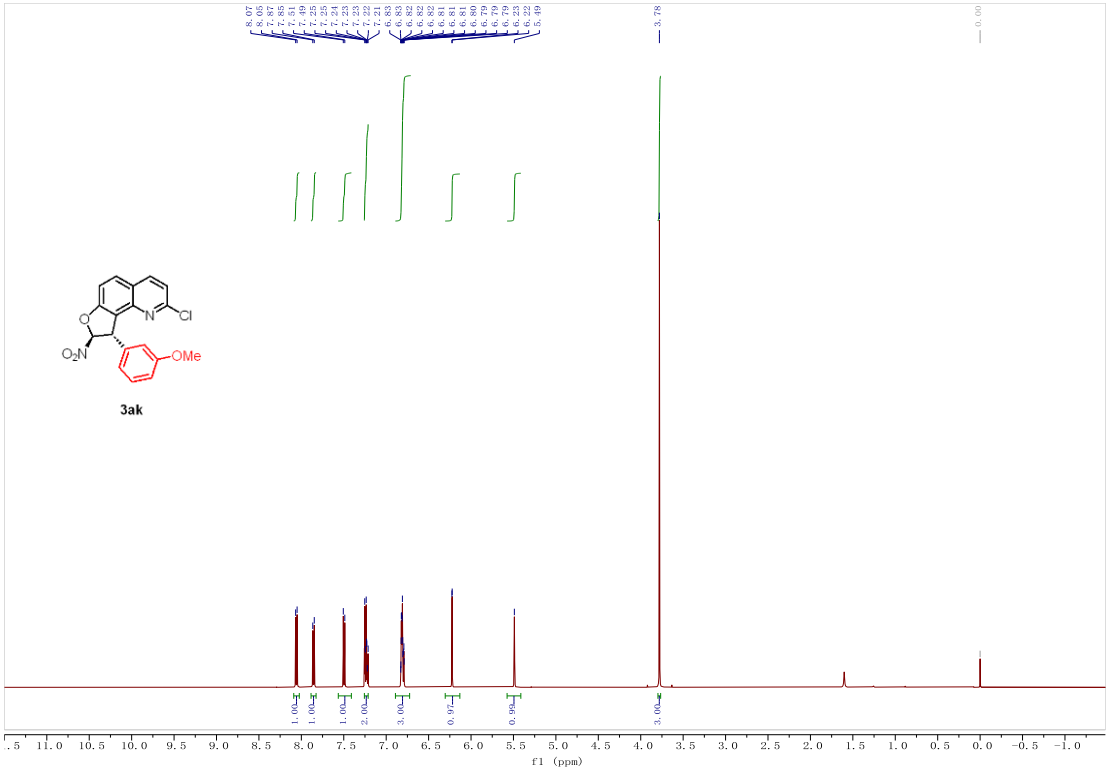


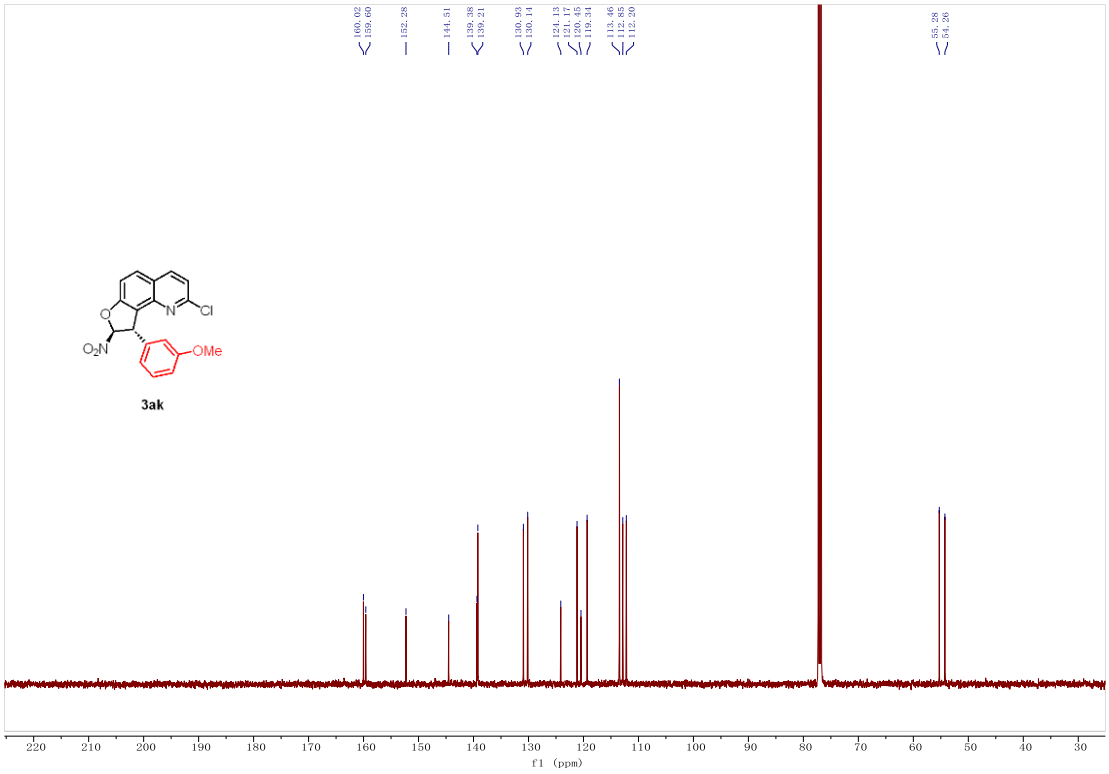
^{13}C NMR of 3aj (126 MHz, $CDCl_3$)



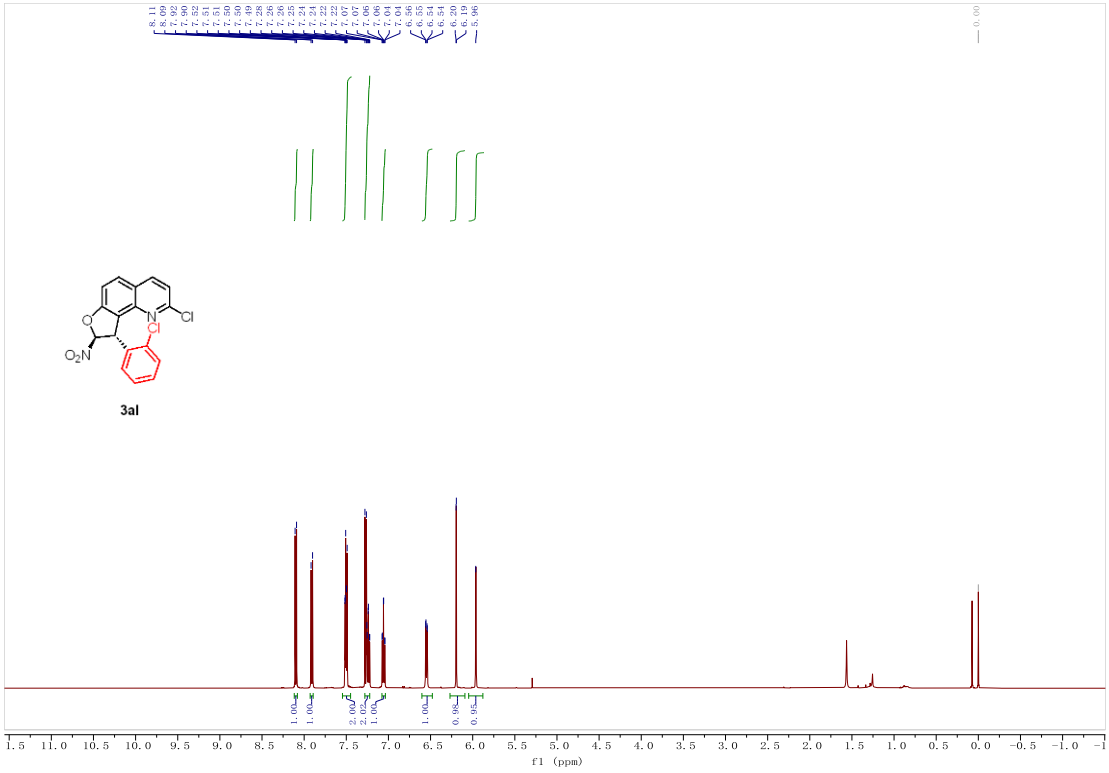
^{1}H NMR of 3ak (500 MHz, $CDCl_3$)



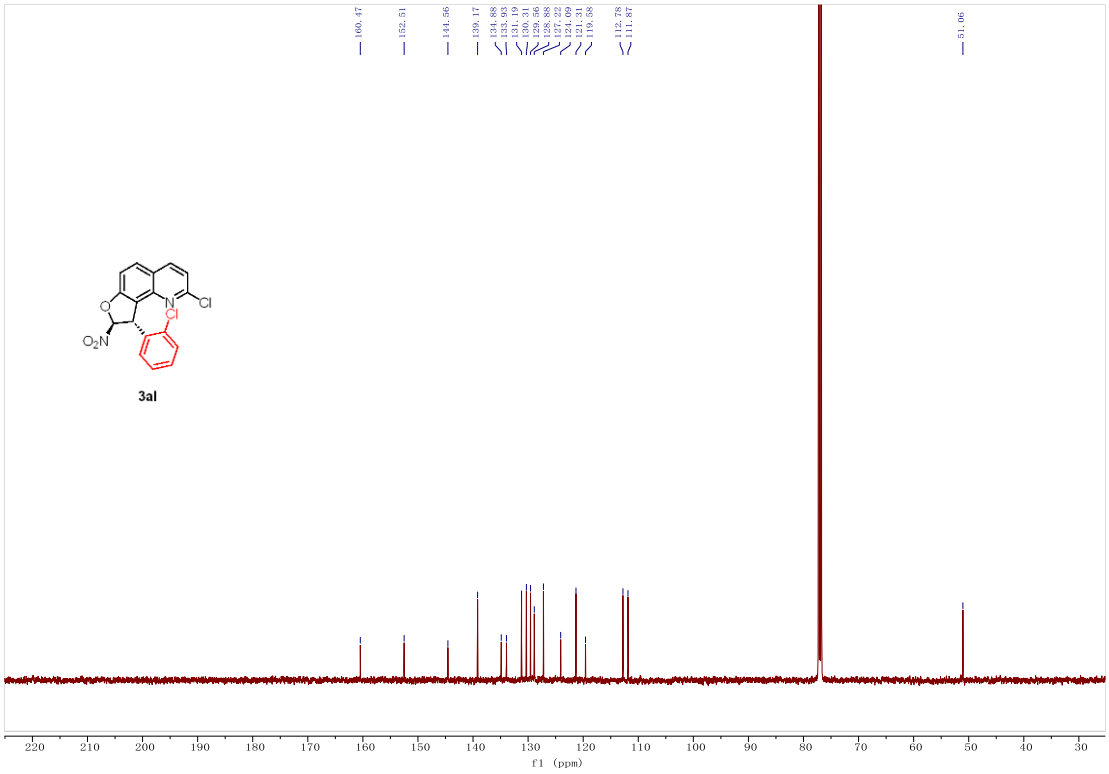
^{13}C NMR of 3ak (126 MHz, $CDCl_3$)



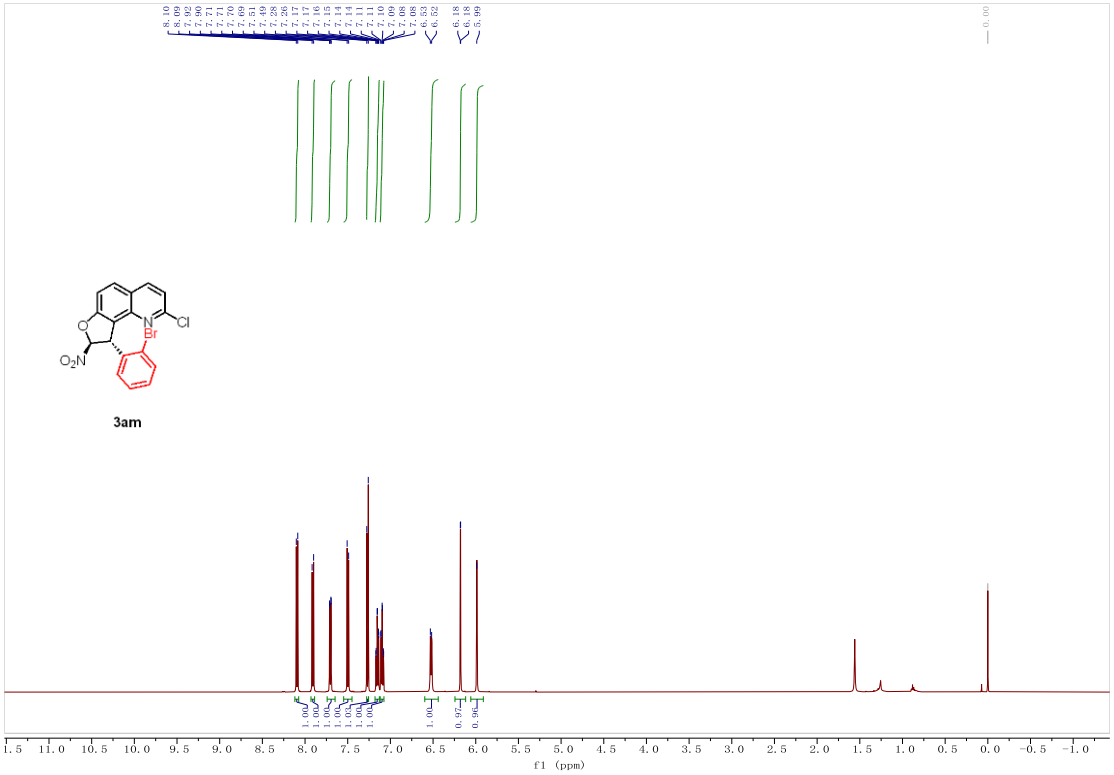
^{1}H NMR of 3al (500 MHz, $CDCl_3$)



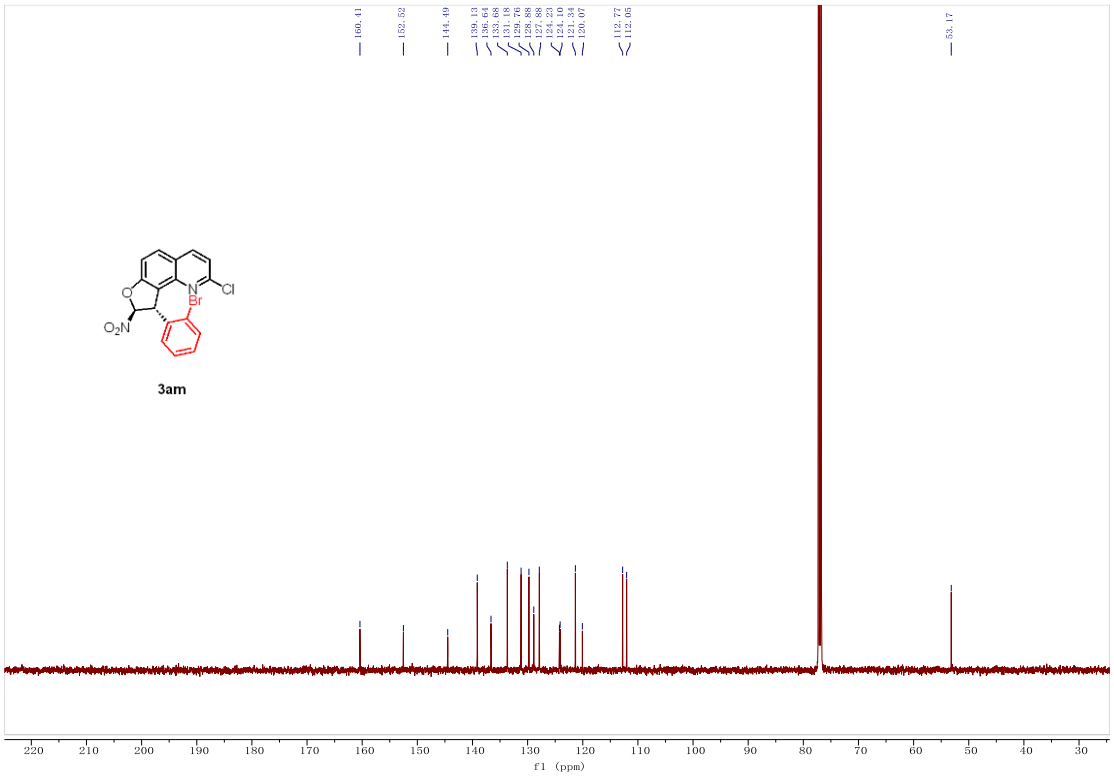
^{13}C NMR of 3al (126 MHz, $CDCl_3$)



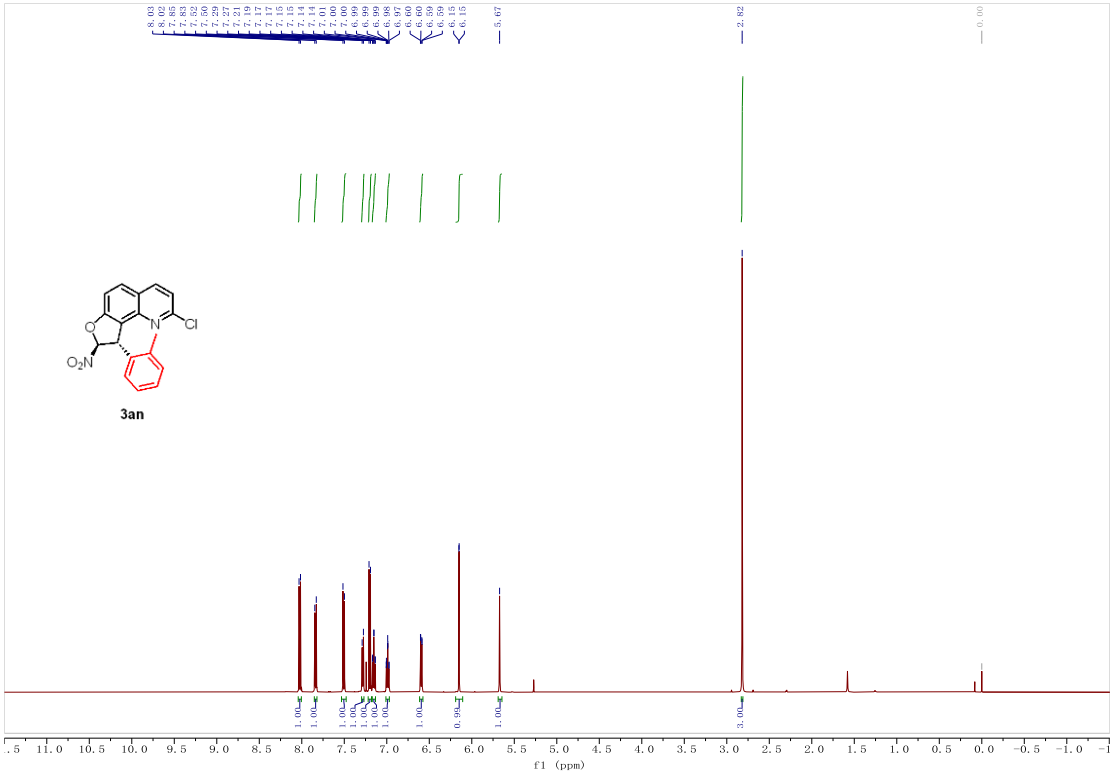
^{1}H NMR of 3am (500 MHz, $CDCl_3$)



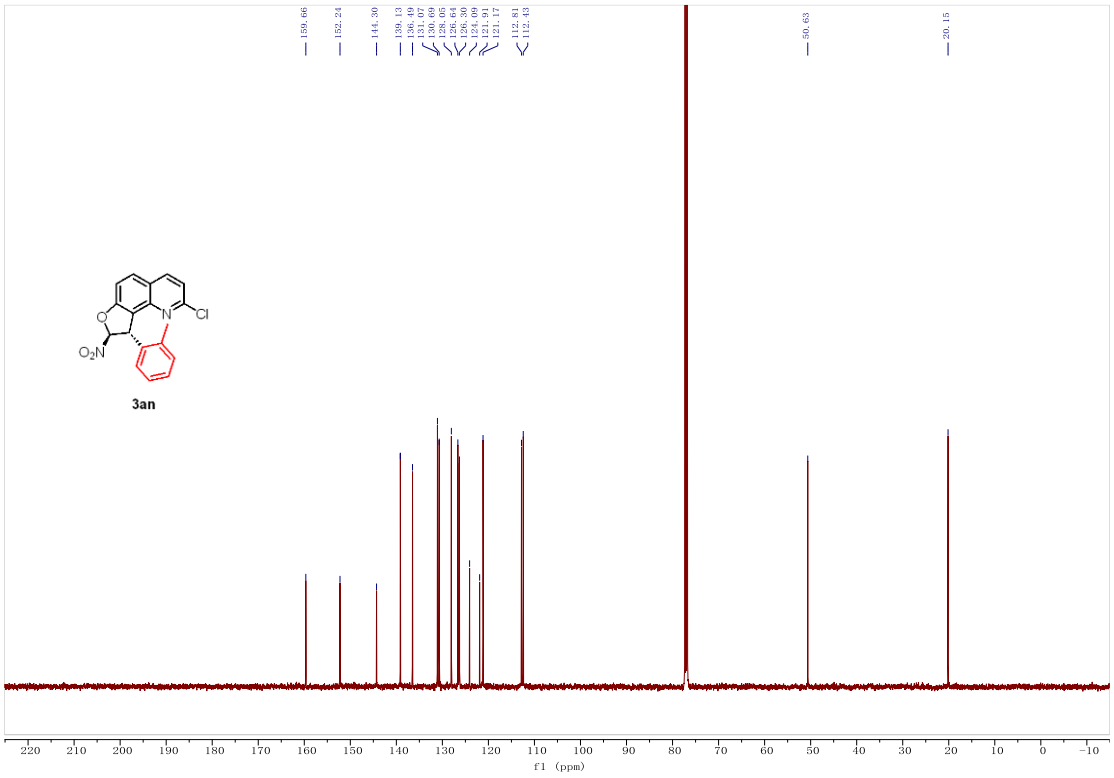
^{13}C NMR of 3am (126 MHz, $CDCl_3$)



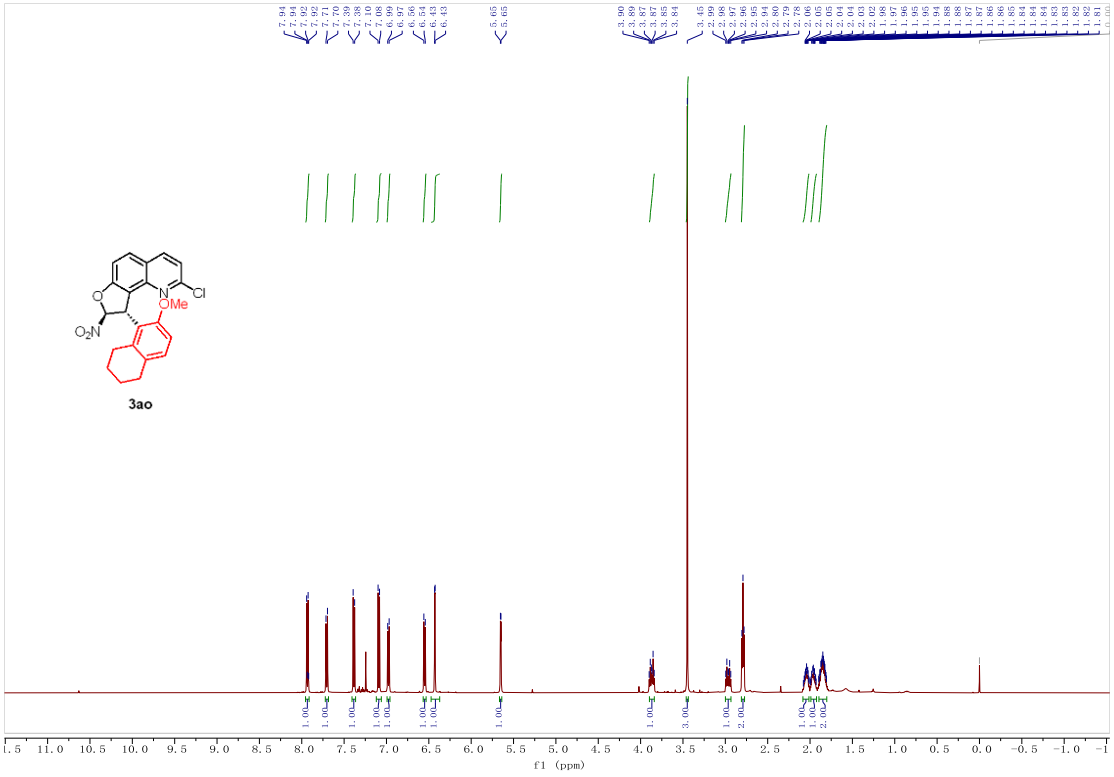
^{1}H NMR of 3an (500 MHz, $CDCl_3$)



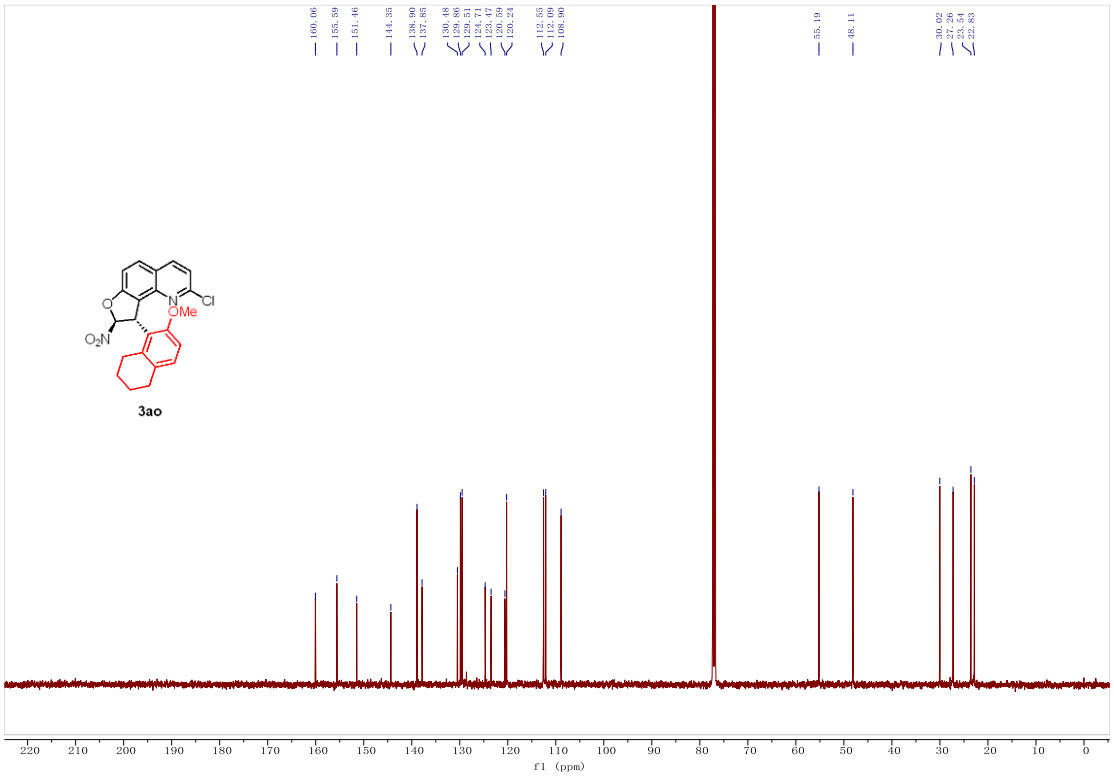
^{13}C NMR of 3an (126 MHz, $CDCl_3$)



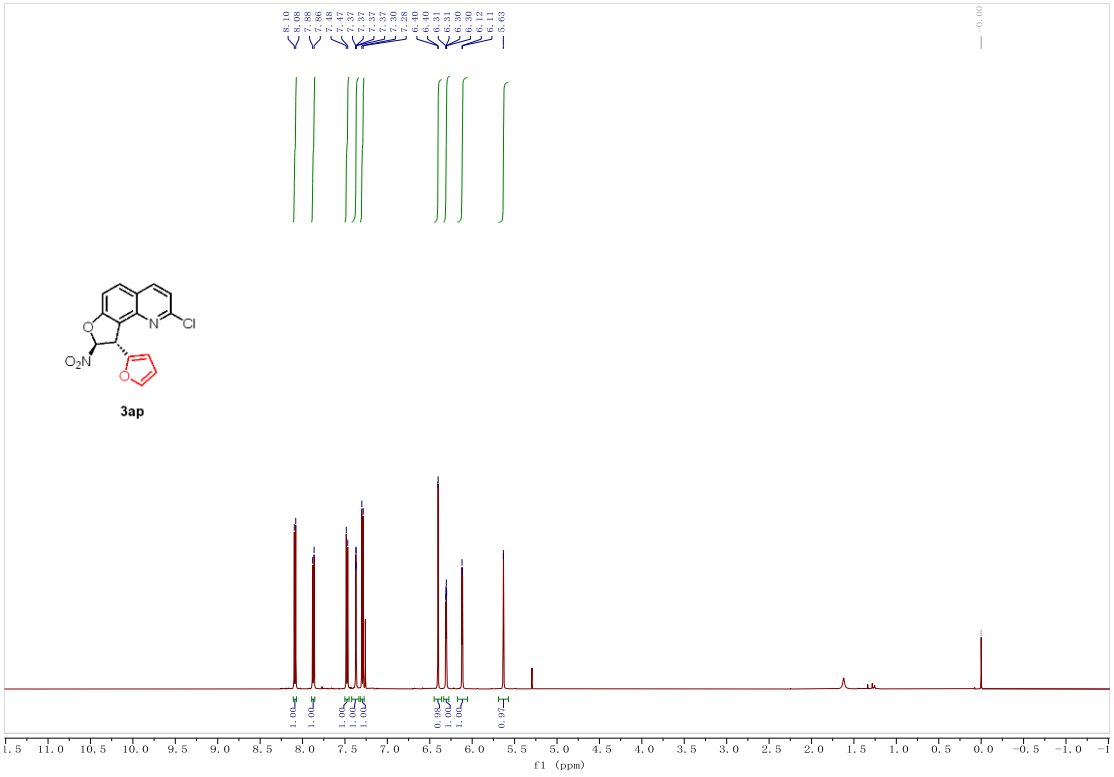
^{1}H NMR of 3ao (500 MHz, $CDCl_3$)



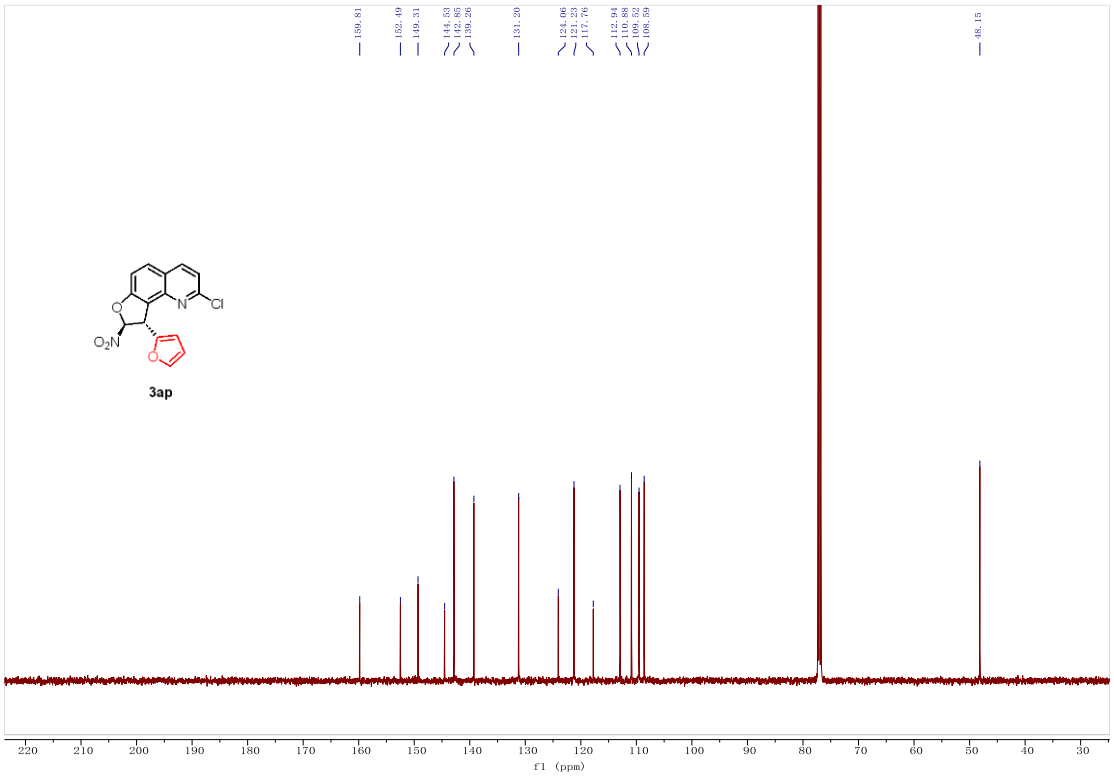
^{13}C NMR of 3ao (126 MHz, $CDCl_3$)



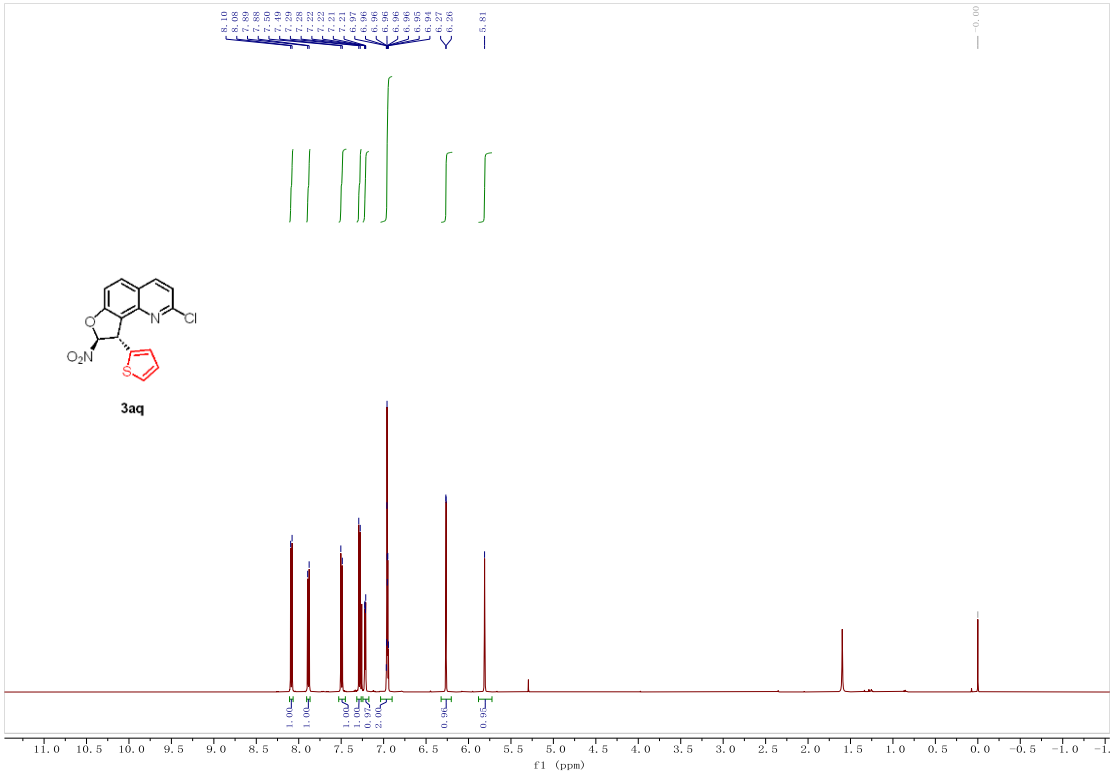
^{1}H NMR of 3ap (500 MHz, $CDCl_3$)



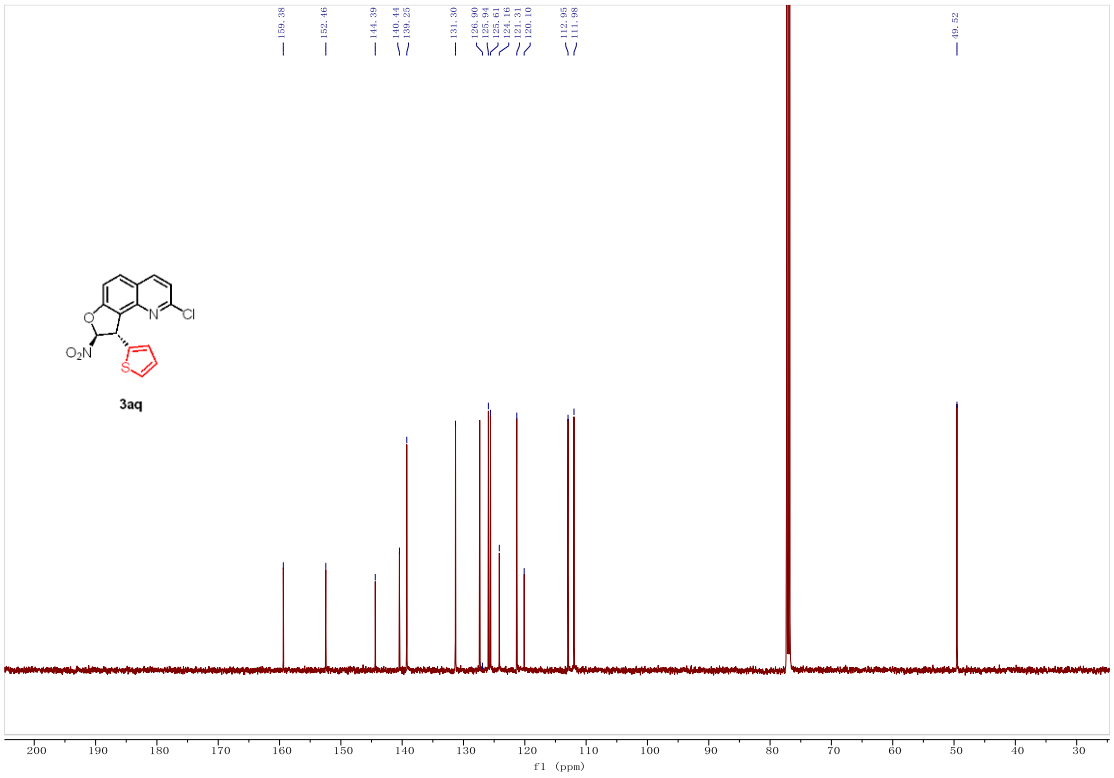
^{13}C NMR of 3ap (126 MHz, $CDCl_3$)



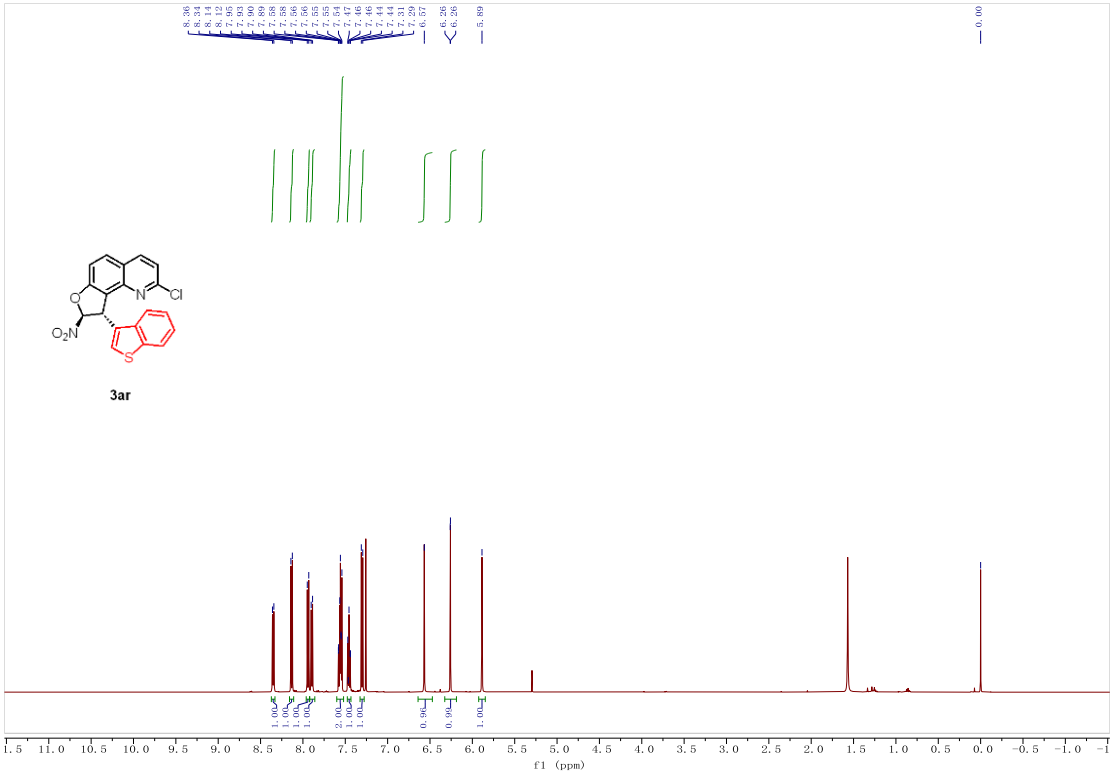
^{1}H NMR of 3aq (500 MHz, $CDCl_3$)



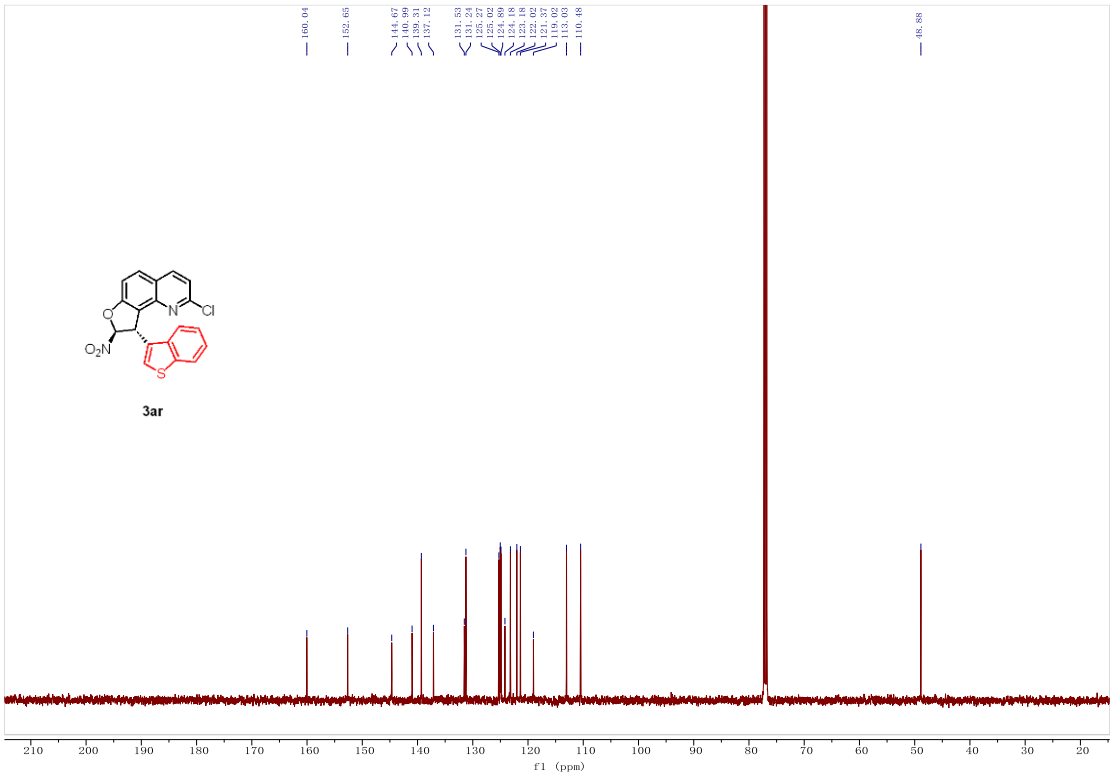
^{13}C NMR of 3aq (126 MHz, $CDCl_3$)



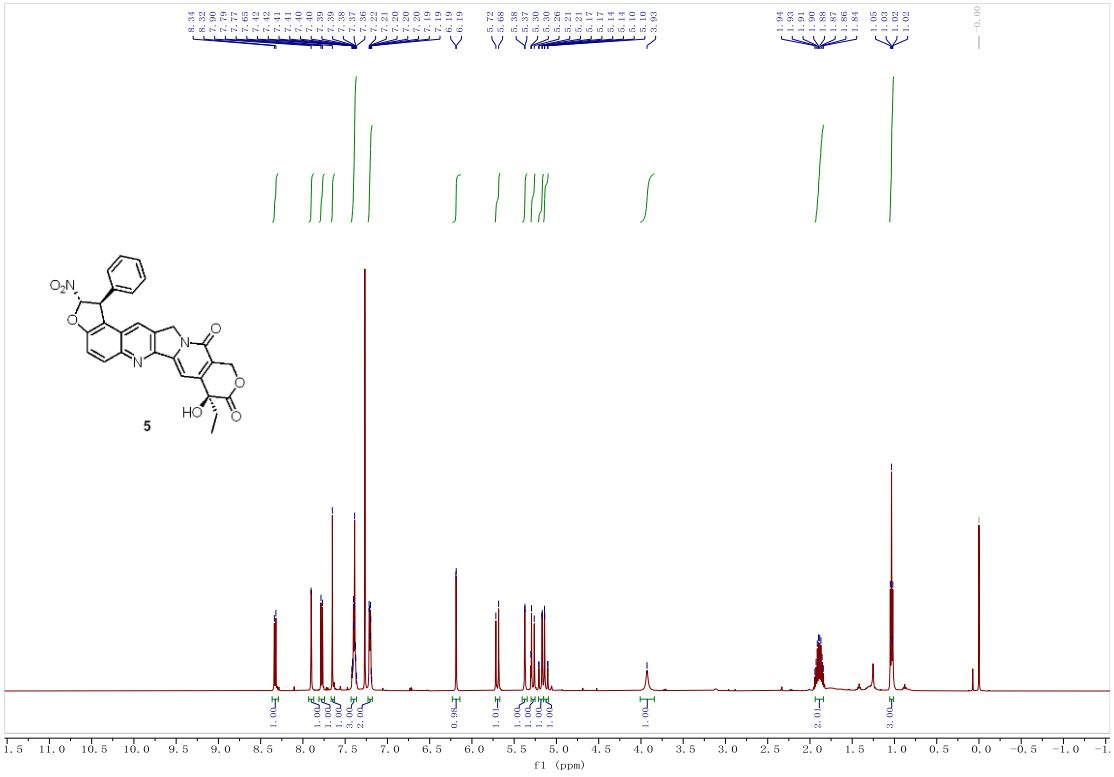
^{1}H NMR of 3ar (500 MHz, $CDCl_3$)



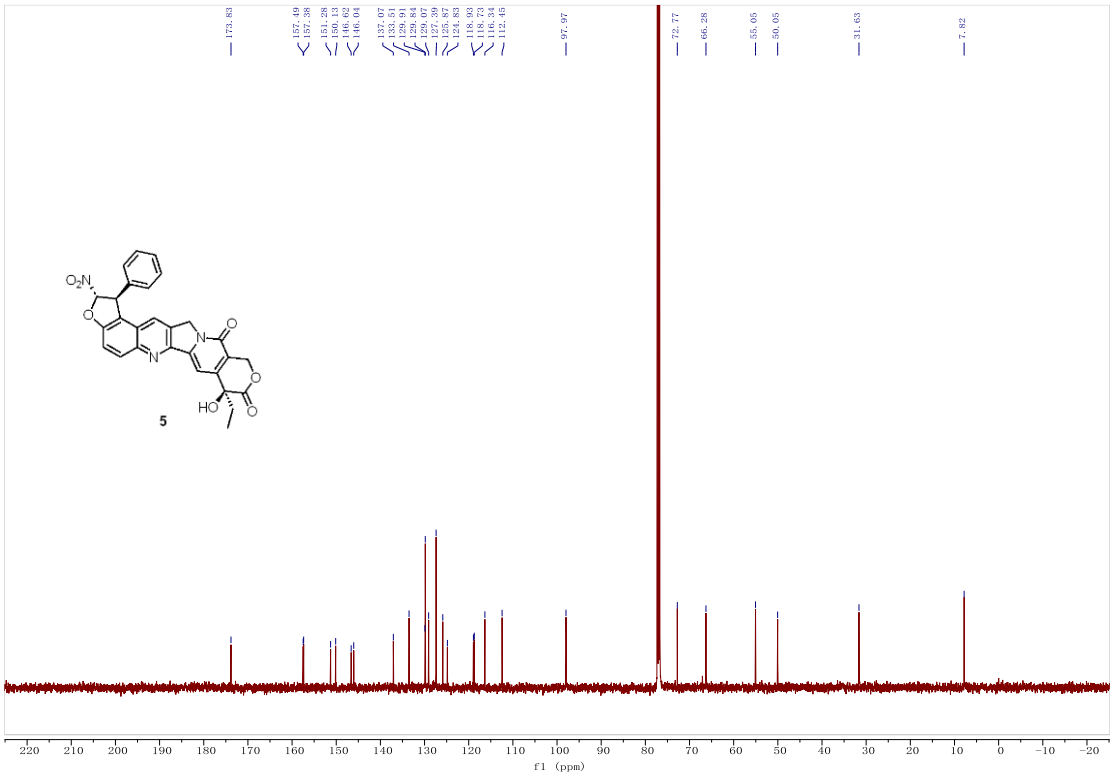
^{13}C NMR of 3ar (126 MHz, $CDCl_3$)



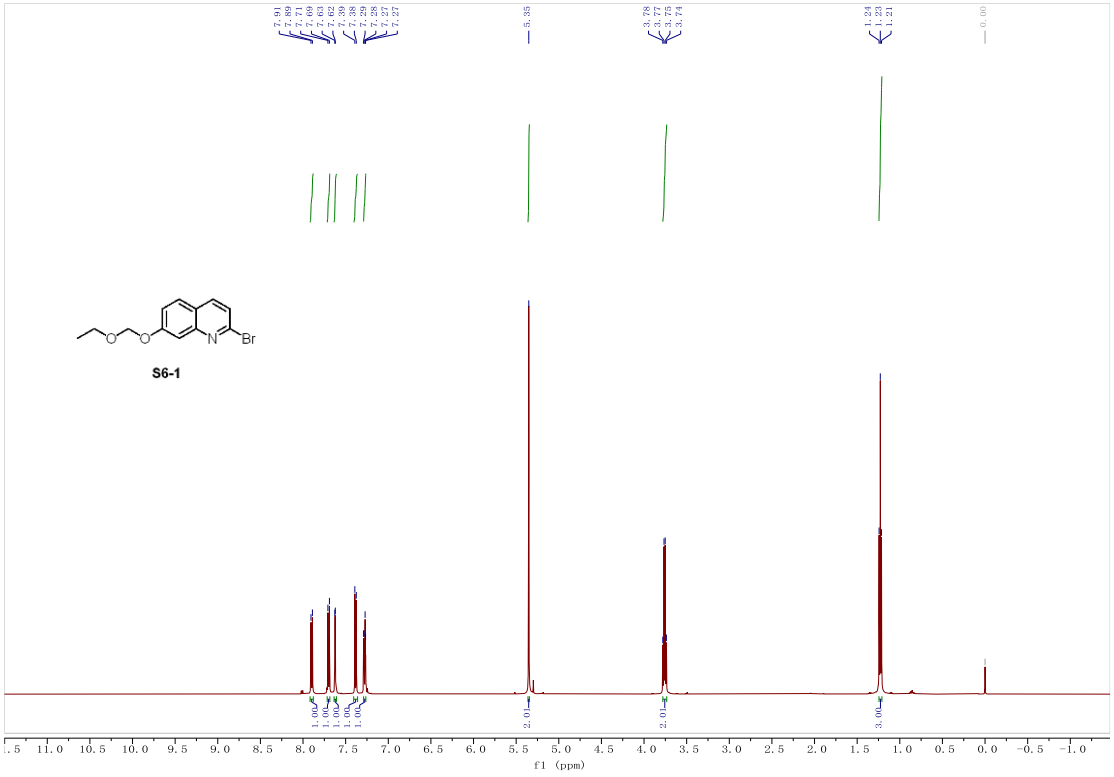
^{1}H NMR of 5 (500 MHz, $CDCl_3$)



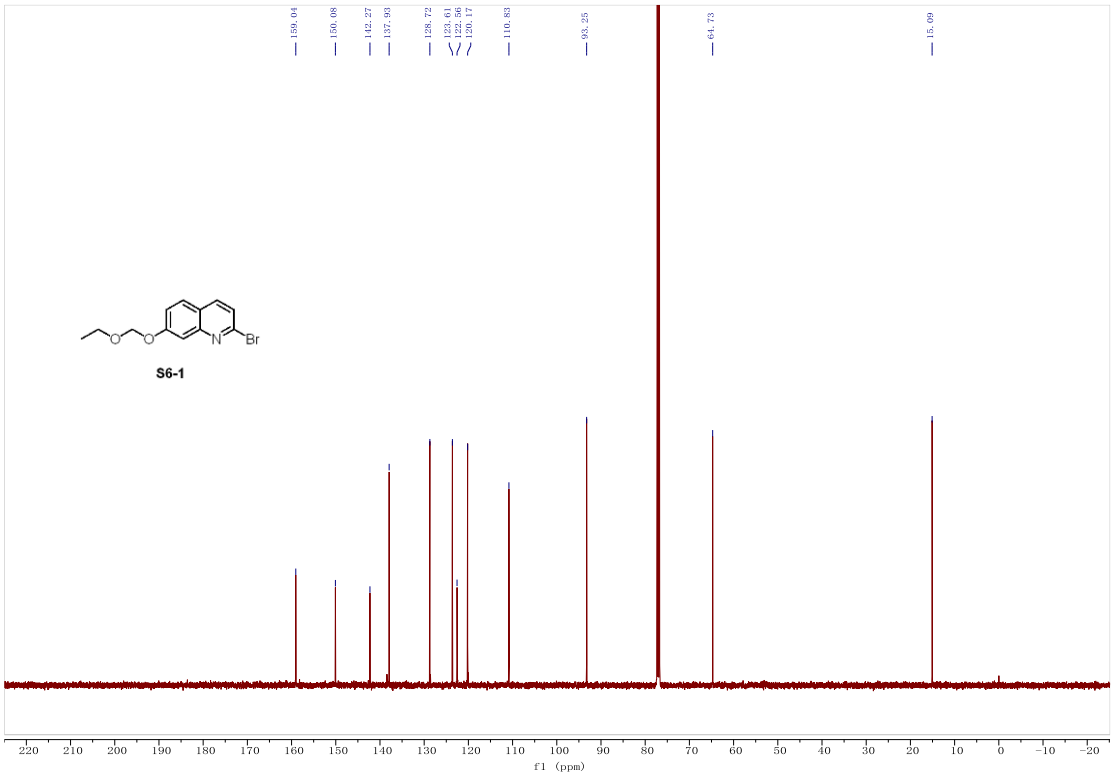
^{13}C NMR of 5 (126 MHz, $CDCl_3$)



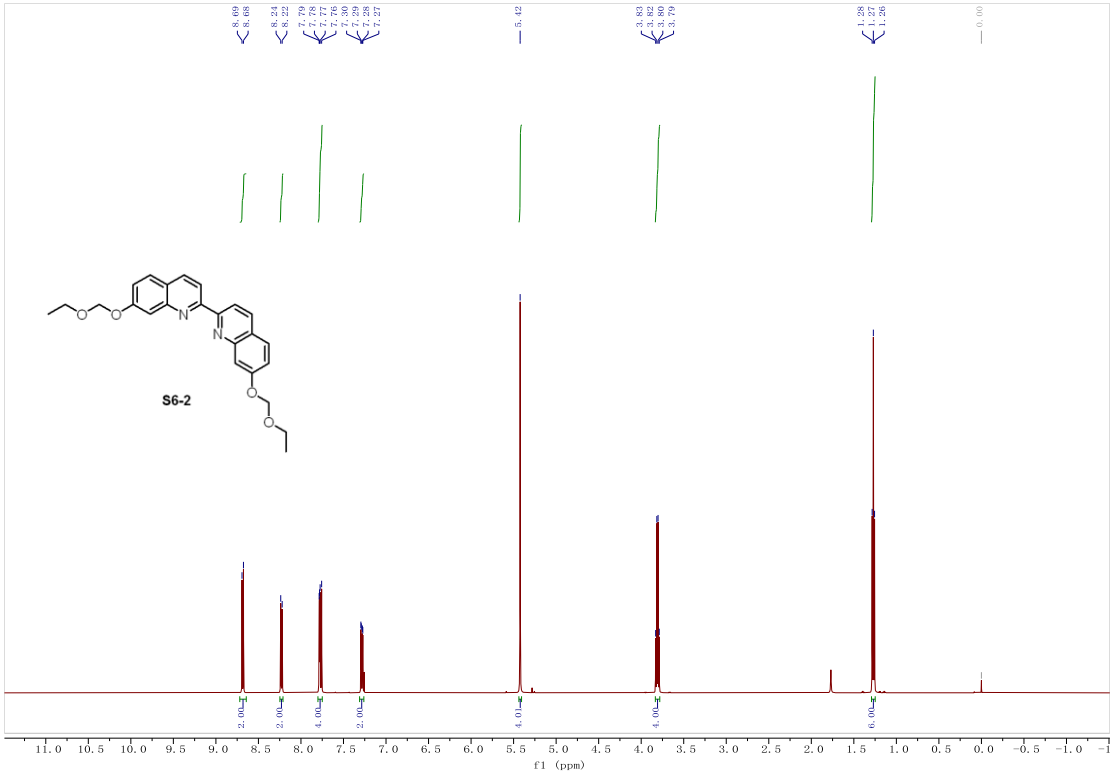
^{1}H NMR of S6-1 (500 MHz, $CDCl_3$)



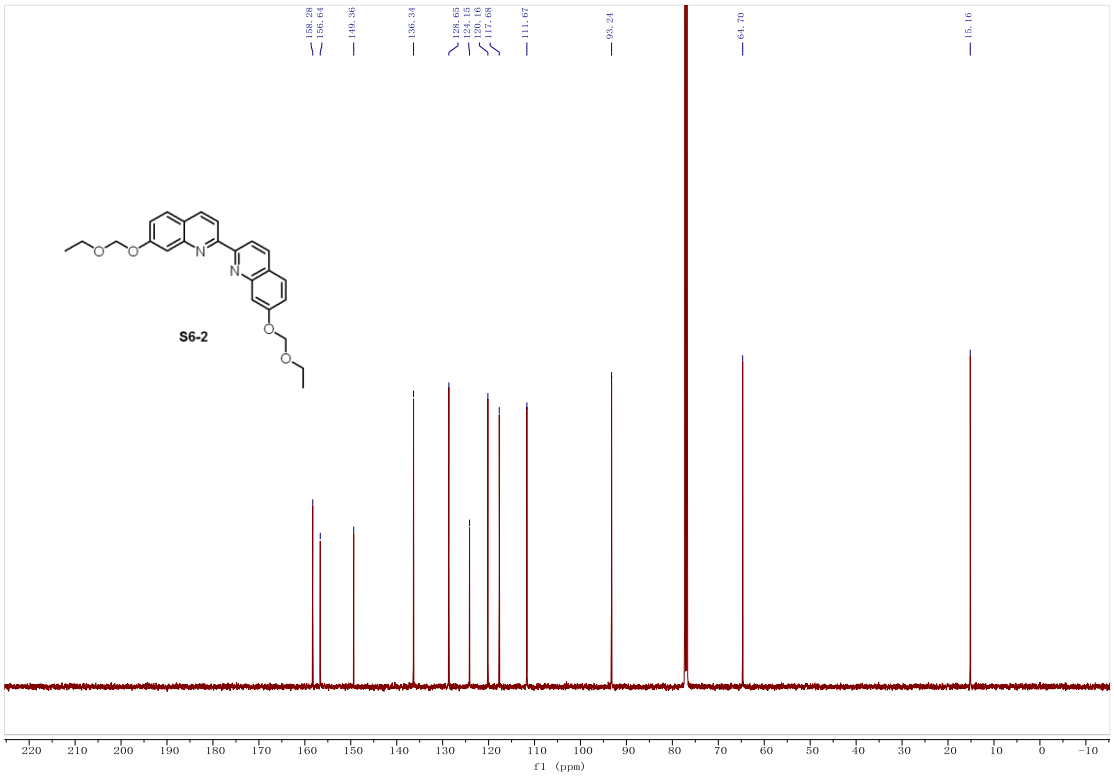
^{13}C NMR of S6-1 (126 MHz, $CDCl_3$)



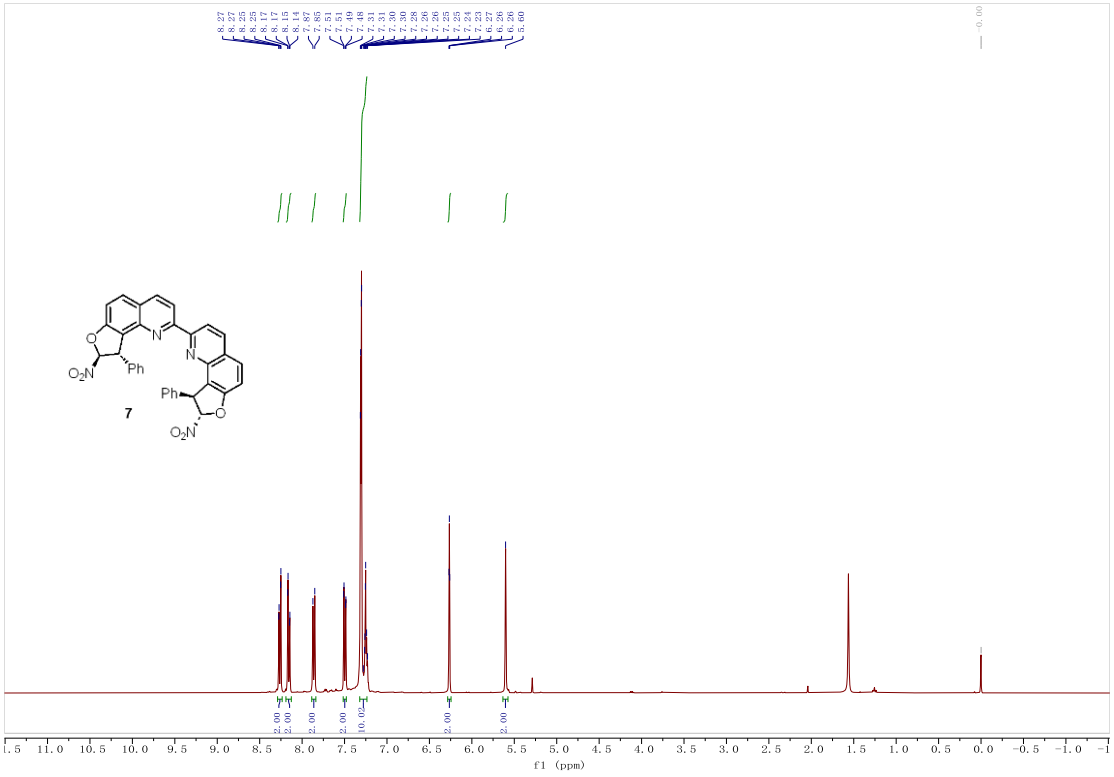
^{1}H NMR of S6-2 (500 MHz, $CDCl_3$)



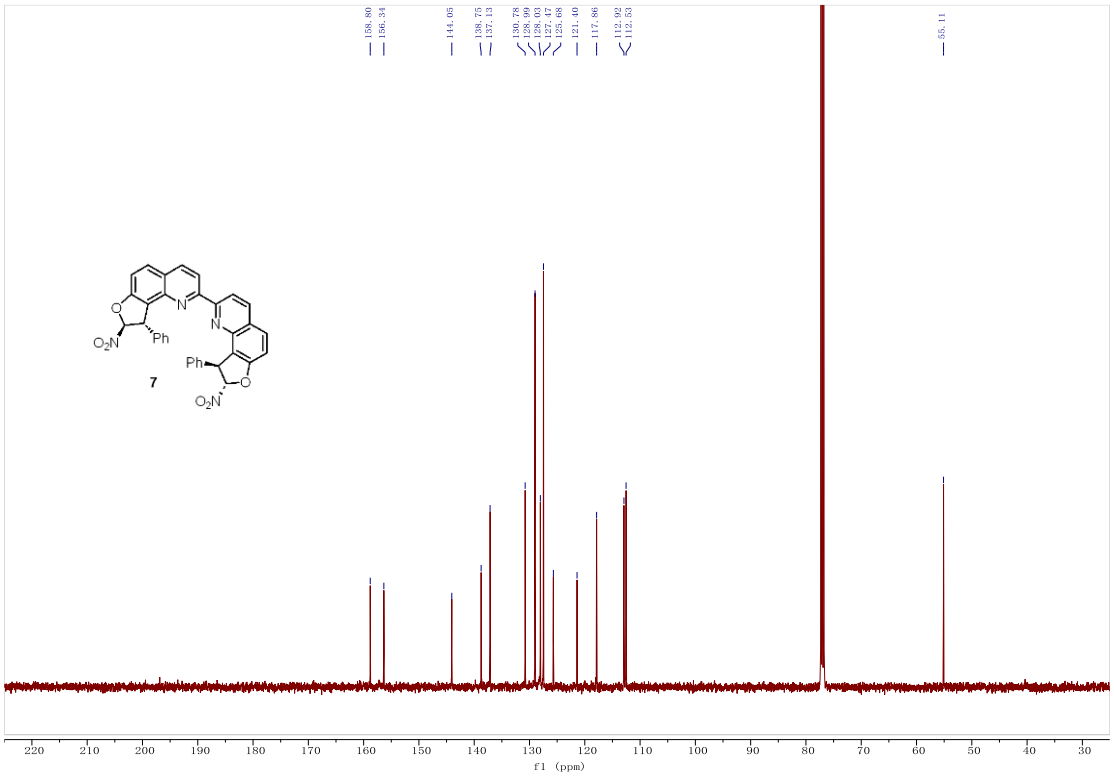
^{13}C NMR of S6-2 (126 MHz, $CDCl_3$)



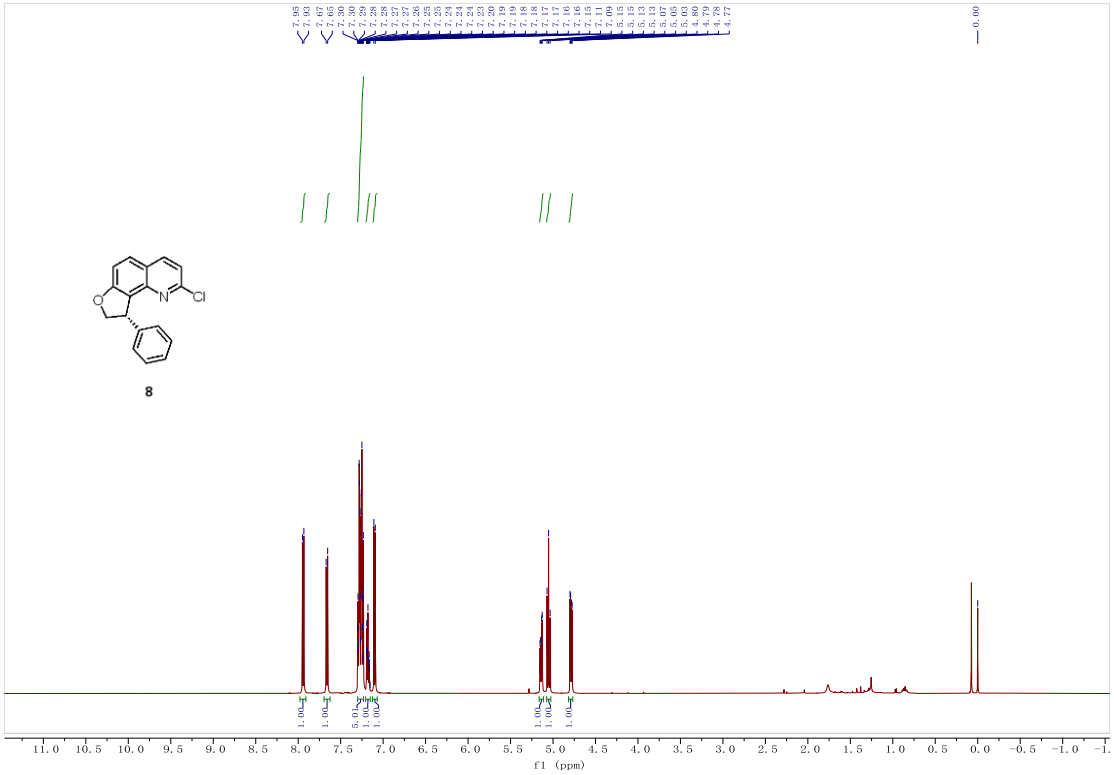
^{1}H NMR of 7 (500 MHz, $CDCl_3$)



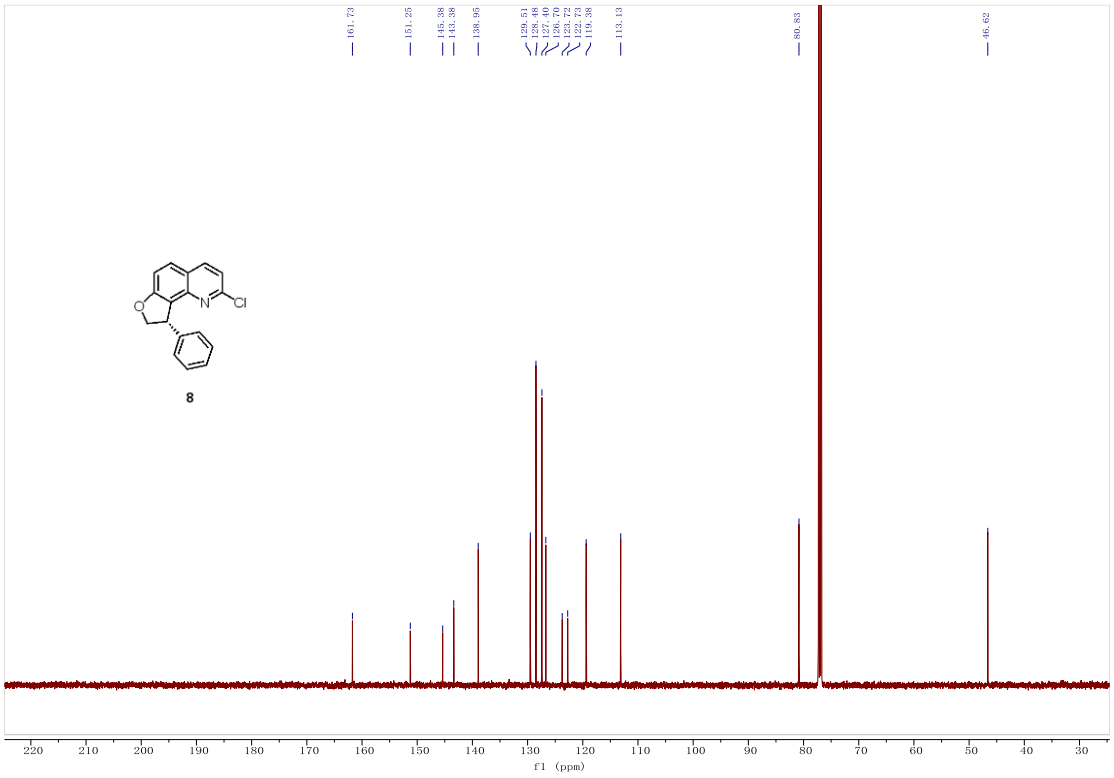
^{13}C NMR of 7 (126 MHz, $CDCl_3$)



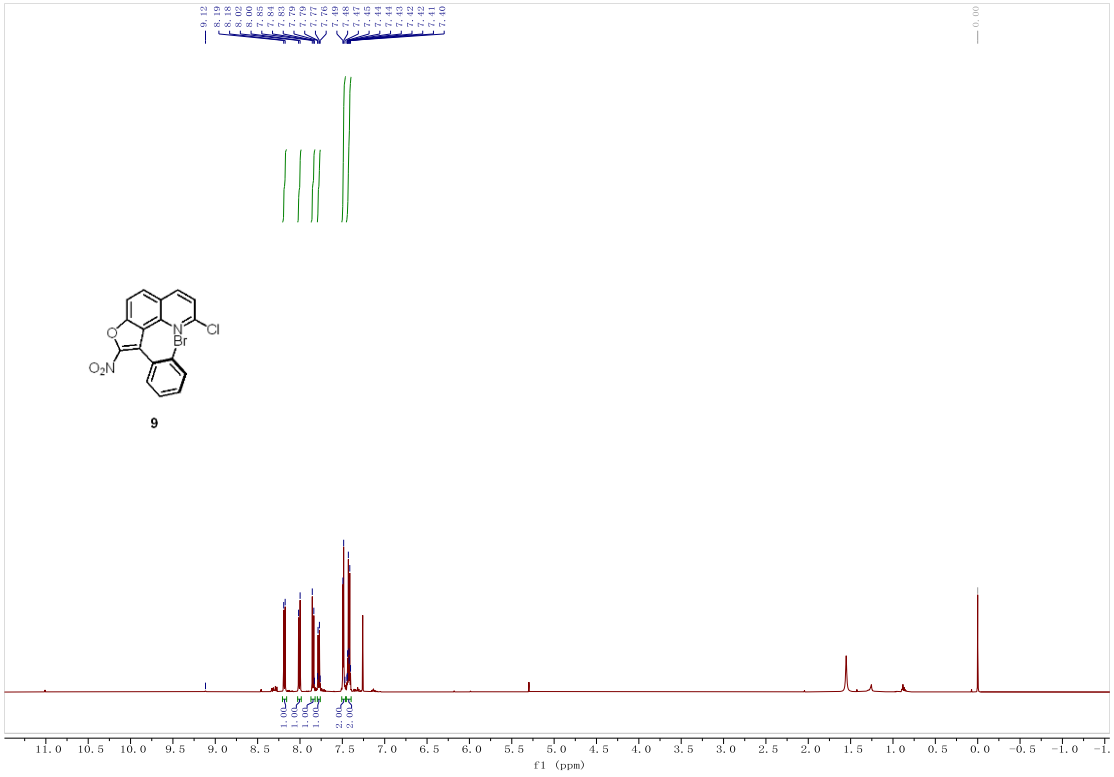
^{1}H NMR of 8 (500 MHz, $CDCl_3$)



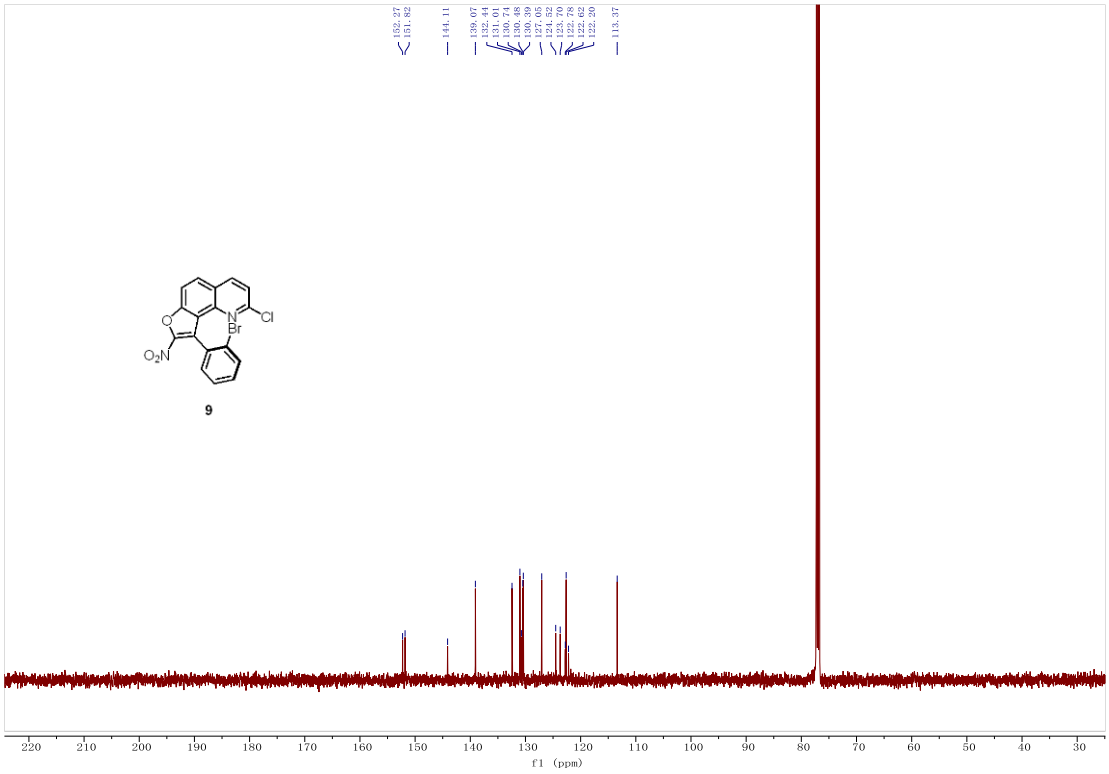
^{13}C NMR of 4c (126 MHz, $CDCl_3$)



^{1}H NMR of 9 (500 MHz, $CDCl_3$)



^{13}C NMR of 9 (126 MHz, $CDCl_3$)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f1 (ppm)