Supporting Information

For

Ligand-Accelerated Palladium(II)-Catalyzed Enantioselective Amination of C(sp^2)–H Bonds

Xiu-Fen Cheng,[§,†,‡] Fan Fei,[§,†] Yan Li,*[,†] Yi-Ming Hou,[†] Xin Zhou,[†] and Xi-Sheng Wang*[,†]

[†]Hefei National Laboratory for Physical Sciences at the Microscale and Department of Chemistry, University of Science and Technology of China, 96 Jinzhai Road, He-fei, Anhui 230026, China

[‡]College of Chemistry, Chemical Engineering and Materials Science, Collaborative Innovation Center of Functionalized Probes for, Chemical Imaging in Universities of Shandong, Key Laboratory of Molecular and Nano Probes, Ministry of Education, Shandong Provincial Key Laboratory of Clean Production of Fine Chemicals, Shandong Normal University, Jinan, 250014 P. R. China.

*liyan08@ustc.edu.cn; xswang77@ustc.edu.cn.

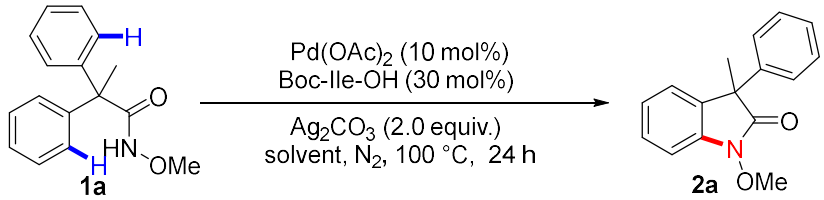
Contents

General Information:

NMR spectra were recorded on Bruker-400 (400 MHz for ^{1}H; 100 MHz for ^{13}C) instruments internally referenced to $SiMe_4$ signal. High resolution mass spectra were recorded on P-SIMS-Gly of Bruker Daltonics Inc. using ESI-TOF (electrospray ionization-time of flight). Optical rotations were determined at 589 nm (sodium D line) by using an Anton-Paar MCP 200 polarimeter. HPLC analysis was performed on Shimadzu LC-20AT. Chiral column AD-H, OD-H, and ID were purchased from Daicel Chemical Industries, LTD. Trifluoroethanol and pentafluoropropanol were purchased from Qinba Chemie and used as received. Sliver oxide was obtained from Sinopharm and used as received. Cbz-Phe-OH was obtained from Darui Finechemical and used as received. Zinc acetate was purchased from Alfa and used as received. Palladium diacetate and palladium hexafluoroacetylacetonate were purchased from Strem and used as received. Dibenzyl phosphate was obtained from Meryer and used as received.

Tables of the Optimization of Reaction Conditions

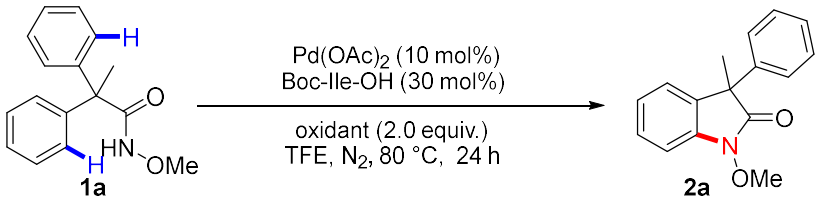
Table S1. Enantioselective C(sp^2)–H activation/C–N formation: Solvent Screening[a]



entry	solvent	yield (%)[b]	*ee* (%)[c]	entry	solvent	yield (%)[b]	*ee* (%)[c]
1	*t*-BuOH	42	0	11	Et_2O	23	0
2	*t*-AmOH	39	0	12	toluene	54	0
3	CF_3CH_2OH	97	14	13	PhCl	70	0
4	MeOH	99	4	14	DMSO	31	16
5	dioxane	32	13	15	*n*-BuOH	58	0
6	DMF	24	0	16	2-Methoxyethanol	45	18
7	THF	24	0	17	EA	26	0
8	DCE	54	0	18	acetone	26	7
9	MeCN	-	0	19	Ethylene glycol	trace	0
10	$MeNO_2$	42	5	20[d]	CF_3CH_2OH	88	14

[a] Reaction conditions: **1a** (0.15 mmol), $Pd(OAc)_2$ (0.015 mmol, 10 mol%), Boc-Ile-OH (0.045 mmol, 30 mol%), Ag_2CO_3 (0.3 mmol, 2.0 equiv.), solvent (1.5 mL), N_2, 100 °C, 24 h. [b] Isolated yield. [c] The ee value was determined by chiral HPLC analysis. [d] 80 °C.

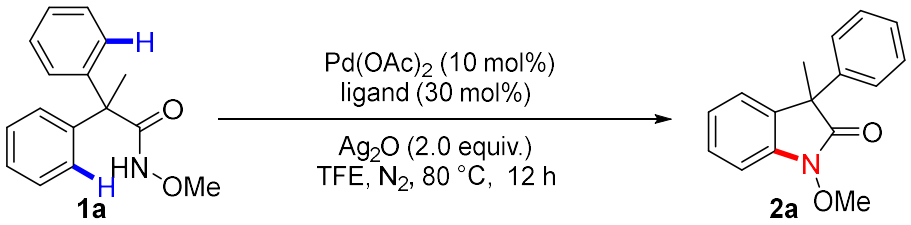
Table S2. Enantioselective C(sp^2)–H activation/C–N formation: Oxidant Screening[a]



entry	oxidant	yield (%)[b]	*ee* (%)[c]	entry	oxidant	yield (%)[b]	*ee* (%)[c]
1	AgOAc	71	13	8	PIDA	95	0
2	Ag_2O	69	28	9	$K_2S_2O_8$	27	2
3	AgOTFA	13	17	10	NFSI	19	7
4	AgOTf	0	0	11	FTB	16	0
5	AgF	42	19	12	BPO	68	9
6	$AgClO_4$	0	0	13	NCS	42	0
7	$Cu(OAc)_2$	trace	-	14[d]	Ag_2O	61	29

[a] Reaction conditions: **1a** (0.15 mmol), $Pd(OAc)_2$ (0.015 mmol, 10 mol%), Boc-Ile-OH (0.045 mmol, 30 mol%), oxidant (0.3 mmol, 2.0 equiv.), TFE (1.5 mL), N_2, 80 °C, 24 h. [b] Isolated yield. [c] The ee value was determined by chiral HPLC analysis. [d] 12 h.

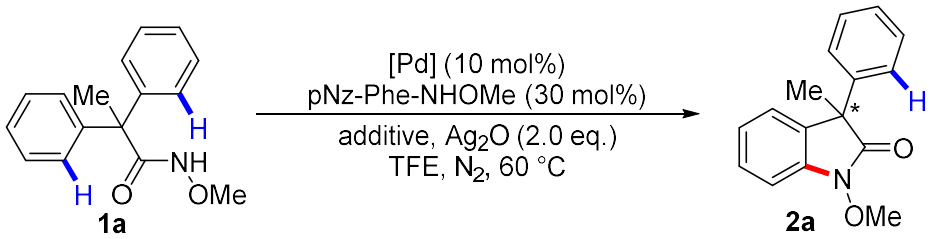
Table S3. Enantioselective C(sp^2)–H activation/C–N formation: Ligand Screening[a]



entry	ligand	yield (%)[b]	*ee* (%)[c]	entry	ligand	yield (%)[b]	*ee* (%)[c]
1	Ac-Ile-OH	56	17	23	Boc-Asp(Bn)-OH	49	41
2	Fmoc-Ile-OH	32	16	24	Boc-Met-OH	48	12
3	Cbz-Ile-OH	66	28	25	Boc-Nle-OH	53	36
4	piv-Ile-OH	44	10	26	Boc-Ser(Bn)-OH	62	29
5	Bz-Ile-OH	48	3	27	Boc-Thr(*t*Bu)-OH	49	35
6	Boc-Ile-OH	61	29	28	Boc-Thr-OH	50	12
7	Boc-Ala-OH	45	40	29	Boc-Trp-OH	33	13
8	Boc-Leu-OH	44	33	30	Boc-Nva-OH	50	33
9	Boc-Val-OH	45	26	31	Boc-Trp(Boc)-OH	51	44
10	Boc-Tle-OH	42	34	32	Boc-Asp(Me)-OH	47	37
11	Boc-Phe-OH	47	45	33	Boc-Thr(Bn)-OH	58	30
12	Boc-CyGly-OH	40	27	34	Cbz-Ala-OH	51	40
13	Boc-Nal-OH	48	45	35	Cbz-Phe-OH	64	57
14	Boc-HPhe-OH	48	32	36	Cbz-Ser-OH	57	13
15	Boc-Tyr(*t*Bu)-OH	47	41	37	Cbz-Arg-OH	32	8
16	Boc-Tyr(Bn)-OH	50	36	38	Cbz-Trp-OH	32	8
17	Boc-Tyr-OH	45	17	39	Cbz-Pro-OH	55	10
18	Boc-Asp(Cy)-OH	58	42	40	Cbz-PhGly-OH	58	17
19	Boc-Asp(*t*Bu)-OH	48	36	41	Cbz-Leu-OH	55	27
20	Boc-Glu(*t*Bu)-OH	54	37	42	Cbz-Nva-OH	62	38
21	Boc-Glu(Cy)-OH	55	34	43	Cbz-Val-OH	54	28
22	Boc-Glu(Bn)-OH	47	34				

[a] Reaction conditions: **1a** (0.15 mmol), $Pd(OAc)_2$ (0.015 mmol, 10 mol%), ligand (0.045 mmol, 30 mol%), Ag_2O (0.3 mmol, 2.0 equiv.), TFE (1.5 mL), N_2, 80 °C, 12 h. [b] Isolated yield. [c] The ee value was determined by chiral HPLC analysis.

Table S4. Enantioselective C(sp^2)–H activation/C–N formation: Palladium Salt and Additive Screening[a]



1a **2a**

entry	[Pd]	additive	time (h)	yield (%)[b]	*ee* (%)[c]
1	$Pd(OAc)_2$	-	12	85	86
2	$Pd(OAc)_2$	$Cu(acac)_2$ (10 mol%)	12	78	91
3	$Pd(OAc)_2$	$Cu(hfacac)_2$ (10 mol%)	12	72	91
4	$Pd(acac)_2$	-	12	69	89
5	$Pd(hfacac)_2$	-	12	43	92
6	$Pd(acac)_2$	$Cu(OAc)_2$ (10 mol%)	12	67	92
7	$Pd(hfacac)_2$	$Cu(OAc)_2$ (10 mol%)	12	70	92
8	$Pd(hfacac)_2$	$Zn(OAc)_2$ (10 mol%)	12	77	94
9	$Pd(hfacac)_2$	$Zn(OAc)_2$ (15 mol%)	12	80	94
10	$Pd(hfacac)_2$	$Zn(OAc)_2$ (15 mol%)	24	86	92
11	$Pd(hfacac)_2$	$Zn(OAc)_2$ (15 mol%)/DPP (10 mol%)	24	93	93
12	$Pd(hfacac)_2$	$Zn(OAc)_2$ (15 mol%)/DBP (10 mol%)	24	93	94
13	$Pd(hfacac)_2$	DBP (10 mol%)	24	60	92
14	$Pd(hfacac)_2$	$Zn(OAc)_2$ (15 mol%)/DBP (30 mol%)	24	90	95
15[d]	$Pd(hfacac)_2$	$Zn(OAc)_2$ (15 mol%)/DBP (30 mol%)	24	95	95
16[d]	$Pd(acac)_2$	$Zn(OAc)_2$ (15 mol%)/DBP (30 mol%)	24	92	95

[a] Reaction conditions: **1a** (0.15 mmol), $Pd(OAc)_2$ (0.015 mmol, 10 mol%), pNz-Phe-NHOMe (0.045 mmol, 30 mol%), additive, Ag_2O (0.3 mmol, 2.0 equiv.), TFE (2.5 mL), N_2, 60 °C, 12 h. [b] Isolated yield. [c] The ee value was determined by chiral HPLC analysis. [d] PFP was used as solvent.

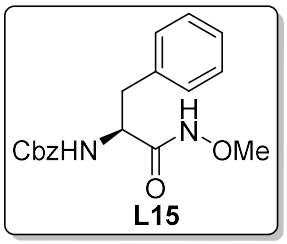
Experimental procedure

All of the substrates were prepared through amidations of diarylacetic acids. The acid, which was used for preparation of **1a**, **1r** and **1s** was purchased from Fluorochem and used as received. The acids, which was used for preparation of **1b**,[1] **1e**,[2] **1g**,[1] **1i**,[1] **1j**,[2] **1k**,[1] **1n**,[1] were prepared according to the reported procedures.

General procedure of preparation of ligands (L15-17)[3]

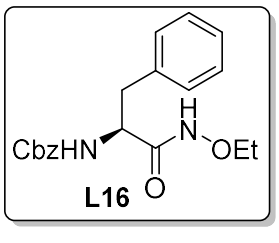
To a DCM (40 mL) solution of mono-protected phenylalanine (10 mmol), HOBt (1.49 g, 11 mmol, 1.1 equiv.) and EDCI (2.1 g, 11 mmol, 1.1 equiv.), *O*-alkyl hydroxylamine hydrochloride (15 mmol, 1.5 equiv.) and DIPEA (2.6 mL, 15 mmol, 1.5 equiv.) were added in an ice-bath. After stirring at room temperature overnight, the reaction mixture was quenched by water. The mixture was extracted by DCM for three times. The combined organic phase was washed with brine, dried over anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. The residue was purified by column chromatography (DCM/MeOH = 100:1 to 50:1), and the ligand was obtained after recrystallization as white solid.

Benzyl (*S*)-(1-(methoxyamino)-1-oxo-3-phenylpropan-2-yl)carbamate (Cbz-Phe-NHOMe, L15)



1.45 g (44% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.05 (s, 1H), 7.39 – 7.20 (m, 8H), 7.18 (d, *J* = 6.8 Hz, 2H), 5.57 (d, *J* = 7.7 Hz, 1H), 5.05 (d, *J* = 12.8 Hz, 1H), 5.00 (d, *J* = 12.2 Hz, 1H), 4.31 (dd, *J* = 15.3, 7.5 Hz, 1H), 3.57 (s, 3H), 3.05 (d, *J* = 7.3 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.5, 156.2, 136.1, 129.5, 128.8, 128.7, 128.4, 128.1, 127.3, 67.4, 64.4, 54.1, 38.5. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{18}H_{21}O_4N_2$ 329.1496; Found 329.1497. $[\alpha]_D^{20}$ = -11.6° (*c* 1.0, $CHCl_3$).

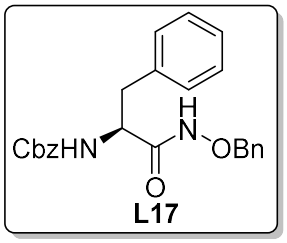
Benzyl (*S*)-(1-(ethoxyamino)-1-oxo-3-phenylpropan-2-yl)carbamate (Cbz-Phe-NHOEt, L16)



1.37 g (40% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.11 (s, 1H), 7.40 – 7.21 (m, 8H), 7.18 (d, *J* = 6.8 Hz, 2H), 5.66 (d, *J* = 8.0 Hz, 1H), 5.01 (q, *J* = 12.2 Hz, 2H), 4.34 (dd, *J* = 15.4, 7.5 Hz,

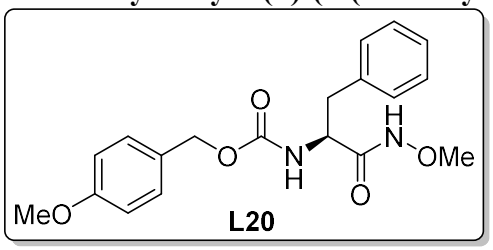
1H), 3.86 – 3.63 (m, 2H), 3.04 (d, J = 7.5 Hz, 2H), 1.11 (t, J = 7.0 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.6, 156.3, 136.2, 136.0, 129.5, 128.8, 128.7, 128.4, 128.1, 127.2, 72.2, 67.3, 54.2, 38.6, 13.4. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{19}H_{23}O_4N_2$ 343.1652; Found 343.1653. $[\alpha]_D^{20}$ = -10.6º (c 1.0, $CHCl_3$).

Benzyl (*S*)-(1-((benzyloxy)amino)-1-oxo-3-phenylpropan-2-yl)carbamate (Cbz-Phe-NHOBn, L17)



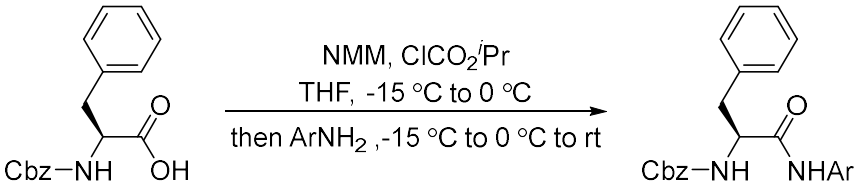
1.77 g (44% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.94 (s, 1H), 7.42 – 7.18 (m, 13H), 7.15 (d, J = 6.4 Hz, 2H), 5.53 (d, J = 8.1 Hz, 1H), 4.97 (d, J = 12.1 Hz, 1H), 4.91 (d, J = 12.2 Hz, 1H), 4.77 (d, J = 11.2 Hz, 1H), 4.64 (d, J = 11.2 Hz, 1H), 4.37 – 4.20 (m, 1H), 3.12 – 2.94 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.5, 156.1, 136.1, 136.0, 135.0, 129.5, 129.4, 128.8, 128.7, 128.6, 128.4, 128.1, 127.2, 78.4, 67.3, 54.1, 38.5. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{24}H_{25}O_4N_2$ 405.1809; Found 405.1811. $[\alpha]_D^{20}$ = -15.3º (c 1.0, $CHCl_3$).

4-Methoxybenzyl (*S*)-(1-(methoxyamino)-1-oxo-3-phenylpropan-2-yl)carbamate (pMz-Phe-NHOMe, L20)



0.47 g (13% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.45 (s, 1H), 7.34 – 7.22 (m, 5H), 7.19 (d, J = 6.8 Hz, 2H), 6.88 (d, J = 8.6 Hz, 2H), 5.35 – 5.21 (m, 1H), 5.01 (s, 2H), 4.23 (q, J = 7.3 Hz, 1H), 3.81 (s, 3H), 3.61 (s, 3H), 3.14 – 2.97 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.6, 159.8, 136.1, 130.1, 129.5, 129.0, 128.1, 127.4, 114.1, 67.3, 64.5, 55.4, 54.2, 38.3. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{19}H_{23}O_5N_2$ 359.1601; Found 359.1615. $[\alpha]_D^{20}$ = -10.0º (c 0.5, $CHCl_3$).

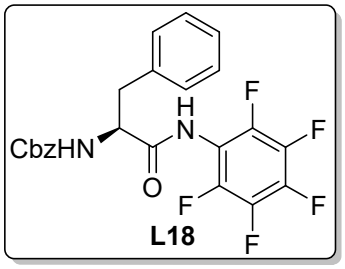
General procedure of preparation of ligands (L18-19)



To a solution of Cbz-Phe-OH (670.4 mg, 2.24 mmol) and NMM (0.25 mL, 2.24 mmol, 1.0 equiv.) in THF (2 mL), isopropyl chloroformate (246 μL, 2.24 mmol, 1.0 equiv.) was added dropwise at -15 ˚C. After stirring at 0 ˚C for 5 min, a solution of arylamine (2.24 mmol, 1.0 equiv.) in THF (2 mL) was added at -15 ˚C. The mixture was stirred at 0 ˚C for 1 h, and then at room temperature overnight. After the reaction was completed, solvent was removed under reduced pressure. The residue was dissolved in EtOAc,

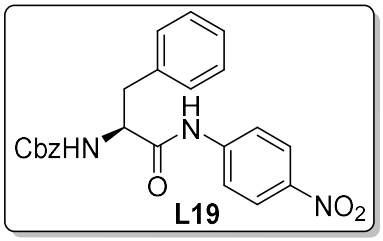
washed with 2N HCl (aq.), 0.5 N $NaHCO_3$ (aq.), and brine, dried over anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. After purifying by column chromatography (DCM/MeOH = 100:1 to 50:1), ligand was obtained through recrystallization as white solid.

Benzyl (*S*)-(1-oxo-1-((perfluorophenyl)amino)-3-phenylpropan-2-yl)carbamate (Cbz-Phe-NHPh^F, L18)



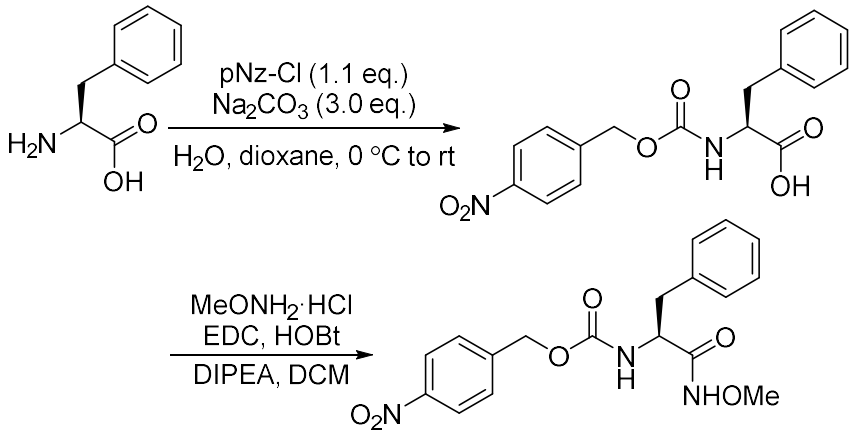
0.23 g (22% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 (s, 1H), 7.37 – 7.25 (m, 8H), 7.22 (d, *J* = 6.8 Hz, 2H), 5.33 (s, 1H), 5.12 (d, *J* = 12.0 Hz, 1H), 5.07 (d, *J* = 12.3 Hz, 1H), 4.67 (d, *J* = 6.2 Hz, 1H), 3.18 (d, *J* = 7.0 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.3, 156.7 (m), 144.2 (m), 141.7 (m), 139.1 (m), 136.5 (m), 135.8 (d, *J* = 5.4 Hz), 129.4, 128.9, 128.6, 128.4, 127.9, 127.4, 111.4 (m), 67.5, 56.3, 38.5. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{23}H_{18}O_3N_2F_5$ 465.1232; Found 465.1230. $[\alpha]_D^{20}$ = +9.7º (*c* 1.0, $CHCl_3$).

Benzyl (*S*)-(1-((4-nitrophenyl)amino)-1-oxo-3-phenylpropan-2-yl)carbamate (Cbz-Phe-NHpNP, L19)



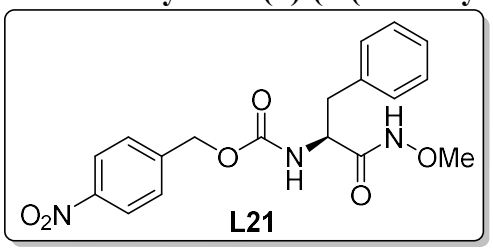
0.31 g (31% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.39 (s, 1H), 8.10 (d, *J* = 9.1 Hz, 2H), 7.46 (d, *J* = 9.1 Hz, 2H), 7.38 – 7.23 (m, 8H), 7.19 (d, *J* = 6.2 Hz, 2H), 5.43 (d, *J* = 7.5 Hz, 1H), 5.10 (s, 2H), 4.56 (d, *J* = 7.2 Hz, 1H), 3.15 (d, *J* = 7.2 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 169.9, 143.9, 143.1, 136.0, 135.8, 129.3, 129.2, 128.8, 128.6, 128.2, 127.6, 125.0, 119.4, 67.8, 57.4, 38.1. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{23}H_{22}O_5N_3$ 420.1554; Found 420.1550. $[\alpha]_D^{20}$ = +2.2º (*c* 0.5, $CHCl_3$).

Preparation of L21[4]



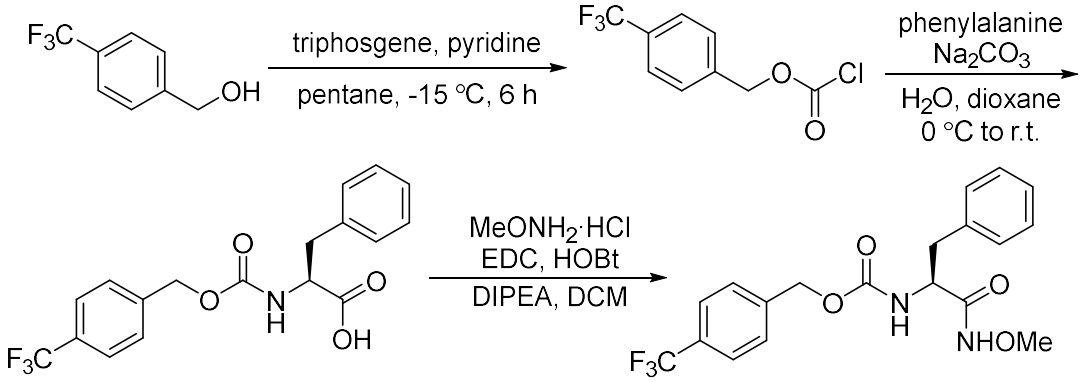
To an aqueous solution of Na_2CO_3 (620 mg, 5.81 mmol, 3.0 equiv.) and L-phenylalanine (320 mg, 1.94 mmol), *p*-nitrobenzyl chloroformate (460 mg, 2.14 mmol, 1.1 equiv.) in 1,4-dioxane (2 mL) was added dropwise at 0 ˚C. After stirring at 0 ˚C for 1.5 h, the reaction mixture was stirred at room temperature for another 20 h. The mixture was separated by Et_2O/H_2O. The aqueous phase was acidified by 3N HCl (aq.) at 0 ˚C to pH = 1, extracted with EtOAc for three times. The combined organic phase was washed with brine, dried over anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. The residue was used directly without purification. Then, the similar amidation according to **L15** was carried out to give **L21** (0.25 g, 34% overall yield) as white solid.

4-Nitrobenzyl (*S*)-(1-(methoxyamino)-1-oxo-3-phenylpropan-2-yl)carbamate (pNz-Phe-NHOMe, L21)



^{1}H NMR (400 MHz, Acetone-d_6) δ 10.39 (s, 1H), 8.21 (d, *J* = 8.7 Hz, 2H), 7.55 (d, *J* = 8.5 Hz, 2H), 7.37 – 7.26 (m, 4H), 7.26 – 7.19 (m, 1H), 6.81 (d, *J* = 8.3 Hz, 1H), 5.17 (q, *J* = 14.0 Hz, 2H), 4.28 (dd, *J* = 15.0, 8.4 Hz, 1H), 3.59 (s, 3H), 3.14 (dd, *J* = 13.6, 6.1 Hz, 1H), 2.95 (dd, *J* = 13.5, 8.8 Hz, 1H). ^{13}C NMR (100 MHz, Acetone-d_6) δ168.7, 156.4, 148.3, 145.9, 138.3, 130.3, 129.2, 128.8, 127.4, 124.3, 65.4, 63.9, 55.3, 39.0. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{18}H_{20}O_6N_3$ 374.1347; Found 374.1347. $[\alpha]_D^{20}$ = -9.2º (*c* 0.5, $CHCl_3$).

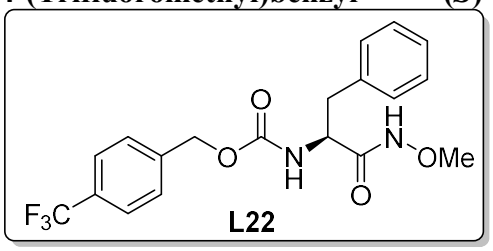
Preparation of L22[5]



In a sealed flask, triphosgene (2.5 g, 8.75 mmol, 1.75 equiv.) was dissolved in pentane (12.5 mL) at -15 ˚C. Pyridine (0.4 mL, 5 mmol, 1.0 equiv.) was added dropwise via syringe. After stirring for 1 h, a solution of 4-trifluoromethylbenzyl alcohol (881 mg, 5 mmol) in pentane (if the alcohol cannot be dissolved completely, acetone should be

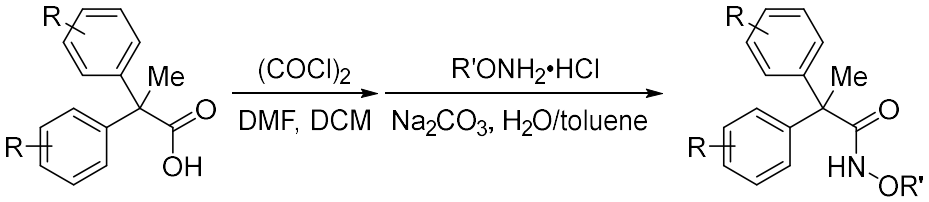
added as little as possible) was added to the reaction mixture dropwise via syringe, and the released gas was aspirated via syringe simultaneously, which was quenched by saturated Na_2CO_3 (aq.). The reaction mixture was stirred until arylmethanol cannot be detected by TLC (6 h usually). After that, the mixture was washed with 3N HCl (aq.) and brine, dried over anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. The residue was used directly without purification. Then, the similar procedure according to **L21** was carried out to give **L22** (0.18 g, 9% overall yield) as white solid.

4-(Trifluoromethyl)benzyl (*S*)-(1-(methoxyamino)-1-oxo-3-phenylpropan-2-yl)carbamate (Tfz-Phe-NHOMe, L22)



^{1}H NMR (400 MHz, $CDCl_3$) δ 8.77 (s, 1H), 7.59 (d, *J* = 8.1 Hz, 2H), 7.37 (d, *J* = 7.9 Hz, 2H), 7.33 – 7.22 (m, 3H), 7.20 (d, *J* = 6.8 Hz, 2H), 5.59 (s, 1H), 5.12 (d, *J* = 12.9 Hz, 1H), 5.06 (d, *J* = 12.9 Hz, 1H), 4.28 (dd, *J* = 15.2, 7.5 Hz, 1H), 3.59 (s, 3H), 3.06 (d, *J* = 7.3 Hz, 2H). ^{13}C NMR (100 MHz, Acetone-d_6) δ 168.7, 156.5, 142.9, 138.3, 130.3, 130.0 (q, *J* = 32.3 Hz), 129.1, 128.6, 127.4, 126.1 (q, *J* = 3.9 Hz), 125.3 (q, *J* = 347.9 Hz), 65.7, 63.9, 55.2, 38.9. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{19}H_{20}O_4N_2F_3$ 397.1370; Found 397.1386. $[\alpha]_D^{20}$ = -9.6º (*c* 1.0, $CHCl_3$).

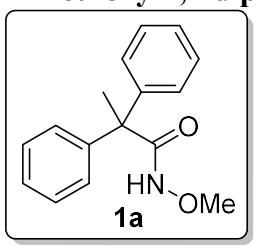
General procedure of synthesis of substrates (1a, 1b, 1e, 1g, 1i-k, 1n, 1r, 1s)[6]



To a solution of diarylacetic acid (10 mmol) in dry DCM (20 mL), DMF (150 μL, 2 mmol, 0.2 equiv.) and oxalyl dichloride (1.7 mL, 20 mmol, 2.0 equiv.) was added successively in an ice-bath. The reaction mixture was stirred at room temperature for 3 h, and then concentrated in vacuo. The residue was dissolved in toluene (15 mL), *O*-alkyl hydroxylamine hydrochloride (11 mmol, 1.1 equiv.), which was added to a solution of Na_2CO_3 (2.12 g, 20 mmol, 2.0 equiv.) in toluene/H_2O (50 mL, v/v = 1:1) slowly at 0 ˚C. The resulting mixture was stirred at room temperature overnight. The mixture was extracted with EtOAc for three times, and the combined organic phase was washed with brine, dried over anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure.

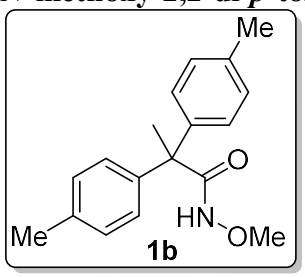
The residue was purified by column chromatography on silica gel (petroleum ether/acetone = 4:1 to 5:2) to give the *N*-alkoxy amide as white to pale yellow solid.

_N_-methoxy-2,2-diphenylpropanamide (1a)



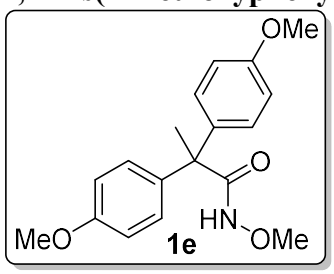
2.40 g (94% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (s, 1H), 7.38 – 7.20 (m, 10H), 3.75 (s, 3H), 2.01 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 172.9, 144.0, 128.8, 128.1, 127.4, 64.5, 55.6, 27.0. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{16}H_{18}O_2N$ 256.1332; Found 256.1335.

_N_-methoxy-2,2-di-*p*-tolylpropanamide(1b)



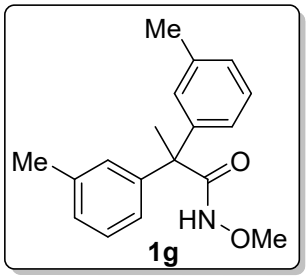
2.57 g (91% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (s, 1H), 7.12 (s, 8H), 3.74 (s, 3H), 2.34 (s, 6H), 1.97 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 173.3, 141.2, 137.0, 129.4, 128.0, 64.4, 54.9, 27.0, 21.1. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{18}H_{22}O_2N$ 284.1645; Found 284.1645.

2,2-Bis(4-methoxyphenyl)-*N*-methoxypropanamide (1e)



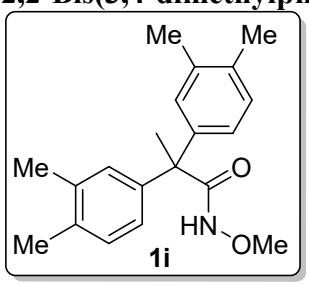
2.74 g (87% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (s, 1H), 7.15 (d, J = 8.7 Hz, 4H), 6.85 (d, J = 8.8 Hz, 4H), 3.80 (s, 6H), 3.75 (s, 3H), 1.96 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 173.5, 158.7, 136.3, 129.2, 114.0, 64.4, 55.4, 27.2. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{18}H_{22}O_4N$ 316.1543; Found 316.1545.

_N_-methoxy-2,2-di-*m*-tolylpropanamide(1g)



2.32 g (82% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (s, 1H), 7.21 (t, J = 7.6 Hz, 2H), 7.09 (d, J = 7.5 Hz, 2H), 7.06 (s, 2H), 7.00 (d, J = 7.7 Hz, 2H), 3.75 (s, 3H), 2.32 (s, 6H), 1.98 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 173.2, 144.1, 138.3, 128.7, 128.6, 128.1, 125.3, 64.4, 55.4, 27.0, 21.8. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{18}H_{22}O_2N$ 284.1645; Found 284.1646.

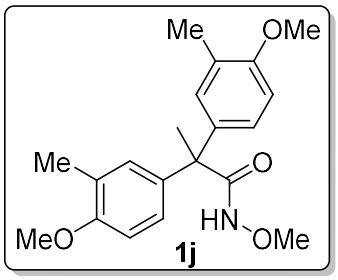
2,2-Bis(3,4-dimethylphenyl)-*N*-methoxypropanamide (1i)



2.76 g (89% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.98 (s, 1H), 7.07 (d, J = 7.9 Hz, 2H), 7.01 (s, 2H), 6.93 (d, J = 7.7 Hz, 2H), 3.75 (s, 3H), 2.25 (s, 6H), 2.23 (s, 6H), 1.95 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 173.5, 141.6, 136.8, 135.6,

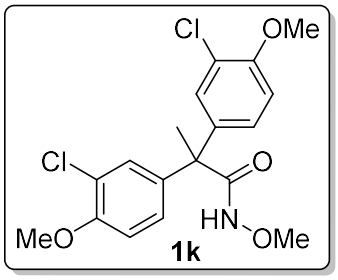
129.9, 129.2, 125.6, 64.4, 54.8, 27.1, 20.2, 19.5. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{20}H_{26}O_2N$ 312.1958; Found 312.1963.

2,2-Bis(4-methoxy-3-methylphenyl)-*N*-methoxypropanamide (1j)



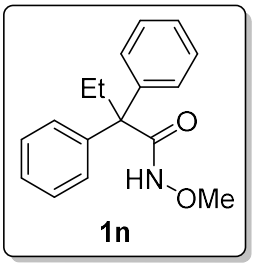
2.88 g (84% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 (s, 1H), 7.04 – 6.96 (m, 4H), 6.79 – 6.72 (m, 2H), 3.82 (s, 6H), 3.75 (s, 3H), 2.18 (s, 6H), 1.94 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 173.8, 156.8, 135.9, 130.3, 126.7, 126.5, 109.8, 64.4, 55.5, 54.2, 27.2, 16.6. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{20}H_{26}O_4N$ 344.1856; Found 344.1870.

2,2-Bis(3-chloro-4-methoxyphenyl)-*N*-methoxypropanamide (1k)



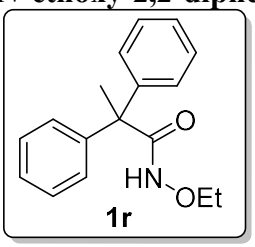
2.98 g (78% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (s, 1H), 7.23 (d, J = 2.4 Hz, 2H), 7.08 (dd, J = 8.6, 2.4 Hz, 2H), 6.89 (d, J = 8.7 Hz, 2H), 3.91 (s, 6H), 3.76 (s, 3H), 1.94 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 172.4, 154.3, 136.6, 129.8, 127.5, 122.8, 112.1, 64.5, 56.3, 54.0, 27.1. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{18}H_{20}O_4NCl_2$ 384.0764; Found 384.0779.

***N*-methoxy-2,2-diphenylbutanamide (1n)**



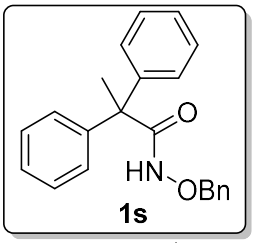
2.47 g (92% yield).^{1}H NMR (400 MHz, $CDCl_3$) δ 8.01 (s, 1H), 7.38 – 7.21 (m, 10H), 3.68 (s, 3H), 2.47 (q, J = 7.3 Hz, 2H), 0.88 (t, J = 7.3 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 172.6, 142.3, 129.0, 128.5, 127.2, 64.2, 59.5, 31.7, 10.0. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{17}H_{20}O_2N$ 270.1489; Found 270.1489.

***N*-ethoxy-2,2-diphenylpropanamide (1r)**



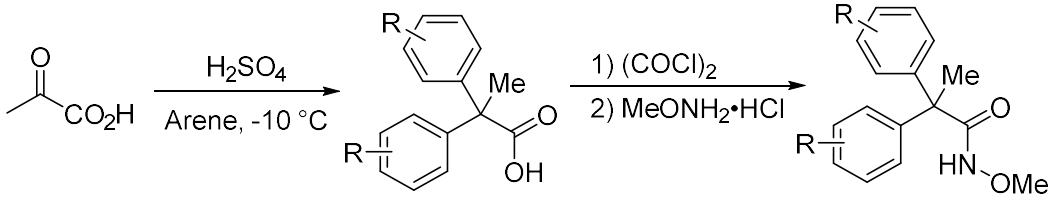
2.42 g (90% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.89 (s, 1H), 7.36 – 7.21 (m, 10H), 3.95 (q, J = 7.0 Hz, 2H), 2.01 (s, 3H), 1.21 (t, J = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 172.9, 144.1, 128.7, 128.1, 127.3, 72.2, 55.7, 27.1, 13.5. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{17}H_{20}O_2N$ 270.1489; Found 270.1490.

***N*-(benzyloxy)-2,2-diphenylpropanamide (1s)**



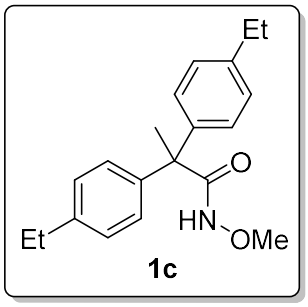
1.81 g (74% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.77 (s, 1H), 7.34 – 7.22 (m, 11H), 7.18 – 7.12 (m, 4H), 4.89 (s, 2H), 1.98 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 172.6, 144.0, 135.1, 129.5, 128.9, 128.7 (2C), 128.1, 127.3, 78.2, 55.7, 27.0. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{22}H_{22}O_2N$ 332.1645; Found 332.1647.

General procedure of synthesis of substrates (1c, 1d, 1l)[1]



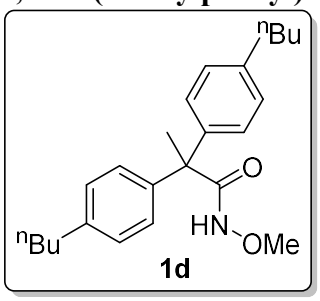
At -10 °C, conc. H_2SO_4 (15.4 mL) was added to pyruvic acid (1.34 mL, 19.3 mmol) slowly. Arene (60 mmol, 3.0 equiv.) was added in one pot. The solution was stirred vigorously for 3 h., quenched with ice, and extracted with Et_2O. The combined organic phase was dried over anhydrous Na_2SO_4, filtered, and concentrated. The crude acid was purified by flash column chromatography (petroleum ether/EtOAc = 10:1 to petroleum ether/acetone = 4:1). Then, the similar amidations according to **1a** was carried out to give the corresponding substrates.

2,2-Bis(4-ethylphenyl)-*N*-methoxypropanamide (1c)



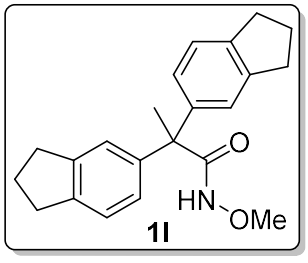
1.62 g (27% overall yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 (d, J = 9.9 Hz, 1H), 7.15 (s, 8H), 3.75 (s, 3H), 2.64 (q, J = 7.6 Hz, 4H), 1.98 (s, 3H), 1.24 (t, J = 7.6 Hz, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 173.4, 143.2, 141.4, 128.2, 128.0, 64.4, 55.0, 28.5, 27.0, 15.5. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{20}H_{26}O_2N$ 312.1958; Found 312.1971.

2,2-Bis(4-butylphenyl)-*N*-methoxypropanamide (1d)



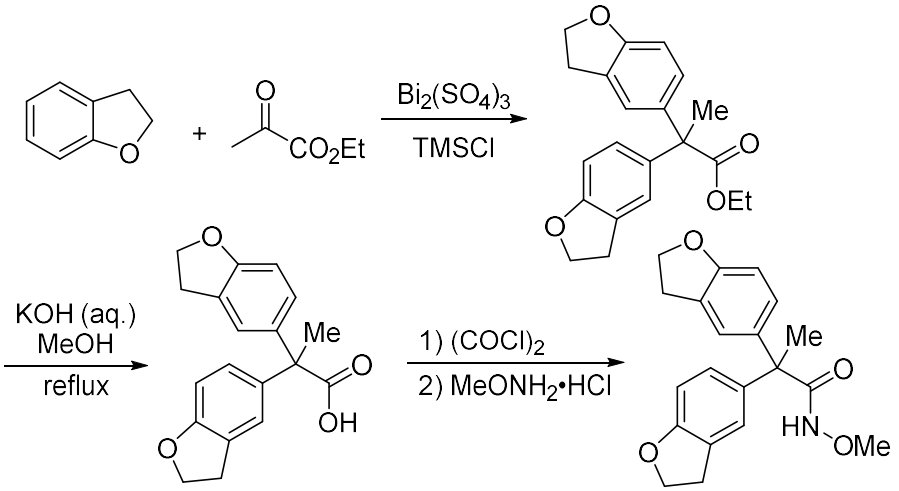
1.20 g (17% overall yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (s, 1H), 7.13 (s, 8H), 3.75 (s, 3H), 2.75 – 2.49 (m, 4H), 1.98 (s, 3H), 1.73 – 1.50 (m, 4H), 1.48 – 1.28 (m, 4H), 0.93 (t, J = 7.3 Hz, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 173.4, 142.0, 141.3, 128.7, 127.9, 64.4, 55.0, 35.3, 33.6, 27.0, 22.6, 14.1. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{24}H_{34}O_2N$ 368.2584; Found 368.2597.

2,2-Bis(2,3-dihydro-1*H*-inden-5-yl)-*N*-methoxypropanamide (1l)



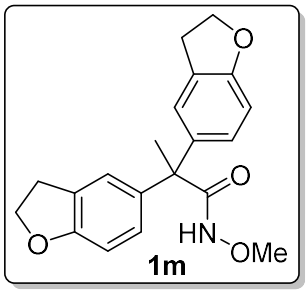
2.13 g (33% overall yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.00 (s, 1H), 7.16 (d, J = 7.9 Hz, 2H), 7.11 (s, 2H), 6.99 (d, J = 8.0 Hz, 2H), 3.75 (s, 3H), 2.88 (q, J = 7.7 Hz, 8H), 2.16 – 2.02 (m, 4H), 1.98 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 173.7, 144.8, 143.2, 142.3, 126.1, 124.4, 124.0, 64.4, 55.3, 33.1, 32.6, 27.4, 25.6. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{22}H_{26}O_2N$ 336.1958; Found 336.1971.

General procedure of synthesis of substrate (1m)[2]



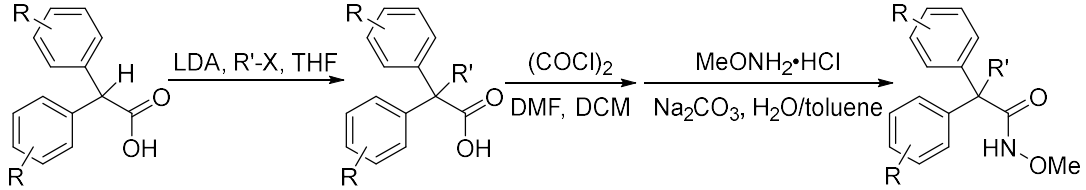
To a mixture of TMSCl (13.0 mL, 100 mmol, 2.0 equiv.), dihydrobenzofuran (16.9 mL, 150 mmol, 3,0 equiv.), ethyl pyruvate (6.1 mL, 50 mmol), $Bi_2(SO_4)_3$ (3.5 g, 5 mmol, 10 mol%) was added in portions. The mixture was stirred at room temperature overnight vigorously. Silica gel was added after completing the reaction, and the volatile was evaporated, then the residue was purified by flash column chromatography (petroleum ether/EtOAc = 15:1 to 4:1). The ester (20 mmol) was dissolved in MeOH (11.2 mL), and was added 11.2 mL 20% KOH (aq.). The resulting solution was refluxed in an oil bath for 24 h. After that, the mixture was cooled to 0 °C, acidified using 4N HCl, and extracted with Et_2O. The organic phase was dried over anhydrous Na_2SO_4. After filtration and concentration, the acid, without further purification, was used in the similar amidation according to **1a** to give **1m** (2.44 g, 36% overall yield) as white solid.

2,2-Bis(2,3-dihydrobenzofuran-5-yl)-*N*-methoxypropanamide (1m)



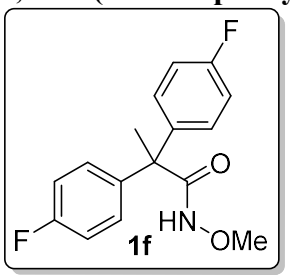
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.01 (s, 1H), 7.06 (s, 2H), 6.96 (d, J = 8.4 Hz, 2H), 6.72 (d, J = 8.4 Hz, 2H), 4.58 (t, J = 8.7 Hz, 4H), 3.76 (s, 3H), 3.18 (t, J = 8.7 Hz, 4H), 1.94 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 173.9, 159.2, 136.5, 127.9, 127.5, 124.7, 109.2, 71.6, 64.4, 54.6, 29.9, 27.5. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{20}H_{22}O_4N$ 340.1543; Found 340.1559.

General procedure of synthesis of substrates (1f, 1o-q)[7]



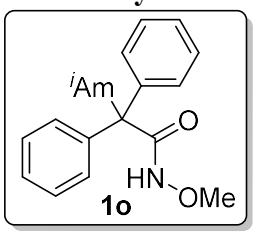
To a solution of diphenylacetic acid (2.12 g, 10 mmol) (2.48 g of bis(4-fluorophenyl)acetic acid[8] for **1f**) in dried THF (10 mL) was added LDA (2.0 M in THF, 11 mL, 22 mmol) under N_2 atmosphere in an ice-bath. The solution was stirred at room temperature for 4 h. After cooling the reaction mixture again to 0 ºC, alkyl halide (15 mmol) was added dropwise. The reaction was stirred overnight at room temperature, quenched by 4N HCl at 0 ºC and then diluted with Et_2O. The phases were separated and the aqueous phase was extracted with Et_2O (3 times). The organic layers were combined, washed with brine, dried over anhydrous Na_2SO_4. After filtration and concentration, the crude acid was purified by flash column chromatography (petroleum ether/EtOAc = 10:1 to petroleum ether/acetone = 4:1). Then, the similar amidations according to **1a** was carried out to give the corresponding substrates as white solid.

2,2-Bis(4-fluorophenyl)-*N*-methoxypropanamide(1f)



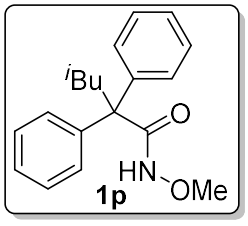
1.80 g (62% overall yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (d, *J* = 5.4 Hz, 1H), 7.20 (dd, *J* = 8.7, 5.2 Hz, 4H), 7.03 (t, *J* = 8.6 Hz, 4H), 3.75 (s, 3H), 1.98 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 172.6, 162.0 (d, *J* = 247.6 Hz), 139.6 (d, *J* = 3.3 Hz), 129.8 (d, *J* = 8.0 Hz), 115.7 (d, *J* = 21.3 Hz), 64.5, 54.5, 27.4. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{16}H_{16}O_2NF_2$ 292.1144; Found 292.1145.

***N*-methoxy-5-methyl-2,2-diphenylhexanamide (1o)**



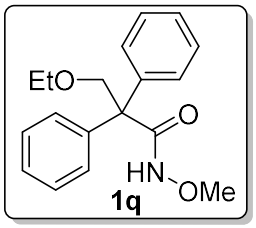
1.99 g (64% overall yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 (s, 1H), 7.39 – 7.15 (m, 10H), 3.69 (s, 3H), 2.45 – 2.34 (m, 2H), 1.57 – 1.45 (m, 1H), 1.18 – 1.06 (m, 2H), 0.85 (d, *J* = 6.6 Hz, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 172.7, 142.6, 128.9, 128.6, 127.2, 64.3, 59.2, 37.0, 34.0, 28.8, 22.7. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{20}H_{26}O_2N$ 312.1958; Found 312.1960.

***N*-methoxy-4-methyl-2,2-diphenylpentanamide (1p)**



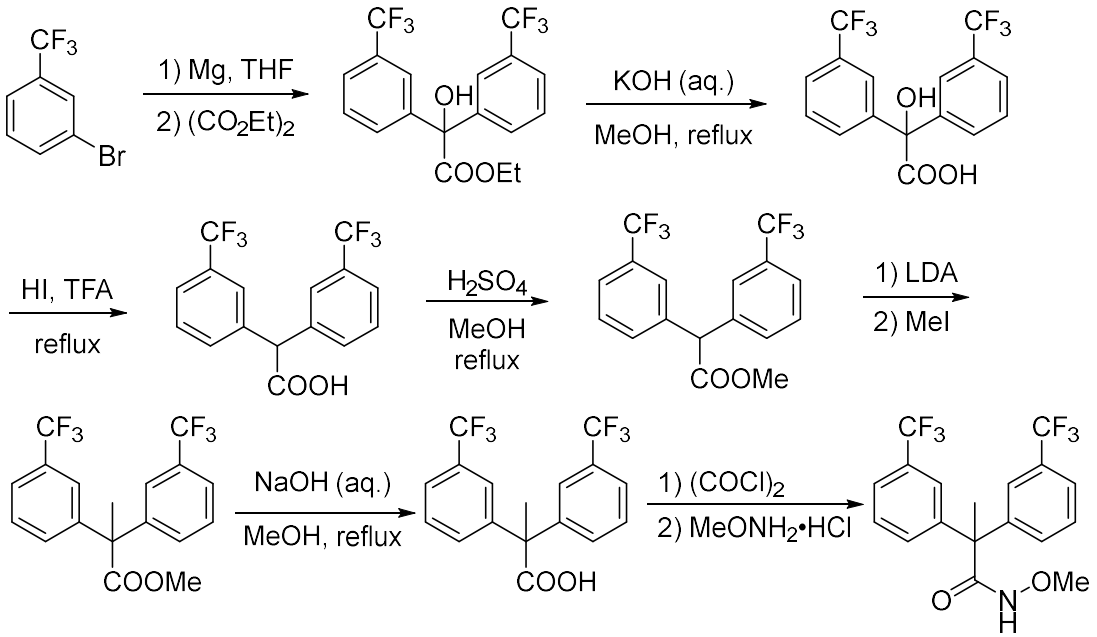
1.25 g (42% overall yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.05 (s, 1H), 7.41 – 7.22 (m, 10H), 3.64 (s, 3H), 2.34 (d, *J* = 5.1 Hz, 2H), 1.68 – 1.58 (m, 1H), 0.70 (d, *J* = 6.7 Hz, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 172.7, 142.8, 129.1, 128.4, 127.2, 64.1, 59.5, 47.3, 25.1, 24.7. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{19}H_{24}O_2N$ 298.1802; Found 298.1803.

3-Ethoxy-*N*-methoxy-2,2-diphenylpropanamide (1q)



2.12 g (71% overall yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.52 (s, 1H), 7.34 – 7.30 (m, 2H), 7.30 – 7.27 (m, 3H), 7.26 – 7.21 (m, 5H), 4.09 (s, 2H), 3.78 (s, 3H), 3.63 (q, J = 7.0 Hz, 2H), 1.24 (t, J = 7.0 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 171.6, 140.9, 128.9, 128.4, 127.4, 74.9, 67.4, 64.2, 60.2, 15.1. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{18}H_{22}O_3N$ 300.1594; Found 300.1596.

Synthesis of 1h[7]

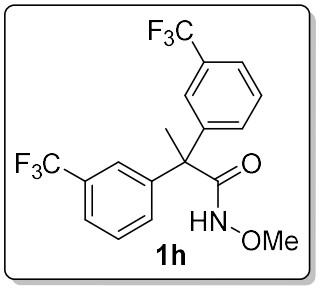


To a solution of diethyl oxalate (8.13 mL, 60 mmol) in dried THF (60 mL) was added 3-trifluoromethylphenylmagnesium bromide (132 mmol, 2.2 equiv., synthesized from 18.48 mL 3-trifluoromethylphenyl bromide and 3.35 g magnesium in 90 mL dried THF) dropwise at -78 ºC, and then warmed to room temperature. After stirring overnight, the reaction was quenched with saturated NH_4Cl (aq.) at -10 ºC, and stirred for another 10 min. The mixture was extracted with DCM for three times, and the combined organic phase was dried over anhydrous Na_2SO_4, filtered, and concentrated. The residue was purified by flash column chromatography (petroleum ether/EtOAc = 5:1) to give the ethyl benzilate (22.57 g, 57.5 mmol, 96% yield). The ester was dissolved in MeOH (57 mL), and the solution refluxed in an oil bath overnight after 2.5 M KOH (57 mL) was added. The reaction was cooled to 0 ºC and then acidified using 4N HCl. The mixture was extracted with Et_2O. The organic phase was dried over anhydrous Na_2SO_4. After

filtration and concentration, the crude acid was purified by flash column chromatography (DCM/MeOH = 50:1) to give the pure acid (20.04 g, 96% yield). The benzilic acid (12 g, 33 mmol) was dissolved in TFA (110 mL), and heated to reflux in an oil bath, then 57% HI (aq., 48 mL) was added dropwise. The solution was cooled to room temperature 5 h later, and most of the volatile was evaporated. The residue was diluted with water, added 30% NaOH (aq.) to adjust pH < 3 in an ice bath, extracted with EtOAc for three times. The combined organic phase was dried over anhydrous Na_2SO_4, filtered, concentrated. The crude acid was purified by flash column chromatography (petroleum ether/acetone = 6:1, 7.04 g, 61% yield).

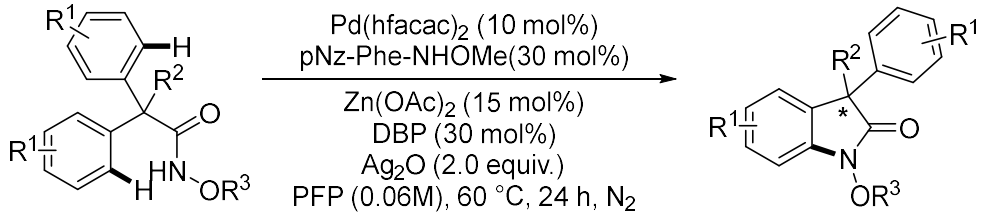
To a solution of diarylacetic acid (6.96 g, 20 mmol) in MeOH (33 mL) was added conc. H_2SO_4 (55.6 μL, 1 mmol, 0.05 equiv.) dropwise in an ice-bath, then refluxed overnight. After cooling to room temperature, saturated $NaHCO_3$ was added, and then extracted by EtOAc three times. The combined organic phase was dried over anhydrous Na_2SO_4, filtered, concentrated. The residue was dissolved in dried THF (20 mL) under N_2, and then LDA (15 mL, 2.0 M in THF, 1.5 equiv.) was added at -78 ºC. The solution was stirred for another 12 h, and iodomethane (2.5 mL, 40 mmol, 2.0 equiv.) was added dropwise. The reaction was stirred at room temperature overnight. The mixture was quenched by water at -40 ºC and extracted with EtOAc (3 times). The organic layers were combined, washed with brine, dried over anhydrous Na_2SO_4. After filtration and concentration, the crude ester was dissolved in MeOH (20 mL), and the solution refluxed overnight after 20% NaOH (20 mL) was added. The reaction was cooled to 0 ºC and then acidified using 4N HCl. The mixture was extracted with Et_2O. The organic phase was dried over anhydrous Na_2SO_4. After filtration and concentration, the crude acid was purified by flash column chromatography (petroleum ether/EtOAc = 10:1 to petroleum ether/acetone = 5:1, 4.20 g, 59% yield). Then, the similar amidation according to **1a** was carried out to give **1h** (3.10 g, 68% yield) as pale yellow solid.

2,2-bis(3-(trifluoromethyl)phenyl)-*N*-methoxypropanamide (1h)



^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09 (s, 1H), 7.59 (d, *J* = 7.7 Hz, 2H), 7.51 (s, 2H), 7.48 (t, *J* = 7.8 Hz, 2H), 7.40 (d, *J* = 8.0 Hz, 2H), 3.75 (s, 3H), 2.04 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 171.5, 144.2, 131.7, 131.4 (q, *J* = 32.4 Hz), 129.5, 124.8 (q, *J* = 3.7 Hz), 124.6 (q, *J* = 3.8 Hz), 123.9 (q, *J* = 272.6 Hz), 64.5, 55.5, 27.0. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{18}H_{16}O_2NF_6$ 392.1080; Found 392.1082.

Pd(II)-Catalyzed enantioselective C(sp^2)–H amination

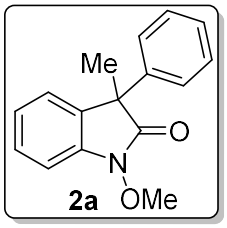


In a 25 mL Schlenk tube, 2.5 mL pentafluoropanol was added to a mixture of diarylamide **1** (0.15 mmol), $Pd(hfacac)_2$ (7.8 mg, 0.015 mmol, 10 mol%), pNz-Phe-NHOMe (16.8 mg, 0.045 mmol, 30 mol%), $Zn(OAc)_2$ (4.1 mg, 0.0225 mmol, 15 mol%), dibenzyl phosphate (12.5 mg, 0.045 mmol, 30 mol%) and Ag_2O (69.5 mg, 0.3 mmol, 2.0 equiv.) under N_2. The tube was sealed with a Teflon lined cap and the reaction mixture was stirred at 60 °C in a preheating oil bath for 24 h. After cooling to room temperature, the mixture was concentrated under vacuum and the residue was purified by column chromatography on silica gel (petroleum ether/acetone = 7:1 to 5:1) to give the chiral lactams as white to pale yellow solid.

Preparation procedure of racemic products was shown as follows:

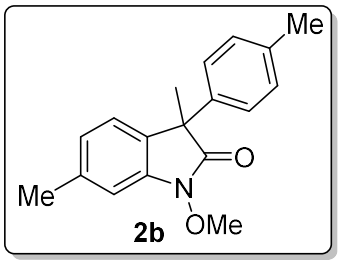
In a 25 mL Schlenk tube, 1.0 mL trifluoroethanol was added to a mixture of diarylamide **1** (0.1 mmol), $Pd(OAc)_2$ (2.2 mg, 0.01 mmol, 10 mol%), Cbz-Gly-NHOMe (7.1 mg, 0.03 mmol, 30 mol%), and Ag_2O (46.4 mg, 0.2 mmol, 2.0 equiv.) under N_2. The following procedure was the same as the enantioselective approach.

1-Methoxy-3-methyl-3-phenylindolin-2-one (2a)



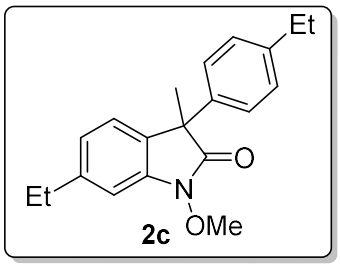
36.2 mg (95% yield), 240.0 mg (94% yield for 1 mmol scale reaction in 100 mL Schlenk tube). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34 (td, *J* = 7.7, 1.2 Hz, 1H), 7.32 – 7.22 (m, 5H), 7.19 (d, *J* = 6.7 Hz, 1H), 7.11 (td, *J* = 7.5, 1.0 Hz, 1H), 7.07 (d, *J* = 7.8 Hz, 1H), 4.02 (s, 3H), 1.80 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.1, 140.0, 139.6, 131.4, 128.8, 128.4, 127.6, 126.7, 124.6, 123.5, 107.7, 63.6, 51.0, 23.6. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{16}H_{16}O_2N$ 254.1176; Found 254.1178. $[\alpha]_D^{20}$ = +101.4° (*c* 1.0, $CHCl_3$). Enantiomeric excess: 95%, determined by HPLC (Chiralpak-AD-H, hexane/isopropanol = 90/10, flow rate 1.0 mL/min, T = 25 °C, 254 nm): t_R = 6.940 min (minor), t_R = 9.382 min (major).

1-Methoxy-3,6-dimethyl-3-(p-tolyl)indolin-2-one (2b)



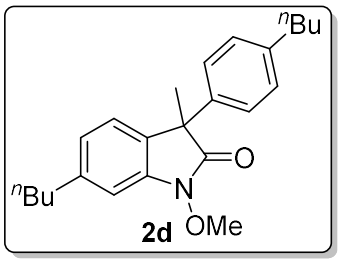
32.4 mg (77% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.19 (d, *J* = 8.3 Hz, 2H), 7.10 (d, *J* = 8.0 Hz, 2H), 7.06 (d, *J* = 7.5 Hz, 1H), 6.91 (d, *J* = 7.5 Hz, 1H), 6.89 (s, 1H), 4.00 (s, 3H), 2.42 (s, 3H), 2.30 (s, 3H), 1.76 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.5, 139.6, 138.6, 137.3, 137.2, 129.4, 128.6, 126.6, 124.3, 124.0, 108.4, 63.5, 50.4, 23.7, 21.9, 21.1. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{18}H_{20}O_2N$ 282.1489; Found 282.1491. $[\alpha]_D^{20}$ = +94.0º (*c* 1.0, $CHCl_3$). Enantiomeric excess: 93%, determined by HPLC (Chiralpak-AD-H, hexane/isopropanol = 90/10, flow rate 1.0 mL/min, T = 25 ºC, 254 nm): t_R = 10.335 min (minor), t_R = 11.668 min (major).

6-Ethyl-3-(4-ethylphenyl)-1-methoxy-3-methylindolin-2-one (2c)



33.7 mg (73% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.23 (d, *J* = 8.3 Hz, 2H), 7.13 (d, *J* = 8.3 Hz, 2H), 7.09 (d, *J* = 7.6 Hz, 1H), 6.94 (d, *J* = 7.6 Hz, 1H), 6.91 (s, 1H), 4.02 (s, 3H), 2.71 (q, *J* = 7.6 Hz, 2H), 2.60 (q, *J* = 7.6 Hz, 2H), 1.77 (s, 3H), 1.29 (t, *J* = 7.6 Hz, 3H), 1.20 (t, *J* = 7.6 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.6, 145.1, 143.4, 139.6, 137.5, 128.8, 128.2, 126.6, 124.4, 122.8, 107.2, 63.6, 50.5, 29.2, 28.5, 23.7, 15.7, 15.6. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{20}H_{24}O_2N$ 310.1802; Found 310.1817. $[\alpha]_D^{20}$ = +77.2º (*c* 1.0, $CHCl_3$). Enantiomeric excess: 93%, determined by HPLC (Chiralpak-AD-H, hexane/isopropanol = 90/10, flow rate 1.0 mL/min, T = 25 ºC, 254 nm): t_R = 9.599 min (major), t_R = 10.931 min (minor).

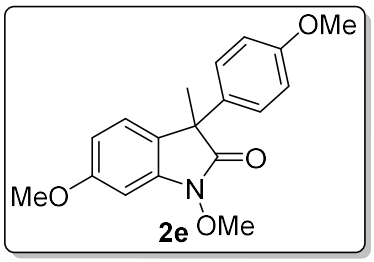
6-Butyl-3-(4-butylphenyl)-1-methoxy-3-methylindolin-2-one (2d)



34.3 mg (63% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.24 – 7.19 (m, 2H), 7.14 – 7.05 (m, 3H), 6.92 (d, *J* = 7.6 Hz, 1H), 6.89 (s, 1H), 4.02 (s, 3H), 2.71 – 2.63 (m, 2H), 2.59 – 2.51 (m, 2H), 1.77 (s, 3H), 1.69 – 1.60 (m, 2H), 1.60 – 1.50 (m, 2H), 1.41 (dt, *J* = 14.9, 7.4 Hz, 2H), 1.32 (dt, *J* = 14.6, 7.4 Hz, 2H), 0.96 (t, *J* = 7.3 Hz, 3H), 0.90 (t, *J* = 7.3 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.6, 143.7, 142.2, 139.6, 137.5, 128.8, 128.7, 126.5, 124.3, 123.4, 107.7, 63.6, 50.5, 36.1, 35.3, 33.8, 33.6, 23.8, 22.6, 22.5, 14.1 (2C). HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{24}H_{32}O_2N$ 366.2428; Found 366.2441. $[\alpha]_D^{20}$ = +67.9º (*c* 1.0, $CHCl_3$). Enantiomeric excess: 93%, determined by HPLC (Chiralpak-AD-H,

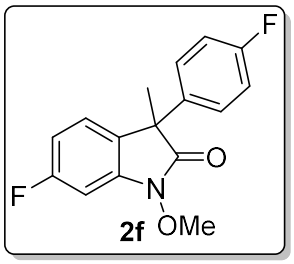
hexane/isopropanol = 90/10, flow rate 1.0 mL/min, T = 25 °C, 254 nm): t_R = 6.768 min (major), t_R = 7.608 min (minor).

1,6-Dimethoxy-3-(4-methoxyphenyl)-3-methylindolin-2-one (2e)



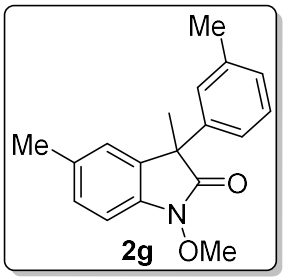
37.6 mg (80% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.22 (d, *J* = 8.9 Hz, 2H), 7.08 (d, *J* = 8.1 Hz, 1H), 6.83 (d, *J* = 8.9 Hz, 2H), 6.65 (d, *J* = 2.2 Hz, 1H), 6.62 (dd, *J* = 8.1, 2.4 Hz, 1H), 4.00 (s, 3H), 3.85 (s, 3H), 3.77 (s, 3H), 1.74 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.9, 160.4, 159.0, 140.8, 132.5, 127.8, 125.3, 123.2, 114.1, 108.0, 95.0, 63.6, 55.7, 55.4, 49.9, 24.0. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{18}H_{20}O_4N$ 314.1387; Found 314.1390. $[\alpha]_D^{20}$ = +104.6° (*c* 1.0, $CHCl_3$). Enantiomeric excess: 92%, determined by HPLC (Chiralpak-OD-H, hexane/isopropanol = 86/14, flow rate 1.0 mL/min, T = 25 °C, 254 nm): t_R = 8.337 min (minor), t_R = 10.972 min (major).

6-Fluoro-3-(4-fluorophenyl)-1-methoxy-3-methylindolin-2-one (2f)



17.4 mg (40% yield) was obtained by using $Pd(OAc)_2$ (10 mol%) as catalyst without $Zn(OAc)_2$. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.31 – 7.22 (m, 2H), 7.15 – 7.09 (m, 1H), 7.00 (t, *J* = 8.7 Hz, 2H), 6.85 – 6.77 (m, 2H), 4.01 (s, 3H), 1.77 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.3, 164.0 (d, *J* = 88.1 Hz), 161.6 (d, *J* = 88.5 Hz), 141.1 (d, *J* = 11.8 Hz), 135.5, 128.4 (d, *J* = 8.2 Hz), 126.2 (d, *J* = 3.2 Hz), 125.8 (d, *J* = 9.5 Hz), 115.7 (d, *J* = 21.5 Hz), 109.9 (d, *J* = 22.6 Hz), 96.7 (d, *J* = 28.3 Hz), 63.8, 50.2, 24.0. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{16}H_{14}O_2NF_2$ 290.0987; Found 290.0993. $[\alpha]_D^{20}$ = +103.5° (*c* 1.0, $CHCl_3$). Enantiomeric excess: 91%, determined by HPLC (Chiralpak-OD-H, hexane/isopropanol =90/10, flow rate 1.0 mL/min, T = 25 °C, 254 nm): t_R = 6.292 min (minor), t_R = 7.296 min (major).

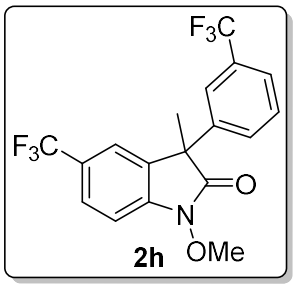
1-Methoxy-3,5-dimethyl-3-(*m*-tolyl)indolin-2-one (2g)



38.1 mg (90% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.19 (t, *J* = 7.6 Hz, 1H), 7.15 – 7.10 (m, 2H), 7.09 – 7.03 (m, 2H), 6.98 (s, 1H), 6.95 (d, *J* = 7.9 Hz, 1H), 4.01 (s, 3H), 2.33 (s, 3H), 2.32 (s, 3H), 1.77 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.2, 140.1, 138.4, 137.1, 133.2, 131.8, 128.6, 128.4, 127.3, 125.2, 123.7, 107.4, 63.5, 50.9, 23.4, 21.7, 21.4. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{18}H_{20}O_2N$ 282.1489; Found 282.1490. $[\alpha]_D^{20}$ = +113.0° (*c* 1.0, $CHCl_3$). Enantiomeric excess: 93%, determined by HPLC (Chiralpak-AD-H, hexane/isopropanol = 90/10, flow rate 1.0

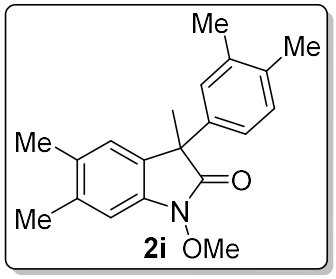
mL/min, T = 25 ºC, 254 nm): t_R = 5.179 min (minor), t_R = 6.919 min (major).

1-Methoxy-3-methyl 5-trifluoromethyl-3-(3-trifluoromethylphenyl)indolin-2-one (2h)



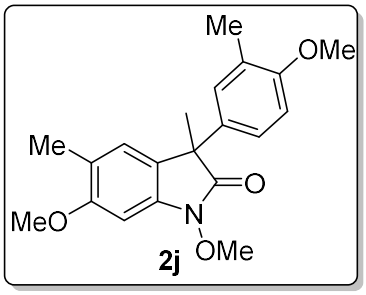
18.0 mg (31% yield) was obtained at 80 ºC for 96 h. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.68 (d, *J* = 8.2 Hz, 1H), 7.60 – 7.55 (m, 2H), 7.47 (t, *J* = 7.9 Hz, 1H), 7.42 (d, *J* = 7.5 Hz, 2H), 7.19 (d, *J* = 8.2 Hz, 1H), 4.06 (s, 3H), 1.86 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 173.3, 142.6, 140.0, 131.4 (q, *J* = 32.3 Hz), 131.0, 130.1, 129.6, 126.8 (q, *J* = 3.9 Hz), 126.3 (q, *J* = 32.8 Hz), 125.1 (q, *J* = 3.7 Hz), 124.2 (q, *J* = 271.7 Hz), 124.0 (q, *J* = 272.5 Hz), 123.4 (q, *J* = 4.0 Hz), 121.7 (q, *J* = 3.7 Hz).107.9, 64.0, 50.9, 23.6. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{18}H_{14}O_2NF_6$ 390.0923; Found 390.0929. $[\alpha]_D^{20}$ = +55.2º (*c* 0.5, $CHCl_3$). Enantiomeric excess: 86%, determined by HPLC (Chiralpak-AD-H, hexane/isopropanol = 95/5, flow rate 1.0 mL/min, T = 25 ºC, 254 nm): t_R = 4.597 min (minor), t_R = 5.140 min (major).

3-(3,4-Dimethylphenyl)-1-methoxy-3,5,6-trimethylindolin-2-one (2i)



35.4 mg (76% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.07 (d, *J* = 1.3 Hz, 1H), 7.05 (d, *J* = 7.9 Hz, 1H), 6.99 (dd, *J* = 7.9, 1.9 Hz, 1H), 6.93 (s, 1H), 6.86 (s, 1H), 4.00 (s, 3H), 2.32 (s, 3H), 2.23 (s, 3H), 2.22 (s, 3H), 2.21 (s, 3H), 1.75 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.6, 137.8, 137.5, 136.9, 136.7, 135.9, 131.5, 129.9, 129.2, 127.8, 125.6, 124.0, 109.0, 63.5, 50.5, 23.5, 20.3, 20.1, 19.8, 19.5. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{20}H_{24}O_2N$ 310.1802; Found 310.1813. $[\alpha]_D^{20}$ = +107.2º (*c* 1.0, $CHCl_3$). Enantiomeric excess: 87%, determined by HPLC (Chiralpak-AD-H, hexane/isopropanol = 90/10, flow rate 1.0 mL/min, T = 25 ºC, 254 nm): t_R = 5.436 min (minor), t_R = 8.260 min (major).

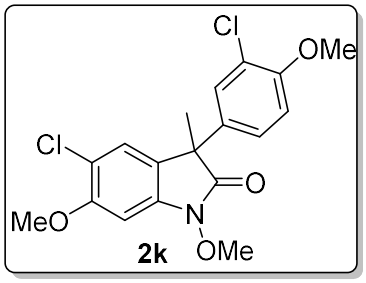
1,6-Dimethoxy-3-(4-methoxy-3-methylphenyl)-3,5-dimethylindolin-2-one (2j)



39.0 mg (76% yield) was obtained by using $Pd(acac)_2$ (10 mol%) as catalyst at 50 ºC for 48 h. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.11 – 7.02 (m, 2H), 6.93 (s, 1H), 6.74 (d, *J* = 8.3 Hz, 1H), 6.62 (s, 1H), 4.02 (s, 3H), 3.90 (s, 3H), 3.78 (s, 3H), 2.18 (s, 3H), 2.17 (s, 3H), 1.72 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.1, 158.0, 157.1, 138.5, 132.0, 129.0, 126.8, 126.4, 125.0, 122.3, 121.1, 109.9, 91.6, 63.6, 55.9, 55.4, 50.0, 23.8, 16.6, 16.3. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{20}H_{24}O_4N$ 342.1700; Found 342.1712. $[\alpha]_D^{20}$ = +70.4º (*c* 1.0, $CHCl_3$).

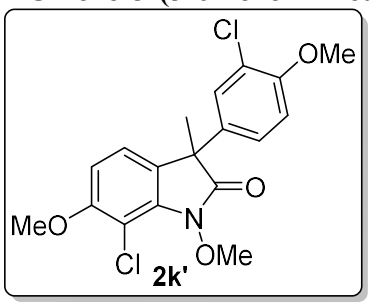
Enantiomeric excess: 83%, determined by HPLC (Chiralpak-AD-H, hexane/isopropanol = 87/13, flow rate 1.0 mL/min, T = 25 °C, 254 nm): t_R = 6.877 min (minor), t_R = 9.890 min (major).

5-Chloro-3-(3-chloro-4-methoxyphenyl)-1,6-dimethoxy-3-methylindolin-2-one (2k)



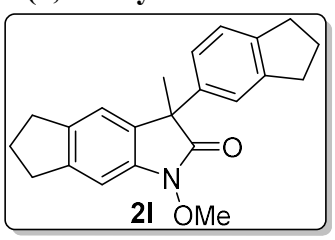
37.8 mg (66% yield) was obtained by using $Pd(acacc)_2$ (10 mol%) as catalyst, AgOAc (15 mol%) as acetate, and Tfz-Phe-NHOMe (30 mol%) as ligand. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.26 (d, *J* = 2.4 Hz, 1H), 7.20 – 7.13 (m, 2H), 6.87 (d, *J* = 8.7 Hz, 1H), 6.71 (s, 1H), 4.03 (s, 3H), 3.99 (s, 3H), 3.87 (s, 3H), 1.73 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.0, 155.8, 154.6, 139.4, 132.7, 128.5, 126.2, 126.1, 122.8, 122.6, 116.8, 112.2, 93.4, 63.9, 56.8, 56.3, 49.8, 23.8. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{18}H_{18}O_4NCl_2$ 382.0607; Found 382.0623. $[\alpha]_D^{20}$ = +90.4° (*c* 1.0, $CHCl_3$). Enantiomeric excess: 85%, determined by HPLC (Chiralpak-AD-H, hexane/isopropanol = 87/13, flow rate 1.0 mL/min, T = 25 °C, 254 nm): t_R = 11.056 min (minor), t_R = 13.336 min (major).

7-Chloro-3-(3-chloro-4-methoxyphenyl)-1,6-dimethoxy-3-methylindolin-2-one (2k')



9.1 mg (16% yield) was obtained with **2k** as separable mixture. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.17 (d, *J* = 2.2 Hz, 1H), 7.09 (dd, *J* = 8.6, 2.2 Hz, 1H), 6.91 (d, *J* = 8.2 Hz, 1H), 6.79 (d, *J* = 8.7 Hz, 1H), 6.59 (d, *J* = 8.2 Hz, 1H), 3.96 (s, 3H), 3.87 (s, 3H), 3.80 (s, 3H), 1.67 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.4, 156.1, 154.5, 137.4, 133.1, 128.6, 126.2, 124.9, 122.9, 122.7, 112.2, 106.2, 105.1, 65.0, 56.7, 56.3, 48.7, 24.1. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{18}H_{18}O_4NCl_2$ 382.0607; Found 382.0622. $[\alpha]_D^{20}$ = +41.3° (*c* 0.4, $CHCl_3$). Enantiomeric excess: 73%, determined by HPLC (Chiralpak-AD-H, hexane/isopropanol = 87/13, flow rate 1.0 mL/min, T = 25 °C, 254 nm): t_R = 15.319 min (minor), t_R = 17.644 min (major).

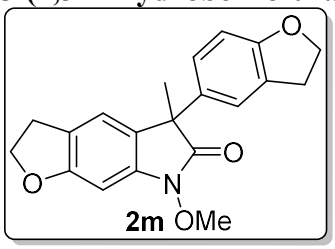
3-(2,3-Dihydro-1*H*-inden-5-yl)-1-methoxy-3-methyl-3,5,6,7-tetrahydrocyclopenta[*f*]indol-2(1*H*)-one (2l)



25.1 mg (50% yield) was obtained by using $Pd(acacc)_2$ (10 mol%) as catalyst. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.18 (s, 1H), 7.14 (d, *J* = 7.9 Hz, 1H), 7.04 (dd, *J* = 7.9, 1.6 Hz, 1H), 7.01 (s, 1H), 6.94 (s, 1H), 4.01 (s, 3H), 2.95 (t, *J* = 7.4 Hz, 2H), 2.90 – 2.82 (m,

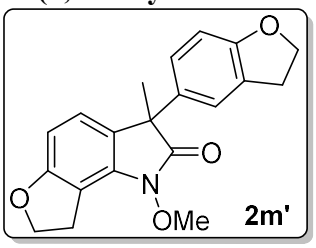
6H), 2.15 – 1.98 (m, 4H), 1.76 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.7, 144.9, 144.2, 143.6, 139.2, 138.3, 137.9, 130.2, 124.5, 124.5, 122.7, 120.6, 104.2, 63.4, 50.8, 33.3, 33.0, 32.6 (2C), 25.7, 25.6, 23.7. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{22}H_{24}O_2N$ 334.1802; Found 334.1816. $[\alpha]_D^{20}$ = +100.3º (*c* 1.0, $CHCl_3$). Enantiomeric excess: 85%, determined by HPLC (Chiralpak-AD-H, hexane/isopropanol = 90/10, flow rate 1.0 mL/min, T = 25 ºC, 254 nm): t_R = 5.770 min (minor), t_R = 8.247 min (major).

5-(2,3-Dihydrobenzofuran-5-yl)-7-methoxy-5-methyl-2,3,5,7-tetrahydro-6*H*-furo[3,2-*f*]indol-6-one (2m)



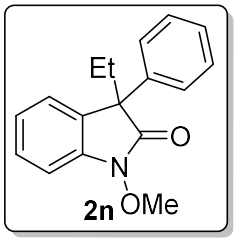
20.7 mg (41% yield) was obtained by using $Pd(acacc)_2$ (10 mol%) as catalyst for 30 h. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.16 (d, *J* = 0.6 Hz, 1H), 7.00 (dd, *J* = 8.4, 2.1 Hz, 1H), 6.96 (s, 1H), 6.69 (d, *J* = 8.4 Hz, 1H), 6.56 (s, 1H), 4.62 (t, *J* = 8.7 Hz, 2H), 4.54 (t, *J* = 8.7 Hz, 2H), 3.99 (s, 3H), 3.17 (td, *J* = 8.6, 5.6 Hz, 4H), 1.73 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.0, 160.3, 159.6, 139.6, 132.6, 127.6, 126.5, 123.5, 123.4, 121.3, 121.0, 109.2, 91.2, 72.1, 71.6, 63.5, 50.2, 29.9, 29.6, 24.0. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{20}H_{20}O_4N$ 338.1387; Found 338.1401. $[\alpha]_D^{20}$ = +136.4º (*c* 1.0, $CHCl_3$). Enantiomeric excess: 90%, determined by HPLC (Chiralpak-AD-H, hexane/isopropanol = 87/13, flow rate 1.0 mL/min, T = 25 ºC, 254 nm): t_R = 14.240 min (minor), t_R = 21.634 min (major).

3-(2,3-Dihydrobenzofuran-5-yl)-1-methoxy-3-methyl-1,3,7,8-tetrahydro-2*H*-furo[2,3-*g*]indol-2-one (2m')



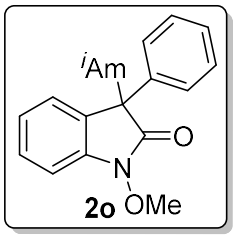
7.1 mg (14% yield) was obtained with **2m** as separable mixture. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.17 (s, 1H), 7.01 (d, *J* = 8.3 Hz, 1H), 6.90 (d, *J* = 7.9 Hz, 1H), 6.68 (d, *J* = 8.4 Hz, 1H), 6.53 (d, *J* = 8.0 Hz, 1H), 4.68 (t, *J* = 8.6 Hz, 2H), 4.54 (t, *J* = 8.7 Hz, 2H), 3.99 (s, 3H), 3.48 – 3.32 (m, 2H), 3.16 (t, *J* = 8.6 Hz, 2H), 1.73 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.6, 161.8, 159.6, 136.4, 132.6, 127.6, 126.5, 124.0, 123.5, 123.4, 109.2, 107.9, 103.7, 72.1, 71.6, 64.5, 50.2, 29.9, 27.5, 24.4. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{20}H_{20}O_4N$ 338.1387; Found 338.1401. $[\alpha]_D^{20}$ = +43.1º (*c* 0.5, $CHCl_3$). Enantiomeric excess: 90%, determined by HPLC (Chiralpak-AD-H, hexane/isopropanol = 87/13, flow rate 1.0 mL/min, T = 25 ºC, 254 nm): t_R = 12.979 min (minor), t_R = 15.573 min (major).

3-Ethyl-1-methoxy-3-phenylindolin-2-one (2n)



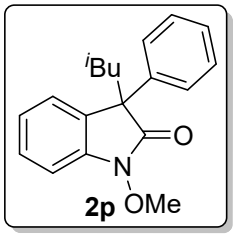
39.1 mg (97% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 – 7.33 (m, 3H), 7.33 – 7.28 (m, 2H), 7.28 – 7.20 (m, 2H), 7.14 (td, *J* = 7.6, 1.0 Hz, 1H), 7.06 (d, *J* = 7.7 Hz, 1H), 4.01 (s, 3H), 2.47 (dq, *J* = 14.8, 7.4 Hz, 1H), 2.24 (dq, *J* = 14.7, 7.4 Hz, 1H), 0.73 (t, *J* = 7.4 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 173.2, 140.5, 139.6, 128.8, 128.4, 127.6, 127.0, 125.1, 123.4, 107.6, 63.6, 56.1, 30.9, 9.1. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{17}H_{18}O_2N$ 268.1332; Found 268.1328. $[\alpha]_D^{20}$ = +114.4º (*c* 1.0, $CHCl_3$). Enantiomeric excess: 90%, determined by HPLC (Chiralpak-OD-H, hexane/isopropanol = 95/5, flow rate 1.0 mL/min, T = 25 ºC, 254 nm): t_R = 8.645 min (major), t_R = 9.438 min (minor).

3-Isoamyl-1-methoxy-3-phenylindolin-2-one (2o)



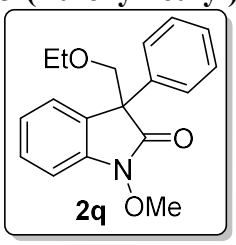
24.0 mg (52% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 – 7.25 (m, 6H), 7.24 (d, *J* = 8.4 Hz, 1H), 7.14 (t, *J* = 7.6 Hz, 1H), 7.06 (d, *J* = 7.8 Hz, 1H), 4.01 (s, 3H), 2.38 (td, *J* = 12.6, 4.4 Hz, 1H), 2.20 (td, *J* = 12.9, 3.9 Hz, 1H), 1.54 – 1.42 (m, 1H), 1.15 – 1.01 (m, 1H), 0.82 (d, *J* = 6.7 Hz, 3H), 0.80 (d, *J* = 6.7 Hz, 3H), 0.78 – 0.70 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 173.3, 140.3, 139.7, 129.0, 128.7, 128.4, 127.6, 126.9, 125.1, 123.3, 107.6, 63.6, 55.4, 35.9, 33.3, 28.3, 22.7, 22.4. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{20}H_{24}O_2N$ 310.1802; Found 310.1806. $[\alpha]_D^{20}$ = +97.7º (*c* 1.0, $CHCl_3$). Enantiomeric excess: 87%, determined by HPLC (Chiralpak-AD-H, hexane/isopropanol =90/10, flow rate 1.0 mL/min, T = 25 ºC, 254 nm): t_R = 8.184 min (major), t_R = 9.188 min (minor).

3-Isobutyl-1-methoxy-3-phenylindolin-2-one (2p)



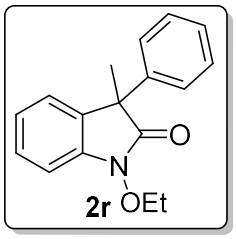
14.1 mg (32% yield) was obtained at 65 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 – 7.33 (m, 3H), 7.31 – 7.20 (m, 4H), 7.15 (t, *J* = 7.5 Hz, 1H), 7.06 (d, *J* = 7.8 Hz, 1H), 4.00 (s, 3H), 2.45 (dd, *J* = 13.9, 7.7 Hz, 1H), 2.16 (dd, *J* = 13.9, 5.1 Hz, 1H), 1.44 (tt, *J* = 13.1, 6.7 Hz, 1H), 0.79 (d, *J* = 6.6 Hz, 3H), 0.69 (d, *J* = 6.7 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 173.8, 140.9, 140.4, 128.7, 128.5, 127.5, 126.7, 125.8, 123.1, 107.7, 63.5, 55.0, 46.5, 25.8, 24.4, 23.1. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{19}H_{22}O_2N$ 296.1645; Found 296.1647. $[\alpha]_D^{20}$ = +87.2º (*c* 0.5, $CHCl_3$). Enantiomeric excess: 82%, determined by HPLC (Chiralpak-OD-H, hexane/isopropanol =95/5, flow rate 0.5 mL/min, T = 25 ºC, 254 nm): t_R = 11.523 min (major), t_R = 12.709 min (minor).

3-(Ethoxymethyl)-1-methoxy-3-phenylindolin-2-one (2q)



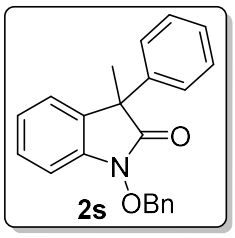
22.9 mg (51% yield) was obtained for 36 h. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.26 (m, 7H), 7.14 (td, *J* = 7.6, 1.1 Hz, 1H), 7.05 (dd, *J* = 8.0, 0.9 Hz, 1H), 4.12 (s, 2H), 3.99 (s, 3H), 3.53 – 3.32 (m, 2H), 1.02 (t, *J* = 7.0 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 171.9, 140.6, 136.6, 128.8, 128.6, 127.9, 127.9, 127.2, 125.5, 123.2, 107.5, 74.5, 67.3, 63.3, 56.4, 14.9. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{18}H_{20}O_3N$ 298.1438; Found 298.1442. $[\alpha]_D^{20}$ = +114.6º (*c* 1.0, $CHCl_3$). Enantiomeric excess: 92%, determined by HPLC (Chiralpak-AD-H, hexane/isopropanol = 90/10, flow rate 1.0 mL/min, T = 25 ºC, 254 nm): t_R = 10.605 min (major), t_R = 13.498 min (minor).

1-Ethoxy-3-methyl-3-phenylindolin-2-one (2r)



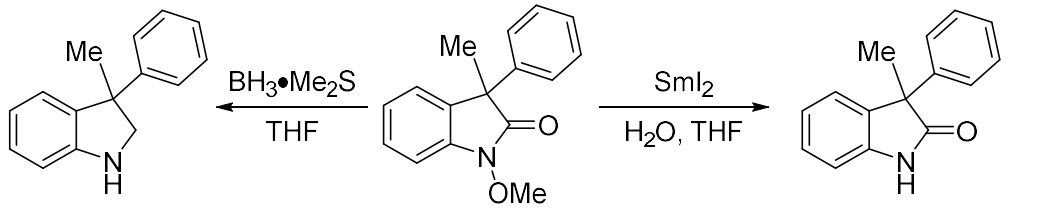
37.9 mg (95% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.33 (td, *J* = 7.7, 1.3 Hz, 1H), 7.32 – 7.22 (m, 5H), 7.18 (ddd, *J* = 7.4, 1.2, 0.5 Hz, 1H), 7.10 (td, *J* = 7.5, 1.1 Hz, 1H), 7.05 (ddd, *J* = 7.8, 1.0, 0.6 Hz, 1H), 4.27 (q, *J* = 7.1 Hz, 2H), 1.80 (s, 3H), 1.39 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.5, 140.5, 140.2, 131.4, 128.8, 128.4, 127.6, 126.7, 124.4, 123.4, 107.9, 72.0, 51.0, 23.6, 13.9. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{17}H_{18}O_2N$ 268.1332; Found 268.1333. $[\alpha]_D^{20}$ = +94.8º (*c* 1.0, $CHCl_3$). Enantiomeric excess: 94%, determined by HPLC (Chiralpak-AD-H, hexane/isopropanol = 90/10, flow rate 1.0 mL/min, T = 25 ºC, 254 nm): t_R = 6.614 min (minor), t_R = 8.667 min (major).

1-(Benzyloxy)-3-methyl-3-phenylindolin-2-one (2s)



43.3 mg (88% yield) was obtained by using TFE as solvent. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.47 – 7.39 (m, 2H), 7.37 – 7.19 (m, 9H), 7.12 (d, *J* = 6.8 Hz, 1H), 7.04 (td, *J* = 7.5, 1.0 Hz, 1H), 6.88 (d, *J* = 7.8 Hz, 1H), 5.18 (s, 2H), 1.78 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.6, 140.5, 140.1, 134.3, 131.1, 130.2, 129.4, 128.7 (2C), 128.2, 127.6, 126.7, 124.2, 123.3, 108.0, 78.0, 51.0, 23.5. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{22}H_{20}O_2N$ 330.1489; Found 330.1489. $[\alpha]_D^{20}$ = +111.6º (*c* 1.0, $CHCl_3$). Enantiomeric excess: 91%, determined by HPLC (Chiralpak-ID, hexane/isopropanol = 90/10, flow rate 1.0 mL/min, T = 25 ºC, 254 nm): t_R = 12.869 min (minor), t_R = 18.349 min (major).

Derivatizations of Product 2a

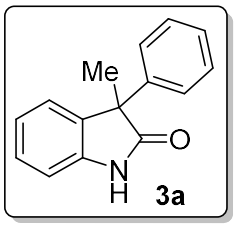


4a, 84% yield, 95% *ee* **2a**, 95% *ee* **3a**, 98% yield, 95% *ee*

Deprotection of methoxy group[6]

To a solution of 1-Methoxy-3-methyl-3-phenylindolin-2-one (50.6 mg, 0.2 mmol) in THF (2 mL) and deoxygenated water (0.1 mL) was added SmI2 (0.1 M in THF, 20 mL, 2.0 mmol, 10 equiv.) in an ice-bath. The mixture was stirred for 1 h, and diluted with EtOAc, washed with saturated $NaHCO_3$, saturated $Na_2S_2O_3$ and brine, dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The residue was purified by column chromatography (petroleum ether/acetone = 4:1) to give **3a** (43.5 mg, 98% yield) as a white solid.

3-Methyl-3-phenylindolin-2-one (3a)



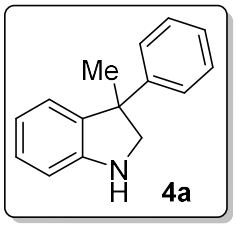
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.21 (s, 1H), 7.36 – 7.18 (m, 6H), 7.12 (d, *J* = 7.2 Hz, 1H), 7.04 (t, *J* = 7.4 Hz, 1H), 6.97 (d, *J* = 7.7 Hz, 1H), 1.83 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 182.5, 140.6, 140.6, 135.7, 128.7, 128.2, 127.5, 126.8, 124.5, 122.9, 110.4, 52.9, 23.5. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{15}H_{14}ON$ 224.1070; Found 224.1079. $[\alpha]_D^{20}$ = +100.5º (*c* 1.0, $CHCl_3$). Enantiomeric excess: 95%, determined by HPLC (Chiralpak-OD-H, hexane/isopropanol = 87/13, flow rate 1.0 mL/min, T = 25 ºC, 254 nm): t_R = 7.518 min (minor), t_R = 15.083 min (major).

Reduction of lactam[9]

To a solution of 1-Methoxy-3-methyl-3-phenylindolin-2-one (101.2 mg, 0.4 mmol) in dried THF (5 mL) was added $BH_3 \cdot Me_2S$ (2.0 M in THF, 0.66 mL, 1.32 mmol, 3.3 equiv.) dropwise in an ice-bath. The mixture was warmed to room temperature and stirred for 2.5 h, then heated to reflux for 48 h. After cooling to 0 ˚C, 10% HCl was added slowly to quench the reaction, and the resulting solution was refluxed for 1.5 h. The mixture was cooled to 0 ˚C again, and 12 N NaOH was added until pH > 10. The mixture was extracted with Et_2O for three times, and the combined organic phase was

washed with brine, dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The residue was purified by flash column chromatography (petroleum ether/EtOAc = 5:1) to give **4a** (35.0 mg, 84% yield) as a colorless liquid.

3-Methyl-3-phenylindoline (4a)

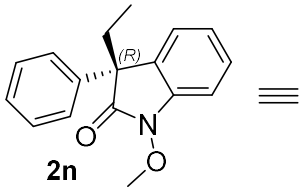


^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35 – 7.25 (m, 4H), 7.22 – 7.16 (m, 1H), 7.09 (td, *J* = 7.7, 1.2 Hz, 1H), 6.97 (d, *J* = 7.4 Hz, 1H), 6.76 (td, *J* = 7.4, 0.8 Hz, 1H), 6.72 (d, *J* = 7.8 Hz, 1H), 3.72 (d, *J* = 8.9 Hz, 1H), 3.57 (d, *J* = 8.9 Hz, 1H), 1.72 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 150.8, 147.8, 137.1, 128.3, 127.8, 126.7, 126.3, 124.3, 119.2, 110.1, 63.8, 49.8, 26.3. HRMS (ESI) m/z: $[M + H]^+$ Calcd for $C_{15}H_{16}N$ 210.1277; Found 210.1285. $[\alpha]_D^{20}$ = +67.3° (*c* 1.0, $CHCl_3$). Enantiomeric excess: 95%, determined by HPLC (Chiralpak-OD-H, hexane/isopropanol = 95/5, flow rate 1.0 mL/min, T = 25 °C, 254 nm): t_R = 8.726 min (minor), t_R = 11.417 min (major).

Determination of the Absolute Configuration of Product 2n

The crystal of **2n** was obtained via solvent diffusion of DCM solution and hexane. The crystal of **2n**, which was detected by X-ray, was the major product determined by chiral HPLC.

X-ray crystal data of the enantiomerically enriched isomer 2n:



≡

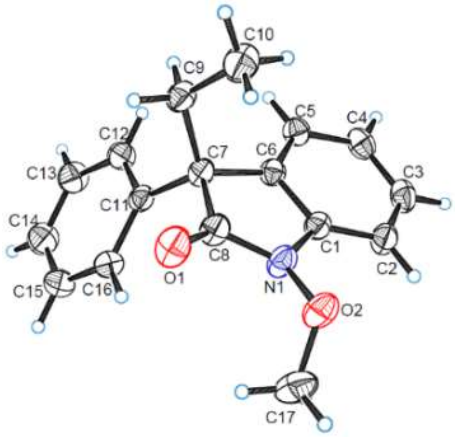


Table S5 Crystal data and structure refinement for cxf-160315.

Identification code	cxf-160315
Empirical formula	$C_{17}H_{17}NO_2$
Formula weight	267.31
Temperature/K	290(2)
Crystal system	orthorhombic

Space group	$P2_12_12_1$
a/Å	7.0909(2)
b/Å	9.2808(2)
c/Å	22.0489(4)
α/°	90
β/°	90
γ/°	90
Volume/Å^3	1451.02(6)
Z	4
ρ_{calc}g/cm^3	1.224
μ/mm^{-1}	0.640
F(000)	568.0
Crystal size/mm^3	0.360 × 0.320 × 0.270
Radiation	CuKα (λ = 1.54184)
2Θ range for data collection/°	8.02 to 140.348
Index ranges	$-8 \le h \le 8$, $-11 \le k \le 7$, $-26 \le l \le 26$
Reflections collected	10055
Independent reflections	2697 [R_{int} = 0.0251, R_{sigma} = 0.0155]
Data/restraints/parameters	2697/0/184
Goodness-of-fit on F^2	1.048
Final R indexes [I>=2σ (I)]	R_1 = 0.0320, wR_2 = 0.0904
Final R indexes [all data]	R_1 = 0.0326, wR_2 = 0.0909
Largest diff. peak/hole / e Å^{-3}	0.14/-0.13
Flack parameter	-0.04(5)

Table S6 Fractional Atomic Coordinates (×10^4) and Equivalent Isotropic Displacement Parameters (Å^2×10^3) for cxf-160315. U_{eq} is defined as 1/3 of of the trace of the orthogonalised U_{IJ}tensor.

Atom	*x*	*y*	*z*	U(eq)
O1	9657(3)	12014.1(15)	3820.8(7)	74.7(5)
O2	8081(2)	10810.1(16)	4874.2(6)	71.9(4)
C7	9544(2)	9569.6(17)	3372.5(7)	47.2(4)
N1	8325(2)	10116.9(17)	4325.1(6)	59.0(4)
C9	11648(2)	9571(2)	3189.1(8)	56.4(4)
C1	8212(2)	8614.3(18)	4275.9(7)	49.1(4)
C6	8953(2)	8217.7(17)	3715.7(7)	45.7(4)
C12	8415(3)	8918(2)	2320.7(8)	56.8(4)
C5	9078(3)	6779.1(18)	3574.0(9)	54.7(4)
C2	7524(3)	7634(2)	4689.6(8)	61.8(5)
C16	6955(3)	10938(2)	2797.8(9)	61.7(5)
C11	8270(2)	9833.3(17)	2818.9(7)	47.0(4)
C4	8431(3)	5762(2)	3988.3(10)	64.1(5)
C8	9225(3)	10752.4(19)	3850.3(8)	54.4(4)
C13	7278(3)	9117(3)	1819.8(9)	70.7(5)
C10	12994(3)	9332(3)	3711.7(10)	81.8(7)
C14	5985(3)	10204(3)	1804.4(10)	78.6(6)
C15	5820(3)	11119(3)	2293.7(11)	77.8(6)
C3	7640(3)	6194(2)	4529.8(10)	66.4(5)
C17	6369(4)	11621(3)	4868.9(13)	90.9(8)

Table S7 Anisotropic Displacement Parameters ($Å^2×10^3$) for cxf-160315. The Anisotropic displacement factor exponent takes the form: -$2\pi^2[h^2a^{*2}U_{11}+2hka^*b^*U_{12}+\ldots]$.

Atom	U_{11}	U_{22}	U_{33}	U_{23}	U_{13}	U_{12}
O1	103.9(11)	49.6(7)	70.6(9)	-10.5(6)	12.3(8)	-21.1(7)
O2	88.7(10)	79.0(9)	48.1(7)	-19.3(6)	8.1(7)	-0.8(8)
C7	53.5(9)	44.3(8)	43.9(8)	-2.4(6)	6.0(7)	-5.5(7)
N1	78.5(10)	54.1(8)	44.3(7)	-8.2(6)	13.2(7)	-3.7(7)

C9	51.9(9)	65.3(10)	52.0(9)	2.9(8)	4.9(7)	-7.3(8)
C1	48.2(8)	51.6(9)	47.3(8)	1.4(7)	2.0(7)	-1.9(7)
C6	45.5(8)	46.6(8)	45.1(8)	1.3(6)	-0.3(6)	-2.9(6)
C12	59.5(10)	57.9(10)	53.1(9)	-3.2(8)	-2.1(8)	2.5(8)
C5	59.5(10)	48.8(9)	55.8(9)	-0.4(7)	-2.1(8)	-0.8(8)
C2	62(1)	71.6(12)	51.9(9)	11.6(8)	6.0(8)	-2.5(9)
C16	60.1(10)	62.5(10)	62.5(10)	2.2(8)	12.1(9)	8.9(9)
C11	47.6(8)	46.0(8)	47.5(8)	3.4(6)	8.1(6)	-4.4(6)
C4	70.3(11)	45.0(9)	76.9(12)	8.5(8)	-11.4(9)	-3.1(8)
C8	64.1(10)	48.7(9)	50.5(9)	-5.1(7)	4.1(8)	-8.0(8)
C13	68.9(12)	85.7(14)	57.4(10)	-6.2(10)	-9.7(9)	-2.0(11)
C10	57.3(11)	121(2)	67.6(12)	7.6(12)	-6.6(10)	-16.9(13)
C14	61.0(11)	106.7(18)	68.1(12)	9.6(12)	-11.6(10)	2.9(12)
C15	58.0(11)	90.5(15)	85.1(14)	17.3(13)	5.4(10)	19.6(11)
C3	67.9(11)	61.5(11)	69.7(11)	23.5(9)	-3.4(10)	-9.2(9)
C17	93.1(17)	93.2(17)	86.5(16)	-25.5(14)	26.4(14)	10.3(14)

Table S8 Bond Lengths for cxf-160315.

Atom	Atom	Length/Å	Atom	Atom	Length/Å
O1	C8	1.212(2)	C1	C6	1.392(2)
O2	N1	1.3819(18)	C6	C5	1.374(2)
O2	C17	1.429(3)	C12	C13	1.380(3)
C7	C6	1.524(2)	C12	C11	1.393(2)
C7	C11	1.538(2)	C5	C4	1.392(3)
C7	C8	1.538(2)	C2	C3	1.385(3)
C7	C9	1.546(2)	C16	C15	1.383(3)
N1	C8	1.361(2)	C16	C11	1.386(2)
N1	C1	1.401(2)	C4	C3	1.379(3)
C9	C10	1.512(3)	C13	C14	1.364(3)
C1	C2	1.377(2)	C14	C15	1.378(3)

Table S9 Bond Angles for cxf-160315.

Atom	Atom	Atom	Angle/°	Atom	Atom	Atom	Angle/°
N1	O2	C17	110.14(17)	C1	C6	C7	109.07(13)
C6	C7	C11	111.32(13)	C13	C12	C11	120.44(18)
C6	C7	C8	101.95(12)	C6	C5	C4	119.25(18)
C11	C7	C8	110.10(14)	C1	C2	C3	116.62(17)
C6	C7	C9	113.33(15)	C15	C16	C11	120.57(19)
C11	C7	C9	111.05(13)	C16	C11	C12	118.31(17)
C8	C7	C9	108.69(14)	C16	C11	C7	122.63(15)
C8	N1	O2	122.07(15)	C12	C11	C7	119.05(15)
C8	N1	C1	113.49(14)	C3	C4	C5	120.35(18)
O2	N1	C1	121.61(14)	O1	C8	N1	125.36(16)
C10	C9	C7	114.19(15)	O1	C8	C7	127.99(16)
C2	C1	C6	123.14(16)	N1	C8	C7	106.65(14)
C2	C1	N1	128.76(16)	C14	C13	C12	120.8(2)
C6	C1	N1	108.09(14)	C13	C14	C15	119.6(2)
C5	C6	C1	118.90(16)	C14	C15	C16	120.3(2)
C5	C6	C7	132.01(15)	C4	C3	C2	121.67(17)

Table S10 Torsion Angles for cxf-160315.

A	B	C	D	Angle/°	A	B	C	D	Angle/°
C17	O2	N1	C8	88.6(2)	C13	C12	C11	C16	0.2(3)
C17	O2	N1	C1	-111.7(2)	C13	C12	C11	C7	179.31(17)
C6	C7	C9	C10	-54.4(2)	C6	C7	C11	C16	108.16(17)
C11	C7	C9	C10	179.44(18)	C8	C7	C11	C16	-4.1(2)
C8	C7	C9	C10	58.2(2)	C9	C7	C11	C16	-124.56(18)
C8	N1	C1	C2	174.97(19)	C6	C7	C11	C12	-70.86(19)
O2	N1	C1	C2	13.7(3)	C8	C7	C11	C12	176.83(15)

C8	N1	C1	C6	-4.6(2)	C9	C7	C11	C12	56.4(2)
O2	N1	C1	C6	-165.90(16)	C6	C5	C4	C3	1.2(3)
C2	C1	C6	C5	-2.7(3)	O2	N1	C8	O1	-11.0(3)
N1	C1	C6	C5	176.92(17)	C1	N1	C8	O1	-172.2(2)
C2	C1	C6	C7	178.99(17)	O2	N1	C8	C7	169.60(16)
N1	C1	C6	C7	-1.41(19)	C1	N1	C8	C7	8.4(2)
C11	C7	C6	C5	70.5(2)	C6	C7	C8	O1	172.3(2)
C8	C7	C6	C5	-172.1(2)	C11	C7	C8	O1	-69.5(3)
C9	C7	C6	C5	-55.5(3)	C9	C7	C8	O1	52.4(3)
C11	C7	C6	C1	-111.45(15)	C6	C7	C8	N1	-8.38(19)
C8	C7	C6	C1	5.91(18)	C11	C7	C8	N1	109.86(16)
C9	C7	C6	C1	122.52(16)	C9	C7	C8	N1	-128.31(16)
C1	C6	C5	C4	1.2(3)	C11	C12	C13	C14	-0.4(3)
C7	C6	C5	C4	179.10(17)	C12	C13	C14	C15	0.3(4)
C6	C1	C2	C3	1.5(3)	C13	C14	C15	C16	0.0(4)
N1	C1	C2	C3	-177.96(19)	C11	C16	C15	C14	-0.1(3)
C15	C16	C11	C12	0.0(3)	C5	C4	C3	C2	-2.4(3)
C15	C16	C11	C7	-178.99(18)	C1	C2	C3	C4	1.0(3)

Table S11 Hydrogen Atom Coordinates (Å×10^4) and Isotropic Displacement Parameters (Å^2×10^3) for cxf-160315.

Atom	***x***	***y***	***z***	**U(eq)**
H9A	11851	8822	2889	68
H9B	11942	10487	3000	68
H12	9284	8167	2326	68
H5	9591	6489	3205	66
H2	7008	7925	5057	74
H16	6836	11562	3126	74
H4	8533	4785	3899	77
H13	7394	8502	1489	85

H10A	12827	10081	4007	123
H10B	14267	9350	3564	123
H10C	12741	8414	3895	123
H14	5220	10328	1466	94
H15	4941	11863	2285	93
H3	7172	5500	4795	80
H17A	6197	12079	5256	136
H17B	5326	10988	4790	136
H17C	6432	12342	4557	136

Crystal structure determination of [cxf-160315]

Crystal Data for $C_{17}H_{17}NO_2$ (M =267.31 g/mol): orthorhombic, space group $P2_12_12_1$ (no. 19), a = 7.0909(2) Å, b = 9.2808(2) Å, c = 22.0489(4) Å, V = 1451.02(6) Å^3, Z = 4, T = 290(2) K, μ(CuKα) = 0.640 mm^{-1}, *Dcalc* = 1.224 g/cm^3, 10055 reflections measured (8.02° ≤ 2Θ ≤ 140.348°), 2697 unique (R_{int} = 0.0251, R_{sigma} = 0.0155) which were used in all calculations. The final R_1 was 0.0320 (I > 2σ(I)) and wR_2 was 0.0909 (all data).

References:

(1) Shi, B.-F.; Zhang, Y.-H.; Lam, J. K.; Wang, D.-H.; Yu, J.-Q. *J. Am. Chem. Soc.* **2010**, *132*, 460.

(2) Liu, C.; Li, M. *Chin. J. Chem*. **2013**, *31*, 1274.

(3) Xiao, K.-J.; Lin, D. W.; Miura, M.; Zhu, R.-Y.; Gong, W.; Wssa, M.; Yu, J.-Q. *J. Am. Chem. Soc.* **2014**, *136*, 8138.

(4) Lai, M. Y. H.; Brimble, M. A.; Callis, D. J.; Harris, P. W. R.; Levi, M. S.; Sieg, F. *Bioorg*. *Med*. *Chem*. **2005**, *13*, 533.

(5) Vincenti, M.; Ghiglione, N.; Valsania, M. C.; Davit, P.; D. Richardson, S. *Helv. Chim. Acta.* **2004,** *87*, 370.

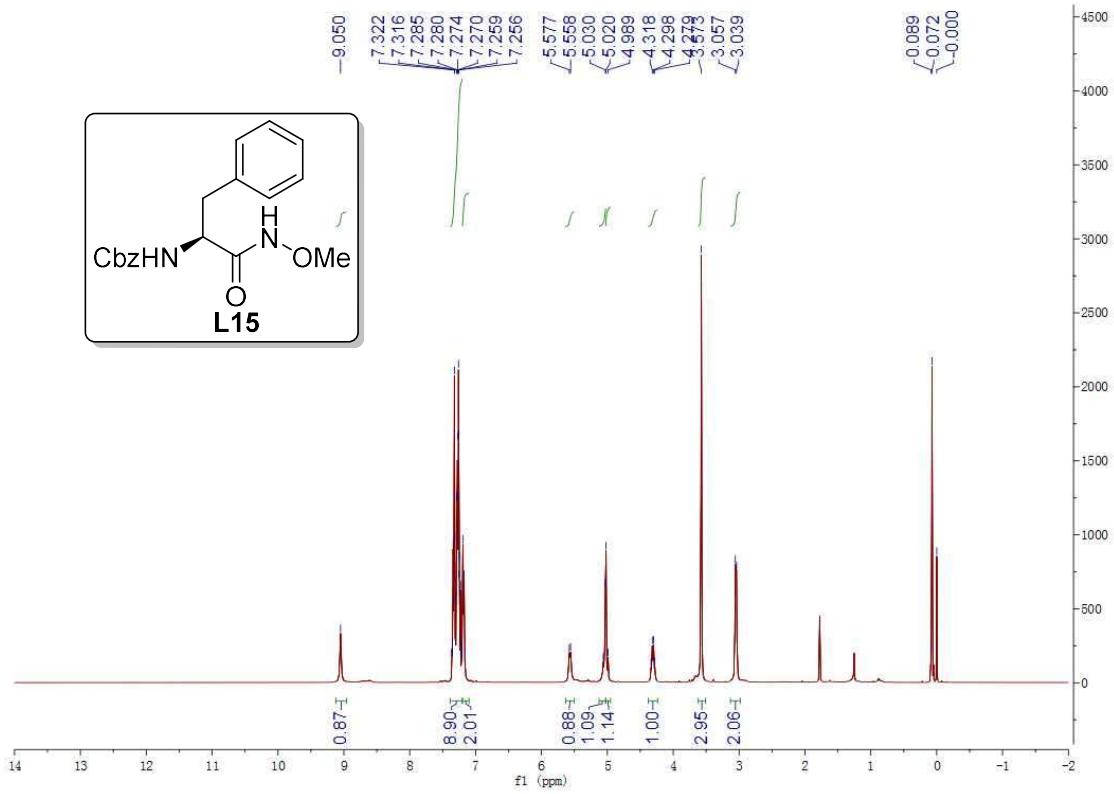
(6) Wasa, M.; Yu, J.-Q. *J. Am. Chem. Soc*. **2008**, *130*, 14058.

(7) Cheng, X.-F.; Li, Y.; Su, Y.-M.; Yin, F.; Wang, J.-Y.; Sheng, J.; Vora, H. U.; Wang, X.-S.; Yu, J.-Q. *J. Am. Chem. Soc.* **2013**, *135*, 1236.

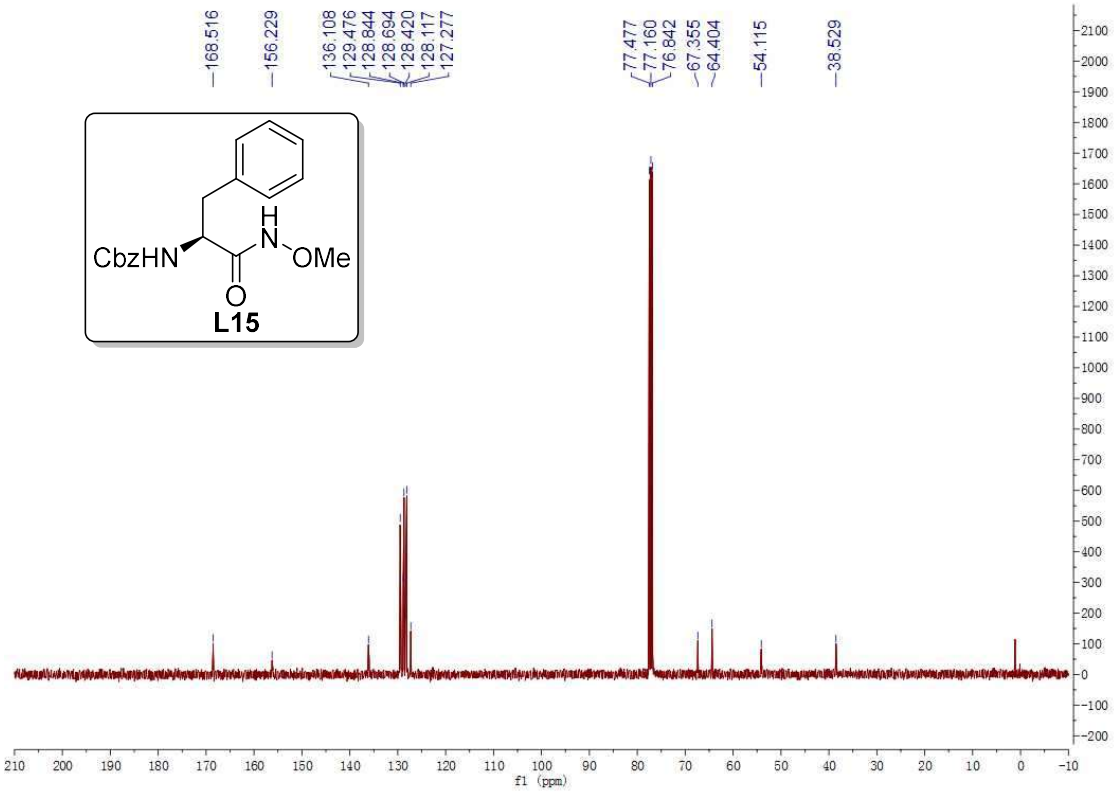
(8) Jiang, Y.; Chen, C.-A.; Lu, K.; Daniewska, I.; De Leon, J.; Kong, R.; Forray, C.; Li, B.; Hegde, L. G.; Wolinsky, T. D.; Craig, D. A.; Wetzel, J. M.; Andersen, K.; Marzabadi, M. R. *J. Med. Chem*. **2007**, *50*, 3870.

(9) Zou, M.-F.; Keck, T. M.; Kumar, V.; Donthamsetti, P.; Michino, M.; Burzynski, C.; Schweppe, C.; Bonifazi, A.; Free, R. B.; Sibley, D. R.; Janowsky, A.; Shi, L.; Javitch, J. A.; Newman, A. H. *J. Med. Chem.* **2016**, *59*, 2973.

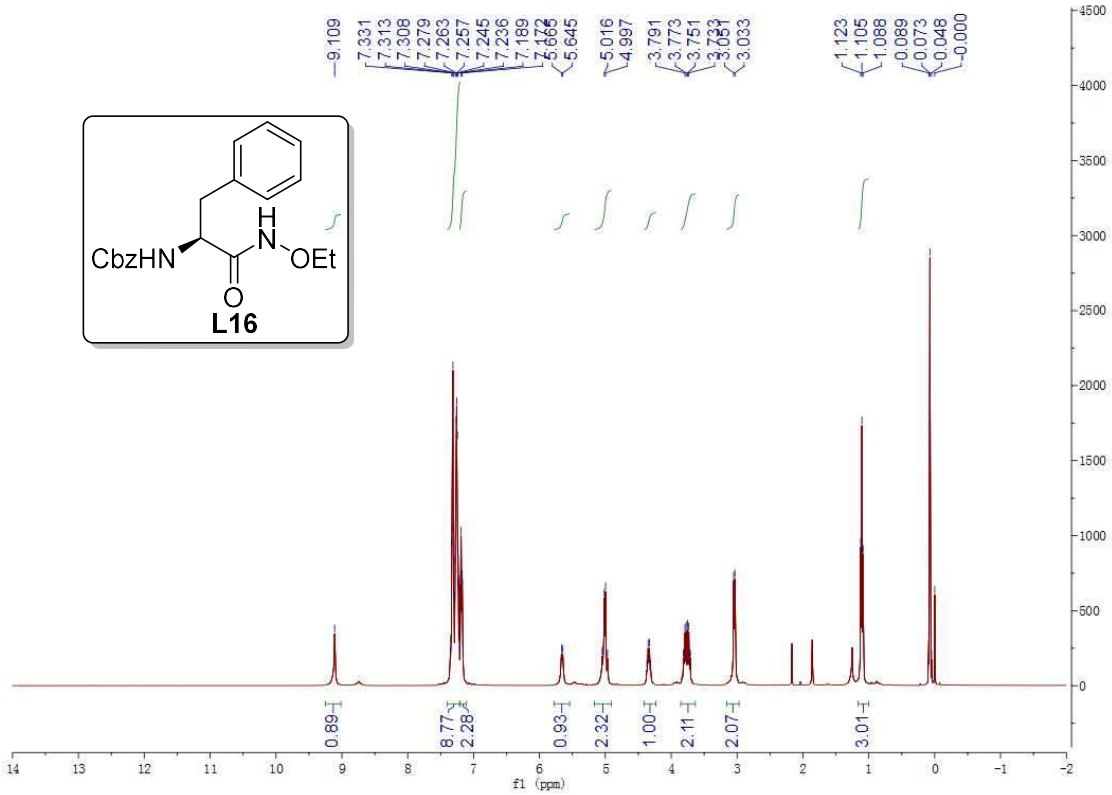
^{1}H and ^{13}C Spectra



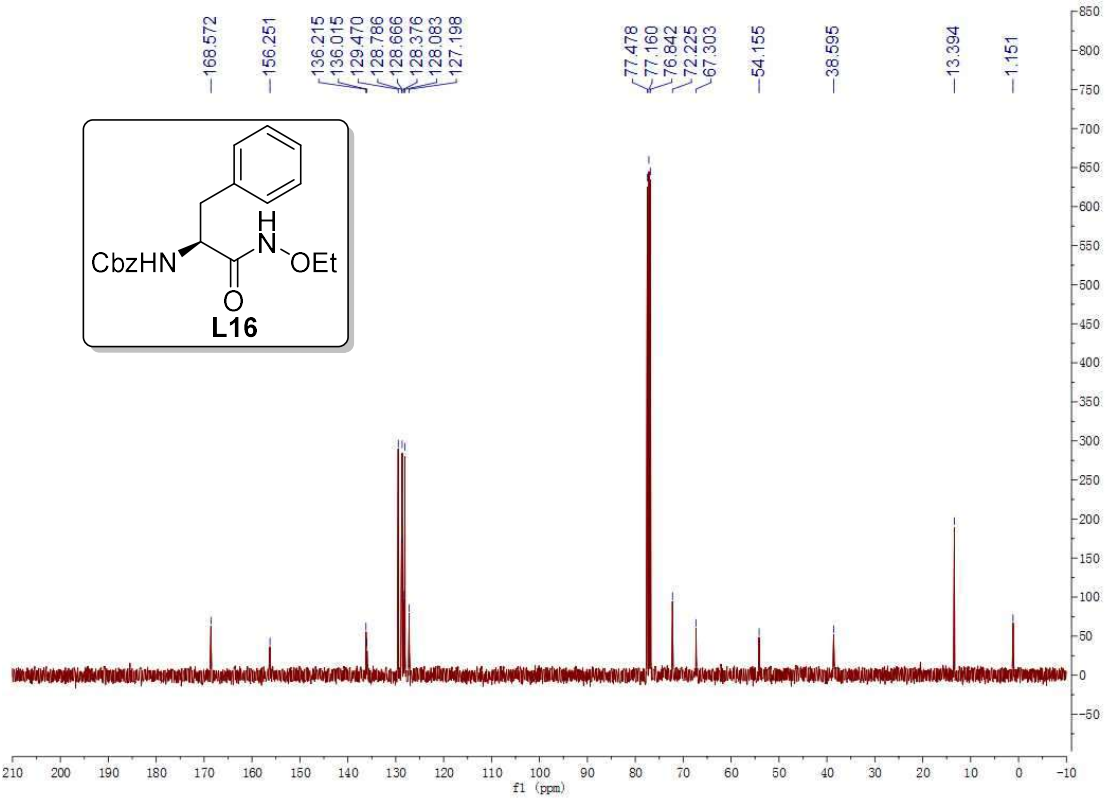
^{1}H NMR Spectrum of **L15** ($CDCl_3$, 400 MHz)



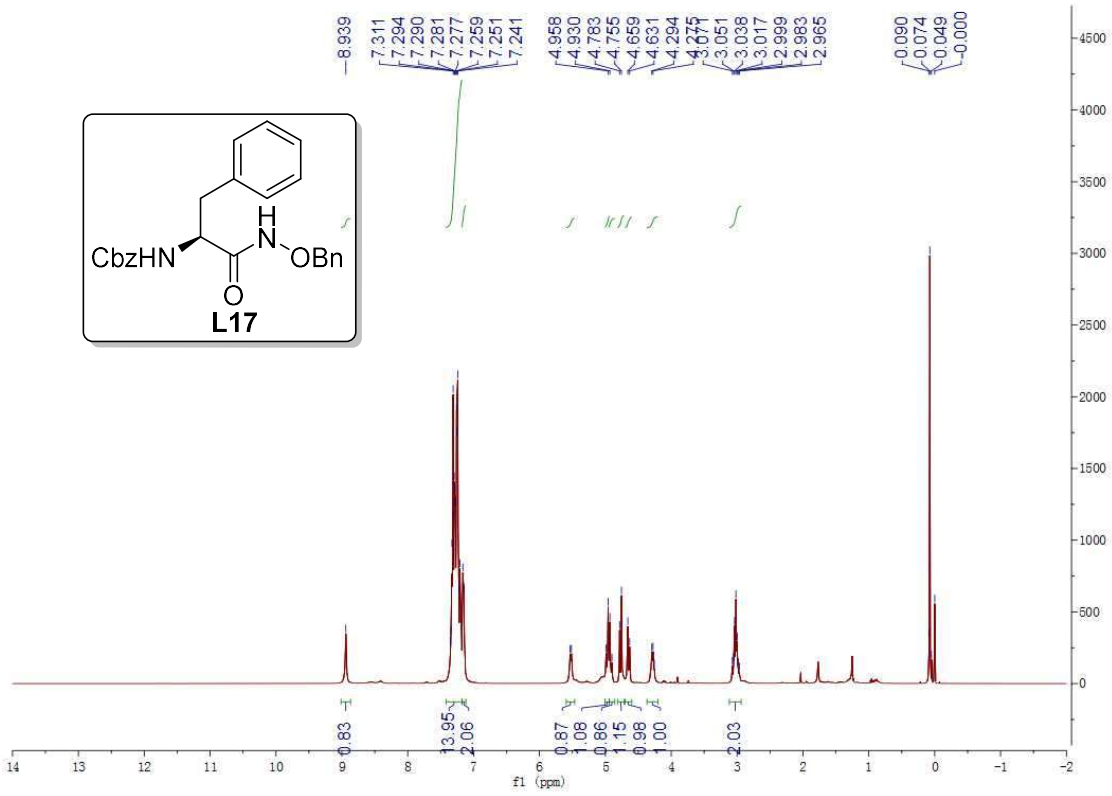
^{13}C NMR Spectrum of **L15** ($CDCl_3$, 100 MHz)



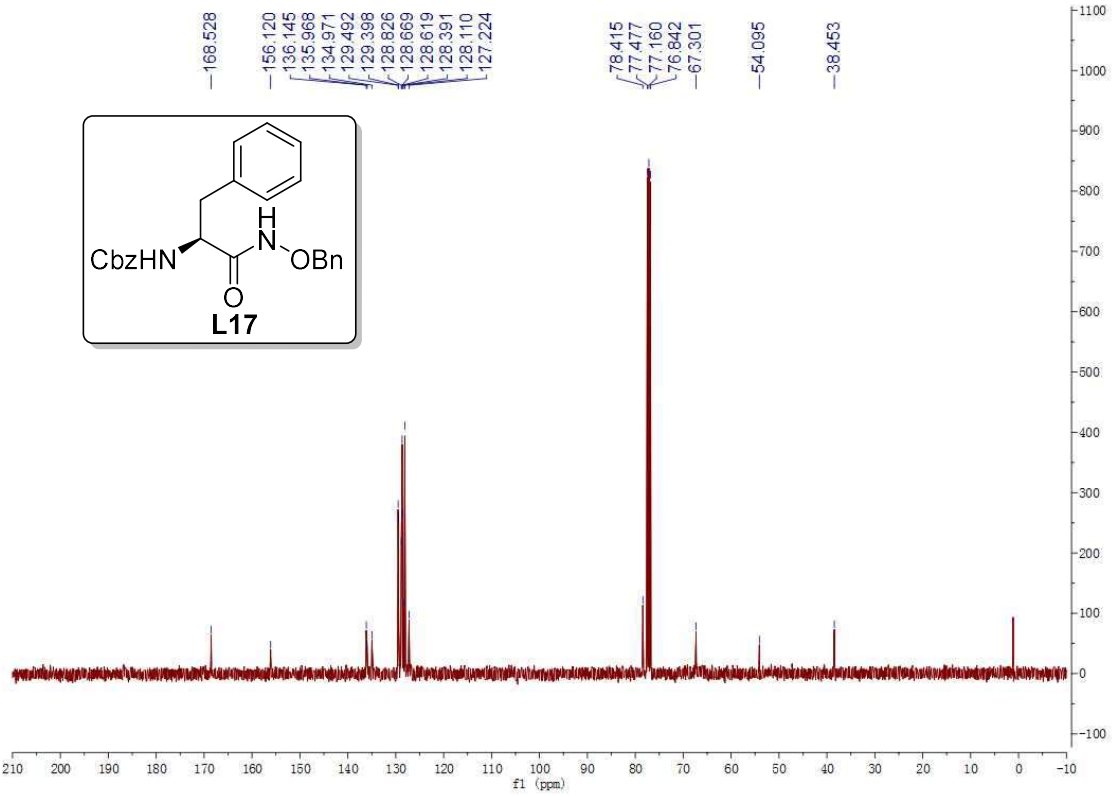
^{1}H NMR Spectrum of **L16** ($CDCl_3$, 400 MHz)



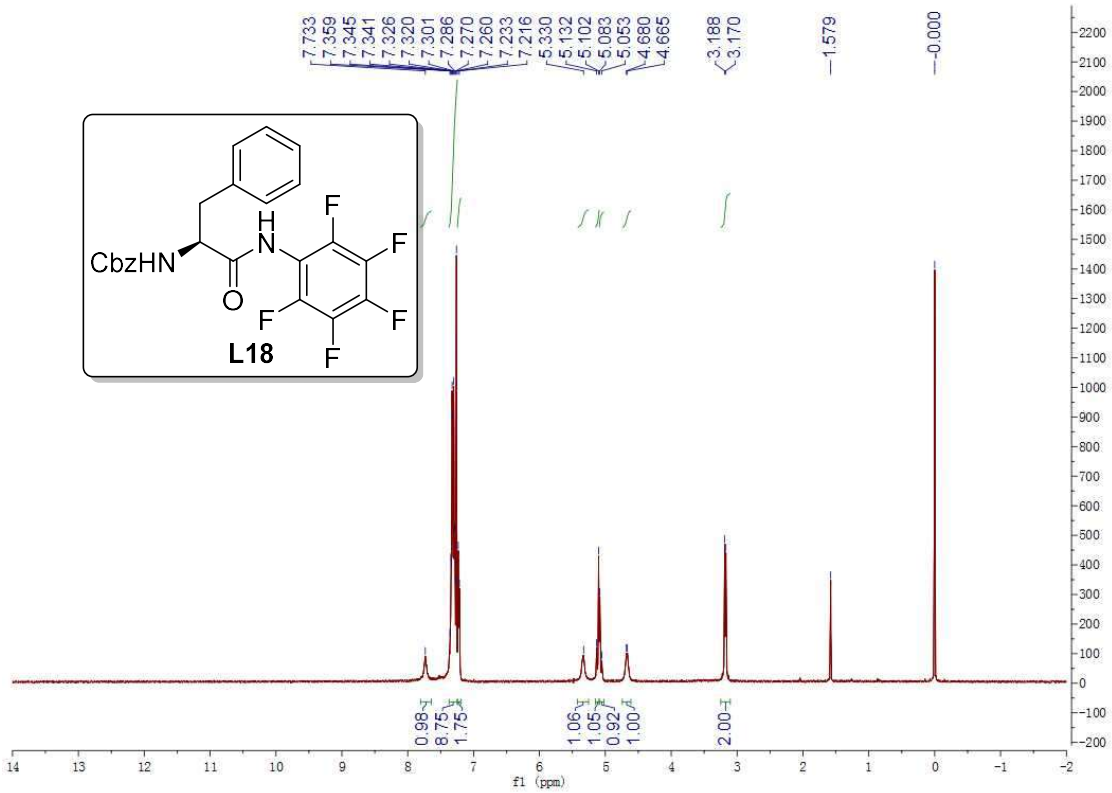
^{13}C NMR Spectrum of **L16** ($CDCl_3$, 100 MHz)



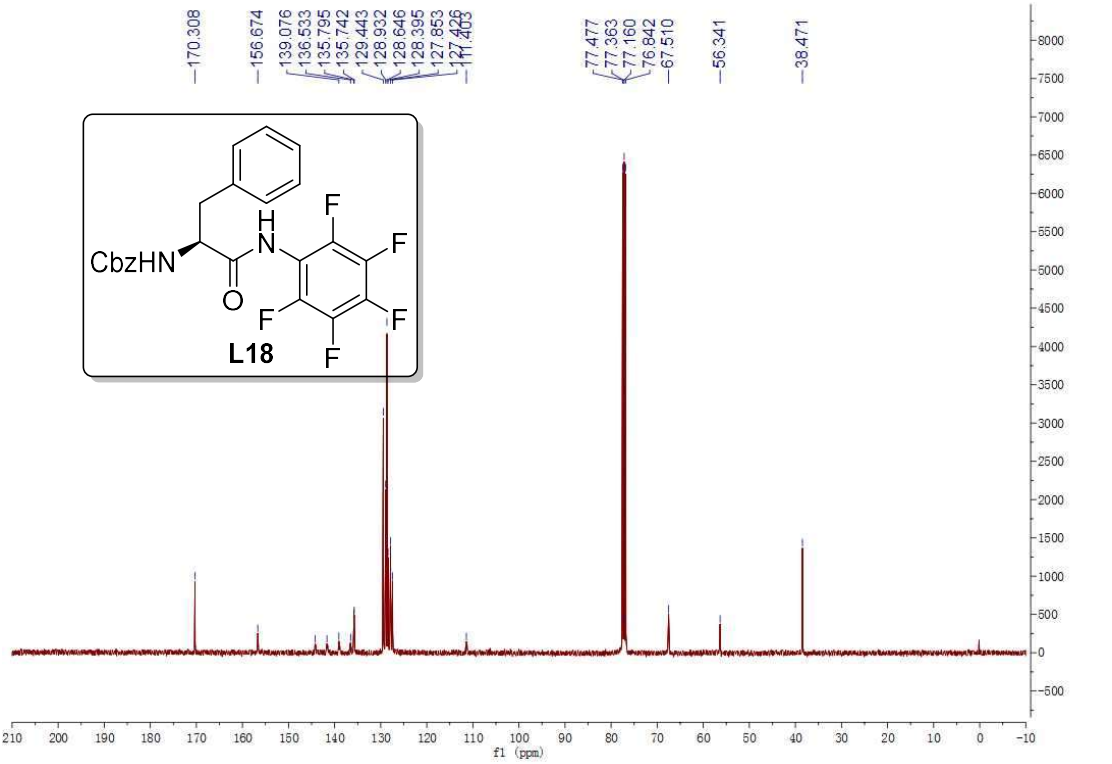
^{1}H NMR Spectrum of **L17** ($CDCl_3$, 400 MHz)



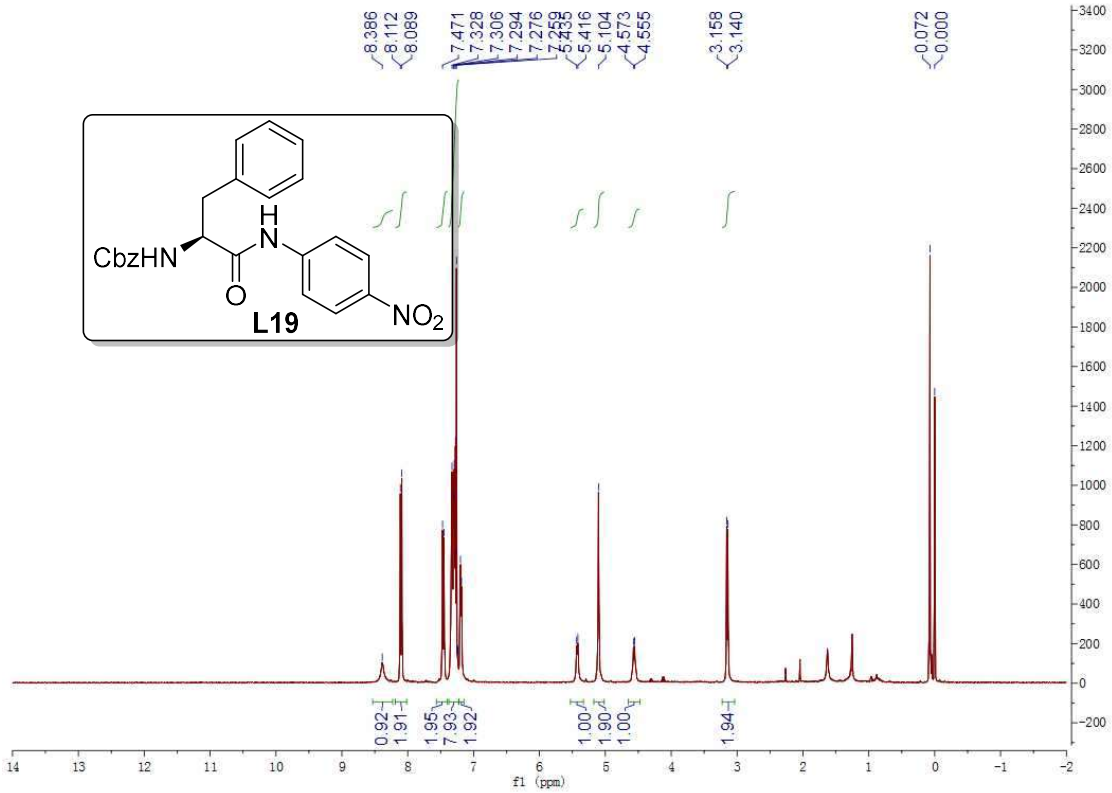
^{13}C NMR Spectrum of **L17** ($CDCl_3$, 100 MHz)



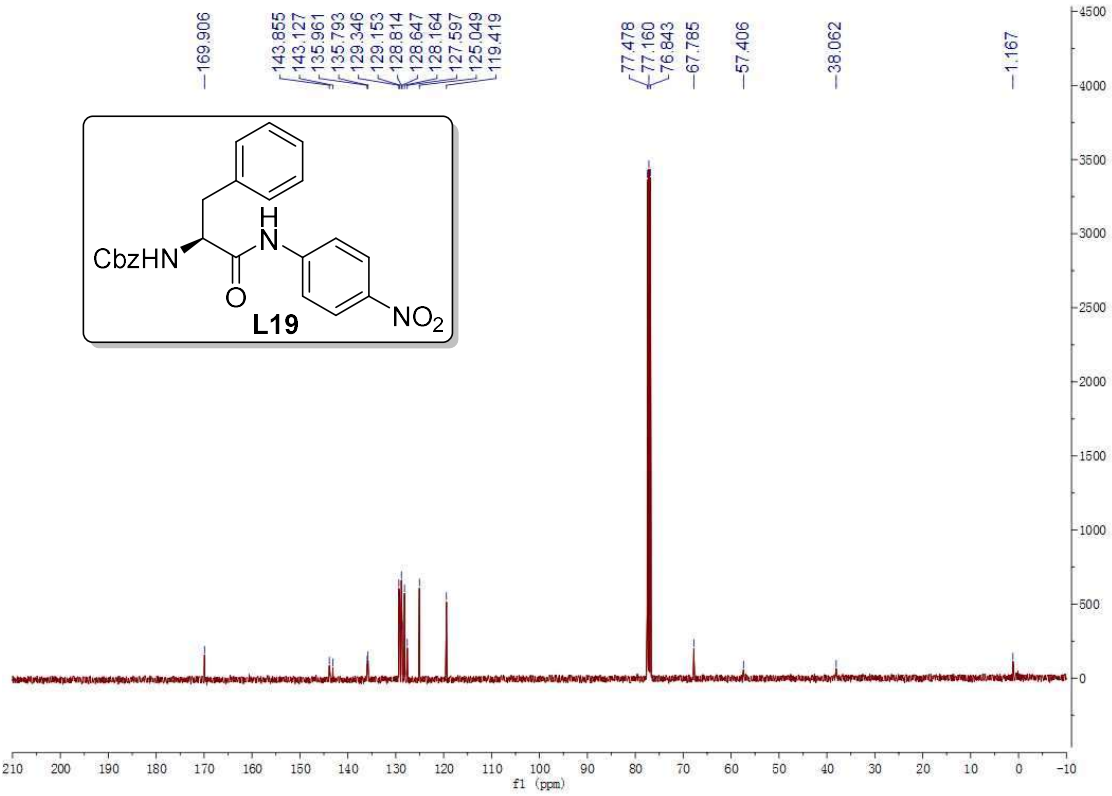
^{1}H NMR Spectrum of **L18** ($CDCl_3$, 400 MHz)



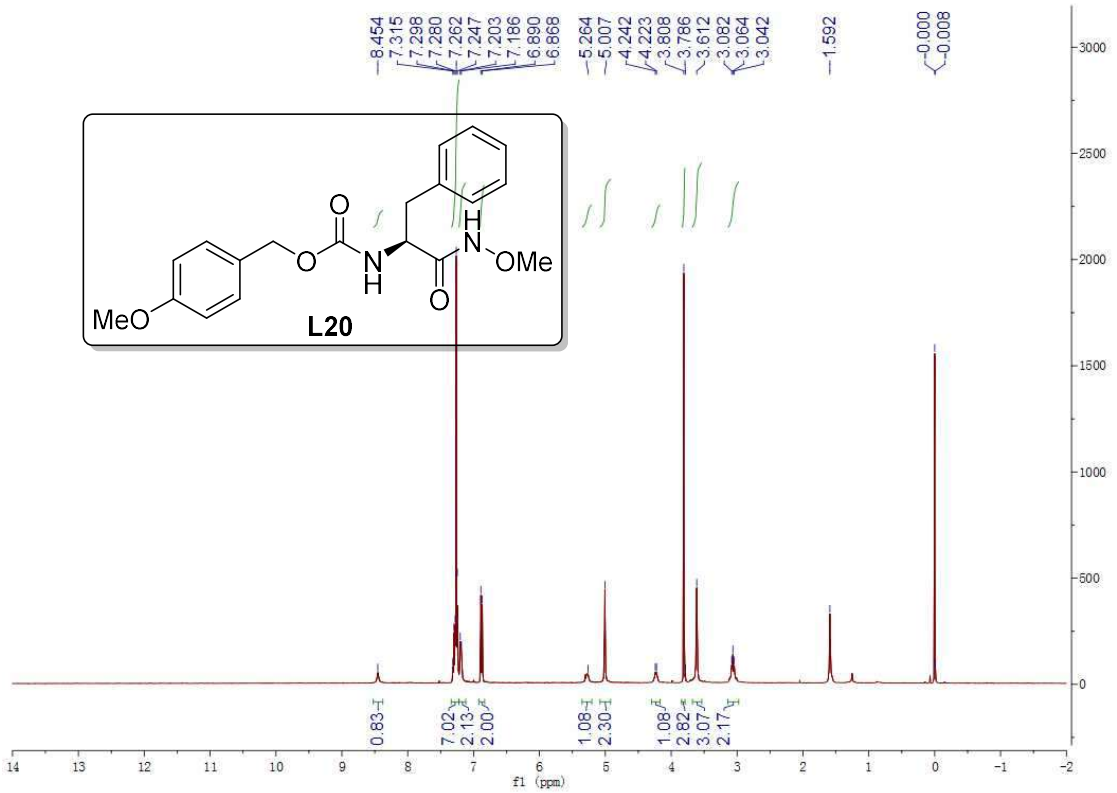
^{13}C NMR Spectrum of **L18** ($CDCl_3$, 100 MHz)



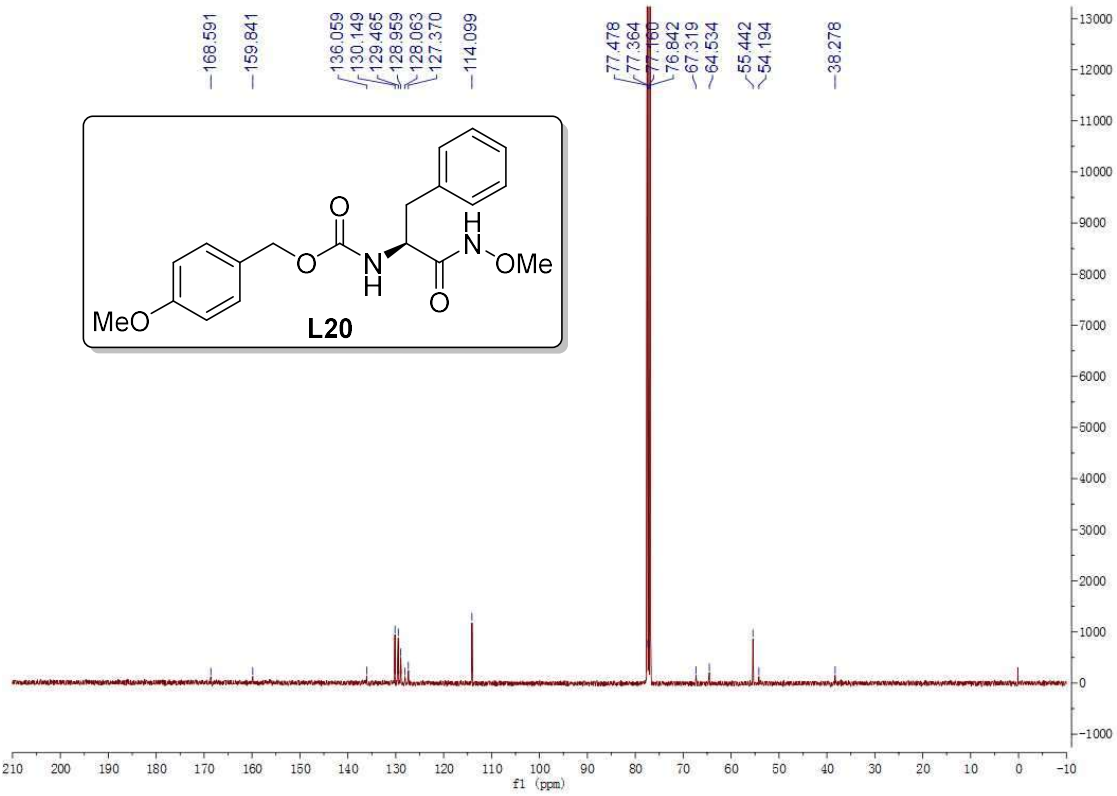
^{1}H NMR Spectrum of **L19** ($CDCl_3$, 400 MHz)



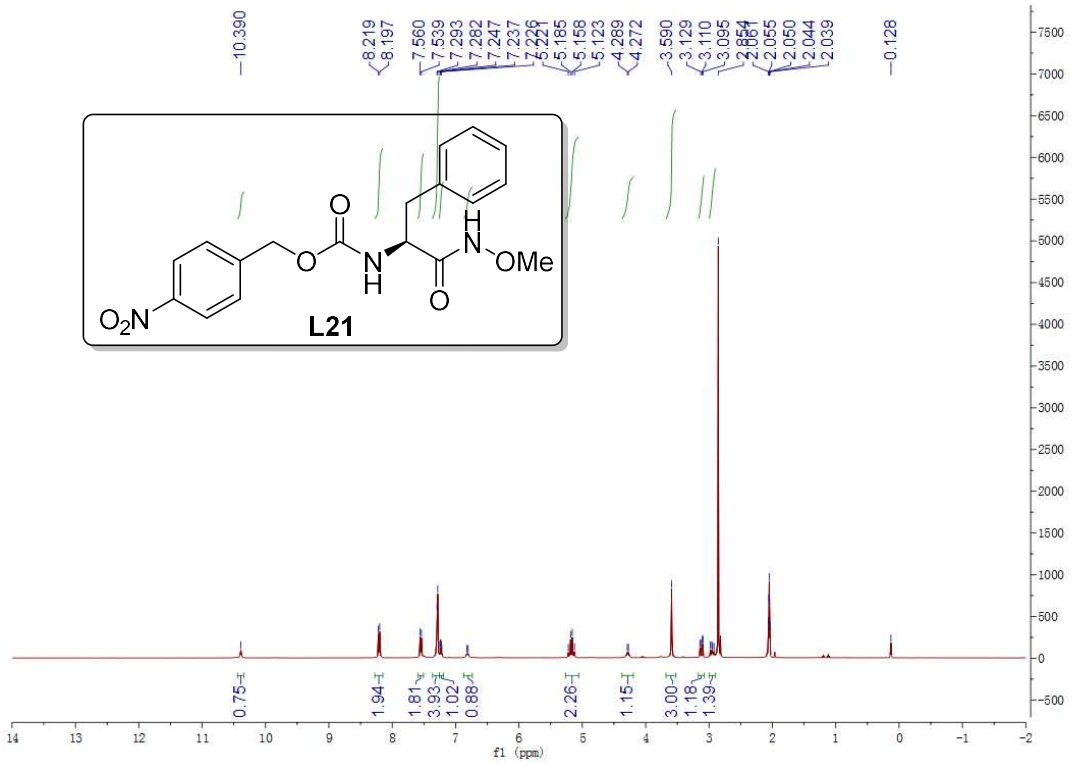
^{13}C NMR Spectrum of **L19** ($CDCl_3$, 100 MHz)



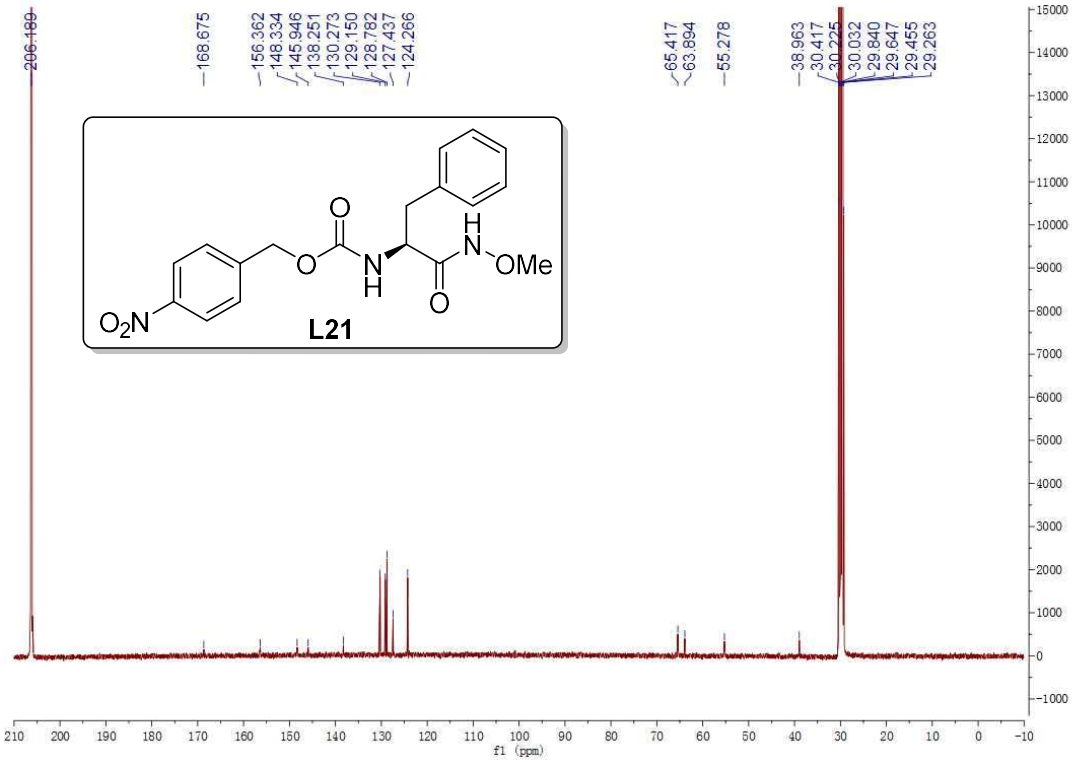
^{1}H NMR Spectrum of **L20** ($CDCl_3$, 400 MHz)



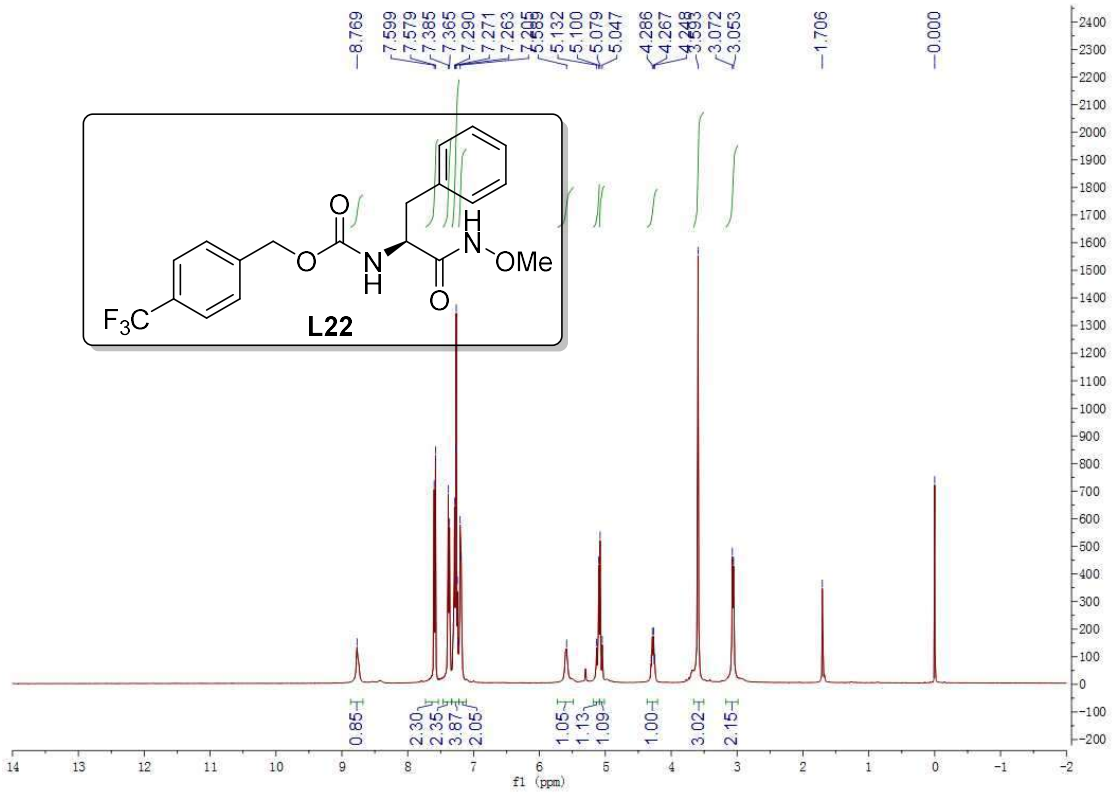
^{13}C NMR Spectrum of **L20** ($CDCl_3$, 100 MHz)



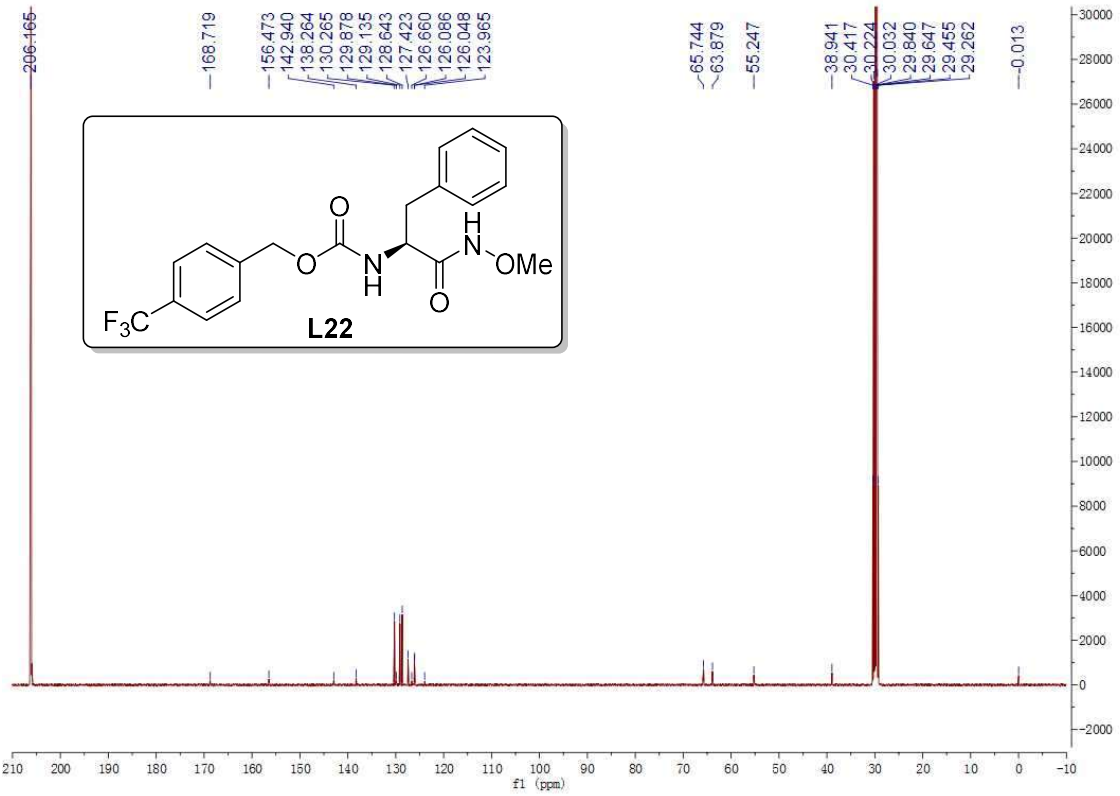
^{1}H NMR Spectrum of **L21** (Acetone-d_6, 400 MHz)



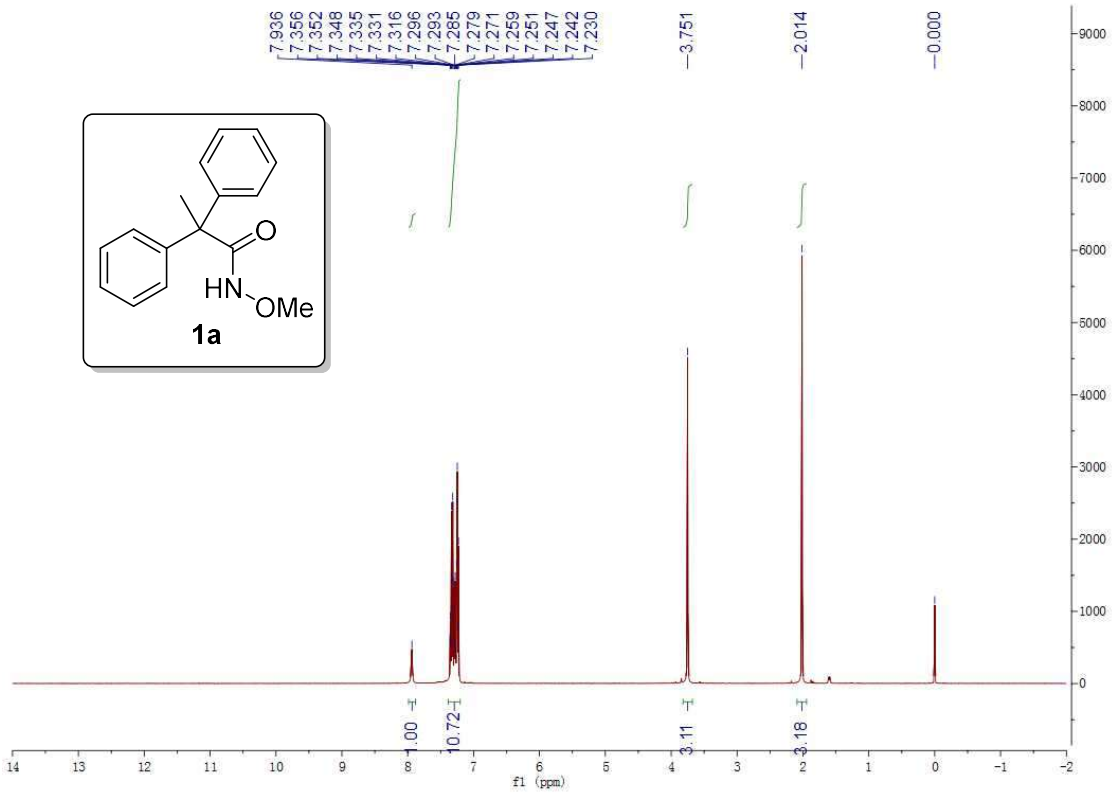
^{13}C NMR Spectrum of **L21** (Acetone-d_6, 100 MHz)



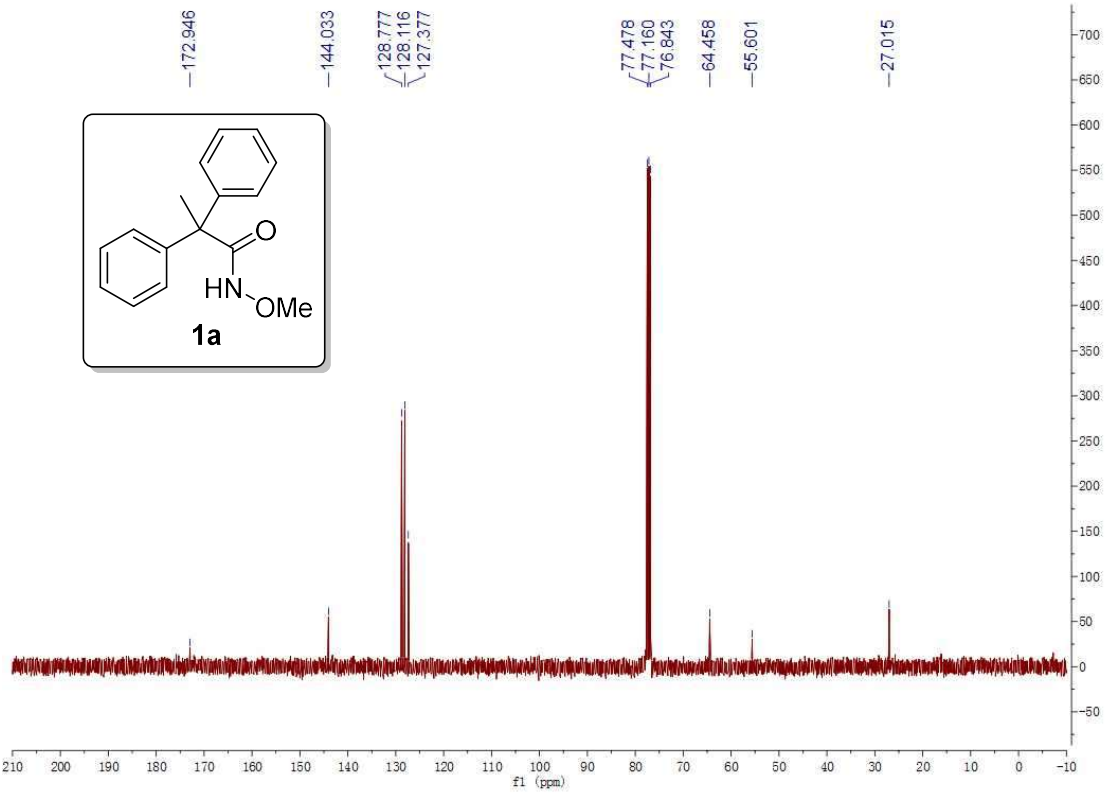
^{1}H NMR Spectrum of **L22** ($CDCl_3$, 400 MHz)



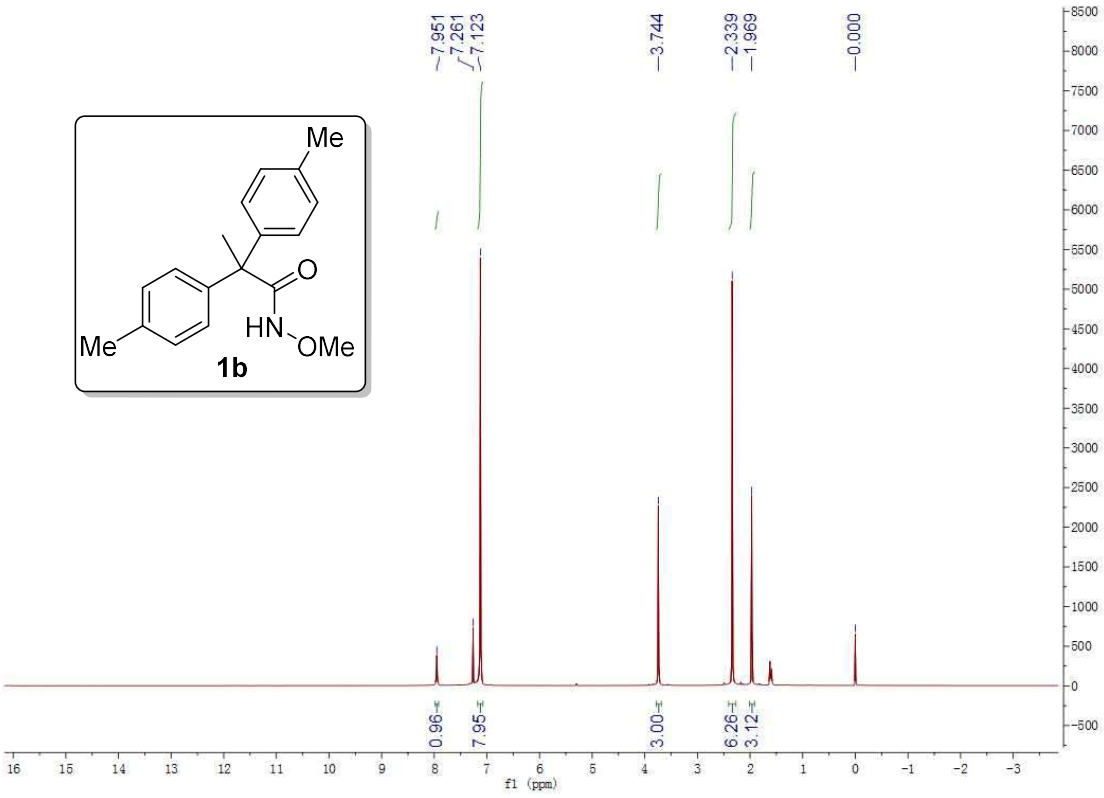
^{13}C NMR Spectrum of **L22** (Acetone-d_{63}, 100 MHz)



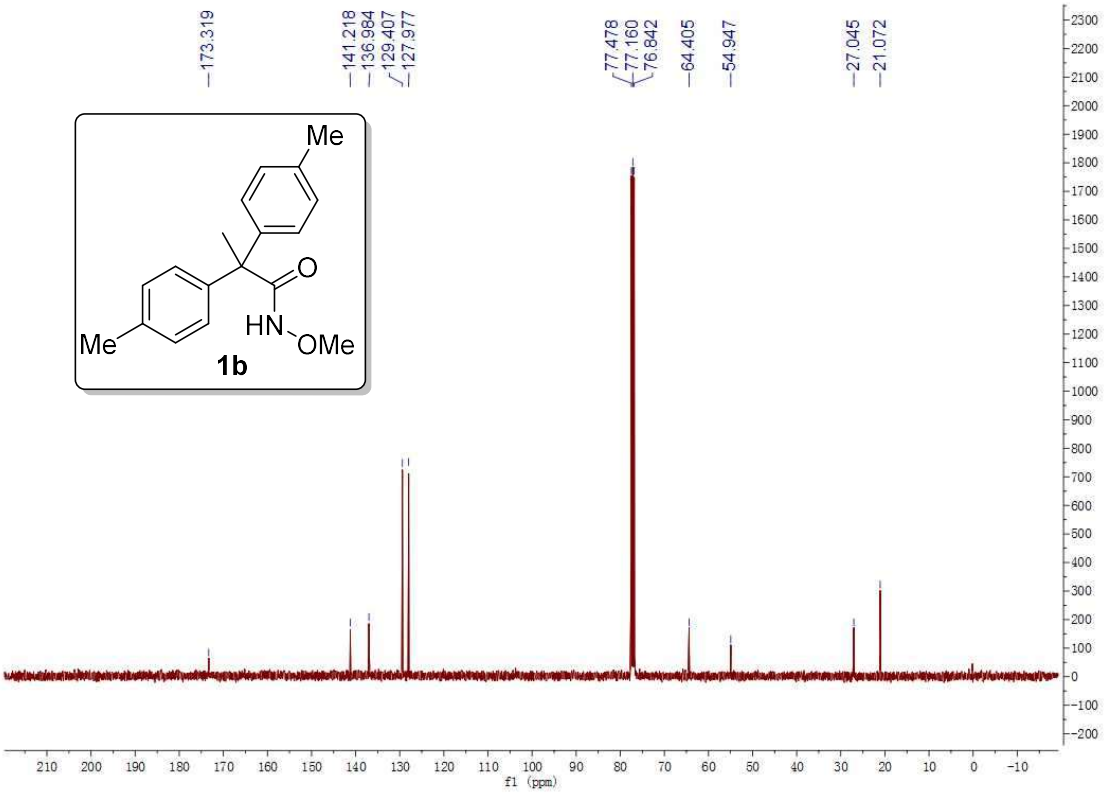
^{1}H NMR Spectrum of **1a** ($CDCl_3$, 400 MHz)



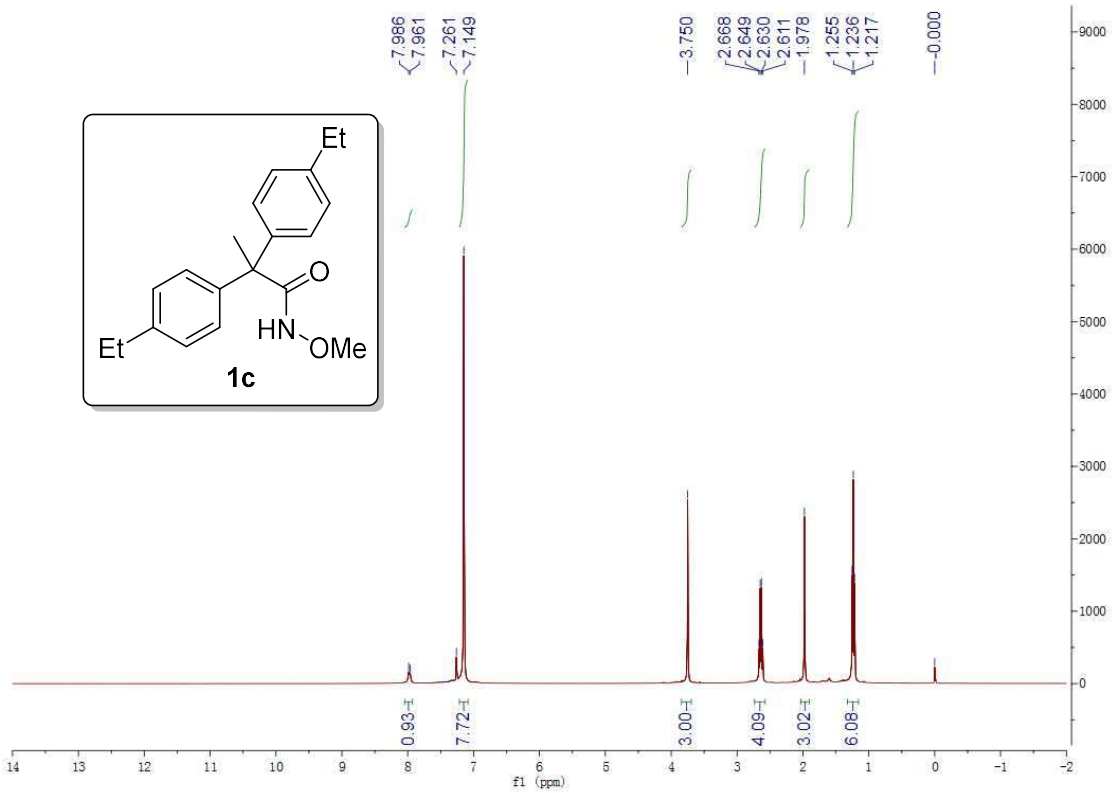
^{13}C NMR Spectrum of **1a** ($CDCl_3$, 100 MHz)



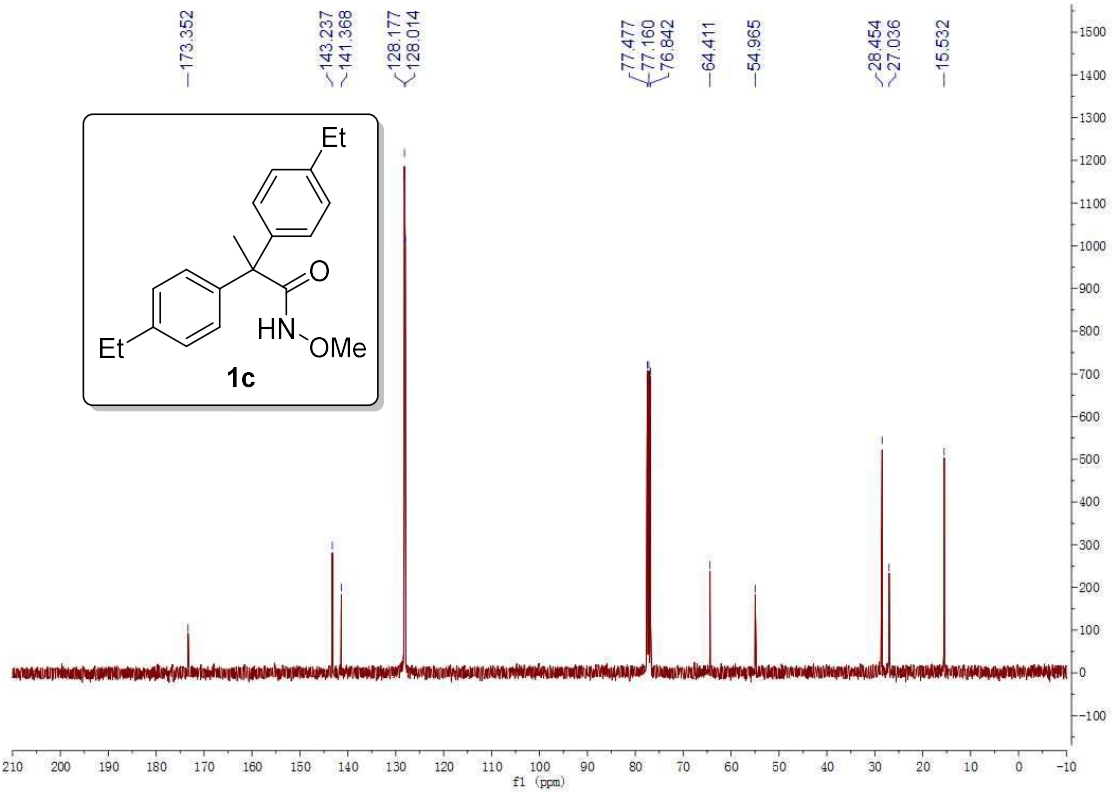
^{1}H NMR Spectrum of **1b** ($CDCl_3$, 400 MHz)



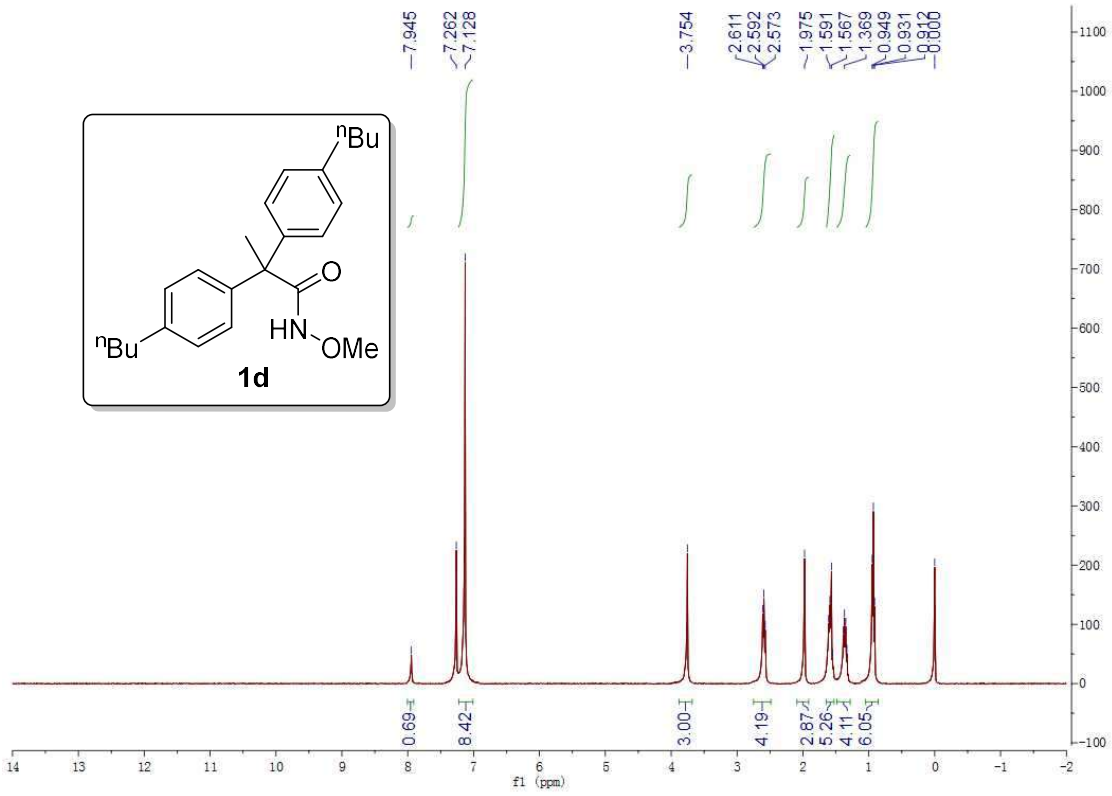
^{13}C NMR Spectrum of **1b** ($CDCl_3$, 100 MHz)



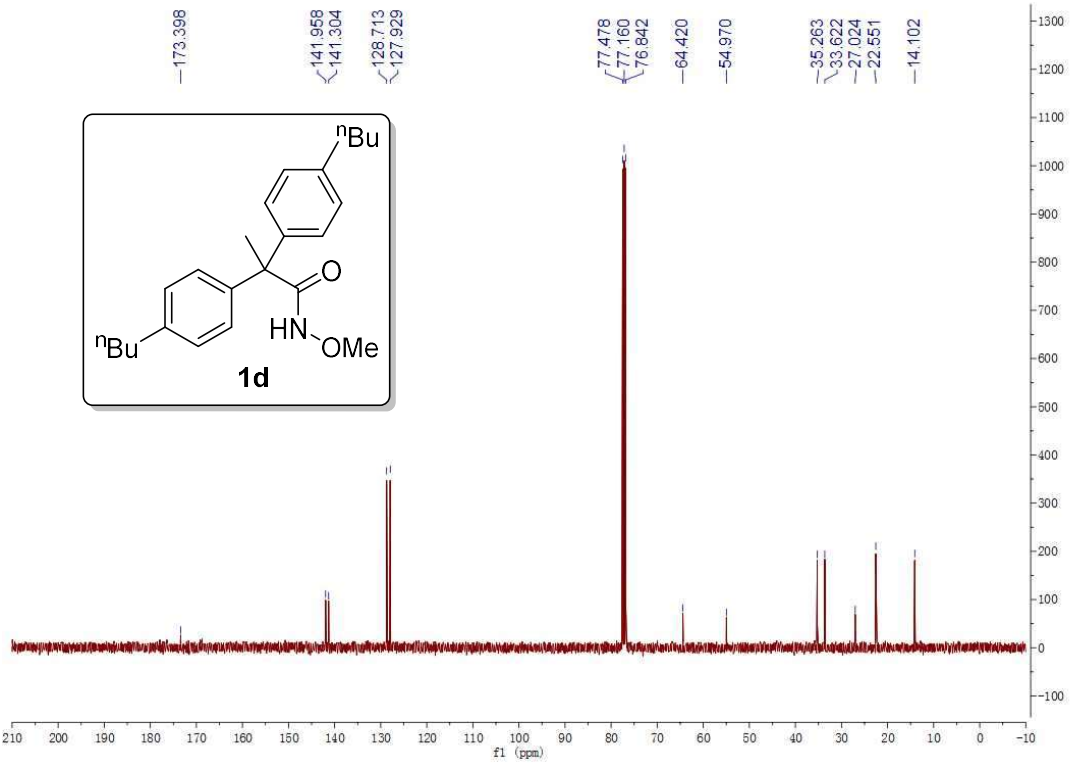
^{1}H NMR Spectrum of **1c** ($CDCl_3$, 400 MHz)



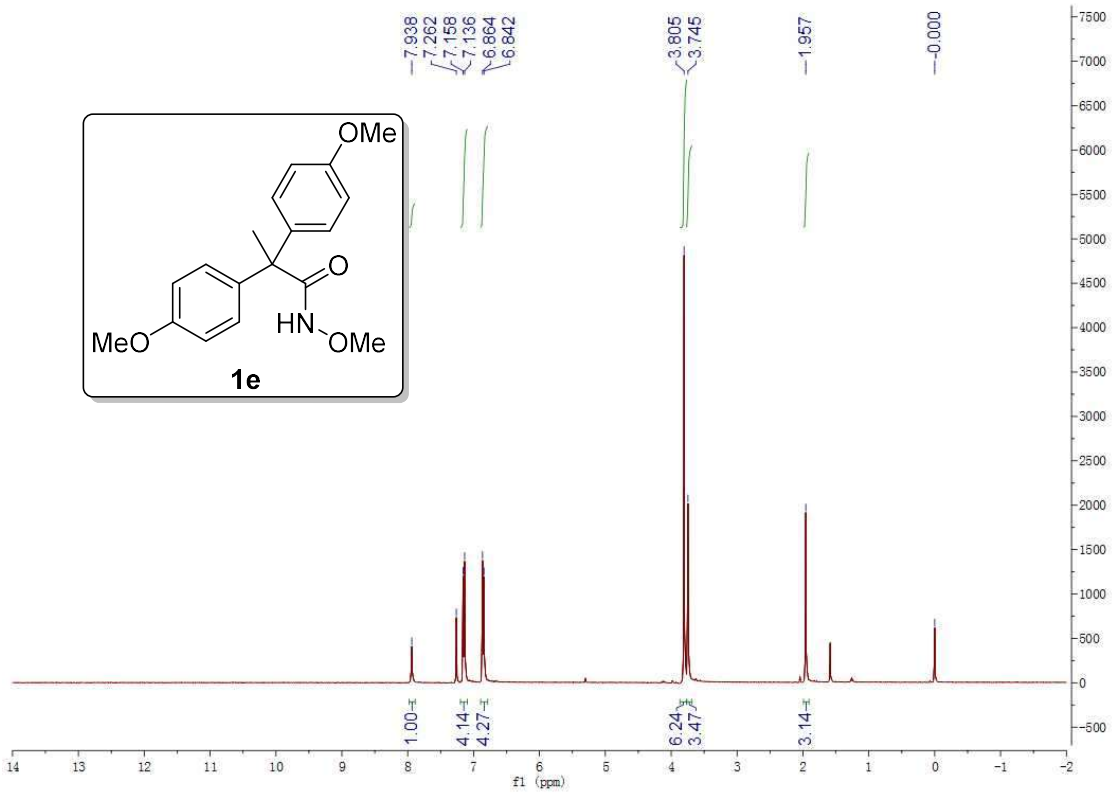
^{13}C NMR Spectrum of **1c** ($CDCl_3$, 100 MHz)



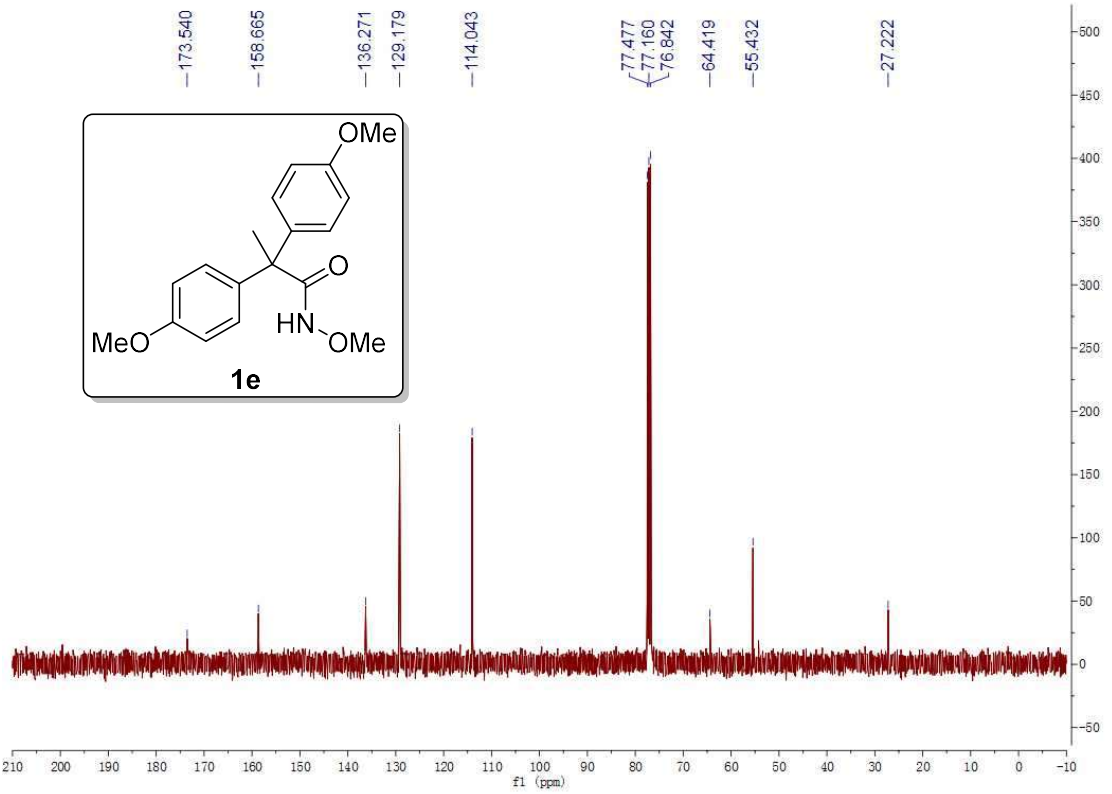
^{1}H NMR Spectrum of **1d** ($CDCl_3$, 400 MHz)



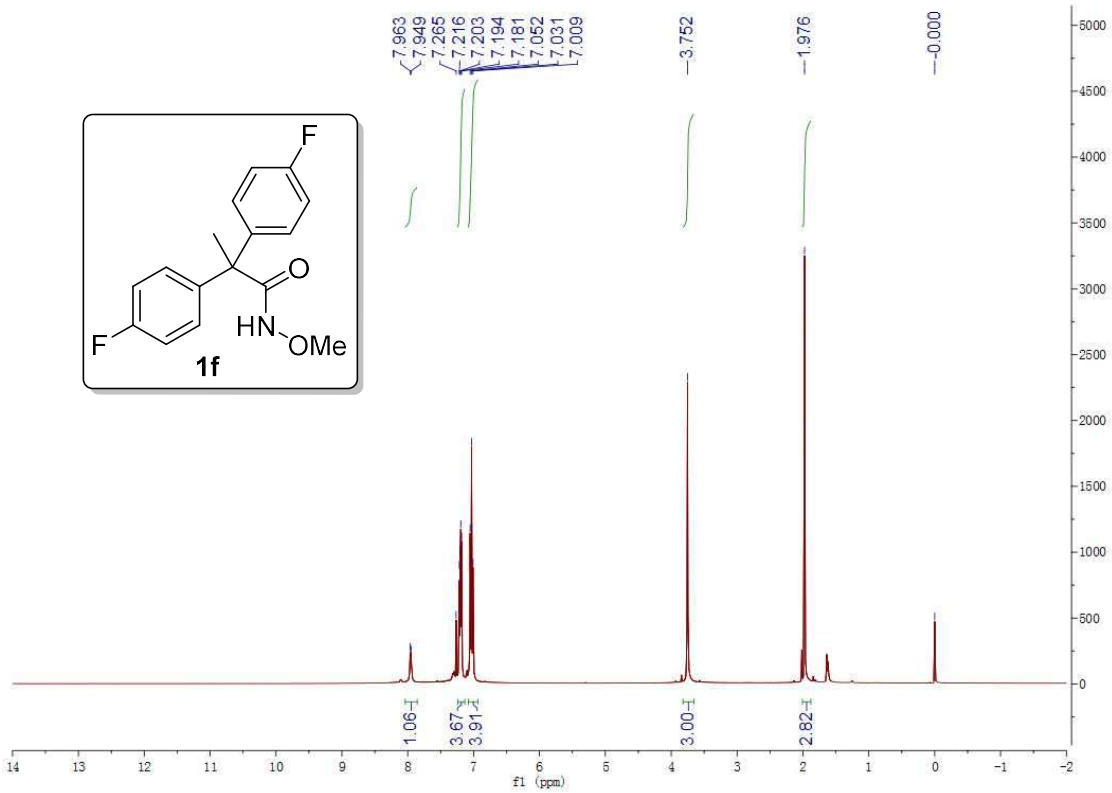
^{13}C NMR Spectrum of **1d** ($CDCl_3$, 100 MHz)



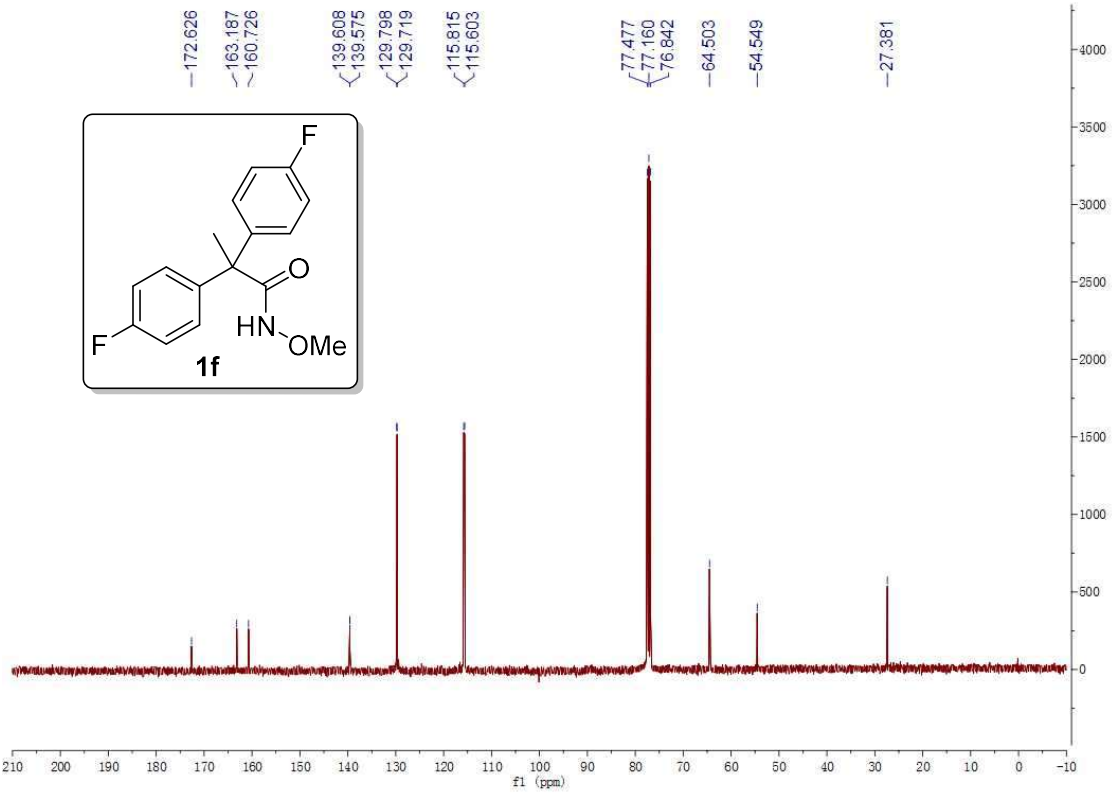
^{1}H NMR Spectrum of **1e** ($CDCl_3$, 400 MHz)



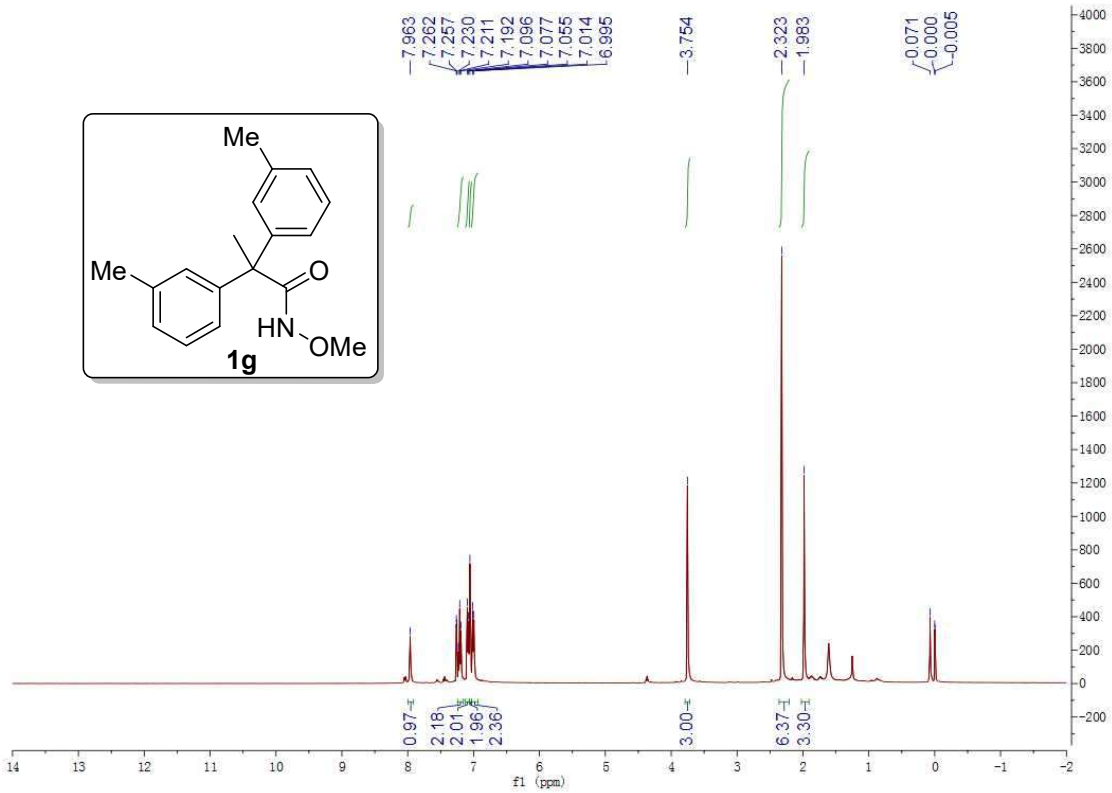
^{13}C NMR Spectrum of **1e** ($CDCl_3$, 100 MHz)



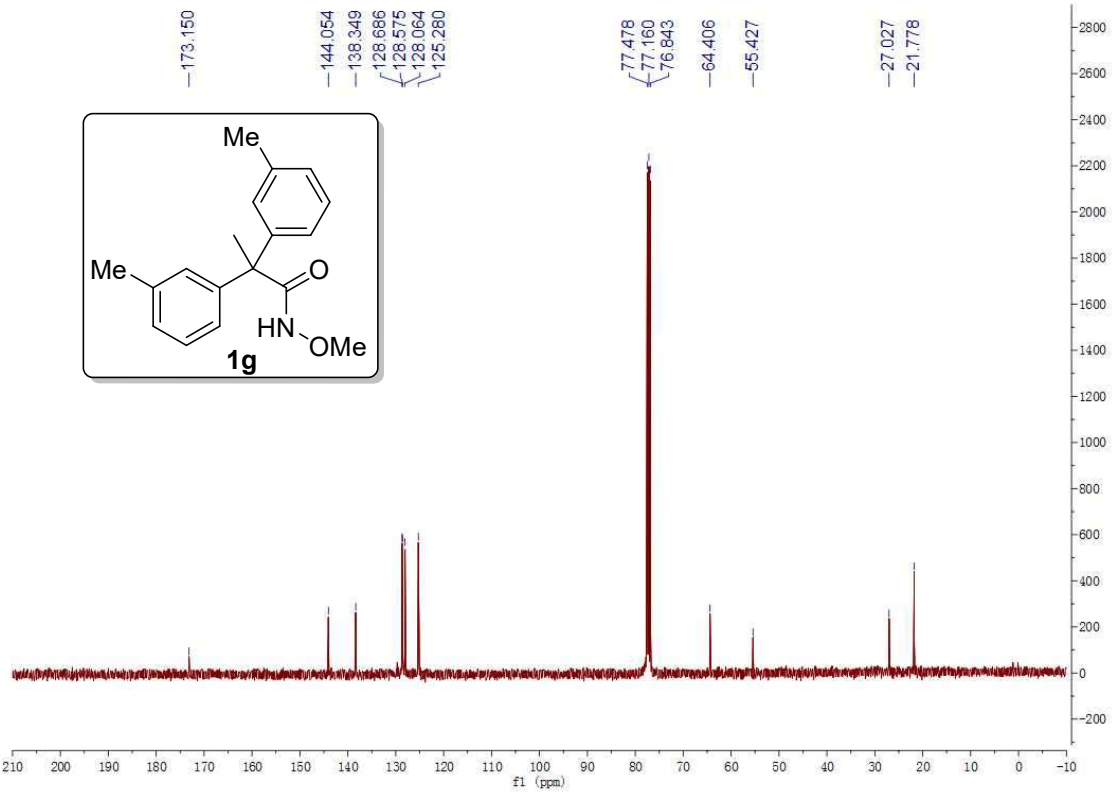
^{1}H NMR Spectrum of **1f** ($CDCl_3$, 400 MHz)



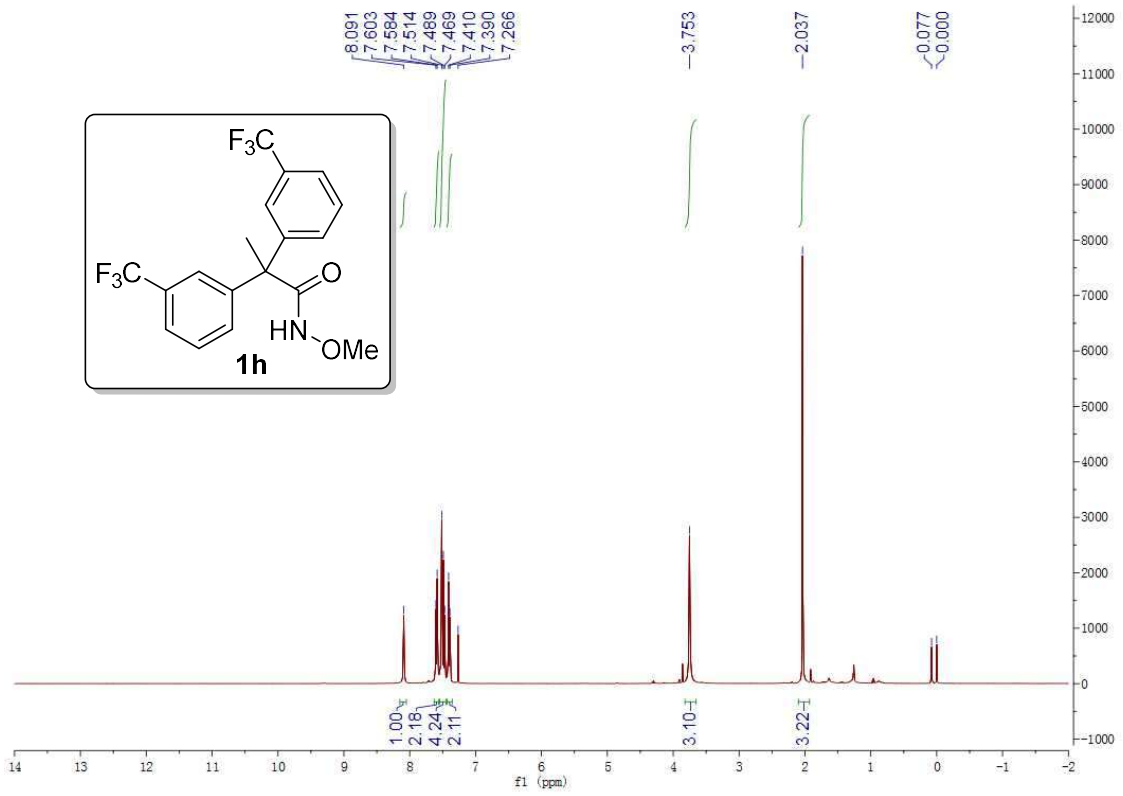
^{13}C NMR Spectrum of **1f** ($CDCl_3$, 100 MHz)



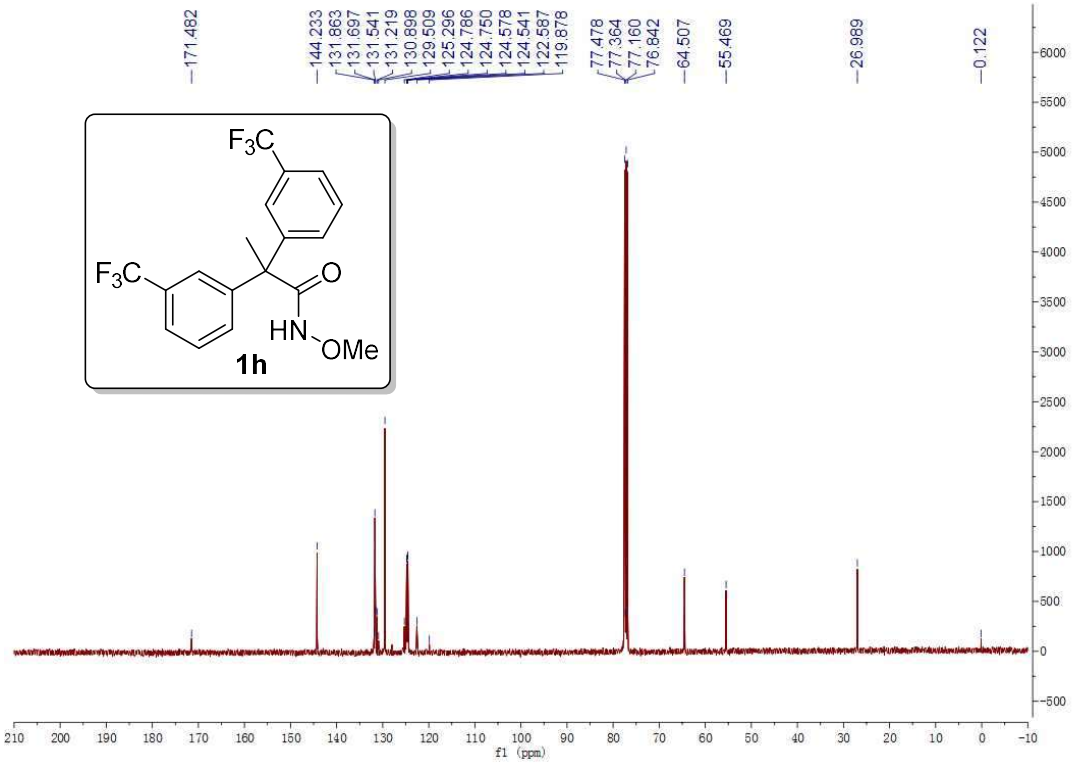
^{1}H NMR Spectrum of **1g** ($CDCl_3$, 400 MHz)



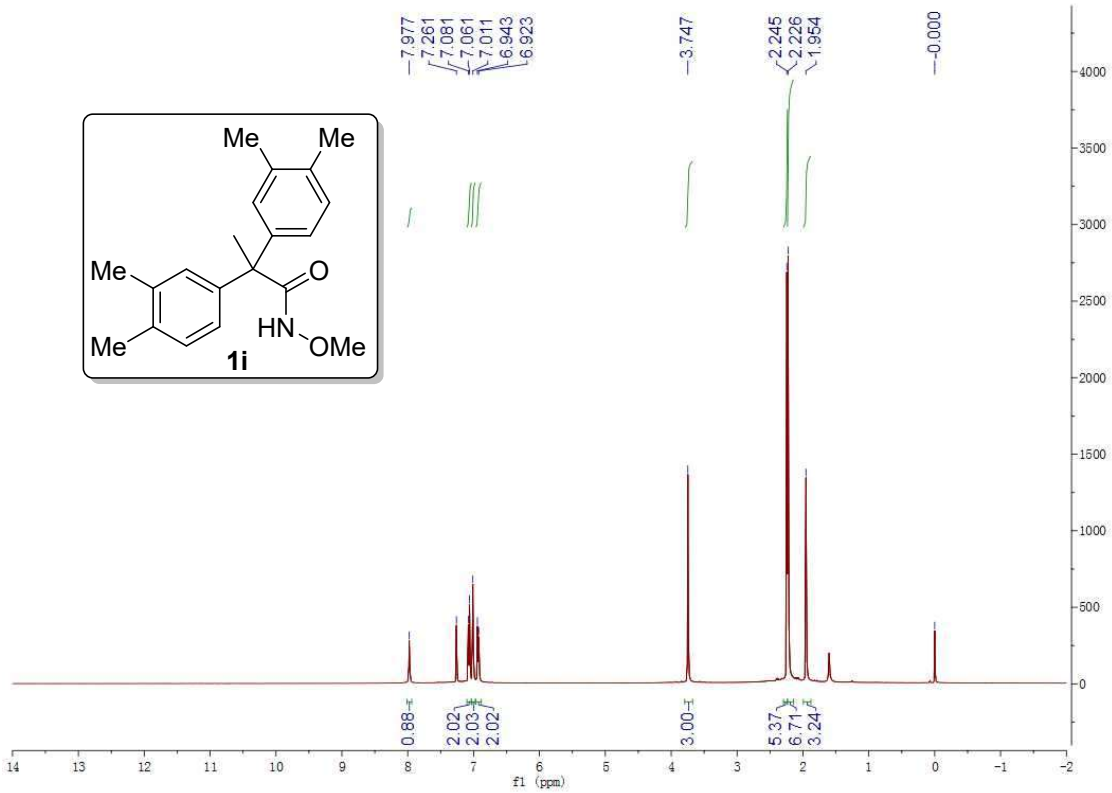
^{13}C NMR Spectrum of **1g** ($CDCl_3$, 100 MHz)



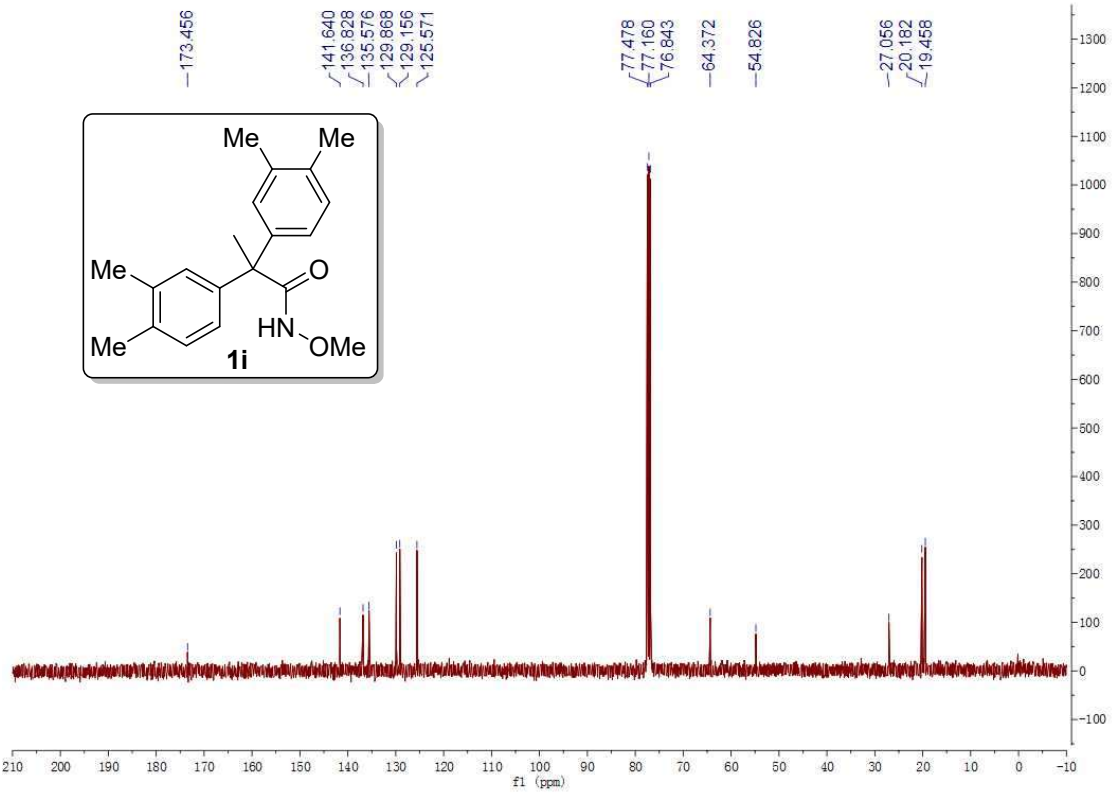
^{1}H NMR Spectrum of **1h** ($CDCl_3$, 400 MHz)



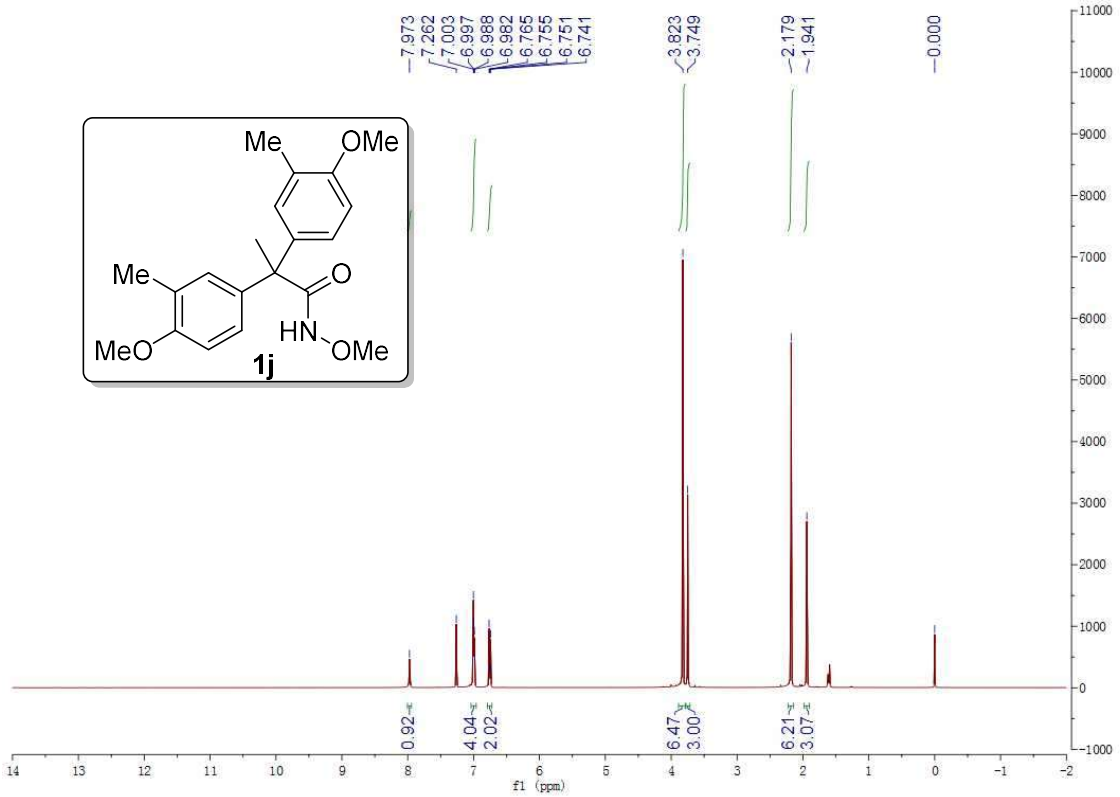
^{13}C NMR Spectrum of **1h** ($CDCl_3$, 100 MHz)



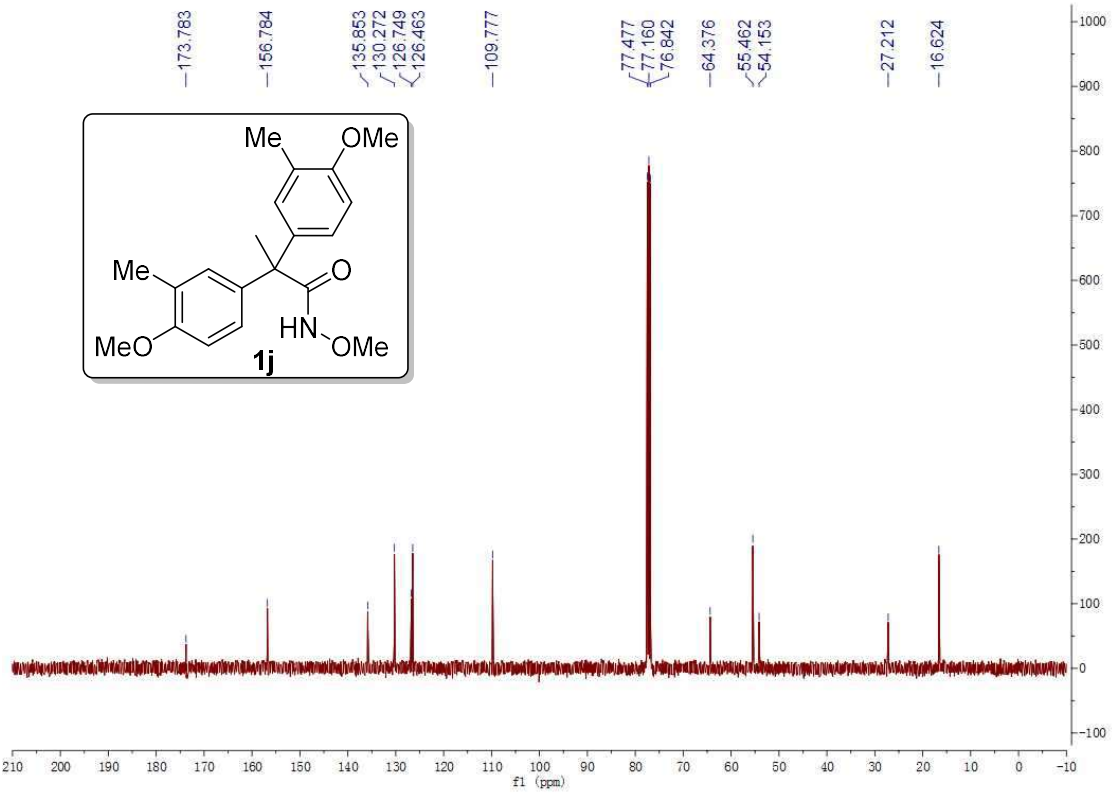
^{1}H NMR Spectrum of **1i** ($CDCl_3$, 400 MHz)



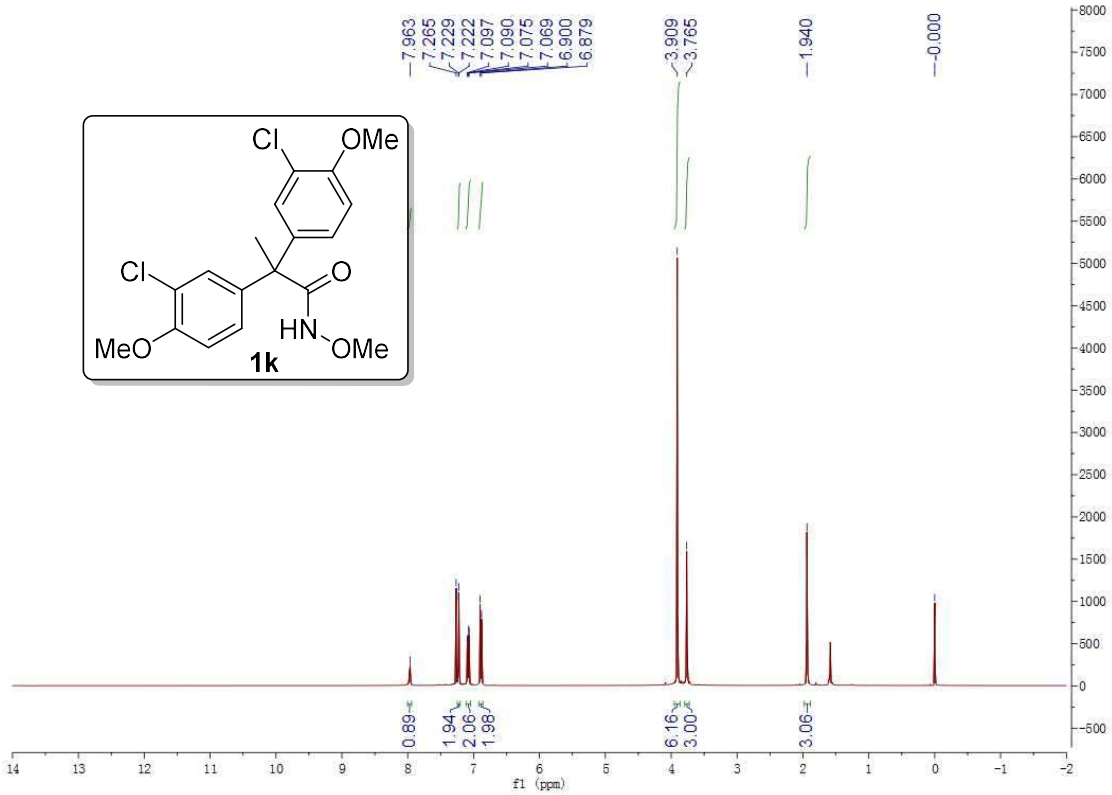
^{13}C NMR Spectrum of **1i** ($CDCl_3$, 100 MHz)



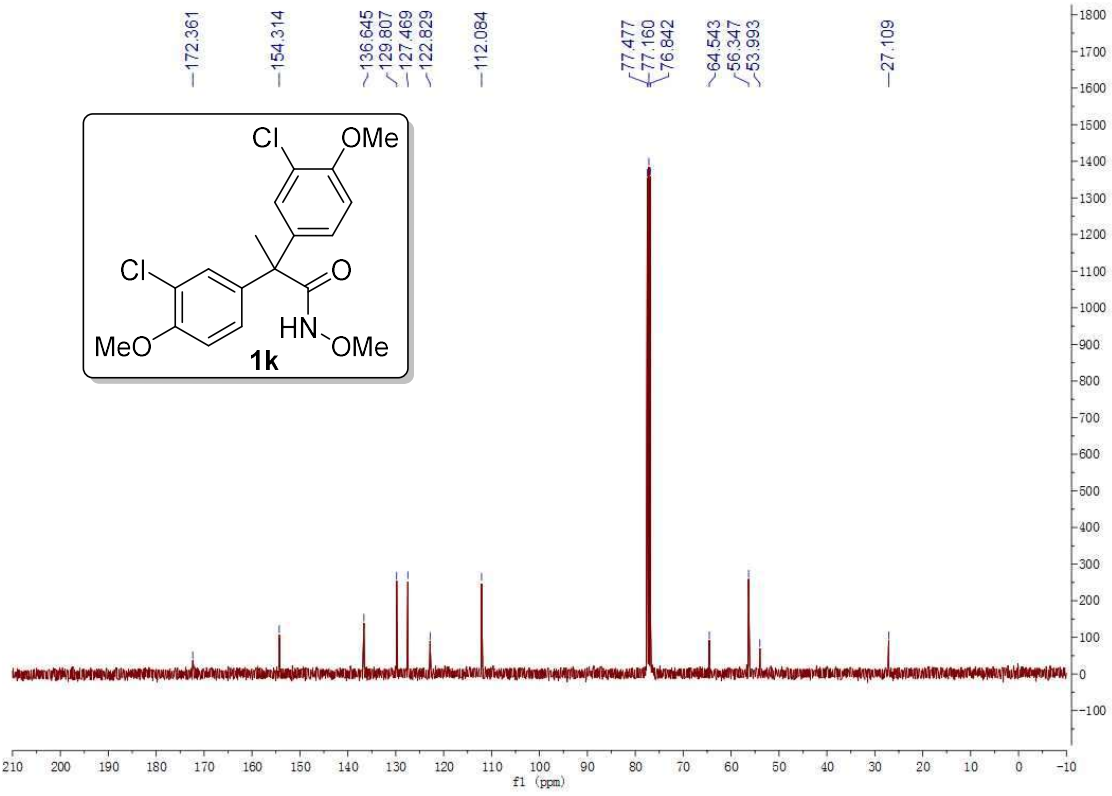
^{1}H NMR Spectrum of **1j** ($CDCl_3$, 400 MHz)



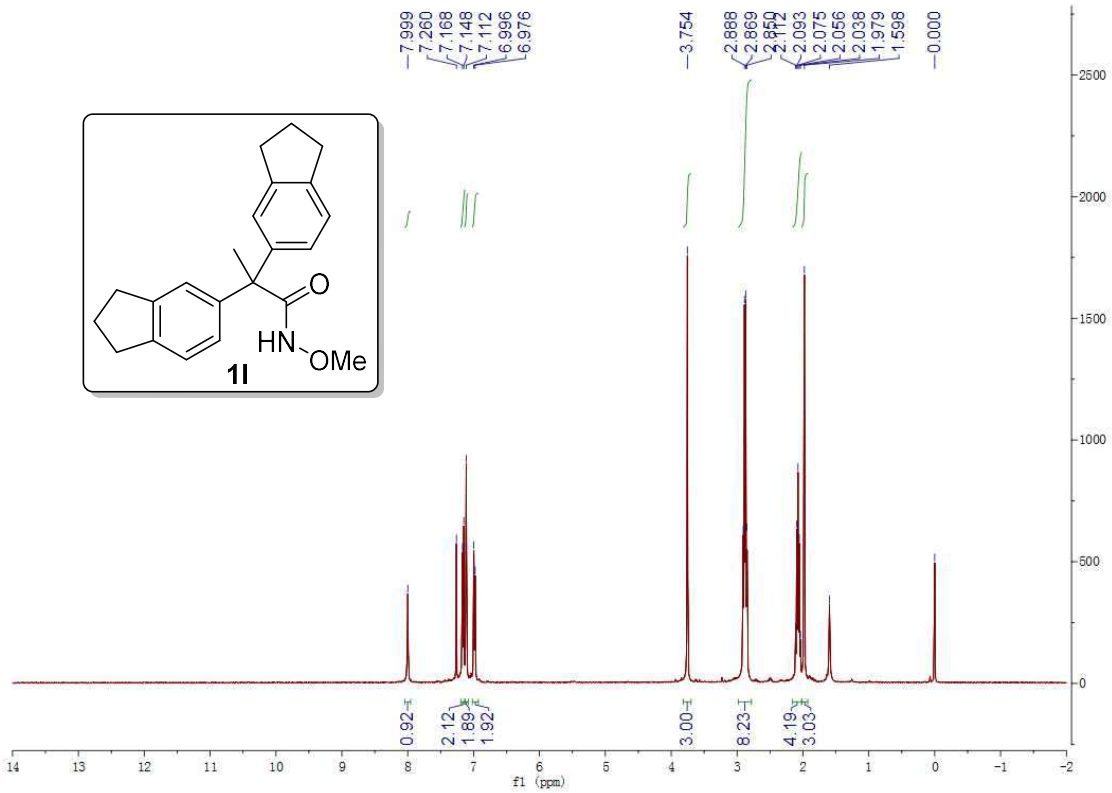
^{13}C NMR Spectrum of **1j** ($CDCl_3$, 100 MHz)



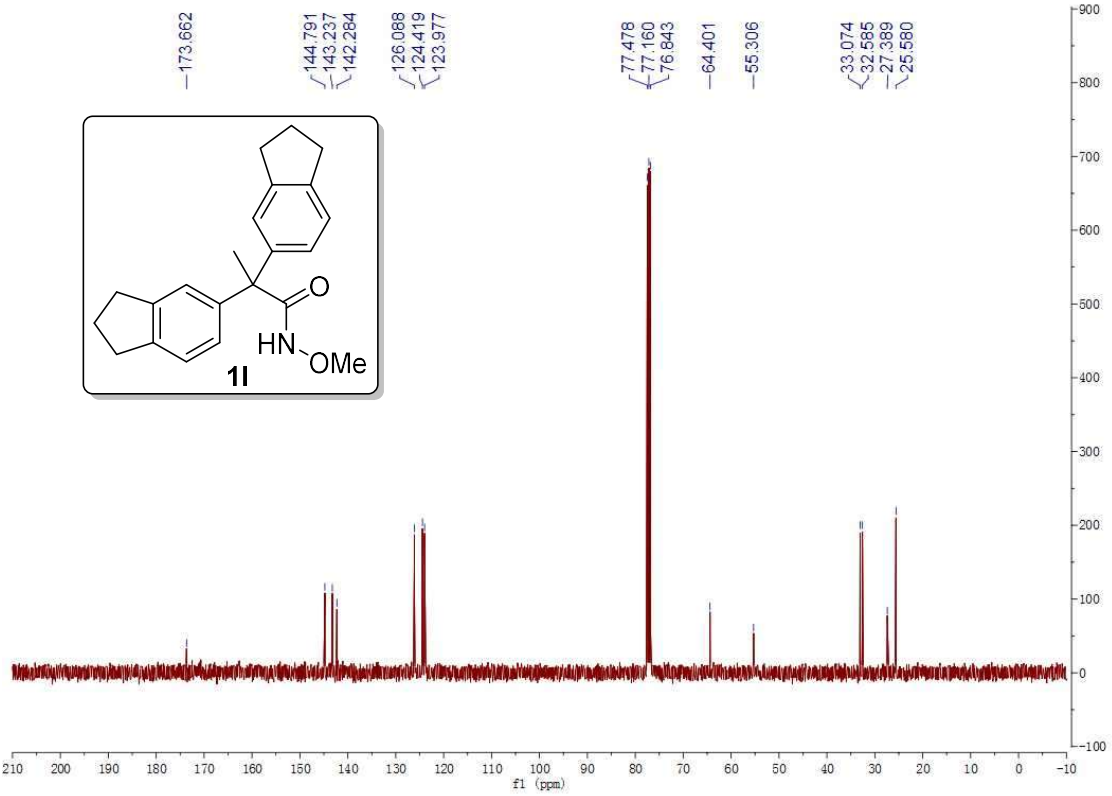
^{1}H NMR Spectrum of **1k** ($CDCl_3$, 400 MHz)



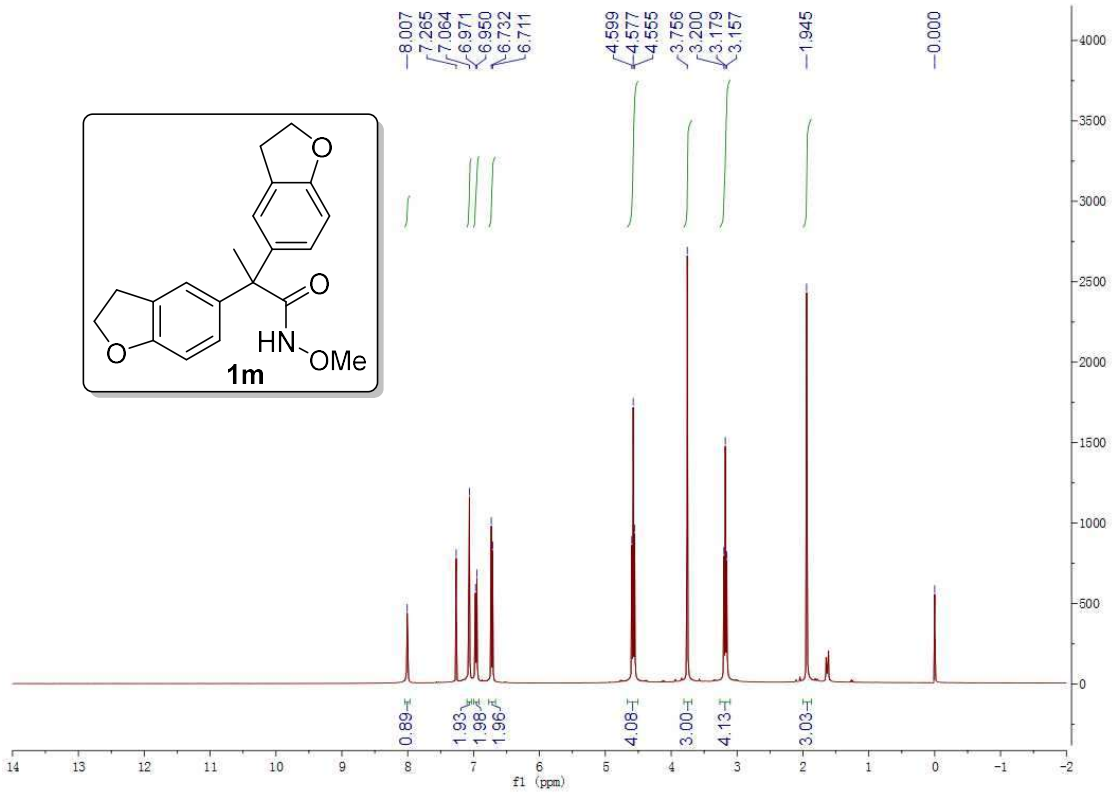
^{13}C NMR Spectrum of **1k** ($CDCl_3$, 100 MHz)



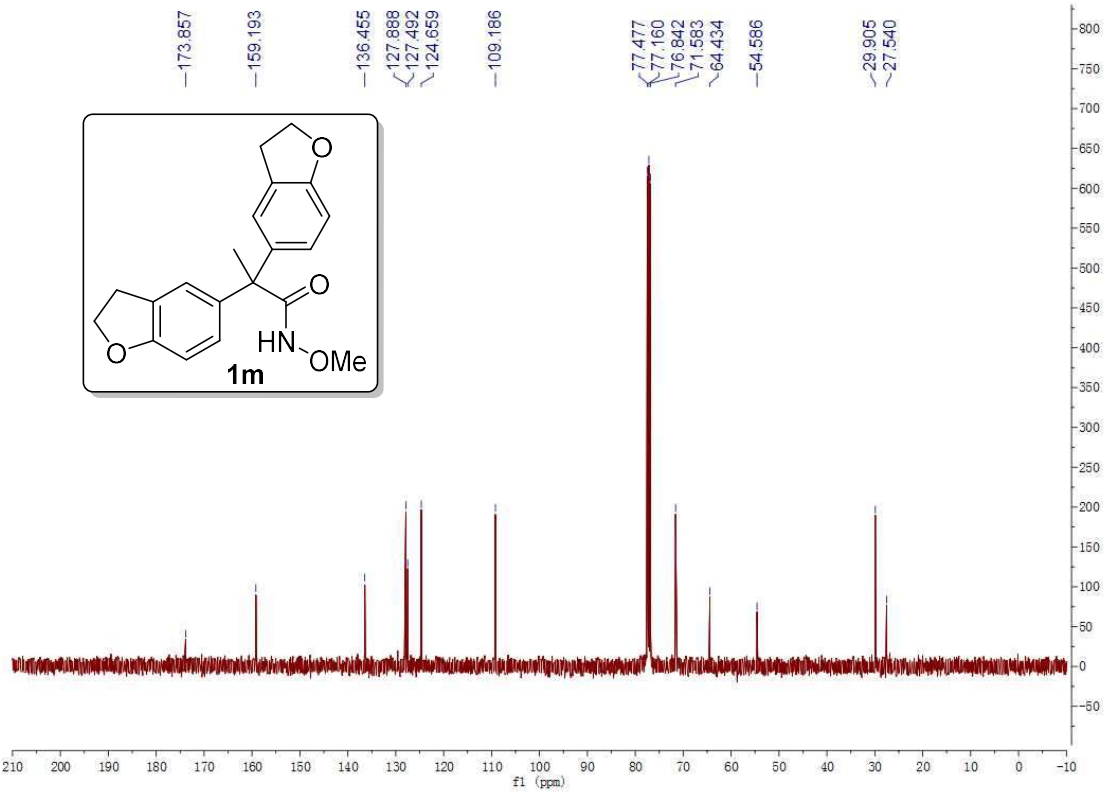
^{1}H NMR Spectrum of **1l** ($CDCl_3$, 400 MHz)



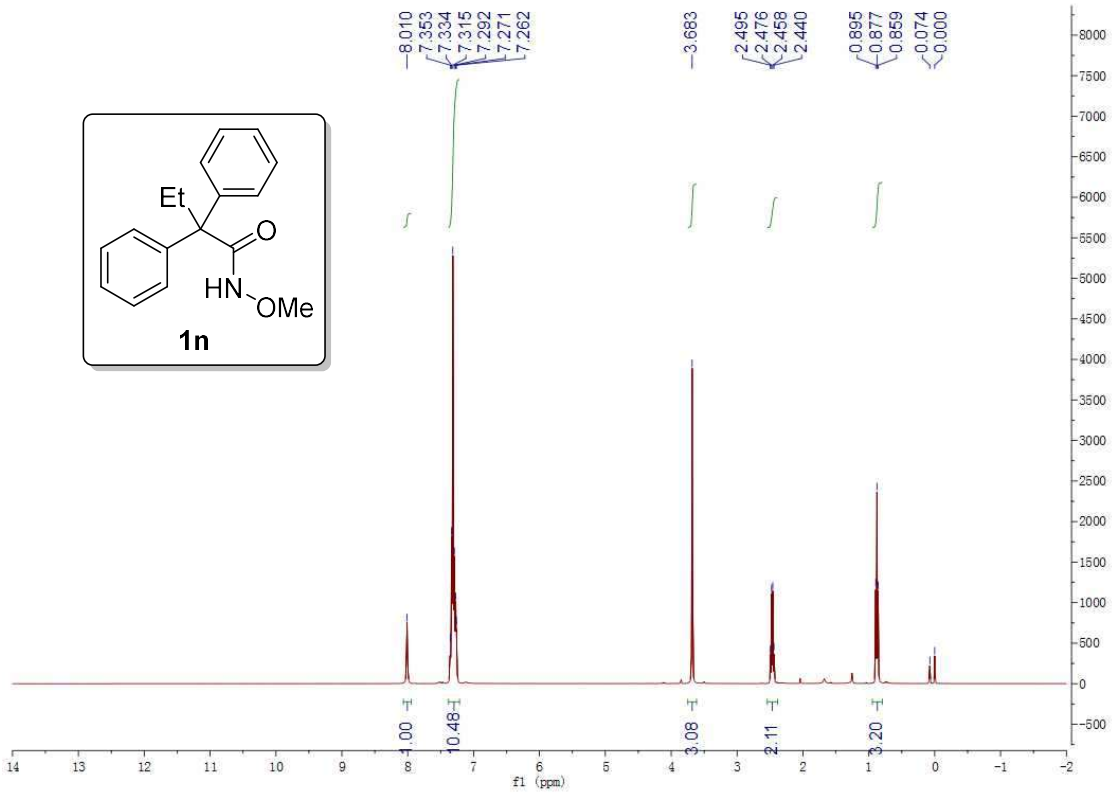
^{13}C NMR Spectrum of **1l** ($CDCl_3$, 100 MHz)



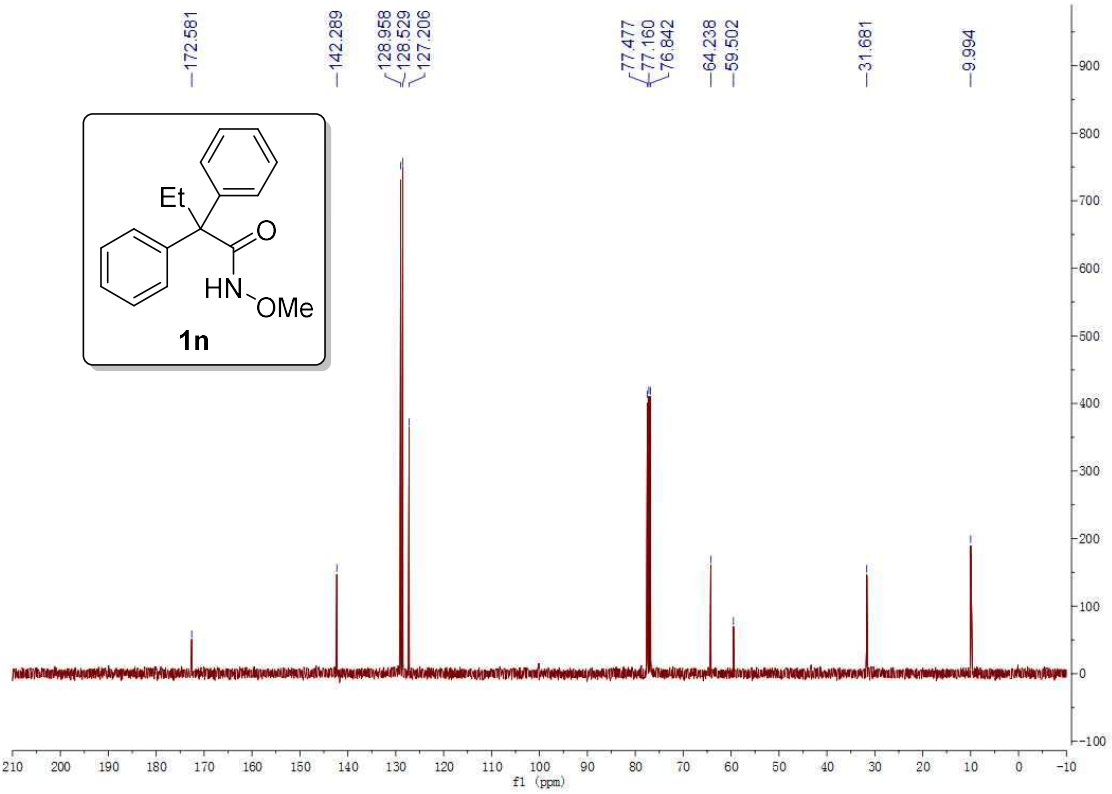
^{1}H NMR Spectrum of **1m** ($CDCl_3$, 400 MHz)



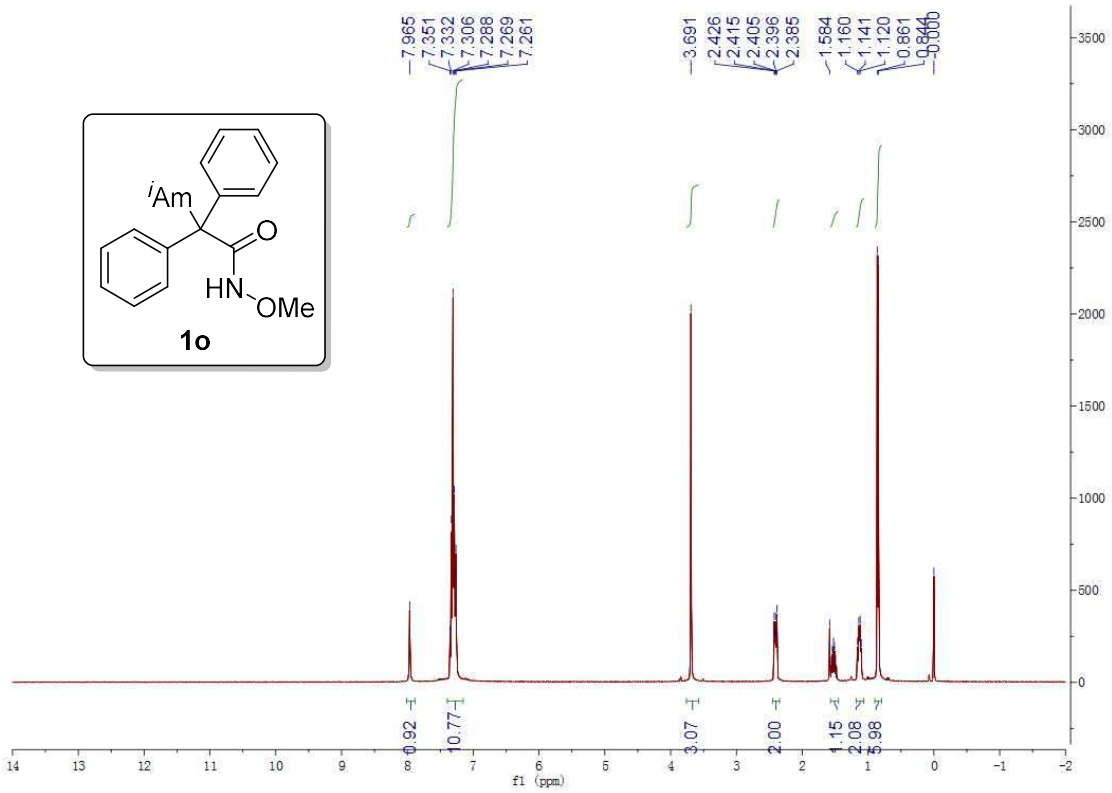
^{13}C NMR Spectrum of **1m** ($CDCl_3$, 100 MHz)



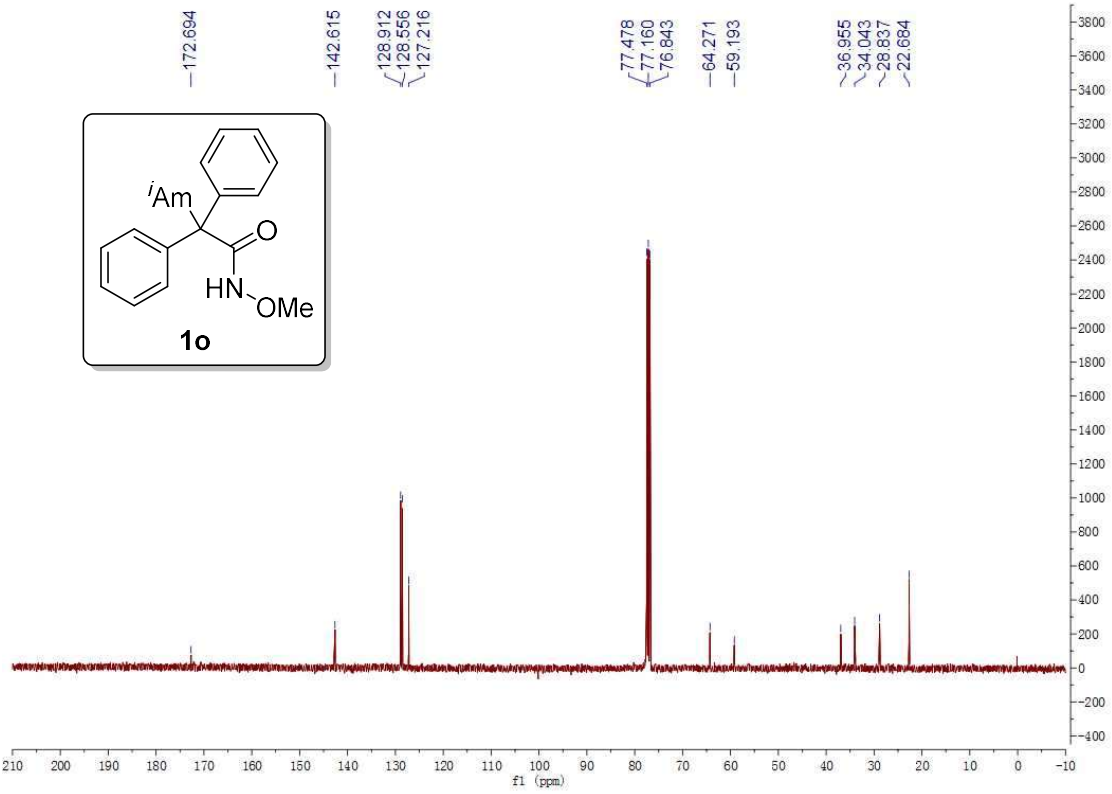
^{1}H NMR Spectrum of **1n** ($CDCl_3$, 400 MHz)



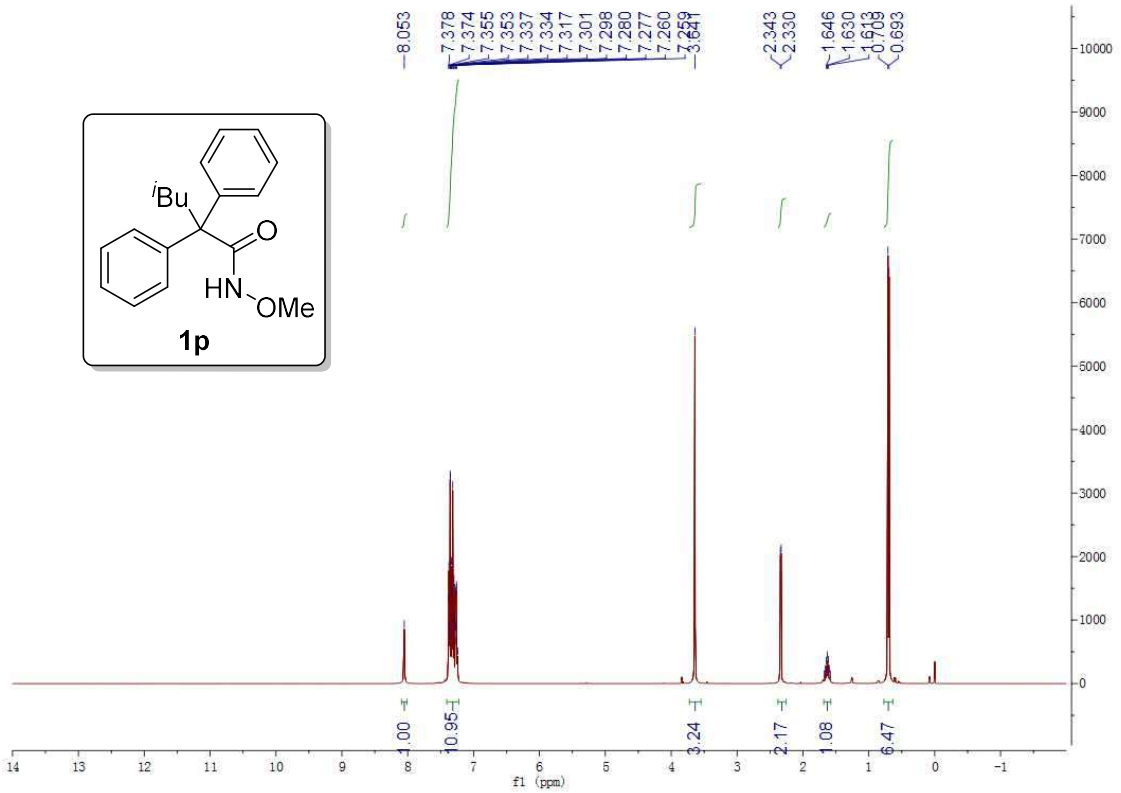
^{13}C NMR Spectrum of **1n** ($CDCl_3$, 100 MHz)



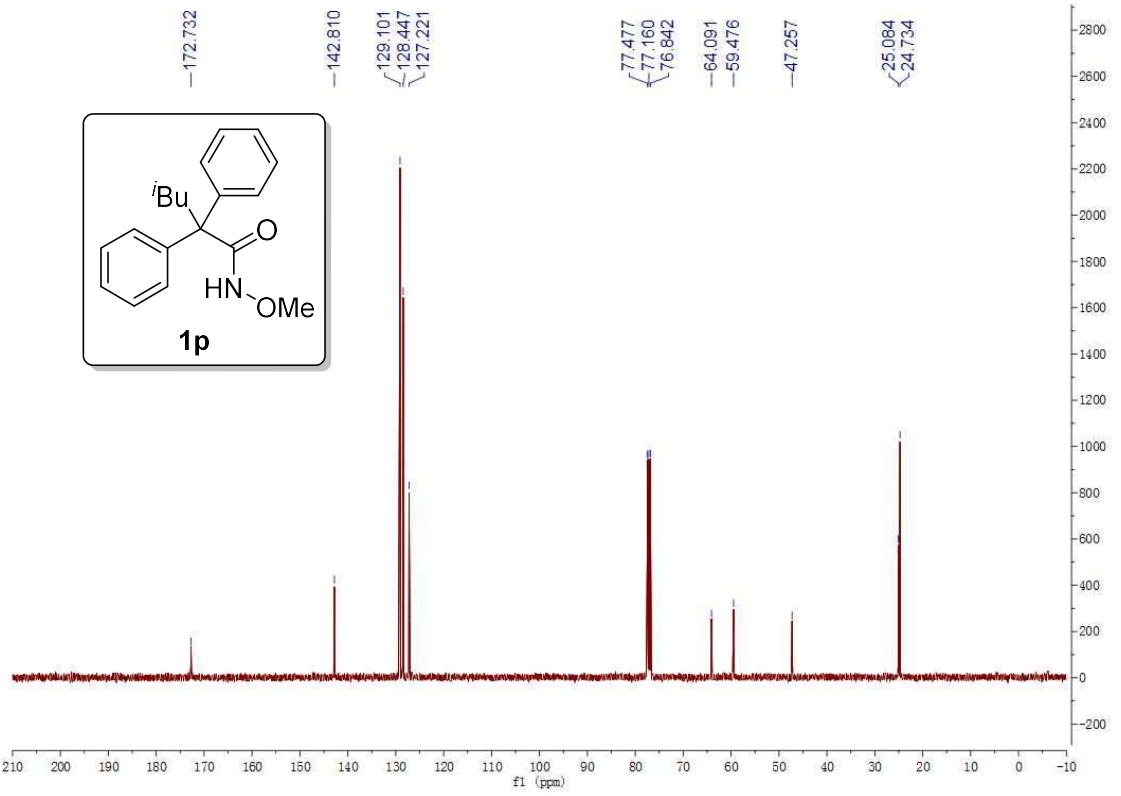
^{1}H NMR Spectrum of **1o** ($CDCl_3$, 400 MHz)



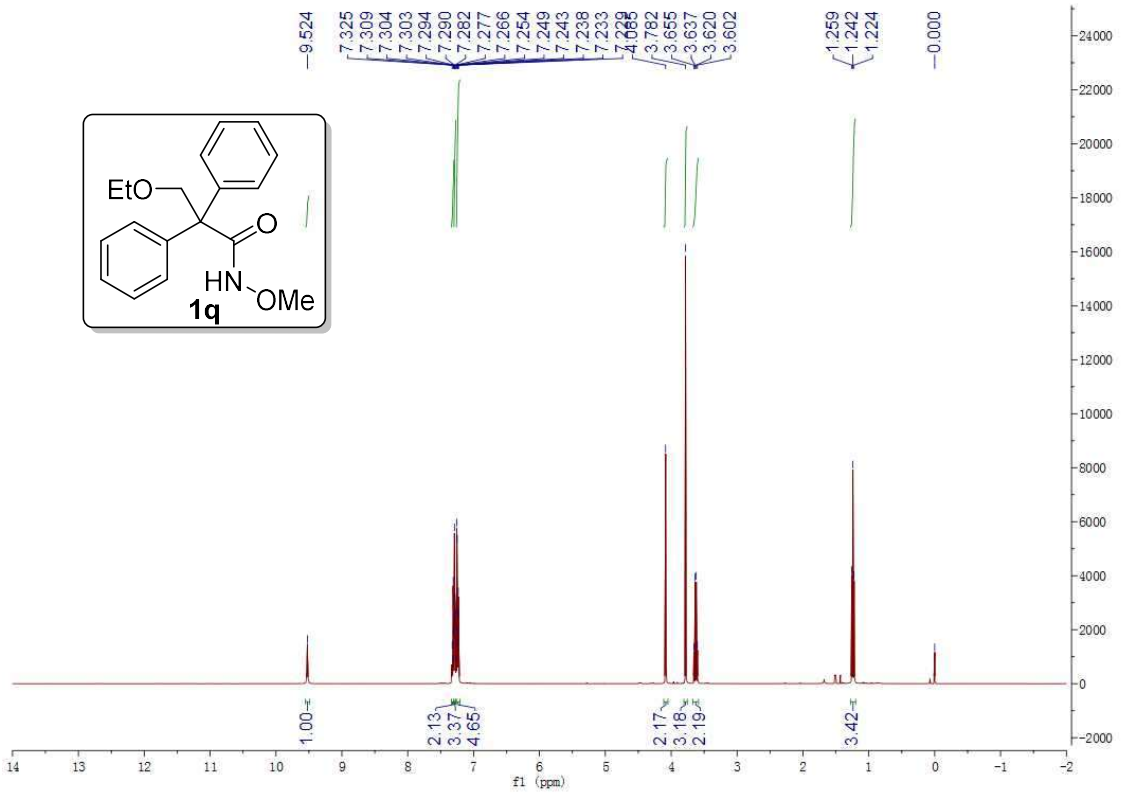
^{13}C NMR Spectrum of **1o** ($CDCl_3$, 100 MHz)



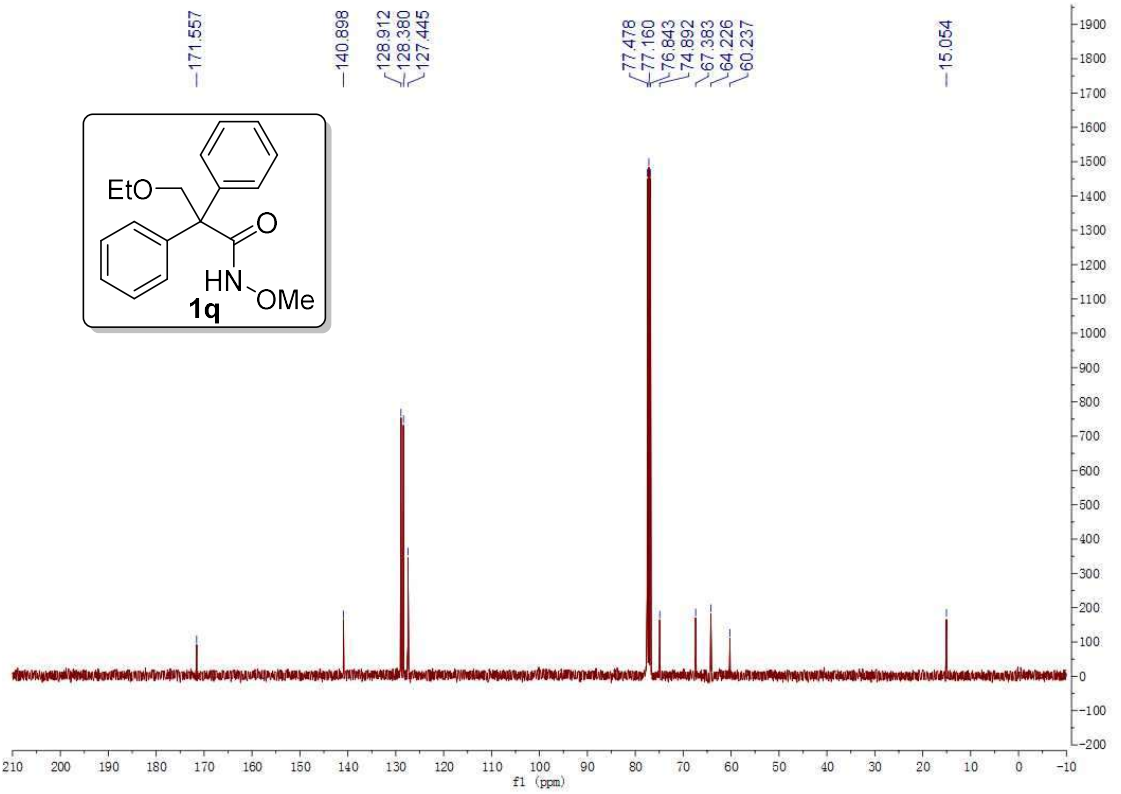
^{1}H NMR Spectrum of **1p** ($CDCl_3$, 400 MHz)



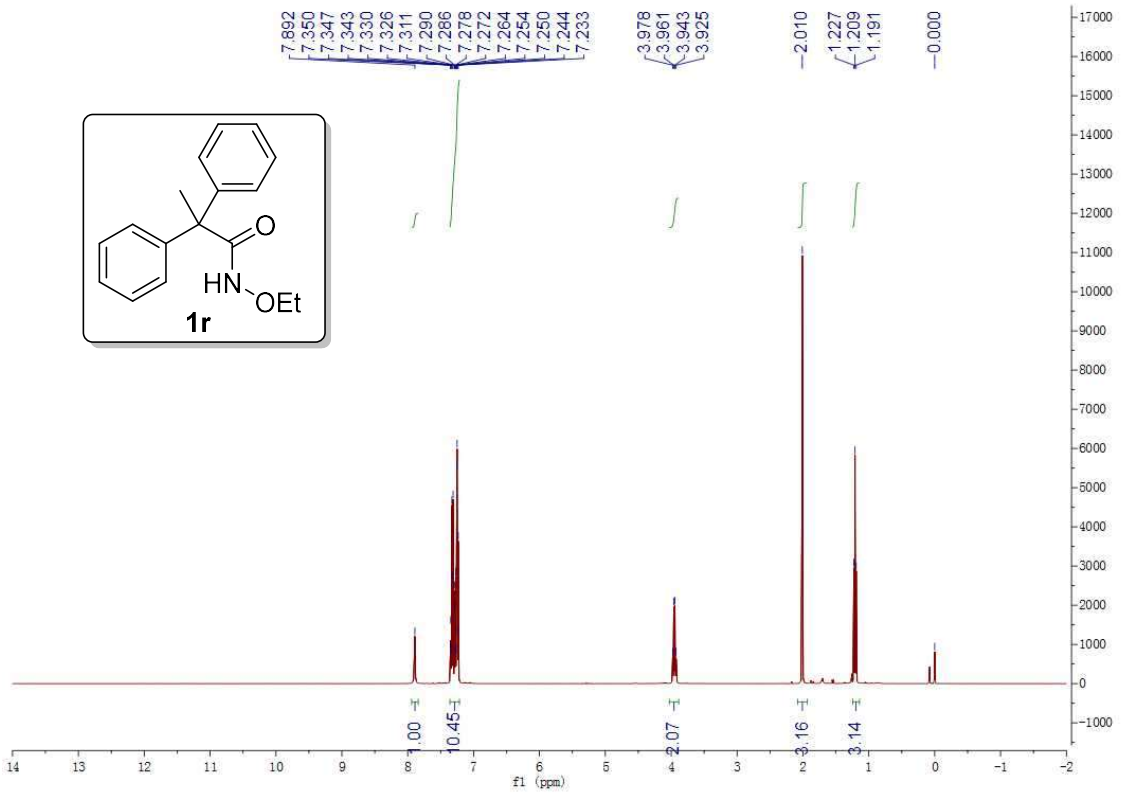
^{13}C NMR Spectrum of **1p** ($CDCl_3$, 100 MHz)



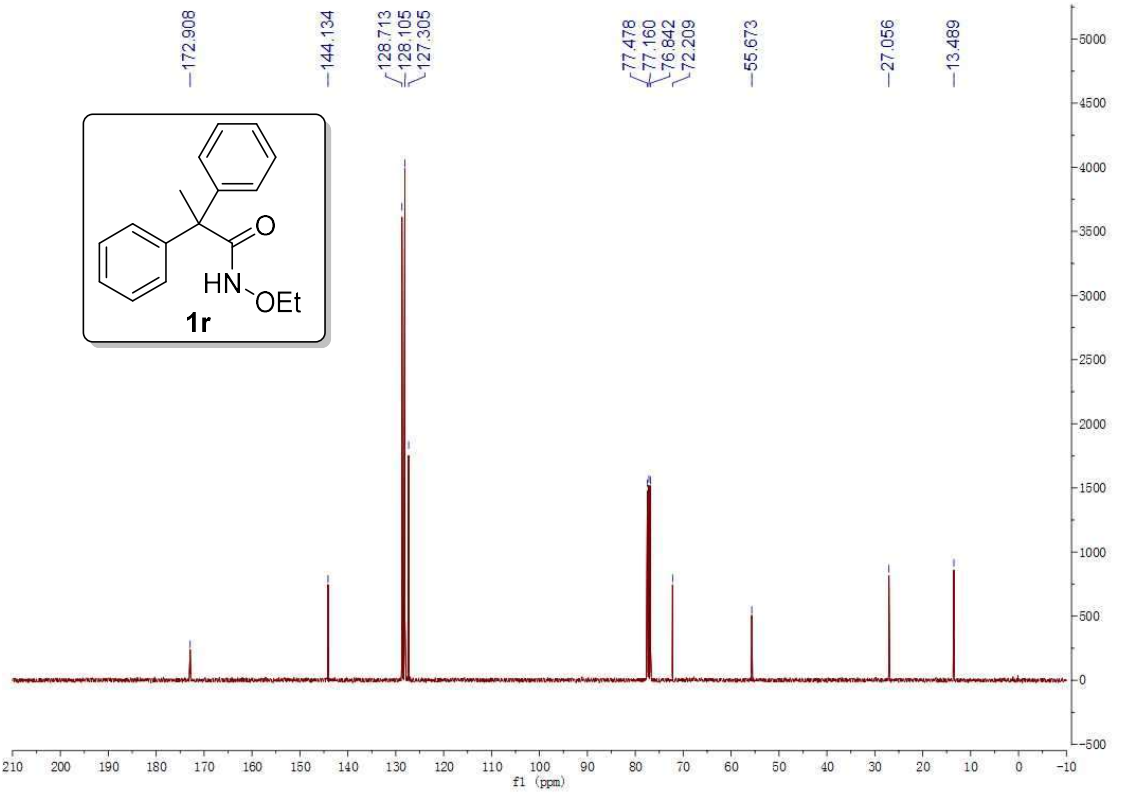
^{1}H NMR Spectrum of **1q** ($CDCl_3$, 400 MHz)



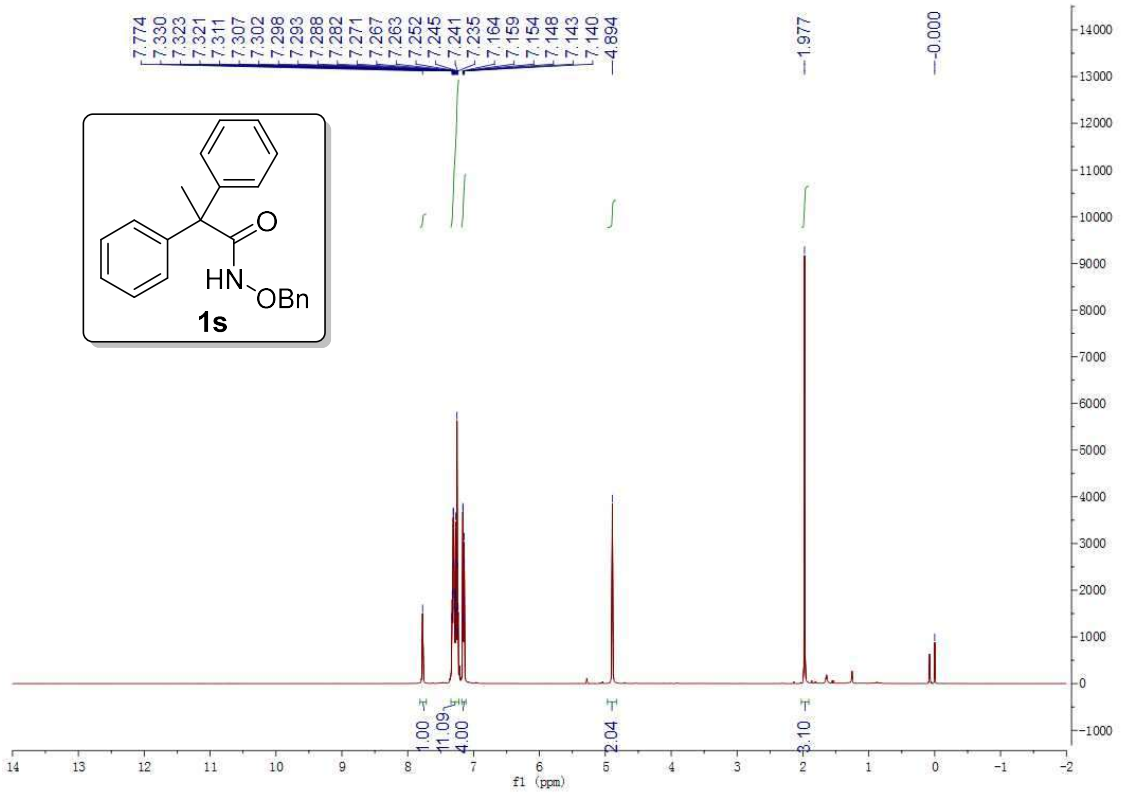
^{13}C NMR Spectrum of **1q** ($CDCl_3$, 100 MHz)



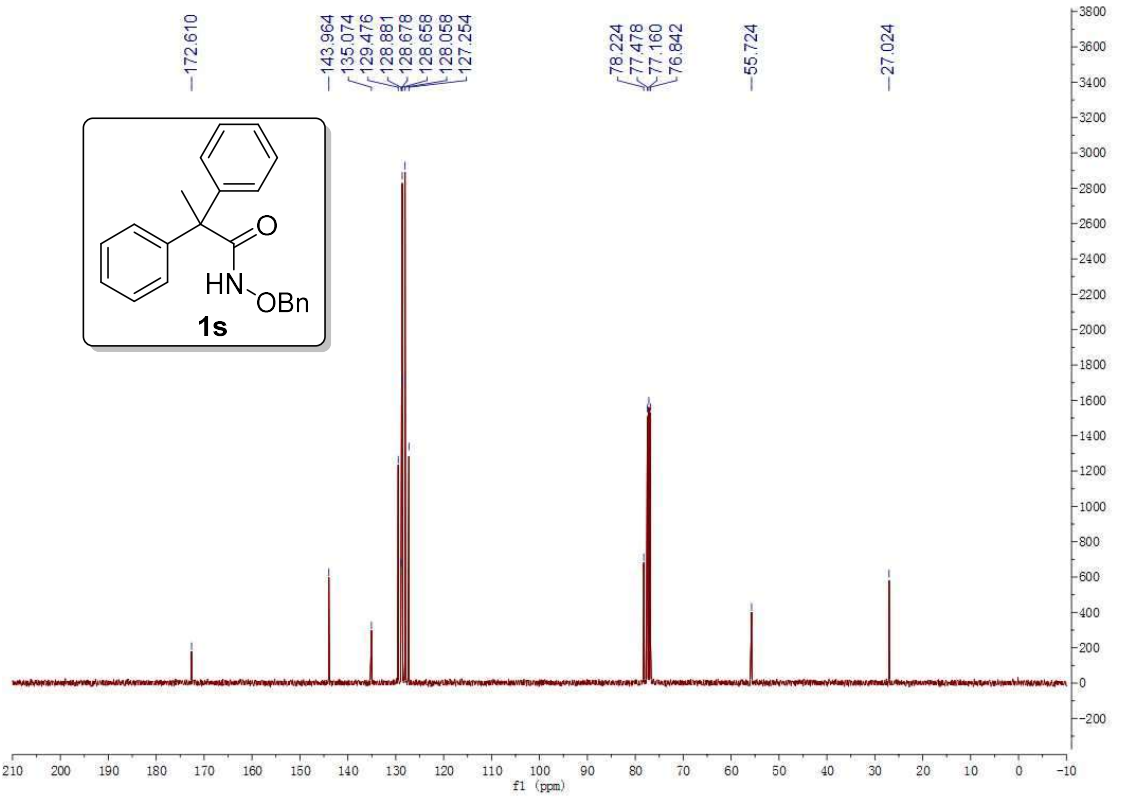
^{1}H NMR Spectrum of **1r** ($CDCl_3$, 400 MHz)



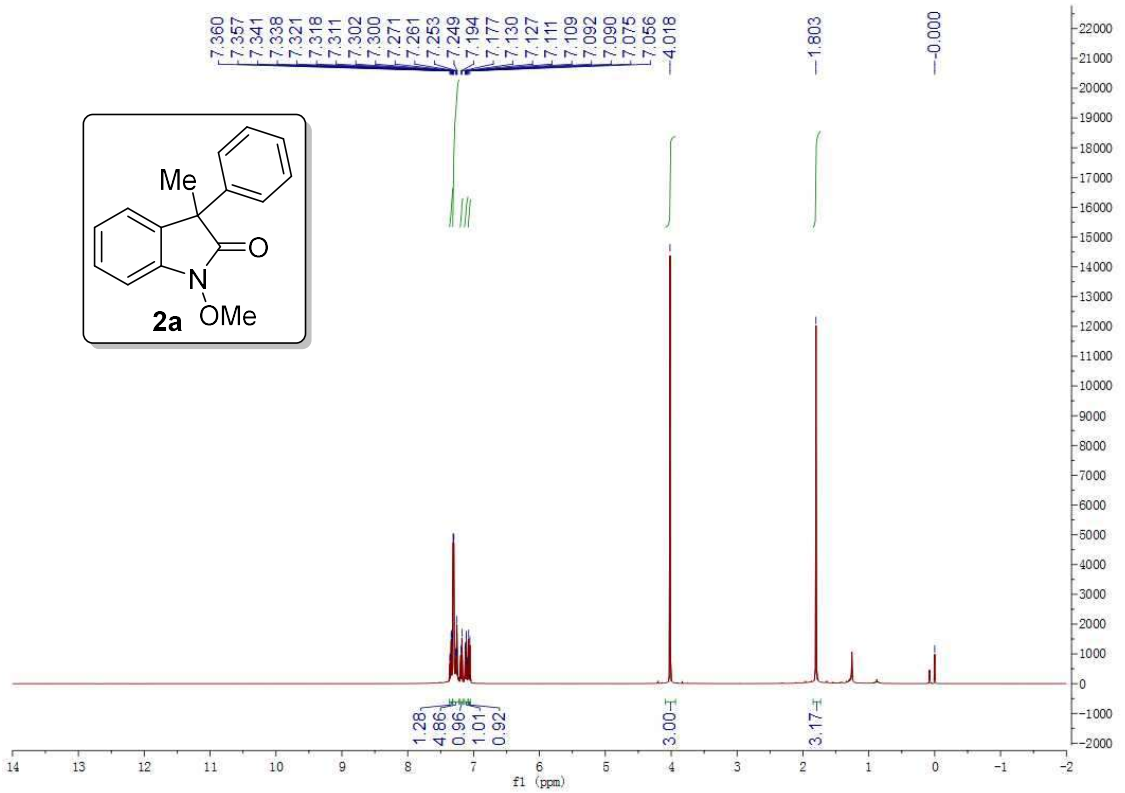
^{13}C NMR Spectrum of **1r** ($CDCl_3$, 100 MHz)



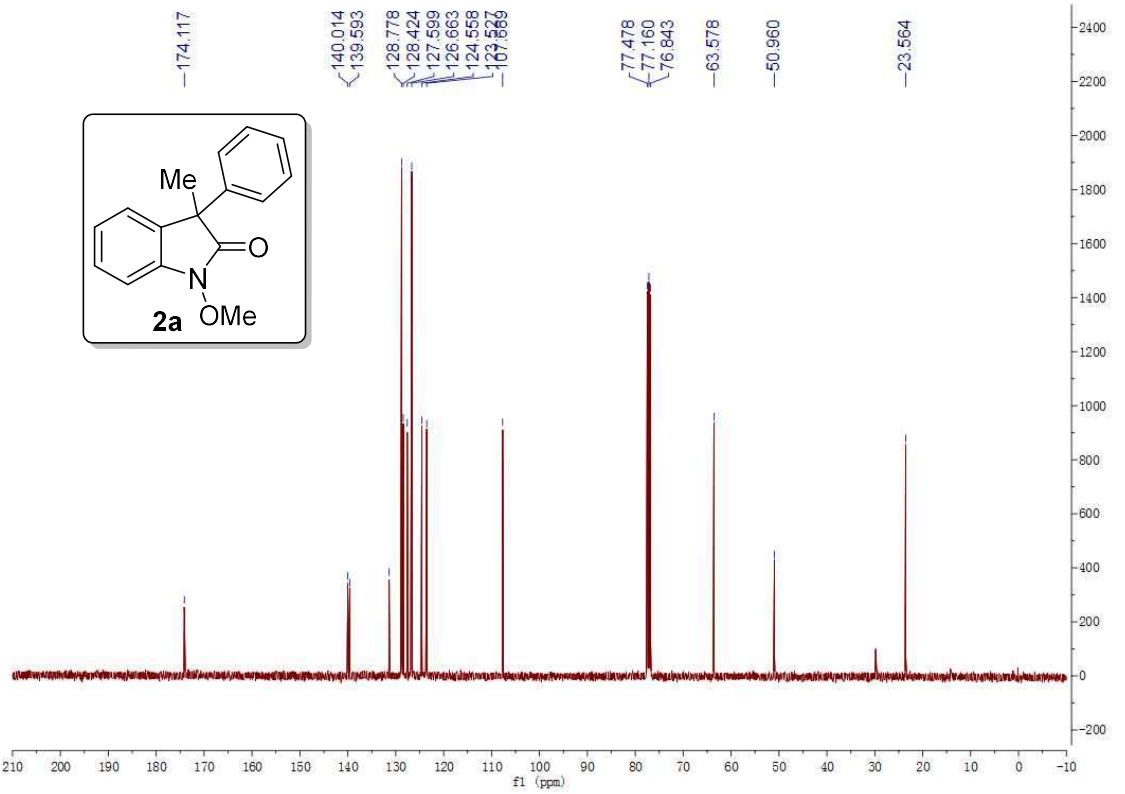
^{1}H NMR Spectrum of **1s** ($CDCl_3$, 400 MHz)



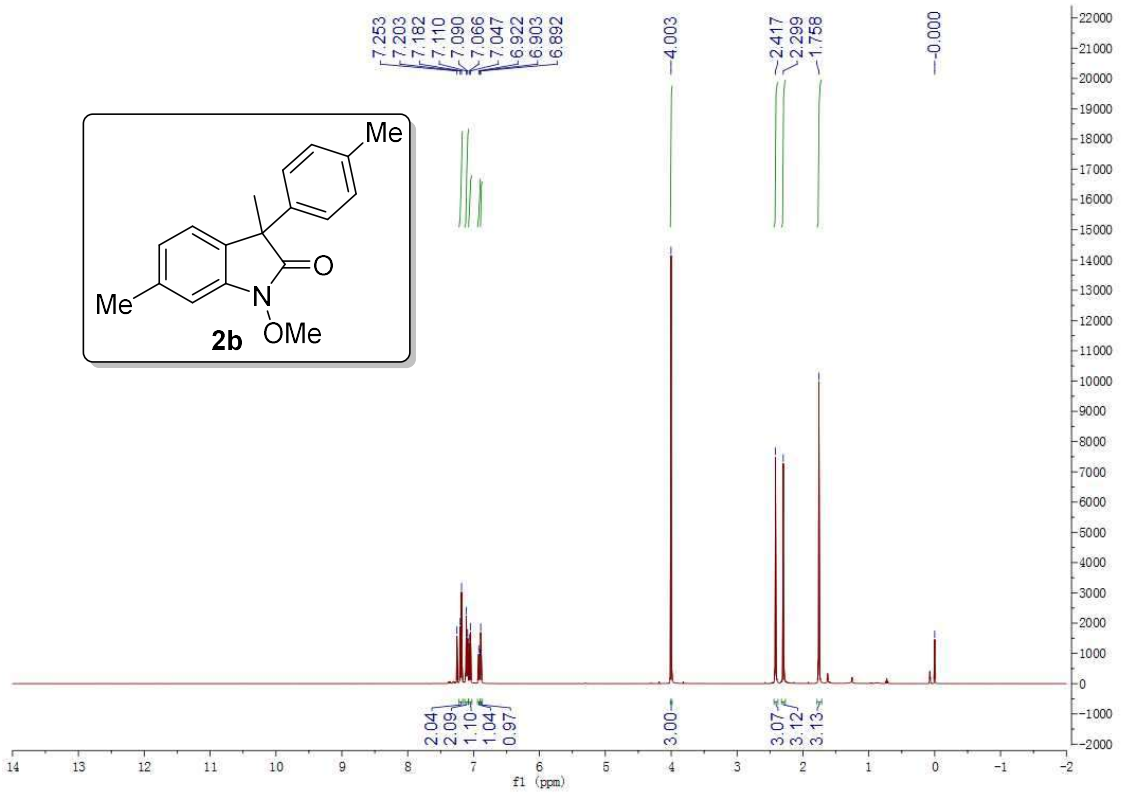
^{13}C NMR Spectrum of **1s** ($CDCl_3$, 100 MHz)



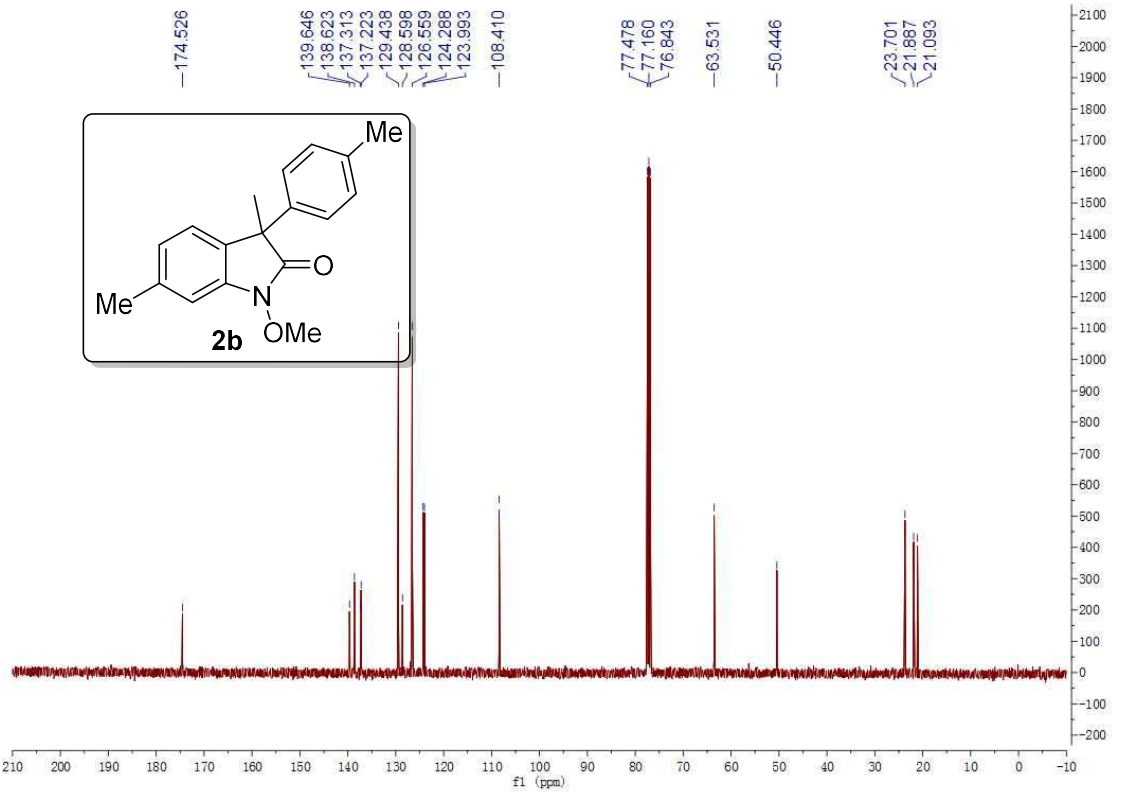
^{1}H NMR Spectrum of **2a** ($CDCl_3$, 400 MHz)



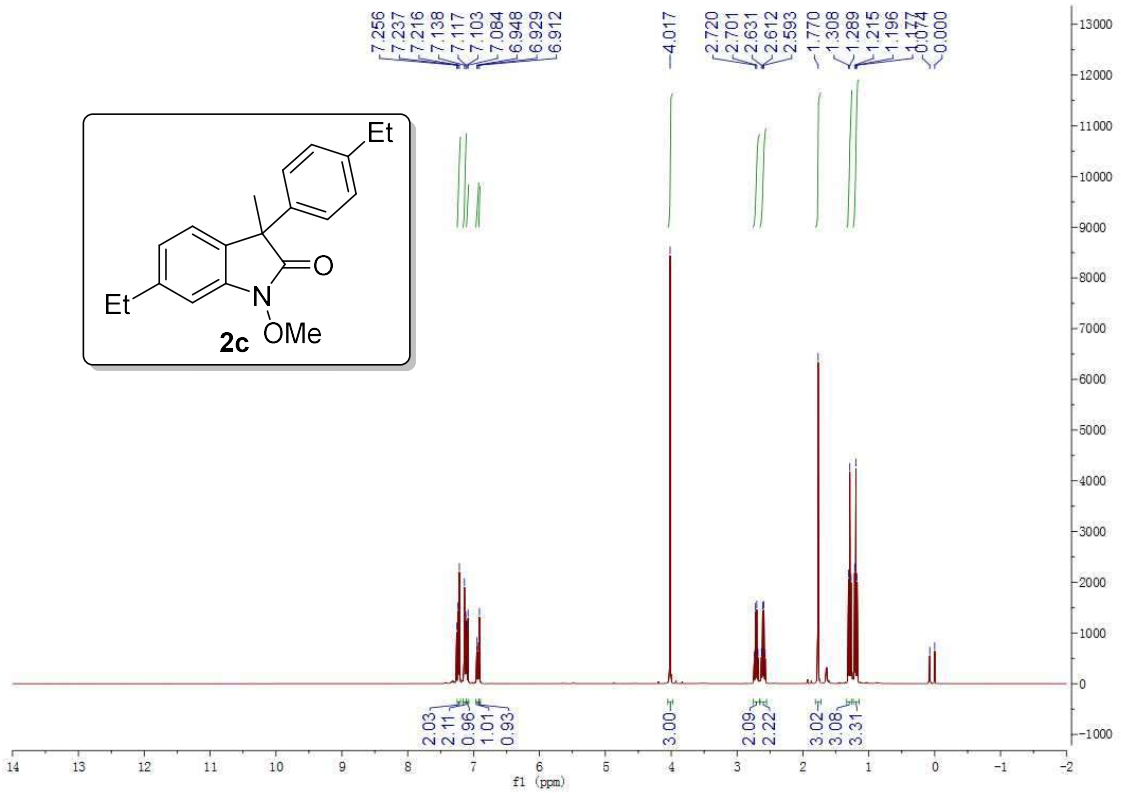
^{13}C NMR Spectrum of **2a** ($CDCl_3$, 100 MHz)



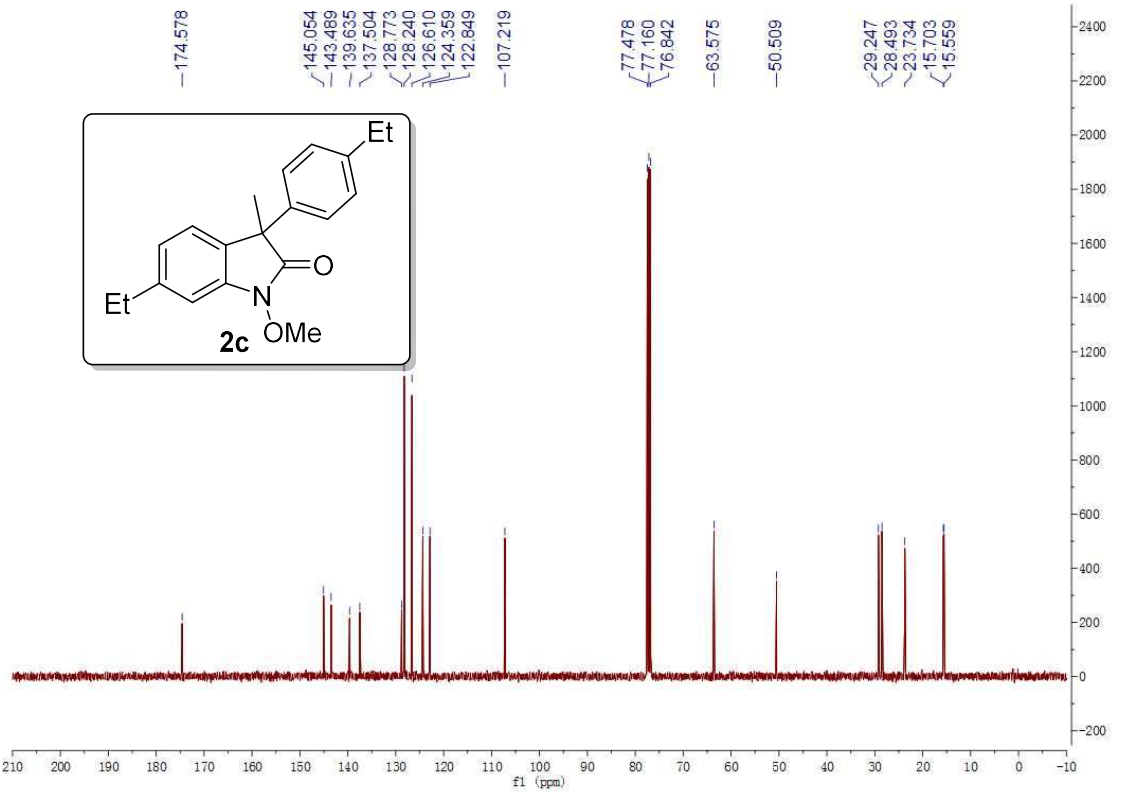
^{1}H NMR Spectrum of **2b** ($CDCl_3$, 400 MHz)



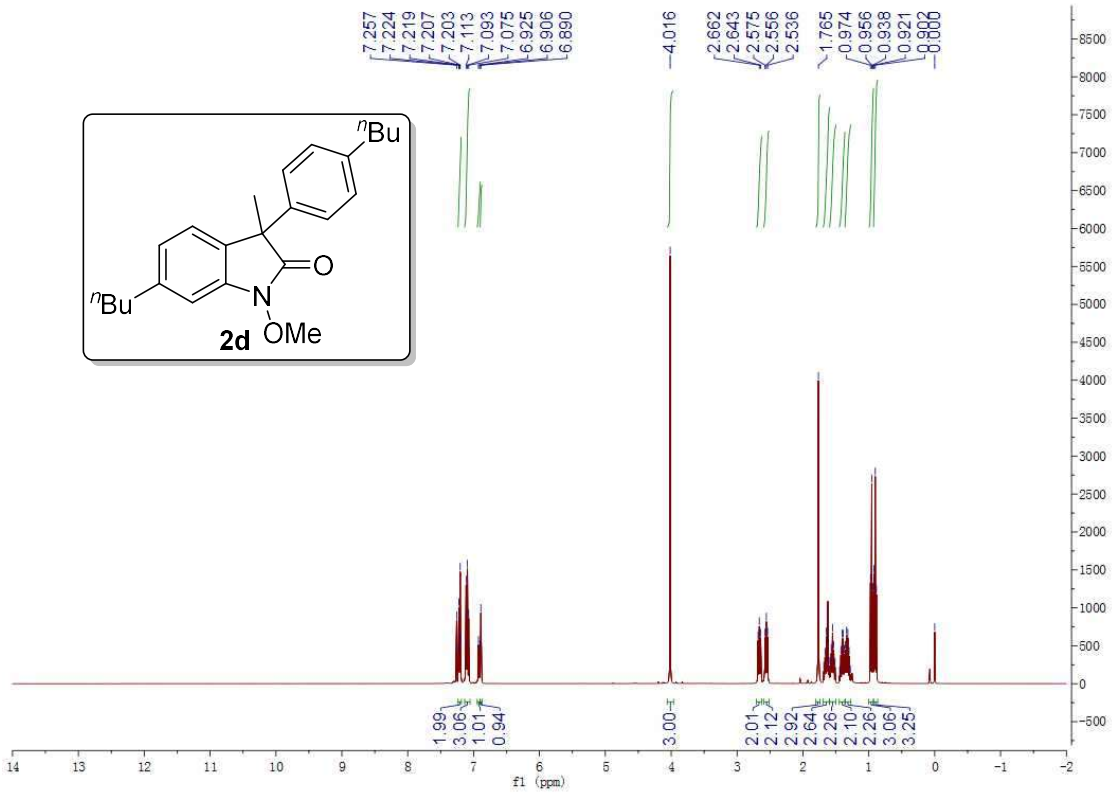
^{13}C NMR Spectrum of **2b** ($CDCl_3$, 100 MHz)



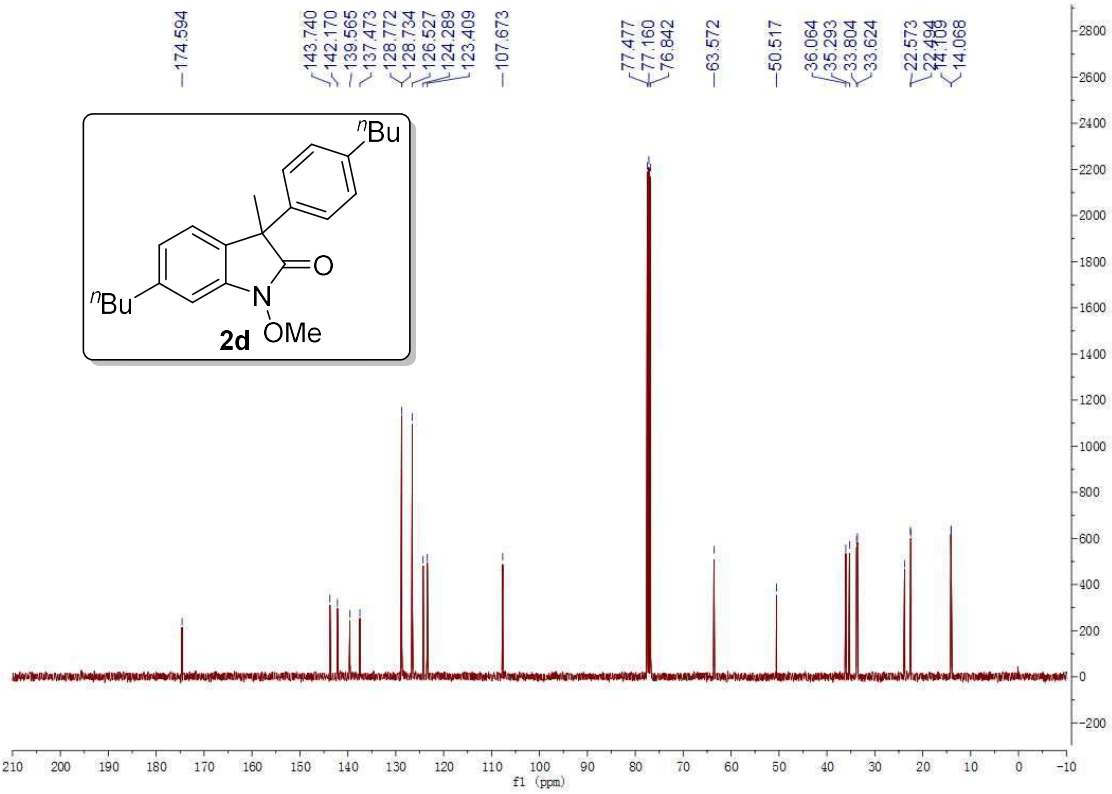
^{1}H NMR Spectrum of **2c** ($CDCl_3$, 400 MHz)



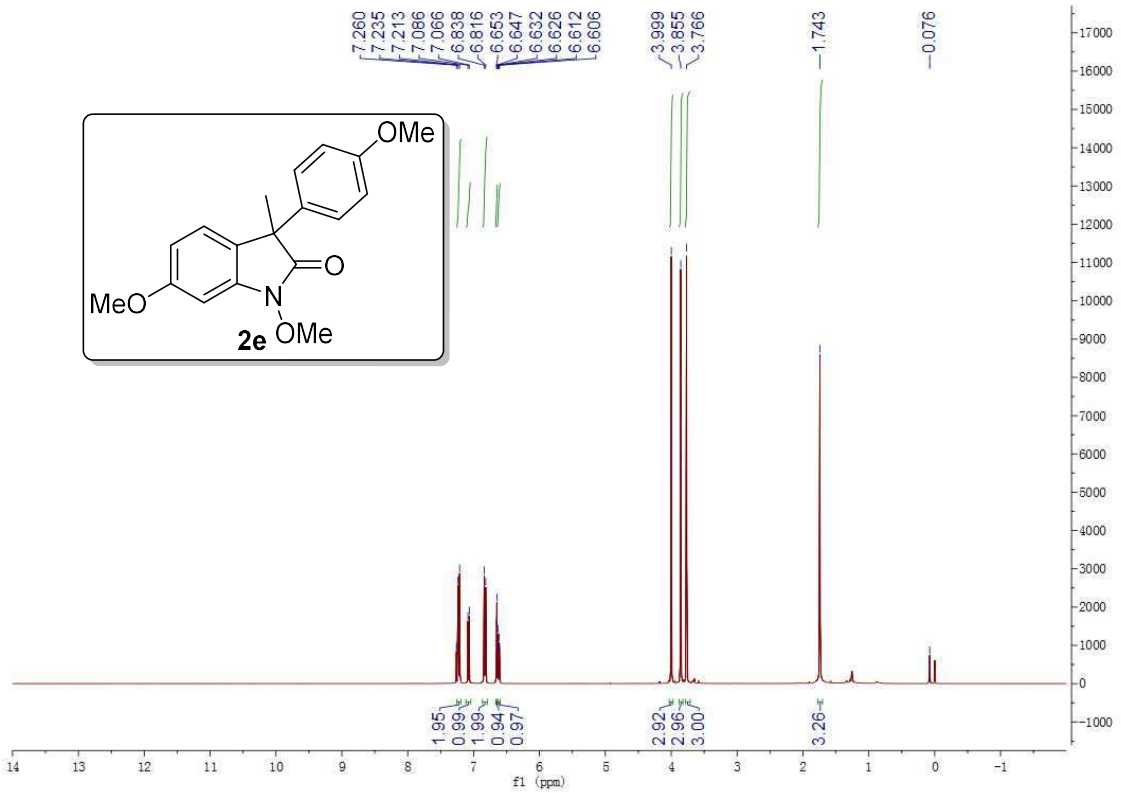
^{13}C NMR Spectrum of **2c** ($CDCl_3$, 100 MHz)



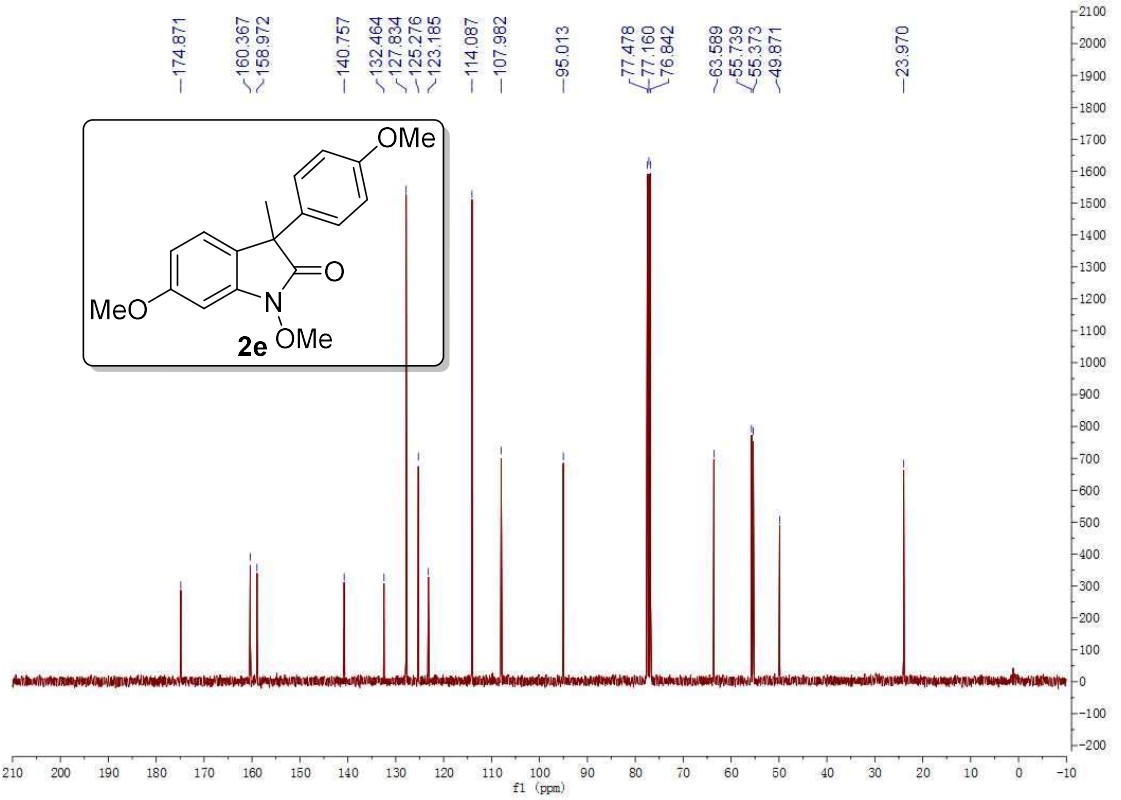
^{1}H NMR Spectrum of **2d** ($CDCl_3$, 400 MHz)



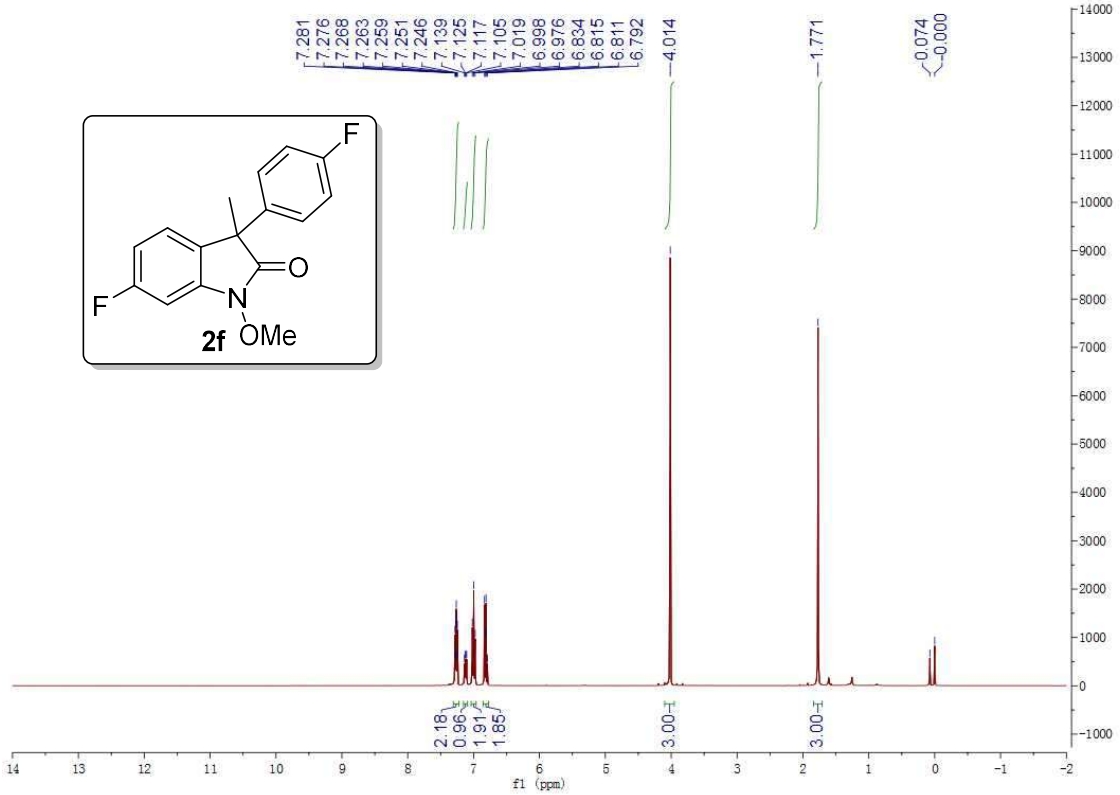
^{13}C NMR Spectrum of **2d** ($CDCl_3$, 100 MHz)



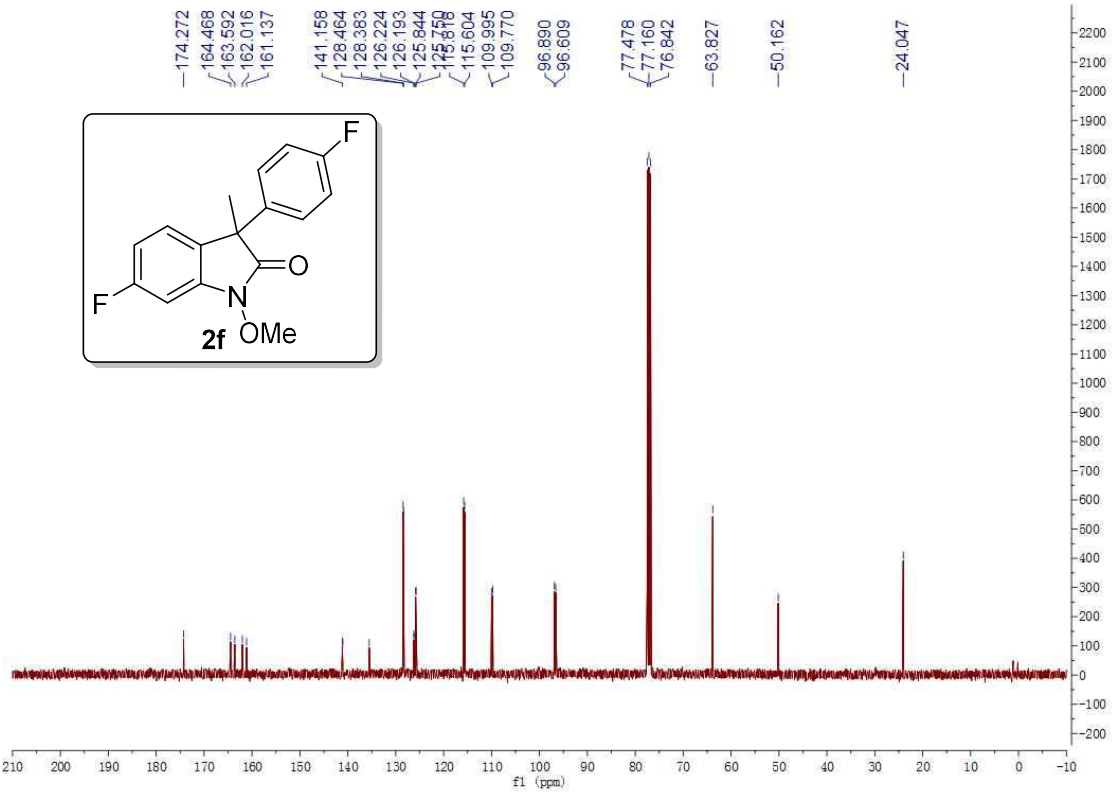
^{1}H NMR Spectrum of **2e** ($CDCl_3$, 400 MHz)



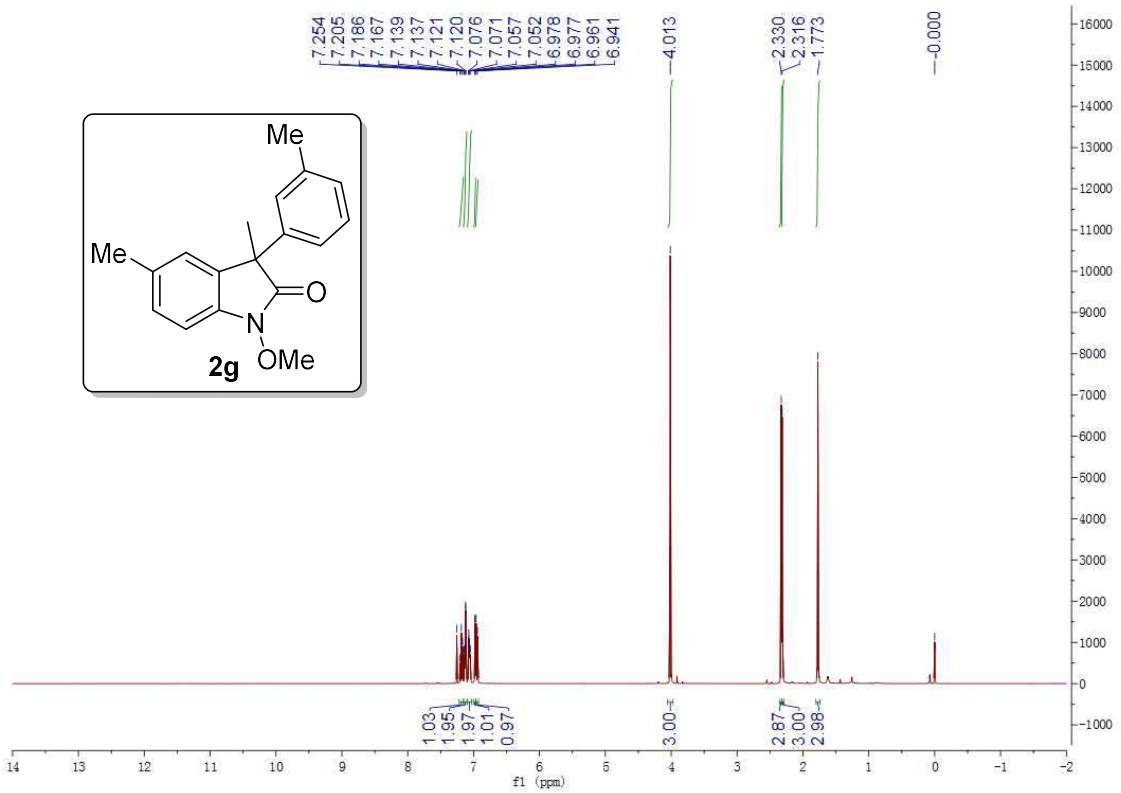
^{13}C NMR Spectrum of **2e** ($CDCl_3$, 100 MHz)



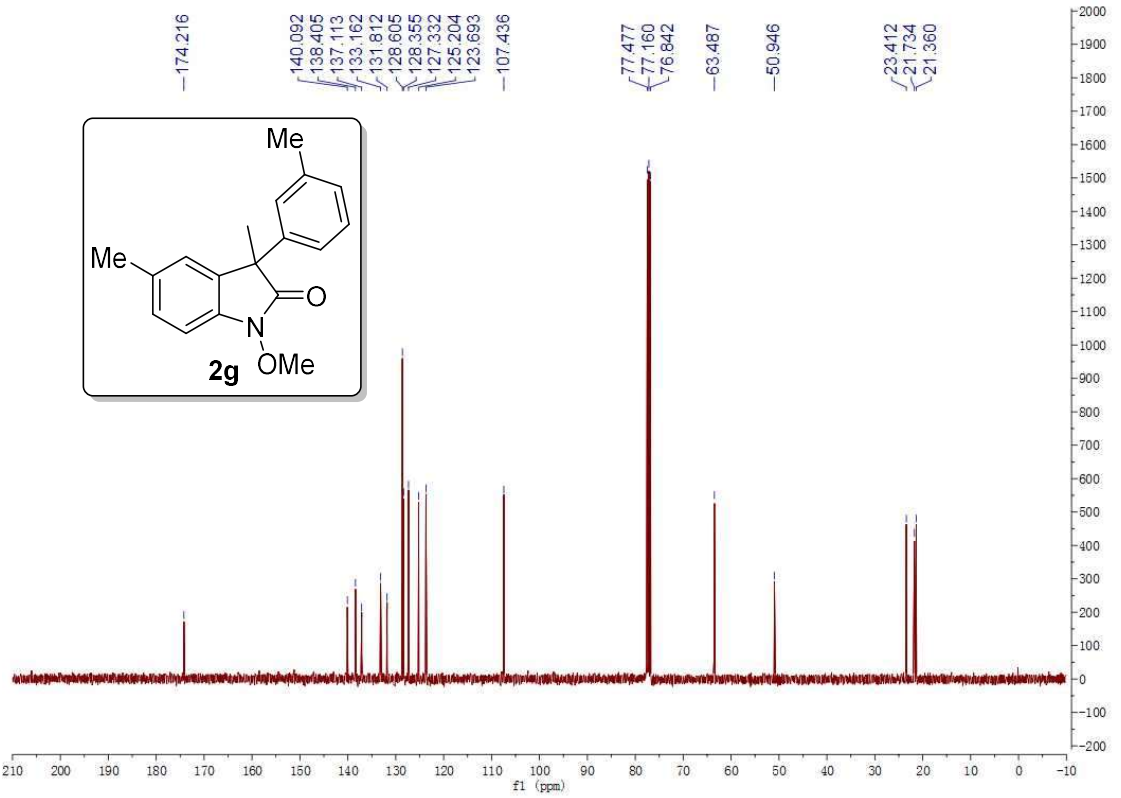
^{1}H NMR Spectrum of **2f** ($CDCl_3$, 400 MHz)



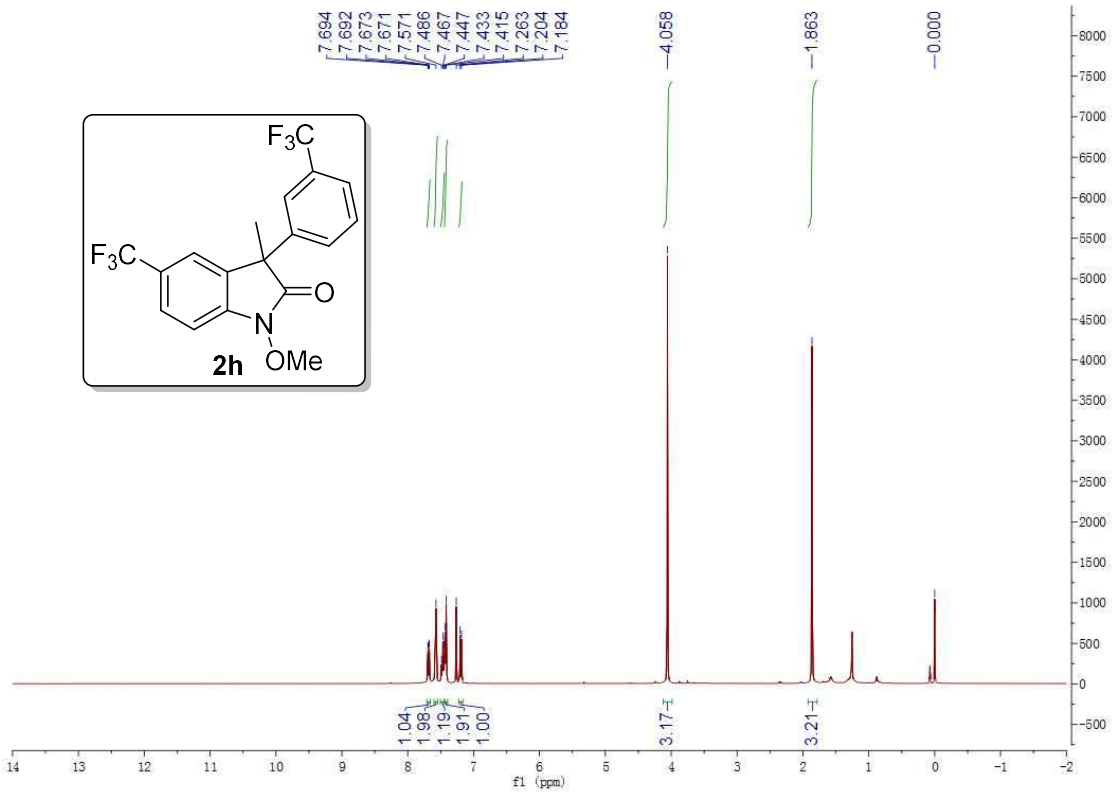
^{13}C NMR Spectrum of **2f** ($CDCl_3$, 100 MHz)



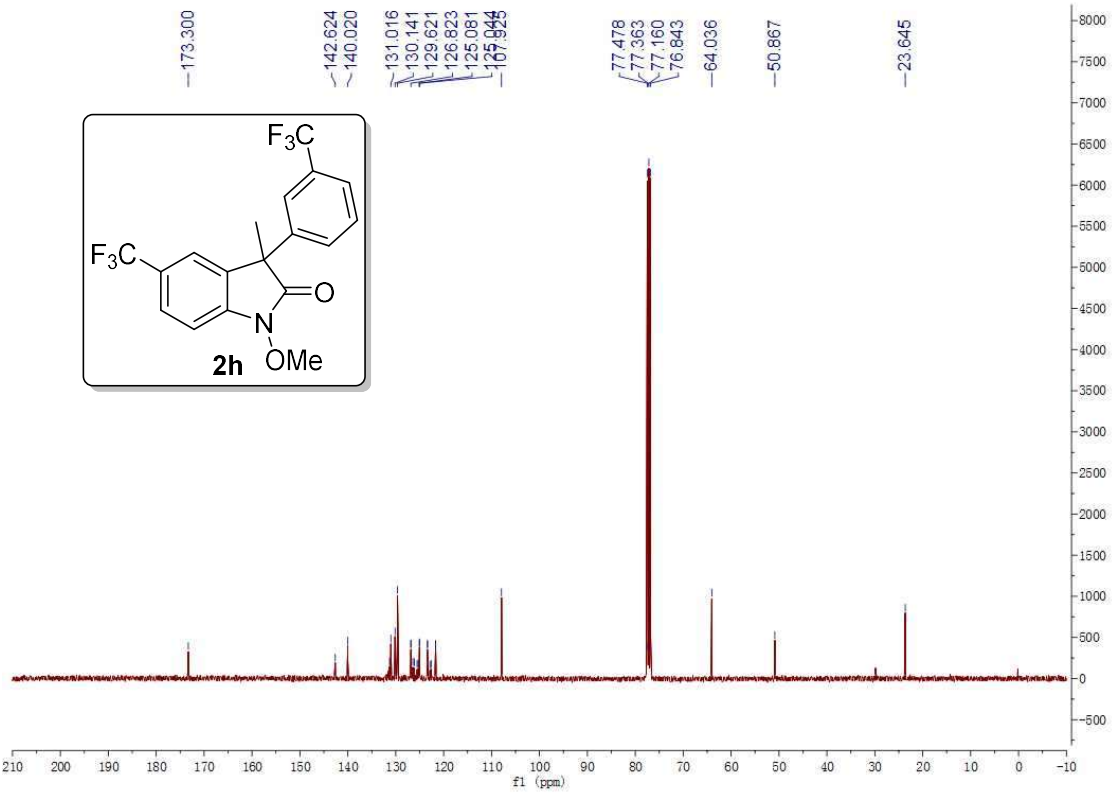
^{1}H NMR Spectrum of **2g** ($CDCl_3$, 400 MHz)



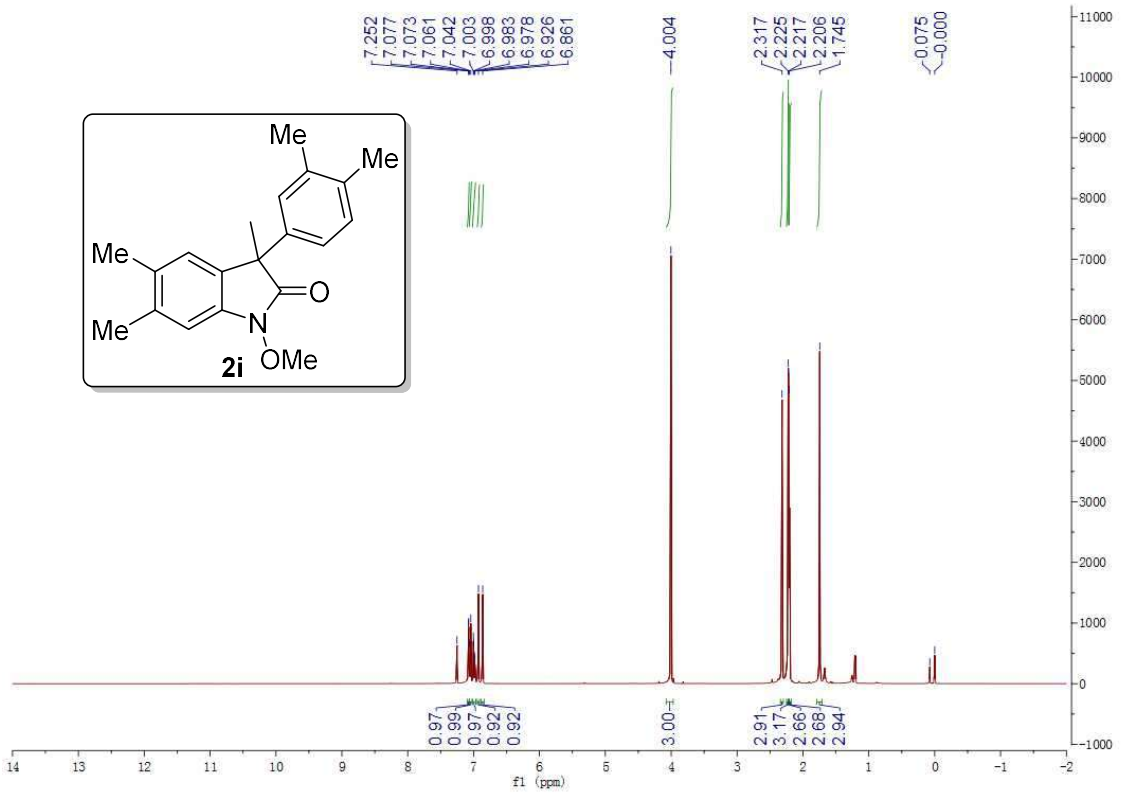
^{13}C NMR Spectrum of **2g** ($CDCl_3$, 100 MHz)



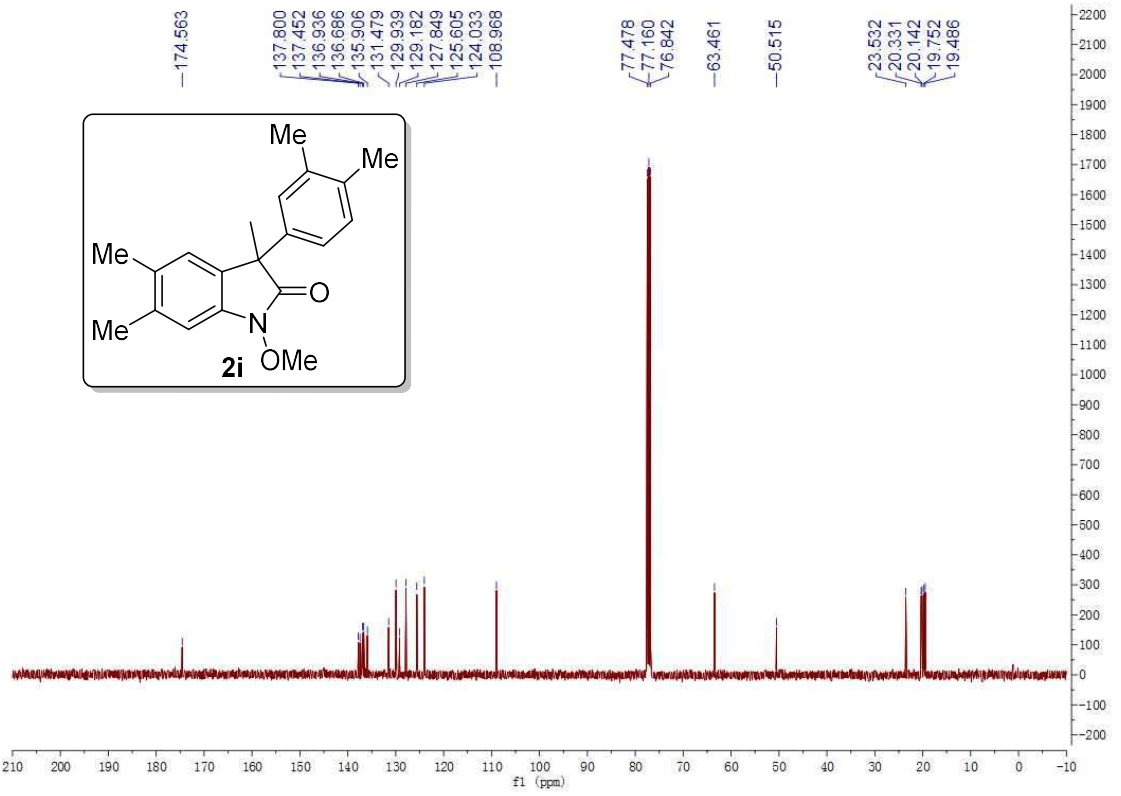
^{1}H NMR Spectrum of **2h** ($CDCl_3$, 400 MHz)



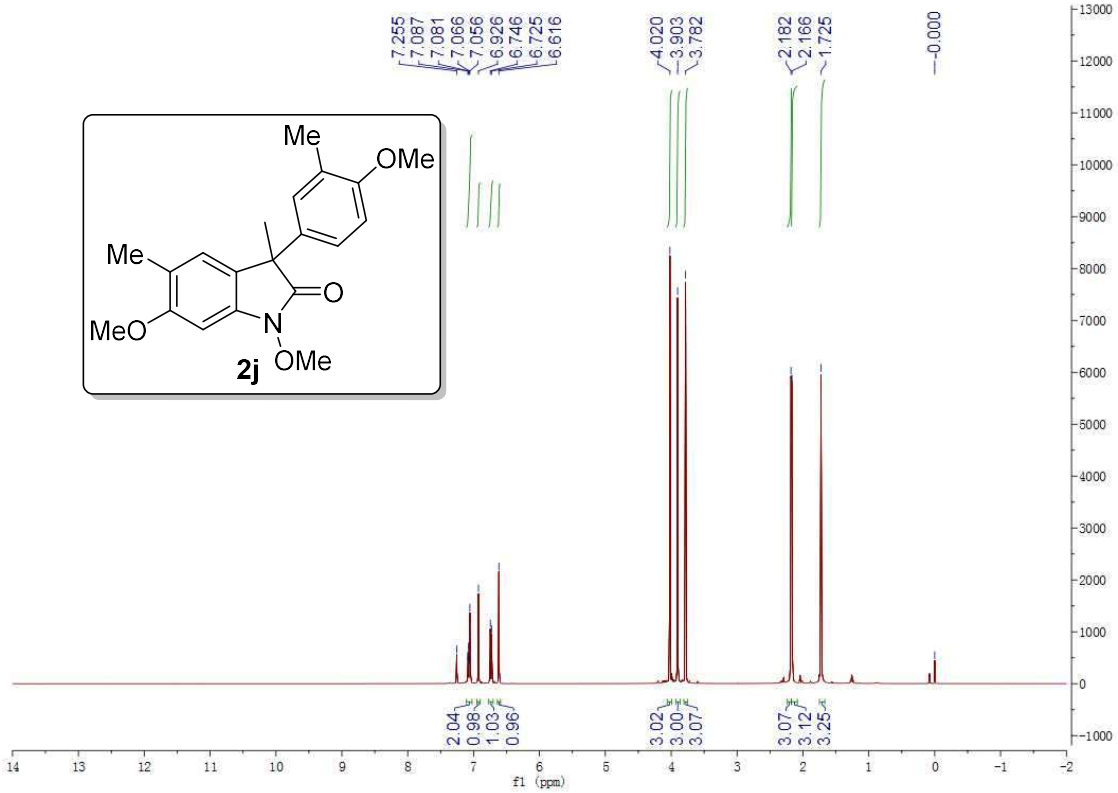
^{13}C NMR Spectrum of **2h** ($CDCl_3$, 100 MHz)



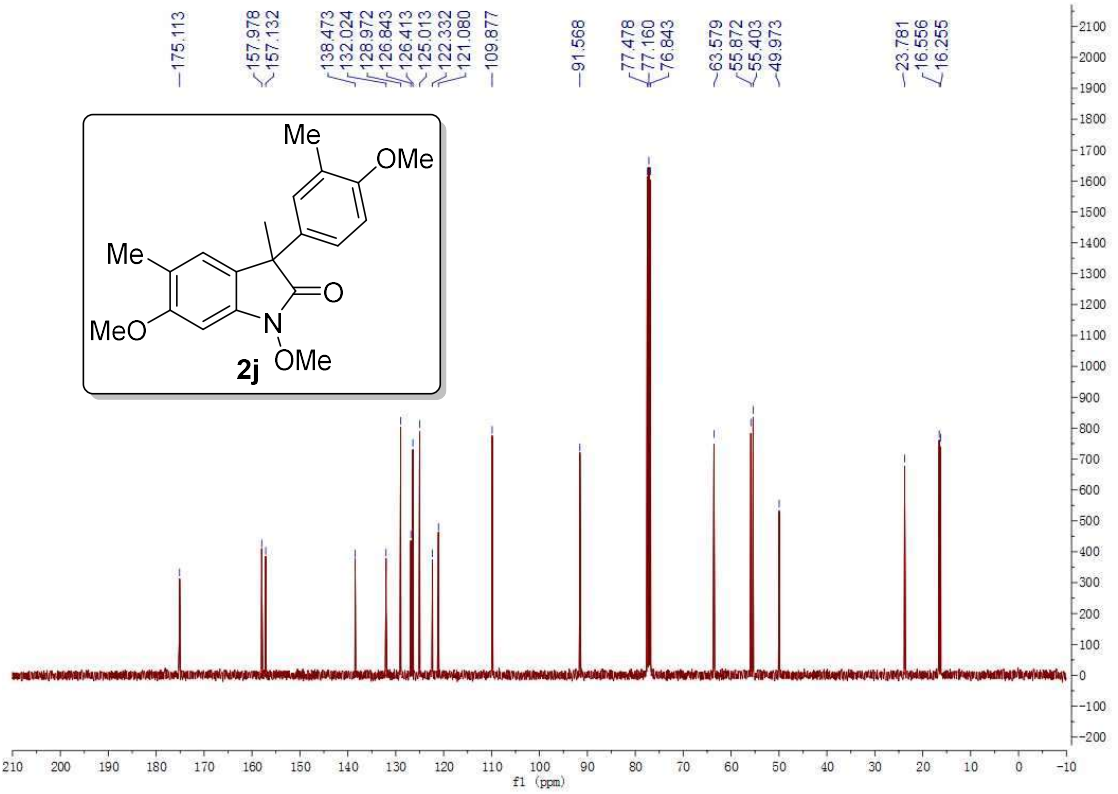
^{1}H NMR Spectrum of **2i** ($CDCl_3$, 400 MHz)



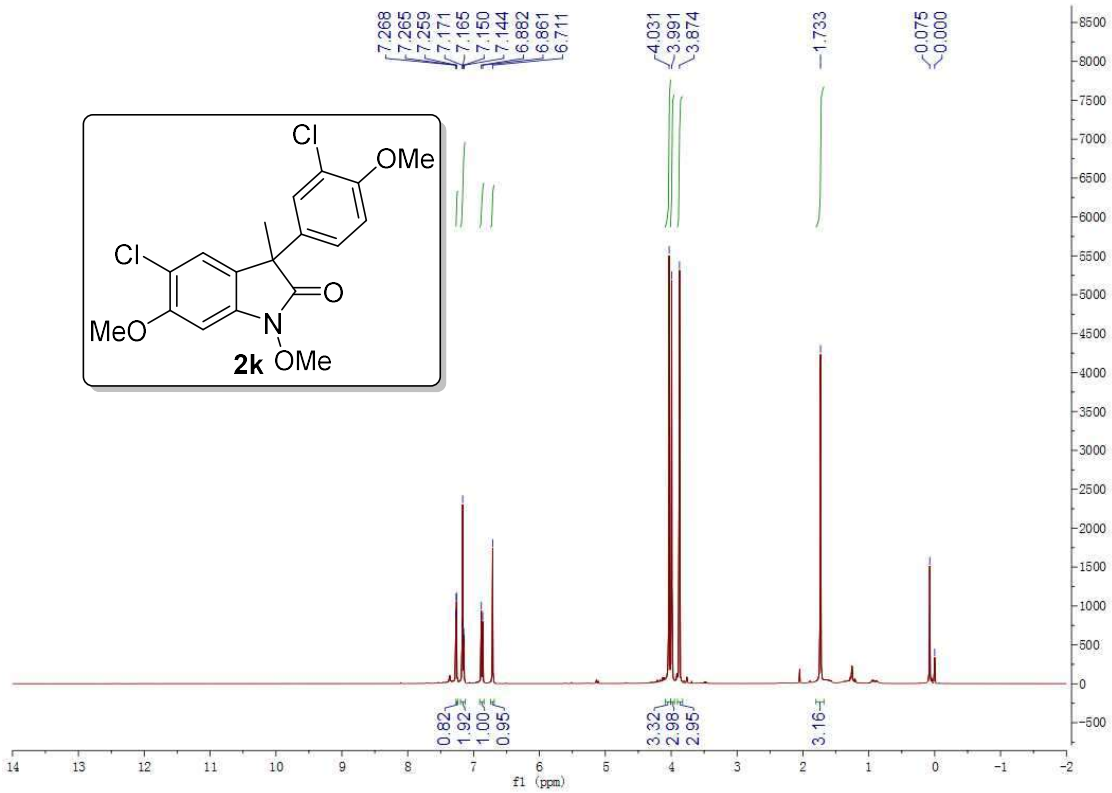
^{13}C NMR Spectrum of **2i** ($CDCl_3$, 100 MHz)



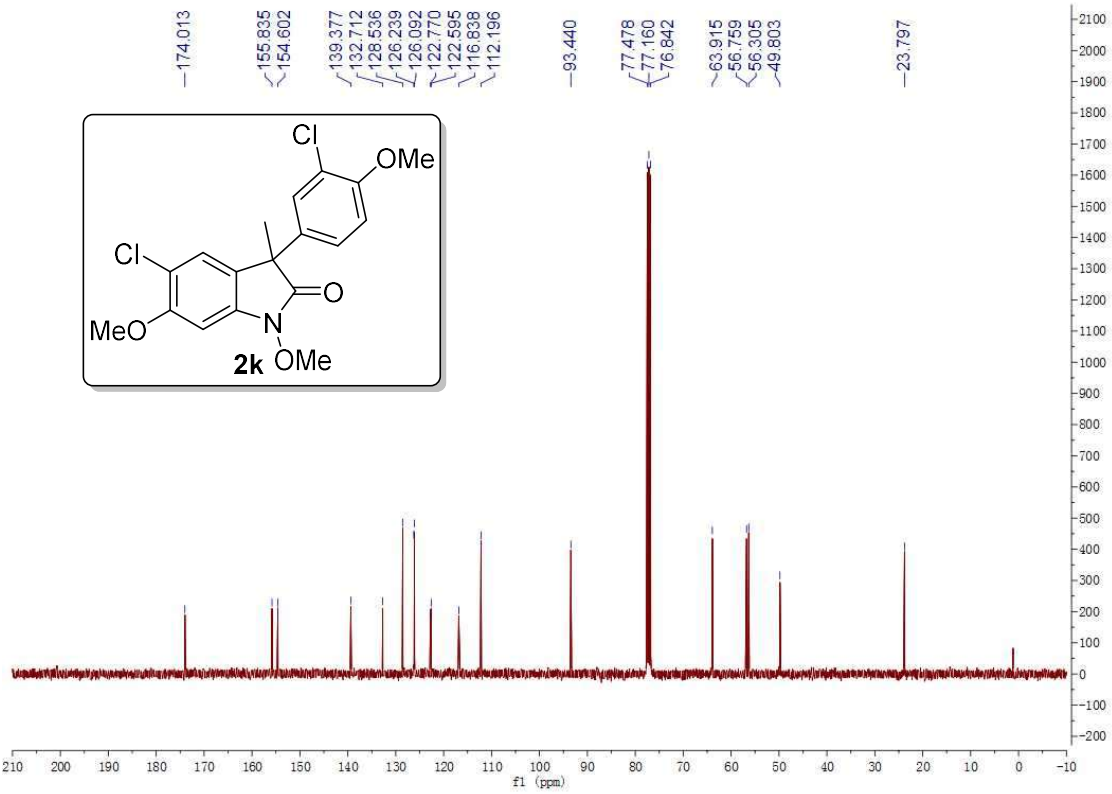
^{1}H NMR Spectrum of **2j** ($CDCl_3$, 400 MHz)



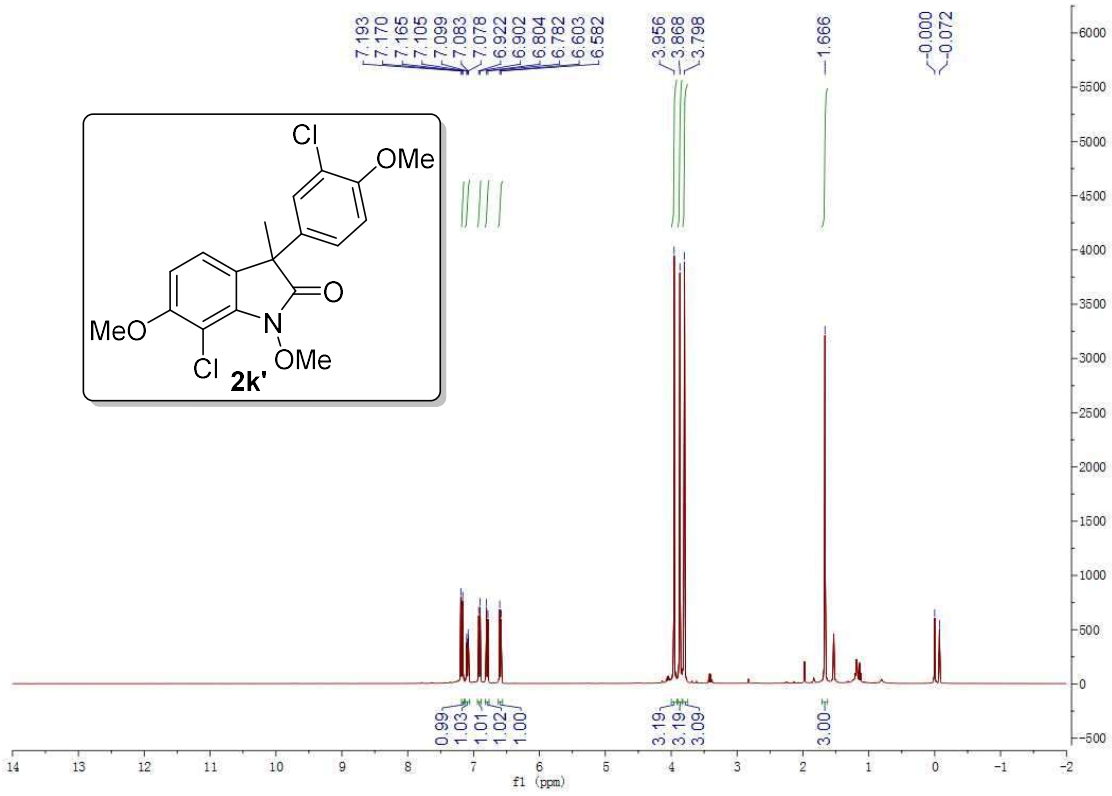
^{13}C NMR Spectrum of **2j** ($CDCl_3$, 100 MHz)



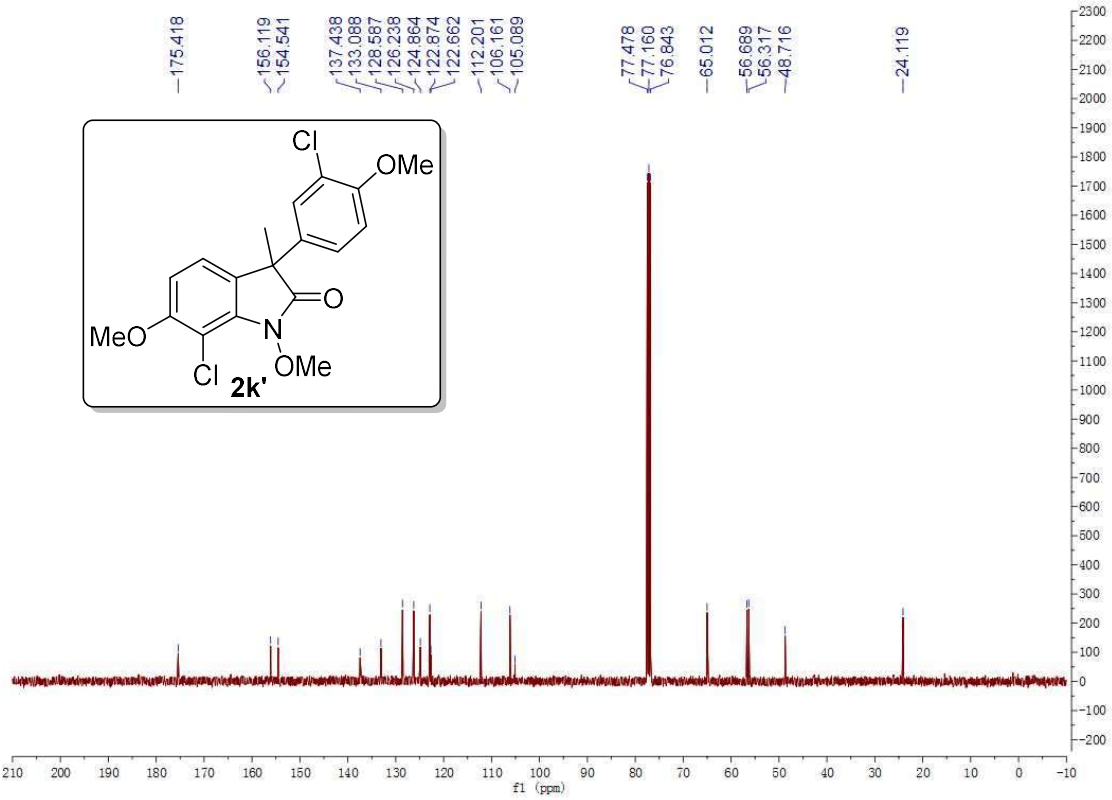
^{1}H NMR Spectrum of **2k** ($CDCl_3$, 400 MHz)



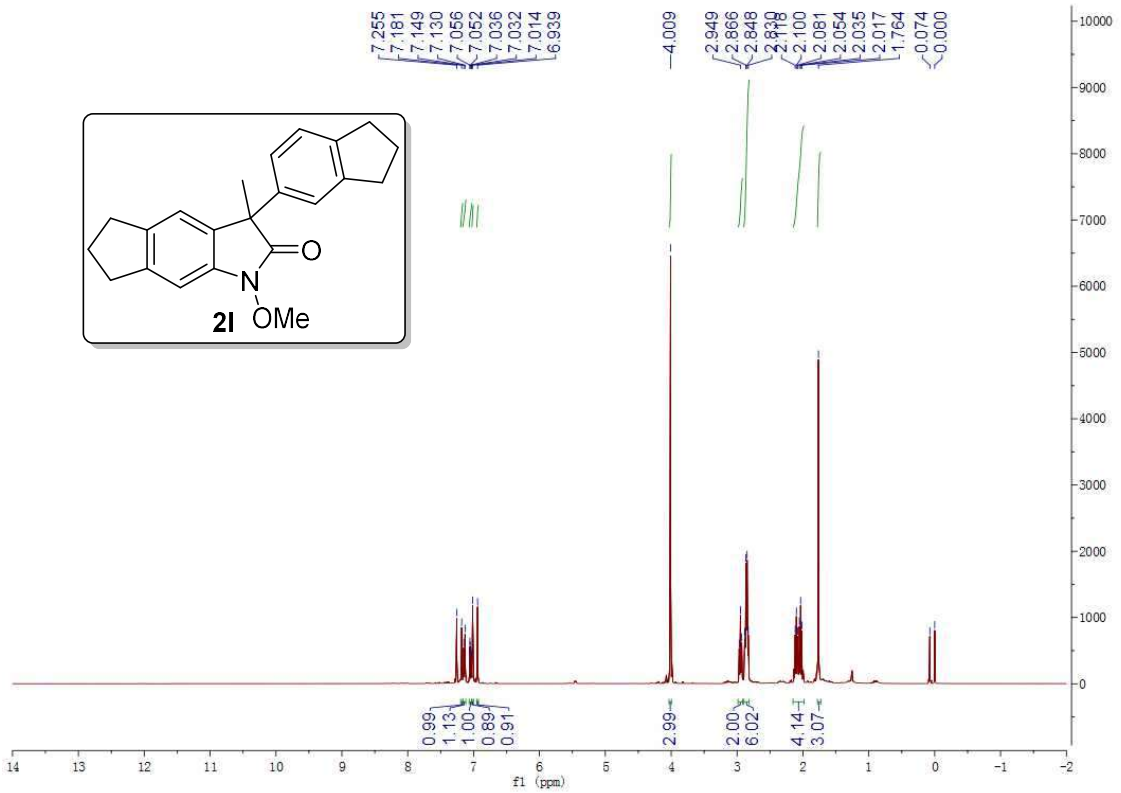
^{13}C NMR Spectrum of **2k** ($CDCl_3$, 100 MHz)



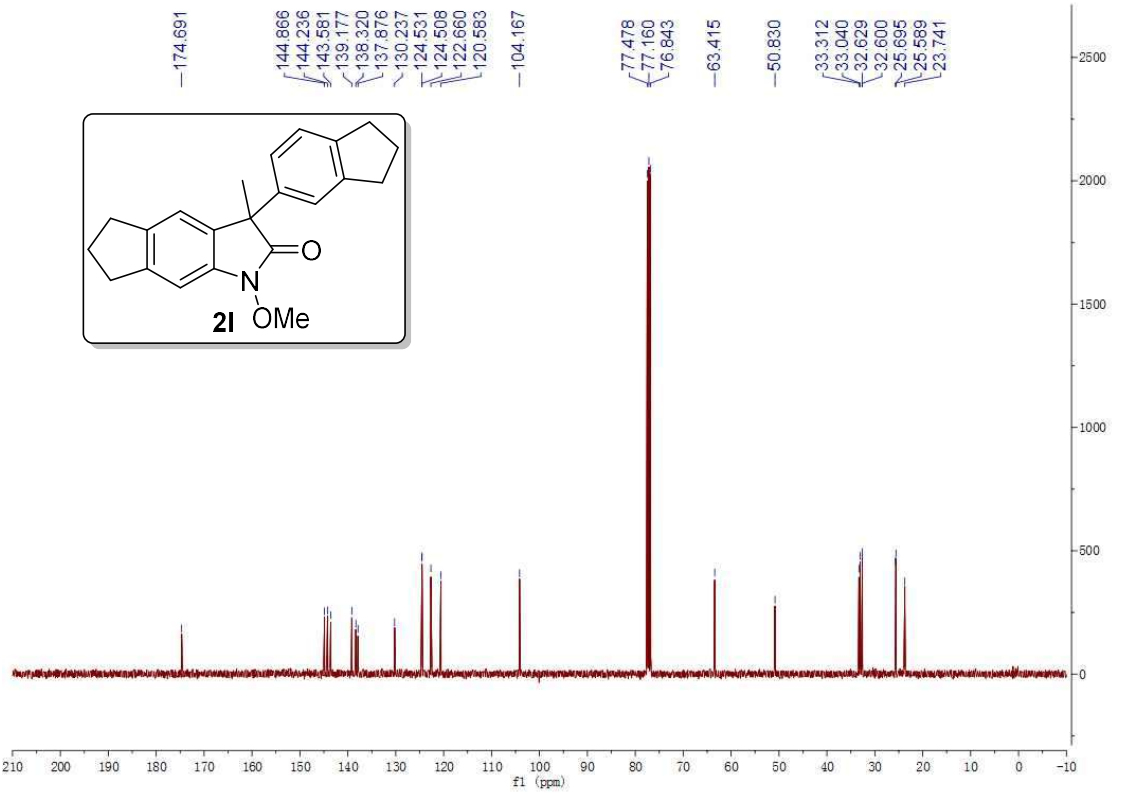
^{1}H NMR Spectrum of **2k'** ($CDCl_3$, 400 MHz)



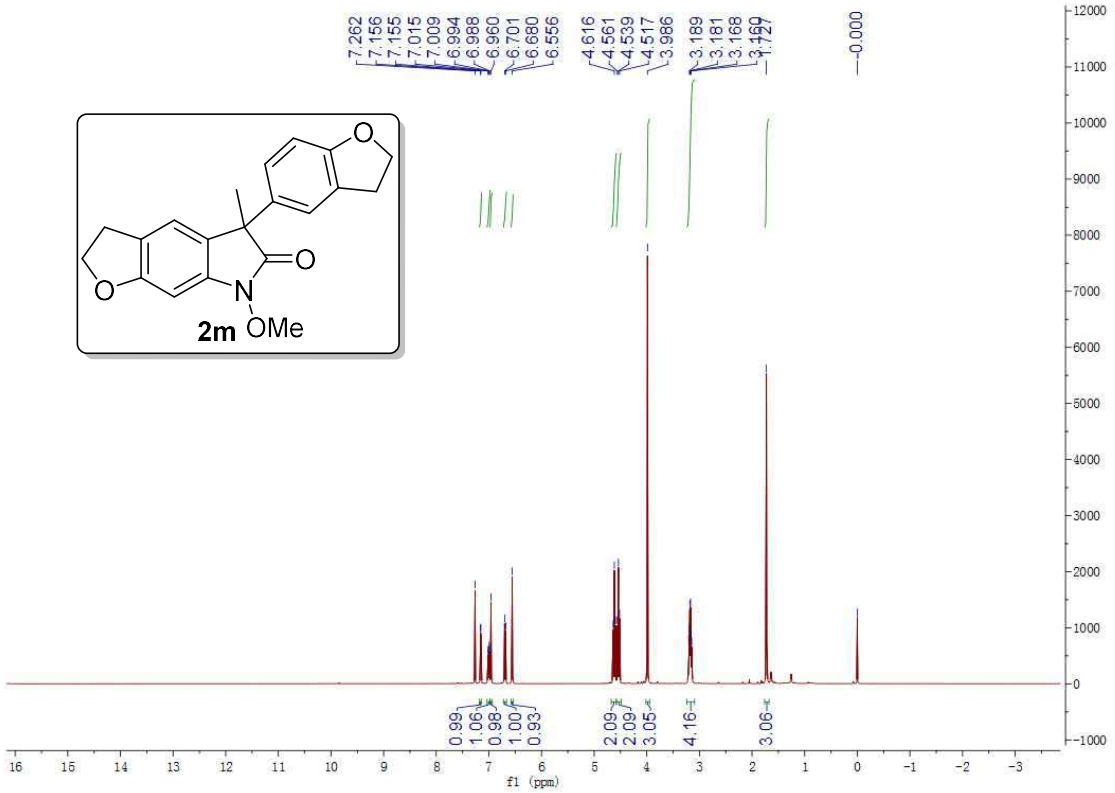
^{13}C NMR Spectrum of **2k'** ($CDCl_3$, 100 MHz)



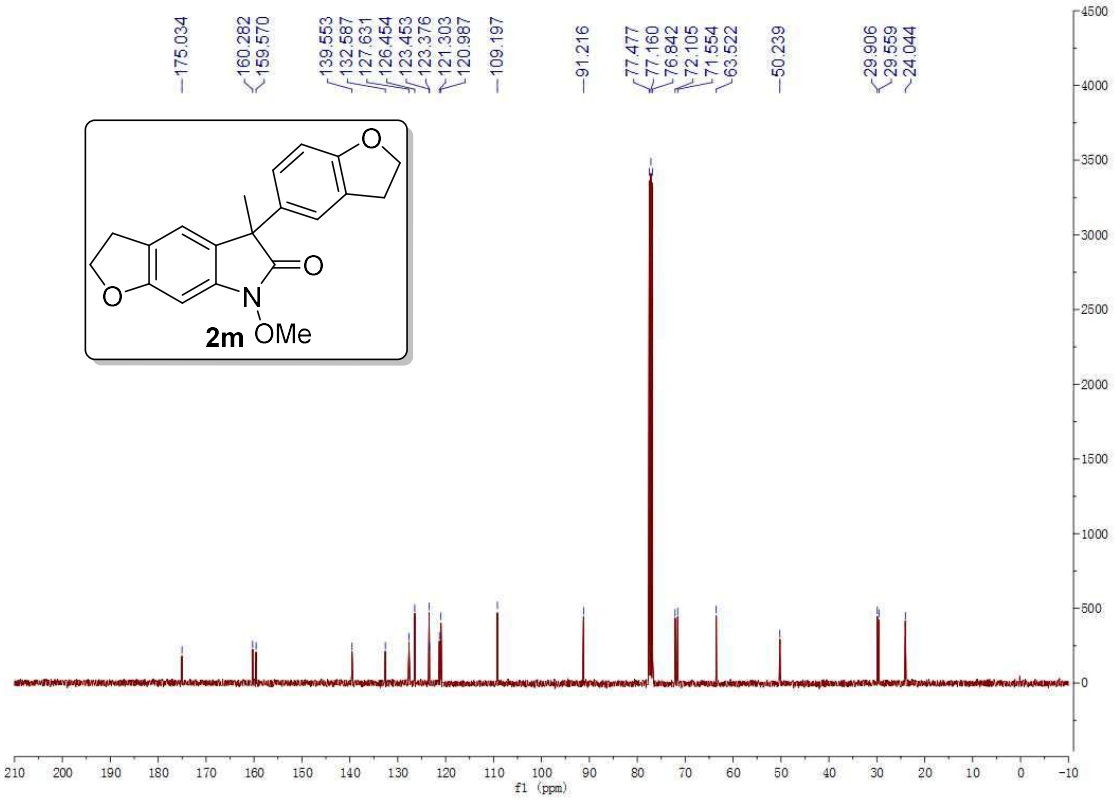
^{1}H NMR Spectrum of **2l** ($CDCl_3$, 400 MHz)



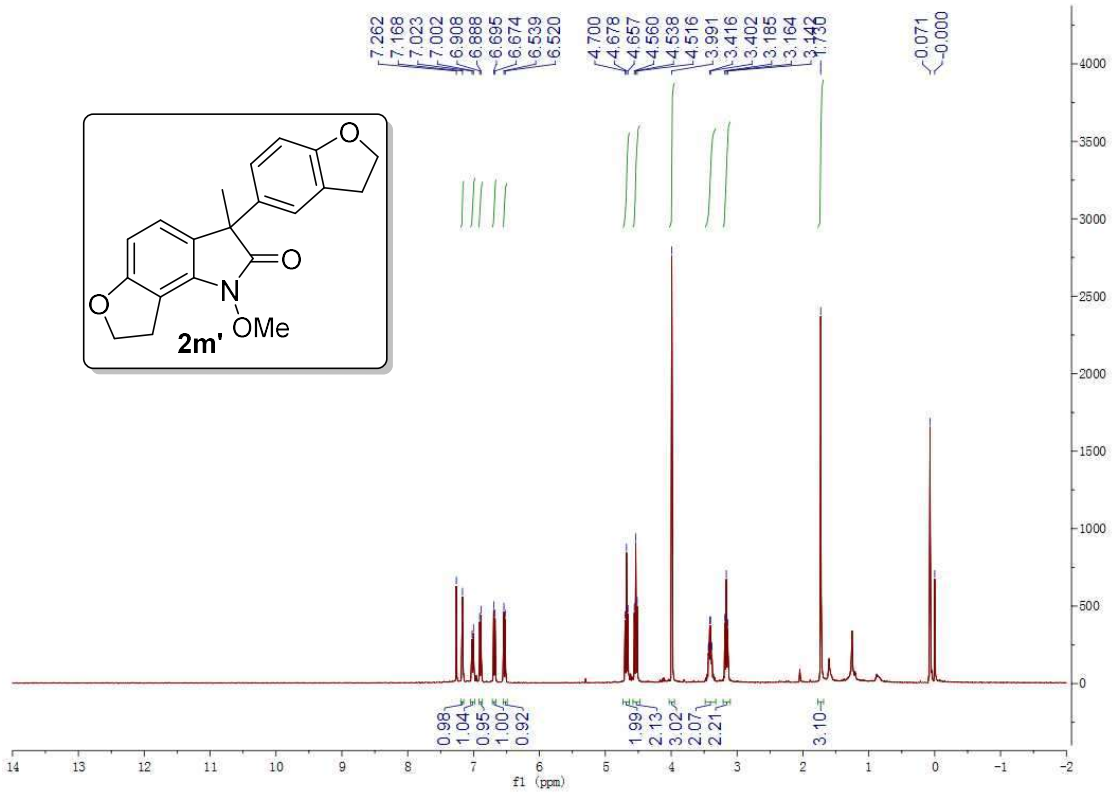
^{13}C NMR Spectrum of **2l** ($CDCl_3$, 100 MHz)



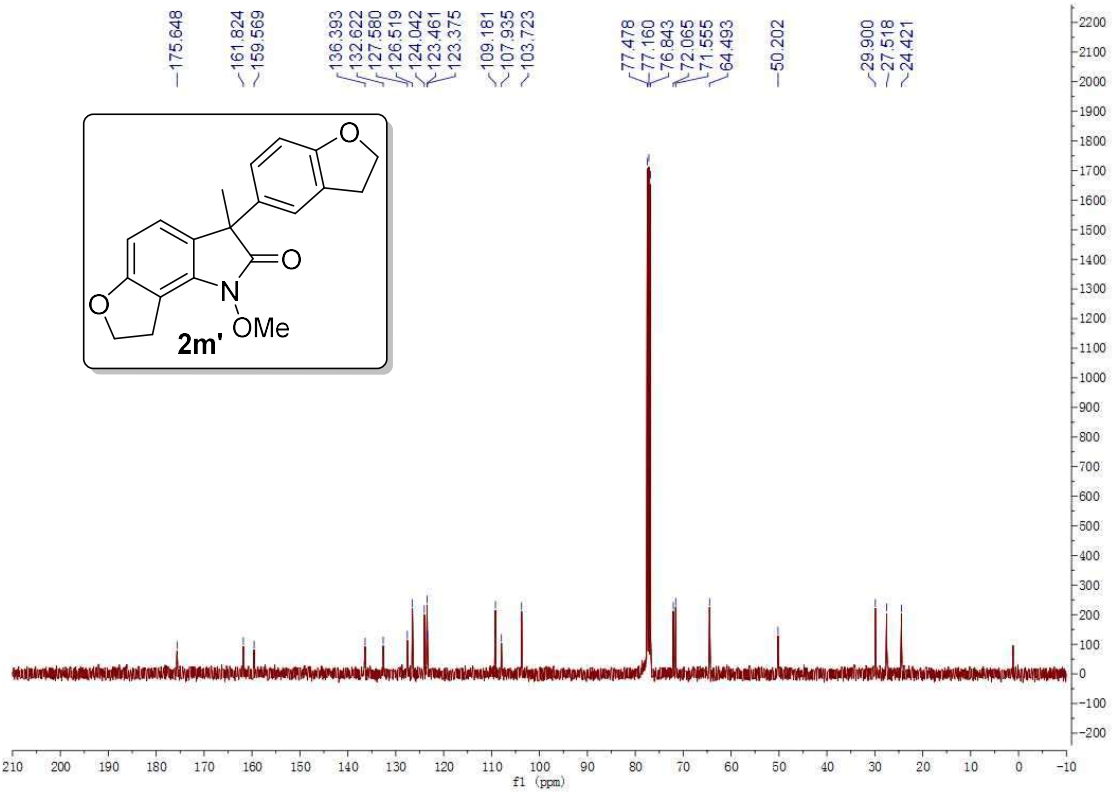
^{1}H NMR Spectrum of **2m** ($CDCl_3$, 400 MHz)



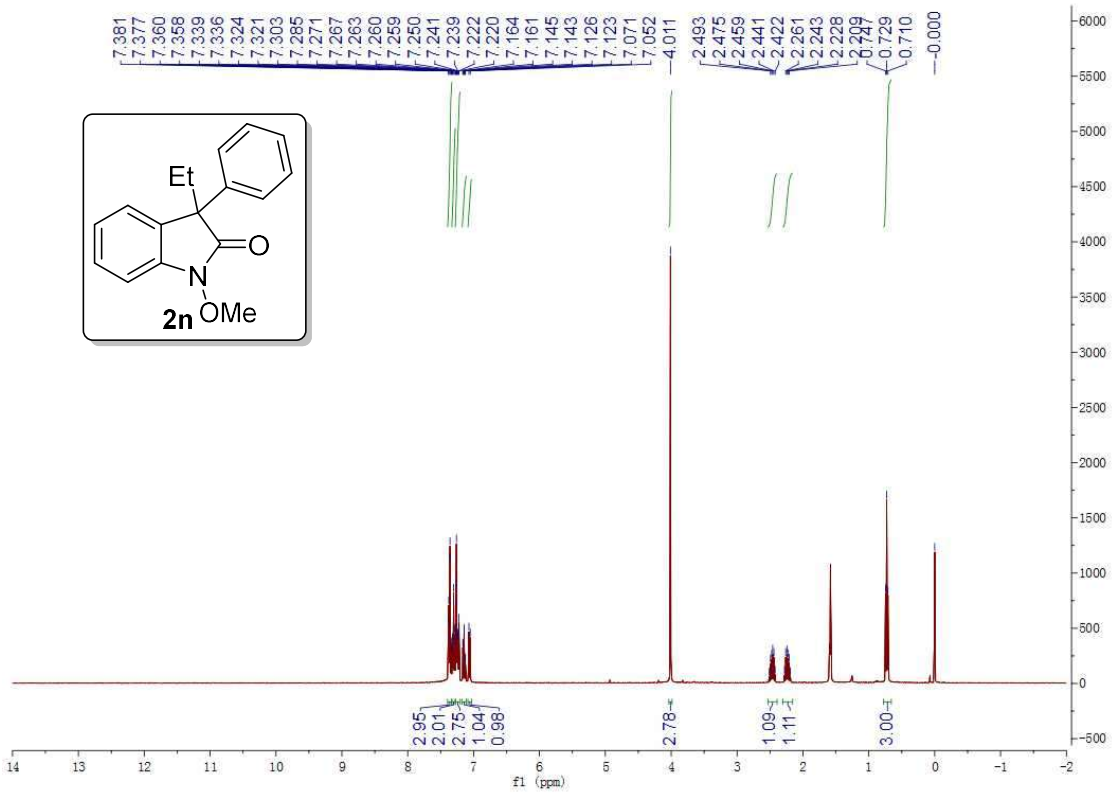
^{13}C NMR Spectrum of **2m** ($CDCl_3$, 100 MHz)



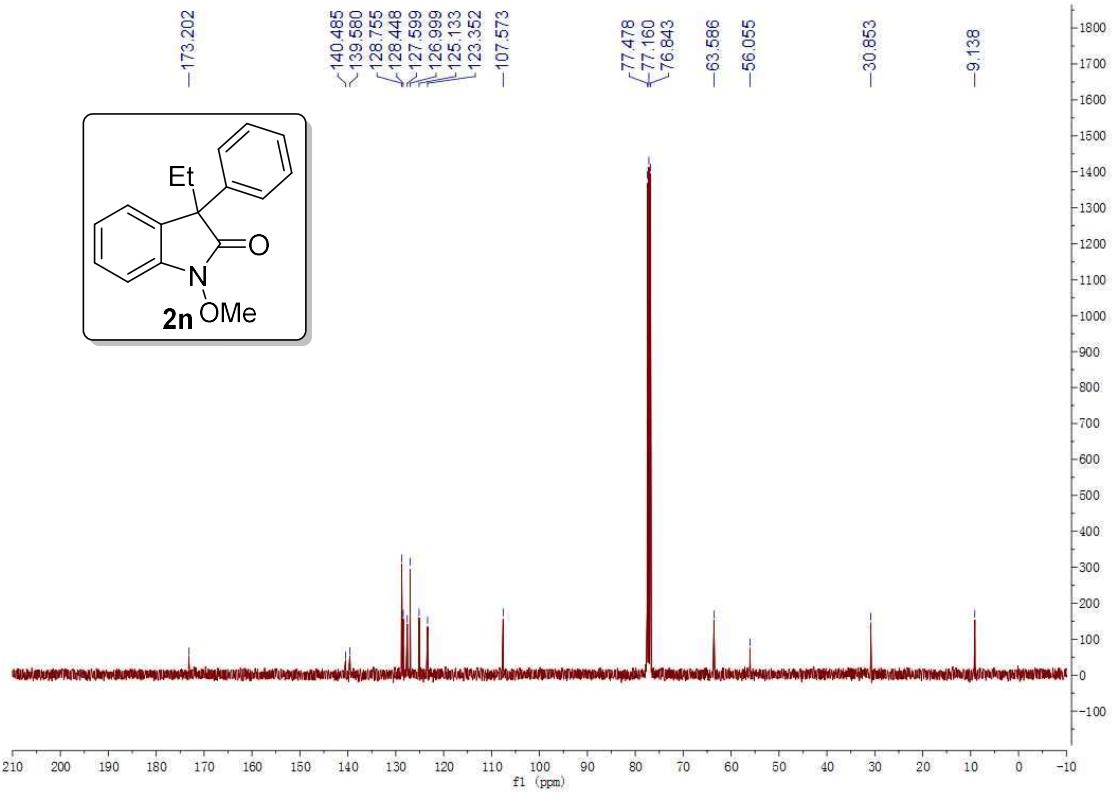
^{1}H NMR Spectrum of **2m'** ($CDCl_3$, 400 MHz)



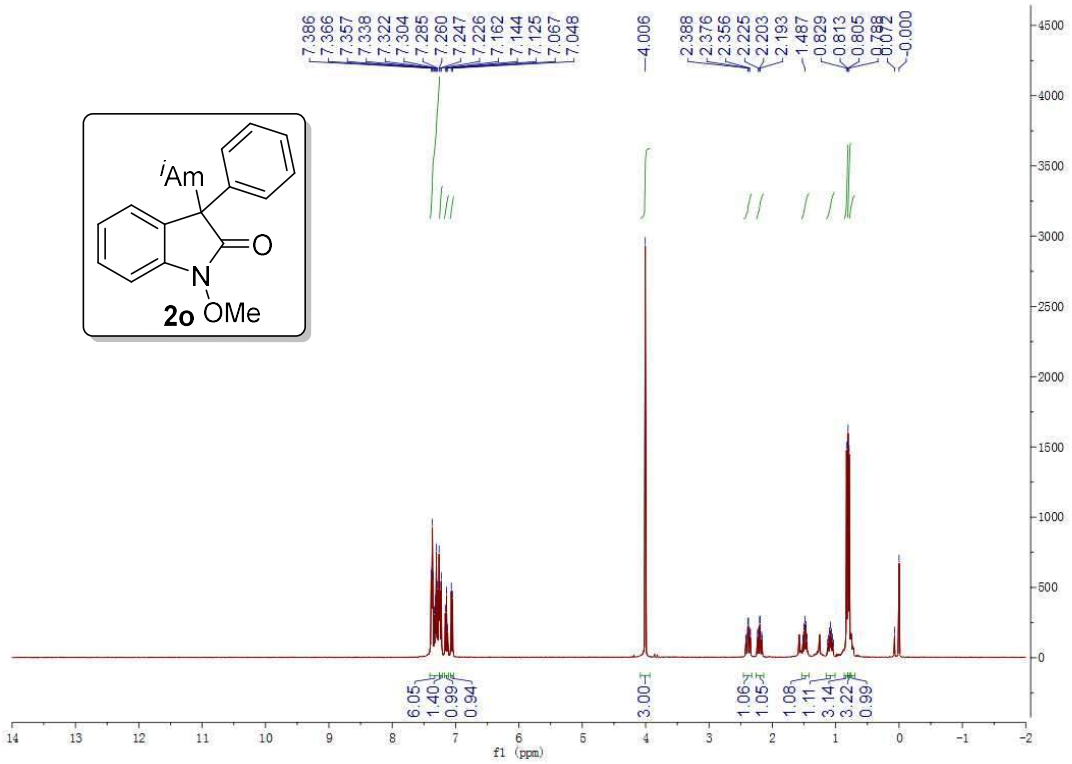
^{13}C NMR Spectrum of **2m'** ($CDCl_3$, 100 MHz)



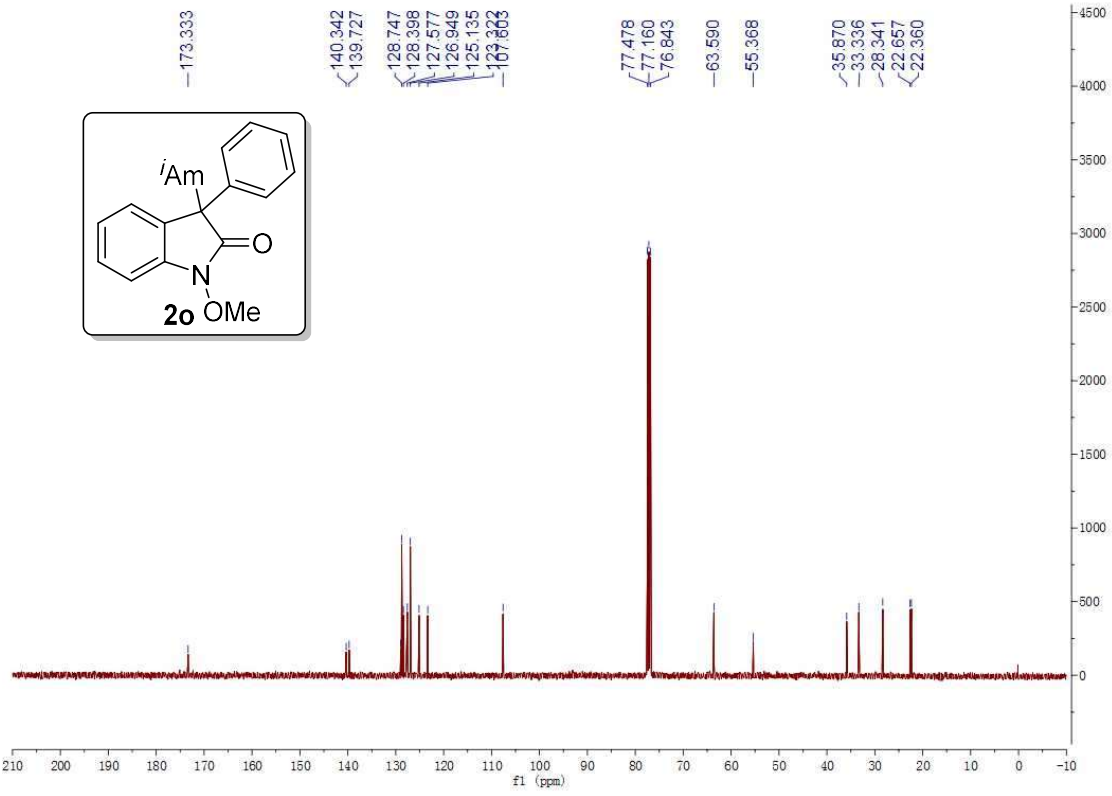
^{1}H NMR Spectrum of **2n** ($CDCl_3$, 400 MHz)



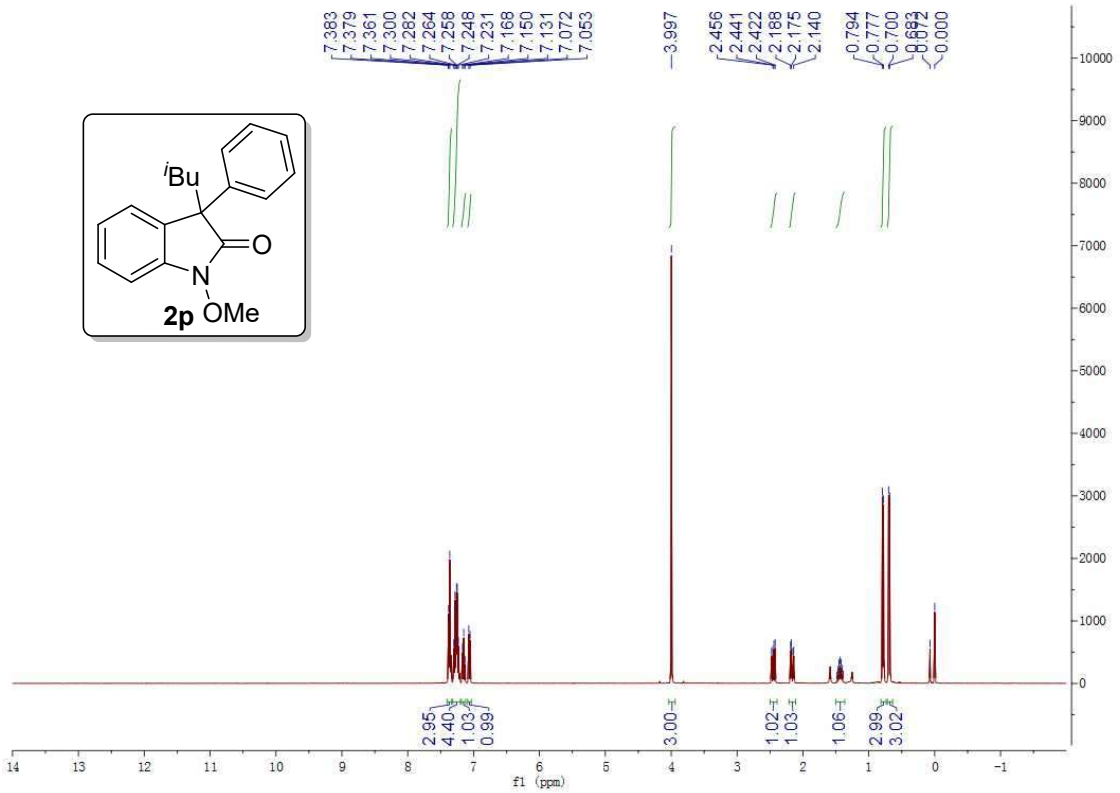
^{13}C NMR Spectrum of **2n** ($CDCl_3$, 100 MHz)



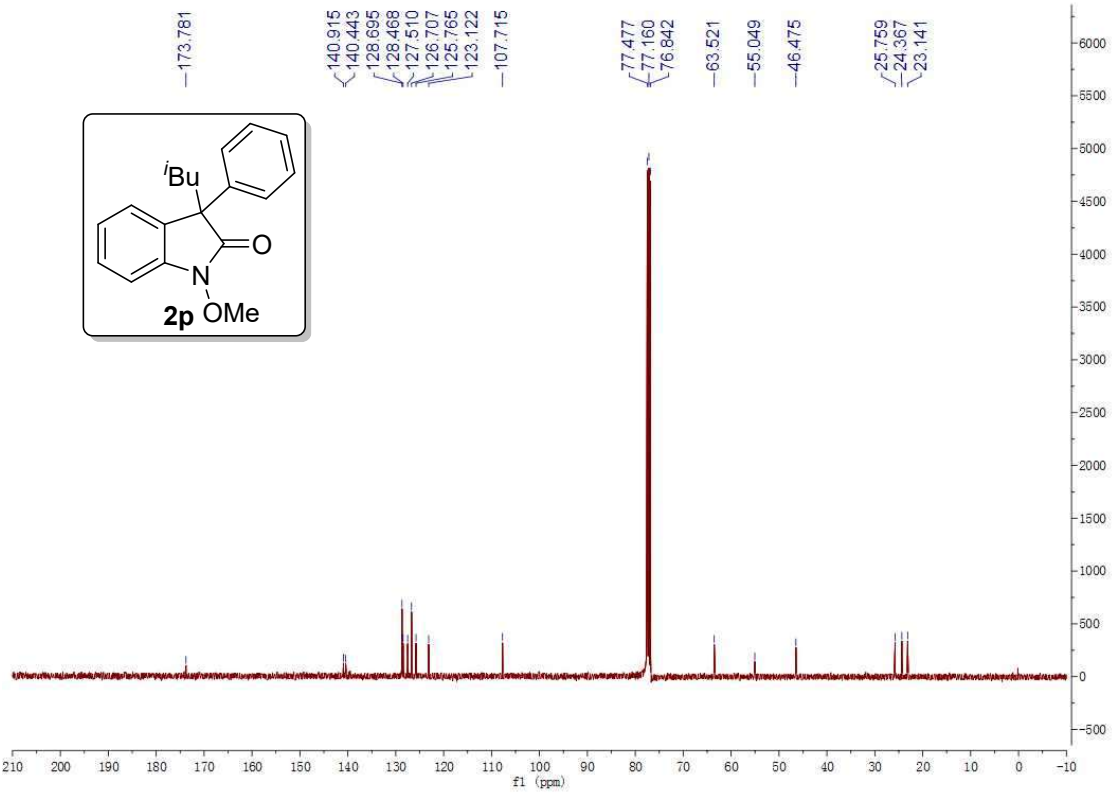
^{1}H NMR Spectrum of **2o** ($CDCl_3$, 400 MHz)



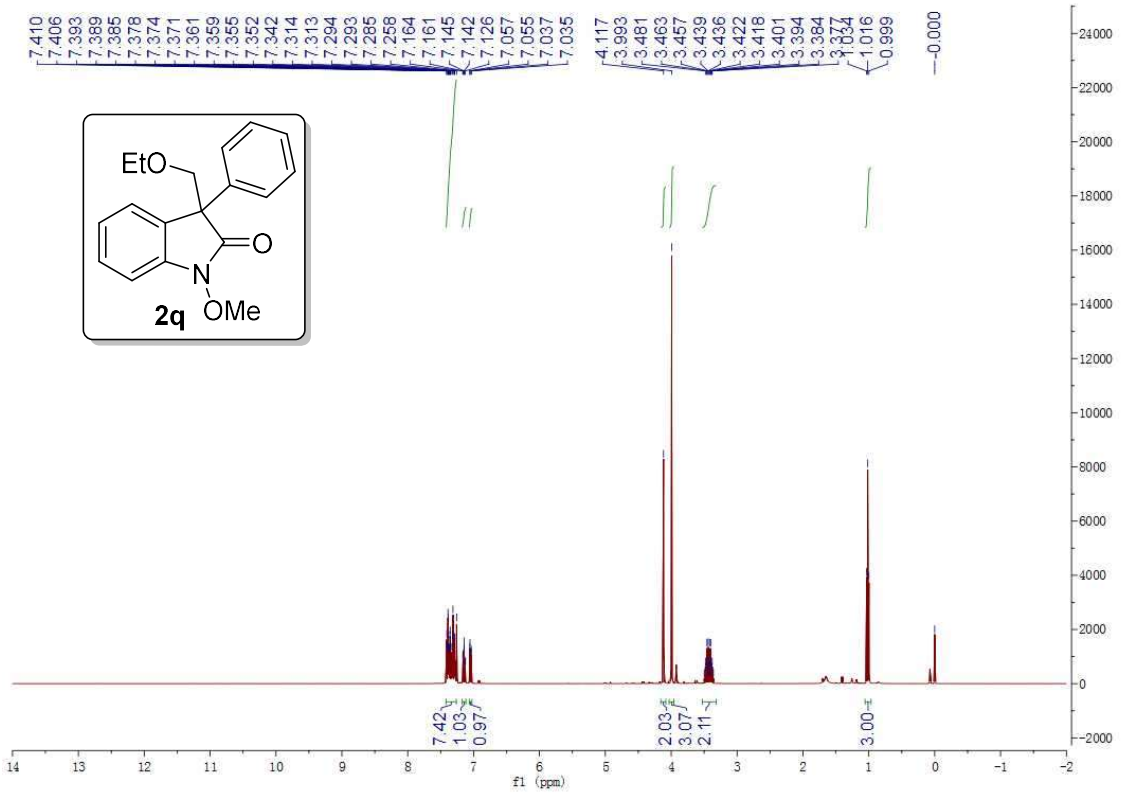
^{13}C NMR Spectrum of **2o** ($CDCl_3$, 100 MHz)



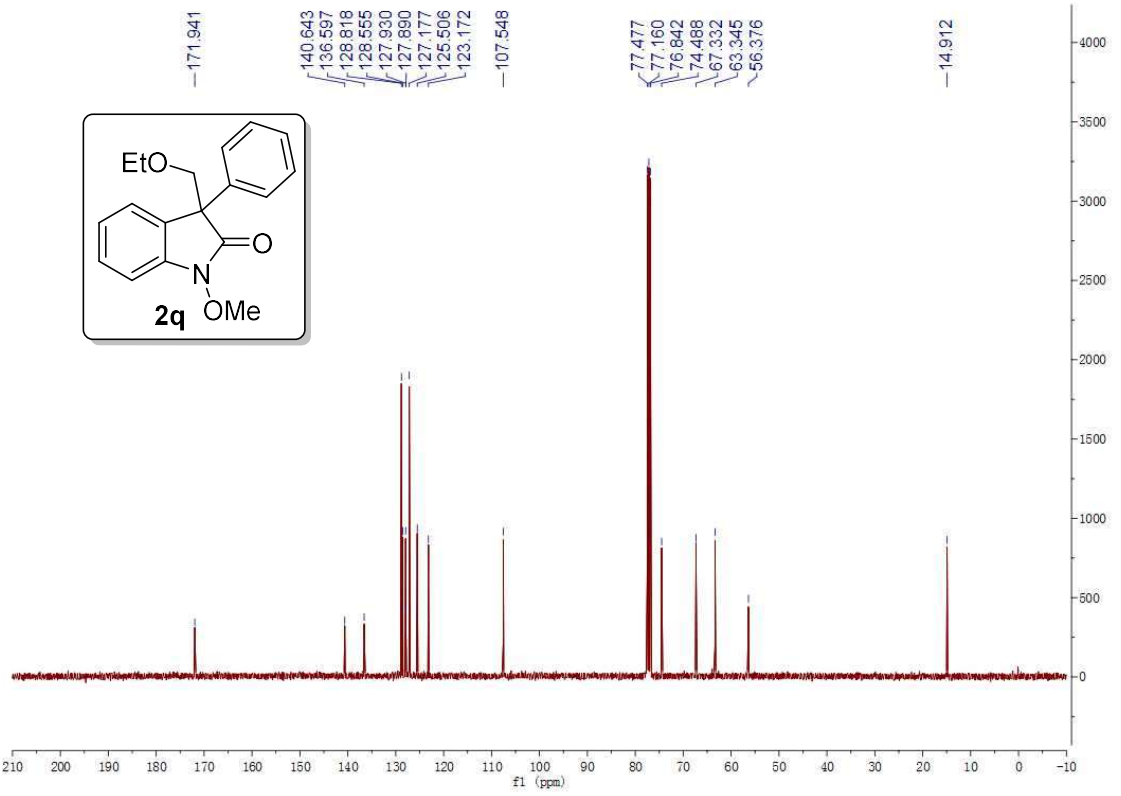
^{1}H NMR Spectrum of **2p** ($CDCl_3$, 400 MHz)



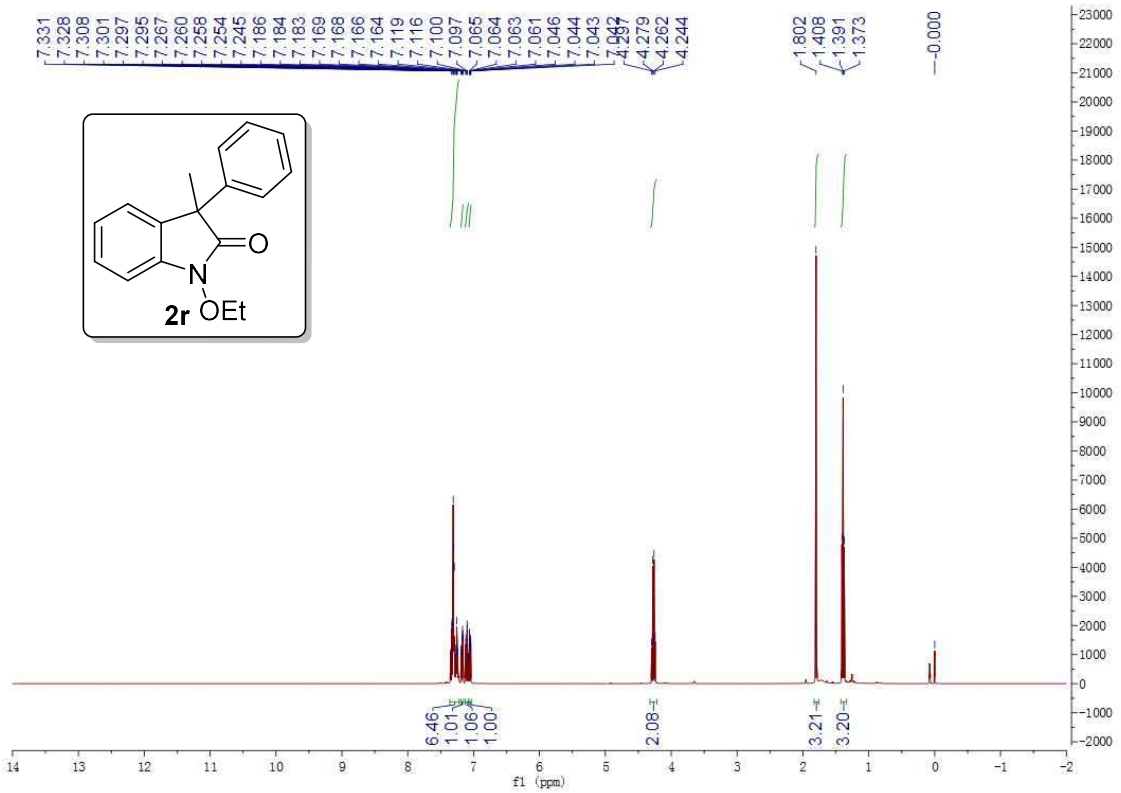
^{13}C NMR Spectrum of **2p** ($CDCl_3$, 100 MHz)



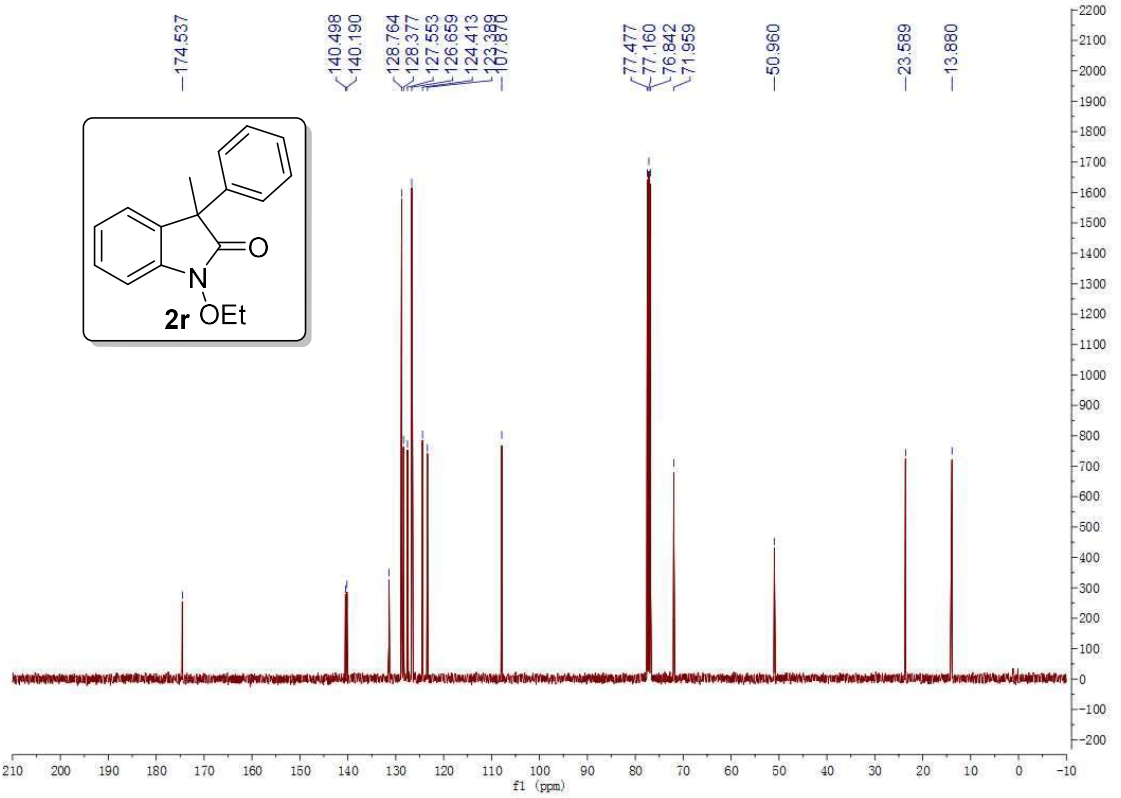
^{1}H NMR Spectrum of **2q** ($CDCl_3$, 400 MHz)



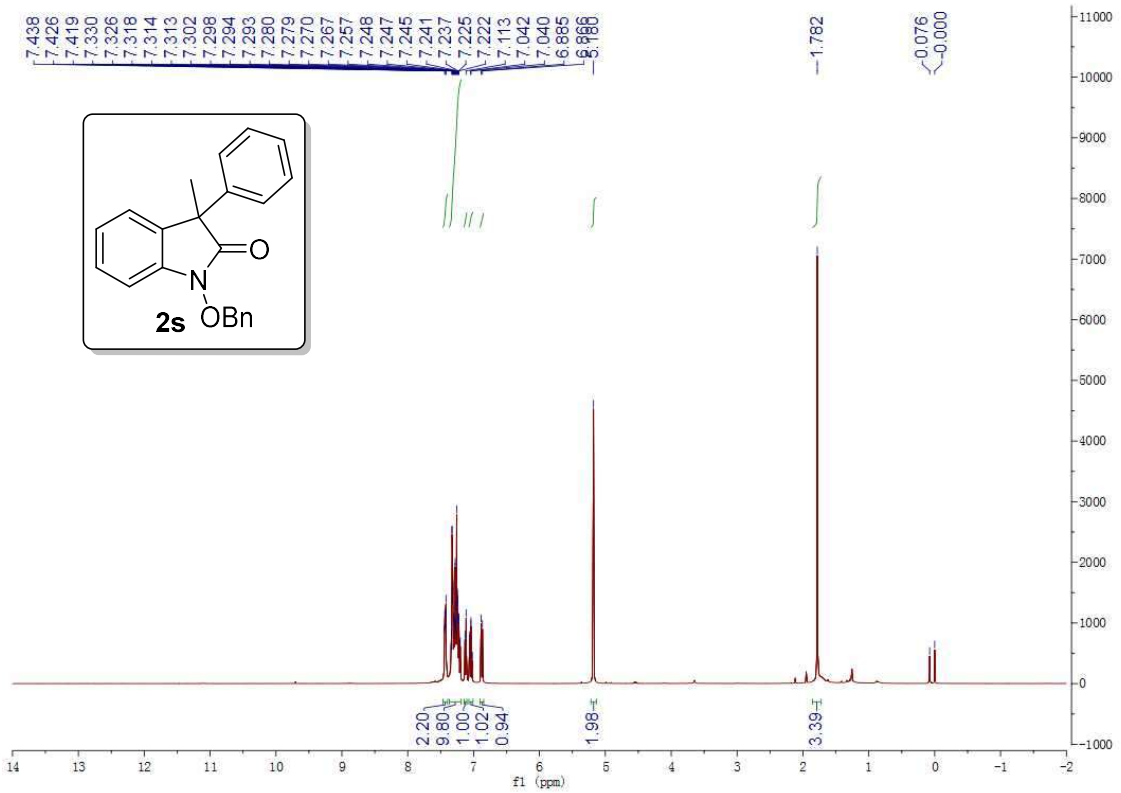
^{13}C NMR Spectrum of **2q** ($CDCl_3$, 100 MHz)



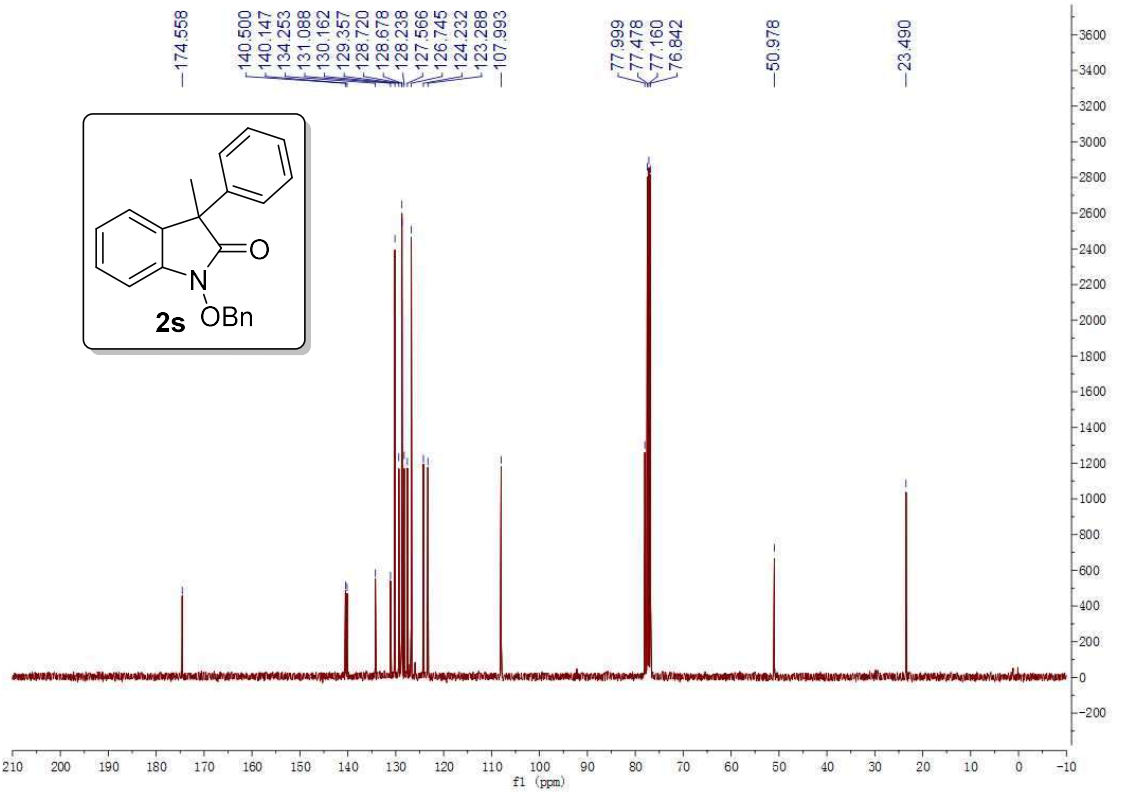
^{1}H NMR Spectrum of **2r** ($CDCl_3$, 400 MHz)



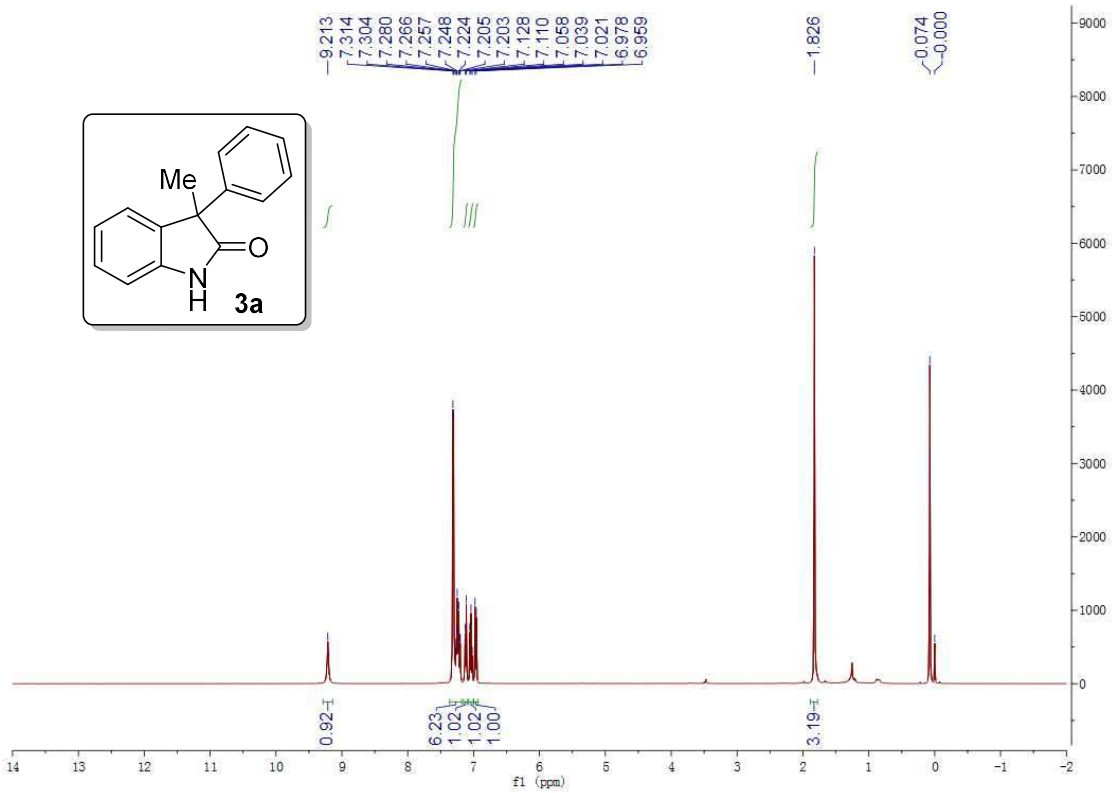
^{13}C NMR Spectrum of **2r** ($CDCl_3$, 100 MHz)



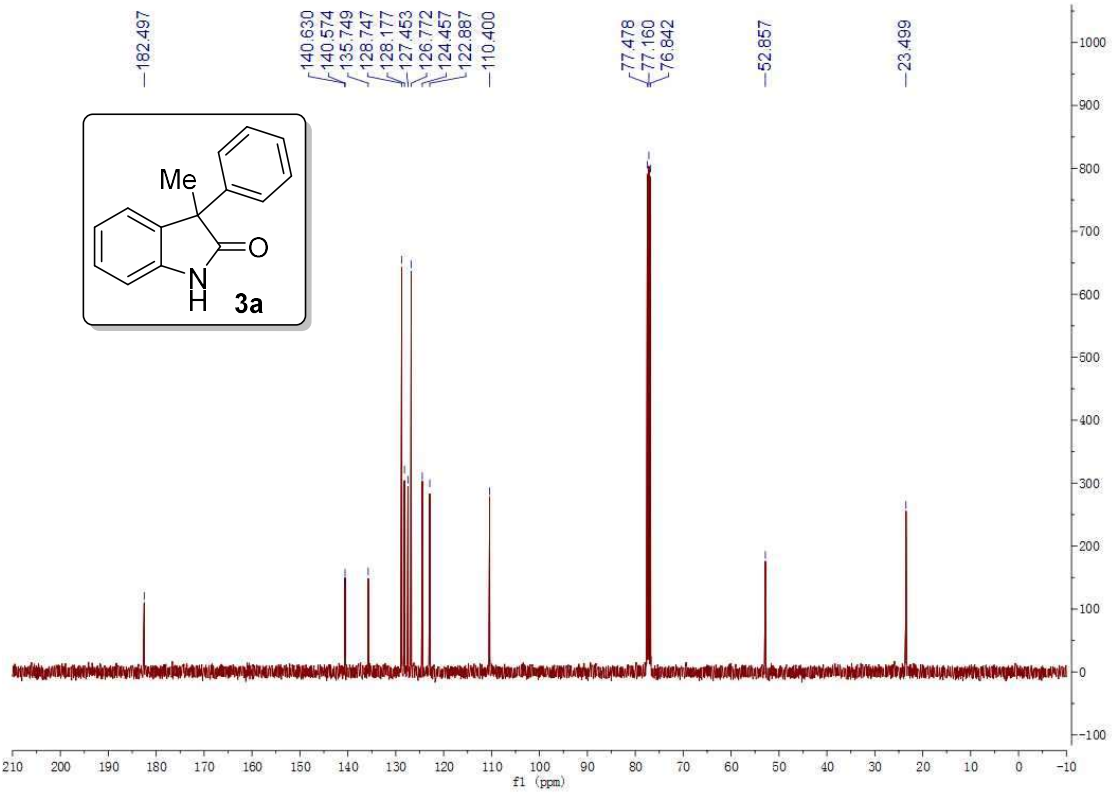
^{1}H NMR Spectrum of **2s** ($CDCl_3$, 400 MHz)



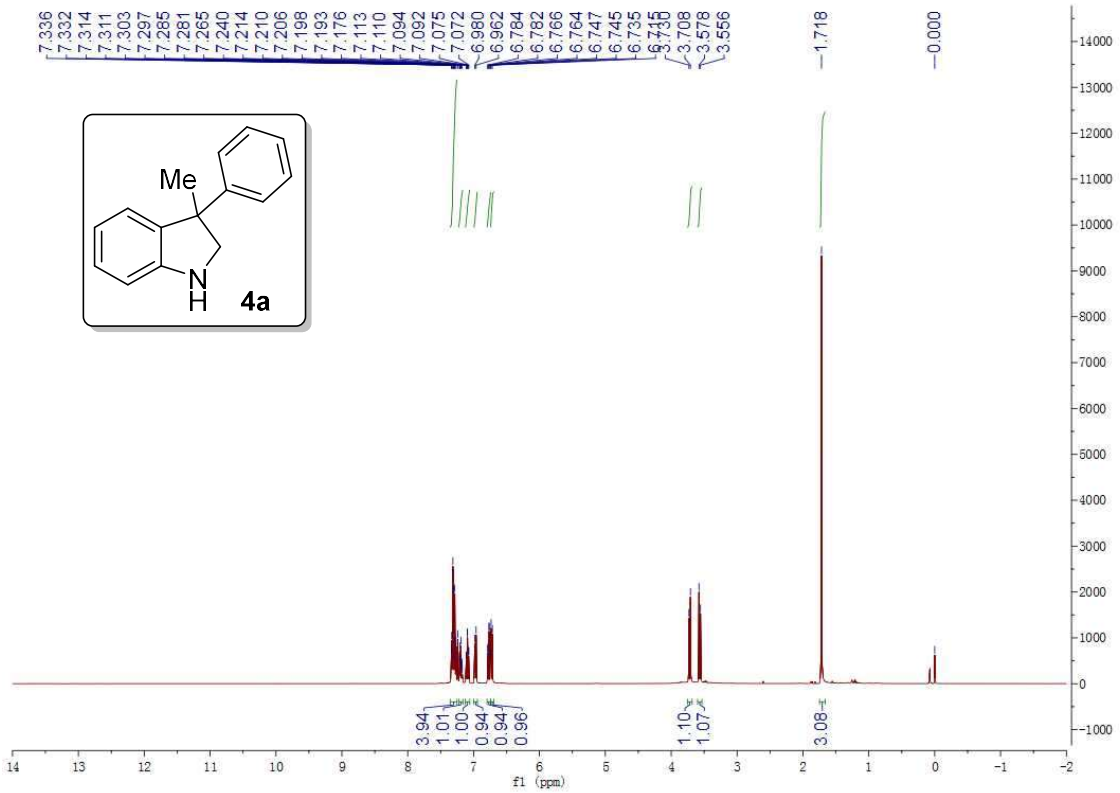
^{13}C NMR Spectrum of **2s** ($CDCl_3$, 100 MHz)



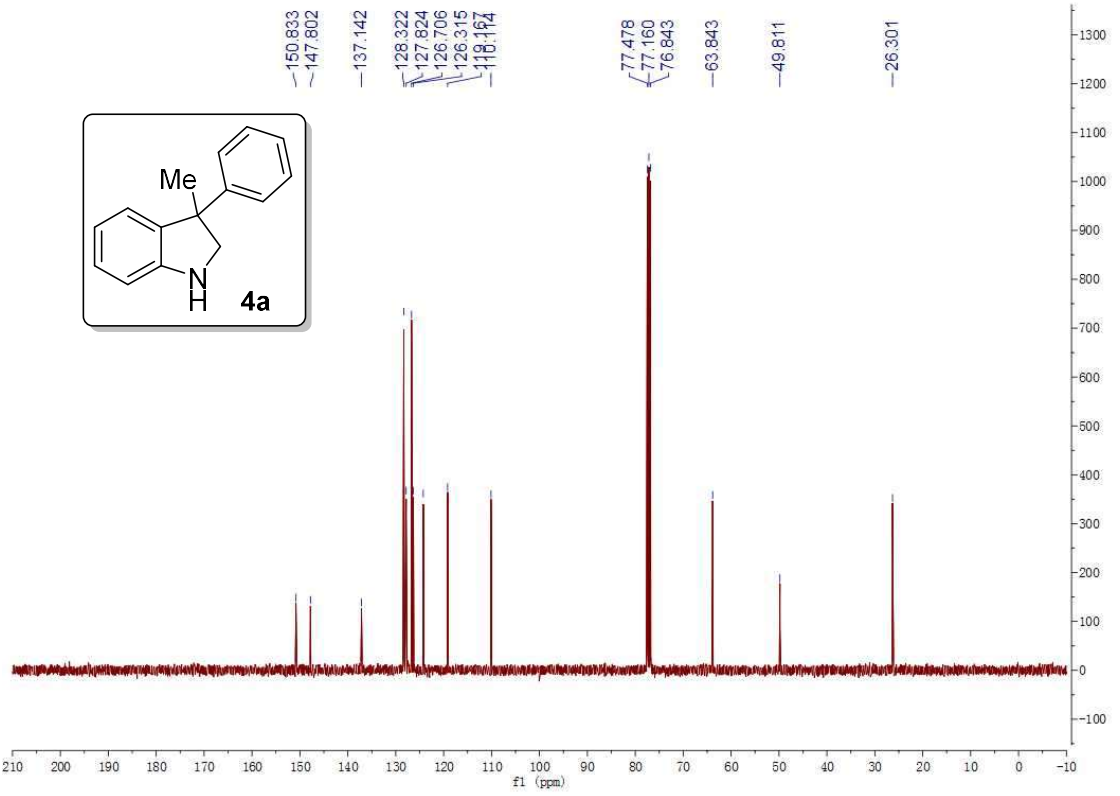
^{1}H NMR Spectrum of **3a** ($CDCl_3$, 400 MHz)



^{13}C NMR Spectrum of **3a** ($CDCl_3$, 100 MHz)



^{1}H NMR Spectrum of **4a** ($CDCl_3$, 400 MHz)

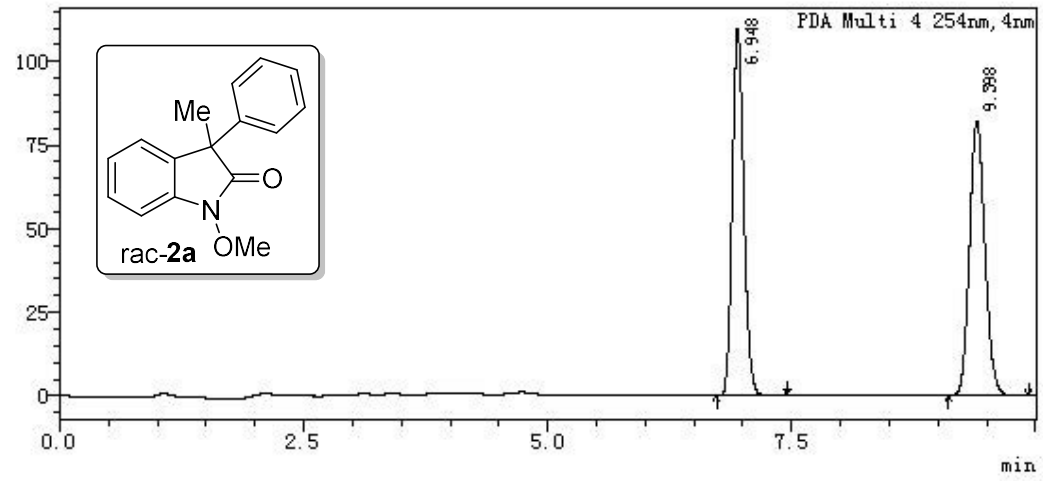


^{13}C NMR Spectrum of **4a** ($CDCl_3$, 100 MHz)

Chiral HPLC Data

Chromatography

mAU



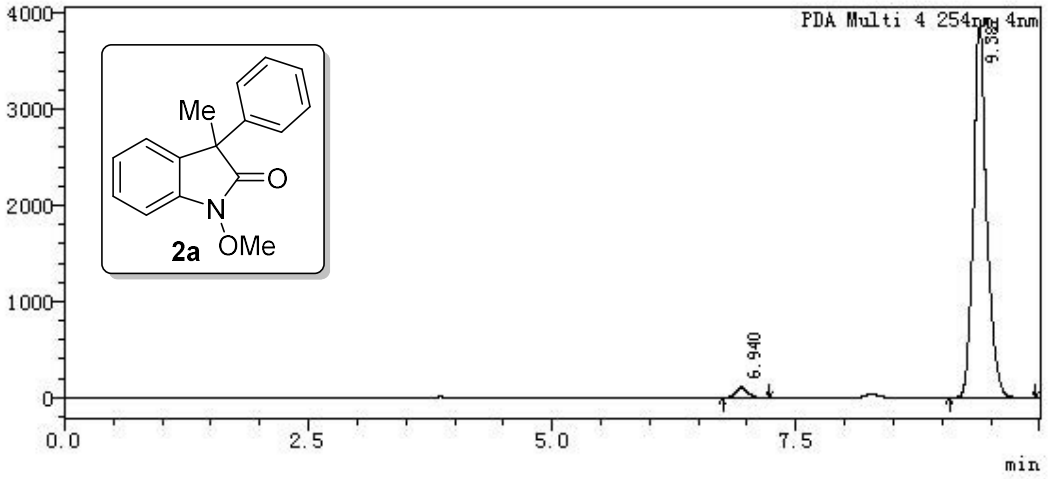
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	6.948	109623	57.146	893872	49.912
2	9.398	82207	42.854	897031	50.088
总计		191830	100.000	1790903	100.000

Chromatography

mAU



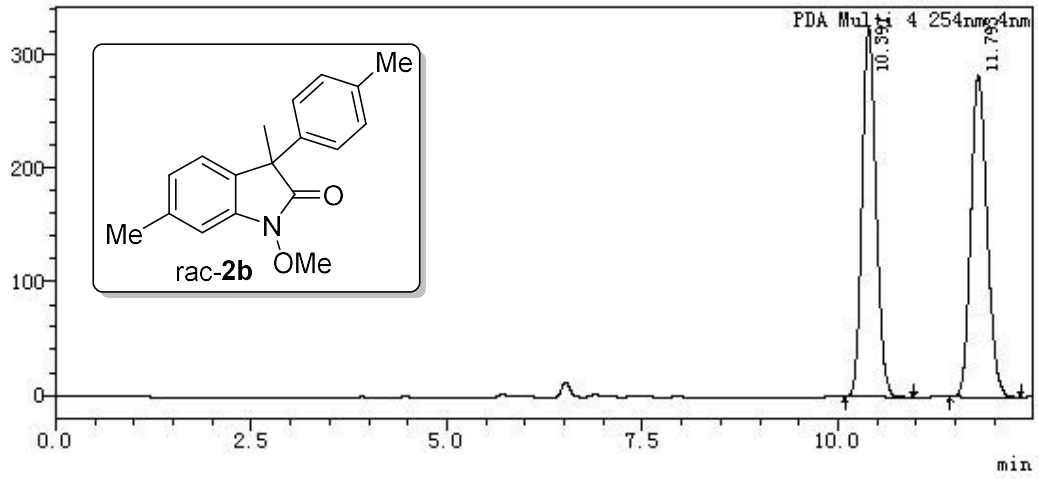
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	6.940	109248	2.761	885466	2.348
2	9.382	3847309	97.239	36824022	97.652
总计		3956557	100.000	37709488	100.000

Chromatography

mAU



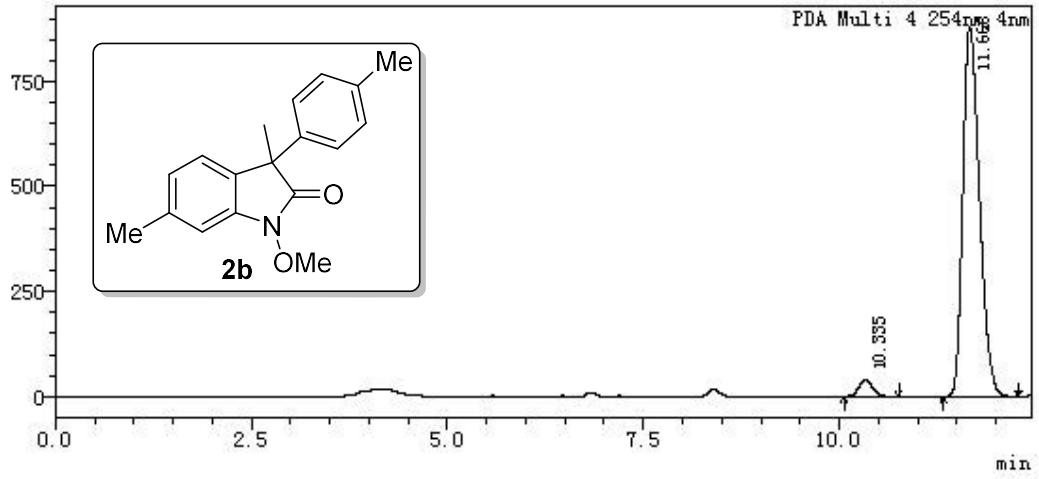
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	10.391	324770	53.450	4027563	49.669
2	11.793	282841	46.550	4081188	50.331
总计		607611	100.000	8108750	100.000

Chromatography

mAU



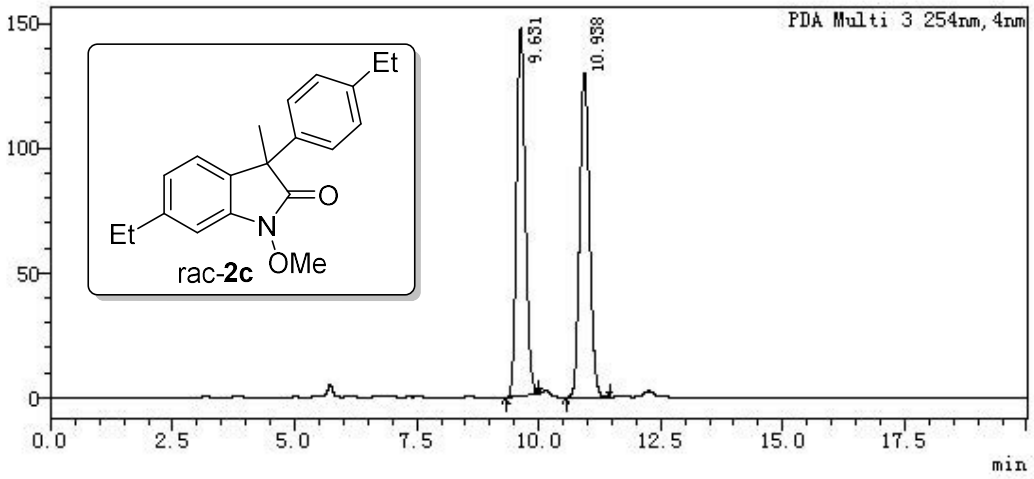
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	10.335	39977	4.343	490396	3.645
2	11.668	880453	95.657	12962472	96.355
总计		920430	100.000	13452868	100.000

Chromatography

mAU



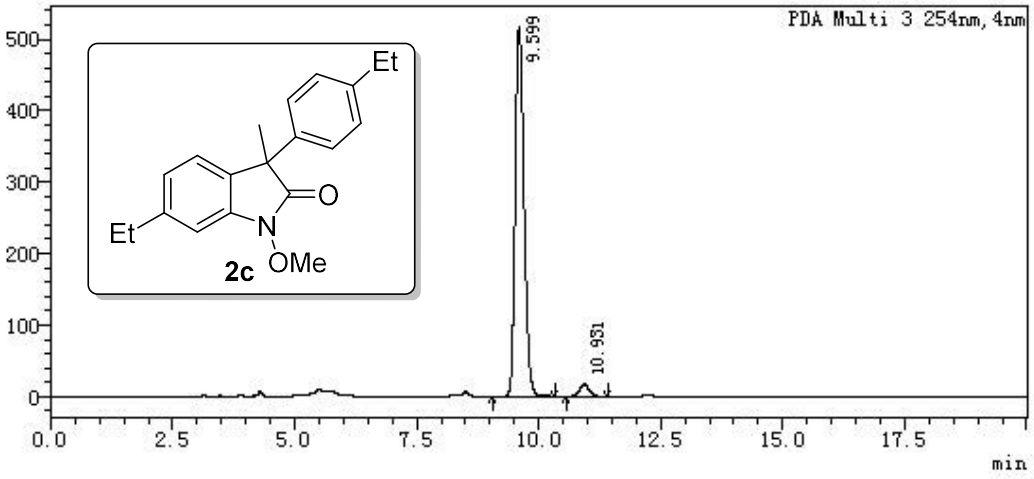
Table

PDA Ch3 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	9.631	147558	53.198	1828537	50.202
2	10.938	129818	46.802	1813823	49.798
总计		277377	100.000	3642360	100.000

Chromatography

mAU



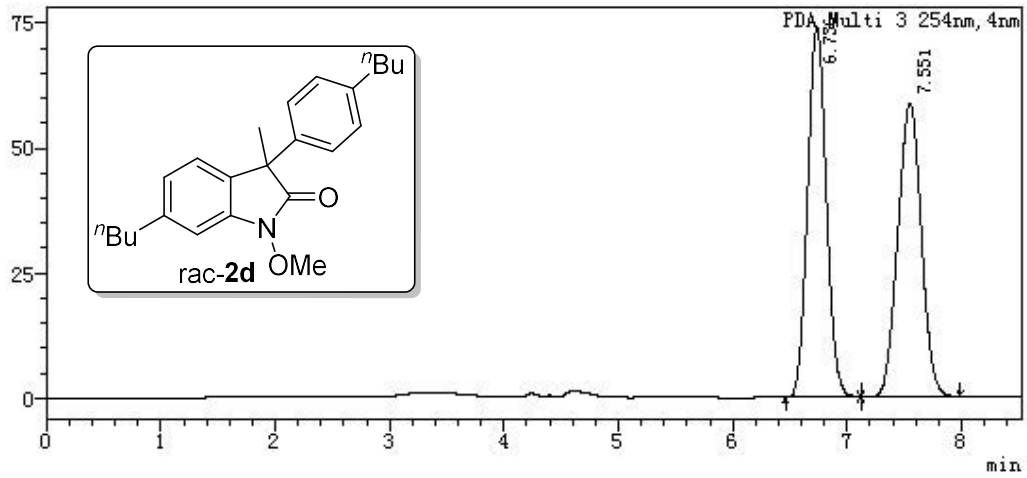
Table

PDA Ch3 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	9.599	517051	96.755	6466577	96.384
2	10.931	17341	3.245	242570	3.616
总计		534391	100.000	6709147	100.000

Chromatography

mAU



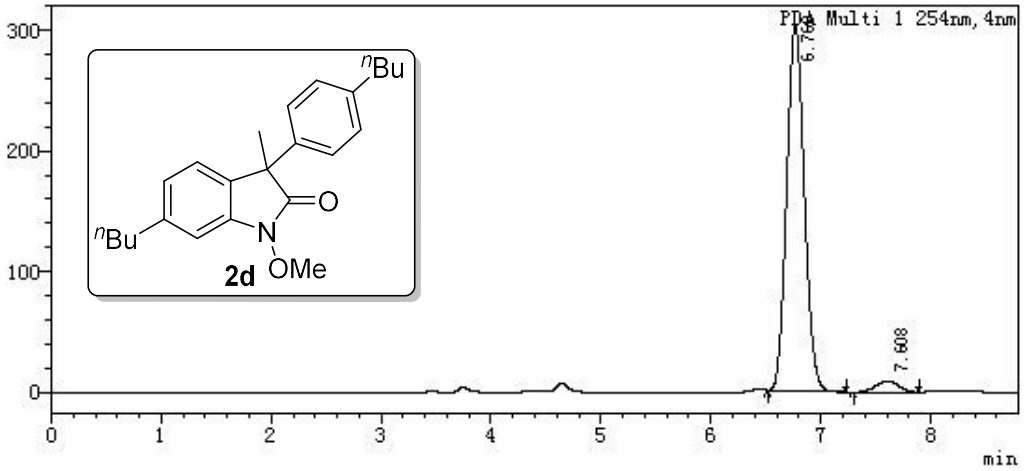
Table

PDA Ch3 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	6.736	73745	55.734	833184	50.078
2	7.551	58570	44.266	830592	49.922
总计		132315	100.000	1663776	100.000

Chromatography

mAU



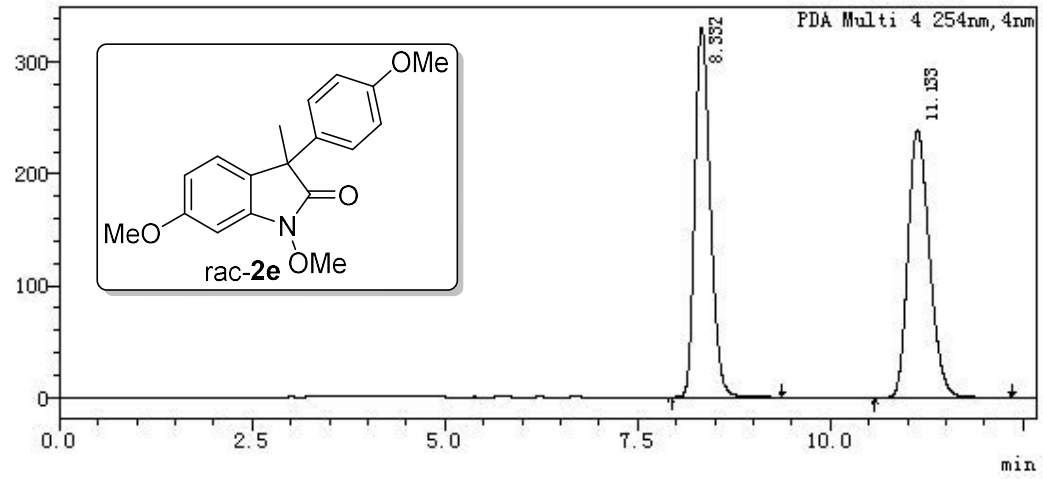
Table

PDA Ch1 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	6.768	302121	97.024	3359483	96.330
2	7.608	9268	2.976	127991	3.670
总计		311389	100.000	3487474	100.000

Chromatography

mAU



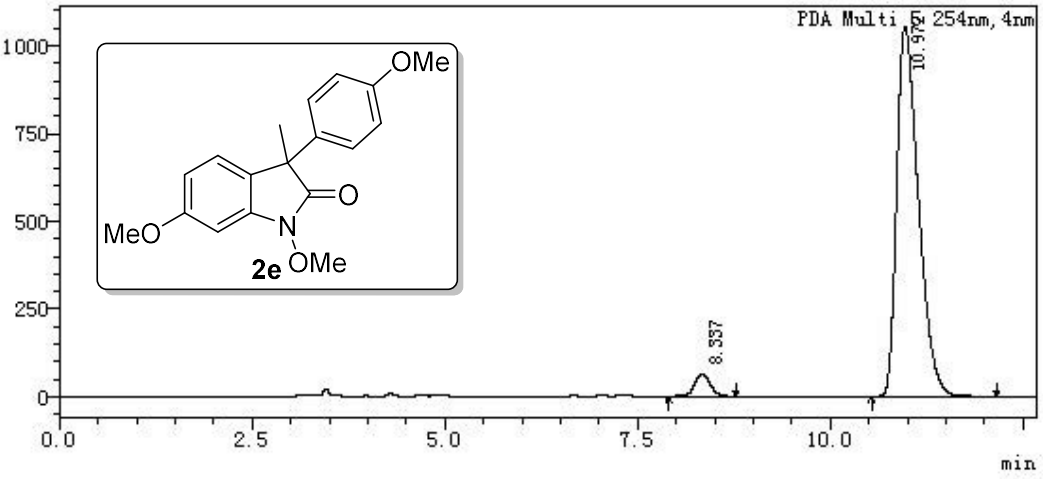
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	8.332	330643	58.066	4610872	49.977
2	11.133	238779	41.934	4615184	50.023
总计		569422	100.000	9226057	100.000

Chromatography

mAU



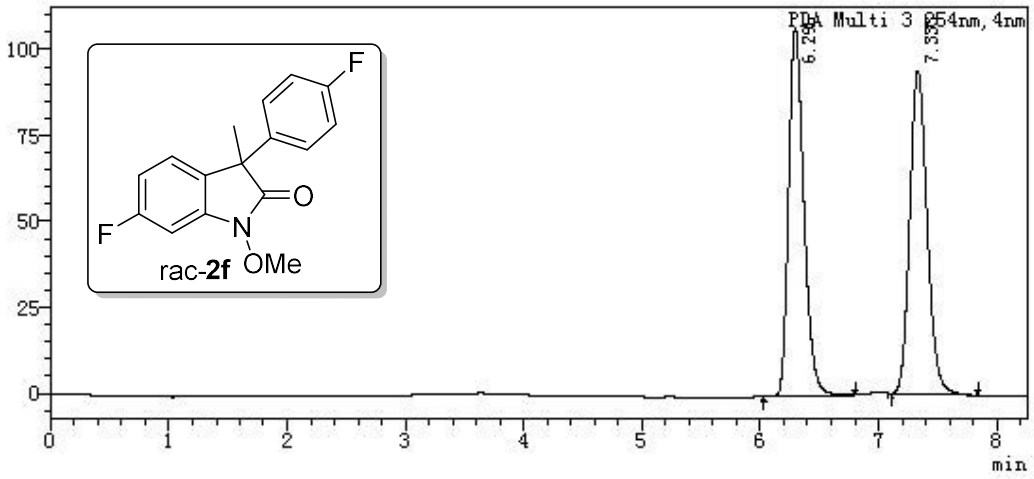
Table

PDA Ch5 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	8.337	63966	5.725	892677	4.141
2	10.972	1053334	94.275	20666238	95.859
总计		1117299	100.000	21558915	100.000

Chromatography

mAU



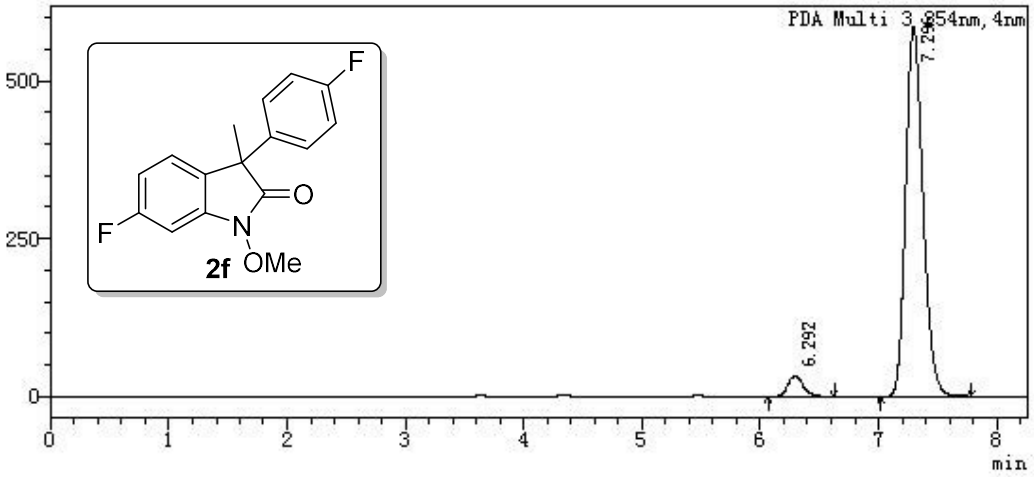
Table

PDA Ch3 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	6.296	107149	53.288	958787	50.108
2	7.333	93927	46.712	954650	49.892
总计		201076	100.000	1913436	100.000

Chromatography

mAU



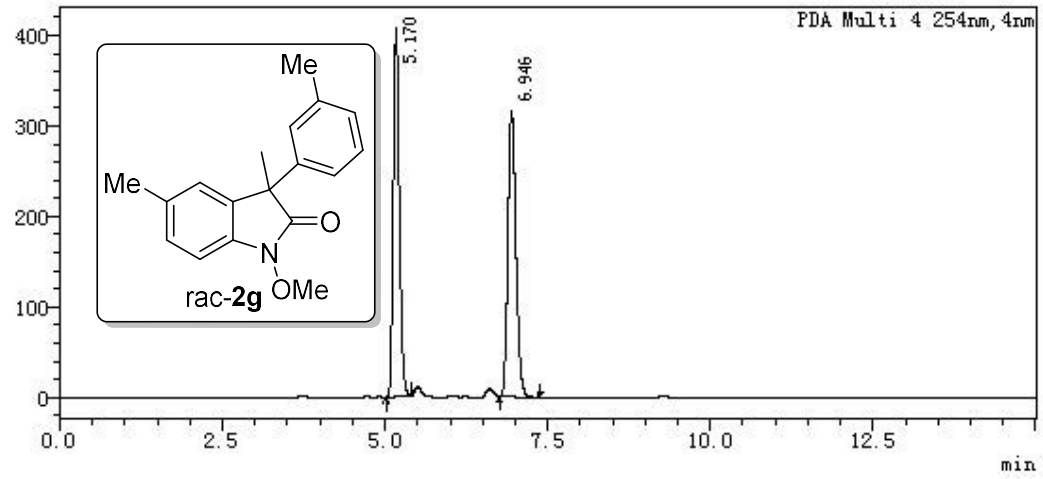
Table

PDA Ch3 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	6.292	32687	5.289	291399	4.698
2	7.296	585380	94.711	5910955	95.302
总计		618067	100.000	6202354	100.000

Chromatography

mAU



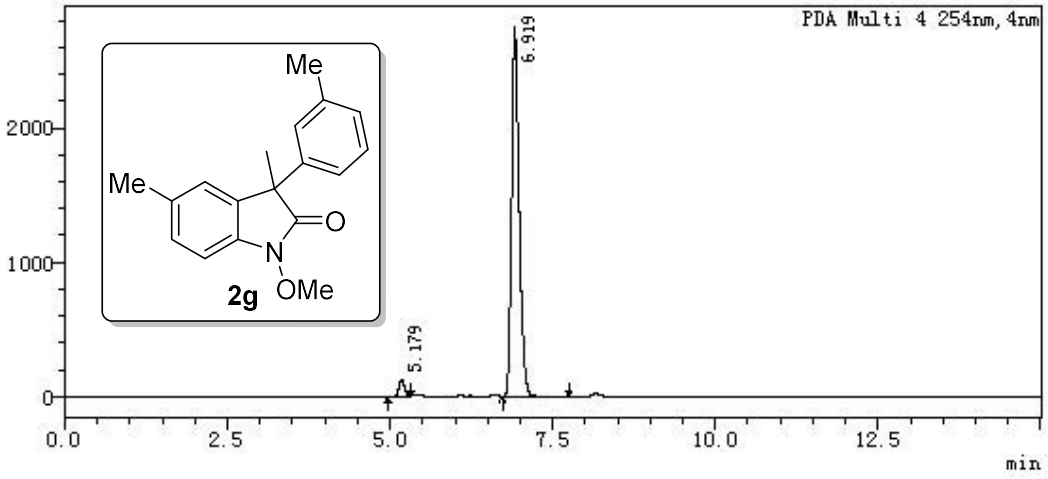
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	5.170	407490	56.325	2646988	49.485
2	6.946	315966	43.675	2702058	50.515
总计		723455	100.000	5349046	100.000

Chromatography

mAU



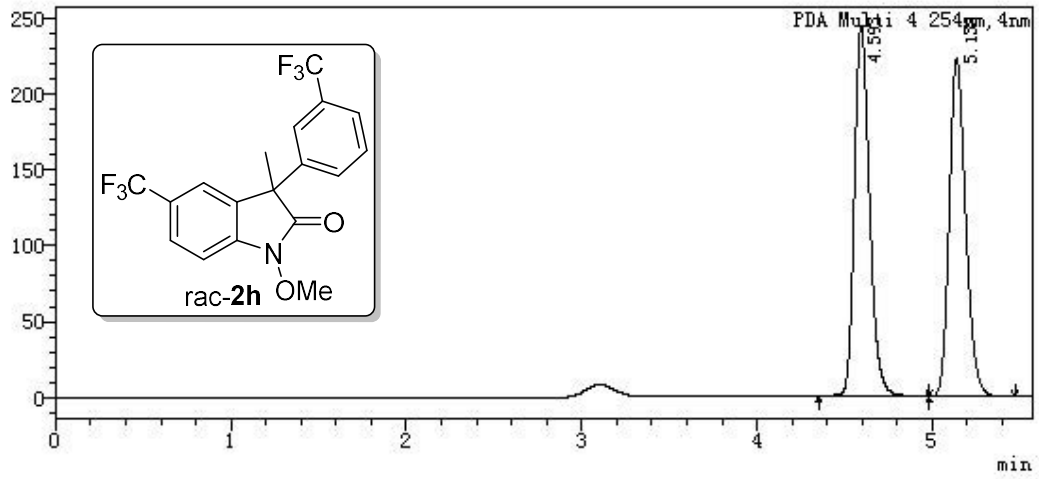
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	5.179	123223	4.285	801585	3.548
2	6.919	2752246	95.715	21792764	96.452
总计		2875469	100.000	22594349	100.000

Chromatography

mAU



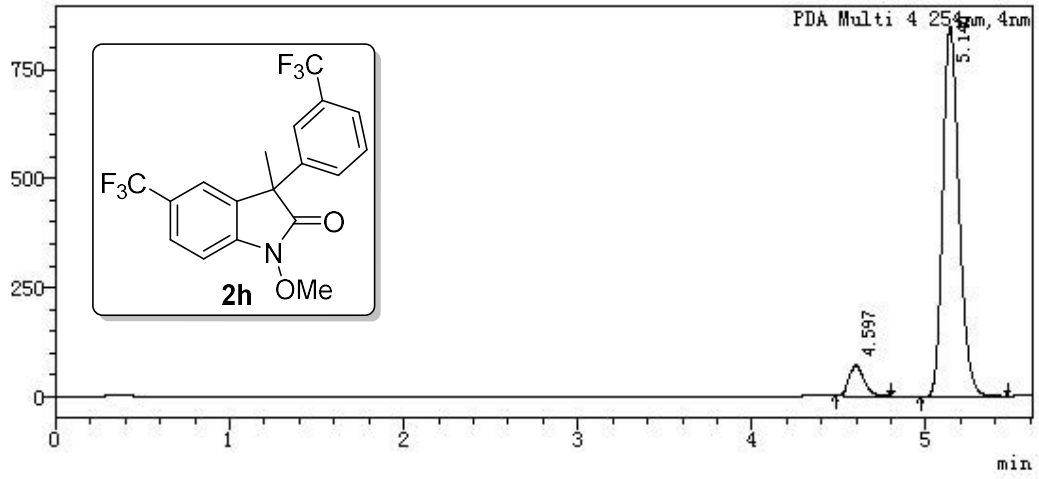
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	4.593	242735	52.144	1463789	50.387
2	5.138	222778	47.856	1441283	49.613
总计		465514	100.000	2905072	100.000

Chromatography

mAU



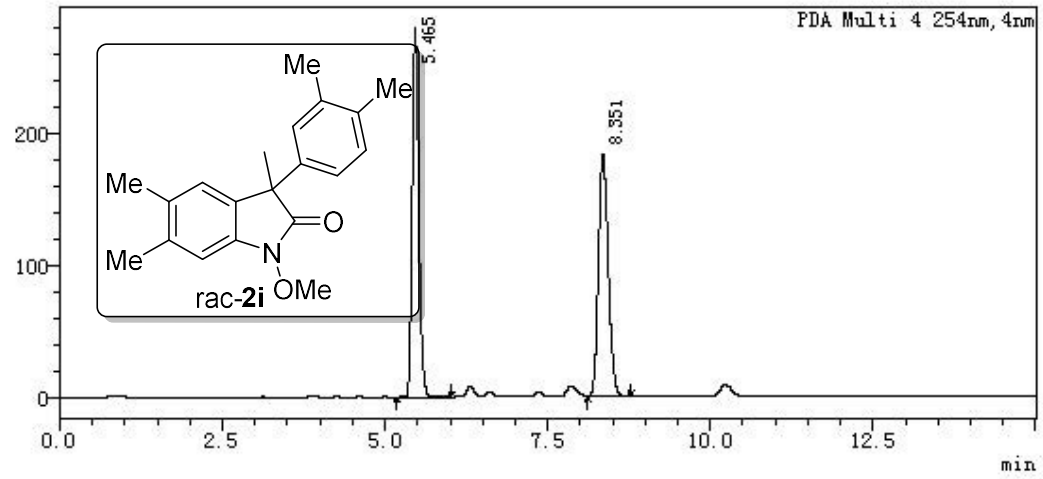
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	4.597	70318	7.666	409422	6.992
2	5.140	846923	92.334	5446469	93.008
总计		917241	100.000	5855892	100.000

Chromatography

mAU



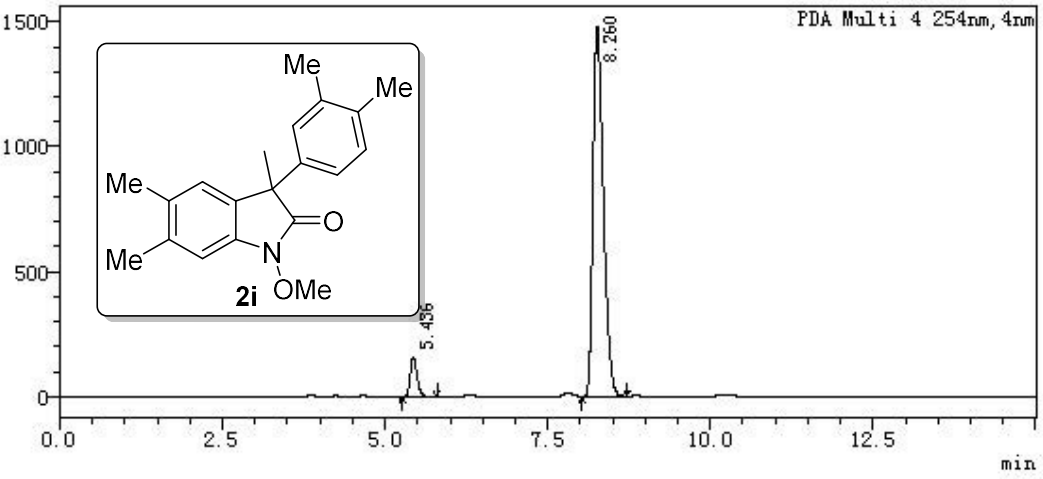
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	5.465	280104	60.357	1966452	50.518
2	8.351	183972	39.643	1926160	49.482
总计		464077	100.000	3892612	100.000

Chromatography

mAU



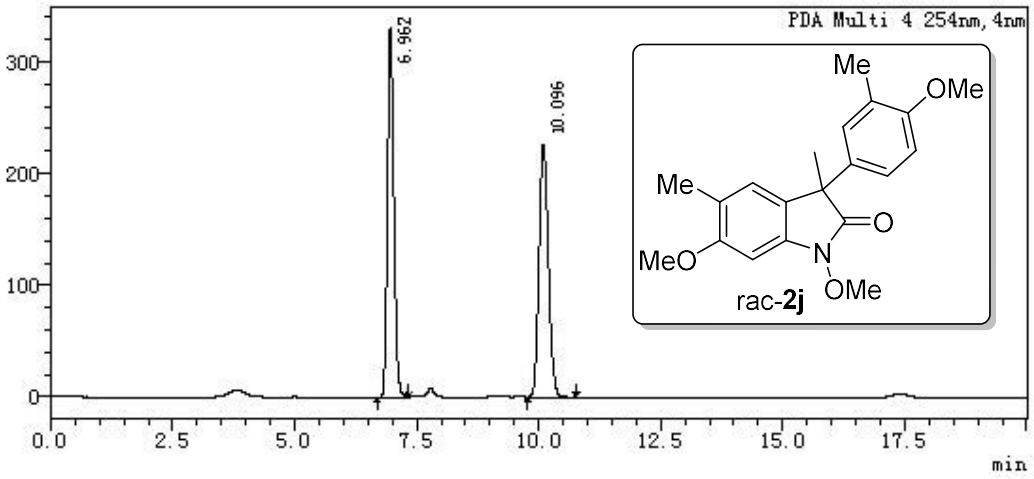
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	5.436	157524	9.630	1111152	6.376
2	8.260	1478188	90.370	16317125	93.624
总计		1635712	100.000	17428277	100.000

Chromatography

mAU



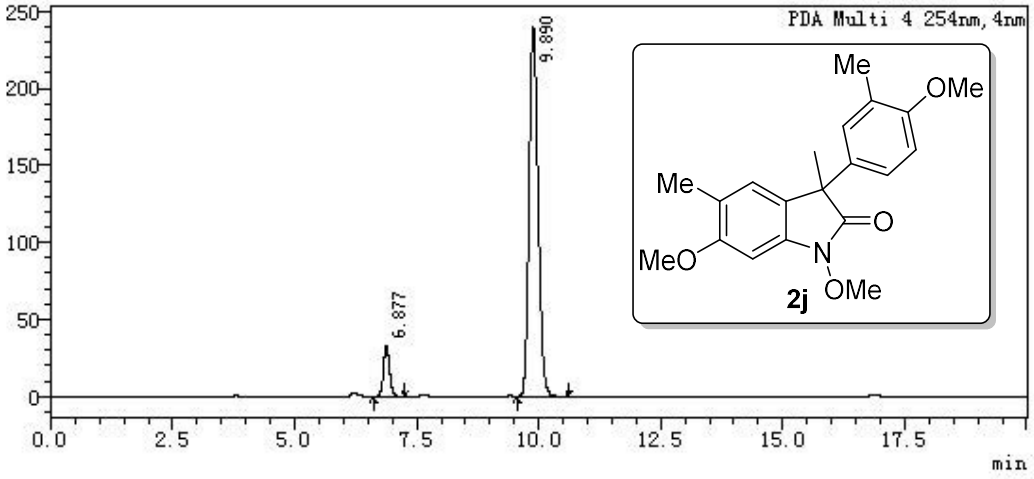
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	6.962	330652	59.391	2997582	50.051
2	10.096	226090	40.609	2991471	49.949
总计		556742	100.000	5989053	100.000

Chromatography

mAU



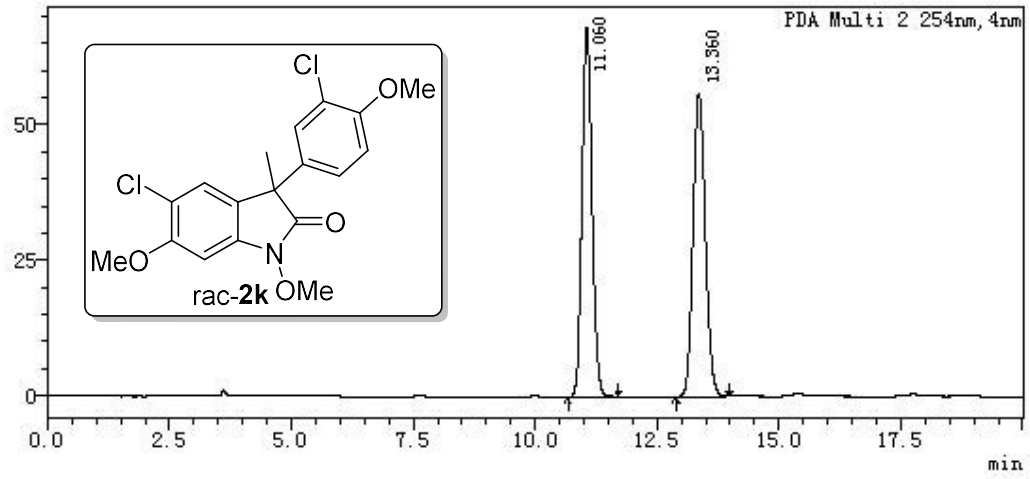
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	6.877	32552	11.936	287873	8.504
2	9.890	240182	88.064	3097324	91.496
总计		272735	100.000	3385197	100.000

Chromatography

mAU



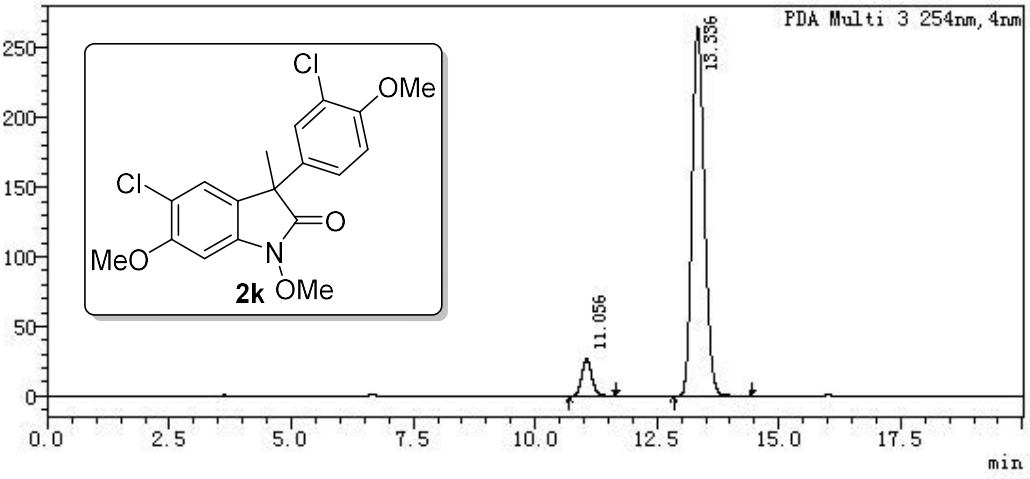
Table

PDA Ch2 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	11.060	68088	54.858	974671	49.963
2	13.360	56028	45.142	976125	50.037
总计		124116	100.000	1950796	100.000

Chromatography

mAU



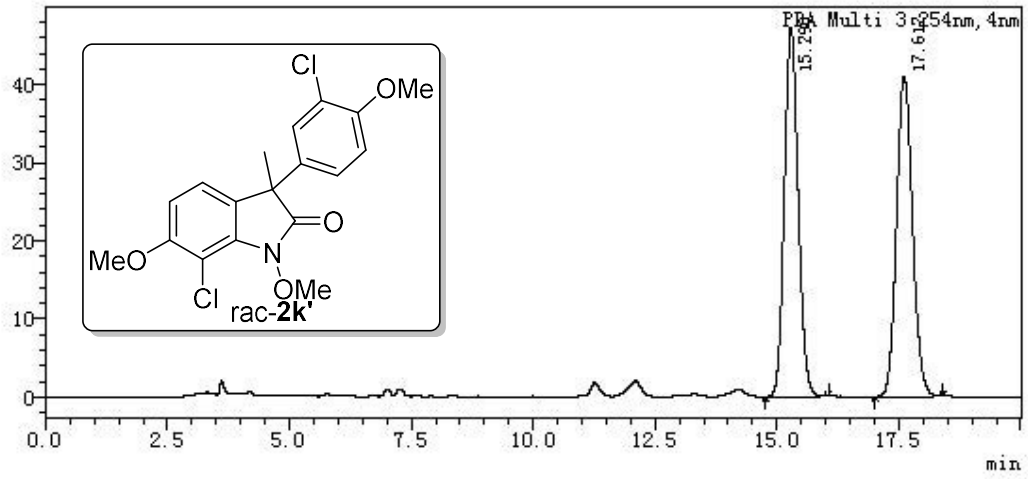
Table

PDA Ch3 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	11.056	26716	9.149	385568	7.648
2	13.336	265307	90.851	4655578	92.352
总计		292023	100.000	5041146	100.000

Chromatography

mAU



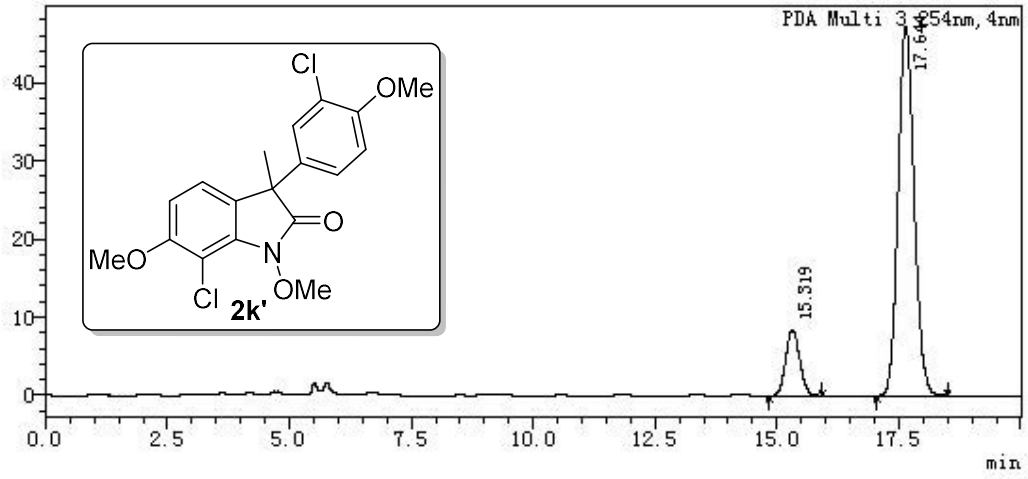
Table

PDA Ch3 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	15.290	47209	53.518	934996	49.977
2	17.612	41003	46.482	935862	50.023
总计		88211	100.000	1870859	100.000

Chromatography

mAU



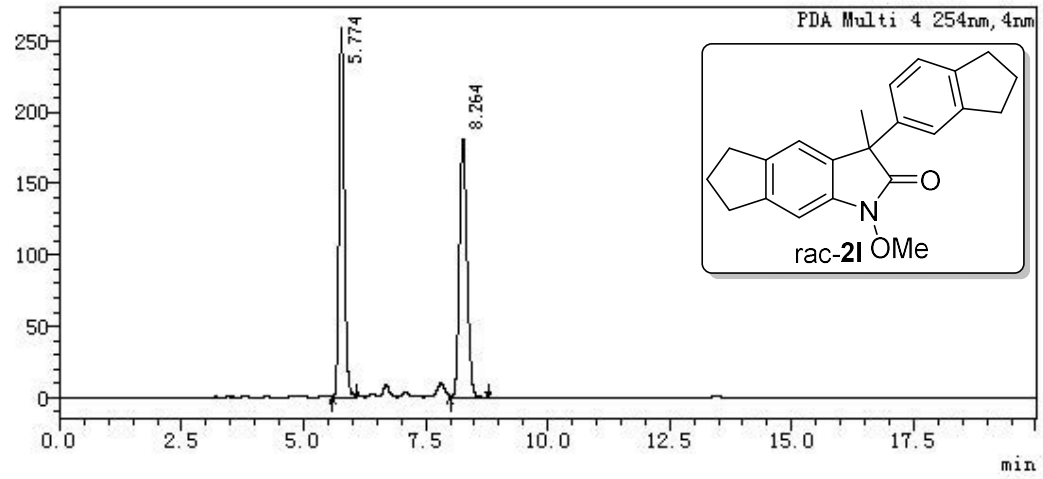
Table

PDA Ch3 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	15.319	8495	15.252	167845	13.447
2	17.644	47203	84.748	1080328	86.553
总计		55699	100.000	1248173	100.000

Chromatography

mAU



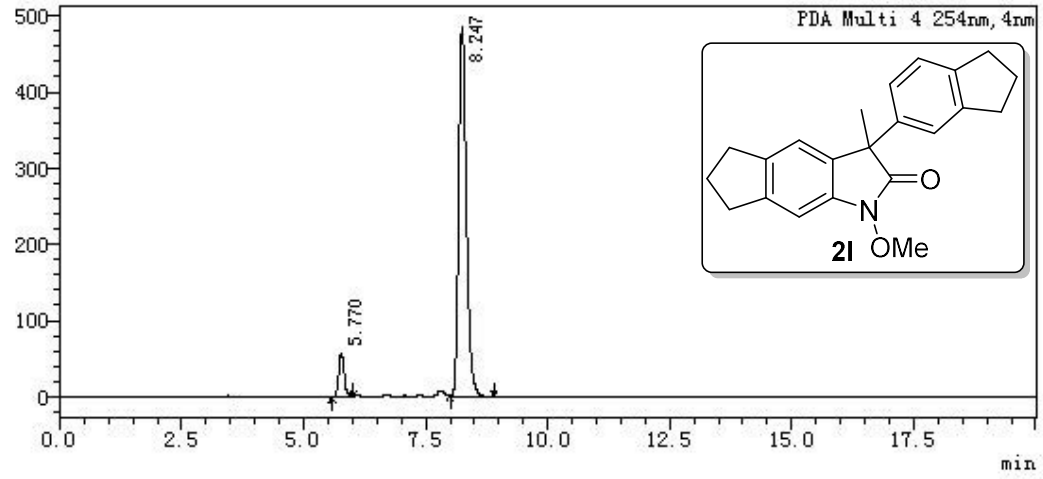
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	5.774	259033	58.815	1960276	49.876
2	8.264	181385	41.185	1970042	50.124
总计		440418	100.000	3930318	100.000

<色谱图>

mAU



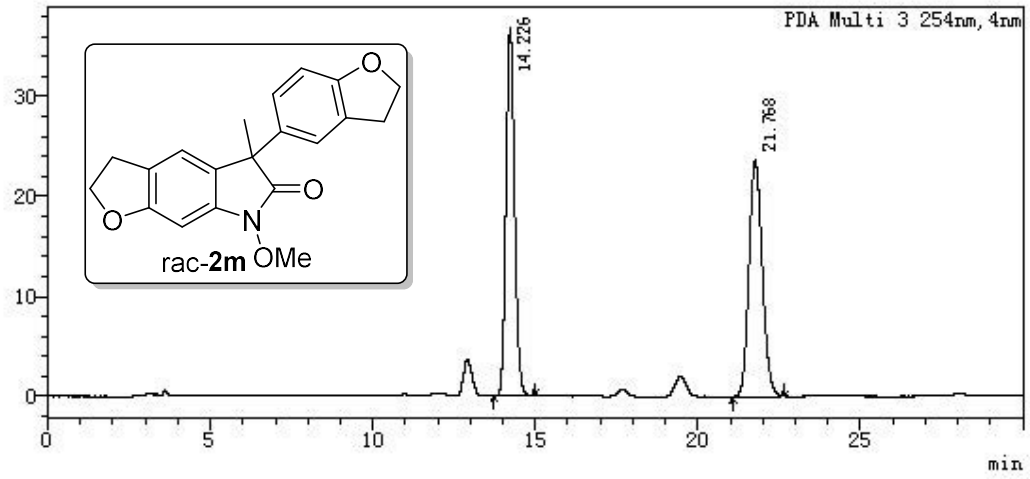
<峰表>

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	5.770	56503	10.430	431445	7.492
2	8.247	485229	89.570	5327287	92.508
总计		541732	100.000	5758732	100.000

Chromatography

mAU



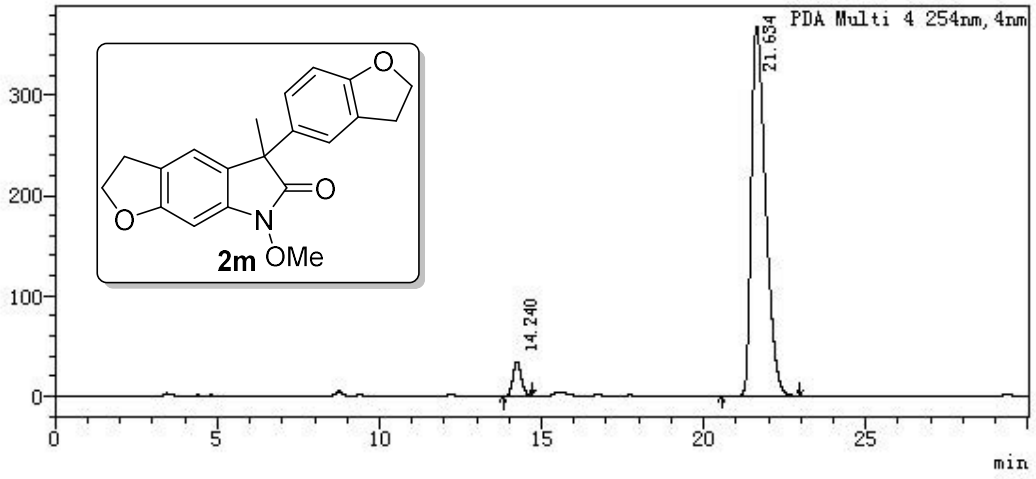
Table

PDA Ch3 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	14.226	36850	60.945	670893	50.089
2	21.768	23614	39.055	668498	49.911
总计		60464	100.000	1339390	100.000

Chromatography

mAU



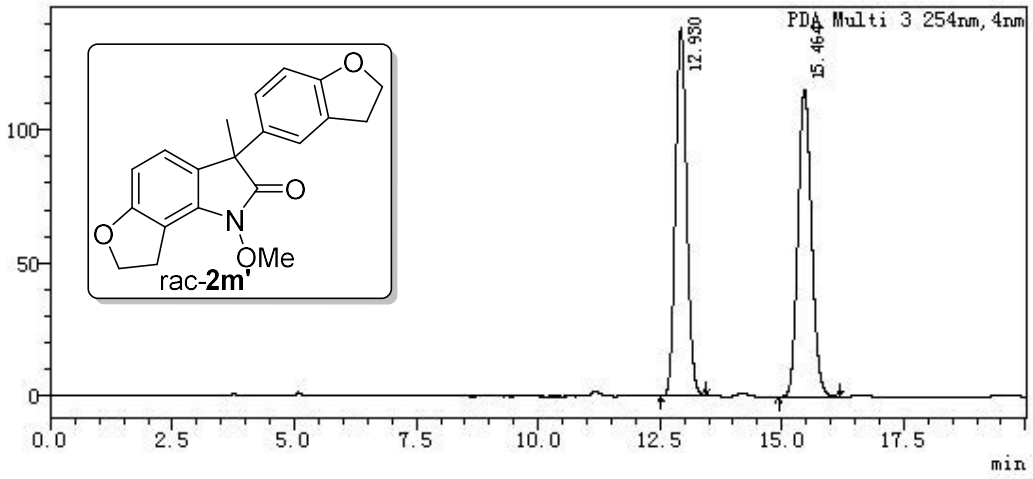
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	14.240	33985	8.456	619663	5.191
2	21.634	367896	91.544	11317255	94.809
总计		401880	100.000	11936918	100.000

Chromatography

mAU



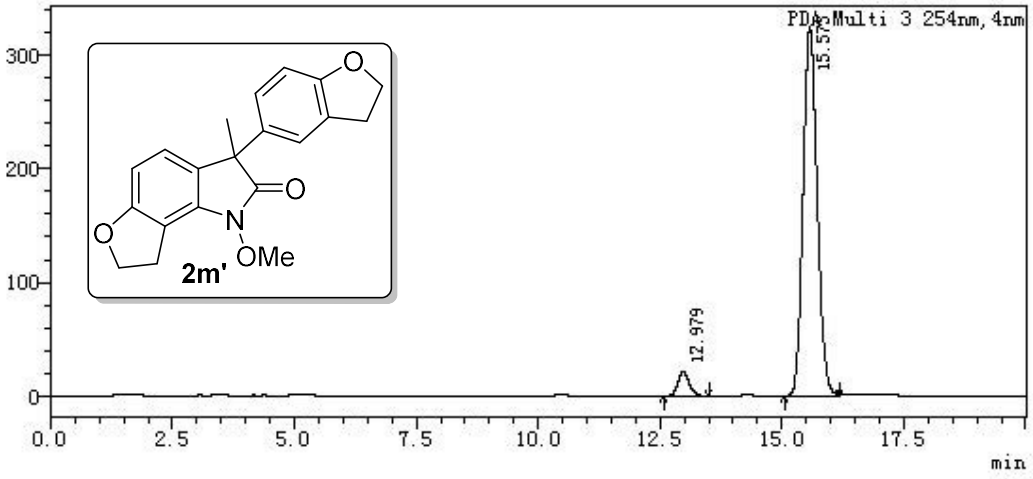
Table

PDA Ch3 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	12.930	138235	54.511	2212852	49.714
2	15.464	115355	45.489	2238284	50.286
总计		253591	100.000	4451136	100.000

Chromatography

mAU



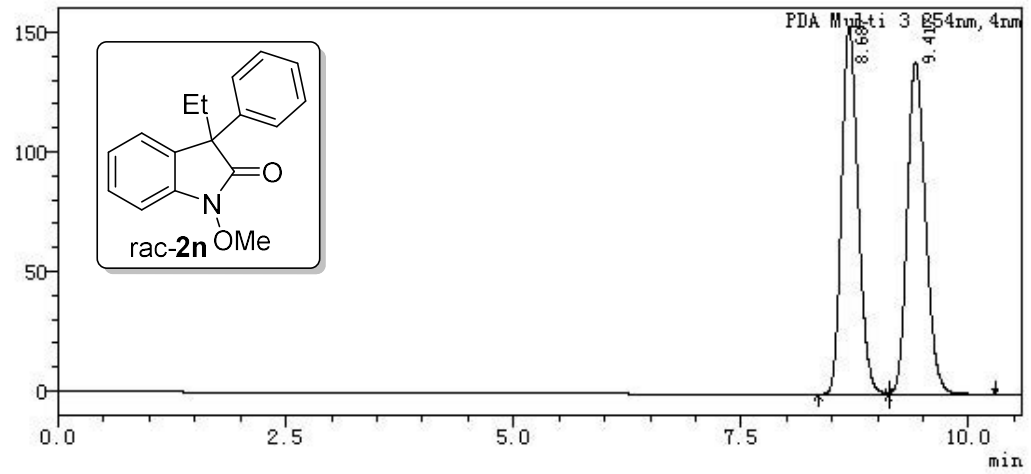
Table

PDA Ch3 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	12.979	20989	6.066	344977	5.035
2	15.573	325028	93.934	6506026	94.965
总计		346017	100.000	6851003	100.000

Chromatography

mAU



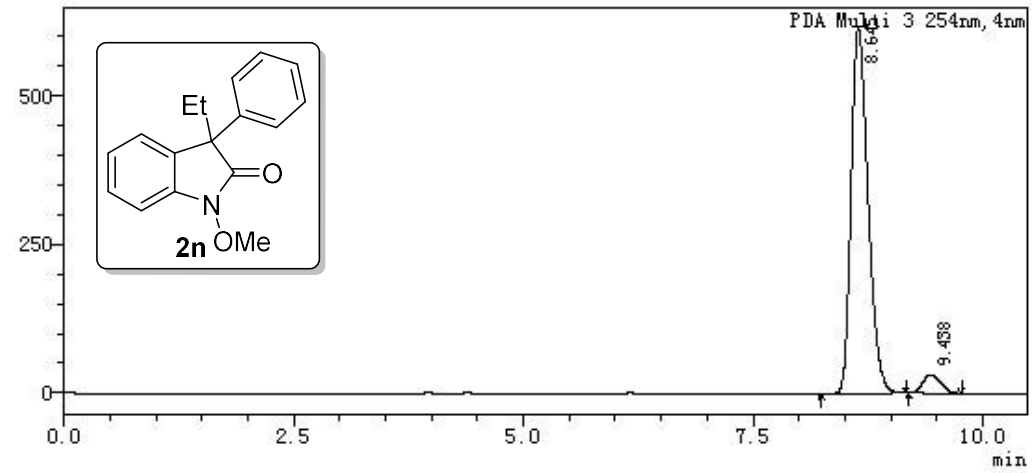
Table

PDA Ch3 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	8.687	152794	52.359	1932538	49.929
2	9.417	139026	47.641	1938014	50.071
总计		291819	100.000	3870551	100.000

Chromatography

mAU



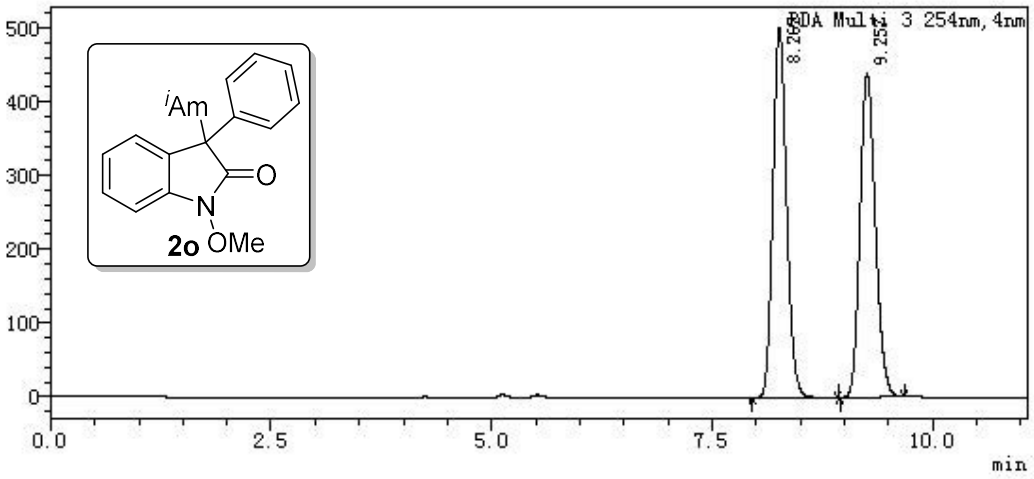
Table

PDA Ch3 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	8.645	613123	95.163	7843920	94.911
2	9.438	31162	4.837	420556	5.089
总计		644284	100.000	8264476	100.000

Chromatography

mAU



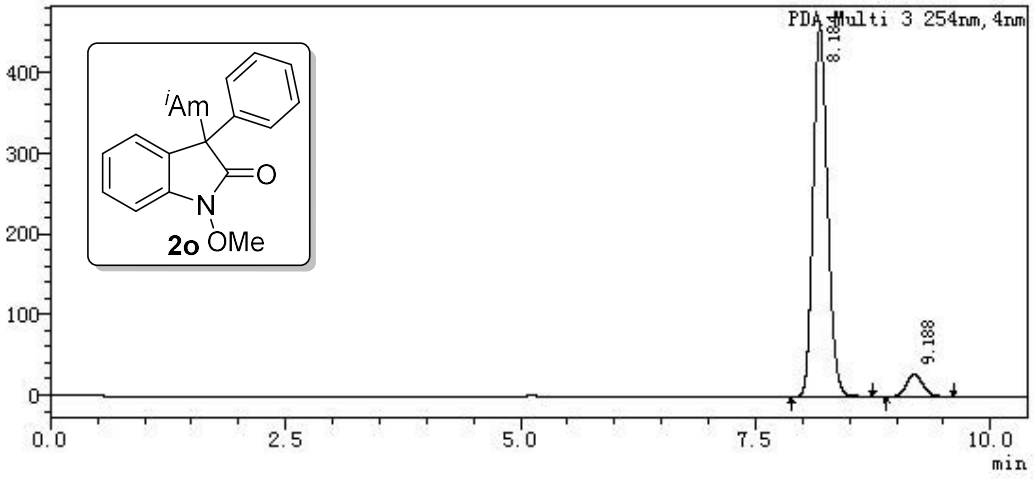
Table

PDA Ch3 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	8.262	501571	53.352	5363431	50.166
2	9.257	438551	46.648	5327927	49.834
总计		940122	100.000	10691358	100.000

Chromatography

mAU



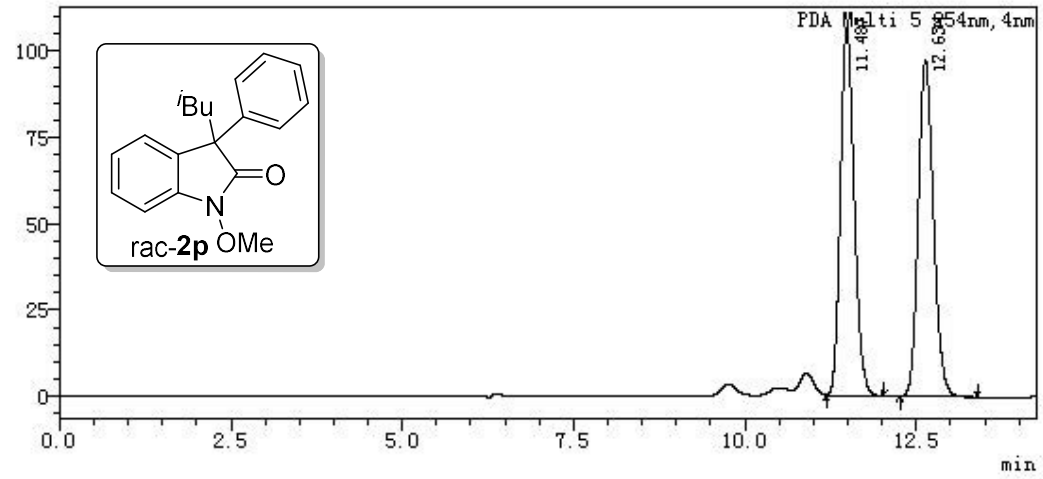
Table

PDA Ch3 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	8.184	459084	94.184	4873427	93.463
2	9.188	28352	5.816	340848	6.537
总计		487435	100.000	5214275	100.000

Chromatography

mAU



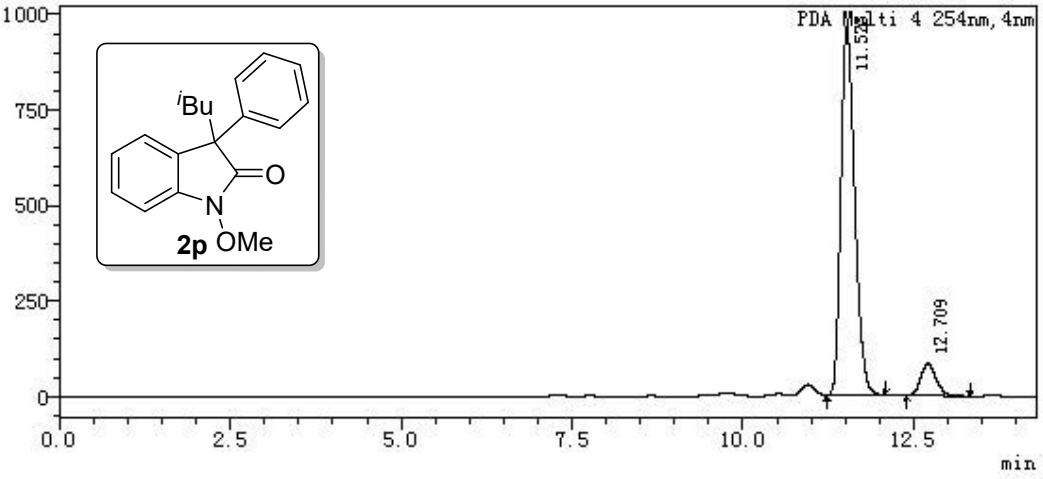
Table

PDA Ch5 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	11.487	106452	52.245	1483140	49.698
2	12.634	97305	47.755	1501191	50.302
总计		203757	100.000	2984331	100.000

Chromatography

mAU



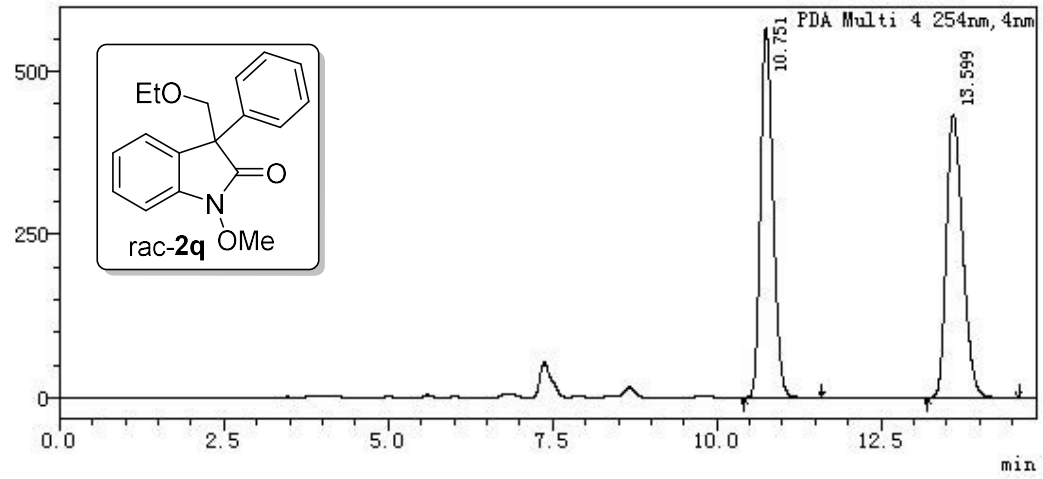
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	11.523	964318	91.899	13583179	91.089
2	12.709	85010	8.101	1328732	8.911
总计		1049328	100.000	14911911	100.000

Chromatography

mAU



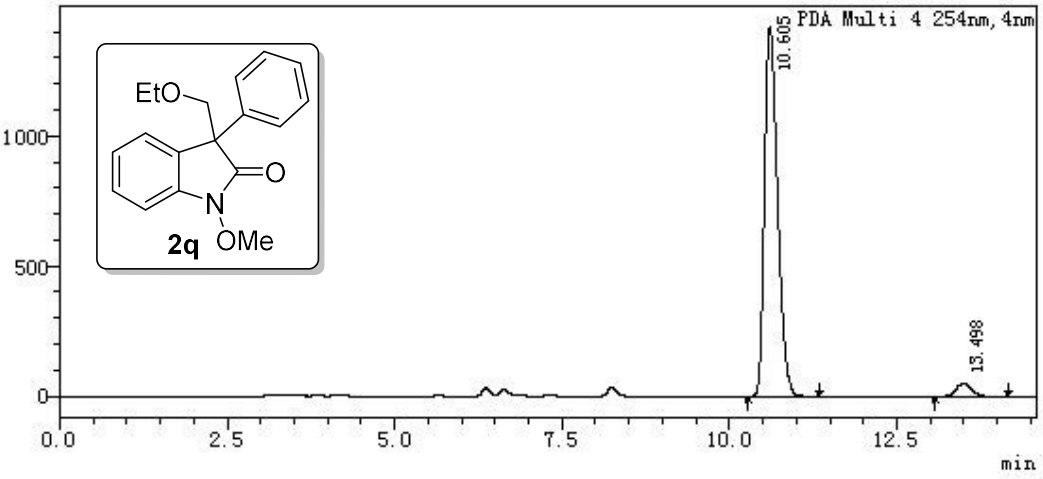
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	10.751	566113	56.687	7461695	50.029
2	13.599	432552	43.313	7453067	49.971
总计		998664	100.000	14914762	100.000

Chromatography

mAU



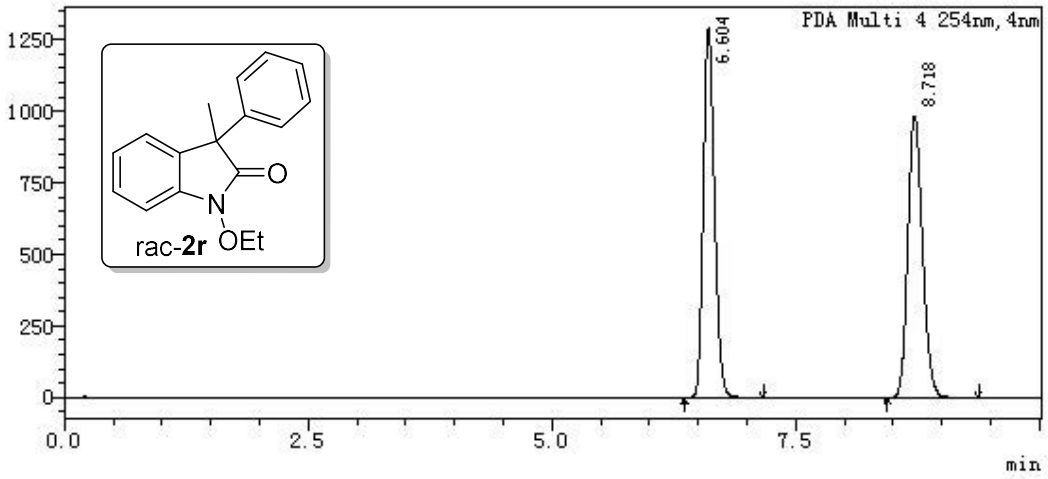
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	10.605	1419473	96.510	19218074	95.790
2	13.498	51329	3.490	844603	4.210
总计		1470802	100.000	20062678	100.000

Chromatography

mAU



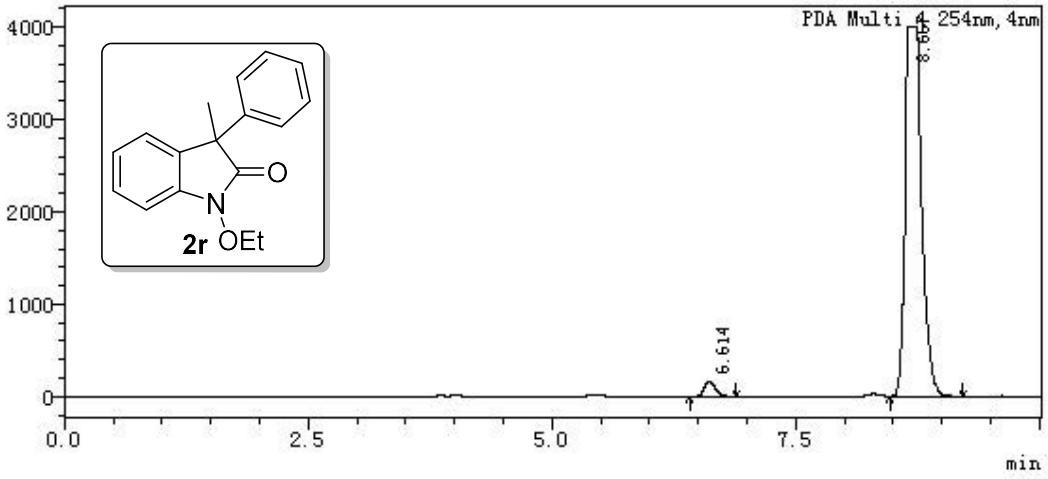
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	6.604	1292900	56.788	10238960	49.971
2	8.718	983805	43.212	10250708	50.029
总计		2276706	100.000	20489668	100.000

Chromatography

mAU



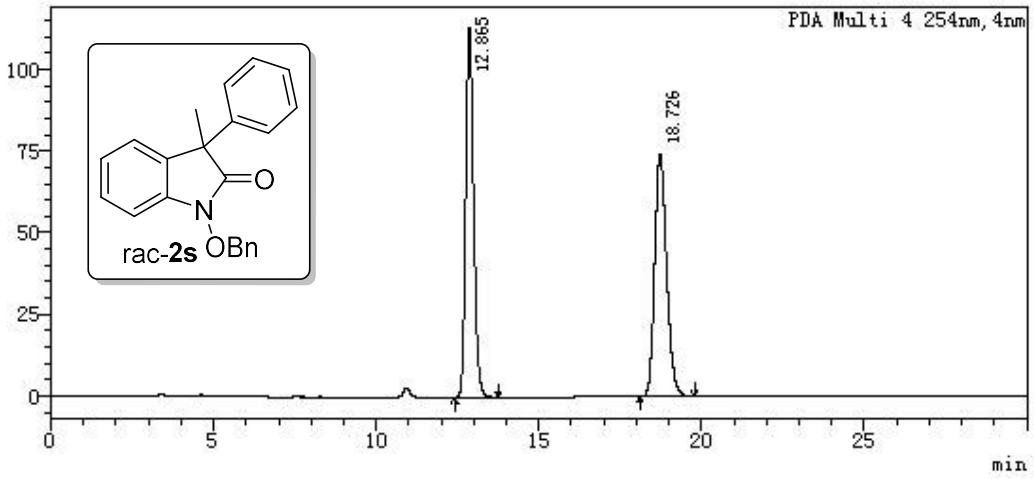
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	6.614	158235	3.807	1268857	2.615
2	8.667	3997858	96.193	47254941	97.385
总计		4156093	100.000	48523798	100.000

Chromatography

mAU



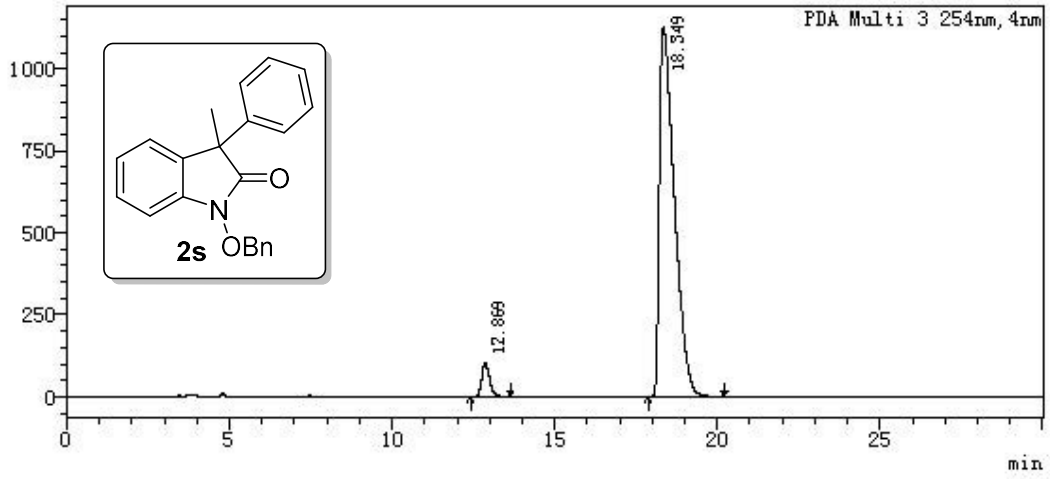
Table

PDA Ch4 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	12.865	113332	60.356	1909931	50.174
2	18.726	74439	39.644	1896650	49.826
总计		187771	100.000	3806581	100.000

Chromatography

mAU



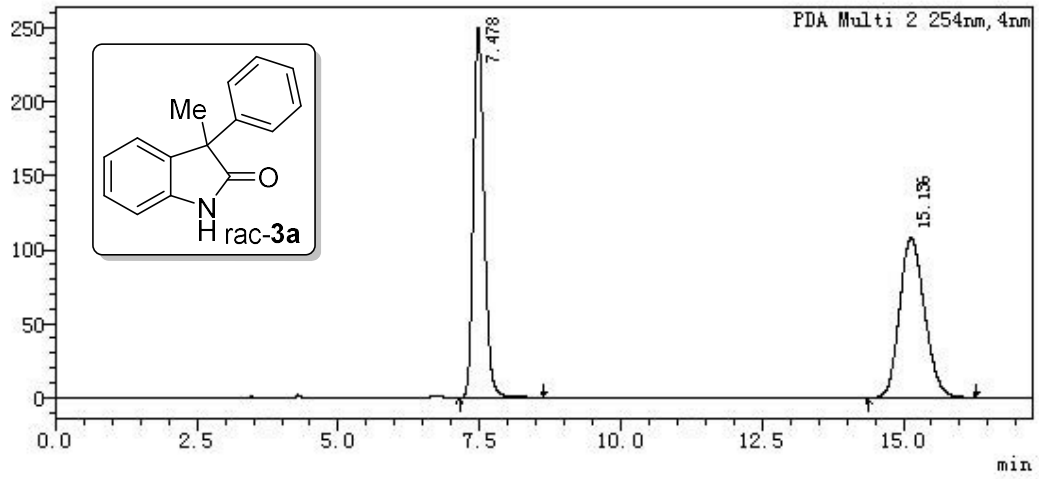
Table

PDA Ch3 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	12.869	100850	8.206	1699816	4.498
2	18.349	1128156	91.794	36088095	95.502
总计		1229007	100.000	37787912	100.000

Chromatography

mAU



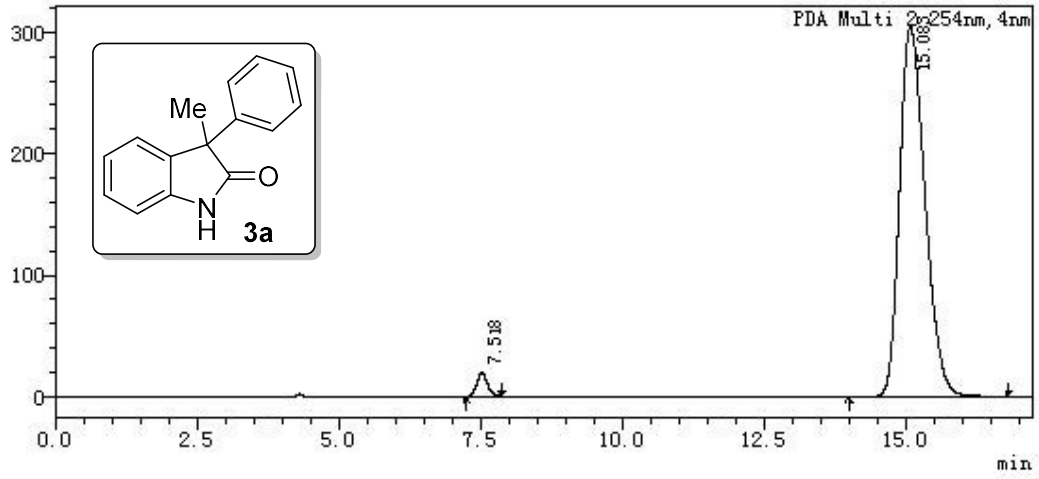
Table

PDA Ch2 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	7.478	250035	69.867	3311576	50.014
2	15.136	107836	30.133	3309696	49.986
总计		357871	100.000	6621271	100.000

Chromatography

mAU



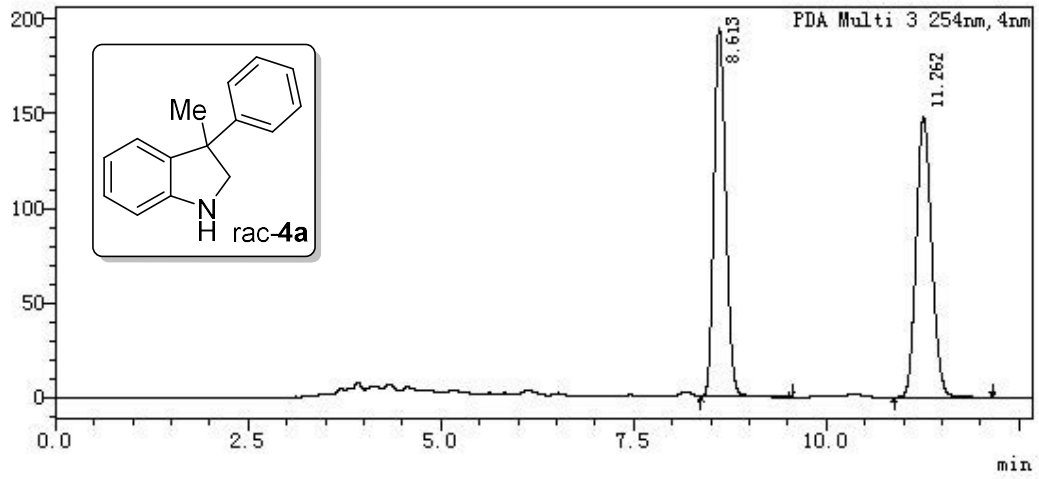
Table

PDA Ch2 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	7.518	19169	5.926	251013	2.588
2	15.083	304324	94.074	9448286	97.412
总计		323493	100.000	9699299	100.000

Chromatography

mAU



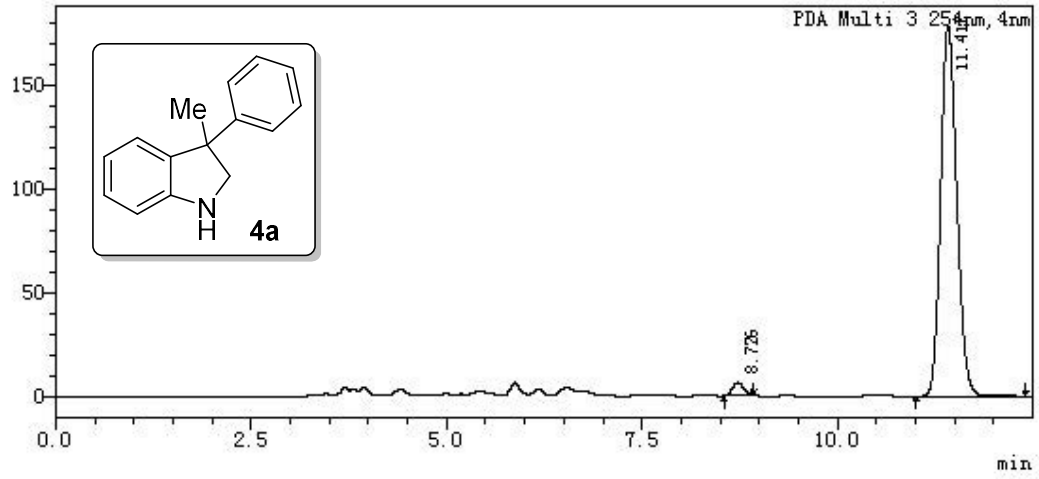
Table

PDA Ch3 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	8.613	194900	56.781	2064363	49.942
2	11.262	148351	43.219	2069188	50.058
总计		343251	100.000	4133551	100.000

Chromatography

mAU



Table

PDA Ch3 254nm

Number	Retention Time	Height	Height%	Area	Area%
1	8.726	6307	3.424	62777	2.410
2	11.417	177910	96.576	2542003	97.590
总计		184217	100.000	2604781	100.000