Supporting Information

Nickel-Catalyzed Aminoxylation of Inert Aliphatic C(sp^3)−H Bonds with Stable Nitroxyl Radicals under Air: One-Pot Route to α-Formyl Acid Derivatives

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Table of contents

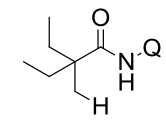
I. General Remarks

NMR spectra were obtained on a Bruker AV II-400 MHz spectrometer. The ^{1}H NMR (400 MHz) chemical shifts were measured relative to $CDCl_3$, or TMS as the internal reference ($CDCl_3$: δ = 7.26 ppm; TMS: δ = 0.00 ppm). The ^{13}C NMR (100 MHz) chemical shifts were given using $CDCl_3$ as the internal standard ($CDCl_3$: δ = 77.16 ppm). High-resolution mass spectra (HRMS) were obtained with a Waters-Q-TOF-Premier (ESI).

Unless otherwise noted, all reagents were obtained from commercial suppliers and used without further purification. $Ni(OAc)_2$, $NiCl_2$, $CoCl_2$, $CuCl_2$ and CuCl were purchased from Chengdu Kelong Chemical Engineering Reagent (China) CO., Ltd. with further purification. Most of bases were purchased from Chengdu Kelong Chemical Engineering Reagent (China) CO., Ltd. 8-Aminoquinoline was purchased from Sichuan Xieli Biological & Chemical Reagent (China) CO., Ltd. The solvents were dried over CaH_2 (for DMF, DMSO, and acetonitrile) or sodium (for 1,4-dioxane, toluene, and *t*-AmylOH). Starting materials **1** were prepared according to the literature procedure.[1,2] Starting material **2a** was purchased from Energy Chemical Reagent (China) CO., Ltd. Other nitroxyl radicals were prepared according to the literature procedure.[3-7]

II. Structures of Substrates

(i) Aliphatic Acid Derivatives



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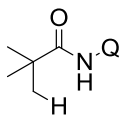

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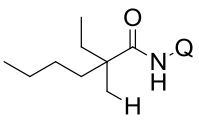

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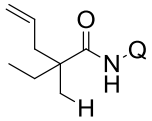

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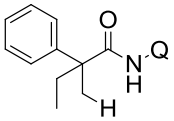

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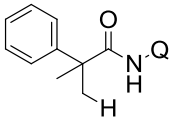

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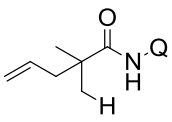

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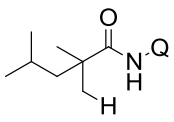

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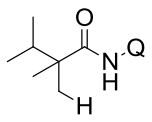

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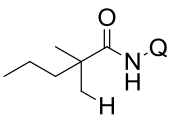

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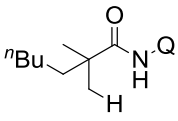

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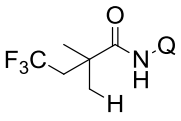

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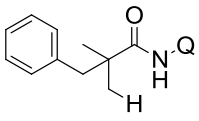

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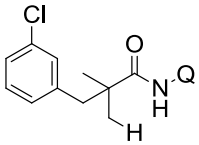

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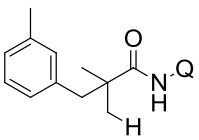

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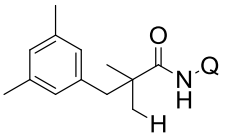

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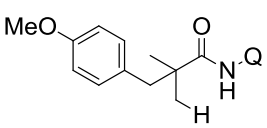

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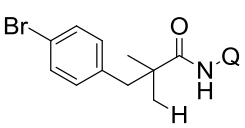

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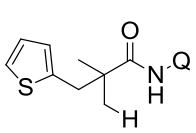

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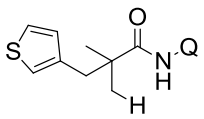

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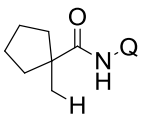

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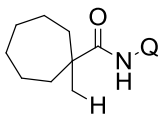

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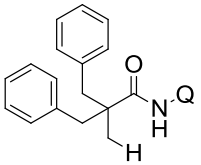

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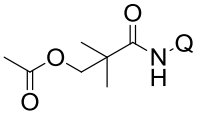

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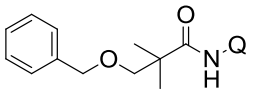

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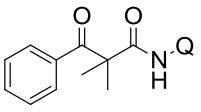

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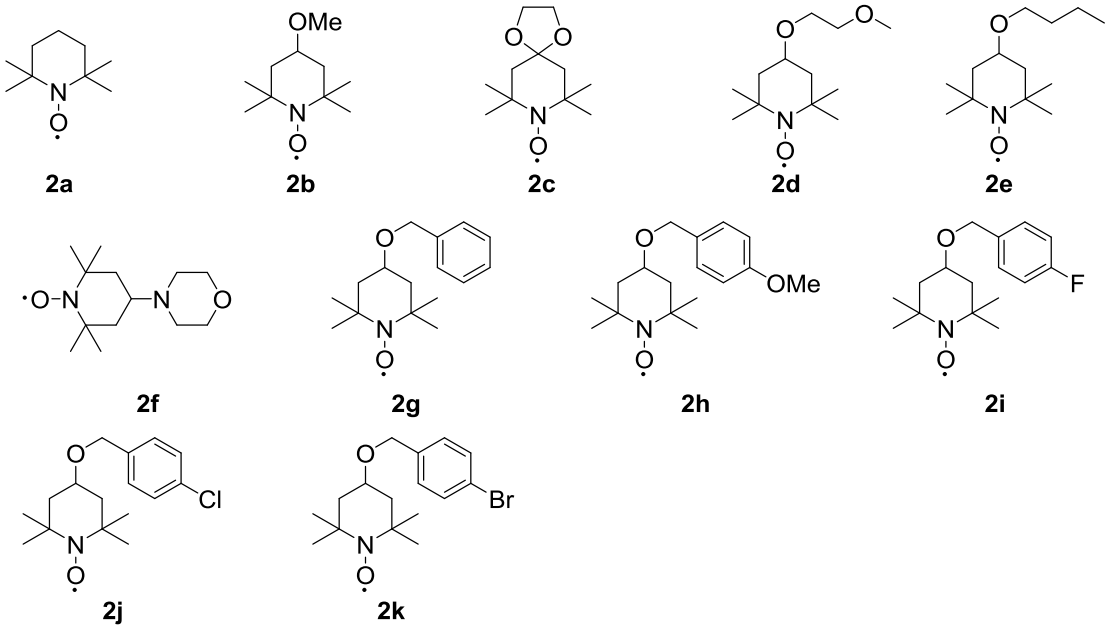
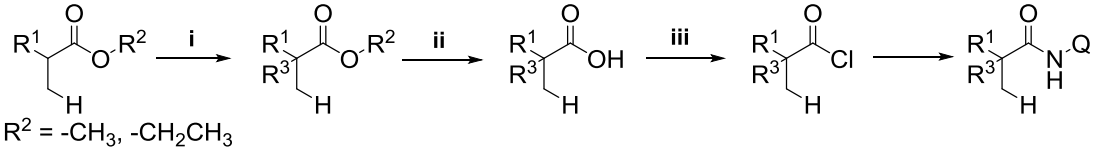
(ii) Stable Nitroxyl Radicals



III. Experimental Section

(i) Preparation of Substrates

Substrate **1:**



i: LDA, THF, R^3-X (X = I, Br), -78 °C - rt

ii: NaOH, MeOH/H_2O (1:1), reflux, HCl aq.

iii: oxaloyl chloride, DMF, DCM, 0 °C - rt

General procedure for the preparation of aliphatic amides: Acid chloride (for example: 1.19 g (*ca.* 8.0 mmol) of 2-ethyl-2-methylbutanoyl chloride) was added dropwise to a solution of 8-aminoquinoline (1.15 g, 8.0 mmol) and Et_3N (2.3 mL, 16 mmol) in CH_2Cl_2 (20 mL). The mixture was stirred overnight at room temperature. Then, the mixture was diluted with petroleum ether (50 mL), filtrated and concentrated under reduced pressure. The residue was next purified by flash column chromatography on silica gel to afford the corresponding aliphatic amide.

Substrate **2:**

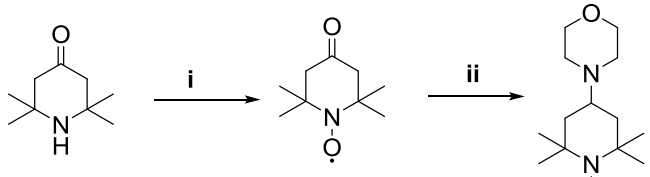
Stable nitroxyl radicals 2b, 2e, 2g and 2i-k:[3,4] To a vigorously stirred solution of 1.72 g (10 mmol) of 4-hydroxy-2,2,6,6-tetramethylpiperidinyl-1-oxy in 15 mL of

anhydrous DMF was added 0.36 g (15 mmol) of NaH. After the suspension was stirred under nitrogen, 15 mmol of halogen compound (for example: 0.93 mL of CH_3I) was added dropwise to the solution at 0 ^oC. The reaction mixture was stirred overnight at room temperature. Then, 50 mL of ether was added. The resulting mixture was washed with water and separated, and the ether layer was dried with anhydrous magnesium sulfate. The ether solution was concentrated in vacuo to give a red liquid. Finally, the residue was purified by flash column chromatography on silica gel to afford the desired product **2b** (1.60 g, 86%), **2e** (1.46 g, 64%), **2g** (1.57 g, 60%), **2i** (1.43 g, 51%), **2j** (1.66 g, 56%) and **2k** (1.64 g, 48%).

Stable nitroxyl radical 2c:[5] To a solution of 2,2,6,6-tetramethylpiperidin-4-one (1.55 g, 10 mmol) in benzene (100 mL) was added ethylene glycol (1.12 mL, 20 mmol) and *p*TsOH · H_2O (3.80 g, 20 mmol). The mixture was refluxed with a Dean-Stark apparatus for about 1 h. The solution was cooled to room temperature, and then adjusted to pH 10 using 10% K_2CO_3, followed by extraction with $CHCl_3$. The concentrated residue was purified with column chromatography to afford the precursor piperidine as yellow oil; Then this oil was dissolved in MeOH (2 mL), and H_2O_2 (0.7 ml, approx. 30%) and Na_2WO_4 $2H_2O$ (248 mg, 0.75 mmol) were added to this solution. This mixture was stirred at room temperature until the compound disappeared. Finally, the solution was quenched by K_2CO_3 and extracted with $CHCl_3$, dried with Na_2SO_4, and evaporated. The residue was chromatographed on silica gel with $CHCl_3$ as an eluent to afford red oil **2c** (1.54 g, 72%).

Stable nitroxyl radical 2d and 2h:[6] A vigorously stirred two phase solution of 1.50 g (8.5 mmol) 1-oxyl-2,2,6,6-tetramethyl-4-hydroxypiperidine, 12 mmol of alkyl/benzyl bromide (for example: 1.13 mL of 1-bromo-2-methoxyethane), 130 mg (0.4 mmol) of TBAB (tetrabutylammonium bromide), 5 mL of 50% aqueous sodium hydroxide and 1.5 mL toluene was heated at 70 ^oC for 2-12 h. Then, 50 mL of ether was added. The resulting mixture was washed with water and separated, and the ether layer was dried with anhydrous sodium sulfate. The ether solution was concentrated in vacuo to give viscous red liquid. Finally, the residue was purified by flash column chromatography on silica gel to afford the desired product **2d** (1.16 g, 59%) and **2h** (1.64 g, 66%).

Stable nitroxyl radical 2f:[7]



i: H_2O_2, C:Na_2WO_4, H_2O, MeOH, 5 d, rt

General procedure: 4-Oxo-TEMPO (1.70 g, 10 mmol) was dissolved in $Ti(O^iPr)_4$ (3.59 mL, 12 mmol). After 20 min of stirring at room temperature, morpholine (1.74 mL, 20 mmol) was added and the reaction was stirred for additional 2 h at room temperature. Subsequently EtOH (8.5 mL) and $NaCNBH_3$ (754 mg, 12 mmol) was added carefully and the resulting solution was stirred 12 h at room temperature. The reaction was quenched by adding water (10 mL) and the aqueous layer was extracted with EtOAc. The organic layer was dried over $NaSO_4$ and the solvent was removed in

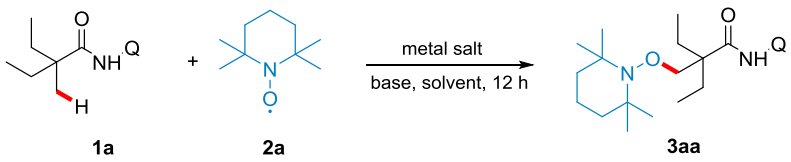
vacuo. The desired nitroxide was afforded as a red oily solid **2f** (0.92 g, 38%).

(ii) Nickel-Catalyzed Aminoxylation of Inert Aliphatic C(sp^3)−H Bonds with Stable Nitroxyl Radicals

A. Optimization of the aminoxylation of unactivated C(sp^3)−H bonds

General procedure for the optimization: A 25 mL Schlenk tube was charged with 2-ethyl-2-methyl-*N*-(quinolin-8-yl)butanamide **1a** (64.1 mg, 0.25 mmol), TEMPO **2a** (0.3-0.5 mmol), [cat.] (10-20 mol%), additive, base (0.3-0.5 mmol), and 0.3-0.5 mL of solvent. Then the tube was sealed, and stirred vigorously at 80-120 °C for 1-12 h. Solvents were removed in vacuo after the reaction finished, and the residue was purified by chromatography on silica gel column (gradient eluent of 5% EtOAc in petroleum ether, v/v) to give the desired product.

Table S1. Investigation of Non-precious Metal Catalysts for the Aminoxylation Template Reaction[a]

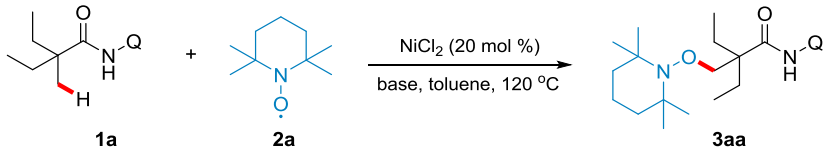


1a **2a** **3aa**

entry	metal catalyst	base	temperature (°C)	solvent	yield[b] (%)
1	$NiCl_2$	*t*-BuOLi	120	toluene	7
2	$CoCl_2$	*t*-BuOLi	120	toluene	n. d.
3	$CuCl_2$	*t*-BuOLi	120	toluene	n. d.
4	CuCl	*t*-BuOLi	120	toluene	n. d.

[a] Reaction conditions: **1a** (0.25 mmol), **2a** (2.0 equiv), catalyst (20 mol %) and *t*-BuOLi (2 equiv) were stirred in toluene (0.5 mL) at 120 °C for 12 h under an atmosphere of air. [b] Isolated yields. Q = 8-quinolinyl.

Table S2. Investigation of Bases for the Aminoxylation Reaction[a]



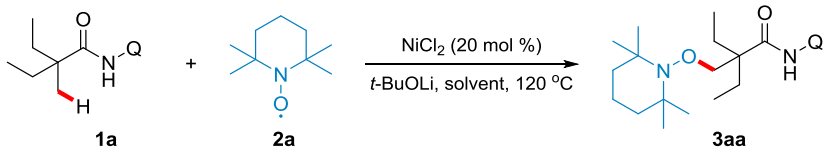
1a **2a** **3aa**

entry	base	yield[b] (%)	entry	base	yield[b] (%)
1	*t*-BuOLi	7	8	Na_2CO_3	n. d.
2	*t*-BuOK	n. d.	9	NaOAc	n. d.
3	*t*-BuONa	n. d.	10	PhCOONa	n. d.

4	K_3PO_4	n. d.	11	DIPEA	n. d.
5	K_2HPO_4	n. d.	12	DBU	n. d.
6	K_2CO_3	n. d.	13	CsF	n. d.
7	Li_2CO_3	n. d.	-	-	-

[a] Reaction conditions: **1a** (0.25 mmol), **2a** (2.0 equiv), $NiCl_2$ (20 mol %) and base (2.0 equiv) were stirred in toluene (0.5 mL) at 120 °C for 12 h under an atmosphere of air. [b] Isolated yields. Q = 8-quinolinyl.

Table S3. Investigation of Solvents for the Aminoxylation Reaction[a]

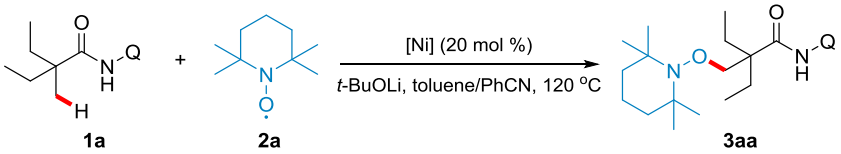


1a **2a** **3aa**

entry	solvent	yield[b] (%)	entry	solvent	yield[b] (%)
1	toluene	7	6	DMSO	n. d.
2	dioxane	n. d.	7	MeCN	n. d.
3	DCE	n. d.	8	NMP	n. d.
4	DMF	n. d.	9	PhCN	21
5	DMA	n. d.	10[c]	toluene/PhCN	20

[a] Reaction conditions: **1a** (0.25 mmol), **2a** (2.0 equiv), $NiCl_2$ (20 mol %) and *t*-BuOLi (2.0 equiv) were stirred in solvent (0.5 mL) at 120 °C for 12 h under an atmosphere of air. [b] Isolated yields. [c] 0.5 mL of toluene and 4.0 equiv of PhCN. Q = 8-quinolinyl.

Table S4. Investigation of Catalysts for the Aminoxylation Reaction[a]



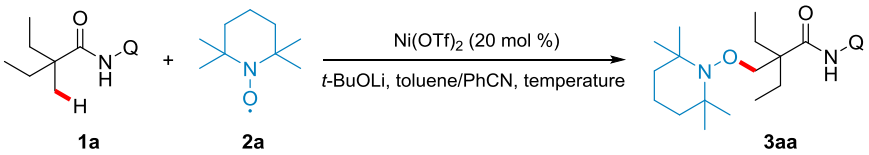
1a **2a** **3aa**

entry	catalyst	yield[b] (%)	entry	catalyst	yield[b] (%)
1	$NiCl_2$	20	5	$Ni(cod)_2$	45
2	$Ni(OAc)_2$	20	6	$Ni(dppe)Cl_2$	61
3	$Ni(OTf)_2$	83	7	$Ni(dme)_2Cl_2$	64
4	$NiBr_2$	35	-	-	-

[a] Reaction conditions: **1a** (0.25 mmol), **2a** (2.0 equiv), [Ni] (20 mol %), PhCN (1.0 mmol) and *t*-BuOLi (2.0 equiv) were stirred in toluene (0.5 mL) at 120 °C for 12 h under an atmosphere of

air. [b] Isolated yields. Q = 8-quinolinyl.

Table S5. Investigation of Other Factors for the Aminoxylation Reaction[a]



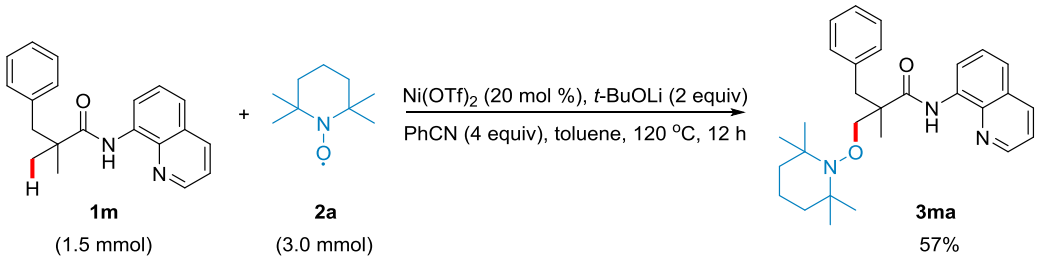
entry	other factors	yield[b] (%)	entry	other factors	yield[b] (%)
1	100 °C	51	8	6 h	81
2	80 °C	trace	9	3 h	60
3	tempo (1.2 equiv)	68	10	1 h	21
4	base (1.2 equiv)	51	11	$Ni(OTf)_2$ (10 mol %)	62
5[c]	toluene/PhCN	83	12	O_2	82
6	toluene	65	13	N_2	69
7	12 h	81	-	-	-

[a] Reaction conditions: **1a** (0.25 mmol), **2a** (2.0 equiv), $Ni(OTf)_2$ (20 mol %), PhCN (1.0 mmol) and *t*-BuOLi (2.0 equiv) were stirred in solvent (0.5 mL) at 120 ℃ for 12 h under an atmosphere of air. [b] Isolated yields. [c] 0.3 mL toluene and 0.2 mL PhCN. Q = 8-quinolinyl.

B. Investigation of substrate scopes

General procedure for the nickel-catalyzed aminoxylation of inert aliphatic C(sp^3)−H bonds with stable nitroxyl radical: A 25 mL Schlenk tube was charged with the *α*, *α*, *α*-trisubstituted *N*-(quinolin-8-yl)acetamides **1** (0.25 mmol), stable nitroxyl radical **2** (0.50 mmol), $Ni(OTf)_2$ (17.8 mg, 20 mol %), cyanobenzene (102 μL, 1.0 mmol), *t*-BuOLi (40.0 mg, 0.5 mmol), and 0.5 mL of toluene. Then the tube was sealed, and stirred vigorously at 120-140 ℃ for 6-24 h. Solvents were removed in vacuo after the reaction finished, and the residue was purified by chromatography on silica gel column (gradient eluent of 5% EtOAc in petroleum ether, v/v) to give the desired product.

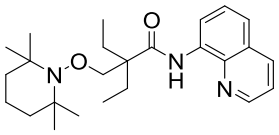
C. Example performed on a 1.5 mmol scale



Procedure for the nickel-catalyzed aminoxylation of inert aliphatic C(sp^3)−H bonds with TEMPO on a 1.5 mmol scale: A 100 mL Schlenk tube was charged with the 2,2-dimethyl-3-phenyl-*N*-(quinolin-8-yl)propanamide **1m** (456.6 mg, 1.50 mmol),

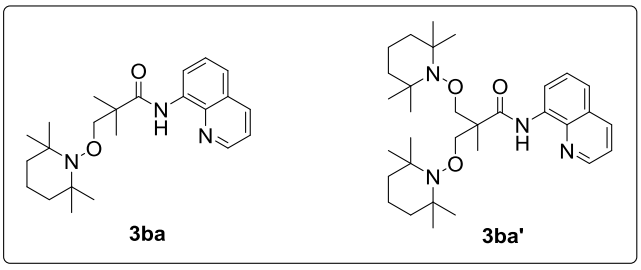
TEMPO **2a** (468.7 mg, 3.0 mmol), $Ni(OTf)_2$ (107.0 mg, 20 mol %), cyanobenzene (613 μL, 6.0 mmol), *t*-BuOLi (240.2 mg, 3.0 mmol), and 3.0 mL of toluene. Then the tube was sealed, and stirred vigorously at 120 ℃ for 12 h. Solvents were removed in vacuo after the reaction finished, and the residue was purified by chromatography on silica gel column (gradient eluent of 5% EtOAc in petroleum ether, v/v) to give the desired product **3ma** as colorless oil (395.5 mg, 57%).

D. Experimental data for the described substances



2-Ethyl-*N*-(quinolin-8-yl)-2-(((2,2,6,6-tetramethylpiperidin-1-yl)oxy)methyl)butanamide (3aa)

Following the general procedure. **1a** (64.1 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3aa** as colorless oil (83.3 mg, 81% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.94-0.98 (m, 12H), 1.15 (s, 6H), 1.36-1.45 (m, 6H), 1.79-1.88 (m, 2H), 1.98-2.05 (m, 2H), 3.94 (s, 2H), 7.42 (dd, *J* = 8.0 Hz, 4.0 Hz, 1H), 7.45-7.54 (m, 2H), 8.13 (d, *J* = 8.0 Hz, 1H), 8.80 (d, *J* = 3.6 Hz, 1H), 8.84 (d, *J* = 7.6 Hz, 1H), 10.41 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 8.5, 17.2, 20.3, 24.3, 29.8, 33.1, 40.0, 51.9, 60.2, 78.7, 116.4, 121.1, 121.5, 127.6, 128.0, 135.0, 136.2, 139.0, 148.1, 174.4 ppm. HRMS (ESI^+): calcd for $C_{25}H_{38}N_3O_2$ $[M+H]^+$ 412.2959, found 412.2962.

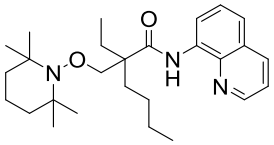


Following the general procedure. **1b** (57.1 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3ba** as colorless oil (66.2 mg, 69% yield) and **3ba´** as colorless oil (37.7 mg, 28% yield).

2,2-Dimethyl-*N*-(quinolin-8-yl)-3-((2,2,6,6-tetramethylpiperidin-1-yl)oxy)propanamide (3ba). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.01 (s, 6H), 1.16 (s, 6H), 1.25-1.27 (m, 1H), 1.35-1.46 (m, 11H), 3.91 (s, 2H), 7.43 (dd, *J* = 8.0 Hz, 4.0 Hz, 1H), 7.47-7.55 (m, 2H), 8.14 (dd, *J* = 8.0 Hz, 0.8 Hz, 1H), 8.80-8.82 (m, 2H), 10.40 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.1, 20.3, 23.3, 33.1, 39.9, 44.9, 60.3, 82.7, 116.4, 121.2, 121.6, 127.6, 128.0, 135.0, 136.3, 139.0, 148.2, 175.2 ppm. HRMS

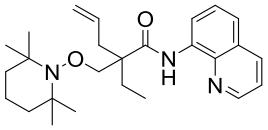
(ESI$^+$): calcd for $C_{23}H_{34}N_3O_2$ $[M+H]^+$ 384.2646, found 384.2649.

2-Methyl-N-(quinolin-8-yl)-3-((2,2,6,6-tetramethylpiperidin-1-yl)oxy)-2-(((2,2,6,6-tetramethylpiperidin-1-yl)oxy)methyl)propanamide (3ba′). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.94 (s, 6H), 1.07 (s, 6H), 1.13 (s, 6H), 1.18 (s, 6H), 1.25-1.44 (m, 12H), 1.66 (s, 3H), 3.90 (ABq, *J* = 8.4 Hz, 2H), 4.17 (ABq, *J* = 8.4 Hz, 2H), 7.41 (dd, *J* = 8.0 Hz, 4.0 Hz, 1H), 7.46-7.54 (m, 2H), 8.12 (d, *J* = 8.4 Hz, 1H), 8.77 (d, *J* = 3.2 Hz, 1H), 8.84 (d, *J* = 7.6 Hz, 1H), 10.51 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.1, 18.5, 20.2, 20.4, 33.1, 33.2, 39.9, 49.9, 60.3, 79.6, 116.4, 121.1, 121.5, 127.6, 128.0, 135.1, 136.1, 138.9, 148.0, 173.0 ppm. HRMS (ESI$^+$): calcd for $C_{32}H_{51}N_4O_3$ $[M+H]^+$ 539.3956, found 539.3957.



2-Ethyl-*N*-(quinolin-8-yl)-2-(((2,2,6,6-tetramethylpiperidin-1-yl)oxy)methyl)hexanamide (3ca)

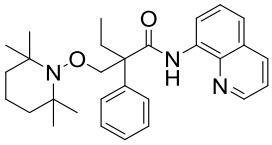
Following the general procedure. **1c** (71.1 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3ca** as colorless oil (100.0 mg, 91% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.91 (t, *J* = 7.2 Hz, 3H), 0.94-1.00 (m, 9H), 1.15 (d, *J* = 4.4 Hz, 6H), 1.25-1.44 (m, 10H), 1.69-1.77 (m, 1H), 1.84-1.95 (m, 2H), 1.98-2.07 (m, 1H), 3.94 (q, *J* = 10.4 Hz, 9.2 Hz, 2H), 7.41 (dd, *J* = 8.0 Hz, 4.0 Hz, 1H), 7.44-7.54 (m, 2H), 8.12 (d, *J* = 7.2 Hz, 1H), 8.79-8.84 (m, 2H), 10.41 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 8.6, 14.1, 17.1, 20.28, 20.31, 23.5, 24.8, 26.1, 31.6, 33.08, 33.09, 40.0, 51.6, 60.2, 78.9, 116.4, 121.0, 121.5, 127.5, 128.0, 135.0, 136.2, 139.0, 148.1, 174.5 ppm. HRMS (ESI$^+$): calcd for $C_{27}H_{42}N_3O_2$ $[M+H]^+$ 440.3272, found 440.3272.



2-Ethyl-*N*-(quinolin-8-yl)-2-(((2,2,6,6-tetramethylpiperidin-1-yl)oxy)methyl)pent-4-enamide (3da)

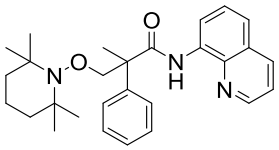
Following the general procedure. **1d** (67.1 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3da** as colorless oil (46.6 mg, 44% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.96-1.04 (m, 9H), 1.14 (d, *J* = 7.6 Hz, 6H), 1.25-1.45 (m, 6H), 1.77-1.86 (m, 1H), 2.04-2.13 (m, 1H), 2.57-2.62 (m, 1H), 2.70-2.75 (m, 1H),

3.95 (q, J = 13.6 Hz, 8.8 Hz, 2H), 5.10 (d, J = 9.6 Hz, 1H), 5.19 (dd, J = 16.8 Hz, 1.2 Hz, 1H), 5.81-5.92 (m, 1H), 7.43 (dd, J = 8.4 Hz, 4.4 Hz, 1H), 7.47-7.55 (m, 2H), 8.14 (dd, J = 8.4 Hz, 1.6 Hz, 1H), 8.79-8.83 (m, 2H), 10.44 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 8.5, 17.1, 20.3, 20.4, 25.4, 33.1, 33.2, 36.1, 40.1, 51.7, 60.3, 79.3, 116.5, 118.4, 121.2, 121.6, 127.6, 128.0, 133.9, 135.0, 136.2, 139.0, 148.2, 173.8 ppm. HRMS (ESI^+): calcd for $C_{26}H_{38}N_3O_2$ $[M+H]^+$ 424.2959, found 424.2961.



2-Phenyl-*N*-(quinolin-8-yl)-2-(((2,2,6,6-tetramethylpiperidin-1-yl)oxy)methyl)butanamide (3ea)

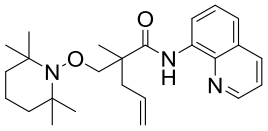
Following the general procedure. **1e** (76.1 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3ea** as colorless oil (58.6 mg, 51% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.87 (s, 3H), 0.92-0.96 (m, 9H), 1.08 (s, 3H), 1.23-1.43 (m, 6H), 2.30-2.39 (m, 1H), 2.44-2.53 (m, 1H), 4.33 (ABq, J = 8.4 Hz, 1H), 4.45 (ABq, J = 8.8 Hz, 1H), 7.24-7.28 (m, 1H), 7.33-7.37 (m, 3H), 7.43-7.45 (m, 3H), 7.52 (t, J = 7.6 Hz, 1H), 8.07 (d, J = 8.0 Hz, 1H), 8.59 (d, J = 2.8 Hz, 1H), 8.80 (d, J = 7.6 Hz, 1H), 9.90 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 9.2, 17.1, 20.2, 20.4, 26.7, 32.6, 33.1, 40.1, 57.2, 60.2, 77.9, 116.3, 121.2, 121.5, 127.0, 127.5, 127.88, 127.94, 128.4, 134.8, 136.1, 138.8, 141.6, 148.2, 173.5 ppm. HRMS (ESI^+): calcd for $C_{29}H_{38}N_3O_2$ $[M+H]^+$ 460.2959, found 460.2967.



2-Methyl-2-phenyl-*N*-(quinolin-8-yl)-3-((2,2,6,6-tetramethylpiperidin-1-yl)oxy)propanamide (3fa)

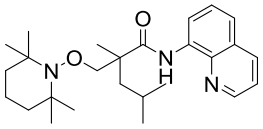
Following the general procedure. **1f** (72.6 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3fa** as colorless oil (57.9 mg, 52% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.96 (s, 3H), 1.00 (s, 3H), 1.10 (s, 3H), 1.16 (s, 3H), 1.25-1.46 (m, 6H), 1.93 (s, 3H), 4.28 (ABq, J = 8.4 Hz, 1H), 4.50 (ABq, J = 8.4 Hz, 1H), 7.26-7.30 (m, 1H), 7.34-7.38 (m, 3H), 7.44-7.46 (m, 1H), 7.50-7.54 (m, 3H), 8.08 (dd, J = 8.4 Hz, 1.2 Hz, 1H), 8.63 (dd, J = 4.4 Hz, 1.2 Hz, 1H), 8.82 (d, J = 7.6 Hz, 1H) 10.04 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.1, 20.3, 20.4, 22.6, 32.9, 33.0, 40.0, 53.1, 60.3, 81.2, 116.3, 121.3, 121.5, 127.1, 127.2, 127.5, 127.9,

128.5, 134.8, 136.1, 138.8, 142.4, 148.2, 173.6 ppm. HRMS (ESI^+): calcd for $C_{28}H_{36}N_3O_2$ $[M+H]^+$ 446.2802, found 446.2807.



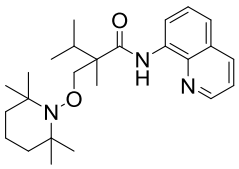
2-Methyl-*N*-(quinolin-8-yl)-2-(((2,2,6,6-tetramethylpiperidin-1-yl)oxy)methyl)pent-4-enamide (3ga)

Following the general procedure. **1g** (63.6 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3ga** as colorless oil (46.5 mg, 45% yield). ^1H NMR (400 MHz, $CDCl_3$): δ = 0.97 (s, 3H), 1.03 (s, 3H), 1.16 (d, J = 7.2 Hz, 6H), 1.25-1.45 (m, 6H), 1.48 (s, 3H), 2.34 (dd, J = 14.0 Hz, 8.0 Hz, 1H), 2.80 (dd, J = 13.6 Hz, 6.8 Hz, 1H), 3.84 (ABq, J = 8.0 Hz, 1H), 4.03 (ABq, J = 8.4 Hz, 1H), 5.06 (d, J = 10.0 Hz, 1H), 5.14 (d, J = 17.2 Hz, 1H), 5.78-5.89 (m, 1H), 7.43 (dd, J = 8.4 Hz, 4.4 Hz, 1H), 7.46-7.55 (m, 2H), 8.13 (d, J = 8.0 Hz, 1H), 8.79-8.82 (m, 2H), 10.39 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.1, 19.7, 20.2, 20.4, 33.06, 33.13, 40.0, 41.2, 48.4, 60.3, 81.9, 116.4, 118.6, 121.2, 121.6, 127.6, 128.0, 133.7, 134.9, 136.2, 139.0, 148.2, 173.9 ppm. HRMS (ESI^+): calcd for $C_{25}H_{36}N_3O_2$ $[M+H]^+$ 410.2802, found 410.2804.



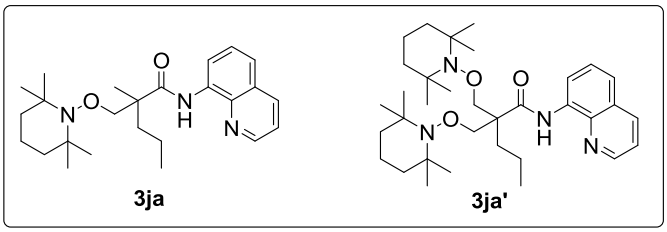
2,4-Dimethyl-*N*-(quinolin-8-yl)-2-(((2,2,6,6-tetramethylpiperidin-1-yl)oxy)methyl)pentanamide (3ha)

Following the general procedure. **1h** (67.6 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3ha** as colorless oil (56.6 mg, 53% yield). ^1H NMR (400 MHz, $CDCl_3$): δ = 0.84 (d, J = 6.8 Hz, 3H), 0.91 (s, 3H), 0.94 (d, J = 6.4 Hz, 3H), 1.01 (s, 3H), 1.15 (s, 6H), 1.23-1.43 (m, 7H), 1.55 (s, 3H), 1.77-1.85 (m, 1H), 2.01 (dd, J = 14.0 Hz, 7.6 Hz, 1H), 3.73 (ABq, J = 8.0 Hz, 1H), 3.99 (ABq, J = 8.0 Hz, 1H), 7.43 (dd, J = 8.0 Hz, 4.0 Hz, 1H), 7.46-7.55 (m, 2H), 8.14 (d, J = 8.4 Hz, 1H), 8.80-8.82 (m, 2H), 10.40 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.1, 19.4, 20.1, 20.4, 23.3, 24.7, 25.2, 32.9, 33.2, 39.89, 39.94, 45.3, 48.4, 60.28, 60.33, 83.2, 116.4, 121.1, 121.6, 127.6, 128.0, 135.0, 136.2, 139.0, 148.2, 174.7 ppm. HRMS (ESI^+): calcd for $C_{26}H_{40}N_3O_2$ $[M+H]^+$ 426.3115, found 426.3116.



2,3-Dimethyl-*N*-(quinolin-8-yl)-2-(((2,2,6,6-tetramethylpiperidin-1-yl)oxy)methyl)butanamide (3ia)

Following the general procedure. **1i** (64.1 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3ia** as colorless oil (71.5 mg, 69% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.85 (s, 3H), 0.91 (d, J = 6.8 Hz, 3H), 0.96 (d, J = 6.8 Hz, 3H), 1.01 (s, 3H), 1.17 (s, 6H), 1.24-1.44 (m, 9H), 2.32-2.39 (m, 1H), 3.80 (ABq, J = 8.0 Hz, 1H), 4.13 (ABq, J = 8.4 Hz, 1H), 7.43 (dd, J = 8.0 Hz, 4.0 Hz, 1H), 7.46-7.55 (m, 2H), 8.14 (dd, J = 8.4 Hz, 1.6 Hz, 1H), 8.80 (dd, J = 4.4 Hz, 1.6 Hz, 1H), 8.85 (dd, J = 7.6 Hz, 1.2 Hz, 1H), 10.34 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 13.8, 17.1, 17.5, 18.3, 20.1, 20.4, 32.5, 33.0, 33.1, 40.0, 51.9, 60.3, 81.6, 116.4, 121.1, 121.5, 127.6, 128.0, 135.0, 136.3, 139.0, 148.2, 174.7 HRMS (ESI$^+$): calcd for $C_{25}H_{38}N_3O_2$ $[M+H]^+$ 412.2959, found 412.2959.

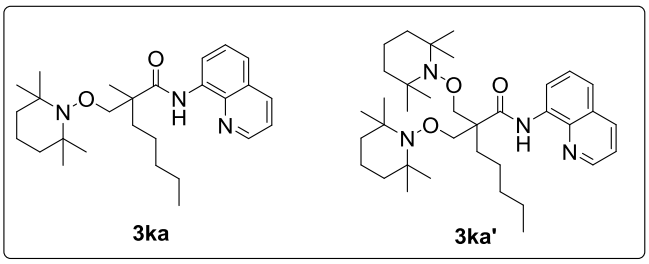


Following the general procedure. **1j** (64.1 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3ja** as colorless oil (66.0 mg, 64% yield) and **3ja´** as colorless oil (23.0 mg, 16% yield).

2-Methyl-*N*-(quinolin-8-yl)-2-(((2,2,6,6-tetramethylpiperidin-1-yl)oxy)methyl)pen tanamide (3ja). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.92 (t, J = 7.2 Hz, 3H), 0.96 (s, 3H), 1.02 (s, 3H), 1.16 (d, J = 6.4 Hz, 6H), 1.25-1.54 (m, 12H), 1.94-2.02 (m, 1H), 3.81 (ABq, J = 8.4 Hz, 1H), 4.02 (ABq, J = 8.4 Hz, 1H), 7.43 (dd, J = 8.4 Hz, 4.4 Hz, 1H), 7.46-7.55 (m, 2H), 8.13 (dd, J = 8.4 Hz, 1.6 Hz, 1H), 8.79-8.83 (m, 2H), 10.38 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 14.8, 17.1, 17.7, 19.6, 20.2, 20.4, 33.0, 33.2, 39.2, 39.9, 48.6, 60.3, 82.3, 116.3, 121.1, 121.6, 127.6, 128.0, 135.0, 136.2, 139.0, 148.2, 174.5 ppm. HRMS (ESI$^+$): calcd for $C_{25}H_{38}N_3O_2$ $[M+H]^+$ 412.2959, found 412.2962.

***N*-(Quinolin-8-yl)-2,2-bis(((2,2,6,6-tetramethylpiperidin-1-yl)oxy)methyl)pentana mide (3ja´).** ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.96-0.99 (m, 9H), 1.10 (s, 6H), 1.16 (s, 6H), 1.22 (s, 6H), 1.32-1.49 (m, 14H), 2.09-2.13 (m, 2H), 4.05 (ABq, J = 9.2 Hz, 2H), 4.16 (ABq, J = 9.2 Hz, 2H), 7.41 (dd, J = 8.0 Hz, 4.0 Hz, 1H), 7.46-7.54 (m, 2H), 8.12 (d, J = 8.0 Hz, 1H), 8.77 (d, J = 4.0 Hz, 1H), 8.80 (d, J = 7.2 Hz, 1H), 10.61 (s,

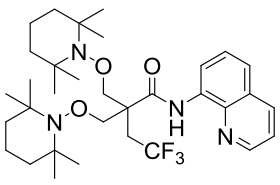
1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 15.0, 17.2, 17.8, 20.4, 20.5, 33.2, 33.3, 33.6, 40.1, 52.9, 60.1-60.2 (m), 77.4, 116.6, 121.1, 121.5, 127.6, 128.0, 135.2, 136.0, 139.0, 147.9, 173.1 ppm. HRMS (ESI$^+$): calcd for $C_{34}H_{55}N_4O_3$ $[M+H]^+$ 567.4269, found 567.4280.



Following the general procedure. **1k** (71.1 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3ka** as colorless oil (69.4 mg, 63% yield) and **3ka´** as colorless oil (22.5 mg, 15% yield).

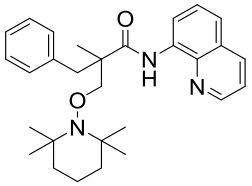
2-Methyl-*N*-(quinolin-8-yl)-2-(((2,2,6,6-tetramethylpiperidin-1-yl)oxy)methyl)heptanamide (3ka). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.83 (t, *J* = 6.4 Hz, 3H), 0.96 (s, 3H), 1.01 (s, 3H), 1.16 (d, *J* = 5.2 Hz, 6H), 1.27-1.55 (m, 16H), 1.97-2.03 (m, 1H), 3.81 (ABq, *J* = 8.0 Hz, 1H), 4.01 (ABq, *J* = 8.4 Hz, 1H), 7.42 (dd, *J* = 8.0 Hz, 4.0 Hz, 1H), 7.46-7.55 (m, 2H), 8.13 (d, *J* = 8.0 Hz, 1H), 8.79-8.83 (m, 2H), 10.38 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 14.2, 17.1, 19.7, 20.2, 20.4, 22.6, 24.0, 32.6, 33.0, 33.2, 36.8, 39.9, 48.6, 60.3, 82.3, 116.3, 121.1, 121.6, 127.6, 128.0, 135.0, 136.2, 138.9, 148.1, 174.5 ppm. HRMS (ESI$^+$): calcd for $C_{27}H_{42}N_3O_2$ $[M+H]^+$ 440.3272, found 440.3274.

***N*-(Quinolin-8-yl)-2,2-bis(((2,2,6,6-tetramethylpiperidin-1-yl)oxy)methyl)heptanamide (3ka´).** ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.83 (t, *J* = 6.8 Hz, 3H), 0.97 (s, 6H), 1.10 (s, 6H), 1.16 (s, 6H), 1.22 (s, 6H), 1.25-1.46 (m, 18H), 2.10-2.14 (m, 2H), 4.05 (ABq, *J* = 9.2 Hz, 2H), 4.16 (ABq, *J* = 9.2 Hz, 2H), 7.41 (dd, *J* = 8.0 Hz, 4.0 Hz, 1H), 7.46-7.54 (m, 2H), 8.13 (d, *J* = 8.4 Hz, 1H), 8.76 (d, *J* = 4.0 Hz, 1H), 8.80 (d, *J* = 7.2 Hz, 1H), 10.60 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 14.2, 17.2, 20.3-20.5 (m), 22.6, 24.1, 31.3, 32.8, 33.2-33.3 (m), 40.1, 52.9, 60.1-60.3 (m), 77.4, 116.7, 121.1, 121.5, 127.6, 128.0, 135.2, 136.0, 139.0, 147.9, 173.1 ppm. HRMS (ESI$^+$): calcd for $C_{36}H_{59}N_4O_3$ $[M+H]^+$ 595.4582, found 595.4592.



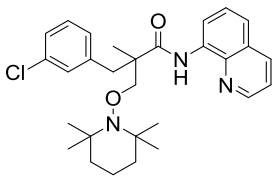
4,4,4-Trifluoro-*N*-(quinolin-8-yl)-2,2-bis(((2,2,6,6-tetramethylpiperidin-1-yl)oxy) methyl)butanamide (3la)

Following the general procedure. **1l** (74.1 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3la** as colorless oil (100.5 mg, 66% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.04-1.08 (m, 18H), 1.16 (s, 6H), 1.26-1.45 (m, 12H), 3.01 (ABq, *J* = 12.0 Hz, 1H), 3.73 (ABq, *J* = 12.0 Hz, 1H), 4.20 (ABq, *J* = 9.6 Hz, 2H), 4.37 (ABq, *J* = 9.6 Hz, 2H), 7.41 (dd, *J* = 8.4 Hz, 4.4 Hz, 1H), 7.48-7.56 (m, 2H), 8.13 (d, *J* = 8.4 Hz, 1H), 8.73 (d, *J* = 2.0 Hz, 1H), 8.80 (d, *J* = 7.2 Hz, 1H), 10.80 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.1, 20.2-20.4 (m), 20.5-20.6 (m), 32.9-33.0 (m), 33.2-33.3 (m), 34.9, 35.2, 40.1, 50.35-50.37 (m), 60.3-60.4 (m), 76.9, 117.1, 121.52, 121.53, 127.5, 128.0, 134.9, 136.0, 138.8, 147.8, 170.2 ppm. HRMS (ESI$^+$): calcd for $C_{33}H_{50}F_3N_4O_3$ $[M+H]^+$ 607.3830, found 607.3836.



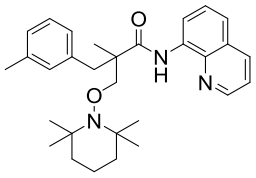
2-Benzyl-2-methyl-*N*-(quinolin-8-yl)-3-((2,2,6,6-tetramethylpiperidin-1-yl)oxy)pr opanamide (3ma)

Following the general procedure. **1m** (76.1 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3ma** as colorless oil (68.9 mg, 60% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.92 (s, 3H), 1.07 (s, 3H), 1.16 (s, 3H), 1.22 (s, 3H), 1.27-1.48 (m, 9H), 2.74 (ABq, *J* = 13.6 Hz, 1H), 3.46 (ABq, *J* = 13.6 Hz, 1H), 3.84 (ABq, *J* = 8.4 Hz, 1H), 4.22 (ABq, *J* = 8.4 Hz, 1H), 7.10-7.21 (m, 5H), 7.40 (dd, *J* = 8.0 Hz, 4.0 Hz, 1H), 7.47-7.57 (m, 2H), 8.12 (d, *J* = 8.4 Hz, 1H), 8.74 (d, *J* = 4.0 Hz, 1H), 8.86 (d, *J* = 7.6 Hz, 1H), 10.33 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.1, 19.1, 20.1, 20.4, 33.0, 33.2, 39.9, 40.0, 42.7, 49.8, 60.3, 60.4, 82.5, 116.4, 121.3, 121.5, 126.5, 127.5, 128.0, 128.1, 130.4, 134.8, 136.2, 137.4, 138.9, 148.2, 173.7 ppm. HRMS (ESI$^+$): calcd for $C_{29}H_{38}N_3O_2$ $[M+H]^+$ 460.2959, found 460.2959.



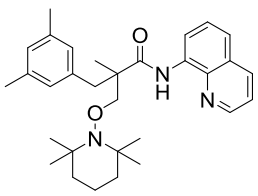
2-(3-Chlorobenzyl)-2-methyl-*N*-(quinolin-8-yl)-3-((2,2,6,6-tetramethylpiperidin-1 -yl)oxy)propanamide (3na)

Following the general procedure. **1n** (84.7 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3na** as colorless oil (90.4 mg, 73% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.92 (s, 3H), 1.08 (s, 3H), 1.16 (s, 3H), 1.20 (s, 3H), 1.26-1.49 (m, 9H), 2.69 (ABq, *J* = 13.2 Hz, 1H), 3.42 (ABq, *J* = 13.6 Hz, 1H), 3.84 (ABq, *J* = 8.0 Hz, 1H), 4.18 (ABq, *J* = 8.4 Hz, 1H), 7.06-7.09 (m, 3H), 7.20 (s, 1H), 7.41 (dd, *J* = 8.4 Hz, 4.0 Hz, 1H), 7.48-7.56 (m, 2H), 8.13 (dd, *J* = 8.0 Hz, 1.6 Hz, 1H), 8.74 (dd, *J* = 4.0 Hz, 1.6 Hz, 1H), 8.82 (dd, *J* = 7.6 Hz, 1.6 Hz, 1H), 10.30 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.1, 19.2, 20.1, 20.4, 33.0, 33.2, 39.91, 39.94, 42.3, 49.7, 60.35, 60.39, 82.3, 116.5, 121.4, 121.6, 126.7, 127.5, 128.0, 128.5, 129.4, 130.6, 133.8, 134.6, 136.2, 138.9, 139.5, 148.2, 173.3 ppm. HRMS (ESI^+): calcd for $C_{29}H_{37}ClN_3O_2$ $[M+H]^+$ 494.2569, found 494.2572.



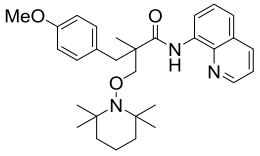
2-Methyl-2-(3-methylbenzyl)-*N*-(quinolin-8-yl)-3-((2,2,6,6-tetramethylpiperidin-1-yl)oxy)propanamide (3oa)

Following the general procedure. **1o** (79.6 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3oa** as colorless oil (85.5 mg, 72% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.93 (s, 3H), 1.07 (s, 3H), 1.15 (s, 3H), 1.21 (s, 3H), 1.23-1.44 (m, 6H), 1.46 (s, 3H), 2.13 (s, 3H), 2.70 (ABq, *J* = 13.6 Hz, 1H), 3.38 (ABq, *J* = 13.2 Hz, 1H), 3.83 (ABq, *J* = 8.0 Hz, 1H), 4.20 (ABq, *J* = 8.4 Hz, 1H), 6.91 (d, *J* = 7.6 Hz, 1H), 6.97-7.06 (m, 3H), 7.42 (dd, *J* = 8.4 Hz, 4.4 Hz, 1H), 7.47-7.56 (m, 2H), 8.14 (dd, *J* = 8.0 Hz, 1.6 Hz, 1H), 8.74 (dd, *J* = 4.0 Hz, 1.6 Hz, 1H), 8.83 (dd, *J* = 7.6 Hz, 1.6 Hz, 1H), 10.29 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.1, 19.2, 20.1, 20.4, 21.4, 33.0, 33.2, 39.89, 39.94, 42.7, 49.7, 60.3, 60.4, 82.4, 116.4, 121.2, 121.5, 127.2, 127.4, 127.5, 127.9, 128.0, 131.2, 134.8, 136.2, 137.2, 137.5, 138.9, 148.1, 173.8 ppm. HRMS (ESI^+): calcd for $C_{30}H_{40}N_3O_2$ $[M+H]^+$ 474.3115, found 474.3108.



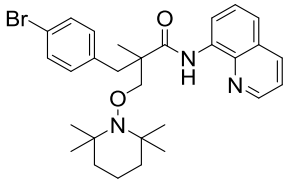
2-(3,5-Dimethylbenzyl)-2-methyl-*N*-(quinolin-8-yl)-3-((2,2,6,6-tetramethylpiperidin-1-yl)oxy)propanamide (3pa)

Following the general procedure. **1p** (83.1 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3pa** as colorless oil (62.6 mg, 51% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.95 (s, 3H), 1.08 (s, 3H), 1.16 (s, 3H), 1.22 (s, 3H), 1.26-1.44 (m, 6H), 1.47 (s, 3H), 2.09 (s, 6H), 2.68 (ABq, *J* = 13.2 Hz, 1H), 3.33 (ABq, *J* = 13.2 Hz, 1H), 3.84 (ABq, *J* = 8.0 Hz, 1H), 4.21 (ABq, *J* = 8.4 Hz, 1H), 6.72 (s, 1H), 6.78 (s, 2H), 7.41 (dd, *J* = 8.4 Hz, 4.4 Hz, 1H), 7.47-7.56 (m, 2H), 8.13 (dd, *J* = 8.4 Hz, 1.6 Hz, 1H), 8.74 (dd, *J* = 4.4 Hz, 1.6 Hz, 1H), 8.83 (dd, *J* = 7.6 Hz, 1.2 Hz, 1H), 10.27 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.1, 19.2, 20.2, 20.5, 21.2, 33.0, 33.2, 39.95, 40.00, 42.8, 49.8, 60.3, 60.4, 82.4, 116.5, 121.2, 121.5, 127.5, 128.0, 128.1, 128.3, 134.8, 136.2, 137.1, 137.4, 139.0, 148.1, 173.9 ppm. HRMS (ESI$^+$): calcd for $C_{31}H_{42}N_3O_2$ $[M+H]^+$ 488.3272, found 488.3262.



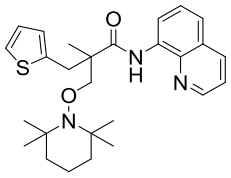
2-(4-Methoxybenzyl)-2-methyl-N-(quinolin-8-yl)-3-((2,2,6,6-tetramethylpiperidin-1-yl)oxy)propanamide (3qa)

Following the general procedure. **1q** (83.6 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3qa** as colorless oil (77.4 mg, 63% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.92 (s, 3H), 1.06 (s, 3H), 1.15 (s, 3H), 1.20 (s, 3H), 1.24-1.44 (m, 6H), 1.46 (s, 3H), 2.68 (ABq, *J* = 13.6 Hz, 1H), 3.38 (ABq, *J* = 13.6 Hz, 1H), 2.59-2.67 (m, 4H), 2.72-2.80 (m, 2H), 3.29 (ABq, *J* = 13.6 Hz, 1H), 3.68 (s, 3H), 3.82 (ABq, *J* = 8.0 Hz, 1H), 4.19 (ABq, *J* = 8.4 Hz, 1H), 6.69 (d, *J* = 8.8 Hz, 2H), 7.10 (d, *J* = 8.8 Hz, 2H), 7.41 (dd, *J* = 8.4 Hz, 4.4 Hz, 1H), 7.47-7.56 (m, 2H), 8.13 (dd, *J* = 8.0 Hz, 1.6 Hz, 1H), 8.74 (dd, *J* = 4.0 Hz, 1.6 Hz, 1H), 8.84 (dd, *J* = 7.6 Hz, 1.6 Hz, 1H), 10.31 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.1, 19.1, 20.1, 20.4, 33.0, 33.2, 39.9, 40.0, 42.0, 49.9, 55.2, 60.3, 60.4, 82.5, 113.6, 116.4, 121.3, 121.6, 127.6, 128.0, 129.4, 131.3, 134.8, 136.2, 138.9, 148.2, 158.2, 173.8 ppm. HRMS (ESI$^+$): calcd for $C_{30}H_{40}N_3O_3$ $[M+H]^+$ 490.3064, found 490.3064.



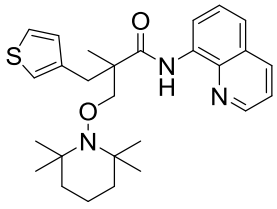
2-(4-Bromobenzyl)-2-methyl-*N*-(quinolin-8-yl)-3-((2,2,6,6-tetramethylpiperidin-1-yl)oxy)propanamide (3ra)

Following the general procedure. **1r** (95.8 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3ra** as colorless oil (78.7 mg, 58% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.92 (s, 3H), 1.07 (s, 3H), 1.16 (s, 3H), 1.20 (s, 3H), 1.26-1.44 (m, 6H), 1.47 (s, 3H), 2.67 (ABq, *J* = 13.2 Hz, 1H), 3.41 (ABq, *J* = 13.2 Hz, 1H), 3.83 (ABq, *J* = 8.4 Hz, 1H), 4.18 (ABq, *J* = 8.0 Hz, 1H), 7.06 (d, *J* = 8.0 Hz, 2H), 7.27 (d, *J* = 8.0 Hz, 2H), 7.41 (dd, *J* = 8.0 Hz, 4.4 Hz, 1H), 7.48-7.56 (m, 2H), 8.12 (d, *J* = 8.4 Hz, 1H), 8.74 (d, *J* = 2.4 Hz, 1H), 8.82 (d, *J* = 7.6 Hz, 1H), 10.29 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.1, 19.1, 20.1, 20.4, 33.0, 33.2, 39.91, 39.94, 42.1, 49.7, 60.35, 60.36, 82.4, 116.5, 120.5, 121.5, 121.6, 127.5, 128.0, 131.2, 132.1, 134.6, 136.2, 136.4, 138.9, 148.2, 173.3 ppm. HRMS (ESI$^+$): calcd for $C_{29}H_{37}BrN_3O_2$ $[M+H]^+$ 538.2064, found 538.2066.



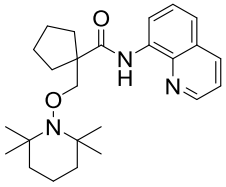
2-Methyl-*N*-(quinolin-8-yl)-3-((2,2,6,6-tetramethylpiperidin-1-yl)oxy)-2-(thiophen-2-ylmethyl)propanamide (3sa)

Following the general procedure. **1s** (77.6 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3sa** as colorless oil (67.5 mg, 58% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.93 (s, 3H), 1.07 (s, 3H), 1.17 (d, *J* = 8.4 Hz, 6H), 1.26-1.47 (m, 6H), 1.53 (s, 3H), 2.97 (ABq, *J* = 14.8 Hz, 1H), 3.69 (ABq, *J* = 14.4 Hz, 1H), 3.88 (ABq, *J* = 8.0 Hz, 1H), 4.14 (ABq, *J* = 8.4 Hz, 1H), 6.83-6.84 (m, 2H), 7.05 (t, *J* = 3.6 Hz, 1H), 7.41 (dd, *J* = 8.4 Hz, 4.4 Hz, 1H), 7.48-7.57 (m, 2H), 8.13 (dd, *J* = 8.4 Hz, 1.2 Hz, 1H), 8.76 (dd, *J* = 4.0 Hz, 1.2 Hz, 1H), 8.86 (dd, *J* = 7.2 Hz, 1.2 Hz, 1H), 10.42 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.1, 19.4, 20.1, 20.4, 33.0, 33.2, 36.9, 39.9, 49.8, 60.4, 82.2, 116.5, 121.3, 121.6, 124.4, 126.6, 127.2, 127.6, 128.0, 134.8, 136.2, 138.9, 139.2, 148.2, 173.4 ppm. HRMS (ESI$^+$): calcd for $C_{27}H_{36}N_3O_2S$ $[M+H]^+$ 466.2523, found 466.2526.



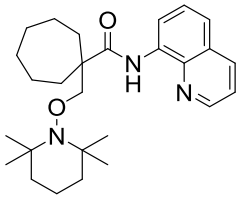
2-Methyl-N-(quinolin-8-yl)-3-((2,2,6,6-tetramethylpiperidin-1-yl)oxy)-2-(thiophen-3-ylmethyl)propanamide (3ta)

Following the general procedure. **1t** (77.6 mg, 0.25 mmol) and **2a** (xx mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3ta** as a colorless oil (73.5 mg, 63% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.94 (s, 3H), 1.06 (s, 3H), 1.15 (s, 3H), 1.20 (s, 3H), 1.24-1.44 (m, 6H), 1.48 (s, 3H), 2.79 (ABq, *J* = 13.6 Hz, 1H), 3.48 (ABq, *J* = 14.0 Hz, 1H), 3.85 (ABq, *J* = 8.0 Hz, 1H), 4.15 (ABq, *J* = 8.0 Hz, 1H), 6.92 (d, *J* = 4.4 Hz, 1H), 7.01 (s, 1H), 7.11 (d, *J* = 1.2 Hz, 1H), 7.41 (dd, *J* = 8.0 Hz, 4.0 Hz, 1H), 7.48-7.56 (m, 2H), 8.13 (d, *J* = 8.0 Hz, 1H), 8.76 (d, *J* = 2.0 Hz, 1H), 8.84 (d, *J* = 7.6 Hz, 1H), 10.37 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.1, 19.4, 20.1, 20.4, 33.0, 33.2, 37.2, 39.9, 49.6, 60.3, 82.4, 116.4, 121.3, 121.6, 123.1, 125.0, 127.6, 128.0, 129.7, 134.8, 136.2, 137.5, 138.9, 148.2, 173.7 ppm. HRMS (ESI$^+$): calcd for $C_{27}H_{36}N_3O_2S$ $[M+H]^+$ 466.2523, found 466.2525.



***N*-(Quinolin-8-yl)-1-(((2,2,6,6-tetramethylpiperidin-1-yl)oxy)methyl)cyclopentane -1-carboxamide (3ua)**

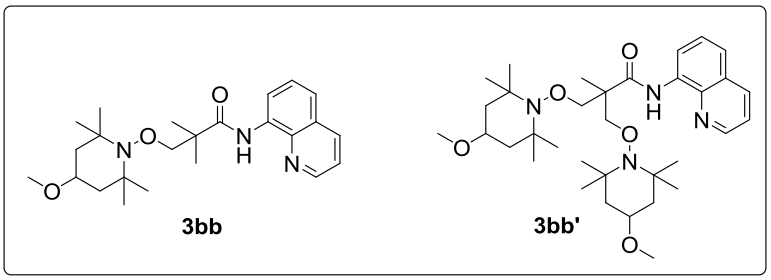
Following the general procedure. **1u** (63.6 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3ua** as colorless oil (67.9 mg, 66% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.98 (s, 6H), 1.13 (s, 6H), 1.23-1.44 (m, 6H), 1.71-1.78 (m, 4H), 1.88-1.94 (m, 2H), 2.26-2.31 (m, 2H), 3.94 (s, 2H), 7.42 (dd, *J* = 8.4 Hz, 4.4 Hz, 1H), 7.46-7.55 (m, 2H), 8.13 (dd, *J* = 8.4 Hz, 1.2 Hz, 1H), 8.78-8.81 (m, 2H), 10.35 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.1, 20.3, 24.9, 33.1, 39.9, 56.7, 60.3, 80.5, 116.2, 121.1, 121.6, 127.6, 128.0, 135.2, 136.2, 138.8, 148.1, 175.3 ppm. HRMS (ESI$^+$): calcd for $C_{25}H_{36}N_3O_2$ $[M+H]^+$ 410.2802, found 410.2809.



***N*-(Quinolin-8-yl)-1-(((2,2,6,6-tetramethylpiperidin-1-yl)oxy)methyl)cycloheptane -1-carboxamide (3va)**

Following the general procedure. **1v** (70.6 mg, 0.25 mmol) and **2a** (78.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3va** as colorless oil (59.2 mg, 54% yield). ^{1}H

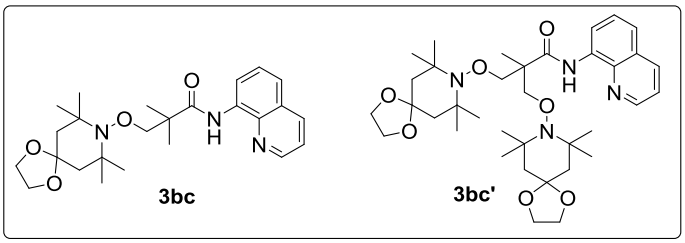
NMR (400 MHz, $CDCl_3$): δ = 0.94 (s, 6H), 1.12 (s, 6H), 1.23-1.43 (m, 6H), 1.57-1.65 (m, 8H), 1.77-1.83 (m, 2H), 2.34-2.39 (m, 2H), 3.83 (s, 2H), 7.42 (dd, *J* = 8.0 Hz, 4.0 Hz, 1H), 7.46-7.55 (m, 2H), 8.14 (dd, *J* = 8.4 Hz, 1.2 Hz, 1H), 8.79 (dd, *J* = 4.0 Hz, 1.2 Hz, 1H), 8.83 (d, *J* = 7.6 Hz, 1H), 10.39 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.1, 20.3, 23.8, 30.7, 33.1, 33.3, 39.9, 52.2, 60.3, 81.5, 116.3, 121.0, 121.5, 127.6, 128.0, 135.2, 136.2, 139.0, 148.1, 175.2 ppm. HRMS (ESI^+): calcd for $C_{27}H_{40}N_3O_2$ $[M+H]^+$ 438.3115, found 438.3121.



Following the general procedure. **1b** (57.1 mg, 0.25 mmol) and **2b** (93.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3bb** as colorless oil (47.9 mg, 46% yield) and **3bb´** as colorless oil (39.4 mg, 26% yield).

3-((4-Methoxy-2,2,6,6-tetramethylpiperidin-1-yl)oxy)-2,2-dimethyl-*N*-(quinolin-8-yl)propanamide (3bb). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.06 (s, 6H), 1.21 (s, 6H), 1.33-1.39 (m, 2H), 1.46 (s, 6H), 1.78 (d, *J* = 12.4 Hz, 2H), 3.27 (s, 3H), 3.36 (t, *J* = 10.0 Hz, 1H), 3.91 (s, 2H), 7.42-7.55 (m, 3H), 8.14 (d, *J* = 8.0 Hz, 1H), 8.79-8.81 (m, 2H), 10.38 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 21.3, 23.2, 33.3, 44.80, 44.84, 55.8, 60.5, 71.8, 82.7, 116.4, 121.3, 121.6, 127.6, 128.0, 134.9, 136.3, 138.9, 148.2, 175.0 ppm. HRMS (ESI^+): calcd for $C_{24}H_{36}N_3O_3$ $[M+H]^+$ 414.2751, found 414.2756.

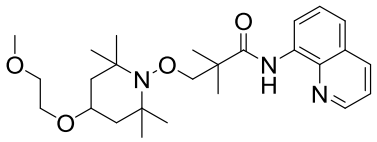
3-((4-Mmethoxy-2,2,6,6-tetramethylpiperidin-1-yl)oxy)-2-(((4-methoxy-2,2,6,6-tetramethylpiperidin-1-yl)oxy)methyl)-2-methyl-*N*-(quinolin-8-yl)propanamide (3bb´). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.98 (s, 6H), 1.11 (s, 6H), 1.17 (s, 6H), 1.22 (s, 6H), 1.32-1.39 (m, 4H), 1.65 (s, 3H), 1.74-1.81 (m, 4H), 3.27 (s, 6H), 3.35 (t, *J* = 10.4 Hz, 2H), 3.88 (d, *J* = 8.0 Hz, 2H), 4.17 (d, *J* = 8.0 Hz, 2H), 7.41-7.55 (m, 3H), 8.13 (d, *J* = 8.0 Hz, 1H), 8.76 (s, 1H), 8.82 (d, *J* = 7.6 Hz, 1H), 10.48 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 18.5, 21.1, 21.4, 33.2, 33.4, 44.76, 44.81, 49.8, 55.8, 60.5, 60.6, 71.8, 79.7, 116.4, 121.2, 121.5, 127.6, 128.0, 134.9, 136.2, 138.8, 148.0, 172.7 ppm. HRMS (ESI^+): calcd for $C_{34}H_{55}N_4O_5$ $[M+H]^+$ 599.4167, found 599.4165.



Following the general procedure. **1b** (57.1 mg, 0.25 mmol) and **2c** (107.1 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3bc** as colorless oil (59.8 mg, 54% yield) and **3bc´** as colorless oil (44.6 mg, 27% yield).

2,2-Dimethyl-*N*-(quinolin-8-yl)-3-((7,7,9,9-tetramethyl-1,4-dioxa-8-azaspiro[4.5]decan-8-yl)oxy)propanamide (3bc). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.19 (s, 12H), 1.46 (s, 6H), 1.59 (ABq, *J* = 13.2 Hz, 2H), 1.76 (ABq, *J* = 14.4 Hz, 2H), 3.75-3.78 (m, 2H), 3.90-3.94 (m, 4H), 7.41-7.54 (m, 3H), 8.13 (d, *J* = 8.0 Hz, 1H), 8.79-8.81 (m, 2H), 10.41 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.5, 23.2, 33.6, 44.8, 46.4, 60.5, 62.8, 64.6, 82.7, 106.9, 116.4, 121.3, 121.6, 127.5, 128.0, 134.9, 136.2, 138.9, 148.2, 175.0 ppm. HRMS (ESI^+): calcd for $C_{25}H_{36}N_3O_4$ $[M+H]^+$ 442.2700, found 442.2700.

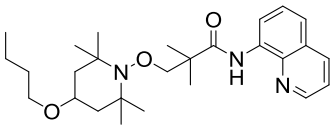
2-Methyl-*N*-(quinolin-8-yl)-3-((7,7,9,9-tetramethyl-1,4-dioxa-8-azaspiro[4.5]decan-8-yl)oxy)-2-(((7,7,9,9-tetramethyl-1,4-dioxa-8-azaspiro[4.5]decan-8-yl)oxy)methyl)propanamide (3bc´). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.11 (s, 6H), 1.16 (s, 6H), 1.21 (s, 6H), 1.25 (s, 6H), 1.55-1.66 (m, 4H), 1.68 (s, 3H), 1.74-1.79 (m, 4H), 3.75-3.79 (m, 4H), 3.91-3.95 (m, 6H), 4.18 (ABq, *J* = 8.4 Hz, 2H), 7.41-7.55 (m, 3H), 8.13 (d, *J* = 8.0 Hz, 1H), 8.78 (s, 1H), 8.82 (d, *J* = 7.2 Hz, 1H), 10.52 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 18.5, 20.4, 20.7, 33.6, 33.8, 46.4, 49.9, 60.5, 62.9, 64.6, 79.6, 106.9, 116.4, 121.2, 121.6, 127.6, 128.0, 135.0, 136.1, 138.8, 148.1, 172.8 ppm. HRMS (ESI^+): calcd for $C_{36}H_{54}N_4O_7$ Na $[M+Na]^+$ 677.3885, found 677.3875.



3-((4-(2-Methoxyethoxy)-2,2,6,6-tetramethylpiperidin-1-yl)oxy)-2,2-dimethyl-*N*-(quinolin-8-yl)propanamide (3bd)

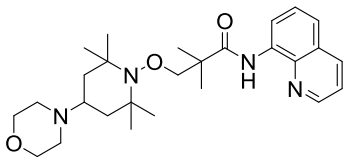
Following the general procedure. **1b** (57.1 mg, 0.25 mmol) and **2d** (115.2 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3bd** as colorless oil (63.2 mg, 55% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.04 (s, 6H), 1.19 (s, 6H), 1.39-1.44 (m, 8H), 1.78 (d, *J* = 12.0 Hz, 2H), 3.34 (s, 3H), 3.48-3.52 (m, 5H), 3.90 (s, 2H), 7.41-7.54 (m, 3H), 8.13 (d, *J* = 8.0 Hz, 1H), 8.78-8.81 (m, 2H), 10.37 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 21.2, 23.2, 33.2, 44.8, 45.0, 59.2, 60.5, 67.4, 70.8, 72.3, 82.7, 116.3,

121.2, 121.5, 127.5, 127.9, 134.8, 136.2, 138.8, 148.1, 174.9 ppm. HRMS (ESI^+): calcd for $C_{26}H_{40}N_3O_4$ $[M+H]^+$ 458.3013, found 458.3010.



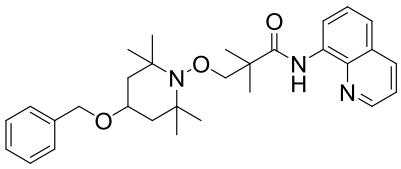
3-((4-Butoxy-2,2,6,6-tetramethylpiperidin-1-yl)oxy)-2,2-dimethyl-N-(quinolin-8-yl)propanamide (3be)

Following the general procedure. **1b** (57.1 mg, 0.25 mmol) and **2e** (114.2 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3be** as colorless oil (57.3 mg, 50% yield). ^1H NMR (400 MHz, $CDCl_3$): δ = 0.88 (t, J = 7.2 Hz, 3H), 1.05 (s, 6H), 1.20 (s, 6H), 1.29-1.42 (m, 4H), 1.45-1.49 (m, 8H), 1.76 (d, J = 10.8 Hz, 2H), 3.34-3.46 (m, 3H), 3.91 (s, 2H), 7.42-7.55 (m, 3H), 8.14 (d, J = 8.0 Hz, 1H), 8.79-8.81 (m, 2H), 10.38 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 14.1, 19.5, 21.3, 23.2, 32.3, 33.3, 44.8, 45.3, 60.6, 68.0, 70.2, 82.7, 116.4, 121.2, 121.6, 127.6, 128.0, 134.9, 136.3, 138.9, 148.2, 175.0 ppm. HRMS (ESI^+): calcd for $C_{27}H_{42}N_3O_3$ $[M+H]^+$ 456.3221, found 456.3217.



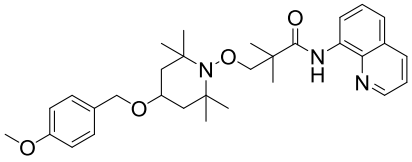
2,2-Dimethyl-*N*-(quinolin-8-yl)-3-((2,2,6,6-tetramethyl-4-morpholinopiperidin-1-yl)oxy)propanamide (3bf)

Following the general procedure. **1b** (57.1 mg, 0.25 mmol) and **2f** (120.7 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3bf** as colorless oil (41.4 mg, 35% yield). ^1H NMR (400 MHz, $CDCl_3$): δ = 1.05 (s, 6H), 1.20 (s, 6H), 1.43-1.46 (m, 8H), 1.56 (d, J = 12.0 Hz, 2H), 2.49-2.54 (m, 5H), 3.68 (s, 4H), 3.91 (s, 2H), 7.42-7.55 (m, 3H), 8.14 (d, J = 8.0 Hz, 1H), 8.79-8.81 (m, 2H), 10.38 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.8, 23.1, 33.3, 41.2, 44.7, 49.6, 54.5, 60.3, 67.3, 82.6, 116.3, 121.1, 121.4, 127.4, 127.9, 134.8, 136.1, 138.8, 148.0, 174.8 ppm. HRMS (ESI^+): calcd for $C_{27}H_{41}N_4O_3$ $[M+H]^+$ 469.3173, found 469.3168.



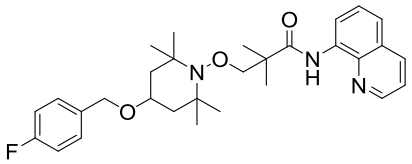
3-((4-(Benzyloxy)-2,2,6,6-tetramethylpiperidin-1-yl)oxy)-2,2-dimethyl-*N*-(quinolin-8-yl)propanamide (3bg)

Following the general procedure. **1b** (57.1 mg, 0.25 mmol) and **2g** (131.2 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3bg** as colorless oil (50.5 mg, 41% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.04 (s, 6H), 1.22 (s, 6H), 1.46-1.49 (m, 8H), 1.83 (d, *J* = 12.0 Hz, 2H), 3.59 (t, *J* = 9.2 Hz, 1H), 3.92 (s, 2H), 4.47 (s, 2H), 7.26-7.30 (m, 5H), 7.43-7.56 (m, 3H), 8.15 (d, *J* = 8.0 Hz, 1H), 8.80-8.82 (m, 2H), 10.38 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 21.2, 23.2, 33.3, 44.8, 45.2, 60.6, 70.10, 70.14, 82.7, 116.4, 121.3, 121.6, 127.56, 127.58, 127.61, 128.0, 128.5, 134.9, 136.3, 138.87, 138.90, 148.2, 175.0 ppm. HRMS (ESI$^+$): calcd for $C_{30}H_{40}N_3O_3$ $[M+H]^+$ 490.3064, found 490.3070.



3-((4-((4-Methoxybenzyl)oxy)-2,2,6,6-tetramethylpiperidin-1-yl)oxy)-2,2-dimethyl-*N*-(quinolin-8-yl)propanamide (3bh)

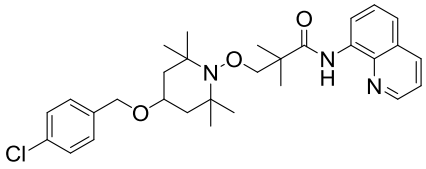
Following the general procedure. **1b** (57.1 mg, 0.25 mmol) and **2h** (146.2 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3bh** as colorless oil (58.8 mg, 45% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.04 (s, 6H), 1.22 (s, 6H), 1.46-1.52 (m, 8H), 1.83 (d, *J* = 12.0 Hz, 2H), 3.56-3.62 (m, 1H), 3.79 (s, 3H), 3.92 (s, 2H), 4.45 (s, 2H), 6.79 (d, *J* = 8.0 Hz, 1H), 6.86-6.89 (m, 2H), 7.20-7.26 (m, 1H), 7.43-7.56 (m, 3H), 8.14 (d, *J* = 8.0 Hz, 1H), 8.80-8.82 (m, 2H), 10.38 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 21.3, 23.2, 33.3, 44.8, 45.2, 55.3, 60.6, 70.0, 70.1, 82.8, 112.9, 113.2, 116.4, 119.8, 121.3, 121.6, 127.6, 128.0, 129.5, 134.9, 136.3, 138.9, 140.6, 148.2, 159.8, 175.0 ppm. HRMS (ESI$^+$): calcd for $C_{31}H_{41}N_3O_4Na$ $[M+Na]^+$ 542.2989, found 542.2989.



3-((4-((4-Fluorobenzyl)oxy)-2,2,6,6-tetramethylpiperidin-1-yl)oxy)-2,2-dimethyl-*N*-(quinolin-8-yl)propanamide (3bi)

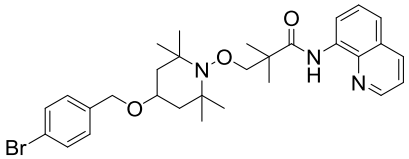
Following the general procedure. **1b** (57.1 mg, 0.25 mmol) and **2i** (140.2 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3bi** as colorless oil (72.7 mg, 57% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.04 (s, 6H), 1.21 (s, 6H), 1.46-1.50 (m, 8H), 1.81 (d, *J* = 12.0

Hz, 2H), 3.57 (t, J = 8.8 Hz, 1H), 3.92 (s, 2H), 4.43 (s, 2H), 6.98-7.02 (m, 2H), 7.24-7.28 (m, 2H), 7.43-7.56 (m, 3H), 8.15 (d, J = 8.4 Hz, 1H), 8.79-8.82 (m, 2H), 10.38 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 21.3, 23.2, 33.3, 44.9, 45.2, 60.6, 69.5, 70.2, 82.8, 115.2, 115.4, 116.4, 121.3, 121.6, 127.6, 128.0, 129.3, 129.4, 134.9, 136.3, 138.9, 148.2, 175.0 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = -115.18 (s, 1F). HRMS (ESI^+): calcd for $C_{30}H_{39}FN_3O_3$ $[M+H]^+$ 508.2970, found 508.2976.



3-((4-((4-Chlorobenzyl)oxy)-2,2,6,6-tetramethylpiperidin-1-yl)oxy)-2,2-dimethyl-*N*-(quinolin-8-yl)propanamide (3bj)

Following the general procedure. **1b** (57.1 mg, 0.25 mmol) and **2j** (148.4 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3bj** as colorless oil (77.9 mg, 59% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.03 (s, 6H), 1.21 (s, 6H), 1.42-1.50 (m, 8H), 1.80 (d, J = 12.0 Hz, 2H), 3.56 (t, J = 9.6 Hz, 1H), 3.91 (s, 2H), 4.42 (s, 2H), 7.21-7.28 (m, 4H), 7.43-7.53 (m, 3H), 8.14 (d, J = 8.0 Hz, 1H), 8.79-8.81 (m, 2H), 10.37 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.3, 22.3, 32.3, 43.9, 44.2, 59.6, 68.4, 69.3, 81.8, 115.4, 120.4, 120.7, 126.6, 127.1, 127.7, 127.9, 132.3, 133.9, 135.4, 136.5, 137.9, 147.3, 174.0 ppm. HRMS (ESI^+): calcd for $C_{30}H_{39}ClN_3O_3$ $[M+H]^+$ 524.2674, found 524.2668.

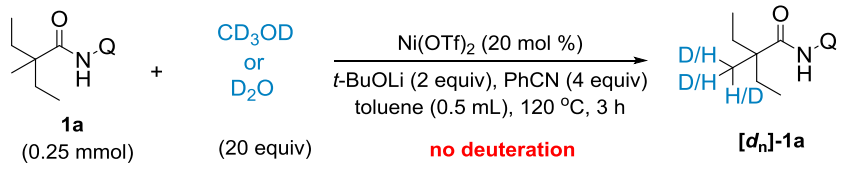


3-((4-((4-Bromobenzyl)oxy)-2,2,6,6-tetramethylpiperidin-1-yl)oxy)-2,2-dimethyl-*N*-(quinolin-8-yl)propanamide (3bk)

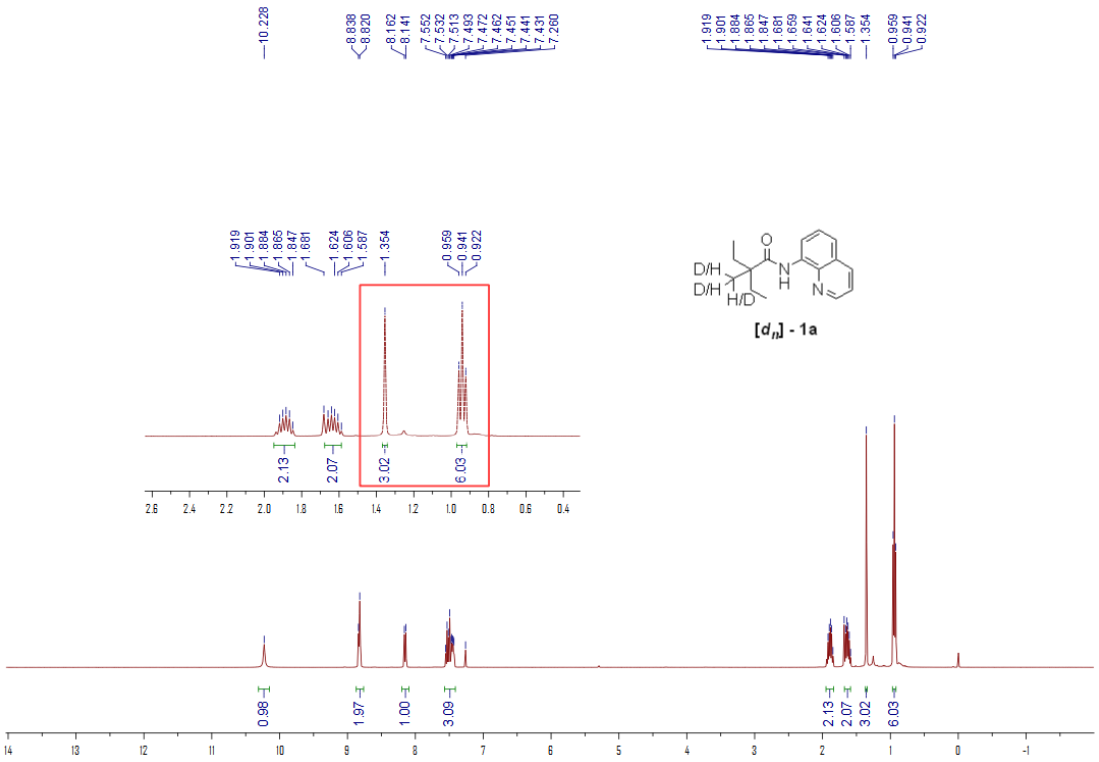
Following the general procedure. **1b** (57.1 mg, 0.25 mmol) and **2k** (170.6 mg, 0.50 mmol) were used. Purification via column chromatography on silica gel (petroleum ether/ EtOAc = 20/1, v/v) afforded **3bk** as colorless oil (77.2 mg, 54% yield). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.03 (s, 6H), 1.21 (s, 6H), 1.46-1.50 (m, 8H), 1.80 (d, J = 12.0 Hz, 2H), 3.57 (t, J = 9.6 Hz, 1H), 3.91 (s, 2H), 4.41 (s, 2H), 7.17 (d, J = 7.2 Hz, 2H), 7.42-7.56 (m, 5H), 8.15 (d, J = 8.0 Hz, 1H), 8.79-8.81 (m, 2H), 10.38 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.0, 22.0, 32.0, 43.5, 43.9, 59.2, 68.1, 69.0, 81.4, 115.1, 120.0, 120.4, 126.3, 126.7, 127.1, 127.9, 130.3, 133.6, 135.1, 136.6, 137.6, 146.9, 173.6 ppm. HRMS (ESI^+): calcd for $C_{30}H_{39}BrN_3O_3$ $[M+H]^+$ 568.2169, found 568.2172.

(iii) Deuterium-labeling Experiments

A. The hydrogen-deuterium exchange experiments with CD_3OD/D_2O as deuterium source

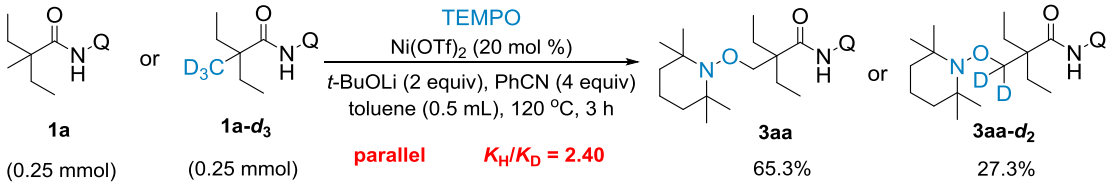


A 25 mL Schlenk tube was charged with **1a** (64.1 mg, 0.25 mmol), CD_3OD or D_2O (5.0 mmol, 20 equiv), $Ni(OTf)_2$ (17.8 mg, 20 mol %), cyanobenzene (102 μL, 1.0 mmol), *t*-BuOLi (40.0 mg, 0.50 mmol), and 0.5 mL of toluene. Then the tube was sealed, and stirred rigorously at 120 °C for 3 h. Solvents were removed in vacuo after the reaction finished, and the residue was purified by flash chromatography on silica gel (gradient eluent of 5% EtOAc in petroleum ether, v/v) to provide **[d_n]-1a**. ^{1}H NMR analysis showed that no deuteration was observed.

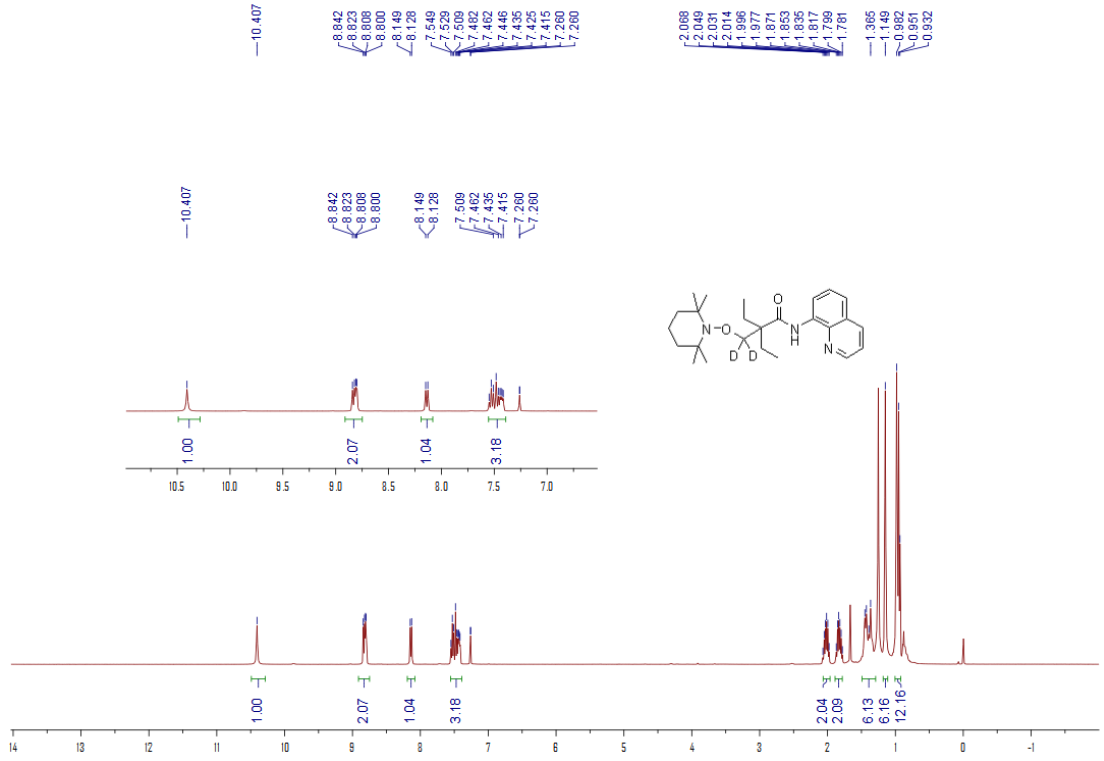


B. KIE experiments

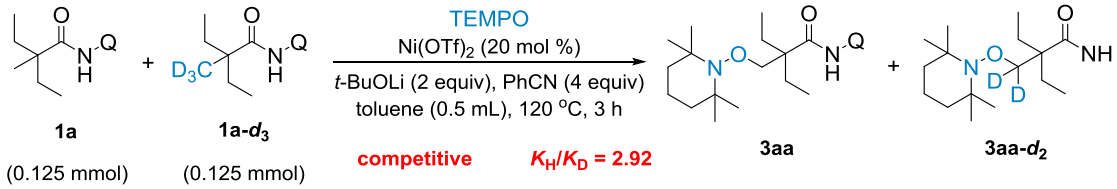
B-1. (Side by side)



A 25 mL Schlenk tube was charged with **1a** (64.1 mg, 0.25 mmol) or **1a-*d*$_3$** (64.8 mg, 0.25 mmol), TEMPO (0.5 mmol, 2 equiv), Ni(OTf)$_2$ (17.8 mg, 20 mol %), cyanobenzene (102 μL, 1.0 mmol), *t*-BuOLi (40.0 mg, 0.50 mmol), and 0.5 mL of toluene. Then the tube was sealed, and stirred rigorously at 120 °C for 3 h. Solvents were removed in vacuo after the reaction finished, and the residue was purified by flash chromatography on basic alumina column (gradient eluent of 5% EtOAc in petroleum ether, v/v) to provide **3aa** (67.2 mg, 65.3%) and **3aa-*d*$_2$** (28.2 mg, 27.3%).

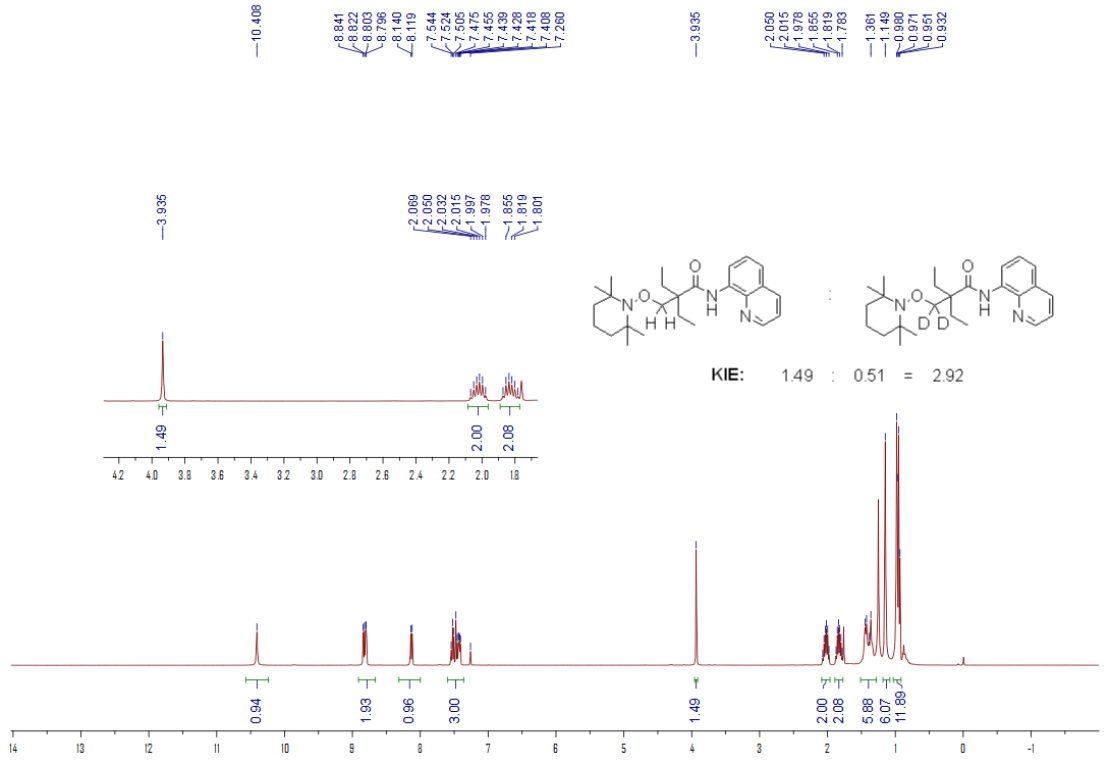


B-2. (Intermolecular competition)



A 25 mL Schlenk tube was charged with **1a** (32.0 mg, 0.125 mmol), **1a-*d*$_3$** (32.4 mg, 0.125 mmol), TEMPO (0.5 mmol, 2 equiv), Ni(OTf)$_2$ (17.8 mg, 20 mol %), cyanobenzene (102 μL, 1.0 mmol), *t*-BuOLi (40.0 mg, 0.50 mmol), and 0.5 mL of

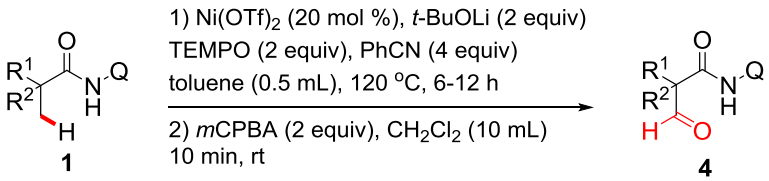
toluene. Then the tube was sealed, and stirred rigorously at 120 °C for 3 h. Solvents were removed in vacuo after the reaction finished, and the residue was purified by flash chromatography on basic alumina column (gradient eluent of 5% EtOAc in petroleum ether, v/v) to provide **3aa** and **3aa-*d*$_2$**. The ratio of **3aa**/**3aa-*d*$_2$** was analyzed by ^{1}H NMR.



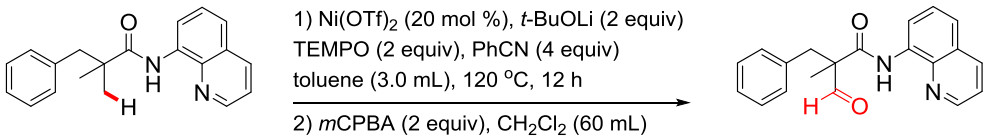
(iv) An Efficient One-Pot Route to *α*-Formyl Acid Derivatives

A. Investigation of substrate scopes

General procedure for synthesis of *α*-formyl acid derivatives: A 25 mL Schlenk tube was charged with the *α*, *α*, *α*-trisubstituted *N*-(quinolin-8-yl)acetamides **1** (0.25 mmol), stable nitroxyl radical **2** (0.50 mmol), Ni(OTf)$_2$ (17.8 mg, 20 mol %), cyanobenzene (102 μL, 1.0 mmol), *t*-BuOLi (40.0 mg, 0.5 mmol), and 1.0 mL of toluene. Then the tube was sealed, and stirred vigorously at 120 °C for 6-24 h. Then, 0.5 mmol of *m*CPBA and 10 mL of dichloromethane were added in the same tube. The system was stirred for 10 min at room temperature. Solvents were removed in vacuo after the reaction finished, and the residue was purified by chromatography on silica gel column (gradient eluent of 5% EtOAc in petroleum ether, v/v) to give the desired product.



B. Example performed on a 1.5 mmol scale

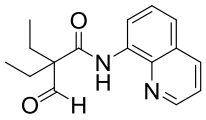


1m
(1.5 mmol)

4-e
49%

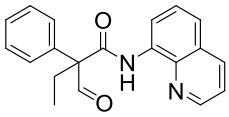
Procedure for the synthesis of 4-e on a 1.5 mmol scale: A 100 mL Schlenk tube was charged with the 2,2-dimethyl-3-phenyl-*N*-(quinolin-8-yl)propanamide **1m** (456.6 mg, 1.50 mmol), TEMPO **2a** (468.7 mg, 3.0 mmol), $Ni(OTf)_2$ (107.0 mg, 20 mol %), cyanobenzene (613 μL, 6.0 mmol), *t*-BuOLi (240.2 mg, 3.0 mmol), and 3.0 mL of toluene. Then the tube was sealed, and stirred vigorously at 120 ℃ for 12 h. Then, *m*CPBA (3.0 mmol) and 60 mL of dichloromethane were added in the same tube. The system was stirred for 10 min at room temperature. Solvents were removed in vacuo after the reaction finished, and the residue was purified by chromatography on silica gel column (gradient eluent of 5% EtOAc in petroleum ether, v/v) to give the desired product **4-e** as colorless oil (234.9 mg, 49%).

C. Experimental data for the described substances



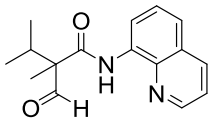
2-Ethyl-2-formyl-*N*-(quinolin-8-yl)butanamide (4-a)

Colorless oil, (45.3 mg, 67%). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.94 (t, J = 7.2 Hz, 6H), 1.95-2.04 (m, 2H), 2.10-2.19 (m, 2H), 7.46 (dd, J = 8.4 Hz, 4.4 Hz, 1H), 7.53-7.54 (m, 2H), 8.16 (dd, J = 8.4 Hz, 1.6 Hz, 1H), 8.82-8.84 (m, 1H), 8.90 (dd, J = 4.0 Hz, 1.6 Hz, 1H), 9.78 (s, 1H), 11.09 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 9.4, 27.0, 63.1, 117.1, 121.8, 122.1, 127.4, 128.1, 134.5, 136.3, 139.1, 148.8, 169.2, 203.6 ppm. HRMS (ESI^+): calcd for $C_{16}H_{19}N_2O_2$ $[M+H]^+$ 271.1441, found 271.1440.



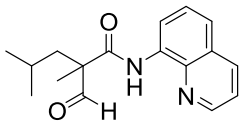
2-Formyl-2-phenyl-*N*-(quinolin-8-yl)butanamide (4-b)

Colorless oil, (34.2 mg, 43%). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.08 (t, J = 7.2 Hz, 3H), 2.57 (q, J = 14.8 Hz, 7.2 Hz, 2H), 7.34-7.48 (m, 6H), 7.50-7.56 (m, 2H), 8.13 (dd, J = 8.0 Hz, 0.4 Hz, 1H), 8.75 (dd, J = 4.0 Hz, 0.8 Hz, 1H), 8.80 (dd, J = 6.0 Hz, 2.8 Hz, 1H), 9.95 (s, 1H), 10.71 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 9.8, 25.5, 66.9, 117.0, 121.8, 122.2, 127.3, 128.0, 128.1, 128.5, 129.5, 134.3, 135.8, 136.3, 138.9, 148.7, 169.6, 198.7 ppm. HRMS (ESI^+): calcd for $C_{20}H_{19}N_2O_2$ $[M+H]^+$ 319.1441, found 319.1440.



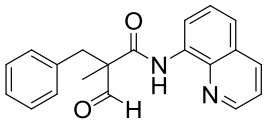
2-Formyl-2,3-dimethyl-*N*-(quinolin-8-yl)butanamide (4-c)

Colorless oil, (34.5 mg, 51%). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.97 (d, J = 6.8 Hz, 3H), 1.02 (d, J = 6.8 Hz, 3H), 1.51 (s, 3H), 2.77-2.84 (m, 1H), 7.47 (dd, J = 8.0 Hz, 4.0 Hz, 1H), 7.53-7.54 (m, 2H), 8.16 (d, J = 8.0 Hz, 1H), 8.75-8.77 (m, 1H), 8.85 (d, J = 2.4 Hz, 1H), 9.88 (s, 1H), 10.48 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 11.4, 17.7, 17.8, 33.2, 63.4, 116.7, 121.9, 122.2, 127.4, 128.1, 134.1, 136.4, 138.9, 148.7, 169.6, 203.4 ppm. HRMS (ESI^+): calcd for $C_{16}H_{19}N_2O_2$ $[M+H]^+$ 271.1441, found 271.1440.



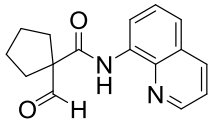
2-Formyl-2,4-dimethyl-N-(quinolin-8-yl)pentanamide (4-d)

Colorless oil, (32.0 mg, 45%). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.92 (t, J = 6.8 Hz, 6H), 1.58 (s, 3H), 1.79-1.83 (m, 1H), 1.94-2.04 (m, 2H), 7.47 (dd, J = 8.4 Hz, 4.4 Hz, 1H), 7.50-7.54 (m, 2H), 8.16 (d, J = 8.4 Hz, 1H), 8.75-8.77 (m, 1H), 8.87 (d, J = 3.6 Hz, 1H), 9.86 (s, 1H), 10.73 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 18.6, 23.6, 24.0, 25.3, 44.6, 58.6, 116.9, 121.8, 122.2, 127.4, 128.1, 134.3, 136.4, 139.0, 148.7, 170.0, 202.7 ppm. HRMS (ESI^+): calcd for $C_{17}H_{21}N_2O_2$ $[M+H]^+$ 285.1598, found 285.1594.



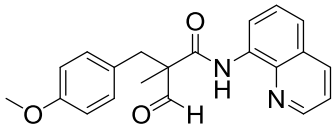
2-Benzyl-2-methyl-3-oxo-N-(quinolin-8-yl)propanamide (4-e)

Colorless oil, (37.4 mg, 47%). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.54 (s, 3H), 3.27 (ABq, J = 13.6 Hz, 1H), 3.46 (ABq, J = 14.0 Hz, 1H), 7.18-7.20 (m, 5H), 7.44 (dd, J = 8.4 Hz, 4.4 Hz, 1H), 7.54-7.57 (m, 2H), 8.15 (d, J = 8.0 Hz, 1H), 8.76-8.79 (m, 2H), 9.96 (s, 1H), 10.41 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.3, 41.4, 60.4, 116.8, 121.8, 122.3, 127.2, 127.4, 128.0, 128.6, 130.2, 134.0, 135.7, 136.4, 138.8, 148.6, 169.1, 201.8 ppm. HRMS (ESI^+): calcd for $C_{20}H_{19}N_2O_2$ $[M+H]^+$ 319.1441, found 319.1441.



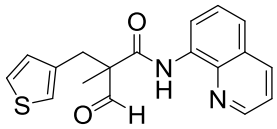
1-Formyl-*N*-(quinolin-8-yl)cyclopentane-1-carboxamide (4-f)

Colorless oil, (32.2 mg, 48%). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.72-1.78 (m, 2H), 1.83-1.88 (m, 2H), 2.31-2.44 (m, 4H), 7.46 (dd, *J* = 8.0 Hz, 4.0 Hz, 1H), 7.49-7.55 (m, 2H), 8.15 (d, *J* = 8.4 Hz, 1H), 8.72-8.73 (m, 1H), 8.84 (d, *J* = 2.4 Hz, 1H), 9.78 (s, 1H), 10.32 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 25.9, 32.2, 67.6, 116.7, 121.8, 122.1, 127.4, 128.0, 134.4, 136.4, 138.8, 148.7, 169.4, 200.2 ppm. HRMS (ESI^+): calcd for $C_{16}H_{17}N_2O_2$ $[M+H]^+$ 269.1285, found 269.1286.



2-Formyl-3-(4-methoxyphenyl)-2-methyl-*N*-(quinolin-8-yl)propanamide (4-g)

Colorless oil, (40.9 mg, 47%). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.53 (s, 3H), 3.20 (ABq, *J* = 13.6 Hz, 1H), 3.39 (ABq, *J* = 14.0 Hz, 1H), 3.69 (s, 3H), 6.73 (d, *J* = 8.0 Hz, 2H), 7.09 (d, *J* = 8.0 Hz, 2H), 7.44 (dd, *J* = 8.0 Hz, 4.4 Hz, 1H), 7.53-7.57 (m, 2H), 8.15 (d, *J* = 8.4 Hz, 1H), 8.76-8.78 (m, 2H), 9.96 (s, 1H), 10.40 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.2, 40.8, 55.3, 60.4, 114.0, 116.8, 121.8, 122.2, 127.4, 127.6, 128.0, 131.2, 134.1, 136.4, 138.8, 148.6, 158.8, 169.2, 202.0 ppm. HRMS (ESI^+): calcd for $C_{21}H_{21}N_2O_3$ $[M+H]^+$ 349.1547, found 349.1548.

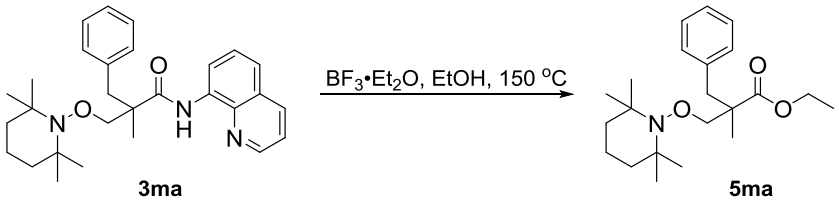


2-Formyl-2-methyl-*N*-(quinolin-8-yl)-3-(thiophen-3-yl)propanamide (4-h)

Colorless oil, (34.9 mg, 43%). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.56 (s, 3H), 3.30 (ABq, *J* = 14.0 Hz, 1H), 3.47 (ABq, *J* = 14.0 Hz, 1H), 6.91 (d, *J* = 4.8 Hz, 1H), 7.05 (s, 1H), 7.15-7.17 (m, 1H), 7.45 (dd, *J* = 8.0 Hz, 4.4 Hz, 1H), 7.54-7.55 (m, 2H), 8.16 (d, *J* = 8.0 Hz, 1H), 8.76-8.78 (m, 1H), 8.81 (d, *J* = 3.6 Hz, 1H), 9.94 (s, 1H), 10.45 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.7, 35.7, 60.1, 116.8, 121.9, 122.3, 123.8, 125.8, 127.4, 128.0, 129.2, 134.0, 135.8, 136.4, 138.8, 148.7, 169.0, 201.7 ppm. HRMS (ESI^+): calcd for $C_{18}H_{17}N_2O_2S$ $[M+H]^+$ 325.1005, found 325.1003.

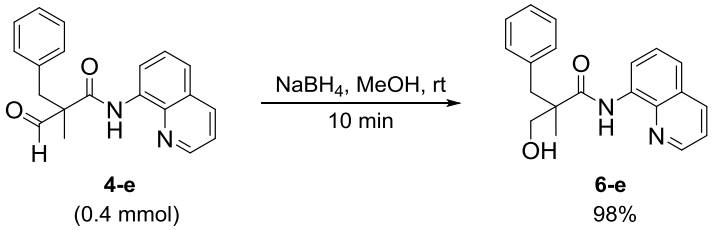
(v) Transformations of the Product

Scheme S1. Esterlysis of Amide 3



Procedure for the esterlysis of amide 3:[8] BF_3•Et_2O (3.6 mmol, 0.45 mL) was added dropwise to a stirred solution of *N*-alkoxyamine **3ma** (0.3 mmol, 138 mg) in EtOH (4 mL) at room temperature. Then the mixture was stirred at 150 °C for 72 h. After cooling to room temperature, Et_3N (6 mmol, 0.84 mL) was added dropwise to the reaction mixture with stirring. The mixture was then concentrated under reduced pressure and the residue was purified by flash column chromatography on silica gel to afford the product **5ma** as nearly colorless oil (51 mg, 47%). ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.06-1.27 (m, 20H), 1.42-1.46 (m, 4H), 2.62 (d, *J* = 13.2 Hz, 1H), 3.04 (d, *J* = 13.2 Hz, 1H), 3.67 (d, *J* = 8.0 Hz, 1H), 4.08-4.16 (m, 3H), 7.10 (d, *J* = 6.8 Hz, 2H), 7.20-7.25 (m, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 14.4, 17.1, 19.2, 20.2, 20.3, 32.9, 33.0, 39.9, 40.0, 42.7, 48.6, 60.3, 60.6, 82.2, 126.6, 128.2, 130.2, 137.1, 175.2 ppm. HRMS (ESI$^+$): calcd for $C_{22}H_{36}NO_3$ $[M+H]^+$ 362.2695, found 362.2691.

Scheme S2. Synthesis of *β*-Hydroxyl Amide 6



Procedure for the synthesis of *β*-hydroxyl amide 6: $NaBH_4$ (0.8 mmol, 30 mg) was added dropwise to a stirred solution of *α*-formyl acid derivative **4-e** (0.4 mmol, 127 mg) in MeOH (10 mL) at room temperature. Then the mixture was stirred at room temperature for 10 min. The mixture was then concentrated under reduced pressure and the residue was purified by flash column chromatography on silica gel to afford the products **6-e** (126 mg, 98%) as nearly colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.34 (s, 3H), 3.12 (d, *J* = 13.6 Hz, 1H), 3.17 (d, *J* = 13.6 Hz, 1H), 3.38 (s, 1H), 3.69-3.78 (m, 2H), 7.16-7.28 (m, 5H), 7.44 (dd, *J* = 8.0 Hz, 4.0 Hz, 1H), 7.52-7.58 (m, 2H), 8.16 (dd, *J* = 8.4 Hz, 1.6 Hz, 1H), 8.76-8.79 (m, 2H), 10.34 (s, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 19.4, 41.9, 49.1, 68.2, 116.9, 121.7, 122.0, 126.7, 127.4, 128.0, 128.3, 130.6, 134.2, 136.4, 136.8, 138.9, 148.5, 176.1 ppm. HRMS (ESI$^+$): calcd for $C_{20}H_{21}N_2O_2$ $[M+H]^+$ 321.1603, found 321.1593.

IV. References

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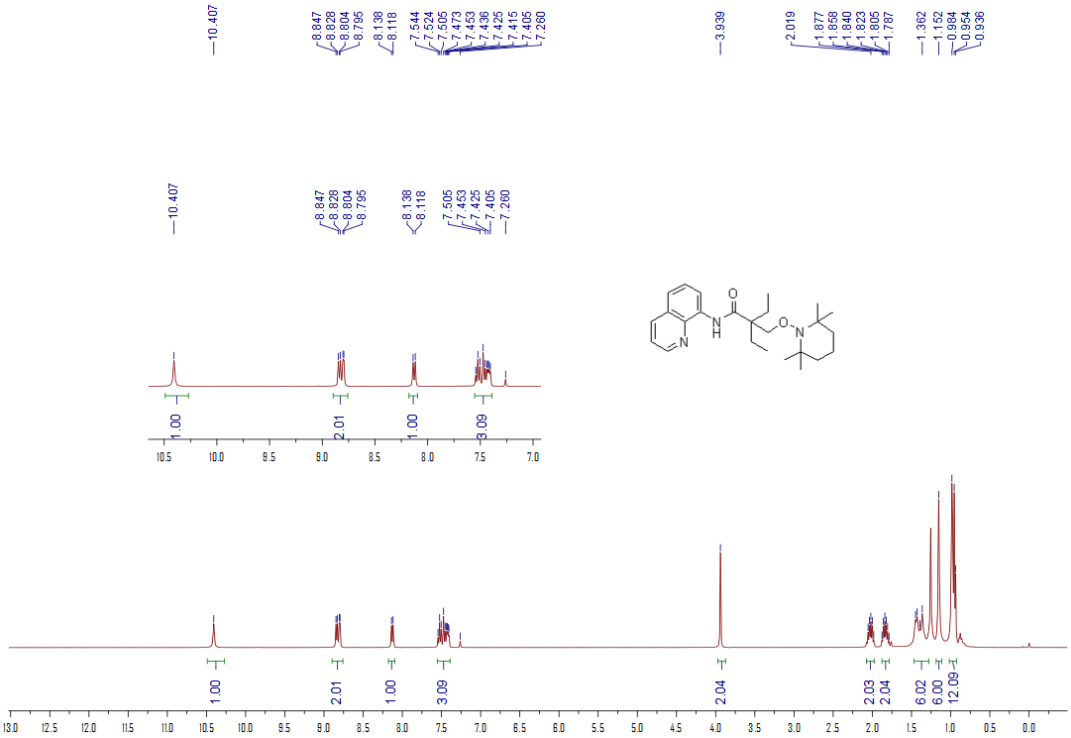
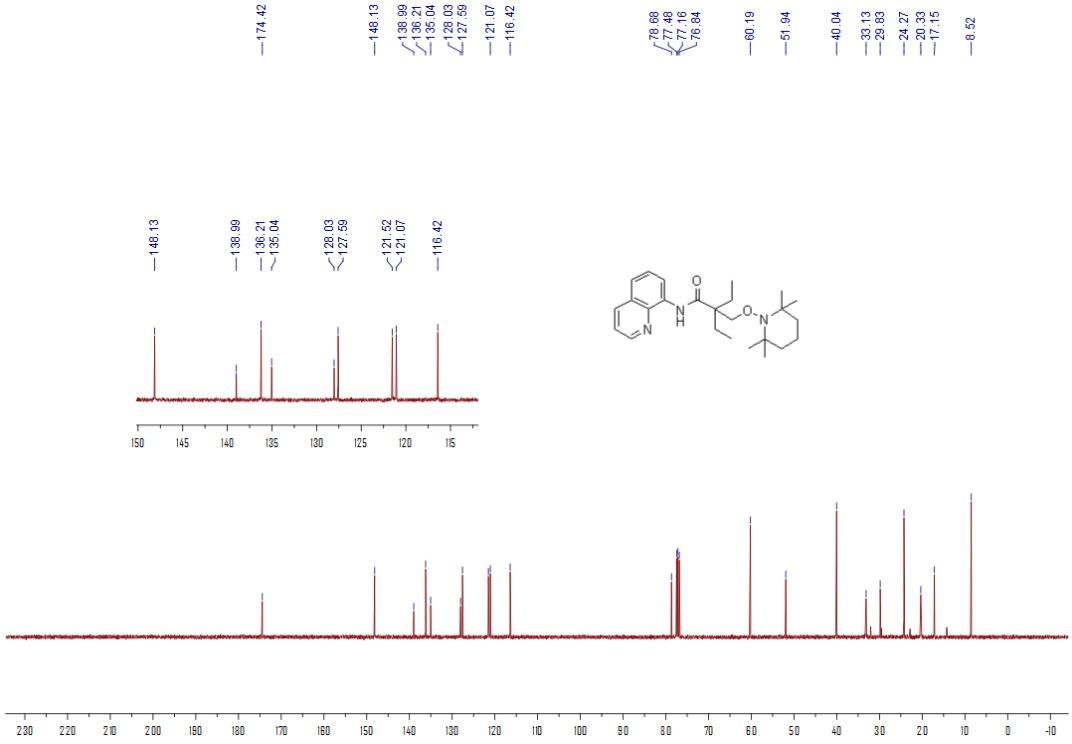
V. Copies of ^{1}H and ^{13}C NMR spectra

3aa ^{1}H NMR (400 MHz, $CDCl_3$)



3aa ^{13}C NMR (100 MHz, $CDCl_3$)



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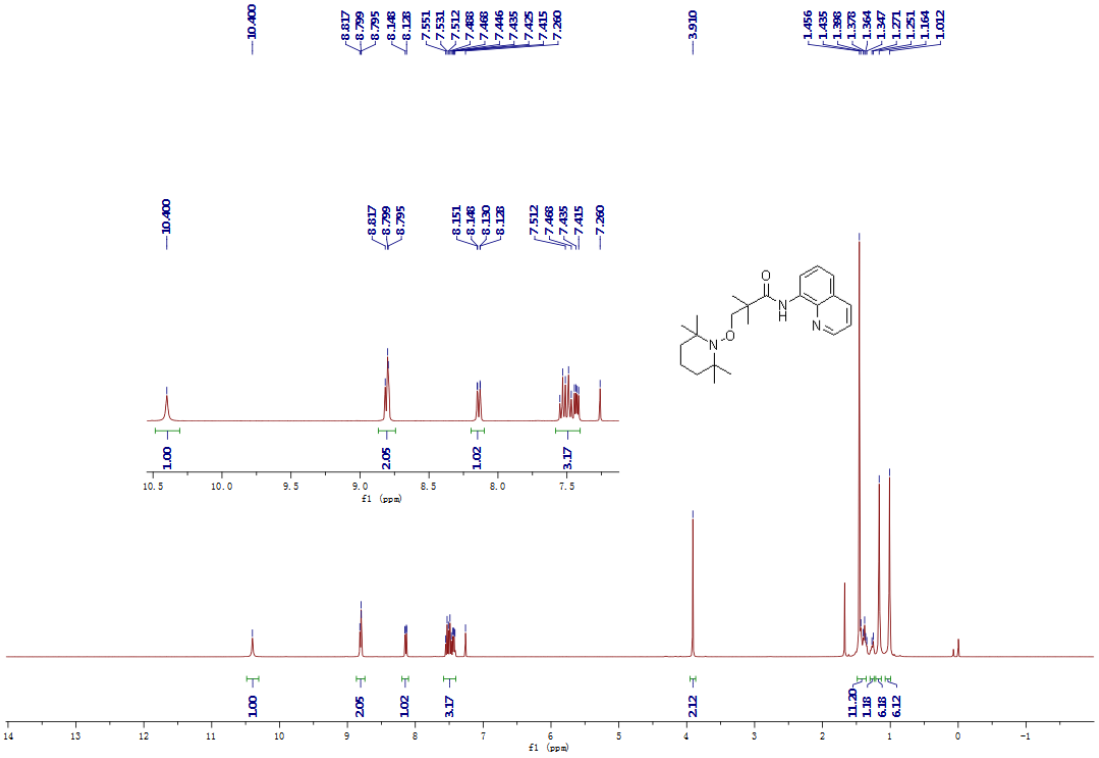
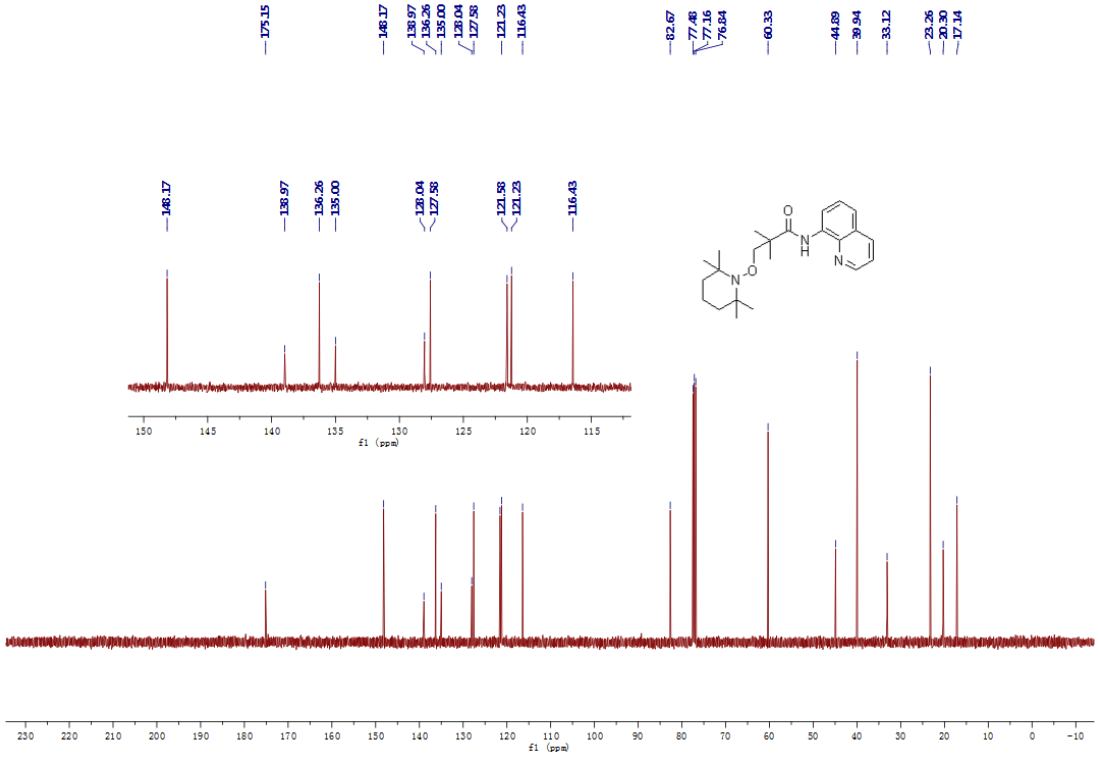
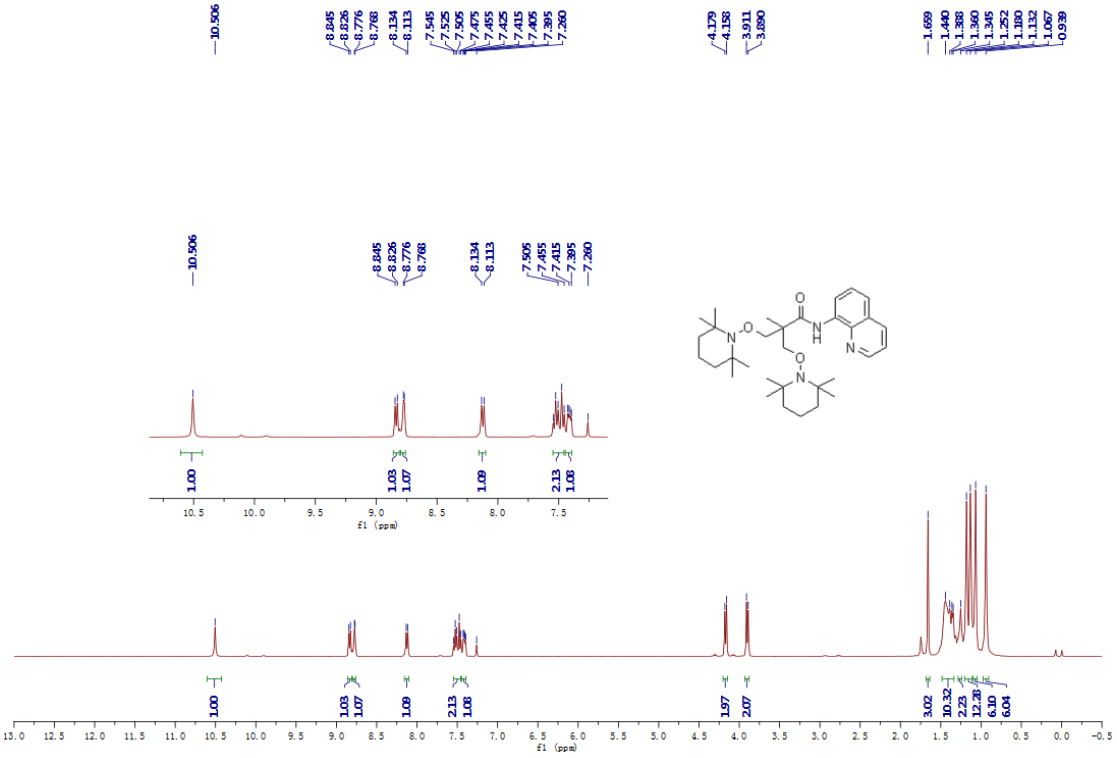


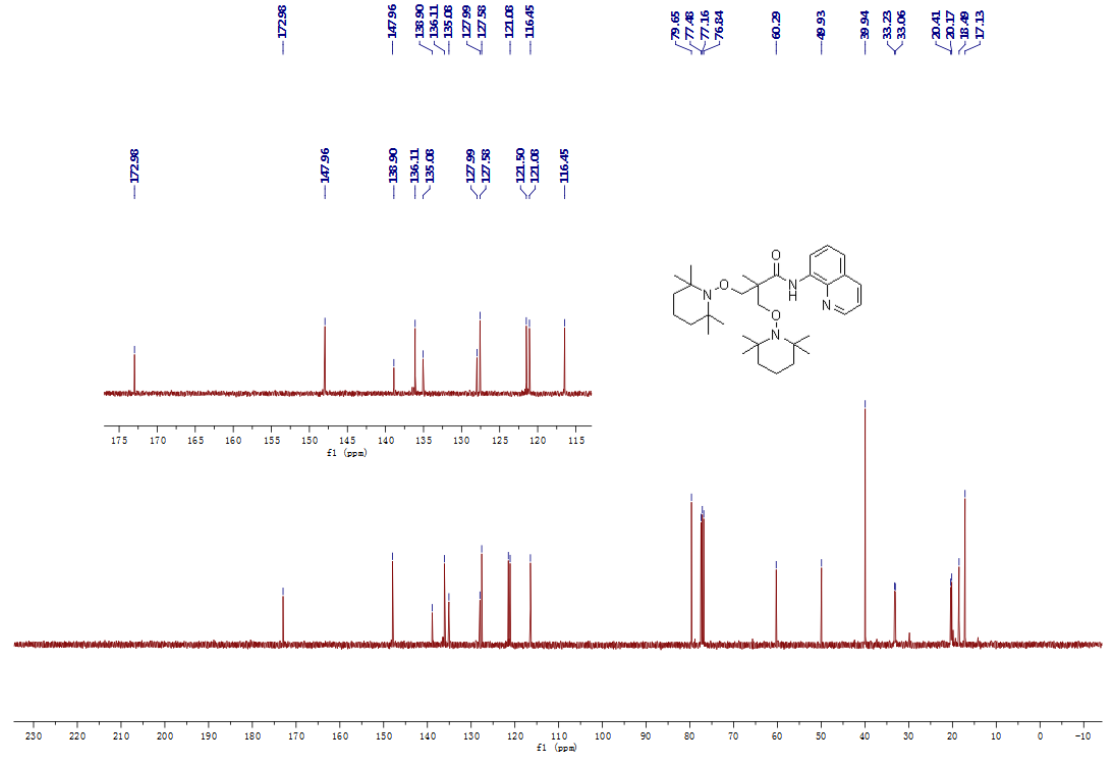
3ba ^{13}C NMR (100 MHz, $CDCl_3$)



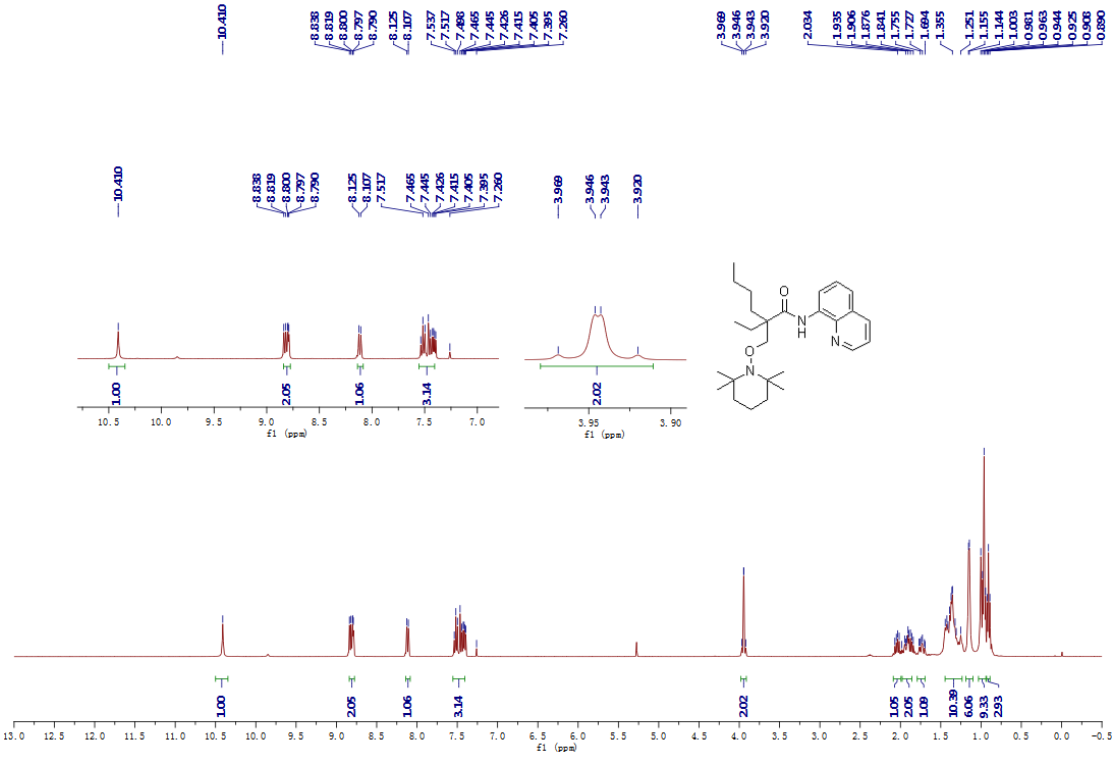
3ba‘ ^{1}H NMR (400 MHz, $CDCl_3$)



3ba‘ ^{13}C NMR (100 MHz, $CDCl_3$)



3ca ^{1}H NMR (400 MHz, $CDCl_3$)



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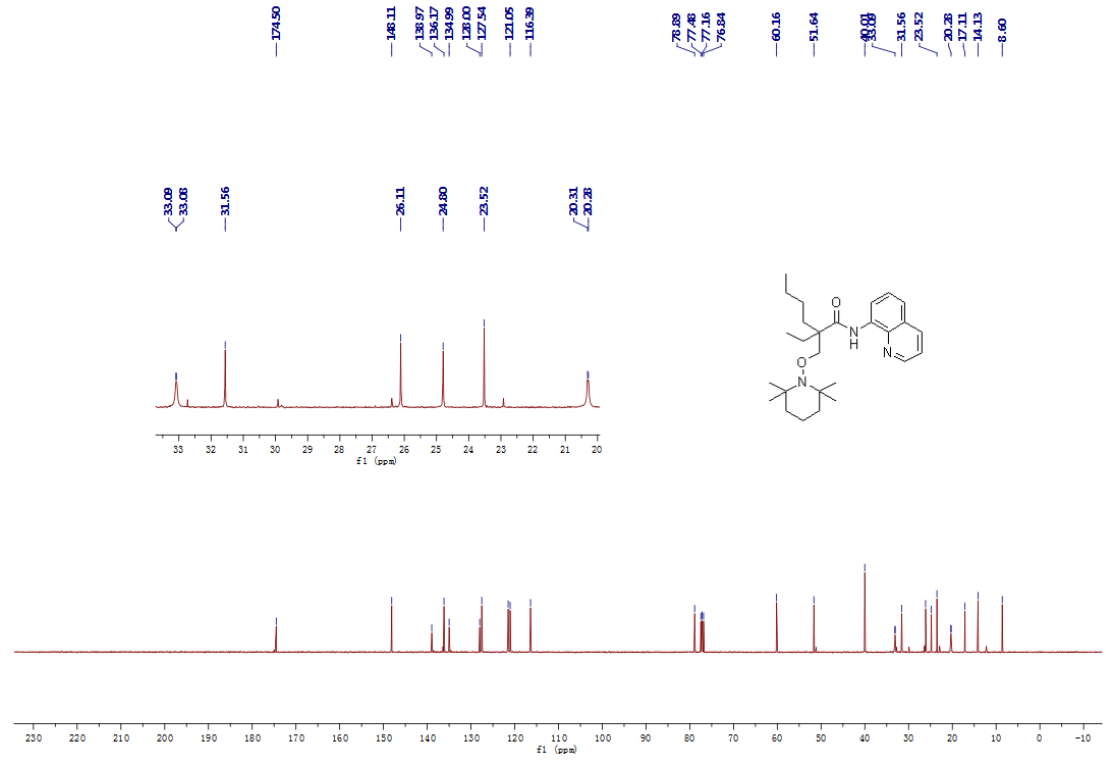

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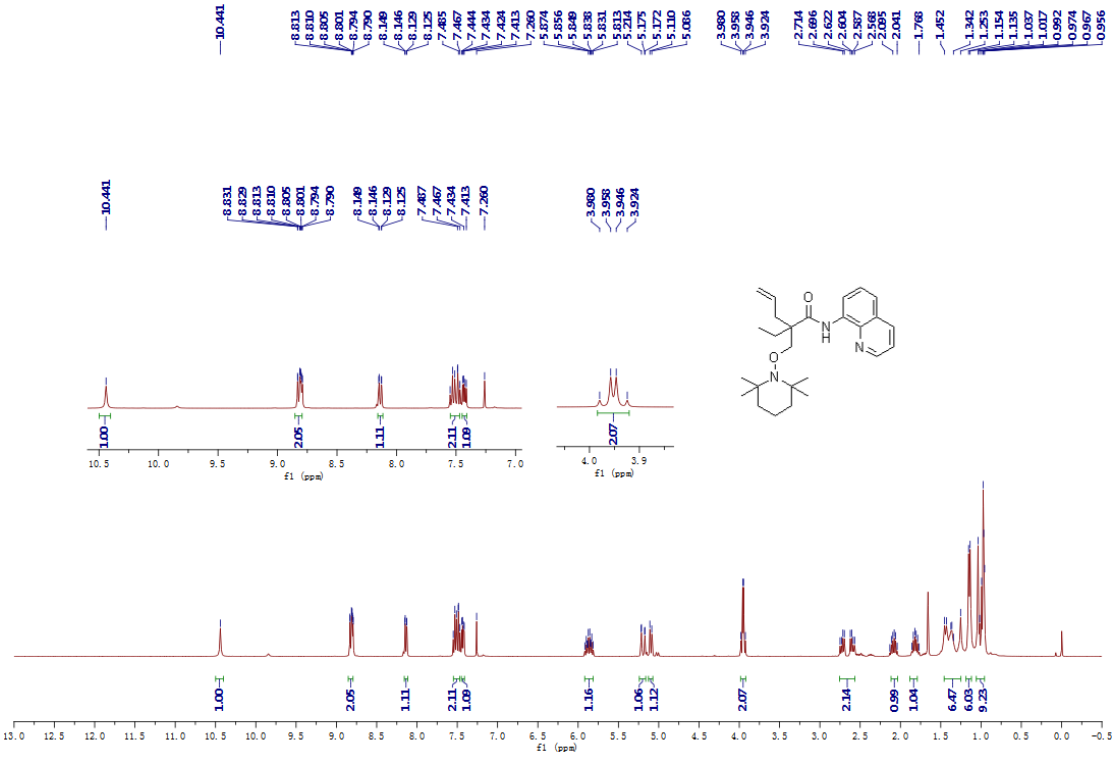

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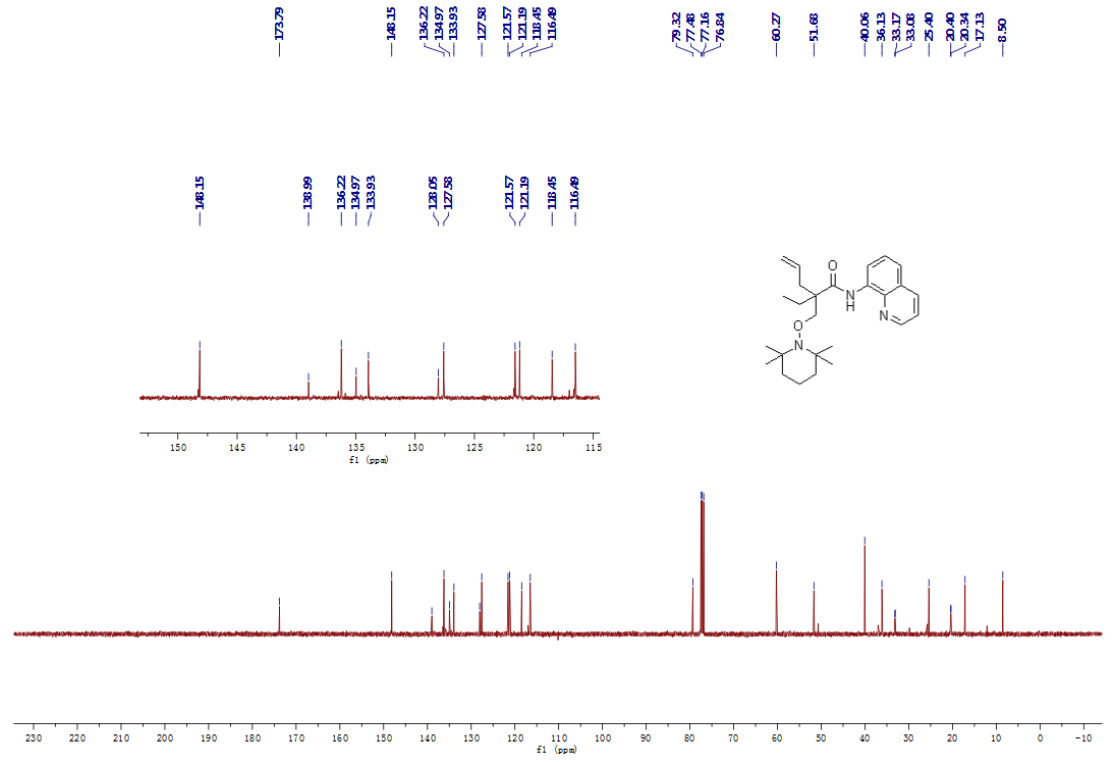

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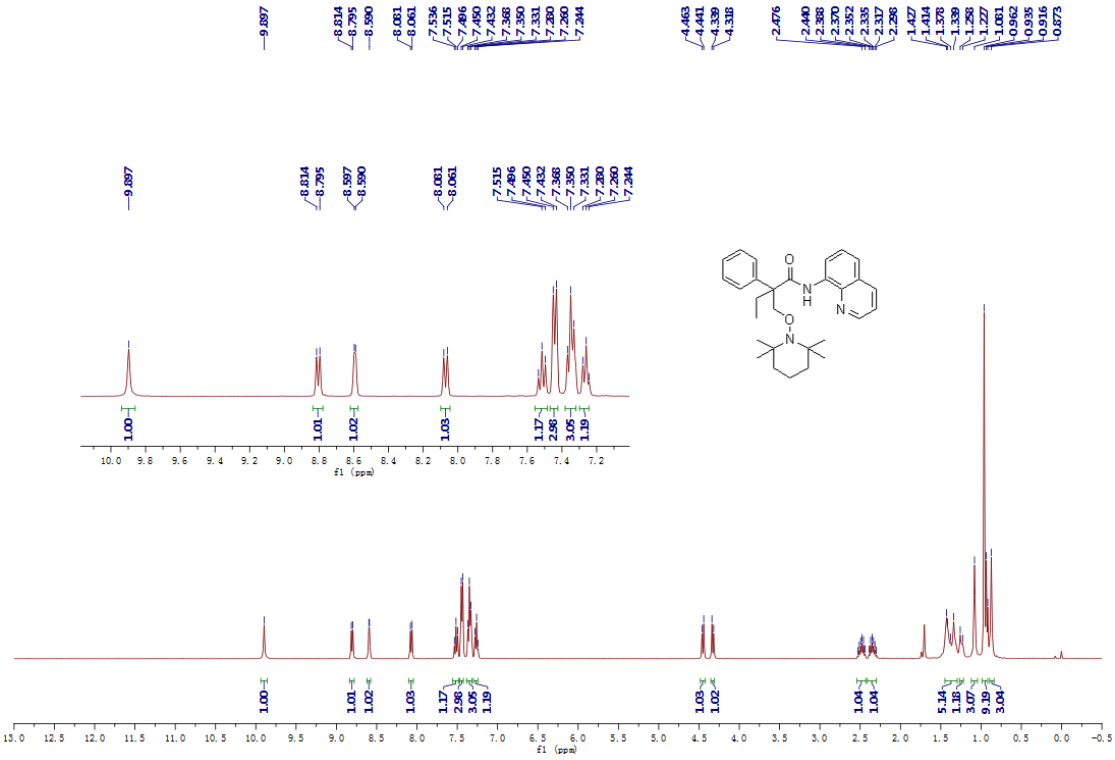

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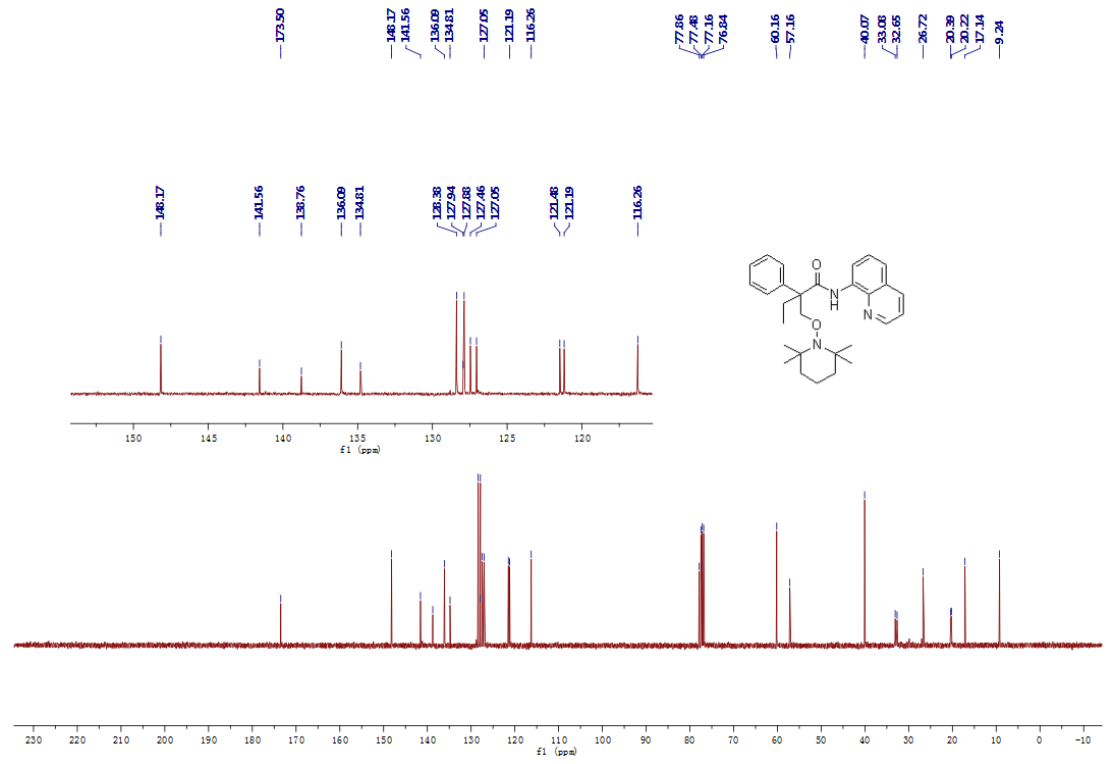

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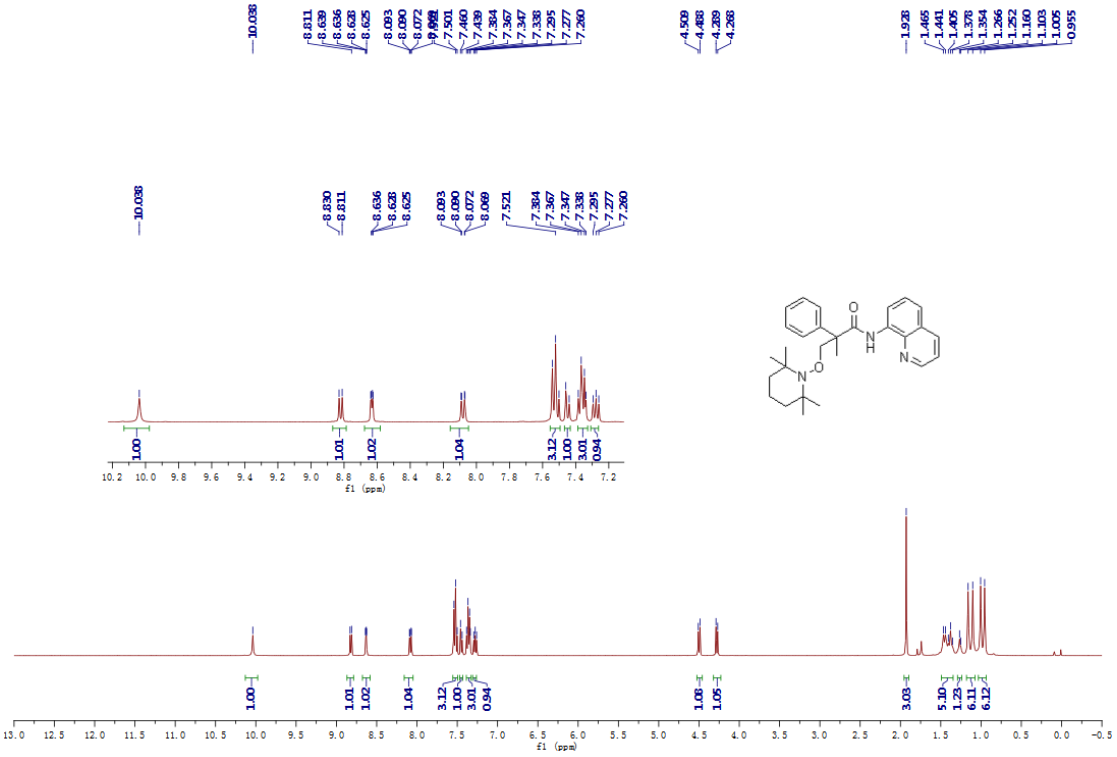

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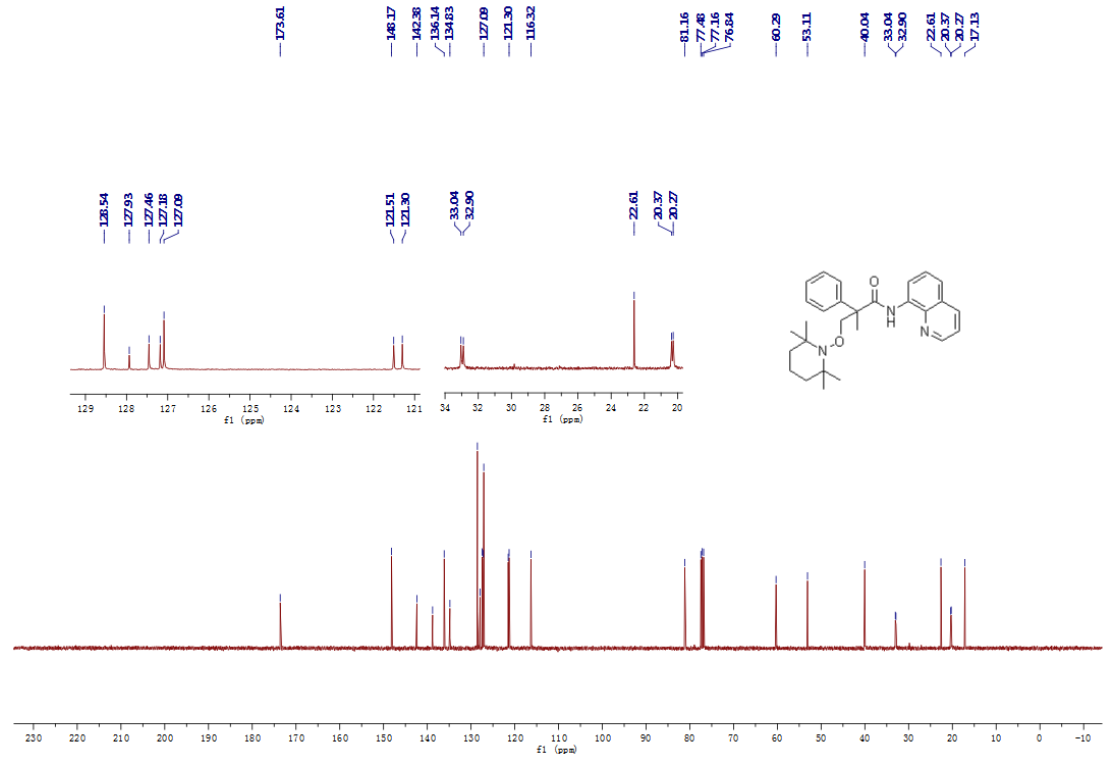
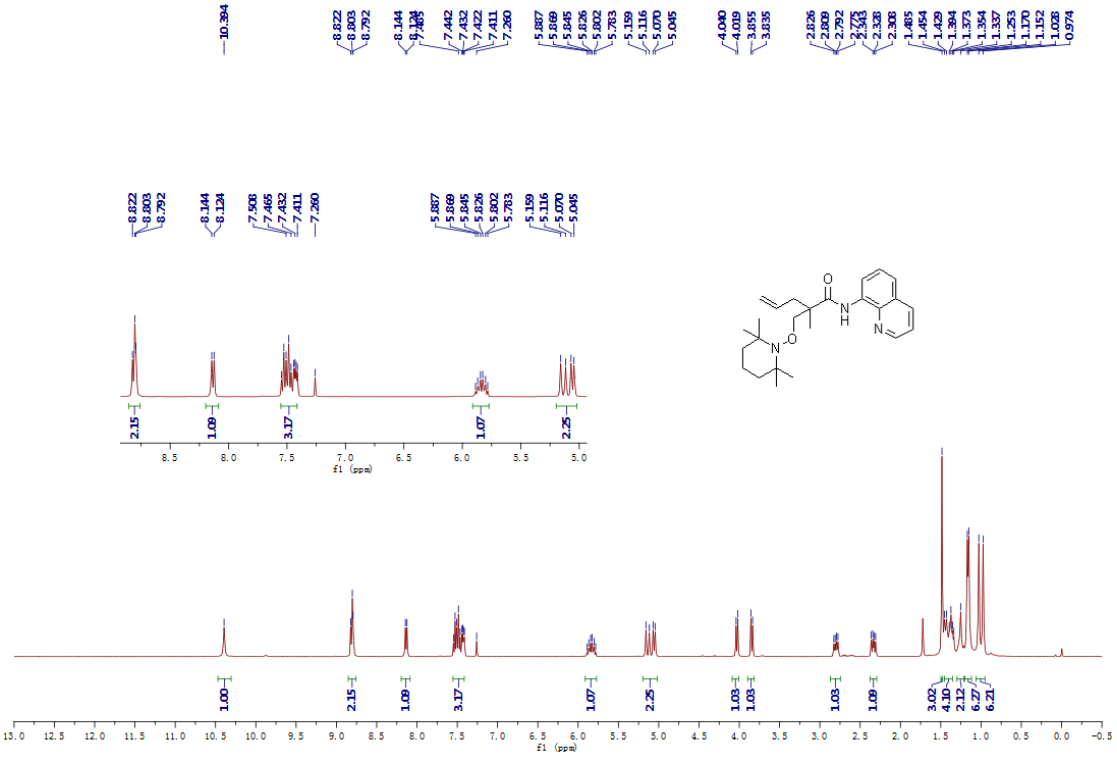
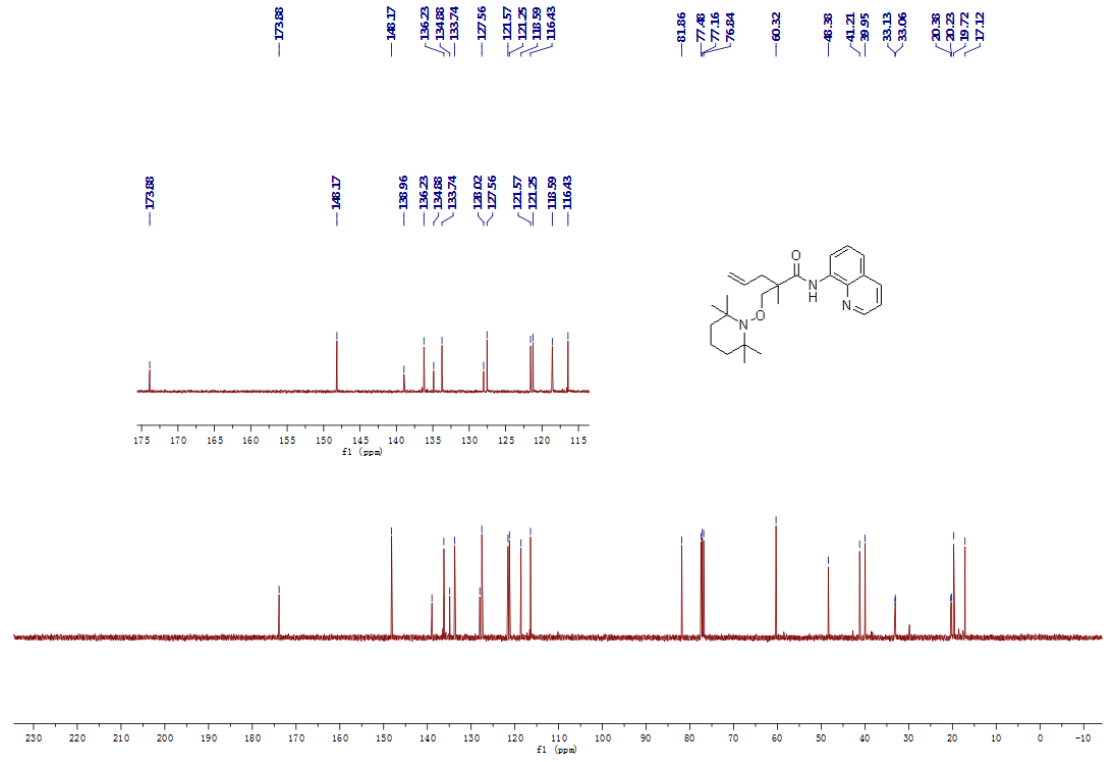


3ga ^{1}H NMR (400 MHz, $CDCl_3$)



3ga ^{13}C NMR (100 MHz, $CDCl_3$)



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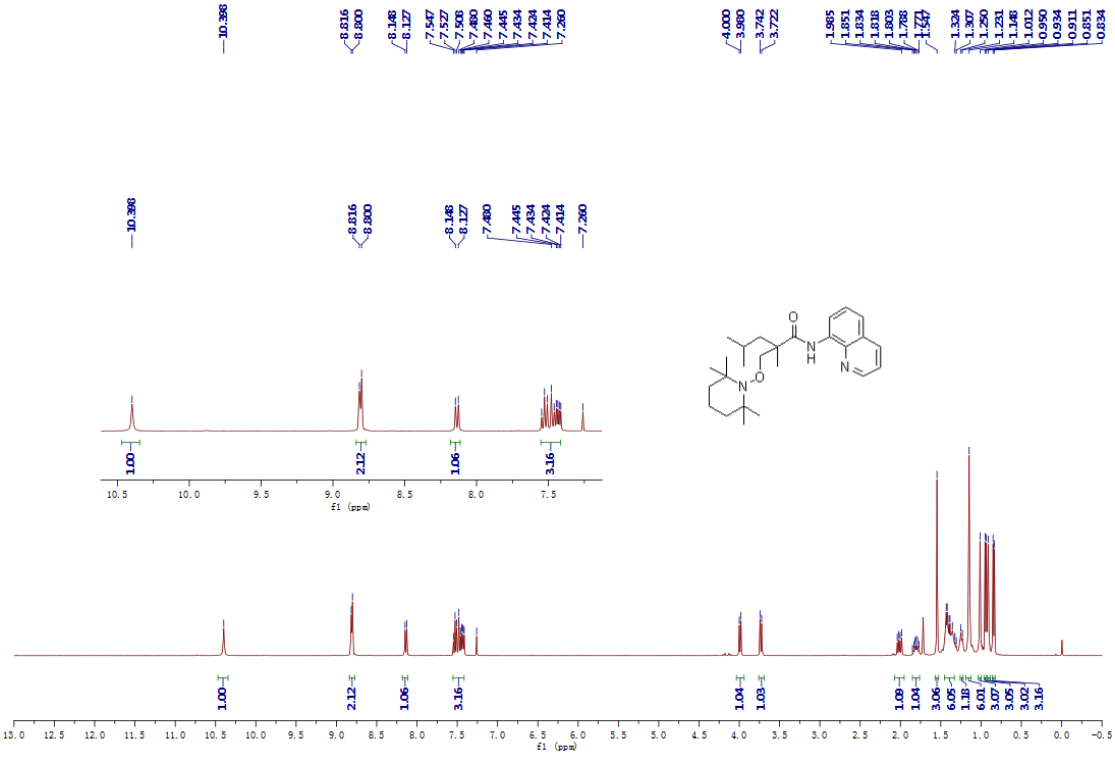
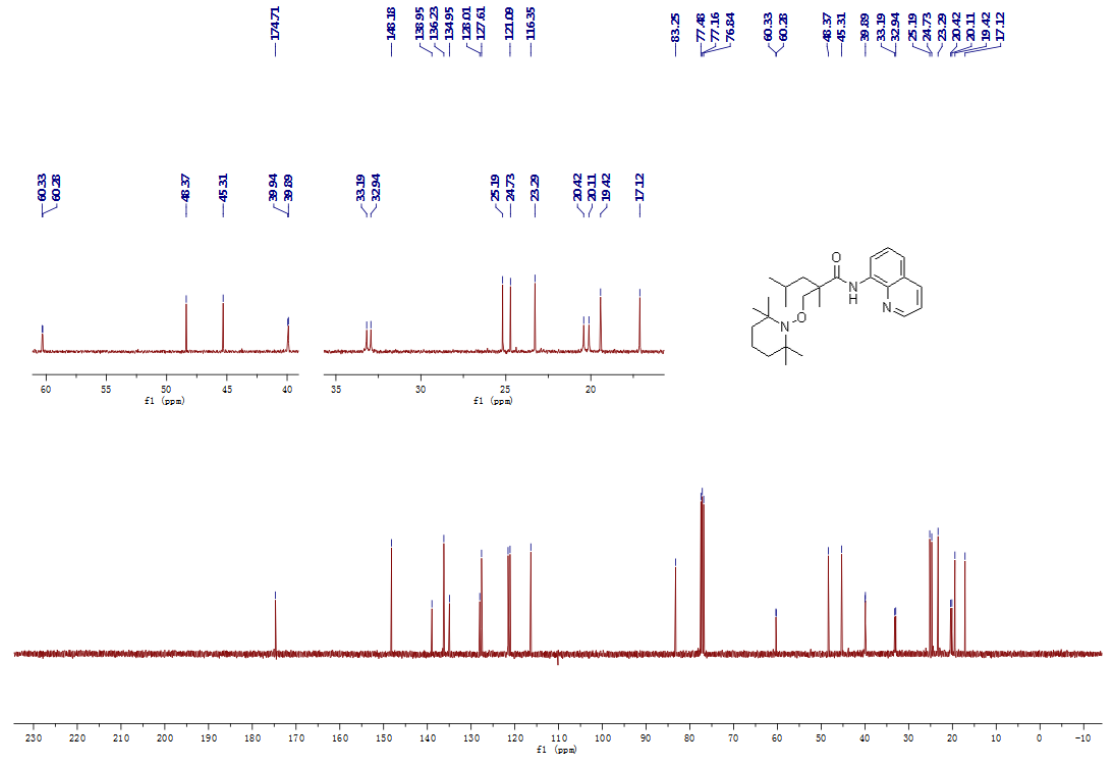
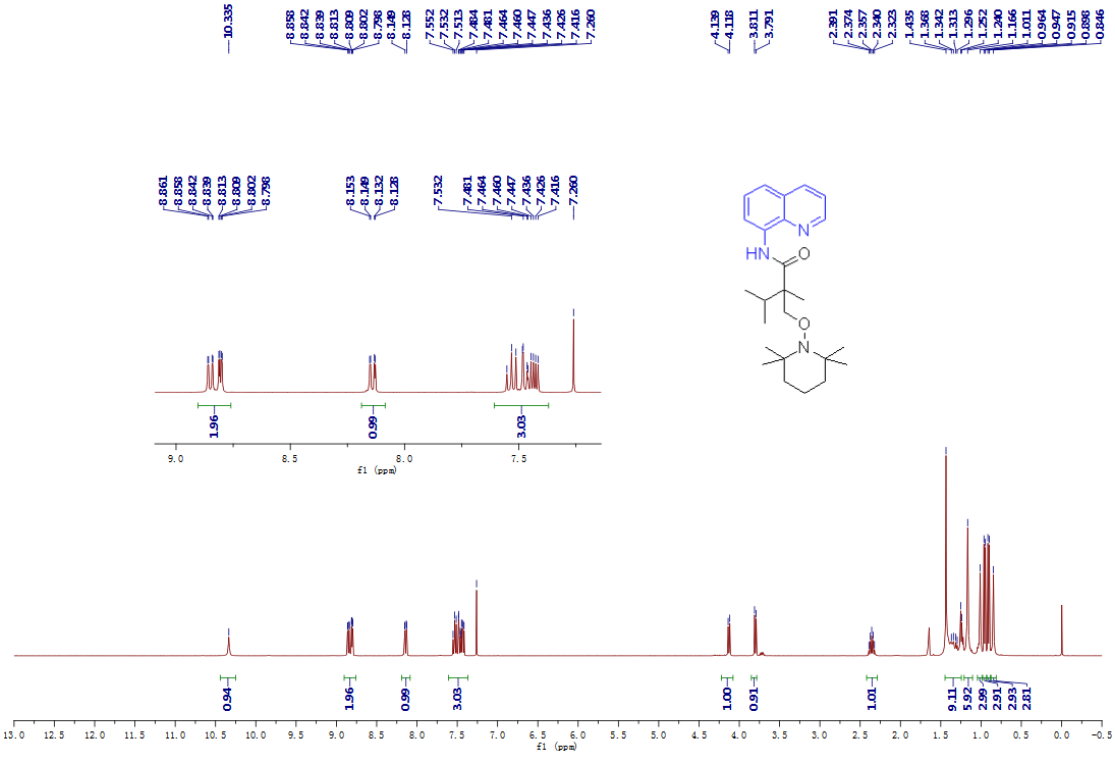


3ha ^{13}C NMR (100 MHz, $CDCl_3$)



3ia ^{1}H NMR (400 MHz, $CDCl_3$)



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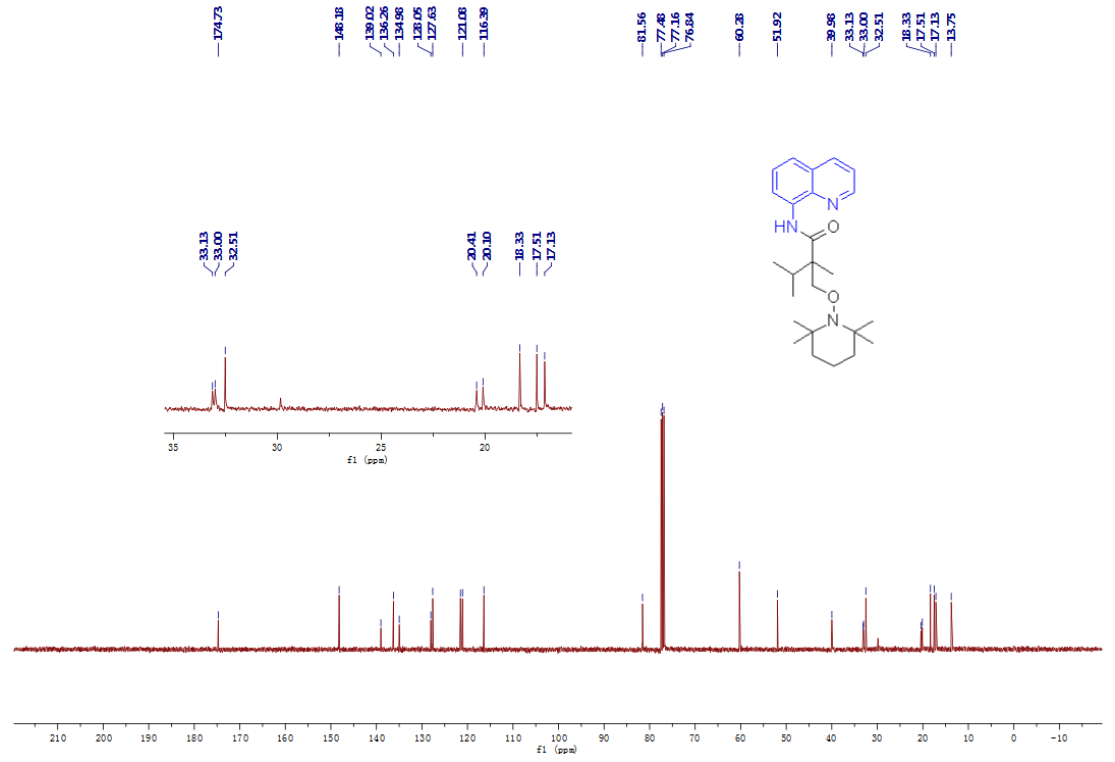

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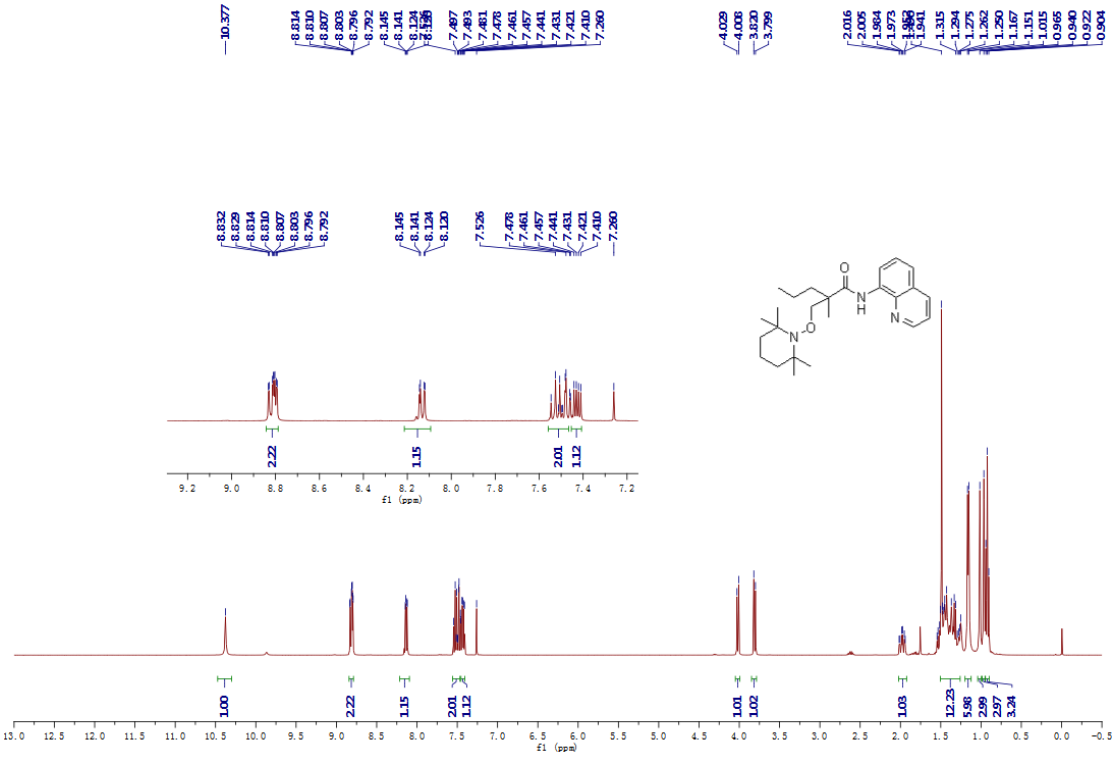

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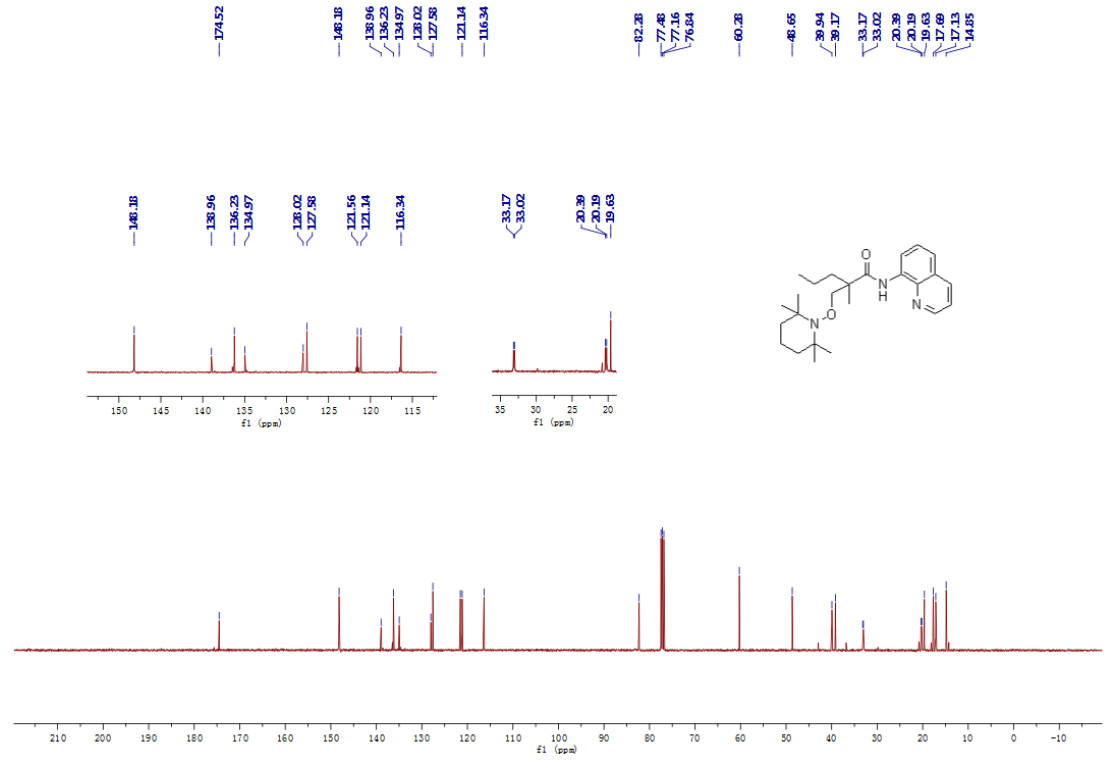

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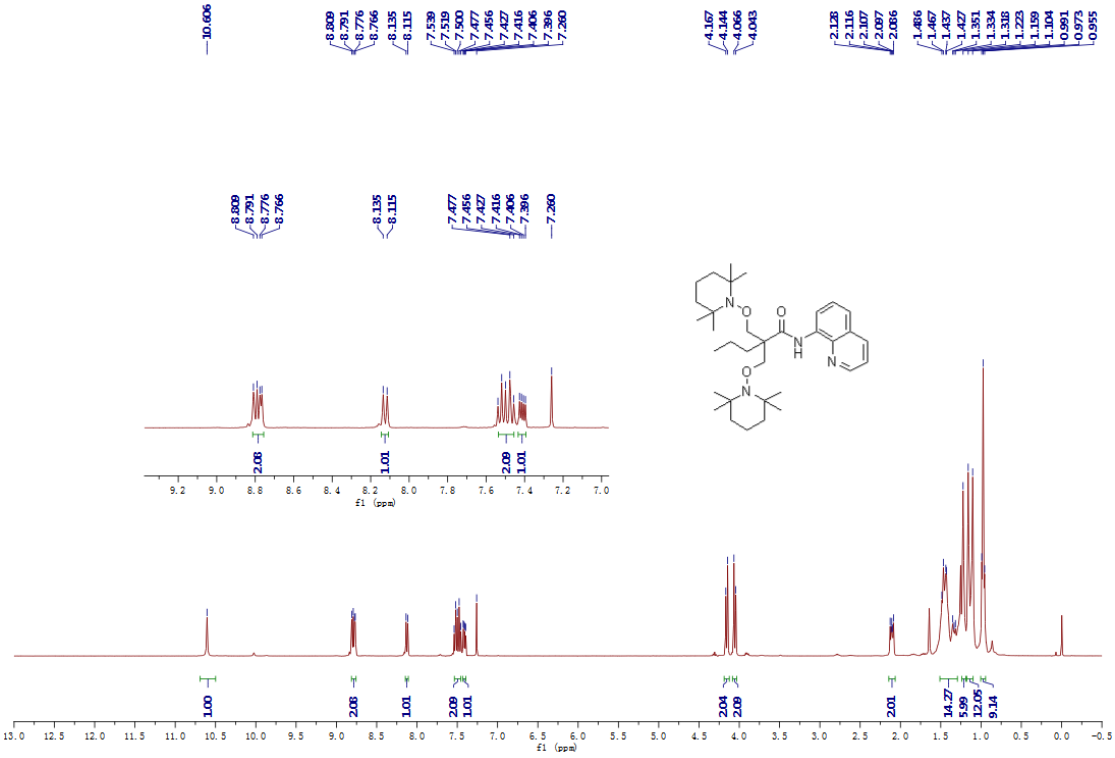

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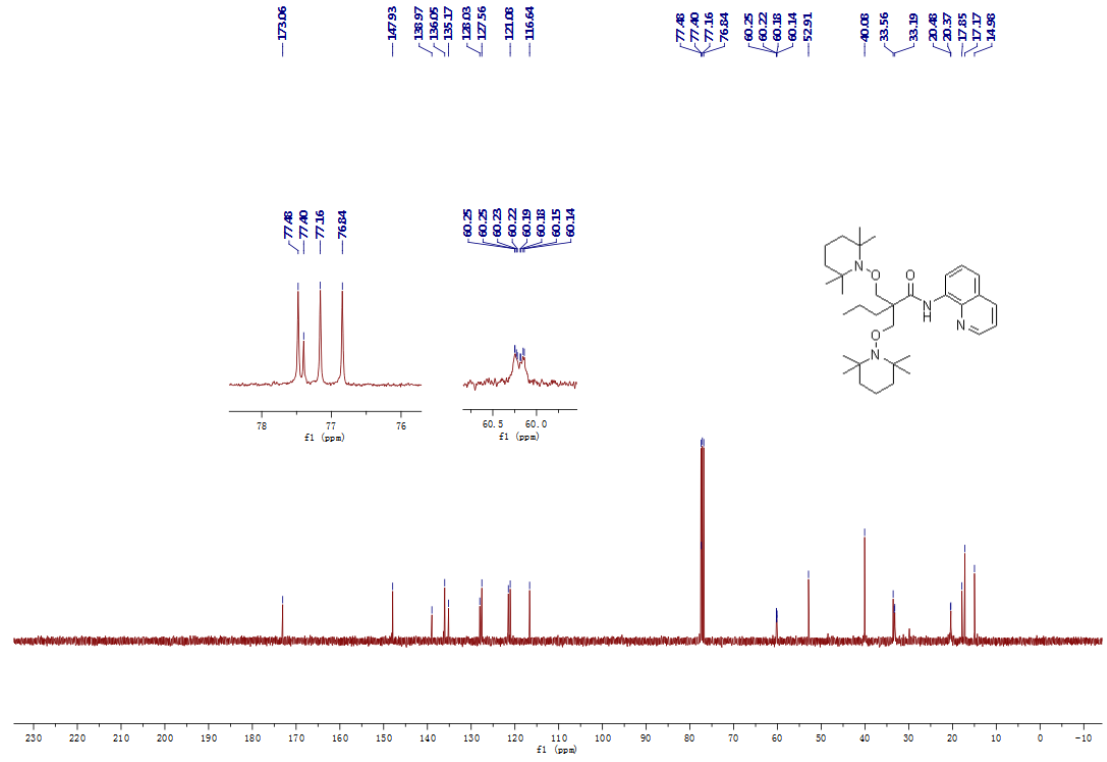

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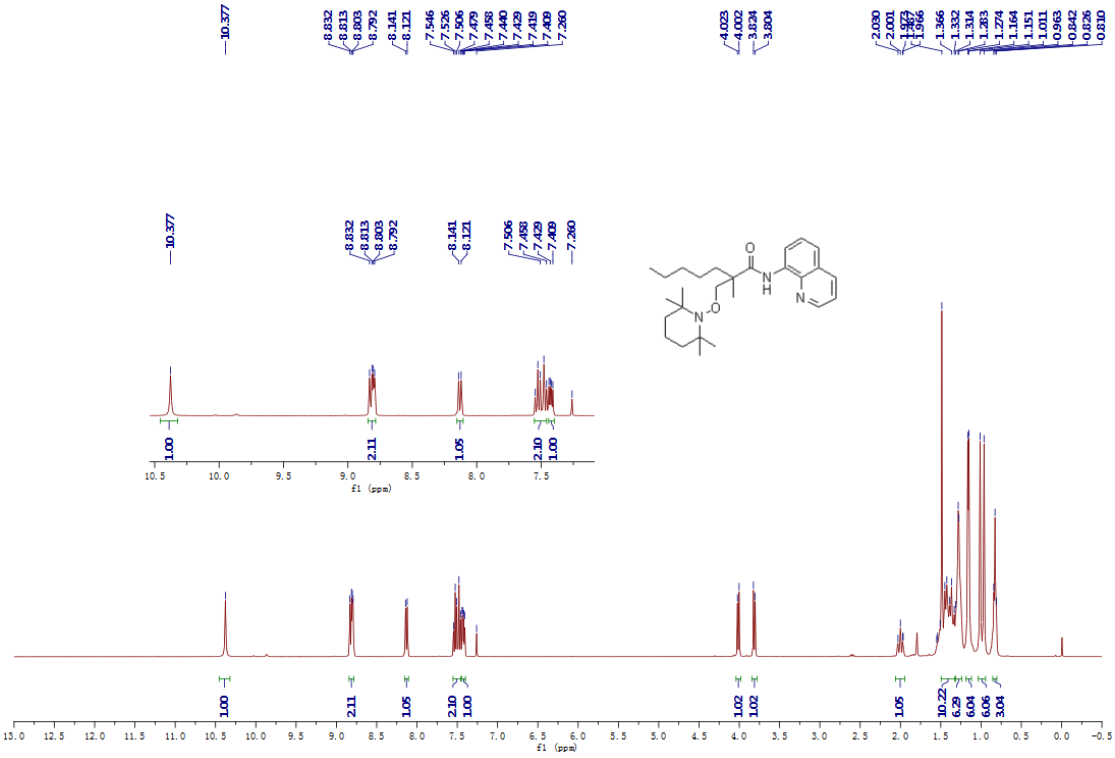

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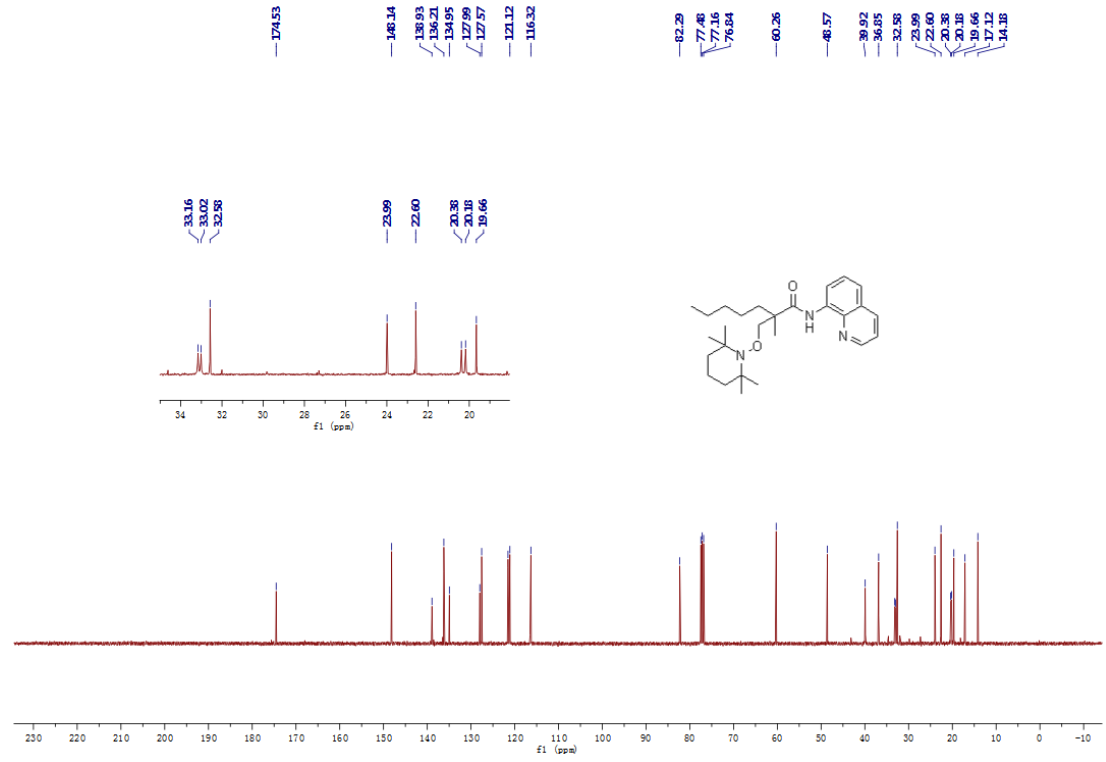

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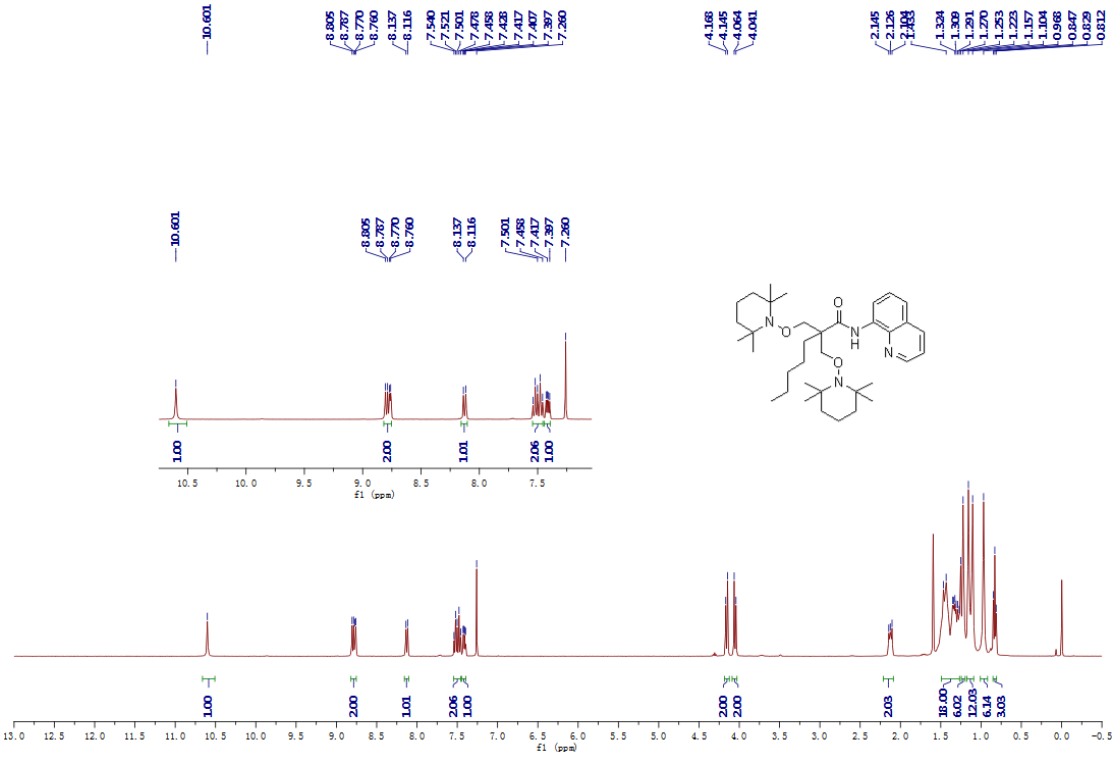

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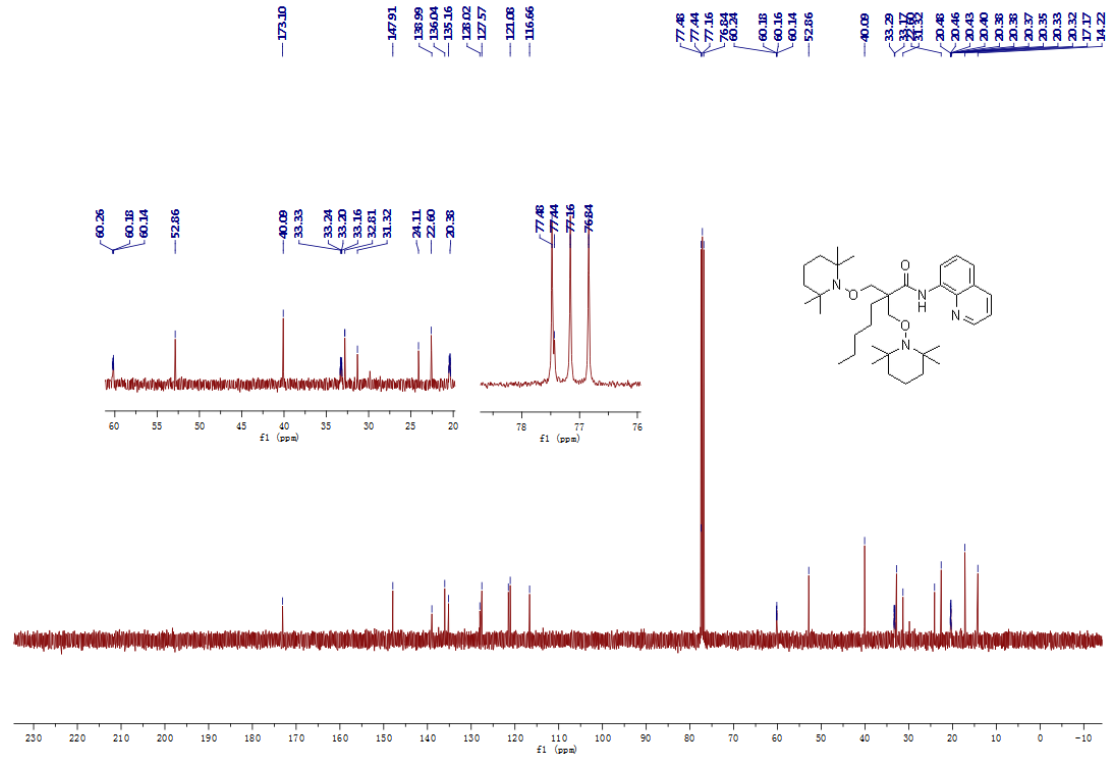

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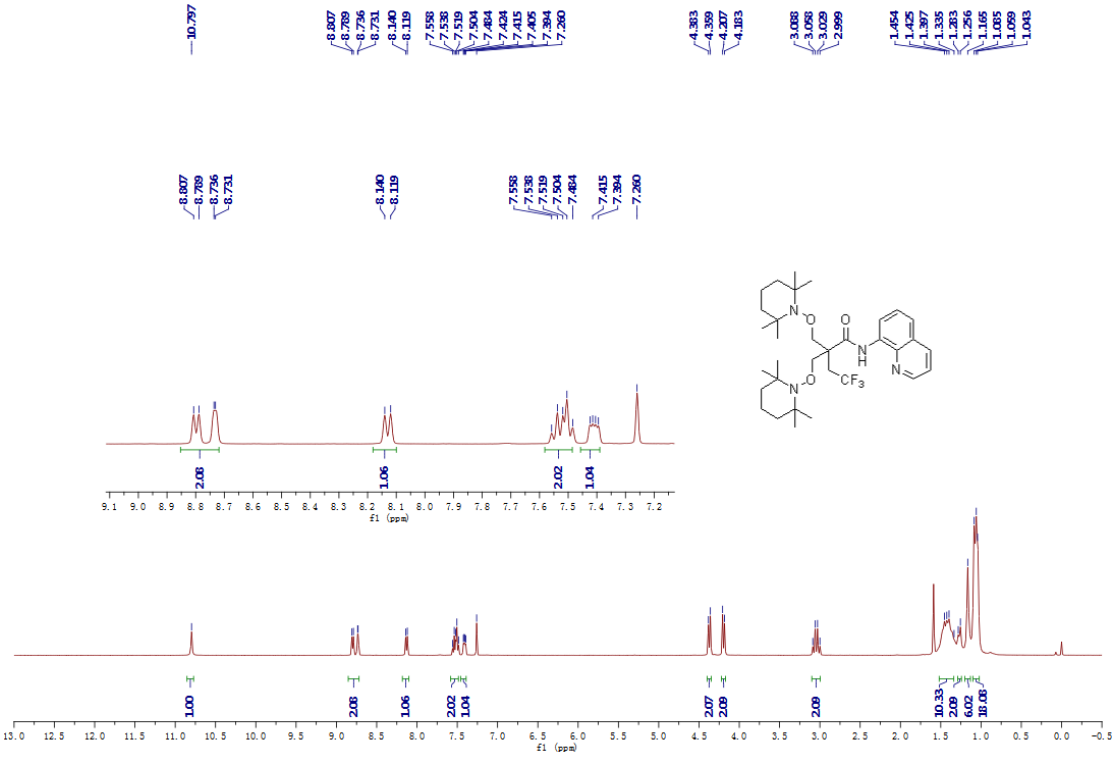

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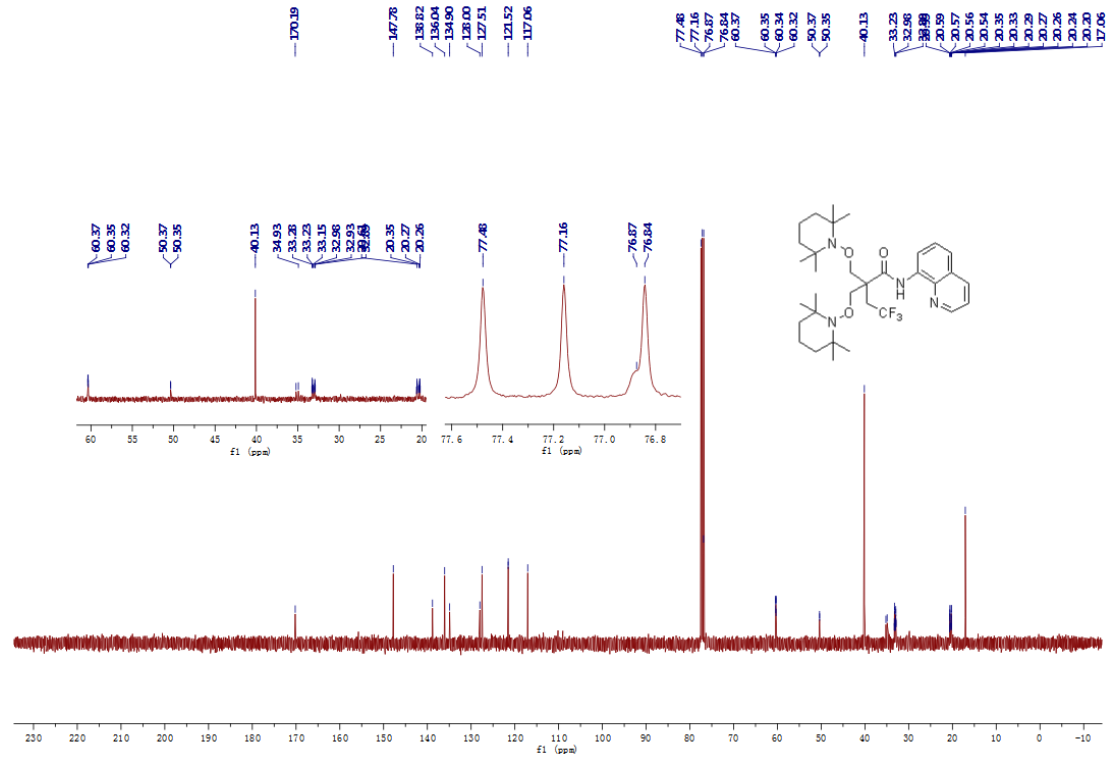
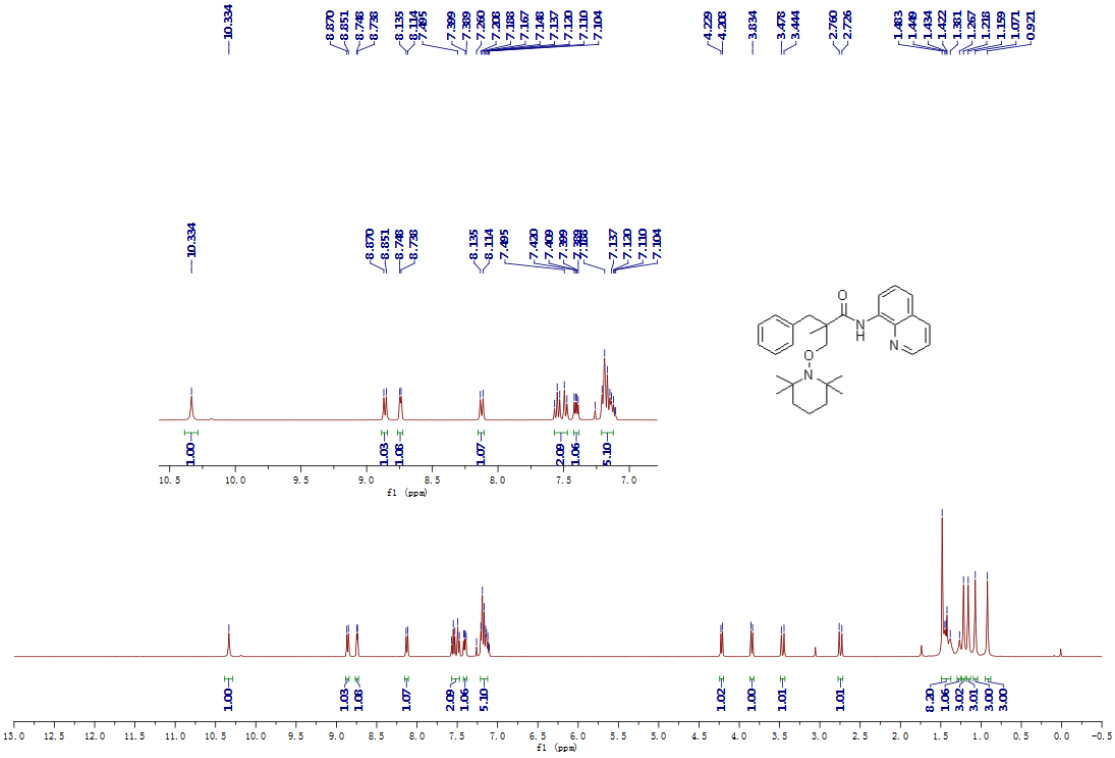


3ma ^{1}H NMR (400 MHz, $CDCl_3$)



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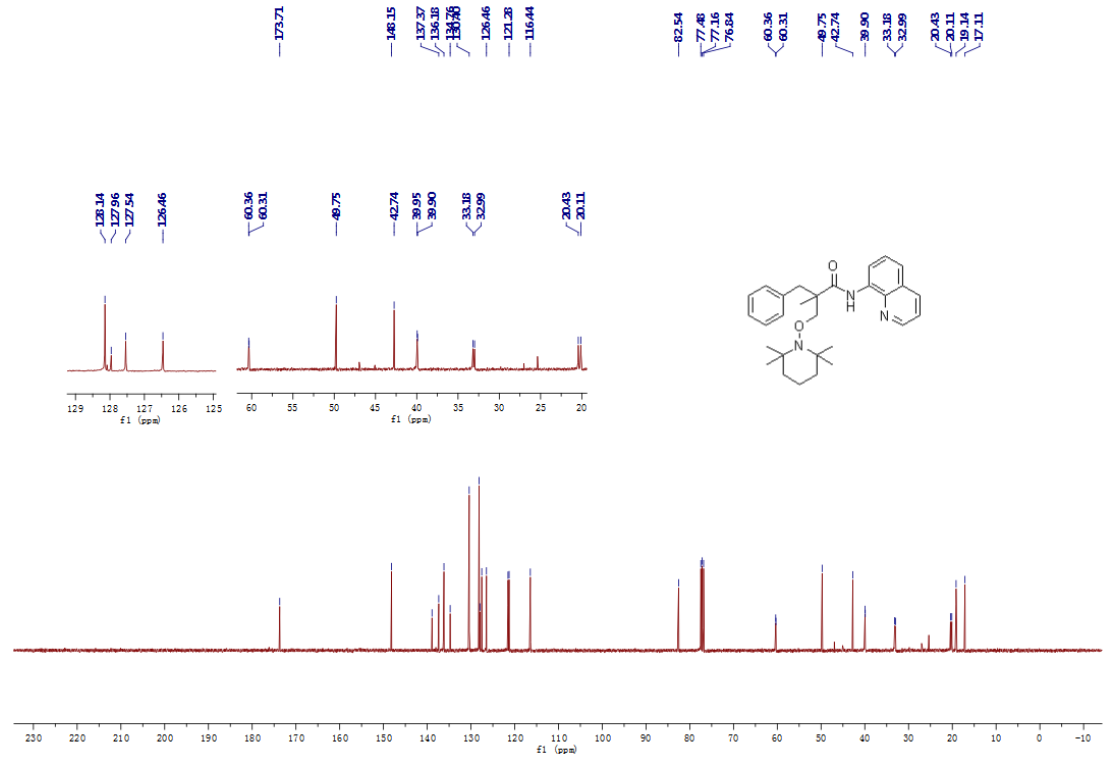

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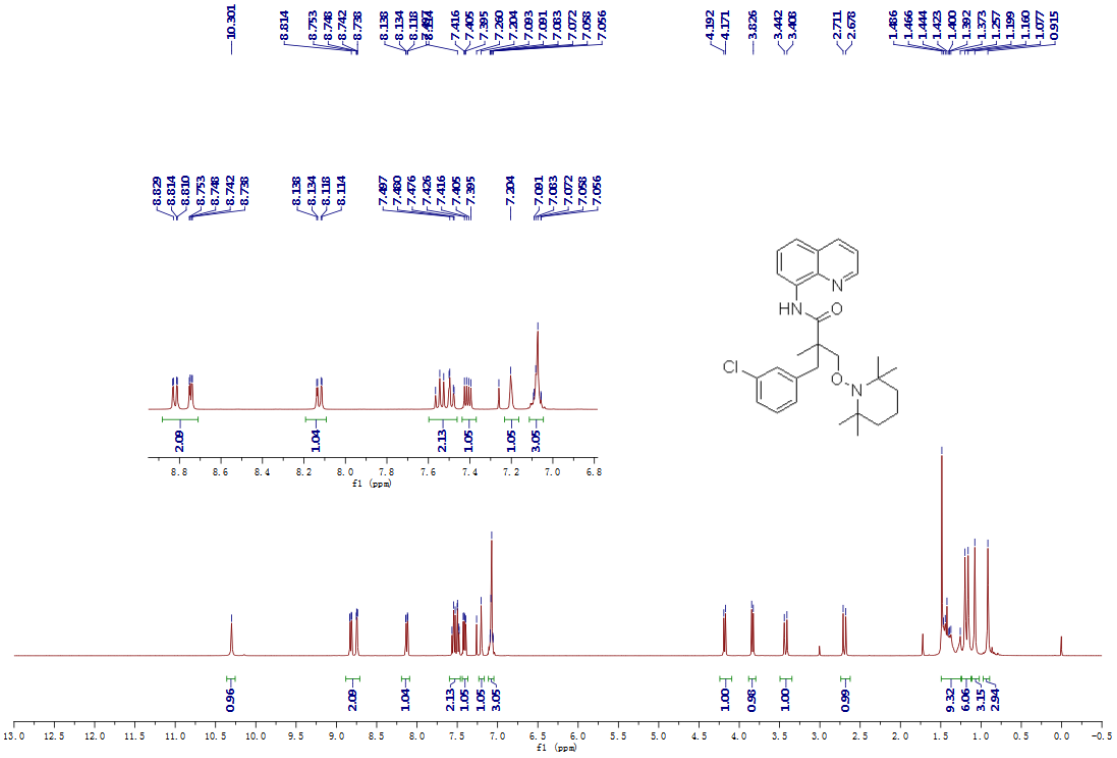

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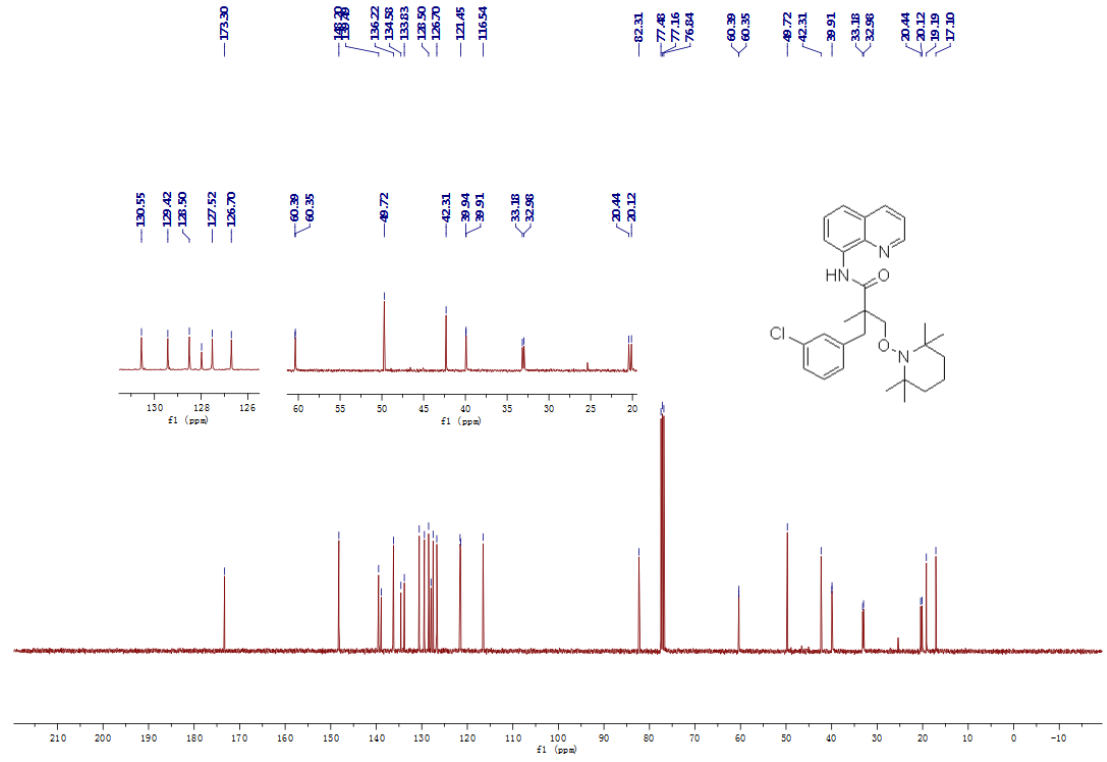

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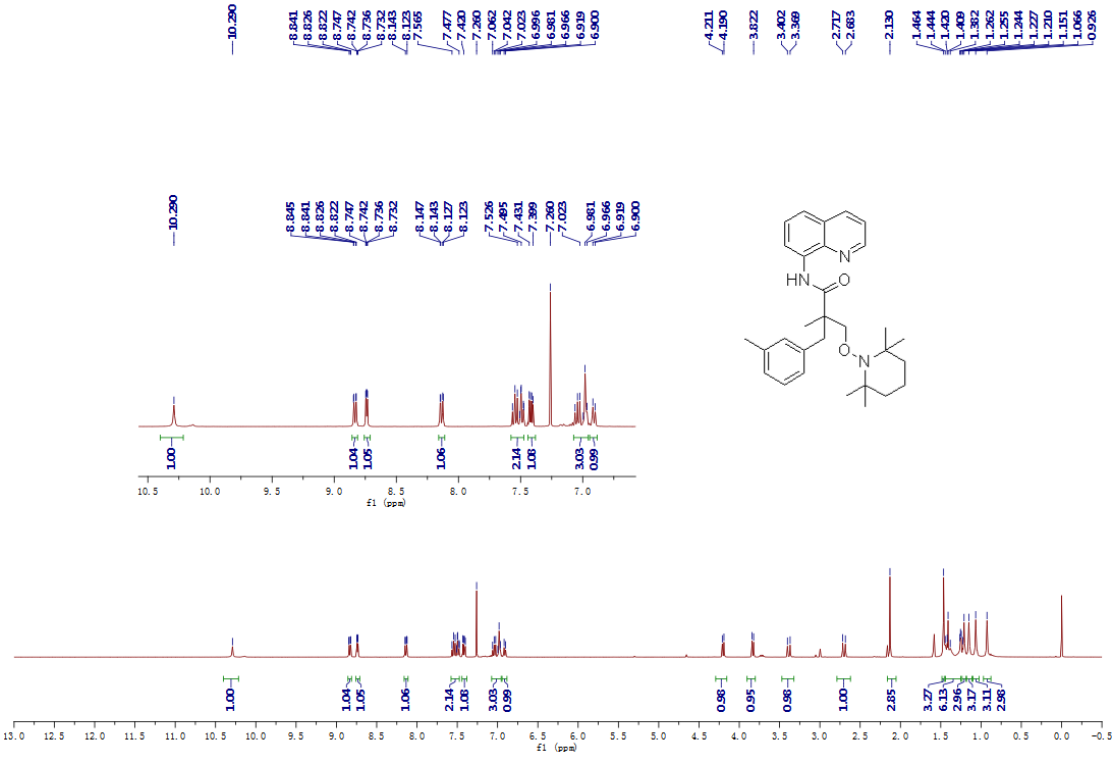

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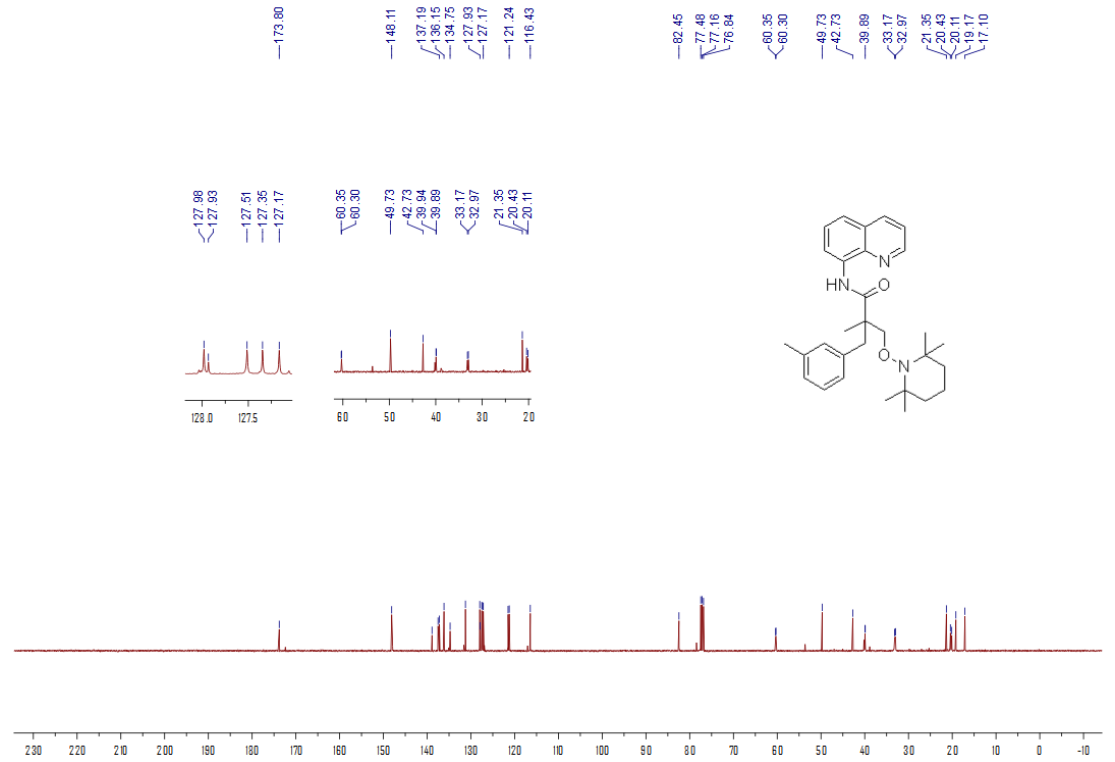
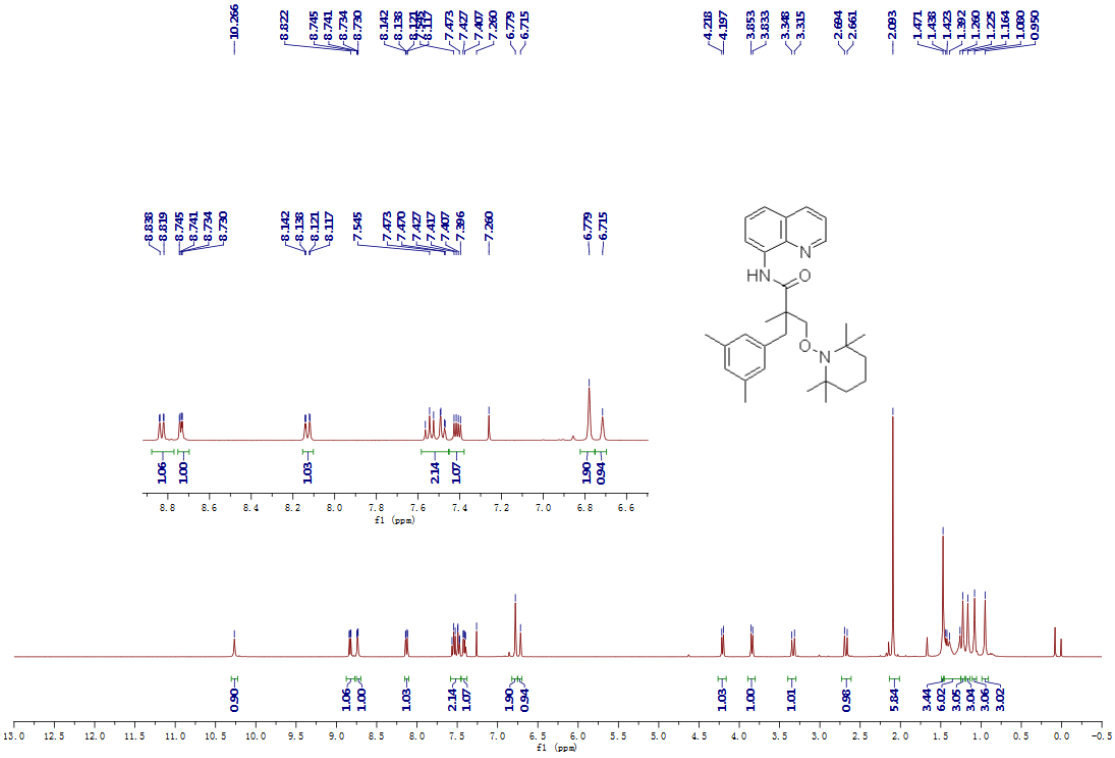


3pa ^{1}H NMR (400 MHz, $CDCl_3$)



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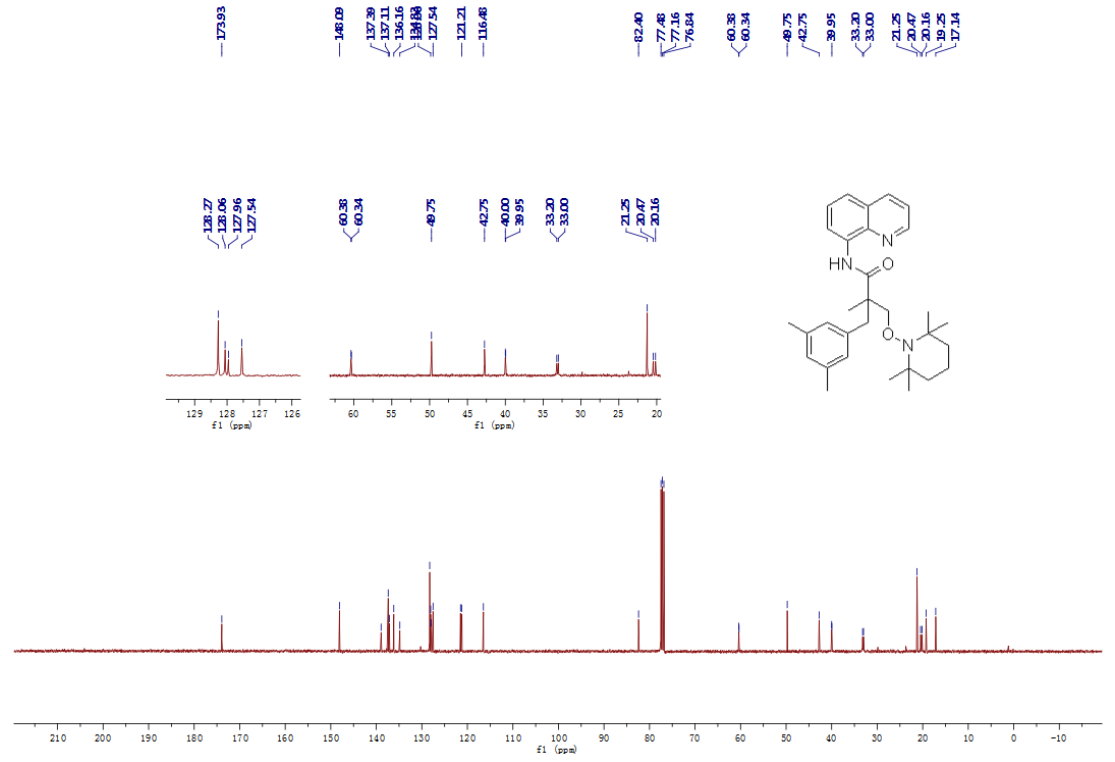

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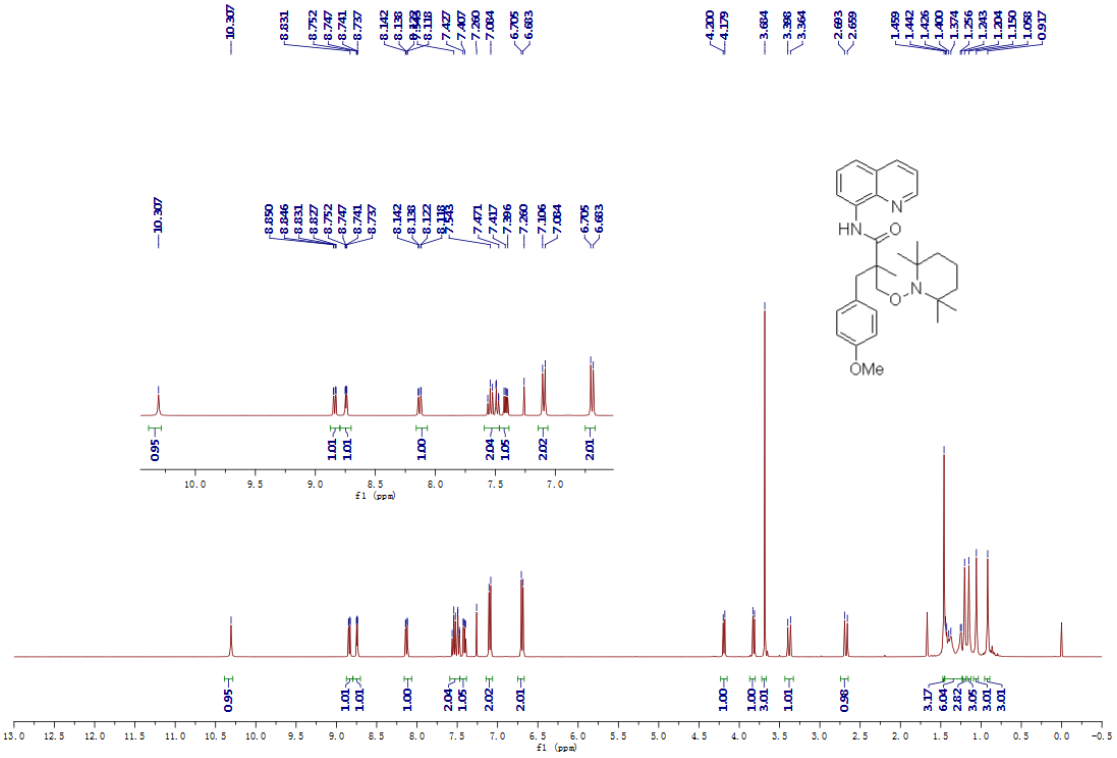

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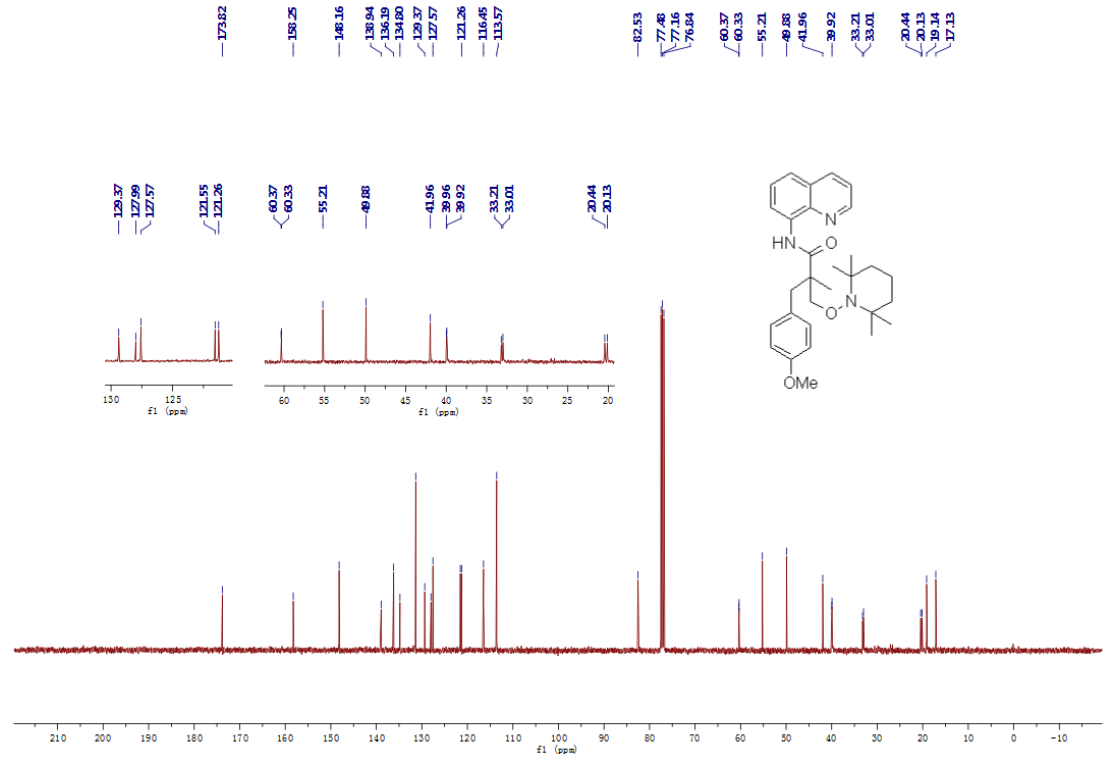

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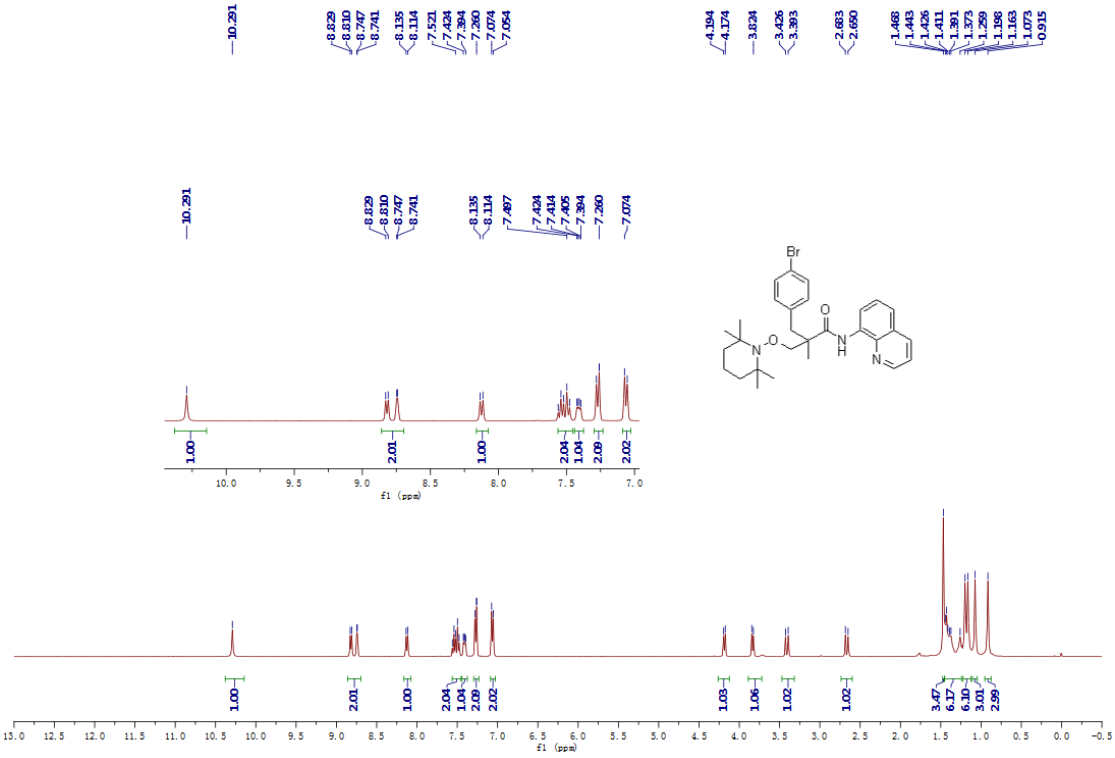

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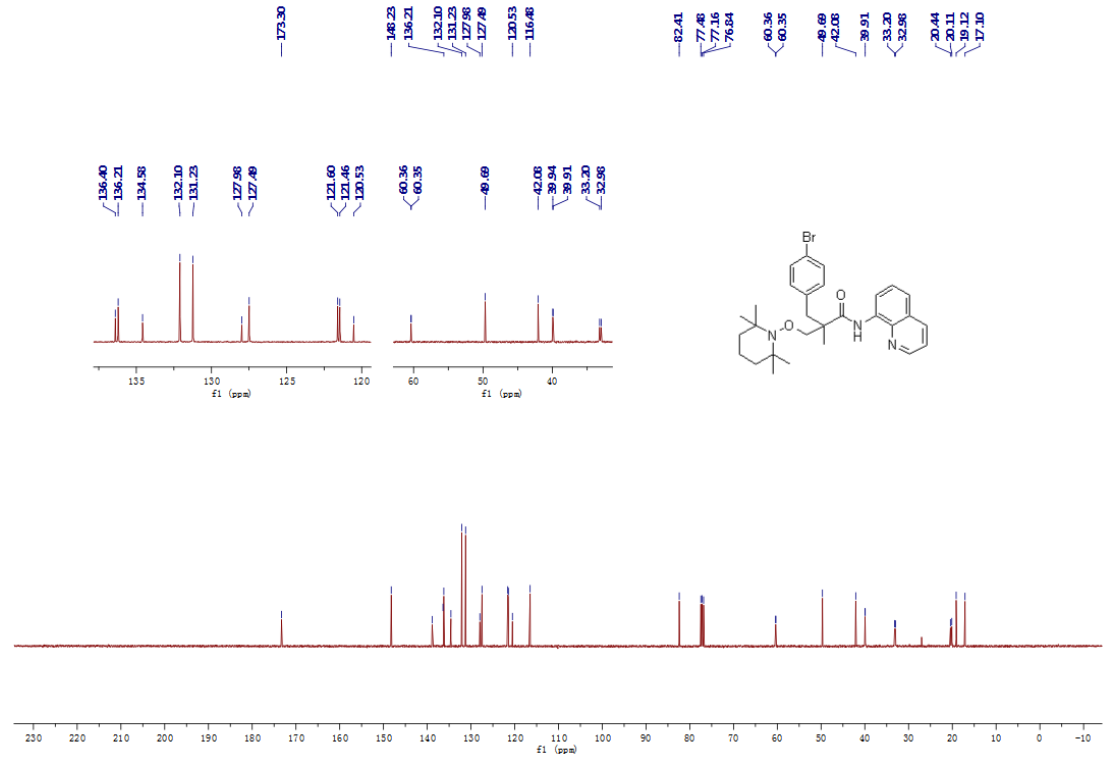
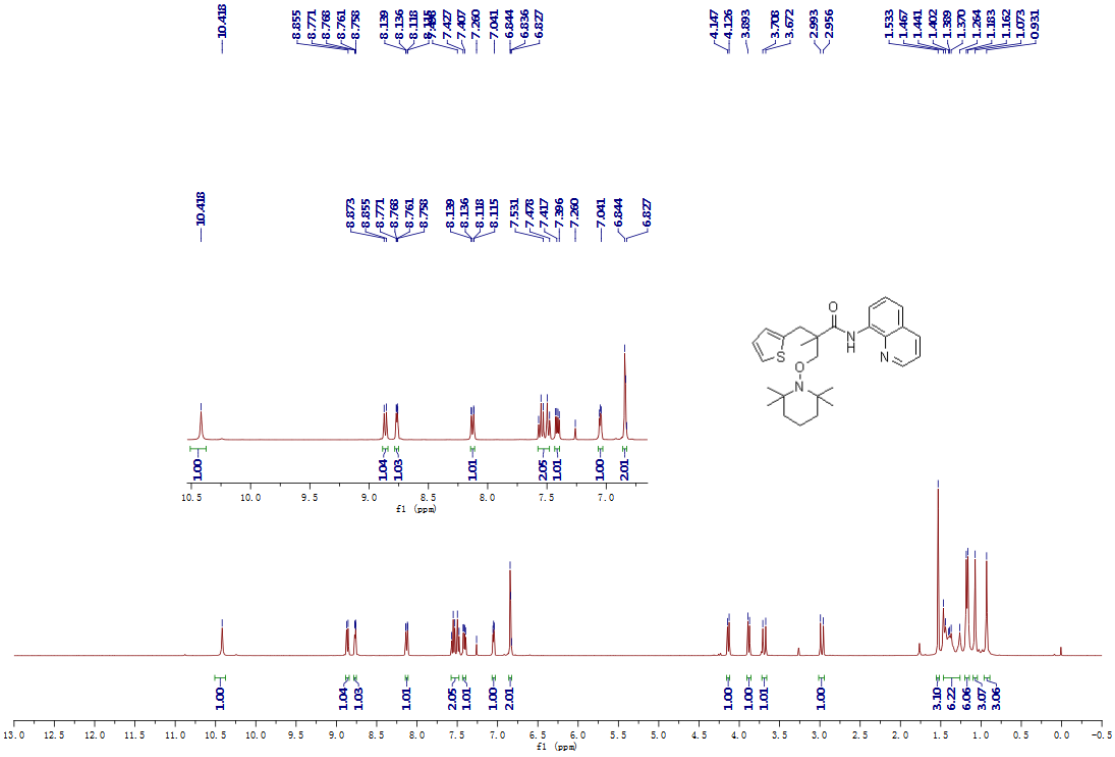


3sa ^{1}H NMR (400 MHz, $CDCl_3$)



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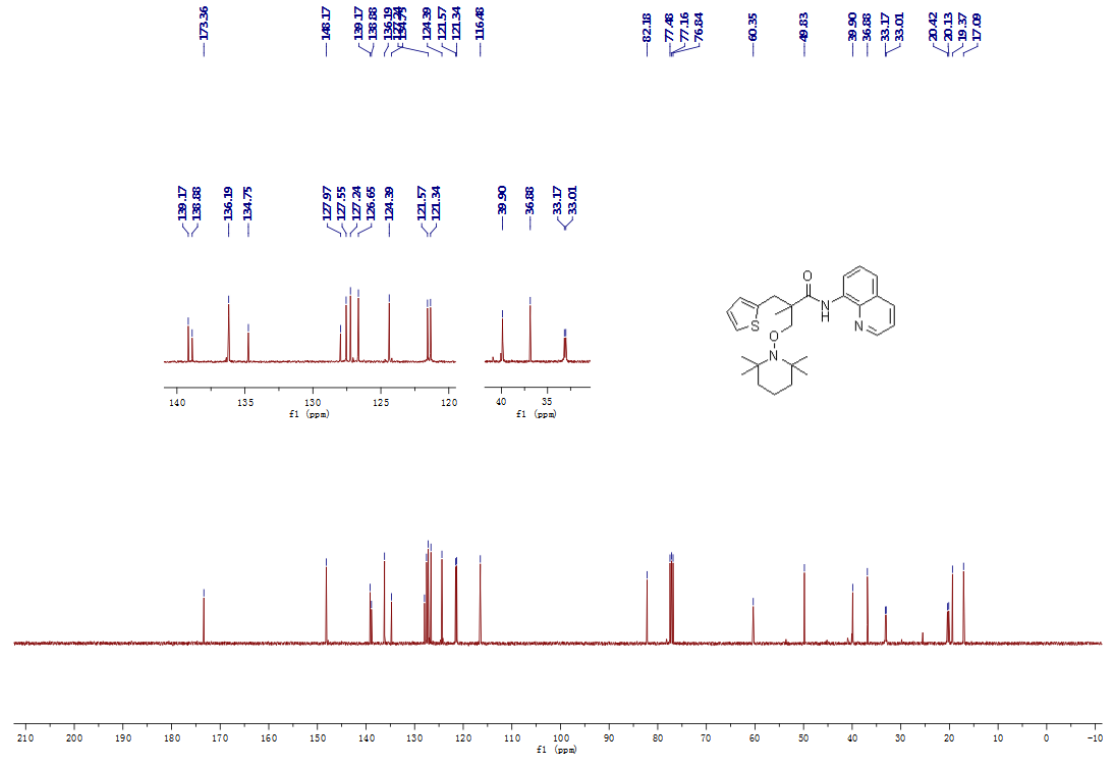

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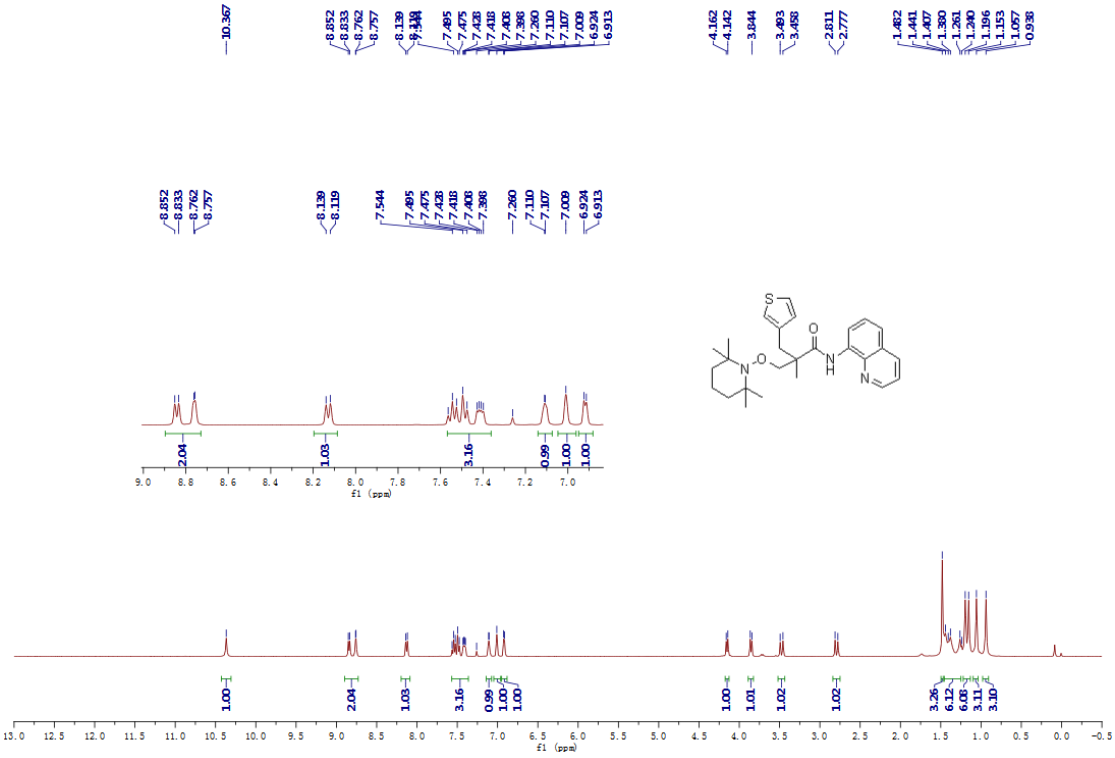
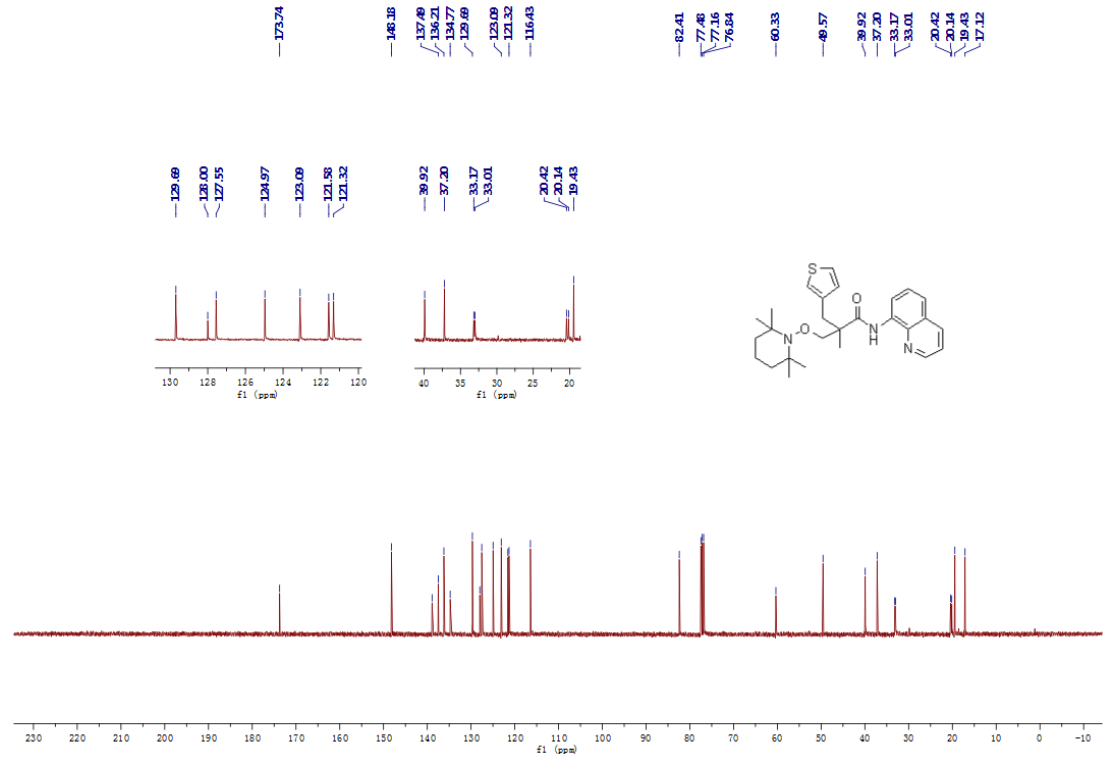
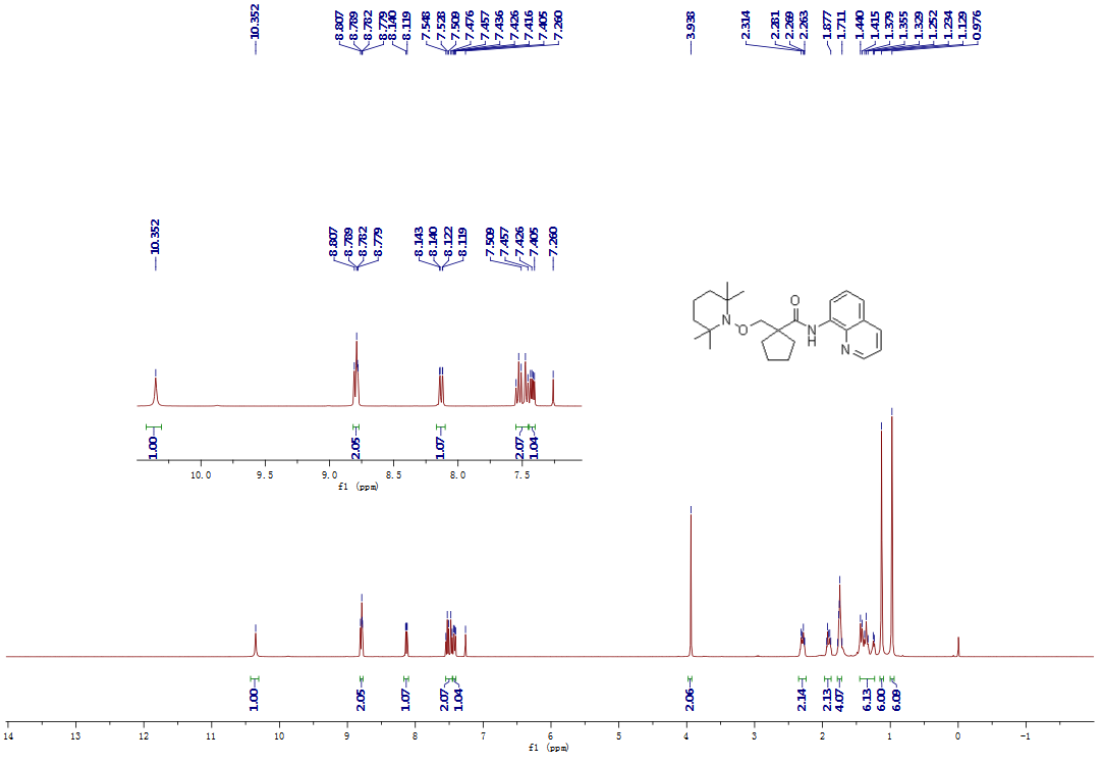


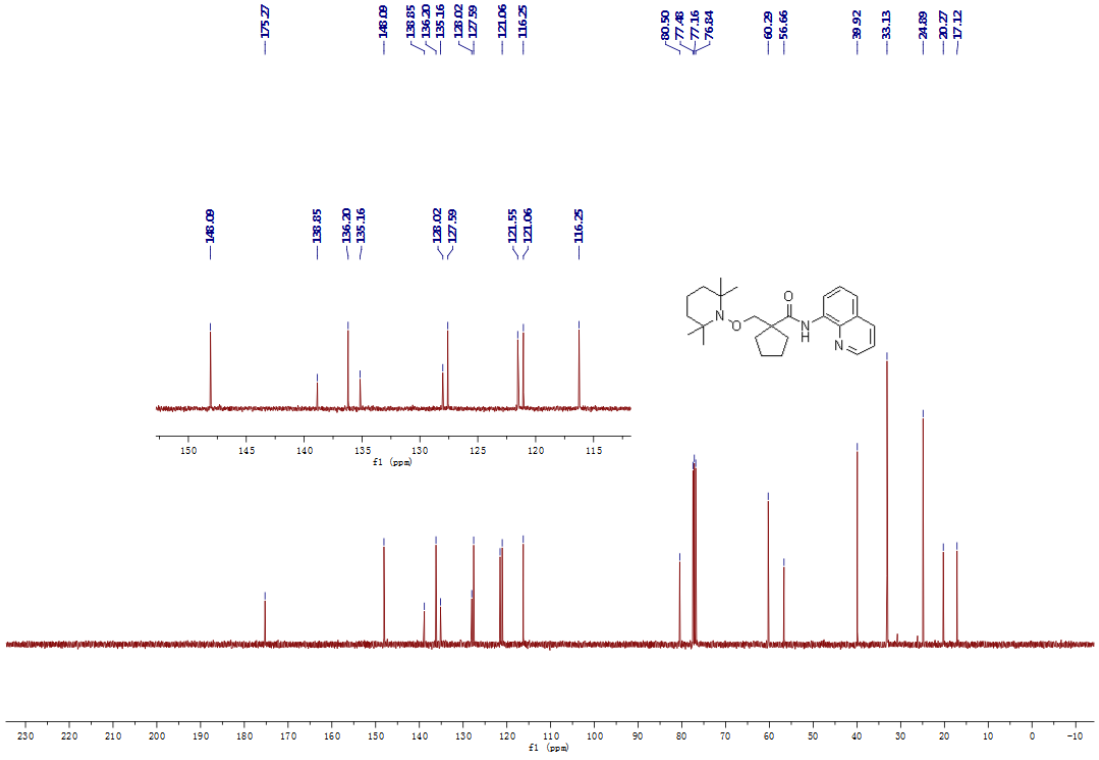
3ta ^{13}C NMR (100 MHz, $CDCl_3$)



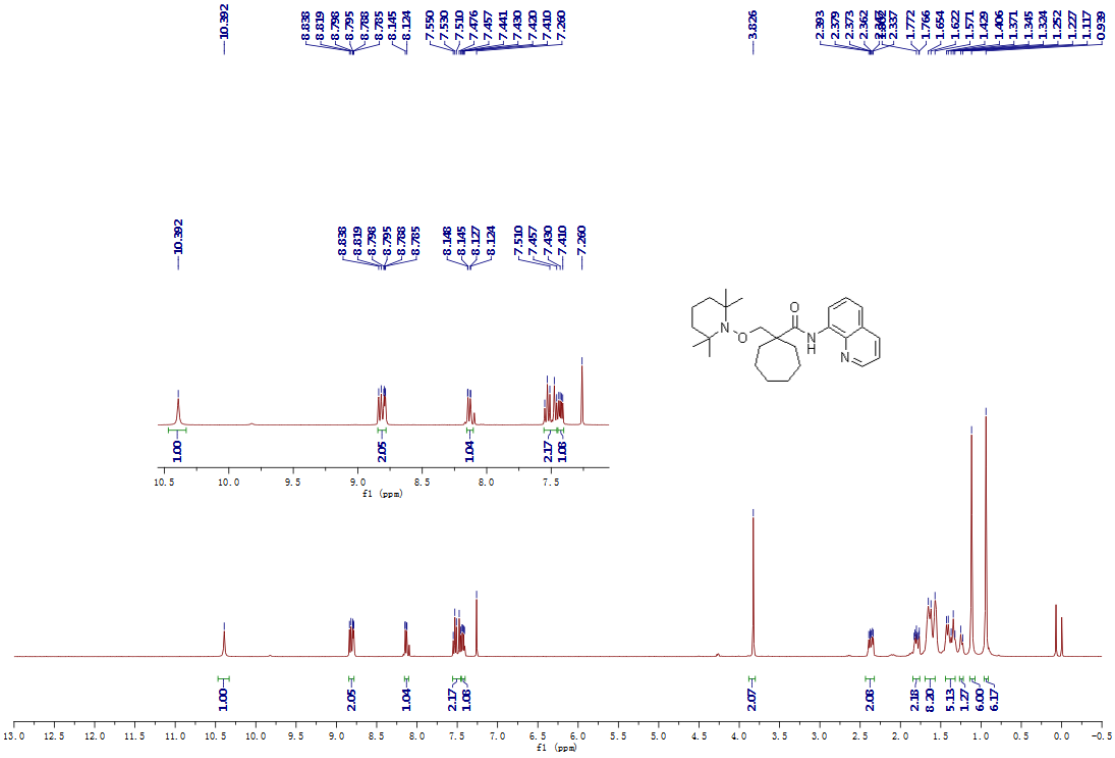
3ua ^{1}H NMR (400 MHz, $CDCl_3$)



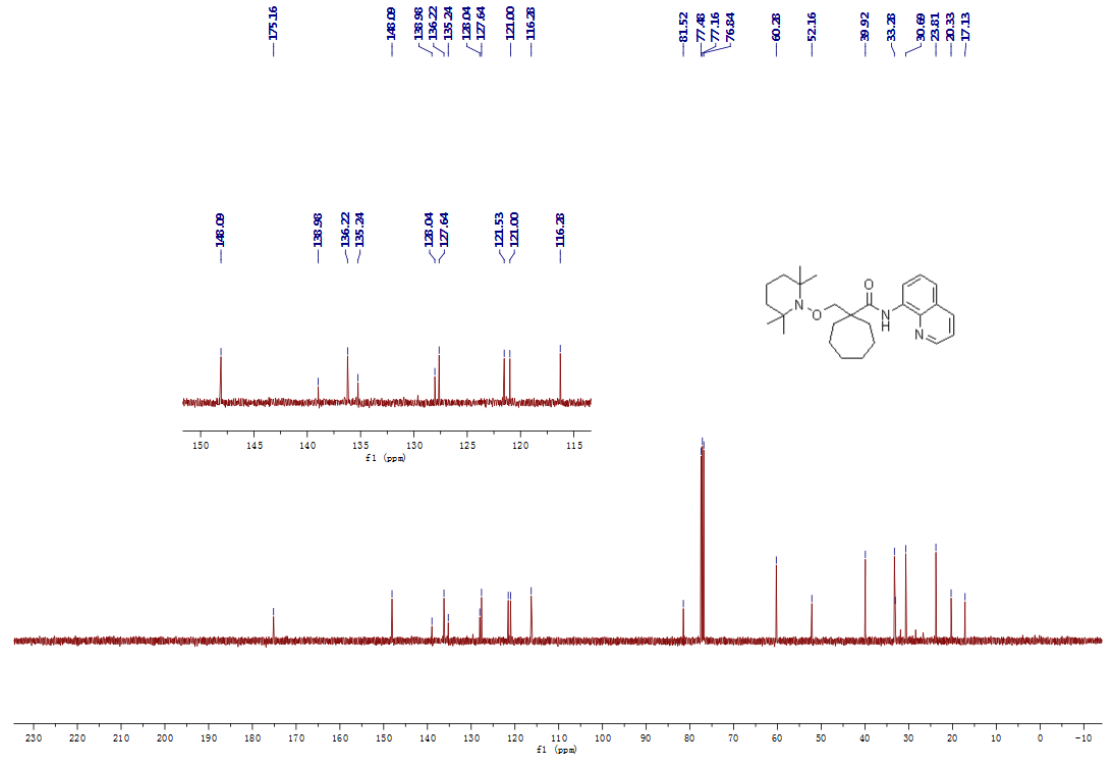
3ua ^{13}C NMR (100 MHz, $CDCl_3$)



3va ^{1}H NMR (400 MHz, $CDCl_3$)

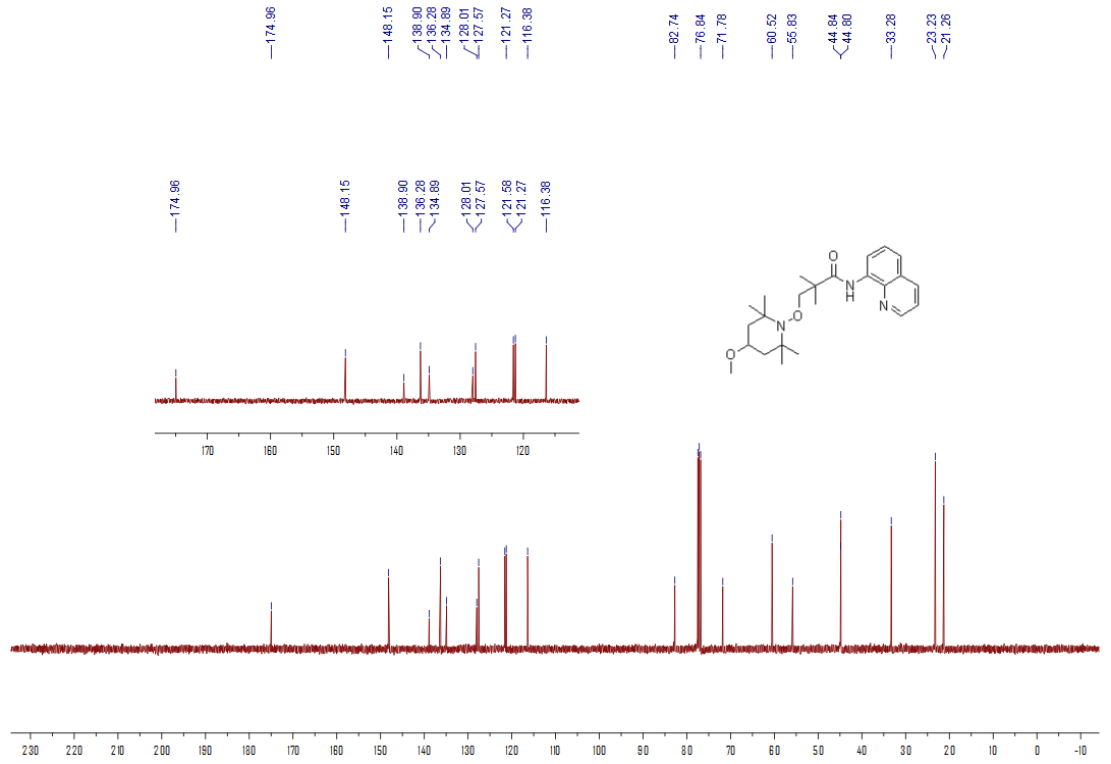


3va ^{13}C NMR (100 MHz, $CDCl_3$)

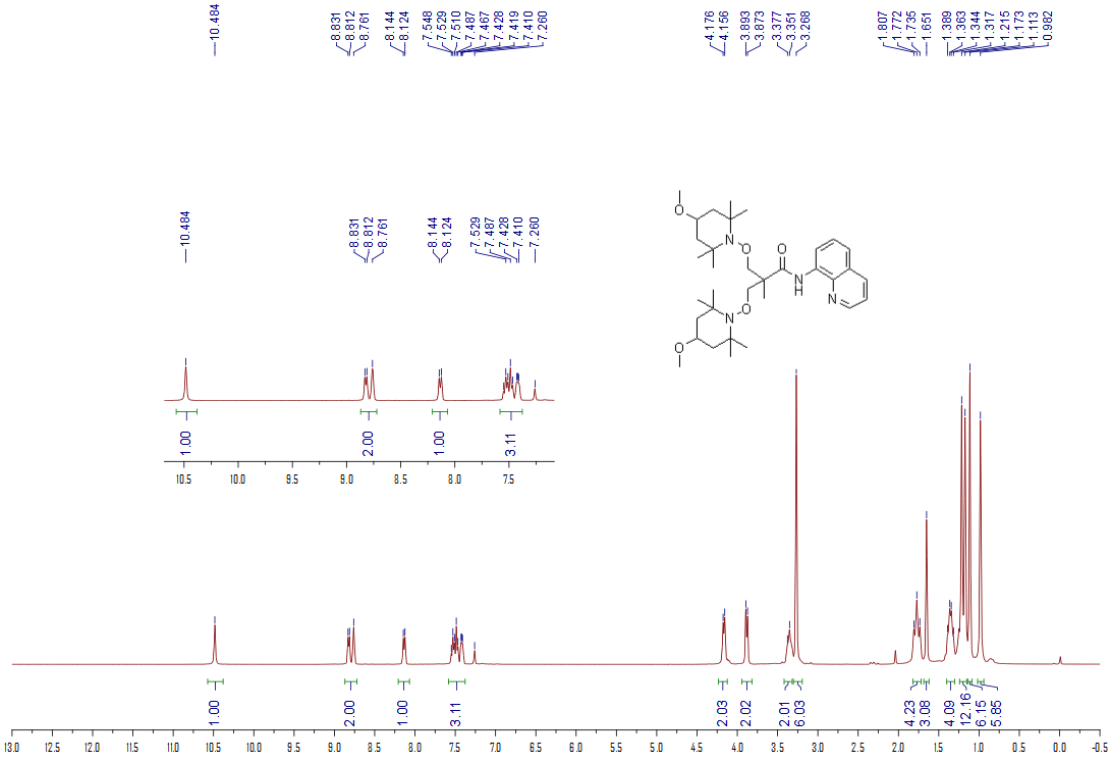


3bb ^{1}H NMR (400 MHz, $CDCl_3$)

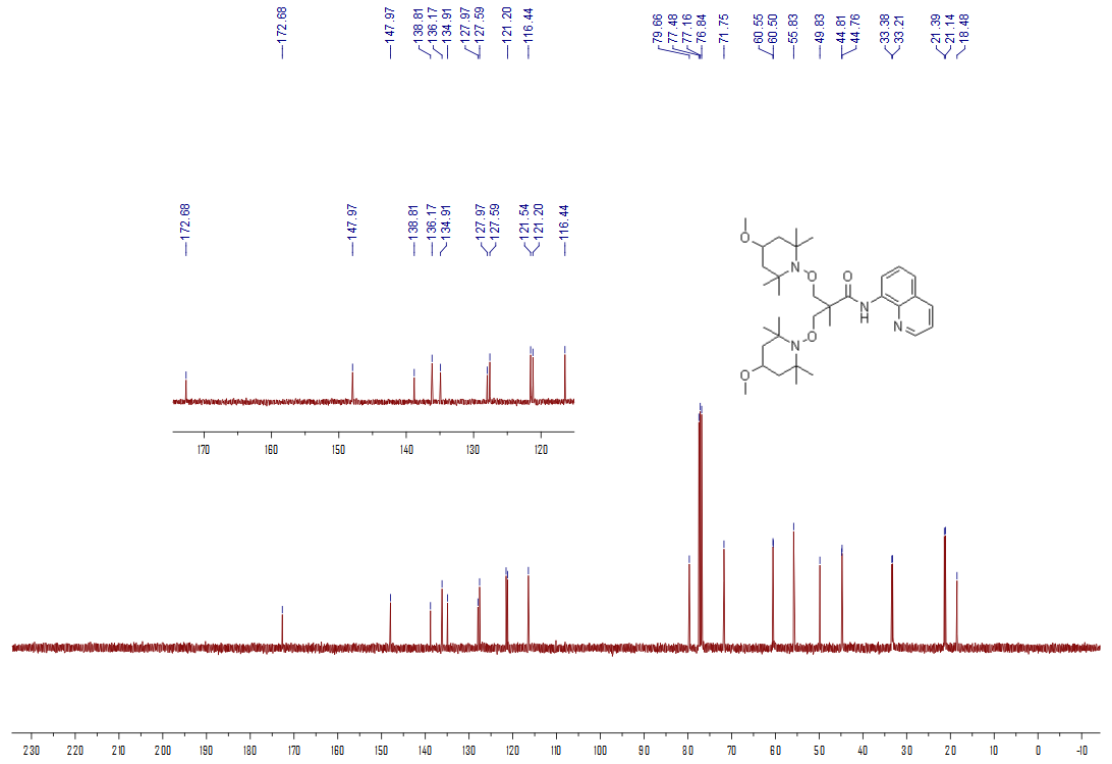
3bb ^{13}C NMR (100 MHz, $CDCl_3$)



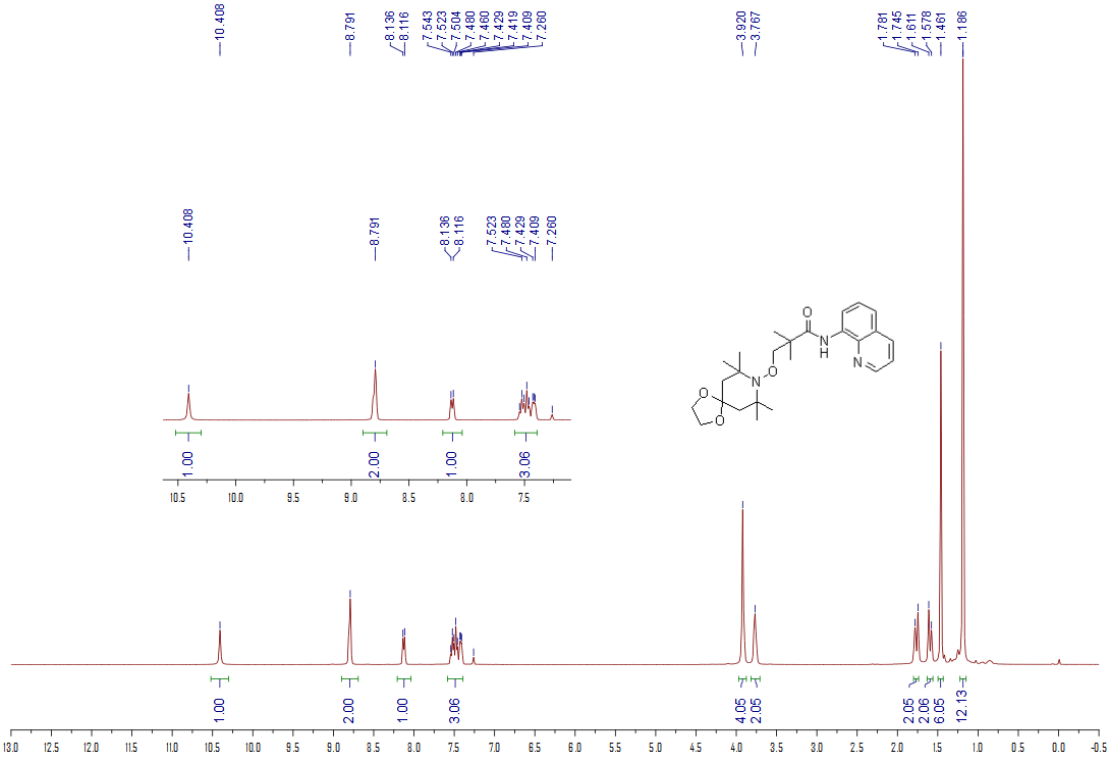
3bb‘ ^{1}H NMR (400 MHz, $CDCl_3$)



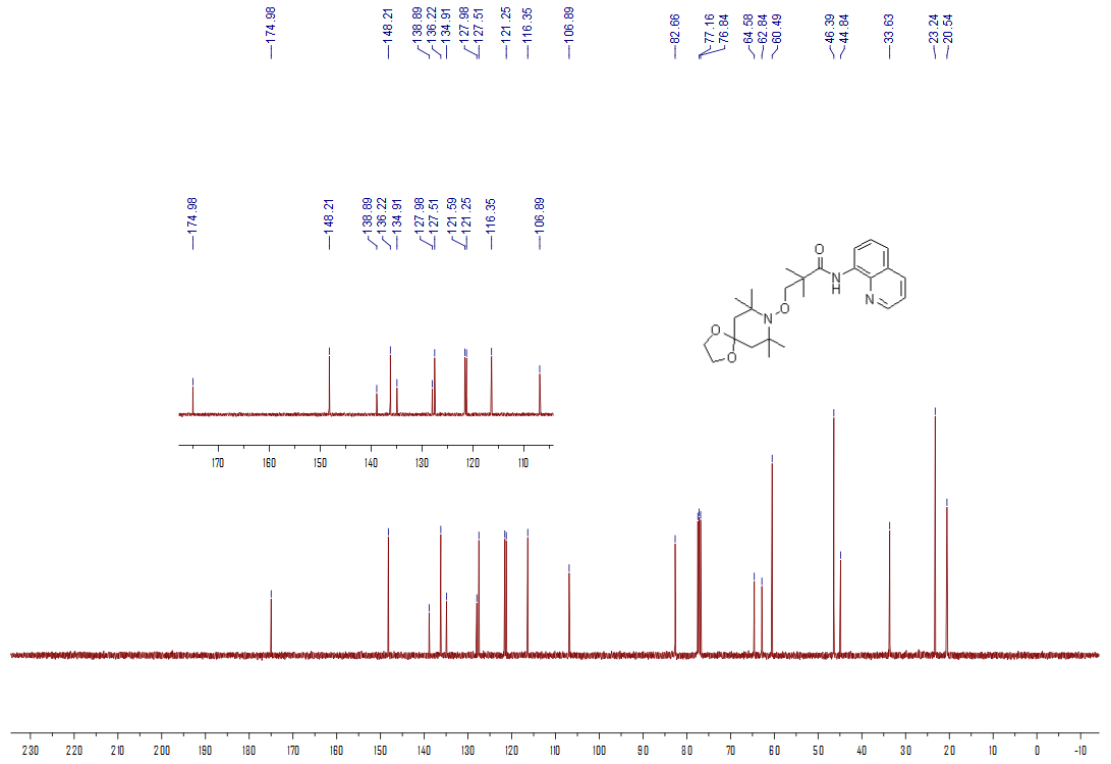
3bb‘ ^{13}C NMR (100 MHz, $CDCl_3$)



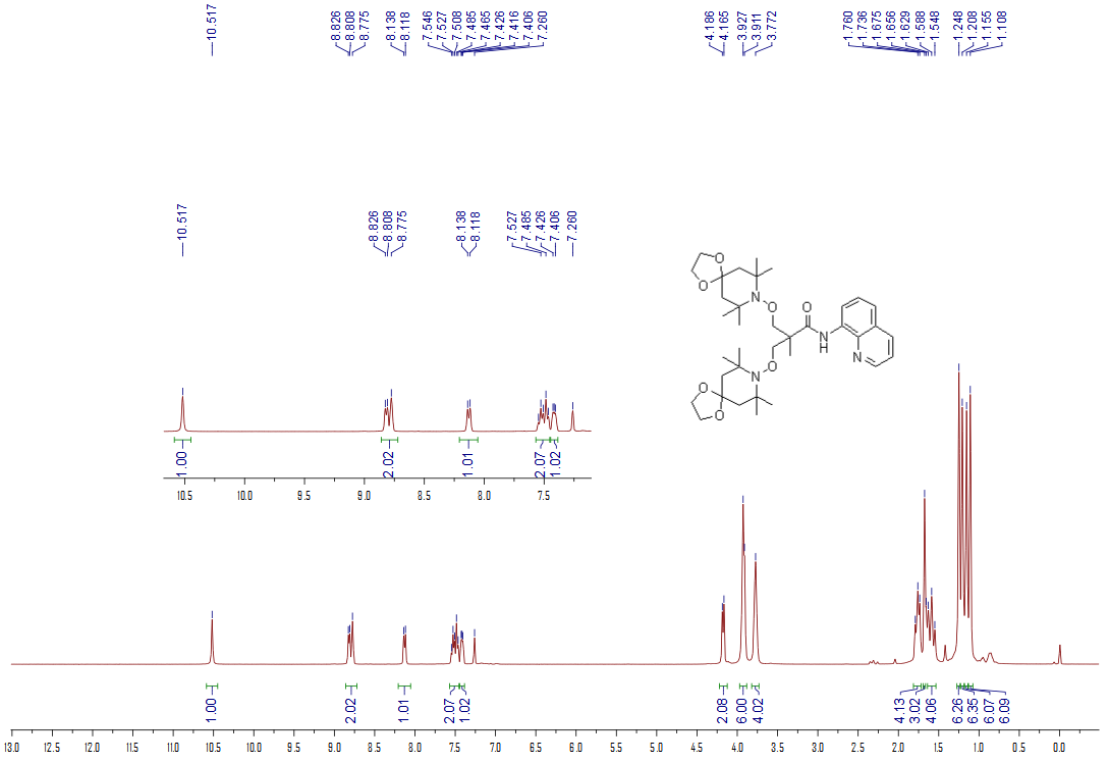
3bc ^{1}H NMR (400 MHz, $CDCl_3$)



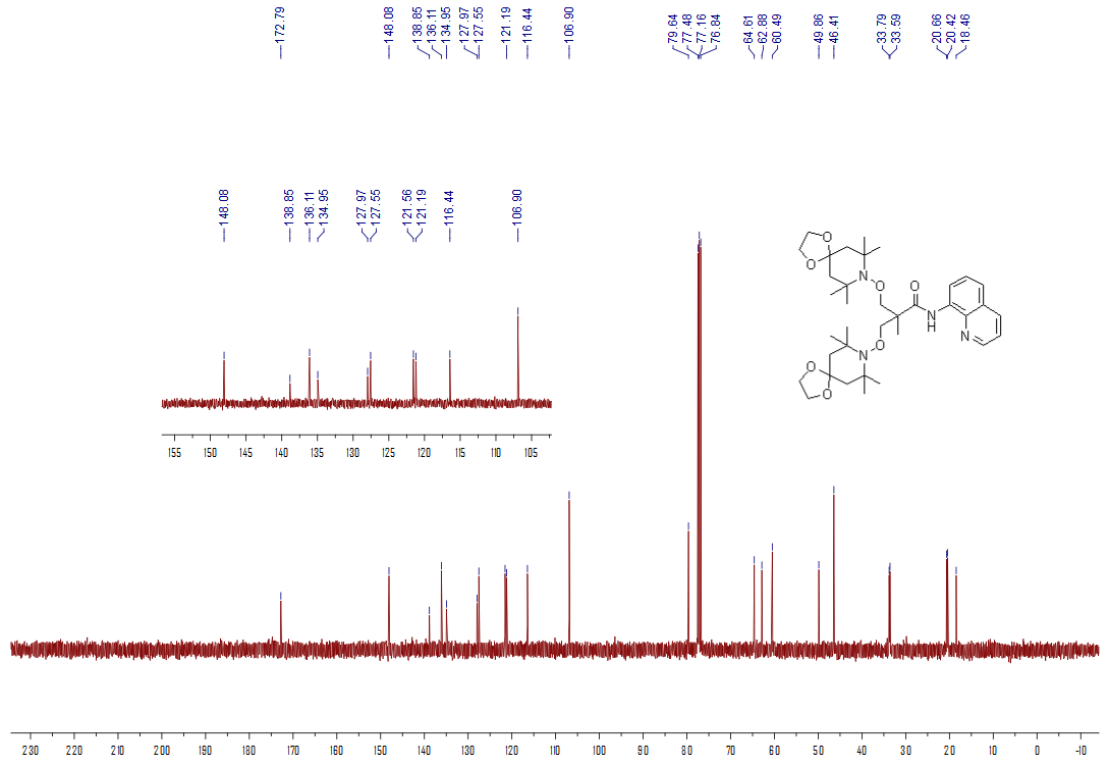
3bc ^{13}C NMR (100 MHz, $CDCl_3$)



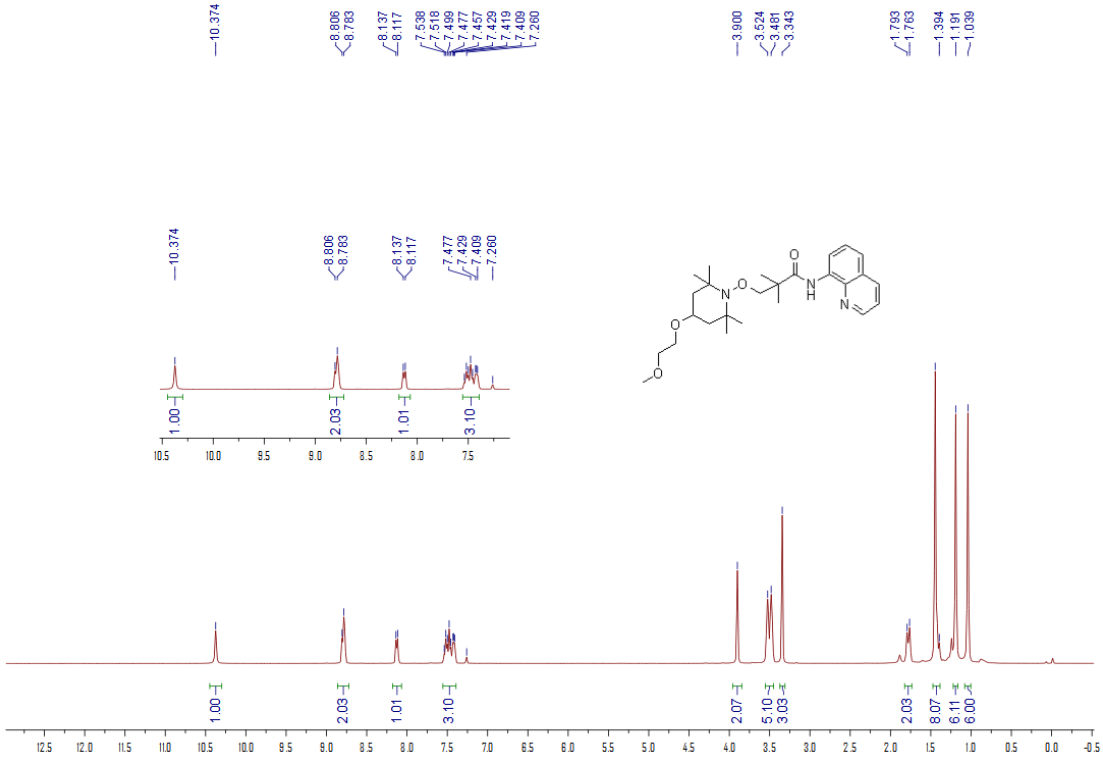
3bc‘ ^{1}H NMR (400 MHz, $CDCl_3$)



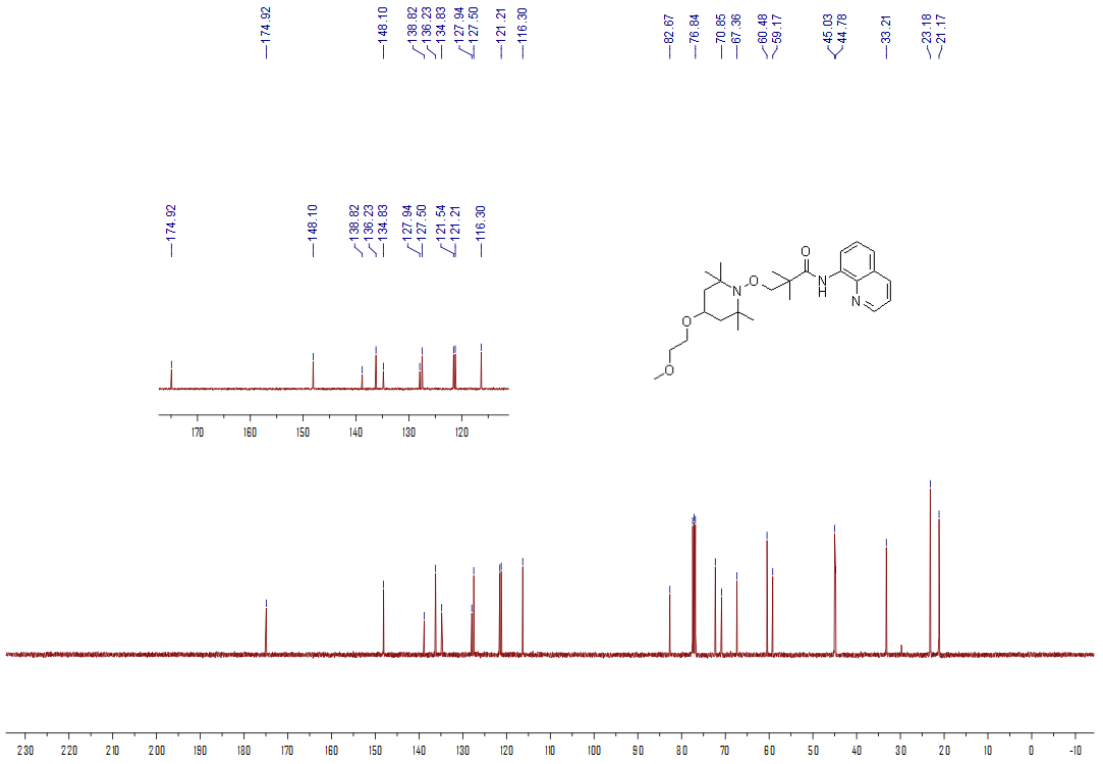
3bc‘ ^{13}C NMR (100 MHz, $CDCl_3$)



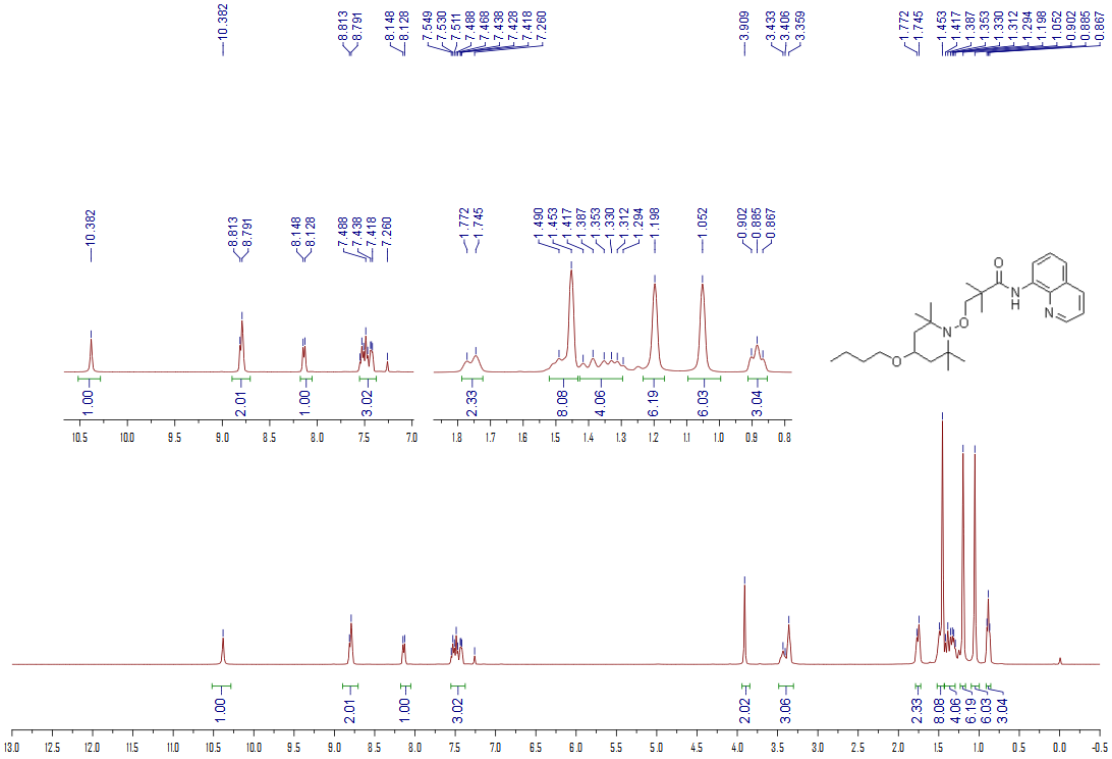
3bd ^{1}H NMR (400 MHz, $CDCl_3$)



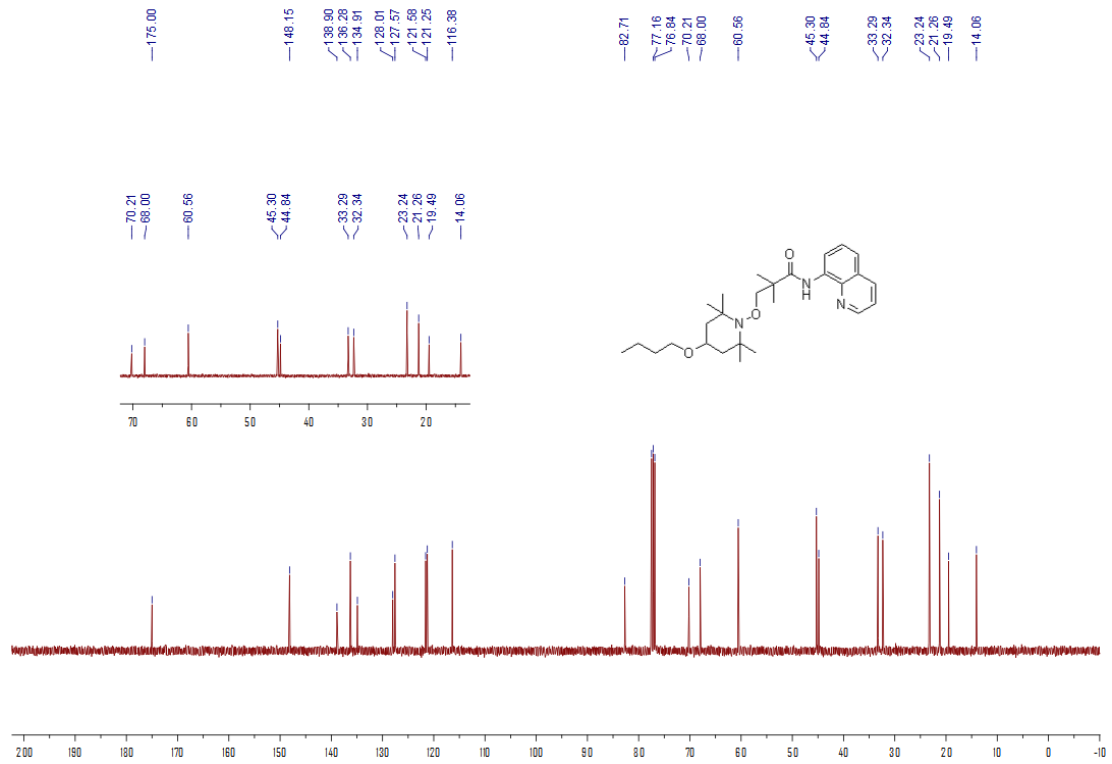
3bd ^{13}C NMR (100 MHz, $CDCl_3$)



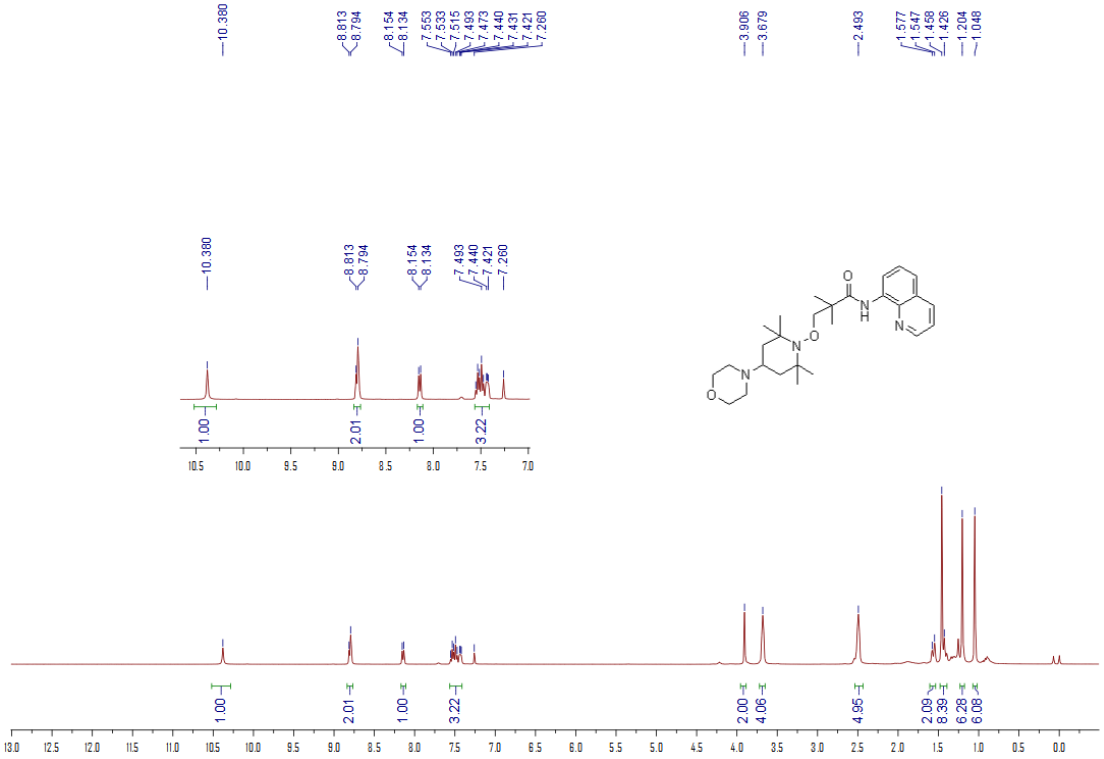
3be ^{1}H NMR (400 MHz, $CDCl_3$)



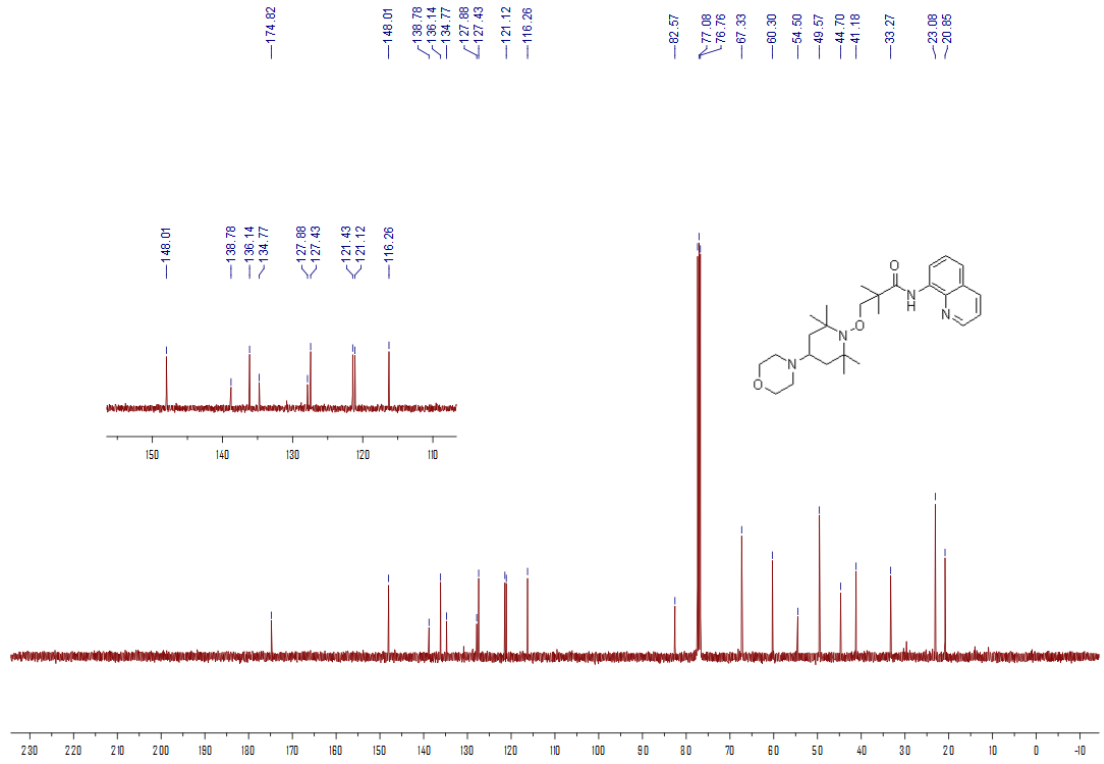
3be ^{13}C NMR (100 MHz, $CDCl_3$)



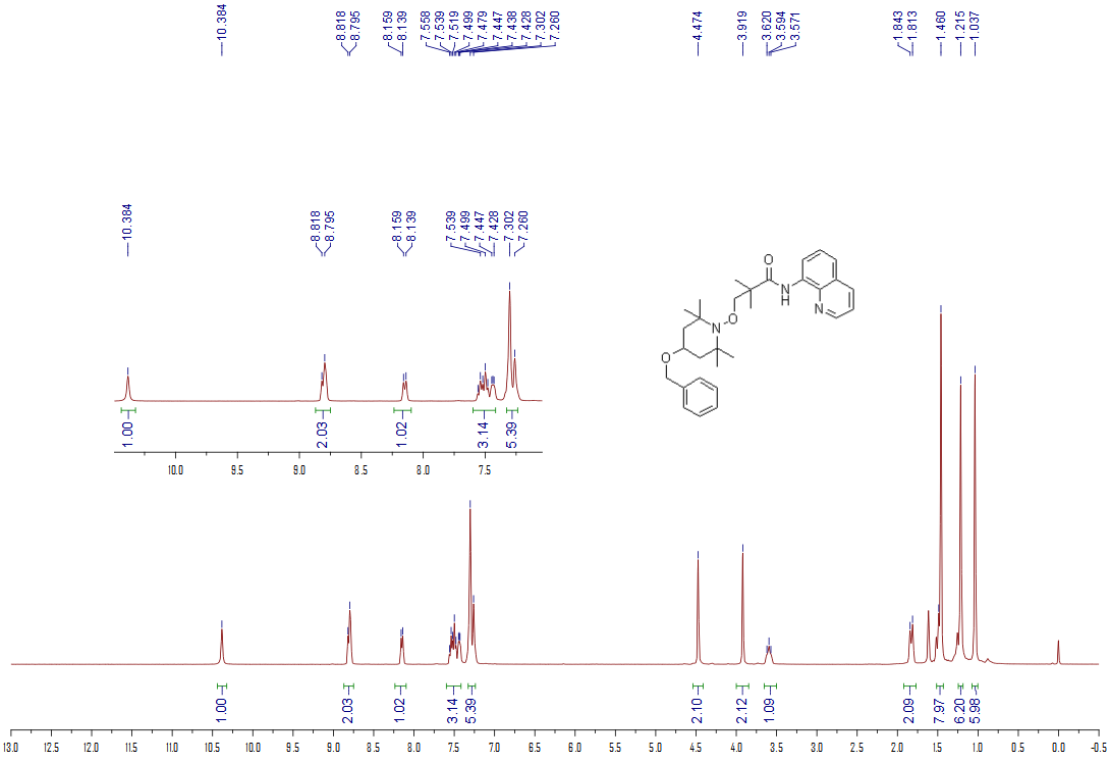
3bf ^{1}H NMR (400 MHz, $CDCl_3$)



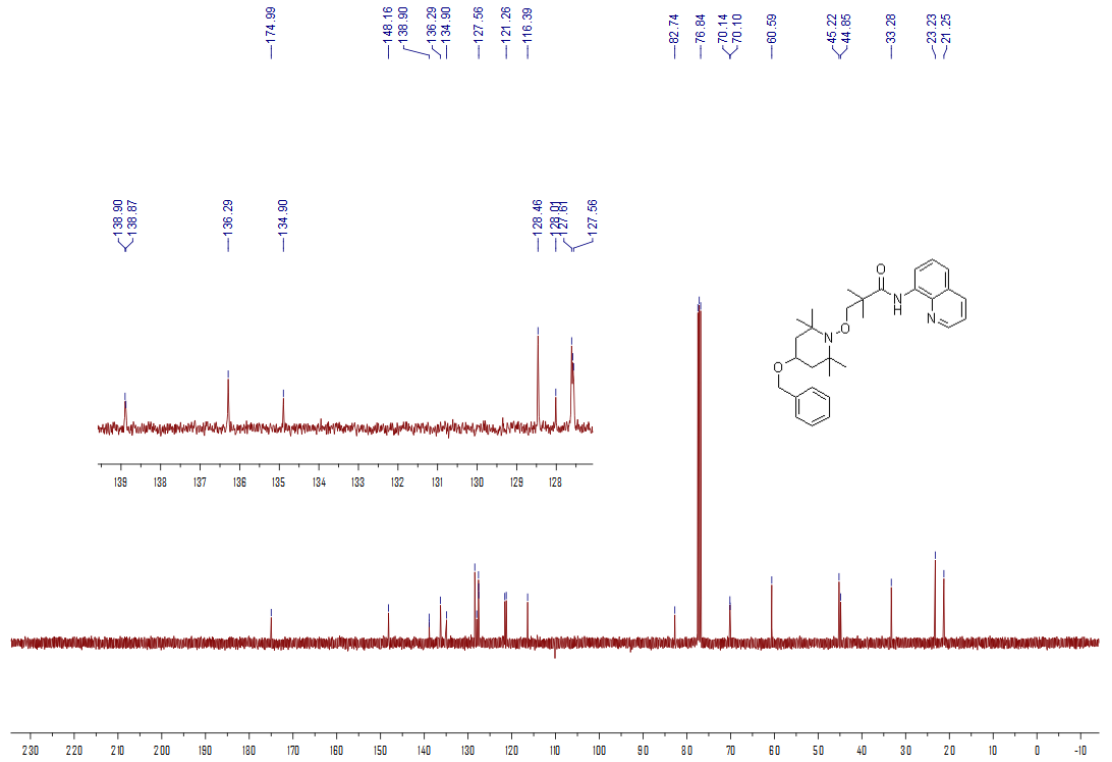
3bf ^{13}C NMR (100 MHz, $CDCl_3$)



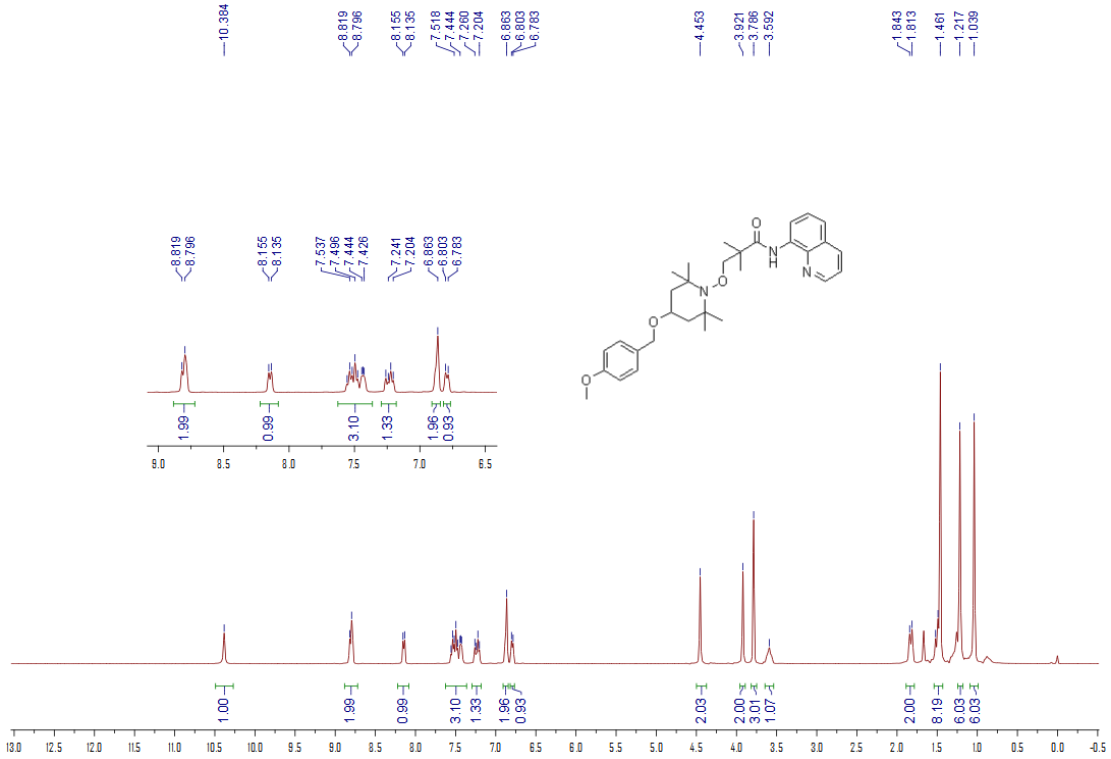
3bg ^{1}H NMR (400 MHz, $CDCl_3$)



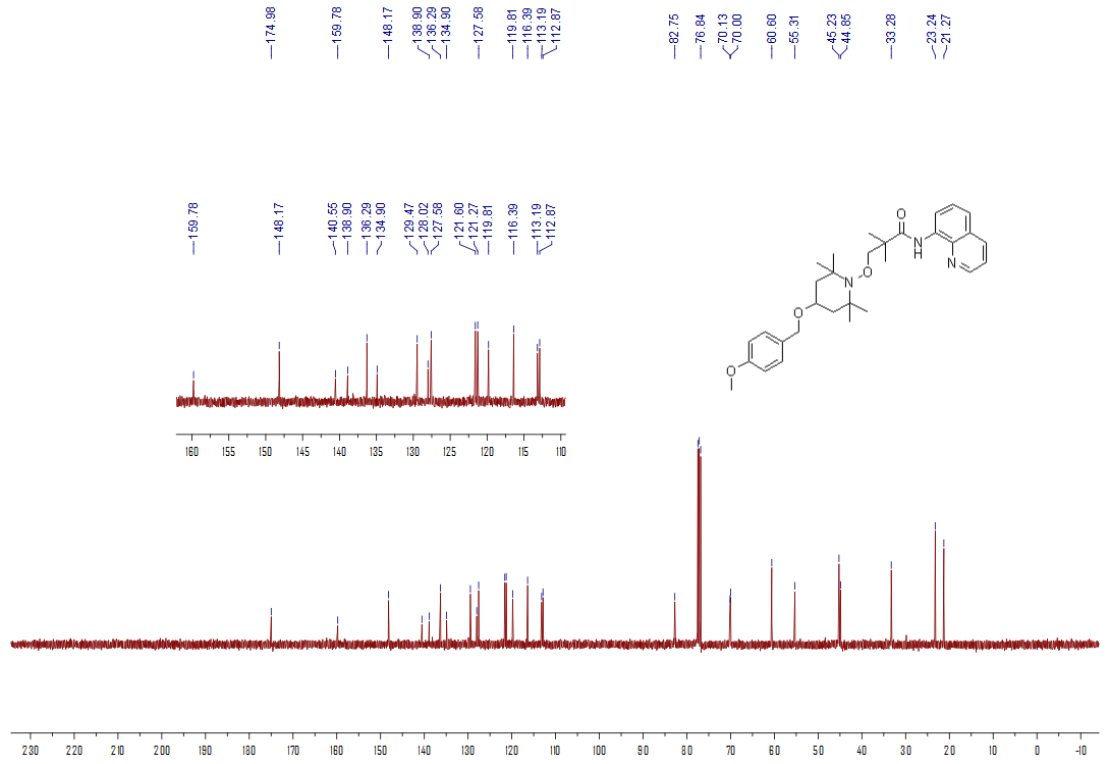
3bg ^{13}C NMR (100 MHz, $CDCl_3$)



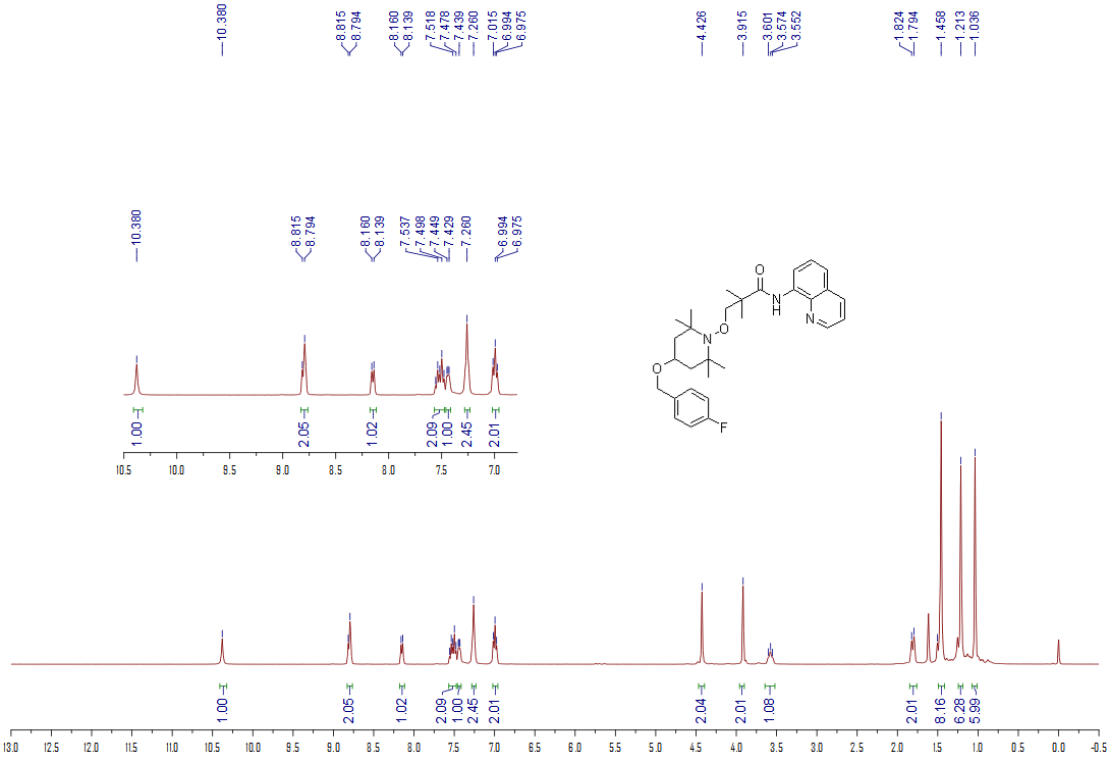
3bh ^{1}H NMR (400 MHz, $CDCl_3$)



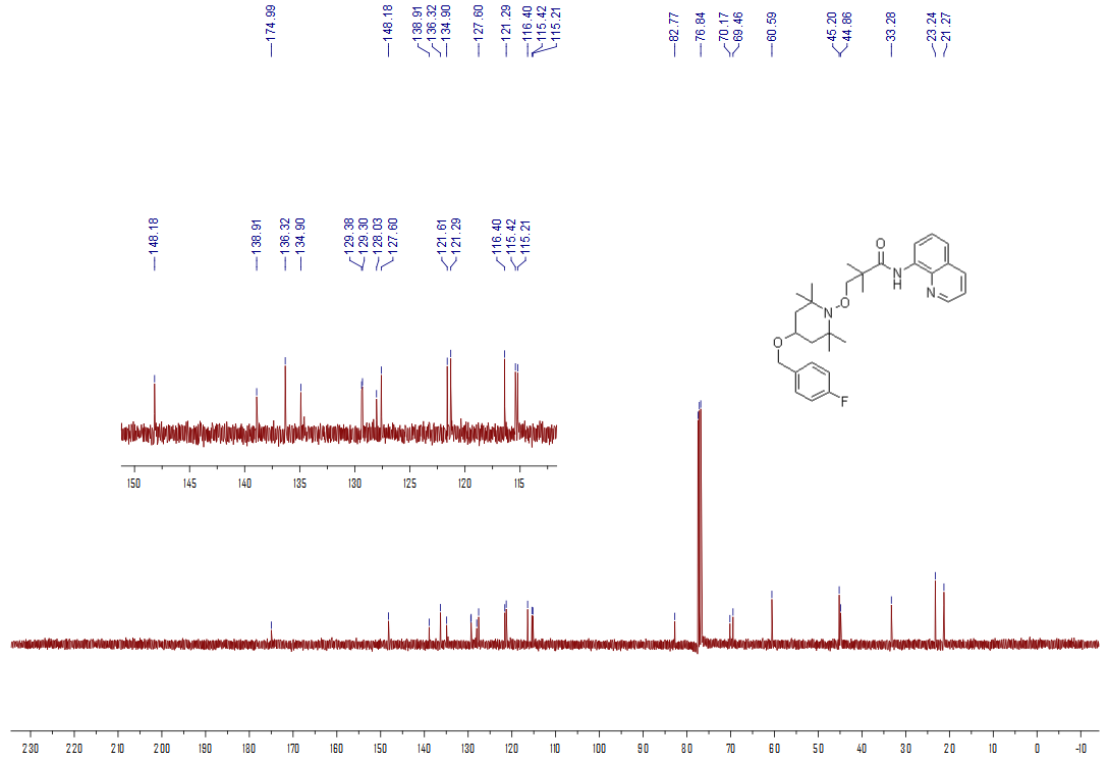
3bh ^{13}C NMR (100 MHz, $CDCl_3$)



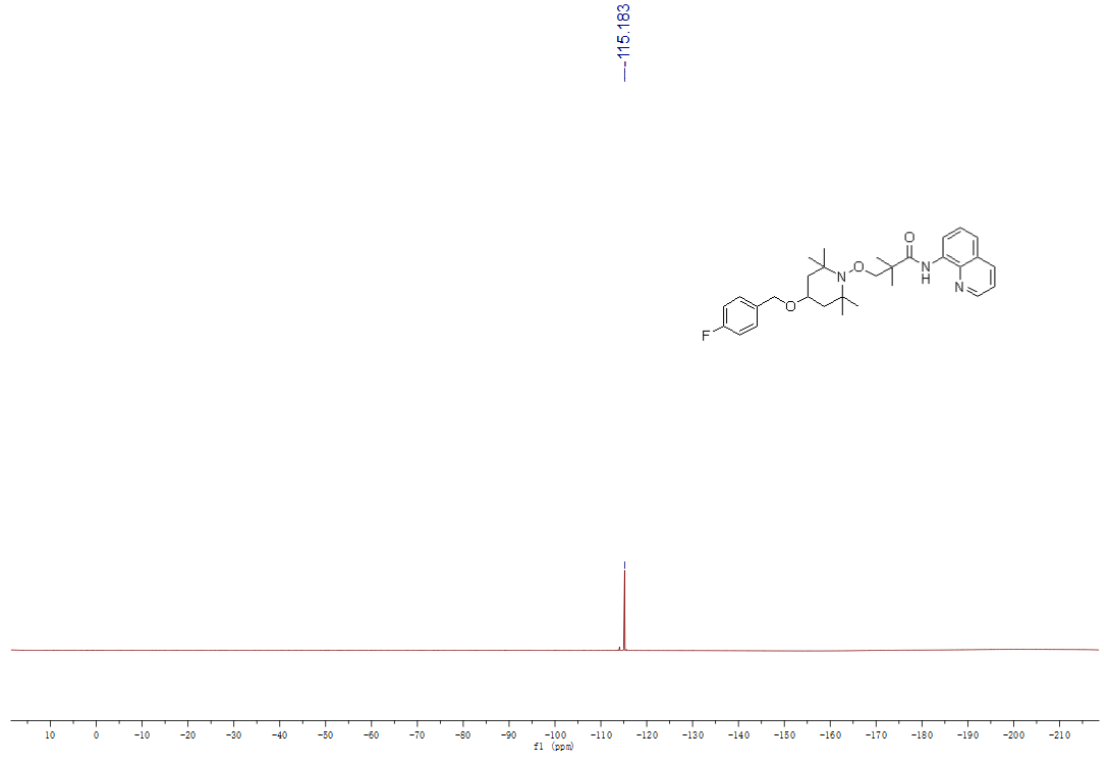
3bi ^{1}H NMR (400 MHz, $CDCl_3$)



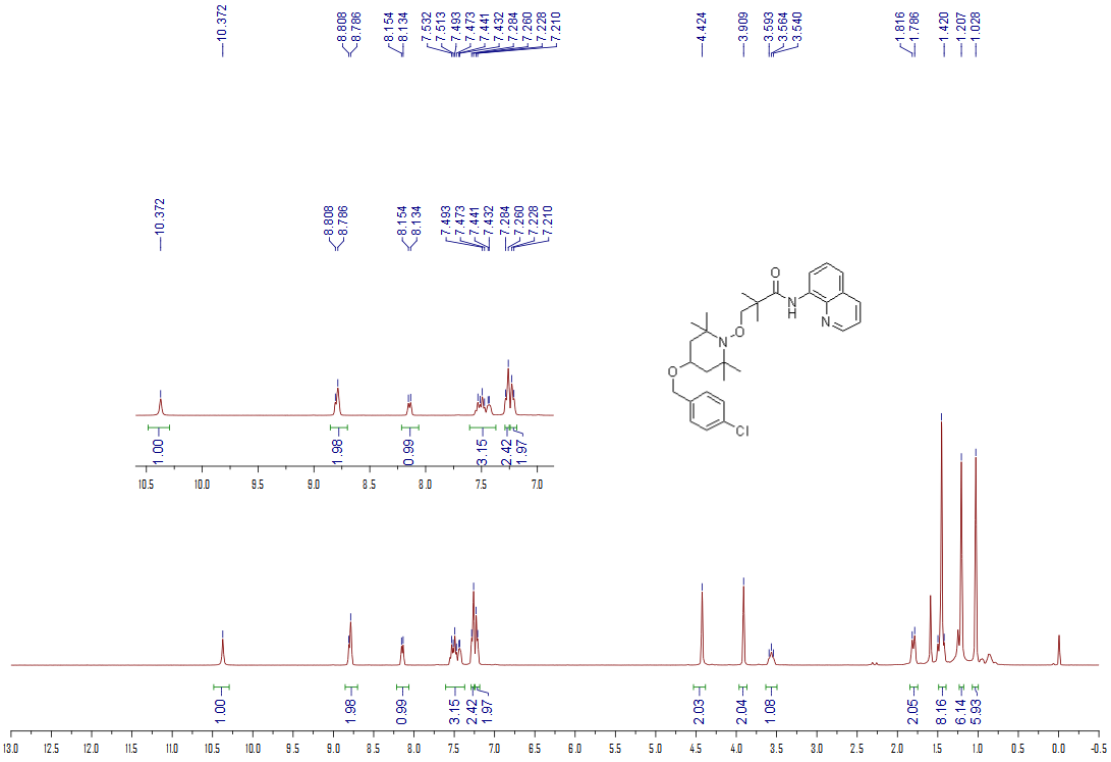
3bi ^{13}C NMR (100 MHz, $CDCl_3$)



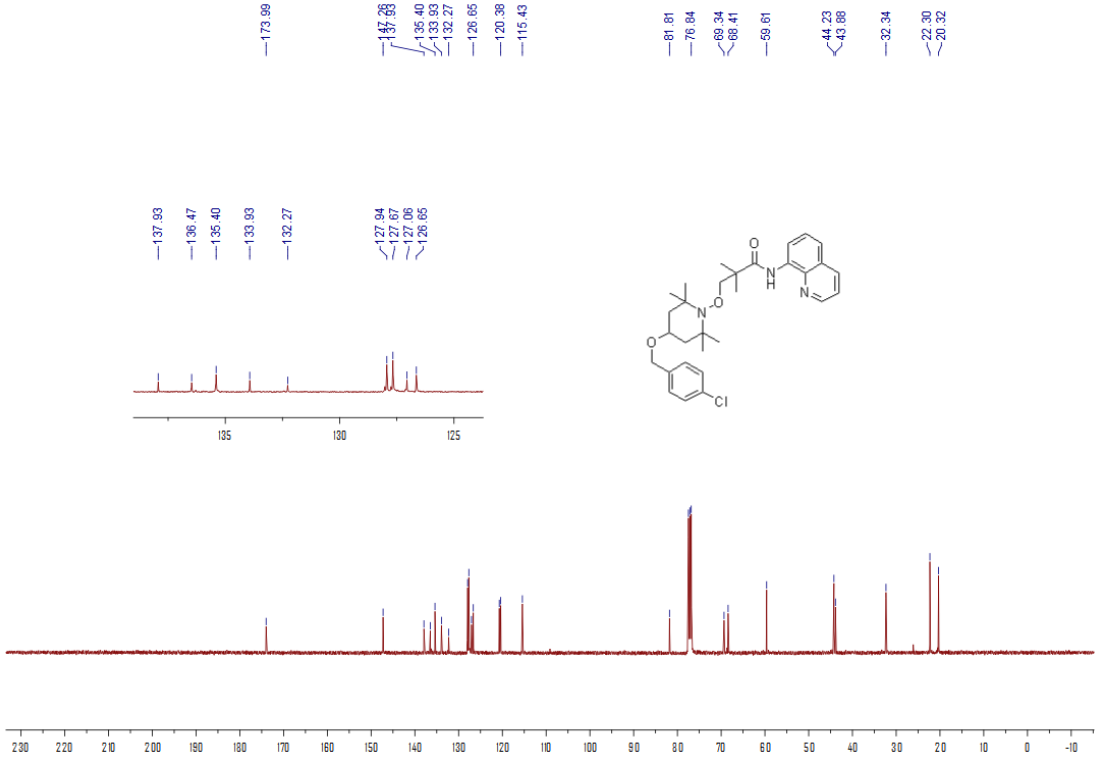
3bi ^{19}F NMR (376 MHz, $CDCl_3$)



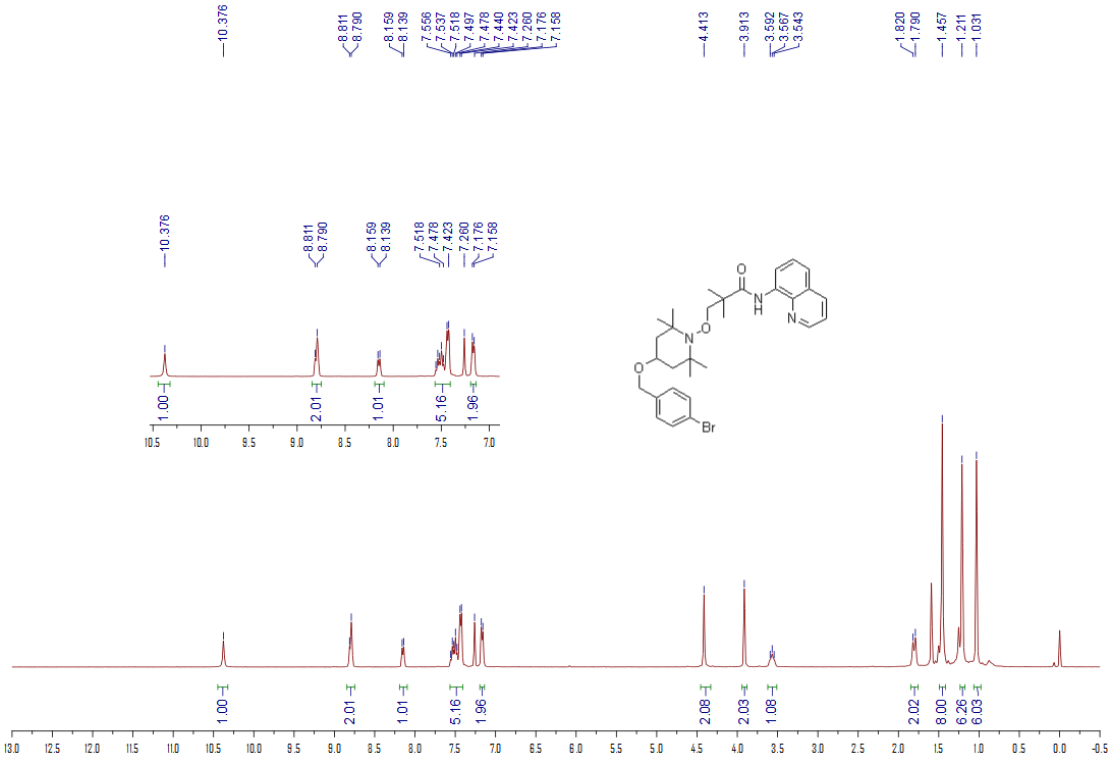
3bj ^{1}H NMR (400 MHz, $CDCl_3$)



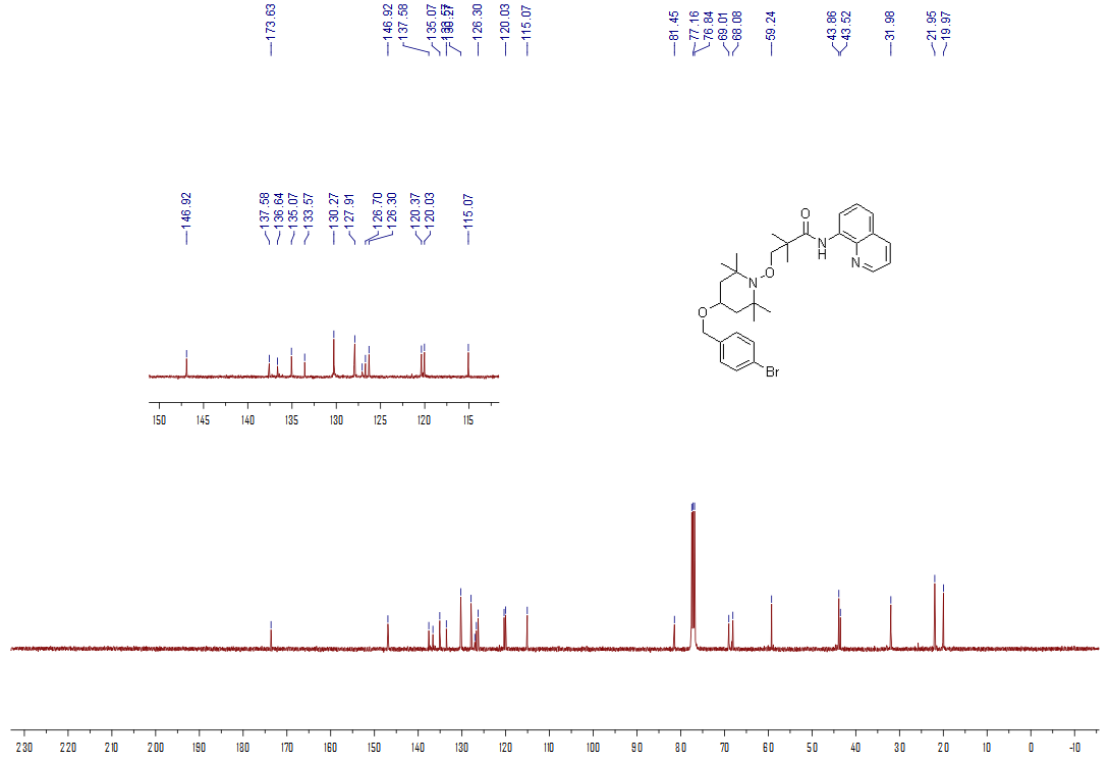
3bj ^{13}C NMR (100 MHz, $CDCl_3$)



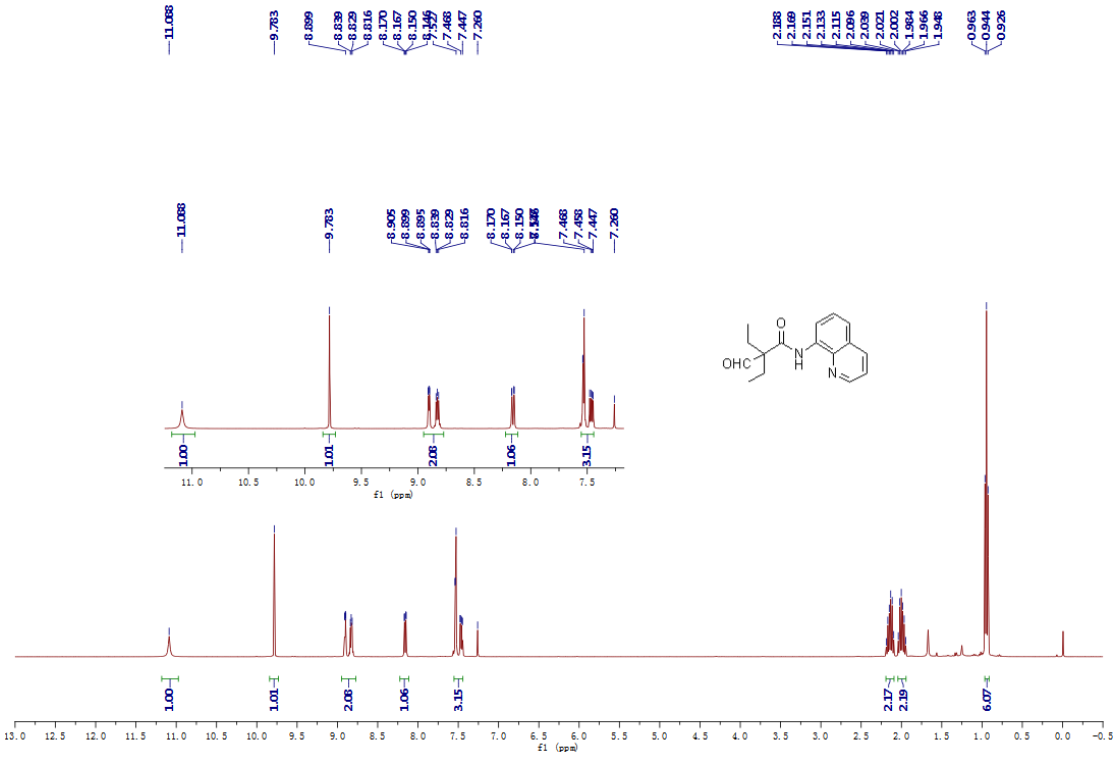
3bk ^{1}H NMR (400 MHz, $CDCl_3$)



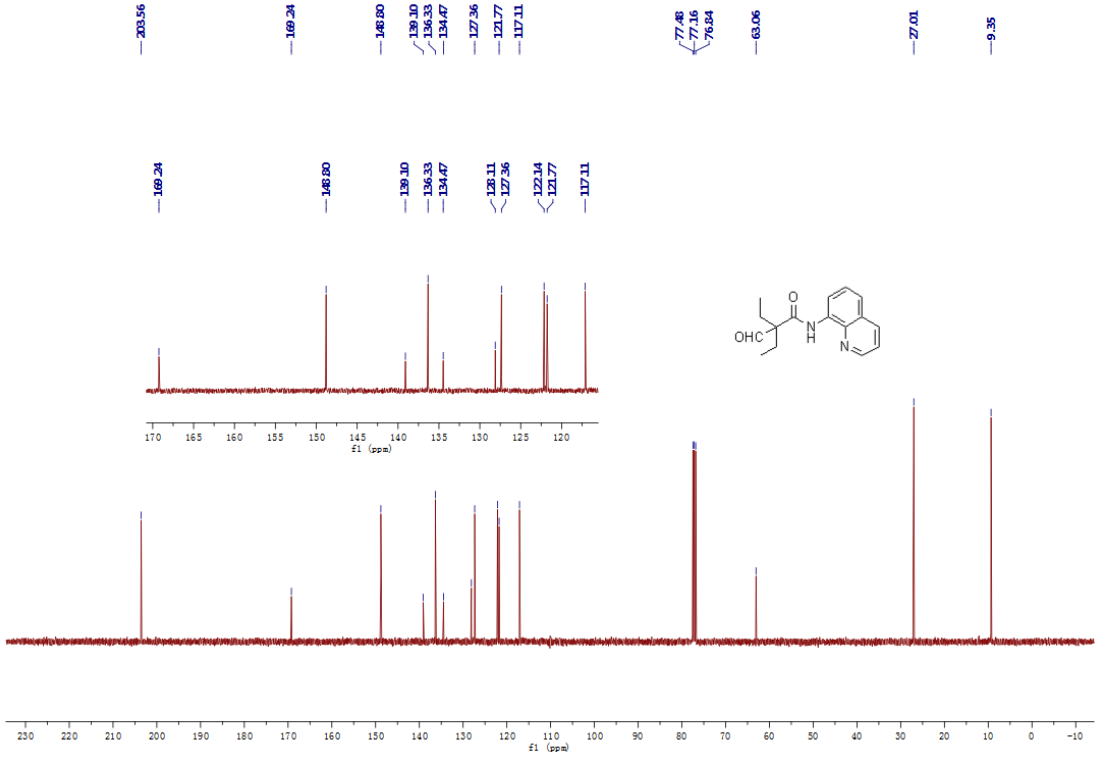
3bk ^{13}C NMR (100 MHz, $CDCl_3$)



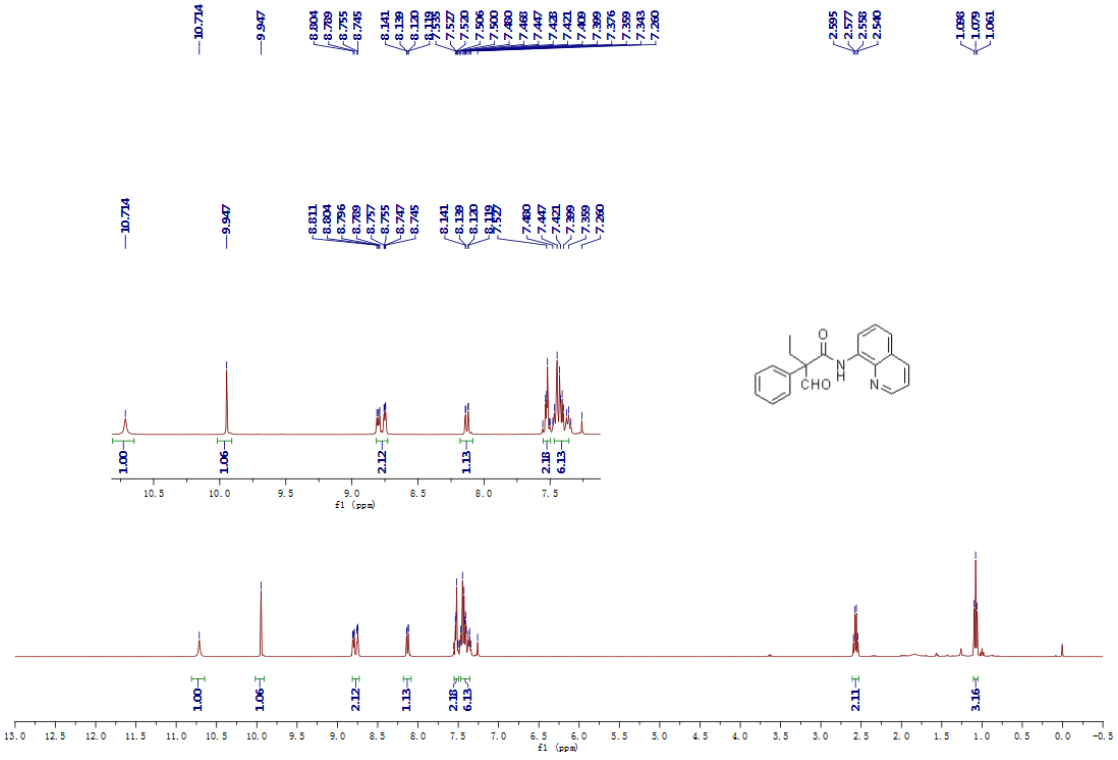
4-a ^{1}H NMR (400 MHz, $CDCl_3$)



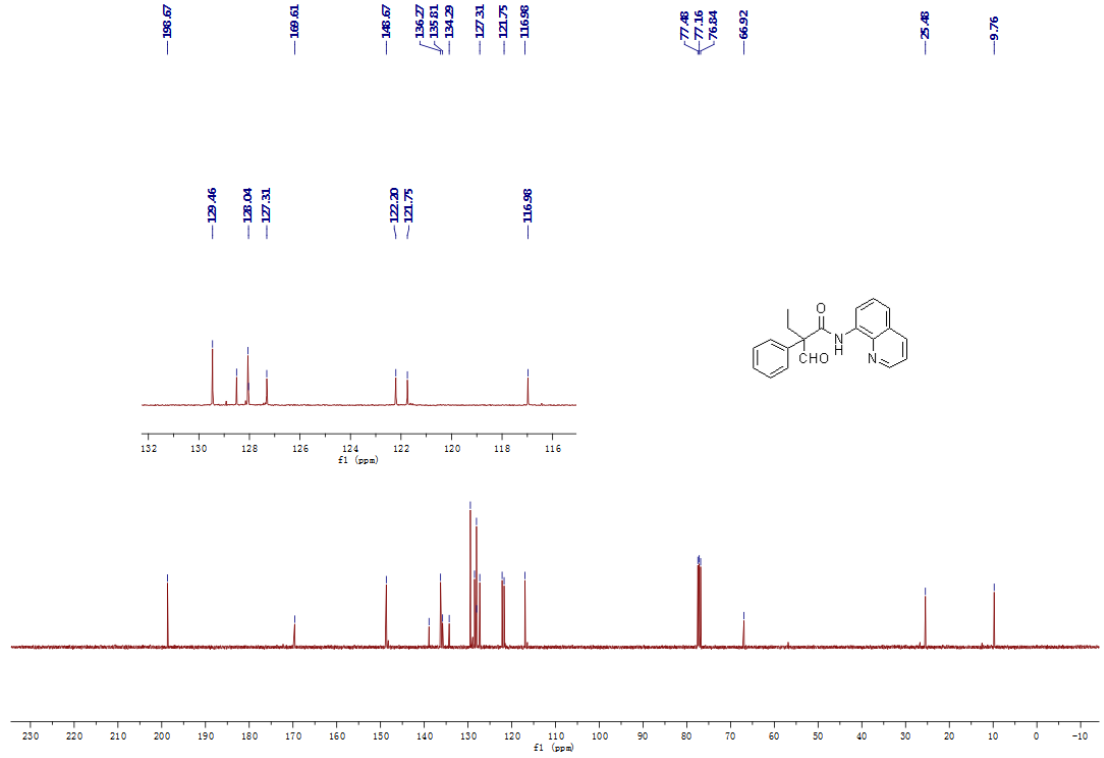
4-a ^{13}C NMR (100 MHz, $CDCl_3$)



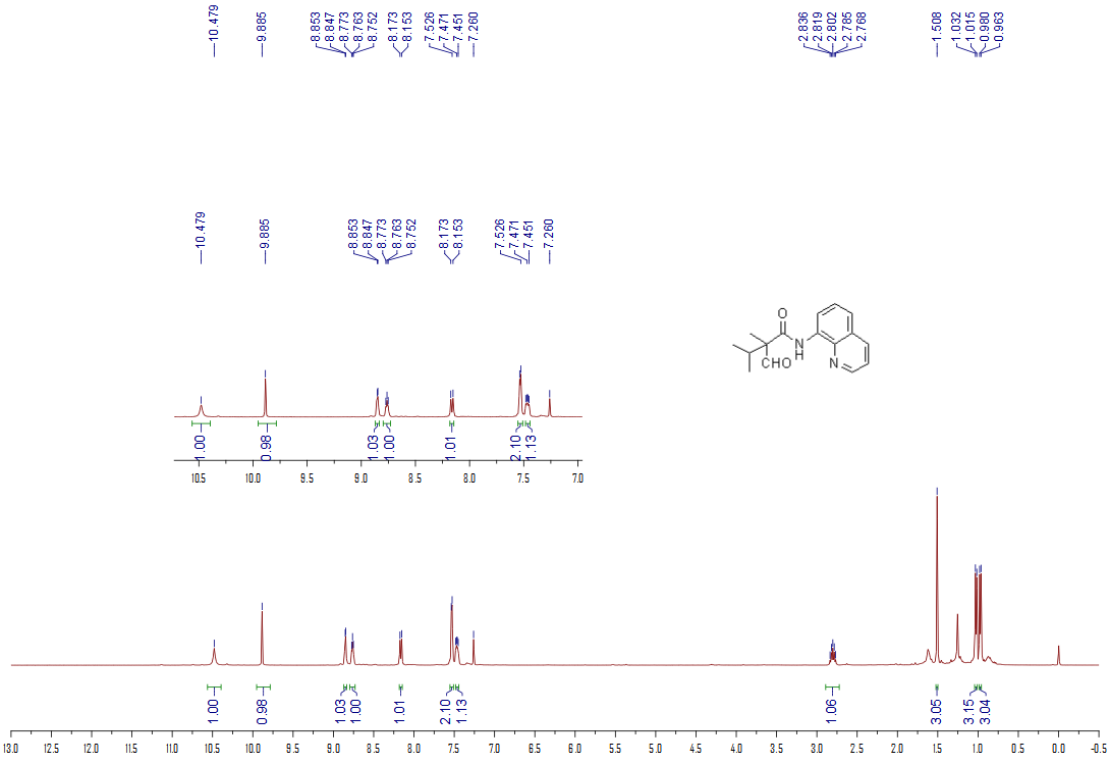
4-b ^{1}H NMR (400 MHz, $CDCl_3$)



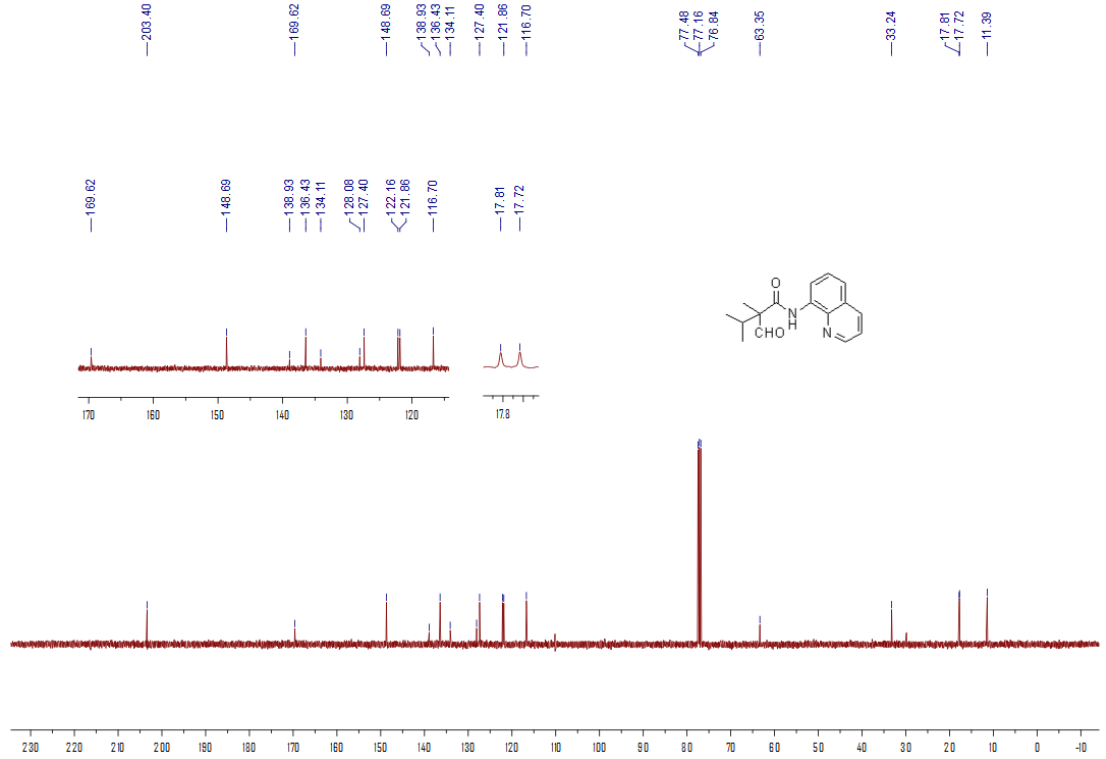
4-b ^{13}C NMR (100 MHz, $CDCl_3$)



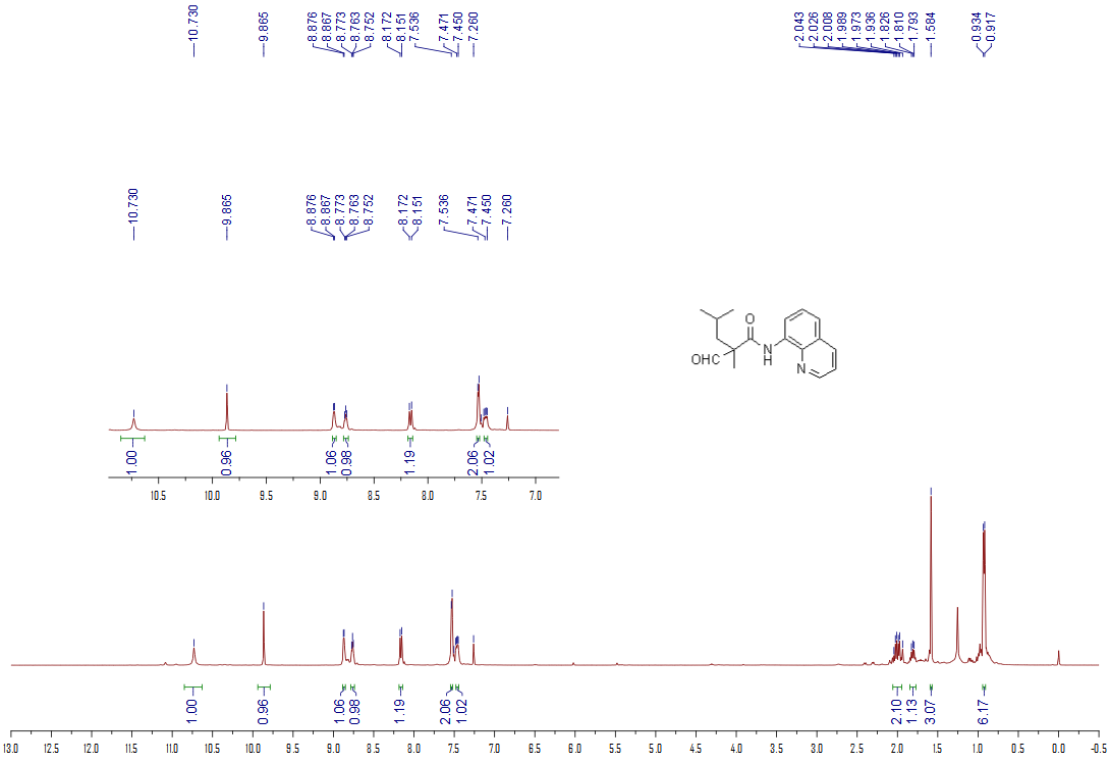
4-c ^{1}H NMR (400 MHz, $CDCl_3$)



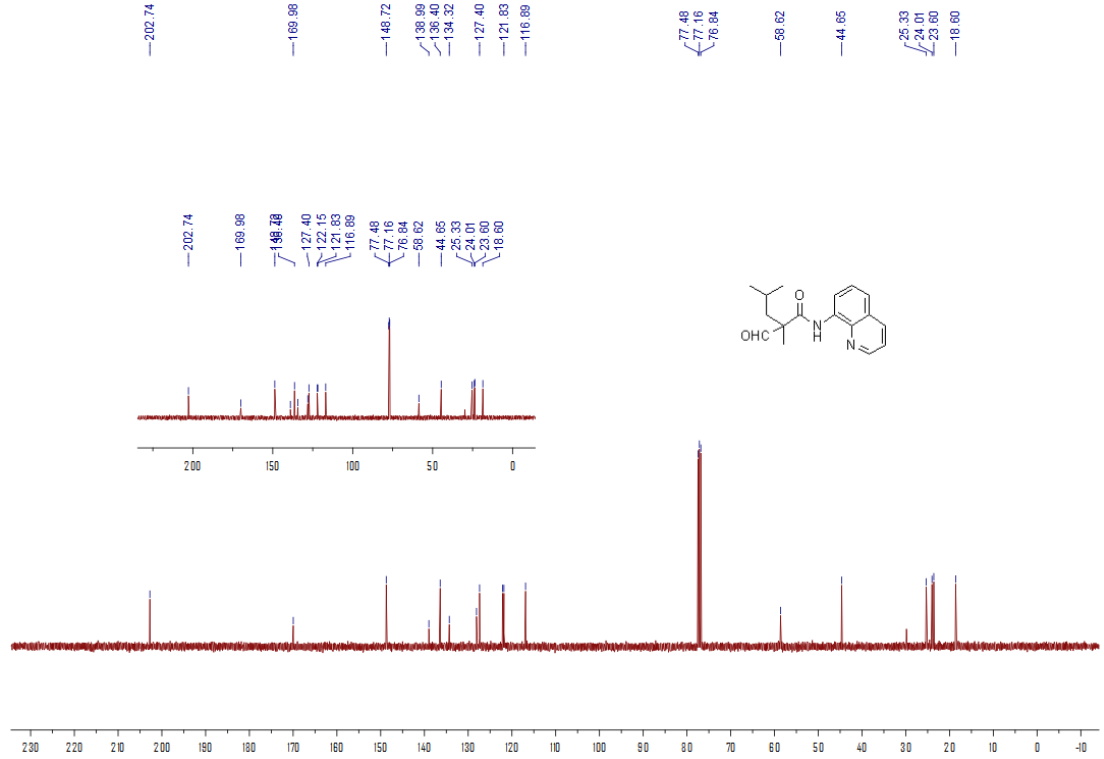
4-c ^{13}C NMR (100 MHz, $CDCl_3$)



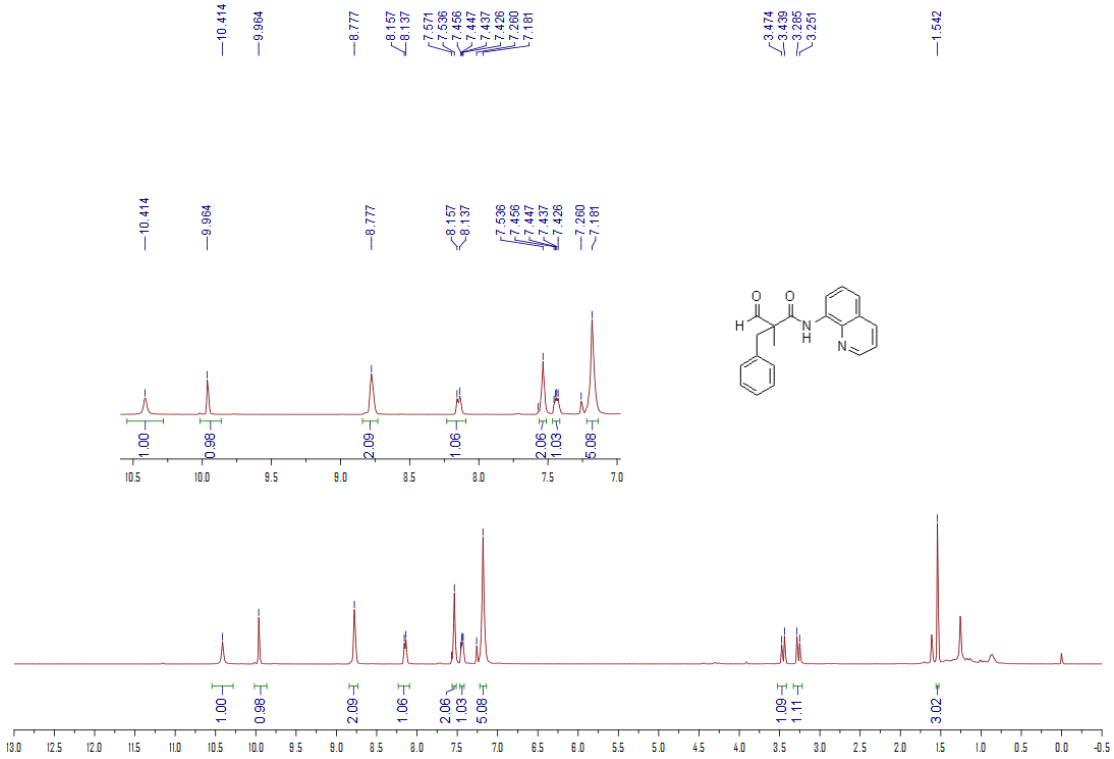
4-d ^{1}H NMR (400 MHz, $CDCl_3$)



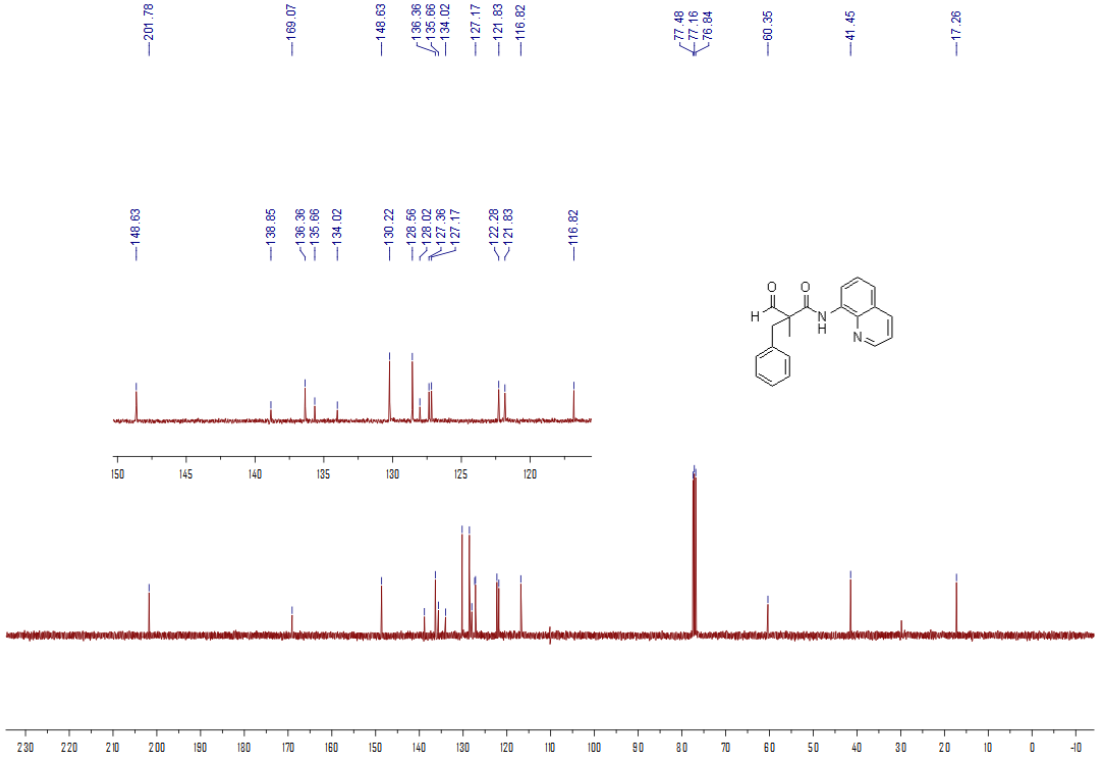
4-d ^{13}C NMR (100 MHz, $CDCl_3$)



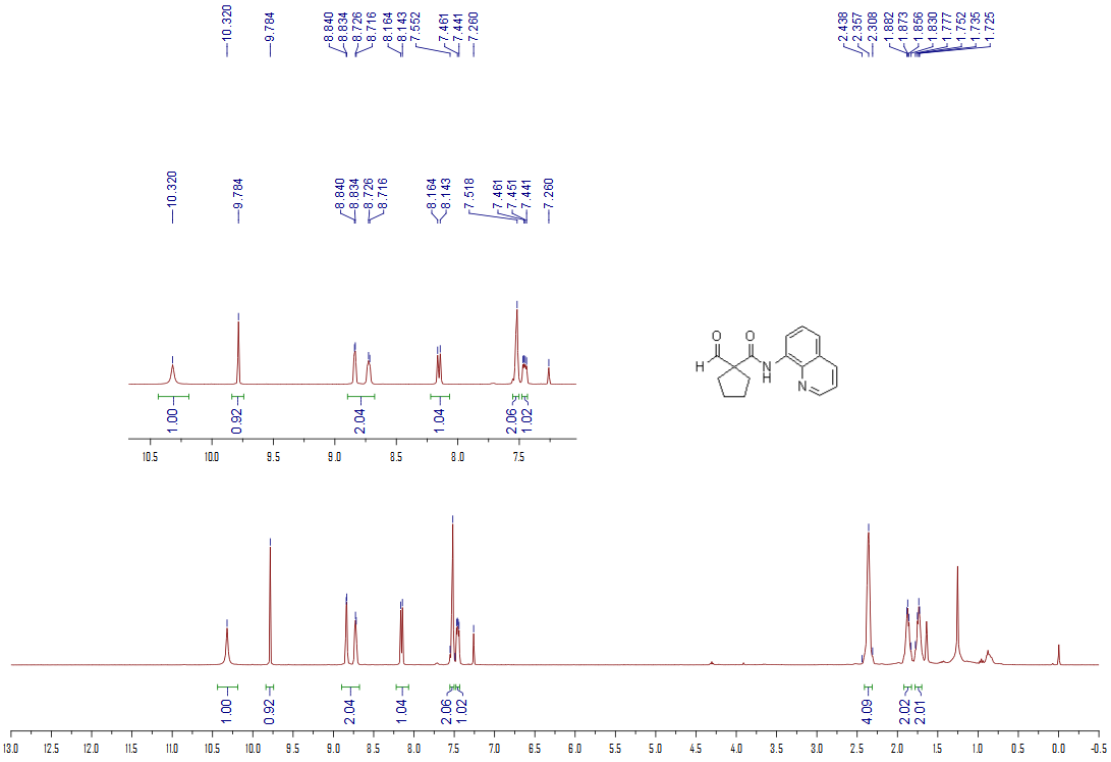
4-e ^{1}H NMR (400 MHz, $CDCl_3$)



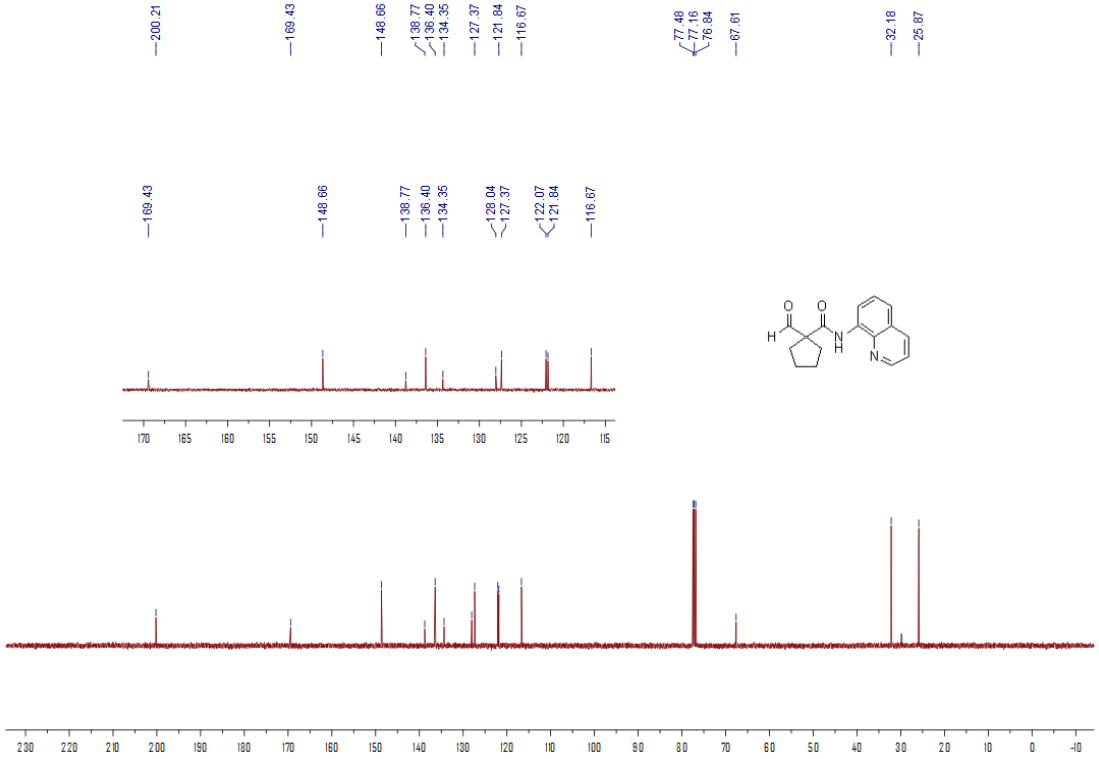
4-e ^{13}C NMR (100 MHz, $CDCl_3$)



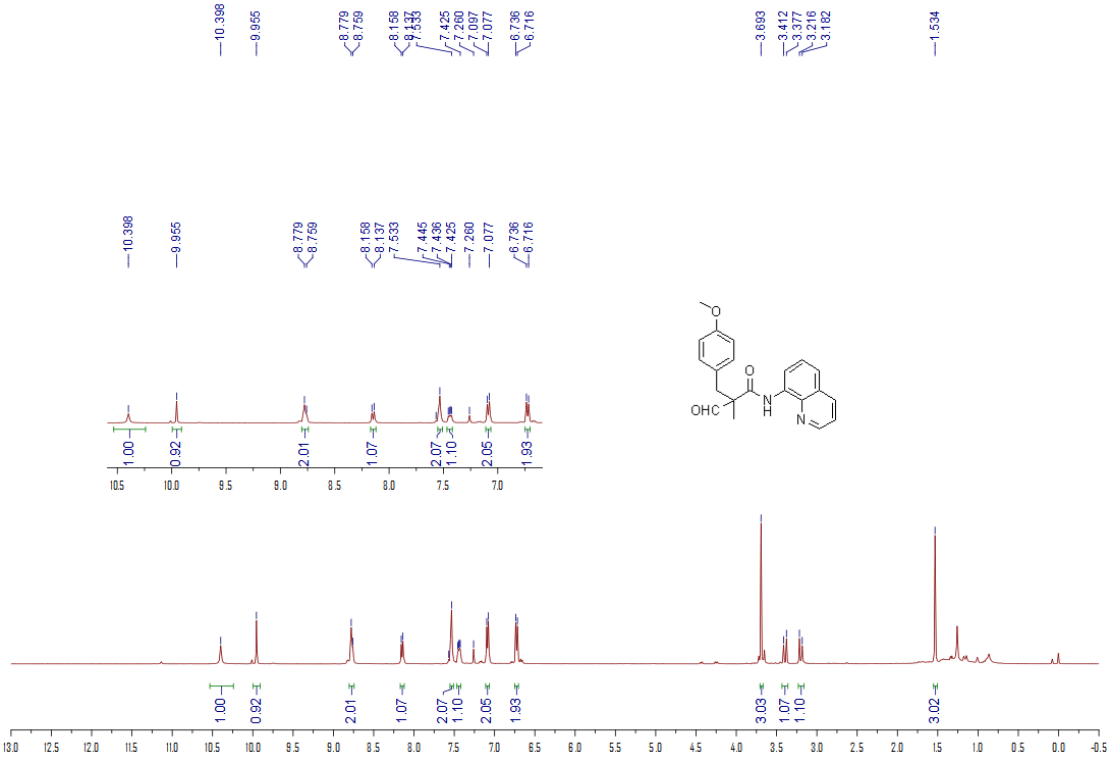
4-f ^{1}H NMR (400 MHz, $CDCl_3$)



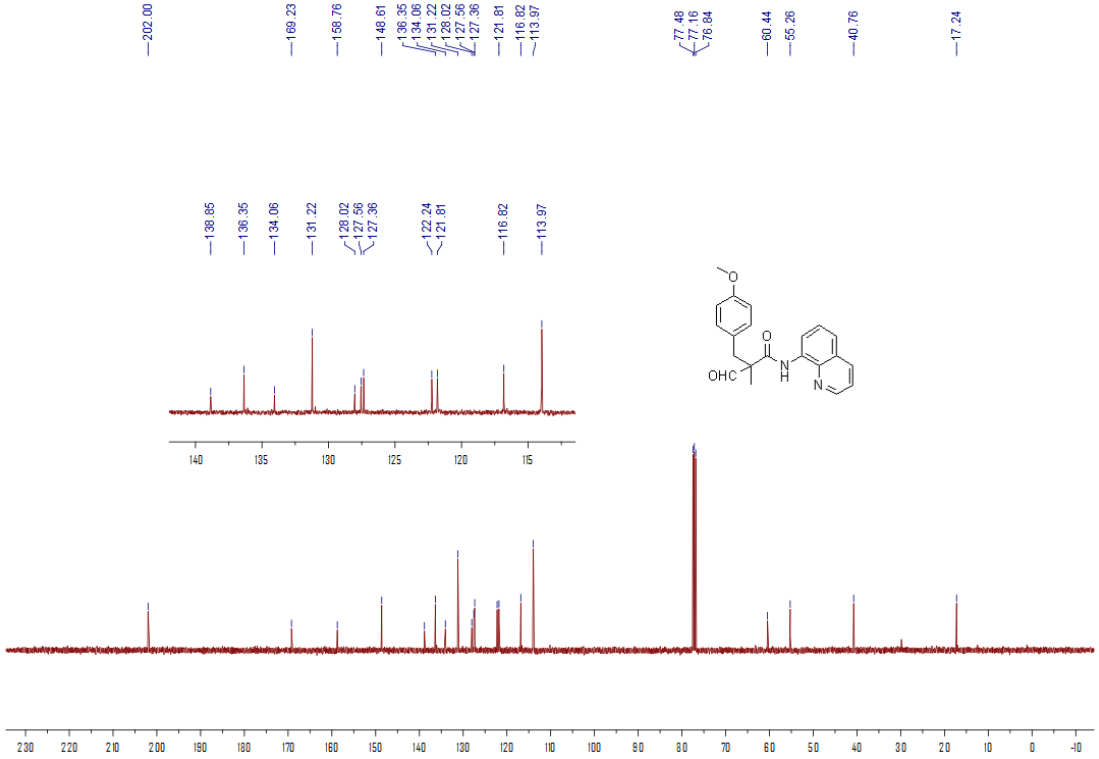
4-f ^{13}C NMR (100 MHz, $CDCl_3$)



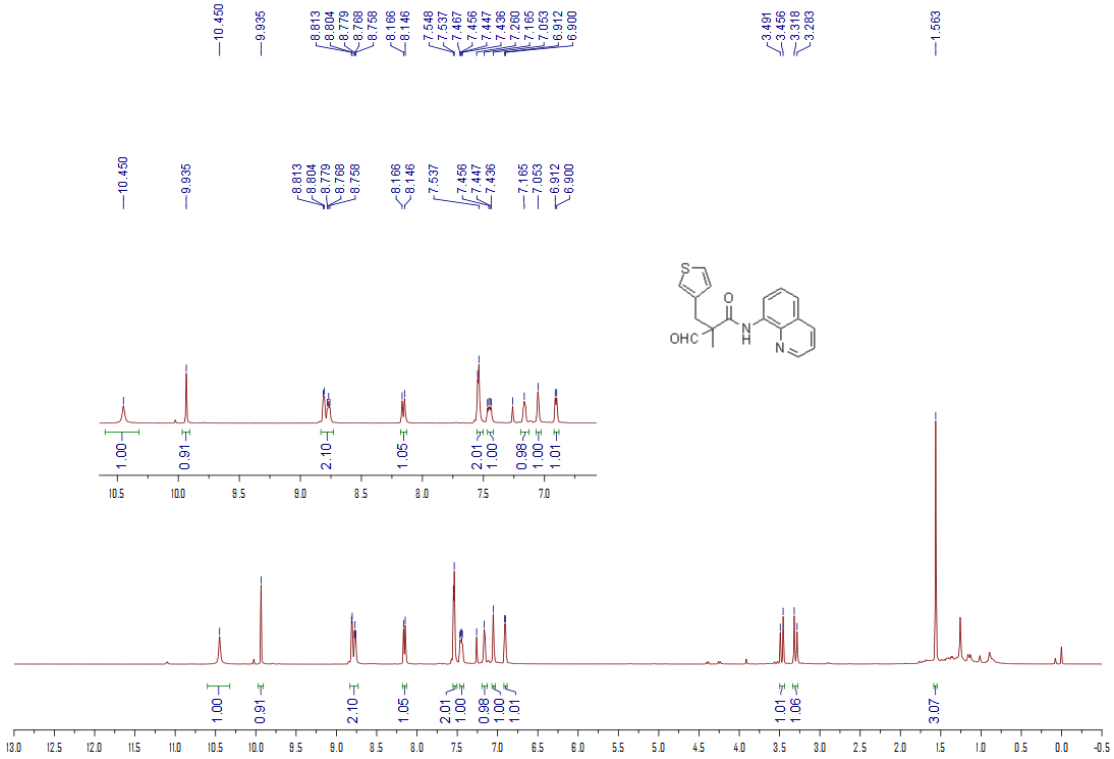
4-g ^{1}H NMR (400 MHz, $CDCl_3$)



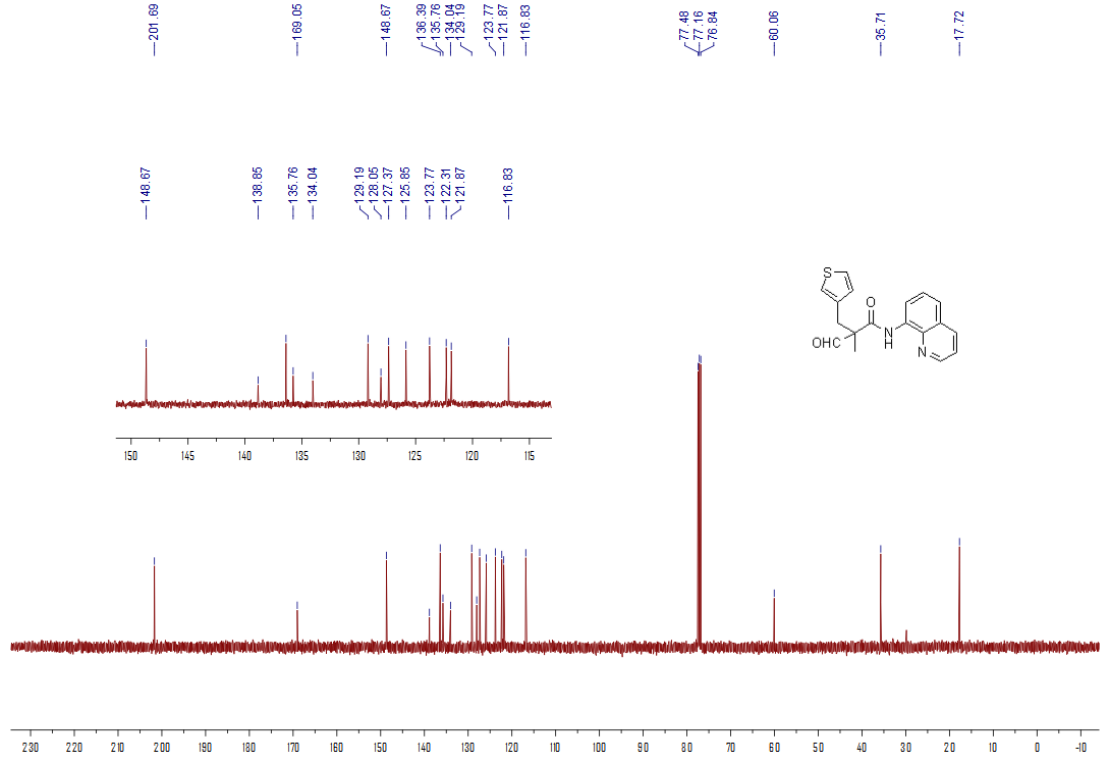
4-g ^{13}C NMR (100 MHz, $CDCl_3$)



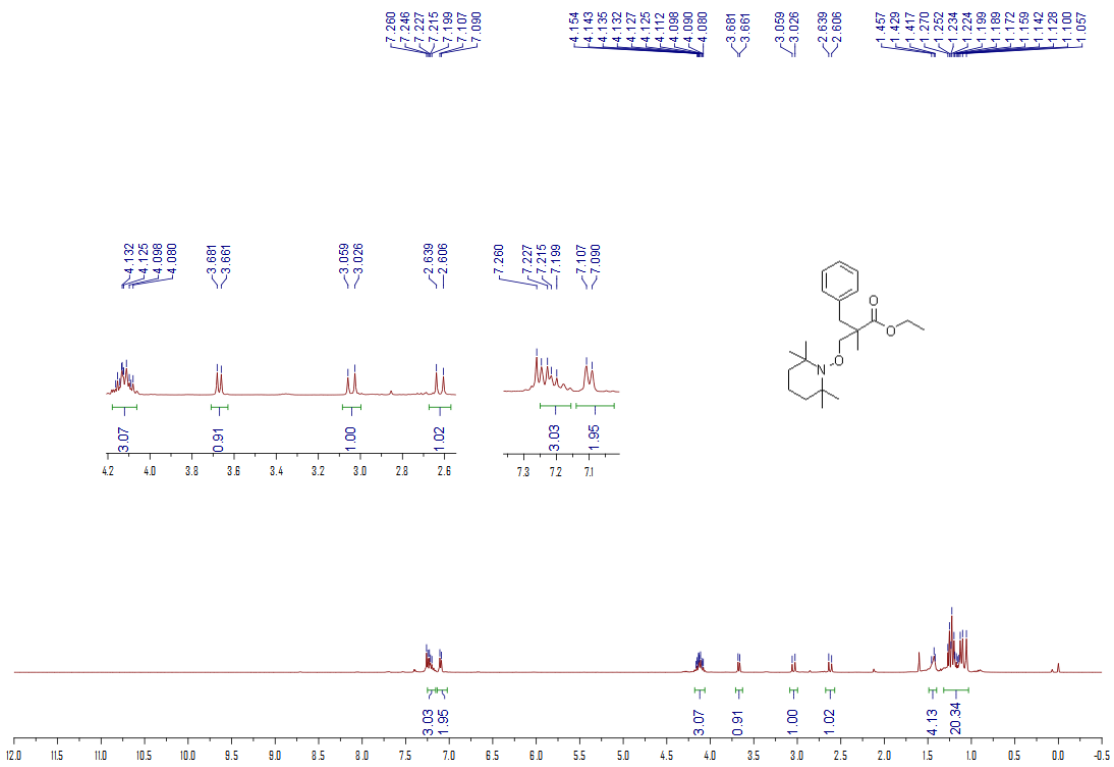
4-h ^{1}H NMR (400 MHz, $CDCl_3$)



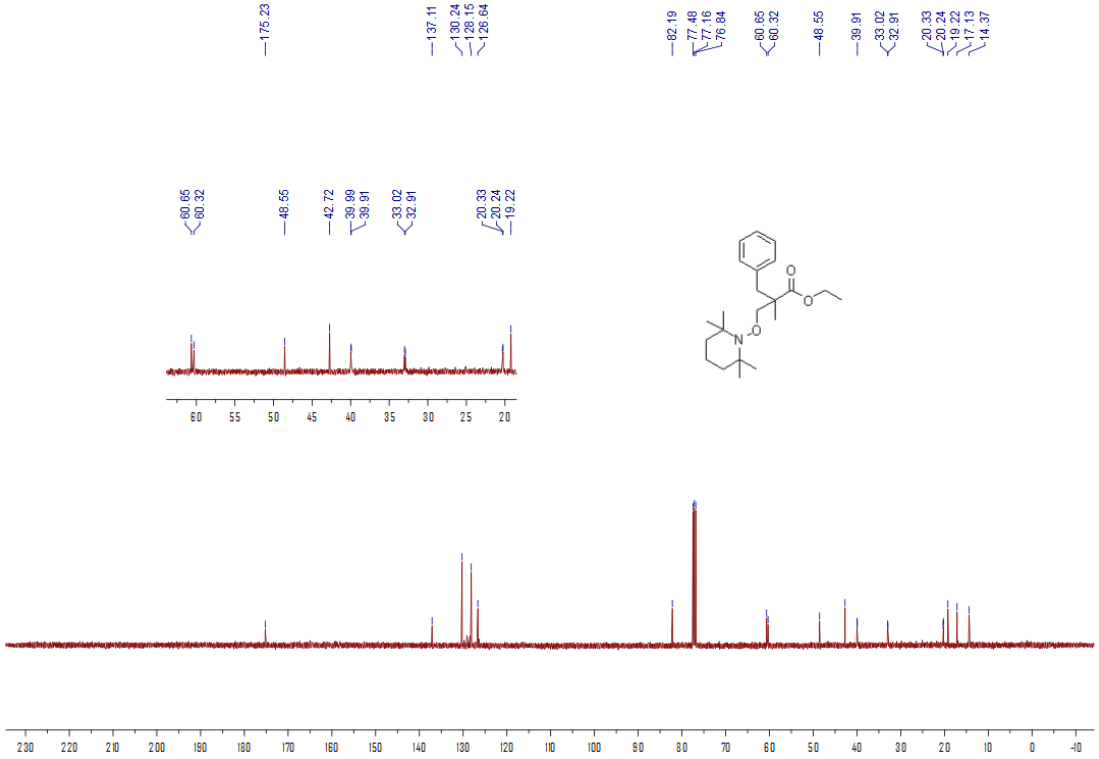
4-h ^{13}C NMR (100 MHz, $CDCl_3$)



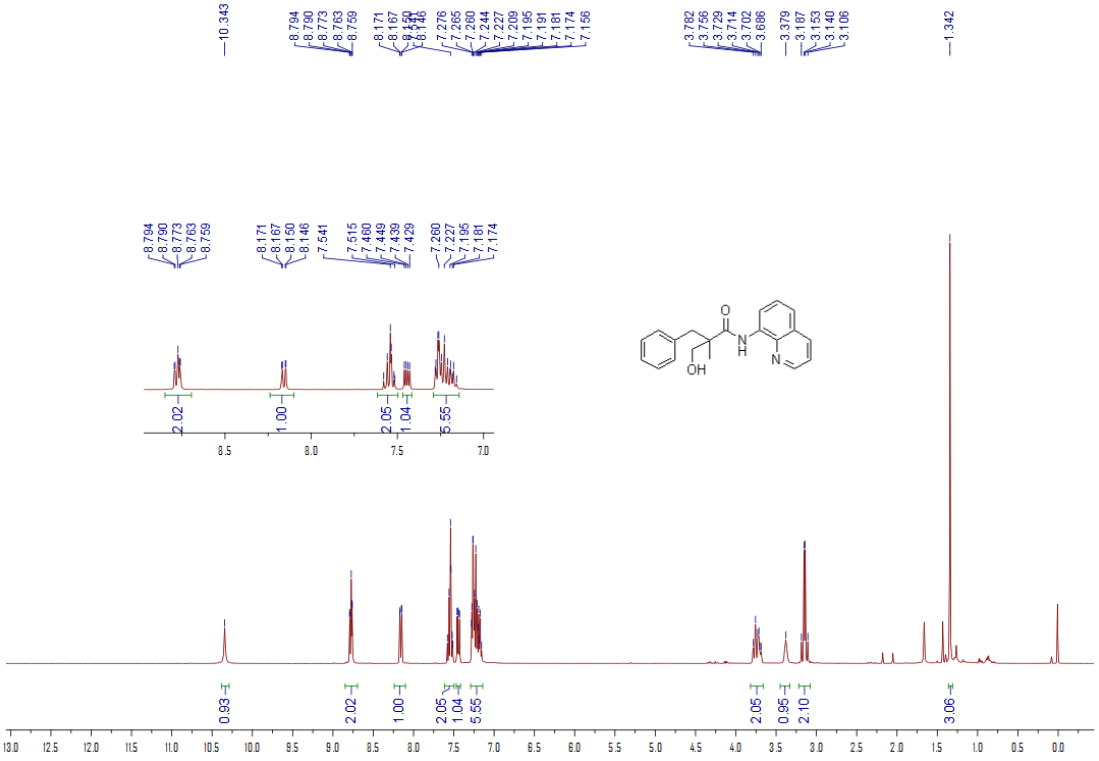
5ma ^{1}H NMR (400 MHz, $CDCl_3$)



5ma ^{13}C NMR (100 MHz, $CDCl_3$)



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



6-e ^{13}C NMR (100 MHz, $CDCl_3$)